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The World de Authority of Amateur and Shortwave Radio

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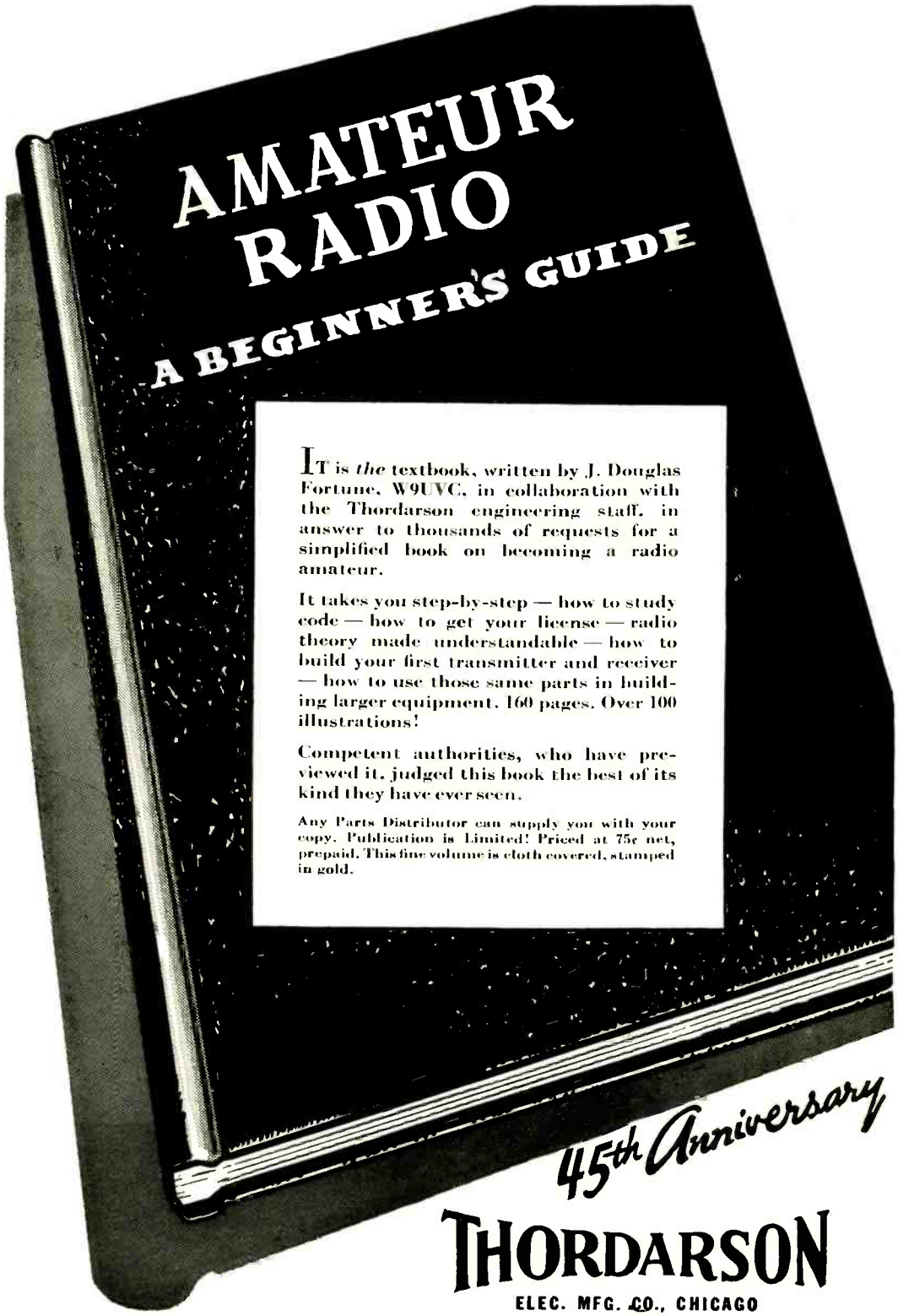

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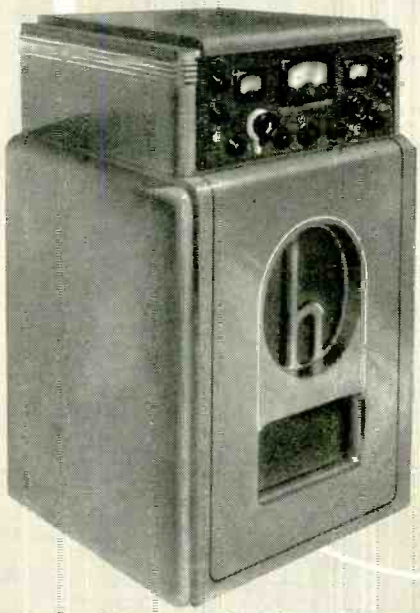

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Past • Present and • Prophetic

Easy To Take

When it comes to sugar-coated theory we'll string along with Howard Burgess. This time it is impedance and impedance matching which he discusses in the leadoff article beginning on page 11. They say a picture is worth a thousand words, and we don't doubt it, but a cartoon like the one Burgess uses to preface his article seems to be worth several pictures. Maybe our sense of humor has been displaced somewhere along the line but we still have to suppress a snicker when we think of that dow (or cog, if you insist) with the lantern tied to its tail which he used to illustrate the elusive db in "Tracking Down the Decibel," in December, 1938. And that you-name-it monster insolently swigging reactance, resistance and impedance in the "Conquering the Q" article of May, a year ago, did much to brighten the subject.

Minus the Frills

In spite of a certain amount of scepticism, there is nothing tricky about battery transceivers using 1.4-volt tubes, as our correspondence from pleased builders of the unit described in the March issue will attest. Picking the right detector-oscillator circuit seems to be the important thing. In fact, we have built two more of them in the lab and they seem to work better than the one which formed a basis for the original article. To show what can be done with little cash and lots of inspiration we present Ed Harris' two "I-built-it-just-like-the-book-said" jobs on page 31.

Hats Off Dept.

When we first told you last month that Editor Smith and W6OIN had made a 175-mile contact on 2½ we didn't know that Smith was going to back up another 25 miles or so on the next week-end and stretch their record out to 200 miles. But by squeezing things here and there we did manage to fit the latter dope into a footnote. However, there wasn't space to tell that Haberlitz, W6QZA, was along on the second trip and also got in on the latest record breaker by extending the 200-mile record another five feet. So to set things right we give you the co-holder's transmitter and receiver on page 14.

In the Nick of Time

When we heard via the grapevine that Dana Atchley was preparing an article on stubs and lines we got off an airmail letter requesting that the article be immediately forwarded if it was to make this, the last issue before our summer shut-down. Just to prove that great minds run in the same channel, the manuscript arrived the day after our letter was mailed, it apparently having passed the latter in midair.

Maybe we shouldn't tell this, but Atchley, as well as Professor Everitt, got his currents and voltages transposed in the original manuscript. The article was followed in a day or so by a note to reverse the current and voltage relationships. The trouble seems to be that there are too many ways of expressing the same thing: the voltage and current loops, nodes, antinodes and peaks insist upon getting all tangled up with one another with the result that no matter how thoroughly you know the subject it is too easy to say *loop* when you mean *node,* or vice versa. A simplification of antenna terminology would seem to be in order.

Vacation

Speaking of our summer shut-down, can't you just see us lolling in the sun for two months in one of those Chamber of Commerce resorts? If you can, let us know if we're having a good time, as we'll be hard at work on the 1941 HANDBOOK. Writing, proofreading and having a 500-page book printed several thousand miles away is just one of the things that can't be done while loafing, doggone it.

And . . . .

This issue contains so much good dope that there is not space enough allotted to us to tell about all of it, but we can give you a quick resumé. You will find Conklin on page 18 telling you when to look for what dx is left, and last month's cover picture as well as the rest of Donn Smith's vertical is described on page 22. You'll find a portable receiver to go with last month's transmitters on page 33. On page 24 is described a dual down-draft carburetor and an overhead camshaft in the form of an outboard i. f. stage to hop up the selectivity of that inexpensive or ailing receiver. And the indefatigable Broderson holds forth in the Newcomer Department with a low-power transmitter.

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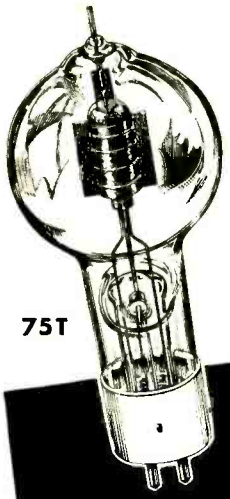

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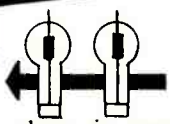

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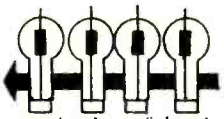

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July · 1940 No. 251

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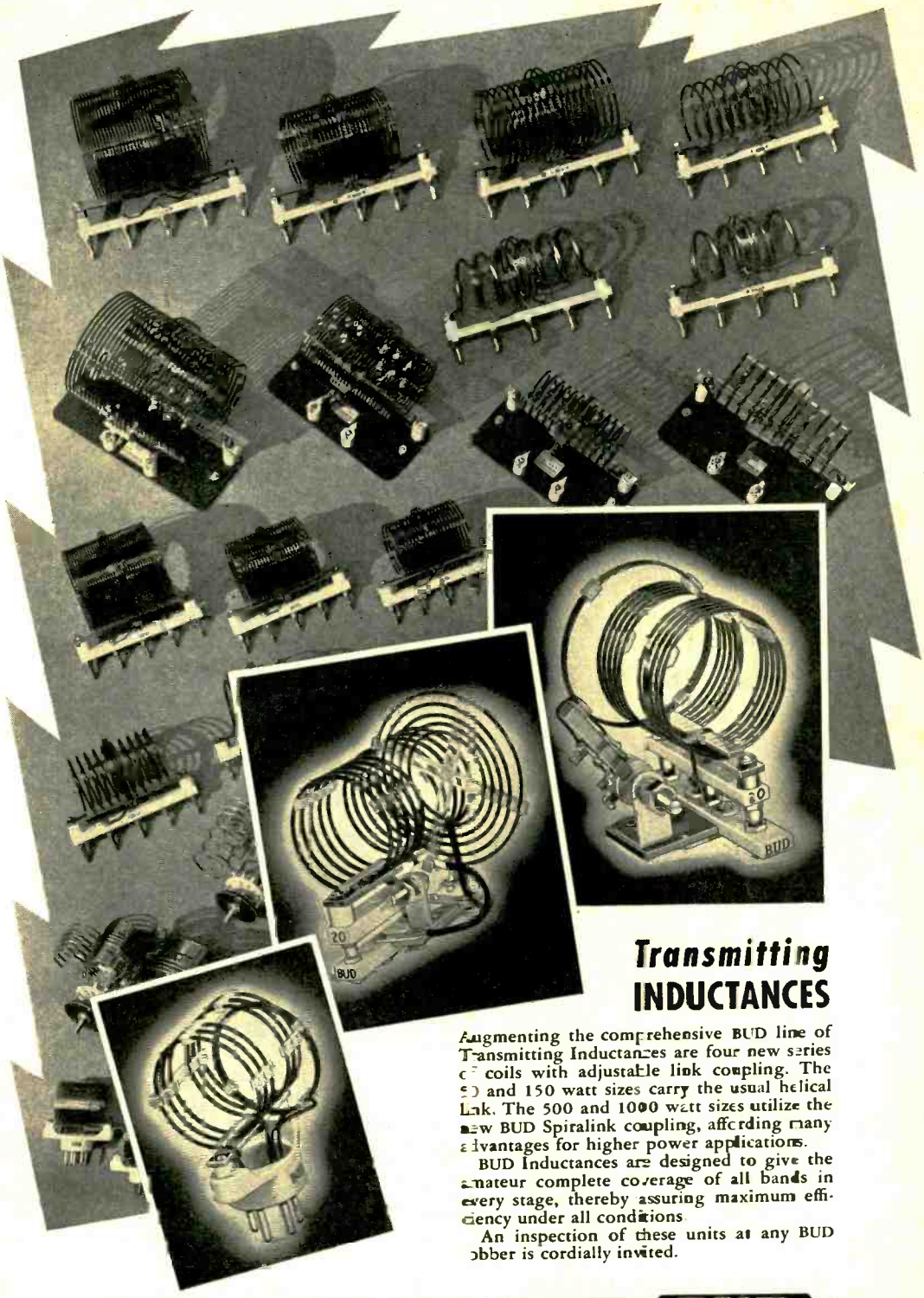

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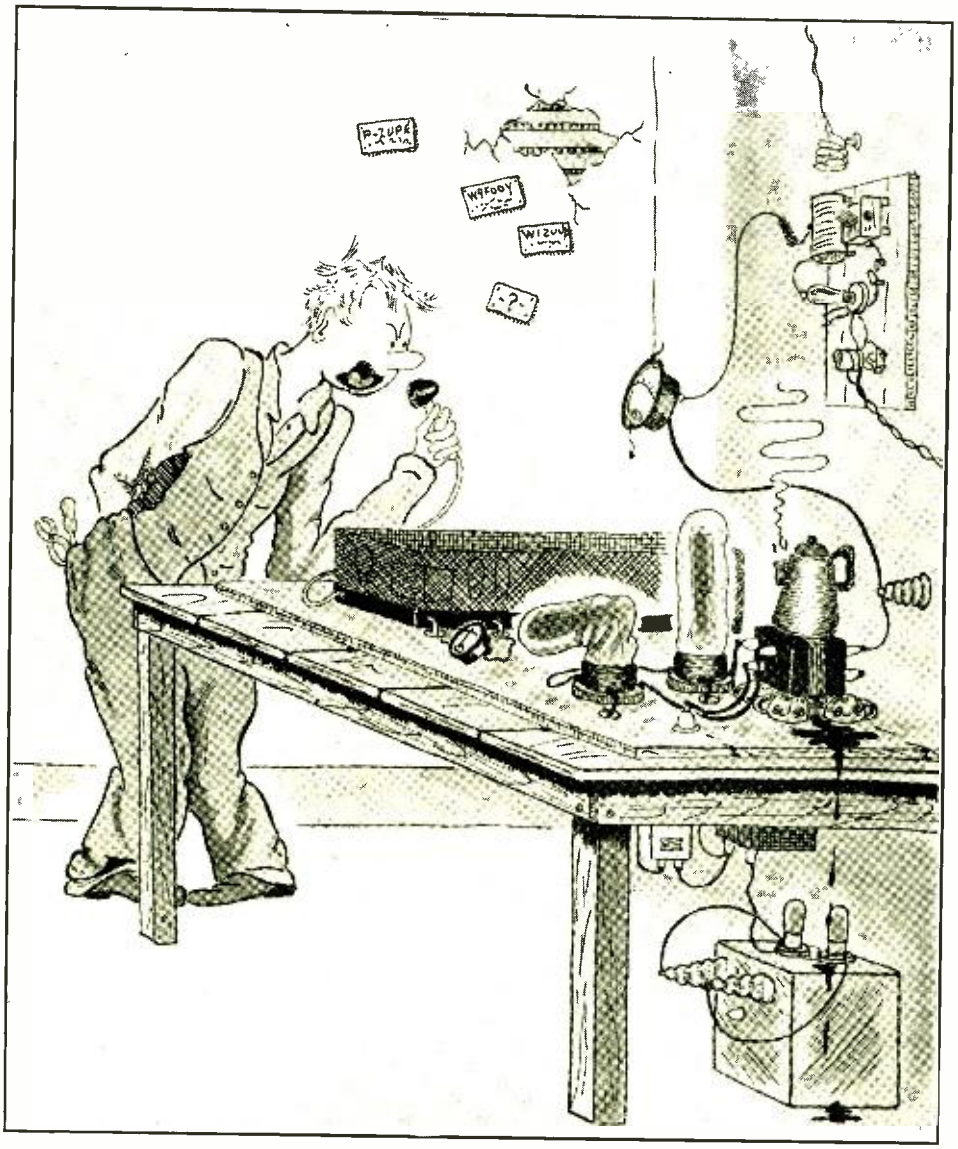

" . . . . Many seem to think that regardless of the secondary load, the only loss is that resulting in the mismatch between the secondary and the load."

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LOAD *and* UNLOAD

By HOWARD BURGESS,* W9TGU

Does your rig have transformer nerves? Do your tubes have chills and fever and see spots before their eyes? Maybe your coils no longer have that skin effect you love to touch. Or perhaps your meters have tattle-tale sway. If these symptoms fit you . . . have no fear for yours is a very ordinary transmitter. There are many remedies which will ease the growing pains and improve the performance of the old rig but as it would take a large book to name them all we will list just a few simple headache cures.

Of course every amateur phone transmitter consists of two sections, the radio frequency section and its associated power supplies and the audio section and its power supplies and accessories. For the time being we will disregard the r.f. section and its problems and concentrate on the audio end.

Every line, microphone, tube and in short every part in the audio section has a certain very definite value of impedance and all of these parts combined form a speech amplifier or modulator unit which also has a very definite value of input and output impedance. A short, not too technical side view of impedance may be of help to some of the fellows who are new at phone work. Impedance is not a definite quantity of something such as the volt or ampere but is merely a ratio, the ratio of the voltage to the amperage in a circuit. For example, if you have 100 a.c. volts across a line and the line has an impedance of 500 ohms, it simply means that the voltage in the line is 500 times greater than the current in amperes. Or the current in the line would be 0.2 amps. If the voltage is raised to 500 volts the current will rise to 1 amp. As the impedance of a circuit is the combined effect of the d.c. resistance and the reactance in a circuit ($Z = \sqrt{R^2 + X^2}$) it is easy to see that it is an a.c. characteristic and may be considered as the a.c. resistance of the circuit. As it is an a.c. characteristic it must be kept in mind that it cannot be measured by any of the common ohmmeters unless the circuit is made up of only non-inductive resistors.

If there is to be a maximum transfer of energy from one unit to another and if the frequency response is to be kept as good as possible, the impedances must always be matched. One of the most common and most important places of mismatch in the ordinary ham rig is the match between the modulator tube or tubes and the tube or tubes to be modulated. Whether a tube is to be used as a class A or a class B modulator it has a certain impedance into which it must work if the desired result is maximum output with minimum distortion. This impedance into which the tubes should work is determined by the type of tube and the voltages used upon it.

A much overlooked point is that every time the plate voltage on the modulator is changed, the load impedance also takes a jump and if optimum results are to be obtained the output transformer or its loading must be changed. Or if the plate voltage on the modulated stage is changed the plate current on that stage must also be raised or lowered in the same proportion; or if this is not done the modulating transformer must be changed to keep the proper load on the modulator tube or tubes.

This brings up the subject of the output transformer. Although a transformer is one of the most used pieces of apparatus in ham gear, some hams are not too sure of their actual function in an audio circuit. The sole purpose in the case of the modulator is to match impedance. If the plate circuit of a modulated stage presents an impedance of 10,000 ohms to the modulator and the modulator which we intend to use requires a plate load of 2500 ohms, for best results we must insert some sort of device to change the 2500 ohms to 10,000 ohms. To do this we use a transformer and the impedance changing ratio will have to be 1 to 4.

Aside from the maximum voltage and current ratings on a transformer, about the only fixed characteristic is the impedance changing ratio. Applying this then to our previous tube lineup, although we may be using a transformer having a 1 to 4 impedance ratio, the primary impedance will be 2500 ohms only as long as the secondary is working into a 10,000-ohm load.

Many seem to think that regardless of the secondary load, the modulator continues to work into the 2500 load and that the only loss would be that resulting in the mismatch

* Elliott, Iowa.

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between the 10,000 secondary and the load. Suppose that in the above case we had been using a plate voltage of 1000 volts and a plate current of 100 ma. to get the 10,000-ohm load in the secondary. Just suppose then, that we want to increase power and so we raise the plate current to 200 ma. This lowers the load on the secondary of the transformer to 5000 ohms and as this is reflected back to the primary in a ratio of 4 to 1 we now have a load of only 1250 ohms on the modulators, and by referring to the tube table we can soon see what results this will have on the modulator. By referring to our idea of impedance we can see that in order to get the correct match with the same transformer the plate voltage of our particular modulated stage must always be 10,000 times the current, or 2000 volts. As this will raise the power four times and we only wanted to double it the answer would be to choose an intermediate value. Or 140 ma. at 1400 volts will give us the desired 10,000 at nearly the desired doubling of power.

Many times a perfect match may be had by using a transformer at other than the impedances specified on the data sheet as long as the impedance ratio is kept in mind. For example, if you should have in the junk box a transformer designed for matching the 20,000-ohm plates of type 800's to a 10,000-ohm load, this same transformer will do a very nice job of matching the 10,000-ohm plates of a pair of 801's to a 5000-ohm load which may be a final running at 625 volts at 125 ma. Of course the physical size of the transformer may be a little large but this will only mean an added safety factor. The same transformer could be used to match the 12,000-ohm plates of a pair of TZ-20's to a 6000-ohm load. When matching tube to transformers in this manner the d.c. current rating of the transformer should not be exceeded.

When buying a modulation transformer every amateur should make it a point to find out its impedance ratio or the turns ratio (the impedance ratio being proportional to the square of the turns ratio). It seems that many manufacturers and wholesalers have slipped into a rather sloppy way of listing this important piece of apparatus. Recently the ad of a well known company ran like this: "Modulation transformers to match TZ-20, HY-25, 210, 809, 6L6 to either a 5000 or 20,000 ohm load."

All of this is about as clear as skywriting on a foggy day. All we know is that it is wound for audio duty and is (perhaps) on a husky core. A look at a tube chart will soon tell why these ratings tell us very little. A pair of 6L6's under class AB_2 conditions with fixed bias in order to deliver their rated output, must work at times into a load as low as 3800 ohms plate to plate. For easy figuring we will call it 4000 ohms. A transformer which would match this 4000 ohms to a 20,000-ohm load as the above one is supposed to do would have to have an impedance ratio of 1 to 5.

Now let's take a look at the ratings on a pair of TZ-20's. Under some conditions a pair of such tubes will, for proper operation, require a plate load of 12,000 ohms plate to plate. Assuming from our former figure then that the transformer had a ratio of 1 to 5, the secondary would have to be loaded with 60,000 ohms to reflect the proper load of 12,000 ohms back on the plates of the TZ-20's. This is "some" load in anybody's figures and would mean that if we were to run the 150 watts input which the TZ-20's could modulate we would have to run the final r.f. stage at 3000 volts plate voltage and at a plate current of about 50 ma. All of which is a bit absurd. Even if we used the low impedance winding which was rated at 5000 ohms we would have to load the secondary with 15,000 ohms and as a great many ham rigs have nearer 5000 ohms resistance in the final plate circuit we still have a 3 to 1 mismatch.

From one end of the above tube lineup it would seem that the transformer had an impedance ratio of about 1 to 1⅔ while figuring from the other end of the tube lineup we would expect it to have a ratio of about 1 to 5. Of course this is a little too much to expect of any transformer not of the variable matching variety. These peculiar ratings on many of the modulation transformers account for the queer results which pop up in many rigs. One ham may have difficulty in modulating 200 watts with a pair of T-40's while a second ham may be giving nearly the same input a terrific beating with only a pair of 6L6's. This is assuming, of course, that the r.f. amplifier is correctly adjusted. For quality and greatest efficiency buy only a transformer on which you can get the impedance ratio, the turns ratio or at least the exact current and voltage to be used on a particular tube with the transformer. Then by referring to tube charts it is possible to come near to the rating of the transformer.

Another place of mismatch is in the speech amplifiers and lower level audio stages. A poor match in the low level stages of the audio section can cause distortion, sometimes a tendency toward feedback and will in most cases seriously decrease the overall voltage gain of the amplifier.

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The amplification factor of a tube and the voltage gain of a stage are two entirely different things even in a resistance coupled stage. Although the voltage gain of a stage depends directly upon the amplification factor of the tube, it seldom if ever approaches the figures given in the tube characteristics. The gain of a stage depends on the load resistance into which the tube is working. Roughly the useful amplification of a tube can be figured by the formula:

$$\text{Voltage gain} = \text{amplification factor} \times \left(\frac{\text{plate resist.} + \text{ohms load}}{\text{ohms load}} \right)$$

So we see that the percentage that the load ohms is of the total resistance around the plate circuit, is the percentage of the amplification constant that is useful.

To illustrate further, in figure 1, the total impedance of the circuit is the sum of R_P, the reactance of R_C and C_C in parallel, the reactance of C, and R_L. As the impedance of the cathode network and the plate by-pass condenser is small in comparison to the total they can be disregarded. The larger, then, that we make R_L the nearer it equals the total impedance around the circuit and the greater will become the gain.

As we can easily see, though $R_L/R_L + R_P$ can never equal 1 and as long as it cannot equal 1 the full amplification constant of the tube cannot be realized. The simplest answer would be to make the plate resistor larger and larger. But this must reach a limit. As the plate voltage is fed through this resistance the larger the R_L is made the more plate voltage is lost between the power supply and the plate of the tube and thus the smaller will be the voltage swing available at the grid of the next tube.

If we apply all of this to some common tube we can soon see why many voltage amplifiers are not working to their best advantage.

A 6J5 under some conditions has a plate resistance of 7700 ohms and an amplification factor of 20. If it is worked into a load of twice its plate resistance, as is many times recommended, the formula will be as follows:

$$\text{Gain} = \frac{15{,}000}{15{,}000 + 7{,}700} \times 20 = .666 \times 20 = 13.3 \text{ approx. gain}$$

We decide that we want more gain in this stage. As the triode section of the 6Q7 has an amplification factor of 70 and as it will fit into an octal socket, why not change a few connections and use it in place of the 6J5? To save time we will use the same plate

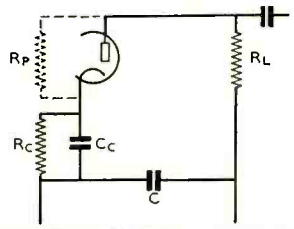

Figure 1. " . . . the total impedance of the circuit is the sum of R_P, the reactance of R_C and C_C in parallel, the reactance of C, and R_L."

resistor for the 6Q7 as we did for the 6J5. Now to substitute the values of the 6Q7 in the formula and see how much we have gained by the use of a tube with an amplification 3½ times greater. As a wild guess, we might expect a gain of 46.5 (3.5 x 13.3). But in the formula we find:

$$\text{Gain} = \frac{15{,}400}{15{,}400 + 87{,}000} \times 70 = .14 \times 70 = 9.8$$

Or our useful amplification is about four less than we had with the low μ tube. We can help things by substituting a larger plate resistor. A recommended value is .15 megohms. With this size the gain then becomes 44 (substituting the new value of plate resistor in the equation).

Since the perfecting of high gain tubes a few years back, the ordinary audio coupling transformer has gone out of use almost entirely by ham builders. Many commercial builders still use them and for good reason. By using a low μ tube and a transformer it is not difficult to get a gain of 45 in a stage with less plate supply voltage and still get a greater voltage swing at the grid of the next tube than is possible with resistance coupling. The use of such transformers is of course limited many times by magnetic coupling to other circuits such as power supplies.

As we go to press . . .

PORTABLE - MOBILE STATIONS PROHIBITED*

The FCC on June 7th issued a ban against the use of practically all portable or mobile amateur radio stations. The announcement followed almost immediately the Commission's ban prohibiting contacts by amateurs of the United States with those of any foreign country. **(See page 17 for details).**

*** It is understood that the Commission has excepted from the ban on portable or mobile operation those stations which operate on or above 56 Mc.; and, on June 22nd and 23rd, 1940, those stations participating in the annual field day tests sponsored by the A. R. R. L.**

If you are uncertain of the status of your portable or mobile equipment under the new order, we urge you to consult your local inspector before taking any unnecessary chances with your license.

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FROM 28- TO 112-MC. MOBILE

In One Easy Lesson

By ELIOT HABERLITZ,* W6QZA, and
VAL SHANNON,* W6DJS

They may laugh when you first start to play on 112 Mc., but what with the sun spotting up reception on 28 Mc., many amateurs have found a new interest in mobile work by dropping down to 112 Mc. It doesn't cost much, and you need not tear up your 28-Mc. rig.

Many amateurs who have elaborate 28-Mc. installations in their autos are finding that often there is nobody on the band to work. Poor conditions on 28 Mc. are driving most of the gang up to 14 Mc. On the other hand, activity on 112 Mc. is steadily increasing, and it is seldom that several stations cannot be heard on this band anywhere near a large city. It is the purpose of this article to show how, by adding a small amount of equipment to the existing 28-Mc. installation, it is possible to work both 28 and 112 Mc. at your leisure. The 28-Mc. equipment is *not* converted for 112-Mc. operation; the existing equipment is made to do double duty and 28-Mc. operation need not be sacrificed for operation on the higher frequency band. What is more, you will have nearly as much power output on 112 Mc. as you are getting on 28 Mc.

* Santa Barbara, Calif.

The Transmitter

The 112-Mc. transmitter consists of an HY-75 ultra-audion oscillator with conventional coil-and-condenser tank circuit. A concentric pipe or parallel rod oscillator would undoubtedly give greater stability, but with a low capacity, high transconductance tube the stability has been found sufficiently good with the tank circuit shown. The only precautions that need be taken in the construction of the transmitters are to make sure that all r.f. leads are as short as possible, that all parts are mounted rigidly, and that good u.h.f. insulation be used where it is in contact with high potential r.f. The tuning condenser should be of the ultra midget type, and it should be wired so that the rotor goes to the grid. The exact number of turns for the tank coil will depend somewhat on the physical layout and particular make of components chosen. Some pruning may be required on the coil. It should hit the band when the tuning condenser is about half meshed. Observe that both rotor and stator are hot to ground, both to d.c. and r.f.

The tube socket is not exposed to r.f., and may be of the inexpensive wafer type. It is important that the tube be mounted in a vertical position for good filament life.

C_1—7-μμfd. sub midget variable condenser
C_2—100-μμfd. midget mica
C_3—.01-μfd. tubular, 400 v.
C_4—0.25-μfd. tubular, 400 v.
C_5—.05-μfd. tubular, 400 v.
C_6—10-μfd. electrolytic, 25 v.
R_1—500,00 ohms, ½ watt insulated
R_2—250,000 ohm midget pot. with switch
R_3—50,000 ohms, 1 watt insulated
R_4—100,00 ohm midget pot., a.f., taper
R_5—600 ohms, 5 watts, insulated
T_1—1-3 ratio a.f. transformer
BC—Bias cell, outside shell to grid

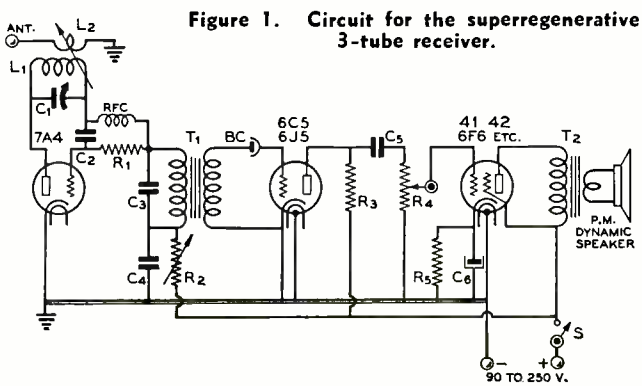

Figure 1. Circuit for the superregenerative 3-tube receiver.

L_1, L_2—See coil data
RFC—U.h.f. choke
T_2—Output transformer (on p.m. speaker)

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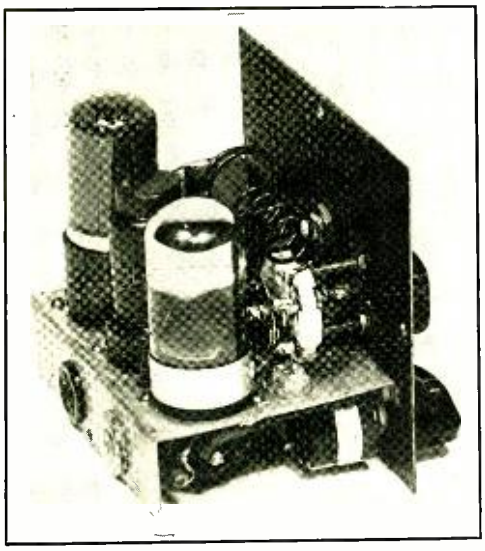
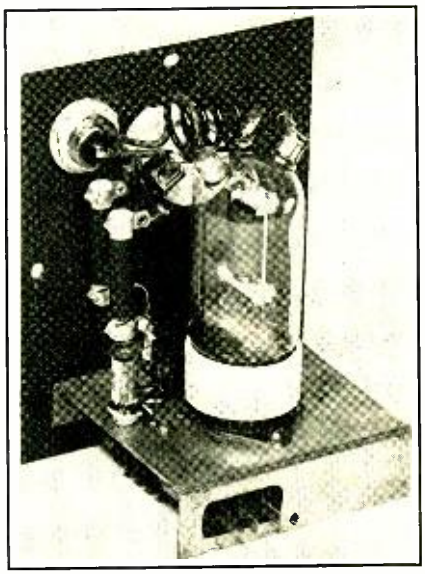


Interior view of the receiver. The tuning condenser is supported from the front panel by means of two long bolts. The variable antenna coupling coil may be seen in back of the tank coil.



This little rig will take 35 watts input, and delivers a hefty signal on 112 Mc. The tube clips are connected to the tank condenser by means of narrow copper ribbon. A one turn coil at the grid end of the tank connects to a coaxial cable connector.

While there are so few components in the oscillator that it can be housed in a small can as shown in the illustration, there is no reason why it cannot be built in a larger cabinet. The same holds for the receiver; for no particular reason both units were made as compact as possible.

The oscillator is mounted alongside the 28-Mc. transmitter and connected as follows. Plate voltage is obtained by tapping on the B plus to the final 28-Mc. stage on the transmitter side of the plate meter. This permits reading of the plate current to the HY-75 with this meter. The r.f. portion of the 28-Mc. rig is provided with an individual filament switch; likewise the HY-75. Thus, to fire up the rig on either band, simply turn on the appropriate filament switch. The tubes whose filaments are not lighted can draw no plate current, and the plate voltage will not harm them. If desired, a single-pole double-throw switch can be used to throw the filament voltage from the HY-75 to the 28-Mc. r.f. tubes; this will make it unnecessary to use two switches.

Assuming that an 8-foot telescoping vertical fish pole, fed with coaxial line, is used for an antenna on 28 Mc., the same antenna can be used on 112 Mc. simply by telescoping it to about 6 feet. The antenna will act as a ¾-wave radiator on 112 Mc. and will work quite well as compared to other types commonly used on that band. The exact length of the antenna for 112-Mc. operation can best be determined with the help of a field strength meter, but usually it will be found close to 6 feet.

By incorporating the type of couplers used for connecting auto-radio antenna cables, the coaxial cable from the antenna can be connected to either transmitter in a jiffy. A one-turn coupling coil of insulated wire pushed down between two of the center turns of the coil usually will be found satisfactory for the 112-Mc. oscillator. The position of this coupling turn should be adjusted for maximum power in the antenna.

The Receiver

While the receiver, a simple superregenerator, is an entirely separate unit from the 28-Mc. receiving equipment, it can be con-

COIL DATA

Both receiver and transmitter tank coils are wound of no. 14 enameled wire, on a ½-inch diameter, and spaced and trimmed as necessary to hit the band (as determined by measurement with Lecher wires or a calibrated wavemeter). As a starter, try 4 turns for each coil. The antenna coupling coil for the receiver is also wound of no. 14 enameled, about ⅞ or 1 inch in diameter. The transmitter antenna coil consists of a single turn of insulated wire at the grid end of the coil, as shown in the photograph.

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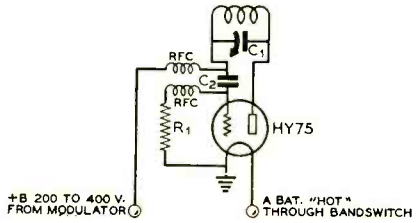


Figure 2. The HY-75 Oscillator circuit.

C_1—15-μμfd. sub midget condenser
C_2—100-μμfd. midget mica
RFC—U.h.f. choke
R_1—2500 ohms, 1½ watts
Coil—See coil table

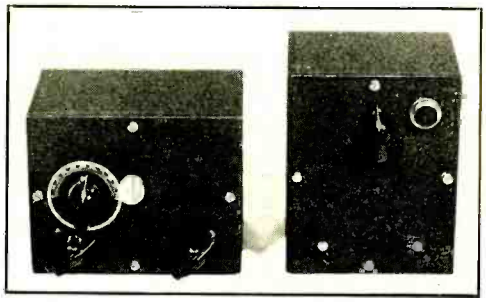
structed quite cheap. The B supply may be anything between 90 and 275 volts, and if desired it may be obtained from the existing receiving equipment by employing a heater switch to kill the plate current to the 28-Mc. receiver (or b.c.l. receiver if a converter is used on 28 Mc.). The receiver illustrated is used with 135 volts of heavy duty B batteries, but most any type of power supply delivering 90 volts or more has been found satisfactory.

A separate antenna consisting of a short "door hinge" type rod is used for the receiver, which is mounted on the underside of the dash. If the lead is kept short, ordinary insulated wire may be used to connect the antenna to the receiver.

It is important that a polystyrene or low loss (mica filled) bakelite loktal socket be used for the 7A4 for best results. Also, care should be taken to see that the rotor of the tuning condenser goes to the grid and the stator to the plate. A bakelite or hard rubber shaft extension must be used with the tuning condenser in order to prevent body capacity detuning effects. As an alternative, an insulated coupler may be used in conjunction with a short piece of metal shafting and a panel bearing. Both r.f. choke and grid leak should be connected with the shortest possible leads to the r.f. circuit.

One of the features of the receiver that results in vastly increased performance and easier tuning is variable antenna coupling. This control has been found of greater importance than the regeneration control, as the latter may be set and left alone if variable antenna coupling is provided.

The antenna coil consists of two turns of wire, somewhat greater in diameter than the tank coil, supported at the grid end of the tank coil. These are cemented with Amphenol 912 to a piece of Lucite or polystyrene ¼-inch shafting, which is supported



To the left is the compact 3-tube 112-Mc. superregenerator. The small white knob immediately to the right of the dial scale adjusts the variable antenna coupling. To the right is the HY-75 oscillator that is fed modulated plate voltage from the regular 28-Mc. modulator and power supply.

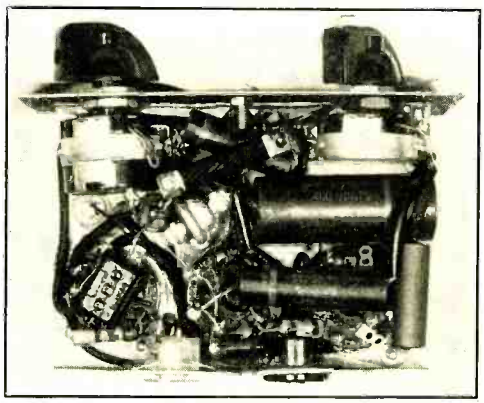
from the front panel by a shaft bearing. The bearing is placed slightly below the level of the bottom edge of the tank coil in order to permit sufficient variation in coupling. Flexible, insulated wire is used for making connection to the two turn antenna coil.

Results

With 350 volts on the plate of the HY-75, a distance of 200 miles has been worked with this outfit without resorting to auxiliary antennas. Stations over 75 miles away are worked consistently from good locations, usually with flattering reports.

The rig can be changed from 112 Mc. to 28 Mc. in less time than it takes the heaters to reach operating temperature.

And the whole business can be built at an additional cost of less than $15.



Under-chassis view of the receiver. An idea of the small size of the unit may be had by comparison with the 6-32 bolt on the front panel. A slightly larger chassis would make the wiring job somewhat easier.

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DX DEMISE

• A last minute press report received as we go to press places a ban on amateur radio communication with all foreign stations. The ruling does not apply to amateur communication between licensed amateur stations in the continental U. S. A. and amateurs in its territories and possessions. The FCC concurrently suspended all its rules and regulations inconsistent with the order. Pending further orders of the FCC, everything in this issue of RADIO pertaining to the proposed fall World Wide DX Contest should be ignored, as the contest automatically is cancelled in accordance with provisions of the contest announcement.

• The explanation of the FCC that they are guarding against "Fifth Column" activities should not be taken to indicate the likelihood of a total ban on amateur radio in this country.

—— The Editors

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LONG RANGE DX TRENDS

By E. H. CONKLIN, W9BNX

There appeared in RADIO in July, 1938, a chart showing monthly and annual averages of sunspots and radio conditions, together with a historical review of long distance work on the higher frequency bands since 1927. The winter of 1940 has brought indications that the trend is definitely downward on 14 megacycles and above, while it is improving on 7 megacycles and below.

The last two years have brought conditions far off of the sunspot peak that occurred in 1937, in spite of the May and July solar

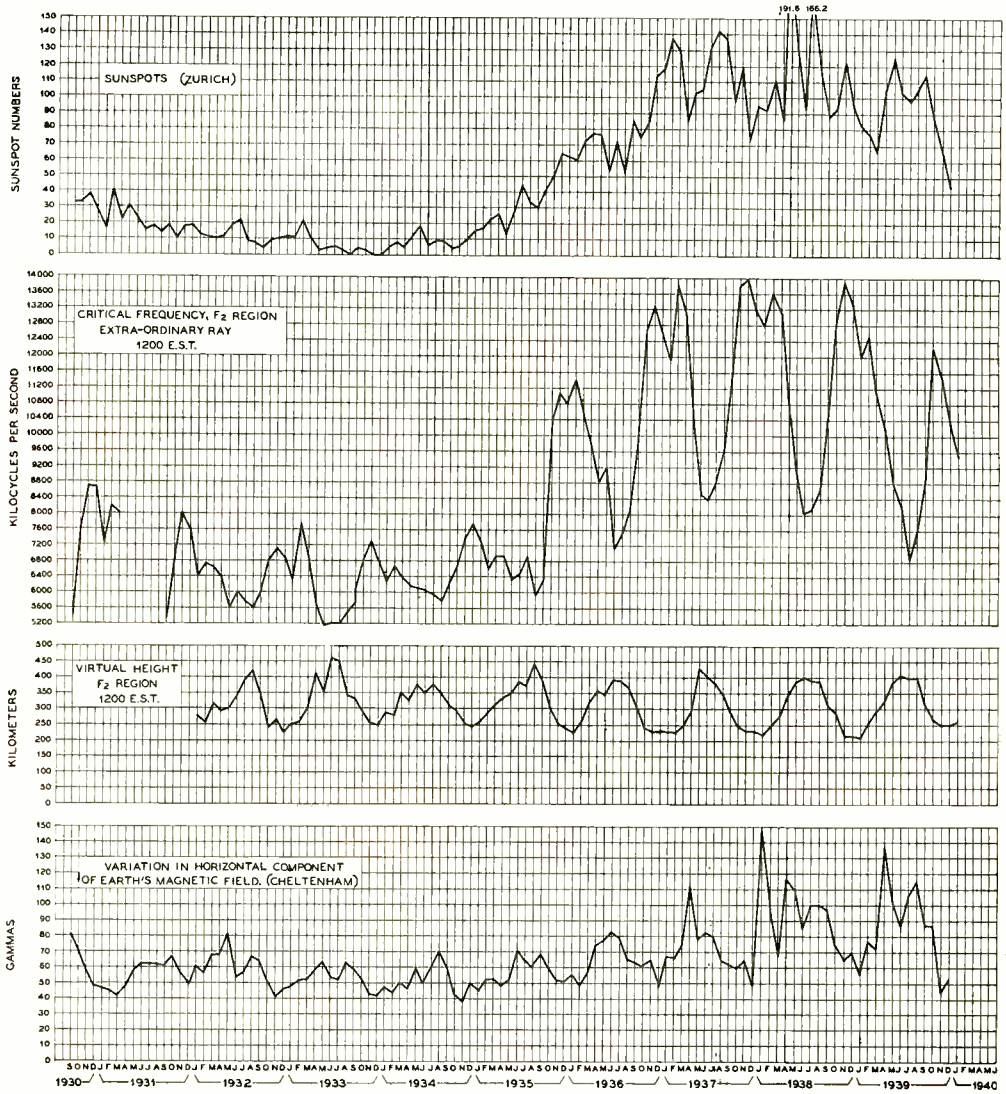

Figure 1.

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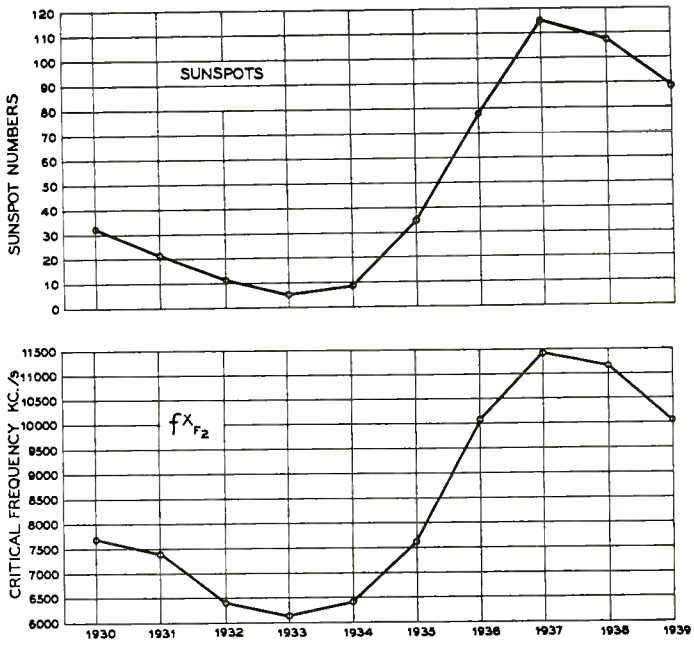

Figure 2.

activity in 1938. It is now possible to picture the way things will be in about 1943 or 1944 when the "low" is expected. Figure 1 gives the monthly data for sunspot numbers, for the critical frequency and height of the F_2 layer of the ionosphere that provides long distance communication above 7 megacycles or so except for summer short skip, and for a measure of magnetic activity.

Figure 2 shows the trend of the annual averages for sunspot numbers and for F_2 layer critical frequency. It will be seen that over such relatively long periods as a year, there is a good deal of similarity between the two curves.

Summer short skip is not covered by these data but indications are that it will be on the decline in number of hours per month that will support communication. The years 1942 to 1945 should see a relatively small amount of this type of work on ten and five meters. Ten meter winter dx should, in the next two years, get down to a point where only Central and South Americans can be heard. At the same time, 14 megacycles is expected to go dead in winter evenings, as early as 5 p.m. A trend toward 7 megacycle operation will be interrupted, then, when U.S.A. contacts under about 1800 miles will not be possible after 8 p.m. The gang will be forced to go back to 80 for contacts on winter nights, or to give ground-wave dx contacts a try on the ultra highs which, then, will include everything above 28 megacycles.

• • •

Filtered-Air Transmitter Cooling

Many amateurs with enclosed rack-mounted transmitters are overlooking a bet in not using some system of air filtration and forced-draft circulation in their transmitters. The advantages of such an arrangement are many and if, when the transmitter is being designed and constructed, provision is made for the installation of such an arrangement, it will be neither too difficult or too expensive.

An installation of such an arrangement is most easily made by using solid sheet metal panels (un-louvered so that they will be air tight) on top, bottom, and all sides of the transmitter frame. Then a small exhaust fan is placed so that it will draw the heated air from the top of the transmitter frame, and an air filter of glass wool or similar material is placed at the bottom of the transmitter rack (usually at the back) so that all air entering the transmitter compartment will have dust, insects, and other foreign matter removed from it. The filter should be made fairly large in cross section so that it will offer little impediment to the flow of air. A two-inch thick layer of glass wool sup-

[*Continued on Page 83*]

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IMPROVED PRACTICES

With Stubs and Lines

By DANA W. ATCHLEY, JR.,* W1HKK

For the past three years the resonant line stub has been one of the most popular devices used by the amateur to transfer power from a two-wire transmission line to an antenna. The stub, usually a multiple of quarter wavelengths in length, is adjusted to resonance by a movable shorting bar as shown in figure 1. This allows the amateur to correct any errors that have been made in the actual cutting of the antenna. It puts the matching system down where it is more easily accessible for adjustment, and in addition provides a high Q-low loss system with a range of impedance from approximately twenty to several thousand ohms. This will provide proper termination for the average line used in amateur work.

Most amateurs know that matching a transmission line into a stub-antenna combination presents several difficulties. One of these difficulties concerns the correct position of the line tap on the resonant stub. Goodman[1] and the authors of the RADIO ANTENNA HANDBOOK have treated matching systems at length, but as neither source gave much information concerning this I shall endeavor to show one very simple method which will easily overcome the difficulty.

The cut and try method outlined in the RADIO ANTENNA HANDBOOK will eventually produce good results. The method I propose will save much time and produce a more precise match and a better balance in the transmission line.

A perfect resistive match between the transmission line and the stub will completely eliminate any trace of standing waves. While a standing wave ratio[2] of two to one is tolerable on transmitting, this ratio plus a slight unbalance in the line may result in some pickup of undesirable signals when the antenna is being used for receiving. In a simple doublet type antenna this pickup is unimportant, but with any type of directive array a perfect line balance is a great asset. Even on transmitting a perfectly matched system gives one the assurance that maximum power is reaching the radiator.

Everitt suggested a rule of thumb method for matching single wire lines[3] to antennas back in 1929. In his latest book, Communication Engineering,[4] he reapplied his theory[5]

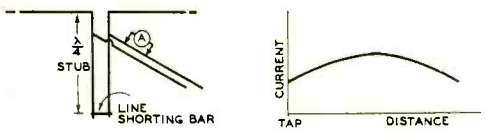
* 56 Concord Ave., Cambridge, Mass.

[1] B. Goodman, "A Few Feeder Consideration," *QST*, Sept., 1939.

[2] The standing wave ratio is the ratio of the maximum current along the transmission line to the minimum current.

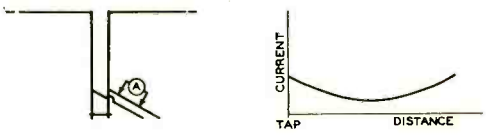
[3] W. L. Everitt and J. F. Byrnes, "Single-Wire Transmission Lines," *Proc. I.R.E.*, Oct., 1929.

[4] W. L. Everitt, "Communication Engineering," second edition, McGraw-Hill, N.Y.C., 1937.



LINE TAPPED ON TOO HIGH

Figure 1. Standing-wave conditions when the feeder is tapped up too high on the stub. Note that the feeder current rises as one proceeds along the wire away from the junction until the first anti-node is reached.



LINE TAPPED ON TOO LOW

Figure 2. Standing-wave conditions when the feeder is tapped too close to the shorting bar on the stub. Note the falling feeder current along the wire away from the junction until the first node is reached.

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to two wire transmission lines. His treatment of this subject supplies a beautiful method for adjusting the average amateur line-stub to antenna combination neatly, quickly, and effectively.

In order to illustrate the rudiments of Everitt's theory, let us consider three cases. The first, when the transmission line is terminated in an impedance higher than its own, the second, when it is terminated in an impedance lower than its own, and third, where the line is correctly terminated in its own characteristic impedance. To illustrate better the first and second case let us consider the two extremes. The extreme termination in the first is air which gives us an open line and in the second a short across the end of the line represents the lowest impedance that can possibly be used for termination.

If the line is coupled to a transmitter of any frequency, and the current along a short section of the line is measured, it will be found in Case I that the current is zero at the open end and that it increases markedly as one proceeds down the line from the open end toward the transmitter until the first current anti-node is reached.

In Case II, the shorted line, the current through the short represents a maximum and the current along the line will decrease as one goes toward the transmitter until the first current node is reached.

In Case III, where the line is terminated in its own characteristic impedance, there will be no standing waves on the line and when one proceeds toward the transmitter along the line there will be only a very gradual rise in current and voltage. This gradual rise is a function of the damping constant of the line and does not indicate incorrect termination.

To apply the observations above to the practical case is very simple indeed. First, however, allow me to assume that we are using a two-wire transmission line of the order of magnitude of six hundred ohms and that it is to be fed into a shorted quarter-wave matching stub. The shorted quarter-wave stub represents the typical case. If the stub is an odd multiple of quarter waves it should be used to feed at a voltage anti-node; if it is an even multiple of quarter waves it should enter the antenna at a current anti-node. I am neglecting the open-ended stubs for the simple reason that they are hard to adjust to resonance in the first place, and in the second, they always may be supplanted by a suitable shorted stub without changing the electrical characteristics of the system. The method involved in this article concerns the bottom quarter wave nearest the short in any resonant stub.

The RADIO ANTENNA HANDBOOK should be followed implicitly until the stub is adjusted to resonance. This resonance point is not final so do not solder the shorting bar to the stub. Simply wrap it on firmly so that it makes a good electrical contact. To avoid much insulation scraping, one should use bare wire in making the stub.

In carrying out the next step of the method it is necessary to have an r.f. current indicating device. As sensitivity is paramount, a current squared thermogalvanometer is by far the most desirable instrument for the purpose. These instruments should be used with caution since the thermocouples will blow on even a moderate overload. The meter should be connected in the manner shown in figure 4 to two razor blades which cut through the insulation on enamelled wire.

[*Continued on Page 74*]

[6] In his reapplication of his theory to two-wire lines Everitt interchanged voltage and current relationships. The current edition of *Communication Engineering* is in error on pages 274 and 275. To make his theory and diagrams correct, simply substitute voltage for current.

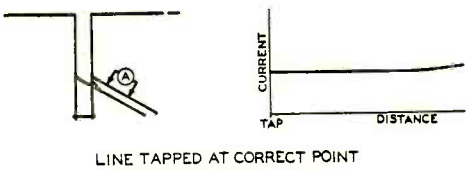

Figure 3. Feeder-current conditions when the feeder is tapped the correct distance up from the shorting bar on the stub. Note that the feeder current rises very gradually with no peaks along the wire.

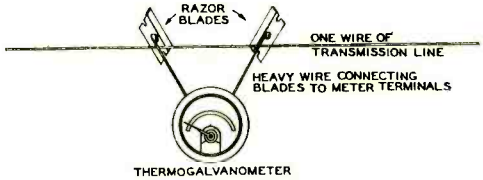

Figure 4. A simple attachment arrangement for measuring the feeder current at any point along the wire. Note that the support wire and the sharp edge of the razor blade should form a "V" which will cut through the insulation on the feeder wire.

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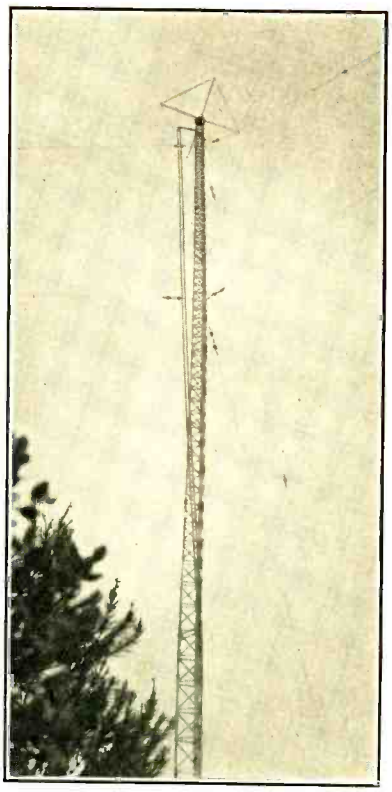
A New Material for ANTENNA CONSTRUCTION

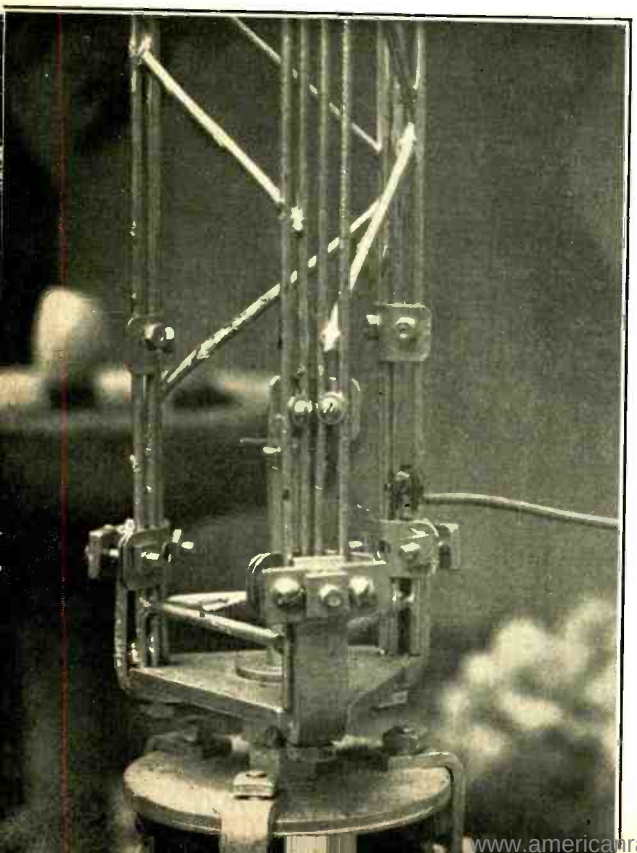
By DONN S. SMITH,* W6JTN

Constructional information on a 44-foot guyed steel vertical which is inexpensive and quite versatile in application. The base of W6JTN's installation was shown on the cover of June RADIO.



A view of the tower from the yard, showing the outrigger atop it, the "in-case-it-is-needed-halyard," and the method of guying the 44-foot 60-pound vertical.

Detail photo showing the base of the tower, its method of assembly from the three "Trussteel" sections, and the construction of the one-point support platform.



Many radio amateurs who live on the ordinary small city residence lots are grateful for the help of the article on top-loaded vertical radiators in the April, 1940, issue of RADIO. After receiving the desired information as to electrical layout the remaining difficulties are usually concerned with the problem of mechanical construction of the radiator. Desired features are rigidity, strength, lightness in weight, durability, and minimum wind-resistance and cost.

One of the strongest structural shapes known is that of the triangle. A common example is an ordinary roof truss which is a large triangle further sub-divided into smaller triangular sections.

The features mentioned above, including economy, are found in a modern building material manufactured for hollow fireproof plaster partitions in buildings. Its trade name is "Trussteel Studs" and is a product of the United States Gypsum Company. Trussteel Studs are obtainable from building material

* 1721 Laguna St., Santa Barbara, Calif.

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supply dealers. They are composed of four no. 9 steel wires, two on each edge, with a no. 6 steel wire running zig-zag fashion between them, as illustrated, and electrically spot-welded at every point of contact, thus forming a long narrow truss.

The principle of the triangular structural shape was carried out further in the construction of the author's vertical radiator by erecting a three-sided tower, each side being a Trussteel Stud. The three sides are secured together by means of clips made from galvanized plumber's tape, which has holes already punched and conveniently spaced. Short lengths of this tape are fastened about every 18 inches along each corner of the tower with 6-32 iron machine screws, using lock washers under the hex nuts.

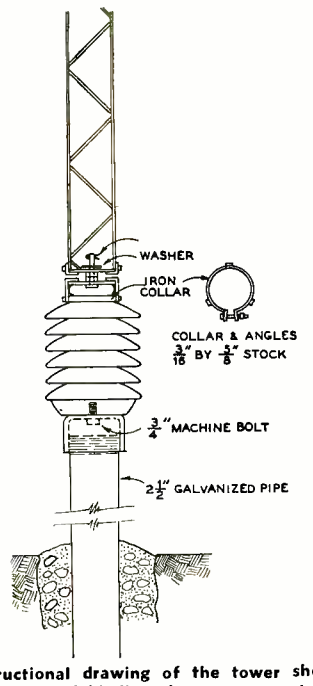
A 4-foot piece of 2½-inch galvanized pipe, with one end threaded to receive a pipe cap, was secured from the local junk yard and set 2 feet in the ground in concrete. Then an old high-voltage ceramic insulator with drilled and tapped metal base was obtained from the Edison Company trash can and bolted to a pipe cap so that the insulator and base fittings could be screwed onto the pipe support. A single-point support for the tower, so that any possible movement of the tower would not subject the insulator to strain, was devised by making an iron collar for the top of the insulator and drilling and tapping it at three points around the circumference of the collar. A heavy iron bearing plate was fastened to the top of the insulator by means of angles bolted to the plate and to the collar. The pin bolt was made by cutting off the head of a ½" x 6" machine bolt and bolting it to the bearing plate.

This particular tower was made up in four sections, with staggered joints, making a total length of 44 feet. The machine screws holding the clips fit tightly in going between the edge wires of the studs, making it unnecessary to install jumper wires to get electrical continuity between sections of the tower.

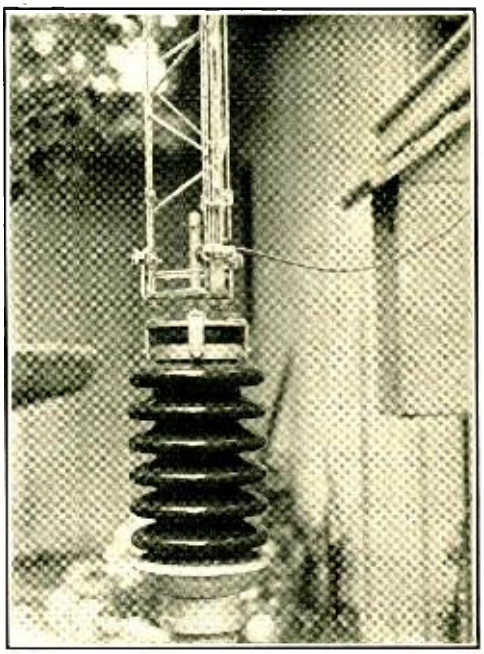
The Top-Loading Unit

The construction of the top-loading unit was similar to that in the April issue of RADIO except that the loading coil was wound on insulating tubing, lacquered and taped, and then mounted on a metal plate and fastened to the top of the tower by means of angles, bolts, and more plumbers' tape. Also, a short piece of channel iron was fastened to the top of the tower, just below the top-loading unit, and a bronze pulley suspended therefrom, so the tower could be used for supporting an

[*Continued on Page 82*]



Constructional drawing of the tower showing the method of binding the corners, and detail of the base collar.



Showing the base of the tower and the method of mounting it upon the single pillar insulator.

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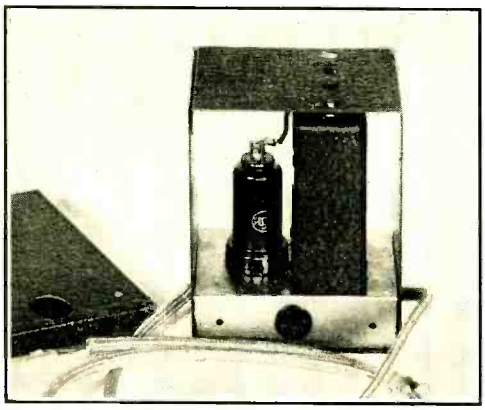
Outboard Selectivity

By W. W. SMITH,* W6BCX

An inexpensive method of increasing the selectivity of any communications receiver having 455- or 465-kc. i.f.



Not much to the device, but it packs a lot of selectivity. The two side covers have been removed from the cabinet to show the works.

What with the amateur phone bands jam packed with signals a good portion of the time, it often happens that the number of signals that can be heard is limited by the selectivity of the receiver and not by the noise level or receiver sensitivity. This is especially true on the widely popular "$30" amateur receivers, which for reasons of economy include only one i.f. stage, and on those receivers employing a 1500-kc. i.f. channel. However, it also applies to any communications receiver that does not have a maximum selectivity sufficient to clip sidebands to the extent of slightly reducing the intelligibility.

When a 1500-kc. i.f. channel is employed, the best way to obtain super-sharp phone selectivity is with a crystal filter, as additional i.f. transformers will add but little to adjacent channel selectivity. Also, a 1500-kc. crystal filter is sufficiently broad to pass intelligible phone signals without the necessity for adjusting the crystal phasing control until the skirts are so broad that most of the advantage of the crystal is lost.

When the receiver employs a 455- or 465-kc. i.f. channel, a crystal filter is little help on phone, being too sharp when adjusted to do much good. A dual crystal filter gets around this, but such an arrangement is quite complicated and expensive. Certainly the sharp-nose, wide-skirt selectivity curve of a single 465-kc. crystal is not the answer to phone selectivity. What is desired is a narrow, virtually flat-topped curve with straight sides. Such a curve may be obtained with a sufficient number of cascaded 465-kc. high Q transformers employing a coupling coefficient somewhat less than the critical value.

Most i.f. transformers, and particularly those used in the less expensive communications sets, were designed primarily for use in b.c. sets, where too much clipping of sidebands cannot be tolerated. The input transformer employs moderately close coupling to give good gain in the one i.f. stage, and the output transformer is in addition loaded by the diode load resistor. It is easy to see why a receiver of the inexpensive type employing but one r.f. stage may perform surprisingly well (considering the price) from the standpoint of bringing in signals, yet be woefully short on selectivity. It is possible to use to advantage in a phone receiver all the selectivity that can be employed without *serious* loss in intelligibility. Also, the selectivity should not all be on the "nose" of the curve; there should be no skirts to permit interference from loud locals 20 or 25 kc. off the signal frequency. Many so-called "sharp" receivers fall down in this respect; they will discriminate between two signals of equal strength on adjacent channels, yet not cut out a loud, powerful local that is many kc. away. Of course if the local is "splattering" with spurious frequencies as a result of overmodulation, the signal will cut a wide swath on the dial of the best receiver in the world. But

* Editor, RADIO.

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usually it is a matter of wide "skirts" in the i.f. amplifier that is responsible for locals covering big chunks of the dial.

With a near-ideal i.f. amplifier having a very narrow, steep-sided curve, it is possible to reject an R9 signal and pull in an R5 signal so closely adjacent that when the receiver is tuned half way between a heterodyne is audible. When the gadget to be described is used in conjunction with a superhet having a respectably sharp two-stage i.f. amplifier, it is possible to do just that, and when used with a set having one i.f. stage it will do nearly as well. It is possible to tune right up into the very shadow of R99 locals with no interference, unless of course they are splattering or have excessive harmonic distortion.

The device is essentially a "gainless amplifier" stage that can be attached quite easily to any superhet having a 455 or 465 kc. i.f. channel. In the interest of obtaining maximum selectivity, the stage will show little or no gain when correctly adjusted, but it is assumed that the receiver to which it is attached had enough i.f. gain to begin with, which is a reasonable enough assumption.

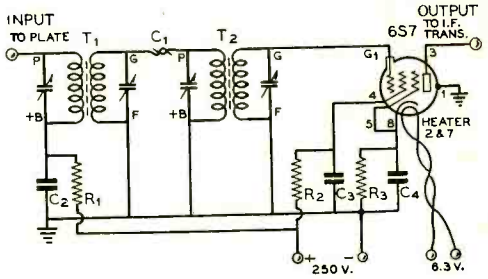
The two transformers are the sharpest inexpensive 455-465 kc. units generally available, being designated by the manufacturer as "interstage" type. The rated gain for one of these transformers is only about half that of a standard input transformer, due to the fact that the coupling between windings is somewhat less than critical; but the selectivity is greater.

To obtain the greatest possible amount of selectivity in one stage, two of these transformers are used in cascade. Coupling between transformers is accomplished by a very small coupling capacity (obtained by twisting together the wire leads for about 1 or 1½ inches).

As the unit is designed to run from the power pack of the regular receiver, a 150-ma. heater type tube was used to minimize the additional drain placed on the power transformer. The 6S7 is almost identical to the 6K7 except for the lower heater current. As the plate current drawn by the tube is only a few ma., there is no need for fear of there being an unduly heavy load placed on the power pack. The unit is quite compact, and will even fit inside the cabinet of some receivers. Where it will not, it may be attached to the outside rear of the receiver cabinet by means of brackets.

Construction

As there are so few components in the device, the construction is not a difficult problem. Most any small shield can be sufficiently large to house the two transformers and the tube with enough room to spare for the resistors and by-pass condensers will serve the purpose. Just remember to make provision for getting at the transformer trimmer screws after the box is all buttoned up, as the aligning is quite important and must be done after the unit is permanently installed with cover on and all wires attached just as they will remain in service.



Wiring Diagram of the Outboard Non-Amplifying Amplifier Stage.

T_1, T_2—High Q, iron core 455-465 kc. interstage i.f. transformers having less than critical coupling. See text.

C_1—I.f. transformer leads twisted together about 1½ inches. See text.

C_2, C_3, C_4—.05-μfd. tubular

R_1—2000 ohms, ½ watt

R_2—75,000 ohms, 1 watt

R_3—500 ohms, ½ watt

Both T_1 and T_2 are alike as purchased, with the grid lead coming out the top of the can. One of the transformers (which will be T_1) must be removed from the can and the grid wire changed to come out the bottom of the can so as to permit a short connection to the plate lead wire of T_2. When this wire is brought through the chassis it should *not be brought through the same hole as the plate lead wire of the same transformer.* In other words, while the "P" and the "G" leads both come out the bottom of T_1, they should be separated by *not less than one inch* at any point. It is important that the coupling between the two windings of T_1 be essentially *inductive* if a symmetrical selectivity curve is to be obtained, and as the inductive coupling is so loose in this type transformer, even a few μμfd. of stray coupling capacity between primary and secondary cannot be tolerated.

Even if the unit is to be housed inside the metal receiver cabinet (when it will fit), the entire gadget should be fitted with a housing of its own to avoid feedback troubles.

For connecting the unit, a four-wire cable, with appropriate miniature plug and jack if

[*Continued on Page 81*]

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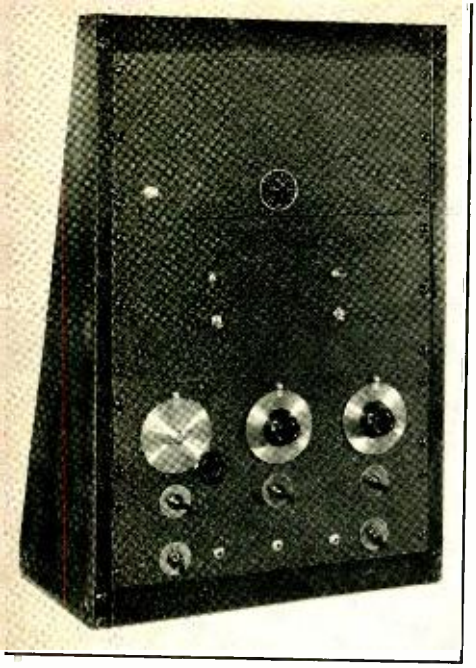

Figure 1. Front view of the 30-watt all-band v.f.o.-controlled phone-c.w. transmitter mounted in its 32-inch table relay rack. The r.f. stages are mounted on the lower shelf with the electron-coupled oscillator tuning dial on the left. The power supplies are on the middle deck and the speech amplifier is on the top.

Flexibility in a

By CHARLES T. KOLZ, JR.,* W2BKZ

In keeping with modern amateur trends, a transmitter which does not possess a provision for quick frequency change is strictly passé. A similar attitude might be taken toward the variable-frequency oscillator. With these two considerations in mind the 30-watt phone-c.w. rig described herein was designed and constructed.

Features of the Transmitter

1. Bandswitching instantly accomplished from 10 to 160 meters.
2. Instantaneous frequency change throughout all bands.
3. 30 watts output on all bands with no neutralization.
4. Excellent quality on plate modulated phone at full output.
5. R.f. section may be used as a driver for a high power final.
6. Modulator is of universal construction so that it may be used as a driver for a high powered audio stage or as a complete system to cathode modulate 250 watts input to a final stage.
7. Speech equipment designed to take care of crystal microphone with output of —60 db.
8. Voltage regulated power supply for more stable e.c.o. operation.
9. Complete assembly in a single unit for operation either as a transmitter or for use as an exciter in conjunction with higher powered equipment.

Construction

The complete transmitter consists of three units: the r.f. section, the power supply, and the speech amplifier-modulator. All are mounted in a 32-inch table type relay rack. The placement of these units in the rack can be seen from the accompanying illustrations. The r.f. section is, unconventionally, placed at the bottom to facilitate band and frequency changing. The power supply is in the center with the audio section in the top position. Aside from their convenience, the units so placed provide a well balanced and symmetrical layout.

The radio frequency chassis consists of a Browning exciter utilizing an RK-25 or 802 electron-coupled oscillator and an 807, HY-61, or RK-39 which may be employed either as a straight amplifier or a frequency doubler. A 6J5G crystal oscillator is also included for use when crystal controlled operation is desired. One switch on the panel selects the type of oscillator while another switch located on the rear of the oscillator compartment permits the selection of one or two crystals mounted adjacent to it.

The mechanical and electrical layout is excellent in that all stages are shielded and arranged so that the input or grid circuit of one stage is one compartment, while its plate or output circuit is in the next. This method of construction provides the shortest leads and consequently improves the overall efficiency considerably.

The bandswitching coil assembly employed in the RK-25 grid circuit has been designed to give stable e.c. operation. The large ratio of capacitance to inductance in conjunction with the use of harmonic operation definitely insures oscillator stability, a prime requisite in amateur v.f.o. operation. Temperature changes in the grid compartment have been kept at a minimum due to this layout with the result that frequency stability comparable to the better X-cut crystals as well as permanent reliability of calibration can be expected.

* Kenyon Transformer Co., Inc., 840 Barry St., N.Y.C.

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30-WATT PHONE-C.W.RIG

The final stage is also mounted in a horizontal plane and incorporates a bandswitching coil assembly similar to the oscillator except that a link on each coil is provided for coupling to either an antenna feeder or a higher powered stage. Here, in this stage, we also have a variable cathode resistor which very effectively and conveniently controls the r.f. output of the unit. The versatile design of the exciter permits operation of any frequency from 10 to 160 meters. Even 5 meters can be covered by a simple adaptation. All the necessary component parts and shields are mounted on a standard 10½-inch panel presenting a neat and well balanced appearance. In order to improve the appearance of the interconnecting cable the five colored wires, normally brought out through a rubber grommet in the rear of the shielded section, were shielded and rerouted to a terminal connector mounted on the RK-39 shield. Figure 2 shows clearly the position of the connectors in the exciter as well as the power supply.

Power Supply

The power unit has been designed for continuous operation and employs a pair of 5Z3's with paralleled plates in a full-wave rectifying circuit. Obviously, in the operation of an e.c.o. it is of the greatest importance to have available a well filtered and well regulated source of power. Hence, the inclusion of a voltage regulation system employing a 6SJ7 and a 6A3 stabilizes the voltage to the point where keying the e.c.o. causes a variation of only 8 volts in 300. The filter consisting of two 11-henry chokes and four 2-μfd. 1000-volt condensers (plus the filtering action of the voltage regulator) reduces the ripple content to an absolute minimum.

Operation of the Voltage Regulator

It might be appropriate, at this point, to discuss the action of the automatic voltage regulation system incorporated in this power supply. A sharp cutoff pentode, 6SJ7, is employed as a control tube and is connected so that any small change in the supply voltage causes a corresponding change in its bias and, thereby, a change in its plate current. This current flows through resistor R_9 causing a voltage drop which is utilized to bias the 6A3 regulator tube. Since its plate-cathode circuit is connected effectively in series with the resistor R_6 which provides correct voltages for the e.c.o. any change in current through it will cause a change in voltage drop across it. This voltage change therefore tends to decrease or increase the output supply voltage inversely as the input voltage varies.

In considering a definite example, let us assume that there is a sudden slight rise in output voltage. This would provide a slight increase in positive bias to the control tube resulting in a rise in plate current. The

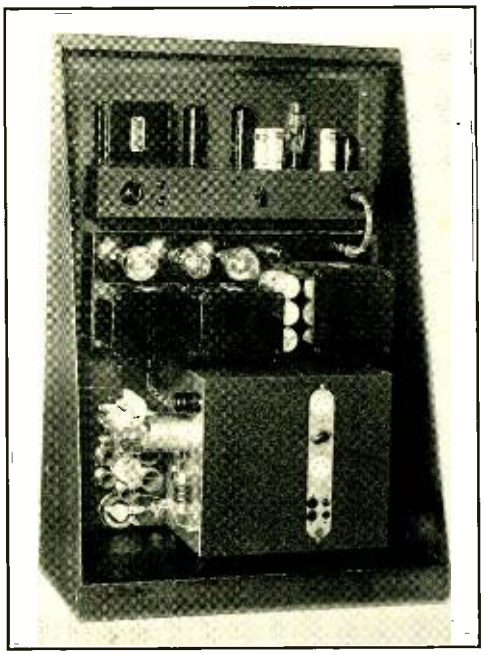

Figure 2. Rear view of the transmitter. Note, on the lower deck, that the oscillator stages of the transmitter are thoroughly shielded while the amplifier stage is out in the open air. Note also the neatness of the interconnecting cables between the units.

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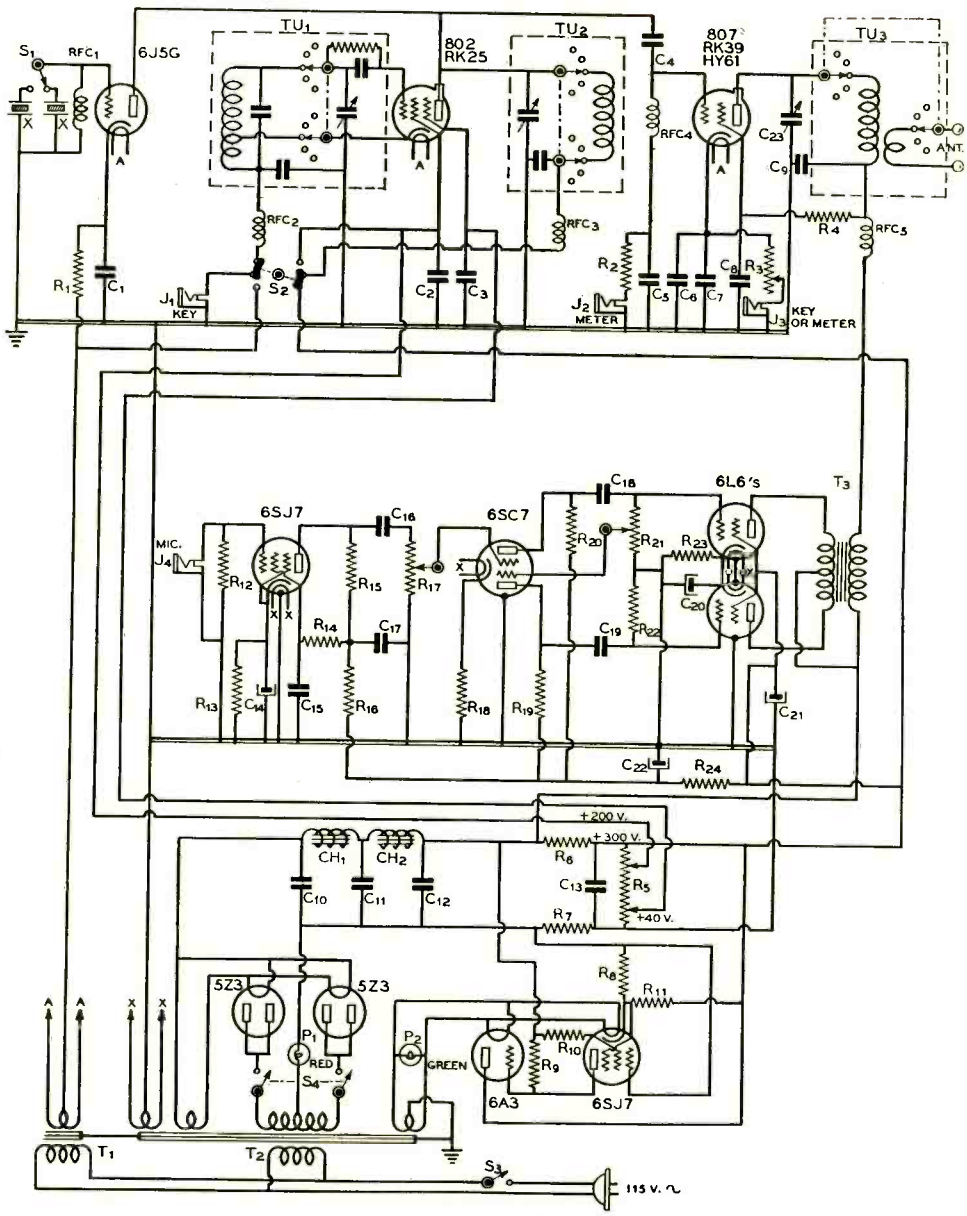

Wiring Diagram of the 30-Watt V.F.O. Transmitter.

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Value of Components in the 30-Watt V.F.O. Transmitter.

C_1, C_2, C_3—.005-μfd. mica
C_4—.0001-μfd. 1200-volt mica
C_5 C_6, — .005-μfd. mica
C_7 — 0.1-μfd., 400-volt tubular
C_8, C_9 — .005-μfd. 2500-volt mica
C_{10}, C_{11}, C_{12}, C_{13}—2-μfd. 1000-volt
C_{14}—25-μfd. 50-volt electrolytic
C_{15}, C_{16}—0.1-μfd. 400-volt tubular
C_{17}—4-μfd. 450-volt electrolytic
C_{18}, C_{19}—0.1-μfd. 400-volt tubular
C_{20}—25-μfd. 50-volt electrolytic
C_{21}, C_{22}—4-μfd. 450-volt electrolytic
C_{23}—100-μμfd., .070" spacing
R_1—300 ohms, 1 watt
R_2—50,000 ohms, 1 watt
R_3—5000-ohm 50-watt rheostat
R_4—25,000 ohms, 10 watts
R_5—25,000 ohms, 50 watts
R_6—1500 ohms, 100 watts
R_7—500 ohms, 50 watts
R_8—2500 ohms, 1 watt
R_9—250,000 ohms, 1 watt
R_{10}—10,000 ohms, 1 watt
R_{11}—150,000 ohms, 1 watt
R_{12}—3 megohms, 1 watt
R_{13}—1000 ohms, ½ watt
R_{14}—500,000 ohms, ½ watt
R_{15}—100,000 ohms, ½ watt
R_{16}—10,000 ohms, ½ watt
R_{17} — 500,000-ohm potentiometer
R_{18}—1500 ohms, ½ watt
R_{19}, R_{20} — 50,000 ohms, ½ watt
R_{21}—100,000-ohm potentiometer
R_{22}—100,000 ohms, ½ watt
R_{23}—200 ohms, 10 watts
R_{24}—10,000 ohms, 1 watt
RFC_1, RFC_2, RFC_3, RFC_4 — 2½-mhy. 125-ma. r.f. choke
RFC_5—2½-mhy. 500 ma. r.f. choke
TU_1—Exciter grid tank assembly (see Buyer's Guide)
TU_2—Exciter plate tank assembly (see Buyer's Guide)
TU_3—75-watt plate coil assembly (see Buyer's Guide)
T_1—6.3 v., 2 a.
T_2—850 v. c.t., 165 ma.; 5 v., 3 a.; 6.3 v., c.t., 3 a.; 6.3 v. c.t., 3 a.
T_3—30-watt modulation transformer
CH_1, CH_2 — 11-hy., 300-ma. choke
S_1—S.p.d.t. tap switch
S_2—D.p.d.t. tap switch
S_3 — D. p. s. t. toggle switch
S_4—D.p.s.t. toggle switch
J_1, J_2, J_3, J_4—Single closed-circuit jacks
P_1—2.5-volt 500-ma. pilot light
P_2—6.3-volt pilot light
X_1, X_2—10 to 160 meter crystals

drop across its plate resistor would also rise thereby providing additional bias in a positive direction causing the regulator tube to draw more plate current. This increase in current would result in a greater voltage drop across the resistor R_6 and the consequent reduction of output voltage to the pre-rise condition. A decrease of the same voltage causes a reverse action to occur. The complete action of system takes place almost instantaneously.

Since regulation is taken care of by this means, condenser input is used to compensate for the voltage loss in the regulator tube. Standby operation is accomplished by the insertion of ganged toggle switches in each of the transformer secondary legs. This unorthodox manner of providing a standby condition prevents unnecessary voltage breakdowns in the power transformer, a danger usually present when the center tap is broken to accomplish the same purpose. Of course, a well insulated switch must be selected to forestall any tendency towards breakdown to ground at that point. A 2.5-volt, ½-ampere pilot lamp is placed in the center-tap lead for visual indication of a "plate on" condition.

The power supply components are mounted on a 7" x 17" x 3" chassis which is secured to an 8-¾" x 19" panel so that all parts are in a horizontal plane. This is done by fastening, with flathead screws, a 6" length of ⅜" x 3/16" cold rolled steel to the underside of the chassis flanges. The six panel mounting holes are then scribed through and drilled and tapped for 8-32 screws, when they have been properly positioned.

Viewing the power supply chassis from the rear it will be noted that the two chokes are mounted side by side in the lower left-hand corner with the power transformer on the right side. Three of the four filter condensers are positioned between one of the chokes and the power transformer, the fourth being mounted on the underside of the chassis. The four tubes in the supply are placed in a line along the top of the chassis with the two 5Z3's at the extreme left. A terminal connector in the upper right-hand corner terminates all voltages for the speech amplifier-modulator units mounted directly above it in the rack. R_8 is mounted to the short right-hand side of the chassis with R_5 fastened perpendicular to it in the upper right corner. R_7 is the 500-ohm, 50-watt resistor secured by a length of 6-32 rod to the lower chassis drop.

The Speech Amplifier-Modulator

The audio portion of the rig is an oft tried and recommended unit consisting of a high gain 6SJ7 input tube resistance-coupled to a phase inverter, 6SC7. The correct out-of-phase voltage necessary for push-pull action is obtained through the use of the second grid of the 6SC7 and a variable resistor (potentiometer) in one of the push-pull 6L6 grids. The last stage is operated in class AB_1 with self-bias and can supply a measured 30 watts of audio.

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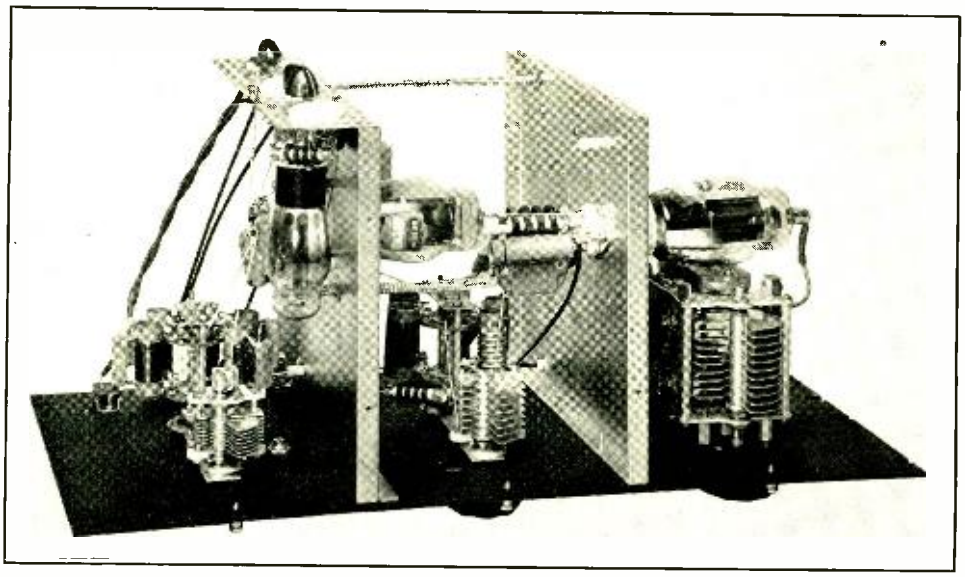

Figure 3. Detail view of the r.f. deck of the transmitter with the shields removed. Note how the grid circuits of the two screen-grid tubes are in one compartment while their plate circuits are in the other.

The amplifier has an overall gain of 100 db. A single high-impedance input connector is provided for use with a crystal microphone having a level no lower than —60 db. This is placed on the panel front as is the gain control. The phasing control is mounted on the chassis back drop where it is once properly set and forgotten. The complete unit is mounted on a 4" x 17" x 3" chassis and secured to a standard 8-¾" panel in the conventional manner.

When completely assembled and interconnected in the table type rack, the three units comprise the coordinated and efficient combination mentioned in the foreword.

Tuning

Three jacks are provided on the r.f. panel for the insertion of milliammeters for tuning. The one at the left reads the oscillator plate current, and also can be used for break-in keying. The center one reads the RK-39 grid current while the right-hand jack may be utilized to read the plate current or for keying of the p.a. stage. Now, assuming that all tubes are in place and that power has been applied to the unit, the sliders on the bleeder resistor R_5 should be adjusted to supply 200 and 40 volts for the 802 or RK-25 screen and suppressors, respectively. Next, the selection of the type of oscillator should be made by setting the lower left-hand knob to either no. 1 for crystal control or 2 for e.c.o., at the same time setting the three bandswitches to the desired band. The tuning control on the upper left side of the panel determines the frequency within a desired band if e.c.o. operation is being employed. In the event that crystal control is being utilized the setting of this dial may be ignored.

The center dial or oscillator plate tank is resonated: this is indicated by a dip of the oscillator plate current as well as by a rise in the p.a. grid current to approximately 2 to 4 ma. At resonance the plate current should be between 30 and 40 ma. depending on the frequency selected. The 807 or RK-39 plate should also be brought into resonance by swinging the extreme right band tuning control until a dip in the p.a. plate current is noted. The external antenna load may now be connected which should increase the p.a. plate current to approximately 90 ma. The low impedance feeder connection to the antenna can be found on the rear of the p.a. bandswitching coil assembly. When all stages are operating with normal currents, it would be wise to recheck and reset all adjustable element voltages to their correct values. If all the tuning and adjustment points covered have been followed carefully, no difficulty should be experienced in getting the transmitter into operation.

[*Continued on Page 96*]

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Minimum-Cost Transceivers

By ED HARRIS, *W5TW

Nothing has stirred up so much interest in a long time as the little 112-Mc. battery transceiver in the March issue. W5TW gives some pointers on building a pair of them when the budget won't permit shiny new parts.

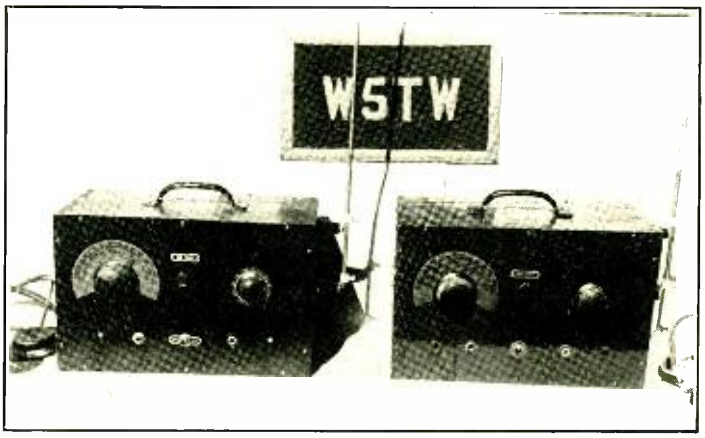
After receiving the March edition of RADIO the writer found himself reading the article by Smith on the 2½-meter transceiver for the second time, and suddenly realized that the little building bugs were beginning to come to life after having been in hibernation for a couple of years. After reading Conklin's column I was thoroughly inoculated; the bugs had burrowed in much deeper than any Oklahoma mountain tick ever did.

A visit to the parts cabinet revealed the distressing fact that most of the parts would have to be purchased. Out came the catalogs and the old pencil was put to work. But this was only the beginning. That evening at dinner the question of how much I had spent in the twenty-six-years-I-have-been-an-amateur was brought up and finally the blunt question was asked, "Are you fixing to build something new?" I had to confess that I was, but quickly explained that they were just little things and would not cost much. Well, after the smoke had finally cleared it was decided that the wife and Anne could each buy them a new Easter coat, dress and hat (boy! *what* hats they were) and the o.m. could go ahead and build his 2½-meter CQer.

Unfortunately they did their shopping first and my bank balance ordained that I would have to build the transceivers from the junk box or not at all. So the o.m. quit smoking and purchased two transceiver audios and two low-loss sockets. These sockets are the kind that melt right around the tube when you solder to the terminals. I was lucky here for once, as I had the tube in the socket when the connections were made. But that is getting ahead of the story.

From the junk box an ancient GE A-53 b.c. radio was stripped. It provided the send receive switch and the volume control. The audio choke was taken from a small a.c.-d.c. junked receiver and the insulated shaft was made by knocking out the centers of two old receiver knobs and saving the metal centers with the set screws in them. Into this was glued a short piece of ¼" glass tubing such as is used around neon plants for cross insulation. No flexible coupling was used. The hole in the panel was lined up with the con-

* Hugo, Oklahoma



The majority of the components in these two 112-Mc. transceivers came from the junk box and old b.c.l. sets; yet they have "worked each other" at 20 miles. The batteries are neither expensive to maintain nor heavy.

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denser shaft and no trouble has been encountered with it. The panel was made from heavy galvanized iron purchased for a dime from the local tin shop. The condensers are Hammarlund neutralizing 35 $\mu\mu$fd. taken from the old 20-meter transmitter. Insulation for the condensers to rest on was made by tearing up several old i.f. transformers and taking all the hardware off the trimmer condensers, which left us a nice flat plate of isolantite and several small buttons of the same material. The condenser was bolted to one of these buttons and then the whole thing was glued to the flat plate with coil dope. The flat plate in turn was bolted to the chassis.

The cabinets were made from 16-gauge shot gun shell shipping cases. These were taken to the local mill and sanded off and given a coat of "Telephone Brown" paint. A dime store furnished the handle and the whole box was lined with sheet-iron. Small lugs were left on the front side of this lining and bent flush with the panel so that when the panel is screwed in place it will be grounded in several places. It was necessary also to solder the chassis to this shielding in the rear. The antenna support was made from two 1½" standoff insulators with two "Kerney" solderless lugs mounted tight on them. These lugs have a set screw that clamps the wire intended for them, and will hold the antenna rod fine and makes taking it off no trick at all. The antenna is a 3-foot bronze ¼" welding rod. A smaller diameter rod was tried but it was found to make the signal wobbly when it vibrated. The ¼" is rigid and no such trouble was experienced.

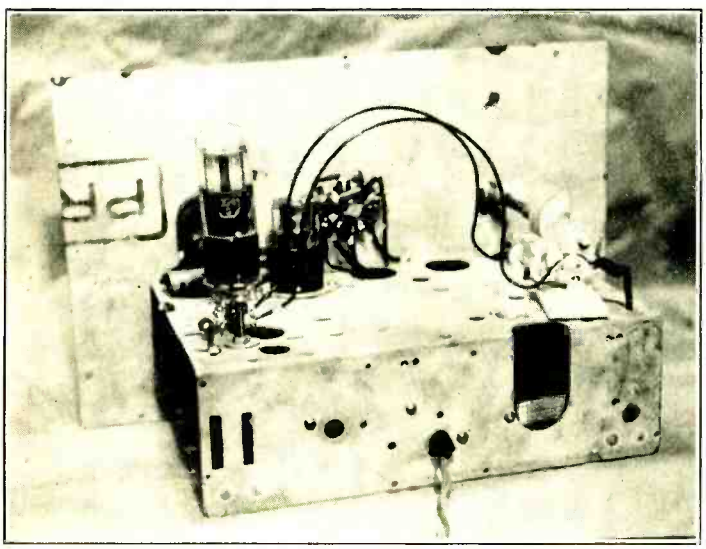
For the second transceiver the GE A-53 that the o.w. used in the kitchen was "borried for use at the shack" and immediately torn down. Anyhow, the parts went for a good cause. And I can always put them back later.

No trouble at all was had getting the machines to work. In fact, they worked the first time they were hooked up. After lugging one of the machines around town all one day with headphones on and a mike in one hand and the transceiver in the other, a hasty conference was called by the women folks. The o.m. was called on the carpet and branded with various uncomplimentary epithets, and look what we were doing to our social standing in the town. I just told them that if I were guilty of paying good cash for such things as they called hats—let alone wearing them—I wouldn't talk, and with the o.m. hastily retreating this chapter came to a close.

It was found that with a distance over two city blocks (antenna not elevated) the signal could be heard, but not loud. By changing the antenna connection to the plate side of the tank circuit this trouble was remedied. Also, with the antenna on the plate, the antenna is not in the least critical. On the grid side it had to be cut to exact length or nothing doing at all.[1]

I soon found that I was not as young as I was when I used to shut off the motor on the old Benwood Rotary gap and let her slow down as I made the ARK. So an antenna

[*Continued on Page 78*]



The innards don't look quite so purty when most of the parts are salvage and makeshift, but if you are more interested in results than beauty you can save a dollar here and there.

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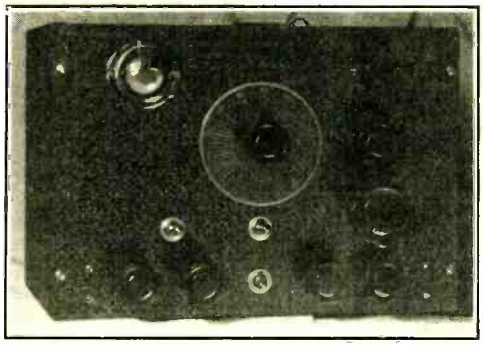
Front view of the portable superheterodyne. The center knob is attached to the center shaft of a planetary unit and the dial plate is attached to the slow speed shaft.



A Portable BANDSWITCHING SUPERHETERODYNE

By K. L. BOWEN,* W8QLN

Another homemade superhet—so it is o.m., and f.b. it is too. The performance of this little receiver has far exceeded my fondest hopes. While primarily designed for 10 and 20 meters, any coils for the ham bands or s.w. broadcast bands may be incorporated. The photographs show the 20- and 80-meter coils.

The reason for the construction of this unit goes back to last summer when the writer acquired many strained muscles and an aching back on field days from lugging so-called portable equipment to the chosen site. The answer to the problem is shown herein —a portable superhet without plug-in coils and having adequate gain and image rejection at 10 and 20 meters.

This receiver, in its cabinet, weighs 12 pounds. It is a full fledged superhet with nine metal tubes, two of the dual-purpose class, with all the audio output a midget p.m. speaker will stand. The chassis measures 9½" x 7½" x 1½" and fits the standard 7" x 10" x 8" cabinet. Every inch has been used to best advantage without unnecessary crowding or unwanted coupling. The receiver has most of the desirable features of its larger brethren: a.v.c., b.f.o., noise limiter, first detector regeneration, tone control, audio gain control and bandswitching. There is also a trimmer control on the first detector to peak this circuit when full regeneration is used.

* 1492 So. Taylor Rd., Cleveland, Ohio

The noise limiter is necessary on 10 meters and is very useful on 20 meters. If the operator happens to be unfortunate enough to live on or to be operating portable in the vicinity of a busy street this noise limiter will be greatly appreciated. Living on a busy street, I found 10- and 20-meter operation most unpleasant until this limiter was incorporated.

This receiver circuit gives better than average selectivity, a high degree of sensitivity and remarkable freedom from images on 10 and 20 meters. Having tried several three-tube superhet circuits and modifications thereof, I marvel at the performance this receiver gives when compared with expensive factory made amateur communications receivers. Every ham that has operated this receiver has pronounced it perfectly satisfactory.

Construction Details

As can be seen from the photographs (by W8GW) the h.f. oscillator compartment is made from two pieces of aluminum with three vertical supports rather than from one piece bent to form the angle. These pieces may be slid in and out of the grooved vertical supports to allow easy mounting of the parts and for soldering the necessary connections. The bandswitch is easily mounted by removing the center spacers and sawing them in half. The switch is then reassembled with two gangs on each side of the 2-¾" x 5" aluminum shield. The placement of parts can be seen in the photographs.

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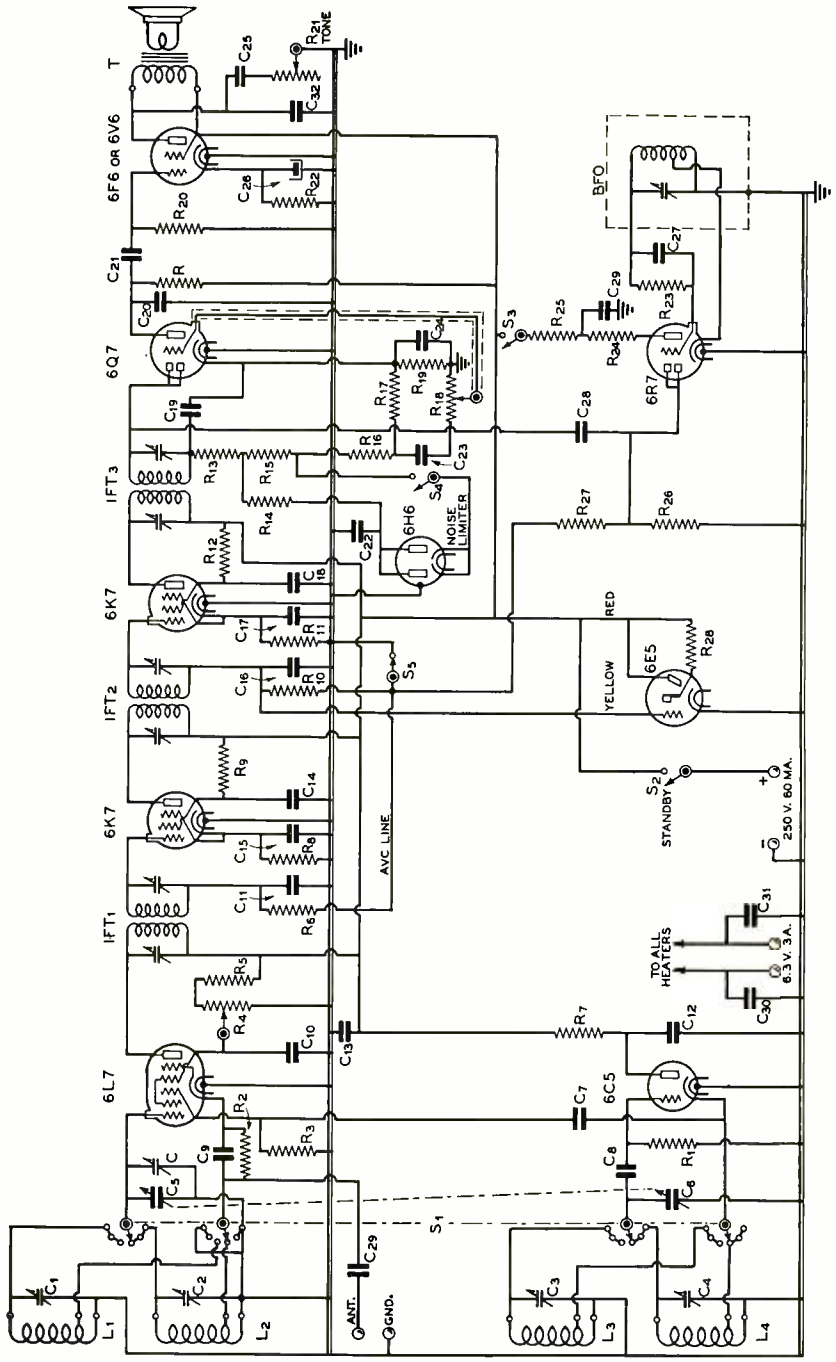

GENERAL WIRING DIAGRAM OF THE PORTABLE BANDSWITCHING SUPERHETERODYNE

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Value of Components in the Portable Bandswitching Superheterodyne.

C—6-μμfd. midget variable
C_1, C_2—70-140-μμfd. mica trimmer
C_3, C_4—100-μμfd. midget variable
C_5, C_6—13-μμfd. midget variable.
C_7—.00005-μfd. mica
C_8—.0001-μfd. mica
C_9, C_{10}, C_{11}, C_{12}—.01-μfd. 400-volt tubular
C_{13}—1.0-μfd. 400-volt tubular
C_{14}, C_{15}, C_{16}, C_{17}, C_{18}—.01-μfd. 400-volt tubular
C_{19}, C_{20}—.0001-μfd. mica
C_{21}, C_{22}—.05-μfd. 400-volt tubular
C_{23}—.02-μfd. 400-volt tubular
C_{24}—0.1-μfd. 400-volt tubular
C_{25}—0.5-μfd. 400-volt tubular
C_{26}—10-μfd. 25-volt electrolytic
C_{27}, C_{28}, C_{29}—.0001-μfd. mica
C_{30}, C_{31}, C_{32}—.01-μfd. 400-volt tubular
R—100,000 ohms, 1 watt
R_1—50,000 ohms, ½ watt
R_2—500 ohms, 1 watt
R_3—50,000 ohms, ½ watt
R_4—50,000-ohm potentiometer
R_5—25,000 ohms, 1 watt
R_6—1 megohm, ½ watt
R_7—20,000 ohms, 1 watt
R_8—500 ohms, ½ watt
R_9—100,000 ohms, ½ watt
R_{10}—1 megohm, ½ watt
R_{11}—500 ohms, ½ watt
R_{12}—100,000 ohms, ½ watt
R_{13}—20,000 ohms, ½ watt
R_{14}, R_{15}—1 megohm, ½ watt
R_{16}—100,000 ohms, ½ watt
R_{17}—250,000 ohms, ½ watt
R_{18}—500,000-ohm potentiometer
R_{19}—300 ohms, ½ watt
R_{20}—500,000 ohms, ½ watt
R_{21}—10,000-ohm potentiometer
R_{22}—400 ohms, 2 watts
R_{23}—50,000 ohms, ½ watt
R_{24}—5000 ohms, 1 watt
R_{25}—10,000 ohms, 1 watt
R_{26}, R_{27}—megohms, ½ watt
R_{28}—1 megohm, ½ watt (supplied with eye assembly)
IFT_1—Input i.f. transformer
IFT_2—Interstage i.f. transformer
IFT_3—Output i.f. transformer
BFO—Beat-oscillator transformer
S_1—Four-section, six-position bandswitch
S_2, S_3, S_4, S_5—S.p.s.t. toggle switch

COIL TABLE

BAND	OSCILLATOR L_3, L_4	MIXER L_1, L_2
10	5 turns no. 16 tinned wire ¾" dia. and 1¼" long. Tap 1½ turns from ground end.	5 turns no. 16 tinned wire ¾" dia. and 1¼" long. Tap ¾ turn from ground end.
20	10 turns no. 16 tinned wire ¾" dia. and 1¼" long. Tap 2½ turns from ground end.	10 turns no. 16 tinned wire ¾" dia. and 1¼" long. Tap 1½ to 2½ turns from ground end.
40	13 turns no. 24 d.s.c. 1" dia. and 1" long. Tap 3½ turns from ground end.	17 turns no. 24 d.s.c. 1" dia. and 1¼" long. Tap 1½ to 2½ turns from ground end.
80	29 turns no. 24 d.s.c. 1" dia. closewound. Tap 5½ turns from ground end.	35 turns no. 24 d.s.c. 1" dia. closewound. Tap 3 turns from ground end.
160	90 turns no. 30 enam. 1" dia. closewound. Tap 20 turns from ground end.	110 turns no. 30 enam. 1" dia. closewound. Tap 3 to 5 turns from ground end.

The oscillator bandset condensers are mounted so that they are adjusted from the underside of the chassis and the detector bandset condensers are mounted on the outside points of the bandswitch. Three switch points are used for the grid end of each coil and two points for the ground end of each coil. The remaining four points are used for the cathode tap. The ground end of each coil is nearest the shield dividing the bandswitch. The cathode taps connect to points 3 and 4 so that one click of the switch changes the coils in use. The bandspread condensers and tube elements connect to the common terminals on the underside of each gang. The antenna blocking condenser is soldered to detector cathode tap common point.

Receiver Panel Controls

The controls along the bottom from left to right are: rotary toggle switch to turn on b.f.o., tone control, send-receive toggle switch, audio control, and first detector regeneration control. Directly above the regeneration control is the extended tuning control. The dial plate indicator knob is string driven from the planetary drive unit. Above the tuning knob is the bandswitch knob and above this is the

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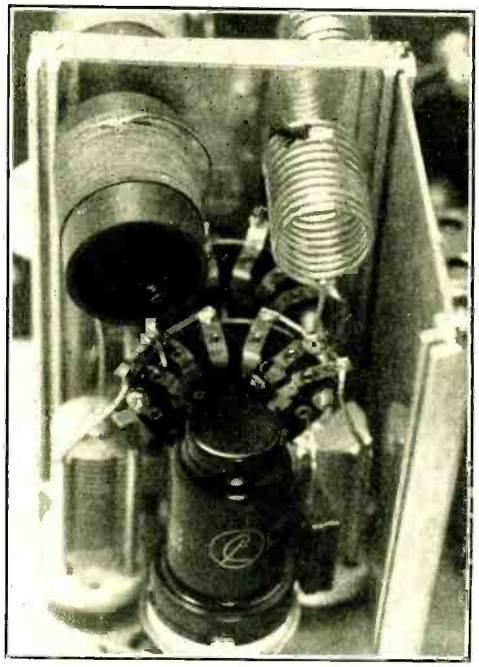
trimmer condenser for the first detector. This condenser should be set at half capacity and will require attention only when the first detector is operated at maximum regeneration. It should be possible to make the set lockup or squeal, when the regeneration control is far advanced, by varying the capacity of this condenser. If the set cannot be made to squeal the front end is not even closely in line. The remaining two toggle switches control the a.v.c. and noise limiter. The magic eye is inoperative when the a.v.c. is off.

Tracking

The front end is made to track by slightly varying the spacing of the air-wound coil turns. On the form-wound coils a turn or part of a turn may have to be added or removed.

When the air-wound coils have been made to track a thin sheet of plastic insulating material should be rolled into a tube and inserted in these coils. Coil dope should then be applied to hold the turns firmly in place. Otherwise, jarring will cause a change in frequency as the coil turns vibrate. A piece of aluminum should cover the coil compartments, otherwise the receiver will change frequency when the cabinet cover is raised or lowered. This piece was removed to allow the parts to be photographed.

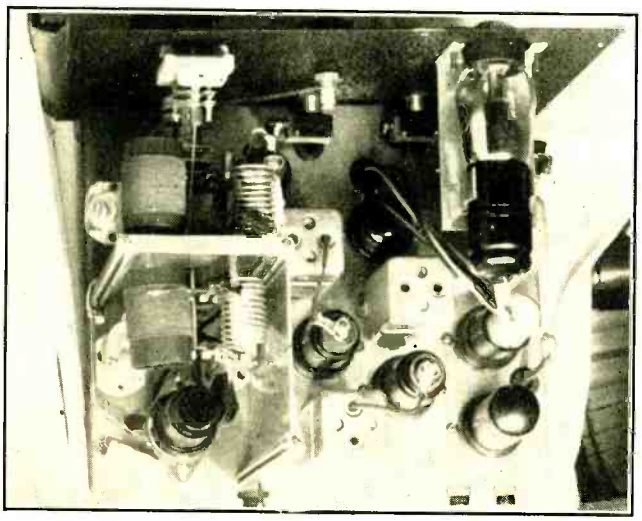
The i.f. is aligned in the usual way between 456 and 460 kc. This model seemed to give better gain at 460 kc. The i.f. was originally lined up by ear and was found to require very little adjustment when a signal generator was used at a later date.



Detail view of the oscillator compartment of the receiver.

Power Requirements

The 6.3-volt filaments draw about three amperes when a 6V6 output tube is used and slightly more with the 6F6. The current is 60 ma. with either tube in the socket, at 250 volts.



Looking down upon the "works" of the portable. Note the dial-cable drive to the condenser shafts.

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112-224 Mc. RIGS

By E. H. CONKLIN,* W9BNX

Figure 1. Simplified schematic of a single-tube oscillator using resonant parallel grid and plate line.

• • •

How long does it take to build a transmitter for 2½ or 1¼ meters? How much will it cost? Those are questions that many might ask or, perhaps, ought to ask. If you are like the writer, it will take you a month to figure out what you want to build, a month to get around to deciding on minor constructional details and to buying some copper pipe, and another month trying to get down to the job of putting the rig together. Finally, after becoming disgusted with your inertia, you will get to work some evening and in two hours will be on the air! The largest job is cleaning the pipe with steel wool, in order for shorting bar and grid tap to make good contact. After the pipes are mounted, there is very little left to do, and it can be done in fifteen minutes. These outfits are certainly simple.

In the course of checking up on the relative merits of junk-box rigs against more carefully built jobs, it was noted that a reasonably satisfactory note and five or ten watts output could be obtained from type 56 or other audio triode tubes capable of handling a fair amount of power.[1] Type 55 and 6R7G tubes with the grid connection coming out the top of the bulb, recommended by O. K. Falor,[2] were not tried because they would have involved spending fifty cents or more per tube, taking the rig out of the junk-box and into the luxury class. But let's take an excursion through some of these experiences.

* Associate Editor, RADIO, Wheaton, Illinois.

[1] "A Simple 2½ Meter Transmitter," RADIO, April, 1939, p. 57.
[2] "U.H.F.," RADIO, June, 1940.

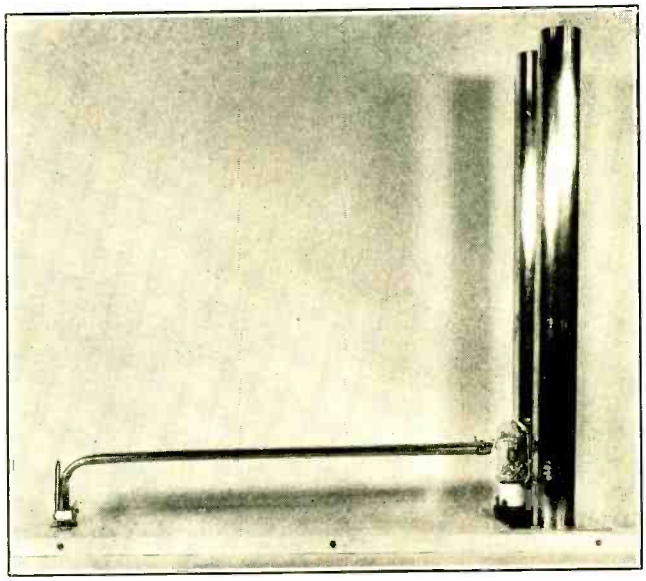

Figure 2. The 112-224 Mc. oscillator using an Eimac Twin-30 tube.

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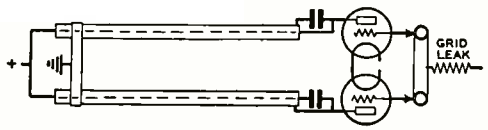

Figure 3. Showing the method of taking the d.c. off the plate pipes used in the oscillators of figures 2 and 4. The condensers at the ends of the pipes consist of metal straps insulated from the pipe ends by a layer of u.h.f. insulating material.

With a type 56 in a single-tube circuit, the grid and plate being connected to the open ends of a parallel-rod line as shown in figure 1, it was noted that the power output fell sharply as a shorting bar was moved toward the tube. This effect appears to result from unbalance presented by the tube, causing the current node on the line to fall somewhat off the shorting bar. A small condenser from grid to cathode might have balanced things up again. This circuit is not recommended unless the line is cut down to the correct length.

The standard t.n.t. circuit with plate lines and a pair of 56's works quite well, even without filament chokes.[1] Putting in a grid line limits the possible plate line tuning to a relatively small distance along the line, showing that the grid circuit is "taking hold." This arrangement produces a better "whistle" in a superheterodyne receiver than did a coil-tuned pair of 59's, but there is some drift and the mechanical layout permits the signal to waver if not anchored down firmly.

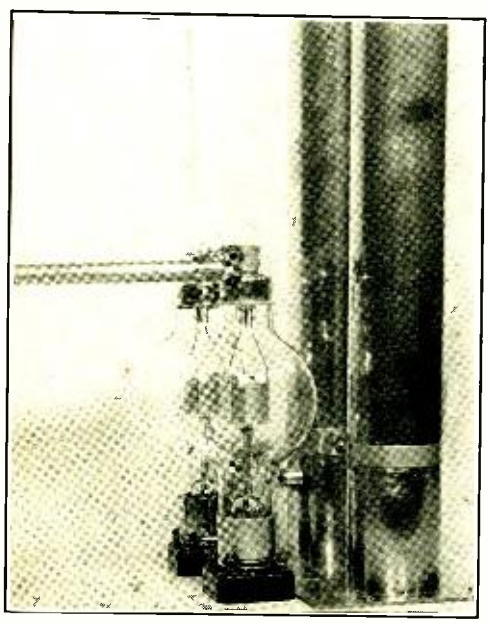

Figure 4. Closeup of the oscillator of figure 2 with a pair of 50T's substituted for the Twin-30.

Twin-30 Rig

Real stability, however, results from using a grid line made of larger diameter pipe, and a tube with leads out the bulb, such as the Eimac Twin-30. One outfit using this tube is shown in figure 2.

The grid line is made up of copper pipe two inches in diameter, a size on hand for use in receiver coaxial line circuits. Smaller diameter pipe had been used in earlier models with satisfactory results. A 1/16-inch copper base plate, drilled to pass the end of the pipes, acts as a shorting bar and mounting. By using hard solder and a hot iron, a clean soldering job can be accomplished from the under side of the plate without surplus solder showing from the top. During the soldering, the pipes can be held parallel by slipping a piece of wood, drilled like the bottom plate, over the far end of the pipes. The bottom plate can be squared up and the soldering done without concern over the final appearance of the job. For high Q, the spacing should about equal the pipe diameter—that is, a two-diameter center-to-center distance.

The tubes load the grid line somewhat; the length of the shorting bar also makes the desired line length less than an actual quarter wavelength. The proper line length can be determined with a temporary breadboard set-up, after which the line can be cut to size to eliminate the need for a separate shorting bar. If this shortening process is overdone, a couple of metal plates can be attached to the "hot" ends of the pipes to form a condenser and load them up again. The proper point for the grid tap appears to be a compromise between more drive, and resistance damping of the circuit Q—the object is to obtain satisfactory power output and frequency stability.

The plate line is similarly constructed but of only ½-inch copper pipe. A 1/32-inch copper mounting plate and shorting bar is strong enough if its edge is bent up to strengthen it and to provide a convenient means of mounting the antenna coupling. A four-diameter spacing, for high impedance, radiates so much power in the room that a high-Q spacing was arbitrarily used in the photographed rig. With the high-Q grid line described above, plate tuning must be within about ¼ inch in order to obtain any output. Here, again, the tube loads the line, both with inductance and capacity, and the proper line

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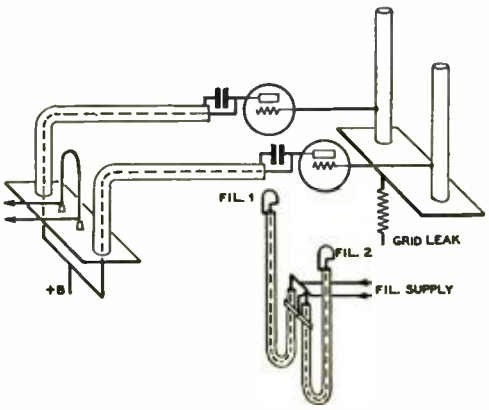

Figure 5. Showing the use of under-chassis folded filament lines in the push-pull 50T oscillator.

length will be less than a quarter wavelength.

Chassis size can be reduced by bending the plate pipes down to the chassis. This is particularly helpful when large tubes are used, so that a considerable part of the pipes can be in a vertical position. Fastening the plate pipes directly to the chassis is better, mechanically, too, and eliminates the need for a mounting insulator as tall as the transmitting tubes.

The pipe bending procedure, using sand inside to keep it from flattening was reviewed in April RADIO on page 19. The shorting bar can be soldered on before bending. Hard drawn copper can be softened before bending by heating it. It is suggested that a rolling-pin be clamped in the vise with the pipe to insure a round bend and avoid a nick from the vise jaw.

When the grid and plate lines are to be mounted above the chassis, it seems unnecessary to go to the cost of mounting the rig on a metal chassis. A board will suffice. However, the d.c. can be taken off of the plate line both for safety and to remove the necessity to insulate the shorting bar from a metal chassis. This is done by pulling insulated d.c. plate leads through the pipes, and by-passing these wires to the hot ends of the pipes, as shown in figure 3. Convenient condensers are readily made by putting a metal strap around each pipe, insulated with mica or polystyrene. The condensers in the rig pictured in figure 2 were made by wrapping a turn of thin polystyrene—the sample attached to page 27 of the 1940 Amphenol radio parts catalog—around the pipe and slipping an 866 plate clip over it. Small manufactured condensers able to stand plate and r.f. voltages would also suffice.

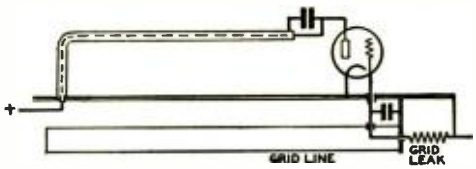

Figure 6. Side view of a layout for a push-pull stage using tubes with grid leads out the bottom.

A very important item in getting the grid circuit to take over control is to reduce the grid leads to practically no length at all, and to make them out of wide copper strip. Generally, a rig can be arranged so that a lug fastened to the pipes can be soldered to a grid clip with no lead at all. The length of the plate lead does not appear to affect operation adversely.

The Eimac Twin-30 tube pictured in figure 2 is a relatively little-known bottle. It contains two separate sets of elements nearly as large as those in the 35TG—the low input capacity variety of 35T. Its filaments are in series, with a short lead between them, and operate on 6 volts a.c. or storage battery. It will go down to about 300 megacycles without filament chokes or lines.

With this tube, the grid line tunes at 20½ inches long with the taps about 3 inches up from the shorting bar. The plate line with wide spacing tunes when 19 inches long, with 2-inch plate leads, but will be longer with closer pipe spacing. The grid leak is 5,000 ohms under the conditions tried, a higher value causing "squegging" with several signals to be heard in a selective receiver. Using 1000 volts at 45 milliamps, the output on 112 megacycles is measured at close to 25 watts without pushing the tube up to its rated input.

On 224 Mc., the grid line is shorted again 9½ inches above the base plate, and the grid taps are moved down to two inches if convenient. The widely spaced plate line resonated at six inches including the 2-inch leads, and the output dropped to ten watts, or 22 per cent efficiency with the limited plate voltage available. Inasmuch as the tube is rated at 15 watts output at 300 megacycles, it will be seen that it was not being pushed with the total input below rated plate dissipation of 60 watts.

A Larger Rig

Using the same pipes, a larger job was tried with the same input and output. This is pictured in figure 4. The tuning is much the same as with the Twin-30 except for a slightly shorter plate line. The output rose

[*Continued on Page 86*]

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WORLD-WIDE DX CONTEST

• for 1940

The second running of RADIO'S contest. C.w. contest on week-end of October 4-6 — phone on October 11-13 — 57 hours operating time—awards to winners.

Last year RADIO sponsored its first major contest—The 1939 World-Wide DX Contest. Unfortunately the contest was anything but world-wide by the time contest time rolled around, Europe having seen fit to embroil itself in a great war between the time of the announcement and the contest period. With well over half of the countries usually active being off the air, it was indeed an inauspicious moment to launch a new dx contest. However, it seems that the dx'er is a hard man to hold down. As long as there are foreign stations to be heard he will attempt to work them—and more of them than his neighbor. So in spite of poor publicity and a radically changed international situation the contest was well supported.

The almost unanimous approval of the rules expressed by the contestants showed that we were on the right track in regard to rules and the general plan of the contest. This, we must admit, was in no small part due to the fact that we were able to draw on the experience of others sponsoring contests for many years. They in turn have since been able to draw on our experience in the 1939 World-Wide affair. In arriving at a set of rules for the 1940 World-Wide Contest we have again been guided by our own and others' experience in the hope that a well-planned set of rules will greatly add to the competitor's enjoyment.

Changes

The most important change in the rules will be found to be the separation of the phone and c.w. divisions so as to have them fall on different week-ends. This was done to allow those who wish to participate in both divisions to do so. Because the former two-week-end plan for each division would make it necessary to allow a whole month for the full contest when the phone and c.w. were thus divided, the contest time for each division has been reduced to a single week-end. We believe that the present reduction in the number of dx stations will allow a good indication of the competitor's relative abilities to be obtained in a single week-end. The contest hours have been lengthened somewhat to squeeze in as much operating time as possible in each division.

Restrictions

It has been necessary to add restrictions in regard to working European stations. Candor compels us to admit that this restriction has been included merely to show that we do not sanction any un-neutral activity between U. S. and foreign stations. Naturally we do not want to be held responsible for any curtailment of amateur activity in this country growing out of un-neutral activity taking place in a contest sponsored by us. It is rather

		STARTING TIME	FINISHING TIME
U.S.A. Pacific Coast	C.W.	Friday, Oct. 4, 3:00 P.M.	Sunday, Oct. 6, 12:00 Midnight
	Phone	Friday, Oct. 11, 3:00 P.M.	Sunday, Oct. 13, 12:00 Midnight
U.S.A. East Coast	C.W.	Friday, Oct. 4, 6:00 P.M.	Monday, Oct. 7, 3:00 A.M.
	Phone	Friday, Oct. 11, 6:00 P.M.	Monday, Oct. 14, 3:00 A.M.
Argentina	C.W.	Friday, Oct. 4, 7:00 P.M.	Monday, Oct. 7, 4:00 A.M.
	Phone	Friday, Oct. 11, 7:00 P.M.	Monday, Oct. 14, 4:00 A.M.
Philippine Is.	C.W.	Saturday, Oct. 5, 7:00 A.M.	Monday, Oct. 7, 4:00 P.M.
	Phone	Saturday, Oct. 12, 7:00 A.M.	Monday, Oct. 14, 4:00 P.M.
Tokyo	C.W.	Saturday, Oct. 5, 8:00 A.M.	Monday, Oct. 7, 5:00 P.M.
	Phone	Saturday, Oct. 12, 8:00 A.M.	Monday, Oct. 14, 5:00 P.M.
Hawaiian Is.	C.W.	Friday, Oct. 4, 12:30 P.M.	Sunday, Oct. 6, 9:30 P.M.
	Phone	Friday, Oct. 11, 12:30 P.M.	Sunday, Oct. 13, 9:30 P.M.

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1940 WORLD-WIDE DX CONTEST RULES

RADIOTELEGRAPH DIVISION

1. CONTEST PERIOD:
   2300 G.m.t. October 4 to 0800 G.m.t. October 7. (See time chart for local times and dates.)
2. BANDS:
   C.w. activity will be confined to the 7, 14 and 28 Mc. amateur bands.
3. SERIAL NUMBERS:
   C.w. stations will exchange numbers consisting of six numerals, the first three being the RST report, and the last three being the contact number (001, 002, 003, etc.).
4. CONTACTS:
   Contacts with amateurs in any of the European countries or their possessions will not count toward the contest score, either as contact points or multipliers.
5. CONTACT POINTS:
   a. Contacts between amateur stations on different continents shall count 3 points.
   b. Contacts between amateur stations on the same continent, but *not* in the same country shall count 1 point.
   c. Contacts between stations in the same country shall be permitted, but for purposes of obtaining multiplier only, and *no* points will be allowed for these contacts.
6. MULTIPLIERS:
   Two types of multipliers will be used:
   a. A multiplier of 1 for each zone contacted.
   b. A multiplier of 1 for each country (prefix) worked on each band.
7. SCORING:
   The total contest score will be the sum of all contact points multiplied by the country and zone multipliers. (See sample log.)
8. EQUIPMENT AND OPERATORS:
   a. Competitors may use the maximum transmitter power permitted by the terms of their licenses.
   b. Competitors will not be limited in the number of operators, or in equipment.
9. ELIGIBILITY:
   All amateurs are eligible to participate in the contest. Employees of Radio, Ltd., will not be eligible for awards.
10. DISQUALIFICATIONS: Falsification of logs in any manner will be cause for disqualification. The decision of the judges will be final in all cases.
11. CLOSING DATE:
    To be entered in the contest competitors must mail their logs so that they will bear a postmark date not later than midnight November 4, 1940.

RADIOTELEPHONE DIVISION

Radiotelegraph rules 4, 5, 6, 7, 8, 9, 10 and 11 also apply to the radiotelephone division. The following rules apply only to the radiotelephone division:

1. CONTEST PERIOD:
   2300 G.m.t. October 11 to 0800 G.m.t. October 14. (See time chart for local times and dates.)
2. BANDS:
   Phone operation will be limited to the 28 and 14 Mc. bands, in all countries.
3. SERIAL NUMBERS:
   Phone stations will exchange numbers consisting of five numerals, the first two being the signal report, and the last three being the contact number (001, 002, 003, etc.).

AWARDS

C.w. and phone winners in each call area of the United States and winners in each other country will be given certificates in recognition of their achievement.

hard to see how operation in the contest is going to alter the present situation in regard to European contacts to any great extent. We all know that, in spite of high-minded admonitions, contacts between European and U. S. amateurs are taking place daily. Careful listening to these contacts has failed to reveal the slightest hint of any statement on the part of the U. S. amateurs that might jeopardize our neutrality, and the hurried number-swapping type of contest contact would seem to provide even less opportunity for un-neutral statements than do the contacts now taking place. In spite of this, contacts with Europeans and their possessions have been ruled out of the contest. Somehow or other it just doesn't seem like a good idea to work the few of them still on the air and we do not wish to be held responsible for any increased activity of this sort. Go ahead and work them if you like. But they will not add to your contest score; so why waste the time? To place all competitors on an equal footing it has been necessary to apply these restrictions to all contest competitors, including those outside the United States. Nobody seems worried about the Asian belligerents so there are no restrictions concerning Asian contacts.

Scoring

Scoring for the 1940 contest will follow last year's plan. One point will be allowed for contacts on your own continent, but outside your own country. Three points will be allowed for contacts with stations outside your own continent. Contacts for stations within your own country will add to country and zone multipliers but will not count toward

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SAMPLE LOG
W1XYZ, C.W. Division

Date	Time	Station	Country	Zone		Country Multiplier for each band			Serial No.		Points
				No.	Total	7	14	28	Sent	Rcvd.	
Oct. 4	7:10 p.m.	CE4AD	Chile	12	1		1		579001	579018	3
"	7:20	HC1FG	Ecuador	10	2		2		569002	569004	3
"	7:55	W9TB	U.S.A.	4	3		3		599003	599025	0
"	8:30	W7AMX	U.S.A.	3	4		3		599004	589017	0
"	9:15	XE1CM	Mexico	6	5	1			595005	579031	1
"	10:40	K6CGK	T.H.	31	6	2			579006	570015	3
"	11:35	LU7AZ	Argen.	13	7	3			589007	589007	3
Oct. 5	12:15 a.m.	J8CH	Korea	25	8		4		559008	559010	3
"	12:40	J2HN	Japan	25	8		5		569009	559021	3
"	8:15	XE1A	Mexico	6	8			1	570010	589035	1

Total—20

Country multiplier 3 + 5 + 1 = 9
Zone multiplier 8
Contact points 20
Total score 9 × 8 × 20 = 1440 points

contact points. Two multipliers will be used: A multiplier of *one* for each zone contacted, and a multiplier of *one* for each country contacted on each band. Working the same country on three bands will give a country multiplier of *three*, while working the same zone on three bands will give a multiplier of *one*.

The contest score will be made up of the total contact point multiplied by *both* the zone and country multipliers. The current zone and country lists as presented in the January, 1940, issue of RADIO, with the corrections noted in the March, 1940, issue, will be used to determine countries and zone boundaries.

Last year's subdivision of single-operator and more-than-one-operator divisions has been eliminated. These divisions were made to allow those who desired to operate as groups from a single location, using several transmitters and receivers and operating day and night, to compete with like stations. However, the dearth of entries in these divisions showed that the interest in this type of operation was slight, so it will not be segregated into a separate division in the 1940 contest.

The contest period has been moved forward to the first two week-ends in October. October, which is usually a good month for dx activity, has previously been given over to the VK-ZL contest. However, with that well-known activity discontinued "for the duration," we have appropriated the time it formerly occupied. We want our friends in Australia and New Zealand to know that we have no intention of usurping the time to which they are rightfully entitled by priority; when the hostilities are over the month of October will be theirs to use for their contest if they so desire.

• • •

Since preparation of the foregoing material,

THE WORLD-WIDE DX CONTEST has been CANCELLED.

See page 17 for details.

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A Four-Band

QUICK CHANGE TRANSMITTER

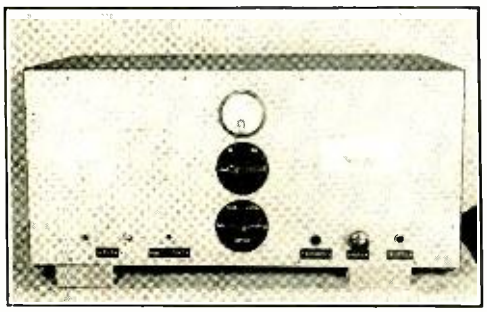
By E. F. KIERNAN,* W6AJR

The transmitter about to be described is the culmination of a number of years experimentation, during which time a variety of types and sizes of transmitters have been constructed and operated. Three objectives governed the design; it was desired to have: first, a reasonable amount of power output in an arrangement easily moved from place to place; second, multi-band coverage without plug-in coils; and third, economy of construction. To enlarge on the first point, a strictly portable job was not aimed at. Past experience with rack and panel, wooden frame, and other layouts, with the attendant inconvenience when necessity demanded a change of location, developed a yearning for something that could be quickly broken up into easily handled units and dumped into the rear of the car. The second point needs no amplification, while the third calls to mind the fact that some of us still have other obligations to worry our finances besides amateur radio.

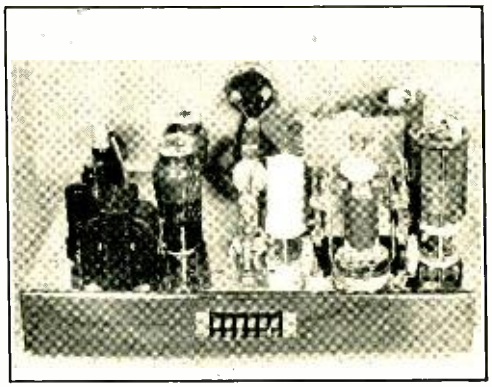
The Oscillator

The construction was started just after the Pierce oscillator circuit had reappeared in our midst. Ah, we thought, there is our oscillator circuit—nothing to tune, sure-fire, and sufficient if not over-abundant output. That was at the start. We have wrestled with various and sundry circuits, but we do believe the Pierce took a small slice off the proverbial cake. We tried a variety of tubes, inserted regeneration in the cathode, varied all circuit values, even went to a tuned plate circuit; results, discouraging. We finally sat down with the various arrangements of the circuit before us and sought to discover just what point we had missed that was gumming up the works. The circuit was supposed to be a ready oscillator with practically any type of crystal. Our experience was just the opposite. Some crystals would not oscillate at all, while the ones that did were anything but robust in their activity. After going over the circuit several times we began to concentrate on the crystal. Up to that point we had inserted the crystal directly from grid to plate. It appeared to us that any leakage in the holder or mount would allow current to flow

* 632 East 92nd St., Los Angeles, Calif.



Front view of the a.f.-r.f. unit. Note the neat appearance of the homemade dial and switch plates.



Rear view of the a.f.-r.f. unit. The speech amplifier-modulator runs along the left end of the chassis, the oscillator and buffer tubes are just to the left of the center, and the band-switching 813 output stage occupies the right-hand half of the chassis.

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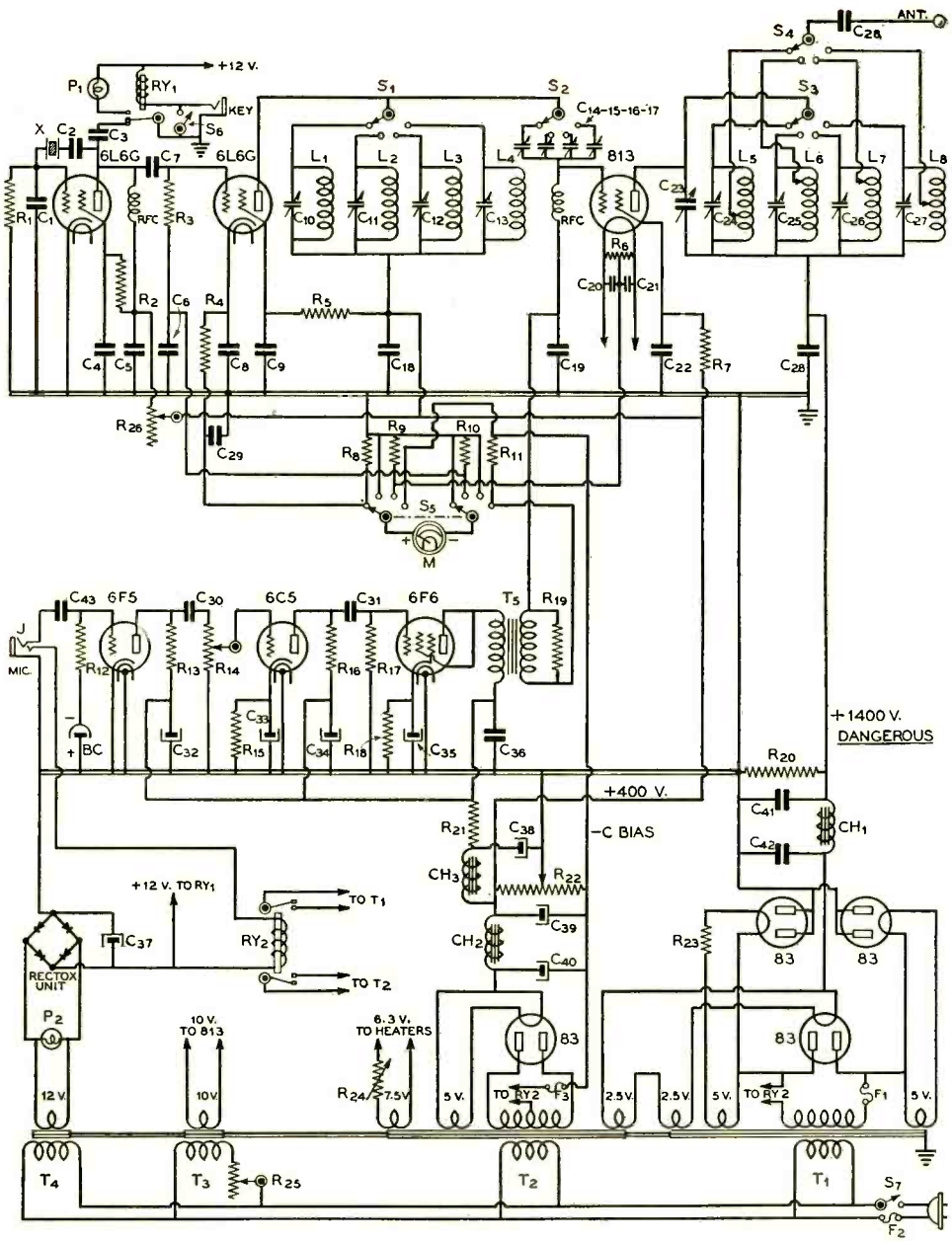

SCHEMATIC OF THE FOUR-BAND TRANSMITTER

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Value of Components in the Four-Band Transmitter.

C_1—.00015-μfd. mica
C_2, C_3, C_4, C_5—.01-μfd. mica
C_6—.002-μfd. mica
C_7—.01-μfd. mica
C_8—.0005-μfd. mica
C_9—.005-μfd. mica
C_{10}, C_{11}—25-μμfd. midget variable
C_{12}, C_{13}—50-μμfd. midget variable
C_{14}, C_{15}—50-μμfd. midget variable
C_{16}, C_{17}—100 μμfd. midget variable
C_{18}—.005-μfd. mica
C_{19}—.0001-μfd. mica
C_{20}, C_{21}—.002-μfd. mica
C_{22}—.01-μfd. mica
C_{23}—50-μμfd. .171" spacing
C_{24}—15-μμfd. midget .030" spacing
C_{25}—25-μμfd. midget .030" spacing
C_{26}, C_{27}—50-μμfd midget .030" spacing
C_{28}—.006-μfd. 2500-volt mica
C_{29}—.002-μfd. mica
C_{30}, C_{31}—0.1-μfd. 400-volt tubular
C_{32}—8-μfd. 450-volt electrolytic
C_{33}—10-μfd. 25-volt electrolytic
C_{34}—8-μfd. 450-volt electrolytic
C_{35}—10-μfd. 25-volt electrolytic
C_{36}—2-μfd. 400-volt paper
C_{37}—50-μfd. 25-volt electrolytic
C_{38}, C_{39}, C_{40}—8-μfd. 400-volt electrolytic
C_{41}, C_{42}—4-μfd. 1000-1500 v. oil filled
C_{43}—0.1-μfd. 400-volt tubular
R_1—50,000 ohms, ½ watt
R_2—40,000 ohms, 10 watts
R_3—40,000 ohms, 2 watts
R_4—800 ohms, 10 watts
R_5—25,000 ohms, 10 watts
R_6—40 ohms, c.t., 10 watts
R_7—50,000 ohms, 20 watts
R_8, R_9, R_{10}, R_{11}—Meter shunts, see text
R_{12}—1 megohm, ½ watt
R_{13}—250,000 ohms, ½ watt
R_{14}—250,000-ohm potentiometer
R_{15}—3000 ohms, ½ watt
R_{16}—100,000 ohms, ½ watt
R_{17}—500,000 ohms, ½ watt
R_{18}—750 ohms, 10 watts
R_{19}—50,000 ohms, 2 watts
R_{20}—50,000 ohms, 75 watts
R_{21}—5000 ohms, 50 watts
R_{22}—25,000 ohms, 50 watts
R_{23}—0.5 ohm, 10 watts
R_{24}—1-ohm rheostat
R_{25}—20-ohm rheostat
R_{26}—25,000 ohms, 25 watts, with slider
RFC—2½ mh. choke
T_1, T_2—650 v. c.t., 2.5 v., 2.5 v., 5 v., 7.5 v.
T_3—10 v., 4 a.
T_4—12 v., 3 a.
T_5—Grid-modulation transformer
CH_1, CH_2—12 hy., 200 ma.
CH_3—30-hy., 100 ma.
J—3-circuit jack
M—Low-current meter, see text
S_1, S_2—Two-section tap switch
S_3—Bandswitch on condenser shaft, see text
S_4—Ceramic tap switch
S_5—Two-circuit 4-position tap switch
S_6, S_7—S.p.s.t. toggle
BC—Bias cell
RY_1—S.p.d.t. 12-volt relay
RY_2—D.p.s.t. 12-volt relay
P_1, P_2—12-volt pilot light
L_1, L_5—10-meter coils
L_2, L_6—20-meter coils
L_3, L_7—40-meter coils
L_4, L_8—80-meter coils

into the grid from the plate and spoil the bias. Sure enough, some of the variations called for a condenser between the crystal and the plate. Ah, success! The insertion or the condenser cleared up the oscillator; practically any crystal we put in went to town and the output was rather gratifying too; that is, until we measured the crystal current, but more of that later.

Layout

Having the oscillator well in hand, or so we thought, it was time to go about laying out the rest of the transmitter. A dive into the "plunder box" brought to light a variety of coils, condensers, sockets, resistors, etc., including the metal cabinet from a Hammarlund Pro receiver, which had been relegated to a rack mount during the heat of some former building activity. Just right, we thought, the cabinet would house the r.f. and audio, making a companion unit for most any communications receiver on the operating table. The power supply could go under the table as a separate unit. With the chassis size more or less fixed by the cabinet, a tentative outline was drawn on paper and a game of checkers started with the available space against the necessary tubes, condensers, etc. We have often wondered just how the "professionals" go about this job of layout. If you think they don't use this same approach (and you get the chance), drop in at the Douglas plant at Santa Monica and watch them shuffle dummy instruments, controls, etc., around in the mock-up of a new plane.

Suppose we finish up the chassis template and drop it off at our friend's, the "tin-bender" who dumped that balky b.c. receiver on our bench not so long ago. Among the loot we find a husky looking variable condenser with about three-sixteenth-inch spacing and fifty micro-mikes capacity. Why not mount a switch arm on its shaft and build the final tank switching arrangement right into the circuit? A trip to Audio Products supplies us with a piece of micalex one eighth inch thick and six inches square. A section approximately four and one half by five is used to support the stationary contacts of the final tank switch, and the remaining "L" shaped piece mounts the coupling condensers between the buffer and final as well as the buffer tank. We started out with the idea of pruning the buffer and final tank coils to hit, but gave it up as a bad job after finding that changes in coupling, load, etc., reflected on the pruned circuits to throw them out of resonance. Small variable condensers are so much easier to adjust. Incidentally, we have

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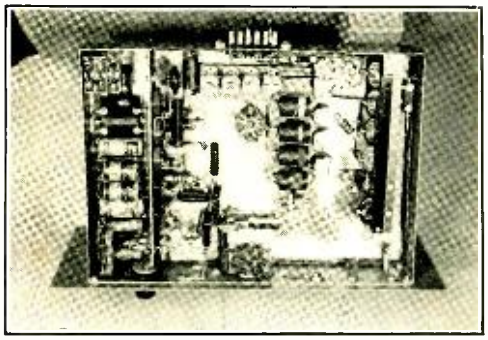
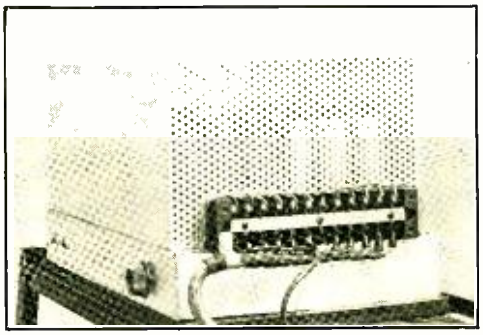


Bottom view of the r.f.-a.f. section. The audio components are mounted along the right-hand edge of the chassis with a shield separating them from the r.f. components which occupy the balance of the underchassis.



The power supply unit. Note the terminal strip and the cable which supplies all voltages to the r.f.-a.f. unit. A 12-contact heavy-duty plug is at the other end of the cable to make connecion to the transmiter secion.

used the small Hammarlund APC type of variable across the final tank (1400 volts, grid modulation) with no trouble from arc-overs; however, the wider spaced midgets offer added safety factor.

The forms for the buffer coils were salvaged from the remains of an old SW5. Fitted with slotted bronze angles at each end, they were mounted on suitable terminals with knurled nuts so as to be readily removable (during the pruning stage). The forms for the final tank are a miscellaneous collection including Bud, National and Hammarlund. The midget adjusting condensers are mounted on top the final coil forms, as the photo shows.

Bandswitching

The bandswitching arrangement consists of a four position bar knob attached to a horizontal shaft which extends from the center of the panel, just below the meter, back to a bracket near the rear center of the chassis. At this point, bevel gears taken from a discarded plane type "coffee grinder" drive the shaft of a two deck switch projecting through the chassis. The below-deck switch changes the coupling condensers between buffer and final, also the buffer tank. The final condenser-switch is coupled to the horizontal shaft by means of two pulleys and a phosphor-bronze belt. The pulleys were made by sawing off two slices from a piece of one and one-half inch dural rod. The phosphor-bronze belt is broken in two places with sections of micalex. Bakelite will not work; we tried it. The antenna switch is a single deck Yaxley mounted on a standoff and coupled to the final condenser-switch shaft by an insulated coupling.

The Final Tube

The first type of tube used in the final was a WE-282A. It worked, but was not all we expected it should be. The appearance of the RCA-813 on the scene at an opportune moment filled the bill very nicely. The initial cost of this tube is quite an item, but figuring our present rate of activity the cost per hour will stretch the outlay over a period sufficiently long to justify the expense.

Metering

The problem of metering was solved by using the movement of a zero to one r.f. ammeter which was minus a thermocouple. Hunting through a catalog we found a full size cut of a 0-20 ma. dial that just fits the small meter. Glued over the r.f. scale, the cut worked very nicely. Shunts were made by wrapping wire taken from defunct rheostats around small rectangular pieces of bakelite. A rotary switch and a homemade dial plate completed the metering facilities.

This dial plate, the one for the bandchange knob, and the switch labels were easily and quickly made from sheet pyralin (celluloid). The inscription is stamped on with metal figures and letters and filled with white lacquer. The back is painted with black lacquer; result, a shiny label very acceptable in appearance. The panel is of one-eighth inch material, grey wrinkle finished to contrast with the black cabinet. On the panel, the meter is located at top center, the bandchange switch just below the meter, and the meter shunt switch at bottom center. At the bottom and to the left, on the panel, is the key jack with its locking switch just to the right. The

[*Continued on Page 88*]

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An RF Driven CW Monitor and Phone Modulation Indicator

By GEORGE W. EWING,* W6GM

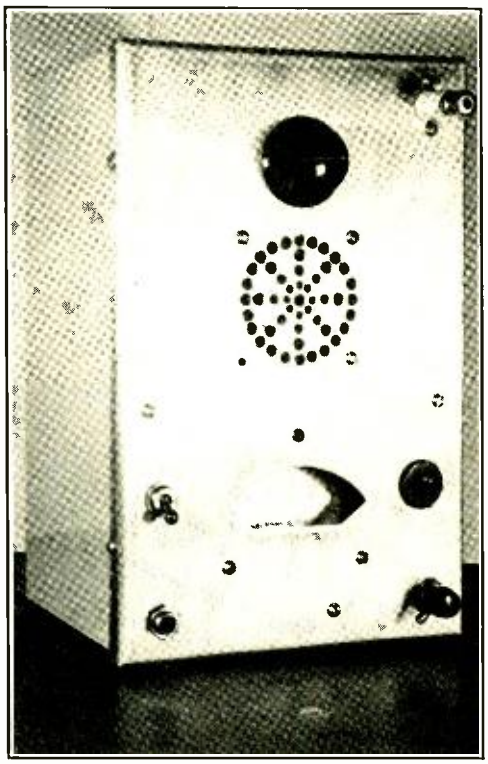
Many c.w. operators desire to have some sort of audible tone follow their keying in order to keep a constant check on their characters and spacing. A more general use of such a system would certainly improve the readability of many c.w. signals.

The stunt about to be described was "uncovered" in connection with the building of a phone modulation-carrier shift indicator such as described by W8LFE on page 60 of RADIO for December, 1939, with certain minor changes. Since both phone and c.w. are used here at W6GM, a combination unit was desired, and after considering a small audio oscillator built into the unit, the question naturally arose as to a source of plate voltage.

The diode rectifier used for the carrier shift indicator has a 5000-ohm load resistance, and, using a 5-ma. meter, 4 ma. of current is a convenient value to use for the steady carrier reading. Since 4 ma. through 5000 ohms will produce a d.c. voltage of 20 volts, why not use this voltage to supply the necessary plate potential to the audio oscillator? In this way, the audio tone follows the keying along with the carrier. Also, since the monitor is coupled to the low impedance transmission line or to a low impedance point on the antenna, it gives a constant check that r.f. is being delivered to the radiating system.

Any serious ripple in the output of the transmitter will show up as a low pitched garble in the tone of the audio oscillator. Although small percentages of ripple will not modulate the tone sufficiently to be noticeable, experiments with small filters (on a dummy antenna) disclosed that any percentage of ripple from about 20% up produced an undertone which was clearly audible. Thus, if the c.w. note should suddenly "sour," the audio tone would be altered enough to warn the operator that some readjustments were in order. Possibly one or two watts of r.f. are robbed from the system to operate this device, but, in any rig of more than 20 watts output, this loss is of no consequence.

The circuit diagram shows just how the unit is hooked up, and possibly a few words of explanation are in order. The installation here uses a short low impedance transmission line to couple the transmitter of 110 watts input to an antenna tuning unit across the room. Preliminary investigation with a v.t.



Front view of the monitor. The input control knobs is in the center at the top, the miniature speaker is behind the circular design of holes, and the input signal meter is behind the hole at the bottom.

* 201 East Tenth St., San Bernardino, Calif.

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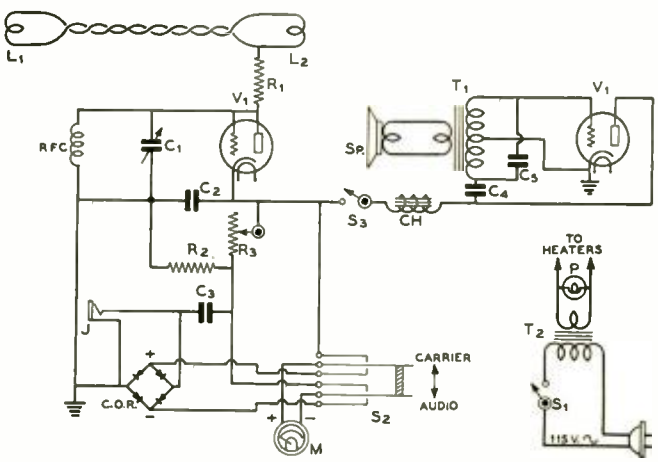
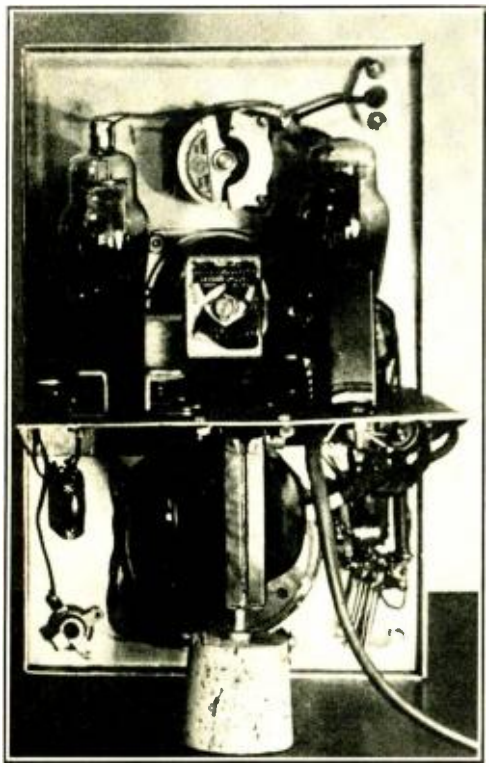
C_1—50-μμfd. midget
C_2—.0005-μfd. mica
C_3—.25-μfd. 400-volt tubular
C_4—0.1-μfd. 400-volt tubular
C_5—.02-μfd. 400-volt tubular. This value may be varied somewhat to change the frequency of the oscillator
R_1—1000 ohms, 2 watts
R_2—5000 ohms, 1 watt
R_3—30-ohm rheostat
RFC—2½-mhy. choke
T_1—Midget push-pull output transformer
T_2—Filament transformer for tubes used
M—0-5 ma.
L_1, L_2 — Transmitter-to-antenna-coupler link
CH—Small 30-hy. choke. A 10,000-ohm resistor may be substituted with a slight loss of volume
P—Pilot light to correspond with filament voltage
C.O.R.—Copper-oxide meter rectifier



Wiring Diagram of the Monitor.

S_1—2-inch p.m. dynamic
S_1—S.p.s.t. toggle
S_2—D.p.d.t. jack switch
S_3—S.p.s.t. toggle
J—Open-circuit jack
V_1—Any triode or diode
V_2—Any triode



Rear view of the carrier-operated monitor.

voltmeter showed that there was approximately 30 volts of r.f. from either side of the line to ground and also that there was only a slight deviation from this value when changing bands.

By connecting directly to one side of the transmission line through a 1000-ohm resistor as shown, the necessity of changing coils and retuning the monitor for different bands is eliminated. A slight adjustment of the variable shunt condenser restores the meter to its original reading of 4 ma. on any frequency from 1.8 to 14 Mc. This value of 1000 ohms would have to be changed to a higher value for higher power inputs.

Considerable experiment on the input circuit revealed the shunt condenser as the best method of adjusting the amount of signal input. Variable potentiometer and series resistances were tried and the average run of carbon variable resistances just would not stand the r.f. and wire wound units had standing waves on them causing very erratic operation. The r.f. choke is necessary to maintain a low resistance d.c. path for the return circuit to the diode.

The output of the audio oscillator is fed to a small 2-inch speaker mounted in the unit, and, although the volume is not very loud, it is sufficient to hear comfortably, which is all that is necessary. The loading of the audio oscillator on the diode pulls the meter reading

[*Continued on Page 86*]

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Calibrating the R METER

By E. H. MORGAN,* W6DZX

During the past year the writer has had occasion, as have many others, to spend many hours checking the front-to-back ratios of various rotary arrays. One of the enlightening facts brought forth by this work was the amazing difference in receiver R meter readings and the general inability of amateurs to give a quantitative measure of the change in strength of a signal. In fact, most of the hams either had a complete faith in the R meter or else refused to rely on it at all; very few seemed to have any idea of the relation between signal inputs and R readings. An investigation of our own receiver showed that its normal calibration didn't mean a thing, so a method was sought which would permit reading power changes directly in decibels. The following method was evolved and since it requires no great degree of mathematical ability it was thought it might be of interest to the ham fraternity.

The method to be described depends upon calculation rather than experimental calibration; it is doubtful if many amateurs would have equipment available for direct calibration. Briefly, the validity of the method is based on each of the following steps:

1. Since practically any type of R meter operates by virtue of a produced a.v.c. voltage, it is really a non-linear d.c. voltmeter for measuring this voltage. It may be as non-linear as necessary, or it may read peak, r.m.s., or average volts; in any one installation this will not affect the accuracy of the method, but will merely crowd the scale at one end or the other.

2. Assuming then that our R meter reads the effective a.v.c. voltage produced, this is really a measure of the signal at the second detector of our receiver. This is true since practically all receivers use diode rectifiers which will give an output which is linear with input voltage. Having then a measure of the signal level in volts at the second detector, it remains to determine the ratio of this signal to the input signal from the antenna, taking into account the change in gain or amplification caused by the different values of a.v.c. bias produced by the signal. This difference can then be translated into decibels and a graph made for the receiver, or the meter calibrated directly. Obviously this method will not depend upon any given reference level, but will be accurate for measuring changes in level.

3. It can be shown that the gain of an r.f. amplifier will vary with the mutual conductance of the tube in that stage, which in turn will vary according to the d.c. bias effective at that level. These values can be obtained from the curves in current tube handbooks. Terman, in his *Radio Engineering*, states: "The tube amplification is equal to the mutual conductance of the tube multiplied by the impedance of the parallel combination formed by the plate resistance and load in parallel. Since the plate resistance is usually very much larger than the load resistance, it is permissible when making calculations to assume that the amplification will approximate the product of mutual conductance and load impedance."

This means that in calculating an absolute value of gain per stage it would be necessary to know the plate resistance and the load impedance. For our purpose, however, we want only the ratio of changes, during which our only variable will be the mutual conductance of the tube, the load impedance remaining constant at some particular value with which we are not concerned. It can be shown from calculus that a curve plotted from an equation containing only one independent variable will not be affected by any constants; rather the curve will be the same shape and will merely be shifted up or down or right or left upon the graph an amount depending on these constants. Thus it can be shown that for any one set of values (any one receiver) the ratio of signal input to output will vary only in accordance with the mutual conductance and the number of stages so controlled by a.v.c.

Accordingly then, we have the following system by which our receiver and R meter can be calibrated to show the amount of change in decibels between the signal at the input

* 1404 South 15 East, Salt Lake City, Utah.

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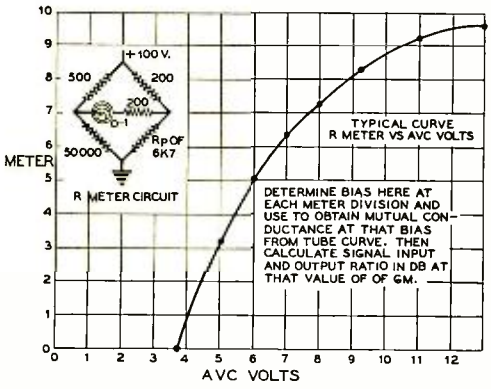
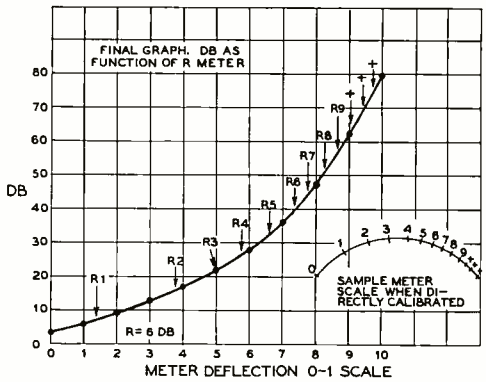


A typical calibration curve showing R meter indications as plotted against a.v.c. voltage.



The final graph showing decibels as a function of R meter indications. If desired (and it will be more convenient) the resulting calibration may be placed on a new calibrated scale to go on the R meter itself.

and that at the second detector. We need a calibrated meter which reads the signal level at the second detector, and which may be calibrated directly to avoid any computation in actual use; and a method of calculating a curve by which the amount of input signal required to produce each different amount of a.v.c. voltage can be determined. A sample set of calculations will be given showing how this method was applied to our particular receiver and how it may be applied to yours.

A very useful scale for calibration is that which depends upon the field strength doubling for each new R point, or a power ratio each time of four to one. This represents 6 decibels change and is most useful, for many amateur transmitters can be adjusted from full output to one-fourth by cutting the plate voltage in half due to a split primary on the plate transformer. At any rate, the 6 db difference was used here; however, any particular number of db can be used and the R division and the calibration made accordingly.

Calibrating the R Meter

The first step in the process is to calibrate the R meter in terms of a.v.c. voltage. This can be done either by calculation or by experimental means. A small battery of the 7.5-volt variety tapped at intervals of 1.5 volts can be applied across the diode load resistor of the receiver and the reading of the R meter noted for each value of bias. (No signal is used during this process.) From this a curve can be drawn which will give the a.v.c. voltage in terms of the R meter readings, and will permit interpolation to values between the 1.5-volt calibration points. Or the circuit of the R meter indicator may be solved mathematically for various values of a.v.c. bias by obtaining the plate current of the tube or tubes at that point from the manufacturer's curve. Special care is required in the case of bridge type circuits—the bridge circuit must be transformed from a delta to a Y configuration before calculating, or the standard formulas for Wheatstone bridges may be used. Probably the easier system is to use the direct method with the battery, which does not require knowing circuit values, and does not require any opening or alteration of the receiver. The bias is merely connected across the diode load resistor in the correct polarity so as to bias the tubes negatively.

Gain Calculation

The next step is to calculate the variation in amplifier gain at each level of a.v.c. voltage and then to transform the ratio of signal input and output to decibels. First obtain a curve for the type tubes used in your a.v.c. controlled stages; if more than one type is a.v.c. controlled, two sets of calculations will be required; however, it is general practice to use remote cutoff tubes of the same type in all stages. Now make a list, for convenience, of the mutual conductance of the tube at each different value of a.v.c. voltage; generally sufficient points for good accuracy will result in using about eight steps of bias. The bias steps will be chosen in accordance with your meter and will lie between the values which produce full scale and zero scale deflections.

Now assume some value of load impedance for the stage; this value will not affect the calculation so long as it is high enough to make the product of mutual conductance and load impedance greater than one—this is obvious since the stage otherwise would have

[*Continued on Page 93*]

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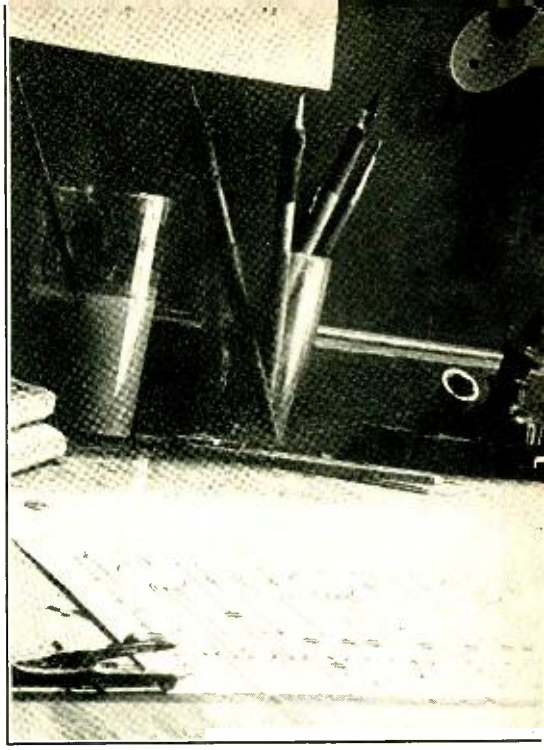

● Our photographer recently invaded the sanctum-sanctorum of B. A. Ontiveros, W6FFF, draftsman for RADIO, and emerged with this closeup. The drawing in preparation will eventually appear in a forthcoming publication after having travelled a somewhat circuitous route via engraver, express, printer and mail.

DEPARTMENTS

- **DX**
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- **U. H. F.**
- **The Open Forum**
- **What's New in Radio**
- **Yarn of the Month**
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"WAZ" HONOR ROLL

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DX AND OVERSEAS NEWS

by Herb Becker, W6QD

Send all contributions to Radio, attention DX Editor, 1300 Kenwood Road, Santa Barbara, Calif.

Before going any further than this first paragraph, turn to page 40 and read the rules for RADIO's World-Wide DX Contest to be held in October. There will be several points mentioned throughout this colyum which will refer to the contest and you might just as well be familiar with them now. I believe the Contest Committee has whipped the rules into a shape which will please the majority. Frankly, I don't think they will please everyone, but I know the gang will cooperate as in the past.

Many of the boys expressed themselves in favor of having one week-end for c.w. and one week-end for phone. In this way they would be able to participate in both. With so many of the gang using both c.w. and phone these days, it appears to be a good idea to me too. Then, with the limited number of dx stations on the air, the majority of the fellows felt that with a single week-end of activity in each division, the operating would be speeded up. The number of operating hours available on each week-end has been stretched from 48, as in RADIO'S contest in December, to 57.

It might be a good idea to spread the word to dx stations you work that the rules of the October contest are contained in the July issue of RADIO, and will again be outlined in the October issue, the October number coming off the press about the 25th of September.

W6VB Grabs AC4YN

It was a bright sunny Southern California morning for W6VB on Mnnday, May 6. It all happened over night for Glenn. His final amplifier was not quite finished on Sunday when he heard that AC4YN was coming through around here every once in a while. Then he started to throw parts into the new final Sunday—he finished it, but there he was without tubes. His former tubes having hit the road West. He borrowed a pair of 250TL's to try out the new final. Early Monday morning he rolled out in time to give a listen for AC4YN . . . and sure enough there he was. After Glenn found his key he gave him a call, resulting in a QSO, and now VB insists upon keeping those same tubes in his final.

I might mention that to date there have been five W6's who have worked AC4YN. They are W6GRL, W6NLZ, W6QD, W6OEG, and W6VB . . . and four of these belong to the South Bay Amateurs Association, which supports a membership of dx men only. W6GRL has worked CR6AF for a new one, and yours truly followed along after a few days to grab him also. CR6AF falls on about 14,060 T9 and said he was trying to get his phone going.

KE6SRA on Johnston Island

KE6SRA is now consistently coming through on c.w., 14,340 kc. This is a nice one to have salted away, not that the country is so hard to work from the standpoint of dx, but mostly due to the scarcity of stations there. He uses from 125 to 150 watts in his portable rig, the antenna is a 66-foot flat-top 110 feet up in the air. Cards may be sent to him by addressing: Roger Parnell, Radioman U.S.N., Johnston Island, c/o Postmaster, Honolulu, T. H. Roger has been there six months and wants to be there another six. He wants to get a class A ticket to use a little more phone than 160, but will have to wait a while for it because he just received his class C on May 1. Roger mentions that there is a ship out there about every month from Honolulu and he will QSL accordingly.

KH6SHS

While speaking of those islands in the Pacific, I should bring up another brand new one, KH6SHS on American Samoa. He is on c.w. at present and can be found around 14,390 kc. If you really want to hear a bunch of dots just listen to the boys rattle off his call. All cards may be addressed as follows: Jerry Petranek, KH6SHS, Box 86, Pago Pago, American Samoa. Jerry informs us that he is using a 6L6 crystal oscillator and an RCA-812 final running 45 watts input. The antenna is a 20-meter doublet, and the receiver is a t.r.f. They have no a.c. mains, therefore the power is derived by means of an inverter. Shack overlooks the bay which probably is quite a view at that. (Almost reminds one of Dorothy Lamour and her sarong . . . or without it.) KH6SHS intends to be there until January, 1941, so that should give ample time for everyone to nab him. Usual operating hours are from 0530 to 0730 G.c.t.

Then there is our old friend Hohdy, K6MV, who has been operating *phone* on Palmyra Island, signing now KG6MV. He has been found around 14,200 kc. This one is the same group as Jarvis, so for those who have not worked Jarvis, there's a good one for you.

W6LS reports that KC4USC is going to be using 28-Mc. phone very shortly, or maybe is now operating for that matter. Frequency is 28,580 kc., and the best time is from 2300 to 0200 G.m.t. Incidentally, the op at KC4USC is Felix, who used to be out at Guam in the old days operating OM1TB . . . remember? And while speaking of 10 meters they have heard W6LR, W6KYL and W6POZ down there. W1ADM is up to 35 and 101 on phone while his combined total in the Honor Roll is 39 and 128. J5CW

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and J2NF were the new ones and help do it for him.

W9BEU has added three to his phone total since last reporting: HA7P, YS1MS and KC4USA, and these give Elmer 88 countries. W9HLF informs us that AC4YN has a new 100-watt rig on the way along with a new receiver, antenna and a raft of other stuff. Oh yes, almost forgot to mention the rig is a 5-band bandswitch job, and for phone operation also. HLF almost forgot the mike . . . but of course not on purpose.

W4EPA has noticed the lack of stations reporting from his neck of the woods, so is going to change the status by giving a bit himself. In the past month EPA has worked YV1AQ, YV1AN, YV5AN, LU5AN, KB6CBN, KF6JEG, KC4USA, YS1MS, TG9BA, PY7AI, YN1FF. All this was worked on 20 phone from one frequency, 14,200 kc. . . . the input being around 300 watts. W2AIW is getting ready for a new final using two 250TH's, and says watch out, because the Calif. kw's will have nothing on N. J. W2CYS also in N. J. has done all his dx from an indoor antenna 99 feet long. Rig runs from 200 to 400 watts input.

W6OAV relates that KB6SQU passed away in the Naval Hospital at Guam during the early part of May. SQU had been ill for some time. His pal KB6EMI gave the information to 6OAV over the air and many of the old gang around Stockton will remember them. Also, OAV says that XU8NR and XU8HB are now in San Diego. While speaking of XU's, a letter has been received from XU8MI, Otto Miller, who can now be reached c/o U.S.S. Savannah, Long Beach, Calif. Miller says that if any of the gang hasn't received a card from him, he will be glad to QSL upon receipt of their card at the above QTH. XU8MI misses the old stamping grounds in China, although between you and myself, I don't think you could get him to go back "for all the tea in China."

Having just taken on a new job which involves travelling around the state a little gives me an opportunity to check up on the gang up north. After bumping into a few of them around the S.F. Bay district, the usual greeting was uttered with an unusual villainous sneer, "Well, I suppose you are now a travelling salesman, eh Herb?" My reply to a thing like this was given with an equal villainous sneer, "Ah yes, but where are these farmers' daughters I have been reading about?" (For the answer, send a self-addressed envelope.) But don't expect the *right* answer.

And speaking of daughters, when I returned home, I found dozens of white flags hanging all over my Lazy H antennas. This was stopped instantly by installing a new clothesline "array" for such purposes, in the backyard. Getting back to the gang in the north, I met quite a flock including W6HB, W6VX, W6UF, W6CHW, W6DUW, W6DUB, W6TT, W6IKQ, W6OCH, W6BIP, W6FFP, W6BAX, W6DZZ, W6SC, W6OS, most of which *were* pretty good dx men. I can't seem to figure out why there isn't more activity up in that area. They are either all hot or all cold. Right now they seem to be concentrating on 160. Don't ask why. . . . I dunno. DUB, TT, OCH, IKQ and BIP seem to be fairly active, with IKQ and OCH using phone altogether. Just as I headed back south W6CHE, Jack McCullough, got the rig harnessed up again and probably is figuring on being on regularly. His pardner W6UF is off temporarily, due mostly to having one of his poles plowed under by the guy who owns the big lot next door.

W8LEC worked AC4JS sometime ago giving him zone 23, and then more recently has hooked KC4USA for a new country. Dick has his new 3-transmitter system all intact and says it is much better than the old coil switching idea. He has separate antenna for each. W8DOD hasn't been heard from for a long time but has not been exactly idle. New ones for Elmer are VK9RM, KF6DHW, HB1CE, OQ5BA, KE6SRA and these bring him up to 37 and 110. Even ol' Fat, W4BZ, is in there pitchin'—on c.w. I thought he was more or less anchored to 160 but he sneaked through with KE6SRA for country no. 145. Now he's gunning for KH6SHS to say nothing of AC4YN.

W2BHW received his card from PK5JT and said it was quite a surprise. Here are a few that Lindy worked over a recent week-end: XU9HH (ex-J5CC) 14,265, J3CW 14,360, J2OP 14,320, J3DG 14,400, J5DB 14,340, XU6DB 14,335, XU5SW 14,330, J2JJ 14,400, J2KL 14,355, PK1FK 14,265. W8LDR passes along a little info . . . W8KTW has plunged into the sea of marital bliss, and marital law. He says he is now living in a state of siege. KTW is chasing XU's and AC4YN as is LDR, too.

W8LRR who lived next door to KTW has had plenty of tough luck . . . his home burned down losing all of their furniture, radio equipment, etc., and sending his mother, father and sister to the hospital with bad burns. We sincerely hope that by the time this gets into print, all will have recovered 100%. W8LDR also says that 8LCI is on the air (more or less) from a new QTH, 1 mile and 5 kc. from him. LCI has had a mast built for months, but it still occupies a horizontal position in back of the shack. W8NKI will soon have his direction indicator on the new 3-element rotary, so they can be expected to boom out with a kw. on c.w. and phone. W8OIV has been doing very well with his 50 watts and will bear watching from now on. As for LDR, he has been doing ok with XU5HR, XU6K, KA1LB, PK1TM, PK1XZ, KF6JEG, LX1SS, U5YH and UE3KX. This gives Bob 101 countries.

W6MPS of San Jose has worked some nice ones such as OQ5AB 28,200, TG9AA 28,450, EA7BB 28,400, YS1JGM 14,300, KC4USA 14,150, HR2A 14,350, ES1E 14,080, HA8C 14,010, KF6JEG 14,180. Incidentally, 6MPS won the phone contest for her section in 1938, and as far as we know is the only xyl or yl to do this. Nell has worked 28 zones and 60 countries on two-way phone, running about 400 watts input. W2AEE is the club station at Columbia University and at present is handling two father and son schedules, W4GKG (son) who is attending U. there to his father W4GOB, and then CM2MR to his father, CO2BL in Havana.

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We get a kick out of a crack made by G2MI in the *T & R Bulletin* regarding TA1AA. He seems to be definitely of the opinion that we have had our leg pulled on the TA1AA setup, just because some guy made a crude drawing of a QSL card patterned after that of TA1AA. This card is of the same general design, only very crude lettering. The call is "SOWAT" and in place of Turkey are the words "MARS" Grand Canal. This card was dropped into G2MI's lap thereby causing wrath to be heaped upon poor ol' TA1AA. Watta life. The only thing we say, and will continue to say is that all of the information points to TA1AA being on the good side of the ledger. It should not be necessary for me to mention here that from several sources in Europe the boys think he is OK. And going a bit further when one receives a letter from Ankara, it would seem to help substantiate what ON4HS originally brought up. Of course we have had our leg pulled and might have it again, but in this case all I can say is that "from the evidence on hand, and until proven otherwise, TA1AA is OK."

W8JSU is having trouble again with his dad's pigeons flying into his antennas. If you will remember his dad raises or trains racing pigeons (or whatever they do with pigeons), and Charlie has to string up his antennas so they won't interfere with said pigeons' flying. Between the pigeons and yl-itis his dx is at a new low. W6MUS has added YS1MS 14,140 for new one on phone, while on c.w. he has logged I1IR 14,400, HA2F 14,400, OQ5BF 14,400, U3BX 14,400, U3BM 14,400, U5YH 14,380, UK3CU 14,400, TA1AL 14,400, YI7KR 14,400, CT1CX 14,400, CR6AF 14,060, UK3AH 14,400—a few of these were new ones for Neil giving a total of 37 and 87.

Correction in "WW" Contest

On page 52 of June RADIO, the Official Scores of the 1939 World-Wide DX Contest list W9DGH as the top man in the ninth call area. Evidently a parasitic sprang up at the printers because it should have been W9GDH, John Dormois.

W5VU still wields a wicked mike and a few of the later ones added to his string include YS1MS 14,116, YS1JGM 14,100, KA1FG 14,136, KA1MN 14,106, KA1HQ 14,082, KA1OZ 14,145, KA1CW 14,116, PK2WL 14,144, J5CW 14,078, PK1FK 14,050, PK3BM 14,062, KC4USA 14,150. Operative no. 1492 is snooping around again and finds that W2GXZ will hear those wedding bells in July, and W2ASF will also hear them in August. And you never can tell, 2BQF may have a jr. op. at his house one of these days. W2CD has organized a Boy Scout troop for ham-minded fellows.

W1JCX, Herb Cole, is just coming out of hiding after about six months married hibernation. Anyway he adds a couple of new ones to his neglected total, C4USC and KB6CBN. JCX explains his inactivity to the following: Snow + 60-mile breeze = no more 3-element beam + building new house = no time. Herb also adds that he is raising a large flock of chickens against the day W1AKY wheezes in again with his 1900 flivver.

Now from W1AKY we learn that he has increased, not only his appetite for chickens, but his zones and countries as well. New ones are KC4USA, KC4USC, ZP3AC, KF6JEG, YS1MS and EA9AI who comes in at 14,058 kc. Ed now has 31 and 93, and should be getting an invite to JCX's for chow one of these days. W8AAJ adds KC4USA to his making 30 and 82 on phone. W6ITH has worked a few YS1MS, EA7BB, KC4USA and KE6NYD, and these give Reg 36 and 101. While in this phone mood I should mention that W2IXY knocked off ZP6AB 14,276 for her 105th country . . . zones 33.

W9ELX didn't know that KC4USA was to be counted as a country so is up one giving him 38 and 114 while his phone total is 34 and 90. Some of the latest worked at 9ELX are YV3OQ, XU1B, J7CB, KA1CW, KA1CD, KA7FS. W6NLZ now has 38 and 106 by working AC4YN. And for everyone's information, AC4YN is still using the 14,292 kc. frequency and drifts a bit higher during transmissions. K4KD has been squawking about wanting to work all the states on four bands . . . so he goes out and works them all on 80 meters first. He is still going after them, however, on the other bands. W5BGP says there is nothing like low power. In this I believe we will all agree . . . there is *nothing* like it. However, 5BGP has done quite well with his 8 watts on 20 meters. He has contacted PY1CI, LU5FB, K6ROC, K6GQF, K6PZP, K6PAH, KF6SJJ, K6ROL and K7FTM. Morris has a half kw. sitting around but finds the 8 watts much more fun.

W5BB comes into the picture again as voting against v.f.o. control. Reminds me of the old days when we were holding out with "Spark Forever" clubs . . . and look at us now. Tom has a new one to add to his collection K6NYD/KE6. This gives him 138 countries as worked. 5BB dishes out a few frequencies: OA4C 14,380, OA4R 28,100, HP1A 14,120, HH2B 14,130, HH4AS 28,190, HH2MC 14,380 c.w., HR5T 14,080, R5C 14,120, HR2T 28,400, XU8WS 14,380 c.w., I1KTG 14,375, I1IR 14,410 c.w., TF5C 14,399 c.w., KF6SJJ 14,325 c.w., CP2AC 14,140, YS1MS 14,125, YS1RP 14,050, and YNU1. Above not marked are phone stations.

To The Gang

I suppose I should compose this like an open letter, but I'll leave that to the newspapers, etc. The whole column is just about the same as an open letter anyway. One thing which I wish you would do for this coming contest in October is spread the word around to the gang in countries which we can contact to get the rigs tuned up so they can be used on all three bands with c.w., 7, 14 and 28 Mc. On phone I believe the fellows take advantage of their two allowable bands, to a greater extent. During the A.R.R.L. contest, 40 meters was as good as one could wish for, if only there had been more stations on the band. The same for 10 meters, except for the last Sunday when the sunspots had a field day. In

[*Continued on Page 89*]

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The Amateur Newcomer

A Low Powered

OSCILLATOR-TRANSMITTER

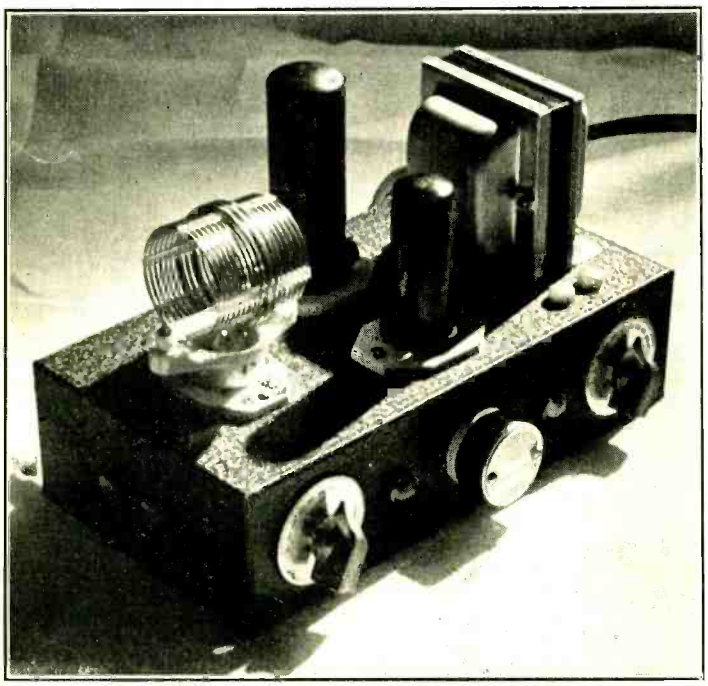
By LLOYD V. BRODERSON,* W6CLV

Although the majority of modern transmitters follow the oscillator stage with buffer and power amplifier stages, an oscillator may be designed as a complete transmitter and coupled to an antenna. There are, however, several factors that must be recognized in order to assure maximum output consistent with efficient operation. Oscillators are usually designed to work into multi-stage transmitters and a comparatively small output power is required of them.

However, an oscillator intended primarily as a transmitter must be capable of furnishing as much power to the antenna as possible without sacrificing frequency stability and the ability to be keyed at reasonable speeds. It is especially important that crystal current be low and circuit losses kept to a minimum.

The unit here described should prove of equal interest to the newcomer attempting his first transmitter, and to the old timer desiring a standby rig.

* 515 Salinas Nat'l Bank Bldg., Salinas, Calif.



Front-side view of the low-power 6L6 oscillator-transmitter.

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Circuit

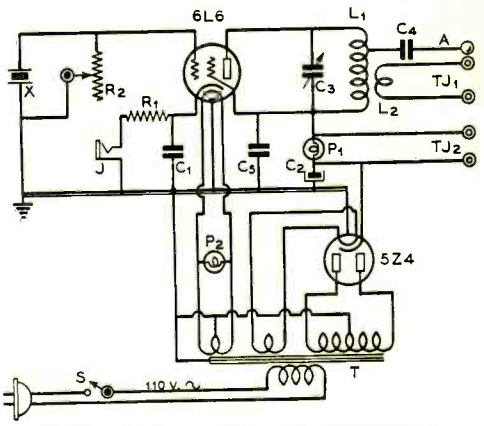
With the exception of a few substitutions which simplified construction and operation, the circuit employed is standard. The absence of a screen dropping resistor will be noted. With such low plate voltage (300) it is permissible to obtain the screen voltage direct from the positive lead. Another departure from the usual procedure is the substitution of a variable resistance for the usual fixed resistor across the crystal. This eliminates the necessity of trying different values of fixed resistors when endeavoring to "start" sluggish crystals. Usually, a rather high value of fixed resistors is inserted and if the crystal "starts" and keys cleanly it is left in the circuit. This procedure, while perfectly adaptable to an oscillator designed as a frequency control for a multi-stage transmitter, can be improved upon when the oscillator is to be coupled to an antenna.

The ability of a crystal to oscillate readily and follow keying is no indication that the optimum resistor value has been found for greatest output and lowest crystal and plate current. However, this optimum value can easily be found by increasing and decreasing the variable resistance and at the same time noting crystal and plate current and power output. There will be one setting at which crystal and plate current is lowest, keying positive, and antenna power greatest.

A 75-ohm cathode resistor replaces the customary r.f. choke and adds a small amount of cathode bias. The filter system is extremely simple and effective. A single 12-μfd. condenser does an excellent job of filtering the output of the 5Z4 rectifier tube. The note is pure d-c. and the keying clean cut. Key clicks, "yoops" and other attendant keying difficulties usually encountered are entirely absent.

Construction

The entire unit is mounted on a black crackle-finish steel chassis measuring 5" wide 9½" long by 2½" high. The photographs clearly show the position of each part and should be followed closely to assure short leads to associated resistors and condensers. The coil shown is a standard center tapped and center linked "air-wound" type, procurable from most dealers. Its insulation is excellent and its construction is such that the coil itself is not too close to the grounded chassis. All sockets are of isolantite and are mounted with top surfaces above the chassis. The crystal socket is also of isolantite and is easily mounted by drilling two clearance holes for the prongs and two holes for mounting bolts.



Wiring diagram of the 6L6 transmitter.

C_1—.001-µfd. mica
C_2—12-µfd. 450-volt electrolytic
C_3—50-µµfd. midget variable
C_4—.001-µfd. mica
C_5—.01-µfd. 600-volt tubular
R_1—75 ohms, 10 watts
R_2—100,000-ohm potentiometer
Coil—Center-link µfd. coil for band of crystal
TJ_1—Tip jacks for link to antenna
TJ_2—Tip jacks for external milliammeter
P_1—60-ma. pilot lamp
P_2—6.3-volt pilot lamp
J—Keying jack
S—110-volt s.p.s.t. switch
T—700 v. c.t., 75 ma. 6.3 v. 1 a.; 6 5. 2 a.

The rotor of the plate tank condenser is "hot" and therefore is insulated from the chassis by means of an insulating bushing. Tube shields and transformer core are grounded. Heater leads to the 6L6 tube are twisted as well as are those leads to the pilot lights on the chassis front. Care should be taken when mounting the tip jacks for link and milliammeter connections as all four of these jacks are insulated from the chassis. Should the builder desire, the link connections may be omitted until some later date when the unit is to be used as an exciter for a buffer or final stage.

When wiring, it will be found that due to the parts placement all leads will be extremely short and rigid. These should be connected direct to their terminating points. Right angle bends present a pleasing appearance but there is no point in making a 12-inch connection when a 2-inch lead will suffice. The chassis in the vicinity of the mounting holes for the keying jack, variable resistance and one side of the crystal should be scraped in readiness for grounding.

Operating and Tuning Data

After the unit has been thoroughly checked

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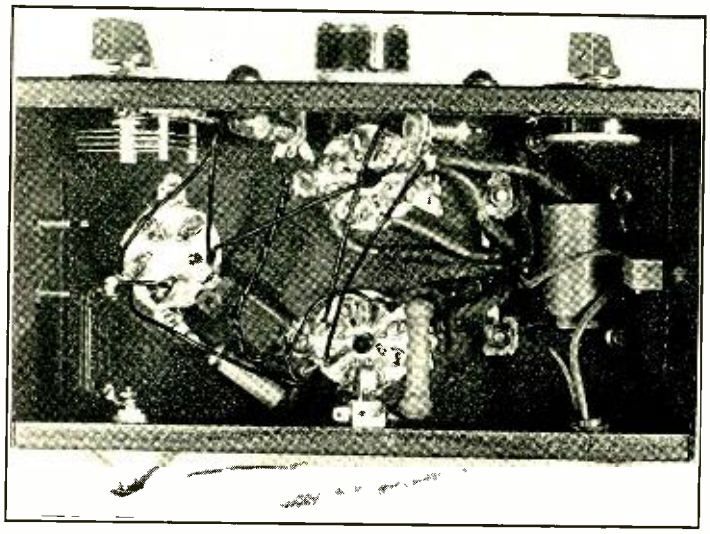

Under-chassis view of the 6L6-crystal transmitter

and it is certain that all wiring is correct, a 2-volt, 60-ma. (.060*a*.) Mazda pilot globe may be inserted in the positive lead light socket. This affords a visual indication of plate current. While this method does not approach the accuracy of readings taken with a milliammeter it does serve to indicate approximate current. It also functions as a protective device, inasmuch as an excess of plate current will burn out the filament and open the positive lead. Half brilliancy will occur at approximately 50 ma. while currents in excess of 100 ma. will burn out the filament. Contrary to popular belief, the brilliancy of the pilot globe does not vary directly as the current.

With the positive lead pilot globe temporarily disconnected and a 0-100 d.c. milliammeter inserted in the tip jacks, oscillation will occur when the plate tank condenser is set at approximately two-thirds its total capacity. With antenna disconnected, the no load plate current will be in the neighborhood of 10 ma.; with antenna connected the loaded plate current should be approximately 50 ma. The signal may then be tuned in on a monitor or receiver and the key down conditions noted. It will aid in tuning if a neon globe of the one-half or one watt size is touched to the antenna terminal. The variable resistance across the crystal is then rotated and left at the point which coincides with cleanest keying, minimum plate current and maximum output. When tuning is completed the plate milliammeter may be removed from the tip jacks and the pilot globe inserted permanently in its socket.

With plate voltage at 300 and plate current 50 ma., an input of 15 watts is obtained. Crystal current is extremely low, resulting in excellent frequency stability.

Antenna Considerations

The unit here described was designed primarily for operation in the 7-Mc. band. However, appropriate coils and crystals may be substituted for operation on other amateur frequencies.

Antenna design and construction covers a vast field and the reader is referred to the several excellent publications dealing with this subject. It should be borne in mind, however, that conditions vary for different locations. The builder should select the radiator he thinks best for his particular location and then proceed to make that radiator as efficient as possible. A good low power oscillator coupled to a good antenna can be just as efficient as some poorly designed multi-stage transmitters coupled to inefficient radiator.

If as much care and forethought is given the antenna as the design and construction of the transmitter, the builder may anticipate many enjoyable contacts.

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

• • •

Inevitable?

A recent operator at *W6PIG*, Santa Barbara, was *W6PEN* from the neighboring city of Goleta.

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By E. H. CONKLIN,* W9BNX

The old band must have known that the Editor wants this column on time this month, for it popped open quite a bit in the last part of April, with maximum activity on May 1 and 2. On the latter date, W5AJG in Dallas rounded out a nice 50 contacts on five meters although he was not able to be on for the whole 13 hours or longer during which signals were coming through.

On April 15, AJG raised W6QLZ in Phoenix, with weak signals. W6KTJ heard both ends. Ten-meter skip was short to the west at the time, according to AJG, who uses that band to indicate when he should "fire up" on five—and he seldom misses. Again on the 25th during ten-meter skip to Florida, AJG raised W4FLH in Miami; they worked for a half hour or so. FLH reported short ten-meter skip to New Orleans at the time. On the same night, W3BYF in Allentown, Penna., said that he worked W3RL on Aurora skip; W8PK heard W1HDQ JMT KLJ W3BYF CUD RL who were on c.w., and worked W8FYC on phone.

Wilmer Allison, W5VV, raised W4EQK by shifting down from ten meters on April 29, but no other signals were heard. Vince Dawson, W9ZJB, assisted W9AHZ in calling W4EDD on April 30 for two hours. W9IZQ did the same thing in vain, deciding that his antenna was no good.

May 1

A very good opening was reported on May 1. W6QLZ heard W5VV on c.w., who worked W4EQK again and added W4FBH EDD. An Illinois station working local was also heard. W5AJG had company and could only run a test tape for a few minutes, but he logged W4AUU FLH EDD EQK. W3RL raised W4AUU W5EHM and heard W4MV EQM. W8OKC in Pennsylvania called CQ and raised W9HHU in Des Moines; Bill also heard W9VHG UDO QNG GVH (GGH?) and got a card from Omaha.

During 350 mile skip to San Francisco on ten, W6QG worked W7HEA FFE FDJ, saying that c.w. would have come through 15 minutes earlier when signals were weak. W6IOJ worked the same stations.

W9IZQ in Milwaukee and W9ZJB in Kansas City again had no luck in raising W4EDD, but ZJB had some better success in getting W1HDQ W2KLZ, hearing W1DEI AZ and others who did not seem to know that the band was open. Vince reports that the boys are surely going over to c.w. which is very readable when weak, where phone is not. W9AHZ hooked W1DEI CZ? and heard W1HDQ AZ. W1LKM worked W4AUU FBH and heard W4EDD FPM MV W9ARN HAQ ZJB.

May 2

According to Leroy May, W5AJG, May 2 was a "whingdilly" of a day for five meters. He started at 9 o'clock in the morning and quit when W8-9 were still filtering through after his 50th contact at 10:21 p.m. On the day before, he thought that W4 was going to have all the fun in May, but how wrong that idea was! What may have been double hop to W1 brought only weak signals, but the few very good stations heard from W1-2 suggests that they may have come through one-hop with a little bending at the east end, accounting for the weaker signals. Or, he thinks, better antennas and receivers may have brought them in when they would not have come through at all on older equipment. May heard W1KTF and worked W1HDQ DEI W2GHV MO W3RL BZJ CRT GQS BKB CIR RUE PZM CLS DAL OLX RKE RFW DJJ LZN MHM MDA FHA TIM TNC CPF AGU AOC JLQ FXM TIU QQS KQC W9VHG WIV ZHB ZHL CBJ RGH FWD ANA USI GGH UDO CLH PQH IZQ HAQ WWH QCY DWU.

The above contacts gave him eight districts, Canada and 32 states. Eight districts and 16 states were worked already this year. He thought he had a bite from the missing W7, but no reports have come in yet on that. He adds that Pat, W5EHM, is back with all his vinegar, checking everything from cold fronts to coldcuts and beer, and keeping Dallas on the five meter map for sure.

W5VV reports raising W9CBJ ZHB RGH WIV in the early afternoon. W5BYV in McCamey, Texas, had his equipment loaned out but near him in Texon and Big Lake, W5FNQ FWS IHT EIN had some nice contacts. IHT writes that he hooked W9ZHB RGH CBJ and heard W9WIV BDL ZHL. The last of these is in Terre Haute, a new point for five meter activity. EIN had a contact with W9ZJB.

Doc Krysinski, W9SQE, admits that the band opened on May 2, with east coast stations getting into Chicago. W9QDA also says that the band was wide open in the evening, while all districts but W6 came through on ten, plus XU8AM, XU1MF and CE2BX on long skip. In Milwaukee, W9IZQ heard numerous W1-2-3 without successful contact, so he dropped his concentric antenna off the roof and used an eight foot wire tied to a bush. W4FBH answered his CQ, then he raised W4AUU MV FPM W5AJG.

W4GMP in Clarksville, Tennessee, completed his superregen one tube receiver in time to hear W8AGU and W8FYC on May 2. He does not know of any other activity in the north central part of his state, north-west of Nashville.

W3RL worked W5AJG in the morning and W9ZJB TOQ USI RGH KZP WIV HAQ CHI ARN AZE VWU DWU AHZ and heard W9ZHB QNG UIZ in the evening. W8OKC heard dx for two hours, including W9ZJB AHZ VHG

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UDO ARN RGH QNG GHW ZHB KZP GWU (DWU or VWU?) and a Minneapolis station, not being able to snag one of them.

Between 6:40 and 9 p.m., W9ZJB worked W1KTF KXK KLJ DEI W2GHV FHJ BZB AYC W3RL BZJ HKM HDJ HBQ CGV HPD WA EIS DBC W8NED JHW AGU CLS CIR and heard W2MO W3BYF W8SYS. W9AHZ was in there too.

W1LKM could not work anyone but heard W9ZJB UDO KZP HAQ GGH PQH ZUL RGH AHZ. On the first few days of May, W8JLQ near Toledo heard W4EDD DRZ FLH W5AJG EHM W9AHZ ZJB.

On May 2 W1HDQ, who handled u.h.f. for our worthy contemporary, hooked up with W5AJG for a 1500-mile hop. The same night W5AJG landed W1DEI.

Later Dates

According to W9PNV, W9CET in Topeka on May 3 heard W1KTF EYM HDQ W2MEU FHJ LVR GHV MO W3DI HCX BZJ RL W8RUE. So far, this is the only report for the day, and may refer to May 2.

A single report for May 4 from W8OKC states that the band opened for five minutes, when a CQ resulted in a call from W4FBH. Joe Seiler, W8PK, heard a weak W9 on phone May 5. On the 11th, W5VV reports the band open for a couple of hours. He worked W9QNG in Davenport, Iowa, W9CLH and W9WAL. Several other weak stations were calling him. W6QLZ keeps reporting him, but no contact has been made. During this time, W5AJG knew that the band was open to Austin, but no signals came through in Dallas although ten was "hot as a pistol." That's just the spotty nature of the sporadic-E layer, Leroy, with insufficient ionization at the proper spots for you. Ten was hot on the 12th, too, he says. Five barely opened on the 13th, when AJG contacted W9UDO and heard W9LF MQM.

During a ten-meter contact with W9ZHB on May 16, W5AJG dropped down to five and connected immediately. Later in the morning, the same thing was tried on W3RL who heard AJG but the signals seemed to be one-way. On the 18th, Leroy worked W4AUU and could not raise W4FKN MV ASE QM who were knocking off W2-3-8.

Less than 200 miles south, W5VV a little later in the evening worked W6OVK W9CLH GHW ARN ZHB QNG. On the 19th, Wilmer felt that the band was open to Alabama, Mississippi, New Mexico and Arizona but he could not get any ten-meter stations to shift to five. He used a delta-match horizontal and a vertical *Q*. All stations reported no difference although they came in 2 R's better on the vertical. His 600 watts may be the cause of his being reported places that he does not hear, so he is going to try a 75-foot high vertical and several lazy-H beams in fixed directions. He is going to the West Gulf Division convention in Fort Worth to try to sell the gang—especially in Waco and San Antonio—on getting down on five.

A letter from W9USI explains that Bill is getting ready for graduation and will turn the rig over to W9USH during summer camps, so something will be heard from them on 56,120. He was in on the May 2 dx, working W1HDQ KLJ W2MO KLZ W3RL W4AUU FBH MV W5AJG EHM W8CLS FYC and hearing W1IZY W2JHW W3HZJ W4FKN W5VV EMQ (harmonic) and W8OLX. That brings his states for 1940 up to nine.

In Milwaukee, W9IZQ has been encouraged with ground wave dx developments and the number of stations springing up from 30 to 60 miles

56 Mc DX
HONOR ROLL

Call	D	S	Call	D	S
W9ZJB	9*	19	W1JFF	6	11
W1EYM	8		W1LLL	6	17
W3AIR	8	24	W2KLZ	6*	
W3BZJ	8	27	W2LAH	6	
W3RL	8	24	W6QLZ	6	11
W5AJG	8*	32	W8LKD	6	11
W8CIR	8*	29	W8OJF	6	
W9USI	8	22	W9NY	6	13
W8JLQ	8				
W8VO	8		W1JLQ	5	16
W9ARN	8	17	W1JMT	5	9
W9CBJ	8		W1JNX	5	12
W9ZHB	8*	29	W1JRY	5	
			W1LFI	5	
W1HDQ	7*	22	W2GHV	5	8
W2AMJ	7	22	W3GLV	5	
W2JCY	7		W3HJT	5	
W2MO	7	25	W6DNS	5	
W3BYF	7	22	W6KTJ	5	
W3EZM		24	W8EGQ	5	10
W3HJO	7		W8NOR	5*	16
W4DRZ	7*	22	W8OPO	5	8
W4EDD	7*		W8RVT	5	7
W4FBH	7	20	W9UOG	5	8
W4FLH	7				
W5CSU	7		VE3ADO	4*	
W5EHM	7		W1LKM	4	6
W8CVQ	7		W3FPL	4	8
W8PK	7*	9	W5VV	4	7
W8QDU	7		W6IOJ	4*	8
W9CLH	7		W8AGU	4	8
W9SQE	7	22	W8NOB	4	
W9AHZ	7*	14	W8NYD	4*	
W9BJV	7	12			
W9CHG	7*		W1KHL	3	
W9IZQ	7	11	W6AVR	3	4
W9WAL	7		W6OIN	3	3
W9QCY	7	10	W6OVK	3	4
W9ZUL	7	16	W7GBI	3	4
W9GGH	7		W8OEP	3	6
W1CLH	6	13	W8OKC	3	6
W1DEI	6	18	W9WYX	3	3

* plus Canada. (reported in 1939)

Note: D—Districts; S—States

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away from him since he put up the vertical H array. On May 18 he worked W9UDO in Union, Illinois, again and W9DRN at Twin Lakes, Wisconsin. A pep talk at the club brought favorable comments but no new transmitters on five. IZQ is on 56,208 kc.

A card from Ed Tilton, W1HDQ, advises that he added W8QDU in Michigan on aurora skip May 4, W5AJG in Texas (1488 miles) and W9HAQ in Iowa on sporadic-E skip May 2 to his honor roll score. He worked HAQ again on May 5 and heard W5EHM AJG on the 21st. Ed's horizontal rhombic and V are doing well on skip dx but still not so good on inversion bending. He adds that his mountain-top location has produced regular contacts on 2½ with W2GPO in Huntington, L. I., a distance of 100 miles. Other good contacts were with W2IQF in the same town, and with W2JND at Syosset, L. I., 105 miles. He does not expect results as good as in California with their "God-made temperature inversions along the coast." (Chambers of Commerce please note.) Ed will have to take full charge of the u.h.f. news for the next two months, but we hope that the gang will continue to send the news to RADIO via this address so that the October issue (out about September 15) will carry a full story.

Hollis French, W1JLK, has worked 8 states in four districts since he moved about the first of the year. That brings him up to five districts and 16 states in the honor roll.

W5AJG is still getting thrills on five. On May 21, W1HDQ broke through on a dead band, when ten-meter signals were weak although semi-short. He worked W1HDQ DEI W3EMM FJ CYW W8RUE NED and then static drove him off. W5EHM in town about 8 miles away had no static at all though he used to have that trouble on his long wires out in the country. AJG wonders if his 80-foot towers are too "hot." Perhaps he needs a lightning rod. He also mentions that the W1's are not loud enough and the band is too inactive to be compared with two-hop signals of the past—agreeing with the conclusion mentioned above that W1HDQ DEI with their long consistent ground-wave range are squeezing a couple of hundred extra miles in on the one-hop 1250 mile stuff.

Five Meter Squibs

Pres Schuler, W3BYF, found the hairpin antenna coupling in his concentric line r.f. stage to be critical, and varies in different installations (and with different transmission line impedance —Ed.). His was badly overcoupled at first and results were not up to expectations.

From McCamey, Texas, W5BYV writes that five-meter skip follows a type of sandstorm with the sand not on the ground but as a powdery fog up several thousand feet that does not settle. This effect has started up again this year. In Big Lake, W5IHT says that he uses a 35T and vertical antenna while W5EIN has a T-40 with 836-foot horizontal antenna.

Wilmer Allison, W5VV, has not yet heard the Dallas gang down in Austin, and is looking for someone in San Antonio with whom he can test. That would be an 80-mile hop, and a good distance for extended ground wave work.

W6QG in Santa Ana tried to stick to c.w. but found that the W7's he worked were not rigged to receive it. So he switched to phone. The transmitter uses an 80 meter crystal, four doublers, and a single 800 in the final, on 56020 and 56400. The home-made superhet has an 1851 r.f. and 4-megacycle iron core i.f.

W6QLZ says that W7GBI is back with a new rig and antenna. W6PBD says that W5INI at Silver City, New Mexico, may be on and help in a relay from Phoenix to El Paso. The route would be W6QLZ to W6GBN on Estrella mountain, then Tucson, W6PBD, W5INI, and on to either W5IHT or W5EIN near El Paso.

W8OKC in Shamokin, Penna., has been attempting schedules with W2MO W3BKB W8QCM but the hills seem to be too high. Other stations getting ready are W8PIK SBH in S. Williamsport, W8RTW in Elmira, N. Y., W3GEJ in Lemoyne, W3HTO at Camp Hill, W3HWN at Harrisburg, W8NUI at Hollidaysburg. That should put central Penna. on the map and help to jump the gap in the relays that only W8CIR portable has been able to fill. OKC now has four vertical half waves in phase. He thinks that conditions have to be just right for it, so he is making comparisons with a horizontal 3-element beam.

From Metamora, Illinois, W9ALU raises a question on using a push-pull r.f. and detector with concentric lines to reduce grid-filament capacity and tube input resistance. Actually, the input capacity gives little trouble except on very high frequencies, but this scheme does keep down the loading of the tuned circuit by the tubes. It is not widely used, however, possibly because the tank must develop twice the voltage to swing two tubes, and the mechanical layout may become complex. He also wonders about using oscillator r.f. output as the only mixer plate voltage (no d.c.). If anyone wants to try these ideas and has interesting results, please pass along the dope.

Chicago-Milwaukee Success

As far as W9IZQ is concerned, the Chicago-Milwaukee barrier to five-meter contacts is definitely hurdled. On May 4 he put up four vertical half waves in phase about 40 feet up, and on the 6th heard W9UDO in Union, Illinois. He raised W9WWH in Racine and W9GGH in Kenosha with much better reports than before. Then he heard W9VHG in Glenview and W9MQM in Evanston, around Chicago. On the 7th he had a three-way with VHG MQM. The 8th brought contacts with VHG WWH. So George is all for "4 half waves in faze."

The Ultra-High Frequency Club of Chicago, according to J. C. Smolek, W9MXK, boasts of a limited membership of 15 who more or less consistently operate on five meters or beyond. Meetings twice a month are at the homes of members, which include W9YSV SQE MXK FEN CX VHG ZUL UOV MQM IUV EMF BSU EWE MVM. MXK is out on 59.27 where he is lonesome and annoyed because fellows do

www.americanradiohistory.com

2½ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6QZA-OIN	201
W6BCX-OIN	201
W9WYX-W9?	160
W6IOJ-OIN	120
W1HDQ-W2JND	105
W6BCX-IOJ	100
W1HDQ-W2IQF	100
W1HDQ-W2GPO	100
W6NCP-OIN	98
W6IOJ-OIN	80
W6CPY-IOJ	80

HOME LOCATIONS

Stations	Miles
W1HBD-W1XW (1935)	90
W1SS-BBM	74
W8CVQ-W8?	48
W1LEA-BHL	45
W2MLO-HNY	40
W3CGU-W2HGU	40

not tune up his way when dx is on. His landlord will not let him on the roof to change his vertical H array. He is all for more general occupancy of the band—at the high end—around Chicago.

In Topeka, W9CET wants to know the best kind of antenna for five. Yeah, so do all of us. Probably it is a well-matched vertical on a ten thousand foot mountain with no auto QRM. But antennas must be built under physical conditions—or handicaps—and for specific types of work. A beam with a concentrated vertical angle, polarized the same way as at the station worked, is generally the best to put over some ground wave dx if a much higher dipole cannot be erected. Skip dx is not so demanding of the antenna system.

W9SQE, like MXK, has landlord trouble. He put an antenna out the window and started working W9UDO in Union, Illinois. W9GGH in Kenosha comes in well now. He was also hearing W8CVQ, who is being worked by W9ZUL using a rotary three element vertical. SQE hears W9ZHB on a horizontal and more rarely on a vertical. UDO can change the polarization of his dipole by pulling a string.

Vince Dawson W9ZJB, says that the Wichita Convention came off satisfactorily, and Kansas City gets it next year. Unofficially he says to come in 1941 and give a talk on coaxial lines or on how to keep the kids out of things. He is neutral on antenna polarization, and is planning a horizontal four-element job to see what Illinois has that Kansas City doesn't. His vertical extended zepp is all right but doesn't load up the final properly. He says five-meter dx over 400 miles must be high angle—well, a scale model or some trigonometry will settle that idea, or someone is all wrong about them there layers.

W1LKM now puts 80 watts on a 35T final and uses an HQ120X with a three-tube converter. Conditions around Mansfield, Mass., are really good with a raft of local and dx stations coming through.

W8JLQ never heard much ground wave dx until he put up a vertical (most stations within range use verticals). Recent reception of this type includes W8CIR VO NYD BMU FHA PWM QDU NKJ CVQ MDA TZM? (Cleveland).

One station near Pt. Clinton using a vertical comes in regularly at W8JLQ while another was heard poorly and was said to use a horizontal. When the latter put up a vertical, he was as consistent as the first. JLQ had a good horizontal available for checking this—which brought in the weaker station more often at first, but never as well as when both used verticals. W9ZHB please note—they are ganging up on you! Out to 15 miles, a given signal would be better by one R with verticals at both ends, and poor with unlike polarization—which is common experience with well-matched antennas. The long wire antenna is often more tolerant as to polarization—but it is probably responsive to both types.

Another thing JLQ brings up is that he tried copper eave-spouting as a coaxial line outer conductor with results below those with a coil. He wonders if W9QDA got 4 R's improvement over *poor* coils. In a way, that is true because any coil produces a poor circuit when shunted by an 1852 on 56 megacycles. Other comparisons were with commercial receivers and signal boosters. JLQ tried the line as a tank circuit in an 807 plate circuit and got less dip. The only defense against this test—perhaps a weak one—seems to be that plate current dips may be misleading due to interstage coupling (the coaxial is shielded). If anyone else fails to get good results from coaxial line circuits, write in about it, giving the details. So far, most or all cases of dissatisfaction have been cleared up. The resultant sharp tuning must mean something (high Q), unless the antenna coupling is inadequate. Also, if the r.f. tube works into a poor load, full benefit cannot be gained from a good grid tank.

During skip dx, W8JLQ switched between verticals at two heights and a horizontal. For some periods the verticals were better and a smaller part of the time the horizontal was superior. Sometimes a fade on a vertical was a peak on the horizontal. This may be due to diversity fading or to the signal swinging in at a "blind" angle of an antenna due to its complex vertical pattern resulting from its height in wavelengths.

Toledo stations now include W8JLQ ARF SUL TWU RZO BIQ.

112-224 MEGACYCLES

A new record on 2½ meters is reported by Woody Smith, W6BCX, editor of this 'yere sheet. Using the QRO transceiver described in June RADIO, on April 21 he worked W6OIN in San Diego, over 175 miles. Woody could not hear the signal on a quarter-wave rod on the car, but could on a single-wire-fed vertical (20 ft. high) put together on the spot, which was 3985 feet up.

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New Shielded
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$1.50

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The famous Taylor 866 is celebrating its Seventh Anniversary—seven years of Sales Leadership—seven years of real "dollar and cents" savings to thousands of amateur and commercial users.

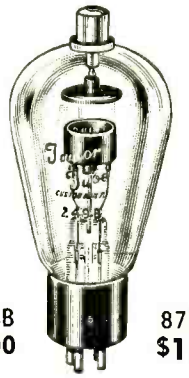
In 1933, with competitive tubes selling for $7.50, (just reduced from $12.50) the announcement of the broadly guaranteed Taylor 866 at $1.65 was the sensation of the radio world. Sales of Taylor's 866 skyrocketed and leadership has been constantly maintained.

In 1939, Taylor introduced its new Heavy Duty Shielded 866 at $1.50*. Since then increasing numbers of unsolicited reports have acclaimed its performance in Broadcast, Police, Airline and Amateur installations.

If you want real "More Watts Per Dollar" value, insist on Taylor Tubes. Taylor's liberal guarantee protects your investment.

** Same characteristics as 866A. Peak inverse 10,000 volts.*

866 Jr.
$1.00



249-B
$5.00

872-A
$10.50

"More Watts Per Dollar"

TAYLOR TUBES, INC., 2341 WABANSIA AVE., CHICAGO, ILLINOIS

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On the following Sunday, April 28, he and W6QZA drove up the coast and on an uncharted (fire) road, together with fried chicken and the yf's. From an altitude of 4300 feet he again hooked W6OIN at a distance of 201 miles. This time W6BCX used a vertical single section W8JK antenna, supported 20 feet above the car on a bamboo pole. The same transceiver with 17 watts input was used. A strong wind blew the antenna around, making necessary very loose coupling to the transceiver and some tinkering to get the right combination. After two solid transmissions each way, the wind brought down the antenna.

The contact was wound up by W6QZA using fishpoles on his car, no external antenna. His outfit is described on page 14 in this issue: a superregen 7A4, 6C5 and 6V6GT, transmitter an HY75 with 30 watts input. Woody thinks that QZA is ahead by five feet for the record! OIN was up only 850 feet but can get up 4000 feet and nearly 35 miles farther, while the Santa Barbara boys can add 25 miles, but both places are on private or fire roads, requiring special permission. It will make 260 miles if it can be done, but the idea is being saved for future competition.

Speaking of 2½, W6IOJ lists several contacts from his home station—without comment—including mobile contacts with W6OIN at 80 and 120 miles from Hollywood, W6CPY at 80 miles and W6BCX at 100 miles. OIJ certainly deserves credit for all of his fine work. His QTH is *not* an elevated location.

Clyde Criswell, W6QLZ, says that W6KTJ KVE are the only other stations on 2½ in Phoenix, with GZU a possibility. The latter won a transmitter hunt at a hamfest with a receiver built in an hour. KTJ hid his rig in a crater on a mountain. Clyde could hear it well at 15 miles, with a mountain between.

Near Chicago, W9PNV has had some good reports and worked W9TXU/BAN in Oak Park. PNV says that the Chicago Suburban Radio Association has voted on 2½ meters as an inter-member band. The club plans some airplane tests to encourage 2½ meter operation over a wide area.

O. K. Falor of WBCM continues to work on 2½ meter rigs. He has been able to get about 15 watts out of a rod-tuned 6N7G with 70 mills at 400 volts on the plates. The grid line was 23 inches long, tapped at 3½ inches. The grid leak was 10,000 ohms. This tube worked well with cathode and heater chokes, or with a short tuned concentric line in the cathode, the heater leads running inside of the center conductor. He got about the same power from a pair of 45's with a 25,000-ohm grid leak, tuning the filaments separately with lines. The filament wires were run down nearly a half wavelength, with one shorting bar across one lead from each tube, another shorting bar across the other pair of leads. This suggestion eliminates the need for tubing in a single filament line so that the a.c. return can be run on an insulated wire inside each pipe.

Some very interesting comments have also been received from Walter Widlar, W8IPU, who is with WGAR in Cleveland. Their mobile unit was changed from 30 to 132 megacycles with a large increase in signal and reduction of noise. W8MAP cooperated in this test. The transmitter uses some 807's and HK24 doublers, and push-pull HK24's in the final. Three-element rotaries are used. The receiver uses acorns, and a 6N7 crystal oscillator-octupler, link coupled to the 954 suppressor grid. Another transmitter at IPU uses a 75 to 225 megacycle tripler that had oscillation difficulties which were traced to widely spaced no. 10 wire plate leads. These were replaced with ⅜-inch pipes 14 inches long, closely spaced, condenser-tuned at the shorted end. IPU is now devoting most of his effort to 225 megacycles, as a result of Bliley's encouragement. The new rig will work into a 75 to 225 megacycle tripler from a 4.7 megacycle crystal rather than from an 18.75 Mc. oscillator. Some of the WGAR staff are working on a 2½ meter FM job; so far, there is trouble from hum in the h.f. oscillator of the receiver.

28 MEGACYCLES

According to G2YL, April was better for ten meters than it was last year, especially in the second week. South Americans were logged on six days and North Americans on nine. W6PCB and W6POD came through on April 12, an otherwise poor day. W9QDA reported contacts with South America and hearing some China stations especially on May 2 when there was considerable short skip. Vic is having better success with 1853's rather than 1852's in converters due to lower input resistance to load the tuned circuit.

W6QLZ in Phoenix continued schedules with W6PBD in Douglas, 250 miles away and over tall mountains. Signals were best in the early evening, but with a fast fade noticeable on a meter. When the band is dead, a rain-barrel effect is noted on these contacts. W6PNO seems to be the best from California over the rain barrel route. May 2 was good for short skip all the way to W2-3, which means two hops, as suggested by W5AJG's five-meter contacts with W1-2.

• • •

Unlicensed Radio Operator Convicted

Following an investigation by inspectors of the Federal Communications Commission of the operation of unlicensed radio stations on Long Island, N. Y., Edward Mathes was indicted for violation of Section 301 and 318 of the Communications Act of 1934, as amended.

The defendant was arraigned in the United States Court for the Eastern District of New York on May 6, and pleaded guilty to charges of operating an unlicensed radio station and operating a radio station without an operator license. The court suspended sentence and placed the defendant on six months' probation.

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Outstanding transmission at 1 k.w. on each of 5 bands by "Tom" Consalvi's W3EOZ at Bryn Mawr, Pa., is matched by the perfect performance of his AR-77 receiver shown in the foreground before installation in the panel.

"It Beats Receivers Costing *Twice as Much!* ...says W3EOZ

Thomas A. Consalvi—W3EOZ—knows receivers. He has seen just about all of them—and he's actually given most of them a whirl. Many manufacturers have sent him sets to be tested under normal as well as exceptional amateur conditions. Here's what he says about the new RCA AR-77 with which he recently replaced a receiver costing more than $300 in his shack:

"In many features, the AR-77 is superior to any other I ever tried—at any price. In every way, it matches the performance of my old receiver costing more than twice as much. Some features, particularly the noise silencer, are far superior. Its performance on high frequencies is unbeatable; its signal-to-noise ratio excellent and its stability unmatched. I've tried it under all sorts of conditions and there is negligible drift, even over long periods."

Getting back to the noise limiter, Mr. Consalvi states: "It's the first really effective noise silencer I've ever tried. It really works. For instance, I've had three automobiles at the same time going full blast just outside of my shack, making all possible ignition noise. Then I've gone to my AR-77, picked up the weakest signals I could find—signals inaudible without the noise limiter in operation—and brought them in 100%!"

AR-77
COMMUNICATION RECEIVER

Tests under average conditions show maximum drift at 30 Mc to be only 3.0 KC on one hour run, thereby keeping signal audible. A 2-to-1 ratio of signal-to-noise is obtained at an average sensitivity of 2 microvolts throughout range. Frequency coverage, 540-31,000 KC in *six* ranges. Try it at your nearest RCA distributor's store. You be the judge! Complete Technical Bulletin sent on request.

Net Price, **$139.50** f.o.b. factory.
8" Speaker in matched cabinet, **$8.00.**

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The Open Forum

Tillamook, Oregon

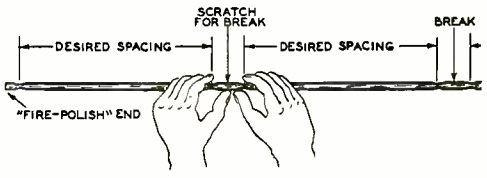
Sirs:

When I put up my 80-meter antenna here the problem of obtaining a large number of efficient but inexpensive feeder spreaders arose. Most of the amateurs in this vicinity use hardwood dowel boiled in paraffin. These seem to work all right but after about six months the sun and weather bake the paraffin out and the losses in the spreaders increase noticeably. I thought up a method to use glass tubing as it is low-loss, light, and inexpensive. The ¼-inch glass tubing may be purchased for about 25c a pound and one pound is enough for a large batch of spreaders.

The only tools needed to make the spreaders from the glass tubing are a small blow torch or a Bunsen burner, a rule, and a file. A tie point for the feeder wire is made by heating a ½-inch section of the glass in the tip of the flame, which is the hottest, and drawing the glass out slightly as shown in the drawing. A little practice will soon show how soft to get the glass before drawing it to make a neat tie point.

Make up the whole 3-foot length of tubing in the general manner shown in the drawing, making the distance between alternate tie points the desired feeder separation. Then cut the individual spreaders apart by first scratching the glass deeply with the file at the proper spot between the spreaders. Then, holding the scratch away from your body, place your thumbs on the inside on either side of the scratch and pull the ends of the rod inward with your hands. A neat and clean break will result exactly at the scratched point if the scratch has been made deep enough. However, one sure, firm stroke of a sharp file will make an ample scratch.

Then fire polish both ends of each spreader by heating the ends in the flame until the sharp edges are rounded. I have been using these spreaders exclusively on 10-meter and 80-meter feeders and they have withstood several windstorms of high velocity without a single one breaking.



DON WILSON, W7HSL

Seattle, Washington

Sirs:

The past year has been an opportunity for me to study the performance of practically all types of u.h.f. receiving antennas. I also have read in RADIO and other radio publications experiences of others. In experimenting with W.E. type coaxial verticals with quarter-wave radials it has been possible to drop street QRM as much as 12 db by the addition of the radials. Disregarding antenna theory of a half-wave antenna against a quarter wave, I have found the Brown type to be so much superior for my purpose to any other type, coaxial Franklin included, that I have practically ended my effort to improve reception from this standpoint. Using the Brown type antenna, it is possible to set the q.a.v.c. circuit of the receivers at approximately 15 microvolts sensitivity for reception from a 50-mile radius. The receiver elevation is 450 feet above sea level. The surrounding territory is far from ideal from a standpoint of ground-wave propagation.

The transmitters used operate on 30,880 kc., 20 watts output, using HY-69's and heavy duty vibrator supply.

FLOYD HATFIELD, JR., W7ASV
Radio Supervisor KGPA

Wheaton, Illinois

Sirs:

The following calculations may interest you.

On the cover of the February, 1939, issue of RADIO was shown a peculiar antenna system for the reception of static originating in the depths of space. As pointed out in a discussion of results the most distant object identified is the spiral nebula in the constellation of Andromeda. While this galaxy of stars is really a gigantic beacon with a luminosity some hundred million times that of the sun, this object is at such a remote distance it appears as only a faint patch in the night sky.

The measured intensity of the energy arriving from the above nebula is 7×10^{-25} watt/cm^2/kc. band which corresponds to a

[*Continued on Page 79*]

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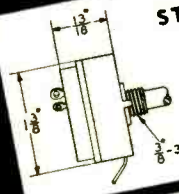
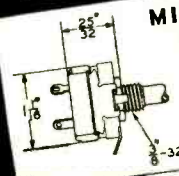
The CENTRALAB Family of VOLUME CONTROLS

In every branch of the electronic industry Centralab Controls play a major part in producing certain, smooth, flawless attenuation. Set manufacturers, servicemen and experimentors turn to Centralab for positive performance. Whatever your Volume Control needs may be . . . specify Centralab.

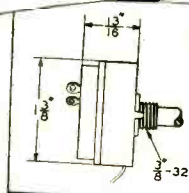
All controls furnished with any desired maximum resistance and with appropriate tapers. Control and resistor problems melt away when you put Old Man Centralab on the job.



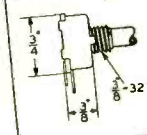
STANDARD
Centralab's non-rubbing contact and long wall type resistor. Available plain, or with one, two, or three taps, and with Underwriters Approved switches.



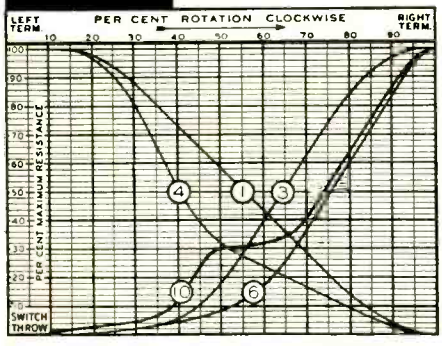
MIDGET
Small in size, large control efficiency, long straight path of wall type resistor. Available single, dual, or triple, plain, or tapped, with SPST, SPDT, DPST, and a special dial lite push switch for battery sets.



WIRE WOUND RADIOHM
Identical in size with Standard Radiohm. Range from 2 ohms to 10,000 ohms. Rating 3 watts. Furnished plain or with SPST, SPDT, or DPST switches.



SUB-MIDGET
The smallest diameter reliable control. Wall type resistor gives low noise, rapid transfer of heat to metal shell. Rating of 1½ watts. No switch or taps.



The resistor curve of a volume control is more important than its overall resistance . . . that is why all Centralab controls are furnished with the variety of curves shown here. Curve six is most widely used for high resistance radio grid and diode controls. Curve 1, or 4, are best for C bias, and Curve 3 for antenna C bias. Curve 10 is used on tapped controls.

TWIN AND TRIPLE CONTROLS
Two or three sections assembled in tandem. Each section fully shielded with all contacts attached to a single shaft. Twin controls available with concentric shafts. Supplied with or without snap switches.

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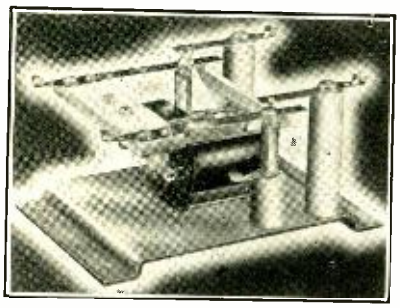
What's New . . . .

IN RADIO

NEW ANTENNA RELAY



The Meissner Manufacturing Co., of Mt. Carmel, Illinois, has announced the introduction of a new antenna-switching relay as an addition to their line of amateur parts and accessories. It is primarily designed for automatic transfer of the antenna from the transmitter to the receiver in amateur station operation but is well adapted to any type of high-frequency switching, providing a double-pole, double-throw arrangement.

Contacts are unusually large, wide opening and designed to handle heavy loads. A 1-kw. transmitter may be switched without danger of arcing or burning. The contact arms are so arranged that a "straight-through" feed is provided—transmitter connections at one end and antenna at the other.

All insulation is of Alsimag 196, permitting operation on 60 Mc. with negligible loss. Mechanically, this new relay is foolproof, fast and positive, unusually quiet in operation. Standard unit is provided with coil for 110-volt a.c. operation.

PLUG-IN ELECTROLYTICS

Of interest to amateur, manufacturer, serviceman and operator of radio and electronic equipment is the perfected plug-in electrolytic condenser now made generally available by Aerovox Corporation of New Bedford, Mass. Handling with the ease and speed of radio tube or vibrator changes, the plug-in feature permits an electrolytic condenser to be instantly removed without tools or trouble, for testing and replacement.

Developed primarily for the U. S. Signal Corps, the plug-in electrolytic has offered very obvious advantages to aircraft, police radio and sound system equipment where continuity of service is of paramount importance; and now, with its transition from a custom-built item to a standard condenser, the plug-in type can provide many new possibilities. The cost is comparable to that of conventional electrolytics.

[*Continued on Page 91*]

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YARN of the MONTH

CONTROL ROOM CHUCKLES

Boobyhatch, Neb.
February 1, 1940

Dear Georgie:

How are ya OT? I suppose you're still sparks on that floating oil can, eh? If so, this ought to reach you just about the time you should be pulling into N.Y.C. if that old tub still runs on the same sked it used to. Before I forget it, even though I haven't answered your last epistle for so long, how's about a quick reply to this as I'm anxious to hear what you've been doing with yourself since I last heard from you. And, no doubt you are wondering what I've been doing these past few months so I might as well tell all . . .

Ahem; about four months ago, I get sick of coaxing sick b.c. sets back to a semi-healthy state so did a bit of greedin' and another ham and I whiz down to the nearest RI's bailiwick and wade through our commercial exams. Both of us survived the ordeal and soon were lucky enough to get our blue tickets whereupon we started pestering all the nearby b.c station managers for jobs. Again we were lucky and each of us got a job in a flea-power station.

He is at one about fifty miles from here as an engineer and also copies press a few hours a day. Yours truly is a combined transmitter nurse and pancake turner here in this glorified record player. Just got a letter from him yesterday and he was telling me that when he first went there he was afraid something in the rig would break down while he was alone on duty and that sometimes now he gets wishing it *would* "just to break the monotony!" Not me though; I have enough to do what with tending to the spinning platters, lugging mikes about from one studio to another, keeping the logs, switching the announcers mikes off and on (*usually* at the right times) and a thousand and one other things without wanting to have to do a repair job on the transmitter just to break the monotony! Our ether tickler is, by the way, located right here in the control room . . . mighty handy . . . yes, yes . . . mighty handy.

Seein' as how we aren't affiliated ($10 word) with any network, most of our programs are made up of records and so I play the darn things every minute I'm on duty. It's getting so I even see 'em whirling around in my dreams! When we aren't grinding out records, we are either using transcriptions (same difference, hi) or else souring the listeners' beer with the so-called music of a bunch of hillbillies in one of the studios. Still, I do get a few minutes spare time when we have a studio program and usually spend it by looking through the radio catalogs sent to me by some of the world's greatest optimists; or, once in a while, I draw up a circuit diagram of some piece of ham gear that I never do seem to get time, money or ambition to build.

One would naturally think that a control room operator has a soft job but I'm telling you, a guy can get himself into a lot of trouble just playing canned music. You see, some of it is played at 33.3 r.p.m. and the rest at 78 r.p.m. as you probably knew, but, just to make things really interesting, some of it starts playing from the outside edge of the disc and some of it starts playing from the inside and, to add insult to injury, some of it has to be played with a vertical type pickup and the rest of it has to be played with a lateral type head. Furthermore, a large percentage of the transcriptions have four different selections on each side which same makes it awful easy to play the wrong selection when one is in a hurry. Another thing that is sure to make a control man curse eloquently under his breath and blush like an old maid at a burlesque show is to get a 33.3 r.p.m. disc on at 78 r.p.m.! If there's any talking on the thing, it sounds like Donald Duck in high gear and if it's someone singing, it

By JAMES L. PRATT, W1GAE

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sounds like a Chinese version of Cuban double talk. I speak from bitter experience, too! And how the dear public does like to call up after each boner and tell us about it (as if we didn't know it had happened ourselves . . . hunh!).

I'll bet my first day at the controls here will no doubt go down in the history of the station as that on which the greatest number of mistakes were made of any one day since it started broadcasting. For instance, about 4 p.m. I am sitting there with the cold sweat popping out on my brow tremblingly awaiting my next opportunity to make another mistake when in comes one of the boys from the back office and hollers above the din of the control room speaker, "Kill the board!" I gasp in astonishment and am about to start hunting for the board of directors as soon as I can find a wrecking bar when he grinningly explains that he doth desire that I switch off the speaker mounted in the baffle-board in the office. Well, I thereupon heave a sigh of relief and start casting my eyes over the array of switches (most of which aren't lettered) wondering which one can possibly do the trick. I tentatively throw several and manage to cut the program off the air only *three* times before I do hit the blasted switch I want and succeed in "killing the board." Ah me, what a life!

But, son, ya hain't heerd nawthin' yet. Fer instance, we have a new spieler named Maxie here that is a jitterbug what am and I don't mean possibly. When he isn't talking to a dead mike due to not waiting for my signal that the mike is on, or bending the needle on the modulation indicator while trying to mug the mike when it *is* on, he is hanging around the control room and, at the first blast of swing music he hears, doing a bit of rugcutting. If he happens to jump hard enough and I am playing a vertical transcription using one of the ounce-and-a-half pick-ups . . . brrram, the needle raises itself coyly into the air and lands about six grooves away and you can imagine how that sounds on the air! Ten seconds later, Maxie gets the bum's rush and lands out in the hall and *that* jar completes the job and the dang needle usually falls entirely off the transcription.

Oh well, somehow, I can't help liking the guy and he certainly can't get me any madder than I was the night I moved the piano around in Studio A for 17 minutes (all the time dashing back to the control room every two or three minutes to put on another record) to get the aforesaid piano where the dame that's gonna sing figures it should be. I wouldn't have minded so much ya know if only the canary was some fb yl but, no, it hasta be a big, homely, crack-brained crackpot with cracked false teeth and a voice that cracks every time she puffingly attempts to hit a high note. There's one in particular she seems to like the feel of that makes her cracked false teeth chime in with about a 500-cycle beat note that would cut through QRM sump'n' swell if I could only use one like it in an i.c.w. rig on 80 meters. One thing is sure, if I ever lose this job, I can always go in business as a qualified piano mover.

Getting back to my bosom pal the announcer—you should hear some of the boners he pulls. Early this evening we were grinding out a conglomeration of canned music called "Bordertown Barbecue" and half way through the program he informs our listeners (if any) that it's the "Barbertown Bordicue!" And this noon he starts an ad for the Green Front Stores with a curious mixture of words that sounded to me like "Green Front Stores are ron ra rare!"

However, Maxie isn't the only announcer who makes mistakes here. Last night we are piping a Nemo from a local auditorium and the sports announcer is giving a running account of the basketball game and along the middle of it, ". . . they are fighting for

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the ball in under the Dodgers' basket . . . somebody has it . . . he's throwing it to another player . . . there it goes . . . high up . . . near the ceiling . . . it looks like it might hit that high window . . . *it did!* . . . I wonder if you listeners could hear the *class of grash?*"

Speaking of mistakes, I've made more than my share of them today all right. To begin with, I was supposed to open the station at 7 this morning. Well, it so happens that last night that red-haired yl of mine decides that we must go out and dance after sign-off so, naturally, out we go. Consequently, I stagger up to my room at 3 a.m., set the alarm for 6, struggle out of my clothes and pour myself onto the bed and rapidly pass into the arms of Morpheus.

Time passeth.

Comes six o'clock. BRRRRRRRRRR goes the alarm and I come out of my state of suspended animation long enough to wonder hazily how long it's going to take that shuddering thing to run down. By the time it does, I am again snoozing blissfully.

Again, time passeth . . .

Comes 7:05 a.m. and, with it, an insistent pounding on my door and the landlady's voice: ". . . telephone. *You're wanted on the telephone.* He says he's an announcer at the radio station."

"Hunh? . . . Wha's thatcha say? . . . HOLY SMOKE! I'm late for work . . . tell him I'll be right over!"

I hop out of bed and on go socks, shoes, etc. Then yours truly whizzes down three flights of tricky stairs and out into the teeth of a blinding snow storm with my shoes untied, overcoat flying out majestically behind me, my shirt unbuttoned and a hastily snatched necktie straggling out of a hip pocket. I'm telling you, I must have looked like an escaping lunatic and brother did I make time! Must have hung up a new unofficial record for the 400 yard dash.

When I get to the station and zoom into the control room I am panting like a Model T half way up Pike's Peak. I glance into Studio A and there sits the announcer studiously twirling his thumbs and grinning like a Cheshire cat. I turn on the speech amplifiers, the frequency monitor, the modulation monitor, the filaments of the transmitter tubes, etc. and put the recorded sign-on theme music on a turntable as I wait for the various tubes to heat up. Eventually we bid our early rising listeners a belated "Good Morning."

Believe it or not, I think that mad dash must have taken ten years off my life not to mention making me so nervous today that I don't know which way is which. Man, I've made so many mistakes that it'll be a wonder if they don't put me on the beach before the

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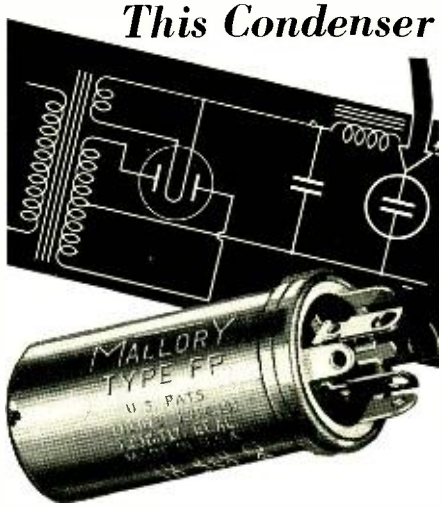

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day is over. I've thrown the right switches at the wrong times and the wrong switches at the right times and started three (count 'em) transcriptions at the wrong speed and snubbed twelve wrong numbers so far. Such a day, such a day—will it never end?

Now what's that Maxie just announced as the title of the transcription I m playing . . . oh yes . . . "Saddle Your Blues to a Wild Mustang" . . . hmmmmm . . . 'sfunny but it doesn't sound like it to me. Ah, here comes the lyrics . . . JUMPIN' JULIUS . . . that guy's singin' *"Goodnight Sweetheart!"* Ohhh . . . and here comes the boss with a wild look in his eye; he must have heard it and what's that he's got in his hand . . . gosh, it's that ornamental sword from Studio B! I gotta do sumpn.

. . . There, I've got the control room door barred. Now look, Georgie, it'll take him quite a while to bust that door down and I'm going to finish this and put it in this stamped envelope and throw it out the window hoping that someone will pick it up and mail it. So, please o.m., if you ever get this, tell mother I was thinking of her when I died . . .

Goodbye Old Pal,
Jim

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Improved Practices with Stubs and Lines

[*Continued from Page 21*]

An alternative arrangement is shown in Goodman's article.[5]

With the antenna and stub fairly well off the ground, tap the line on to the stub at any arbitrary point. Using the galvanometer measure the current along the line from the stub to the first node or anti-node. If the current rises as the stub is left, the feed line is tapped on to the stub too high above the shorting bar. If the current drops as one proceeds away from the stub toward the first node, then the line is tapped too close to the shorting bar.

By finding a point on the line where the feeder current rises and another where it drops as the stub is left, it is possible approximately to locate the point of inflection. By several jumps back and forth it is soon possible to find a spot on the stub where the current rises very gently on the line as the stub is left. This, of course, is the correct point of termination. A convenient temporary method for attaching the line to the stub during the run is to use long nosed clips. When the run is completed the line should be soldered into its permanent position.

It has been found by several observers that there is some undesirable inductive and capacitive coupling between the line and the stub. This effect, especially noticeable at the higher frequencies, changes the resonant length of the stub. To correct for this, loosely couple the line to the transmitter and shunt the thermogalvanometer across the shorting bar and retune the stub for maximum current. When this position is found remove the meter and solder the bar into its permanent position. Further information on this is given in the RADIO ANTENNA HANDBOOK and in Goodman's[5] article.

The author is greatly indebted to Professor Ronold King of Harvard University for testing the theory in his ultra-high frequency laboratory. The measurements were run at one meter on a quarter-wave stub, and were made with a vacuum tube voltmeter designed by Prof. King.

The theory was put into practice in matching a 600-ohm line into a stub-fed pair of stacked co-phased vee beams.[6] The method worked beautifully and the antenna displayed greatly improved characteristics both on receiving and transmitting. This work was carried out at W1HKK with the able assistance of ex-VE2PH and ex-VE2JZ.

[6] P. S. Carter, C. W. Hansell, and N. E. Lindenblad, "Development of Directive Transmitting Antennas by RCA Communication, Inc.," *Proc. I.R.E.*, Oct., 1931.

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POSTSCRIPTS... and Announcements

NEW AMATEUR EXAMINATIONS

After July 1, 1940, all amateur operator license examinations will consist of questions of the multiple choice type. This type of question, which has been used quite successfully in commercial examinations for the past year, consists of a question and several answers, the correct answer being indicated by placing its number in a space provided for the purpose.

The new class A examination will contain a maximum of forty advanced questions dealing mostly with radiotelephony. The class B and C examinations will contain a maximum of fifty questions of which approximately 60 per cent will be technical and 40 per cent will concern regulations and laws.

It is expected that the new examination will reduce both the examination time and the time required in the grading and issuing of licenses. The code requirements remain at 13 words per minute.

SOUTHWEST DIVISION CONVENTION

So that amateurs may arrange their vacations to coincide with the big Southwestern Division Convention, the dates have been definitely set: August 31, Sept. 1, 2. The Associated Radio Amateurs of Long Beach are putting it on with the assistance of the city of Long Beach, in the big new $3,000,000 auditorium. Dwight Williams, W6RO, president of the Associated Radio Amateurs, recently announced that the beautiful music hall of the auditorium had been reserved for the convention sessions. These begin on Saturday. A free harbor boat trip is scheduled for Saturday afternoon, smoker and entertainment Saturday evening, convention sessions Sunday, banquet Sunday evening. Those who send in their $3 to W6RO early get a chance on the pre-registration drawing of an RME-99.

I.R.E. PACIFIC COAST CONVENTION

The Institute of Radio Engineers plan a Pacific Coast Convention to be held in Los Angeles, August 28, 29 and 30. This is a combined effort of the A.I.E.E. and the I.R.E., with one joint session of interest to both groups. Anyone desiring to present an original paper of interest to the art of communication should communicate with Dr. Samuel S. Mackeown, Chairman of the Convention Papers Committee, California Institute of Tech-

[*Continued on Page 96*]

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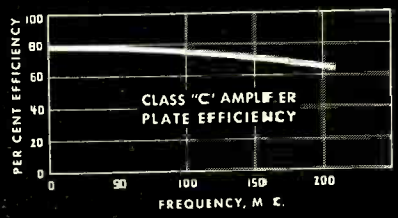

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Curing "QRK-QTH Personality"

By DE FOREST O. ROMAIN, *W2IEV

How often we hear it repeated that the QSO of today lacks most of the interest which those of a few years back possessed. Think back, you old timers. Didn't you get a much bigger "kick" in working a station when your transmitter consisted of a pair of 45's or O1A's than you now get with your half kw. and your beam antenna? Radio was new and so was the thrill of talking to someone miles away. Any minute the unexpected might happen.

QSO's then were more than just a report on the signal strength, the weather and a QTH. The participants became acquainted and before they had signed they really knew something about each other.

I needn't tell you that the situation has changed. Amateur radio has so developed technically that many commercial stations can look at some amateur stations with envy. Today we can just about look on a chart and tell just when we can work a certain station and when we can't. And suppose we do have all these advantages and are able to train our beam antenna on a certain place and work it without fail; so what? After we have finished, what has been accomplished? Perhaps it was snowing there or the sun was shining; so what? The sun often shines here and in season we too have our snow, probably as much as there. Doesn't it seem to you that more might be derived from a QSO than just that confounded signal and weather report? And why should I care about the complete layout of your transmitter? Even the input power to the final isn't important; if I am copying you that is all that is necessary. Your signal is readable whether it's R7 or R9 plus. Surely you don't ask every person you meet if you are speaking loudly enough at the beginning of your conversation. Even commercial stations seldom give or request a report, and the substance of their communications is of far more importance than amateur QSO's.

With all the new circuits, high powered equipment, hypersensitive and super-selective receivers flooding the market, we should be able to obtain more from each contact—not less. It is no longer necessary to play with the receiver constantly to keep the other station tuned in and transmitters are so designed that there is little reason to lose a station because of frequency shift. Today ham radio is almost as dependable as the telephone.

Almost every time artisan travelers get together, whether at a visit, luncheon or banquet, the subject of conversation invariably leads to descriptions and incidents about places where these persons have been. And invariably they prove entertaining and interesting. How, then, can it be that perhaps these same people contact the same localities over the air and find them so seemingly uninteresting? Except, of course, for a QRK and weather report.

Listen in on a phone band some time to a visitor speaking into an amateur mike. To him, being able to speak to someone in a far-away place is a thrill. It evokes his sense of curiosity and desire to travel. What does he ask the other station and in what line does his interest run? Not so much about the radio itself, but of things concerning the distant place. There is absolutely no reason why amateurs too cannot make better use of their equipment by using it for truly social

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communication. No matter how interested in radio we might be, we should have other interests. I myself am interested in travel, history, geography and other general information which makes up this complex life of ours. Perhaps you too are interested in history and geography; and I have yet to find anyone so apathetic as not to be interested in travel.

Unfortunately, most of us must work for a living and a two-weeks vacation (if any) does not provide enough time for any great amount of travel. But here we have radio, a medium through which we can be in a flash in Alaska, South America, or most anywhere on the globe. Far better than looking at a movie travelogue, or reading a book. Here we may actually converse with people in that locality; ask questions, find out facts and get a true picture of the place. Why, it's the next best thing to being there personally. Added to this, all the discomforts of reaching the place and returning home are eliminated. Evenings after finishing our supper we are able to take a few minutes sojourn to South America and be back in time to hear the "Lone Ranger."

Looking at the subject from another angle, consider the wide variety of persons making up amateur radio. Not only are almost all professions represented herein, but all types of people, and I've found them all willing to relate facts about their work.

Embarking on such a QSO requires an average amount of prudence. Naturally, it can't be one sided, with just a series of questions originating at your station. You must use acumen in discovering his interests. After the apparently requisite report, etc., are over, I ask the other fellow his name and occupation, of course giving him mine also. If the QRA is one of great historic importance, questions relating to the past episodes will suggest themselves. Perhaps the place isn't of great historic importance. But upon inquiring, it so happens that many times one finds minor incidents to have taken place there. Oftentimes these turn out to be unusual and stimulating even though they weren't "decisive battles." Nor does it have to be historic, for there is probably an abundance of everyday facts to relate.

When you QSO W2IEV I'm sure I can relate enough to make the contact last for hours. With all this material there must be some of it which would strike your fancy, and Pompton Lakes is only a town of slightly more than three thousand population. For example, I could tell you facts which you probably don't know about Joe Louis, the world's heavyweight boxer, for he trains here whenever he fights in New York. Some unusual hunting and fishing stories spring from these woods and streams. Or suppose you are

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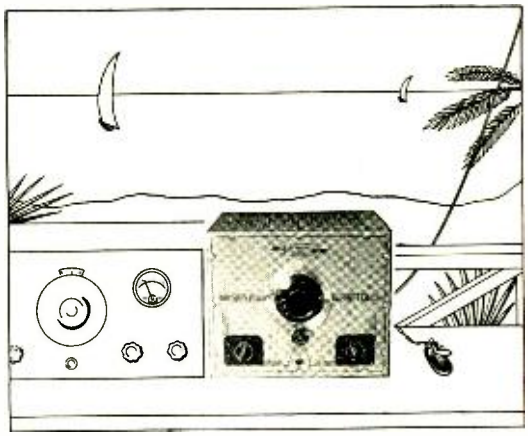

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interested in books and literature. Well, here lives A. P. Terhune, the famed writer of dog stories. In the next town lives Sidney Kingsley, playwright and Pulitzer prize winner. Madge Evans also lives there. Cecil B. DeMille lived here for many years. Besides, this section of the country is immensely rich in historical background.

Any seriously minded amateur will find it of value to keep a permanent record of information obtained in this way. Space provided for in the standard log is insufficient to write down any large amount of information.

With these facts in mind, we find it better to have a separate log for "rag chew" data. By using a loose-leaf notebook, there are numerous methods of grouping the acquired material. One well-adapted system is to prearrange the notebook into call districts, with the notes jotted down under the appropriate section, according to location. This provides us with a simple yet effective means of referring to the material at some later date. More elaborate methods should be obvious to those who want a more detailed record. No matter how you handle it, I'll guarantee you won't part with your log of information once you try it.

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THE EDITORS OF RADIO 1300 Kenwood Road, Santa Barbara CALIFORNIA

Minimum Cost Transceivers

[*Continued from Page 32*]

was installed on the old "Squad Car" and one of the transceivers made portable mobile. Then the fun began. There were some dead spots but not many, and the little jobs worked up to twenty miles over rough country very consistently but seemed to work with more volume when I was either due north or due south. On Easter Sunday they refused to work at all when I was either east or west, but worked well when in either north or south positions. This was probably due to the sunspots that we all have been reading about Or maybe to the way I part my hair.

We have had five-meter transmitters on here for the past seven years and have listened a lot on five with a converter on the RME in the shack. We can hear some sky wave signals nearly every day on this band but in all these years one half mile is the best dx we have ever got out of the various 56-Mc. transmitters (I had 150 watts running at one time). A half mile seems to be the greatest distance that 56 Mc. will go in this location, but this condition seems to be reversed on 112 Mc.

At the present time I have under construction a 100-watt 2½-meter transmitter and will erect several beam antennas and no doubt will have the rig on the air by the first of May. I am planning now to build another transceiver using a concentric line tank. Maybe this will give more gain and selectivity. That's ham radio. No matter how good something works, a guy is always trying to make it better.

Note:

It is suggested that 1T5-GT be substituted for the 1Q5-GT shown in the original diagram, in order to cut down the filament drain. The newer 1T5-GT has a 50-ma. filament and delivers all the audio that can be used. No changes in circuit constants are required.

One manufacturer is now offering a 1G4-GT, which can be used to advantage if the tank elements are lengthened accordingly.

In "trimming up" the transceiver to cover the band, bear in mind that while the frequency can be varied appreciably by changing the spacing between the parallel wires slightly, the change is just the reverse of what one might expect, due to the fact that there is a lumped capacity at the high impedance end. Spreading the two wires will *lower* the frequency.—Ed.

[1] Some seem to work better with the antenna coupled to the grid; others work better with the antenna coupled to the plate as did W5TW. It seems to depend upon the mechanical layout and capacity of the antenna to the cabinet. It is a simple matter to try both connections in order to determine which works better.—Ed.

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Open Forum

[*Continued from Page 66*]

field strength of .0016 microvolts/meter/(kc. band)$^{\frac{1}{2}}$ at a frequency of 162 megacycles.

Assuming the nebula radiates equally in all directions, the transmitter power then becomes 5.1 x 10^{21} kilowatts/kc. band. The distance is 805,000 light years or 4.7 x 10^{18} miles.

Not only do these signals originate at a great distance but also a long way in the dim past. According to geological reckoning, the static and light from this nebula started on its way when man was just beginning to reason and learning to make crude stone implements.

[1] February, 1940, *Proc. I.R.E.* and May, 1940, *Astrophysical Journal.*

GROTE REBER, W9GFZ

Knox, Pennsylvania

Sirs:

With reference to the suggestion appearing in May for changing the c.w. and phone allocations on the 14-Mc. band:

This looks like a very good idea, as I have often given thought as to what might possibly happen to the lower portion of our 14-Mc. band if more use is not made of it. I am primarily interested in c.w. and often work the low end of this band, but contacts are hard to make; few c.w. stations seem to operate there. It's a shame that more use isn't made of this section of the band. C.w. stations can't be *made* to occupy it; so I think the suggestion to turn lower end over to phone and at the same time widen out the high end for more QRM-less c.w. looks like a fine proposition and should meet with favor by all.

R. R. ROSENBERG, W8NCJ

Hollywood, California.

Sirs:

Somebody seems to bob up every month or so with some sort of low power record, so here's another one for the gang to shoot at.

On March 6, 1940, at about 1:00 A.M., PST, I worked W9VZZ with my little portable transmitter using .007 watts input—7 volts at 1 mill plate current. Hollywood, California, to Denver, Colorado, on seven thousandths of a watt! This figures out to better than 118,000 miles per watt and is hereby offered as a record for QRP at this distance. Any takers?

COURT MATTHEWS, W6EAK

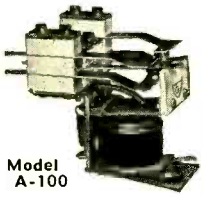
[*Continued on Page 85*]

LOW PRICED ANTENNA RELAYS by GUARDIAN

★ Low priced, because of modern production methods and volume sales, Guardian furnishes these antenna relays to thousands of radio amateurs.

Famous for ease and flexibility of mounting—famous for compactness and sturdy dependable operation—these Antenna Relays by Guardian give you maximum value at minimum cost.

Tested under actual operating conditions, they have proved capable of handling any power up to a K.W. on any frequency up to and including 28 M.C. on A.F. or R.F. circuits.



Model A-100

Standard A-100 and A-100-C Antenna Relays AlSiMag insulated operate on 110 V. 60 cycle A.C.

Amateur Net Prices:

A-100 Double Pole Double Throw Relay, net $3.93

A-100-C Single Pole Double Throw Relay, net $2.19

R-100-G Triple X insulated, net $3.30

Write for New Bulletin "B" and Free Circuit Diagram!

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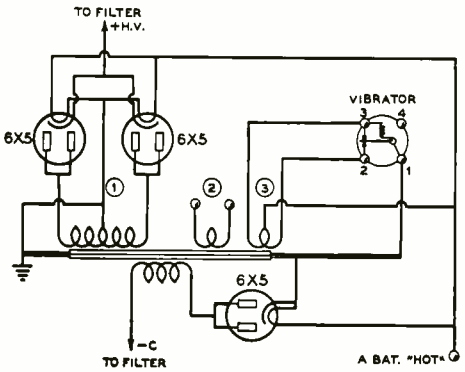
Inexpensive Vibrator Supplies

Although the idea is not new, having been used by some amateurs and p.a. men for a comparatively long period of time, it is a good enough one to remind those amateurs who have neither thought of it nor seen in print the fact that a quite satisfactory vibrator power supply can be made with a non-synchronous vibrator and a conventional 110-volt power transformer. The suggestion for the particular arrangement shown in the diagram was sent in by Herbert Kauffman, New Orleans, La.

The transformer had, in addition to the 110-volt primary, a 700-volt center-tapped secondary rated at 100 ma. (1), a 5-volt secondary which was originally designed for an 80 rectifier and which may or may not be used (2), and a 6.3 volt center-tapped secondary which was rated at 3.5 amperes (3). The 6.3-volt winding is used as the primary of the transformer and is fed from the vibrator. When the supply is being run unloaded and there is a full 6.3 volts of battery on the vibrator, the peak voltages appearing at the secondaries will be about 40 per cent higher than they were with 110 volts a.c. on the primary. This is so because the crest-to-crest voltage output of the vibrator is 12.6 volts while the peak output of the winding when there was 6.3 volts a.c. on it was about 8.8 volts. However, when the vibrator supply is operating under normal load the output voltages will be approximately the same as they were with 110 volts a.c. on that primary. The greater drop is due to the poorer regulation of a vibrator power supply.



Wiring diagram of the vibrator supply using a conventional a.c. b.c. transformer.

The output of the high-voltage supply may be filtered in the normal manner, and up to the normal current drain of the winding may be taken provided the particular vibrator used does not have a tendency to overheat. Improved vibrator operation with less sparking and more efficient conversion may usually be obtained through experimentation with different values of condenser (.005 μfd. to .02 μfd., 1600-volt metal cased) across each side of the vibrator winding. Condensers from .005 μfd. to .002 μfd. placed across each side of the secondary also will sometimes have a beneficial effect.

If not over 70 ma. is to be taken from

[*Continued on Page 86*]

NEW W.A.Z. MAP

The "DX" map by the Editors of "Radio" consists of the W.A.Z. (worked all zones) map which shows in detail the forty DX zones of the world under the W.A.Z. plan. This has become by far the most popular plan in use today for measurement of amateur radio DX achievement.

An additional feature of this new, up-to-date edition is the inclusion of six great-circle maps which enable anyone, without calculations, to determine directly the great-circle direction and distance to any point in the world from the base city for the map in use!

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Outboard Selectivity

[*Continued from Page 25*]

desired, is used for power connections. Both heater leads are brought through the cable, as in some sets one side of the heater winding is not grounded as is the usual practice. Low capacity shielded wire should be used for the input and output leads. This type of conductor has a very fine inner wire, and considerable insulation between the wire and outside shield braid. The type of wire commonly employed for making connection to auto radio antennas will be found satisfactory. If the wire has too much shunt capacity per unit length, or if the leads cannot be kept shorter than about 18 inches, trouble may be experienced in getting some of the trimmers to "hit." In some cases it may be necessary to start from scratch and realign the whole i.f. system on a slightly lower frequency. However, in most receivers the same intermediate frequency may be used if the input and output leads are kept reasonably short. The B plus may be obtained from the screen of the output tube in the receiver or most any point at approximately 250 volts potential which does not have excessive series resistance.

Before tearing into the receiver, observe the strength of a local broadcast station (one that is not so loud that it blocks the receiver) on the R meter. If the set does not have an R meter or "eye," stick a 10-ma. meter in the plate or cathode lead of the i.f. tube (or one of the i.f. tubes) in the receiver. This will give you a reference gain. If the set does not have an R indicator the milliammeter can be used later for realigning the set when the outboard amplifier is added.

The coupling capacity C consists simply of the two lead wires twisted together for about 1 or 1½ inches. The idea is to use the loosest possible coupling at this point which will not result in an actual loss in gain. The wires should be twisted together more tightly or untwisted until the receiver gain is the same as it was before the outboard amplifier was added. A further increase in coupling capacity will result in a voltage gain through the outboard amplifier, but the selectivity will be less (a "double peak" selectivity curve occurring in some cases) and some of the trimmer adjustments will tend to interlock, the adjustment of one trimmer affecting the others.

Instead of twisting the two lead wires together, a small 3-30 $\mu\mu$fd. mica trimmer may

Plug in a

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The Bliley LD2 Crystal Unit for 80 and 160 meters requires no constant supervision, no pampering, no finger crossing. Just plug it in your transmitter and forget it!

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BLILEY LD-2 CRYSTAL UNIT

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be substituted if desired. About 6 or 8 $\mu\mu$fd. will be found optimum. Keep the trimmer away from the "P" lead of T_1. *Unscrew the trimmer as far as you can and still have sufficient gain.*

The best place to connect the outboard amplifier to the receiver is probably at the plate of the i.f. stage (or the first i.f. stage if the receiver has more than one). Simply unsolder the lead from the plate to the primary of the i.f. transformer and connect the shielded "input" lead to the plate of the i.f. tube and the lead marked "output" to the loose wire on the primary of the i.f.t. That's all there is to it, except that it will be best to use shielded wire right up to the receiver connections, and not just up to where the input and output wires enter the receiver cabinet.

Not only is the added selectivity a boon to the phone man, but the c.w. gang will be surprised at how their little single i.f. stage super will truly single signal when the outboard stage is added. Static has a "ring" to it when the b.f.o. is switched on that makes the set sound almost as though it had a crystal filter. It must be admitted that it isn't as good as a *good* crystal filter for c.w., but it is the next best thing.

In an early issue we hope to show for the benefit of the c.w. men how an effective outboard crystal filter unit may be added at little cost to most any commercial superhet.

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

TO OUR READERS:

"RADIO" publishes no August or September issues. The next issue will be the October number, out about September 20th.

If you are going away, but will be back to your old address by September 20th, please DO NOT send us a change-of-address notice.

●

THE EDITORS OF RADIO 1300 Kenwood Road, Santa Barbara CALIFORNIA

A New Antenna Material

[*Continued from Page 23*]

ordinary antenna, or a 2½-meter array, or even as a flag pole—not forgetting, of course, to thread the rope through the pulley *before* raising the tower!

Raising the tower was easily done with the help of several fellow hams in pulling it up from the roof of the house and guiding it by means of the two sets of guy wires. Then one of the members of the "heavy gang" picked up the whole tower, walked over and set it over the pin bolt on the base insulator. The 3¼" size studs were used, the whole tower weighing around 60 pounds. The weatherproof tuning box was mounted on the side of the radio shack close to the tower and the variable condenser shaft was extended through the wall at the rear of the operating desk so as to be handy for adjustments.

Trussteel Studs can be obtained in various lengths up to 14 feet, and possibly 20 feet. Prices run about as follows, depending upon

[*Continued on opposite Page*]

• • •

Television Articles?

If you have very definite ideas on whether you would like to see or would not like to see construction articles on television appear in RADIO, won't you drop us a postcard? We know there are some that are interested, but we have no way of determining how many. Also, we know there are some who have little or no interest in television, and would resent any portion of RADIO being devoted to television articles. Neither do we know how many of our readers fall in the latter group. The only way we can determine whether the first group outnumbers the second is to get an expression from you.

Just address us a postcard saying "Would like television", or "No television," depending upon your preference. Please sign your name or call letters. Whether or not we run anything in the fall on amateur television will depend upon the results of this poll. Let us have your vote, today!

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2"	$40.00	375 lbs.
3"	44.00	400 "
3¼"	45.00	405 "
4"	50.00	425 "
6"	78.00	475 "

Using a material for a purpose other than that for which it was intended calls for a little inventing as you go along, and when you are through you usually have learned a thing or two in event of a "next time." In the author's case one thing learned was that aluminum paint will stick better if the japanned finish of the studs is first sand-blasted off, and the other was that the spray-gun is mightier than the brush. Using a brush calls for painting the studs before assembly and then touching up the clips, screws, etc., later. It is quite difficult to poke a paint brush through the openings in the studs in order to cover all surfaces. The setup would be ideal if it were possible to obtain the material welded together in 20-foot sections and to have them heavily galvanized to eliminate painting and to improve the electrical conductivity. Other uses for this type of material may suggest themselves, such as using short single sections for rotary beam antenna elements, and similar applications.

• • •

There he goes expressing his personality with that banana-boat roll again.

Filtered-Air Transmitter Cooling

[*Continued from Page 19*]

ported between wire screen meshes 6 inches by 18 inches will be ample for most amateur transmitter racks.

The advantages of such an arrangement which forces clean dust-free air through the transmitter are that: components run cooler, thus giving longer life and more trouble free operation; dust cannot collect on neutralizing condensers and other equipment to cause flashovers (insects are also kept out of the transmitter); the safety factor of the transmitter is greatly improved since it is completely enclosed.

—*W6ROA*

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FM Deviation Measurements Simplified

A simple method of measuring frequency deviation in frequency modulated transmitters is described by Murray G. Crosby in the April, 1940, issue of the *RCA Review*.[1] The method is derived from the fact that for certain modulation indices the amplitude of the carrier becomes zero, all the energy being in the side frequencies. The modulation index is defined as being the ratio of the frequency deviation[2] to the modulation frequency, or F_d/F_m.

The first of these points of zero carrier is obtained when the modulation index has a value of 2.405, in other words when the deviation is 2.405 times the modulation frequency. For example, if a modulation frequency of 1000 cycles is used and the modulation is increased until the first carrier null is obtained the deviation will then be 2.405 times the modulation frequency, or 2.405 kc. If the modulating frequency happened to be 2000 cycles, the deviation at the first null would be 4.810 kc. Other carrier nulls will be obtained when the index is 5.52, 8.654 and at increasing values separated approximately by π. A listing of the index at successive carrier nulls is given below:

Zero carrier point no.	Modulation index
1	2.405
2	5.520
3	8.654
4	11.792
5	14.931
6	18.071
7	21.212
8	24.353
9	27.494
10	30.635

The only equipment required for making the measurements is a calibrated audio oscillator and a selective communication receiver equipped with beat oscillator. The receiver should be used with its crystal filter set for a bandwidth of approximately twice the modulation frequency, to exclude sidebands spaced from the carrier by the modulation frequency. The unmodulated carrier is tuned in on the receiver with the beat oscillator operating and modulation is then applied until the first carrier null is obtained. This first carrier null will correspond to a modulation index of 2.405, as previously mentioned. Successive null points will correspond to the indices listed in the table. A volume indicator in the transmitter audio system may be used to measure the audio level required for different amounts of deviation and calibrated in terms of frequency deviation. If the measurements are made at the fundamental frequency of the oscillator it will be necessary to multiply the frequency deviation by the harmonic upon which the transmitter is operating of course. It will probably be most convenient to make the determination at some frequency intermediate between that of the oscillator and that at which the transmitter is operating. A harmonic of the oscillator in the 18-Mc. range would probably be best; the deviation at this frequency should be multiplied by the ratio of the measurement frequency to the transmitter frequency to obtain the deviation ratio of the transmitter.

[1] Crosby, "A Method of Measuring Frequency Deviation," *RCA Review*, April, 1940, p. 473.

[2] Deviation is equal to one half the total "swing," for symmetrical modulation.

THE "RADIO" NOISE REDUCTION HANDBOOK

Tells in simple language how to eliminate or greatly reduce practically every form of radio noise with the exception of natural static.

Use of the noise-reducing systems described in this book often mean the difference between an unintelligible signal and one which can be read. Particular emphasis is laid on the elimination of the noise at its source. When this is impractical, a new, modification of the noise balancing method used in commercial work, which brings equally good results, is explained. A complete description, theoretical and constructional, of the application of this method is included.

35c U.S.A. (including possessions) Elsewhere **40c**

THE EDITORS OF RADIO 1300 Kenwood Road, Santa Barbara CALIFORNIA

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The Open Forum

[*Continued from Page 79*]

Tacoma, Wash.

Sirs:

Enclosed please find a self-explanatory "form letter" petition, which I, on behalf of the committee, ask you to publish in the earliest convenient issue of RADIO.

The plan has met with widespread approval among active hams on 20 meters and your cooperation would place it in the hands of others not otherwise available.

These forms may be obtained from several different active 20-meter stations, chiefly, W9HLZ, W8GXU, W6ONQ and W7ETK. Anyone wanting one copy or several copies, who feels that he can do it, should please send stamps. However, copies will be sent upon request, stamps or no stamps. As the explanatory note indicates, anyone desiring to contribute toward expense of printing and mailing please forward contributions to W9HLZ, care KGLO, Mason City, Iowa.

W. KING, W7ETK

Dear OM:

The Committee on 20-Meter Reorganization is a temporary and at present loosely-knit group of active amateurs who are endeavoring to improve operating conditions on the 20-meter band.

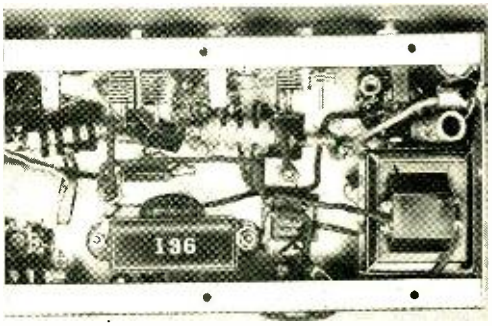
It is felt that much is to be gained in having the c.w. portion of 20 meters in a single band. The inconvenience to the phone stations in moving would be small relative to the advantages which would accrue to both phone and c.w. stations; even this difficulty could be minimized by a QST or RADIO sponsored free "swap service" for xtals.

Realizing the difficulties involved in phone dx work, a 50-kc. band reserved for phone dx has been suggested. Any immediate tendency for foreign phones to move to the high frequency c.w. band to escape the American phone QRM after such a change would therefore be minimized because (1) QRM in the high frequency band would be much heavier than the QRM they have experienced in the low frequency and where a hefty c.w. signal is indeed a rarity, and (2) their operation would prove more effective in the 50-kc. band reserved for them because it would contain no American c.w. or phone signals. It is believed that the situation demands eventual international regulation by treaty, but in presenting a unified expression of American amateur sentiment *now*, we are laying the foundation for action in the next international convention, where, it is hoped, the American amateur will be more adequately represented.

[*Continued on Page 95*]

INCA

TRANSFORMERS



For better portable "rigs"

Since the midget "I-a" series of Inca transformers were first developed for the U. S. Forest Service, Inca transformers have occupied important positions in ultra portable equipment for the U. S. Park Service, for Police, for Aviation, and especially for fine amateur equipment. The above illustration, (taken from the article by William J. Driml "A Compact 28 MC Mobile Transmitter," in June "Radio") shows Inca Midget transformers in their usual helpful spot; with their high gain reducing the number of tubes, and with their high efficiency permitting improved and increased output. To quote Mr. Driml; "Without the high efficiency and minute dimensions of Inca transformers, designing good mobile equipment would be a much tougher job."

Complete data on Inca transformers for all types of amateur work is listed in Inca Bulletin L-41; available without charge from your jobber or directly from:

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Inexpensive Vibrator Supplies

[*Continued from Page 80*]

the high voltage supply a single 6X5 or 6X5-G rectifier may be used. However, if the current drain is to be greater than this amount a pair of 6X5's may be used as shown in the diagram. Notice also the use of an additional 6X5-G connected as a half-wave rectifier of the output of the original 110-volt winding of the transformer to make another supply which may conveniently be used for bias on a power amplifier. The voltage out of the filter from this winding will be from 65 to 100 volts depending upon the amount of current that is being bled from the supply.

112-224 Mc. Rigs

[*Continued from Page 39*]

very substantially on 224 megacycles—to 20 watts—when the proper grid leak resistance was used and when a small diameter folded filament line was installed below the base board as shown in figure 5. The filament line used wide spacing—five diameters—and gave maximum output when shorted at 32 inches for 112 Mc. and 18 inches for 224 Mc.

When using tubes with the grid lead out the base, construction is facilitated if a copper or aluminum chassis is used. The grid pipes can be mounted horizontally underneath, so placed that the tube sockets are directly above the proper point for short leads to the grid taps, as sketched roughly in figure 6. This will require use of insulators at the "hot" end of the grid line for mechanical support in most cases. A filament line, if found necessary with small tubes, will then have to be put along the sides of the chassis or run in the direction opposite to the plate pipes.

An R.F. Driven C.W. Monitor and Phone Modulation Indicator

[*Continued from Page 48*]

down somewhat, but that is of no consequence on c.w. On phone, S_3 is naturally left open, and the reference level can be set as described in the earlier article referred to.

For the "c.w. exclusive" station, the meter S_2 and the instrument rectifier can be eliminated; then the complete unit consists of only the addition of the diode rectifier circuit to any existing audio oscillator. In case no low impedance transmission line is used, the input lead can be connected to a low impedance point on the antenna system or connected through a high voltage blocking condenser to a low impedance point near a voltage node on the tank coil. Or, if none of the foregoing suggestions seems to fit, an auxiliary loop of wire coupled to the tank circuit can be used.

The photographs show the unit as built here, although any mechanical layout can be arranged to suit one's own fancy. The tubes chosen were a 76 and a 36, but any triode can be used for the audio oscillator and any diode for the r.f. rectifier. The choice of a 36 for the diode was brought about by the fact that one was found in the junk box and there was small chance that it would be wanted for anything else. The meter is mounted behind a window and lit from a pilot lamp behind the panel which throws a soft light on the meter and is easy on the eyes. This unit was designed to be used on a shelf, bringing the meter to eye level, but if one desires to use it on a table, a slanting panel is suggested.

The dielectric constant of the inverted rivet and the cork was not determined but they aided materially in getting a photograph of the works in the rear.

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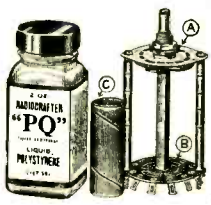

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NEW BOOKS
and trade literature

RADIO AT ULTRA-HIGH FREQUENCIES. Published by RCA Institutes Technical Press, 75 Varick Street, New York, N. Y. 456 pages, 6 by 9 inches, paper cover on standard copy. $2.00 extra for cloth-bound edition lettered in gold including name of owner. Price: at present not for sale but released as complimentary feature with the *third* year of a subscription to *RCA Review*, either new or renewal.

The book consists of a compilation of technical papers by RCA engineers on propagation, transmission, relaying measurement, and reception on frequencies above 30 Mc. Most of the papers have been published in *RCA Review, Proceedings of the I.R.E.*, etc., but several of them were written especially for publication in this work. The text of the book is divided into five parts: (1) transmitting methods and equipment, (2) propagation and relaying, (3) measurement, (4) reception, (5) ultra-high frequencies above 300 Mc.

TELEVISION, the Electronics of Image Transmission, by V. K. Zworykin and G. A. Morton, RCA Manufacturing Company. Published February, 1940, by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y. Cloth-bound edition. 646 pages 6 by 9 inches, 494 illustrations, price $6.00 in U.S.A.

From two men well known in the field comes this book on this newest practical means of communication. Authoritative, well organized, written in direct, clearcut English, this volume brings to radio and communication engineers, television engineers and servicemen more than six hundred pages of much needed factual material.

The first part of the book is devoted to a consideration of the fundamental physical phenomena involved in television—emission of electrons, electron optics and fluorescent materials. This is followed by analyses of fundamentals of picture transmission and resolution; various forms of electronic terminal tubes used in television; problems of video amplification, radio transmission and reception, etc. One of the most important sections of the book is the concluding one, in which the RCA-NBC television project is described.

NEW UNIVERSAL RELEASES

Universal Microphone Co., Inglewood, Cal., on April 30 issued three new publications for the trade. One is the annual issue of the microphone catalog and another the same for recording machines and accessories. Both are in loose leaf form and contain many new items since the 1939 issue. The third leaflet describes recording and playback turntables that can quickly and easily be mounted in cabinets, cases, desk or table. This includes four types of recording chassis and also a synchronous playback and turntable assembly.

RADIOTRON DESIGNERS HANDBOOK

The latest "couldn't be without" book that has come to our attention is the third edition of

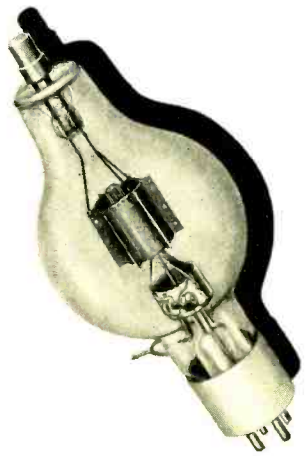
[*Continued on Page 92*]

Step up your performance

WITH THE NEW

Sheldon

S-100TH



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Absolute *precision* in the manufacture c SHELDON TRANSMITTING TUBES, plus c policy of only *first grade* materials is your guarantee of many hours of satisfactory and dependable operation.

Write for additional information and Technical Data on the S-100TH. Also the S35TH and S-250TH, and other Sheldon Transmitting Tubes.

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4 Band, Quick Change Transmitter

[Continued from Page 46]

hole next in line was originally intended for a switch to change the value of the final grid coupling condenser when shifting from phone to c.w. but it was never installed.

The right-hand jack is a three circuit type for the mike and carrier control cord. The mike used is an American Clipper dynamic with a built-in switch in the handle. The switch, as originally built, was arranged to remove a shorting connection from across the mike. It was rebuilt to close the relay in the power supply, i.e., from normally closed to normally open construction. To the left of the mike jack is the speech amplifier gain control; adjacent to the gain control is the bull's eye "carrier on" indicator. Two pieces of pyralin are mounted on the right and left halves of the panel with 2-56 machine screws. The left-hand side is intended as a mount for the station license, while an ornamental design balances on the other. All power leads are terminated at a twelve point Jones plug at the rear center of the chassis.

Under-Chassis Details

The bottom view of the chassis gives a fair idea of the arrangement below deck. To the right, in the photo, is the speech amplifier with the various condensers, resistors, etc., mounted on a bakelite terminal strip over the tube sockets. A great deal of time and space can be saved by laying out the terminal strip pictographically on paper before starting the assembly. The audio section is separated from the balance of the chassis by a partition of 1/16" aluminum. The partition acts as a mount for a row of by-pass condensers which are spaced out from the partition by a ½" strip of 1/16" brass, which serves as a ground bus. Additional condensers and resistors are mounted between these by-pass condensers and the tube socket prongs of the oscillator and harmonic amplifier. The "L" shaped micalex mount for the harmonic amplifier tanks and the final grid coupling condensers with the associated switches is seen in the center. The socket for the 813 is mounted below deck to the left of the micalex strip. At the extreme left is another ground bus with a row of by-pass condensers associated with the 813. The top rear view of the chassis indicates the layout above deck. The final tank coils plug into standard ceramic four-prong sockets. The audio coupling transformer was a discarded modulation unit out of an aircraft transmitter. It was prone to arc over at the voltages it was originally designed for, but works very nicely in its present location.

Power Supplies

The power supplies are mounted on a 12" by 18" by 3" chassis with a removable safety cover of perforated material for ventilation and protection. Although considerable time was spent eliminating surplus weight, this unit is still a hefty chunk for one person to toss around (75 lbs.). The transformers T_1 and T_2 are Thordarson type T-6878, which could be purchased some time ago at very reasonable figures. One is arranged together with three 83 rectifiers in a bridge circuit to supply the 1400 volts for the final. You will notice that all the filament windings have been used. There is no doubt some question as to the insulation on the 2.5-volt filament windings, but by slipping varnished cambric sleeving over the leads as far into the transformer as possible, breakdowns at this point have been avoided. The second power transformer is connected in a full-wave circuit to supply the lower plate voltages and the bias for the final.

Since it was necessary to let the filaments remain lighted all the time the transmitter was in use, it was necessary to break the high voltage windings with a relay for carrier control on phone, hash squelch from the rectifiers, etc. The relay was a rebuilt affair with long narrow strips of bakelite and pigtails to the contacts to take care of the voltage. The twelve volts for the operation of the power supply and keying relays is obtained from a Rectox unit and a 12-volt filament transformer. (I actually used two midget 6.3-volt transformers in series). The filament of the final is supplied from a separate transformer with a rheostat in the primary for voltage adjustment. The leads on the power unit are brought out to a bakelite terminal block at one end. A three-foot flexible shielded cable terminating in the Jones plug

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completes the circuits to the r.f.-a.f. unit. The filter condenser assembly is a polyglot collection of odds and ends. Considerable difficulty was had at first with breakdown of the input section on the 1400-volt supply. A 1000-volt (working) unit with Pyranol insulation was finally installed and has shown no signs of distress during eighteen months of intermittent operation.

Operation has been confined mostly to 20, 40 and 75. Two crystals suffice to cover the three bands; the harmonic amplifier acting as a doubler on 75 and 40 and as a quadrupler on 20. With adjustments on both excitation and bias for the final it is relatively easy to obtain proper values for grid modulation. From 50 to 60 watts carrier on phone and from 100 to 125 on c.w. can be had without too much strain. Taking it all in all, the rig has answered fairly well the original intent; however, we still have a one-tube layout in mind.

Oh yes, we had to drop the plate voltage on the oscillator to 140 volts to keep the crystal from boiling over.

DX

[*Continued from Page 55*]

other words, both of these bands would be very much like old times if the whole gang would plan for them ahead of the contest.

During the past few years 40 meters hasn't been given much of a play. 20 has been so good everyone followed the path of least resistance, thereby forsaking 40. If the fellows in all countries would realize all the additional multipliers that could be picked up, I think they would spring loose on 40 and 10 a bit more. Let's all get together and spread the word around during the summer, no matter what station you work, to get primed for 10, 20 and 40. Many of the dx men during the contest are heard almost begging some of these stations to make a sked with them on one of the other bands. Many times it is to no avail because they can't get their rigs on any band but 20. The same thing should apply to the phone men who operate only on 20 . . . get the others on 10.

In this contest we have tried to make it more wide open than before. If you think more than one operator will be a benefit to you, you are welcome to use them. If more than one rig or receiver appeals to you, go ahead and use them. Some fellows think they will help, while the theory of others indicates that too many ops and receivers get in the way. It's up to you. There is no quota on contacts. Be sure you understand the rule pertaining to country and zone multipliers. You may work the same country on three bands and gain a country multiplier of 3. However, in zones it is a bit different, in that when you work the same zone on different bands, it still only counts as a zone multiplier of 1. It was noticed in the last RADIO WW Contest, some of

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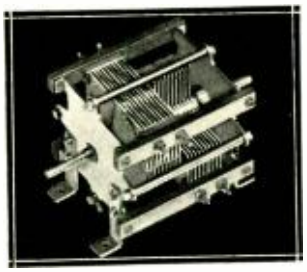

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Since our recent catalogs have not included them, we present two representative types with general characteristics for your information.

Amateur and commercial engineers will be interested in the fixed units for loading medium power tank circuits, and the dual variable is noteworthy for its adaptability for mechanically balanced, low torque work, particularly where a necessity for perfect bearings dictates the use of ball races.

General Characteristics of the "F" Frame:

- *End plates and tie rods*—Brass, nickel plated.
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- *Frame size*—4" wide x 1" high.
- *Mounting*—2 standard "X" mounting feet, or 4 special long brackets (see cut of variable unit) or by 3 mounting posts on end plate.
- *Bearings (on variables)*—May be standard ball thrust rear bearing with front shoulder bearing, full ball bearings at each end, or any desired combination.
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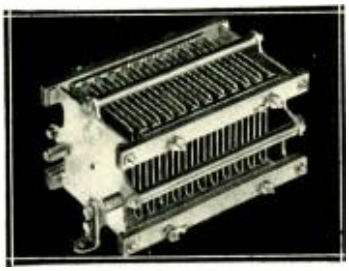

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the gang forgot to work one W station on *each* band to count for U.S.A. There are only three zones in U.S.A., so a maximum of three W's can be worked for zone multipliers. No contact points are counted for any stations worked in your own country.

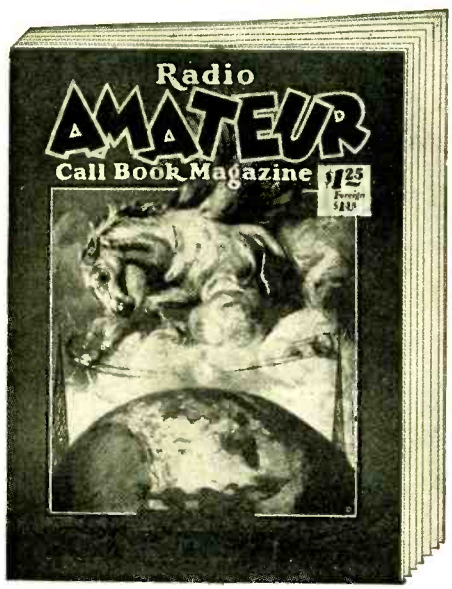
Let's make this a good clean cut contest. (Some guy will pipe up with the crack that it can't be clean if you want to win.) We recognize that with the continent of Europe left out, together with their possessions, the west coast will have an advantage for total points. We should not let this affect the fellows on the east coast, because recognition will be given to each call area as in the past. The time will probably never come when all sections of the country will be on equal footing in respect to dx potentialities. The mid-west is possibly the section which has suffered the most, and the west coast for years has taken a back seat to the east coast, so the best we can do is dig in, have the most fun you can in your area, and when it is over, you will know you have done your best.

All logs must be mailed showing the postmark of *no later than* November 4, 1940. This includes both c.w. and phone divisions, from all parts of the world. We urge that this be passed around so that none will be omitted due to arriving too late. It will give three weeks from the closing of the phone portion of the contest to make up the log. We would like to have everyone submit a log no matter how small it may be. In this way it will enable us to judge the activity. Just because you might have had only 15 or 20 QSO's, is no reason for not sending in the log. We will surely appreciate everyone's cooperation in this. Highlights of the contest from your point of view will be welcome.

A parting shot at v.f.o. operation. If you have an e.c. or any type of v.f.o. do your part in keeping off the dx station's frequency. Of course, if someone down the street starts by clamping down zero beat with a dx sig, you will probably have to do the same, or get shut out. In such cases make the calls *short* . . . if you don't he may have answered a short call and you will be QRMing both of them. Simply remember, if you must zero beat the dx station, make your calls *short* . . . and if possible keep off the frequency altogether.

Well, gang, this winds up the fifth year your "dx ed" has been grinding out this column. It has been harder work than most of you imagine, and without the cooperation all of you have given it would have been impossible. We could have responded to more suggestions regarding the conducting of this department, if it were possible to have a corps of secretaries, assistants, etc. W6-NNR has volunteered help during the year, in tabulating, and keeping the phone news up to par. The contest committee has functioned very well, and will continue to do so. *But* . . . the meat of the column must come from you, and without it there would be no department called "DX." Some of the boys still feel that they shouldn't send in any info because it looks like they are trying to "blow their own horn." In one way it could be termed as such, but we prefer to look at it from the standpoint of information given to the whole gang. The dx fraternity wants to know what's going on, what the other guy has done, and if he could possibly do as well. There are still a lot of dx men "buried" in regard to interesting news. Let's dig 'em out. With not so much dx on the air, we are going to continue to talk about the fellows who have been working it in the past, as well as at present. Now is a good chance to catch up on who the other guy is and what he is up to.

We intend to show photos of the fellows listed in the Honor Roll, so fire them in, will you? I'll see you in the October issue, which will begin the sixth year for dx. This issue will be out the middle of September. In the meantime, have fun this summer. . . . I know I'll miss those W9's.



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What's New in Radio

[*Continued from Page 68*]

NEW CRYSTAL MIKE

Universal Microphone Co., Inglewood, Cal., has issued a new loose leaf catalog sheet announcing their new "KO" microphone and accessory items. It is a new high output crystal unit with slightly rising frequency characteristics, providing exceptional tonal quality with well rounded bass response. The output level is 48 db below one volt per bar; frequency range is from 50 to 6000 c.p.s.

RCA DEVELOPS NEW LOUDSPEAKER CONE

Representing an important basic improvement in loudspeaker design, a new type of "accordion edge" loudspeaker has been perfected by the RCA Manufacturing Company to reproduce low frequencies with a fidelity never before possible with a small speaker in a small cabinet. Although only 7 inches in diameter, the new instrument has a frequency response of from 80 to 7000 cycles. The new loudspeaker makes effective use of a folded or "accordion edge" cone support principle which permits the cone to move more freely when driven by the permanent magnet speaker mechanism.

Designated as Model MI-6233, the loudspeaker includes an attractive walnut wall housing with sloping baffle. The speaker mechanism is also available separately.

The new "accordion" support increases the lower reproducing range of the speaker cone by at least one octave, and is extremely simple in design and construction. Overall frequency response is very smooth, and requires less power. Permanent field excitation requires no power supply. Power handling capacity is three watts continuously.

FREQUENCY MODULATION COMPONENTS

The Browning Laboratories, Winchester, Mass. has recently announced various component parts for receiving Armstrong wide-band frequency modulation signals. Special broad-band 3-Mc. i.f. and detection transformers are available as well as a special high frequency tuner. A completely wired and aligned adapter is in production which

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Circuits in *QST* for June 1939, and April 1940, *Radio* for June and July 1940, A.R.R.L. 1939 and 1940 Handbooks.

Instant-heating TETRODE—TWIN TRIODE

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may be plugged into the phonograph jack of any receiver.

The Browning Laboratories' bulletin 105A lists the components and includes a circuit wiring diagram of a complete receiver.

RCA AR-77 COMMUNICATION RECEIVER

RCA recently announced a new communications receiver primarily designed for amateur use which should find widespread popularity. The new ten-tube superheterodyne has been designed with particular emphasis upon the elimination of frequency drift. First, the production of heat by components within the cabinet has been reduced to as low a value as possible, and second, the oscillator circuit is equipped with a temperature-compensating capacitor which automatically compensates for frequency drift, particularly when the receiver first warms from a cold start.

An improved approach to constant sensitivity throughout each tuning range is achieved by dual alignment of each tuned r.f. circuit. This system maintains uniform tracking of the r.f., first detector, and oscillator circuits on all bands. As a result of the improved tracking and high Q r.f. circuits, the image ratio at 30 Mc. is 40 to 1 with a 50-ohm antenna load.

Electrical bandspread tuning is used. The bandspread dial is calibrated for 10, 20, 40 and 80 meters and each band is spread out over approximately 270°. After bandswitching, accurate resetting of the receiver is made practical by a vernier-index scale which may be used for both the main-tuning and bandspread dials. Improved maintenance of calibration, even on the bandspread ranges, is made possible through the careful selection and use of good insulating materials. Polystyrene is used in the two highest frequency r.f. transformers and in the i.f.'s; ceramic insulation is used in the tuning condensers, band-change switch, and r.f. trimmers.

A very worthwhile feature of the AR-77 is the manually adjusted noise limiter. The circuit is very effective in that peak noise voltages many times as loud as the signal will be pulled down to the signal level.

Other features of the receiver include the use of a voltage regulator for the plate supply of the high-frequency oscillator, a carrier-level meter, and the use of negative feedback in the audio output circuit to improve the audio fidelity. The tube lineup is as follows: 6SK7 tuned r.f. stage, 6K8 mixer-oscillator, two 6SK7's in the i.f.'s, 6H6 second detector and noise limiter, 6SQ7 a.v.c. and first a.f. stage, 6F6 power audio, 6SJ7 b.f.o., 5Z4 rectifier, and one VR-150-30 voltage regulator.

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New Books

[*Continued from Page 87*]

the Radiotron Designer's Handbook, by F. Langford Smith. Published by the Amalgamated Wireless Valve Co. Pty. Ltd., 47 York St., Sydney, Australia, the book contains 352 pages and some diagrams, graphs, etc. pertaining to the application of vacuum tubes in radio receivers. It is *not* a tube data book, and no specific data on various tubes are given. The book is devoted entirely to design data. While applicable to the Australian line of RCA tubes, fortunately these tubes are identical to RCA tubes manufactured in this country.

The following is a summary of the contents:

PART I.—A.F. Amplifiers, Power Amplifiers, Relation between Output and Speaker, Biasing, Bypassing, Decoupling, Fidelity, Distortion, Negative Feedback, Miller Effect, Audio Amplifier Design, Tone Compensation and Control, Volume Expansion and Compression, Recording, Pick-ups, Microphones, Microphone Amplifiers, A.F. Mixing Systems, Decibels, Nepers, Volume Units and Phons.

PART II.—R.F. Amplifiers, Frequency Conversion, Tuned Circuits, Calculation of Inductance, Low-Loss Inductances, I. F. Amplifiers, Detection, A.V.C., Automatic Frequency Control, Frequency Drift, Reflex Amplifiers.

PART III.—Rectification, Filtering and Hum.

PART IV.—Voltage Dividers, Dropping Resistors, Transformers, Iron-Core Inductances, Voltage and Current Regulators, Tuning Indicators.

PART V.—Receiver Tests and Measurements, Valve Testing, Valve Voltmeters, Measuring Instruments.

PART VI.—Valve Constants, Graphical Representation of Valve Characteristics.

PART VII.—Resistance, Capacitance, Inductance, Vectors, Complex Algebra, Simple Trigonometry, Units.

PART VIII.—Tables, Charts and sundry Data.

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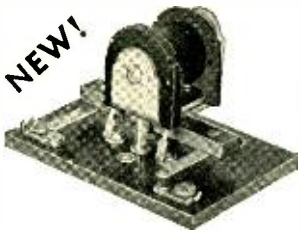
Calibrating the R Meter

[*Continued from Page 50*]

a loss of gain and would require a greater signal input than output. A convenient value which is within the actual range is 10,000 ohms. Our formula now for calculating the input signal is obtained in this manner. Since the voltage of the a.v.c. system is a measure of the signal level at the second detector, it is used as the output signal. This voltage divided by the product of the mutual conductance at that bias voltage and the load impedance will give the value of the input voltage to that stage; similarly that value of voltage divided by the same factor will give the input voltage of the next stage—in other words the number of divisions will depend on the number of stages controlled by the a.v.c.

$$E_{in} = \frac{E_{AVC}}{G_M Z}, \text{ or } E_{in} = \frac{E_{AVC}}{(G_M Z)^3}, \text{ etc.}$$

This may be simplified and done in one operation by raising the product of mutual conductance and load impedance to the third power for three controlled stages; fourth power for four stages, etc. The number of decibels change is then calculated in the usual manner by dividing the output voltage by the input voltage, taking the logarithm to the base ten of this number and then multiplying by twenty, since we are dealing with voltages. In this manner if we take zero on our R meter as reference, each check point above that will represent so many decibels change in signal level and a graph may be drawn from which other values are obtainable by interpolation. The last stage of our job is then to locate the R meter readings which are exactly 6 decibels apart, and then to calibrate these directly upon the meter or upon a final graph as R1, R2, R3, etc. We now will be able to tell a station, with a good degree of ac-



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curacy, just how many db his signal changes and increases or decreases when checking antennas; and the difference in these readings and the readings you previously gave will probably amaze you. In our particular case it was found that what we were reporting as one R change, reading near R9, was actually 26 decibels, or a pretty good front back ratio on any beam.

A few cautionary remarks may be in order. The validity of raising the factor to a power for the number of stages involved presupposes that these stages are exactly similar; using the same tubes, voltages, and type of i.f. transformer. If not, the calculation will be more accurate by going through the separate calculations for each stage, using data which correspond to that particular type of tube, etc.

Care should be used in obtaining the values from the manufacturer's tube curves; these are sometimes hard to read accurately due to the steep change of curvature at particular voltages, particularly in the case of remote-cutoff tubes. When the calculations are finished all points should lie in a smooth curve, usually of the power type, either parabola or hyperbola; if any point is way out from the curve drawn through the rest, that point should be rechecked and probably represents an improperly read value from the tube graph or an error in one of the mathematical steps. The sample set of graphs for our own installation is shown in the figures; graphs of the same type should be made as you go along.

While it is not felt that this method will revolutionize the R meter industry, we do feel that it will enable the ham who cares to give a report which means something and it probably will save an untold amount of needless work on front-back ratios of beams.

Commercial R Meters

That most R meters check widely different from these values can be seen by inspection of almost any tube curve. The reading is always dependent upon the a.v.c. voltage, which always increases for stronger signals, and an inspection of tube curves shows that none of the tubes is linear as far as mutual conductance versus bias volts is concerned. It will be seen that the variation in mutual conductance is relatively great per volt during the first few volts of bias and then tapers off until many times more volts are needed to produce the same change in mutual conductance when approaching cutoff. As a result practically all R meters will become more and more cramped towards the R9 end

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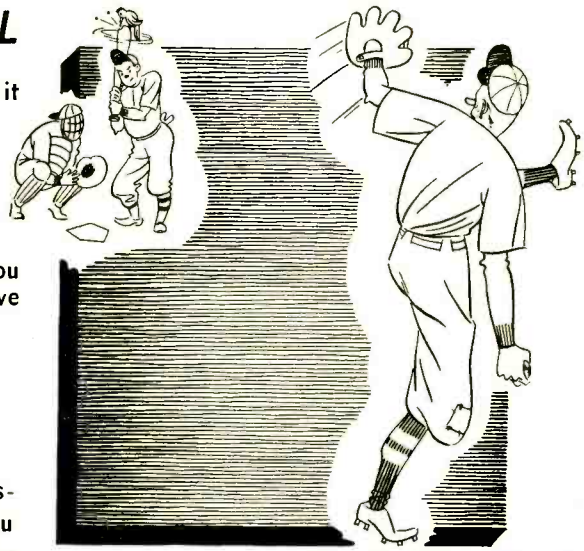

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of the scale, and the amount of deflection for 6 db will be many times less than for 6 db near R1 on the meter.

Some R meters actually show the graduations becoming larger near R9, which is obviously absurd, for this crowding near the full scale reading is not controlled by the R meter but by the tube constants, which are the same in nearly all receivers. Thus it doesn't make a lot of difference what type R meter we use; the final curve is controlled by the number and type of tubes in our a.v.c. controlled stages, which will be nearly alike for different receivers.

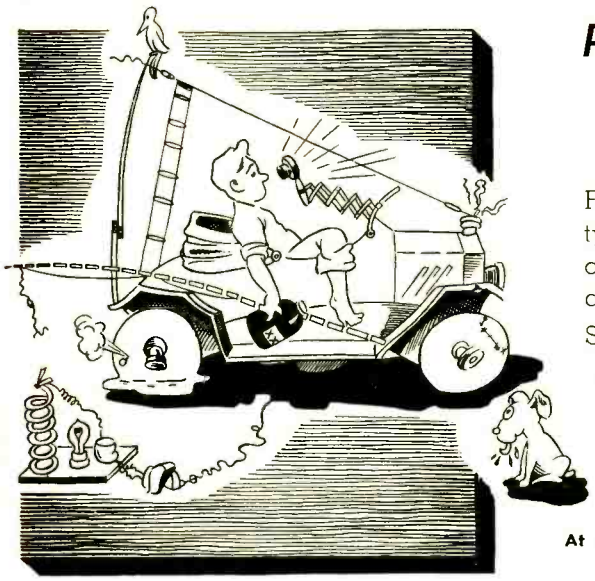
The Open Forum

[*Continued from Page 85*]

Frequently we hear the plan doomed to immediate failure. We realize that some time is necessary to bring such changes to pass, but even though the campaign brings no immediate results, by crystallizing amateur opinion and bringing the whole situation to a crisis or focus, it should be possible to determine exactly who or what is blocking such a beneficial change. Knowing this is tantamount to success, for it then shows us where to point our guns.

You are asked to help in this rather large undertaking. First by signing and mailing to W8CMP, President ARRL, the enclosed letter. (The letters mentioned may be obtained by writing to the four stations listed bove.—Ed.) Second, and very important, if you have the necessary time (or know someone who does have) write for additional copies of the letter to send to stations you QSO who desire to support the campaign. Talk it up on the air and in ham clubs. Our success depends upon getting as many letters as possible mailed to W8CMP, and this in turn means having many stations actively engaged in promotion of the plan on the air working. Some stations have voluntarily offered to contribute small sums of money to help defray printing and postage expenses. Such support is greatly appreciated, although when time is available it is suggested that this money be used to have additional copies printed for distribution. Your suggestions, criticisms and ideas are welcomed, so let's hear from you. Wishing you the best of success and 73,

COMMITTEE OF 20 METER REORGANIZATION,
W9HLZ, Mason City, Iowa, Chairman



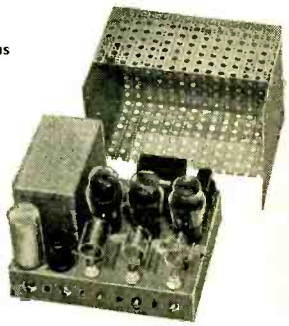
PORTABLE MOBILE *this Summer*

Look at the fun he's having!

Frankly, we do not approve of his type of mobile operation but we must admit he's getting a "bang" out it anyway.

Summer is the ideal time to go portable-mobile . . . and for *real* enjoyment the Hughes-Mitchell 10-meter Converter and Transmitter is the answer.

At your dealer, or write us for Bulletin No. 20



HM-401 CONVERTER
$12.90 Net

HM-102 TRANSMITTER
$36.00 Net

Prices are F.O.B. Los Angeles. All units are supplied COMPLETE with Tubes. Wired and Tested, and Licensed by RCA.

RADIO-TELEVISION SUPPLY COMPANY, INC.
1701 So. Grand Ave. Los Angeles, Calif.

www.americanradiohistory.com

Flexibility in a 30-Watt Rig

[*Continued from Page 30*]

The rig functioned exceptionally well, both as a separate transmitter and as the radio frequency driver for a higher powered final stage, a 250-watt amplifier to be exact. In the latter instance, the speech amplifier modulator output transformer was changed to the correct cathode modulation unit and the 250 watts input was cathode modulated with, also, excellent results.

Incidentally, complimentary reports of fine quality on phone, excellent frequency stability, and clean cut keying of the e.c.o. on c.w. came so thick and fast that the writer was taken aback. It proved the everlasting contention that simple things are the basis for better efficiency.

●

Superregen Tip

On loud, nearby sigs that tend to block your supergenerator and sound distorted, have you tried kicking the detector out of oscillation and running up the a.f. gain? The quality is improved about 500 per cent, but there is no longer any a.v.c. action and there will be bad fading if you are working mobile.

Postscripts and Announcements

[*Continued from Page 75*]

nology, Pasadena, California, at an early date for preferred program listing.

CIRCULATION POSITION OPEN SOON

We expect to have an opening in our Circulation Department later in the season for a man experienced in magazine circulation correspondence and office routine, and in direct-by-mail sales work. Knowledge of amateur radio helpful but not essential. Complete data regarding experience and salary expected should be given in first letter. Address inquiries to the Publisher.

●

Too Bad

For the benefit of those pleasant pipe dreamers who have long discoursed on r. f. built up from the power-line frequency, we make the tearful disclosure that only one ham band limit (14,400) is an exact multiple of 60 cycles, it would take 240 doublers to do the job, and an error of only a quarter cycle at the fundamental would produce a 240 kc. error at 14.4 Mc. And those fellows talk about using the system as a frequency standard!

Advertising Index

www.americanradiohistory.com

The Marketplace

Classified Advertising

(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; minimum, 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.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(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 Santa Barbara accompanied by remittance in full payable to the order of Radio, Ltd.

TRANSMITTING TUBES REPAIRED—Save 60%. Guaranteed work. KNORR LABORATORIES, 5344 Mission St., San Francisco, Calif.

QSL's—Samples. Brownie, W3CJI, 523 North Tenth Street, Allentown, Pennsylvania.

CRYSTALS—Police, marine, aircraft, amateur. Catalog on request. C-W Mfg. Co., 1170 Esperanza, Los Angeles, Calif.

SEVERAL guaranteed reconditioned 350 watt JRA3 110-v. A.C. light plants at $45. Ideal for amateurs. Write Katolight, Inc., Mankato, Minnesota.

UNIVERSAL POWER TRANSFORMER—Primary switching produces 600 - 750 - 1000 - 1250 - 1500 v.d.c. @ 250 ma. Excellent regulation. Husky hum-free. Sensational price $6.50 uncased. $8.25 Aluminum cased. PRECISION TRANSFORMER CO., Muskegon, Michigan.

14" RACKS—24 x 14 x 8" with three 8 x 14" panels, chassis, brackets and dust cover. $9.25. Two panel rack complete. $7.25. Mobile transmitter cabinets. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

BARGAINS—Reconditioned guaranteed receivers and transmitters. All shipped on free trial. Same guarantee as new receivers. Practically all models cheap. For example: HQ-120Xs $99.00; latest 1940 model Super Pro at $100.00 reduction; NC101XA $89.00; RME-69s $79.00; SX-24 Defiants $49.00; S-20 Sky Champions $29.00; Sky Buddies $15.00; SW3s $9.00; FB7s $9.00. Terms. List free. Write. W9ARA, Butler, Missouri.

QSL's—HIGHEST QUALITY—LOWEST PRICES. RADIO HEADQUARTERS. FT. WAYNE, INDIANA.

CRYSTALS—80-160M crystals, $1.00. 80-160M crystal in ceramic holder, $1.75. KORADIO, Mendota, Illinois.

LISTEN HAMS!—Why use heavy current bias supplies and batteries? Small efficient supply now available will bias your entire transmitter. Only $17.50. Send for literature. PRECISION TRANSFORMER COMPANY. Muskegon, Michigan.

QSL's—Prices cut—July only! Fritz. 455 Mason, Joliet, Ill.

RECEIVER SERVICE—Factory authorized and approved by Hallicrafters—National—Hammarlund—Howard—RME. 4018 W. Olympic Blvd., Los Angeles, Calif.

XTALS—rejuvenated. 75c. Increased output and activity guaranteed. 4018 W. Olympic Blvd., Los Angeles, Calif.

QSL's—Samples. W9RUJ. P. O. Box 27, Auburn, Nebraska.

MACAUTO—ALL ELECTRIC CODE MACHINES. Low monthly rental 50,000 words practice tape write N. C. Ayers, 711 Boylston Street, Boston, Mass., Dept. B.

FLUORESCENT—AC Daylight lighting for desk; office; windows; home. Latest sensation. 50% discount. Literature FREE. McGEE RADIO, F-2013. Kansas City, Missouri.

AMAZING—value in multi-feature VFO-Pierce-French. Box 722. San Carlos, Calif.

CRYSTALS—in plug-in heat dissipating holders. Guaranteed good oscillators. 160M—80M $1.25. (No Y Cuts) 40X $1.65. 80M Vari-frequency. (5 Kilocycle variance) complete $2.95. State frequency desired. C.O.D.'s accepted. Pacific Crystals, 1042 South Hicks, Los Angeles, Calif.

SELL—New Recorder, Neil Stevey, 1064 - 85th St., Brooklyn, N. Y.

SACRIFICE—SX-17, Perfect condition. Performs beautifully on high frequencies, no images, excellent noise silencer, super-selective, make offer! New National 1" oscilloscope, complete $12.50, field strength meter with tube & 0-1 Beede Meter, in crackle case, $5.00. W2EZC, Lynbrook, New York.

WANTED—Used components for medium Hipower final, power Supply, 2000 volt-olmeter. W6COX, Box 972, Monterey, Calif.

ROANOKE DIVISION—A.R.R.L. CONVENTION. Chamberlin Hotel, Old Point Comfort, Virginia, August 3 & 4, 1940.

BATTERY—powered converter described in April issue, complete with tubes and all coils, but less batteries, $15, f.o.b. Radio, Ltd., 1300 Kenwood Rd., Santa Barbara, Calif.

FOR SALE—One new PP75T phone in small relay rack. 200 watts carrier. Complete with tubes and coils 10-160 meters $135. Also W6AJF's year old 354D-CM phone in relay rack. Complete with tubes and coils for 10-80 meters. In good condition with output over 200 watts. $95. Frank C. Jones, 2037 Durant Ave., Berkeley, Calif. All prices f.o.b. Berkeley.

Changes of Address

To become effective with

The Next Issue

must be RECEIVED at SANTA BARBARA

by the 5th of this month

Address labels are shipped to our mailers on that date. Remember: under U. S. postal laws, magazines sent to an old address are junked unless forwarding postage has been left in advance with the postmaster; unlike letters and cards, magazines are not forwarded either free or collect (except to addresses in the same city).

Circulation Department

www.americanradiohistory.com

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.

HABERLITZ AND SHANNON 112 MC. MOBILE STATION

Page 14

Receiver

C_1—Johnson 7J12
R_1, R_3—Centralab 710, 714
R_2, R_4—Centralab Midget Radiohm
R_5—Sprague 5-K Koolohm
BC—Mallory Bias Cell
T_1—Thordarson 13-S-34
Cabinet—Bud CU-728
RFC—Bud CH-925

Transmitter

C_1—Johnson 15J12
C_2—Solar type MO
RFC—Bud CH-925
Tube—Hytron
R_1—Centralab 516

●

SMITH OUTBOARD AMPLIFIER

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T_1, T_2—Meissner 16-6131
R_1, R_2, R_3—Centralab 710, 714
C_2, C_3, C_7—Solar Sealdtite

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KOLZ 30-WATT TRANSMITTER

Page 26

C_1, C_2, C_3, C_5, C_6—Cornell-Dubilier 4-12050
C_4—Cornell-Dubilier 4-23010
C_7, C_{15}, C_{16}, C_{18}, C_{19}—Cornell-Dubilier DT-4P1
C_8, C_9—Cornell-Dubilier 9-22050
C_{10}—Cornell-Dubilier TQ-10020
C_{11}, C_{12}, C_{13}—Cornell-Dubilier TLA-10020
C_{14}, C_{20}—Cornell-Dubilier BR-255
C_{17}, C_{21}, C_{22}—Cornell-Dubilier KR-504
C_{23}—Cardwell MT-100-GS
R_1, R_2, R_8, R_9, R_{10}, R_{11}, R_{24}—Ohmite Carbohm
R—Ohmite 0330
R_4, R_{23}—Ohmite Brown Devil
R_5—Ohmite 0585
R_6—Ohmite 0610
R_7—Ohmite 0402
R_{12} to R_{16}, inclusive, R_{18}, R_{19}, R_{20}, R_{22}—IRC BT-½
R_{17}—IRC 13-133
R_{21}—IRC 11-128
TU_1—Browning BL-5G
TU_2—Browning BL-5P
TU_3—Browning BL-5PL
T_1—Kenyon K-6.3
T_2—Kenyon T-244
T_3—Kenyon T-454
CH_1, CH_2—Kenyon T-166
Receiver-type tubes—RCA
802, 807—RCA
RK-25, RK-39—Raytheon
HY-61—Hytron
10½" by 19" panel—Parmetal 3605
8¾" by 19" panels—Parmetal 3604
A.f. chassis—Parmetal B-4518
Power supply chassis—Parmetal C-4515

●

BOWEN SUPERHETERODYNE

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C—Bud LC-1653
C_1, C_2—Hammarlund MICX-140
C_3, C_4—Bud LC-1684
C_5, C_6—Bud LC-1641
C_7, C_8, C_{19}, C_{20}, C_{27}, C_{28}, C_{29}—Aerovox 1467
C_9 to C_{18}, inclusive, C_{21} to C_{25}, inclusive, C_{30}, C_{31}, C_{32}—Aerovox 484
C_{26}—Aerovox PRS25
R, R_2, R_5, R_7, R_{24}, R_{25}—IRC BT-1
R_1, R_3, R_6, R_8, to R_{17}, inclusive, R_{19}, R_{20}, R_{23}, R_{26}, R_{27}—IRC BT-½
R_4—IRC 11-123
R_{18}—IRC 13-133
R_{21}—IRC 13-116
R_{22}—IRC BT-2
IFT_1—Meissner 16-6658
IFT_2—Meissner 16-6659
IFT_3—Meissner 16-6660
BFO—Hammarlund STBO-465
S_1—Centralab 1427
Tubes—RCA
Planetary dial drive—Crowe

●

BRODERSON NEWCOMER TRANSMITTER

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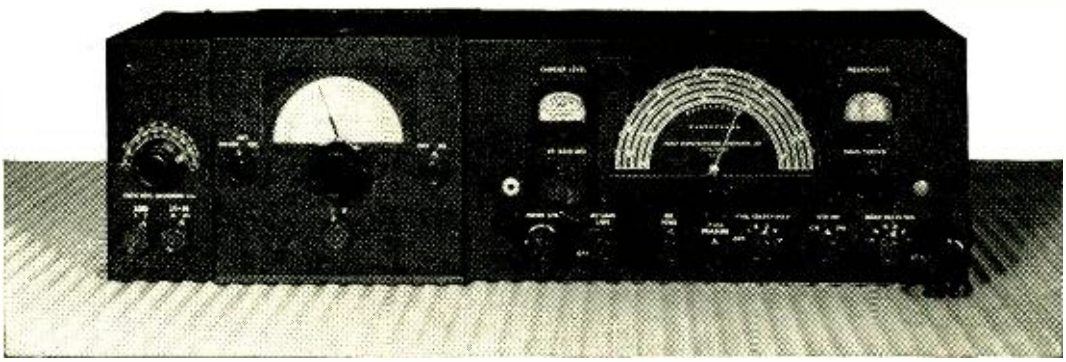
Chassis—Bud CB-644
Coil—Bud OCL-40
Sockets—Hammarlund S-5, S-8
Crystal socket—Hammarlund XS-2
Tuning cond.—Bud 148
Dial plates—Bud 717
Dial lamp brackets—Yaxley 310-R
R_1—IRC AB
R_2—IRC 11-128
Crystal—Bliley LD-2

HUGHES PRINTING CO.
EAST STROUDSBURG, PA.

www.americanradiohistory.com

COMPLETE COVERAGE
90 KILOCYCLES—60 MEGACYCLES



INSTANTANEOUS FINGER-TIP CONTROL OF LOW, MEDIUM OR HIGH FREQUENCY TUNING

CONVENIENT . . . *SELECTIVE* . . . *EFFICIENT*

IMAGINE tuning all frequencies from 90 kilocycles to 60 megacycles, efficiently and accurately from one receiving position, with never a thought to peaking critical circuits, plug-in inductances or complicated switching arrangements. Imagine having at your finger-tips the finest superheterodyne type receiver for reception of almost everything to be heard in the present day radio spectrum.

You can have all this and more when you assemble RME units as we have them pictured above. The basic, foundation unit is the new RME-99, outstanding precision communications receiver. The unit at the extreme left is the LF-90 LOW FREQUENCY INVERTER which permits reception of all channels from 90 to 600 kilocycles. The center unit is the DM-30X BAND EXPANDER designed to expand the RME-99's frequency coverage to include all channels up to and including 60 megacycles (or the DM-36 for specific ham band coverage of 28 and 60 MC permitting extended bandspread tuning).

This line-up presents a truly commercial control panel with every adjustment for precise and efficient FULL RANGE reception. In this modern era of diversified radio reception, the receiver which does not receive *all* the useful communication channels, is a receiver of incomplete capability.

In buying your new receiving equipment, check its tuning range for FULL COVERAGE. Make certain it is COMPLETE. A combination of RME receiving units assures you of COMPLETE tuning. Write us today for complete information, and be satisfied in the long run.

▲

Radio Mfg. Engineers
—Inc.—

RME
TIME WILL TELL

111 Harrison Street
Peoria, Illinois

www.americanradiohistory.com

PRACTICAL TELEVISION

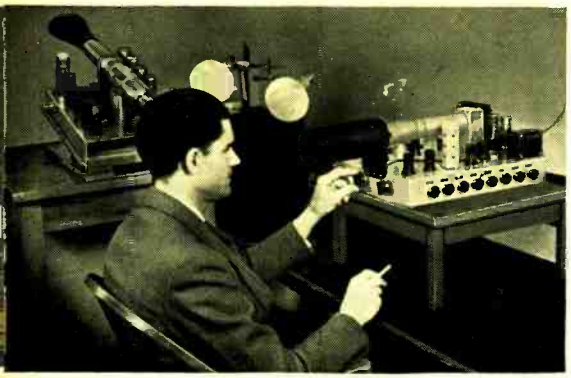
for the amateur IS HERE!

"CQ-ing" the Television way

Amateur Iconoscope RCA-1847

Just announced by RCA—designed and licensed specifically for amateur and experimental use—engineered by the same men who produced the larger Iconoscopes—this "Mini-ike" paves the way for a brand new thrill for the radio pioneer. In size it is 7⅝" long, with a 2" face on which the images are focused. The free booklet mentioned below includes full specifications, with circuit diagrams and equipment information.

Amateur Net Price **$24.50**



Think of the thrill of seeing the fellow amateur you've been talking with — of pioneering your way to new air adventures!

New Thrills, New Adventures for the Radio Pioneer . . . .

The experimental equipment pictured on this page was designed and constructed by RCA engineers to illustrate the possibilities of the new RCA-1847 Iconoscope in Amateur Television. Demonstrated in actual operation, this equipment was the hit of the Chicago Parts Show. Most amateurs already have many of the required components. And, even though you start from "scratch," it is possible to duplicate this system for no more than the cost of a medium-power transmitter!

Images are 30 frame, 120 line; require a total band width of less than 0.4 Mc, and are amazingly clear and stable. Operation is on the 2½-meter band where there is plenty of room. See articles in May and June QST for further details.

FREE! A new booklet, hot off the press, containing complete data on how to build this complete Television Rig is yours for the asking. Get one from your nearest RCA Amateur Equipment Jobber, or write to RCA Commercial Engineering Section, Harrison, N. J.

JUST OUT! New RCA HAM GUIDE, 15c Net. Ask your nearest RCA Distributor.

RCA *for Amateur* TELEVISION

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