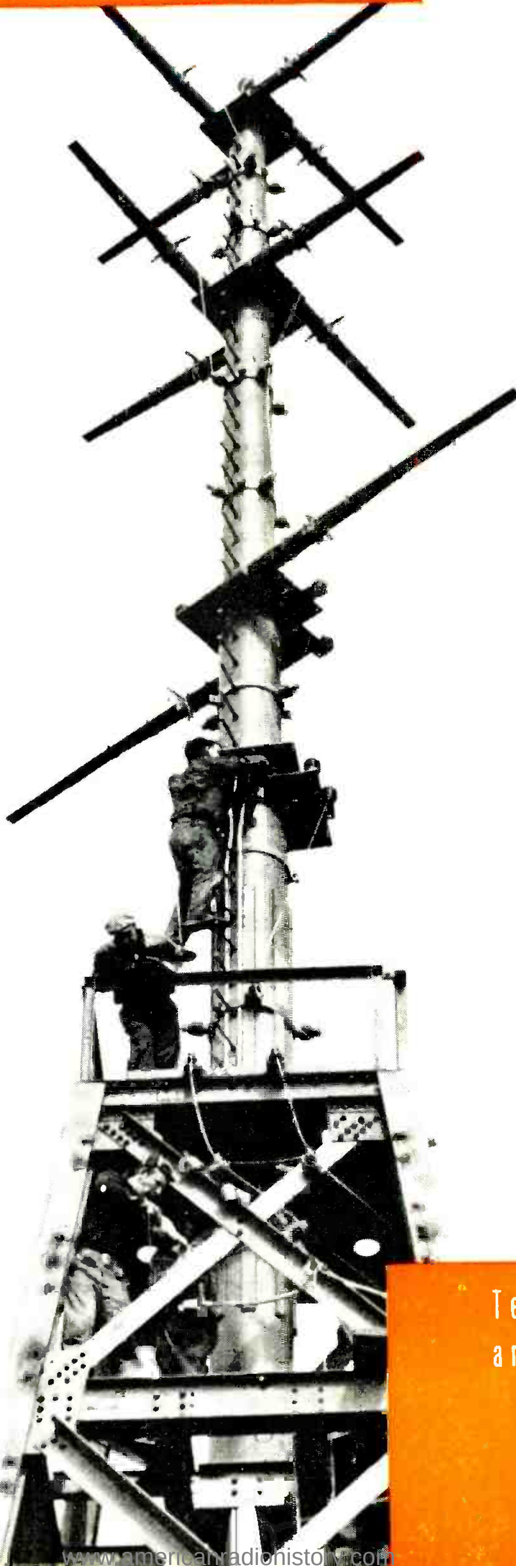
RADIO

ESTABLISHED, 1917



THIS MONTH

- HIGH-FIDELITY RECEIVER
- MOBILE POLICE XMTTR
- 56-MC. PRESELECTOR
- BANDSPREAD DATA

Technical Radio
and Electronics

★

April 1941

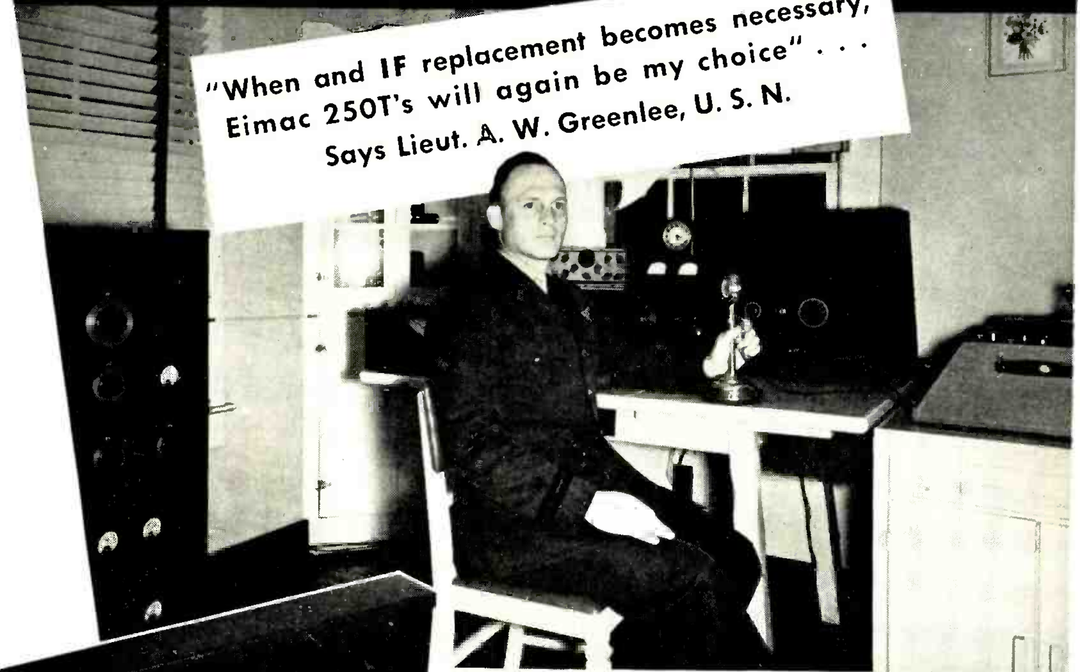
NUMBER 258

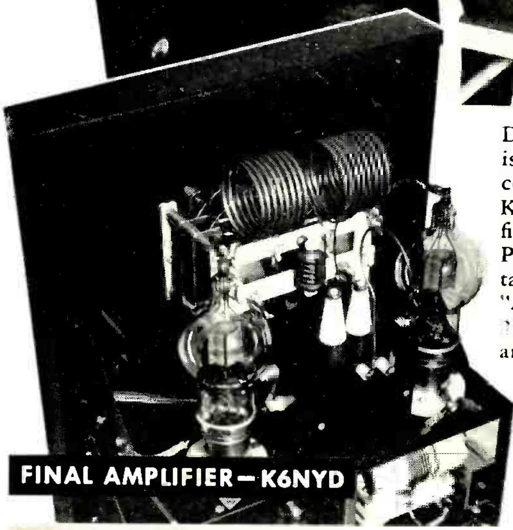
30c IN U.S.A.

K6NYD One of the best known Amateurs of the Hawaiian Islands uses Eimac 250T's

(Now W4HGN in Pensacola, Florida

"When and IF replacement becomes necessary, Eimac 250T's will again be my choice" . . .
Says Lieut. A. W. Greenlee, U. S. N.





FINAL AMPLIFIER—K6NYD

DX is no longer permitted but the past record of K6NYD is still impressive. On fone: 87 countries worked with 78 confirmed. On CW: 108 worked with 86 confirmations. K6NYD has been using Eimac 250T's in his final amplifier since 1937 and says they are extremely dependable. Prize feat with his "rig" was the regular schedule maintained with the evasive AC4YN . . . once on fone with the "AC" on CW. Lieut. Greenlee says: "In spite of more than 1500 hours service, my 250T's still neutralize perfectly and appear to have full filament emission."

Outstanding performance like this and long dependable service without a let down is typical of the results being obtained by amateurs who use Eimac tubes. Make no mistake about it, you can benefit greatly by the experiences of the worlds leading radio men, most of whom use Eimac tubes.

3 ELEMENT ROTARY ANTENNA—K6NYD

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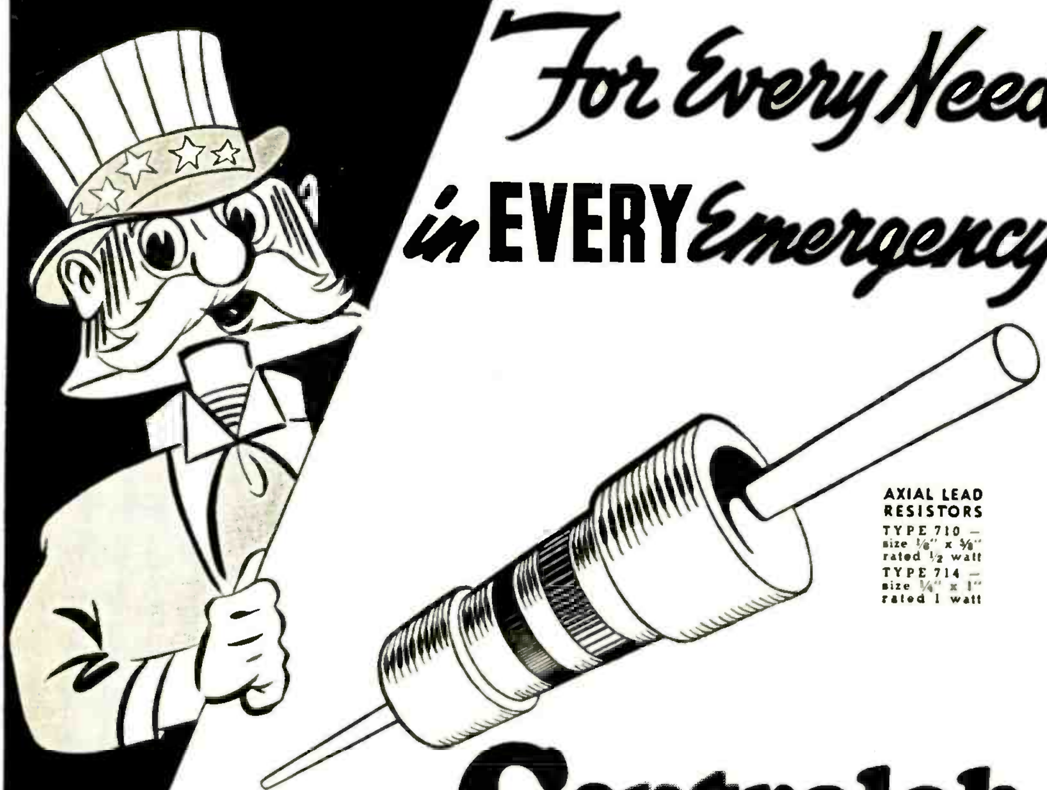
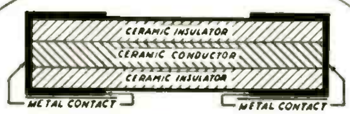


Centralab

AXIAL LEAD RESISTORS



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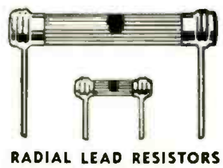

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Under water . . . in the air . . . under ground . . . on every "front" these famous resistors are proving their fitness in routine as well as emergency work.

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April • 1941 The publishers assume no responsibility for statements made herein by contributors and correspondents, nor does publication indicate approval **No. 258**

Table of Contents

Cover: The three-bay turnstile for W39B under construction atop Mount Washington, N. H. Note the strength and mounting of the "auto-spring" elements to withstand the wind force, the weight of ice and snow and the impact of ice chunks falling from the elements above.

ARTICLES

MISCELLANEOUS FEATURES

DEPARTMENTS

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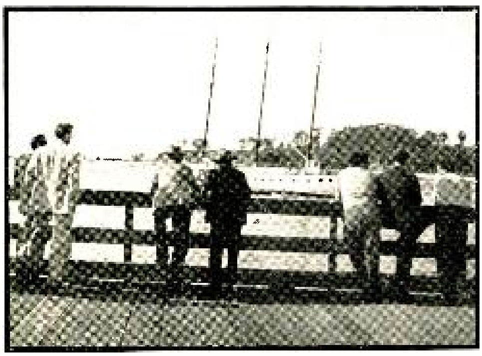
Past • Present and • Prophetic

Transmitter Trailing

With Spring not far away—we hope—it behooves the u.h.f. addicts to begin thinking about their direction finding apparatus for transmitter hunts. Willburn tells how *he* does it on page 44. His system works, too; we saw a user of a similar method drive right to a hidden transmitter while others with more elaborate equipment, including a truck surmounted by a windmill, were beating the brush ten miles away.

This u.h.f. direction finding is worthy of more notice. Let's hear how some of the others do it. Or is it a secret, like the home-brew recipe?

The Staff—Rear View



During a recent spot of unusual weather the *San Wan* dragged its anchor and ran aground inside the local breakwater, thus providing the above picture of ye staffs watching a vain effort to refloat the ship. From left to right: editors Smith and Dawley; two unidentified surfside superintendents; draftsman Ontiveros; Haberlitz, W6QZA, who happened along; and laboratorian Rothman. It has been calculated that were the sails of the *San Wan* fully rigged it would long ago have been blown out to sea by the free advice emanating from shore.

Pipe Again

Under the constant prodding of Bill Conklin, we've been plugging pipe for u.h.f. tank circuits pretty steadily. At last we seem to be getting results. This time Leroy May provides us with an article on a 56-Mc. preselector with concentric tank circuits. We won't say any more—just see page 16.

High Fidelity

Editor Smith has long been a high-fidelity addict. Why, we don't know. It seems that every time you get a "flat" b.c. set going, the visiting b.c.l. always seems a bit skeptical of your claims. If pressed, he will usually admit that he thinks his $19.95 midget has better "tone," meaning faked bass. But if you have an ear for real fidelity Smith tells the proper approach on page 46. You can tell the difference between a studio program, a recording, and a network program with this sort of an outfit, if that's any incentive.

Speaking of high fidelity, those who have heard the amazing sound reproduction in Walt Disney's "Fantasia" will be interested to know that at least two of the three men given program credit for the sound are amateurs. It may be that all three are amateurs. At any rate, C. O. Slyfield is W6WQ, and J. N. A. Hawkins, our former technical editor, is W6AAR.

Back to Breadboard

After his first fling of authoring in RADIO with the dialogue meter of last February, W. T. Caswell decided to have another try at it. This time it's on the serious side, with a 100-watt transmitter built in a modified form of the good old breadboard style—the sign of an unreconstructed dx'er. If you want to see some of the advantages of breadboard construction and there are plenty, as even the rack advocates will admit—turn to page 33.

Lost and Found Dept.

We just know you have been sitting on pins and needles waiting to hear if the George Banks mentioned here in February read his press notices. He did. The Handbook has gone to his friend. Now all we have to worry about is whether our latest correspondent was actually Mr. Banks. The signature seemed authentic, though.

Quick Get-Away

When we think of the trouble that editor Dawley went to when he designed the mobile transmitter with instant-heating filaments described in the July, 1939, issue, we can wager that he wishes he had waited about eighteen months. There is now a whole series of real transmitting tubes available for this type of mobile service. Newnan shows how some of the tubes may be applied to a mobile police transmitter in an article starting on page 26. Long-time power consumption is reduced con-

[*Continued on Page* 97]

● Overall view of f.m. station W2XOR. Note the "patchwork" acoustic treatment of the room. This is WOR-Mutual's 1-kilowatt f.m. outlet in New York.

The Coincidence of

U. H. F. FADING

By PERRY FERRELL, Jr.*

Since the start of our study of weak f.m. signals many interesting sidelights have arisen. Out of these have grown a series of papers on the propagation of the ultra high frequencies.[1, 2]

Fading

Fading at ultra high frequencies, which has already been described[1], is caused by rapid variations in the reflection boundaries at different levels in the troposphere. These change the propagation characteristics and cause fluctuations in signal strength at the receiving position. Fortunately, however, fading is a long drawn out procedure most of the time and wave interference or selective fading is practically unknown in air boundary bending signals. The predominant fade is illustrated quite excellently in figure 1, which is the type of fade classified as "roller." As can be seen, there is no general periodicity, and no exacting rhythmical cycle persists.

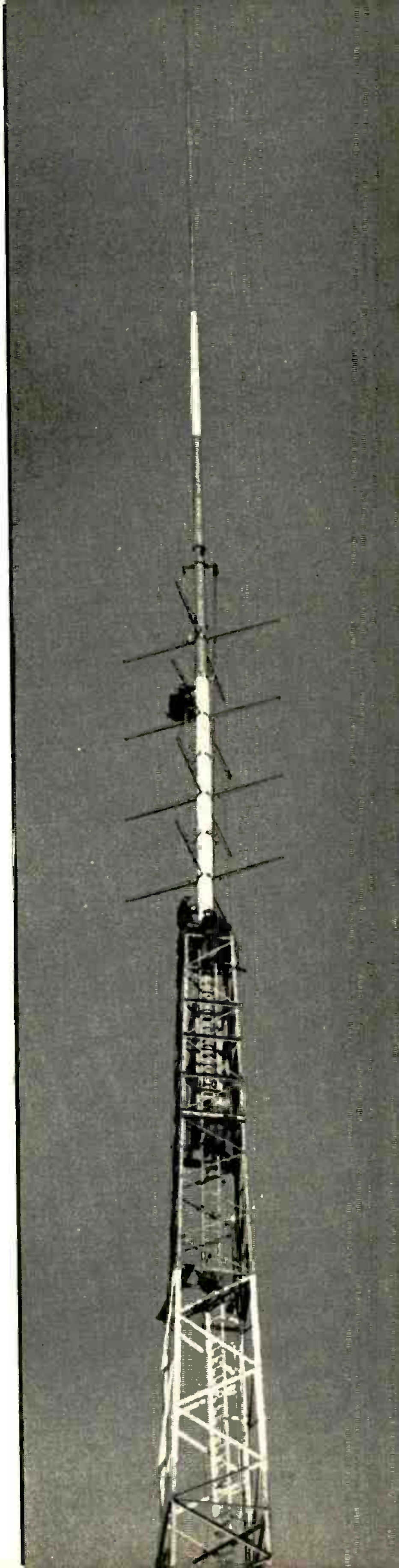
The actual average of fading is better shown, perhaps, in figure 2, as figure 1 was made during a period of exceptionally fine air boundary bending. To clarify that latter condition figure 3 is shown. This is one of the daily weather maps covering that period in which it can be seen that the local Atlantic seaboard was along a contact plane of a "low" centered over Michigan and a "high" moving northeastward along the seaboard itself, and for which a time was centered over Rhode Island, Connecticut and Massachusetts.[3]

*107 East Bayview Ave., Pleasantville, New Jersey.

[1]Ferrell, "Weak Signal F. M. Reception," RADIO, December, 1940, p. 11.

[2]Ferrell, "Aurora V.H.F. Propagation," RADIO, February, 1941, p. 20.

[3]Special attention is called here to the paper, "U.H.F. and the Weather," M. S. Wilson, RADIO, January, 1940, p. 34, in which this condition is described in detail.



The turnstile antenna being installed for W47NV at Nashville, Tenn., atop the WSM tower. The vertical radiator belongs to W4XA, 26.15 Mc., who specialize in the broadcasting of high-fidelity orchestral selections.

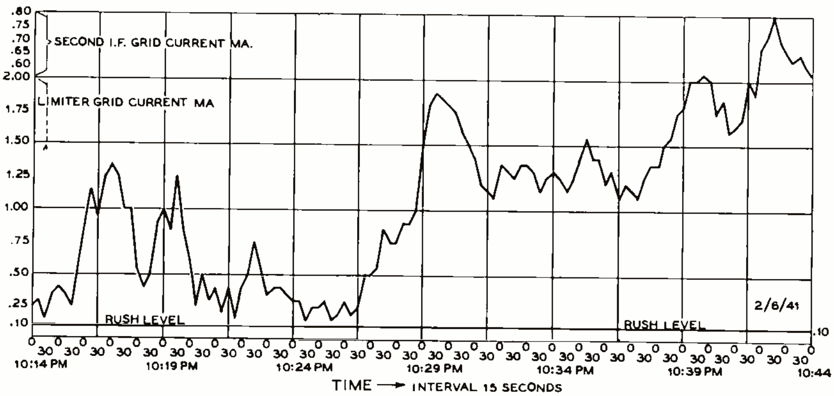


Figure 1. Simple roller fade during t.a.b.b. as recorded from the W2XMN f.m. signal. The total swing of fade is over 40 db in strength.

The furtherance of these measurements upon u.h.f. fading required additional equipment. Major Armstrong thereupon supplied us with a second REL-517A f.m. receiver.[3] This made it possible to make accurate comparative tests by recording two stations at the same frequency with different antennas or on different frequencies, as the case might be. Also added was a special r.f. stage with tuned input and output and utilizing another 1852 type tube and separate power supply. The gain afforded in this extra stage considerably improved limiter operation[4] and also improved the weak signal response as shown in figure 4.

Since antennas are of the utmost importance, a new horizonal dipole using ½" copper elements resonant on 44 Mc. and fed with 50 feet of EO1 cable was erected 75 feet above sea-level. For vertical polarization another dipole was suspended in midair from a pole atop the house where the receiving equipment is located. This was also resonant on 44 Mc. and fed with about 30 feet of EO1. Along with an output meter, complete antenna switching, and steps taken to reduce the first oscillator interaction between the two receivers (both 1700 kc. i.f.), our installation became complete enough to carry on the outlined tests.

[4]Browning, "F. M. Limiter Performance," September, 1940, *QST*, p. 19.

The Coincidence Of Fading

The first noted coincidence of fading occurred when it was observed that the rate and severity of fading is materially the same throughout the f.m. commercial band (42.0-50.0 Mc.). This would imply that fading at closely allied frequencies in the u.h.f. bands with like polarizations and from identical transmitting and receiving positions is the same. While conclusive experiments to show the above as being true over a broad range were impossible, figure 5 shows the relative fades of W2XOR, 43.50 Mc. and W2XWG, 45.10 Mc., both in Manhattan, New York City. This preliminary test did indicate the fading is about the same regardless of small differences in frequency. As can be seen from the graph, the general tone of fading is well followed.

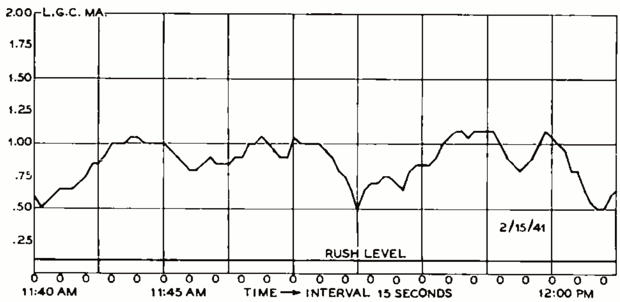


Figure 2. The normal fade of the f.m. signal of W2XMN (114 miles distant). Note the lack of extreme variations as in figure 1, which was made during t.a.b.b. This amount of fade is unnoticeable during normal f.m. reception.

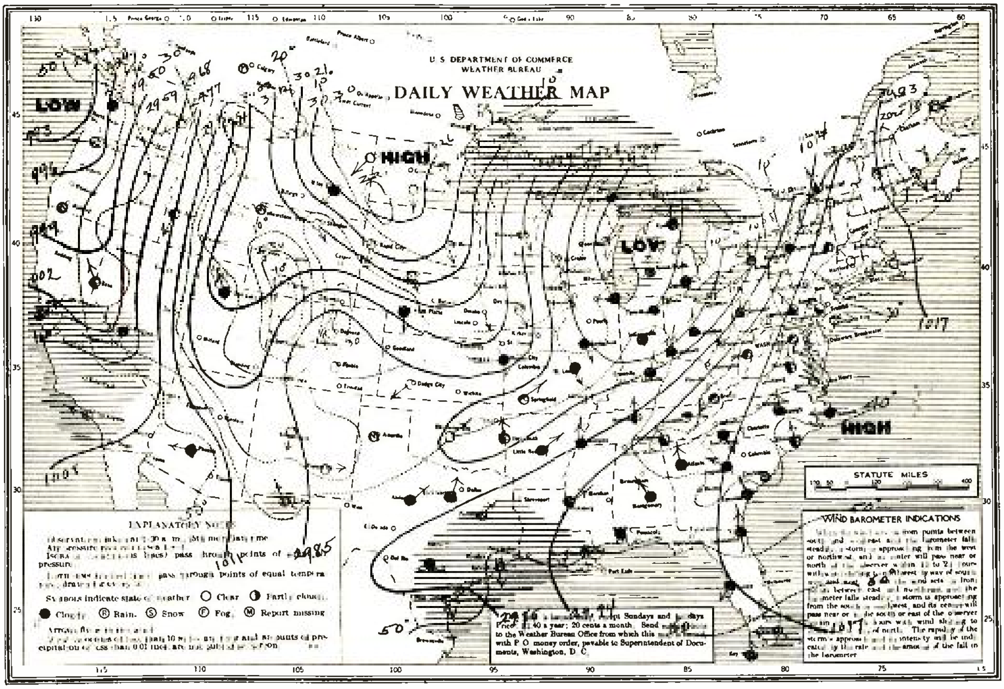


Figure 3. Weather map issued by the U.S. Weather Bureau for the date of February 6, 1941. Note how a "high" is centered from Cape Hatteras to the coast of Maine, while a favorable "low" is over Michigan and western New York State. The contact plane at the time of recording the W2XMN fade at 10:30 p.m. on the 6th was running north and south over upper eastern New York state to lower New Jersey.

The discrepancies in the graph can be attributed to several factors which override any irregularities that might have been caused by the small frequency difference. So in the limited f.m. commercial band it is assumed for all means and purposes of this paper that the fading at independent frequencies is the same from identical transmitting locations.

It might be well to mention here that the difference in the effective field strengths is apparently the result of the differences in the transmitting antenna heights, that of W2XWG being atop the Empire State Building,[5] and that of W2XOR being about 630 feet below it at 444 Madison Ave., a short distance away. Fading is again assumed to be the same, since the receiving antennas were at about the same height.[6]

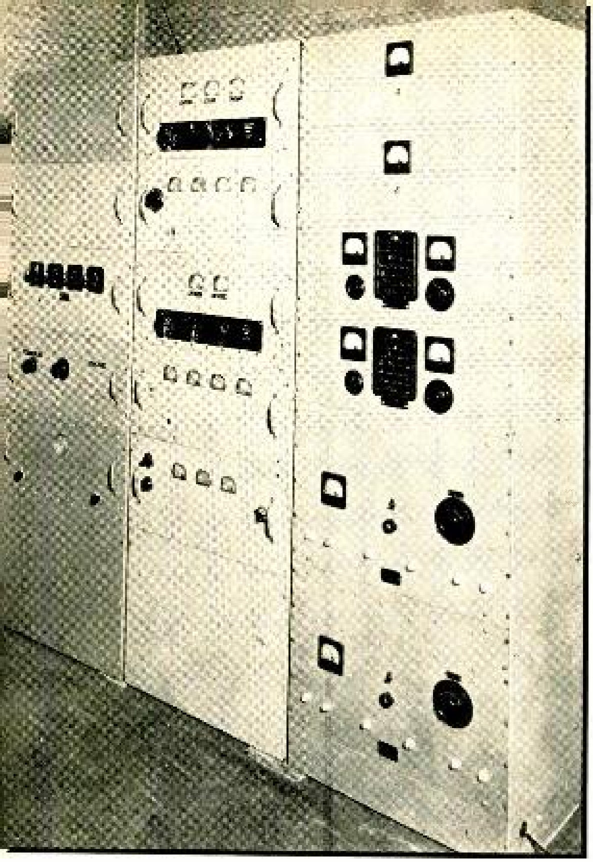
It has been believed heretofore that unlike polarizations (W2XWG using horizonal, W2XOR using vertical) would show no coincidence of fading from nearly identical transmitting locations. While observations that could not be shown in the graph (figure 5) proved that fading was worse on the horizontal, when it was bad on the vertical itself there seemed to be a strong coincidence between the two fades.

A review of the causes of u.h.f. fading pointed out that fading can be the effect of a distortion of the plane of polarization of the radiated wave. Since this applies primarily to the reflection of signals from the ionosphere, the thorn in the side of our various antenna polarization experimenters has long been comment from "reliable" sources to the effect that polarization was practically ineffectual for signals of tropospheric air boundary bending origin. These reports had indicated a random twisting of the plane of polarization as the wave passed through the lower atmosphere.

It is best to remember here that the reflection boundaries, although generally found above 400 meters and below 5 kilometers, can exist up to 10,000 meters in a very weakened condition.

[5]Note: "N.B.C. Frequency Modulation Field Test," RADIO, January, 1941, p. 12.

[6]E. H. Conklin, "Antenna Polarization on the Ultra Highs," RADIO, March, 1940, p. 44.



The line input and modulator equipment of M2XMN, Alpine, N.J.

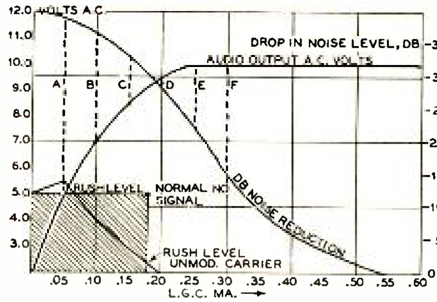


Figure 4. The plot of signal input against audio output of the revised f.m. receiver is shown in this graph. At (A) a received signal would be unreadable, although a slight increase in the background rush would be noticeable, due to the presence of the carrier. At (B) the audio out of the 1000-cycle tone has risen to 7.0 volts a.c., and the rush level has dropped to 4.0 volts on an unmodulated carrier. (C) shows another rise in audio output with a corresponding reduction in noise and carrier rush level. The signals at (B) and (C) would be, in no fading, entirely readable though well into the rush and noise. At (D), or 0.20 ma. l.g.c., noise and rush are still dropping rapidly, which they continue to do at (E) and (F), the audio output from the 1000-cycle tone having assumed a 10-volt level in the latter two cases. Signals above these readings are of program value.

For example, in the tropospheric reflection measurements of Professor A. W. Friend, Harvard University, for July 6th, 1940, a reading like this resulted:

h_1— 1100 m. to 1200 m.—strong and sharp.
h_2— 1900 m. }
h_3— 2880 m. } very disturbed region
h_4— 4900 m.—weak and broad boundary
h_5—10000 m.—weak.

This condition was excellent for signals in New England, especially those between Boston and Bristol, Conn. If, by the way, you're a fanatic on sporadic-E skip for 5 meters, you will find that sporadic-E had opened 5 to the west and southwest at the time of the observation, and hence could account for some of those oversize S.E. hops! Thusly, it would appear that the name "tropospheric air boundary bending" (troposphere meaning the portion of the earth's atmosphere extending up to about 36,000 feet or 10.96 km.) would suit our case best. However, this is clumsy to discuss, so the term is shortened to its initials, *t.a.b.b.*, for use hereafter in this paper.

Theoretically, these radical changes involved in polarization twisting are possible only to a limited extent, assuming that the receiving and transmitting antenna systems are ideal in design. Since many installations are far from

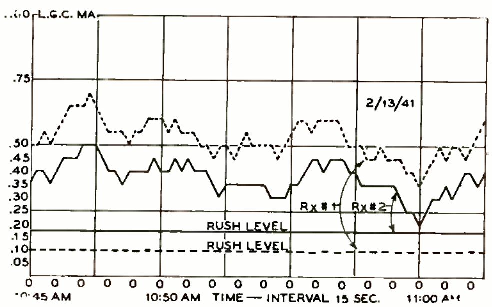
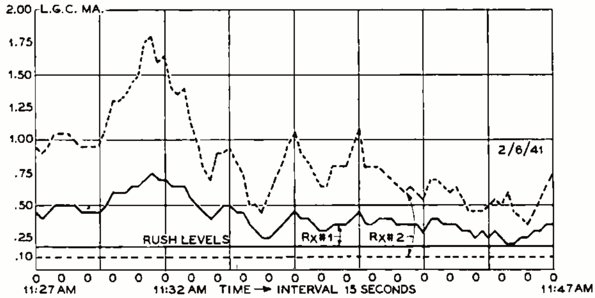


Figure 5. Comparison of fading of W2XWG on receiver no. 2 (horizontally polarized transmission) and W2XOR on receiver no. 1 (vertically polarized), both being received on their respective polarizations. More than a little coincidence in the fading of the two types of polarization is shown, although greater severity of fading was noticed on the horizontally polarized signals, as would be expected.

ideal, due probably not to the constructor or the amateur himself but to the lack of equipment to measure and correct these faults, the extraneous fields in the vicinity of unbalanced feeders and leadins can seriously distort the actual polarization of the transmitting or receiving array.

Figure 6. Graph of comparison of the horizontally polarized W2XMN transmissions as received on no. 2 receiver using a horizontal antenna (actual readings reduced), and the no. 1 receiver using a vertical antenna. Although there is a great difference in signal strength and the fade on the vertical is less great, note that the general tone of fade is fairly well followed on the two.



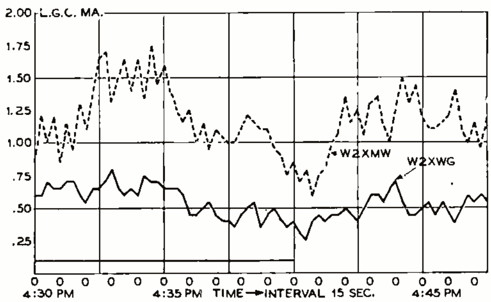


Figure 7. The fading records of W2XWG and W2XMN who are on the same azimuth leading away from the receiving location but are separated by 14 miles. The existence of a very slight general correspondence can be seen, but there does not seem to be any evidence of a definite lag or lead between the two records.

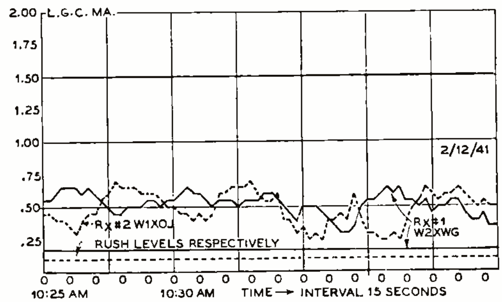


Figure 8. Plot of the fading of W2XWG against that of W1XOJ showing the expected lack of coincidence due to the propagation of the signal over many paths.

Commercial f.m. installations, of course, take great pride in the character of their wave polarization. Hence these easily enough provided an "ideal design." Tests were then carried out to determine the effectiveness of polarization and whether or not a condition unknown to us existed which in t.a.b.b. caused the so-called twisting action.

In figure 6 we see the results obtained by recording W2XMN with the horizonal dipole on the standard REL and the vertical dipole on the special double r.f. stage REL. The r.f. gain on the standard receiver was reduced to 40% of the actual l.g.c. reading for ease of comparison.

Since the transmissions of W2XMN are horizontally polarized the ratio of horizonal to vertical is very great. However, as far as fading is concerned the general tone is quite similar for the two. Particularly of notice is the fact that the severity of fading on the horizontal antenna is greater than that of receiving on the vertical, even though the radiation from the transmitter is horizontally polarized.

In figure 7, which is the graph comparing the fades of W2XMN (relative strength—actual strength 20% more) and W2XWG (actual strength; using dual r.f stage REL), we find the separation of 14 miles on the same azimuth, plus the 100 miles to W2XWG, has apparently caused a reaction in the severity and rates of the two fades. This was to be expected, and no coincidence now exists.

It is now obvious that the signal is being refracted at several different levels in the troposphere. The in- and out-of-phase effects of the components of the signal result in fading. Application of logic, although in the face of a great number of variables indicates that the "front" affording this fading probably is equidistant from both the transmitting and receiving positions and must be spread out over a considerable area. A scintillating fade, although not invariably the inverse, would most likely be due to refraction from a weak front, local either to the transmitter or to the receiver. Turbulent conditions within 1000 meters of the surface in all probability also cause scintillating fades.

Fading at extreme distances from W1XOJ (243 miles distant) during t.a.b.b. is shown in

[*Continued on Page 68*]

A Practical
SINE-WAVE GENERATOR

By JOHN MacALLISTER,* ex-W9JLR

If you've ever felt the desire to know how a sine wave would look after negotiating two or three stages of speech and the class B modulator, then you've learned that the cost of a good frequency generator runs into healthy figures. The general run of oscillators, such as can be thrown together with a tube and an audio transformer, don't do much to remedy this situation. Usually their output has more wrinkles than a corrugated roof, the result of a heavy harmonic component. All in all it's a bit tough on the Johnny who wants to know how the stuff looks before it goes over the garden wall.

There is an alternative, however; there are two, in fact. The first, and obvious, is to take one of the commercial gadgets out on trial, use it for a week-end, then return it to your dealer with apologies. The other is the contrivance shown in the accompanying sketch.

This type of frequency generator is often used in geophysical labs and other services where high audio frequencies (above 2000 cycles) are not essential. Briefly, it consists of a photo-cell, a light source, and a revolving, perforated disc, so arranged that the perforations admit light pulses to the cell at the desired sound frequency. In laboratory practice the perforated disc is generally replaced with one having a serrated edge, the pitch and depth of the teeth being so laid out as to provide a perfect sine wave. However, the perforated disc is capable of producing an excellent wave-form at, let us say, 400 c.p.s.

"Aha," says the gentleman who owns one of the laboratory-type vacuum-tube oscillators, "how do you vary the pitch with your gadget? How do you get anything but 400 cycles out of it?"

"Brother, you don't!" Arbitrarily, 400 c.p.s. has been accepted by the F.C.C. as a satisfactory test-frequency for broadcast stations; the full story being that an audio system which distorts at one frequency will do so at all frequencies. It holds true, therefore, that a normal transmitter operating with a meager four percent harmonic distortion at 400 c.p.s. will have no less than this at any useful frequency.

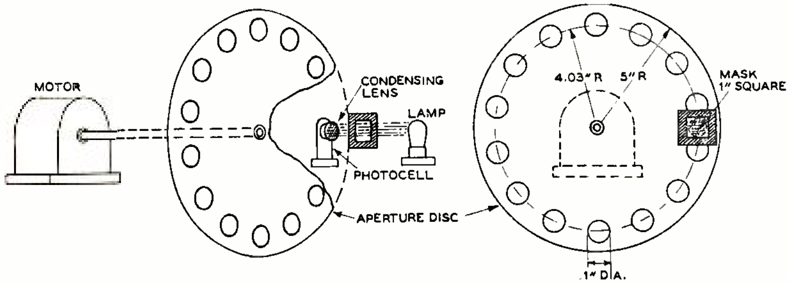
However, if you insist upon a variable frequency-generator you can have it. You can make it as complicated as you wish, or spend as much as you like. Or you can design it to operate at two hundred, a thousand cycles, or any frequency you wish, but for the moment let's concentrate on exhibit A.

Material Requirements

The motor can be anything of 1/20 horsepower or over. One having good regulation; i.e., compounded, shunt-wound, or synchronous, is desirable. The more constant the disc's velocity, the more constant the frequency. The disc mounts directly upon the motor shaft by means of an emery-wheel adapter. It can be of any suitable material—aluminum, or even bristol board. A ten-inch aluminum recording blank adapts itself admirably, being, in fact, more practical for this purpose than for that for which it originally was intended. The lamp is mounted upon one side of this disc, the photo-cell upon the other, and between the lamp and the disc is any opaque mask, slotted the width of the disc apertures. With these elements properly positioned, light is admitted to the photo-cell only as the disc apertures move past the mask opening. If the holes in the disc are perfectly round, symmetrical, and spaced exactly one diameter apart, the voltage output of the photo-cell will be a more than reasonable facsimile of a sine wave. For a given motor speed, the frequency of this signal can be pre-determined through proper design of the disc.

Assuming a motor speed of 1750 r.p.m., we can anticipate a disc speed of approximately 29.2 revs. per second. Knowing this, and desiring a frequency of approximately 400 c.p.s., a simple process of "gozintas" shows us that 14 apertures will do the job. For 1000

*Vard Mechanical Labs., Pasadena, Calif.



General layout of the aperture-disc audio source showing the dimensions for constructing a ten-inch disc with 14 one-inch holes.

cycles, we would arrive at 34 apertures by the same process.

Disc Layout

The holes should be large enough to admit ample light to the cell, this determining within limits the output level. For cutting these holes a center-drill is advisable. Lacking this tool, a 1″ socket hole punch is generally available and represents an excellent means of cutting the apertures. Holes of this size, however, do necessitate the use of a condenser lens (from an old flashlight), to focus the light upon the cathode of the photo-cell. With apertures ½ inch in diameter or less no focusing is essential. In any event, workshop facilities can best determine the aperture size. The disc should then be laid out with these holes exactly one diameter apart; no more, no less! The nice trick comes in determining the exact radius that will result in a circle which exactly accommodates 14 holes, or whatever number your particular requirements suggest. This being merely a mathematical function, no sorry details are needed here.[1] Exact dimensions for a disc using 1″ holes are shown in figure 1.

Cutting the Apertures

In the next operation, extreme care is essential. If you are lucky enough to have a precision mill available for cutting the apertures, use it and consider yourself fortunate. It is for this same reason that a center-drill or socket-hole punch is advisable; the use of a small guide-hole reduces the percentage of error. Finally, whatever the radius on which the holes are laid out, it is best scribed *after* the disc has been permanently mounted in the adapter. Any discrepancies in laying out the disc will show up later as stray wiggles on the scope.

The rest is quite simple. The disc and other parts may or may not be given a coat of black paint and are assembled as shown. With a polarizing voltage applied to the cell through a suitable resistance (no polarizing voltage is required for a selenium or barrier type cell), turn on the exiter lamp (**d.c.** filament supply), and start the motor. No fuss, no bother, no harmonics. Simple, eh-what?

Notice, we said **d.c.** back there. If you are a stickler for detail, 60-cycle a.c. on the light source will modulate a bit of 120-cycle ripple into the photo-cell output. You can overlook it, or, on the other hand, you can use d.c. An ordinary flash-light lamp and battery will furnish light for several hours of intermittent operation.

Photo Cells

Generally speaking, any type photo-cell will operate effectively. The barrier type cells, of which there are several, are self-generating and

[*Continued on Page 89*]

[1]A simple way of approximating this computation is to multiply the total number of holes by 4, then divide this result into 360°. The resulting figure is the angle in degrees which will be subtended by the radius of the holes at their proper distance from the center of the disc. Look up the sine of this angle, and divide this figure into the *radius* of the holes which are to be cut. The resulting figure will be the radius of the circle for the line of centers of the holes. Expressed as an equation:

$$R = \frac{r}{\sin \frac{360}{4N}}$$

Where N is the number of holes to be cut, r is the radius of the holes, and R is the radius of the circle on which the centers of the holes are to be placed.

The circle of radius R is then inscribed and the proper number of points for the desired number of holes is stepped off with a divider on the circumference of this circle.—*Editor.*

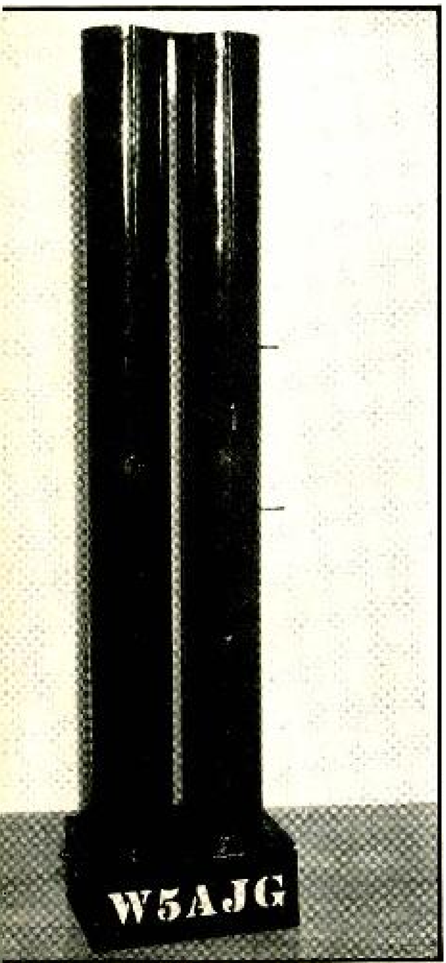
56-MC. PRESELECTION

By LeROY W. MAY, Jr.,* W5AJG

Many amateurs have felt the urge to try the 56-Mc. band after having heard lush reports of the dx being heard and worked. Many have been properly impressed—and are now among our "leading citizens" of the band. Far too many, however, have been quite unimpressed with their venture and have immediately snapped back to the lower frequencies, branding such reports of dx as a pure myth and non-existent.

*R4, 9428 Hobart Street, Dallas, Texas.

The completed 56-Mc. resonant-line preselector. The small quarter-inch pipes can be seen running on the outside of the large pipes. These carry grid and plate returns. The output coupling loop can be seen on the right hand pipe. The input loop is at the rear of the left pipe and cannot be seen in this photograph.



In most cases, mediocre reception of dx type of transmission on 56-Mc. results from the use of a single tube type of converter, performing the functions of both oscillator and mixer, this in turn working at a correspondingly lower i.f. into the regular station communications receiver. This type of converter which contains no r.f. stage has its proper place. For the expenditure and little effort involved, fair results are achieved under favorable conditions.

Weak signal dx, however, is another matter, and when band conditions are rather poor and spotty (which is all to frequent with those who spend most of their time on 56) it is the same old story. The dx buries itself just about the noise level and is most "irritatingly" elusive.

The solution to the improvement of most of this type of 56-Mc. dx reception lies in adequate preselection ahead of the mixer stage. When it is realized that a mixer stage has only one third of the gain of an r.f. tube of the same type, coupled with the fact that in a properly designed receiver noise in the first tuned circuit is amplified by subsequent tubes and predominates in the output, it can readily be realized that for good signal-to-noise ratio one must have a high gain non-regenerative r.f. stage. It might also be stated that 56-Mc. converters of commercial manufacture, which already contain an r.f. stage, can usually be improved by the addition of more r.f. preselection. Two r.f. stages preceding the mixer tube appear to be about the maximum r.f. gain usable at the average 56-Mc. location.

In previous articles[1] it has been shown that

[1]Conklin, "Transmission lines as circuit elements," RADIO, April, May, June, 1939. Conklin, "Superhet Tracking at ultra-high frequencies," RADIO, February, 1940.

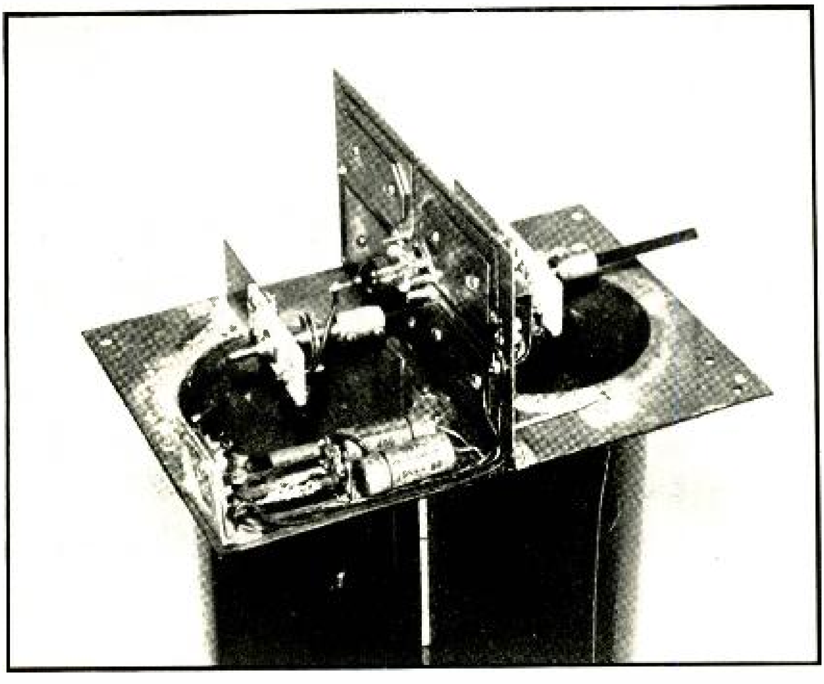
for Weak-Signal DX

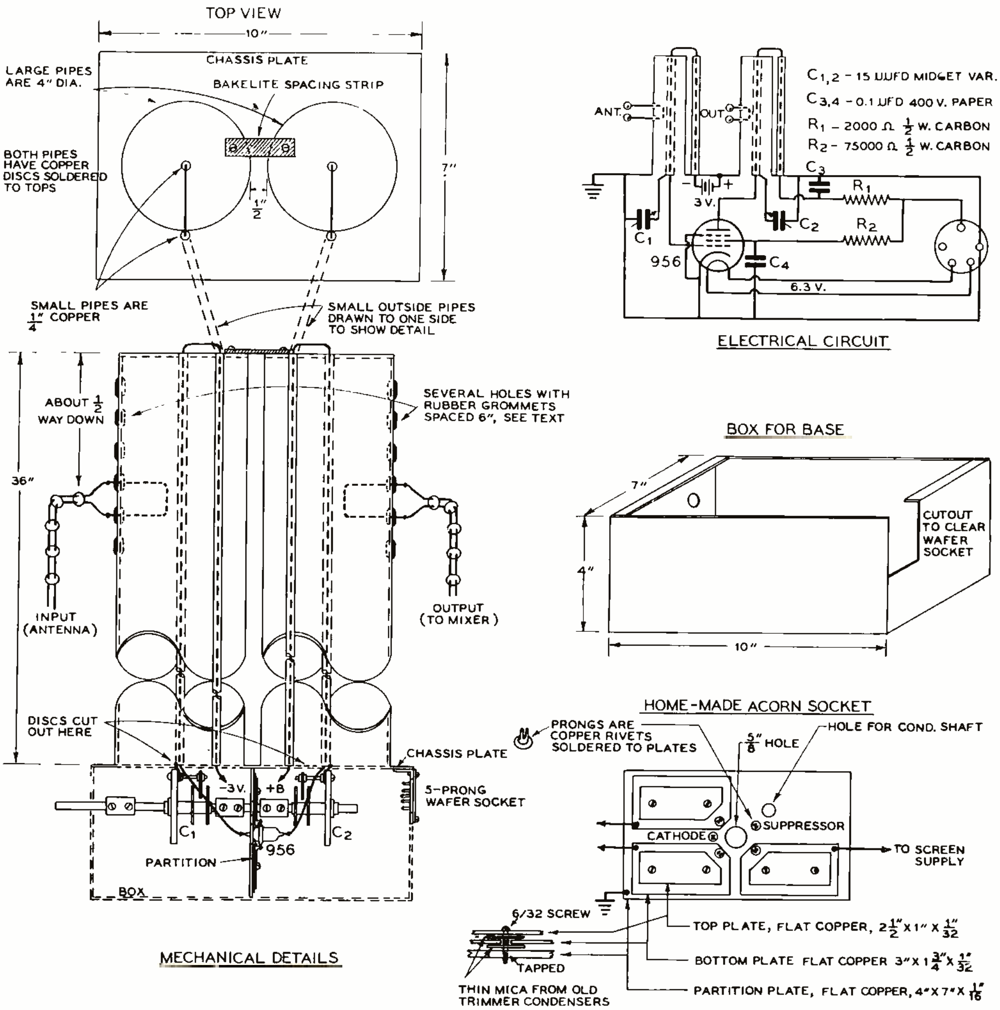
quarter wavelength sections of parallel conductors or concentric transmission lines, used in conjunction with special built u.h.f. tubes, such as acorns, are infinitely superior in gain and stability to ordinary coils and condensers and conventional tubes on 56-Mc. and higher frequencies. The reader is referred to these articles for a more detailed discussion of operation.

Here at W5AJG, excellent success has been had with a concentric preselector following the design considerations mentioned above. For the serious 56-Mc. dx enthusiast, the "plumbing circuits" are heartily recommended. Admittedly a separate preselector unit, such as the one to be described, presents a greater problem in efficiently coupling the output to the mixer or receiver than a unit in which the mixer stage is included. But with reasonably careful design excellent results are achieved. Furthermore, as one gets accustomed to the peculiarities of concentric tuned circuits, a mixer can be added to the preselector to make a complete converter in one unit.

Therefore, to get on with the business of building the preselector, a visit to the local junk yards was indicated. Since becoming a plumbing addict such a sojourn may now be termed positively fascinating. The second shop visited unearthed some 4-inch diameter copper down spout in excellent condition at one cent per inch. Two photographic copper engraving plates at fifteen cents per and about twelve feet of ¼-inch copper tubing were also

The bottom end of the preselector, as it looks when removed from the mounting base, showing the acorn tube, its socket, and the method of mounting the tuning condensers. The output pipe is to the left of the partition, the input pipe on the right. The penlite grid-bias cells are strapped on to the right of the center partition. The inner conductors of the lines are soldered to the stator lugs of the tuning condensers. The five-prong wafer socket, to which all leads are terminated, can be seen on the left edge of of the chassis.





Schematic and mechanical diagram of the 56-Mc. preselector.

picked up on the way out, and the net result was the staggering sum of one buck, fifteen. For this moderate expenditure one has the majority of ingredients necessary for a couple of ultra-efficient 56-Mc. tank circuits.

Both the grid and plate circuits of the preselector are tuned for maximum gain and employ the recently procured 36-inch lengths of copper pipe. The inner conductor is made of the ¼-inch copper tubing. This 16-to-1 ratio of diameters results in quite substantial open end impedance Z_s. This is desirable for maximum gain where selectivity is not imperative, as in an r.f. stage. In passing, it might be stated that although the circuits were designed for maximum gain and not for maximum Q (selectivity), the selectivity is much better than the best constructed coil and condenser combination ever observed in the writer's experience on 56-Mc.

Either a 954 or 956 acorn pentode may be used. The cost of the tube represents the major cost of the unit, but the constructor may be sure that in the long run the result in gain and performance at this frequency will justify the cost. After all, one doesn't regret spending five dollars on a particular unit in the transmitter if it is necessary to get certain results.

Remarkably little wiring is necessary in a unit of this type and the picture diagram illustrates both the wiring and method of assembly. A shorting disc will be necessary at the closed end of the pipes (end opposite tube and tuning condensers) and the open ends mount in two 4-inch diameter holes cut in one of the 7 x 10 inch flat copper photographic plates. The two circles of copper removed from the plate are used as the shorting discs. A husky soldering iron or small blowtorch is then used to solder both ends thoroughly in place.

A vertical copper shield partition is then soldered between the pipes under the base. This partition is used as a support for the tube socket, aside from providing isolation between input and output circuits. At the time of construction no commercially made sockets were in stock in the city, so one was built up using the shield partition as a mounting base and incorporating the tube element bypass condensers thereon. Alternately, a commercial manufactured acorn socket with built-in bypasses should be entirely satisfactory and construction would be simplified somewhat. The large drawing shows a sketch of the homespun socket, should anyone be interested in "rolling his own." The 3-plate tuning condensers are mounted on small pieces of this same flat copper which are in turn soldered onto the base plate. The condensers are lined up and mounted so that the stator plate mounting lugs fall exactly over the center of the 4-inch pipes. Then the ¼-inch inner conductor is soldered to and supported by the tuning condenser. At the opposite end of the pipes, the inner conductor is soldered to the shorting disc. It is important that a good low resistance connection be made at this shorted end for maximum efficiency.

The two copper tubes which can be seen on the outside of the large pipes provide the path for the plate and grid return wires. This eliminates the need for decoupling or bypassing these return circuits at the shorted end. The leads run up through the inside of the inner conductor, thence over the top of the shorting disc and down the inside of the small tube into the base plate. Two penlite cells provide 3 volts of fixed grid bias and are used in preference to a cathode resistor with its attending problems in regard to bypassing at this frequency.

A screen dropping resistor of 75,000 ohms is shown. This will be approximately correct when a 200-volt plate supply is used. A five-prong wafer socket is mounted on angles attached to the baseplate. Then the filament and plate voltage wires are terminated at this socket, making a plug-in unit of the preselector. Voltages may be taken from a receiver, speech amplifier or any other source of supply which will furnish 200 volts for the plate and 6.3 volts for the filament. The drain is very low and will not affect the unit from which the voltages are taken.

The entire structure is amply supported by the heavy base plate. When completed it is slipped down into a simple sheet iron box bent from a thin sheet of metal in an ordinary vise. The outside of the copper pipes may be cleaned with steel wool until shiny and given a coat of clear lacquer to preserve the finish. Or it may be painted to suit the individual. No loss in efficiency will result with painting as the outer sides are "cold."

Several small holes to take rubber grommets are drilled along the length of the pipes to take the input and output coupling loops. These loops are made of no. 14 wire in spaghetti and slid in and out in relation to the inner conductor. Experiment here is quite necessary, although 6-inch loops approximately half way down from the shorted end of the pipes will usually be satisfactory for a starting point.

Testing the Preselector

No particular difficulty should be experienced in getting the preselector to working. After checking the voltages to be sure they are correct, the 5-meter receiving antenna is coupled into the grid pipe and the output plate pipe coupling loop is hooked to what was previously the antenna coil of the existing mixer or converter. It is well to mention at this point that the input and output leads should not be "twisted pair". In nearly every case improvement will be noted when twisted pair is replaced with two closely spaced wires running parallel but separated by air. Better still, polystyrene beads designed to carry two no. 18 bare copper wires are now available. This combination makes an excellent balanced low-loss coupling line, not only for receiver work, but also for coupling between stages of a transmitter at these frequencies. The beads cost less than a penny each and the whole assembly may be pulled into a copper tube to make a *balanced* concentric line, if grounding is desired.

A test oscillator or local 56-Mc. ham across town should be enlisted and with a steady carrier, the input and output coupling loops should be adjusted for maximum signal or "S" meter reading. When properly adjusted the preselector should perform just as any other preselector on the lower frequencies, that is, as the unit is tuned across the fre-

[*Continued on Page 90*]

BANDSPREAD

By LEIGH NORTON,* W6CEM

It goes without saying that bandspread, in one form or another, is almost a necessity for high-frequency work. Bandspread takes two general forms: a mechanical device to cause a small change in tuning condenser capacity for a large knob rotation, or an electrical circuit arrangement which causes a small variation in net tuned-circuit capacity or inductance for a large variation of the variable element. Were it not for the prohibitive cost of producing a non-backlash high-ratio mechanical speed reducing unit, there is no reason why mechanical bandspread alone would not be suitable for high-frequency work. However, to make the inevitable mechanical imperfections have as little effect as possible on the action of the bandspread circuit, dials having a moderate amount of reduction are usually used and the desired frequency interval spread across the dial range by means of an electrical circuit designed for the purpose. It is with the design of the electrical part of the bandspread arrangement that this article is concerned. Three commonly used bandspread arrangements will be considered.

Parallel Bandspread

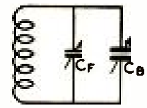
In parallel bandspread, as illustrated in figure 1, a trimming or "padding" capacity is used across the tuned circuit to set the minimum capacity and another condenser employed to increase the net capacity by a small amount. The latter condenser is the one connected to the dial mechanism, of course. The amount of frequency variation which may be obtained depends upon the ratio between the variation in capacity of the tuning condenser and the capacity of the fixed condenser.

If the frequency shift required from the bandspread circuit,

$$\frac{\text{high frequency end of bandspread range}}{\text{low frequency end of bandspread range}}$$

is denoted by A, the amount of bandspread capacity required is equal to $C_F\ (A^2-1)$, where C_F represents the trimming capacity necessary to tune to the high frenquency with the bandspraed condenser set a minimum capacity.[1]

Figure 1.
PARALLEL BANDSPREAD.



In the usual case the bandspread capacity, C_B, is known and it is desired to find the amount of fixed capacity needed. In this case

$$C_F = \frac{C_B}{A^2-1}\ .$$

The use of this simple formula in several typical examples will show one of the principle disadvantages of parallel bandspread for amateur purposes. Taking the case of a bandspread condenser having a variable range of 25 μμfd. to tune the 160-meter band:

$$A = \frac{2050}{1750} = 1.17, \text{ and}$$

$$C_F = \frac{25\mu\mu\text{fd.}}{1.17^2-1} = 67.4\ \mu\mu\text{fd.}$$

This 67 (approx.) μμfd. is not an unusual value of padding capacity for the 160-meter band, but using the same bandspread condensers for tuning the 20-meter band it is found that

$$A = \frac{14.4}{14.0} = 1.028, \text{ and}$$

*Associate Editor, RADIO

[1]By "bandspread capacity" is meant the *variation* in capacity of the bandspread condenser from minimum to maximum setting. In well-designed midget condensers the variation will closely approach the maximum capacity.

$$C_F = \frac{25\ \mu\mu fd.}{1.028^2-1} = 438\ \mu\mu fd.$$

A padding or "trimmer" capacity of 438 μμfd. is almost out of the question on 20 meters, as it would be impossible to obtain a high-impedance tuned circuit with this much capacity across the coil.

The obvious solution to the parallel bandspread problem is to reduce the capacity of the bandspread condenser to a point where a reasonably small padding condenser can be used on 20 meters, but this leads to difficulties on the 160-meter band. If, in the average receiver, the padding capacity is reduced to a total (actual padding condenser plus tube input capacity, bandspread condensers minimum, and "stray" capacity) of 50 μμfd., it is found that the bandspread condenser for full dial coverage on the 20-meter band should have a capacity range of 2.85 μμfd. At the other end of the scale it is found that 2.85-μμfd. bandspread condenser necessitates that the total capacity across the coil must be reduced to only 7.7 μμfd. to permit full coverage of the 160-meter band. Since probably 15 μμfd. of the 50 μμfd. total capacity across the coil on 20 meters was made up of fixed capacities not further reducible, it is apparent that the total parallel capacity on 160 meters could not be reduced enough to make it possible to cover the complete band with the 2.85-μμfd. bandspread condenser.

From these examples it can be seen that compromises are necessary when the parallel type of bandspread circuit is used. Usually the bandspread condenser is made large enough to cover the 160-meter band with a reasonable amount of padding condenser and a compromise between tuned-circuit impedance and bandspread made on the 10- and 20-meter bands. An alternative method is to switch the bandspread condenser along with the coils, using two or possibly three different sizes of bandspread condensers across each coil. This method is wasteful of tuning condensers, however, and also leads to complications in mechanical design. Some of the disadvantages of parallel bandspread may be eliminated through the use of series bandspread.

Series Bandspread

Series bandspread is simply parallel bandspread with a circuit arrangement to allow the capacity range of the bandspread condenser to be varied from band to band. Instead of a single tuning condenser across the coil, two condensers in series are used. One of these is considerably larger than the other, and acts as the bandspread tuning condenser. The smaller condenser serves to set the maximum capacity which the series combination can obtain, the minimum capacity varying but little for any change in the setting of the small condenser. A separate "small" condenser is usually used on each band, the different condensers being associated with the coils in such a manner that they are automatically switched into the circuit when bands are changed.

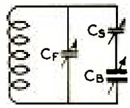


Figure 2
SERIES BANDSPREAD

To get a mathematical expression for the values of any one of the three condensers shown in figure 2 the resultant capacity of the two series condensers may be set equal to the bandspread capacity given in the case of parallel condensers:

$$C_F(A^2-1) = \frac{C_S C_B}{C_S + C_B}$$

Solving for C_S, the fixed series condenser:

$$C_S = \frac{C_F C_B (A^2-1)}{C_B - C_F(A^2-1)}$$

Example:

Frequency range = 3500 to 4000 kc.
$A = 1.14$
$A^2 = 1.3$
$C_F = 100$ μμfd.
$C_B = 150$ μμfd.

$$C_S = \frac{100 \times 150 \times (1.3-1)}{150 - 100 \times (1.3-1)} = \frac{4500}{147} = 30.6\ \mu\mu fd.$$

A small variable condenser having a maximum capacity of 35 μμfd. would be suitable for the "fixed" series condenser. Calculation for C_S with values of A corresponding to other bands will show the maximum and minimum values which the fixed series capacity must have in an all-band tuning system, and thus show the capacity of condenser which must be used if it is desired to have a single manually-set unit serve for C_S on all bands.

The series bandspread system has the advantage that it allows slight manufacturing variations in commercial receivers to be compensated by simply juggling the capacity of the "fixed" series condenser and the parallel trimmer. Another great advantage is that it allows either full-coverage or bandspread tuning simply by shorting C_S or leaving it in the circuit.

The above equation represents the usual case where the sizes of the bandspread and trimming condensers are known and it is desired to find the value of series condenser required to give a certain amount of bandspread. Occasionally it might be useful to know the value required for C_B or C_F when C_F and C_S or C_B and C_S are known. In these cases:

$$C_B = \frac{C_F C_S (A^2 - 1)}{C_S - C_F (A^2 - 1)}$$

$$C_F = \frac{C_B C_S}{(C_B + C_S)(A^2 - 1)}$$

One great disadvantage of series bandspread is the extreme non-linearity of tuning when the bandspread and "series" condensers have widely different capacities. The net capacity across the coil changes rapidly with the change in bandspread capacity when the bandspread condenser is near minimum capacity. As the bandspread condenser is rotated toward minimum capacity the change in net capacity becomes more and more for each degree of angular rotation. Series bandspread thus causes the high frequency end of the band to be squeezed into a few dial degrees and the rest of the band spread out across the rest of the dial range. Some of this difficulty can be eliminated by placing a fixed minimum capacity across the bandspread condenser to keep the minimum capacity substantially greater than the capacity of the series condenser or by using a bandspread condenser with specially shaped plates. The first method has the disadvantage of requiring still another condenser in the tuned-circuit assembly, while the second requires a tuning condenser ordinarily not available to the home constructor.

Tapped-Coil Bandspread

Series bandspread is not often used in home-built amateur equipment. This is probably because it is wasteful of condensers, and its most important advantage—that of allowing any amount of bandspread with any coil, up to the point where the bandspread condenser must be connected across the whole coil—is also obtainable in the less costly tapped-coil system. A rough parallel may be drawn between the tapped-coil and series systems by considering that the series method allows the capacity across the coil to be spread out so that some of it may be tapped by the bandspread condenser. Since two condensers are required to "spread out" the capacity, one of these by itself may also serve as a bandspread tuning condenser. With a coil, however, the

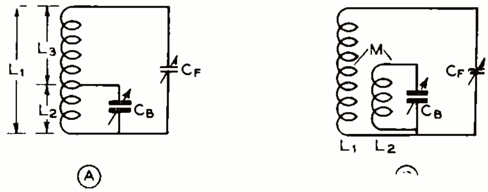


Figure 3.
TAPPED-COIL BANDSPREAD.

inductance is already "spread out" along the coil form so that any portion of it may be used, and the bandspread condenser tapped directly across that part of it. The burning question is, of course, where to put the tap.

In analyzing the tapped-coil system shown in figure 3A, it is necessary to delve into the theory of coupled circuits. In this type of circuit the presence of C_B across L_2 will cause an impedance to be coupled into L_1. The nature and amount of the coupled impedance will depend upon the series impedance of the L_2-C_2 combination and the mutual inductance between L_1 and L_2. If the resistance component of the impedance of L_2 is disregarded and the reactance alone considered, the coupled impedance will be a reactance having a value equal to

$$\frac{\omega M^2}{\frac{1}{\omega C_B} - \omega L_2}, \text{ where}$$

M = Mutual inductance betwen L_1 and L_2,
C_B = Capacity of C_B,
L_2 = Inductance of L_2,
$\omega = 2\pi F$, and
F = Frequency.

In the ordinary bandspread circuit the reactance given by the above equation will be inductive (positive) and the resonant frequency with C_B added will be lower than that of L_1-C_F alone.

The amount of additional coupled series inductive reactance necessary to shift the resonant frequency of L_1-C_1 from that which it would be without C_2 to another lower frequency is equal to:

$$\omega L_1 (A^2 - 1),$$

Where A represents the bandwidth as previously given and ω represents $2\pi F$, F being the low-frequency end of the band. By setting the previous two equations equal to each other, it would be possible to find the necessary mutual inductance for any desired amount of bandspread for any values of L_1, L_2 and C_B with the circuit shown in figure 3B. With the arrangement shown in figure 3A, however, it is obviously impossible to vary M without also varying L_2. The problem is complicated by the fact that although L_2 and M vary in the same direction they do not vary linearly in respect to each other.

Determining the Mutual Inductance

The mutual inductance, M, between L_1 and L_2 in figure 3A is made up of two parts; one of these is the self-inductance of L_2 alone, since L_2 is quite obviously common to both itself and L_1. The second part of the mutual inductance is that obtained by magnetic coupling between L_2 and L_3, considered as though they were separate coils. The latter portion of the mutual inductance is not a linear function of the number of turns in the two coils. To determine the mutual inductance between L_2 and L_3, the well-known expression, $L_2+L_3+2M=L_1$, may be used. The mutual inductance thus found may be added to the self-inductance of L_2 to obtain the total mutual inductance between L_1 and L_2. The inductance of L_2 in terms of L_1 and the ratio between the turns of each follows the equation:

$$L_2=L_1\left(\frac{289B^3}{200B^2+90B-1}\right),\ \text{where}$$

$$B=\frac{\text{number of turns on } L_2}{\text{number of turns on } L_1}.$$

The inductance of L_3 will be:

$$L_3=L_1\left(\frac{289(1-B)^3}{200(1-B)^2+90(1-B)-1}\right).$$

When the inductances of L_2 and L_3 found by the above two equations are added together the sum will be less than L_1 by an amount equal to twice the mutual inductance between L_2 and L_3. When the mutual inductance between L_2 and L_3 is added to L_2 the total mutual inductance between L_1 and L_2 may be found. The above two equations are derived from Wheeler's inductance formula as modified to include coils in which the length is small in proportion to the diameter. They assume that the winding pitch of L_1 is constant and that L_1 is approximately "square" (diameter equal to length). The modified form of Wheeler's formula is:

$$L(\mu hy)=\frac{r^2N^2}{r\left(9-\frac{r}{5l}\right)+10l}$$

Where:

N = Number of turns
r = Radius in inches
l = Length in inches

Wheeler's formula is accurate within 2 per cent for all values of diameter-to-length ratio from zero to twenty[2].

In constructing the tapped-coil charts of figure 5 the inductance required for a given bandspread condenser tapped at a given point has been determined rather than to try to locate the tap directly. The required inductance is obtained from the relationship:

$$\omega L_1(A^2-1)=\frac{(\omega M)^2}{\frac{1}{\omega C_B}-\omega L_2}$$

which was previously shown to be correct. For any given tap point the mutual reactance, ωM, may be replaced by the product of a constant, G, and ωL_1. The constant may be taken from figure 4 and represents the relationship between the mutual inductance and the inductance of L_1 for the tap point chosen. The reactance of the tapped portion of the coil, ωL_2, may likewise be replaced by a constant, H, and ωL_1 for the same tap point. Constant H represents the relationship between the inductances of L_1 and L_2 for a given tap location and is also given in figure 4. Replacing ωM and ωL_2 by their equivalents in terms of ωL_1 and the constants gives:

$$\omega L_1(A^2-1)=\frac{(G\omega L_1)^2}{\frac{1}{\omega C_B}-H\omega L_1},\ \text{and}$$

$$\omega L_1=\frac{A^2-1}{\omega C_B[G^2+H(A^2-1)]}$$

Dividing by ω gives:

$$L_1=\frac{A^2-1}{\omega^2 C_B[G^2+H(A^2-1)]}$$

In a more useful form:

$$L_1(\mu hy)=\frac{A^2-1}{0.395\,F^2C_B[G^2+H(A^2-1)]\times 10^{-10}}$$

where

A = bandspread range, as previously given,
F = low-frequency end of tuning range, in kilocycles
G = constant from figure 4 for any given tap point,
H = constant from figure 4 for the same tap point, and
C_B = capacity of C_B, in $\mu\mu$fd.

[2] "Radiotron Designer's Handbook," p. 145.

Using the Charts

The tapped-coil charts apply only to circuits tuned to the signal frequency; i.e., they are not accurately applicable to all superheterodyne oscillator coils. The lower the i.f. channel frequency and the higher the signal frequency the greater will be their accuracy for oscillator coil purposes. When the intermediate frequency is 465 kc. or thereabouts the curves for the three higher frequency bands will also serve with acceptable accuracy for locating the oscillator coil bandspread tap.

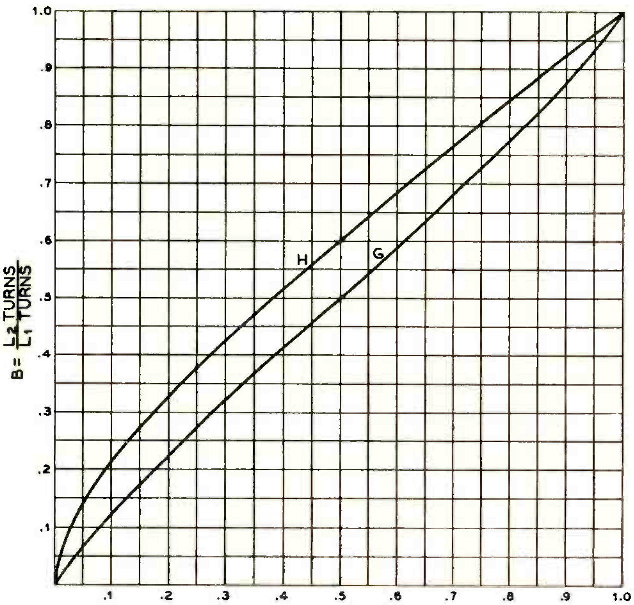
Theoretically, allowance should be made for the effective increase in oscillator coil inductance when the "hot cathode" type of oscillator with the cathode tapped on the coil is used. In practice it has been found, however, that the filament-cathode capacity of most tubes is low enough so that the effect may be disregarded. The effect of loosely coupled oscillator ticklers and signal-frequency coil primaries may likewise be disregarded in most cases.

The figures given on the various tapped-coil curves correspond to the maximum capacities of the bandspread condensers indicated. The reduction of tuning range caused by the presence of a definite minimum capacity in the bandspread condenser is offset by an increase in the effective inductance—and an increased tuning range—when the bandspread condenser minimum is placed across the coil. The other capacity figures on the charts refer to the total (trimmer plus stray capacity) capacity required to tune the coil to the *high frequency* end of the tuning range with the bandspread condenser *disconnected* from the coil. It will probably be more convenient to calculate the coil inductance directly than to try and estimate the stray and trimmer capacities. The following formula[3] will give the coil inductance directly:

$$L(\mu hy) = \frac{0.2\ d^2N^2}{3d+9l}\text{ , where}$$

d = coil diameter, in inches,
l = coil length, in inches, and
N = number of turns.

[3]Franklin "How Many Turns?" RADIO, Jan., 1939, p. 50.

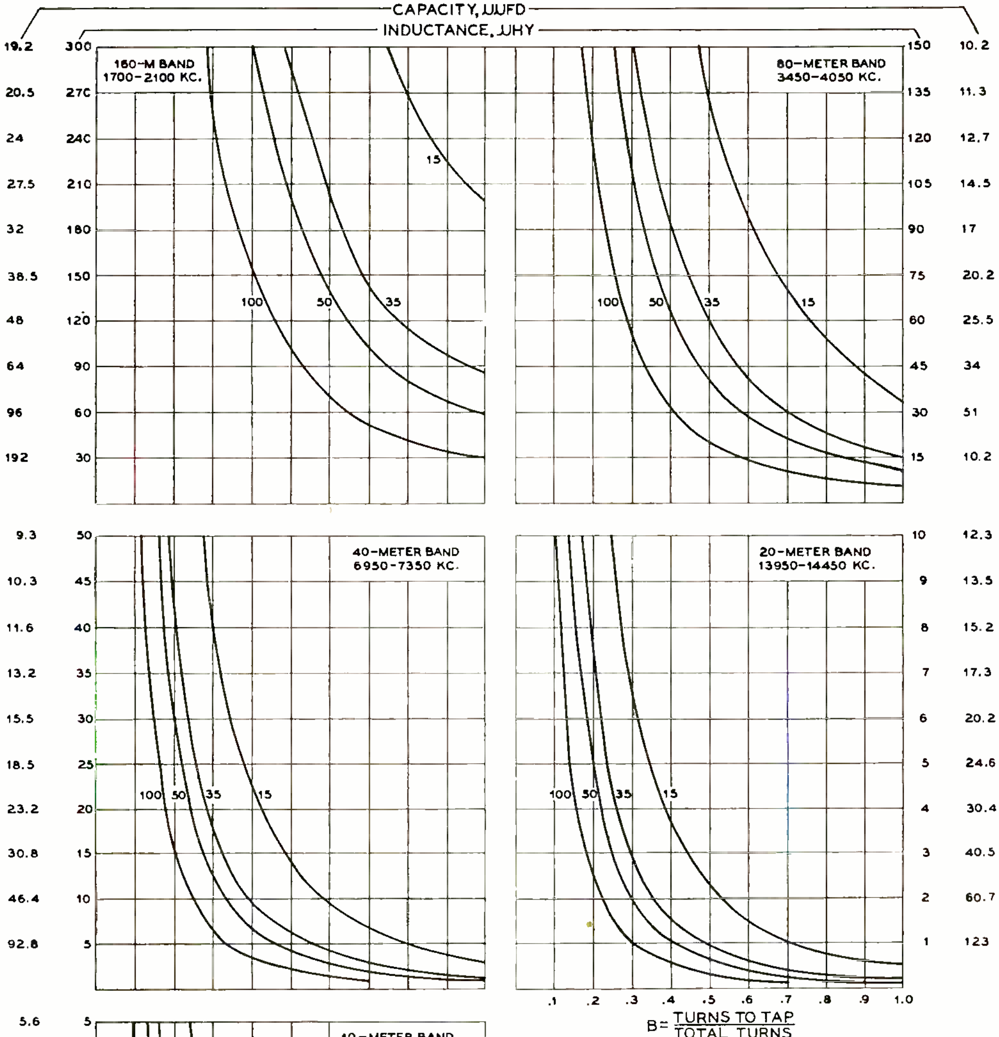


FACTOR BY WHICH INDUCTANCE OF L_1 MUST BE MULTIPLIED TO GET:
G—MUTUAL INDUCTANCE BETWEEN L_1 AND L_2
H—INDUCTANCE OF L_2

Figure 4.
The curves show the factors by which the total coil inductance must be multiplied to get the mutual inductance, M, between L_1 and L_2 (figure 3) or the inductance of L_2. If greater accuracy than can be obtained from the curves is desired the formula for L_2 as given in the text may be used. M is equal to

$$L_1\left(\frac{L_2 - L_3 + 1}{2}\right).$$

The formula for L_3 is also given in the text.



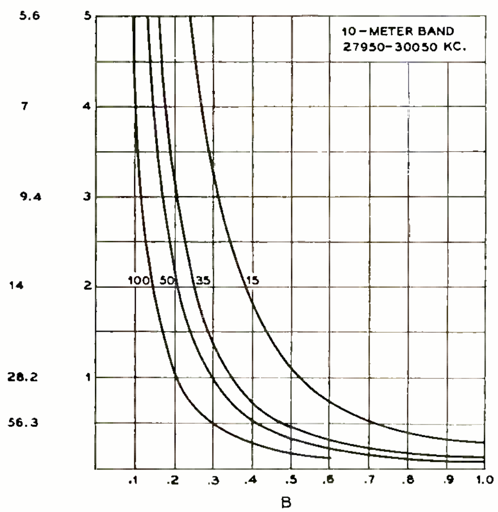


Figure 5.

TAPPED-COIL BANDSPREAD CHARTS.

To use the charts, locate the coil inductance in the columns at the right or left opposite the band in question. Reading to the right or left opposite the coil inductance, the proper location of the bandspread tap "B" will be found below the intersection of the inductance and the curve marked with the bandspread condenser capacity. The capacities given in the vertical columns are those required to resonate a coil of the indicated inductance at the high frequency end of the tuning range with the bandspread condenser disconnected from the coil. This capacity will include the parallel trimmer condenser and all stray capacity across the coil. Greatest accuracy in using the charts will probably be obtained by calculating the coil inductance directly from the formula given in the text. The charts assume that the coil length and diameter are equal, but will be acceptably accurate for moderate deviations from this d/l ratio.

The complete transmitter unit, with the dust cover in place, makes a very neat installation. Note that the mike is in the remote control jack for making an adjustment on the transmitter.

A MOBILE TRANSMITTER

With Instant Heating Tubes

By H. L. NEWNAN*

A filament-tube mobile transmitter capable of 40 watts input to the final stage. Through the use of quick-heating tubes the average daily drain in police work has been reduced to about 10 ampere-hours from the 70 ampere-hours average requirement of a heater-tube transmitter of comparable ratings.

A short time ago it became necessary to obtain six additional mobile police transmitters for use in our department. There were a number of excellent commercial jobs available at the time, but all of them employed heater-type tubes that had to be left on when in standby position, or they used slow-heating dull-filament tubes that required several seconds to come to operating temperature. Since previous experience had shown that these were not all that could be desired, the unit described herein which employs thoriated, quick-heating filament tubes was developed.

Two tube types are used throughout in the transmitter: the HY69, a beam tetrode that has been available for some time, and the new HY31Z, a dual triode developed primarily for use as a zero-bias class B modulator. Our results have shown that this latter tube type works quite as well as a doubler or push-pull modulated amplifier as it does as a class B modulator. This fact simplified the selection of tube types in the design of the transmitter.

*2756 Marty Way, Sacramento, Calif.

The R.F. Circuit

The HY69 beam tetrode is used as the crystal oscillator with a 7 to 8 Mc. crystal, and with the plate circuit tuned to the crystal frequency. The next tube is an HY31Z, each triode of which acts as a doubler. The second doubler is link coupled to the grid of the final stage, in this case another HY31Z. The grid inductance for the final push-pull stage should be adjusted by cut-and-try to the point where a minimum amount of tuning capacity is required. In other words, the coil should be cut so that the 25 $\mu\mu$fd. per section grid condenser tunes nearly clear out; this allows maximum excitation voltage to be developed on the grids of the final stage.

Audio Lineup

The audio section of the transmitter ends up in another HY31Z as a class B modulator. Then, still another HY31Z acts as two stages of audio between the mike and the modulator —one stage acting as a voltage amplifier and the other acting as driver for the class B tubes. Note that the return from the center tap of the driver transformer goes to the positive side of the A circuit. By connecting to this side of the A line the no-signal plate current on the modulators is increased somewhat, thus reducing plate voltage fluctuation under modulation. Resistance coupling is employed between the two speech stages. Grid bias for them is obtained from a 100-ohm center-tapped resistor across the 6.3-volt line. The bias voltage is of course filtered by a resistance-capacity circuit before application to the grids of the tubes.

Mechanical Details

All tuning controls, and the jacks for current measurements, are brought out to the front of the chassis. The four insulated plate current jacks are mounted on a bakelite plate, then this plate is bolted to the front drop of the chassis with clearance holes for the jack bodies. The grounded jack near the left edge of the chassis is in series with the grid return of the final amplifier; hence, it reads grid current to these tubes.

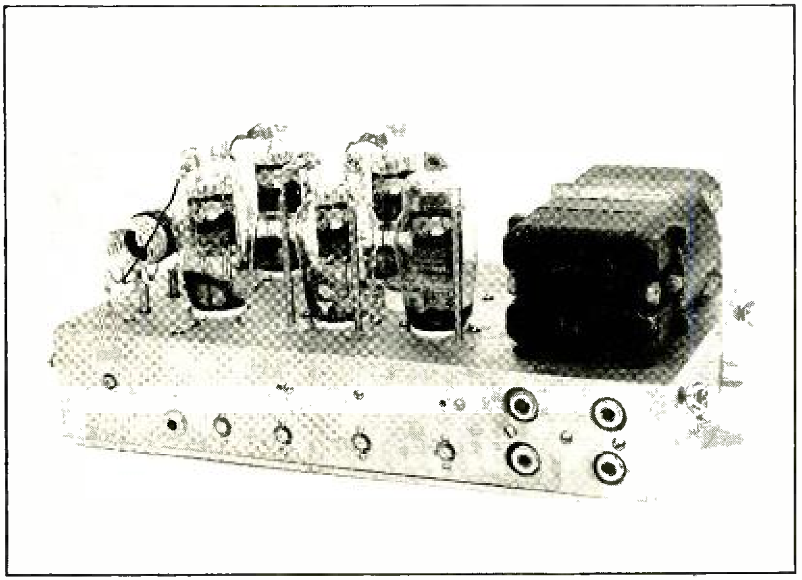
The tuning condensers are in sequence from right to left across the front of chassis. All are of the screwdriver-set type. The neutralizing condensers for the final are adjusted from the top, and are located one on each side of the output tube. A 30-$\mu\mu$fd. compression type padder condenser is coupled between the plate and grid of the oscillator due to the high degree of shielding in the HY69. This condenser, in actual use, is left nearly open. The adjusting screw is removed and about a third of the movable plate is trimmed off.

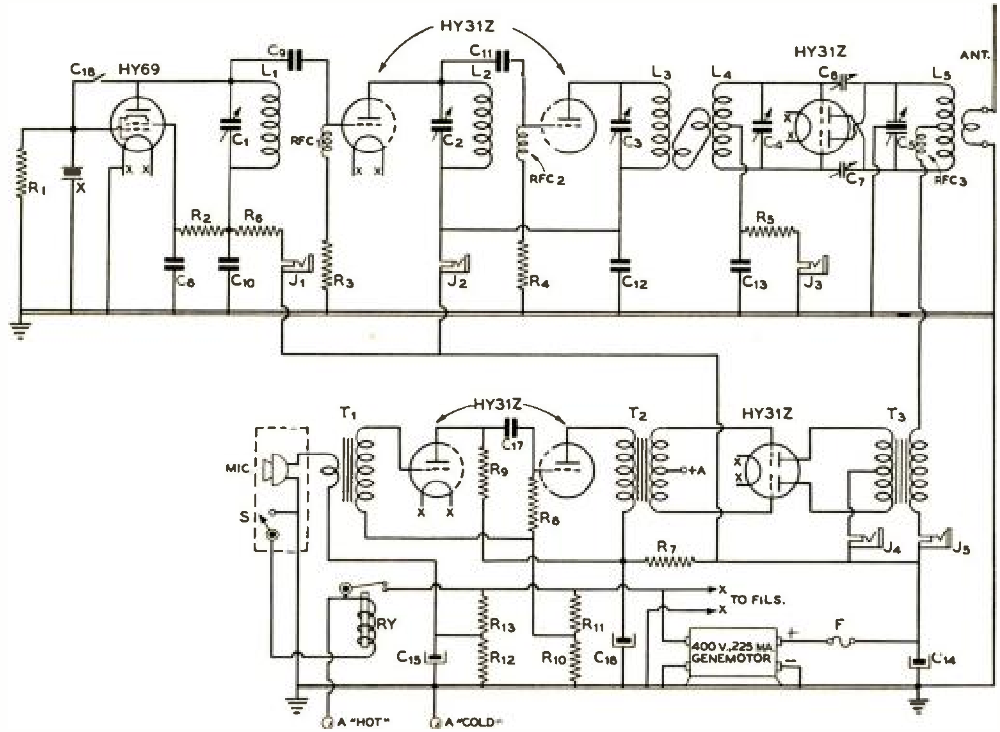
All sockets are ceramic and are mounted on collars one inch below the chassis top. The genemotor mounts on four rubber grommets to reduce vibration. Lucite feed-through bushings are used where the radio frequency plate leads pass through the chassis, while rubber grommets are used for audio leads. The chassis is of cast aluminum, 8″ by 15″ by 2-5/8″ high, with a cast aluminum base. A standard type dust cover is held in place with 10-32 wing nuts and lock washers. Standard cadmium plated steel chassis with dust covers to match are available in the 8″ by 17″ by 2-1/2″ size and could be used just as readily.

Installation

Since the transmitters are placed in the rear compartment of our cars, it was found necessary to run a zero B & S starter cable from the car battery to the rear. This line is fused with a 60-ampere 250-volt cartridge fuse as near the battery as possible. The fuse mounts in a standard porcelain holder. Any cable smaller than zero B & S gauge will re-

Front view of the transmitter with the case and control cables removed. The functions of the five screwdriver-set tuning condensers and the five meter jacks are described in the text.





Mobile transmitter wiring diagram

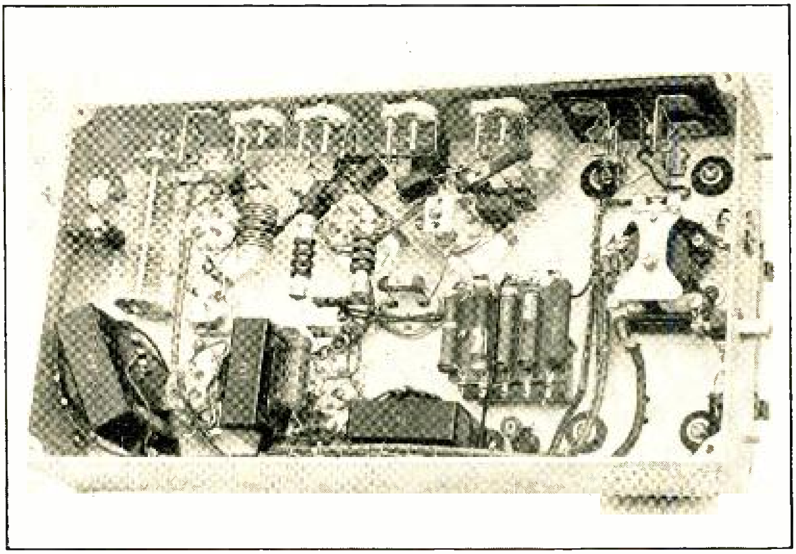
- C_1, C_2, C_3—50-μμfd. midget variable
- C_4—25-μμfd. midget variable
- C_5—Dual 30-μμfd. midget, double spaced
- C_6, C_7—10-μμfd. midget, double spaced
- C_8—.005-μfd. mica
- C_9—.0001-μfd. mica
- C_{10}—.005-μfd. mica
- C_{11}—.0001-μfd. mica
- C_{12}—.005-μfd. mica
- C_{13}—.002-μfd. mica
- C_{14}—20-μfd. 450-volt electrolytic
- C_{15}—1000-μfd. 6-volt electrolytic
- C_{16}—8-μfd. 450-volt electrolytic
- C_{17}—.05-μfd. 600-volt tubular
- C_{18}—See text
- T_1 — Single-button-microphone-to-grid transformer
- T_2—Class B driver transformer
- T_3 — 10-watt modulation transformer
- R_1—75,000 ohms, 1 watt
- R_2—30,000 ohms, 2 watts
- R_3—75,000 ohms, 2 watts
- R_4—50,000 ohms, 2 watts
- R_5—1000 ohms, 2 watts
- R_6—8000 ohms, 10 watts
- R_7—10,000 ohms, 1 watt
- R_8—10,000 ohms, 1 watt
- R_9—7500 ohms, 1 watt
- R_{10}, R_{11}—100 ohms, 1 watt
- R_{12}, R_{13}—50 ohms, 1 watt
- J_1, J_2, J_3, J_4, J_5—Closed-circuit jack
- S—"Push-to-talk" switch in mike handle
- RFC_1, RFC_2, RFC_3—2½ mhy., 125 ma. r.f. choke
- RY—6-volt s.p.s.t. relay

Coils for 33- to 36-Mc range:

- L_1—24 turns of no. 20 enam. close-wound on ¾" form
- L_2—12 turns of no. 20 enam. wound 12 turns per inch on ¾" form
- L_3—8 turns of no. 20 enam. wound 12 turns per inch on ¾" form
  Link: 2 turns of hook-up wire at cold end
- L_4—10 turns of no. 20 enam. wound 12 turns per inch on ¾" form
  Link: 2 turns of hook-up wire at center
- L_5—10 turns of no. 12 bare hard-drawn copper wire, self supporting. Wound in two sections with space at center for antenna coil. Total length—2", diameter—1".
- Antenna Coil—4 turns between halves of L_5. Insulated with Empire tubing

sult in an appreciable voltage drop at the transmitter end. Connection is usually made to the starting relay "hot A" terminal under the hood of the car. The microphone and press-to-talk switch wiring consists of a two conductor rubber covered extension cord run from the transmitter to the instrument panel of the car. The common return from the mike and switch runs to ground. Jones plugs and receptacles are used so the mike can be plugged in either in the driver compartment or direct into the transmitter chassis for operation while tuning up.

No attempt has been made completely to eliminate the genemotor hum. The 20-μfd. 450-volt condenser was found entirely satisfactory for our purpose. For those who desire complete elimination of hum, a choke with 250-ma. capacity and two 8-μfd. condensers should be used.



Underside of the chassis. Note the power control relay in the right hand portion of the chassis under the genemotor; note also that this particular chassis is of cast aluminum construction.

Operating Data

The oscillator plate current is about 20 ma., and the two buffer-doubler stages combined draw 50 to 60 ma. The final is loaded to 100 ma. and at 400 volts, hence the input is 40 watts. The final uses a 1000-ohm resistance for bias and the grid current is from 22 to 28 ma. Operating at from two to three times cut-off and with ample grid current, the efficiency of this stage is high. While our license only calls for 50 per cent efficiency, the actual efficiency is nearer 70 per cent, or 28 watts output. The plate current on the audio driver is about 15 ma. The total drain from the 400 volt 225 ma. genemotor is about 225 ma. when unmodulated. On audio peaks the drain is about 260 ma. However, the genemotor carries the load easily, and when the transmitter is modulated 100 per cent with a sustained note the voltage drop is only 10 volts. This is better regulation than many a.c. power units will give.

Neutralizing of the final is quite critical, but it can be done in the conventional manner by opening the plate jack to the final and using a 2-volt 60-ma. dial light, with a link, coupled to the final tank inductance. With average wiring the 10-$\mu\mu$fd. condensers are about 55 per cent closed. After the circuit is roughly neutralized with the dial light, it can be more completely neutralized by connecting a 0-150 voltmeter (with polarity reversed) between the chassis and the center tap of the final inductance and tuning for maximum dip. Be sure to disconnect this meter before connecting the plate voltage again.

Radio frequency by-pass condensers to the oscillator and doubler stages should be connected to a common point such as one metal socket frame. Make sure that condenser C_{15} is polarized properly depending upon whether or not A positive is hot or ground.

Johnson-Bassett 34-ohm concentric line couples the final tank inductance to the quarter wave antenna on the car. On some installations this is not necessary as only a few inches of wire is required between the transmitter and the antenna connection.

The writer is partial to an r.f. amplifier with push-pull output and the results obtained with these transmitters far exceeded our expectations. There are numerous methods of obtaining equal results with oscillator-doubler circuits or beam doublers and these were tried out. But we found a high mu triode hard to beat as a doubler, even taking into consideration the fact that it requires a few more ma. of grid current.

Total battery drain with full output is about 41 amperes. As the average police car operates intermittently for less than fifteen minutes daily the battery drain is only about ten ampere-hours. Transmitters with heater tubes drawing 3.5 amperes that must be kept turned on for 20 hours a day use up 70 ampere hours from the car battery for filaments alone.

See Buyer's Guide, page 97, for parts list.

A Wide Range

U. H. F. WAVEMETER

By M. P. REHM,* W2HNY

In our work on the ultra-high frequencies we have often needed a means of quickly spotting the frequency of a new transmitter oscillator or receiver detector. Lecher wires will give a good indication, but they are bulky, must be used carefully, and should really be calibrated before use. There are other methods, one of which will be described later, but all seem unsatisfactory for quick, accurate frequency checks.

The General Radio *Experimenter,* August 1940 issue, gave a description of a new u.h.f. wavemeter consisting of a 270-degree straight-line frequency condenser with a contact arm and single-turn coil forming a variable inductance that covers 55 to 400 megacycles. Variable inductors of this type have been used before in u.h.f. apparatus such as the Western Electric mobile police transmitters. We decided to make a "junk-box" version of this wavemeter, also having in mind its use as a transmitter or receiver tuning unit.

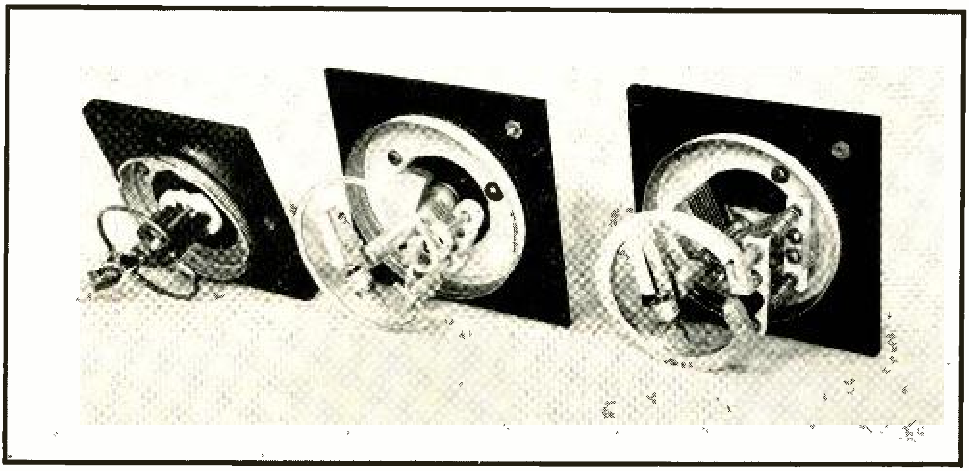
*969 Roanoke Ave., Riverhead, N.Y.

The first unit, shown to the left in figure 1, was built with a Hammarlund APC-75 condenser. An old rheostat provided us with a silver-plated spring-brass slider and some no. 10 hard-drawn copper wire was bent into a 2½-inch diameter ring. One end of the coil was bent and soldered to a post of the stator. The other coil end was fastened to a ¼-inch hard rubber rod. The condenser shaft was extended with a ½-inch length of ¼-inch brass rod which was drilled and soldered to it. Then the slider was fastened to the condenser rotor. After some "cut and try" we found that a single-turn coil 2¼ inches in diameter resonated at 55 megacycles with the condenser at maximum capacity.

A resonance indicator was made from a one inch long loop of wire with the ends soldered to a 60-ma. dial lamp. A piece of varnished cambric tubing (spaghetti) was used for insulation and the entire loop was duco-cemented and tied to the variable arm.

For protection of the parts we found a small glass jar of the proper size on the xyl's

Figure 1. The three u.h.f. wavemeters. From left to right they are: no. 1, the one using the APC-75 condenser; no. 2, with an MC-50-M in the center; no. 3, with the 270° straight-line frequency condenser, is on the right.



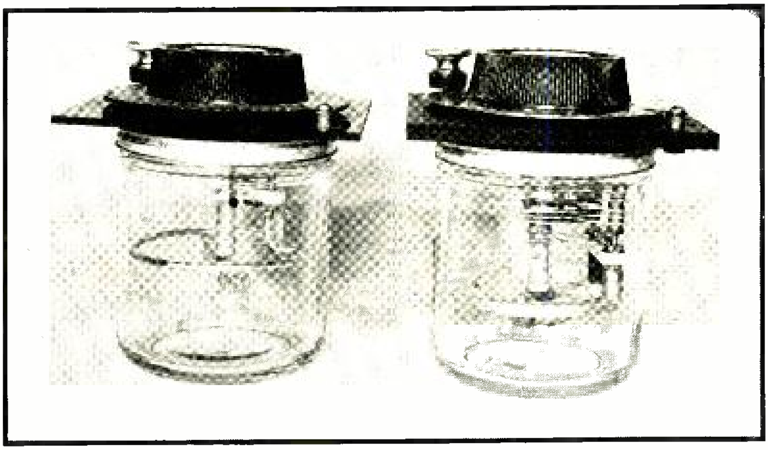


Figure 2. U.h.f. wavemeters no. 2 and 3 complete in their mounting jars. Note the square panel larger than the jar which allows the meter to be set on its side without rolling off the table. Note also the rubber-tire vernier dial drive and the metal dial scale.

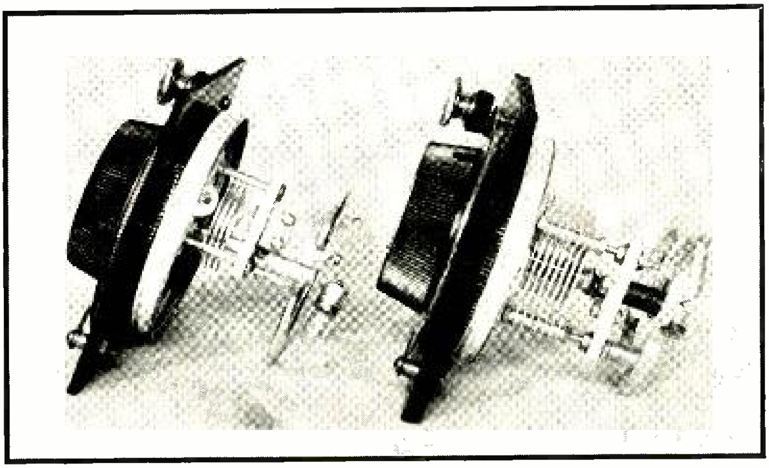


Figure 3. U.h.f. wavemeters no. 2 and 3 showing constructional details.

pantry shelf.[1] The center of the metal cap is cut out to clear the condenser. It is drilled and mounted on the underside of the four inch square bakelite top, then the glass jar is simply screwed into the cap. This also provides a good means of holding the wavemeter and the resonance lamp can be seen from most any angle.

We were able to get a general idea of the frequency coverage from our acorn super-regenerative receiver. This receiver has plug-in coils for 50 to 300 megacycles and it had previously been calibrated from harmonics of the high frequency oscillator in our Hallicrafter Five-Ten, and also from various u.h.f. signals. With the wavemeter condenser at maximum and the coil adjusted for 55 Mc. at zero dial degrees, the high frequency end shows about 340 Mc. on a plotted curve. Since the condenser plates are straight-line capacity, the curve shows plenty of spread at 56 Mc. but very little at 112 or 224 Mc. However, it was a good start as this unit has been in use for several months and it is holding its calibration very well.

The Second Unit

Our second step was to find a condenser to provide a more even frequency spread. The next one used was a Hammarlund "Midline" MC50M, as seen in the wavemeter in the center of figure 1. In the meantime, we had been covering the grocery stores and had found a pickle jar that measured 3¼ inches

[1]Broderson, "A 112 Mc. Bandspread Wavemeter", RADIO, Mar., 1941, p. 57.

inside diameter. This meant that we could use a larger coil, which matched the 50 $\mu\mu$fd. condenser. Preliminary tests on this unit showed that the minimum capacity of the condenser was comparatively high, so the rear bearing was removed. This reduced the minimum capacity an estimated two $\mu\mu$fd. In its place on the isolantite strip was mounted a small bracket and a one inch by one-half inch piece of polystyrene to support the coil. The 1½-inch spring bronze slider was soldered to a 1¼-inch piece of brass rod drilled to fit the condenser shaft.

The coil is made of no. 8 copper wire. One end is threaded 6-32, then bent and bolted through the polystyrene support. The other end is bent in, then back to the condenser stator and soldered as shown in figures 1 and 3.

The resonance indicator loop is made from a piece of spring bronze with the brass shell of a dial light socket soldered to one end. The other end is bent to touch the lamp tip contact. It is mounted on the slider on a small piece of drilled and tapped polystyrene.

The dial is four inches in diameter and has a "rubber-tire" vernier. The hard rubber top is four and one half inches square and this makes it possible to lay the wavemeter on its side without having it roll away. The frequency range of this unit is 55 to 270 Mc.

The Final Version

The right hand unit in figure 1 was built around a National SE-75 condenser. It is close to straight-line frequency and has 270 degrees of rotation as against 180 degrees for the other condensers used. The particular one we used was ordered special with a rear shaft extension in place of the usual "constant impedance pig-tail." As a further modification the aluminum supporting bracket was cut off the bottom to lessen the minimum capacity. Also, the rotor stops were removed to give 360-degree rotation and to prevent the dial from slipping if it were turned too hard against these stops.

The coil is a 3-inch o.d. brass ring ¼ inch square. A 3/16-inch piece is cut out and the coil is notched with a hack saw so that the ends can be bent to fit the mountings. Holes are drilled near the ends for flat-head 6-32 screws. The contact surface is rounded slightly with a fine file, then buffed and polished with rouge until it is very smooth. One mounting is a ⅜-inch brass rod tapped and screwed to one of the stator plate studs. The other mounting is made of hard rubber rod, tapped and fitted with a 6-32 stud to replace one of the rotor bracket screws as shown in figure 3. The hard rubber has since been changed to polystyrene with no noticeable difference in performance.

The condenser shaft is threaded 14-20 and a piece of ⅜-inch brass rod is tapped to fit on ¼ inch. Set screws are used to prevent the rod from changing position. Since the coil is fixed in diameter, the frequency is set by changing the length of the center rod and the coil mounting. Final dimensions were: center rod ⅞ inch long and coil mountings 19/32 inch. The contact arm is a piece of spring bronze 1½ inches long by ¼ inch wide soldered to the shaft extension. The contact end is bent slightly U-shaped—similar to a rheostat arm—to insure good contact at one spot on the coil. Since the slot between coil ends is small, the arm will ride over it and continuous rotation is possible.

The resonance indicator is mounted the same as on the previous model.

The dial is four inches in diameter and 0 to 100 divisions cover 270 degrees of rotation. The hard rubber top is 4½ inches square by ¼ inch thick.

Calibration

All premilinary frequency checks were taken from the aforementioned super-regen. This number 3 unit covers 55 to 290 megacycles. The final calibration of all three units was done with our small crystal-controlled transmitter, which has a Bliley HF2 14490 kc. crystal (the fundamental of which is actually 4830kc.) in a regenerative 6L6, then into an RCA 807, into an HK24. The 6L6 will give very small grid current at the twelfth harmonic of 4830kc., and harmonics through the ninth are very usable. The 807 will double or triple and HK24 will double, triple or quadruple so that frequencies to 232 megacycles are available. Other crystals gave various reference points so a good calibration was obtained. One or two watts will light the 60 ma. resonance indicator. For closer coupling the glass jar can be removed.

The number 3 wavemeter gave the best curve due to the straight-line capacity characteristic of the condenser. The additional rotation and spread gives more accurate frequency readings.

The nos. 2 and 3 wavemeters were disassembled and all coil parts were silver-plated. There was no noticeable difference in operation after silver-plating, but it has recently been said that tarnished silver has a much lower contact resistance than tarnished copper or brass.

[*Continued on Page 91*]

This 100 watt unit may be used either as an exciter or as a c.w. transmitter, on all bands from 10 to 80 meters. The chassis as well as the front panel is constructed of Masonite.

A 100 Watt Semi-Bandswitching TRANSMITTER or EXCITER

By W. T. CASWELL, Jr.* W5BB

Like many amateur transmitters, the one at W5BB "just grew." Its tube lineup, physical construction, and minor details were changed dozens of times until a recent and "final" rebuilding was completed which included all features that had been proven desirable during the years of alterations, and which left out all those found to be unnecessary. The result was an inexpensive exciter so efficient, so fool-proof, and so genuinely satisfactory to me that I thought a description of it might save some constructors the trouble of going through the "cut and try" process for themselves.

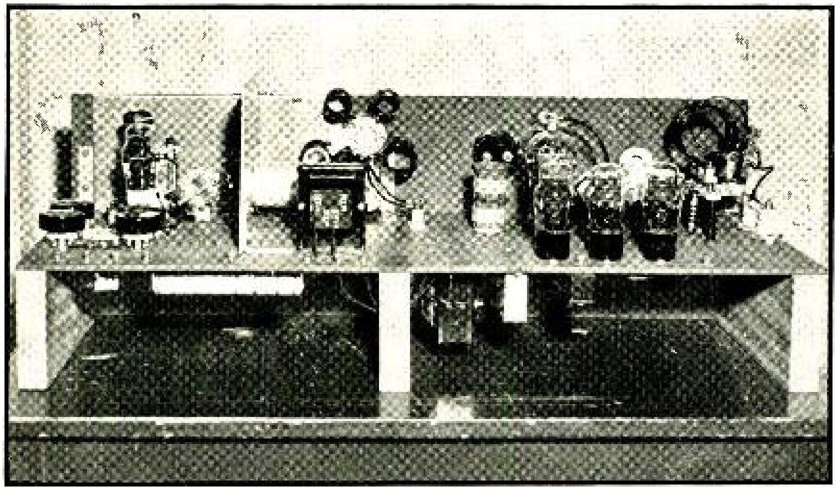
The exciter, using a 6A6, an 807, and two TZ20's in push-pull, covers the 80, 40, 20, and 10 meter amateur bands with bandswitching in the first two stages. Since the pictures show quite clearly the mechanical construction of the unit, I shall not bore the reader with the exact measurements for mounting the parts, but shall instead emphasize the features of the set that might be of interest to anyone wishing to build a similar exciter or transmitter, and point out the reasons for incorporating those features.

*1502 West Ave., Austin, Texas.

Chassis Construction

Complete shielding is of course a necessity in the oscillator and high-gain buffer stages of any transmitter, but the use of a metal chassis in an amplifier stage only presents problems of construction, insulation, electrical balance, and wasted r.f. in the metal itself, without serving any essential purpose. Therefore, the basic chassis of this exciter is made of rugged, inexpensive, one-quarter inch tempered Masonite, and shielding is used only where desirable.

At first glance the oscillator and buffer stages do not seem to be completely shielded from each other, but a more careful examination of the pictures will show that the sub-chassis is lined under the bottom with a sheet of duralumin, that the front panel is backed up with a similar sheet of metal, and that the support for the horizontally-mounted 807 is a thicker piece of aluminum. A further advantage of this combination of Masonite and



Rear view of the 100 watt exciter/transmitter. The bandswitching turret (center) is homemade. Observe the interstage shield upon which is mounted the 807 in a horizontal position.

metal is that it removes all strain from the shielding, thereby permitting very thin, inexpensive, and easily-drilled aluminum or duralumin to be used. Twenty gauge duralumin was used in this case because it happened to be available, but thinner twenty-two or even twenty-four gauge metal would be satisfactory.

The support for the 807 was made of one-eighth inch aluminum for the sake of rigidity, since it stands alone, and the customary shield is employed around the lower portion of the tube. When the various pieces of shielding are solidly connected together through angle brackets and lockwashers, the overall shielding is so complete that it is impossible to obtain any type of oscillation from the 807 on any band with or without excitation and without the help of any parasitic suppressors in the circuit. No shielding is used in the push-pull TZ20 stage, and, since the wiring is kept short and symmetrical, a perfect balance results and complete and fixed neutralization is obtained on all bands. If the natural color of the Masonite panel is not desired, a black wrinkle finish may be applied and will make it virtually impossible to detect the difference between this panel and a metal one. Last, but not least, the total cost of the chassis and all shielding is less than two dollars.

The Tube Lineup

Although the "v.f.o." has become very popular, a crystal-controlled oscillator was the author's choice. However, quick and easy QSY is almost a necessity these days, and this need had to be provided for at a minimum of expense. My particular solution to this common problem was found in the use of a Coto-Coil solenoid relay in the crystal circuit, which allows instant QSY to any one of four crystals at the touch of a push-button at the operating position. It is necessary to run only two wires to the control location to operate it, and voltage for it is readily obtained from the filament circuit in the exciter. In order to have as many frequencies available as possible without spending too much on crystals, a crystal oscillator was needed that would perform readily with any crystal, one that would not cause frequency drift when using inexpensive X-cut crystals.

A dual-triode 6A6 operating with a scant two-hundred volts on the plate of the oscillator section not only fills these requirements, but also permits doubling in its second section. A few zero-drift crystals are used for the band edges, and advantage is taken of the present low price of good X-cut crystals to obtain numerous frequencies throughout the bands. As a matter of fact, enough crystals can be bought to come within ten kc. of any phone or c.w. signal in the 20-meter band for the cost of a so-called "good" v.f.o., and with the crystals you *know* that your signal is T9X!

The many well-known advantages of the 807 made it the logical choice for a buffer/doubler, and the inexpensive TZ20's require no fixed bias because of their high amplification factor. They are capable of handling one hundred watts as drivers or amplifiers.

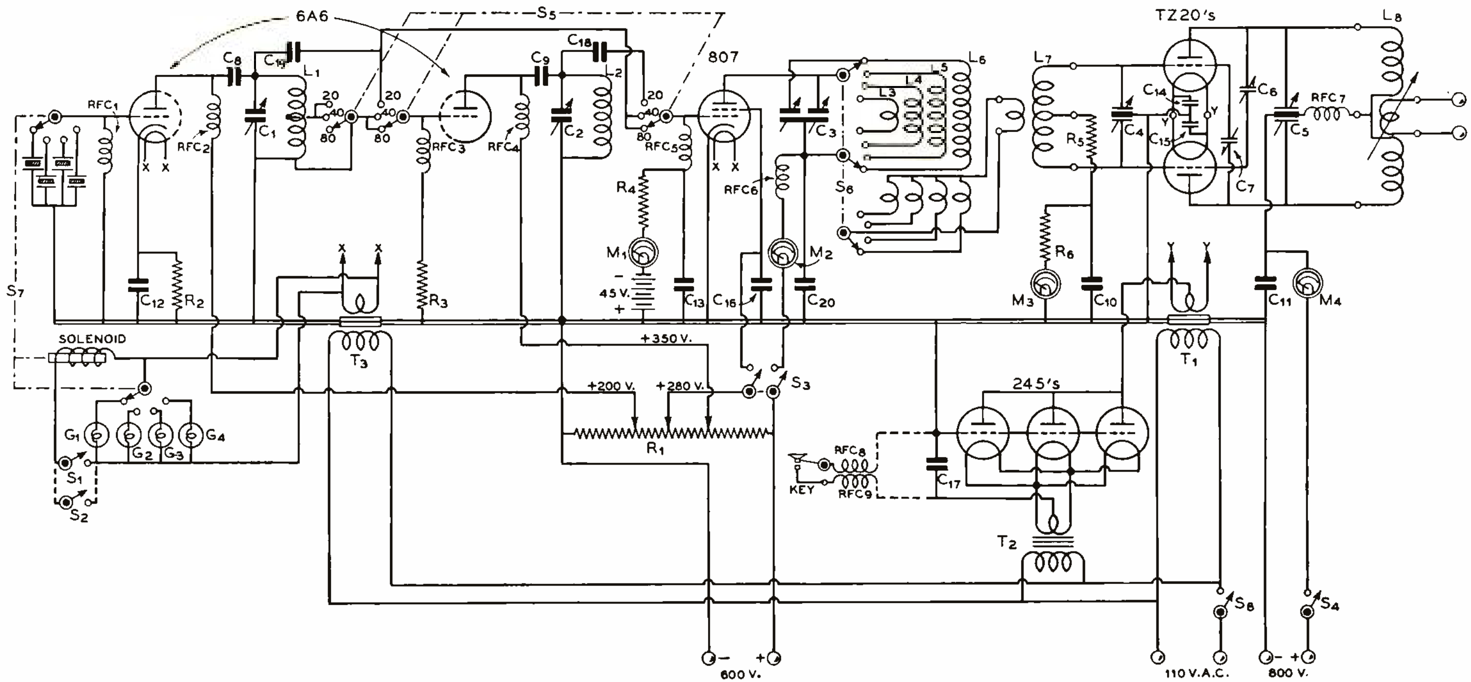


Figure 1.

Schematic Diagram of 100 Watt Bandswitching Exciter

C_1, C_2—35 μμfd. midget variable
C_3, C_4—35 μμfd. per section split stator, double spaced
C_5—50 μμfd. per section split stator, .07 in. spacing
C_6, C_7—15 μμfd. double spaced
C_8, C_9, C_{10}—.002 μfd. mica
C_{11}—.002 μfd. mica, 2500 volts test
C_{12}, C_{13}, C_{14}, C_{15}, C_{16}, C_{17}—.01 μfd. 600 v., paper or mica
C_{18}—.00025 μfd. mica
C_{19}—30 μμfd. mica trimmer
C_{20}—.006 μfd. mica, 1200 volts test
R_1—25,000 ohm slider-type divider, 150 watts
R_2—450 ohms, 5 watts
R_3—10,000 ohms, 2 watts
R_4—40,000 ohms, 2 watts
R_5—200 ohms, 2 watts (serves as r.f.c)
R_6—1000 ohms, 10 watts
RFC (all)—2.5 mh. 125 or 150 ma.
T_1—7½ volts, 4 amps.
T_2—2.5 volts, 5 amps.
T_3—6.3 volts, 5 amps.
S_1—S.p.s.t. toggle switch (on exciter)
S_2—S.p.s.t. toggle switch (remote)
S_3, S_4—D.p.s.t heavy duty toggle switch
S_5—3 pole 3 throw isolantite rotary switch
S_6—3 pole 4 throw isolantite rotary switch
S_7—Solenoid type crystal selector switch
G (all)—6.3 volt pilot lights
M_1—0-10 ma. d.c.
M_2—0-150 ma. d.c.
M_3—0-100 ma. d.c.
M_4—0-300 ma. d.c.

Bandswitching

Bandswitching, although certainly desirable in an amateur transmitter, is apt to be quite expensive if all manufactured coils are used. Therefore, all coils in this exciter are homemade with the exception of the swinging-link assembly in the plate of the TZ20 stage which serves to vary the output of the exciter. It is surprising how easily rigid and efficient air-wound coils can be made using celluloid strips and duco cement. This process, whereby the coils are wound over the celluloid strips on a wooden form sawed so as to allow it to slip out of the finished coil, is thoroughly covered in various Handbooks, but is really simpler in practice than it sounds in the texts.

If a small amount of the XYL's nail polish remover (a thinner for Duco cement) is brushed over the wound-and-spaced coil before the cement is applied, the celluloid and cement will blend together perfectly, and the result will be a coil that compares favorably with the manufactured ones.

Even though the three-section isolantite switch for the turret in the 807 stage was bought completely assembled, the homemade turret cost less than one-half as much as comparable ones on the market. Furthermore, the assembly may be made more compact, and the inductance of the coils may be made to fit the particular condenser on hand for tuning the stage. In my case a dual 35 μμfd. split-stator condenser was on hand; so approximately proper L/C ratios were maintained by using only one section of the condenser for 10, 20 and 40 meters and leaving the second section permanently connected in parallel across the 80 meter inductance. All coils throughout the exciter are air-wound except the grid coils for the TZ20 stage, which are wound on conventional plug-in forms because of the mechanical difficulty in maintaining proper balance for a push-pull stage if a turret were used.

A tapped coil is used in the oscillator section of the 6A6 and permits the use of either 40 or 80 meter crystals. The latter are normally used only for the 80 meter band (conventional 40 meter crystals are used for all the higher frequency bands), but they may be used on 40 meters by doubling in the 807. 20-meter output from the oscillator is obtained by switching in the second section of the 6A6 as a doubler. This operation is performed by the same three-pole triple-throw rotary switch used to tap the oscillator coil, which gives instant switching of oscillator output to any of the three bands. The 807 may be used as a buffer or doubler, and its output is approximately the same in either case. However, it is not normally called upon to double except in reaching 10 meters, where its output is adequate to excite the TZ20's fully.

COIL TABLE

L_1—34 turns no. 24 enameled, space wound diameter of wire, tapped at 19 turns from ground end with ½ inch spacing between sections, wound 1⅜ in. dia.

L_2—12 turns no. 18 enamelled wire, space wound, 1 in. dia.

L_3—10 turns no. 14 enamelled spaced to cover 2¼ in., 1 in. dia. Link 2 turns at ground end. (28 Mc.)

L_4—20 turns no. 16 enamelled spaced diameter of wire, 1 in. dia. Link 2 turns at ground end. (14 Mc.)

L_5—30 turns no. 18 enamelled spaced diameter of wire, 1⅜ in. dia. Link 2 turns at ground end. (7 Mc.)

L_6—42 turns no. 18 enamelled close wound on 1¼ in. form. Link 3 turns at ground end. (3.5 Mc.)

L_7—Plug in coils wound on standard 1½ in. dia. form, as follows:
28 Mc.—6 turns, c.t., no. 16 enam. spaced to 1½ in. Link 2 turns around center of coil.
14 Mc.—16 turns, c.t., no. 16 enam. spaced to 1¾ in. Link 2 turns around center of coil.
7 Mc.—30 turns, c.t., no. 20 d.c.c. close wound. Link 2 turns around center of coil.
3.5 Mc.—60 turns, c.t., no. 22 d.c.c. close wound. Link 3 turns around center of coil.

L_8—Manufactured 100 watt swinging link assembly and coils. Regular coils are used "as is" on 28, 14, and 7 Mc. For 3.5 Mc. use 1,7 Mc. band coil with 4 turns removed from each end.

Metering

A 0-10 ma. meter in the grid circuit of the 807 stage gives a better indication of oscillator tuning and output than could be obtained by metering any portion of the 6A6 circuit. Likewise, a grid current meter in the TZ20 stage greatly simplifies tuning. The plate and grid meters in the TZ20 stage are conventional types, but the two meters in the 807 stage are revamped filament voltmeters once used in old six-volt receivers.

These meters may be obtained from servicemen for a few cents, and, after removing the series resistor and shunt within the meter, (a very simple process) have good movements of approximately 10 ma. Shunts may be made for the meters from the wire of an old filament rheostat, and they may be calibrated accurately for any range by placing them in series with a conventional meter and a resistor across any source of a few hundred volts d.c. The resulting "homemade" meter has a fast-acting and accurate movement superior to the cheaper milliammeters on the market.

[*Continued on Page 74*]

The ARMY AMATEUR *Radio System*

The Army Amateur Radio System originated in 1925 under the direction of Captain "Tommy" Rives at the Signal School, Ft. Monmouth, N.J. Official organization was authorized by the Army General Staff provided "that no expense to the government" would be involved. The original call was W2CXL with Capt. Rives in charge and with Capt. Norman Lee Baldwin as one of the first operators. Capt. Baldwin was then a student in the "Company Officers'" course at the school and did AARS work in addition to his studies.

After Capt. Rives and Capt. Baldwin had left Ft. Monmouth the activity (which had been more or less confined to the Corps Areas in the East) gradually died down until in 1929 there were only 35 active members. At this time the Chief Signal Officer, General Gibbs, decided that the activity should be developed or dropped completely. Capt. Baldwin was ordered to Ft. Monmouth and as Signal Officer at that post was put in charge of the activity, operating directly under the office of the Chief Signal Officer. Net control station, W2CXL, was completely rebuilt, and, operating on two bands, the AARS was extended to all nine Corps Areas, direct contact being made on schedule with the Net Control Stations of all nine Corps Areas on drill nights for the first time.

The activity and membership grew rapidly and the first Armistice Day message from the Chief Signal Officer was broadcast from W2CXL in November of that year, 1929. The active guiding personnel of the AARS at that time was General Gibbs and Major D. M. Crawford, Signal Corps, at Washington, and Capt. N. L. Baldwin assisted by Sgt. G. C. McVicar in operation of the Net Control Station and the growing correspondence. Major Crawford secured the frequency of 6990 kc. for the Army Amateur Radio System and W2CXL was signing WLM on that frequency from that date. By June of the next year (1930) the activity had become so extensive that Capt. Baldwin, Sgt. McVicar and the entire station equipment was transferred to Washington, D.C., old W2CXL became W3CXL and the 3500 kc. band Control Station (owned and operated by Capt. Baldwin) became W3CMX at Alexandria, Va.

During the period, 1930-1933, the system was built up to approximately 1000 stations and each Corps Area was publishing its AARS bulletin. The frequency of 3497.5 kc. was secured and nation-wide contests were held; the System was officially affiliated with the American Red Cross, cipher devices were issued to all members, and training in Army tactical radio procedure was inaugurated.

The operation of the AARS was turned over by Capt. Baldwin to Capt. Black in 1933 and training and operation has continued since under Lt. H. P. Roberts, Capt. R. W. Minckler, Capt. S. P. Collins and is at present under Lt. A. D. Stephenson.

Membership and Objectives

Latest official figures give the membership as 1835 for May 1940. Since all U.S. amateurs have been forbidden to work foreign countries by the FCC and the dx activities have dropped off there has been a steadily increasing membership trend. The AARS is composed of licensed amateur radio station owners and operators who have been organized under the leadership of the Army to provide additional channels of communication within the United States, its territories and possessions, in times of emergencies such as fire, flood, earthquakes and the like. Close cooperation is maintained between the AARS and the American Red Cross and other organizations interested in Disaster Relief.

A secondary purpose is to familiarize the members with military methods of handling traffic, procedure and cryptography. Approximately forty percent of the membership is within the recognized "military age limits." Another forty percent could, in case of dire necessity, take over ground radio stations, message center work, and such, to relieve the younger and more active operators for actual duties "in the field."

Members of the AARS are not required to "enlist" for any sort of Army "Reserve." It is purely a voluntary organization. Members are free to quit at any time they see fit. They are required, however, in order to continue as members, to attend at their own station a majority of the "drills" in the nets to which they are assigned. There are no sex nor age limits. Many women are very active in the nets. The ages of the members vary from 14 to over 70. No physical examination is required to become a member and there are quite a few who would never be selected for military service due to various physical handicaps.

Organization

The AARS is organized after the style of the Army. AARS activities for the entire U.S. are directed by a Liaison Officer in the Office of the Chief Signal Officer of the Army. W3CXL-WLM is the headquarters station and Net Control Station for the "Army" net. Member stations in the Army net include stations representing every Corps Area in the U.S. and each department (military organization) outside the U.S. such as the Canal Zone, Hawaii and the Philippine Islands. This net is maintained to distribute traffic between the various Corps Areas and departments and to speed up delivery of such traffic. Members of this net are selected because of their outstanding telegraphic and station superiority.

Just as in the Army the basic organization is the Division, in the AARS it is the Corps Area. Each Corps Area is capable of functioning alone as a separate unit. It provides for teaching message handling, procedure and cryptography. Each Corps Area publishes a monthly bulletin containing instructions to and news of the members. For example: The Ninth Corps Area headquarters is at the Presidio of San Francisco, Calif. Personnel there supervises the activities of the various state organizations, keeps records of all members, publishes the monthly bulletin "El Toro" and other instruction circulars and supervises the operation of the "Corps Area" net. It could be roughly compared with the Signal Section at Division headquarters. Corps Area nets are maintained to distribute traffic between the various states in each Corps Area, and to distribute from and collect traffic for the Army Net.

Each State has a separate organization which could be compared with a regiment. It is under the control of a civilian State Net Control Station. The SNCS is provided with sufficient alternates (assistants) to help him supervise the training of the members. Some of the larger (in number of amateurs) States have more than one State Net. California, Massachusetts and New York each have three such Nets. For actual training the State is further divided into Districts which correspond to battalions in the Army. Each District is under the direct control of a District Net Control Station which supervises the Net operation and training of the Local members of the District. Training in the District Net includes procedure, message checking and handling, net operation, etc. Emergencies are simulated and the members taught what could and should be done in event certain things happened.

Cryptography

Radio is not secret at present. Anyone with a receiver and the necessary operating ability can listen in and make copy of anything sent, if he so desires. Recording apparatus is so cheap that even though the speed at which a message is transmitted is above that which the receiving operator is capable of working, the message can be slowed down and copied at leisure from the tape or Ediphone record. Therefore, for military purposes, every message must be cryptographed. Cryptograms are of two general kinds: "Codes" where an arbitrary word or group of letters is assigned to mean a different word, a phrase or perhaps even a whole sentence; and "Ciphers" wherein the letters in the words are shifted about or others substituted for them in order to conceal the original meaning of the message. AARS

[*Continued on Page 93*]

Using THE BAROMETER

By CAPT. HORACE L. HALL, Lieut. Comdr. USNR (Ret.)

A large number of amateurs (especially those on c.w.) start a QSO with an exchange of information concerning weather conditions. Frequently this consists of a half-hearted mention of the fact that it is or isn't raining, or that it has looked like rain except that the sun is shining right now so maybe it isn't going to rain after all. How much more useful this exchange of information could be if one of the stations could volunteer the information that, "The barometer has been falling steadily for the last eight hours. That, coupled with this north wind makes it look as though we'll have some snow before morning."

The writer has lived by a barometer for thirty years so feels qualified to speak with authority on the interpretation of its indications. The accompanying illustration shows a portion of the face of an aneroid barometer having a dummy hand in addition to the regular pressure indicating hand. By setting the dummy hand to the barometric pressure at the moment it is easy to tell at a glance later on whether or not the pressure has risen or fallen, and how much.

A barometer must be kept constantly under observation, and readings noted at least every four hours, if it is wished to foretell coming weather changes. The least rise or fall in the indication denotes a change. The direction of the wind must also be noted at each reading of the barometer. Hand-in-hand, the barometer and the wind intensity and direction act as guide posts in forecasting weather conditions.

Face of an aneroid barometer showing the portion of the face from 29 to 31 inches of mercury. The barometer hand cuts 30.43 inches, and the dummy hand cuts 29.29 inches. Note that every tenth of an inch is divided into five parts, making each of the smallest division equal to 0.02 inch. By recording the readings to one-half division or 0.01 inch, it is at once noticed by reference to the last reading whether the barometric pressure is rising or falling.

A rapid rise indicates unsettled weather. A gradual rise indicates settled weather. A rise with dry air and increasing cold in summer indicates wind from the northward. If rain has fallen, better weather may be expected. A rise with moist air and a low temperature indicates wind and rain from the northward. A rise with southerly wind indicates fine weather. A steady barometer and temperature with dry air indicates a continuance of fine weather.

A rapid fall indicates stormy weather. A rapid fall with westerly wind indicates stormy weather from the northward. A fall with northerly wind indicates a storm with rain and hail in summer and snow in winter. A fall with increased moisture in the air and increasing heat, indicates southerly wind and rain. A fall with very calm and warm weather indicates rain and squally weather.

The barometer rises for northerly wind (including wind from N.W. by N. to the eastward), for dry or less wet weather, for less wind, or for more than one of these changes. However, it will rise on some occasions when rain, hail or snow comes from the northward with a strong wind. The barometer falls for southerly wind (including wind from S.E. by S. to the westward), for wet weather, for stronger wind, or for one or more of these

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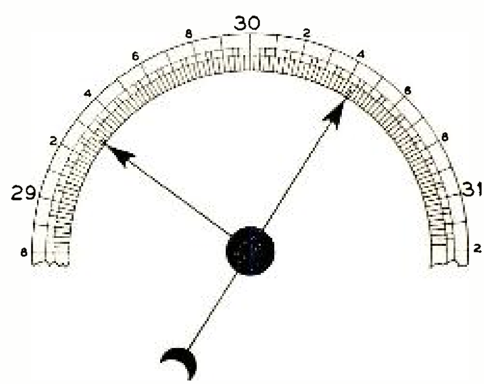


A Versatile

ELECTRONIC KEY

of Low Cost and Simple Design

By G. W. GUNKLE*

No doubt many of the brethren have toyed with the idea of automatic dashes on their speed keys. Here is an inexpensive electronic key that will accomplish just that in a way to warm the cockles of one's heart. It also provides automatic dots and can be used in a variety of combinations as will be explained. It can be adjusted to any speed between ten and fifty words or more per minute. The entire unit—with a little judicious shopping around—can be built for less than ten dollars.

*U. S. Coast Guard Radio Sta. NMQ, Point Vicente, Palos Verdes Estates, Calif.

This electronic keying "gadget" can be used either with a "sideswiper" or regular bug to send automatic dots, automatic dashes, or both.

The circuit is nothing more than a simple transformer coupled audio frequency oscillator. The diagram is almost self explanatory. No trouble was had in obtaining stable oscillations in the vicinity of one cycle per second.

The entire unit, including the power supply, is housed in a six- by six-inch shield box. However, any type of construction can be used, as the placing of parts is not critical.

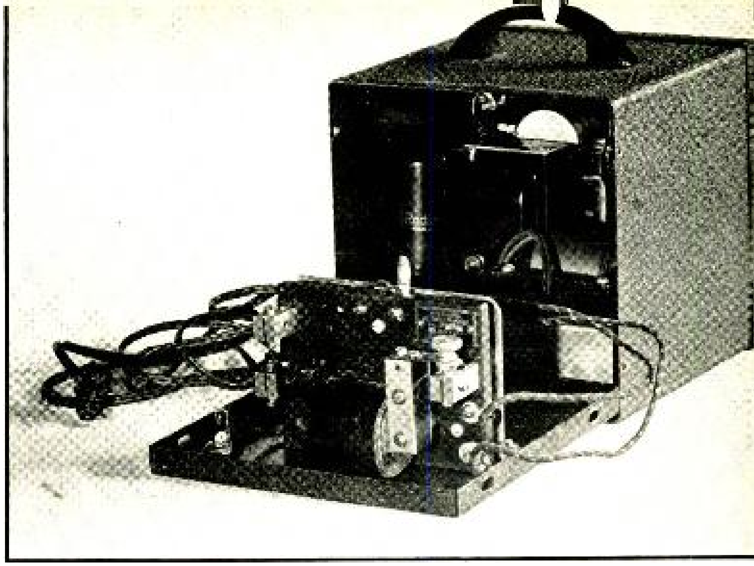
The trick of fitting the parts in a six- by six-inch shield box is the mounting of the relay on the rear cover of the box by means of a bracket. The shell is removed from the power transformer. The relay will then slip in place over the power transformer, which is mounted on a standard six- by six-inch subpanel. The placing of the rest of the parts will be self-evident.

The frequency of the oscillator is varied by means of two potentiometers (the dot and dash controls, R_1 and R_2). These resistors are placed in the cathode of the 6F6 and provide very good frequency control. A current of about ten ma. flows through the controls and they carry this without overheating.

The relay RY is a 250-ohm single pole job and is used for no other reason than that it happened to be in the junk box. One point of prime importance as regards the relay is an arm with adjustable tension. While not critical, this should be adjusted to the point where the arm snaps out smartly when the current is off.

A 6Z4 tube is used in the power supply because of its small size. A high degree of filtering is not necessary. The power supply should have good regulation, and for that reason is bled rather heavily. With poor regulation, the first dash is shorter than the rest, which results in a 'dit-dah-dah-dah' effect. The voltage di-

Interior of the electronic keyer. It consists essentially of a 6F6 a.f. oscillator and associated power supply. An idea of the compactness of the device may be had from the dimensions of the shield cabinet, which is 6 inches on a side.



vider should have an adjustable tap on it. This is adjusted to the point where R_1 and R_2 give the desired control over dots and dashes. This point will be reached when there is about 130 volts on the plate of the 6F6. The current requirements are modest, a 40 ma. transformer being sufficient.

A number of different audio transformers were tried and all worked fairly well. Some changes in C_1 may be necessary with another transformer, more capacity if the frequency is too high, less capacity if too low. However, it probably will be unnecessary to change C_1 as the tap on the voltage divider provides a great deal of frequency regulation.

There are four jacks on the panel. J_1 permits the use of the "old reliable bug" without any change in its dot adjustment. It provides automatic dashes. The mechanical dots from the regular speed key are used, keying the relay RY through the 20,000-ohm resistor R_3. This is fine for those of us who have the dot adjustment sealed and are ready to fight at any change in its adjustment.

J_2 provides automatic dots. Dashes are made by hand in the same manner as a regular speed key. An adaptation of the "cootie key" or "sideswipe" is used with this jack. The big advantage over a mechanical key is the fact that the speed of the dots can be adjusted by simply turning a knob on the panel instead of the shifting of weights. In this case dashes are made by keying the relay RY through the resistor R_3.

J_3 is used for automatic dots and dashes. As above, a "sideswipe" is used for keying, although a regular bug can be used if the dot contact is screwed over far enough so that the dot spring doesn't vibrate and make mechanical dots. Keying is accomplished by switching ground from R_1 to R_2.

J_4 is provided so that a regular speed key can be used without having to disconnect the unit and mess around with rewiring the speed key. Usually, at a station keeping a 24 hour watch, traffic slows down in the "wee small hours" and the use of J_4 obviates leaving the power on the unit all night long.

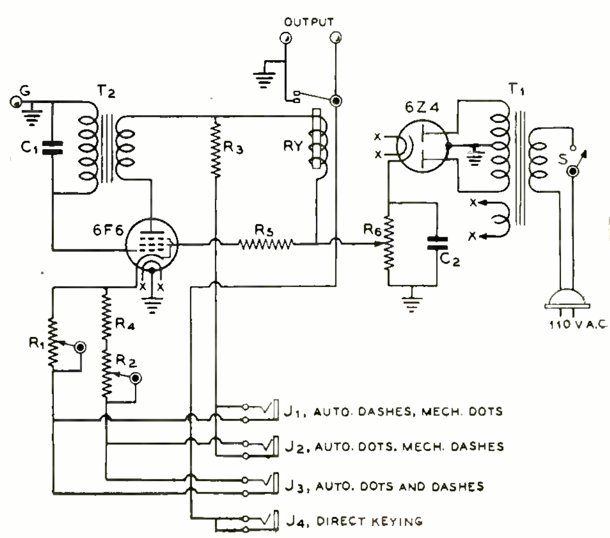
If any of the above features are not desired, the jacks and associated unnecessary parts can be eliminated.

[*Continued on Page 91*]

Figure 1.

Schematic Diagram of the Electronic Keyer.

R_1—3000 ohm wire wound pot.
R_2—10,000 ohm wire wound pot.
R_3—20,000 ohms, 2 watts
R_4—500 ohms, 2 watts
R_5—50,000 ohms, 1 watt
R_6—20,000 ohm 40 watt divider (with slider)
T_1—Interstage replacement type a.f.t., 1:3 ratio
T_2—250 v. each side c.t., 40 or 50 ma.; 6.3 v. and 5 v. fil. windings.
C_1—.015 μfd. paper tubular
C_2—16 μfd. 450 volt electrolytic
$J_{1, 2, 3, 4}$—Open circuit midget jacks (insulate from panel)
G—Binding post on panel
RY—250 ohm single pole relay



An Inexpensive

BEAM ROTATOR

From Old Washing Machine Parts

By JAY N. EDMONDSON,* W8BYV

A 1980 to 1 reduction antenna rotator, less motor, for approximately $3.00! Yes, the $3.00 rotator to be described is entirely practical and can be duplicated at that figure anywhere in the U.S.A. Parts from old washing machines, a suitable motor, and you have a rotator that will "take it" from a 70 mile gale without shearing off a single gear tooth, a rotator that requires no brake.

Figure 1 is a photo of the completed rotator, and figure 2 is a sketch of the same in which the motor drives the pulley on gear box B, which is direct coupled through a short length of rubber hose (automobile generator to pump type) to the worm and wormwheel gear box C. The vertical shaft of the wormwheel carries the small pinion gear D, driving the large spur gear E. The shaft of gear E rotates at less than 1 r.p.m. and is coupled to the antenna shaft.

A brief discussion of speed ratios obtained from gears and pulleys will enable anyone to determine whether or not certain gear boxes obtainable at your local washing machine repair shop are suitable for the job. Assume a "round number" motor speed of 1800 r.p.m. (most motors are 1750 or 1725). A pulley 2" dia. driving one that is 10" dia. will reduce the speed to 360 r.p.m. If this speed is applied to a pair of gears in the first gearbox, the small gear driving the larger, the speed will be further reduced. This ratio depends upon the number of teeth in the pinion gear to the number in the larger spur gear: if there are 12 teeth on the pinion and 96 on the spur, the 8 to 1 ratio will reduce the 360 r.p.m. to 45 r.p.m. Feeding this 45 r.p.m. through the coupling to the worm, the 19 to 1 ratio of the wormwheel to worm further reduces the r.p.m. down to about 2.3. The large gears outside, the smaller on the wormwheel shaft and the larger on the antenna shaft, are in the ratio of 23 teeth to 60 teeth, which brings the antenna rotation down to 0.91 r.p.m.

A word as to choice of pulleys and gears: The figures given are those pertaining to the

*1280 Broadview Avenue, Columbus, Ohio

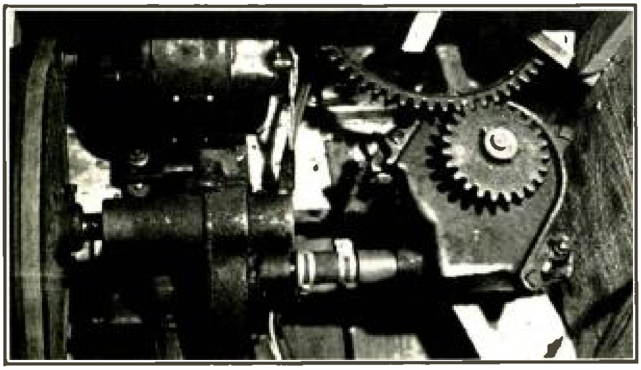


Figure 1.
This hefty rotator was built at low cost with but little work by utilizing old washing machine parts.

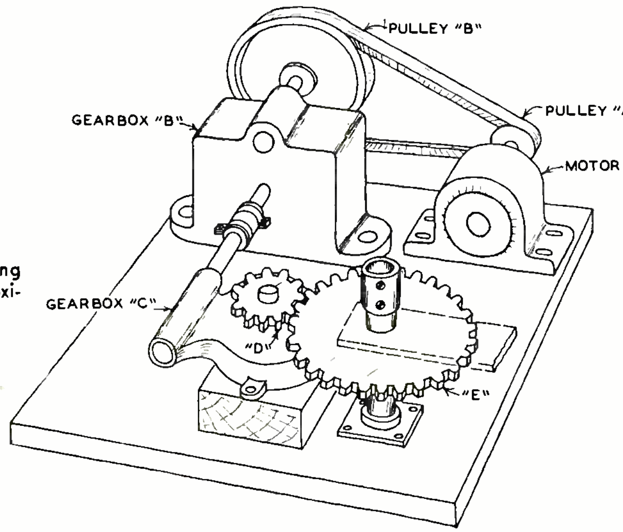


Figure 2.
Suggested method of arranging gearboxes to provide approximately 1 r.p.m. rotation.

author's installation, but can vary widely. It is possible to determine quickly whether or not available gear boxes are suitable, and various combinations worked out. Particularly select the larger boxes, with shafts ½" or more in diameter coming out of the boxes. The gears D and E have teeth about ⅓" high, and in this case are cast iron teeth. Steel teeth, finished, from automobile or washing machine parts could be used and might be slightly smaller. However, all wind strain on the system hits hardest on the meshing teeth at this point, and it is wise to select the largest teeth possible.

In worm and worm-wheel gearing, account should be taken of whether or not the small worm is "single thread" or "double thread." Single thread means only one thread is cut along the worm, though this one thread may make several turns the same as the thread on a regular bolt or capscrew. If a double thread worm, it will have two threads cut around the outside, each having several turns along the entire length. A single thread worm will turn the larger wormwheel only one half as fast as the double thread type. Usually the type encountered is single, which is the one desired for the rotator because it gives more reduction.

It is possible to use two or three gear boxes, all worm-wheel and worm. Two worm-wheel and worm boxes connected together might give, say, 20 x 20 or 400 reduction, and 5 to 1 on the pulleys would make the total 2000 to 1. However, select them with care in the larger sizes.

The two boxes and gears D and E were purchased for $2.00 total. Added to this is the cost of an additional small pulley, rubber coupling, and belt, making the total about $3.00. The motor was picked up (used but in good condition) for $2.00. It is an induction motor, and can be reversed when connected as shown in figure 3.

The vertical shaft runs to the roof of a back porch. Mounted on top of the shaft is a bicycle sprocket, chained to a sprocket at the bottom of the antenna tower shaft. In this way any servicing can be done on the ground, a direction indicator is easily installed outside the window of the radio location, and the unit needs only slight protection.

The entire unit can be mounted under the tower if more suitable. Mounting it lower

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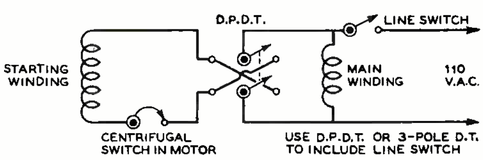
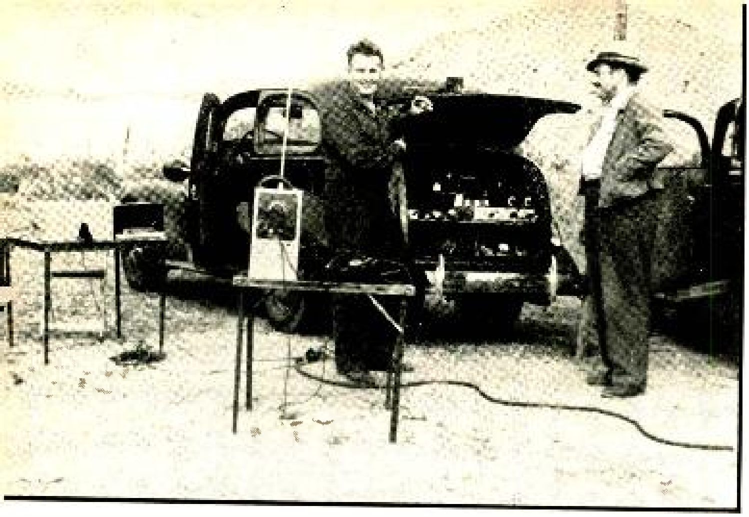


Figure 3.
Most induction type motors can be made reversable by bringing out leads from the "reversing strap" terminals, as shown above. If a three pole switch is available, a separate line switch will not be required.



W6KEI, left, and W6DDA, right, custodians of the hidden transmitter during a game of 112 Mc. hide-and-seek.

"TALLYHO, TWO-AND-A-HALF!"

● Helps for Hidden Transmitter Hunters

By FRANK WILBURN,* W6EL

This is not a technical article. Any resemblance to radio engineering is unintentional and purely coincidental. However, it is hoped that the writer's long experience with u.h.f. may have uncovered some points of interest to amateurs engaged in u.h.f. activity, and particularly hidden transmitter hunts.

Our radio club here in the San Fernando Valley, the *Valley Radio Society,* has done considerable work on u.h.f. during the last two years. This interest was created and kept alive mainly by holding frequent transmitter hunts on 112 Mc. Our location is ideal for such contests. The valley is almost entirely encompassed by hills and mountains. Roughly it is triangular in shape, about 30 miles long, and about 15 miles across at the wide end. In placing the hidden transmitter we have a rule that the rim of the valley is the limit in order to assure a good signal everywhere in the valley.

This information is given because a knowledge of the nature of the area to be covered is extremely important in u.h.f. direction finding work.

The transmitter we use is a conventional 112 Mc. mobile rig running at about 10 watts. It is owned and operated by W6KEI, and runs continuously during the hunt.

As regards receiving equipment, it is a different story. The number and diversity of ideas in the shape of loops, beams, and gadgets that have shown up on these hunts would make Flash Gordon envious. And strangely enough, it is possible to get results with all of them, when operated correctly. We have come to the conclusion that anything from a hairpin to a railroad bridge can be used for u.h.f. direction finding *if* you know how to use it. That's the sticker: almost any sort of antenna will show directional properties on 112 Mc., but with most of these contraptions the reasons for their operation are so obscure that the average amateur is forever at a loss to interpret the results.

We have tried just about every type of antenna that can be imagined for direction finding, and various variations of the three element beam and Reinartz loop were the most consistent; but there still was plenty wrong with both of them. The front-to-back ratio never was high enough and often was completely upset by reflections so that the bearing was in error by as much as 180 degrees. Both types were fairly sensitive and worked well on weak signals when spurious reflections were not present. But they were

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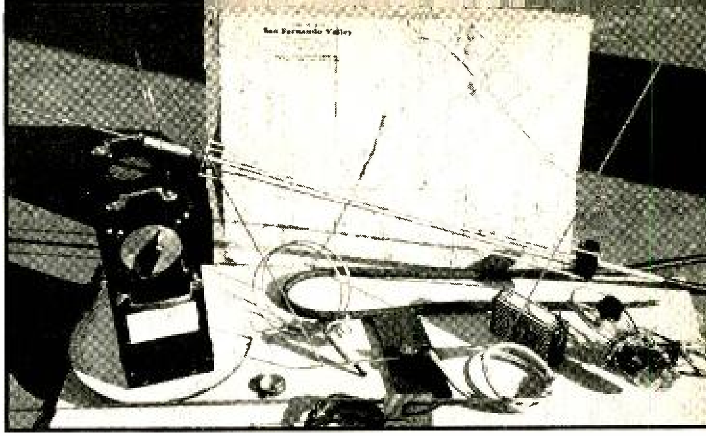
A few of the direction finding gadgets used for direction finding in hidden transmitter hunts.



so broad and indiscriminate on strong signals that they were useless when in the immediate vicinity of the transmitter. This was made worse by the fact that they required feed lines to connect them to the receiver, and these lines, no matter how well constructed or shielded, still picked up enough signal to ruin what little discrimination the antenna had. Also, even though comparatively small on 112 Mc., they were somewhat bulky and unsightly when mounted atop one's car, let alone when mounted on one's person. When an attempt was made to mount the beam atop a low pole a short distance from the car, we found that pickup from the feeders and reflections from the car body introduced serious errors in readings.

From all this it was concluded that most of the troubles could be eliminated by utilizing a receiver that was completely self contained and totally shielded, with the antenna connected directly to the receiver without benefit of feed line. The answer, of course, was a battery operated pack set.

After completion of the construction of such a set, the first thing that was discovered while experimenting with various antennas was that simply walking between the pack set and the transmitter gave a greater variation in signal than any of the directional antennas would give. There was the answer: just plug an adjustable (telescopic) quarter wave rod into the top of the pack set.

The set is held against the belt (centered on the lunch muscle) while the operator swings around and observes the peak and null points. As such points can be determined more accurately by ear when the signal is weak, the antenna can be telescoped as necessary when in the vicinity of the transmitter and there is excessive pick up with the rod fully extended. On very weak signals the antenna is extended fully and the set held at arm's length, with the reading taken only on the peak. When the set is held about 18 or 20 inches from the body, the latter acts somewhat as a reflector, serving to increase the strength of the peak but having no more effect upon the null than when the set is held close to the body.

While the procedure and equipment are simple, the results are surprisingly accurate. Tests have shown that at 15 miles it is possible to spot a transmitter with an error of never more than 4 degrees. If your jalopy doesn't throw a wheel you will get there first in almost anybody's 2½ meter hunt with that kind of accuracy. The pack set described and shown in the accompanying illustration has been in 7 of our club hunts. It has won

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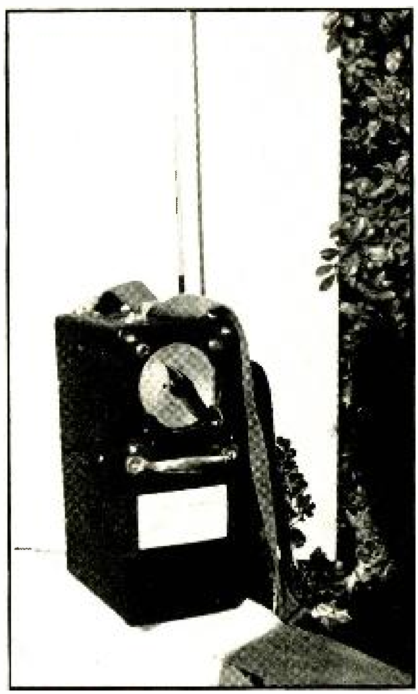

The pack set of W6EL, used for taking accurate bearings simply by making use of one's body as a reflector.

An Inexpensive

HIGH FIDELITY RECEIVER

for Local Broadcast Reception

By W. W. SMITH,* W6BCX

For approximately $30 and a few hours work one can have a receiver which, on standard broadcast, will sound as good as most $200 so called "high fidelity" receivers. It is suitable only for reception of local stations.

Some amateurs evidence little interest in listening to broadcast programs and others appear to have "tin ears" whose fidelity requirements are satisfied by a class C pentode feeding a five-inch speaker. But the amateur who really appreciates good quality reproduction is not such a rare animal as one might imagine from observing the type broadcast receiver reposing in the homes of most hams. Most amateurs who have to manage on a limited budget would rather put one or two hundred dollars into a new communications receiver or in higher power for the transmitter than for a high quality broadcast receiver.

Few broadcast receivers selling for less than $100 have really good fidelity, or as good fidelity as can be utilized for standard broadcast reception. Usually the response is down considerably at audio frequencies as low as 5 kc., though admittedly in many cases the bass response is adequate and harmonic distortion low. Let's look at a receiver that really deserves the name of "high fidelity" and see just why it costs $235 (without phonograph).

First, it has a cabinet that obviously wasn't made of old apple boxes. It is a nice piece of furniture, but this factor probably represents a fair dent in the $235, and certainly it doesn't contribute to the tone quality of the receiver any more than would a cabinet that was similar acoustically but made of pine boards.

Then, the receiver has push-button tuning, which requires a.f.c. and discriminator circuits; two short wave bands; band expanding i.f. transformers to permit high fidelity yet allow reception of dx stations without adjacent channel interference when so desired; and dual speakers with a crossover network (woofer and tweeter).

While all these features may be nice to have, they are not strictly necessary and can be dispensed with when the pocketbook won't permit. One can't listen to the push buttons, and as for adjustable i.f. bandwidth and the short wave bands, we can use our regular station receiver for short wave broadcast or when sharp selectivity is required to avoid adjacent channel interference when listening to dx stations in the broadcast band.

Dual speakers are almost a necessity when response from 30-40 cycles up to 15,000 cycles is required, and certainly are indicated for use with good f.m. receivers. By using one of the new concentric dual speakers it is possible to overcome a very objectionable feature of the earlier woofer-tweeter installations: the lows coming from one direction and the highs from another.

For standard broadcast reception, however, a *good* single speaker is perfectly satisfactory if one is content with bass response down to 40 or 50 cycles, because single unit speakers are now available which cover the range from 40 or 50 cycles (when proper baffling is used) up to 8,000 or 10,000 cycles. This range will do justice to practically any station in the regular broadcast band so far as the upper register goes, because very few stations ever transmit anything over 7500 cycles. The F.C.C. requires that when interference is caused to reception of

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*RADIO

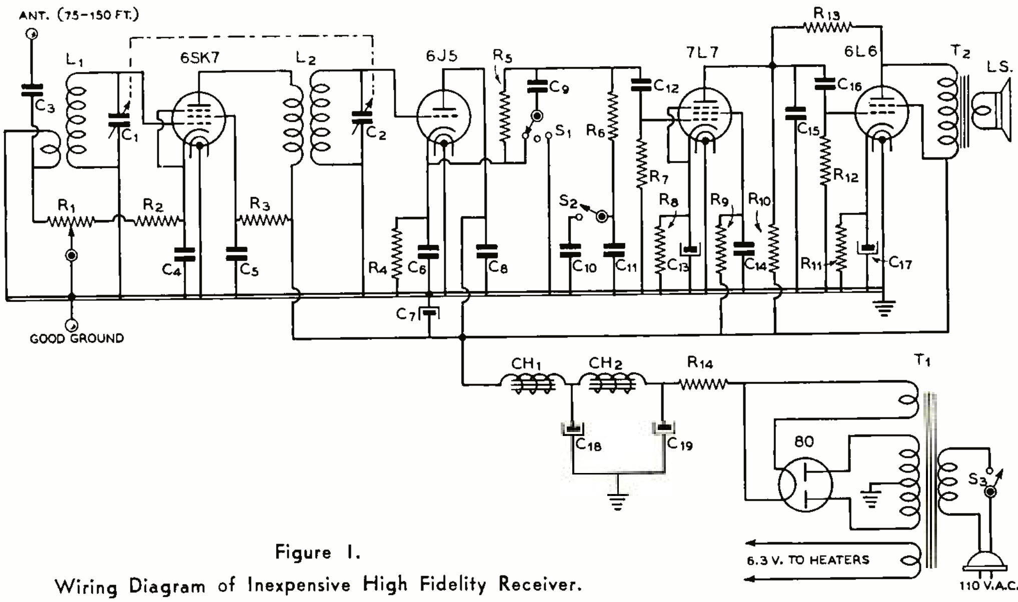

Figure 1.
Wiring Diagram of Inexpensive High Fidelity Receiver.

C_1, C_2—Two gang replacement type 365 µµfd. per section with trimmers.
C_3—.002 µfd. mica
C_4, C_5—.05 µfd. tubular paper, 400 v.
C_6—100 µµfd. mica
C_7—16 µfd. electrolytic, 450 volts
C_8—.05 µfd. tubular, 400 v.
C_9—200 µµfd. mica
C_{10}—.05 µfd. tubular 400 v.
C_{11}—.01 µfd. tubular, 400 v.
C_{12}—.02 µfd. tubular, 600 v.
C_{13}—25 µfd. 25 v. electrolytic
C_{14}—0.25 µfd. tubular, 400 v.
C_{15}—100 µµfd. mica
C_{16}—.05 µfd. tubular, 400 v.
C_{17}—25 µfd. 25 v. electrolytic
C_{18}, C_{19}—16 µfd. 450 v. electrolytics
L_1—Broadcast antenna coil, shielded, high imp. pri.
L_2—Broadcast band r.f. coil
R_1—25,000 ohm. pot., "double ended" taper for combined bias and antenna shunt
R_2—300 ohms, 1/2 watt
R_3—125,000 ohms, 1 watt
R_4—75,000 ohms, 1 watt
R_5—500,000 ohms, 1/2 watt
R_6—250,000 ohms, 1/2 watt
R_7—1 meg., 1/2 watt
R_8—500 ohms, 1/2 watt
R_9—500,000 ohms, 1/2 watt
R_{10}—100,000 ohms, 1 watt
R_{11}—200 ohms, 5 or 10 watts
R_{12}—250,000 ohms, 1/2 watt
R_{13}—400,000 ohms, 1/2 watt
R_{14}—10 watt wire wound resistor (about 750 ohms; see text)
T_1—700 volts. c.t., 100 ma. or more, with 6.3 and 5 v. fil. windings
T_2—Husky (preferably 3 lbs. or so) output transformer to handle 80 ma. and reflect 2500 ohm load on 6L6 for particular voice coil impedance of speaker used.
CH_1, CH_2—15 hy. or more, 100 ma. or more.
LS—12 inch high fidelity p.m. dynamic speaker in infinite baffle type cabinet
S_1—Single pole 3 throw Switch
S_2—S.p.s.t. toggle switch

adjacent channel stations by transmission of frequencies above 7500 cycles, the station incorporate a filter to prohibit transmission of such frequencies. Incorporation of such a filter has become virtually standard practice among a.m. broadcast stations, not only to assure compliance with the F.C.C. requirement but because such a filter cuts out the objectionable high frequency line noises which are common to network programs.

There is room for argument as to just how low a set should go in the bass register to be worthy of the term high fidelity. Most of the better broadcast stations are capable of transmitting stuff down to 30 cycles, but except for certain pipe organ passages, seldom is there need for response below 40 or 50 cycles. If the bass is good down to 50 cycles, with a *broad* hump of 6 to 12 db around 100 cycles, the bass response will sound full, adequate and natural to the most critical listener. If one doesn't insist upon response down to 30 cycles, the receiver problem is greatly simplified and the cost greatly reduced.

It is natural when appropriating a limited amount of cash for a receiver for high quality broadcast reception that a substantial portion of the total outlay be assigned to the speaker. The choice of speaker and its method of baffling has more bearing upon the fidelity than has the choice of circuit or particular components used in the receiver itself.

The receiver which is the subject of this article is built around one of the new Jensen type PM12CT high fidelity permanent magnet dynamic speakers. This speaker, when properly baffled, will show good response from below 50 cycles to over 10,000 cycles. Not only is the high frequency response good, but the speaker is relatively free from the high frequency "beam effect" common to large dynamic speakers. Many 12 inch speakers which respond to frequencies above 7500 cycles tend to confine the higher frequencies to a narrow beam, so that the listener must be located directly in front of the speaker to get the benefit of the high frequency response. Small dynamic speakers, and 12 inch speakers such as the PM12CT with "trick" curved cones do not confine the high frequencies to a narrow arc directly in front of the loudspeaker.

The receiver proper consists of a single r.f. stage feeding an infinite impedance detector, with a single ended a.f. amplifier consisting of a glass type 7L7 into a 6L6 with shunt type inverse feedback.

The set is designed only for local reception (1 to 5 kw. stations up to 20 miles or so, and 25 to 50 kw. stations up to 30 miles or so). It is designed for use with an outside antenna of from 75 to 150 feet over all, preferably over 100 ft. Under these conditions there will be no pick up of dial telephone or electrical appliance clicks, as is so often the case when a short indoor antenna or loop is used. There will be no difficulty from adjacent channel interference or 10 kc. whistles because the desired station must be putting in a pretty good signal in order to provide good volume. This means that no 10 kc. filter need be employed, in spite of the comparatively broad response provided by the two tuned circuits.

This broad response avoids clipping of sidebands, but may give trouble if there happens to be a powerful station within a mile or so on a frequency only 30 or 40 kc. away from a weaker, desired station. In such a case a wave trap can be inserted in series with the antenna and tuned to the frequency of the nearby station. Such a trap may consist of a 10c midget replacement r.f. coil across which is placed an adjustable mica trimmer of suitable capacity. An idea of the correct size trimmer may be obtained by tuning in the offending station and observing approximately how much tuning capacity it takes to hit.

It will be noted that no a.v.c. has been incorporated. A.v.c. would complicate the circuit considerably, and would be none too effective anyhow, when applied to the single r.f. stage. It is a simple matter to turn down the gain when tuning to the frequency of another station, then turn up the gain to the desired level.

A slight amount of bass boost is provided, and made optional. The frequency of maximum boost is considerably below the average fundamental voice frequency, and therefore the boost will not tend to make speech "boomy" as do so many bass boost arrangements. The bass boost will be found particularly pleasant when the volume is turned down low, because the ear imagines an apparent loss in bass when volume is turned down. On good broadcast receivers bass compensation is incorporated in the volume control, so that the bass is boosted automatically when the volume is turned down low. However, the arrangement used here is satisfactory and is much simpler.

It should be born in mind that there will be no noticeable increase in the bass when S_2 is opened unless the music *contains* a substantial amount of stuff below 100 cycles. Too much bass boost becomes very tiresome in time, and the amount of boost deliberately was limited to approximately 9 db.

It will be observed that the boost is not obtained by means of a resonant tuned circuit. Such boost circuits tend to have "hangover" unless critically damped, which means that but little boost can be obtained from a single tuned circuit without encountering hangover effects. While 9 db boost can be obtained from a single tuned circuit (with suitable damping) without too much hangover, the R-C circuit used here is just as effective and less expensive.

Music is given more brilliance and dialog more "presence" by boosting the highs above 2000 cycles. The booster circuit may either have a broad hump around 2500 cycles, or else may rise from 1500 to 4000 and remain substantially flat from 4000 on out. On dialog, the former characteristic seems more pleasing (except on an occasional speaker with excessive sibilance, in which case any type of high boost aggravates this objectionable quality). On music the latter type of boost appears more pleasing, *but only when both transmitter and receiver are relatively free from harmonic distortion.*

The high frequency booster circuit used in this receiver combines simplicity with versatility. It can be seen from the foregoing discussion that high boost is not always desirable. The circuit shown permits the highs to be raised slightly, left alone, or attenuated. The latter sometimes is desirable when listening to stations that are playing regular phonograph records (not high quality transcriptions) in which considerable scratch is present. Such records actually sound better with frequencies above 4000 cycles attenuated considerably, because higher frequency components are almost entirely masked by needle scratch. This assumes that the station is using either a magnetic pickup or *equalized* crystal pickup. If the

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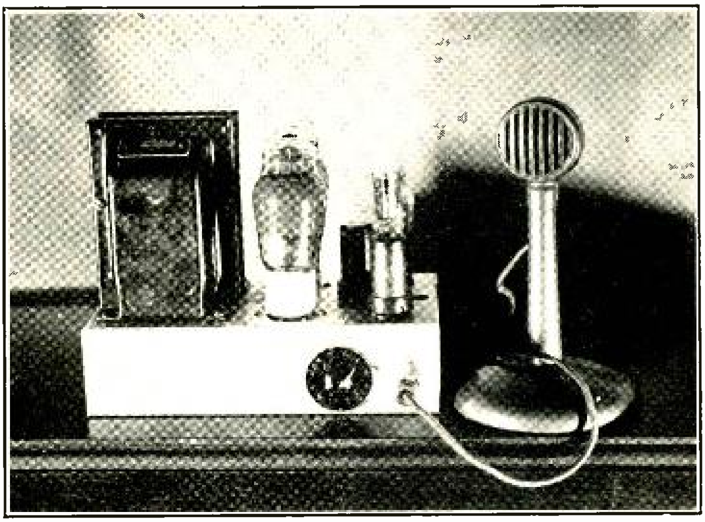


Like the proverbial keg of dynamite—"Small but mighty!" This Midget Modulator develops a respectable punch by utilizing push-pull 6L6GXs as power amplifiers. Noteworthy feature of the unit is the use of a VR-90-30 as a dropping resistor for the output tubes.

MIDGET MODULATOR

By TOM PATTERSON,* W6DDX

Using a VR tube for screen voltage stabilization in an audio amplifier.

Ever since the eminent Mr. Smith of RADIO's editorial staff broke out in a now long lost copy of RADIO (or was it *R9?*) with a method of prying thirty-five watts of audio out of a pair of 46's, the market has been flooded with such modulators designed for modulating one hundred watts of input to a class C amplifier. In more modern times beam power tubes have simplified this problem.

But in so doing these beam tubes have presented a problem or two of their own. The solution of one of these is the "piece de resistance" of the Midget Modulator. So this and a few other virtues we present forthwith.

The title "Midget Modulator" was suggested not by its power output but by its physical dimensions. The complete unit, including the modulation transformer, is built on a chassis which measures but 5½" x 9" x 2½". This is exclusive of power supply, of course.

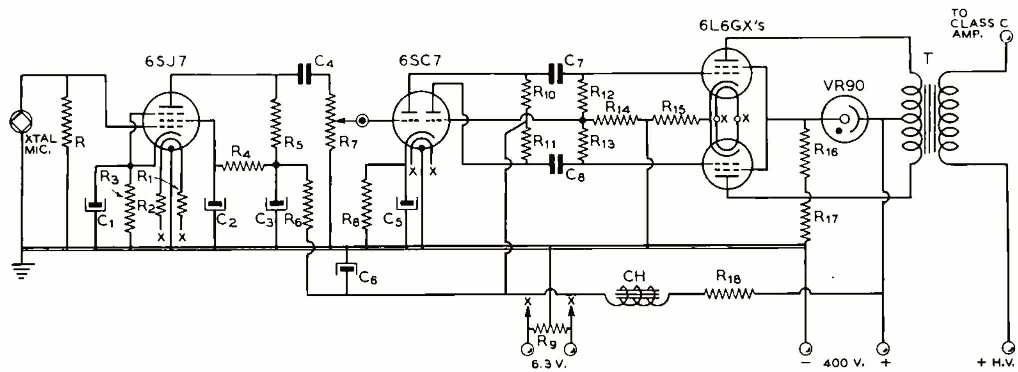
At the outset we find a very unoriginal pentode input stage. The pentode is a 6SJ7. And the two ohm resistors, one in each filament leg, are the result of a suggestion in RADIO, Dec., 1940.[1] Their purpose in life is the reduction of filament induced hum.

The middle of the midget modulator is a 6SC7 used as a self-balancing phase inverter. This particular circuit is a very nice one. It can be driven quite hard without losing its equilibrium while producing a very commendable amount of gain. Balance should be checked at the grids of the 6L6GX's by a vacuum tube voltmeter. By raising or lowering the value of resistor R_{11} an excellent balance can be achieved.

The power amplifier stage departs from the usual in only one respect. And this is the use of a VR 90-30 as a screen voltage dropping resistor. In this we have our "piece de resistance." Perhaps it is a dirty trick to play on a

*6858 Magnolia Avenue, Riverside, Calif.

[1] "Minimizing Noise Level in A.F. Systems," RADIO, Dec. 1940, p. 38.



Wiring diagram of the midget modulator.

C_1—20-µfd. 25-volt electrolytic
C_2, C_3—8-µfd. 450-volt electrolytic
C_4 — .005-µfd. 600-volt tubular
C_5—20-µfd. 25-volt electrolytic
C_6—8-µfd. 450-volt electrolytic
C_7, C_8—.01-µfd. 600-volt tubular
R—250,000 ohms, 1 watt
R_1, R_2—1-ohm, wire-wound
R_3—2500 ohms, 1 watt
R_4—2 megohms, 1 watt
R_5—250,000 ohms, 1 watt
R_6—50,000 ohms, 1 watt
R_7—500,000-ohm potentiometer
R_8—1500 ohms, 1 watt
R_9—50 ohms, c.t., 10 watts
R_{10}, R_{11}—100,000 ohms, 1 watt
R_{12}, R_{13}—250,000 ohms, 1 watt
R_{14}—250,000 ohms, 1 watt
R_{15}—250 ohms, 25 watts
R_{16}, R_{17}—25,000 ohms, 1½ watts
R_{18}—5000 ohms, 10 watts
T—3800-ohms-to-class-C-load
CH—25 hy., 45 ma.

self-respecting voltage regulator tube, but, to go no further, it works. The plate voltage used on the midget modulator is four hundred volts. With a ninety-volt drop through the VR-90, three hundred and ten volts are applied to the screens of the 6L6GX's. And at three hundred and ten volts the screen voltage remains, regardless of screen current excursions, thereby eliminating the principal difficulties involved in providing good screen voltage regulation.

Operating Data

The m.m. was tested on a class "C" r.f. amplifier running 100 watts input. Under these conditions approximately 90 per cent modulation was obtained. All stations worked reported excellent quality. The power supply used in these tests furnished 400 volts at 200 ma. with very excellent regulation, a factor which must not be overlooked if good results are expected from this type of unit. The plate and screen currents, which were measured together, swung from a static 100 ma. to approximately 185 ma. on modulation peaks. Several types of crystal microphones were used with best results being obtained with the high output types recommended for amateur use.

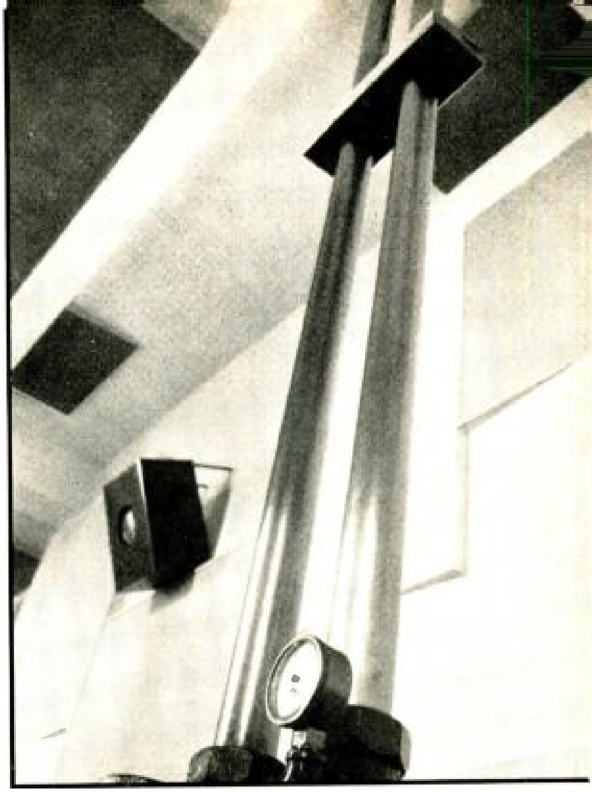
In closing, the author wishes to include a line of acknowledgment to Mr. Vic Emmert, W6DVV, of Covina, California, who suggested the use of a gaseous voltage regulator tube as a screen voltage dropping resistor for beam tube modulators.

●

Helpful Hints

For adapting a receiver to headphone use, place a closed circuit phone jack in series with the voice coil. This will give a satisfactory level in the phones, and their high series impedance will effectively kill the speaker when they are in use.

When using the kitchen table for a workbench, keep a large diameter container such as a pie tin or baking pan handy. Shake excess solder from the iron and insulation scrapings into this instead of allowing them to fall onto the table top or onto the floor. The xyl will appreciate it.



● Close-up view of the co-axial transmission line connecting the transmitter at W2XOR to its antenna system. Note the short section of tubing on the left which acts as a harmonic suppression shunt.

DEPARTMENTS

- X-DX
- U. H. F.
- Amateur Stations
- The Amateur Newcomer
- Yarn of the Month
- What's New in Radio
- The Open Forum
- New Books and Catalogs
- With the Experimenter

X-DX AND OVERSEAS NEWS

By Herb Becker, W6QD

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

We were beginning to think that we never would see any others added to the WAAP list when along comes a new member. He is the first W6 to confirm the 16 possessions necessary to obtain the WAAP certificate. You'll probably only need one guess as to who the W6 is so we won't keep the few who can't guess in the dark too long. He was this same ol' guy Doc Stuart, W6GRL. He has so many "firsts" now it would seem he would be getting tired of it. His 16th possession worked was KD4GYM on Swan Island, January 15th. Following is the present status of the stations who have been awarded the elusive WAAP certificate, and the order in which they were issued:

WAAP

Worked All American Possessions

1. W5BB
2. W2GTZ
3. W8ADG
4. W5VV
5. W6GRL

PREFIXES AND RULES FOR WAAP

K4	Puerto Rico
KB4	Virgin Islands
KC4	Little America
KD4	Swan Island
K5, NY	Canal Zone
K6	Hawaiian Islands
KB6	Guam
KC6	Wake
KD6	Midway
KE6	Johnston
KF6	Baker, Howland and American Phoenix Islands
KG6	Jarvis and Palmyra
KH6	American Samoa
K7	Alaska
KA	Philippines
W	United States

1. Sixteen confirmations must be submitted which will entitle the operator to a WAAP certificate. A list will be published in RADIO showing the order in which they have been awarded.
2. Either 'phone or c.w. may be used, or both.
3. Confirmations may consist of QSL cards, letters, or lists sent in by the station to RADIO. Those having confirmation slips from A.R.R.L. on KC4 contacts only, will be accepted. Other forms of confirmation will be acted upon by the committee.
4. All confirmations should be addressed to RADIO, attention DX Editor, 1300 Kenwood Road, Santa Barbara, California. They should be sent via registered mail, and enclose a self-addressed envelope with sufficient postage to cover their return.

KD4HHS, New Station on Swan Island

As was mentioned in March "X-DX," there will be no "swan song" for Swan Island. George Grover, who replaced Steve Paull, is now on the air with the new call of KD4HHS. He expects to operate on the same frequencies that Steve used—at least for a while. On c.w. he will use 14280 while on 'phone it's 14240. Incidently, we have a list from KD4GYM covering all QSC's between September 7, 1940, and February 6, 1941. He says that eventually everyone he contacted will get a card . . . . a batch of cards were sent sometime ago but apparently have been lost. You bug artists will have a deuce of a good time with the new call, KD4HHS. For those of you who want to send a card to Steve Paull, KD4GYM, please do not send any more of them to Swan. If you like you may mail them to me and I'll see that Steve gets them, wherever he may be.

To The Boys in the Service

You fellows who are in one of the branches of our service may like to take advantage of this "QRA Listing." This applies to the x-dx men who may like to list their present address so that some of their dx pals can drop them a line every now and then. There are, no doubt, many of the old died-in-the-wool dx men who are stationed around in one of our various camps, either in the States or in one of our possessions, who would like to have their present QRA listed. As long as it doesn't develop into such proportions as the Callbook we will be glad to do this. I would like to ask one thing, when sending in your present address, please keep in mind that it will not show up in print for about four or five weeks and if there is a pretty good chance you will not be there at that time . . . . let us know. It is possible that with transfers, etc., it may be pretty hard to keep up with everyone. In addition to this I would like it restricted to those only, who might expect some of the readers of "X-DX" to be interested in their where-abouts. It is not our intention to run competition to the Callbook.

W1HKK has been with the Hygrade Sylvania Corp. for about a year but has received a nice invite from "Uncle" to put on a nice blue uniform. Dana says being a reserve officer may have expedited things a bit. W1HKK says his best dx on 75 has been K6FKN. Others who swore never to leave 20 include 1FH, 1ADM, 1COI, 1DQ, 3FJU, 8QXT, and 9NDA. Same, men, shame for breaking your word.

K4KD doesn't like the WAAP setup because when KC4 leaves Little America, it might be ages before someone else shows up there. 'Tis true . . . it may make it a little tough to nab a KC4 with no one there to work, but the same thing holds true with WAZ. How many fellows in the world have shown proof of working 40 zones? Just three, that's all. There are hundreds of the fellows who have had no trouble getting a QSO from KC4, even with their heavy traffic schedules. They have had three stations from which to choose and I would say some of the other possessions would be tougher by far to work than was KC4. The Jr. op. of K4KD who is 15 years of age has just received his ticket and his call is K4HEB. He is working 20, 40, and 80 c.w. A chip off the ol' block, I'd say.

W6KW-KC4USB in First 2-Way 75 'Phone Hookup

On January 27th W6KW worked KC4USB for what might be the first 2-way 75-meter phone QSO on record. It should be some kind of a record. There have been other W's who have worked KC4 on 75 phone but I think KC4USB was using c.w. Oh yes, W6KW says they are having a little difficulty in getting out down there due to ice conditions and it may be that they will be there another year. Anyway here it is the first part of March and 6KW is still holding skeds with them, and they should have been out by this date. You guys may have another year in which to work Little America at that.

W8CED is off the air for the duration. Though I don't exactly agree with his idea, he did draw a smile when he mentioned this, "I even cut my poles up and but bird houses on them." Lee has sold everything except his bug, but plans on keeping in touch with the outside world through this pillar. 8CED says he received a card from W9ZVN who is deserting Nebraska for the Navy. He thinks he is going to iron out this thing of so few stations on the Pacific islands. More power to him. But Lee thinks the real reason for leaving Nebr. is because they couldn't beat Stanford in the Rose Bowl. He believes in what some guy said, "If you can't lick 'em, join 'em."

W1JRP relates that he has been using an indoor antenna about 12 feet long. But "comes the thaw" and he will shoot up some poles, after which will come 40 meter c.w. W1JRP is an old timer from W6, holding calls 6AKH and 6XG. He pounded brass on a flock of the Matson and President boats along about 1921 to 1926. And now Chas is located in Hartford for some reason or another. But I still think we can hear him on 40 in spite of this.

W9CVL wants to know why I don't lay off of the 9's for awhile? Aw Milton, don't be cruel! However, I sometimes ask myself the same question . . . but never can come up with a good answer so I guess my obsession for W9's will just keep on. W9CVL passes along some nice info regarding K6BZD who is perched on top of Haleakala Crater which is about 10,000 feet up on the island of Maui. Milt says they are using a tremendous power plant. The rig uses a pair of '30 tubes and 180 volts of "B's". Input: 4 watts. Antenna is a 400-foot wire putting a swell signal into W9CVL.

W9VDX is no more. He has had his old call issued to him; it is a pip too—W9CR—and his name is Chas. Reese. Well, Chas. was formerly the traveling salesman in Ill., Ind., and Wisc., but now has moved to a little jernt in Mo. He is now working Nebr., Kans., and part of Mo. And while I think of it my ol' operative No. 1492 would like some info on the farmers' daughters in that area. Along with a new call, Chas. has a swell new QRA for dx (1) and a new receiver which makes him ready for anything.

XU8AM, Bill Wood, is now in Washington, D.C. For those who would like to write him for one reason or another, mostly to get QSL's I rather suspect, I'm listing his full address: W. H. Wood, 616 Greenwood Ave., Takoma Park, Washington, D.C. Bill is attending the Graduate School of the U. of Maryland, working on an M. S. degree. He is somewhat irked because he had to leave 5 years of back issues of RADIO in Shanghai. You guys might find Bill operating at W3FII every now and then, so lend an ear.

Years ago some screwball told me that if I kept after anything long enough I was sure to get it. Well, I'm not going to say that it has proved to be true or false in every detail lest I incriminate myself. But in at least one small incident it has borne fruit. Ever since I met W9RBI last year in Milwaukee, it appeared that he has been on the air less and less. Thinking that maybe I was to blame for his decreased activity this column queried several times to find out what had happened to RBI. The nearest we could come to an answer was given by his old friend W9CIR, who said that RBI now had a commercial ticket and was angling for a berth somewhere.

Well, now along comes ol' man Ross himself with the whole answer. Better let me just quote from his letter: "On account of continued reference to my absence from the ether by my public, W6QD, I consider it my duty to give an accounting of the latest hobby of dx men. After chasing elusive square roots, invisible currents, mythical distortion, etc., until the wee small hours night after night, I finally acquired a certificate to hang along side the DXCC, one reading RTF. So now here I am watching the meters swing back and forth, and wondering how a 400 foot rotary would work out in WIBU's backyard. Since the dandy ice storm we had in December I have a vertical rotary instead of a horizontal one and no matter which way I swing it it's directional toward China. However, it did stay up long enough for me to add KC4USA on 20 fone so now I am definitely anchored at 113 countries. This doesn't bother me as I received my com'l. ticket on Friday the 13th. (That's nuthin', Ross, your letter was received on Feb. 13th). After the KC4 comes through with a card I'll only need cards from EA9AH and SV1RX to complete my files (Mediterranean correspondents please copy). W9DJA and I run the WIBU transmitter at Poynette, Wisc. Give a listen for 9DJA sometime."

The Pacific Island Situation

K6OLU bursts forth with a bit of information regarding who's who in the Pacific. KF6OWR, Howland Island, is on 7160 nightly from 9 to 11 p.m. p.s.t. KF6JEG/KG6, Jarvis, is operating portable on 14 Mc. phone, 14190, about 4 p.m. p.s.t., but will probably not be on much until a supply ship arrives bringing more gas for the put-put. K6SBM/KG6 is on 7180 once in a while around 10:30 p.m. p.s.t. W7DBR/KF6 Canton, returned to the mainland January 1st. As far as K6OLU knows there are no stations operating on either Wake or Midway at the present time.

Out of This Month's Mail Bag

A note comes from Doc Westervelt, K6QYI saying that he has been transferred from Schofield to somewhere in the 9th district. Doc's call there will no doubt be his old 9 call, W9LKH, and for those who haven't been able to squeeze a QSL card out of him we'll show his full QRA: Capt. F. B. Westervelt, 1117 North Church St., Rockford, Ill.

A card from W2LUT states he worked some guy signing KB6VV on 7150 kc. LUT hopes he is genuine. So do I. But without trying purposely to throw cold water on his chances I must say that to date no one else has reported KB6VV—so don't bet any money on it being a good 'un.

Here's a note from W6IKQ, the best liked guy in his neighborhood, who relates that his latest is KD4GYM, raising his countries to 86. Gee, almost makes us think of dx. Phil also says that in a note from G3DO he wants his 73 passed along to the gang and that he hasn't missed a copy of RADIO yet.

W6MCG has nabbed KD4GYM and only needs KB4 for his WAAP cert. W6JNV formerly from San Luis Obispo (that's in Calif.) is wearing a nice new blue uniform. Spent a short time in San Diego, then shoved off for Hawaii where he is now stationed. Walt will be missed around in this neck of the woods as he managed to cover all bands with consistency. For those who might like to write him, because he will be using W6JNV/K6 very soon now, here's his address as of this date: Walt Long, W6JNV, RM2C, N.C. Division, U.S.S. Chicago, Pearl Harbor, T. H.

W6ITH has been working with a flock of KA's lately around 8 a.m., our time. He informs us that some of the active KA's are KA1JH, 1CW, 1AC, 1GC, 1RX, 7FS, 4LH, and KA1AN is using 12 watts. 1AR is not too active, 1ME is seldom on and 1LZ is in the States. KA1CM is on 10 phone Sunday a.m., his time.

OVERSEAS NEWS

G2WD is doing some specialized work on his radio job in the Royal Corps of Signals and says it will be of great interest to hams in years to come. He says that before the mess started he counted up his zones and countries to find he had 36 and 89 while on phone only he had 33 and 80. G2WD says he missed his December RADIO and it probably has been sunk. In another letter from G5SA we find several items of interest. Dave says that due to quite a number of fine receivers being used by the British forces, the hams are looking forward to getting some of them cheaply after the war. Quoting a portion of his letter . . . "We have been having it fairly free from Jerry's activities around here since I wrote last. Some towns have had bad blitz by the latest method of showering down incendiary bombs all over the place. They are apparently not aimed at any particular target with the result that living houses and office buildings seem to get the worst of it. This is very unpleasant of course, but it doesn't get them anywhere." Dave says that the RSGB is flourishing as never before with the membership keeping up. The boys in the service look upon it as a sort of a Club where they can keep in touch with each other. They meet many of the Colonial lads who have come over and in addition to this there are quite a few OH and PA hams. G5SA is building a multi-vibrator type of frequency checker in his spare time.

Photographs

There are no station photos in this month's section. Unfortunately they were not available sufficiently in advance of the copy to arrange for printing. However, I promise you I'll have a couple of pips next month . . . . My main interest at present is to maintain our space by catching up on USA station photos and delving into our own W hams for personality items—and I mean delving, too. After this war mess is over then we will still have our space to devote to real honest-to-gosh DX. So, why not scare up a good clear-cut photo of yourself, your station, or better yet, both. Give us a little history of your activities. If you don't your "pal" across town might . . . and you know what that might mean!!!

Shhh! Lifted From the T. & R. Bulletin

From November, 1940, T & R: Congrats are extended to ZD2G, account of new Jr. op. and to VQ3FAR on his recent marriage. VQ3FAR is now stationed in ZD2. In a ragchew (personal) with ZD2H, FAR bemoaned the fact when the ban came he was just about ready to start up under a ZD2 call. ZD2H has renewed his acquaintance with ZD4AB over a commercial circuit, a long way removed from ol' 14 Mc. It was agreed that they should renew their previous 7Mc. sked as soon as possible after the cessation of hostilities.

G2RC and several others have reported "ZB2FQ" who says he is in Gibraltar! From observations made during a contact between ZB2FQ and D3DSR it would seem likely that he is in Spain. Other DX heard includes NY1AE

[*Continued on Page 68*]

U. H. F. . . .

By JOSEPHINE CONKLIN,* W9SLG/3

There are two French phrases that are occasionally heard in this country: *C'est la guerre* and *Cherchez la femme.* The first is often used as a fatalistic response, the second as a method of attacking a crime wave. Taken together, they seem to mean something, for when there is a war there are soldiers and sailors and these, in turn, create a demand for "la femme." This time, though, with Bill Conklin off to duty in the Navy, it is a case of delegating the job of writing this column to "the woman" until we are settled in our new home in a Washington suburb, or until a new columnist is found.

One thing about living in Washington these days, you can raise all districts with a whistle in a restaurant. W2MO dropped in a few days ago. W1DEI, W6DNS, W7ESK, W8JK, and dozens if not hundreds of others are either in Washington or come here on business. The city is in the valley of the Potomac river, but there are high points on either bank from which a little u.h.f. rig can cover the countryside and—we hope—far beyond. The only trouble is that rents seem to be closely correlated with altitude.

Relay Extended Westward

Miles Lusher, W9ZWF, tried to telephone us in Wheaton, Illinois, on January 28 after Bill had left for Washington. Miles had a message from W9ZJB in Kansas City, and the whole five meter circuit across Illinois and Iowa and down to Kansas City was standing by for a reply. Here was the message:

```
8:30 p. m. January 28, 1941
Conklin
Hello Bill stop Message is by
ground wave from kilocycle farm
stop are you yehudi query please
answer
                    Vince Dawson W9ZJB
```

Vince calls his jernt *Megacycle Farms*—so the message sounded too low in frequency for him, but we can skip that. The distance covered by this message was a little less than 700 miles, in two hours and five minutes on the first try. Apparently it required only three or possibly four relays, depending on whether W9YKX was working W9NFM at 235 miles or W9HAQ at 285 miles. With nice long hops like that, five meters can really get over some territory. This means that messages coming from New England to Illinois on the League's relays can now be "set down" (as the London bus man says) in Kansas City or just outside of Omaha. Shortly, they can also be passed on to Topeka, Kansas, where W9VWU did not go to war after all but cannot work W9ZJB any more until one of them changes antenna polarization. Schedules that W9YKX in Iowa has had with W9ZQC NLR in Brookings, South Dakota, have not yet been reported to be successful, so the branch relay circuit up that way is not yet open. ZJB says that W9PKD expects to get in on the circuit.

These midwestern stations are doing plenty of consistent work at distances above 200 miles, which the eastern gang considers good dx for winter. Knowing full well that ham radio often refuses to perform normally when the visiting firemen are getting a demonstration, W9ZJB took a chance when Ben, W9GHW, dropped in during January. During the evening, W9YKX who is over 200 miles away came in above R9 until they signed off at 12:45 a.m. Ben absorbed some of Vince's enthusiasm, no doubt!

W9ZJB thinks that he is just a lucky lad to get low atmosphere bending for every schedule, or else his new horizontal beam is a honey, for during the first 27 days in January he had 13 contacts with YKX. No schedule failed, though often c.w. was used part of the time. The signals are best at ZJB from around 6:30 to 9 p.m. with fading generally present.

The spark-plug of the circuit west of Illinois seems to be W9YKX who is in Western Iowa north-east of Omaha. YKX first connected with W9NFM, 235 miles across Iowa at Solon, on January 10. C.w. was used for a 100% contact because phone did not get over so well. W9TTL using a standard converter could not pick up NFM. HAQ at the time did not hear YKX. For 16 days, YKX heard NFM and made the contact on all but one. Then on January 24, YKX made a contact on c.w. with W9HAQ in Davenport, 285 miles away across practically the whole state of Iowa. That night, NFM was R7 to R9 on phone and HAQ was 569 on c.w. YKX had put a second concentric line in his receiver between the acorn r.f. stage and the 6K8 mixer, replacing the former choke coupling. While this change boosted the local signals of W9TTL

*300 Wilson Lane, Bethesda, Maryland.

56 Mc. DX HONOR ROLL

Call	D	S
W9ZJB	9	28
W9USI	9	23
W9USH	9	18
W9AHZ	9	16
W5AJG	9	34
W1DEI	8	20
W1EYM	8	20
W1HDQ	8	26
W2GHV	8	24
W3AIR	8	24
W3BZJ	8	27
W3RL	8	29
W6QLZ	8	21
W8CIR	8	32
W8JLQ	8	
W8QDU	8	25
W8QQS	8	17
W8VO	8	
W9ARN	8	17
W9CBJ	8	
W9CLH	8	
W9EET	8	15
W9VHG	8	
W9VWU	8	16
W9ZHB	8	29
W2AMJ	7	22
W2JCY	7	
W2MO	7	25
W3BYF	7	22
W3EZM	7	24
W3HJO	7	
W3HOH	7	17
W4DRZ	7	22
W4EDD	7	
W4FBH	7	17
W4FLH	7	18
W5CSU	7	
W5EHM	7	
W8CVQ	7	
W8PK	7	9
W8RUE	7	18
W9BJV	7	15
W9GGH	7	
W9QCY	7	15
W9IZQ	7	14
W9SQE	7	22
W9WAL	7	
W9YKX	7	13
W9ZQC	7	13
W9ZUL	7	18
W1LLL	6	24
W1CLH	6	13
W1JFF	6	11
W1JJR	6	17
W2KLZ	6	
W2LAH	6	
W5VV	6	18
W8LKD	6	11
W8NKJ	6	16
W8OJF	6	
W9NY	6	13
W1GJZ	5	15
W1HXE	5	18
W1JMT	5	9
W1JNX	5	12
W1JRY	5	
W1LFI	5	
W2LAL	5	11
W3CGV	5	10
W3EIS	5	11
W3GLV	5	
W3HJT	5	
W4EQM	5	8
W6DNS	5	
W6KTJ	5	
W6OVK	5	11
W8EGQ	5	10
W8NOR	5	16
W8OKC	5	10
W8OPO	5	8
W8RVT	5	7
W8TGJ	5	9
W9UOG	5	8
W9WWH	5	
VE3ADO	4	
W1LKM	4	6
W1LPF	4	16
W3FPL	4	8
W4FKN	4	8
W6IOJ	4	7
W7GBI	4	6
W8AGU	4	8
W8NOB	4	
W8NYD	4	
W8TIU	4	8
W1KHL	3	
W6AVR	3	4
W6OIN	3	3
W6PGO	3	6
W6SLO	4	6
W7FDJ	3	3
W8OEP	3	6
W9WYX	3	3

Note: D—Districts; S—States.

somewhat, the improvement was mainly on weak signals which came in better over the internal set noise. Now Bill wants to rebuild with chromium plated lines and chassis—and that should be something to see! Bill plays the pipe organ, so he is right in sympathy with putting pipes into his receiver.

Early in February, W6OVK reported that he is continuing the twice daily five meter contacts with W6QLZ. The latter has also been heard by W6PQG at Benson, 35 miles farther, and the OVK-QLZ hop has also been covered on 2-½ crossband February 5 and 6, using horizontal polarization.

More Coaxial-Tuned Receivers?

Sh! Put your head down close and listen to a bit of hot dope. Ed Tilton, W1HDQ, is in the process of putting pipes in his 112-Mc. f.m. receiver and is throwing out the coils. He says that the plumbing idea has not progressed far in New England, what with the boys more interested in working on their transmitters. They have been getting so much gain with coil-tuned 1232 and 1852 type tubes (with regeneration, bringing up set noise with the signal?) that they have been satisfied just to whoop up the signal.

Still another satisfied customer is Leroy May, W5AJG, who found a lot of good 4-inch diameter pipe selling for a cent an inch, in a junk yard in Dallas. He thought he would start out gradually with just a 956 t.g.t.p. preselector stage, using a pair of lines. He writes, "Hoorah, I have my acorn 956 concentric line preselector about whipped into shape and, from the preliminary trials, she is a honey. You are 100 percent correct when you say that plumbing will work better than coils and condensers. That is not news to you, but I just wanted to tell you that another customer is satisfied. I have not brought it home yet to try on my antenna but if it will work on a poor converter and poor antenna in the field of two 500-watt transmitters, I am sure that when I get it home, it will be a whiz." (See article on it in this issue.—Ed.)

W6SLO put a concentric line r.f. stage in his receiver, using a 1232 tube, and OVK thinks it is "hot stuff." The 1232 probably acts like a very low resistance across the line, reducing its effectiveness compared with the lines when acorn tubes are used, though.

More Band Openings

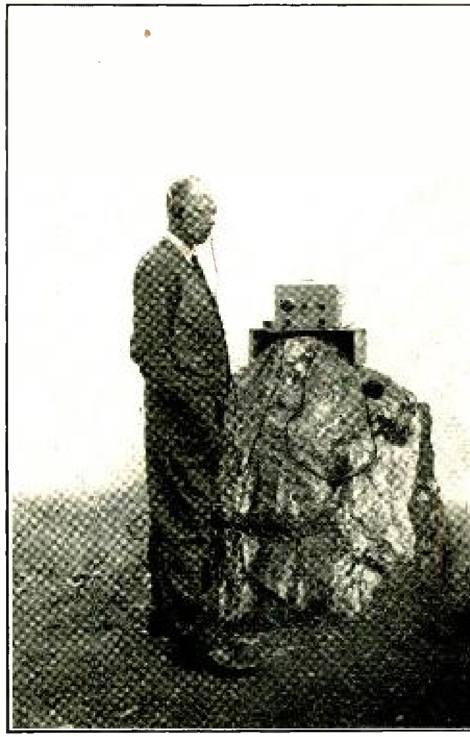
January did not fail us, but brought several days of five meter dx. New Year's Day was reviewed in this column last month. On the 8th, W5VV raised W9ZQC in South Dakota and heard several weak carriers. On the 13th, W6QLZ had a severe aurora effect that was too bad even for c.w. work; a station near W5VV's frequency went to c.w. every time QLZ did, which sounds like an unusable opening. Next evening W5AJG worked W4EDD W6OVK W9VHG and heard W4FLH FVW W8SLU W9ZHB W9QCY, which means that he heard five districts including his own. W6OVK and W6SLO found signals very strong for several hours. OVK worked W5AJG EHM DXB W6BPT, while SLO raised all but AJG. Neither could hear W4EDD that night. QLZ had better luck hearing EDD but still could not raise him though he was Q5 with no antenna. Clyde did work W5AJG, though, and heard a W5 around 58 Mc. whom he thought to be EEX or DXB.

On January 15, W5AJG heard W4EDD FLH again but had company and did not try to contact them. W8RUE, however, raised EDD and heard W4FLH DRZ FVW. It's nice to see that the Voice of Fort Lauderdale is back on the air. During short ten meter skip on February 1, five opened at W6OVK who had a contact with W5VV and heard strong harmonics from Oklahoma and northern Texas.

Several additional reports cover days mentioned in last month's issue to have been open. Bill closed the column early in order to be free to take care of moving details at the last minute, or some of these might have been given a month ago. W8RUE added a new state on December 24 by raising W4EQM in Langdale, Alabama, before his contact with W5AJG; W5VV had nice contacts with W6OVK QLZ. VV thought that the band had been open just before he got home. On the 26th, W8RUE hooked W5AJG EHM while W9QCY got Leroy that afternoon and the next one also. QCY worked W9ZQC on January 1.

Antenna Polarization

W3DBC in Washington threatens to go over to horizontal polarization to reduce interference with b.c.l. receivers on 5 and especially 2-½, even if there is no other horizontally polarized station around to work. He figures that he is sufficiently persuasive to get someone else to shift. As one well known W1 puts it, you just *have* to be vertical in the east. He adds that he does not have any conviction of the accuracy of someone's statement that a horizontal will pick up either polarization at some distance. John Reinartz, W1QP and



W6CLV atop Mt. Davidson in San Francisco —usual fog in background.

now a W3, supported the corkscrew theory during the Washington I.R.E. meeting in February, while others think that the theory is less corkscrew than screwball! Some Bell Laboratories tests at 40 miles showed practically no signal pickup when the antennas were in different planes.

W6IOJ says that so far as his location is concerned, 20 miles into the California hills, pre-skip contacts require vertical polarization.

In Fort Wayne, W9QCY remains unconvinced. He has a coaxial-fed vertical that he pulls up between 50 and 75 feet, and a rotary three element horizontal with a four-wire radiating element, mounted 54 feet up, with a little ground screen below it. His location is in a small valley. He has worked W8QDU mobile 20 miles away on the vertical,, and has nearly daily contacts with W9AQQ in Indianapolis on the horizontal. The latter has also worked to others in the horizontal net including W9ZHL in Terre Haute and W9BDL in Marshall, Illinois, a good long way off. Nothing has been heard from Louisville, where someone should find it easy to get over to Terre Haute or Indianapolis.

General

Due to the imminence of active duty in the Naval service, some of the following was held over for this issue. Please excuse it.

On his trip east, Bill tried to get in touch with W9QCY and W8CIR by telephone and arrange to meet them. Somehow they could not be located. It is a great pleasure to call on other amateurs about the world, but unless a trip is taken leisurely, it is sometimes difficult to arrange to stop. When a stop *is* made and then the name is not in the telephone book and the unknown street is somewhere out in the country where u.h.f. work is most pleasant, it is generally necessary to go right on. Sorry, Glen and Ed!

Ed Tilton points out that the gang holds it against him for not turning out a carload of technical articles for *QST,* and against us for not being on the air whenever the band opens up. As a matter of fact, these u.h.f. columns are done as a hobby, not as a full time job; the extra work involved just has to cut into something. Now that Bill has made radio and the Navy his business rather than his hobby, yours truly may get him to take up contract bridge.

A u.h.f. dinner and "session" was held on February 13 in Washington when W3CUD came in town and got some of the gang together, including W3AWM HDC DBC EIS RL CUD W7ESK W9BNX/3. They went round and round about receiver sensitivity and such. Someone had better watch that stack of nice copper gutter-pipe behind the Army building.

G6CL points out that letters posted from the U.S.A. between about November 7 and December 8 never arrived in England. Boy, what an excuse for not having answered some letters!

In giving us more details on his fine 2-½ meter home location contact with W2LAU, W1MON says that the Coast Guard charts show it to be 203 miles rather than 198 miles as published. MON is at Holbrook, 12 miles south of Boston. The contact was at 10:57 p.m. on October 5, 1940, with two witnesses at MON. W2MPQ and W2PP in Irvington, New Jersey, separately overhead the contact, and PP subsequently heard MON. The latter uses a 45 oscillator in a t.n.t. circuit, 35 watts input. The antenna is a three element rotary. Receiver uses a 6J5GT.

56 MEGACYCLES

Twice more, W1HDQ has put up his eight half waves, this time perhaps to withstand the winter. The arrangement is a stack of four verticals, with another four broadside, giving sharp vertical directivity but broad horizontal directivity so that it is not ordinarily rotated. Usually, it is about 8 db better than two half waves in phase except on good nights when it shows up five units better on the NHU receiver, for some reason.

[*Continued on Page 81*]

2½ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6KIN/6-W6BJI/6 (airplane)	255
W6QZA-MKS	215
W6BKZ-QZA	209
W6QZA-OIN	201
W6BCX-OIN	201
W6NJJ-NJW	175
W1DMV/6-W6HJT (airplane)	165
W9WYX-VTK	160
W6KIN/6-W6OMC/6	140
W6IOJ-OIN	120
W2LBK-W1HDQ	118
W1HDQ-W2JND	105
W6BCX-IOJ	100
W1HDQ-W2IQF	100
W1HDQ-W2GPO	100
W6NCP-OIN	98
W1KXK-MNK/1	81
W6IOJ-OIN	80
W6CPY-IOJ	80

HOME LOCATIONS

Stations	Miles
W1MON-W2LAU	203
W8CVQ-QDU (crossband)	130
W1IJ-W2LAU	105
W2ADW-W2LAU	96
W1HBD-W1XW (1935)	90
W2LBK-W1IJ	76
W2LBK-W3BZJ	76
W1MWN-W2LAU	75
W1SS-BBM	74
W1KXK-IZY	73
W1MRF-W2LAU	68
W2GPO-LAU	50
W1LAS-W2LAU	45
W1LEA-BHL	45
W1MON-HEN	45
W2JND-LAU	44
W2MLO-HNY	40
W3CGU-W2HGU	40

1¼ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W6IOJ-LFN	135
W1AJJ-COO (crossband)	93

112 Mc. Net Aids Red Cross at Presidential Inauguration

By OSCAR W. B. REED, Jr., W3FPQ

Shortly after Christmas the Washington Radio Club was invited to provide communications for ten field first aid stations. Calling upon those registered in the emergency corps of the A.R.R.L. and drawing upon other sources of available emergency equipment, the club set out under the leadership of its emergency coördinators to do the job. Ten field tents located between the White House and the Capitol served as first aid stations. To make each of these units capable of communicating with the District Headquarters building, the nerve center of the entire organization, required the use of self-powered radio units at each location.

At the first conference called, members who were later to provide this emergency service decided that the 2½-meter band was the most satisfactory one to use because of present restrictions regarding use of portable equipment below 28 Mc. Luckily, it was discovered that enough existing 2½-meter phone apparatus was available to do the job. However, some additional equipment was developed and used. Improvements in existing equipment were made wherever it seemed advisable.

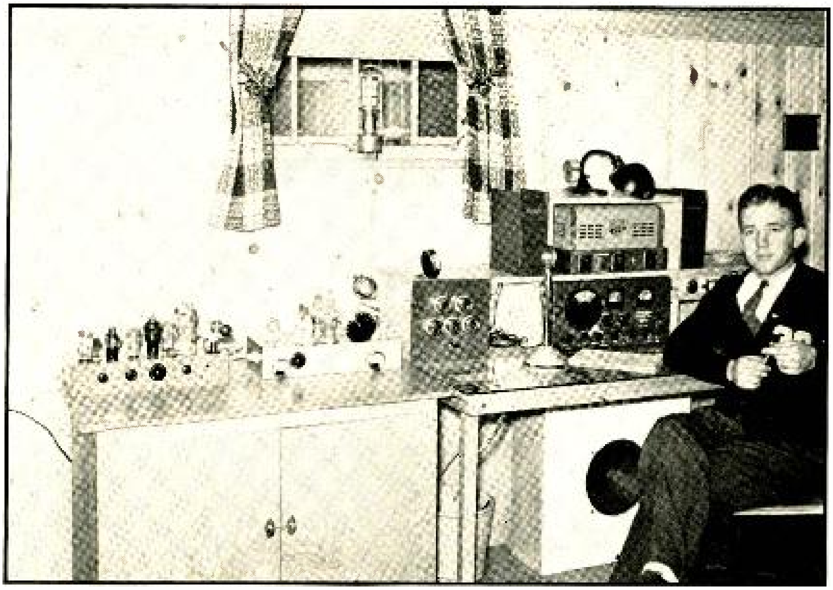
Master control station W3ING at the Red Cross District Chapter Building. The transmitter on 115.2 Mc. used 65 watts input to the final.

The master control station at the District Chapter building (where A.C. power was available) made excellent use of the crystal controlled transmitter of W3ING, running about 65 watts input to a pair of HK-24's on 115.2 megacycles. In addition to the field radio stations located in the tents, two mobile units also were used. These two units, containing Red Cross personnel as well as the radio operators, served as liaison for all fixed units. Carrying supplies of additional emergency equipment, these units were called upon several times to replenish emergency power sources and provide an additional flexible message service. Six of the field stations used a storage battery and vibrapack power source while the remainder depended upon dry battery supply. Where dry batteries were used, communications equipment consisted of transceivers. In the other cases separate transmitter and receiver units were used at each location. In general the transceiver equipped stations were those placed nearest the master control station. The remaining stations of somewhat higher power were along the farther end of the two-mile radius which took in all the area required.

On the hour and half hour, whenever the

[*Continued on Page 90*]

Battery-powered portable station W3IUZ/3, one of the ten field stations, was located in a first aid tent on the route.



AMATEUR

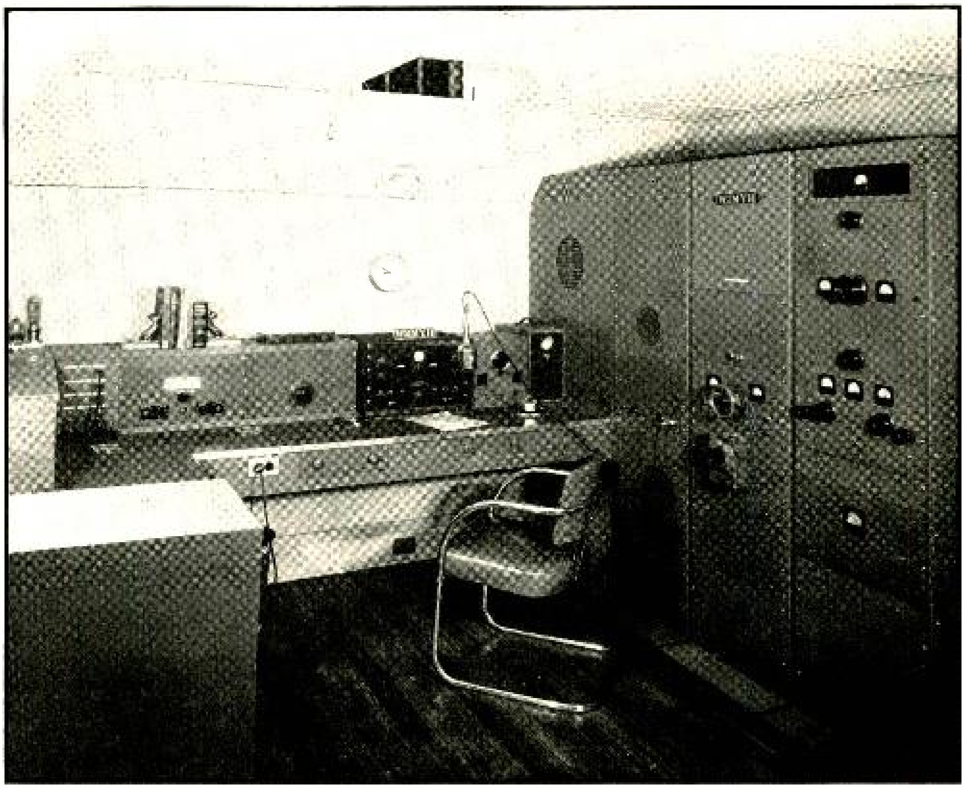
W9LXC

● W9LXC, Sheboygan, Wisconsin, is operated by R. H. Ebenreiter. The shack is a 14- by 20-foot basement room finished in knotty pine. The transmitter on the cabinet to the left of the operating desk uses a 6A6 oscillator, 6L6 doubler, 809, and push-pull 812's. Input to the final amplifier is normally 250 watts. The 811 modulators and the power supplies are located inside the cabinet. Note the beer-can shield over the 809. After being driven to drink by oscillations in this stage, Ebenreiter found that the beer can made an excellent shield for the 809, and thus eliminated the oscillation. The receiver is an SX-24, and the antenna is a two-element beam located on the garage 90 feet from the shack. Operating frequency—28,560 kc.

● W2MYH, Summit, N.J.—Operator, H. O. Pattison, Jr. This modern amateur station was built—with exception of the receiver and monitoring equipment—entirely by the owner. The transmitter proper is enclosed in the rack at the right. An 811 doubler is followed by a pair of 810's. Another pair of 810's serve as modulators. Excitation for the 811 is obtained from the Signal Shifter on the desk. The receiver is a Super-Pro. Other equipment on the desk is an oscilloscope, high-fidelity broadcast tuner, and—behind the filing cabinet at the left—a recorder built around a manufactured cutting-head assembly. Most operating is done on 28 Mc., where a 700-watt signal is obtained from the transmitter.

W2MYH

STATIONS



KEYING THE V.F.O.

Without Clicks, Chirps, or Tails

By W. W. SMITH,* W6BCX

Not so many years ago there was a common impression among amateurs that to get rid of key clicks without putting long "tails" on the signals all one had to do was to key the crystal oscillator. The "inertia" of the crystal was supposed to iron out keying impacts and permit a lovely clickless signal. The fallacy of this line of reasoning soon was apparent. A crystal oscillator will click no more and no less than a well designed self-excited oscillator, when both oscillators are adjusted for minimum clicks.

Another erroneous idea regarding keying impacts is that the tuned circuits of several stages following a keyed stage will virtually eliminate all trace of key clicks. It may be true so far as keeping key clicks of a 40 meter transmitter from bothering neighboring b.c.l. sets, but the discrimination of the rather heavily loaded (low Q) circuits will not afford much reduction in clicks on the band to which the transmitter is tuned, particularly on the higher frequencies. In fact, it is possible to take a 10 watt 40 meter rig which is free of any trace of keying impacts (let's assume primary keying of the 10 watt stage), and, by feeding it into a heavily excited 100 watt stage which in turn feeds into a heavily excited 1 kw. stage, develop such bad key clicks that locally they will be heard over the entire band. Thus it can be seen that in a case of this kind the additional stages actually have been responsible for the key clicks. The reasons for this will be explained subsequently. The clicks are *not* simply a result of the greater antenna power.

Before proceeding further, let's dwell for a moment on the fundamentals of key clicks.

Key clicks are of two types. The first is caused by sparking at the key or relay, and will be just about as bothersome if the transmitter is worked into a dummy load instead of an antenna. The click is the same sort of animal that one encounters when turning a light on and off, and is cured in the same manner.

The spark at the key generates a pulse of highly damped r.f., which is radiated directly by the leads to the key or relay. Clicks of this type are cured by putting an r.f. bypass across the key, right at the key or relay contacts, and possibly an r.f. choke in each lead to the key or relay, as close as possible to the bypass condenser. Care should be taken to see that these components resonate well below the broadcast band unless you are a block or more from any b.c.l.'s.

Clicks of this nature are heard only in the immediate vicinity of the transmitter, and will be particularly bad on receivers served by the same 110 volt system.

The second type of click is caused by a too sudden build-up or decay of the power in the antenna. When the amplitude of an r.f. carrier is changing rapidly, sidebands are produced, the sidebands lasting only as long as it takes for the antenna power to reach maturity on the "make" or to reach zero on the "break." The more rapidly the antenna power changes (in other words, the faster the "make" or the "break"), the wider the band taken up by the sidebands. The greater the transmitter power, the greater the amplitude of the sidebands.

This type of key click, besides bothering neighboring b.c.l. receivers, will be a source of considerable annoyance to amateurs in the

*RADIO

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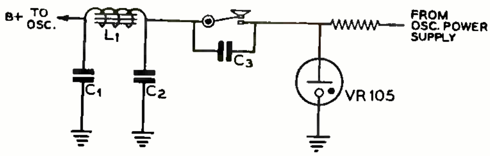


Keying system for oscillator drawing approximately 2 ma. at 105 volts. With a crystal oscillator the voltage regulator tube is not required. Oscillator grid condenser should not be over 100 μμfd.

C_1—.01 μfd. mica bypass. Actually this condenser is in the oscillator circuit (plate bypass condenser). If existing condenser is between .006 and .015 μfd. it need not be changed.

C_2—.01 μfd. paper tubular

C_3—.002 μfd. mica, right at key terminals

L_1—Approximately 60 hy., 2 ma. or more. Primary of a small interstage audio transformer will serve nicely. Exact inductance is not critical; it may be anywhere between 30 and 80 hy. Do not use a choke of higher inductance and attempt to "lower the inductance" by means of a shunt resistor.

same locality operating on the same band, and if bad enough will cause interference to other amateurs even at great distances. Fortunately for the b.c.l.'s, the selectivity of the transmitting antenna and of the tuned circuit feeding the antenna will greatly reduce the strength of the sideband components falling in the broadcast band, and the only broadcast receivers bothered at distances of more than a few hundred feet from the transmitter will be those which are also subject to radiotelephony interference: those with images or poor discrimination against high frequency signals. The $14.95 superhets are subject to this type of QRM, because while the keying sidebands may have negligible amplitude at broadcast frequencies, the mixer tuned circuit does not provide sufficient rejection to the high frequency keying sidebands, and harmonics of the superhet oscillator will beat with those that get to the grid of the mixer tube, thus permitting the sidebands to find their way into the i.f. channel.

Contrary to popular belief, too sudden application of plate voltage (or screen voltage or bucking bias or whatever the keying circuit controls) is not the only cause of the antenna power building up too rapidly. The same applies to the antenna power decaying too rapidly.

It is possible to take a pure sine wave, and, by passing it through several limiting amplifiers, to change it into a wave with corners so sharp that the waveform will closely resemble a square wave. And a class C amplifier with heavy excitation unfortunately makes an excellent limiting amplifier. It is for this reason that primary keying of the final amplifier is preferable to center tap keying of the oscillator, from the standpoint of key clicks. However, it *is* possible to use oscillator keying in a multi-stage rig and not have key clicks, as will be shown shortly.

Let's consider the ideal keying system. It should not produce key clicks, either of the "arc" type or the "sideband" type. It should be simple and not require expensive equipment. It should permit good copy at speeds up to 50 words per minute. It should permit break in, even on the transmitter frequency.

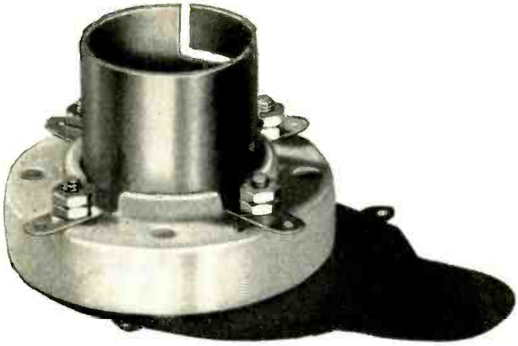
Primary keying of the final amplifier, long a favorite of the high power gang, produces virtually no sideband clicks, and the clicks from arcing at the key or relay contacts can be suppressed quite easily. Also, this method of keying it easy on high voltage filter condensers. However, it does not permit break-in on frequencies close to the transmitter frequency, and when single phase power of 60 cycles or less is employed, it is difficult to get sufficiently pure d.c. without having too much keying lag for code speeds in excess of about 20 words per minute.

Clickless QRQ Keying

It *is* possible to obtain clean, clickless oscillator keying (either crystal or v.f.o.) that will follow the fastest bug, no matter how many amplifiers follow the oscillator. First, the oscillator itself must be keyed without producing tails, clicks, or chirps. This is accomplished by running the oscillator at very low plate input and keying right in the B plus lead, the keying trains being rounded off by means of a low pass filter designed with a cut off in the vicinity of 300 cycles. At this point someone is bound to ask why the key isn't put in the center tap lead instead of the B plus. The reason is that center tap keying is popular only because it is possible to key a high powered stage with but little sparking at the key or relay contacts. However, it is much easier to eliminate all trace of *sideband* thump if the oscillator is keyed in the B plus, rather than in the center tap. If you wanted distortionless modulation of an oscillator where would you modulate: in the B plus lead or in the center tap? Nuff sed. Now refer to figure 1.

To keep down sparking at the key, the plate voltage and plate current to the oscillator are kept low. A 6J5 or 7A4 oscillator is recommended, with a 50,000 ohm grid leak to

[*Continued on Page 94*]



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A WORD TO THE WIVES

I don't believe we had been married more than four weeks when Dan first mentioned amateur radio to me. It was a brisk winter morning. I was busily scraping toast at the kitchen sink, when out of a clear sky, he casually remarked: "I imagine amateur radio must be a lot of fun."

I looked up from my toast scraping long enough to smile at him brightly and remark that I imagined it must be fun, too. That will give you some idea of just how innocently these things start. The subject was forgotten. At least, *I* forgot about it, but it was brought forcibly to my attention again a few days later when Dan came home with three antique radios, battery type, which he had garnered from his dear students of science at the local high school. He put them all in the storage room and went happily to work ripping them apart.

I found this form of insanity vastly amusing and even helped him a little. Then one day he began putting some of the parts together in a chalk box, and a very efficient oscillator was the result. Dan was sure I was interested in his experiments. Accordingly, he spent much time explaining them to me and showing me how they worked. I made admiring noises at all his efforts, because every book you read about happy marriages tells you to take an interest in your husband's hobbies and encourage him.

There must be some physical law which makes hams gravitate toward each other because they certainly do. In no time at all my friendships were colored by whether the husbands were hams or not.

Then Dan and I both began to learn something. He progressed apace toward owning a rig and getting a ticket; and I was initiated into the hardships of being an XYL, against which, at least for my money the struggles of the early pioneers were as nothing.

I finally dragged my darling away for a weekend to visit our folks. He seemed his old self in these familiar, sane surroundings. We had a lovely time. We said our final farewells and walked down the drive to board the Ford. Then I got the shock of my life. The Ford had turned into a freight carrier. It looked for a time as though it would be impossible to accommodate passengers, for it was completely camouflaged by lumber. Yes, lumber. All sizes and shapes, tied on the sides, the roof, and the fenders. And from the luggage compartment protruded several large, business-like pieces with a red bandana floating from the longest and strongest.

I turned to Dan with a puzzled smile. "I had no idea we were going to build a little place of our own so soon, dear," I said. He laughed a little doubtfully and explained that these few pieces of lumber were for a work bench and the frame for his rig and he might just be able to get small beam antenna out of it. Looking back at those days I can laugh merrily at our capers, for later we thought nothing of carting long two by fours for a forty foot antenna. (They might possibly have been longer but there was a borough ordinance against it.) Then there was the time we tied the pieces under the car and the friction damaged the wiring so that we had to drive blind down a very steep mountain in the dark. Whew!

It must have been about this time that Dan built his first rig, because we moved from an apartment into a house. The house was a bungalow type with a large unfinished second floor, ideal one would say for the pursuit of ham radio. But no. The Master of the Manor thought it would be much cozier in the kitchen where he could keep me company while I labored at my chores. Since I was inexperienced

[*Continued on Page 87*]

By MERLE LEIBENSPERGER (Mrs. W8PIK)

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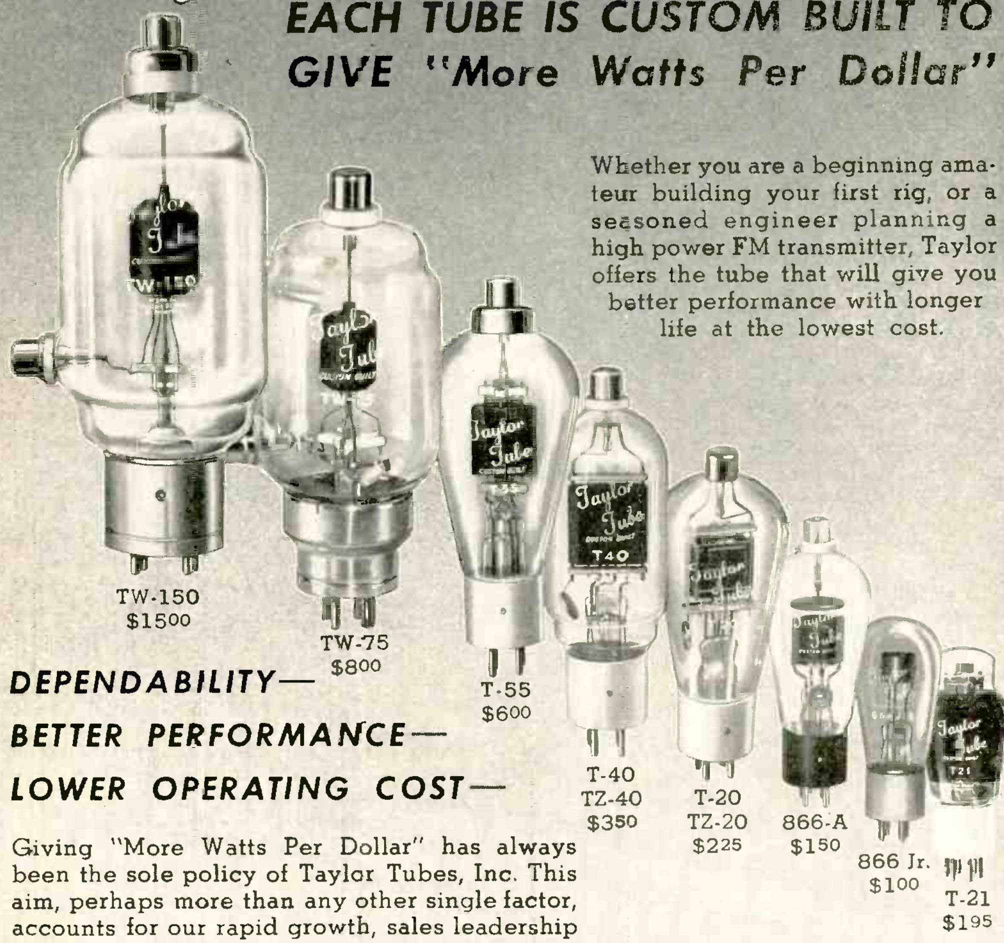

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The Coincidence of U.H.F. Fading

[Continued from Page 13]

figure 8. In the same graph a comparative record of the fade of W2XWG (100 miles distant) is also run. If these signals were being refracted from layers adjacent to the receiving position some coincidence might be possible. There is none indicated in the graph.

The fades of W1WOJ have another peculiar tendency which cannot be shown on a long-period graph. Short sporadic periods of from 5 to 10 seconds of extremely strong signal will show up during a day when the normal strength is varying between .05 and .10 ma. These periods are very sudden and unheralded and the l.g.c. meter may rise to over 1.00 ma., stay there for a fraction of a minute then disappear as suddenly as it came. While "spot-tuning" that channel (44.3 Mc.), words and music may suddenly be read with no distortion from a signal whose average input to the receiver itself is of the order of 4 to 5 mv. One theory advanced to cover this type of sporadic signal (it is assumed the slowly moving air masses could not account for these signals of so short and strong duration) which frankly could be considered to be a little on the fantastic side, is that the signal is reflected from an ionized patch or train left of a meteor entering the earth's atmosphere.[7]

Summary

All observations indicate that fading will accompany all u.h.f. signals whose primary service area is exceeded by approximately 20% or more, or in such positions where the signal can only be propagated by t.a.b.b. (tropospheric air boundary bending). Fading has no definite rate, severity or pronounced time of maximum severity. The most common type of fade called the "roller" may actual assume many patterns if shown graphically. There appears to be no distortion of the plane of the radiated wave in fading accompanied by t.a.b.b. There does exist a well defined coincidence in fading at independent frequencies (i.e. of course, within the limited f.m. commercial band where the tests were carried on) and from the two different types of polarization from similar transmitting locations.

It was further shown that separate and distinct layers in the troposphere affect the fading of individual stations, and that fading is a proposition of localization. Severe localization of the refracting media causes scintillating fades. These may indicate the approach or the removal from an area of good t.a.b.b.

---

[7]A. M. Skellett, "The Ionizing Effect of Meteors" *I.R.E. Proc.*, Dec., 1932, p. 1933.

X-DX

[Continued from Page 54]

14260, CE3AJ 14326, CX1BO. KC4USC, K4EIL K4DIF and K4GTH have been heard on 28 Mc. BRS991 and G5RI both report ZB2OD and ZB2FQ as stating they are in Gib. Other "had hats" include ZC6Q, TA1UR, SV1XA, LZ3WW, HB3BZ, HB3BB and SM7NR; all but ZC6Q were heard on 7 Mc.

The above paragraphs from the T. & R. *Bulletin* are being run because I have a hunch you fellows are interested in what's going on in about the only ham organization outside of USA. You can do me a great favor by sending me your comments on this practice and if you like it we will be happy to run more. By the same token don't limit your comments to favorable, as if you don't think that stuff is of interest we can drop it much easier than we can print it.

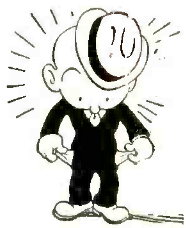
Exeunt

While prowling around the 40-meter band the other night I actually ran into signals other than W9's. Although I must confess the evening started off with a contact with W9TAU and W9AOB was at the key, then who should pop up but W8ZY, with his Defiance Kw. Karl is still using those same old 852's on 40 which have been grinding away now for years. To make matters more binding when that QSO ended, ran head-on into W3DGP, the Barker half of B. & W. It's funny the impression one gets when one meet's one for the first time. Barrie (that's 3DGP) and I met in Chi last June and I had always thought he was a died-in-the-wool phone man. And then to hear the guy on the air actually sending code . . . real great big dots and dashes. Anymore jolts like that and 5000 v.d.c. will just be fun to take.

W7GGG still rattles the cans for the boys around while he wiggles his bug with much gusto. For local scandal ol' 1492 went snooping through one of the department stores recently and what do you think he saw? Why, there was W6OEG buying a pair of hose. (You ask, "What's wrong with that). Oh nothing at all, except he was at the ladies' hosiery counter. We can't hold that against Bill though, especially after hearing him on 40 lately and working W2BHW, too. This proves that Lindy is not yet in uniform anyway.

If you should suddenly hear W6SA booming out with a husky signal it will be because of a certain wager I have with him. He has been bragging about the new final he is building for about a year now. So in order to squelch some of this we engaged in a bet with May 1st as a deadline. After 6SA we'll have to dig out CUH.

That's it for this time, gang, and I wish you would dig up some photos, etc., and shoot 'em in to us. And now, in abiding by the wishes of a few W9's that I lay off them for a while, I won't even bring up the point I was about to mention. Oh it was nothing . . . no, you can't coax a thing out of me on nines this time. So long, see you around the corner next month.



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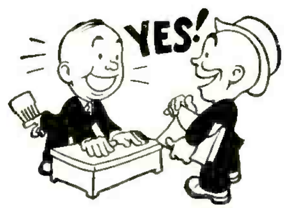
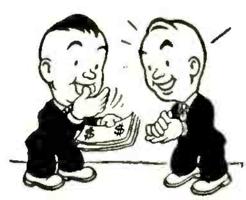


Oh, goody!

"He jumped down my throat and gurgled, 'Yes, we'll accept them, and any others you can dig up that are as good.' Then he took me down to W6QX, who has charge of the purse strings.

"Now I'm a successful author—articles published in black and white with my name at the top, and best of all, money in my pockets!

"Any time I'm short of cash I just dust off the mill and grind out a blurb for RADIO, for which I often get nice soft folding money in return. I get rejection slips, too; I'm papering the shack with them where the QSL cards don't quite cover. But I do like those engraved pictures of Lincoln, Jefferson, and Chase."



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High Fidelity Receiver

[*Continued from Page 48*]

station uses an unequalized crystal pickup (as do some of the 100 watters) the highs will be so attenuated that further attenuation at the receiver will be undesirable. The important thing is that when one has the option of boosting the highs, lopping them off, or leaving them alone, one can suit the receiver characteristic to the particular program and station being received.

No particular care need be taken in the construction of the receiver except to isolate the input and output circuits of the 6SK7 r.f. amplifier in order to avoid regeneration or oscillation. Reasonable care should be taken to keep the grid circuit components of the 7L7 close to the tube and the "hot" leads short. If this is not done, some "grid hum" may be picked up.

The resistor R_{14} is chosen so that the voltage at the screen of the 6L6 is between 260 and 280 volts to ground. It should be of the wire wound type. At this voltage the 6L6 will deliver 5 or 6 watts of audio with very low distortion, the distortion being mostly 2nd harmonic if the load on the 6L6 is close to the recommended value of 2500 ohms. Second harmonic is not nearly so objectionable as 3rd harmonic, the latter type distortion usually predominating in a push-pull amplifier. Thus, a single-ended stage with inverse feedback appears to be preferable to a push-pull stage (employing the same class of output tube) without feedback. Of course the ideal amplifier would consist of push pull 2A3's in the output stage with inverse feedback on all audio stages. However, there seems little point in having an a.f. amplifier capable of delivering the desired output at less than 1 per cent distortion when few people can detect 1 per cent and there is already more than 1 per cent distortion in the signal anyhow, some being present at the transmitter and some being contributed by the detector, even when an infinite impedance detector is usd.

The output of the single 6L6 is sufficient for good room volume even when a moderate amount of bass boost is employed, provided an efficient speaker is used. The single ended output stage does have two disadvantages, though they are not serious. More power supply filter is required than is needed for a push-pull output stage, and the output transformer must be larger for a given power output, because the saturating effect of the d.c. in the primary does not cancel out as it does with a push-pull stage.

A 7L7 was used in preference to a 6SJ7 a.f. voltage amplifier because of the tendency of many 6SJ7's to be quite microphonic. Glass type 7L7's usually are less microphonic. A type 1620 is better yet from the standpoint of microphonics, but had the disadvantage of being a double ended tube and more expensive.

As the receiver tunes rather broadly, a vernier type dial is not necessary, and need not be incorporated unless it is desired to "doll up" the receiver. A large, pointer-type knob can be used for direct drive, with the stations marked directly on a hand-lettered scale.

Speaker Baffle

The method of baffling the speaker is every bit as important as the choice of a speaker unit. If the receiver is to be used in an amateur "shack," the speaker often can be mounted on the wall at one end of the room. If the speaker is to be mounted in a "box," the box should be constructed of heavy wood and be ruggedly put together. About 2 db of bass boost can be obtained by utilizing the "bass" reflex principle, in which the cabinet contains a bass reenforcement port and is made broadly resonant in the lower register (say, 85 cycles) by proper proportioning of dimensions and using only a moderate amount of damping in the cabinet.

Much simpler to construct is an "infinite baffle" cabinet. The cabinet is nothing but a completely enclosed box (air tight except for a small "breather"), of any convenient shape or size so long as it contains at least 9 cubic feet of air space. The inside of the cabinet should be lined with rug cushion felt, and further dampened by stuffing various old pieces of wool clothing into the corners and tacking a piece of vest or trouser here and there on the sides. The box should be solidly constructed so as to avoid any possibility of vibration. For best high frequency response the speaker grill cloth (if used) should not be of too heavy material.

Antenna

A good external ground should be used (such as a waterpipe). The antenna, discussed previously, should be as high and in the clear as possible. A "T" type is to be preferred to an "L" type for local ground wave reception. An excellent antenna consists of a "T" with the flat top suspended from two 20 foot 2 x 2's placed atop the house as far apart as possible. The amateur, when using the receiver in his "shack," probably will prefer to utilize an existing antenna rather than clutter up the air with more wire and the yard with more poles.

It should be born in mind that the performance of a high fidelity receiver is no better than that of the signal being received. In fact, a station with bad harmonic distortion actually will sound *worse* on a high fidelity receiver, unless the highs deliberately are lopped off to correspond to the response of a $44.50 department store bargain console.

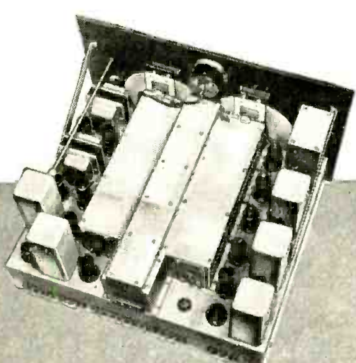
See Buyer's Guide, page 97, for parts list.

Super Pro

SERIES 200

for the *Tough* jobs!

THE illustration above shows "Bob" and "Mabel" Beebe operating W7HXU, one of their two fine amateur stations. "Bob" has his own station, W7IGM, at his place of business. Both stations use "Super-Pro" receivers. Here is what "Bob" writes: "We have, beyond doubt, the world's worst receiving location, bar none, including three 26,000 volt transmission lines exactly 35 feet from the transmitter, and when the old-timers saw what we were blundering into, we were assured that 'It could not be done', and actually were out looking for a new home with suitable reception when someone suggested Hammarlund 'Super-Pro'. The 'Super-Pro' changed the situation completely, and when the band is open, Mabel works 'em."



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IN RADIO

Hallicrafters Radio Compass and Receiver

The Hallicrafters have announced a compact combination broadcast receiver and radio compass designed particularly for the small boat owner. Three tuning bands are provided, covering the 220-540 kc. beacon band, broadcast band, and 1200-3000 kc. marine band. Accurate null indications are provided both visually by a tuning eye and aurally by headphones. Operating power is supplied by a 6-volt storage battery and a Vibrapak. A comprehensive instruction manual describing the proper use of the radio compass is provided with the receiver.

Record QSL's

In addition to their line of albums, pickups, marking ink, mailing envelopes, needles and styli, National Recording Supply Co., Hollywood, Calif., is prepared to supply a patented QSL disc for recording QSO confirmations. The record is of small size and may be used on both sides. Space is provided for writing in pertinent information concerning the contact and equipment.

Presto Recorder

To meet the present demand for high-quality home-recording equipment, Presto Recording Corp. has released as a separate unit the 12-inch turntable formerly sold only as part of their model K commercial recorder. The new unit will be designated as model 11-A. The turntable is rim driven by a metal pulley on the motor shaft operating against a rubber tire on the turntable. A slip-over pulley is removed to change speed from 78 to 33⅓ r.p.m. The motor and turntable are mounted on a steel base ready for installation in portable or console record and 16-inch transcription players.

Small Mercury Switch

A midget mercury switch designed for use on low-voltage circuits up to 25 volts a.c. or d.c. has been announced by Littelfuse, Inc., Chicago, Ill. Current ratings range from 10 amperes at 6 volts to 3 amperes at 25 volts. The switches measure ⅜-inch in diameter by 7/16-inch long.

MICROTUBES

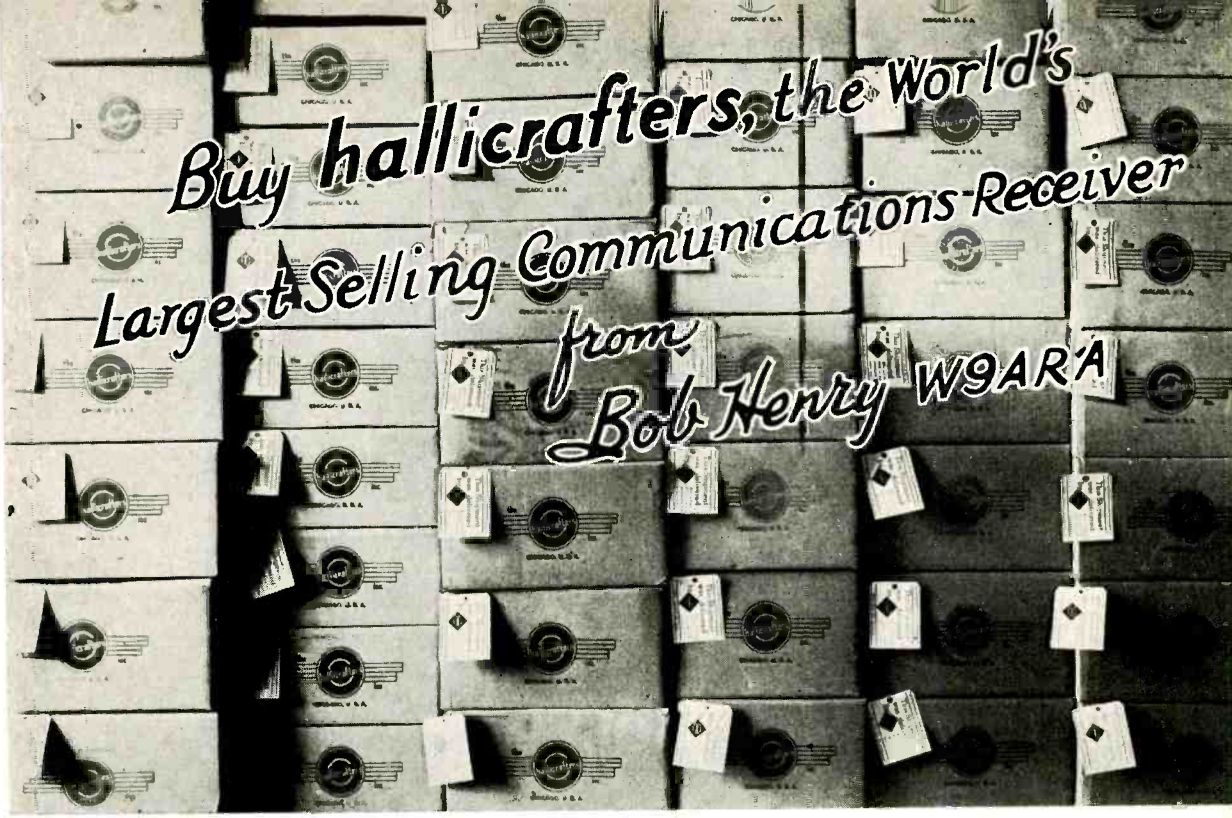
Microtube Laboratories, 2414 Lawrence Avenue, Chicago, Illinois, is manufacturing a line of vacuum tubes so small that they make the "peanut" tubes of some years back look like 50 watters in comparison. The new tubes are designed primarily for use in hearing-aid amplifiers of extremely small size, and the tubes are proportionately small. As a matter of fact, they are just a little bit smaller than the conventional dial lamp—0.36″ in diameter and 1.1″ long. All tubes are tetrodes, and due to unusual element geometry they give excellent beam-tube performance without secondary emission kinks.

The usual hearing aid uses three of these tubes. The two voltage amplifier tubes have 20-ma. filaments each, while the output tetrode has a 40-ma. filament. Since they are all ⅝-volt filaments, a series-parallel connection is required to operate all three tubes from a single 1.4 volt cell without a rheostat. The total filament drain is thus about 40 ma., giving a life of about 40 hours with the smaller hearing aid cell. Although tubes of several amplification constants and impedance values are made, the most common combination of three tubes requires less than one ma. of plate current at a battery potential of 45 volts. The life expectation of the tubes themselves is estimated to be in excess of 7000 hours as indicated by accelerated laboratory life tests.

New Tubes

RCA has announced three new tubes, the 6SG7, 12SG7 and 930. The 6SG7 and 12SG7, which are identical except for the heater rating, are high-transconductance r.f. pentodes. A unique feature of these tubes—and one which should make them of interest and value to u.h.f. experimenters—is the use of two separate cathode leads. The separate cathode leads eliminate the coupling inductance of a com-

[*Continued on Page* 77]



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Write me about type of receiver you want. I will help you get the right receiver and will cooperate with you to see that you are 100% satisfied. Ask for technical information about any receivers.

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Bob Henry
W9ARA

HENRY RADIO SHOP

BUTLER, MISSOURI

100-Watt Transmitter-Exciter

[*Continued from Page 36*]

Keying

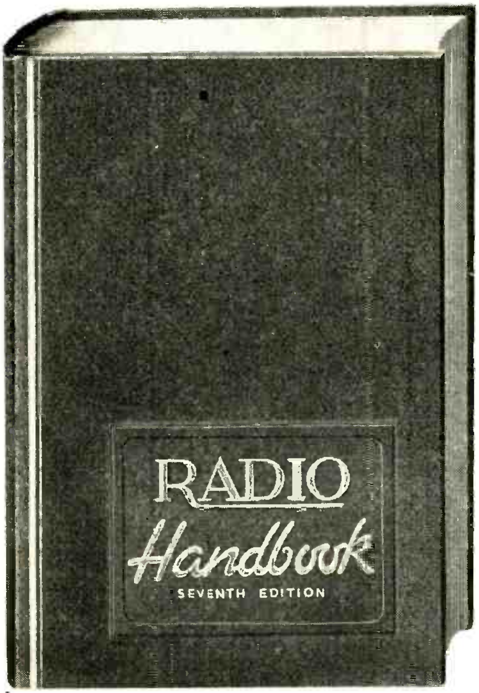
Although the tube keyer used in this exciter is a guarantee of smooth clickless keying, it is not a luxury, for the additional parts used cost no more than the keying relay which the circuit eliminates. The low-potential keying leads may be any reasonable length, provided r.f. chokes are placed in each lead *directly at the key,* and the lag present in even the best keying relays is thus eliminated. A one μfd. condenser in series with a 200-ohm resistor across the keying circuit may make the keying even smoother, but in no case should any resistor be placed directly across the key, since even 100,000 ohms will cause a slight back-wave. It is quite permissible to run the filaments of the three 245's in series off of a 7½-volt transformer, if desired. The TZ20's receive fifty volts of cathode bias because of the voltage drop across these keyer tubes, and hence require little additional bias.

Filament transformers for all tubes are mounted directly on the exciter chassis in order to insure full filament voltage and hence long tube life. The voltage divider for the oscillator power supply is also mounted on the rear of the chassis where good ventilation may be had, and where taps for lower voltages may be taken from it without having to run a multitude of wires to the power supply. The switches shown on the front panel are heavy-duty 110 volt type, and are used for turning off the plate voltage to the TZ20 stage and the plate and screen voltage to the 807 stage. These switches facilitate tuning up by allowing one stage to be tuned at a time without the following stages "running wild."

The four pilot lights on the front panel below the oscillator controls are operated by an auxiliary section of the crystal-selecting relay, and give direct indication of which of the four crystals is in the circuit. The switch directly above these pilot lights serves as a push-button and allows the crystals to be switched directly from the exciter for tuning up as well as from the operation of the push-button at the control position. The crystal oscillator uses parallel feed, since this simplifies mounting of the tank condensers and causes no noticeable losses.

No credit is claimed for having developed anything new in this transmitter-exciter, for there are no *new* features incorporated. However, experience on the air, in chasing dx, and in different contests has shown the effectiveness of this *combination* of features.

Incidentally, I have found that this unit gets an average of only one S unit less when



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used as a transmitter than when used to drive a pair of Gammatron 254's to a kilowatt; in short, the little set can be depended on to give a good account of itself by itself.

See Buyer's Guide, page 97, for parts list.

"Tally-Ho, Two and a Half!"

[*Continued from Page 45*]

first place in 5 of the hunts and second place in one. It is just a conventional superregen transceiver using a 958 acorn detector-oscillator and a 1Q5GT in the audio. A compact 90 volt B unit and 1½ volt A battery provide power. A 2 inch p.m. speaker is mounted in the top of the cabinet; it was feared that a phone cord might distort the pattern.

All of the findings are based on results obtained under "ideal" conditions. The bearings were taken in flat, open country, shooting at a signal above the horizon with no obstructions between. Such conditions are necessary when conducting experiments of this type, because otherwise one is just shooting in the dark. Under conditions other than ideal, things really get complicated—and interesting. Then the ingenuity and common sense of the operator count for as much or more than the equipment. 112 Mc. waves will reflect off most anything that offers a conducting surface. They bounce around among hills and through canyons like a rubber ball, and they will thumb a ride on an overhead power line to come out several miles away going in a different direction. For this reason bearings usually are highly inaccurate when taken at ground level among buildings, behind hills, or near power or telephone lines.

When conditions are not *too* complicated, it is possible to take several bearings under such adverse conditions, and, by an analysis of the possible reflections, etc., to work out an answer and get a bearing that is accurate to, say, 15 degrees.

As an illustration, suppose that we have arrived in the vicinity of the transmitter and upon taking a bearing we find that we have two distinct "dips" about 45 degrees apart. This indicates that we are receiving the signal from two directions. Facing around we observe ahead of us a small, round-topped hill. It is evident that the transmitter is on the slope behind the hill and the signal is reaching us by bouncing around each side as well as over the top.

In all cases it is necessary to remember that unless most of the signal is reaching the receiver in a direct line of sight from the transmitter, no direction finding equipment will be consistently accurate. It is up to the operator to supply the horse sense that the equipment lacks.

We always have lots of fun on these hunts, and seldom is one concluded without the participants learning something new about u.h.f. behavior. U.h.f. is playing a big part in national defense, and as it is not advisable to publicize important u.h.f. developments, the only way we hams can keep abreast of things is by trying things for ourselves and comparing notes with others who are working on the same problems.

●

Proud of your station? Got a camera? Send good photographs to The Editors of RADIO.

What's New

[*Continued from Page 72*]

mon cathode return for the input and output circuits. As a result of this feature the input conductance may be maintained at a high value at high frequencies. Other features of the new tubes are low grid-to-plate capacitance and moderately low input and output capacities.

The 930 is a gas phototube recommended for use in sound reproduction and relay applications. Electrically, the 930 is similar to the 923. The 930 is mounted on a standard octal base.

Preferred Replacement Types

RCA also announces the "preferred tube type" program to include the replacement market. A list is supplied dealers showing 66 types of tubes out of the 500 types needed for replacement purposes. It is stated that these 66 types will meet 66 per cent of all replacement requirements.

RCA-1629 Electron Ray—RCA-8000 Power Tube

The 1629 is an electron-ray tube with a built-in voltage amplifier for indicating negative d.c. voltages from 3.3 to 8 volts. It is essentially similar to the 6E5 except that the heater potential is 12.6 volts as compared to 6.3 for the older tube type. Because of its 12.6-volt heater and its octal base, the 1629 is particularly suitable for use in aircraft radio equipment. The tube is also well suited to use in a.c.-d.c. receivers employing a 150-ma. heater string.

The RCA-8000

The 8000 is a transmitting triode having a maximum plate dissipation of 150 watts under ICAS conditions. The tube is similar in external appearance and ratings to the 810. The chief difference between the two tubes is the fact that the amplification factor of the 8000 is 16.5 as compared to 36 for the 810. The lower amplification factor of the 8000 makes this tube well suited for use in self-rectified radiotherapy equipments. In such a self-rectified oscillator circuit as is frequently used in therapeutic applications, two 8000's are capable of delivering a useful power output (at 85 per cent plate efficiency) of 550 watts. The 8000 is rated for operation with full input at frequencies up to 30 Mc., but it may be used with reduced plate voltage and input at higher frequencies up to 100 Mc.

●

Shopping? *The Marketplace* has bargains!

The Open Forum

Clacton, Essex, ENGLAND

Dear Fellers Over There:

Please excuse this circular letter but as we have the same things more or less to say to all of you and as there seems so much to do these days, we thought this would be the best way to let you know that, so far, we are still alive and kicking—especially Clive aged 18 months—and that, while we are now not able to have our enjoyable contacts over the air, we often think of those happy days and still listen to your signals occasionally.

Thank you also for all your kind letters and Christmas cards, etc., which are always very welcome.

To tell you all that has happened in the last 18 months or so would take many pages —I have kept a diary since the war began and this now contains about 850 pages—but, briefly our personal 'history' is as follows:

In the summer of 1939 we started a new firm for the manufacture of amateur radio equipment, etc. With the outbreak of war in September things looked pretty black for us, as, of course, all amateur radio ceased and trade flopped just when in the ordinary way the radio season would begin. However, after some months of indecision various government orders began to replace the original amateur trade and since the summer of 1940 we have been very busy indeed manufacturing radio equipment of various types. Since my work was of military importance I was not conscripted, so that at any rate I have been able to live with my family, which is something to be thankful for!

Apart from the black out, which we soon got accustomed to, during the winter of 1939-40 we hardly knew there was a war on. German planes used occasionally to fly over the coast, generally to lay mines in the Thames Estuary, but they hadn't started bombing then. We had our first rude awakening at the end of April 1940 when a German mine laying plane crashed in our town and one of its mines exploded doing widespread damage. I shall not forget that night in a hurry, was on the spot a few minutes afterwards. Incidentally, also during last winter, we used to have quite a few floating mines washed up and sometimes these would 'go up' with a tremendous explosion.

During May, June and July aerial activity increased considerably and we had our first taste of indiscriminate night bombing by the "Jerries," some months before they started the blitzkrieg of London. We were then not so used to this sort of thing as we are now and many nights were spent without much sleep until dawn, listening to that awful drone of planes overhead and every now and then the thud of bombs. Fortunately the summer nights were short and we could sleep after 4 a.m. if not before!

It's surprising how adaptable the human body is! Once upon a time we would have felt quite "shaky" when the sirens went, let alone if any planes were over. Nowadays the sirens have sounded so many times that we hardly notice them and the evenings are spent more or less normally at home with the Nazis flying overhead almost every night. Only when we hear the whistle of falling bombs do we make a dive for cover under the table or anything else that is handy. That "whistle" doesn't make you feel at all good but gives you a second or two's warning of an approaching "wallop" and you must hold on tight and hope for the best!

Just how indiscriminate the German bombing is it is probably unnecessary for me to mention, as no doubt you have read about it in the newspapers. They must have wasted thousands of tons of bombs by now. Around our town alone, for instance, more bombs have fallen into the sea and open fields than have struck the homes of local people and I have yet to see anything in this locality that could be termed a military objective, hit by bombs!

Our short stay in London also confirmed this fact. For every bomb that found a target thousands fell on the houses and streets of purely residential districts.

To continue our story, when France fell and the threat of invasion of Britain came, people living in coastal areas such as our town (especially those with babies) were advised to evacuate to inland districts. We couldn't make up our minds whether to go or not but in July finally decided and went to a house in N. London. At that time London was the most peaceful place in the country and for six weeks we had freedom from sirens and bombs. But—my goodness—when the raids did come they came with a vengeance! Mostly all night long from soon after dark until dawn, in all kinds of weather, the Nazis would fly over. If it was cloudy or raining they just flew over the clouds and dropped their bombs without having the slightest idea where they were falling. And if it was a clear night they flew so high that accurate bombing would be absolutely impossible! When the A. A.

barrage was flung up at them the nights were like hell let loose. We had several guns around our district and they certainly made plenty of noise! However, after a week or two we even got used to that racket and slept through quite a bit of it. We never slept in an air raid shelter, just chanced it and moved our beds down stairs away from the windows.

After four houses in our road were demolished and about a dozen very badly damaged, also a bomb had caused a great crater right across the road about 75 yards from our house, we began to think that we might just as well be home at Clacton—especially as Hitler didn't seem to keen on visiting us! So towards the end of October we moved back home.

Compared to London we find this part comparatively quiet. Plenty of Jerries fly in or out over the coast at night with their cargoes of death, generally destined for inland towns and London. Every now and then they let us know we are not forgotten and drop a few assorted bombs around in occasional sporadic raids! They don't seem to fancy coming over much in daylight nowadays!!!—unless it's cloudy and then an odd raider dodges in and out of clouds doing his dirty work. Daytime dogfights are very exciting to watch but we've only been lucky enough to witness about three fights. Most of the fighting has been over Kent. It gives you a kick to see our squadrons of Hurricanes and Spitfires going out to 'entertain' the Jerries!

So much for the efforts of the Luftwaffe! In other respects our lives are not very much changed. We have quite enough food to eat and grow most of our own vegetables. I find gardening a pleasant change to my radio work. In some respects the war does one good. It teaches us how wasteful we were in many ways. We are all in good health, including baby Clive. He is full of life and always getting into mischief.

To turn to radio, the old 28-Mc. band seems to be pretty erratic now and is often dead. Heard quite a few W's on several days in October and November.

Well, here's wishing you all the best for 1941 and hoping that again one of these days we shall again be able to renew our acquaintances over the air, if not in person. Little did we think when we were over there in 1938 that this is what 1940 would bring. We shall always remember the fine time you gave us during our visit to U. S. A., and Canada.

DENNIS AND EILEEN HEIGHTMAN (G6DH)

Editor, U.H.F. Dept.:

How are you all? Are many of you in the U.S. service? The technical knowledge of the multitude of u.h.f. men over there should be invaluable to your government.

I am still a civilian but my firm has government contracts; in between raid alarms we do a little work. I hope to obtain further government contracts which should enable us to carry on during the war. I am still doing my nightly A.R.P. duties and of course we get a little work to do now that Jerry visits us nightly.

We have had very few bombs as yet in our *immediate* vicinity. The wireless station close to our home had a concentrated attack during September, hordes of JU87 dive bombers and escorts. We were in our shelter (Beick, built-in garden) and we really thought the sides of the shelter were about to fall in. On another occasion a dive bomber dropped a stick across the village, the last bomb missing the house by about 70 yards. During the months of August and September we had terrific battles overhead. On two occasions there must have been over 500 aircraft involved. On every occasion huge forces were put to flight by a handful of Spitfires and Hurricanes, in some cases one fighter has dived into the middle of a tighty packed formation of the enemy and completely broken them up. The Polish pilots are particularly good at this—head on attacks every time, pulling the stick back a split second before the crash! You must have heard Churchill say "never before has so much depended on so few." These words were the very essence of the truth. During August our boys fought from dawn to dark and shot down numbers far in excess of those published by the Air Ministry news service. In one fight over us I saw eight bombers shot down in just a few minutes. We now seem to be in a position where your help must be forthcoming. I mean, of course, to the *full extent* of your manufacturing abilities. Your governmental process seems to be slow. We have columns and columns in our newspapers every day about what the U.S.A. are going to do for us, but the ordinary man in the street (who I admit is uninformed) is a little worried as to the extent of this help. During 1941 it seems we shall be "on the spot." I do hope the U.S.A. will not put their own military strength before the absolute necessity of assistance to us.

I suppose you still receive the *T & R Bulletin*. You have probably noted over 1000 members of the society are serving in the forces; in addition to this something like an additional 1000 are doing jobs of (voluntary) civil defense, etc.

Dennis Heightman evacuated from Clacton to North London but has now moved back (after most of the houses in his street were damaged). He is quite busy building equipment for the government. Nelly Corry had a 500 lb. bomb in the garden but is still going strong. Clarry and H. A. M. Clark are right in the thick of things but full of beans.

Williams (2XC) is engaged upon important work and I hear it is improbable that he will ever return to schoolmastering.

I am of course still a subscriber to RADIO and enjoy reading your U.H.F. Most of us though are doing very little experimenting—keep track on the progress you are making. I must say your boys seem to be doing quite well. Progress in this country is of course at a very high level and we shall be able to show you all a thing or two after the war.

Kindest regards and best wishes to you all from

ERIC C. COSH.

Roehampton, London, ENGLAND

Sirs:

Here's a shout out from under—if it gets to you. Californy seems a great way off these days.

It seems the Jerries got at the December number of RADIO on its way over here. And while we can do with rationing of grub—how many hams get *all* their meals reg'lar, anyway?—we can't do with rationing of RADIO.

So would you repeat the December number of RADIO to me please; and since I can't remit cash please lop the odd number off the far end of my current subscription.

We're kind of busy over here, as you may have heard, but there's always an odd minute or two for "the game"—what's left of it. Right now this callsign is thinking in terms of instruments rather than rigs. The kind of gadgets a good station needs but which never get made while the mike is in circuit . . . . . .

E. HAYTER SIMMONDS (G8QH)

U. H. F.

[Continued from Page 58]

Near Philadelphia, W3CUD feels that he could get out well enough if he had a chance to stay home instead of travelling. W3RL is now home only Saturday evenings and has those taken up. He insists that he will not completely give up 5 though he is also on 10 and 2-½.

W5VV and W5AJG are still trying to hook up with some ground wave pre-skip dx. Someone of these days they should do as well as their friends W6OVK QLZ W9ZHB ZJB and others.

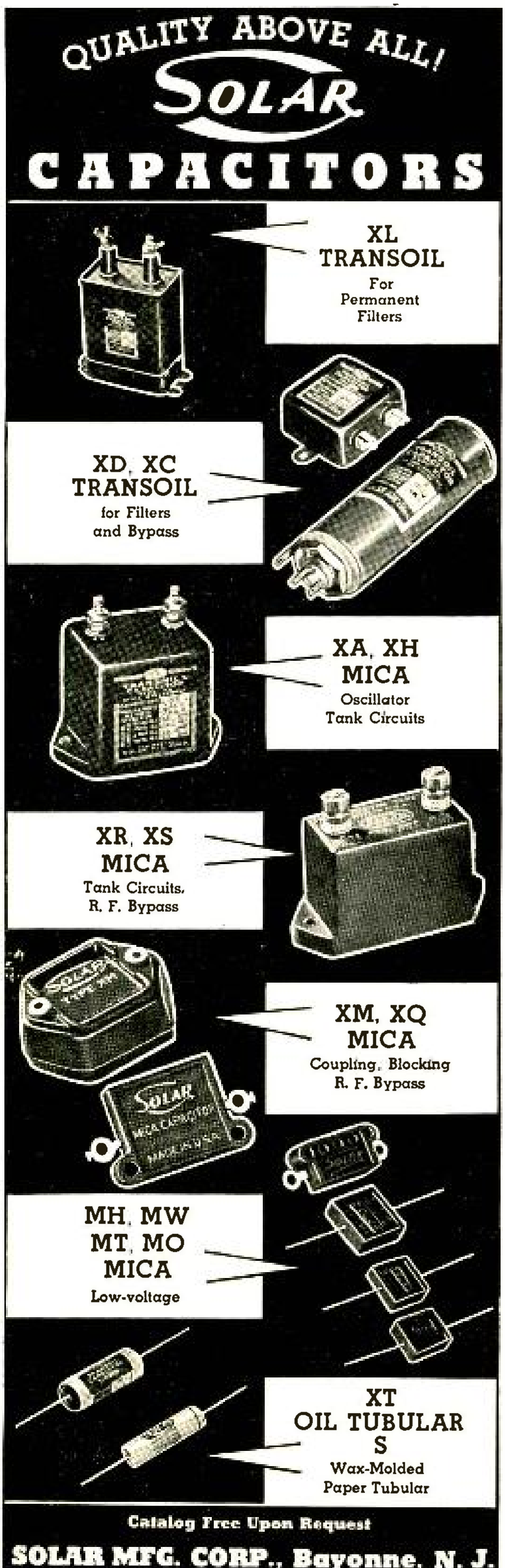
W6IOJ says that he is giving up some of his 2-½ meter work to devote more time to five along with W6QG MYJ LFN with whom he has daily schedules at 8 p.m. Others are invited to join this round table.

Out in the Arizona net, W6GBN got up his four element beam and connected with W6OVK in Tucson, using c.w. at both ends. This is about 92 miles, over several mountain ranges. GBN puts 40 watts on a 6L6 doubler. W6OWX is also putting up a four element array and will bring the active list up to four in Tucson again. W6PQG in Benson brought his converter over to OVK for an alignment check with good results, bringing in W6QLZ. Soon, W6PQG will be on the air with a transmitter too. As soon as W6MLL puts up his 5 and 2-½ meter antennas in Nogales, he and OVK will run some tests. W6GBN is putting in a new a.c. plant so he can use his converter and superhet instead of a three tube t.r.f. receiver. W6QLZ put two 1232 r.f. stages in his 5-10 receiver and can now hear W6OVK without an antenna, which is rather good for 107 miles.

In Detroit, W8QDU keeps files on his correspondence and every now and then really brings one up to date with a nice long letter. Since he lost his tower on November 11, his u.h.f. activity has not been high but he had worked 47 u.h.f. stations during the local contest with three weeks to go. He wants to get some use out of his low frequency rigs before they are obsolete.

In Pittsburgh, W8RUE gets in on the winter dx with 28 watts into a T21 doubler working into a half wave vertical. He has worked 18 states in 7 districts on this rig.

Activity in Fort Wayne, Indiana, includes W9QCY UJE UUN ODW YQV DCI QEI with W9EEV SWH as prospects. W9UUN



ODW QCY have raised W9AQQ in Indianapolis, Ed, W9ZHB, has heard the carriers of W9QCY UUN. QCY has heard ZHB and CNJ (CBJ?) on his coaxial tuned receiver.

In Slater, Iowa, W9TIO points out that his transmitter is on 10 not 5, but he does work cross-band. He says that W9OLY has his old call back and his five meter rig is intact. W9UOP has almost completed his 500-watt 5-meter rig and will be another Des Moines station to shoot at. W9CHI in Grand Junction, Iowa, is also on 5 with a 100TH in the final. The relay network that now goes across Iowa seems to be getting some new recruits. W9YKX who now works 235 miles to W9NFM and 285 to W9HAQ, clear across the state, is happy about the whole thing even without contacts with the Des Moines area. YKX is still trying to get to ZQC and NLR in Brookings, South Dakota. A good guess is that he will keep at it until the difficulty is removed and contacts are made.

W9ZJB has loaned W9PKD a mobile rig to use as a five meter exciter. There is no stopping some of these five meter enthusiasts —they'll move in on you with a complete rig, the next thing you know, just to show that dx can be worked from your location. Vince is putting up a vertical for all-around skip work, even if the horizontal does do well on the 200 mile stuff—except W9VWU. Vince has worked 68 of the stations in the honor roll.

W9VWU went with the Topeka police instead of to camp with the National Guard, so got in touch with W9ZJB to renew the old schedules and extend the five meter relay terminal to Kansas, from the east coast. VWU did not get over with his vertical antenna now that ZJB has gone to horizontals. Either Vince will have to make it on the new vertical he has in mind, or Johnny will have to go horizontal too.

The message from Kansas City came to Wheaton via W9ZWF. Miles Lusher has been a ten meter man recently, but must have doubled his frequency. He will make another contact for the Chicago gang.

ABOVE 112 MEGACYCLES

At several points in the country, five meter activity is suffering from a shift to 2-½. Chicago and Washington are only two of them. A discussion recently with a group of W3's brought out some thoughts on the noise problem—which can be attacked by (1) increasing antenna gain and directivity, (2) increasing the gain of the first r.f. tube in the receiver, and (3) narrowing the bandwidth by sharper circuits, including narrow band i.f. in a superhet.

W1HDQ's 112 megacycle f.m. work has been stopped while Ed puts concentric lines into his receiver. W1MON states that he has worked 187 stations on the band in nine months—which sounds like plenty of activity up New England way.

Frank Heubner, who is with New York Telephone Co., tried Falor's 6N7 m.o.p.a. and measured his output at 4 watts. With a pair of 6J5GTX tubes, he got 10 watts. An HY75 with parallel grid and plate line somehow produced only 7 watts.

W3EIS looks forward to the completion of his house at a high point in Arlington County, Virginia, which should increase his dx. He was one of a gang that constructed eleven 112 megacycle portable stations for use at first aid stations during the inauguration ceremonies. This started quite a wave of 2-½ meter building in Washington. Don speaks longingly of a 750 megacycle net among the Navy gang, but has not yet offered to supply the necessary inductive output tubes to do it. They require more plumbing than a Conklin coaxial job. W3RL is one of those who was hit by the 112 megacycle rebuilding boom.

W5AJG has procured copper pipe for a 2-½ meter superhet and hopes to make up a whole superhet with 12-inch lines, rather than just a converter or r.f. stage. Will such a receiver encourage or discourage the embryo 112 Mc. activity in Dallas?

Lloyd Broderson, W6CLV, encourages the California gang to send in a little more news. CLV took his monthly trip to San Francisco on February 2 and had some contacts from Twin Peaks. He says that W6JDJ TMV IVN JCD are active. JCD also has one of Smith's transceivers and has worked out to between 50 and 65 miles with ½ watt. CLV says that weekend activity in S.F. and the bay region is always high with seven or eight on the air within ten or twenty miles. There seems to be very little activity on 224 megacycles just now.

According to W6IOJ, there are a lot of good W6 contacts that should be in the honor roll. Give, boys, give! IOJ claims that activity down his way on 400 megacycles is gathering momentum; W6LFN has a 955 transceiver going and W6QG CLH are experimenting with concentric line oscillators while W6MYJ IOJ plan some further work in the near future.

The 2-½ meter rig at W6OVK uses three 6L6's in an exciter delivering about 15 watts on five meters to an HK24 doubler with 110 watts input and 30 out. The antenna is a three element horizontal rotary 35 feet up, fed with a 1-½ inch spaced line, delta matched 8 inches each side of the center of the radiator. The receiver is a converter using a 1232 mixer and 6C5 oscillator. A voltage regulated supply seems to be a necessity where he is. This was the receiver that brought in W6QLZ at 107 miles on the first night it was tried. OVK is building a concentric line tuned r.f. stage, hoping to improve things. This converter proved to be much better than a 6J5 superregen, both on W6SLO's local harmonic and on the distant W6QLZ, the latter using a modulated oscillator.

W6QLZ says that if anyone is going to build a pipe organ, he has the pipe. In addition to getting 107 miles into Tucson on the first night he tried to do it on 112 megacycles, he worked W6GBN across the Sierra Estrella range. Clyde found the efficiency poor with tuned filament lines so he by-passed the filaments and put the pipes in the grids. He got the same output with 22-inch pipes unloaded and with 15-inch pipes tuned with 2-inch copper disk condensers. He rebuilt his HY615 superregen, using a 50,000 ohm ½ watt grid leak in series with a 2-megohm midget variable resistor that seemed to give him much better control over the adjustment. Direct coupling of the r.f. stage into the detector did not work very well. Clyde tried a converter but was bothered with a.c. hum on the oscillator. His transmitter now is a pair of HK24's with 170 watts on the plates. He waited two years for someone two miles south to get 110 volts, figuring that the power company would run the line by the shack, but it was brought in from the other direction.

Clyde favors some articles on how to get on 2-½ easily when you have a pair of tubes working on five or ten meters (or anywhere, for that matter). One of his ideas is to use the same plate voltage on the same final tubes used as an amplifier driven by a concentric-line-controlled oscillator. He figures $15 would pay for the shift.

Although W8QDU has a crystal-controlled rig on 112, he borrowed an HK54 oscillator and has been using it ever since instead of his doubler. The instability seems to work better on superregen receivers. The grid and plate lines are ½ inch copper tubing spaced ½ inch, 20 inches long. The grids are tapped six inches up from the shorting bar (Fred, that sounds more like 100 Mc.). There are no chokes or lines in the filament circuit. The average input is 250 watts. Fred also has a pair of 24's in a 1-¼ meter rig, working into a six element beam of two half waves in phase broadside with reflectors and directors. Other local Detroit stations on 224 megacycles use a 316A and a pair of HY615's.

Fred has observed that it is considerably easier to get a push-pull stage to oscillate than it is to get a single ended one to work, at increasingly higher frequency bands. Also, he finds that the tuned grid circuit is better than the tuned filament arrangement with a shunt across the grids. Lines in the filament are helpful, though, where their purpose is to put a ground on the filaments rather than to build up a tuned circuit.

In attempting to improve efficiency and stability of a modulated oscillator, he has been impressed by the importance of the grid current. Some oscillators will show excellent characteristics unloaded or unmodulated, but may not operate the same when in service. Overcoupling to the antenna may bring about a decrease in grid current with over-modulation occurring at relatively low modulation percentages. Fred also points out that stability results from the use of good grid lines, but they are effective only when the grid leads are short and made of low inductance wire or strip.

W8UKS has asked for 112 megacycle dx schedules with W8QDU. W8IPU is also active.

W9AVE in Chicago is building up a push-pull 112 megacycle rig controlled by a single coaxial grid line to which the grids are coupled with hairpins with the polarity reversed. He has noted the effect of passing airplanes on signal strength, which in the past has been attributed to interference between the direct wave and another which arrives via a reflection from the plane's body. W9TZC and W9OFV are rebuilding with grid rods.

In Rockford, Illinois, W9AGV BRY RBT are on nightly and W9ASB is building up a rig. They want schedules with stations around Chicago. W9PQH RQG and some of the others outside of the city are nearer and should make fine points to try to work.

A 112 megacycle round table was held on January 9 in Chicago. In addition to 17 s.w.l.'s and several hams who did not sign the book at the door, these attended the meeting:

W3FEW/9 W8VHI W9AIO ANJ AOB AVE BNX BON BWS CML (Brookfield) DZL EDG ELH FHI GPQ GPV HLI HUU

IWA (Steger, Ill.) IWZ LLM (Downers Grove) LRT MCS MFS MQF MTL (Gary, Ind.) MUB NHH OBY OFV (East Gary, Ind.) OYR PEQ PNV PSP QHS SIO SRL SSU SXQ TAK TAL TJL TLQ (Park Ridge, Ill.) TOJ TXU TYP TZC VTJ (Steger) VUK (Gary, Ind.) WAY (Lake Bluff, Ill.) WIF WL WXZ XBK YDV YWQ ZHR.

This list should be useful in locating other interested stations with which to test.

Questions and Answers

Q: If short leads and low interelectrode capacities are desirable above 100 megacycles, why not use pentodes?—*W9AVE.*

A: Pentodes are used—such as the 815, 829, etc., but remember that while the grid-plate capacity in them is low, the capacities across the input (grid-cathode) and output (plate-cathode) are high which make it necessary to reduce the inductance of the tuned circuits.

Q: I have built an acorn superregen. To get the 955 to oscillate, an r.f. choke was placed in the cathode lead. Adding an r.f. stage with its plate circuit across the whole concentric line which forms the grid circuit of the detector, however, stops the detector from oscillating. How can the 955 be forced to oscillate?—*Huebner.*

A: If the cathode choke coil is found to be insufficient (usually a few turns of hook-up wire will do it), a short condenser-tuned line can be used in the cathode circuit. This need not be retuned over a frequency range of several megacycles. However, more certain regeneration can be obtained by tapping the cathode up on the grid line in the familiar e.c.o. arrangement. The heater leads should have chokes in them or be brought into the inner conductor at the cathode tap.

Q: In a 112 megacycle converter, it has been impossible to remove a.c. hum from the oscillator. What remedies are there? —*W6QLZ.*

A: Ordinarily, one first suspects the tube. Satisfactory operation has been obtained with the 955 acorn triode as an oscillator. Often, the hum is the result of using a circuit in which the cathode is above ground potential for r.f. but the heater is grounded. A change in the circuit may be possible, but heater chokes or bringing the heater leads alongside or inside of the cathode lead is sufficient in many cases. As a last resort, oscillator injection can be at a harmonic, direct or through a doubler or quadrupler.

New U.H.F. Dept. Address

Note that letters should now be sent to this department at 300 Wilson Lane, Bethesda, Maryland, rather than to Wheaton, Illinois.

Yarn of the Month

[Continued from Page 66]

in the habits and habitat of radio hams I consented. Then began a siege of code practice, incident to getting the "ticket."

I hate to admit this but I taught My Darling the code. So that which followed was in a sense my own fault. But you know how love is. I had a Girl Scout troop in the days when you had to pass a speed test in code before you could be a second class scout. So I knew the code all right. Many were the nights we sat on the sofa and sent dit da dits to each other. It was bliss, pure bliss. I confess that too. Which all goes to show how a person's ideas can change.

I used to listen to him recite pages from the manual. I knew it by heart and could correct him to the last comma, because that's the kind of a memory I have. But did I have the faintest idea what the stuff meant? Not at all. It was just so much spilled ink to me. Dan knew the stuff cold, but he didn't use book language; so in the end I never knew if he was saying it right or not. If it wasn't just like it was written in the manual I was lost.

Eventually there came the night when Dan took his class C exam. The two hams who came to give the test looked grim and foreboding to my unitiated eye. I've learned since they are perfectly harmless and real good fellows when you get to know them.

Finally the test was over and we could breathe again, although we often got cold all over thinking that maybe Dan gummed the works through sheer nervousness. I honestly wanted him to get his ticket. It's terrible to have anything matter that much, but I knew if he didn't I'd lose a lot more sleep helping him again. The guy is persistent.

He got his ticket. I sighed with relief, "Now that's over." But I can laugh merrily over that one, too, because since then I sacrificed a two weeks vacation while my esteemed spouse sat up till all hours studying and practicing for a Class A.

You'd think, wouldn't you, that after winning a ticket things would settle down to normal and a fellow would need a little social whirl just to retain his balance? But that isn't the way it works. Not in ham radio, at least. After getting a ticket the title "Amateur" radio operator should be abandoned and in its place the word "fanatical" substituted.

It was then I staged my first scene. The first of many in the drama of home radio. "What do you get out of all this?" I demanded harshly. "What do *I* get out of it, staying home all the time, and how about the money you're spending, as long as we're having a quiz program?"

Dan looked at me sternly. "Someday this stuff will earn me my living. Any guy in radio now is on the ground floor. This is going to be big! Someday I'll show you."

"I hope I live," I said dully. Women are practical and not usually scientific so you've got to forgive them. They have the Race on their minds and it makes them cosmic and pyschic and a little difficult.

Radio continued unabated. I lived to see myself rise at dawn to pack a lunch and speed a five meter expedition on its way. I have spent many evenings and weekends alone minding the junior op, with whom we were subsequently blessed. I have stood holding antenna wires in my hands, and, because I am deathly afraid of anything electrical, been sure each time my end was near. I have called "Test 1, 2, 3, 4" endlessly. I have sat in darkness, on and off, while My Darling and one of his cronies tried to light our house with a generator hooked to the Ford, and did, too. I have waked in the small hours with the ghostly light of "stray r.f." shining at me from the ceiling fixture. I have taken messages during flood times for somebody's loved ones. That was pretty grand, I admit. I have taken messages from b.c.l.'s that blistered my ears, too.

In short I became a radio widow. It's much worse than a golf widow because golf is seasonal. All the time I kept asking Dan, "What does it get you?"

Last week I got my answer. Dan is teaching radio now. The goal he set for himself six years ago is a reality. He's gone and done it. I feel very humble and very proud because he was right.

But a medal should be struck for radio wives for, lo, they endure much. But it's worth it because it's fun to have your wagon hitched to anything as big as radio, even if it's only a little wagon.

New Books

Amplifier Catalogue

The Amplifier Company of America has issued a new catalogue covering their new line of Master Beam Power Amplifiers. Amplifiers having output rating of from 15 to 68 watts are shown in the catalogue, which is available from the Amplifier Co. of America at 17-19 West 20th St., N.Y.C., N.Y.

Recording Handbook

A revised edition of "How to Make Good Recordings" is announced by Audio Devices, Inc., 1600 Broadway, N.Y.C. The subject matter covers every phase of instantaneous disc recording in a non-technical manner. The book sells for $1.25.

Howard Issues New Catalogues

Howard announces three new free catalogues. In the 490 technical manual, in addition to full charts and schematics on the Howard 14-tube professional receiver, several pages are devoted to the art of receiver measurements. The other catalogues are Folder 103, containing recording discs and needles; and Folder 104, complete line of Communication Receivers and Accessories. The catalogues are obtainable from: Howard Radio Co., 1731 Belmont Ave., Chicago, Ill.

A Practical Sine-Wave Generator

[*Continued from Page 15*]

require no polarizing potential. They are more expensive, however, and a gaseous type photo-tube, such as the RCA-923 will operate with ample output when fed from a 45-volt battery through a 1-meg ohm resistor. Peak voltage for this tube is 120 volts and it is one tube for which there are no ICAS ratings. The tube is definitely allergic to higher potentials and a voltage divider is in order if you intend to obtain your operating voltage from the speech amplifier supply.

Photo-tubes of the high-vacuum type are less critical as to voltage, but for low values of illumination afford somewhat lower output. Whatever photo-cell or tube is used, it will, if properly shielded from stray light, deliver an output voltage at least the equivalent of that generated by a diaphragm type crystal microphone. The output will, moreover, be a sine wave of excellent form and good constancy. The stability will be sufficient to lock in with any scope having a synchronized sweep. If the resultant tonal frequency is not exactly as calculated, bear in mind our pardonable antipathy toward having more than two ciphers south of the decimal. But it will be a sine wave.

Possibilities of the Device

It would seem that the output frequency of this device could be raised indefinitely by increasing the number of apertures, and by increasing disc r.p.m. But in practice there are many drawbacks. Without resorting to a precision mill, it is not only monotonous, but durn near impossible to do a clean job of fifty or more quarter or three-eighths holes. That is what it would require to go to 2000 c.p.s. The matter of increasing disc r.p.m. runs into purely mechanical limitations. In either case, motor inadequacies become apparent at higher frequencies. Even with synchronous motors where r.p.m. is positively constant, armature velocity varies between the pole-pieces, undergoing, in effect, a series of small spurts or accelerations. At higher frequencies, this becomes apparent in the appearance of harmonics of the desired frequencies.

Through careful construction, using an adequate synchronous motor in conjunction with a roller and disc friction drive, continuously variable operation may be obtained between limits of 200 to 1000 cycles with a given disc. But the cost of construction in this case approaches that of a good vacuum tube frequency generator, and is therefore unwarranted.

Our original quest was for a gadget of minimum cost, utilizing the materials already at hand. At the expense of the family washing machine we accomplish that end. And we have a device which can also be used for slicing carrots, french-fries—and bologna.

112 Mc. Net Aids Red Cross

[*Continued from Page 59*]

flow of traffic would permit, master control W3ING transmitted a time check which also served as a frequency check for all stations. This frequency was used as the receiving frequency of all Washington Radio Club field stations forming the net. On the quarter hour W8SVW/3, using a grid-line controlled oscillator, transmitted a time check on 114 megacycles (which was used as a transmitting frequency by all other net stations). In this manner any frequency drift in equipment at individual stations was accounted for and corrected, and all stations had no difficulty staying in the band, and were always in a position to contact net control readily. Initially it was required that field stations communicate solely with the net control and never with each other. On rehearsals held for two weekends prior to Monday, January 20th, this rule was followed. On Inauguration day it was periodically relaxed to allow relaying from the most distant station due to reception difficulties.

Messages originated were accepted only on the signed authority of the Red Cross station commander. In every case these messages were typewritten copies bearing the signature of the executive officer in command of the station. Operators were not allowed to originate personal messages or information on their own authority. In cases of necessity the operator first requested authority to transmit. In this manner the net control station retained the initiative at all times, with the result that there was very little confusion. Form messages authorized in advance with particular information filling given gaps were used in about 30% of the traffic handled. In a period of operation of seven hours, 8:30 A.M. to 3:30 P.M., 509 messages were originated, received, and delivered.

The Red Cross Field Stations functioned smoothly as 235 persons were treated along the Inaugural Parade Route, about fifty of whom were sent to the hospital in ambulances. Messages relayed by radio stations included requests for misplaced supplies, additional personnel, information on injury cases, and lost child registration. A temperature of 28 degrees in a lukewarm winter sun provided sufficient operating hardships to test the mettle of all services concerned.

From nine until ten o'clock in the morning all Red Cross Field Stations were inspected by a party led by Rear Admiral Rossiter, Ret. USN, of the Red Cross, under whose direction the Red Cross participation in the Inauguration took place. This group included Lt. E. K. Jett, chief engineer of the Federal Communications Commission, and several members of the National Defense Communications Board. All members expressed particular interest in the work being done by the radio personnel, whose operations received much favorable comment.

56 Mc. Preselection for Weak-Signal DX

[*Continued from Page 19*]

quency of the mixer, the signal should increase sharply.

Measurements at W5AJG, in which the concentric preselector is operated into a commercial type 56-Mc. converter, showed an increase of approximately 7 "S" units, with only 2 "S" points increase in noise, which is a net result of 5 "S" points gain in signal. This represents real usable gain and will go a long way in helping to pull out those weak close-to-noise-level dx signals that often turn out to be that missing call area or elusive state.

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Doughnut- and wheel-shaped quartz crystals are used in the National Primary Standard at the Bureau of Standards.

An Electronic Key

[*Continued from Page 41*]

If a regular mechanical speed key is used with the unit, *the dash contact must be insulated from the dot contact.* On some keys, such as the Vibroplex, the dash contact is connected to the dot contact by means of a piece of wire running below the base of the key. All that need be done with this type key is to disconnect this wire. However, on some keys the dash and dot contact screws are tapped through a common metal bracket. In this case the dash screw is removed and a contact soldered to a smaller screw. This screw is run through the same hole and insulated from the bracket by means of fiber washers and fastened by means of nuts on each side of the bracket.

Three leads are taken from the bug. Two of them (from the dot and dash contacts) terminate in a fone plug. The dot contact is connected to the tip of the plug and the dash contact to the shell. The lead from the base of the bug is connected to a binding post on the panel of the oscillator.

In the event anyone is unfamiliar with a "sideswipe(r)," it is briefly a single-pole double-throw switch. An arm provided with a certain amount of tension is moved from side to side between two contacts in the same manner as a regular bug except that the "sideswipe" dots are made manually. With the usual "sideswipe," the dot and dash contacts are connected together. However, for use with this electronic key, they must be insulated from each other and connected as explained above relative to a regular key.

This key has been in use at a regular traffic station for the past month and when used as a straight bug (manual dashes), it is (in the opinion of the ops here) the equal of any mechanical key on the market. When used with automatic dashes it sounds very much like tape transmission when manipulated properly. However, some practice is necessary to master the automatic dashes, because one must "let go of a dash" at precisely the right moment. A little practice using automatic dashes will do wonders towards improving timing and spacing with a regular key.

A Wide Range U.H.F. Wavemeter

[*Continued from Page 32*]

The number 1 wavemeter has been tried in our super-regen receiver as a tuning unit and it worked o.k. For continued use, however, a micrometer dial would have to be used. Also, the L/C ratio is poor, especially at the lower frequency end, which would make it impractical for transmitter use.

●

Using the Barometer

[*Continued from Page 39*]

changes. But it will fall on some occasions when moderate wind with rain or snow comes from the northward.

A falling barometer with north wind indicates rain and wind in summer, and snow in the spring. A sudden fall with the wind west is an indication of very bad weather from the north or northwest. A steady fall with the wind east indicates that the wind will change to south, or be followed with rain or snow. A fall of the barometer with a south wind is followed by more or less rain. If the barometer falls, and after the storm remains steady and does not rise, bad weather may be expected within a change of wind. On the other hand, if the barometer rises, the wind may change.

The words: fair, change, etc. on the barometer should be disregarded, as they have no value. To obtain advantageous results from the use of a barometer its reading should be recorded at regular intervals. At the same time a record of the temperature and the dirction of the wind should be made. During very bad or unsettled weather, and at times when such weather is expected, the observations should be as frequent as may be convenient. During fine or settled weather, the barometer will stand highest at 10:00 A.M. and 10:00 P.M. and lowest at 4:00 A.M. and 4:00 P.M. This oscillation amounts to about .05 of an inch. The other hours of high or low must be considered when the observations are of any importance.

Most barometers are not exactly correct, and before the instrument is put to practical use its error should be known. This calibration can be obtained at any branch Hydrographic office without cost.

With the general rules given above for using the barometer in foretelling the weather, the following weather indications must be considered, as they not infrequently give warning of the coming weather earlier than the barometer.

A clear red sunset with red sky is an indication of fine weather, and probable westerly winds. A red sunrise with a red sky is an indication of bad weather with east or northeast winds. A pale sky and sunset in a bank of clouds is an indication of easterly wind. A clear yellow sunset indicates strong breezes. A clear pale or gray sky at sunrise indicates fine weather. Soft, downy, delicate clouds and a blue sky indicate fine weather with light variable winds. A dark and gloomy blue sky is an indication of strong wind, and if the clouds are hard and ragged looking, strong gales may be expected. A small, white, fleecy cloud often hangs over a small island or reef. When keeping a record of the barometer readings, it is necessary that they be exact to the nearest hundredth of an inch. The common practice of reading the instrument to tenths only is not sufficiently accurate.

The Army Amateur Radio System

[*Continued from Page 38*]

members are taught to take the original message and change it into a cipher or code message for telegraphing. They are also taught to take a cipher or code message, where the key is known, and translate it back into the original text. Those who wish are further taught to take a message received in an unknown cipher, even when the method of enciphering it is unknown, and break it down to find the real message it conceals.

There is at present no "Army" Phone net similar to the c.w. net described above. Army frequencies are not available and interference prevents establishing such a net within the amateur bands. Most Corps Areas have radiophone nets similar to the c.w. nets. Approximately half the states in the U.S. are operating AARS phone nets. Others are being formed as fast as suitable control stations can be obtained.

The majority of the c.w. nets are on the 80-meter band, while Phone Nets are on all the phone bands except 20 meters. In general the stations in each state net operate on a single spot frequency, the various District Nets drilling on separate days of the week to reduce interference and congestion. This also gives better traffic distribution than the original plan of having every net drill on Monday night.

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Didjano . . . ?

RCA was organized during the first world war at the suggestion of the Navy Department chiefly to keep control of the Alexanderson alternator in the United States.

The Amateur Newcomer

[*Continued from Page 64*]

limit the plate current to about 2 ma. To prevent "arc" clicks from the tiny spark that does occur, condenser C_3 is placed directly across the key terminals.

While this may sound like a terrific sacrifice to make in antenna power, actually there will be little difference in antenna power, or at least not enough reduction to make one db difference in the received signal. While the output of the stage has gone down a few per cent, the plate input will have gone down a little too, and the actual efficiency will be almost as good. To bring the input back up to where it was, provided the tubes will stand a tiny bit more dissipation, simply tighten up the antenna coupling a bit and then repeat the excitation adjustment outlined above.

Many amateurs who take pride in their signal strength and "fist" continue to clutter up the band with clicks. We hope it has been inability to cope with the problem, and not just indifference. The problem really isn't so tough—when it is tackled right.

The oscillator must be *very lightly loaded*, and provided with sufficient feedback that it will break into oscillation with only 1 or 2 volts on the plate. If the oscillator takes 20 or 30 volts to make it oscillate, bad clicks are bound to occur no matter how slowly the plate voltage is applied. The grid condenser should be small, 50 or 100 $\mu\mu$fd., to give the bias circuit a fast time constant.

The low pass filter, consisting of C_1, L_1, and C_2, is designed with a low enough cut-off frequency that keying sidebands are restricted to a narrow band, yet high enough that "yoop" as a result of the frequency of the oscillator changing during the build up and decay of plate voltage will occur so rapidly that the operator will not be aware of keying "chirps."

Incidentally, if the oscillator is of the electron coupled type, it is advisable to key only the screen, though keying both plate and screen may be found satisfactory if the right "combination" is found. The usual trouble is a "yoop" caused by the time constant of the screen dropping resistor and screen bypass. The author prefers a straight triode oscillator, which requires no "monkeying."

With a good self-excited oscillator the frequency change with plate voltage will not be sufficiently great to combine with the amplitude modulation and produce an objectionable amount of phase modulation interference.

If one desires to use a crystal oscillator, the same arrangement can be used. With 105 volts on a 6J5 crystal oscillator the r.f. crystal current will be very low, and what can be simpler than a triode crystal oscillator? The same remarks apply, with regard to feedback and grid leak, as for the v.f.o.

To prevent excessive generation of spurious keying sidebands in succeeding stages, all stages following the oscillator should be provided with a *minimum of bias and excitation*. If fixed (protective) bias is used, as will be the case except when "zero bias" tubes are used throughout, the protective bias should not be greater than cutoff on any stage. Additional bias, really not required except on frequency multipliers, should be provided by grid leaks. The excitation to each stage should be reduced until the output is only about 90 per cent of what is obtained with adequate excitation. Starting with the stage following the oscillator, and going right down the line, couple an r.f. indicator to the plate circuit and reduce excitation to that stage until it begins to drop off noticeably. On doubler stages you may find that any reduction at all in excitation will reduce the output. If so, no reduction in excitation will be required on that stage.

The Marketplace

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WRITE BOB HENRY—W9ARA, for best deal on all amateur receivers, transmitters, kits, parts. You get best terms (fianced by myself); big trade-in; personal cooperation; lowest prices. NC-200s and all other National, Hallicrafter, RME, Echophone, Howard, RCA receivers positively in stock for immediate delivery. Special bargain prices on several models of new receivers. Write. Bob Henry, Butler, Missouri.

RECONDITIONED—guaranteed amateur receivers and transmitters. All makes and models. Lowest prices. Free trial. Terms. List free. Write. Bob Henry, Butler, Missouri.

TRANSMITTING TUBES REPAIRED—Save 60%. Guaranteed work. KNORR LABORATORIES, 1722 North Pass Avenue, Burbank, California.

LEO, W9GFQ OFFERS THE HAMS MORE—and a better deal always. Lowest terms, no red tape, on all new and used equipment. Free trial. Write for 124 page bargain catalog and get acquainted. WHOLESALE RADIO LABS, Council Bluffs, Iowa.

RECEIVERS—New Howard 460's with crystal, $59.95. New factory reconditioned SX-23's, $79.50. Reconditioned types all makes lowest terms. Write Leo, W9GFQ, today.

TRANSMITTING HEADQUARTERS—of latest Stancor, Thordarson, and other kits . . . commercially wired at low cost. New 70 watt xmtr kits complete only $35 . . . speech amplifier modulator up to 80 watts $25 . . . up to 150 watts $49.50. Write Leo, W9GFQ.

CHASSIS. PANELS.—Write for new price sheet. Our chassis flanged on all bottom edges eliminating that wobbly feeling. Special size chassis. Cabinets, racks, carrying cases. Lynch 970 Camulos, Los Angeles, Calif.

RECEIVERS—New and reconditioned. For better values send for list. Easiest terms. Square deal. Bill Harrison, W2AVA, 12 West Broadway, New York City.

CRYSTALS—in plug-in heat dissipating holders. Guaranteed good oscillators. 160M-80M at $1.25. 40X $1.65. 80M vari-frequency (5 Kilocycle Variance) Complete $2.95. State frequency desired. C. O. D.'s accepted. Pacific Crystals, Box 6679, East Los Angeles Branch, California.

FINEST FILAMENT TRANSFORMERS—comparable to the very best manufactured shipped postpaid. Buy direct for less! Literature free. PRECISION TRANSFORMER CO., Muskegon, Michigan.

TRANSMITTERS—bought and sold. Cash; terms. W2AVA, 12 West Broadway, New York, New York.

RADIO KITS—$3.95 up. Single band; all wave. 5-10 tubes. Fluorescent lighting. Save 50%. Radio Parts catalog—FREE. McGee Radio, P-2015, Kansas City, Missouri.

CRYSTALS—in plug-in holders. 160M-80M at $1.00. 40X, $1.35. Money back guarantee. COPPLE, W6JEB, 344 So. Fetterly, Los Angeles, California.

RECEIVERS WANTED!—Cash or trade-in. Best deal. Bill Harrison, 12 West Broadway, New York, New York.

ALNICO MAGNETS—They "float." Only 35c per pair postpaid. Satisfaction guaranteed. William D. Hayes, Box 1433-D, Oakland, California.

SELL—1600V, 600V pwr. supply plus breadboard 35T rig Complete $45 plus freight, details. Write W6BLZ, Box 44, Wendover, Utah.

SELL—Used six channel 6L6 amplifier, four speakers, microphones, motor, pickup, cabinets Thordarson equipped. Beggs, 5321 Wayne Avenue, Philadelphia, Pa.

SACRIFICE—Pair T125's—100th—Power Supplies. 6 ft. custom built metal cabinet. Miscellaneous equipment. Send for list. W6NGC, 3234 Fernside, Alameda, Calif. Fone LA 2-3199.

WANT 75 WATT PHONE—Bandswitch transmitter, good receiver, exakta kine camera, southbend 9" lathe, drillpress, offer excellent stamp collections. W2DLH, Newark, New Jersey.

WILL PAY CASH—for Phone Xmitter, 10 to 160 meters, 300 watts or more. Send photo, line up and complete details. Must be a bargain. Box 1350, Santa Barbara, California. Southern California answer only.

MOVING?

We'd like to know about it, if you are. Please send us your new address in advance so that you will be assured of receiving your copy of RADIO without interruption.

Circulation Department.

The Editors of RADIO, 1300 Kenwood Road, Santa Barbara, California

An Inexpensive Beam Rotator

[*Continued from Page 43*]

cuts down the length of a.c. line leads to practically nothing and keeps them out of the antenna field. Also, the problem of a direction indicator is thus easily solved because the vertical shaft rotates at the same speed as the antenna (since the sprockets are the same size). A direction indicator consisting of a round scale calibrated 360°, set on a center bearing, and coupled to the shaft by means of a flat copper belt will be the next addition. This will be located directly outside the window next to the operating table. At present a pointer on the vertical shaft serves as a crude but workable direction indicator.

Manufactured gear reducers are fine if you can afford them. From an engineering standpoint some in use are not as strong as they should be, as evidenced by shearing of pins, breaking of teeth and need for brakes to protect small gear teeth and keep the antenna from turning in the wind.

The rotator described, due to the large teeth in the boxes, will really "take it" and stand the strain of far above normal wind conditions. Don't worry about power: the motor may be as small as 1/20 horsepower.

The only care that need be exercised is in reversing the rotation. *Be sure to wait until the motor comes to a complete stop before reversing it.* Failure to observe this precaution may result in damage to the motor. By using a three pole double throw switch, one pole can be used for line voltage and connected so that the voltage to the main winding is applied no matter which way the switch is thrown. With this arrangement, simply throw the switch to "neutral" while the motor comes to a complete stop, then throw it the rest of the way to reverse the motor.

Also, be sure to obtain a motor which can be reversed from the outside. Many so-called reversible motors are so only in the sense that they can be torn down and the starting winding reversed—steer clear of this type.

●

Add—appropriate call letter assignments: Charles (Buddy) Rogers of Beverly Hills, Calif., is among those licensed to operate radio aboard private aircraft. His particular call letters are KHBUD.

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.

NEWNAN MOBILE TRANSMITTER

Page 26

C_1, C_2, C_3—Hammarlund APC-50
C_4—Hammarlund APC-25
C_5—Hammarlund HFD-30-X
C_6, C_7—Bud LC-1648
C_8 to C_{13}, inclusive—Aerovox 1467
C_{14}, C_{16}—Aerovox PRS450
C_{15}—Aerovox PRS6
C_{17}—Aerovox 684
T_1—Inca I-I
T_2—Inca L-11
T_3—Inca L-41A
R_1, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}—Centralab 514
R_2, R_3, R_4, R_5—Centralab 516
R_6—I.R.C. AB
Tubes—Hytron, throughout

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100 WATT EXCITER/TRANSMITTER

Page 33

C_1, C_2—Hammarlund "Star"
C_3, C_4—Hammarlund MCD-35-MX
C_5—Cardwell MT-50-GS
C_6, C_7—Cardwell ZT-15-AS
RFC(all)—Bud type CH-920
S_5—Centralab 2515
S_6—Centralab 2544
S_7—Coto solonoid crystal switch
R_1—Ohmite Dividohm
R_2—Ohmite Brown Devil
R_3, R_4, R_5—Centralab 516
TZ-20's—Taylor
Other tubes—RCA
T_1—Thordarson T-19F93
T_2—Thordarson T-19F88
T_3—Thordarson T-73F60
Crystals—Bliley BC-3

●

ELECTRONIC KEY

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R_1, R_2—Centralab type VF
R_3, R_4—Centralab 516
R_5—Centralab 514
R_6—Ohmite "Dividohm"
T_1—Thordarson T-13R14
T_2—Thordarson T-57A36
C_1—Solar "Sealdtite"
C_2—Solar M-416
$J_{1,\ 2,\ 3,\ 4}$—Mallory-Yaxley A-1
Tubes—RCA

●

SMITH HIGH-FIDELITY RECEIVER

Page 46

Tuning Condenser—Meissner 21-5214
L_1—Meissner 14-1024
L_2—Meissner 14-1025
CH_1, CH_2—Thordarson T-57C53
T_1—Thordarson T-13R14
T_2—Thordarson T-17S10
LS—Jensen PM12CT
Filter Condensers—Aerovox PRS-450 16 μfd.
R_1—Centralab 72-102
Carbon Resistors—Centralab 710 ½ watt and 714 1 watt
6SK7, 6J5, 6L6, 80—RCA

Past, Present and Prophetic

[*Continued from Page 6*]

siderably by the use of the filament type tubes. The article is well worth reading for ideas to apply to mobile amateur equipment when such operation is again authorized. The advantage of instant-heating filament-type tubes in the emergency transmitter, too, is quite obvious.

Secrets

A number of our readers have accused us of being asleep at the switch because we have run nothing on the Klystron or inductive output amplifiers or any of the various new electron multiplying contraptions.

We must admit that technical dope on these items would be very interesting to our readers. Uncle Sam figures it might also be of interest to certain foreign governments. So it looks as though these things will have to wait till the "emergency" is over.

Incidentally, our "G" friends inform us that they will have for us some interesting dope on a number of startling new developments . . . when we've won the war."

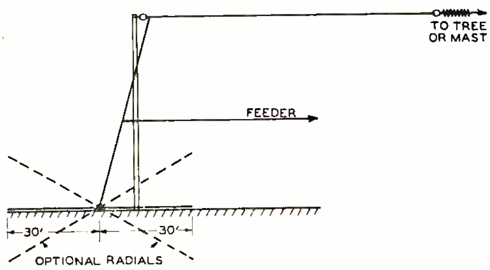
Advertising Index

With the EXPERIMENTER

A COMPACT 160 METER ANTENNA

By Ed. Rimathe, *W9TIO

Here is a quarter wave 160 meter antenna for small space that has good efficiency, and is easy to install and feed. It should be of interest to those who would like to work 160-meter phone but find antenna space at a premium.



The antenna I use is 125 feet long. The bottom end is soldered to a 4 foot woven fence around our house yard. From there it runs to the top of a 45-foot mast, then horizontally to a tree with a heavy screen door spring to compensate for swaying. The feed is a single wire about 19 ft. above ground. For best results the antenna should be cut for frequency and the feeder adjusted for best results, as the antenna resistance will vary at different locations. I realize that few hams have fences around their yard, but it is easy to bury a 60-foot piece of wire about an inch or two, so as not to stumble into it. This wire can be galvanized no. 12 or so. You may use more than the 60 feet if you care to, as per the diagram.

To couple the feed line directly to the transmitter you must use a good blocking condenser, as the antenna will short the d.c. plate voltage if you don't. A better method is to use an antenna tank link coupled to the transmitter, as the harmonic radiation is usually bad with a directly coupled feeder.

If you can make it reasonably high, you will be pleasantly surprized at the results you will obtain with this antenna.

*Slater, Iowa.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866-A/866

HALF-WAVE MERCURY-VAPOR RECTIFIER

Handles Higher Voltages ..Lasts Longer..Costs Less

$1.50
Amateur Net

RATINGS

Filament Voltage (A-C) 2.5 volts
Filament Current 5.0 amperes
Peak Inverse Voltage
Up to 150 cycles per second 10,000 max. volts
Up to 1,000 cycles per second 5,000 max. volts
Peak Plate Current 1.0 max. ampere
Average Plate Current 0.25 max. ampere
Tube Voltage Drop (approx.) 15 volts

In the few months the RCA 866-A/866 has been on the market, more than 9,000 of these tubes have been *sold!* There is no better evidence that here is another RCA winner—a sensational performer at an equally sensational low price.

This new tube supercedes the 866 and 866-A and may be used in equipment designed for these types. It combines the low starting voltage of the 866 with the ability of the 866-A to withstand a high peak inverse voltage—and, in addition, gives *plus* performance all along the line. It handles higher voltage at lower initial cost—and, equally important, it has amazingly long life achieved by virtue of a new filament. This filament is made of a new material having great emission capabilities. Edgewise-wound "ribbon" construction assures great mechanical strength, at the same time providing more emitting area for the same filament power.

Important among the tube's other features is the special filament shield designed so as to make practical a very low starting voltage. A ceramic cap insulator and a new dome-top bulb minimize danger from bulb cracks caused by corona discharge and resultant electrolysis.

THE RCA PHOTOTUBE BOOK IS HERE!

This comprehensive new booklet on Phototube theory, design and operation should prove both interesting and helpful. Free copy on request to Commercial Engineering Section, RCA Manufacturing Co., Inc., Harrison, N. J. Ask for the RCA Phototube Book.

Ask your RCA Amateur Equipment jobber for copies of the January and Feb.-March issues of RCA Ham Tips containing details on design of rectifier systems and filter systems applicable to the RCA 866-A/866.

RCA Transmitting Tubes

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