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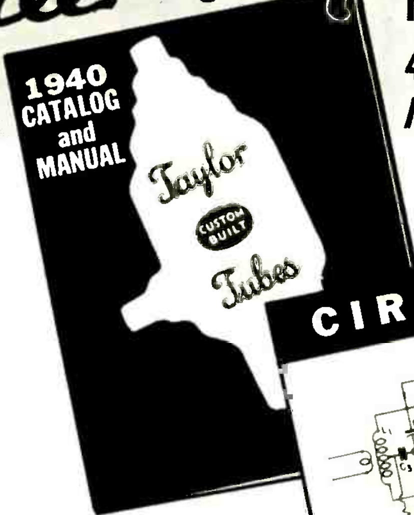

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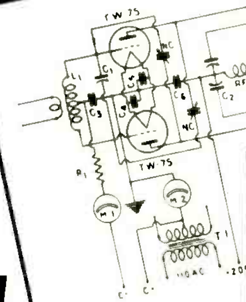

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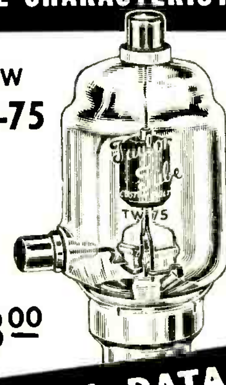

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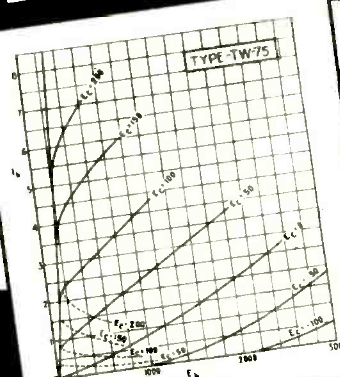

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The Worldwide Technical Authority of Amateur, Shortwave, and Experimental Radio

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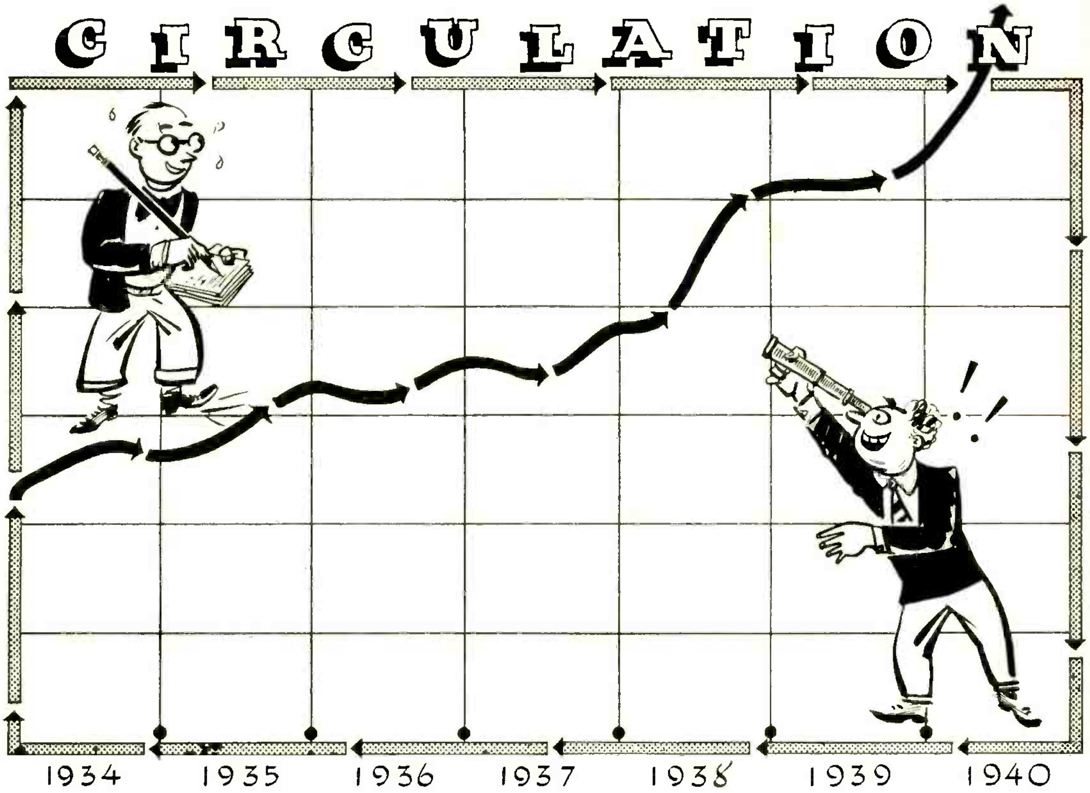

★ ★ ★ MAYBE the characteristic curve of RADIO's circulation isn't quite as linear as a 2A3 with inverse feedback, but it has a lot more gain. And from the slope of the curve where it goes off the chart, it looks as if it will be a long time before the diode bend is reached!

★ ★ ★ SINCE 1935, the circulation has increased more than 2½ times. Even if allowance is made for the somewhat greater number of amateurs now on the air, it still goes to show that every day more and more amateurs are turning to RADIO!

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THE EDITORS OF RADIO *technical publishers* **1300 Kenwood Road, Santa Barbara** CALIFORNIA

Past • Present and • Prophetic

Trapped

The lab has looked like a spider's web for the past week. Editor Smith has had a maze of 2½-meter antennas stretched across the room, making it practically impossible to sneak out the back door for a cup of coffee without falling over 6 half waves in phase on the way out and catching a three-element beam under the chin on the way back. Some good comes of all evil, however, and we thus have the new set of X-H dimensions on page 37.

Converter and Inverter

Those who have had the experience of having broadcast stations spread over the communication receiver's dial when it and the transmitter were both turned on may be pleased to know that this sometimes distressing phenomenon has a practical application. On page 40 Associate Editor Conklin shows how to bring in stations both lower and higher than the frequency to which the receiver is tuned.

Plumbing

It seems as though we are running to converters and plumbing this month. But if Victor Reubhausen says you can get better results on 5 and 10 meters with a single "pipe" than you can with a pair of coils, we're inclined to take his word for it. The converter description starts on page 34.

Hot Oscillator

Speaking of pipe, Technical Editor Dawley has been boring holes in the concentric tank shown on the cover of the February issue with the idea of trying various tubes and u.h.f. oscillator circuits with the tank as the frequency-controlling element. When great clouds of foul-smelling smoke began to pour from the inner conductor while one of the oscillator circuits was being tested, one of the more addled members of the staff immediately dubbed the thing the *Smokestack Oscillator,* and suggested that we had better rig up a smoke precipitator to show as an attachment. A discussion of the best oscillators, minus the smoke, is tentatively scheduled for next month.

Now It's Up to You

Now that you have all built f.m. transmitters similar to the one shown last month you will want some f.m. receivers to listen to each other. You'll find the complete receiver described in an article starting on page 11. This undoubtedly will appear to be an admission that the resistance-coupled i.f. set we mentioned here in March didn't work out as expected for f.m. Which it didn't.

Good Deed

If John Tynes' filter charts in this issue are an incentive to the phone contingent to narrow their transmission band width, we shall consider our daily good deed well done. To our way of thinking, "broadcast quality" with its attendant wide band is not for the crowded amateur bands.

A letter which recently passed through this office on its way to Herb Becker suggested a simple solution to both the phone and c.w. QRM situation which we think worthy of passing on for comment. The writer of the letter suggested that the 14-Mc. phone band be changed to 14,000-14,150, and the rest left for c.w. In effect this would give 50 kc. more space to the phones and another 100 kc. to the c.w. stations—everybody gains and nobody (except foreign phones at present occupying 14,000-14,150) loses from this arrangement.

Mightier Mite

John Griggs is back with a vegeance on page 21. This time the Mighty Mite has sprouted a set of bandswitches and a few extra watts of output. For downright convenience and flexibility it doesn't seem as though the "Band Jumper" version could be improved upon. At least until Johnny gets around to bringing out a 1941 model.

New Oscillator

It has always seemed to us that the beat-oscillator type of audio signal generator was an unduly expensive and complicated arrangement for obtaining sine-wave audio over a wide range of frequencies, but we hadn't been able to find a simpler system until a few weeks ago. The unharmonious sounds issuing from the lab seem to indicate that our new audio oscillator puts out sine-wave audio from somewhere below 100 cycles up to and past the cutoff frequency of these ears. Those who have been watching the 'scope assert that the upper frequency limit is well above 20,000 cycles. It's scheduled for next month.

All in a Day's Work

Quoting from a recent letter: "I have built the High-Gain 5-Band Preselector described in your latest handbook, and find that it works well except that it steps up the R

[*Continued on Page 80*]

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Cover: "Dee" Pomatto, W6PEN, handing the 112 Mc. superhet described in this issue to Eliot Haberlitz, W6QZA, for an aerial tryout from "Dee's" Fairchild.

ARTICLES

MISCELLANEOUS FEATURES

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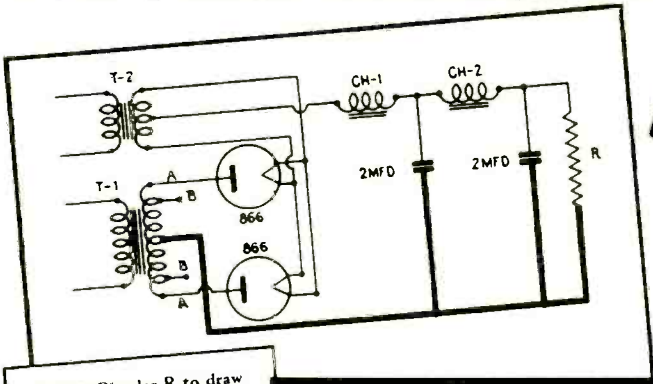
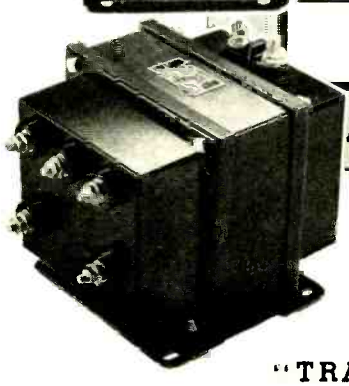


16 Matched POWER SUPPLIES

Adjust Bleeder R to draw approximately 10% of Rated Current. Regulation on all types approximately 15%. Ripple on all types approximately 1%. D. C. rating of filter condensers approximately 25% greater than supply voltage.

Power TRANS. T-1	DC VOLTS from TAP A	DC VOLTS from TAP B	DC MA	Input Choke CH-1	Smoothing Choke CH-2	FIL. TRANS. T-2	TOTAL NET TRANS. COST
T-19P54	400		150	T-19C39	T-19C46	T-19F91	$ 8.70
T-19P55	500	400	250	T-19C36	T-19C43	T-19F90	14.10
T-19P56	750	600	225	T-19C36	T-19C43	T-19F90	14.40
T-19P57*	1000	400	125 and 150	T-75C51	T-75C51	T-19F78	15.15
T-19P58*	1000	750	200 and 150	T-19C39 T-19C35	T-19C46 T-19C42	T-19F90 T-19F90	20.10
T-19P69	1000	750	300	T-19C36	T-19C43	T-19F90	17.40
T-19P59	1250	1000	300	T-19C36	T-19C43	T-19F90	19.20
T-19P60	1500	1250	300	T-19C36	T-19C43	T-19F90	20.70
T-19P61	1750	1500	300	T-19C36	T-19C43	T-19F90	21.60
T-19P62	2000	1750	300	T-19C36	T-19C43	T-19F90	23.10
T-19P63	1250	1000	500	T-19C38	T-19C45	T-19F90	32.40
T-19P64	1500	1250	500	T-19C38	T-19C45	T-19F90	35.70
T-19P65	2500	2000	300	T-19C36	T-19C43	T-19F90	27.30
T-19P66	1750	1500	500	T-19C38	T-19C45	T-19F90	34.60
T-19P67	2000	1750	500	T-19C38	T-19C45	T-19F90	44.10
T-19P68	2500	2000	500	T-19C38	T-19C45	T-19F90	48.60

* These transformers designed for double rectifiers and will deliver both secondary ratings simultaneously. If only the lower voltage taps are used the current rating is equal to the current rating of both windings.



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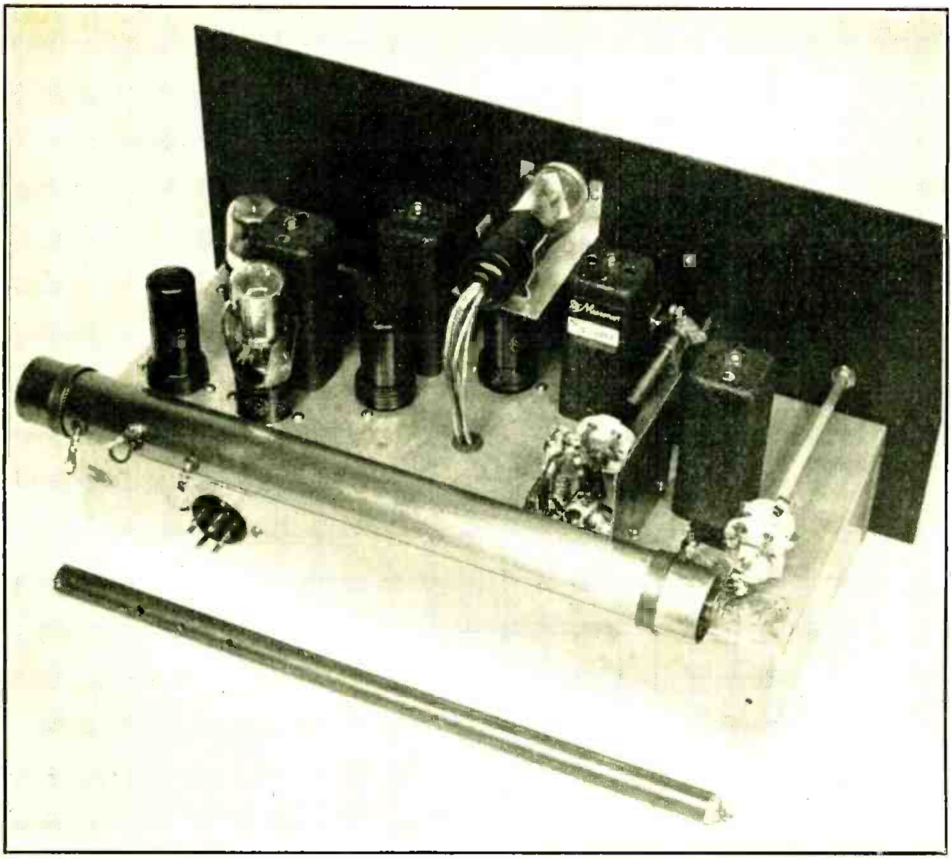


FIGURE 1. REAR VIEW OF THE F.M.-A.M. RECEIVER

Both the 1⅜-inch and the ½-inch concentric mixer grid tanks are shown in this photograph. The smaller tank was not used because of mechanical difficulties in obtaining a good variable antenna-coupling system. The larger tank is held to the receiver chassis by a narrow copper strap near each end. Note the shield partition between the oscillator and mixer circuits. The shielding helps eliminate stray coupling between the two sections of the receiver, thus making the variable coupling arrangement more effective.

112-MC. FM and AM SUPERHET

By LEIGH NORTON,* W6CEM

Although it is possible to obtain good results with a super-regenerative receiver when used for frequency-modulation reception the full advantages of f.m. can only be realized with a receiver designed particularly for that type of reception. Such a receiver is the subject of this article. To increase the receiver's utility, a simple switching circuit to allow the reception of amplitude modulation, when desired, has been incorporated.

The construction of a 2½-meter super is not to be taken lightly, even by those who have had considerable experience in building lower frequency sets. However, for the experimentally inclined, the u.h.f. super can be a mighty interesting piece of equipment to build.

Although there is no question that an r.f. stage ahead of a mixer gives an appreciable improvement in signal-to-noise ratio on frequencies below 30 Mc., where a gain of 10 or more may be realized in the r.f. stage, the situation becomes somewhat different at the higher frequencies where the r.f. stage gain drops to a low figure and the tube noise becomes a large part of the output. In such cases it would seem better to use a mixer having high conversion transconductance and to eliminate the r.f. stage. A recent article[1] has shown that the best tube in regard to noise and conversion g_m is the type 1852, but the high input capacitance and electrode loading make the 1852 unsuitable for mixer use at frequencies much above 60 Mc. These considerations make it almost imperative to use an acorn type tube for the mixer stage of a 112-Mc. super, and also show that unless another acorn is used as an r.f. stage, the mixer is best operated directly from the antenna. The addition of an acorn r.f. stage would greatly complicate the mechanical arrangement of the u.h.f. super, as well as increase the cost, so a 956 mixer coupled to the antenna is used in the receiver to be described.

Mixer Grid Tank

In order to secure the maximum possible signal voltage at the grid, a concentric line has been used as the mixer grid tank. Several lines of different diameters and sending-end impedances were tried. Although it is difficult to make accurate measurements on the mixer gain at these frequencies, the conclusion was reached that there is little to choose between various lines having different conductor radius ratios and different outside diameters. The smallest line tried is shown in figure 1 along with the completed receiver. This line which has a conductor radius ratio of 6.3/1 consisted of a piece of ½-inch hard copper tube as an outside conductor with a length of No. 12 bare copper wire as an inner conductor. Its performance was nearly as good as that of the line finally used on the receiver, which has a 7-1 (approximately) conductor radius ratio. This ratio is obtained through the use of a 1⅜-inch copper pipe as the outer conductor and a 3/16-inch copper tubing as the inner conductor. All of the lines tried were between 13 and 16 inches in length, the one shown mounted on the receiver in the photographs having a length of 14 inches.

The cnnclusion reached on the concentric line matter was that for lines appreciably shorter than a quarter wavelength the choice of conductnr radius ratios and overall tank diameter can well be tempered by a consideration of the mechanical difficulties involved. There are three considerations leading to the conclusion that a radius ratio somewhat less than the optimum for maximum sending-end impedance should be used: One of these is that it is obviously unnecessary to use a line having a sending-end impedance nf much more than two or three times the mixer input resistance, since a further increase in line impedance will result in a very slight increase in the total grid-ground impedance of the mixer

* Associate Editor, RADIO.

[1] E. W. Herold, "Superheterodyne Converter System Considerations in Television Receivers," *RCA Review*, January, 1940.

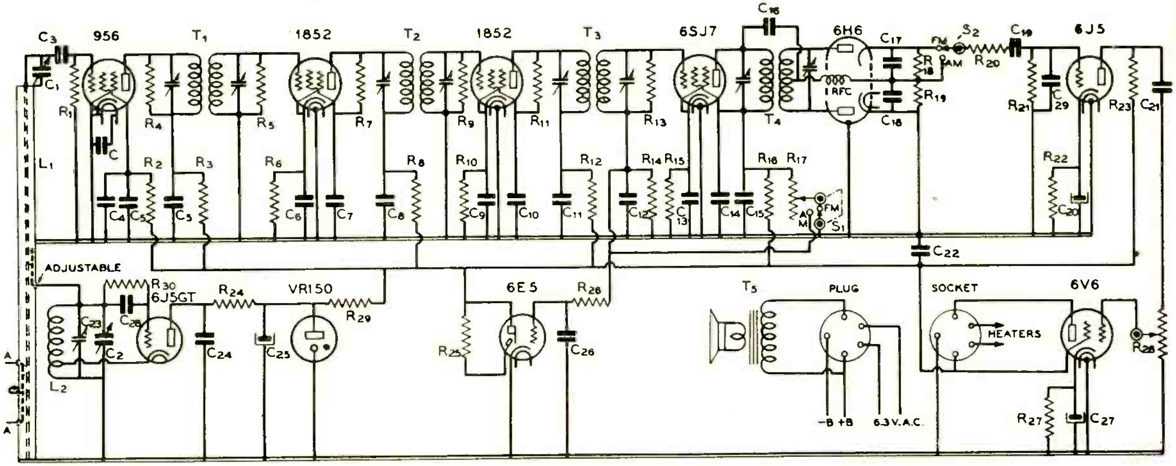


Figure 2.
Wiring Diagram
of the
F.M.-A.M. Receiver.

C—.0001-μfd. mica
C_1—7-μμfd. midget with one stator plate removed
C_2—15-μμfd. midget variable
C_3, C_4—.0001-μfd. mica
C_5, C_6, C_7, C_8, C_9, C_{10}, C_{11}—.01-μfd. 600-volt tubular
C_{12}—.0001-μfd. mica
C_{13}, C_{14}, C_{15}—.01-μfd. 600-volt tubular
C_{16}—.00005-μfd. mica
C_{17}, C_{18}—.0001-μfd. mica
C_{19}—.01-μfd. 600-volt tubular
C_{20}—10-μfd. 25-volt electrolytic
C_{21}—.01-μfd. 600-volt tubular
C_{22}—0.1-μfd. 600-volt tubular
C_{23}—2-35-μμfd. mica trimmer
C_{24}—.0005-μfd. mica
C_{25}—8-μfd. 450-volt electrolytic
C_{26}—.01-μfd. 600-volt tubular
C_{27}—10-μfd. 25-volt electrolytic
C_{28}—.0001-μfd. mica
C_{29}—.0005-μfd. mica
R_1—5 megohms, ½ watt
R_2—100,000 ohms, 1 watt
R_3—2000 ohms, ½ watt
R_4, R_5—50,000 ohms, ½ watt
R_6—150 ohms, ½ watt
R_7—30,000 ohms, 1 watt
R_8—2000 ohms, ½ watt
R_9—50,000 ohms, ½ watt
R_{10}—150 ohms, ½ watt
R_{11}—30,000 ohms, 1 watt
R_{12}—2000 ohms, ½ watt
R_{13}—50,000 ohms, ½ watt
R_{14}—250,000 ohms, ½ watt
R_{15}—100 ohms, ½ watt
R_{16}—75,000 ohms, 1 watt
R_{17}—10,000-ohm wirewound potentiometer
R_{18}, R_{19}—100,000 ohms, ½ watt
R_{20}—50,000 ohms, ½ watt
R_{21}—500,000 ohms, ½ watt
R_{22}—2000 ohms, ½ watt
R_{23}—50,000 ohms, 1 watt
R_{24}—3000 ohms, 1 watt
R_{25}—1 megohm, ½ watt (supplied with 6E5 socket assembly)
R_{26}—1 megohm, ½ watt
R_{27}—500 ohms, 10 watts
R_{28}—500,000-ohm potentiometer
R_{29}—3000 ohms, 10 watts
R_{30}—100,000 ohms, ½ watt
T_1, T_2, T_3, T_4—3000 kc. output i.f. transformer. See text for alterations to T_4
T_5—Pentode-plate-to-voice coil transformer (on speaker)
S_1—S.p.d.t. switch (on R_{17})
S_2—S.p.d.t toggle switch
RFC—2½ mhy.
L_1—14" copper concentric line. Outer conductor 1⅜" o.d., inner conductor 3/16" o.d. See text.
L_2—5 turns of No. 16 bare copper ¼" in inside diameter and wound to a length of ½" cathode tap 1½ turns from ground end.

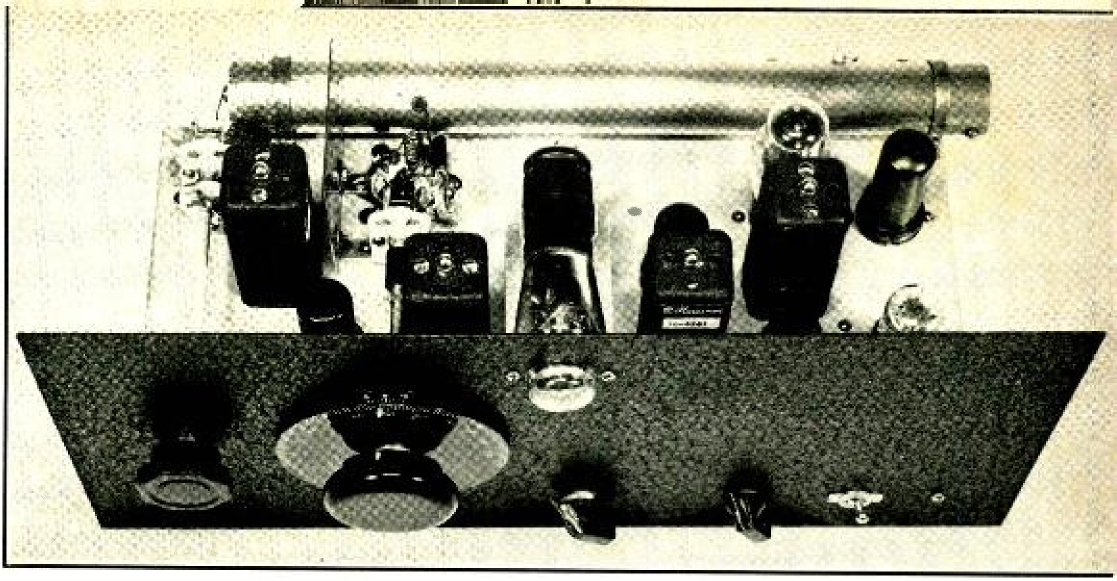


Figure 3. Looking down from the front of the f.m.-a.m. receiver. The adjustable coupling lead from the oscillator grid through the concentric mixer grid tank is visible in this photograph. The controls are, from left to right, mixer tuning, oscillator tuning, limiter "threshold," audio gain, and f.m.-a.m. switch.

input circuit. Another factor involves mechanical difficulties in holding the inner conductor in place. When a small inner conductor, such as a piece of wire, is used to obtain a high radius ratio with a small outer conductor it becomes necessary to use some sort of insulator at the open end of the line to hold the inner conductor in place, thus complicating the mechanical arrangement and increasing the losses in the tank circuit. In the small line shown with the receiver in the rear-view photograph this insulator consisted of a small disk of Lucite. The inner conductor is soldered to a brass screw across the outer conductor at the shorted end and threaded on the outer end to allow a nut to be run up against the Lucite, thus holding the wire taut and at the same time keeping the insulator in place.

The third factor which must be considered also involves mechanical difficulties; in this case those of providing for antenna coupling. This caused the smaller line shown with the receiver to be replaced by the 1⅜-inch one. If the constructor has the ambition to devise a good, easily-adjustable method of antenna coupling to the smaller line, it might well replace the larger one in the receiver, since there seems to be very little difference in sensitivity obtained with the two lines. A convenient method of antenna coupling is harder to devise with the small tank, however.

From the standpoint of selectivity in the mixer, a high Q line is to be preferred, provided the lower conductor radius ratio required for the high Q line does not reduce the impedance to such an extent that the gain of the input circuit is materially reduced. A consideration of all the factors involved resulted in the previously mentioned line, having a 1⅜-inch copper pipe as the outer conductor and a 3/16-inch copper tubing inner conductor, being used in the receiver. These conductors give a radius ratio of approximately 7-1, which seems to be a good compromise between impedance, Q, and overall tank size.

No actual "shorting disc" is used with the line shown in the receiver. The inner conductor is merely flattened at the "closed" end of the tank and two short right-angle bends made to allow it to be held to the outer conductor with a screw. This method is perfectly permissible where extremely high Q in the line is not necessary.

The antenna coupling "loop" is a piece of No. 10 wire covered with "spaghetti" where it is inside the tank, and supported within the tank by being run through tight fitting grommets in the outer conductor. A lead soldered to the center of the loop inside the tank is brought out and provided with a lug to enable the center of the loop to be grounded when a balanced, two-wire feeder is used. The end of the loop nearest the shorted end of the tank is grounded when a single-feeder type antenna is used. The loop is 2½ inches wide, but experiment will probably be necessary to obtain optimum coupling with lines of different impedance than the 400-ohm feeder used with the original receiver. Coupling adjustments are made by pushing the loop toward or away from the inner conductor.

Mixer Circuit

The 956 mixer uses a circuit suggested in the previously mentioned article.[1] In this

[1] *Loc. Cit.*

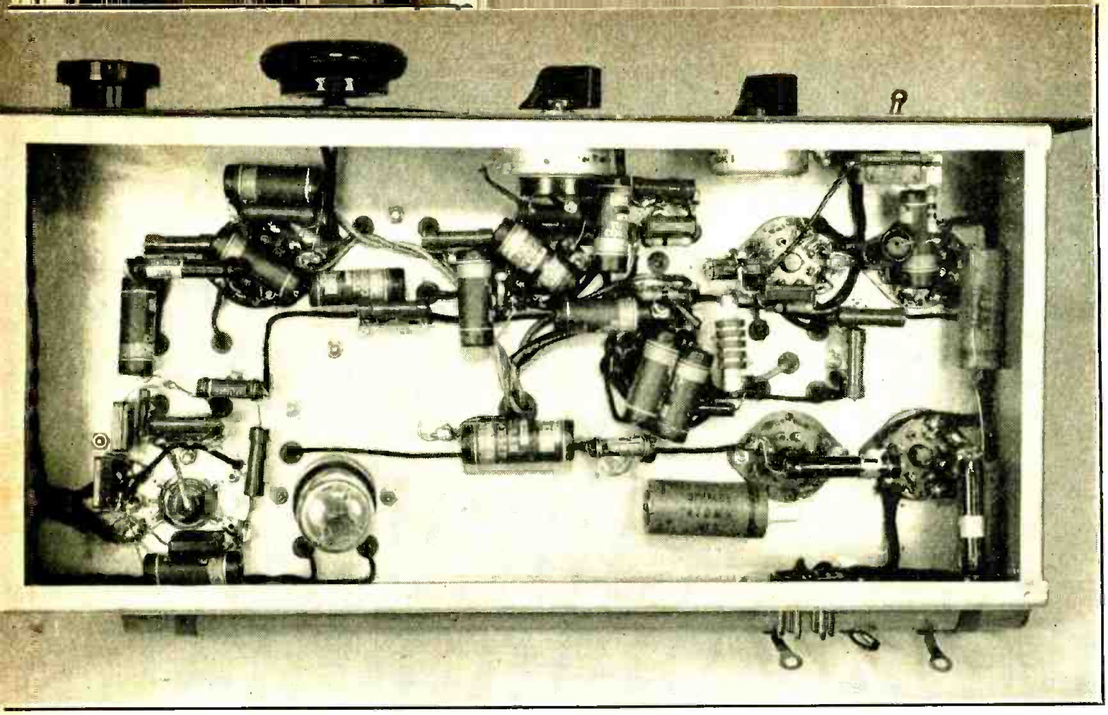


Figure 4. The 956 mixer and the 6J5GT oscillator may be seen under the chassis of the receiver. The two lugs protruding from the concentric tank at the upper left of the photograph are for antenna connections.

article it was shown that the highest conversion transconductance, consistent with low mixer noise, obtainable with a given tube results when a pentode mixer is used with the signal and oscillator applied to the same element, i.e., control-grid injection. One of the disadvantages of previous control-grid injection systems has been the difficulty in balancing the oscillator peak r.f. voltage at the mixer grid against the mixer bias, since best operation is secured with the mixer operating at or slightly above the grid-current point. The system suggested, however, eliminates this difficulty through the use of grid-leak bias on the mixer, bias being obtained from rectification of the injection voltage, and from contact-current flow.

While this arrangement was originally intended to allow a wide variation in oscillator voltage when making large frequency changes without affecting the conversion transconductance of the mixer, it is also well suited to adaptation to an u.h.f. super for an entirely different reason. This is because it allows the elimination of the usual troublesome —at u.h.f.—cathode resistor and by-pass condenser. While it is possible to eliminate the cathode resistor and by-pass arrangement and use fixed bias by insulating the inner conductor of the concentric tank at the "shorted" end and by-passing it to ground, the by-pass condenser at the shorted end must be an extremely good one to be effective at 112 Mc. The fixed-bias arrangement also has the disadvantage that the oscillator injection must be adjusted to match the bias used. On the other hand, the grid-leak bias arrangement is not at all critical, and the injection voltage may vary widely without affecting the mixer operation.

The only disadvantage to the grid-leak biased mixer is that it loses most of its bias when the oscillator is not operating. It is unlikely that the oscillator will ever stop working during ordinary operation of the receiver, since there is no provision for changing coils. However, to prevent damaging the 956 just in case the oscillator should become inoperative for any reason whatsoever, a high value of series screen resistor is used. The 100,000-ohm screen resistor limits the cathode current of the 956 without oscillator injection to slightly less than 5½ milliamperes, which is within the manufacturer's maximum rating.

The Oscillator

A 6J5GT is used as the high-frequency oscillator. This type of tube makes a good oscillator in any one of several suitable circuits. After trying a few circuits, the conventional grounded-plate Hartley shown in the diagram was decided upon as being the most convenient to use. As might be expected, there is a considerable amount of hum modulation on the oscillator when it is checked by coupling a beat oscillator to the i.f. channel and receiving a signal of known stability, such as the battery transceiver shown in the March, 1940, issue of RADIO.[2] However, it seems impossible to eliminate oscillator modulation at 112 Mc. with any sort of oscillator

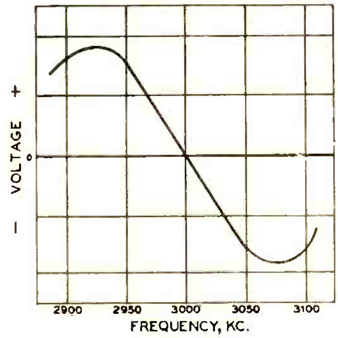


Figure 5. Typical discriminator voltage-frequency characteristic. When operated over the linear portion of the characteristic the discriminator gives an output voltage which is proportional to the direction and amount of frequency deviation.

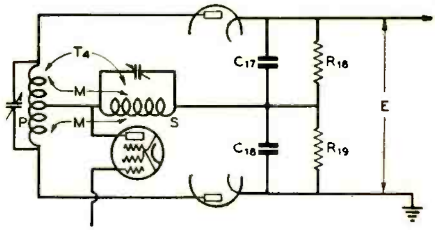


Figure 6. The essential parts of the discriminator circuit redrawn to show its operation more clearly.

when a.c. filament supply is used, the "hot-cathode" Hartley apparently being no worse than any of the others tried in this respect.

Checking the oscillator against a pure unmodulated signal with the receiver controls adjusted for frequency modulation showed that the hum frequency modulation was not great enough to give an audible output, so the oscillator was assumed to to be sufficiently stable for the purpose. A VR-150 voltage regulator maintains the oscillator voltage at a constant value, as well as acting as a section of filter.

I. F. Amplifier

There is little that need be said about the two stages of i.f. amplification. Conventional, inexpensive 3-Mc. mica-tuned i.f. transformers are used throughout. Those who have had experience with single-ended i.f. stages need not worry about regeneration in the two 1852 stages since the loading resistors across the grids and plates lower the stage gains sufficiently so that no trouble from this source is apparent. It had been hoped originally that a single stage of i.f. might be sufficient to operate the limiter. In fact the receiver was originally constructed with but a single i.f. stage ahead of the limiter. The crowding toward the right edge of the chassis is due to the addition of the second 1852 stage after it was found that the single stage would not supply enough voltage to the limiter grid on any but extremely loud signals.

The wiring of the screen dropping resistors will probably appear somewhat unusual. By connecting the screen resistors directly to the tube plates, the function of screen dropping and plate loading may be combined in a single resistor. There is no objection to this arrangement if the screen by-pass condenser is located directly at the screen.

Limiter

The limiter stage is the first place—aside from the extra-ordinarily wide i.f. bandpass —where the f.m. receiver differs from the conventional super to which we are accustomed. It is the function of the limiter to remove substantially all the ampliture modulation from the received signal and pass on to the discriminator a signal modulated only as to frequency. It should not be thought that the limiter in itself removes noise appearing as frequency modulation. This it cannot do; it does, however, remove noise which appears as amplitude modulation.

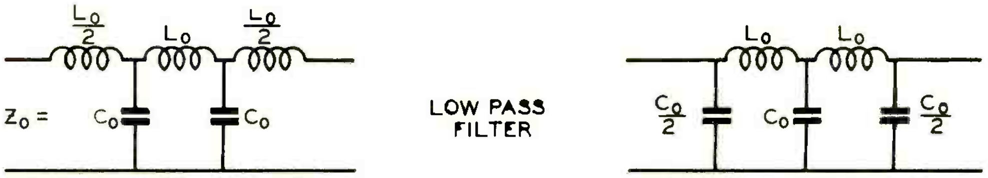
The limiter is essentially a grid-leak detector operated at low plate voltage so that it saturates quite easily. With the grid bias varying in accordance with the amplitude of the impressed signal and the plate voltage at a low value around 10 or 15 volts, very little amplitude modulation can get through the stage when a carrier voltage above the minimum "limiting level" is applied to the grid.

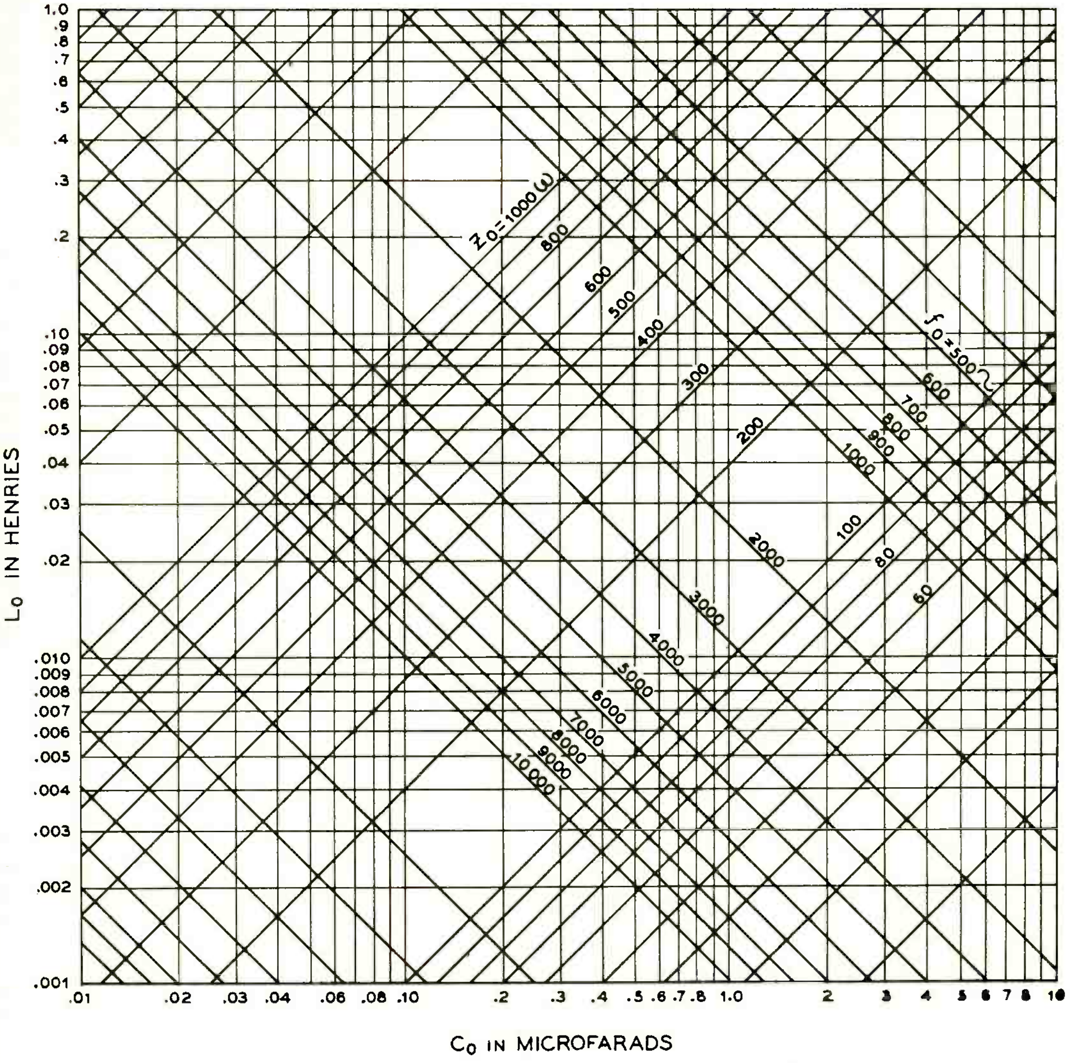
Discriminator

After leaving the limiter the frequency modulated signal minus any amplitude modulation it may have picked up between the transmitter and the limiter is passed on to the discriminator, which takes the place of the usual second detector. The discriminator, like the reactance-tube modulator usually used in the amateur f.m. transmitter, is an arrangement borrowed from broadcast receiver a.f.c. circuits. Its purpose is to give an output voltage proportional to the change in frequency of the impressed signal; as the signal frequency varies on each side of its "resting"—or unmodulated—frequency the discriminator output voltage varies from zero to some positive or negative value depending upon the direction and magnitude of the fre-

[*Continued on Page 81*]

[2] Smith, "A Self-Contained, Battery-Powered 2.5 Meter Transceiver,' RADIO, March, 1940, p. 11.





$$L_0 = \frac{2Z_0}{\omega_0} \qquad C_0 = \frac{2}{\omega_0 Z_0} \qquad \omega_0 = 2\pi f.$$

FIGURE 1. DESIGN CHART FOR LOW PASS FILTERS.

SIMPLIFIED FILTER DESIGN

MODULATION BANDWIDTH CONTROL BY MEANS OF HIGH AND LOW PASS FILTERS

By JOHN P. TYNES,* W6GPY

The crowded condition of the phone bands makes it imperative that each phone operator use as small a chunk as possible and still transmit an intelligible signal. The phrase "broadcast quality" indicates a band width of ten kilocycles—five each side of the carrier. A band width that allows "broadcast quality" is certainly not justified in the crowded amateur bands. A band width of five thousand cycles each side of the carrier is about the minimum requirement for the transmission of music, but the amateur is not allowed to transmit music. Adequate speech transmission can be had with a band width of three thousand cycles each side of the carrier. The lopping off of the higher two thousand cycles from the conventional transmitted band allows almost enough room in the band for another station to operate with a minimum of interference.

Highly selective receivers, crystal filters, heterodyne filters, etc., have been used at the receiving end to eliminate the objectionable sideband chatter. How much better it would be if those interfering frequencies which cause the chatter had never been transmitted in the first place.

Most amateurs pride themselves on the high fidelity of their speech systems. In fact, many amateurs use their fine speech equipment to good advantage as phonograph amplifiers. This desire for high quality equipment is laudable and should be encouraged.

There are means, however, by which the frequency range of these speech systems may be limited when used in the modulating portion of the amateur transmitter. One of the most effective and simple methods is to insert a suitable filter in the 500- or 200-ohm line between the speech amplifier and the transmitter.

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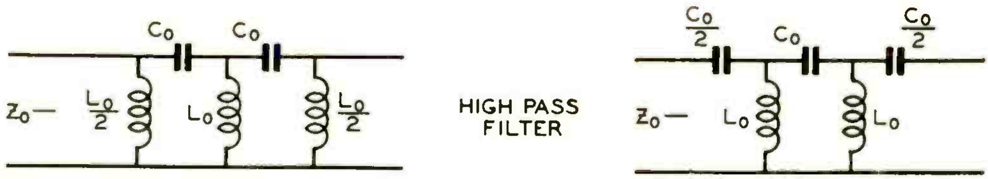
Filter Circuits

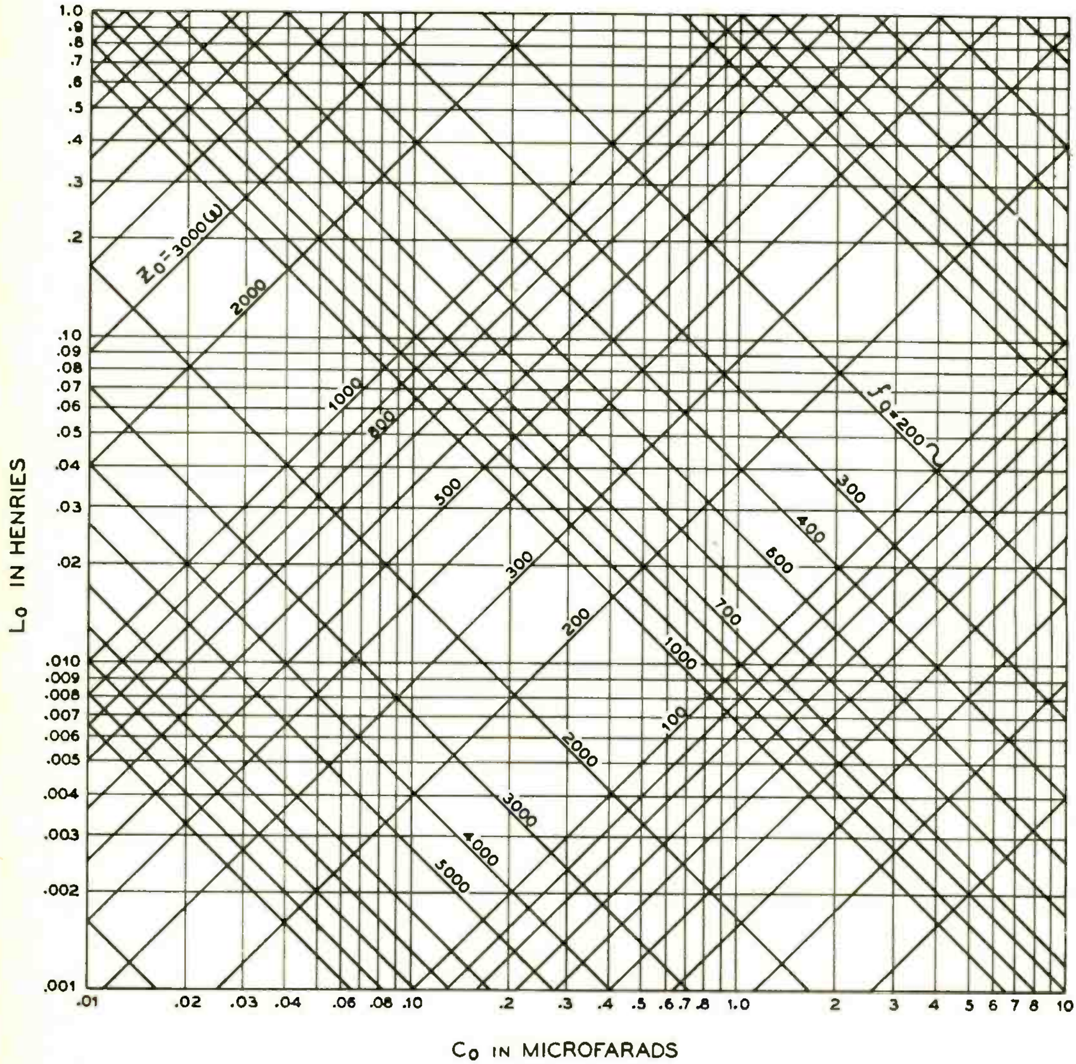
There are many types of discrimination circuits in use today; some of them use quartz plates as elements, others use resistance capacity networks, and still others are of the inductance capacity type. All of these schemes have their place in circuit design, and each one has its advantages and disadvantages.

It is our purpose in this article to deal only with the inductance capacity type of networks of the "T" and "PI" type. These types of frequency filters are probably the oldest and yet the amateurs have, in general, been very shy about using them, except in their power supplies.

We believe that the reason they are not used more is due to the lack of information on the subject. There have been numerous articles written giving the mathematics of the subject, but very little of a nature that would help the amateur who might build a filter if it weren't for the equations. Many amateurs will read through the available literature in quest of some new idea to try, and then will spend many an hour in constructing a new piece of equipment. But they will fight shy of the thought of wading through mathematics and long computations.

We recently tried our hand at designing a low-pass filter to put in the 500-ohm line between the speech amplifier and the high level modulator, to cut off all frequencies above three thousand cycles. After going through the computations several times, it was made clear that it would be a nice thing if all that it was necessary to do would be to read the answer off a chart. Further study was given to the matter with the result that the charts and design information given here were developed. It is being passed along in the hope that others who might be interested may make use of the information.





$L_0 = \frac{Z_0}{2\omega_0}$ $C_0 = \frac{1}{2\omega_0 Z_0}$ $\omega_0 = 2\pi f.$

FIGURE 2. DESIGN CHART FOR HIGH PASS FILTERS.

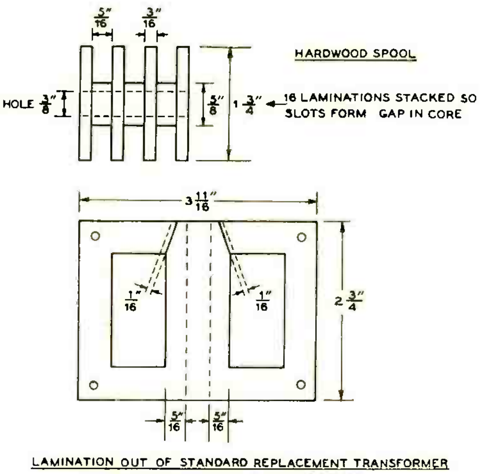


Figure 3. Showing the dimensions of the winding spool and the method of cutting the replacement transformer laminations, each one of which forms two laminations for the filter inductances.

The basis of the charts is the design formulas which have appeared in the other articles previously referred to. You may skip them if you so desire as they were used only in making up the charts; they are given below the charts merely to show the derivation of the chart information.

Practical Application

So much for the way the charts came into being, now to make use of them.

Let's say we want to design the filter mentioned a little while ago. It is to have a cutoff frequency of 3000 cycles —that's our F_o. The filter is to be inserted in the 500-ohm line—that's our Z_o. It's to be a low pass filter so we take the low pass filter chart figure 1 and find that the diagonal lines are designated for various values of F_o and Z_o. We find the point of intersection of the lines for 3000 cycles and 500 ohms, and then from that point of intersection, read off the value of L_o on the left hand margin, and the value of C_o at the bottom of the chart. We find these values to be $L_o = 0.053$ hy. and $C_o = 0.215$ μfd.

Now we come to the tough part of the design—where do we get these values of inductance and capacity. Here is the answer. 0.215 μfd. is a bad value to find, but 0.2 μfd. is easy, so let's see what happens to our design if we use 0.2 μfd. instead. We find that 0.2 μfd. intersects the 500-ohm line at a point that gives us a value of .05 hy. for L_o and a new cutoff frequency of about 3100 cycles. That's OK with us, so now how do we get the .050 hy. for L_o.

To the writer's knowledge there are no small inductances sold on the market that are suitable for use in these filters. To be a good choke for filter use, it must have a low d.c. resistance and be available in a wide range of values of inductance. Faced as we were with this situation, we decided to make our own chokes. Design charts figure 3 and figure 4 give the necessary information for their design. The materials are usually available and only a small amount of machine work is required.

The spool is turned out of a ten-cent rolling pin, with the slot dimensions shown. This part of the design should be followed carefully if the inductance of the finished choke is to agree with the value on the turn chart (figure 4). The lamination material used was taken from a standard replacement transformer, and modified with a pair of tin snips as shown on the dotted lines; each lamination from the transformer makes two laminations for our choke. The laminations are all stacked so that the slots in the assembled core appear at the same place and form an air

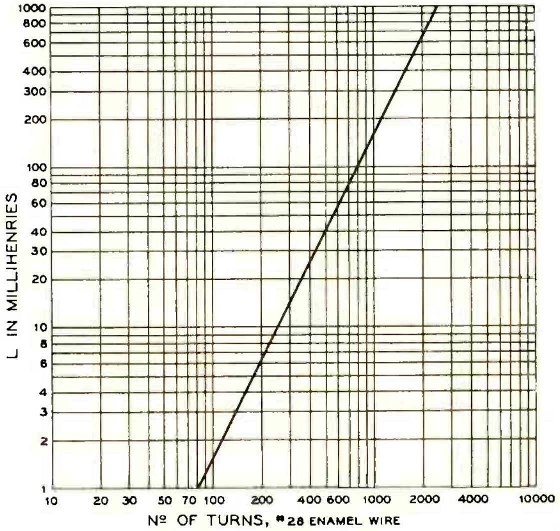


Figure 4. Inductance design chart for use with the spool and core design given in figure 3. Wind each slot in the spool with 700 turns before proceeding to the next slot.

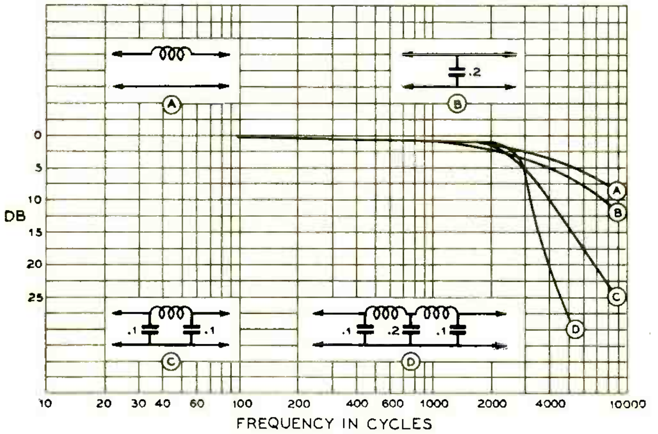


Figure 5. Results of a frequency run on the 500-ohm line between the transmitter and the speech amplifier with the various filter sections inserted in it. All inductances shown are .050 hy. (50 millihenry) units. (A) shows resultant curve and the circuit with a single inductance in the line. (B) shows the curve with a single 0.2-μfd. condenser across the line. (C) shows the curve with a single section of filter, and (D) shows the resultant curve with the full two-section filter as finally employed.

gap in the core. The lamination material from several makes of transformers has been used and the results have all fallen very close to the values as shown on the chart. The chart is based on a core made up of sixteen laminations.

The chokes and condensers may be connected up in two different ways as shown on the design chart. One way forms the well known "T" type filter and the other way forms the "PI" type filter. We chose the "PI" type since it required the construction of only two chokes as against three with the "T" type. The input and output condensers of the "PI" type filter are half the value as shown on the chart but the 0.1 μfd. value is still easy to obtain.

Figure 5 shows some attenuation curves obtained with the chokes and condensers used in the final filter. There are some interesting features here. Figure 5A shows the attenuation of just the inductance inserted in one side of the 500-ohm line. Figure 5B shows the attenuation of just the 0.2-μfd. condenser across the line. Figure 5C shows the attenuation of the choke and condensers when formed into a single section filter. The value of capacity has been split into two condensers of 0.1 μfd. each (required by the "PI" type filter). Figure 5D shows the attenuation of the completed filter of two sections.

It is hoped that this simplification in filter design will appeal to a number of other amateurs with the result that our bands will be freed of a great amount of sideband chatter.

• • •

"Radio's" Contributing Authors

The February issue of the *Proceedings* of the I. R. E. is replete with articles by writers who are also listed on the roster of contributors to RADIO. Grote Reber, W9GFZ, whose article on Improved U. H. F. Receivers was co-authored with Bill Conklin in the January, 1939, issue, discusses the measurement of QRN disturbances arising from the electronic-ionic collisions within the Milky Way. His first measurements were attempted at 3300 *megacycles*, subsequent ones were attempted at 900 megacycles, but conclusive results were attained at 160 megacycles with the receiver aforementioned being fed from the parabolic collector and drum resonator shown on the cover of the February, 1939, RADIO. To quote, the received energy has an ". . . absolute intensity at 160 megacycles of 7 x 10^{-41}, erg per second per square centimeter per circular degree per kilocycle band."

F. Alton Everest, whom long term readers of RADIO will remember, is co-author with H. R. Johnson of an article on the Application of Feedback to Wide-Band Output Amplifiers, with particular reference to the television aspect. Then our many-time contributor, John Kraus, W8JK, has an excellent article on Antenna Arrays with Closely Spaced Elements which persons interested in the theoretical aspects of the flat-top beam will find of considerable value. Also shown in the Kraus article is a four-element three-dimensional array which gives a considerable bi-directional gain considering the small space it requires. A pair fed in-phase, end-to-end, would occupy a length of only one wavelength and would give a gain approaching 10 decibels.

The Mighty Mite

BAND JUMPER

By JOHN R. GRIGGS,* W6KW

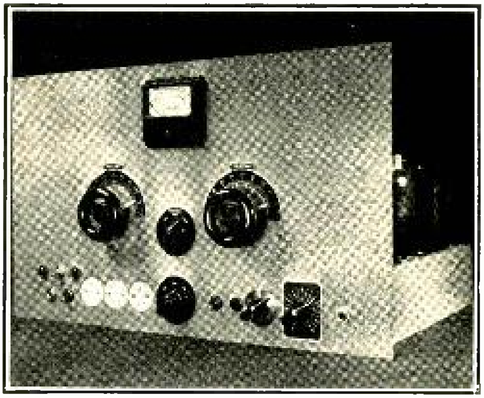
A self-contained 60-watt phone and c.w. transmitter with the following features: bandswitching for any three chosen bands from 10 through 160 meters, automatic L/C ratio switching, automatic crystal selection, and meter switching.

The trend in recent months among radio amateurs has been toward bandswitching exciters and transmitters to facilitate operation on the various bands as conditions permit or as the operator desires.

This evolution in transmitter design has come about due to the great influence upon amateurs of efficient band selection in all-wave communication receivers and it is only natural that a bandswitching transmitter should eventually come into general use. Heretofore, plug-in coil transmitters have been accepted as sufficient, as witnessed by the amazing success of the Bi-Push and the Mighty Mite.

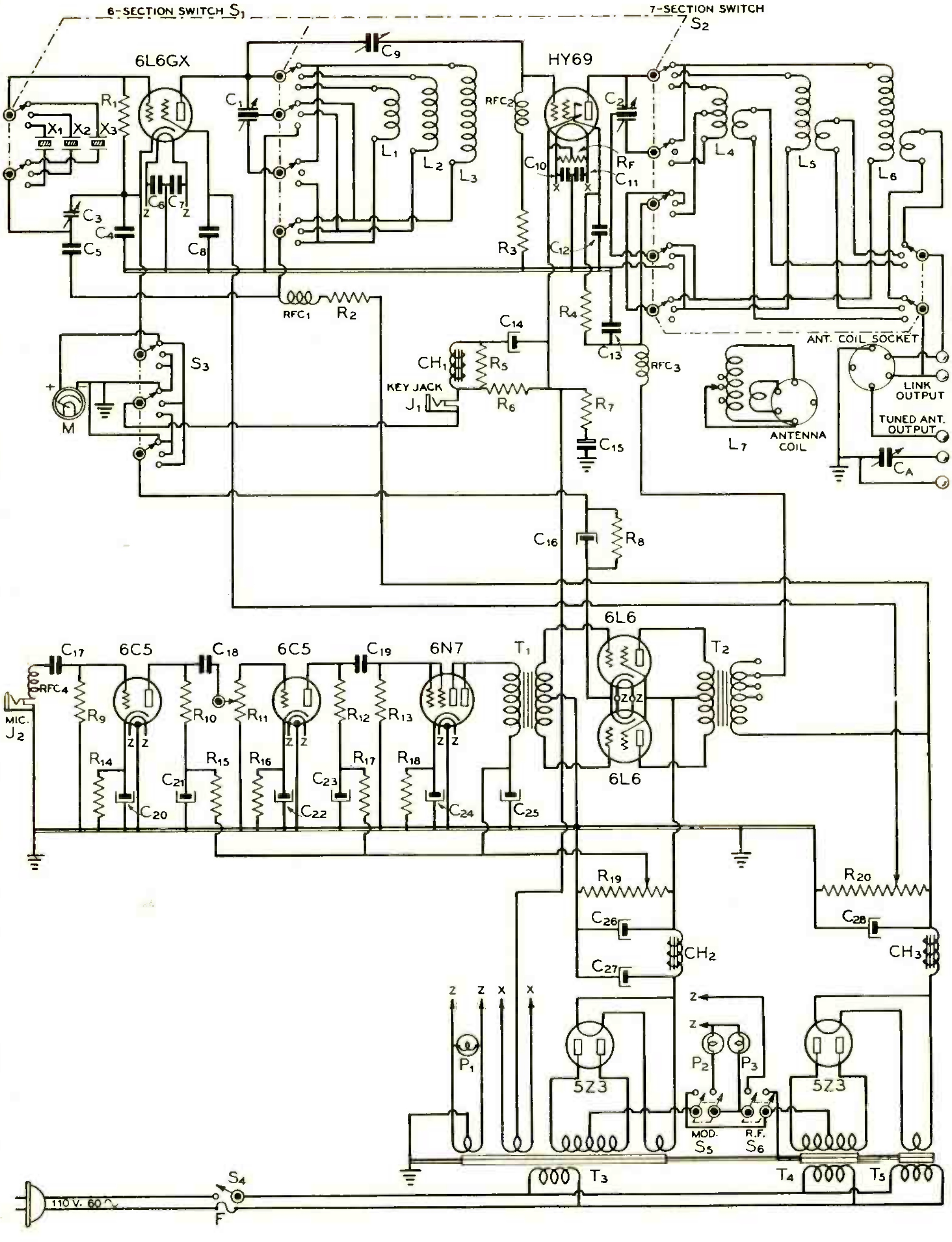
It is true, however, that in a great many bandswitching units now in use little or no attention has been paid to the matter of correct L/C ratio, it being felt that the flexibility of operation over several bands repaid for the loss of efficiency thus entailed. For instance, a bandswitching unit with 100 μμfd. capacity across the tank coils will be fairly efficient on 80 or 40 meters, but will have insufficient C for proper operation on 160 meters, and will have too much C and therefore insufficient L for efficient operation on ten meters.

To keep the L/C ratio approximately correct on all bands, the author incorporated in the original Mighty Mite the idea of using split-stator condensers with single-ended r.f. stages, utilizing a tube in the final of the 807 type which required no neutralization. By switching the stator sections of the tank condenser to parallel against the rotor for 80-160 meter operation, using a single section for 20 and 40 meters, and using the two in series or regular split-stator arrangement for 5 and 10 meters, approximately the correct L/C ratio was obtained for all bands. Thus a dual 75 μμfd. condenser would give a maximum capacity of 150 μμfd. across the 80 and 160-meter coils; 75 μμfd. on 40 and 20, and 37.5 μμfd. on 10 or 5. Condenser sections were connected to the coil sockets and inter-connections were made through the various plug-in coil forms. Anyone familiar with the formula for circuit Q will readily see the advantages of this idea and the inherent efficiency therein. Due to the switching of the condenser sections and the problem of neutralization, this system cannot be used with triodes, but is confined to use with tubes of the 807 and HY69 type.



Front angle view of the Mighty Mite Band Jumper showing symmetrical panel design, with bandswitch and meter switch, crystal sockets for the three bands, antenna tuning and audio gain controls, key and microphone jacks.

*3575 Boston Ave., San Diego, Calif.



COMPLETE WIRING DIAGRAM OF THE MIGHTY MITE BAND JUMPER.

Values of Components in the Mighty Mite Band Jumper.

C_A—Dual 365-μμfd. b.c. condenser, paralleled
C_1—Dual 75-μμfd. tuning condenser
C_2—75-μμfd. per section, 4000-volt spacing
C_3—Dual 365-μμfd. b.c. condenser, paralleled
C_4—.001-μfd. mica
C_5—.002-μfd. mica
C_6, C_7, C_8—.001-μfd. mica
C_9—100-μμfd. air padder condenser
C_{10}, C_{11}, C_{12}—.001-μfd. mica
C_{13}—.01-μfd. mica
C_{14}—8-μfd. 450-volt elect.
C_{15}—0.5-μfd. 600-volt tubular
C_{16}—25-μfd. 25-volt elect.
C_{17}, C_{18}, C_{19}—.02-μfd. 400-volt tubular
C_{20}—10-μfd. 25-volt elect.
C_{21}—4-μfd. 450-volt elect.
C_{22}—10-μfd. 25-volt elect.
C_{23}—4-μfd. 450-volt elect.
C_{24}—10-μfd. 25-volt elect.
C_{25}—4-μfd. 450-volt elect.
C_{26}—16-μfd. 450-volt elect.
C_{27}—8-μfd. 450-volt elect.
C_{28}—8-μfd. 600-volt (working) electrolytic
R_F—50 ohms, 1 watt, c.t.
R_1—50,000 ohms, 1 watt
R_2—7500 ohms, 25 watts—slider type
R_3—40,000 ohms, 2 watts
R_4—25,000 ohms, 10 watts
R_5—10,000 ohms, 1 watt
R_6—200 ohms, 10 watts
R_7—1000 ohms, 1 watt
R_8—200 ohms, 25 watts
R_9—500,000 ohms, ½ watt
R_{10}—250,000 ohms, 1 watt
R_{11}—500,000-ohm potentiometer
R_{12}—250,000 ohms, 1 watt
R_{13}—100,000 ohms, 1 watt
R_{14}—1000 ohms, 1 watt
R_{15}—25,000 ohms, 1 watt
R_{16}—2000 ohms, 1 watt
R_{17}—25,000 ohms, 1 watt
R_{18}—1000 ohms, 1 watt
R_{19}—20,000 ohms, 25-watt slider type
R_{20}—25,000 ohms, 50-watt slider type
S_1—6-section three-position isolantite bandswitch
S_2—7-section three-position isolantite bandswitch
S_3—3-circuit, three-position switch
S_4—S.p.s.t. toggle line switch
S_5, S_6—D.p.s.t. toggle switch
J_1—Keying jack, closed circuit
J_2—Microphone jack, open circuit
Coils — Manufactured plug-in type for desired bands of operation
RFC_1, RFC_2, RFC_3, RFC_4 — 2.5-mh. 125-ma. chokes
M—0-200 d.c. milliammeter
X_1, X_2, X_3—Crystals for desired band
P_1—On-off pilot lamp
P_2—Modulator pilot lamp
P_3—R.f. pilot lamp
T_1—Plate-to-AB_1 6L6 grids
T_2—40-watt multiple-match output
T_3—800 v. c.t., 200 ma.; 6.3 v., 1.5 a.; 6.3 v., 5 a.; 5 v., 3 a.
T_4—1200 v. c.t., 250 ma.
T_5—5 volts, 3 amperes
CH_1—2-hy. 120-ma. choke
CH_2—20-hy. 200-ma. choke
CH_3—8-hy. 200-ma. swing choke

Two recent developments by prominent manufacturers make this transmitter possible. One of these is the Hytron HY69, a beam power tetrode of the 807 type, but with a quick heating filament and with 40 watts plate dissipation, thus being ideally suited for the role it plays in the new "Mighty Mite" Band Jumper.

The other is the development of bandswitches made of steatite, available in the switch kits of the Centralab Company. Required for the Band Jumper are two such switch units, one having six switch sections and the other with seven, both with three positions. On these are mounted the jack bars for the coil mountings. These coils are plug-in, of course, and while you have three bands available at any time on the switch itself, you may change the coils at will for operation on any three selected bands. These two switches are set up in tandem, with a shield plate placed between for isolation of the two r.f. circuits, i.e., the oscillator and the r.f. amplifier.

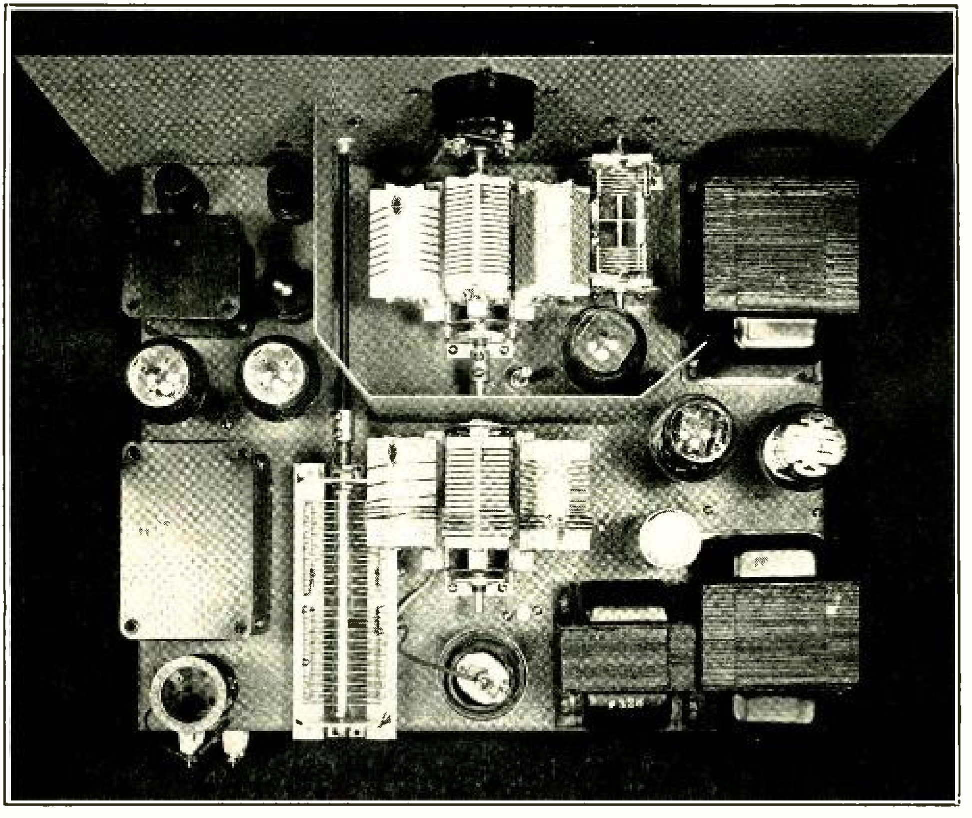
Other features, too, have been added, such as automatic crystal switching, making it unnecessary to change crystals when bands are changed. An increase in power to 60 watts, phone and c.w., has been made, as compared to the original Mighty Mite. Automatic link output switching and built-in antenna tuning features are also incorporated in the new Band Jumper.

The Band Jumper will operate as efficiently on 10 as it will on 160 and you can jump from one to the other, or stop on 80, 40 or 20 in between, merely by the flick of a wrist. It may be built for a cost of about $85, complete, with tubes, coils and crystals, and represents a permanent investment.

Possibly the greatest advantage of the Band Jumper is the fact that it can readily be used as the basis for a higher powered transmitter, as its r.f. portion will easily excite a 250 or 300-watt final amplifier through the link coupling output, and the modulators can readily be used to cathode modulate a final of such power whenever such a change should be desired. Thus an increase to higher power could be made very reasonably whenever desired.

Construction

The chassis utilized for the construction of the Band Jumper is 14 by 17 by 3 inches in size, with a front panel 19 by 11½ inches. The shield plate between the r.f. stages may be bent in a regular tinner's "brake" or over



Top view of the Band Jumper showing the power supplies along the right-hand edge, modulation equipment along the left-hand edge, bandswitching oscillator in front of the shield in the center, and bandswitching final amplifier behind the shield.

the edge of a table, and need not necessarily have the angle corners shown, although they do allow a bit more room on the chassis for other components. A hole must be cut in this shield for both the final condenser shaft and the bandswitch shafts, coupling between the two switch shafts being made in the oscillator section. Both bandswitches are mounted above the chassis on small brackets which must be made or obtained to fit from a hardware dealer.

Careful consideration should be given the layout of parts to insure efficient operation and to prevent feedback and spurious oscillation of the final amplifier.

In the oscillator section is placed the bandswitch unit with the six-section switch, the tube socket, and the dual 75-$\mu\mu$fd. variable tuning condenser of 1000-volt rating. This condenser is mounted on brackets above the chassis and is entirely insulated from ground. Extending up from the underside of the chassis directly back of the bandswitch is the shaft (slotted for screwdriver adjustment) of the regeneration condenser, useful for controlling harmonic operation of the oscillator. This condenser is an ordinary b.c. type dual condenser of .00036 μfd. capacity, with stator sections wired in parallel.

Beneath the chassis are the other components of the oscillator circuit, such as tube socket leads, by-pass condensers, resistors, and the like. Note that both the B power and plate leads to the bandswitch of the oscillator are run through the chassis from the underside. In the r.f. amplifier section, only the B power and link leads are run through the chassis to the bandswitch above. Also shown in the illustration are the crystal socket leads, bunched in parallel near the front panel.

Looking at the front of the panel, from left to right, the three crystal sockets hold crystals for (a) low frequency, 80 or 160-

meter bands; (b) medium frequency, 40-meter band; and (c) high frequency bands, such as 10 and 20 meters. Of course, various other combinations are possible, such as using a 40-meter crystal in socket C and doubling in the oscillator to 20, with output in the final on either 20 or 10 as desired. Innumerable combinations can thus be worked out to suit the available parts and crystals of almost any amateur. In fact, a crystal holder with a condenser between the two prongs may be used in socket A when operating on 160 meters, giving the operator a self-excited oscillator which offers all the advantages of variable frequency operation. However, it is not advisable to use this on the higher frequency bands due to drift caused by heating of circuit components and consequent instability.

The shaft of the tuning condenser for the oscillator must be insulated from the panel by air space, inasmuch as it has d.c. on it when in operation on two of the bandswitch settings, i.e., low and medium frequency bands. On the high frequency setting of the bandswitch, the shaft of this condenser is automatically connected to ground. The shaft of the r.f. amplifier tuning condenser is extended by a fiber rod, thus eliminating the difficulty of insulating that shaft from the panel. No worry over possible r.f. losses in this rod need be expressed as they will be negligible on the lower frequencies, and on the high frequencies the rotor is grounded anyway. Incidentally, it was found advisable to use a panel bearing for this shaft, as well as for the underside antenna condenser shaft, due to the length of fiber rod extensions used. The use of panel bearings gives more rugged construction and holds the dial pointers in adjustment.

One central hole under each bandswitch is all that is necessary to bring through the chassis all the leads used in each section. In the oscillator section this hole should be large enough to accommodate a rubber grommet of about half inch size or larger, as six crystal sockets leads, B power and oscillator plate leads and a ground lead are run through it. It is recommended that spaghetti be used to insulate these leads. In the r.f. amplifier stage the hole need accommodate only four leads, two of which are r.f. link output, another is B power and the fourth is ground. A rubber grommet of ⅜ inch size is sufficiently large to accommodate these.

In both r.f. stages, the tank condenser connections are made above the chassis directly to the bandswitches. In the r.f. amplifier, the plate lead for the HY69 is taken directly from a stator section of the tank condenser, a dual 75-$\mu\mu$fd. 3000-volt variable condenser. Be certain connection is made to the correct stator when wiring as the other stator would not permit correct operation if wired to the plate, due to the bandswitch arrangement.

The HY69 must have a shield can placed around it to prevent stray feedback. This can must be equal in height to the bottom of

Rear view showing the HY-69 final amplifier, tapped antenna coil, the tank condenser and coil assembly of the final, and the power supplies.

the electrodes contained inside the tube, and of a diameter sufficient to clear the tube on all sides by at least one-sixteenth inch.

A 100-$\mu\mu$fd. coupling condenser of the variable air type is used as the grid coupling condenser between the oscillator and the final. The illustration of the underside of the chassis shows this condenser near the grid of the HY69 at the rear of the chassis. Its shaft extends through a hole in the chassis to permit adjustment from topside during operation. At the grid connection on the socket of the HY69 is shown a grid leak resistor of 40,000-ohm 2-watt rating connected to ground on a nearby resistor mounting. This has since been changed to include an r.f. choke in series with the resistor, as shown in the circuit diagram.

Filament Circuits

The filament of both the HY69 and the 6L6GX oscillator are by-passed to ground at the tube sockets with 1000-volt, .001-μfd. mica condensers. While the oscillator filament is supplied by the same winding used for the speech and modulator filaments, the filament supply for the HY69 is separate, due to the fact that the HY69 has a directly heated cathode of the quick heating filament type, and must be keyed and biased separately. The beam plates of the HY69 must be tied to a center-tapped 50-ohm 1-watt wirewound resistor placed across the filament connections directly at the socket. This is done to keep the beam plates at zero potential in respect to the filament. The center tap of this resistor is connected to the center tap of the filament winding and run through a 10-watt resistor for bias, going through a key click filter and keying jack to ground. The bias resistor is by-passed for audio as well as r.f. The key click filter is of the conventional type used in cathode circuit, utilizing a 2-henry 125-ma. choke with a 10,000-ohm 1-watt resistor across it, and a condenser of 0.5-μfd. 600-volt rating in series with a 1000-ohm 1-watt resistor across the key jack to ground.

Meter Switching Circuit

From the bottom view of the chassis may be seen, at the center of the front panel, the meter switch. This is a three-circuit three-way fibre switch made by Centralab or Yaxley. The wiring of this switch is similar to that first used in the original Mighty Mite, but in this case it is used to read plate currents (cathode currents) in three circuits from *two different* power supplies, and therefore it must be in the ground or cathode leads of the three stages measured, i.e., oscillator, r.f. amplifier and modulators. As the switch is of the shorting type, any circuit may be switched through the meter at any time without disturbing its operation. The advantage of meter switching is readily seen by the man of limited purse, inasmuch as it eliminates the necessity for two additional meters. The meter used in the Band Jumper is a 0-200 milliammeter.

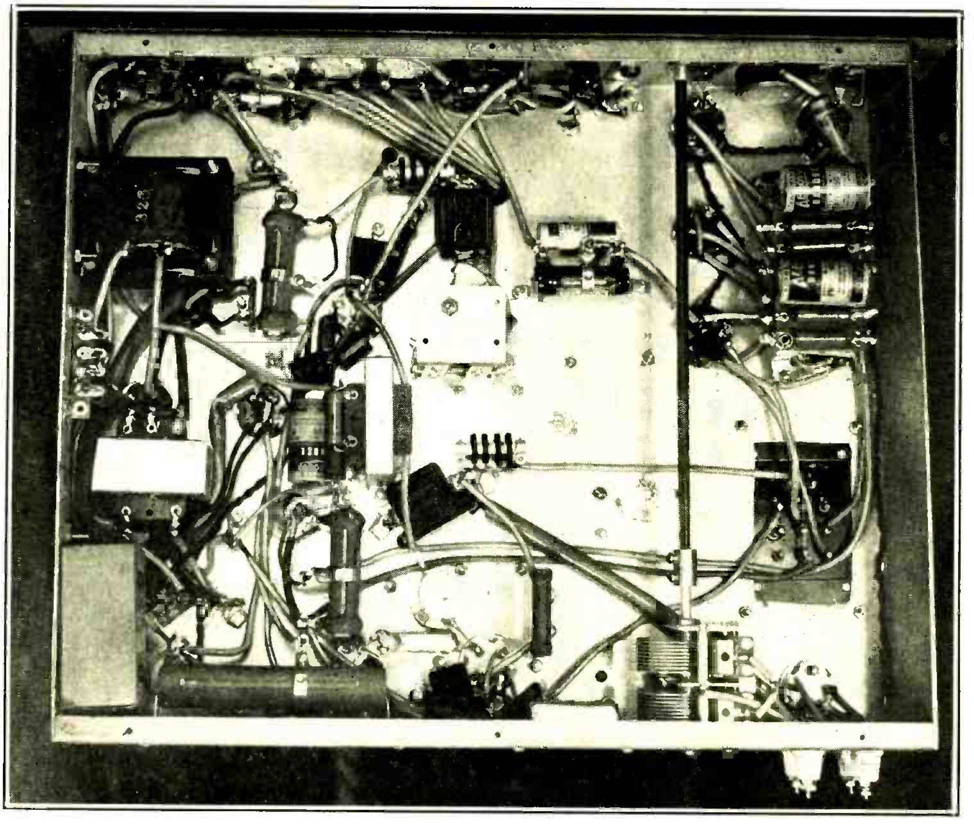
The Speech System

The bottom view of the chassis also shows the resistor and condenser mounting strip used for the speech amplifier components. The speech and modulators are more or less conventional, as will be seen by the diagram. The tube lineup is simple and easy to get working, due to the low-gain type tubes used, and the 6L6G's are capable of a good 40 watts of audio as plenty of driving power is available from the 6N7 speech driver. The use of triodes in the speech stages represents the author's favored use of such tubes as contrasted to pentodes of high gain, and their resultant generation of second harmonic distortion. The 6L6G's used in the modulators should eliminate any possible second harmonic distortion possibly generated in that stage, due to push-pull operation which tends to cancel it out. No trouble was experienced with r.f. feedback in the speech amplifier, but if such should be experienced, the first speech stage should be covered thoroughly around the socket by a small shield can. As may be seen, very little shielding was used in the speech amplifier. However, it may be necessary in some cases to shield all the grid and plate leads, though it is felt that the small shield can noted above would provide sufficient shielding to prevent any r.f. feedback trouble in the speech.

The modulation transformer is a 40-watt Kenyon Ken-O-Tap of the multi-match type. Its secondary is capable of carrying from 150 to 200 ma. of r.f. plate current, thus being ideally suited for use as a cathode modulation transformer through its 500-ohm taps when the time comes for expansion in power to a 300-watt final. If more current should be needed for such power, it is advisable to replace the modulation transformer with a regular cathode modulation type transformer capable of carrying the heavier currents.

Connections for the plates of the modulators should be so as to reflect a 6600-ohm load to the 6L6G's with an r.f. load of about 100 ma. at 600 volts on the final, or 60 watts input. Audio output of the modulators will fully plate modulate this amount of input.

At the rear underside of the chassis may be



Bottom view showing wiring and placement of components. Note antenna tuning condenser controlled from panel by extension shaft.

seen a dual b.c. type variable condenser with a fibre extension shaft running through the front panel. This is used to tune the antenna circuit over a wide range of frequencies. It is a dual .000365-μfd. condenser with the stators wired in parallel. The antenna tuning network is intended to be used in a number of different connections. For instance, the condenser may be connected through the feedthroughs at the rear of the chassis so as to be across the antenna coil for parallel tuning. It may also be used for series tuning. When using the link coupling output, as might be the case for a doublet antenna, the antenna coil must be removed from the socket, as the link there is connected at all times when the coil is in the socket, and thus would absorb needlessly some of the r.f. output.

The four feedthroughs are used as follows: the two at the top rear of the chassis are for the link output from the r.f. amplifier; then the two lower ones are used as follows: one from the top end of the antenna coil through the socket, and the other to the paralleled stators of the antenna condenser. The grounded end of the antenna coil and the rotor of the antenna condenser are connected to a binding post directly on the chassis which serves as ground connection.

Power Supplies

It will be noted that two power supplies are used, one of which supplies plate power for the r.f. portion, and the other for the speech amplifier and modulators. A separate filament transformer is used for the rectifier in the r.f. plate supply circuit. All other filaments are supplied by the same transformer used to furnish plate current for the speech and modulators. Either 5Z3's or 83's may be used as rectifiers.

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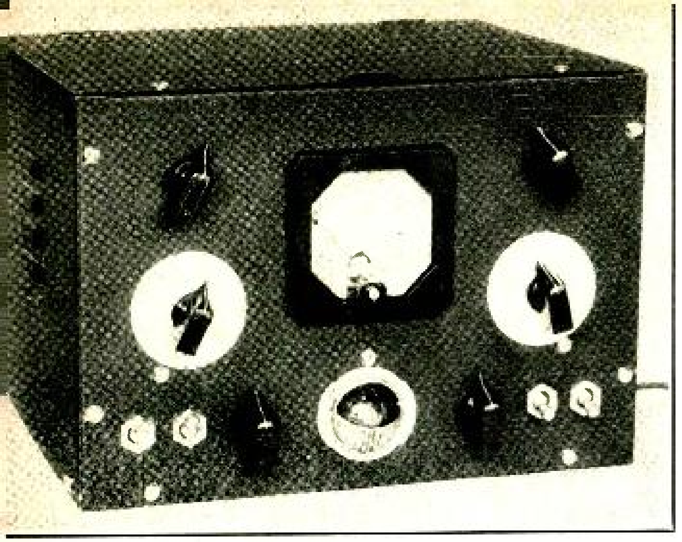

Figure 1. Front view of the modulation meter mounted in its cabinet.

A combined "R" meter, monitor, and modulation meter which can be used both on the station transmitter and upon incoming signals as brought in by the station receiver.

A DUAL MODULATION METER

By RICHARD O. GRAY,* W9JJV

Each year an increasing number of swl's join the ranks of hamdom. The problem of finding room for them becomes more acute each year. This situation can be helped in the phone bands by reducing the disturbances caused by overmodulation.

There are very few hams on the air who will not try to improve their signals if they are politely informed that they are causing a disturbance, especially if continued operation will mean a ticket from the FCC for improper operation. This, in part, was the incentive for the design of the modulation meter described in this article.

The new feature of this modulation meter is the ability to measure the modulation of any received signal that is free of interference and above a minimum signal strength. In addition, the meter can be used to measure the modulation, average and peak, of an adjacent transmitter, to indicate the signal strength of received signals, and to monitor the quality of modulation of the adjacent transmitter.

Design

Two factors, performance and cost, were taken into consideration in the design of this modulation meter.

Most modulation indicators use two meters, one to indicate carrier level, and one to read per cent modulation. This circuit eliminates one meter and one tube by switching from carrier to modulation, thus reducing the cost and at the same time securing greater accuracy. After the carrier level has been set, no additional amplification is necessary for measuring the audio component of the signal. There can be no error due to a change in amplification.

A pentode is used in the meter circuit because the amplification is constant for a normal change in line voltage. Accuracy is not impaired by a change in amplification ahead of the meter tube.

A remote cutoff tube is used in the meter to give a logarithmic scale for carrier voltage, making the R scale as linear as possible. A linear modulation scale was obtained by operating the meter to get full scale deflection from a variation in plate current from 3.5 to 5 ma. The current sensitivity is practically constant over this range.

The 6J7 and 6C5 tubes are required to give sufficient amplification to the i.f. signal from the receiver to operate the meter circuit.

In the original circuit the signal from the receiver was fed directly into the two diodes. The d.c. output of the second diode was then

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amplified sufficiently to excite the meter tube in a direct coupled circuit. This setup had two major faults. The direct coupled amplifier was unstable, and the first diode had to be reversed to read positive and negative peaks. Reversing the diode also reversed the polarity of the contact potential of the diode. This made it necessary to reset the zero adjustments when switching from peaks of one potential to the other.

The final setup uses two amplifiers and two diodes to operate the meter tube. The first amplifier, a 6J7, isolates the modulation meter from the receiver. The input impedance is about one megohm.

Enough gain is obtained by using resistance coupling for the 6J7 but the i.f. transformer is used because it provides a desirable method of reversing the peaks. If the meter is used for high fidelity work, it is absolutely necessary to check the response curve of the i.f. transformer with its load resistance R_3. The curve can be flattened out by adjusting the coupling and reducing R_3. For amateur purposes, any transformer, loaded with the specified resistance, will be sufficiently accurate.

The first diode is used to rectify the carrier voltage. The voltage across R_7 is made up of two components, rectified carrier and audio. C_7 is used to by-pass the carrier. Since the amount of carrier leaking to the second diode caused an error of only one per cent, a low pass filter was considered unnecessary.

S_1, S_2, S_3, and S_4 are sections of a gang switch. The three positions are for setting the carrier level or reading the R scale, for reading average modulation, and for reading peak modulation.

With S_1 closed, the second diode presents very little resistance to the rectified carrier which excites the meter tube. With S_1 open, C_8 provides an open circuit for the rectified carrier. The alternating or audio component is rectified by the second diode which excites the meter tube.

With the gang switch set for average modulation, an audio pulse charges C_9, which then slowly discharges through R_9. This, in conjunction with a sufficiently damped meter, facilitates reading average modulation.

When setting the carrier voltage, or using the R meter, the switch is in position 1. R_{11} and R_{12} act as a shunt so the 0-1 milliammeter will read five ma. full scale. Since R_{10} is large compared with R_{11}, it can be neglected. The meter and shunt are then in series with the meter tube plate. With no signal, the meter should read full scale.

When reading average modulation (position 2), S_3 is open and S_4 is in the center position. The meter circuit is then balanced so a reduction of 1.5 ma. in plate current will give full scale deflection. This circuit not only gives a linear modulation scale as explained before, but also increases the current sensitivity of the meter circuit.

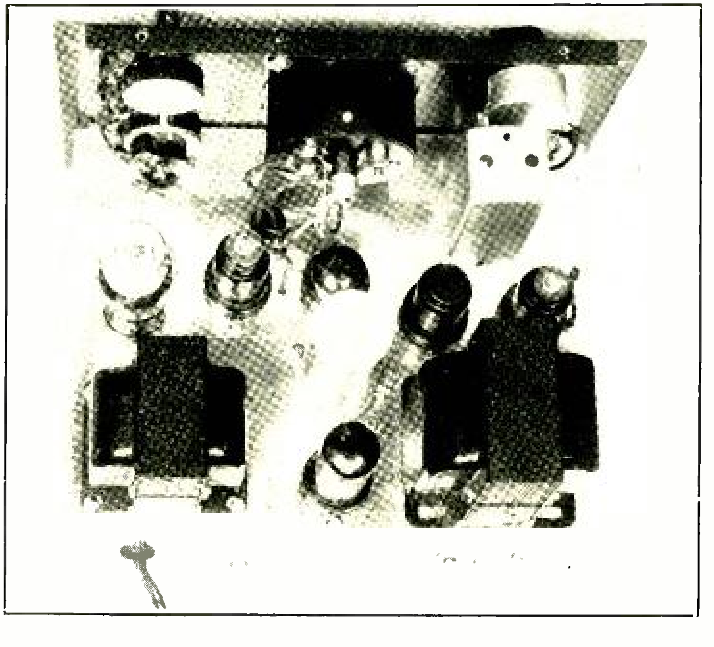


Figure 2. Looking down on the components inside the box.

When reading peak modulation (position 3, to the right) S_3 connects the plate of the meter tube to the grid of the 884. R_{23} is used solely to prevent excessive grid current. S_9, attached to P_5, is closed. Bias for the 884 is obtained across the resistance R_{10}, some of it being balanced out by P_4. A reduction in plate current of the 6K7 reduces the bias to the critical grid voltage and the 884 fires, igniting the neon lamp. P_5, calibrated in per cent modulation, is adjusted until the grid voltage reaches the critical value only on peaks.

Construction

The circuit can be adapted to relay-rack mounting, or to any other type of construction, since it is very versatile. There is one wiring precaution that must be observed: all leads up to and including the diodes should be as short and direct as possible. In some cases it may be necessary to shield some of the plate, grid, or cathode leads, depending upon the operation of the meter in its initial test. This can be determined by connecting any unmodulated signal to the input of the modulation meter. After the zero adjustments have been set, adjust the carrier to the proper level (see "Operation"). Put the gang switch on average modulation. Any deflection observed by throwing the signal switch on and off is due to r.f. leaking to the second diode. For best results, the deflection should be not more than one per cent of the modulation scale.

The model is built into a 10" x 8" x 7" crystal finished cabinet which can be procured from any large wholesale radio concern. The chassis of 43 gauge steel is 9½" wide by 7¾" deep. The four flanges, back, sides, and front are, respectively, 2½", 2¼", and ⅝". The front of the chassis is notched to allow the flanges on the sides of the cabinet to fit behind the panel. The chassis should be sprayed or plated. The model shown is cadmium plated.

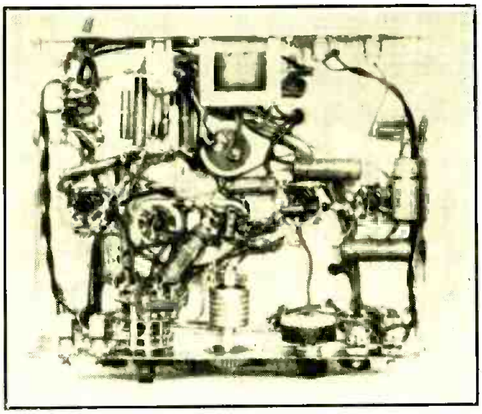


Figure 3. Under-chassis view.

The controls on the front panel are, left to right: top row—carrier zero adjustment P_2, and peak-modulation zero adjustment P_4; second row—average modulation zero adjustment P_3, and the combined per cent peak modulation control and the 884 on-off switch, P_5 and S_9; bottom row—receiver-transmitter switch S_5, positive and negative peak switch S_6, carrier gain control P_1, gang switch S_1, S_2, S_3 and S_4, signal shorting switch S_7, and line on-off switch S_8.

The escutcheon plate from an electric eye unit is used for the neon glow lamp. The mounting is made of parts of a standard light socket and a small piece of bakelite as shown in figure 3.

The Beede meter (Model 2, 0-1 ma., translucent dial) was found to be sufficiently accurate. It is damped enough to prevent excessive overthrow without being too sluggish to miss peaks of relatively short duration. The pilot light is mounted on one of the meter lugs. It is insulated from the lug by mounting a metal strip on a small piece of bakelite bolted to the lug. The pilot light socket slips over the metal strip, making it easy to change the light if necessary.

Potentiometers P_1, P_3, P_4, and P_5 are Centralab Standard Radiohm type with no. 1 taper. S_9 is attached to P_5. P_2 can be any ½-watt, 200-ohm, wirewound potentiometer.

S_5, S_6, S_7, and S_8 are H & H toggle switches. S_1, S_2, S_3 and S_4 is a four-section, non-shorting, gang switch cut down to two sections, four poles. Any four-pole, three position, non-shorting switch will do the job.

Mounted on the back of the chassis are, left to right, figure 2: earphone jack, female Delco-Remy (auto-antenna type connector) for the transmitter connection (insulated from the chassis), and a Delco-Remy for the receiver connection.

Figure 2 shows the layout above the chassis. The tubes, left to right, are: 884, 6K7, 6H6, 6C5, and 6J7. The 5W4 and dual filter condenser are mounted between the two transformers. The 884 transformer is on the left. The i.f. transformer is mounted in front of and between the 6C5 and 6J7.

The power supply transformer, T_1, can be any transformer with 350-0-350 volts at 50 ma., 6.3 volts at 1.2 amps., and 5.0 volts at 1.5 amps. The 884 transformer T_2 may be any small 6.3-volt transformer with 300 volts each side of center tap. The current drain is approximately 15 ma.

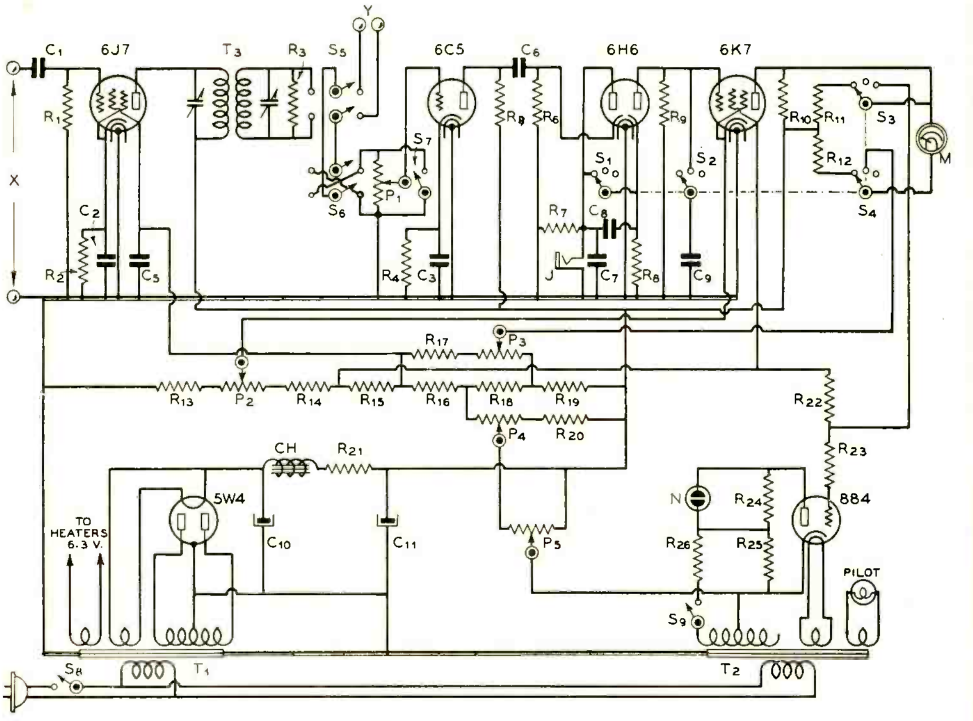


Figure 4. Schematic diagram of the dual modulation indicator.

C_1—.00005-µfd. mica
C_2, C_3, C_4, C_5—.05-µfd. 400-volt tubular
C_6, C_7—.00025-µfd. mica
C_8, C_9—0.1-µfd. 400-volt tubular
C_{10}, C_{11}—8-µfd. 450-volt elect.
R_1—1.0 megohm, ½ watt
R_2—4000 ohms, ½ watt
R_3, R_4—10,000 ohms, ½ watt
R_5, R_6—100,000 ohms, ½ watt
R_7—500,000 ohms, ½ watt
R_8—1.0 megohm, ½ watt
R_9—2.0 megohms, ½ watt
R_{10}—20,000 ohms, ½ watt
R_{11}—250 ohms, ½ watt
R_{12}—1000 ohms, ½ watt
R_{13}—150 ohms, ½ watt
R_{14}—6000 ohms, 2 watts
R_{15}—2000 ohms, 1 watt
R_{16}—1000 ohms, ½ watt
R_{17}—10,000 ohms, ½ watt
R_{18}—4000 ohms, 2 watts
R_{19}—6000 ohms, 2 watts
R_{20}—25,000 ohms, ½ watt
R_{21}—4000 ohms, 5 watts
R_{22}—1.0 megohm, ½ watt
R_{23}—25,000 ohms, ½ watt
R_{24}—50,000 ohms, 1 watt
R_{25}—10,000 ohms, 2 watts
R_{26}—15,000 ohms, 2 watts
P_1—250,000-ohm potentiometer
P_2—200-ohm wire-wound pot.
P_3, P_4—10,000-ohm potentiometer
S_1, S_2, S_3, S_4—4-pole, 3-position gang switch
S_5, S_6—D.p.d.t. toggle switches
S_7, S_8—S.p.s.t. toggle switches
S_9—S.p.s.t. switch on P_5
M—0-1 d.c. milliammeter
N—110-volt, ½-watt neon lamp
CH — 30-hy. 50-ma. filter choke
T_1, T_2—See text
T_3 — I.f. transformer for frequency of receiver — see text
J—Open circuit jack
X—Receiver connection
Y—Transmitter connection

The i.f. transformer was chosen from the author's junk box because it was small in size. The type is not important, except as explained before.

It is suggested that all fixed resistors be IRC type BT. They are accurate to ten per cent and add to the appearance of the chassis. Any good grade mica condensers can be used although leakage and the effect of humidity will be less with the ceramic type. Any low-leakage and moisture-proof paper condensers can be used.

As many as possible of the filament and power supply leads should be connected before the small resistors and condensers are wired.

Shielded wire should be used to connect S_7.

As shown in figure 3, the bleeder resistances are mounted on two five-lug terminal strips. The remainder of the resistors and all the fixed condensers are mounted where most convenient and where the leads are the shortest. In some cases, socket lugs that are not used for tube connections are used for connection junctions. For instance, R_{17} is connected to the bleeder terminal strip and then to lug no. 3 on the rectifier socket. The lug is then connected to P_3, on the panel. C_8 and C_9 are connected directly to the gang switch, thus shortening the leads to only one-half inch.

The filter choke is mounted on the back of the chassis between the jack and Delco-Remy connector. It should not be mounted until the 5W4 has been wired.

Operation

The modulation meter should be placed as close to the receiver as possible so that the lead to the receiver can be made short. Connect a twisted pair, or a shielded cable of ten micromicrofarads or less per foot, from the hot side of the secondary of the output i.f. transformer to the chassis. This can be done by installing a Delco-Remy connector in the receiver or by using some kind of an adapter on the second detector tube. The other end of the cable is plugged into the Delco-Remy on the back of the chassis.

After this connection is made, the trimmer on the output side of the i.f. transformer will have to be re-peaked. If it won't peak, the capacitance of the cable is too high. The cable will have to be shortened or a lower capacitance cable will have to be substituted.

If the receiver does not have a potentiometer in the antenna circuit, one will have to be installed in or external to the receiver. Since the type of control used depends upon the type of antenna, the choice must be left to the operator. If an antenna is used with ground, a 10,000-ohm potentiometer should be connected from the antenna to ground. The movable arm is connected to the antenna post on the receiver, and the ground is connected to the ground post.

The connection from the transmitter to the modulation meter depends to a great extent upon the power output and output circuit of the transmitter. The best method will have to be determined by the operator.

In some cases, where the transmitter is close enough to the meter, a pickup coil, coupled to the plate tank or antenna circuit, with a sufficient number of turns to give the required voltage, can be used. In other cases, two lengths of wire from three to six feet long connected to the Delco-Remy will be sufficient. It may be necessary to use a tuned circuit coupled with small links and a low impedance line to the plate tank.

With either the transmitter or receiver connected to the modulation meter, the carrier level should remain constant when switching from peaks of one polarity to the other. In order to make this possible, it may be necessary to balance the coupling from transmitter to meter, and to place a static shield between the windings in the i.f. transformer in the meter.

There is only one difference between monitoring received signals and monitoring signals from the transmitter. The operations for the transmitter will be discussed first. The variation for received signals will then be added.

Adjustments for Monitoring the Transmitter

With the receiver-transmitter switch on transmitter, and the signal shorting switch closed, set the zero adjustments for carrier and average modulation so that the meter will read maximum with the gang switch in the respective positions. Now, with the gang switch on peak modulation and the peak modulation control on zero, set the peak zero adjustment until the neon lamp just starts to flash.

Open the signal shorting switch and put the gang switch on carrier. Adjust the carrier gain control until the meter is set on the mark S (see "Calibration"). Put the gang switch on average modulation and read the per cent modulation as the transmitter is modulated. To read peak modulation, put the gang switch on peak modulation, and set the peak control at the point where the neon lamp flashes only on infrequent peaks. The reading on the peak control will give the peak modulation.

For monitoring received signals, the carrier gain control should be set on maximum, and the potentiometer in the antenna circuit should be used to set the carrier level to the mark S.

Checking Received Signals

The new feature to this modulation meter was based on the idea that the modulation factor would not be changed from the time a signal entered the receiver to the time it reached the meter tube. This was found to be true only when the carrier level was less than a maximum value. The potentiometer in the antenna circuit is used to keep the carrier level in the receiver and modulation meter at the same level while monitoring signals.

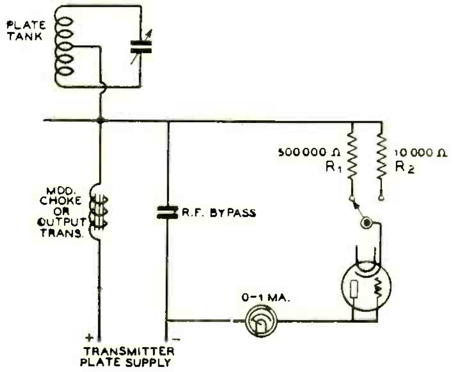


Figure 5. Connections for reverse diode indicator of 100 per cent modulation on negative peaks.

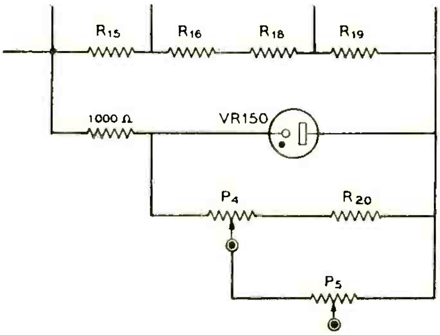


Figure 6. Optional connections for the use of VR-150-30 voltage regulator in the potential divider circuit of the modulation indicator.

The modulation meter works equally well on receivers with or without a.v.c. Since the level at which the receiver works is low, the a.v.c. has little effect.

To use the R meter, turn the antenna potentiometer to maximum and set the carrier gain control to the white mark (see "Calibration").

Calibration

The only equipment necessary to calibrate this meter is a transmitter connected to a dummy antenna with the modulated amplifier operating true class C, an audio oscillator with fairly good sine wave output, and a device for indicating 100% modulation.

If an oscilloscope is not available, the reverse diode circuit in figure 5 is suggested for indicating 100% modulation. The reverse diode is connected in the circuit where the audio voltage is superimposed on the d.c. plate voltage of the modulated amplifier. The diode should have a voltage rating equal to twice the d.c. voltage. R_1 is used for initial modulation adjustments and R_2 for fine adjustment. The audio gain control should be turned up or down to the point where the meter is on the verge of drawing current. At this point, the peak audio voltage is equal to the applied d.c. voltage, and the modulation is 100%.

PERCENT MODULATION	DEFLECTION MILLIAMPERES	"R" STRENGTH	DEFLECTION MILLIAMPERES
0	1.000	2	.977
20	.872	3	.950
40	.752	4	.900
60	.628	5	.811
80	.504	6	.668
100	.380	7	.482
120	.256	8	.300
140	.132	9	.970
160	.008	CAL. SETTING	.540

Chart I
Meter dial calibration values.

The meter dial on the model was calibrated with an oscilloscope connected to the transmitter which was modulated at 1000 c.p.s. Since the calibration of the meter dial depends only upon the type of meter tube and to a very small degree on the approximate voltages, the calibration will be the same despite slight variations in circuit constants.

The first step is to calibrate the meter dial as shown in Chart I. The first column shows the position (expressed in ma.) of the graduation shown in the second column. The mark S should be left off. Blank dials may be obtained from the manufacturer of the meter.

With the transmitter modulated 100%, the zero adjustments set, and the gang switch on average modulation, turn up the carrier gain control until the meter shows 100% modulation. Put the gang switch on carrier and the meter will indicate the position for the mark S. This procedure should be repeated a number of times, checking the zero adjustments each time. Use the average value of the indications.

Place a blank piece of paper behind the bar knob on the peak modulation control. With the peak control turned to the left so the switch is off, mark the paper, for future reference, at the position of the bar knob. Turn the knob until the switch snaps on and advance it about 20 degrees farther. Put a mark on the paper at this position and mark it zero. With the peak modulation control on zero, and the signal shorted, set the peak zero adjustment until the neon light just starts to flash. Modulate the transmitter 50%, for example, by measuring the modulation with the average modulation indicator.

[*Continued on Page 76*]

56 and 28 Mc.

RESONANT LINE CONVERTER

By VICTOR REUBHAUSEN,* W9QDA

After reading about very short concentric lines used as resonant circuits[1], it was decided to build up an acorn tube converter with a short pipe extending out the back. A comparison of the finished article with the 1852 converter previously in use at W9QDA for ten-meter work indicates that the sensitivity is better and the signal-to-set-noise ratio is very much improved. The work was well justified, and even with the acorn tube, the cost compares favorably with the old 1852 job with its r.f. stage.

The tuning capacity charts shown in the February article[1] are theoretical, not experimental. Considerable reliance in the theory is justified by the fact that transmission lines are now being used as standards for measuring reactance and resistance at ultra-high frequencies. However, there are available several checks on the calculations. The lines in the W9GFZ 160-megacycle receiver[2] act like they are 2.2 centimeters (0.87 inch) longer than indicated by the estimated capacity across them—a reasonable difference, accounted for by the inductance of the shorting disk, the tube, and the condenser. The 8⅜ inch lines in a Civil Aeronautics Authority receiver on 75 megacycles show an error amounting to 1.66 inches of line, part of which may have been caused by the coupling and indicating system used in the experiment, inasmuch as the test was made with a separate line not in the receiver at the time.

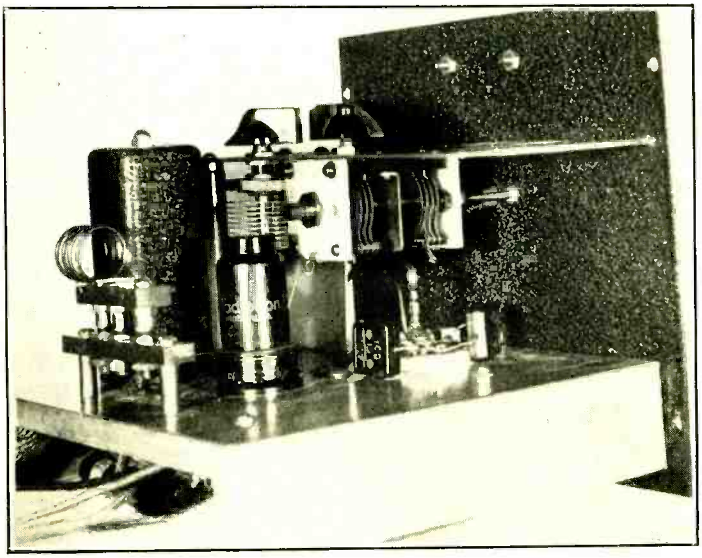
Selection of Line Dimensions

With a line effectively 15 inches long, a lot of capacity is necessary in order to tune it to 28 Mc. unless a very small inner conductor is

* 7434 No. Oakley Avenue, Chicago, Ill.

[1] E. H. Conklin, "Superhet Tracking at Ultra-High Frequencies," RADIO, February, 1940, p. 11.

[2] Reber and Conklin, "An Improved U.H.F. Receiver," RADIO, January, 1939, p. 17.



Rear three-quarter view of the u.h.f. converter. The resonant line has been removed so that the other elements of the circuit can be seen.

used. Starting with an estimate of 10 $\mu\mu$fd. minimum capacity, a 15-inch line's characteristic impedance cannot exceed 114.3 ohms to get down to 120 Mc., calling for a conductor ratio not to exceed 22-to-1. But such a line would require a capacity of 190 $\mu\mu$fd. to get to 30 Mc.!

A 228-ohm line, calling for a 45-to-1 ratio of conductor diameters would require 95.2 $\mu\mu$fd. to get to 30 Mc.; this would be provided by a 2⅞ inch outer conductor and a no. 14 wire as the inner conductor. This high line ratio appears to involve a greater sacrifice in Q (selectivity) than in Z_s (sending-end impedance which determines stage gain). The layout, as it evolved, requires long leads which have the effect of lengthening the concentric line and reducing the needed tuning capacity; for that reason, no. 12 wire is used as the inner conductor. The larger diameter together with the fact that the pipe is actually only 13 inches long, increase the necessary tuning capacity and more or less compensate for the lead length.

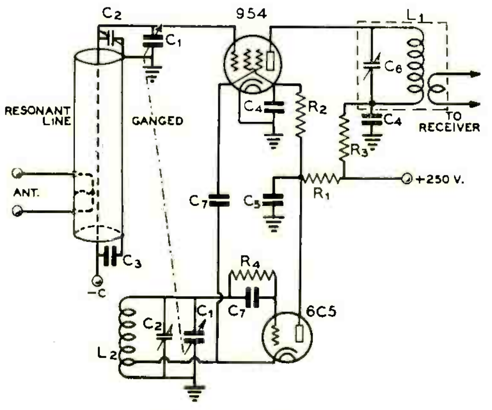


Figure 1. Schematic of the acorn-resonant-line converter.

- C_1 — 100-$\mu\mu$fd. midget variable
- C_2 — Dual 15-$\mu\mu$fd. variable
- C_3, C_4, C_5—.001-μfd. mica
- C_6—Trimmer in i.f. trans.
- C_7—.0001-μfd. mica
- R_1—20,000 ohms, 10 watts
- R_2—50,000 ohms, 1 watt
- R_3—1000 ohms, ½ watt
- R_4—60,000 ohms, ½ watt
- Resonant line — Copper pipe 13 inches long, 2⅞" dia.
- L_1 — Rewound i.f. trans.—see text
- L_2—5 turns ½" dia., tap 1 turn from gnd. end

Construction

A 13-inch cylinder was made up from 24-gauge copper sheet. It has an inside diameter of 2⅞ inches and plenty of strength for the job. The metal cost was around 30 cents, comparing favorably with the cost of hardware and insulation ordinarily used in a receiver. The inner conductor is insulated and by-passed at the shorting disk where bias may be applied, thus eliminating the cathode resistor by-pass condenser which often causes instability in h.f. amplifiers.

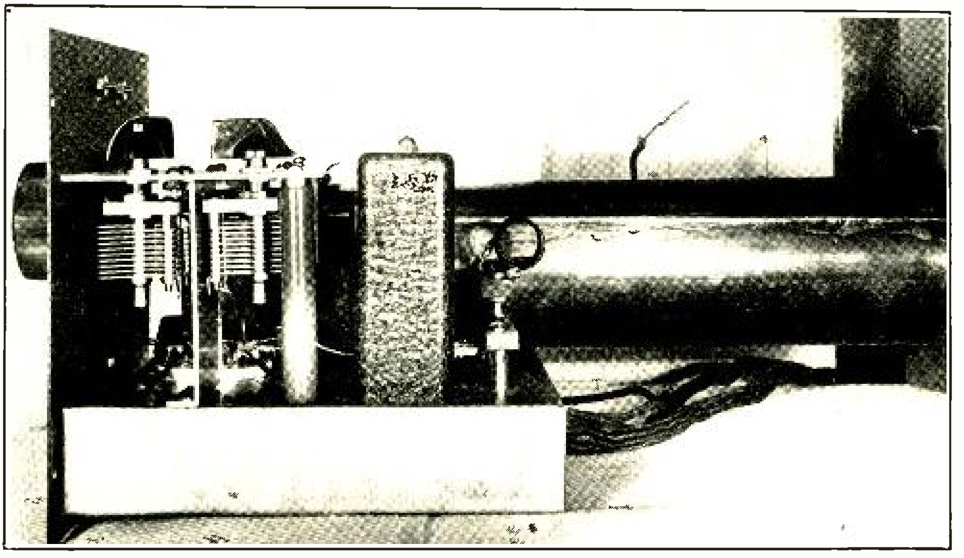
A small cabinet provides enough space for the mixer and oscillator. A 3-inch hole cut in the back passes the pipe. Two 100 $\mu\mu$fd. padding condensers are mounted near the ganged tuning condenser. This condenser, originally a 25 $\mu\mu$fd. two gang midget, has had one plate removed to make it into a standard 15 $\mu\mu$fd. condenser. It is the only thing mounted on the front panel. The acorn socket, i.f. transformer, oscillator tube and coil are mounted on the chassis that comes with the cabinet.

Parts should be mounted rigidly, and a copper ground should be run between them instead of relying on the conductivity of the panel or chassis.

The prongs of the acorn tube should be cleaned carefully with emery cloth to assure good contact with the socket clips (be careful not to scratch the glass with the emery cloth). The tube should be put in the socket with very light pressure on the bulb, by opening the socket clips one at a time with a screw driver so that the tube leads can drop in place. Plate voltage should not exceed 250, and screen voltage 100. At least three volts negative on the control grid should always be provided. With care in these matters, acorn tubes will last a good long time.

The oscillator is standard; a resonant line in it would give only the promise of better stability, but it is satisfactory with a coil down to 60 megacycles, possibly because of the size of the padding condenser. Suppressor injection is used, connected to the oscillator coil at the cathode tap.

Figure 1 shows the circuit used. A cathode bias resistor of 20,000 ohms, by-passed with a physically small mica condenser mounted close to the tube, has been tried with the inner conductor connected directly to the shorting disk. On ten meters, it worked satisfactorily. Inasmuch as the by-pass condenser may have too much inductance in it to be effective at ultra-high frequencies, the optional d.c. bias method was provided in case operation at 2½ meters should require it. Also, with either kind of bias, a "safety" grid leak resistance to protect the tube from the transmitter's r.f. can be placed between the by-passed end of the inner conductor and ground or the d.c. bias source. However, if any



Side view of the converter with the resonant line in place.

oscillator output leaks into the control grid circuit, the resistor will raise the bias and reduce the gain unless the d.c. bias is reduced a corresponding amount. Three volts of d.c. bias should be used to protect the tube from too heavy a cathode current in the absence of oscillator output.

A condenser in the suppressor lead was tried, with and without a resistor from suppressor to ground. Ten volts negative was tried in series with the resistor on the theory that the oscillator should not be allowed to drive the suppressor positive. However, it was found that even with no positive injection, the leakage to the control grid circuit was adequate injection. With the mixer grid circuit properly isolated from the plate and oscillator circuits by the chassis or a shield, a connection between the oscillator and mixer grid will probably be required.

Inasmuch as cut-off bias is used, the oscillator output should be adjusted for a mixer plate current of 0.1 ma. The oscillator output can be controlled with a grid leak, plate voltage, cathode or suppressor tap. Altogether too many receivers in use probably have never been checked for adequate mixer injection, the lack of which is often the cause of an apparently high noise level on the highest frequency bands, resulting in low gain and an attempt to recover it by running up i.f. or audio gain, thus amplifying tube noise. An acorn or HY615 tube should produce more stable oscillations, but the 6C5 has been satisfactory so far.

The i.f. output transformer is a standard one with the secondary removed and replaced with a low-impedance winding of six to twelve turns to match the receiver input. This converter is used with a receiver tuned to 1500 kc., but the low gain of many receivers at this frequency may make it desirable to shift to 1800 or 2000 kc., while even higher frequencies would be very satisfactory. The higher i.f. should make tracking somewhat more difficult but no trouble from this has been encountered by the author. The grid line has proved sufficiently selective so that images are definitely reduced compared with the 1852 converter and fall outside of the ten meter band with an i.f. above 1000 kc. The grid circuit becomes *more* selective at five meters.

Alignment

An effective way to align the converter is with the help of an oscillator or crystal harmonic used as a signal generator. A signal on the band can also be used but generally gives very little time for adjustments. If a ten-meter receiver is available, it can be used to set the converter oscillator to the band. Because most receivers use an oscillator on the high frequency side of the signal, the receiver can be set at 28 Mc. and the converter oscillator tuned so as to be heard in the receiver, using

[*Continued on Page 70*]

New X-H Dimensions

A more symmetrical current distribution and a flatter transmission line result when the length of the phasing section of an X-H array is increased slightly over the values originally given.

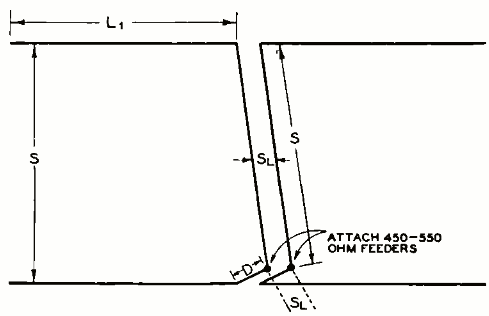
Subsequent tests since the original article on the expanded "Lazy H" array* indicate that a worthwhile increase in performance results when the length of the phasing section is increased slightly. This complicates the mechanical problems somewhat, because the spacing between upper and lower elements must not exceed the value originally given, but the resulting improvement is definitely worth while.

It will be noted from the table of dimensions that the length of the radiators and the *spacing between them* has not been altered. The only change that need be made in an existing X-H is to lengthen the phasing section by about 11 per cent, leaving the feeders tapped on the phasing section the same distance from the top as before.

To keep the phasing section from flopping around in the wind, it should be pulled away from the array by means of the feed line. The schematic diagram gives the impression that the phasing section is pulled to one side, because of lack of perspective in such a drawing. In actual practice the stub should be pulled in such a manner that the phasing section is still at *right angles to the radiating elements*. The feeders need not be pulled tight, but just enough to keep the phasing section from whipping excessively in the wind.

For the benefit of those desiring to erect an X-H and not having the original article to hand, the following recapitulation is given.

An X-H array is an expanded version of the popular "Lazy H" array, also known as "four half waves in phase." The X-H provides slightly greater directivity in both a horizontal and vertical plane and consequently has greater gain, but has low-magnitude parasitic lobes not present with a conventional "Lazy H.". The array is bi-directional, in a broadside direction. The radiation resistance is high, which means that one can be used successfully over the whole 14-Mc. band if cut for the center.



28–29 Mc.	$L_1 = 21\frac{1}{2}'$	$D = 3'$	$S = 24'$
28.5–29.5 Mc.	$L_1 = 21\frac{1}{4}'$	$D = 2\frac{3}{4}'$	$S = 24'$

S_L = $1\frac{1}{2}''$ OR 2" FOR 112 MC.
2" OR 4" FOR 56 MC.
4" FOR 28 MC.
4" OR 6" FOR 14 MC.

THIS ARRAY MAY BE USED ON HALF (NOT TWICE) FREQUENCY WITH GOOD RESULTS. NO CHANGES ARE REQUIRED.

The biggest advantage of the X-H array is the fact that it requires no matching stub for an untuned transmission line, and that it can be used with good results on the next *lower* frequency band. Thus a 28-Mc. X-H array can be used on 14 Mc. with only a moderate reduction in gain and directivity.

With a line of 450 to 550 ohms, the standing wave ratio (current excursions) will be very low on the higher frequency band, and will be about 2/1, when the array is used at half frequency. If a slight amount of reactance appears at the transmitter end of the line at half frequency and is found objectionable, the reactance can be eliminated by making the line an integral number of half waves long, and then lengthening or shortening it a small amount until all reactance is eliminated.

On 112 Mc., polystyrene or Lucite spreaders and insulators will be found superior to ceramic ones, though the actual difference will be small unless the line is unusually long.

* Smith, "The X-H Array," RADIO, July, 1939.

A 913 Frequency Meter Modulation Monitor

By ROBERT E. BAIRD,* W7CSD

If one is to use a v.f. oscillator for transmitter control the first essential is a good frequency meter. We have seen several varieties of frequency meters published from time to time, all of which have certain advantages and certain disadvantages. The chief disadvantage is that of calibration and the dependence upon the correctness of that calibration over a period of time. Also some of these frequency meters run into a considerable outlay of cash.

It has long been known that if an a.c. voltage of frequency F is applied to one set of plates of an oscillograph and another frequency any multiple of F is applied to the other set of plates a clear stationary waveform will result. If both frequencies are F the figure will vary from a straight line to a circle, depending upon the phase. The second harmonic forms a figure 8, the third a figure with three humps, and so on down. Each harmonic will give a clear pattern and in between there will just be a green field such as that observed with an unmodulated carrier. The fiftieth harmonic will, however, be just as clear cut as the second or any other.

The frequency meter brought forth in this article employs the above mentioned principle. A small electron-coupled oscillator covering the broadcast band furnishes the signal to one set of plates on the 913. The other set of plates is coupled to the final amplifier of the transmitter which uses a v.f. oscillator for frequency control. The oscillator in the broadcast band is heterodyned against a broadcast station tuned in on the station's broadcast receiver. This can be done down to about 20 cycles of the broadcast signal by ear. The transmitter may then be tuned to any harmonic of the broadcast signal by observing the 913. It is necessary to know the approximate frequency of the transmitter in order to

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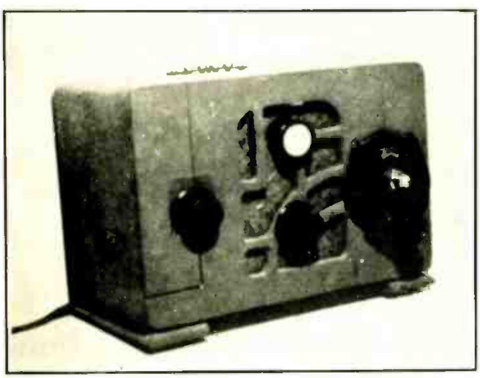
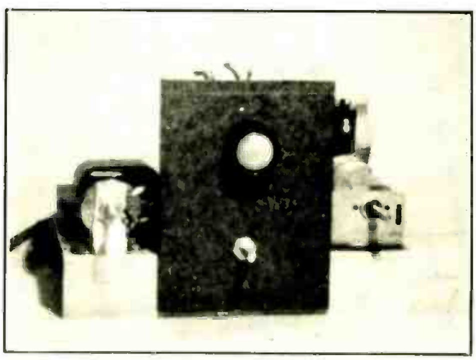
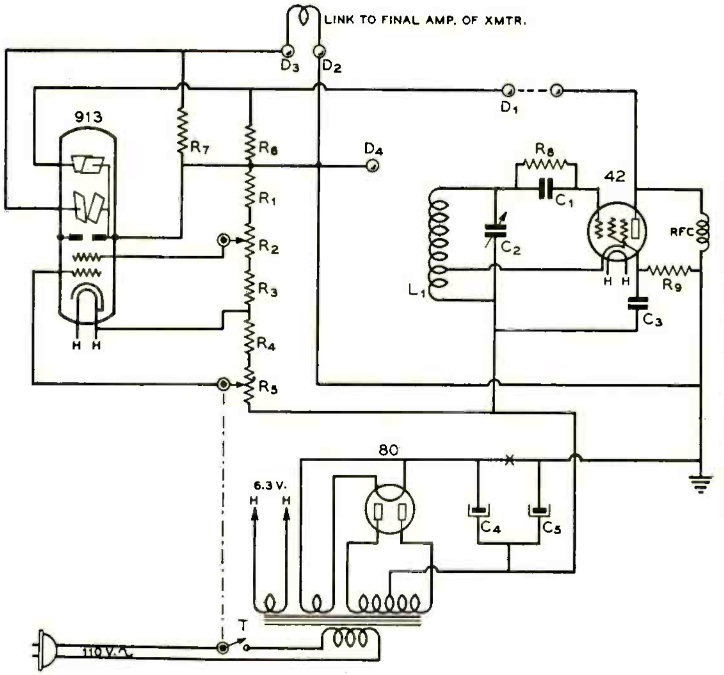


Front view of the revamped midget-set oscilloscope which is used both as a frequency meter and modulation monitor. Note the viewing end of the 913 tube protruding through the former speaker grille.



The chassis of the frequency-meter modulation monitor. Note that the 913 tube and its intensity control are mounted upon a masonite panel which has been bolted to the chassis in place of the speaker.

C_1—.0001-µfd. mica
C_2—Original tuning condenser
C_3—0.1-µfd. 400-volt tubular
C_4, C_5—Original 8-8-µfd. elect.
R_1—100,000 ohms, 1 watt
R_2—50,000-ohm potentiometer
R_3—1500 ohms, 1 watt
R_4—500 ohms, 1 watt
R_5—12,500-ohm potentiometer
R_6, R_7—50,000 ohms, 1 watt
R_8—200,000 ohms, 1 watt
R_9—50,000 ohms, 1 watt
L_1—Original detector coil, tapped—see text
X—No choke because speaker field removed
RFC—3.5-mh. single-pie



Wiring diagram of the 913 frequency monitor.

know on which harmonic it is operating. This can be done with almost any type of communication receiver.

For example, let us assume that we want a spot frequency in the ten-meter phone band. We find then that the 40th harmonic of a broadcast station on 720 kc. is 28,800 kc. and the 41st harmonic is 29,520 kc. This will give us two spot frequencies in the ten-meter phone band.

Construction

The frequency meter described herein was constructed with a minimum of expense. A midget broadcast set was obtained for less than a dollar because the speaker was inoperative. The power supply and other parts were still in workable condition, however. The speaker was removed and a 913 tube mounted in a piece of masonite took its place.

The 50,000-ohm potentiometer R_2 was the only additional part placed on the front panel. R_4 was the previous volume control and it happened to be 12,500 ohms. A 25,000-ohm potentiometer might be better but this serves all right for our purpose. The only other parts that were needed were R_1, R_3, R_5 R_6 and R_7.

The midget set was rebuilt using a 42 electron-coupled oscillator in the previous detector socket. The coil is the previous detector coil tapped one third of the way up from ground. The grid leak for the oscillator was taken out of the grid circuit of the audio stage of the set and is somewhere in the neighborhood of 200,000 ohms. The same tuning condenser is used, but it will be found necessary to have some kind of a vernier dial on the condenser as it is impossible to tune close enough to zero beat with a plain knob.

The cathode-ray tube is wired conventionally; for detailed information on its operation see the RADIO HANDBOOK. Inasmuch as the 913 is connected to the positive high voltage on the shell, it is necessary to insulate it from the negative chassis. The shell of the 913 should be grounded to the common ground lead of the station. The 913 was insulated from chassis simply by twisting a piece of spaghetti-covered heavy wire around the base and bolting the wire to the chassis—the masonite holds up the front end of the tube. The terminal strip on top of the cabinet brings out the leads to the deflector plates.

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A GENERAL COVERAGE CONVERTER

For Specialized Receivers

By E. H. CONKLIN,* W9BNX

In choosing a new receiver, did you ever pause because of an occasional desire to listen on frequencies not covered by the model that you most wanted? You need not have done so. Even if your main interest lies in amateur bands only, or in five and ten meters, a specialized receiver may be purchased. It can be used later on broadcast and other frequencies with the help of an inexpensive converter or "inverter."

The fact that the general coverage type is not a necessity for occasional use, was amply demonstrated one time when a local five-meter test oscillator brought broadcast stations in on a five-meter receiver better than the family b.c. set did. Subsequently it was decided to junk a regenerative receiver for Navy drills and broadcast use in favor of a one-tube "inverter" working into an amateur band receiver as an intermediate frequency amplifier. The bill of material was small, requiring only an inexpensive set of plug-in coils, tuning condensers, a tube and a few small parts.

* Associate Editor, RADIO.

Frequency Range

Some combinations of oscillator and intermediate frequencies in kilocycles are listed below:

7 Mc. I.F.

Antenna	*Oscillator*
100- 550 kc.	7100- 7550 kc.
550- 1500	7550- 8500
1500- 2000	8500- 9000
2000- 3500	9000-10500
3500- 4000	10500-11000
4000- 7000	11000-14000

3.5 Mc. I.F.

Antenna	*Oscillator*
100- 550 kc.	3600- 4050 kc.
550- 1500	4050- 5000
1500- 2000	5000- 5500
2000- 3500	5500- 7000
4000- 7000	7500-10500
7000-14000	10500-17500

It will be seen that with the oscillator frequency above the i.f., images and oscillator second harmonic beats fall at very high frequencies where they cause no trouble at all.

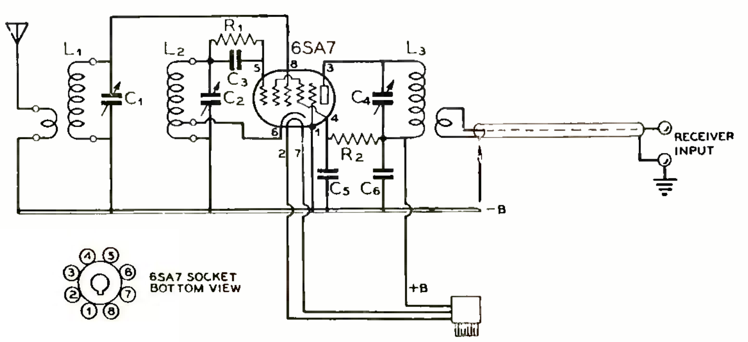

Figure 1. Wiring diagram of the frequency "inverter."

C_1—140-μμfd. midget variable
C_2—100-μμfd. midget variable
C_3—.00005-μfd. midget mica
C_4—70-μμfd. mica trimmer
C_5, C_6—.01-μfd. 400-volt tubular
R_1—20,000 ohms, ½ watt
R_2—20,000 ohms, 2 watts
L_1—80, 160, and b.c. four-prong pre-wound plug-in coils
L_2—20-meter plug-in coil
L_3—40-meter plug-in coil

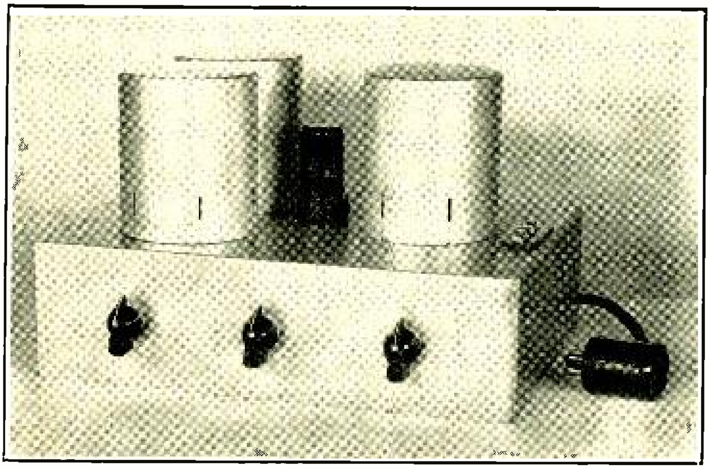

Figure 2. The specialized to general coverage converter or "inverter." The three large shield cans house the plug-in mixer, oscillator, and output coils.

The oscillator can be below the i.f. if the i.f. is so high that the oscillator second harmonic does not cause additional signals to come through. That is, if a 3-Mc. oscillator converts a 4-Mc. signal to 7 Mc., interference may be heard from a 1-Mc. broadcast signal heterodyned by the 6-Mc. second harmonic of the oscillator.

Construction

Any standard circuit can be used, with or without a separate oscillator tube. An old 57 as a mixer and 56 as an oscillator will be satisfactory. Figure 1 shows the connections for a single-ended 6SA7 used as a converter. This tube oscillates with the cathode above ground, all other elements acting like a grounded plate.

Figure 2 shows a completed inverter using standard prewound four-prong plug-in coils. The middle knob has been replaced with a power and antenna switch since the photograph was taken. Space could have been saved by omitting the coil shields, and by winding small oscillator and plate coils to go underneath the chassis. The grid coil, however, should be plug-in if the broadcast, 160 and 80 meter bands are to be covered with factory-wound coils. These ranges overlap using a 140-$\mu\mu$fd. tuning condenser, and are just about covered with 100 $\mu\mu$fd.

The plate coil is a 40-meter plug-in that came with an inexpensive coil set. It is tuned to the i.f. with a 70 $\mu\mu$fd. mica trimmer. The antenna or regeneration winding is suitable to couple the converter output to the receiver. Flexible shield braid can be used to cover the leads to the receiver input in order to reduce the probability of picking up a 7-Mc. signal on them.

The only coil left in the coil set is that for 20 meters. It can be used in the oscillator by wiring its socket to connect both windings in series, using the junction for the cathode tap. A 100-$\mu\mu$fd. condenser will cover the full range. If a coil is not available for this position, one can be wound with about 17 turns of no. 22 on a 1-inch form, tapped at the second turn. This will cover the range with about 60-$\mu\mu$fd. of condenser, and will bring in signals from the broadcast through 4 Mc. even with a smaller condenser if the number of turns is carefully adjusted so as to oscillate from 7.5 to 11 Mc. The number of turns is correct for a 7-Mc. i.f. when the oscillator, with its condenser all the way in, blocks the receiver when tuned just outside 7.3 Mc.

Filament and plate power are taken from the receiver's power tube socket with a tube adapter using an octal socket and octal plug. The plug and socket are wired straight through, with the converter power cord connected to the filament and screen leads. The negative in this case comes through the grounded shield braid. If the oscillator has hand capacity or is unstable, a separate ground lead may have to be run from the converter chassis to the receiver.

Operation

There is very little work in adjusting a simple converter. The plate circuit is tuned so as to bring the noise level up when the receiver is set at 7 Mc. With the broadcast coil in the grid circuit, the oscillator should bring in broadcast stations if it will cover the range of 7.5 to 8.5 Mc., which should be with the oscillator condenser nearly all in. Signal

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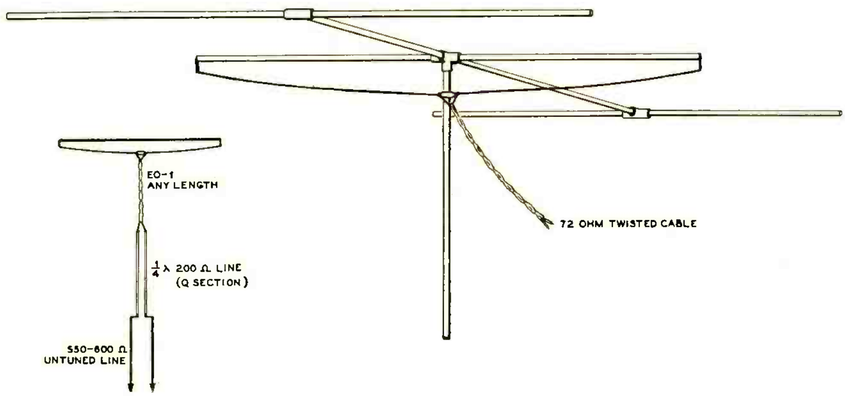

Simple method of feeding the popular, all-pipe version of the three-element close-spaced array. The radiation resistance of the driven element is increased and a better match to the transmission line is obtained. Also, there is no need to keep the feed line from shorting out on the supporting pipe as the array is rotated, as is the case with a delta matched open wire line.

Feeding the "Plumber's Delight"

By W. W. SMITH,* W6BCX

One very popular version of the three-element close-spaced array, especially on 10 meters, is the all-pipe-constructed model variously referred to as the "plumber's delight," the "plumber's beam," and even the "plumber's dream." Almost invariably this array is fed by means of a Y-matched open-wire line, sometimes with slip rings. When slip rings are used, there is no trouble with the feed line shorting against the supporting pipe; but slip rings are not particularly easy to install. When no slip rings are used, the arc of rotation is limited to about 270 or 300 degrees, and even then there is often trouble with the feed line twisting on itself or shorting out against the pipe.

The method of feed shown in the illustration permits full 360 degree rotation, yet no precautions need be taken with the feed line as the EO-1 cable can not only touch but even can be wrapped around the supporting pipe without detrimental effects. Another advantage is that the radiation resistance of the driven element is raised, thus permitting the array to be used over a wider band of frequencies without standing waves appearing on the line.

If the transmitter is not more than a few yards from the base of the array, the line may consist entirely of EO-1 cable, as the losses will be quite low for a *well-matched* 72-ohm twisted line of this length even at 28 Mc. For longer line lengths, the arrangement shown in the inset should be used in order to minimize line losses. Just sufficient twisted cable is used to permit satisfactory rotation. The 72-ohm cable is matched to the open-wire line by means of a quarter-wave "Q" matching section of the type used to match a 550-600 ohm line to a half-wave doublet. The Q section may consist either of parallel close-spaced tubing or of four wires, so long as the surge impedance is close to 200 ohms.

Construction

The array is exactly the same as a regular "plumber's beam" except that the driven element is made about 4 per cent longer than usual and is fed as shown in the illustration. For 28-29 Mc. operation the driven element should be about 17 feet long. To hold the wire away from the pipe and keep it from slapping the ends of the pipe in a heavy wind, two projections are bolted or soldered or brazed to the ends of the pipe to extend downward about 1 or 1½ inches. A piece of No. 12 wire is stretched between these as shown in the illustration, the wire being split in the center with an insulator. The voltage at this point is not high, and most any insulation will

* Editor, RADIO.

be satisfactory. If a porcelain or glass antenna insulator is used, it should be taped to the vertical pipe to prevent its hitting against the pipe and breaking.

Multi-Wire Parasitic Elements

While the two-conductor radiating element raises the radiation resistance of the array and permits use over a wider band of frequencies without the appearance of bad standing waves, the directivity or front-to-back ratio falls off quite badly when the array is not used on the exact frequency for which the parasitic elements were cut.

In an attempt to maintain good directivity over a wider frequency range, the parasitic elements were adorned with wires the same as the driven element, except that the wires were continuous instead of being split for attachment of feeders. The first thing that was noticed was that the parasitic elements had to be lengthened considerably to restore optimum directivity after a parallel wire was added to each parasitic element.

This experimental setup showed slightly less directivity at the peak frequency, due probably to less mutual coupling between the driven element and the parasitic elements, and therefore a smaller proportion of the total element current in the parasitic elements. However, the directivity at a frequency 5 per cent off the peak frequency (frequency for which the parasitic elements were tuned) appeared to be slightly better. Because of the difficulty in adjusting the lengths of the parasitic elements in minute steps when a parallel wire was added to each, nothing conclusive was proved by the tests except that the difference was not enough to get particularly excited about and that single-conductor parasitic elements therefore might just as well be used for the sake of simplicity.

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A SIMPLE Q.A.V.C. SYSTEM

• *Using a Relay for Squelch*

In many applications where a Q.A.V.C. action or "squelch" circuit is desirable in a communications type receiver, the incorporation is not especially easy, because oftentimes the circuit does not lend itself to the necessary circuit changes without making drastic revisions in the existing circuit or tube lineup.

A simple and inexpensive method of squelch that can be applied to most any communications type superheterodyne is that shown in figure 1. The 2500-ohm relay is of the inexpensive type (costing less than $1.00) which normally closes at about 7 ma. and opens at about 5 ma. The points are adjusted to reduce the allowable movement of the armature, so that the armature makes just a perceptible movement. This spacing is sufficient, because the amount of voltage handled by the contacts is very small. When the contacts are so adjusted they close and let go at more nearly the same value of plate current.

The "fixed" cathode bias or the screen voltage on the i.f. tube is then varied until the tube draws 10 ma. plate current when no sig-

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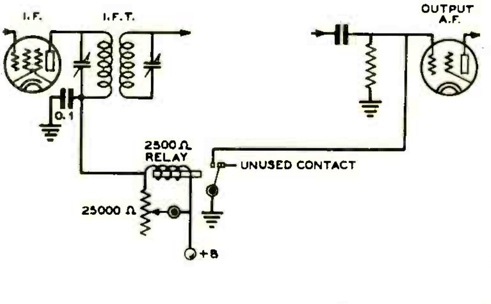


Figure 1. Simple method of obtaining "squelch" action in a communications type superhet. A signal knocks down the plate current to the i.f. tube due to increased bias from the a.v.c. bus, and the decrease in plate current causes the relay to "let go." When the signal is removed, the plate current rises sufficiently to close the contacts, making the a.f. system inoperative.

AUTO-ALARM SYSTEM

• for U. H. F.

By J. EVANS WILLIAMS,* W2BFD

An automatic call system which will signal the station being called even though the operator may not be listening in to the band. The unit features low enough power drain so that it may be left running whenever the operator is at home with negligible expense of operation.

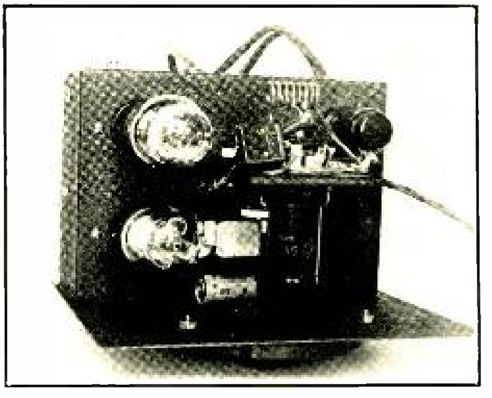
A realization that there is a genuine need for a system permitting amateurs to signal one another even though the one called may not be listening in led the author to make a number of attempts in the past several years to develop such a device.

The earlier efforts were spent on producing a special relay system that could be attached to the receiver in place of the phones or speaker which would actuate a buzzer or bell upon reception of a prearranged signal.

That this in itself is not much of a problem will be attested by visitors to W2BFD who have been shown a "graveyard" of dial pulse operated selectors, tone operated selectors, etc. What is wanted is a practically foolproof call system drawing negligible power even though left running continuously 12 to 24 hours daily. It must be admitted that these requirements cannot be met by any conventional receiver.

There have recently been made available by tube manufacturers, at a price within amateur reach, several types of grid glow tubes among which is the OA4G. This tube is ideally suited to our purpose as it requires no filament heating power, can be triggered by an insignificantly small audio signal to work an inexpensive 25-ma. relay and, best of all, consumes zero power and undergoes no deterioration in the no-signal condition.

Associate this tube with the receiver to be described *which draws only 6.6 watts from the a.c. line* and which finally, by means of a sharply peaked audio stage and a time delay in the relay, will only operate the bell or buzzer alarm upon reception of a signal of proper tone and duration and you have pretty close to the ideal combination. Incidentally, if you leave off the OA4G and relay you still have a good 2½-meter receiver that will operate a p.m. speaker on the louder signals and with phones will bring in anything its bigger brothers can catch.



Top view of the auto-alarm receiver showing the horizontally placed superregenerative detector tube. The midget 2500-ohm control relay can be seen between the detector tube and the 37 rectifier.

The circuit will be recognized as the old familiar self-quenching superregenerative detector followed by a stage of triode audio amplification. The plate supply, which amounts to 4 or 5 milliamperes at 135 volts, is rectified directly from the a.c. line by a 37 tube with the grid and plate tied together. The original intention was to construct it as an a.c.-d.c. receiver but running the filaments in series with the a.c. line through a ballast resistor draws 35 watts to start with. This was prohibitive so the present arrangement

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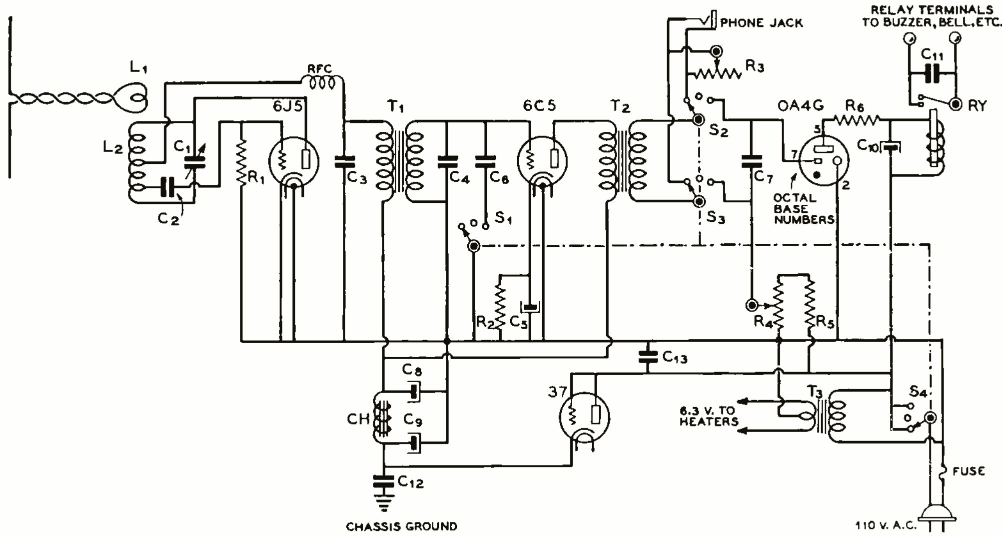
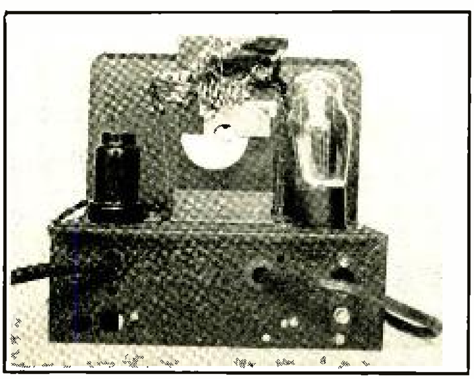


Wiring schematic of the auto-alarm 2½-meter receiver.

C_1 — 2-plate midget variable
C_2—.0001-µfd. midget mica
C_3—.004-µfd. mica
C_4—.0005-µfd. mica
C_5 — 10-µfd. 25-volt elect.
C_6—.003-µfd. mica (see text)
C_7—.002-µfd. mica (see text)
C_8 — 8-µfd. 200-volt elect.
C_9—32-µfd. 200-volt elect.
C_{10}—8-µfd. 150-volt elect.
C_{11}—.006-µfd. mica
C_{12}, C_{13}—.00025-µfd. mica
R_1—50,000 ohms, ½ watt
R_2—1000 ohms, ½ watt
R_3—1.0 megohm tapered pot.
R_4—10,000-ohm potentiometer
R_5—25,000 ohms, 1 watt
R_6—1500 ohms, 1 watt
RFC — Midget u.h.f. choke
L_1—2 turns no. 18, ½" o.d.
L_2—6 turns no. 18, ½" o.d., tapped at center and 1 turn from grid end
T_1, T_2—Small p.p. input trans.
T_3 — Midget 6.3 v., 1.1 a. trans.
CH—Midget a.c.-d.c. filter choke
RY—Small 2500-ohm relay
S_1, S_2, S_3, S_4—4-pole 3-position switch

was decided upon using a transformer for the filaments but not for the plate.



Back view of the auto alarm. The tube on the left is the audio amplifier and the one to the right of the 2½-meter tuned circuit is the OA4G trigger tube.

In order that the danger of grounding (the usual undesirable accompaniment of direct line operation) should not appear, there is no direct connection made to the chassis except through C_{12} which in conjunction with C_{13} serves to remove rectifier hash.

S_1, S_2, S_3, S_4 is a three-position rotary switch. In the center position it breaks the line, turning off the apparatus. Turned to the left it connects the secondary of T_2 to the phone jack and audio volume control R_3. In the right-hand position it connects T_2 to the grid glow tube throwing C_6 and C_7 across the secondaries of T_1 and T_2 resulting in an audio stage with an amazingly sharp peak and an almost complete elimination of the characteristic hiss.

It will be noticed that there is no audio volume control in the circuit when the switch is thrown for relay operation. Sensitivity is controlled by R_4 which places an advance bias on the gas tube. C_{10} determines the relay time

[*Continued on Page* 79]

A Feed System for the Four-Element Beam

By W. B. THOMPSON,* W8OKC

After attempting in vain to apply the matching system for low impedance radiators which employs a delta-matched length of EO-1 to feed a 212-ohm Q which in turn feeds a supposedly flat 600-ohm line, it was found impossible to remove the standing waves completely from the system. The r.f. potential, at a low value where the delta match connects to the radiator, increases gradually along the EO-1 cable and the Q section, resulting in a high value of standing waves on the 600-ohm line. Adjustment of the taps on the delta match didn't seem to help matters a great amount.

It was hence decided to cut the driven element in the center and to use a short section of EO-1 as a Q bar. Due to the decreased velocity of propagation along EO-1 as compared to air, the proper length of the quarter-wave Q section was found to be 5 feet 4 inches for the lower end of the 28-Mc. phone band. In using the arrangement illustrated in figure 1 there will usually be an amount of standing waves remaining on the 600-ohm line inasmuch as it should really have an impedance of 1000 ohms for a perfect match, a value which is impractical. However, the 5-ohm center impedance of the driven radiator is evidently subject to considerable variation, depending upon the height of the beam above ground, the manner in which it is tuned, the proximity of other objects, etc. In one particular case (W6KLU) EO-1 permitted a better match than a regular 50-ohm concentric transformer manufactured especially for the purpose. This would indicate that the actual center resistance was more closely in the order of 8 ohms. Loss of energy in the short length of twisted pair does not seem objectionable, even on 28 Mc.

If standing waves still persist, the chances are the center resistance, being nearer 5 ohms, can be perfectly matched by using the layout shown in figure 2. In this arrangement two EO-1 Q sections are hooked in parallel to feed into a 400-ohm Q section, and thence to the 600-ohm feed line. When rigging up the EO-1 be very sure to maintain correct polarity between the individual wires of each length of EO-1 cable. Polarity may be checked by following the tracers on the wires, by checking with an ohmmeter, or by actually following the wire along the ridges in the short lengths of cable.

The 400-ohm Q section connecting the bottom end of the EO-1 Q bar to the 600-ohm line can be constructed of no. 10 wire spaced 1.5 inches between centers.

* 410 W. Pine St., Shamokin, Pa.

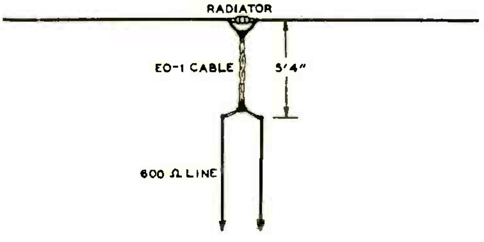


Figure 1. Matching system for use where the center impedance of the driven element approaches 8 ohms, or where a small amount of standing wave can be tolerated on the 600-ohm line to the transmitter.

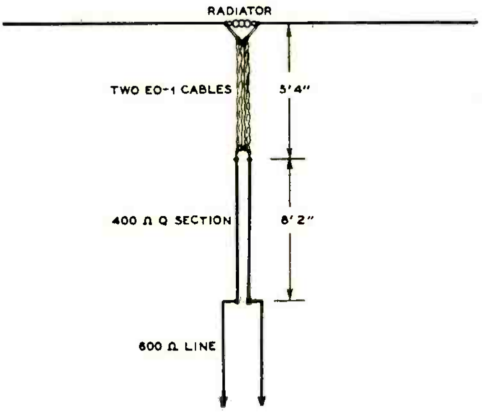


Figure 2. Matching system for use where the center impedance of the driven element is approximately 5 ohms, to give a perfect match to the 600-ohm line. Be sure that the two lengths of EO-1 are paralleled properly; the tracered wires should be connected together at either end of the Q section, and the untracered wires should be connected together at each end.

● RCA's suitcase television equipment shown installed in a UAL flight research plane for a test transmission of television from a moving plane. The mobile television unit, which is to be used for relay purposes, operates on a frequency of approximately 288 Mc.

DEPARTMENTS

"WAZ" HONOR ROLL

CW and PHONE

	Z	C
ON4AU	40	158
G2ZQ	40	147
J5CC	40	130
W8CRA	39	156
W2BHW	39	156
W8BTI	39	154
W1BUX	39	153
W2HHF	39	152
G6WY	39	151
W6CXW	39	150
W6GRL	39	150
W2GT	39	150
W9TJ	39	149
W2GTZ	39	149
W6CUH	39	143
W6KIP	39	143
W8OSL	39	143
W9KG	39	141
W6ADP	39	140
W6BAX	39	140
W8OQF	39	139
W4CBY	39	138
W9TB	39	134
W2ZA	39	134
VK2EO	39	133
G5BD	39	133
W2GVZ	39	132
W6QD	39	132
W4CYU	39	132
W3EVT	39	131
W5KC	39	130
W2GWE	39	129
W6KRI	39	129
VE4RO	39	126
W7BB	39	123
W6HX	39	123
G5BJ	39	120
W2IYO	39	119
W8JSU	39	118
W2CYS	39	117
G2LB	39	115
W4IO	39	115
W7DL	39	115
W2GNQ	39	113
W6FZL	39	112
ON4HS	39	111
ON4FE	39	110
W1AQT	39	110
W6FZY	39	109
W9NRB	39	98
W6SN	39	96
W6GPB	39	94
XE1BT	39	90
K6AKP	39	78
W1CH	38	150
W2GW	38	143
W5VV	38	144
W3HZH	38	139
W3EMM	38	139
W8BKP	38	138
ZL1HY	38	138
W5BB	38	136
W8LEC	38	136
W3EPV	38	136
W9GDH	38	134
W3HXP	38	133
W4FVR	38	130
W9FS	38	130
W3EAV	38	130
W8JMP	38	127
W2GRG	38	127
ON4EY	38	126
W8ZY	38	125
W1ADM	38	125
W3GAU	38	125
W3EVW	38	124
W3GHD	38	121
W8AU	38	120
W8LYQ	38	120
W8DFH	38	119
W9PST	38	119
W8QXT	38	119
W8JIN	38	119
W3FQP	38	119
W8DWV	38	118
W1GDY	38	118
W2BMX	38	118
W1BGC	38	117
W6AM	38	117
LU7AZ	38	116
W3DDM	38	116

	Z	C
W9UQT	38	116
W8MTY	38	114
W9KA	38	114
W6VB	38	113
G6CL	38	112
W8HWE	38	112
G2QT	38	112
W8EUY	38	112
W9CWW	38	112
W9ELX	38	112
W2BXA	38	111
W6GRX	38	111
LY1J	38	110
W1AB	38	110
W6HZT	38	110
W8LFE	38	110
W4MR	38	108
W8KWI	38	108
W3BEN	38	108
W8BOX	38	106
W9ADN	38	106
W8OE	38	106
W9PK	38	105
W8GBF	38	105
ON4UU	38	104
G2IO	38	103
W8BWB	38	98
J2KG	38	95
G6XL	38	95
ON4FQ	38	92
W9VDQ	38	79
SU1WM	37	138
W2BJ	37	134
W6GAL	37	131
W8KKG	37	127
W7AMX	37	125
J2JJ	37	123
W1BXC	37	123
W2IOP	37	122
W1RY	37	120
G6NF	37	115
W8PQQ	37	115
W9RCQ	37	114
W3TR	37	113
ON4FT	37	112
W9RBI	37	112
W6MEK	37	112
W6ADT	37	111
G2MI	37	110
VE2EE	37	108
W4DMB	37	108
W7AYO	37	108
W5ENE	37	107
W3KT	37	105
W6NLZ	37	105
W9PTC	37	103
W6ITH	37	103
W3FJU	37	103
W9GBJ	37	103
G6GH	37	102
W3AYS	37	102
VK2DA	37	101
W6FKZ	37	101
W6JBO	37	101
W8KPB	37	100
W4DMB	37	100
W9AJA	37	99
W4EQK	37	99
ON4VU	37	99
W3EXB	37	98
ZL2CI	37	97
W6MHH	37	95
G2UX	37	91
W2BSR	37	90
W6MCG	37	84
W9UBB	37	77
W8AQT	36	120
W6MVK	36	117
K4FCV	36	109
W8AAJ	36	106
W3GGE	36	106
W6BAM	36	106
W8DOD	36	106
W9AFN	36	105
W5PJ	36	105
W8QDU	36	105
W5ASG	36	104
SP1AR	36	103
W6NNR	36	100
W6KWA	36	99
W8LZK	36	99
G6BJ	36	99
VE1DR	36	98

	Z	C
W9VES	36	98
W8LDR	36	97
W8AAT	36	96
W6DLY	36	96
W9GKS	36	95
G6YR	36	94
W2IZO	36	94
VE5AAD	36	92
W4ADA	36	90
W1APU	36	91
W9LBB	36	90
W8JAH	36	89
OK2HX	36	86
VK2NS	36	84
W6TI	36	80
W6GCX	36	76
W7DSZ	36	73
W2GXH	36	71
W1WV	35	119
W8OXO	35	113
W6GHU	35	103
W4QN	35	103
W9PGS	35	103
W6HJT	35	103
K6NYD	35	100
W8OUK	35	99
W8CJJ	35	98
W2WC	35	98
OK1AW	35	96
W3RT	35	95
W8CLM	35	95
W9EF	35	94
G6QX	35	94
W3DRD	35	93
W6AQJ	35	92
VE5ZM	35	92
LU3DH	35	89
W9GNU	35	88
W9ERU	35	88
K6CGK	35	88
W9VDX	35	86
W6KQK	35	85
W6ONQ	35	83
ON4NC	35	82
GI6TK	35	80
W4ELQ	35	80
W8QIZ	35	78
W6MUS	35	77
W6GK	34	105
W6HEW	34	103
K7FST	34	102
W8CED	34	102
W8BSF	34	100
W1APA	34	98
W2BZB	34	99
W9VKF	34	96
VK2AS	34	94
W8HGA	34	93
W3EYY	34	91
W8NV	34	91
W9MQQ	34	89
W2FLG	34	89
W6TE	34	88
G6WB	34	88
W6CVW	34	88
VK2OQ	34	87
G5VU	34	85
W9BCV	34	83
ZS1CN	34	82
W6PNO	34	82
VK2TF	34	81
W6MJR	34	81
ON4SS	34	80
W6HIP	34	76
VK2TI	34	75
W7AVL	34	75
W8JK	34	75
ZL2VM	34	72
W6LHN	34	71
VK2AGJ	34	70
VK2EG	34	70
VE5MZ	34	69
VK2VN	34	63
W9QOE	34	56
F8XT	33	112
W8ACY	33	106
W3DAJ	33	97
W6KEV	33	96
W8BWC	33	93
W6KUT	33	90
W6CEM	33	88

PHONE

	Z	C
W3LE	38	128
F8UE	38	103
W6OCH	36	107
W6ITH	36	97
W3FJU	36	87
VE1CR	36	81
W9NLP	35	95
W9TIZ	35	93
KA1ME	35	79
F8VC	35	78
W4CYU	34	100
W9ELX	34	86
W1ADM	34	93
ON4HS	34	92
W6EJC	34	84
W7BVO	34	80
W4DAA	34	71
W6NNR	33	92
GM2UU	33	84
F8XT	33	70
W3FAM	33	68
W6MLG	32	97
W8LFE	32	91
W2IKV	32	90
W4DRZ	32	89
W9QI	32	86
W1HKK	32	85
W8QXT	32	85
G5BY	32	85
W9BEU	32	85
VK4JP	32	85
W4DSY	32	84
W6OI	32	83
W9TB	32	82
W6IKQ	32	80
VE1DR	32	59
W3EMM	31	88
W1AKY	31	88
W8LAC	31	85
G6BW	31	83
G3DO	31	78
W1KJJ	31	78
W6FTU	31	77
G8MX	31	73
W8RL	31	71
W9UYB	31	71
W6AM	31	67
F8KI	31	58
W9ZTO	31	53
W4EEE	30	86
W2GW	30	86
W1JCX	30	81
W2IUV	30	79
W2AOG	30	77
W8AAJ	30	77
W9BCV	30	68
W6MZD	30	52
W2IXY	29	93
G6DT	29	83
W4BMR	29	80
K6NYD	29	78
CO2WM	29	78
W9RBI	29	71
W6NLS	29	64
W6NRW	29	60
KA1CS	29	59
W2GRG	28	74
W6PDB	28	65
W7EKA	28	63
VE2EE	28	62
W4DRZ	28	62
W1BLO	28	62
VK2AGU	28	61
W6GCT	28	56
W3EWN	27	93
W2DYR	27	77
W2HCE	27	76
W5CXH	27	52
G5ZJ	26	77
W5ASG	26	62
W8NV	26	62
W5VV	26	61
W4EQK	26	61
W8QDU	26	61
W9NMH	26	61
W5DNV	26	60
VK2OQ	26	56
W4TS	26	54
W6MPS	26	51
VE4SS	26	50
W6FKK	26	47
K6LKN	26	46
G6CL	26	46

DX AND OVERSEAS NEWS

by Herb Becker, W6QD

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

The International DX Contest is well under way and a word or two might be in order. Maybe I should have said one weekend of it is history. One thing seems to be certain, conditions are definitely good, there seems to be no letup in interest although some of the old standbys are not in there. This indicates there are more and more of the newer hams stepping in to fill the gap. It really shows that in spite of the lack of the dx as we knew it before last September the gang will not keep off the air. Competition is competition. For a while it looked as though most of the dx men were through because they couldn't sit down and bat off a couple dozen Europeans, South Africans, and AC4YN thrown in for good measure. The old spirit is there and is surely reflected by the turnout in this contest as well as the "World-Wide DX Contest" sponsored by RADIO last December.

At the time this is being cranked through the mill it appears that the South American phones are turning out in huge numbers. At the same time the c.w. stations are fewer than ever before. It seems that a flock of the LU's have tossed out the key in favor of the mike. The CE's are plentiful on phone. There is one exception to the above statement, there are more PY's on c.w. than have ever been heard before. They are for the most part very good op's and have good signals. It was good to see the old timer LU8BAJ back after an absence of about five years. He will be remembered for having the QSL card resembling a Foster & Kleiser billboard.

OA4U was doing overtime business on c.w. I wonder what has happened to OA4J. CX2AJ springs a surprise by appearing in the band. Another surprise will be had when he appears with a d.c. signal. Maybe next year for that. LU7AZ was splitting a chunk out of the band, or I should say out of three bands. Milo explained hastily, "You see, I am in contest though still married." Next day when on 28 Mc. he said, "I am still in contest and xyl still here." Well, I guess it's the same in LU. Another one going to town was LU9AX. The CM's are back with a vengeance. It seems that the short layoff did them some good. One CM on 14,402 was heard telling another CM who was on 14,412 to get back in the band, and that his crystal wasn't working. Neither was the filter. W6SN bears down the first Friday p.m. with a mighty CQ SS. It's just in Bill's blood and couldn't shake it. Anyway he worked 81 W's, a K6 and J. TI2FG popped out on 28 Mc. and gave the boys (including thisun) a 4-aspirin headache. If anyone can figure out how he tunes he should deserve a few million extra points. The K6's were out in huge numbers. At times it looked as if every other signal on the band was a K6. K6NYD flew over to KE6, Johnston Island, for a few days and thrilled some of the fellows by working them with his portable, K6NYD/KE6. He thrilled W6OEG so much, Bill had no trouble staying awake all night that night . . . this on c.w. Possibly one reason for my mentioning this is that OEG is a member of the S.B.A.A. And you must have heard of the S.B.A.A. Getting back to NYD, he was on phone mostly so some of the gang in this division were equally thrilled.

There was a scarcity of Asians on 10 meters, that is c.w., while the phone boys were more fortunate because of several J's and XU's. XU8AM punches in a nice signal, no fooling. Then there was someone having fun, ZC3C, who should have been on Christmas Island. After a Merry Xmas he signed off. W6SA dropped in just now and cracked, "I suppose that next Sunday being Easter you will work someone on Easter Island." At this point I should start doing a little crowing all on the strength of the 40-meter band. Everyone seems to think the band sounded more like the old times than at any time during the past few years. The J's were certainly plentiful with lots of sock, too. I can just imagine how the VK's, ZL's, South Africans, and Europeans would have poured through on 40 had they still been on the air. Yes sir, 40 meters is quite a band.

Here and There

"Doc" Hector, G8MX, writes that he is in the R.A.F. in the Medical Branch. Occasionally he gets a chance to listen in and claims it's torture to hear the W's rip through on 10. Doc has gone into his old hobby, photography. G5ZJ and G2HK are also in the R.A.F. Bob Dealey, G6DT, states G2TR is with the R.A.F. and G2IS is with the Air Ministry. G6DT hadn't revised his Honor Roll standing for some time so brings it up to September 1. Bob has 29 zones and 83 countries worked on phone.

This is sure a funny world . . . W8ZY, a staunch c.w. man, is now on 160 phone, or maybe I should say was until the contest rolled around. He was in there pitching a little code last weekend so guess he still knows it. Then, there's this guy Fat Benning, W4BZ, ex-W4CBY. Fat had been on 160 phone for a year or so (why . . . ? . . . I don't know) and he too was throwing lots of numerals. Said the "corn" crop was good this season . . . but I don't get it.

Last year W4CGG worked and sent a card to VO6J via VE2IS. The card was finally returned to W4CGG. The other day he received a card from Stewart Rolland, ex-VE2IS who is with the C.R.A.F. in Jerusalem, Palestine. Rolland stated that VO6J, Ed Gaynor, got in one of their planes

Johnny Shirley (ZL2JQ) —photo taken during his stay in Los Angeles in the summer of 1938.

and as yet had not been found. VO6J was also VE2KD. We will remember VO6J for a long time. For those who would like to write Rolland, they may do so as folows: S. Rolland, 882 P.O.B. 670, Jerusalem, Palestine. He would appreciate hearing from any of the gang as it gets rather lonesome over there.

TA1AA has asked Hensley Morehen, 66 Curtis St., San Francisco, Calif., to act for him in handling the QSL cards to SWL's in USA. It seems that many have heard TA1AA and it is quite a burden on ON4HS to handle this too. Anyway, any of the readers who have heard TA1AA should send their card with TWO reply coupons to the above address. He also says that if anyone tries to chisel a card from him they will be told just what to do.

W9ELX worked CP2AC on phone, 14,295 kc., giving him a much needed new country, while KF6JEG gave him another. He gave the QTH as Carlos Goday, Box 268, La Paz, Bolivia. ELX also received a card from XU0A and says he was *not* in Zone 23 . . . another was received from YM4AV via Belgium. This makes 34 and 86 on phone, while his total is 38 and 112.

W1HIO thinks the colyum has been slipping so he rushes to the rescue to bolster it up a bit. We know doggone well the ol' section has slipped and until dx is restored to its former proportions, there isn't much we can do except talk about the guys who have been working it all these years. It gives a pretty good chance to catch up on some of the gang around the good ol' USA. We will gradually find out what they are doing, what they have been doing and what they are going to do. We're going to get just awfully snoopy from now on in. Mebbe I should really go back to where I began to breeze about W1HIO. Well, he isn't using much power . . . that is, not yet he isn't. He'll come to it sooner or later, they all do. Oh, I'll take that back, there is one guy who never has increased power and that's Budlong, W1JFN. W1HIO has done some swell work with his RK11 with 60 watts, AC4JS, XU6K, XU6SF, J2OV, J6DV, KA1LB, KA1FG, YU7MM, EA5A.

W8CVU and W9FJB have worked a station signing ON4A but to date we don't know anything about him. He came in on 14,400 kc. About the best dx for him other than this has been HA4H, LY1KK, LY1AP, HK2BD, OA4R, CX2AJ, KA1HR, KA1FG, KA1MN, XU6K, XU8WS, KB6RWZ. W6NNR, who has the worst location in Los Angeles for automobile ignition noise, has added a few . . . EK1AF, ZP1AC, K6NYD/KE6, KC4USC . . . thus making 33 zones and 92 countries on two-way phone. Guy uses one rig with 75T's in the final for 10 and 75 meters, while 250TH's are used in his 20-meter transmitter. Receiver is a PR-15 and his antennas consist of a 4-element on 20 and a 3-element for 10 meters. W6MLG also worked the above four mentioned stations plus KF6JEG, giving him 32 zones and 97 countries on phone. There seems to be some mystery as to what "Doc's" total is on c.w., but I'm sure if you ever hear him punching away on the key, he would be glad to tell you.

W1APU is hearing more XU's and KA's than ever before. Some of his latest are PX1B, supposedly in Andorra, HC2CC, KA1LB, HA1E, HA7M, YU7LX, PY1FM. Bam now has 36 and 91. W3GAU is up to 125 countries with his 38 zones remaining intact. Joe has added LZ1ID, VU7BR, PK6XX, PK4KS and CR4HT. Of course these were all done before last September, but we don't hear from him very often.

Sunspots

Well, the second weekend of the Contest is just over. From the way I feel I'm in about the same boat. However, this Chapter may just as well be called "Sunspots Before Your Eyes." Everything seemed as if we were to have a pretty good weekend of dx when all of a sudden ol' Sol decided to get a bad case of "spots." The result was obvious, but 'twas a dirty trick to play on the dx friends. Most of the boys had bitten their nails off to their elbows in an effort to locate new stuff to work. Then this sunspot thing had to happen.

Looking at the last weekend of the brawl there were a number of things that will stand out for quite some time. XE1CM appeared suddenly with a T9 signal so those around town immediately drew the conclusion that he has a nice sounding signal . . . when he plugs in the crystal. XU8MA, who is the old timer Doc Malcolm, ex-XU3MA, was in it on 14 Mc. ZP1AA and ZP6AB had the boys tearing their hair for hours. The v.f.o.'s were sure given a real workout, squeezing in and around to say nothing of landing on him zero beat. As usual Doc Stuart, W6GRL, explained the rules to more dxers than anyone else. There's a reason . . . he gets 'em first. One of the South American boys understood him so well that he immediately came back with, "OK, OK nr. hr 589,001,777." As Doc said, "How was I to know that he hadn't worked 1,777 fellows."

Just when everything was running along quite normal KF6SJJ pops off, this being on the night of the 23rd. At this point the gang began another dog fight. It is estimated that more key contacts were shattered on this session than on any for a long time. To make it more irritating, he would leave the air after every two or three QSO's, leaving the boys hanging out on a limb with mouths wide open. Then out of a clear sky he would appear with a CQ. We guess he had to let the batteries charge up, but it's only a guess. After uttering a few magic words Allah smiled on QD . . . resulting in a contact. This in itself was a complete surprise, because Canton Island is quite a long way from the W9's . . . but I'll make it up to 'em in some way. Anihoo, KF6SJJ said, "Tell the boys through RADIO that I am ex-W1KFV."

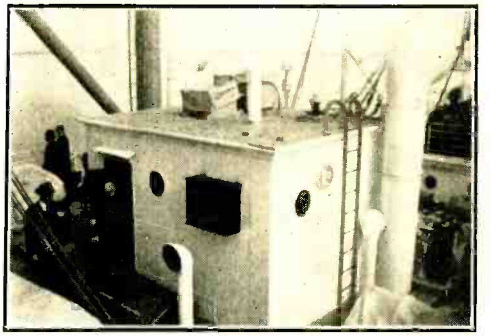
CM5TG proved a smart op. When he came boiling through with a fine signal, and a swell fist too, the gang hopped all over his frequency. He got a little fed up with the dog pile, and after a couple of QSO's he breaks loose with, "Hey you guys . . . spread out. I won't work anyone within 10 kc. of my frequency." They spread and he worked 'em. On the other hand, another CM was heard selling Cuba to a W station who was frantically trying to get a number out of him. The gang around town swear he must have been with the Havana Chamber of Commerce. Personally, I think a guy should get additional points for explaining the rules, and spending so much time trying to get numbers from some of them. The K4's were going to town with K4DTH and K4FCV leading the way.

About 20 different J's showed up on 40 meters. This would be a good spot for me to crow about 40 again but I'll spare yo'all this time. But it really did sound pretty swell to hear that stuff roll through with good strength on 40.

The guy who said the contest was a sort of K6 affair wasn't far from wrong. There surely was a carload of them on, and most of them were really in it for keeps. At this time it would be unfair to enumerate just a few of the K6 boys as tops because there must be a batch of them bunched close together. KA1HQ, KA1MN, KA1FG, and KA1ER all were doing quite well; in fact, KA1FR was a life saver on 28 Mc. for most of the gang. The last Sunday afternoon found the low frequency half of 20 almost solid with South American and Central American phones. Here is one time where the c.w. boys didn't stand a chance. W6OCH and W6ITH on phone were hitting it off, with OCH getting the better of it. Others up in the northern part of the state going to town on phone were W6CQS and W6EJC.

Down south around Los Angeles W6NNR surprised everyone including himself by nosing out W6AM in a whirlwind finish. Every once in a while I would listen to the phone gang and at no time were they separated by more than three contacts. Both ended with 192 QSO's but NNR had a higher multiplier. The fellows around here think Guy must have a magic touch because his location is one that no one would pick for a dx spot. It is on one of the main traffic arteries in Los Angeles city. He uses two antennas, one for 10 and the other for 20. Needless to say he would hear nothing if it were not for a receiver with a real noise silencer, as the ignition noise from cars is deafening.

We missed Henry, W6CXW, in this one. This if the first contest in 8 or 9 years that he has not entered. No, he is not fed up with dx, he is just too darn busy. Henry is quite a business man now-a-days—in the shipping business—and is at



XX2JQ, since mined—Johnny at the door to the radio room.

his office downtown. Seems funny not to be able to find CXW at home like we had before. Don't worry, though, he's not through . . . he'll be in there pitching before long.

So much for the contest at present. We'll travel along into the mailbag now and see what comes forth. W9NRB has heard AC4YN but not worked him as yet. W9VKF has his card from TA1AA and has worked a couple of new ones in YN1IP and OQ5AV. Here are a few worked by W5DYT on phone . . . CP2AC, CE2BK, CE1AO, HI6Q, YV5ACA, YV5ACM, TI5NA, HK4DK, YS1YO, TG9BA, EK1AF. W5ENE springs up from nowhere. He hasn't been very active for some time and the main reason is because of attending S.M.U. Ben says that between school and a certain y.l. he is kept pretty busy.

K4FCV said last month that he didn't think LX1SS was very good. He has since received some cards from LX1SS for himself and the other K4's and at the same time states he is in Luxembourg, not Belgium. A few days later Ramon hooked up with PX1B who is supposed to be in Andorra. PX1B said that he knew LX1SS. Then a few days later K4FCV worked LX1SS again who told him that PX1B was in Andorra all right. PX1B uses 14,307 kc. and is usually on around 5:30 a.m. to 7:00 a.m. on Sundays. Providing the above isn't the old army game K4FCV has 36 zones and 109 countries.

KC4USB on the Air

W6KW, Johnny Griggs of San Diego, Calif., was the first station to hook up with KC4USB. This was on March 26 at 1:30 a.m. USB is the East Base station of the Byrd Expedition and may be found on 7075 kc. while W6KW uses 7104 kc. Just a word of warning . . . KC4USB will not work any of the boys who insist upon cranking their v.f.o.'s on his frequency. Or for that matter he will not work those who get on W6KW. This is only fair as there is no particular reason these fellows should be handicapped in keeping their skeds. W6KW has a twice a week sked and said that KC4USB will work the boys if they stay clear of their frequencies. Incidentally, USB is being operated by Elmer Lamplugh, W1LWD.

"Doc" Hector, G8MX.

W1AKY says that dx has been so bad that he has been getting at least 4 hours sleep every night now. Says he's waiting for an invite to W1JCX's home for dinner. You see, the point is that not so long ago JCX was married and the xyl is a gal from the south. AKY can just about taste that southern fried chicken. W1HKK is still honeymooning but is planning to get back into the swing of dx again soon.

W4DRZ, Bud Haskins, has a new way to put it. He had been taking a little kidding about the new junior op. Bud said, "Junior ops really help the dx situation. You *have* to wear the earphones." W1APA tells of the DX Roundup held at Bridgeport on February 24. Lew Bellem, W1BES, showed pictures of Pitcairn Island. A few of those attending were W2AIW, W2AER, W1JPE, W2GTZ, W1HE. Gil tells about making several trips during some of that good ol' New England weather. A usual 40-minute trip was made in 6 hours, etc. Br-r-r-r. Did ya ever hear of sunny Southern California?

W5BB confesses that my operative no 1492 had the lowdown on him. However, Tom wants it plainly understood that he is not so occupied with his yl that he hasn't found time to work a new country. The new one was KC4USC. W1WV has worked 1134 G stations and has cards from 932 of them. A new one for Miles was KC4USC on c.w. W1BUX received a letter from G6WY stating that VU7BR is in England now. If any of you fellows haven't received your card from him, this will at least tell you how you can get in touch with him. Doug worked AC4JS and accordingly has 39 zones now. He also has been hearing AC4HN around 14,292 kc., but can't convince him that he should come back to him once in a while.

OFFICIAL RESULTS
RADIO'S WORLD-WIDE
DX CONTEST
Will be tabulated in the June issue

W2GVZ, Pat Jessup, of Ridgewood, N. J.

W6GRL worked a station signing FY3PP. You've probably guessed that he couldn't be in FY. Also your beam would tell you as much. We could tell you more about him, who he is and where he was, but at present think it better not to put it in print. We will say, however, that he formerly was a ham on the European continent, and many of you have worked him under another call. He is returning to the continent and will send cards for QSO's with FY3PP as soon thereafter as is possible. No, he wasn't on a ship either.

It is with deep regret we record the passing on of that old timer in dx circles, ZL1AR, Les Mellars. Les was one of the best known ZL's on 40 in the old days. He later could be found on either 20 or 40, the conditions permitting. Les and a party of four were yachting off the shores of one of the islands. A raging storm came up and in an effort to make for shelter, they ran ashore. The fury of the storm and the terrific rain made it impossible for bearings. The hull was smashed to bits and four of the five aboard were lost.

W2GVZ has 38 cards out of the 39 zones worked. His countries are up to 132 and Pat is wondering just when that card from U9AW or U9AV will arrive. Yes, the cards include one from AC4JS, which arrived the day after he took a picture of his shack.

Last week Bill Halligan of Hallicrafters was in
[*Continued on Page 90*]

NEW BOOKS

and trade literature

NEW ALLIED RADIO CATALOG

The new 172-page Spring-Summer Catalog of ALLIED Radio Corporation, Chicago, contains complete listings of all the latest Radio equipment.

Completeness is combined with many new features. Each Radio field is arranged in individual sections for speedy reference. All sections and all items are clearly defined and carefully indexed.

For Builders and Experimenters there is an unusually complete section featuring the latest kits, accessories, projects, diagrams, and Allied's new Radio Builder's Handbook. The Amateur Section features the latest receivers of the country's leading Manufacturers and the complete story of Allied's new separate, exclusively-amateur catalog.

A copy of this new 172-page Spring Catalog is available by writing to Allied Radio Corporation, 833 West Jackson Blvd., Chicago, Illinois.

1940 TAYLOR TUBE MANUAL

The new Taylor Tube manual is quite similar to its predecessors in that it is divided into three main parts: the first section is devoted to characteristics and ratings for all Taylor tubes, the second section is devoted to tube and transmitter operating data, and the third section is devoted to descriptions of complete transmitters.

In the transmitter section constructional information is given on five units which cover a wide enough power range to be of interest to the majority of amateurs. The first is the 175-watt phone and c.w. transmitter which was described in the February, 1940, issue of RADIO, and which uses a T55 in the final modulated by a pair of TZ-40's in class B. The next is a field day-emergency duo-power transmitter which uses a T-21 in the final stage modulated by a pair of T-21's. This unit is designed to be operated either from the 110-volt lines or from a vibrapack and a storage battery. The next is a safety kilowatt transmitter utilizing a pair of TW-150's in the final stage. The Taylor de-luxe all-band transmitter which uses a separate r.f. system for low and for high frequencies, and which was described in the previous edition of the book also is shown as is a push-pull 500-watt amplifier designed around a pair of TW-75's.

RCA RECEIVING TUBE CHARACTERISTICS CHART

The new RCA Receiving Tube Characteristics Chart (1275-B) is just off the press. This new chart retains the convenient booklet form of the preceding edition but has been made larger to facilitate filing. It gives characteristics data on all RCA glass, glass-octal, octalox, and metal types in numerical-alphabetical order. The first two pages show a classification of the types according to their cathode voltages and their functions. This classification will assist the tube user in identifying type numbers and in choosing a tube type for an application. The last two pages show socket connections with RMA designations (4AD, 4B, 4C, etc.). Readers can obtain a copy of the 1275-B on request from Commercial Engineering Section, RCA Manufacturing Company, Inc., Harrison, N. J.

LAFAYETTE 1940 SPRING CATALOG READY

Radio Wire Television Inc., (formerly Wholesale Radio Service Co., Inc.) announces the publication of the Spring edition of its 1940 catalog. Comprising 124 pages, this new catalog includes a comprehensive listing of the new line of Lafayette radios and radio-phonograph combinations.

The new catalog also contains the first listing of the complete new line of Lafayette Public Address equipment featuring several innovations in circuit design as well as new cabinet styling. In addition the Spring edition lists more than 64 pages of equipment, parts and tools for the servicemen and more than 10 pages of interest

[*Continued on Page 90*]

Power Line Operated

2.5 METER TRANSCEIVER

By WILBUR C. BABB*

Many an amateur with leanings toward 2½ meters has delayed getting on this band because of the impression that it costs too much to build both a transmitter and receiver. The unit described herewith is inexpensive and easily built, yet extremely effective for 2½-meter communication.

The cost of this transceiver is but a few dollars since most amateurs will have most of the parts on hand. For economy, the unit is built around one of the ceramic base 6J5GTX tubes. This tube is of the bantam type construction and the shorter lead wires and ceramic base noticeably increase the power output capability on 2½ meters.

*42 Brattle St., Boston, Mass.

Rear three-quarter view showing layout of components, especially the inverted mounting of the oscillator in the interests of shortened leads.

The circuit employed is the conventional Hartley oscillator when transmitting, modulated by a 6K6GT tube. While receiving, the circuit is the usual superregenerative followed by a two-stage audio amplifier.

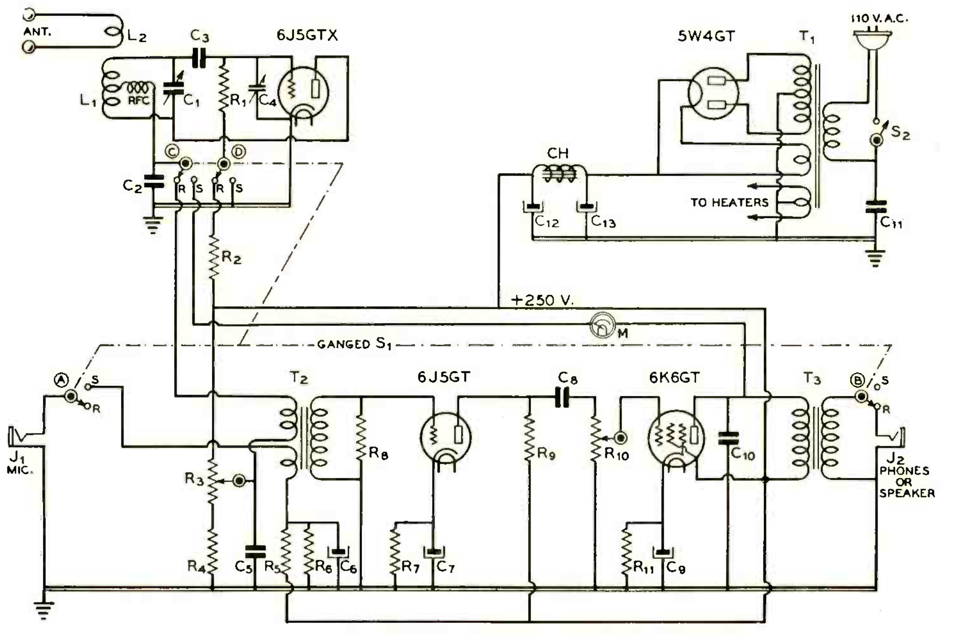
A power supply was built into the unit since it was desired only for operation at home. The power supply delivers about 250 volts d.c. which is ample for the tubes employed.

In any device operating on 2½ meters, it is essential that the mechanical layout of the high frequency circuits be correct and that all leads be as short as possible. In the interests of achieving this, the 6J5GTX tube is mounted in an inverted position. The ceramic socket is mounted off the chassis by long screws while the top of the tube projects below the chassis. This arrangement keeps the r.f. circuits completely isolated from the rest of the unit.

The coil is wound from no. 14 wire on a ⅝-inch form, has 3 turns ⅜ inch long and is self-supporting. Plate voltage to the 6J5GTX tube is fed through a Bud u.h.f. choke connected to the center of the coil.

The tuning condenser, which incidentally supports the coil, has 6 $\mu\mu$fd. maximum capacity. The extension on the rotor shaft was sawed off to permit placing the condenser closer to the tube socket. An insulated coupling is necessary to isolate the rotor from the dial. The grid coupling condenser should be as small as possible so as to minimize inductive effects.

The 7500-ohm grid resistor connects from the grid to an unused connection on the



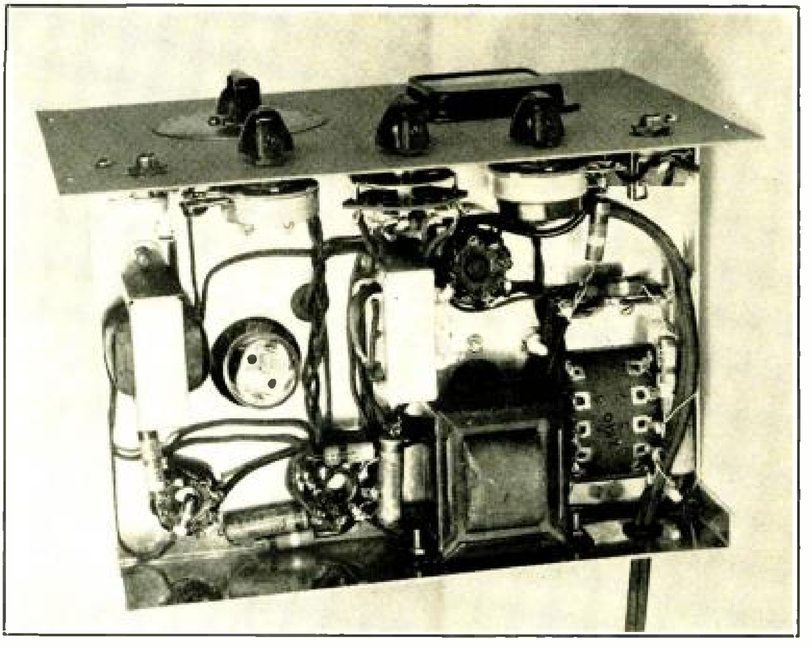
Schematic of the a.c. operated transceiver.

C_1—6-μμfd. midget variable
C_2—.002-μfd. mica
C_3—.00005-μfd. mica
C_4—3-30-μμfd. mica trimmer (oscillation control)
C_5—0.1-μfd. 400-volt tubular
C_6—25-μfd. 25-volt elect.
C_7—5-μfd. 25-volt elect.
C_8—.02-μfd. 400-volt tubular
C_9—5-μfd. 25-volt tubular
C_{10}, C_{11}—.01-μfd. 400-volt tubular
C_{12}, C_{13}—8-μfd. 450-volt elect.
R_1—7500 ohms, 1 watt
R_2—10 megohms, ½ watt
R_3—100,000-ohm potentiometer (superregen control)
R_4—50,000 ohms, 1 watt
R_5—50,000 ohms, 3 watts
R_6—750 ohms, 1 watt
R_7—3000 ohms, 1 watt
R_8—100,000 ohms, ½ watt
R_9—50,000 ohms, 1 watt
R_{10}—100,000-ohm potentiometer
R_{11}—600 ohms, 2 watts
L_1—3 turns no. 14, ⅝-inch dia., ⅜-inch long, tap in center
L_2—2-turn coupling coil
S_1—Ganged 4 p.d.t. switch
S_2—S.p.s.t. switch on R_{10}
M—0-50 d.c. milliammeter
T_1—650 c.t., 75 ma.; 5 v. 2 a.; 6.3 v. 1.5 a.
T_2—Transceiver transformer, plate and mike to grid
T_3—Output transformer, about 1:1 ratio for phones or voice-coil secondary for speaker
CH—30-hy. 75-ma. filter choke
RFC — Midget u.h.f. choke

socket. A wire from there goes to the 4-circuit 2-position switch which changes set operation from transmit to receive. In the receive position, a 10-megohm resistor is connected between the 7500-ohm grid resistor and the high side of the superregen control.

The circuit change switch is quite simple in operation when its functions are analyzed. One section, in the transmit position, connects the single-button microphone to the mike winding on the input audio transformer. A second section disconnects the headphones from the audio output transformer. The third set of contacts connects the cold side of the oscillator plate choke to the plate of the 6K6GT tube which operates as a Heising modulator. The fourth contacts return the 7500-ohm grid resistor to ground so that the tube will oscillate satisfactorily on transmit.

In the receive position, the contacts are set as follows: first, the microphone is disconnected; second, no. 3 contacts connect the plate of the oscillator through the input audio transformer so that the audio stages can amplify the detected signal; and third, the no. 4 contacts put the high resistance, which is



Under-chassis view of the unit. Note the top of the envelope of the oscillator tube protruding through the chassis, and the send-receive switch in the center of the front drop of the chassis.

necessary for superregeneration, in the grid circuit of the oscillator.

Four controls are provided in the unit: the tuning condenser, volume control, superregeneration control, and send-receive switch. An inexpensive meter is used in the plate circuit of the 6J5GTX oscillator to indicate resonance and proper loading.

A two-turn coupling coil, supported by feedthrough insulators on the side of the cabinet makes possible the use of either a vertical antenna or transmission line to a doublet. The antenna should of course be placed as high and in the clear as possible.

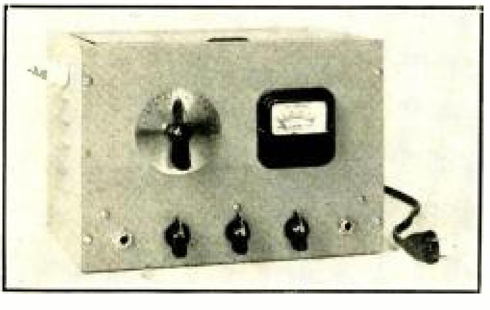
A metal cabinet was found to be essential in order to avoid capacity effects. A standard manufactured chassis and cabinet are used.

Resistance coupling is used between the audio stages. Likewise, the power supply circuit is simple enough so as not to require explanation.

The mike receives its power from the high voltage circuit through a resistance-capacity filter which isolates it from the rest of the circuit and keeps the microphone current down to a safe value. A dual primary transformer is used to take care of both the mike and the plate of the 6J5GTX tube.

There is nothing unusual or tricky about operating the transceiver unit. Those amateurs who are completely unfamiliar with transceivers should refer to the RADIO HANDBOOK for instructions pertaining to the adjustment and operation of such equipment.

See Buyers' Guide, page 98, for parts list.



Front panel view of the power line operated transceiver. A milliammeter is used in the plate circuit of the oscillator to indicate proper loading of the 6J5GTX when in the transmit position.

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The letters I and O are the only ones not used in designating tube types.

U. H. F. . . .

By E. H. CONKLIN,* W9BNX

The trend to the very high frequencies is developing considerable momentum. The first complaint of interference on 112 Mc. has come —from W2KDB of South Ozone Park, New York, who says that there are so many hams and listeners in his neighborhood that he can work only the strongest locals or go to another band! Malcolm Rhomberg, W9BE, says that the whole CBS gang in Chicago is going "high." Wilmer Allison, W5VV, calls himself "another Century Clubber gone wrong!" He is weary of listening for dx that doesn't exist, so has gone to five meters.

Those with phone rigs can easily move the final amplifier tubes over to a little 112-Mc. oscillator using the same power supply and modulator as on the lower frequency bands, built at a cost of only a couple of dollars; or they can also push-push double in the final or add an "outboard" doubler-final to get down to 5 and 2½ from 10. Those phones that haven't used the ten-meter band just can't know what they have missed.

On Chicago's north and north-west side, there is an ultra-high-frequency club, attended by W9TVT, SQE and others. The formation of many such groups to bring together those interested in u.h.f. work should be very beneficial, especially if the fellows will make it a point to try to assemble information about who is working on each band within 100 or 200 miles, and to advise the magazines so that all can readily contact others to carry out tests and experiments.

Frequency Measurement

Frequency measurement on the ultra-highs usually calls for a Lecher wire to determine the wavelength approximately, and a harmonic from a lower frequency band for closer work. Lecher wires often have double humps, and they are troublesome to set up. Satisfactory results are obtainable simply by using a "quarter-wave Lecher frame" which is a pair of stiff wires, rods or tubing slightly over a quarter wave long. The unshorted end is placed near an oscillating circuit, and a screw-driver run down the rods as a shorting bar until an indication of resonance is given. The latter may be a yoop or loss of superregeneration in a receiver, a dip in plate current or neon light brilliancy in a transmitter. The frequency is given by the length of one rod plus the length of the shorting bar. A recent test of this gave a frequency within a megacycle at 58 Mc., and it would have been closer had the bolts at the end of the rods been considered. A useful table of quarter wavelengths, for this and other purposes, follows:

Frequency (Mc.)	¼ Wave (inches)
56	52.73
57	51.80
58	50.91
59	50.05
60	49.21
112	26.36
113	26.13
114	25.90
115	25.67
116	25.45
224	13.18
225	13.12
226	13.06
227	13.01
228	12.95
229	12.89
230	12.84
400	7.38
410	7.20

Transmitters

Interesting tubes for u.h.f. work are those with short grid and plate leads coming out of the bulb in the same general neighborhood. Several manufacturers produce them. Eimac has one that is like two 35T's in one bulb; it will go to 300 Mc. before the grid leads, which come out on opposite sides, limit the frequency. This tube probably will not require filament chokes or lines because of the short interconnection inside of the tube. The idea of such filament lines or chokes seems to be to provide a connection between the tubes that is equivalent to connecting the centers of the filaments in a push-pull stage. Those on 112 Mc. or higher should give some attention to the filament leads for best results. In a pair of T55's, W9SQE recently found that chokes reduced his plate current and dissipation materially, resulting in a large increase in signal on 2½.

A lot of transmitters with plate rods and grid coils are being built, in which the plate rods determine the frequency. Coupling the antenna reduces the Q as well as tuned circuit impedance. It should be better, it is

* Associate Editor, RADIO, Wheaton, Illinois.

believed, to attempt getting the grid circuit to control the frequency, and to put the best lines there. Ordinary wire may do, in the plate circuit.

Exposed plate rods are not very safe, especially when the power supply is grounded or when a metal chassis is used. The high voltage can be removed from plate lines by bringing the plate leads inside of tubing used as plate lines, by-passing the plates to the hot end of the line. This also simplifies construction because the plate line can be soldered to a plate bolted to the base or chassis, with no insulator to support it.

More on Short Lines

There seems to be very little appreciation of some factors to be considered in using rods in transmitting and receiving equipment. When a tube is placed across the unshorted end of a line, the capacity and lead inductance in the tube load the line, making it necessary to have it considerably shorter than a quarter wavelength in order to resonate. A handbook photo shows a ¾-meter acorn detector with an inch or so of wire leading from the tube to a large tuning condenser. The Q can be increased considerably by replacing the two wires with large, closely spaced rods which, because the tube loads them to a much smaller extent than it does two widely spaced wires, can be quite a lot longer.

About using a large variable condenser as a shorting bar—Woody Smith's transceiver story in RADIO for March gave a hint as to what goes on. When he placed a small fixed condenser in parallel with the variable, the latter no longer controlled the frequency. The reason, it appears, is that the variable is acting like a fixed condenser in series with a variable inductance; shunt it with a good condenser (equivalent to a shorting bar) and the variable inductance is shorted out so it cannot affect the frequency. Also, considerable tuning of short lines can be accomplished by spreading the rods or bringing them closer together. This works only on rods loaded with a tube or other capacity because, with wider spacing, a given capacity loads them more. Without the capacity, a quarter wave is still a quarter wave no matter what the spacing, within reason.

In a circuit where *Q* is important, such as in an oscillator grid or in some receiving applications where selectivity is desired, a concentric line should have a conductor ratio of around 3.6 to 1. In a parallel-rod line, this means a spacing between rods, of slightly less than the rod diameter. When the rods are less than a quarter wave and are loaded with capacity, however, the spacing should be smaller if it is conveniently possible to lengthen the line to restore resonance without using more capacity. In a high impedance circuit, such as in a plate circuit that does *not* determine the oscillator frequency, a ten-to-one ratio is satisfactory in a line close to a quarter wavelength. In the case of rods, this means spacing-to-*radius*, or a center-to-center spacing of five diameters. Inasmuch as such lines are generally loaded with a tube's capacity, the spacing can be smaller to enable use of a longer line; when the line cannot be lengthened but must be loaded with a lot of capacity to resonate at a low fre-

56 Mc. DX HONOR ROLL

Call	D	S	Call	D	S
W9ZJB	9*	18	W1VFF	6	11
W3AIR	8	24	W1LLL	6	17
W3BZJ	8	27	W2KLZ	6*	
W3RL	8	24	W2LAH	6	
W5AJG	8*	27	W6QLZ	6	11
W8CIR	8*	29	W8OJF	6	
W9USI	8	22	W9NY	6	13
W8JLQ	8				
W8VO	8		W1JMT	5	9
W9ARN	8	15	W1JNX	5	12
W1EYM	8		W1JRY	5	
W9CBJ	8		W1LFI	5	
			W2GHV	5	8
W9ZHB	7		V3GLV	5	
W2AMJ	7	22	W3HJT	5	
W2JCY	7		W6DNS	5	
W2MO	7	25	W6KTJ	5	
W3BYF	7		W8EGQ	5	10
W3EZM	7	24	W8NOR	5*	16
W3HJO	7		W8OPO	5	8
W4DRZ	7*	22	W8PK	5	
W4EDD	7		W8RVT	5	7
W4FBH	7	20	W9UOG	5	8
W5CSU	7				
W5EHM	7		VE3ADO	4*	
W8CVQ	7		W3FPL	4	8
W8QDU	7		W6IOJ	4*	
W9CLH	7		W8AGU	4	
W9SQE	7	22	W8NOB	4	
W1HDQ	7*	18	W8NYD	4*	
W9AHZ	7*	14			
W9BJV	7	12	W1KHL	3	
W9VHG	7*		W6AVR	3	4
W9WAL	7		W6OIN	3	3
W9QCY	7	10	W6OVK	3	4
W9ZUL	7	11	W7GBI	3	4
W9GGH	7		W8OEP	3	
W1CLH	6	12	W8OKC	3	6
W1DEI	6	18	W9WYX	3	3

* plus Canada. (reported in 1939)

Note: D—Districts; S—States

The arrays at W6QLZ, Phoenix, Arizona. Reading from left to right they are: the 56-Mc. 4-element rotary, the 56-Mc. lazy H, and the 28-Mc. 3-element rotary. The rhombic terminates just under the lazy H.

quency, higher impedance (and more gain or efficiency) can be obtained by using wider spacing or smaller diameter rods, reducing the loading capacity to resonate at the desired frequency. It also follows that rods cut too short can be used by spacing them farther, or using longer leads from their ends to the tube plates. The same effect is present in concentric lines.

Sheet metal near a short parallel line should be silver, copper or, next best, aluminum. It will increase losses somewhat. A copper can around such a line will probably have losses about equal to power otherwise radiated from the line, but the resulting reduction of field strength in the room generally is an advantage.

Overheard on 28 Mc. was the statement that short lines won't resonate—that it would take about a four-foot line to reach 28 Mc. Someone promptly corrected him. The 13-inch line in W9QDA's simple ganged converter set him back just 16 cents. Using it one night, W9FXB was reported to have worked a lot of Indiana and Illinois ten meter stations after the band "closed," while others in Chicago just tuned around looking for the "dx." W9TVT and QDA also took the little gadget over to W9UZ where Fred Schnell found that it had 18 db better gain and 6 db *less* noise than one of the best communications sets, whereas a signal-booster had 6 db better gain but 36 db *more* noise. That was a fairly convincing test of the better signal-to-noise ratio obtainable with an acorn tube and a short concentric line, even without an r.f. stage.

Tubes

Acorn tubes should give long life if properly used. Care should be taken in putting them in sockets, the screen voltage should not be run above 100, and the control grid bias should be at least three volts. One of the most common troubles with the tubes is shorting between grids—which can be checked with an ohmmeter, and often repaired by tapping the tube. Obtaining screen voltage through a series resistor may give a degree of protection in case a short between control grid and screen results in too heavy a plate current. Tubes with permanent shorts between grids seem to be 100 percent replaceable.

These new miniature battery tubes have closely spaced elements and short leads, but have such a low transconductance that their higher input resistance, and consequent lower loading of the tuned circuit, may not result in particularly good gain. In respect to input resistance and transconductance, they are just the opposite of the 1852. The latter's input resistance loads the circuit badly so that a high impedance cannot be developed (as well as having about 13.5 $\mu\mu$fd. input capacity), but can still turn out some gain at five meters.

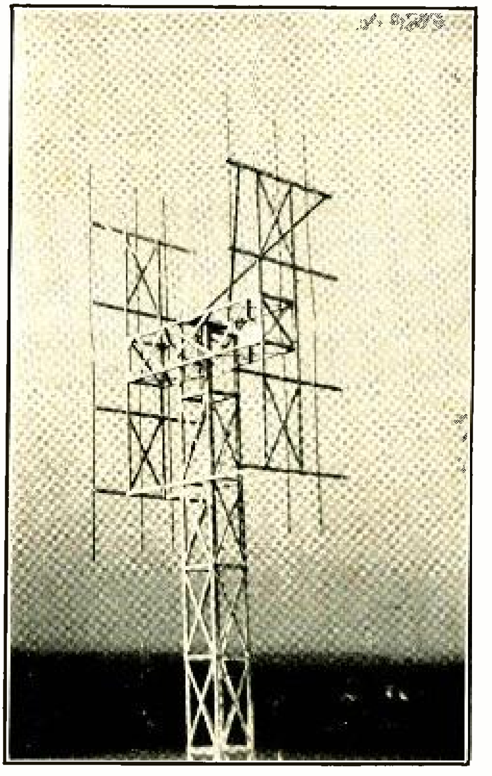
The use of voltage regulator tubes for better power supply regulation and filtering in u.h.f receivers should probably be encouraged.

Antennas

The February issue of *IRE Proceedings* contains an article on u.h.f. applications in air transport. The radio range beacon near Pittsburgh was tested on 63 Mc., using vertical antennas 3/2 wavelengths high. A pattern in the vertical plane shows clearly how antennas more than a wavelength or so high produce nulls at some vertical angles, explaining some peculiar antenna comparisons on skip dx at ultra-high frequencies. These nulls at angles above that of the major lobe give false "cone of silence" effects when a plane flies nearly over the beacon, so they were eliminated by placing a large horizontal screen just below the vertical antennas. This screen extends several wavelengths in each direction, and produces a pattern similar to that of an antenna a quarter wavelength high. The published patterns also show that power at angles within a few degrees of the horizontal can be very largely cancelled in the case of a vertical antenna above average ground, without use of the ground screen.

Really, the pattern of a low vertical antenna over perfect ground is ideal, but height is desirable at ultra-high frequencies to clear surrounding objects and to extend the horizon. Ground screens composed of radial wires might be very useful when antennas are mounted above flat roofs.

Because phase relationship is so important in multi-element arrays, there is much to be said against using a screen of eight half-wave antennas in phase, and in favor of going in all directions by using two four-element H arrays in phase. Much the same effect has been obtained in the very successful five-meter antenna at W1DEI in Natick, Mass. Mel has four vertical three-element arrays fed in phase. Two are placed broadside, stacked above two others. Each driven element can be the same distance from the feed line.



The 12-element vertically-polarized 56-Mc. array which provided many dx contacts for W1DEI up through last winter when an ice storm brought down it and one of the supporting poles for his stacked rhombic array.

Polarization Again?

The following is quoted from a letter recently received:

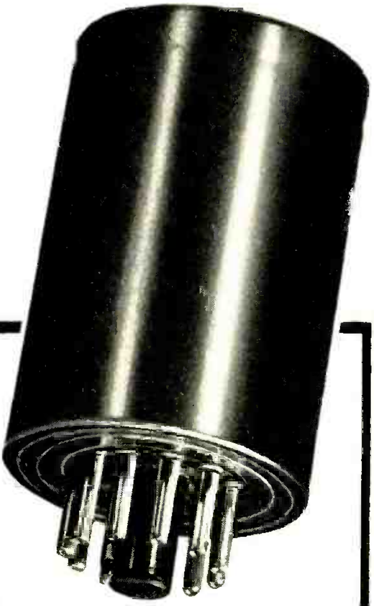
"Again you amaze me! In your vertical versus horizontal article the way it started out I felt sure that you would finally admit that the vertical was best inasmuch as the illustrations you gave indicated that tests had proved the vertical produced the stronger signal. However, you wind up by making some rather weak remark about noise pickup and suggest that there *might* be a possibility that the horizontal would be superior even though not producing as strong a signal, due to the fact that the signal-to-noise ratio might be better.

"I wish somebody would get this thing settled as I had a letter from Frank Lester (W2AMJ) saying, 'You fellows out in the Middle West feel that horizontal polarization is the best.' Of course, I proceeded to deny this fact very emphatically and repeated the statement that everybody I had worked and everybody that I knew of that had done anything on five meters, with the exception of skip dx, use verticals.

"Don't misunderstand me. I'm not a bull-headed narrow-minded conformist, but I do believe that until such time as the facts have really been proven, it would be wise to clarify this argument, and a bit more fully, and explain the circumstances. I have tried horizontal to horizontal and find that it is definitely inferior in every respect to the vertical. This is over distances both short and long. I am not the only one, either, who has made these tests and can cite you several concrete examples. The net result is always the same, and that is that the vertical is much superior. I am speaking, of course, of ground wave work and must concede that for skip work the horizontal would prove equally as satisfactory where the angle of radiation is somewhat higher. . . . As to your examples of commercial horizontal use . . . the antennas are mounted at extremely high elevations."

Lest only one side be given too much emphasis, the following is quoted from a letter dated March 4, 1940, received from Mr. H. O. Peterson of the Engineering Department of RCA Communications, Riverhead, Long Island:

KENYON



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Again Kenyon sets the pace. Here truly is an amazing new idea in transformer design . . . a unit with an octal base that may be plugged in just like a radio tube. Where space is at a premium and where efficiency must be maintained at a high standard—these new Kenyon "A" Line transformers fill the bill.

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TYPE	MAX SEC. D.C.	AUDIO TUBES	CASE SIZE	NET PRICE
T-471	200 M.A.	SINGLE 6F6	2 A	$ 2.40
T-472	300 M.A.	PP 6V6's or 2A3's	3 A	3.00
T-473	450 M.A.	PP 6L6's - AB_1 or AB_2	4 A	3.60
T-474	500 M.A.	Universal (120 Watts of AUDIO)	6 A	7.20

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T-489	15 watts audio	3 A	$ 2.40
T-493	40 " "	4 A	3.60
T-494	75 " "	5 A	5.40
T-495	125 " "	7 A	12.00

SPECIAL AMATEUR PLATE TRANSFORMERS

	D.C. Volts	D.C. M.A.		
T-668	500/7500	300	5½ A	$ 5.85
T-669	1000/1250	300	7 A	9.60
T-670	1500/1750/2000	300	8 A	12.90
T-671	1000/1250	300	8 A	12.90
T-672	1000/1250/1500	300	8 A	11.85

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The unusually neat and commercial appearing installation at PAΦBB which was in use until Dutch equipment was interned by the authorities as a precautionary measure.

• • •

"Our experience in quite a few surveys made around New York City has been that on the average, we receive a little more field strength from the transmitter and a little less field strength from the noise sources when we use horizontal polarization. These observations are on the basis of equal effective radiated power. The transmitters were generally from points over 600 feet above street level. The receiving antenna in most of this work was about 10 feet above street level. Frequencies were 40, 50, 83, 100, and 142 Mc. Distances were from a few miles up to about 80 miles."

During the last year or two, English amateurs did considerable five meter dx work at distances of 100 to 200 miles, with low power and, presumably, poorer receivers and antennas than used by our stations covering similar distances. 2DDD sends these comments on polarization:

"I am afraid that it would be very difficult to persuade us to desert horizontal polarization; all of the best work here is done with this method. In the 'G.W.' contest, we had in use a vertical ½ wave; I frankly would not trouble with vertical polarization again unless I were able to get fellows at, say, 50, 100, 150 and 200 miles to conduct regular experiments over a period of time. . . . I note that you somewhat easily dismiss the matter of delta matching the feeder at the bottom of stacked dipoles; have you ever tried to do this? You will remember when on the *Kungsholm* I ventured to suggest that we English amateurs were inclined slightly to skip over American articles on aerials. A few odd watts lost here and there does not worry you people, but to us with our very low input, it is very important; this question of matching into a dipole or doublet, with an open wire line, is extremely tricky, in particular where the impedance at the centre is lowered by the presence of other closely spaced elements. I admit the difficulty is a practical one, and needs only patience and a thermo-galvanometer."

28 MEGACYCLES

When this issue appears, cross-country ten-meter work should be closed for the summer, but short skip should pop in now and then for a few hours. South Americans may continue to come through in the afternoons. In the first part of March, conditions gave little cause for complaint, with KA and XU stations being raised from the Chicago area in the early evening. Many South Americans came through regularly. The maximum usable frequency at Washington has been just above 30 megacycles on Wednesday noons.

The last comment from G2YL covers January, reported to be the worst winter month since October, 1935, when the band first opened for world-wide contacts. No signals were heard from four continents, and HC1JB who came through on two days, was the only one reported from the fifth continent. U. S. A. signals were reported on 18 days but may have come through on a few more when no one listened. A few east coast stations came through from 9 a.m. to noon eastern time, but the 4th, 5th and 9th districts were rarely heard, with no western stations at all. Signals usually faded badly.

W6QLZ reported short ten-meter skip on February 14 and 18 but he was unable to duplicate the contacts on 56 Mc. He hears W6DOZ NKF KYL nearly every night—about 400 miles away.

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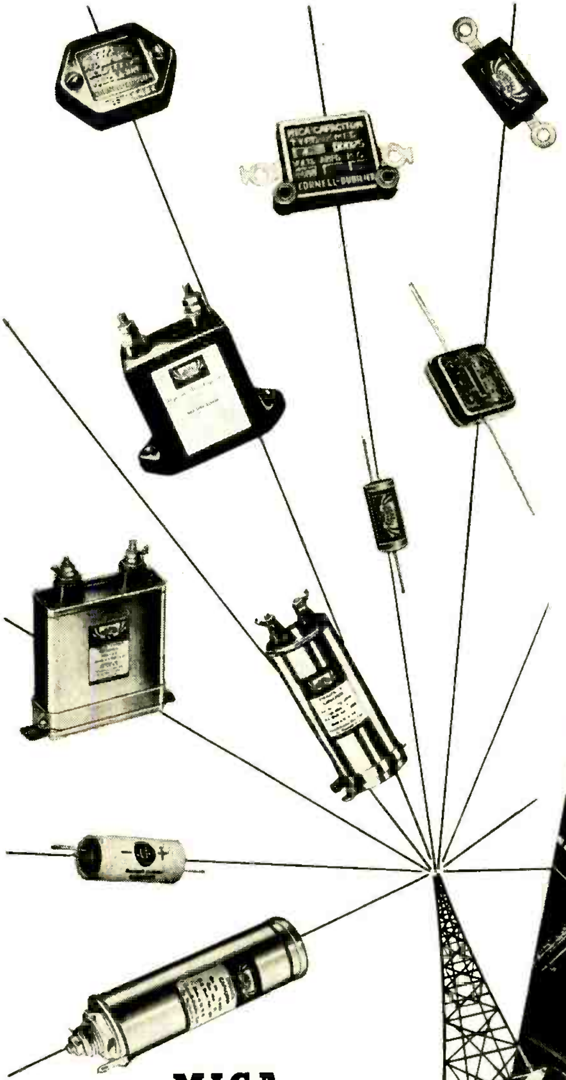

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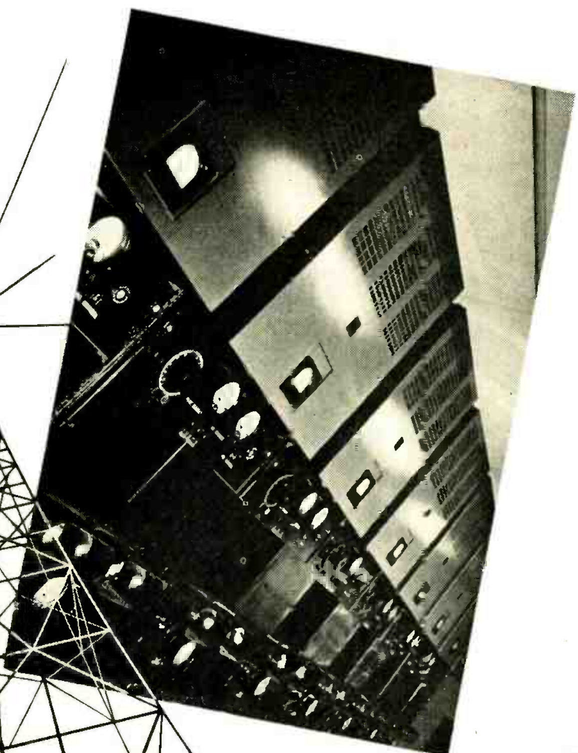

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From Oregon, W7GLX writes about those queer short-skip conditions on ten meters. On February 29, he found the band dead at 4:30 p.m., with his beam east, but heard W6CQS in Oakland when he turned it south. A CQ brought in W9CXU in Missouri, who disappeared when the antenna was turned that way. With the antenna south, a three-way including W9YZK in Iowa was accomplished, the latter also having his beam south. For over an hour, the original two stations had a 100 per cent contact. Afterwards, the band east was still dead. W7GLX is on 28,632 with 85 watts into an 812. His 3-element array is 70 feet high. He has worked all *states* and continents with this power on ten meters. Who says that the band doesn't get around?

A possible explanation of long delay echos has been discussed in the *Physical Review*. The idea is that the signal goes up and bounces between the E and F layers, finally coming back the same way, landing near the transmitting station or in the skip zone. It is not clear how frequencies around 30 megacycles could do this, however, because it seems to require reflection of signals going practically straight up after several bounces, whereas the layers generally pass high-angle high-frequency signals.

W9QDA reports that W9RRX ZHB DAX are all starting to build concentric-line-tuned acorn converters. QDA has had so many inquiries to buy his that someone has promised to go into the business.

56 MEGACYCLES

Dx again! W6QLZ heard W9USI and received a QSL from St. Joseph, Missouri, around January 28. He heard W9USI on February 14. On the latter date, USI heard W4MV in Atlanta, fading badly. W1DEI mentions the same date as being open but may refer to one of the above reports. W1LSN mentions a contact with W8LKD last November 5. Going back further, W6QLZ is still receiving reports from July 27; plotting them, he notes how narrow the "second silent zone" was on that two-hop day. He received reports covering Oklahoma City to Detroit, none from Detroit to Pittsburgh, and then reports again covering Pittsburgh to Boston.

Considerable "aurora-type" dx was reported on February 24. W8QDU in Detroit had a "field day," working W1IZY, HDQ, W2AMJ, W3BZJ, BYF. All were on c.w. because distortion prevented understanding the weak modulation. Fred wants more emphasis on the use of c.w. which he says accounts for half of his dx contacts which would be sketchy at best on phone. W3BZJ noted flutter on W2AMJ and other consistent New York area stations (75 miles) about 10:30 p.m. that night; carefully checking the band, Bob Elmer found a number of carriers, on which the modulation was practically unreadable. W1IZY in Bridgewater, Mass., (260 miles) was contacted on c.w. followed by W8QDU (450 miles) and W1FJN in Scituate, Mass., (270 miles) also on c.w. W1HXP in Worcester was heard very strong on phone but hardly understandable. W1HDQ was contacted on c.w. with a weak signal, whereas on normal nights his signals are generally better. W8QDU faded out at midnight.

Speaking of DX . . .

Via G2YL and G8LY we hear that Mr. W. Wadsworth, VE5ZM (now in England with the Canadian Expeditionary Force), last August 27 worked J2KE at 0135 G.m.t. after a prolonged series of tests between Canadian stations and J2KE KG NF. These schedules, it is learned, were kept every third day for six months. Signals faded out after J2KE gave a 449 report. It is said that a confirmation was received three days before VE5ZM was called for military service. His transmitter (portable) used 6L6GX's as crystal, doubler and final stages, modulated with a 6F6G. The input was 50 watts. The receiver was an RME69 with 510X expander, operating from a vibrator supply. The location was in a car 5400 feet up. We hope that someone will check into this oft-relayed report, and will have better luck than the G's did when they called on that fellow in Wales who twice reported VK2NO (verified) and many unmentioned W's. The G's told ye ed. that he didn't even have a receiver on the band!

Here and There

W1DEI had a fine twelve-element beam on a rotary tower, which provided many dx contacts during the winter. Came the ice, and down came tower, antenna, and all. Mel is looking for another big five-meter day around May 15, but a good guess (probably) is that he will be in on any openings before then.

In Exeter, New Hampshire, W1LSN says that the band is being kept alive in his area by W1JK (formerly W1FGA), W1COO HRP IUI LSN all within 20 miles. Boston activity is picking up with new stations frequently appearing.

No 56-Mc. news letters have been received this month from W2-4-7. What ho? Waiting for the dx?

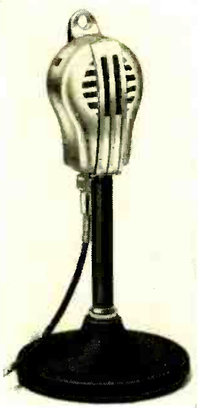
[*Continued on Page 86*]

What's New . . . .

IN RADIO

TURNER 22X MIKE

The Turner Co. of Cedar Rapids, Iowa, is meeting the demand for a low cost Crystal Microphone with the new Turner R22X, just put on the market. This microphone is identical in performance with the Turner 22X, but does not have the swivel and cable coupler, thus affording a saving to the buyer.

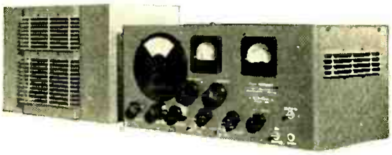


The R22X is streamline in design, with a range of 30-7000 cycles, and a level of —52db. The 8 foot cable furnished with R22X can be changed without opening the microphone, and each mike is packed complete with wiring diagrams and a chamoisette mike pouch.

The R22X has a built-in diaphragm guard to protect the cartridge, which is also inertia mounted to absorb mechanical shock and prevent breakage. The crystal is impregnated against moisture, and the unit has an automatic barometric compensator. The large capacity crystal permits long lines to be run with minimum loss of level.

HALLICRAFTERS SX-25 COMMUNICATIONS RECEIVER

The new Hallicrafters SX-25 "Super Defiant" Communications Receiver, although selling in the medium-price class, offers an array of features usually found only in more expensive sets. Included among these are two preselector stages, four degrees of selectivity including broad and sharp crystal filter circuits, temperature and line voltage compensation with consequent freedom from tuning drift, frequency calibrated handspread, automatic noise limiting, single signal c.w. reception, a continuous range of 538 kc. to 42 Mc. in four bands, "S" meter calibrated in "S" units and decibels, a 6-position switch which in one movement selects the type of reception desired (phone or c.w.) the selectivity desired and automatically cuts the a.v.c. in or out depending on the type of reception selected, and provision for operation from

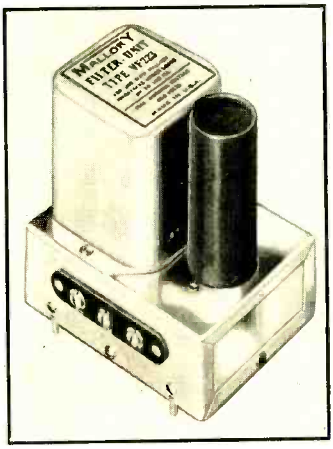


the a.c. line or for instant changeover to a battery-vibrator combination for mobile or emergency work.

The circuit employs 12 tubes in 2 r.f. stages, mixer-oscillator, 2 i.f. stages, detector-a.v.c.-1st audio, noise limiter, b.f.o., phase inverter, push-pull output, and rectifier circuits. It is inclosed in a crackle-finished metal cabinet with satin steel trim. A separate loudspeaker in matching cabinet is included.

MALLORY VF-223 FILTER UNIT

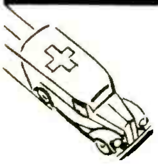
A new audio or hum filter unit, the Mallory VF-223, is now available for use with all single unit Mallory Vibrapacks. It was designed especially for application where voltage regulation is important, as in Class "B" Audio Amplification; or where the utmost in hum suppression is required as in high gain audio amplifiers.

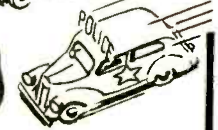


The filter condenser is a three-section Mallory FPT-390, of 15-15-10 μfd. capacity, 450 working volts. The two 15 μfd. sections are used with the choke to form a conventional pi-section filter, while the third 10 μfd. section connects to a separate terminal so that, if desired, a filtered intermediate output voltage may be obtained. The

[*Continued on Page 93*]

Stancor MOBILE TRANSMITTER KIT!





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- Antenna change-over relay switch.
- Easily installed; requires connections only to battery, microphone and antenna.
- Complete metering provided by selector switch and either self-contained or plug-in meter.
- Servicing and operating breakdowns reduced to a minimum through the use of heavy duty components.
- Easily assembled and wired with Stancor's exclusive "POINT TO POINT" instructions.
- Size—14½" x 10" x 8" overall—Weight, complete, 39 lbs.

This unit may be purchased in kit form, less accessories (tubes, crystal, meter and power supply, etc.), for approximately **$41.00**

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YARN of the MONTH

A SHATTERED ROMANCE

A soft, southern moonlit night. The waters of the blue Atlantic gently rolling in from far off climes. A sweet y.l. beside me, her little hand tenderly patted by mine. A little home of our dreams, gradually taking shape in our minds, to be built on this same spot. A little home with ivy and wisteria in abundance in the trees surrounding it. A perfect match. A lovely kiss. Bliss.

No doubt you wonder as to the sobriety of the mental state of yours truly. I am in love. Of late, a great change has taken place. My outlook on the world has taken a definite trend toward the finer things in life. Cobwebs have gathered on the old exhaler, and the inhaler.

This wonderful vision of delight with whom I am QSOing at the water's edge became known to me through the medium of radio. A casual remark at an exhibit at the county fair, concerning the mystery of the radio station which our local club sponsored, brought about an introduction. About 30 minutes of peak resonance and we find ourselves with a nightly sked at the beach.

Three weeks have passed. Never yet have I had an opportunity to meet her family. Thinking that it would favorably impress the y.l., I suggested that I drop in the next night for a personal QSO with her folks. What quirk of fate prompted this remark, I do not know. As I told you earlier, my whole outlook on life changed.

Thus began the darkest period of my young life.

How was I to know that this jewel of mine, this beautiful creature, this incomparable bit of superlative femininity, was afflicted with a Kid Brother. And to make matters worse, a KB with yearnings toward radio. Oh, woe is me, woe is me.

The next night I met the family.

Pop was a good old soak: never mad, never grouchy. Ma wasn't a bad sort either, although she did wear the pants. But that KB. In some mysterious way, I immediately had a feeling that an evil spirit was upon me. The y.l. introduces me to the gang, with a side remark, "He's a radio amateur." The KB's flaps, what would ordinarily have been called ears had they been of normal size, began to twitch. "Can you build a radio?" was his first remark. With a sheepish grin, I modestly admitted that I could.

Well, right away, the KB comes back with, "Have you got a radio?"

Like a dern fool, I blurted out, "Boy, you should see the very f.b. super I finished up about a month ago." Incidentally, that set represented about 6 months skimping on everything from soup to nuts to buy the parts, and no little bit of 4 weeks labor in building it. The little menace just couldn't rest another minute until I had promised to bring it over and let him see it.

True to my word, the next night sees me lugging the old inhaler up the parental domicile's walk. The KB went crazy. He grabbed it away from me and yelled, "Hook it up and make it work." After tuning in about 40 foreign phones, I turned it over to him with an admonishment to be careful with my masterpiece, and the y.l. and I took off for the beach.

A week passed. The y.l. and I were in perfect resonance, and everything was vy f.b. Exceeding my expectations, the receiver was still intact and the KB had actually become friendly enough to speak to me when I came in. Of course, it wasn't much of a greeting, just a "Come here and make this set work better on this guy." He had never learned to trim the antenna. I had almost decided to

[*Continued on Page 70*]

By W. H. HUMPHREY, JR., W4BPL

AR-77

COMMUNICATION RECEIVER

Use of an over-size power transformer to reduce heat; Polystrene insulation at strategic points; a temperature-compensated trimmer that automatically prevents frequency drift, and other RCA features make this new super "tops" in stability of tuning. For instance, during a 60-minute test starting one minute after turning "on", the drift at 30 megacycles was only 3.0 kilocycles. In this same test, when the line voltage was varied from 105 volts to 125 volts the drift at 30 Mc. was only 1300 *cycles.* Match this performance if you can!

As for sensitivity—well, the AR-77 has the highest signal-to-noise ratio of any receiver made by RCA, and that's saying plenty.

These features are typical of the superiority that has been built into *every* electrical and mechanical characteristic of this new receiver. In it, RCA engineering has gone the limit in providing the most exacting performance at a moderate price. Try it at your nearest RCA distributor's store. You be the judge!

Complete Technical Bulletin on request.

Frequency coverage, 540–31,000 KC in *six* Ranges—dual R-F alignment; stay-put tuning; negative feedback in audio amplifier; uni-view dial; calibrated bandspread for 10, 20, 40 and 80 meter bands; accurate signal reset; variable selectivity in six steps with crystal filter; improved image rejection; *adjustable* noise limiter and many other features.

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

RCA *for Amateur Radio*

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J. • A Service of the Radio Corporation of America change my opinion of the boy. Maybe he was OK after all. Alas, how wrong I was. His reason for inactivity was a simple one.

He had not fully made up his mind as to the logical point at which to strike.

One gorgeous night, the y.l. and I decided to see if it was true that two could live as cheaply as one and all that. With malice toward none and goodwill toward all mankind, we entered her chateau at the unusual hour of 10 p.m., with all good intent of breaking the glad tidings to her Pa and Ma.

What a horrible sight smote my eyes. My receiver, my one and only receiver was no more. Only an empty chassis, tangled wires, broken resistors, bent condenser plates, cracked tubes, remained of what had been the best little 12-tube super in town. That fiend of satan, whom I just contracted to become my own kin, was sitting in the middle of this ruin. With a gleam in his eye, he calmly states, "This thing quit working and I took it apart to find out why. You don't even know how to build a radio, 'cause I can't find a plan of one like it in any of my magazines."

Well, brother, I told you earlier that some strange force had changed my outlook on life, and that my actions were not my own. To this day, I am at a loss to understand how that boy left the floor in such a rush, or how it was that my foot collided with the lower portion of his anatomy. I dimly remember hearing the fateful words of my beloved, "To think that you would treat my own flesh and blood in such a cruel way. Go, you brute, and never darken the portals of my home again. It is all over. Go!" Brother, I went, with what unbroken parts remained.

A soft, southern moonlit night. The waters of the blue Atlantic gently rolling in from far off climes, bringing a flock of clear dx signals. A sweet receiver in front of me, a kw. transmitter by my side. A good old bug, its little paddles tenderly patted by my paw. A little shack built near my dream house, with rhombics, Vees, and signal squirters all around it. A perfect antenna match. The sound of a lovely fist. Bliss.

56 and 28 Mc. Resonant Line Converter

[*Continued from Page 36*]

the setting involving the greater amount of oscillator trimmer capacity. With the converter feeding the receiver to be used as the i.f. channel, the plate circuit and grid line are tuned for maximum test signal or noise. Due to the low set noise level of this converter, it is difficult to align it on noise alone, without the help of a receiver to set the oscillator or a signal on which to test, but it can be done.

This converter tuned to 28 Mc. with the grid padder 55 per cent in, and to 56 Mc. with the padder 3 per cent in. The same oscillator coil is used on both bands, but in some layouts, a separate oscillator coil for five meters may be desirable for good tracking.

The tracking can be checked by setting the condenser gang at one end of the band, lining up the grid carefully, then setting the gang at the other end and seeing how much the oscillator or grid must be re-trimmed for proper alignment. The oscillator coil can be cut to make the tracking quite accurate; in fact, no adjustment at all was required on the converter described above to get signals of good intensity all over the band.

The final adjustment is the antenna coupling—so often overlooked on high frequency receivers. The hairpin coupling coil shown in figure 1, with its center grounded, produces less ignition noise than does the unbalanced method of grounding one feeder and hooking the other directly to a tap on the inner conductor. It will probably require a loop six inches wide in order to match an open-wire feeder on ten meters. The one in the picture is 4½ inches wide but gives the best signal when pushed in until it is touching the insulation on the inner conductor. With an unbalanced (concentric) line or unbalanced coupling of a two-wire feeder, hooked directly to the grid line's inner conductor, the tap should be moved up from the shorting disc until signals reach maximum.

Operation

When a converter is placed ahead of a receiver, the set noise generally increases because of the additional amplification behind the first tube and tuned circuit. This has often misled fellows into calling a good converter "noisy." Actually, the receiver's gain should be run down and a signal tuned in at normal volume before judgment is passed on the signal-to-set-noise ratio.

The 1852 converter previously used was far better than a conventional all-band communication receiver used alone on ten meters. The new acorn with its concentric line grid circuit is as great an improvement over the 1852 job, the noise level actually being four R's lower on the receiver's R-meter, with signals of about comparable strength, even before adjustment of the antenna coupling. There should be no comparison at all on five meters where the acorn is much superior, and where the short concentric line becomes a greater part of a quarter wave and involves less sacrifice from the ideal length. The gain apparently does not fall off at the higher frequencies because the pipe becomes more efficient as the tube becomes less so; with a coil, this would not be true.

General Comments

Recently, the writer heard a west coast station say: "If I had the best ten-meter converter in the world, I would not use it unless it had the best dial." There is much to be said for this position, for which reason the matter should be considered carefully in building a converter. Some like the slide-rule type dial on which the whole band can so well be pictured; others get used to a dial that must be wheeled considerably between stations, and a mental note made of the relation between dial divisions and frequency. Whatever the decision, the converter can be laid out to match the dial and the resulting position of the tuning condenser gang. Fore-and-aft gangs call for placing the pipe vertically or out the side; right-angle dials that place the condensers parallel with the panel permit use of pipes in a vertical position or extending out the back. This converter might better have been arranged with more room between the open end of the pipe and the panel, in which the padding condenser can be placed with a short lead to the inner conductor. The pictured layout, with the longest leads to the greatest capacity, makes the pipe act as if it were 18¼ inches long, as calculated from the total capacity required for ten and five meters.

This converter apparently falls short of maximum efficiency in only two respects. First, the gain of a mixer cannot exceed one-third that of the same tube used as an r.f. amplifier. For that reason, a still better signal-to-set-noise ratio should be possible if an r.f. stage of similar efficiency is added. Second, the short pipe involves some sacrifice from the ideal length, resulting in lower Q and tuned-circuit impedance (Z_s) which bring about lower selectivity and gain than would result from the use of a longer pipe. There are some extenuating factors here, however, that deserve comment.

A resonant line will have the highest Q and Z_s when it is ¼ wavelength. As the line is shortened and brought back to resonance with a tuning condenser placed across the open end, the Q and Z_s fall—the latter nearly as fast as the length is decreased.[3] The Q can be restored by using a larger diameter pipe, maintaining the same ratio, which also favorably affects the Z_s. The impedance also appears to be improved in a line of given length by using a smaller inner conductor (higher ratio line) which makes necessary a smaller capacity to restore resonance.

But all of this assumes that no resistor is placed across the open end. A vacuum tube has an input resistance, due largely to transit time of electrons, and cathode lead length, which decreases with frequency. When this input resistance is placed across the open end of the line, the Q and Z_s are reduced. It may be of little practical advantage to build up a tuned circuit impedance of more than three or four times the tube's input resistance, which is the limiting factor in the input circuit anyway. Because of this tube input resistance, a short line in practice does not involve as much of a sacrifice as a study of an *ideal* line would indicate, particularly as the frequency is increased, and with tubes poorer than the acorn.

The noise generated by tubes and their grid circuits has been studied. Data have been prepared by R.C.A. engineers showing the resistance which would produce a noise equivalent to that appearing in the plate circuit of each tube type.[4] This measure reflects the amplification in the tube and is useful at frequencies low enough so that the tube's input resistance does not limit the stage gain. The 1852 is very good in this respect, and some converter tubes are very poor. At high frequencies, however, it is necessary to consider the loss of gain due to placing the tube's input resistance across the tuned circuit. The 1852 has such a low input resistance at 60 Mc. compared with acorn tubes that the voltage developed across the grid circuit is low, giving all the advantage both as to noise and gain to the acorns. The advantage of acorn tubes increases with frequency, for which reason there is good justification for the statement that no serious-minded worker above 28 megacycles should use anything else in receivers. A table showing noise equivalent and input resistance for several tube types appears on page 73.

As this converter stands now, 2½ meters cannot be reached without disconnecting the padder and shorting out a sizeable part of the line. With a layout that keeps the condenser and tube leads short—and with the padder disconnected—the pipe will almost get down there without using a larger inner conductor

[3] Nergaard and Salzberg, "Resonant Impedance of Transmission Lines," *IRE Proceedings*, September, 1939, p. 579.

[4] E. W. Herold, "Superheterodyne Converter System Considerations in Television Receivers," *RCA Review*, January, 1940, p. 335.

Tube	Conversion transconductance	Equiv. Noise Resistance	60 Mc. Input Resistance
6SA7	450	210,000	—10,000
6L7	400	210,000	+ 2,300
1853	1,900	13,000	+ 8,000
1852	3,600	3,000	+ 2,500
954		1,400	+54,000
956		1,800	+54,000

or shorting out several inches of pipe near the shorting disk. Modulated oscillator signals can then be received only with a broad high-frequency i.f., resistor loading of the i.f. transformers, or turning the converter into a superregen receiver. As long as five and ten present a problem that is different from that of 2½ and 1¼ meters, there seems to be no hurry to make the converter hit three bands without a "coil change." This approach to the receiver problem, nevertheless, should be of interest both to the dx man and the pre-skip u.h.f.

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

The Mighty Mite Band Jumper

[*Continued from Page 27*]

The r.f. power supply furnishes 600 volts d.c. at a maximum of 250 ma. This transformer is shown next to the front panel by the oscillator section in one of the illustrations. Its rectifier is located directly beside it and the bottom view of the chassis shows the filament transformer for it, located directly by the socket. D.c. output from the rectifier is fed through the 8-henry 250-ma. choke shown on the underside of the chassis near the filament transformer. An 8-μfd. 600-volt electrolytic filter condenser is used across the output of this choke, and a 50-watt, 25,000-ohm bleeder is utilized. It was found inadvisable to use condenser input in this filter and the components named provide a very pure d.c. The bleeder is tapped down to provide screen and plate voltages for the oscillator. These voltages should be about 325 for the plate and 180 for the screen.

The other power supply utilizes a transformer delivering 400 volts d.c. at 200 ma., with filament windings as follows: 5 v. at 3 a. for the rectifier; 6.3 v. at 5 a. and 6.3 v. at 1.5 amps. This latter winding is used exclusively for the HY69. The d.c. output of the speech-modulator power supply is filtered through a 5 to 30 hy. 250-ma. swinging choke, mounted beside the plate transformer on top of chassis at rear, with 8 μfd. of 450-volt electrolytic filter condenser on the input side and 16 μfd. on the output, furnished by a triple 8-μfd. metal can type condenser, as shown. This supply uses a 20,000-ohm 25-watt bleeder, and full voltage is applied to the speech and modulators.

The method by which the two power supplies are switched on and off is somewhat novel, and works well. It is impossible to turn on the speech and modulator plate supply without also turning on the r.f. supply, as these are controlled in series. However, the r.f. may be used independently of the audio portion whenever desired for c.w., merely by turning to "off" position the modulator supply switch. In actual operation, whether for c.w. or phone, only the r.f. power switch need be thrown to operate the rig, providing the modulator switch is left in the "on" position when working phone. This simplifies operation and makes it impossible for "forget" and leave the speech and modulator running idle, with no r.f. load. The value of this is appreciated by those of us who have blown up class B modulators by removing the r.f. load accidentally and leaving the speech "on."

Operation

In tuning up the Band Jumper, after testing all filament connections, and the power supplies for output, place a 6L6GX in the oscillator socket and turn on the power. With the bandswitch set to the desired band, and proper crystal in place, tune for the oscillator dip. This should be somewhere between 14 and 40 ma., depending on the frequency band used, and also whether operating on fundamental frequency or doubling. Of course, the meter switch should be set on "oscillator" position. It is wise to use a flashlight globe with a single turn of wire to indicate presence of r.f. in the oscillator coil. If it is found to oscillate indiscriminately, adjust the regeneration condenser for more capacity and try again. As more capacity is added, less regeneration occurs. Inversely, if one desires harmonic doubling in the oscillator, this regeneration condenser is useful for controlling the correct amount of feedback needed to give smooth operation and proper harmonic output. It is advisable to test with crystals that are known to be active oscillators.

Doubling in the oscillator is done simply by replacing the fundamental coil with one for the next higher frequency band, and retuning for dip. If no dip is found, the regeneration condenser should be turned for less capacity until sufficient regeneration is added to the circuit to permit harmonic output. Oscillation can be controlled very easily by a combination of adjustments on the regeneration condenser and by varying the screen voltage. The latter, however, once set, need not be changed afterwards. If the oscillator draws too much current, it may be reduced merely by reducing the screen voltage.

Doubling in the oscillator circuit cannot be done with 10- or 20-meter crystals as they are of a harmonic type, operating on their third harmonic. However, it is possible to use a 40-meter crystal in the oscillator with output on 20, and double in the final to ten. Successful operation has even been had on 5 meters by quadrupling, using a special coil, as 5-meter coils are not available at present from Coto in the Pee-Wee type, as used elsewhere in this transmitter.

Successful operation on ten meters is possible by using a 10-meter crystal and operating straight through, or a 20-meter crystal and doubling in the final. One is about as efficient as the other, due to the ease of drive possible in the HY69.

The final amplifier is excited through the variable coupling condenser described earlier in the text. When plate power is applied to the HY69, first tune for the dip, which can usually be found with little difficulty. Adjustment of the coupling condenser to the grid is not critical and is of value most on 10 and 20 meters where it is desirable to refrain from overloading the oscillator to prevent excessive drift.

Where doubling is desired in the r.f. amplifier, merely plug in a coil for the next higher frequency band into the final bandswitch coil position in use, and retune for the dip. For instance, with a 160-meter crystal and coil in the oscillator, an 80-meter coil in the amplifier will double very nicely with the same efficiency as if it were directly excited on 80. With a 20-meter crystal, doubling in the final is practically as efficient as if excited straight through on 10.

No trouble with parasitics was experienced in this particular transmitter, but they may occur in some instances, especially in the r.f. amplifier on high frequency operation. A simple cure is a 50-ohm 1-watt resistor in the grid circuit of the final, directly at the tube socket in series with the coupling condenser and the grid of the HY69, and also a 50-ohm 1-watt resistor in series with the screen, directly at the tube socket also. The antenna coil may next be plugged in and tuned up for operation on whatever band the set is operating. Taps are used on the coil to allow immediate adjustment for various antennas and bands of operation.

Normal load for the HY69 is 100 ma. plate current at 600 volts. However, it is well to remember that the meter is in the cathode circuit and reads grid and screen grid current also. Therefore allow about 20 ma. for these elements, and thus the proper current will be about 120 ma. fully loaded. The HY69 has proven to be such a husky tube that even when operating at 160 ma., no plate color is apparent. This would be an input of about 84 watts, after deducting screen grid and grid currents.

The speech and modulator may next be tested, by turning on the modulator power switch. However, as it cannot be turned on without turning on the r.f. also, it is best to remove the rectifier tube from the r.f. power supply so that a straight test on the speech amplifier may be made. A simple test is made as follows: first, remove the two modulator tubes. Then place a pair of headphones in series with a 1-μfd. condenser to the plate of the 6N7 driver and ground. Next, plug in the crystal microphone and turn on the power. Gradually increase the gain until you hear the room noises. Then, try speaking. If ok, you may remove the phones and plug in the modulators. A 40-watt lamp may be coupled across the lowest available impedance taps on the output of the modulation transformer. Turn on the power again and speak into the microphone, gradually increasing the gain. You should be able to light the lamp practically to full brilliance on sustained tones. If trouble develops, check tubes and circuit thoroughly, as usual in most cases of trouble shooting, i.e., voltage at plates, resistors, condensers, etc.

Modulator plate current should read approximately 120 ma. when idling and increase to 150 or 160 ma. on voice peaks.

When properly coupled to a good antenna, this type of transmitter will make its signal heard for many miles of dx, as has been proven with this particular unit. Its flexibility of operation in band jumping will be of particular value to the man who likes to operate on all bands with one rig, and its ease of operation will prove a lasting pleasure to its owner.

And, too, don't forget the very great advantage that its 45 or 50 watts of r.f. output and 30 to 40 watts of audio make it highly suitable for a future increase in power, to 250 or 300 watts, cathode modulated, at but little increase in cost.

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

A Dual Modulation Meter

[Continued from Page 33]

Check all the zero adjustments, the carrier level, and the average modulation. With the gang switch on peak modulation, adjust the peak modulation control until the neon light is just on the point of flashing. Put a mark on the paper indicating the position of the bar knob and record 50%. Repeat this procedure in steps of 10% from 0 to 160%.

Cut two disks of celluloid and two of good grade paper 2" in diameter with a 3/8" hole in the center. Transfer the graduations for per cent peak modulation on one paper disk and mark it, "% Mod.-Peak." Black India ink should be used. This scale, covered with a celluloid disk, is placed behind the nut on the peak modulation control.

An arrow in the clockwise direction is drawn on the other paper disk which should be marked, "Increase." Mount it behind the nut on the average modulation zero adjustment to balance the panel.

Since there is no standard definition of an R9 signal, considerable leeway can be used in calibrating the R scale. The suggested method is to set the antenna potentiometer on maximum and choose a signal that is R9 in the operator's estimation. The carrier gain control should be turned to the point where the meter indicates R9. A small dot of white lacquer should be put on the panel to indicate this position of the bar knob.

The first step in calibrating the model meter dial for the R scale was to draw the curve of E_g, the total grid voltage from cathode to grid, versus I_p, the plate current, for the 6K7. With the excitation voltage e_g equal to zero, I_p equal to 5 ma. is obtained when E_g is equal to E_c, the grid bias, or —4.4 volts. It was then assumed that an R9 signal was 54 db, with a grid voltage E_g of —20 volts. Then e_g for an R9 signal, e_{g9}, is (—20)—(—4.4) or —15.6 volts. With E_g equal to —20 volts the curve shows the plate current to be .85 ma. An R8 signal, 48 db, represents a voltage one-half that of an R9 signal. Therefore, e_{g8} equals ½(—15.6) or —7.8 volts. E_{g8} is then equal to (—4.4) (—7.8) or —12.2 volts. The plate current corresponding to E_g equal to —12.2 is 1.5 ma. This process is then repeated in steps of 6 db.

While the foregoing may seem complicated, only two simple equations are involved, viz:

$$E_g = E_c + e_g,$$

and

$$db = 20 \log_{10} V_1/V_2.$$

Accuracy

This modulation meter was designed to have greater stability than most modulation indicators on the market and with the knowledge in mind that it need not be as theoretically accurate as the broadcast type indicators approved by the FCC for broadcast stations.

The accuracy of the meter operated in conjunction with a receiver depends upon the fidelity of the receiver, the signal-to-noise ratio, and the amount of interference to the monitored station. With a high fidelity receiver and under ideal receiving conditions the accuracy is the same for receiver and transmitter.

If the voltage regulator circuit of figure 6 is used, the accuracy of the peak indicator is improved by nullifying the effects of changes in line voltage on the balancing voltage of the peak modulation control. There is ample room for the VR150 in front of the 6K7 and 884.

The accuracy of the peak indicator is the same as that of the average modulation indicator if the voltage regulator is used. The overall accuracy is 4%, 2% for meter and observation error, 1% for changes in circuit constants, and 1% for carrier leakage.

Meters approved for broadcast stations are supposed to have an accuracy of 2%.

In order to get the greatest accuracy out of this modulation meter, frequent checks should be made on the zero adjustments.

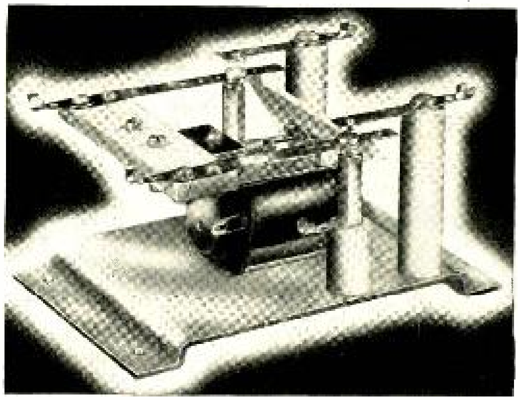
913 Frequency Meter Modulation Monitor

[*Continued from Page 39*]

Operation

After ascertaining the approximate frequency of the transmitter to the nearest 250 kc. (which can be accomplished even with a very poor receiver) set the receiver to the broadcast band, and tune it to a station which has a harmonic frequency in the amateur band that you wish to use. With the electron-coupled oscillator in the cathode-ray frequency meter tune to zero beat with the broadcast station. Then tune the transmitter to the harmonic frequency of the broadcast signal in the amateur band and a clear and stationary waveform will appear on the screen of the oscillograph at the exact frequency. This tuning will be exceedingly sharp as it is a matter of cycles. An auxiliary tuning condenser made of a couple of half-inch discs, one stationary and the other on a threaded shaft, will be found very helpful in tuning.

Caution: When tuning to zero beat using a superhet broadcast receiver care should be taken to beat with the incoming signal and not with the oscillator in the set. This can be determined by tuning the set. If the beat note immediately goes to a high pitch upon tuning the dial on the b.c. set slightly off the broadcast signal frequency the e.c.o. is not on the



signal frequency but beating against the local oscillator. If the pitch of the beat note remains the same this shows correct adjustment.

Accuracy and Availability of Signals

The accuracy of this meter depends on the accuracy of the broadcast station, which is usually within 10 cycles of assigned frequency, and the ability of the operator to get a close beat note. Physics texts say the average ear can hear as low as 16 cycles. Let us assume an error of a possible 30 cycles. Then if the b.c. signal is on 1000 kc. and we desire to work on 30,000 kc. the error will be about 900 cycles, or close to 1 kc. On 4000 kc. the error would be only slightly over 100 cycles.

The number of spot frequencies available greatly increases with frequency. Practically all b.c. signals have harmonic frequencies lying in the 10-meter band. Over half have harmonic frequencies in the 20-meter band. Even under the poorest conditions of broadcast reception half a dozen spot frequencies on the 80-meter band will be available. The variable-frequency oscillator used in the transmitter can be calibrated to a fair degree of accuracy between spot frequencies anyway. At night with a good broadcast receiver the number of available broadcast signals having harmonic frequencies in the amateur bands is very large.

Use as a Modulation Monitor

After setting the transmitter to the desired frequency the lead from the 42 oscillator to deflecting plate D_1 can be disconnected and a lead from the audio system substituted. With the proper value of audio impressed on D_1 a very satisfactory trapezoidal modulation check upon the transmitter's operation may be made. Also, if desired, 60-cycle a.c. may be applied to D_1 to act as sweep voltage for visual monitoring of the transmitted carrier. Or, naturally, by removing the link from the unit to the transmitter the unit may be used in the conventional manner as a cathode-ray oscilloscope for checking audio waveforms, receiver alignment, etc. with the appropriate signal applied to D_3 and the appropriate sweep applied to D_1.

General Coverage Converter

[*Continued from Page 41*]

strength can then be increased by tuning the grid circuit. Local broadcast can be received with a choke or amateur band coil in the grid, but other signals will require a resonant input circuit for suitable results.

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

A Simple QAVC System

[*Continued from Page 43*]

nal is being received. In many receivers employing remote cutoff tubes such as the 78, 6D6, 6K7, 6SK7, etc., the tube will draw just about 10 ma. without signal, and no alteration in the screen voltage or cathode bias will be required.

The 25,000-ohm variable resistor across the relay is adjusted until with no signal the relay contacts won't quite open. Then, when a signal is tuned in and the increased a.v.c. bias voltage causes the tube to draw less plate current, the contacts will open and the a.f. stage will be operative. Except on very weak signals the action of the relay will be positive and no chattering or erratic operation will be experienced, even when the relay is being jarred moderately, as would be the case in mobile service.

Observe that the operation of the relay is "backward"; the *reception* of a signal causes the armature to *let go*, and thus open the short across the a.f. system.

One I.F. Stage

In some of the less expensive communications type receivers having no r.f. stage and but one i.f. stage, the a.v.c. action will not be sufficient to cause a satisfactory plate current change in the i.f. stage on weak signals. This condition can be helped by using a divider instead of a simple dropping resistor for screen voltage.

If the screen voltage is already "tied down" fairly well yet the plate current change is not great enough for satisfactory operation of the relay, a greater change in plate current can be obtained by substituting a sharp cutoff tube for the remote cutoff tube generally used in the i.f. stage.

It might appear that the substitution of a sharp cutoff tube (57, 6C6, 77, 6J7, 6SJ7, etc.) would result in crosstalk or distortion when receiving on or near the frequency of a nearby powerful station. In actual practice this does not happen, at least in the case of receivers having but one i.f. stage and no r.f. stage, and the a.v.c. action is improved. In other words, not only do we get a better plate current swing for operation of the relay, but for a given setting of the a.f. gain control all signals are more nearly the same a.f. volume than when a remote cutoff tube is used. Also, a fading phone signal is held at more nearly the same volume.

A sharp cutoff tube draws somewhat less plate current than its remote cutoff equivalent at the *same bias voltage.* This means that the cathode bias resistor will probably have to be lowered to a value as low as 150 ohms (and possibly the screen voltage raised slightly) in order to get the tube to draw 10 ma. with no signal. Under these conditions, however, the gain is greater than for a remote cutoff tube, and therefore the i.f. stage will provide more amplification on weak signals. This is due to the fact that a sharp cutoff tube has somewhat greater transconductance than a remote cutoff tube at the same plate current.

Auto Alarm System for U.H.F.

[*Continued from Page 45*]

lag; a value of 1 μfd. giving snappy enough operation to work a tape recorder at 40 w.p.m. A large time lag eliminates the likelihood of false buzzer signals due to reception of voice frequencies of the same pitch as that to which the audio system is responsive. C_{11} prevents relay clicks reaching the detector (the buzzer should also be shunted).

The photographs should give a fairly good idea of the construction. The detector is mounted horizontally at the top of a bakelite strip fastened to the chassis with an angle iron bracket. Below the tube socket is the tuning condenser connected with its dial by means of a flexible coupling and a piece of ¼-inch bakelite rod. The coil is soldered directly to the tuning condenser. As no provision has been made for a regeneration control (because of the low detector plate voltage) the antenna coupling must be adjusted for smooth operation over the band. If the coupling is too tight it will go out of oscillation or squeal at one end of the dial while if it is too loose the receiver will be insensitive. At the low plate voltages involved the radiation is negligible.

The relay with C_{10} is mounted behind the tuning dial and in front of the detector assembly. Under the chassis (which measures 7"x5"x2½" with a 7"x7" panel) may be seen the two audio transformers T_1 and T_2 bolted on one side at right angles to one another to reduce mutual coupling. The rotary switch is mounted on the panel next to the transformers while on the opposite side is the filament transformer T_3 with R_4 (which is adjusted by screw-driver) fastened right next to it by means of a bracket. The volume control R_3 is on the panel in front of R_4. The jacks for phones and relay contacts occupy the bottom center of the panel and the filter block comprising C_5, C_8 and C_9 is fastened under the rear edge of the chassis.

The only difficulty liable to bother the constructor of this apparatus will be the tuning of transformers T_1 and T_2 by C_6 and C_7. This tuning operation can be done easily enough if the station has a variable audio oscillator for i.c.w.

Remove the antenna from the transmitter and modulate the carrier with approximately a 1000-cycle tone. Turn down the speech amplifier gain until the relay R just drops back, then connect various condensers across T_1 until that value is found which will operate the relay with the smallest amount of transmitter modulation. Repeat this process with T_2 and C_7.

It should be pointed out here that high quality audio transformers with large cores will not be suitable. Only the midget variety such as shown have values of inductance tunable to a reasonably sharp peak. Those used in the model pictures here gave maximum amplification at 960 cycles with signals of 800 and 1300 cycles attenuated 40 db, giving some idea of the selectivity to be expected.

Audio oscillators used do *not* have to be sine wave but for most effective operation should not have too large a harmonic output.

If a group of 2½-meter enthusiasts wish to use this system to call the different members there is a choice in the method of operation. Either all of the receivers may be left tuned to one spot in the band, calling being done by variable-pitch pre-calibrated audio oscillators, or else one audio pitch can be used and the transmitters tuned to the various receivers. The former method is most likely the simplest.

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

Past, Present and Prophetic

[*Continued from Page 6*]

readings on stations much higher than is normal . . . I would greatly appreciate any suggestions you may make to improve this condition." From another recent letter: "As to date I haven't seen any of your circuits work. They are extravagant, expensive, complicated and unauthentical." Ordinarily two letters such as these would command but little general interest since we can understand the dilemma in which the first, a new ham, finds himself, and ignore the second, which was signed by "A Hamburger W4—" who was probably angered by an r.f. burn from his Bi-Push. But the fact that they arrived in the same mail sort of amused us.

●

A recent applicant asked the F. C. C. to license an experimental station to replace the wire circuit between announcer and public address amplifying set.

A 2.5 Meter F.M.-A.M. Superhet

[*Continued from Page 15*]

quency change. This is shown graphically in figure 5. It is apparent from this curve that the maximum undistorted audio output is obtained from the limiter when the transmitter swing under full modulation corresponds to the frequency range included under the straight portion of the discriminator characteristic.

A complete explanation of the operation of the discriminator would require an article in itself and is beyond the scope of this description. However, a redrawing of the discriminator circuit with the d.c. voltages eliminated will aid somewhat in gaining an understanding of the operation. The redrawn circuit is shown in figure 6, the components being identified by the same indications as in figure 2.

From figure 6 it may be seen that each of the discriminator diodes has one half of S and all of P supplying r.f. voltage to it. Aside from being common to both diode circuits, P is also inductively coupled to both sides of S. This leads to a condition where at resonance the voltage across the two halves of S are equal and, as P is common to both diodes, the d.c. voltages developed across R_{18} and R_{19} are equal and oppositely polarized, and cancel, resulting in E, the output voltage, being zero.

At frequencies off the resonant peak of S, an entirely different situation results, since the phase relationships between each half of S and P change considerably with variations in frequency. The result of the phase changes occurring is that although the voltages at opposite ends of S are still 180 degrees out of phase with each other, each has a different phase relationship with the voltage across P so that the resultant voltage applied to each diode is different. This results in different voltages across R_{18} and R_{19} and a positive or negative output voltage, equal to the algebraic sum of the voltages across the two load resistors, at E.

In a practical discriminator it is necessary to replace the primary winding with an r.f. choke and use a coupling condenser between the limiter plate and the secondary center tap to isolate the d.c. voltages in the circuit. When this is done the circuit used in the receiver is obtained.

When the impressed signal is at the resonant frequency of T_4 and steps are taken to allow the limiter stage to pass amplitude variations the voltages across R_{18} and R_{19}, while still equal and opposite in polarity, are proportional to the amplitude of the signal. Thus, by the simple expedient of taking the audio output from the junction of the two resistors, amplitude modulation may be received. The two s.p.d.t. switches, S_1 and S_2, allow the change from one method of operation to the other to be simply made in the receiver. S_2 moves the audio output lead from the top to the center of the load resistors and S_1 on the limiter "threshold" control raises the plate voltage on the limiter by disconnecting the limiter potentiometer, R_{17}, from ground, and shorts out its grid-leak bias. A relatively small amount of cathode bias is required, since the plate and screen voltage does not rise to a very high value, even with R_{17} cut out of the circuit.

Discriminator Transformer

As received from the manufacturer the transformer, T_4, specified in the diagram has no center tap on its secondary and lacks sufficient coupling to serve as a discriminator transformer. Consequently the transformer must be altered as follows: After removing the transformer from its shield can, the lower winding, which is to become the secondary, is completely unwound from the dowel. If the unwinding is done carefully a narrow ridge of the compound with which the windings are impregnated will be left on each side of the space the winding occupied. These ridges will form a sort of "slot" in which to rewind the wire which has been removed. It will be found that about 65 turns of wire were on the winding but it will be impossible to get more than 55 to 58 turns back in the slot by hand scramble-winding methods. In the receiver shown, a trial rewinding of the wire indicated that 56 turns could be replaced, necessitating that the center tap be brought out at the 28th turn.

After the secondary has been rewound on the dowel it should be thoroughly covered with Duco cement or a similar coil compound and allowed to dry for an hour or more. When the cement has dried thoroughly it will be found that a firm pressure aginst the winding will allow it to be slid along the dowel toward the primary to increase the coupling between the windings. The proper location for the secondary is a position where the distance between the adjacent edges of primary and secondary is about 1/8 inch. Another coating of the coil dope will hold the winding in place, and the transformer may be reassembled in its shield can and installed in the receiver.

Audio Section

From the discriminator the audio voltage is passed on to the audio amplifier through the resistance R_{20} and the coupling condenser C_{19}. R_{20} in conjunction with C_{29} supplies a small amount of attenuation to the higher audio frequencies and thus helps to reduce any noise which gets this far in the receiver.

The rest of the audio section is strictly conventional. The gain control is placed in the grid of the 6V6 output stage. The connections to the permanent-magnet speaker are brought out at the power plug. The usual precautions regarding the application of voltage to the receiver without the speaker connected should be observed here, of course.

Aligning the I.F. Channel

There is no really simple way of accurately aligning the i.f. and discriminator in a f.m. receiver. The inclusion of a 6E5 "magic eye" tube operating from the voltage developed across the limiter bias does help considerably, however, aside from its intended use as an accurate tuning indicator for placing f.m. signals "on the nose." Probably the easiest method of aligning the receiver is first to loosely couple an ordinary tone-modulated signal generator to the plate of the mixer stage. With both switches set for "a.m." make a rough alignment for maximum audio output. This assumes that the i.f. transformers are somewhere in the vicinity of alignment so that some sort of signal may be forced through the i.f. channel to get a start on the trimming process. If no signal is heard at the output when the signal generator is applied at the mixer plate and tuned around over a narrow range around 3000 kc. it must be assumed that the i.f. transformers are considerably out of alignment and the usual procedure of first coupling the signal generator to the primary of the last i.f. transformer (T_4) and then working back toward the mixer stage must be followed.

After a rough setting of the trimmers has been made the alignment may take on a more exact nature. With the signal generator still applied to the primary of T_1, but with switch S_1 changed to the "f.m." position by cutting in all of R_{17}, each trimmer on the first three i.f. transformers should be adjusted for maximum voltage across R_{14}, as indicated by the closing of the "eye." Next, the setting of the trimmer across the secondary of T_4 should be tackled— and here is where the trimming becomes critical. Since the trimmer adjusting screw is "hot" for r.f., the tool used for this adjustment should be of the low-capacity type having a long composition or wood handle. The discriminator output switch, S_2 should be thrown to the "f.m." position and—assuming that the primary of T_4 has been set somewhere near resonance in the previous rough alignment—tuning the secondary winding through resonance should give a very sharp and definite drop in the audio output, the audio-tone volume increasing on either side of resonance but dropping to a very low value or disappearing entirely at exact resonance. The signal from the signal generator should be kept at i.f. resonance, as indicated by the 6E5, during the alignment, of course.

The last adjustment to be made should be that on the primary of T_4. There are two ways of getting this circuit properly tuned. Probably the simplest method is to keep the signal generator tuned right in the "notch" of the secondary winding but increase the amount of signal applied to the i.f. channel until a small amount of audio comes through at this frequency and then tune the primary winding for maximum decreases or "dip" in the remaining audio.

The other method of trimming the primary involves rocking the signal generator back and forth across the resonant frequency previously obtained observing the strength of the peaks in audio output which are heard on each side of the "notch." When the primary is properly tuned these peaks will be symmetrically located, one on each side of the "notch" frequency, and of equal strength. If the i.f. loading resistors are of the values indicated under the diagram and the coupling between the primary and secondary of T_4 has been properly adjusted the peaks will be approximately 130 kc. apart.

For the purists who may object to this method of adjusting the discriminator, it might be mentioned that the results obtainable correspond exactly with those obtained when a vacuum-tube voltmeter is used to measure the voltage from the top of the discriminator load resistors to ground, and T_4 adjusted to secure equal and oppositely-polarized voltages for equal deviations each side of mid-frequency.

Those who find it more convenient to use an unmodulated signal at the i.f. frequency and a vacuum-tube voltmeter or zero-center high-resistance voltmeter to align the i.f. and discriminator may do so by connecting the indicating instrument between the top of R_{19} and ground and, after aligning the i.f. transformers up to T_3 by the 6E5, adjusting T_4 so that zero voltage is obtained at the center of the i.f. band, and equal and oppositely-polarized voltages are obtained for equal and opposite shifts in signal-generator frequency from center frequency. When a vacuum-tube voltmeter is used for this adjustment it will be necessary to place a battery in series with the instrument to bring it somewhere near half scale.

R.F. Alignment

There is little that need be said about tuning up the front end of the receiver, since the only problem is to find the band. The simplest way to do this is to hunt for a 2½-meter signal with the oscillator padding condenser, C_{23}, keeping the mixer grid aligned by following with C_1. In the absence of signals the best procedure would be to set the oscillator tuning condenser at mid scale and adjust the padding condenser so that the oscillator is on a frequency 3000 kc. lower than the center of the band, or 111 Mc. The frequency should be measured by Lecher wires, the proper distance between points being very close to 53 inches. A detailed discussion of the use of Lecher wires was given in the April, 1940, issue of RADIO.[3] The glow in the VR-150 makes a fairly good resonance indicator for this purpose.

Lining up the mixer grid involves only tuning the mixer grid condenser and adjusting the antenna and oscillator coupling for maximum background or signal. The two coupling adjustments will be found to be somewhat interdependent and should be ad-

[3] "Finding the 2.5-Meter Band," p. 53.

justed simultaneously. The mixer coupling is not extremely critical, however, and optimum results should be obtained over a wide range of injection voltage. Two inches of wire available for pushing through the grommet and into the mixer grid tank will provide sufficiently wide range of coupling from the oscillator. Too little coupling will result in a loss of sensitivity, while too much coupling will cause bad pulling of the oscillator by the mixer tuning. Fortunately maximum sensitivity is realized with quite a bit less coupling than is required to cause serious pulling.

Chassis Layout

It is unlikely that anyone having ambition and fortitude enough to undertake the construction of a f.m. receiver will want to copy the mechanical layout of this one down to the last detail. However, the chassis layout will be described briefly for the benefit of those who might like to know "what is located where."

The chassis, which is surmounted by an 8" x 17" panel, measures 7 by 15 by 3 inches. The 956 is located near the left rear corner of the chassis, with its concentric grid tank running along the rear of the chassis, as is apparent from the photographs. The concentric tank is held to the chassis by two copper straps, one near each end. The mixer grid condenser is placed between the 956 and the left edge of the chassis, making it convenient to secure short leads to both the mixer and the inner conductor of the tank circuit.

To help in obtaining short leads, the oscillator socket has been mounted with its base above the chassis, making it necessary that the 6J5GT be located under the chassis. The oscillator grid coil is supported from the tuning condenser on one end and the no. 1 socket terminal on the other. The plate by-pass C_{24} is located right at the socket and connected in the shortest possible manner between the plate and no. 1 terminal. A dial having a built-in planetary reduction unit is used on the oscillator to allow accurate tuning.

To aid in isolating the oscillator and mixer from each other so that the injection may be controlled by pushing the lead from the mixer grid in and out of the mixer tank circuit, a 3 by 4 inch copper shield is placed between the two stages. The shielding is supported from the chassis by small angle brackets.

The first i.f. transformer, T_1, is located directly in front of the mixer, with the first 1852 between this transformer and the panel. The second i.f. stage with its associated transformers, T_2 and T_3, runs along the front of the chassis from left to right. Behind T_3 is the 6SJ7 limiter, which feeds through the discriminator transformer at its right to the 6H6 discriminator between the transformer and the panel. The audio follows along the right edge of the chassis, while the VR-150 regulator is located behind T_4.

The only wiring precaution that need be observed is keeping the grid and plate leads short. This holds for the i.f. section as well as for the high frequency circuit. No regeneration trouble in the i.f. section should be experienced if the grid and plate leads run directly from small holes below the i.f. transformer to their proper terminating point of the sockets.

The mica by-pass and coupling condensers in the mixer and oscillator sections should be of the smallest physical size available, since a physically small .00005-μfd. condenser will often prove to be a better by-pass or coupling device at 112 Mc. than a .002-μfd. or larger mica condenser having proportionately larger dimensions.

U. H. F.

[*Continued from Page 64*]

W3BZJ has worked eight states in four districts so far in 1940. How are *you* doin'? He is on 56,512 with 125 watts into T-40's. The receiver is an RME HF10. The antenna, just recently put up, is an extended vertical H using 10½ foot elements spaced 12 feet—it is far superior to anything else he has tried, which includes everything from a rhombic to one of those "four stacked element colinear down-spout monstrosities." Consistent day or night range is about 100 miles to the west (W3BKB in York), and northeast, but about 35 miles over a hill to the southwest (W3CGV in Wilmington, Delaware).

Down in Austin, Texas (there's a town!), Wilmer Allison of tennis and dx fame, has a new rig using HK24 doubler and buffer stages, and 100TH's in the final with 600 watts input. There is plenty of drive although the HK24's are pushed a bit hard. The receiver uses a DM36. The antenna is a five-meter Johnson *Q* but he has just finished a three-element rotary. The only QSO by mid-March was with W5GGS in Elgin, Texas (30 miles), achieved by taking his receiver out there and working cross band. He might watch for XE1A this summer, and should make a fine point for Dallas–Ft. Worth stations on "extended ground wave." Texas might be covered nicely by such 150-200 mile hops as between W5AJG EHM in Dallas, EEX in Houston, VV in Austin, and BYV in San Angelo.

It is rumored that W6PBD in Douglas, Arizona, is going on five soon. W6KTJ is back after putting up a two-section W8JK and two new finals for his transmitter. The all-band uses 812's; the five-meter rig uses a pair of HK54's with 300 watts input.

W8OKC in Pennsylvania has bought acorns for his new concentric line receiver. W8SCS in Benton Harbor, Michigan, has ordered some pipe, too. W9VEK in Indianapolis has built up one of the sewer-pipe jobs described in June, 1939, RADIO. W8QDU says he might take a gander with concentric line resonant circuits. Speaking of QDU, Fred has put HK254's in his final, though he doesn't expect a great improvement in his signal. His concentric (W.E.) vertical antenna finally ended with a 48-inch top and 50½ inch skirt, with several quarter-wave horizontal radials placed ⅛ wavelength below.

W8OKC now has HK54's in his final for the summer dx. He received a confirmation of a June 27 contact with W4AUU. Bill says that W2MO points his beam west every night at 10:15 to work W3BYF in Allentown.

According to W9USI, South Dakota activity is coming along nicely. He keeps twice daily schedules with W9BJV CJS and has EOJ in Aberdeen (180 miles) lined up. Here are some of the active stations in that area:

W9USI	350 w.	Brookings, S. D.
W9ZQC	100 w.	Brookings, S. D.
W9BJV	250 w.	Watertown, S. D.
W9CJS	200 w.	Bryant, S. D.
W9TI	200 w.	Milbank, S. D.
W9PZI	500 w.	Milbank, S. D.
W9EOJ	150 w.	Aberdeen, S. D.
W9AZE	100 w.	Bellingham, Minn.
W9QIQ	85 w.	Marshall, Minn.

Speaking of dx, at least of stations remote from the center of the continent, K6RRA sends in a private newspaper with the news from Hawaii. K6CGK is said to have a transmitter on five but it is idle. On Maui, K6LKN would like to get on but says he has no one to work. At Wahiawa, K6MVV sometimes looks over the band with his DM36. MVV's fine ten-meter signals are from 801's and four half waves in phase with power lines for reflectors!

G8LY has purchased G2ZV's acorn superhet, but now who can she listen for? Oh well, she can give it all up and meet VE's at G2YL's house—which seems to be the custom, what with the war and all.

2DDD (England) got all the parts together for a concentric-line-tuned receiver, and then the war broke out. What with trying to run his electrical business and not having slept at home but one night since September 10, he has not had much chance to do anything about radio. He has to sleep at the depot several miles from home where he is on duty in the Civil Defense Service as an ambulance and casualty car driver between midnight and 8 a.m. When there is an air raid warning, there just isn't any sleep for him. No wonder they call it "the war of nerves."

W. ½ S.

A few years ago it would have been hard to believe that conditions would ever permit working all states on ten meters. Now look in the honor roll and see how many fellows have worked half of the states on five: W3BZJ, W3RL, W5AJG, W8CIR, W3AIR, W3EZM, W2MO. How many more are there? Approaching the mark are W9USI, W9SQE, W2AMJ, W4DRZ, W4FBH.

112 MEGACYCLES AND ABOVE

It is about time for us to receive some additions to the "distance honor roll" run last month. Don't forget to report the news of 2½- and 1¼-meter work when the five-meter dx starts to come through and when bending is at its best.

It is reported in the Merrimack Valley club news that W1LGG is trying to modulate a 2½-meter oscillator with a mike, and no modulator. Now, that's something badly needed. Ye u.h.f. ed. once worked a W6 that way on 200 meters, hooking a carbon mike across some of the inductance. Old methods may yet come back. W1BHL is putting a pair of HK24's on the band. W1LEA burned up his tubes in a bar oscillator and has switched to 35T's in a TNT circuit. It must be stable like the one they keep horses in. W1HXE found the band, but W1LGG LGY could not understand his modulation while W1LEA DOO IFB thought they could; some receivers just may be broader than others. After all, if you modulate a receiver much more than 100 percent with the interruption oscillator, why shouldn't it spread out? It is probably an illegal transmitter, too (the over-modulated receiver, that is). W1DOO has an HK24 in TNT. W1KBP KNU LTT DXR LSS promise to get on 112 in the Lawrence, Mass., area while W1LEA DOO LGG LGY HXE IFB IZE ABD AHE are already thereabouts. W1LBH is operating—unheard. W1DEK LEA JNU demonstrated a 112 Mc. contact and lectured about the band at a club meeting.

W2KDB in South Ozone Park gives us the latest correct dope on his equipment. One receiver uses an 1851 detector, 6C5 quench, 6C5 and 6V6 audio. The second uses a 955 acorn detector and 42 audio. Neither has any noticeable radiation, he says, but why doesn't RADIO exhort the builders of superregens to do something to squelch radiation? (Yeh, and why don't readers write some u.h.f. articles for us?) He is putting about 40 watts on a 304A or on T20's with tuned lines. On 401 Mc. he uses a HY615 and eight-element Yagi. On 224 he has a 304A operating into his 2½ meter Q antenna as two half-waves in phase. KDB says that the 1851 makes a fine superregen detector, superior to the regular run of triodes. The most popular tube locally is a 6E6; with a grid coil and plate lines, nine watts input shoves an R8 signal out to 35 miles.

He wants RADIO to publish something about superhets for 2½ with broad i.f. stages. He should not miss Frink's articles on superregens in the March and April, 1938, issues. A superhet appeared in the March, 1939, issue, while a sensitive acorn job with 4-Mc. i.f. was described in June, 1939. The latter can be cut down to 2½ by using lines a foot or so long; in order to receive lousy transmitters, use 1852's in the i.f. stages or put resistors across the i.f. coils to broaden them.

Glenside, Penna., is represented on 2½ by W3BZJ who has had a few contacts with his 100 watts.

W. C. Wray in Puyallup, Wash., is putting together a concentric line superregen receiver.

W8OKC finds that his new final will double nicely to 2½ but he gets lonesome there in central Pennsylvania. W8QDU built a push-push doubler with his HK54's to get to 2½ with 200 watts. The antenna is a cut-down concentric with radials like the five-meter job described above. He is saving his HK24's for a doubler to 1¼. Activity in Detroit above 112 Mc. is low except for talk. What with W8CVQ in Kalamazoo and W8NYD across Ohio able to provide nice dx contacts, Fred is looking for some good fun this summer, especially if he can replace his acorn superregen with a converter using concentric lines that will handle the stabilized dx signals nicely.

W9PQH in Batavia, Illinois, is on all bands below 112, and now he is giving that a fling—

which is nice for the Chicago gang fifty miles or so away. W9RQG and W9LN in Des Plaines, Ill., have not been reported yet in Chicago. W9BAN in Oak Park put on a 2½ meter contact with W9LRT in Chicago for a C.R.T.A. club meeting, and works into Evanston nicely. LRT wrote W9ZGD in Milwaukee about tests with Chicago; ZGD will have to come back up from 470 Mc. for that!

W9BE in Elmhurst comes on once in a while. W9TVT in Evanston, using 150 watts, has been reported ten miles south of the Chicago "loop," a total of about 25 miles of tough territory. W9SXQ on the north side is building up a 2½-meter concentric-line-tuned superhet. W9SQE is on with T55's and something unusual in a superregen—a TNT transmitter! He got rid of hand capacity and an antenna dead spot by using an untuned grid coil, a 6J5 tube, a condenser-tuned plate line a foot long with the antenna coupled into the plate circuit. It is quite stable, and does not shift even when the plate line is touched. One side of the two-plate condenser is grounded, of course.

John Wallace, formerly of Newark Electric, went to a Davenport (Iowa), Rock Island and Moline (Illinois) club meeting loaded with 2½-meter dope. Perhaps he will also dig up W9UOB or someone to hook up with the Central Illinois five meter net.

W9USI has T20's on 112. W9ZQC, also in Brookings, S. D., has 50 watts on the band.

All of the u.h.f. activity in Honolulu, according to K6RRA, is on 2½, mostly with transceivers. K6GQF is building a rig. K6NSD is said to be responsible for the activity on the band; he uses a 6F6-6C5 transceiver working into an end-fed vertical antenna. He recommends shielding such rigs for, otherwise, they may not oscillate when coupled to an antenna. Other Honolulu stations on 2½ are K6RNX QZW. On the windward side of Oahu, K6KSI QGF and W7GVN/K6 are on the band. KSI uses a pair of T20's. K6RRA RAP SFB are building sets.

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Boy Meets Man

W1BOY, 33 years old, and W1MAN, 14 years old, met at the 1939 Massachusetts State A. R. R. L. Convention.

New Books

[*Continued from Page 53*]

to the ham, experimenter and television enthusiast.

Copies of the Lafayette Spring 1940 catalog may be obtained from the above company at 100 Sixth Avenue, New York City, without charge. Copies are also available at any of the following branches: 265 Peachtree St., Atlanta, Ga.; 110 Federal St., Boston, Mass.; 901 W. Jackson Blvd., Chicago, Ill.; 542 E. Fordham Rd., Bronx, N. Y.; 90-08 166th St., Jamaica, L. I.; and 24 Central Ave., Newark, N. J.

SIMPLIFIED FILTER DESIGN, by J. Ernest Smith, Central Office Engineering Laboratory, RCA Communications. Inc. First edition, August, 1939, published by RCA Institutes Technical Press, 75 Varick Street, New York, N. Y. 64 pages, 8½ x 11, board covers, price $1.00 postpaid.

This book presents a short-hand method of accurate filter design. It supplements the usual filter theory with a system of graphs which eliminates the necessity for cumbersome and involved mathematics. It is a tool of great practical utility for the design engineer.

DX

[*Continued from Page 52*]

town and a pretty good gag was sprung on him which I think will bear repeating here, especially because so many of the gang know Bill as an old time ham. Anyway, it seems that at the time of Bill's leaving Chicago some of his boys were taking movies of the Hallicrafter plant. This was to be used later as an educational film on assembling. Here is about where the fun began. The factory made arrangements with a few of us in Los Angeles to show the film at a meeting which Bill might attend. They developed, cut and titled it and then shipped it out air express. Naturally Bill was unsuspecting of the whole thing . . . as it hadn't even been finished when he left. The film arrived and Bill Halligan was a guest at the meeting. During the course of this meeting the chairman said, "Now, Bill, as is our usual practice at meetings of this kind, we endeavor to get a film to show the boys. We don't know if this is as spicy as usual but hope that it won't *bore* you?" He didn't know what was coming . . . the operator flashed the first frame of it on the screen showing the title "W. J. Halligan presents Hallicrafters." You could have floored him . . . he didn't know whether to get red in the face or under the collar. A lot of fun was had by accusing *him* of a put up job. The film is really good, though, but the fellows were attracted more by the gals on the assembly line than the sets.

I don't know whether I mentioned it or not but W6HJT is a very proud poppa. It's a gal, and 4 weeks old up to contest time.

Another item that just came to me again is that so many fellows ask, "What is a good antenna for 40 meters that doesn't take too much room?" Some object to the weight of Q bars for a 40-meter half wave. The answer is very simple; look up the article by Leigh Norton, W6CEM, on the four wire matching section. This assembly is very light and efficient. It will match an open-wire line to the center of a half-wave flat top, full wave, or three half waves. The formulas are given and it is easy to construct. Of course, the same principle can be used for 20- and 10-meter jobs. No one yet has been disappointed with their operation. In my particular case at 6QD, there are two of them up in the air about 75 feet, and at right angles. That was the 40-meter setup during the contest just concluded. The 5 and 10 stores are stocking some coasters which are better than those of a few years back. They are of clear plastic material, which look a bit more sensible than the multi-colored things available before. The article appears in the November issue of RADIO for 1938, page 49.

ZL2JQ Home at Last

About a year and a half ago you will recall ZL2JQ, Johnny Shirley, spending considerable time in USA. He was in Los Angeles for about a month and many a fine time was had with him. Since leaving USA he has been pounding brass at sea and signing a call or two whenever the time and place permitted. Two of them were ZX1A and XX2JQ. Needless to say after war broke out he shut down with all of this and until this last December Johnny has been having some pretty thrilling experiences at sea. You will note a shot of the "wireless shack" aboard the ship on which he was signing XX2JQ. This has since been mined and sunk.

In a short personal note Johnny says, "I have arrived back in N.Z. safely. We had an adventurous voyage and believe me thrills a million. The gang gave me a great reception upon my arrival and it's been a series of celebrations ever since. I found my transmitter sealed from oscillator to antenna, and now it is gathering cobwebs. At present I am on home defence with a field artillery but may go overseas any day. This may be the last letter you will get from me. I still treasure the pleasant memories of sunny California, Herb, and someday I hope I'll see yc u all again under similar happy circumstances."

One parting word on the contest. I believe the W boys who speak Spanish had a definite advantage in the phone division. Then the question is, will the rest of us have to learn Spanish or should it be limited to the speaking of English in this country? All in all everybody had a fine time in it, even though at times the shack at 6QD looked like a hamfest was in progress, with the fellows dropping in all night long. 'Sfunny thing, I didn't have a bit of trouble working my quota of W9's, although the odds were against me. And so far into the night went number after number . . . 569307.

• • •

1623 Exciter-Transmitter

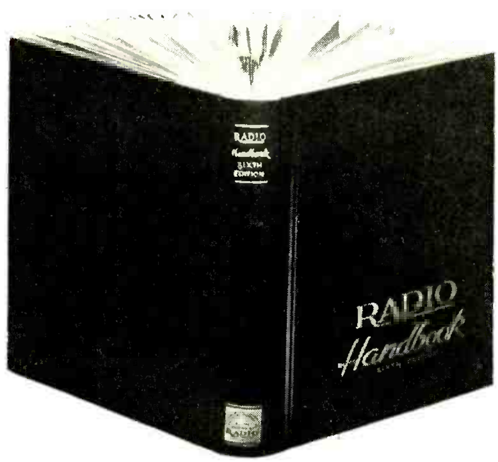
The resistor R_{10} in the circuit diagram on page 36 of the January RADIO, in the article "A 1623 Exciter-Transmitter", was incorrectly shown as 25,000 ohms. The correct value for this resistor is 250,000 ohms, 2 watts.

640 PAGES—640 PAGES—640 PAGES—640 PAGES—640 PAGES—

BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER —

BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER —

TOPS!



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THE EDITORS OF RADIO *technical publishers* 1300 Kenwood Road, Santa Barbara CALIFORNIA

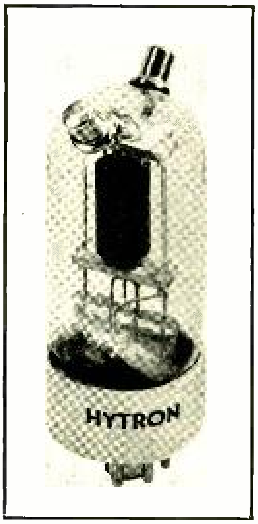
What's New in Radio

[*Continued from Page 66*]

filter choke is rated at 100 ma. and has a d.c. resistance of only 90 ohms, resulting in a minimum of voltage drop.

HYTRON U.H.F. POWER TRIODE

The HY75 is a medium power triode designed specifically for efficient operation at frequencies from 50 to 300 megacycles. Short connection leads, small internal elements, low interelectrode capacitances produce unusually high plate circuit efficiency. Close spacing of elements reduces transit time to negligible value further increasing the efficiency of operation.



The filament of the HY75 is of thoriated-tungsten, wound in a spiral for greatest efficiency. A graphite anode permits a high plate dissipation from the tiny elements at a low temperature and prevents hot spots and warping of the plate. A pure tantalum vertical-bar grid is also used. This combination of elements provides cylindrical or fully symmetrical construction of the tube resulting in highest efficiency.

The HY75 has been designed for efficient operation at low voltages, thus reducing cost of associated parts. With fifteen watts plate dissipation, the anode of the HY75 shows no color. The presence of a red glow indicates that the rated dissipation is being considerably exceeded; and if such occurs, the plate input power should be reduced or adjustments made in the transmitter to increase the plate circuit efficiency thereby lowering the value of plate dissipation to its rated value.

Values on page 94 are for continuous-service operation of one tube. Two tubes in push-pull will provide substantially higher efficiencies with a resultant increase in power output.

Electrical Characteristics of HY75

Filament ....6.3 volts @ 2.75 A.
Plate voltage ....450 max. volts
Plate current ....100 max. ma.
Plate dissipation ....15 max. watts
Mutual conductance 2300μmhos
Amplification factor 10

Typical Operating Characteristics Oscillator and Class C R.F. Amplifier

D.c. Plate voltage ....450 max. volts
D.c. Plate current ....100 max. ma.
D.c. Plate input†
30 max. watts @ 224 Mc.
35 " " @ 120 Mc.
45 " " @ 60 Mc.
D.c. Grid current ....20max. ma.
D.c. Grid voltage ....−150 max. volts
Plate dissipation ....15 max. watts

Plate Modulated Oscillator and Class C R.F. Amplifier

(Values below are for speech modulation only)
D.c. Plate voltage ....450 max. watts
D.c. Plate current ....100 max. ma.
D.c. Plate input†
24 max. watts @ 224 Mc.
28 " " @ 120 Mc.
36 " " @ 60 Mc.
D.c. Grid current ....20max. ma.
D.c. Grid voltage ....−150 max. volts
Plate dissipation ....12 max. watts
(No modulation—rises to 15 watts when 100% speech modulated.)

Operating Data for 2½ Meters

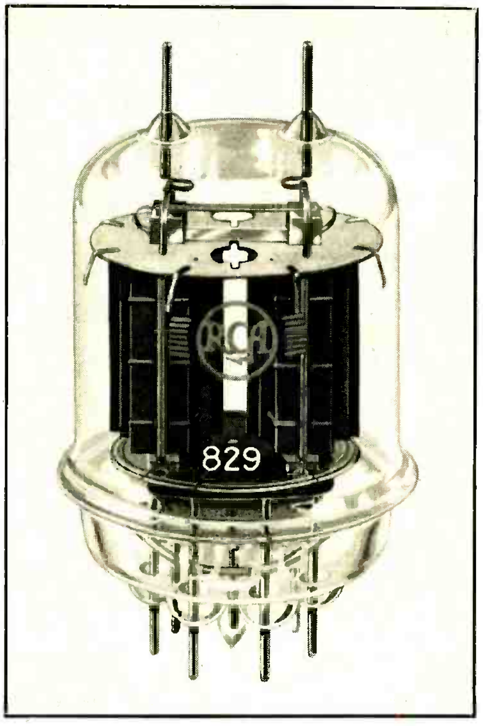
D.c. Plate voltage	300	450 volts
D.c. Plate current	93	62 ma.
D.c. Grid bias‡	−60	−90 volts
D.c. Grid current*	20	20 ma.
Nominal r.f. carrier output*	16	16 watts

† Maximum plate voltage may be used at any frequency if maximum plate dissipation is not exceeded. Values of plate input given above assume reasonably efficient circuits and operation conditions.

‡ Bias and excitation should be adjusted to optimum value for the particular circuit and other constants employed.

* Subject to wide variations, controlled by circuit constants and operating characteristics of associated input and output circuits.

RCA-829 UHF TWIN BEAM TETRODE



A new push-pull beampower amplifier has been announced by RCA for use primarily on the ultra-high frequencies. It has the unusually high transconductance of 8500 and a combined plate dissipation for the two units of 40 watts. The maximum plate voltage rating is 500 volts and the maximum plate current is 240 milliamperes.

A single 829 tube operated in push-pull class C telegraph service is capable of handling a power input of 120 watts with less than a watt of driving power—and at frequencies as high as 200 megacycles. The tube may be operated practically at full ratings as high in frequency as the amateur 224-Mc. band. The exceptional efficiency of the 829 at the ultra-high frequencies is made possible by the balanced and compact structure of the two units, excellent internal shielding, and close electrode spacing. The internal leads are short and heavy in order to minimize internal lead inductance. The tube has no base, the terminal wires being large and heavy and brought out through heavy individual glass seals. The two plate leads are brought out through the top of the envelope. This terminal arrangement provides excellent electrical insulation and is designed to facilitate symmetry of circuit layout.

POSTSCRIPTS...
and Announcements

Amateur Calls

The F.C.C.'s files bulge with requests in regard to amateur calls. In addition to petitions for non-assignment or non-reassignment, there are requests for transfer of a call from friend to friend, husband to wife, father to son, etc.; also supplications for calls to match names, nicknames, initials or other assorted abbreviations, and, of course, many express a desire for "two-letter calls." One file contains some sixty pieces of correspondence with a single ham persistently trying to get one particular call.

Although it appreciates the intense interest and enthusiasm on the part of the radio amateur, the Commission is guided by its rules and regulations when it is obliged to say "no" to most special call requests. The only assignments in the nature of exceptions are those provided for in the rules themselves.

However, for many years it has been the practice not to reassign amateur calls to others so long as the alphabet permits allocation of new calls to stations.

Under present rules, a vacated call is kept unused for a period of five years before it is subject to request from any one but the latest holder, and then it can only be requested by a previous holder. In other words, reassignment of a call is limited to previous holders of that particular call.

Lucite and Lucite

There has been considerable discussion as to the merits of Lucite as an insulator at radio frequencies. Some seem to have good luck with it, others poor. The reason is that there are many varieties and forms of Lucite. The power factor depends upon whether or not the object is injection molded, the nature and amount of plasticizer, etc. The original squib in RADIO calling attention to the fact that Lucite made a pretty good insulator at ultra high frequencies where many other dielectrics went to pot referred to the sheet Lucite turned out by the Du Pont factory. We since have seen Lucite objects fabricated by the injection molding process which were little if any better than ordinary celluloid in so far as electrical characteristics were concerned.

World Time Chart

A chart that enables radio amateurs to compute the time of day at any point on the globe has been made available by General Electric's international stations WGEO and WGEA in Schenectady and KGEI at San Francisco.

With the simplified chart, one can readily convert standard time in any zone to Greenwich Meridian Time or tell what time it is in other parts of the world. By means of dark and light shading, the chart also shows where day and night begin and end.

The chart has been printed in Spanish, Portuguese and French as well as English, and is being distributed upon request without charge.

15th Annual Hudson Division ARRL Convention

The 15th annual Hudson Division Convention is being sponsored by the Union County Amateur Radio Association, Inc. and is to be held on May 11, 1940 at the New Kreuger Auditorium, Springfield and Belmont Avenues, Newark, New Jersey.

This Convention is open to all persons interested in amateur radio. Admission to Convention (including banquet) is $2.25. Banquet alone is $1.25 and Convention alone is $1.25. For tickets or information write Stanley Allen, W2CZS, 116 Poplar Street, Roselle, New Jersey.

Bantam Type 1G4-G

Amateurs interested in 2½ meter portable transceivers will be glad to know that one of the manufacturers is now supplying a bantam (GT) version of the 1G4-G.

Advertising Index

The Marketplace

Classified Advertising

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

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

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

(d) No display permitted except capitals.

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

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

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

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

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

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

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

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

MOBILE cabinets. Chassis. Panels. Racks. Specials. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

RECONDITIONED guaranteed receivers and transmitters. Practically all models cheap. Free trial. Terms. List free. New SX-23s $89.00. W9ARA, Butler, Missouri.

BEST place to get amateur receivers is W9ARA. Best price; best trade; best terms (financed by myself); free trial. Prompt shipment from world's largest stock. Shipment from factory if preferred. W9ARA, Butler, Missouri.

NATION'S greatest values; Completely cased PRECISION TRANSFORMERS. Full year's unconditional guarantee. 2½v @ 10a, 6.3v @ 6a, 5v @ 6a, $1.92 each postpaid. Write for list of real values. PRECISION TRANSFORMER COMPANY, Muskegon, Mich.

QSL's—That stand out above others! Fritz, 455 Mason, Joliet, Ill.

CUSTOM ground 40M X-cut crystals in ceramic holders $2.50. 160 or 80M crystals $1.00. KORADIO, Mendota, Illinois.

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

FOR SALE—Complete Recording Mechanism—$40. W2IEF, Irvington, New Jersey.

ALL communication equipment at lowest prices. SALE on used RECEIVERS, write for list and details. W9KJF, Van Sickle, 34 W. Ohio St., Indianapolis, Indiana.

CRYSTALS—dollar, 160, 80 meter, low drift, ¾ inch. W8OUE.

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

SELL—Special 75 watt phone and c.w. station, everything in shack, list, photo, make offer, W8OGG, 940 Northampton St., Buffalo, N. Y.

NEW RIG?—ENJOY earning cost, make-sell baseball games. Write W2HJM.

MUST SACRIFICE—brand new NC-101x complete with speaker and crystal, excellent condition—best offer takes it. W4FKK, 1672 Fulton Avenue, Birmingham, Alabama.

ATTENTION—Bay Area hams: For sale: Complete 500W phone-cw xmtr. 75T's P.P. 100TH Modulators. a.m.c. Signal Shifter, Coils for 10-20. Triplett Meters. Thordarson, Cardwell Parts. Enclosed rack. 3 Element 20M Rotary beam. Call evenings. W6NKZ, 2265—33rd Avenue, San Francisco, Calif.

MUST SELL—all transmitting and receiving equipment. Write for list. Carl A. Kowalski—W9KHC.

SELL—Hallicrafters SX17. Just like new, used very little on B.C. only. Make offer. Stanley O. Bennett, 2219 Norwalk Ave., Los Angeles, Calif.

SACRIFICE—Half kilowatt ten and twenty meter instantaneous band switching plate modulated rack and panel phone transmitter. Complete. $100, Parts cost $300. Write, W6NLP.

FOR SALE: Entire transmitting equipment including complete 500 watt transmitter. Net value $360. What am I offered? W7HKV, Box 701, Medford, Oregon.

Z872A RECTIFIERS—2.5 Amps 10,000 Volts Inverse Guaranteed $7.95 Mason Shaw, Rt. 1, Box 830, Redwood City, Calif.

FOR SALE—Brand new SX-24 "Defiant" receiver with factory guarantee—without speaker—$59.50. W9LXC. Bob Ebenreiter, 413 Lincoln Ave., Sheboygan, Wisc.

FOR SALE—Excellent SW-3 receiver with National power pack, 20, 40, 80 meter coils—$14.00. W9LXC, Bob Ebenreiter, 413 Lincoln Ave., Sheboygan, Wisc.

W8BNP SELLING OUT—1 KW phone and RME69. Stamp for list.

SELL—Gross CP-55, 42, 6L6G, pair T20's 100 watts, W1KUM.

Changes of Address

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

Circulation Department

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"Sure! Those new ICAS Ratings represent a swell 'yardstick' that tells me just what to expect of RCA Transmitting Tubes in my amateur rig—but, shucks! I've known all along an amateur could load a lot more power into RCA's than the old, continuous 'key-down' commercial ratings would indicate. On sprints, I've poured power into a couple RCA-809's to the tune of 500 watts input, although I knew they were rated at only 150 watts—and still they always came back for more. I've done almost the same thing with other RCA's, too. ICAS Ratings? Sure! I'm the guy that invented 'em!"

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These Ratings Tell Their Own Story of Values Unexcelled!

RCA Tube Type	Tube Classification	Amateur Net Price	D-C Plate Input, Watts* CCS Rating	ICAS Rating
802	Pentode	$3.50	25	33
804	Pentode	15.00	120	150
806	Triode	22.00	600	1000
807	Beam	3.50	60	75
809	Triode	2.50	75	100
810	Triode	13.50	500	620
811	Triode	3.50	155	225
812	Triode	3.50	155	225
814	Beam	17.50	180	225
828	Beam	17.50	200	270

*Class C telegraphy values

FREE! *20-page booklet, "INCREASED RATINGS," giving full information on the new RCA Dual Rating System (originally announced October 15, 1939) gladly sent upon request to Commercial Engineering Section, RCA Manufacturing Co., Inc., Harrison, N. J.*

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(Effective April 1st, 1940)

		Previous Net	New Net
RCA-813	... Beam Power Amplifier—360 watts input up to 30 Mc.	$28.50	**$22.00**
RCA-832	... Push-pull Beam Power Amplifier—36 watts input up to 150 Mc.	28.75	**17.00**
RCA-1624	... Beam Power Amplifier (Filament type)—54 watts input up to 60 Mc.	4.75	**3.50**

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