RADIO

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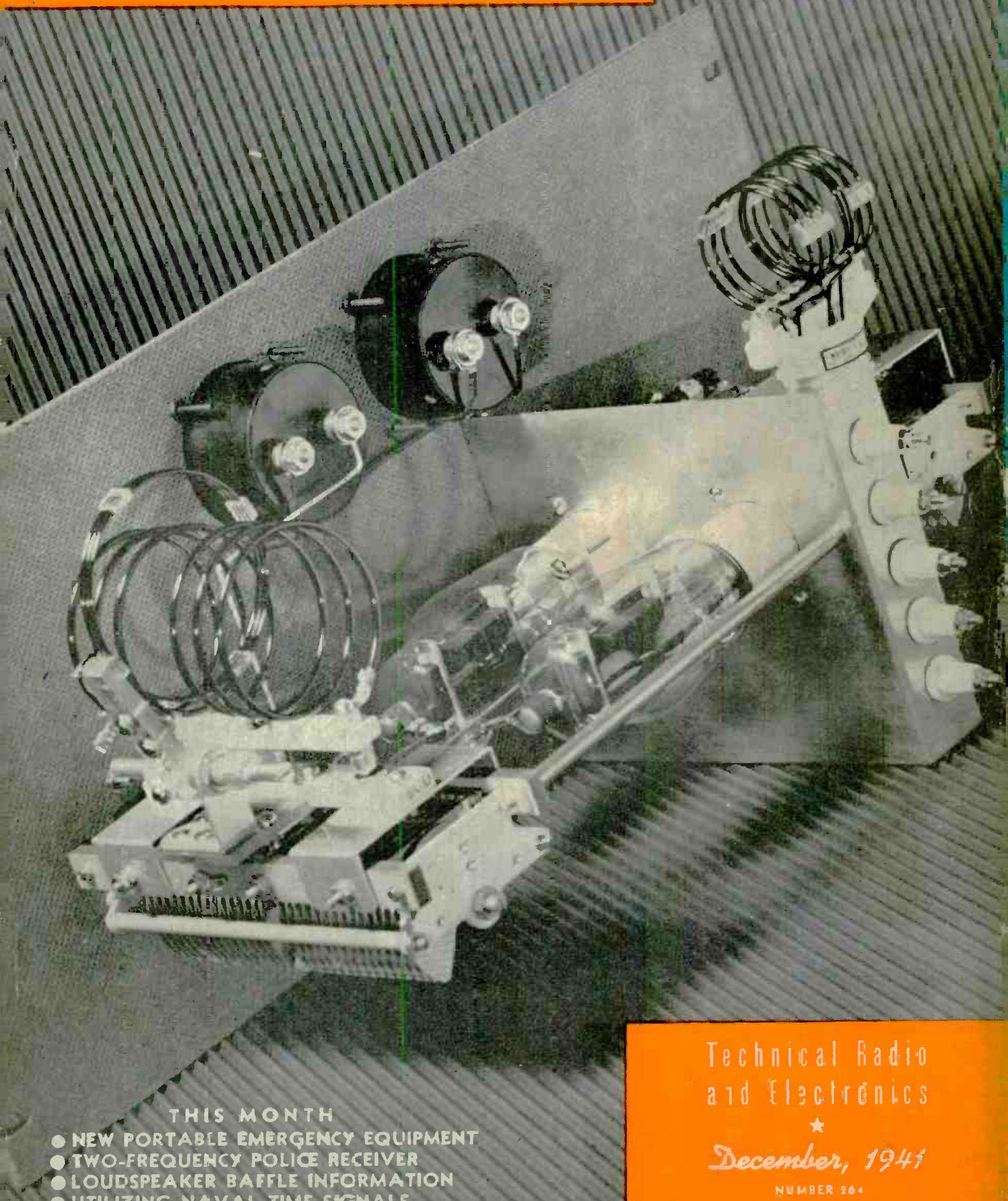

THIS MONTH

- NEW PORTABLE EMERGENCY EQUIPMENT
- TWO-FREQUENCY POLICE RECEIVER
- LOUDSPEAKER BAFFLE INFORMATION
- UTILIZING NAVAL TIME SIGNALS

Technical Radio and Electronics

★

December, 1941

NUMBER 264

30c IN U.S.A.

What a Whale of a Difference $1.00 Can Make

90% MORE

OUTPUT ON PHONE

90% LESS

PARASITIC TROUBLE

The HY1269, exactly $1.00 more in price than our famous HY61/807*, will give you outputs far exceeding what its slight additional cost leads you to expect. Although the popular HY69 has the same 40-watt plate dissipation as the HY1269, the HY1269 has much greater power capabilities, because its husky, 21-watt filament has twice the power of the HY69 filament. Full advantage of the HY1269's 40-watt plate dissipation can be taken with consequently greater outputs.

Parasitic oscillations, the common trouble encountered when using beam tetrodes of the cathode type, usually vanish when thoriated-tungsten filament-type beam tubes are substituted. Major reason for this superior performance is that Hytron filament-type beam tubes are specifically designed for transmitting applications, while the HY61/807 is, after all, merely an adaptation of the receiving type 6L6G. Substitution of the HY1269 in your transmitter will probably wipe out those annoying parasitics.

CONTINUOUS-DUTY RATINGS

	Plate and Screen Modulated			Unmodulated	
Type	Watts output	Watts per dollar	Price	Watts output	Watts per dollar
HY61/807	27.5	7.9	$ 3.50	40	11.4
HY69	42	10.6	3.95	42	10.6
HY67	100	12.9	7.75	152	19.6
HY1269	52	11.5	4.50	63	14.0
Tube A	87	5.0	17.50	130	7.4
Tube B	175	7.8	22.50	260	11.3

DUAL FILAMENT

6 or 12 Volts Gives Versatility

CHARACTERISTICS OF HY1269

Filament potential 6.3/12.6 volts
Filament current 3.5/1.75 amps.
Plate input (cw) 750 V. at 120 ma.
Plate input (phone) 750 V. at 100 ma.
Plate dissipation (CCS) 40 max. watts
Fully shielded for RF
Full ratings to 60 megacycles

BRIDGES GAP BETWEEN HY61/807 AND EXPENSIVE LARGER BEAM TYPES

Continuing its policy of supplying popular tubes at lower prices, as exemplified by its recent offering of the 65-watt HY67 at less than half the price of other comparable types, Hytron gives you another much-needed, medium-sized beam tube at a bargain price. The HY1269 is the reasonably-priced beam tube you have been looking for to give you more output than your HY61/807.

*HY1269 fits the same socket. Only slight circuit changes are necessary.

Specify Hytron; get the most for your money. Available from leading distributors.

HYTRON RADIO TUBES

HYTRONIC LABORATORIES

23 New Darby St., Salem, Mass.

MANUFACTURERS OF RADIO TUBES SINCE 1921

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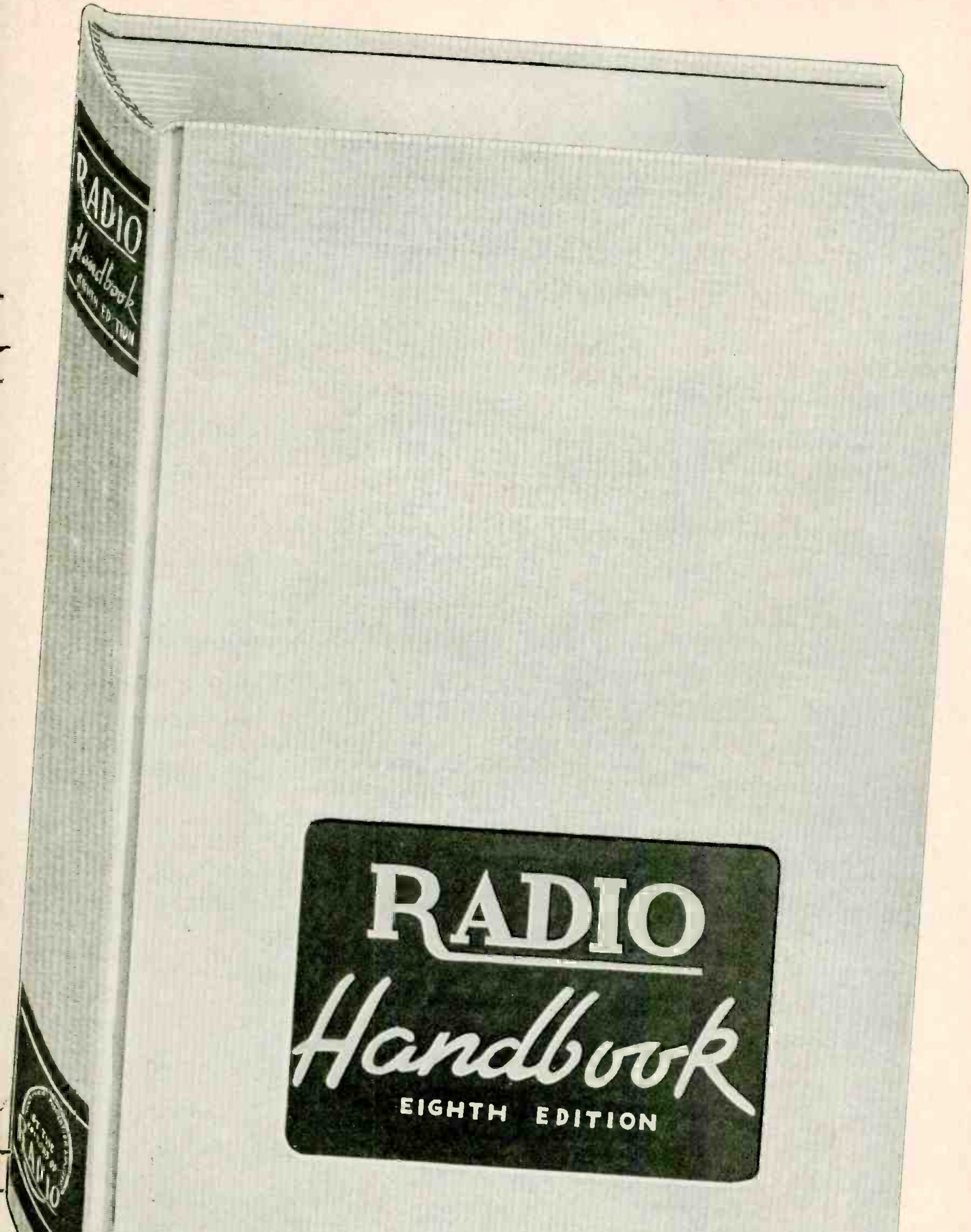
RADIO
Handbook
EIGHTH EDITION
RADIO
Handbook
EIGHTH EDITION

Past • Present and • Prophetic

QTO QUD and USO

It has been estimated that there are over 10,000 radio amateurs in the Services, the majority of them selectees. This means that there is bound to be a substantial number of amateurs even at the smaller camps. A few of these fellows are fortunate enough to be stationed close enough to home that they can visit over the weekend. But most of them are not so lucky.

The amateurs in the latter group deserve our attention. It is true that the non-hams get just as lonesome, but we can do *more* to brighten up things for the amateurs, because if there is anything a fellow enjoys more than being invited into a private home for dinner it is being invited to dinner by someone who follows the same hobby and likes to talk about it.

If you live fairly close to one of the camps, why not give the nearest USO Headquarters a ring and let them know that you would enjoy having two, three, four (or as many as you can handle) ham-selectees for Sunday dinner. Better explain what a radio amateur is, and why you prefer to have hams. And remember, transportation may be a problem. If you can't pick the boys up and take them "home," it is a good idea to work out the transportation problem with the USO.

Even if you live some distance from a camp, there is a chance that you are in a position to entertain some of the boys if you reside in a city or large town. Often a large number of selectees is transported to the city, a different bunch each weekend, to get them away from camp for a while. Usually the boys in such a group are furnished sleeping quarters by the army, but they are on their own when it comes to meals and entertainment. The USO will be glad to arrange a sked for you with some of these fellows.

Worm Turns

When the 112-Mc. dx record was held by the West Coast, and California amateurs worked over distances of 200 miles with regularity, the East Coast brethren complained that the boys out West had a great natural advantage because of the topography and weather conditions "peculiar to the West Coast." Never could the Easterners hope to compete with the Californians on equal terms so far as 112-Mc. dx was concerned, or so they contended.

But along comes a New York ham who goes up to Maine and proceeds to work a station 335 miles away and hears one about 400 miles away.

Never, say the California 112-Mc. dx-ers, can they hope to equal this record, because the only likely path would put one of the stations down in Mexico. Any other 350-mile path is intercepted by high mountains, or else does not permit working from elevated locations, or else is almost entirely over land not close to the ocean, or else puts one of the stations on land closed to the public on account of being taken over by the Army.

Reminds us of the old beef regarding the international dx contest: Were the Westerners at a disadvantage or weren't they just any danged good?

Of course there is always the airplane. But without belittling the accomplishment of the W6 amateurs who made a record (which stood up for quite a while) with the aid of a plane, we would like to express the opinion that records made with the aid of air power should be listed separately; land-based stations certainly should be put in a separate classification.

Making the land stations compete on equal terms would be like matching a tank against a dive-bomber. The plane most likely would win, but it couldn't be considered a fair match.

Transceiver QRM

We were proud to note that the new 112-Mc. record was made with an HY-75 transceiver, the prototype of which was first described in RADIO some time ago. However, transceiver QRM in the larger centers of population is becoming serious, and it appears that the only thing to do is to switch to circuits which cause less QRM, even though they may not be quite so simple or inexpensive. Transceivers could be confined to 224-Mc., where there is still plenty of elbow room. It might help to get the 224-Mc. band populated. Then, when things began to get crowded on 224 Mc., the transceivers could be moved up to a still higher frequency. In time, maybe we could get some transceivers going in the infra-red spectrum—say in a couple of hundred years.

The Hytron ad for last month shows a circuit which may be used to minimize superregen radiation. Separate detector and power oscillator are used, the detector being operated at very low plate voltage. The radiation from the antenna of a superregenerating oscillator is determined by two things: the plate voltage and the antenna coupling. By running the

[*Continued on Page 90*]

RADIO

the worldwide authority . . .

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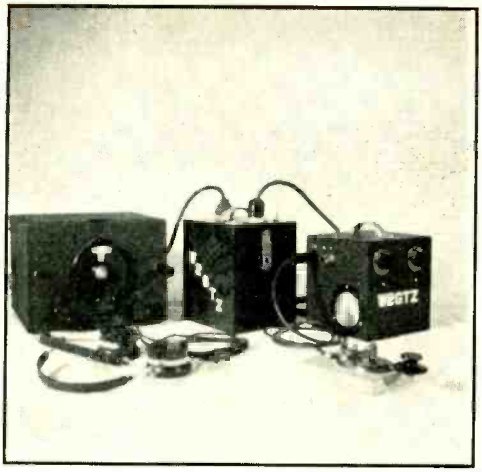


• • • Figure 1. The complete field unit for dry-battery power. The universal SW-3 is on the left, the battery box (which houses the batteries for both transmitter and receiver) is in the center, and the c.w. transmitter is on the right. All are described in the text.

Another Version of PORTABLE EMERGENCY EQUIPMENT

By REEVE O. STROCK,* W2GTZ

A complement of portable equipment consisting of two universal transmitters, a receiver, and a battery box, designed to furnish emergency communication under any conditions and to take advantage of a local supply of power if one is at hand.

It should be the imperative duty of every radio amateur in times such as these to be equipped with emergency equipment that he knows will work under any and all conditions he might encounter. We owe it to our own communities to be prepared in cases of emergencies when other normal forms of communication are disrupted. A realization of this need prompted the assembly of the emergency equipment about to be described.

Besides fulfilling its initial requirement as emergency equipment, it has given much enjoyment as a home station equipment to one who in the past few years has been concentrating on dx and transmitter efficiency up to the last allowable watt. Having pushed around a kilo-

*178-15 Henley Road, Jamaica, Long Island, N.Y.

watt for years in search of those elusive countries I have been amazed at just how much enjoyment can be gotten from the satisfaction of a 100 per cent QSO with only a few watts in the antenna. Because of the versatility of the equipment it has instilled a new enthusiasm for traffic nets, emergency nets, and even low power 'phone contacts. If such equipment can convert a dyed-in-the-wool dx hound into an "all band activities" ham, besides providing more pleasure by possessing a more than adequate outfit for field emergency purposes, it has indeed proved its worth.

Two forms of emergency equipment were specified: one a universal a.c.-d.c. unit with approximately 10 watts output which could be used for prolonged periods in cases of necessity; and a small, compact, low power unit that could be used for short periods anywhere in the field. An assembly of both units is shown in figure 1 and figure 2.

The 110-Volt A.C. 6-Volt D.C. Transmitter

The universal transmitter equipment used was a Thordarson 10-watt transmitter kit which operates both 'phone and c.w. on all bands from 28 Mc. to 1.7 Mc. inclusive. This unit is so assembled that by the simple replacement of the power plug and cable the unit may be operated from either 110 v. a.c. or from a 6-volt storage battery. The power supply is self-contained and uses a vibrator from 6 v. d.c. or a normal tube rectifier when the supply is 110 v. a.c. The r.f. circuit uses a 6V6 as a crystal oscillator and an 807 as the output amplifier feeding a pi network. A pi network is an almost indispensable item for an emergency transmitter since one is never sure what exact facilities will be encountered for an antenna. Almost any length of wire will take power from a pi network.

While 'phone is definitely not a necessity for an emergency transmitter, it may be very useful at times. Especially since it was planned to use this unit as a low power "home" station as well. The a.f. lineup uses a crystal microphone feeding a 6SJ7 and a 6V6 which modulates the plate and screen of the 807 power amplifier. Because of its simplicity the audio quality is very good and high percentage modulation is provided by the 6V6 modulator.

The All-Purpose Receiver

The receiver provided for both this transmitter and the smaller one is a universal model a.c.-d.c. SW3. A s.p.d.t. switch is provided on the transmitter for transferring the plate power from either the vibrator, or rectifier filter, to either the transmitter or receiver. The filament supply for the receiver is fed directly from the transmitter unit. The power cable from the receiver is plugged into a corresponding jack in the transmitter and all power for the receiver is taken from the transmitter. When the transmitter is being operated from either 6 v. d.c. or 110 v. a.c. the SW3 uses 6.3 v. heater tubes and a switch inside the receiver is thrown to the 6.3 position. When the receiver is used with the small field transmitter the 6.3 v. tubes are replaced by 1.4 v. tubes and the switch is thrown to the 1.4 v. position. No further changes are necessary in the receiver. Therefore for this application it serves its purposes admirably.

• • • Figure 2. The phone-c.w. field station for operation from 110 a.c. or a 6-volt storage battery. The same SW-3 is used (with 6.3-volt tubes substituted for the 1.4-volt ones) as is shown in figure 1. The crystal microphone, the emergency kit, and the manufactured 10-watt transmitter (kit type) are also shown in this photograph.

The Case for Accessories

An accessory case is provided for carrying all spare parts for use in any emergency. A photo of this case and its contents are shown in figures 3 and 4. Necessary spare tubes, crystals, antenna wire, tools, message pad, pencils, antenna rope, tape, clip leads, insulators, key, and microphone are included. Two of the most useful accessories are a pair of fish-line "sinkers." You will be surprised how simple it is to tie a line with a 5 oz. sinker on the end of the antenna and insulator and throw it up in a tree. I have yet to see one that won't get tangled up in the branches, and your antenna is there to stay.

Figure 3. The accessory kit. Note how neat compartments have been built into the kit—with sockets for the coils, tubes, and crystals—so that everything will be in its place when the cover is opened at the field operating position.

The Battery-Power Field Transmitter

The small low-power field unit is really a jewel and has performed far beyond all expectations. It is really a lot of transmitter wrapped up in a 4-pound package! Full credit for the development of this unit in schematic goes to Mr. C. F. Hadlock, W1CTW. The unit normally uses a pair of type 1Q5 tubes, one as a straight Pierce crystal oscillator and the other as a final power amplifier which also feeds a pi network to the antenna.

To add to the versatility of this little unit the 1Q5 tubes can be replaced by 6L6's. With no other changes in the transmitter itself the power of this unit can be increased to 15 to 20 watts. The battery supply normally used with this unit is replaced by an a.c. power pack supplying from 300 to 400 volts d.c. at 100 ma. Then if this little unit is to be used in the field where a.c. is found to be available, we have a little package of 20 watts that will perform with complete satisfaction.

It is possible to accomplish the above power change by the simple replacement of the tubes as can be seen from the bottom views of the respective socket connection for the 1Q5 and the 6L6 tubes.

The finished unit is shown in figures 5 and 6. The chassis is bent to form a square shaped S. The crystal is mounted from the bottom to make easy accessibility, as is also the coil. In addition, such a mounting allows the leads to be very short.

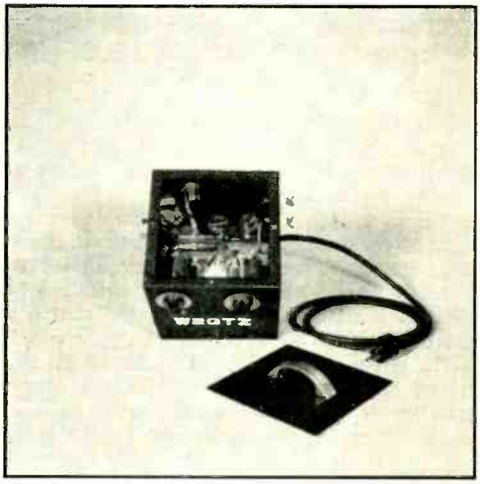
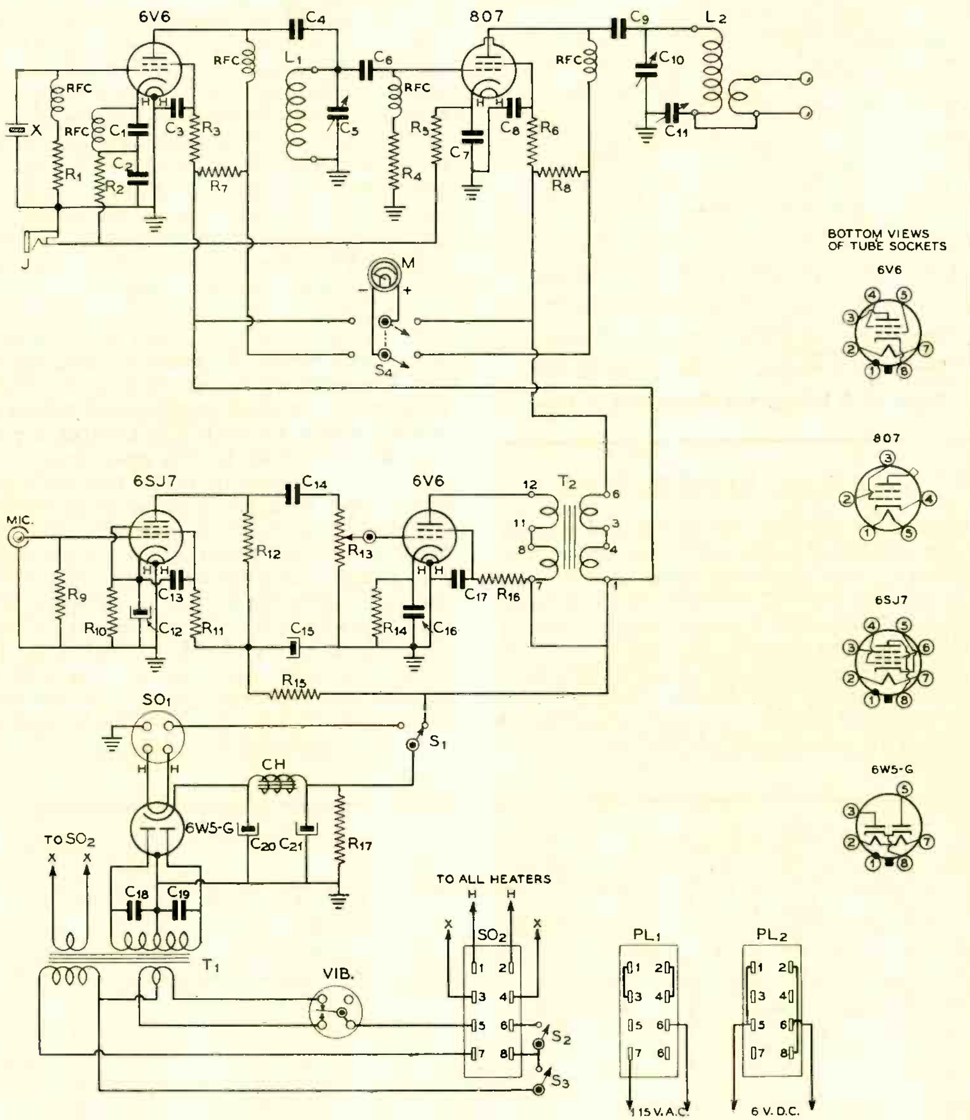


Figure 4. Looking down into the battery-power field transmitter. The bottom plate of the cabinet housing this transmitter is also removable to allow changing of the coil and crystal.

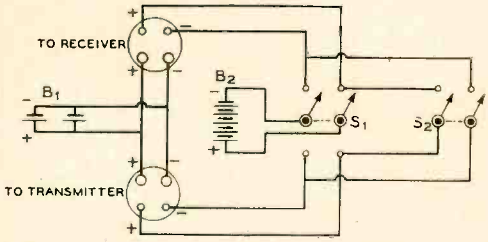
Keying

Two means for keying are provided, one in the negative B lead and the other in the screen of the final amplifier. With any reasonably active crystal, keying in the negative lead is very satisfactory. Negative-lead keying also permits break in operation which can be most useful during emergencies to eliminate unnecessary QRM. With crystals not so active, keying is accomplished in the screen of the final. This provides very smooth keying, but of course precludes use of break-in, as the oscillator is running continuously.



WIRING DIAGRAM OF THE UNIVERSAL A.C.-D.C. 'PHONE-C.W. TRANSMITTER

C_1—.0001-µfd. mica
C_2—0.01-µfd. mica
C_3 — 0.01-µfd. 600-volt tubular
C_4—.002-µfd. 1000-volt mica
C_5—100-µµfd. midget variable
C_6—.0001-µfd. 600-volt mica
C_7, C_8—.002-µfd. 600-volt mica
C_9—.002-µfd. 1000-volt mica
C_{10}, C_{11}—100-µµfd. midget variable
C_{12}—10-µfd. 25-v. tubular
C_{13}, C_{14}—0.04-µfd. 400-volt tubular
C_{15}—8-µfd. 450-volt electrolytic
C_{16}, C_{17}—0.04-µfd. 400-volt tubular
C_{18}, C_{19}—0.05-µfd. 1600-volt tubular
C_{20}—4-µfd. 450-volt electrolytic
C_{21}—8-µfd. 450-volt electrolytic
R_1—20,000 ohms, 1 watt
R_2—350 ohms, 10 watts
R_3—15,000 ohms, 10 watts
R_4—100,000 ohms, 1 watt
R_5—300 ohms, 10 watts
R_6—15,000 ohms, 10 watts
R_7, R_8—50 ohms, 10 watts
R_9—5 megohms, 1/2 watt
R_{10}—3000 ohms, 1/2 watt
R_{11}—3.0 megohms, 1/2 watt
R_{12}—500,000 ohms, 1/2 watt
R_{13}—250,000-ohm potentiometer
R_{14}—300 ohms, 10 watts
R_{15}—20,000 ohms, 1 watt
R_{16}—20,000 ohms, 1 watt
R_{17}—20,000 ohms, 20 watts
RFC — 2 1/2-mh. 125-ma. chokes
L_1, L_2—Bud OEL for band used
CH—30-hy. 100-ma. filter choke
T_1—700 c.t. 135 ma., 6.3 v. 4.75 a., with 110 a.c. and 6 v. vibrator primary
T_2—15-watt universal modulation trans.
J—Keying jack, closed circuit
M—0-100 d.c. milliammeter
S_1—S.p.d.t. toggle switch, receiver control
S_2—S.p.s.t. toggle, fils on d.c.
S_3—S.p.s.t. toggle, main switch
S_4—D.p.d.t. meter toggle
SO_1—Output socket for power to receiver
PL_1—Line plug for 115-volts a.c.
PL_2—Line plug for 6.3 volts d.c.



Connections inside the portable battery box.

S_1—D.p.d.t. toggle switch, plate voltage to transmitter or receiver
S_2—D.p.s.t toggle switch, standby switch for transmitter or receiver
B_1—1½-volt A battery, two dry cells or 4FH's in parallel
B_2—90-volt B battery, two 45-volt Z30N in series

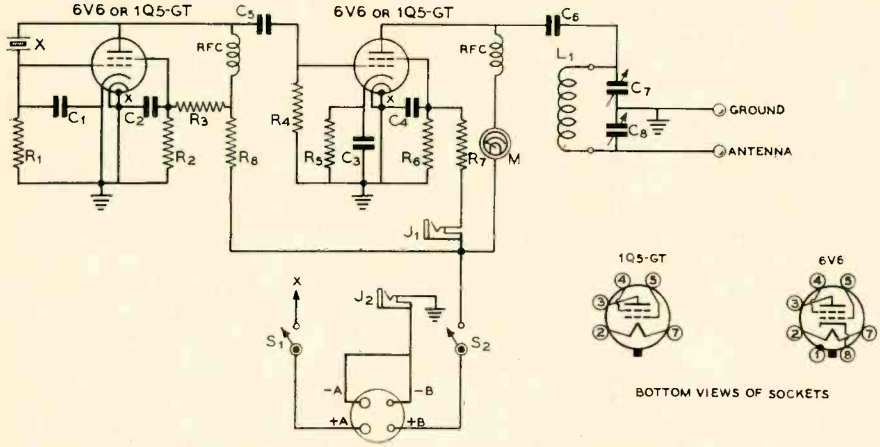
Power Supply for the Field Unit

Power for this little unit is obtained through a four-conductor power cable which plugs into the battery box shown in figure 7, or into an a.c. power pack. The battery box was "custom built" from thin plywood to reduce weight and to provide strength. It contains a pair of 1.5-volt dry cells and two small 45-volt Burgess B batteries, type Z30N. Only one dry cell is needed but two are used, connected in parallel, to give prolonged life and, in addition, to equalize the weight in the battery box. The power from the batteries is brought out to two four-prong sockets, one to provide power for the transmitter and the other for the receiver. Two toggle switches are also provided to disconnect the B supply at the battery box or to parallel the B supply to both the receiver and the transmitter. Dime store "moderne" handles are used on both the transmitter and battery box for ease in carrying. The total weight of the receiver, battery box, and transmitter won't inconvenience anyone.

The SW3 receiver is also used with this unit, but of course the 6.3-volt tubes are replaced by the 1.4-volt type. No circuit changes of any sort are necessary in this receiver, except the throwing of the single toggle switch within the receiver which automatically changes the circuits for 6.3-volt or 1.4-volt operation.

The plate power input to this little unit when using batteries is 90 volts at 10 ma., actually 0.9 watt. It is incredible what this small amount of power in even an ordinary emergency antenna can do. This unit has been used with complete success in our emergency net here on Long Island, and it covers the complete length of the island, approximately 100 miles, with ease. This has all been done on 80 meters. The unit can be operated with comparable efficiency on any of the bands from

[*Continued on Page 91*]



WIRING DIAGRAM OF THE EMERGENCY FIELD-UNIT TRANSMITTER

C_1 — .00005-µfd. midget mica
C_2—0.005-µfd. mica
C_3, C_4, C_5 — .00025-µfd. mica
C_6—0.001-µfd. mica
C_7, C_8—100-µµfd. midget variable
R_1—50,000 ohms, ½ watt
R_2—100,000 ohms, ½ watt
R_3—50,000 ohms, 1 watt
R_4—20,000 ohms, ½ watt
R_5—350 ohms, 1 watt
R_6—100,000 ohms, ½ watt
R_7, R_8—15,000 ohms, 2 watts
J_1—Screen keying jack, closed circuit
J_2—Break-in keying jack, closed circuit
S_1—S.p.s.t. toggle filament switch
S_2—S.p.s.t. toggle plate switch
M—0-50 d.c. milliammeter
RFC—2½-mh. 125-ma. r.f. choke
L_1—Bud OEL plug-in coil
X—Crystal to match L_1

A SUBSTITUTE *for* SAFETY BIAS

When Using Screen Grid Tubes

By W. W. SMITH,* W6BCX

Grid leak bias is highly desirable with r.f. amplifiers because of its unique characteristic of accommodating the bias to the available excitation, and also because it allows more linear modulation when high level modulation is employed. But, unfortunately, at normal plate voltage tubes other than those of the high-μ triode "zero bias" variety will draw sufficient plate current to cause excessive plate dissipation when a grid leak is the only source of bias and no excitation is being applied.

The latter condition may result from failure of some component in a preceding stage, or as a result of tuning preceding stages, or as a result of keying a preceding stage. For this reason, sufficient "safety bias" is used in conjunction with the grid leak bias to limit the static plate current to a safe value. This bias may be supplied from a battery or bias pack, or may be generated by the stage itself by the incorporation of a cathode bias resistor.

But batteries frequently have to be replaced, and are becoming increasingly hard to get. Bias packs are comparatively expensive. And cathode bias has the disadvantage of wasting plate voltage, because a resistor of sufficient resistance to limit the static current to a safe value will cause appreciable voltage drop when excitation is applied and the plate current assumes its normal operating value. Also, the resistor must be bypassed for audio frequencies when plate modulation is employed.

It is the purpose of this article to introduce a substitute for safety bias which possesses none of the foregoing disadvantages. It requires the addition of only one inexpensive receiving tube and one carbon resistor. It is so simple that it is quite possible that it has been described previously, but if so it escaped the author's notice. Unfortunately the system is applicable only to screen grid tubes.

The basic circuit is shown in figure 1. Resistor R_1 is a small carbon resistor of 250,000 ohms, placed right at the grid lead of the r.f. amplifier. The resistance is so high that it will act as an effective r.f. choke, yet will allow the d.c. bias developed by the grid leak to be applied to the ballast-control tube V_1. When the r.f. amplifier tube is being excited, the bias will cut off the plate current to V_1 and the amplifier will function just as though the ballast tube were not in the circuit. When excitation is removed and the bias drops to zero, the ballast tube draws appreciable plate current—considerably more than the screen current to the r.f. amplifier—and causes the screen voltage to drop to a very low value, so low that the amplifier draws but little plate current even though no bias is applied to the control grid. The only requirements are that the screen voltage be obtained through a dropping resistor rather than direct from a fixed low-voltage supply, and that the supply voltage be at least 2 times the screen voltage. A study of the circuit of figure 1 and how it operates will make it apparent why it is necessary that the screen voltage be supplied by a dropping resistor and why the supply voltage must be enough greater than the screen voltage to allow the use of a dropping resistor possessing appreciable resistance. However, there is nothing against the use of a dropping resistor for obtaining screen voltage; in fact, taking the screen voltage from the plate sup-

*Associate Editor, RADIO

ply through a dropping resistor is the only practical method for high level modulation when telephony is used.

The tube V_1 should have sufficiently low "static plate resistance" at zero bias to cause a considerable increase in current to flow through the screen resistor. It should have sufficiently high μ to be cut off with only a small amount of bias when the peak r.f. amplifier screen voltage is applied to its plate. Also, it should have a reasonable amount of plate dissipation and be inexpensive. A single 6V6-GT (cheaper than a metal 6V6) can be used as a medium μ low resistance triode (screen connected to plate) for low power stages; a triode connected 6L6 is satisfactory for most medium power stages; and two triode connected 6L6's in parallel will suffice for a high power amplifier. The accompanying table gives the recommended ballast complement for a number of popular power tetrodes and pentrodes, either for c.w. or telephony. The only requirement is that the grid bias to the r.f. amplifier be at least 1/8 the screen voltage for c.w. operation or at least 1/3 the d.c. screen voltage for phone operation. If the amplifier is running with recommended excitation, these requirements are sure to be met. With this amount of bias the specified ballast tube is sure to be cut off under all conditions (including a moderate amount of overmodulation) and the amplifier will act just as though the ballast tube were not in the circuit.

For those who want to calculate the ballast tube requirements for an amplifier not given in the table, the following empirical rule is given. Choose the screen dropping resistor without being concerned with the ballast circuit. Then assume that this resistance is placed across the full screen supply voltage. Calculate the amount of current that would flow through the resistor. If it is less than 65 ma., a triode connected 6V6-GT may be used as a ballast. If it is less than 95 ma., a triode connected 6L6 may be used. If it is less than 190 ma., two 6L6's in parallel may be used. In no case will the voltage call for con-

[*Continued on Page 92*]

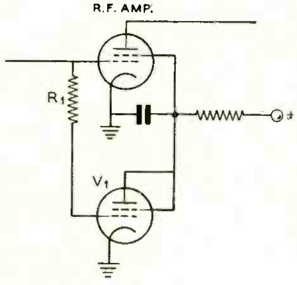


Figure 1

Basic circuit for safety screen ballast. R_1 should be about 250,000 ohms, placed right at the grid lead of the r. f. amplifier. A 1/2-watt carbon resistor will suffice for power inputs up to 100 watts, a 1 1/2 or 2 watt carbon resistor for powers up to 1 kilowatt. The ballast tube V_1 may be chosen by referring to the accompanying table or by the calculation prescribed in the text.

BALLAST TUBE CHART

R.F. AMP.		BALLAST	
1	HY-60	1	6V6-GT
2	HY-60	1	6L6
1	HY-61	1	6V6-GT
2	HY-61	1	6V6-GT
1	HY-65	1	6V6-GT
2	HY-65	1	6V6-GT
1	HY-67	1	6L6
2	HY-67	2	6L6
1	HY-69	1	6V6-GT
2	HY-69	1	6L6
1	125-M	1	6L6
2	125-M	2	6L6
1	HK-257	1	6L6
2	HK-257	2	6L6
1	802	1	6V6-GT
2	802	1	6L6
1	803	1	6V6-GT
2	803	1	6L6
1	804	1	6L6
2	804	2	6L6
1	807	1	6V6-GT
2	807	1	6V6-GT
1	813	1	6L6
2	813	2	6L6
1	814	1	6L6
2	814	2	6L6
1	815	1	6V6-GT
1	828	1	6L6
2	828	2	6L6
1	829	1	6L6
1	832	1	6L6

These recommendations assume that the screen supply voltage is at least twice the normal screen voltage at the tube. If the screen voltage is taken from the plate supply, this requirement ordinarily will be met. The "GT" version of the 6V6 is specified because it is less expensive than the metal type. In every case the ballast tube is connected as a low μ triode (screen tied to the plate). If the screen supply voltage is more than 5 times the normal screen voltage, it is likely that the next smaller ballast complement will suffice, because the ballast tube then will have less work to do. The action of the ballast tube is aided by a high value of screen dropping resistor, and the greater the supply voltage, the greater the required resistance of the screen dropping resistor.

SYNCHRONIZE YOUR SKEDS

with Arlington Time

By J. H. POOLE,* W6LWP

This article deals with two important angles in maintaining accurately timed schedules—first, the interpretation of Arlington time signals; second, the calibration of the error of the station timepiece so that the proper correction can be made.

Having been absent from amateur activities for a few years while pounding brass and fish in the San Diego Tuna Fleet I am not sure just how extensively the Arlington time signals are used by amateurs. But these signals are so useful and simple to employ that we should all be familiar with them.

When I first came out afishing I was completely stymied by the QRM. When the 'Old Man' would ask, "Well, Sparks, what say the other boats?" I was forced to mutter, "Oh, nothing much. Can't seem to hear our code boats." Or else, "Well I called the Belle of Lisbon for two hours and they won't answer. I don't know what's the matter with that guy!"

Then on the second trip I discovered that our set of code boats was working on schedule, using a prearranged frequency generally clear at that time. Three times a day the boats would call at the appointed moment, exchange messages, then quit. If I didn't work the boys on time it meant hours of battling QRM to collect three or four messages with the valuable fish dope. Now the reason their skeds were clicking so nicely was that every operator knew the correct time within just a few seconds.

It is possible to keep time within less than five seconds using just an ordinary alarm clock and no great amount of effort. So when you tell your ham friends, "See you near fourteen-two-hundred kaycee at oh-two-fifteen GMT tomorrow," your particular friend will be there, tuning across your clear channel v.f.o.

*Box 2371, San Diego, California.

signal at the very moment you make your first call, provided he too knows how to keep time within a few seconds.

The Clock

A recipe for rabbit stew in our old family cookbook starts, "First shoot your rabbit . . ." so I say, "First get your alarm clock, Pocket Ben, or whatever you wish, just so it has a second hand you can read." However, a synchronous electric clock will not be suitable since the time it indicates is controlled by the power station which furnishes your electric power. If you can get something with a sweep second hand so much the better, but that's not absolutely necessary, as a dime store magnifying glass mounted before the face is just as good an eyesaver.

The Signals

Now you must choose the most serviceable time signal for a daily check on your new timepiece. Hundreds of radio time signals are sent every day, issuing from nearly every country of the world. A list of some of these may be found in Volume I of "Radio Aids to Navigation," for sale by the Hydrographic Office, Washington, D.C., for ninety cents. In addition the Berne List people (Bureau of the International Telecommunication Union, Berne, Switzerland) publish a book called "List of Stations Performing Special Services" which contains an excellent section on time signals. This book also is available in this country. For western hemisphere amateurs, however, the Arlington signals herewith described will be sufficient.

For the proper times and frequencies to receive Arlington and secondary signals consult figure 1. The signals are accurate within 0.02 seconds, close enough for our ham schedules! The actual signal consists of a series of dashes starting five minutes before the hour, and lasting up to the hour when a final dash, longer than the rest, indicates the beginning of the new hour. The twenty-ninth second of each minute is left silent, and there is a silent space just before the end of each minute which contains a number of dashes, isolated from the rest, indicating the number of minutes remaining to the final dash on the hour.

Thus, if you were to tune in just before the signals began, you would first hear a series of 28 dashes followed by a second's silence and then twenty more dashes. Then would come another brief silence interrupted by four dashes (indicating four minutes to go until the hour). After the four dashes would come another short silence followed by the signal resuming on the beginning of the next minute. To clarify this graphically, figure 2 has been drawn. In all cases the beginning of the dashes indicate the beginning of the seconds, but the end of the dash is without any particular significance.

Checking

By watching your timepiece as the signal comes through, it is possible to observe the

FIGURE 1. U. S. NAVAL OBSERVATORY TIME SIGNAL SCHEDULES.

NAA/NSS—Washington, D. C., and Annapolis, Md.

02 55 00 to 03 00 00 GMT—64 kc., 113 kc., 4390 kc., 9250 kc.
14 55 00 to 15 00 00 GMT—64 kc., 113 kc., 4390 kc., 9250 kc., 12,630 kc.

NAA/NSS time signals are also given on 9425 kc., 12,630 kc., and 17,370 kc. every hour except 0100, 1000, 1100, 1200, 1800, 2000, and 2200 GMT, also omitting 9425 kc. at 0200 and 1500 GMT.

NPG—San Francisco, Calif.

02 55 00 to 03 00 00 GMT—42.8 kc., 113 kc., 9090 kc., 12,540 kc.
14 55 00 to 15 00 00 GMT—42.8 kc., 113 kc., 9090 kc., 12,540 kc.

NPM—Hawaiian Islands

03 55 00 to 04 00 00 GMT—113 kc., 9090 kc., 12,540 kc.
15 55 00 to 16 00 00 GMT—113 kc., 9090 kc., 12,540 kc.

difference between correct time and your time. It is not necessary to wait for the final signal to see this difference, but it can be done with equal accuracy on the fourth, third, or second minute, or if you prefer, at the moment a twenty-ninth second is omited. You now have a method of determining the error of your timepiece within at least a second's accuracy.

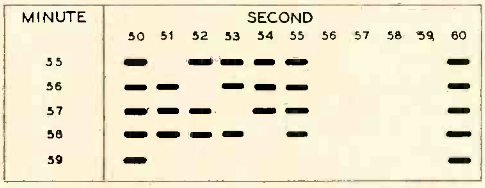


Figure 2. Graphical representation of the characteristic dashes of the last ten seconds of each minute of the time signal.

But suppose the battered old warrior gains a minute every time you look away from it. First you must adjust the regulator until the rate of gain or loss is not so high as to be an absurdity. But don't fuss around trying to hit the point where there will be no error at all. You can't do it. What you do want is to find the rate of change of gain or loss and reduce this value as much as possible.

Charting

To do this make up a chart as shown in figure 3. When you get your first tick, fill in the top line, all except the box on the extreme right. Under TICK put the exact second of the signal at which a comparison is made, and under CLOCK put the exact time your instrument then indicates. Clock time may be local or Greenwich, whichever you prefer. Under ERROR put the number of minutes your timepiece is fast or slow. After the error has been determined three or four times it can be seen whether it is increasing or decreasing. The rate of change of error is entered in the final column under RATE. If you have a fairly good timekeeper the rate will be in seconds per day. If you have a foul one the rate will be in seconds per hour, but if this is the case I would do something about it.

If the rate seems too high try readjusting the regulator. If the rate varies try mounting the clock where the temperature will be fairly constant and where there will be an absence of vibration or of sudden shocks such as a slamming door might cause. Wind the clock at regular intervals and never completely tight.

Now assuming that you have been making time checks for several days (it doesn't matter if you miss a day occasionally) and you have finally determined the rate, you will at any moment be able to state the correct time with a very small margin of error. Simply glance at the chart to find the ERROR at the last time check. Then multiply the RATE by the time period which has elapsed since the check. Apply the result as a correction to the ERROR which will give you the exact error at the moment. With a little practice you can go through the operation in a moment and have a correction to apply to the clock mentally.

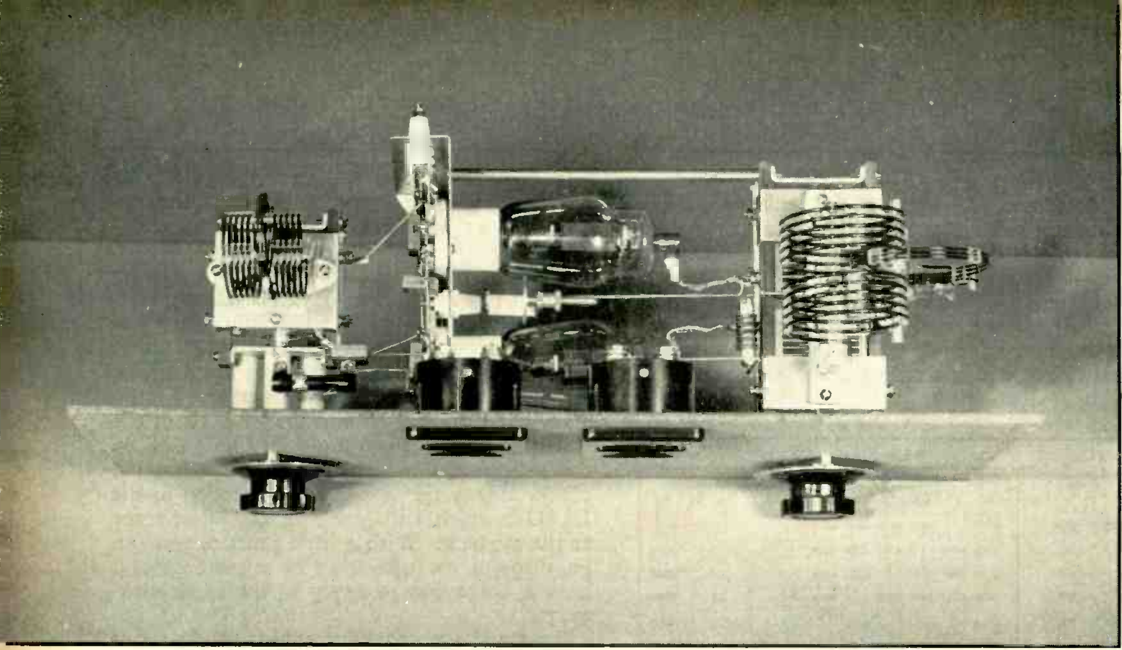
To avoid the confusion which might result when the timepiece is "getting faster" at a decreasing rate, etc., always designate ERROR as *slow* or *fast,* but mark RATE as *plus* or *minus* (plus if the amount of error is on the increase and vice versa). Then apply the "rate times time" correction to the error in accordance with the arithmetical sign.

A careful inspection of figure 3 will reveal more about the system than will words. Note especially the treatment of the rate when more than one day elapses between checks, or when the checks are not twenty-four hours apart. Remember that elapsed time and rate should be in the same units, usually days for rate, so the elapsed time would be in fractions of a day. A little simple arithmetic has to be improvised.

All right, fellow hams, think up some good excuses for you and me to use when we show up thirty seconds too late on some of those future skeds!

DATE	STATION	TICK H M S	CLOCK H M S	ERROR M S	RATE SEC/24H
NOV. 3	NSS	02 00 00	01 55 37	04 23 SL	
4	NSS	02 00 00	01 55 53	04 07 SL	
5	NSS	01 58 00	01 54 10	03 50 SL	
6	NSS	01 59 00	01 55 27	03 33 SL	−17
8	NSS	01 58 00	01 55 01	02 59 SL	−17
9	NPG	15 00 00	14 57 10	02 50 SL	−17
13	NPG	14 58 00	14 56 22	01 38 SL	−18
17	NPG	15 00 00	15 00 16	01 16 FST	−19
18					

Figure 3. Sample chart for determining the error and rate of the station clock.



Top view of the amplifier. Only one of the plates had been removed from the neutralizing condenser when this photograph was taken. It was later found necessary to remove this remaining plate also and to replace it with a 1½-inch machine screw. The method of mounting the various components can be clearly seen in this photograph.

A Push-Pull BEAM TETRODE AMPLIFIER

By K. H. ROTHMAN,* W6KFQ

A 75 to 100 watt buffer or final amplifier designed to be fed from the conventional v.f.o. exciter.

Although the trend is toward the use of a v.f.o. exciter to excite the transmitter proper at a comparatively high power level, the majority of transmitter designs using this system which have been published have been for a fairly high power output. It was felt that a design for the medium power station, using 600 to 750 volts on the plates of the tubes for 75 to 100 watts output, should find comparatively wide application.

Since the 600 to 750 volt range is within the capability of some of the new double-ended beam tubes, it was decided to use a pair of them in push-pull as the amplifier. HY-69's were chosen, since past experience had shown that they are easily excited, that their internal shielding is good, and that they have almost no tendency toward parasitic oscillations when used in such a circuit.

*Laboratorian, RADIO.

Mechanical Construction

The circuit diagram was drawn and the components were gathered together (some of the components came from previously constructed pieces of equipment, as is common practice in these days of priorities). So few parts were needed that it seemed unnecessary to waste a metal chassis on the unit, considering how difficult it is to obtain one at the present time. With this thought in mind, it was then decided to use just as little metal as possible throughout the amplifier.

The panel for the amplifier is a standard manufactured unit, being made of 3/16″ masonite with a grey crackle finish. In this connection remember that the commonly available type of masonite is only about 1/8″ thick, which is a little too thin for a panel-supported amplifier of this type when plug-in coils are employed. So be sure and get the thicker type if a manufactured panel is not going to be used.

A simple shield, made of light metal, is used to support the tube sockets, to act as a bottom brace when the amplifier is not being used in a rack, and to act as a binding post strip. The shield is held to the panel with two 6-32 machine screws. Two more screws could be placed through the panel and the four of them used to hold a tuning chart, if it should be desired to dress the panel up a bit and keep it more symmetrical.

The tuning condenser in the grid circuit is a single-section job with a heavy frame, since the plug-in coil for the grid circuit is mounted upon this tuning condenser. The condenser itself is supported directly from the panel by means of three 2-inch ceramic insulators. A piece of scrap aluminum 2″ by 5″ was bent and placed over the condenser to hold the grid coil socket.

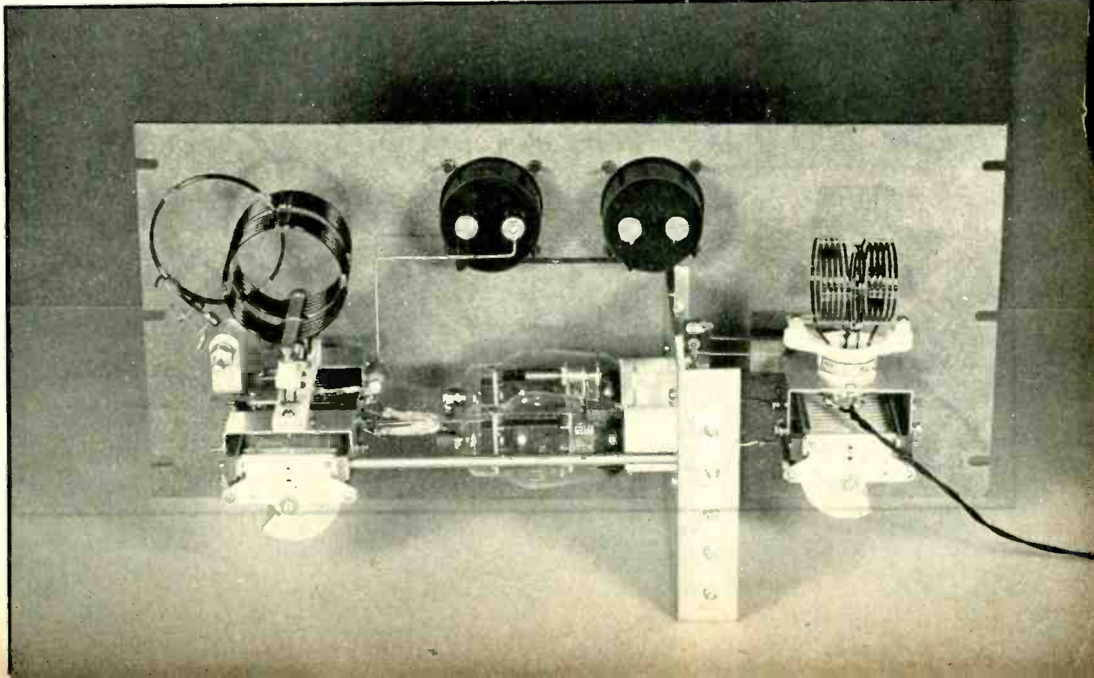
The tuning condenser for the final has 180 $\mu\mu$fd. per section with about 0.050″ spacing. Two aluminum straps 1″ by 4″ were bent and placed across each end of this condenser from the stator bolts on one side to those on the other side. Holes were then drilled in the flat portion of these straps both for the 6-32 screws which support the jack bar and for the jacks themselves. Thus the aluminum strap is made the connecting conductor from each stator on the tuning condenser to the proper end of the coil.

The photographs of the amplifier plainly show the brace which runs from the plate tank condenser to the metal shield. This brace was made from a piece of 1/4-inch brass rod, tapped in each end. One end of the rod is screwed to the end plate of the plate tank condenser and the other end is bolted to the shield. The use of this brace makes the unit quite solid, and in addition the brace serves as the ground return for the rotor of the split-stator plate tank condenser. The plate tank condenser itself is bolted to the panel with three 6-32 flat-head screws with 1/2-inch spacers.

Tuning Up

After the amplifier was completely wired and checked for errors, it was connected up to the proper plate and filament voltages and to a v.f.o. Much to our disappointment, the v.f.o. portion was not needed, as the ampli-

Rear view of the amplifier, showing further details of the method of assembling the amplifier without the use of the conventional metal chassis.



her acted as a very good t.p.t.g. self-excited oscillator. After making several tests it was ascertained that the gain of the amplifier was so high that the very low residual grid-to-plate capacity of the HY-69's was great enough to cause self-oscillation.

One test made upon the amplifier showed that only a very small amount of capacity going from either plate to the opposite grid would completely stop all oscillation. Then, since the amount of neutralizing capacity was so small as not to unbalance the amplifier, only one small neutralizing condenser was used. This condenser was placed between the two tubes and mounted upon a feed-through insulator that connected to one of the grids. In fact, the amount of neutralizing capacity was so small that the plates had to be removed from the neutralizing condenser. The frame of the neutralizing condenser with both plates removed was *almost* enough capacity to accomplish the neutralization. But a little more capacity was desirable, so a screw was put through one side of the condenser to finish the job. The location and type of screw used can best be seen in the photograph of the amplifier which appears on the cover. After getting the amplifier neutralized it worked perfectly, showing no sign of either parasitics or self-excited oscillation.

Operation

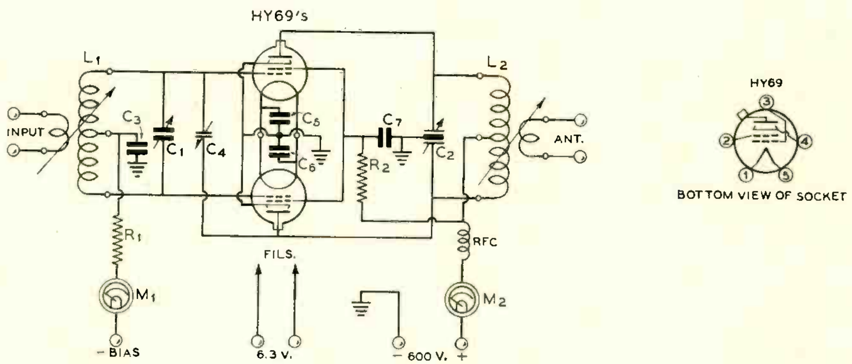
The plate current dip on the amplifier is surprisingly low, even on the 28-Mc. band; with 600 volts on the plate the dip is about 30 ma. on this band. But if the tank condenser is momentarily thrown out of resonance the tubes will draw up to 300 ma. plate current, considerably more than their normal 200 ma.

The grid excitation requirement of the amplifier was found to be unusually small. With 67 volts of fixed bias, the grid current for maximum output under full load was found to be 9 ma. A greater or smaller amount of excitation resulted in a decrease in output. Six watts of driver tube input (300 volts at 20 ma.) was found to be all that was required for full output from the tubes on the 14-Mc. band.

It will be noted that a separate terminal has been brought out for fixed bias on the HY-69's. This was done primarily for c.w. operation with keying in the v.f.o., since the plate current on the tubes is excessive without bias. Increasing the bias voltage on the tubes will call for a small increase in the excitation power. Also, the screen voltage under load should be 250 to 260 volts with 600 volts applied to the plates of the tubes.

[*Continued on Page 93*]

Wiring diagram of the push-pull beam tube amplifier. Note that the lower end of the screen resistor is shown connected to the center tap of the plate tank coil. This is incorrect; the lower end of this resistor should connect to the B plus side of the meter M_2.



C_1—100-μμfd. tuning condenser, 0.030" spacing

C_2—180 μμfd. per section, 0.050" spacing

C_3—0.003-μfd. mica condenser

C_4—Midget neutralizing condenser altered as in text

C_5, C_6—0.005-μfd. mica condensers

C_7—0.003-μfd. mica condenser

R_1—7500 ohms, 10 watts

R_2—15,000 ohms, 10 watts

M_1—0-25 d.c. milliammeter

M_2—0-300 d.c. milliammeter

RFC—2½-mh. 250-ma. r.f. choke

L_1—Manufactured variable-link grid coil, 50-watt type

L_2—150-watt μfd.-type plate coil

GREAT CIRCLE Calculations

By DR. T. A. GADWA,* W2KHM

The article "Calculating Distance and Direction" which appeared in the March, 1941, issue of RADIO contained an error in method which gives an incorrect answer. The following article corrects this error in method and gives the proper procedure for making these calculations.

A study of the article in the March, 1941, issue of RADIO entitled "Calculating Distance and Direction" revealed an error in the method used.

Figure 1 should use the small letters p, r, and t instead of P, R, and T for the sides of the triangle. The use of the colatitude to determine the sides t and r is in error. Side t is the arc of a great circle between the North Pole and the receiver and is determined from the latitude of the receiver. Similarly, side r is determined from the latitude of the transmitter. Therefore, the following relations hold:

$$\text{Cos } t = \text{Sin lat } r$$
$$\text{Cos } r = \text{Sin lat } t$$
$$\text{Sin } t = \text{Cos lat } r$$
$$\text{Sin } r = \text{Cos lat } t$$

This interchange of the latitudes of the transmitter and the receiver introduces no error in the calculation of distance, since the equation involves the product of the sines of both latitudes and the product of the cosines of both latitudes. However, the difference in longitudes is not general and would give a minus sign if the longitude of the transmitter is west of the receiver. If the general equation had been used, and point B is assigned as always west of point C, there would always be a positive angle at A or the North Pole. Since the same antenna is often used for both transmitting and receiving, the use of T and R to designate the two points is confusing and the general equation is recommended.

The calculation of direction by the equation given on page 85 gives the wrong angle because of the interchange of latitudes. The equation should read as follows:

$$\text{Cot } T = \frac{\text{Tan(lat } r) \text{ Cos(lat } t) - \text{Sin(lat } t) \text{ Cos(lon } t - \text{lon } r)}{\text{Sin (lon } t - \text{lon } r)}$$

The general equation using points B and C (see figure 4):

$$\text{Cot } B = \frac{\text{Tan(lat C) Cos(lat B)} - \text{Sin(lat B) Cos(lon B} - \text{lon C)}}{\text{Sin (lon B} - \text{lon C)}}$$

$$\text{Cot } B = \frac{\text{Tan(lat C) Cos(lat B)} - \text{Sin(lat B) Cos(lon C} - \text{lon B)}}{\text{Sin (lon C} - \text{lon B)}}$$

(see figure 5)

The correct solution for the direction of Boston from San Francisco is as follows:

Point	Name	Latitude	Longitude
B	San Francisco	37° 49′	122° 29′
C	Boston	42° 21′	71° 03′

Lon B-Lon C	51° 26′
Log Tan 42° 21′	9.95977—10
Log Cos 37° 49′	9.89761—10
Log product (1)	9.85738—10
Product (1)	0.72009
Log Sin 37° 49′	9.78756—10
Log Cos 51° 26′	9.79478—10
Log product (2)	9.58234—10
Product (2)	0.38225
(1)-(2)	0.33784
Log (1)-(2)	9.52872—10
Log Sin 51° 26′	9.89314—10
Log Cot B	9.63558—10
B	66° 37′ 52″

[*Continued on Page 82*]

*214 Hillcrest Road, Mt. Vernon, N.Y.

Figure 1. The completed transmitter test set. The lower controls, left to right, are: audio gain, bandswitch, degenerative feedback voltage, and a.m.c. bias. Above are the phase switch, the main tuning condenser, and the 'phone jack.

"THE GIMMICK"

A Transmitter Tester

By C. J. STATT*, W2NTC, and W. J. BEEBE

The "gimmick" is not, as its name might imply, just another gadget to clutter up the shack. Although at first glance it may seem to be a somewhat glorified hammeter, it was designed to incorporate all the necessary accessories to the average 'phone rig and to consolidate into one unit the functions of several meters and gadgets which were taking up valuable space on the operating table and occupying parts which were needed elsewhere.

Here are some of the things we've used the gimmick for: wavemeter, field strength meter, neutralization indicator, 'phone monitor, carrier level and shift indicator, direct reading percentage modulation meter, source of degenerative feedback and automatic modulation control voltages, and many other special uses from time to time.

*24 Front Street, Schenectady, N. Y.

Construction

The complete unit is housed in a 7″ x 10″ x 6″ cabinet and mounted on a 5½″ x 9″ x 1½″ chassis. Figure 1 shows the finished product. Figure 2 gives a rough idea of the parts layout. Since we used nothing but parts we happened to have on hand, we won't attempt to supply dimensions with figure 2. The bias cells are mounted above the chassis just behind the 6Q7G. Figure 3 shows the crowded underchassis view. We had to do a lot of squeezing to get it all in but the gimmick can be put on a larger chassis if you wish. The filter condensers are mounted beneath the filter choke shown on the right hand side of figure 3.

Figure 4 is the schematic diagram. We'll admit it looks a bit different, but don't let it scare you. A bit of the unusual was necessary to get the desired results. The tuning condenser cannot be grounded. It is mounted on top of the chassis and driven by a hi-ratio vernier dial. Leads to the condenser are brought up through grommets in the chassis. The coils are wound on Amphenol no. 24 polystyrene forms. After winding the coils, give them a coat of liquid polystyrene. The coupling coil is then wound around one end of the coil and the whole thing is given another coat of dope.

Automobile antenna connectors are used to bring out the degenerative feedback and automatic modulation control voltages. The connector shells are soldered in holes in the back chassis drop. Holes will have to be drilled in the back of the cabinet to allow these connectors to project slightly. The porcelain feed-through insulators shown on the left hand side of the cabinet are for coupling to the transmitter. The coupling leads to the coils on the gimmick can be seen hanging over the top of the 6Q7G in figure 2. A small copper-oxide rectifier unit is mounted on the back of the percentage modulation meter. Any meters of reasonable sensitivity can be used, although, needless to say, the more sensitive the meter used for the carrier level indicator, the better will be the operation of the gimmick. We show O-1 milliammeters on the diagram although we used five hundred micro-ampere meters on our model. However, one-ma. meters are plenty sensitive. The audio transformer should have as high a turns ratio as possible.

Adjustment and Operation

To adjust the gimmick properly it will be necessary to use the 'phone rig, an a.f. oscillator, an oscilloscope (which can be borrowed for the occasion), a self-excited oscillator or signal generator that will cover the range of the gimmick, and a heterodyne detector or receiver.

The percentage modulation meter must be calibrated first, as the calibration of this affects the other circuit calibration. To do this, load the transmitter into a dummy load. Connect the oscilloscope to the output of the transmitter with a loop of wire. Feed the output from the audio oscillator into the modulator input circuit on the rig. Loosely couple the gimmick to the transmitter output, first making sure that the variable shunt on the carrier level meter is completely out—zero resistance. Now adjust the input to the modulators to give about a hundred and twenty-five per cent modulation as indicated by the oscilloscope. Increase the resistance of the shunt on the carrier level meter until the needle rests at dead center or zero on the dial. Now increase the coupling to the transmitter until the percentage modulation meter shows full scale deflection of the needle. As the coupling is increased, keep increasing the resistance of the shunt on the carrier level meter, always keeping the needle at center. A mark on the dial at full scale deflection will permanently calibrate the meter for one hundred and twenty-five per cent modulation.

Leaving the variable shunt in the position determined by this first calibration point, and keeping the coupling such that the carrier level meter always shows deflection to the center of the scale, modulate the transmitter to several other percentages of modulation as indicated by the oscilloscope, marking the meter dial at each point. With proper adjustment of the variable shunt at the first calibration point and proper coupling it will be possible to calibrate the modulation meter over a range of approximately eighty to one hundred and twenty-five per cent modulation. Any maximum desired can be chosen, but the maximum point must always be calibrated first, as this determines the point for the shunt on the carrier level meter.

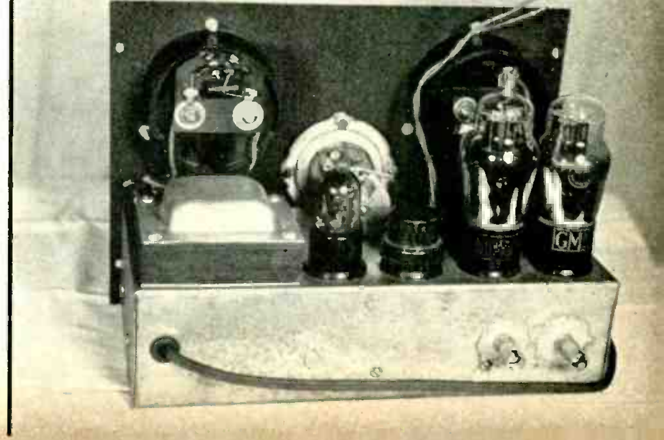


Figure 2. Notice the small instrument-type copper-oxide rectifier on the rear of the meter. The twisted pair leading to the pick-up coils connects to a pair of feed-through insulators on the cabinet. The bias cells are mounted vertically directly in front of the 6Q7-G.

The calibration will remain accurate as long as the life of the tubes used in the gimmick, but should always be rechecked whenever any tubes, with the exception of the rectifier, are changed. When taking a reading of percentage modulation on the meter, coupling to the transmitter should always be adjusted to give deflection of the carrier level meter needle to the center or zero point on that dial. Dials for the meters can be made from fiber board or any such suitable material.

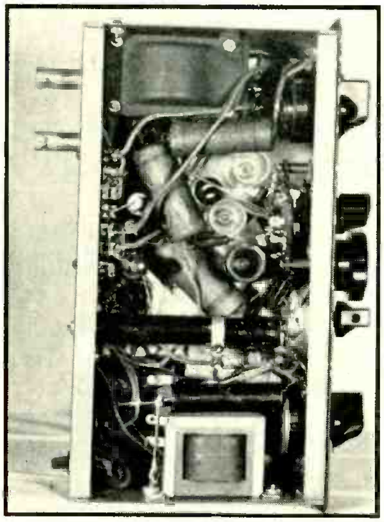


Figure 3. Underchassis view. The bleeder resistor is mounted away from the chassis on metal brackets. The filter choke is mounted under the power transformer with the filter condensers tucked on top. The audio transformer is mounted on the other end of the chassis.

Wavemeter Calibration

The next step is to calibrate the wavemeter. Feed the output from the self excited oscillator or signal generator into the heterodyne detector or receiver. Loosely couple the gimmick to the oscillator. Now tune the oscillator to zero beat with signals of known frequency spotted throughout the range of the three bands on the gimmick. At each frequency tune the gimmick for maximum deflection on the carrier level meter. The tuning of the gimmick will probably react on the oscillator or signal generator, hence the signal will have to be readjusted to zero beat. When the oscillator is tuned to zero beat with the known signal and the gimmick shows maximum deflection on the carrier level meter, plot the dial reading on graph paper. When several points have been plotted for each band on the gimmick the calibration curves can be drawn.

Use As a Neutralization Indicator

When using the gimmick as a neutralization indicator, couple it to the transmitter and with the plate voltage removed from the stage being neutralized, use the carrier level meter to indicate presence of r.f. in the tank.

Degenerative Feedback Output

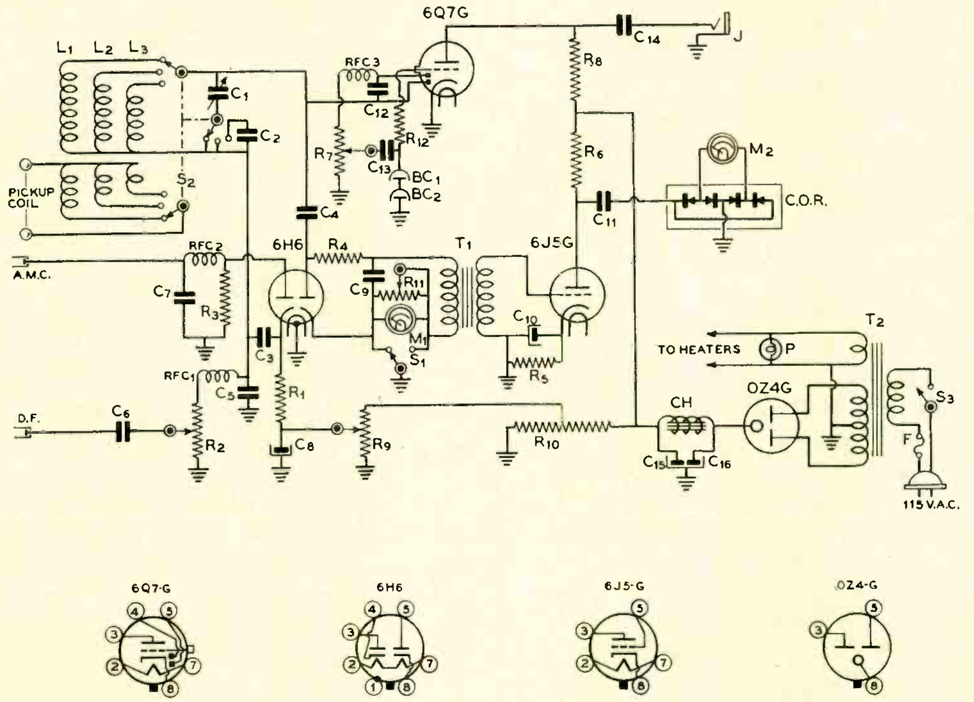
The degenerative feedback voltage can be injected into the modulation system at any convenient place. Using the micro-ammeters in the gimmick and the necessary coupling as determined by our calibration, we obtained about two and a half volts of degenerative feedback voltage at one hundred per cent modulation. The use of less sensitive meters will naturally increase the amplitude of both this and the a.m.c. voltage.

Adjusting the A.M.C. Circuit

The a.m.c. circuit should be adjusted so that the a.m.c. diode conducts only above about ninety per cent modulation. Using the calibration of the gimmick to indicate the percentage of modulation, tie the oscilloscope across the load resistor in the a.m.c. diode circuit. Adjust the bias on this diode so that the tube conducts at the proper point as indicated by the oscilloscope. The voltage output here is rather low but is sufficient for use as a firing or control voltage in several types of a.m.c. circuits. If you don't have any a.m.c. facilities on your rig, tie the a.m.c. voltage from the gimmick into the number three grid to a 6L7 speech input stage on the modulators, across a hundred-thousand-ohm resistor to ground. The action won't be quite as effective as it would in a proper a.m.c. circuit, but it will help.

Audio output is obtained from the jack on the lower right hand side of the panel and is controlled by the gain control on the lower left hand side of the panel.

The switch just below the carrier level meter on the panel in figure 1 is a phase re-



BOTTOM VIEWS OF TUBE SOCKETS

WIRING DIAGRAM OF THE ALL-PURPOSE TRANSMITTER TEST SET.

C_1—100-µµfd. midget variable
C_2—.0001-µfd. midget mica
C_3—0.25-µfd. 400-volt tubular
C_4, C_5—.0001-µfd. midget mica
C_6—0.25-µfd. 400-volt tubular
C_7—.002-µfd. midget mica
C_8—16-µfd. 35-volt electrolytic
C_9—.002-µfd. midget mica
C_{10}—25-µfd. 25-volt electrolytic
C_{11}—0.05-µfd. 400-volt tubular
C_{12}—.0001-µfd. midget mica
C_{13}, C_{14}—0.25-µfd. 400-volt tubular
C_{15}, C_{16}—Dual 8-µfd. 350-volt electrolytic
R_1—100,000 ohms, 1 watt
R_2—500,000-ohm potentiometer
R_3—100,000 ohms, 1 watt
R_4—100,000 ohms, 1 watt
R_5—4000 ohms, 1 watt
R_6—100,000 ohms, 1 watt
R_7—500,000-ohm potentiometer
R_8—500,000 ohms, 1 watt
R_9 — 3000-ohm potentiometer
R_{10}—15,000 ohms, 50 watts, slider type
R_{11} — 1000-ohm potentiometer
R_{12}—100,000 ohms, 1 watt
T_1—3:1 ratio audio transformer
T_2—600 v. c.t. 40 ma., 6.3 v. 2 a.
CH—30-hy.. 50-ma. filter choke
RFC_1, 2, 3—2½-mh. r.f. chokes
S_1—S.p.d.t. peak polarity switch
S_2—3-pole 3-position range switch
S_3—S.p.s.t. on-off switch (mounted on R_7)
P—6.3-volt pilot lamp
J—Open circuit jack
BC_1, 2—1.25-volt bias cells
F—2-ampere line fuse
COR — Small instrument rectifier
M_1, M_2—0-1 d.c. milliammeters
L_1—93 turns no. 28 enam. closewound, 20-turn ant. coil
L_2—49 turns no. 22 enam. closewound, 10-turn ant. coil
L_3—12 turns No. 16 enam. closewound, 4-turn ant. coil
All coils wound on ¾" dia. polystyrene forms.

versing switch to measure percentage modulation on both positive and negative peaks. The position of this switch should be noted at the time of calibration, and whenever the gimmick is used in such a manner that the calibration is of any importance, the phase switch should be returned to its proper position. Over-modulation on either peak of the envelope will be indicated by a fluctuation of the carrier level meter as well as on the percentage modulation meter. The percentage modulation meter is not a true peak-indicating device, giving more of an r.m.s. indication of the modulation peaks. But throwing the phase reversing switch to one side or the other will give an idea as to whether or not the peaks of one polarity are exceeding those of the other polarity.

All ready to go for a walk. From a good vantage point, this little self-contained 112-Mc. transceiver has a range of several miles. The vertical rod radiator is supported as shown. Two bolts are soldered to the front lip supporting the hinged lid, and by removable thumb screws the lid either may be held down tightly for carrying by the handle or opened for access to the "works".

A Self-Contained Battery Powered 2.5 METER TRANSCEIVER

By W. W. SMITH,* W6BCX

Weighing but 11 pounds (not including microphone or phones) this transceiver can be carried considerable distance without fatigue, and for this reason is suitable for many applications where a heavier transceiver or a transceiver requiring a storage battery for power would not be practicable.

The above title and "sales talk" are the same as those appearing on an article in RADIO for March, 1940. The reason is that the transceiver to be described is simply an improved version of the job which appeared last year. The wide popularity of the prototype was incentive to see what could be done to bring the transceiver up to date.

Actually, the improvements and modifications are of a minor nature, and have but little effect upon the performance. However, as they result in a job which is lighter, more compact, and less expensive, they were deemed worth while.

The original version was built just before the 1G4-GT became available, and as the 1G4-G would not oscillate properly with a coil-condenser tank circuit, a tuned line was used for the tank. However, as a coil-condenser arrangement is simpler and more compact, and since such a tank works fine with a 1G4-GT (now generally available) the latter combination was incorporated in the new model.

The new model employs a 50 ma. audio tube instead of a 100 ma. tube, resulting in a reduction in total filament drain of 33 per cent. The 1T5-GT, not yet out when the original job was designed, delivers virtually as much a.f. power as the 1Q5-GT in spite of the fact that it draws only half as much filament current. The new

*Associate Editor, RADIO

model employs individual A and B batteries, which are more readily available than a suitable "pack" type battery, and also afford greater economy. When a pack is used, it is necessary to discard the whole thing when *either* the A or B section is exhausted.

The cost of operation of the new transceiver is about 0.4 cents an hour, the exact cost being determined by the relative time spent transmitting, and whether operation is intermittent or continuous. Any dry battery will give more hours of service in intermittent service than it will in continuous service.

The transceiver will provide reliable communication over a distance of 20-25 miles when both stations are sufficiently elevated so as to be in line of sight.

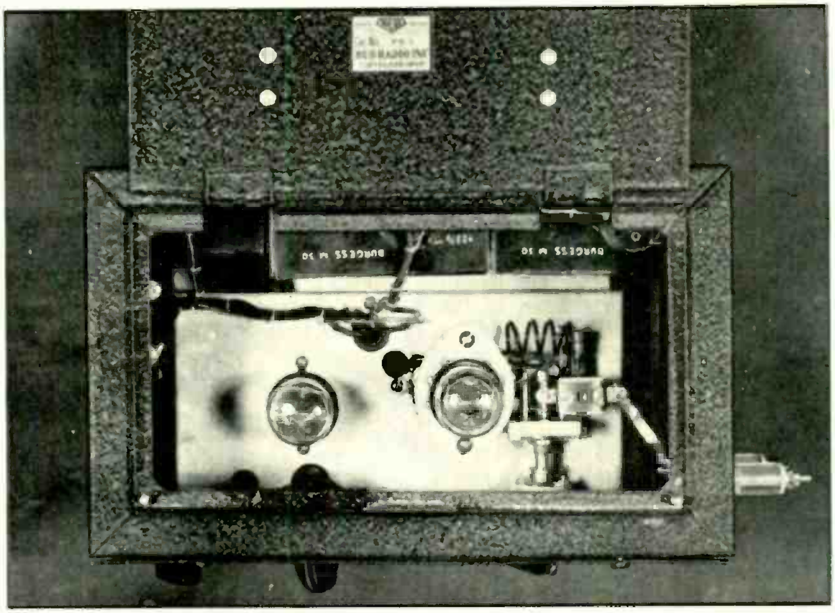
The set quite easily could be made lighter and more compact. Bias cells could be used for bias, a flashlight cell for filament power, hearing aid B batteries for plate power, and a small "tailored" aluminum box for a cabinet. This would cut the weight in half and the size even more. However, it also would cut down the economy of operation, as batteries of this type would not give very many hours of service. A compromise must be made between portability and economy of operation. The particular model illustrated is both reasonably portable and reasonably economical to operate.

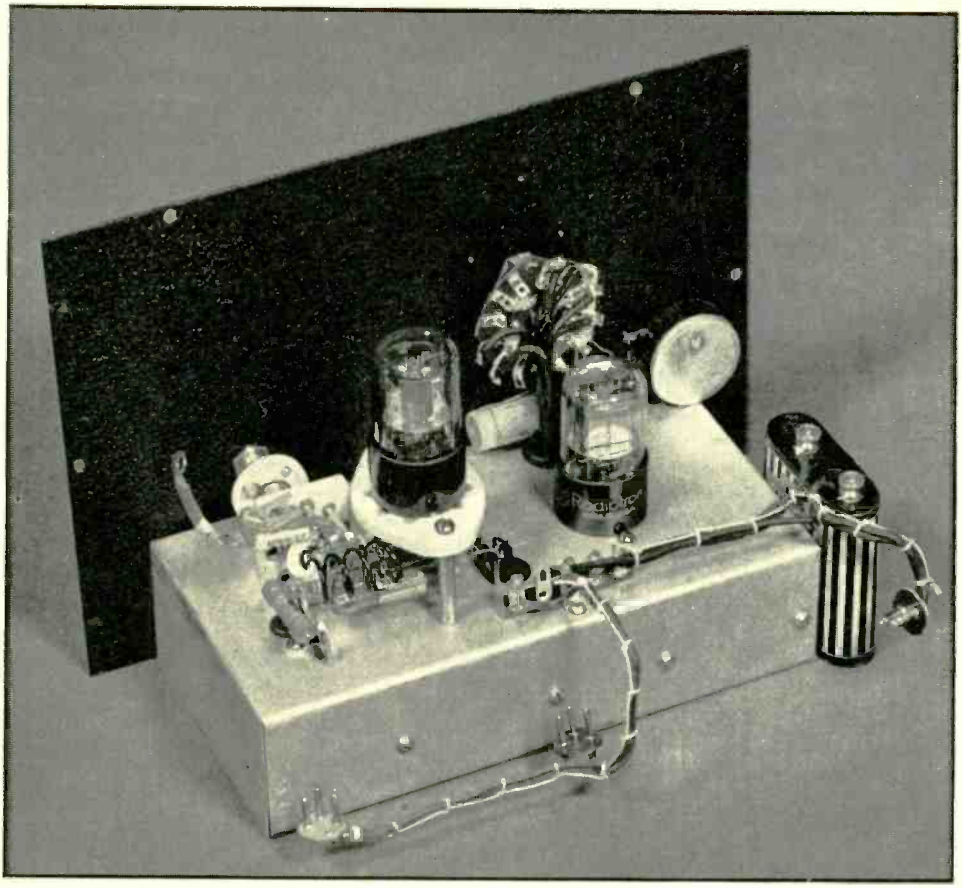
Construction

The transceiver is constructed in a standard, manufactured cabinet measuring 7 x 10 x 6 inches deep, a sub-chassis measuring 4 x 8 x 2 inches high being supported from the front panel as shown in the illustrations, these illustrations giving an idea as to the physical layout of the various components. The chassis is sufficiently small to allow the various batteries to be placed between the chassis and walls of the cabinet. Small pieces of wood or heavy cardboard are wedged between the chassis and batteries to hold the latter firmly in place, a necessary requirement if the instrument is to be used while in motion.

As both sides of the tuning condenser are "hot," the shaft is driven through a ceramic coupler. It is necessary that the grid condenser go to the rotor rather than the stator of the tuning condenser. The ceramic tube socket, the tuning condenser, the grid condenser, and the coil are all placed as close together as possible to provide the shortest possible leads. The coil is soldered directly to the condenser ter-

The various batteries are arranged around the space between the chassis and cabinet, and held firmly in place by wedges of wood and cardboard. A midget 4½-volt C battery, a small 1½-volt A battery, and two portable size 45-volt B batteries make up the battery complement.





Looking down on the transceiver with cabinet removed. The flexible lead terminated in a solder lug must be unfastened from the lower antenna feed-through insulator before the unit can be slid out of the cabinet.

minals. The "hot" lead wire on each r.f. choke is cut off short before wiring the choke in the circuit.

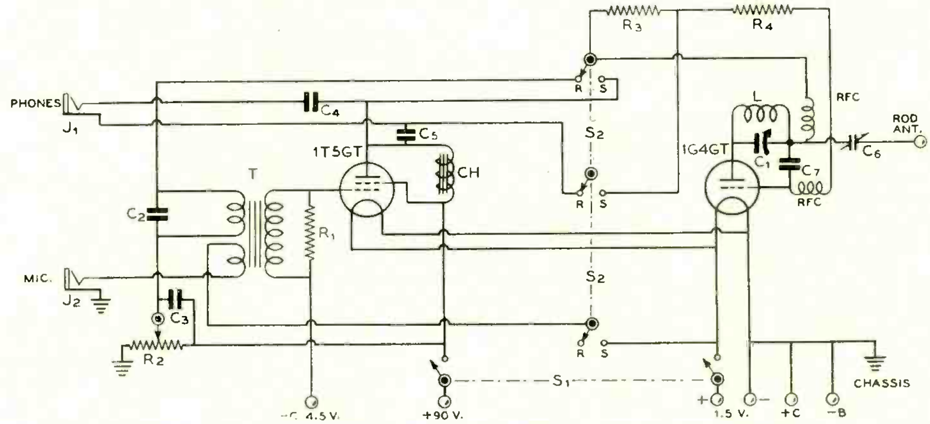
The antenna consists of a vertical half-wave rod, capacitively coupled to the grid of the tube. Better results, both receiving and transmitting, are obtained with the antenna coupled to the grid rather than the plate. The length of the antenna, *overall,* from the tip of the rod to the coupling condenser C_6 should be about 3 feet 6 inches. This is not quite as long as the usual 114-Mc. dipole, but it is an electrical half wavelength just the same because of the loading effect of condenser C_6.

The antenna rod proper is about 3 feet 3 inches long. The rest of the length is made up by the feed-through insulator bolt and the flexible lead to the coupling condenser. Two medium-sized feed-through insulators are mounted one above the other to support the antenna rod, as shown in the illustration. The top insulator does not connect to anything; it merely serves to hold the antenna rod vertical. The two threaded rods for the feed-through insulators should be no longer than necessary, in order to reduce the stray capacity to ground (cabinet) as much as possible.

To permit carrying of the transceiver by means of a drawer pull fastened to the lid, the lid is fastened down by means of removable thumb screws. To facilitate carrying the unit when space is limited, the antenna rod is readily detachable.

Initial Adjustment Procedure

Remove the adjusting screw from the antenna coupling condenser C_6, and attach the antenna, making sure the flexible wire is connected from the coupling condenser to the terminal on the *bottom* insulator (this wire must be unhooked each time the set is re-



WIRING DIAGRAM OF THE SELF-CONTAINED TRANSCEIVER.

C_1—Sub-midget variable condenser; all but 2 plates removed, about 5 µµfd. Rotor insulated from frame. Connect rotor to grid, stator to plate. Ceramic coupling must be used on shaft
C_2—.002-µfd. midget mica
C_3—0.1-µfd. tubular 200 or 400 v.
C_4—0.1-µfd. tubular, 200 or 400 v.
C_5—.01-µfd. tubular, 400 v.
C_6—3-30 µµfd. mica trimmer, ceramic insulation, screw removed. Soldered directly to rotor terminal of C_1
R_1—100,000 ohms, ½ watt
R_2—100,000-ohm potentiometer
R_3—1 meg., ½ watt
R_4—25,000 ohms, ½ watt
CH—Midget 7 to 10 hy. choke, 15 ma. or more
T—Transceiver type midget dual purpose a.f.t., plate and single button mike to grid
S_1—D.p.s.t. toggle switch
S_2—4-pole 2-throw rotary "send-receive" switch
J_1, J_2—Open circuit jacks
RFC—U.h.f. type radio frequency chokes
L—4 turns no. 14 enamelled wound on ½" dia., spaced to hit 114 Mc. with C_1 set at half capacity

moved from the cabinet). Insert the microphone and earphone plugs, making sure to get them in their correct respective jacks. It is possible to hear very weakly with the phones in the mike jack, but needless to say it is impossible to transmit with the microphone in the earphone jack. No damage will result if the two plugs are accidentally transposed.

With the switch on "receive," a loud hiss should be observed when the potentiometer is advanced full on and the tuning condenser is rotated.

By means of another transceiver or Lecher wires the frequency should be checked. If necessary the coil turns should be spread or squeezed together until the center of the band is found at about ½ maximum capacity. The nodes or dips on a pair of Lecher wires should measure 4 feet 3 inches apart for the approximate center of the band. The points can be observed quite readily by putting the potentiometer right on the edge of superregeneration. When the slider-jumper hits a node the receiver

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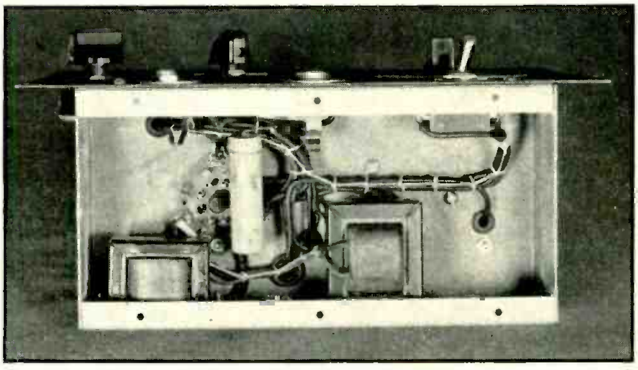

Under chassis view, showing layout of parts.

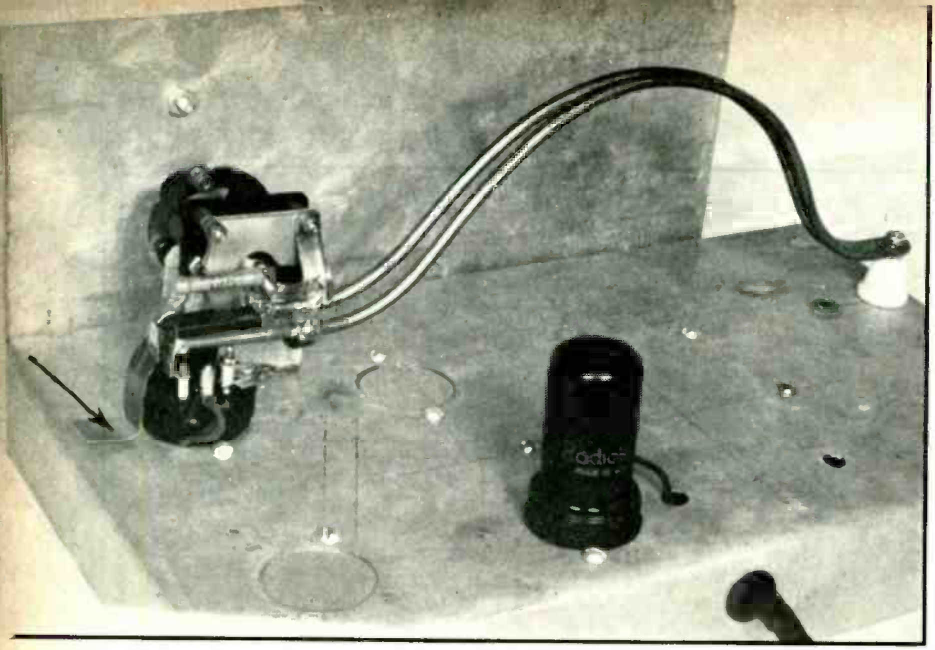

Figure 1. Rear view of the experimental model superregenerator. Arrow points to the balancing capacity discussed in the text.

Adjusting the SUPERREGENERATIVE RECEIVER

By LAWRENCE FLEMING,* W3HQP

Ultra-high frequency gear still has a reputation for being tricky and hard to get working. A seemingly small change in the mechanical layout often makes all the difference between "works" and "doesn't work." Superregenerative detectors are considered particularly critical. Short leads, physically small components, and good insulation in the r.f. circuits, together with the use of special u.h.f. tubes, are the usual expedients, but sometimes other factors enter into the picture to puzzle the constructor.

Capacitances to Ground

In building the 112-Mc. self-quenched superregenerator shown in figures 1 and 2, the writer located a factor which seems to deserve special emphasis in line controlled u.h.f. oscillators. This factor is the stray capacity to ground of the grid and plate sides of the circuit. If the ratio between these capacitances is not about right for the particular type tube used, the tube will not superregenerate properly. It may even refuse to oscillate at all.

For tubes of medium μ, the ratio should be about 1-1. Tuning with a split-stator condenser will help, and has been used in the 224-Mc. receiver described in Radio for November 1940 (page 14).

More convenient and just as effective is the scheme which inspired this article: to the stator side of the tuned circuit add a small capacity to ground. The stator side needs the extra capacity because its capacity to gronnd is always less than that of the rotor side of

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the tuning condenser, due to the amount of metal in the shaft and bearings. The voltage distribution is affected by these capacitances, together with the tube capacitances.

In the set shown the added capacitance takes the form of a piece of sheet copper about ½ inch by 1 inch, soldered to the tube terminal and bent so that part of it extends near and parallel to the chassis.

General Arrangement

The circuit, shown in figure 1, is a conventional 112-Mc. superregenerator using a parallel-conductor "line" shunted by a midget tuning condenser. The tuning condenser C_3 is a Cardwell "Trim-Air" cut down to 1 rotor and 2 stator plates. Both stator and rotor are hot to ground; so the dial shaft is connected through an insulating coupling.

The capacity to ground of the rotor is greater than that of the stator. This unbalances the circuit, tending to make the stator side the "hotter" of the two. The unbalance is corrected by adding the balancing capacity C_1 to the stator side. C_1 is the small piece of sheet copper mentioned above. It was found that it made no difference whether the rotor of tuning condenser C_3 was connected to the grid or to the plate of the tube, so long as balancing capacity C_1 was connected to the stator side. If C_1 were put on the wrong side in either case, the tube would hardly "supe" at all. In the photograph of figure 1, C_1 is marked by an arrow.

Tube Mounting

The tube is a metal 6J5, used because it happened to be available. It is mounted upside-down with the base sticking up through a hole in the chassis. Under the chassis it is held in place by a home-made metal bracket (figure 1) clamped around the metal shell. The shell is thus grounded. No socket is used. Connections are made directly to the exposed tube prongs by clips taken from a dismembered wafer socket.

A 7A4 should be a better tube, because it has shorter internal leads and a glass instead of a bakelite base, but care should be used in mounting it. A polystyrene loctal socket is recommended.

Line Dimensions

The parallel-conductor line is made of no. 8 bare wire bent into a "hairpin." The line is supported at its closed end by a feed-through insulator, and at its open end by the tuning condenser and the tube terminals. The length from the center of the feed-through insulator to the plate prong of the tube is 12¼ inches. Spacing is 0.66 inch, center to center. The theoretically best size conductor for the highest Q circuit is 3/16 inch[1], but the no. 8 wire (0.13″ dia.) works very well. The theoretical optimum spacing of 0.66 inch is best for either conductor size.

Antenna Coupling

A single wire fed antenna has been used with the feeder tapped directly onto the hairpin line. With the balancing capacity C^1 adjusted for best operation with the antenna disconnected, no particular unbalance seems to result when the feeder is tapped on. The usual inductive hairpin coupling can be used, and perhaps the best arrangement of all would be to use such a hairpin with means to vary its coupling to the tank.

Audio System

The 6J5 audio stage gives more than enough volume for headphones. The detector

[1]E. H. Conklin, "Transmission Lines as Circuit Elements." RADIO, April 1939, pp. 43-45, 75, 76.

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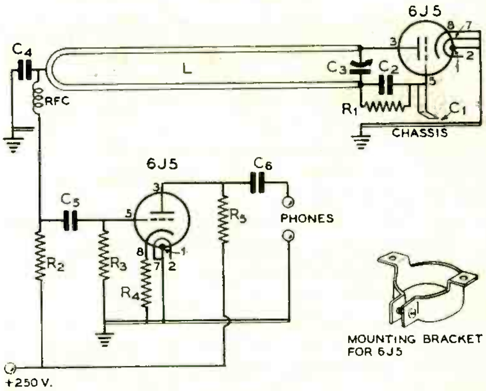


Figure 2.

WIRING DIAGRAM OF THE SUPER-REGENERATOR.

C_1—Balancing capacity, see text
C_2—.0001-μfd. midget mica
C_3—Midget tuning condenser cut to 3 plates
C_4, C_5—.005-μfd. midget mica
C_6—0.05-μfd. 400-volt tubular
R_1—1.0 megohms, 1 watt
R_2—50,000 ohms, 1 watt
R_3—500,000 ohms, 1 watt
R_4—2500 ohms, 1 watt
R_5—100,000 ohms, 1 watt
RFC—Midget u.h.f. choke
L—Resonant line, see text

BAFFLING
The Loudspeaker

By ROBERT M. GILBERT*

Many an amateur has a dynamic type loudspeaker that he would like to use in conjunction with his radio and recording equipment, but is at a loss when it comes to choosing and calculating dimensions for a suitable enclosure. For those faced with such a problem this article is written. First there will be a brief discussion of the theory involved, then construction details for some cabinets that will improve the frequency response of an ordinary speaker, yet cost so little as to fit into anybody's budget.

Theory

At low frequencies, where baffling is most important, the cone of a dynamic loudspeaker can be considered as a piston, because the entire cone moves as a unit. As shown in figure 1, on the forward stroke the cone (or piston) compresses the air before it and rarefies the air behind, and reverses the procedure on the backward stroke.

The illustration shows the action of the cone as it moves from its rest position forward, back to rest, and backward. At the start the air pressure is the same on both sides. When the cone moves forward the air in front is compressed and a slight "vacuum" is produced behind. This compression moves out from the cone, leaving the air immediately in front of the cone at normal pressure again. Then as the cone returns to its rest position again the air in front is rarefied and the air in the rear is compressed, as will be seen in the third part of figure 1. Part four shows the conditions existing when the cone moves back from its rest position. The rarefication and compression are both increased, and the preceding pressure changes continue to move out from the cone.

In accordance with well-known laws of physics, the air that has been compressed will tend to flow around the edge of the speaker into the vacuum on the other side, thus greatly reducing the pressure changes caused by the movement of the cone.

To prevent this effect, or to shift it to a much lower frequency, is the purpose of a baffle, which in its most elementary form is simply a flat partition of acoustically insulating material that serves to isolate the pressure or vacuum area at the front of the cone from the vacuum or pressure area at the rear.

When the sound radiation from the rear of the cone reaches the front of the cone exactly 180° out of phase with the front radiation, cancellation takes place, and causes a dip in the speaker's response curve. This occurs at a frequency where the length of the path from the rear center of the cone around the baffle to the front center of the cone is exactly *one* wavelength. Since the wavelength varies inversely with frequency according to the relation $\lambda = 1089/f$, where f is the frequency in cycles per second and λ is the wavelength in feet, it is clear that the lower the frequency at which the baffle is to be effective the larger will be the baffle required.

The dip in the response curve will be very pronounced when a regular baffle, such as a square or a circular one with the speaker mounted concentrically, is used. The reason for this is that all paths from rear to front are of essentially the same length, so that cancellation occurs at one frequency. A great improvement can be effected by the simple trick of using an irregular baffle (even a rectangular one is better than a square one) with the speaker mounted asymmetrically, rather than in the center, in order that no two rear-to-front paths are of the same length. The result is a smoothing out of the response curve, be-

*Contributing Editor, RADIO.

cause the cancellation frequencies are spread over a considerable portion of the spectrum.

At low frequencies the radiation angle of a speaker mounted in a flat baffle is a solid angle of 180° (in other words, a hemisphere), if the speaker is well clear of the walls, ceiling and floor of the room. By mounting the speaker near one edge of an irregular baffle, as explained above, and then locating the baffle at right angles to the floor with this edge on the floor, the radiation angle can be reduced almost to a quarter-sphere. This will result in loading the cone much better and the cone will therefore radiate much more efficiently. Care must be exercised to prevent reflections from the floor surface. A rug on the floor in front of the speaker will be of help in this respect.

An improvement in efficiency can also be effected in the case where two speakers are used on the same baffle by locating them as close together as possible. The phase of both cones is the same (if properly connected), so that the pressure area of each cone helps to load the other, thereby increasing the efficiency and improving the bass response.

Designing The Cabinet

To be considered really high fidelity, especially from the standpoint of frequency modulation, a speaker or speaker system should reproduce all frequencies from 30 to 16,000 cycles per second with a response that is flat within about 5 db. So for the purposes of illustration a lower limit of 30 cycles has been chosen in the following designs.

For adequate baffling down to 30 cycles a baffle 36.3 feet square (or an irregular baffle with the longest dimension 36.3 feet and the shortest at least 15 feet) is necessary. Obviously, for home use such a large baffle is out of the question, and that required for a still lower cut-off frequency would be even worse. To obtain the beneficial effects of such a baffle

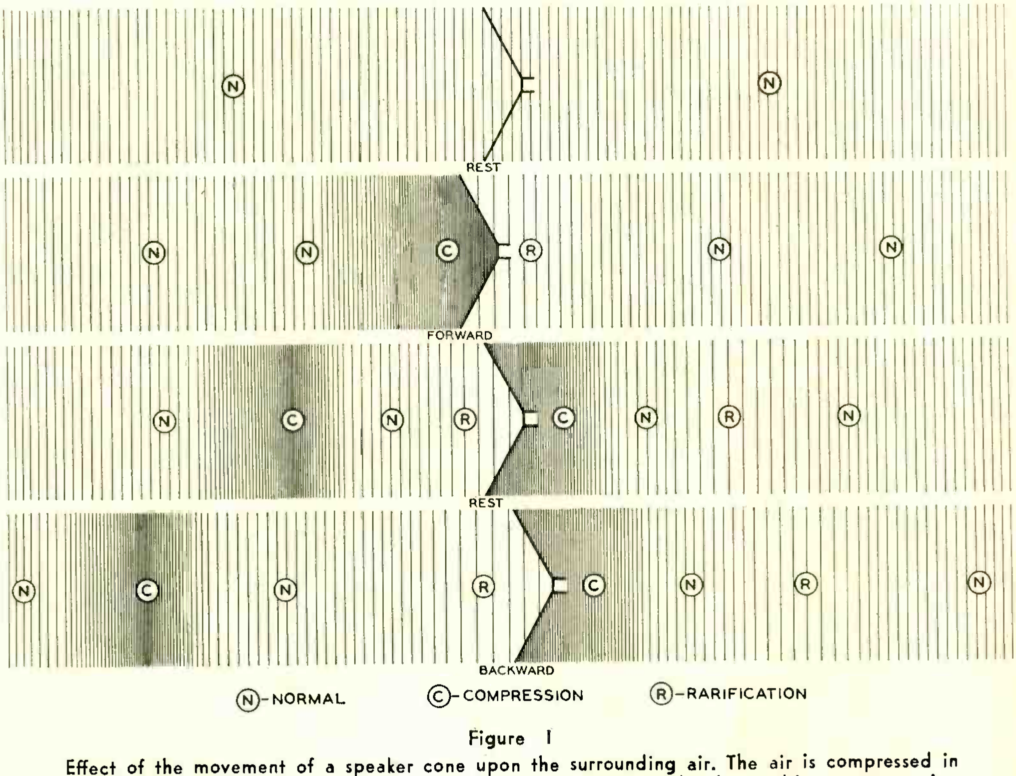


Figure 1

Effect of the movement of a speaker cone upon the surrounding air. The air is compressed in the direction in which the cone moves and rarified on the other side, the resulting waves moving out from the cone similarly to the movement of waves in a pool when a stone is dropped into the water.

and still stay within reasonable limits as to size, some form of cabinet enclosure seems to be the best answer at present.

Before going ahead with the cabinet design it might be in order to mention that the effect of an infinitely large baffle can be obtained by mounting the speaker unit in a hole in the ceiling of the room, or in one of the walls, thus preventing the rear radiation of the speaker from combining in any way with the front radiation at any frequency.

Infinite Baffle

One of the simplest enclosures that can be built to provide the necessary baffling action is an "infinite baffle," so called because it approaches the action of an infinitely large flat baffle when properly designed and built. It consists of a box with a single hole for the speaker, strongly constructed and with the walls braced to prevent vibration. The shape is unimportant as long as the box is large enough for its resonant frequency to fall at or outside the lower limit of the speaker's response range, and has sufficient lining of high absorption material. A half-inch layer of rock wool, felt, or rug cushioning will usually be enough.

A twelve-inch speaker requires a box of about eight cubic feet volume, and an eighteen-inch speaker should have about fifty per cent more volume. Using these figures as a basis, the following table gives the approximate box sizes for various speakers:

Speaker Size	Volume of Box	Speaker Size	Volume of Box
18″	12 cu. ft.	10″	6.7 cu. ft.
15″	10 cu. ft.	8″	5.3 cu. ft.
12″	8 cu. ft.	6″	4 cu. ft.

Acoustical Labyrinth

An acoustical labyrinth speaker is one having a long tube with absorbent walls closely coupled to the rear of the cone. The tube should be one-half wavelength long at a frequency near the lower end of the response range, and is normally folded into a console cabinet with the open end at the bottom or in the front of the cabinet.

The absorption of the tube lining increases with frequency, thereby greatly attenuating all except the lower frequencies. Making the tube a half-wavelength long, as mentioned above, causes a reinforcement of the front radiation of the cone by the radiation from the tube, since these are in phase at this point.

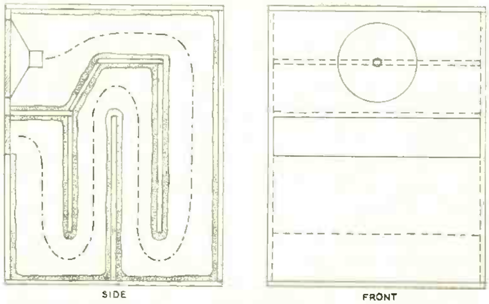


Figure 2
Acoustical labyrinth speaker design. The tube coupled to the rear of the cone is folded into a cabinet to conserve space. This is only one of many possible arrangements, but serves to illustrate the general principle.

Not all of the improvement of the response range credited to the labyrinth is due to reinforcement of the low frequencies, however; a great deal of improvement is the result of the baffling action of the long tube.

An example of this type of speaker system is given in figure 2. No dimensions are included, as these will depend upon the speaker to be used and the type of cabinet into which the labyrinth is to go. Possibly better arrangements of the interior will suggest themselves to the constructor. The cross-section area of the tube should be approximately equal to the area of the speaker cone (as calculated by the formula given in the next section), and the center-line length, as indicated by the dot-dash line, should be a half wavelength at some frequency near the low end of the response range.

Vented Enclosure

A vented enclosure for a speaker is another type of cabinet baffle which improves the speaker's low frequency response by the in-phase addition of the back radiation to the front radiation of the cone at these low frequencies.

It consists of a box having two holes in the front, one for mounting the speaker and the other by which the air in the box is acoustically coupled to the outside air. The box is partially lined with an absorbent material such as hair felt or acoustic insulating board to absorb the higher frequencies and to prevent excessive cabinet resonance. The cabinet should not be *completely* damped, as is required for the "infinite baffle" type cabinet.

For the same reason mentioned in the last paragraph of the theory section of this article it is best to locate the speaker hole and vent fairly close together.

Figure 3 shows the necessary details and dimensions of a cabinet of this type intended to house a twelve-inch speaker. No claim is made that these dimensions are the only correct ones; merely that they worked well with a particular speaker. Ambitious constructors may be able to improve upon the performance of such a unit by experimenting a little with the various dimensions.

If the box is made of ¾″ five-ply wood and fastened together with wood screws it can easily be disassembled for shipping or storage. The inside of the box is acoustically treated as follows: a piece of ½″ Celotex or other similar acoustic insulating board about 10″ x 24″ is placed vertically in the center of the back, and another piece about 8″ x 24″ is placed on each side. Some cut-and-try will probably be necessary to obtain optimum results. During this process the back can be held on with only two or four screws if the volume is reduced to less than maximum, thereby reducing the labor involved in closing and opening the cabinet several times.

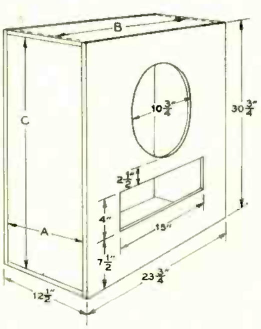


Figure 3
Dimensions for a vented enclosure intended for a twelve-inch speaker. The letters designate the dimensions given in the table in the text.

In the following table the dimensions of a slightly different enclosure are given for several different sizes of speakers:

	A	B	C	Volume
8″	9⅞	16	22⅛	3495
10″	10⅞	19¾	26¼	5640
12″	11⅜	22	28⅞	7230
15″	12⅜	23¾	31⅞	9370
18″	14⅛	26½	34¾	13020

The linear dimensions are *inside* measurements, in inches, and the volumes are in cubic

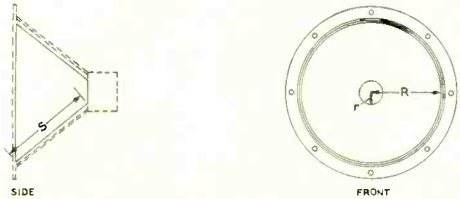


Figure 4
Measurements to be taken in using the formula for the surface area of the speaker cone. They should be taken in inches.

inches. The diameter of the speaker mounting hole is not given, since it depends upon the speaker to be used. The vent (or port) area likewise depends upon the particular speaker involved and can be easily calculated by the formula $A=3.14\times S(R+r)$, where A is the area in square inches, S is the slant height as shown in figure 4, and R and r are one half the diameter of the mouth of the cone and of the voice coil, respectively. Shape of the vent is unimportant—either round or rectangular being equally good.

Bibliography

Olson, H. F.: Elements of Acoustical Engineering, D. Van Nostrand Co., Inc., New York, 1940.

Olson, H. F., and Massa, F.: Applied Acoustics, P. Blakiston's Son and Co., Inc., Phila., 1939.

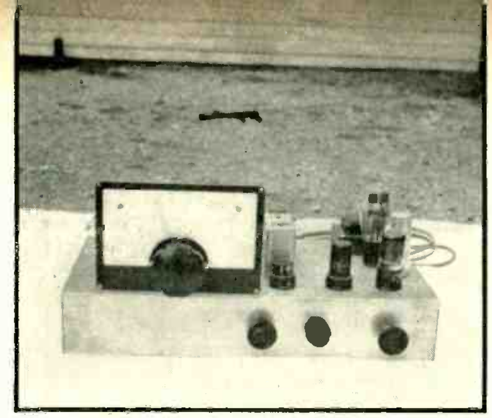
Henney, K.: Radio Engineering Handbook, McGraw-Hill Book Co., New York, 1941.

Terman, F. E.: Radio Engineering, McGraw-Hill Book Co., New York, 1937.

• • •

Soldier-Musicians On The Air

Four regiments from the anti-aircraft training center at Camp Davis, North Carolina, are putting regular weekly programs of music—instrumental and vocal, sweet and hot—on the air over station WMFD, in Wilmington, North Carolina. The musical organizations at the camp include dance orchestras, concert orchestras, bands, choruses, glee clubs, and quartets. The entire programs are handled by the soldiers, including production and announcing. Many of the men were professional musicians in civilian life.



10 to 2½ meter superheterodyne of W6SLO. Using the new "button" u.h.f. tubes of the 9000 series, it provides excellent reception on both f.m. and a.m.

TEN TO TWO-AND-ONE-HALF METERS

F. M. and A. M.

By NEAL H. BROWN,* W6SLO

Having built a number of receivers and converters for the high frequencies, using regular type receiver tubes with varying degrees of success, the need was felt for something just a little better and that would cover the high frequencies from 28 Mc. down to and including the 112 Mc. amateur band.

With the rising interest in f.m. transmission and the opening of a portion of the ten meter band for f.m. it was decided to build a set that would receive both f.m. and a.m. With the advent of the new 9000 series of RCA high frequency tubes it was decided to build up a superhet using one each of these tubes as r.f., mixer and oscillator, followed by an i.f. and second detector system that would handle both f.m. and a.m. signals. While fair results may be obtained by super-regen detection on f.m. signals, true f.m. reception requires a special i.f. system followed by a limiter and discriminator.

After a lot of experimenting and searching through the current issues of the handbooks, tube manuals, etc., the circuit of figure 1 was worked out. A good high gain r.f. stage has been found to be a necessity for really getting down to the actual noise level, and bringing in those weak signals "just over the hump" that would ordinarily be lost. It also makes the 112 Mc. band sound definitely alive, comparing favorably with the 56 and 28 Mc. band.

The receiver starts out with the 9003 in the r.f. stage, using the old familiar tuned grid tuned plate circuit commonly used in preselectors, and which has proven to be a good high gain circuit for the high frequencies. This is followed by the 9001 in a grid leak type detector capacity coupled to the plate

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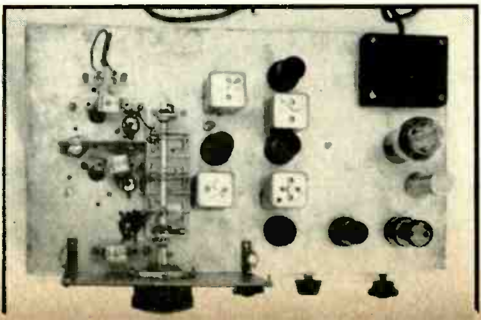

Looking down into the f.m.-a.m. superhet, showing placement of components.

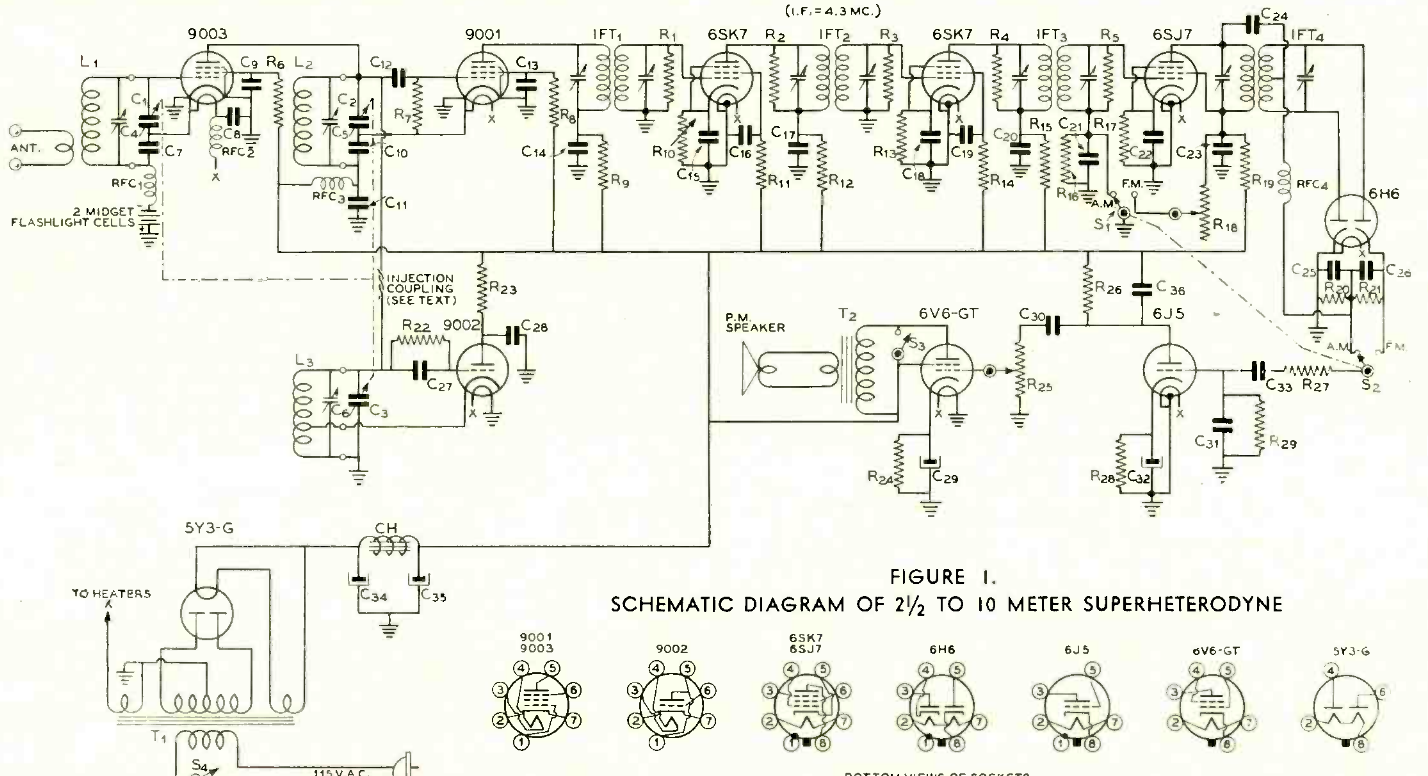

FIGURE I.
SCHEMATIC DIAGRAM OF 2½ TO 10 METER SUPERHETERODYNE

C_1, C_2, C_3—Three gang midget condenser, cut down to one rotor and two stator plates per section.
C_4, C_5, C_6—3-30 µµfd. ceramic type mica trimmers, mounted on individual coils.
C_7, C_8, C_9, C_{10}, C_{11}—.0005-µfd. midget mica condensers, smallest physical size.
C_{12}—.00025-µfd. midget mica
C_{13} — .0005-µfd. midget mica
$C_{14\text{-}20}$ — .01-µfd. tubular paper
C_{21}—.00025-µfd. mica
C_{22}, C_{23}—.01-µfd. tubular
C_{24}—.00005-µfd. mica
C_{25}, C_{26}, C_{27}—.0001-µfd. midget mica
C_{28}—.00025-µfd. midget mica
C_{29}—10-µfd. 25 v. electrolytic
C_{30}—.01-µfd. paper tubular
C_{31}—.0005-µfd. mica
C_{32}—10-µfd. 25 v. electrolytic
C_{33}—.01-µfd. paper tubular
C_{34}, C_{35}—10-µfd. 450 v. electrolytics
C_{36}—.002-µfd. mica
R_1—50,000 ohms, ½ watt
R_2—25,000 ohms, ½ watt
R_3—50,000 ohms, ½ watt
R_4—25,000 ohms, ½ watt
R_5—50,000 ohms, ½ watt
R_6—100,000 ohms, ½ watt
R_7—3 megohms, ½ watt
R_8—150,000 ohms, ½ watt
R_9—2000 ohms, ½ watt
R_{10}—25,000-ohm tapered pot., used as rheostat
R_{11}—60,000 ohms, ½ watt
R_{12}—2000 ohms, ½ watt
R_{13}—400 ohms, ½ watt
R_{14}—60,000 ohms, ½ watt
R_{15}—2000 ohms, ½ watt
R_{16}—250,000 ohms, ½ watt
R_{17}—100 ohms, ½ watt
R_{18}—10,000-ohm potentiometer
R_{19}—2000 ohms, ½ watt
R_{20}, R_{21}—100,000 ohms, ½ watt
R_{22}—50,000 ohms, ½ watt
R_{23}—50,000 ohms, 1 watt
R_{24}—500 ohms, ½ watt
R_{25}—500,000-ohm pot., a.f. taper
R_{26}—50,000 ohms, 1 watt
R_{27}—100,000 ohms, ½ watt
R_{28}—1000 ohms, ½ watt
R_{29}—500,000 ohms, ½ watt
RFC_1—15 turns no. 30 s.s.c. on ¼-inch polystyrene rod
RFC_2—10 turns no 22 d.c.c. on ¼-inch polystyrene rod
RFC_3—15 turns no. 30 s.s.c. on ¼-inch polystyrene rod
RFC_4—2.5 mh. r.f. choke
T_1—350 v. each side c.t. at 85 ma. and fil. windings
T_2—Speaker output transformer for 6V6
CH—30 hy. 85 ma. high resistance filter choke

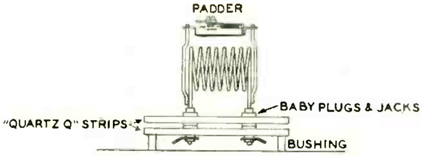

Figure 2. Illustrating plug-in coil arrangement, showing individual ceramic trimmer for each coil.

coil of the r.f. stage. As may be seen in the diagram no cathode resistors and bypasses are used on either the r.f. or mixer, the cathodes being grounded directly to chassis by shortest leads possible. Bias for the r.f. stage is obtained from two small flashlight cells mounted under chassis while the mixer, of course, uses grid leak bias. This system has proven very effective at the high frequencies, as cathode bypassing becomes difficult as the frequency increases. It also is an easy way of taking advantage of the double cathode feature of these tubes.

The triode 9002 is used as the high frequency oscillator in a conventional type cathode-above-ground oscillator circuit. No trouble has been experienced with oscillator hum even on the 112 Mc. band. A voltage regulator may be installed if desired for stabilizing the oscillator voltage, but no need has been found for this on this set under actual operating conditions, on all bands, provided the line voltage is reasonably steady.

Injection from the oscillator to the mixer is secured by means of a small gimmick made with two small pieces of insulated hook-up wire soldered to the grids of the oscillator and mixer and twisted together for about 3/8 of an inch. The injection seems to be a little critical on the 112 Mc. band, but may be easily adjusted until proper mixer action is obtained on this band; it will then hold for the lower frequency bands.

The i.f. system is constructed with regular commercial type 4.3 Mc. transformers. 6SK7's are used in the i.f. stages followed by a 6SJ7 limiter and a 6H6 in a Foster-Seeley type discriminator. Care should be taken in mounting the i.f. transformers and their associated tube sockets, so that shortest leads possible may be obtained, especially plate and grid leads, as oscillation at this i.f. frequency can be troublesome. All bypasses should be as short and direct as possible, running direct from socket prongs to ground. It is a good plan in mounting the i.f. loading resistors R_7, R_8, R_{11} and R_{12} to slip the shield cans off the transformers and solder the resistors directly across the coils, being careful in replacing shield cans that they do not short out against the cans. No attempt will be made here as to the proper way of aligning the i.f. system and discriminator as this is covered fully in almost any of the amateur handbooks, and will vary according to the equipment that the constructor may have available. We might say that this set was lined up with an ordinary signal generator available at any radio repair shop. Obviously this set is not for the inexperienced constructor; anyone who has any business constructing it will know which u.h.f. leads should be short, how to align the i.f., etc., etc.

A single-gang double-pole two-position band switch is used for switching from f.m. to a.m. position. This is shown as S_1 and S_2 in the schematic diagram. The audio system is quite conventional except for the coupling and high frequency bypass on the grid of the first audio and needs no further comment.

Little need be said as to the alignment of the oscillator, mixer and r.f., as the conventional methods may be employed. After the various bands are located, the padders of the r.f. and mixer can be adjusted for maximum signal gain. The tuning condenser as used by this constructor is three-gang Bud condenser of 20 $\mu\mu$fd. per section, cut down to two rotor and two stator plates on each section. A good smooth dial is almost a necessity for tuning the high frequencies, and the National Type A.C.N. velvet vernier seems to fill the bill very nicely.

Because amateur f.m. stations seldom employ pre-emphasis as do the commercial f.m. broadcasters, the standard 100 microsecond corrective filter was not considered necessary or desirable in this receiver. Such a filter gives a bit too much attenuation of the highs when

[*Continued on Page 81*]

COIL TABLE

28 Mc.

R.f. 12 turns, det. 12 turns, osc. 9 turns, all 7/8 inch in dia.

56 Mc.

R.f. 7 turns 5/8 in. dia., det. 6 turns 5/8 in. dia., osc. 7 turns 7/16 in. dia.

112 Mc.

R.f. 4 turns, det. 3 turns, osc. 3 turns, all 3/16 in. dia.

All coils are air wound with no. 14 enam., space wound with spacing adjusted to give proper coverage and tracking.

Would You Pass?

By J. E. KITCHIN*

A few do's, don'ts, and suggestions in regard to the taking and passing of government radio examinations—direct from an R.I. to you.

With large numbers of the boys now preparing for amateur and commercial examinations, as well as for Army, Navy, and Air Force tests, the present is perhaps as good a time as any to offer a few hints to prospective candidates.

Not all of us have the stability of a temperature controlled crystal when faced with either written or oral questions, on the correct answering of which the hoped-for "ticket" depends. The temperature rises and the pulse quickens as the candidate goes about the job of digging a large hole and falling in.

The first requirement, then, is a thorough knowledge of the subjects concerned, so that you will not say (as one candidate did), "To ascertain if a receiver is in good order, I would plug in a meter. If the receiver is OK the meter will indicate 'good' and if out of order the meter will indicate 'bad.' ") Through such a meter would be the answer to the service man's prayer.) And another, "When a manufacturer makes a condenser the capacity is unknown. Its capacity is determined by the amount the dial is turned."

After having acquired the necessary technical knowledge, the best way to become accustomed to the business of answering questions is to try writing the answers to the questions found in many textbooks. All too frequently, one is apt to glance down the list of questions, frame a rather sketchy answer for the easy ones in one's mind, and pass on as rapidly as possible. A little practice in writing the answers to all will repay you for the effort. In some cases, it will also show that you are not as sure as you thought you were.

If the examination has an oral section, obtain the assistance of a technical friend. Preferably one with a certificate of the same, or higher, grade as the certificate you are aiming for. Thus, you will avoid committing the same errors as the candidate who calmly stated, "When using Ohm's Law, the quantity Z is always unknown." And, "A cathode bias resistor allows the charge to drain off the filament."

Having arrived at the examination room thoroughly prepared (we hope), the next problem is to keep things straight in your mind so that you will not imitate the candidate who said: "There are several parts to a direction-finder, such as the goniometer and loop, which are strung on a case-like top and called the 'figure eight' loop." Had he untangled his facts before answering, he might have given a better answer. As a general rule, an examiner will not object to a slight "thinking" period provided that it doesn't too closely resemble a stalled car.

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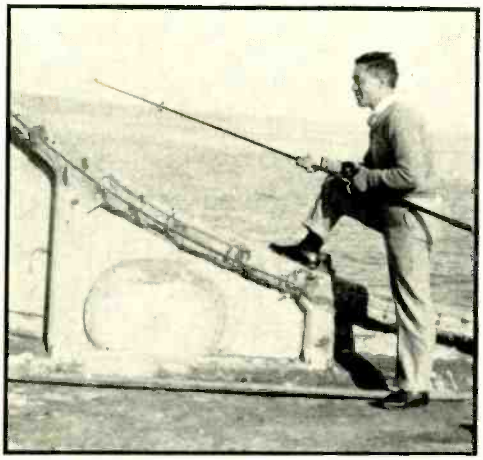
*Canadian Radio Inspector, 524 Gladstone Ave., Ottawa, Ont.



W6OUE after the big ones!

Becoming An Amateur

By GEORGE H. BRADLEY,* W6OUE

The only excuse for writing this article is the hope that it may help and encourage other would-be hams, who are similarly handicapped, in getting their licenses and getting on the air.

At present I hold a class B amateur license and a radio-telephone third class commercial license. The station includes two transmitters —a 160-meter 'phone rig having an output of about 70 watts, and a 40-meter c.w. rig with an input of about 70 watts, and an RME-69 receiver.

My amateur activity includes membership in three traffic nets: Mission Trail, American Legion, and Army Amateur Radio System. I also hold a Public Service certificate from the ARRL and a WACC certificate (Worked All California Counties) from the Oakland Radio Club.

So far—nothing out of the ordinary. But there is one thing I haven't mentioned. I am totally blind, and have done all my radio work since losing my sight.

*910 Santa Barbara Rd., Berkeley, Calif.

About six years ago I heard a ham break in on the broadcast band on a t.r.f. receiver. He gave his telephone number in code, and my Boy Scout code had stayed with me enough to decipher the number. I called him and so became acquainted with Reg Tibbetts, W6ITH.

He took me to his home, where I was introduced to amateur radio through the description of his station. My interest having been aroused, I wanted to play with transmitters as a start, of course. But Reg saw to it that I learned some theory and code and obtained my license first.

An ordinary home "all-wave" receiver provided some of the necessary code practice. To speed up the process, I attended Central Trade School, in Oakland, California, for about a year.

There were no radio books or diagrams in Braille, so it was necessary to produce them. Translating theory into Braille was merely a matter of having it dictated to me while I wrote it out by hand with an ordinary guide or on a Braille typewriter. Making Braille diagrams was another and probably more interesting matter.

An NYA student at the trade school did the work. Circuits were drawn to a large scale on one foot square sheets of heavy manila paper (tag-board), with a sheet of carbon paper underneath to transfer the lines to the back of the manila paper. The scale of the diagrams was such that vacuum tube symbols were approximately an inch and a half in diameter. This size was necessary in order that I could feel all the parts and the elements of the tubes when the diagrams were completed. The lines of the carbon paper impression were then traced with a dressmaker's tracing wheel, which raised dots on the top of the paper at intervals of about 3/32 of an inch. The parts of the circuit were marked in Braille, after which the sheet was shellacked to prevent constant fingering from pressing the dots down. Legends for each of these diagrams were written in Braille, also.

As can be imagined, it took quite a while to make all the diagrams for the class B examination, together with several for the commercial examination. Some of the larger ones required several of the foot-square sheets. I believe that this is the first time that anyone has attempted to make radio circuit diagrams that could be read by the blind. Perhaps the method may find more general use in the future.

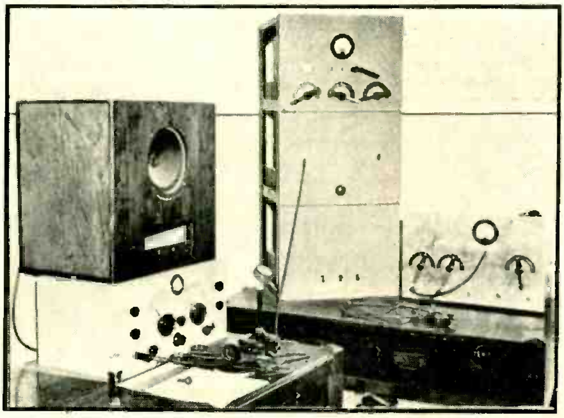
Mastering the theory and code required about a year and a half. After obtaining my ham license W6ITH loaned me a Collins 32-G transmitter, and later one of the type designed for the fishing boats. I used these for about a year before my present rig was acquired. I had been buying parts for quite a while, so about this time the members of the Mission Trail net donated the parts I lacked and Clayton Murdock, W6OMC, built the transmitter, mounting it in a three-deck rack.

It uses a 6C5 as a Pierce oscillator, followed by an 807 buffer-doubler and a pair of 10's in push-pull in the final. A crystal microphone feeds into a 6D6, which works into a 76 and then into a 42 that drives a pair of 6L6's in a class AB_1 as the modulator.

The dial scales have raised spots at every five divisions, enabling me to tune the rig to any freqeuncy for which I know the dial settings. Using the receiver as a monitor, the transmitter also can be tuned by tuning each stage for the strongest signal. Probably the most interesting method is the one in which the hum of the plate transformers furnishes the indication of resonance. First, all three tuned circuits must be off resonance. Then the buffer is tuned for maximum hum, the final plate circuit is set for minimum hum, and the antenna coupling unit is adjusted for maximum hum. With these methods it is about as easy for me to QSY as it is for others using e.c.o.'s.

The smaller c.w. rig uses a 6L6 crystal oscillator, with an 809 in the final amplifier. The power supply of the 'phone transmitter serves for this one also, by changing over the power cable. The same tuning procedure is used, but care must be taken in adjusting the oscillator to eliminate keying chirps. W6CML built this transmitter for me.

A large measure of thanks is due the family with whom I live. They helped me with the theory, and with the construction of a room in the basement of their home for my "shack," office, and living quarters. There are many hams whom I haven't mentioned whose help has been very valuable, too.



The station at W6OUE. On the left is the RME-69 and its speaker, then the 160-meter 'phone rig and the 40-meter c.w. r.f. section. In front of the receiver is the Braille guide and punch.

"TRMA"

Helpful Hints for Code Learners

By O. P. PARKER*

> The author of this article is an old timer who can send better code with his left foot than most amateurs can with their good right arm, and can copy as fast as anybody we have seen can send respectable code, weights off the bug and no holds barred. In spite of many other duties he has for some time made a hobby of helping amateurs, Naval Reserve men, etc., learn to send good code and receive fast code good or otherwise. Some important things he has run across while thus teaching are covered in this article. Unless your middle name is Kleinschmidt you undoubtedly can benefit by giving it your attention.

The handling of the telegraph codes is an art, but scientific application of instruction is an important attribute. It is definitely proven that many beginners as well as technically advanced amateurs, owing to the lack of supervised practice, have acquired a certain "inadvertent" manner of forming their radiocode signals.

There is no excuse for putting out ambiguous code. In my opinion, an operator should not attempt to use a "bug" until he has thoroughly mastered the key. Of course, some of the old timers can manipulate a bug with nearly the precision of automatic signals, but these fellows have worked the Kleinschmidt high-speed system for so many years that it is not particularly difficult for them to put faultless code on the air, especially in the case where heavy, manually-operated channels are worked in addition to the visual system of tape reading. Many of these fellows can copy consistently, hour after hour, by ear at speeds up to 45 w.p.m. without bulling up the business.

Every amateur would benefit by listening to automatic signals running at manual speeds. The regular point-to-point circuits of the big commercial companies normally run in excess of 100 w.p.m. and up to 250 w.p.m., which speed sounds like a door-bell buzzer; but there are numerous night press transmissions of news items to ships at sea on 36 meters at about 20 w.p.m. That's fine practice, inasmuch as this traffic is punched on a perforator to insure perfect signals, and it can be copied with a "stick."

There is the problem, however, of obtaining supervised coaching to enable the boys to advance from the 8 w.p.m. class into the higher speeds. In this respect, it is my belief that every amateur club should somehow arrange with an operator of outstanding ability to conduct regular code practice at the club rooms. A capable instructor can work marvels in a short time, and it behooves every club to take steps toward this end.

Ambiguous Signals

One important item in connection with code practice has to do with ambiguous signals, such

[*Continued on Page 74*]

*P. O. Box 2202, Carmel, Calif.

● The latest thing in b.c. station studio construction: WFAA-KGKO, Dallas. The arrangement of cylindrical wall surfaces and sound-absorbent material is for acoustical purposes. Photo courtesy Armstrong Cork Co.

DEPARTMENTS

- **Police Department**
- **U. H. F.**
- **The Amateur Newcomer**
- **Yarn of the Month**
- **Postscripts and Announcements**
- **Open Forum**
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- **New Books and Catalogues**

POLICE DEPARTMENT . . .

A TWO-FREQUENCY POLICE RECEIVER

By H. W. BRITTAIN,* W6OQX

A description of an ingenious multi-frequency fixed-tuned receiver wherein the low-frequency station is received directly on the i.f. channel and the high-frequency mobile transmitters are received through a crystal controlled front end into the i.f. channel as a conventional superhet.

On duty or off, the officials of police, fire and sheriffs' departments served with radio are generally interested in calls sent out to the cars and the transmissions received from them. Most of these officials have the usual type of small broadcast receiver with two or three bands enabling them to listen in on the lower frequency police frequency bands but not to the mobile transmitters.

Our lower frequency police transmitter operates on 2414 kilocycles and our cars or mobile units operate on 30,580 kilocycles. In an attempt to hear both the cars and the main station a receiver was designed and constructed to fill these requirements.

Receivers generally available for the lower frequency bands are quite satisfactory. But the usual tunable receiver that is capable of receiving calls from the cars is so noisy that after a while it is turned off. Communication receivers with noise silencers are considerably better but are not too satisfactory. All tunable receivers tried had very bad drift at the start, generally requiring one to two hours to tune in a signal to stay. After about six weeks of experimenting with converters, "all band" jobs, and communications receivers, all were discarded.

The knowledge gained from the foregoing helped in the design of a special receiver for

*Radio Supervisor, City of Santa Barbara, Calif.

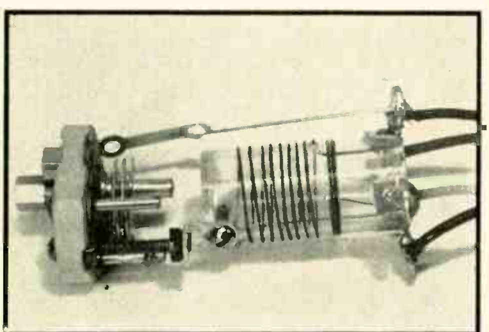


Figure 1. One of the coils used at L_1 and L_2 shown removed from its shield can. These coils are wound on 1/2-inch polystyrene coil forms. The closed end of the form was drilled and tapped on the side to take a 6-32 brass screw. A small angle bracket and a 4-40 by 1 1/2-inch bolt holds the coil form to the trimmer condenser.

Figure 2. One of the 9-meter coils shown installed in its shield can. The holes in the top of the can were hand made to fit the condenser mounting holes.

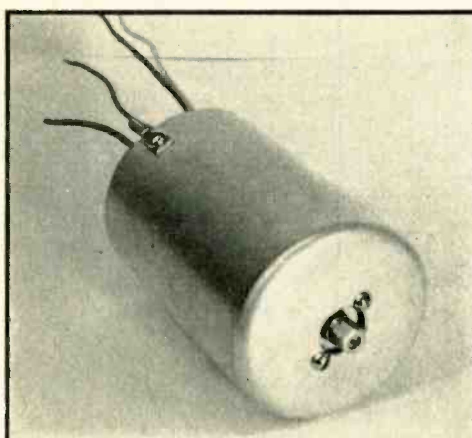


Figure 3. The receiver installed in its cabinet. The knob on the left actuates the volume control and the on-off switch. On the right is the squelch control.

both frequencies. These three features can be listed as "musts" for such a receiver: crystal control of the h.f. oscillator, automatic volume control, and a good signal-to-noise ratio. The front end of any superhet receiver is always improved by the use of a preselector stage, so one was incorporated into the design of this superhet.

Main-Station-Frequency I.F.

An intermediate frequency of 2414 kilocycles was used so that the i.f. channel could be used to receive the signals from the main transmitter which was on 2414 kc. This part of the receiver operates as a tuned radio frequency amplifier. It gives good sensitivity on local signals but naturally does not have the sensitivity of a superhet. The antenna for this section was coupled by a third winding consisting of about thirty turns of no. 30 wire scramble-wound ½ inch below the secondary of the first i.f. transformer; one end of this winding goes to the antenna, the other end to ground. Enough antenna was used to get 2414 kc. main station volume comparable to that from the local cars.

An alternate way of coupling the 2414 kc. antenna to the receiver was to wrap about three or four turns of hookup wire around the grid wire of the first i.f. tube. This seemed to give as good results as the coil method and the coupling could be varied to suit the location. No trouble was experienced with noise pickup in this portion of the set with an antenna from thirty to fifty feet long.

The Mixer

In most receivers the h.f. oscillator operates higher in frequency than the received signal by the amount of the intermediate frequency. But the h.f. oscillator can just as well be on the low side. A little figuring shows that the

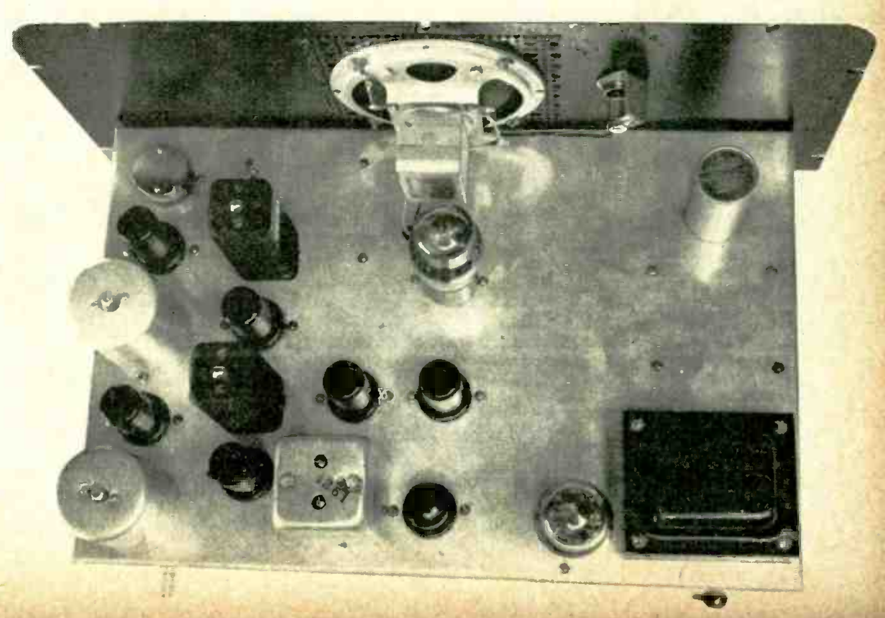


Figure 4. Top view of the finished receiver. The antenna post for 2414 kc. is on the front of the first i.f. can.

fourth harmonic of a 7041 kc. amateur band crystal beating with a 30,580 kc. signal gives an i.f. of 2414 kc. (A higher-than-signal frequency crystal is available at about three times the cost of the amateur band crystal.)

Two of the later types of oscillator-mixer tubes were tried but were not satisfactory for two reasons. First, when enough plate voltage was applied to the oscillator section to give the proper translation gain, tube hiss increased out of proportion to the signal gain. Second, the tube life was impaired from overload. The dual purpose tube was abandoned and a separate tube was used for each function. A 6V6-GT was used for the oscillator and an 1852 for the "mixer." This combination gave a much superior signal output.

I.F. Details

Several types of super i.f. tubes were tried and all worked well in a straight i.f. amplifier. But some of the mobile transmitters have a habit of being off just enough in frequency to make reception weak or distorted. Shunting the i.f. coils with resistors seemed to be the only way this could be cured. The low-mu tubes lost all their pep after this had been done. If the coils in the i.f. were squeezed closer together this would probably do the job just as well as the resistors, but after ruining a whole set of coils the idea was given up. The 1852 intermediate frequency amplifiers gave all the gain needed even though resistors had been placed across the windings of the intermediate frequency coils to make them broad tuning.

The Squelch Circuit

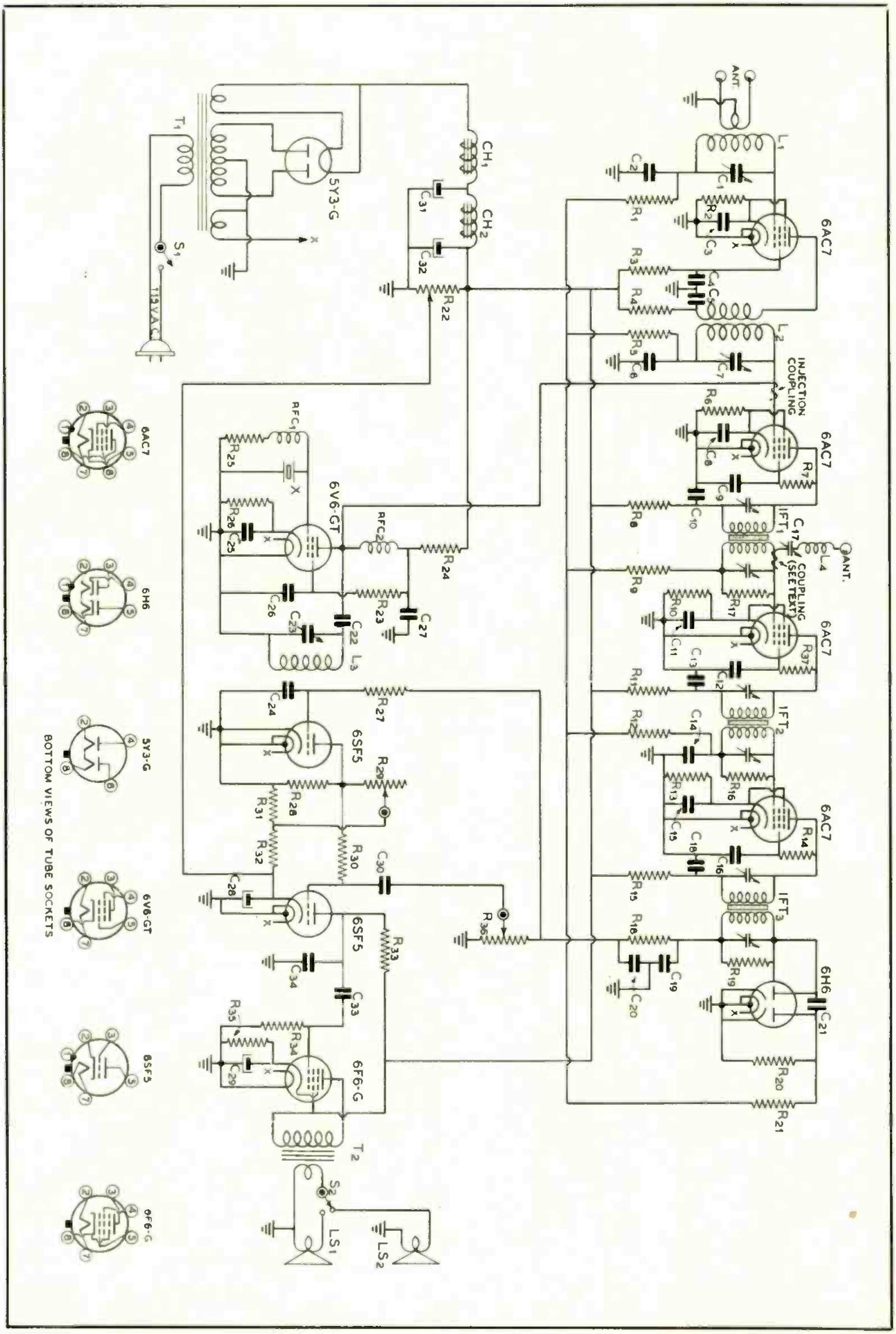
The "squelch" is similar to the one used by Moynahan in his fixed frequency receiver in the October, 1940, issue of RADIO. One change was made, however, to secure more effective squelch action. A 5-megohm resistor was connected between the plate of the squelch tube and ground, with a variable resistor in place of the on-off switch for controlling the squelch action. By doing this, enough squelch action was secured to stop the worst type of noise—namely auto ignition interference. In fact, the squelch when turned up to maximum caused the audio to be somewhat distorted because of the high negative potential on the audio grid. However, all the squelch need not be used at any time since the first receiver of this type was used in a very noisy business section and it did not require all the squelch to "hold quiet" with no signal. For the most part, signals are loud enough to give good noise-free reception.

To one who listens to a receiver for several hours at a time, auto ignition, power leaks, electric motors, and other types of interference are not enjoyable. A properly adjusted squelch takes practically every trace of this type of interference out and affects the signal very little if any. A squelch or Q circuit is practically the same as the inter-channel noise suppressors used on some receivers. In building a circuit of this type a triode of the high-mu type is desirable. For a given signal or a.v.c. voltage a high-mu squelch control tube will trigger much sooner making

[*Continued on Page 76*]

WIRING SCHEMATIC FOR THE TWO-FREQUENCY RECEIVER.

C_1—15-µµfd. air padder
C_2, C_3, C_4, C_5, C_6—.01-µfd. 600-volt tubulars
C_7—15-µµfd. air padder
C_8, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}, C_{16}—.01-µfd. 600-volt tubulars
C_{17}—50-µµfd. air padder
C_{18}—.01-µfd. 600-volt tubular
C_{19}, C_{20}—.00025-µfd. mica
C_{21}—50-µµfd. mica
C_{22}—.006-µfd. 600-volt mica
C_{23}—100-µµfd. air padder
C_{24}, C_{25}, C_{26}, C_{27}—.01-µfd. 600-volt tubulars
C_{28}, C_{29}—10-µfd. 25-volt electrolytics
C_{30}—.01-µfd. 600-volt tubular
C_{31}, C_{32}—8-8 µfd. 450-volt electrolytic
C_{33}—.01-µfd. 600-volt tubular
C_{34}—.001-µfd. mica
R_1—10,000 ohms, ½ watt
R_2—200 ohms, 1 watt
R_3—60,000 ohms, 1 watt
R_4—1000 ohms, 2 watts
R_5—10,000 ohms, ½ watt
R_6—300 ohms, 2 watts
R_7—60,000 ohms, 1 watt
R_8—1000 ohms, 2 watts
R_9—10,000 ohms, ½ watt
R_{10}—150 ohms, 2 watts
R_{11}—1000 ohms, 2 watts
R_{12}—10,000 ohms, ½ watt
R_{13}—150 ohms, 2 watts
R_{14}—60,000 ohms, 1 watt
R_{15}—1000 ohms, 2 watts
R_{16}, R_{17}—50,000 ohms, ½ watt
R_{18}—25,000 ohms, ½ watt
R_{19}—50,000 ohms, ½ watt
R_{20}—500,000 ohms, ½ watt
R_{21}—1 megohm, ½ watt
R_{22}—50,000 ohms, 25 watts
R_{23}—30,000 ohms, 2 watts
R_{24}—7000 ohms, 2 watts
R_{25}—50,000 ohms, 2 watts
R_{26}—400 ohms, 2 watts
R_{27}, R_{28}—1 megohm, ½ watt
R_{29}—1-megohm potentiometer
R_{30}—1 megohm, ½ watt
R_{31}—10,000 ohms, 10 watts
R_{32}—700 ohms, ½ watt
R_{33}—500,000 ohms, ½ watt
R_{34}—250,000 ohms, ½ watt
R_{35}—700 ohms, 10 watts
R_{36}—250,000-ohm potentiometer
R_{37}—60,000 ohms, 1 watt
IFT_1—2414-kc. iron-core input transformer
IFT_2—2414-kc. iron-core interstage transformer
IFT_3—2414-kc. iron-core output transformer
RFC_1, RFC_2—Small pie-wound chokes
CH_1, CH_2—120-ma. filter chokes
T_1—6.3 v., 4.5 a., 5v., 2a., 760 v., c.t., 125 ma.
X—7041.5 kc. crystal. Fourth harmonic of crystal freq. should be 2414 kc. lower than signal freq.
L_1, L_2—9 turns no. 18 wire spaced to cover 1¼ inches on ½-inch diam. forms. Primaries — 6 turns no. 30 wire wound at ground end. L_1 primary center-tapped to ground for noise-eliminating antennas.
L_3—40-meter coil
L_4—10-meter coil


6AC7
6AC7
6AC7
6AC7
6H6
5Y3-G
6V6-GT
6SF5
6SF5
6F6-G
ANT.
ANT.
INJECTION COUPLING
COUPLING (SEE TEXT)
115 V.A.C.
BOTTOM VIEWS OF TUBE SOCKETS

U. H. F. . . .

By JOSEPHINE CONKLIN,* W9SLG/3

December, a month not generally associated with five meter skip dx, is beginning to receive some attention because of the recurring sporadic-*E* work that has been done during the month in recent years.

Last winter the band was open on a whole string of days ending in early January. So get ready, watch the band, and catch 'em as they break.

Horsetrader's Shindig

In order to allow the W1 members of the Horsetraders to meet some W2's who are also members, the gang held a shindig in New York City in October. Among those present were W1HDQ, W4EDD, W9BNX/3, W9SLG/3 herself, a certain well known G2 (hush, hush!), and last but not least, the Jerk, Vince Dawson, W9ZJB-W3JSL. In fact, there was a bit of initiation cooked up for Vince. He had enough of gazing up at tall buildings, letting his tonsils get rained on—and a touch of eastern five and 2½ meter work at W2AMJ.

There were plenty of W1-2-3 hams there, and a representation from every district except W5-6-7, although the organization is essentially a u.h.f. one. The opportunity to talk with many who have written to us in past years was enjoyed thoroughly.

The increased number of Horsetraders in the third district has brought out the suggestion that a weekly get-together of W3's on the ultra-highs be organized. Such a gathering may result in a nice increase in band activity—though Vince reports that 112 megacycles is getting to be a madhouse around New York, judging from what he heard at W2AMJ. A meeting over the air, with some distance involved, may bring out improved equipment.

*300 Wilson Lane, Bethesda, Maryland

56 Mc. DX HONOR ROLL

Call	D	S
W5AJG	9	38
W5HTZ	9	29
W8CIR	9	35
W8RKE	9	
W9AHZ	9	16
W9AKF	9	
W9AQQ	9	25
W9CBJ	9	31
W9CLH	9	23
W9GHW	9	
W9GJS	9	22
W9NYV	9	
W9PK	9	25
W9QCY	9	25
W9USH	9	18
W9USI	9	24
W9WAL	9	
W9YKX	9	30
W9ZHB	9	43
W9ZJB	9	31
W9ZQC	9	26
W1DEI	8	20
W1EYM	8	20
W1HDQ	8	31
W1SI	8	
W2BYM	8	27
W2GHV	8	24
W3AIR	8	24
W3BZJ	8	27
W3RL	8	29
W5AFX	8	
W5DXW	8	21
W6QLZ	8	23
W8JLQ	8	
W8QDU	8	25
W8QQS	8	17
W8VO	8	
W9ARN	8	17
W9EET	8	15
W9VHG	8	
W9VWU	8	16
W2AMJ	7	22
W2JCY	7	
W2MO	7	25
W3VYF	7	22
W3EZM	7	24
W3HJO	7	
W3HOH	7	17
W4DRZ	7	22
W4EDD	7	
W4FBH	7	17

Call	D	S
W4FKN	7	16
W4FLH	7	18
W5CSU	7	
W5EHM	7	
W6OVK	7	23
W8CVQ	7	
W8OKC	7	12
W8PK	7	9
W8RUE	7	21
W9BJV	7	15
W9GGH	7	
W9IZQ	7	14
W9PKD	7	13
W9SQE	7	22
W9WWH	7	26
W9ZUL	7	18
W1LLL	6	24
W1CLH	6	13
W1JFF	6	11
W1KHL	6	11
W1JJR	6	17
W2KLZ	6	
W2LAH	6	
W5VV	6	18
W8LKD	6	11
W8NKJ	6	16
W8OJF	6	
W8PKJ	6	12
W9NY	6	13
W9CJS	6	
W1GJZ	5	15
W1HXE	5	18
W1JMT	5	9
W1JNX	5	12
W1JRY	5	
W1LFI	5	
W2LAL	5	11
W3CGV	5	10
W3EIS	5	11
W3GLV	5	
W3HJT	5	
W4EQM	5	8
W6DNS	5	
W6KTJ	5	
W6QAP	5	14
W6SLO	5	19
W8EGQ	5	10
W8NOR	5	16
W8OPO	5	8
W8RVT	5	7
W8TGJ	5	9
W9UOG	5	8

Note: D—Districts; S—States.

Desert Rats

In addition to being Horsetraders number 52 and 37, we have also been made honorary members of the Desert Rats, the regular membership to which requires five meter contacts with two or more of the Arizona gang. Clyde

Photograph of half of the Horsetraders' Shindig, New York City, October 5, 1941. Stooping down at the end of the "dance floor" is Vince Dawson, W9ZJB/W3JSL. Behind him is Jo Conklin, W9SLG. To the left of her is Bill Conklin, W9BNX/W3JUX and to the right is Ed Tilton, W1HDQ, Robbie, W4EDD, and Frank Lester, W2AMJ. Other u.h.f. calls represented include W1KTF, W1KLJ, W3CUD, W3HDJ, W3HOH, a G2, W3HWN, W3BZJ, W3AWM, W1DEI, W1QB, W2TP, W2FHJ, and many another from New England and down to Washington.

Criswell, W6QLZ, is Rat No. 1. Jim Brannin, W6OVK, is another active member; write him if you have qualified and have not yet received a membership card.

F.M.

Returning to the more serious phases of this business, the column has received a fine letter from Captain Shirley G. Blencoe of the Signal Corps. He is W4HVU in Memphis now, but has been W9ESM, WGP, CAV. He agrees that reports of numerous observations will be desirable in order to arrive at any definite conclusions with respect to how f.m will act on skip dx. He provides two observations of skip contacts on a frequency somewhat above the ten meter band, conducted by Army Signal Corps personnel. They are quoted below:

"On June 5, 1941, at 8 a.m., in eastern Tennessee, using a standard f.m. receiver similar to those used in commercial police sets, a transmitter with an 807 at 25 watts output, in conjunction with a quarter wave vertical rod antenna, considerable interference was experienced with our local testing. Signals were QSA5 R9 at both ends. Upon calling the interfering station it was found to be a similar f.m. set located just outside of Washington, D.C., a distance of approximately 520 miles. Both sets were in motor vehicles which were travelling at approximately 30 miles per hour. Excellent contact was maintained until 9:15 a.m., at which time all signals dropped out completely.

"Again on June 11, 1941, at 10:55 a.m., another contact was similarly established over the same route with another similar station for a period of 25 minutes. Clarity was excellent, no 'double-talk' whistling interference being experienced."

While on the subject of f.m., W8JLQ reports that W8QUO started f.m. in Toledo on August 19, and about a week later JLQ joined him. QUO also has a mobile job. W8ARF HSW are using adapters on communication receivers for narrow-band f.m. JLQ has noticed the following advantages for f.m. over a.m.:

(1) Noise reduction: complete, if sufficient receiver gain is available and if double limiter is used.

(2) Carrier silence.

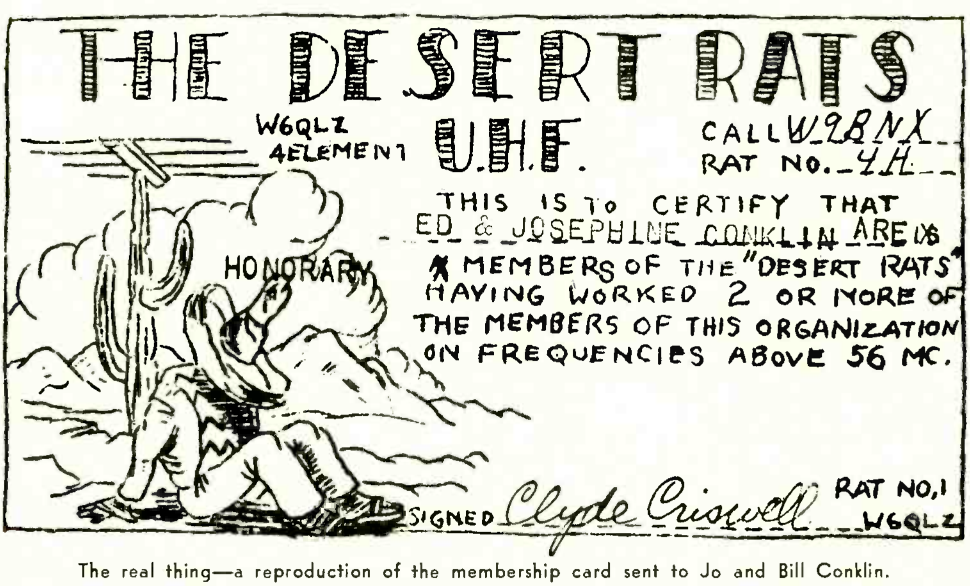
(3) Better fidelity, voice more natural and realistic.

(4) No high power modulator.

September 18 Aurora

If our memory is correct, W2MIY telephoned a message from W8OKC about his work during the aurora dx of September 18; one or two verbal or second hand reports have also been received. But as the column is written, the only reports at hand appear to be from W9YKX in Woodbine, Iowa, and W8RUE in Pittsburgh.

Bill Copeland, W9YKX, was listening for



The real thing—a reproduction of the membership card sent to Jo and Bill Conklin.

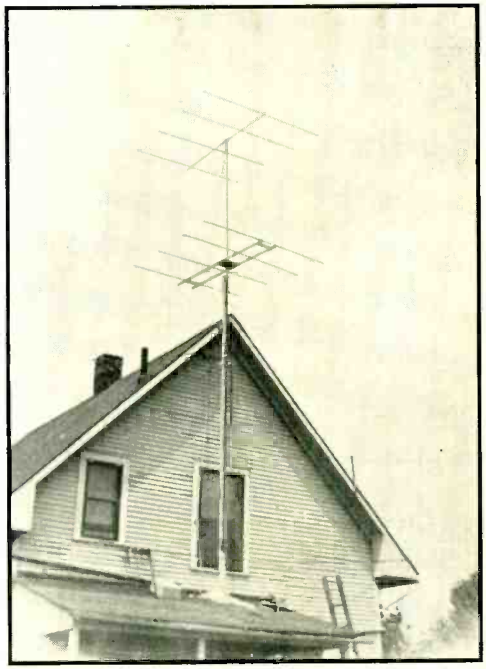
W9PKD in Kansas on schedule at 7 o'clock when he heard W9IOW call W8KWL. He could not see any aurora at the time but listened on the ten and twenty meter bands which "sounded like the stagger of a bunch of drunks." In about ten minutes the band was full of loud c.w. He worked W8NSS W9GGH LLM QUV DWU FFV BDL AEH IOD and heard W8KKV QQP W9RBK HAQ ARN ZHL. His slow speed on code cut down the number of contacts. The band was still open at 12:30 a.m. when he gave up and went home. The evening added two new states to his list—Wisconsin and Minnesota.

In Pittsburgh, W8RUE worked W1LLL W3AXU W8NSS KKD and heard W1KDQ NF KZU W2BYM W3HWN HDJ W8QQS QYD OKC KQC W9IOD RBK TMK ZHB AEH.

What appears to be a new aurora day is July 5 when W8RUE raised W3HDJ and logged W1HXP W2TP AMJ W3HGU IIS.

W8JLQ reports aurora dx on July 6.

On August 6, W9PK worked W9NFM on aurora but heard no other signals on c.w. He lists July 6 as another aurora day when he got W8QDU KKD NSS, but missed out on five meter work on September 18 because his W6QLZ beam had blown down. He did similar ten meter work, though, during the aurora.



The double W6QLZ beam which was in use from July 20 to September 24, 1941, by W8JLQ, Toledo, Ohio. The stacked affair has since then been replaced by a single section of the array.

Pre-Skip Antennas

Mel Wilson, W1DEI, points out that correct antenna height is as important as a lot of height. This statement probably requires a great deal of thought. On skip dx, height is nice to clear houses and trees but it results in "nulls" which might be at the vertical angle at which a signal would come in. On ground wave work, the direct and ground reflected waves can interfere with each other to cancel at certain distances. This cancellation effect, however, may be of relatively little importance at very low angles for beyond-the-horizon work; a little study of the problem might be very much worth while.

Antenna experience at W8JLQ is of interest. Howard used a horizontal stacked job in former years, and made a W6 contact or two with it on relatively low power. His local range was limited because verticals were commonly used, so he shifted.

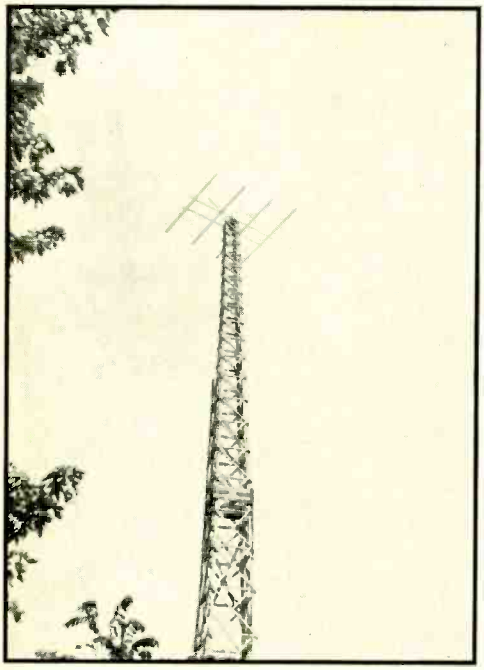
This year, he used verticals before about May 15. A horizontal dipole was tried but with such mediocre results that he hesitated to put up a beam. W8QUO did, however, with such good results that JLQ put up a W6QLZ four element job 35 feet high and had similar good results. Many of the ground wave dx stations had shifted to horizontals. W9QCY at 90 miles became more consistent than anyone had been with a vertical at the same distance. Detroit became more consistent and louder with the horizontal beam 35 feet high than with the old vertical 75 feet high at Holland, Ohio.

Next, JLQ put up a "stack" of two W6QLZ beams which was just barely better than one beam—possibly because the additional 3 db was not much more than noticeable. This array was discarded in favor of the single array, which was arranged so that it could be tilted vertical to permit contacts with mobile rigs. In the meantime, W8QUO has also been doing well on the W6QLZ beam 65 feet high.

JLQ lists the following ground wave stations logged since June 8, all on the horizontal except mobile stations:

Approx. freq.	*Call*	*Location*
56.05	W8ARF/8	Toledo, Ohio
56.3	W8QXV	Barberton, Ohio
56.35	W8CIR	Aliquippa, Penn.

56.4	W8QQP	Fremont, Ohio
56.5	W8TWU	Toledo, Ohio
56.55	W8KKD	Detroit, Mich.
56.65	W9PK	Downers Grove, Ill.
56.7	W8QUO/8	Toledo, Ohio
56.7	W8NSS	Dayton, Ohio
56.8	W8NYD	Kent, Ohio
56.85	W8DDO	Lincoln Park, Mich.
56.86	W9IOD	Elmhurst, Ill.
56.9	W8FGV	Barberton, Ohio
57.0	W9QCY	Ft. Wayne, Ind.
57.0	W8QDU	Detroit, Mich.
57.0	W9DAX	Sandwich, Ill.
57.0	W8QQS	Saginaw, Mich.
57.02	W9ODW	Ft. Wayne, Ind.
57.03	W8TDJ	Morgantown, W. Va.
57.05	W9LMX	Elkhart, Ind.
57.05	W8LZN	Detroit, Mich.
57.1	W9AQQ	Indianapolis, Ind.
57.15	W8VIB	Three Rivers, Mich.
57.25	W8ARF	Toledo, Ohio
57.3	W8KQC	Detroit, Mich.
57.35	W9AB	Mishawaka, Ind.
57.5	W8HSW	Toledo, Ohio
58.0	W8CVQ	Kalamazoo, Mich.
58.6	W8QUO f.m.	Toledo, Ohio
58.7	W8QUO/8 f.m.	Toledo, Ohio



Another W6QLZ beam in use at W8QUO, Toledo, Ohio. This one is 65 feet in the air.

W9PK lost his W6QLZ beam and claims that his new radiator and director, 45 feet high, work about as good.

Ground Wave DX

Other low atmosphere bending or extended ground wave dx has been reported regularly. W9YKX still works W9NFM at Solon, Iowa, 235 miles away, several times a week. NFM has his antenna up to 70 feet now and is about an R stronger than before. YKX thinks that the 240 miles to W9PKD in Kansas should be a cinch, but no contact has been made so far (PKD was heard here on 14 megacycle c.w. last week). Perhaps Joe needs one of those large multi-element collapsible (when the wind blows) beams.

On September 1, W9PK near Chicago worked W9RBK in Newport, Kentucky, about 300 miles. Going back through PK's log, June 2 was a good night on which he hooked W8QUO in Toledo. July 3 was similar, with a contact with W8JLQ.

W6OVK finds five and 2½ meter crossband contacts with W6QLZ to be poorer than last winter, with more fading. W6KBM in Globe hears OVK regularly and will soon be on both 5 and 2½ for tests.

August 7 was a particularly good night for Toledo-Detroit work, according to W8JLQ.

Skip DX

In checking the summer dx list in Radio for October, W9PK lists the following open days on five meters except for aurora on July 6, August 6 and September 18:

May 10, 11, 29, 30.
June 1, 5, 12, 18, 21, 23, 24, 25, 28.
July 2, 4, 7, 11, 22, 29.
August 2, 11.
September 1.

On August 11, Jack hooked W4FVW in Miami, repeating the contact on September 1 at 11:30 a.m. June 23 was the big W7 night for him, working W7IFL FFE and hearing W7HEA FLQ GBI AMX ERA ACD (whom he worked on June 28).

W7ERA says that he missed reporting the opening of July 22 when he worked W5HYT EHM W6QAP PGO SLO OVK W7IFL. On July 27, ERA heard W6HDY on five meters calling "CQ 112 Mc." but a five meter contact was not established.

In August, W8RUE worked W5ANN and heard W5EHM on the 2nd. He raised W4FVW and logged W4FLH on the 11th. In September, he heard W5AJG W3BKB on the 2nd. July contacts not previously reported by him are: July 4, worked W5AFX W9OLY and heard W9ZJB ZHB ARN PKD CCY; July 7, heard W5EHM AFX W9ZJB; July 8, heard W5EHM AJG AFX; July 16, worked W4DXP W5AFX HTZ.

Additional reports also come from W8JLQ as follows:

May 10: W5VV AJG
May 18: heard W1GJZ
May 30: W5HTZ
June 1: W5HTZ. Heard W5AAN HYT W9PKD
June 5: W5HYT. Heard W5AJG AFX EYZ HTZ ATH
June 9: heard W5AFX EHM
June 12: W5EHM. Heard W5DNN
June 15: W5HYT AJG ATH. Heard W5DXW.
June 18: W5HTZ HYT AJG CHG. Heard W5CQV EHM AFX
June 23: heard W5AFX AJG W7IFL
June 25: W5CHG. Heard W5HYT CQV
July 2: heard W5HYT
July 7: W5JXS
July 16: W7IEL. Heard W4DXP W5HTZ AJG W9ZJB
August 11: W4DXP FVW DRZ

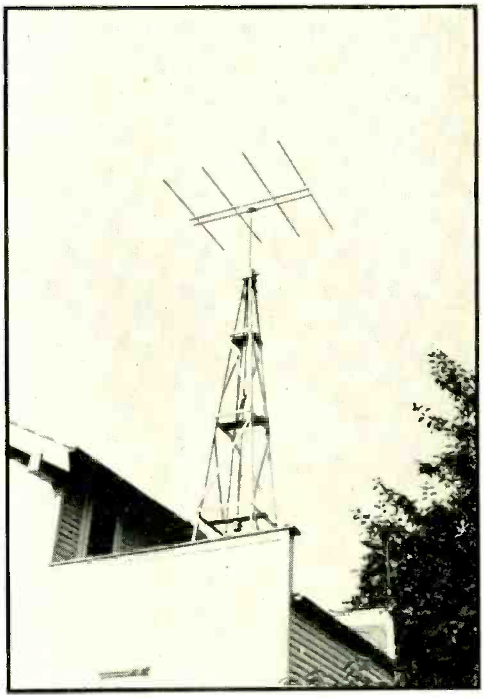
How To Do It

One of our English friends points out that transmitting and cathode ray tubes should be cheap after the war when surplus supplies are liquidated. They may be put to good use in more logical methods of pushing a signal across the pond. We all know that sporadic-*E* dx is enjoyed more hours by the stations with the best equipment—which is illustrated by the fact that W5AJG often found the band open for W1DEI HDQ and nobody else. Our friend says that we have the technical ability now to take advantage of the fact by radiating *kilowatts*. This power is legal if the key is pressed a short enough time so that the average power is within the proper limit. Such short spurts might be received on a cathode ray tube hooked to the receiver. Noise silencers, however, would be no help under such conditions—except that they would be necessary on the neighbors' broadcast receivers!

The idea is one that might be worked out in this country and put to use before there is a chance to try it on transatlantic dx. Does anyone want to try? There is Hawaii, you know.

Miscellany

K6OQM has promised W9PK to be on five meters by next spring.



Another W6QLZ-type beam in Toledo, Ohio. This one is in use at W8TWU.

W9BNX/3 has received a "worked" card from W4GSW covering a ten meter contact. While we may be on the air shortly now, the landlord permitting, this card makes it look badly for the Army's code copying ability.

Answering several inquiries, the deadline for material for this column is the 15th of each month. And don't forget to send in some pictures, such as the nice beam at W3OR with motor driven polarization control.

Speaking of 9001 tubes, they appear to be equal to the acorn 954 at 100 megacycles if used in the polystyrene socket; the worst comparison is at 300 megacycles (and not so bad, either) beyond which tube losses become greater than socket losses and the gains of 9001 and 954 types become almost the same. The higher noise output under vibration that is typical of the 9000 series may be reduced in an improved design in which the upper ends of the elements are snubbed against the glass bulb.

Have you seen the Hygrade Sylvania 1201 series of acornish tubes? These are not to be confused with the 1231 television pentode.

Recently Bill telephoned Major David Talley, W2PF, and asked if he remembered operating 9AAW's spark transmitter until sunrise one night during the 1923 A.R.R.L. National Convention. Dave said, "Yes, and we tried to work 2RC and a 6 at the same time." That is a far cry from u.h.f. work, but the spark set was not as broad as some of these modulated oscillators we have heard, you betcha.

Bill says that there are Navy jobs open for hams as inspectors or scientific aids (no college required), for draftsmen (who should know enough not to dip a drawing pen in an ink bottle), for crystal grinders and machinists. Some of these jobs are important enough to get deferment from the draft for those who fill the positions.

Above 112 Megacycles

Often, people refer to oscillators as "short lines" or "long lines." Going back into literature, long line oscillators are not the pipe-controlled variety but are essentially unstable oscillators with a transmission line several wavelengths long connecting the grid coil to the plate coil so that a frequency shift reacts in such a manner as to correct itself. A short line oscillator, therefore, would seem to be one of these jobs with pipes ¼ wavelength or less.

At the risk of repetition, we mention that the way to clean up a modulated oscillator is to use the best pipes in the grid circuit, with the grids tapped down near the shorting bar. A test of the *Q* of the grid line is to slide the plate shorting bar along and see how short a distance along it the tubes will oscillate. If the *Q* is high, the shorting bar must be within about ¼ inch of the correct place. These jobs that will work at varying frequencies when the plate rods are lengthened or shortened materially, are probably going to splatter all over the band when modulated.

Use of 2½ meter rigs for these aircraft warning nets may expand the population of the band. If handled right, the project may bring plenty of pressure upon the government to see that we get to keep at least one band, no matter what happens. The hope is that the matter is studied early enough that the new rigs built will be on the band that we have the best chance to keep. Everyone should look into this net as a means of showing the interest of thousands of amateurs in helping national defense—and, ultimately, of getting back plenty of frequencies.

W3FZ has a set of 9001-2-3 tubes with which he intends to build up a concentric line receiver, especially for 2½ meters. He is one of the more serious experimenters here in Bethesda.

[*Continued on Page 89*]

2½ METER HONOR ROLL

ELEVATED LOCATIONS

Stations	Miles
W2MPY/1-W1JFF	325
W2MPY/1-W1BHL	295
W6KIN/6-W6BJI/6 (airplane)	255
W6QZA-MKS	215
W6BKZ-QZA	209
W6QZA-OIN	201
W6BCX-OIN	201
W3BZJ-W1HDQ (crossband)	200
W6FVK-BIP	190
W6LSC-NNN	190
W6OXQ-NNN	190
W1JYI/6-W6NNN	190
W3HOH-W1HDQ	175
W6NJJ-NJW	175
W1DMV/6-W6HJT (airplane)	165
W9WYX-VTK	160
W6KIN/6-W6OMC/6	140
W6ADM-NJJ	130
W6IOJ-OIN	120
W2LBK-W1HDQ	118
W6BCX-IOJ	100
W6NCP-OIN	98
W1KXK-MNK/1	81
W6IOJ-OIN	80
W6CPY-IOJ	80

HOME LOCATIONS

Stations	Miles
W1MON-W2LAU	203
W1LZB-W2ADW	200
W1LZB-W2NCG	200
W6ECP-W6NNN	190
W6NNN-W6OIN	185
W2BYM-W1LZB	160
W2FJQ-W1LZB	140
W8CVQ-QDU (crossband)	130
W3BZJ-W1MRF	130
W6QLZ-OVK (crossband)	107
W1IJ-W2LAU	105
W3BZJ-W1LAS	105
W2ADW-W2LAU	96
W1LPO-W1KLJ	92
W1HBD-W1XW (1935)	90
W1JFF-W1IJ	85
W1JFF-W2KPB	80
W2LBK-W1IJ	76
W2LBK-W3BZJ	76
W1MWN-W2LAU	75
W1SS-BBM	74
W1KXK-IZY	73
W1MRF-W2LAU	68
W2OEN-W1LAS/2	57
W2GPO-LAU	50

1¼ METER HONOR ROLL

ELEVATED LOCATIONS

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

The Amateur Newcomer

A SIMPLE SUPERHETERODYNE

for the Amateur Constructor

This 20-160 meter receiver gives surprising performance, considering the cost and number of components. It is an excellent project for the amateur constructor who has built a "blooper" and is ready to graduate to the superhet class.

For some time now it has been apparent to anyone who wants to take the trouble to add up the cost of parts that it is possible to buy a communications receiver, complete and ready to go, for about the same price as the component parts for an equivalent home-constructed receiver. This is true of any mass-produced article in which the factory's assembly cost isn't too great compared to the cost of manufacture of the component parts.

A competent auto mechanic might be able to build himself a Chevrolet from the necessary component parts purchased from the local agency. But even if he were to obtain the parts wholesale, the car would cost him considerably more than a new, factory-assembled job.

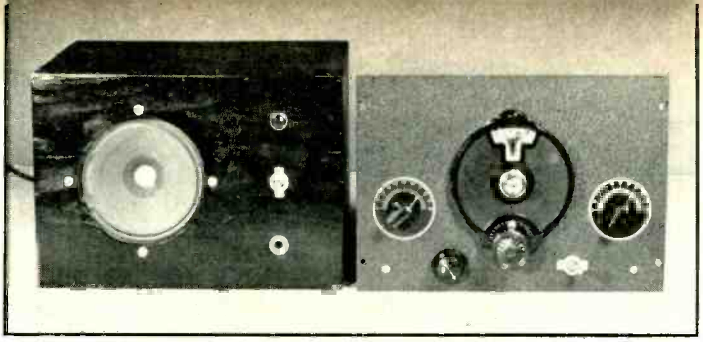
It may be said without fear of contradiction that the only justification for an amateur's constructing his own receiver is the practical experience and satisfaction gained thereby. Therefore, the following article, while coming under the classification of a "construction" article, will not be confined strictly to information on how to get the receiver built as quickly and painlessly as possible. It will also include a discussion of the various technical considerations that went into the design of the receiver.

The set is an improved version of the popular three-tube superheterodyne described in the RADIO AMATEUR NEWCOMER'S HANDBOOK and in the last two editions of the RADIO HANDBOOK. The new version is somewhat more sensitive than the older one, yet costs no more to construct. Except for the substitution of a resistor for the high impedance a.f. choke in the plate of the regenerative second detector (at a saving in cost), the new set is almost identical with the old one *with an untuned r.f. stage added.*

The untuned r.f. stage requires the addition only of a tube, socket, and four bits' worth of resistors, etc. The stage provides a gain of between 6 and 7 between 160 meters and 20 meters, and knocks down the apparent "conversion hiss" of the 6K8 when listening to weak signals. No gain is provided on 10 meters, the sensitivity of the receiver being about the same either with or without the r.f. stage. The r.f. stage has fairly uniform gain down to 20 meters, but the gain falls off rapidly at higher frequencies. However, the new receiver has been designed primarily for use between 1.7 and 16 Mc.

The Untuned R.F. Stage

It would be foolish to try to argue that an untuned r.f. stage, no matter how much gain it might have, is as good as a tuned r.f. stage. A tuned r.f. stage not only can be made to provide much more gain than an untuned stage, but in the case of a superheterodyne, to provide increased image rejection. However, an untuned stage can be added at little cost and with little trouble, while a tuned stage cannot. Therefore, when cost and simplicity are important factors, the use of an untuned r.f. stage has much to commend it.



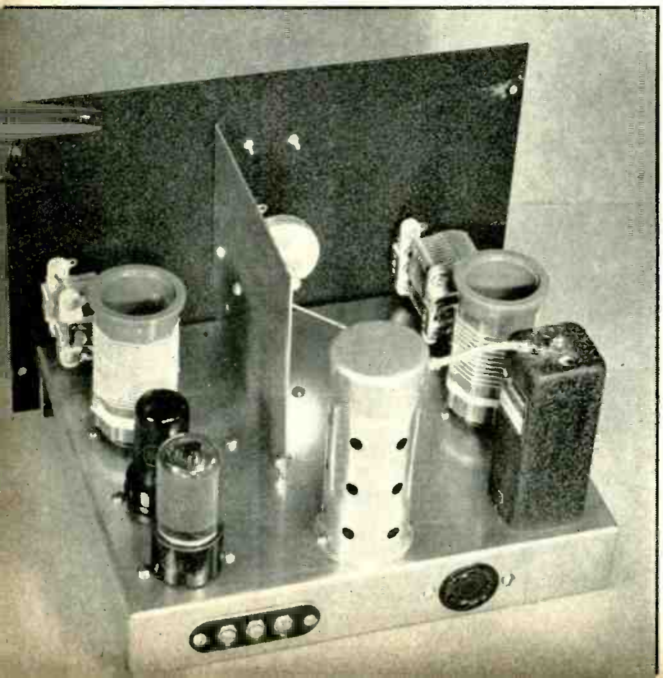
This simple 20-160 meter superheterodyne may be constructed for about $20, and will give excellent results. The power supply and speaker are housed in a plywood box of the same approximate size as the receiver proper.

At low frequencies almost any tube can be used to give considerable gain as an untuned r.f. amplifier. At high frequencies, however, the tube must have very high transconductance and low output capacity in order to give any gain at all; likewise the following tube must have low input capacity, as this capacity also is in shunt with the plate circuit of the untuned amplifier.

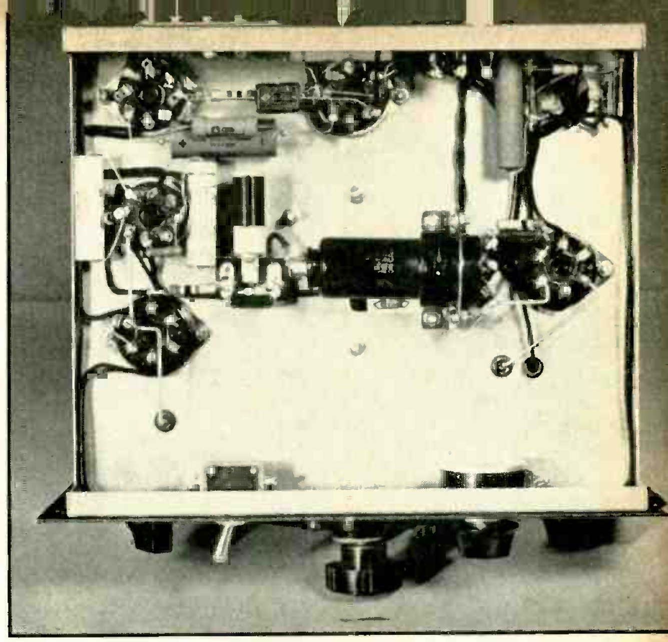
The new 6SG7 and 6SH7, recently released, have a transconductance of about 4000 with an output capacity of only 7 $\mu\mu$fd. These tubes sell for about the same price as their less efficient prototypes, and in a straight resistance-coupled amplifier will give a gain of 5 or 6 or 7 Mc. when feeding a tube with low input capacity. By using the lowest possible value of plate resistor which will not knock the 7 Mc. gain appreciably, the gain will be substantially uniform at all frequencies below 7 Mc. To increase the gain at higher frequencies a "peaking coil" can be employed. This is simply a broadly resonant inductance which tends to "neutralize" the loading effect of the shunt capacitance and raise the effective load impedance. At resonance, where the inductance and stray capacitances are equal, the gain would increase to a comparatively high value were it not for the limiting effect of the fixed resistive load and the poor Q of the peaking coil.

The peaking coil, which is L_3 in the wiring diagram, should be as low C as possible. This means that the capacity of lead wires to the chassis should be kept to the lowest possible value. For this reason the following 6K8 converter is mounted horizontally, underneath the chassis. This permits a very short lead to the control grid. Coil L_3, resistors R_2 and R_3, and condenser C_6 (as well as their connecting wires) should be kept away from the chassis by at least a half inch.

The exact resonant frequency of the peaking coil is not especially critical: anything between 13 and 17 Mc. will give a very uniform gain of 6 or so at all frequencies down through the resonant frequency of the peaking coil. For this reason, it is satisfactory simply to follow the winding data for this coil and not worry about slight differences in



Interior view, showing layout of components. Note that the 6J7-GT, its grid leak and condenser, and the grid lead to the i.f. transformer are all shielded. The shield partition minimizes coupling between the two tank circuits.



Under-chassis view. The 6K8 is mounted so as to permit the shortest possible grid lead. The "peaking coil," wound on a piece of wood dowel, is mounted at least a half inch away from the chassis and any other components.

stray capacities as a result of slightly different parts placement or lead length.

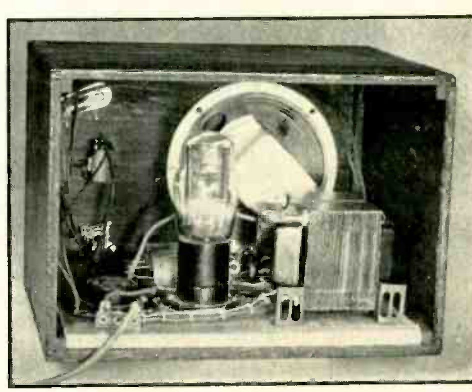
The 6K8, besides being an excellent converter tube, has very low control grid input capacity. This makes it a good choice for a mixer following an untuned r.f. stage, the reasons for the desirability of low shunting capacity in an untuned r.f. stage already having been discussed.

A question of terminology comes up when referring to the 6SG7 stage as an "untuned r.f. stage." In the first place, it would appear from the circuit diagram that the 6SG7 stage is tuned and the 6K8 mixer section is not. This is true if we are speaking of the *grid* circuits. However, because the loss in gain entailed in the use of resistance coupling in place of tuned coupling is determined primarily by the transconductance of the *preceding* tube, the test as to whether a stage is "tuned" or not according to common usage is whether or not the *plate* works into a tuned circuit. Even if the stage works into an untuned primary, it may be considered as a "tuned" stage if the output primary is closely coupled to a tuned secondary, in which case the primary will act as though it were tuned.

Strictly speaking, an "untuned" r.f. stage which employs a "peaking coil" is neither fish nor fowl: at low frequencies it operates much in the same manner as a resistance coupled stage, but at the resonant frequency of the peaking coil one might argue that the stage is tuned. However, so long as the peaking coil isn't *tunable,* and so long as the gain is substantially uniform at all frequencies at which the stage is designed to work, the stage probably is more correctly designated as "untuned."

An economical feature of the plug-in coil system is the arrangement whereby the coils are made to do double duty. As the oscillator tank should be high C and the antenna input tank low C, it is possible to use the oscillator coil for one band as the antenna coil for the next higher frequency band. What serves as the tickler when the coil is used in the oscillator serves as the antenna winding when the coil is used in the antenna input circuit. To permit adjustment of antenna coupling, the tickler or antenna coil is center tapped. When used in the oscillator all of this winding always is used; but when used as the antenna winding, either half or all of the winding may be employed, depending upon the position of the d.p.d.t. toggle switch S. This permits one to adjust the coupling

The speaker box houses the power supply, as shown in this illustration. A pilot jewel, on-off switch, and phone jack are placed on the front of the box. All components except those mounted on the front of the box are fastened to a removable wood baseboard.



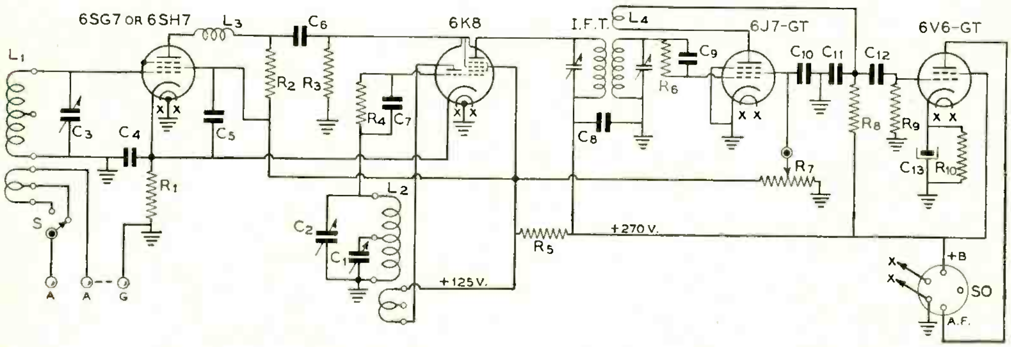
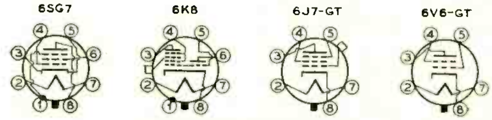


Figure 1.
Schematic Diagram of Simple Superheterodyne

C_1—50-μμfd. semi-circular plate midget condenser (main tuning condenser)
C_2—140- or 150-μfd. midget condenser (bandset)
C_3—50-μμfd. tapered plate midget condenser (r.f. resonator)
C_4—.05-μfd. paper tubular condenser, 400 v.
C_5—.05-μfd. tubular condenser, 400 v.
C_6 — .00025-μfd. midget mica condenser
C_7—.0001-μfd. midget mica condenser
C_8—.05-μfd. tubular condenser, 400 v.
C_9—.0001-μfd. midget mica condenser
C_{10}—.05-μfd. tubular condenser, 400 v.
C_{11}—.001-μfd. mica condenser
C_{12}—.003-μfd. mica condenser
C_{13}—5-μfd. 25 v. electrolytic condenser
R_1—50-ohm ½-watt carbon resistor
R_2—2000-ohm ½-watt carbon resistor
R_3—10,000-ohm ½-watt carbon resistor
R_4—50,000-ohm ½-watt carbon resistor



R_5—5000-ohm 5- or 10-watt wire-wound resistor
R_6—5-megohm ½-watt carbon resistor
R_7—100,000-ohm potentiometer, linear taper (regeneration control)
R_8—100,000-ohm 1-watt carbon resistor
R_9 — 500,000-ohm ½-watt carbon resistor
R_{10}—400-ohm 1½-watt carbon resistor
IFT—1600 kc. air core "replacement type" i.f. transformer with moderately close coupling (high gain type). Tickler L_4 is added. (See text.)
S—Single-pole double-throw toggle switch (antenna coupling selector)
L_1, L_2, L_3, L_4—Refer to coil table.

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for maximum gain with minimum image response regardless of the particular antenna used.

Because of the 1600 kc. intermediate frequency, images are not bothersome even at 14 Mc. If a bad image does persist, say from a powerful local, it may be dodged by shifting the 6K8 h.f. oscillator to the "other side." The conversion efficacy of the 6K8 appears to be about equally good with the oscillator tuned either 1600 kc. higher than the signal frequency or 1600 kc. lower than the signal frequency. The bandset condenser is fitted with a calibrated scale to enable the operator to locate quickly the two oscillator settings for each band by referring to a log made for all coils.

Care should be taken in wiring the two coil sockets so that the proper connections are made when the coils are inserted. Observe that the bandspread coil tap is not used when a coil is inserted in the antenna input coil socket. The data given for the bandspread tap is for a moderate amount of bandspread. If greater bandspread is desired (broader tuning), the tap should be located somewhat closer to the ground end of the coils. All windings should be wound in the same direction, to insure that the tickler polarity always will be correct for oscillation when the coils are used in the oscillator coil socket.

It was first thought that the use of the untuned r.f. stage would virtually eliminate "pulling" between the tuning controls as the resonating condenser was passed through the frequency of the h.f. oscillator. However, while the pulling was greatly reduced, some still remained, probably caused by stray coupling between the two tank circuits external to the converter tube. Because the antenna input circuit resonates so far off the oscillator frequency (1600 kc. away), pulling is not especially troublesome anyhow.

The Regenerative Second Detector

While the receiver employs no i.f. amplifier stage, the regenerative, grid leak type second detector is so sensitive and selective that the sensitivity and selectivity are comparable to that of an i.f. system employing a non-regenerative i.f. amplifier stage feeding a diode second detector.

In order to obtain regeneration, a tickler coil is added to the 1600 kc. i.f. transformer. The transformer should be of the high gain type; this may be insured by purchasing one designed to work into a diode detector. Somewhat greater gain is obtainable with a closely coupled transformer of this type than is possible with a loosely coupled "interstage" type, and the selectivity is the same in either case because of the regeneration. Because of the regeneration, an air core transformer will work just as well as an iron core transformer, and is cheaper.

The optimum number of tickler turns will depend upon the particular make and type of transformer used. The number of turns is correct when the 6J7-GT slides smoothly into regeneration when the regeneration potentiometer R7 is advanced to between ¼ and ⅓ "on." When making this test, a check first should be made to ascertain that the potentiometer is not wired up backwards so that the screen voltage increases with counter-clockwise rotation, and also to see that the primary of the i.f.t. is resonated. Ordinarily 3 turns will be required on the tickler. This consists of no. 22 d.c.c. tightly wound around the center dowel, as close to the grid winding as possible. The leads are twisted together and brought out the bottom of the transformer can. Correct polarity for oscillation is determined by experiment. If oscillation is not obtained at

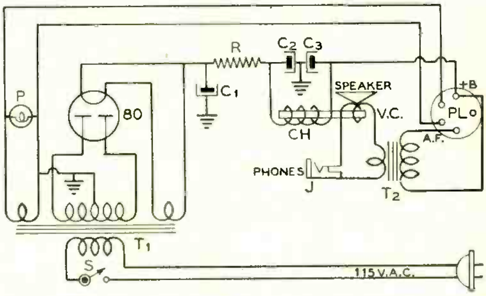


Figure 2
Wiring Diagram for Speaker and Power Supply

T_1—700 volts c.t., 65 or 70 ma., with 6.3 and 5 volt fil. windings
C_1, C_2, C_3—Midget 8-µfd. 450 v. electrolytics
R—1000 or 1500 ohms, 10 watts (see text)
CH—Speaker field
Speaker—5 inch with 1000- or 1500-ohm field and voice coil of at least 4 ohms
J—Closed circuit jack for 'phones
P—6.3 volt pilot light
S_1—A.c. toggle switch
T_2—Output transformer to match speaker, 5000- to 7000-ohm primary

any setting of the poteniometer even with 3 or 4 tickler turns, the polarity probably is wrong and the two leads should be reversed.

Because the 6J7-GT is not loaded by an antenna, very little feedback is required for oscillation. This explains the small number of tickler turns required for feedback.

A 6J7-GT was chosen for the regenerative detector for several reasons. First, the tube is less microphonic than most tubes having similar electrical characteristics, and a grid leak detector followed by a high gain a.f. system is susceptible to microphonics. Second, the double-ended construction with grid lead out the top makes it easy to protect the grid from hum pickup, and a grid leak type detector followed by a high gain a.f. system is highly susceptible to "grid hum." Grid hum in a grid leak type detector is caused by the fact that the tube acts very much as an a.f. amplifier with high impedance input. The high value of grid leak (5 megohms in this case) does not provide a very low impedance path to ground for hum which arrives at the grid via electrostatic pickup. Likewise, the grid condenser has too high an impedance at audio frequencies, and particularly at 50 or 60 cycles, to act as an effective shunt.

The arrangement used in this receiver completely eliminates every trace of grid hum. The 6J7-GT, the grid leak, the grid condenser, and the grid lead are all enclosed in a tube

[Continued on Page 86]

COIL TABLE

160 Meter Detector

58 turns no. 24 enam. close wound, shunted with fixed 50-µµfd. silver mica condenser placed inside form. Antenna winding 14 turns close wound at ground end, spaced 1/16" from main winding.

160 M. Osc.—80 M. Det.

42 turns no. 22 d.c.c. close wound. Bandspread tap 20 turns from ground end. Tickler-antenna winding, 9 turns close wound, center tapped, spaced 1/16" from main winding.

80 M. Osc.—40 M. Det.

20 turns no. 22 d.c.c. spaced to 1½". Bandspread tap 12 turns from ground end. Tickler-antenna winding, 8 turns close wound, center tapped, spaced 1/16" from main winding.

40 M. Osc.—20 M. Det.

11 turns no. 22 d.c.c. spaced to 1¼". Bandspread tap 5 turns from ground end. Tickler-antenna winding, 6 turns close wound, center tapped, spaced 1/16" from main winding.

20 M. Oscillator

4½ turns no. 22 d.c.c. spaced to ⅞". Bandspread tap 3 turns from ground end. Tickler, 2 turns close wound, spaced 1/16" from main winding.

6SG7 Peaking Coil

No. 28 enamelled, close wound on ½" wood dowel to a length of exactly ⅞".

All coils except peaking coil are wound on standard 1½" plug-in forms. Tickler always is at ground end of main coil. Tickler polarity must be correct or 6K8 will not oscillate.

TRANSCEIVER DATA

For the Newcomer

By LLOYD V. BRODERSON,* W6CLV

This article is recommended reading for the fellow about to take his first "crack" at 2½ meters. Most of the data will be old stuff to anyone who has done much work above 112 Mc., but for the uninitiated it contains valuable dope.

The majority of newcomers to the 112-Mc. band make their debut with the simplest equipment possible. In most instances, this is a transceiver employing standard tubes and circuits doing double duty in the role of transmitter and receiver.

In view of this fact, the remarks to follow apply chiefly to transceivers, and in some cases are also applicable to ultra-high frequency transmitters and receivers.

Herein are offered some practical suggestions to those amateurs already active on 2½ meters in order that they may realize increased performance from their equipment.

Insulation

The newcomer to u.h.f. learns early in his operations that many insulating materials deemed satisfactory for low frequency applications prove to be inadequate on the ultra highs. The oscillator-detector socket in many transceivers is the biggest offender and can usually be classified as public enemy number one. A socket of inferior insulation often can mean the difference between negligible and normal r.f. output, or the difference between erratic and smooth superregeneration. One experiment in which a standard socket was replaced with one of polystyrene insulation resulted in increased output on "transmit" and a complete removal of dead-spots on "receive."

A further slight increase in efficiency results when the unused prongs of a socket are removed. This is easily accomplished with a polystyrene socket by placing the socket in a vise. While pulling on the prong to be removed, apply the tip of a soldering iron to the center area of the prong. Inasmuch as the melting point of polystyrene is very low, the job should be done as quickly as possible.

The advantages of employing a socket thus operated upon are readily apparent. Capacity effects within the socket itself are reduced. In transceivers employing linear tank circuits, it will be found necessary to lengthen the lines to restore resonance.

There is little to be gained by merely clipping short unused socket prongs; an appreciable length remains imbedded in the socket.

Stand-off and feed-through insulators supporting components in r.f. fields always should be of excellent insulation. Present day practice dictates the use of polystyrene products (Victron, Quartz-Q, Plasticine, etc.). These materials are available for almost any application and are far superior to most ceramics.

Tank Circuits

Tank circuits usually fall into either of two classes: parallel lines, or the conventional coil-condenser version. High-Q circuits are coming into favor more and more as it is realized that circuit efficiency goes hand in hand with oscillator stability.

While the action of ultra-high frequency coil-condenser tank circuits is identical with low frequency practice, it is well to remember that capacity loaded linear tank circuits function "in reverse." Closer spacing of the lines results in an increase in frequency while a wider separation decreases the frequency. It is usually possible to compensate for slight discrepancies in the length of the lines by varying this spacing until the frequency falls within the band.

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

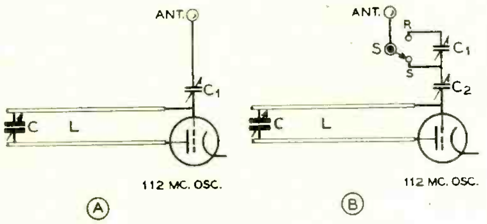


Figure 1. Simplest method of permitting optimum antenna coupling both on send and receive, applicable only when capacity coupling is employed, is shown at "B".

Coupling Methods

Transferring r.f. energy from the oscillator tank circuit to the radiator usually is accomplished by capacitive or direct inductive coupling. Most transceivers designed primarily for portability employ capacity coupling. A small condenser of approximately 1 or 2 μμfd. is placed in series with the radiator and oscillator tank (see figure 1A). The usual procedure is to vary this coupling until the transceiver superregenerates over the entire 112-116 Mc. band with the closest possible coupling. The coupling condenser is then left in this position.

While the setting of C_1 may be optimum for "receive," it leaves much to be desired when the transceiver is placed in the "transmit" position.

Tighter coupling on "transmit" and a resultant increase in r.f. output is obtained by the system shown in figure 1B. Condenser C_2 is adjusted for maximum capacity while C_1 is set at minimum capacity. Any low-loss antenna changeover system may be employed whereby C_2 only is connected in the circuit on "transmit" and both C_2 and C_1 are in series in the "receive" position. The switch must have *very low capacity* and *good insulation.* However, this arrangement causes the transceiver to send on one frequency and receive on another, making it necessary to retune slightly when switching from transmit to receive and vice versa.

Some transceivers employ inductive coupling. When the antenna coil remains in a fixed position, results are seldom obtained on both "transmit" and "receive." Variable inductive coupling permits maximum transfer of r.f. energy on "transmit" and maximum signal pickup on "receive," but requires retuning of the transceiver each time the coupling is changed.

Tone Modulation

For some reason many newcomers fail to incorporate means of tone modulating the carriers of their transceivers. It is a well established fact that communication on the 2½ meter band in many instances can be carried on successfully by means of i.c.w. long after voice has fallen below the receiver noise level.

There are many ingenious methods in use—some complicated, others simple. Three elementary versions are shown, any one of which may be satisfactorily used for tone modulation. Figure 2A is perhaps the acme of simplicity, consisting of a key, battery and buzzer in series. In operation, the buzzer is placed close to the microphone.

Figure 2B may be likened to the usual audio oscillator. Here, a small tubular condenser of approximately .001 μfd. is connected from the plate of the oscillator tube to one side of the microphone transformer

[*Continued on Page 70*]

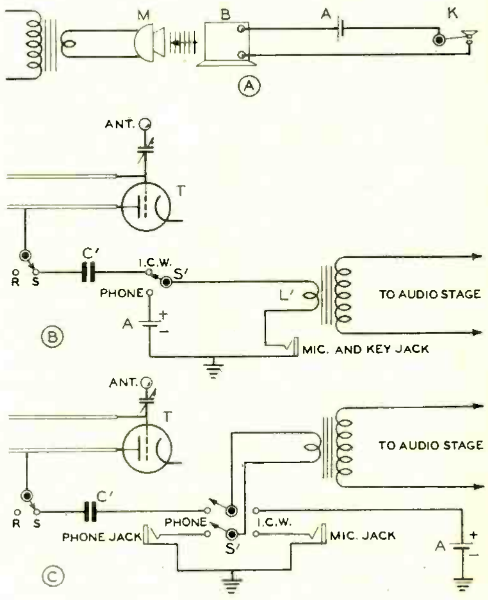
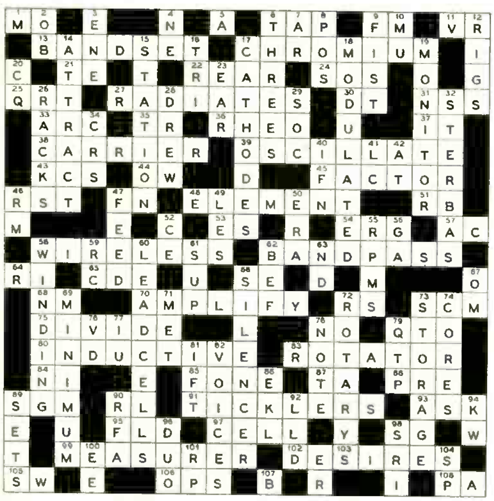


Figure 2. Three methods of obtaining a tone for i.c.w. The system of "C" is essentially the same as that of "B" except that a d.p.d.t. switch makes it unnecessary to plug the mike and key plugs in and out when changing from voice to i.c.w.

POSTSCRIPTS... *and Announcements*

RADIO CROSS-WORD PUZZLE

Herewith is the correctly filled-in cross-word puzzle which appeared on pages 62 and 63 of the November issue of RADIO. We hope you had fun racking your brain for the words, and that the result of your efforts agrees with this drawing.



Heater 0Z4's?

Don't worry about the 0Z4's bearing heaters and cathodes which were shown in the diagram of Leroy May's mobile power supply in the July issue of RADIO. The rectifier sockets in the power supply were wired in this manner so that either 6W5-G or 0Z4 tubes could be used merely by inserting them in the sockets.

Clark Electronic Bug

An error was made in the circuit diagram of D. L. Clark's electronic bug, beginning on page 36 of the October issue of RADIO. In the diagram R_8 was shown as being a fixed resistor while R_{10} was shown as being a variable. The types of resistor should have been reversed: R_8 is a variable and R_{10} is fixed. But the *caption* for the circuit diagram is correct as it stands.

Concerning "Perfect-Balance Self-Balancing Phase Inverter"

By Henry Wallman

In my article on "A perfect-balance self-balancing phase inverter" (RADIO, October 1941, pages 46 and 89) I showed how one can modify a known self-balancing phase inverter circuit so as to achieve absolutely perfect balance.

Unfortunately my work contains an error: although the general principle of obtaining perfect balance by making R_4 (in figure 2 on page 46) slightly larger than R_3 is perfectly correct, and so are each of equations (1), (2), (3), and (4) on page 89, the definitions given for the ratios α and β are incorrect. Moreover this incorrect definition had the effect of yielding a wrong value for R_4 in the 6SC7 case on page 89.

In order to make the work correct it is necessary to replace the left-hand column of page 89 by the following:

The exact value of R_4 for perfect balance will be developed from the following analysis. Let

$$\alpha = \frac{1/R_3}{(1/R_3)+(1/R_4)+(1/R_5)}$$

$$\beta = \frac{1/R_4}{(1/R_3)+(1/R_4)+(1/R_5)}$$

and m = voltage gain (without feedback) of tube T_2.

Denote the voltage between point (A) in figure 2 on page 46 and ground by *a*, so that *a* is the actual input voltage to tube T_2. Now E_b is the output voltage from T_2; since the voltage gain of T_2 is m we must have

(1′) $E_b = ma$.

In order to determine *a* we apply Kirchhoff's laws to the two-mesh circuit consisting of $E_a, -E_b, R_3, R_4, R_5$. It turns out that

(1) $a = \alpha E_a - \beta E_b$.

Solving (1) and (1′) for *a:*

(2) $a = \alpha E_a/(1+m\beta)$.

Hence,

(3) $E_a/E_b = (1+m\beta)/(m\alpha)$.

Therefore in order that $E_a/E_b = 1$ we must have

(4) $\alpha = \beta + (1/m)$.

This gives us the following general principle: *in order to get perfect balance choose* *resistors* R_3, R_4, R_5 *so that* $\alpha=\beta+(1/m)$.

If we leave R_3 equal to R_5 then (4) yields

$$(5) \qquad R_4=R_3[1+3/(m-2)]$$

as the condition for perfect balance, that is,

R_4 *must be* $\frac{3}{m-2}$. R_3 *ohms larger than* R_3.

It is very easy to apply this general principle. Let us consider, for example, the 6SC7 case above. Here, as we see from the tables on resistance-coupled amplifiers, m is equal to 42. Leaving R_3 and R_5 (and R_1 and R_2) unchanged, it turns out that for perfect balance it is only necessary to change R_4 to 268,-750 ohms (=250,000 ohms plus a parallel combination of 25,000 and 75,000 ohms). This gives a "perfect-balance self-balancing" phase inverter circuit, which in a single tube yields a voltage gain of 84, grid to grid.

The modified circuit retains, of course, the valuable feature that variations in tube gain affect E_a/E_b very little. Thus, a 25% decrease in the gain of section T_2 of the 6SC7 above would create an unbalance of less than 2.5%.

The Open Forum

Tucson, Arizona

Sirs:

Personally, I think W3AG's letter, printed in the October issue of RADIO, is absurd. The idea of allowing us to contact South and Central American countries would pave the way for our complete removal from the air, and it would do it quickly. There is little doubt that it would open up possibilities for fifth column work not only through these South American countries but through stations in Europe who would certainly use South American prefixes and contact stations all over this country.

I suggest that he get out all the old issues of RADIO and *QST* back in "those good old days" and bury himself in a lot of rags (to soak up the tears) and read about DX in years gone by.

There's another solution and a better one. That is to get on the ultra-high frequencies where there is so much to be done. That is real, and that is certainly worthwhile.

JAMES W. BRANNIN, W6OVK

Calistoga, California

Sirs:

How many times do you hear the complaining operator say, "Sorry, OM, but QRN is so bad we can't pull you through"?

I've said this plenty of times, as QRN up here usually is R6-7. So as a last resort I started using a well designed loop for reception. The receiver here is a low-priced superhet and it has ahead of it a single stage of r.f. for the loop. This arrangement will cut down signal strength possibly to 10% of that obtained with an outside antenna. But it certainly brings in stations that are unintelligible with the normal aerial due to the increase in noise level.

I got this idea from recent b.c.l. receivers and from experimenting some years past with direction finders. I have found a loop 30 inches square to be plenty large, although smaller loops will work but with lower pickup. With modern receivers and a loop I have never had to shut down on account of QRN, even with the source of noise very close. But one thing is very important; to be sure to stop all the noise coming into the receiver through the a.c. line. A couple of good by-pass condensers from each side of the line to ground will stop most of this.

I don't claim to be an expert on loops, but a little more attention to this type of antenna will be well worth the expense of obtaining one. Also, I have used loops for reception on frequencies as high as 30 Mc. with excellent results.

J. W. CLARK, W6CAN

• • •

Lucite vs. Polystyrene

There seems to be a common misconception among amateurs and radiomen in general that Lucite is a polystyrene product. True, they are both synthetic plastics, but that is as far as the similarity goes. Lucite is the trade name of a product manufactured by DuPont, consisting of polymerized methyl meth-acrylate; Plexiglas, the trade name of a similar product manufactured by Rohm and Haas, is of similar chemical composition. On the other hand, the name polystyrene is an actual condensation of the chemical name of the product—polymerized meta-styrene. Some of the *trade names* for polystyrene are: Victron, 912-A, Trolitul, Quartz-Q, and Styron.

It should be remembered that the polystyrene products are manufactured primarily for use as insulating materials, while the methyl meth-acrylate plastics are manufactured primarily for their light transmission efficiency. It stands to reason, then (and this fact is borne out by experiment), that the polystyrene products are the best dielectrics.

YARN of the MONTH

COUSIN ZEB'S GREBE

It was nine year ago when maw moved the chicken roosts out of the spare bedroom and turned it over to me to use for fixing up radio sets. I had just finished reading one of them mail order radio courses that learns you how to fix up sets. I got a 69c meter with the course and a few resistors, so I wired me up a voltmeter.

You city fellers probably don't know how to do this so I'll tell you. Just hook a resistor in series with the meter and she's ready to perk. Well, sir, I had one of the neatest little voltmeters you ever seen; the meter drawed fifteen mils so it checked battries under load—something the factry built meters didn't do till only recently. I ordered an oscillator and tube tester out from Louisville but the durn things jostled apart on the twenty-two mile of rock road that the mail scout had to travel to get from the local post office to our mail box. Back when maw and pappy were first married the mail box was at our cabin but after the mail scout started using a buggy to carry mail in, he couldn't get over the twelve mile of bad road that led up to our house, so they put the mail box out on the main turnpike.

Word soon got around that South Hill, Kentucky, had a radio serviceman. My first job was toted in on a mule by Cousin Zeb; it was a 1924 model Grebe using two 201-A's r.f., 201-A detector, and two 201-A's a.f.—cost Cousin Zeb his autumn tobacco crop, two hawgs, and a mare.

Cousin Zeb was a real dude; whenever he went sparking he would load up his Grebe in the front of the buggy, with the battries and loop in the back. You can't find it in any of the records, but South Hill had the first pleasurable vehickle equipped with radio in the United States.

Well, sir, I reckon I never will forget that day I saw Zeb shinnying up the hillside to our cabin; pappy saw Zeb first when he come out of the woods and started up the hill. He hollered at me to get the shotgun while he got the powder and balls; it wasn't until Zeb got within shout that we found out he wasn't a revnooer. When pappy first spied Cousin Zeb he mistook him for a revnoo man because he had shoes on. (Zeb was a dude.)

Like I said, when Cousin Zeb got within shout we found out he wasn't a revnooer; it was about 10 minutes later before Zeb got to where pappy and me were sitting and Zeb and us was hollering back and forth all the while, so by the time Cousin Zeb got to where pappy and me were, we knew all about his set being out of whack. The old Grebe with its battries was so heavy we decided not to unpack the mule till after we'd got him inside of the house.

After Cousin Zeb and me got the mule unpacked he told me one of his kids had taken a tube out of it. I went over to my tube supply shelf and after setting a case of tomatoe preserves and a ham out of the way I fetched a 201-A over to Zeb. When I unflapped the tube carton and showed the tube to cousin Zeb, he told me the tube his kid busted wasn't atall like that one, it had metal on both ends and a black streak down the middle.

Well, sir, I never heard of such a tube so I asked Zeb if he was still making it with corn. He told me he was and I'm sorry I recklected it to his mind cause I had to go directly and unstop us two fresh jugs. After a spell, my curiosity got to pestering me so I opened the set's top and peered inside. Seeing all five 201-A's in their respectable sockets, I was more fusstrated than ever and asked Cousin Zeb to show me the socket his kid took the tube out of. Zeb peared to be sort of vexed that me, a radio wizzard, couldn't smell his set

[*Continued on Page 96*]

By JOHN JACKSON

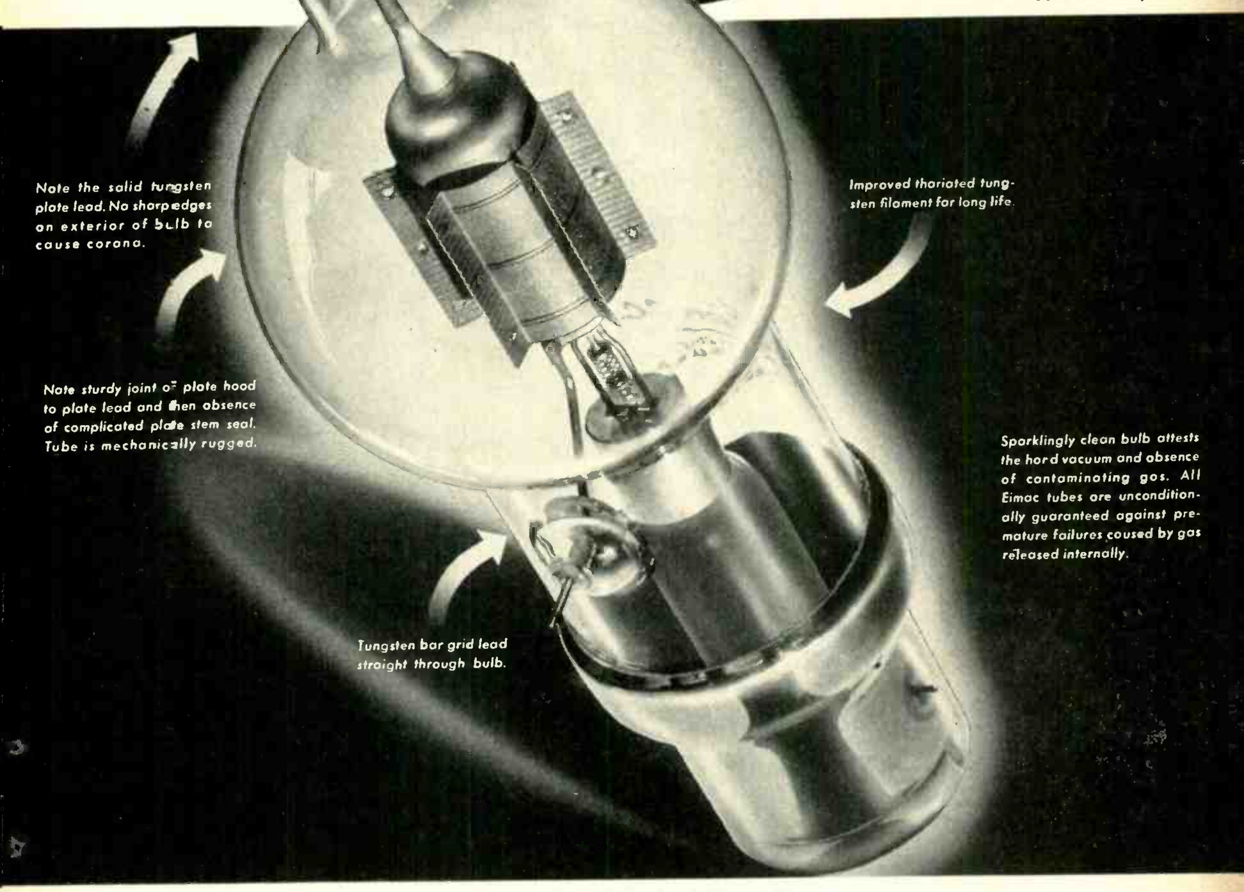
In the considered judgment of leading engineers...

When important decisions are made about vaccum tubes it is not uncommon for an Eimac tube to win the honors. *Reason:* the designers of Eimac tubes have consistently held as their objective the anticipation of the future requirements of the radio industry. Efforts have not been confined to the production of a tube for yesterday's requirements.

This policy has kept Eimac tubes ahead of the industry . . . a factor that is logical because the efficiency and progress of radio depends almost entirely upon the development of new ideas...new improvements in vacuum tube performance. Take the Eimac 250T, for example, which now possesses the most recently developed refinements. Check these features illustrated below and then check the performance of Eimac tubes in your transmitter. You'll see then why Eimac tubes are to be found in most of the important new developments in radio.

Follow the leaders to **Eimac TUBES**

Eitel-McCullough, Inc.
San Bruno, Calif.



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What's New . . . . IN RADIO

BLACKOUT-PANEL OSCILLOGRAPH

In keeping with the growing blackout consciousness of the times, the Allen B. Du Mont Laboratories, Inc., of Passaic, N.J., announce their new Blackout-Panel Type 208 Oscillograph which can be used under adverse lighting conditions or in total blackness when necessary. This feature may be particularly desirable in certain military applications.

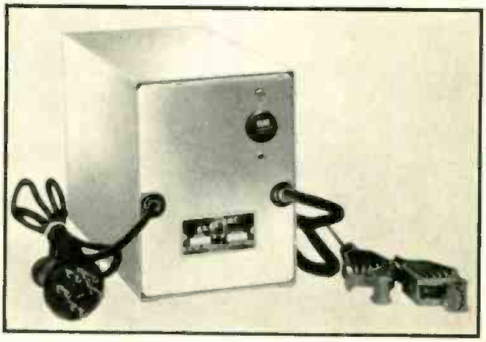
The specially processed steel panel is treated with a non-radio active luminous paint that retains its maximum luminosity for several minutes after exposure to ordinary light, and can be comfortably observed for an hour or more after that. The glow is of the same color and intensity as the standard medium persistence screen of the cathode-ray tube used, thereby minimizing eye-strain. The Blackout Panel is now an optional feature with the Type 208 Oscillograph.

SPECIAL KENYON TRANSFORMER

The Kenyon Transformer Co., Inc., of 840 Barry Street, Bronx, New York, recently announced a new transformer designed especially for use with the new RCA-931 Electron Multiplier Tube. This transformer is housed in a standard 4A case and is known as the Kenyon Type T-211. Specifications are as follows: Primary—0/105/115/125 volts, 60 cycles. Secondary 1—0/100/200/300/400/500/600/700/800/900/1000 volts at 10 ma., r.m.s. Secondary 2—2.5 volts at 1.75 amperes. Complete description as well as the new 1941 catalog are free upon request.

SUM-UP SLIDE RULE

The new Sum-Up Plus and Minus Slide Rule is an aid to making and checking calculations for mechanical drawings, laying out machine-shop jobs, making patterns, etc. Unlike the usual slide rule which multiplies and divides, this rule adds, subtracts, and converts decimals of an inch, fractions of an inch, and millimeters interchangeably, and the answer can be read in fractions, decimals, and millimeters. It is made by the Sum-Up Slide Rule Company, 114 Liberty Street, New York.



VIBRATOR POWER SUPPLY

The Model 2500 Synchro Power Supply is a vibrator type supply which furnishes 6 volts filament and 300 volts at 100 milliamperes d.c. power from a 6-volt storage battery. Complete radio-audio filter system, input and output battery cable, plug, clips, and fuse are provided with this unit.

Suited for use as a power supply for portable public address systems, low power radio transmitter-receiver units and any service where a high efficiency, light weight, low cost power source is required. A product of the Electro Products Laboratories, Chicago, Illinois.

JUST OUT!

NEW CATALOG 18

Especially useful today! Gives complete up-to-date information on the wide range of Ohmite stock resistors, rheostats, chokes and switches used in all types of applications . . . Lists over a thousand stock items, including new developments . . . Gives descriptions, ratings and prices . . . Helps you select the right units for each job, easily, quickly. Get your copy of this handy new Catalog 18 now! It's FREE. *Send the Coupon today!*

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TEMPERATURE COMPENSATING CAPACITORS

Compensating capacitors obtainable in any temperature coefficient from -.005% to + .005% per degree C. over a temperature range between -40° C. to + 70° C. are announced by Aerovox Corporation of New Bedford, Mass. Such capacitors can be used to correct the normally positive temperature coefficient of inductances for the maintenance of constant L-C products (resonant frequency) of tuned circuits independent of temperature.

These Aerovox Type "K" mica capacitors are supplied only in low-loss (yellow) XM bakelite cases and are sealed for immersion. They are available in a limited range of capacities and voltage ratings. Inasmuch as the capacity, voltage rating, and temperature coefficient are equally contributory to the design and size of the unit, specifications for individual requirements are being supplied on application.

To appreciate the purpose served by temperature compensating capacitors it should be noted that the normal temperature coefficient of the components in tuned circuits is usually positive. Thus the inductance of the coils and the capacitance of the capacitors both increase with an increase in temperature. When coils and capacitors are used in tuned circuits such as oscillators or amplifiers, the resonant frequency of the circuit will vary with the temperature so that the frequency of an oscillator will decrease as the temperature increases. So that the frequency of an oscillator or the constants of an amplifier circuit may remain constant, it is necessary that either the inductance or the capacitance have temperature characteristics that compensate for any change in the characteristics of the other. The Type "K" capacitors provide such capacitance compensation.

An oscillator circuit using compensating capacitors will provide a constant frequency source independent of any changes in ambient temperature or any temperature changes in the units caused by current flow in the circuit. Zero temperature coefficient capacitors may be used wherever a capacity independent of temperature is required. One suggested application is as a shunt for the measurement of r.f. currents with a vacuum-tube voltmeter as an indicating instrument. Since the compensating capacitor is available in any temperature coefficient from -.005% to + .005% per degree C., many circuits can be improved in stability, and new circuits developed to utilize the negative, zero or positive temperature coefficients of the compensating capacitor. For instance, an outstanding example where the application of compensating capacitors is desirable is in radio range beacons where it is vitally necessary to maintain uniform currents both in magnitude and phase relationships simultaneously in several circuits. Compensating capacitors used in such circuits will maintain the resonant frequency of the circuits regardless of temperature changes.

Another example would be in high-power oscillators for radio transmitting, especially where weight and space are of utmost importance and do not allow for use of quartz crystal oscillators and their associated apparatus. By the use of compensating capacitors it is possible to obtain oscillator frequency stability comparable to that obtained with quartz crystals.

NEW TYPE MARINE RADIO EQUIPMENT

A new type of commercial marine radio equipment of revolutionary design which can be installed on board ship in one-fifth the time usually required has been developed in connection with the emergency shipbuilding program. Among the vessels on which it is to be installed are the 312 Liberty type ships now being built by the Maritime Commission. The new unit combines in a single cabinet radio equipment which ordinarily requires as many as twelve separate units, and eliminates the intricate system of interconnecting wiring in the radio cabin. It includes all of the radio apparatus necessary for safety and communication purposes.

The new set was designed and is being manufactured by the Federal Telegraph unit of the International Telephone and Radio Manufacturing Corporation. It will be made available to private shipping and shipbuilding companies through the Mackay Radio and Telegraph Company.

Rough Going!

TAYLOR TUBES ARE BUILT FOR IT

In Uncle Sam's Armored Tank Forces or in an amateur's rig, TAYLOR TUBES are built to take the toughest kind of punishment and still deliver top performance with longer life.

Years of serving the knowing amateur and developing and manufacturing tubes to meet his exacting demands, has made this possible.

The HIGH SAFETY FACTORS, characteristic of all TAYLOR TUBES have long been the amateurs protection against unexpected tube failure and now more than ever they are the choice of thinking hams who are rebuilding or overhauling their rigs for amateur defense.

Whether it be on the low or high frequencies, a kilowatt or a low power rig you are planning, TAYLOR TUBES will give "MORE WATTS PER DOLLAR."

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Of course, the requirements of our government must come FIRST—so, if your Distributor is unable to give you prompt service, we ask that you understand the situation. Taylor Tubes and their Distributors are doing their very best to continue the fine service they have always given.

"More Watts Per Dollar"

T-40 and TZ-40

FIL. VOLTS . . 7.5
FIL. CURRENT AMPS. 2.5
D.C. PLATE VOLTS . . . 1500
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Taylor HEAVY CUSTOM BUILT DUTY Tubes

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

The Amateur Newcomer

[*Continued from Page 61*]

winding. In operation, a key is inserted in the microphone jack and the microphone battery disconnected by throwing S_1 to the "tone" position. Substituting different values of capacity for C_1 will vary the tone. Should the circuit fail to oscillate, the leads to the microphone winding should be reversed.

Figure 2C is a modification of figure 2B. In this circuit a d.p.d.t. switch is employed and a separate keying jack has been added. Both microphone and keying plugs may remain in their respective jacks at all times; voice or tone is selected by a flip of the switch S_1.

For the more advanced operator, there are systems employing separate audio oscillator tube circuits, neon globe oscillators, etc. The circuits illustrated, however, represent the more elementary versions employed for tone modulation consistent with worthwhile results.

Mobile Operation

The average newcomer whose only 2½ meter equipment consists of a strictly portable transceiver, hesitates "going mobile" usually because of erroneous ideas concerning power requirements and elaborate antenna installations.

Transceivers powered by dry batteries are usually designed for portability. When used "as is" for home or mobile operation, the life of these batteries is greatly shortened. By installing a 4p.d.t. switch (figure 3) it is possible to use external batteries for both

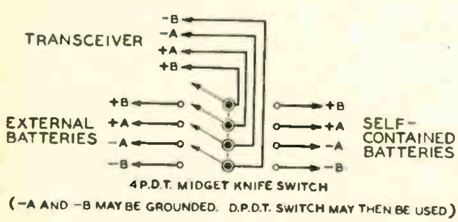


Figure 3. A midget knife switch makes it possible to save the midget self-contained batteries for portable use. The wires marked "external batteries" are terminated in a four prong jack on the rear of the transceiver. In most circuits, A- and B- may be grounded. This will permit use of a d.p.d.t. switch.

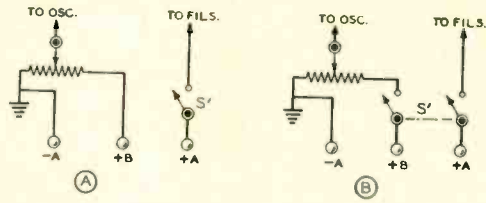


Figure 4. By using a d.p.s.t. switch instead of a s.p.s.t. as the off-on switch, there is no danger of running down the batteries by the regeneration potentiometer drain while the set is not in use.

filament and plate requirements, conserving the smaller batteries for portable use.

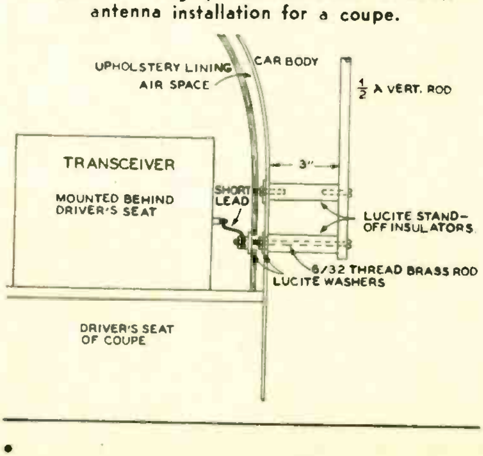
Some transceivers are so designed that the regeneration control can at times act as a "bleeder" resistor, causing premature battery failure. Analysis of figure 4A shows the following: A 100,000-ohm variable resistance is connected in series from "B" positive to ground (chassis). When the transceiver is supposedly turned off (filament supply disconnected), it is still possible for the "B" battery to slowly dissipate its energy to ground through R_1.

This situation may be remedied by installing a d.p.s.t. switch as shown in figure 4B. Thus, when S_1 is in the "off" position, both "A" and "B" supplies are completely isolated.

Antennas

A popular misconception of the newcomer desirous of "going mobile" is that an elaborate antenna system is required. While not

Figure 5. Highly recommended 112-Mc. antenna installation for a coupe.



Ted

Bob

Henry Goes Hollywood!

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In order to give better service to my ever increasing list of western customers, I have opened a completely stocked branch in Los Angeles. My brother Ted is in charge—drop him a line, or stop in and see him.

There are many good reasons for our increasing sales of Amateur Receivers. Each order receives our personal attention, a service you cannot get elsewhere. You get IMMEDIATE SHIPMENTS from the WORLD'S LARGEST STOCK of all makes and models of Amateur Communication Receivers. We finance our own time payment sales—no red tape—and less cost to you, easy 6% terms. We can afford to give you better trade-in—send us a description of your old receiver.

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comparable to rotary beam installations fed by co-axial cables, a simple half wave vertical element is perhaps the easiest to install consistent with worthwhile results. Capable of providing low angle radiation and being inherently non-directional, it is entirely practical for the newcomer's initial debut to mobile and portable-mobile operation.

Vertical telescoping auto antennas are not recommended. Insulation will be found to be inadequate and the antenna connection from the b.c.l. rod (usually a "connector" type) will act as u.h.f. as a high resistance contact. In addition, the lead-in (which should be as short as possible for an end-fed vertical rod) is usually much too long. In many cases the telescoping joints will be the cause of receiver noise when the antenna is whipping about.

Figure 5A illustrates the mechanical details of a vertical half wave rod or tubing radiator mounted on the driver's side of the car by means of two, three-inch lucite "pillar type" standoff insulators.

The length for optimum performance is determined by experiment. Several factors must be taken into consideration, such as the distance between antenna and car body, lead-in length, and proximity of other nearby objects.

Because of the effect of the car body, the radiation from the antenna will not be strictly non-directional. The car body will distort the pattern somewhat, causing the antenna to give about 1 or 2 R points better radiation in the favored direction as compared to the least favorable direction. As the distortion depends upon so many factors and will be different in every case, it is a good idea to determine the "best" direction by experiment.

This can be done by listening to another station while out in a clearing and not close to large objects which might cause confusing reflections. Turn the car in a circle and see at what point the signals are loudest. The latter check can be done most accurately by detuning the signal until it is just barely audible.

After the favored direction is determined (usually it will not be exceptionally sharp), it is a simple matter always to aim the car in the proper direction when trying to work dx.

In almost every case the favored direction will be found to be *through* the car body, though in some cases it might be towards the opposite front fender, while in others it might be towards the opposite rear fender.

Conclusion

The newcomer to the ultra highs would do well to remember that u.h.f. practice follows quite closely accepted theory on the lower frequencies. Obviously, the higher frequencies necessitate smaller values of inductance and capacity, and insulation assumes an all-important role.

While the physical dimensions of radiating systems are much smaller, the theory and operation remain much the same as for those used at lower frequencies.

The u.h.f. spectrum offers a vast field for experimentation. Although modulated oscillators on the 2½ meter band are at present in the majority, the trend is toward oscillator-power amplifier transmitters. In some instances, crystal control is being employed successfully.

Increased activity on this highly popular amateur band will no doubt lend impetus to new approaches to transmitter stability and receiver selectivity.

• • •

New International Broadcast Station to Serve the Far East

A new international broadcast station to serve the Far East has been initiated through the cooperation of various broadcasters, the Defense Communications Board, the Coordinator of Information, and the Federal Communications Commission.

The latter has authorized The Associated Broadcasters, Inc., licensee of standard broadcast station KSFO, at San Francisco, to construct an international station there to broadcast to the Orient and Australia. For 16 to 20 hours a day news and entertainment will be sent in English, French, Dutch, Spanish, Portuguese, Japanese, and, when possible, Chinese, Thai, Russian, and Korean. Frequencies of 6060, 9570, 11,870, 15,350, 17,760 and 21,610 kc. will be used. In some instances this will mean sharing time with other domestic international stations.

Though about a dozen international broadcast stations now operate in the United States, only one—KGEI, licensed to General Electric—is on the West Coast (near Belmont, Calif.). The other stations, being located in the eastern part of the country, cannot serve the Orient. Distance is too great and the path through the North Polar regions plays hob with transmission. Yet the desirability of broadcasting across the Pacific is self-evident in the light of international conditions.

The Defense Communications Board urged additional facilities, and the Coordinator of Information has arranged for delivery of a 100-kilowatt transmitter from the General Electric Company to speed this new service.

How Many Shopping Days Left Until Christmas?

(This is the sixty-four dollar question)

And here's the answer: Do this year's shopping from your fireside. RADIO'S Christmas gift rates will be in effect from November 15th to January 15th and a subscription is the easiest way to be Santa to your Radio-minded friends. We'll take care of the greeting card, too, and send an attractive card announcing your gift and greetings. Subscriptions will begin with the January issue—delivered just about Christmas time.

ONE SUBSCRIPTION (one year)	$2.50
TWO SUBSCRIPTIONS, each	2.35
THREE or more SUBSCRIPTIONS, each	2.25
SIX or more SUBSCRIPTIONS, each	2.00
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73—and a Merry Christmas to you!

THE EDITORS OF RADIO technical publishers
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1300 KENWOOD ROAD, SANTA BARBARA, CALIFORNIA

"TRMA"

[*Continued from Page 42*]

as "C" rendered "ten," and "space" rendered "sanace," and "6th" being garbled into "66." All the dots and dashes are therein accounted for, but something happened to the timing. There is no end to the possible bad combinations that can result from improper spacing of radiocode characters, and if this fact is kept in mind, the progress is sure and rapid.

Exercises

The title of this article, "T R M A," is not intended as a chide, but merely to point out that to some of the boys it isn't exactly "CQ." The code exercises outlined below should help a lot in guarding against bad habits of sending. Note that the 2nd and 3rd letters if improperly formed resemble the first letter:

AET	
BTS	
CTR	CNN
DTI	
FIN	FUE
GME	GTN
JWT	JAM
KNT	KTA
LAI	LRE
PAN	PWE
QMA	QGT
REN	RAE
UIT	
VST	
WAT	WEM
YTW	YKT
ZMI	

Figures, too, can sound disconnected unless carefully made:

1WM
2UM
3VT
4HT
6TH
7MS
8MD
9ON

One of the most magical sentences for code improvement is:

I PACKED MY BOX WITH FIVE DOZEN LIQUOR JUGS.

It has all the letters of the alphabet with but few repetitions. If you can sit down and bat that off with reasonable accuracy, then you're well "on the way."

I could relate some astounding successes with that sentence in my past teaching. For one thing, it starts a beginner off with a bang. If he can send that sentence, then he can send any sentence. For variation, it can be sent backward with the effect of cipher words when divided into 5-letter groups.

Punctuation

One of the reasons that copying tape press may seem difficult, perhaps, is that some punchers incorporate a liberal amount of punctuation of strange characters into their work, with the result that not everybody can recognize these symbols. While it is true that only eleven punctuation marks are admitted in the International system, there are plenty used on domestic circuits. Maybe I'd better put down everything appearing on this typewriter keyboard, so that none will escape:

PUNCTUATION		CODE	SOUNDS LIKE
	"	.-..-.	AF *together,* not double R
	#	-.-..-	KU *together,* not CA
	$	...-..-	VU *together,* not SX
	%	---...---	
Underline		..--.-	UK *together,* not IQ
	&	.-...	AD *together,* not WI
Apos.	'	.----.	WG *together,* not IE
	(	-.--.-	YA *together,* not double K
Dash	—	-....-	6T *together,* not T4
Double dash	=	-...-	BT *together,* not TV
	:	---...	OS *together,* not MB
	;	-.-.-.	KR *together,* not NC
	/	-..-.	XE *together,* not DN
Space		.-..-	AU *together,* not RA

The space symbol is sometimes used to indicate that a space between characters is desired, as for instance, 45 ½ is not the same, necessarily, as 45½.

Pointers

Summed up briefly are some pertinent points: Try not to rest the butt of your hand in front of the key, and avoid finger-tapping. Rather, use a light but firm grip on the button with the thumb and first two fingers, with an easy wrist motion, straight up and down. Send slowly and strive for accuracy. Be careful of combinations, such as bad spacing and running two letters together so that they resemble one letter. Space well between letters and words. 25 w.p.m. with a key is moving right along, and the same is true of copying that fast, but your writing speed will increase with your normal progress.

Let's get in some A-1 practice; the A-3 can wait!

• • •

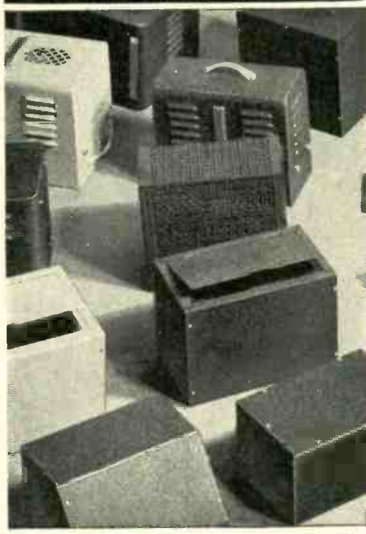
X-ray technique is being used by b.c. station KSTP, St. Paul, Minnesota, to locate internal faults in operating vacuum tubes, as a means of determining when to remove them from service before they fail.

Use BUD CABINETS *for appearance and protection*

STREAMLINE UTILITY CABINETS

A new type of utility cabinet that has a removable bottom plate, allowing under-chassis wiring to be done with the chassis mounted in the cabinet. Chassis is supplied with cabinet.

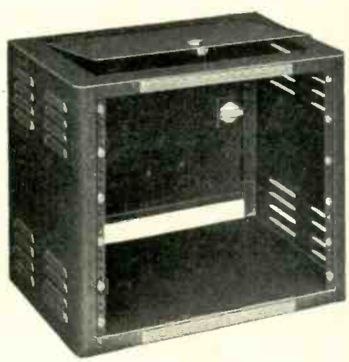
Cat. No.	Size H W D	Net Price
CU-1990	6″ x 5″ x 4″	$1.50
CU-1991	6″ x 6″ x 6″	1.80
CU-1992	6″ x 8″ x 6″	2.10
CU-1993	7″ x 10″ x 7″	2.70
CU-1994	7″ x 12″ x 8″	3.00



SLOPING PANEL CABINETS

Ideally suited for housing test instruments, desk control units and other similar equipment. The entire front panel is removable.

Cat. No.	Size H W D	Net Price
C-1584	6½″ x 7″ x 7¼″	$2.16
C-1585	6½″ x 9″ x 7¼″	2.49
C-1586	6½″ x 11″ x 7¼″	2.82
C-1892	8″ x 13″ x 8½″	3.30
C-1893	10″ x 18″ x 10½″	4.50



STREAMLINE CABINET RACKS

These modern, sturdy Cabinet Racks are made in five sizes to fit a variety of applications. Panel mounting flanges are drilled to fit W. E. and Amateur type panels.

Cat. No.	Panel Space	Net Price
CR-1741	8¾″	$ 8.25
CR-1742	12¼″	9.90
CR-1743	17½″	13.05
CR-1744	26¼″	14.85
CR-1745	35″	16.20

● BUD Metal Cabinets are "tops" in appearance, durability and protection. They give your equipment that handsome, finished appearance that will withstand the most strenuous service.

● You'll like the way BUD Cabinets, Panels and Chassis fit together. You'll like their easy workability and the many "extras" that reflect their careful design and accurate construction. Your jobber will be glad to assist you in making selections to fit your requirements.

Prices subject to change without notice.

SLOPING PANEL AMPLIFIER FOUNDATIONS

These foundations add a real "commercial" appearance to any amplifier. The sloping front on the amplifier chassis provides adequate space and easy visibility for controls and indicators. Finished in two-tone gray and black crackle enamel.

Cat. No.	Chassis Top Area	Net Price
CA-1980	5″ x 10″	$3.24
CA-1981	7″ x 12″	3.75
CA-1982	7″ x 17″	4.35
CA-1983	10″ x 17″	4.89

BUD

BUD RADIO, INC.
CLEVELAND, OHIO

BUD

Police Department

[*Continued from Page 47*]

the reception of rather weak signals possible while still having "quiet" between calls.

A couple of noise silencers and limiters were tried but did not help enough to warrant using them in the set, principally because noises do not bother when the signals are on. A 6H6, 6SF5, and 6SF5 are respectively: second detector a.v.c., Q tube or squelch, and first audio. Any tube having a high mu (100) is satisfactory for the Q circuit and first audio. Too much cannot be said in favor of a good Q circuit; and the one employed in this set has given the best results of any tried.

Output Audio

A single audio tube was chosen in preference to push-pull as one pentode gives all the audio necessary for average use. Provision was made for an external speaker to be used in an office or in another room. It seems almost uncanny at times to hear a car call in and hear the answer coming out the same loudspeaker.

Antennas

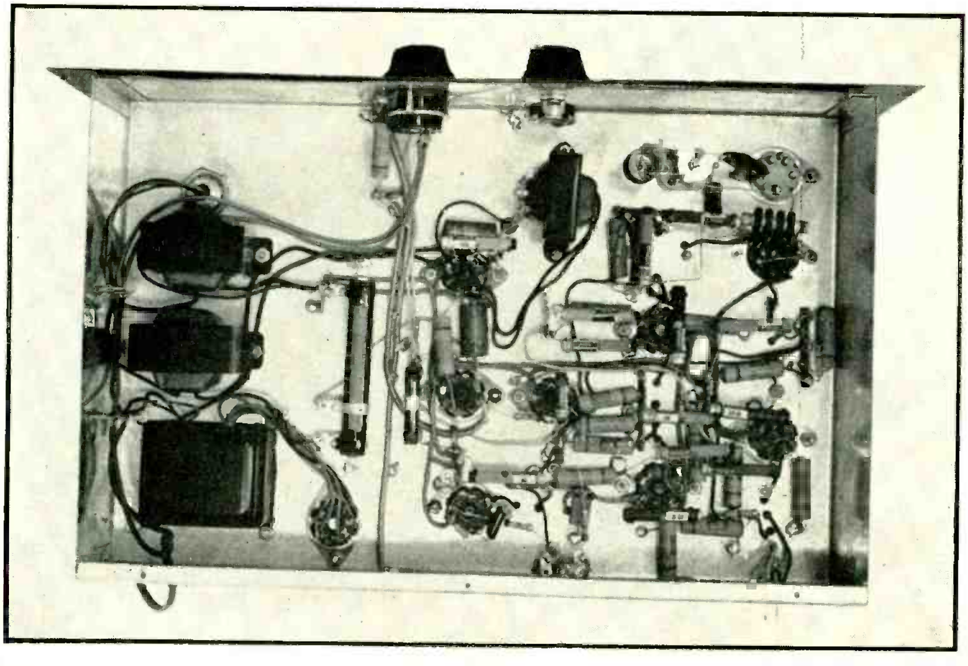
Experimenting with antennas for the high frequency end required some time. But all the general types such as ground-plane vertical, concentric vertical, half-wave vertical, and long-wire vertical were tried. Any antenna with twisted pair or concentric lead-in with the antenna itself up out of the noise and clear of surrounding objects will give satisfactory results. Practically all police cars use vertical transmitting antennas of necessity, so the receiving antenna must also be vertically polarized. If the two antennas are too close together there may be feedback from the mixer stage to the preselector stage, so a wave trap will have to be used as shown in L_1-C_{33}.

Tuning Up

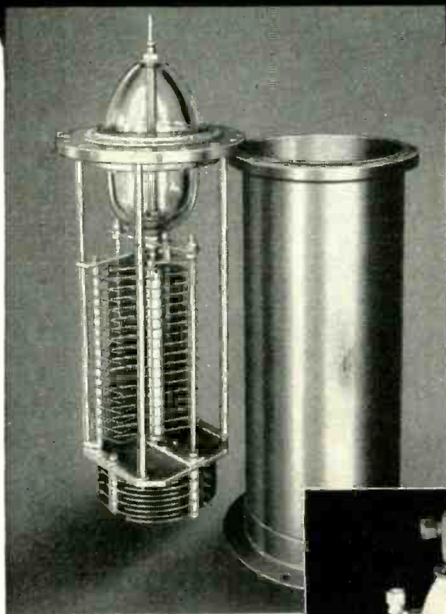
In tuning up this receiver, start with a 2414 kc. oscillator. Tune the i.f.'s to peak, then put an antenna on to this part of the receiver, listening for main station calls. The i.f. coils used are 2000 to 3000 kc. coils so they will take in any police station in the 2300 to 2600 kc. band. The i.f. coils are Meissner coils and are a stock item.

Next, the front end can be tuned simply by

Figure 5. Underchassis view of the completed receiver. Note the position of the tap on the bleeder. This tap controls the squelch action and must be carefully adjusted for best results. From 18 to 25 volts has proven to be best in the sets that have been built up to this time.



GAS FILLED CONDENSERS



Available in any capacity, and RMS voltage ratings of from 15,000 to 40,000. Can be furnished with fixed capacity, variable capacity, or a combination of fixed and variable sections. Other variations include gear housing for right angle drive and insulated shaft coupling.

Efficient DESIGN
Sturdy CONSTRUCTION

Compact design and low price are features of Johnson Gas-Filled Condensers. Dry, oil-pumped nitrogen under pressures up to 350 pounds make possible closer spacing, greater capacity, and higher voltage rating. Gas tight joints prevent leakage over long periods of time. Designed for commercial application, these condensers are being widely used by broadcast stations and other high power transmitters.

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tuning for the most noise with the squelch out of action. Next couple the oscillator to the grid of the 6AC7 with more turns around the grid wire to see where the maximum signal with the least hiss occurs. Considerable experimenting was done along this line. Grid injection gave by far the best results. About two turns of hookup wire around the grid lead was found to be optimum.

Operation

Police calls from cars have been heard from coast to coast on the receiver and from practically every state in the Union during short skip. The antenna used in this instance was a vertical doublet with matching transformer at each end of feed line. Three of these sets have been in operation for more than a year with no service difficulties whatsoever.

• • •

The Set-Builder's Nightmare

With a 6 L 6 and a 12 K 8
And a 6 H 6 to discriminate,
Where can I put a 7 Q 7
(Socket connections on p. 211)?

1 1 7 N 7 — G T
6 J 5 — G T or — G?
Take me back to the grand old day—
When we built our rigs 'round a '01-A.

—*The Man in 222.*

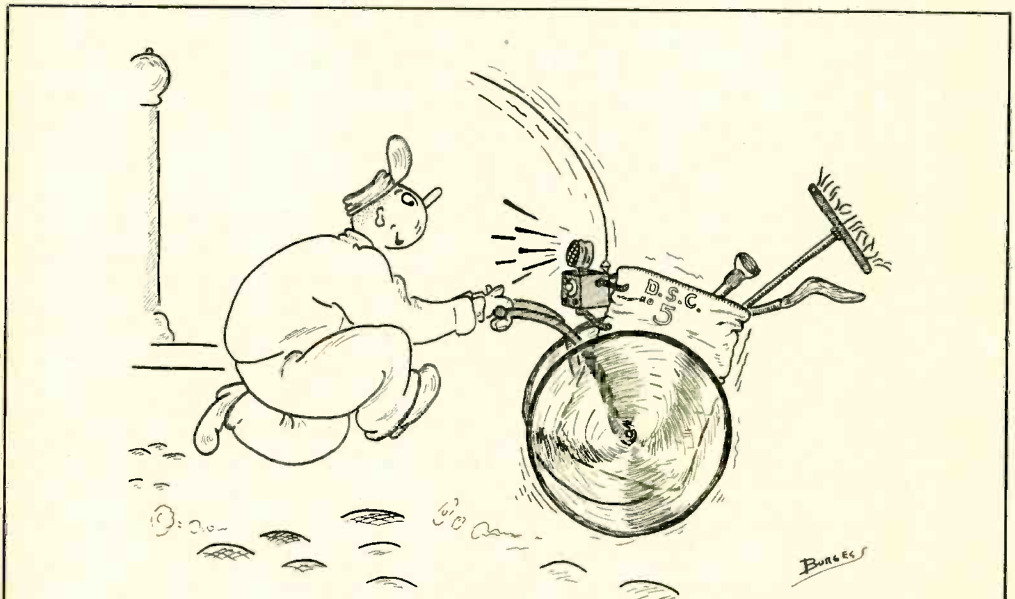
Triode Connected 6V6's and 6L6's

In spite of the fact that the 6L6 is rated at 19 watts plate dissipation and 2.5 watts screen dissipation as a tetrode, the combined "plate" dissipation for triode operation (plate and screen tied together) is only 10 watts "max." The latter figure would appear to be low, but it seems the manufacturer should know how much the tube will stand. If any of our readers have had experience with running 6L6's as triodes at high plate dissipation (say 20 watts) over a considerable period of time, we would appreciate hearing the results so that we might pass the information along.

The Australian 6V6-G "Radiotron," which is exactly the same as our 6V6-G except for being called a valve instead of a tube, is rated at 12.5 watts dissipation when used as a triode, or approximately the same as for tetrode use. This would lead one to suspect that a triode connected 6L6 will stand more than 10 watts dissipation with safety.

The amplification factor of a triode connected 6L6 is 8, while that of a triode connected 6V6 is (according to the Australians) 9.6.

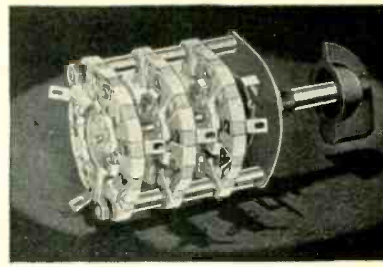
And while on the subject of 6L6's, it might be in order to point out that for the last year or so these tubes have been provided with improved insulation, which enables them to withstand higher peak voltages.



"Unit number five . . . 15 East 14th . . . a pickup . . . that is all."

Centralab

The Quality Line



SELECTOR SWITCH

Available in an almost infinite variety of combinations . . . in bakelite or steatite . . . in single or multiple gang . . . from two to eleven positions on any one switch . . . also available for use in amateur transmitters.

Hams, Servicemen, Experimenters and Manufacturers appreciate the utter dependability of Centralab products. Since 1922 more than a hundred million radio parts bespeak the universal acceptance accorded Centralab products. Send for catalog if your jobber cannot supply you.

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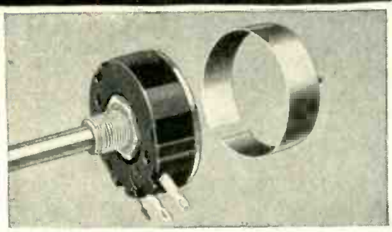
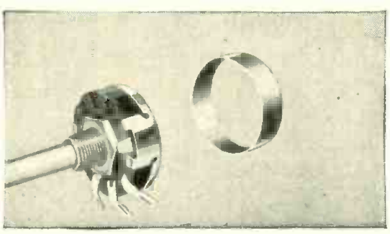


STANDARD RADIOHM

Wall type resistor. Exclusive non-rubbing contact band. 1⅜" diameter x 9/16" deep. Available single, twin or triple, plain or tapped . . . with S.P.S.T., D.P.S.T. or S.P.D.T.

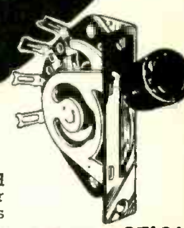


MIDGET RADIOHM

Companion to "standard" . . . small size but large control efficiency. Available single, dual or triple . . . plain or one, two or three taps . . . with S.P.S.T., S.P.D.T., or D.P.S.T. Moulded bakelite case, 1⅛" diameter, ¼" metal shaft 3⅜" long.

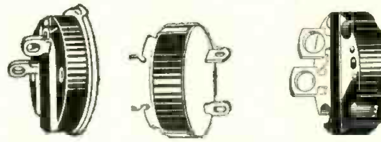
WIRE WOUND RADIOHMS

In values from 2 to 10,000 ohms . . . insulated construction . . . 3 watts . . . universal shaft for all replacements . . . regular Radiohm switch covers may be attached . . . in linear curve only . . .



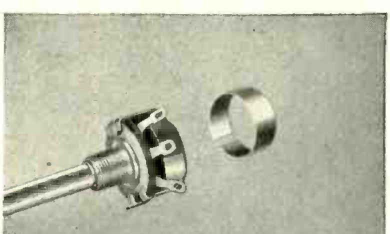
LEVER ACTION SWITCH

Used singly or in groups . . . for broadcasting, receiving, public address, test instruments and industrial uses. Available in any one of ten different combinations including positive and spring return action.



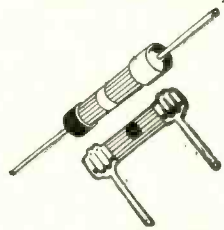
ATTACHABLE SWITCH COVERS

For standard and wirewound resistors (Radiohms) as well as Midget and Elf Radiohms . . . S.P.S.T. . . . S.P.D.T. . . . D.P.S.T . . . four point . . . S.P.D.T. (operates at clockwise position) and S.P.S.T. with Dummy Lug.



ELF RADIOHM

Smaller but also features the long, straight resistor strip. Available plain or tapped with S.P.S.T. switch . . . with or without dummy lug. Bakelite case 57/64" diameter, 17/32" deep (less switch) 25/32" deep with switch.

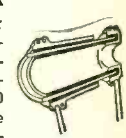


AXIAL LEAD RESISTORS

Body is insulated by inert ceramic jacket . . . proof against vibration and humidity . . . will withstand five times rated load without permanent change. In two sizes . . . RMA coded . . . ½ watt at ⅛" x ⅝" and 1 watt at ¼" x 1" . . . Also supplied in conventional RADIAL LEAD Style . . . ½ watt — 1 watt or 2 watt.

CERAMIC TRIMMER CONDENSER

where greater stability than ordinary types is required. Supplied with neg. temp. coefficient of .006 MMF/MMF/C°. With or without mounting brackets.



CERAMIC CAPACITOR

Small "special purpose" for h.f. circuits where temperature compensation, low power factor, or absolute permanence are important. 1000 V.D.C. leakage resistance more than 10,000 meg. Power factor less than 1%.

SEND FOR CATALOG NO. 23

Would You Pass?

[*Continued from Page 39*]

Then there is the matter of being so familiar with a subject that one becomes careless—which is why good men have died in the past from failing to cut off the power supply before fixing a plate lead in the transmitter. Arithmetic is a good example of this, as witness the following actual answer: "R=E/I=6/0.25=28,000 ohms." Something surely went wrong somewhere. Ohm's Law, however, is a constant source of howlers, as the following: "The current in volts equals the power in cycles divided by the resistance in watts." "By Ohm's Law we can find the inductance in henries if we have the capacity and the impedance." May the good professor's bones lie in peace.

Possibly the next consideration is the type of answer required. To determine this, study the question. All too often the little words "in detail" are completely ignored, as was done when a candidate stated: "A tube detects because signals from the secondary coil go to the grid condenser, which helps them, and they then appear as a pulsating current in the plate circuit and are heard in the phones."

Brevity may be the soul of wit but an examination is not an appropriate place for witticisms. An excellent example of how not to be brief is the following gem: "To change the frequency of a type . . . transmitter, I would move the switch from A to B." It would, obviously, be unfair to such exponents of brevity not to mention the candidate who, in answering the question, "Describe a lead-plate type storage battery and state the care necessary for its maintenance," wrote steadily for four hours. This is a mark you might try for next time you have to be towed in to a garage because your car battery is dead.

If a question is not quite clear, try telling the examiner what point is obscure to you. If he is permitted to do so, he may re-word the question (particularly in oral examinations) or give you other advice within the permissible limits. Possibly, to give the benefit of the doubt, the candidate did not clearly understand the question when he said, "Capacitive reactance is the same as resistance; inductive reactance is another name for the same thing; we have to call it by some name so we call it that."

After answering a question in a written test, check your answer carefully—particularly in answering the objective type questions where, although knowing the correct answer, an "X" may be inadvertently placed in the wrong space or the wrong number may be placed in the proper place.

A slip of the pen can lose marks as easily for you as for the candidate who wrote, in describing a certain type of receiver, "The primary of the a.f. transformer is connected to the goniometer." Quite obviously, "galvanometer" was intended, but we all know which road is paved with good intentions.

And, finally, because we all make errors at times, it is good to think that perhaps our technical mistakes may not be as bad as the following howlers:

"The grid of a detector tube becomes negative due to the decreasing resistance of the secondary coil as the tuning condenser is turned from maximum to minimum."

"The purpose of the r.f. choke coils is to adjust the frequency."

"A transmitter will emit a continuous wave if the power supply is continuous."

"'Direct reception,' in direction finding, is when the coast station takes a bearing of the ship, and when a ship takes a bearing of a coast station it is called 'indirect reception.'"

Example of how to take a bearing: "Half of 350 plus 20 is 180 so that is the reciprocal and the ship is not there."

"After 1/5 second the relay contact closes and nothing happens."

"The auto alarm signal is used, when the main transmitter is out of order, to determine another ship's position when foggy."

"If a circuit has any reactance it will cause an ammeter to flicker."

"A rectifier tube with two plates is a half-wave rectifier because it rectifies half a cycle at a time."

"One cannot have more than 110 volts in a receiver because that is all the power company supplies."

And, for the benefit of commercial operators and other traffic handlers:

"When a message is incorrectly received due to poor signals, the word 'amplitude' must be placed in the preamble."

"If a reply-paid message is received by a station it should give a receipt to the addressee."

"The position of a ship is given in degrees and minutes, the latter in Greenwich Mean Time."

"The word 'radio' is not used in the preamble because its use would only confuse the operator."

But, what could be more apt than the simple and pointed statement that: "When an operator is in distress he should stop work immediately!"

• • •

WEKC is the yacht *Electron*.

Ten to Two-and-One-Half

[*Continued from Page 38*]

receiving signals (either a.m. or f.m.) not having pre-emphasis.

Instead a filter with a 50 microsecond time constant is employed. This results in a characteristic which is satisfactory for either a.m. or f.m., either pre-emphasized or not pre-emphasized.

Condenser C36 also acts to reduce high frequency noise, but is small enough in value so as not to have a detrimental effect upon the intelligibility of voice signals which are not pre-emphasized.

The r.f. gain control in the cathode of the first i.f. stage ordinarily is run wide open for a.m. reception, volume being controlled by the a.f. gain control. However, on loud local signals, the r.f. gain is backed off to prevent blocking of the second detector and first audio stage. When the receiver is used for f.m., the r.f. gain always is run wide open.

The plug-in coils are home built from strips of Quartz Q and baby size plugs and jacks, the coils being self-supporting (air wound). Commercial type forms and sockets may be used if desired but the home built type were preferable in this case as short direct leads were easier to obtain with these coils. Constructional details are shown in figure 2. In wiring the oscillator circuit it was found that shorter leads and a better balanced circuit could be obtained by mounting the oscillator tube upside down, the tube extending below the chassis instead of above.

Results

Results with this receiver have been very gratifying on all bands. On the 112 Mc. band signals from W6QLZ, Phoenix, Arizona, have been received here R9 on peaks, a distance of a little over 100 miles. 56 Mc. signals from the same location are also R9, being received quite consistently, and this from a location that is not favorable for ground wave work. We feel that with better equipment and high gain beam antennas the ultra highs can be brought up to compare favorably if not better than the lower frequencies, especially for extended ground wave work. For the fellow interested in the ultra highs and f.m. reception this receiver should prove to be an interesting and valuable piece of equipment to add to his station or short wave listening post.

• • •

Broadcaster Korn is located in the Corn Belt.

Great Circle Calculations

[*Continued from Page 21*]

This angle is measured clockwise from the North Pole and is east of north.

78° 52′ 32″
66° 37′ 52″

12° 14′ 40″ Difference or error.

Trigonometry measures angles counterclockwise while navigation uses clockwise. The quadrants for trigonometry are shown in figure 1. Orienting the base line to the vertical from the North Pole gives figure 2. If the proper signs had been observed, the above case would be in the IV quadrant and the angle would be the supplement or 293° 22′ 08″ as shown in figure 3.

Figure 1.

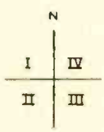


Figure 2.

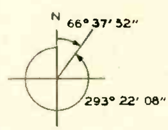


Figure 3.

By assigning the proper letters to the two points, simplification is possible and angles less than 180° measured either counterclockwise or clockwise from North will determine the direction. The two possible cases are shown in figures 4 and 5.

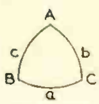


Figure 4.

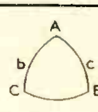


Figure 5.

For instance, if the longitude of C is east of B, then figure 4 is used, and figure 5 when C is west of B. In the above case, figure 4 applies and B is San Francisco and C is Boston.

Great accuracy is usually not required, since most beam antennas are relatively broad. The use of the slide rule is more satisfactory. In this case, the natural trigonometric function instead of the logarithm of the function is used. The calculation of the same problem by this method is as follows:

Tan 42° 21′	0.9115
Cos 37° 49′	0.7900
Product (1)	0.719
Sin 37° 49′	0.6131
Cos 51° 26′	0.6234
Product (2)	0.382
(1)-(2)	0.337
Sin 51° 26′	0.7819
Cot B	0.431
B	66° 41′

This is a reasonably close check by the logarithm method. It is good enough for most amateur purposes and reduces the use of the tables by three steps.

It is of interest to determine the direction of San Francisco from Boston. Now B is Boston and C is San Francisco from figure 5. The calculation is as follows:

Tan 37° 49′	0.7761
Cos 42° 21′	0.7390
Product (1)	0.573
Sin 42° 21′	0.6737
Cos 51° 26′	0.6234
Product (2)	0.418
(1)-(2)	0.155
Sin 51° 26′	0.7819
Cot B	0.198
B	78° 48′

This is measured counterclockwise from North and is west. The value of the angle is the same as the solution given in the earlier article for the bearing of Boston from San Francisco. The bearing in the clockwise direction is 360°-78° 48′ or 281° 12′.

The example of the direction of Miami from Chicago is also in error. The correct solution is as follows: Figure 4 is used where B is Chicago and C is Miami.

Tan 25° 46′	0.4827
Cos 41° 53′	0.7445
Product (1)	0.361
Sin 41° 53′	0.6676
Cos 7° 29′	0.9915
Product (2)	0.661
(1)-(2)	-0.300
Sin 7° 29′	0.1302
Cot B	-2.30
Cot (180°-B)	2.30
180°-B	23° 30′
B	156° 30′

Clockwise from north and also the bearing. The previously shown angle of 160° 58′ is 4° 18′ in error.

Similarly, the direction of Chicago from Miami is as follows: Using figure 5 where B is Miami and C is Chicago.

Tan 41° 53′	0.8952
Cos 25° 46′	0.9001
Product (1)	0.807
Sin 25° 46′	0.4358
Cos 7° 29′	0.9914
Product (2)	0.431
(1)-(2)	0.376
Sin 7° 29′	0.1305
Cot B	2.88

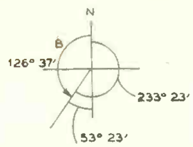


Figure 6.

B	19° 09′ West of North
	349° 51′ Bearing.

The angle 180°-160° 55′=19° 05′ is in agreement but because of the reversal in latitudes, the wrong direction was indicated.

The third example of the direction of New Orleans from Boston is also incorrect. The solution should be: Using figure 5 where B is Boston and C is New Orleans (figure 6).

Tan 29° 0′	0.5543
Cos 42° 21′	0.7390
Product (1)	0.409
Sin 42° 21′	0.6737
Cos 18° 07′	0.9504
Product (2)	0.640
(1)-(2)	-0.231
Sin 18° 07′	0.3110
Cot B	-0.743
Cot (180°-B)	0.743

180°-B		53° 23′
B		126° 37′
53° 23′		42° 45′
180°		180°
233° 23′	Bearing vs.	222° 45′
222° 45′		
9° 38′	Difference or error.	

The direction of Boston from New Orleans using figure 4 where B is New Orleans and C is Boston is as follows:

Tan 42° 21′	0.9115
Cos 29° 0′	0.8746
Product (1)	0.795
Sin 29° 0′	0.4848
Cos 18° 07′	0.9504
Product (2)	0.458
(1)-(2)	0.337
Sin 18° 07′	0.3110
Cot B	1.090
B	42° 41′ East of North and also bearing.

Note again the angle 42° but the reversal in direction.

There are several other methods that may be used to obtain directions without the necessity of determining the distance between the two points. One of these is known as the tan ½ angle formula and is as follows:

$$\text{Tan}\ \frac{(B-C)}{2} = \frac{\text{Sin}\ \frac{1}{2}(b-c)\ \text{Cot}\ \frac{1}{2}A}{\text{Sin}\ \frac{1}{2}(b+c)}$$

$$\text{Tan}\ \frac{(B+C)}{2} = \frac{\text{Sin}\ \frac{1}{2}(b+c)\ \text{Cot}\ \frac{1}{2}A}{\text{Sin}\ \frac{1}{2}(b+c)}$$

Another case was chosen to compare methods. This required the direction of Portland, Oregon, from New York City. The conditions are:

	Latitude	Longitude
New York City	40° 48′ 35″N	45° 31′ 00″W
Portland, Ore.	73° 57′ 43″N	122° 40′ 39″W

Using the earlier published method, the angle is 29° 02′ or a bearing of 330° 58′. The direction by my method is 65° 40′ W of N or a bearing of 294° 20′. The tan ½ angle method gives 65° 41′. The nautical navigator usually uses the haversine method.

Those interested in obtaining the latitude and longitude of other cities in the United States and the world can refer to the World Almanac of 1941, pp. 176-177. This book is published by the *World-Telegram* of New York City.

Temperature Characteristics of Capacitor Impregnating Oils

Since capacitors employed for transmitting and associated equipment are often subjected to extremely wide ranges of temperatures—from 40° below zero F. (-40° C.) to temperatures in the vicinity of 180° F. (82° C.), it is important that the user of such equipment be cognizant of the characteristics of the impregnating materials and the capacitors in that temperature range.

There are at present for standard commercial usage, three types of impregnating material. These are mineral oils, the Hyvol oil used by Aerovox, and certain synthetic oils. Of these, mineral oil has the best temperature characteristics—the smallest temperature variation of capacity with the highest insulation resistance and the lowest power factor. However, because of its low dielectric constant, capacitors impregnated with mineral oil are much bulkier and correspondingly more costly than capacitors using the other two oils, and therefore such dielectric oil is seldom used except where extreme constancy of capacity is essential.

The synthetic oils, such as chlorinated hydro-carbons, all exhibit the same temperature characteristics. That is, they show a very sharp drop in capacity in the vicinity of 32° F. (0° C.) and, at temperatures of -40° F. (-40° C.) show an average capacity decrease of 25% or greater from the capacity at room temperature. The same is true at elevated temperatures in the vicinity of 180° F. (82° C.) at which the synthetic oil capacitors will show a capacity decrease of 2 to 5%.

Hyvol capacitors, on the other hand, are considerably more stable with temperature variations, and show no drop in capacity until temperatures of -20° F. (-29° C.) are reached. At -40° F. (-40° C.) the maximum capacity drop that can be expected is of the order of 5 to 10%.

The insulation resistance of both the synthetic oil and Hyvol exhibits the same decrease with an increase in temperature.

The power factor of Hyvol and synthetic oils is of the same magnitude at normal temperatures.

NEW BOOKS *and catalogs*

Hallicrafters Catalog for 1942

Amateur and commercial radio men, short-wave listeners and boat owners will find particular interest in the fresh-from-the-press 1942 catalog of Hallicrafters receiving, transmitting and radiophone equipment.

Included among the nine communications receivers described and illustrated are models in every price range to meet the varied requirements of amateur and commercial operations as well as those of the broadcast listener who desires effective, direct short-wave reception of foreign war news. Further, all but one model includes provision for operation from either batteries or a car battery and vibrapack, in addition to its normal line operation. This independence of line power is particularly important in emergency communications facilities now being developed as a vital part of the civilian defense program.

Three amateur transmitters described have outputs of 25, 100 and 450 watts and provide both phone and c.w. operation. All include bandswitching of exciter circuits and operate on desired bands from 10 to 160 meters, while one also includes 5-meter operation. Each is completely self-contained except that the 450-watt model has the speech amplifier and remote control equipment in a separate table-mounting cabinet for maximum operating convenience.

[*Continued on Page 88*]

The Amateur Newcomer

[*Continued from Page 59*]

shield of the type designed for use with the older "G" type glass tubes. The shorter height of the "GT" tube allows room for the grid leak and condenser inside the tube shield.

If the grid lead does not come out the top of the i.f. transformer, it should be changed when the tickler is being added. (Some i.f. transformers come with the grid lead out the bottom, some out the top; but all have a hole in the top of the shield can to accommodate a grid lead.) If the transformer is of the diode load type, the grid lead is the one marked for connection to the diode.

The grid wire between the i.f. transformer and the shielded leak-condenser is not subject to hum pickup, being effectively grounded so far as a.f. is concerned, but nevertheless is shielded for another reason. When the 6J7-GT is used as an oscillating autodyne detector, it generate harmonics of 1600 kc., which might be picked up as steady c.w. carriers. Shielding this lead effectively minimizes the radiation, and the only harmonic loud enough to amount to anything is the one falling on 3200 kc. (the second harmonic).

The A.F. Stage and Power Supply

The a.f. system consists of a 6V6-GT tetrode, which always runs "wide open." Satisfactory control of volume is had by adjustment of the resonating condenser C_3 and the regeneration potentiometer R_7. The 6V6-GT has noticeably better power sensitivity than a pentode such as a 6F6 or 6K6, and is considerably less expensive than a metal 6V6.

The homemade plywood housing for the loudspeaker also contains the power supply. This keeps the heat away from the receiver components, minimizing drift. Also, it permits a smaller, less expensive chassis, panel, and cabinet to be used for the receiver proper.

No filter choke is used in the power supply, sufficiently good filtering being obtained with the resistor R and the speaker field serving as the series elements of the two-section filter. This keeps down the cost of the power supply.

A speaker with either a 1000-ohm field or a 1500-ohm field may be used. The size of the resistor R in figure 2 should be such that the plate voltage at the set is close to 275 volts measured to chassis. With the transformer, rectifier, and input condenser specified, this will call for about 1000 ohms when the speaker field is 1500 ohms, or about 1500 ohms when the speaker field is 1000 ohms.

If the voice coil is of at least 4 ohms impedance (and most are), then sufficient earphone volume is obtained simply by inserting the 'phones in series with one of the voice coil leads. This automatically mutes the speaker, as virtually all of the a.f. voltage is applied across the high impedance of the earphones rather than the few ohms of the voice coil. This provides a very simple method for accommodating 'phones, and no d.c. appears on the 'phones to subject the operator to possible shock.

Construction

The receiver proper is constructed on a 7½″ x 9″ x 1½″ open-ended chassis 7″ x 10″ metal front panel. The placement of the various parts is shown clearly in the accompanying illustrations. Power and speaker connections are made to a 5-prong socket on the rear drop of the chassis. A three-terminal strip on the rear drop takes care of the antenna connections, one terminal being grounded to the chassis.

The two coils are kept as far apart as possible, and to minimize electrostatic coupling between the oscillator and the antenna input circuit, a 4½″ square shield baffle is placed as shown in the top view illustration. This baffle is bolted to the main tuning condenser (Which is mounted on its side, supported by the front panel) and, by means of a spade bolt at the rear bottom, to the chassis.

Data for the small "peaking coil" is given in the coil table. It is mounted so as to keep the capacity of the coil and leads to chassis at a minimum. A piece of dowel considerably longer than the winding length is used so that the presence of the wood screw which fastens the coil to the mounting bracket won't alter the inductance appreciably.

The main tuning dial should be the best vernier dial that the constructor can afford, as no receiver is a joy to operate when it is handicapped with a poor dial. The bandset knob is furnished with a calibrated scale to facilitate logging, and the resonating knob is furnished with a scale simply for the sake of symmetry and eye appeal. The scale costs but a few cents, and it is an inexpensive way to doll up the set.

The speaker and power supply box is constructed of ¼″ plywood, fastened together with brads and glue. It is made the same size as the receiver cabinet, so as to match when placed adjacent to it. On the front of the box are the 'phone jack, pilot jewel, and on-off switch. The phone jack may be omitted if earphone operation is not desired. The speaker is of the inexpensive 5″ "replacement type."

Operation

All that is necessary to put the set into operation is to hook it to an antenna and peak up the i.f. transformer. The trimmer on the grid coil of the i.f.t. fixes the frequency, which should be set on a "clear" channel near 1600 kc. Adjustment of the primary (plate) trimmer will have little effect upon the freqeuncy, and it simply is resonated for maximum signal strength. Slightly greater regeneration will be required for oscillation when the primary trimmer is adjusted for maximum signal. In fact, this serves as one method of peaking up the plate winding: the regeneration is adjusted so that when the primary trimmer is turned through resonance, the "dead spot" or non-oscillation is very sharp. The trimmer then is adjusted to the center of the dead spot and left alone. The primary trimmer always should be peaked with the detector just on the verge of oscillation.

The receiver will be most sensitive when a resonant antenna is used, but it will work satisfactorily on any antenna more than 20 or 25 feet long. If a two wire feed line is used, connections should be made to the two "A" posts, the "G" post being left vacant or connected to a waterpipe ground. For use with a single wire Marconi antenna, the antenna is connected to one of the "A" posts and the other "A" post is jumpered to the "G" terminal.

Television Leads To Reduction of Reflections From Glass

Research in television in RCA Laboratories has led to a new chemical process to reduce extraneous reflections from glass. It now becomes possible virtually to eliminate the streaks that glare across show windows, framed pictures, ground-glass screens on cameras, and other glass surfaces or panels. For example, the glass faces of electric meters and the multiplicity of dials that confront airmen now can be made reflection-proof, minimizing chance of error in reading.

Dr. F. H. Nicoll, research scientist in the laboratories, developed the new formula. His process is based upon the exposure of the glass surface to hydrofluoric acid vapor. The vapor etches away a small amount of surface, leaving a thin, transparent film of calcium fluoride measuring in thickness approximately one-quarter wavelength of light. This film is purple, indicating that yellow and green, to which the human eye is quite sensitive, are not being reflected. Exhaustive tests show that the film withstands hard rubbing, that it can be washed with water, alcohol, and a number of other solutions, and can be subjected to relatively high temperatures without impairment.

New Books and Catalogues

[*Continued from Page 85*]

The marine radiophones range from a low-power, 3-channel model for harbor craft to a 50-watt ocean-going model which provides 5 transmitting and 6 receiving channels, all crystal controlled. Receiving channels are switch selected, as are the transmitting channels in all except the low-power model, which includes a manually tuned receiver. A 110-18,000 kc. marine receiver and a compact radio compass round out the line of marine equipment.

Copies of the new catalog are available from radio dealers everywhere, or from the Hallicrafters Co., 2611 Indiana Ave., Chicago, Ill.

New Thordarson Book for Servicemen

Transformer replacements for over 4,000 receivers are given in Thordarson's new edition of the Replacement Encyclopedia, No. 352-F, available free to servicemen. Receiver types have been carefully arranged to enable quick and accurate selection of power transformer, filter choke, audio or output transformer. A special feature of the book is the addition of electrical and physical characteristics of recommended replacement types listed in the book. A copy may be obtained from any distributor or directly from the Thordarson Electric Manufacturing Co., 500 W. Huron Street, Chicago, Ill.

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Band Shrinkage

The recent F.C.C. orders taking away certain portions of the amateur bands have been accepted in almost 100 per cent good graces by the amateur fraternity. As always, there were a few to grouse and gripe—at the F.C.C., at the A.R.R.L., and at their fellow hams who did not write scathing notes to their congressmen.

This minority is always with us. They'd gripe if they had fried chicken every day. They'd want turkey. The majority, though, realize that the pilot training program is far more important than rag-chewing right now. Until the end of the emergency, we can get along quite well on the restricted frequencies.

We're not howling for scalps, nor for blood. But we think there's a real lesson for every ham. If the Commission decides national defense needs more of the amateur frequencies, they're going to take more. Don't worry about that. But we can determine a little bit how much they'll take. If we don't use the bands, they'll take more than they would if we were using them.

How about a symbol—like Britain's "V" campaign—only this one wouldn't be underground. We'll leave it up to you what you want to call it. Our suggestion is just: "Let's Get on the Air!"

U.H.F.

[*Continued from Page 54*]

W9YKX is also thinking of using some 9001's in a 1¼ meter converter with which he hopes to work W9FZN TTL.

Vince, W9ZJB-W3JSL, had a lesson in smeared-up bands when he operated W2AMJ on 2½ just before the Horsetraders' shindig. There has been no campaign to speak of to clean up the band, but there may be places where a little of it would help.

W6OVK gave us some figures last month on his 2½ meter W6QLZ beam. He says that the feeder had to be fanned out to 17 inches instead of 13 inches when the antenna was raised to 35 feet. This improved reception considerably. Jim has rebuilt his converter-superregen combination which now uses 9003 r.f., 1232 mixer, 6C5 oscillator, 6SK7 as a 20 megacycle i.f. amplifier, followed by a 7A4 superregen detector and some audio. It runs into quite a display of different types of tubes; for instance, the 6C5 is not a preferred type and can be replaced with a 6J5, which is electrically like the 7A4.

Wandering Willie

Give a prayer for the ham with the e.c.o.,
Who wanders all over the band—
Looking hither and yon for a hole in the mess—
A place for his signals to land!

He whistles "hello" when he comes to your station;
As he passes, he whistles again,
Then continues his search for what he won't find
On eighty, or forty, or ten.

So he shifts down to five, then to two-and-a-half;
Next to twenty—and gives that a try,
This wandering one with the e.c.o.,
Who whistles as he goes by.

He then winds some coils and moves to one-sixty—
Chirps merrily over THAT band;
As he twists the knob on his e.c.o.,
With a steady, unshakeable hand.

And so he continues his hunt for what ain't:
A hole through which signals will go—
Whistling merrily all of the time—
This nut with the e.c.o.

Past, Present and Prophetic

[*Continued from Page 6*]

detector with the loosest antenna coupling which will permit good sensitivity, and at the lowest plate voltage which permits oscillation, the radiation can be cut down about 4 or 5 "R" points.

Base Remark

Many years ago, RADIO ran along the edge of its cover each month all the commonly used tube base connections. In time, the number of tubes became so numerous that the practice had to be discontinued.

Amateurs still comment on how handy it was for them when wiring a piece of equipment: all they had to do was grab for the closest issue of RADIO and there were the base connections right smack on the cover.

So that our readers can construct something from the magazine without the annoyance of having to refer to a book for the base connections, we are inaugurating the practice of running the base connections of all tubes used in a circuit *right below the diagram.*

Numbering the leads on the diagram symbol used in the diagram proper seems to make the diagram a bit "messy" and also makes it more difficult to picture the "working" of the circuit at a glance. Hence, the base connections will be shown separately. But you won't even have to turn the page.

Very "Hush Hush"

In spite of the fact that we have explained it all before, we still get requests to run microwave circuits, and inquiries as to why no such data appears in the magazine.

Basic microwave dope, reflecting the stage of the art two or three years ago, can be found in various books. There would be no reason for our running this material. And because microwave apparatus has come to have such great military importance, we don't dare run any new dope.

But great strides are being made. Just wait till the war is over!

Better Late Than Etc.

We are sorry that the new 1942 Handbook wasn't on sale as soon as it was supposed to be. But we got caught with our pan . . . excuse please, we mean our *paper* down. When it came time to put the book on the press, advance orders were found to be double those of last year. This meant increasing the "run," and because of the present paper shortage, the paper was not immediately available.

All we can say is, with as much modesty as we can muster but with pardonable pride, that it was worth waiting for.

Blown Condenser?

If the headlines depress you and you feel the need for a good belly laugh, turn to page 94 and read the story of poor McPoostoe the Cat, who was lucky or unlucky enough to be born with QRO.

Portable Emergency Equipment

[*Continued from Page 12*]

10 to 160 meters simply by changing the crystal and the one coil used in the final amplifier.

The top and bottom of the transmitter are removable to change the tubes, crystal, and coil. The circuit diagram and a list of the components are mounted on the inside of the bottom plate under a piece of acetate for protection. Likewise the circuit diagram and component list for the larger transmitter unit is mounted on the inside of the top lid.

Anyone who builds one of these small units will most certainly be well repaid, in satisfaction and operating efficiency, for his efforts.

A Self-Contained Battery Powered 2.5 Meter Transceiver

[*Continued from Page 29*]

will be thrown out of superregeneration. A 0-10 or 0-25 d.c. milliammeter temporarily connected on the B plus lead also can be used as an indicator. In this case the switch S_2 should be thrown to 'transmit." The tube will draw 5 or 6 ma. and dip slightly when a nodal point is reached.

The Lecher wires should be coupled to the tank circuit by means of a single turn loop of insulated wire pushed down between the center turns of the coil.

The antenna coupling is varied by adjusting the distance between the movable and the stationary plate of C_6. Closer spacing provides tighter coupling. The coupling should be increased to as much as will still permit superregeneration over the entire band, and then left alone. Ordinarily this adjustment will be about the same as the position assumed by the movable plate when the adjusting screw is removed. When the coupling is increased until a "dead spot" appears, it should occur near the center of the band (114 Mc.). If it occurs at a different frequency, the antenna length should be altered accordingly.

It will be observed that on receiving some signals, better intelligibility is obtained when the transceiver is retuned very slightly from the transmit position. If this is done, be sure to return the dial to the original scale setting when the switch is turned to "transmit"; otherwise you and the station you are working will "chase each other across the band." In most cases the intelligibility will be sufficiently good with the dial left at one position for both receive and transmit.

A Substitute for Safety Bias

[*Continued from Page 14*]

sideration for powers up to 1 kilowatt; either a 6V6-GT or 6L6 will stand any bias or screen voltage that will be encountered at plate inputs not in excess of a kilowatt.

This calculation will determine the smallest ballast tube that can be used without danger to the ballast tube. However, it will not indicate whether or not the ballast tube will lower the r.f. amplifier screen voltage sufficiently to limit the r.f. amplifier plate current to a safe value in the absence of excitation. This can be determined as follows:

Assume that each 6V6-GT is a 3000-ohm resistor, each 6L6 a 2000-ohm resistor. Actually the static resistance at zero bias varies somewhat with plate voltage. However, these values will give results sufficiently accurate for the purpose of determining approximately how much the screen voltage will be "pulled down" by the ballast tube or tubes.

Now assume that this amount of resistance is connected from screen to ground. Without regard for the screen current, calculate the voltage at the screen. Actually the screen current, even though reduced by the reduction in screen voltage, will cause a further reduction in screen voltage. But this current will be small in proportion to the ballast current, and therefore may be ignored.

After calculating the "resting" screen voltage from the supply voltage, the resistance of the screen resistor, and the resistance represented by the proposed ballast tube, then look up the curves for the r.f. amplifier tube being used and see whether, at zero bias, the tube will draw excessive plate current at this value of screen voltage. If not, the proposed ballast tube may be used. If the screen voltage is still too high for zero bias operation, then a lower resistance ballast should be substituted.

Ordinarily all this calculation is not necessary. For commonly used screen grid power tubes run at normal plate voltage, the accompanying table may be consulted for ballast tube requirements. The ballast complement specified in each case is conservative.

Should the r.f. amplifier be subject to self-oscillation, either at the fundamental frequency or at a parasitic frequency, bias will be developed by the grid leak, and the ballast tube may be made non-operative. However, the tube still would self-oscillate if cathode bias were used or if fixed bias not greatly exceeding cut-off were used. The only way to suppress the self-oscillation in the absence of external excitation is to use fixed bias equal to several times cut-off, which calls for a bias pack.

But a little thought will show that this method of suppressing self-oscillation is poor practice anyhow. Therefore, the fact that the ballast tube does not operate when self-oscillation is present may be considered as a blessing in disguise, because it makes a handy indicator of parasitic oscillations when no grid meter is employed. If the oscillation is strong enough to develop enough bias to operate the ballast tube, then the amplifier is in need of cleaning up.

If the screen dropping resistor was conservatively chosen with regard to wattage rating, no change in the transmitter is required when the ballast circuit is added. However, if the screen resistor already is running right at maximum wattage rating, then a heavier one should be substituted. When the ballast tube is operating, the dissipation in the screen resistor is increased somewhat over the normal dissipation resulting from screen current only.

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"Maybe we'd better take it along as a spare."

Push-Pull Amplifier

[*Continued from Page 20*]

Variable link coils have been used in both the grid and plate circuits. The reason for the variable link coils for output coupling is obvious, but the variable-link grid coil is equally important. A variable-link grid coil is required so that an accurate adjustment of the excitation may be made. Too much grid excitation causes a more rapid decrease in power output than too little excitation. It seems that excessive excitation increases the screen current to the tubes. Since the screen voltage is fed through a dropping resistor, the increased screen current causes lowered screen voltage. Then, naturally, the lowered screen voltage cuts down the output of the amplifier. Hence, the use of a variable-link grid coil so that the excitation to the tubes may be accurately controlled to give 8 to 9 ma. grid current.

Adjusting the Superregenerative Receiver

[*Continued from Page 31*]

is resistance coupled to the audio stage, using a 50,000-ohm plate load R_2. A 250,000-ohm variable resistor was tried in series with R_2 as a regeneration control, but gave no particular advantage in reception.

On the audio output, a resistance-coupled arrangement R_5-C_6 is shown because crystal phones are used, and d.c. must be kept out of them.

At the cold end of the r.f. tank circuit, bypass condenser C_4 must be about .005 μfd. or larger for proper superregeneration. However C_4 is not essential to the r.f. performance of the detector, and can be connected on either side of the r.f. choke with equally good results.

Adjustment

In spite of the title of this article, there is little to adjust in a receiver of this type once the tuned circuit constants have been fixed, except the balancing capacity C_1. This is not at all critical, but a little more discussion of its behavior might be in order.

The set shown "suped" very nicely with the tuning condenser removed. When it was connected, the detector worked properly over only a small part of the condenser range at the low-capacity end. When a minute capacitance in the form of a small battery clip (not connected to anything) was added to the rotor side of the line, oscillation stopped entirely. When the clip was moved to the stator side of the line, the detector worked over nearly all of the range. Changing the clip for a larger capacity made of sheet copper helped still more. After bending the copper strip C_1 a few times, a position was found which gave the best results.

When the detector was superregenerating weakly, there was a marked difference in the r.f. voltages at the two sides of the line. When C_1 was added and adjusted for best results, both sides of the line appeared to be equally hot.

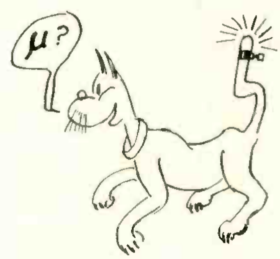
A Good Omen for Amateur Station Owners

An encouraging indication that amateur station operation will be allowed to continue in spite of the emergency is found in the fact that a completely modern ham station has recently been installed at the Radio School, U.S. Signal Corps Replacement Training Center at Fort Monmouth, N. J.

W2OEC is a strictly amateur station, governed by exactly the same rules and regulations under which private amateur stations operate. Its primary purpose is to handle messages, via amateur relay, between trainees at Fort Monmouth and their homes. Its second function is to provide recreational and operating practice facilities for the many licensed hams in training with the Army.

Two complete operating positions are provided with identical Hallicrafters HT-4 transmitters delivering 450 watts on c.w. and 325 watts on 'phone. These transmitters operate into a choice of seven antennas including rotary beams for 10 and 20 meters and doublets for 20, 40, 75, 80 and 160 meters. The doublets are strung between 70-foot wood poles in a large open area remote from the shack and are fed by ⅜-inch underground concentric lines maintained at an internal (dry air) pressure of 50 pounds.

The photograph shows one of the operating positions with First Lieut. P. W. Simms (W9DTF and W2KWH), Officer in Charge of the station, operating. The equipment, in addition to the transmitter, is, left to right, a Meissner signal shifter, a frequency standard, a speech amplifier, and the communications receiver.



Danger—High Voltage!

This is the tale of McPoostoe the cat,
  A saga of brave deeds and daring.
It's a tale of the tail, boys, which once saved
    the day;
  The tale of the tail he was wearing!

Now, McPoostoe was owned by a radio ham
  Who one day, just by chance, on a trip
Discovered his cat had a *thousand* volt drop
  'Cross his tail, from the root to the tip!

Now, radio hams (or at least so it seems)
  Are a specialized type, who, I hear
Are on the alert for a new source of power
  To operate portable gear.

So McPoostoe the cat was put in a cage,
  Electrodes were tied on with care,
And the juice was piped off to the radio
    shack
  To fire up the tubes that were there.

And when the flood came, and the power
    was off,
  And the panic was on without fail,
This radio ham with his rig saved the day
  With the juice from McPoostoe's fine tail!

But McPoostoe's gone west now, he's with
    us no more,
  And I'll bet you are wondering why—
While courting one night in a yard down the
    block,
  He shorted his power supply!

—*W7FPP*.

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.

HENRY RADIO SHOP—Has branch store, 2335 Westwood Boulevard, West Los Angeles, California, operated by Bob's brother, Ted Henry. Western Amateurs write Ted and get acquainted.

I WANT GOOD USED RECEIVERS—AM OFFERING THE BEST TRADE-IN ALLOWANCES ON THE WEST COAST. NEW NATIONAL, HALLICRAFTER, HAMMARLUND, RME, HOWARD RECEIVERS IN STOCK FOR IMMEDIATE DELIVERY ON TERMS. WRITE OR SEE TED HENRY, 2335 WESTWOOD BLVD., WEST LOS ANGELES, CALIFORNIA.

LEO, W9GFQ—offers the hams more and a better deal always. Lowest terms without red tape on all new and used equipment. Free trial. Personalized service. Write for big Free ham bargain catalog and used receiver list. WHOLESALE RADIO LABORATORIES, Council Bluffs, Iowa.

NEW TRANSMITTING KITS—all phone and CW from 15 watts through 150 watts. Also new ECO unit for $39.50. New 40 meter phone transmitters reasonable. Also plenty of 40 meter crystals. Write for details today. Leo, W9GFQ.

PANELS—chassis, racks, cabinets, but defense work first. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

RECONDITIONED—guaranteed amateur receivers and transmitters. All makes and models cheap. Free trial. Terms. List free. Write W9ARA, Butler, Missouri.

QSL's. SWL's—Free Samples. Theodore Porcher, 7708 Navahoe, Philadelphia, Penna.

NEW AND USED—Katolight Plants, 300 watts through 10,000 watts. $42.00 upwards. Write Katolight Corp., Mankato, Minnesota.

TRANSMITTING HEADQUARTERS—on latest Stancor, Thordarson, and other kits—commercially wired at low cost. New 70 watt transmitter kits complete only $35.00—speech amplifier modulator up to 80 watts at $29.50—up to 150 watts $49.50. New JT-30 mike and stand $5.95. Easy terms. Write Leo, W9GFQ, today.

R9 CRYSTALS—At 160-80, in attractive heat dissipating, dust proof holders $1.25. A. Zellefrow, 338 Murray Avenue, Arnold, Penna.

WRITE BOB HENRY, W9ARA—for best deal on all amateur receivers, transmitters, kits, parts. Bob offers you largest trade-in allowance for your equipment; best terms (financed by Bob with no red tape); lowest prices; quickest delivery, ten day trial. Write Bob for anything. Tell what you want; what you have to trade-in; what terms you want. You will get immediate personal attention. Henry Radio Shop, Butler, Missouri.

NEED PARTS—Why wait? Large surplus new and slightly used Triplett meters; modulation and audio transformers; xmiting condensers; and misc. parts. W7DSQ, St. Ignatius, Montana.

RECEIVERS—all types—new and reconditions. Easy terms. Free trial. Send for big list and other specials. Get acquainted with Leo, W9GFQ, Council Bluffs, Iowa.

ANSWERS TO YOUR RADIO PROBLEMS—complete analysis, circuits designed, reasonable fees. STUART AND COLEMAN, ENGINEERS AND RADIO TECHNICIANS, 327 Mifflin Street, Huntingdon, Penna.

SELL OR SWAP—National FB-7, tubes, coils, supply, A-1. $15.00 or photographic equipment, 46 Marshall, Buffalo, New York.

SALE OR TRADE—One Stancor 12 E Phone and C W Emergency Xmtr. complete with tubes, less Vibrapack, also one Stancor 10 P xmtr. complete, including tubes, and 10-40-160 meter coils. Wanted RME DM 36A or ME 13 Portable receiver. W8NGY, 7829 Euclid Avenue, Cleveland Ohio.

SELL—like new. Webster W1205 recorder complete at bargain for cash. Write for details, W9ULJ, Emerson, Iowa.

TUBES WANTED—RCA. 1628's new. S. Osterlund, W9TJL, 914 Wellington Avenue, Chicago, Illinois.

Yarn of the Month

[*Continued from Page 64*]

and tell what's the matter—like some of these newfangled analyzing contraptions we have nowadays can. Cousin Zeb pointed meek like at the empty space between the two clips that once held the glass grid leak resistor!

That was a situation; the glass grid leaks I had ordered out from Louisville got broke coming over that turnpike, so I was up a stump to get Zeb's set fiddlin' again. I dug up my mail order course and looked up resistors. Seems they are made out of carbon. Why not burn a broom straw and use the carbonized stem?

Well, I meandered over to a broom sage bush growing in a corner and unplucked a few stalks of it. I lit a match to one straw but it burned down to a tolerably fine powder, so I decided something must be done to stiffen the burned stalk. The mule was getting tiresome in the house and was stomping around considerable; he edgewised himself up close to the fresh jug I had just fetched for myself and kicked a considerable gash down one side of it, so that it began to dripple out on the floor (it wouldn't have made any difference if it had been Zeb's jug cause it was empty). I never was one to misuse a good horse or corn likker, so before calling in the hounds to lop it up, I calculated on trying an experimentation; I set a stage straw in the puddle and lit fire to it. After picking up Cousin Zeb's uppers that the explosion scared out of him I got down on my knees and examinized the straw. Sure nuff it worked; the straw was stiff and charred. I picked the straw up, bit it to the right length, sucked it dry, and stuck it in where the leak had been.

We started wiring battries to the set then. We worked fast and in a couple of hours had the old Grebe squealing like a hit hawg on station WSM in Nashville. Cousin Zeb allowed it wasn't as loud as it used to be, so I figgered the leak was too low. Increasing its value was tolerably simple. I took my bear knife and scraped off char until WSM sounded natcheral to Zeb. Well, Cousin Zeb was so tickled you could almost see the smile behind his U. S. Grant fodder. (Zeb was a dude.)

After repacking his mule, Cousin Zeb bound his way for home. But a change other than the used straw for a grid leak was made in Cousin Zeb's set: the top was fasted with nails. He wasn't aiming on paying another two dollar bill for a piece of straw again, even if it was Confedrate.

Buyer's Guide

Where to Buy It

• • •

ROTHMAN HY-69 AMPLIFIER

Page 18

C_1—Cardwell MT-100-GS
C_2—Cardwell MO-180-BD
C_3, C_7—Solar MW-1235
C_4—Bud NC-890, cut down as in text
C_5, C_6—Solar MW-1237
R_1, R_2—Ohmite Brown Devil
M_1, M_2—Triplett 227-A
RFC—Hammarlund CHX
Tubes—Hytron HY-69
L_1—Bud OLS Series
L_2—Bud RLS Series
L_2 jack bar—Bud AM-1339
Panel—Bud PM-1593
Shield—Bud IS-1347
Dials—Bud D-1732

• • •

SMITH 2.5 METER TRANSCEIVER

Page 26

C_1—Bud LC-1640 with one plate removed
C_2—Solar type MW
C_3, C_4, C_5—Solar "Sealdtite"
C_6—Bud MT-833
R_1, R_3, R_4—Centralab 710
R_2—Centralab 72-104
CH—Thordarson 13C26
T—Thordarson 72A59
S_1—Bud SW-1119
S_2—Centralab 1450
RFC—Ohmite Z-O
Cabinet—Bud 993
Panel—Bud PS1201
Dial plate—Bud DP1176
Name plates—Bud N1150, DP1180, DP1182
Knobs—Bud K581, K579, K182
Shaft coupling—Bud FC795
Bearing—Bud PB532
Feed-through insulators—Bud I 1911
Batteries—(A) Burgess 2F; (B) Burgess M-30; (C) Burgess 5360

• • •

SIMPLE SUPERHET

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C_1—Bud MC-1853
C_2—Bud MC-1857
C_3—Bud MC-903
C_4, C_5, C_8, C_{10}—Solar "Sealdtite" S-0228
C_6, C_7, C_9—Solar type MO
C_{11}, C_{12}—Solar MW
C_{13}—Solar DT-878
R_1, R_2, R_3, R_4, R_6, R_9—Centralab 710
R_5—Sprague "Koolohm"
R_7—Centralab 72-104
R_8—Centralab 714
R_{10}—Centralab 516
IFT—Meissner 16-8100
S—Bud SW-1118
Dial—National type B

• • •

POWER SUPPLY

T_1—Thordarson T-7543
C_1, C_2, C_3—Solar M-408
R—Sprague "Koolohm"
J—Mallory-Yaxley 702
P—Mallory-Yaxley 310

Dear RADIO:

Kindly send me the items listed below for which I enclose $........................ in payment.

- ☐ "Radio" (five issues)
- ☐ "Radio" (one year)
- ☐ "Radio" (two years)
- ☐ "Radio" (three years)
- ☐ "Radio" Handbook
- ☐ "Radio" Amateur Newcomer's Handbook
- ☐ "Radio" Noise Reduction Handbook
- ☐ "Radio" Binder
- ☐ W.A.Z. Map (6 great circle maps)

Name ....

Call ....

Address ....

....

Note: All shipments are **prepaid** by us. Current editions are always supplied unless previous or future editions are requested in the original order. California and Illinois customers: please add sales tax.

THE EDITORS OF RADIO 1300 Kenwood Road, Santa Barbara CALIFORNIA

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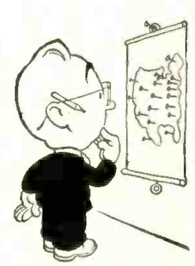

Look, chum: Radio's WAZ World Map (defining the forty DX zones under the WAZ plan) will lick all your map problems—it's literally all there. Besides, there are those five great circle maps so you can determine distance and direction to any point in the world! How about it? Only 35 cents, postpaid anywhere.

THE EDITORS OF RADIO 1300 Kenwood Road, Santa Barbara CALIFORNIA

Typical of RCA Tube values is the RCA-8005 Transmitting Triode de luxe, priced at only $7 net. Designed for use as a radio frequency amplifier and class B modulator, this tube is capable of handling 300 watts (ICAS) input at 5 meters!

PRODUCTION FOR DEFENSE ...COOPERATION FOR ALL!

Defense production with RCA gets first call—and always will. Suffice to say that a tremendous quantity of RCA Transmitting Tubes is being supplied for a wide variety of defense needs. Meanwhile, although the 1941 total of RCA Transmitting Tubes supplied through our regular distribution channels will exceed that of last year, there is a scarcity of certain types.

We know you will understand that this is unavoidable. We know, too, that we can count on your cooperation during these trying times—just as we want our countless friends in amateur Radio to know that they can count on ours.

RCA Transmitting Tube quality is being rigidly maintained. RCA publications will be kept strictly up-to-date. Ham Tips will be continued. New data and construction material will be supplied. Inquiries about RCA Tubes and their applications will be answered promptly. Above all, research and development work is continuing as never before.

Thus, although it may not always be possible to supply the tubes you want during the National Emergency, RCA is still on the job to help wherever and whenever it can!

RCA BROADCAST EQUIPMENT
From microphone to antenna

RCA

TRANSMITTING TUBES

RCA MANUFACTURING CO., Inc., Camden, N. J.

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