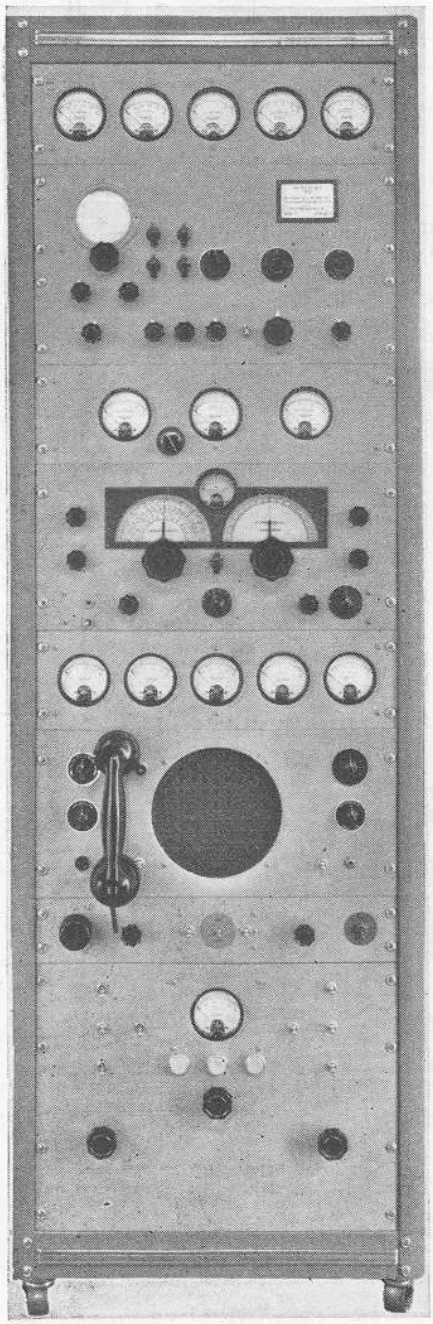
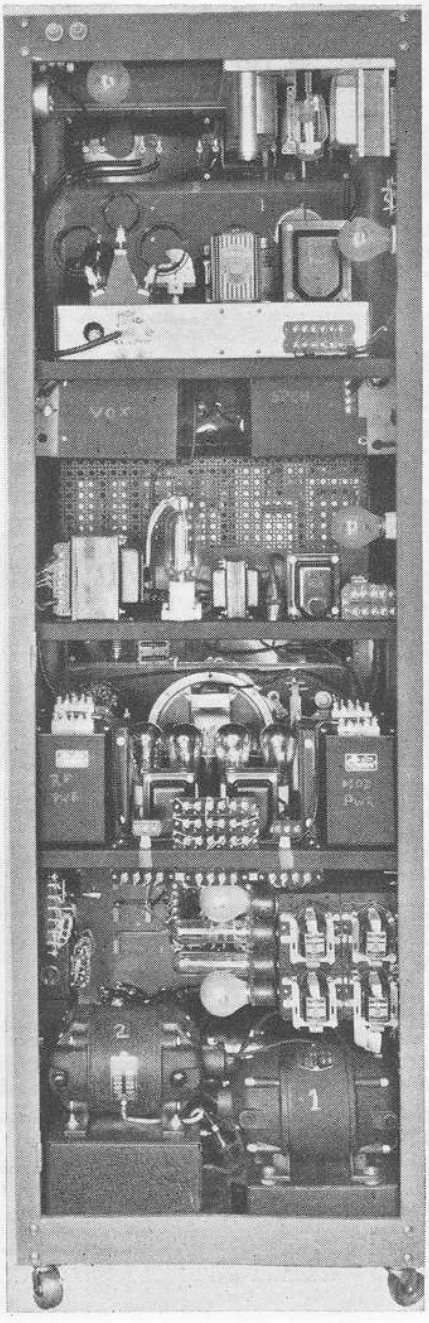
1940 Radio News "ALL

by KARL A. KOPETZKY, W9QEA and OLIVER READ, W9ETI
Managing Editor, RADIO NEWS Technical Editor, RADIO NEWS

Everyone said that it could not be done, but finally a unit was designed and constructed that included almost everything any operator, ham or professional, wants





INTERESTING FACTS ABOUT THE 1940 RADIO NEWS "ALL-PURPOSE" TRANSMITTER-RECEIVER

The unit contains:
305 different terminal connections.
54 different controls.
12 different relays.
40 control knobs.
14 meters.
25 switches.
3 pilot lamps.
13 indicator plates.
3 input plugs.
33 tubes.
4 crystals.
7 25-watt light bulbs.
3 generators—equalling 1000 watts of 115 v. AC.
34 transformers and chokes.
and:
it weighs over a ¼ ton.

The unit was built in about 600-man hours, and is valued at $5,000.

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OUTSTANDING FEATURES OF THE 1940 RADIO NEWS "ALL-PURPOSE" TRANSMITTER-RECEIVER

1. Full operation from 115 v. AC or DC.
2. Automatic keying.
3. Automatic voice-controlled carrier.
4. Two types of CW monitoring.
5. Complete 'phone monitoring.
6. Complete manual control if desired.
7. Handset-microphone-loudspeaker operation as desired.
8. Push-to-talk operation.
9. Peak limiting modulation.
10. Modulation percentage indication.
11. 6-band superheterodyne included.
12. 160M-10M band operation.
13. Choice of ECO or Crystal exciter.
14. 100% safety & overload factors.
15. Overload & Underload protection.
16. Audio cutoff for QRM conditions.
17. Automatic bias supply.
18. AC or DC operated relays.
19. Commercial construction throughout.
20. Phone-CW switching.
21. Fully metered circuits.
22. Fixed neutralization.
23. 200-watts input on all frequencies.
24. Automatic antenna changeover.
25. Matched receiver input to 73 ohm transmission line.

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PURPOSE" TRANSMITTER-RECEIVER

IN the forty-six years, total, during which time the authors have watched transmitters and receivers come and go, it has always seemed that the one in their possession lacked certain features which were to be found either in commercial rigs, more advanced amateur rigs or in the experimenter's shop.

For several years the idea of putting all of the features found in these three classifications in one cabinet has titillated the fancy and imagination of the writers. After much research in pouring over the books, burning the midnight oil, the fundamental circuit was evolved. Using this as a starting place, improvements were added and features included until the 1940 RADIO NEWS ALL-PURPOSE TRANSMITTER-RECEIVER was created.

Before going into the technical details, which should enable any ambitious radio man to duplicate this unit, it may be well to consider some of the features used and the reason for their inclusion.

The consideration of 110 volts d.c. operated transmitters has always been vexatious for that amateur or professional operator whose very location made access to 110 volts a.c. lines impossible. This situation is prevailing in certain of our cities and on a great many of our ships, both commercial and pleasure type. The first condition, therefore, to be met was to make a transmitter operate equally well from 110 volts a.c. or d.c. In this way the unit could be moved from shore to ship and *vice versa* without any change in circuit and without sacrificing its usefulness during those months in which either one or the other type of voltage was not available.

The 1940 RADIO NEWS ALL-PURPOSE TRANSMITTER-RECEIVER when operating from 110 v. d.c. mains provides a fully modulated signal of 200 watts input to the final Taylor T55. This is not to be considered the usual portable a.c-d.c. power, especially when one considers that this means an 800 watt signal at 100% modulation. To have increased this power, for example, to 400 watts would have been impractical. In the first place the received signal would only be 1/7th greater than the signal of the 200 watt transmitter; and in the second place in order to make a 400 watt input available at the final tube, the generators would have to be able to deliver 3 kilowatts of power instead of one. The amateur has not yet found out that the ratio of increase of "source-power" does not rise in direct proportion with the gain of input to the r.f. stage. Thus, it would take 3 kilowatts of generators for 400 watts and almost 9 kilowatts of power for 1 kilowatt of 100% modulated input. It has been long known that 200 watts of signal efficiently placed in an antenna and allowing for the usual efficiency coefficient in the final stage will "go as many places" as will a kilowatt, especially in the ultra high frequency bands.

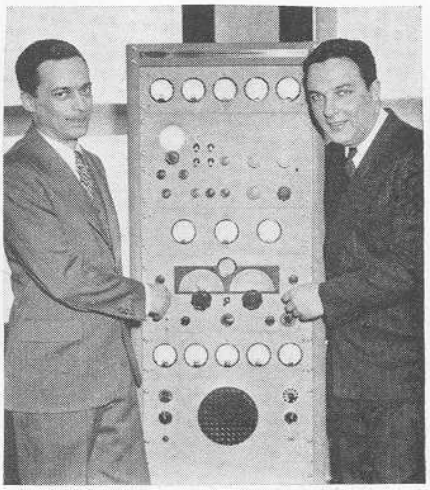
Automatic keying, the joy of every commercial operator, has been added so that the c.w. man need not throw a switch: merely sending a few dots to put the carrier on the air. Automatically, when he finishes his transmission, the receiver comes on and the carrier goes off.

For the telephone operator, the counterpart of automatic keying is provided in the voice control carrier. The *VOX* system which makes this possible is fully described later.

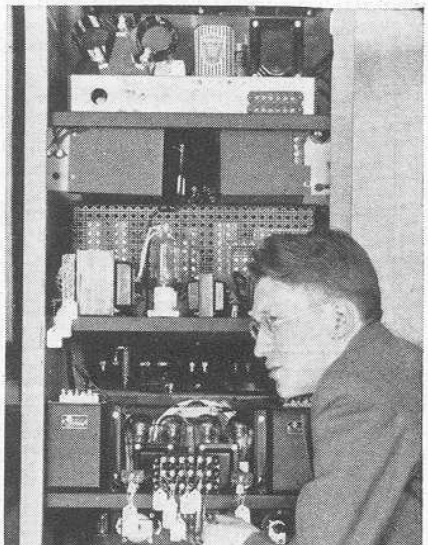
The choice of the *RME* 69 receiver enabled us to include c.w. monitoring as an additional feature. C.W. monitoring is also provided by listening to the buzzer normally used to activate the *VOX* system in the automatic keying setup. Following some of the latest trends in phone transmission audio peak limiting, push-to-talk operation, telephone hand set operation, and modulation percentage indicating were all included.

We have always wished to be able to jump not only from band to band, but also within each band and so the choice of crystal control or electron coupled control by means of a *Meissner Signal Shifter* was provided. By choosing the coils carefully, continuous coverage was offered from 160 meters through 10 meters together with variable crystal control in the 20 meter 'phone band. For protection's sake, both overload and underload relays (Guardian) are used and a fixed bias supply using a single RCA84 rectifier tube is placed in the grid circuit of the final T55 tube.

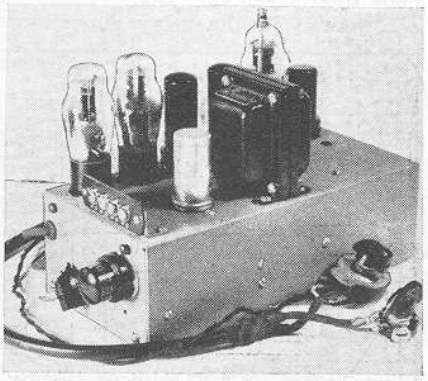
Considering the bias on the final T55, commercial practices were adopted. It is only necessary to bias the tube to that stage which is less than the rated dissipation of the tube itself, figuring the bias for the tube without excitation. Naturally, with excitation the bias should be at least twice cutoff for proper Class C operation. The bias, therefore, was a combination of bias pack operating independently of excitation, and resistor operating only when there was excitation. The 45 v. automatic bias supplied by the RCA84 rectifier was more than enough to limit the plate current of the tube to a figure within the rated dissipation as stated by the manufacturer. With excitation, this 45 volts plus a voltage drop across the resistor creates suffi-



W9ETI, (L), explains the works to the prominent band leader, Bob Crosby.

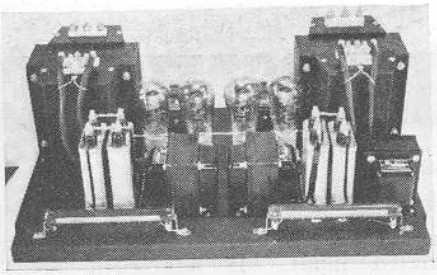


Ed W9HPW Kelly, Stancor engineer, was a constant visitor during the building of the various power components.

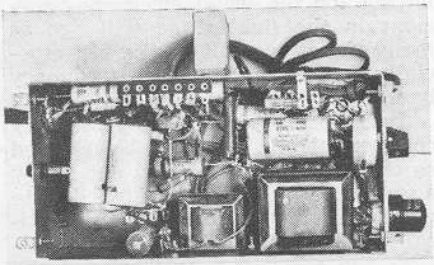


The speech amplifier is complete unit with its peak compression built in.

A Triplett Ohmmeter, Model 666H, was the only instrument used for test.



Symmetrical layout was a big feature in the power supply chassis.

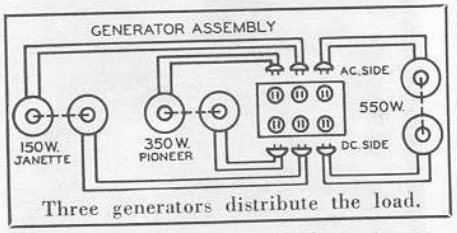


There's no wasted space under the chassis of the speech amplifier.

cient bias to operate at twice cutoff.

Long ago it was discovered that audio frequencies of less than 2500 cycles in amplitude had a better opportunity to "get through" the QRM than those rising to the usual amateur's goal of 10,000 cps. This audio cutoff is made by means of an audio tone control on the speech amplifier.

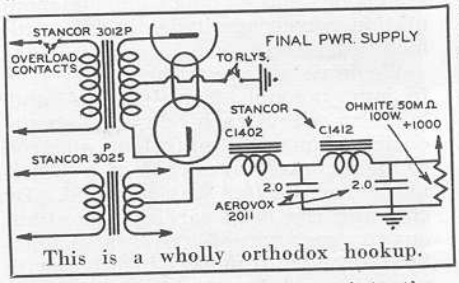
During the actual construction of the transmitter, which took over 600 hours, every effort was made to do a real commercial job. At first glance it will seem impossible to have placed all of this equipment in a 5½ foot cabinet (Par Metal). But not only was this done, but there is an excess room of about a foot to a foot and a half left over. Having inspected many commercial rigs we were impressed by the fact that our professional brethren did not "scrawl their equipment all over the map" and we intended to copy their style.



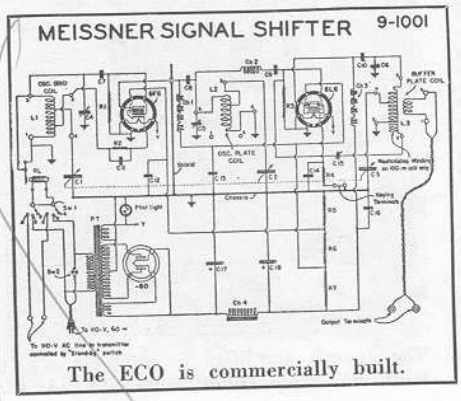
Three generators distribute the load.

Research in the relay department indicated that a.c. relays could be made to run from d.c. current and the manner in which this is accomplished is explained later. By putting the relays on the d.c. voltage, when using d.c. input, the 40 or 50 watts required to run them could be saved.

It must be remembered that in a d.c. installation where one manufactures one's own a.c. voltage, every watt counts and the problem becomes one where a savings of one or two watts of a.c. is serious and worthwhile. Power factors of transformers enter into the problem and it will never pay in this type of installation to use a transformer whose current carrying capacities are exceeded and waste valuable wattage in heat.



This is a wholly orthodox hookup.



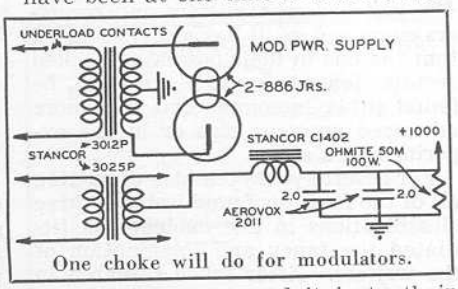
The ECO is commercially built.

Briefly reviewing the uses to which this transmitter-receiver can be placed, it was found that it meets the usual requirements for the following services:

1—As a ham rig.
2—As a ship-to-shore marine rig.
3—As a commercial c.w. rig.
4—As a short wave broadcast transmitter.
5—As an airport transmitter-receiver.
6—As a military service transmitter especially for use with the Navy where 110 volt d.c. is available and on those ships (believe it or not, the Army operates ships) of the Army which do not have 110 volts a.c.

The efficiency quotient of the entire unit is remarkable, not only from an operating but also from a technical standpoint. Impedances are carefully matched. Controls, while numerous on the panel, are few in operation.

The authors believe that the unit at once represents a visible proof of the development of radio by the amateur fraternity to the stage where it can match the best that the commercials can put out in a rig of similar qualifications. All of the circuits used have been at one time or other developed by amateurs and it is to their credit that they can be so joined together as to create a transmitter-receiver which has so many varied and different uses.



One choke will do for modulators.

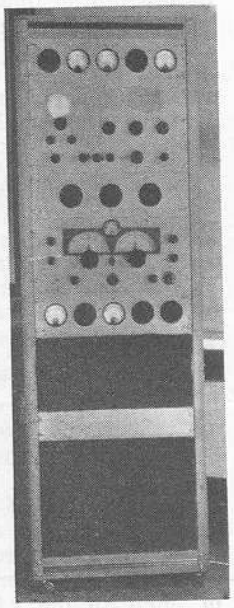
CONSTRUCTION

General Information

The amateur operator has long followed certain general set-forth ideas in the construction of the various component units which make up his transmitter. Much can be learned by following the general procedure used by the manufacturers of marine and commercial radio transmitting equipment. Compactness is the keynote of this latter type of construction and mechanical details are carefully planned in order that the assembly be one of rugged and foolproof design.

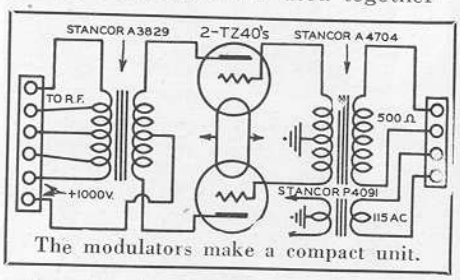
As mentioned earlier, the entire transmitter and receiver will operate both from 110 volt, 60 cycle, a.c. and from 110 volt d.c. Reference to the illustrations will show that the lower compartment houses the three converters, one of which is a heavy duty type rated at 550 watts, one of 350 watts and one of 150 watts output rating. By distributing the whole load to the three generators, all will work at best possible regulation.

It is extremely important that the generators be supported on a shock-proof mounting. This has been accomplished by using a live sponge rubber mat which is 1" thick. Vibrations which nominally would be transmitted to the cabinet are now confined to the units themselves.



The half-way mark of construction.

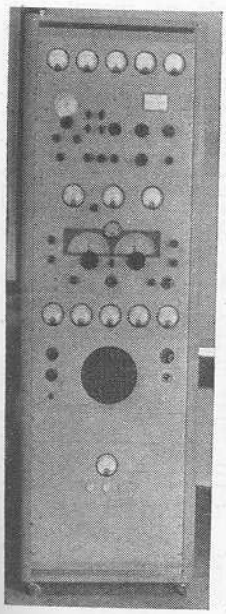
The four Ward-Leonard controlling relays are mounted on a sub-chassis which measures 7" x 7" x 2", and are completely wired, together with the 25-watt lamp bulbs in series with coils to lower the current for 110 volt d.c. operation. When operating from 110 volt a.c. supply these bulbs are removed and are replaced with 5 ampere fuses which are effective shorts, at the same time providing adequate protection to the relay coils. Amphenol female receptacles are used together with rubber insulated adapters to hold the 25-watt lamps so that they may be removed by the usual plug-in method.



The modulators make a compact unit.

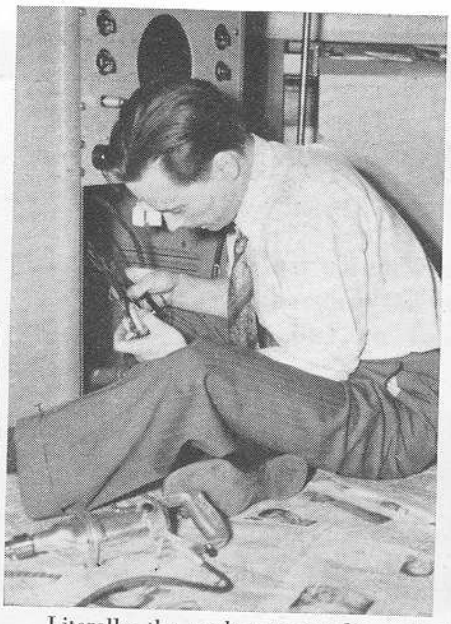
Inasmuch as the main control panel is the heart of the power supply system, it was located where it would be accessible for wiring to the various units. This has been done by first mounting all of the individual switches to the panel and by mounting terminal assemblies by means of brackets to the rear of the assembly where all inter-connecting leads may be secured with a screw driver. It is extremely important that the terminals be identified by either numbers or by using paper tags as no wiring takes place before all of the units are mounted within the cabinet and connections are easily forgotten.

To the left, looking at the rear of the bottom deck will be seen an autoformer which is used to control the voltage coming from the 550-watt generator. This unit is made variable from the front panel and is driven by means of a flexible cable which is of the type used by the commercial manufacturers and may be obtained from the S. S. White Dental Manufacturing Company. Directly in back of the autoformer and on the same side of the cabinet is mounted a small 9"x5" chassis which contains the female plug assembly together with the necessary terminal strips. The main line cord coming from either the 110 volt a.c. or d.c. city main is plugged into the input receptacle on this box and by means of plugs it is possible to arrange the connections so that either a.c. or d.c. will be applied to the transmitter. It is well to color-code or otherwise identify these various receptacles and to keep the d.c. coils isolated from those used on a.c.


Almost finished, it looked like this!

The main controlling switch wiring is located directly back of the switch assembly on the front panel above the three pilot lamps. The *green* bulb serves as an indicator to show the operator when the 150-watt generator —the *amber* when the 350-watt—and the *red* when the 550-watt generator is running.

One of the most important considerations as far as wiring is concerned is the size or diameter of the connecting leads. It must be remembered that when operating on d.c. the load to the generators will require the use of either solid or flexible wire, which should preferably be of the Number 10 gauge, as any IR drop caused by resistance would tend to lower the overall efficiency of the converters and cause a diminishing of output.

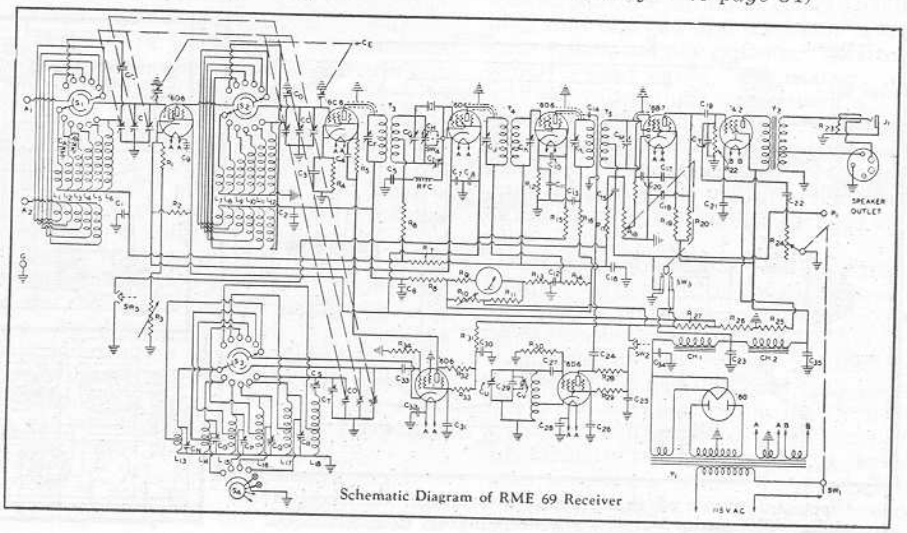



Literally, the work went on day and night. Paper development was the least part of the job, while the greatest labor was in interconnecting the units.

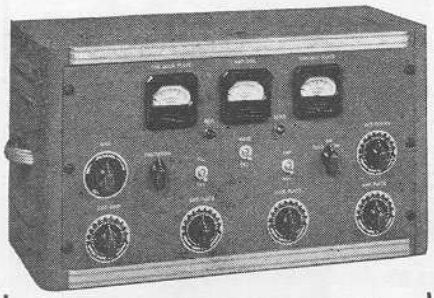
Liberal use of spaghetti tubing will prevent shorts where wiring is crowded. The constructor of this type of equipment will do well to color-code the wiring as regards to the different types of current, namely—AC and DC. In this way proper reference may be made to either type of current and wiring will be greatly simplified by following the above procedure and mistakes will be less likely to occur. Provision for bonding of the cables should be made in the form of metal straps.

Directly above the three converters and mounted on the back edge of the first shelf is located a series of terminal lug assemblies which connect by means of cable to the relay control box. It is possible to remove the entire assembly consisting of the control box and the terminals by loosening the two screws which hold the latter and by taking out the three insulated screws which mount the control box. Between the inside of the cabinet and the metal box is mounted a live sponge rubber strip. The purpose of this construction is to eliminate the chatter which is to be expected when power

(*Pse QSY to page* 54)


Schematic Diagram of RME 69 Receiver

A 50 Watt All-Band Phone-CW Transmitter



Three Necessities of Radio

(*Continued from page* 33)

pair of trousers. We do not think of these small "trifles" when first we begin practice, but we invent as we go along.

IT is handy to learn to be handy, for then we learn the need of organization when we must "tear the drawers apart" to search after a needed size bolt, screw or nut. An indexed "high-boy" or storage stand makes for elimination of such worries. It stands 5′ high, and is wide enough to hold two tiers of cigar boxes. It is 8″ deep. The mantel on top could hold a small radio or books or even a spare battery. It surely clears the floor space and after a while, we begin filling in the walls with more of such high-boy units, for holding tubes, and who-knows-how-much other small stuff.

I COME to my third improvisation, which I prize very much. In trying out battery-operated sets on the table, I've had to clutter up the whole table with the set, the speaker, the tester and meters, *plus* the unsightly mess of the batteries. Yes, I've done that so many times that finally I said to myself, let's have a light on this problem, and soon I made myself the candelabra illustrated in Figure 4.

This "candelabra" is just a handle 8″ long by 1½″ in diameter screwed to a circular base 6″ in diameter by 1½″ thick. Turned pieces of redwood, shellacked, are used. The top is a 4″ square of bakelite with at least six to a dozen binding posts. These are labeled in volts (plus and minus) for "A," "B" and "C" power supply. Each post is the end of a lamp cord, six feet long, color-coded. This candelabra can stand on the table, easily set out of harm's way and fool-proof. —30—

50 Watt All-Band Xmtr

(*Continued from page* 32)

means of the Excitation Control to the proper value, 3 to 5 ma., or perhaps slightly more for the higher frequencies. The Tune-CW-PH switch is now thrown to the c. w. position actuating relay Re_2, turning on the 500 volt supply, and the red pilot light and the final tank condenser is now rapidly tuned to resonance. Non-resonant magnitudes of plate current should not be allowed to flow for more than a second or so. The 807 should be given a few seconds to cool between surges until the resonance point is located. The antenna may then be coupled until the 807 draws rated plate current, 90-100 ma. The key jack is located in the rear of the cabinet. For c. w. operation, the filaments of the a.f. tubes are cold, plate voltage is not applied to them and the modulation transformer's secondary is shorted.

For Phone operation, with the 807 coupled up to full load into the antenna, the Send-Receive switch in the "Receive" position, turn the Tune-CW-PH switch to the "PH" position. Heater current now flows in the a.f. tubes, and the modulation transformer's short is removed. The microphone jack is located in the back of the chassis next to the key jack. Any of the usual crystal mikes may be used.

In constructing the transmitter, be sure to bond all the grounds. With so much material in such a small space (the transmitter chassis is only 8″ x 15″ x 2½″ with a panel 8¾″ x 16¾″) it is necessary to use plenty of care and foresight to avoid a tangled confusion of parts. —30—

RADIO NEWS 1940 Xmtr

(*Continued from page* 9)

relays open and close and is not an indication of poor performance.

The two smaller autoformers which are used in connection with the 150 and 350 watt converters (Stancor & U.T.C. make respectively) are mounted on the side of the cabinet directly in back of the relay control box. The taps are fed by means of cable to the switches (Ohmite) which are located on the control panel.

The amateur operator has been slow to follow the safety rules as recommended and used by commercial manufacturers. A line switch called an "interlock" is used to break the primary circuit as it enters the transmitter. When the rear door is open voltage cannot (*Next page, please*)