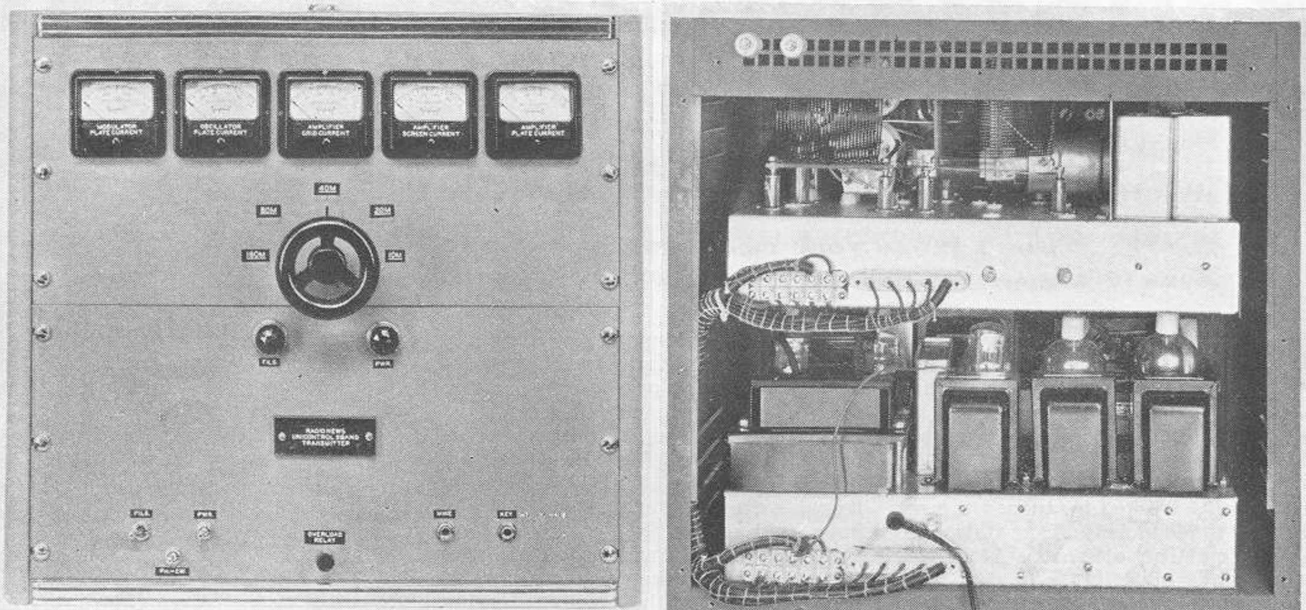

Front and back view of the compact 200-watt *output* Unicontrol 5-Band Transmitter.

THE UNICONTROL 5-BAND TRANSMITTER

by
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PART 2

Concluding the series with the building of the r.f. chassis and the assembling of the entire transmitter. The gear drive is fully described

IN the last issue we discussed the transmitter generally, and described the power supply—modulator—speech chassis more or less in detail. In order for the constructor to follow the building of the units coherently, it might be well to review the last issue's advices somewhat sketchily.

Our original consideration was to design a transmitter which would have as many of the new improvements in it as possible. Among the "musts" we numbered: 1. Compactness; 2. Bandswitching; 3. Automatic Modulation Compression; 4. Least number of tubes for the maximum output; and 5. The controls must be at a very minimum.

Considering first compactness, we decided that the size would have to be comparable to the size of the ordinary receiver and speaker, certainly no larger. This limited our available space to about 15" deep by 19" wide by 18" high. Since only two panels (8¾"x19") can pe put in such a small space, the power supply and modulators have to fit on the bottom chassis behind one panel while the r.f. stages would take up the other panel and chassis. Each chassis was 17"x13"x3".

Taking and reviewing first the power supply chassis, under it were mounted the assorted filament transformers plus one filter condenser and the entire speech equipment. The relays are also to be found underneath the chassis; and the choice of the make of these relays was quite a problem since space was at a premium. Finally chosen were 3 by *guardian* and one by *Ward-Leonard.*

On top of the power chassis are mounted the power transformers, chokes (three of them), the tube sockets, sunk 1" below the top of chassis, three filter condensers, modulation transformer, a filament transformer, power transformer, etc. The constructor is urged carefully to examine the pictures for layout. If this layout is not followed, the parts will not fit together on the chassis and the rig cannot be built as compactly.

In building the new rig it was decided that it should be 100% safe. Such "safety" was included, that the builder could, if necessary, place his hand upon any top part of the *power supply chassis* while the high voltage was "on" without running the slightest danger of being electrocuted providing only that the insulation did not break down. In order to accomplish this, certain changes were made in the transformer. This "conversion" was fully covered, and the insulated leads and cap can be seen both on the modulator tubes as well as on the power rectifiers. In fact, the sole leads which appear, are those to the plates of the rectifiers and to the plates of the modulators.

Going further into the matter of compactness, we found that the average ham is more than liable to space his components "all over the lot" sometimes with the unnecessarily long leads, *and always allowing for some future rebuilding or adjustment.* On the other hand, the commercial engineer has been compacting his equipment until today, some of the commercial rigs that run a kilowatt *output* could be placed inside the cabinets of some of the ham rigs whose power *input* is less than one-tenth of that.

When reproached by the commercial operator, the ham builder will always state that his rig is "easier to service" and that with the continual changes in tubes and transmitting components, he may wish to make alterations in his equipment, hence he is unwilling to "tie down" his components in such a manner as to make a rebuilding job a super-human effort.

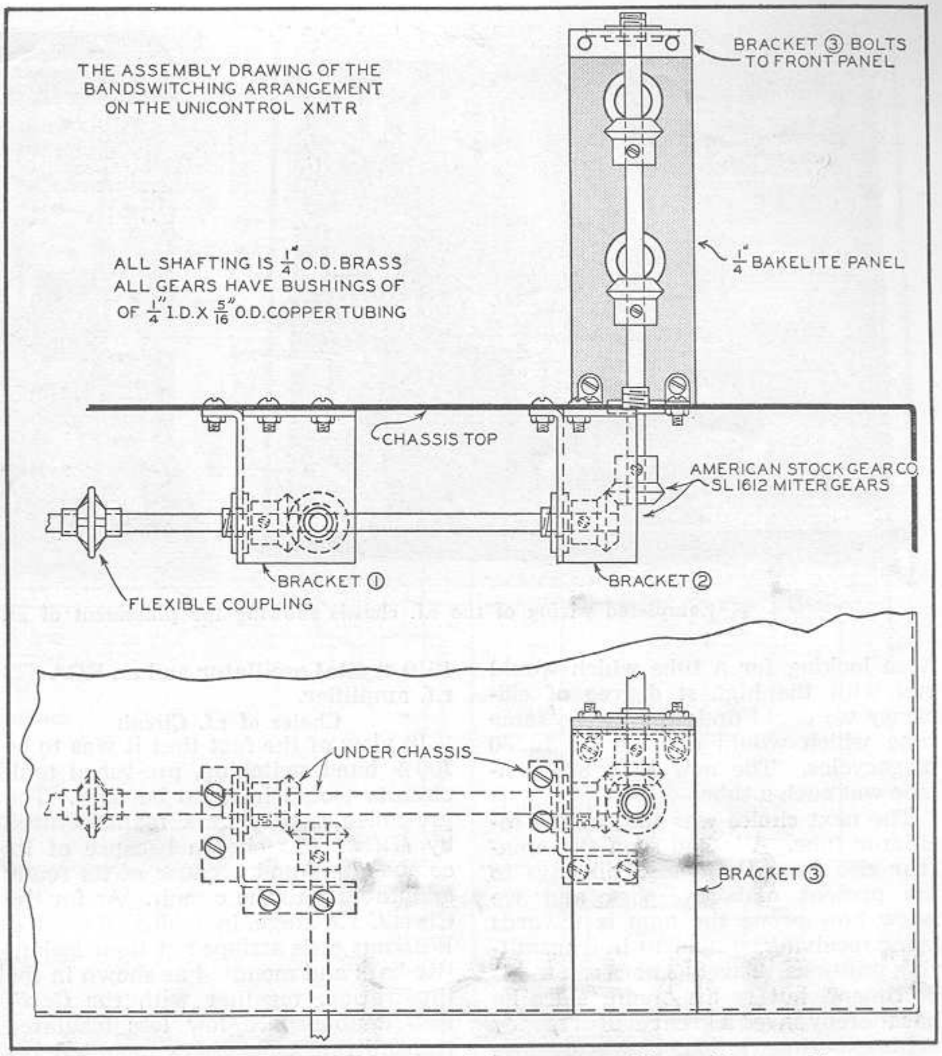
However, the parts manufacturer has not been standing still, and today there are available to amateurs better components, more carefully engineered, and more compactly built than ever before.

Input *vs.* Output

Since the transmitter would probably be used in an apartment house where a flickering of the lights every time the switch was thrown, would be annoying as well as inducive of landlord complaints, not to mention B.C.L. anger, the amount of power was limited to 200 watts *output.*

At this time it might be well to state that while the amateur has continued to use the *input* to his final stage as a measure of the power of the transmitter, his commercial brother has proceeded along different lines and most commercial transmitters' "powers" are measured in terms of *output.* True it is that the amateur has been aided and abetted in his choice of *input* versus *output,* by the United States Government. The *F.C.C.* regulations have limited the amateurs' power to that which is fed to the *input stage.* However, there is not any reason, unless the amateur is running to the very outside limits prescribed by law, why he should continue to measure the *capabilities* of his transmitter in terms of *input.* As a matter of fact, if the amateur will begin to think in terms of *output, he will thereby begin to think in terms of efficiency.* What does it gain an amateur to run an *input* of 750 watts with an efficiency of lower than 10%, so that his *output* is only 75 watts, if his neighboring amateur is running a 100 watt transmitter with an efficiency of 80%? It is high time that the amateur began to think in terms of *output* and, accordingly, this rig was designed with the *output* power in view.

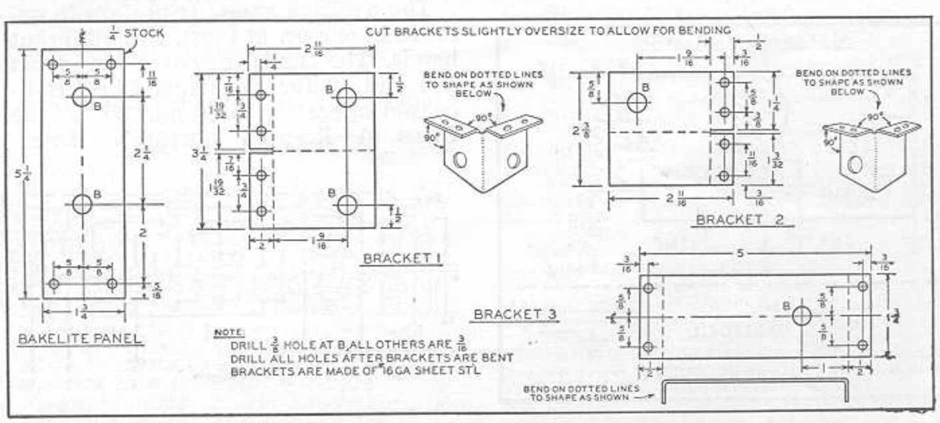
It is an axiom that the received signal, all conditions being equal, is inversely proportional to the square of the power *output,* so that a medium powered output rig would be one in the neighborhood of a quarter kilowatt. Assuming that the *output* was about 250 watts, and that the received signal therefrom would be R5, (the R meter being linear), in order to receive a signal of R10 from the same transmitter under the same conditions, it would be necessary to run a kilowatt *output,* or *four times* the previous output power, in order *to double the received signal.* A cursory inspection of the "Hamchatter" column will show that the average ham rig will run around a quarter of a kilowatt *output* and be able to work *WAC* (pre-War) and *WAS* with comparative ease. Power *outputs* of less than a quarter of a kilowatt are somewhat less desirable, while those of a greater *output* than that figure will be found not to give any superlatively great advantage excepting in QRM conditions. So we decided to use something around a quarter kilowatt output.



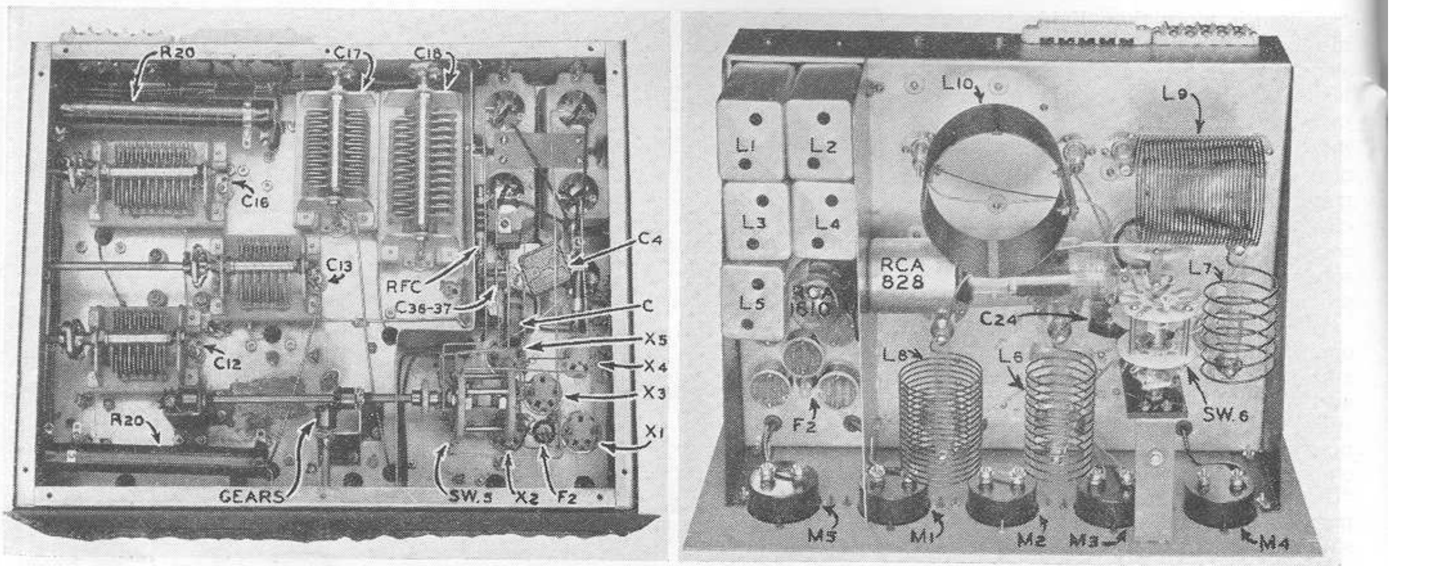
By using this mechanical drawing of the gear assembly, and by watching the illustrations carefully, the constructor should have no trouble in building and running the various switches from one central control.

Choice of r.f. Tubes

Having found our output figure, the next choice was that of tubes. Using band-switching we were immediately forced to use a pentode in the final r.f. amplifier stage. The question was *which* pentode to use. Remembering that we wanted to approach a quarter kilowatt of *output* as closely as possible and still maintain a high degree of efficiency, we scouted through the tube manuals and tube charts. We



How the brackets are made can be seen from this line drawing.



Completed wiring of the r.f. chassis showing the placement of all the parts. Note gears.

were looking for a tube which would run with the highest degree of efficiency we could find, and at the same time which would operate up to 30 megacycles. The new RCA 828 pentode was such a tube.

The next choice was that of the oscillator tube. We had seen the amateur rise from the spark-coil days to the present elaborate rigs and we know how prone the ham is towards using receiving equipment in transmitting positions. This has not been to his detriment, but to his credit, since he has thereby saved a great deal of money in his experimentation. However, since we were going to compact his rig so that servicing would be difficult, and since we wished rugged, trouble-free construction, we decided it would probably be best to use for the crystal oscillator, a tube which the manufacturer recommended exactly for that purpose. Once again, the tube tables came into play and the RCA 1610 was decided upon. This small tube is recommended by the manufacturer especially for use as a crystal oscillator. Actually, such tubes are in use in broadcast stations and we, therefore, thought that the 1610 would answer both the requirements of sufficient output to drive the 828 and at the same time offer the ruggedness and trouble-free operation the unit demands. The r.f. section, finally chosen, was an RCA 1610 crystal oscillator and an RCA 828 r.f. amplifier.

Choice of r.f. Circuit

In view of the fact that it was to be 100% band switching, pre-tuned tank circuits would have to be used. The pre-tuned exciter tank manufactured by *Millen* was chosen because of its compactness and because of its ready adaptability to the circuit. As for the Class C r.f. stage, individual *Barker & Williams* coils stripped of their isolantite bars and mounted as shown in the illustration, together with the *Cardwell* double-space low loss insulated transmitting condensers mounted beneath the chassis were also used.

In talking about band-switching and pre-tuned exciters, some one will surely mention plugin coils. There is nothing inherently wrong with plugin coils except that the inconvenience of rising, opening the top or bottom of a transmitter and placing the coils in their proper positions. If any one of the readers has ever used a table-mounted transmitter with the receiver alongside and the loud speaker on top the receiver, together with the usual papers that clutter up the operating desk, he can readily appreciate the difficulties and the annoyances involved in shifting from one band to another by means of plugin coils. Therefore our choice was a band switching unit.

The average amateur prefers to operate in one or, at most, two, different bands. The bands vary anywhere from 160 and 10 for the usual Class B licensed operator, to 80 and 20 for the Class A licensed operator. Interspersed between these two classes, are the code boys who like to use their 40 meter c. w. This eliminated any choice in the matter of band switching and it became imperative that the entire five amateur bands from 160 down to 10 meters be included in the table-mounting rig.

Bias Considerations

The *Thordarson* 19T60 power transformer furnishes 1500 volts at 300 ma. from the filter circuit and this was the power transformer chosen. A small power transformer sufficient to supply proper 400 volts voltage for the RCA 1610, the speech supply and the screen of the RCA 828 was also picked. In order to eliminate bias batteries for the Class C r.f. stage, it was decided to take the minus 100 volts required from the high voltage power supply, running the r.f. stage and the modulators at 1400 volts instead of 1500 volts. By this time the components of the rig had more or less resolved themselves into those which we finally did use. They appear in the parts list.

R.F. Chassis Construction

Before getting into the actual construction of the r.f. chassis, it would be well for the builder to study the illustrations showing the placement of parts. Do not only just "look," but really "study" them. For it is in the placement of the parts that the whole secret of the operation of the transmitter rests. After a full understanding of the parts placement is arrived at, then take the 17"x13"x3" chassis,

(*Pse QSY to page* 60)

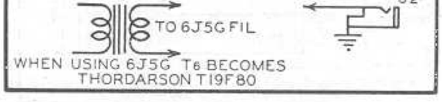
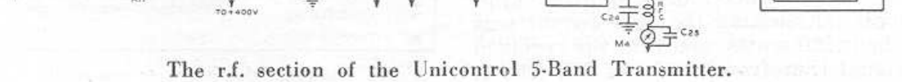
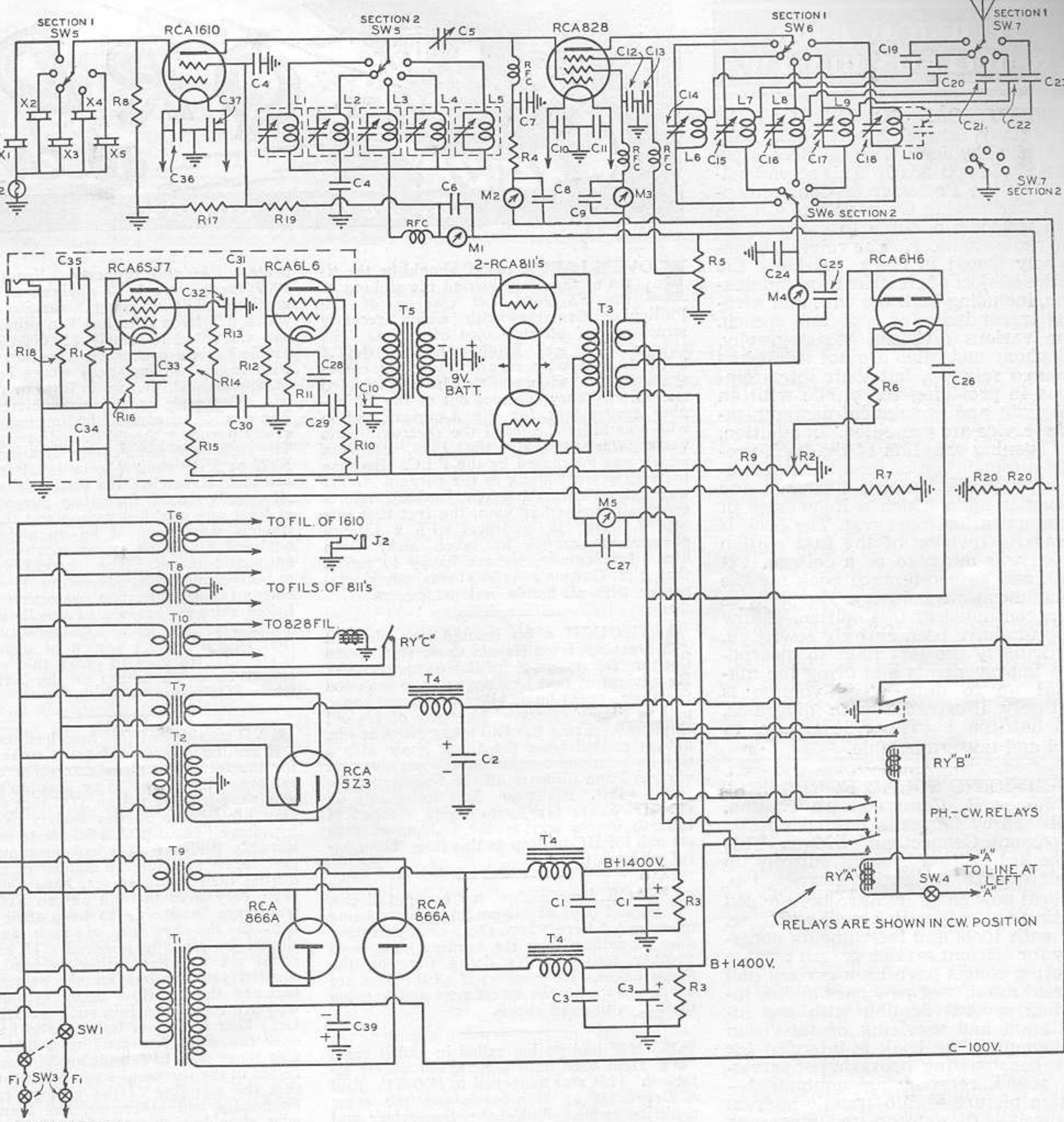


Diagram of the alternate oscillator.



The r.f. section of the Unicontrol 5-Band Transmitter.



C_1, C_3—2 mf. 2000 v. oil-filled. Aerovox.
C_2—8 mf. 800 v. electro. Aerovox.
C_4—.005 mf. 1000 v. mica. Aerovox.
C_5—75 mmf. variable. Cardwell ZR75AS.
C_6, C_7, C_8, C_9—.002 mf. 1000 v. mica. Aerovox.
C_{10}, C_{11}, C_{36}, C_{37}—.006 mf. 1000 v. mica. Aerovox.
C_{12}, C_{13}—.002 mf. mica. Aerovox.
C_{14}, C_{15}—mmf. Cardwell NP50DS.
C_{16}, C_{17}—75 mmf. Cardwell NP75DS.
C_{18}—100 mmf. Cardwell NP100DS.
C_{19}, C_{20}, C_{21}, C_{22}, C_{23}—.0025 mf. mica. Aerovox.
C_{24}—.002 mf. 5000 v. mica. Aerovox.
C_{25}—.002 mf. 1000 v. mica. Aerovox.
C_{26}—.5 mf. 200 v. paper. Aerovox.
C_{27}—.002 mf. 100 v. mica. Aerovox.
C_{28}—10 mf. 50 v. electro. Aerovox.
C_{29}, C_{30}—4 mf. 450 v. electro. Aerovox.
C_{31}—.1 mf. 200 v. paper. Aerovox.
C_{32}—4 mf. 450 v. electro. Aerovox.
C_{33}, C_{34}—10 mf. 25 v. electro. Aerovox.
C_{35}—.02 mf. 200 v. paper. Aerovox.
C_{39}—8 mf. 450 v. electro. Aerovox.
R_1—500,000 ohm pot. Yaxley.
R_2—50,000 ohm pot. Yaxley.
R_3—100,000 ohm, 100 watt. Ohmite.
R_4—10,000 ohm, 10 w. Ohmite.
R_5—25,000 ohm 50 w. with adj. tap. Ohmite.
R_6—10,000 ohm, 1 w. Aerovox.
R_7—100,000 ohm, 1 w. Aerovox.
R_8—40,000 ohm, 2 w. Aerovox.
R_9—50,000 ohm, 1 w. Aerovox.
R_{10}—10,000 ohm, 10 w. Ohmite.
R_{11}—500 ohm, 10 w. Ohmite.
R_{12}—500,000 ohm, 1 w. Aerovox.
R_{13}—250,000 ohm, 1 w. Aerovox.
R_{14}—1 megohm, 1 w. Aerovox.
R_{15}—50,000 ohm, 1 w. Aerovox.
R_{16}—2,000 ohm, 1 w. Aerovox.
R_{17}—30,000 ohm, 10 w. Ohmite.
R_{18}—5 megohm, ½ w. Aerovox.
R_{19}—30,000 ohm, 10 w. Ohmite.
R_{20}—500 ohm, 100 w. Ohmite.
T_1—Thordarson T19P60 plate trans. ("Converted")
T_2—Thordarson T19P54 plate trans.
T_3—Thordarson T19M16 modulation trans. ("Converted")‡
T_4—Thordarson T67C49 chokes (3).
T_5—Thordarson T19D02 driver trans.†
T_6—Thordarson 50F61 fil. trans.
T_7—Thordarson T19F83 fil. trans.
T_8—Thordarson T19F99 fil. trans.
T_9—Thordarson T19F90 fil. trans.
T_{10}—Thordarson T19F95 fil. trans.
Ry.A—DPDT 120 v. ac relay. Ward leonard 507-531.
Ry.B—DPST 120 v. ac relay. Guardian 21139.
Ry.C—Adjustable overload relay. Guardian X-100.
J_1, J_2—Single closed-circuit jack. Yaxley.
SW_1—DPST heavy-duty toggle switch. C-H.
$SW_{2, 4}$—SPST heavy-duty toggle switch. C-H.
SW_3—DPST door interlock switch. Bud.
SW_5—2 pole, 11 position selector switch, Shallcross 532 (xtal-tanks). See text.
SW_6—2 pole, 11 position selector switch, Shallcross 532 (both coil ends). See text.
SW_7—2 pole, 11 position selector switch, Shallcross 532 (1 section used). See text.
M_1—0-100 DCMA. Triplett Model 326.
M_2—0-50 DCMA. Triplett Model 326.
M_3—0-75 DCMA. Triplett Model 326.
M_4—0-500 DCMA. Triplett Model 326.
M_5—0-300 DCMA. Triplett Model 326.
X_1—28 mc. crystal. Hi-Power Ruby.
X_2—14 mc. crystal. Hi-Power Emerald.
X_3—7 mc. crystal. Hi-Power Emerald.
X_4—3.5 mc. crystal. Hi-Power Emerald.
X_5—1.7 mc. crystal. Hi-Power Emerald.
F_1—15 amp. 120 v. fuse.
RFC—2.5 mhy. RF Chokes. 125 ma. Millen.
Cabinet—ParMetal DeLuxe. DL 1713.
Chassis—ParMetal. 17"x13"x3" steel.
Panels—ParMetal. 19"x8¾" steel.
L_1—Millen 70225 Exciter tank.° "5 turns, #24e. 24 turns per inch."
L_2—Millen 70225 Exciter tank.° "9 turns, #24e. 24 turns per inch."
L_3—Millen 70225 Exciter tank.° "20 turns, #24e. 24 turns per inch."
L_4—Millen 70225 exciter tank.° "36 turns, #28e. 60 turns per inch."
L_5—Millen 70225 Exciter tank.° "90 turns, #31e. close wound."
L_6—Barker & Williamson 10 BX 10 meter coil.*
L_7—Barker & Williamson 20 BX 20 meter coil.*
L_8—Barker & Williamson 40 BX 40 meter coil.*
L_9—Barker & Williamson 80 BX 80 meter coil.*
L_{10}—B & W 160 BX.* Padded by 50 mmfd. air cond.

° Condensers included by manufacturer.

* Remove banana plugs and spacers.

† Use total primary: Secondary-connect G-G terminals to 2.4-2.4 lugs. Two black leads connect together for center tap. Red lead unused.

‡ Primary: Wire No. 1 & No. 6 to plates of 811's; No. 3 & No. 4 connect together, and are primary center tap. Secondary No. 7 connects to 1500 V.D.C., No. 10 connects to R.F. Amp. tank, No. 9 connects to plus 400 V.D.C., No. 11 connects to R.F. Amp. Screen, Taps No. 2, No. 5, No. 8 & No. 12 are not used.

RADIO PHYSICS COURSE

by Alfred A. Ghirardi

(Continued from March issue)

"Magnet" originated from the fact that the best specimens of lodestone were originally found mostly in the city of *Magnesia* in Asia minor. A knowledge of these stones reached Greece as early as 585 B. C. Magnets of lodestone are called natural magnets, because they are found in the earth already magnetized.
up in the first two laws of magnetic attraction and repulsion:

(1) *Unlike magnetic poles attract each other.*

(2) *Like magnetic poles repel each other.*

It has become common practice to call that pole of a magnet which is attracted toward the earth's north geographical pole, the *North* magnetic pole. Therefore, it is evident that since unlike poles attract, the earth's magnetic pole in the northern hemisphere must really be a *south* magnetic pole. Likewise, the earth's magnetic pole in the southern hemisphere is really a *north* magnetic pole.

The force of magnetic attraction and repulsion between two magnets decreases very rapidly as the distance between them is increased, and of course increases greatly as they are brought nearer together. This can be proved experimentally by placing the unlike poles of two bar magnets about one half inch apart and noticing the strength of the attraction, and then placing them about four times as far apart and again noticing the attraction. If a delicate spring balance were used to measure the force in each case, it would be found that when the distance is *increased four times,* the force of attraction or repulsion is only 1/16 *as* much. That is:

(3) *The force of attraction or repulsion between two magnetic poles is inversely proportional to the square of the distance between them.*

Representing the pole strengths by *m* and m^1 respectively and the distance between them by *d*, the force *F* is found from the equation:

$$F = \frac{m\,m^1}{d^2}$$

This relation is a very important one to remember. We shall see later that the distances between the stationary magnet poles and the poles on the moving parts of loud speakers are kept as short as is practical, in order to develop strong forces to move the loudspeaker cone or diaphragm. If the air gap is made large the speaker will sound weak. The reader will note the similarity between the laws of attraction and repulsion between magnets and the laws of attraction and repulsion between electric charges already stated.

When a magnetic substance is stroked by a magnet, the induced pole is opposite to the inducing pole. —30—

The Unicontrol 5

(Continued from page 22)

(1/16″ steel, cadmium plated) and paste a piece of wrapping paper over the top. On the paper you will first place the parts and indicate the holes.

After you have the locations of all the parts, so that each fits in its respective place, carefully saw and drill the chassis so that the parts can be fitted. At this time, *do not mount anything,* just write the name of the part where it will eventually fit, and proceed with the construction of the gear assembly.

Gear Assembly

As the gears come from the factory, they are bored to 5/16″. Since we use a quarter-inch brass shafting, the gears must be bushed. For this purpose we used a standard stock brass pipe, 5/16″ outside diameter by ¼″ inside diameter. Measure the width of the gear through the hole and then cut a piece of brass pipe exactly that long. Insert the cut piece, or bushing, into the gear and drive it home with a *wooden mallet* or a piece of heavy wood. Do not use a metal hammer since it will only serve to bend the brass bushing out of shape. Bush each of the eight gears in the same manner.

Take each of the gears separately and placing it in a vise, drill a set-screw hole through both the gear shaft and bushing. Do not drill all the way through the entire gear. With a well lubricated 8-32 tap, thread the hole previously drilled, using plenty of Lard oil, or similar cutting oil, in the process.

For those who are not familiar with tapping process, you make a quarter of a turn to the right after the tap has bitten in, and then back it off a half a turn. After backing it off a half turn, then make a three-quarter turn forward and back it off a half turn. By this method your threading is done with quarter-turn jumps. When the hole has been completely tapped out, it should accept an *Allen* 8-32 screw, ¼" long.

The *Allen* set-screw is used because it is made of hardened steel and comes equipped with a small recessed hole and a key by means of which it may be tightened far beyond that stage possible with an ordinary screw.

Converting the Switches

As the *Shallcross* switch comes from the factory, it consists of an uninsulated shaft for one section of the switch coupled to a second section with a small piece of isolantite. It will be necessary to convert *one* of these switches for use in the plate circuit of the final amplifier. This is accomplished by carefully taking the entire switch apart. Under the isolantite coupling piece will be found two screws, which should be removed. Insert two *Cardwell Trim-Air* condenser extensions into the holes previously occupied by these screws. The extensions should be tightened as far as possible in a vise. Using a *Bud* isolantite flexible coupling, the two sections of the switch are then joined together. The side stringers, previously used to hold the two sections of the switch together, are not used in this one unit, and the switch is mounted by means of *Cardwell* brackets with nuts and bolts through each one of the holes previously occupied by the stringer connector screws. On the end of the switches are mounted *Bud* or *Millen* isolantite couplings. These serve to isolate the shafts of the three switches, one from the other, since the gear-train assembly would short all of them to ground. The crystal switch is mounted by means of *Cardwell* brackets as is the amplifier-plate-tank switch, while the antenna switch is strapped to the plate tank switch.

Gear Parts Assembly

Study the mechanical drawing of the various brackets and the bakelite strip and then construct each bracket carefully and exactly, according to the specifications. Cut the brackets to size and then bend them, leaving the drilling to be done after the bracket has been formed. Do not attempt the construction of these brackets without a square since they form the foundation of the switches as well as the bearings for the gear train. If the bearings are not squared properly, the switches and gears will bind. After the brackets

(*Pse QSY to page* 64)

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(*Continued from page* 61)

have been formed, they should be drilled, according to the specifications. The plentiful use of Lard oil on the drill is recommeded.

Mounting the Gear Assembly

The switches, brackets, gears, etc., should be laid aside and the holes upon which the switches are to be mounted and the brackets to be fastened to the chassis, should be laid out on the chassis. Brackets and switches are fastened to their respective standards by means of 6-32 bolts and nuts, safetied with lock washers. Mount the gear train assembly brackets first. Thread the quarter inch brass shafting through the proper holes, using standard *Yaxley* quarter-inch panel bushings as bearings. Be sure that the shaft turns freely. Assemble the gears on the shafts in their approximate positions and tighten them lightly. Now mark and then cut the shaft to exact size. File a flat place where each bevel gear set-screw will "hit." Mount the switches as indicated in the illustrations and on the mechanical drawings. Assemble and mount the bakelite bracket, using *Yaxley* bushings throughout wherever the quarter-inch shafting passes through a hole.

Adjusting Gear Train Assembly

It is necessary, in order that the gear-train assembly run smoothly, that the adjustments and tightening of the gears and switches be accomplished with a certain routine. First, loosen all bushings so that they are "floating." Next, tighten up all insulator couplings so that the switches will track evenly. Starting with the gear at the end of the *Coto* wheel shaft, tighten this gear with the *Allen* key so that it meshes with the bevel gear driving the main length-wise shaft running parallel to the front of the chassis. Tighten the main driving gear on this shaft. Tighten the coupling between the crystal switch and the main drive shafting. At this time, a test should be made to see whether turning the *Coto* wheel turns the crystal switch and no further adjustments should be attempted until this particular switch turns freely and easily. Naturally, since the bushings are all "floating," there cannot help but be considerable "play." This is of no importance at this time. Having adjusted the crystal switch to perfection, the bevel gear at the other end of the main drive shaft is tightened and intermeshed with the driving gear to the final amplifier plate and antenna switches.

Tests should now be made to see whether turning the *Coto* wheel not only runs the crystal switch, but turns the shaft from which the final amplifier and antenna switches are to get their turning power, and no further adjustment should be made until this step has been accomplished perfectly.

Next, tighten the coupling between the antenna plate switch and its driving bevel gear. Placing the plate tank

switch in proper position so that it tracks with the crystal switch, tighten the driven bevel gear on the extension to the final amplifier switch. Next, intermesh the driving gear on the vertical shaft and tighten it so that it will drive the driven gear.

Tests should now be made to see whether turning the *Coto* wheel drives both the crystal and final amplifier tank switch and that these switches are tracking.

The adjustment and tightening of the antenna switch is but a repetition of the process applied to the final amplifier switch.

Completing the Gear Assembly

If everything has been worked out properly to this stage, turning the *Coto* wheel will serve to turn all three switches but there will be considerable "play." The elimination of this play is a slow, tedious, but exact process. Tighten up all of the *Yaxley* bushings closest to each of the three switches. Do this a little bit at a time, testing after each step to see that the switches turn freely, and that the shafting is not binding at any one point. When the bushings mentioned above, have been tightened as far as they will go, attention should be turned to the bushings in the various brackets and these should be tightened in the same manner. Eventually a stage will be reached where all bushings are as tight as they can be made and yet the switch assembly turns freely and smoothly. Do not rely upon oil at the bearings to accomplish this, but make each step carefully and slowly such that the shafting turns with a minimum of friction "as is". Upon tightening all of the bushings to a maximum state, as mentioned above, they should be locked to the chassis and brackets by means of solder. Use acid core solder, if necessary, wiping away all excess acid, and following it up with a bit of rosin-core solder.

Balance of the R.F. Assembly

The shield between the crystal and final amplifier stages should next be constructed and the tube socket mounted where indicated on the illustration. The under-chassis shield should be bent as indicated, inserted, and bolted down, lock washers being used throughout. Either a hole or a slot can be cut for the drive shaft of the gear assembly; but if the former is used the shield will have to be installed before the gear assembly is completed. With a small blow torch, or heavy iron, flow solder along the junction between the under-chassis shield and the chassis so as to make an electrically tight joint.

The balance of the R.F. components may now be mounted in order from the crystal stage forward.

Testing the Unit

While the use of standard *Barker & Williamson* coils is recommended, it may be found owing to vagaries in the wiring, (since no two hams wire alike) that the coil and condenser combinations will not hit the band for which the coils were purchased. This is overcome by taking off turns, one at a time, for each coil until that coil hits the crystal frequency with the final amplifier tank condenser 50% meshed. As many as four turns, two from each end, may be required to be removed. In the laboratory model, on the contrary, it was found that the 160 meter coil did not hit resonance because the condenser or the coil was too small. It was remedied by padding the tank condenser with a 60 micromicroferad fixed *Cardwell* air condenser *(Cardwell Type EE-60-FS)*.

The oscillator coils may also need considerable tailoring to accommodate the wiring. The actual coils used in the laboratory model were as follows:

160 meters—48 turns, close wound, No. 30 EC.
80 meters—30 turns, close wound, No. 28 EC.
40 meters—15 turns, No. 22 EC, spaced to ¾″.
20 meters—6 turns, No. 22 EC, spaced to ⅜″.
10 meters — 7 turns, No. 14, tinned, ⅝″ diam., spaced to 1″.

All the coils excepting the 10 meter coil were wound on *Millen* 1″ forms, while the last mentioned coil was self-supporting.

In testing the set, care should be taken to remove not only the plate but the screen voltage from the *RCA 828* while tuning the oscillator, since leaving the screen voltage on the tube with the plate voltage removed might cause its sudden destruction. While the *RCA 1610* is a standard oscillator tube, grid bias and screen voltage will have to be experimented with, in order to find optimum operating conditions.

After the laboratory model had been built and was working and because many of the amateurs still feel that they would not care to expend the additional money for a special oscillator tube both the *RCA 6V6* and *6L6* were tried as oscillators. Both of these tubes performed excellently and, as a matter of fact, gave increased drive on ten meters.

Suitable changes to accommodate the transmitter for *6V6* or *6L6* operation include the replacement of the 2½ volt filament transformer in the power supply chassis with one of similar physical dimensions delivering 6.3 volts A.C. at 1 ampere. The center-tap of the 6 volt transformer is not grounded and the ground end of the cathode of the crystal oscillator *6V6* or *6L6* is brought out to key-jack J2 with a .1 microfarad by-pass condenser to ground inserted in the R.F. chassis. The circuit for the optional additional crystal oscillator is shown. Metal tubes in the *6V6-6L6* class are to be preferred for this purpose over those made of glass since the feed-back trouble is minimized.

Conclusion

There are several points of general nature which should be considered by the constructor. Firstly, make sure that every connection is tight. You will regret a "Rosin-Core Jernt" more than you imagine. When the unit is finished, it will be very difficult to dig into its "guts," not only to find the bad connection but to get a soldering iron into the restricted space. "So make 'em good, and make 'em sure."

The switching from band to band with the power on is to be discouraged. Not only will this serve to burn the switch points, but the shock to the tube and the condensers is serious. *Before switching from one band to another, turn off the high voltage. It's safer.*

While on the subject of safety, do not forget to insert the interlocks on the top of the cabinet. True, there is no need for the interlock during the testing period. That's when you are on your guard. But later you will forget, and put your hand on some coil in changing crystals, or making some slight adjustment, and you will not remember the lethal 1500 volts coursing through the set. That is when the interlock will do you the most good. Don't leave it out for the sake of the few cents you will save. There is no chance for your electrocution from the back of the set, since you will find that its door cannot be closed with the chassis recommended. Remove the door entirely and construct a metal-cane cover to bolt over the entire back; and you *must* keep your hands out. That is what was done in the laboratory model.

Once the set has been completed, the antenna situation arises. Provision has been made for a double and a single-wire feed type to be used. Tune your antenna for each band separately. We used a 160 meter single wire feed, and found it satisfactory on all bands. Once adjusted, switching is sure-fire and more rapid than the other fellow can *QSY* on his receiver.

If the instructions have been carefully followed, the resulting transmitter will exceed your fondest dreams, and will leave the proud possessor of what might truly be called the "Rig of 1940". —30—

Servicemen's Cases

(Continued from page 34)

		second audio stage. Replace it with a 0.005 to 0.01-mfd. unit
Noisy reception	1)	noisy a-f transformer primaries
	2)	tube and circuit noises can be materially reduced by shunting each of the grids of the power tubes to the chassis with 56,000-ohm 1-watt resistors
"Frying" noise	1)	replace the first audio transformer
	2)	reverse the a-c line plug. One side causes more hum than the other
Volume control inoperative	1)	20,000-ohm green resistor "grounding"
Slipping dial	1)	check clearance between dial drum and volume control
	2)	pour some finely-powdered rosin between the disc and the engaging drum on the driving mechanism

FADA 30, 31

Same Case Histories as those listed for Fada 10, 11

FADA 32

Same Case Histories as those listed for Fada 16, 17, 20

FADA 35, 35B

Inoperative, Weak reception	1)	r-f coil lugs short-circuiting or grounding to chassis
Intermittent reception	1)	open-circuiting r-f cathode or plate by-pass condenser (block)

—30—