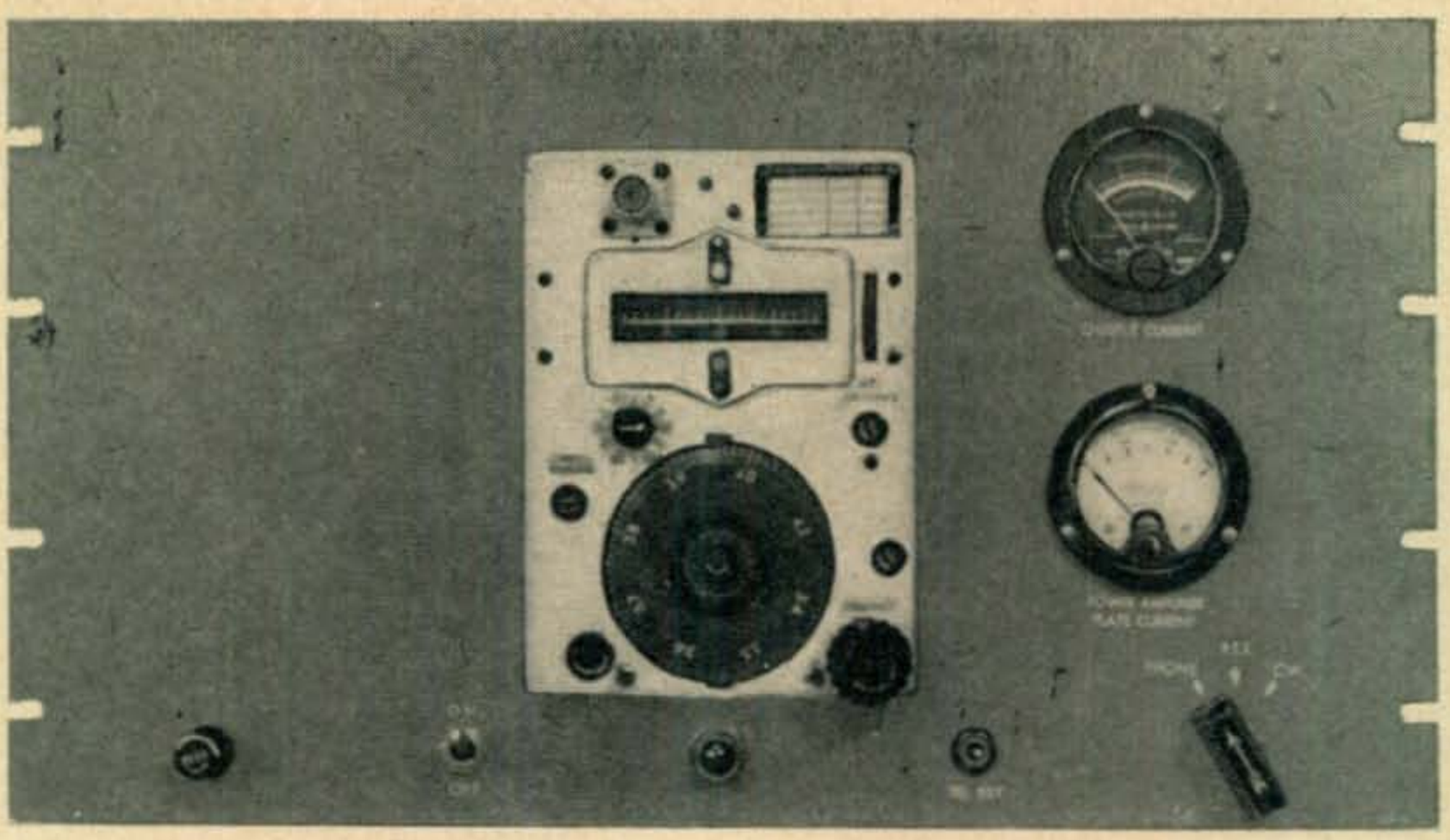

Fig. 1. An attractive appearance is easy to attain with 274-N transmitters.

SCR-274N Transmitter Modifications

JAMES N. WHITAKER, W2BFB*

Some helpful suggestions and words of warning to those planning to use these excellent units for amateur transmitter and VFO applications. Particular emphasis is placed on good keying.

THE SCR-274N COMMAND SETS have unquestionably been the most popular of all war surplus equipments for conversion to amateur use. The transmitters are by far the most useful of all units included. They not only are used as transmitters directly, but are also very popular as exciters and variable frequency oscillators for larger transmitters.

As is the case in most war surplus items, the amateur use of these excellent little transmitters requires a certain amount of modification. Articles too numerous to mention have been written describing various ways of modifying the units for amateur service, each modification having its own particular advantages and disadvantages. With such a well-designed piece of equipment to start with, it is reasonable to expect that the most satisfactory modification would be the one that disturbed the original circuitry the least. Actually, very little is required in the way of modifications to the sets which cover the amateur bands as is. For instance, the BC-696-A and the BC-459-A cover the 3.4–4 mc band and the 7-mc band respectively. The only absolutely necessary modification to these two units is the provision of a suitable output connection and a means for operating the keying relay. It is also generally desirable to parallel the heaters for 12-volt operation.

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If the unit is to be used as a VFO for driving a string of multipliers for operation in the higher amateur bands, it is wise to provide for operating the oscillator heater from rectified and fairly well filtered power. This is to prevent the slight amount of frequency modulation at a 60-cycle rate which is present in some instances when raw a.c. is used for the oscillator tube heater power. This frequency modulation is not sufficient to be noticeable on the fundamental or even at twice the oscillator frequency. It is also not present in all sets. It is present in some, however, and in some instance, is very noticeable on 28 mc.

The power requirement for the oscillator tube is rather low, and a 250 ma selenium rectifier followed by about 250 μf of capacity (dry electrolytic) is all that is required. Listen to the 28-mc harmonic of the transmitter with a good receiver. If no a.c. hum is noted, it is safe to say that your particular unit is free from serious 60-cycle frequency modulation.

The original schematic diagram is shown in *Fig. 2*. The modification preferred by the author appears in the modified schematic diagram, *Fig. 4*, which includes the changes required to produce satisfactory keying to be described.

Numerous ways have been suggested for changing the frequency of the BC-457-A (4–5.3 mc) and the BC-458-A (5.3–7 mc) to the amateur frequencies.

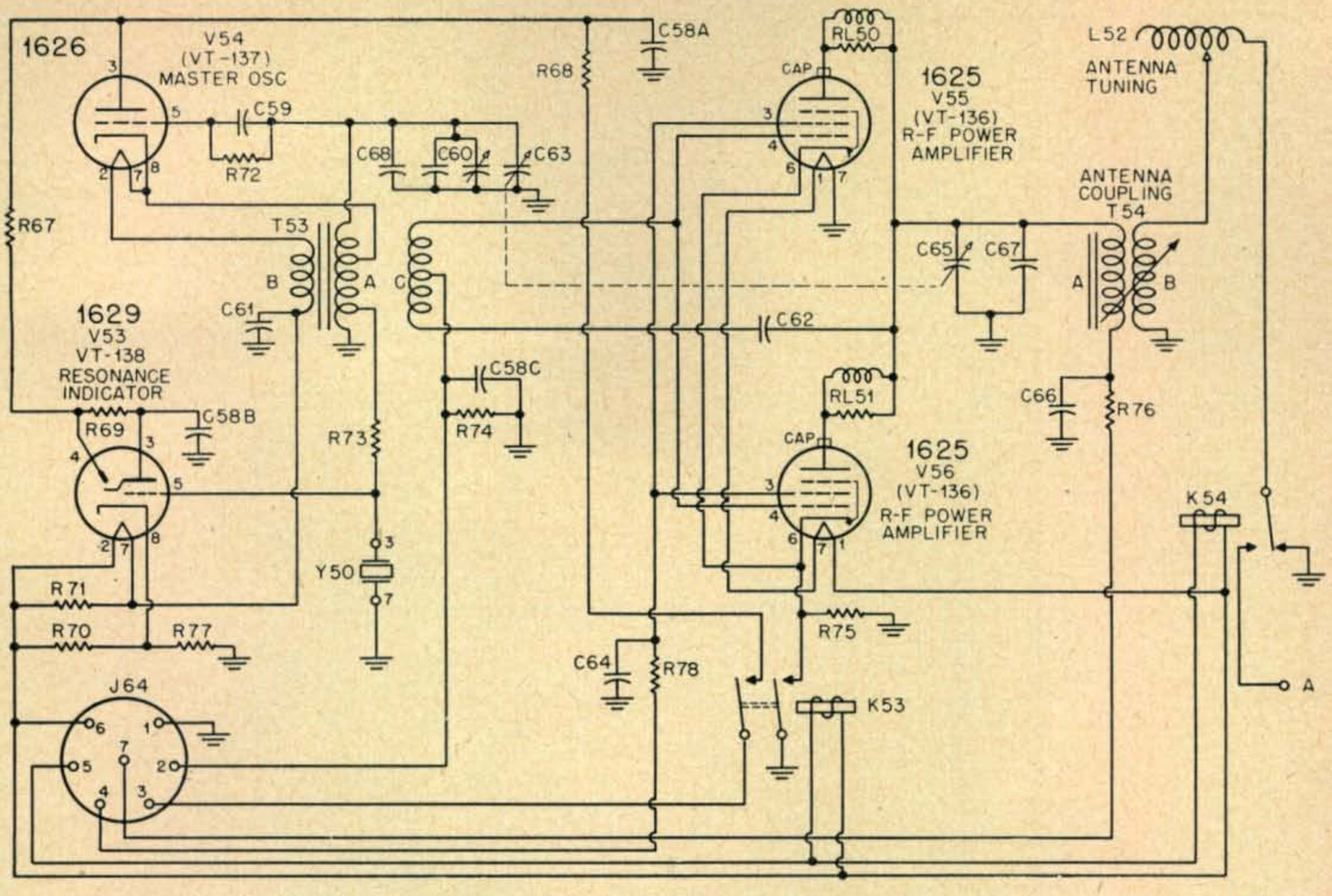

Fig. 2. The original circuit of the 274-N series transmitters.

Most of the suggested systems involve modifications to the inductances of the oscillator and P. A. tank circuits. The BC-457-A may be changed to cover the 3.5 mc amateur band by the simple addition of a good quality capacitor of between 25 μμf and 50 μμf capacity in parallel with the oscillator tuning capacitor, and by a readjustment of the variable padders in both the oscillator and P. A. plate tank circuits. The BC-458-A may be adjusted to cover the 7-mc band by simply adjusting the oscillator and P. A. padder capacitors.

To adjust the BC-457-A to frequency after adding the capacitor to the oscillator circuit, insert a 4-mc crystal in the crystal socket. (An FT-243 type crystal is excellent for this purpose, and is inserted in the socket using pins 3 and 7.) Next, remove the cover from the oscillator coil and capacitor assembly, using care not to disturb the iron core setting (screwdriver slotted screw on top, sealed with blue glyptal). Cut a screwdriver opening in the end of the shield opposite the variable capacitor shaft. Loosen the setscrews which lock the capacitor shaft, and replace the shield cover over the oscillator tuning assembly. Turn on the transmitter, and with the tuning eye in place, adjust the main tuning dial to 5.2. Adjust the oscillator padder until the eye indicates resonance with the crystal. The oscillator is now operating at 4 mc. Remove the oscillator tuning assembly cover, tighten the capacitor shaft lock setscrews, and replace the cover.

Tune the fixed padder of the P. A. stage for resonance as indicated by a minimum of P. A. plate current. If the iron cores in the tuning coils have not been disturbed, or if the coils have not been modified, the tuning will track over the entire range, and the new range will be 3.4 to 4.1 mc. The dial may be

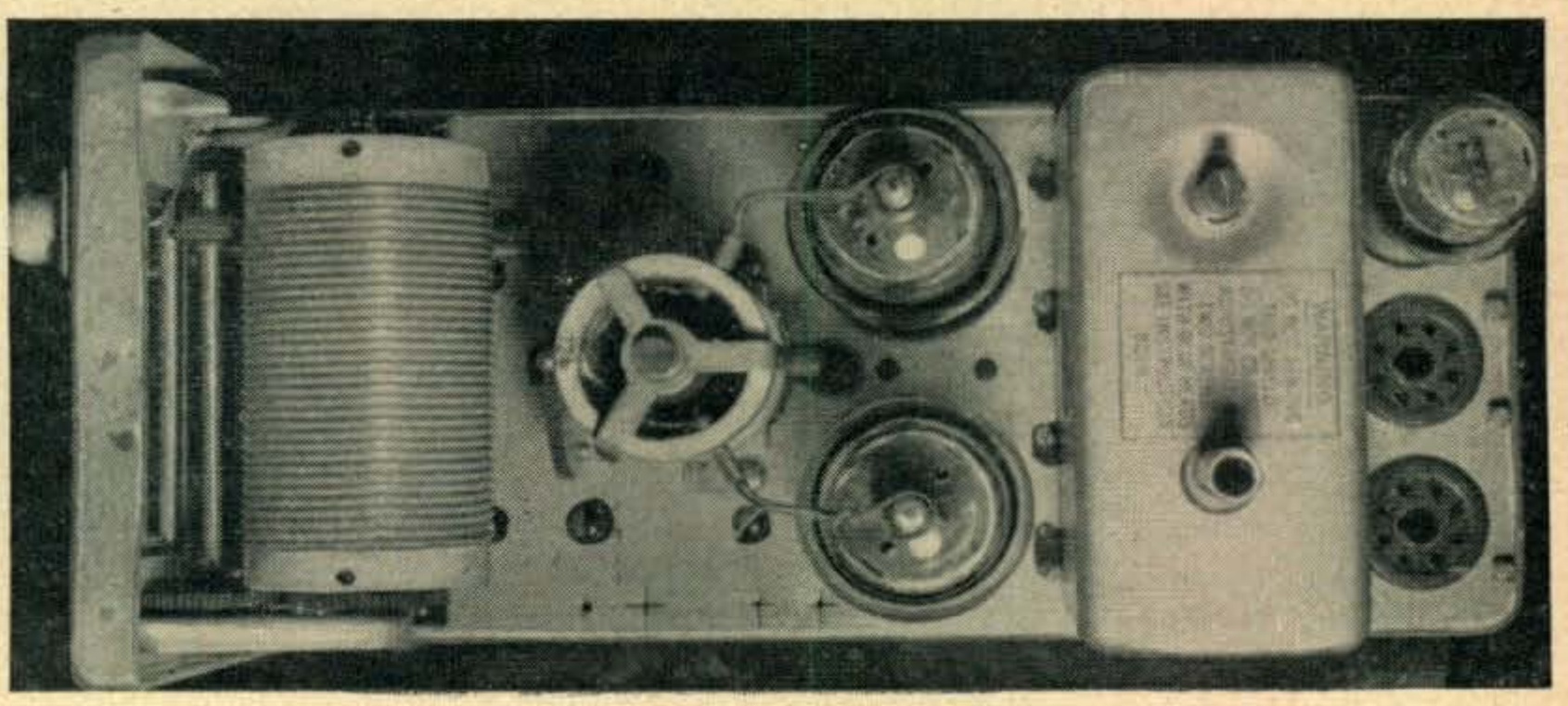

Fig. 3, illustrating the location of the mounting holes for the time constant capacitor C69.

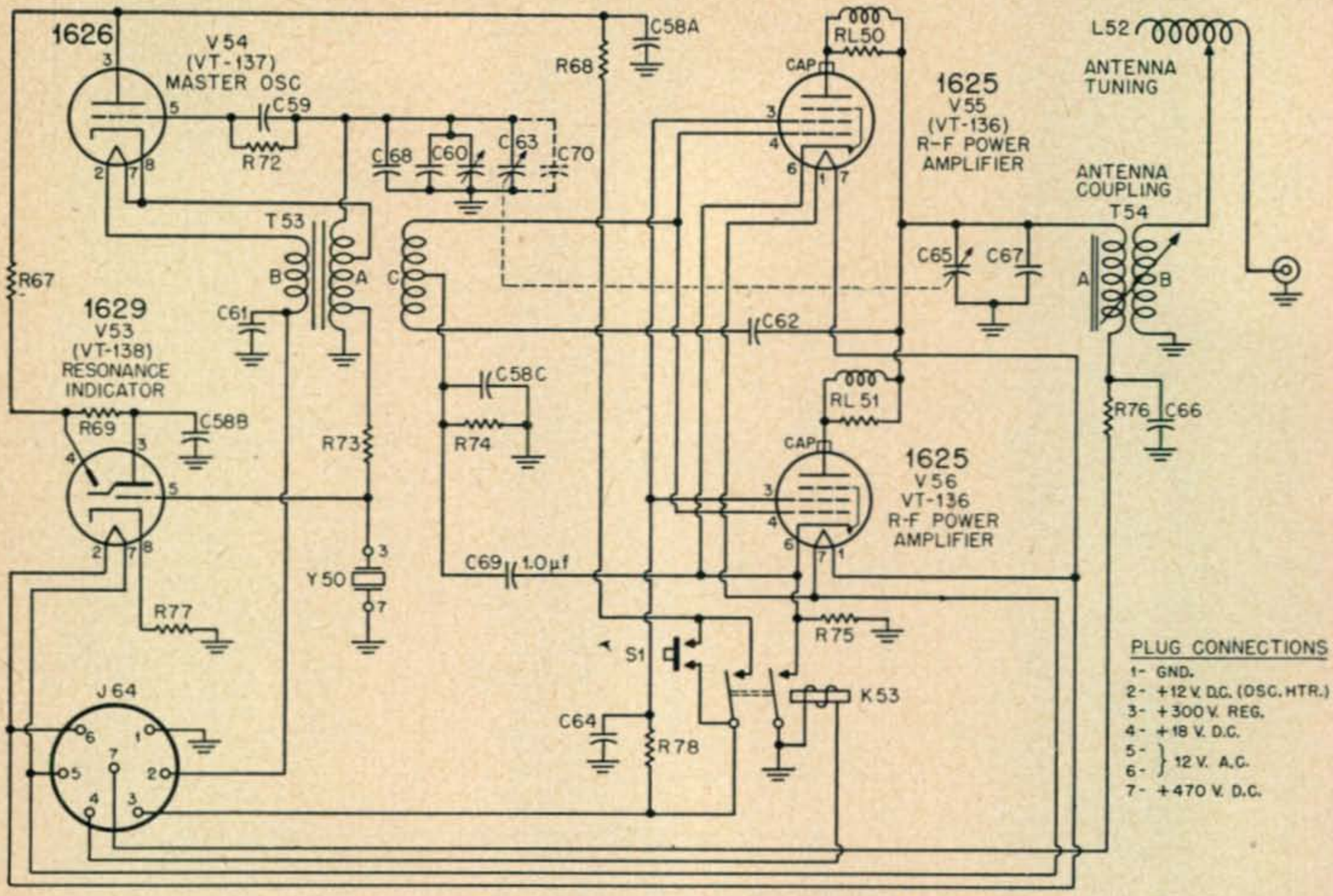

Fig. 4. The circuit of the modified transmitter. K53 is used as the keying relay.

C58A, B, C—.05 μf
C59—.00018 μf
C60—Osc padder
C61—.006 μf
C62—Fixed neut. cond.
C63—Osc. tuning
C64—.002 μf
C65—Amp. tuning
C66—.01 μf
C67—Amp. padder
C68—3μμf
C69—See text
C70—25 to 50 μμf (BC-457A only)
RL50, RL51—42 ohms
R67, R72, R75—51K
R68, R76—20 ohms
R69—1 meg.
R73—10K
R74—15K
R77—390 ohms
R78—51 ohms
S1—Push button osc. test switch

covered with paper and a new scale inscribed thereon, or the dial may be removed and turned down on a lathe, repainted, new calibration lines painted on, and new numerals added. (A handy numeral set is included in most popular panel marking decal sets.) The same general procedure is used when tuning up the BC-458-A for operation in the 7-mc band, except that a 7.5-mc crystal is used.

If the adjustment of the iron core has been disturbed, the transmitter may be completely realigned by first adjusting the oscillator section for the desired frequency coverage by tuning the padder capacitor at the high frequency end of the tuning range, and by adjusting the iron core at the low frequency end of the tuning range. It may be necessary to repeat this several times to obtain the desired frequency spread or to obtain coincidence between the frequency and the calibration of the dial.

Having adjusted the oscillator, the P. A. tank tuning may be made to track with the oscillator by using a similar procedure. Adjust the capacitance trimmer at the high frequency end of the tuning range, and adjust the inductance trimmer at the low frequency end of the tuning range, repeating the two adjustments until perfect tracking is obtained. This is the same procedure as is used in adjusting the gang-tuned stages of a receiver.

If the SCR-274-N transmitter is to be used as a complete transmitter, or if it is to be used as a keyed VFO, it will be necessary to clean up the keying. Many systems suggested in the past include radical modifications, with the installation of vacuum tube keyers in some instances. Let us bear in mind that whenever we make changes in one of these units, we are modifying a piece of precision apparatus and should disturb it as little as possible.

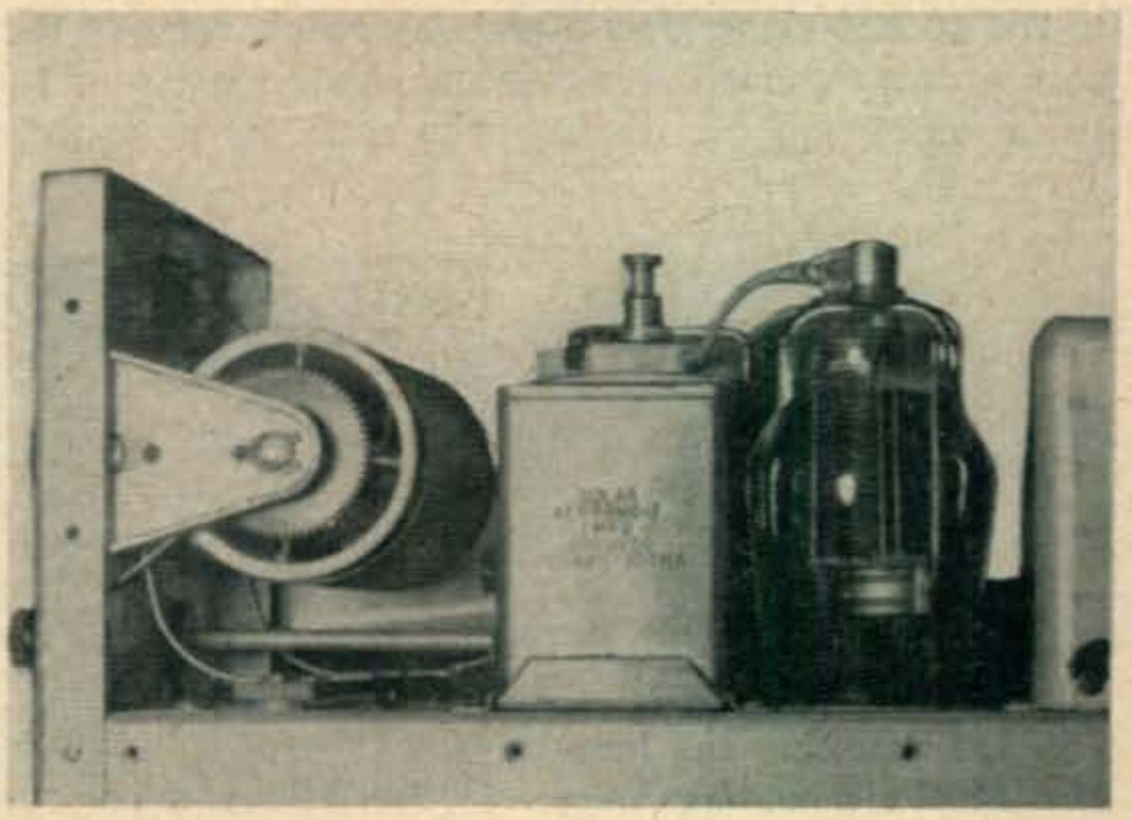

Fig. 5. Side view of the transmitter showing capacitor C69.

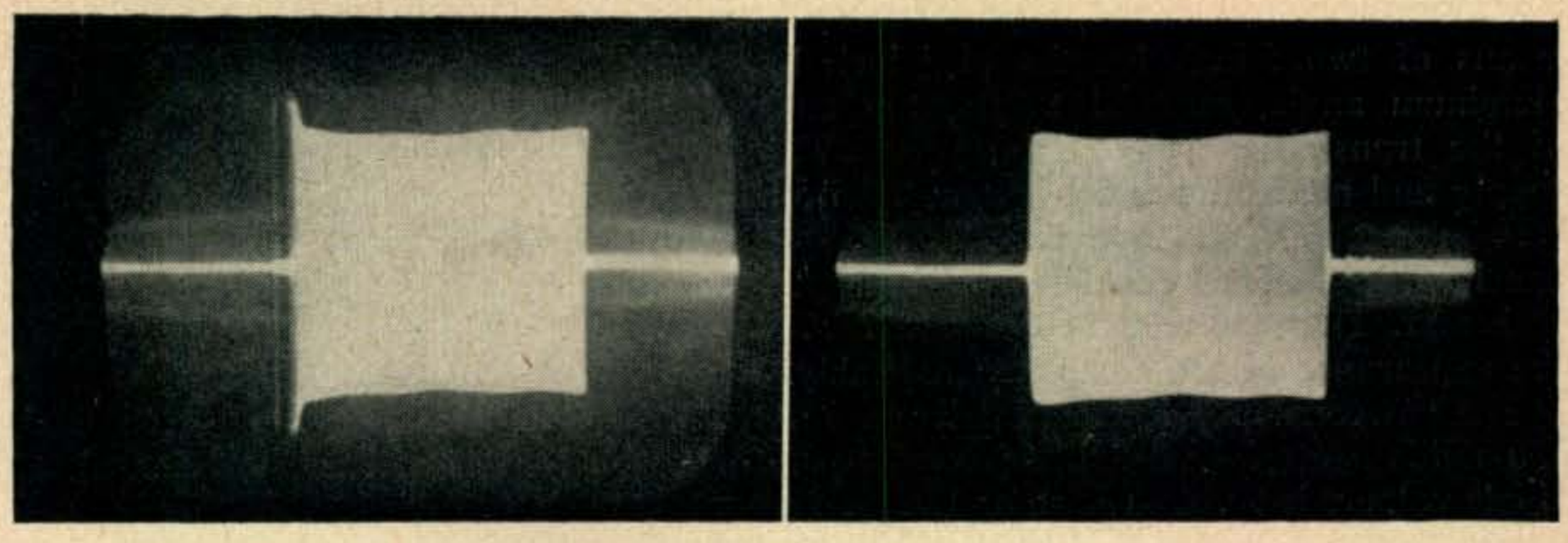

Fig. 6, L., the keying oscillogram before modification, and Fig. 7, showing the improvement attained.

Therefore, why not use the keying system included, after cleaning it up so that it is free from clicks, thumps, and chirps?

We have 12.6 volts available from the tube heater supply. From this we can get approximately 17.5 volts of d.c. for operating the keying relay by the simple addition of a low voltage senenium rectifier and a high capacity electrolytic capacitor. The keying relay will follow keying up to more than 40 words per minute with the power thus supplied if the relay armature and contacts are carefully adjusted.

The keying relay is quite noisy as it is. If this noise is objectionable, a short piece of small rubber tubing, soft plastic tubing, or "spaghetti" tubing may be placed over the armature arm stop. If this is done, the armature arm will require re-adjustment so that the relay contacts will open when the relay coil is de-energized. The contacts should be adjusted until the P. A. cathode circuit is closed just slightly before the relay armature comes to rest on the pole face of the relay coil. The contacts closing the circuit to the oscillator plate supply should be adjusted to close before the P. A. cathode circuit is closed. This is important if the operation is to be free from a keying "chirp." If the oscillator plate circuit is closed slightly ahead of the closing of the P. A. cathode circuit, the oscillator frequency will be stable before the power is actually applied to the P. A., and the "chirp" will not be present in the transmitter output.

The keying waveform before modification is shown in *Fig. 6.* Note the sharp spike just ahead of the main keying pulse, and the high amplitude of the start of the pulse. The sharp spike is caused by relay chatter, and the high amplitude at the start of the pulse is due to power supply regulation. Both of these faults are corrected very nicely by the addition of the time constant in the keying system, as is indicated in the oscillogram shown in *Fig.* 7.

The time constant which has been added to the keying circuit is a bit unusual in its operation. While the relay is open, the potential appearing in the cathode to ground circuit of the P.A. tubes will charge capacitor C_{69} through resistor R_{74}. When the relay closes, the terminal of C_{69}, which connects to the P.A. tube cathodes, is connected to ground. C_{69} then discharges through R_{74}, placing a negative potential upon the grids of the P.A. tubes, momentarily holding them at cutoff. As the charge is reduced in C_{69}, the potential across R_{74} is reduced, and the P.A. tubes start operating normally, until the full output is reached. This delaying action is just sufficient to produce a starting slope of approximately 2 milliseconds duration in the keying pulse, resulting in the desirable keying pulse shape shown in *Fig. 7.*

Figure 5 shows the location of C_{69}. This capacitor is a Solar No. XEMRBW6-1. This same type of capacitor is produced by several other manufacturers. (The JAN type designation is CP68B1EF105WK. These units are generally available in the surplus market at less than one dollar.) The mounting of this capacitor is rather simple. It involves the drilling of two one-half inch diameter holes and one small screw hole. One existing screw hole is used. This existing hole is used to fasten a wire clamp on the underneath side of the chassis. This wire connects to the antenna shorting relay. The antenna shorting relay is removed, and the wire is therefore no longer needed. The wire clamp bracket and the wire are both removed. The screw which originally held the clamp in place is now used to fasten one end of the capacitor bracket. The two ½-inch holes and the small screw hole are drilled in line with the wire clamp screw hole and spaced as shown in *Fig.* 3.

One very convenient arrangement when using a SCR-274N transmitter as a complete transmitter for phone-cw, work in the 3.5–4 mc band is shown in *Fig. 1.* The assembly pictured consists of a BC-457-A modified, as shown in *Fig.* 4, together with power supply and modulator units, all mounted on a standard 19-inch relay rack type of panel. The schematic diagram of the power supply, modulator, and the incidental connections between units and to the pilot light, switches, etc., is shown in *Fig.* 9. This arrangement includes a power switch and fuse, a pilot light, a plate current meter, an r.f. output ammeter, and a "phone"-"push-to-talk phone"-"c.w." selector switch. When operating "push-to-talk" phone, the push-to-talk switch connection is plugged into the telegraph keying jack.

An additional filter section is added to the P.A. plate power supply system when the unit is operating as a phone transmitter. This provides ample filtering to produce a hum-free signal for phone work. Type 1625 tubes are used in the modulator, since they are also used in the transmitter. Type 807 tubes could be used with identical results. Either type will provide sufficient power for producing 100% modulation of the power amplifier.

The panel used for mounting the entire system is made from 3/16-inch thick 24ST aluminum, 19 inches wide and 10½ inches high. A cutout is made in the center of the panel to accommodate the transmitter. The transmitter is mounted in place by

means of two 5-inch lengths of ½-inch by ½-inch aluminum angle, screwed to the top and bottom of the transmitter and to the panel. The power supply and modulator units are built on 5″ by 10″ standard chassis and are mounted end-on to the panel, with standard chassis panel brackets, two to each unit. The rear view of the unit, *Fig. 8,* shows the appearance of the completed assembly.

The power supply described delivers 470 volts at 170 milliamperes. Under these conditions, the a.c. ripple voltage is 9 volts r.m.s., or 1.92%. The output of the transmitter on c.w. is 38.5 watts, with an input of 56.4 watts to the p.a., representing an efficiency of 68%. The r.f. current into a 52-ohm load is 0.86 amperes. The output when operated with telephone modulation is reduced slightly due to the additional load on the power supply by the modulator tubes. The output under these conditions is approximately 35 watts.

The values given in the parts list of *Fig. 4* are taken from the instruction book covering this particular equipment, with the exception of C_{69} and C_{70}, and are listed for the convenience of those who may not otherwise have access to this information.

The SCR-274-N transmitters will perform very satisfactorily if treated properly and if not altered unnecessarily. Make as few changes to the frequency determining portions of the circuit as possible; don't try to overload the output stage, regulate the plate supply to the oscillator and to the screen grids of the power amplifier, and you will have a signal that will be outstanding in quality and a joy to copy.

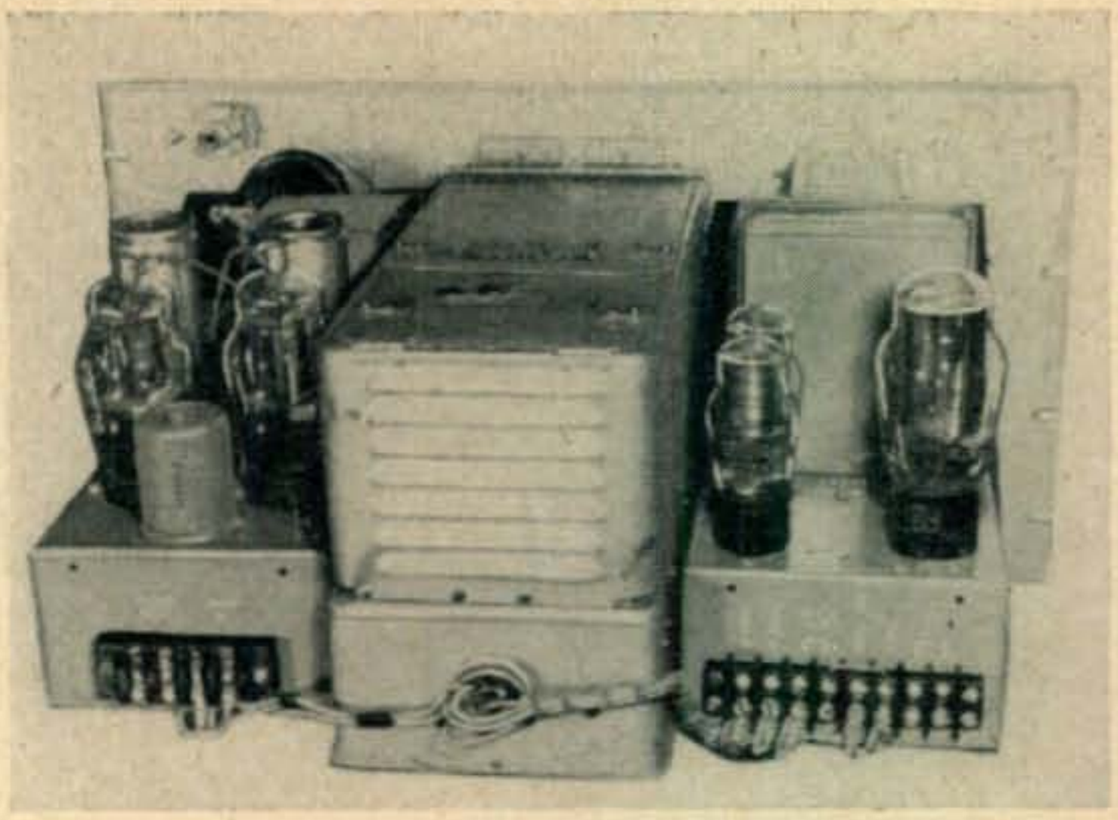

Fig. 8. Rear view of complete phone/c.w. transmitter.

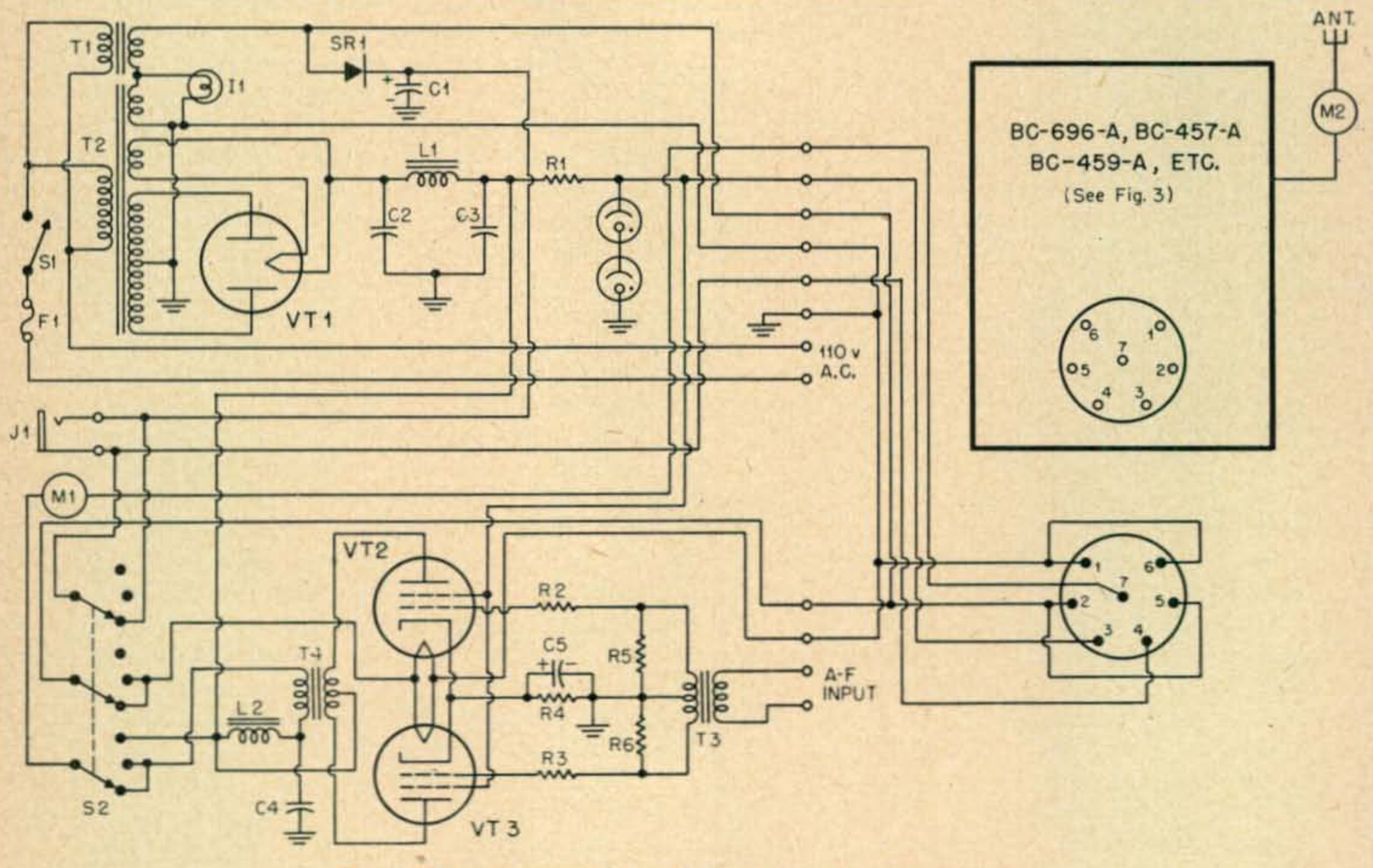

Fig. 9. The power supply, modulator, and interunit cabling.

C1—500 μf, 25-volt dry electrolytic
C2—1 μf, 600 v., oil filled
C3—10 μf, 600 v., oil filled
C4—4 μf, 600 v., oil filled
C5—40 μf, 150 v., dry electrolytic
L1, L2—Thordarson T-20C64 chokes
R1—5K, 20 w., wirewound
R2, R3—500 ohms, 1 w.
R4—250 ohms, 5 w., wirewound
T1—6.3 v. at 3 amp, fil. trans.
T2—Plate and filament transformer, 400 v. each side c.t. at 250 ma, with 6.3 and 5 v. windings
T3—Mike or line to grid trans.
T4—25-watt modulation transformer, select to match p.o. 807s to 3,000-5,000 ohm load
S1—S.p.s.t. toggel switch
S2—Three-pole, 3-position wafer switch
SR1—Seletron 1M1 selenium rectifier
F1—Bussman type 3AG 3-ampere fuse
I1—6.3-volt pilot lamp
J1—Single-circuit jack
M1—0-300 ma d.c. miliammeter
M2—0-3 amp r.f. ammeter