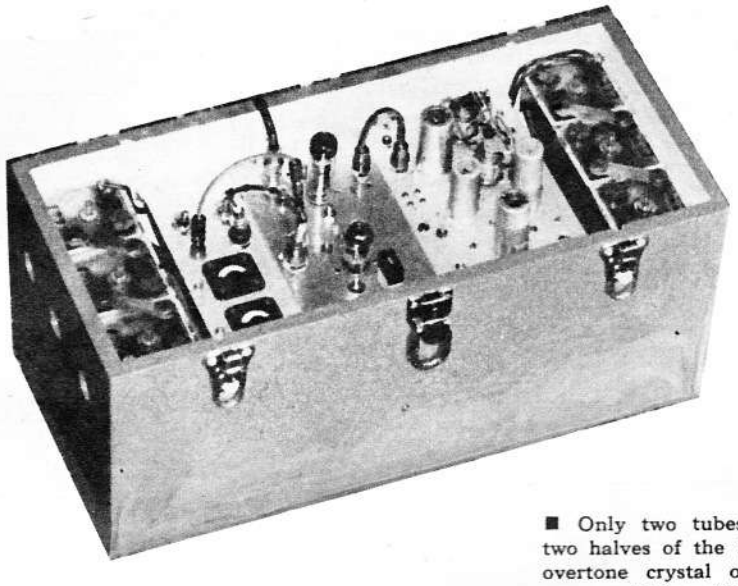


By JOHN W. HAMBLEN W3TIK

RADIO CONTROL ON THE TECHNICIAN'S BAND:

220 MC. TRANSMITTER

Companion unit to 220 megacycle receiver of last issue, this sturdy unit is for any class except Novice

■ Only two tubes are employed, the two halves of the 12AU7 serving as an overtone crystal oscillator and a frequency tripler. Thus, the crystal frequency is multiplied nine times when we come to the grid circuit of the power amplifier. The 6360 is employed as a push-pull tripler, giving output at 27 times crystal frequency. As much as 3 W. has been obtained, but 1.5 W. is adequate, and can be had using standard vibrator power supplies. Note that no neutralization is required in the transmitter, an important feature deemed necessary for ease of tune-up by the newcomer to VHF.

Standard crystals in the frequency range of 8.15-8.33 mc. have been found to work very satisfactorily, and can be had at surplus prices (99¢ each from Sun Radio, 520 10th St., N.W., Washington, D.C.). It is wise to select a frequency near the center of the band, to avoid possibility of out-of-band operation, since normal crystals used in overtone oscillators do not operate at exactly three times their fundamental frequency.

Simple capacity coupling is used between oscillator and tripler, while inductive coupling was found better between the second half of the 12AU7 and the 6360. Metering of the 12AU7 is had by connecting a ma. meter from test points 1 or 2, to ground. A separate plate lead is brought out from the 6360, and it is wise to connect a meter permanently here.

Construction. The chassis is a plain aluminum plate, and parts placement shown should be followed carefully. The newcomer to 220 mc. will soon learn that short leads in the RF circuits are a must; for example, plate connections between the socket and tuned circuit of the 6360 are to be just as short as possible. Sloppy wiring will mean that you might not be able to tune up with the values of coils and condensers given. The circuit follows right across the chassis, from the crystal and L1 at left, to L4 and the antenna terminal at far right.

L1 is made from 24 turns cut from a commercial inductance, and is center-tapped. One half is tuned by C1, while the other half furnishes the needed crystal feedback. Solder one end of L1 to the crystal socket and the other to the stator of C1. The tap goes to a tie-point, and furnishes added support.

The tuning range of L2—if made according to the parts list—should be 73-75 mc., and it is tuned solely by circuit and tube capacitance across it.

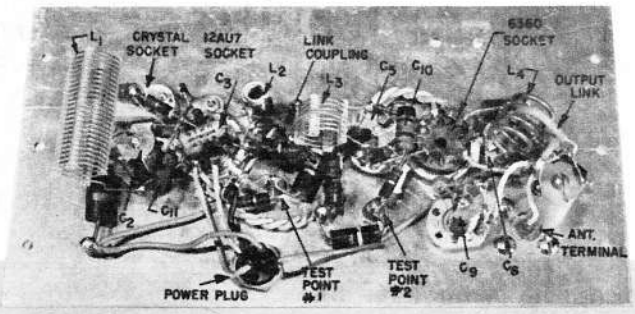
L3 is cut from the same sort of coil as was L1, and is also center-tapped. The outside ends go to the two fixed plates of C2, with the tap held on a tie-point. It was found necessary to add a small fixed capacity (1.5 mmf.) across C2, to lower the tuning range a bit.

L4 is four turns of #14 solid copper wire, wound on the shank of a 13/32" drill, and spaced to mount diagonally across the fixed plates of C3.

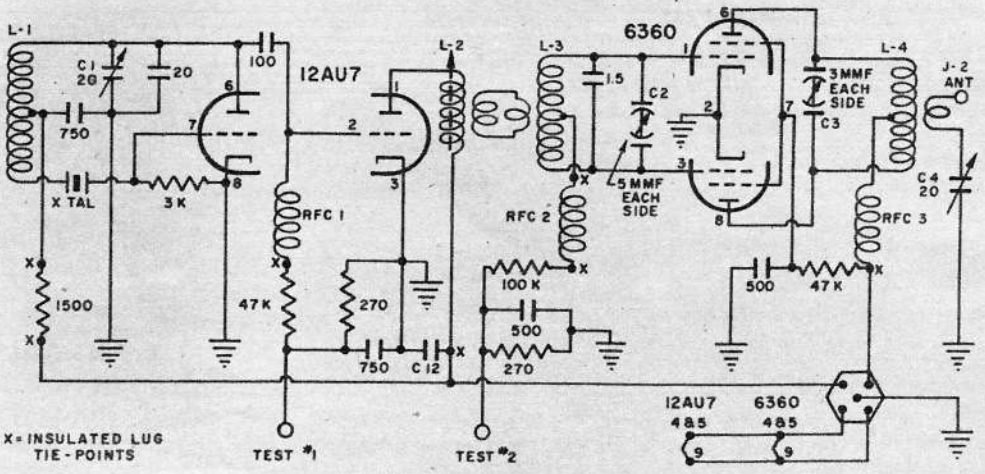
A link with two turns of flexible hookup wire around the *base* (end connected to C12) of L2 and one turn around the *center* of L3 couples these inductances.

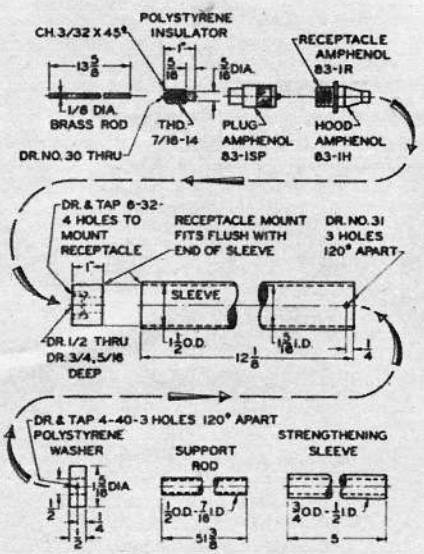
Output coupling is accomplished by a single turn of insulated wire around the center of L4.

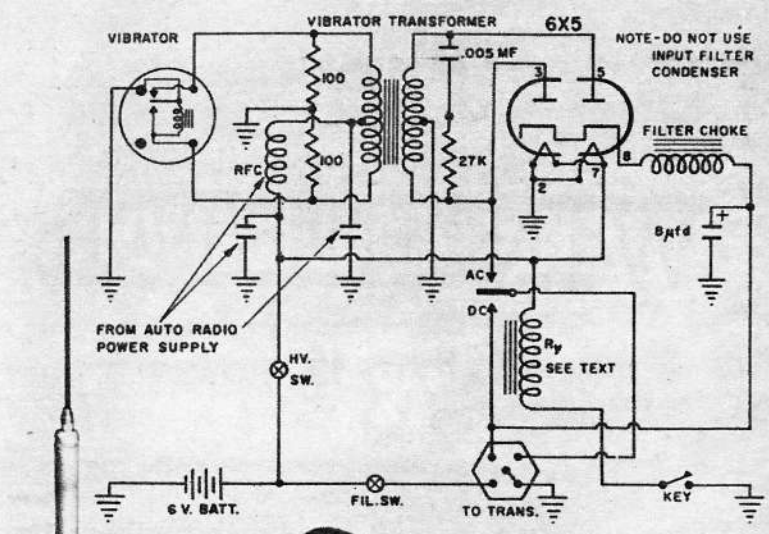
Note that quite a few tie-points are used, to anchor loose ends of parts, when wiring up. A check of the top and bottom views will show where these go; such points are marked "X" on the circuit diagram. Test points 1 and 2 are simply insulated feed-through insulators



Object here is to keep all leads to absolute minimum length. Follow the chassis layout exactly.







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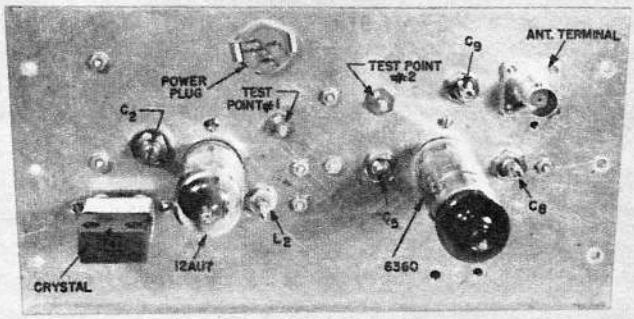
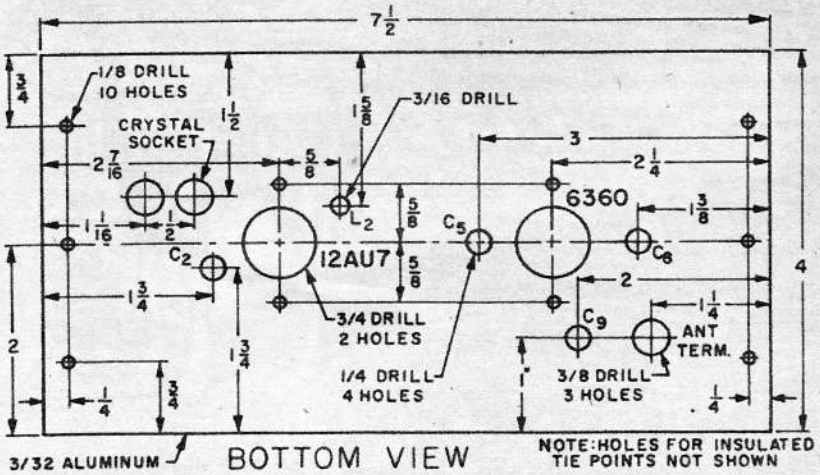


Top view of transmitter. In photo, top page 52, you see earlier modulator. Schematic is of the improved version.



and also function as tie-points. Keep all leads carrying RF as short as possible. Heater and DC leads may be laid out as you wish.

Adjustments. You can connect power to the 12AU7 separately, or in combination with the 6360, by utilizing the correct leads of the power socket. For line-up purposes, use a supply giving about 200 V. and run 6 V. (either AC or DC) to the heaters. Connect a 100 ma. meter in series with the lead to the two halves of the 12AU7, with only filament power going to the 6360. Connect a 5 ma. meter between test-point 1 and chassis, and note reading as you rotate C1; you should find one setting of C1 that gives a noticeable peak reading. If you don't, and a check shows everything wired properly, try another crystal. (14 surplus crystals were tried and only two refused to work). You should get about 2.5 ma. reading here.

Now shift the 5 ma. meter to test-point 2, and tune L2 and C2 for maximum reading, which should be about 1 ma. If you get nowhere near this, get no indication at all, or can't get a definite maximum as L2 and C2 are rotated through their ranges, make a little RF indicator. Bend a piece of insulated hookup wire into a 1" loop and solder the ends to a 60 ma. pilot bulb (pink bead). Hold the loop near the L2 and turn the screw to get maximum brilliance. If you can't get a good bright light here, it is likely that your wiring differs somewhat from that of the original unit, and you should try adding or taking off a few turns.

If L2 tunes OK and you get a good indication on the bulb when it is held near this coil, but can get nothing when it is held near L3, it is possible that you may need another value of capacity in place of the 1.5 mmf. (or perhaps you can do without this capacity entirely). When all circuits up to and including C2 are tuned properly, you should read about 1 ma. at test point 2 (other end of 5 ma. meter to chassis) and 34 ma. in the plate supply to the 12AU7.

Shift the 100 ma. meter to the plate lead from the 6360, connect 200 V. to both tubes and tune C3 and C4 for maximum output. A lamp load should be made from a 6.3 V. *blue bead* pilot bulb connected to a 3" piece of co-ax cable and a plug to fit the antenna socket. Move the coupling link in and out of L4 and retune C3 and C4 for greatest brilliance. Best coupling will give about half full brilliance, and a plate current reading of about 40 ma.

Modulator. The transmitter is powered with a vibrator pack removed from a discarded auto radio. The power supply also acts as a modulator; the relay shifts the 6360 power output tube from the normal DC output of the vibrator supply to the AC appearing on one half the secondary winding. In the AC position, the square-wave voltage provides negative modulation and the power output will drop to about ½ the value obtained with DC. This gives a very effective modulation, with the receiver described in the February '55 issue. Because of the added load on the transformer secondary in the AC connection, it is necessary to change the buffer condenser normally connected across the secondary winding, to prevent excessive arcing in the vibrator. The 27K resistor and .005 mf. condenser shown here have been found adequate in all units tried so far.

The relay is not a critical item, but should be able to follow the fastest pulses you get from your control button

(*Continued on page 89*)

220 Mc. Xmtr

(*Continued from page* 53)

or pulse box. The armature should be insulated from the chassis.

Antenna. An exploded sketch of the original antenna is shown. It is of the co-axial type, and the one shown was made entirely from aluminum. Copper tubing from a plumbing supply shop will work very nicely, and you can then soft-solder the parts. The only critical dimensions are the length of the antenna rod and the outer co-ax sleeve. The latter may be as small as 1" in diameter, with little change in output. The supporting rod may be of any length—the longer the better—the only limitation being ease of portability. This rod should not be greater than ½" in diameter; if smaller than shown, bear in mind that the co-ax cable must pass through the center. The 5" length of larger diameter tubing at the lower end of the support serves merely to afford extra strength at this point.

The center conductor of a 73 ohm co-ax cable is extended ¼-wave beyond the upper end of the line (by means of the ⅛" dia. brass rod), while the outer sleeve surrounding the support rod acts as another ¼-wave; the latter is connected to the outer conductor of the co-ax at the upper end, while the lower end is insulated from the support rod.

No special tests are needed on the antenna, except to check it with an ohmmeter to make sure there is no connection between the co-ax conductors. Best results will be obtained if a field strength meter is used to check output, while C3 and C4 are tuned for highest reading. With an antenna of this type, it makes little difference what sort of surface the transmitter is placed upon, and the key lead will not be "hot" with RF—a welcome difference from the usual situation with most 27¼ mc. transmitters.

Parts List

Resistors (all ½ W. carbon): one 1500 ohms, one 3000 ohms, two 270 ohms, two 47,000 ohms, two 100,000 ohms. Fixed condensers (all Erie Ceramicon GP except as noted): one 1.5 mmf., one type NPO 20 mmf., one type NPO 100 mmf., two 500 mmf., three 750 mmf. Variable condensers (all Johnson Miniature type): C1, C4—Type 20M11, 20 mmf.; C2—Type 5MB11, 5 mmf. per section; C3—type 3MB11, 3mmf. per section. L1—24 turns of B & W Miniductor #3003; L2—15 T #28 enam. wire spaced to occupy ½" on CTC type LS-6 coil form (use white slug); L3—7 turns B & W #3003; L4—see text. RFC1100 uh; RFC2—50 uh; RFC3—1 uh; all National type R33. Two 9-pin tube sockets and one crystal socket. 5-pin plug and socket for power leads. Antenna receptacle and plug, Amphenol type BNC 31-003 and 31-002; co-ax cable as needed—RG 59/U. One each, Amperex 6360 and 12AU7 tubes. Antenna parts as in Fig. 5. Power supply parts as in schematic.