Breaking into the Amateur Game

Part III—The Transmitter, Power Supply and Antenna

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IN the last article we discussed the requirements of the amateur operator's examination; this included a description of a low-priced transmitter suitable for a beginner. The simplicity and cheapness of it will probably surprise the reader, but though using no more power than a large receiver, it is nevertheless a transmitter capable of sending signals considerable distances. Most amateurs commence transmitting with just such apparatus, and invariably increase it as they gain experience in its operation. This transmitter is mainly for Morse work.

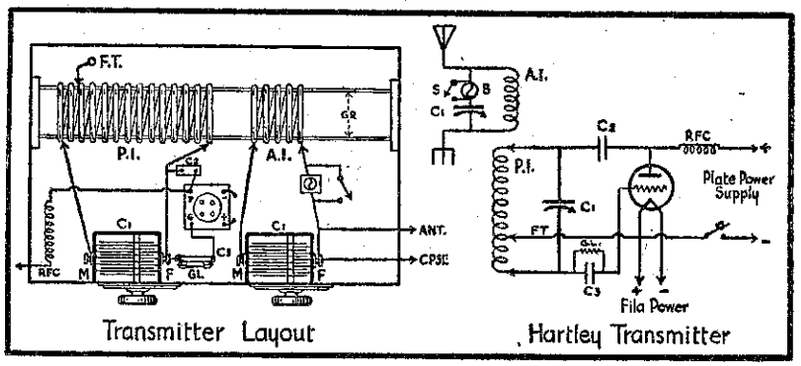
In general, a transmitter may be divided into three parts—the transmitting circuit, the power supply, and the antenna, each of which will be dealt with in turn.

The Transmitting Circuit.

THERE are several different types of transmitting circuits, with different numbers of valves, but the great majority of amateurs use only a single valve, which is simply an oscillator, or generator of radio-frequency current, as in the transmitter described. Now with an oscillator, as with a regenerative receiver, there are only two fundmental circuits, which are those using inductive coupling feed-back from the plate to the grid to cause oscillation, and those using capacitive coupling feed-back. A circuit consists simply of a means of varying this feed-back, of varying the frequency of the wave, and of resonantly coupling the antenna circuit to the oscillator. The chief factor in a circuit is to get the largest output for a given input, other things remaining equal, but in this respect, however, there is no circuit particularly better than the others, as each will give the same performance, if correctly adjusted, which is important.

The circuit shown here is simple and popular, and is just as efficient as any other when handled correctly. It is known as the Hartley circuit and employs the inductive coupling method of plate to grid feed-back. The plate inductance (PI) is virtually divided into two by the tapping from the filament (FT), making the smaller portion in the grid circuit and the larger in the plate circuit, and induction between these two portions maintains the feed-back and oscillation. The amount of this feed-back will be varied by the number of turns in both the grid and plate parts of the coil, thus by changing the point of tapping of the filament clip. For best results it should be on about the fourth turn from the grid end of the coil.

As with a receiver, the frequency of the wave will be varied by means of the variable condenser C, across the plate coil. The wavelength span with the coil shown is from 70 to 100 metres approx., so as to get the 75-85 metres amateur band in comfortably. For the other bands a proportional number of turns in the coil would be used—e.g., for the 40-metre band, seven turns. It is in this condenser-coil circuit that the heaviest R.F. currents flow, these being much greater than those in a receiver, hence the necessity for heavy conductors in the inductances, etc., as later described. The antenna circuit is coupled inductively to the oscillator through the antenna coil (AI), resonance being obtained by tuning with the antenna condenser C, and indicated by the lighting of the bulb B, as in the absorption wavemeter described in the last article.



HARTLEY TRANSMITTING CIRCUIT.

AI.—Antenna Inductance.
PI.—Plate Inductance.
B.—6-v. Torch Bulb.
C1.—.0005 mfd. Var. Condensers.
C2.—.002 mfd. Plate Blocking Cond.
C3.—.00025 mfd. Grid Condenser.
GL.—5000 to 10,000 ohm Grid Leak.
K.—Morse Key.
RFC.—Radio Frequency Choke.
S.—Shorting Switch.
V.—Receiving Valve, UX-201A, 112A, or 171A.

Making the Transmitter.

NOW for the individual parts of the transmitter. Firstly, all are mounted, as shown in the plan diagram, on a wooden baseboard, about 14in. x 8in., which should preferably be shellaced. The layout of the parts need not be strictly adhered to, but as all leads are conveniently short, it is hard to better. For the low power input being used, the valve V may be any receiving type such as UX-201A, 112A, or 171A. The power amplifying valves give a little more output than the 201A, but the latter is entirely satisfactory for this transmitter If the input is later increased, however, larger transmitting valves will be necessary, its size being directly dependent on the input used. An ordinary UX type socket with terminals arranged as in the plan holds the valve.

The two variable condensers, C, are simply good receiving type condensers of a .0005 mfd. capacity, with any kind of dial (not necessarily slow motion), and mounted on short strips of ebonite screwed to the front edge of the baseboard, a whole panel being superfluous. It will be seen in the plan diagram that connections to the moving plates of the condensers are made to the metal frames at either side, thus simplifying wiring. For this purpose most condensers have convenient screws and nuts, which may be used as terminals, holding the frame together.

Next come the plate and antenna inductances. They consist of about 3-16 in. diameter soft copper tubing, wound in 3in. diameter coils, with approx. 3-16in. spacing between them. Once wound, the coils are self-supporting and need no former, thus avoiding dielectric losses. There are fourteen turns in the plate coil, requiring 12 feet of tubing and 5 turns in the antenna coil, requiring 4 feet. For winding the coils, a 3in. diamater former, preferably wooden, is used, and the tubing wound on with the turns touching. The former is then displaced with, and the turns pulled apart, until the desired spacing of 3-16in. is obtained. On the baseboard the coils are mounted on two ¼in. diameter glass rods (GR), 2½in. apart, running the length of and 1in. above the baseboard, and held in place by two wooden blocks with suitable grooves.

A simple means of sending "'phone" with the transmitter is shown in Fig. I. From the grid end of the plate coil a similar coil of about three turns is coupled about ½in. away, and an ordinary carbon telephone microphone connected to its ends. This system of modulation is not very efficient. It is known as "loop" modulation.

The antenna coupling, or amount of RF energy transferred from the oscillator to the antenna, is varied by sliding the antenna coil along the glass rods to or from the plate coil, and the distance between the two should not be less than 2in. or the tube may be put out of oscillation.

The purpose of the radio frequency choke (RFC) is to prevent the RF currents generated from leaking away into the power supply, but to allow the D.C. to pass. The choke is a coil of 150 turns wound on a half-inch wooden dowel with about 30 g. d.c.c. wire, and mounted with small clips.

C2 is the plate blocking of condenser, which allows the R.F. current to pass, but blocks the D.C. It may be any receiver type fixed condenser of capacity .002 mfd., but as the whole plate voltage is across it, it should have good insulation, say 500 volts test.

The grid condenser (C3) is for the purpose of passing R.F. voltages on to the grid, causing on it a charge which is eventually allowed to leak off by means of the grid leak to the filament. For this transmitter the grid leak may be any 5000 to 10,000-ohm resistance, and the grid condenser a .00025 mfd. fixed receiver type.

In the antenna circuit the bulk B is an ordinary 6-volt torch bulb in a suitable socket, with a small shorting switch, which is closed after the antenna has been tuned, as later described.

No metres have been included in the transmitter, as for the power used they are not absolutely neeessary, and would add considerably to the initial cost. If the constructor does not mind this, however, suitable metres would be a filament voltmeter, a plate milliammetre, reading 0—100 mills., and an r.f. ammeter (0.1 amp.), the latter to take the place of the torch bulb.

The whole of the transmitter must be firmly constructed so that the parts and leads, especially the inductances, cannot vibrate, as this would cause the signal to "wobble." For the leads between the condensers and coils, heavy rubber covered flex should be used, with strong clips to connect to the ends of the coils, so that here losses through resistance will be minimised. The remainder of the wiring may be done with 14g. copper wire. No terminals are used, as the power wiring to the filament, choke and coil-tapping is run direct underneath the baseboard with insulated cable.

The key may be mounted anywhere convenient on the operating table or bench.

The Power Supply.

THERE is nothing more to the oscillator portion of the transmitter, so we may go on to the next part, the power supply. This in turn is divided into the filament supply, and the plate supply. For the filament, the same 6-volt battery as is in use in the receiver may be used, with a D.P.D.T. switch to change it over from the receiver to the transmitter, and vice versa. Alternating cur-