A Low-Power 1715-kc. C. W. Transmitter[1]

By George Grammer, Assistant Technical Editor[2]

(With Notes by Robert D. Keys, NA4G)

This little transmitter is a classic example of the self-excited Hartley oscillator transmitter. It is a very workable QRP rig for the "top" band. The original used a Type '45 tube, but the modern version uses a common Type 6SN7 tube. About 2.5 watts are output to a simple Marconi antenna. (Robert D. Keys, NA4G).

Whether or not the sun-spot cycle is responsible, it is an undoubted fact that during the past year or so amateur activities have shown a decided swing toward the lower frequencies. The eccentricities of "20" and "40" have driven a great many stations to "80", and the peculiar antics of the latter band lately have been responsible for the construction of more than one "160-meter" c.w. transmitter. The last-named band seems to be the only one in which reliable communication can be held over moderate distances at night, which just about duplicates the conditions existing back in 1923 and '24 when the big parade to the "short waves" was in full swing[3].

All of which brings us to believe that the group of frequencies between 1715 and 2000 kc. is a pretty nice piece of territory[4]. It is an especially good place for beginning amateurs, not only because, in comparison with the other amateur bands, it is practically free from QRM. This in itself is a tremendous point in favor of the 1715-kc. band, particularly because most beginners start out with transmitters of relatively low power and often find it difficult to make a dent in the interference on the higher frequencies.

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[1]Reprinted, courtesy QST, from the March, 1932, issue, pages 8-10. This particular Hartley oscillator transmitter is a classic from that era (RDK).

[2]George Grammer was a very well known 1930's-1940's editor of QST. His construction and technical articles are legendary (RDK).

[3]The "parade" to the short waves brought the amateur down to the bands "200 meters and down" — i.e., those "useless" short waves which became the mainstay of modern HF communications, and which became the envy of all the commercial and military folk, and which resulted in great losses of spectrum by the hams (RDK).

[4]The modern 160-meter band was shrunk to 1800-2000khz. (RDK).

For this reason the transmitter described here, designed especially for beginners, is built to work in the 1715-kc. band. Because it *is* a beginner's outfit it uses about the minimum of parts and is therefore inexpensive and simple to construct, although capable of producing a signal which will fully comply with the amateur regulations[5] On the other hand, even the old timer can find it a handy gadget for local rag-chews and short-distance traffic handling.

The circuit, Fig. 1, is a series-feed arrangement of the Hartley. As the diagram shows, no radio-frequency chokes or filament by-pass condensers are required, resulting in a substantial simplification of the set. The oscillator tube, a Type '45, will deliver 5 or 6 watts to the antenna. The parts should be laid out on a 7- by 14- inch baseboard about as indicated in the photographs, this layout giving decently short leads without undue crowding of the apparatus. The antenna tuning condenser is at the left-hand end of the board with the oscillator or "tank" condenser alongside it at the right. The remainder of the space is taken up by the tube socket, fixed by-pass condensers, grid-leak resistor, filament center-tap resistor and the Fahnestock clips for making connections. The coils, of course, are in back of the condensers.

WINDING THE COILS

It is a little difficult to find much to say about the construction of the set which is not already clearly shown in the photographs. There is very little wiring to do, and that of the easiest kind. Perhaps the hardest job is making a pair of ship-shape coils, although even that is simple enough if one goes about it right. To make the tank coil, procure a piece of bakelite tubing 2-1/2 inches in diameter and 3-1/2 inches long. Draw a straight line along the length of the tubing at right angles to the ends and mark a point on the line a half inch in from each end. The distance between the two points will then be 2-1/2 inches. Drill a 1/8-inch hole through the tubing at each point to hold a pair of half-inch 6-32 screws, to which the ends of the coil are fastened. Next cut a piece of No. 12 enamelled antenna wire long enough to make the coil (about 13 feet) and scrape the enamel off one end for a distance of about an inch. Bend this bright end around one of the screws and fasten it in place with a nut. Then fasten the other end of the wire in

[5]The amateur regulations of 1932. Properly made, adjusted and operated it will still put out a stable and clean signal. Improperly used, it can put out an absolutely horrid signal (RDK).

a vise or to a hook so it will be solidly anchored, pull the wire taut, and wind the coil by rotating the bakelite tube in your hands, walking toward the vise or hook as the turns are put on. When the 18th turn is completed bend the wire around the remaining screw and cut off the excess. Scrape off the enamel where the end of the wire goes around the screw and fasten it temporarily. Now take a piece of fairly heavy string and wind it between the turns of the coil. If the right thickness of string is used the entire coil will just occupy the space between the two machine screws. The string may be left in place permanently if desired, in which case it should be of the waxed variety, to make it moisture-proof. This, in fact, is a good plan because the wire is likely to slip if the string is taken out. Tightening up the nuts which hold the ends of the wire in place usually will pull the coil tight if it has not been allowed to slip during winding.

The tap on the oscillator coil is placed at the 8th turn from one end, in line with the two terminals of the coil, by scraping off the enamel for a distance of about a half inch and running solder on the bright part, taking care that none of the solder gets on the adjacent turns. The piece of bus bar or wire which connects to the tap can be tinned similarly and then the job of making a good joint is quite simple.

The antenna coil is made in the same way as the oscillator coil except that a shorter piece of tubing and a smaller number of turns are used[6].

The two coils should be mounted as shown in the photographs, and should be placed as close together as possible. It is not necessary to make the coupling between the coils variable, since their dimensions are such that the spacing shown will give just about the right amount. The distance between the two adjacent ends of the windings is 1-1/2 inches. The 8-turn side of the oscillator coil is connected to the grid end of condenser C_1 (rotary plates and frame) and the 10-turn side to the plate end (stationary plates). Both coils should be fastened solidly to the baseboard, preferably raised from it a half inch or so by means of small pieces of metal tubing or some similar means[7].

POWER SUPPLY

The power supply for the transmitter should furnish 2.5 volts a.c. for lighting the filament and 300 to 400 volts d.c. for the plate. A power pack

[6] See the notes by RDK at the end of the text (RDK).

[7] One to two inch metal or porcelain standoffs work well (RDK).

made up from broadcast replacement parts will be entirely satisfactory. Constructional details of such a power supply are contained in the November, 1930, issue of QST, and also in the Ninth Edition of *The Radio Amateur's Handbook*[8].

As a preliminary test the power supply and key should be connected to the set to check for oscillation. The oscillator condenser, C_1, should be set with the rotary plates all "in". With the key closed, touch a pencil to the stationary plates and if an appreciable spark appears the set is oscillating[9]. If there are no signs of oscillation check over the wiring for mistakes. If the wiring appears to be correct another tube should be tried. There is little to go wrong if the construction shown in the photographs and the wiring diagram is followed carefully.

TUNING

The transmitter is intended to be used with an antenna and ground. The antenna may be a single wire such as those used with broadcast receivers, and should be at least 120 feet long counting the total length from the transmitter to the open end. Lengths up to 160 feet may be used[10]. The shape of the antenna is not a matter of great importance; it should be kept in a space by itself as much as possible, of course, and should be fairly straight except for the lead-in, but if these conditions cannot be fulfilled the reduction in radiation should not be very harmful. The ground lead should be short. The "ground" may be a buried metal rod or else the water or steam circulation system of the building. In the latter case the connection may be made by means of an ordinary ground clamp to a cold water pipe or a radiator in the heating system. The pipe should be sandpapered until bright before the clamp is installed[11].

If the specifications, particularly those for C_1 and L_1, have been followed very carefully the low frequency end of the 1715-kc. band will be reached with the plates of C_1 just about fully interleaved. The entire band will be

[8] A battery pack of 135 to 270 volts will also work very well (RDK).

[9] A better option is to use a field strength meter placed nearby. Using a pencil in such a manner can be *exceedingly dangerous* and should probably *not* be done (RDK).

[10] This type of antenna is, in essence, a grounded quarter-wave "Marconi" low impedance antenna (RDK).

[11] Modern plumbing uses a lot of plastic tubing, so a real ground rod or a quarter-wave counterpoise is best (RDK).

covered in the last 10 or 15 dial divisions. Of course before going on the air the frequency should be checked carefully to make sure it is inside the band. Any one of several simple methods of frequency checking can be used, repetition of these being unnecessary in this article[12] Once the frequency has been set the antenna circuit is brought into resonance by adjusting C_2 until the flashlight lamp shows the brightest glow. The lamp should then be cut out of the circuit by connecting a short piece of wire between the terminals on the lamp base, and the transmitter is all ready to go.

It is hard to make any predictions as to the range of a transmitter of this type. With a reasonably well-located antenna and a good ground connection it should be good for distance up to 100 miles or so in daytime and up to 500 at night.

NOTE. — This transmitter is intended for c.w. (code) only and is not suitable for radiotelephony.

[12]Frequency checking methods are fully described in *The Radio Amateur's Handbook*. Simple methods of correctly tuning this transmitter are described in *How to Become a Radio Amateur*, a booklet which also gives complete instructions for building an inexpensive receiver and power supply, as well as instructions on how to learn the code, obtain licenses, and other information from the American Radio Relay League, Inc., West Hartford, Conn., for twenty-five cents (*don't we wish — but that was in 1932 cents*! (RDK)).

NOTES by NA4G

Some additional notes for modern usage of this rig are given below. These modifications have been successfully used by NA4G to tame the rig and make it suitable to a commonly available modern tube type such as the 6SN7 or 12SN7. The slightly modified circuit diagram is shown in Fig. 2. Almost any indirectly heated tube can be used. If the tube has multiple grids, wire the grids up in parallel and use the tube as a triode.

1. *Be Very Careful Around This Rig. The Voltages Present on the Exposed Parts of the Rig Can be Lethal!*

2. For operator protection, a black plastic front panel sized to suit would be appropriate. It can be screwed to the front of the baseboard with several wood screws. A diagonal corner brace from the top of the panel to the back corner of the baseboard for stiffening may be appropriate, but is not absolutely necessary if the panel is 1/4 inch thick black sheet acrylic plastic. If 1/8 inch thick material is used, the stiffeners will be required. The panel can be labelled by using self-adhesive mailing labels printed on a laserjet printer and cut to suit.

3. The antenna coil is a bit undersized for correct use. An antenna coil of 25 to 30 turns close-spaced is more appropriate than the original 12 turn coil for feeding a grounded quarter-wave Marconi antenna.

4. Both coils may be wound with modern No. 12 or 14 sized black single strand copper household wire. The black color is approximately "period" looking and works just fine.

5. REAL bakelite tubing is scarce as hen's teeth these days, but good ol' black plastic plumbing pipe works just fine, and can be had in a 2 inch I.D. size that fits perfectly. It is convenient to use one piece 9 inches long, and to wind both coils on the one piece.

6. For ease in tuning, make C_1 a 50-100pf variable and pad it down with fixed mica transmitting tub capacitors (approximately 400pf).

7. A Type 6SN7 or 12SN7 tube in a breadboard octal relay socket works very well on plate voltages up to 275 or so. If a 6/12SN7 type tube is used, the grid bias resistor should be about 15,000 ohms.

8. The use of non-a.c. power supplies is highly recommended. In particular, a d.c. filament supply should be used if possible. This will reduce hum modulation of the signal. If a 6/12SN7 type tube, with an indirectly heated filament, is used, a.c. or d.c. filament power may be used. If sufficient batteries are available of the 6-10 ampere hour capacity size to series into packs of 48 or 96 volts, use sufficient to give 192 to 288 volts on the plate. This will give the *most stable* and pure d.c. note to the signal.

9. The use of an RF choke in the plate lead is highly recommended. A choke of 2.5 millihenries is sufficient. A manufactured one will work fine, or wind your own with 250 turns of No. 24 wire on a 1/2 to 1 inch diameter ceramic standoff form about 4 inches long. The winding should occupy about 3 inches or so on the form. At plate voltages of less than 400 volts, it can be scramblewound on the form. If you don't have a ceramic form handy, use a dowel rod, or a plastic rod, or a piece of black plastic plumbing pipe. At these frequencies and powers, such will work just fine.

10. If Fahnestock clips of a sufficiently large size cannot be found, simply make up binding posts out of 1/8-inch screws and nuts, and washers and wing-nuts.

11. The use of rubber or plastic feet on the bottom of the baseboard is highly recommended to keep from shorting any boltheads underneath or scratching the tabletop. Alternatively, 3/4 inch wooden runners along the underside of the baseboard will work.

12. The transmitter can be made to cover the 80 meter band instead of the 160 meter band by appropriate scaling of the number of turns of the plate and antenna coils. The coils should be reduced by about half the number of turns, or maybe one or two even less than that. Make the antenna coil about 12-15 turns and the plate coil about 10-12 turns.