SELF-CONTAINED TRANSMITTER for the 1·8, 3·5 and 7 Mc/s. Bands

By G. G. GIBBS (G3AAZ)*

SPECIFICATION

- **Frequency coverage: 1715-2000 kc/s; 3500-3800 kc/s; 7000-7300 kc/s.**
- **Types of emission: Telegraphy and telephony.**
- **Power Input: 18 watts telegraphy; 15 watts telephony.**
- **Oscillator: Electron coupled.**

SPECIAL FEATURES

- **Complete metering of stages.**
- **Provision for "netting" with carrier off.**
- **Link coupled output, and universal aerial tuner.**
- **Push-pull modulator.**
- **Bias supply for Class "C" operation of P.A. stage.**
- **Screening, and low impedance link coupling, minimising T.V.I.**

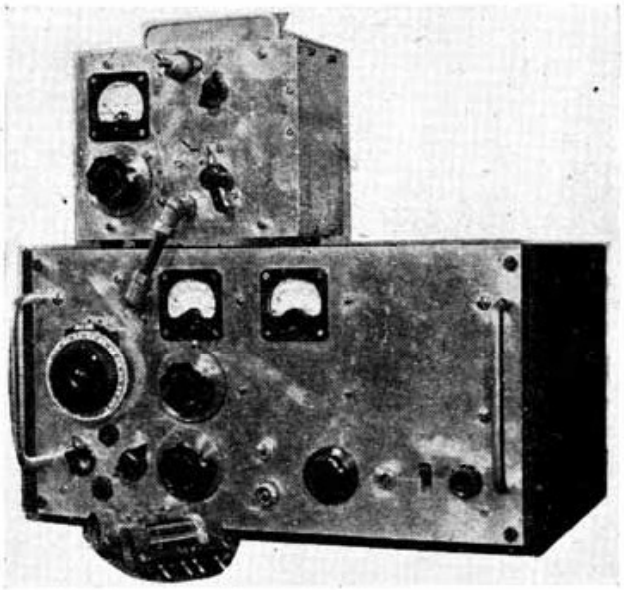

Fig. 2.
Front view of the transmitter and aerial tuner.

THIS self-contained semi-portable transmitter is a permanent piece of apparatus at the writer's station, designed chiefly to enable either a telephony or telegraphy signal to be radiated on any of the three lower frequency amateur bands at times when the main station is off the air for major alterations or rebuilds.

While a transmitter of this type is a little more difficult to construct than most, the amateur, with even modest workshop facilities, should be able to reproduce it with the minimum of trouble.

The Oscillator

This stage employs a 6AG7 connected as an E.C.O., the particular valve and circuit being chosen to ensure a fair degree of output consistent with stability. This is an important factor for 7 Mc/s. operation, as will be seen later. Keying is effected in the screen circuit of the 6AG7. Built into a copper cube, the oscillator works solely in the 1.8 Mc/s. band. The supply to the unit is stabilised by a VR105/30.

In order to remove the last trace of "chirp," the screen of the 6AG7 is fed *via* a potential divider, its decoupling condenser being restricted to a relatively small value.

The Buffer-Multiplier Stage

This stage, whilst isolating the P.A. from the oscillator, provides the requisite drive at the desired frequency. Another 6AG7 is employed here, as its high slope ensures excellent power output, coupled with good frequency multiplying characteristics.

The stage is used as a buffer on 1.8 Mc/s., a doubler on 3.5 Mc/s., and a quadrupler on 7 Mc/s., the desired frequency being selected by three switched coils tuned by a common capacity. The drive obtainable on the first two bands is more than adequate, and can be regulated by detuning the output circuit. On 7 Mc/s. it is possible to provide 4 mA. drive to the 807.

The Power Amplifier

A conventional, series-fed, Class C stage, comprising an 807, is used as power amplifier. Parasitic suppressors are fitted to both grid and screen pins.

The Modulator

The modulator consists of a 6SH7 speech amplifier, resistance-coupled to a 6J5. This in turn is transformer-coupled to a pair of 6V6s in push-pull, working in Class AB1. This arrangement gives more than adequate power to provide 100 per cent. modulation at full input, and is always operated well within its limits, thus ensuring a minimum of distortion. Because the power supply is common to all stages of the transmitter it is necessary to economise in current drain. For this reason the screens of the 6V6s are supplied with a reduced voltage obtained from a potential dividing network formed by R14 and R15, thus limiting the standing current.

The Power Supply

The power supply is quite conventional and employs a condenser input filter. Providing the specified value of capacity (4 μF.) for each of the input and reservoir condensers is not exceeded, no harm should befall the 83 rectifier. The bias supply for the P.A. is derived from one half of the mains transformer secondary winding, connected through a suitable resistance network and a selenium rectifier.

The Control Circuit

The send-receive switch S3 is a double-pole single-throw pattern, which passes H.T. to the buffer, modulator and P.A. through one side, and to the oscillator through the other. Thus, in the make position, the whole transmitter is energised. When broken, H.T. is supplied to the oscillator *via* the "netting" button, S4.

* *Chesilbank, Digswell, Welwyn, Herts.*

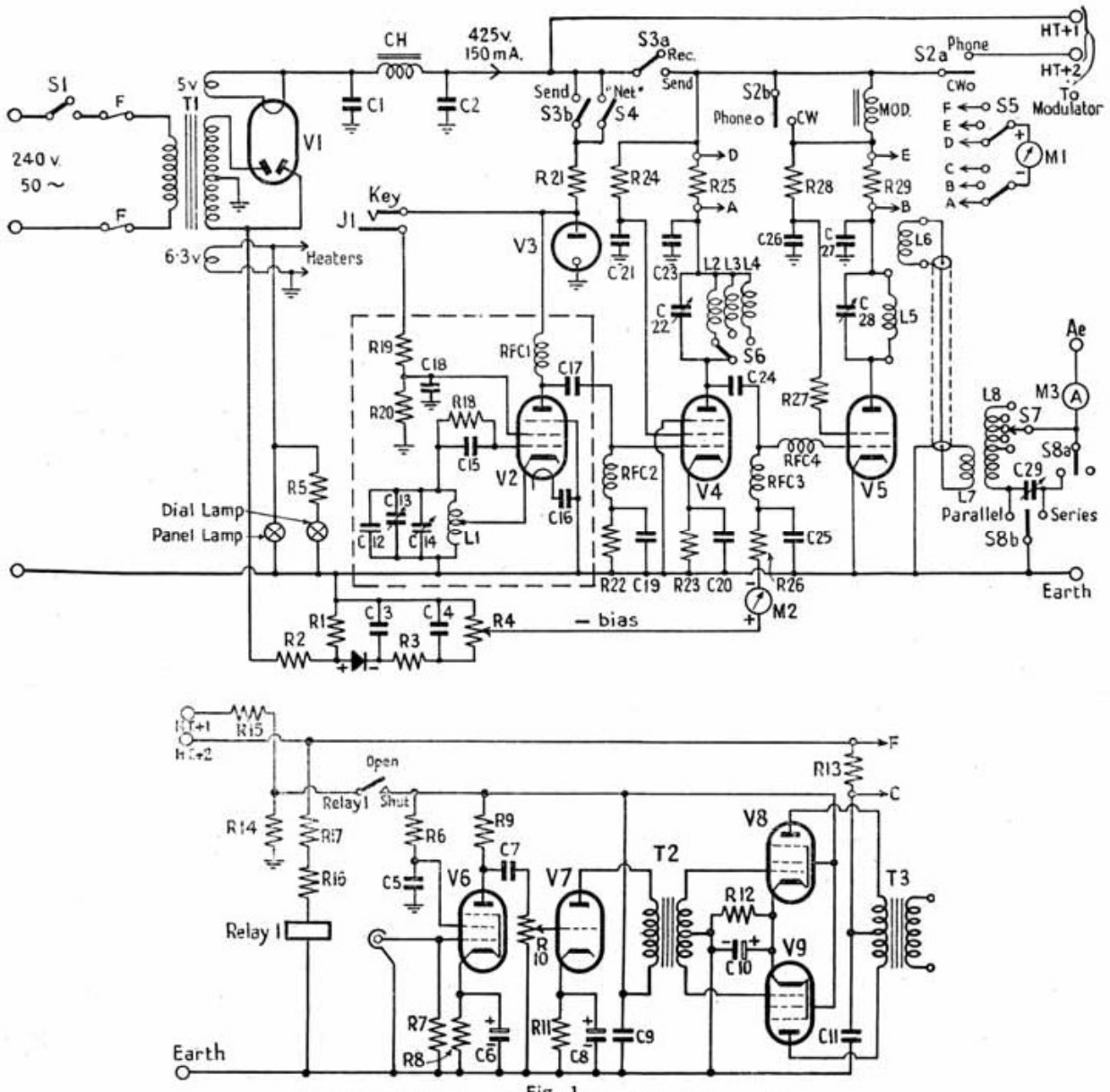

Fig. 1.
The circuit diagram of the self-contained transmitter.

COMPONENT LIST FOR SELF-CONTAINED TRANSMITTER

RESISTANCES

R1, 17, 21	15,000 ohms, 10-watt
R2	50,000 ohms, 10-watt
R3	10,000 ohms, 1-watt
R4	50,000 ohms wirewound pot'meter
R5	60 ohms, 1-watt
R6	270,000 ohms, ½-watt
R7	2 megohms, ½-watt
R8, 11	1,000 ohms ½-watt
R9	100,000 ohms, ½-watt
R10	1 megohm miniature pot'meter
R12	250 ohms, 10-watt
R13, 25, 29	30 ohms, ½-watt
R14	30,000 ohms, 25-watt
R15	10,000 ohms, 25-watt
R16	60,000 ohms, 10-watt
R18	50,000 ohms, ½-watt
R19, 20	25,000 ohms, 1-watt
R22	100,000 ohms, 1-watt
R23	700 ohms, 1-watt
R24	20,000 ohms, 1-watt
R26	5,000 ohms, 2-watt
R27	50 ohms, ½-watt
R28	27,000 ohms, 10-watt

CONDENSERS

C1, 4	4 μF. paper, 1,000 V. working
C3	2 μF., 350 V. working
C4	8 μF., 350 V. working
C5	.1 μF., 350 V. working
C6, 8, 10	25 μF., 25 V. working
C7	.002 μF.
C9, 11	8 μF., 500 V. working
C12	300 μμF., silver mica
C13	60 μμF. trimmer
C14	100 μμF., miniature variable
C15	100 μμF. silver mica
C16, 19	500 μμF.
C17	50 μμF. ceramic
C18, 26, 27	.001 μF. 500 V. working
C20, 21, 25	.005 μF., 500 V. working
C20	160 μμF., variable, *Eddystone*
C23	.01 μF., 500 V. working
C24	300 μμF.
C28	150 μμF. (from osc. section of TU5B)

Selenium rectifier, 100 V. 30 mA.

VALVES

V1	83
V2, 4	6AC7
V3	VR105/30
V5	807
V6	6SH7
V7	6J5
V8, 9	6V6

MISCELLANEOUS

T1	PTM14A *Woden*
T2	Push-pull driver transformer, 3:1 overall
T3	UM .1 *Woden*
CH	Choke 15 H., 150 mA. R.F.C.
1, 2, 3	*Eddystone* Type 1010
R.F.C. 4	10 turns of No. 18 S.W.G. ¼" diameter
M1	0–50 mA.
M2	0–5 mA.
M3	0–½ A. thermocouple
J1	Closed circuit jack
Relay	Operating coil, 1,000 ohms, single make-break, normally open

When S2 is in the right hand or 'phone position, H.T. is supplied to the P.A. (through the secondary winding of the modulator transformer), and to the anodes of the 6V6s. Relay 1 (normally open) is energised through R16 and R17, and closes, so that reduced voltage from the potential divider R14-R15 is applied to the speech amplifier and driver, and to the screens of the 6V6s. When S2 is in the C.W. position, the secondary winding of the modulation transformer is short-circuited, and power to the relay and 6V6 anodes is cut-off; the whole modulator then being isolated from the supply.

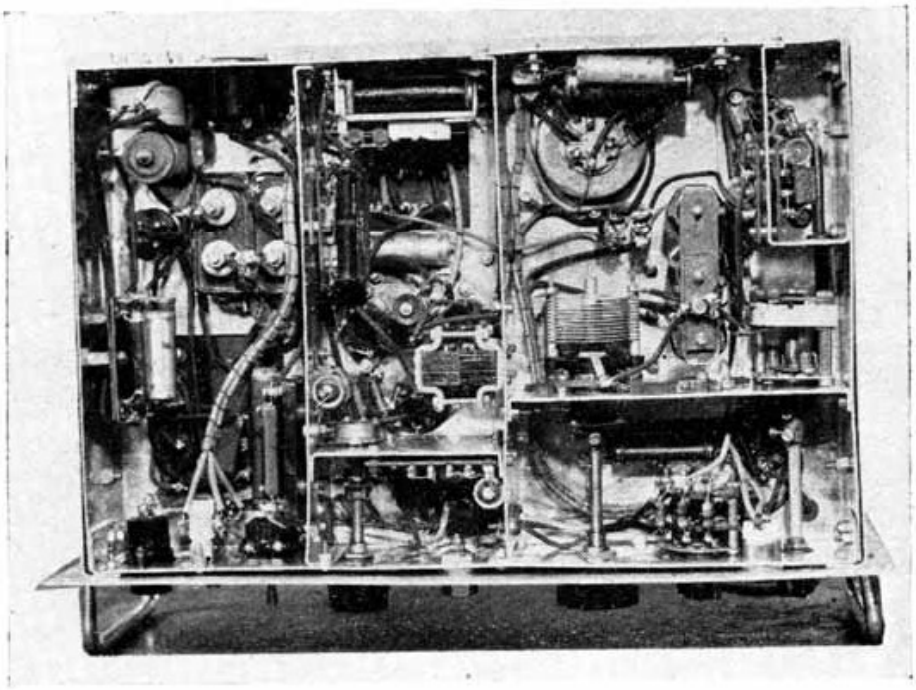

Fig. 3.
Under chassis view of the transmitter, showing screening.

Construction

The size of the chassis and panel will depend upon the dimensions of the cabinet in which the unit will eventually be housed. If the layout of components is adhered to, the size of the chassis—to within an inch or two—does not matter. At G3AAZ the dimensions are as follows: chassis length 15¼in., breadth 10in., height 3in., panel length 16¾in. (overlapping chassis by ¾in. at each end), and height 9in. (extending beyond base of chassis by ¼in.).

Once the chassis, panel and brackets have been made and assembled the internal screening can be fitted, the position of this being clearly shown in Fig. 3 and 4. No. 16 gauge aluminium is used throughout. Owing to the weight of some of the larger components, a lighter gauge would be unsuitable, as "whip" and ultimate distortion would occur.

The oscillator box is constructed from No. 16 gauge copper sheet, with seams sweated together, and one side left open to accommodate a detachable copper cover (Fig. 5). The bottom of the box is fitted with an octal plug (removed from an old valve), which facilitates the easy removal of the oscillator unit for adjustments and modifications when required. Although this base is not visible in the photographs, its position can be judged by referring to the extreme lower right of the underside view (Fig. 3), where the holder accommodating it can clearly be seen. Of the eight pins available, five are used as follows: 1—earth; 2—6.3 V.; 3—H.T. (anode); 4—H.T. (screen) and key; 5—blank; 6—blank; 7—R.F. output; 8—blank. This arrangement, of course, need not be strictly adhered to, and is mentioned only as a guide.

The tuning condenser employed in the oscillator unit should be of the double-bearing type, examples of which are to be found on the surplus market. This component, and the bandset condenser and valveholders for the 6AG7 and VR105, are mounted in the positions shown in Fig. 4 and 5. The layout of the remaining components in this box is not critical, but whatever method is adopted, absolute rigidity must be observed if a steady note is to be achieved.

On the "Top Band" the buffer amplifier is working "straight through." For that reason care must be taken to avoid any form of feedback or instability, hence the screen across the valve base (Fig. 3, upper right). The grid resistor and associated components are mounted to the right of the screen; the coaxial-line feed from the oscillator base can also be seen on this side. The components on the output side of this stage are mounted to the left, and the position of the three coils, switch, and condenser are apparent from the illustrations. The switch is a ceramic wafer type, salvaged from a Type 25 converter.

A copper screening can 3½in. deep is used to recess the 807, approximately 1¾in. being below

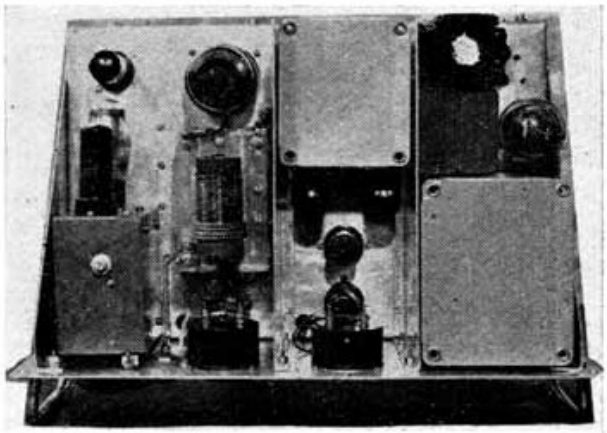

Fig. 4. Plan view, showing layout above chassis.

chassis level. These cans may be purchased ready made, although the particular one used at G3AAZ was built from copper sheet and the seams sweated together.

The P.A. tank condenser was taken from the oscillator section of a TU5B, and the coils are of the type used in the B2 transmitter, having low loss formers and size in keeping with that of the transmitter. The coils should be dismantled and

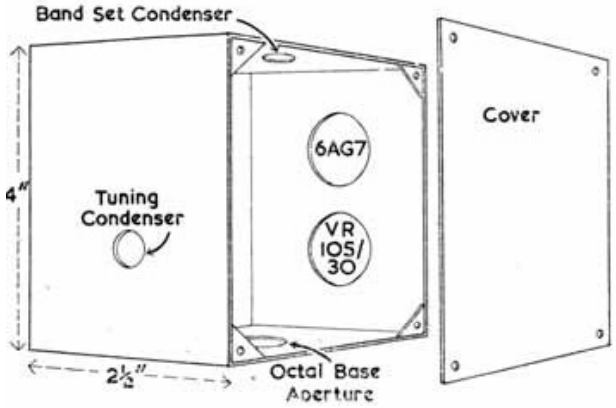

Fig. 5.
The oscillator box and cover, constructed from 16 gauge copper sheet, with the seams sweated together, and tapped 4 B.A. lugs sweated in each corner.

stripped, and their bases modified by the removal of pins 2 and 5. After cleaning, they should be rewound in accordance with the coil data table, the main winding being connected to pins 1 and 6 (outer), and the link winding to the centre pins 3 and 4. A liberal coating of polystyrene cement completes the process.

A piece of ¼in. polystyrene sheet is then cut to fit exactly over the tank condenser, and is provided with four sockets, spaced to receive any one of the three coils. At the same time, tags for H.T. feed, P.A. anode, and link output are bolted in three of the four corners (Fig. 4), with connections made from them to the coil base sockets. The condenser frame is fitted with three small brackets, on which the polystyrene sub-assembly can be firmly mounted. The coil and condenser unit is then securely bolted to the chassis.

The construction of the modulator and power supply should present no difficulties, as both circuit and layout are straight-forward. The positions of the U.M.I. and P.T.M.14a transformers should, however, be carefully worked out, because space is limited, and mistakes are not easily rectified.

Wherever possible, leads travelling in the same direction should be formed with waxed cord, and laid into the corners of the chassis and screening. The provision of grometted holes for these leads, and others which pass from one component to another, must not be forgotten. These should be made when the metalwork is complete, and before any components are mounted.

Controls

Referring to Fig. 2, the controls along the lower line of the front panel from left to right are as follows: 1—band-switch (buffer-multiplier); 2—netting button; 3—key jack; 4—meter switch (in conjunction with 0-50 mA-meter); 5—buffer-multiplier tuning control; 6—(upper) send-receive switch; 7—microphone input; 8—modulator gain; 9—supply on-off; 10—'phone-C.W. switch; 11—warning light.

The position of the oscillator and P.A. tuning controls is obvious. The 0-5 milliammeter permanently records the 807 grid current, whilst

COIL DATA

L1	57 turns with cathode tap 6 turns from base, No. 30 S.W.G.
L2	160 m., 63 turns No. 24 S.W.G.
L3	80 m., 35 turns No. 20 S.W.G.
L4	40 m., 20 turns No. 18 S.W.G.
	All the above coils are wound with enamelled wire on 1" diameter ribbed polystyrene formers.
L5, 6	160 m., 60 turns No. 24 S.W.G. enamelled, 6-turn link.
	80 m., 41 turns No. 18 S.W.G. enamelled, 4-turn link.
	40 m., 20 turns No. 16 S.W.G. enamelled, 3-turn link.
	The above coils are wound on 1¼" diameter ceramic formers with 4-pin bases (from B2 transmitter).
L7, 8	58 turns overall, tapped at 16, 27, 37 and 48, 6-turn link.
	This coil is wound on a 1½" diameter ribbed ceramic former, with length of winding 3½" overall.

the 0-50 milliammeter records either buffer, P.A., or modulator current, according to the selector switch setting.

The aerial tuner is very simple to construct, provided the metal box housing is rigidly made and the components are firmly mounted. The upper switch (Fig. 2) is S8 (for series-parallel connections), and the lower one S7 (coil tapping).

Tuning

It is recommended that all initial adjustments and tuning be carried out on a dummy load. This is best done by connecting a resistance of 70 to 80 ohms and of at least 20 watt rating between the aerial terminal and earth. First select the "Top Band" switch position. Set the 'phone-C.W. switch to the C.W. position, and switch-on the supply. The oscillator can now be tuned, and if properly adjusted will just cover the entire band between scale extremities. Adjustment is effected by depressing the netting control and listening for the beat notes in a frequency meter.

Next, the send-receive switch should be set to "send." Rotate the buffer-multiplier control until about 0.3 mA. P.A. grid current is flowing, and quickly bring the P.A. tank to resonance. The transmitter can then be loaded up in the usual way.

If a wrong harmonic is selected in the buffer stage, it is possible to obtain output on frequencies outside the amateur bands. However, once the "feel" of the transmitter has been experienced, there is little likelihood of this happening. Tuning up on the 3.5 and 7 Mc/s. bands is carried out in the same manner as described for "Top Band."

Results

The transmitter has been in operation for two years, and has given very good results. The aerial system used throughout this period has been an end-fed 132ft. wire. No spectacular claims are made as regards "getting out"; suffice it to say that the writer can "row along" with the other amateurs in his district, and occasionally, when conditions are good, work GDX and DX according to the band in use.

Telephony operation has been particularly encouraging, and when the transmiter is used with a good quality microphone, the speech quality can give little ground for criticism.