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The SHORT WAVE Magazine

VOL. XIX — JUNE, 1961 — NUMBER 4

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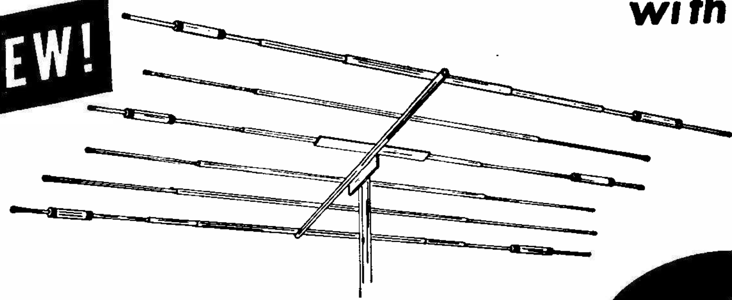

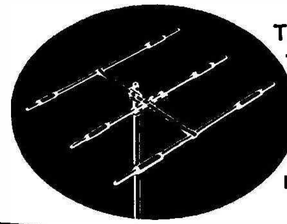

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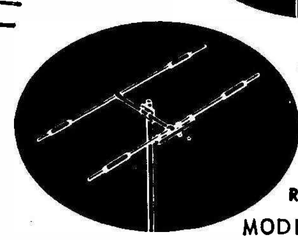

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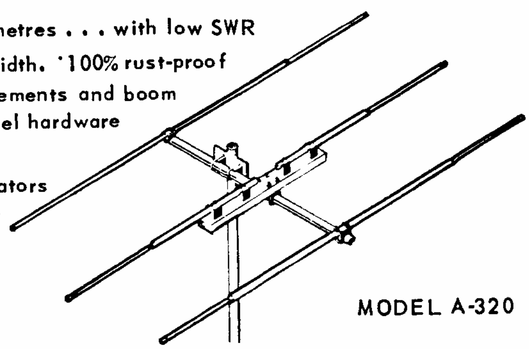

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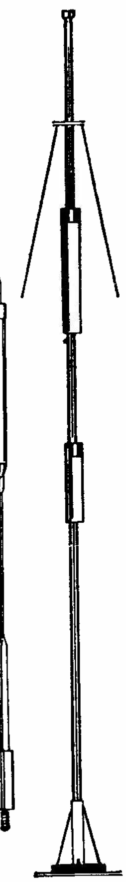

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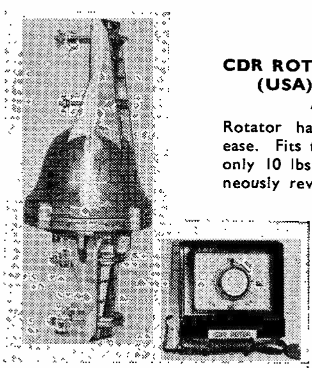

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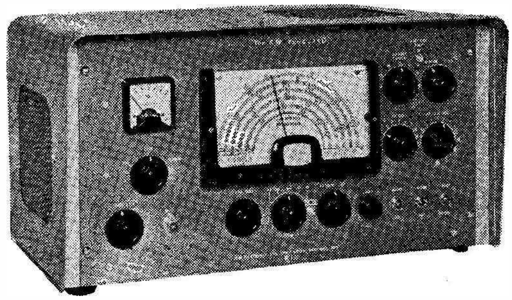

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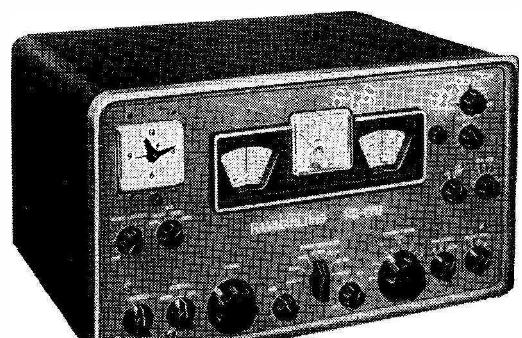

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Vol. XIX JUNE, 1961 No. 212

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FOR THE RADIO AMATEUR AND AMATEUR RADIO

The SHORT-WAVE Magazine

EDITORIAL

QSL *In the early days, the exchange of QSL cards was part of the radio amateur's code of procedure — you worked a station and as a matter of course you sent him your QSL card, knowing that he would be doing the same from his end. While the numbers involved up to about the mid-1930's were manageable — in terms of contacts made and the flow of QSL cards occasioned thereby — as the scope for Amateur Radio has widened, so the QSL position has become more difficult.*

Most AT station operators new on the air naturally take to the idea of QSL'ing and for the first year or so are meticulous in their observance of the etiquette of card exchanging. Then it starts to pall a bit, especially when the long delays inevitable (and unavoidable, let it be said) through most bureaux organisations begin to be experienced. In the present context, the actual working of QSL bureaux as such is an entirely separate matter, though it can be stated that the delays in bureaux QSL traffic are due almost entirely to addressees failing to lodge envelopes for cards received for them; this is the ever-present difficulty of QSL bureau managers throughout the world, and is also the cause of much disappointment among those expecting a quick QSL response.

Additional to this traffic in transmitter QSL card exchanges, amounting to many millions of cards a year — it only needs 10,000 active stations to be sending 100 cards each in one year to make the total one million, so that the actual total of cards circulating through the world's bureaux is probably nearer 15 million !— is the great volume of SWL cards, mainly unsolicited and so, alas, largely unwanted. While this output does of course add to the load on the bureaux, it is not to quite the extent that might be expected, because in the main SWL's are careful to keep their bureau stocked with return envelopes.

The only way to diminish the flow of QSL cards — if, indeed, any diminution is desirable — is by individual operators who find them a nuisance letting it be known, over the air and otherwise, either that they are not interested in QSL cards at all, or will only QSL on receipt of a card. While it might seem that if followed to its logical conclusion this would stop the flow of cards altogether, in fact what it could mean is that if an operator specially wanted a particular station's card, he would originate the QSL process from his end, to which the recipient would be expected to respond promptly. This is actually what a number of amateurs are now doing, and what some have been doing for years, with entirely satisfactory results.

Austin Forsyth G6FO.

The Natterbox—SSB Transmitter for the LF Bands

EASY TO BUILD—DESIGN, CONSTRUCTION AND SETTING UP

J. D. Heys (G3BDQ)

This is a simplified, but nevertheless highly effective, Sideband transmitter for low power operation on the 80- and 160-metre amateur bands. From the constructional point of view it could well serve as an introduction to SSB for those who are not yet familiar with Sideband techniques. As the author explains, the general design can be adapted for HF band working, and a linear PA added for inputs up to 50 watts.—Editor.

MANY would-be SSB operators find themselves unable to purchase an expensive commercial transmitter and feel disinclined to "roll their own" when confronted with complicated all-band circuits involving a considerable cash outlay and even more considerable technical know-how. The Natterbox transmitter described here was designed with just such people in mind.

A few months ago the writer was approached by the local club group and asked to design a simple but effective SSB transmitter for the LF bands. It had to be compact, easy to build and capable of putting out an acceptable SSB signal. No crystal etching was to be involved and the necessary test equipment had to be reduced to the minimum. Bearing these points in mind a circuit was developed and the prototype was constructed and put through its paces. Encouraged by the performance of the Natterbox on 80 and 160 metres, seven other club members began assembling their own versions of the basic design. (The local Top Band QSO party on Sunday mornings is known as the "Natter Net" so it is easy to see how the transmitter got its name!)

Design Features

Only four valves are involved in the transmitter and it gives good results when used "barefoot," *i.e.*, without a PA stage, having a lower sideband peak output of around half a watt. The addition of a simple linear amplifier running at ten watts input adds greatly to the range and effectiveness of the transmitter and a suitable PA circuit is given.

By using high frequency crystals in the filter, an output on two bands is achieved by single conversion. The crystals are all surplus FT-243 types and are used as purchased without etching or grinding. This is possible because certain channels in this range of crystals are only separated by about 1·67 kc and so enable the easy construction of half-lattice filters having a bandwidth of 2·5 kc. Crystals other than the ones suggested may be used so long as they have the same frequency separation. In this case, of course, different frequencies will have to be used in the mixer-oscillator circuit to give final output in the two LF amateur bands.

The writer has found it no real hardship to be crystal controlled, having several frequencies in the two bands, but there is no reason why a VFO should not be used. A VXO has been tried and this gave about 4 kc shift around each spot frequency; enough to dodge QRM or to zero on to another station.

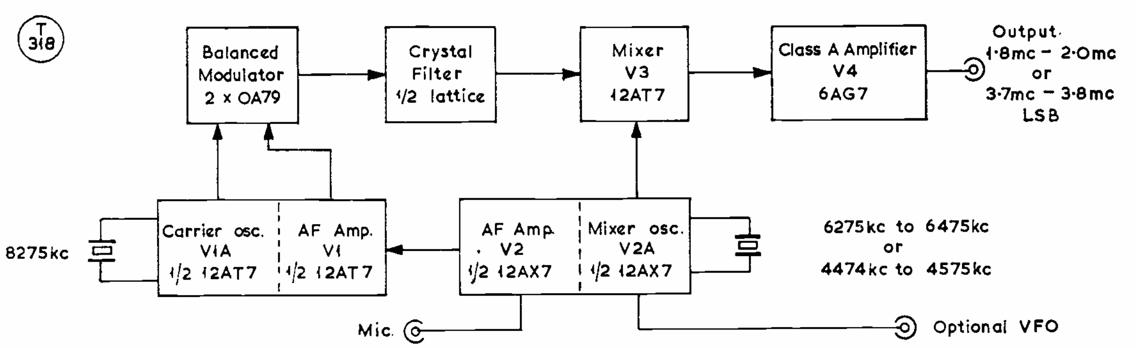
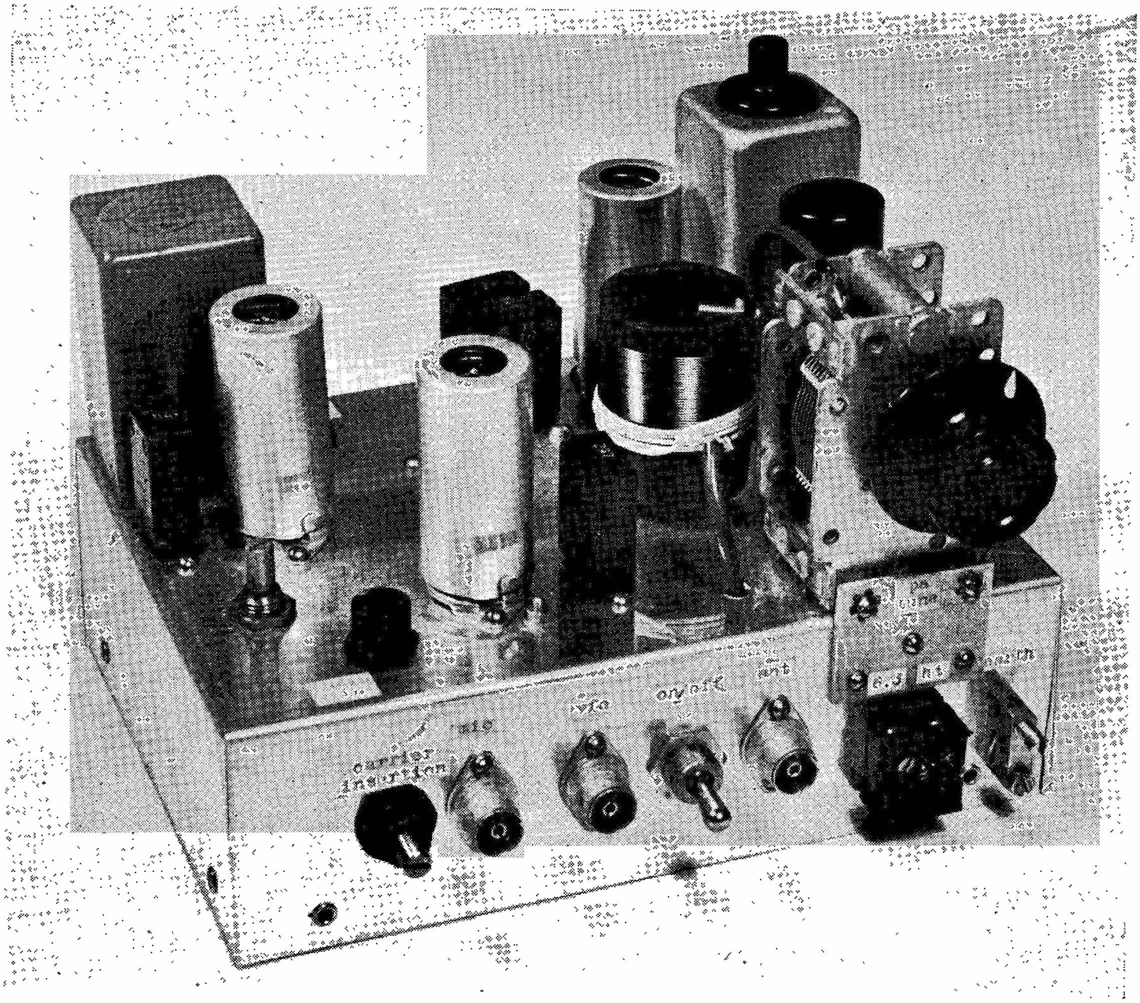


Fig. 1. Block diagram of the LF-band SSB transmitter designed and described by G3BDQ. The 6AG7 Class-A RF amplifier produces a half-watt of lower sideband power, which can go straight into the aerial for local working, or be used to drive a small linear amplifier — see Fig. 6.



General view of the Sideband transmitter described in the article. It is a simplified QRP design for the LF bands, 80-160 metres, requiring only four valves and two germanium diodes ; it can be used either directly into an aerial for nattering on the local net, or as an exciter for a linear PA, about $\frac{1}{2}$-watt of LSB drive being available. This is a proven design and a very good introduction to Sideband techniques.

Most of the components are easily available as ex-Government surplus, the only special item being the ferrite ring for the toroidal transformer, which may be obtained from Standard Telephones and Cables, Ltd.

The writer made a bulk purchase of crystals, making up eight complete sets and with this number it was easy to sort out the correct frequencies for the respective carrier oscillators. For the individual it is recommended that two or three extra 8275 kc crystals be obtained, then there will be no need to resort to etching or grinding. In a batch of eighteen crystals with this marked frequency there were considerable variations in actual frequency ; the worst ones being 1 kc either side of 8275 kc.

Reference to the block diagram (Fig. 1) will explain the basic design of the Natterbox. Two stages of AF amplification are used, each stage being one section of a twin triode. By using halves of separate valves there is less likelihood of stray carrier voltage from V1A getting around the filter to the mixer V3. Although a simple series-fed balanced modulator is used, by employing a matched pair of Mullard OA79's a carrier suppression of the order of 35 dB or better can be realised. V3 is a cathode-coupled double-triode mixer using a 12AT7. The use of a balanced mixer is normally only necessary when low-frequency SSB generation is employed. The purist could of course easily modify the V3 circuit and it would reduce the small amount of mixer-oscillator voltage which gets through when the transmitter is on 80m.

The Class-A output stage is a conventional one using a 6AG7 and does not call for comment.

Construction

To reduce the amount of metal work to a minimum the transmitter is built upon a standard 16g. aluminium chassis measuring 5½ ins. x 7½ ins. x 2¼ ins., obtainable from most radio shops. A suitable base-plate can be cut from expanded aluminium mesh.

Detailed drilling and cutting information is given in Fig. 3, although some of the measurements can be changed to suit the components available, especially with regard to the hole for the AF transformer, T. (It will be noticed that the measurements are given in millimetres, so conforming to modern engineering practice.) The filter compartment is L-shaped, made from 16g. aluminium sheet, and is 2 ins. deep; its edges are turned under to form fixing lugs and a cut-out is made to clear the balance potentiometer, R7.

It is important that pin No. 1 on each of the valveholders (when viewed from above) is located as indicated in Fig. 3. This ensures short connections in the wiring and the proper disposition of the below-deck components. The two filter crystals plug into an octal holder with sockets 2, 4, 6 and 8 removed to reduce the capacity between the crystal pins. Details of L1 are given in a later paragraph, but they are plug-in units made from the IF transformers in the BC-454 receiver. The mica based socket to receive these coils is taken from the same receiver and some care must be exercised in its fitting, for it is secured by the fold-over-and-hammer-down technique.

Followers of the school addicted to the complete construction of a piece of gear, followed by a hopeful switching on and possibly hours of frustrating trouble hunting are advised to mend their ways and join the ranks of the test-as-you-go brigade. A step-by-step wiring and testing technique should be followed as outlined.

Mount the valveholders, AF transformer and major components to the chassis, including the sockets etc. on the front drop and fit the filter shield. Locate several tag strips in strategic positions near the valveholders and run in the heater wiring. Use the chassis as one conductor and keep the live wiring close to the chassis. Wire up the AF stages V1 and V2, then test by connecting a pair of phones across the secondary of T. A fairly sensitive crystal microphone should be used; there should be ample gain and very little hum. If all is well remove the valves and begin work on the oscillators V1A and V2A. Both are conventional Pierce type oscillators and C2 enables the carrier frequency to be "pulled" to an optimum point on the HF side of the filter response curve. SW1 is provided in conjunction with R2 and R3 to enable some carrier to get across the filter when required as an aid to tuning up, or to produce an AM signal acceptable by receivers without BFO's! If a VFO is used it should have high impedance output and the crystal X4 must be removed from its socket.

Table of Values

Fig. 2. Circuit of the Natterbox SSB Transmitter

C1, C4, C10, C12, C13, C16, C23, C24	.0015 μF tubular ceramic
C2	3/30 μμF Philips trimmer
C3	.01 μF disc ceramic
C5, C7	39 μμF silver mica
C6, C17, C19	.001 μF disc ceramic
C8	65 μμF silver mica
C9	air trimmer (*see* text)
C11	680 μμF tubular ceramic
C14	.006 μF mica
C15	350 μμF variable, BC type
C18	8 μF midget, 25v. elect.
C20	16 μF, 350v. elect.
C21	25 μF midget, 25v. elect.
C22	100 μμF silver mica
R1, R26	100,000 ohms
R2	5,600 ohms
R3, R7	1,000 ohm carbon track pot., linear taper
R4	40,000 ohms 1 watt
R5	22,000 ohms
R6, R8 R10, R25	1,000 ohms
R9	3,300 ohms
R11, R18	4,700 ohms
R12	680 ohms
R13	22,000 ohms 2 watt
R14	33,000 ohms
R15	47 ohms
R16	150 ohms, 1-watt
R17, R21	2,200 ohms
R19	500,000 ohm pot., carbon track
R20	220,000 ohms
R22	15,000 ohms
R23	1 megohm
R24	10,000 ohms
R27	47,000 ohms, 1-watt
R28	220 ohms
RFC1	Midget transistor type about 100 μH
RFC2	2.5 mH 100 mA
SW1	single pole rotary low capacity
SW2	Single pole toggle
T	Command Receiver output transformer or similar (anode to 500 ohm load)
TC	Toroid coil, bifilar windings on 1 in. dia. ferrite ring type WP.3808 in SF6, S.T.C. Ltd. (*see* text)
L1	Modified plug-in IF transformers from BC-454 Command receiver (*see* text)
L2	30 turns 24g. enam., close-wound on 1⅜ in. diameter alkathene (water pipe) former
L3	5 turn link winding at cold end of L2
X1, X2	8275 kc FT-243 crystals (*see* text)
X3	8273.33 kc FT-243 crystal
X4	Suitable FT-243 crystal to give transmitter output on 80m. or 160m. bands (*see* Fig. 1)
D1, D2	Matched pair Mullard OA79 germanium diodes
V1	½ 12AT7 Brimar
V1A	½ 12AT7 Brimar
V2	½ 12AX7 Brimar
V2A	½ 12AX7 Brimar
V3	12AT7 Brimar
V4	6AG7

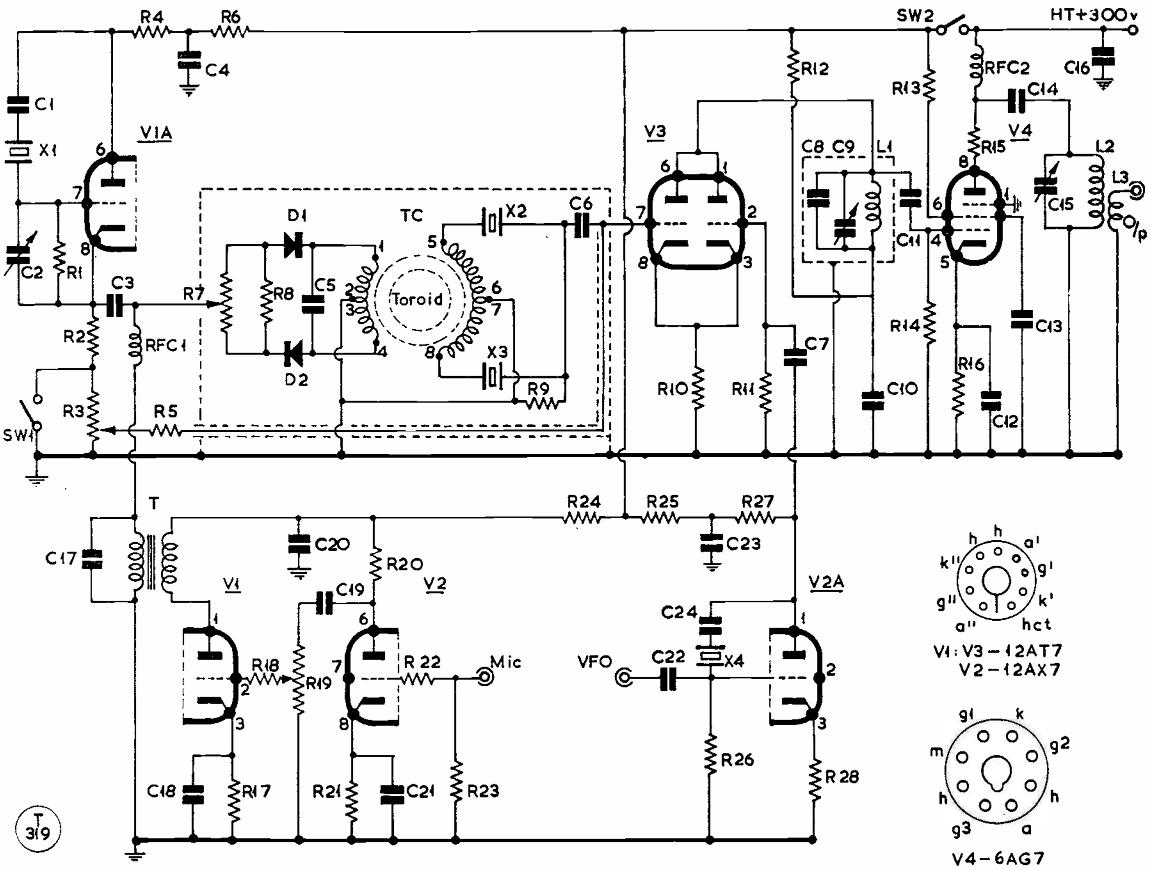


Fig. 2. Circuit complete of the " Natterbox " SSB transmitter/exciter, as described by G3BDQ in his article. Only four crystals are involved, and they do not require either etching or grinding — *see* **text. Many of the components used can be surplus items.**

Test each oscillator in turn by listening on the station receiver. Of the 32 crystals tested by the writer in the prototype Natterbox only one proved sticky and it was easily cured by washing in luke-warm water with a little household detergent added. Do not leave the HT on when the crystals are removed from their sockets or the sharp rise in anode currents can damage the load resistors R4 and R27.

Balanced Modulator and Filter

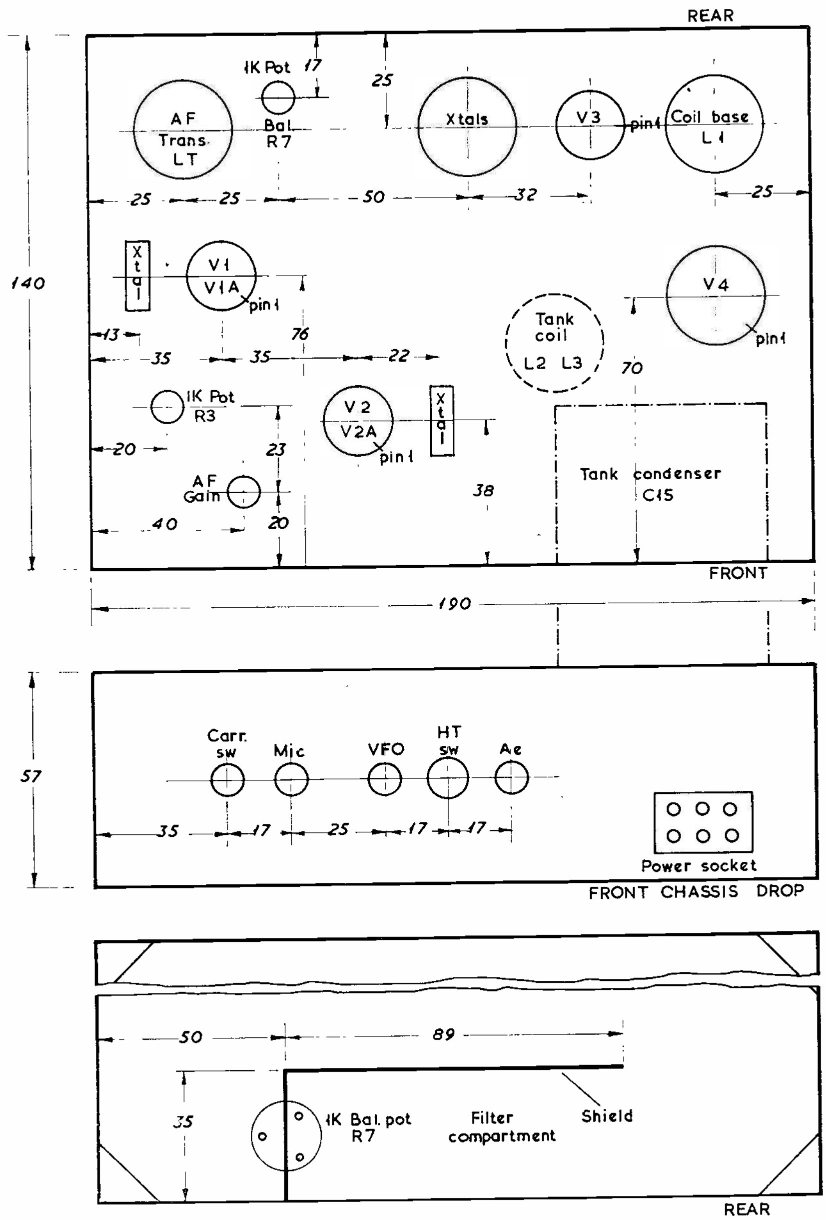
The only important point to remember when wiring the Balanced Modulator is the absolute electrical and mechanical symmetry which must be observed. The diodes D1 and D2 should be kept equidistant from the chassis and have their leads trimmed to equal length. If this is done there will be no need to use a balancing trimmer on the input side. A midget RF choke was used for RFC1 as it fitted conveniently betweeen T and the slider of R7.

The heart of the filter is the toroidal coupling transformer. The necessary tight coupling between X2 and X3 is achieved by having the two halves of the toroid secondary bifilar wound. This winding has a total nominal inductance of 100 μH, whilst the primary is much smaller and is tuned to the carrier frequency.

The ferrite ring specified can be obtained quite cheaply (see Fig. 2, Table of Values). Similar rings from other sources can be used but the winding data will not necessarily apply in these cases and some experiment may be necessary.

Before winding the toroid give the core a coat of polystyrene cement and allow to harden. To make the secondary, twist together two lengths of 32g. enam. silk covered wire about 4 ft. long and wind on 40 turns, spaced so that half an inch of core remains for the primary winding. The latter is wound in the same manner for 8 turns. Reference to Fig. 4 will show the toroid winding plan and it should be noted that points 1 and 2 are ends of the same wire. This also applies in respect of points 3 and 4 ; 5 and 6 ; and 7 and 8. The completed toroid must be liberally coated with polystyrene cement to set the inductance.

Fig. 5 explains the method of mounting and supporting the finished toroid. The numbers on the six-point tag strip correspond with the numbered points in Figs. 2 and 4. The completed toroid is positioned in the filter compartment, as shown in the photograph opposite.



Note: All dimensions in mm.

T 320

Fig. 3. Chassis layout and drilling details — with dimensions given in millimetres — for the "Natterbox" SSB LF-band transmitter. A standard size of aluminium chassis is used.