# THE B2 TRANSMITTER with a modern receiver

*Ross Bradshaw G4DTD finds a new match for the old B2 Tx.*

Many people who served in organisations that used radio have memories of certain types of equipment. For the Army it's the Number 19 set, for the Royal Navy the B40 receiver, for the Royal Air Fore the 1154/1155 set up. For Ex-Merchant navy Radio Officers lide myself, the Marconi 'Oceanspan' transmitter and 'Atalanta' receiver bring back certain memories.

From GCHQ and the Diplomatic Wireless Service comes the expected deafening silence or at best an epidemic of selective amnesia. This brings us quickly to the Special Forces and the SOE of the last war. To them the memory that one often hears is the B2 or, to give it its proper name, Type 3 Mark 2. But what is the B2?

## No Distance

Any radio amateur that gets his or her hands on a B2 usually tries it out for half and hour and then gives up. Why? Because what a lot of amateurs do not realise is that the B2, like its contemporary the 'A Mark 3', was never intended to work the distances or listen to the low power signals that an amateur does. The A Mark 3 was usually used from France to England with five watts output. Yes, five watts, the upper limit that today's QRP crowd use. For more reliable contacts, the B2 with its 20 watts was needed. As to distance, Len Key MBE G0FQX used a B2 in 1944 to work from Yugoslavia to Brindisi, a distance of 400-odd miles. I hope to persuade him to write his account of the episode for HRT at a later date.

The B2 usually came in a small suitcase, so we will examine it as such.

In this small suitcase were four metal boxes. One contained the power supply unit, one the transmitter, another the receiver and the last was a spares box. The whole lot, laughingly classed as 'portable', weighed in the region of 32 pounds. My Mark 123 (see HRT August 1989) weighed less than eight pounds. But that came out about fifteen years after the B2.

The spares box contained the aerial wire, earth wire, morse key, headphones, plug-in tank coils for the transmitter, spare valves and fuses and various mains plug adaptors. The morse key could be screwed to the lid of the spares box when operating.

The psu could work from AC mains of 97-140 or 190-250 volts. This covered the main 110 and 220 volt situations. Also built in was the forerunner of the solid state inverter, an electro-mechnical device called a vibrator. This worked from a six (repeat, six) volt battery. The psu on its own weighed 12½ pounds.

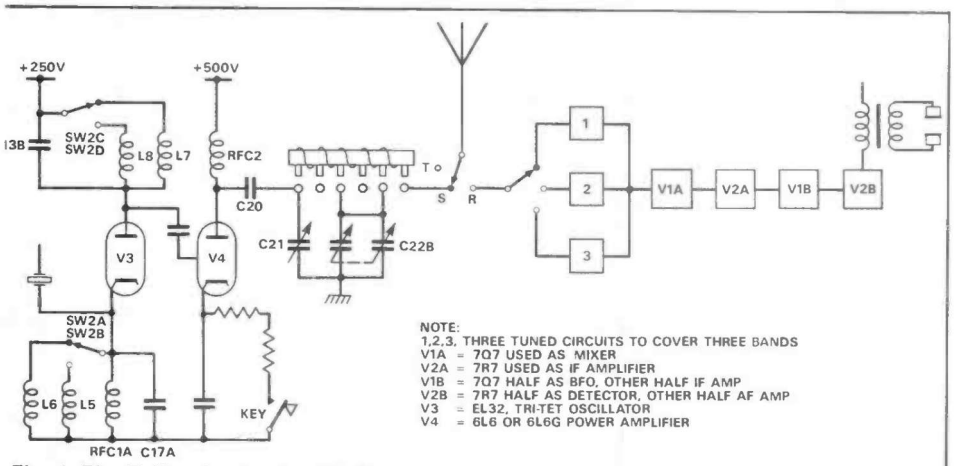


**Fig. 1. The Tx/Rx circuit (simplified).**

## Power

Refer to **Figs 1, 2 and 4.** On receive you have 500 volts for the transmitter power amplifier stage still applied, but due to the send/receive change over switch being on receive, the 250 volts from the psu is taken into the transmitter and then routed out on segment 'A' of the send/receive switch to the receiver for ht supply.

From the psu we have -ht for grid bias to use on the volume control of the receiver and 6.3 volts for valve heaters as well as an earth return line. When the send/receive switch on the transmitter is on 'receive', we can use

the built in meter to monitor three voltages for the receiver:

Position (1) 250 volts, for reciever ht

Position (2) 500 volts, not used for receiver

Position (4) -ht supply, for receiver grid bias

Note that altering the volume control does not alter the reading on the meter in position (4), as the -ht supply is metered before it gets to the receiver.

## Transmitting

On transmit we have 500 volts supplied to the anode of the power amplifier. The 250 volts is removed from the receiver and is now applied via R12 to the screen grid of the power amplifier and also to the anode of the oscillator valve via R11A. The -ht line is taken to earth via a section of the send/receive switch. On tune or transmit we can meter the following:

Position (1): 250 volts applied as above

Position (2): 500 volts applied to anode of pa

Position (3): pa grid current drive to the pa

Position (4): oscillator crystal current

Position (6): pa current (only on key down)

Position (4): is a good check to see if the crystal is working or not.

First look at the layout of the B2 front panel **(Fig. 3).** The unit at middle top is the transmitter. From left to right we have:

**The aerial terminal.** This is for a long wire aerial. The wire supplied with the B2 was 60 foot long.

**TSR switch.** This switched the B2 to either tune (T) to send (S) or to receive (R). This switch is shown in **Fig. 1.**

**The earth terminal.** Ten feet of wire was supplied to connect to earth proper, or a water pipe, or in some cases, a counterpoise earth was recommended.

**The tank coil socket.** As mentioned the tank coils could be used in one of two ways to give the following range coverage.

L1A 3 MHz to 4 MHz
L1B 3.75 MHz to 5.25 MHz
L2A 4.5 MHz to 6.25 MHz
L2B 5.5 MHz to 7.5 MHz
L3A 6.5 MHz to 9 MHz
L3B 7 MHz to 10 MHz
L4A 9 MHz to 13 Mhz
L4B 12 MHz to 16 Mhz

As can be seen there was an overlap for all the frequency bands.

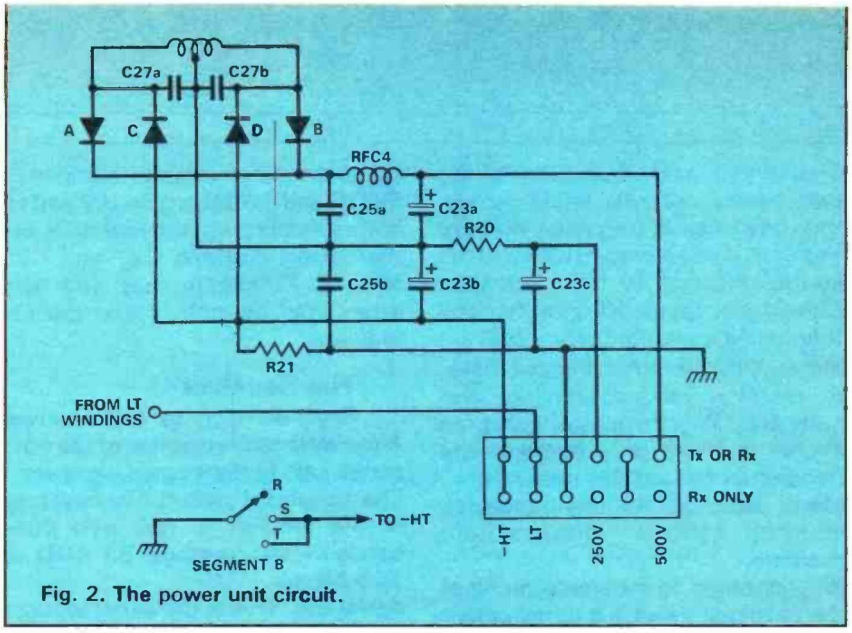


**Fig. 2. The power unit circuit.**

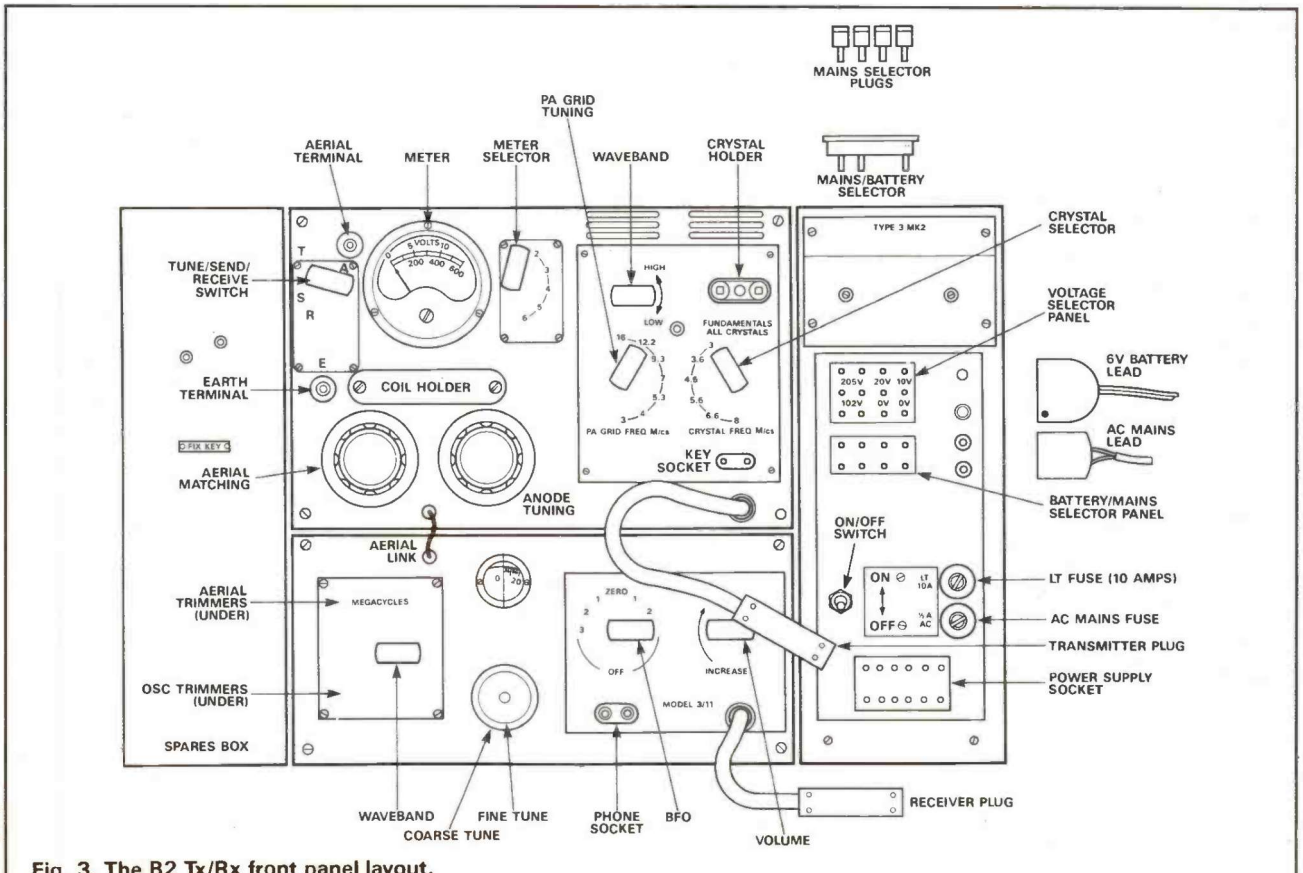


**Fig. 3. The B2 Tx/Rx front panel layout.**

Should you reach 0 on either of the two tuning controls while tuning, then use a higher frequency coil. For example, if you are using L3A and the control reaches 0, then use L3B. Should you reach 10 on either coil then use a lower frequency coil.

**Meter.** This was a moving coil meter to monitor various voltages and currents. The resistors used as shunts, etc. are on a board in the transmitter behind this meter.

**Meter selector.** As mentioned, to monitor various voltages and currents.

**PA** grid tuning. In the anode circuit of the oscillator valve is a tuned circuit consisting of two coils, L7 and L8 and a capacitor C13B. When tuning this control you are fine tuning C13B to give drive to the pa stage.

**Crystal Socket.** Usually type 10X crystals are used, but by using a crystal adaptor you can use the FT 243 type as well.

**Crystal Frequency Control.** In the cathode circuit of the oscillator valve, this control is SW2A and SW2B.

**Waveband.** This taps certain segments of L7 and L8 by using SW2C and SW2D in the anode circuit of the oscillator valve. Note that with the B2 you had a transmitter and what is in effect a built-in ATU. Basically SW2A and SW2B in the cathode circuit of the oscillator valve select the fundamental or second harmonic of the crystal and the output frequency was determined by SW2C and SW2D tapping L7 and L8 in conjunction with the tank coils and the tuning controls C21 and C22 form a PI circuit that will also attenuated harmonics that are not required.


## The Receiver

Now we turn to the receiver. Again refer to the drawing of the front panel. Left to right again, we see:

**The waveband switch.** The coverage of the receiver is split into three bands. Total coverage 3.1 MHz to 15.5 MHz.

**Aerial link.** This is the aerial brought via the transmit/receive switch out to the receiver. If you are using a different receiver this would be your aerial input to it.

**Coarse/fine tune.** This is the tuning control for the receiver. When using the fine tune the tuning is geared down to 50 to one.

**Tuning scale.** Unlike a normal dial read out, under the magnifying lens over the tuning scale is a scale that goes from zero to 180. With the B2 is a chart with scale against frequency. I have found the best way is to use a 1 MHz crystal marker to give you the MHz markings and keep your own scale chart, or failing that use a small oscillator into the aerial socket of the receiver and zero beat using the fine tuning control. When listening for a station replying to your calls, search a small distance each side of where the crystal was heard.

**Phones.** The B2 used low impedance phones of 120 ohms.

**BFO.** This gives plus or minus 3 kHz each side of the intermediate frequency of 470 kHz. It can be switched off for reception of broadcast stations.

The receiver itself uses four valves to give one frequency changer stage (note that there is no RF stage), two IF stages with an IF of 470 kHz, a bfo stage, detector and AF stage. It was rated as having a sensitivity of one to three microvolts to give 10 milliwatts output at 1 kHz. The selectivity was rated as 1 kHz at the 3dB points. Today the receiver is not up to the crowded amateur bands, unfortunately, but it still can be a challenge. The transmitter consists of two valves, an EL32 used as a tri-tet oscillator and a 6L6 used as a class C power amplifier. The power amplifier is keyed in the cathode circuit.

## One Crystal For Three Bands

One can use a single crystal of say 3.509 MHz on the bands of 3.5 and 7 and 14 MHz. Note (for the unwary) that you can also go out on 10.527 (the third harmonic) if you are not careful. The actual tuning I leave to you but the following will assist for use of the waveband switches, etc.

| Output frequency | Crystal selector | Waveband | Tank coil |
|---|---|---|---|
| 3509 | Fundamental | 3-4 | L1A |
| 7018 | 3-3.6MHz | 7-9 | L3B |
| 14036 | 3-3.6MHz | 12.2-16 | L4B |

So as you see, the waveband switch and tank coil selected decide the outgoing frequency.

If you ever have to work on the transmitter to clear a fault and need the power on to check voltages, look at that tagboard just above the two valves. Do not — repeat, do not — let your fingers stray onto it. Voltages, apart from the 6.3 heaters, enter the transmitter, are taken up to this tagstrip and onto the meter board and tsr switch and then back to the tagstrip and down into the transmitter. If your fingers touch that tagstrip you can have 250 volts incoming on one finger, 250 volts outgoing on another finger and 500 volts on another finger. Not nice.

Also do not let your fingers bridge the key contacts of your up and down key, otherwise you will be keying the transmitter with up to 60 milliamps going through your finger. Also not nice.

## A Modern Receiver

Now onto a practical suggestion for using the B2 under today's conditions. As we have seen, the well-known B2 transmitter is crystal controlled and covers the bands 3.5MHz, 7MHz, 10MHz and 14MHz. However, the receiver does not have the selectivity required for today's operation on the amateur bands. This is therefore an idea about how to use

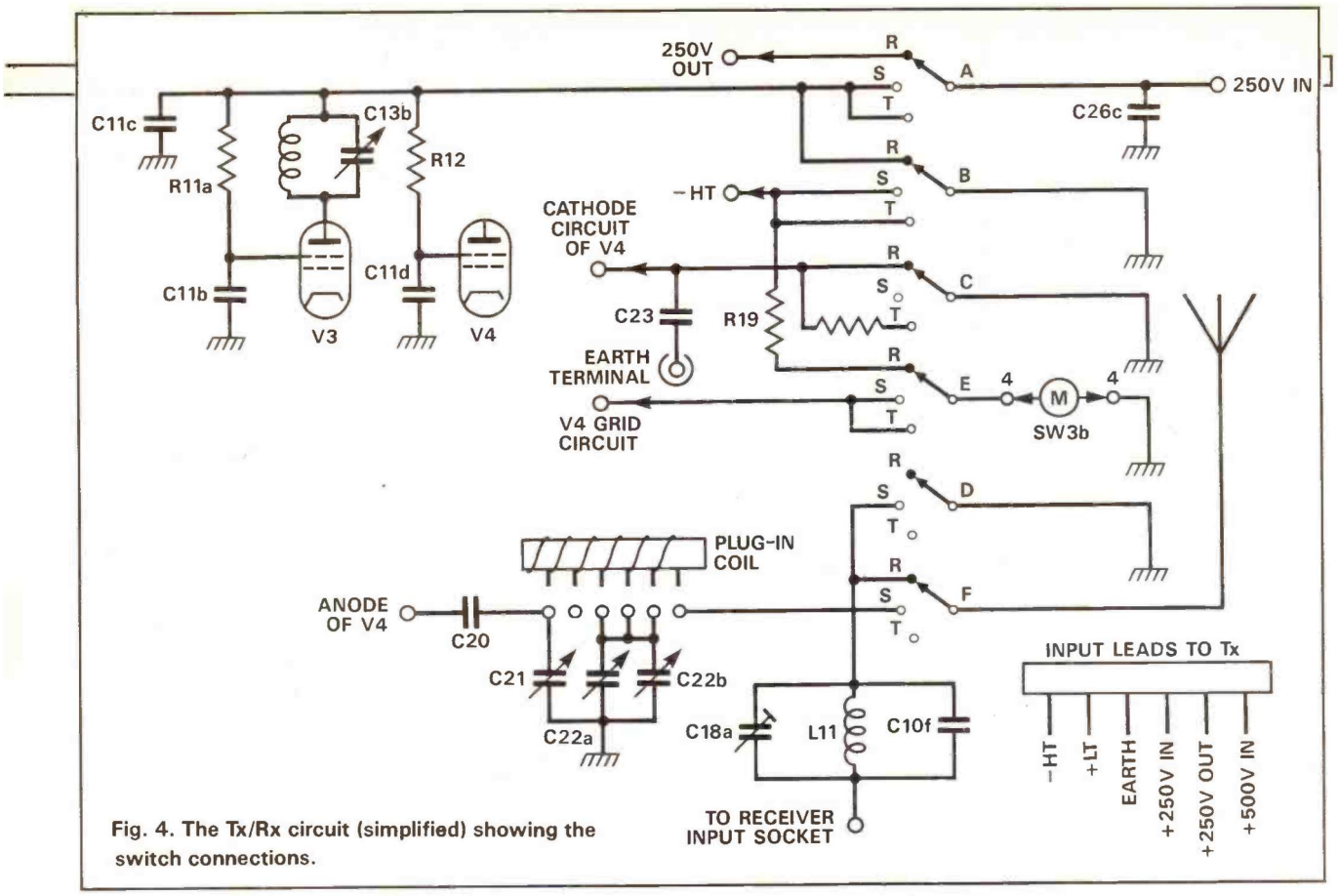


**Fig. 4. The Tx/Rx circuit (simplified) showing the switch connections.**

the transmitter with a modern receiver such as the FRG-7 or the R-600 and similar. First, what do we need to know about the B2?

## The Switching

The B2 transmitter has, on the front panel, a switch marked R (receive), S (send) and T (tune). This switch, which is on the top left as you look at the front panel, has two layers. We have re-drawn the switch connectors, rather than show the original diagram. The switch was labelled (for those that have the original diagram) A,B,C,D,E,F. We have redrawn the switch in **Fig.1** in a clearer form: the six segments all move when the switch is moved, so the diagram shows all the segments ganged and, like the original, is shown in the receive position.

## Receive Segments

Segment A: in the receive position, 250 volts from the power unit was taken into the transmitter and routed by this switch back out again to the receiver for HT to the valves.

Segment B: in the receive position this places an earth on the screen grids of the two transmitter valves as well as the anode of the oscillator valve.

Segment C: in the receive position this places the cathode of the power amplifier valve V4 to earth.

Segment D: this is not used when in receive or tune.

Segment E: assuming the built in meter was on position 4, then the minus HT voltage for grid bias to the receiver could be monitored. If it was not, then this segment in receive did nothing.

Segment F: this placed the aerial onto the receiver.

## Transmit

Segment A: this takes the 250 volts from the power unit and routes it to the screen grids of the two transmitter valves, as well as the anode of the oscillator valve.

Segment B: this puts an earth on the minus HT line from the power unit. Refer to **Fig.2**.

Segment C: this is not used in send position.

Segment D: this puts an earth on the receiver input circuits to protect them while the transmitter is being used on transmit.

Segment E: when the built in meter is switched to position 4 then the power amplifier V4 grid circuit can be monitored so as to check the input to the power amplifier.

Segment F: the aerial is now connected to the output of the power amplifier valve V4 so that transmission takes place.

## Tune Segments

Segment A: as for the transmit condition above.

Segment B: as for the transmit condition above.

Segment C: this puts a resistor in series with the cathode of the power amplifier valve to limit the power when on tune.

Segment D: this is not used in the tune position.

Segment E: as for the transmit condition above.

Segment F: the aerial is removed from the power amplifier during tuning up.

Of all the segments shows, we only need to consider segment B and the minus HT line. To see why, look at the power unit. A simplified diagram is shown in **Fig.2**.

By taking the minus HT line to

earth we get from the power unit 500 volts for the anode of the power amplifier valve V4, 6.3 volt heaters for the valves, and 250 volts for the screens of the two valves as well as the anode of V3. Therefore, if you are going to use the original power unit all you need to do is take the minus HT line to earth in the power unit. Bear in mind that you have no need of voltages for the B2 receiver as you are not going to use it. If you are using a homebrew power unit then that only needs to be able to supply you with 500 volts, 250 volts, heaters and earth line return. This means you now have the minus HT lead going into the B2 transmitter spare for another use.

Most modern receivers are muted by taking the mute line to earth when using a nearby tranmitter so, if you connect your mute lead to the minus HT lead going into the B2 transmitter as soon as you switch the B2 form receive to send or tune, the mute line is taken to earth and the receiver is muted. Simple, is it not? By using the common aerial from the transmitter as soon as you go to send or tune, the aerial to the receiver is taken to earth via segment D and protects the receiver. I have used this system some time ago when I owned a B2 and an FRG-7.

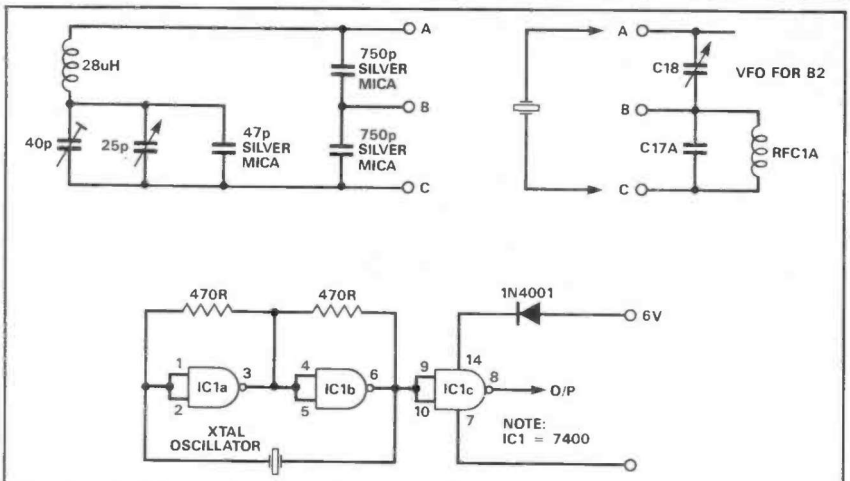


**Fig. 5. The vfo and crystal oscillator circuits.**

I conclude with a diagram of a vfo (**Fig.5**) for the transmitter that an old amateur gave me many years ago. Alas, I have forgotten his name but I never got round to using it. It may be of help to someone who has a B2. I hope this item has shown what a good little set the B2 was and still is, and when you sit in your warm shack playing with one and the XYL brings you a cup of tea and biscuit, spare a thought for those in the past, waiting behind the locked door of a safe house, watching the time creep up to sked time, a pistol handy by the morse key, the first thing to grab when the door was kicked in, the cyanide capsule next . . . (*That's what we always do at home when someone approaches with a biscuit — Ed.*)