CHAPTER 3.

AMPLIFIER M101, PATT. 59934 (PRE-AMPLIFIER).

PURPOSE AND GENERAL DESCRIPTION.

1. Amplifier M101 is a modified M58 amplifier, for use with Receiver P114 (itself a modified P11). It will increase the maximum range of the set and will give increased detection at all heights. The Unit contains a single grounded grid triode CV53 mounted on a smaller unit which plugs into a box containing the power pack. The power pack, however, is not used, as this pre-amplifier takes its supply directly from the receiver P114. On the front of the panel are the input and output Pye plugs (see Fig. 1), a preset tuning condenser (not used), the tuning condenser and a 4-pin "Breeze" plug for the power supply. There is also a 2-pin Breeze plug and fuse holder which are not used.

DETAILED DESCRIPTION. (See Figs. 1 and 2)

2. The unit is mounted on end with the input plug upper-most. A 4-pin Breeze plug is fitted on the bottom right hand side of the receiver from which is obtained the pre-amplifier H.T. voltage of 280v. D.C. and heater voltage of 4 volts A.C. The unit consists of a special grounded grid amplifier valve type CV53. A grounded grid triode is superior to a pentode at these frequencies in that screen partition noise is absent. Due to its grid being earthed and acting as an efficient screen between the input and output circuits it provides an easy alternative to neutralisation which would be required if it were possible to use an ordinary triode amplifier.

3. The CV53 grounded grid triode valve has its grid earthed by means of a copper disc, sealed through the wall of the glass envelope at right angles to the longitudinal axis of the valve. In the centre of the disc is a hole with the grid mounted across it. The disc also provides a mounting for the valve. The grid disc slides into a pair of vertical clips, which, while holding the valve firm also provides an efficient screen between the input and output circuits at opposite ends of the valve.

4. The aerial input is taken to the cathode circuit, consisting of an inductance (L3) tapped at the sixth turn and a heater choke (L4). The choke is in the heater lead and the inductance (L3) is in the common heater-cathode lead. The aerial input is connected to the tap on the cathode inductance (L3) via a blocking condenser C4 which prevents the bias resistance (R2) from being shorted to ground by the external circuit.

5. The characteristics of the cathode input circuit of the CV53 valve are such that it does not require any tuning, for with grounded-grid operation, the input and output circuits are coupled through the valve impedance, and this coupling produces negative feed-back which damps the input circuit. Thus it accepts a broad band of frequencies, and there is no need to make the tuning adjustable.

6. The output circuit of the valve amplifier consists of an anode inductance (L1) tuned by a plunger type variable condenser (C2). This is adjusted by the knurled knob on the front panel of the unit. The amplifier signal is taken from the anode circuit by a coupling condenser C10. The associated matching circuit L5 and C9 provide the correct impedance matching (43 ohms) to the flexible concentric cable connected to the Receiver input. The conventional choke (L5) presents a high impedance to R/F and the condenser C9 has a reactance suitable for matching the output. The pre-amplifier is inserted in series with the aerial lead and the aerial input of the receiver.

TUNING THE PRE-AMPLIFIER.

7. Adjust the main tuning control and the input circuit of P114 receiver together to give a maximum amplitude of P114 receiver together to give a maximum amplitude of a fixed echo. But see also Chapter 6 on the use of the Performance Meter in tuning the set.

REPLACEMENT OF CV53 VALVE.

8. Remove the smaller unit from the box containing the power pack. Take off the screening cover after unfastening the spring clips. Disconnect the filament leads of the valves from the two terminals and remove the valve from the vertical clips. Replace the new valve in the vertical clips and connect the filament leads to the terminals making sure that the lead coloured red is connected to the terminals marked C. Replace the screening cover and secure with the spring clips.

PERFORMANCE CHECKS ON PRE-AMPLIFIER.

9. (a) To check gain on pre-amplifier.

Tune pre-amplifier and receiver.
Set noise to full scale reading on second detector meter.
Remove output lead from pre-amplifier. The noise level should drop to about 25% of the previous reading.

(b) To check emission of valve.

Remove pre-amplifier and power pack from box and connect the positive terminal of Avometer to the cathode and the negative to the chassis. Switch the Avometer to the 0-12v. D.C. range. The reading should not be less than 0·5 volts and not greater than 1·5v.

(c) To check that signal input is connected to cathode side of heater.

Connect Avometer between heater and chassis (pins 4 and 2). Use 0-12v. A.C. range. Voltage should be 2·5v.

CHAPTER 4.

VIDEO FILTER UNIT.

(Filter Unit, Video, Design 15 Patt. 56952).

PURPOSE

1. Filter Unit, Video, Design 15 is intended to improve the performance of Type 79/279 (and 281) when R/T interference or enemy jamming is present. It contains filters to take out the jamming frequencies and pass on the beat frequencies between jamming and echo. (There are gain control and A.G.C. circuits in the unit but these are used only with Type 281).

2. The unit is contained in a box ($17\frac{1}{2}$" x $8\frac{1}{2}$" x 11") which must be mounted horizontally. There are four fixing screws to be unscrewed if the unit is to be taken out of its box.

3. Certain modifications are carried out in Receiver P11 (part of its conversion to P114) and C.R.T. Unit Design 'B' when the Filter Unit is fitted. The circuit diagram of Receiver P114 is shown in Fig: 20 (See also Chapter 7, para. 10).

CONNECTIONS.

4. The unit has the following outside connections :-

(a) Supply input of 230 volts 50 cycles to Breeze plug labelled "230v. 50 c/s INPUT" by twin-cored, screened cable (Patt. 9085).

(b) "OUTPUT" jack of Receiver P114 to "VIDEO INPUT" jack on Filter Unit by the lead provided.

(c) "TYPE 79 OUTPUT" jack on Filter Unit to "INPUT" jack on C.R.T. Unit, either by 4-ft. lead (Patt. W572 Assembly "B") or by a 6-ft. lead (Patt. 1115 Assembly "C"). This lead must be of low capacity and not more than six feet long.

(d) The cannon socket labelled "-4 volts D.C." and the Patt.4125 plug labelled "GAIN CONTROL" are not used with Type 79. Keep the Patt. 4129 socket, which is supplied fitted to the "GAIN CONTROL" plug in this position as a protection from the voltage on this plug.

CONTROLS.

5. With Type 79 the controls labelled "RECEIVER GAIN" and "A.G.C. SWITCH" are inoperative.

6. The A.J.SWITCH has the following positions :-

NORMAL	To be used when no interference or jamming is present.
A.J.1.	Interposes high pass filter with 250 kc/s cut-off.
A.J.2.	Interposes high pass filter with 75 kc/s cut-off.
A.J.3.	Introduces a differentiating circuit - used as an anti-clutter device.

An indicator lamp on the front panel lights when the power supply is on. Fuses in the supply circuit are fitted in the front panel.

OPERATING INSTRUCTIONS.

7. After connecting up (para. 4) put the A.J.switch to "NORMAL" and adjust the gain control on the Receiver P114 until the grass on the scan is at its normal level.

8. To reduce the effect of R/T interference or enemy jamming :-

(a) Put the A.J. switch to "A.J.1" or "A.J.2" whichever gives the best result, altering the gain control on the receiver to give normal noise level after moving the A.J. switch.

(b) If this fails, change the transmitter pulse length and try again.

9. It may be found that although interference is not completely removed, it is possible to detect normal echoes and noise through the interference. If this is so, do not alter the position of the A.J.switch, but try to get slightly better results by varying the gain or local oscillator control. Do not alter the tuning of the R/F stages.

10. If much wave-clutter is present or if there are large land echoes put the A.J. switch to A.J.3 and readjust gain control. Blocks of land echoes will be broken up and aircraft may be seen in the gaps between them. Putting the switch in the A.J.3. position may also be useful against "window".

TECHNICAL DESCRIPTION.

Refer to Figs. 3 and 4.

11. A.J. Switch at "NORMAL".

With the switch in this position, video signals from the P114 receiver are fed to the grid of the output cathode follower valve V4. From the cathode of V4 signals pass to the grid of the video amplifier V5, from the anode of which they are fed via a D.C. restoring circuit to one Y-plate of the C.R.T.

12. In the absence of interference, P114 receiver (modified P11) when used with the Filter Unit should have the same performance as the unmodified P11 receiver, but there may be some slight change in saturation level.

13. A.J.Switch at A.J.1. and A.J.2. (High Pass Filter).

Two high pass video frequency filters are provided of cut-off frequencies 250 kc/s and 75 kc/s; these are similar in principle.

14. The purpose of the filters is to remove the jamming modulation frequencies whilst passing the beat frequencies between jamming and echo. Some of these beat frequencies are also removed by the filter, depending on how far the interference is off tune, therefore the echo shape is distorted. It would have a ringing appearance (i.e. it would appear below as well as above the trace) and to restore it to normal shape, a phase splitting valve V3 and two diodes V7 and V8 are used for rectification. These are followed by a smoothing circuit, appropriate to the cut-off frequency of the filter. With a filter in circuit the pulse is lengthened to two or three times normal. A delay of 150 yards is introduced when the 250 kc/s filter is in circuit and 450 yards when the 75 kc/s filter is in circuit.

15. To reduce the overloading of the pre-detector stages, additional amplifying valves V1 and V2 are added between the filters and detectors. The gain of the pre-detector stages can thus be reduced by a corresponding amount.

16. If there is one interfering signal, either R/T or enemy jamming, of strength less than 40 times noise, each filter will wholly remove modulations up to half its cut-off frequency. With higher strengths or higher modulation frequencies there will only be part removal, but echoes may still be picked out on the "A" scan. If two or more interfering signals are accepted by the response band the beats between these may not be removed by the filter, which is then ineffective.

17. A.J.Switch A.J.3. Differentiation.

With the switch in this position the video signals pass through the double diode differentiating circuit before being applied to the grid of the output cathode follower valve V4. The effective circuit is C31 and R36 via V10 which is introduced to block the reverse swing at the end of the pulse; V9 is a D.C. restoring diode. The time constant has been chosen as 1·5 microseconds, and causes a drop in gain to about 60%. A 15 microsecond pulse will be shortened, with a paralysis tail lasting for the remainder of the 15 microseconds. If the echoes are beating, owing to interference, a 15 microsecond pulse may appear as a double echo.

18. This circuit is used for anti-clutter (to most advantage with the shortest pulse) and breaks up blocks of land echoes into a number of small responses; thus aircraft echoes may be seen in the gaps between them. It may be similarly useful against Window.

A.G.C.

19. Since A.G.C. is not applied to Type 79 it is necessary to reset the P114 receiver gain for each position of the A.J.switch and also after any large change in jamming signal strength.

VALVES AND VOLTAGES.

20. The following valves are fitted in the unit :-

One CV1289	-	H.T.Rectifier
One CV173	-	A.G.C.Valve (not required for Type 79)
Five CV1091	-	Amplifiers, cathode followers.
Eight CV1092	-	Used for differentiation, signal rectification and D.C. restoration.

21. The following table gives the normal operating voltages (± 20% tolerance) of certain valves shown in the circuit diagram.

VALVE	CATHODE VOLTS	SCREEN VOLTS	ANODE VOLTS
V1	2	260	230
V2	2	260	230
V3	56	270	230
V4	16	290	290
V5	0	150	180

CHAPTER 5.

THE SINGLE AERIAL SYSTEM AND DIODE SWITCH.

BRIEF GENERAL DESCRIPTION OF THE MODIFICATIONS IN SINGLE AERIAL WORKING.

1. Aerial System. (Figs. 5 and 24).

The Aerial Outfit ATD is connected as in Type 79/279 by a flexible feeder to the masthead bracket. From this a short length of open wire feeder Patt. W3228 leads to the transformer and matching unit mounted on the ship's mast. The output from the transformer is fed through a pyrotenax cable down the ship's mast to the diode switch in the transmitting office. The transmitter is connected by a pair of pyrotenax cables, called the Feeder Unit, to this switch, while a pyrotenax cable from the switch leads to a jack socket in the receiving office. ~~The Pre-Amplifier M101 is provided with two flexible feeders, one of which terminates in a jack which is plugged into the jack socket. The other feeder connected to the Pre-Amplifier is attached at its other end to the receiver input terminal and clamp. If a Pre-Amplifier M101 has not been fitted,~~ the jack socket is connected directly to the input of Receiver P114 by a flexible feeder.

2. The Diode Switch.

The arrangement of the switch unit and feeders is such that during transmission of a pulse nearly all the power is supplied to the aerial and the receiver is short-circuited. During the intervals between the pulses, however, most of the energy received passes to the receiver so that, in effect, the aerial is connected alternately to the transmitter and receiver. This switching action is performed by a diode in conjunction with quarter-wave transformers, the whole being combined in the diode switch and feeder unit. Slight modifications have been carried out to the Diode Switch to ensure that the modified CV8 diode valve now supplied functi satisfactorily and protects the receiver.

3. The Transmitter and Receivers.

These have been slightly modified to permit the use of the modified type of receiver.

4. Power Supply. (The following does NOT apply when synchronised power supplies for two sets are fitted. See Handbook for 281BQ).

As there is only one aerial in Type 79B/279B, the 14 kVA. alternator will give sufficient power to rotate the mast as well as supply the set. The load due to rotation varies considerably, however, and in order to keep the voltage constant a carbon pile voltage regulator has been fitted.

THE THEORY OF QUARTER WAVELENGTH TRANSFORMERS. (Fig. 6).

5. If a transmission line has an electrical length equal to a quarter of a wavelength and its characteristic impedance is Z ohms, then a resistance R at one end is transformed into a resistance R1 at the other where $RR^1 = Z^2$. It can also be shown that if the input at one end is V volts the current at the other is V/Z, whatever the terminating resistance. If two quarter wave transformers ab, bc, (Fig. 6) of impedance Z, Z^1 respectively are connected they are said to form a double quarter wave transformer. An impedance R at a becomes Z^2/R at B and $R(Z^1/Z)^2$ or R/M^2 at c where $M = Z/Z^1$. It can also be shown that the voltage V at A becomes V/M at c, while the current I at a becomes I.M. at c.

6. Owing to the use of these transformers, different pattern articles must be used with each type of aerial outfit as shown in the table below :-

Aerial Outfit	C	H	J
Frequency in megacycles	39	40	41
Transformer and Matching Unit	W2945	W2946	W2947
Diode-Switch	W2941	W2942	W2943
Feeder Unit	W3235	W3236	W3237
Length of $\frac{1}{2}$ wavelength of pyrotenax	80"	78"	76"
Socket with screened lead and cable eye for receiver connection (P11)	W2933	W2934	W2935
Socket with screened lead single for receiver connection (P12)	W2937	W2938	W2939

AERIAL MATCHING TRANSFORMER (Figs. 7 and 8)

7. Description and Theory.

The aerial array is connected by flexible feeders to the mast-head bracket from which a pair of open wire feeders lead to the aerial matching transformer, mounted on the forward side of the mast at the level of the platform (Figs. 5 and 24). The function of this unit is to transform the balanced load of 400 ohms of the open wire feeders into an unbalanced load of 43·5 ohms at the top of the pyrotenax cable.

8. The unit consists essentially of $1\frac{1}{2}$ wavelengths of pyrotenax cable bent into U shape with a quarter wave transformer connected at C half a wavelength from the top of one limb. For convenience the tops A, B of the U are bent inwards so as to have the same spacing as the open wire feeder to which they are connected. For the same reason the whole U is bent back on itself so as to form a reasonably compact unit.

9. The load at AB is 400-ohms which may be regarded as 200-ohms on each side between the central conductors and the earth screen. At C these impedances are in parallel giving 100-ohms at the end of the quarter wave transformer CD. This transformer, which is of different dimensions from the main pyrotenax feeder, has a characteristic impedance of 67 ohms. The impedance at D is therefore $67^2/100 = 45$ ohms (5·1) which matches approximately the main feeder of 43·5 ohms impedance.

10. Since AC, BC are one and one half a wavelength respectively power fed in at C will produce voltages in antiphase at A, B, which is the condition for an open wire feeder.

11. Connecting, sealing and testing.

The unit will be supplied with the ends A and B sealed with temporary sealing plugs, and the junction box C connected and sealed. The end of the cable at D is brazed to one side of the junction box which is sealed with ART compound. The complete unit should be tested for insulation and continuity before any connections are made. If the insulation on a megger test is less than 20 megohms, the temporary seal at D should be removed and the cable heated until it changes colour. The blow lamp should be applied at a point on the cable nine inches away from D, and should be moved slowly towards D as the cable changes colour. If after this the reading is still low a new unit must be obtained.

12. The main pyrotenax cable should be run straight up the mast to a point just below the mounting plate and then bent round and cut

off so that it will fit squarely and easily into the junction box D. In cutting the cable it must be remembered that the outer must be cut back to leave $\frac{3}{4}$" for joining on to the connector on the inner conductor in the junction box. With the cable end cut and prepared, the ring seal, nut and ferrule should be slipped over the outer, the inner sweated into the connector, and the ring seal nut tightened up with a large spanner. The box should now be sealed with ART compound, care being taken to dry out the end of the main feeder. For a good seal the following points should be noted :-

(a) All metal surfaces must be bright.

(b) The box must be hot enough to make the ART compound run.

(c) The box should be filled with compound, left for some hours and then topped up before the cover is put on.

The pyrotenax lead down the mast should if possible be made of one piece, but two junction boxes (W2931) are provided in case joints occur in it.

THE DIODE SWITCH AND THE FEEDER UNIT (Figs. 12 and 13).

13. Description.

This consists of three main parts, the balance to unbalance transformer AEFB (similar to the aerial matching transformer), the diode transformer EHJK and the receiver feeder HL. The main pyrotenax feeder is connected to a half wavelength line at G giving an unbalanced load of 43·5 ohms at E. (There is no reason why GE should be half a wavelength. The pyrotenax feeder could have been led in at E). This becomes a balanced load of 4 x 43·5 = 174 ohms at A, B which are tapped on to the anode lines of the transmitter. In order that this may be done conveniently, the diode switch is mounted on a frame on the bulkhead behind the transmitter, while EA and FG (called the feeder unit) are bent into a convenient shape. A clamp is mounted on the back of the transmitter to hold EA and FG in place.

14. The diode itself is connected through a double quarter wave transformer KJH to a junction box H, from which a quarter wavelength transformer leads to E and a half wavelength line to the junction box L which in turn is connected to the receiver. All the cables are of pyrotenax of characteristic impedance 43·5 ohms, except for HJ which has an impedance of 8·55 ohms. The ratio of the transformer HJK is therefore 43·5/8·55 or 5.

15. Action of the Diode Switch.

When the transmitter oscillates, a considerable potential is developed across the diode, causing it to conduct and reducing its impedance to about 25 ohms. This is transformed to 1-ohm at H, so that this small impedance, across the receiver impedance of 43·5 ohms, effectively short circuits the receiver during transmission. Furthermore the impedance presented by the receiver feeder at E will be $43{\cdot}5^2$ ohms, since EH is a quarter wavelength transformer of impedance 43·5 ohms. The impedance of the aerial at E is 43·5 ohms, so that only $\frac{43{\cdot}5}{(43{\cdot}5)^2}$ or $2\frac{1}{2}\%$ of the transmitter power will be lost. Thus during transmission the diode switch prevents loss of power to the receiver and at the same time protects the receiver.

16. During the intervals between the pulses, the small bias applied to the diode prevents it from conducting, so that it acts as an impedance of approximately 10,000-ohms. This will give an

impedance of 400 ohms at H in parallel with 43·5 ohms in the receiver feeder so that roughly 1/11 of the received power will be lost in the diode switch. There will be an additional loss of power to the transmitter, but since EC, FB are half wavelengths the impedance of the transmitter is transferred to E and this is quite large when the transmitter is not oscillating. Thus in the intervals between the pulses most of the received power passes to the receiver.

17. Mounting, Sealing and Testing.

As stated above the diode switch and feeder unit are mounted behind the transmitter in such a position that the junction boxes E, F are opposite the centre of the panel. The back of the transmitter panel is drilled so that the aerial coupling circuit can be mounted in various positions. With type 79B/279B it should be adjusted so that the aerial coupling is on a level with the band in the anode lines, and this should be done before the feeders AE, BF are bent to shape.

18. When the unit is supplied the junction boxes H, J are permanently sealed, the ends C and D are sealed with plugs while all other cable ends are temporarily sealed. The same precautions with regard to testing and sealing should be taken as described above.

19. The Diode Circuit.

The circuit diagram and layout are shown in Figs. 10 and 11. The valve is a CV8 diode which has its anode sealed directly to the glass. The cathode, which is a copper cylinder inside the anode, carries a tungsten rod joined to a brass connector at one end of the valve, while the heater leads are taken out at the other end. One of these leads is painted black and this one is connected to the cathode. The lead painted black is connected to the choke which is wired to the terminal marked BIAS +ve in the Diode switch box.

20. The diode is mounted in a brass case as shown in Fig. 11 with a brass ring locking the valve and connecting the anode to the case. The cathode connector makes contact with a spring in the bottom of the case, while the heater leads clip into split pins connected to the chokes J.

21. The whole diode circuit is mounted in a heavy box to distribute the heat generated in the diode. There are holes in the box and in the cover for ventilation (which are covered with copper gauze) to prevent overheating when the cover is on. The outer of the pyrotenax feeder cable is brazed to a brass plate which is secured by screws to the side of the box. The inner carries a 4 BA thread which projects inside the box, and to which is connected the aerial blocking condenser F. A three core screened cable leads from the box to the transformer and rectifier unit from which the bias voltage and heating current are supplied.

22. The diode capacity is tuned by means of the coil L and condenser C as described in Chapter 2, paragraph 2 (b), so that during reception there is an impedance of 10,000 ohms at K. Since the cathode of the valve is live, the chokes J are inserted to give a high impedance to earth. The negative bias is connected between earth and the common cathode heater connection, and in order to prevent this from being shorted through the coil C or the aerial feeder, the condenser K and the aerial condenser F are inserted. The large heater current gives a voltage drop in the chokes J, and in the supply cable so that a supply voltage of 7·25 volts is required to maintain 6 volts at the valve filament leads.

23. The D.C. resistance of the valve is 12·5 ohms when conducting, but since it only conducts on alternate half cycles, it acts as a damping resistance of 25 ohms across the tuned circuit during

transmission. The current passed has a peak value proportional to the square root of the transmitter power and is about 30 amps for 100 kW. When passing this current the peak voltage is 375 volts but owing to the properties of the quarter wave transformers only 1/5 of this appears across the receiver.

24. When the diode conducts it acts as a rectifier and passes a large pulse of current into the bias circuit Fig. 9. A 4 mfd. condenser is placed directly across the input to give a low impedance path for the pulse. The condenser becomes charged and discharges through 1,000 ohms leak and rectifier. This discharge current, which is the mean of the H/F diode current, is measured on the diode current meter in the modulator panel and gives an indication of the output of the transmitter. (See Chapter 2, paragraph 2 (c)).

THE TRANSFORMER AND RECTIFIER UNIT.

25. The circuit diagram of this unit is shown in Figure 9. The input is 230 volts 50 cycles taken from the terminals marked "From Gate Switch" on Panel 3AA rectifying upper. These are connected to terminals "230 volts" and "common" on the unit. The unit provides D.C. bias which can be varied by means of the preset resistance up to 5 volt. A lamp is provided in the circuit to show that the unit is working.

26. The heater current for the diode is supplied by another winding of the transformer which has two tappings. It is essential that the tapping marked 7·25V. and not the tapping marked 6·5V is used. One end of this heater winding must be connected to the positive bias output. A screened three core cable connects the unit to the diode switch, the bias winding, and the other end of the heater winding. The correct cable (Patt: No.) must be used to avoid voltage drop.

27. A jack socket is provided in the bias circuit so that the milliammeter on the modulator panel may be used to measure the diode current (See Chapter 2 Para. 2 (c)).

NOTE:- In some units the bias leak resistance is only 20 instead of 1,000 ohms. If insufficient bias is obtained, a 1,000 ohm resistance should be inserted instead of 20 ohms.

THE RECEIVER FEEDERS.

28. Theory.

As mentioned above, during the transmitted pulse there is an impedance of about 1 ohm at H and a voltage of 75 volts. As the receiver feeder has a characteristic impedance of 43·5 ohms, it is mismatched and has large standing waves on it during transmission. To prevent a high voltage appearing across the receiver, it is therefore essential that it should be connected at a distance separated from H by a whole number of half-wavelengths. The voltage across the receiver will then be a minimum, equal to the voltage at H.

29. Instructions for fitting.

The pyrotenax must be run from the junction box L to the connecting box W2932 mounted above the right-hand front corner of the P114 receiver within reach of the operator. The cable should be cut to allow about 9 feet spare in the receiving office, and after it has been run, cut back to a whole number of half wavelengths to an accuracy of $\pm$ 3 inches (the length of a $\frac{1}{2}$ wavelength is shown in para. 5). The cable should be sealed into the junction box and the spare cable clipped up out of the way. The length of the cable from