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Richard Hankins, VMARS Archivist, Summer 2004

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**W. 9 A. 92**

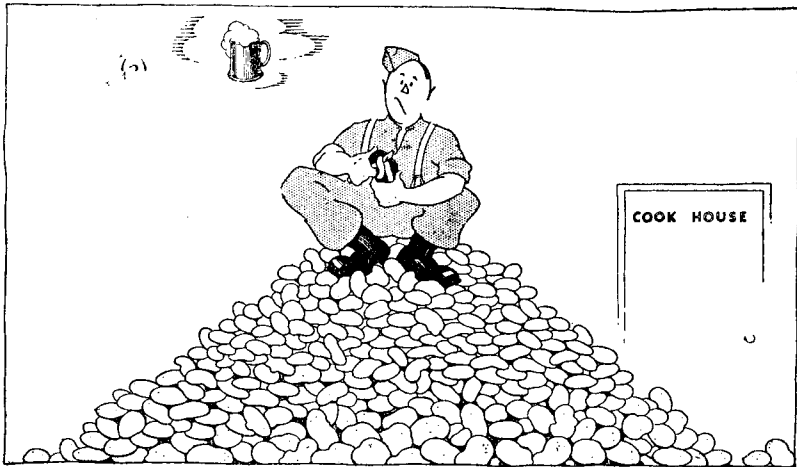
**WORKING  
INSTRUCTIONS  
PART I**

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**Z.A. 14048  
(P.C. Ref. No. 64697)**



**THE CONTROL-STATION OPERATOR WHO RETURNED AFTER NETTING**





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## CHAPTER I GENERAL DESCRIPTION

### 1. Purpose and facilities.

Wireless Stations No. 22 are complete R/T and W/T stations for the purposes indicated hereunder:—

Ground station.

Truck station with facilities for use on the ground.

Man-pack.

When fitted in trucks they are readily removed for use as ground stations and are arranged for transport in three man-carried loads when required.

For W/T operation, facilities are available for C.W. and M.C.W. (keyed modulation), with provision for break-in working on C.W. and M.C.W.

Remote control units F, Nos. 1 and 2, as supplied with the sets, enable the latter to be operated on R/T or W/T from a point up to  $\frac{1}{2}$  mile distant. By means of these units, signals coming in from a separate receiver can be transmitted by the sender of the W.S. 22 on a different frequency, and signals from the receiver of the W.S. 22 can be retransmitted by a separate sender on a different frequency.

Aerial coupling equipment unit J enables the set, when used as a ground station, to have a suitable aerial erected in the open and to be operated from cover at a distance up to 50 ft.

Immersion cover bags are provided with the man-pack station for fully waterproofing the sets for use in beach landings and river crossings when required.

Fig. 1 shows the layout of a complete ground station, indicating the necessary items of equipment for this purpose.

### 2. Range.

The range of the set is under all conditions similar to that of Wireless Set No. 19. The ranges obtainable in average daylight conditions are set out in Table I below:—

TABLE I.—RANGE: MILES.

<i>System</i> <i>AE</i>	<i>R/T</i>	<i>M.C.W.</i>	<i>C.W.</i>
12' rod on move	15-30	25-35	30 and upwards
34' rod stationary	30-40	35 and upwards	35 and upwards
140' wire AE	50 and upwards	50 and upwards	50 and upwards

### 3. Frequency.

The set operates on the range from 2 megacycles to 8 megacycles in two switched bands. It can therefore work with Wireless Sets No. 1, No. 9, No. 11 and No. 18, and with Wireless Set No. 19 in armoured formations.

### 4. Power supply.

The power-supply unit is of the vibrator type operating from a 12-volt battery and developing 325 volts at 80 mA. for the sender valves. The voltage is dropped to 150 volts for the receiver valves by series resistance. The station will normally be used with a 12-volt 75-A.H. battery when installed in a truck or worked as a ground station, and with a 12-volt 22-A.H. battery when used as a man-carried station. The battery drain and hours of working with either battery under various working conditions are tabulated hereunder:—

TABLE 2.—BATTERY CONSUMPTION.

Condition	Average Battery drain (amp.)	Approx. hours working	
		12 V. 75 A.H.	12 V. 22 A.H.
Send R/T ..	4.1		
Send C.W. ..	4.6		
Receive ..	2.6		
Listening watch..	2.2	35	10
Normal working	3.0		
3 hrs. receiving to 1 hr. sending		25	7.5

### 5. Sender-receiver.

#### (1) Function of controls.

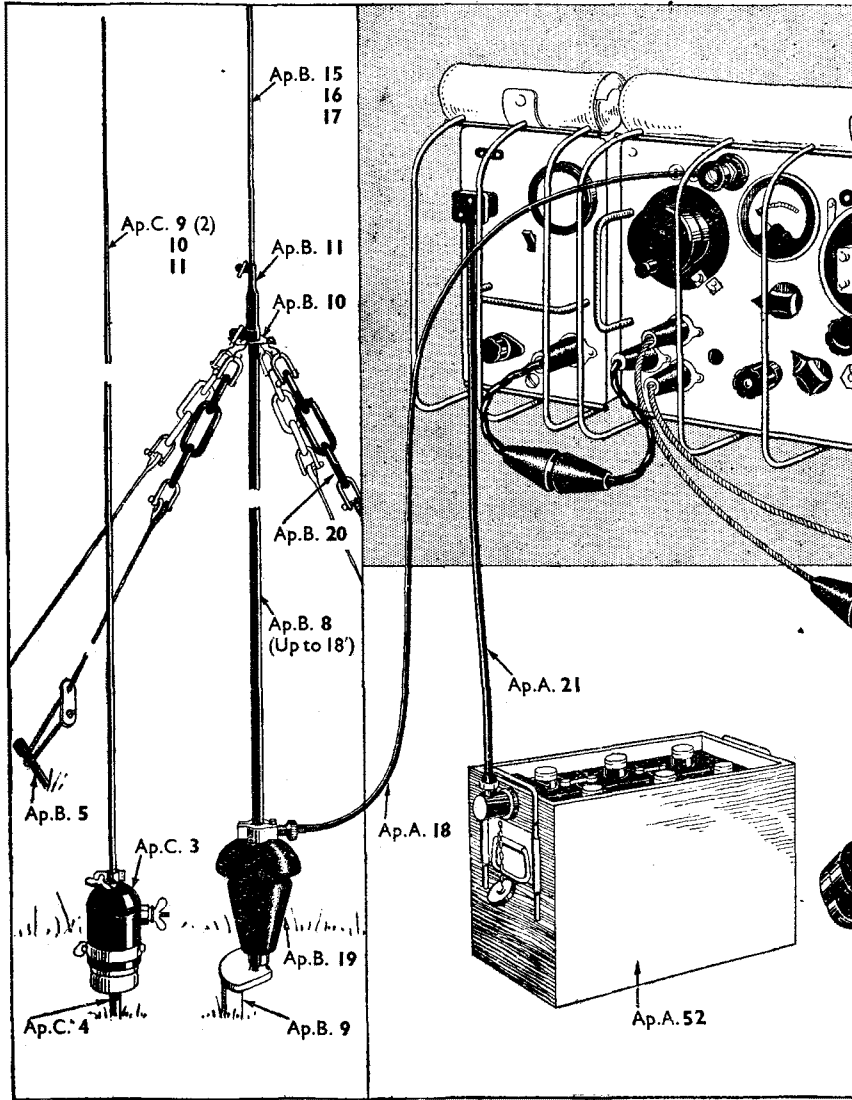
Fig. 2 shows a front view of the panel of the set and power unit, and indicates the purpose and method of operation of all controls and switches. The operator should study this carefully with the set before him.

#### (2) The valve layout.

Fig 3A indicates, in the form of a block diagram, the arrangement of valve stages in the sender-receiver. Valves V1A, V1B, V1C, V1D, V1E, V2A, V2B, and V3A are working when the set is used as a receiver, and valves V1E, V2A, V3A, V4A, V5A, V6A, V6B and V6C are working when the set is used as a sender as shown in Figs. 3B and 3C. With this information these figures become self-explanatory

# AERIALS

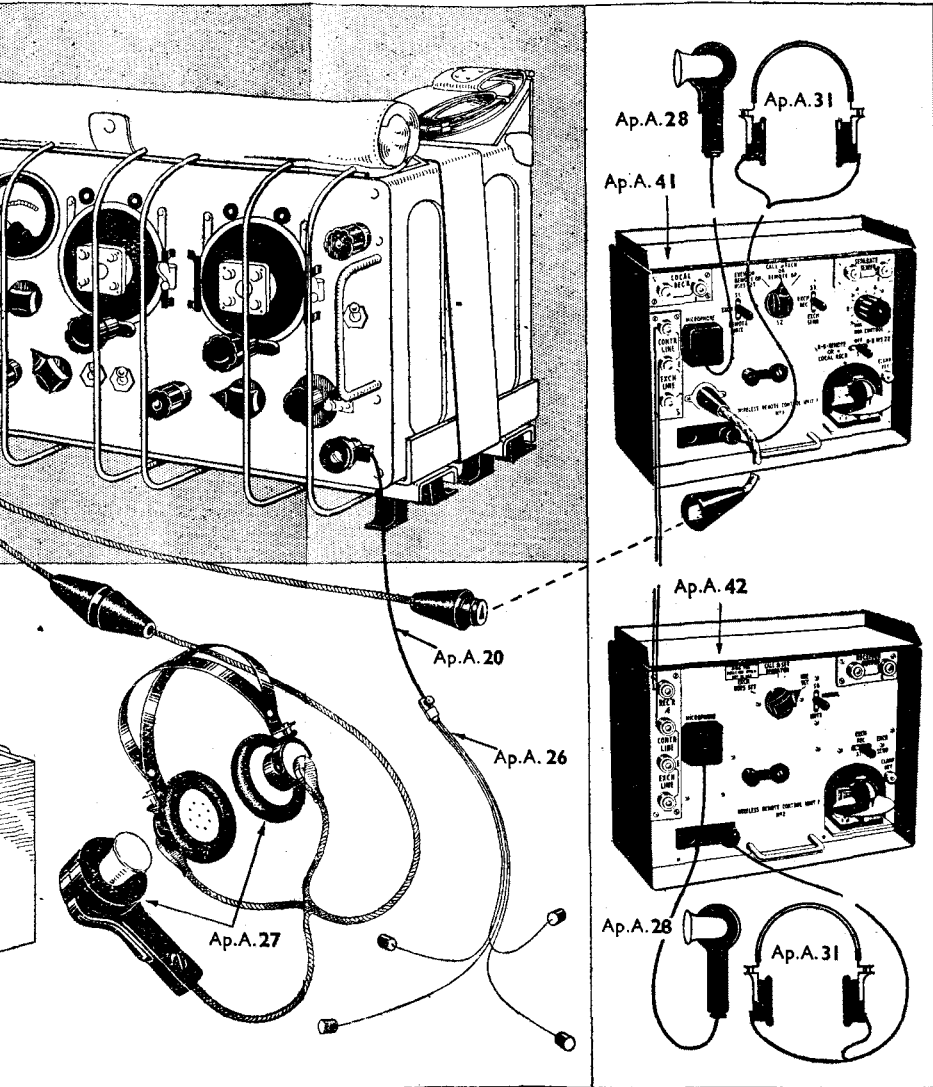
# LAYOUT OF COM



Description of parts can be found



# COMPLETE STATION REMOTE CONTROL



be found in Appendix A, B or C as indicated.

Fig. 1

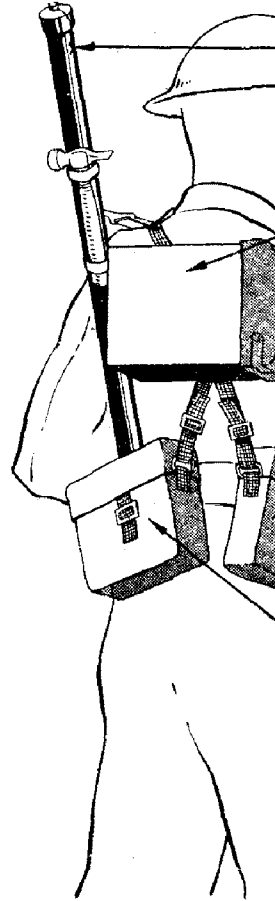
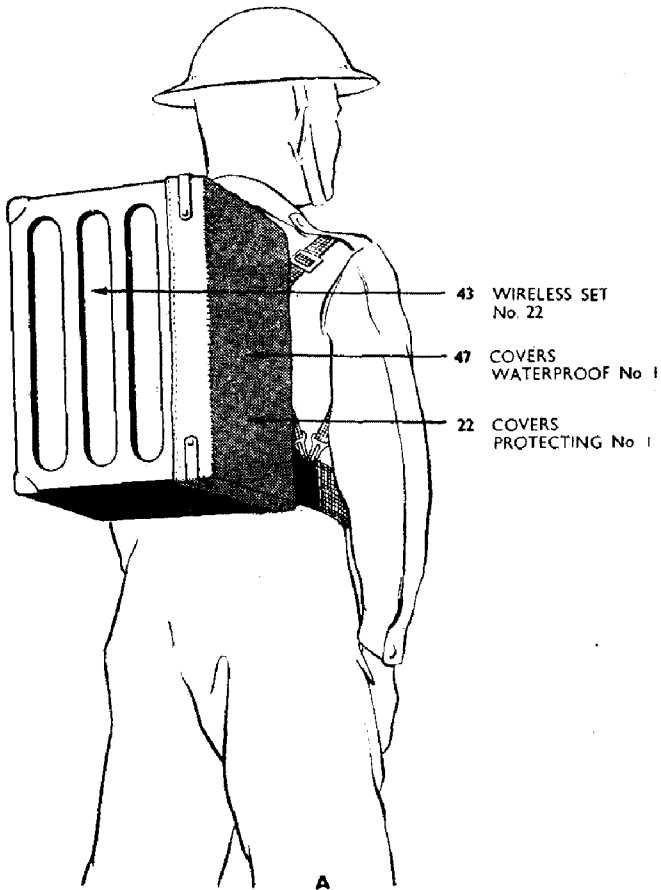






# MAN-PACK STATION.

unless otherwise stated, Index Nos. refer to Appendix A Complete Station List





st

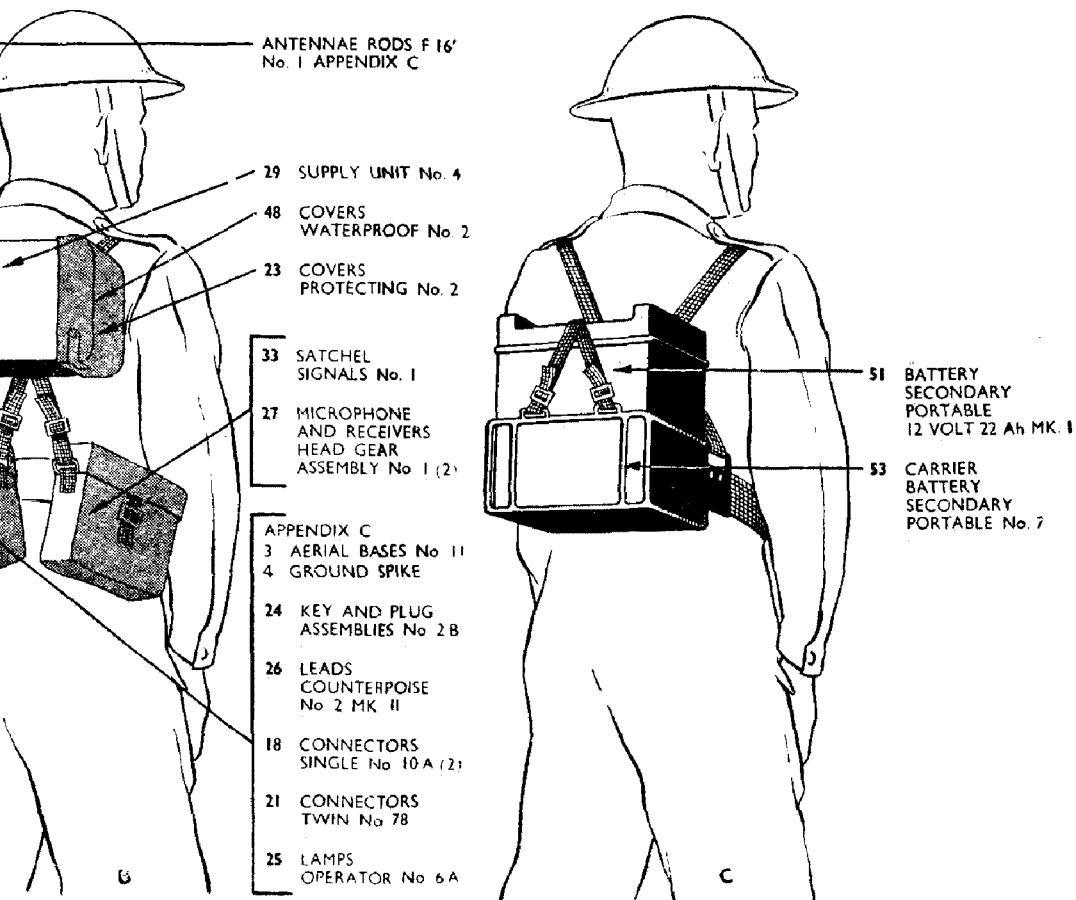


Fig. 5.



Fig. 3A

BLOCK DIAGRAMS OF CIRCUIT

'A' Sender Receiver

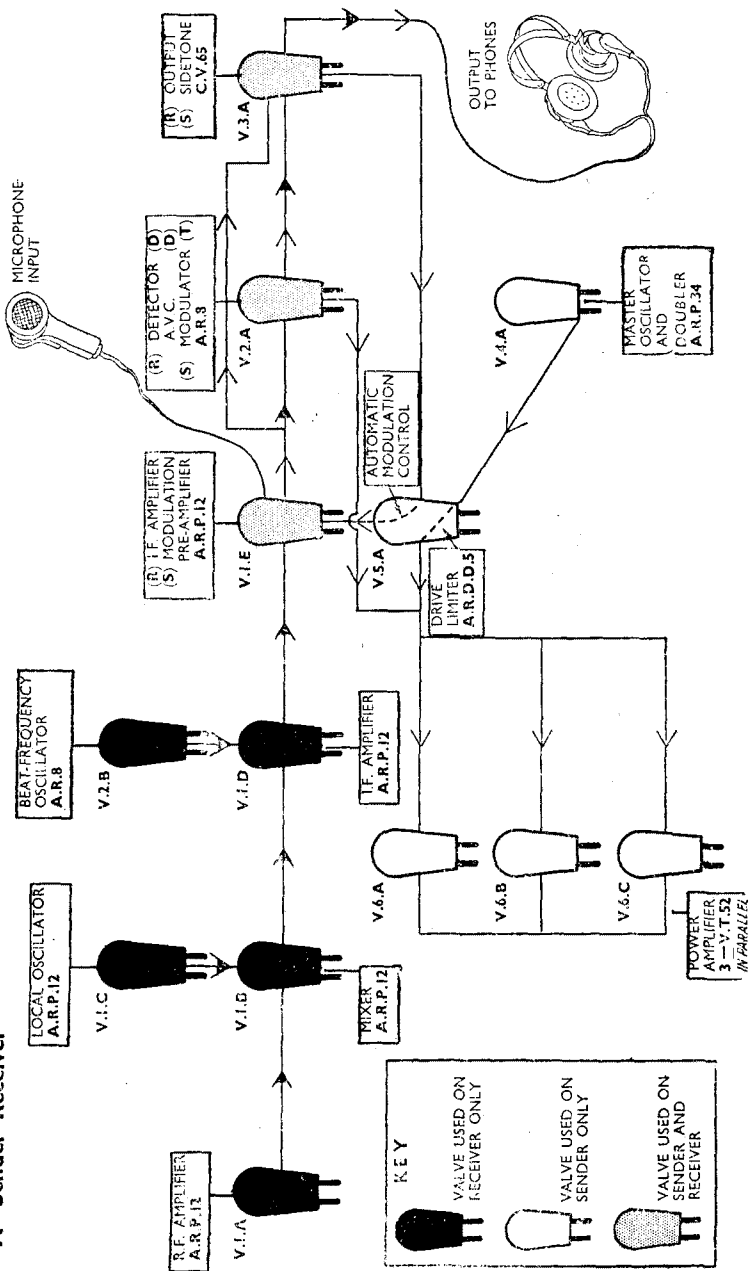


Fig. 3 B

'B' Receiver only

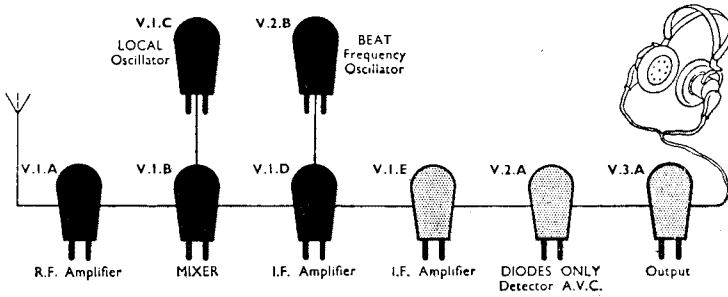
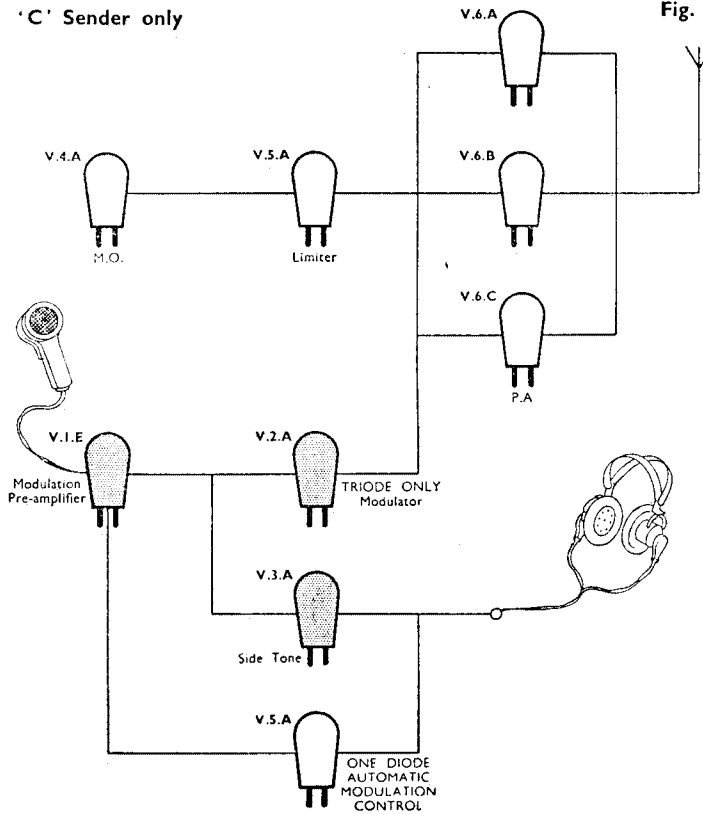


Fig. 3 C

'C' Sender only



Figs. 3B & 3C

(3) *Tuning system.*

The set is fitted with a 4-gang condenser (control marked on panel "FREQUENCY MC/S.") which tunes the R.F. circuits of the sender and receiver together, so that the sender frequency is at all times quite close to the receiver frequency. On account of small errors in the gang condenser and other components, slight differences occur between sender and receiver frequencies and these differences are corrected by the NETTING TRIMMER. The aerial circuit is separately tuned and is common to both sender and receiver. The aerial is tuned to resonance by the variable inductor marked "AERIAL TUNING," and the coupling to the plate of the power amplifier is adjusted by altering the matching condenser, marked "AERIAL COUPLING."

(4) *Aerials*

The set is designed primarily for use with rod aerials between 12' and 34' in length. Aerials shorter than 12' will not, in general, be tunable except at the higher frequencies. Provision is made for the use of a wire aerial 140' long. (See notes in section 6 (d) below.)

(5) *Systems*

The set can be used on C.W., M.C.W. (with keyed modulation) and R/T. Break-in working is possible on C.W. and M.C.W.

(6) *Break-in working*

Send-receive switching is carried out by two relays in the set; these are controlled by the pressel switch when R/T is being used, and by the key when W/T (C.W. or M.C.W.) is being used. The relays are so arranged that during gaps in the keying the receiver becomes operative, and if signals have not been correctly read the operator at the other end can break in with a message to that effect without waiting for completion of the transmission. *In the sidetone* on M.C.W. the initial dot or dash in each morse group is clipped or shortened and this is slightly confusing on the first two or three occasions of use, but the operator soon becomes accustomed to it.

*Note.*—This clipping does not occur in the carrier and on no account must the initial dot or dash be lengthened in an attempt to correct it.

**6. The complete station.**

Details of the stores required for complete stations, Wireless station No. 22, are given in Appendix A for the four conditions of use described in section 1. Many of these stores are standard service equipment and call for no comment, but attention is drawn to the following points:—



(1) *Battery fuse.*

A rewirable fuse is included in the battery circuit and is fitted in clips at the top of the inner face of the power-unit panel. The reel of spare fuse wire (item 8) is housed in the top of the power-unit case.

(2) *Aerials*

(a) *The vehicle aerial.*—Item 15 is the rod aerial used in the vehicle; it comprises three sections, Nos. 1, 2 and 3, which plug together, forming a 12' rod. A shorter aerial should not be used as it will be found impossible to tune it at the low-frequency end of the tuning range. An aerial base, item 11, an isolating condenser for protection in the event of the aerial touching an overhead power line, item 17, and the two connectors, item 19, for connection between the isolating condenser and the aerial, complete the vehicle equipment.

On the move the 12' rod as described above is normally carried, but when the vehicle is stationary a longer aerial can be used.

(b) *The 34' vertical aerial.*—This is normally used as a ground-station aerial, but it may also be used from a stationary truck by mounting the earth spike (item 9, Appendix B) at the side of the vehicle by means of suitable clamps. The complete equipment required is listed in Appendix B. Items 18, 20 and 26 of Appendix A are required to complete the aerial system.

Refer to Fig 1 for method of erection.

(c) *The 16' vertical aerial.*—This is included as part of the equipment for (b) above and is used as a ground-station aerial when a long range is not required or the 34' aerial would be too conspicuous.

It is also used when the set is worked as a man-carried station. Details of the components of this aerial are given in Appendix C. For details of erection, see Fig. 1.

(d) *Wire aerials.*—An end-fed wire aerial 140' long with suitable loading condenser may be used when ranges exceeding 50 miles are required. The length is measured from the aerial terminal to the insulator at the remote end of the aerial. The wire should preferably be erected at the greatest possible elevation; an aerial comprising an inverted L with the horizontal portion 30' from the ground would be regarded as very good, but good results may be obtained with the horizontal portion no more than 18' from the ground. For many purposes it will be possible to obtain satisfactory results by attaching one end of the wire to a tree or mast and driving the truck or vehicle containing the set away until the wire is stretched taut from the tree or mast to the top of the vehicle.

The aerial-current indications on the panel meter of the W.S. No. 22 will be of the same order as the current indicated with the 12' rod. Under certain circumstances it may be less, but it should not be assumed that for this reason the radiation will be less. Table 3 gives typical settings of the tuning and coupling controls for use with this aerial. The loading condenser is connected between aerial and earth.

TABLE 3.—140' ELEVATED AERIAL (END-FED).

<i>Freq.</i> Mc./s.	<i>Meter</i> <i>reading</i>	<i>Tuning</i>	<i>Coupling</i>	<i>Loading</i> <i>condenser</i> ( $\mu$ F.)	
2.0	290	256	70	400	} L.F. Band
2.3	230	265	45	400	
2.5	600	280	20	400	
3.0	350	195	45	400	
3.5	600	128	65	400	
3.5	600	233	31	100	
4.0	580	178	30	100	
4.5	400	166	10	100	
4.5	300	166	10	100	
4.75	250	140	0	100	
5.0	110	129	0	100	} H.F. Band
5.0	340	127	0	400	
5.25	160	125	0	400	
5.5	470	121	0	400	
5.5	40	137	0	100	
6.0	150	142	0	100	
6.5	400	118	0	100	
6.75	480	109	0	100	
7.0	480	100	0	100	
7.5	420	087	0	100	
8.0	300	073	0	100	

$\frac{3}{4}$  wavelength aerials of lengths shown in Table 3A may also be used. These should be erected as high as possible in the form of an inverted "L" as in the case of the 140' aerials described above. The aerials should be connected direct to the set aerial terminal without aerial condenser.

The tuning settings will be approximately the same as those shown in Table 7 for a 12' aerial, and the aerial current indication will be approximately the same as when a 12' aerial is used.

TABLE 3A.  $\frac{3}{4}$  WAVELENGTH AERIALS

<i>Description of</i> <i>aerial</i>	<i>Frequency band</i> <i>covered</i>
Aerials 250' No. 1	2.0 -2.65 Mc/s.
„ 185' No. 1	2.6 -3.5 „
„ 150' No. 2	3.45-4.5 „
„ 110' No. 1	4.45-5.6 „
„ 90' No. 1	5.55-6.65 „
„ 70' No. 1	6.6 -8.0 „

The use of the counterpoise provided will, in many cases, improve radiation on "send" and signal-noise ratio on "receive." This is particularly the case when the set is working over very dry ground. In wet situations a simple earth pin will give similar results. For the best results the radial conductors of the counterpoise should be increased to at least half a wavelength of the frequency in use.

(e) *Use of Remote aerial.*—Item 12, aerial unit J, enables a rod aerial or a wire aerial to be used from cover at a distance from the set. Details of the use of this unit are given in Chapter 3, Section 19.

(3) *Telephones and microphones.*

Item 27 comprises a pair of moving-coil telephones and a moving-coil microphone wired in a common head harness, the microphone handle incorporating a pressel switch. This type of acoustic equipment gives exceptionally good intelligibility, especially under noisy conditions such as exist in a vehicle in motion.

(4) *Battery for man-pack station.*

Item 51 with its carrier (item 53) is used with the man-carried station, and if the battery is fully charged should give about 8 hours' normal working.

(5) *Connecting leads.*

Item 18, Connector Single No. 10A. Used for aerial connection on ground station. It should be carried permanently connected to aerial base No. 11 in Satchel, Signals A.

Item 19, Connector Single No. 10C. Used for aerial connections in vehicle. One from aerial terminal on set to condenser X5 5KV Mk. II, and one from this condenser to the aerial base.

*Note.*—These connectors are not removed from the vehicle when the set is taken out for use as a ground station.

Item 20, Connector Single No. 33. Used to connect Leads Counterpoise No. 2, Mk. II (item 26) to earth terminal on set, when set is used as ground station. Should be carried in Bags, Aerial Gear No. 2, permanently connected to lead counterpoise.

Item 21, Connector twin No. 78. Lead from battery to power unit. In the case of the vehicle station this lead is not removed from the vehicle when the set is used as a ground station. A separate lead for ground station use is carried in Satchel, Signals A.

## 7. Weights and dimensions.

The weights and dimensions of the major items of equipment are tabulated hereunder. Table 4.

TABLE 4.

No.	Item	Weight (lb.)	Dimensions (ins.)		
			Long	Deep	High
1	Sender-Receiver .. .. .	36½	17½	13½	8½
2	Power Unit .. .. .	20½	7	13½	8½
3	Remote-Control Unit F, No. 1 .. .. .	20½	11	7	10½
4	Remote-Control Unit F, No. 2 .. .. .	21½	11	7	10½
5	Aerial Remote Unit J .. .. .	9½	6½	12	8
6	Sender and Receiver and Power Unit on Carrier No. 1 .. .. .	67½	24	13½	14

## 8. Strength and duties of detachment.

### (1) *Detachment.*

The detachment normally comprises three numbers.

When remote-control facilities are to be provided at a man-pack ground station, two additional numbers are needed to carry the cable and other remote-control stores.

### (2) *Erection of ground station adjacent to the vehicle.*

One operator can, if necessary, perform the duties of all three numbers and erect the station single-handed.

No. 1 disconnects the aerial lead, which he will leave behind in the vehicle; disconnects the power unit, key, phones and microphones; dismounts the set and power unit; carries the set to the ground position; connects the battery, power unit, aerial lead, phones and microphone; and tunes and nets the set.

No. 2 carries the aerial, power unit, key, phones, microphones and accessories; places them as directed by No. 1; erects the aerial with the aid of No. 3; and hands the aerial lead to No. 1.

No. 3 carries the large (75-A.H.) battery, places it as directed by No. 1, and helps No. 2 to erect the aerial.

On reconversion to a vehicle station, No. 1 dismantles the ground station, carries the set to the vehicle, and re-establishes the vehicle station. No. 2 dismantles and repacks the aerial, and carries the aerial, power unit, key, phones, microphones and accessories to the vehicle. No. 3 helps No. 2 to dismantle the aerial, and carries the battery to the vehicle.

(3) *Man-pack ground station.*

- (i) Table 5 shows how the stores must be packed and carried. Great care must be taken in checking the items to make sure that none shall be left behind.
- (ii) The duties of the detachment are as detailed in subsection (2) above, with the additions that:—

No. 1 also fastens down the waterproof cover of the set before leaving the vehicle;

No. 2 also fastens down the waterproof cover of the power unit; packs and checks the contents of Satchels, Signals, A and B; removes the fishing-rod aerial, hammer, spike, and carrying-case from the carrier bag, and leaves the remainder of the aerial equipment behind in the bag in the vehicle;

No. 3 immobilizes the vehicle.

TABLE 5.—DISTRIBUTION OF STORES FOR MAN-PACK GROUND STATION.

<i>Carried by</i>	<i>Parts carried</i>		<i>Appendix</i>	<i>How carried</i>
	<i>Designation</i>	<i>Item No.</i>		
No. 1	Set .. .. .	22, 43 47	A	See Fig. 5A.
No. 2	Antennae, Rods, F, Sections 1, 2, 3	9, 10 & 11	C	See Fig. 5B. In Antennae, Rods, Case, Carrying, No. 1 (item No. 5), with two straps, retaining (item No. 6 & 7) and Straps, carrying H (item No. 2).
	Spike .. .. .	4		
	Hammer, Engineers, Ballpane, 8-oz. .. .. .	1		
	Aerial base No. 11, with Connector, Single, No. 10A ..	3 18	C A	See Fig. 5B. In Satchel Signals A (item 33).
	Lead, counterpoise, No. 2, Mk. II	26	A	
	Connector, Twin No. 78 .. ..	21	A	
Key-and-plug Assembly, No. 2B	24	A		
Connector, Single, No. 33 ..	20	A		
Two Microphone and Receiver Headgear Assemblies, No. 1 ..	27	A	See Fig. 5B. In Satchel, Signals B (item 33).	
Power Unit .. .. .	23, 29, 48	A	See Fig. 5B. Slung on webbing equipment as haversack.	
No. 3	Battery Secy., Portable, 12V, 22A.H. .. .. .	51	A	See Fig. 5C. On Battery, etc., Carrier No. 1 (item 53).

(4) *Remote-control equipment.*

(i) The stores required are shown in Table 6.

TABLE 6.—REMOTE-CONTROL EQUIPMENT.

<i>Designation</i>	<i>Item No. (Appendix A)</i>	<i>How carried</i>
Wireless Remote-Control Unit F, No. 1.	41	Slung on shoulder with Strap Carrying, G.
Wireless Remote-Control Unit F, No. 2.	42	Ditto.
Microphone, Hand, No. 8. Receivers, Headgear, DLR, Double No. 1 or No. 2.	28 and 31 or 32	Satchel, Signals C (item 33).
Duplicate of preceding equipment.	28 and 31 or 32	Satchel, Signals D (item 33).
Cable, Electric, D3, twisted, $\frac{1}{2}$ mile.	3	Drum, Cable, No. 5 (item 5).

(ii) *Vehicle station.*

No. 1 connects Remote-Control Unit, F, No. 1 to the set; connects phones, microphone, and line to the unit; and stands by to test the line.

No. 2 (carrying Satchel, Signals, D) and No 3 (carrying Remote-Control unit, F, No. 2) lay the cable to the remote-control point. No. 2 ascertains where the unit is to be put; connects phones and microphone; loops the line through the empty drum so that the latter may not be salvaged; connects the line to the unit; tests the connection to No. 1; and hands over to the prospective user of the No. 2 unit.

On reeling in, No. 2 takes over the No. 2 unit, disconnects the accessories and packs them in Satchel, Signals, D, which he carries. No. 3 disconnects the line from the unit, which he carries. Nos. 2 and 3 together reel in the line.

(iii) *Ground station adjacent to the vehicle.*

While the set and aerial are being erected by Nos. 1 and 2, No. 3, after putting down the battery as detailed in subsection (2) above, fetches Remote-Control Unit No. 1 and Satchel, Signals, C, from the vehicle, and places them as directed by No. 1.

When the station has been set up, Nos. 1, 2 and 3 proceed to set up the remote-control circuit as detailed in paragraph (ii) above.

(iv) *Man-pack ground station.*

In this case two additional numbers are needed.

Nos. 1, 2 and 3 (operators and driver) proceed in accordance with subsection (3), page 17, above.

No. 4 carries Remote-Control Unit F, No. 1 and Satchels, Signals, C.

No. 5 carries Remote-Control Unit F, No. 2 and Satchel, Signals, D.

Nos. 4 and 5 carry the cable between them, and lay out the remote-control line, in the manner detailed for Nos. 2 and 3 in paragraph (ii), page 19, above, while the station is being set up by Nos. 1, 2 and 3.

## CHAPTER 2

### INSTRUCTIONS FOR OPERATING

#### 9. Erecting aerial.

Before you can operate the station a suitable aerial must be erected. Details to enable you to find the correct stores and method of assembly are given in Section 6 (2) of Chapter 1, and in Fig. 1.

#### 10. Preparing for work.

- (1) Roll up waterproof cover and stow at top of set. (Fig. 6.)
- (2) See that headsets are plugged into the sockets of the drop leads on the set panel. (Fig. 7.)
- (3) See that the connector from the power unit is connected to the plug of the power drop cord on the set panel. (Fig. 7.)
- (4) See that the battery lead is plugged into its socket on the panel of the power unit and correctly connected to the battery.
- (5) Check that aerial and earth connections have been made and that the cases of the set and power unit are connected together. A jumper lead is provided on the power unit and should be connected to the earth terminal on the sender-receiver.



- (6) See that key plug is inserted in jack and pushed fully home.
- (7) Put battery switch on supply unit to "ON" and wait at least half a minute for the valves to heat up.

### ROLLING UP THE WATERPROOF COVER

1. Lift up Cover
2. Roll up Tightly
3. Fasten Press-Studs

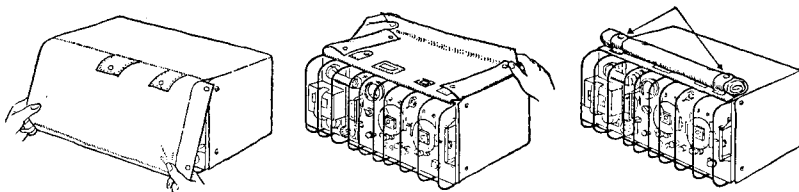


Fig. 6

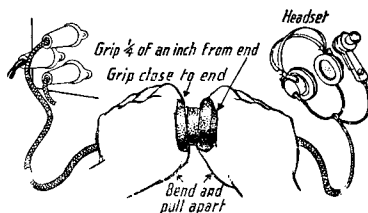
## II. Tuning the sender-receiver.

Before you can net your set in a group you must learn to tune it to the required frequency and to use the flick controls.

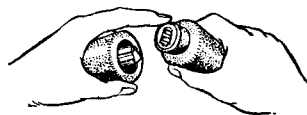
Normally your group will be given two frequencies to work on, the blue or normal and the red or spare frequency. The flick tuning allows you to tune the set for working on either and to change quickly from one to the other. You will notice beside each of the main tuning controls a small lever with three positions, "TUNE," "SET," and "FLICK." Fig. 8 shows how to set up a tuning dial for two flick frequencies. When this flick lever is turned to "TUNE" the fine tuning knob will turn the tuning dial to any frequency as in a broadcast receiver, and if flick frequencies are not in use, the set may be tuned in this way. Fig. 9 shows exactly how to tune the sender-receiver.

### CONNECTING HEAD-SET LEADS TO DROP LEADS FROM PANEL

1. Undoing



2. Moisten brass ring before plugging in again

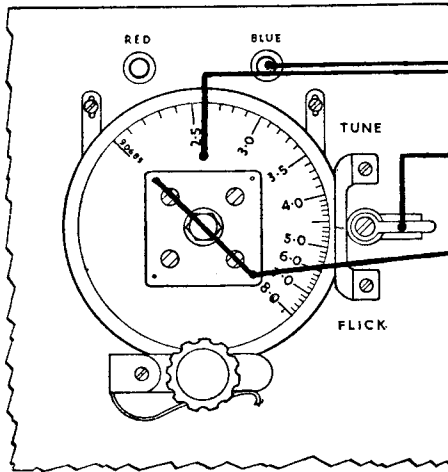


3. Plugging in



Fig. 7

## SETTING UP A TUNING DIAL FOR FLICK WORKING



A.2. Turn dial until blue flick engages—white disc shows in blue ring.

A.1. Before Tuning to BLUE Frequency—Turn to 'SET.'

A.3. Slacken off blue screws—half a turn only.

B.4. After netting on BLUE Frequency—Tighten up blue screws—see frontspiece.

C.5. Before Tuning to RED (spare) Frequency—Turn dial till red flick engages—white disc shows in red ring. Do the rest as for Blue—but using RED screws of course.

Fig. 8

## 12. Netting. VERY IMPORTANT.

It doesn't matter how good the wireless set you are using may be, you will not have good signals on a group of stations unless they are all accurately tuned to the same frequency. Bringing a group of stations on to the same frequency is called "NETTING," and to do it successfully all the operators in the group must:—

- (1) Know exactly how to tune the wireless set quickly and with confidence.
- (2) Understand and carry out the netting drill accurately, remembering that the control station is always right and his instructions must always be obeyed immediately.

Netting is always done before a force goes into action. The enemy must not hear you netting if it can be helped, since if he does:—

- (1) He will know your frequency and listen to your instructions, or jam them.
- (2) He may find out, roughly, where you are by direction finding.

Netting is done in three ways:—

- (1) Netting vehicle stations in harbour with sender aerial circuits detuned to reduce range.

Used whenever it is possible, since the enemy is not likely to hear you.

(2) Netting by wavemeter.

Used when it is not possible to bring all the sets together and it is vital that the enemy should not hear the netting. Also used by control station whenever a wavemeter is available.

(3) Netting at a distance.

Used when (1) and (2) are impossible.

Before opening up you will have been told the frequency or frequencies, code-signs for the group, the time at which the netting is to begin, and the details of the netting signals.

Switch your set on fifteen minutes before netting is due to start (because the set takes a quarter of an hour to settle down) and spend the time making the tests for Daily Maintenance (*see* pages 45, 46).

### NETTING VEHICLE STATIONS IN HARBOUR WITH DETUNED AERIAL CIRCUITS.

Detuning the aerial circuit means adjusting it so that the signals are too weak to be heard far from the harbour. Use the same length of aerial as you will use out of harbour. Make sure you are detuned before sending; AERIAL COUPLING dial should be set to 100 for this purpose.

#### A. Tuning the control station's set.

(1) With a wavemeter. (You will always use one whenever possible, as it gives better results.)

Net the set by wavemeter as below.

(2) Without wavemeter.

(a) PREPARE SET FOR NETTING (*see* Fig. 9) on BLUE frequency, setting frequency as accurately as possible. (The electrician signals will give you details of the errors in your FREQUENCY MCS. dial calibration.)

(b) Depress NET switch. Turn NETTING TRIMMER for maximum rise of meter reading. Turn AERIAL COUPLING dial to 100.

(c) Call one outstation and order him to net on your signal and give you a netting call in reply with his aerial detuned.

(d) Do netting drill (Fig. 9) on signal from outstation.

(e) Repeat (a)—(d) for RED frequency, if used.

(f) Turn AERIAL COUPLING dial to 100 and FREQUENCY MCS dial to BLUE frequency and AERIAL TUNING to setting logged for this frequency.

(g) Switch to M.C.W.

*Note.*—After setting up as above, control station must on no account re-tune. (*See* Frontispiece.)

### *B. Netting the group.*

- (a) Before Netting Time, Control Station will tune as above and outstations will PREPARE SET FOR NETTING. (See Fig. 9.)
- (b) At the time ordered for netting, Control will send tuning call for a short period. If netting by numbers continue keying until order 3, Fig. 9.
- (c) Stop keying, switch to C.W. and hold key down until outstations have had time to net, or if netting by numbers till order 9.
- (d) Control Station will switch to R/T and give Group Call.
- (e) While outstations answer in turn, Control listens carefully with NET switch depressed. Control should hear clear answers with no whistle or only a very low-pitched hum. If any reply is badly distorted or gives a high-pitched whistle, the outstation is off net, and should be ordered to net again by doing (b)—(d) again.
- (f) If the group has an alternative frequency, the netting is repeated for this frequency with the tuning dials set for RED.

### *NETTING BY WAVEMETER.*

All sets are netted alike, as below:—

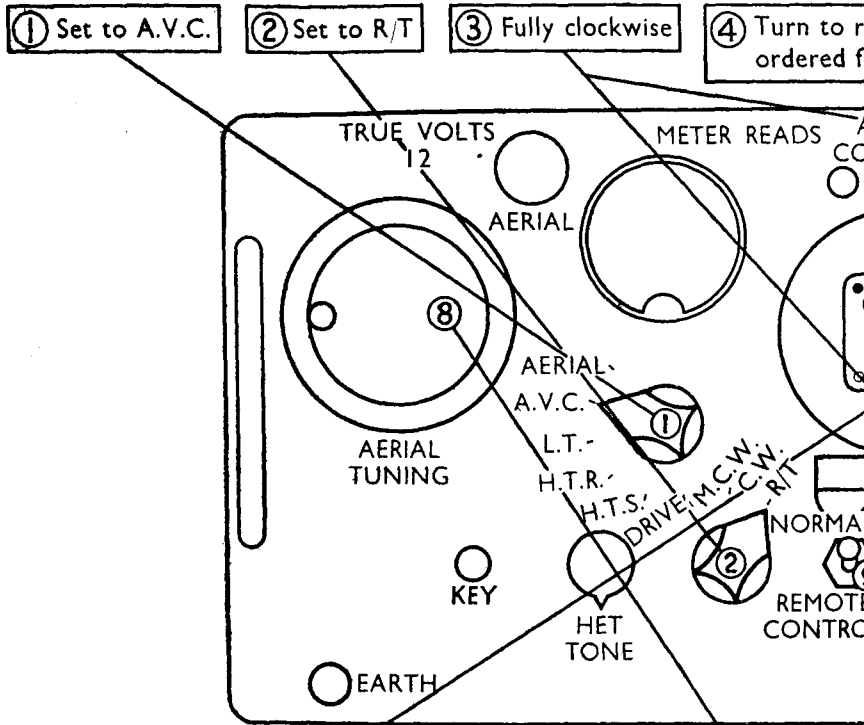
- (a) "Prepare set for Netting" (see Fig. 8) on blue frequency before wavemeter arrives.
- (b) The wavemeter will be brought near to your aerial, and will be sending a weak "C.W." signal of the ordered frequency.
- (c) Do "Netting Drill" as in Fig. 9.
- (d) If the group has been given a spare frequency the wavemeter will now be set to this frequency and you will net on it with the red flicks engaged. (See Fig. 8C.)

### *NETTING AT A DISTANCE.*

#### *A. Tuning control station's set.*

- (1) With a wavemeter.
  - (a) Net set by wavemeter as in harbour, but set AERIAL COUPLING to setting given in Table 7.
  - (b) Switch meter to  $\text{Æ}$  and do 8 to 10 in the NETTING DRILL (See Fig. 9) for maximum radiation.
  - (c) Repeat (a) to (d) for RED frequency, if required.
  - (d) Switch to M.C.W.
- (2) Without a wavemeter.

# NETTING PREPARE SET



**7** Set to reading given in Table 7 and lock flick

**8** Set to point near reading given in Table 7 where rustling noise in phones is just starting

# NETTING IN

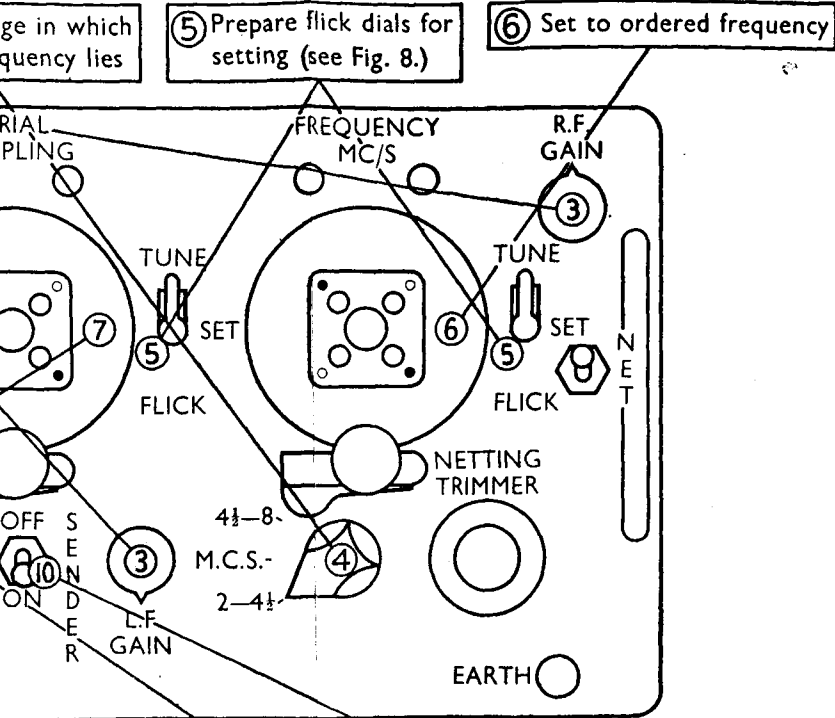
USE THE NUMBERS HERE FOR NETTING

- 1** Search boldly for Signal  
Tune for Max. deflection on meter
- 2** Press NET. Tune NETTING TRIMMER for zero beat reducing R. F. Gain to give strength 3 signal. (see Fig. 10.)
- 3** Lock FREQUENCY M.C.S screws of correct colour

- 4** Lock NETTING TRIMMER
- 5** Turn to FLICK
- 6** Turn dial away from signal carefully
- 7** Check if netting is correct  
If not do 1-6 again



# DRILL FOR NETTING



age in which  
quency lies

⑤ Prepare flick dials for  
setting (see Fig. 8.)

⑥ Set to ordered frequency

OFF S  
E N D  
O N D  
E R

4½-8-  
M.C.S.-  
2-4½

Table 7  
oudest

⑨ Set to normal

⑩ Switch to "On" position

# HARBOUR

NG BY NUMBERS WHEN TRAINING

IMMER

⑧ Turn R.F. Gain to Max. and adjust AERIAL  
TUNING for Max. deflection on meter

re-engage flick

⑨ Lock AERIAL TUNING

still good

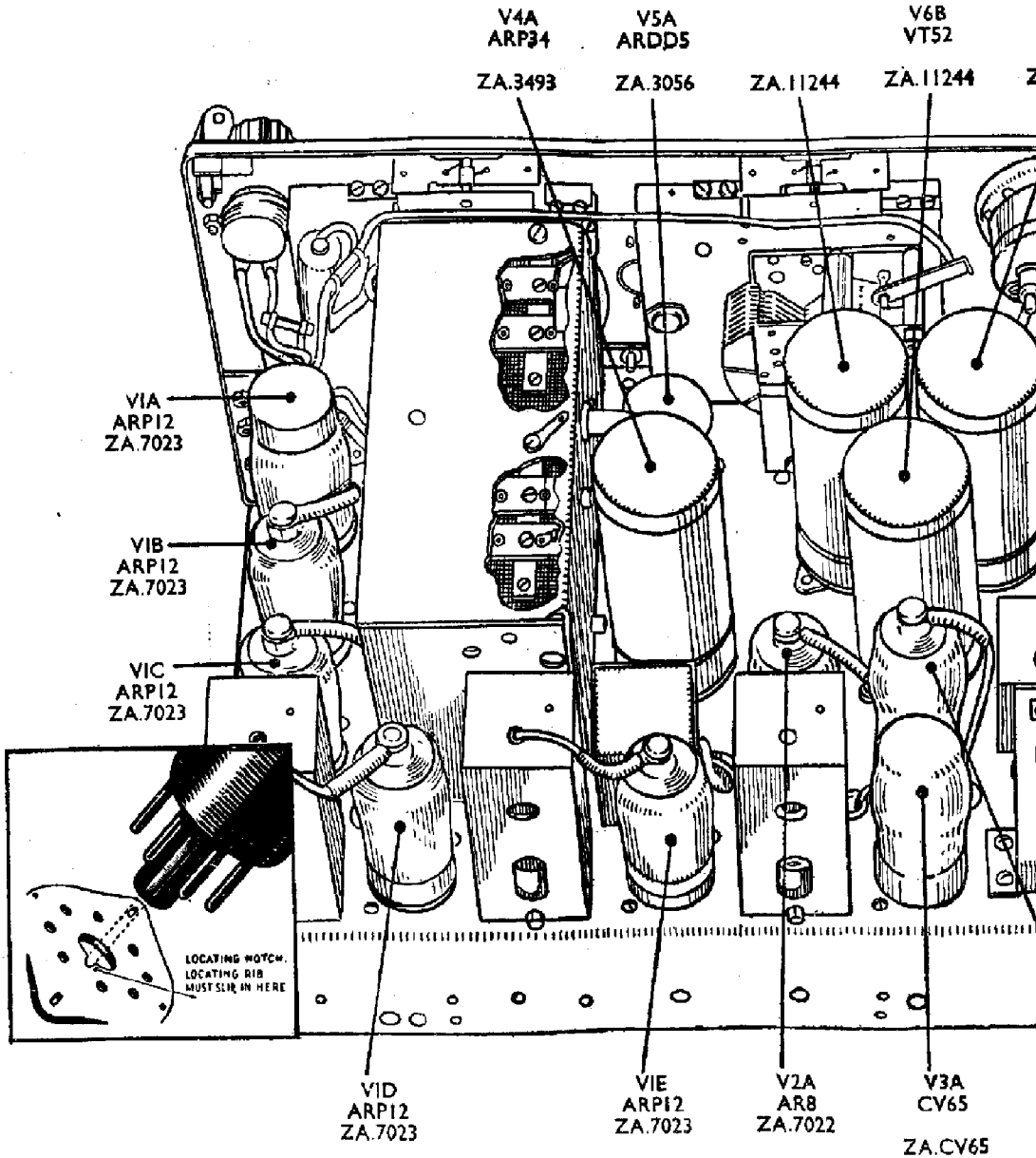
⑩ Log AERIAL TUNING Reading and  
NETTING TRIMMER Reading on tablet







# CHANGING VAL





# VALVES, ETC.

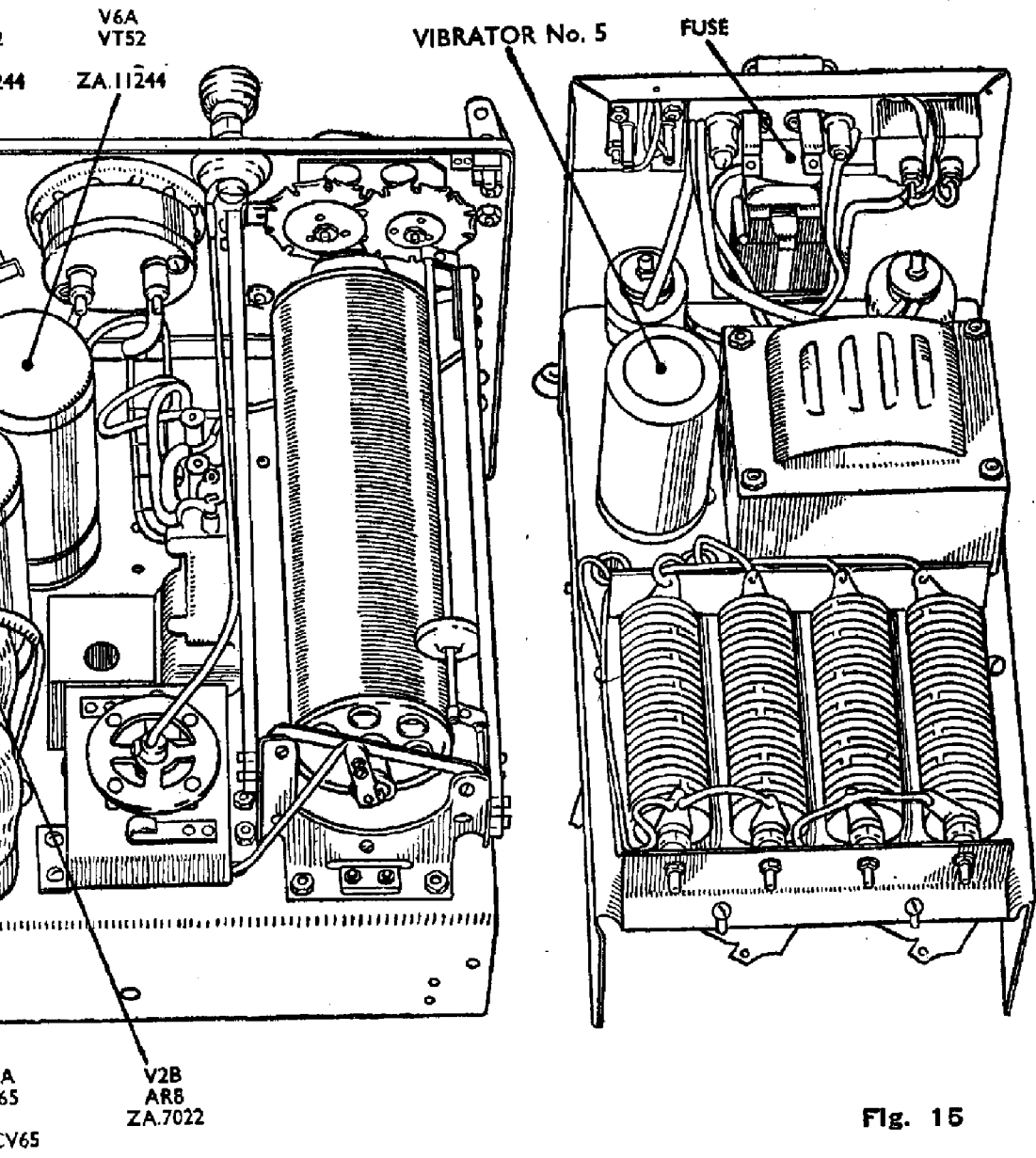


Fig. 15

- (a) Net set exactly as when netting in harbour with detuned aerials, except that AERIAL COUPLING dial will be set to reading given in Table 7.
- (b) Switch meter to  $\text{Æ}$  and do 8 to 10 in the NETTING DRILL (See Fig. 9) for maximum radiation.
- (c) Repeat (a) and (b) for RED frequency, if used.
- (d) Switch to M.C.W.

*Note.*—After setting up as above, Control Station must on no account retune. (See Frontispiece.)

### B. Netting the group.

As in harbour, but leave AERIAL COUPLING dial set to reading given in Table 7.

TABLE 7.—SETTINGS OF AERIAL COUPLING AND TUNING.

$\text{Æ}$	12'		16'		22'		28'		34'	
	Coupling	Tuning	Coupling	Tuning	Coupling	Tuning	Coupling	Tuning	Coupling	Tuning
2	45	912	34	812	30	739	28	703	28	648
2.5	41	616	24	581	22	526	20	501	20	472
3	37	463	20	436	20	391	17	378	14	361
3.5	33	367	15	351	14	317	11	306	3	302
4	23	298	9	295	5	273	2.5	258	0	244
4.5	19	254	4	242	2	224	0	200	0	198
5	12	219	0	208	0	187	0	173	0	158
5.5	6	192	0	180	0	161	0	148	0	128
6	0	168	0	156	0	141	0	124	0	110
6.5	0	145	0	136	0	121	0	105	0	091
7	0	121	0	119	0	105	0	091	0	073
7.5	0	103	0	105	0	091	0	074	0	054
8	0	075	0	094	0	070	0	061	0	0

Outstations will switch meter to  $\text{Æ}$  and see that they have good radiation whilst answering the Group Call. If any outstation has very low radiation he should adjust his AERIAL TUNING while speaking.

### 13. Miscellaneous hints.

- (1) *The NETTING TRIMMER* must always be clamped after netting and flick-setting have been carried out. When a spare frequency is used the setting of the trimmer for it

will usually differ from the setting for the normal frequency. The two settings for normal and spare frequencies should be noted so that readjustment can be quickly made when flick change is called for.

- (2) *Checking netting; re-netting.*—For various reasons, such as the heat of the day or the state of the battery, the frequency of the set will vary slightly and this will put you off net. A good operator knows immediately when he is tending to go off net by a rise in the pitch of the control's voice, which also becomes slightly distorted, and by a rise in the pitch of the background hiss. Bad quality, too, usually means bad netting. You must correct this; so wait till you hear control sending to another station and press your "NET" button. You should hear nothing, or perhaps a grunt; if you hear a high-pitched whistle it means that you are going off net, and you must re-net. Do this exactly as in "Netting at a distance" but control MUST be sending all the time while you are doing it.
- (3) *Use of the "TUNE" position of flick lever.*—If your set goes off net very frequently, set the flick levers to "TUNE" when you are checking net. You can now adjust both dials with the fine adjuster without loosening the flick screws each time. But remember that if you turn back to "FLICK" or "SET," your tuning dial will be back at its old setting and not at its corrected setting. The first opportunity should be taken to re-set the flick device, but this should NOT be attempted unless you are stationary and unless control is making a long transmission which does not concern you. The flick having been re-set, the levers should be left at FLICK until the set is next noticed to be going off frequency.
- (4) *The AERIAL TUNING control and AERIAL COUPLING control.*—These require readjusting whenever the frequency of the set or length of aerial is altered. Typical settings with rod aerials between 12', 16' and 34' are tabulated in Table 7, and these should be used when the sender-receiver is initially being set up

The tuning and coupling controls should be rocked successively around the values indicated until the aerial current with the set switched to M.C.W. is maximum. This gives the correct aerial adjustment. When normal and spare frequencies are being set up, the  $\text{\AA}$  TUNING setting for each flick position should be noted to enable readjustment to be made quickly.

- (5) *System switching.*—The set can be used for three kinds of working:—

R/T, radio telephony.

C.W., continuous wave.

M.C.W., modulated continuous wave.

C.W. and M.C.W. are two kinds of Morse working. On C.W., pressing the Morse key sends out a signal which can only be heard when the receiving station is switched to C.W. On M.C.W., pressing the key has the same effect as whistling into the microphone in R/T; that is to say, a signal is sent out which can be heard even if the receiving station is switched to R/T.

Advantages of M.C.W. are:—

- (1) If there is interference on your frequency from other groups using C.W. you may get less interference if you use M.C.W.
- (2) You can hear your own Morse signals in the phones. (On C.W. you only hear clicks.)

Advantages of C.W. are:—

- (1) You get greater range.
  - (2) If there is interference on your frequency from other groups using R/T or M.C.W., you may get less interference if you use C.W.
- (6) *Send-recvie switching* is effected by relays which are operated on R/T by the pressel switch on the microphone handle, and on C.W. and M.C.W. by the Morse key. This method of keying permits break-in working. That is, the receiver is operative during gaps in the sending, so that if the receiving operator requires to interrupt the sending operator he can do so by keying, whereupon his signals will be heard by the sending operator every time the latter allows his key to remain raised for more than about half a second.
- (7) *While working, if signals become worse and worse, or fail altogether, keep calm. You can't do much but you CAN:*
- (1) Check the netting. If your set is going off net, re-net it on the Control Station. (See page 26.)
  - (2) Check your "ends"—batteries, headset and aerial and their connections. Check the meter reading on  $\mathcal{A}$ . Is there sidetone?
  - (3) Call a nearer station, to prove your own set O.K.
  - (4) If there is still no answer and if you are using a rod aerial, put up an additional aerial section and call again, resetting the AERIAL TUNING and AERIAL COUPLING for maximum radiation.

## FINDING THE SILENT POINT

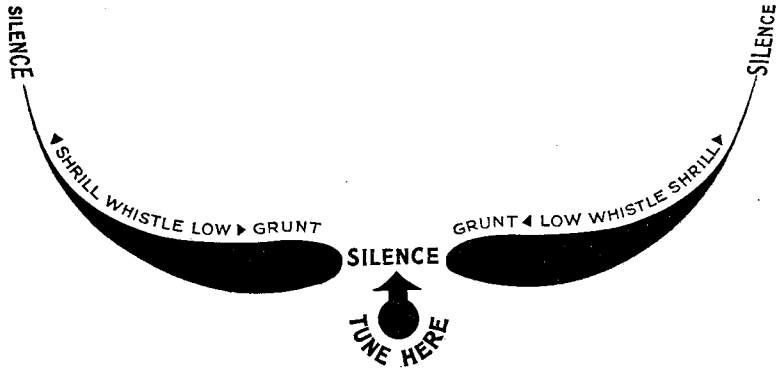


Fig. 10

### 14. Removal of set from vehicle and erection of ground station.

See Chapter 1, Section 8. The set should be placed if possible on a box or similar support. If it is necessary to operate in mud, set and power unit may stand panel upwards.

### 15. Economy in battery drain.

If you have to listen for signals for a long period but need not be ready to send without having been warned, turn the sender "ON/OFF" switch to the "OFF" position, as this will save your battery and enable you to work for a longer period without having to change it.

## CHAPTER 3

### USE WITH REMOTE-CONTROL UNITS

### 16. Facilities.

Wireless Set No. 22 can be used at a distance with the aid of Wireless Remote-Control Units F, Nos. 1 and 2. No. 1 Unit is used adjacent to the set and No. 2 at the remote point. Panel views of these units are shown in Fig. 11.

The functions of the control switches S1—S7 will be understood on reference to Figs. 11A, 11B.



PANEL VIEW OF REMOTE-CONTROL UNITS 'F'.

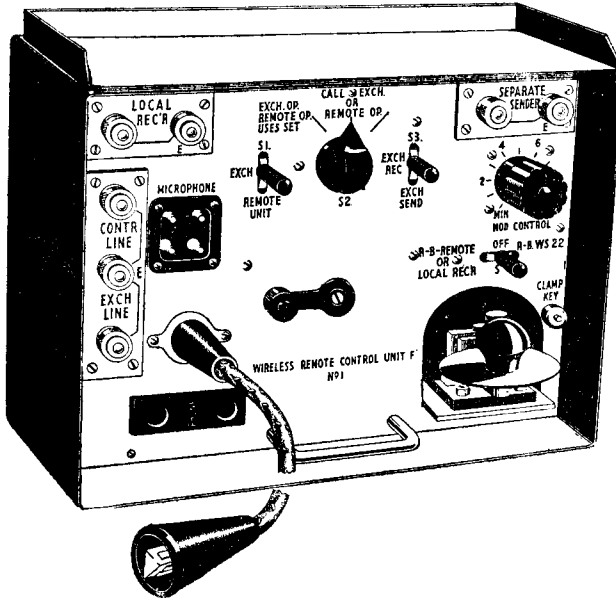


Fig. 11A

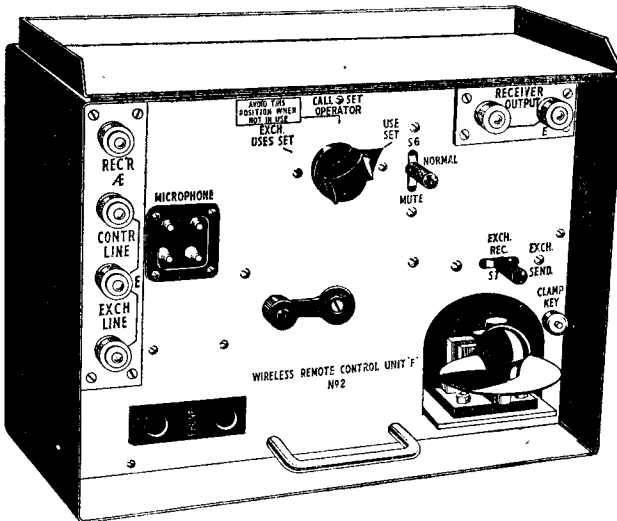


Fig. 11B

The following facilities are provided:—

(1) *At the set unit.*

- (i) Calling of remote unit.
- (ii) Calling of telephone exchange.
- (iii) R/T and W/T control of W.S. No. 22 from set unit. (See Fig. 12A.)
- (iv) R/T operation only from exchange connected to set unit; set operator performs send-receive switching. (See Fig. 12B.)
- (v) Re-broadcasting on a separate sender of signals received by W.S. No. 22 or by an alternative receiver adjacent to W.S. No. 22. (See Fig. 12F.)

(2) *At the remote unit.*

- (i) Calling of set operator.
- (ii) R/T and W/T operation of W.S. No. 22. (See Fig. 12C.)
- (iii) R/T operation only from exchange connected to remote unit. Operator at remote unit performs send-receive switching. No calling facility available for this service. (See Fig. 12D.)
- (iv) Re-broadcasting on separate sender connected to set unit or on W.S. No. 22 of signals coming from a separate receiver adjacent to remote point. (See Fig. 12E.)

Normal distance between set and remote unit is up to half a mile, but this may be increased considerably if sufficient cable is available.

(3) *Frequency-changing link between two stations for relaying purposes.*

Two No. 1 Units and two W.S. No. 22 are needed (see Fig. 12G). A wireless set situated at point B receives signals from a set at A on a frequency differing from that used by A. This facility is effected as follows:—

Signals from a sender situated at point A are received on W.S. No. 22 at a point C. From here the signals reach a second W.S. No. 22 at D (via both No. 1 Units) and are re-broadcast on a different frequency. A receiver situated at B receives these signals. Monitoring is available on both units.

*N.B.*—The W.S. No. 22 (at D) acting as sender must have its Morse key or pressel switch closed for the sending period and its system switch must be turned to “R/T”.

The switch positions on each of the No. 1 Units under the above conditions are:—S<sub>1</sub> down, S<sub>2</sub> left, S<sub>3</sub> centre.

Fig. 12

**SCHEMATIC DIAGRAM SHOWING USE OF REMOTE CONTROL UNITS**

(Set Unit is No. 1, Distant or Remote Unit is No. 2).

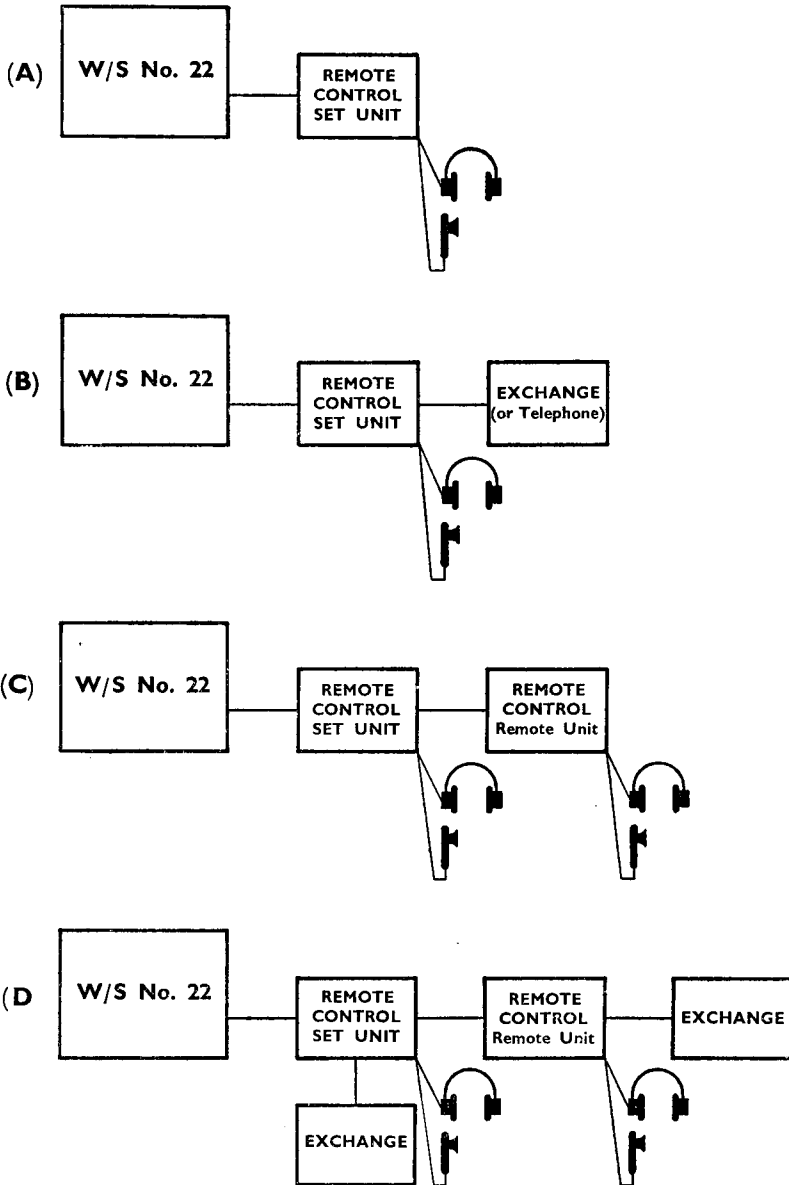
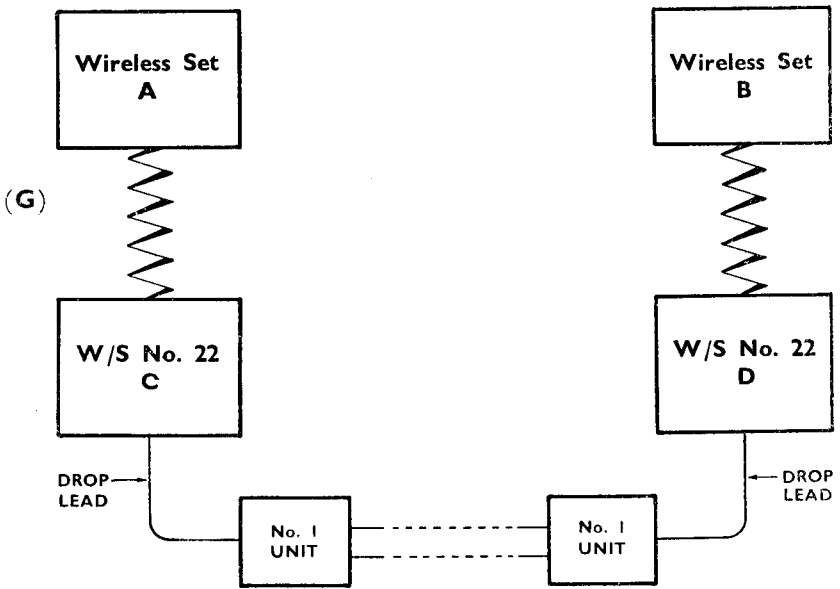
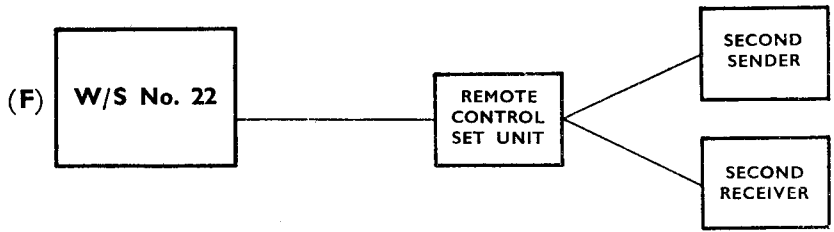
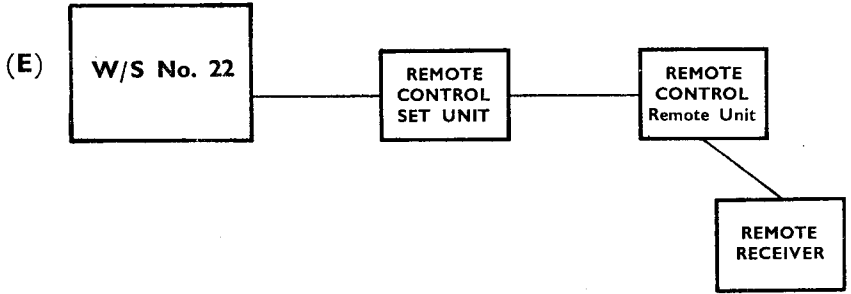


Fig. 12 (continued).  
**USE OF REMOTE CONTROL UNITS**



## 17. Connecting and operating Remote-Control Unit F, No. 1.

(1) *To connect up Remote-Control Unit, No. 1.*

(i) *To Wireless Set No. 22.*

Plug in:—

(a) Drop lead to one of corresponding leads on W.S. No. 22.

(b) Hand microphone, No. 8.

(c) One or two headphone sets DLR, No. 1 or No. 2.

*N.B.*—See that NORMAL-REMOTE switch on W.S. No. 22 is at “REMOTE” position.

(ii) *To Remote-Control Unit F, No. 2.*

Connect lines between units to terminals marked “CONTROL LINE.”

(iii) *To telephone exchange.*

Connect lines from exchange to terminals marked “EXCHANGE LINE.”

*N.B.*—Remote operator cannot call while switch S<sub>1</sub> is on “EXCHANGE.”

(iv) *To separate sender for re-broadcasting.*

Connect separate sender INPUT to terminals marked “SEPARATE SENDER.”

(v) *To adjacent receiver for re-broadcasting.*

Connect adjacent receiver OUTPUT to terminals marked “LOCAL RECEIVER.”

(2) *Operation.*—See Table 8.

## 18. Connecting and operating Remote-Control Unit F, No. 2

(1) *To connect up Remote-Control Unit, No. 2.*

(i) *To Remote-Control Unit, No. 1.*

(a) Connect lines from No. 1 unit to terminals marked “CONTROL LINE.”

Plug in:—

(b) One or two headphone sets DLR, No. 1 or No. 2.

(c) Hand microphone, No. 8.

(ii) *To telephone exchange.*

Connect lines from exchange to terminals marked “EXCHANGE LINE.”

*N.B.*—

(a) No facility is provided for ringing exchange or vice-versa.

(b) When switch S5 is thrown from either "CALL SET OPERATOR" or "USE SET" positions to "EXCHANGE USES SET," the exchange lamp indicator may be tripped or call bell rung. The exchange operator should clear this immediately.

(iii) *To a separate receiver.*

Connect separate receiver aerial to terminal marked "RECEIVER A," and output to terminals marked "RECEIVER OUTPUT."

(2) *To operate Remote-Control Unit, No. 2.—See Table 9.*

TABLE 8. OPERATION OF REMOTE-CONTROL UNIT F, No. 1.

Facility	Settings of switches				Further action	Remarks
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>		
(1) No. 1 operator calls exchange.	Centre	Centre	Centre	Centre	Turn magneto.	
(2) No. 1 operator calls No. 2 operator.	Down	Centre	Centre	Centre	Turn magneto.	
(3) No. 1 operator uses set.		Right	Centre	Centre	For R/T, press pressel switch while speaking. For W/T, clamp key in working position by means of CLAMP KEY.	
(4) Exchange uses set.	Centre	Left	Centre for receiving Down for sending	Centre		
(5) No. 2 operator uses set.	Down	Left	Centre	Centre		
(6) Signals received on W.S.22 are re-broadcast via an additional sender adjacent to W.S.22. (See Fig. 12F.)	Down	Right	Centre	Right	Adjust input for sender by means of MOD CONTROL knob.	Re-broadcast is monitored on No. 1 unit.
	Down	Left	Centre	Right	No additional receiver is connected to set unit (No. 1). For re-broadcasting, additional sender must be at SEND, M.C.W. or R/T; use send/receive switch or pressel switch accordingly.	Re-broadcast is monitored on both remote-control units.
	Centre	Left	Centre	Right		Re-broadcast is monitored on local exchange.

TABLE 8.—continued.

Facility	Settings of Switches				Further action	Remarks
	S1	S2	S3	S4		
(7) Signals received on receiver connected to remote unit No. 2 are re-broadcast. (See Fig. 12E.)	Down	Left	Centre	Centre	No additional receiver is connected to set unit.	For re-broadcast via sender of W.S.22.
	Down	Centre	Centre	Left	Adjust input for additional sender by means of MOD CONTROL knob. No additional receiver is connected to set unit.	For re-broadcast via additional sender.
(8) Signals received on additional receiver connected to set unit No. 1 are re-broadcast. (See Fig. 12F.)	Down	Centre	Centre	Left	Monitor re-broadcast on set unit No. 1.	For re-broadcast via additional sender.
	Down	Left	Centre	Right	Monitor re-broadcast by side-tone of W.S.22.	For re-broadcast via sender of W.S.22.
(9) Signals received on one frequency are re-broadcast on another frequency. (See Fig. 12G.)	Down	Left — (both units)	Centre — (both units)	Centre	The sending set must have key down or pressel switch pressed—see Section 16 (3).	Two interconnected R.C. units No. 1 are connected by drop leads and snatch plugs to two W.S.22 as shown in Fig. 12G.



TABLE 9.—OPERATION OF REMOTE-CONTROL UNIT F, No. 2.

<i>Facility</i>	<i>Settings of Switches</i>			<i>Further action</i>	<i>Remarks</i>
	S5	S6	S7		
(1) No. 2 operator calls No. 1 operator.	Centre	Centre	Centre	Turn magneto.	S5 must NOT be left in centre position, or 24-v. battery may run down. When S6 is down, No. 1 operator cannot call.
(2) No. 2 operator uses W.S.22 connected to R.C. unit No. 1 when no additional receiver is connected to No. 2.	Right	Centre	Centre	For R/T, press pressel switch while speaking. For W/T, clamp key in working position by means of CLAMP KEY.	
(3) As (2) above, but when an additional receiver is connected to R.C. unit No. 2.	Right	Down	Centre		
(4) Exchange connected to unit No. 2 uses W.S.22 connected to unit No. 1 (R/T only) when no additional receiver is connected to unit No. 2.	Left	Centre	Centre for receiving Right for sending		See notes (a) and (b) in sub-sections 18 (1) (ii).
(5) As above, but when an additional receiver is connected to unit No. 2.	Left	Down	Centre for receiving Right for sending		See notes (a) and (b) in sub-sections 18 (1) (ii).
(6) Signals from receiver connected to R.C. unit No. 2 are re-broadcast from sender connected to R.C. unit No. 1.	Right	Centre	Centre		Operator No. 2 monitors broadcast.

*Connecting up.*

1. Place the aerial unit J at the base of the vertical aerial.
2. Connect the aerial to the terminal on this unit marked  $\text{\AA}$  by a short wire.
3. Connect the terminal marked EARTH to an earth spike, or a counterpoise, if necessary.
4. Connect the SET UNIT J to AERIAL and EARTH terminals of the set.
5. Connect the two units J.

*Procedure.*

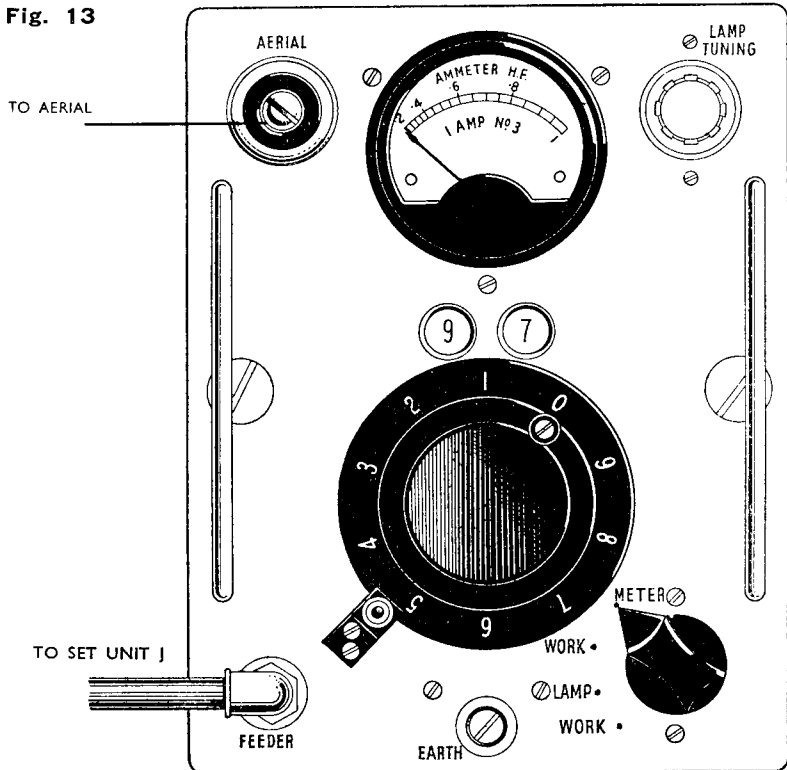
Setting and tuning instructions for the aerial unit J are given on the tablet attached to the unit.

**19. Use of Aerial Coupling Equipment.**

*General.*

This equipment is designed for use with vertical aerials up to 34 ft. It enables the set to be operated from cover at a distance from the aerial, with the connectors supplied. It consists of an aerial unit J (see Fig. 13) and a set unit J, with co-axial connecting cable.

**Fig. 13**



## CHAPTER 4 MAINTENANCE AND TESTING

### 20. General remarks.

This chapter is written not to enable you to correct every fault which may occur in the wireless set, but to help you to keep the set working efficiently and to detect trouble before it becomes serious. There are three routines which you must be able to carry out quickly and efficiently. You must:—

- (1) Test the set to see that every part of it is working. Do this daily, whether or not the set is going to be used. The tests are described on page 40 under "Daily Maintenance."
- (2) Go over all external parts of the set and its equipment, clean and check that controls run smoothly, and looking for parts which are beginning to wear out or come undone. You will often be able to find trouble before it has become serious, and prevent a breakdown which might occur when the set is in use. The paragraph on weekly maintenance, page 40, tells you how to do this.
- (3) Repair the more common faults which may occur in the field. Some rules to help you in this are given under "Running repairs," page 42.

The VITAL thing is that you should find out and report anything wrong AS SOON AS POSSIBLE so that the instrument mechanics can repair it BEFORE THE BATTLE; halfway through is TOO LATE, SO IT DEPENDS ON YOU.

### 21. Connecting up the set and changing parts.

Normally the set will be ready for working when you first meet it. But you may have to disconnect various parts for cleaning and replacement—the kit for your set includes spares for most removable parts, so here is how to do it:—

- |  |  |
|--|--|
| (1) Connect the power supply. (See Fig. 14.)     | } Do NOT disconnect unless removing set or power unit. |
| (2) Connect aerial feeder. (See Figs. 1 and 14.) |  |

- (3) Connect up the head sets. (*See Fig. 7.*) The snatch plugs are made so that they will come undone if you move away from the set while wearing your head set.
- (4) Rewiring the L.T. fuse. (*See Fig. 15.*)
- (5) Changing the indicator bulb. (*See Fig. 14.*)
- (6) Changing the aerial pigtail. Remove the aerial base by unscrewing the six fixing bolts, then fit new pigtail as shown in Fig. 16. Get the Electrician Signals to do this if possible.
- (7) Taking off the grille. (*See Fig. 17.*)
- (8) Taking the set and power unit out of their cases. (*See Fig. 14.*) Never take the set out except to change the valves. Never take the power unit out except to rewire the fuse or change the vibrator.
- (9) Changing valves. Valves need never be touched unless the set breaks down. If this happens you may have to change a valve or two. (*See "Running repairs," page 42, which will tell you which valves to change.*) To take out or put in a valve, take the set from its case and follow the instructions given in Fig. 15. A diagram on the screen behind the aerial-tuning inductor shows where each valve goes. Leave the changing of valves to the Electrician Signals wherever possible.

## 22. Daily maintenance.

As has already been explained, the set must be tested daily, whether it is going to be used or not. Table 11, pages 45, 46, shows how to test it. The tests must be done in the order given; for instance, test 10 will not work unless you have previously done test 4.

## 23. Weekly maintenance.

The reasons for this are given in Section 20 (2) of this chapter. EVERY week, without waiting to be told, you should:—

- (a) Do your daily maintenance tests for the day. (*See page 45.*)
- (b) Clean the outside of the set, power-supply unit, and carrier with cloth to take off dirt and grease. Do not use water, Brasso, petrol, or anything for polishing

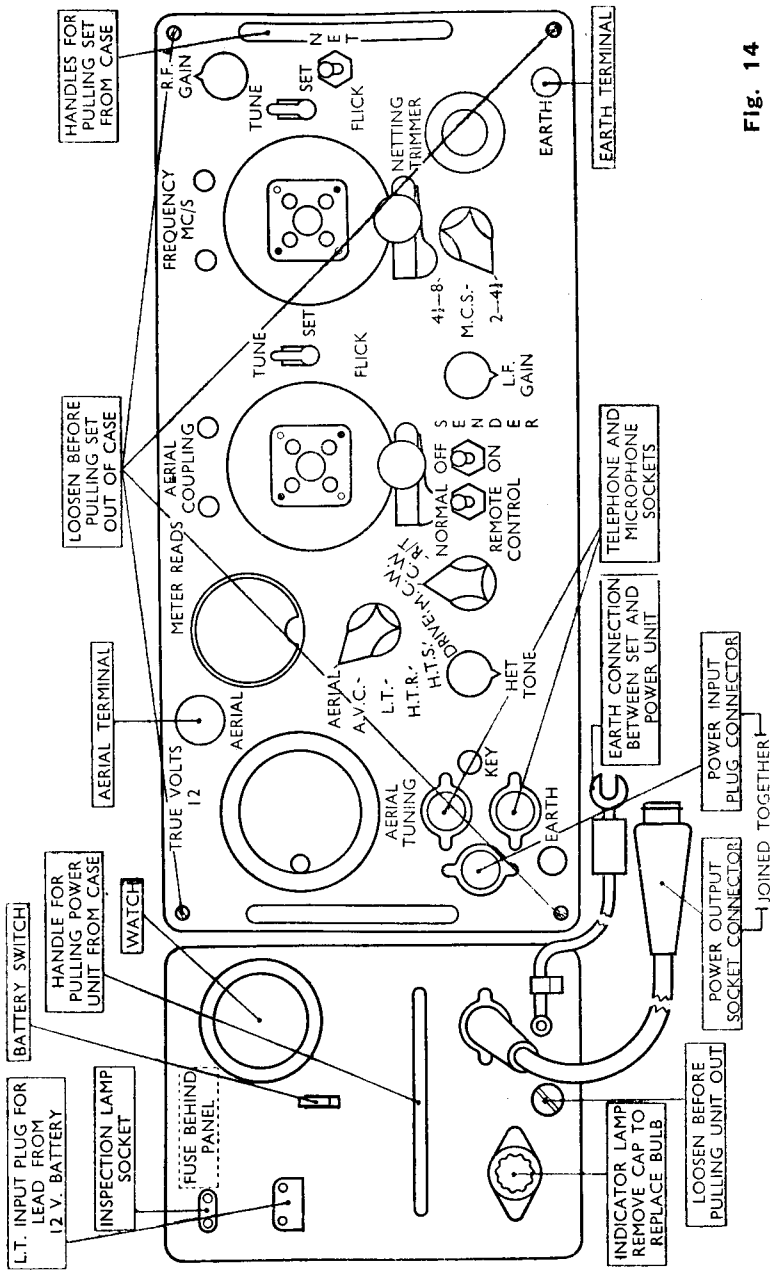


Fig. 14

FRONT VIEW OF SET SHOWING DETACHABLE PARTS AND CONNECTIONS.

## CHANGING AERIAL PIGTAIL

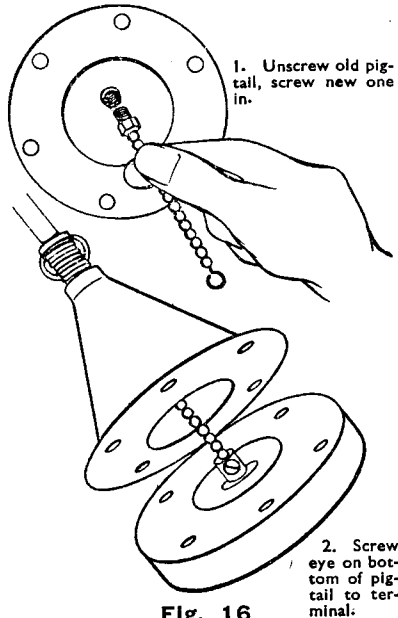


Fig. 16

- (c) Overhaul the rod aerial. (See Fig. 18.)
- (d) Try all controls and see that they are not jamming, nor turning so easily that their settings would alter through the shaking of the vehicle. See that all the knobs are tightly secured to their spindles. If they are not, get the Electrician Signals to tighten the grub screws which hold them on.
- (e) Meter readings. Check the meter readings and enter in Appendix D.
- (f) Check kit. See that your spare parts, spare valves and spare head sets are complete.
- (g) Vertical aerial. Check that the contents of the aerial bag are complete and in good order.
- (h) Remote-control units. Check that these are in good order and working correctly. (See Table 12.)
- (k) Remote aerial unit. Check that this is in good order and working correctly. (See Fig. 13.)
- (l) Report:—
  - (a) Any faults which you have found and cannot put right.
  - (b) Any pieces which are missing.Your maintenance is USELESS unless you do this AT ONCE.

## 24. Monthly maintenance.

This is NOT your job. Once a month an Electrician Signals will inspect your set thoroughly and will overhaul it where necessary.

## 25. Running repairs.

If the set, or any part of it, works badly or stops working, try the

cure for the particular failure as shown in Table 13, page 49. When replacing valves, work on the lines of these two examples:—

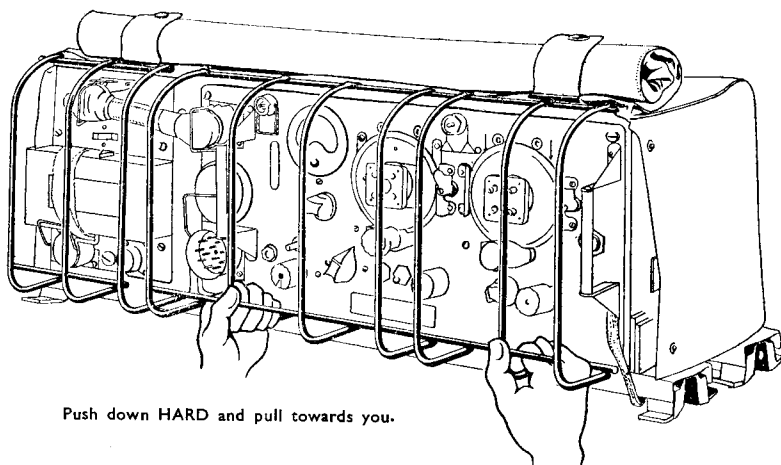
- (1) (Failure No. 4—Receiver O.K., sender aerial current and drive very low, but netting whistle O.K.; due to V6C burning out.) Put in new V6B; test set—no result. Put in new V6C; test set—set working, therefore old V6C faulty. Put old V6B back; test set—set still working, therefore old V6B is sound.
- (2) (Failure No. 5—Receiver dead and sender O.K.; due to V1D being faulty.) Put in new V1B; test set—no result. Put in new V1C; test set—no result. Put back old V1B and V1C. Put in new V1A; test set—no result. Put in V1D; test set—set works. Put old V1A back; test set—set still works, therefore old V1A is sound, old V1D is faulty.

Do not put faulty valves back in the spare-valve case. Exchange for sound ones as soon as possible, and put the sound ones back in the case.

## 26. Wireless Remote Control Units "F".

Table 12 sets out the tests which should be made to ensure that the Units are working correctly, and the steps to be taken in the event of incorrect operation.

### TAKING OFF THE GRILLE



Push down HARD and pull towards you.

Note illustration is of 19 Set but applies equally to 22 Set.

Fig. 17

## AERIAL MAINTENANCE

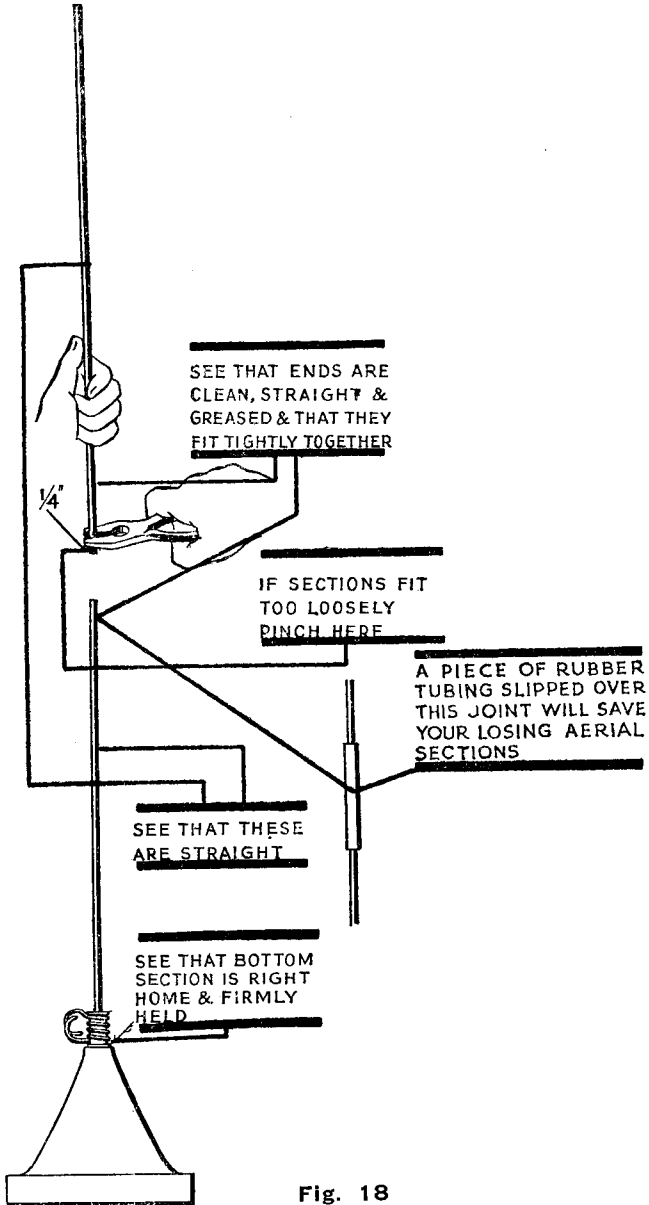


Fig. 18



TABLE 11.—DAILY TESTS

<i>Part tested</i>	<i>No.</i>	<i>Test</i>	<i>What should happen</i>	<i>What should not happen</i>	<i>What is likely to be wrong</i>	<i>What to do about</i>
Power Supply.	1	Put switch on supply unit to "ON".	Red lamp on supply unit should light if fitted and slight hum or vibration from vibrator.	(a) No red light, no vibration.  (b) Vibration but no red light.	1. Power unit not connected to battery. 2. Fuse blown in power unit.  1. Bulbs burnt out. 2. Bulbs removed for security reasons.	Check connections. Rewire fuse.  Replace by new bulb. Replace bulb if security permits.
L.T. Voltage Supply.	2	Meter switch to L.T.	Meter reading normal 11-12 volts.	(c) Lamp lights but no vibration.  Meter reading less than 10.5 volts.	1. Vibrator makes bad contact in holder. 2. Faulty vibrator.  Batteries need charging.	Clean vibrator pins and replace. Replace by new vibrator.  Replace by spare and connect up run-down battery for charging.
H.T. Voltage Supply.	3	Sender switch "ON" Meter switch to H.T.S. Meter switch to H.T.R.	Meter reading about 260 volts. Meter reading about 90 volts.	Meter reads zero.	Internal fault.	Report.
Receiver. (Try on both frequency bands.)	4	Turn system switch to R.F. and meter to A.V.C. and tune in any strong R.F. station "L.F. GAIN" and "R.F. GAIN" turned to maximum.	(a) Station is heard in phones.  (b) Meter reads higher when set is tuned to station than when it is not.	1. No station can be heard.  2. Station is heard but very noisy.  Meter reading does not alter.	1. Aerial disconnected. 2. Defective phones. 3. Receiver faulty.  1. Loose connections. 2. If connections are tight.  Internal fault.	Examine all aerial and earth connections, including pigtail. Report.  Check all connections. Report.  Report.

TABLE II.—continued.

<i>Part tested</i>	<i>No.</i>	<i>Test</i>	<i>What should happen</i>	<i>What should not happen</i>	<i>What is likely to be the only</i>	<i>What to do about it</i>
	5	Press net switch with strength 3 signal and adjust netting trimmer.	Whistle is heard.	No whistle heard.	Internal fault.	Report.
Sender (NOT TO BE TESTED IF UNDER WIRELESS SILENCE).	6	Put meter switch to "AERIAL", press preset switch and adjust "AERIAL TUNING" and "AERIAL COUPLING" for highest possible meter reading (see Fig. 9).	Meter should show reading.	Meter does not read or reads very low.	1. Preset switch not working. 2. Aerial connection faulty. 3. Sender faulty.	Try another headset; if still no good, report. Check all connections. Report.
	7	Put meter switch to A. V. C. and speak loudly into microphone.	1. Meter needle kicks upwards. 2. Sidetone is heard.	Meter reading does not alter. No sidetone.	Internal fault. Internal fault.	Report. Report. <i>Note:</i> Set may still send well.
Morse Key and C.W. Reception. (NOT TO BE TESTED UNDER WIRELESS SILENCE.)	8	Meter switch to Æ. System switch to C. W. Plug in key and depress.	Meter reads as in Test 6.	Meter does not read or reads very low.	1. Fault in key or key lead. 2. Internal fault.	Check key, lead and plug. Report.
	9	Switch to M.C.W. and back with key still depressed.	Whistle heard in phones.	No whistle.	Internal fault.	Report.
	10	Release key.	Distorted speech and whistle heard after a very slight delay.	No whistle heard.	Internal fault.	Report.
General.	11	Check all controls when necessary.	Controls should feel "smooth" and should work.	Controls jam, feel "rough" or fail to work.	Internal fault.	Report.

TABLE 12.—TESTS FOR LOCALIZING FAULTS IN REMOTE CONTROL UNITS "F" Nos. 1 and 2.

<i>Part tested</i>	<i>Test</i>	<i>What should happen</i>	<i>What should not happen</i>	<i>What is likely to be wrong</i>	<i>What to do about it</i>
Headphones and microphone on either unit.	With S2 or S5 in centre position, blow into microphone mouthpiece.	Response in phones when Presse switch is closed.	No response in phones.	(a) Microphone battery down. (b) Presse switch faulty. (c) Microphone faulty. (d) Headphones faulty.	Check microphone battery voltage and replaces cells if below 2.5 V. (Type X Mk. II). Check connections and tighten up terminals. Remove microphone cap and capsule and examine switch contacts. Adjust if necessary. Try another microphone. Examine centre pin and side contact of capsule and adjust if necessary. Try another pair of headphones. Check leads to ear pieces. Short circuit each earpiece in turn, if faulty, the other one will work.
Generator and Bell.	With S2 or S5 in centre position, short-circuit top two contacts to generator switch with a screw-driver, and turn generator handle.	Bell rings.	Bell does not ring.	(a) If No. 2 unit is under test, the 24-V. battery connections may be faulty. (b) Generator handle not engaging dogs on shaft. (c) Bell out of adjustment.	Examine 24-V. battery connection, particularly the link between the two units of the battery, and tighten up where necessary. Slacken centre screw in handle and turn on shaft until dogs engage slots. Push home and retighten. Slacken centre bolt of bell, and adjust gong. Remove gong and examine connections.
I-C system between Units Nos. 1 and 2.	S2 or S5 in centre position on caller's unit. 1. Ringing. 2. Speaking.	Called operator's bell rings and voice heard clearly in phones.	No response or voice weak, or reception noisy.	(a) Faulty connection or no connection of control lines. (b) Microphone battery down or bad connection. (c) Switch S1 on No. 1 unit in wrong position. (d) Switch S6 on No. 2 unit in wrong position. (e) Headphone plug not making contact.	Tighten up control line terminals. Make sure insulation is removed under terminals. Replace battery in caller's unit, or tighten connection if necessary. Put switch S1 to "down" position. Put switch S6 to "Up" position. Push home headphone plug into socket.

TABLE 12—continued.

<i>Part tested</i>	<i>Test</i>	<i>What should happen</i>	<i>What should not happen</i>	<i>What is likely to be wrong</i>	<i>What to do about it</i>
High speed Relay on No. 1 unit.	"CONTROL LINE" Terminals of No. 1 unit connected to corresponding terminals of No. 2 unit by lines. Switch S5 on No. 2 unit in "USE SET" position. 24-V. Battery on No. 2 unit O.K.	Contacts of H.S. Relay on No. 1 unit should close when pressel switch or morse key on No. 2 unit is closed.	H.S. Relay in No. 1 unit fails to close.	H.S. Relay sticking.	Examine for dirt between pole piece and armature.
Working W.S. 22 from No. 1 unit.	Drop leads of unit and W.S. 22 plugged together switch S2 in "USE SET" position.	W.S. 22 is changed over from Receive to Send by closing Pressel Switch or morse key on No. 1 unit.	No effect on W.S. 22.	(a) Faulty contact in snatch plug. (b) W.S. 22 battery switch "OFF."	See that contact blades in snatch plug and socket are clean, and push plug well home into socket. Close battery switch on W.S. 22.
Working W.S. 22 from No. 2 unit via No. 1 unit.	No. 1 unit as above S2 in "REMOTE OP. USES SET" position. Switch S5 in Unit No. 2 in "USE SET" position.	As above but on No. 2 unit.	(a) Output from W.S. 22 not heard at No. 2 unit. (b) Change over from "RECEIVE" to "SEND" not effected on W.S. 22.	"NORMAL-REMOTE CONTROL" switch on W.S. 22 in "NORMAL" position. Check up all connections of 24v battery and renew battery if reading below 15v (type 8 cell No. 1, MK.L).	Change "NORMAL-REMOTE CONTROL" switch on W.S. 22 to "REMOTE CONTROL" position. Check up all connections of 24v battery and renew battery if reading below 15v (type 8 cell No. 1, MK.L).

TABLE 13.—RUNNING REPAIRS.

<i>No.</i>	<i>Failure</i>	<i>Possible cause</i>	<i>Possible cure</i>
1	Set completely dead.	Failure of power.	Do tests 1-3 of Daily Tests.
2	Power unit working but sender and receiver dead.	Aerial disconnected.	Examine and replace pigtail if necessary.
3	Receiver dead, sender works, but no modulation or sidetone.	1. V5A. 2. V3A.	Replace valve. Replace V3A and V1B.
4	Receiver dead, sender works and modulates but no sidetone.	V3A.	Replace valve.
6	Receiver very weak, sender O.K.	V2A.	Replace valve.
7	Receiver dead, sender works O.K.	V1A.	Replace valve.
8	Receiver dead, sender works O.K. on M.C.W. but no sidetone on R/T.	1. V1B, V1C. 2. If receiver still dead, V1D, V1A.	Replace valves in turn. Replace valves in turn.
9	Receiver O.K. sender no aerial current, no netting whistle.	V1E.	Replace valve.
10	Receiver O.K. sender arial current and drive very low. Netting whistle O.K.	V4A, V6A.	Replace valves in turn.
11	Receiver and sender O.K. on R/T, but no beat tone on C.W. Receiver.	V6B, V6C.	Replace valves in turn.
12	Receiver and sender O.K. on R/T, but no aerial current on C.W. or M.C.W. when key is pressed, but current when pressel switch is pressed.	V2B.	Replace valve.
13	Receiver and sender O.K. on R/T, but no aerial current on C.W. or M.C.W. when key or pressel switch is pressed.	Faulty key, key lead or plug.  Internal fault.	Examine—repair if possible otherwise report.  Report.

## APPENDIX A

List of equipment normally associated with Wireless Sets No. 22.  
For up-to-date information on all W.S. No. 22 stations, see the relevant A, E & S. scales.  
This list must not be taken as an authority to draw stores.

Item No.	Cat. No.	Designation	No. 22 (Ground)			No. 22 (Truck) with facilities for use on the ground.			No. 22 (man pack)			Remarks
			Min. for work	Essen. spares	Total	Min. for work	Essen. spares	Total	Min. for work	Essen. spares	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13
SECTION W.2												
1	WB.0027	Batteries, dry, rell, 8-cell No. 1, Mk. I.	2(a)	2(b)	4	2(a)	2(b)	4	—	—	—	—
2	WB.1490	Bulbs, 12-volt, F.	1(s)	2(c)	3	1(s)	2(c)	3	1(s)	2(c)	3	—
3	WB.0104	Cable, electric, D 3, twisted (b) (d) mbs.	‡	—	‡	‡	—	‡	—	—	—	—
4	WB.0200	Cells, dry, X, Mk. II.	4(e)	4(b)	8	4(e)	4(b)	8	—	—	—	—
5	WB.0282	Drums, cable, No. 5(b). Wire, electric.	1	—	1	1	—	1	—	—	—	—
6	WB.1042	P.11, Mk. I. Yds.	—	12	12	—	12	12	—	—	—	—
7	WB.1057	R.4, Mk. I (b). Yds.	82	41	123	82	41	123	—	—	—	—
SECTION X.2												
8	X.A.0926	Fuses, wire, copper, 34 S.W.G. oz. reel.	—	1	1	—	1	1	—	1	1	—
SECTION Y												
9	YA.2481	Straps, carrying G (p) SECTION Z.1	1	—	1	1	—	1	1	—	1	—
10	ZA.14172	Aerial Base No. 10 Mk. II or	—	—	—	—	—	—	—	—	—	—

APPENDIX A.—continued.

1	2	3	4	5	6	7	8	9	10	11	12	13
		SECTION Z.1 (contd.)										
11	ZA.14040	No. 14.	—	—	—	1	—	1	—	—	—	—
12	ZA.12641	Aerial Coupling Equipmt., Aerial Units J.	1	—	1	1	—	1	—	—	—	—
13	ZA.10560	Aerial coupling Equipmt. Set Unit J.	1	—	1	1	—	1	—	—	—	—
14	ZA.11519	Aerials, Vertical, 34 ft. Steel (f).	1	—	1	1	—	1	1	—	1	—
15	ZA.11207	Antennae Rod F, 12 ft. No. 2 (g).	—	—	—	1	—	1	—	—	—	—
16	ZA.14041	Cases, Spare Valves, No. 4C.	1	—	1	1	—	1	1	—	1	—
17	ZA.2060	Condensers X.5, 5-kv., ME. II.	—	—	—	1	—	1	—	—	—	—
		Connectors. Single.										
18	ZA.2261	No. 10A (k) (o).	2	—	2	2	—	2	2	—	2	Aerial leads for ground use.
19	ZA.0933	No. 10C (p).	—	—	—	2	—	2	—	—	—	Aerial leads for vehicle use.
20	ZA.10320	No. 33 (n) (o).	1	—	1	1	—	1	—	—	—	Earth leads for ground use.
21	ZA.11018	Twin, No. 78. Covers, Protecting.	1(o)	—	1	2(w)	—	2	1(o)	—	1	Battery lead.
22	ZA.2950	No. 1.	1	—	1	1	—	1	1	—	1	—
23	ZA.2951	No. 2.	1	—	1	1	—	1	1	—	1	—
24	ZA.4500	Key and Plug assemblies, No. 2B (i).	1	—	1	1	—	1	1	—	1	—
25	ZA.12645	Lamps, Operator's, No. 6A.	1	—	1	1	—	1	1	—	1	—
26	ZA.2784	Leads, Counterpoise, No. 2, ME. II (o)	—	—	1	1	—	1	1	—	1	—

APPENDIX A.—continued.

1	2	3	4	5	6	7	8	9	10	11	12	13
		SECTION Z.1 (contd.)										
27	ZA.2904	Microphone and Receivers, Head-gear, Assembly No. 1 (t).	2	—	2	2	—	2	2	—	2	
28	ZA.13859	Microphones, Hand, No. 8 (g).	2	—	2	2	—	2	—	—	—	
29	ZA.14047	Power Supply unit No. 4 MK. I or										
30	ZA.10478	MK. II	1	—	1	1	—	1	1	—	1	
31	ZA.3238	Receivers, Headgear, D.L.R., Double (g).										
		No. 1 or										
32	ZA.10810	No. 2.	2	—	2	2	—	2	—	—	—	
33	ZA.6292	Satchels, Signals No. 1 Valves, W.T. type:—	4(g)	—	4	4(g)	—	4	2	—	2	
		A.R.S.										
34	ZA.7022		2	2(r)	4	2	2(r)	4	2	2(r)	4	
35	ZA.3056	A.R.D.D.5.	1	1(r)	2	1	1(r)	2	1	1(r)	2	
36	ZA.7023	A.R.P.12.	5	5(r)	10	5	5(r)	10	5	5(r)	10	
37	ZA.3493	A.R.P.34.	1	1(r)	2	1	1(r)	2	1	1(r)	2	
38	ZA/CV65	C.V.65.	1	1(r)	2	1	1(r)	2	1	1(r)	2	
39	ZA.11244	V.T.52.	3	3(r)	6	3	3(r)	6	3	3(r)	6	
40	ZA.3231	Vibrators, No. 5.	1	1(c)	2	1	1(c)	2	1	1(c)	2	
		Wireless Remote-Control Units, F.										
41	ZA.12642	No. 1.	1	—	1	1	—	1	—	—	—	
42	ZA.12643	No. 2.	1	—	1	1	—	1	—	—	—	



APPENDIX A.—continued.

1	2	3	4	5	6	7	8	9	10	11	12	13
		SECTION Z.1 (contd.)										
43	ZA.11694	Wireless sets, No. 22.	1	—	1	1	—	1	1	—	1	
44	ZA.14042	Carriers No. 1.	1(m)	—	1	1	—	1	—	—	—	
{ 45	ZA.14043	Covers, Immersion (p).	—	—	—	—	—	—	1	—	1	} Only issued with early sets.
{ 46	ZA.14044	No. 2.	—	—	—	—	—	—	1	—	1	
47	ZA.14045	Wireless Set No. 22. Covers Waterproof. No. 1.	1	—	1	1	—	1	1	—	1	
48	ZA.14046	No. 2.	1	—	1	1	—	1	1	—	1	
49	ZA.15449	Straps No. 1	1	—	1	1	—	1	1	—	1	
50	ZA.14048	Working instructions.	1	—	1	1	—	1	1	—	1	
		SECTION Z.2.										
51	ZB.10118	Batteries Secy. Port. 12 Volt, 22 Ah., Mk. I	1	1	2	1	1	2	1	1	2	
52	ZB.0220	12 Volt, 75 Ah.	1	1	2	1	1	2	—	—	—	
53	ZB.10119	Carriers, Bty., Secy. Port. No. 7.	1	—	1	1	—	1	1	—	1	

NOTES

- (a) Carried in Wireless Remote-Control Unit, F., No. 2.
- (b) Carried in unit transport.
- (c) Carried in Power supply unit, No. 4, Mk. I or Mk. I.\*
- (d) Carried in drums, cable, No. 5.
- (e) Carried in Wireless Remote Control Units, F, Nos. 1 and 2.
- (f) For details see Appendix B.
- (g) Two with set and one with each control unit.
- (h) For end-fed aeriels.
- (i) Carried in Satchels, signal No. 1.
- (j) For details see Appendix C.
- (k) Aerial leads for use on the ground.
- (l) For earthing set to carrier.
- (m) Only required when Handcarts, Wireless, No. 1 are issued.
- (n) For connecting leads, counterpoise No. 2, Mk. II, to set.
- (o) Carried in bags, aerial gear, No. 2, Mk. II.
- (p) Only issued when specially authorised.
- (q) For use with Wireless Remote-Control Units, F, (1 per unit).
- (r) Carried in Cases, spare valve, No. 4C.
- (s) For use in Lamps, operator No. 6A.
- (t) Aerial Leads for use on Vehicle.
- (u) One for use on vehicle, and one for use on ground, and normally carried in Bags, Aerial Gear, No. 2, Mk. II.
- (v) Only required when P.S.U. No. 4 MK. I is issued.

APPENDIX B. AERIALS VERTICAL, 34-FT., STEEL (ZA.11519).

1	2	3	4	5	6	7
		SECTION F				
1	FA.2137	Hammers, Engineers Ball-pane 8 oz. . .	1	—	1	
2	YA.4050	SECTION Y	1	—	1	
		Straps, Carrying H . . .				
3	ZA.11009	SECTION Z.1	1	—	1	
4	ZA.11010	Aerial Bases, No. 11 . . .	1	—	1	
		Spikes . . .				
5	ZA.0874	Antennae Rods, A . . .	8	2	10	
6	ZA.0878	Pegs . . .	1	—	1	
		Peg Bags . . .				
7	ZA.5341	Antennae Rods, D . . .	1	—	1	
8	ZA.5346	Reamers . . .	6	4	10	
9	ZA.5325	Sections 3 ft. . .	1	—	1	
10	ZA.11538	Spikes . . .	2	—	2	
		Stayplates No. 4 . . .				
		Antennae Rods, F . . .				
11	ZA.4135	Adaptors No. 1 . . .	1	—	1	
12	ZA.11011	Cases Carrying No. 1 . . .	1	—	1	
13	ZA.11462	Straps, Retaining	2	—	2	
14	ZA.12764	No. 1 . . .	1	—	1	
		No. 2 . . .				
15	ZA.0894	Sections	2	2	4	
16	ZA.0895	No. 1 . . .	1	1	2	
17	ZA.0896	No. 2 . . .	1	1	2	
18	ZA.0437	No. 3 . . .	1	—	1	
		Bags Aerial Gear No. 2, Mk. II . . .				
19	ZA.4432	Insulators W.T. . .	1	—	1	
20	ZA.4444	B . . .	—	4	4	
21	ZA.6579	Chain Small 3-link . . .	—	2	2	
		Staytighteners Small . . .				

APPENDIX C  
ANTENNAE ROD, F. LIST OF COMPONENTS

Item No.	Catalogue No.	Designation	12 ft. 6 in., No. 2			16 ft., No. 1		
			Minimum for work	Essential spares	Total	Minimum for work	Essential spares	Total
1	FA.2137	SECTION F Hammers, Engineers', Ballpane, 8 oz.	—	—	—	1	—	1
2	YA.4080	SECTION Y Straps, Carrying, H . . . . .	—	—	—	1	—	1
3	ZA.11009	SECTION Z.1 Aerial Bases, No. 11 . . . . .	—	—	—	1	—	1
4	ZA.11010	Spikes . . . . . Antennae Rod, F.— Cases, Carrying—	—	—	—	1	—	1
5	ZA.11011	No. 1 . . . . . Straps, Retaining—	—	—	—	1	—	1
6	ZA.11462	No. 1 . . . . .	—	—	—	1	—	1
7	ZA.12764	No. 2 . . . . .	—	—	—	1	—	1
8	ZA.11562	No. 2 . . . . . Sections—	1	—	1	—	—	1
9	ZA.0894	No. 1 . . . . .	1	1	2	2	1	3
10	ZA.0895	No. 2 . . . . .	1	1	2	1	1	2
11	ZA.0896	No. 3 . . . . .	1	1	2	1	1	2

APPENDIX D  
READINGS OF METER

SET No. :

OPERATOR'S WEEKLY READINGS.

<i>Date</i>	<i>Drive</i>	<i>HTS</i>	<i>HTR</i>	<i>LT</i>	<i>AVC</i>	<i>Aerial</i>			
						<i>1st freq.</i>	<i>Rdg.</i>	<i>2nd freq.</i>	<i>Rdg.</i>

APPENDIX E  
PROTECTION AGAINST GAS

(1) *Protection against gas vapour.*

Respirators which facilitate speech are being designed. Meanwhile it should be found possible to speak with the microphone over short lines by holding it against the metal cap of the existing respirator. Should difficulty be experienced, use the key.

(2) *Protection against gas spray.*

- (a) *Vehicle stations.*—The rear flaps of the vehicle should be closed when precautions against spray are ordered. Respirators need not be worn unless the gas can be smelt.
- (b) *Ground stations.*—When precautions against spray are ordered, improvise covering for the operators and station, using Aerial coupling Unit J if necessary. Alternatively, use the remote-control unit from a point under cover. Throw a cape, A.G., over the set and the adjacent unit, but leave the aerial exposed to spray.

If no cover can be improvised, take the following action. As soon as the fall of spray has been detected, carry out personal decontamination (COE-CDO) in accordance with A. F. A2022, or Section 7 (2) of Pamphlet 8 (*Protection Against Gas*) of the *Field Service Pocket Book*.

Wipe the panel and controls clean with dry swabs, paying particular attention to all parts that are likely to be touched with the fingers. Continue to operate the set, but carry out decontamination as soon as an opportunity occurs, and in any case before moving the station. Keep the fingers well treated with ointment, A.G., No. 3.

In a man-carried ground station, the set and aerial should be carried outside the cape, A.G.

- (c) *Decontamination.*—As soon as an opportunity occurs, decontaminate the equipment as fully as circumstances permit.

Apply Ointment, A.G., No. 3, to the hands.

Clean the aerial and all other metal or painted parts by swabbing with petrol or paraffin.

Treat canvas covers and carrying-straps by removing all free liquid with swabs, and applying Ointment, A.G., to all surfaces which will come into contact with the hands or body.

If canvas parts have been splashed with liquid blister gas, boil them for an hour, when an opportunity occurs, in soda solution (1 oz. washing soda to every 5 gallons of water). If, however, canvas parts have been only slightly contaminated, they will decontaminate themselves in the course of a day or two's exposure to the air.

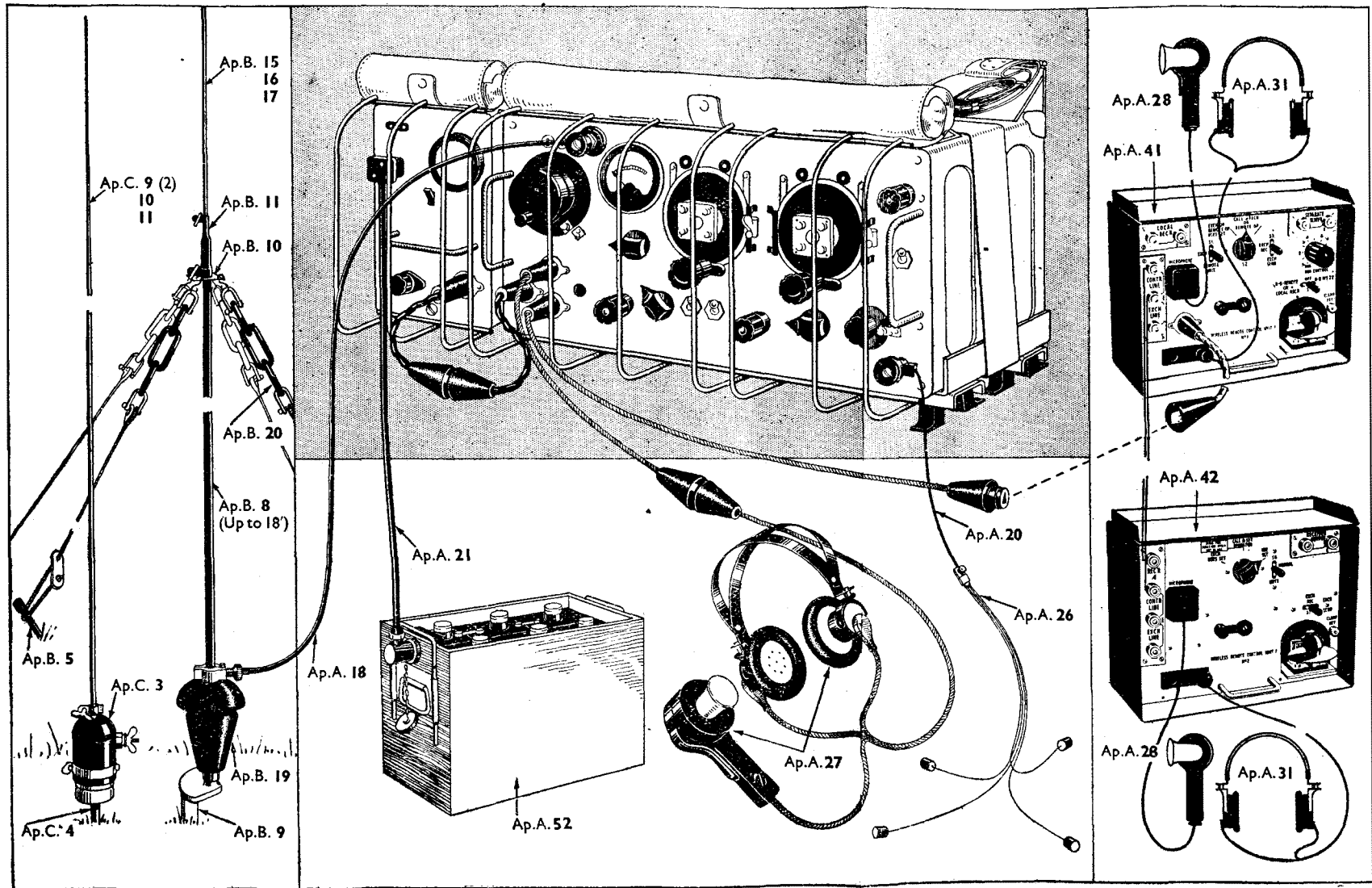
Give the panel and controls a final treatment with petrol or paraffin, and leave them dry and clean.

If the vehicle has been contaminated, the detector paint should be renewed and decontamination should be carried out, so far as may be necessary, in accordance with Section 12 of *Gas Training*, 1942. Only those contaminated parts which are likely to be touched by personnel need be treated; the remainder can be left to weather. Maintenance must be carried out under precautions; i.e., personnel must wear gloves or use A.G. ointment.

AERIALS

LAYOUT OF COMPLETE STATION

REMOTE CONTROL



Description of parts can be found in Appendix A, B or C as indicated.

Fig. 1

# MAN-PACK STATION.

unless otherwise stated, Index Nos. refer to Appendix A Complete Station List

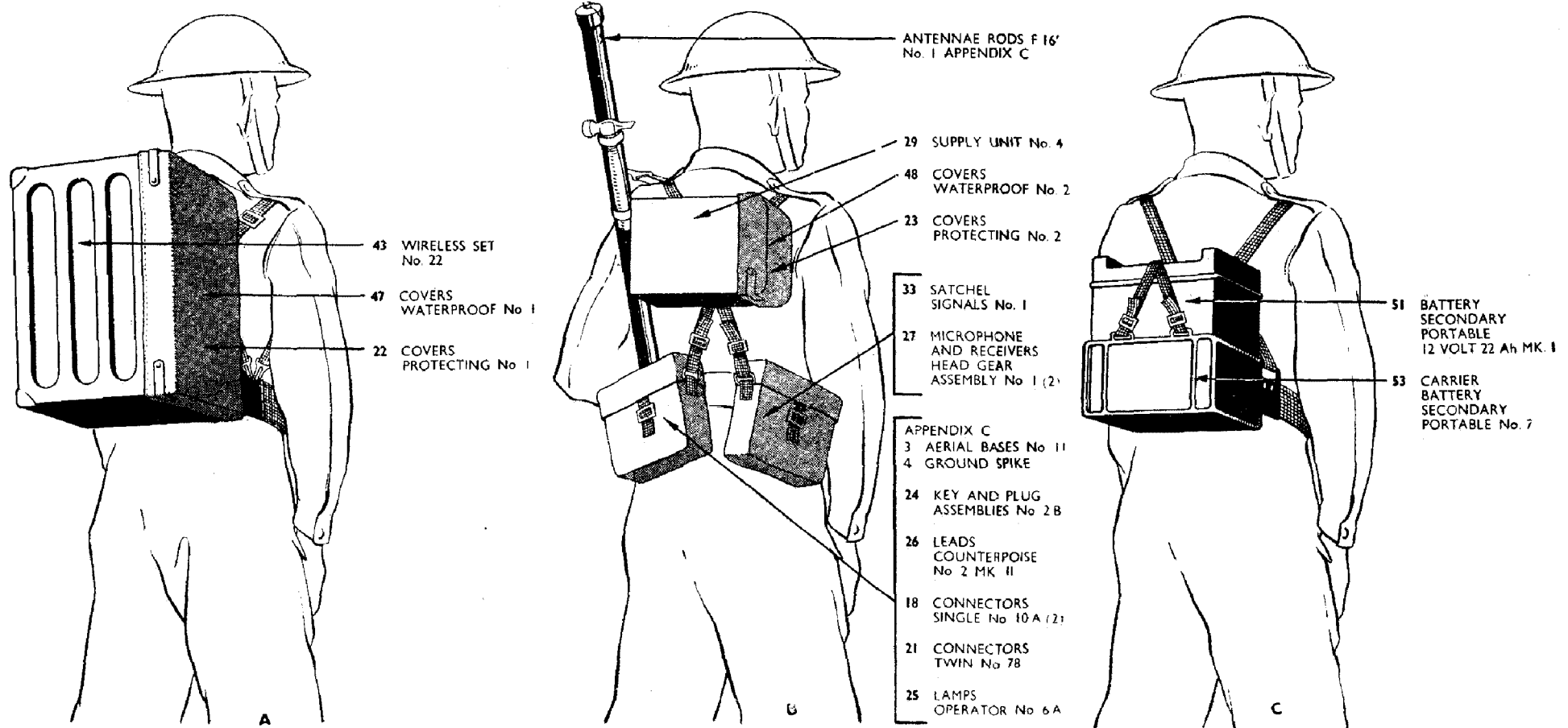
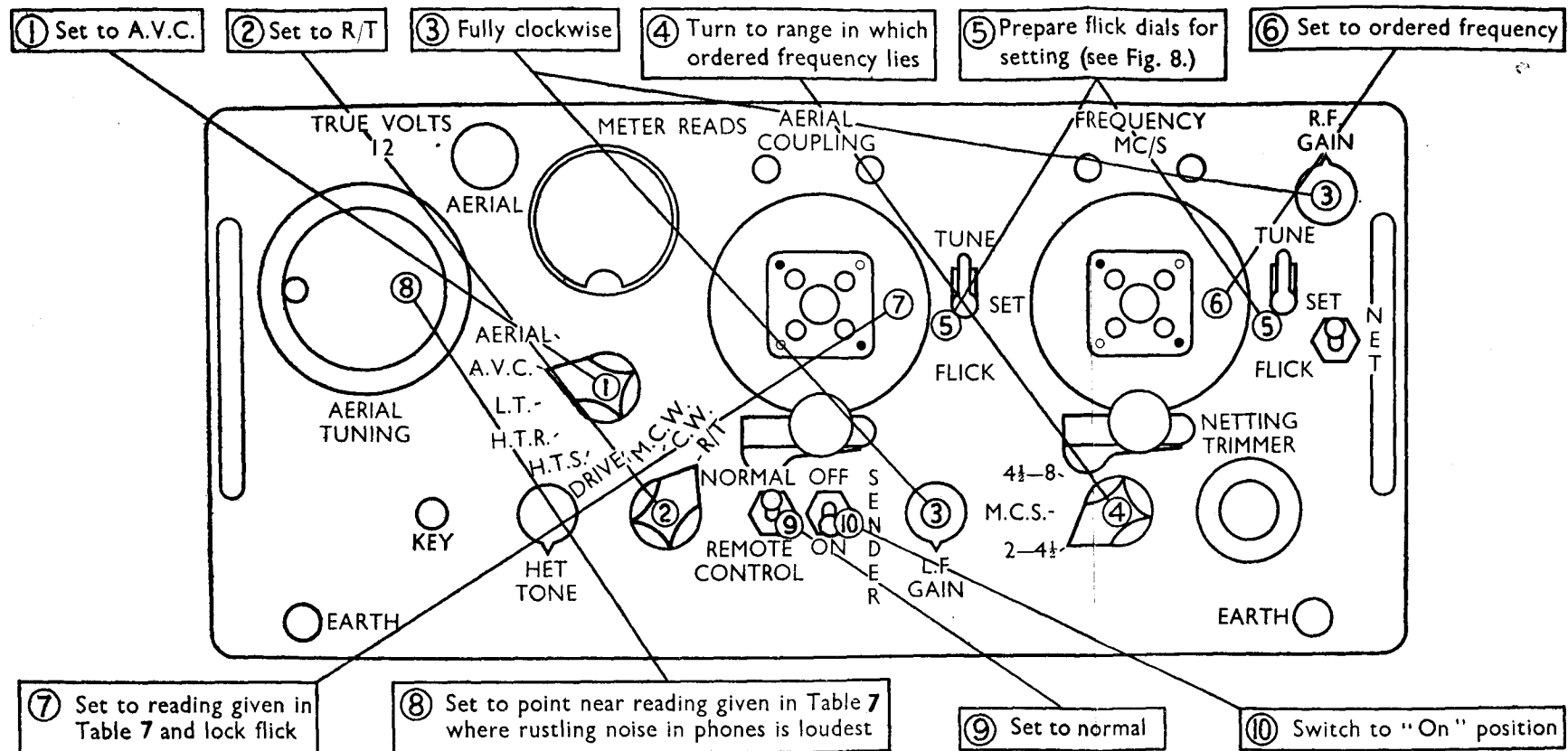


Fig. 5.



# NETTING DRILL

## PREPARE SET FOR NETTING



## NETTING IN HARBOUR

USE THE NUMBERS HERE FOR NETTING BY NUMBERS WHEN TRAINING

- |   |   |  |
|---|---|--|
| ① Search boldly for Signal<br>Tune for Max. deflection on meter   | ④ Lock NETTING TRIMMER                                  | ⑧ Turn R.F. Gain to Max. and adjust AERIAL TUNING for Max. deflection on meter |
| ② Press NET. Tune NETTING TRIMMER for zero beat reducing R. F. Gain to give strength 3 signal. (see Fig. 10.) | ⑤ Turn to FLICK   | ⑨ Lock AERIAL TUNING   |
| ③ Lock FREQUENCY M.C.S screws of correct colour   | ⑦ Check if netting is still good<br>If not do 1-6 again | ⑩ Log AERIAL TUNING Reading and NETTING TRIMMER Reading on tablet              |

Fig. 9

# CHANGING VALVES, ETC.

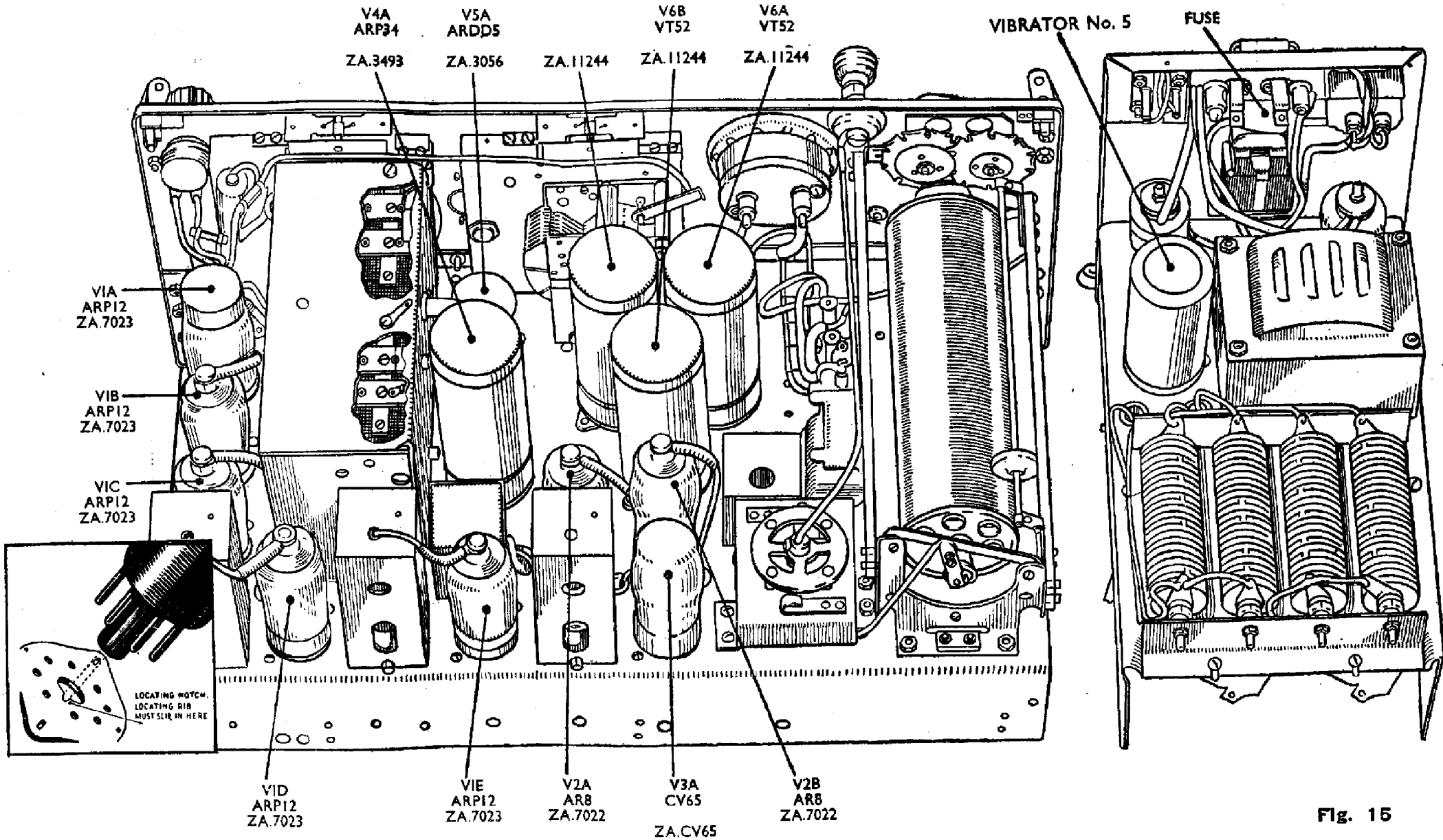


Fig. 15