CHAPTER 1.

GENERAL DESCRIPTION.

1. GENERAL DATA.

Type 686M, which is generally similar to Type 686, is modified to incorporate a loudspeaker and to make it possible to feed headphones at a higher level than formerly. An external vernier control of the transmitter frequency has also been added. Type 686M is not fully tropicalized.

This set is used for communication between Combined Operations craft over distances of from 2 - 10 miles according to whether R/T or M.C.W. is employed, and also depending upon the maximum height at which aerials can be fixed in the craft concerned.

The set, which is transportable, has been designed for operation by unskilled personnel. To ensure efficient operation it is most essential that adjustment of the set before issue for service should be carefully carried out.

Whilst it is prefereble that the set should be operated under cover it is splash-proof and robust.

The set may be adjusted to operate on either of two frequency bands. On band 1, the transmitter has three spot frequencies A, B and C, while the receiver frequency is continuously variable over the band. On band 2, the transmitter has spot frequencies C, D and E, the receiver frequency being continuously variable over the band. Spot frequency E is higher than A, the others being intermediate, with C common to both bands.

Date of Design.	1944.
Character of Transmission.	R/T or M.C.W.
Power Supply.	12v. (50 A.H.) Battery (A.P.W3433A). This allows 11 hours continuous operation if used in periods of 10 min. transmission, 10 min. reception.
Power Output.	3 watts.
Range.	R/T. 2 - 5 miles) Dependent on M.C.W. 3 - 10 ") aerial height.
Aerials.	Two types are provided:- (a) Dipole aerial - Omnidirectional. (b) 4 - element array - Unidirectional. (See Chapter 2, para. 1(b)).
Dimensions.	11" x 10" x 15½". To this must be added the space required for battery accomodation. (12½" x 6⅞" x 9¾").
Weight.	Set : 44 lbs. Dipole Box : about 24 lbs. Battery 61 lbs. Array Box: about 20 lbs.
Time required for installation.	15 - 30 minutes.

2. UNITS OF THE EQUIPMENT.

Type 686M comprises the following units:-

1 Metal case complete with removable cover, containing the set, power pack, handset, amd leads. Two spare fuses and one trimming tool are fixed in the removable cover. (Transmitter-Receiver Unit Type 7AW, A.P.W9411A).

1 wooden box containing one single dipole aerial, feeder, padded headphones, set spares, aerial bracket and radiation meter.

1 wooden box for every two sets containing one directional "Yagi" aerial array, aerial bracket and feeder.

1 12v. battery.

NOTE:- The complete list of components for the above units is given at the end of the book.

3. UPPER CHASSIS (Transmitter - Receiver Unit).

The transmitter and receiver are assembled together on the chassis in the top part of the housing. The transmitter portion occupies the front part of the chassis while the receiver portion occupies the back of the same chassis. The relays used to change over from "Transmit" to "Receive" operation are situated in the lower part of this chassis.

The controls on the front of the panel of the top chassis are as follows:-

Top left-hand side.	Transmitter Tuning Control (Three position). "Netting Cotrol"
Top right-hand side.	Receiver Tuning Control.
Right centre.	Morse Key.
Bottom right-hand side.	Low Audio Level 'Phones Jack (J1). Receiver Volume Control. R/T - M.C.W. Switch.

The socket for the concentric aerial feeder is situated on the top right-hand side of the housing itself.

4. LOWER CHASSIS (Power Unit).

The lower chassis accommodates a vibrator with its associated smoothing circuits and also the modulator valve (V2) together with its associated components. The lower panel also contains a general purpose meter for measuring H.T. current or L.T. voltage and a small loudspeaker.

The controls on the front of the panel of the lower chassis are as follows:-

Left-hand side.	Clips to accommodate the handset during transportation. The headphones should be stowed in the Dipole Unit box.
Top centre.	Loudspeaker and Switch.
Top right.	High Audio Level Phones Jack (J2).

Centre right.	Main "ON/OFF" Switch Fuse, 10 amp.
Lower centre	Meter and switch.
Lower right	Pilot lamp for main switch.

A press-to-speak switch is situated on the telephone hand-set, and is used as the "Send-Receive" switch for R/T operation.

5. FREQUENCY BANDS.

Type 686M is designed to operate on one of 5 spot frequencies which are colour coded on the transmitter and receiver tuning dials, as follows:-

A - blue; B - white; C - yellow; D - black; E - brown.

Each set may be adjusted to operate on either of two frequency bands, the first containing frequencies A, B and C, and the second C,D and E. When a set is adjusted to operate on one band, any one of three frequencies is available, but changing from one band to the other may only be performed at base, and requires the use of Test Set A.P. 54455 (see Chapter 4).

One side of each of the transmitter and receiver dials is marked with the colours and letters of band 1, whilst the other side is marked with those of band 2. The dials are secured to the front panel by two screws and can be fixed with either side showing, so that they are used to indicate the band on which the set is adjusted.

CHAPTER 3.

TECHNICAL DESCRIPTION.

1. TRANSMITTER.

Valves:- 2 VR135.
1 6J7G (Common to Receiver).

The two valves VR135 (V4 and V5) are used in a push-pull line oscillator which is anode modulated. The modulator valve 6V6G (V2) situated in the lower chassis, is driven by a pre-amplifier stage using the valve 6J7G (V1) operated by the output from the microphone or buzzer in the grid circuit.

The oscillator is coupled to the aerial by a coupling loop, placed adjacent to the oscillator anode line, and connected to the feeder when the set is in "Transmit" operation. The position of the loop is adjusted at base for maximum output and should not require re-adjustment. (See Chapter 4, para. 6).

The transmitter spot frequencies are selected by means of a variable (three position) condenser incorporated in the anode line of the transmitter output circuit, and controlled by the transmitter tuning control. A "Netting" control is provided to enable small adjustments to be made to the frequency in operation. The netting control operates a cam which slightly alters the setting of the variable condenser without affecting the click plate setting. A trimming condenser is also incorporated in the line, and can be adjusted through a hole in the front panel, accessible by loosening two screws and lifting the cover (see Fig. 2). A shorting bar on the lines is used in conjunction with the trimmer for setting the transmitter to the required frequency band (see Chapter 4, para. 2).

The contact distance of the morse key is adjustable by a screw.

2. RECEIVER.

Valves:- 1 NR88.
1 6J7G (Common to Transmitter).
1 6V6G (Common to Modulator).

The NR88 (V3) is used as a super-regenerative line oscillator, followed by V1 and V2 which function as audio amplifiers when the set is in "Receive" operation.

The anode line of V3 is coupled to the aerial by a trimming condenser TC3 which is connected to the feeder when the set is in "Receive" operation.

The output from V1 is fed to the telephone handset and to the jack (J1) in the upper panel. It is also fed to the grid of V2, the output from which feeds the loudspeaker and the jack (J2) in the lower panel.

The volume control (VR1) varies the input to the grid of V1.

When the set is adjusted on the first band, the receiver can be tuned continuously over the frequencies A, B and C. When it is adjusted on the second band, it can be tuned continuously over frequencies C, D and E. Tuning is effected in each case by a variable condenser, incorporated in the anode line of V3 and controlled by the receiver tuning control on the front panel. A trimming condenser also incorporated in the line, can be adjusted through a hole in the back of the case, normally covered by

a protecting plate, which can be slid aside by removing a fixing screw. This trimmer is used for setting the receiver to the required frequency band (see Chapter 4, para. 3).

NOTE:- The red dot on the envelope of V3 indicates the anode.

3. MODULATOR AND RELAYS.

Valve:- 1 6V6G. (Common to Receiver).

This valve (V2) derives its input from V1, and is common to both transmitter and receiver circuits. On "Receive" operation this valve is biassed back further than on "Transmit" by adding the resistance R22 in series with R14 in the cathode lead. For M.C.W. a buzzer is used in the grid circuit of V1, while for R/T the microphone output is fed into V1.

When the R/T-M.C.W. switch is on R/T, the relays incorporated in the upper chassis of the equipment, which transfer the set from "Receive" to "Transmit" operation, are actuated only when the press-to-speak switch on the telephone handset is closed.

When the R/T-M.C.W. switch is on M.C.W. the relays are thereby actuated and the set put into "Transmit" operation. To change from "Transmit" to "Receive" when working on M.C.W. it is necessary to switch over the R/T-M.C.W. switch to R/T.

4. SEQUENCE OF OPERATION.

Refer to the circuit diagram (Fig. 8).

(a) Reception on R/T or M.C.W.

R/T-M.C.W. switch on R/T. Press-to-speak switch open. Relays not actuated. H.T. applied to valves V1, V2 and V3.

Aerial input transferred to anode line of super-regenerative oscillator (V3) through TC3. Output from V3 passed on to grid of audio-amplifier (V1).

(b) Transmission on R/T.

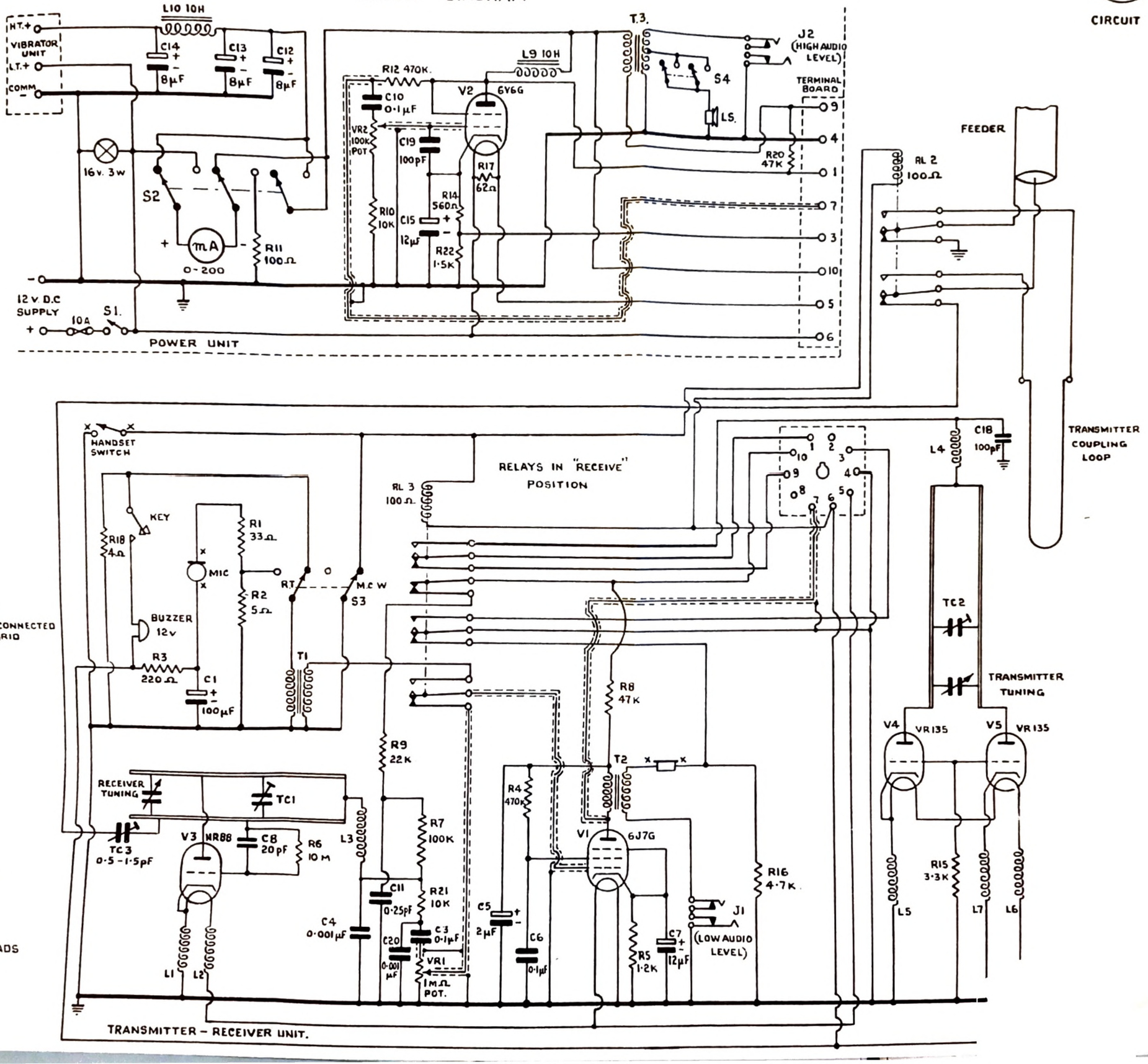
R/T-M.C.W. switch on R/T. Press-to-speak switch closed. Relays actuated. H.T. applied to valves V1, V2, V4 and V5.

Microphone output passed on to grid of pre-amplifier (V1) by transformer (T1). Output from V2 passed to oscillator stage (V4 and V5). Anode line of oscillator coupled to aerial by coupling loop.

(c) Transmission on M.C.W.

R/T-M.C.W. switch on M.C.W. Press-to-speak switch open. Relays actuated. H.T. applied to valves V1, V2, V4 and V5.

Operation as above except that buzzer output replaces microphone output.

TYPE 686M

CIRCUIT DIAGRAM