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1. Work out the page numbers you want to print. If you want to print the whole document, then within "Bookmarks" (see above), first click on "**Front**", and note the page number given at the bottom of the Acrobat window – this will give you the page number of the first page to be printed. Similarly click on "**End of A4 printable copy**", to determine the last page to be printed.

2. Select "File – Print" or click on the printer icon. This will bring up the print dialog box.

3. Select the correct printer if necessary.

4. In the area marked "Print Range" click on the radio button marked "Pages from..", then enter the first and last page numbers worked out in step 1 into the "from" and "to" boxes.

5. In the "Page Handling" area, next to "Page Scaling", select "Fit to paper". The press "OK"

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Please get in touch with me at archivist@vmarsmanuals.co.uk.

Richard Hankins, VMARS Archivist, Summer 2004

RESTRICTED

1st TRAINING REGIMENT
ROYAL SIGNALS

TRADE TRAINING NOTES

Part No 10

WIRELESS SET No. 53

RESTRICTED

RESTRICTED

WARNING

The voltages employed in this equipment are sufficiently high to endanger human life.

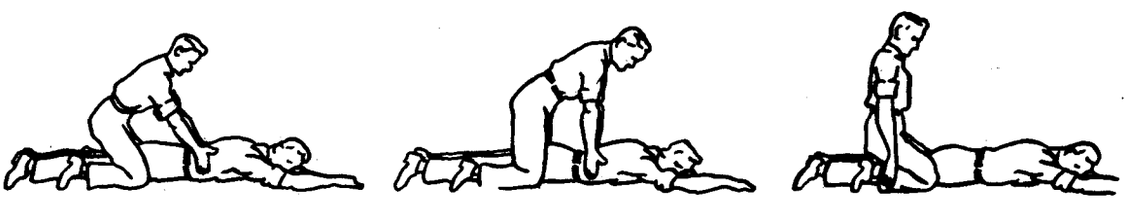
Every reasonable precaution has been observed in design to safeguard operating personnel. DO NOT TAMPER with the gate switches or interlocks. The power must be switched off before changing valves or making internal adjustments. If the procedure given in this book is carried out no danger to personnel is entailed. But do not touch any bare wires in the aerial system while the sender is in operation. All insulated connectors (such as the 1500 V.H.T. connector between units) must be kept in good order, bare wires are a source of danger.

FIRST AID IN CASE OF ELECTRIC SHOCK

1. PROTECT YOURSELF with dry insulating material.

2. BREAK THE CIRCUIT by opening the power switch or by pulling the victim free of the live conductor.

DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS until the circuit is broken.



3. LAY PATIENT ON STOMACH, one arm extended, the other bent at elbow. Turn face outward resting on arm or forearm.

4. REMOVE FALSE TEETH FROM PATIENT'S MOUTH.

5. KNEEL STRADDLING PATIENT'S THIGHS. See A.

6. PLACE PALMS OF YOUR HANDS on patient's back with little finger just touching the lowest ribs.

7. WITH ARMS STRAIGHT, swing forward gradually bringing the weight of your body to bear upon the patient. See B.

8. SWING BACKWARD IMMEDIATELY to relieve the pressure. See C.

9. AFTER TWO SECONDS, swing forward again. Repeat twelve to fifteen times per minute.

10. WHILE ARTIFICIAL RESPIRATION IS CONTINUED, HAVE SOMEONE ELSE:-
    (a) Loosen patient's clothing.
    (b) Send for doctor.
    (c) Keep patient warm.

11. IF PATIENT STOPS BREATHING, CONTINUE ARTIFICIAL RESPIRATION. Four hours or more may be required.

12. DO NOT GIVE LIQUIDS UNTIL PATIENT IS CONSCIOUS.

INDEX

Special Note:- The component numbering will be found to vary from that adopted in E.M.E.R's.

WIRELESS SENDER NO. 53 Mk. 1 and 2

1. GENERAL DESCRIPTION

A. Purpose and Facilities

The Wireless Sender No. 53 is used in either ground or vehicle installations for long range communication. The W.S. No. 53 Mk. 2 has all the facilities of the W.S. No. 53 Mk. 1, but has an added facility so that 5 unit code teleprinter signals can be transmitted by means of carrier frequency shift. The use of 5 unit code (teleprinter) equipment enables CW morse to be dispensed with except in case of an emergency when CW may be used. CW, amplitude modulated MCW and speech facilities are provided.

Any one of the four types of transmission may be used, selection being made by switch operation. When operating on carrier frequency shift (telegraph operation) the mark impulses are transmitted on one radio frequency and the space impulses on another radio frequency, the higher frequency normally being used for the mark signals. The difference between these two frequencies is the frequency shift. The shifting of the sender frequency from space frequency to mark frequency is effected by changing the frequency of the master oscillator of the sender. This is done automatically and in sympathy with the 5 unit code signals from the teleprinter. It is the equivalent of swinging the MO tuning dial very rapidly backwards and forwards a very small amount corresponding to the shift.

B. Power Output

The nominal available carrier power is about 250 Watts. It should be noted here that the range of the sender is greatest if CW is used.

C. Frequency Range

The sender covers part of the medium frequency and high frequency bands. The total coverage of 1.2 Mc/s to 17.5 Mc/s is covered in five ranges by the R.F. amplifier and the appropriate range is selected by switching:

Range	1a	: 1.2 - 1.7	Mc/s
"	1b	: 1.7 - 2.2	"
"	2	: 2.2 - 4.4	"
"	3	: 4.4 - 8.8	"
"	4	: 8.8 -17.5	"

In the master oscillator the above ranges 1a and 1b are grouped together into a single range 1.

The frequency shift (teleprinter operation) is approximately 850 c/s.

D. Power Supply and Consumption

The set requires an A.C. supply of 230 volts, 50 - 500 c/s single phase and a 12v. D.C. supply capable of providing 4 Amps. The maximum A.C. power consumption of the set is approximately 1.8 kW., the current being approximately 8 Amps.

E. Aerials

The aerial coupling unit feeds into a rod or end fed wire aerial. It embodies a resistance for use as an artificial or dummy aerial. It also has a feeder plug for an 80 ohms feeder line for connection to a dipole aerial. More details on aerials and how to erect them are given later.

F. Control

The LOCAL H.T. CONTROL on the R.F. amplifier panel, a Remote Control Unit, or microphone pressel switch may be used for actuation of the send/receive aerial change/over switch. Remote control facilities are available. See the appropriate section for these.

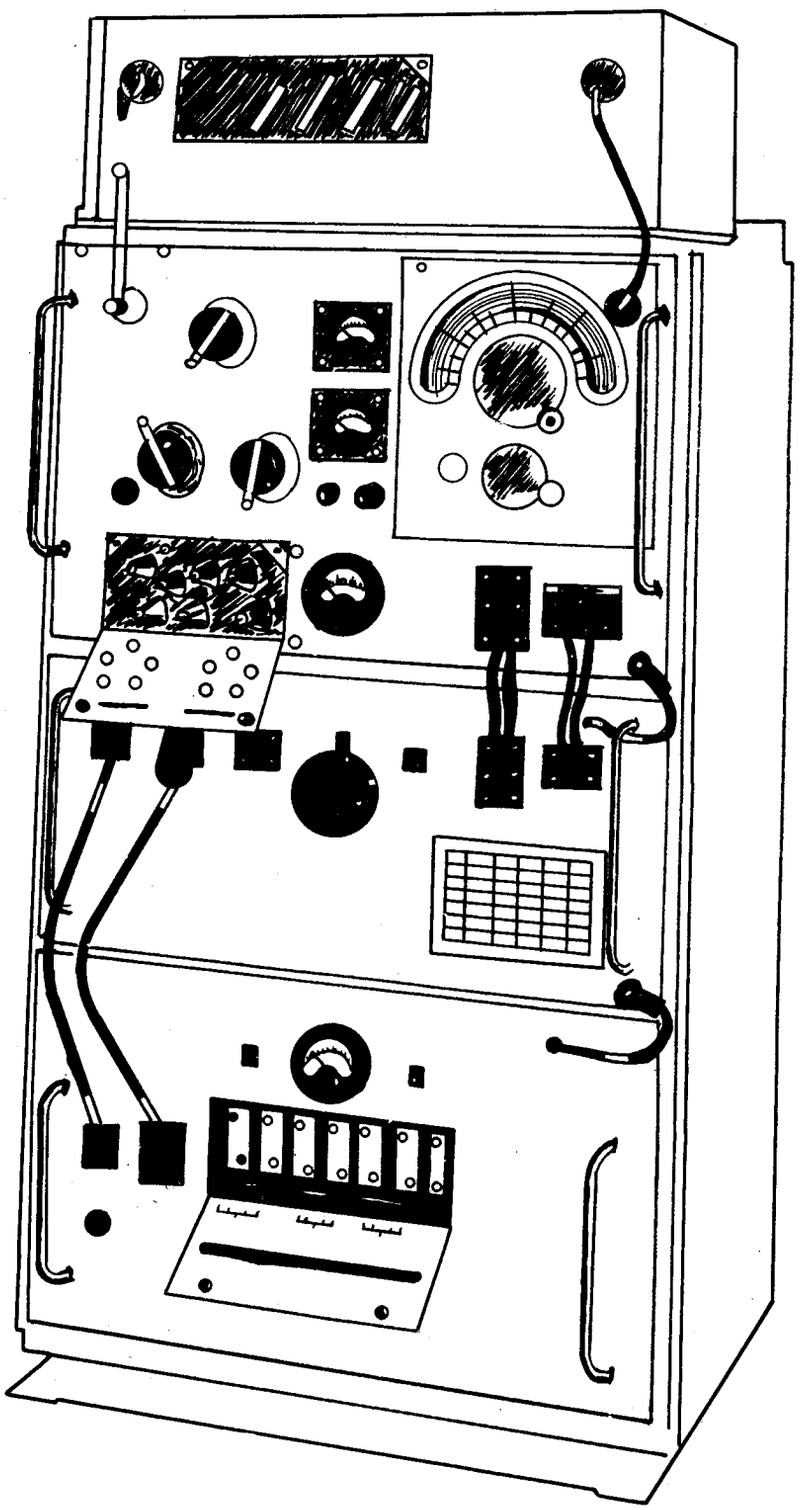
G. Receiver

The receiver used with the set is usually a Reception Set R.107 or R.209. The receivers which may be used for the reception of carrier shift (teleprinter signals) are Reception Sets R.209 Mk.2 modified or Reception Sets R.107 Mk.2 modified or Reception Sets AR88 D Mk.4 modified.

H. General Construction

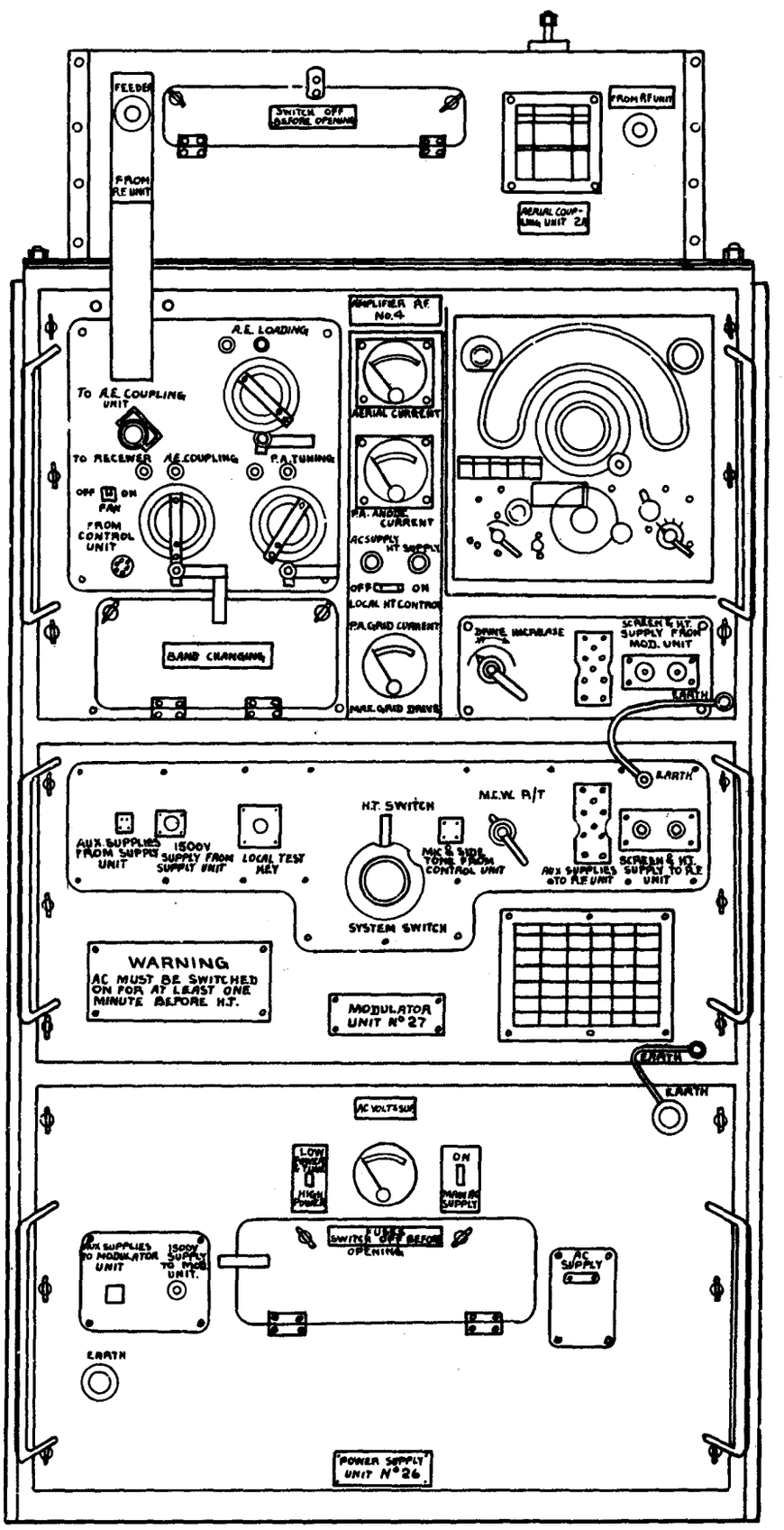
The units of the sender are mounted in a single rack with:-

(i) The Power Supply Unit No. 26 at the bottom. This provides the H.T. supplies from 230v. A.C. mains.



WIRELESS SENDER No. 53 MK I

FIGURE 1



FRONT VIEW OF WIRELESS SENDER No. 53 MK 2

FIGURE 2

(ii) The Modulator Unit No. 27 immediately above the Power Supply Unit. This includes the modulator valves and system switching, together with two self contained sub-assemblies These sub-assemblies, which are mounted on the chassis within the main unit, are:-

(a) The sub-modulator, supplying drive to the modulators. Input to this section is from the microphone on R/T or a keyed 900 c/s tone from the second sub-assembly on MCW.

(b) A chassis containing the D.C. keying valve and the MCW oscillator.

(iii) The Amplifier R.F. No. 4 above the Modulator Unit. This includes the Master Oscillator Unit No 2 as a self-contained unit and contains the R.F. power amplifier circuits and an aerial loading inductance. The M.O. Unit No. 2 comprises an R.F. oscillator, which may be either crystal-controlled on one of four spot frequencies or else controlled manually, and also buffer and driver stages.

The additional valve and components used for the operation of Frequency Shift are mounted on a sub-unit near the Master Oscillator.

(iv) The Aerial Coupling Unit No. 2A, bolted to the top. This contains the necessary components for three alternative functions. These are:-

(a) To provide a dummy aerial.

(b) To provide an outlet for a concentric feeder to a dipole aerial.

(c) To supply an inductance, coarsely variable by links, which, in conjunction with the aerial tuning inductance of the Amplifier, R.F. No. 4, loads rod and wire aerials to resonance.

The chassis of the units are of mild steel and are held to the steel angle rack by quick release fasteners along each side. Steel sheets cover the back and sides of the assembly; the side sheets are louvred at the bottom and an exhaust fan is mounted at the back part for cooling purposes. The assembly is provided with rubber blocks for mounting on the floor of a vehicle. The various units are inter-connected by leads. Heaters are fitted in the base of the rack.

Other forms of mounting than the rack mounting may be used, for example, in vehicle installations.

Quick release fasteners enable the units and also the back and side covers to be quickly fixed or released. The fastener heads are turned vertical to fix and horizontal to release.

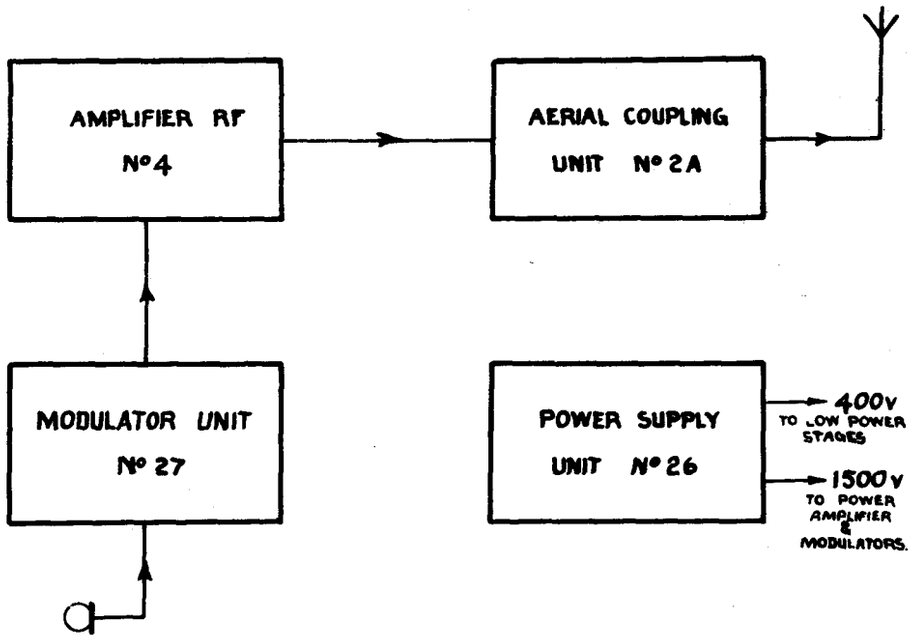
I. Brief Technical Description

The arrangement of the main units is illustrated in Fig. 3. The A.F. signal from the microphone is fed into the Modulator Unit No. 27, and thence to the Amplifier R.F. No. 4,(which includes the master oscillator), where modulation takes place. The output from the Amplifier R.F. No. 4 is then fed into the aerial by means of the Aerial Coupling Unit No. 2A. The Power Supply Unit No. 26 provides 400 volts to the low power stages and 1,500 volts for the modulator unit and power amplifier. The HIGH POWER/LOW POWER AND TUNE switch when set to LOW POWER AND TUNE reduces the 1,500 volts to approximately half when the anode current is 110 mA.

Referring to the more detailed block diagram Fig. 4, the Master Oscillator Unit No. 2 comprises a master oscillator, which may be crystal controlled, V1A, doubler and buffer valve V1B and drive amplifier valve V2A The valve V2A in the Master oscillator Unit drives the Power Amplifier valves V3A and V3B. The output from the latter passes to the aerial via the Aerial Coupling Unit No. 2A.

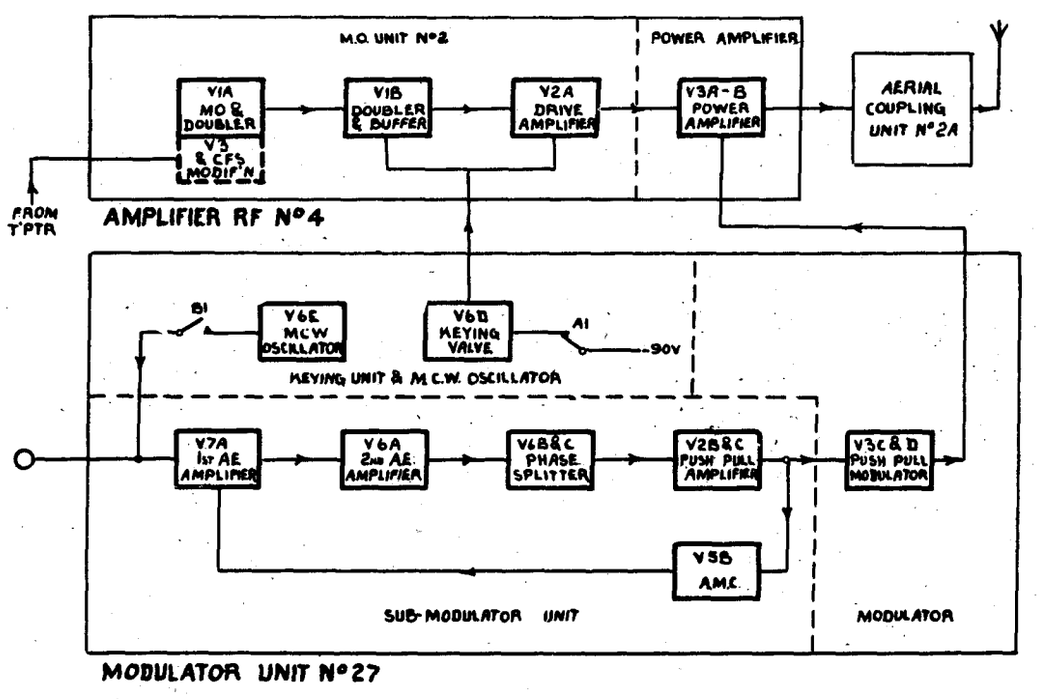
The A.F. output from the microphone is amplified by the two valves V7A and V6A. It is then passed to the phase splitter valves V6B and V6C, then to the amplifier valves V2B and V2C. The output from these valves is then applied to the push-pull modulator valves V3C and V1D. These valves modulate the power amplifier. Automatic modulation control is obtained from the output of the push-pull amplifier feeding the A.M.C. valve V5B, which in turn controls the first A.F. amplifier valve V7A.

When C.W. telegraphy is transmitted, the keying valve V6D in the Keying Unit keys the screens of the doubler and buffer valve V1B and the drive amplifier V2A.



BLOCK DIAGRAM OF MAIN UNITS

FIGURE 3



DETAILED BLOCK DIAGRAM

FIGURE 4

When sending from a teleprinter carrier shift operation is used. A diode operates in effect as a switch and switches a capacitor across the M.O. tuned circuit, thus slightly altering its frequency. The nominal frequency shift is 850 c/s.

It will be seen from Fig. 4 that, when operating on M.C.W., the keyed tone follows the same route as the output from the microphone already described.

J. Weights and Dimensions

TABLE 1. WEIGHTS AND DIMENSIONS

UNIT	WEIGHT	LENGTH	HEIGHT	DEPTH
Power supply unit. Modulator unit. R.F. Amplifier with Master oscillator. Aerial coupling unit. Rack mounting fan at back of top part of chassis.	600lbs. approx.	2 ft. 5 ins.	4 ft. 7 ins.	2 ft. 3 ins.

2. DETAILED TECHNICAL DESCRIPTION

A. Master Oscillator

A simplified diagram of the Master Oscillator, omitting range switching, is shown in Fig. 5.

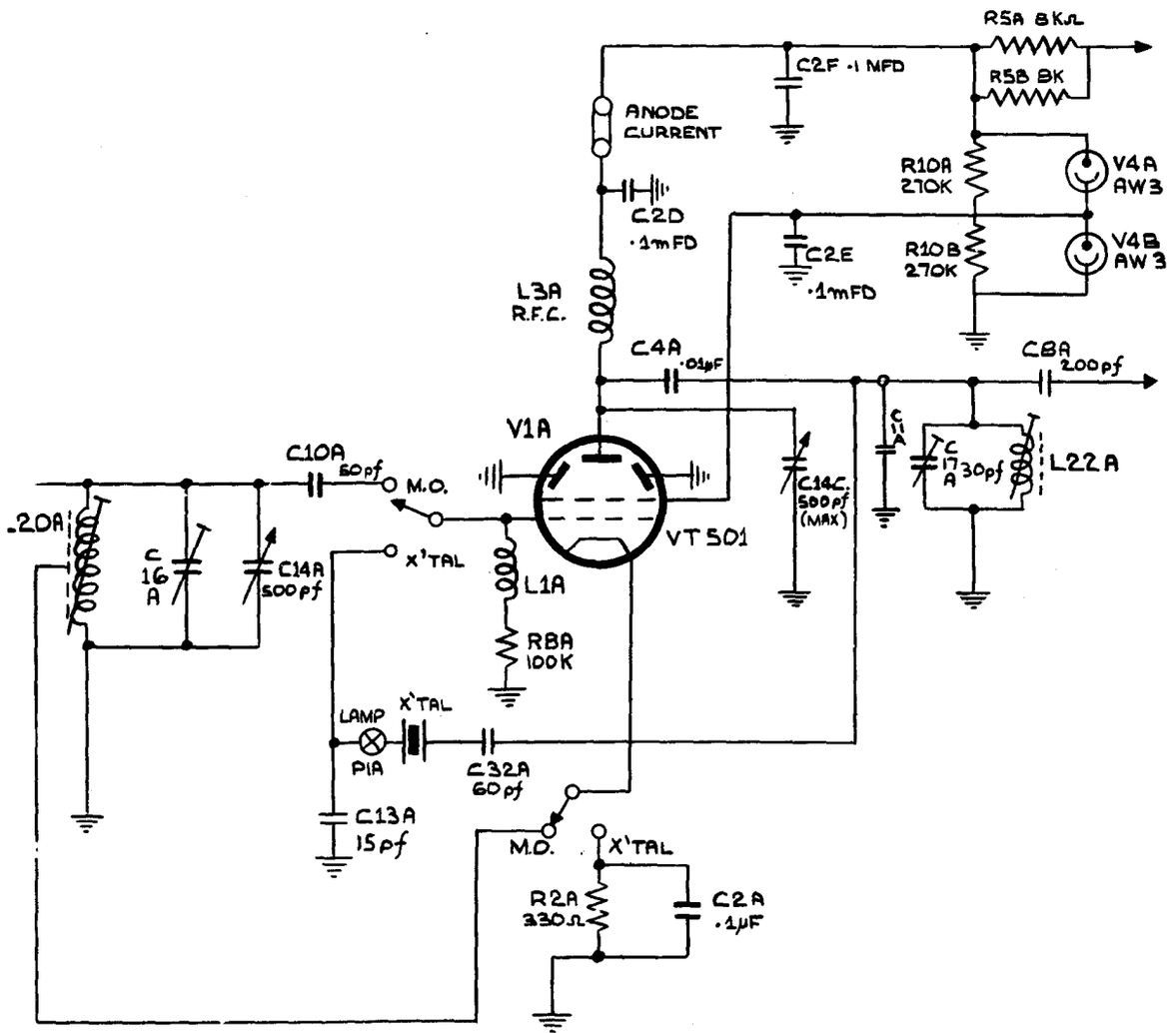


FIGURE 5 MASTER OSCILLATOR.

FIG. 5. MASTER OSCILLATOR

With the "M.O. - Xtal" switch in the "M.O." position the beam tetrode V1A is connected as an electron- coupled Hartley oscillator with parallel HT feed. The grid and anode tuning condensers are ganged together, and the coil and condenser values are so chosen that the anode circuit is always resonant at twice the frequency of the grid circuit. Trimming condensers C11A and C17A are provided to maintain this adjustment. The valve therefore acts simultaneously as an oscillator and frequency doubler. The electron- coupled oscillator gives a more stable frequency under varying conditions of anode circuit loading than is obtained with most other oscillator circuits, and provided the anode and screen grid supply voltages are suitably proportioned the frequency is less subject to variation with changes in the supply voltages.

This is due to the fact that if the anode and screen voltages are obtained from a common supply any fluctuations in the supply voltage will cause both the anode and screen voltages to vary simultaneously, and since these have opposite effects upon the frequency this will remain practically unaffected.

In the 53 Set a further safeguard is provided by the voltage regulator tubes V4A and V4B, which maintain the H.T. voltages to anode and screen-grid practically constant against any fluctuations in the output from the power supply unit.

It should be noted that the beam-forming plates of V1A are connected directly to earth, and not the cathode. The grid-leak R8A is of comparatively low resistance and is in parallel with the grid tuning circuit. To avoid excessive damping of this tuned circuit an R.F. choke L1A is placed in series with the grid-leak.

With the "M.O.-Xtal" switch at "Xtal" the grid tuning circuit is disconnected, and the valve is reconnected as a Pierce crystal oscillator. Provision is made for four crystals to be carried, each ground to a different predetermined frequency, so that the particular frequency required can be selected by switching the appropriate crystal into the circuit. These details are omitted from Figure 5 for the sake of simplicity. A lamp P1A in series with the crystal serves to indicate when the crystal is oscillating.

A cathode-bias resistor R2A and its by-pass condenser are switched in circuit in the "Xtal" position. This is to protect the valve from excessive anode current when not oscillating.

An explanation of this form of oscillator circuit is given in Wireless Theory Notes.

A link is provided in the anode supply lead to permit the insertion of a milliameter for testing purposes. It is placed at the rear of the chassis.

In the complete circuit diagram (Figure 67) the R.F. chokes L2A and L2B are shown in the heater circuit. These serve to keep R.F. currents out of the heater supply, where they might cause trouble due to feedback. These chokes are wound with resistance wire, so that they also serve to drop the 10v heater supply to 6.3v.

There are two tuning coils for the grid circuit and two for the anode circuit, and in each case one coil is for use on ranges 1 and 2, and the other for ranges 3 and 4. Thus the oscillator itself covers only two frequency ranges, i.e., 0.55 - 1.1 Mc/s on ranges 1 and 2, and 2.2 - 4.4 Mc/s on ranges 3 and 4. The oscillator tuning dial however has four frequency scales on it, calibrated to show the final output frequency of the sender, which is different for each position of the range switch. The table below shows the actual oscillator frequencies and final output frequencies in Mc/s for each range.

Range	Final Output	M.O.	
		Grid Circuit	Anode Circuit
1	1.2 - 2.2.	0.6 - 1.1	1.2 - 2.2
2	2.2 - 4.4	0.55 - 1.1	1.1 - 2.2
3	4.4 - 8.8	2.2 - 4.4	4.4 - 8.8
4	8.8 - 17.5	2.2 - 4.375	4.4 - 8.75

B. The Buffer Amplifier (See simplified diagram Figure 6)

The Buffer amplifier uses a VT 501 beam tetrode as a Class "C" amplifier, which acts as a straight amplifier on ranges 1 and 3 and as a frequency doubler on Ranges 2 and 4.

Drive from the M.O. is fed through the coupling condenser C3A on to the grid of the valve. The grid circuit is supplied with two forms of bias:-

(a) Cathode bias from R3A by-passed for R.F. by C7A.
(b) Grid-leak bias from R9A.

The anode tuned circuit is parallel fed by L6A and C5B and is ganged with the Driver.

The R.F.C. L5A maintains a high impedance from grid to earth and prevents too great a load being placed on the M.O. The valve will be drawing grid current and this in itself will cause power to be consumed from the M.O.

The combined effect of the two biasses is to work the valve under Class "C" conditions. The cathode bias protects the valve from excessive anode current in the event of oscillator failure.

A complete diagram showing the range switching is given in Figure A. There are four coils in the anode circuit covering the complete frequency band of the sender 1.2 - 17.5 Mc/s as in the table below. The range-switch is ganged with M.O. range-switch.

Range	M.O. Output	Buffer Output
1	1.2 - 2.2. Mc/s	1.2 - 2.2. Mc/s
2	1.1 - 2.2 "	2.2 - 4.4 "
3	4.4 - 8.8 "	4.4 - 8.8 "
4	4.4 - 8.75 "	8.8 - 17.5 "

A link is included in the anode circuit to measure the anode current as in the M.O.

C. Driver Stage (See simplified diagram Figure 7)
This stage uses an 807 (or ATS 25) beam tetrode as a Class "C" Amplifier.

Drive from the Buffer is fed through C6A and the parasitic-stopper R1B. There is no grid leak bias and a fixed bias of - 60v is supplied from the GB supply. The valve is driven in to grid current which can be measured by opening the link at the rear of the chassis marked "Grid Current V2A" and inserting a milliameter. There is no cathode bias.

The beam plates in this valve are connected internally to the cathode and not brought out to a pin on the valve base as in VT501. The screen supply for both this valve and the buffer comes from the 400v supply through the keying valve and drive control. (See para.H).

The anode circuit is parallel fed and there are 4 tuning coils selected by the range switch. The tuning condenser is ganged with that of the Buffer stage designated on the front panel as "Driver Tuning".

D. M.O. Unit (See Figure 9)
The three stages so far considered are mounted in one sub-assembly removable from the R.F. Unit No. 4. The R.F. output from the Driver Stage is fed to the P.A. stage through a co-axial cable.

All the tuning coils in this sub-assembly have adjustable iron cores, which facilitate alignment of the tuned circuits.

E. The P.A. Stage (See Figure 8)
Two R.F. beam tetrodes are used in parallel.

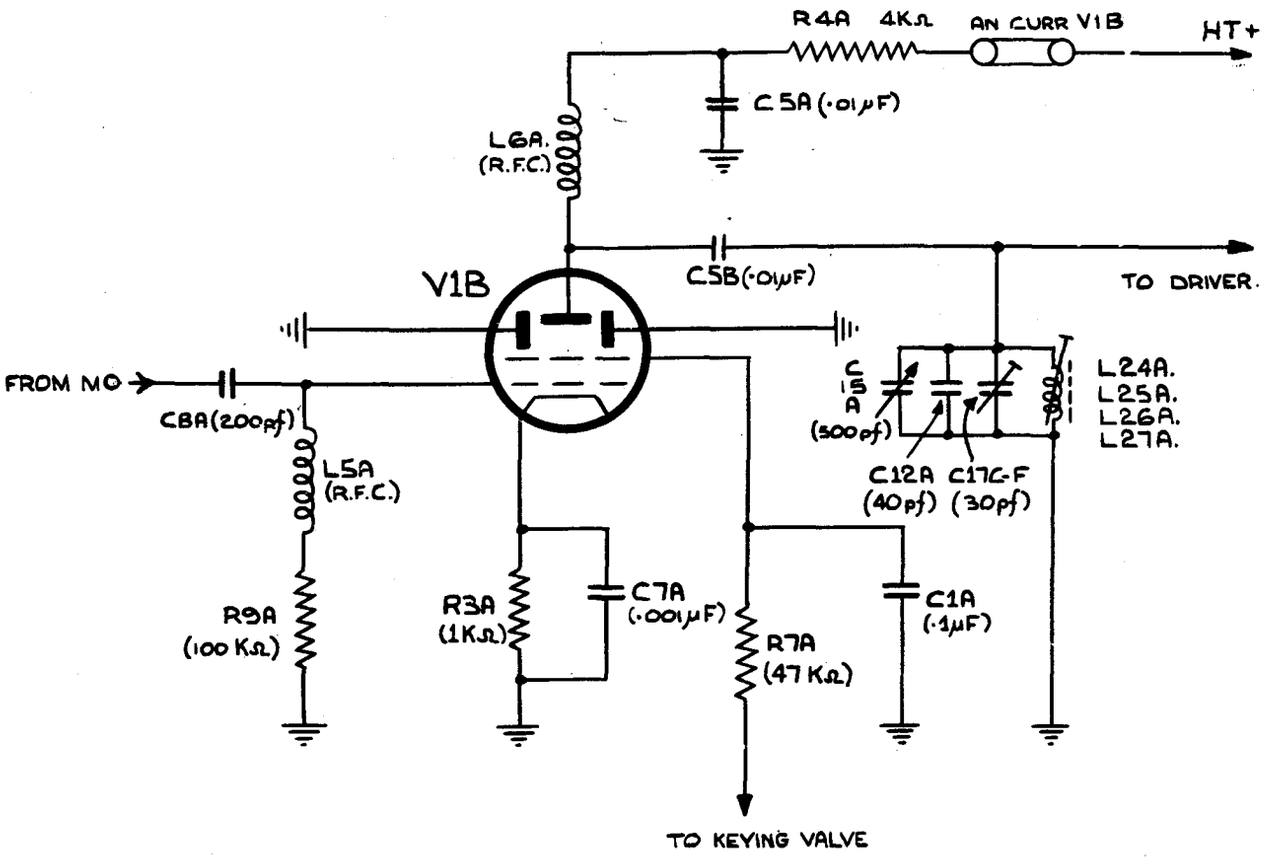
R.F. drive from V2A is fed through the co-axial inter-connector and blocking condenser C5G on to the grids of both the P.A. valves. The valves are CV26 beam tetrodes but in some sets types CV177 or 813 are used. All three types are, however, very similar.

The control grids are connected via the R.F. choke L10C to the -90v grid bias supply. The valves are worked in Class "C" and driven into grid current. This current is measured on the "P.A. Grid Current" meter M1A which is by-passed for R.F. by the condenser C5F. When correctly driven the grid current is 15mA on R.T. or M.C.W., and 10mA on C.W.

The P.A. valves have directly heated 10v filaments. Filaments are by-passed to earth by C5H and C5J.

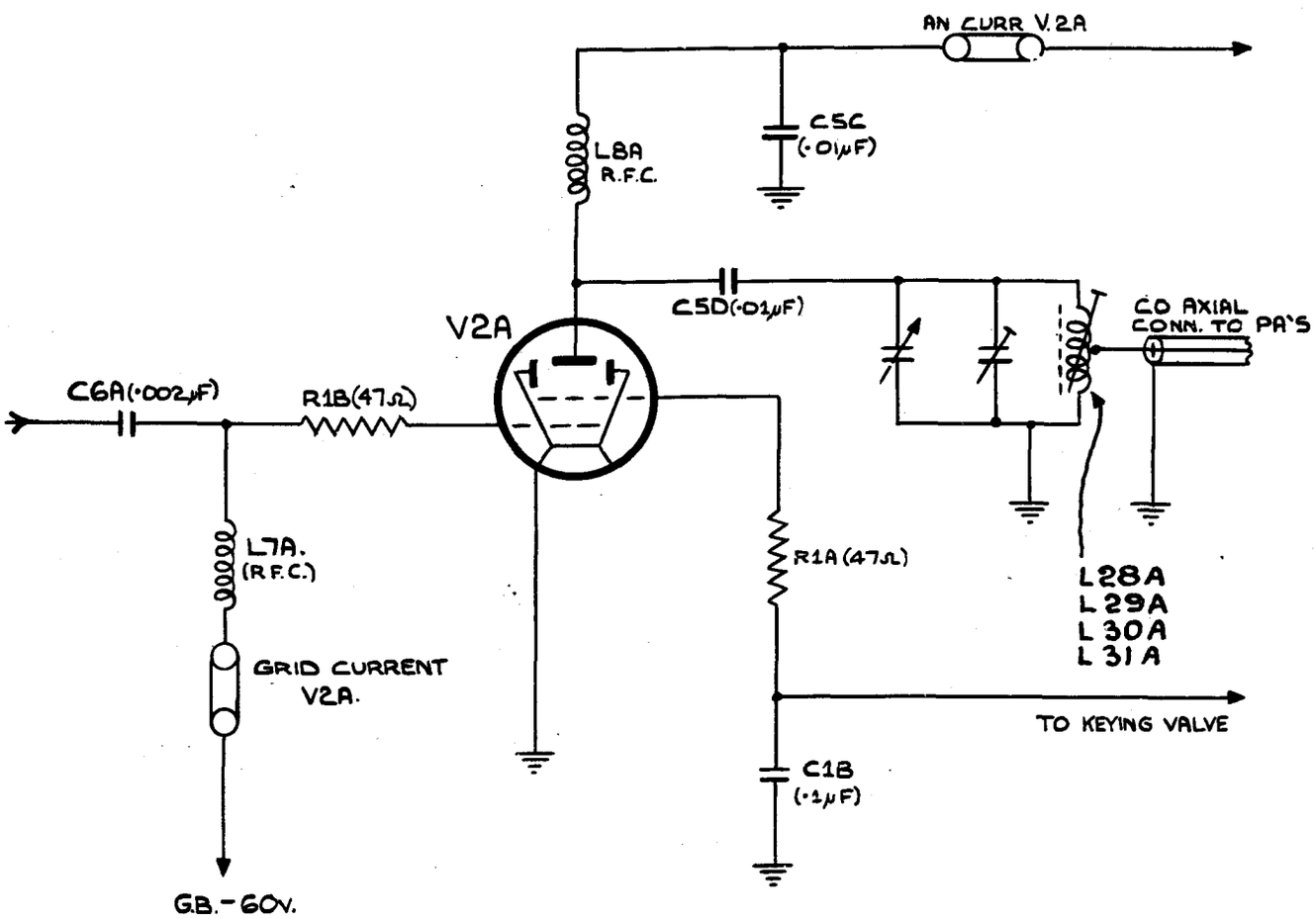
The "Tank Circuit" consists of L32A and L32B in parallel, tuned by C33A and by "X", the capacity of which latter is varied for different ranges by the band change links. L32A is made variable and is designated as "P.A. Tuning" on the front panel.

The aerial impedance is matched to the P.A. anode circuit by a tap on L32B. L32C brings the aerial to resonance by adding lumped inductance and is required when using a rod or end fed type of aerial. When using an aerial with untuned feeders L32C is cut out by rotating the control to the zero position.



BUFFER AMPLIFIER

FIGURE 6



DRIVER STAGE

FIGURE 7

6.

Switches 1A1, 1A2 and 1A4 are contacts of the send-receive relay and are shown in the receive position. When sending, 1A4 is closed connecting the P.A. to the aerial coupling unit and thence to the aerial. Contact 1A2 will be opened and contact 1A1 closed which will isolate the R107 input from the P.A. and connect its co-axial feeder to earth to avoid any R.F. pick up damaging the receiver input circuit. When receiving, the aerial is disconnected from the P.A. and connected to the R107 through the co-axial cable.

H.T. supply to the anodes of the P.As. (1500v) is through L13A, M2A (anode current meter) and L11A. C20A and C20C are both blocking condensers.

H.T. supply to the screen grids (400v) is through L14A, L10A and L10B the screens are decoupled to earth by C19A and C19B.

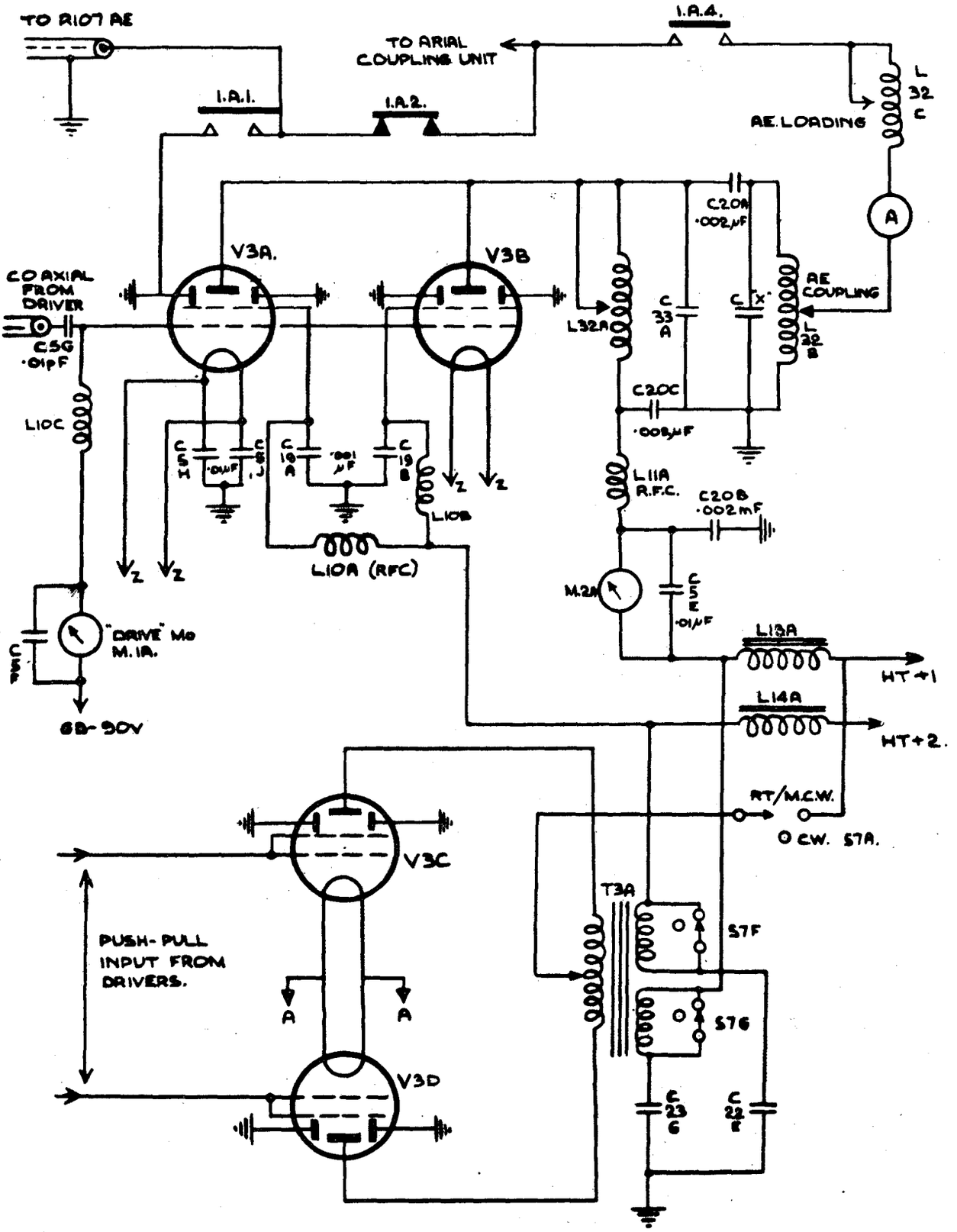


FIGURE 8. THE P.A's. AND MODULATORS

F. Controls

The actual panel layout of the stages so far described is given in Fig. 9.

F CONTROLS.

THE ACTUAL PANEL LAYOUT OF THE STAGES SO FAR DESCRIBED IS GIVEN IN FIGURE 9

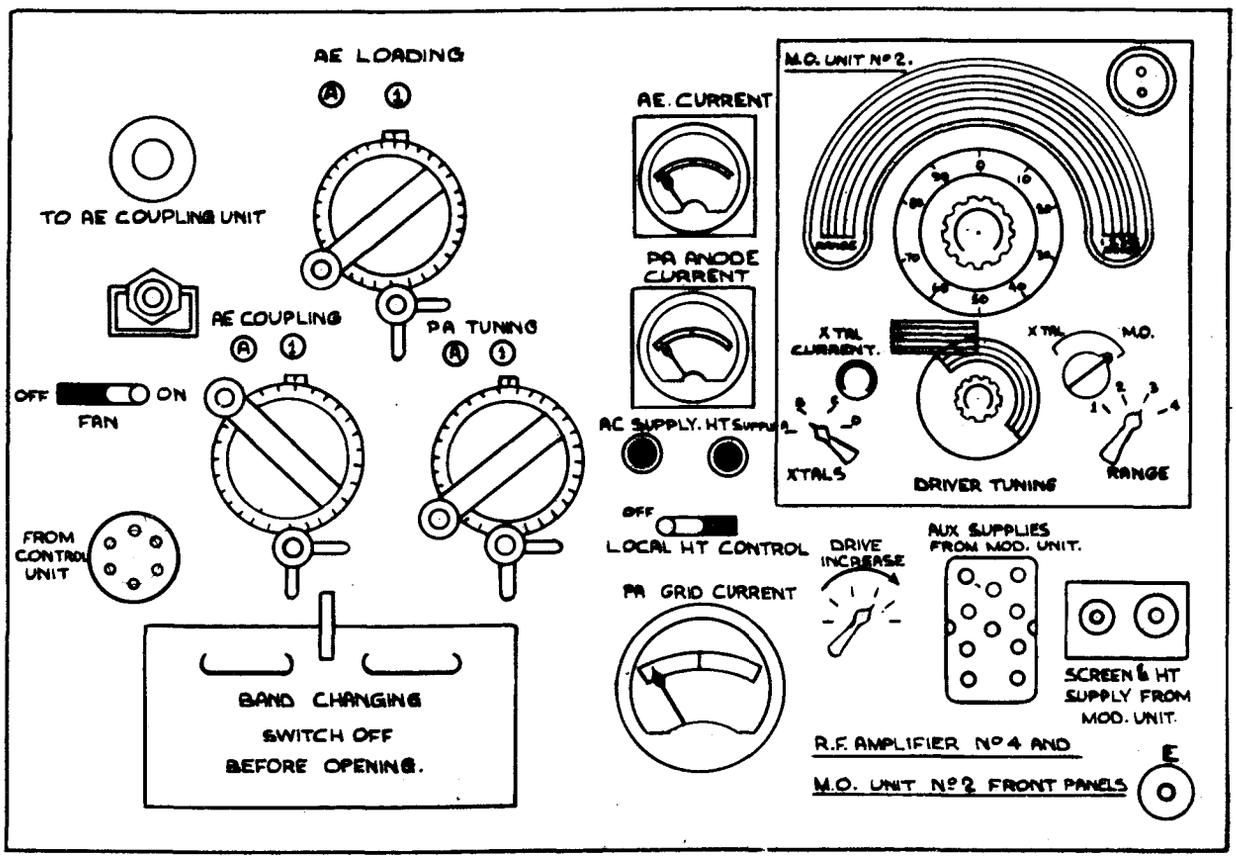


FIGURE 9

G AERIAL COUPLING UNIT.

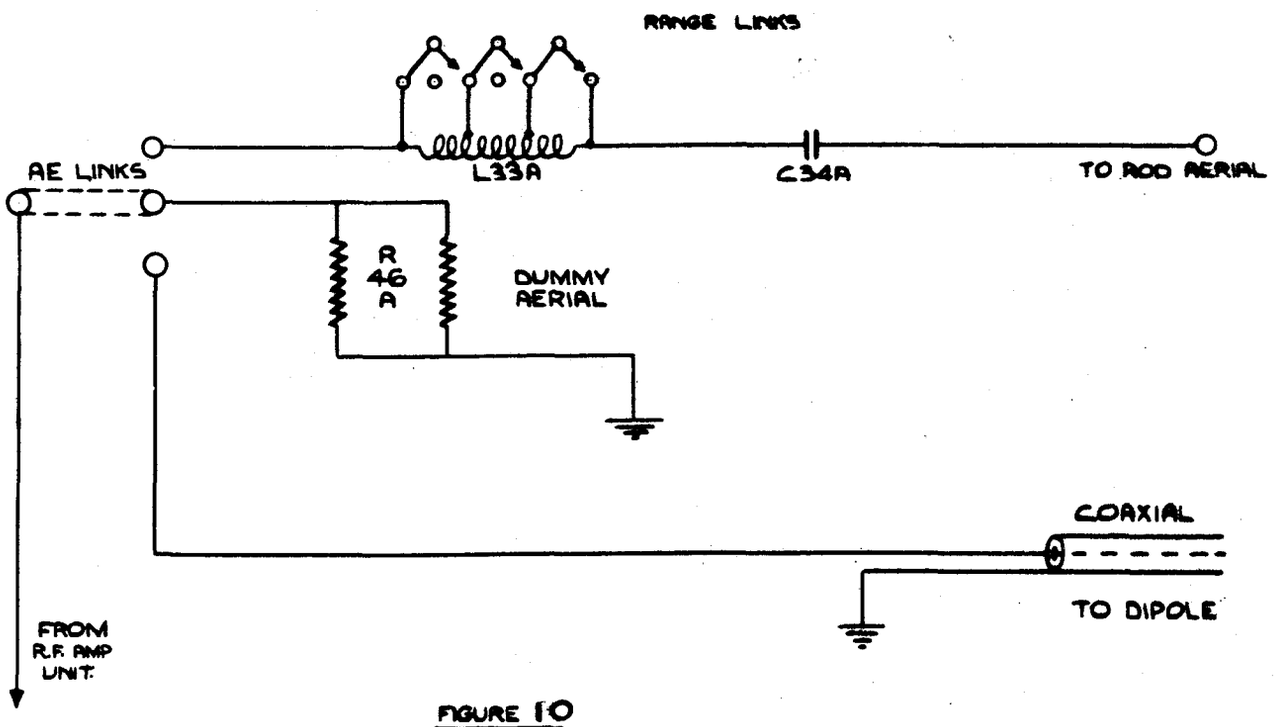


FIGURE 10

G. The Aerial Coupling Unit

Fig. 10. shows the circuit of the "Aerial Coupling Unit No. 2A". The three position aerial link selects between the rod aerial loading coil L33A, "dummy aerial" R46A and a dipole feeder. The coil has three taps adjustable by range links, aerial loading being finely adjusted by the slider on L32C in the R.F. amplifier unit (see Fig. 8). The function of C34A is to protect the sender from high voltages should the aerial touch a power line while on the move.

H. C.W. Keying and Drive Control

In a set of this power it is necessary to break a fairly large current in order to key the H.T. loads of the R.F. valves. If this were done by means of a relay contact excessive sparking would result, so in the 53 set use is made of a keying valve which is incorporated in the H.T. supply to the screen-grids of the Buffer and Driver stages.

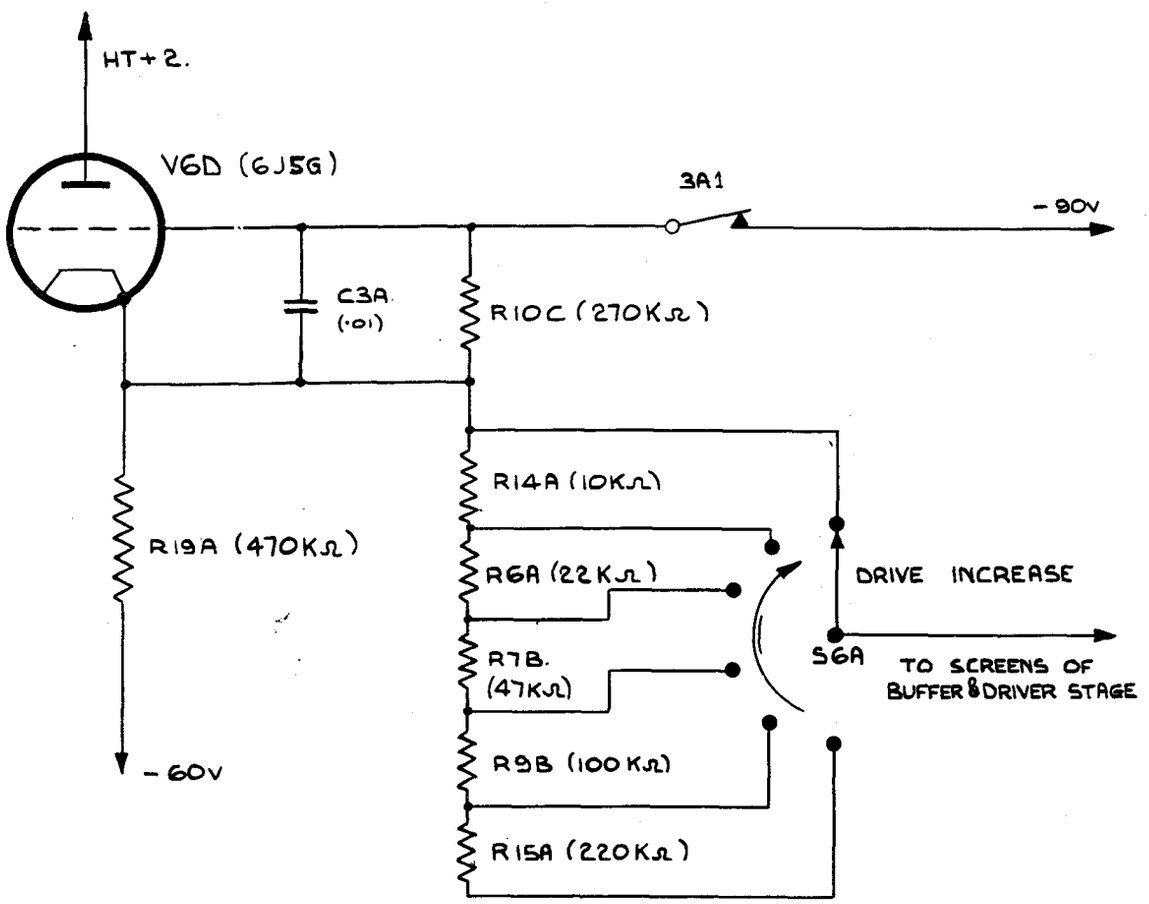


FIGURE 11 KEYING VALVE.

The anode of V6D is connected directly to the H.T. + 2 line; the control grid is connected through R10C and R19A to the -60v line and, when the key is up (3A1 closed), directly to the -90v line. The cathode is connected via S6A (Drive Increase Control) to the screen-grids of the Buffer and Driver valves, and to the junction of R10C and R19A. If V6D were removed this junction would be at a potential of approximately -80v, and the bias available for the valve is -10v. (insufficient to cut it off). With the valve inserted, a small cathode current flows through R19A and in the normal steady-state condition the cathode voltage, and hence the screen-grid voltage of the keyed valves is approximately -50v giving V6D a working bias of -40v. The keyed valves are thus cut-off.

When the key is down, contact 3A1 is open and the control grid of V6D is at the same potential as the cathode due to R10C, the valve thus conducts and forms a low resistance in series with the high resistance R19A. The cathode voltage then rises to almost that of the anode (+ 400v) and this voltage is applied to screen-grids of the controlled valves so enabling them to conduct. Owing to the high resistance of R19A, very little current passes through it. When the key is pressed the majority of the cureent through V6D comes from the screen-grids of the Buffer and Driver valves.

By altering the position of S6A various resistances can be placed in series with the H.T. line, changing therefore the potential applied to the Buffer and Driver stages. This alteration of potential effects the efficiency of these stages thus changing the drive which is applied to the P.A. valves. The six-position switch S6A therefore acts as a drive control.

The condenser C3A across R10C will charge up when contact 3A1 is closed, and therefore when this contact opens on depressing the key, the condenser will have to discharge through R10C before the valve will start to conduct. This results in gradual rise in output current from the set when the key is pressed, so that the danger of causing interference with nearby receivers is reduced.

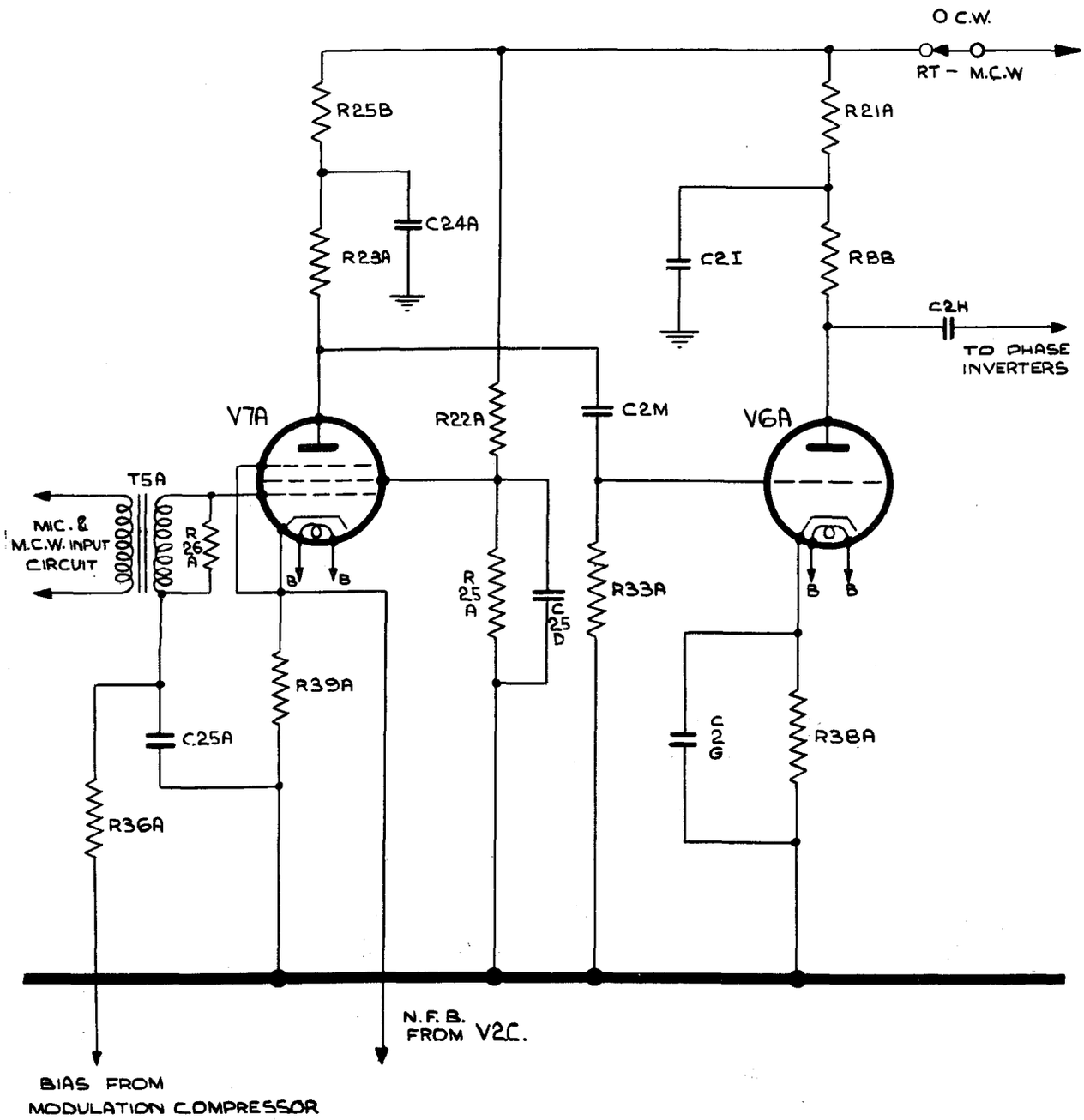


FIGURE 12 A.F. AMPLIFIERS.

			VALUES		
R8	100KΩ	R23	75KΩ	C2	1μF
R26	500KΩ	R25	51KΩ	C24	4μF 400 volt
R36	5KΩ	R33	10KΩ	C25	4μF 200 volt
R21	200KΩ	R38	3KΩ		
R22	150KΩ	R39	2KΩ	T5	1: 100

I. The A.F. Amplifiers. (See Figure 12)

The audio-frequency output from the microphone (or from a 900 c/s oscillator when working on M.C.W.) is fed into the speech amplifier through a 100:1 step-up transformer T5A. The impedance of the microphone used is 50 ohms, and a 0.5 M ohm resistor R26A is connected across the secondary of the transformer to provide a proper match for this.

V7A is supplied with bias from two sources, namely cathode bias from R39A and grid bias through R36A, from the modulation compressor. This latter will be considered later. Note that there is no decoupling condenser across R39A, and therefore negative feedback is obtained. Further negative feedback is supplied from V2C (one of the driver valves) and this will be explained later.

V7A is a variable-mu valve, and the amplification given by it is controlled by the bias supplied by the modulation compressor. The screen-grid voltage is obtained from a potential divider R22A and R25A connected across the H.T. supply.

V7A is resistance-capacity coupled to the following stage. Note the low value of the grid resistance R33A (10,000 ohms). This is in parallel with R23A for audio-frequency, and the anode load on V7A is thus of low value. Due to the use of a pentode, however, a useful amount of amplification is still obtained (A = approx. 15), while the frequency response at high audio frequencies is improved by using a low resistance load.

V6A is a normal R.C. - coupled triode amplifier.

J. The Phase Inverter

The valves V6B and V6C are connected in what is known as a "Floating Paraphase" circuit, the function of which is to convert the unbalanced input from the previous stage into a balanced output, so giving equal and opposite signal voltages for the push-pull driver valves V2B and V2C.

In Figure 13, which shows a simplified version of the circuit, the incoming signal from the previous stage is amplified in the normal way by V1. If now a fraction, say 1/nth, of the input from V1 is applied to a second valve V2, and the amplification given by V2 is adjusted to be the reciprocal of this fraction (i.e. n), then the output from V2 will be equal in amplitude to the output from V1. But, since the anode voltage of V2 will be 180° out of phase with its grid voltage, it follows that the output from V2 is in opposite phase to that from V1.

Thus in Figure 13 the output from V1 appears across the resistances R1 and R2, which together form a potential divider, proportioned so that 1/7th of the output from V1 is applied to V2. The amplification given by V2 is 7 and thus the output from this valve is the same as that from V1.

Note that part of the output of V2 is fed back through C1 and R3 to the grid of V2. This provides negative feedback to the valve and gives a self-balancing effect to the stage.

Figure 14 gives the actual circuit used in the 53Set. The output from V6B is applied across R30A and R37A (R34A being decoupled by C25C). The proportion of the output developed across R37A is applied to the grid of V6C. The stage gains of V6B and V6C are such that the output voltages are equal in amplitude and due to the output of V6B being 180° out of phase with the signal voltage, they, are also in anti-phase.

Negative feedback from the anode of V6C via C2R and R28A compensates for any alteration in the amplitude of output voltage from V6C due to changes of gain of the valve. Thus if the gain of V6C decreases the amount of negative feedback decreases. In effect this is equivalent to an increase in the input to the valves, and increasing the input will compensate for lack of gain. Similarly should the gain of V6C increase the negative feedback increases in value and the applied signal is decreased.

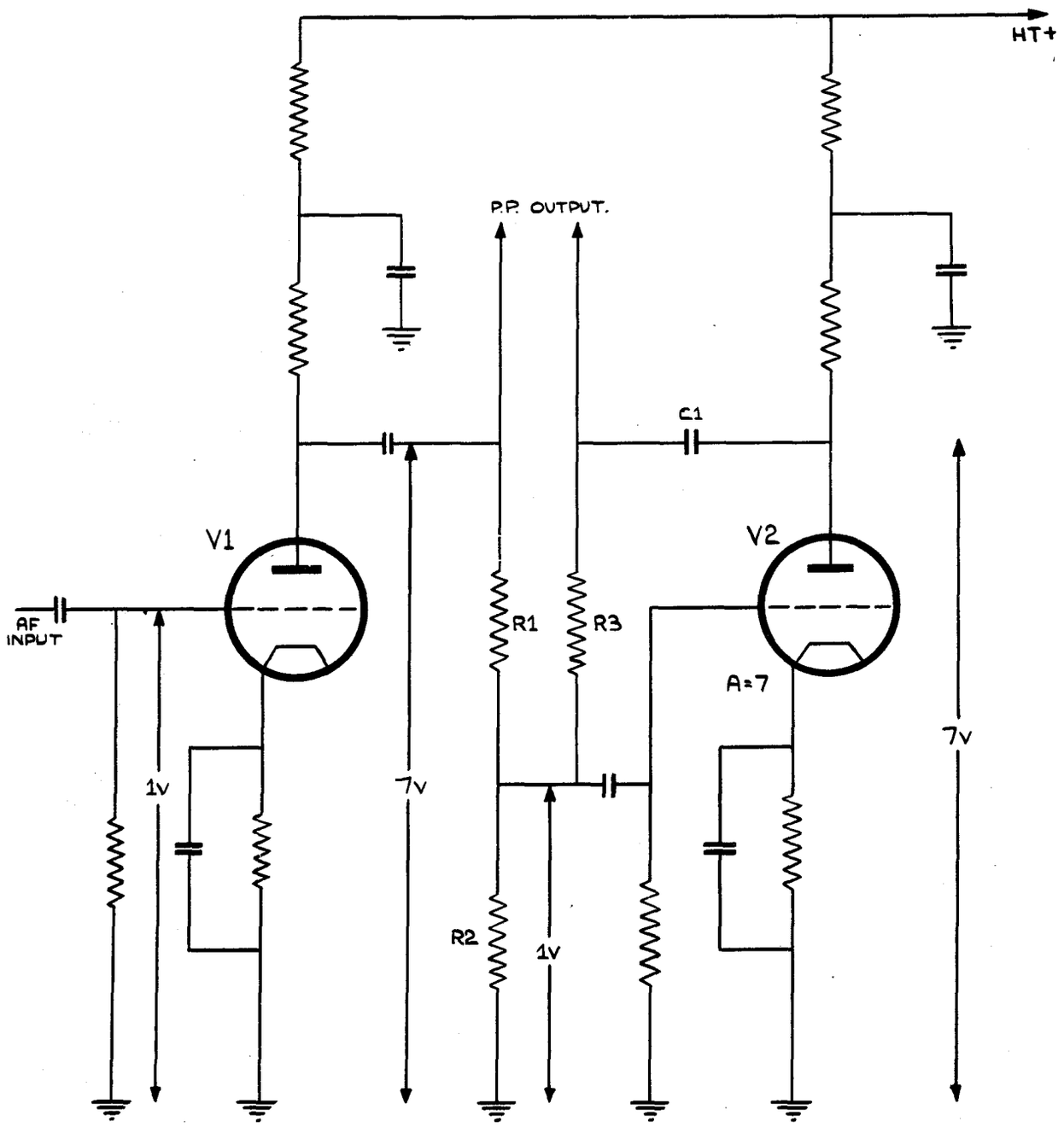


FIGURE 13 A SIMPLE "FLOATING PARAPHASE" CIRCUIT.

Fig.13. A SIMPLE "FLOATING PARAPHASE" CIRCUIT

K. Driver Stage. (See Fig.14)

The driver valves (ATS.25) are operated in Class "AB", i.e., at a point between Class "A" and Class "B". Thus greater efficiency is obtained than in Class "A", with less drive than is required for Class "B". The necessary bias of -22v. is obtained from the potential divider R32A and R34A connected to the G.B. supply. H.T. + 400v to the anodes is supplied through the C.W.-M.C.W./R.T. switch, S7B, and the primary of T4A matches the output impedance of V2B and V2C to the modulators. As the grid-current curves of the modulators V3C and V3D are non-linear the load on the Driver valves will not be constant and will in fact be lower at high levels of modulation. To counteract this effect negative feedback is included, which, apart from reducing harmonic distortion and flattening the response curve, will decrease the output impedance of the Driver valves and make the load value less critical. Negative feedback for V2B and V2C is obtained through C2Q/R20A and C2S/R20B respectively.

R35A drops the screen-grid potential on the Drivers to + 350v.

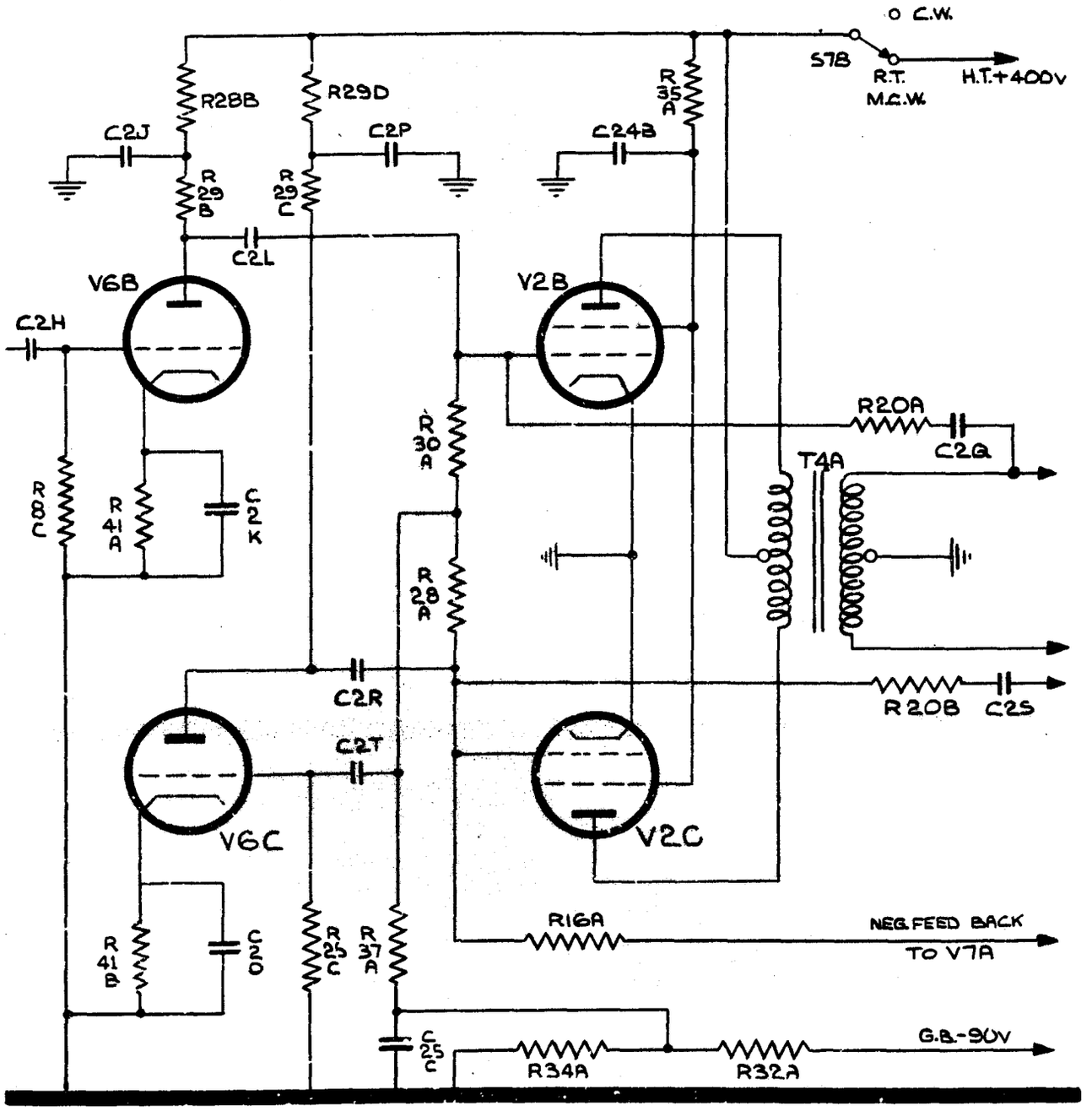
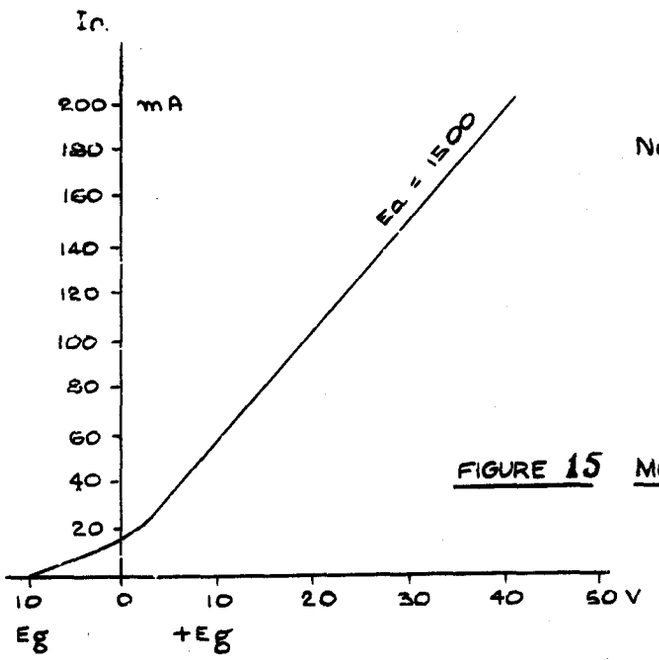


FIGURE 14 PHASE INVERTER AND DRIVERS.



NOTE:-

g_m = 4mA/V

μ = 212

FIGURE 15 MUTUAL CHARACTERISTIC 813 WITH G_1 & G_2 STRAPPED.

L. The Modulators

A circuit diagram showing the modulator valves and modulation circuit is given in Fig. 16.

The control-grids and screen-grids of the tetrode valves V3C and V3D are strapped together, This converts these valves into triodes with a high amplification factor, so that only a very small negative bias is required to cut-off the anode current completely, (See Fig. 15). At zero bias these valves are just above the cut-off point, and the centre-tap of T4A is accordingly connected direct to earth, no bias being necessary for Class "B" operation.

The modulation transformer T3A has two secondary windings, one in the anode circuit and the other in the screen-grid circuit of the P.A. valves. The A.F. voltages developed across these windings alternately add to and subtract from the anode and screen-grid voltages, thus varying the current in the P.A. valves to give amplitude modulation. The chokes L13A and L14A prevent the low impedance of the power supply condensers acting as a virtual short-circuit across the transformer windings.

H.T. + 1500v. and + 400v., and the A.F. output are fed from the Modulator Unit to the P.A. Unit via twin connector PL "F". (See Fig. 67).

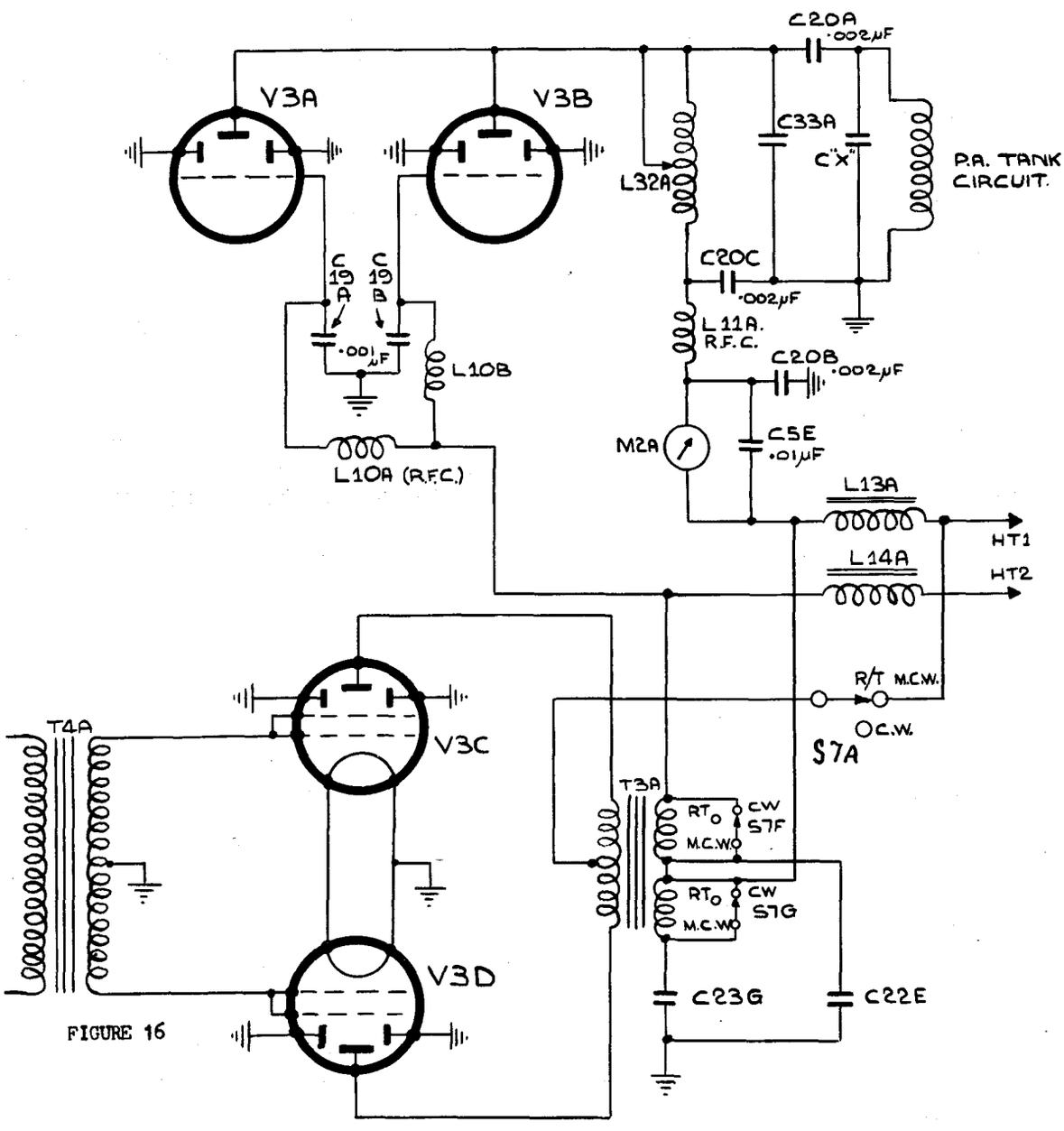
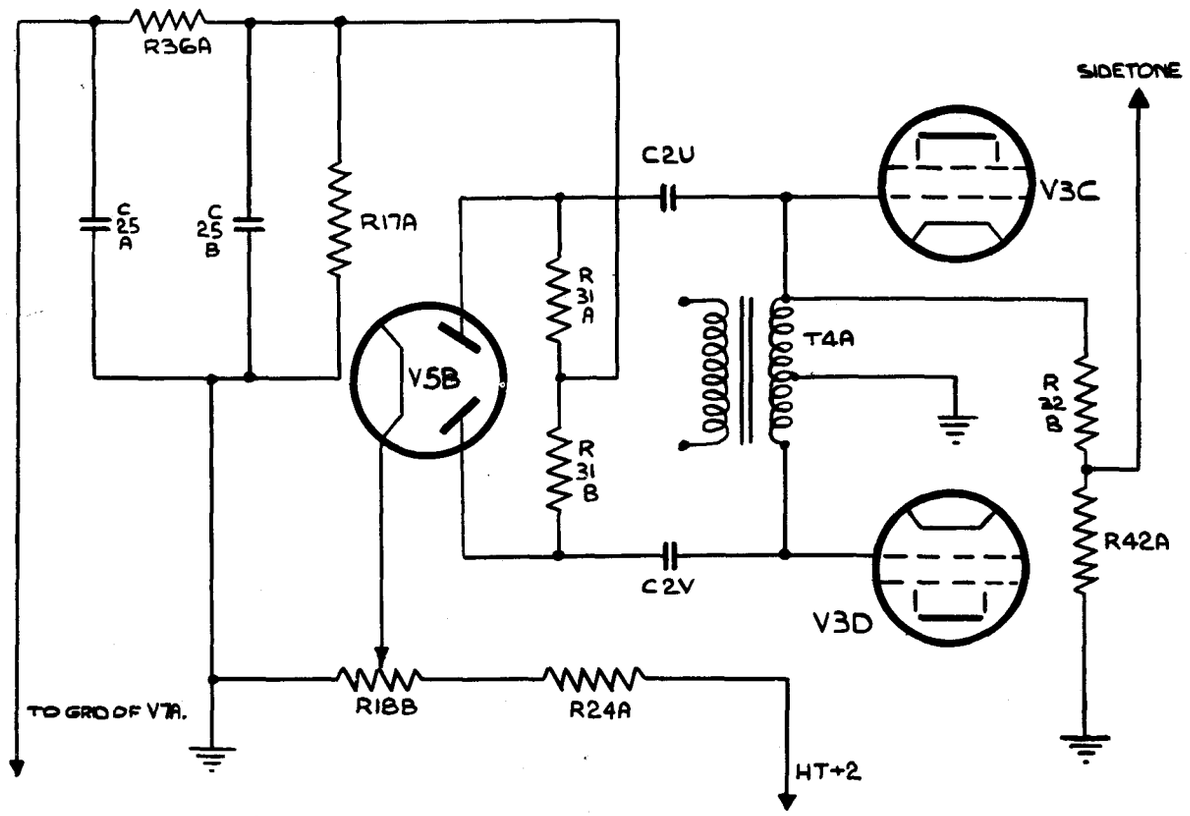


FIGURE 16

M. The Modulation Compressor

No gain control is fitted to the speech amplifier. The gain is controlled automatically to prevent over-modulation by means of the "AUTOMATIC MODULATION COMPRESSOR" V5B. This is a mains double diode rectifier type 6X5G. A valve of this type is used because quite high voltages are entailed. The circuit is similar to that used to obtain delayed A.V.C. in a normal receiver, except that a full-wave rectifier is used.



R17	510 KΩ.	R18	50 KΩ.		
R36	5 KΩ.	R33	10 KΩ.		
R24	51 KΩ.	R42	510 KΩ.	C2	·1μF.
R31	15 KΩ. 12 WATT.			C25	4μF.

AUTOMATIC
FIGURE 17 MODULATION COMPRESSER.

The output voltage from T4A (drive for the modulators) is applied to the anodes of the double diode. A parallel diode rectifier circuit is used with R31A and R17A in series acting as the load for one diode and R31B and R17A in series for the other.

Because R17A is of much greater value than R31A/B the majority of the D.C. output will be produced across R17A. A.F. is by-passed to earth through C25B and is further filtered out by R36A and C25A, leaving a negative D.C. potential to be applied to the grid of V7A.

The cathode of V5B is joined to the potentiometer R18B which in turn is joined to H.T. + 400v through R24A. Thus an adjustable delay bias is applied to the diode. The diode is in practice adjusted so that it does not operate unless the A.F. signal is large enough to over-modulate the P.A. valves. Details of these adjustments are given in the section devoted to adjustments.

Note that C25A/B are very large and therefore will take an appreciable time to charge and discharge through R36A and R17A. Thus the D.C. voltage applied to V7A is proportional to the average and not the instantaneous speech level.

N. Side-Tone

In order to obtain side-tone a small portion of the voltage across T4A is fed to the R.C. unit, and thence to the phones from the potential divider R33B and R42A. This gives approximately 1v of side-tone on full modulation.

O. M.C.W. and Microphone Input Circuits. (See Figure 18)

The M.C.W. oscillator V6E is connected in a simple Colpitts circuit. A fixed-inductance iron-cored coil L17A is used, and the main tuning capacity comprises C3B in parallel with the centre-tapped condenser C26A-B. Additional condensers C27A and C27B are included, and the final tuning is done in the factory by connecting either or both of these as necessary.

C3D is the normal blocking condenser, to keep H.T. from the grid of the valve. R22B is a stablizing resistance which improves the frequency stability and reduces the production of harmonic frequencies.

Class "A" bias is provided by the cathode resistor R40A, in addition to normal grid-leak bias.

Since only a small output is required from the oscillator an anode resistance R27A is satisfactory in place of the more usual choke, and is more economical. Note that H.T. is only applied to the valve when the R.T./M.C.W. switch S8A is switched to M.C.W.

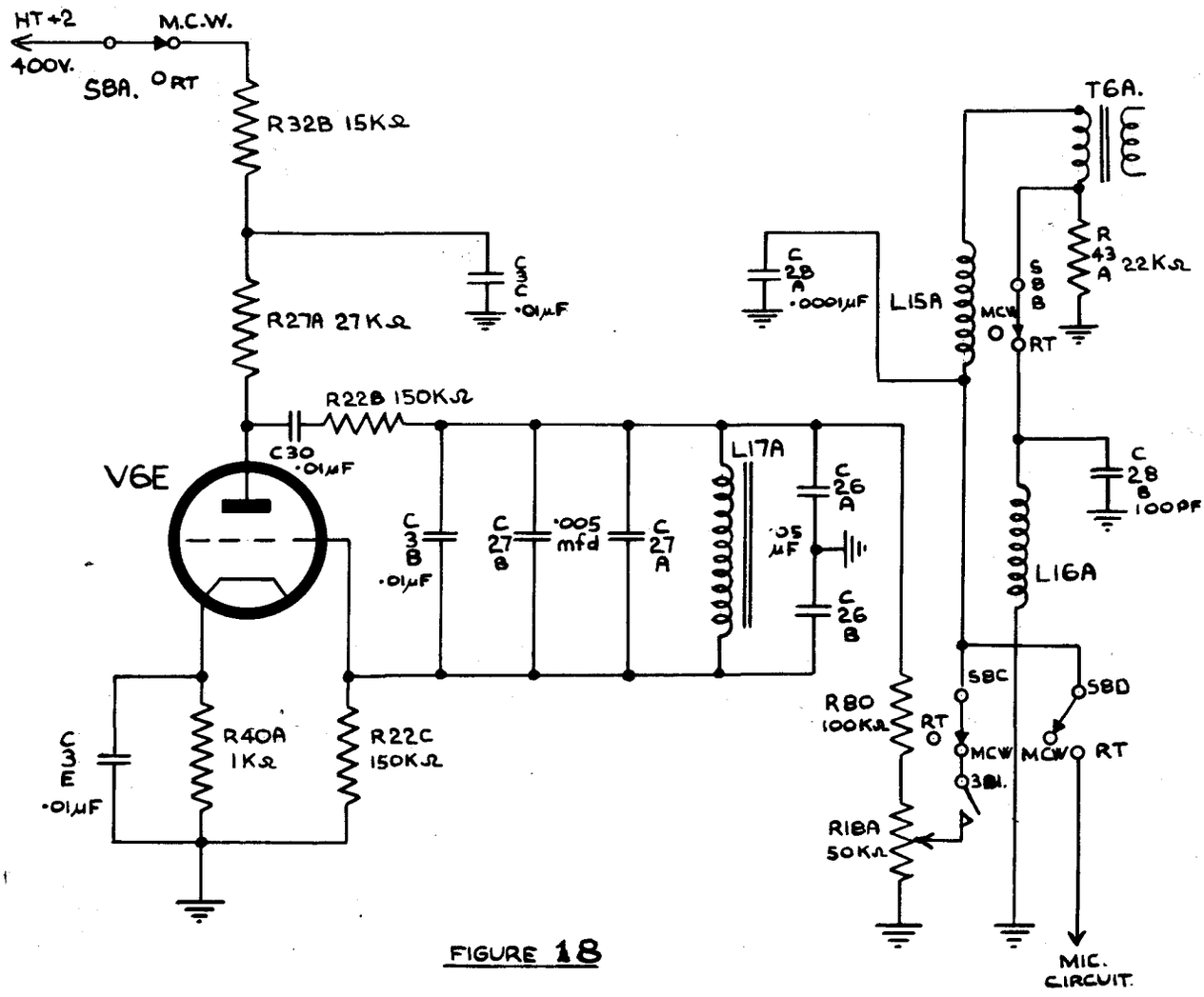


FIGURE 18

M.C.W. AND MICROPHONE INPUT CIRCUIT.

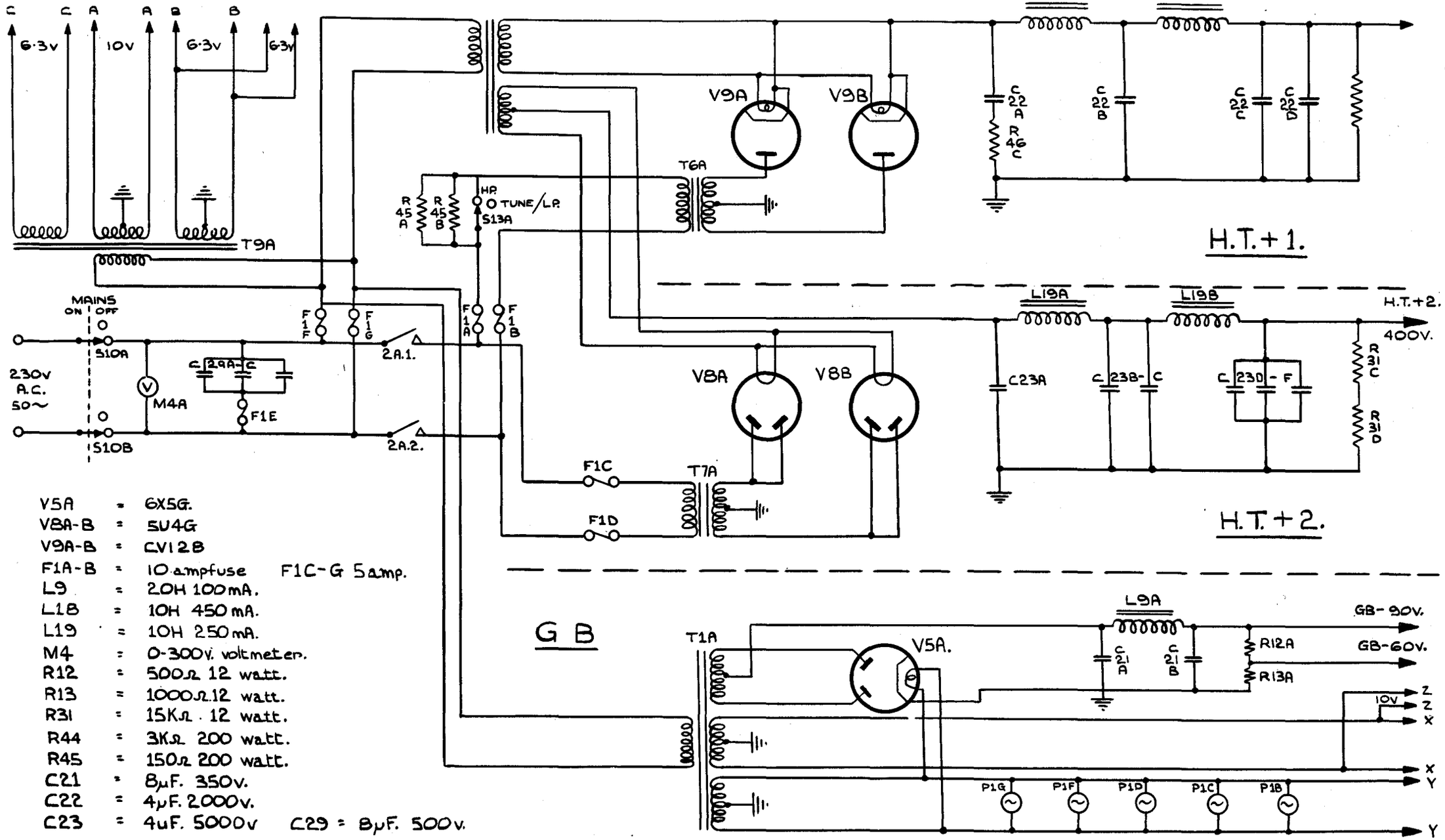
The A.F. input required by the speech amplifier for full modulation is approximately 2 mV, which is very much less than the output of the oscillator. To bring the output down to the required level a potential divider is connected across the oscillator output. This comprises R8D in series with R18A. R8D is 100K ohms and R18A 50k ohms, so that only a third of the total A.F. voltage appears across the latter. The slider of R18A can be adjusted to pick off a

fraction of the A.F. voltage, which is applied through relay contact 3B1, switch S8C and L15A to the primary of T5A which is in series with another resistance R43A. Thus, as the primary impedance of T5A is only 50 ohms, the voltage developed across it is only a fraction of that existing between the slider of R18A and earth.

The adjustment of R18A is pre-set, and is not brought out as a control on the front panel.

When the morse key is up the relay contact 3B1 is open, so that there is no A.F. input to the set, and an unmodulated carrier is radiated. With this key down the relay contact closes, and the oscillator output is connected to the modulation amplifier.

When S8 is switched to the R.T. position the M.C.W. oscillator is disconnected, and T5A is now joined through S8D to the microphone input. Speech current from the microphone flows through S8D, L15A, T5A, S8B and L16A to earth. L15A and L16A are R.F. chokes which offer negligible impedance to speech frequencies. These chokes, together with the by-pass condensers C28A and C29B, are inserted to keep R.F. currents out of the amplifier. The leads in which they are incorporated are long ones, and will act as small aerials. Thus, when the set is transmitting, R.F. may be picked up in the leads and if it were not filtered away would be fed in to the A.F. amplifier where it would cause instability.



V5A = 6X5G.
V8A-B = 5U4G
V9A-B = CV12B
F1A-B = 10 ampfuse F1C-G 5amp.
L9 = 20H 100mA.
L18 = 10H 450mA.
L19 = 10H 250mA.
M4 = 0-300V. voltmeter.
R12 = 500Ω 12 watt.
R13 = 1000Ω 12 watt.
R31 = 15KΩ . 12 watt.
R44 = 3KΩ 200 watt.
R45 = 150Ω 200 watt.
C21 = 8μF. 350v.
C22 = 4μF. 2000v.
C23 = 4uF. 5000v C29 = 8μF. 500v.

FIGURE 19

3. POWER SUPPLY

A. General

The power supply comprises three separate transformers, with their associated rectifiers and filters to provide:

(a) GB 90v from T1a
(b) HT + 1 1500v from T6A.
(c) HT + 2 400v from T7A
(d) Heater current T8A and T9A. (with T1A)

Two more transformers T8A and T9A, together with further windings on T1A provide heater current for all valves in the set. These transformers are all supplied from the same 230v A.C. mains input socket.

T1A and its associated equipment for the G.B. supply are mounted in the R.F. unit. All the remaining power supply equipment is in the power Supply Unit No. 26.

T8A supplies the rectifier filaments for HT + 1 and HT + 2. T1A supplies the R.F. unit heaters as follows:-

XX - Master Oscillator V1A.
YY - Buffer and Driver valves, V1B and V2A.
ZZ - The P.A. valves V3A and V3B.

T9A supplies the Modulator unit heaters as follows:-

AA - The Modulators V3C and V3D.
BB - The Speech Amplifiers V6A-C, V2B-C, V5B and V7A.
CC - The Keying Valve V6D.
EE - The M.C.W. Oscillator V6E.

On closing the mains On/Off switch S10, current is supplied to the transformers T1A, T8A and T9A. These three transformers are supplied through the fuses F1F and F1G. The lamp P1G is brought out on the front panel and is the green light labelled "AC Supply". This lamp will show that the heaters are on.

The lamps P1B-D&P1F illuminate the P.A. anode current and aerial current meters and the M.O. tuning dial.

Thus, the closing of the mains switch S10 completes both heater and grid-bias supplies. The H.T. transformers T6A and T7A, however, are not energised until the contacts 2A1 and 2A2 are closed. These contacts are on the Mains Contactor Relay 2A/2, which is operated by closing the microphone pressel switch or by closing the "Local H.T. Control" on the Modulator Unit. ("See Sec. 4 - Relay Circuits").

B. G.B. Supply

This is a normal full-wave rectifier arrangement with a single-section smoothing filter L9A, C21A and C21B. The resistances R12A and R13A form a potential divider, providing a tapping at -60v for the keying and driver valves (V6D and V2A). These resistances serve as a constant load on the rectifier in addition to that provided by the valve grid circuits, so that the percentage change of load when keying the set is reduced, thus assisting to stabilize the grid-bias voltage.

C. H.T. + 1

A full-wave rectifier is used, with two separate half-wave rectifier valves V9A and V9B and a two-section smoothing filter. The reservoir condenser C22A has a resistance R45C in series with it to prevent excessive peak current surges through the rectifiers. R44A provides a stabilizing load on the rectifiers during keying, as in the G.B. supply. The two resistances R45A and R45B, when brought into circuit by switching S13A to "Low Power and Tune", reduce the input to T6A so that the D.C. output voltage drops from 1500v to 950v.

The H.T. + 1 supply provides the H.T. for the modulators and the anodes only, of the power amplifiers. This supply is protected by the fuses F1A and F1B.

D. H.T. + 2

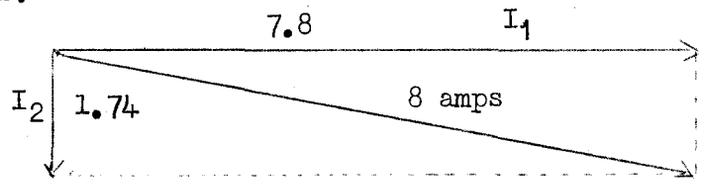
This is supplied by T7A in a 2-valve full-wave rectifier circuit with a 2-section filter. The transformer T7A gives a secondary voltage of 450-0-450 (i.e. 900v centre-tapped,) when the 230v supply is connected to the corresponding primary tapping point. This, however, does not give sufficient H.T. to correctly supply the modulator valves and therefore the 210v tap is used giving 986v centre-tapped.

V8A and V8B are double diodes and are strapped to operate as single diodes in a full-wave rectifier circuit. There is a stabilising resistor R31C and R31D.

H.T. + 2 supplies 400v for all the remaining valves in the set and the screen-grids of the P.A. Valves.

E. The Power Factor Correctors

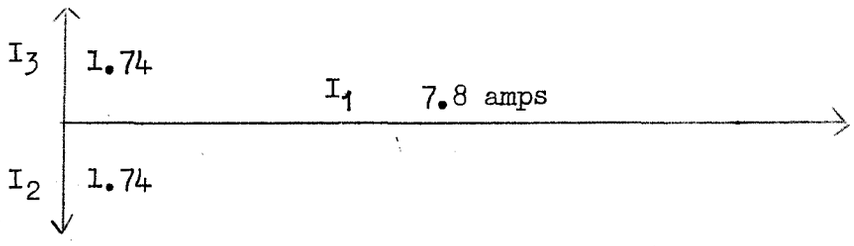
The load normally offered by the set to the generator is partly inductive. The in-phase component of the consumption is 7.8 amps (I_1) whereas the inductive 90° out of phase component is 1.74 amps (I_2). This may be expressed vectorially thus:-



The resultant current consumption would therefore be:-

$$\sqrt{1.742^2 + 7.82^2} = 8 \text{ amps.}$$

By putting the condensers C30A-C across the input they will consume a current (I_3) in anti-phase with I_2 thus reducing the total current consumption to 7.8 amps and again making the input purely resistive. Expressed vectorially thus:-



The condensers are 8μ Fd each and will therefore present a total capacity of 24μ Fd. The current through them can be calculated as follows:-

$$X_c = \frac{1}{\omega C} = \frac{1}{2\pi \times 50 \times 24 \times 10^{-6}} \text{ ohms}$$

Therefore $I_3 = \frac{V}{X_c} = 230 \times 2\pi \times 50 \times 24 \times 10^{-6}$

= 1.74 amps as stated above.

A fuse is put in the condenser circuit to safeguard the generator should any of the condensers break down.

4. SWITCHING AND RELAY CIRCUITS

A simplified diagram of the switching and relay circuits is shown in Fig. 20.

A. Mains Contactor Relay 2A/2

As described in section 3 the A.C. supply to the two H.T. transformers T6A and T7A is not applied until the contacts 2A1 and 2A2 on Relay 2A/2 close. Relay 2A/2 is energised from the 12v. D.C. supply through a number of safety

switches all connected in series, so that H.T. cannot be applied to the set until all connections have been properly made and the doors closed.

Starting from the +12v terminal, the sequence of switches is:-

(i) Fan Switch S16A. Closing this applies 12v to the fan as well as completing the circuit as far as the next switch, thus the set cannot operate unless the fan is switched on.
(ii) Contact 1A on Relay 1A/5.
(iii) R.F. Unit gate-switch, thence to one side of a two-pin socket on the M.O. Unit panel.
(iv) From the two-pin socket via a short connector to the Aerial Coupling Unit 2A, in which is a gate-switch S18A.
(v) From S18A through a two-way connector to three gate-switches on the main frame, and thence back to the two-pin socket on the M.O. Unit.
(vi) A switch S4A built into the power socket labelled "Screen and H.T. Supply from Modulator Unit" on the R.F. Unit (Socket marked PL "F" in Fig. A). This switch is automatically closed on insertion of the plug, and is opened when the plug is withdrawn.
(vii) A similar safety switch S15A on the "Screen and H.T. Supply" connector socket on the Modulator Unit.
(viii) "H.T. On/Off switch S9A on the Modulator Unit, (interlocked with the C.W.-R.T./M.C.W. system switch).
(ix) Safety switch S14A on the "1500v supply from PSU" socket on the Modulator Unit.
(x) A similar safety switch S12A on the 1500v outlet socket on the Power Supply Unit.
(xi) Gate-Switch S11A in the fuse-box door on the Power Supply Unit.

Thus with all gates closed and connector plugs in their sockets, and the fan switch and "H.T.ON/OFF" switches closed, H.T. will not be applied until Relay 1A/5 is operated. This relay is operated by closing the "Local H.T. Control" switch S5A.

NOTE. With the Remote Control Unit "H" No. 1 connected to the set, the contact D3 on Relay D/5 is in parallel with the "Local H.T. Control" switch, and operation of Relay D/5 in the Control Unit will therefore operate Relay 1A/5 to switch on the H.T.

B. Keying Relays 3A/1 & 3B/1

(i) Keying C.W. is accomplished by varying the grid bias to the keying valve through contact 3A1 on Relay 3A/1, Relay 3B/1 being disconnected. Relay 3A/1 is connected to +12v D.C. through the chain of switches described in Para. A(i) to (xi) above, and is returned to earth via the system "C.W. - R.T./M.C.W." switch and morse key.
(ii) When working on M.C.W. or R.T. a continuous carrier is required, which is obtained by connecting the earthy end of Relay 3A/1 direct to earth through the System Switch.

At the same time the earthy end of Relay 3B/1 is connected through the morse key to earth.

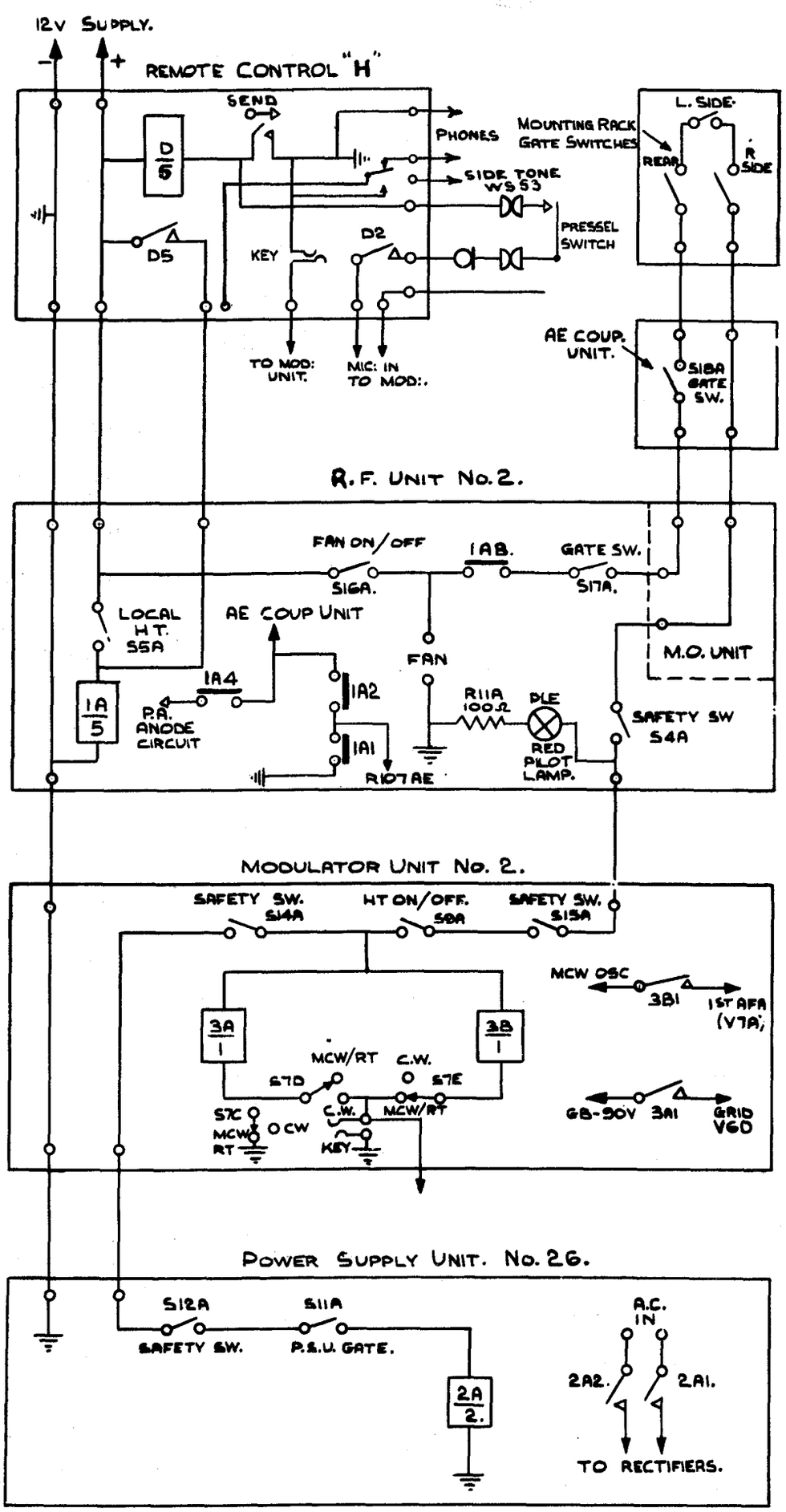
Pressing the key now operates Relay 3B/1 which will apply 900 c/s tone from the M.C.W. oscillator to the modulating stages through the contact 3B1.

C. Aerial Change-over Relay (1A/5)

In addition to closing the Mains Contactor Relay circuit through contact 1A3, Relay 1A/5 also operates contacts 1A1, 1A2 and 1A4 in the Aerial circuit.

While sending, (i.e., Relay 1A/5 energised), the P.A. input is connected via contact 1A4 to the Aerial Coupling Unit, and the Aerial input to the receiver is earthed via contact 1A1.

While receiving, (i.e., Relay 1A/5 NOT energised), the Aerial Coupling Unit is disconnected from the P.A. and connected through contact 1A2 to the receiver. Contact 1A1 is now open. Contact 1A5 removes the short-circuit across part of the relay coil when operated and serves to reduce the operating current of 2 Amps to 1 Amp for holding purposes.



SIMPLIFIED DIAGRAM OF RELAY CIRCUITS.

FIGURE 20

D. Summary of Operations on R.T

On switching to R.T. the bottom end of Relay 3A/1 is earthed by the C.W. - R.T./M.C.W. switch. Therefore, on pressing the Pressel Switch the following operations are performed:-

Pressel Switch closes.
D/5 operates.
D1 -------
D2 Earths output from receiver.
D3 Operates Relay 1A/5.
D4 Connects line to microphone.
D5 ------
1A/5 Operates.
1A1 Earths receiver aerial terminal.
1A2 Disconnects aerial from receiver.
1A3 Closes safety gate-switches and operates 3A/1 and 2A/2.
1A4 Connects P.A. to Aerial.
1A5 Removes short from section of 1A/5 to reduce holding current.
3A/1 Operates and 3A1 connects 90v negative line to grid of keying valve.
2A/2 Operates.
2A1, 2A2 } Switch on H.T. + 1 and H.T. + 2.

5. REMOTE CONTROL

A. General

(i) For remote control two control units are required. One unit is connected direct to the Sender and is known as the No. 1 unit; the other is situated at the remote operating position and is known as the No. 2 unit.

(ii) With the equipment provided, the following facilities are available:-

(a) At the "Local" Position

(1) The operator can use the set on R.T., C.W., or M.C.W.
(2) The set can be used on R.T. from any No. 19 Set Control Box connected to the Control Unit No. 1.
(3) The operator can speak to the remote operator over the Remote Control line on a Telephone "L".

(b) At the "Remote" Position

(1) The operator can use the set on R.T., C.W., or M.C.W., including switching the set from "send" to "receive" and vice versa.
(2) The Control Unit No. 2 can be connected to a telephone exchange enabling any subscriber on the exchange to speak over the set.
(3) The operator can speak to the "Local Position" operator on a Telephone "L".

When working on remote control a separate receiver must be provided at the remote position.

B. Remote Control Unit Type "H"

(i) Control Unit No. 1

Control Unit "H" No. 1 comprises a box containing the necessary components and switches to provide the facilities described in Sec. 5. It has two terminals for connection to the Remote Control Line, to which a Tele. "L" is also connected, and all other connections are made via a 12-point plug and socket and 12-way lead to a distribution panel. The 12v. supply required for the relays in the unit is obtained from the 53 Set relay supply battery.

There are three switches on the unit, S1 is a 3-position "system" switch, with positions marked "Normal", "Remote R.T.", and "Remote C.W.". When the 53 Set is being operated by the local operator on either C.W., M.C.W. or R.T. this switch is put to normal. S2 is a 2-position switch marked "Send" and "Normal"; it is used as the send-receive switch when working C.W. or M.C.W. on local control. S3 is an "On-Off" switch used to switch off the 12v. battery supply. The complete circuit diagram is shown in Fig. 65.

(ii) Control Unit No. 2

Control Unit "H" No. 2 has two 3-position switches. With both switches in the "Normal" position, the remote operator can modulate or key the 53 Set provided that S1 in the Control Unit No. 1 is put to the appropriate position. The other position of the switches in the No. 2 unit permit the remote operator to switch off the sender, to connect his Tele "L" to the R/C line or to the exchange, or to connect the exchange to the R/C line.

The unit uses a self-contained 12v. battery. The complete circuit diagram is shown in Fig. 66.

(iii) Local Operation - R.T.

For the local control on R.T., S1 on the No. 1 unit is put to "Normal" and the system switch on the 53 Set to "R.T.". Fig. 21 is a simplified diagram of the circuits thus provided.

The output from the receiver is connected through relay contact D2 to the phones, which are also directly connected to the side-tone output from the sender. The Tele "L" is connected directly across the R/C line.

Closing the Pressel switch completes the circuit from the battery through R2A and Relay D/5 to earth, and so actuates the relay. This causes contact D2 to operate, which disconnects the receiver output from the phones. At the same time contact D3 closes, thus operating the relay in the 53 Set and so switching it to "send".

A second contact on the Pressel switch completes the microphone circuit.

Note that the muting relay in the R107 receiver is not used. The aerial input to the receiver is earthed by the aerial change-over relay, and the A.F. output is earthed by the contact D2.

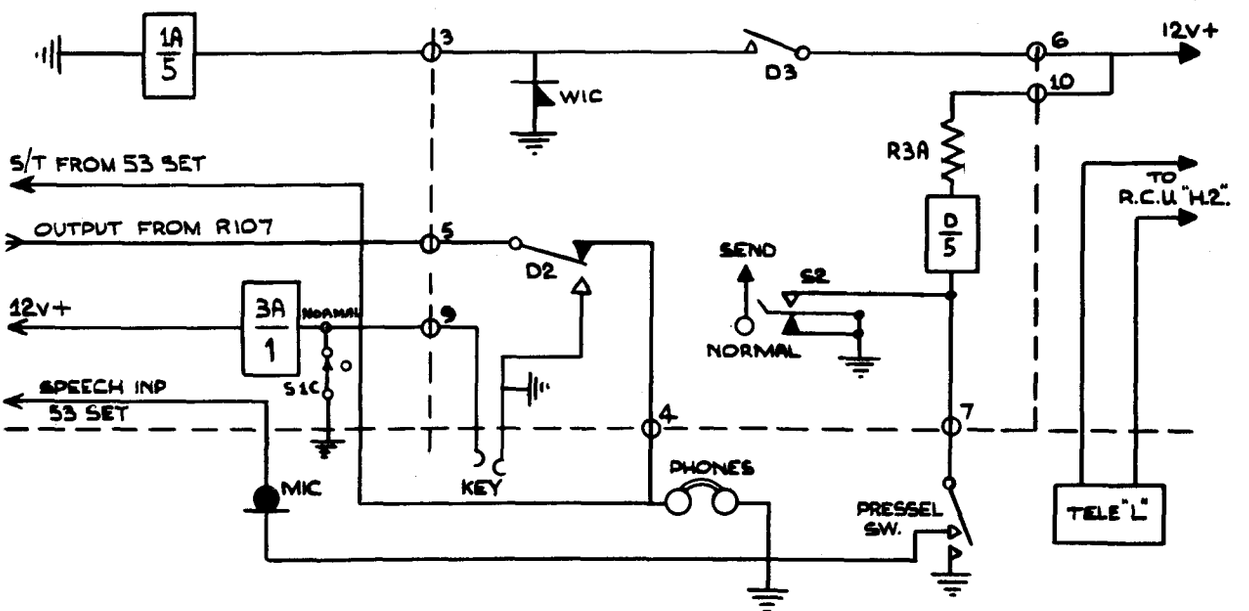


FIGURE 21 SIMPLIFIED DIAGRAM - LOCAL OPERATION.

On releasing the Pressel switch all relays return to the "receive" position. A rectifier W1C is connected in parallel with Relay 1A/5 to eliminate sparking at contact D3.

Officers using No. 19 Set control boxes connected in parallel with the operator's microphone and headset can also speak over the 53 Set.

(iv) Local Operation - C.W.

The switch positions are the same for C.W. as for R.T., EXCEPT that the 53 Set system switch is put to C.W. and that send - receive switching is done by S2. One pair of contacts in this switch are connected in parallel with the Pressel switch, so that on putting S2 to "Send" Relay D/5 is operated and the rest of the operation is as before. The Sender is keyed by means of Relay 3A/1.

(v) Local Operation - M.C.W.

For M.C.W. the control unit switches are in the same positions as for C.W. but the 53 Set is switched to M.C.W. The circuit diagram is the same as for C.W. except that Relay 3A/1 is replaced by 3B/1.

(vi) Remote Operation - R.T.

For the remote operator to use the set on R.T., S1 on the control Unit No. 1 is put to "Remote R.T.". On the No. 2 unit S4 is left at "Normal" and S5 is put to "Tele to Exchange". A simplified diagram of the circuit is shown in Fig. 22.

Output from the local receiver is connected as before through contact D2 to the local operator's phones. Output from the remote receiver is connected to the remote operator's phones, the circuit being completed to earth through the back contact on the Pressel switch. Since the winding 3-4 of transformer T2A is in parallel with the phones, signals from the remote receiver are supplied to the R/C line and thence to the transformer T1A. The winding 3-4 on this transformer is connected to the local operator's phones through contact D4. Thus the local operator can hear the output from both receivers simultaneously. Similarly, both receivers are audible in the local operator's Tele "L" and in the remote operator's headphones.

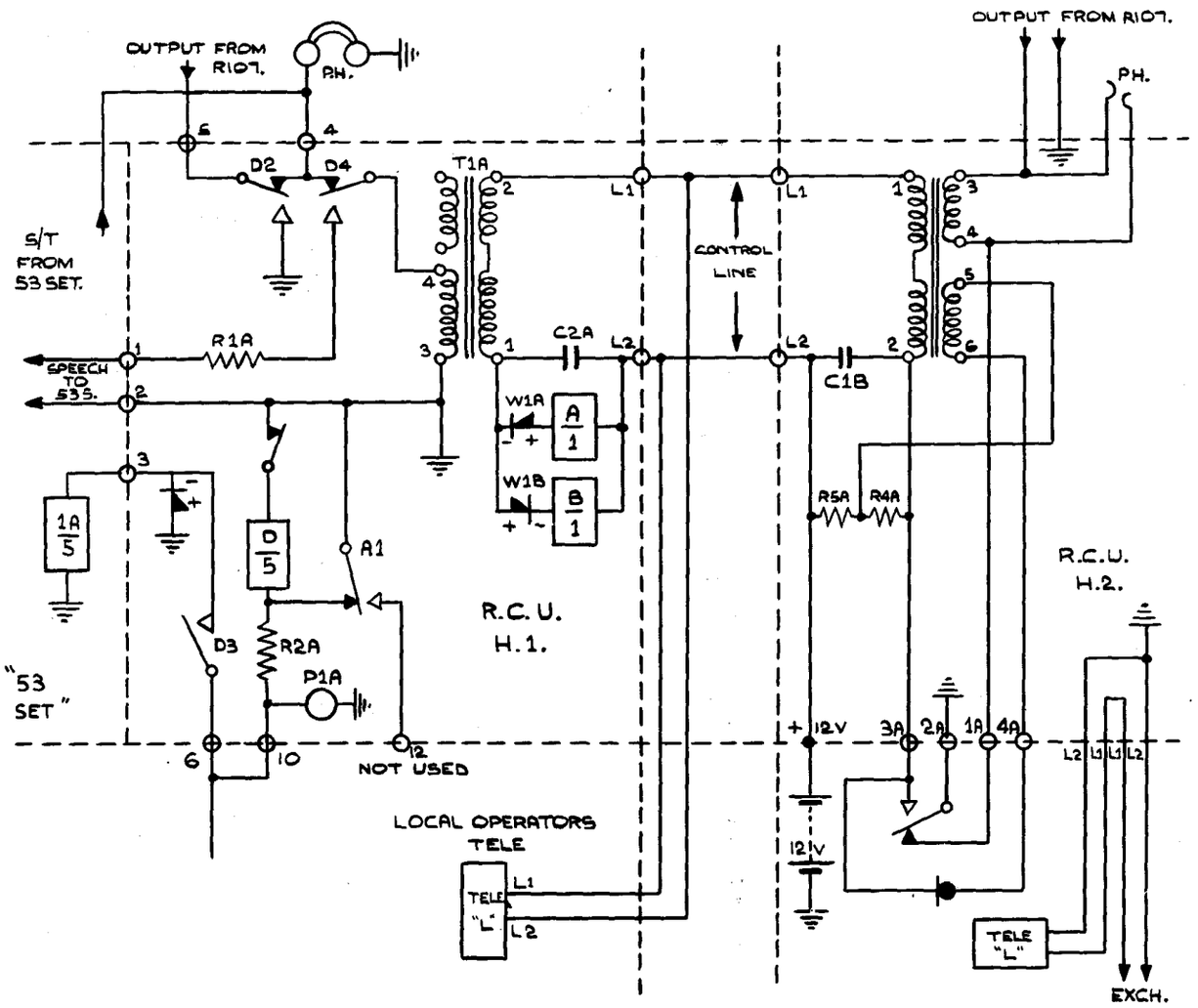


FIGURE 22. SIMPLIFIED DIAGRAM REMOTE R.T.

If, for netting purposes, the local operator wishes to receive the signals from the remote receiver only, this can be done by turning down the gain control on his own receiver.

To transmit speech, the remote operator closes his Pressel switch. This completes the circuit from the battery through R3A, primary winding 5-6 of T2A and microphone to earth. At the same time a circuit is completed from the battery along control line L2, through Relay A/1, and rectifier W1A, through winding 1-2 of T1A, along control line L1 and thence through winding 1-2 of T2A and the Pressel switch to earth. This energises Relay A/1 and so causes contact A1 to operate.

In the "Receive" condition contact A1 provides a short circuit across Relay D/5 and contact B1. In the Send condition this short circuit is removed so causing Relay D/5 to operate. The operation of relay D/5 causes all the "D" contacts to operate, making the following connections:-

(i) Contact D2 earths the output from the local receiver.
(ii) D3 connects the 12v supply to relay 1A/5, so switching the 53 set to "Send".
(iii) D4 disconnects winding 3-4 of the transformer T1A from the "phones and connects it through R1A to the modulation amplifier, so that speech from the remote unit will modulate the sender.
(iv) D1 and D5 do not affect the circuit.

During the transmission, the local operator can listen to the sender side-tone in his headphones, or to the direct speech in his Tele "L".

At the remote unit speech currents from the microphone circuit are induced into winding 3-4 of T2A, giving side-tone in the remote operator's phones.

In the "Remote R.T." position there is a constant drain on the battery through R2A. This is also the case with "Remote" C.W. In case S1 is left in either of these positions pilot light and battery on/off switches are incorporated.

(vii) Remote operation - C.W.

For remote C.W. operation, the No. 1 unit is switched to "Remote C.W." and S4 in the No. 2 unit put to "Normal". Fig. 23 shows the simplified circuit.

Pressing the key on the remote unit completes a circuit from the battery through contacts 1 and 2 of S4 to line L2, thence through relay A/1, W1A and T1A to line L1, through contacts 4 and 5 of S4, and thence through T2A and the key to earth. Relay A/1 is therefore energised and contact A1 is operated. This breaks the short-circuit across relay D/5, which is thereby energised.

When relay D/5 is energised the contact D1 opens, and so prevents the short circuit from being restored by contact A1 when the line current ceases.

As before, Relay D/5 operates Relay D/5 through contact D3, earths the local receiver output at contact D2, and disconnects the local operator's headphones from T1A at contact D4.

The first time the morse key is pressed, therefore, the sender is switched on, and further operation of the key will affect only relay A/1. When this relay is energised contact A1 completes the circuit from the 12v supply to relay 3A/1, which keys the sender.

To return the 53 set to "receive the remote operator puts S4 to "Stop Sending" with S4 in this position, current flows from the remote operator's battery through L1, T1A, W1B Relay B/1, and thence through line L2 to the negative side of the battery. Relay B/1 is therefore operated and contact B1 opens.

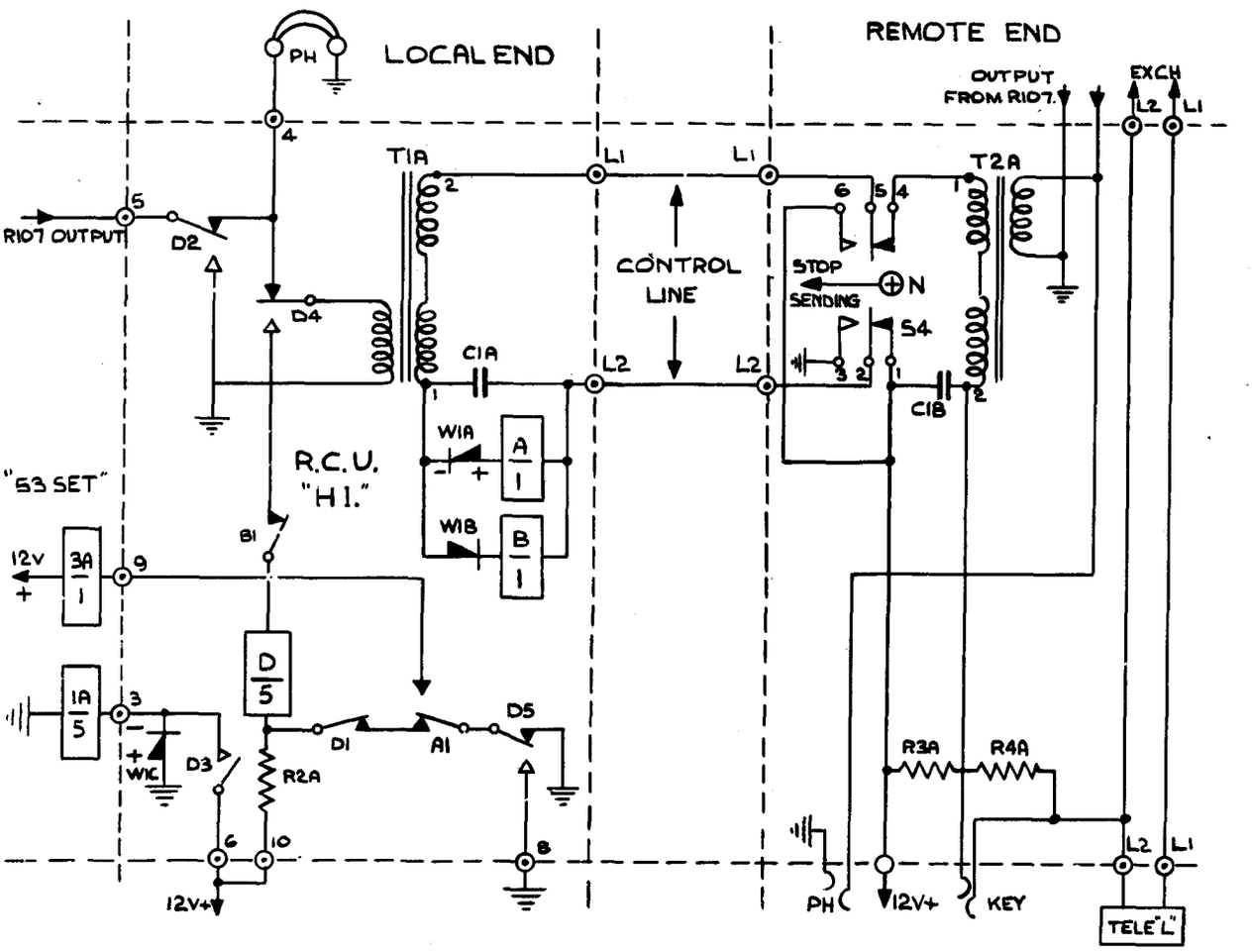


FIGURE 23 SIMPLIFIED DIAGRAM - REMOTE C.W.

This breaks the circuit through Relay D/5 and all the D contacts return to the "Receive" position. Since this restores the short-circuit across Relay D/5 this relay will not again operate when the reversed line current ceases.

The "Stop Sending" position of S4 is non-locking i.e. the switch returns to "Normal" when pressure is removed.

While operating the sender, the remote operator puts S5 to the "Tele to Exchange" position, thus connecting his telephone directly to the exchange.

(viii) Remote operation - M.C.W.

Operation on M.C.W. is identical with that on C.W. except that the 53 Set is switched to M.C.W, which substitutes Relay 3A/1 for 1A/5.

(ix) Speech between Operators

When the remote operator is not using the set he places S4 in the position "Tele to Set". Referring to Fig. 24 it will be seen that L1 of the remote operators Tele "L" is connected through contacts 4 and 5 of S4 to L1 of the set operators Tele "L". The circuit is then completed from L2 of the set operator's Tele "L" through the 12V battery in the remote control unit to earth and thence to L2 of the remote operators Tele "L". There will thus be normal ringing and speech facilities between the two telephones; the resistance of the battery not being sufficient to influence the operation.

Provided the "Pull for C.B." swi ches in the Tele "L" are not closed there will be no D.C. circuit, and no current will be consumed from the battery.

If the remote operator wishes to speak to the exchange he puts S5 to the position "Tele to Exchange". This connects his Tele "L" through C2A to the exchange. The reason for C2A will be seen later under "Exchange Facilities". In order that the exchange may not be left unattended S5 is usually left in the "Tele to Exchange" position. Note that when S4 and S5 are in their normal position L1 of the exchange is connected through contacts 5 and 6 of S4 to L1 of the set operator's Tele "L".

The circuit is complete from L2 through the 12v battery as before. Under these conditions therefore the set operator may speak directly to the exchange if he so requires.

(x) Exchange Facilities

To enable a subscriber in the exchange to speak over the 53 Set, the control unit No. 1 is put to "Remote R.T." and S4 in control Unit No. 2 is left at "Normal". The remote operator does the "Send-Receive" switching by means of S5. The "Normal" position of S5 corresponds to "Exchange Receive". The simplified circuit diagram is shown in Figure 25.

Output from the remote receiver is connected to the operator's phones and to winding 3-4 of T2A, the circuit being completed to earth through S5 and the back contact on the microphone pressel switch. The secondary winding 1-2 of T2A is connected to exchange line L1 through C2A, and to earth through S5, C1B and the battery. The exchange can thus receive the incoming signals. Due to the presence of C1 and C2A no current is consumed from the battery by this circuit.

On putting S5 to the "Exchange Send" position, terminal 2 of T2A is connected to earth, thus completing the D.C. circuit from the battery through line L2, Relay A/1, T1A line L1 and T2A. The 53 set is therefore switched to "Send" as before. Since the exchange is connected, through condenser C2A, in parallel with T2A across the R/C line, outgoing speech from the exchange will modulate the sender in the same way as speech from the operator's microphone. Speech from the exchange is also heard in the operator's headphones.

If the remote operator either closes his pressel switch, or switches S5 to "Exchange Send" a circuit is completed from the battery through R3A, winding 5-6 to T2A, and the microphone, to earth. Thus the operator can speak over the set and to the exchange simultaneously. Note that if C2A were not included there would at all times be a D.C. circuit from the battery along line L2, through Relay A/1 and W1A to T1A, and thence along line L1 and through the exchange to earth. Relay A/1 would therefore close and the set would be switched permanently to "Send".

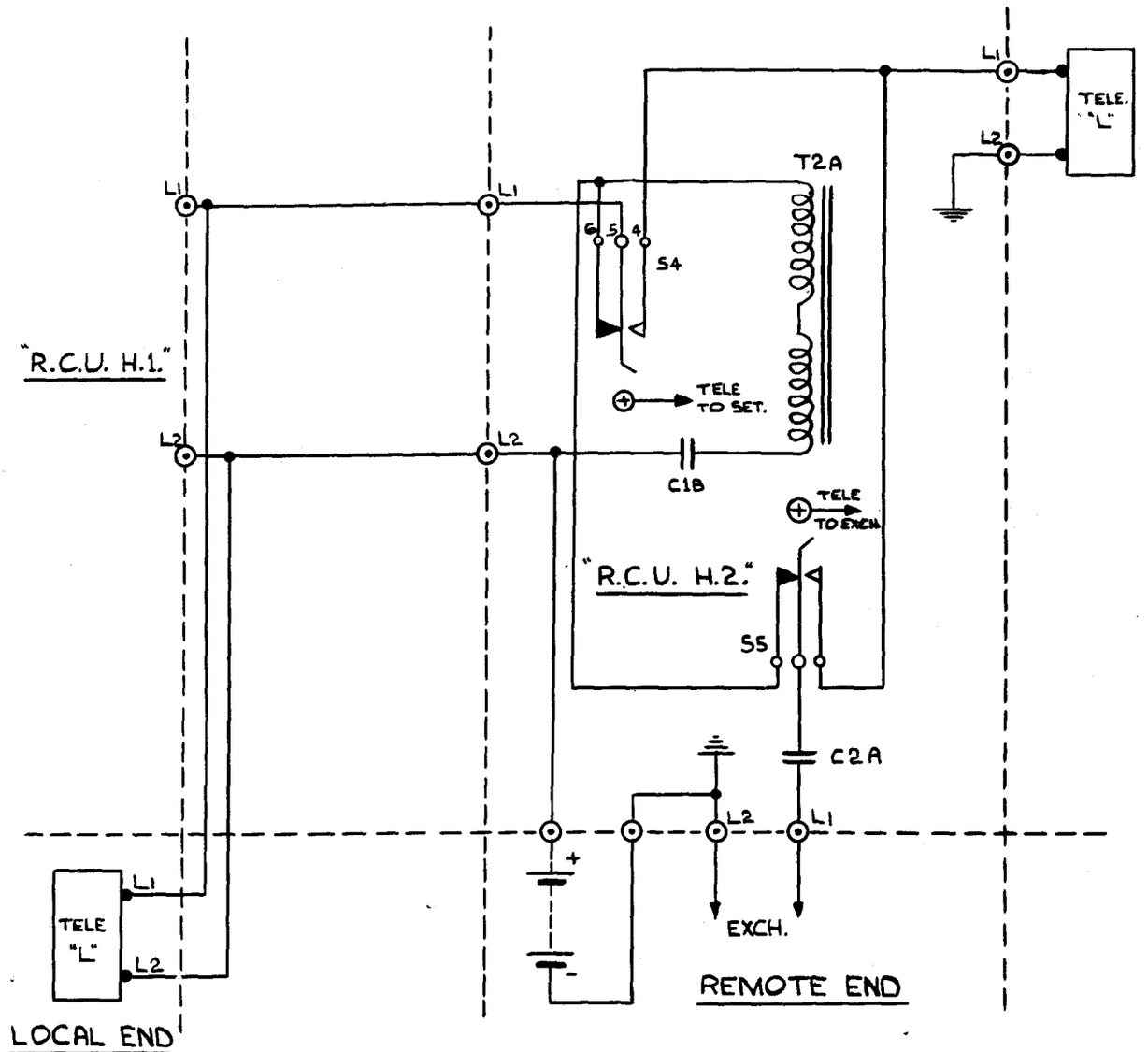


FIGURE 24 SPEECH BETWEEN OPERATORS.

There are several additional methods of using "Remote Control Units "H" which will be described briefly here. Circuit diagrams are not given in all cases, but the reader should be able to trace out the circuits concerned from the complete circuit diagrams given in Fig. 65 and 66.

(xi) Direct Communication to Tele "L" of Exchange

It is possible to connect either a Tele "L" or an exchange directly to L1 and L2 of the control lines from the "N1" unit. The set operator then does the send-receive switching using S2. A circuit diagram showing this arrangement is given in Fig. 26.

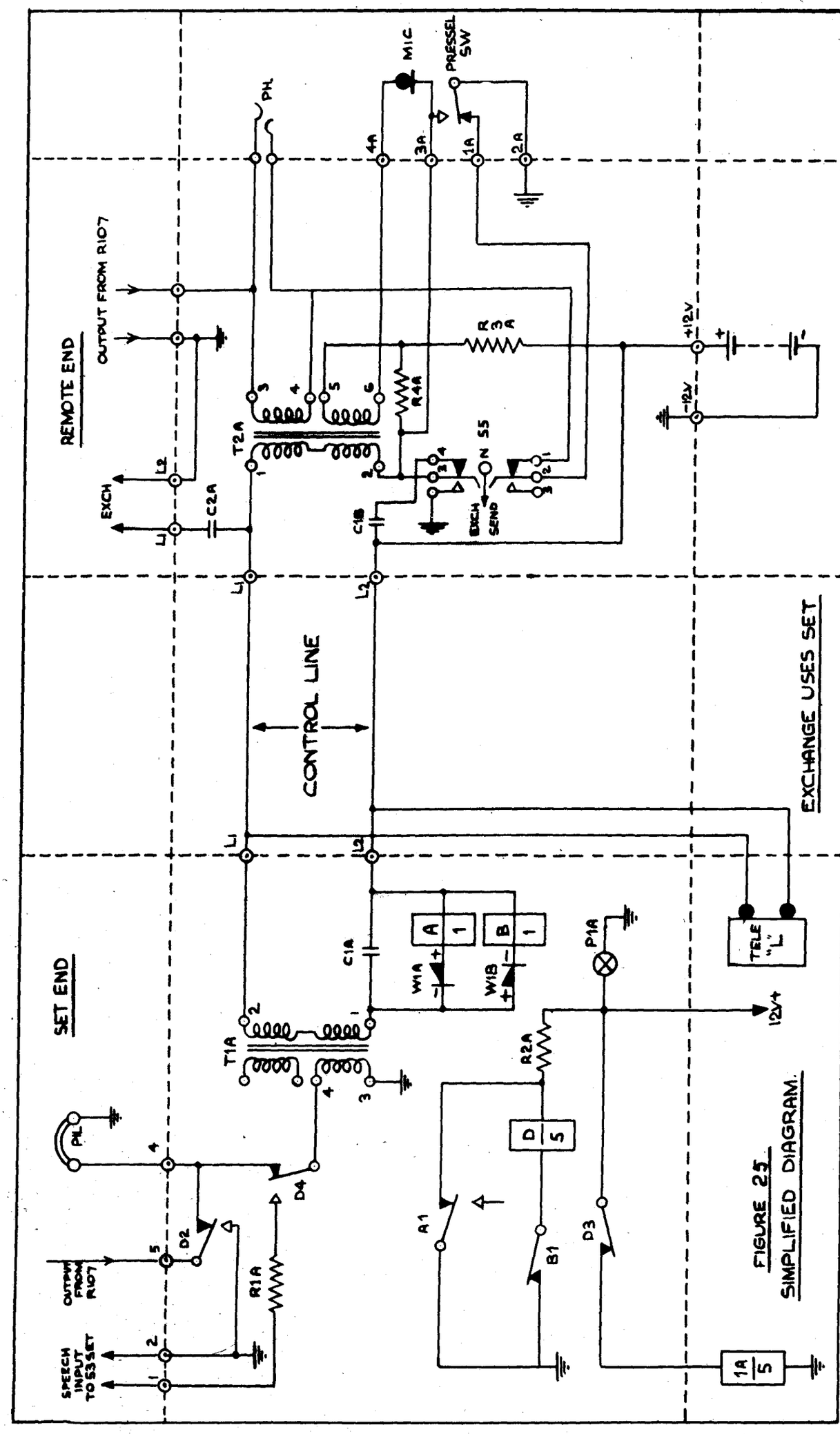


FIGURE 25
SIMPLIFIED DIAGRAM.

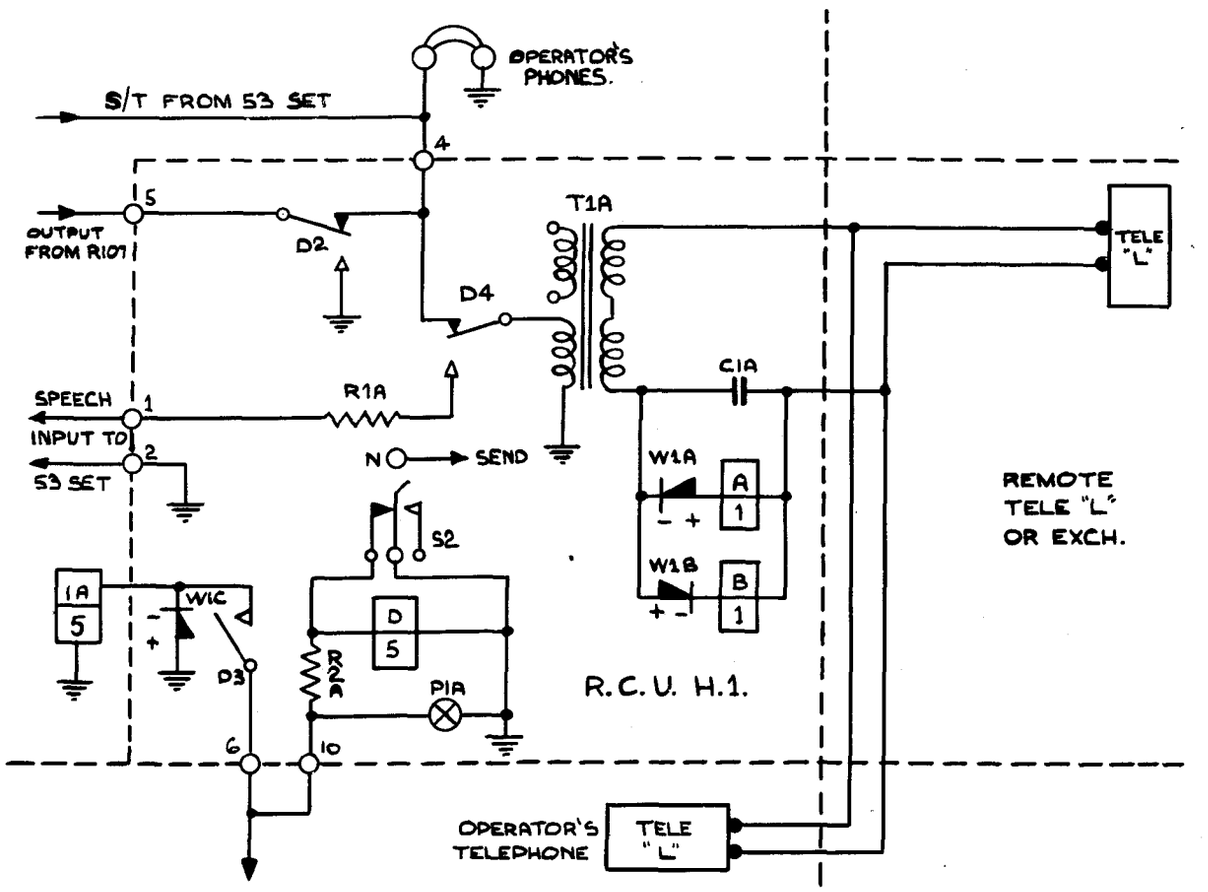


FIGURE 26 REMOTE OPERATION DIRECT TO TELEPHONE.

The diagram shows the "Receive" position with S1 at "Remote R.T.". Note that the output from the receiver is connected through contacts D2 and D4 to T1A and thence along the control line to the remote telephone or exchange. The operator's phones are connected in parallel so that he can monitor the conversation. Alternatively, if he so desires, the operator can monitor the conversation on his Tele "L" which is connected in parallel with the control line.

On switching S2 to "Send" the short-circuit across Relay D/5 is removed and the "D" contacts will operate. As with "Remote R.T. Operation" previously described, this will switch the set to "Send" and therefore speech from the remote telephone or exchange will be connected via T1A and contact D4 to the speech amplifier of the 53 Set.

(xii) Use of the "C.B." Switch on a Tele "L"

Where remote operation on R.T. only is required a Tele "L" may be used in place of the "H2" unit and the "C.B." switch on the telephone can then be used at the remote end as a send-receive switch. To operate the relays a 12v battery has to be included in series with one leg of the control line. The general set-up is shown in Fig. 27. When the "C.B." switch is pulled up to the "call" position a D.C. loop will be completed and current will flow from the battery through Relay A/1 in the "H" control unit. Referring to Fig. D it will be seen that with S1 in the "Remote R.T." position, contact A1 will remove the short-circuit across Relay D/5 thus switching the set to "Send".

It is important that the battery be connected in the correct polarity as otherwise Relay B/1 will be operated which would not switch the set to "Send".

(xiii) Re-broadcast

Many re-broadcast facilities are available with this remote control unit. The three main useful ones are:-

(1) Operator on each set. Where it is required to re-broadcast from one 53 Set to another, and where there is an operator on each set, the arrangement shown in Fig. 28 can be used. Each station is switched to "Remote R.T." and each operator uses his "Normal-Send" Switch S2 for send-receive switching. Thus, referring to the diagram, the switching operations are as follows:-

Re-broadcast Set "A" to Set "B" S2A to "Normal"
S2B to "Send"

Re-broadcast Set "B" to Set "A" S2B to "Normal"
S2A to "Send"

(2) Operator on one set only. By using the arrangement given in Fig. 29 it is possible for one operator to use both sets. Here he has local control of Set "A" and remote control of Set "B". By connecting the sets together as shown it is also possible to re-broadcast from one set to another. With switches S1A and S1B at "Remote R.T.", switch S2A and S4 at "Normal" the switch operations are as follows:-

Re-broadcast Set "A" to Set "B" S5 to "Normal"
S2B to "Send"

Re-broadcast Set "B" to Set "A" S5 to "Exchange Send"
S2B to "Normal"

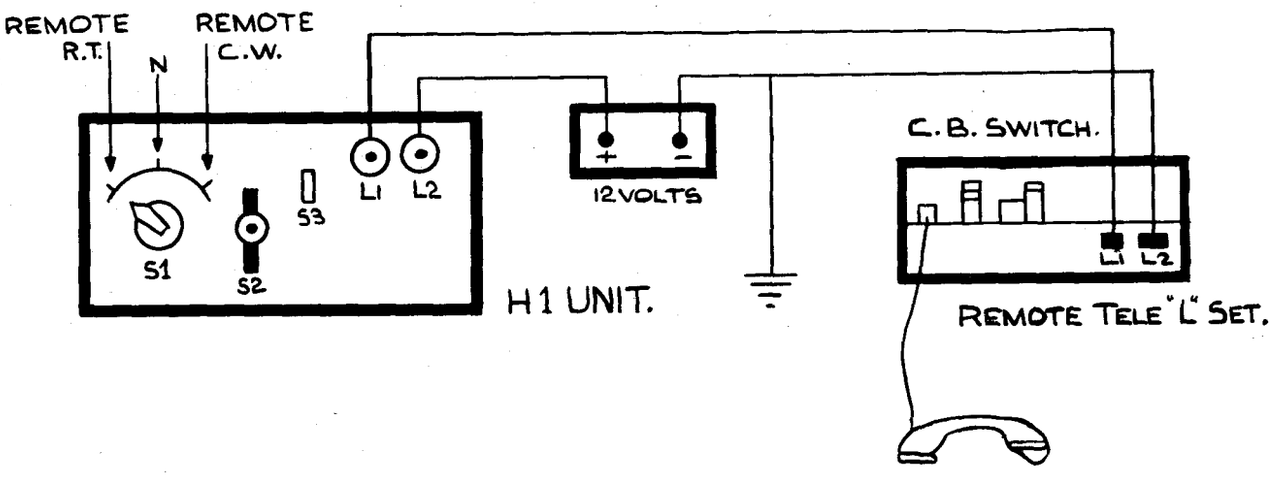


FIGURE 27. REMOTE OPERATION USING C.B. SWITCH ON TELE "L" AS THE S/R SWITCH.

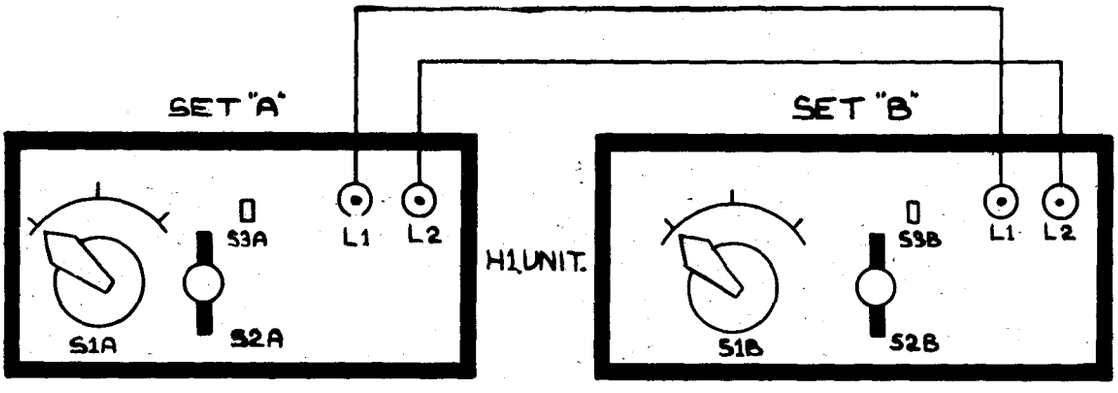


FIGURE 28

(3) Both Sets remote from operator. With the arrangement shown in Fig. 30, it is possible for both sets to be operated by one remote operator using two remote units. Re-broadcast is now accomplished as follows:-

Switches S1A, S1B to "Remote R.T.", S2A and S2B to "Normal". S4A and S4B to "Normal".

Re-broadcast Set "A" to Set "B" S5A to "Normal"
S5B to "Exchange Send"

Re-broadcast Set "B" to Set "A" S5A to "Exchange Send"
S5B to "Normal"

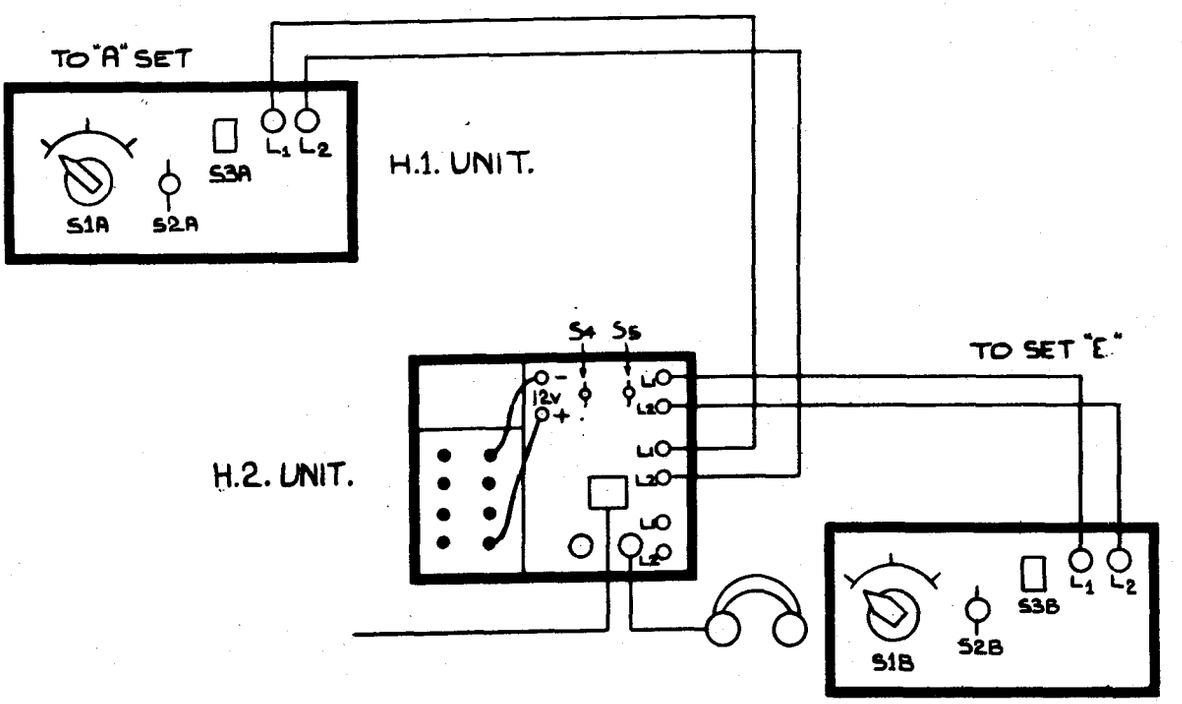


FIGURE 29 RE-BROADCAST B. OPERATOR ON ONE SET.

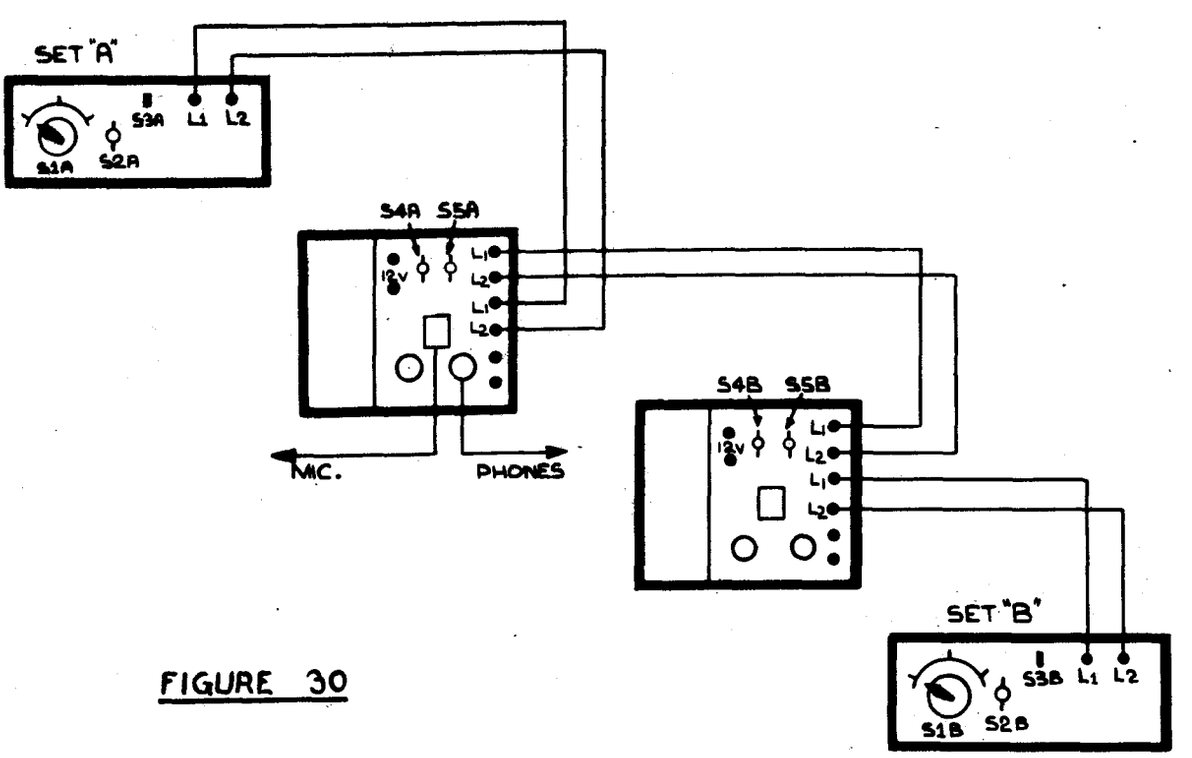


FIGURE 30

6. INSTALLATION IN A COMMAND VEHICLE

A. General

The 53 Set is usually installed in a 3-ton lorry which is arranged to accommodate the various officers who normally wish to use the set. The vehicle is sub-divided into two compartments, a staff compartment for the staff officers concerned and a second compartment for the operators.

The vehicle is normally equipped with a second low power set (e.g. a 19 Set) together with all the power supply and charging arrangements to make a self sufficient unit. The layout of a typical command vehicle (C.V.) containing a 53 Set and a 19 Set is shown in Fig. 31.

The 19 Set comprises two transreceivers (Set 'A' for 2-8 Mc/s and Set 'B' for 235 Mc/s) together with a two valve inter-communication A.F. amplifier. A control system is incorporated in the vehicle which enables any member of the staff to operate, from his headgear assembly, the 53 Set, the 19 Set A, B, or i/c or either of two external wireless sets connected to the vehicle. There are four sets of headgear (W, X, Y and Z in Fig. 31) which give these facilities and they are all controlled by switches on the Control Unit No. 15. Referring to Fig. 31 this control unit is situated on the inter-compartment partition and can be controlled from either side.

Each of the three operators is supplied with a separate control box, (control units P, Q and R in the diagram) which enables him to operate the sets, monitor staff conversions, and to control re-broadcast facilities. A further control unit(S) is situated in the drivers cab for intercommunication and to enable an officer in the cab to operate the 53 Set or the 19 Set.

The power supply for the 53 Set is from an A.C. petrol generator (see Para. D, Sub-para 1) whilst the 19 Set, which requires a D.C. supply at 12v, is supplied from a secondary battery. There are four such batteries, the remainder being for lighting, the 53 Set relays, and one spare.

B. The Control System

(i) Control Unit No. 15

The Control Unit No. 15 contains four 5-position switches, W, X, Y and Z, one for each of the headgear assemblies, each with points labelled 1, 2, 3, 4 and i/c, to give the following facilities:-

Positions 1, 2, 3.	Connect the phone, microphone and relay leads of the headgear assembly to any one of three wireless sets.
" 4.	Connects the phone, microphone and relay leads from the headgear assembly to control either of two sets according to the position of switch marked '4 INT/4 EXT'.
" i/c.	Connects the phone and microphone leads only to the inter-communication A.F. amplifier.

There is also a 3-position switch marked 'P.s.B.s' which is used in conjunction with control unit 'P' giving to the operator of this control unit the same facilities as in positions 2, 3 and 4 above.

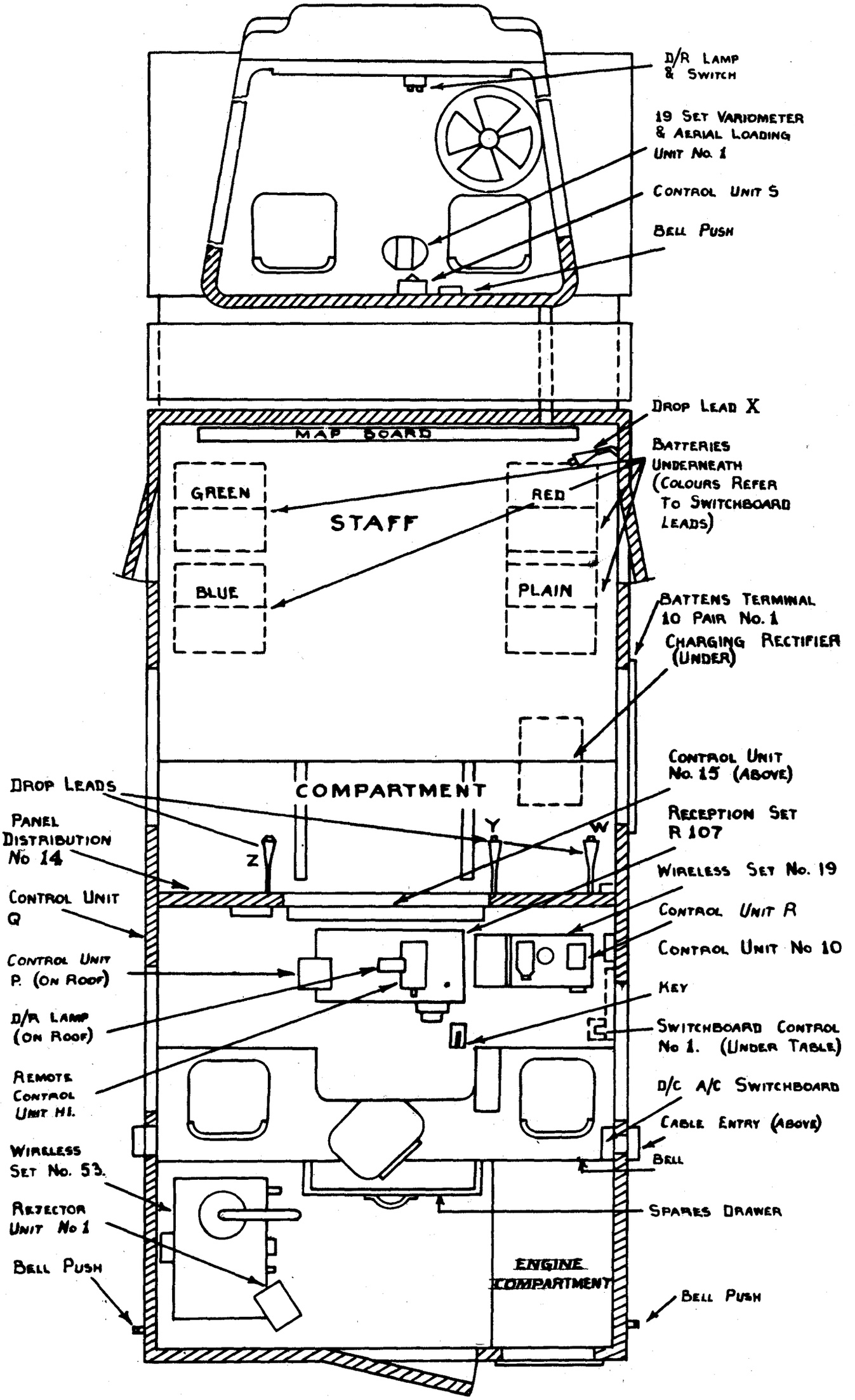
Fig. 32 shows the connections of one 5-position switch in Control Unit No. 15. All four switches are connected in the same way, and similarly numbered contacts connected together.

Note that for each switch-position except i/c there are three circuits (phones, microphone and relay).

Each switch connects its headset to any one of the 6 sets of control circuits, with a common earth return.

(ii) Control Boxes No. 2 Mk 11

The operator's headgear assemblies are connected to the sets by Control Boxes No. 2 Mk. 11. These boxes enable the operator to control any one of three circuits, the circuits being selected by a 3-position switch labelled A - i/c - B. Positions A and B connect the headgear assembly to control either of 2 wireless sets alternatively. Position i/c connects the



CV HP INSTALLATION

FIGURE 31

headgear assembly to the inter-communication amplifier. A second switch inter-connects circuits 'A' and 'B' for re-broadcast purposes and is marked "N-R" (normal-re-broadcast).

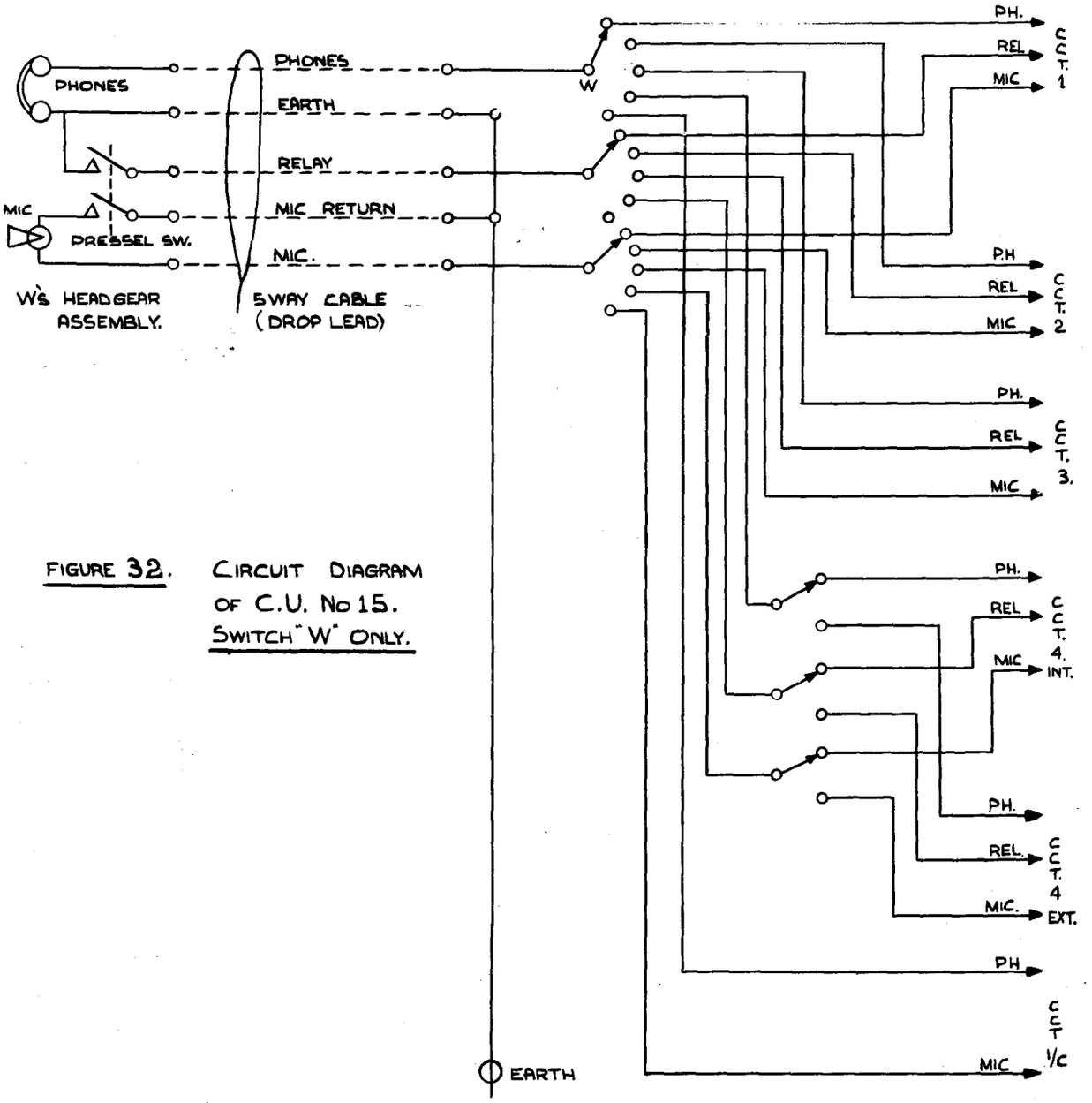


FIGURE 32. CIRCUIT DIAGRAM OF C.U. No 15. SWITCH "W" ONLY.

A circuit diagram of Control Unit No. 2, Mk 11 is shown in Fig. 33. There are two 12-point plugs in the unit with straight-through connections between corresponding pins. By this means several boxes can be inter-connected so that they can reach control the sets independently.

With S2 in the normal position switch contacts S1A - C select the connection of the phones to the telephone lead of either the A, B, or i/c circuit. Similarly contacts S1D - F select the microphone circuits. The contacts S1G and S1H connect the pressel switch to either the 'A' or 'B' circuit relay line; these lines are connected to the respective send-receive relays of the set and to a D.C. supply. Thus operation of the pressel switch completes the circuit to earth and actuates the relay. For re-broadcast operation a second set of lettering (B A, A & B, A B) on S1 designates the facilities obtained.

When the 'Normal - Rebroadcast' switch is put to 'Rebroadcast' the following facilities are given:-

(a) S1 to position 'B A'. Signals received on Set 'B' are rebroadcast on Set 'A'.

(b) S1 to position 'A B'. Signals received on Set 'A' are re-broadcast on Set 'B'.

(c) S1 to position 'A B'. Signals can be received and transmitted from the operators headgear assembly on both 'A' and 'B' Sets simultaneously.

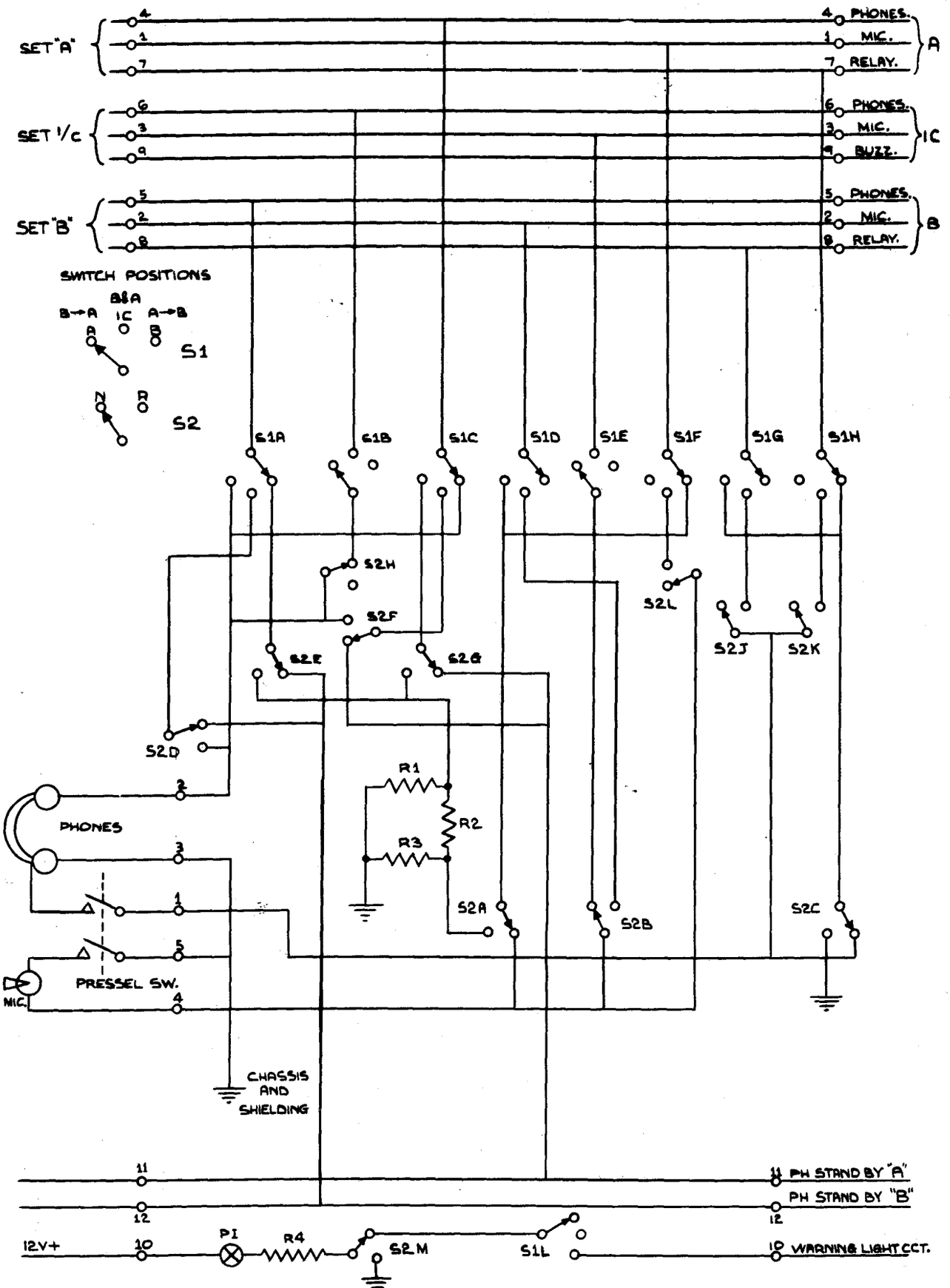


FIGURE 33 CIRCUIT DIAGRAM C.U. No. 2. Mk 11.

Referring to Fig. 33, with S1 in position 'B - A' signals received from the receiver of Set 'B' are connected through S1A and S2E to the attenuator R1, R2 and R3. This attenuator brings down the level to the same as that normally supplied by the microphone and is inserted to avoid over-modulation. From the attenuator the signal passes through S2A and S1F to the microphone line of the 'A' Set. Set 'A' is switched to send by S2C through S1H.

For rebroadcast operation the operator will need to monitor the conversation so that he can perform the necessary change-over switching. The phones are thus connected through S1C to the 'A' set phones line. Set 'A' will be transmitting and the operator will receive side tone from this set.

With A1 in position 'A - B' set 'B' is switched to 'Send' by S2C via S1G and the receiver output from Set 'A' is connected through S1C, S2G and the attenuator through S2A and S1D to the microphone line of set 'B'. The phones are connected to receive sidetone from set 'B' via S1A.

When S1 is put to the central position (A & B) the phones are connected to set 'A' through S2F and S1G, and to set 'B' through S2D and S1A, thus receiving signals from both sets simultaneously.

When the pressel switch is closed the relay lines of both the 'A' and 'B' sets are earthed through S1H, S2K and S1G, S2J respectively. The microphone circuit is completed by S2B, S1D, and S2L, S1F.

The remaining auxilary circuits in this box perform functions as follows:-

(a) Buzz Circuit

Pins 9 on both plugs are joined together and can if desired be connected to a push button in the driver's compartment to operate a buzzer for calling on the i/c circuit. A special control unit is used which contains the buzzer and push-button and is called a Control Unit, Junction Distribution No.1. A second push-button is situated on Control Unit No. 15 to enable the operator to call the driver's compartment.

(b) Stand-by Circuits

If a pair of phones be connected to pin 11 they will receive signals from Set 'A' when this is not being used; this is known as the 'A' stand-by circuit. Similarly the operator can listen out on set 'B' whilst this is not being used by connecting the phones to the 'B' stand-by circuit (pin 12). Both stand-by circuits are disconnected on 're-broadcast'.

The 'A' stand-by circuit is connected to the phones line (pin 4) via S2F, S2G, and S1C, whilst the 'B' stand-by circuit is connected to pin 5 via S2D, S2E and S1A.

(c) 'A' Set Unattended Lamp

The bulb P1 is known as the 'A' set unattended lamp and is arranged so that when using a series of boxes the lamp will light if all units are switched to 'B' thus leaving the 'A' set unattended.

Referring to Fig. 33, when S1L is at 'B' a circuit is completed from 12v + through the lamp and R4 to pin 10. If all control units are at position 'B' and pin 10 on the last one is connected to earth then the lamp will light. In Control Units No. 10 this earth connection is made via a fuse within the unit and this is the type usually used for the terminating box. Note that the lamp will also light when operating 're-broadcast'.

(iii) Control Unit No. 10

This box is identical in principle to the Control Unit No. 2 Mk 11 but contains no re-broadcast facilities, and, as stated in para. (ii)(c), forms the earth loop for the warning lamp circuit.

(iv) Control Unit No. 10

When a 19 set is used in a C.V. a Control Unit No. 10 is usually incorporated. The 19 Set was originally intended for use in tanks and, in order to overcome the heavy mechanical background noise, is designed so that to obtain full modulation it is necessary to shout into the microphone. Where members of the staff may be speaking from the same compartment over different sets simultaneously the speech level required must be kept low. Control Unit No. 10 contains the necessary circuits to accomplish this. The unit has two

12-point connectors as in the No. 2 unit and is controlled by a 3-position switch marked 'N - 1 - 2'. In the 'N' (Normal) position the unit has no effect whatsoever, but in positions 1 and 2 it passes speech from the microphone through the 19 set intercommunication amplifier before being fed to the 19 'A' set modulation input. The degree of pre-amplification thus obtained can be altered by positions 1 and 2 on the switch (position 2 gives greater gain than position 1). A circuit diagram of Control Unit No. 10 is given in Fig. 34.

With S1 in the normal (N) position the microphone line is connected direct to the 19 'A' Set AF input. In positions 1 and 2 the microphone line is connected through S1C to the i/c amplifier and thence through the attenuator to the 19 'A' Set. Note that the 10,000 ohms resistor is shunted by 5,000 ohms in position 2 by S1D giving less attenuation and thus greater overall gain.

The normal i/c microphone circuit is disconnected when this control unit is in use (i.e. in positions 1 and 2) by S1C.

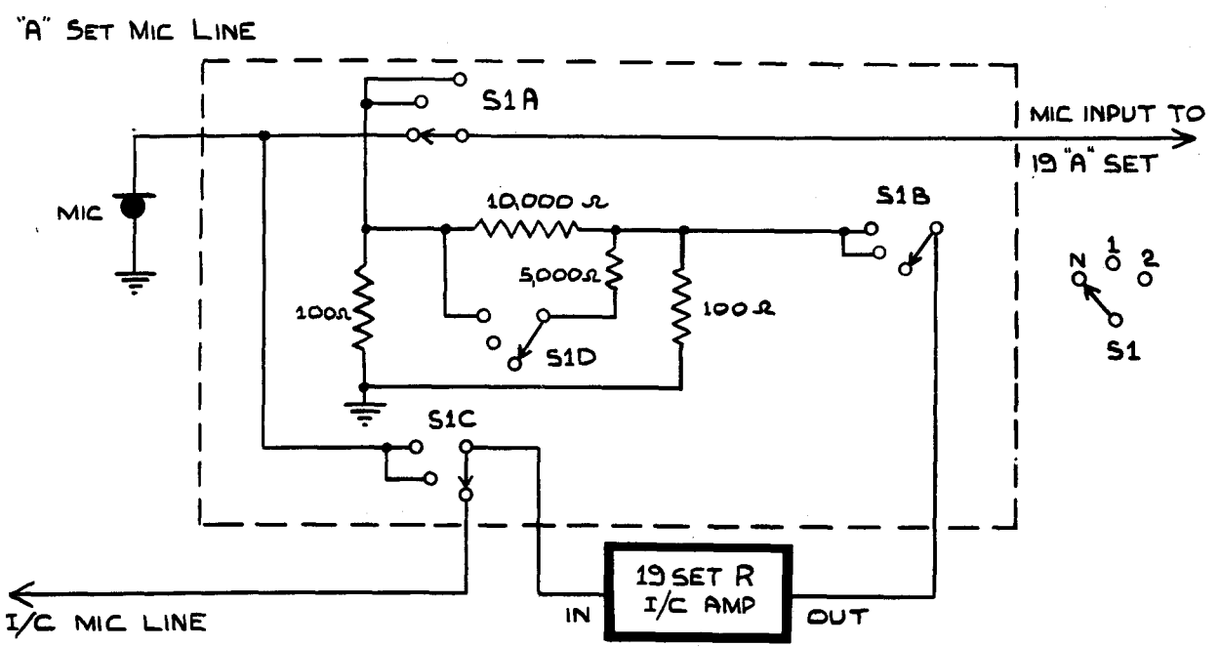


FIGURE 34 SIMPLIFIED DIAGRAM OF C.U. No. 10.

(v) Complete Control System

The complete control system comprises the units mentioned in the preceding paragraphs. A block diagram of the system is given in Fig. 35. There are numerous possible combinations of these units but that shown is standard to the 53 Set Command Vehicle. The system can however easily be modified to suit special requirements.

In this arrangement circuit 1 is connected to the 53 Set, circuit 2 to the 19 'A' set, and circuit No. 3 to an external set controlled by means of a 5-way extension cable termed a 'borrowing lead' (lead 'U' in Fig. 39). Position 4 as mentioned in para. 1 connects to the '4 INT/4 Ext' switch, 'INT' position of which is joined to the 19 'B' Set, whilst the position can give control of a second external set by means of another 'borrowing lead' ('T' in Fig. 35).

The main set operator is equipped with a control unit No. 2 ('B' in Fig. 35) the 'A' circuit of which (pins 4, 1 and 7, Fig 33) is connected to control the 53 Set, via a distribution panel. The i/c circuit is connected to the 19 Set i/c amplifier via a terminal board on the Control Unit No. 15 whilst the 'B' circuit is connected to the switch "P's B". Thus in position 'B' the main set operator can control:-

(a) The 19 'A' Set.
(b) A set connected to the borrowing lead 'U'.
(c) Sets connected to the 4 INT/4 EXT switch.

By means of the N.R. switch C.U. 'P' can re-broadcast between the 53 Set and any of the sets in (a), (b) and (c) above.

The 19 Set operator's control unit (C.U. 'R') is connected in the normal way (i.e. 'A' to the 19 Set, 'i/c' to i/c amplifier and 'B' to 19 'B' Set).

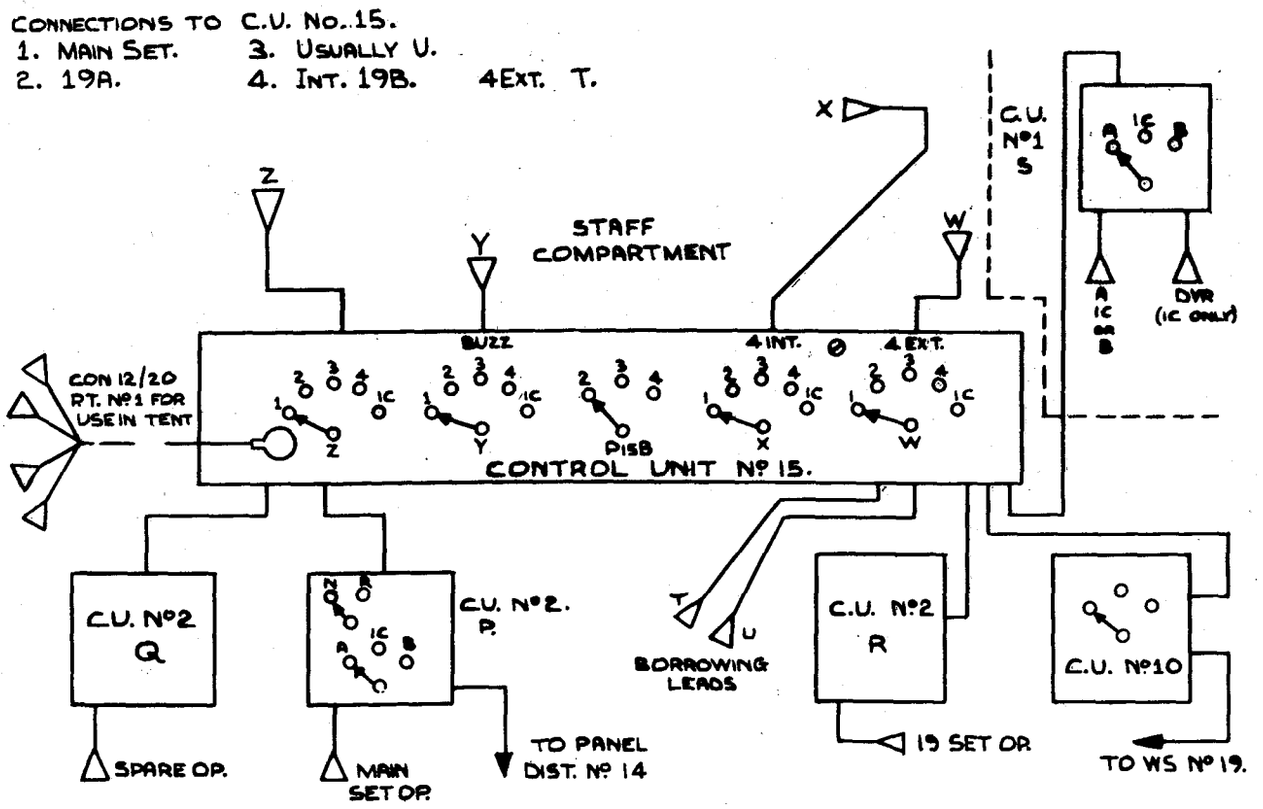


FIGURE 35 CONTROL SYSTEM.

All three circuits to the 19 Set are connected through the Control Unit No. 10 thus giving "quiet speaking" facilities on the 19 "A" Set. Note that this control unit will also give a useful boost, if required, for re-broadcast operation.

Control units "Q" and "S" are usually connected in parallel (via the terminal board on C.U. No. 15) so that the three positions "A", "I/C" and "B" control the 53 Set, the i/c amplifier and the 19 "A" Set respectively.

Note that a second "drop lead" on control unit "S" is permanently connected to the i/c amplifier for the use of the driver.

The twelve circuits from the control units (see Fig. 33) can be connected via Con. 12/20 Pt. No. 1 to 4 control units No. 2, Mk. 11 fixed to tables which can be erected in a tent adjacent to the vehicle. This arrangement is sometimes preferred when static for any period of time and the three control box circuits are usually connected to operate the 53 Set, the i/c amplifier, and the 19 'B' Set respectively.

A diagram showing the layout of one of these boards, together with two sets of connections, is given in Fig. 36.

Each circuit is bunched in groups of three (microphone, phones and relay) and labelled with the control unit to which it belongs and the circuit it represents. Thus "PA" represents the "A" circuit from box "P", "RIC" the inter-communications circuit from Box "R" and so on. A table showing the normal connections follows, but, as should be realized, practically any required facilities can be arranged.

From	Label on Group of three wires	Circuits on Terminal strip
P. (OP.P's Control Unit)	PA 147	1
P. (OP.P's Control Unit)	PIC 36E PB 258	IC P's B
Q. (OP.P's Control Unit)	QA 147 QIC 36E QB 258	1 IC 2
R. (OP.R's Control Unit)	RA 147 RIC 36E RB 258	2 IC 4
S. (Driver's Cab)	147 SIC 36E SB 258 Buzz (single lead) 9	1 IC 2 Buzz
19 Set	19A 147 19 IC 36E 19B 258 + 12v. (single lead)	2 IC 4 INT + 12v. (for buzzer circuit)
T. (borrowing lead) U. (borrowing lead)	Earth (T Earth (single lead) U Earth (single lead)	4 EXT E 3 E

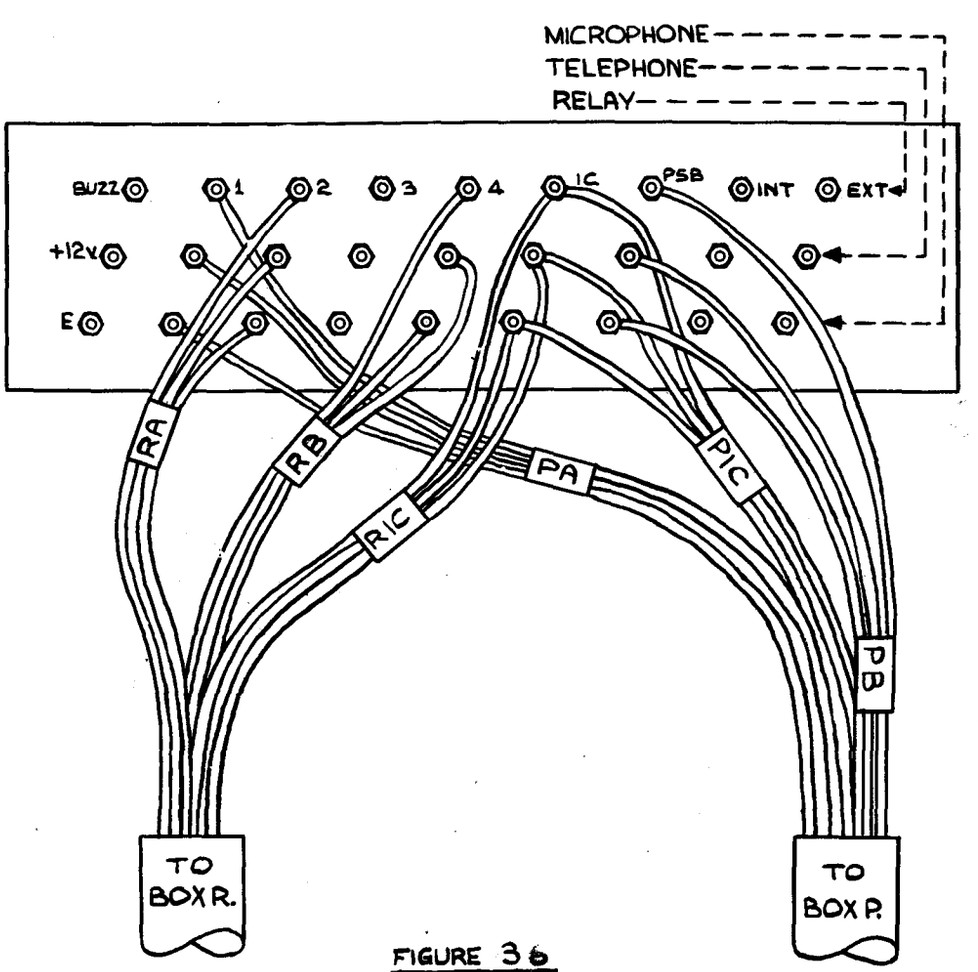


FIGURE 36

CONNECTIONS ON C.U. 15.

C. Main Set Inter-Equipment Wiring

(i) General

The connections between the 53 Set, the receiver and the local R.C.U. are made via a Distribution Panel No. 14. These connections comprise the reception and transmission speech circuits, the 53 Set send-receive and keying relay circuits and the A.C. and D.C. supplies.

The inter-equipment wiring includes two further pieces of apparatus, viz. the Rejector Unit No. 1 and the Relay Unit No. 1. These units are included in the R107 aerial input lead, the former being to prevent damage and interference to the receiver from a nearby sender, and the latter to earth the R107 input terminals when the 53 Set is sending.

A block diagram of the arrangement is shown in Fig. 37.

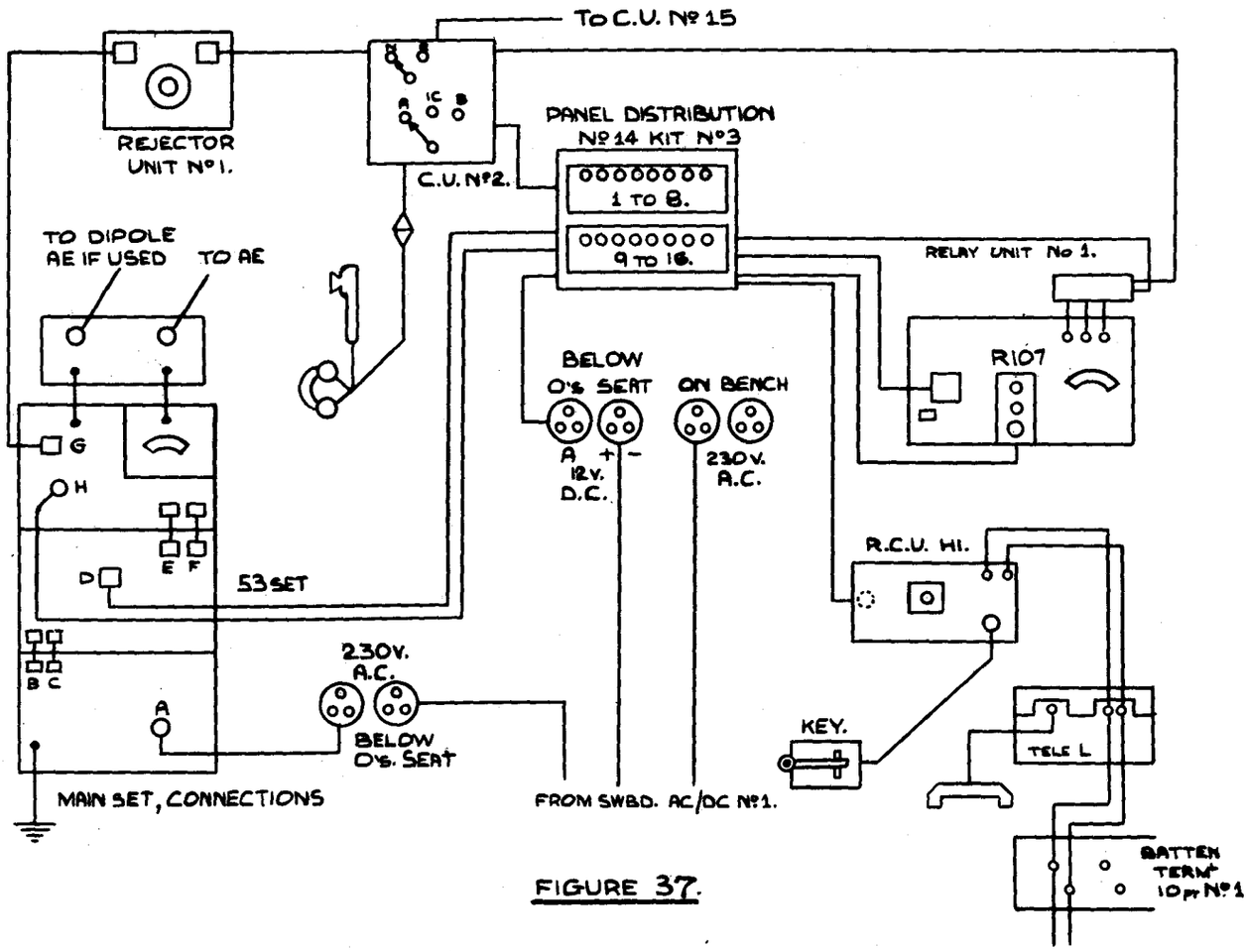


FIGURE 37.

(ii) Distribution Panel No. 14

The actual connections to this panel are shown in Fig. 38.

For a description of Relay Unit No. 1 see paragraph (iv) below.

(iii) Interference Suppression

As two complete stations (viz. the 53 Set and the 19 Set) are usually installed in the one vehicle, mutual intereference between the sets may be experienced. The trouble can, to a large extent, be overcome by using widely separated frequencies. To minimise the effects of interference, however, a simple rejector unit is included in the co-axial feeder to the receiver. Tuning the unit to the frequency of the interfering signal will cause a high impedance in the aerial lead to that frequency.

A circuit diagram of the Rejector Unit No. 1 is given in Fig. 39. It consists of a parallel tuned circuit arranged, by a range switch, to cover from 1.2 to 10 Mc/s. in 4 bands. A fifth position marked "off" on the range-switch shorts out the tuned circuit rendering the unit inoperative. The four coils L1-L4 are tuned by C1A. Note that the frequency coverage of this rejector unit includes the whole of the 19 'A' Set band.

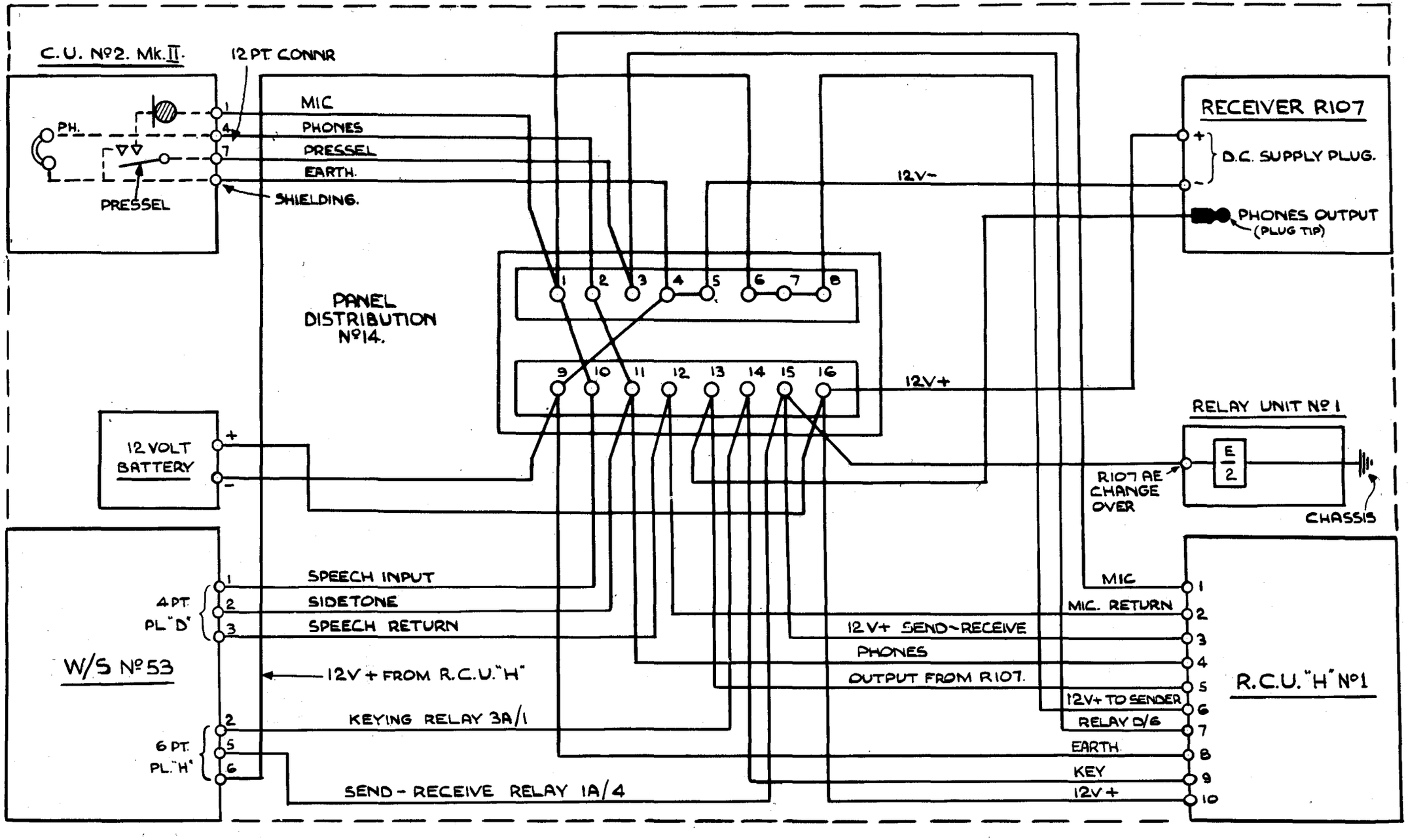

C.U. Nº2. Mk.II.
12 PT CONNR
PH.
PRESSEL
MIC
PHONES
PRESSEL
EARTH.
SHIELDING.
RECEIVER R107
D.C. SUPPLY PLUG.
12V-
PHONES OUTPUT
(PLUG TIP)
PANEL
DISTRIBUTION
Nº14.
12V+
RELAY UNIT Nº 1
R107 AE
CHANGE
OVER
CHASSIS
12 VOLT
BATTERY
SPEECH INPUT
SIDETONE
SPEECH RETURN
4 PT.
PL "D"
W/S Nº53
12V + FROM R.C.U."H"
KEYING RELAY 3A/1
6 PT.
PL."H"
SEND - RECEIVE RELAY 1A/4
MIC
MIC. RETURN
12V+ SEND-RECEIVE
PHONES
OUTPUT FROM R107.
12V+ TO SENDER
RELAY D/6
EARTH
KEY
12V+
R.C.U."H" Nº1

FIGURE 38

No rejector unit is included in the 19 Set aerial lead. A small unit (Aerial Loading Unit No. 1) is however inserted between the variometer and the aerial. The unit has two functions:-

(a) It includes a fuse to protect the variometer and the 19 "A" Set should it be tuned through the frequency of the 53 Set whilst the latter is sending.

(b) It has an adjustable link which will switch a loading condenser in or out of the aerial circuit. This condenser is in parallel with the aerial and will increase the capacity of a 6' rod so that it can be tuned by the variometer. Used in this way the 19 "A" Set has a limited range and can be used with comparative security for inter-vehicle communication with greater reliability than that of the 19 "B" Set.

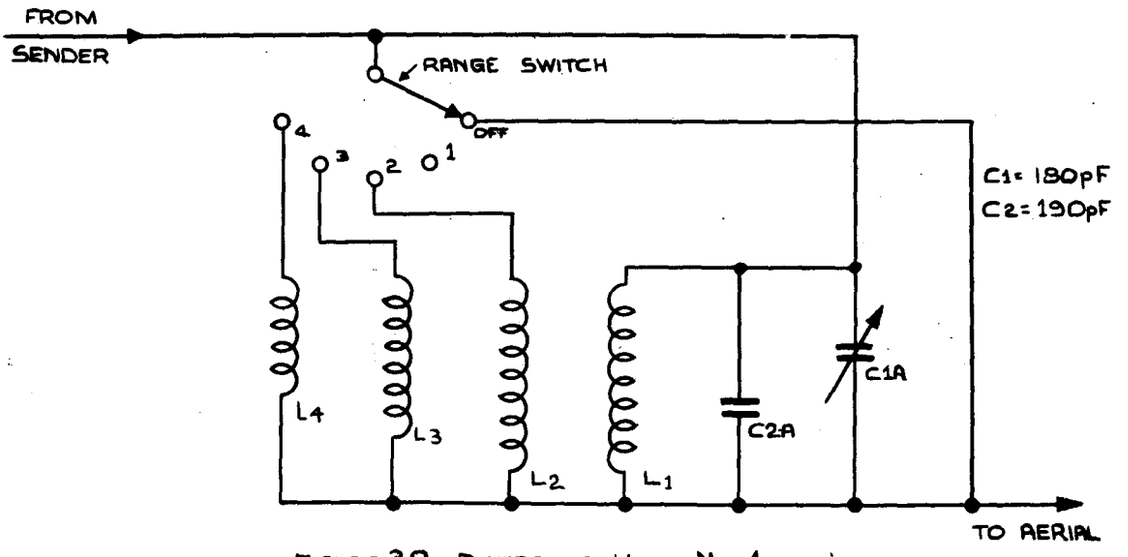


FIGURE 39. REJECTOR UNIT. NO. 1

(iv) Relay Unit No. 1

This relay unit is attached to the receiver and its function is to earth the aerial input terminals whilst sending, to avoid damage to the receiver.

Referring to Fig. 38, the relay unit contains a relay, E/2, which is connected to tag "15" on the distribution panel. The relay is thus energised from the 12v send-receive line and will be operated whilst sending.

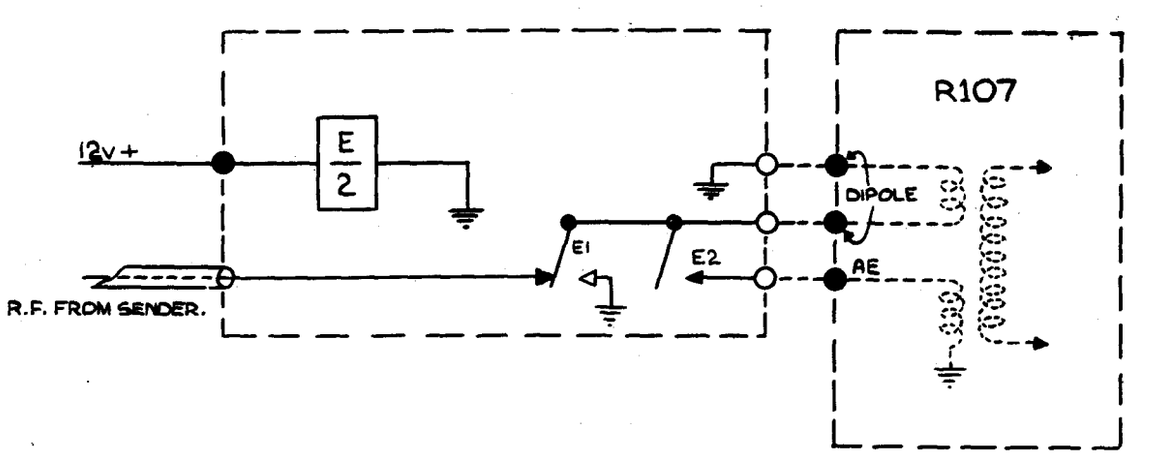


FIGURE 40. RELAY UNIT NO. 1. (CIRCUIT DIAGRAM.)

Fig. 40 shows a circuit diagram of the relay unit. Contacts E1 and E2 are shown in the "Receive" position, and the co-axial feeder from the 53 Set is connected by contact E1 to one end of the "dipole" feeder winding in the R 107. The circuit is completed from the other end of the winding to earth. The single-ended aerial input to the receiver is not used.

When sending, contact E1 shorts out the dipole winding whilst the other winding is shorted by contact E2, thus ensuring that none of the transmitted R.F. can reach the receiver and cause damage.

D. Supply Circuits

(i) A.C. Supplies

The A.C. supply is obtained from a petrol driven alternator which may be either an Onan (W3S., 3 K.V.A., 60 c/s), or a Coventry Climax (C.S.M. 4 K.V.A. 100 c/s).

The output from the alternator is stabilised by means of a "voltage regulator". The voltage regulator contains circuits which make the field current vary inversely to the output voltage. Thus an increase in output voltage will cause a decrease in the alternator field strength, tending to counteract the change.

The generating set includes a 12v starter-motor which may be energised from a secondary battery by means of a push-button. The generator may be stopped by pressing a second push-button arranged to earth the magneto output.

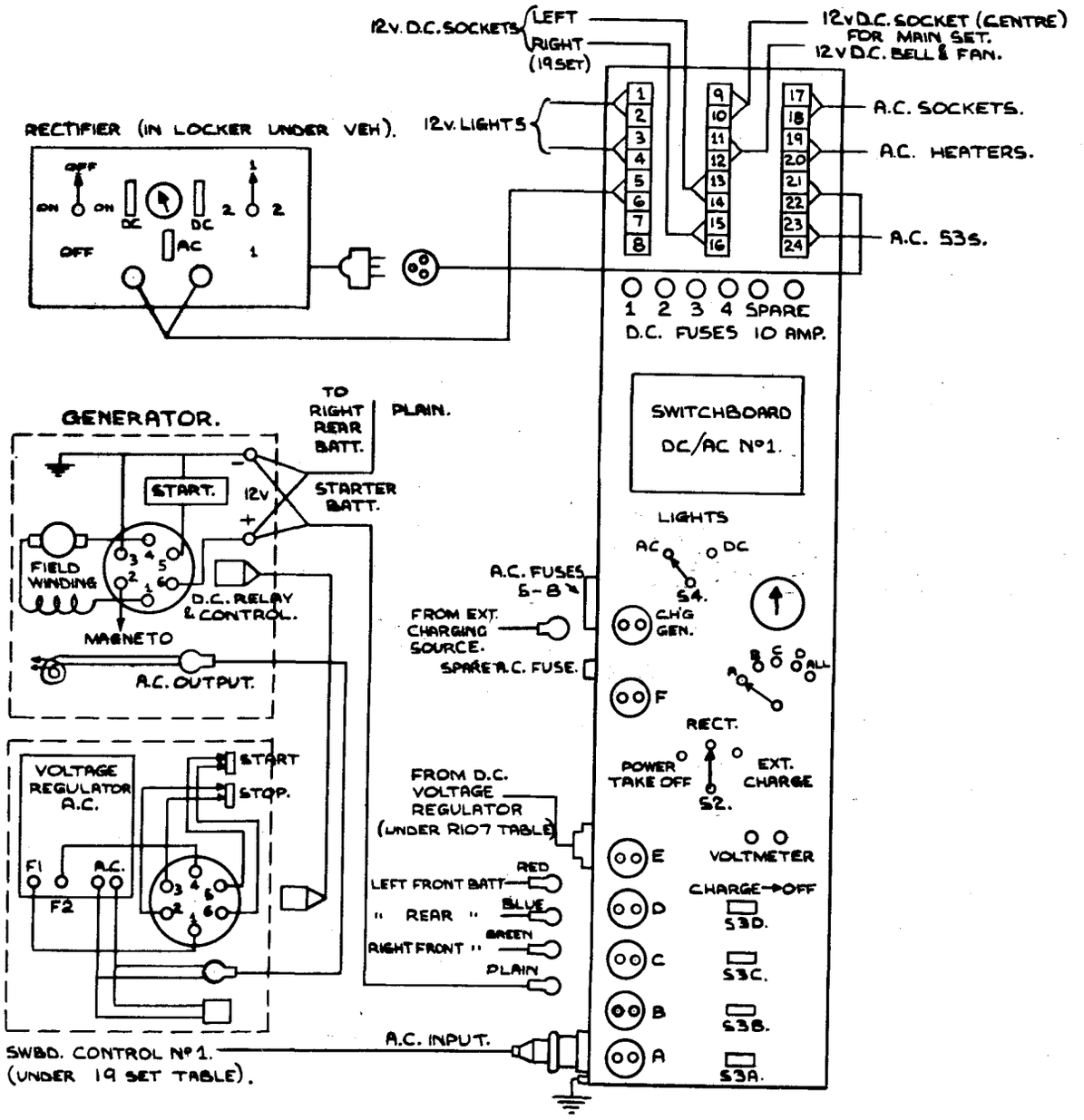


FIGURE 41 LAYOUT OF SUPPLY CIRCUITS

Referring to Fig. 41, the various connections to the alternator, the field winding and the stop-start circuits are made via a 6 point socket on the generator.

The regulated A.C. supply is connected through fuses 5-8 as follows:-

F.5 and F.6 connect to:- (a) A.C. sockets.
(b) Vehicle heaters.
(c) Charging rectifier.

F.7 and F.8 connect to:- 53 Set.

(ii) D.C. Supplies

The D.C. circuits give 12v for the 19 Set, the 53 Set relays and the lighting, bell and fan circuits. Four banks of 12v secondary batteries are used for this purpose, together with charging arrangements. The charging switchboard contains four charging circuits which may be supplied from (a) the A.C. generator via a transformer and metal rectifier, (b) an external A.C mains supply as in (a) above, (c) the vehicle engine auxiliary dynamo (the "Power take off"), or from (d) an external charging generator. The 12 volt lighting circuits may be operated from the A.C. generator via a step-down transformer when required. The general layout of the supply circuits is shown in Fig. 41, whilst the electrical circuits are given in Fig. 42.

The four banks of batteries are utilised as follows:-

(a)	Plain	(1) 12v lighting	(Fuse F.1.)
		(2) D.R. bell and fan	(" F.3.)
		(3) 19 Set	(" Fuse inside set)
(b)	Green	(1) 12v lighting	(Fuse F.2)
		(2) Left 12v D.C. socket spare.	
		(3) Centre D.C. socket for 53 Set relays.	
(c)	Blue	(1) Terminals 7 and 8 (Spare).	
(d)	Red	Spare bank only connected to charging circuit.	

If so desired the banks may be inter-changed by the plugs "A" - "D" ("E" and "F" are blanks).

Any bank may be put on charge from the rectifier by means of the switches S3A - D. The rectifier may be substituted with the power take-off (vehicle generator) or an external charging plant connected to the "CHARGING GENERATOR" socket, by the selection switch S2. A charge/discharge ammeter can be connected in series with any battery bank by the switch S1. This meter has a central zero position. A deflection to the right indicates a discharge current whilst a deflection to the left indicates a charging current. Provision is also made for connecting a voltmeter across any bank selected by S1 so that the state of charge can be checked.

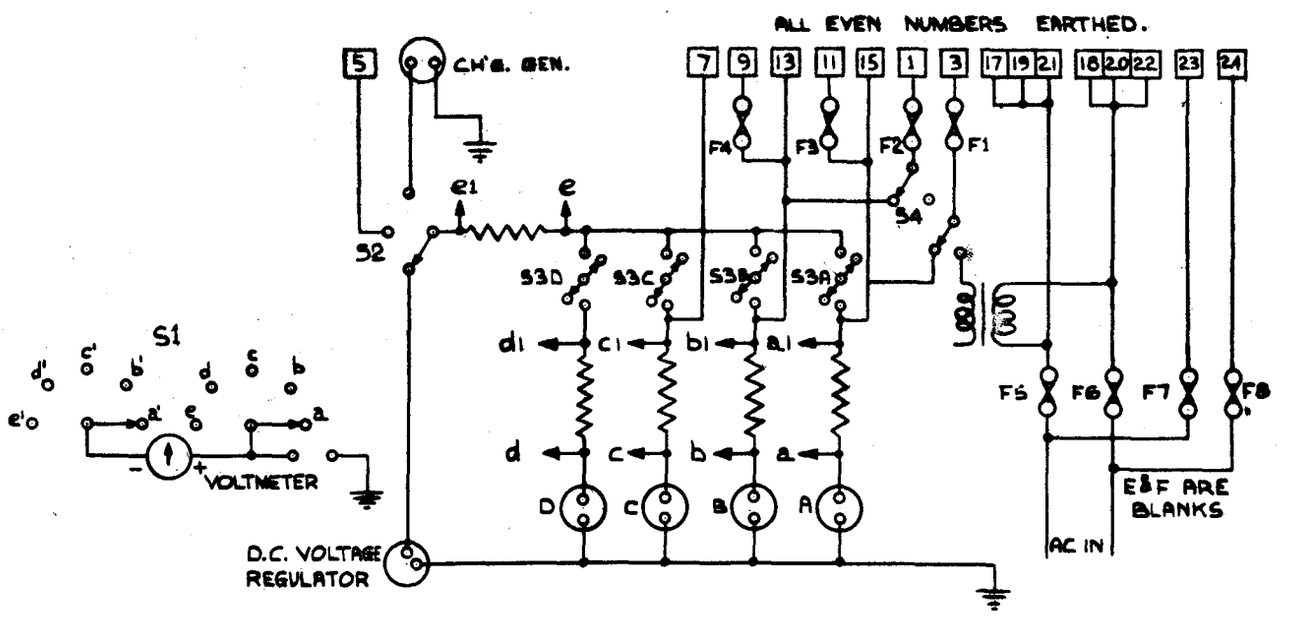


FIGURE 42. WIRING OF SWITCHBOARD D.C. A.C. No.1.

7. Aerials

A. The importance of aerial selection

Before proceeding to erect any aerial it must be decided whether mobile, ground or skywave working is required. The whole of the tuning procedure depends entirely upon what type of aerial is chosen.

For mobile operation 16 ft. V aerial must be used and in no circumstances must a shorter aerial be erected as damage to the sender will result.

In use on the halt the best aerial to suit the circumstances should be used. A ground wave aerial must be used if possible. If it is not known by experience whether or not a ground wave aerial will provide the necessary communication, reference should be made to "Ground and Skywave Ranges of Field Army Wireless Sets" for the appropriate theatre.

B. Mobile operation

16 ft. V aerial

The 16 ft. V aerial is for mobile operation only and is as good as possible for mobile use, but it has limitations due to the maximum length that can be erected when on the move.

Remember this aerial gives some ground-wave and some sky-wave radiations. It will give mobile sky-wave communication over considerable distances in addition to the ground-wave range.

C. Ground-wave working

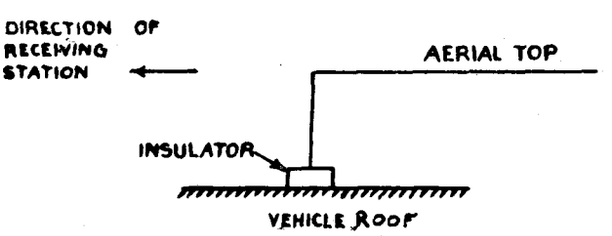
(i) 34 ft. rod aerial

The 34 ft. rod aerial is a good ground-wave radiator and should be used in preference to the 16 ft. V aerial whenever the station is static. This aerial radiates very little sky-wave and therefore cannot be expected to work in excess of 100 miles.

(ii) End-fed wire aerials (66 - 150 ft.)

Erect an aerial for the required frequency, the length of which is given in the Table. This aerial should be erected in the form of an inverted L, the vertical portion being made as long as possible.

It should be erected as shown in the figure with the top of the aerial pointing away from the receiving station.



ORIENTATION OF END-FED AERIAL FOR GROUND WAVE WORKING

FIGURE 43

This type of aerial under given circumstances may prove a better radiator than a 34 ft. rod aerial, but it should be remembered that some sky-wave radiation will also be omitted. Sky-wave radiation can:

(a) Cause interference to other and friendly stations;
(b) Provide a good signal for enemy intercept operators at a considerable distance away.

Frequency (Mc/s.)	Length (ft.)	Remarks
1.2 - 1.55	150	Ground or sky-wave operation
1.55 - 2.2	100	
2.2 - 3.2	66	
3.2 - 4.4	150	
4.4 - 6.0	100	
6.0 - 7.9	75	
7.9 - 17.5	150	
2.1 - 3	230	Sky-wave operation only

NOTE:- The lengths are NOT those of combinations of 1/4 wavelengths of the frequencies used.

D. Sky-wave working

(i) Horizontal dipole aerial

The dipole aerial is the best type to use and gives a good all-round coverage. It should be adjusted to the correct size as given in the Table. It should be erected as high as possible and positioned as shown in the figure, broadside to the receiving station.

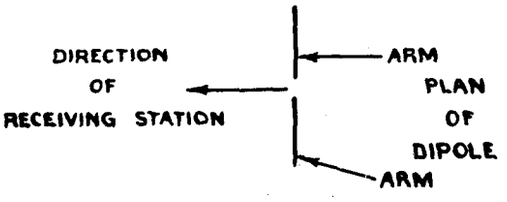


FIGURE 44 ORIENTATION OF DIPOLE AERIAL

(ii) End-fed wire aerials (66 - 150 ft. and 230 ft.)

Erect an aerial for the required frequency, the length of which is given in the Table. It should be erected as shown in the figure with top of the aerial broadside to the receiving station. This aerial will not be quite so efficient as a dipole aerial but will provide a good means of communication. The aerial should be erected with 1/3 of its length vertical and 2/3 horizontal. As an example a sky-wave aerial working on 3.5 Mc/s. should be 150 ft. long. This aerial should be erected with the first 50 ft. (from the aerial terminal on top of the vehicle) vertical and 100 ft. top (horizontal). It should be noted here that this is the ideal to be aimed at but of course 150 ft. aerial could be effectively erected on 36 ft. masts, the down lead being about 34 ft. with a top of 116 feet.

If sky-wave operation is being used on frequencies between 2.2 Mc/s. and 3 Mc/s. and if space permits it will be preferable to erect a 230 ft. end-fed wire aerial. The top portion of the aerial should be as high as possible.

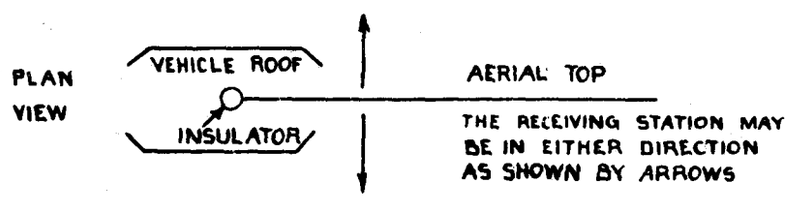


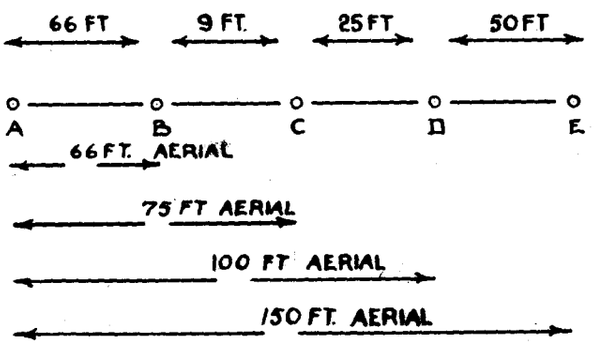
FIGURE 45 ORIENTATION OF END-FED AERIAL FOR SKY-WAVE WORKING

DIPOLES

Freq.(Mc/s.)	Type	Total length (ft.)		Freq.(Mc/s.)	Type	Total length (ft.)	
2.3	9B	203	2½"	7.0	9	66	11"
2.4	9B	195		7.1	9	65	11"
2.5	9B	187	2½"	7.2	9	65	
2.6	9B	180		7.3	9	64	1"
2.7	9B	173	3½"	7.4	9	63	2½"
2.8	9B	167	1"	7.5	9	62	5"
2.9	9B	161	5"	7.6	9	61	7"
3.0	9B	156		7.7	9	60	9½"
3.1	9B	151		7.8	9	60	
3.2	9B	146	2½"	7.9	9	59	5"
3.3	9B	141	9½"	8.0	9	58	6"
3.4	9B	137	7"	8.1	9	57	9½"
3.5	9B	133	8½"	8.2	9	57	1"
3.6	9B	130		8.3	9	56	5"
3.7	9B	126	6"	8.4	9	55	8½"
3.8	9B	123	1"	8.5	9	55	2½"
3.9	9B	120		8.6	9	54	6"
4.0	9B	117		8.7	9	53	9½"
4.1	9B	114	1"	8.8	9	53	2½"
4.2	9B	111	5"	8.9	9A	52	7"
4.3	9B	108	9½"	9.0	9A	52	
4.4	9B	106	5"	9.1	9A	51	5"
4.5	9B	104		9.2	9A	50	11"
4.6	9B	101	8½"	9.3	9A	50	3½"
4.7	9B	99	8½"	9.4	9A	49	9½"
4.8	9B	97	6"	9.5	9A	49	3½"
4.9	9B	95	6"	9.6	9A	48	8½"
5.0	9B	93	7"	9.7	9A	48	2½"
5.1	9	91	9½"	9.8	9A	47	9½"
5.2	9	90		9.9	9A	47	3½"
5.3	9	88	3½"	10.0	9A	46	9½"
5.4	9	86	8½"	10.5	9A	44	7"
5.5	9	85	1"	11.0	9A	42	6"
5.6	9	83	7"	11.5	9A	40	8½"
5.7	9	82	1"	12.0	9A	39	
5.8	9	80	8½"	12.5	9A	37	5"
5.9	9	79	3½"	13.0	9A	36	
6.0	9	78		13.5	9A	34	8½"
6.1	9	76	8½"	14.0	9A	33	5"
6.2	9	75	6"	14.5	9A	32	3½"
6.3	9	74	3½"	15.0	9A	31	2½"
6.4	9	73	1"	15.5	9A	30	3½"
6.5	9	72		16.0	9A	29	2½"
6.6	9	71	1"	16.5	9A	28	5"
6.7	9	69	11"	17.0	9A	27	6"
6.8	9	68	9½"	17.5	9A	26	8½"
6.9	9	67	9½"				

E. The make-up of end-fed wire aerials

The figure below shows how 150 ft., 100 ft., 75 ft. or 66 ft. aerials may be constructed:-



MAKE-UP OF END-FED WIRE AERIALS

FIGURE 46

All end-fed wire aerial lengths are measured down to the aerial terminal on top of the vehicle.

A 66 ft. aerial is made up of AB which is a 66 ft. length of wire, an insulator being provided at B.

NOTE:- "A" is assumed to be the insulated aerial terminal on top of the vehicle.

A 75 ft. aerial is made up of AB and BC linked together at B (66 ft. and 9 ft. wire joined together) with an insulator at C.

A 100 ft. aerial is made up of AB, BC and CD linked together at B and C (66 ft., 9 ft. and 25 ft. wires joined together) with an insulator at D.

A 150 ft. aerial is made up of AB, BC, CD and DE linked together at B, C and D (66 ft., 9 ft., 25 ft. and 50 ft. wires joined together) with an insulator at E.

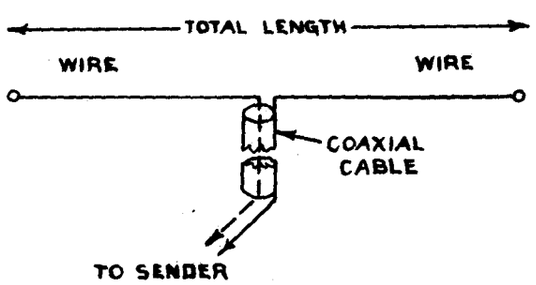
The 230 ft. aerial comprises simply 230 ft. of wire provided with insulator links.

F. The make-up of dipole aerials

Dipole aerial connections are made by means of a coaxial feeder to FEEDER on the AERIAL COUPLING UNIT. The two arms of the dipole must be accurately adjusted and be of equal length.

Types of dipoles:-

Aerial Dipole No. 9B (210 ft.)
" " " 9 (92 ft.)
" " " 9A (53 ft.)



MAKE-UP OF DIPOLE AERIALS

FIGURE 47

The feeders issued are 50 ft. long, normally only one should be used but if the aerial masts have to be some distance from the set the feeders may be joined together to make lengths of 100 or 150 ft. It should be noted the longer the feeder the less the power radiated.

8. OPERATION OF SENDER

A. Preliminary Operation

(i) See that the various units are in their correct positions.

(ii) Open the FUSES door (A1 Fig. 48) of the power supply unit and see that correct fuse wires, as indicated on the back of the door, are inserted in the fuse holders. Close FUSES door.

(iii) Check each unit for proper insertion of valves and necessary internal inter-connections:

(a) RF Amplifier and Master Oscillator (Fig. 48 and 49)

(i) Remove the cover (C1) over the stand-off insulators. Loosen the knurled nuts (E6) on the top of these insulators and swing the connecting link (E5) clear of the RF unit.

(ii) Remove all other connections to the front of the unit, not forgetting the earth connection to the modulator unit.

(iii) Turn the fasteners at the sides of the panel horizontal and pull the unit forward.

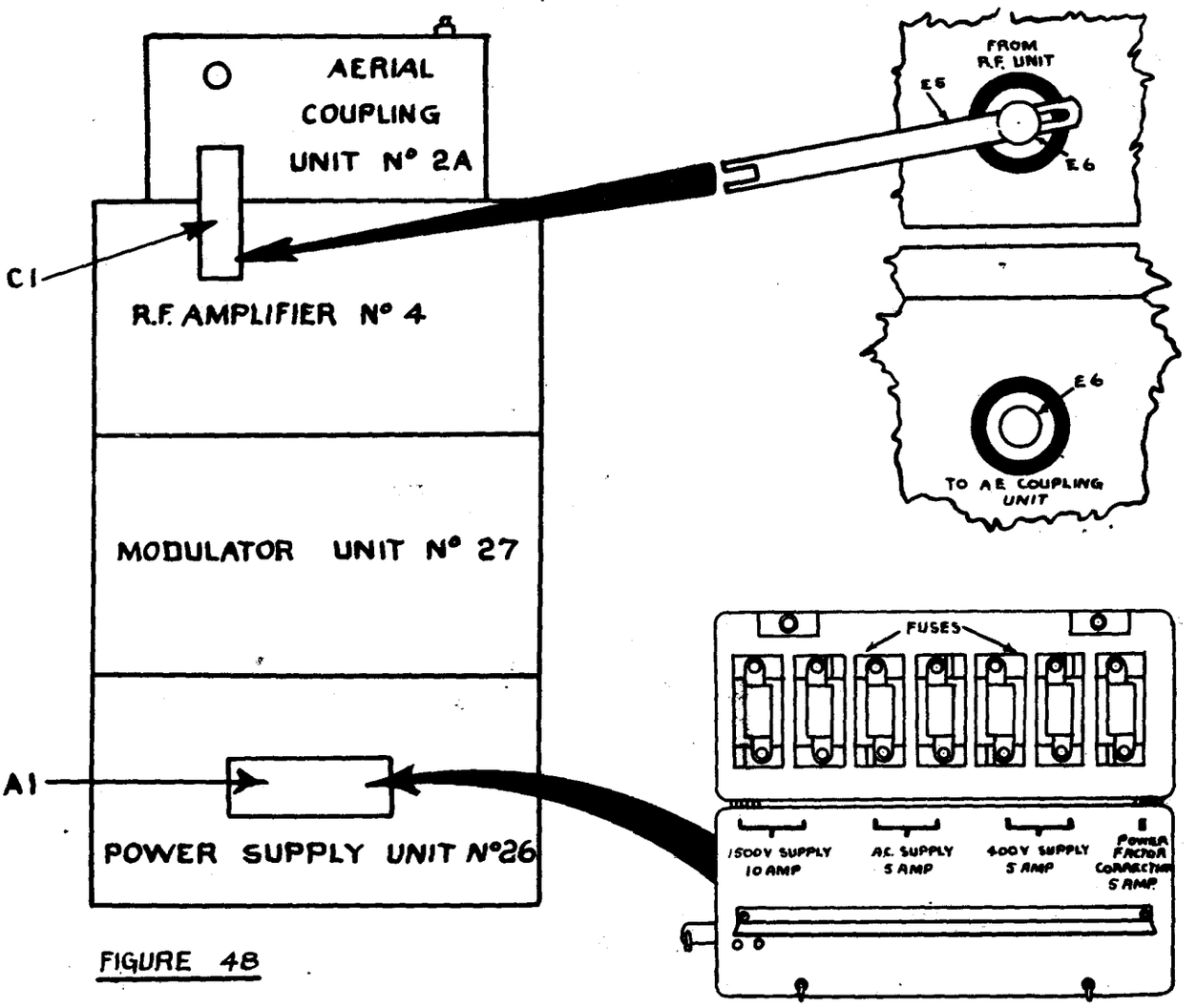


FIGURE 48

(iv) The RF amplifier has two type CV26 valves (C2 Fig.49). See that these are firmly inserted in their sockets and that the top clamping bar is screwed down firmly on the central pillar.

(v) The master oscillator has two type CV1501 (VT501) (C3), one type CV1374 (ATS25) (C4), one type CV572 (6X5G) (C5) and two type CV1110 (AW3) (C6) valves.

(vi) If crystals are to be used insert in any of the four sockets (lettered A, B, C and D) which are at the front left-hand corner of the units Master Oscillator No.2. Record working frequencies on the tablet on the front of the unit.

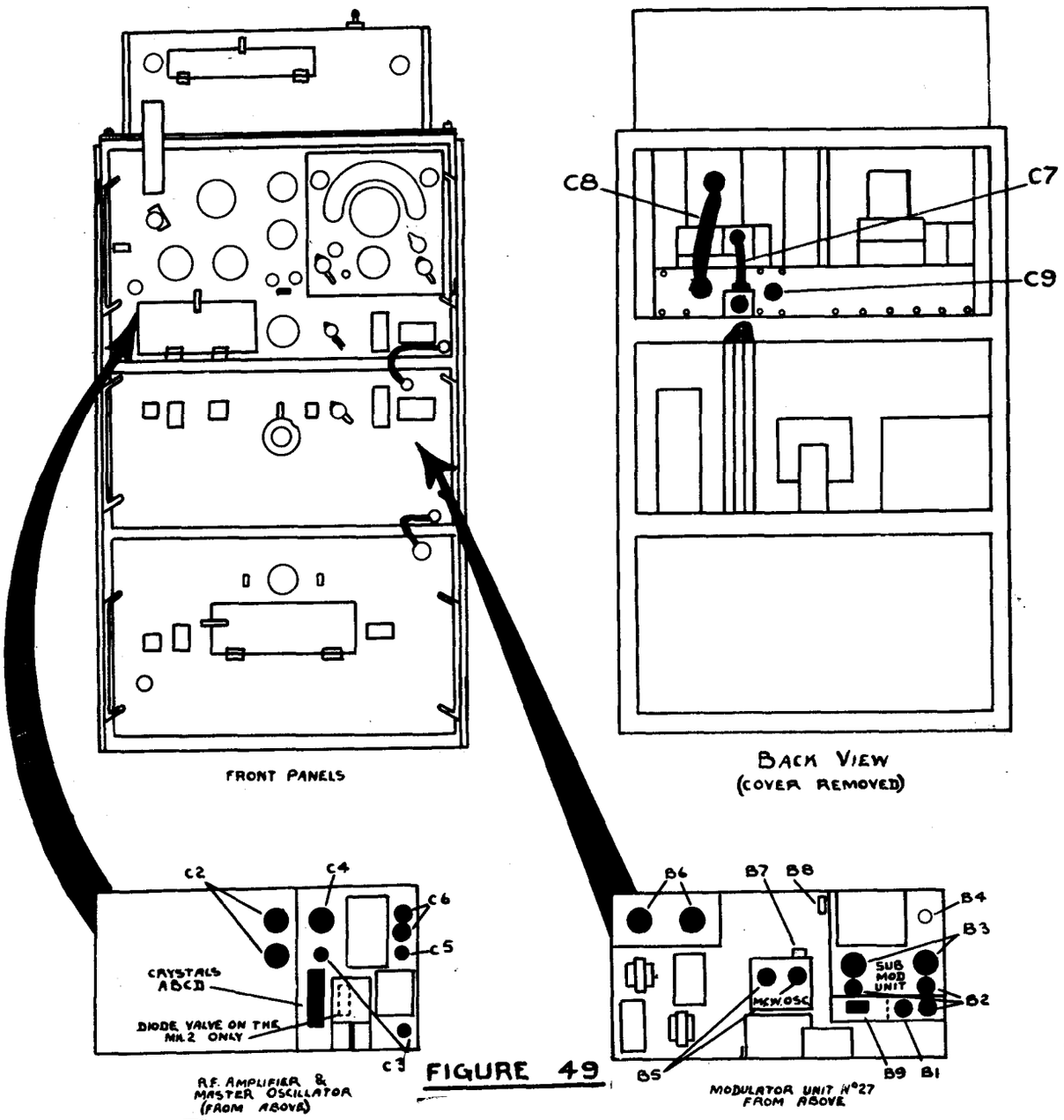


FIGURE 49

(vii) Push unit well back. See that the end of each fastener enters its hole in the frame, turn the fastener heads vertical and press home each in turn.

(viii) Reconnect link on insulators and replace the cover.

(ix) Bulbs. Check that the following three bulbs are inserted and are all 6v. 60 mA. (J type) AC SUPPLY, HT SUPPLY, XTAL CURRENT.

(x) Unfasten the back cover of the sender by turning the fasteners horizontal.

(xi) See that the screened lead (C7) has its two terminating 12-point sockets inserted firmly into the the two 12-point plugs at the rear of unit.

(xii) See that concentric feeder (C8) connects up master oscillator and RF amplifier at back of unit.

(xiii) See that 2-point socket is inserted into plug (C9) at back of unit and that other end of lead is inserted into fan on the rear panel (not shown in illustration). NOTE: The fan is not fitted in the ACV installation.

(xiv) Refasten back cover of sender by seeing that the end of each fastener enters its hole in the frame, turning the fastener heads vertical and pressing home each in turn.

(b) Modulator Unit No.27 (Fig. 49)

(i) Remove all connections to the front of the unit not forgetting the earth connection to the power supply unit.

(ii) Turn the fasteners at the sides of the panel horizontal and pull the unit forward.

(iii) The sub-modulator has one type CV1053 (ARP34) (B1), three type CV581 or CV1932 (6J5G) (B2), two type CV1374 (ATS25) (B3) and one type CV572 (6X5G) (B4) valves. See that these are properly inserted.

(iv) The keying and MCW oscillator unit has two type CV581 or CV1932 (6J5G) valves (B5). Check proper insertion of these valves.

(v) Two type CV177 or CV26 (B6) valves are at the left-hand side of the unit. See that these are firmly secured in their sockets.

(vi) See that the 12-pin socket is inserted firmly into plug (B7) at back of keying and MCW oscillator unit.

(vii) See that a 4-point socket is inserted into plug (B9) at top front of sub-modulator unit.

(viii) See that a 6-point socket is inserted into plug (Plug B8) at rear left of sub-modulator unit.

(ix) Push unit well back. See that the end of each fastener enters its hole in the frame, turn the fastener heads vertical and press home each in turn.

(c) Power Supply Unit No. 26 (Fig. 50)

(i) Remove all connections to the front of the unit.

(ii) Turn the fasteners at the sides of the panel horizontal and pull the unit forward.

(iii) See that two type CV575 (5U4G) (A2) valves are inserted in front left of panel.

(iv) See that two type CV128 (A3) valves are properly inserted in rear left of panel.

(v) Push unit well back. See that the end of each fastener enters its hole in the frame, turn the fastener heads vertical and press home each in turn.

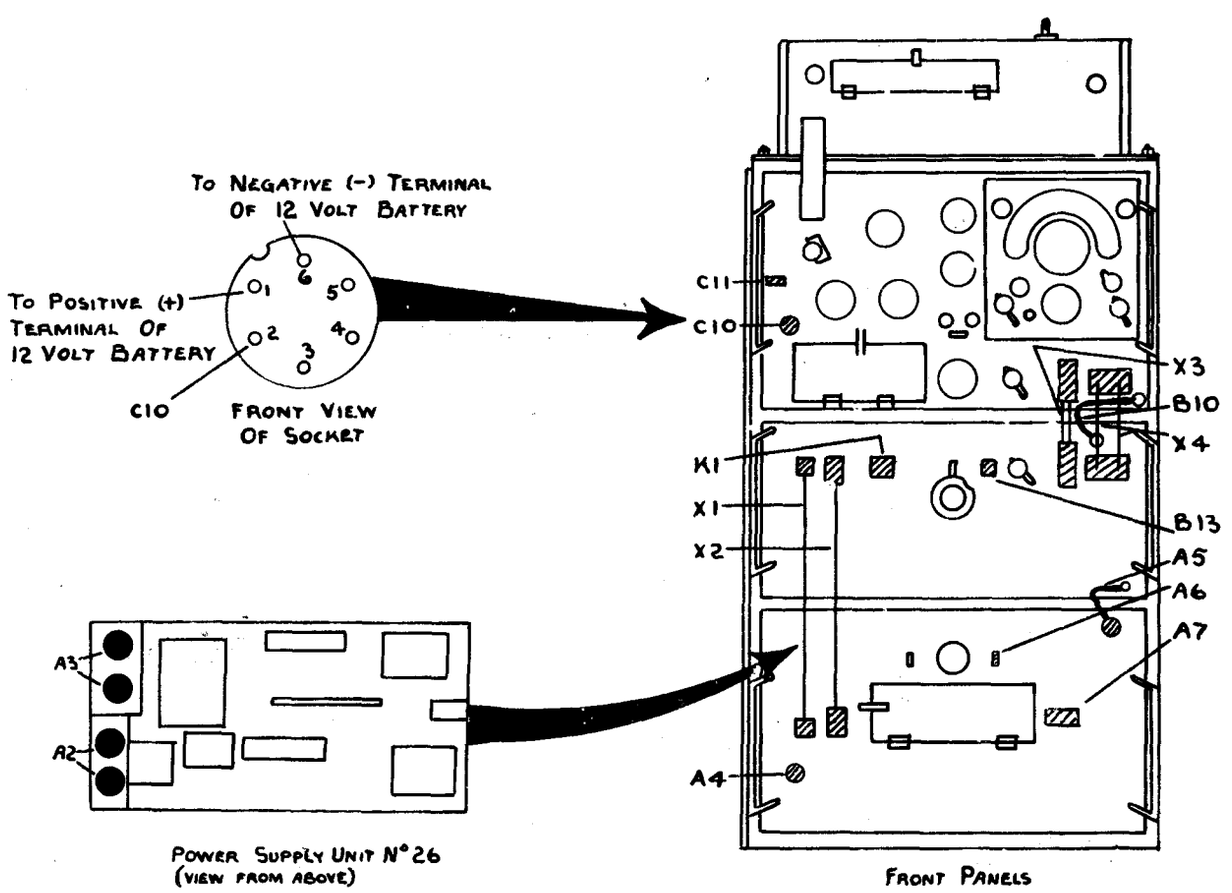


FIGURE 50

B. Connecting Up (Figs 50/51)

(i) Connect EARTH terminal (A4) on the power supply unit to earth. See that the earth connection (A5) is made between the modulator unit and the power supply unit. See that the earth connection (B10) is made between the RF unit and the modulator unit.

(ii) Set the MAIN AC SUPPLY switch (A6) on the power supply unit to OFF.

(iii) Connect AC SUPPLY plug (A7) on power supply unit to source of supply, 230 volts AC 50-500 c/s.

(iv) (a) Connect a 12 volt DC supply, capable of giving 4 amps, to the socket which is inserted into the 6-pin plug (C10) (engraved FROM CONTROL UNIT on RF AMPLIFIER No.4). This should be done as shown in diagram;

alternatively

(b) Insert the 6-pin socket connected to Panel Distribution No.14 into the plug (C10) (see Remote Control Units H Instructions or relevant Installation Instructions).

Note: When Control Unit H No.1 is used connection to the 12 volt supply is through this Unit No.1.

(v) (a) Insert the 4-pin socket of Microphone Hand No.7 into the plug (B13) engraved MIC and SIDETONE FROM CONTROL UNIT on the modulator unit:

alternatively

(b) Insert the 4-pin socket connected to the Panel Distribution No.14 into plug (B13) on the modulator unit (see Wireless Remote Control Unit H Working Instructions Cat. ZA23822 or relevant Installation Instructions).

(vi) Set the FAN ON/OFF switch (C11) on the RF amplifier unit to ON. The exhaust fan should be heard to start immediately. Check that this is so; this is important. Having made certain that the fan is working set the FAN ON/OFF switch (C11) to OFF.

IMPORTANT NOTE: In an ACV the fan is not used but care must be taken to see that the air conditioning equipment is functioning.

(vii) Connect AUX SUPPLIES on power supply unit to modulator AUX SUPPLIES by X1 (Connector 4 pt. 9B).

(viii) Connect 1500V SUPPLY on power supply unit to modulator 1500V SUPPLY by X2 (Connector Single 29B).

(ix) On modulator unit connect local test key to K1 (engraved LOCAL TEST KEY).

(x) Connect AUX SUPPLIES on modulator unit to AUX SUPPLIES on RF amplifier unit by X3 (Connectors 10 pt. 1B).

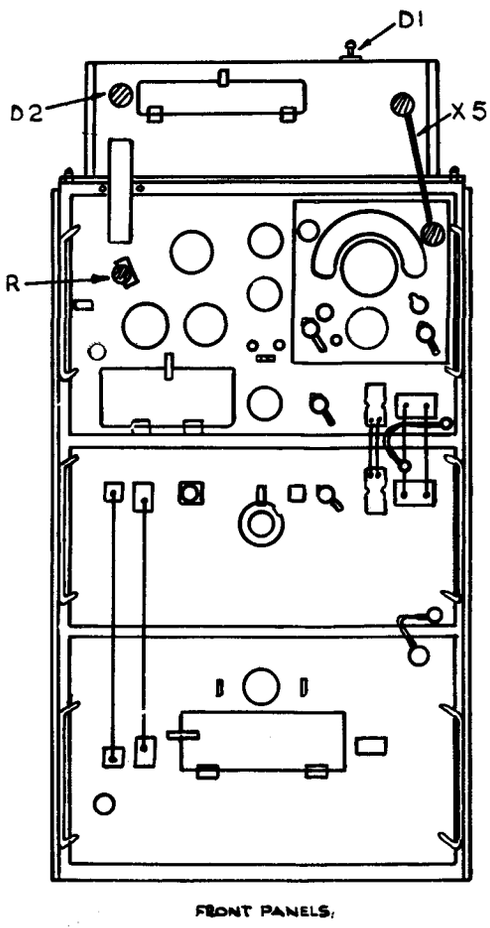
(xi) Connect SCREEN AND HT SUPPLY on modulator unit to SCREEN AND HT SUPPLY on RF unit by X4 (Connectors Twin 189).

(xii) Connect socket at top right-hand corner of RF amplifier unit to socket at top right-hand corner of aerial coupling unit by X5 (Connector Twin 112).

(xiii) Connect the socket on top and at the rear of the RF amplifier unit to the socket on the back of the aerial coupling unit by X6 (Connector Twin No.112).

(xiv) If a 16 ft. V, 34 ft. rod aerial or an end-fed wire aerial is used the connecting lead must be made to D1 on top of the aerial coupling unit. If a horizontal dipole aerial is used connect the coaxial feeder to plug D2 on the front of the aerial coupling unit.

(xv) If R.107 Receiver is used, connect the coaxial plug R to the coaxial plug of the Relay Unit No.1, by coaxial cable.



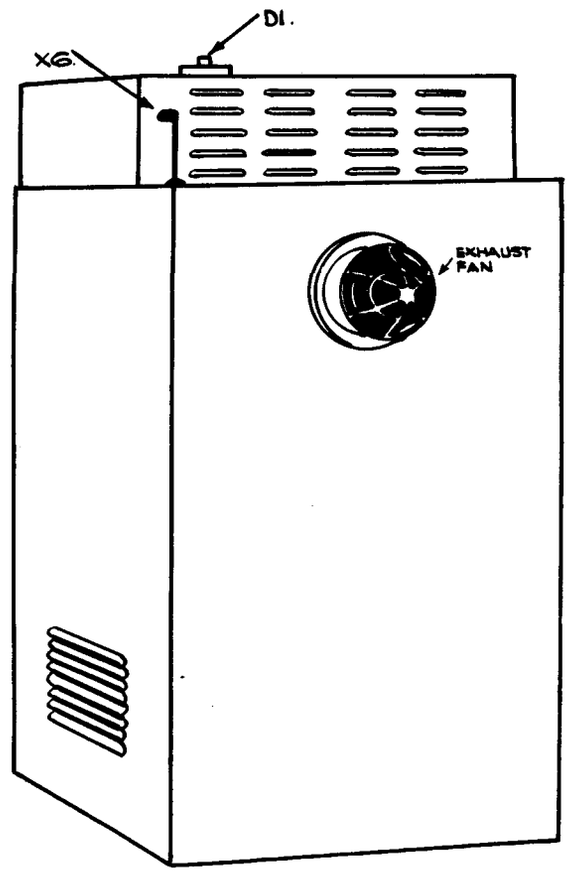


FIGURE 51.

(xvi) If R.209 Receiver is used connect the coaxial plug R to the Plug and Clamp Assembly No. 1 (connected to 80 ohm terminals) on the R.209 by coaxial cable.

C. Summary of Operation

(i) The operation is divided into two main parts:-
Preliminary - no power radiated.
Final tuning - in two parts.

(a) Early stages - two procedures, MO/XTAL.

(b) Subsequent stages - two procedures, aerial coupling series loading.

(ii) Timings

Communications are established by the usual tuning, netting and pause procedure.

Tuning call - $\frac{1}{2}$ min.
Netting call - $\frac{1}{2}$ min.
Pause - 2 mins.

(iii) Control Stations
Preliminary and final tuning followed by tuning and netting call.

(iv) Sub-Stations

Preliminary tuning before control's tuning call followed by final tuning during the 2 minutes pause.

(v) Accurate frequency determination

If a crystal of the correct frequency is available this should always be used as it sets the transmitter accurately on frequency irrespective of MO dial calibration. If, however, MO operation has to be used it is NOT sufficient to rely on the calibration of the MO dial and a wavemeter must be used by the control station to tune the MO to exact frequency. This may be done either by direct pick-up into a wavemeter placed close to the Wireless Sender No. 53 or, when a receiver is used locally, by tuning the receiver to the wavemeter and the Wireless Sender No. 53 to the receiver.

(vi) Use of Receiver with Wireless Sender No. 53

Receivers may be either remote from the Wireless Sender No. 53 or local. Remote receivers may be tuned either by wavemeter or by tuning to the control stations tuning call.

Local receivers are tuned as follows:-

(a) Control Station

(i) MO operation. Receiver switched to CW with BFO control at central position. Tune to zero beat using a wavemeter. This is done at the end of Wireless Sender No. 53 preliminary tuning and before final tuning.

(ii) XTAL operation. Receiver controls as for MO operation. Tune to zero beat using output of Wireless Sender No. 53 during final tuning of early stages (crystal operation).

(b) Sub-station

MO and XTAL operation. Receiver is tuned to control's tuning call. Then with system switch at CW and BFO control at central position it is further tuned to zero beat on control's netting call.

D. Preliminary tuning procedure (Fig. 52/53)

Adjust controls as follows at least 10 minutes before the time fixed for first establishing communications and at each frequency change.

(i) See that the MAIN AC SUPPLY switch (A6) is OFF

(ii) HIGH POWER/LOW POWER AND TUNE switch (A8) to LOW POWER AND TUNE.

(iii) LOCAL HT control (C12) to OFF. If Remote Control Unit is used with the sender put the ON/OFF switch on this unit to ON.

(iv) SYSTEM switch (B11) to CW for MO operation or RT/MCW for XTAL operation.

(v) MCW-RT switch (B12) to MCW. DO NOT PRESS KEY DURING TUNING.

(vi) SYSTEM switch locking switch (B13) to ON.

(vii) RANGE switch (C18) to correct range.

(viii) MO tuning (C17) to approximate frequency, irrespective whether you are working on XTAL or MO.

(ix) MO/XTAL switch (C20) depending whether you intend working on MO or crystal.

(x) (XTAL OPERATION ONLY) XTAL switch (C21) to required crystal for the frequency used.

(xi) DRIVER TUNING (C19) to the approximate frequency.

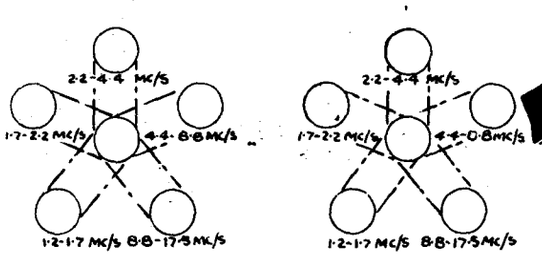
(xii) DRIVE INCREASE (C16) fully anti-clockwise.

(xiii) Open BAND CHANGING door (C22) and put both the band changing links to the correct range. The links may be made to take up any of the positions shown dotted in the diagram. Whatever positions these links are set the links should be firmly clamped by the wing nuts.

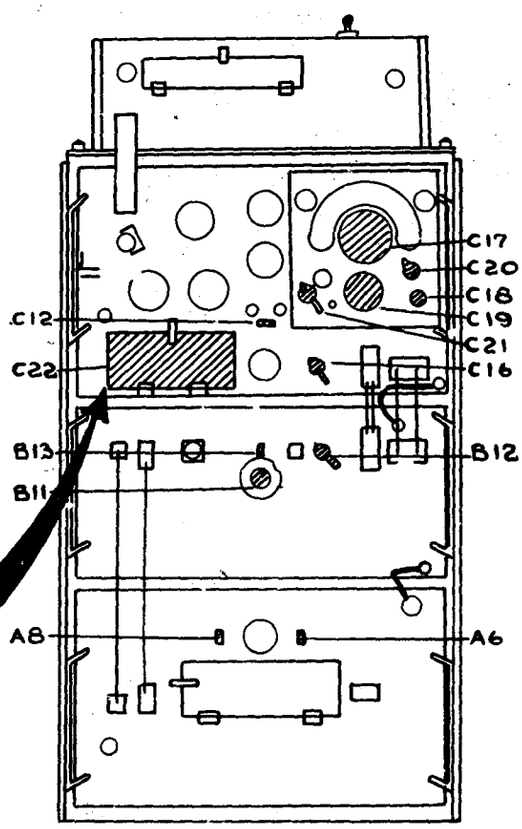
(xiv) Close and fasten BAND CHANGING door.

OUTPUT/CRYSTAL FREQUENCY

RANGE	OUTPUT FREQUENCY Mc/s.	XTAL FREQUENCY MUST BE BETWEEN Mc/s
1	1·2-2·2	1·2-2·2
2	2·2-4·4	1·1-2·2
3	4·4-8·8	4·4-8·8
4	8·8-17·5	4·4-8·8



BAND CHANGING

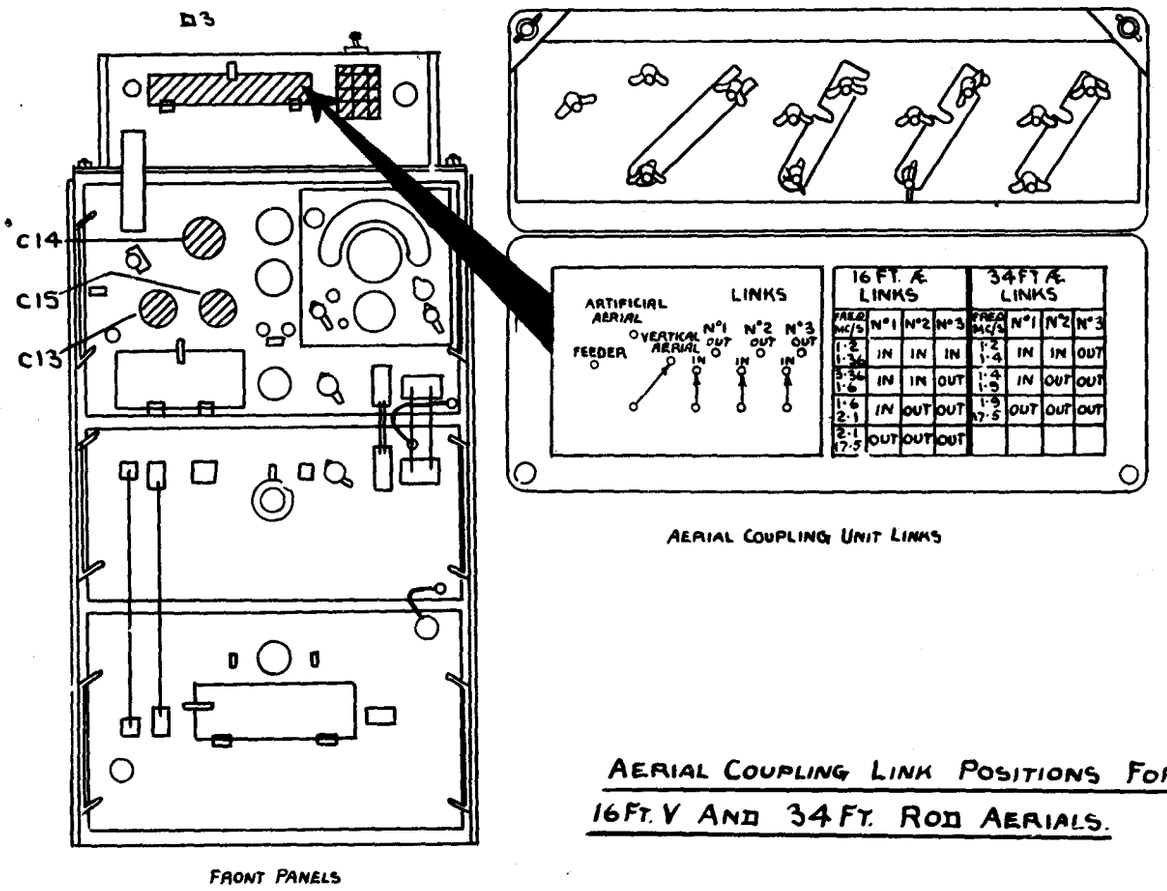


FRONT PANELS

FIGURE 52

(xv) PA TUNING (C15) as given for the required frequency from Table - "Initial Approximate Settings of PA Tuning." Rotate this tuning control until the desired letter and number appear in the small left-hand and right-hand windows respectively above this control, i.e. to set to a frequency of 1.5 Mc/s. the nearest frequency shown on the table is either 1.4 Mc/s. or 1.6 Mc/s. so that we can set the control for a reading of C or D in the left-hand window and 2 in right-hand window. Alternatively say we wish to work on 7 Mc/s. the nearest frequency to this shown in the table is 6.8 Mc/s. so we set the control so that the left-hand window reads F and the right-hand window 5.

(xvi) AERIAL COUPLING (C13) to A-1-0 (control fully anti-clockwise)
A in left-hand window above control
1 in right-hand window above the control
0 on dial against indicating mark immediately above dial scale.



AERIAL COUPLING LINK POSITIONS FOR 16FT. V AND 34FT. ROD AERIALS.

FIGURE 53

INITIAL APPROXIMATE SETTINGS OF PA TUNING

FREQUENCY Mc/s	PA SETTING RANGE 1A
1.2	B1
1.4	C2
1.6	D2

FREQUENCY Mc/s	PA SETTING RANGE 1B
1.8	C5
2.0	D4
2.2	E1

FREQUENCY Mc/s.	PA SETTING RANGE 2
2.2	C6
2.8	E3
3.2	E6
3.6	F1
4.0	F3
4.4	F5

FREQUENCY Mc/s	PA SETTING RANGE 3
4.4	E3
5.2	F1
6.0	F3
6.8	F5
7.8	F7
8.8	G1

FREQUENCY Mc/s	PA SETTING RANGE 4
8.8	F6
10	F7
12	F2
14	G3
16	G3
17.5	G4

NOTE: The PA Setting Range letters and figures must be chosen from the same band as that for which the band changing links are set, e.g. for 1.7 Mc/s. with BAND CHANGING 1.2 - 1.7 Mc/s. PA must be set to RANGE 1A.

(xvii) AERIAL LOADING (C14) to A-1-0 (control fully anti-clockwise)
A in left-hand window above the control
1 in right-hand window above the control
0 on dial against indicating mark immediately above dial scale.

(xviii) Open the door (D3) of the Aerial Coupling Unit and set the left-hand link to:-

(a) FEEDER if using a dipole aerial

or

(b) VERTICAL if using a 34 ft. rod, 16 ft. twin V, or wire end-fed aerial.

Tighten wing nuts so that the link is held firmly in position.

NOTE: The ARTIFICIAL position of the link is only used when testing the sender. DO NOT use during "Wireless Silence" as there is some radiation.

(xix) Set the other three links to positions shown in Table (back of cover D3) (the position depends on frequency) if working on 16 ft. V or 34 ft. rod aerial.

For other aerials all links must be at OUT.

(xx) Close the door of the aerial coupling unit. Do not adjust any other controls given in the tables at this stage of the tuning procedure.

(xxi) Main AC supply switch (A6) to ON (green lamp C23 glows). Check that the supply voltage (M3) is between 220V and 240V. NOW WAIT ONE MINUTE FOR THE VALVES TO HEAT UP BEFORE SWITCHING ON THE HT (Leave the fan switch off as this prevents anyone else, e.g. a staff officer in a CV, from applying the HT).

(xxii) FAN ON/OFF switch (C11) to ON. Check that the fan is working. This is the end of preliminary tuning.

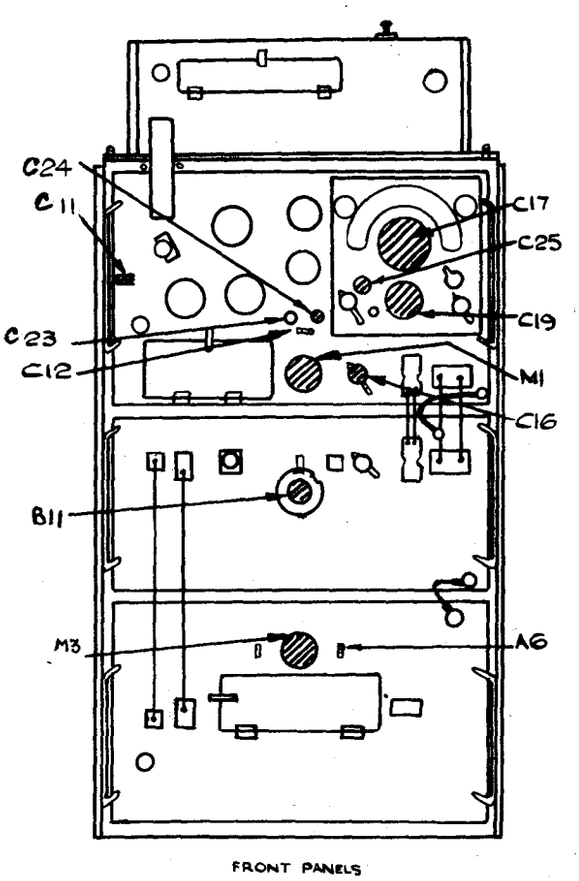


FIGURE 54.

E. Final tuning of early stages - MO operation

(i) LOCAL HT CONTROL (C12) to ON, red HT SUPPLY lamp (C24) glows.

(ii) Rotate MO tuning (C17) to give zero beat either in a wavemeter set to frequency, or in a receiver previously tuned to frequency and with its system switch to CW and BFO in the central position.

NOTE: Although the set is on CW, the key must not be pressed during this operation.

(iii) SYSTEM SWITCH (B11) to RT/MCW.

(iv) Adjust the DRIVER TUNING (C19) for maximum PA GRID CURRENT on the meter (M1), checking that the DRIVER TUNING dial (C19) indicates approximately the correct frequency.

(v) If no current is indicated by the meter (M1), turn the DRIVE INCREASE (C16) one step clockwise and repeat (iv) above. If there is still no current continue to turn the DRIVE INCREASE (C16) clockwise step by step, repeating (iv) after each step, until a current does appear and a maximum is obtained.

(vi) After a maximum has been found with the DRIVER TUNING, turn the DRIVE INCREASE control (C16) clockwise as far as possible without the PA GRID CURRENT exceeding 10 mA. for CW operation, or 15 mA. for RT/MCW operation.

NOTE: If a maximum deflection of the meter does not occur exactly at the figures in (vi) above, the DRIVE INCREASE must be set as near as possible to obtain 10 mA. or 15 mA. The DRIVE INCREASE must never be set, however, so that 10 mA. (for CW) or 15 mA. (for RT/MCW) are exceeded.

DO NOT MISTUNE THE DRIVER TUNING IN ORDER TO OBTAIN THE 10 OR 15 ma.

F. Final tuning of early stages - Crystal operation

(i) LOCAL HT Control (C12) to ON, red HT SUPPLY lamp (C24) glows.

(ii) Adjust MO tuning control (C17) for maximum brilliance of the white XTAL lamp (C25).

NOTE: If control station, now adjust receiver to zero beat from the MO signal.

(iii) Adjust the DRIVER TUNING (C19) for a maximum PA GRID CURRENT on the meter (M1), checking that the DRIVER TUNING dial (C19) indicates approximately the correct frequency.

(iv) If no current is indicated by the meter (M1), turn the DRIVE INCREASE (C16) one step clockwise and repeat (iii) above. If there is still no current continue to turn the DRIVE INCREASE (C16) clockwise step by step repeating (iii) after each step until a current does appear and a maximum is obtained.

(v) Slightly adjust the MO tuning control (C17) to make sure that the PA GRID CURRENT on the meter (M1) is a maximum.

(vi) After a maximum has been found with the DRIVER TUNING, turn the DRIVE INCREASE control (C16) clockwise as far as possible without the PA GRID CURRENT exceeding 10 mA. for CW operations or 15 mA. for RT/MCW operation.

G. Final tuning of subsequent stages applicable to both MO and Crystal operation (Fig 55)

Having tuned the sender for either MO or crystal operation as in Para E and F, proceed as follows:-

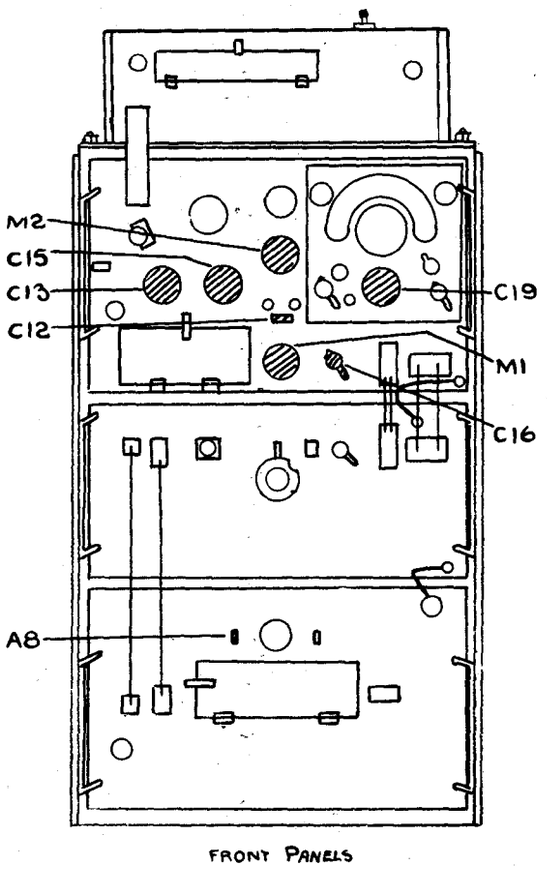


FIGURE 55

(i) Adjust PA TUNING (C15) about 1 turn on either side of the original setting until MINIMUM PA anode current is found on meter (M2).
NOTE: This position is not far from the original setting.

(ii) Check that DRIVER TUNING (C19) is still giving a maximum deflection on the meter (M1), by rotating the DRIVER TUNING (C19) control a small amount in both directions.

(iii) Check that the value of the PA grid current is still correct. If it is not correct, re-adjust the DRIVE INCREASE control (C16).

(iv) Upon the type of aerial and frequency to be used the subsequent tuning depends. Therefore from the Table below determine the tuning method which is applicable.
NOTE: Although a dipole could be erected to cover all frequencies it becomes impracticable to erect a dipole for frequencies of less than 2.3 Mc/s. owing to size.

METHOD OF TUNING FOR DIFFERENT AERIALS AND FREQUENCIES

Aerial	Frequency in Mc/s.	Tuning Method
34 ft. rod aerial	(1-2 - 5.0 (5.1 - 17.5	Series Loading Aerial Coupling
16 ft. twin V	(1.2 - 7.9 (8.0 - 17.5	Series Loading Aerial Coupling
Dipole	2.3 - 17.5	Aerial Coupling
End-fed wire	(1.2 - 7.9 (8.0 - 17.5	Series Loading Aerial Coupling
Artificial	All Frequencies	Aerial Coupling

(v) Having decided from the Table the tuning method to be used, proceed as in Para H Aerial Coupling method of tuning or in Para I Series Loading method of tuning.

H. Aerial Coupling method of tuning

During the succeeding operations, the aerial is coupled directly into the sender.

(i) Rotate the AERIAL COUPLING (C13) a few turns clockwise. The PA anode current as given on the meter (M2) will rise.

(ii) Re-adjust the PA TUNING (C15) for a minimum PA anode current (new minimum will be higher than the old one).

(iii) Repeat (i) and (ii) above until a minimum occurs at 110 mA.

NOTE: Occasionally it will be found that after proceeding in the above manner the PA ANODE CURRENT first of all rises above its initial figure, for example to 80 mA., and then after a further increase of aerial coupling and PA retune, the PA ANODE CURRENT will have fallen instead of increasing in the usual manner, again for example, to 70 mA. Ignore this point and again increase the aerial coupling, when it will be found that a new and higher minimum will be found with increased coupling.

(iv) HIGH POWER/LOW POWER and TUNE switch (A8) to HIGH POWER watching the PA ANODE CURRENT meter (M2). PA anode current should now be 250 mA. If it is not, switch back to LOW POWER and proceed to (v), (vi) and (vii). It must never exceed this figure.

(v) Rotate AERIAL COUPLING (C13) a few turns anti-clockwise if it was more than 250 mA., or a few turns clockwise if it was less than 250 mA.

(vi) Re-adjust PA TUNING (C15) for a minimum PA anode current.

(vii) Proceed as in (iv) above. If the PA anode current still is not 250 mA. carry out (v) and (vi) until 250 mA. is obtained.

NOTE: Always carry out these operations on LOW POWER and TUNE.

(viii) Check readings and control settings against those given in the tables, depending upon the type of aerial used. But note AERIAL LOADING must remain at A-1-0.

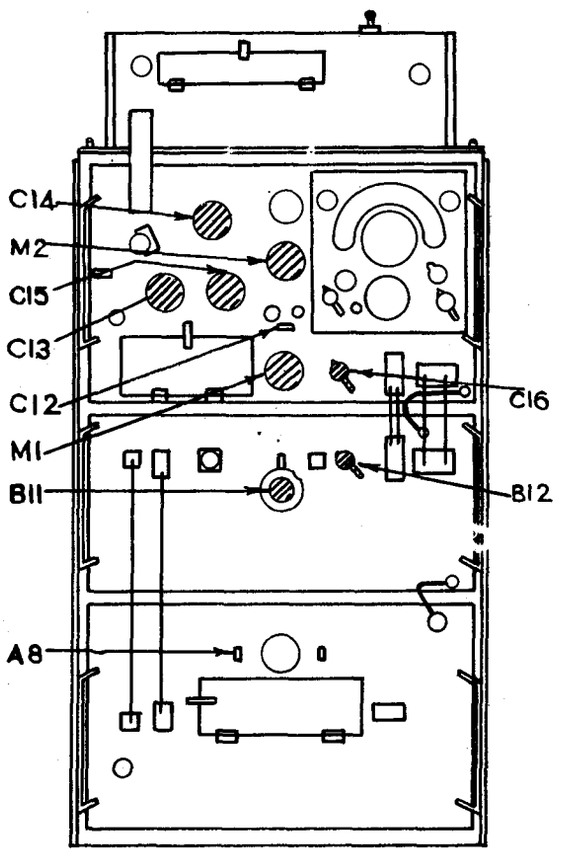
Table 1	16 ft. V aerial	-	page
Table 2	34 ft. rod aerial	-	page
Table 3	Dipole aerials	-	page
Table 4	End-fed wire aerials (66-150 ft.)	-	page
Table 5	End-fed wire aerial (230 ft.)	-	page

(ix) Switch Local HT control (C12) to OFF.

Proceed now to Para. "J".

I. Series loading method of tuning (Fig. 56)

During the succeeding operations, the aerial is loaded and coupled into the sender.



FRONT PANELS

FIGURE 56

(i) Rotate AE COUPLING (C13) to A-3-0.

(ii) Rotate AE LOADING (C14) until PA anode current as given by the meter (M2) rises to a maximum.

(iii) Re-adjust PA TUNING (C15) for minimum PA anode current on meter (M2) (very little adjustment should be necessary).

(iv) If PA anode current is now below 110 mA. rotate AE COUPLING (C13) half a turn clockwise, or if it is above 110 mA., half a turn anti-clockwise. Then repeat (ii) and (iii) above.

(v) Repeat (iv) above until a minimum occurs at 110 mA.

(vi) HIGH POWER/LOW POWER and TUNE switch (A8) to HIGH POWER watching the PA anode current meter (M2). The PA anode current should now be 250 mA. If it is not switch back to LOW POWER and TUNE (A8) and proceed to (vii) below. 250 mA. MUST NEVER BE EXCEEDED.

(vii) Repeat (iv) above again but for a figure above or below 110 mA. until the PA anode current (M2) is correct on HIGH POWER.

(viii) Check readings and control settings against those given in the tables depending upon the type of aerial used.

(ix) Switch Local HT control (C12) to OFF.

J. The following is applicable for both Aerial Coupling and Series Loading methods of tuning

The sender is now correctly tuned for MCW operation.

NOTE: The send/receive switching is done by the key on the local remote control unit.

(i) RT operation

Put the MCW/RT switch to RT (B12) and see that the SYSTEM switch (B11) on the modulator unit is at MCW/RT and that the locking switch is ON as for MCW operation.

(ii) CW operation

(a) Put the locking switch on the SYSTEM switch to OFF.
(b) Rotate the SYSTEM switch (B11) anti-clockwise until CW comes opposite the locking switch.
(c) Put the locking switch to ON.
(d) Put the transmitter to SEND.

NOTE: The send/receive switching is done by the key on the local/remote control unit.

(e) Turn the DRIVE INCREASE (C16) one step anti-clockwise, then press morse key and check that the drive (M1) does not exceed 10mA. and the PA anode current (M2) does not exceed 300 mA. If the drive (M1) is above 10 mA. turn DRIVE INCREASE (C16) one step anti-clockwise. If PA anode current (M2) exceeds 300 mA. repeat either Para H(iv) or Para I(vi) but aiming for a reading of 300 mA. instead of 250 mA.

(iii) Carrier Frequency Shift operation (Teleprinter)

IMPORTANT NOTE: This can be used only on MO operation.

(a) System switch (B11) to CW and locking switch ON.
(b) Set the SHIFT CONTROL to the operating frequency.

NOTE: The locking switch has to be put to OFF before the SYSTEM switch can be rotated. Do not forget to put the locking switch to ON after rotation.

K. Notes of general interest

(i) Dangers from bad earths, filling petrol tanks and climbing on roof of vehicle

(a) The chassis of a CV or other vehicle when stationary must be earthed as efficiently as possible. The earth connection should be short and the earth spike should be well driven into the best ground available. Soft, moist ground is much better than hard stony ground. This is particularly important when external AC mains are used, as fatal casualties have occurred when personnel have ignored this warning or have thought that they had a good earth which was really no earth at all, although the earth spike was driven well into the ground.

(b) Do not climb on the roof of the vehicle while sending. Always switch off the HT and the fan before going on the roof of a vehicle which is sending or see that the HT is switched off when at any time anyone is on the roof of a vehicle.

(c) Always switch off the HT and the fan before the vehicle or generator petrol tanks are filled.

(ii) The importance of correct AC mains voltage

(a) The AC voltage should be kept within ±5% of the 230V. AC which is normally required, i.e. between 220 volts and 240 volts. If these limits are exceeded material damage may be caused either to the valves or the sender.

(iii) The importance of aerial size and swaying of aerial in wind

(a) The sender must never be tuned up on any aerial which is less than 24 ft. in length (equivalent to the 16 ft. twin V).

(b) When using a 16 ft. twin V on the move or in a high wind, swaying of the aerial will vary the PA anode current. Tying back the aerial will prevent this. For details see relevant installation instruction.

(iv) Use of LOW and HIGH POWER

(a) LOW POWER should always be used when this is sufficient. There is no point in operating on HIGH POWER if communication is satisfactory on LOW POWER.

(v) Meter readings, tuning and use of receiver loudspeaker

(a) Make frequent checks of current readings when transmitting.

(b) A figure of 15 mA. is normally the maximum grid current which should be used on R/T operation. It may be found in an old set, where the components have aged, that one position of the DRIVE INCREASE control gives less than 10 mA., and the next step slightly over 16 mA. In these conditions it is preferable to go to the higher value, but in no circumstances whatsoever, should more than 20 mA. be used.

If the drive is too low, it will be found that the minimum PA anode current obtained by adjusting the PA tuning will not coincide with the maximum obtained when turning the AERIAL LOADING, and the controls tend to chase each other.

(c) The figure of 110 mA. PA anode current on 'LOW POWER and TUNE' was chosen because, with an average set, this value will ensure a figure of 250 mA. on HIGH POWER. It may be found on a particular set, however, that when this value is used on LOW POWER, the PA anode current is always either more or less than 250 mA. on HIGH POWER. In these circumstances, the figure of 110 mA. can be modified to suit the operator's convenience, so as to avoid having to readjust after switching to HIGH POWER.

For instance, if the set consistently gives 110 mA. on LOW POWER and 270 mA. on HIGH POWER, then always tune, for example, to 100 mA. on LOW POWER to give 250 mA. on HIGH POWER.

(d) The loudspeaker on the receiver should never be used because a whistle will be transmitted if this is done.

NOTE: The whistle is built up by sound from the loudspeaker impinging on the microphone.

TABLE 1 16-FT 'V' AERIAL

APPROXIMATE FINAL SETTINGS OF CONTROLS

Frequency in Mc/s	PA Tuning	AE Coupling	AE Loading	AE Coupling Unit - Number of links IN
1.2	A.5	A.5	G.2	3
1.36	C.1	A.7	A.6	3
1.36	C.1	A.6	F.4	2
1.60	D.2	A.6	A.4	2
1.60	D.3	A.6	F.6	1
2.10	D.6	A.4	A.6	1
2.10	D.6	A.4	F.6	NIL
2.5	D.5	A.2	E.3	"
3.0	E.4	A.2	D.4	"
3.5	F.1	A.2	C.3	"
4.0	F.3	A.2	B.6	"
4.5	E.4	A.2	B.3	"
5.0	E.7	A.2	B.2	"
5.5	E.2	A.2	A.7	"
6.0	F.3	A.3	A.5	"
6.5	F.5	A.3	A.4	"
7.0	F.6	A.3	A.2	"
7.5	F.6	A.3	A.1	"
8.0	F.3	F.4	A.1	"
9.0	F.1	F.4	A.1	"
10.0	F.6	F.4	A.1	"
11.0	G.1	F.1	A.1	"
12.0	G.2	F.2	A.1	"
13.0	G.2	F.2	A.1	"
14.0	G.3	F.6	A.1	"
15.0	G.3	F.5	A.1	"
16.0	G.3	F.7	A.1	"
17.0	G.4	F.5	A.1	"
17.5	G.4	F.6	A.1	"

TABLE 2 34-FT. ROD AERIAL

APPROXIMATE FINAL SETTING OF CONTROLS

Frequency in Mc/s	PA Tuning	AE Coupling	AE Loading	AE Coupling Unit - Number of links IN
1.2	A.4	A.7	G.5	2
1.4	C.2	B.1	C.2	2
1.4	C.3	B.2	G.5	1
1.9	D.2	A.6	B.1	1
1.9	D.2	A.5	G.3	NIL
2.5	D.5	A.4	D.5	"
3.0	E.4	A.4	C.4	"
3.5	F.1	A.5	B.6	"
4.0	F.3	A.5	B.2	"
4.5	E.4	A.5	A.7	"
5.0	E.7	A.5	A.3	"
6.0	E.7	E.4	A.1	"
7.0	F.4	E.4	A.1	"
8.0	F.7	D.7	A.1	"
9.0	F.6	D.6	A.1	"
10.0	F.7	E.4	A.1	"
11.0	G.1	F.1	A.1	"
12.0	G.1	F.4	A.1	"
13.0	G.2	F.3	A.1	"
14.0	G.1	G.1	A.1	"
15.0	G.1	G.2	A.1	"
16.0	F.5	G.4	A.1	"
17.0	G.4	F.7	A.1	"
17.5	G.4	G.1	A.1	"

TABLE 3 - HORIZONTAL DIPOLE AERIALS

APPROXIMATE FINAL SETTING OF CONTROLS

Frequency in Mc/s.	PA Tuning	AE Coupling	AE Loading	AE Coupling Unit - Number of links IN
2.0	D.4	A.4	)	
2.5	B.6	E.1	)	
3.0	D.7	E.4	)	
4.0	F.3	C.1	)	
5.0	E.4	E.4	)	
6.0	F.2	C.5	)	
7.0	F.3	E.6	)	
8.0	F.3	F.5	)	Not required for dipole operation - can remain at any setting.
9.0	F.5	F.4	) A-1-0	
10.0	F.7	F.3	)	
11.0	G.1	F.1	)	
12.0	G.2	F.4	)	
13.0	G.2	F.4	)	
14.0	G.3	F.5	)	
15.0	G.3	F.3	)	
16.0	G.4	F.3	)	
17.0			)	
17.5			)	

TABLE 4 - END-FED WIRE AERIALS (66-150 FT.)

APPROXIMATE FINAL SETTINGS OF CONTROLS

All links OUT

Frequency in Mc/s.	Length (Ft.)	PA Tuning	AE Coupling	AE Loading
1.2)		A.5	B.2	F.3
1.4)	150	C.4	B.3	D.7
1.55)		D.1	B.4	B.4
1.55)		D.2	A.6	E.7
2.0)	100	D.4	A.7	B.7
2.2)		E.1	B.2	A.7
2.2)		C.7	A.3	D.3
2.7)	66	E.1	A.4	B.7
3.2)		E.6	A.7	A.2
3.2)		E.6	A.7	D.6
3.5)	150	F.1	A.5	B.5
4.0)		F.4	A.5	B.4
4.4)		F.5	A.4	A.5
4.4)		E.4	A.5	C.3
5.0)	100	E.7	A.5	B.7
5.5)		F.2	A.5	B.3
6.0)		F.3	A.5	A.5
6.0)		F.3	A.5	B.3
6.5)		F.5	A.5	A.7
7.0)	75	F.5	A.4	A.5
7.5)		F.6	A.4	A.3
7.9)		F.7	A.4	A.2
8.0)		F.6	E.6	A.1
9.0)		F.6	E.4	A.1
10.0)		F.5	F.3	A.1
11.0)		F.7	F.4	A.1
12.0)		G.2	F.1	A.1
13.0)	150	G.1	F.6	A.1
14.0)		G.2	G.2	A.1
15.0)		G.3	F.5	A.1
16.0)		G.3	G.1	A.1
17.0)		G.4	F.6	A.1
17.5)		G.4	F.6	A.1

TABLE 5 - END-FED WIRE AERIAL (230 FT.)

APPROXIMATE FINAL SETTINGS OF CONTROLS

All links OUT

Frequency in Mc/s.	PA Tuning	AE Coupling	AE Loading
2.1			
2.2	C.7	A.7	G.2
2.3	D.2	A.6	F.1
2.4	D.4	A.6	E.2
2.5	D.6	A.5	D.4
2.6	D.7	A.5	C.7
2.7	E.1	A.5	C.3
2.8	E.2	A.5	B.7
2.9	E.4	A.6	B.3
3.0	E.5	A.7	A.6

9. MAINTENANCE

A. General

Appendix 1 has been designed as a means of recording completion of maintenance tasks, repairs and inspections. It has been produced separately as Army Form B.2661 - Unit Maintenance Log and covers a period of 24 weeks. The completed and current sheets will be kept. The form has been promulgated in Army Orders and may be obtained on indent in the normal manner.

The completion of maintenance tasks will be recorded by initialling in the spaces provided. Repairs and valve replacements will be recorded on the reverse of Army Form B.2261.

Further instructions for the Unit Commander are promulgated in ACI 1076 of 1945.

The following is a list of maintenance tasks to be carried out by the operator. The frequency and order with which they will be carried out will be detailed by the Unit Commander. The tasks are laid down as suggestions to the Unit Commander and he may omit or add to them at his discretion. It is advised, however, that all these tasks are carried out especially in the case of new equipments.

When the set is in continuous use it is impossible to carry out a full task system every day. However, during slack periods some maintenance can be done, for example, the set can be kept clean and a set normally working on, e.g. R/T can be tested on CW and MCW. It is strongly recommended that where a set is in continuous use for long periods it should be withdrawn from service for about six hours at periods of 14 days and given a full maintenance check (i.e. all tasks) by a radio mechanic.

When the set is out of use for long periods it should be run up to full power for a short period every day.

In the field it is usually possible to check the set once a day on an external aerial and this should be done where possible in preference to using the artificial aerial.

B. Tasks

TABLE 6 - STANDARD DAILY TASK

Item No.	Detail
1	Check that all connections including the earth and aerial connections are in order.
2	Clean the exterior of the set.
3	Tune up the set on artificial aerial on each of the following frequencies:- (a) 1.55 Mc/s. (c) 6.05 Mc/s. (b) 3.1 Mc/s. (d) 12.1 Mc/s. Check for the correct operation of all controls and compare the meter readings with those given in Table 7. Report any large discrepancies. (Once a week record these readings (on weekly Record Log sheets, Appendix II) and compare with those of the previous week. Report any discrepancies.
4	Tune up the set using the usual working aerial (rod, end-fed wire or dipole) on an alloted frequency suitable for the length of aerial in use. Check for correct operation.
5	Check the operation of the set on RT, MCW and CW and remote control if connected. (The PA anode current should vary on whistling into the microphone on RT or on keying on MCW. The aerial current should increase slightly.)

TABLE 7 - AVERAGE READINGS

Frequency (Mc/s.)	1.55	3.1	6.05	12.1
AC volts supply	230	230	230	230
Drive setting	2	2	2	4
PA grid current (mA.) CW	11.13	11-13	11-13	11-13
PA anode current (mA.) MCW	250	250	250	250
CW	300	300	300	300

TABLE 8 - TASK NO. 1 (30 MIN.), POWER SUPPLY UNIT

Item No.	Detail
	Do not attempt to lift this unit without assistance
1	Unfasten the two earth connections and withdraw the three plugs from the front panel, looping the leads clear of the PSU.
2	Unfasten and check the action of the three Oddie fasteners each side, and withdraw the unit from the main frame; a 2 ft. x 2 in. wooden batten a few inches in front of the unit will make this simpler.
3	Turn the unit panel upwards, with the bottom facing you, and examine the 1,500 V plug AUX SUPPLIES plug and AE SUPPLY plug for damaged pins and signs of bad contact.
4	Open the fuse door, checking that the two Oddie fasteners operate correctly. Withdraw each fuse holder, clean and examine for burnt contacts: replace firmly. Release door.
5	Dry and dust the tops of the seven condensers under the front edge of the top panel, checking that the wiring is secure. Pay particular attention to the cleanliness of the brown bushings on the four large condensers.
6	Turn the unit on to its left-hand side and dust and dry the tops of the six condensers mounted on the baseplate and now at the top right-hand corner of the unit.
7	Turn the unit back on to its base.
8	Close the HT contactor gently by hand, checking that the contacts make before the contactor has fully closed. Brush the contactor and examine the bakelite for signs of cracking. If the contactor requires adjustment, inform the Radio Mechanic.
9	Brush and dry the components on the top of the chassis, checking that wiring is secure. Inspect the contacts of the TUNE-HIGH POWER and MAINS SUPPLY switches for signs of arcing, and check that the switches operate positively.
10	Check that the four valves are firmly seated, that the CV575's (5U4G's) have retaining rings and springs in working order and that the CV128's have clips gripping the top caps tightly and that the base clamps are secure.
11	Without withdrawing them ensure that the four wire-wound resistors are firm in their clips.
12	Slide the unit back into the chassis (again using a batten if available), steering the Oddie fasteners back into their sockets. Refasten the fasteners and reconnect the three plugs and two earths.
13	Switch the set on and check operation on any frequency without loading into an aerial, i.e. on dummy aerial.

TABLE 9 - TASK NO. 2 (30 MIN.), MODULATOR UNIT

Item No.	Detail
1	Remove the five interconnecting plugs and two earth connections.
2	Unfasten and check the operation of the three Oddie fasteners on each side of the panel.
3	Withdraw the unit from the main frame, standing it on its base.
4	Dust and dry the interior, paying particular attention to the bushings of the condenser in the front left-hand corner. Check the security of all connections whilst doing this.
5	Check that all valves are firmly seated, and that bottom clamping rings on the two CV26's (or CV177's) and the retaining rings and springs on the other seven valves visible are tight
6	Four valves have top cap clips. Check that these make good contact.
7	Withdraw the four-point socket at the front of the sub-modulator chassis, open the hinged lid beneath the plug and check that the two valves are firmly retained and that the top cap of the left-hand valve is secure. Inspect the plug and reinsert the socket.
8	Ensure that the 6-point plug and socket on the left-hand side of the sub-modulator chassis and the 12-point plug and socket on the back of the smaller MCW oscillator chassis are both making good connection. See that both ends of the black coaxial connector running from the system switch are held by their retaining springs. NOTE: The 12-point socket must not be unscrewed unnecessarily and, in any event, before replacement, must be cleaned with a stiff brush and replaced dry.
9	Check that the system switch contacts act positively, paying particular attention to the second contact set from the back; the contacts must slide into position and not just make. See the interlocking HT switch clicks firmly into position on both CW and MCW-R/T. Check the MCW-R/T switch for positive action.
10	Carefully withdraw the two relay covers and examine for cleanliness. Ensure that the relay tags do not foul the cans. Do not attempt to adjust these relays. Restore the covers. If adjustment is required inform the Radio Mechanic.
11	Return the unit to the main chassis; reconnect five plugs and two earths.
12	Tune up on dummy aerial at any frequency, and check modulation and keying as in the standard daily task.

TABLE 10 - TASK NO. 3 (30 MIN.), RF UNIT, PART 1

Item No.	Detail
1	Withdraw the five plugs from the panel and disconnect the earth. Remove the box covering the strap to the aerial coupling unit and disconnect strap.
2	Unfasten three Oddie fasteners each side and check that they operate correctly.
3	Remove RH side panel of the sender and disconnect fan plug, inspecting lead for wear, and check commutator and brush gear on fan.
4	Withdraw the unit and place base downwards on the floor.
5	Clean carefully with a dry rag the aerial loading coil, including the contact wheel and bar. Do not twist the contact bar or the fragile contact strips at the ends will be damaged.
6	Turn the control knob to A-1-0 and check that there is between one half and one turn between the contact wheel and the back end of the coil.
7	Rotate the control knob steadily to G-5-340, watching the contact wheel and checking its contact along the length of the coil, and testing for smooth operation of the control.
8	Check that there is between one half and one complete turn left between wheel and front of coil.
9	Inspect the semi-flexible coupling between control knob and coil for signs of fracture.

(TABLE 10 cont.)

Item No.	Detail
10	Carefully rotate the control knob against the stop to check that the friction clutch slips smoothly.
11	Test the lock on the control dial for satisfactory operation.
12	Repeat Items 5-11 for aerial coupling coil.
13	Repeat Items 5-11 for the PA tuning coil.
14	Return the unit to the main chassis, steering the Oddie fasteners into their holes.
15	Reconnect fan plug and replace side panel.
16	Refasten Oddie fasteners and replace five plugs, one earth and the strap and cover to the aerial coupling unit.
17	Tune up and load the sender on CW on alloted frequency to check operation, using the normal aerial.

TABLE 11 - TASK NO. 4 (30 MIN.), RF UNIT, PART 2

Item No.	Detail
1	Withdraw the unit as detailed in Table 10, placing it on its base.
2	Dust and dry the top of the aerial change-over contactor, examining the top connections for signs of burning. Ensure that the connecting leads are firm and well spaced from each other.
3	Clean and dry the porcelain insulators on the aerial connectors on the front panel and check that connections are tight.
4	Check that the PA valves are firmly held in their sockets and that the top connecting bar is secure.
5	Make sure that the internal wiring in this part of the unit is well spaced, paying particular attention to the leads to the three tuning coils and to leads near the aerial current meter. Always report any signs of arcing or burning.
6	Do not turn the unit on to its front without a support as the main tuning control will be damaged. A small wooden block or metal box from the link to the aerial coupling may be used. Turn the unit on to its front panel, avoiding pressure on the earth terminal when turning over. Examine the contacts of the aerial change-over contactor for signs of arcing. Gently close the contactor by pushing under the central operating link with a screwdriver or pencil, checking that the contacts make firmly and smoothly, closing the centre pair first.
7	Clean and dry the white porcelain bushing leading through the chassis in between and at the rear of the tuning inductors.
8	Check that the 12-point connector (see note on Table 9, Item 8) and coaxial connectors between the MO unit and the PA unit are firm and that the test links on the back of the MO unit are not loose.
9	Turn the unit on to its base again. Ensure that the six valves in the MO unit are firm in their sockets, and check the three top cap clips and the CV1374 (ATS 25) retaining ring for tightness. DO NOT INTERFERE WITH THE WIRING OR TRIMMERS.
10	Restore the unit to the chassis.

TABLE 12 - TASK NO. 5 (30 MIN.), RF PANEL AND AERIAL COUPLING UNIT

Item No.	Detail
1	Withdraw all plugs from the RF panel, and examine for defective pins. Replace.
2	Open BAND-CHANGE gate, checking the Oddie fasteners for correct operation, clean all link insulators and dry. Examine all links and terminals for tightness.
3	Tune up the unit on any frequency and dummy load, and check all controls for smooth working and all switches for positive action.
4	Check that the following lamps are working:- (a) AC SUPPLY (b) HT SUPPLY (c) Dial lights (two) (d) Aerial current meter lamp (e) PA anode current meter lamp (f) Crystal current
5	Switch off the sender. Open the AERIAL LINKS gate in the aerial coupling unit. Clean and dry both sides of the insulator on the link to the RF amplifier. Check that this link is tight.
6	Examine the other links and butterfly nuts for free operation.
7	Clean the large aerial condenser on the top of the aerial coupling unit, if accessible, and check the tightness of the aerial connectors.
8	Close the AERIAL LINKS gate.
9	Clean and dry the insulator on the aerial base.

TABLE 13 - TASK NO. 6 (30 MIN.), DC OPERATING CIRCUITS, ETC.

Item No.	Detail
1	Tune up the sender on any frequency with AE COUPLING and AE LOADING at zero and LOW POWER and TUNE/HIGH POWER switch at TUNE, but do not load; use the LOCAL HT CONTROL.
2	Switch the HT ON-OFF switch up and down. Check that HT contactor operates quickly and firmly, and see that the HT SUPPLY lamp is extinguished in the OFF position.
3	Switch LOCAL HT control OFF and ON, checking that the AE change-over contactor operates quickly and firmly, that the HT SUPPLY lamp is extinguished in the OFF position, and that the HT contactor in the power supply unit closes firmly and opens quickly.
4	Switch FAN OFF and ON, checking that the HT contactor is opened in the OFF position.
5	Switch to HIGH POWER and check that the PA anode current is approximately doubled. Restore to TUNE.
6	Remove the right-hand side panel of the sender; check that the gate switch has operated. Switch HT OFF and replace panel. Repeat for the rear and right-hand panels, if accessible. In ACV installations check any additional gate switches at this stage.
7	Switch ON and open the AE LINKS gate to check that gate switch operates. Switch HT OFF. Close gate.
8	Switch ON, open the BAND-CHANGE gate to check gate switch operation. Switch HT OFF. Close gate.
9	Switch ON; carefully withdraw SCREENS AND HT SUPPLY plug from RF amplifier. Check that this safety switch has operated. Switch HT OFF. Replace.
10	Repeat 9 for the modulator unit end of this connector.
11	Repeat 9 for the modulator unit end of the HT connector to PSU.
12	Repeat 9 for the PSU and of the HT connector to modulator unit.
13	Switch ON. Open the fuse gate on the PSU. Check that gate switch has operated. Switch HT OFF. Close gate. Switch HT ON.
14	Load the sender on dummy aerial to test operation. WARNING: Repeated switching of the HT ON and OFF on HIGH POWER will cause more damage to the HT contactor than the normal operation of the set. Check that the HT contactor opens freely at the end of the test.

C. Monthly Maintenance Task

This task is to be carried out by a Radio Mechanic.

(i) Inspect Maintenance Log of Sender. Have all tasks been carried out regularly? If not, report to the Section Officer.

(ii) Is there any irregularity or steady decline in any one of the meter readings logged by the operator? If so, test immediately for a fault or change the valve concerned.

(iii) Withdraw the R.F. Amplifier and remove the base plate.

(iv) Lubricate the spindle of the three tuning inductances with Oildag. or, if none, is available, a thick oil, and clean the contact wheel rods thoroughly.

(v) Lubricate the drive between the M.O. tuning dial, and the main condenser, and the joints in the operating links for the RANGE 1-2, 3, 4 switch with thin oil and grease the rim of the locking cam on this switch.

(vi) See that the gate switches are full of grease.

(vii) Apply 12v. D.C. to the aerial change-over contactor coil and check that all contacts make and break cleanly. Clean with methylated spirits and, if burnt, with a very smooth file or with fine emery paper.

(viii) Turn the three inductances to G-5-90 and check that both ends of the contact wheel rod are correctly spaced from the coil. (see Para. D, sub-para v).

(ix) Clean the insulators and the porcelain mounting pillars of the three condensers under the chassis, and the insulators of the metal can condensers at the M.O. end of the unit.

(x) Clean the insulators at the rear of the band-changing links panel.

(xi) Inspect sub-chassis components, especially valve bases, for loose connections. Check spacing of 'hot' wiring above the chassis. Replace base plate.

(xii) Remove and inspect fan. Clean commutator and ensure that the brushes are not unduly worn. Replace latter if necessary. Remember that this is a mechanical device which is in action for the whole period of sender operation and the wear is correspondingly heavy. Replace R.F.A. in chassis.

(xiii) Withdraw the modulator unit. Open the lid on the sub-modulator chassis and examine the ball insulator spacing the top cap lead on the ARP 34, V7A, from the top cap for cracking and incorrect spacing.

(xiv) Check that the automatic gain control potentiometer (at rear of sub-modulator) is tightly locked by the three grub screws; readjust if loose or if V3A has been changed.

(xv) Check that the potentiometer screw in the centre top of the M.C.W. and Key unit is tight and that the three grub screws are accessible, readjust if loose or if V6E has been changed.

(xvi) Withdraw the two relay cans on the M.C.W. and keying unit; ensure that the relay contacts are well clear of the cans. Adjust the relays.

(xvii) Replace unit in chassis.

(xviii) Extract PSU fuses and examine for partial breaks, replacing defective fuse wire.

(xix) Slide the PSU three-quarters out of the chassis. Apply 12v. D.C. to the coil of the H.T. contactor, checking that contacts make firmly. Adjust, Clean the contacts with a cloth and methylated spirits and, if pitted, clean with very smooth file or fine emery cloth.

(xx) Examine the tops of the 1,500v condensers for signs of arcing; clean the bushings.

(xxi) Re-connect all units and tune on a dummy aerial to 3.4 Mc/s. Check all meter readings with those obtained in operator's maintenance.

(xxii) Adjust all meter zeros after switching off the power supply; recheck readings and insert the corrected readings in the maintenance log if they differ from those obtained in (xxi).

(xxiii) Remove the rear panel shorting out the gate switch as previously explained.

(xxiv) Swing the test link "V1A anode Current" to one side and connect an Avometer or equivalent milliameter across the terminals, and switch on; tune up on M.C.W. to 1.55, 3.1, 6.05, 12.1 Mc/s and check the current readings. Switch off. Replace link. Log all readings.

(xxv) Repeat (xxiv for "V1B anode current").

(xxvi) Repeat (xxiv for "V2A grid current").
(xxvii) Repeat (xxiv for "V2A anode current").
(xxviii) Remove the gate switch short; replace side panel.
(xxix) Check M.O. calibration with W/M Class "D", or, after valve change or circuit repair, with a calibrated R107. Log the error at the top and bottom of each band.
(xxx) Complete and sign maintenance sheet.

D. Adjustments

(i) M.C.W. Level control

When correctly adjusted the output from the M.C.W. Oscillator should be sufficient to give full modulation to the carrier, but must not be so great as to cause over-modulation. It is difficult to make any direct measurement of the degree of modulation without the use of a cathode ray oscilloscope. This latter piece of apparatus may not necessarily be available but it is found that, when the M.C.W. Oscillator is developing its correct output, an Avometer Model No. 7 switched to the 10v A.C. range will read 1v when connected across the side-tone output of the modulator, (i.e. between pin 2 of plug "D" and earth).

The modulation compressor V5B will obviously affect the amplification of the speech amplifier. If it is working correctly it should not operate until the modulation exceeds about 90%. In order that this valve may be correctly adjusted later, it must be removed when adjusting the M.C.W. level.

The procedure for adjusting the M.C.W. Oscillator is as follows:-

(a) Unlock the 3 grub screws on the hexagon head of R18A. (See Fig. 57.).
(b) Adjust the centre screw until the meter reads 1v.
(c) Lock the 3 grub screws.

Note: Without extending the leads to the modulator unit this control is difficult of access. It is therefore necessary to remove the various inter-connection plugs before it is accessible, and the adjustments will have to be made in steps with the H.T. off, and then checked with the H.T. on. Alternatively the chassis' may be removed from the main frame and connected together on the test bench as described in Para. E sub-para. 1.

(ii) Automatic Modulation Control

After adjusting the M.C.W. level, as explained in para. (i), the modulation compressor can now have its bias so adjusted that it will just operate at approximately 90% modulation. The general procedure is as follows:-

(a) Restore the 6X5G valve V5B.
(b) Withdraw the modulator Unit as far as possible from the main frame and remove the right hand side panel.
(c) Short out the main frame gates by withdrawing the 2-hole socket on the Aerial Coupling Unit and connecting its terminations together with a spare piece of wire.
(d) Loosen the 3-grub screws on the hexagon head of R18B in the speech amplifier sub-assembly, (see Fig. 57) and adjust the centre screw until the meter reading of 1v, obtained in the previous adjustment of the M.C.W. level control, is slightly reduced.

The modulation gain control will now be just operated and therefore if on R.T. this degree of modulation is exceeded, then V5B will prevent over modulation of the sender.

(iii) H.T. Contactor

This contactor needs careful adjustment. The contacts pivot about a rod held in a bracket towards the bottom of the contactor by a bent pin at one end and a split pin at the other. To adjust, proceed as follows:-

(a) Remove the bent pin and pull the pivot rod from the split pin end.
(b) Lift the armature assembly gently backward until it is vertical. A brass screw will now be exposed on the tail of the armature. This adjusting screw bears on the actual frame and limits the travel of the contactor.
(c) Adjust the screw by trial to give a travel of a $\frac{1}{4}$ inch.

Should the relay be slow or hesitant in breaking, the spring which is connected to the tail of the armature can be tightened by unscrewing the anchor screw on the armature tail and cutting off a few turns of the spring before replacing.

The contacts of this relay should be frequently inspected and cleaned with emery cloth.

(iv) M.C.W. and Keying Relays

The sequence of adjustment for these high speed relays is as follows:-

(a) Loosen locking screws and withdraw both contacts. Withdraw tension screw. Check that contacts are clean and that the armature is not kinked.
(b) Carefully bow the armature towards the break contact. It will probably be necessary to remove the armature to do this. When replacing the armature, care must be taken that the armature contacts are aligned with the make and break contacts, and that the spring lines up with the rear pole face.
(c) Press armature gently against the pole faces and advance the make contact until it just touches the armature. Release the armature and give a further $\frac{1}{4}$ inch turn forward. Tighten the locking screw.
(d) Set break contact to give an armature travel of 4-5 mils.
(e) Adjust milled pressure screw to give an armature pressure of 5-10 grams back on the break contact. Check that the detent engages with the milled edge of the pressure screw head.

(v) Inductance Coils

The correct wheel position on the three tuning inductances is such that on A - 1 - 0 and G - 5 - 90 there is at least one half-turn between the wheel and the coil end.

The contact wheel rod must also be maintained at a certain minimum distance from the coil to prevent flash-over between the coil and the rod; when the indicator is at G - 5 - 90 the rear end of the rod must be at least 3/16 inch from the former. If the rod gets closer to the coil than this, a piece of wire may be soldered to the end of the contact rod so as to maintain this minimum spacing.

Never use any lubricant on these inductances as it may cause arcing and overheating.

(vi) Meter Zeros

Especially when the sender is installed in a vehicle, the meters may not maintain their correct 'zero'. To overcome this the grid current and A.C. supply meters have zero adjusting screws accessible from the front. The method of adjustment is obvious, but it is important that operators be not allowed to interfere with these adjusters.

The PA anode current and aerial current meters are also supplied with adjusting screws, but as they are mounted on a separate sub-panel behind a glass window, this panel will have to be removed before they can be adjusted.

This, it will be found, will necessitate removing the leads from the meters and undoing four screws. To ensure meter accuracy make sure when restoring the leads that they do not lie close to the chassis.

(vii) Calibration

The usual method of checking the calibration of the Master Oscillator is to use a wavemeter Class 'D'. The Master Oscillator can then be sent at suitable points throughout the range and "zero beated" with the wavemeter. When calibrating, the sender should be switched to "Tune" with the R.F. amplifer undriven (ie.. drive control to minimum).

Should the above test show that the M.O. is more than 50 Kc/s off calibration then a calibration chart should be prepared using a calibrated R107. In this case, of course, it is merely necessary to make a graph with the correct frequency on the horizontal axis (from the R107 dial), and the error above or below the correct frequency on the vertical side.

Should the M.O. calibration error exceed 3% it will need readjustment.

Royal Signals personnel must not carry out this re-alignment and sender must be sent to workshops.

E. Fault Finding

(i) General

As the Power Supply, Modulation and R.F. sections of the 53 Set are mounted on separate chassis' completed enclosed in a mounting rack, it is impossible to remove either the R.F. unit or the Modulator unit for testing purposes or fault location without disconnecting the power supplies essential to the operation of the unit.

Unless, therefore, special extension leads are constructed, fault location will have to be done by external tests and point to point resistance checks. The tests that can be made without dismantling the various assemblies and sub-assemblies are however limited and incomplete. Thus, it is practically essential to construct the necessary extension leads and to mount the various chassis' and sub-chassis' on the test bench. By these means every component is accessible under working conditions. Great care however is needed as HIGH VOLTAGES are present.

Before testing, all chassis' should be linked and earthed to avoid high voltages between chassis'.

Remember that it is usually possible to localise a fault to a given circuit merely by the intelligent use of the various controls and meters, before dismantling the set.

Having localised the fault to a given unit or circuit the tests that follow should enable the faulty component to be found.

WARNING: All valves and bulbs can be changed and fuses replaced by the operator. All other faults must be reported for a Radio Mechanic to carry out necessary repairs.

The faults listed are given as a general guide but it is advised that the Radio Mechanic should consult the W.S. 53 EMER where he will find a more complete fault table.

Table 14 gives some common faults and their causes which may assist in localising the faults, other tables given information for checking the voltage and current readings which should be obtained.

The Test Panel is located on the rear of the M.O. unit chassis and is accessible by removing the rear panel of the mounting rack. When the set is mounted in a vehicle it is necessary to mount the set on the test bench before the test panel can be used. Table 15 gives the average readings obtained for the conditions shown.

Table 16 gives some useful figures for checking the power supply system.

Any given stage can (to a large extent) be checked for correct operation from Table 17.

Complete component location diagrams and parts lists are given. It should be noted that the numbering of components is different from that given in the relevant EMER.

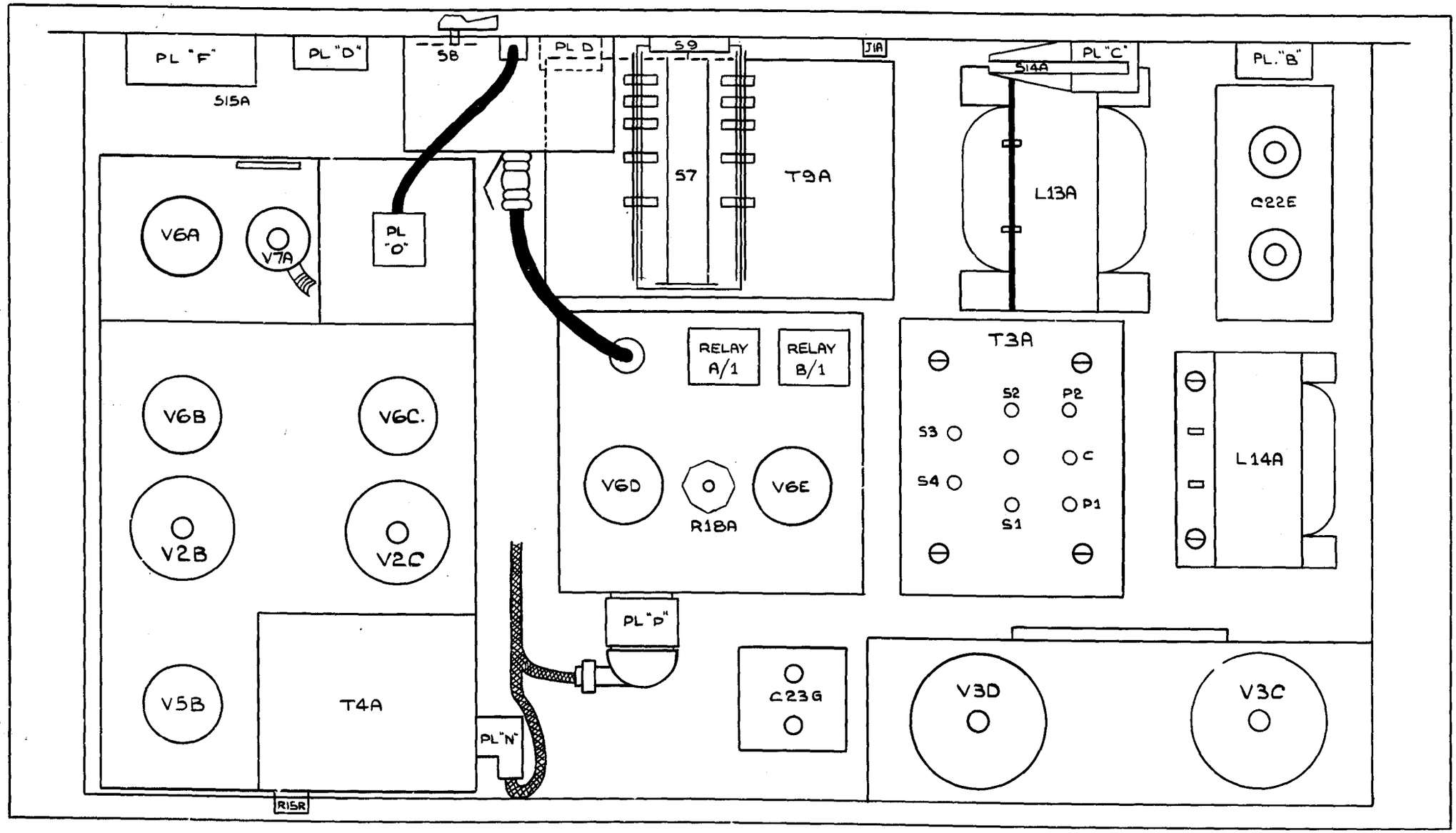


FIGURE 57. MODULATOR UNIT No 27.

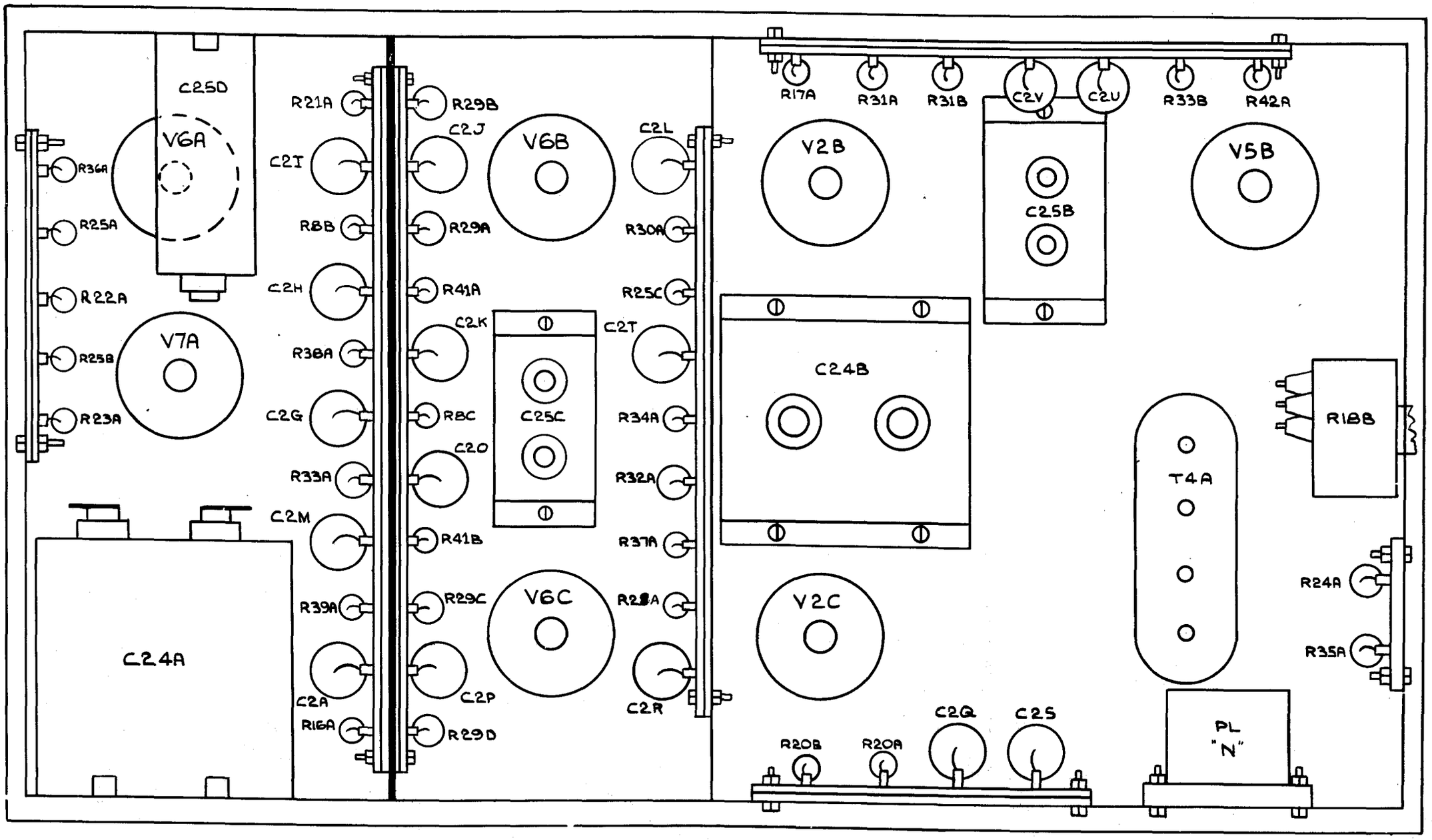


FIGURE 58. MODULATOR SUB-ASSEMBLY. (UNDERSIDE).

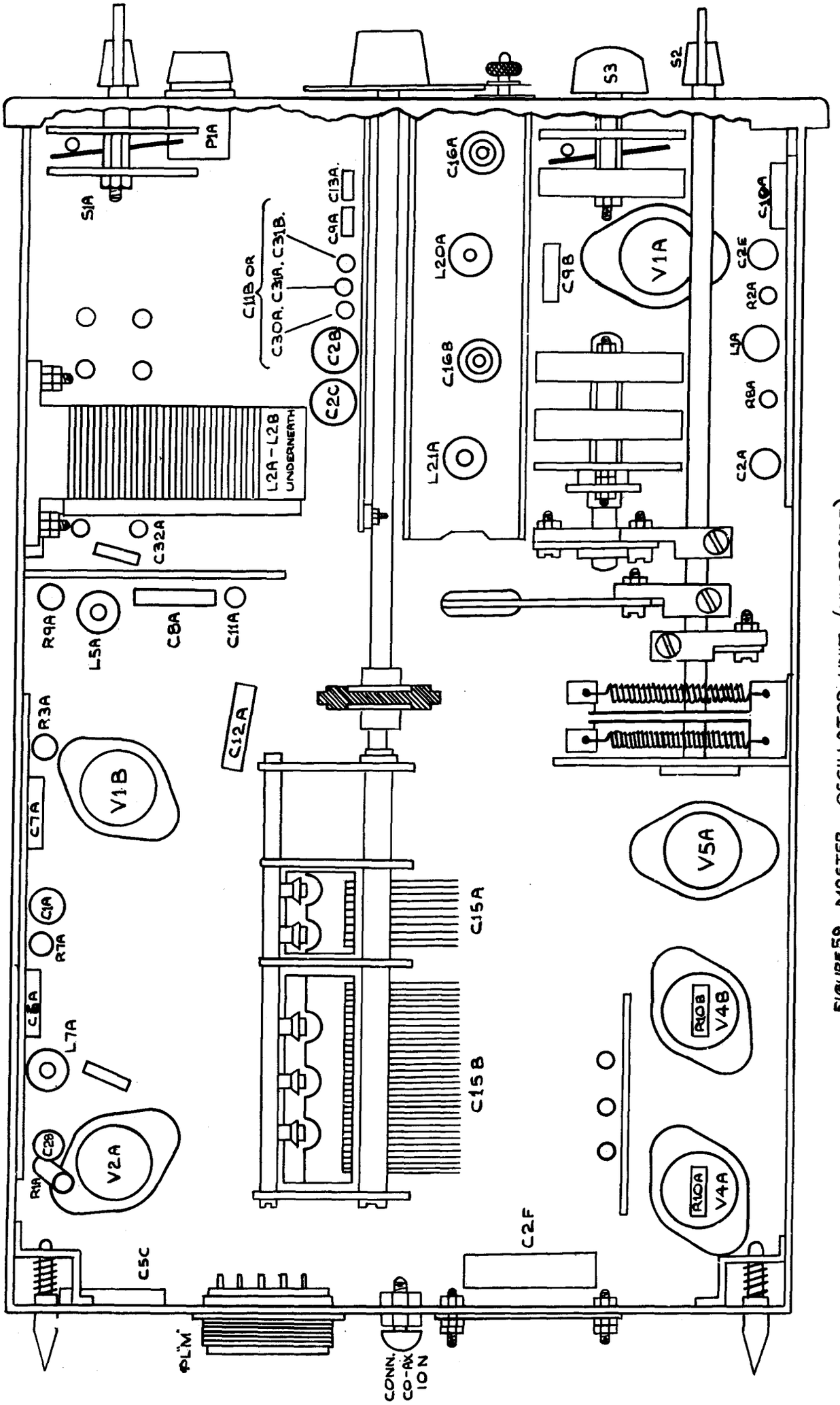


FIGURE 59 MASTER OSCILLATOR UNIT (UNDERSIDE).

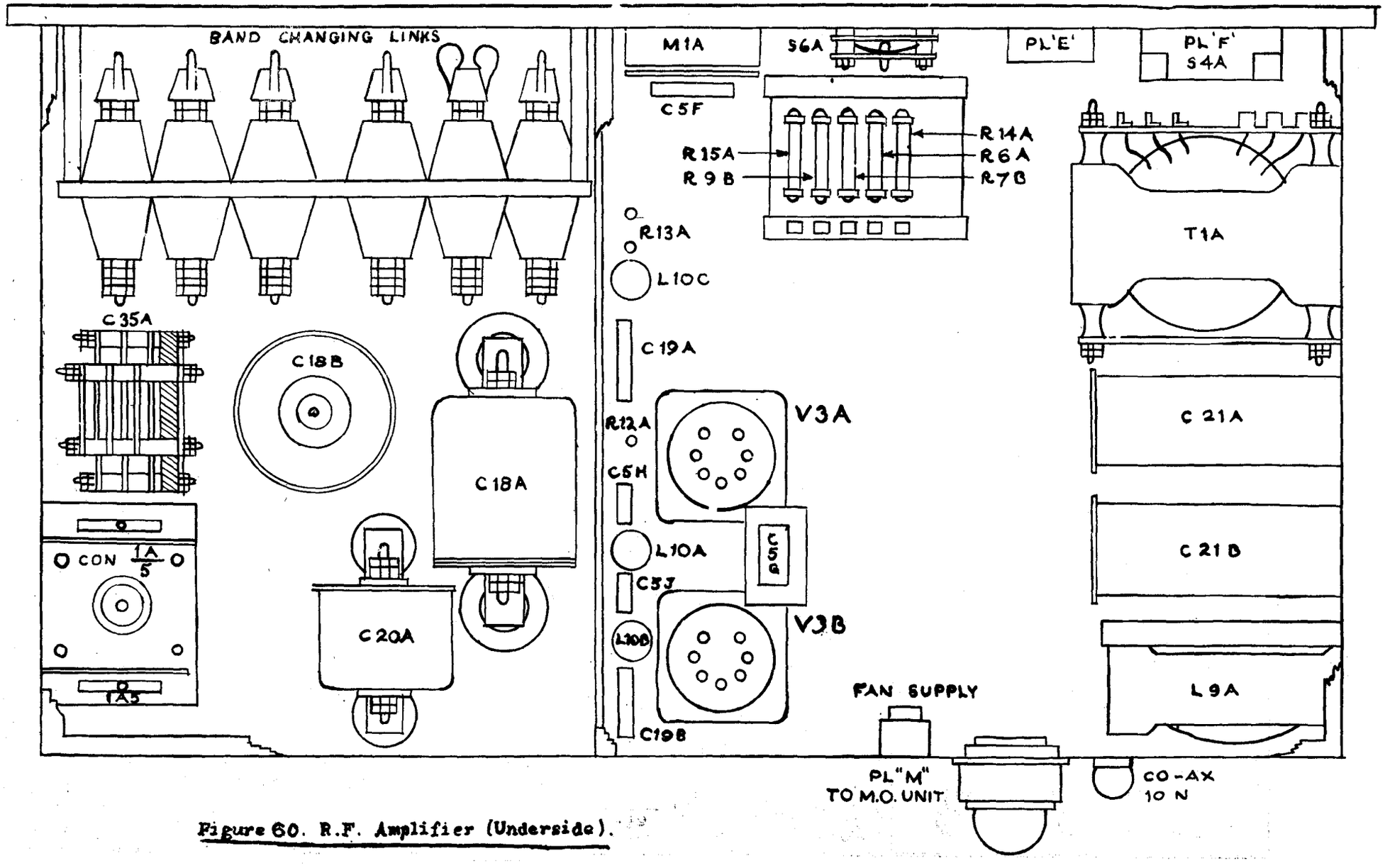


Figure 60. R.F. Amplifier (Underside).

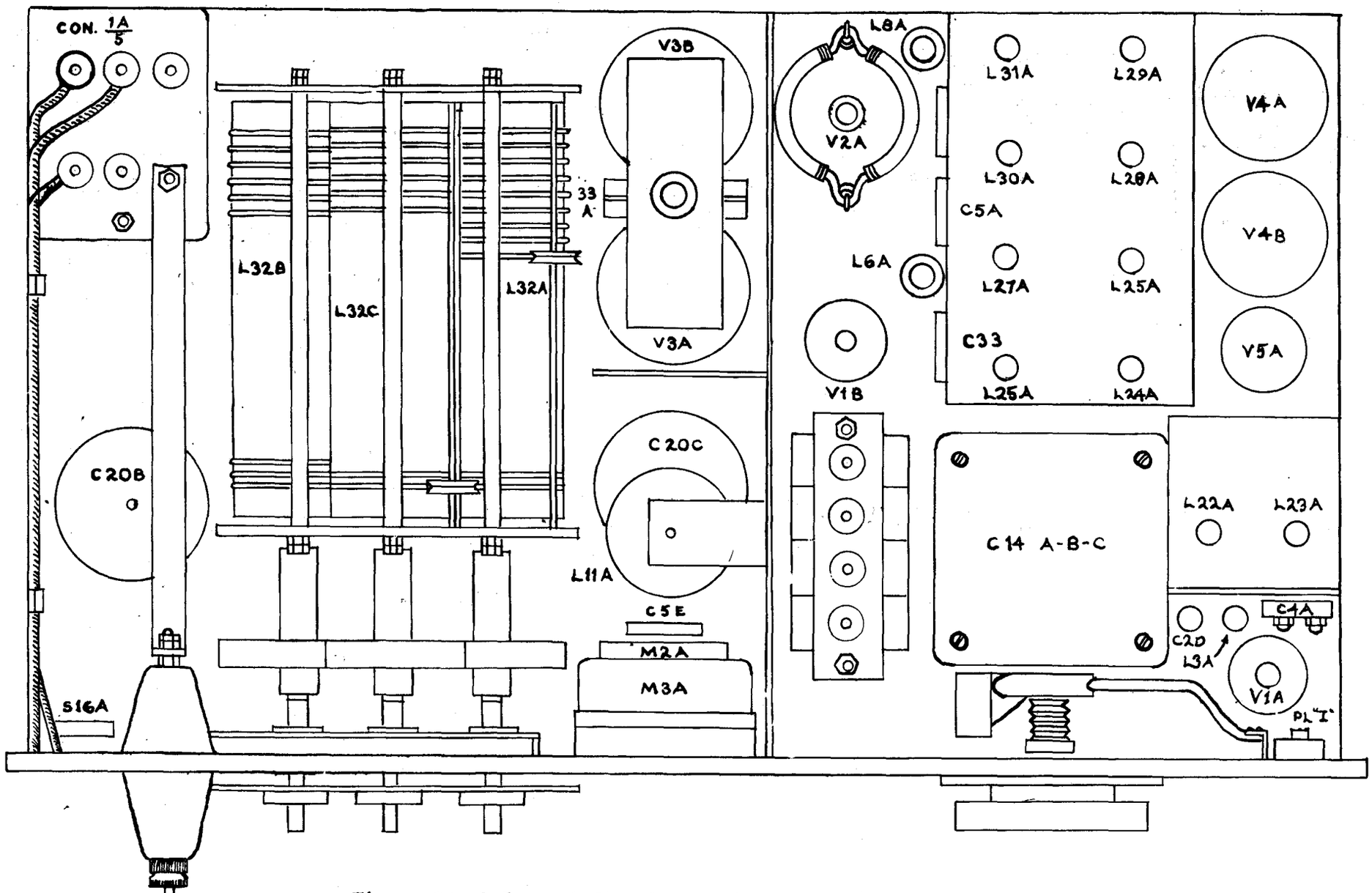


Figure 61. R.F. Amplifier No. 4. (Upper Side).

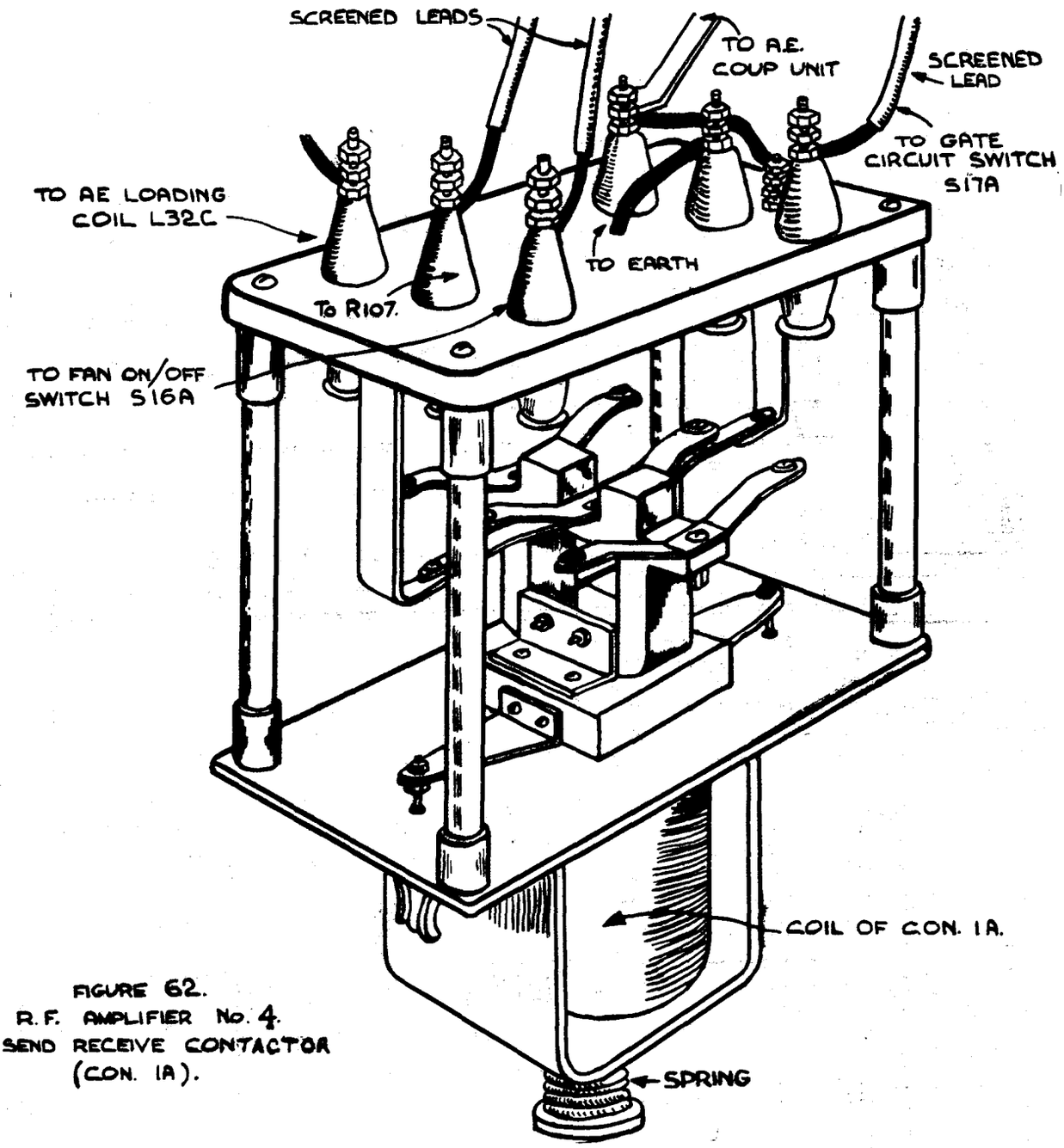


FIGURE 62.
R.F. AMPLIFIER No. 4.
SEND RECEIVE CONTACTOR
(CON. 1A).

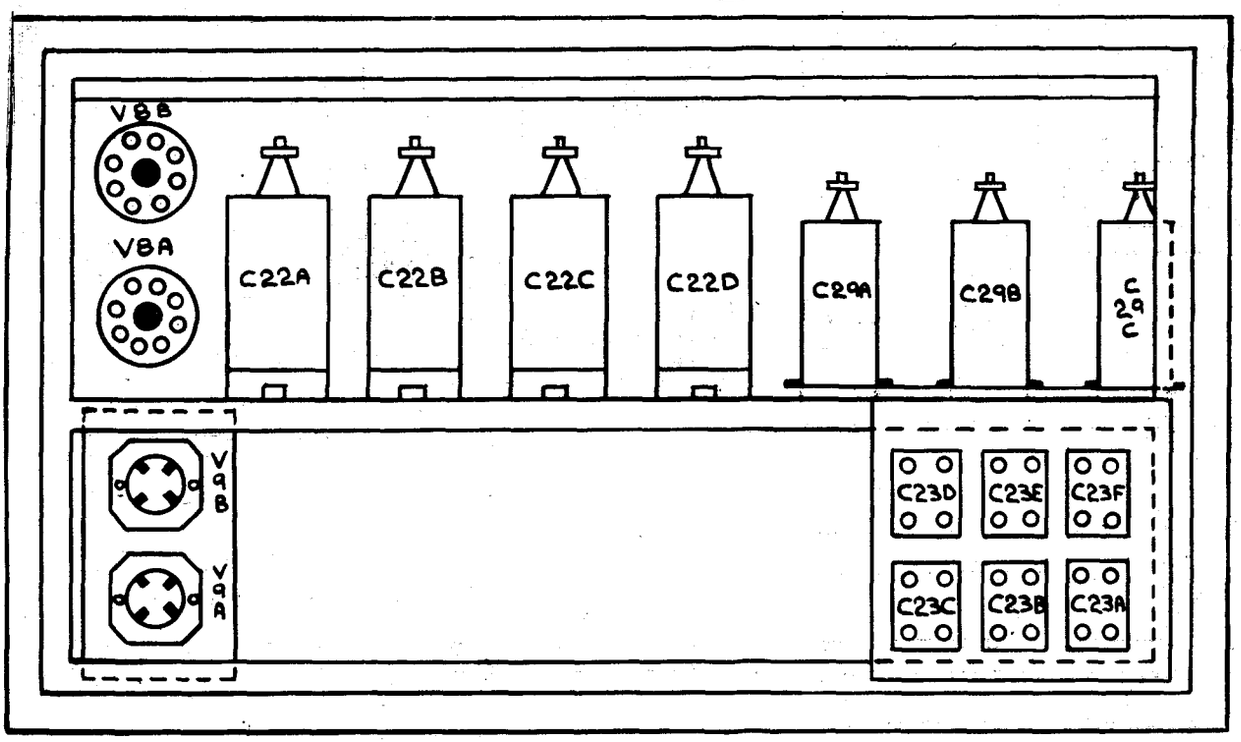


FIGURE 63. POWER SUPPLY UNIT (UNDERSIDE).

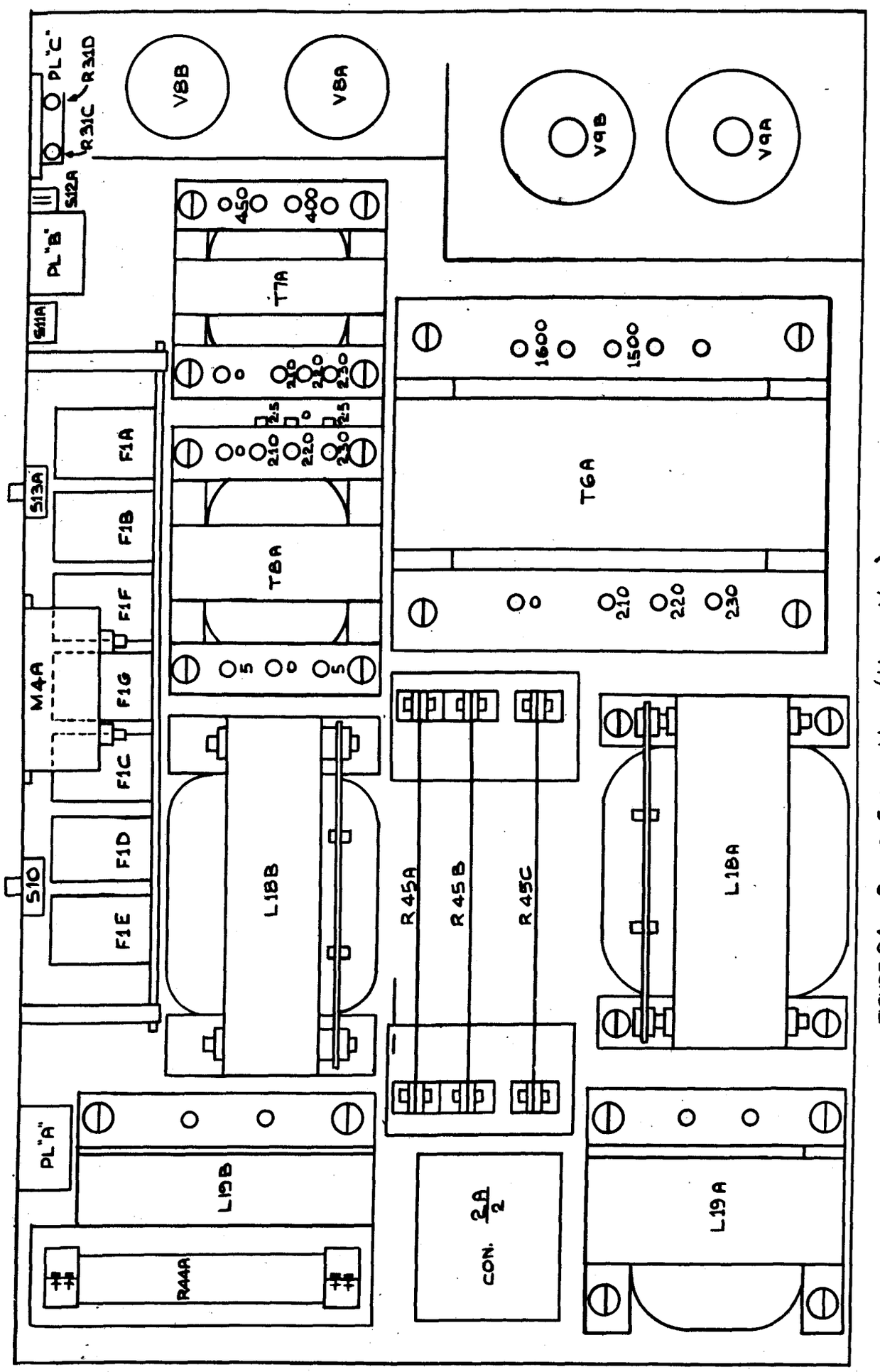


FIGURE 64. POWER SUPPLY UNIT. (UPPER VIEW).

TABLE 14 - COMMON FAULTS

FAULT		COMMON CAUSES
AC SUPPLY FAILURES	(1)	No Green Light) No AC supply is reaching set No AC Meter Reading) Bulb faulty.
	(2)	No Green Light) AC mains fuses blown. A loose Meter reads O.K.) inter-unit connector.
AC SUPPLY O.K. GREEN LIGHT O.K. NO HT NO RED LIGHT	(1) (2) (3) (4) (5) (6)	Fan switched off. W.R.C.U. H No. 1 switched off. One or more gate switches open. Batteries less than 12 volt. 1,500 volt inter unit connecting plugs not pushed home. Earth connectors between units not made.
NO DRIVE READING	(1) (2) (3) (4)	400 volt HT fuses blown. Step up drive increase control, tune dial, check range switch. Coaxial connector at back of MO unit is loose or open circuited. Crystal faulty.
DRIVE O.K. PA ANODE CURRENT WILL NOT DIP	(1) (2) (3) (4)	Wrong initial setting of DRIVE TUNING and/or PA Tuning Control. PA band changing links wrongly set. Fault on PA Tuning Coil. MO, Drive Range Switch is wrongly set.
WILL NOT COUPLE OR PA ANODE CURRENT DOES NOT RISE AFTER COUPLING	(1) (2) (3) (4) (5) (6)	Aerial circuit is open-circuited. Coupling Coil or Ae Loading Coil open-circuited. If a dipole aerial is used, then one or both arms may be of wrong length, the feeder may be open-circuited or the waterproof cap on the aerial feeder connector may be fouling and shorting one aerial wire. Any other aerial used may be wrong length. Aerial change-over relay not making. Ae loading links in Ae Coupling Unit set incorrectly.
SET COUPLES BUT WILL NOT LOAD	(1) (2) (3)	Aerial circuit open-circuited. Aerial change-over relay not making. Aerial loading links wrongly set.
LOW READINGS OF PA ANODE CURRENT DRIVE O.K.	(1) (2)	Rectifier valves CV. 128 require changing. PA valves require changing.
LOW READINGS OF DRIVE	(1) (2) (3)	V1A - CV1501 (VT501) MO valve faulty. V1B - CV1501 (VT501) Buffer Amplifier faulty. V2A - CV1374 (ATS25) Drive Amplifier faulty (most likely). Assuming drive increase and buffer controls are correct. N.B. Drive Readings on high band, e.g. 8.8. to 17.5 Mc/s. are always low.
TRANSMITTER O.K. POOR RECEPTION (on adjacent receiver)	(1) (2) (3) (4)	Receiver controls such as gains, selectivity, noise limiters, etc., set wrongly. Coaxial Connector to W.S.53 from receiver has loose contact or fault. Rejector Unit, if fitted, is set to own or harmonic frequency or is faulty. Aerial change-over relay in W.S.53 is not making.

(TABLE 14 contd.)

FAULT		COMMON CAUSES
EXCESSIVE NOISE ON CARRIER OF TRANSMITTED SIGNAL, POOR SPEECH ETC.	(1)	Try moving Microphone and Sidetone lead to a different position. Switch off loudspeaker of receiver.
	(2)	Loudspeaker switched on.
	(3)	In a Command Vehicle, check control boxes, noise may be picked up from W.S.19 or IC amplifier.
	(4)	Bad earthing of set or one unit of set, or bad earth on Panels distribution or receiver.
NOTES: Aerial Current should be obtained on 16 ft. Twin V (good). 34 ft. Rod and End-fed wire (small). Dipole, Dummy Aerials) No or very small aerial current reading.		

TABLE 15

Test Panel on rear of R.F. Unit Chassis
(Set to CW send H.P. key down)

Link	Readings		Meter range		
Frequency (Mc/s)	1.55	3.1	6	12	
Anode Current V1A					
M.O. Xtal switch to (1) M.O.	24 m/a	24	21	21	120 M/a
(2) Xtal (crystals removed)	27 "	27	29	29	120 "
Anode Current V1B					
(1) With drive from M.O.	7.5 "	8	10	20	120 "
(2) No drive (link V1A open)	27 "	27	27	27	120 "
(3) Voltage, link to E.	415v	415	420	410	480v
Grid Current V2A					
(1) Drive	7.9 m/a	1.45	3.20	2.95	12 M/a
(2) No drive (link V1B open)	Nil	Nil	Nil	Nil	
(3) Voltage, link to E. volts	63.5v	60.0	63.0	64.5	120v
Anode Current V2A					
(1) With drive	36.0 m/a	27.5	49.5	68.0	120 M/a
(2) No drive (link to V1B open)	Nil	Nil	Nil	Nil	

TABLE 16

Power Supplies

Unit	Circuit on Test	Test Point	Reading	Meter Range
P.S.U.	H.T. + 1 PL's "B" and "C" withdrawn	Pins of F1A with (i) L.P. Fuse removed. (ii) H.P.	0.79 A 1.4AA	1.2A.A.C 12 A
	H.T. + 2	Pins of F1C, fuse removed. S13 to 'HP'	0.11A	1.2A.A.C.
	G.B. PL's "B" and "C" replaced.	Pin 5 (grid) of V6D with valve removed to E.	-90v	480v D.C.
	Heaters	Pins F1F with fuse removed.	1.65A	12A A.C.

(ii) Point to Point Resistance Tests

Where the test bench cannot be used, a fault diagnosis on any particular chassis will have to be carried out without the power supplies connected. The most convenient way of making circuit checks is then by the use of an ohm-meter. Table 18 gives point to point readings for various circuits under faultless conditions.

TABLE 17

(Set to C.W. send, key down unless otherwise stated)
Frequency 1.375 Mc/s.

UNIT	VALVE	TEST POINT	READING	METER TO
(a) R.F. Unit	V1A	(i) C2E to earth	130v.	480v.
		(ii) R2A to earth	10v.	120v.
	V1B	(i) Top of R9A to E.	-70v.	120v.
		(ii) R3A to E.	4v.	12v.
		(iii) C1A to E.	30v.	120v.
	(key up)	(i) Top of R9A to E.	-80v.	120v.
		(ii) R3A to E.	5v.	12v.
		(iii) C1A to E.	-4v.	12v.
	V2A	(i) Screen to E.	30v.	120v.
		(ii) Ditto (key up)	-4v.	12v.
	V3A & B loaded on dum aerial to 110 m.a. 1a.	(i) Screens to E.	410v.	480v.
		(ii) M.A. to E.	-90v.	120v.
		(iii) Ditto (key up)	-90v.	120v.
(Set to M.C.W. send, low power, key down unless otherwise stated)				
(b) Modulator Unit No. 27	V7A	(i) Screen to E.	31v.	120v. D.C.
		(ii) Cathode to E.	1.5v.	12v.
		(iii) C24A to E.	185v.	480v.
		(iv) R33A to E.	.06v.	12v. A.C.
	V6A	(i) Cathode to E.	1.1v.	12v.
		(ii) C21 to E.	29v.	120v.
		(iii) R8C to E.	.4v.	12v. A.C.
	V6B	(i) Cathode to E.	1.1v.	12v.
		(ii) C2J to E.	225v.	480v.
		(iii) Grid V2B to E.	2.9v.	12v. A.C.
	V6C	(i) Cathode to E.	3.1v.	12v.
		(ii) C2P to E.	222v.	480v.
		(iii) Grid V2C to E.	2.9v.	12v. A.C.
	V2B & C	(i) R35A to E.	312v.	480v.
		(ii) Grid V2B to E.	.075v.	0.12v. D.C.
		(iii) Grid V2C to E.	.75v.	0.12v. D.C.
	V3C & D	(i) Anode Current	23 ma	120 ma
		(ii) Ditto (key up)	9 ma	121 ma
		(iii) R42A to E	.9v.	10v. A.C.
			(1v. with V5B removed)	
	V6E	(i) R18A to E.	0.3v.	12v.
		(ii) Cathode to E.	2.5v.	12v.
	V6D	(i) Cathode to E.	300v.	480v.
		(ii) Anode to E.	400v.	480v.

TABLE 18

("Valve pin" numbers refer to connections on the valve base with the valves removed. All readings are with the sender switched to R.T.)

Valve	Circuit or Component on test	Test Point From	To	Meter Reading
V7A (ARP 34)	Anode H.T. Circuit	Valve pin 3	H.T.	25kΩ
	Screen H.T. Circuit	Valve pin 4	H.T.	150kΩ
			Chassis	50kΩ
	Cathode bias	" " 5	"	2kΩ
		" " 8	"	2kΩ
	Heater supply	" " 7	L.T.	S.C.
		" " 2	"	S.C.
	Modulation Comp. Bias line Valve screening	Top Cap	Chassis	515kΩ
		Valve pin 1	"	S.C.
V6A (6J5G)	Anode H.T. Circuit	" " 3	H.T.	300kΩ
	Cathode bias	" " 8	Chassis	3kΩ
	Heater supply	" " 2	L.T.	S.C.
		" " 7	"	S.C.
	Grid leak R33A and condenser C2M	" " 5	Chassis	10kΩ
V6B (6J5G)	Anode H.T. Circuit	" " 3	H.T.	40kΩ
	Cathode bias	" " 8	Chassis	820 Ω
	Heater supply	" " 7	L.T.	S.C.
		" " 2	"	S.C.
	Grid leak R25C and condenser C2T	" " 5	Chassis	51kΩ
V2B (ATS 25)	Anode H.T. Circuit and T4A primary	Top Cap	H.T.	S.C.
	Screen grid primary	Valve pin 2	"	5kΩ
	Cathode circuit	" " 4	Chassis	S.C.
	Grid bias (R30A, R37A R34A)	" " 3	"	28kΩ
	Grid bias (R32A)	" " 3	GB(Pl."N" pin 6)	39kΩ
	Heater supply	" " 1	L.T.	S.C.
		" " 5	"	S.C.
V2C (ATS 25)	Anode H.T. Supply and T4A primary	Top Cap	H.T.	S.C.
	Screen grid H.T. Supply	Valve pin 2	"	5kΩ
	Cathode circuit	" " 4	Chassis	S.C.
	Grid bias (R28A, R37A R34A)	" " 3	"	228kΩ
	Grid bias (R32A)	" " 3	GB(Pl."N" pin 6)	239kΩ
	Heater supply	" " 1	L.T.	S.C.
		" " 5	"	S.C.
V5B (6X5G)	R31A, R17A.	Valve pin 5	Chassis	525kΩ
	R31B, R17A.	" " 3	"	525kΩ
	Delay bias circuit and adjustment	" " 8	"	50kΩ
		" " 8	H.T. +	51kΩ
	Heater supply	" " 2		S.C.
V6D (6J5G)	Anode H.T. supply	" " 3	Pin A.Pl.'B'	S.C.
	Grid bias supply and contact 3A1	" " 5	GB - 90v	S.C.
	Cathode circuit	" " 8	GB - 70v	470kΩ
	Heater supply	" " 2	L.T.	S.C.
		" " 7	L.T.	S.C.

(TABLE 18 contd.)

Valve	Circuit or Component on test	Test Point From	Test Point To	Meter Reading
V6E	Anode HT dropping and load resistances R32B and R27A.	Valve pin 3	H.T. +	42kΩ
	Grid circuit, R22C, R8D, R18A and condensers	" " 5	Chassis	75kΩ
	Cathode bias	" " 8	"	1kΩ
	Heater supply	" " 2	L.T.	S.C.
		" " 7	L.T.	S.C.
V1A (VT 501)	L1A, R8A	" " 4	Chassis	100kΩ
	Anode supply	Top cap	Pin 7,Pl.'E'	4kΩ
	Screen supply	Valve pin 5	-do-	274kΩ
	Cathode circuit (S3 to Xtal)	" " 8	Chassis	330 Ω
	" " (S3 to M.O.)	" " 8	"	S.C.
	Heater supply L2A, L2B	" " 2	Pin 1,Pl.'M'	2 Ω
		" " 7	" 2 " "	2 Ω
	Beam Plates	" " 3	Chassis	S.C.
V1B (VT 501)	Anode Supply	" top cap	Pin 9,Pl.'M'	4kΩ
	Screen grid supply	" pin 5	" 10 " "	47kΩ
	Drive control. S6 to pos Min	Pin 10 Pl.'M'	" 8, " "	400kΩ
	Max			S.C.
	Grid Circuit L5A and L9A	Valve pin 4	Chassis	100kΩ
	Cathode bias	" " 8	"	1kΩ
	Heater supply	" " 2	Pin 3,Pl.'M'	S.C.
		" " 7	" 4 " "	S.C.
	Beam plates	" " 3	Chassis	S.C.
V2A (ATS25)	Anode supply	" top cap	Pin 9,Pl.'M'	10 Ω
	Screen grid supply	" pin 2	" 10, " "	47 Ω
	Grid circuit (R1B, L7A & R13A)	" " 3	Chassis	1047 Ω
	Cathode circuit	" " 4	"	S.C.
	Heater supply	" " 1	Pin 9,Pl.'M'	S.C.
		" " 5	" 4 " "	S.C.
V5A (6X5G)	Anode circuits	" " 3	" 5, " "	S.C.
	(Pl. 'M' removed)	" " 5	" 6 " "	S.C.
	Transformer 6B winding (Pl. 'M' replaced)	" " 3	Valve pin 5	S.C.
	Cathode circuit	" " 8	Chassis	S.C.
	Heater supply	" " 2	Pin 3,Pl. 'M'	S.C.
		" " 7	" 4 " "	S.C.
V4A (AW3)	Resistance network, R5A, R5B, R10A, and anode and	" " 1	Pin 9,Pl.'M'	274kΩ
	Cathode connections	" " 3	" 9 " "	4kΩ
V4B (AW3)	Anode and cathode	" " 1	Chassis	S.C.
	connections and R10B	" " 3	"	270kΩ
	R10A, R5A and R5B	" " 3	HT (pin 9, PL.'M')	274kΩ
V8A V8B (5U4G)	Anode connections and secondary winding of T7A	" " 6	Chassis	9 Ω
	Heater connection.	" " 2	Valve pin 8	S.C. Ω
	Smoothing circuits and voltage stabilising resistances (Sender disconnected).	" " 2	Chassis	30kΩ
V9A V9B (CV128)	Anode connections and secondary winding of T6A	" top cap	Chassis	8 Ω
	Heater connection	" pin 2	Valve pin 4	S.C.Ω
	Smoothing circuits (sender disconnected)	" " 2	Chassis	30kΩ

(TABLE 18 contd.)

Valve	Circuit or Component on test	Test Point From	Test Point To	Meter Reading
V3C	Anode circuit	Valve top cap	Plug C	70Ω
V3D	Grid circuit (6-point plug 'N' inserted)	" pin 3&4	Chassis	30Ω
	Beam plates	" " 5	"	S.C.
	Heater supply	" " 1&7	"	S.C.
V3A	Anode circuit	" top cap	Plug Y(anode)	11Ω
V3B	Screen circuit	" pin 3	" "(screen)	10Ω
	Grid circuit C5D, L10C, M1A, R12A, R13A, (GB supply)	" " 4	Chassis	1500Ω
	Heater supply	" " 1&7	"	S.C.

TYPE OF EQUIPMENT --

SERIAL No. OF EQUIPMENT ----------------------

NOTE—UNIT TASKS ARE DETAILED IN WORKING INSTRUCTIONS

UNIT MAINTENANCE LOG

DATE (WEEK ENDING)	1 DAY	2 DAY	3 DAY	4 DAY	5 DAY	6 DAY	7 DAY	1ST ECHELON MAINTENANCE LOG.

INITIAL | DATE

NOTE—1ST ECHELON TASKS ARE DETAILED IN RELEVANT E.M.E.R.

INITIAL | DATE

INITIAL | DATE

INITIAL | DATE

INITIAL | DATE

INITIAL | DATE

REPAIR RECORD

(E.G. VALVE REPLACEMENTS, MAJOR REPAIRS, R.E.M.E. INSPECTIONS, ETC.)

DATE	REMARKS

APPENDIX 4

Specimen of Army Form B2661

APPENDIX 2 – WEEKLY RECORD LOG (Average readings)

Date	Serial No. of Set	Frequency Mc/s.	AC volts Supply	Drive Setting	PA grid current (mA) CW	PA anode current mA	
						MCW	CW
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					
		1.55					
		3.1					
		6.05					
		12.1					

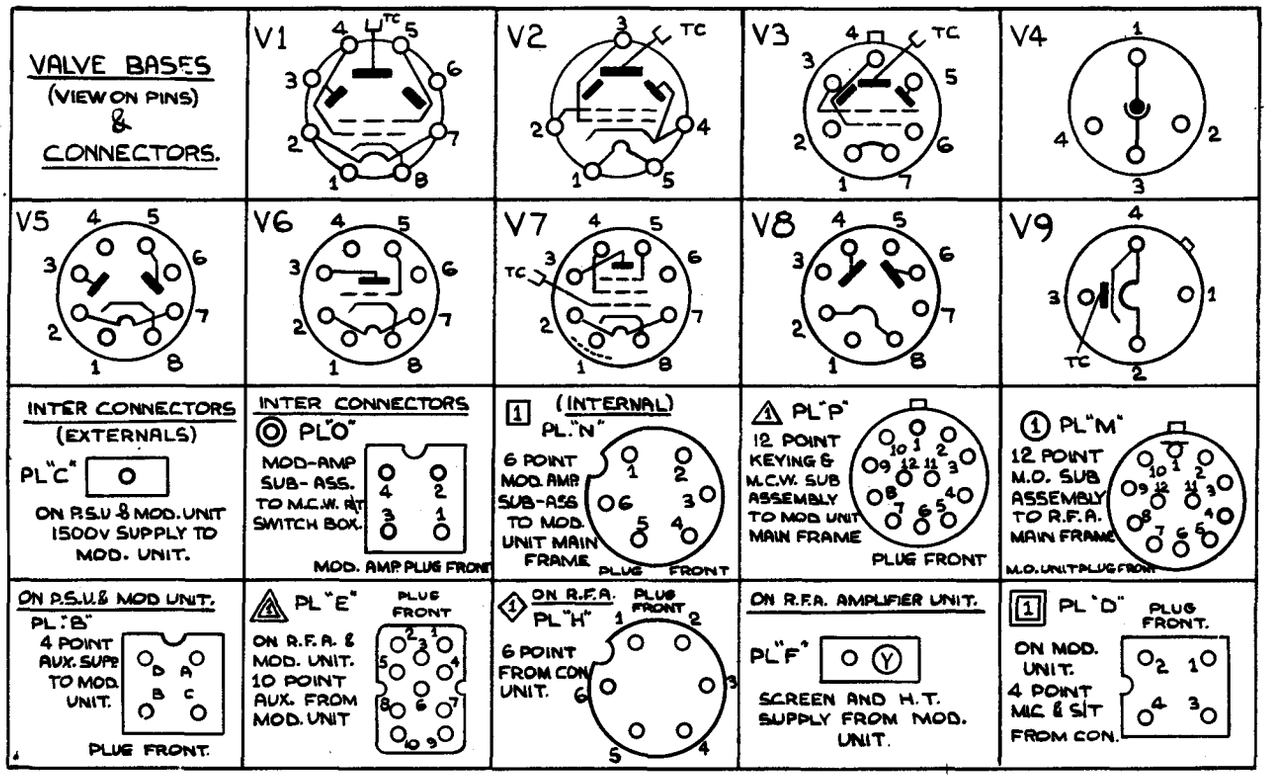

VALVE BASES
(VIEW ON PINS)
&
CONNECTORS.
V1
V2
V3
V4
V5
V6
V7
V8
V9
TC
INTER CONNECTORS
(EXTERNALS)
PL "C"
ON P.S.U. & MOD. UNIT
1500v SUPPLY TO
MOD. UNIT.
INTER CONNECTORS
PL "O"
MOD-AMP
SUB-ASS.
TO M.C.W. RT
SWITCH BOX.
MOD. AMP PLUG FRONT
(INTERNAL)
PL "N"
6 POINT
MOD. AMP
SUB-ASS
TO MOD.
UNIT MAIN
FRAME
PLUG FRONT
PL "P"
12 POINT
KEYING &
M.C.W. SUB
ASSEMBLY
TO MOD UNIT
MAIN FRAME
PLUG FRONT
PL "M"
12 POINT
M.O. SUB
ASSEMBLY
TO R.F.A.
MAIN FRAME
M.O. UNIT PLUG FRONT
ON P.S.U. & MOD UNIT.
PL "B"
4 POINT
AUX. SUPP
TO MOD.
UNIT.
PLUG FRONT.
PL "E"
PLUG
FRONT
ON R.F.A. &
MOD. UNIT.
10 POINT
AUX. FROM
MOD. UNIT
ON R.F.A.
PLUG
FRONT
PL "H"
6 POINT
FROM CON
UNIT.
ON R.F.A. AMPLIFIER UNIT.
PL "F"
SCREEN AND H.T.
SUPPLY FROM MOD.
UNIT.
PL "D"
PLUG
FRONT.
ON MOD.
UNIT.
4 POINT
MIC & S/T
FROM CON.

FIGURE 64A

Condensers

C1	0.1 µF	500v
C2	0.1 µF	350v
C3	0.01 µF	1000v
C4	0.01 µF	750v
C5	0.01 µF	2200v
C6	0.002 µF	
C7	0.001 µF	350v
C8	200pF	750v
C9	70pF	
C10	50pF	
C11	50pF Neg. Temp. Coeff	
C12	40pF	
C13	15pF	
C14)	500pF Max.	
C15)	each section	
C16	100pF Max.	
C17	30pF pre-set	
C18	600pF	2000v
C19	0.001 µF	2500v
C20	0.002 µF	3000v
C21	8 µF	350v
C22	4 µF	2Kv
C23	4 µF	500v
C24	4 µF	400v
C25	4 µF	200v
C26	0.05 µF	300v
C27	0.005 µF	1000v
C28	0.0001 µF	
C29	8 µF	500v
C30	10pF Neg. Temp. Coeff	
C31	20pF " " "	
C32	60pF Mica	
C33	5pF Air Spaced	
C34	0.0015 µF	6,600v
C35	39-45pF Air Spaced	

Inductances

L1-8	R.F.C.
L9	20H 100 mA
L10	R.F.C.
L11	R.F.C. 16mA
L13, 14	Mod. Chokes
L15, 16	R.F.C.
L17	75H
L18	10H 450mA
L19	10H 250H
L20-31	Tuning Coils

Resistances

R1	47 Ω	½W
R2	330 Ω	½W
R3	1KΩ	1W
R4	4KΩ	12W
R5	8KΩ	12W
R6	22KΩ	1W
R7	47KΩ	1W
R8	100KΩ	½W
R9	100KΩ	1W
R10	270KΩ	½W
R11	100KΩ	1W
R12	500 Ω	12W
R13	1000 Ω	12W
R14	10KΩ	1W
R15	220KΩ	1W
R16	820KΩ	½W
R17	510KΩ	½W
R18	50KΩ	VAR
R19	470KΩ	1W
R20	249KΩ	½W
R21	200KΩ	½W
R22	150KΩ	½W
R23	75KΩ	½W
R24	51KΩ	1W
R25	51KΩ	½W
R26	500KΩ	½W
R27	27KΩ	1W
R28	220KΩ	½W
R29	20KΩ	1W
R30	20KΩ	½W
R31	15KΩ	12W
R32	15KΩ	1W
R33	10KΩ	½W
R34	5100KΩ	½W
R35	5KΩ	12W
R36	5KΩ	½W
R37	3900 Ω	½W
R38	3KΩ	½W
R39	2KΩ	½W
R40	1KΩ	½W
R41	820KΩ	½W
R42	510 Ω	½W
R43	30KΩ	20W
R44	22KΩ	½W
R45	150KΩ	200W
R46	25 Ω	

Fuses

F1A-B	10A
F1C-G	5A

Meters

M1	0 - 50mA
M2	0 -350mA
M3	0 - 12A RF
M4	0 -300v AC

Lamps

P1F,B	Scale Lights
P1C,D	Meter "
P1E	H.T. Supply
P1G	A.C. Sup. Indicator

Switches

S1	XTAL SELECTOR
S2	03 02 RANGE. 4 1 0 0 0
S3	XTAL O O.M.O.
S4	SAFETY SW. ON CONN.Y
S5A	LOC. H.T. ON/OFF
S6A	DRIVE CONT.
S7	C.W.O. O.R.T. M.C.W.
S8	R.T.O. M.C.W. RT/M.C.W.
S9A	H.T. ON/OFF
S10	Mains ON/OFF
S11	P.S.U. Gate
S12	Safety Sw. Plug C.
S13	Tune - High Power.
S14	Safety Sw. Plug. C.
S15	Safety Sw. Conn'r. Y.
S16	Fan ON/OFF
S17	R.F.A. Gates
S18	A.C.U. Gates

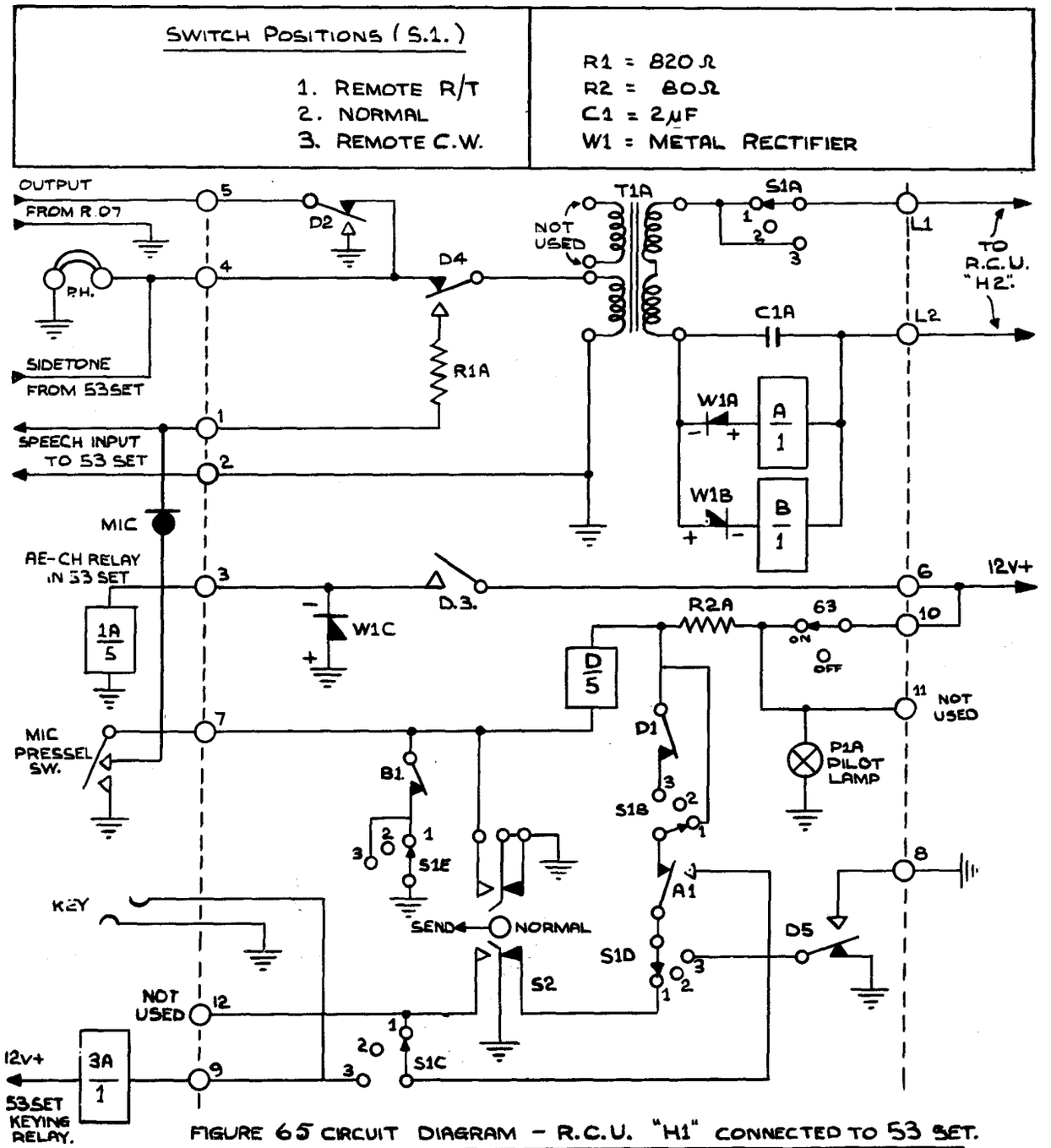


FIGURE 65 CIRCUIT DIAGRAM – R.C.U. "H1" CONNECTED TO 53 SET.

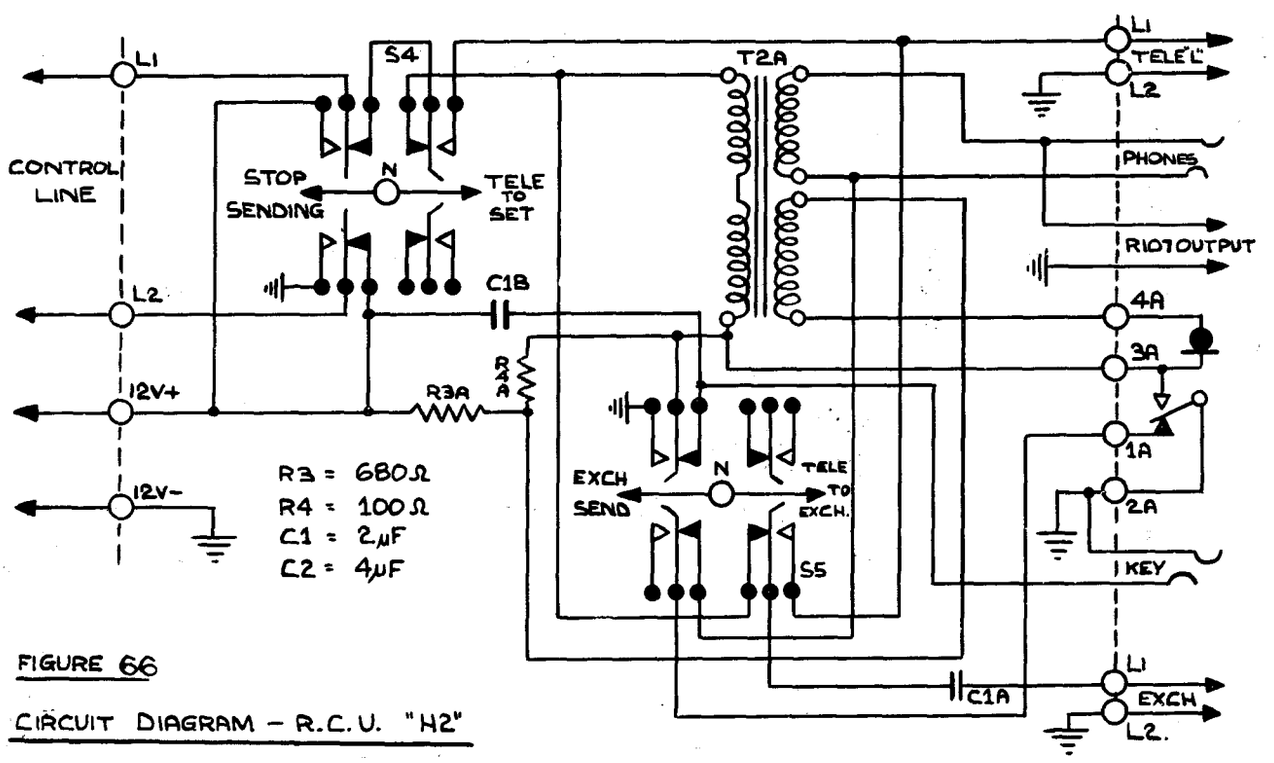
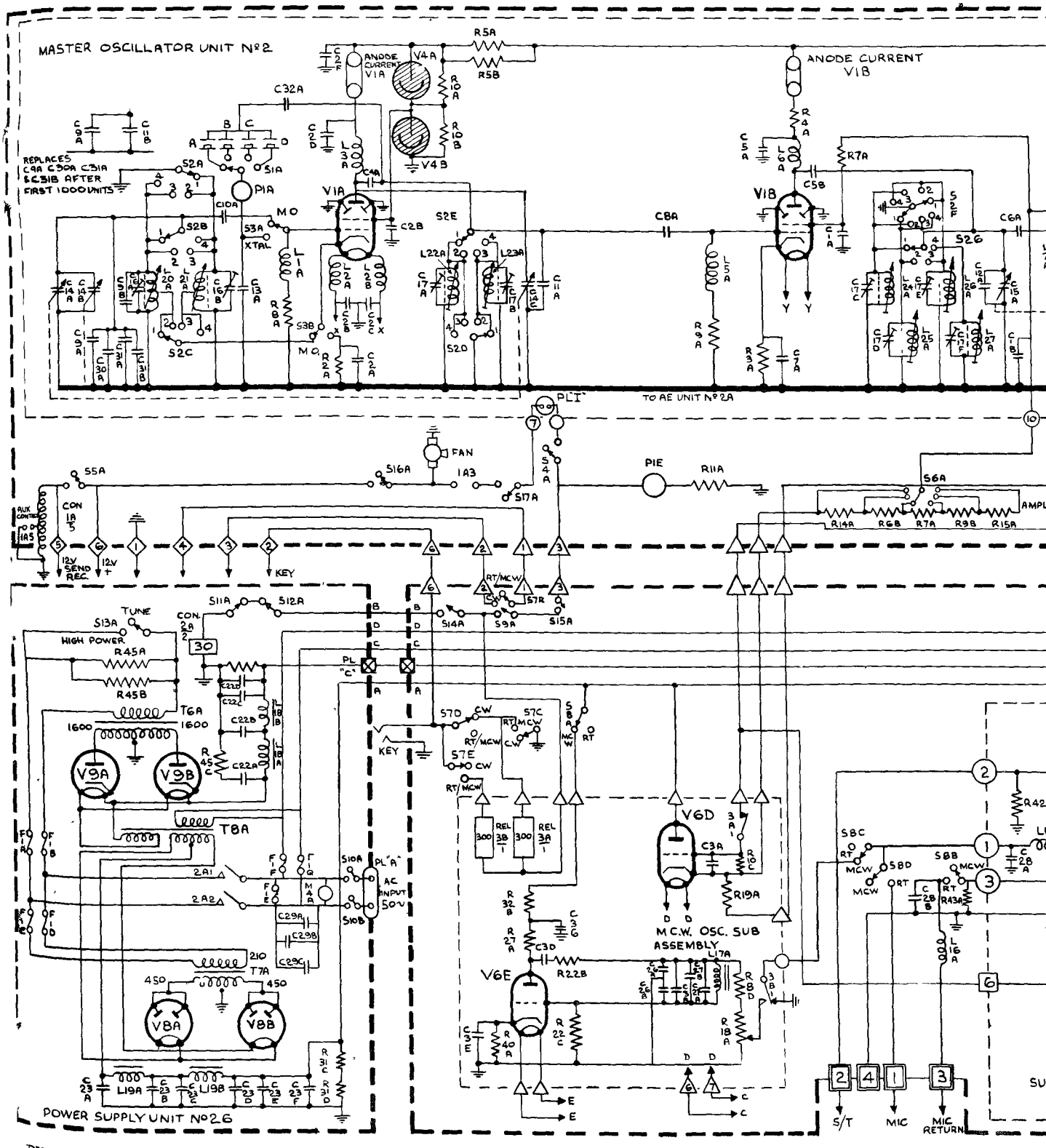
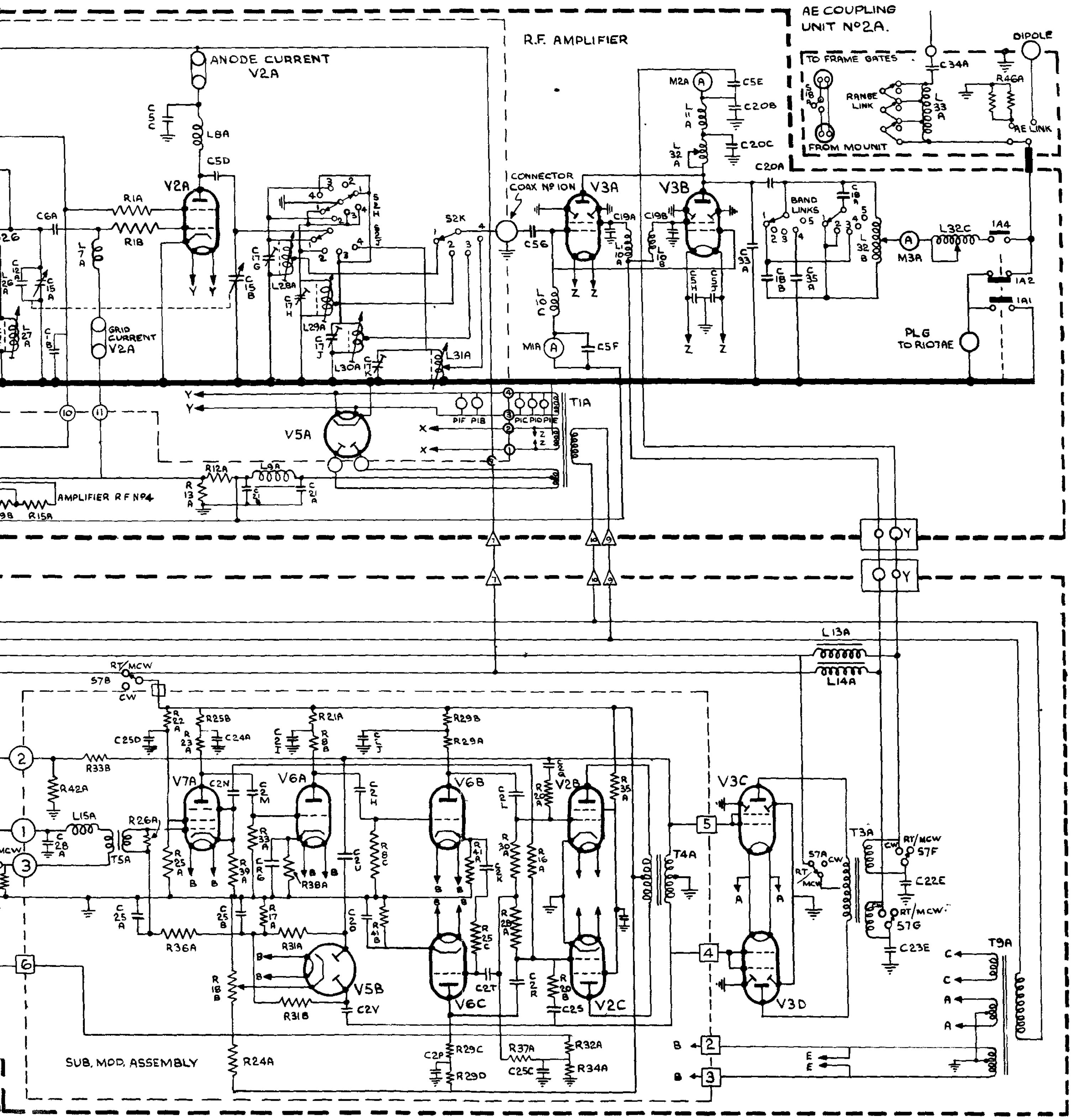


FIGURE 66

CIRCUIT DIAGRAM – R.C.U. "H2"


MASTER OSCILLATOR UNIT Nº2
REPLACES C9A C30A C31A & C31B AFTER FIRST 1000 UNITS
ANODE CURRENT V1A
ANODE CURRENT V1B
V4A
V4B
V1A
V1B
TO AE UNIT Nº2A
PL1
FAN
1A3
PIE
R11A
AUX CONTROL
CON 1A 3
12V SEND REC
12V +
KEY
TUNE
HIGH POWER
R45A
R45B
T6A
1600
V9A
V9B
T8A
T7A
210
450
V8A
V8B
POWER SUPPLY UNIT Nº2.6
PL "A" AC INPUT 50V
PL "C"
RT/MCW
CW
V6D
V6E
M.C.W. OSC. SUB ASSEMBLY
L17A
SBC
SBD
SBB
MCW
RT
S/T
MIC
MIC RETURN
AMPL



AE COUPLING
UNIT No2A.
R.F. AMPLIFIER
ANODE CURRENT
V2A
GRID CURRENT
V2A
CONNECTOR
COAX No ION
TO FRAME GATES
FROM MOUNT
RANGE LINK
AE LINK
DIPOLE
BAND LINKS
PLG
TO R107AE
AMPLIFIER R F No4
SUB. MOD. ASSEMBLY
RT/MCW
CW

FREQUENCY SHIFT SIGNALLING

Introductory

The two conditions of a telegraph code, which are known for convenience as "mark" and "space", may most simply be represented in an electrical circuit as "current" and "no current". This representation may be achieved by the use of on-off keying as in ordinary morse telegraphy over radio links. For the marking condition (dots and dashes) the Key is held down, so that the transmitter carrier is switched on, while for the spacing condition (intervals between dots and dashes) the key is released, so that the transmitter carrier is switched off.

This is only one method of telegraph signalling, a number of other methods are used in practice. One of these is known as "Frequency-Shift Signalling".

This is a method of telegraph transmission in which the mark and space conditions of the telegraph code are represented by the transmission of two different frequencies, one frequency for mark and the other for space. The two frequencies may both be in the audio frequency range, in which case the system is said to employ "Tone frequency-shift signalling". Alternatively the mark and space may be each represented by a radio frequency. In this case the system is said to emply "Radio Frequency-shift Signalling" or "Carrier Frequency-shift signalling". This is the method of signalling which will now be considered.

The difference between the marking and spacing frequencies is called the "frequency-shift", and is usually about 850 c/s. Normally the mark frequency is higher than the alloted frequency by half the frequency-shift, and the spacing frequency is lower by a similar amount.

The distinctive feature of C.F.S. is that two radio frequencies are transmitted, both of which are used at the receiver. Thus the presence of the spacing frequency can be seen to be the essential difference between C.F.S. and an ordinary On-Off telegraphy transmission.

C.F.S. may be looked upon as the telegraph equivalent of frequency modulation speech transmission, which it resembles in the following respects:-

(a) The carrier frequency is varied to convey the required intelligence.
(b) The factors governing signal/noise ratio are the same as for F.M.
(c) The possible improvement in signal/noise ratio in both cases arises entirely as a result of the receiving methods used.

In the past telegraphy has been mainly effected manually, using the morse code. This code has usually been transmitted and received by an operator trained to interpret this code into normal figures and letters. Although morse code signals can be used in an automatic telegraphy system it is not the most suitable code for this purpose. The teleprinter, which uses the 5-unit or Murray code lends itself much more efficiently to automatic telegraphy systems and is the normal method used with C.F.S. This system automatically transmits code when a plain language message is typed out on a keyboard, it is received and typed at the receiving end without the necessity for an operator to interpret the signals, it is unnecessary for an operator to be present when a message is being received, as the machine types the message automatically. This gives a big saving in time and man-power.

The fundamental method of obtaining C.F.S. is to vary the reactance of the tuned circuit controlling the transmitter oscillator frequency. The required variation in reactance could be achieved by keying a small capacitor across the tuned circuit, the value of the capacitor determining the frequency-shift. This is shown in Fig. 68 using a series fed tuned-anode oscillator, though any conventional oscillator could be used.

With this simple arrangement difficulties arise due to the capacity between the keying contacts, and between the leads to them. To overcome these defects, keying is usually carried out electronically. There are two basic ways of doing this, the "impedance-valve" and the "reactance-valve" methods.

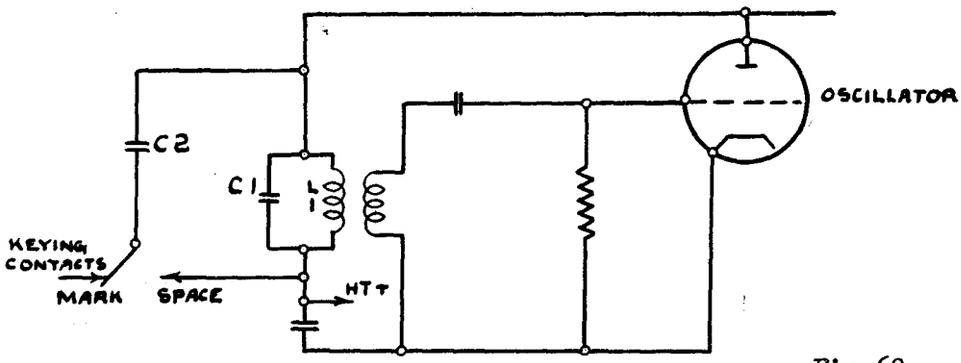


Fig. 68

SIMPLE METHOD OF OBTAINING C.F.S.

Impedance-valve Keying

The impedance-valve method of Keying is similar to the simple method of figure 68 except that the Keying contacts are replaced by a thermionic valve, usually a diode, to which a biasing voltage is applied by the keying contacts. In Fig. 69 a typical arrangement is shown. When the Key is on "mark" the diode is biased beyond cut-off by the negative voltage on its anode so that the capacitor C2 has no effect upon the tuned circuit L1 C1. The frequency of oscillation is therefore determined by L1 C1 only.

When the Key is moved over to "space" the positive bias on the anode allow the valve to conduct, so that C2 is virtually connected in parallel with C1 and the oscillator frequency is decreased. The extent of the frequency-shift may be controlled either by adjustment of C2 or by adjustment of the biasing voltage applied to the diode. Adjustment of this bias varies the extent to which the valve conduct.

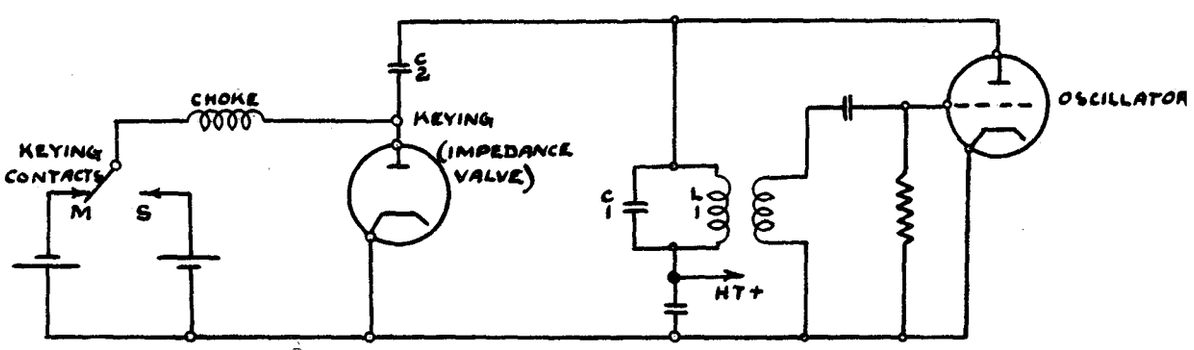
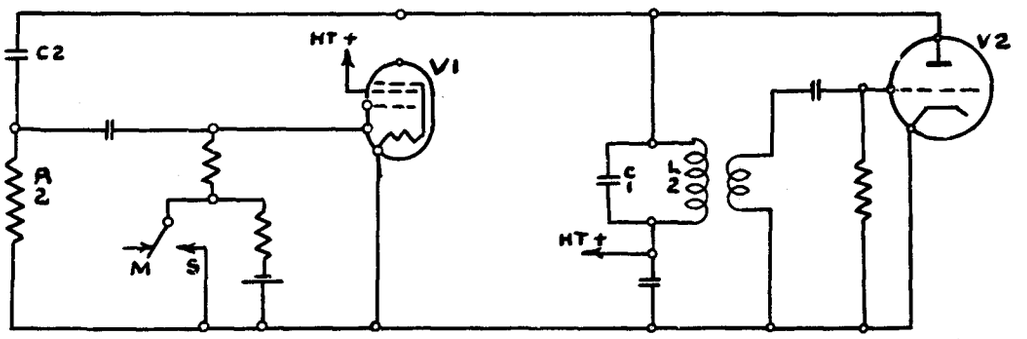


Fig. 69 IMPEDANCE - VALVE KEYING

Reactance-valve Keying

In this method of Keying, the Keying contacts are again arranged to alter the bias on a valve connected across the oscillator tuned circuit, but the mod of operation is different. The grid of this valve is so connected to the anod through a phase-changing network, that the anode current is 90 degrees out of phase with the anode voltage, i.e. the valve itself behaves as a reactance (capacitance or inductance).

Fig. 70 shows a typical reactance-valve circuit. The phase-changing network, R2 C2, is such as to make the anode current of V1 lead the anode voltage by 90 degrees. Thus the anode and cathode of V1 form two plates of a capacitor, the value of which can be varied by altering the grid voltage. Sin this capacitance is in parallel with C1 it follows that any change in the grid voltage of V1 will result in a change in the frequency of the oscillations. When the Keying contact moves from "mark" to "space" the negative bias on the grid of V1 is reduced, the anode current is increased, and the ratio of anode voltage to anode current (the reactance) will decrease, thus the valve will behave as a larger value capacitor and the oscillator frequency will drop.



REACTANCE VALVE KEYING FIGURE 70

Pulled-crystal Method of Keying

It is possible to apply the impedance-valve or reactance-valve methods to "pull" the frequency of a crystal controlled oscillator. A typical arrangement is shown in Fig. 71.

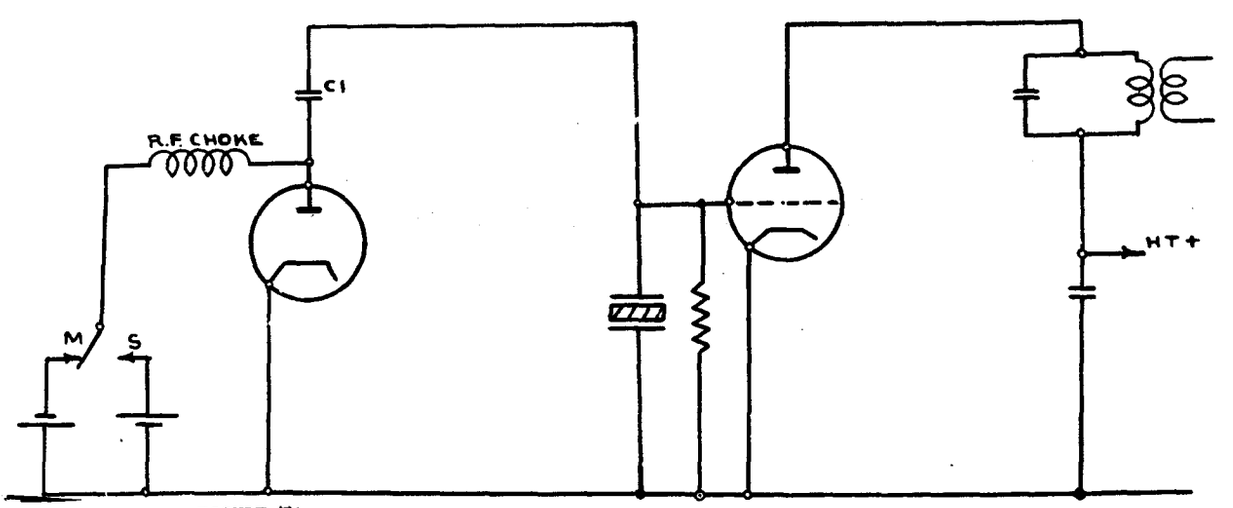


FIGURE 71

PULLED CRYSTAL CIRCUIT

Distorted Telegraph Signals

When the telegraph signals have been passed over a long line to the transmitter, they are frequently rounded as in Fig. (b) instead of being the ideal square shape as in (a). Further rounding of the signals may occur during radio transmission and reception. In order to prevent the over-all distortion of the signal wave-shape reaching an unduly high value, and so causing misprinting at the receiving teleprinter, steps must be taken at every stage to keep the signal wave-shape as near the ideal as possible. It is particular important to "square" the signals at the transmitter, so that changes from the "mark" to "space" frequency, and vice versa shall be as fast as possible. This can be done by means of a telegraph relay or by means of a thermionic valve used as an electronic relay. The electronic relay is merely a thermionic valve which is biased beyond cut-off in one condition, and right up to saturation point in the other condition.

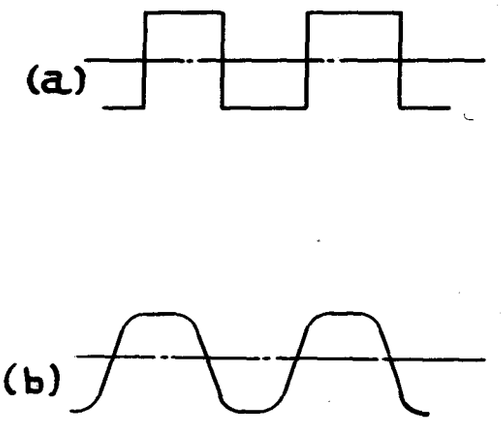
Methods of C.F.S. Reception

There are two basic methods of receiving C.F.S. signals,

(a) The use of a pair of filters, one to pass the space frequency and one to pass the mark frequency.

(b) The use of a discriminator circuit as in F.M. telephony.

The discriminator method is the one generally in use with the W.S. No. 53 (modified) equipment, and is described in detail in the appropriate section of this book. The discriminator method gives a very good signal/noise ratio.



TELEGRAPH SIGNAL WAVE FORMS

FIGURE 72

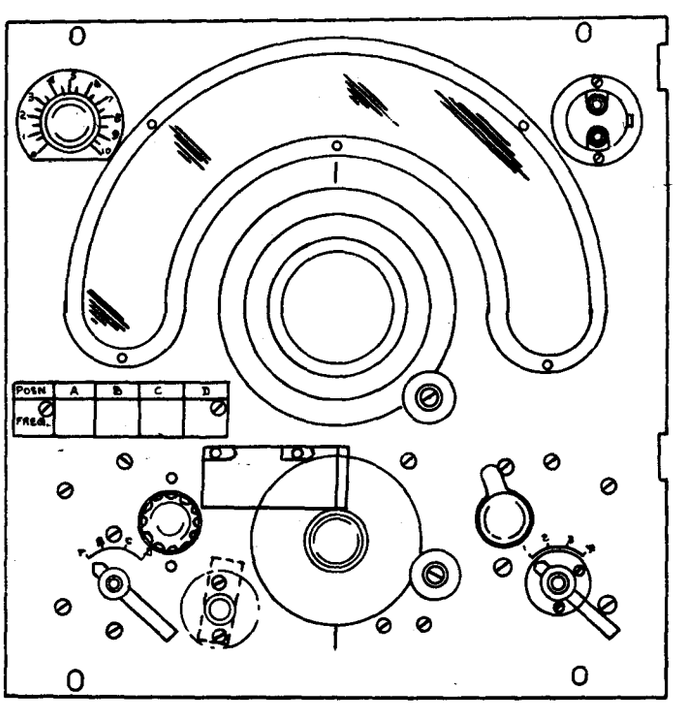
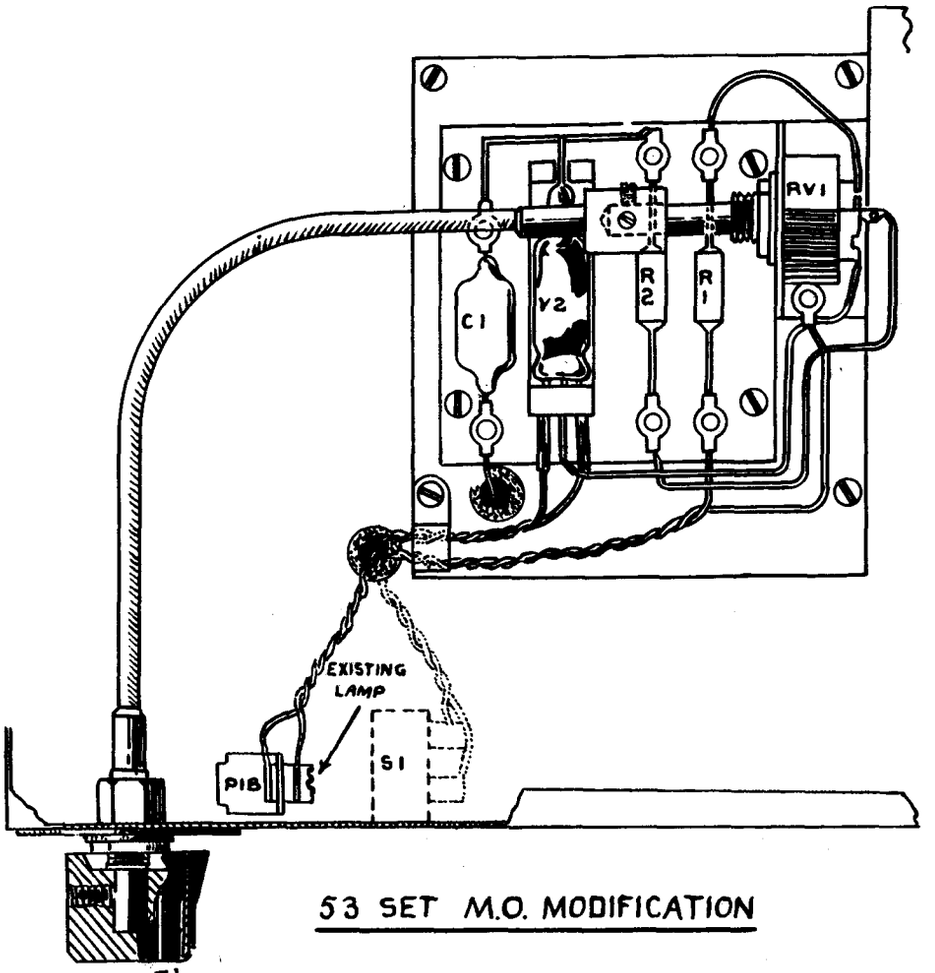
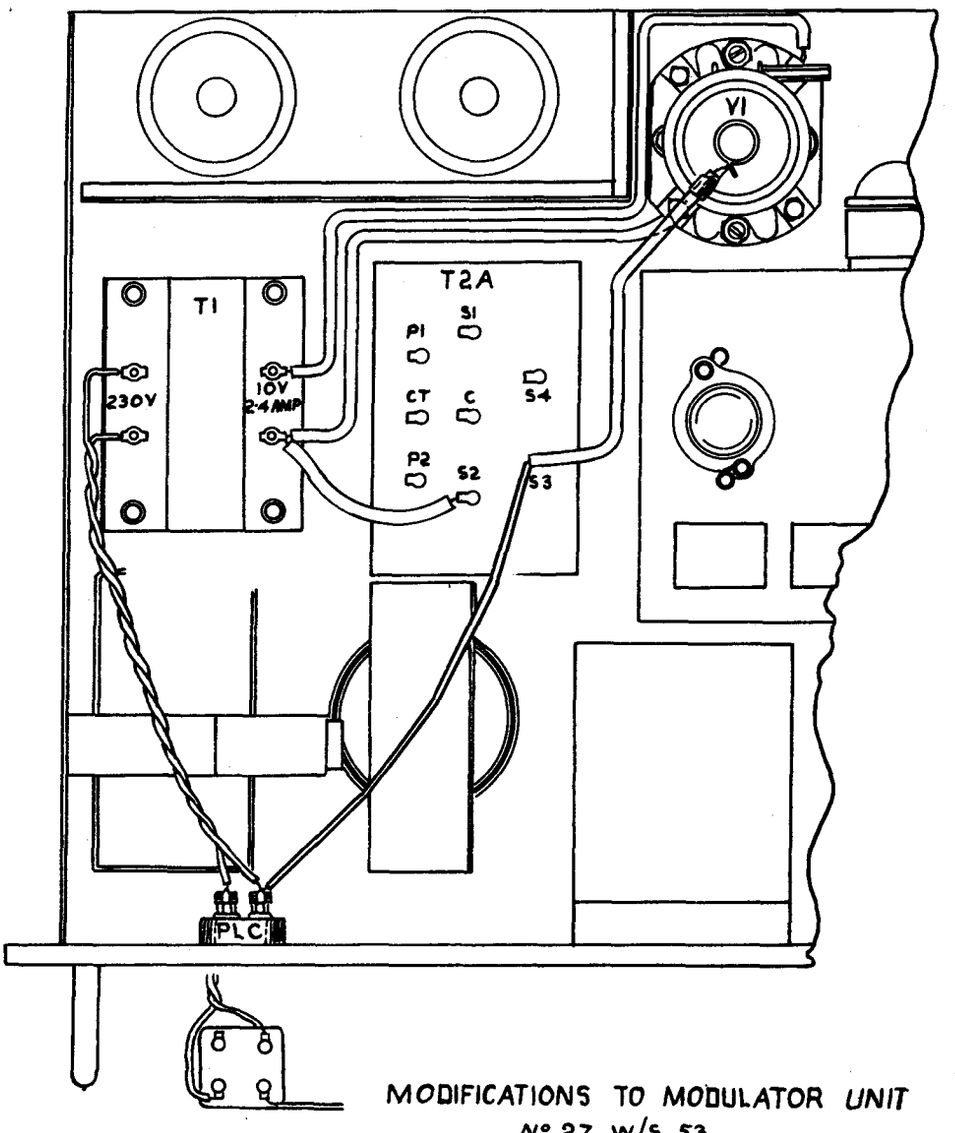


FIGURE 73 MODIFICATIONS TO MASTER OSCILLATOR UNIT No 2 W/S 53



53 SET M.O. MODIFICATION

FIGURE 74



MODIFICATIONS TO MODULATOR UNIT
Nº 27 W/S 53
FITTING TRANSFORMER VALVE HOLDER & VALVE

FIGURE 75

C.F.S. As Applied to the W.S.53 and Ancillary Receivers

1. Sender Circuit

To obtain C.F.S. with the W.S.53 a diode valve is connected in series with a small value capacitor across the M.O. circuit. Part of the 80+80 Volt Keying voltage from the Adaptor Unit is applied to the diode valve through a potentiometer. This is Impedance-valve Keying which has already been described in detail. The total impedance of the diode plus the capacitor is changed with the Keying, and as this circuit is connected across the M.O. circuit, the frequency of the latter changes with the keying. Thus the telegraph signals transmitted by the W.S.53 are on two radio frequencies. The differences between the two frequencies is known as the frequency-shift. The higher frequency is used for the "mark" signals and the lower for the "space" signals.

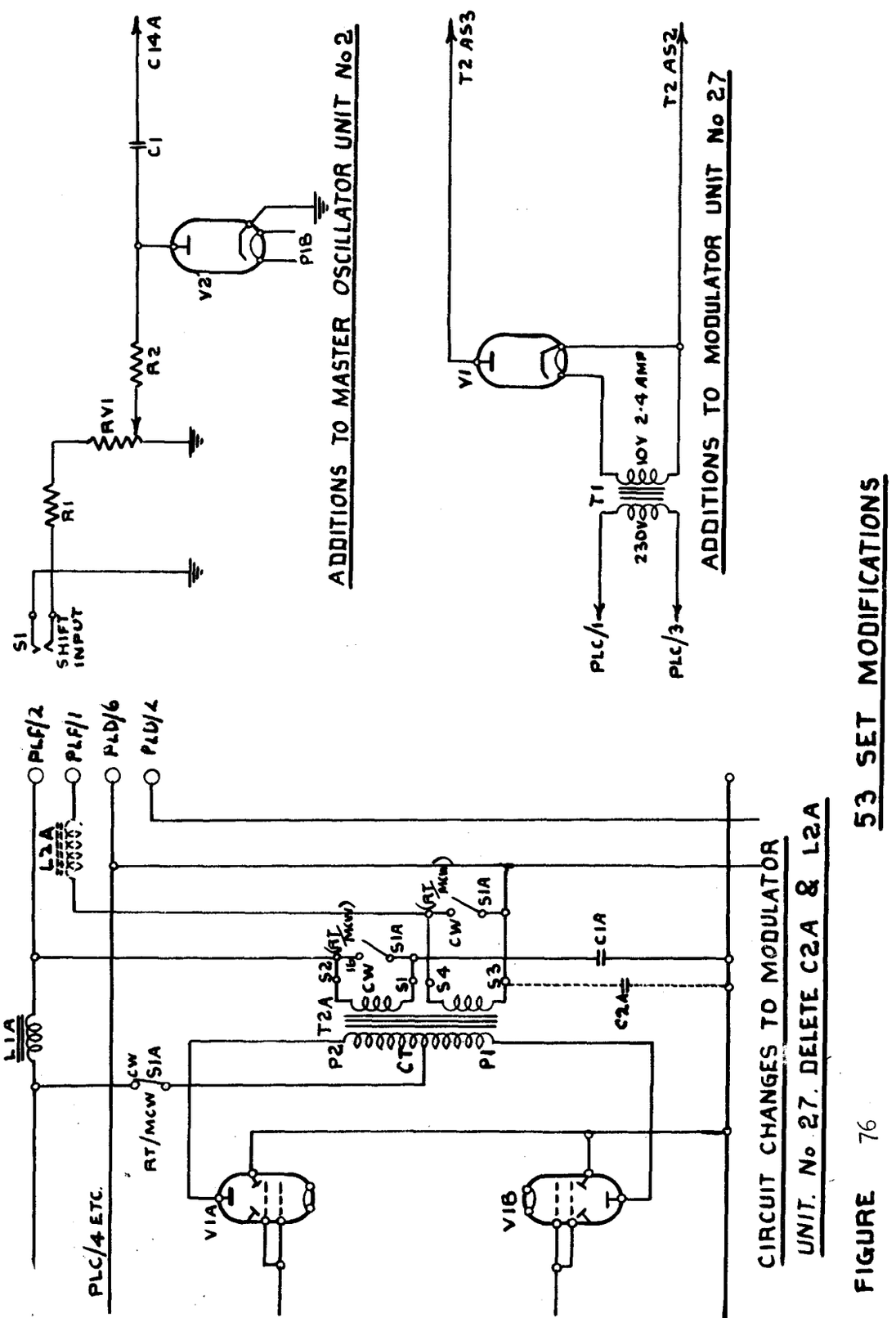


FIGURE 76

2. Receiving Circuits

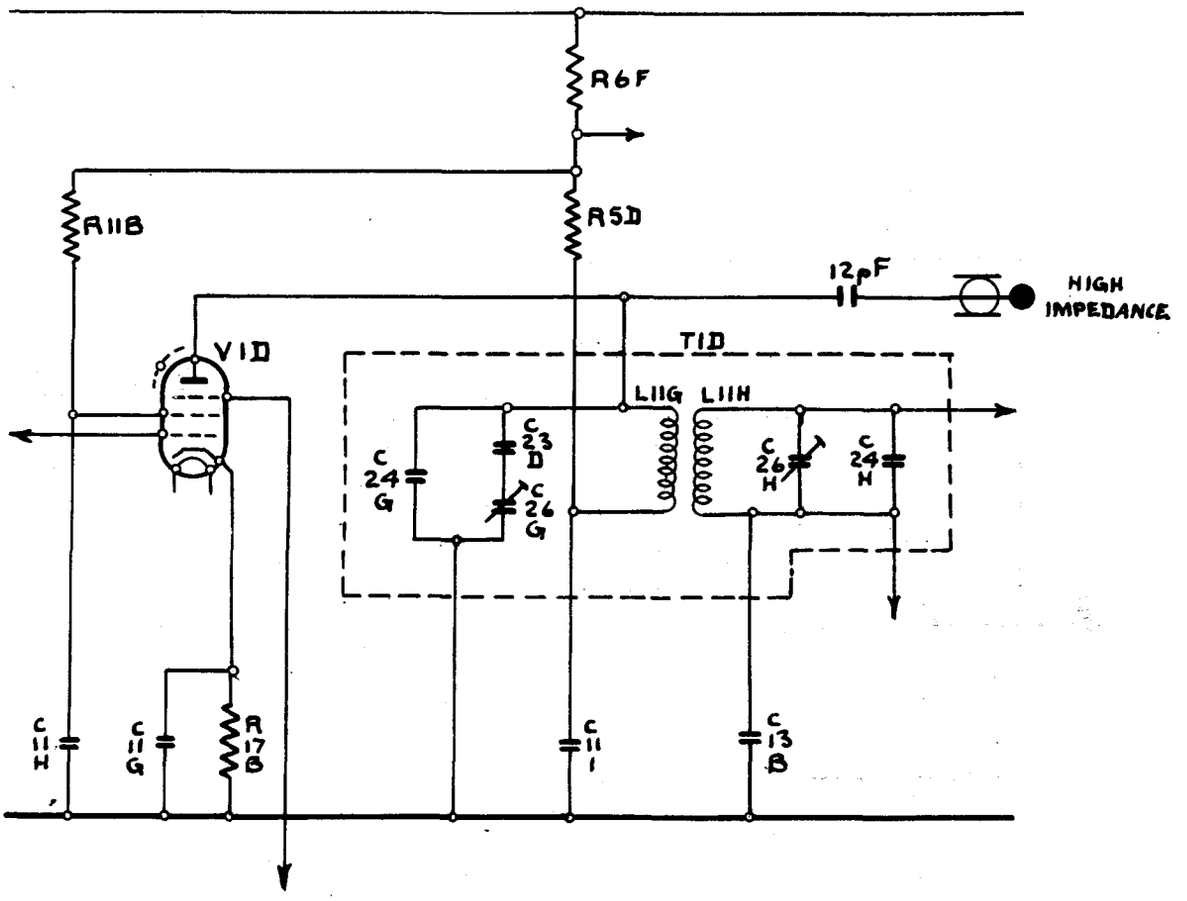
(a) Signals from the last I.F. stage of the R107, AR88, or R209 are fed by means of coaxial cable to the "Frequency Shift Adaptor" into a frequency doubler valve V1. The coupling between the receiver and the adaptor is adjusted to suit the output of the receiver I.F. stage. The input to the adaptor may be applied direct to a capacitor C2 or C3 according to the modification made to the receiver I.F. stage.

The doubled frequency is then amplified and limited by the valves V2 and V3. V3 then feeds a Foster Seely discriminator valve V6. The output of the discriminator is connected to a low pass filter after which the signal is amplified in a D.C. amplifier V10. The output of the D.C. amplifier separates into two paths, one for the keying circuits and the other to a D.C. feedback circuit which neutralises any D.C. bias in the discriminator due to frequency drift. The output to the Keying circuits is first passed through a slicer so that any amplitude modulation due to L.F. noise is eliminated and this voltage is then made to operate a keying circuit.

(b) Receiver Slicer Circuit

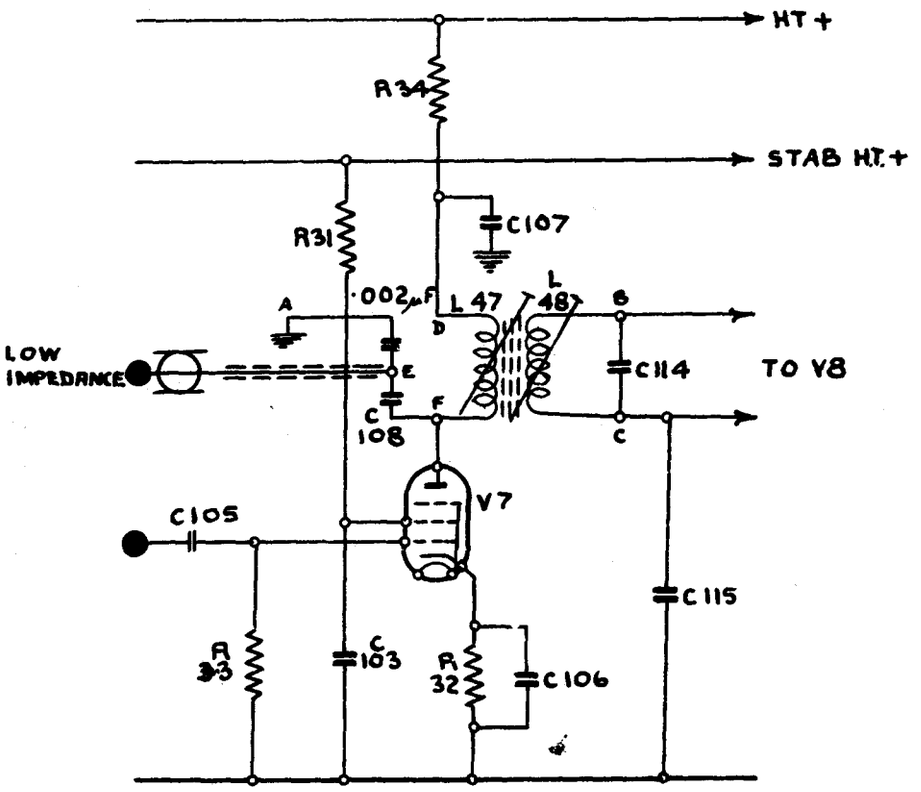
The slicer comprises the valves V5 and V7. These valves have short grid bases and are normally positively biased. Initial adjustment of this bias is obtained by means of a variable resistor RV2. When a signal which is going positive is connected to the grid of V5 the waveform across the common cathode resistor R16 is an exact replicas of the input signal due to the fact that V5 is connected as a cathode follower. When the signal is going negative however, V5 is cut-off, therefore the negative peak of the signal is sliced off. V7 is a cathode driven amplifier and the reverse procedure happens. When the signal across R16 goes positive V7 is cut-off, and when negative it conducts. The signal at the anode of V7 is therefore both positively and negatively limited. Thus the two valves together slice the incoming signal so that any L.F. noise amplitude modulation is simply sliced off.

The output from the slicer valve is applied to the Keying circuits, V9(a) and Keying valves V12 and V15.



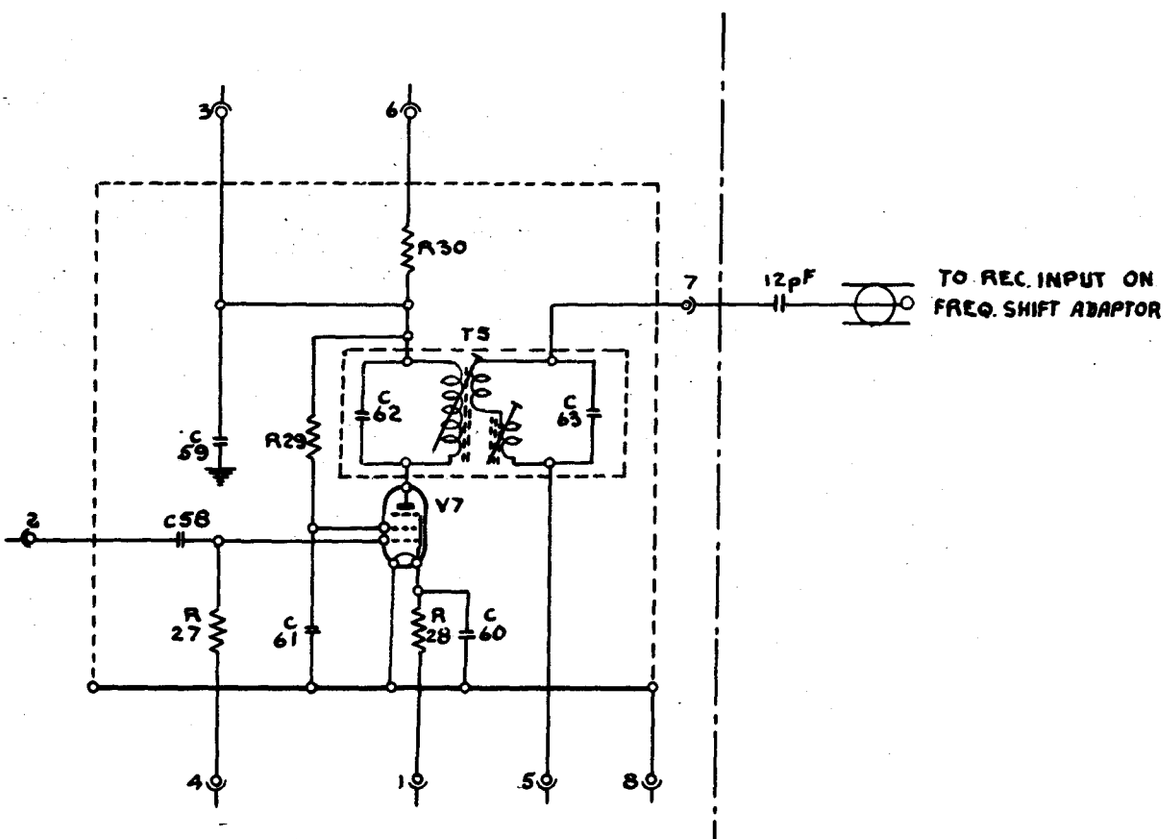
MODIFICATION TO R107

FIGURE 77



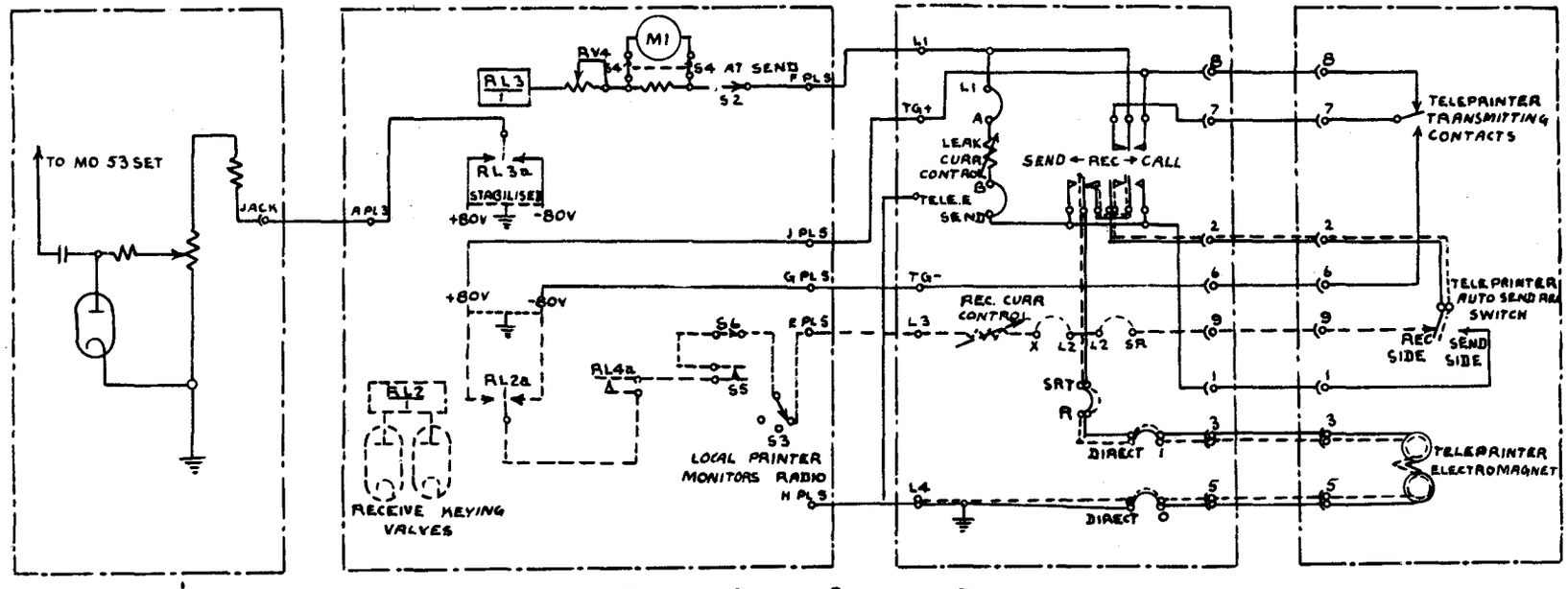
MODIFICATION TO A.R. 88

FIGURE 78



MODIFICATION TO R 209

FIGURE 79



NOTE:- RECEIVE CIRCUIT SHOWN IN DOTTED

FIGURE 80

BASIC CIRCUIT

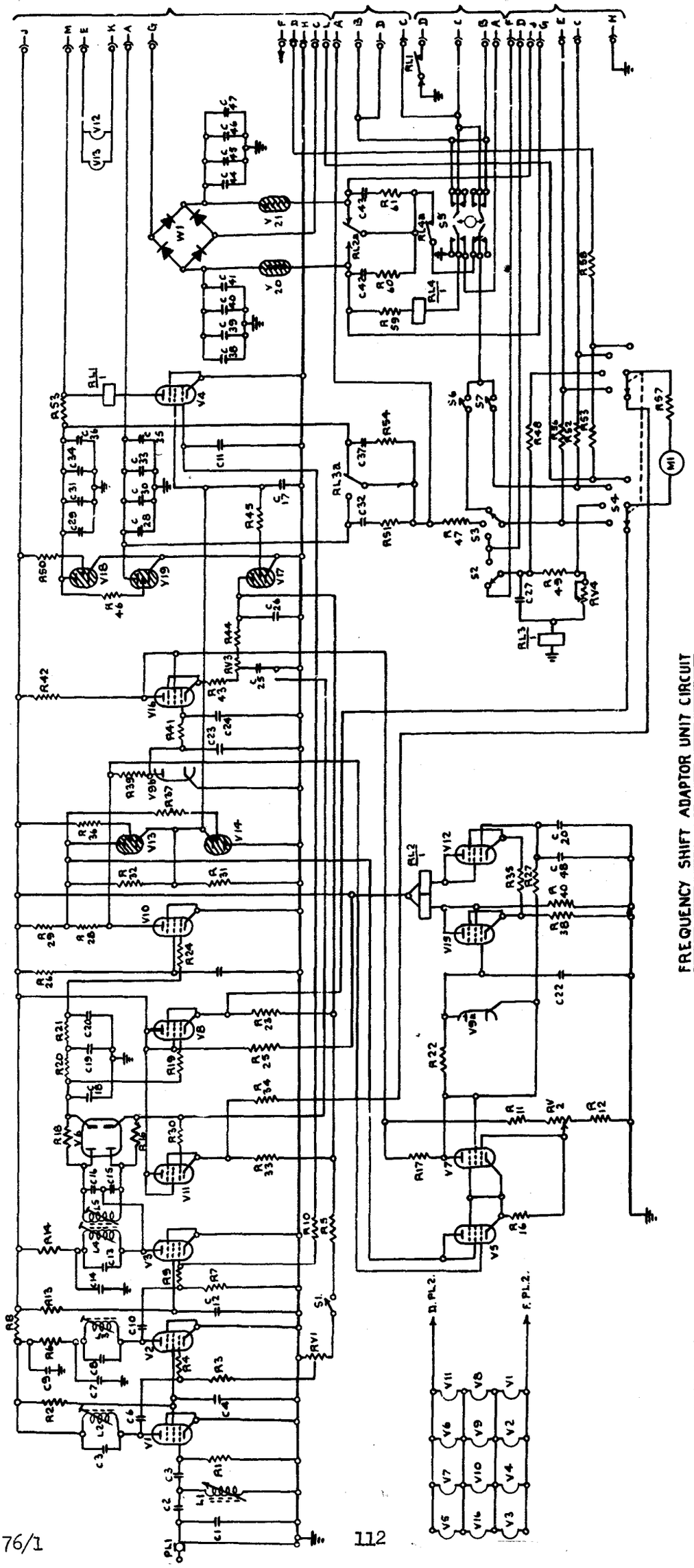


FIGURE 81

(c) Keying Valves

The Keying circuits are so arranged that when a "mark" signal is applied to the Keying valves, V12 passes current and the Keying relay operates in one direction. Owing to R35, V15 cuts off so that no current flows in the other half of the relay winding.

When, however, a "space signal" is applied to the Keying valves, V15 passes current and V12 cuts off.

The valve V9(a) and its time constant circuit R22 and C22 ensure that after a "space" signal the circuit returns to the correct condition for a "mark" signal.

(d) D.C. Feedback Circuit

The D.C. bias feedback circuit employs the diode of V9(b) and the cathode follower V16. The amount of feedback is controlled by RV3. This D.C. feedback neutralises any D.C. bias in the discriminator so that the net change in voltage at the grid of the D.C. Amplifier is practically zero for quite a large drift in frequency.

(e) Valve Voltmeter Circuits

In order to obtain a measurement of the frequency drift, the discriminator valve V6 is connected to two cathode followers V8 and V11. The cathodes of these two valves are connected together through the meter when the switch S4 is at "DRIFT INDICATOR".

When no signal is coming in the voltages applied to the grids of V8 and V11 are equal. When a signal is coming in, provided the discriminator is working correctly, the meter should still read zero since the meter is still connected to points of equal potential. If, however, the frequency drifts then a higher voltage will be applied to the grid of one valve relative to the other, and, since the two valves are connected as cathode followers, a higher voltage will appear at one cathode relative to the other. The meter will thus give a reading. In practice the average value of both "mark" and "space" is used to indicate centre zero.

(f) Squelch Circuit

A squelch circuit is provided in order to prevent the teleprinter printing from noise during the interval of switching off and on the two teleprinters after a message has been sent. The valve V2 is biased back by the SQUELCH CONTROL RV1 to a suitable point. With no incoming signals V2 cuts off and no signal is applied to V3 or to the grid of the squelch muting relay valve V4.

Under these conditions V4 passes current and the muting relay operates to indicate at the remote control that the squelch is on.

With a signal coming in V2 conducts and the valve V3 passes grid current, so that V4 is now biased and no current flows in the relay circuit. R10 prevents any RF reaching the grid of V4. The squelch circuit may be disconnected if required by the switch S1.

3. Keying Circuits

(a) Sending from Local Teleprinter to Distant Radio Receiver

The teleprinter terminal unit forms a convenient method of connecting the teleprinter to the adaptor. Telegraph signals sent from the sending contacts of the teleprinter are passed via the 9 point plug into the teleprinter terminal unit, L1 being the send line, and L4 being earthed on the T.T.U. The signalling currents then pass to the adaptor unit through "F(PL5)", over the switch contacts S2 and operate the relay RL3. The current in the relay is adjusted for correct working by the variable resistor RV4. Relay RL3 then operates and applies the 80+80v signalling voltage through "A(PL3)" to the carrier shift network connected to the M.O. circuit of the W.S. No. 53.

The 80+80v stabilised supply on the teleprinter "send" contacts is obtained from a bridge connected rectifier in the adaptor.

(b) Receiving from a Distant Radio Sender on Local Teleprinter

The receiver passes on at I.F. signals from the distant radio sender to the adaptor. The signals, after passing through the adaptor which has already been described, operate the Keying valves, which in turn operate a Keying relay RL2. 80+80 signalling voltage is applied via contacts RL4, S5, S6, S3, through

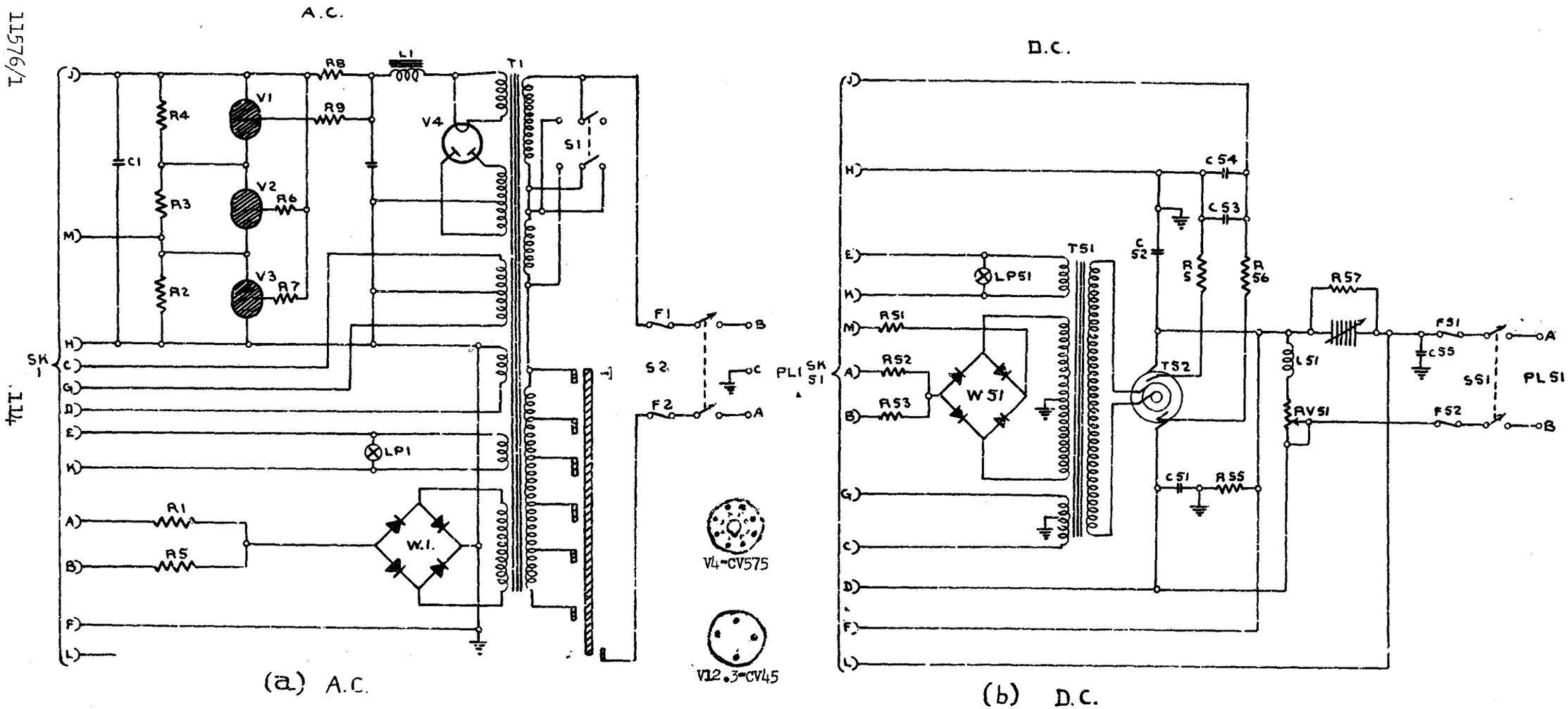


FIGURE 82

POWER SUPPLY UNIT

R56 to "E(PL5)". The meter, when so connected by S4, measures this current. From "E(PL5)" the current passes to L3, via a receive current control in the T.T.U. and over the U-links XL2, L2R, DIRECT I, to the 9 point socket and plug and on to the electro-magnet of the teleprinter.

The other end of the electro-magnet is connected to earth via the 9 point plug and socket and the U-link DIRECT 0.

This operates the printing mechanism.

4. Power Supply Circuits

The Adaptor Power Supply Unit may be connected to either 50 c/s mains or a generator, or 24v battery, and is fitted with an input plug and ON/OFF switch for each supply. A lamp connected in each circuit indicates when the circuit is in use.

(a) A.C. Supply

The A.C. mains supply should be between 100 and 250 volts, 50 c/s.

A switch and voltage taps are situated inside the fuse box in the front panel. These are for adjusting the circuit to suit the supply voltage. The supply from the mains is fed into the P.S.U. through the ON/OFF switch and fuses to a transformer. This transformer supplies the adaptor circuits and the output is rectified partly in the P.S.U. and partly in the Adaptor.

H.T. supplies are rectified and stabilised in the P.S.U. and fed into the Adaptor Unit valve circuits. The 80+80v supply to the radio sender circuits is obtained through a bridge connected rectifier in the P.S.U. and is stabilised in the Adaptor Unit.

Unrectified current is fed to a bridge rectifier and then through two protective barretters in the A.U. and then into the teleprinter and remote control circuits via the relay contacts.

L.T. supplies are obtained from tappings on the P.S.U. transformer.

(b) D.C. Supply

Direct current from the 24v batteries is fed through a carbon pile regulator built into the P.S.U. The regulator functions satisfactorily providing the battery voltage does not fall below 21 volts or rise above 31.6 volts. The regulated supply is then used to drive a rotary transformer. Direct current is taken from the rotary transformer to feed the A.U. valve circuits.

The A.C. output of the rotary transformer is taken to a transformer from which current is taken to supply the A.U. circuits as detailed in the previous paragraph.

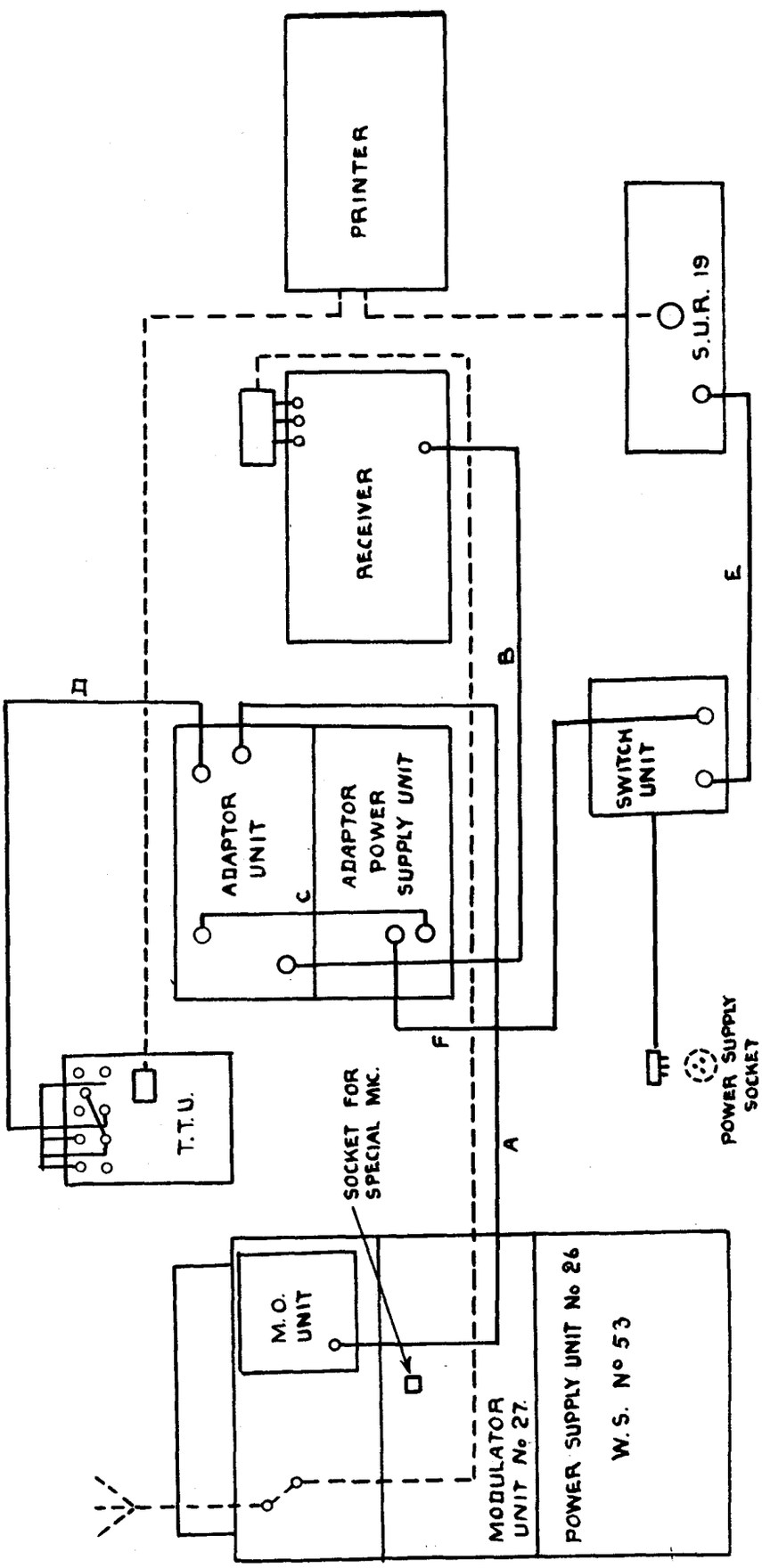
5. R/T and C.F.S. Telegraphy

The modified W.S. No. 53 can be used for the simultaneous transmission of speech and C.F.S. telegraphy. This is achieved by means of a modified Modulator Unit No. 27 and a special microphone. These modifications, which are shown in Fig. 76, consist of the removal of the modulation choke L2A and the capacitor C2A, and the fitting of a diode valve type CV128 and associated heater transformer. This circuit acts as a form of Signal Limiter.

For normal working of C.F.S. the socket and lead fitted into the plug marked MIC AND SIDETONE FROM CONTROL UNIT on the 53 Set, modulator unit No. 27 should be disconnected.

When R/T communication is required, the special Microphone Hand No. 7 as issued with the modification kit should be used. This is simply plugged direct into the M.U. No. 27. No sidetone will be heard under these conditions.

When using the special microphone care should be taken to keep its lead away from the H.T. and modulator leads connecting the M.U. to the R.F. unit. Failure to do this may cause self-oscillation.

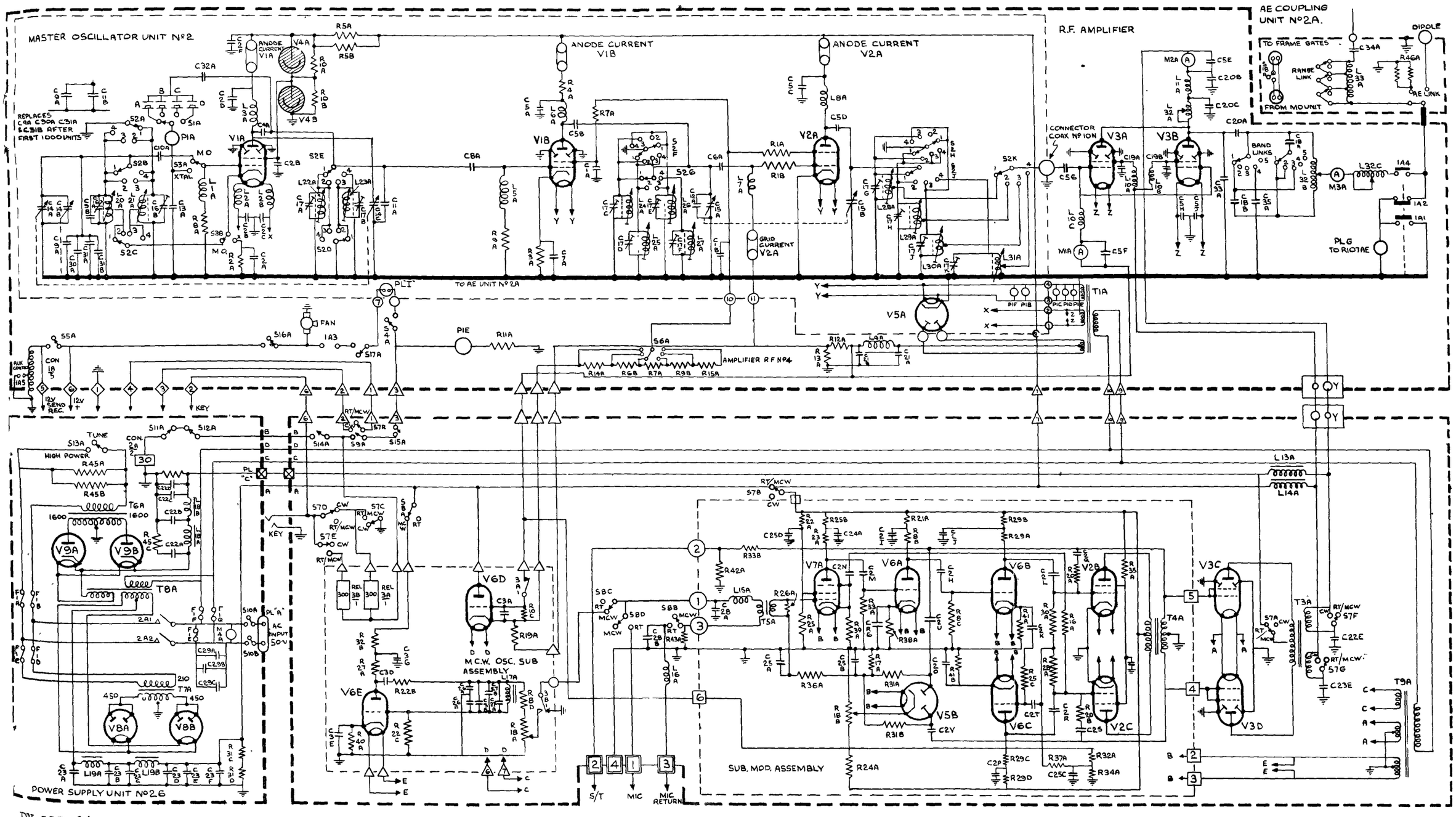


INTERCONNECTION OF UNITS FOR FREQUENCY SHIFT WORKING

FIGURE 83

RESTRICTED

RESTRICTED


MASTER OSCILLATOR UNIT Nº2
R.F. AMPLIFIER
AE COUPLING UNIT Nº2A.
TO FRAME GATES
DIPOLE
RANGE LINK
AE LINK
FROM MO UNIT
ANODE CURRENT V1A
ANODE CURRENT V1B
ANODE CURRENT V2A
REPLACES C9A C30A C31A L63B AFTER FIRST 1000 UNITS
CONNECTOR COAX Nº1 ON
BAND LINKS
PLG TO R107AE
TO AE UNIT Nº2A
GRID CURRENT V2A
FAN
AMPLIFIER R.F Nº4
KEY
RT/MCW
TUNE
HIGH POWER
AC INPUT 50-V
M.C.W. OSC. SUB ASSEMBLY
SUB. MOD. ASSEMBLY
S/T
MIC
MIC RETURN
POWER SUPPLY UNIT Nº2.6

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