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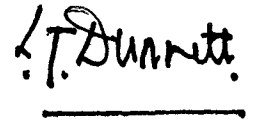
AMPLIFIER TYPE A.1961 AND ASSOCIATED I/C EQUIPMENT

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL



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AMPLIFIER TYPE A.1961 AND ASSOCIATED I/C EQUIPMENT

Heavy type indicates the books being issued under this A.P. number ; when issued they will be listed in A.P.113

VOLUME 1	**General and technical information**
VOLUME 2	**General orders and modifications**
VOLUME 3, Part 1	Schedule of spare parts (*Application to be decided later*)
VOLUME 3, Part 2	*Inapplicable*
VOLUME 3, Parts 3 and 4	Scales of unit equipment and servicing spares (*application to be decided later*)
VOLUME 4	Planned servicing schedules (*application to be decided later*)
VOLUME 5, Part 1	Basic reconditioning schedule (*application to be decided later*)
VOLUME 5, Parts 2, 3 and 4	Daily, weekly, major, and minor servicing schedules. (*application to be decided later*)
VOLUME 6, Parts 1 and 2	Minor and major repairs (*application to be decided later*)
VOLUME 6, Part 3	*Inapplicable*

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The reference number of this publication was altered from A.P.2876E, Vol. 1 to A.P.116N—0105—1 and the security grading changed from RESTRICTED to UNCLASSIFIED in March 1968. No general revision of page captions has been undertaken, but the code appears in the place of the earlier A.P. reference and the word RESTRICTED removed on new or amended leaves issued subsequent to that date. Leaves removed which are marked RESTRICTED must be disposed of by methods appropriate to that grade of security.

LIST OF PARTS

Note—A list of chapters appears at the beginning of each part

1 General information

2 Technical information

Chapter 1

PRINCIPLES OF STANDARD UNIT I/C SYSTEM

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Standardized control units

1. Many of the control units associated with radio and inter-communication equipment in future installations will be provided with universal mountings to permit either horizontal or vertical installation. Where several such units are to be mounted in close proximity under the control of one individual, one of the possible methods of horizontal mounting is upon a pair of rails, spaced to accommodate control units of the standard width of six inches. If such rails are drilled and tapped with a 4 BA thread on 6·36 in. centres transversely, the holes being spaced $\frac{3}{8}$ in. apart in the lengthwise direction, any control unit of standard width can be fitted.

2. Where such rails are used, sufficient space is left below the units to allow the control unit to drop between the rails and so to rest upon their upper flanges, and further space is left for the accommodation of the cables. Space is also left above the units so that they may be removed for servicing.

3. Where vertical mounting is adopted, a clearance of 6 in. is required below each unit to accommodate the cables.

4. The nominal lengths of all standardized units are in multiples of $\frac{3}{8}$ in. and the width is just under 6 in., so that each can be fitted between two rails spaced 6 in. apart. The width across fixing centres is 6·38 in., and the spacing between the fixing holes on the same side is a multiple of $\frac{3}{8}$ in. The length of any unit will normally not exceed 9 in.

5. A universal design has been worked out in which the plate carrying the plugs and sockets can be fitted either on the side opposite the top panel in horizontal mounting, or as the bottom side (adjacent to the panel) for vertical mounting. The general layout of a typical control unit case is shown in fig. 1 and 2. Variants of this design may be adopted where control units are designed for only one method of mounting, either horizontal or vertical. Switches may be mounted directly upon panels within the aircraft.

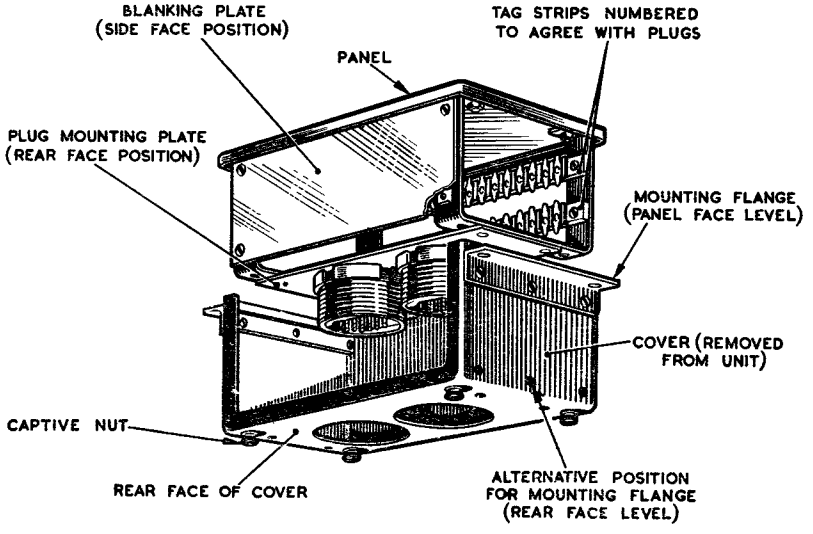

Fig. 1. Standard control unit, typical assembly

Unit inter-communication system

6. The unit inter-communication system consists of a number of individual elements of audio-frequency equipment used for inter-communication and radio services switching in aircraft. The elements will be standardized with regard to such components as plugs and sockets, terminal blocks, etc., in order that it may be possible to build up from basic units a system which will meet any particular operational requirement in a manner economical in space and weight, and yet technically sound. From this feature of building up complete installations from standardized elements, the term "brick system" is sometimes employed.

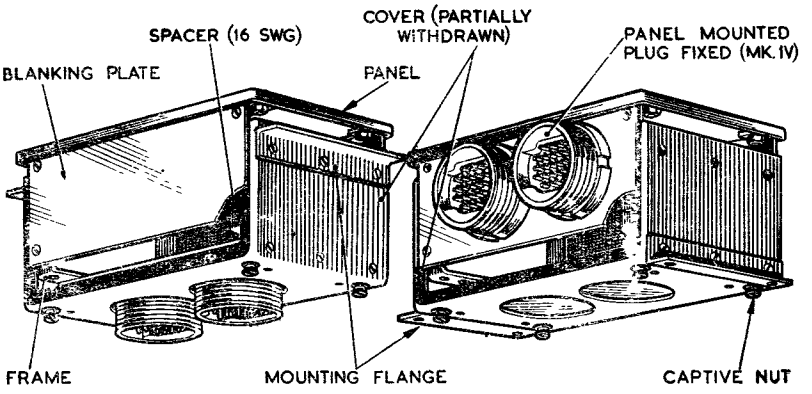

Fig. 2. Alternative positions for plugs

7. In the design of the system certain fundamental principles have been adhered to; these are as follows:—

(1) Each item is fully independent of others, with regard to power supply and connection into the aircraft wiring system. A junction box will normally be associated with each electronic device (see Note). In general, connection between the electronic devices and junction boxes will be by screened miniature cables, using multiple plugs and sockets. The junction boxes are connected into the aircraft wiring through panel-mounted terminal boxes, suitably labelled.

(2) Particular attention is paid to the necessity for reducing the weight and space required for each type of installation to a minimum.

(3) Where power supplies are required, these are obtained from the aircraft battery.

Note . . .

The term electronic device used in sub-para. (1) *means any electronically active device such as an amplifier, transmitter, receiver, etc.*

8. As the requirements of future aircraft cannot be foreseen, it is intended to provide additional items as necessary to give any new facility which cannot be met by units already developed or under development. A list of the items of equipment at present developed or projected is given below.

tem No.	Description	Function	Remarks
1	AF amplifier Type A.1961	Central AF amplifier with radio mixing facilities	See Note
2	Junction box Type 154	Used with item 1. Also provides emergency intercomm. and VHF microphone switching	See Note
3	Control unit Type 702	Remote switching of item 1 and selection of emergency inter-communication	Dimensions approx. $1\frac{1}{2} \times 1\frac{1}{2} \times 3$ in.
4	Control unit Type	Provides for mixing of up to three selected services without cross-talk	Standard width. Depth of panel approx. $2\frac{1}{4}$ in.
5	Junction box Type	Provides for the installation of items 4 and 8	Will allow for the connection of any two control units
6	Control unit Type	Provides wiring-up of five (or less) selected plus two permanently mixed services without cross-talk	Standard width. Depth of panel approx. $3\frac{1}{4}$ in.
7	Junction box Type	Provides for the addition of control unit, item 6, to the installation	Will allow connection of any two control units
8	Control unit Type	Provides mixing of any three selected services, with volume control, without cross-talk	Dimensions identical with those of item 4

Note . . .
Items 1 and 2 will be used in future installations instead of amplifier Type A.1134A and panel Type 192 respectively, but are not direct replacements in existing installations.

9. In the foregoing list, where the Type number is not shown, the unit is still under development. Air Ministry Type and Stores Ref. numbers of items actually introduced into Service installations will be given in other chapters dealing with particular items and/or installations. In this chapter however it is proposed to discuss briefly a simple typical installation consisting of amplifier, item 1, junction box, item 2, and control unit, item 3. These three units in association represent the 'brick' system in its simplest form; such an installation will meet the present requirements for bombers.

10. The complete installation consisting of items 1, 2 and 3 (with the appropriate aircraft wiring) is therefore a substitute for the existing inter-communication system using amplifier Type A.1134A with Panel Type 192 (see Note). It provides additional facilities, however, with a substantial saving in weight and installation space.

Note . . .
Individual units (items 1, 2 and 3) are not normally adaptable for substitution in the existing A.1134A installation.

Inter-communication amplifier

11. The amplifier is a self-contained unit including HT generator and carbon pile regulator for heater supplies. It occupies a space of approximately 5 in. width, 7 in. height, and 6 in. depth. It weighs approximately 6 lb., as compared with the 18 lb. of the amplifier Type A.1134A (complete with batteries). It is described in greater detail in Part 2, Chap. 1.

12. The performance of the amplifier is substantially independent of variation in the battery supply voltage provided the latter does not fall below approximately 20 volts. The output circuit of the amplifier will supply power at any pre-set level between approximately $\frac{1}{3}$ watt to 1 watt into a load representing ten pairs of headphones, i.e., about 15 ohms. Negative feedback is used to maintain the voltage gain sensibly independent of the output load.

13. The amplifier is designed for optimum performance when working into a load representing five pairs of headphones, but the output remains undistorted if the load varies between two and twenty pairs. The frequency response of the amplifier is constant to within 3dB between 300 and 5,000 c/s, but is sharply attenuated outside these limits.

14. Provision is made for three separate inputs, viz.,

(1) From the microphone line, at normal impedance and level

(2) From the VHF transmitter-receiver.

(3) From any other receiver, e.g., general-purpose.

Either or both the two latter may be connected, the gain from the receiver inputs being independently variable. These two pre-set controls, together with the main gain control which operates in the feedback circuit, are brought out to the front panel of the amplifier and can be adjusted as requisite after the installation is completed.

15. A pre-set control is also provided for the carbon pile voltage regulator, but this is set up during test at the makers' works (or a corresponding Service Unit) and should not be adjusted in the aircraft. To obtain access to this control the amplifier must be taken from its mounting and the dust cover removed.

16. Two six-way connections are provided via sealed multi-pin plugs and sockets and screened cable from the amplifier to the junction box, one providing microphone, telephone and external switch connections and the other radio services and 24-volt supply line. Thus if only a simple inter-communication system of microphones and telephones with a remote on/off switch were required, a simplified type of junction box utilizing one connector only could be employed.

17. The junction box, item 2, provides for a more elaborate installation, for example, as required in bombers. It includes terminations for the aircrew microphone and telephone wiring, connection to other services (e.g., VHF audio warnings), special provision for emergency inter-communication using the VHF audio circuits and VHF transmission with non-radiated inter-communication.

18. Emergency inter-communication is selected by changing over crew microphones and telephones to the appropriate VHF terminals on a sealed relay incorporated in the junction box. This relay is normally energized when the power supply to the amplifier is connected and in these circumstances the amplifier is used for inter-communication in the normal manner. Should this power supply fail, the relay is de-energized and the inter-communication circuits automatically lapse into the emergency connection, using the VHF audio circuits for amplification. A switch is provided by which the emergency system may be brought into action with the amplifier power supply 'on.' This switch is mounted in the control unit, item 3. This item also carries the main on/off switch for the amplifier.

19. The junction box, item 2, also provides a 24-volt supply point for other apparatus which may be connected, for example the electronic mixer referred to in the following paragraph.

20. The control units, items 4 and 8, provide for the mixing of any three selected radio services at any crew station without introducing cross-talk into other crew stations. In item 4 these services are selected at pre-set level by on/off switches, while in control unit item 8 a complete range of volume control is available on each channel. The control unit item 6 and its associated junction box item 7 will provide for the selection of five independent services and permanent mixing of two further services not switchable. This increased capacity and flexibility is obtained at the expense of increased dimensions and weight in the control unit and junction box.

Typical application

21. Fig. 3 shows a simple application of units items 1 and 2 and 3 to meet the requirements of a five-seater bomber. The following paragraphs explain how the requirements are fulfilled.

22. Inter-communication is provided between all occupants of the aircraft so that every member can hear and join in all conversations. This is achieved by arranging that, except when voluntarily isolated, all telephone circuits are permanently in parallel on the output circuit of the I/C amplifier, or in an emergency, by the switch C to the audio circuits of the VHF transmitter - receiver. Except when the press - to - transmit button is pressed, all microphones are connected in parallel. The press-to-transmit button is fitted only at those stations where VHF transmission is necessary.

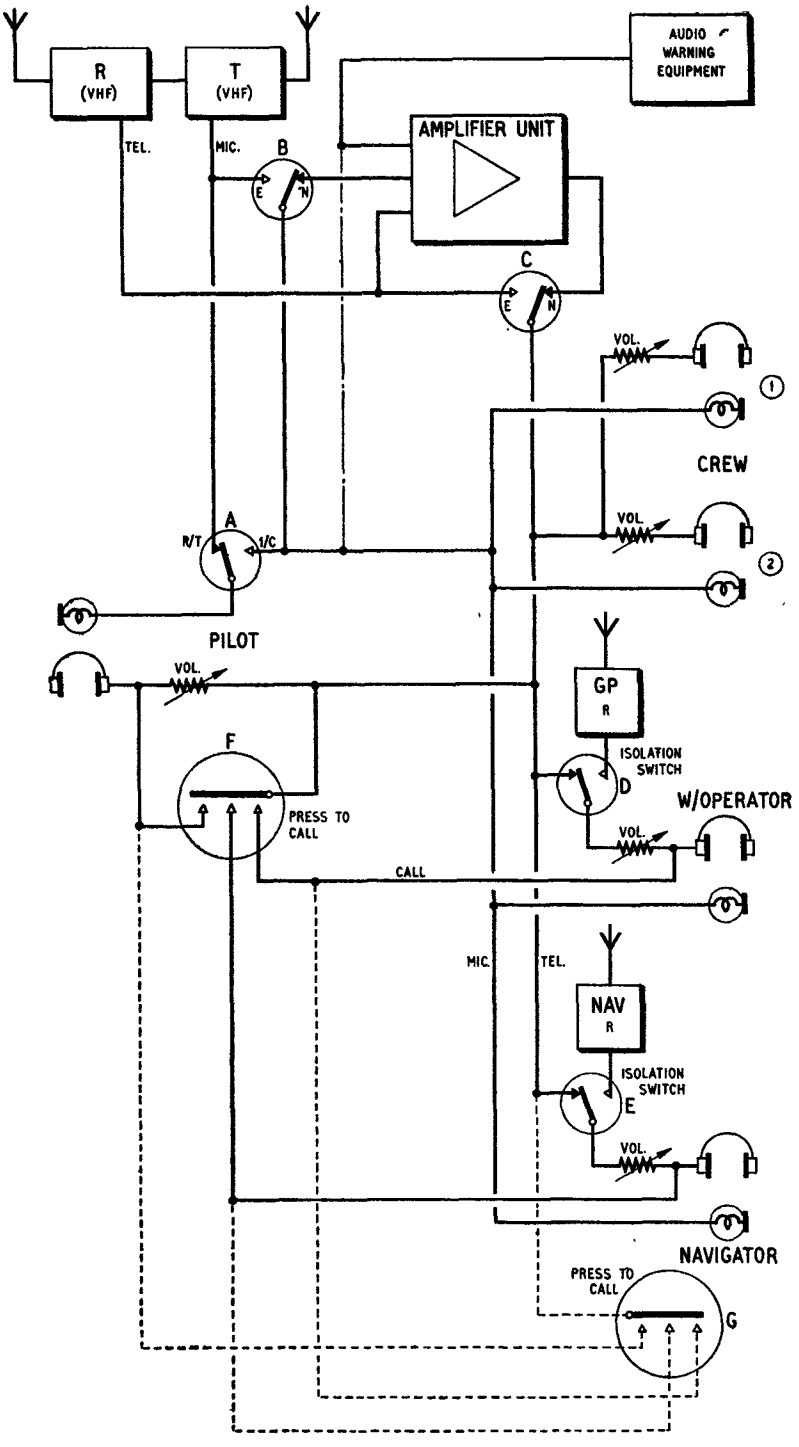

Fig. 3. Typical I/C and radio services schematic

23. Crew members requiring to operate certain radio services, e.g., W/T, radio compass, etc. can be isolated from the I/C system. Voluntary isolation is provided for by the incorporation of simple change-over switches in the telephone circuits as at D and E.

24. A call system may be required whereby selected crew members can attract the attention of isolated members. In some cases it is also necessary to provide for the selected crew member to override the isolating switch of the isolated member. The attraction of such members may be accomplished by the fitting of a call-up lamp system, but this is not regarded as part of the radio inter-communication system. In the typical installation shown in fig. 3, the isolation can be overridden by the pilot, using call button F. The telephones of the navigator are wired up to this switch, so that even if his telephones are switched to the navigational receiver at the switch E, they are connected through F to the main telephone circuit shown in heavy line. As the inter-communication amplifier is of comparatively low impedance this will have the effect of reducing the output of the isolated service by approximately 10 dB, giving the call signal preference.

25. The wireless operator's position is also shown with an isolation switch D and the same remarks apply if he is switched over to the G.P. receiver. Another press-to-call button G is shown at the navigator's position. No specific housing has been designed for the call switches, but the types to be used for any particular installation will be specified.

26. A volume control will usually be fitted at each crew station. This may consist of a suitable variable resistor such as volume control Type 9, which will be connected in series with the telephones via a suitable terminal block.

27. Speech on the I/C system, speech from the VHF R/T, and the audible warning system, should be received simultaneously by all members of the crew. This is effected by feeding the R/T into the I/C amplifier so that the common telephone output contains received R/T, side-tone (when transmitting) and inter-comm. signals. Audio warning can be fed into the system either as the R/T is fed, or directly into the common telephone line, the latter providing for full emergency operation.

28. In the installation shown in fig. 3, external transmission on the VHF R/T is limited to the pilot, or pilots, but provision is made to extend this facility, with press-to-transmit switches but without channel selection apparatus to other crew members if necessary (see Note). Normal inter-communication must not be radiated over the R/T. For example, to extend the R/T transmission to the position marked CREW 1 in the diagram, the microphone may be disconnected from the 'common mic.' line and wired either permanently, or via a change-over switch, in parallel with the pilot's microphone. A second press-to-transmit switch must be provided in parallel with that of the pilot.

Note . . .

The crew member concerned must take care that the press-to-transmit button is not pressed unless R/T transmission is required; it is obviously impossible to provide an automatic safeguard against this.

29. Crew members transmitting speech over the R/T must be provided with side-tone. This is accomplished by feeding the receiver telephone output into the inter-comm. amplifier and so feeding side-tone into the common telephone line. If the R/T transmitter-receiver does not provide side-tone, the common microphone line may be used for modulating purposes and side-tone will then be generated in the I/C amplifier.

30. An inter-communication point will normally be installed external to the aircraft to enable I/C contact with the ground crew to be maintained up to just before take-off.

Extension of system

31. The above simple system may in due course be extended by the use of the control units and junction boxes listed in para. 6 to provide the following facilities.

(1) Mixing the output of the I/C with two or three radio services for selected crew members and elimination of cross-talk for the others.

(2) Where mixing is employed, individual volume control may be required at the crew members' stations.

These requirements may be met by the addition of items 4 or 8, as required, with junction boxes, item 5, one per pair of control units.

(3) Provision for temporarily confining both R/T transmission and reception to one or two selected crew members. This may be arranged by the addition of a change-over switch, which will route the VHF receiver output directly to the required crew stations instead of to the I/C amplifier input. Separate microphone lines as suggested in para. 28 would meet the transmission requirement.

32. The incorporation of switches providing these additional facilities depends to some extent upon the space available at the appropriate crew station. Where necessary, such controls, together with those for other services, e.g., photographic, could be centralized upon a console.

Appendix 1

ANTI-CROSSTALK NETWORKS

1. In this Appendix it is proposed to discuss briefly the problem of cross-talk, as it affects I/C systems. First, consider the simple system shown in fig. 1 (a), in which two electro-magnetic microphones A and B are directly connected to the input circuit of a single-valve AF amplifier and the latter supplies the telephone circuit. Let the resistance between the control grid and cathode of the valve be 5,000 ohms, and the effective resistance of each microphone 50 ohms.

2. Suppose that on speaking into the microphone A, a mean EMF of 1 volt is generated. This is applied to a circuit consisting of a 50-ohm microphone B, shunted by the amplifier input resistance 5,000 ohms. The resistance of the microphone and input resistance in parallel is 49·5 ohms, and since this is in series with the resistance of the microphone A, only about one-half of the generated voltage is applied to the amplifier. Also, practically all the resultant current flows through the microphone B, and since this is an electro-magnetic device it acts as a telephone receiver, converting the received energy into sound waves. This phenomenon is liable to set up howling in the microphone circuits and to give rise to other undesirable effects.

3. Now suppose the circuit to be rearranged as shown in fig. 1 (b) with a 20,000-ohm resistor in series with each microphone. The energized microphone A will now work into a 20 K resistor in series with a load consisting of 20,050 ohms in parallel with 5,000 ohms, i.e., a total load of 24,050 ohms. Ignoring the odd 50 ohms, then, 20/24ths of the 1 volt generated by the microphone A will be dropped in the 20K series resistor and only 4/24ths of 1/6th of a volt will be applied to the amplifier input terminals.

4. The 1/6th volt developed across the amplifier input terminals will also be applied to the second microphone B, through its 20K series resistor. Since the microphone resistance is 50 ohms, only about 50/20,000ths or 1/400th of this will be applied to the microphone itself. Hence the speech voltage across the microphone B, when the microphone A is spoken into, will only be $1/6 \times 1/400$ or 1/2,400th of that generated by the speech input to microphone A. Converting this into decibels, if L is the loss in dB, Va the voltage at microphone A, Vb the voltage at microphone B,

$$L = 20 \log_{10} \frac{Va}{Vb}$$
$$= 20 \log_{10} 2{,}400$$
$$= 67{\cdot}6 \text{ dB}$$

5. It must be remembered that with this arrangement, for 1 volt generated in the microphone, the input to the amplifying valve will be

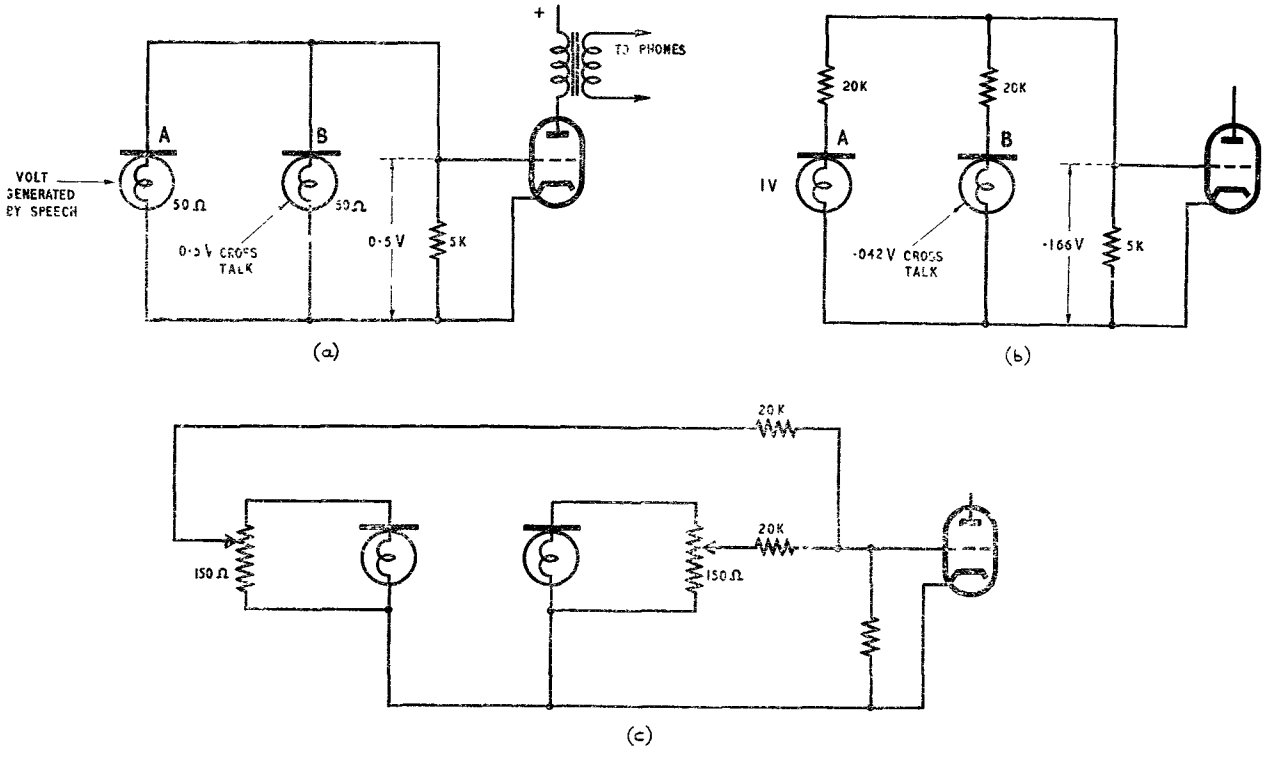

Fig. 1. Development of anti-cross-talk network

only 1/6th volt, i.e., about 16dB loss. Hence an additional stage of amplification may be required in the amplifier to restore the speech to normal level.

6. Under the above conditions each microphone would work into a badly mis-matched load, requiring much greater speech amplitude for a given output than would be obtained with a matched load. By inserting resistors across the line at the microphone terminals, as shown in fig. 1 (c), a better match can be obtained. In practice, such resistors are usually of the order of 150-250 ohms each. If potentiometers are used for this purpose, they may be used to give control of the input level also.

7. Anti-crosstalk circuits of this kind will be incorporated in the control units, items 4, 6 and 8. Because they permit the connection of several microphones to one amplifier with negligible cross-talk, an amplifying stage with a number of input circuits of this kind is sometimes referred to as an electronic mixer. The principle is not confined to microphone inputs ; for example, the audio outputs from two or more radio receivers may be fed into an audio amplifier in a similar manner, having regard to the terminal impedances between which they are required to operate.

Chapter 2

TYPICAL I/C INSTALLATIONS

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Introduction

1. In this chapter it is proposed to discuss briefly some typical R.A.F. aircraft W/T and I/C installations using the amplifier Type A.1961 (with or without junction boxes). A variety of installations is possible depending on the requirements of the aircraft using each installation.

*Amplifier Type A*1961

2. The amplifier Type A.1961 is a self-contained unit, the only essential external requirement being a 24-volt d.c. supply and a remote on/off switch. The supply is provided by the aircraft supply system; this supply system employs a battery which is charged by a generator. The battery potential is nominally 24 volt but the generator maintains the output of the battery at about 28 volt. Hence the supply system may be referred to as the 24-volt supply or the 28-volt supply.

3. The output signals of two radio receivers and the output from the aircraft microphone line may be connected to the amplifier input. The output of the microphone line is connected by way of a balanced matching transformer. The receiver output signals are connected across pre-set potentiometers, one for each receiver; the potentiometers are joined together by two resistors and the junction of these resistors is connected to the secondary circuit of the transformer. By means of these potentiometers the level of each receiver signal can be adjusted before being applied to the first stage of the amplifier. Provision is made for connecting the output of the amplifier to a telephone line.

4. The amplifier has three outlets for connectors: These are shown in fig. 1 and 2. Socket SK1 connects the output from two receivers and provides a 24-volt supply for equipment associated with the amplifier, i.e., the junction box Type 154. Plug PL1 connects the incoming 24-volt power supply. Plug PL2 connects the microphone input, the telephone output and the remote on/off switch.

5. Further details of the amplifier Type A.1961 are given in Part 2, Chapter 1, of this Volume.

Junction box Type 154

6. The junction box Type 154 provides the means of connecting the microphone and telephone lines of an aircraft W/T and I/C installation to the various services of that installation.

7. Connection to the junction box is provided by eight 2-way terminal blocks, two plugs and a socket; these are shown in outline in fig. 2 The plug PL1 connects the remote "on/off" switch (which operates a power relay in the I/C amplifier) and the "normal/emergency" switch (para. 9 refers). Plug PL2 and socket SK1 provide the means of connecting the junction box to the I/C amplifiers: microphone, telephone and power relay connections are made at PL2; receiver output signals to the amplifier and a 24-volt supply from the amplifier are connected at SK1.

8. The 24-volt supply from the amplifier is used to energize the normal/emergency (N/E) relay

and the transmitter (Tx) relay contained in the junction box. The supply is also used to provide a 24-volt outlet on the junction box; this outlet is not used in the installations which are to be described.

9. The normal/emergency switch operates the N/E relay. In the NORMAL position of the switch the relay is energized and all the microphone lines brought into the junction box are connected to the I/C amplifier. In the EMERGENCY switch position the N/E relay is de-energized and the microphones are connected to the microphone line of an appropriate transmitter-receiver. Also, all telephones are connected to the output of the transmitter-receiver. The audio circuits of the transmitter-receiver can then be used as an emergency I/C amplifier. The "on/off" and the "normal/emergency" switching arrangements may be effected by two separate switches or by one NORMAL/EMERGENCY/OFF switch. Alternative switching arrangements are given in fig. 2 and 3.

10. Separate terminals are provided on the junction box for the pilot's microphone; terminals are also provided for the pilot's PRESS-TO-TRANSMIT switch. When this switch is made the Tx relay operates and the pilot's microphone (normally in parallel with the crew microphones) is disconnected from the I/C amplifier and connected to the transmitter audio circuits for the purpose of modulating the transmitter.

11. The output signals from the two receivers referred to in para. 3 may be connected to the amplifier by way of the junction box. One of these receivers (REC. 1) is normally part of the transmitter-receiver referred to in para. 9; the other receiver (REC. 2) is not used in the installations to be described in this Chapter but it may be used for the connection of, for example, an ILS receiver.

12. Further details of the junction box Type 154 are given in Part 2, Chapter 2 of this Volume.

Simple installation

13. A schematic diagram of the simplest installation using the amplifier Type A.1961 only is shown in fig. 1.

14. Socket SK1 is not in use and is fitted with a cover. The 24-volt supply for the amplifier is applied through a 5-amp. fuse and twin cable to plug PL1.

15. The microphone, telephone and on/off switch outlet, PL2, is connected by a six-core connector (*item* 4, *fig.* 1) to the nearest crew position; the cable is terminated on three 2-way terminal blocks (*item* 6, of *fig.* 1). One of these blocks is used for connecting the on/off switch; the other two blocks provide the means of connecting the mic/tel. socket at the first crew position and at additional crew positions. If the nearest crew position is beyond the reach of the six-core connector additional six-core cable will be used, the cable being joined to the connector by three more 2-way terminal blocks.

16. The microphone cable must be bonded across each terminal block and earthed at intervals; all microphone cables should be spaced at least 18 ins. from cables carrying alternating current.

Installation with junction box Type 154

17. An installation using the amplifier Type A.1961 with the junction box Type 154 is shown in fig. 2. The microphone and telephone sockets at each station are connected to 2-way terminal blocks. The microphone terminal blocks of all stations excepting the pilot's are interconnected, one of the blocks being connected to the "crew mic" terminals of the junction box. The terminal block at the pilot's station is connected to the "pilot's mic" terminals on the junction box. All telephone terminal blocks including the pilot's are interconnected, one of the blocks being connected to the "telephone" terminals on the junction box. The microphone and the telephones are connected to the amplifier by way of PL2.

18. The pilot's microphone is wired separately so that he may use the VHF transmitter. Details of the VHF connections are shown in fig 3 and described in para. 22.

19. Coming in to the junction box by way of SK1 is a 24-volt supply from the amplifier; this supply energizes the N/E relay in the junction box. The relay must be energized in order to connect the crew microphone line and the telephone line to the appropriate terminals on PL2.

20. The remote "on/off" switch and the switch for operating the N/E relay are connected to the junction box at PL1. Alternative switching arrangements are shown in fig. 2.

W/T and I/C installation

21. The I/C system described in para. 17 to 19 can, with suitable switching arrangements, be used to include additional services. One additional service, the VHF transmitter, has already been mentioned (*para.* 18 refers). In the example given in fig. 3 additional services are a general purpose receiver and a radio compass as well as the VHF transmitter-receiver.

22. The I/C service is basically the same as that shown in fig. 2. The output from the telephone terminals of the junction box is common to all stations. The pilot's microphone is connected to terminals which are separate from the crew microphones but is connected by the contacts of the Tx relay (relay de-energized) to the microphone outlet of the I/C amplifier. When the pilot operates his PRESS TO-TRANSMIT switch a relay (*item* 17 of *fig.* 3) operates, this in turn operates the Tx relay in the junction box and the transmit relay in the VHF transmitter. As described in para. 10, the Tx relay connects the pilot's microphone to the transmitter modulator circuits. The "master" relay (*item* 17 of *fig.* 3) is necessary for the following reason. If the Tx relay in the junction box Type 154 is wired directly in parallel with the transmit relay in the VHF transmitter a circulating current will flow

which will operate the Tx relay permanently in the "transmit" position. The use of a double-pole relay keeps the two "press-to-transmit" circuits separate from each other.

23. In fig. 3 a 2-way switch is shown at the radio operator's position and at the navigator's position. The radio operator's switch connects his telephone to either the I/C signal or to the output of a general purpose W/T receiver. Similarly the navigator's switch connects his telephone to either the I/C signal or to a radio compass.

24. A PRESS-TO-CALL switch (*item* 16 *on fig.* 3) may be provided at the pilot's position. This switch permits the pilot to call any crew member who has broken contact with the I/C system in order to listen to one of the other services. The "call" switch provides a parallel contact which reconnects the telephone of each isolated crew member to the I/C system for as long as the switch is pressed. Intercommunication under these conditions is not good and the switch should be used for "call" purposes only.

25. Other crew positions may be added to suit aircraft requirements. The external socket (*item* 13 of *fig.* 3) is accessible to personnel outside the aircraft. It is provided so that the aircraft crew can communicate with attending ground staff who are preparing the aircraft for flight.

26. In the arrangement in fig. 3 all positions, when on I/C, hear the VHF receiver but the pilot's position is the only one from which the VHF transmitter can be operated. If other crew members are required to use the VHF transmitter they will be furnished with "press-to-transmit" switches. Crew members should inform the pilot by I/C when they intend to use the VHF transmitter. It is possible for crew members at all positions to speak on the VHF when the "normal/emergency" switch is in the EMERGENCY position, i.e., all microphones connected to the transmitter input. When the PRESS-TO-TRANSMIT switch is operated speech from all crew positions will then be transmitted. It should be noted that if under these conditions, the emergency I/C system is used speech intended for internal communication will be radiated hence some prior organization is necessary to prevent this.

ARI.5388

27. The ARI.5388 is a switching system for the W/T and I/C equipment of multi-seater aircraft. The system is capable of providing a total of 7 services (3 receive and 4 transmit-receive). Five of these seven services, in addition to I/C, may be connected to any station box (control unit Type 349) via a main junction box (junction box Type 131) and a sub-junction box (junction box assembly Type 63/1). These alternative services are allocated when the system is installed.

28. Each member of the crew requiring the services referred in para. 27 is provided with a control unit Type 349. These control units contain a six-position switch which enables the crew member to select two receiver services and three transmitter-receiver services: the five services can be used without affecting the services received by other crew members. A sixth position of the switch provides "I/C only".

29. "Call" and "press-to-transmit" facilities are also provided on the control unit and provision is made for mixing the I/C signal with any of the five services.

30. Crew members requiring I/C only can be furnished with a control unit Type 350. These control units provide "I/C" and "call" facilities and are used in positions in the aircraft where only these facilities are required.

◀**31.** Further details of the ARI.5388 will be found in Part 2, Chapter 4.

ARI.18089/1

32. The ARI.18089/1 is a service-selecting and I/C-distributing arrangement; its main function is to provide the following —

(1) A means of selecting available services.

(2) A means of mixing two or more audio signals without one adversely affecting the other.

(3) A channel for distributing I/C signals throughout the aircraft and a means by which this signal can be used to alert members of the crew.

The total number of services available at any one station is seven. One of these services must by I/C; three others may be "transmitter-receiver," the remaining services will be two "receivers only" and "conference I/C".

33. The general arrangement of the ARI.18089/1 is given in fig. 4; this shows that all services are brought to the main junction box (junction box Type 7684). These services are: "transmitter-receiver", up to four in number connected to the main junction box at outlets A, B, D and E; "receivers only", up to eleven in number at outlet L; I/C between all stations; conference I/C at outlet C.

34. The services referred to in para. 32 may be selected only at stations where a control unit (Type 7681, 7681A or 7681B) is fitted. At such stations the user's microphone input to the selected I/C amplifier or transmitter is connected to the main junction box via a rotary multipole switch within the control unit, a sub-junction box (junction box Type 7682) and the main microphone cable; audio outputs from the I/C amplifier and from the receivers are connected to the user's telephone via the main junction box, the main telephone cable, a sub-junction box (junction box Type 7683) and switches or volume controls (viz. potentiometers) within the control unit.

35. The seven audio output signals (from receivers or from the I/C amplifiers) that can be selected at any one station can be mixed together

so that they may be heard simultaneously. The audio signals received at any one station are in no way affected by the mixing circuits of the other stations. The mixing is achieved in the control unit of each particular station by decoupling circuits, one such circuit for each signal. To compensate for the loss in signal strength due to the attenuation of the decoupling circuits an amplifier is fitted in each control unit.

36. The main microphone cable carries six pairs of microphone lines, viz. four pairs for transmitters and two pairs for connection to the I/C amplifiers. The cable is connected to the main junction box at outlet N and to the microphone sub-junction boxes at outlets C and D. The telephone cable carries: seventeen telephone positive lines, viz., one from each I/C amplifier, fifteen from receivers (four of which are associated with the four transmitters); four "press-to-transmit" lines; lines for operating the call facilities. The telephone cable is connected to the main junction box at outlet M and to the telephone sub-junction boxes at outlets C or D.

37. For ease of cable connecting all outlets are labelled with a letter, these letters correspond, in each case, to the letter which labels the cable terminations.

38. The amplifier Type A.1961 provides the necessary amplification for the normal I/C system; the amplifier is connected to the main junction box at outlet K. Another amplifier Type A.1961, used for "conference" I/C is connected to the main junction box at outlet C.

39. Standard mic-tel. sockets Type 359 are provided at all stations (including those stations requiring I/C only for connection of the microphone and telephone of each crew member. A press switch is associated with each of those sockets which are at "I/C only" stations. The switch permits the crew members at these stations to call, on the I/C system, all other stations. (Note that each control unit is fitted with a CALL switch to provide similar "call" facilities to those of the "I/C only" stations).

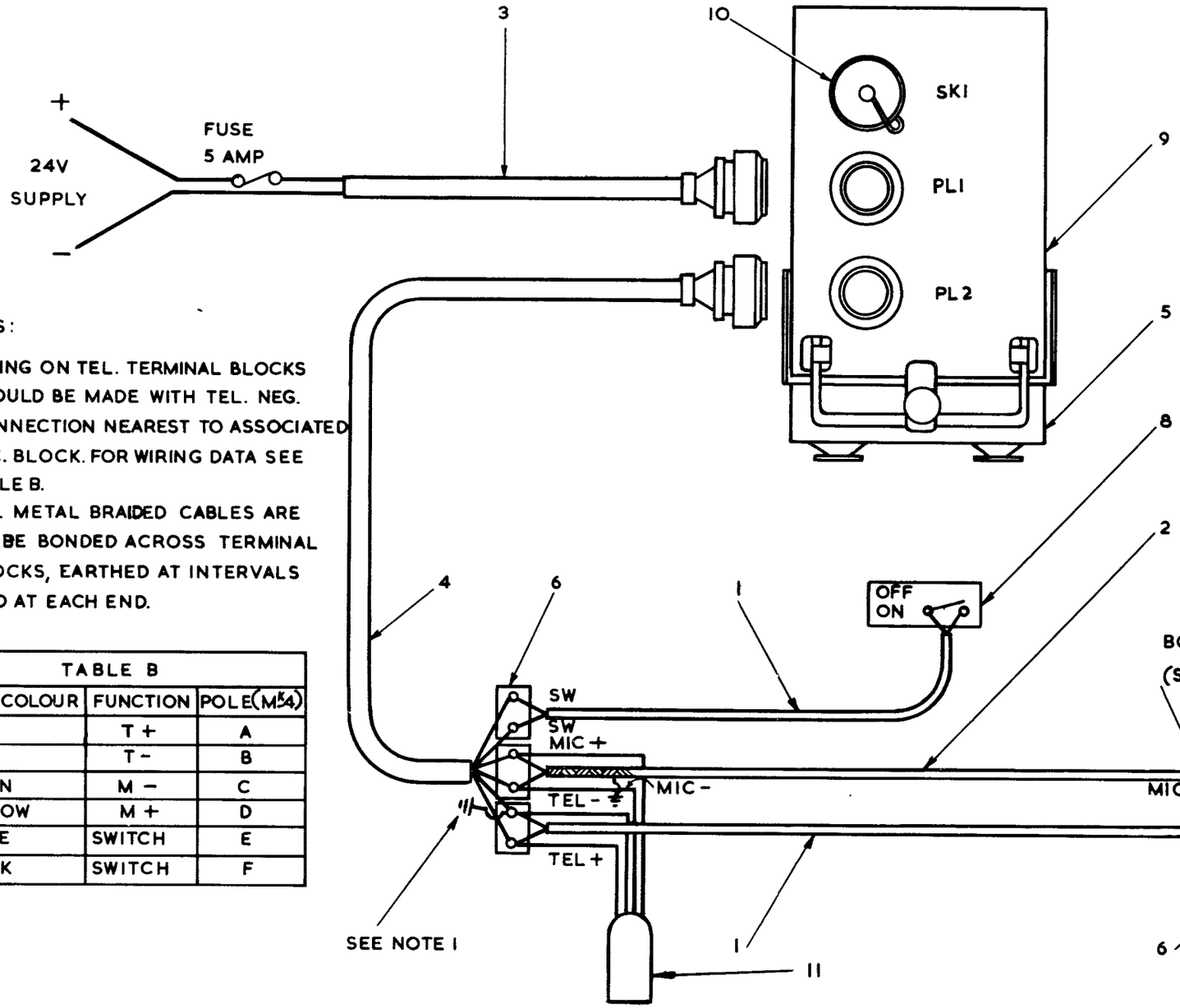
40. A remote switch is connected to the main junction box at outlet J; this switch has three positions: NORMAL, EMERGENCY and OFF. It provides a power switch for the amplifier Type A.1961 (positions OFF and NORMAL); in the EMERGENCY position it operates a relay which connects in circuit the audio circuits of one of the transmitter-receivers which then acts as an emergency I/C amplifier.

41. The conference I/C amplifier is provided with a separate ON/OFF switch.

42. The call lights shown in fig. 4 are not part of the ARI.18089/1; they may be provided, one for each station, if required. A means of connecting the call lights to the installation is provided by outlet G on the main junction box. A supply of 24 volts for the lights is provided at this outlet when the CALL switch at any station is pressed.

43. Power is supplied by the aircraft 28-volt electrical system; fig 4 shows, in outline, the power supply connections. The power for each amplifier Type A.1961 is supplied through a separate fuse and then directly to the amplifier. The amplifier power switches are remote and, as stated in para. 40, the normal I/C amplifier switch is connected by way of the main junction box. The power for the relays in the main junction box is supplied through a separate fuse and connected to the junction box at outlet H. The power for the control units is supplied by way of their associated junction boxes Type 7683 and through one fuse for up to three control units. When there are more than three control units in the installation, the power supplies are arranged to serve groups of control units (not more than three in a group) and each group is separately fused.

44. Further details of the ARI.18089/1 are given in Part 2, Chapter 3, of this publication. ▶



TO OTHER POSITIONS INCLUDING EXTERNAL I/C SOCKET IF REQUIRED (SEE FIG. 3)

NOTES:

1. WIRING ON TEL. TERMINAL BLOCKS SHOULD BE MADE WITH TEL. NEG. CONNECTION NEAREST TO ASSOCIATED MIC. BLOCK. FOR WIRING DATA SEE TABLE B.
2. ALL METAL BRAIDED CABLES ARE TO BE BONDED ACROSS TERMINAL BLOCKS, EARTHED AT INTERVALS AND AT EACH END.

TABLE A	
1	CABLE DUPREN 6
2	CABLE DUPRENMET 6
3	CONNECTOR TYPE B1/50 DUVINMETSMALL 16
4	CONNECTOR TYPE B23/50 SEXTOCOREVINSMALL No.1
5	MOUNTING TYPE 936
6	BLOCK TERMINAL TYPE B 2 WAY
7	SOCKET TYPE 359 (MIC – TEL)
8	SWITCH SINGLE POLE
9	AMPLIFIER TYPE A1961
10	COVER
11	SOCKET TYPE 359 (MIC–TEL)

TABLE B		
CORE COLOUR	FUNCTION	POLE (M54)
RED	T +	A
BLUE	T −	B
GREEN	M −	C
YELLOW	M +	D
WHITE	SWITCH	E
BLACK	SWITCH	F

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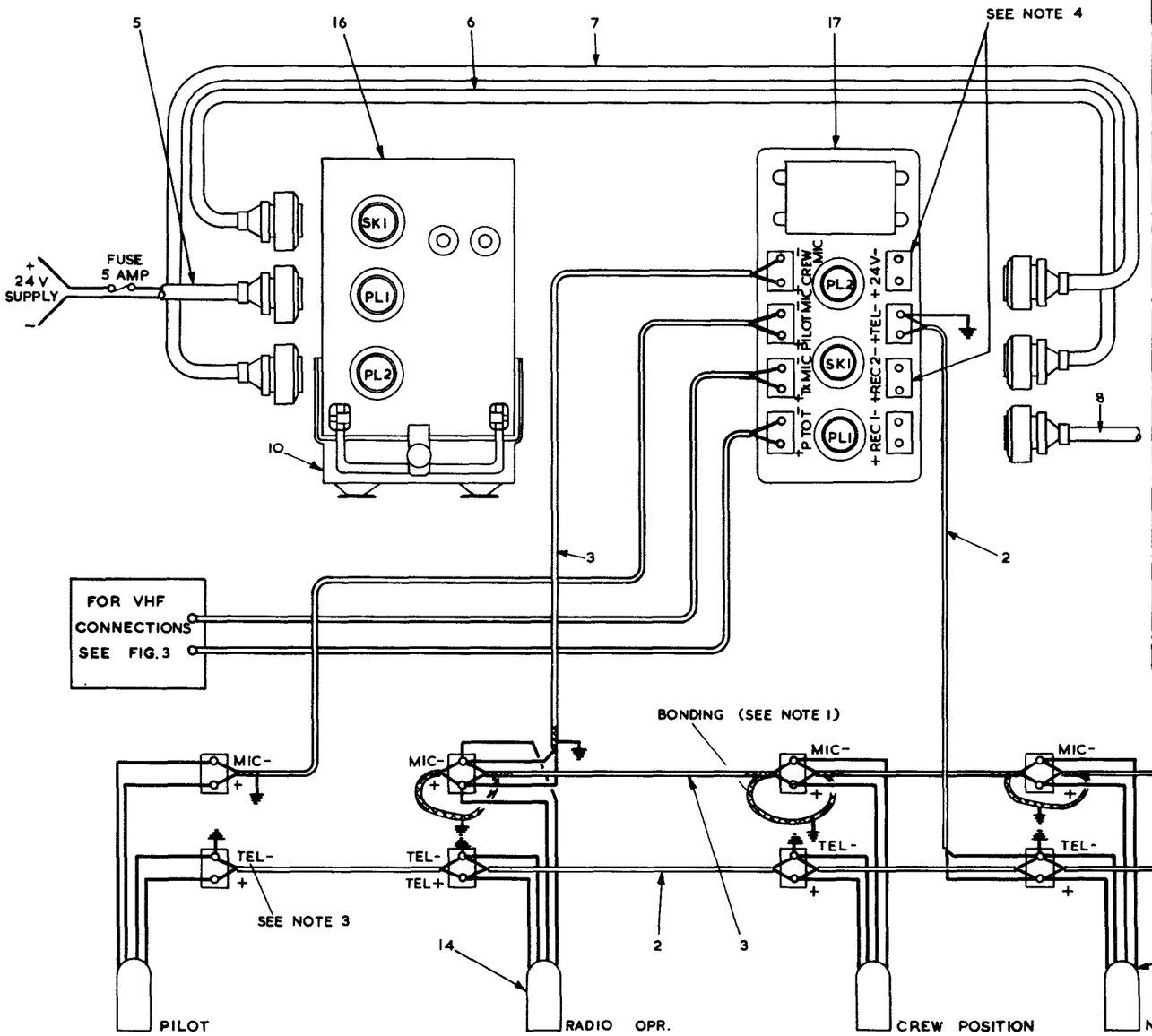
Fig. 1. Schematic — amplifier Type A.1961 only *(A.L.6 Sept '56)*



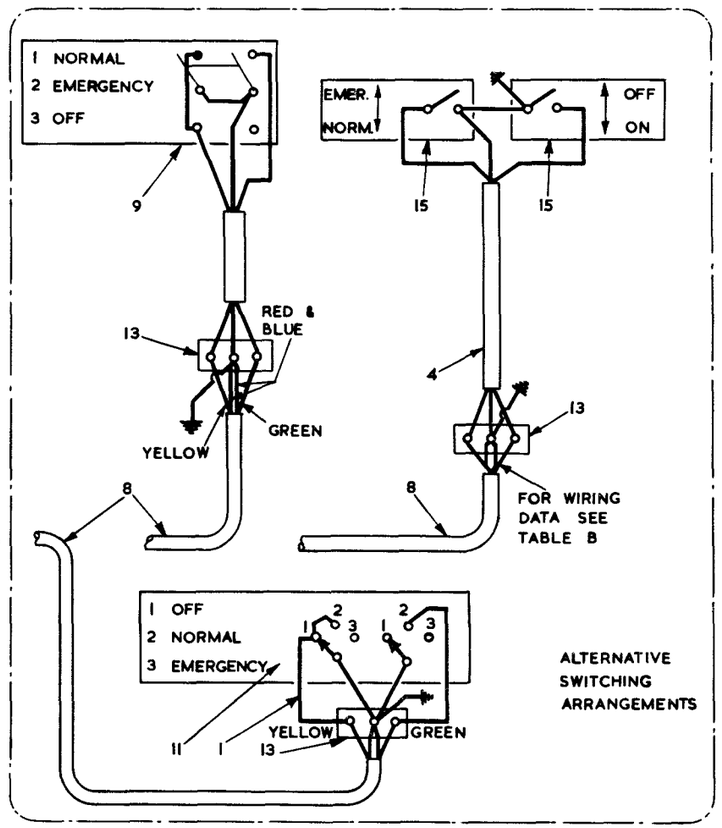


	TABLE A
1	CABLE UNIPREN 6
2	CABLE DUPREN 6
3	CABLE DUPRENMET 6
4	CABLE TRIPREMET 6
5	CONNECTOR TYPE B1/50 (DUVINMETSMALL 10)
6	CONNECTOR TYPE B7/10 (SEXTOVINMETSMALL 2·5)
7	CONNECTOR TYPE B23/30 (OR TYPE B23/50) (SEXTOCOREVINSMALL No. 1)
8	CONNECTOR TYPE B5/50 (QUADRAVINMETSMALL 2·5)
9	SWITCH TOGGLE D.P.C.O.
10	MOUNTING TYPE 936
11	SWITCH TYPE 1155 OR TYPE H.I.
12	BLOCK TERMINAL, TYPE B, 2 WAY
13	BLOCK TERMINAL, TYPE B, 3 WAY
14	SOCKET TYPE 359 (MIC-TEL)
15	SWITCH SINGLE POLE
16	AMPLIFIER TYPE A 1961
17	BOX, JUNCTION, TYPE 154

NOTES:-

1. ALL METAL BRAIDED CABLES TO BE BONDED ACROSS TERMINAL BLOCKS, EARTHED AT INTERVALS & AT EACH END.
2. ALL EARTH LEADS MUST BE AS SHORT AS POSSIBLE.
3. WIRING ON TEL. TERMINAL BLOCKS SHOULD BE MADE WITH THE TEL. NEG. CONNECTION NEAREST TO ASSOCIATED MIC. TERMINAL BLOCK.
4. NO CONNECTIONS TO BE MADE TO THESE TERMINAL BLOCKS UNLESS SPECIFIED.
5. EXTERNAL I/C SOCKET MAY BE ADDED AS IN FIG. 3

TABLE B		
CORE COLOUR	FUNCTION	POLE (MK 4 PLUG)
RED	EARTH	A
BLUE	EARTH	B
GREEN	ON/OFF POSITION	C
YELLOW	NORMAL EMERGY. POS.	D

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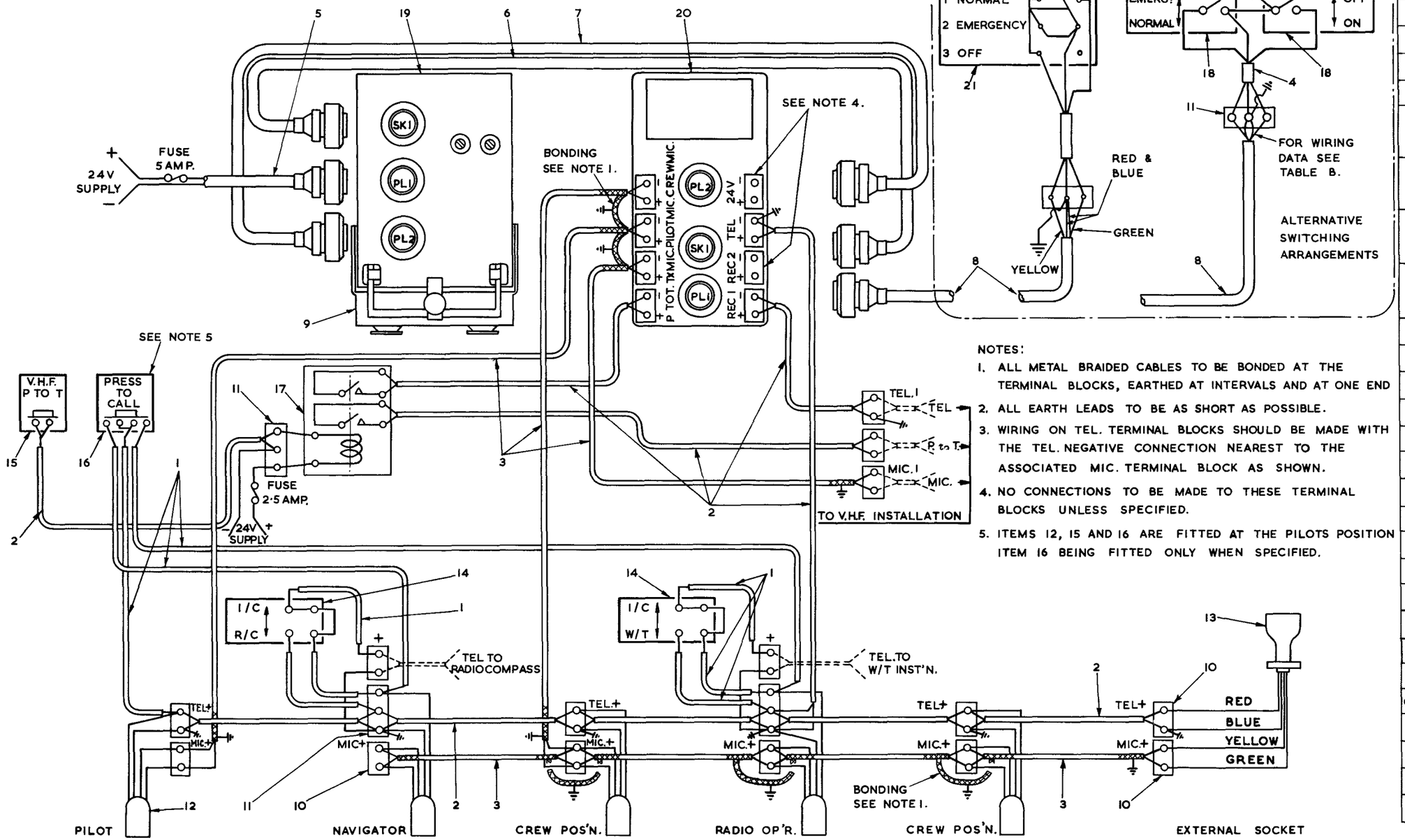
Fig. 2 Amplifier Type A.1961 with junction box Type 154 — schematic

(A.L.6 Sept'56)



NOTES:

1. ALL METAL BRAIDED CABLES TO BE BONDED AT THE TERMINAL BLOCKS, EARTHED AT INTERVALS AND AT ONE END
2. ALL EARTH LEADS TO BE AS SHORT AS POSSIBLE.
3. WIRING ON TEL. TERMINAL BLOCKS SHOULD BE MADE WITH THE TEL. NEGATIVE CONNECTION NEAREST TO THE ASSOCIATED MIC. TERMINAL BLOCK AS SHOWN.
4. NO CONNECTIONS TO BE MADE TO THESE TERMINAL BLOCKS UNLESS SPECIFIED.
5. ITEMS 12, 15 AND 16 ARE FITTED AT THE PILOTS POSITION ITEM 16 BEING FITTED ONLY WHEN SPECIFIED.

TABLE A	
1	CABLE UNIPREN 6
2	CABLE DUPREN 6
3	CABLE DUPRENMET 6
4	CABLE TRIPRENMET 6
5	CONNECTOR TYPE B1/50 (DUVINMETSMALL 16)
6	CONNECTOR TYPE B7/10 (SEXTOVINMETSMALL No.1)
7	CONNECTOR TYPE B 23/30 (SEXTOCOREVINSMALL No.1)
8	CONNECTOR TYPE B5/50 (QUADRAVINMETSMALL 2·5)
9	MOUNTING TYPE 936
10	BLOCK TERMINAL, TYPE B, 2 WAY
11	BLOCK TERMINAL, TYPE B, 3 WAY
12	SOCKET TYPE 359 (MIC-TEL)
13	CONNECTOR, EXTERNAL, I/C, TYPE 3570
14	SWITCH TYPE 170
15	SWITCH, PUSH, TYPE 1290 SINGLE POLE
16	SWITCH PUSH, TYPE C DOUBLE POLE
17	SWITCH MAGNETIC RELAY TYPE Q. No.1
18	SWITCH SINGLE POLE
19	AMPLIFIER TYPE A1961
20	BOX JUNCTION, TYPE 154
21	SWITCH TOGGLE D.P.C.O.

TABLE B		
CORE COLOUR	FUNCTION	POLE (MK.4)
RED	EARTH	A
BLUE	EARTH	B
GREEN	ON/OFF POSITION	C
YELLOW	NORMAL/EMERGY POS.	D

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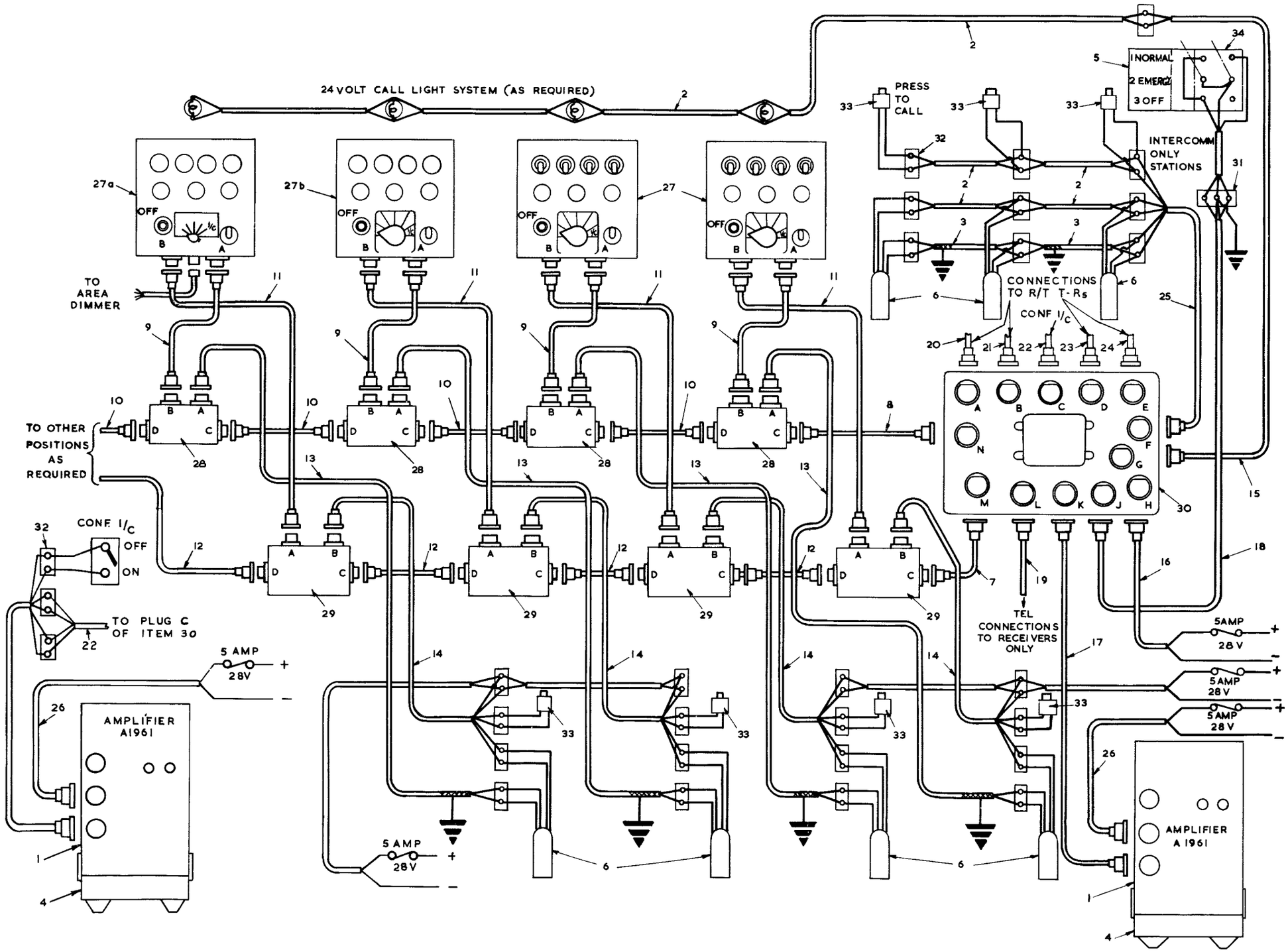
Fig.3 Amplifier Type A.1961 with VHF, radio compass and GP set

(A.L.6 Sept'56)



ITEM	DESCRIPTION
1	AMPLIFIER TYPE A 1961
2	CABLE ELECTRIC DUPREN 6
3	CABLE ELECTRIC DUPREN MET 6
4	MOUNTING TYPE 936
5	LABELS SPECIAL
6	SOCKET TYPE 359 (MIC – TEL)
7 TO 26	CONNECTORS
27 OR 27a OR 27b	CONTROL UNIT TYPE 7681 CONTROL UNIT TYPE 7681A CONTROL UNIT TYPE 7681B
28	JUNCTION BOX TYPE 7682 (MICROPHONE SUB – JUNCTION BOX)
29	JUNCTION BOX TYPE 7683 (TELEPHONE SUB – JUNCTION BOX).
30	JUNCTION BOX TYPE 7684 MAIN JUNCTION BOX
31	BLOCK TERMINAL TYPE B 3 WAY
32	BLOCK TERMINAL TYPE B 2 WAY
33	SWITCH BUTTON (S.P.) FIRING BARE OR SWITCH TOGGLE QMQB (UNSEALED)
34	SWITCH TOGGLE D.P.C.O.

NOTE:
FOR FUSING PURPOSES THE CONTROL UNITS (ITEM 27) ARE TO BE ARRANGED IN GROUPS OF NOT MORE THAN THREE UNITS ON ONE 5AMP FUSE E.G. THREE UNITS CAN BE SUPPLIED FROM ONE 5 AMP FUSE BUT FOUR UNITS MUST BE PROVIDED WITH TWO SEPARATE FUSES AS SHOWN

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ISSUE 1 Prepared by the Ministry of Technology

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A.R.I. 18089/1 schematic

Fig. 4

PART 2

TECHNICAL INFORMATION

LIST OF CHAPTERS

Note:—*A list of contents appears at the beginning of each chapter.*

1 Amplifier Type A.1961

2 Junction box Type 154 and control unit Type 702

3 ARI.18089/1

4 ARI.5388

5 Amplifier Type A.1961M

Chapter 1

AMPLIFIER TYPE A.1961

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	Para.
Purpose of equipment	1
General description	2
Constructional and circuit details ...	12

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	Fig.		Fig.
*Amplifier Type A*1961, *front view* ...	1	*Underside with cover of suppressor unit removed*	5
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Underside of top deck	3	*Amplifier Type A*.1961, *wiring* ...	7
Upper side of top deck	4		

LEADING PARTICULARS

Stores Ref.	*IOU*/16596
Purpose of equipment	*Airborne-intercommunication amplifier*
Valves	*Two CV*417, *one CV*139
Power supply	...*From aircraft battery* (24 *volts*). *Consumption approximately* 36 *watts.*
HT supply	...260 *volts from incorporated rotary transformer Type* 103
Power output	...*Normal*, 500 *mW into* 30-*ohm load, Max.*, 1 *watt into* 15-*ohm load. The pre-set volume control is set for normal output when supplied.*
Overall dimensions	*Height* $6\frac{3}{4}$ *in.*
... ...	*Width* $4\frac{3}{4}$ *in.*
... ...	*Depth* $5\frac{3}{4}$ *in.*
Weight	6 *lb.* 6 *oz.*
Associated equipment	...*Junction box Type* 154 (*Stores Ref.* 10*D*/17805) *Control unit Type* 702 (*Stores Ref.* 10*L*/260)

Fig. 1. Amplifier Type A 1961 Front view

Purpose of equipment

1. The amplifier Type A.1961 is fitted in multi-seater aircraft to provide inter-communication facilities between all occupants of the aircraft, in conjunction with junction box Type 154 and control unit Type 702. The three units mentioned replace the amplifier Type A.1134A and panel Type 192, but cannot be used as direct replacements in existing installations.

General description

2. The amplifier Type A.1961 is designed for use with standard low-impedance telephones and electro-magnetic microphones. Various views are given in fig. 1, 2, 3, 4 and 5, and the circuit diagram in fig. 6.

3. The unit is a three-stage audio-frequency amplifier operating directly from the 24-volt aircraft battery supply. A rotary transformer Type ◀262▶ is incorporated to supply HT voltage (260 volts) for the anodes of the valves. The valve heaters are fed from a stabilized supply at 19 volts; this is also derived from the 24-volt aircraft supply, a carbon pile regulator Type 40 being used to stabilize the heater voltage.

4. The outputs of two radio receivers, and one output from the aircraft microphone line, may be connected to the first stage of the amplifier. The microphone line input to the amplifier is fed into an iron-core transformer T1, the primary winding of which is balanced to earth by the 470-ohm resistors R3, R4. This arrangement equalizes the potentials of the ends of the primary winding with respect to earth, and so reduces the tendency to oscillation ('instability') which might otherwise arise.

5. The connections from the two radio receivers are arranged as follows. Taking the incoming signal from receiver No. 1 (which is usually, though not necessarily, the VHF R/T receiver), the input terminals at the I/C amplifier are shunted by a pre-set potentiometer R1 (250 ohms). The tapping point on this potentiometer is connected to earth through a chain of resistors, namely, the 27K resistor R5, the 2·2K resistor R8, and the 220-ohm resistor R9. Receiver No.2 is connected in a similar manner through the pre-set potentiometer R2 and the 27K resistor R6 to the junction of R5 and R8, so that R8 and R9 form a common load on the outputs of the two pre-set potentiometers. The junction

of R5 and R8 is connected to the control-grid of V1 through the secondary winding of the transformer T1 (shunted by the 470K resistor R7).

6. The resistors R1, R5 for the one receiver, and R2, R6 for the other constitute (in conjunction with the common resistors R8, R9) a mixing network. By arranging the connections of the two receivers in this manner, the output voltage at the volume control potentiometer R1 suffers an attenuation of about 67 dB when it reaches the output of receiver No. 2; similarly, the output voltage at R2 is attenuated by about 67dB at the output of receiver No. 1.

7. The price paid for this considerable reduction of coupling between the receivers is a loss of about 22dB for each receiver at the control-grid of the first valve. This reduction is acceptable, however, as the receiver input in any event must be attenuated to approximately the same level as the output from the microphone transformer secondary. The microphone line input is so arranged that there is negligible cross-talk between the microphones and the radio receivers. The controls R1, R2 are pre-set before issue to give satisfactory signal level when the amplifier is giving 140 milliwatts output into a 50-ohm load.

8. The power supply to the amplifier is switched on and off by an external switch, the latter being normally incorporated in the control unit Type 702. As this switch may be situated at some distance from the amplifier and junction box, a power relay P/2 is incorporated in the amplifier to avoid an unnecessary voltage drop in the cable.

9. When used with standard Service electromagnetic microphones the amplifier will supply an audio power of 1 watt into ten pairs of telephones, with the volume control R10 (*para.* 11) set to maximum. This control is however pre-set before issue to give 500 milliwatts into a load of 30 ohms, equivalent to five pairs of telephones. Further adjustment should not be necessary under normal conditions, as the output remains undistorted over any loading from two to twenty pairs of telephones. The frequency response is constant to within 3dB over the range 300 to 5,000 c/s, but is sharply attenuated outside these limits.

10. The layout of the amplifying stages themselves is fairly conventional. The HT supply is fed through a low-pass filter L3, C9, L4, C10, decoupling resistors and condensers being fitted in the anode circuits of each of the first two stages. These are R11, C6 and R15, C11 respectively. The output stage is transformer coupled to the output load, consisting of telephones connected to the telephone line of the aircraft via pins A and B of plug PL2. Since there are no AF by-pass condensers across the cathode bias resistors R13, R17, R19, each valve operates with a small fraction of negative feedback, thus reducing the distortion while at the same time causing a small decrease in the gain per stage.

11. In addition to this negative feedback, a fraction of the final output from the transformer T2 is fed back to the control grid of V1 via the fixed resistor R20, the pre-set rheostat R10, and the resistor R9 in the control grid circuit. The sense of this feedback is also negative, and the control R10 functions in such a manner that as the resistance of R10 is increased, both the gain and the distortion factor increase. As stated in para. 9, R10 is normally set to give adequate output in five pairs of telephones.

Constructional and circuit details

12. Referring to fig. 1 and 6, the connections to the amplifier are made via a six-pole plug PL2, a two-pole plug PL1, and a six-pole socket SK1. The microphone input and telephone output are taken into the amplifier at PL2, each microphone lead being individually screened. The 24-volt supply from the aircraft battery is connected at the two-pole plug PL1. The six-pole socket is used to connect the two radio

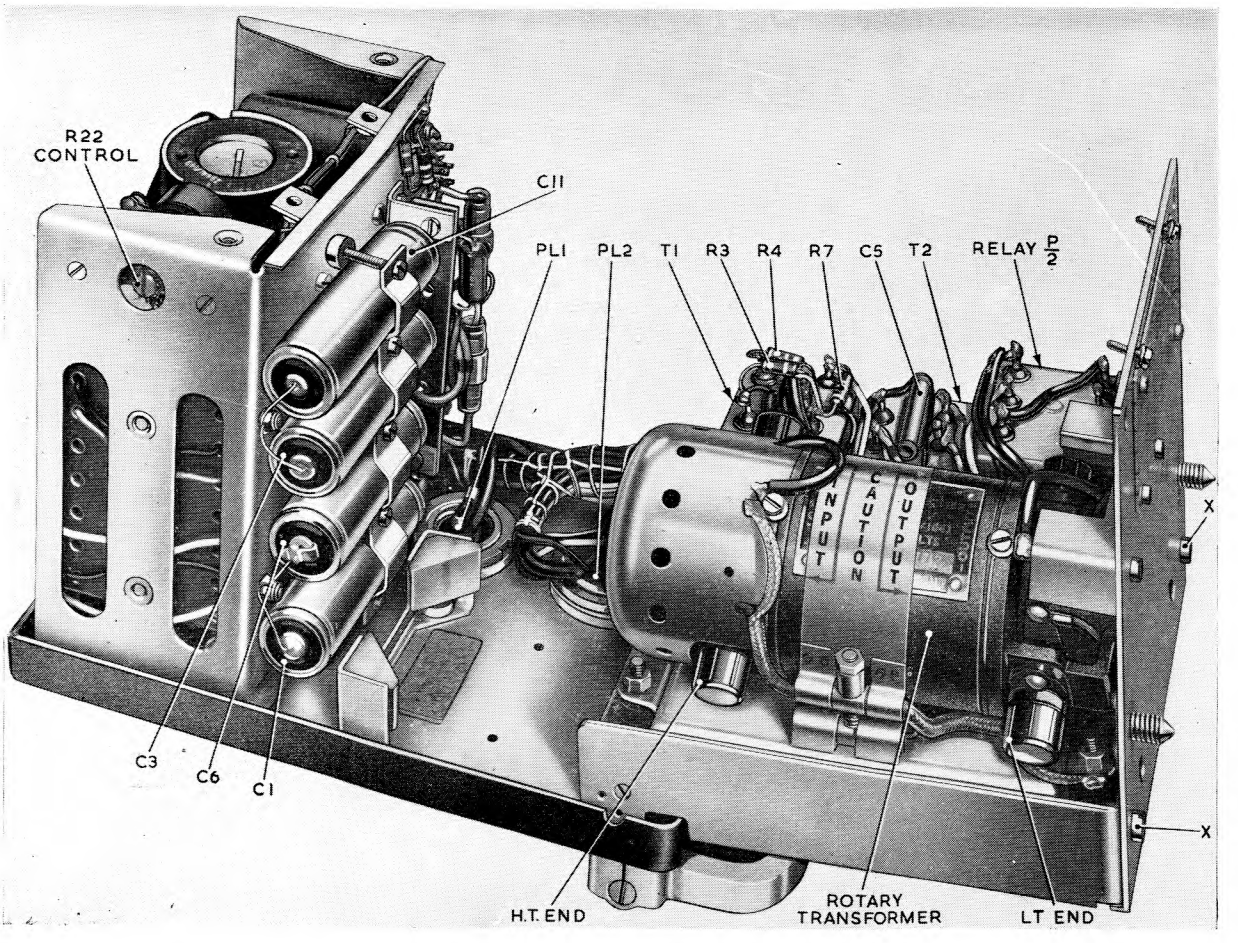


Fig. 2. Amplifier opened for servicing

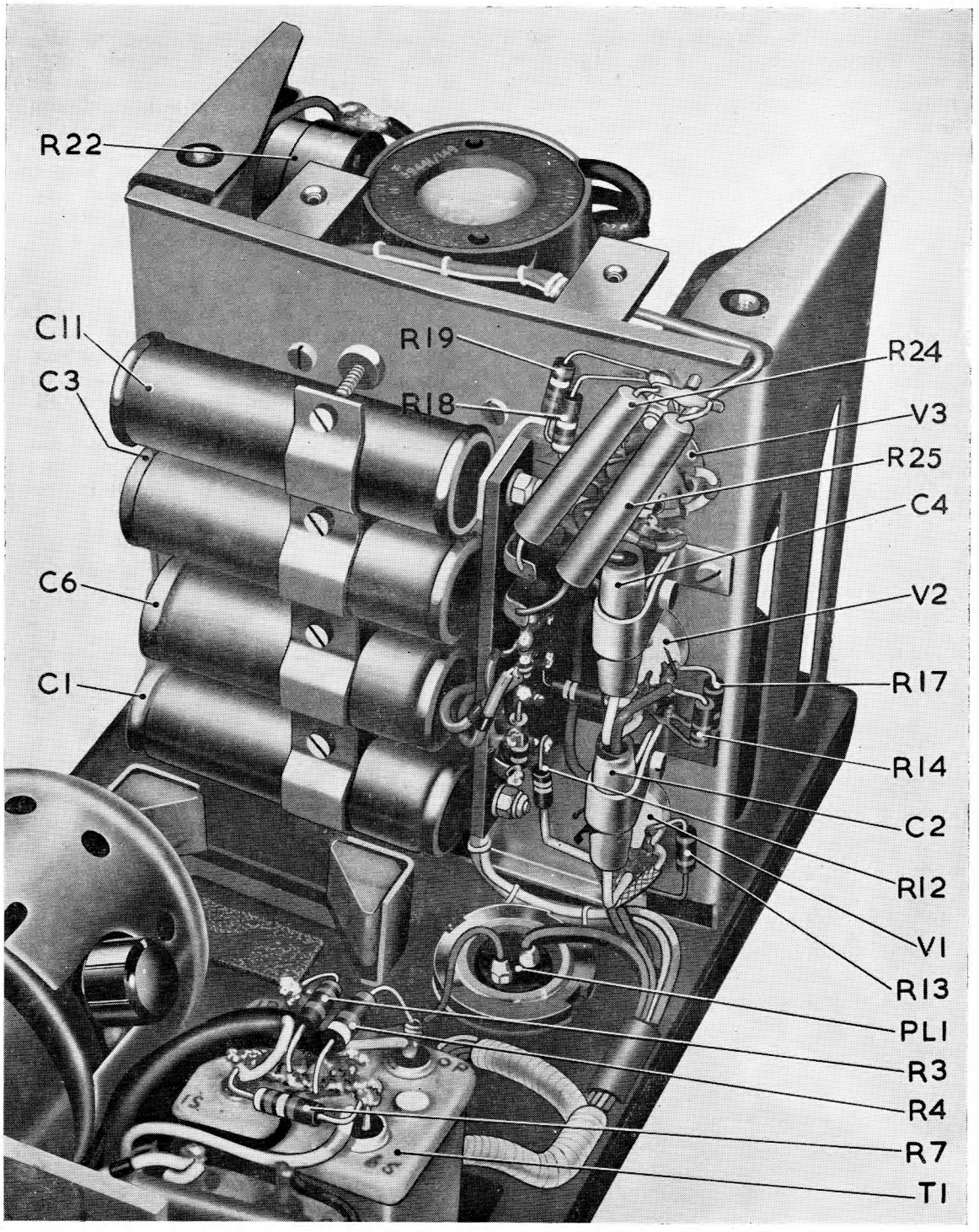


Fig. 3. Underside of top deck

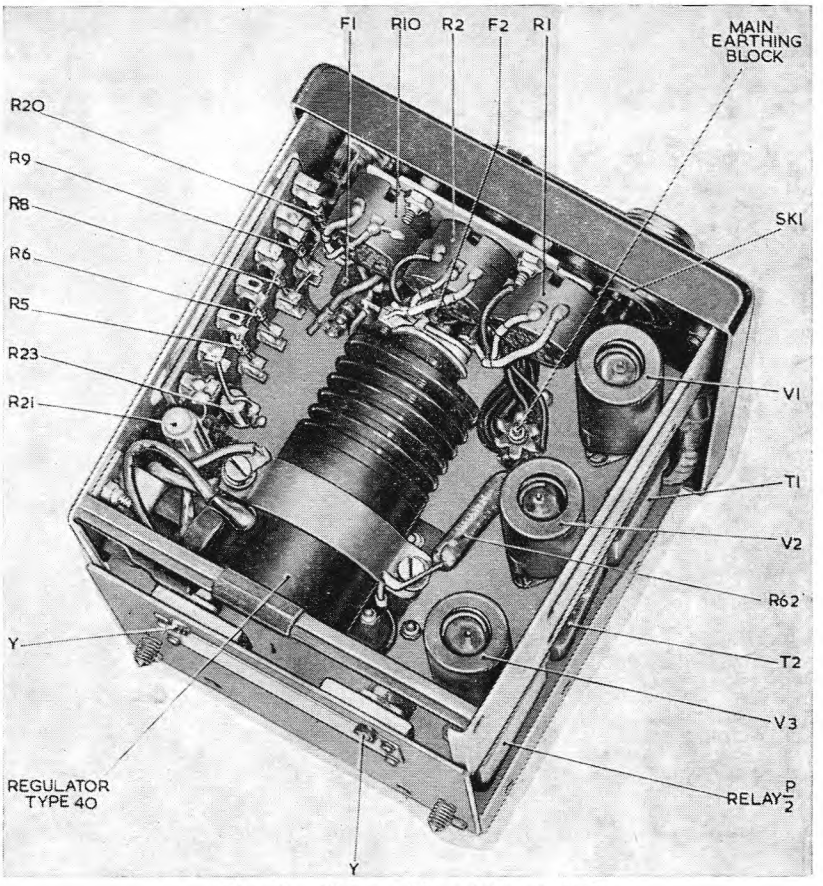


Fig. 4. Upper side of front deck

receiver inputs to the amplifier; it also provides a 24-volt output for supply to the junction box, when the circuit is completed by the operation of the remote ON-OFF switch.

13. The winding of the relay P/2 is connected between plug A on PL1 and plug E on PL2, the remote ON-OFF switch being connected between the latter point and plug F on PL2, which is connected to the chassis earth block. When the relay is operated, the 24-volt supply from plug A on PL1 is connected through both contacts of the relay in series to the voltage regulator and also through a low-pass filter C8, L2, C7, L1, to the motor end of the rotary transformer.

14. The regulated 19-volt supply for the valve heaters is obtained as follows. When the relay contacts are closed, the 24-volt supply is connected first, to the carbon pile element of the voltage regulator; the circuit then divides into two branches, namely, the heater circuit proper, as described in para. 15, and a branch consisting of the regulating winding, the pre-set resistor R22 and the resistor R21 to earth. The resistor R22 is set before issue to the Service to give 19 volts across the heater circuit with the original valves, and should rarely, if ever, require subsequent re-adjustment.

15. Connected in series with each valve is a ballast resistor which limits the current of its associated valve to the required amount. Each valve with its ballast resistor is connected across the regulated supply, the connection to the regulator being made through the fuse F1. The resistor R26 (*fig.* 6 refers) provides an additional load on the carbon pile since the latter must be loaded to 0·9A.

16. The two volume controls R1, R2, for the radio receiver inputs, and the main feedback control R10, are mounted at the top of the front panel under a hinged cover held by a captive screw. To obtain access to the interior, the dust cover must be removed; this is very easily done as it is secured only by two coil-slotted screws at the rear.

17. For ease of servicing, the chassis may be opened out as shown in fig. 2, by removing two small screws (painted red) at the top of the rear plate. These screws are marked YY in fig. 4 and 5. Except during repair, the chassis should not be opened out by removing the two bottom screws XX, nor should the back plate be completely removed. Access to the components of the suppressor unit is obtained by removing four small screws at the corners of the filter cover-plate.

18. When the chassis is opened out in this manner, all the components are accessible, but the connections all remain intact, and if the external cables are connected, the amplifier will function in the normal manner. If the suppressor unit cover has been removed, special care must be exercised before standing the amplifier on a test bench or other place where metal tools, etc., may be lying. An accidental short-circuit on any of these components may have serious consequences.

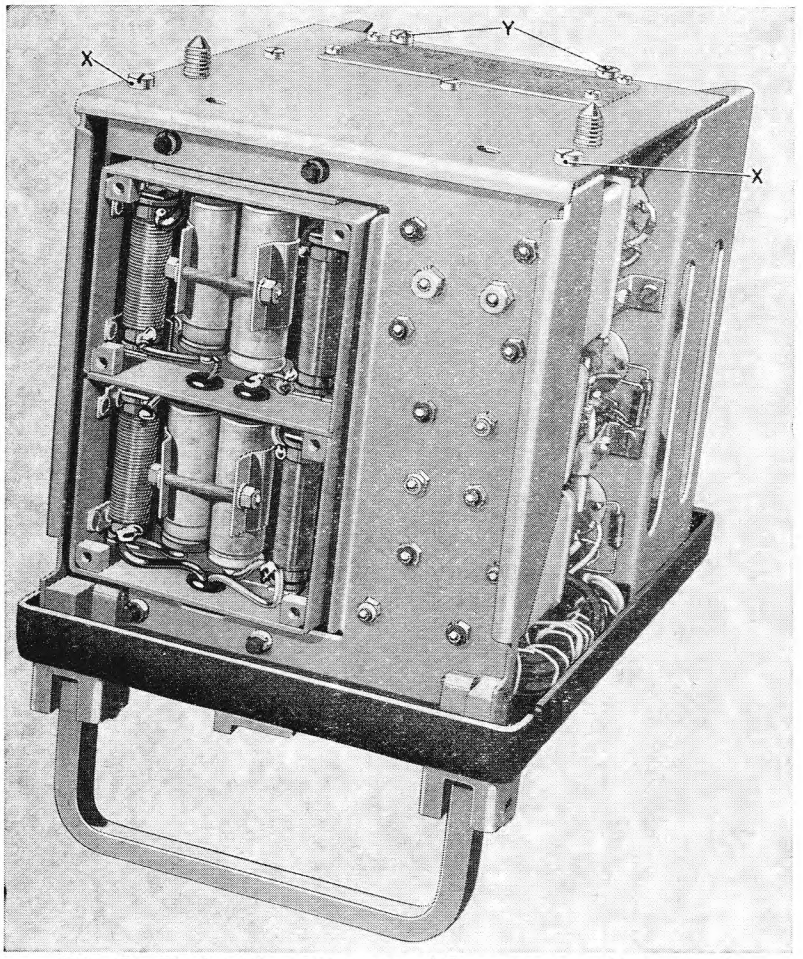


Fig. 5. Underside with cover of Suppressor unit removed

19. The rotary transformer, power relay P/2, input transformer T1 and output transformer T2 are mounted on the bottom deck of the chassis (*fig.* 2). The suppressor unit is mounted in the base of the rotary transformer mounting (*fig.* 5), and the latter is fitted to the chassis by the use of special resilient mountings to eliminate the transfer of vibration from the rotary transformer to other components, particularly the valves.

20. The input transformer T1 is that nearest the front panel (*fig.* 2). It is fitted in a double-screened can, and external pick-up is absolutely negligible. As already stated, the primary winding is balanced to earth, and all wiring which is not at earth potential is carried out in screened cable.

21. The three valves, the voltage regulator, a resistor tag board, and a common earthing tag, are mounted on the top deck (*fig.* 4). The two anode decoupling condensers C6, C11 and the two HT smoothing condensers C1, C3 are mounted on the underside of the top deck (*fig.* 3) together with a small tag board, carrying resistors R11, R15, and R24,. Other resistors and condensers are mounted adjacent to this tag board and the underside of the valve holders.

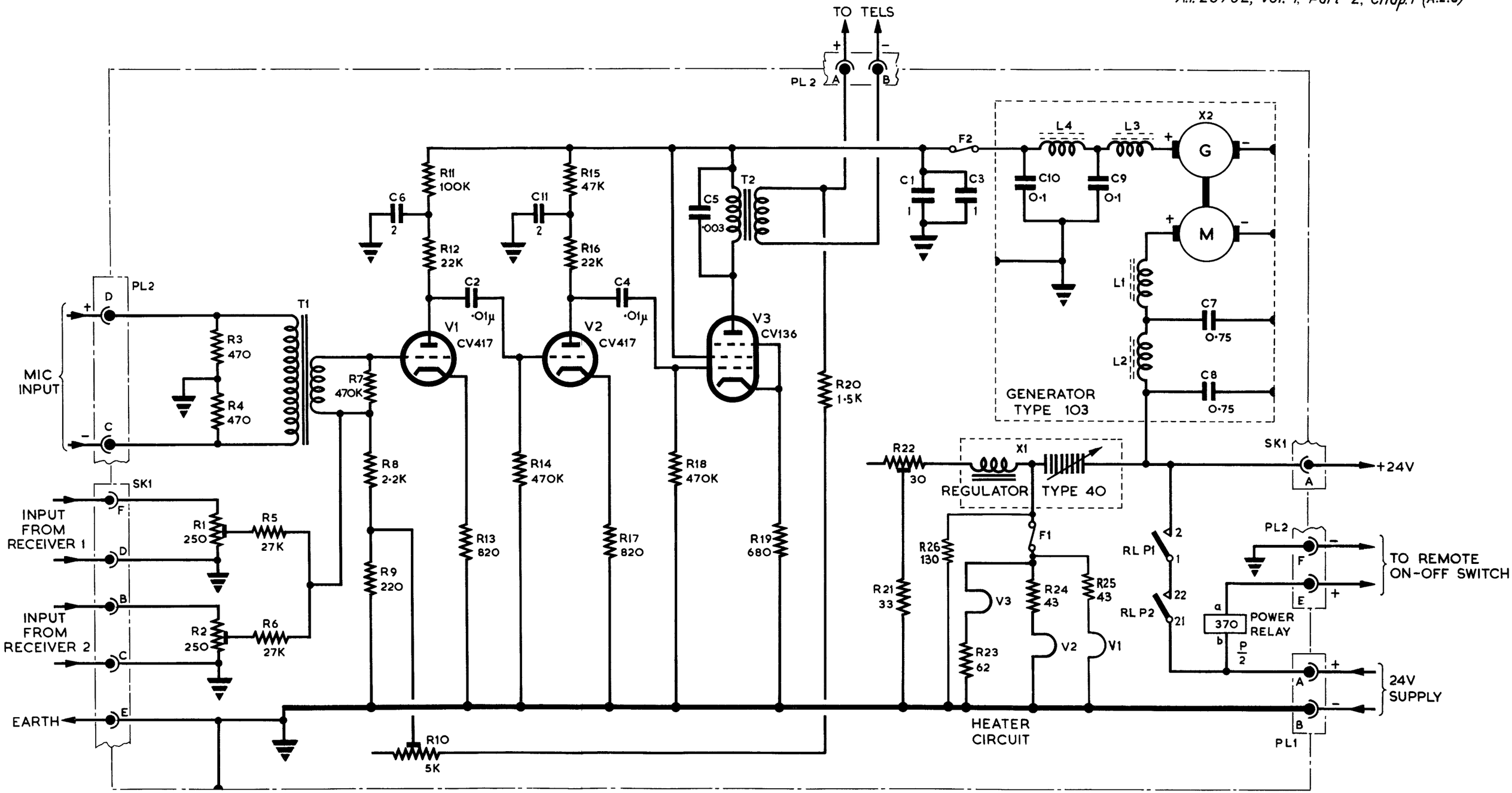
22. Should it be necessary to release the clamping strap securing the voltage regulator, the regulator may be moved from its position; the following procedure should then be observed when the strap is again tightened. The regulator should be positioned so that there is approximately one-sixteenth inch clearance between the rear top end of the regulator and the synthetic-rubber sleeve on the support rod. A clearance of more than one-sixteenth inch is not advised as further complications could ensue if the clamping strap was pressed against the sleeve containing the leads from the regulator.

23. The two fuses, F2, the HT fuse (rated at 100 mA) and the LT fuse F1 (rated at 1A) are fitted in panel mountings and are removable by the use of a coin.

24. Most of the wiring is loomed up into two cable forms, the individual leads being colour-coded to facilitate identification at each end. The inter-connections and colour-coding are shown in fig. 7, in which wiring incorporated in the main cable form is denoted by B, and that in the smaller cable form by C. The connections to the valve bases are also shown in this diagram.

25. The amplifier is normally mounted in a small tray fitted with resilient mountings. It is held in position by a screw retaining clamp, which grips the transport handle after the latter has been folded downwards.

26. A ventilation hole is provided in the front panel and the fan of the rotary transformer is utilized to draw air into the unit through it. Holes are provided in the upper chassis and in the rear of the cover Type 801. This arrangement ensures a maximum flow of air over the rotary transformer and the carbon pile regulator.

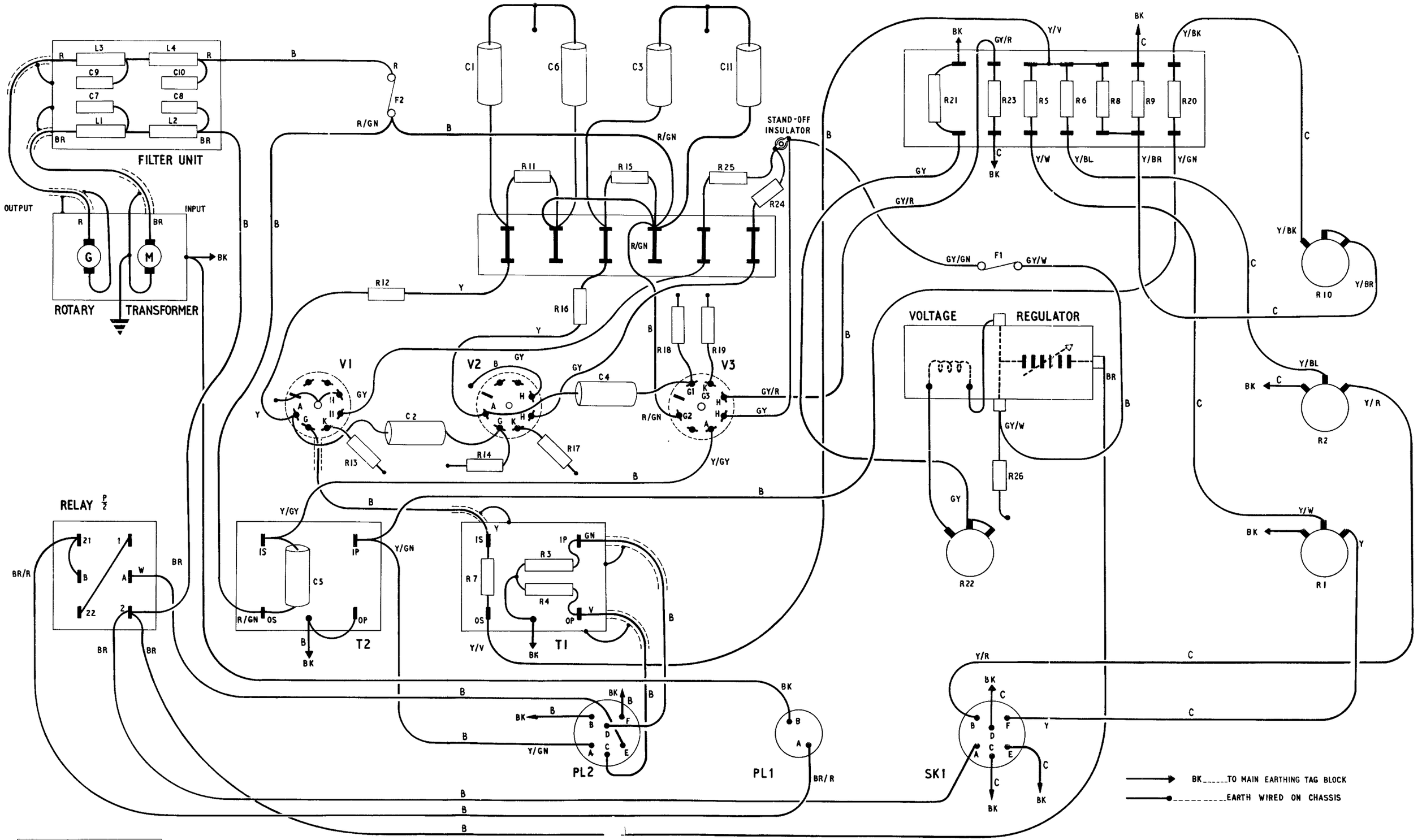


AIR DIAGRAM 6130E/MIN.	
ISSUE 1	PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

Amplifier Type A1961, circuit

Fig. 6

(A.L.8 Nov. '56)



AIR DIAGRAM
6130F/MIN.
ISSUE 1 | PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY

Amplifier Type A1961, wiring

FIG.7

(A.L.8 Nov '56)

Chapter 2

JUNCTION BOX TYPE 154 AND CONTROL UNIT TYPE 702

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1. The junction box Type 154 consists of a small chassis approximately 8 in. long, $4\frac{1}{4}$ in. wide, and $\frac{3}{4}$ in. deep, upon which are mounted one 4-pin plug, PL.1, one 6-pin plug, PL.2, and one 6-pin socket, SK.1, together with eight 2-way terminal blocks (TB.1 to TB.8) and two relays, NE/4 and TX/2; these relays are mounted underneath a small screening cover. The relay NE/4 is known as the normal-emergency relay, and relay TX/2 as the transmitting relay. A front view of the junction box is given in fig. 1, and the circuit diagram in fig. 2.

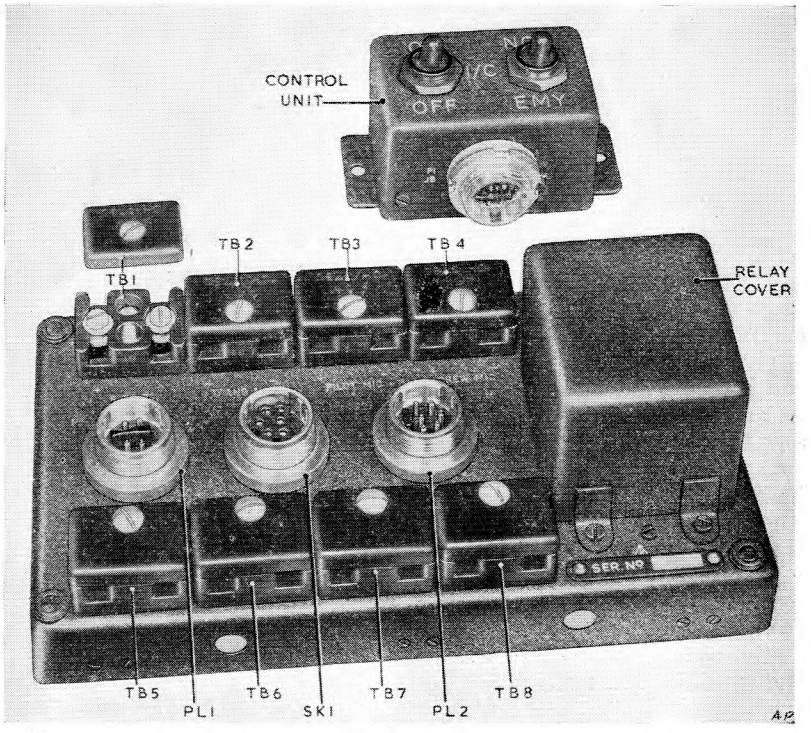

Fig. 1 Junction box Type 154 and control unit Type 702, front view

2. Fig. 1 also shows the control unit Type 702, which is a small metal case carrying two single-pole switches, one being labelled ON/OFF and the other NOR/EMY (normal/emergency). The former is the on/off switch for the amplifier Type A.1961, the switching being actually performed by a power relay P/2 fitted inside the amplifier. The NOR/EMY switch provides a facility by which the audio-frequency stages of the VHF receiver may be used as a substitute for the I/C amplifier, in the event of a failure of the latter.

3. In certain installations, the control unit Type 702 may not be used, separate ON/OFF and NOR/EMY switches being fitted instead so that the two controls may be exercised by different members of the air crew.

4. The action of the NOR/EMY switch is briefly as follows. Assuming the 24-volt supply to be reaching the junction box, and the on/off switch to be ON, the relay NE/4 will be energized when the NOR/EMY switch is at NOR. All microphones are then connected to the microphone terminals of the I/C amplifier, but the pilot's microphone can be isolated from this circuit and connected instead to the microphone input line of the VHF transmitter-receiver by operating the PRESS-TO-TRANSMIT button. All the telephones, including those of the pilot, are connected to the amplifier output line.

5. When the switch is in the EMY position however, the relay NE/4 is not energized. All the microphones, including the pilot's, are then connected to the microphone line of the VHF transmitter-receiver. Also, all the telephones are connected to the AF output line of the VHF transmitter-receiver, so providing emergency inter-communication.

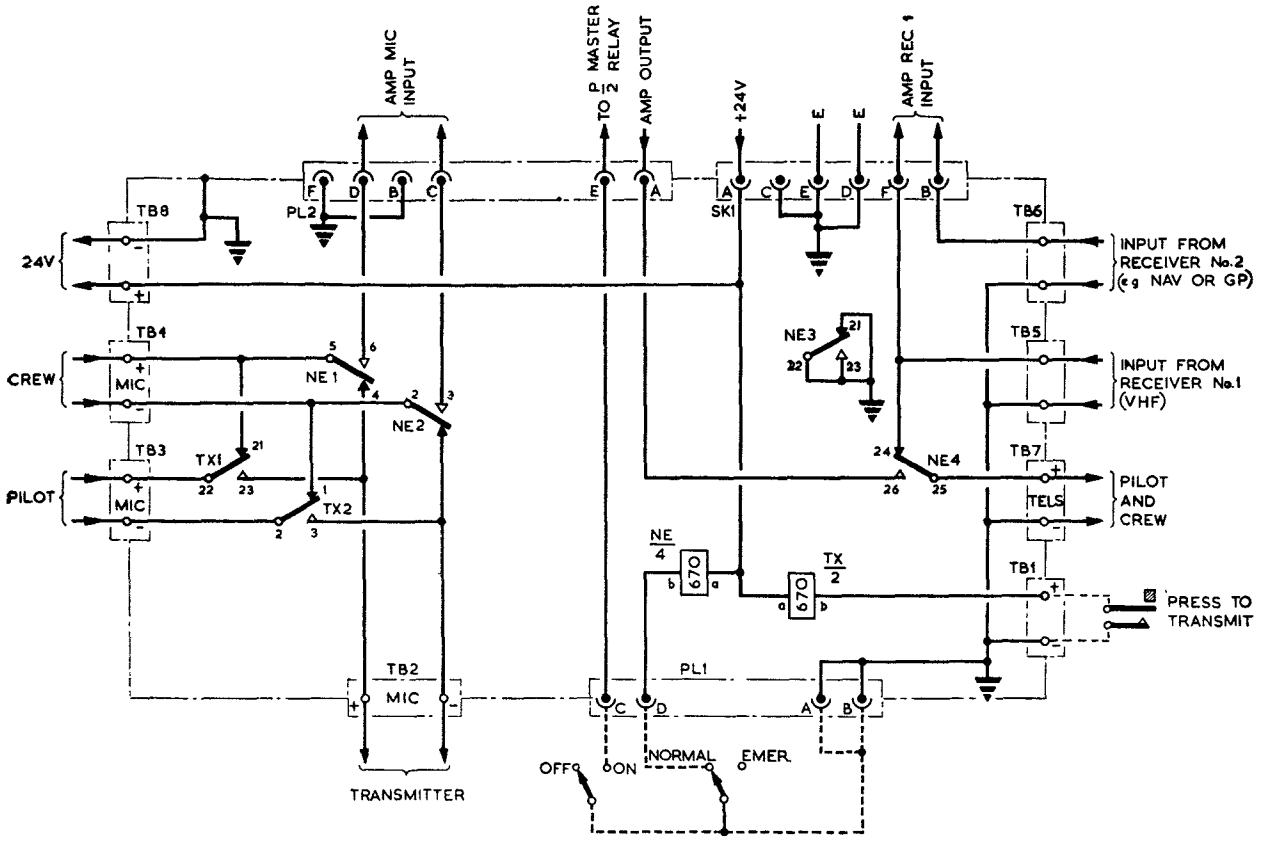

Fig. 2. Junction box Type 154, circuit

6. A schematic diagram of a typical installation is given in fig. 3. The aircraft 24-volt supply to the I/C amplifier, reaches the amplifier on pins A and B of PL.1. The power relay in the amplifier is energized when the ON/OFF switch is closed, the circuit being carried through pin E of PL.2, on both the amplifier and the junction box. The circuit then leaves the junction box at pin C of PL.1 and is taken into the control unit, where the ON/OFF switch completes the circuit to earth. The power relay thus completes the circuit to the heaters of the valves and to the motor end of the rotary transformer which in turn supplies the amplifier HT rail.

7. The AF output of the VHF transmitter-receiver is fed into the junction box on terminal block TB.5, and the output of a second receiver on TB.6. These outputs pass through the junction box and leave via pins F and B respectively of SK.1, entering the amplifier on corresponding pins.

8. All the telephones are connected to a two-wire line from terminal block TB.7. The pilot's microphone is connected to TB.3, and the remainder of the microphones to TB.4. The outgoing lines from the junction box to the microphone terminals on the VHF transmitter-receiver are connected to TB.2. These services are switched by the relays TX/2 and NE/4 in the following manner.

9. When the ON/OFF switch is closed, the relay NE/4 is energized. The pilot's microphone is switched through the contacts of the transmitting relay TX/2 (which is not energized) and the contact assemblies NE.1 and NE.2, to the microphone input terminals of the I/C amplifier; the crew's microphones are also switched to the same terminals, but through contact assemblies NE.1 and NE.2 only. When the pilot energizes the transmitting relay by pressing the PRESS-TO-TRANSMIT button, his microphone is switched over to the transmitter microphone line, via TB.2.

10. Under normal conditions therefore, the crew's microphones on TB.4 are never switched to the transmitter microphone line, and their telephones are always switched to the I/C amplifier output. If however, the NOR/EMY switch is thrown to EMY, the relay NE/4 is no longer energized. All microphones are then switched via contact assemblies NE.1 and NE.2 to the transmitting microphone line, and all telephones will be connected to the AF output of the VHF receiver via contact assembly NE.4.

11. If this emergency I/C system is used while the transmitter-receiver is switched to 'transmit' the speech will be radiated as an R/T transmission, which is generally undesirable. It is therefore necessary to prevent this by prior organization. On the other hand, it is possible that under certain conditions it may be necessary for some member of the crew, other than the pilot, to use the R/T for transmitting, and the NOR/EMY switching permits this, subject to the necessary internal organization.

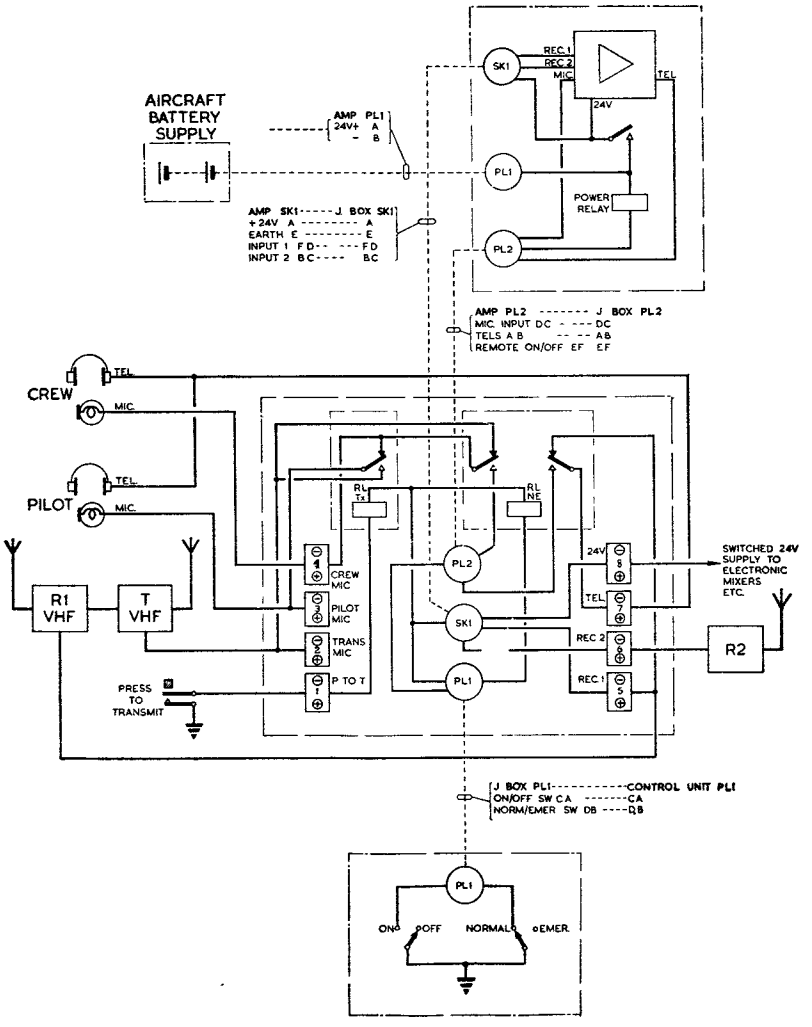

Fig. 3. Typical installation diagram

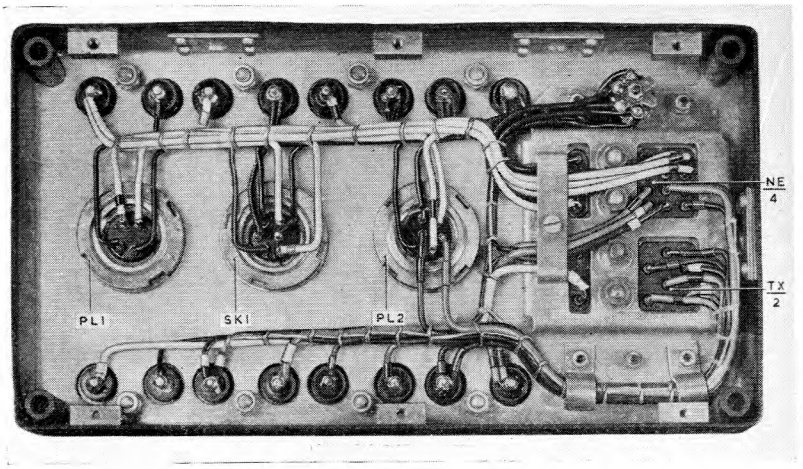

Fig. 4. Junction box Type 154, underside view

12. All the wiring of the junction box is on the underside, which is shown in fig. 4. All leads are covered with P.V.C., and colour-coded, sleeves of a different colour being used where necessary for identification. The leads are lashed together in groups with nylon cord, and cleated in the vicinity of the relay connections. Separate earth leads are run from all earthy points to the common earthing block (top right-hand corner of fig. 4). The following table gives the colour coding of all leads.

Lead No.	*From*	*To*	*Basic colour*	*Sleeve colour*
1	Earth block	PL.2, pin B	Black	—
2	Earth block	PL.1, pin B	Black	—
3	Earth block	PL.1, pin E	Black	—
4	Earth block	PL.1, pin A	Black	—
5	Earth block	SK.1, pin D	Black	—
6	Earth block	TB.8, —ve	Black	—
7	TB.8, —ve	TB.7, —ve	Black	—
8	TB.7, —ve	TB.6, —ve	Black	—
9	TB.6, —ve	TB.5, —ve	Black	—
10	Earth block	TB.1, —ve	Black	—
11	TB.6, +ve	SK.1, pin B	Yellow	Red
12	TB.8, +ve	SK.1, pin A	Brown	—
13	TB.5, +ve	SK.1, pin F	Yellow	—
14	PL.1, pin C	PL.2, pin E	White	—
15	Earth block	PL.2, pin F	Black	—
16	Earth block	SK.1, pin C	Black	—
17	TB.8, +ve	NE/4, (a)	Brown	—
18	TB.2, —ve	NE/4, (1)	Violet	Yellow
19	TB.2, +ve	NE/4, (4)	Green	Yellow
20	TB.4, +ve	NE/4, (5)	Green	Blue
21	TB.4, —ve	NE/4, (2)	Violet	Blue
22	PL.2, pin C	NE/4, (3)	Violet	—
23	PL.2, pin D	NE/4, (6)	Green	—
24	Earth block	NE/4, (22)	Black	—
25	Earth block	NE/4, (23)	Black	—
26	PL.2, pin A	NE/4, (26)	Yellow	Green
27	PL.1, pin D	NE/4, (b)	White	Black
28	Earth block	NE/4, (21)	Black	—
29	TB.5, +ve	NE/4, (24)	Yellow	—
30	TB.7, +ve	NE/4, (25)	Yellow	Blue
31	TB.3, +ve	TX/2, (22)	Green	Brown
32	TB.8, +ve	TX/2, (a)	Brown	—
33	TB.4, +ve	TX/2, (21)	Green	Blue
34	TB.2, +ve	TX/2, (23)	Green	Yellow
35	TB.1, +ve	TX/2, (b)	White	Yellow
36	TB.4, —ve	TX/2, (1)	Violet	Blue
37	TB.3, —ve	TX/2, (2)	Violet	Brown
38	TB.2, —ve	TX/2, (3)	Violet	Yellow

Chapter 3

(completely revised)

ARI.18089/1

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GENERAL DESCRIPTION

1. The ARI.18089/1 is a service selecting and intercommunication (i/c) system intended primarily for use in reconnaissance, transport and large bomber aircraft; it has been developed to meet the operational requirements of these roles. The installation has been designed in accordance with the basic system described in Part 1, Chapter 1 of this publication.

2. In certain respects the installation resembles the ARI.5388 (Chap. 4); the new arrangement, however, is much lighter and more compact since miniature plugs, sockets and other components are used throughout.

3. Essentially, the ARI.18089/1 fulfills three distinct but inter-related functions; these functions are as follows:—

(1) To provide a means of selecting available transmitter-receiver services.

(2) To provide a means of mixing two or more receiver services without one adversely affecting the other.

(3) To provide a channel for distributing i/c signals throughout the aircraft and a means by which this signal can be used to alert members of the crew.

The selecting and mixing device is referred to as a station box or control unit; these control units are described in detail in para. 29 to 50.

4. The total number of services available at any one control unit is seven. One of these services must be normal i/c; three others may be TRANSMITTER-RECEIVER; of the remaining services two will be receivers only and the other "conference i/c."

General arrangement

5. The ARI.18089/1 comprises:—

(1) Control unit Type 7681 Stores Ref. 10L/16320

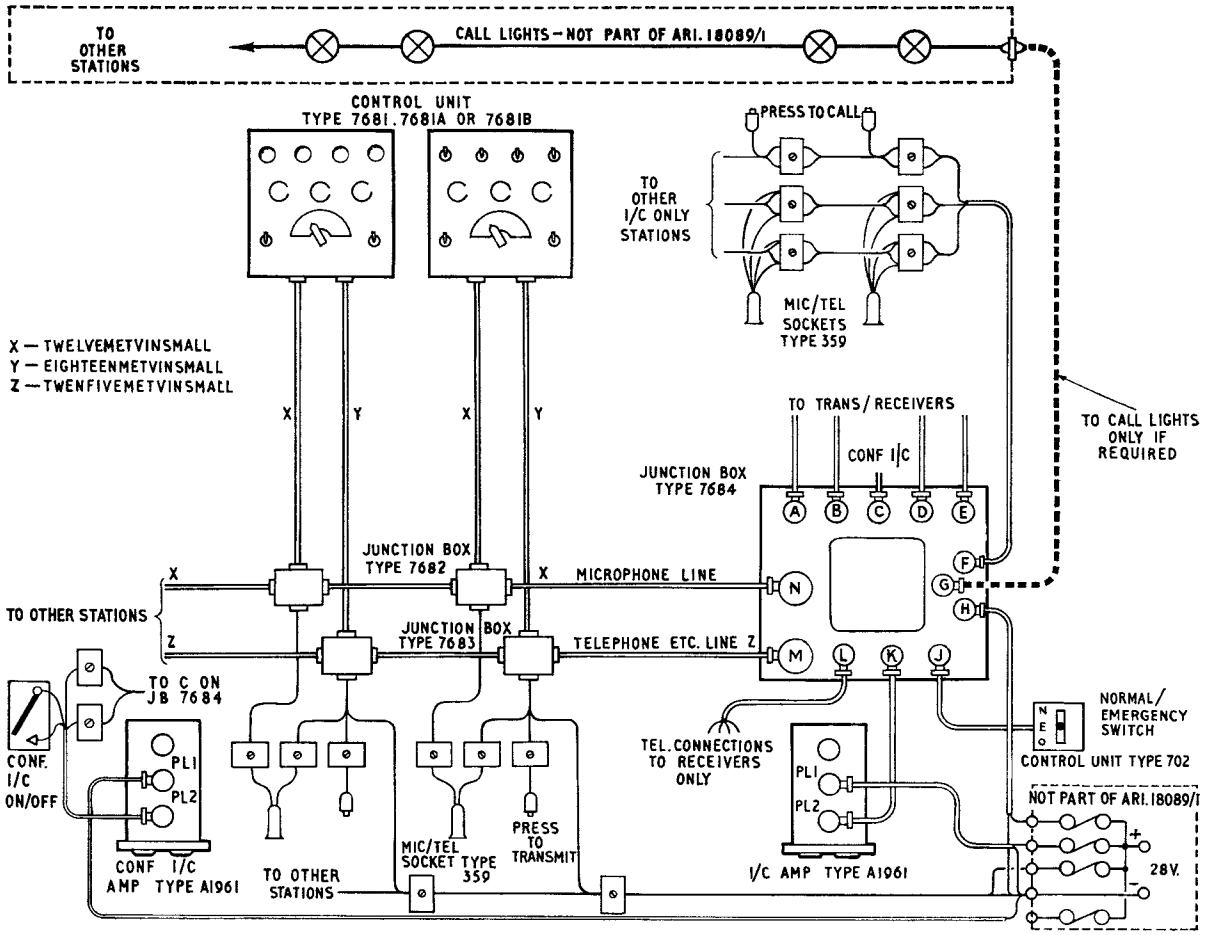


Fig. 1. General arrangement of ARI. 18089/1

or

Control unit Type 7681A Stores Ref. 10L/16748

or

Control unit Type 7681B Stores Ref. 10L/16856

(2) Junction box Type 7682 Stores Ref. 10D/19820

(3) Junction box Type 7683 Stores Ref. 10D/19821

(4) Junction box Type 7684 Stores Ref. 10D/19822

(5) The appropriate connecting cables.

One of each items (1), (2) and (3) are used at each position in the aircraft where radio services are required in addition to i/c. Item (4) is the main junction box and one only is required for the installation. Items (1) to (4) are used in conjunction with amplifiers Type A.1961.

6. The general arrangement of the ARI.18089/1 is given in fig. 1; this shows that all services are brought to the main junction box (junction box Type 7684). These services are: "transmitter-receiver", up to four in number; "receivers only", up to eleven in number; "conference i/c" and "i/c" between all stations.

I/C amplifiers

7. An amplifier Type A.1961 provides the necessary amplification for the i/c system: should the amplifier fail the audio stages of the transmitter-receiver occupying the TX1-REC1 position of the control unit switch can be used as an emergency i/c amplifier. Another amplifier Type A.1961 provides a conference i/c service.

8. The service referred to in para. 6 may be selected only at stations where a control unit Type 7681, 7681A or 7681B (also referred to as a "station box") is fitted. At such stations the user's microphone input to the selected i/c amplifier or transmitter is connected to the main junction box by way of a rotary multipole switch within the control unit and then through a sub-junction box (junction box Type 7682); audio outputs from the i/c amplifier and from the receivers are connected to the user's telephone by way of another sub-junction box (junction box Type 7683) and the switches on the control unit.

Connectors

9. The cable used for the microphone and telephone lines is indicated in fig. 1 by the letters X, Y and Z and the associated key. The method of arranging the main microphone lines and the main telephone lines in separate multicore cables with separate sub-junction boxes reduces the possibility of interaction between microphone and telephone. By this method it is necessary to screen only the separate cables and not the individual lines within the cables; the weight of the cable, therefore, is considerably reduced.

Note . . .

In the following detailed description of the

circuits of the ARI.18089/1, for ease of reference, plugs are denoted by PL. and sockets by SK. In practice, for ease of cable connecting, the plugs and sockets are each labelled with a letter. These letters correspond, in each case, to the letter which labels the mating cable terminations. On the circuit diagrams in the chapter both terms of reference are given; fig. 1 shows the letters labelling the plugs and sockets of the junction box Type 7684.

Call switches

10. Standard mic-tel. sockets Type 359 are provided at all stations (including those stations requiring i/c service only) for connection of the microphone and telephone of each crew member. A press switch is associated with each of those sockets which are at I/C ONLY stations. The switch permits the crew members at these stations to call, on the i/c system, all other stations. (Note that each control unit is fitted with a CALL switch to provide similar call facilities to those of the I/C ONLY stations).

Remote on/off switch

11. A remote switch is connected to the main junction box; this is a 3-position switch. The first position of the switch is OFF; in the second position (NORMAL) the normal amplifier Type A.1961 is switched on; in the third position (EMERGENCY) a relay in the junction box Type 7684 operates and this relay connects in circuit the emergency amplifier referred to in para. 7. The switch is known as the NORMAL-EMERGENCY switch or N/E switch (para. 15). The conference i/c amplifier has a separate ON/OFF switch.

Call lights

12. The call lights shown in fig. 1 are not part of the ARI.18089/1; they may be provided, one for each station, if required. To facilitate their connection to the installation a 28-volt (switched) outlet is provided on the main junction box. The lights come on when the CALL switch at any station is pressed.

Power requirements

13. Power is supplied by the aircraft's 28-volt electrical system, the power requirement being as follows:—

(1) Amplifiers Type A.1961. 1·5A each with a starting peak of 5 amps.

(2) Control Units Type 7681, 7681A and 7681B: each control unit 0·4A with a starting peak of 1·2A.

(3) Junction box Type 7684: maximum of 100 milliamps for operating relays.

Fig. 1 shows, in outline, the power supply connections. The power for each amplifier Type A.1961 is supplied through a separate fuse and then directly to the amplifier. The amplifier power switch is remote and, as stated in para. 11, is connected to the amplifier by way of the main junction box. The power for the relays is supplied through a separate fuse. The power for the control units is supplied by way of their associated junction boxes Type 7683 and through one fuse for up to three control units. When there are more than three control units in the installation, the power supplies are arranged to serve groups of control units (not more than three in a group) and each group is separately fused).

DETAILED DESCRIPTION

Junction Box Type 7684

14. The circuit diagram of the junction box Type 7684 is given in fig. 2. The diagram shows the provision made for the distribution of the available services. The relays are shown on fig. 2 in their de-energized positions; relays contact units O2 and NE3 are not required and their contacts are earthed.

15. The "normal-emergency" relay, NE/4, is normally energized since terminal A of the relay coil is connected to earth by way of terminal D of SK4 and the N/E switch. Hence, normally: the microphone input connections to the i/c amplifier are made through contacts 2 and 3 of NE2 and contacts 5 and 6 of NE1; the telephone output from the i/c amplifier is connected to the i/c line (the line which is connected to terminals J of SK1 and A of SK3) by way of contacts 25 and 26 of NE/4, one side of the output being connected to a common earth at terminal B of PL7. Should the normal i/c amplifier fail, the audio circuits of the transmitter-receiver that is connected to PL1 can be utilized as an emergency i/c amplifier by operating the N/E switch. When the N/E switch is switched from normal to emergency: relay NE/4 is de-energized; the i/c microphone is transferred to the microphone input of TX1 at PL1 by way of contact 1 of NE2 and contact 4 of NE1; the i/c output from REC.1 is fed by way of contact 24 of NE4 to the i/c line.

16. Normally the "call relay", relay O/2 is de-energized. When the CALL switch at any station is made the call relay is energized and power for the call lights, if used, is provided at SK5. With the operation of relay O/2 terminal H of SK1, which is normally earthed, is connected, through contacts 25 and 26 of NE4, to the i/c amplifier output at terminal A of PL7. Terminal H of SK1 is connected to all control units, hence, when the call relay is energized, an i/c signal is provided which is superimposed on all other signals entering the control unit.

17. The incoming microphone connections for the four transmitter-receivers and i/c microphone connections from the control units are made at PL6, which is connected to the first microphone sub-junction box, a junction box Type 7682; the microphone connections from the I/C ONLY stations are made at SK3. The transmitter-receiver connections are taken to their associated transmitters on plugs PL1 to PL5 excluding PL3 which is used for conference i/c; the microphone connections for the normal i/c are taken to PL7 and from there to the input of the i/c amplifier.

All the microphone wiring within the junction box is screened.

18. The inputs from independent receivers, i.e. receivers not forming part of the transmitter-receivers referred to in para. 17, are brought in by way of the twelve pole socket SK2. Socket SK2 facilitates the connection of eleven receivers (eleven positive connections and one common negative). In practice, as many poles of the socket will be wired up as there are receivers required up to a maximum of eleven. The receiver connections are joined to their outlets on SK1. The PRESS TO TRANSMIT switch connections to the transmit relay of each transmitter are made by way of SK1 and the appropriate transmitter-receiver plug. SK1 is connected to the first telephone sub-junction box, a junction box Type 7683.

19. The 28-volt supply for the relays O/2 and NE/4 and for the call lights, when used, is brought in at PL8. The power relay or internal starting relay of the i/c amplifier is operated by the N/E switch in its normal position; one side of this starting relay is connected to the 28-volt positive and the other side is returned to earth by way of PL7, SK4 and the ON/OFF part of the N/E switch.

20. The component layout of the junction box Type 7684 is shown in fig. 3. The plugs and sockets are each identified by a capital letter. Items lettered A to E, H, K and N are all plugs multipole Mk. 4 of varying sizes. Plugs A to E, and K differ only in their key locating positions; the purpose of the differing key positions on these plugs is to avoid the sockets being inadvertently interchanged. Items lettered F, G, J, L and M are all sockets multipole Mk. 4 of varying sizes.

Junction box Type 7683

21. The junction box Type 7683 is a tee-junction device for connecting its associated control unit to the telephone main cable as shown in fig. 1; the circuit diagram of the junction box is given in fig. 4. The main cable which covers the telephone services and the transmit relay control lines enters the box by one of two 25-pole plugs. These plugs, PL1 and PL2, are identical and the main cable may be connected to either plug as required by the cable routeing. In fig. 4 it is assumed that the input is connected to PL2; the main cable, therefore, will be continued at PL1 where it is routed to the next junction box Type 7683.

22. All the input terminals are connected to a set of soldering spills that are on a tagboard, TB. The services from up to fifteen receivers are available but the control unit has facilities for only five of these receivers (apart from i/c). However, any five receivers can be selected by jumpering, with short flexible leads, from the first set

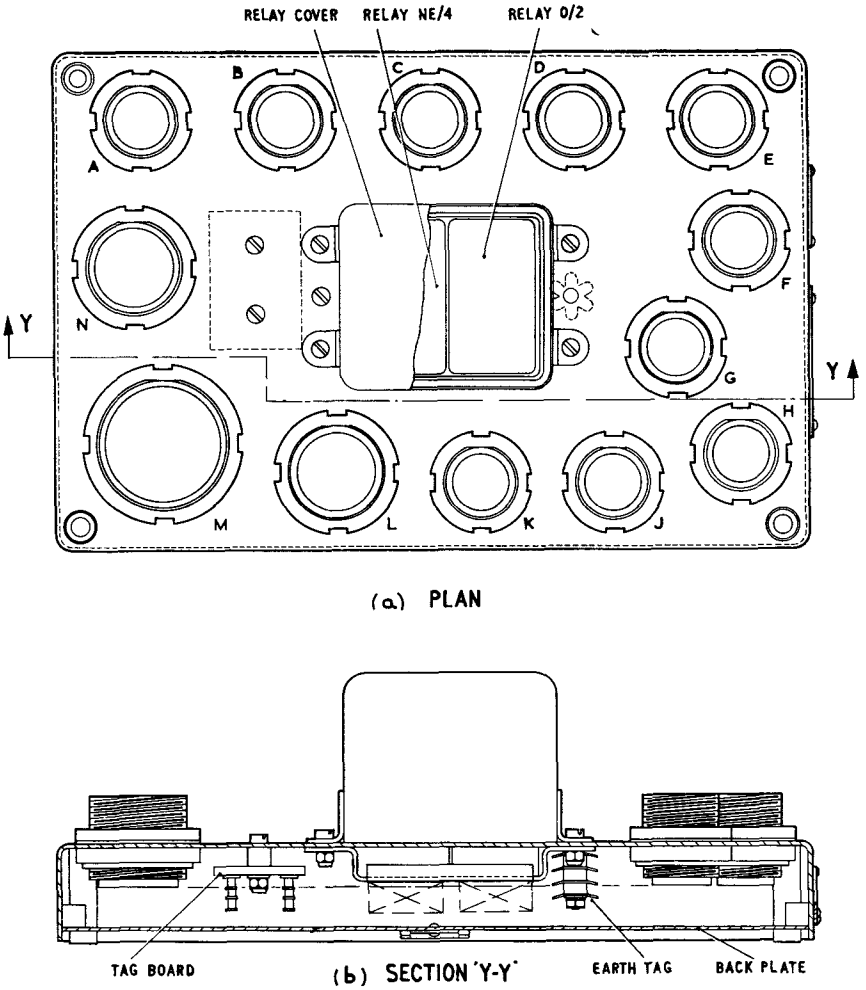


Fig. 3. Junction Box type 7684—component arrangement

of spills to a second set. The five selected receiver connections are taken to the control unit by way of SK1. Incoming "normal" i/c signals and the audio call (CALL TEL) signal are connected to spills on the tagboard and then directly to SK1; from SK1 the signals are taken to the control unit. Any one of seven signals (two i/c and five receiver outputs) can thus be selected at the control unit. The CALL TEL signal, when used, is superimposed on the selected signals.

Note . . .

The incoming conference i/c signal is brought in at pole M of the input plug and connected to spill M on the tagboard; it is then jumpered to one of the receivers spills usually Ms, the REC3 spill (see para. 30).

23. The audio output from the control unit is brought to SK1 and then to PL3 and the user's telephones by way of mic-tel. socket Type 359, which is connected to PL3. Also coming in to PL3 are the connections for the user's PRESS-TO-TRANSMIT switch. These connections are taken to the control unit by way of SK1 and are connected to any one of three transmitter relay control lines. The three control lines are brought to SK1 and connected to a set of soldering spills on the tagboard where they are jumpered to three of the four transmitter relay control lines that are connected to another set of spills. The latter set of spills are connected to the trunk lines at PL1 and PL2.

Note . . .

As the conference i/c amplifier occupies the TX3 position para. 30) the TX3 relay position is not used.

24. The connection from the CALL switch in the control unit is made at SK1 and is then connected

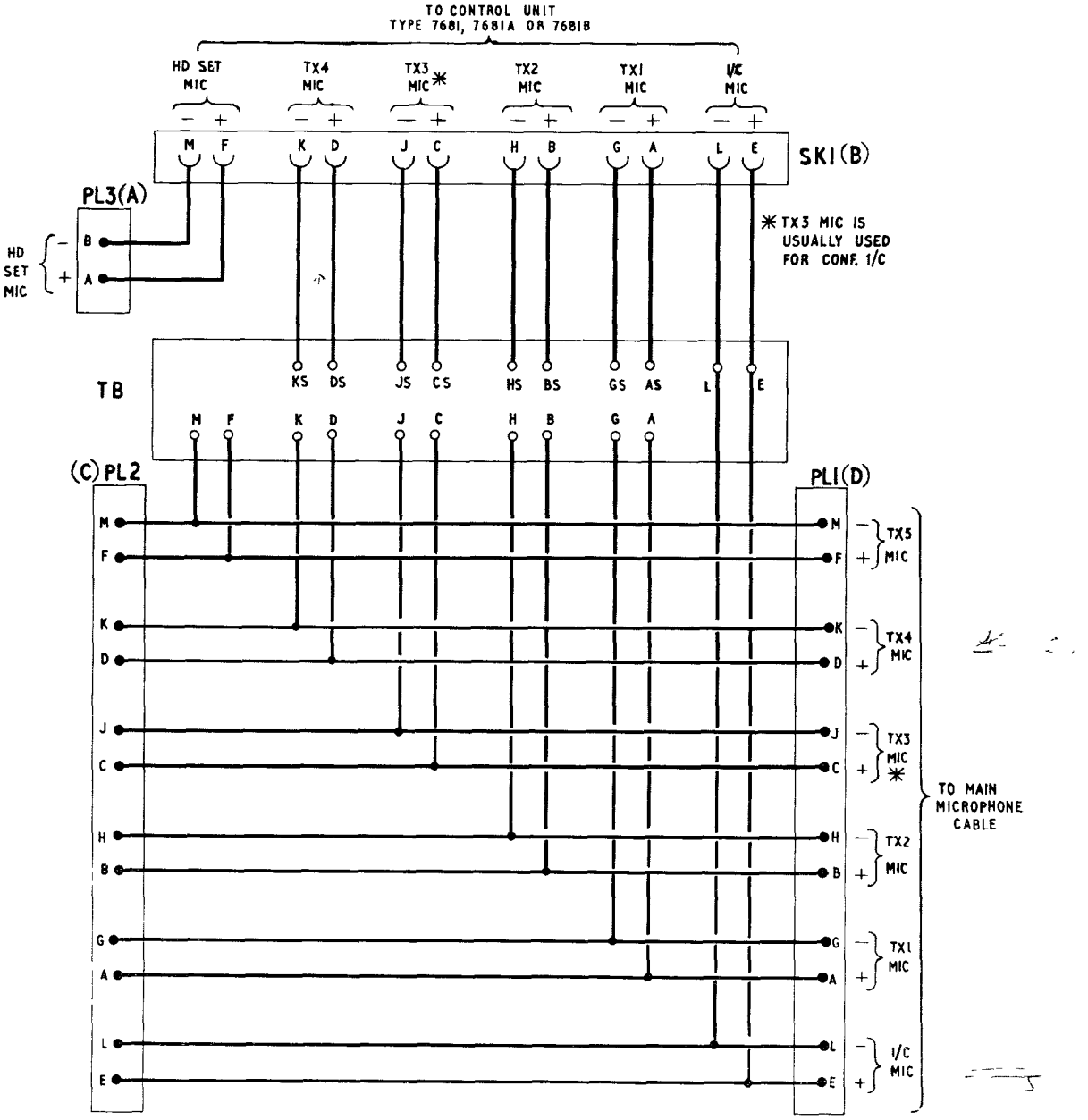


Fig. 5. Junction Box type 7682—circuit

to PL1 by way of a soldering spill on the tagboard.

25. The 28-volt power supply for the control unit is brought into the junction box at PL3 and passed to the control unit by way of SK1.

Junction box Type 7682

26. The junction box Type 7682 is a tee-junction device for connecting its associated control unit to the microphone main cable as shown in fig. 1; the circuit diagram of the junction box is given in fig. 5. The microphone main cable carries the microphone lines for two i/c and up to four transmitters; the main cable can be connected to either PL1 or PL2 (since these plugs are identical), as required by the cable routeing.

27. The user's microphone is connected to PL3 by way of the mic-tel socket Type 359 (para. 23) and then to the control unit by way of SK1. At the control unit the microphone output may be switched to either of the i/c lines or to any one of three transmitter microphone lines. These transmitter lines are brought in to the junction box at SK1 and are connected to a set of soldering spills on the tagboard TB. These spills may be jumpered, by short, flexible leads, to any three out of four transmitter-microphone lines which are connected to another set of spills. The latter set of spills are connected to the trunk lines at PL1 and PL2 as shown in fig. 5.

Note . . .

The conference i/c microphone lines occupy a position previously used for a transmitter-receiver (para. 30) and are usually jumpered Js to J and Cs to C but spills other than Js and Cs may be chosen.

28. The normal i/c microphone lines are brought into the junction box at SK1, connected to a pair of soldering spills on the tagboard and then, without jumpering, to the i/c line in the trunk cable by way of PL1.

Control unit Type 7681

29. As stated briefly in para. 3 and 4 the control units Type 7681 provide the following facilities:-

(1) Selection of the output of the i/c amplifiers and one or more of five receivers. By means of toggle switches or potentiometers any number of these seven services can be selected simultaneously.

(2) Selection of any one of five "transmit" positions, two of which connects the inputs to the i/c amplifiers. By means of two sections on a six-pole, four-section, rotary switch the user's microphone is transferred to any one of these five transmit positions; by means of another section on this switch user's PRESS TO TRANSMIT switch is simultaneously transferred to the control line of the selected transmitter (the i/c poles of the latter switch section are not connected).

(3) Selection of the receiver associated with a selected transmitter (or the output of the i/c amplifier) by means of the remaining section on the rotary switch. These selected services are five of those already referred to in sub-para. (1), however, the receiver sections have been added to the rotary switch so that selection of a transmitter automatically selects the associated receiver thus avoiding having to operate an independent control.

(4) Ability to alert other stations and to make an i/c call which is superimposed on all other selected services.

30. It is assumed for the purpose of description, that the five receiver inputs are from receivers that are numbered 1 to 6. The receivers that are numbered 1 to 4 are part of those transmitters-receivers that may be numbered 1 to 4. Note that the conference i/c amplifier takes one of the transmitter-receiver positions, usually the TX3-REC3 position, but the position will depend on the jumpering arrangements (para. 27).

31. The circuit diagram of the control unit is given in fig. 6; the external appearance and component arrangement are shown in fig. 7 and fig. 8. For clearness certain components are not shown on fig. 7 and 8; these componenets are C1 and C2, R5 to R11 and R14 to R20.

32. A transmitter-receiver, or i/c, is selected by means of switch SWF which is known as the SPEAK-LISTEN switch (fig. 7). Sections (a) and (b) of this switch connect the user's microphone to i/c or to the required transmitter; section (c) connects the incoming i/c signal or the receiver signal that is associated with the selected transmitter to the user's telephones by way of an amplifier; section (d) connects the user's PRESS-TO-TRANSMIT switch to the control lines of the selected transmitter.

33. Mixing of signals is made possible by four switches, apart from SWF (c), and three potentiometers. By means of switch SWF (c) the output from the two i/c amplifiers or from one of three receivers (in this example receivers 1 to 3) may be connected by way of resistor R12 to the primary of the amplifier input transformer, TR1. Of the four services which have not been selected by SWF (c) any number of them may be connected to TR1 by means of the mixing circuit. Hence, if the receiver (REC 1) has been selected by SWC (c), i/c may be selected by means of switch SWB, REC 2 by SWD, CONF i/c by SWE and REC 4 by operating the potentiometer R3. The remaining services may also be connected to the input transformer; viz: REC 5 by operating the potentiometer R2 and REC 6 by the switch SWC.

34. Transmitter-Receiver (1), selected by SWF, position 5, provides "emergency i/c" facilities, when the normal i/c service is inoperative.

35. In addition to selecting services, the switches apply an additional load resistance of about 550 ohms to the output of each selected service. The purpose of this resistance is to reduce capacitive leakage which may occur when the switch is in the 'off' position.

36. The mixing of the output of these services (i/c and receivers) necessitates the use of anti-

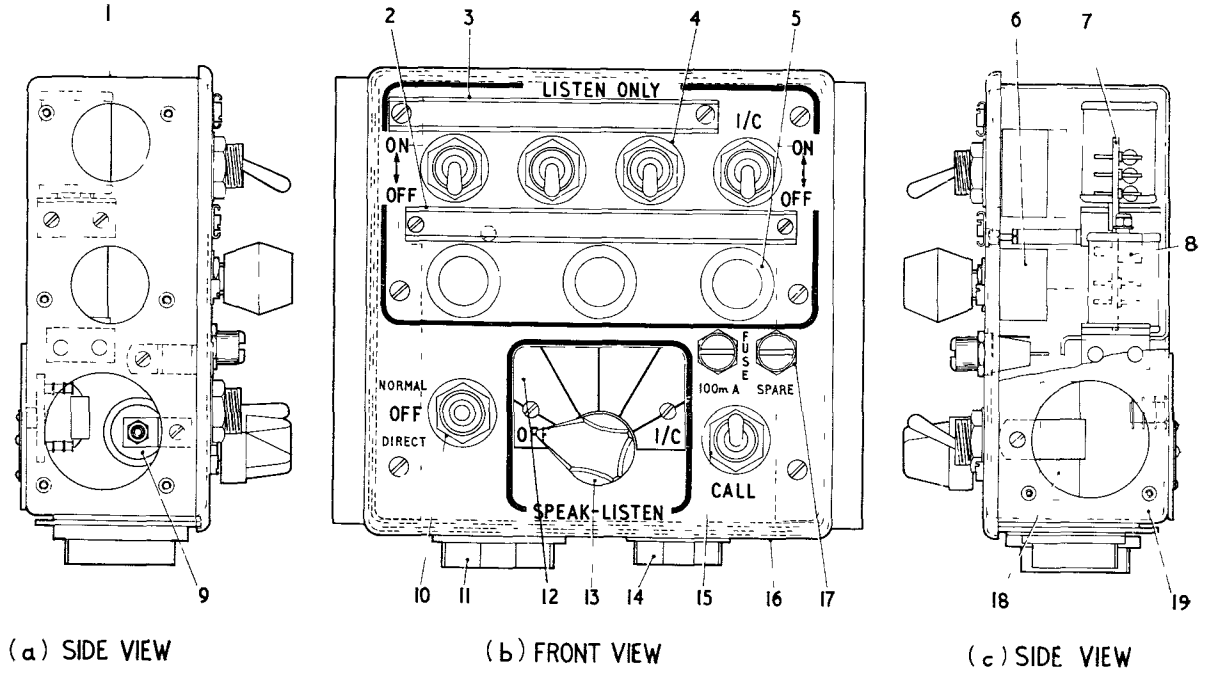


Fig. 7 Control Unit Type 7681—front and side views

KEY TO FIG. 7

1 SIDE PLATE
2 LABEL HOLDER
3 LABEL HOLDER
4 TOGGLE SWITCH (SWITCHES B, C, D AND E SIMILAR)
5 POTENTIOMETER CONTROLS
6 POTENTIOMETERS (R1, R2 AND R3)
7 AMPLIFIER BOARD
8 TRANSISTORS VT1 AND VT2
9 C 3
10 SWITCH G
11 18 POLE PLUG (PL1)
12 ENGRAVED LABEL
13 ROTARY SWITCH CONTROL
14 12 POLE PLUG (PL2)
15 SWITCH A
16 FRONT PANEL
17 FUSEHOLDER
18 C 4
19 SIDE PLATE

crosstalk networks. The principle of the networks is given in Appendix 1 to Chapter 1 of Part 1 of this publication. Briefly, the principle is as follows. In the output circuit of each service there is a high resistance; this resistance is in series with a low impedance load which is common to all services selected by the switches or potentiometers. A mixture of the desired signals thus appears across this load circuit but the high impedance presented by each resistor effectively decouples each service from the signals emanating from the other services.

37. Across the low impedance load circuit the mixed signals are now very low in amplitude due to the potential divider formed by each series resistor and the load. An amplifier is necessary to restore the signals to a normal level.

38. The amplifier uses two transistors in push-pull and negative feedback is applied from the secondary of the output transformer, TR2, to the primary of the input transformer, TR1. The feedback reduces the output impedance of the amplifier and reduces the effect of component changes.

39. The aircraft 28 volt supply is used, without additional regulation, and a cartridge fuse is fitted in the supply.

40. A switch, SWG, (NORMAL-OFF-DIRECT) is provided to permit the control unit 28 volt supply and also the output to the user's telephone to be switched off. In the event of failure of the power supply, or of the amplifier, the incoming signals can be connected to the user's telephone by SWF(c) and SWG in the DIRECT position. However, facilities for mixing will not be available.

41. If switch SWF(c) is not in the i/c position, or SWB is in the "off" position, the crew-member using the control unit is "isolated" from the rest of the crew. A CALL switch, SWA, is provided, therefore, to permit isolated crew-members to be alerted.

Note . . .

Crew members of "i/c only" stations may use the alerting facility by operating their PRESS-TO-CALL *switch.*

42. When switch SWA or a PRESS-TO-CALL switch is made the "call" relay in the junction box Type 7684 is operated (para. 16). Operation of this relay connects the CALL TEL line (normally earthed) to the telephone output of the central i/c amplifier. All other stations can then be alerted by means of the i/c system. The alerting signal is applied to the control unit amplifier input transformer through a series resistor R4 and will

KEY to FIG. 8

1 EARTH TAG

2 REAR PLATE

3 AMPLIFIER BOARD

4 TR2

5 VT1 and VT2

6 COVER ASSEMBLY

7 PL2

8 ANGLE STRIP

9 C3

10 TAGBOARD WITH R4, R12 AND R13

11 L1

12 TR1

13 DECK ASSEMBLY

14 SWF

15 PL1

16 PLUG PANEL

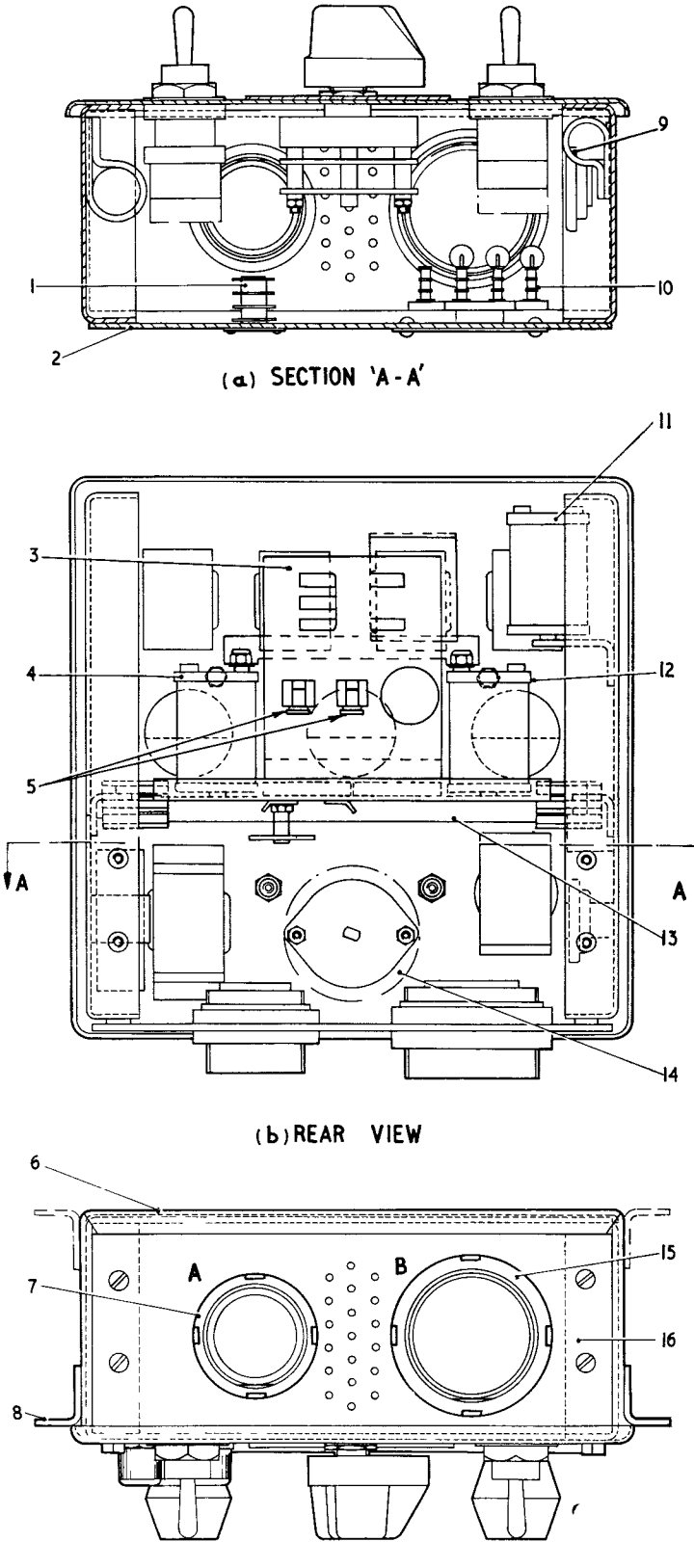


Fig. 8. Control unit type 7681—rear and underside views

then be superimposed upon all other signals that may have been selected.

43. The numbers within the circles on fig. 6 correlate key positions of the circuit. These numbers will be marked, permanently, on the front panel of each control unit. The positions of switch SWF will be marked 1 to 6, number one position being "off". The numbers 2 to 6 will also be marked, respectively, on SWD, switch SWE, potentiometer R3, potentiometer R1 and switch SWB. Switch SWC will be numbered 7 and potentiometer R2 will be numbered 8.

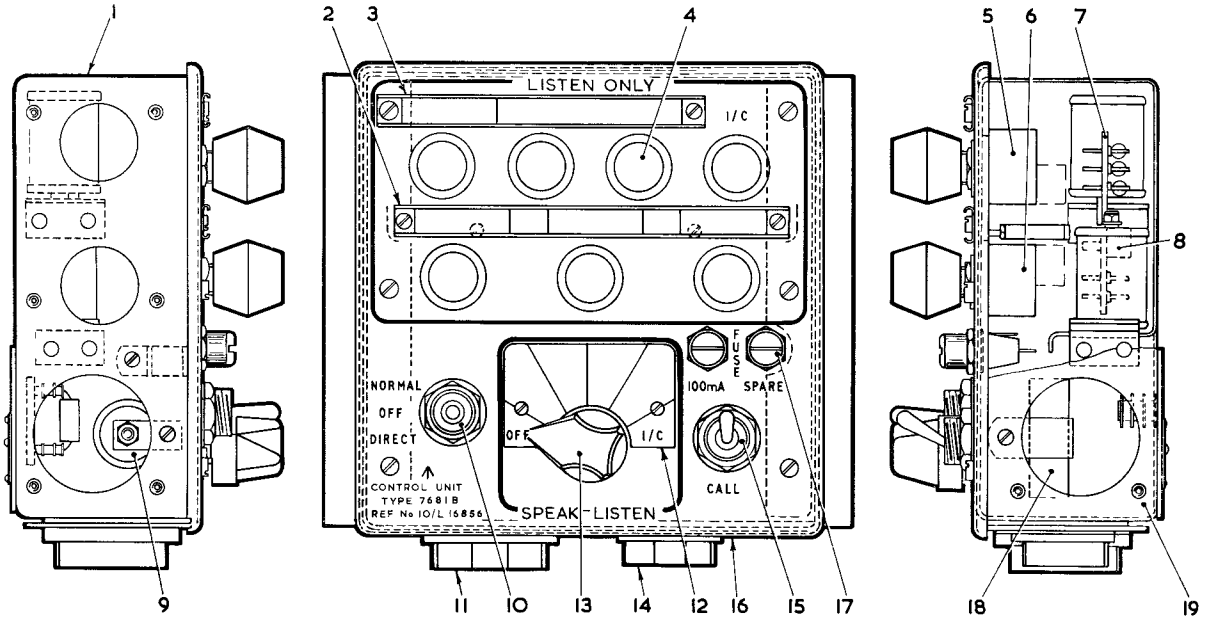
44. The control units have been built in accordance with the standardised control units described in Chapter 1, Part 1 of the publication. Hence they have a standard width of six inches and the angle strips by which the control unit is attached to the aircraft structure can be fitted in one of two positions. These positions permit the control unit to be mounted above a table or, panel or alternatively, recessed below a panel or console so that the top is flush. This method of fitting facilitates installation in various types of aircraft. The angle strips are shown in fig. 8; they are shown in full line for flush mounting and in broken line for stand-off mounting.

Control unit Type 7681B

45. The control unit Type 7681B provides similar facilities to those provded by the control unit Type 7681, described in para. 29 to 44; the toggle switches referred to in para. 29 (1), however, are replaced by potentiometers; thus the selection of the seven services (i/c and receivers) are all controlled by potentiometers.

46. The switches SWB, C, D, and E; and their associated load resistors, have, in this version of the control unit; been replaced by four potentiometers, these are:— R14, 15, 16 and 17 which provides speech level control for the services concerned.

47. The circuit diagram for the control unit Type 7681B is given in fig. 9; the external appearance and component arrangements are given for the front and side views in fig. 10.



(a) SIDE VIEW (b) FRONT VIEW (c) SIDE VIEW

Fig. 10. Control Unit type 7681B— front and side views

KEY TO FIG. 10

1 SIDE PLATE
2 LABEL HOLDER
3 LABEL HOLDER
4 POTENTIOMETER CONTROLS
5 POTENTIOMETERS (R14, R15, R16 AND R17)
6 POTENTIOMETERS (R1, R2 AND R3)
7 AMPLIFIER BOARD
8 TRANSISTORS VT1 AND VT2
9 C 3
10 SWITCH G
11 18 POLE PLUG (PL1)
12 ENGRAVED LABEL
13 ROTARY SWITCH CONTROL
14 12 POLE PLUG (PL2)
15 SWITCH A
16 FRONT PANEL
17 FUSEHOLDER
18 C 4
19 SIDE PLATE

Control unit Type 7681A

48. The control unit Type 7681A provides similar facilities to those provided by the control unit Type 7681B; the seven telephone services being controlled by means of potentiometers. To eliminate the requirement for flood lighting in aircraft this unit is fitted with a plastic lighting panel, providing illumination of all engraved details by edge lighting techniques.

49. The circuit diagram for the control unit Type 7681A is given in fig. 11; the external appearance and component arrangements are given for the front and side views in fig. 12.

50. The plastic lighting is illuminated by six lamps; LP1, 2, 3, 4, 5 and 6 which derive their 28-volt supply from the four pin plug PL3 mounted on the plug panel between the plugs PL1 and PL2.

INITIAL INSTALLATION

51. The control unit Type 7681 is provided with four toggle switches and three potentiometers each controlling a separate telephone service (i/c or receiver). In the present arrangement the four switches and one potentiometer deal with circuits that are also switched by the main rotary switch. The remaining potentiometers are used for "receiver only".

52. The controls unit Type 7681A and 7681B are provided with seven potentiometers controlling the separate telephone services (i/c or receiver). Five of the potentiometers deal with circuits that are also switched by the main rotary switch. The remaining potentiometers being used for "receiver only".

53. These arrangements are not hard and fast ones, and can easily be altered (within the limits of three transmitter-receivers, "normal" and "conference" i/c and two receivers) to suit operational requirements; the position of normal i/c must not be altered.

54. The alteration of the arrangement of selected services of the individual control units is made possible in the sub-junction box (junction boxes type 7682 and Type 7683). As shown in fig. 4 and 5 microphone and telephone leads from the control units are connected to the main microphone and telephone lines by way of tagboards in these sub-junction boxes.

55. The tagboard of each sub-junction box has a number of spills whose main identifying letters are suffixed (in fig. 4 and fig. 5) by the letter S. These spills provide the means of varying the order in which services can be selected at each control unit.

56. The key numbers referred to in para. 43 are used as a guide in the initial jumpering of the required services and in any subsequent changes in the jumpering. Table 1 gives the possible jumpering arrangements with reference to these key numbers.

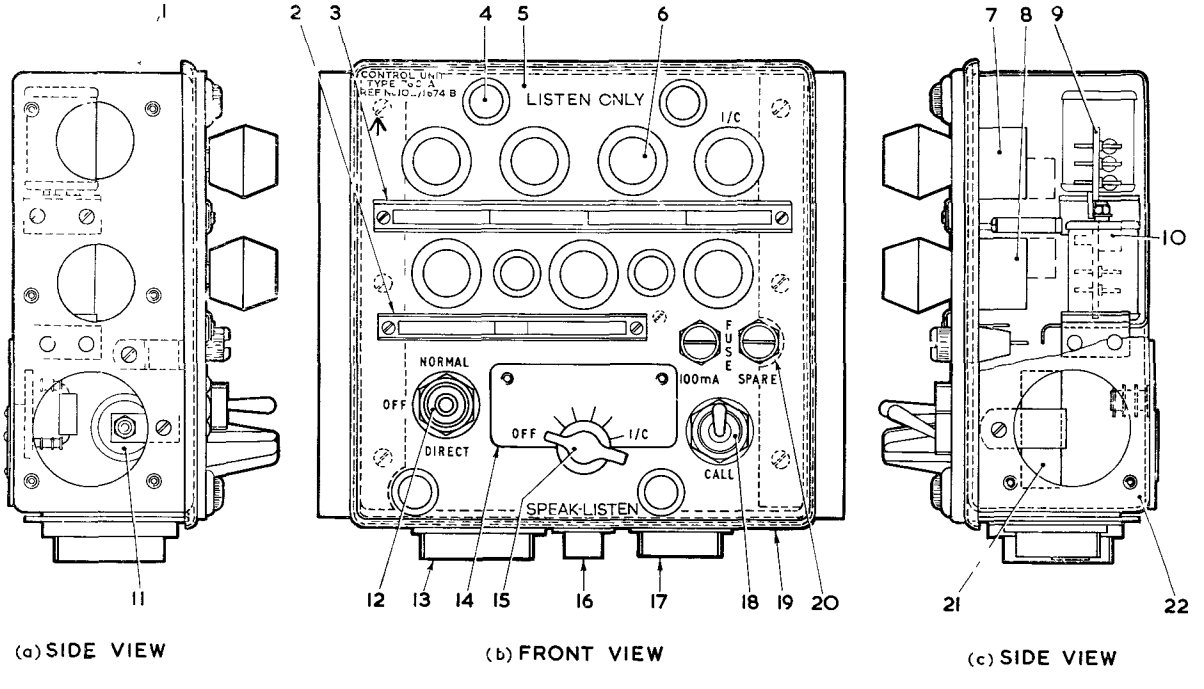


Fig. 12. Control Unit Type 7681A—front and side views

KEY TO FIG. 12

1 SIDE PLATE
2 LABEL HOLDER
3 LABEL HOLDER
4 LAMP
5 INDICATOR PANEL
6 POTENTIOMETER CONTROLS
7 POTENTIOMETERS (R14, R15, R16 AND R17)
8 POTENTIOMETERS (R1, R2 AND R3)
9 AMPLIFIER BOARD
10 TRANSISTORS VT1 AND VT2
11 C 3
12 SWITCH G
13 18 POLE PLUG (PL1)
14 INDICATOR PANEL
15 ROTARY SWITCH CONTROL
16 4 POLE PLUG (PL3)
17 12 POLE PLUG (PL2)
18 SWITCH A
19 FRONT PANEL (SUB)
20 FUSEHOLDER
21 C 4
22 SIDE PLATE

TABLE 1

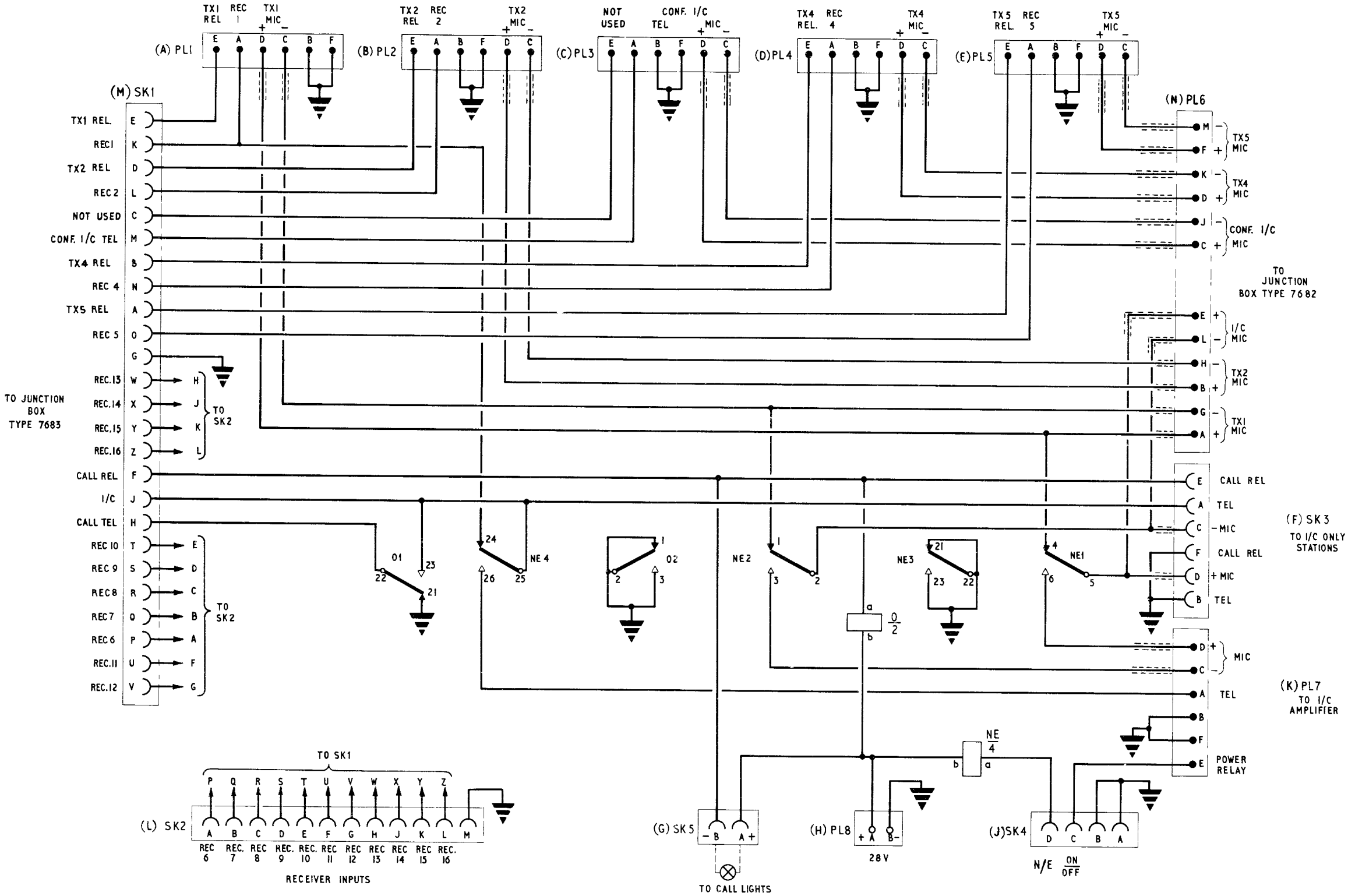
Jumpering arrangements

Switch position or Key Number	Tel only or Mic/Tel	Potentiometer (P) or switch (S) Control Unit 7681	7681A and B	Electrical Function (if permanent)	JUNCTION BOX TYPE 7682 Tagboard spill (mic)	Possible Jumpering	Connection (via J.B. 7684)	JUNCTION BOX TYPE 7683 Tagboard spill (Press-to-transmit)	Possible Jumpering	Connection (via J.B. 7684)	Tagboard spill (Tel. positive)	Possible Jumpering	Connection (via J.B. 7684)
1	Mic/Tel	S	P	OFF	—	—	—					—	
2	Mic/Tel	S	P	—	Hs and Bs	H and B	TX2 via PL2	Ds	D	TX2 via PL2	Ls	L	REC2
						J and C	TX3 via PL3		C	TX3 via PL3		M	REC3
						K and D	TX4 via PL4		B	TX4 via PL4		N	REC4
						M and F	TX5 via PL5		A	TX5 via PL5		O	REC5
3	Mic/Tel	S	P	—	Js and Cs	J and C	TX3 via PL3		C	TX3 via PL3	Ms	M	REC3
						H and B	TX2 via PL2	Cs	D	TX2 via PL2		L	REC2
						K and D	TX4 via PL4		B	TX4 via PL4		N	REC4
						M and F	TX5 via PL5		A	TX5 via PL5		O	REC5
4	Mic/Tel	P	P	—	Ks and Ds	K and D	TX4 via PL4	Bs	B	TX4 via PL4	Ns	N	REC4
						H and B	TX2 via PL2		C	TX2 via PL2		L	REC2
						J and C	TX3 via PL3		D	TX3 via PL3		M	REC3
						M and F	TX5 via PL5		A	TX5 via PL5		O	REC5
5	Mic/Tel	P	P		Gs and As	G and A	TX1 via PL1	Es	E	TX1 via PL1	K	None	REC1
6	Mic/Tel	S	P	I/C	E and L	None	—	—	—	—	J	None	I/C
7	Tel	S	P	REC 5	—	—	—	—	—	—	Os	O to Z	REC5to16
8	Tel	S	P	REC 6	—	—	—	—	—	—	Ps	O to Z	REC5to16

Note . . .

(1) PL1=A PL2=B PL3=C PL4=D PL5=E

(2) TX3 and REC 3 positions will normally be taken by CONF. I/C



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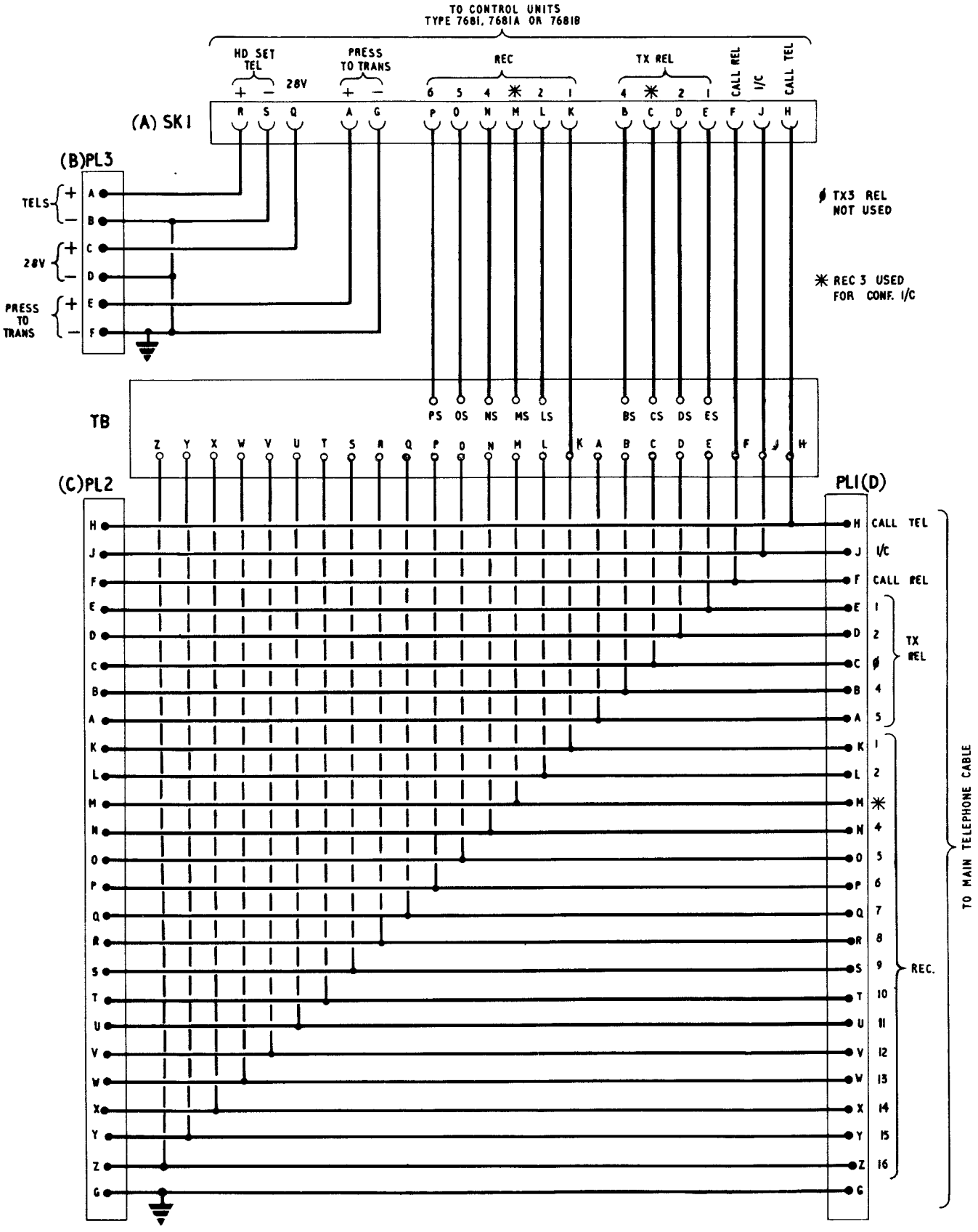
ARI. 18089/1, Junction box Type 7684—circuit

Fig. 2



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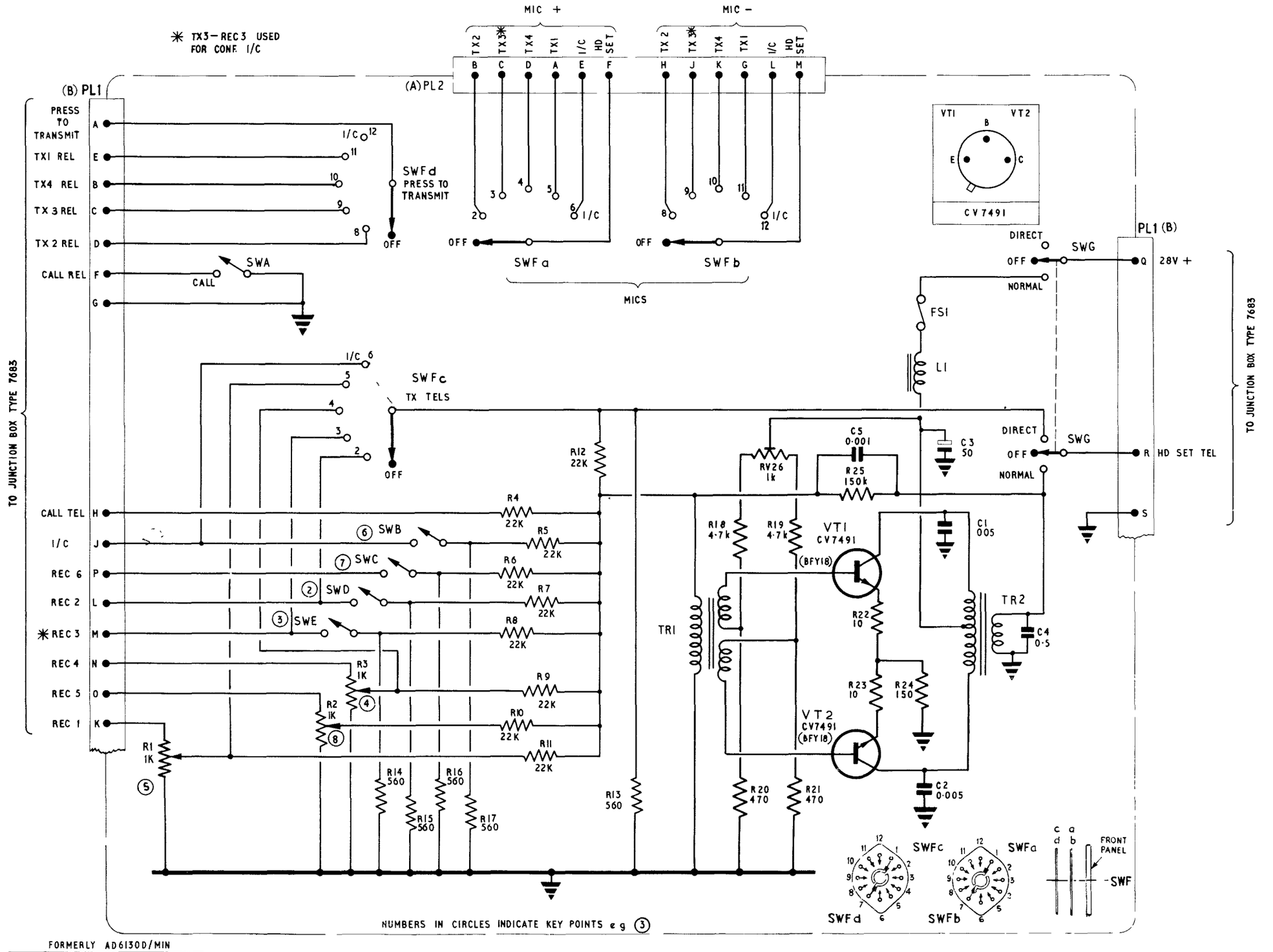
Junction box, 7683: circuit

Fig.4

631164/372393/9/68 J. T. & S./L



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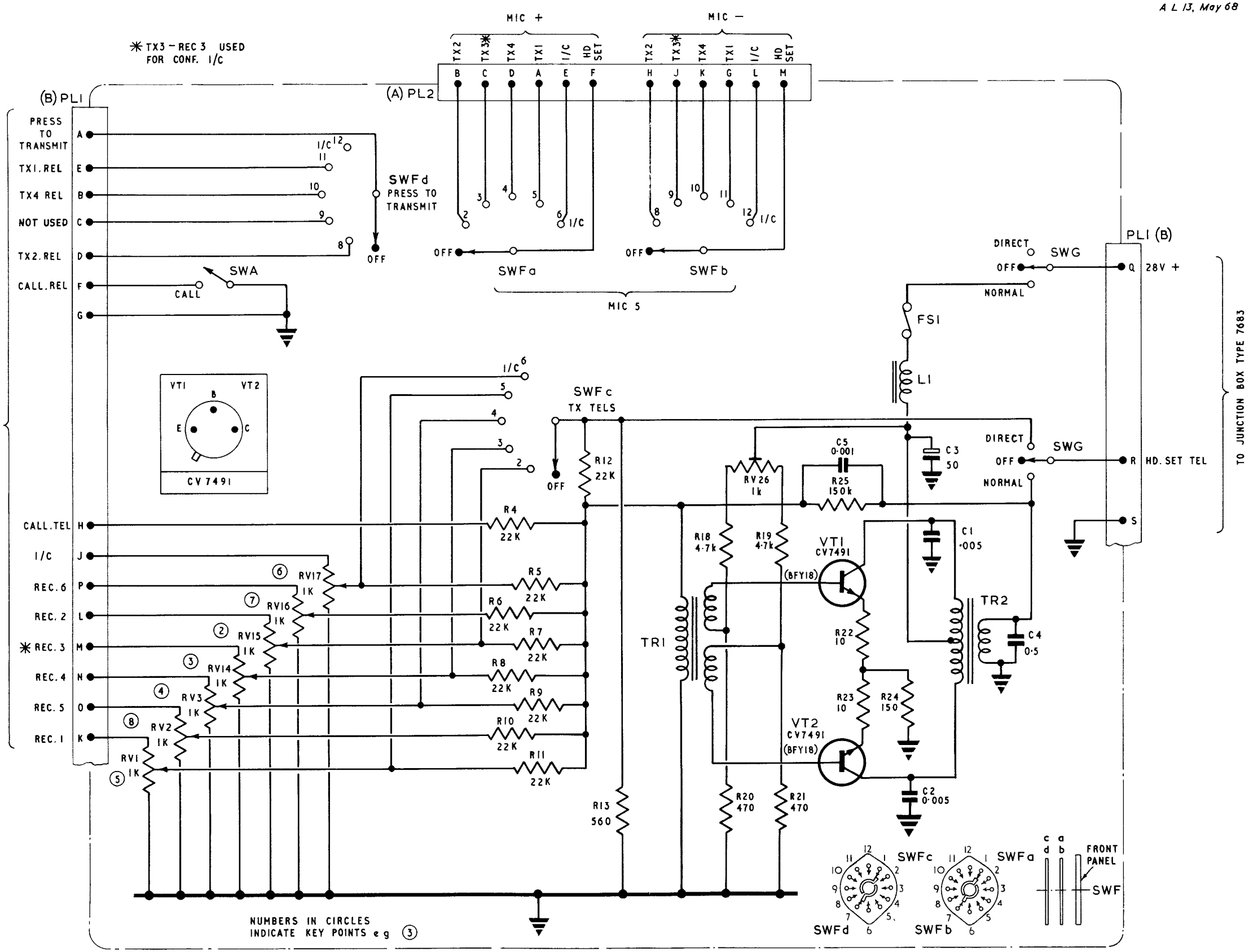
ARI.18089/1, control unit Type 7681 : circuit

Fig.6



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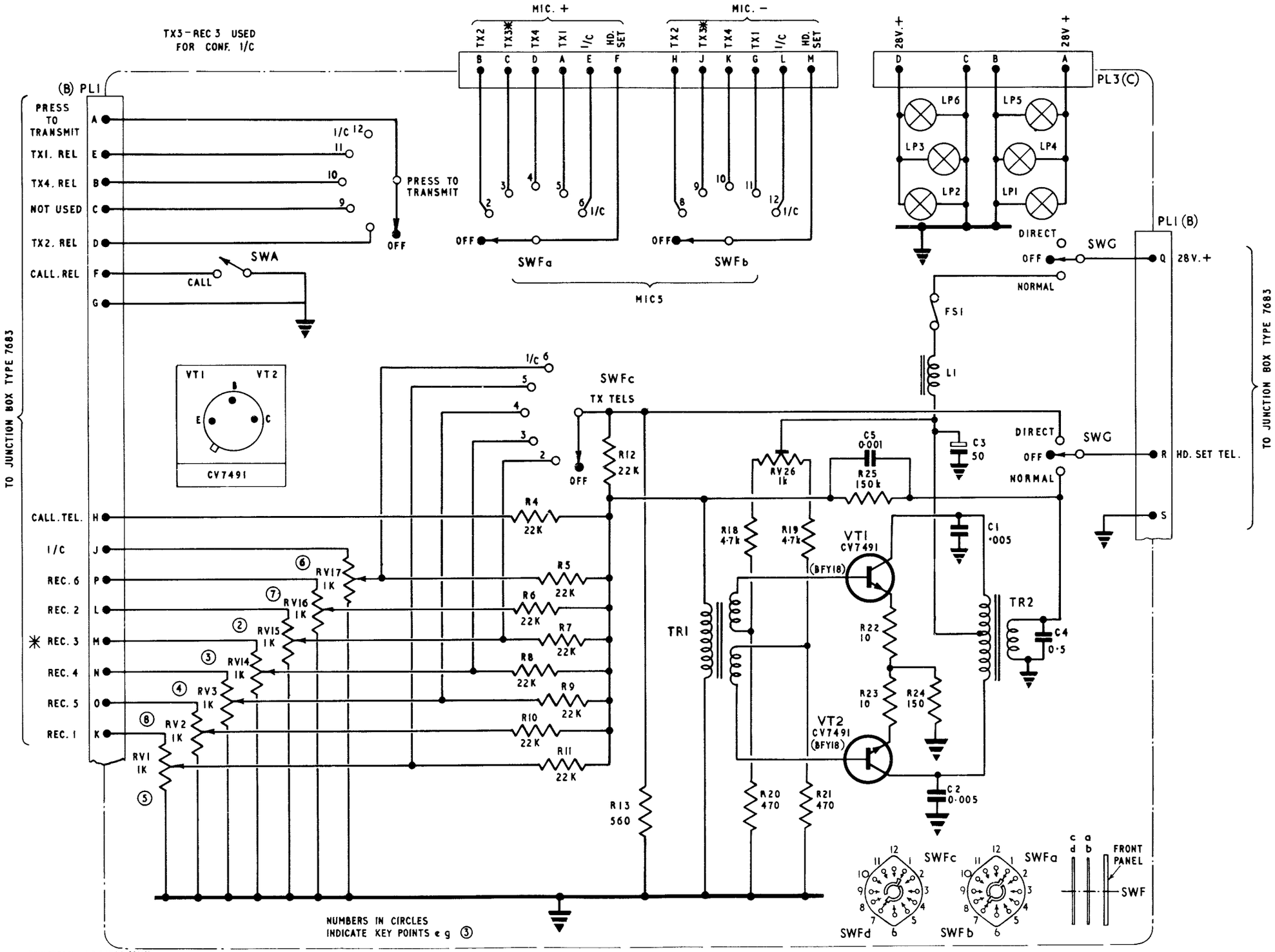
ARI. 18089/1, control unit Type 7681B : circuit

Fig.9



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ARI.18089/1, control unit Type 7681A : circuit

Fig. 11

Chapter 4

(formerly A.P.2876A Vol. 1, Sect. 5, Chap. 1)

ARI. 5388

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**At end of chapter*

Introduction

1. The ARI.5388, shown in fig. 1, is a switching system for the radio and intercomm. equipment of multi-seater aircraft. Designed to meet a requirement in Transport Command, it is also applicable with or without modification, to other aircraft of the R.A.F. and Naval Air Arm.

2. The system may provide a total of seven services (3 receive and 4 transmit-receive) excluding intercomm. Five of these services may be connected to any control unit via a main junction box. These alternative services are pre-allocated during installation.

3. Each member of the crew is provided with a six-position control unit which enables the user to select two receiver services and three transmit-and- receive services. these five services are quite independent and can be used without affecting other members of the crew. A sixth position of the switch provides intercomm. only. "Call"and "Press-toTransmit" facilities are also provided on the control unit and provision is also made for mixing the intercomm. if desired with any of the five services. "Call" facilities (intercomm.) are also provided by means of a separate control unit situated at some convenient position in the aircraft.

4. There is, in fact, provision for seven services in the junction box, which provides alternative receiver and transmitter-receiver services.

GENERAL DESCRIPTION

Equipment

5. For ease of installation and servicing the ARI.5388 comprises a central junction box, Type 131, to which all control units, Type 349 (six-position) and Type 350 (intercomm. only) are joined by multi-way connectors and into which inputs, outputs and control circuits of the various radio sets are fed as shown in fig. 1 and 2.

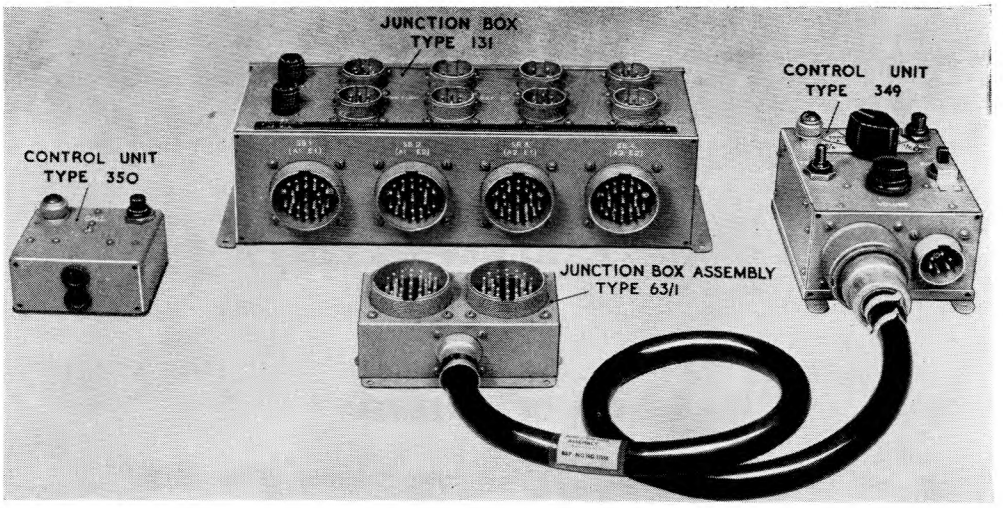


Fig. 1. Main items of ARI.5388

6. It will be seen, by reference to fig. 3, that the number of junction box assemblies, Type 63/1, used is governed by the number of control units, Type 349, used in the installation. All control units used are identical.

7. Each control unit is provided with a six-position switch of the Yaxley type as shown in fig. 4 and 5. This enables the microphone, telephone and "press-to-transmit" circuits of the particular crew station to be switched to any of five radio services and to Intercomm. A volume control is included in the telephone leads of the selected radio service and operates on all radio services and in the "intercomm. only" position.

8. On each control unit a "press-to-transmit" switch is provided, but to cater for positions when the "press-to-transmit" button is remotely situated from the control unit, a remote "P to T" button may be wired to the six-way W-socket.

9. Each control unit is provided with an intercomm. call switch which is spring-loaded press button. By operating this button, a relay is energised in the control unit and this disconnects the microphone from the service to which it is connected and reconnects it to the particular intercomm. amplifier being used in the installation. At the same time, the press-to-transmit switch is disconnected and crews telephones (already connected to the radio services) are paralleled with the intercomm. telephone circuit. A warning lamp (call light) also lights. This call facility is also available from a remote switch or push button, if required.

10. Intercomm. can also be mixed with any one service. A "normal-i/c-receive" switch is locked in the normal position by a guard. If it is desired to permanently superimpose intercomm. on one selected service, the guard is removed and intercomm. is then superimposed on the service

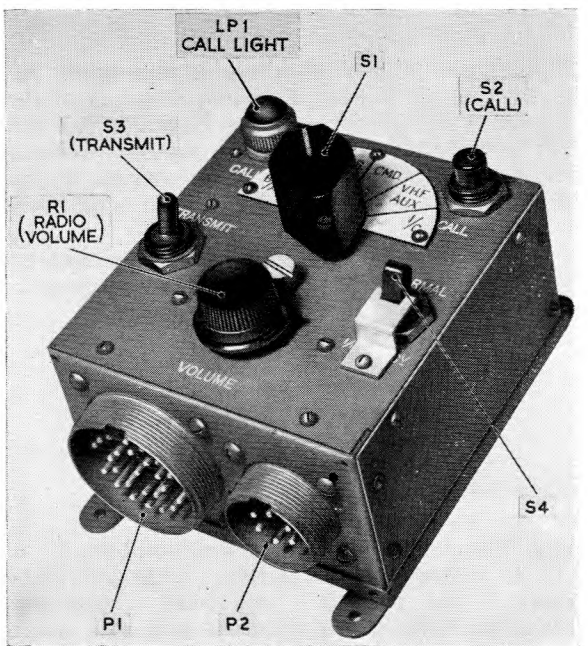


Fig. 4. Control unit, Type 349

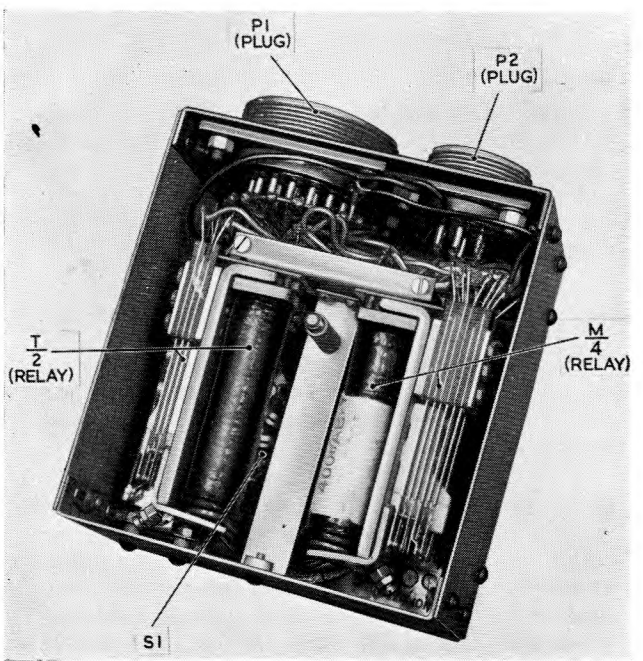


Fig. 5. Control unit, Type 349—underside view

to which the control unit, Type 349 is connected. This facility applies only to the control unit concerned; no other control units in the system are affected. When the switch is not in the normal position, transmit facilities are inoperative.

Available services

11. As mentioned in para. 2 there is provision for seven services in the aircraft which are pre-allocated during installation. The services which can be selected from the junction box will be three transmit-receive services, two receive services, and one intercomm. service. Table 1 lists a possible allocation of services.

TABLE 1
Possible allocation of services

Switch position on control unit, Type 349	Facility
A	Blind landing
B	Radio compass
C	Main general purpose transmitter-receiver
D	Standby HF transmitter-receiver
E	V.H.F.
F	Intercomm.

One transmit-receive service and one receive service are available as alternatives.

12. It is possible to maintain a continuous listening watch on v.h.f. and have an instantaneous v.h.f. transmit facility, merely by pressing the "transmit" switch, with reversion to full intercomm. on cessation of transmission.

TECHNICAL DESCRIPTION

Junction box, Type 131

13. This is the central connecting point for all control units, radio services, and the inter-communication and electrical supplies. Fig. 6 and 7 show the front and underside view of the box. A circuit is given in fig. 2 and 8.

14. Connection to the control units is obtained by one of the four 25-way Type W plugs situated along one face of the box (fig. 6). The four 25-way plugs are all wired to plugs B, C, D and F as shown in fig. 2 and 9, and in order to arrange for alternative selection of additional services, these plugs are also wired with various combinations of the plugs A1, A2 and E1 and E2.

15. The alternative services capable of being used are marked adjacent to the 25-pin W-plugs; thus plug SB1 (A,E1) indicates that services B, C, D, and F plus service A1 and E1 can be used with any control unit connected to this particular plug on the junction box.

16. On the upper face of the junction box, six 6-way W-plugs, one 4-way, one 2-way and two M-plugs are fitted. The three 6-way plugs marked B, C and D connect, via the normal connectors, to the three services using microphones, telephones and press to transmit. The 6-way plugs marked E1 and E2 provide an alternative microphone telephone service and the 2-pin M-plugs give the alternative telephone-only service.

17. The 4-pin plug is connected to the inter-comm. amplifier and the 2-pin plug adjacent to it is the 24-volt d.c. supply. The remaining 6-pin plug marked I/C STATIONS is available for connecting separate intercomm. and call facilities only and provision is made for this on the control unit, Type 350. A removable label is fitted along the edge of this face so that the actual names of the services in any particular aircraft can be readily identified.

Junction box, Type 63/1

18. This junction box, which is shown in fig. 9, with a circuit diagram in fig. 10, has been designed so that any number of control units may be connected to the system by means of an intermediate junction point in preference to having a large number of plugs fitted on the junction box to which each control unit would have to be independently connected. This considerably reduces the length of cabling required for the installation.

19. The length of cable from the junction box, Type 63 to the 25-way W -plug concerned can be varied to suit any particular installation, but it is desirable to keep the cable lengths to a minimum. It has been decided to standardize, whenever possible, on lengths of 2 ft. 6 in. This assembly is know as Type 63/1 and any departure from the length will necessitate a different stroke number. Connections from the main junction box through this assembly, to the control unit, will be shown on fig. 2.

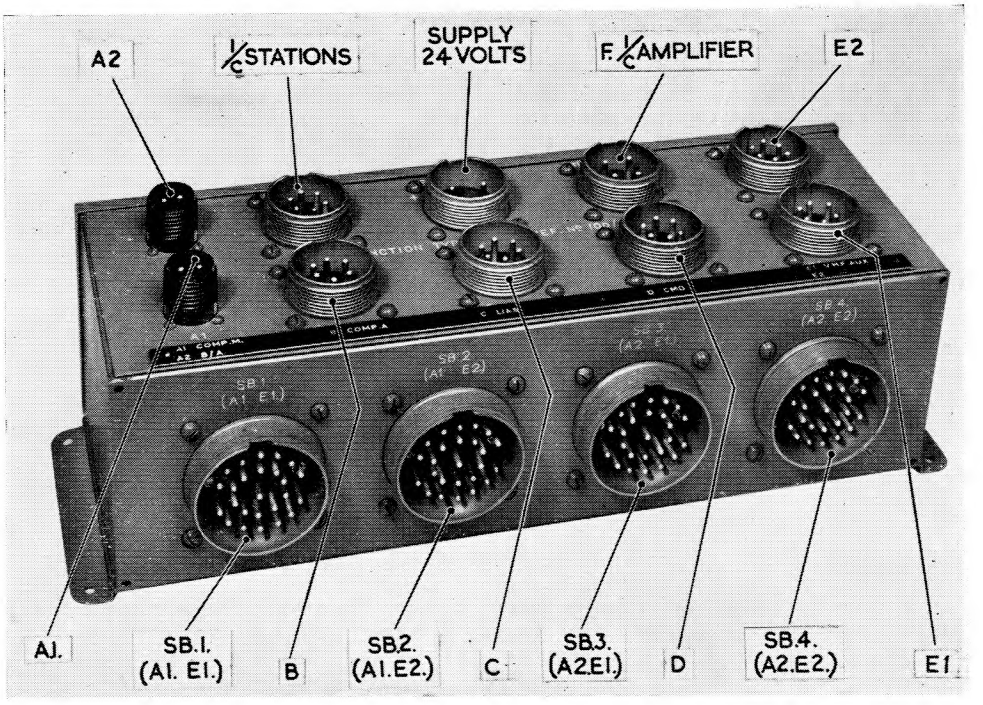


Fig. 6. Junction box, Type 131

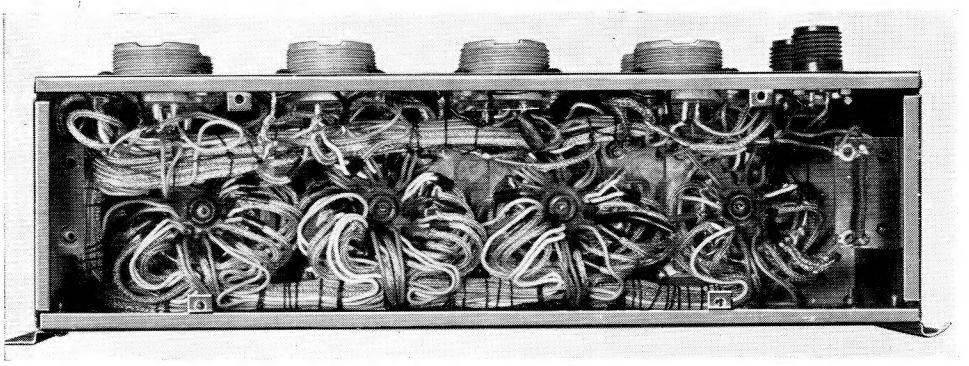


Fig. 7. Junction box, Type 131—underside view

Control unit Type 349

20. Normally, one control unit is used at each crew position and consists of a rectangular metal box approximately 5in. by 4½in. by 2½in. as shown fig.4. On the bottom face are two W-plugs, that is, a 25-way plug to which is connected the socket of the junction box assembly, Type 63/1, and a 6-way plug which supplies microphone and telephone press-to-transmit, and, if required, press-to-call at particular crew stations. Normally, it is only in the pilot's position that an external press-to-transmit switch is used.

21. The controls are positioned on the front face of the control unit and these comprise a two-bank Yaxley type switch (4 pole, 6 way) for selecting any one of the six services available, that is, two receive three transmit-receive and one intercomm. A spring-loaded TRANSMIT switch (S3) is situated to the left of this selection switch as well as a call light (LP) with a red glass cap. A spring-loaded CALL switch (S2) is situated to the right of the call light. The 2,500 ohm volume control (R) enables the user to control the volume of the received radio signals, as well as the intercomm. When transmitting on one of the transmit services the TRANSMIT switch (S3) situated to the left of the volume control must be held in the transmit position. The double pole switch (S4) is situated to the right of the volume control is for mixing intercomm. with one radio service. When the switch (S4) is in the NORMAL position, it provides continuous listening watch on the service selected with instantaneous press-to-transmit facility by means of switch (S3). When the CALL switch (S2) is used the red warning lamp (LP1) lights and intercomm. is superimposed on reception of the service selected. When switch (S4) is in the MIX position, the microphones are connected to intercomm. and telephones to intercomm. as well as the service selected so that intercomm. is continuously superimposed, on the reception. When the TRANSMIT switch (S3) is used, microphones are disconnected from intercomm. and connected to the transmit service.

22. Location of the relays is shown in fig. 5. Relay information is given in Table 2.

TABLE 2
Relay Information

Circuit	Relay magnetic	Value of Solenoid Winding	Remarks
T	Type 979	600 ohms	2 Changeover contacts
M	Type 1109	400 ohms	2 Changeover contacts 2 make-before-break contacts

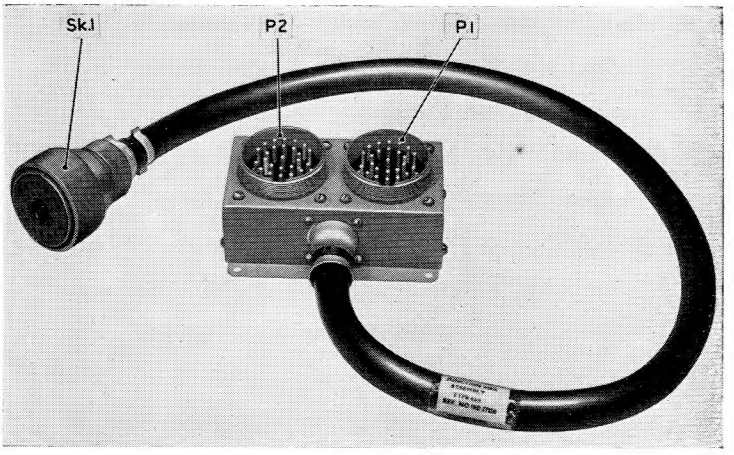


Fig. 9. Junction Box, Type 63/1

23. It can be seen by reference to fig. 2 and 11 that the service selection switch (S1) throws over to the service both microphone leads, telephone positive and press-to-transmit. As the press-to-transmit can only be used on four of the services, the first and last positions on the switch wafer are not wired and, similarly, on microphone positive and negative circuits, the first position on the wafer is not wired. The telephone negative lead and the other side of the press-to-transmit circuit are connected to earth in the radio equipment and brought into the control unit as a common earth lead. In series with the telephone positive circuit on the telephone side of the wafer switch, a 2,500-ohm volume control (R1) is inserted and this volume control varies the strength of the signal on all radio services and intercomm.

24. When switch (S4) is in the NORMAL position relays T and M are both de-energised. The telephones and microphones are connected only to the service selected. In this condition operation of the TRANSMIT switch (S3) merely completes the press-to-transmit circuit of the selected transmit ter. Operation of the CALL switch (S2) energises relay M and simultaneously illuminates the CALL light. The contacts of relay M have the following functions:—

(1) Contacts M1 and M3 disconnect the microphone from the service selected and reconnect it to intercomm.

(2) Contact M2 ensures that operation of the TRANSMIT switch (S3) has no effect.

(3) Contact M4 connects the telephone to the intercomm system thus enabling the intercomm and the signal from the selected receiver to be heard.

25. When switch (S4) is set to the MIX position relay M is energised. In this condition the microphone is connected to intercom and the telephones to intercom and the service selected, thus providing a continuous listening watch for receiver signals. Operation of the TRANSMIT switch energises relay T. Contact T1 de-energises relay M and T2, in parallel with M4 ensures that the telephones remain connected to intercom and the service selected. Contacts M1 and M3 connect the microphone to the selected transmitter and M2 completes the press-to-transmit circuit.

Control unit, Type 350

26. This control unit, which is shown in fig. 12, provides intercomm. and call facilities and is used in positions in the aircraft where only these facilities are required. The number of control units used is governed by the particular installation. The dimensions of the metal case of the control unit are 3in. by $2\frac{1}{2}$in. by $1\frac{1}{2}$in.

27. It will be seen by reference to the circuit diagram, fig. 2, that the control unit, Type 350

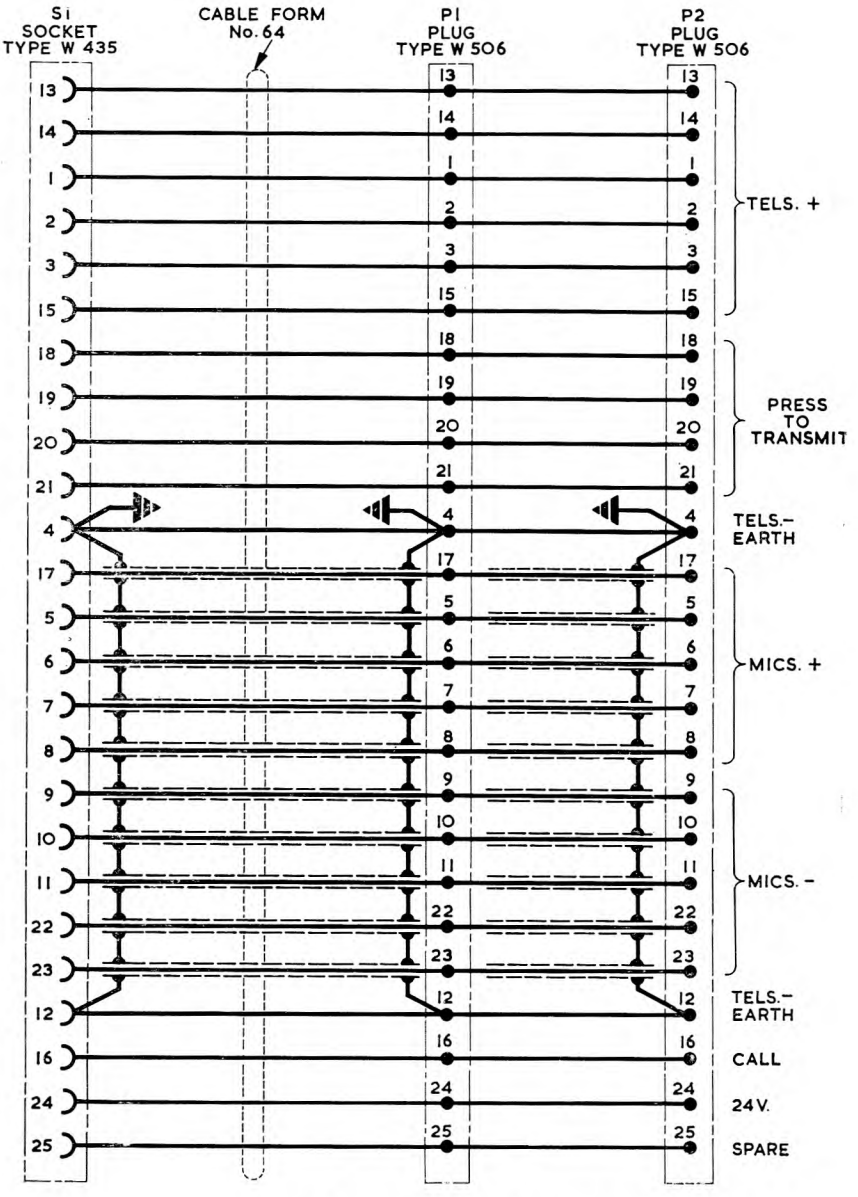


Fig. 10. Junction box 63/1 circuit

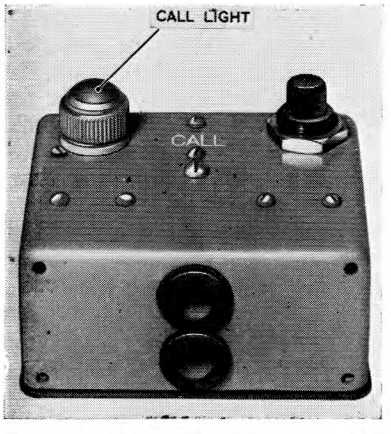


Fig. 12. Control unit, Type 350

consists only of a call light and PRESS-TO-CALL button. The call light is connected across terminals 3 and 5 of the termminal block; these terminals in turn are connected to the I/C STATIONS W-200 plug on the junction box, Type 131. The pins 3 and 5 of the W-200 plug are connected to pins 16 and 24 of the SB1 to SB4 plugs on the junction box, Type 131. It will be seen that pin 24 is the 24 volts positive pin and pin 16 the call line pin.

28. As soon as the CALL BUTTON in the control box, Type 350 is depressed, the call line is earthed thus completing the 24-volt negative circuit and lighting the call light on all control units, Type 350. As the call line circuit is also connected to the call lights on all the control units, Type 349, the negative side of the call light circuit on each of the control units, Type 349, will also be earthed. All the call lights on the control units Type 349 will light and thus attract the attention of any member of the crew who is not connected to the intercomm. line.

29. The call light on control units, Type 350 will be similarly brought into operation when the CALL button (S2 of fig. 4) is depressed on a control unit, Type 349.

30. The microphone and telephone circuits used in conjunction with the control units, Type 350 (all the microphone circuits and all the telephone circuits are each in parallel) are connected via the junction box, Type 131 plugs I/C STATIONS and F (I/C AMPLIFIER) to the intercomm. amplifier.

31. It should, of course, be understood that unless the 6-position switch on the control unit, Type 349, is placed in the I/C position, or the call button on the control unit pressed, no intercomm. can be received by members of the crew using these control units, although the lamps LP1 may light due to the operatior of a control unit, Type 350 having depressed the CALL button.

INSTALLATION

32. Care should be taken to install the control unit, Type 349 in a position in the aircraft where the switch label can be readily seen, the controls easily operated and the plugs easily removed.

33. The junction box, Type 131 should also be fitted so that the two faces containing the various plugs are readily accessible.

34. The junction box assembly, Type 63/1 is similarly fitted. A typical installation is shown in fig. 3.

OPERATION

35. The ON OFF switch on the intercomm. amplifier, which may not be readily accessible, should be permanently left in the ON position and the supplies to the amplifier controlled by a remote ON-OFF switch which is normally fitted on the operator's panel.

36. The services required at each individual station box must first be selected by plugging into the required 25-way plug at the bottom of the junction box, Type 131 (fig. 6), i.e. SB1, SB2, SB3 or SB4. Reference should be made to para. 12 and 13 for information concerning the services available at any particular 25-way plug on the junction box, Type 131.

37. The selector switch (S1 of fig. 4) on the control unit, Type 349, is set to give the particular radio service required and the volume control, R1, on the control unit adjusted to give signals at a comfortable level. As some equipments have their own volume controls, there will be, in effect, two volume controls in series and its is advisable to set the volume control of the radio receiver at, or nearly at, maximum. Only the volume control on the control box is then used.

38. If two or more of the crew have their control boxes switched to the V.H.F. position, it is, of course, possible to use intercomm. on the v.h.f. set; the only danger is that if one of the crew uses the PRESS-TO-TRANSMIT switch (S3) the intercomm. will be radiated.

39. If a member of the crew wishes to call another member of the crew, he should press the CALL button (S2) and speak to the crew member required. If intercomm. is required for long periods the members of the crew should, of course place the selection switch (S1) in the INTERCOMM. position. Call facilities (lamp LP1) are still available. Should the call light at any station become an embarrassment, e.g. in the pilot's Type 349 box when the aircraft is flying at night, the lamp can be removed. Audio call is still available.

SERVICING

40. To remove the control unit for servicing, it is only necessary, after removing the connections, to unscrew the centre screw situated above the volume control knob (refer fig. 4) and this will enable the unit as a whole to be removed leaving the back plate still fixed in the aircraft.

41. The most likely faults which will occur in the ARI.5388 are broken wiring due to vibration and low-resistance due to moisture seeping into the control units.

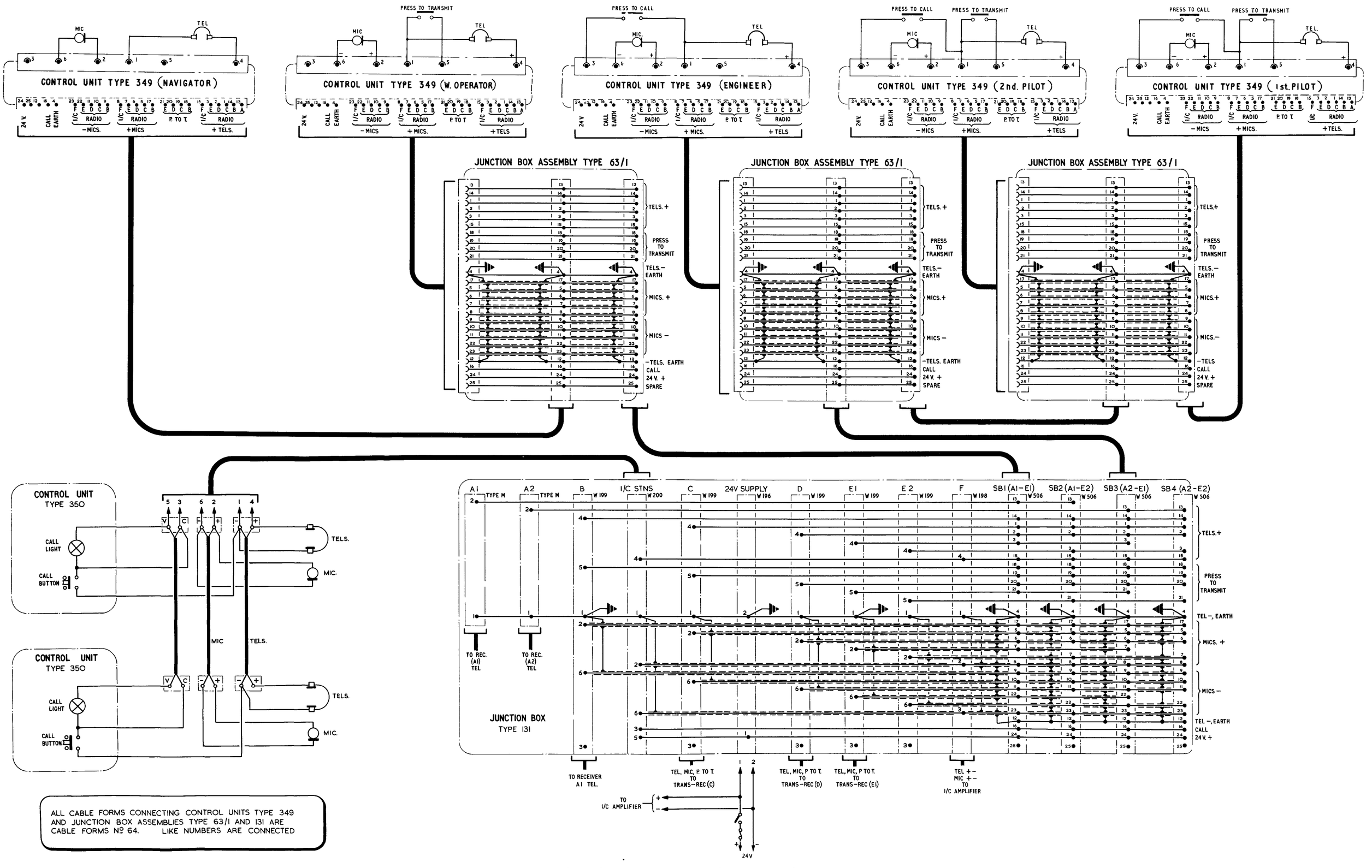
42. Table 3 lists the Type and Stores Ref. numbers of the components which may need renewal. The information given here may be added to or superseded by Vol. 2 or by Vol. 3.

TABLE 3
List of Components

Stores Ref	Nomenclature	Qty	Ref. in fig. 2	Remarks
	ARI.5388 Consisting of:—			Aircraft radio and I/C switching system
10D/2784	Junction box, Type 131	1		
10D/17150	Junction box, Type 63/1	As required		Component details follow
10L/208	Control unit, Type 349	As required		
10L/209	Control unit, Type 350	As required		

TABLE 3—contd.

10D/2784	Junction box, Type 131			
	Components:—			
5X/750	Plug, Type M	2		Two pole, 4 amp.
10H/389	Plug, Type W.196	1		Two-pole, panel mounting
10H/391	Plug, Type W.198	1		Four-pole, panel mounting.
10H/392	Plug, Type W.199	5		Six-pole, panel mounting.
10H/393	Plug, Type W.200	1		Six-pole, offset pins, panel mounting.
10H/13873	Plug, Type W.506	4		25-pole, panel mounting.
	Accessories:—			
10AM/7	Labels, Type 246/1	1		Plug identification label 10·37in. x 0·37in., engraved white characters
10D/17150	Junction box assembly, Type 63/1	As required		Junction box with 25-way connector 2 ft. 6 in. long.
	Components:—			
10H/13873	Plug, Type W.506	2		25-pole, panel mounting
10H/13874	Socket, Type W.435	1		25-pole, straight cable entry
5E/—	Cable, electric, form No. 64	1		25-way, 10 screen P.V.C. covered 2 ft. 9 in.
5X/1893	Ferrule, size B	1		Brass, for boxes, Type V.S.B.
5K/98	Nut	1		Cable gland, 1·03 i/d, 1·25 threaded 16 T.P.I.
5X/1531	Ring	1		Clamping No. 3, for B ferrules.
5X/1532	Ring	1		Clamping No. 4, for C ferrules.
10L/208	Control unit, Type 349			
	Components:—	As required		
10A/—	Caps, lamp	1		Red glass.
10A/11839	Knob, Type 11	1		Moulded black.
10A/14801	Knob, Type 263	1		Moulded black, fine ribbed or knob, Type 41 (Stores Ref. 10A/12464).
5L/107	Lamp, filament	1		29V, 3W, (M.E.S.).
10A/19918	Lampholder, Type 172	1		M.E.S., two fixing holes.
10H/392	Plug, Type W.199	1		6-pole, panel mounting
10H/13873	Plug, Type W.506	1		25-pole, panel mounting.
10FB/1359	Relay, magnetic, Type 979	1	$\frac{T}{2}$	P.O. 600 Type, low voltage, 600 ohms 2C
10F/16602	Relay, magnetic, Type 1109	1	$\frac{M}{4}$	P.O.600 Type, low voltage 400 ohms 2C, 2K.
10W/9640	Resistance, Type 2875	1	R2	150 ohms ± 20 per cent, $\frac{3}{4}$W.
10W/0119490	Resistor Variable	1	R1	Potentiometer 2500 ohms ± 10 per cent, $\frac{1}{2}$W.
10F/Z510505	Switch, Type 895	1	S3	"Transmit" switch
10F/Z510504	Switch toggle type QMQB	1	S4	"Normal i/c and Receive" switch
10F/1786	Switch Type 1290	1	S2	Push-button for CALL
10F/16519	Switch Type 1665	1	S1	"Service Selection" switch
10A/972	Nuts, spigot	2		Fixing for S3 and S4
10AM/8	Label, Type 247/1	1		"Service Selection" switch label. Or, Type 247/2 (Stores Ref 10AM/9).
10W/0221110	Resistors	2	R3, R4	100 ohms ± 10% $\frac{1}{4}$W.
10L/209	Control unit, Type 350	As required		
	Components:—			
5C/430	Block, terminal, Type B	3		2-way, No. 1.
10A/—	Cap, lamp	1		Red glass.
10A/12489	Grommet, Type 6	2		
5L/107	Lamp, filament	1		29V, 3W.
10A/19918	Lampholder, Type 172	1		M.E.S. two fixing holes.
10F/1786	Switch, Type 1290	1		CALL push button.



ALL CABLE FORMS CONNECTING CONTROL UNITS TYPE 349 AND JUNCTION BOX ASSEMBLIES TYPE 63/1 AND 131 ARE CABLE FORMS Nº 64. LIKE NUMBERS ARE CONNECTED

Fig. 2

Circuit of typical installation

Fig.2

ITEM Nº	STORES REF.	DESCRIPTION
		CABLE ELECTRIC L.T.
1	5E/2105	UNIVIN 4. TEL. AND EARTH WIRING
2	5E/2108	DUVIN 4. TEL. AND FIXED WIRING TO "CALL" AND "P TO T" SWITCHES
3	5E/2109	DUVIN 7. SUPPLY WIRING TO AMPLIFIER
4	5E/1328	DUMET 4. MIC. WIRING
5	5E/1611	DUSHEATHSMALL 4. FLEXIBLE WIRING TO "CALL" AND "P TO T" SWITCHES
		CONNECTORS TYPE —
6		3044/-, DUVIN 4
7		3045/-, DUVIN 4
8		3046/-
9		3047/-
10		3048/-, DUVIN 4
11		3049/-
12		3050/-
13		3051/-
14		3052/-
15		3053/-
16		3054/-
		FIXED EQUIPMENT
17	10D/2784	JUNCTION BOX, TYPE 131
18	5C/430	BLOCK TERMINAL, TYPE B, 2-WAY, Nº 1 (TO BE MARKED)
19	5C/432	BLOCK TERMINAL, TYPE B, 3-WAY, Nº 2 (AS INDICATED)
20	10L/208	CONTROL UNIT, TYPE 349 RADIO, I/C AND CALL FACILITIES
21	10L/209	CONTROL UNIT, TYPE 350 I/C AND CALL FACILITIES ONLY
22	10D/17150	JUNCTION BOX, ASSEMBLY, TYPE 63/1
		(C/W 2'6" CONNECTOR AND STRAIGHT "W" SOCKET)
23	10H/2206	SOCKET, TYPE 359 (MIC. TEL. PARALLEL)
24	5D/534	SWITCH BUTTON S.P. (FIRING BARE)
25	5C/898	SWITCH BUTTON S.P. (FLANGE TYPE B)
26	5C/543	SWITCH BOX. TYPE B, 1 UNIT, 24V SUPPLY SWITCH
		REMOVABLE EQUIPMENT
27		INDICATING LABEL, TYPE 247 SERIES FOR CONTROL UNIT, TYPE 349
28		INDICATING LABEL, TYPE 246 SERIES FOR JUNCTION BOX, TYPE 131

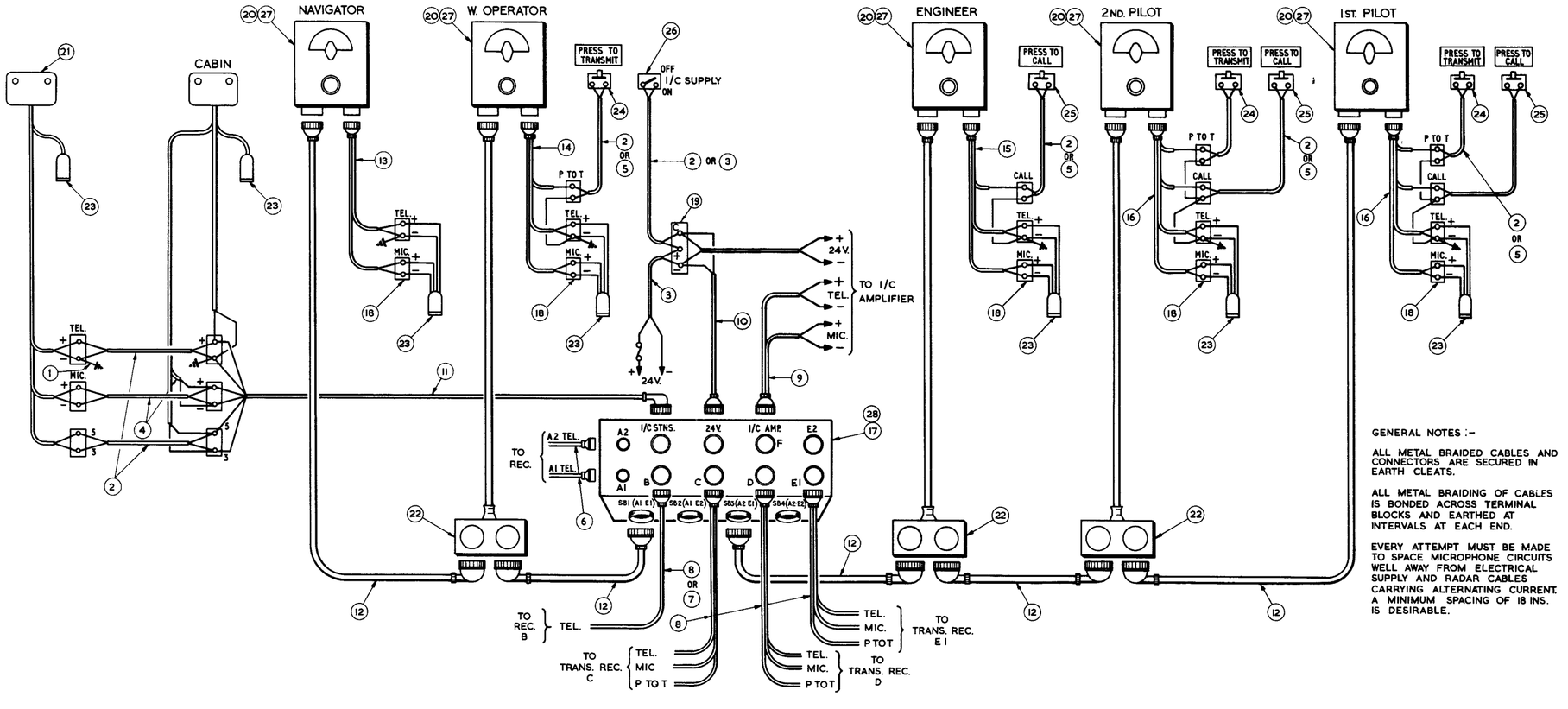


Fig. 3

ARI. 5388: typical installation

Fig.3

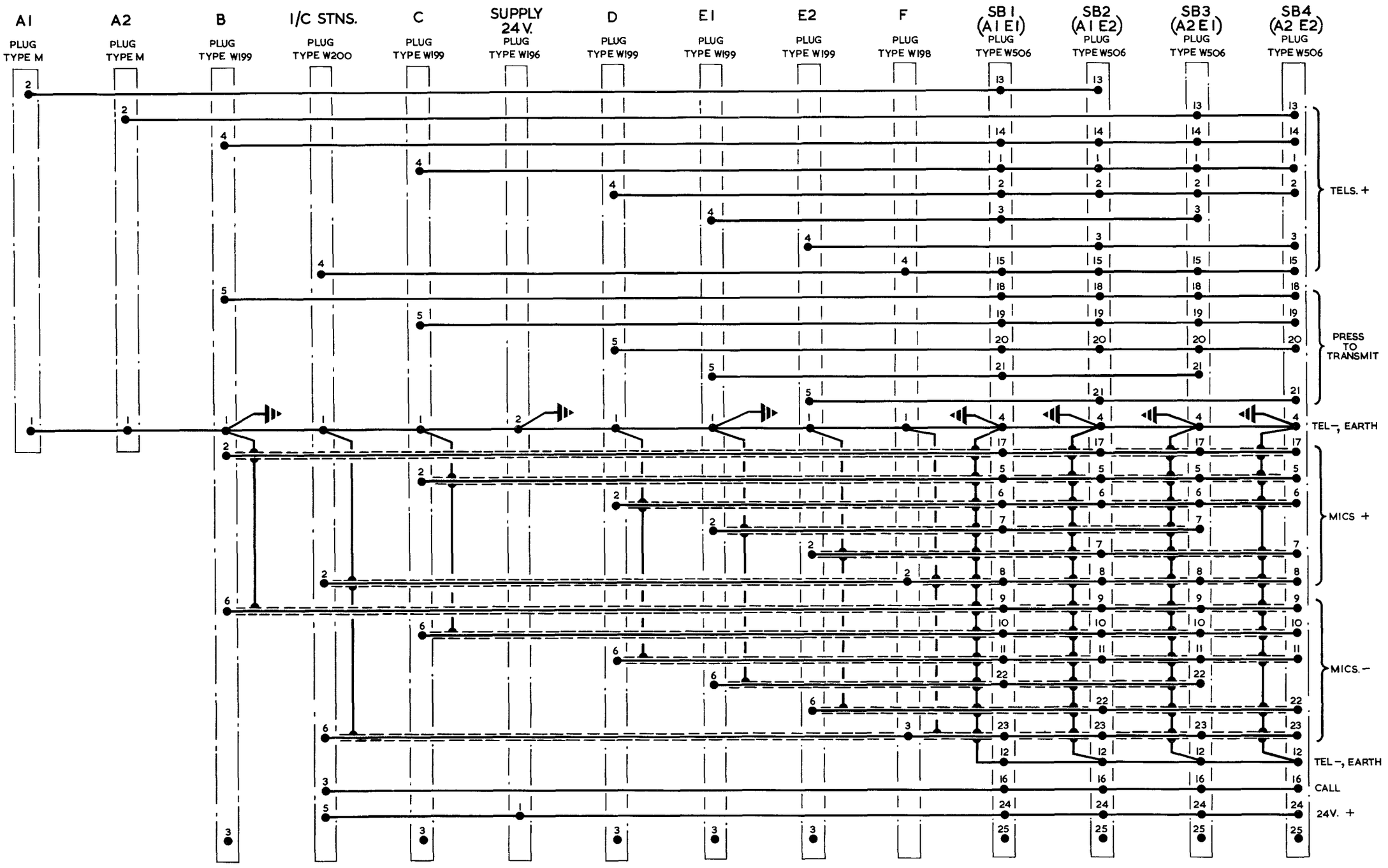


Fig.8

Junction box, Type 131 : circuit

Fig.8

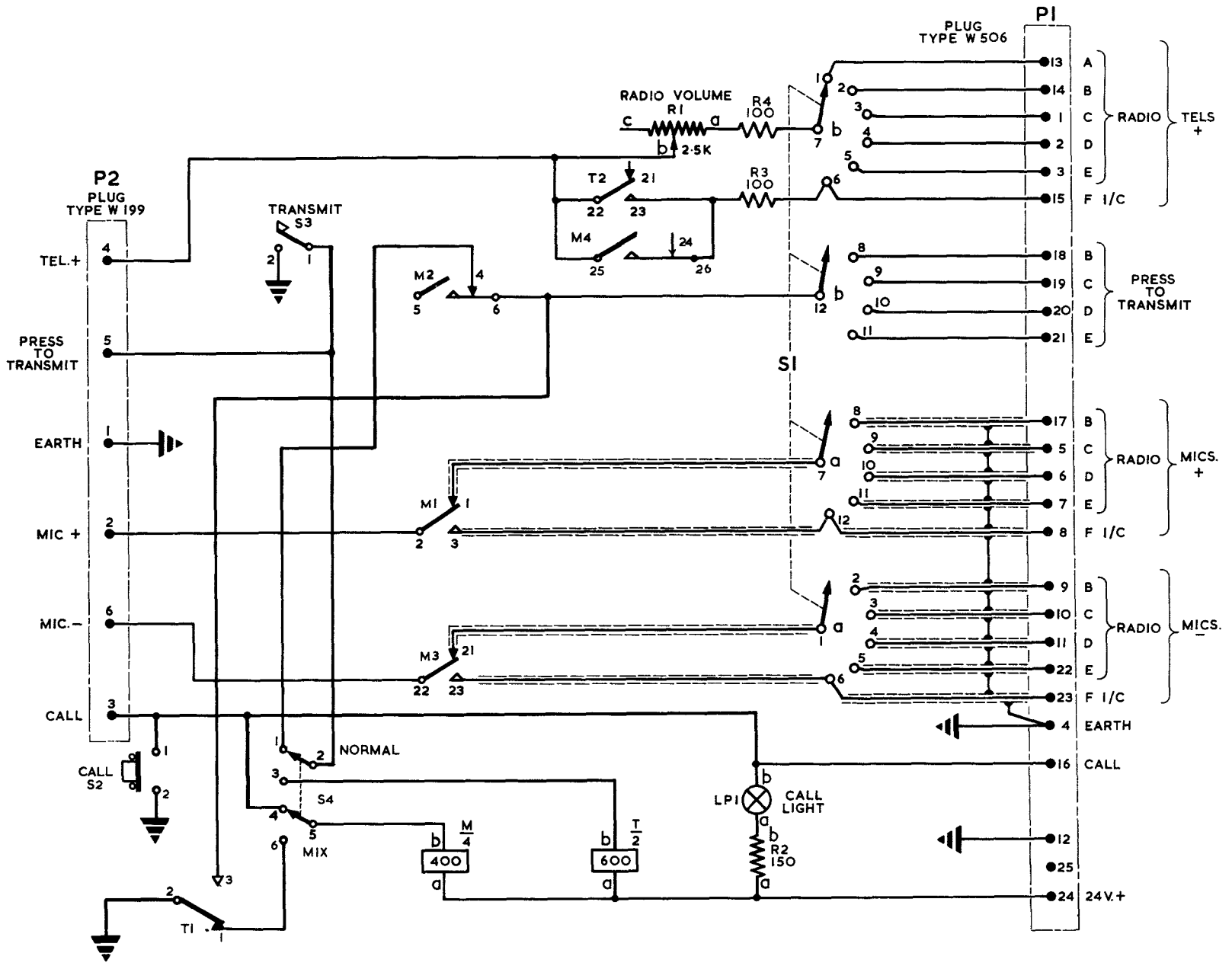


Fig.11 Control unit Type 349 : circuit Fig.11

Chapter 5

AMPLIFIER TYPE A.1961M

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2	Amplifier opened for servicing	4
3	Amplifier Type A.1961M: top chassis	5
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5	Amplifier Type A.1961M: circuit	9

LEADING PARTICULARS

Ref. No.	5821-99-223-7295.
Power supply	24V (from aircraft battery). Consumption approximately 8W.
Mic. input	For an input of 10 mV from a 200 ohm source maximum output can be obtained.
Rec. 1 and 2 input ...	For an input of 2.75V from a 200 ohm source maximum output can be obtained.
Output power	Max. greater than 1W into 15 ohm load. Normally set to 1W into 15 ohm load.
Transistors	Three CV7723 one CV8889 and one CV10541.
Associated equipment ...	Junction box Type 154 (stores ref. 10L/17805 or interconnecting box Type 154A. (NSN 5821-99-194-9024) in certain aircraft. Control unit Type 702 (stores ref. 10L/260).
Overall dimensions ...	Height 175 mm Width 120 mm Depth 145 mm
Weight	1.8 kg

Introduction

1. Amplifier Type A.1961M is the transistorized version of the a.f. amplifier Type A.1961 used in multi-seater aircrafts to provide intercommunication facilities, together with control unit Type 702 and junction box Type 154. These units are complementary to, but not interchangeable with amplifier Type A.1134A and panel Type 192, and are not a direct replacement in existing installations.

Note...

Interconnecting box Type 154A (Ref. No. 5821-99-194-9024) may be encountered in certain installations in place of the Type 154.

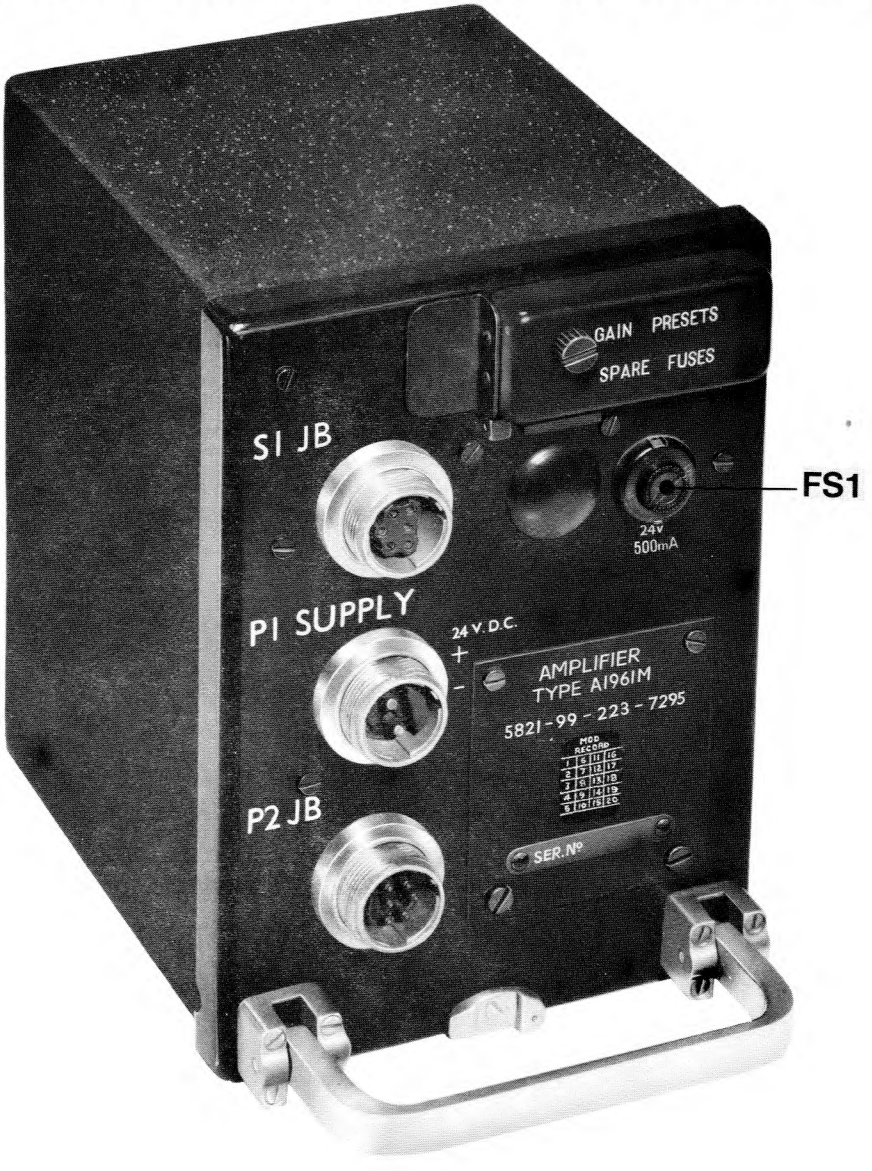


Fig.1. Amplifier Type A.1961M: front view

2. The Type A.1961M amplifier is specifically intended to work with low impedance telephones and e.m. microphones, and is basically a 3-stage amplifier with push-pull output and provision for three separate inputs. Two of these inputs are unbalanced and have independent preset controls, whilst the third is balanced for e.m. microphones. Gain and linearity controls (presets) are also provided and voltage negative feedback is applied to the intermediate stage, whilst both the first and intermediate stages are frequency compensated.

3. DC supply for the amplifying stages is derived from the aircraft 24V supply via a regulator circuit. An isolating relay is also included to minimize losses in the supply lines when the on/off switch is remotely sited. To enhance stability and reduce hum, extra smoothing is used.

DESCRIPTION

Mechanical

4. All the components used in the amplifier Type A.1961M, except the transformers, transistors VT1, VT3 and VT4, relay RLP/2 and variable resistors RV1 to RV4 are mounted on printed circuit boards. The location of these boards is shown in fig. 2 and 3 and the layout of components on each board is shown in fig.4. Preset volume controls RV1 and RV2 and the gain control RV3 are mounted at the top of the front panel under a hinged cover held by a captive screw. To obtain access to the interior, the dust cover secured only by two coin-slotted screws must be removed.

5. For ease of servicing, the chassis may be opened out as shown in fig.2 by removing two small screws YY (painted red) at the top of the rear plate. Except during repair, the chassis should not be opened out by removing the two bottom screws XX (fig.2) nor should the back plate be completely removed. When the chassis is opened out all components are accessible, but the connections remain intact, and if the external cables are connected, the amplifier will function in the normal manner.

6. Relay RLP/2, input transformer T1, coupling transformer T2, output transformer T3 and VT1 are mounted on the bottom deck of the chassis (fig.2). The input transformer T1 is that nearest the front panel. It is fitted in a screened can, and external pick-up is negligible. The primary winding is balanced to earth, and all wiring not at signal earth potential is carried out in screened cable. The fuse FS1 (500 mA) is fitted in panel mountings and is removable by the use of a coin.

Note...

> The original Relay RLP2 is obsolete and has been replaced by Type 4190 GD Relay (700 ohms) under MODIFICATION NUMBER A3117. This new relay is mounted on a bracket in approximately the same position as the original. It must be carefully noted that this new relay is NOT suitable for the valve Type A.1961 (Ref. 10U/16596).

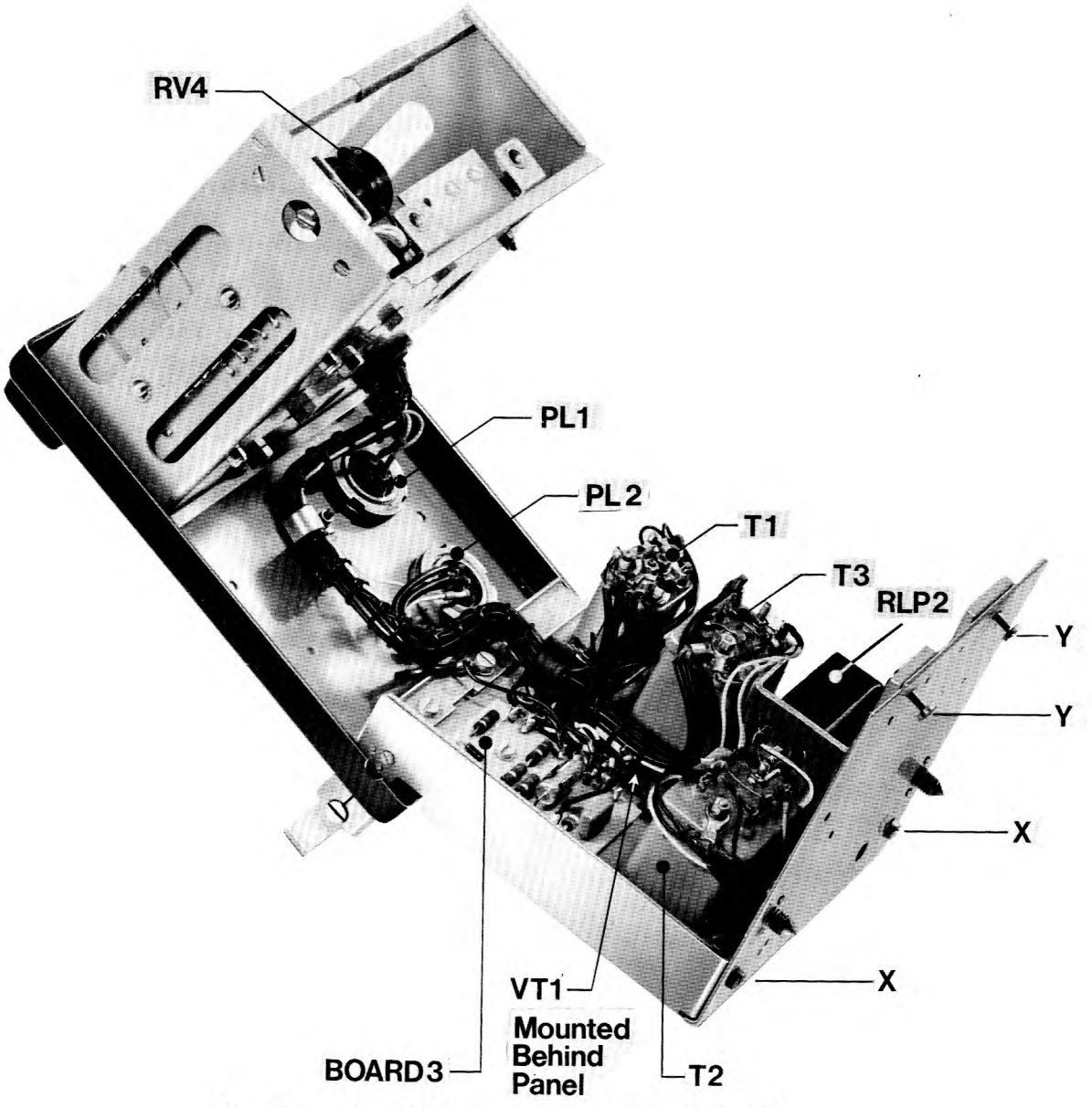


Fig.2. Amplifier opened for servicing

7. The amplifier is normally mounted in a small tray fitted with resilient mountings and held in position by a screw retaining clamp, which grips the transport handle after the latter has been folded downwards.

Amplifier circuit

8. The circuit of the amplifier is given in fig.5. Inputs REC.1 and REC.2 are identical unbalanced lines terminated by the preset controls RV1 and RV2 respectively, the sliders of which are taken to the base of transistor VT2. Resistors R2 and R3 together with that portion of the preset controls between slider and earth act as an attenuator and minimises cross-talk between inputs. When the amplifier is being set up for use these presets are adjusted such that with normal output to the telephones from the microphone inputs, a satisfactory signal from the associated receivers may be heard.

9. The microphone input via connector MIC I/P is balanced to earth by the resistors R4 and R5 which reduces the incidence of instability with the microphone disconnected. The secondary of the input transformer T1 is held at a positive d.c. potential by resistor R6 (decoupled by capacitor C1) which together with R8 and R7 determines the d.c. operating point for the base of VT2. Since the junction of R6 and C1 is at earth potential to the input signal, R7 also serves to increase the effective input impedance to the stage.

10. Mixing of the inputs from the receivers and microphone occurs at the base of VT2, which, but for the frequency compensation effected by capacitor C6, is a conventional amplifier, the output of which is fed to the intermediate stage via the preset gain control RV3. Current feedback (via R11) is also applied to VT2 and d.c. to this stage is decoupled from the main supply to enhance stability.

11. The intermediate stage VT3 provides drive via the phase-splitting transformer T2 for the push-pull output pair VT4 and VT5. The gain of this stage is restricted by negative feedback from collector to base through capacitor C9, as well as from the secondary of the output transformer to the emitter circuit. Hence the overall gain of the amplifier is controlled by the setting of the preset control RV3. This control is normally set to give 1W output into a load of 15 ohms across the telephone terminals, for a microphone input of 10 mV.

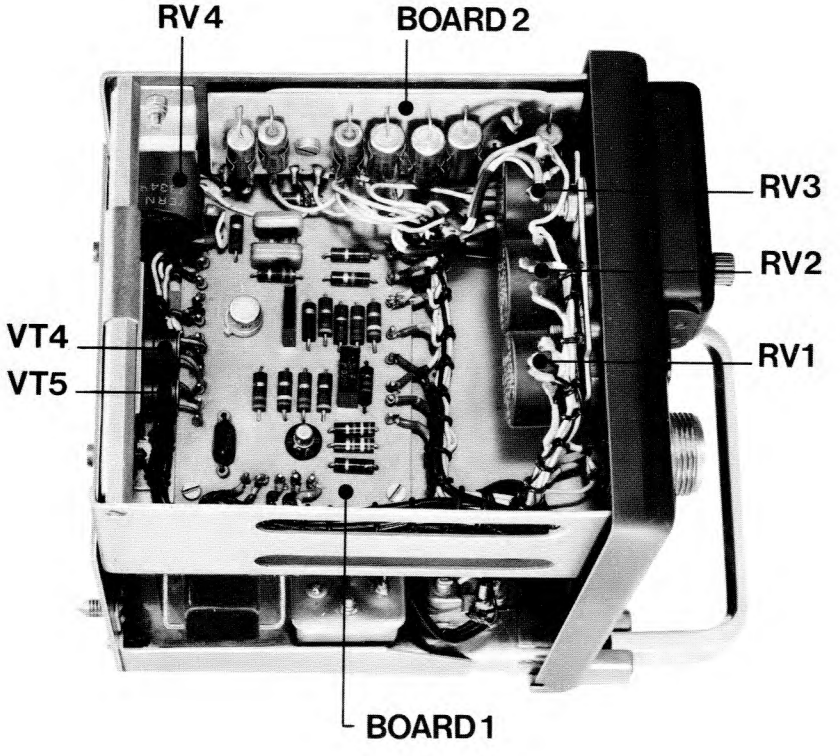


Fig.3. Amplifier Type A.1961M: top chassis

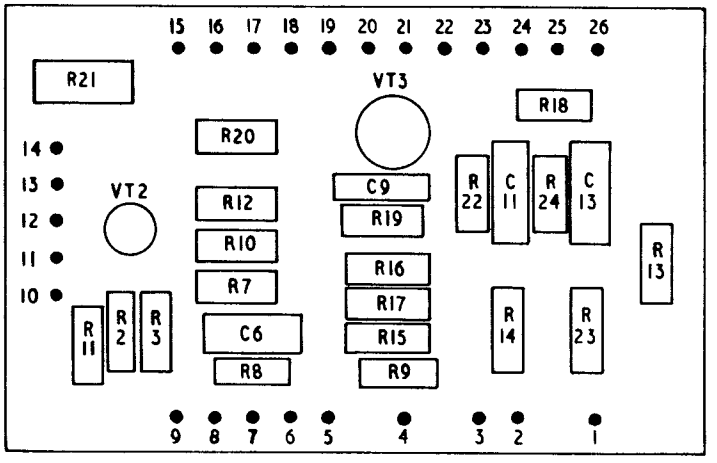
12. Transistors VT4 and VT5, together with the associated transformers constitute a conventional push-pull stage, with the preset RV4 acting as a bias control. Selective negative feedback from the secondary of the output transformer T3 to the base of VT3 improves the overall frequency response.

13. The amplifier is normally preset for an optimum output by the manufacturers before issue (para 11) and the gain control should not require further adjustment. When used with a standard e.m. microphone, however, the unit will deliver 1W into ten pairs of telephones with RV3 at maximum, and due to the substantial amount of negative feedback employed a varying load of from two to twenty pairs of telephones can be driven without excessive distortion. The frequency response is substantially flat between 300 Hz and 5 kHz, but is sharply attenuated outside these limits.

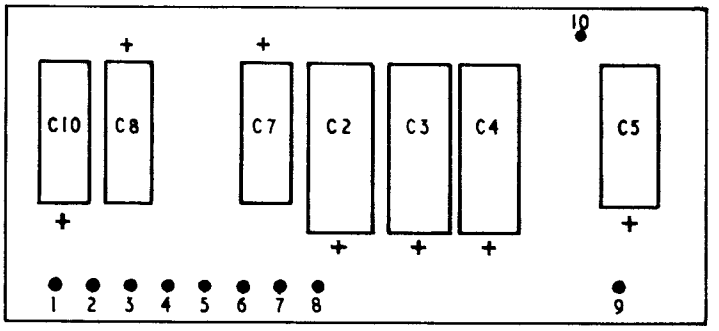
Power supply

14. DC supply to the amplifier is obtained from the aircraft 24V supply via the regulating circuit consisting of the zener diode MR1, resistor R1 and transistor VT1. When the ON/OFF switch on the control unit Type 702 is made, relay RLP/2 operates and the 24V is applied across the diode and R1. The diode clamps the base of VT1 to +15V with a resultant +14.5V at the emitter.

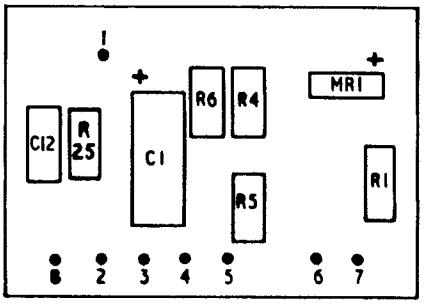
15. No extra smoothing is required for the final and intermediate stages, but the supply to the input stage VT2 is decoupled by resistor R9 and the capacitors C2-C4, to minimize the possibility of feedback. The supply available at the junction of R9 and R10 is approximately +13.5V.



(a) Board 1



(b) Board 2

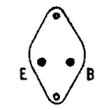
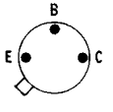
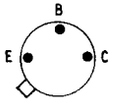


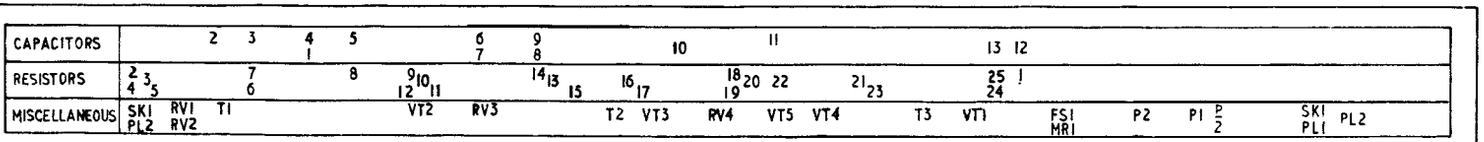
(c) Board 3

Fig.4. Printed circuit board layouts

CAPACITORS 5910-99-					
C1	56 ±10% 15V	013-0388	C10	56 ±10% 15V	013-0388
C2	150 ±20% 15V	013-0495	C11	0·1 ± 5% 100V	223 4847
C3	150 ±20% 15V	013-0495	C12	0·1 ± 5% 100V	223-4847
C4	150 ±20% 15V	013-0495	C13	·047 ±5% 100V	223-4850
C5	100 ±20% 10V	013-0490			
C6	5000pF±1%125V	519-8529			
C7	56 ±10% 15V	013-0388			
C8	56 ±10% 15V	013-0388			
C9	560±10%500V	932-5894			

RESISTORS 5905-99-					
R1	1k ±10% ¼W	022-2004	R18	820 ±10% ¼W	022-1226
R2	39k ±10% ¼W	022-2205	R19	15 ±10% ¼W	022-1010
R3	39k ±10% ¼W	022-2205	R20	3·3k ±10% ¼W	022-2067
R4	270 ±10% ¼W	022-1163	R21	3·3 ± 5% 2½W	014-0501
R5	270 ±10% ¼W	022-1163	R22	330 ±10% ¼W	022-1172
R6	2·7k ±10% ¼W	022-2058	R23	68 ±10% ¼W	022-1088
R7	470 ±10% ¼W	022-1193	R24	330 ±10% ¼W	022-1172
R8	18k ±10% ¼W	022-2163	R25	27 ±10% ¼W	022-1037
R9	390 ±10% ¼W	022-1184			
R10	3·3K ±10% ¼W	022-2067			
R11	10 ±10% ¼W	022-1001			
R12	390 ±10% ¼W	022-1184	RV1	250 ±10% ½W	011-9487
R13	2·2k ±10% ¼W	022-2046	RV2	250 ±10% ½W	011-9487
R14	10k ±10% ¼W	022-2130	RV3	5k ±10% ½W	011-9491
R15	8·2k ±10% ¼W	022-2121	RV4	30 ±10% ½W	223-4882
R16	470 ±10% ¼W	022-1193			
R17	68 ±10% ¼W	022-1088			

VT1	VT2	VT3, 4 AND 5
		
CV8889	CV10541	CV7723



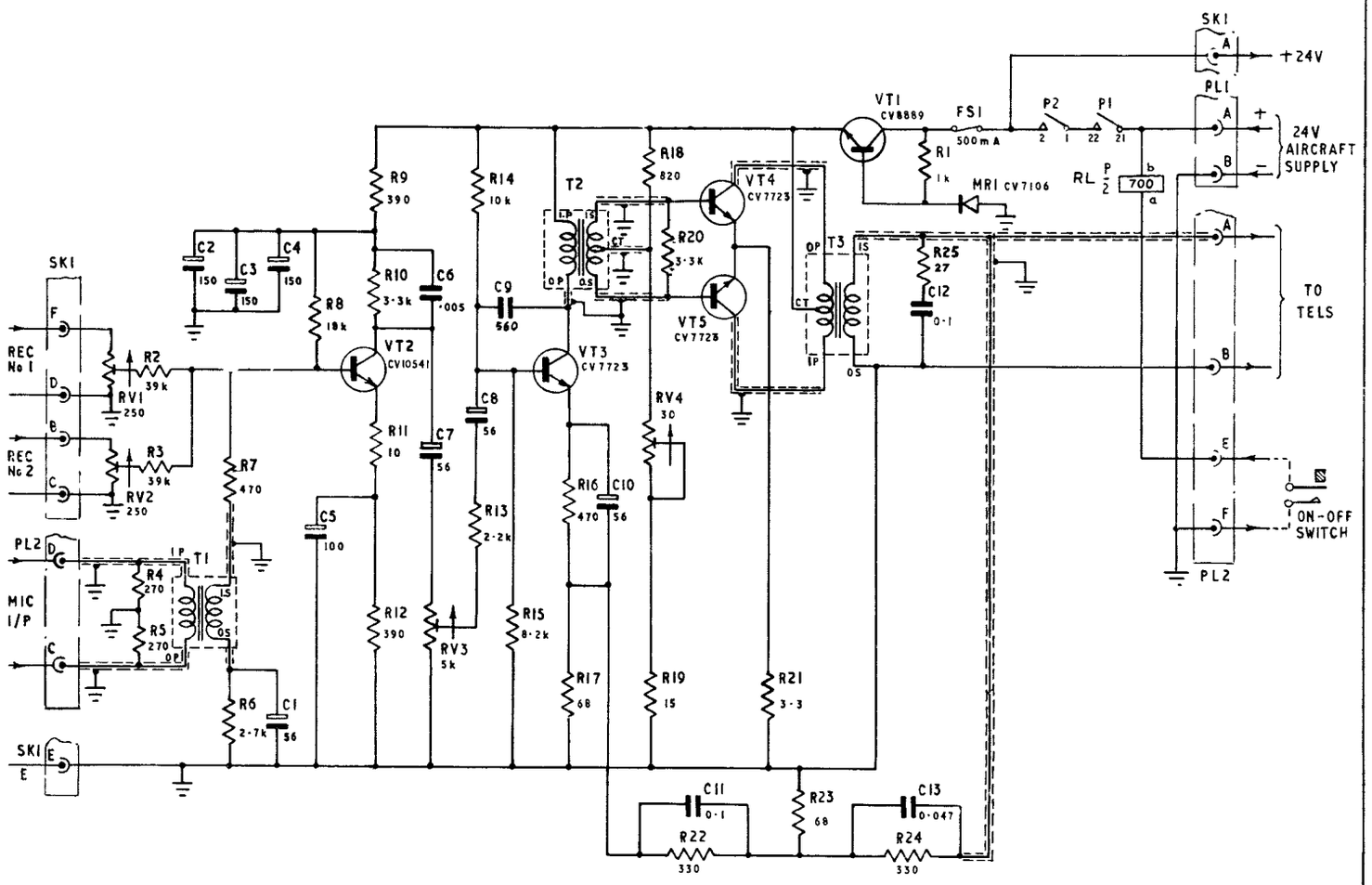


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Fig. 5 Amplifier type A.1961M: circuit Fig. 5