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SECTION 4, CHAPTER 1

INTER-COMMUNICATION AMPLIFIERS, TYPES B AND C

Contents

List of Illustrations

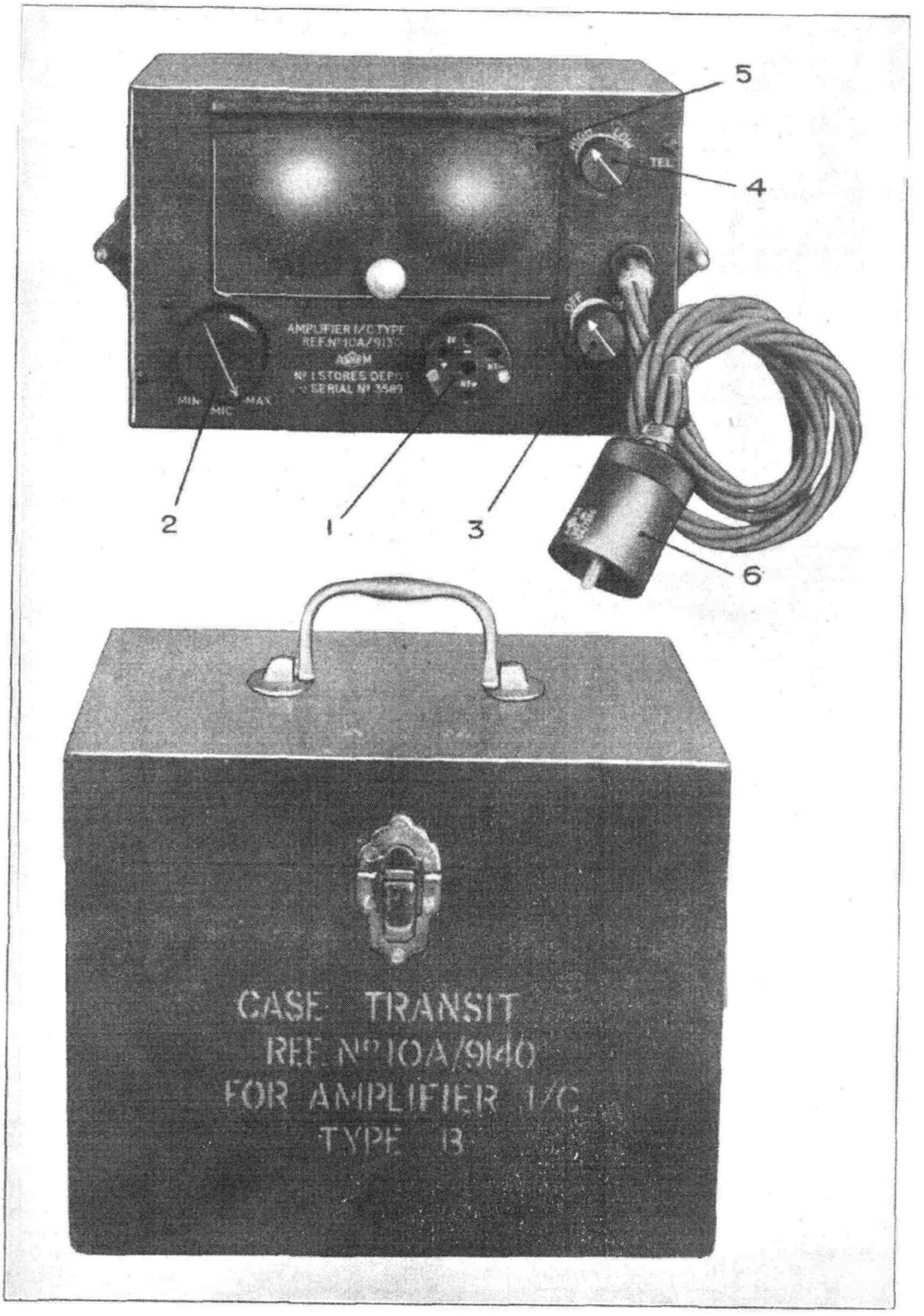
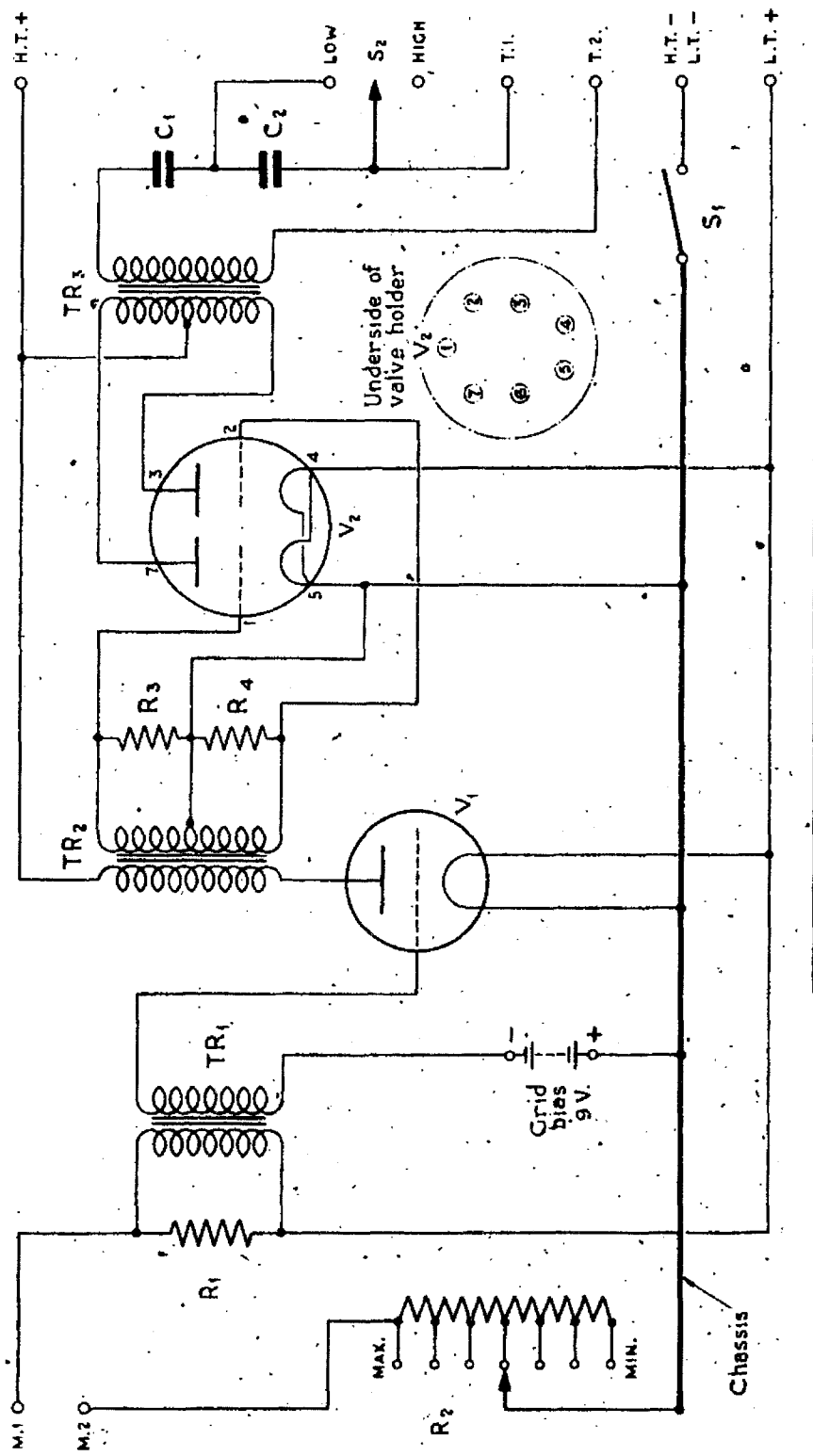


FIG. 1. Amplifier 1/C, type B, with transit case.



Resistances (Ω)		Condensers (μF)	
R_1	200	C_1	·001
R_2	1,790	C_2	·001
R_3	50,000		
R_4	50,000		

FIG. 2. AMPLIFIER I/C TYPE B — THEORETICAL CIRCUIT DIAGRAM.

Facing fig. 1

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INTER-COMMUNICATION AMPLIFIERS

TYPE B

(Stores Ref. 10A/9130)

and

TYPE C

(Stores Ref. 10A/11268)

INTRODUCTION

1. The inter-communication amplifiers, types B and C, are employed in order to facilitate telephonic communication between members of the crew of multi-seater aeroplanes. They are suitable for use only with carbon microphones; where electro-magnetic microphones are fitted, a suitable amplifier, e.g. type A1134, must be installed. The two amplifiers are similar in design except for the output transformer. In the type B amplifier, this transformer is designed to match a load consisting of seven pairs of telephones in series, to the impedance of the output valve. The type C instrument is intended to work into a load consisting of from three to seven pairs of telephones in parallel.

2. The dimensions of the amplifier are 7 in. by 4½ in. by 6 in., and its weight, including valves, is approximately 3½ lb. The total weight of the I/C installation, including crates and batteries, is about 28 lb. Fig. 1 shows an amplifier, type B, together with its transit case.

GENERAL DESCRIPTION

3. A theoretical circuit diagram is given in fig. 2. The amplifier is seen to consist Class B output stage and a driver stage. The microphones, which are connected in par at the input terminals M_1 M_2, are energized from the L.T. supply of the I/C amplifier, a vari resistance R_2 being connected in series to act as a volume control. A 200-ohm resistance l connected across the primary winding of the input transformer TR_1, in order to suppress tendency to self-oscillation, and also to reduce distortion due to the frequency-resp characteristic of the amplifier. The driver valve V_1 is a triode, and its grid is negatively biased (—9 volts). It operates as a class A power amplifier.

4. The anode load impedance of the driver valve consists of the transformer TR_2. The primary winding is included in the anode circuit while the centre-tapped secondary winding supplies grid excitation to the Class B amplifier valve, V_2, which consists of two complete triode assemblies in a single glass envelope.

5. The centre point of the secondary winding of the transformer TR_2 is connected directly to the negative side of the filament, no grid bias being employed. The resistances R_3, R_4, which are connected across the respective halves of the secondary winding, serve more than one purpose. In the first place, their presence ensures the suppression of parasitic oscillation, to which the circuit would otherwise be subject, owing to the normally inductive nature of the input and output loads. Secondly, they maintain a nearly constant load upon the secondary winding of the transformer TR_2. If these resistances were absent, the load would vary with the amplitude and frequency of the signal to be amplified, giving rise to considerable distortion.

6. The output impedance of the Class B valve consists of the transformer TR_3, the primary winding of which is centre-tapped for anode feed purposes. The secondary winding is connected to the telephone terminals T_1, T_2, through a capacitance consisting either of two condensers C_1, C_2,

in series, or the condenser C_1 alone. The condenser C_2 may be short-circuited at will by means of the switch S_2. This switch is engraved TEL and has two positions HIGH and LOW, with reference to the comparative pitch of voice frequencies. The LOW position may be found to give better quality in the absence of noise, but the HIGH position should give a greater ratio of signal to noise, and the overall intelligibility in this position may be superior.

CONSTRUCTIONAL DETAILS

7. The amplifier is built up on an aluminium chassis consisting of a front panel carrying a U-shaped shelf. It is fitted in a mahogany box which is covered with fabric and painted in standard grey colour. Four suspension spigots are provided for holding it in the amplifier crate. Fig. 1 shows the general appearance, and also the transit case. On the front of the panel are the battery socket (1), the volume control (2), the battery switch (3) and the tone control (4). The valves are inserted in the appropriate sockets through the door (5). When the amplifier is installed in an aeroplane this door should be closed and secured by means of the knurled screw. Connection to the permanent microphone-telephone circuits of the aeroplane is made by means of the four-pin plug (6).

8. Fig. 3 shows the wooden box (1) which houses the grid bias battery. The cells are maintained in a position by a wooden cover, not shown in the illustration. The battery consists of three dry cells (Stores Ref. 5A/1548) which are connected in series by soldering the terminal lugs. The external leads are also soldered to the end connectors. In renewing this battery it is

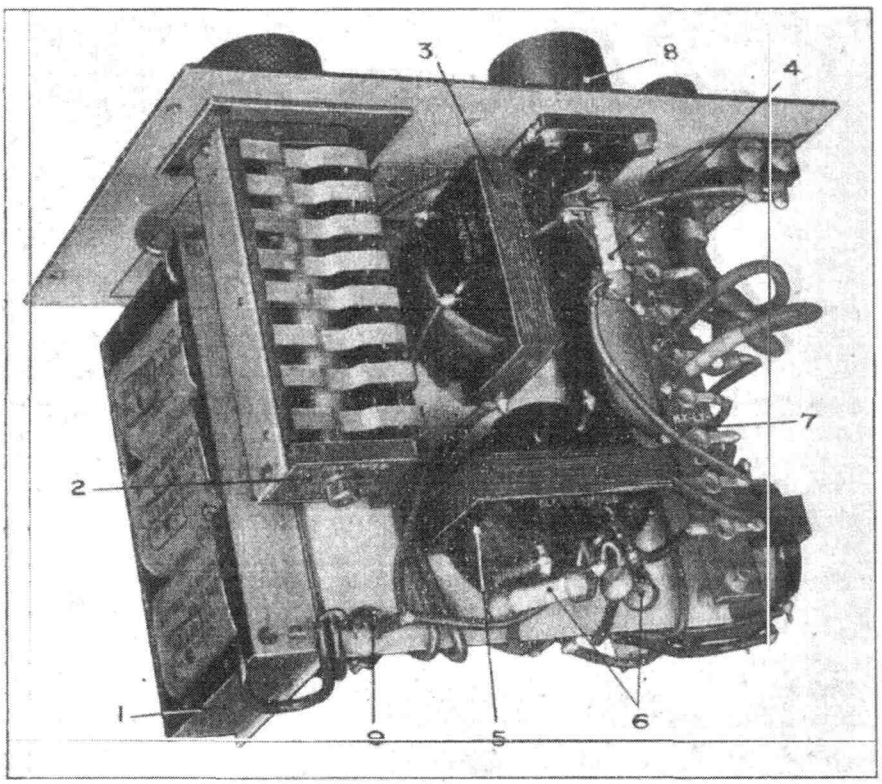


FIG. 3. Chassis, rear view

most important to perform the requisite soldering operations as rapidly as possible, and with the minimum heat consistent with efficient joints. It is therefore necessary to take particular care in cleaning the connections before soldering.

9. The volume control rheostat (2) consists of a resistance having a maximum value of 1,790 ohms. Eight tappings are provided, the resistance in series with the microphone on the respective tappings being 0, 20, 80, 210, 440, 760, 1,190, 1,790 ohms. The microphone transformer (3) is mounted on the underside of the shelf, a ½-watt rod type resistance (4) of 200 ohms being connected directly across the primary terminals. Below the microphone transformer is the inter-valve or driving transformer (5). Resistances (6) of the ½-watt rod type, 50,000 ohms each, are connected directly across each half of the centre-tapped secondary winding. To the right of the transformers is the terminal strip (7) to which are taken the battery leads from the socket (8) and the microphone-telephone leads from the external circuits. The "filament-negative" line is earthed to the chassis at (9).

10. Fig. 4 shows the 4-pin socket (1) for the driver valve, the 7-pin socket (2) for the output valve, and the output transformer (3). Adjacent to the latter are mounted the two tone control condensers (4). The tone control switch (5) and battery switch (6) are also shown in this illustration.

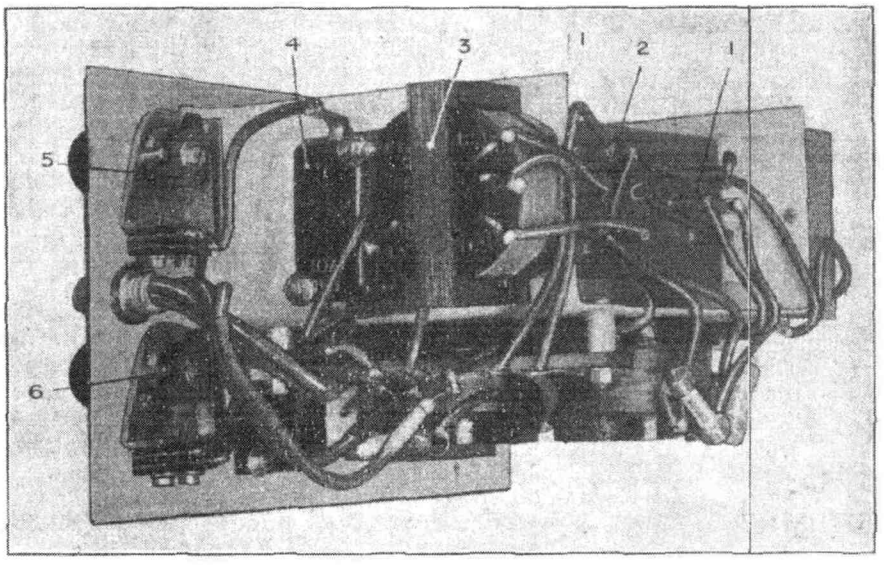


FIG. 4. Chassis, side view.

11. The photographs (figs. 3 and 4) actually show the details of the amplifier, type B. In this instrument, the output transformer is a transformer L/F, type G (Stores Ref. 10A/9139). In the amplifier, type C, the output transformer is a transformer L/F, type F (Stores Ref. 10A/9138) and is identical with the driving transformer. In the amplifier, type B, each tone control condenser has a capacitance of 0·001 μF (condenser type 260, Stores Ref. 10A/9133), while in the amplifier, type C, condensers, type 324, 0·05 μF (Stores Ref. 10A/9629) are fitted. Fig. 5 is a bench wiring diagram of the type B amplifier, and is also applicable to the type C amplifier, subject to the above modifications.

VALVES AND BATTERIES

12. The driver valve is a V.R.19 (Stores Ref. 10A/7846) and the Class B valve a V.R.32 (Stores Ref. 10A/9141). A 2-volt 20 Ah. accumulator (Stores Ref. 5A/1387) is used for L.T.

supply and a 120-volt dry battery (Stores Ref. 5A/1333 or 5A/1615) for H.T. supply. The grid-bias supply consists of three 3-volt dry batteries (Stores Ref. 5A/1548) connected in series, and fitted inside the amplifier. The other supply batteries are fitted in a special crate.

INSTALLATION

Amplifier I/C, type C

13. Certain types of aircraft R/T apparatus, e.g. the T.1083-R.1082 installation, are adapted for inter-communication by employing the microphone circuit of the transmitter and the A/F stages of the receiver as an I/C amplifier. This arrangement is primarily intended for use only in two-seater aeroplanes, but it may also be installed in three-seater aeroplanes, if one of the three positions is rarely manned. When inter-communication is required between all three positions, an I/C amplifier, type C, may be installed. This equipment is particularly adapted for use with the microphone-telephone circuit wiring, as fitted for transmitter-receiver inter-communication in the installation referred to above.

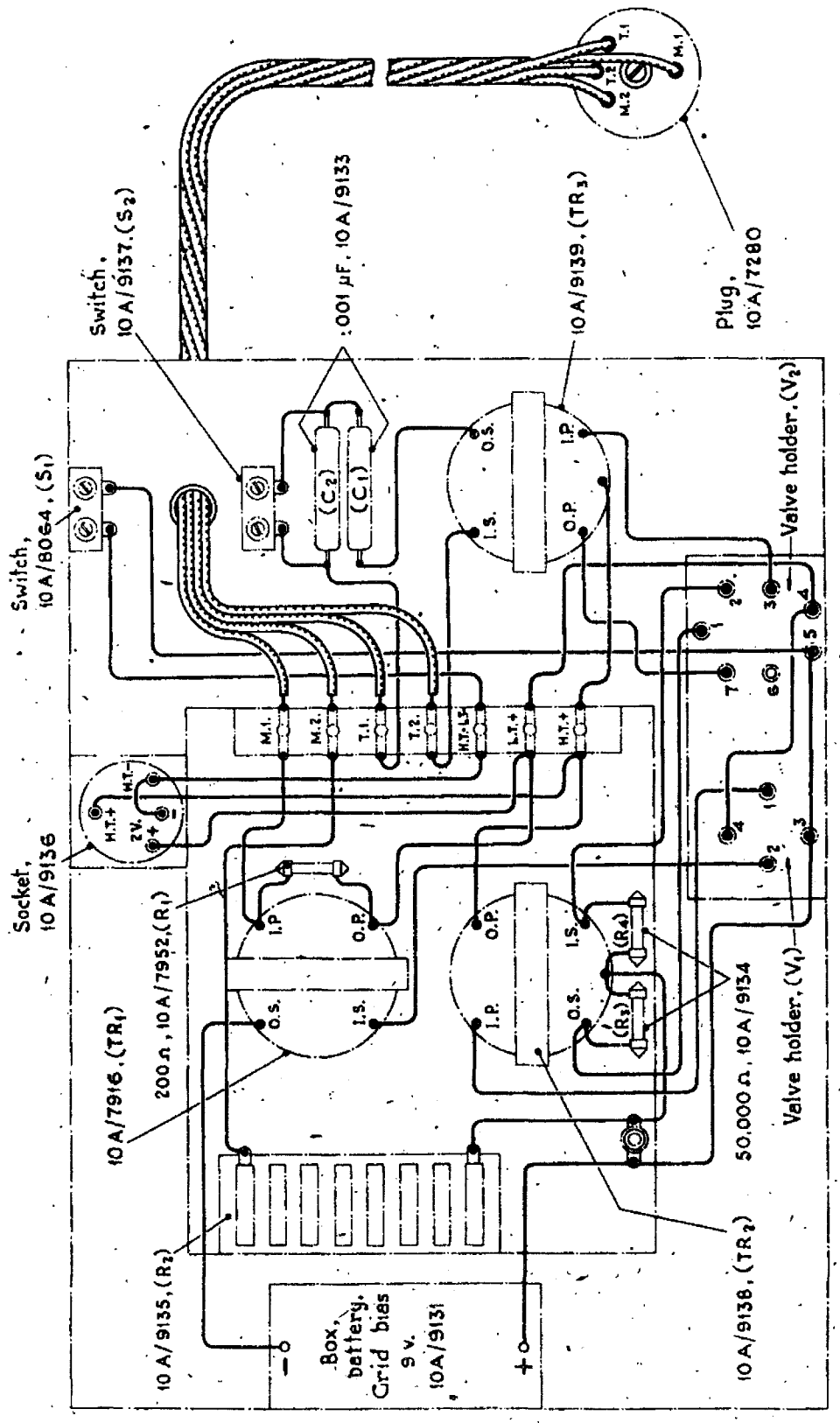
14. A typical installation diagram is given in fig. 6. The I/C amplifier is mounted by means of rubber slings in a special crate, the L.T. and H.T. batteries being fitted in a second crate as close as possible to the amplifier crate. The batteries are connected to the I/C amplifier by suitable plugs and sockets as shown. The requirements of the installation are as follows. The radio operator's microphone and telephones are normally connected to the radio transmitter and receiver respectively, while the microphones and telephones of the other members of the crew are connected to the input and output terminals respectively of the I/C amplifier. Arrangements must be made for the radio operator to transfer his equipment to the I/C circuits as necessary. The other members must therefore be able to inform him that he is required to transfer to this circuit. In addition, provision must be made for other members of the crew to use the R/T installation when necessary.

15. In the installation shown in fig. 6, these requirements are met in the following manner. The " telephone " and " microphone " connections of the I/C amplifier, type C, are brought to a combined micro-telephone socket, type 29, which carries a distinguishing label engraved I/C. Similarly, the input terminals of the transmitter microphone circuit, and the output terminals of the radio receiver, are brought to a similar socket carrying a distinguishing label engraved W/T. These sockets are additional to the three sockets, type 29, appropriate to the three I/C positions, e.g. " pilot ", " bomb aimer ", " radio operator ", which are connected to the microphone and telephone lines by means of terminal blocks, type B.

16. The microphone (+ and —) and telephone (+ and —) lines are connected to a combined micro-telephone plug, type 58, referred to in fig. 6 as the I/C line plug. If this plug is inserted in the " I/C " socket, the I/C lines are connected to the I/C amplifier. If the radio operator inserts his micro-telephone plug, type 58, into the " W/T " socket, he is able to transmit and receive on radio, while the other occupants are connected to the I/C amplifier only. In order to transfer to the I/C system, the radio operator shifts his micro-telephone plug into the " operator's I/C " socket. He is then entirely isolated from the radio installation.

17. Should the pilot or bomb-aimer require to use the R/T installation, the I/C line plug must be transferred to the " W/T " socket, the radio operator's micro-telephone plug being inserted into the " operator's I/C " socket. The R/T installation may then be used by any occupant, the send-receive switch, receiver volume control, etc., being operated by either remote or local control, according to circumstances.

18. The required manipulation of plugs and sockets is performed by the radio operator; the " I/C ", " W/T ", and " Operator's I/C " sockets must be grouped and mounted in a convenient position for this purpose.



Note :- Annotations shown thus (S1) refer to the corresponding annotations in Fig. 2.

FIG. 5. AMPLIFIER I/C TYPE B — BENCH WIRING DIAGRAM.

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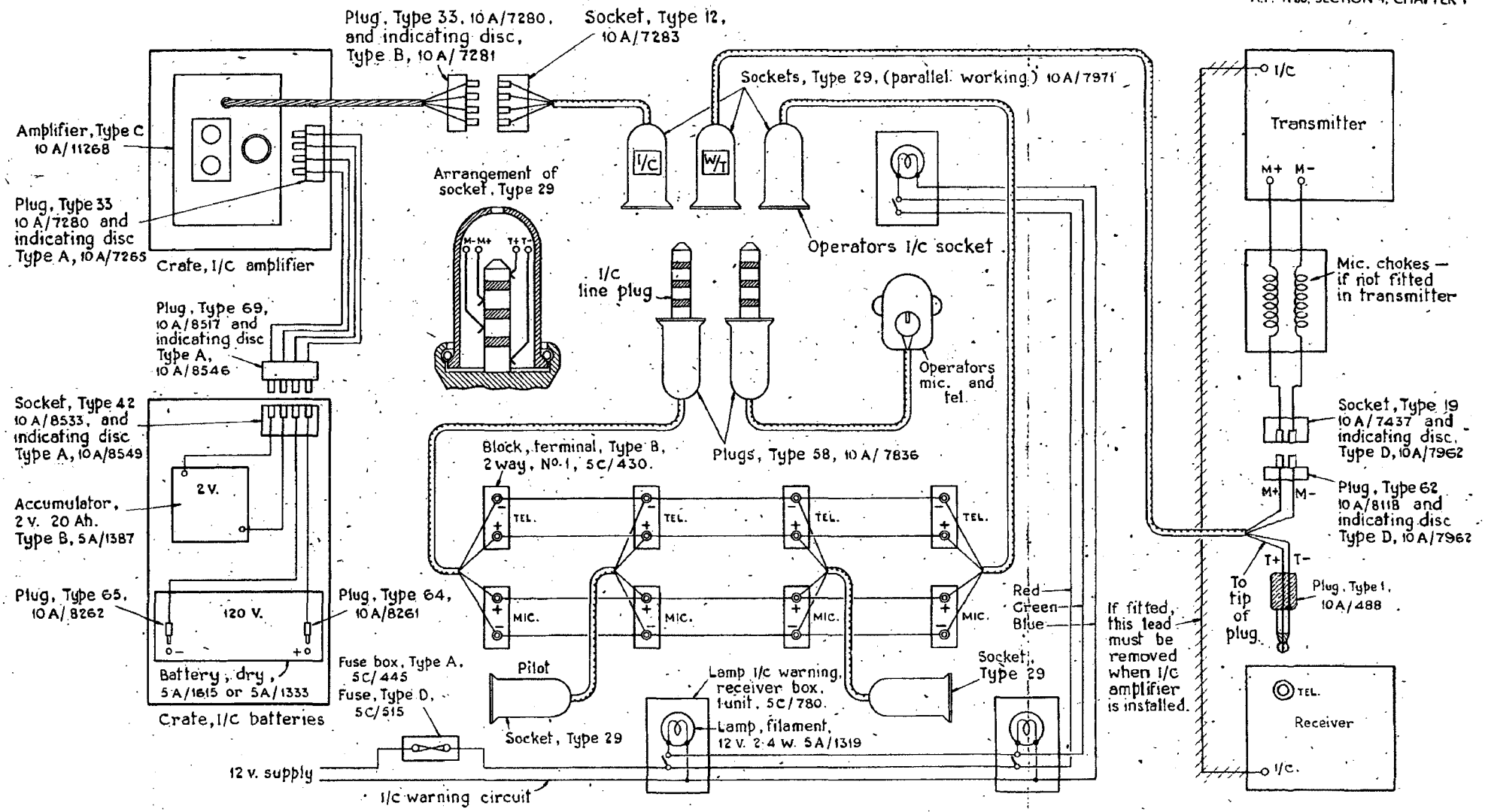

FIG. 6. TYPICAL INSTALLATION DIAGRAM (I/C AMPLIFIER TYPE C)

Following fig. 5

19. In order to attract the attention of members of the crew before using the I/C system, and in particular that of the radio operator (who may be connected only to " radio ") a system of warning lamps is fitted. This consists of a lamp and push switch at each I/C position. These are fed from the 12-volt general service accumulator through a fuse, type D, mounted in a fuse box, type A. The wiring is so arranged that the operation of any switch causes all three lamps to light.

20. When this system of I/C is installed to replace the transmitter-receiver I/C system, the following points require attention. Unless already mounted in the particular type of transmitter, special microphone chokes will be provided, e.g. in the case of transmitter T.1083, the choke unit, H.T. key and mic (Stores Ref. 10A/8464). Care must be taken that the " Tel + " terminals of all sockets, type 29, are connected to the positive terminals of the telephone terminal stocks, and the latter to the tip of the telephone plug, type 1. The lead connecting the I/C terminals of the transmitter and receiver must be removed before fitting the " operator's I/C " socket.

Amplifier I/C, type B

21. The I/C amplifier, type B, is used to provide inter-communication in multi-seater aircraft. As many as nine I/C points may be wired up, but not more than seven of these, including that of the radio operator, will be in use during any one flight. Each I/C point is fitted with a telephone terminal block, a microphone terminal block, and a combined micro-telephone socket, type 28. This socket is externally similar to the socket, type 29, but the telephone contacts are arranged for connecting telephones in series, i.e., unless a plug, type 58, is actually fitted in the socket, the telephone contacts are short-circuited.

22. In addition to the I/C amplifier, the I/C system incorporates a control switch, by means of which the radio operator exercises a certain degree of control over the microphones and telephone receivers which are connected to the radio installation and the I/C system. The

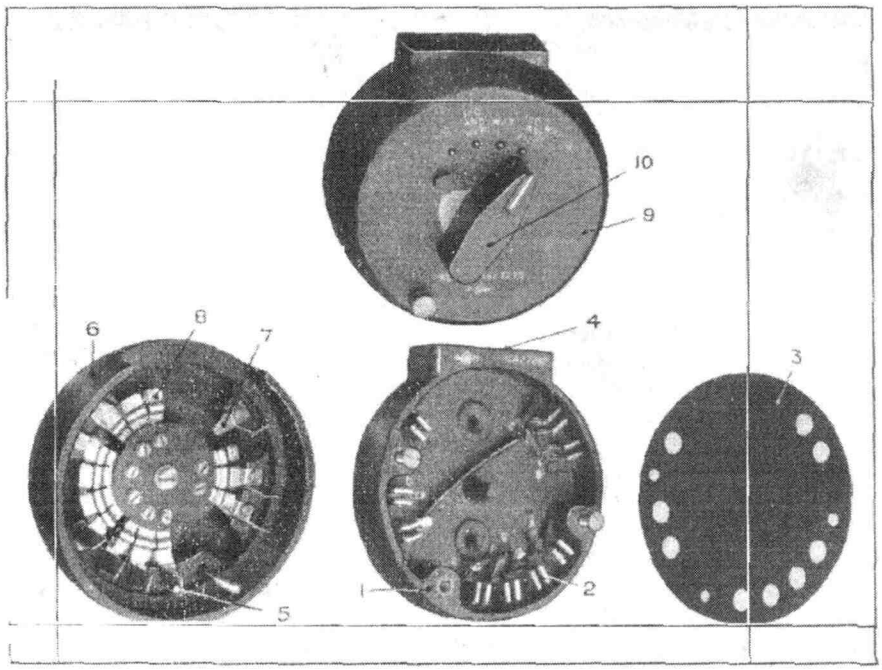

FIG. 7. Switch I/C, type 25.

switch, type 25 (I/C control) is used for this purpose. The general appearance and construction of this switch, and the base upon which it is mounted, is seen in fig. 7. The base is the centre one (1) of the three lower units. It is secured in a position convenient to the radio operator by countersunk screws. The base is fitted with nine female spring contacts (2) carrying soldering tags; these are lettered A to G, C. and G being duplicated. An ebonite cover plate (3) is fitted over the base and secured thereto by countersunk screws shown in the photograph. The wiring is taken through the rectangular duct (4). The cover plate is pierced in order that the male contacts (5) of the switch (6) may engage with the spring contacts in the base.

23. The switch (6), as viewed from the rear, is shown on the left. The nine fixed contacts (only one of which (7) is clearly visible) and thirteen flat spring-jaw contacts (8) form, in effect, four separate four-point switches. A front view of the completely assembled switch (9) is seen above. The switch handle (10) has four positions respectively engraved I/C, I/C and W/T, W/T, I/C, W/T AND PILOT.

24. The four positions function in the following manner:—

I/C.—All telephone receivers are connected in series across the output winding of the I/C amplifier. The radio receiver is isolated from all telephones.

I/C and W/T.—All telephone receivers are connected in series, across the output winding of the I/C amplifier. In addition the radio operator's telephones are connected to the output valve of the radio receiver in the normal manner. Thus the radio operator receives both radio and I/C signals at (practically) full strength. The remainder of the crew obtain full strength I/C, and feeble radio signals which suffice to inform them that the radio operator may be " busy ".

W/T.—In this position, the radio operator's telephones are disconnected from the I/C circuit and connected only to the radio receiver. It will be noted that although he is unable to listen to I/C, he may still speak to any member of the crew.

I/C, W/T and Pilot.—This position is similar to I/C and W/T, except that pilot's and radio operator's telephones are connected to the W/T radio receiver, while all members of the crew are on I/C.

The manner in which these connections are obtained is shown in fig. 8.

25. A typical installation diagram, utilizing what is called the split microphone circuit, is given in fig. 9. The I/C amplifier crates and batteries are omitted as these are exactly the same as in fig. 6. In the split microphone circuit system, there are, in effect, two I/C microphone lines, one for those positions which may require to use the radio installation, and the other for those points which require I/C only. Referring to fig. 9, the input circuit to the transmitter microphone transformer is connected to a plug, type 62, via a pair of microphone chokes. The " I/C only " microphone line is connected to a second plug, type 62. The " R/T and I/C " microphone line is connected to a socket, type 19. By shifting the latter socket from one plug, type 62, to the other, the microphone in positions on the " I/C and R/T " line may be connected either to the position on the " I/C only " line, or to the R/T transmitter. This socket is under the control of the radio operator.

26. The various telephone connections which are obtained by manipulation of the switch, type 25 (I/C control), are easily traced with the aid of fig. 8. It will be observed that although both first and second pilots' positions are wired between points B and E, only one of these will normally be manned. The bomb-aimer's microphone is wired on the " I/C and R/T " line, but his telephones are wired on the " I/C only " line, since he may require to transmit, but not to receive, R/T signals. The navigator's socket may be connected either on the " R/T and I/C " line (in series with those of the pilot) or as shown in the diagram.

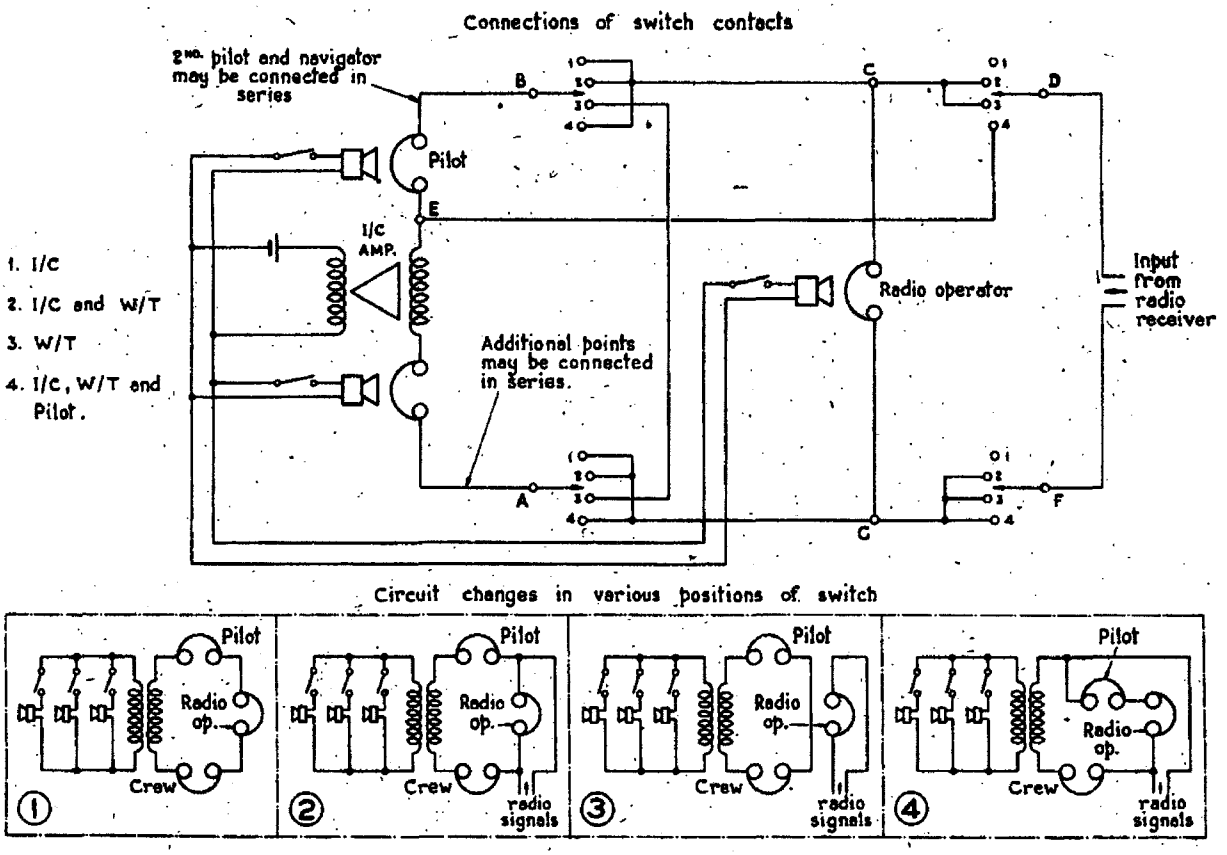

FIG. 8. ACTION OF SWITCH, TYPE 25

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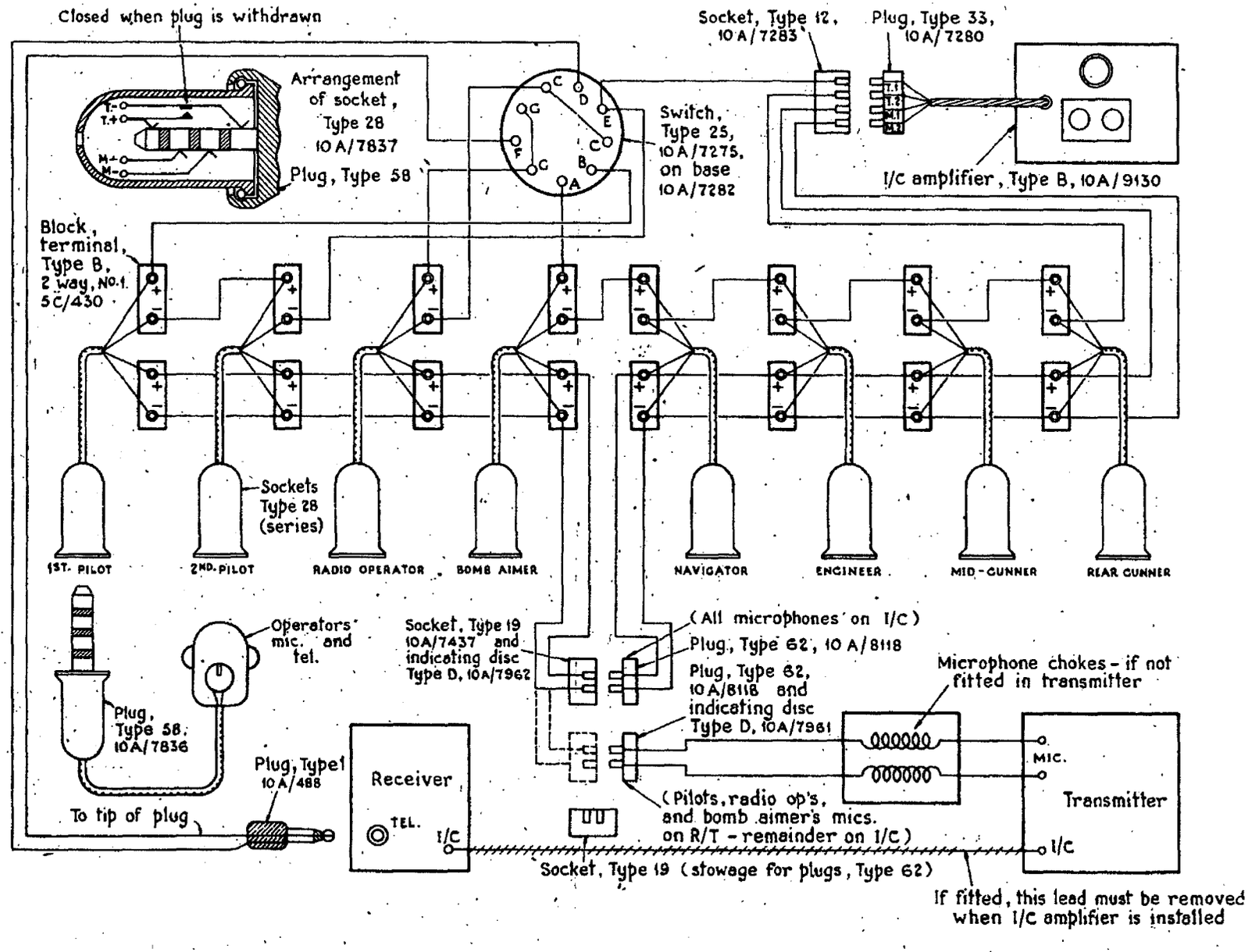

FIG. 9. TYPICAL INSTALLATION DIAGRAM (I/C AMPLIFIER TYPE B, WITH SPLIT MICROPHONE CIRCUIT)

OPERATION

27. In installations incorporating the amplifier, type C, the operator's microphone-telephone plug is normally maintained in the W/T socket and the I/C line plug is fitted in the I/C socket. The W/T operator is therefore isolated from the I/C system, but his attention may be attracted by flashing the warning lamps. A simple pre-arranged code may be arranged, e.g. in order that the W/T operator may indicate that he is handling radio traffic and therefore not able immediately to revert to I/C.

28. In the type B (split microphone circuit) installation, the switch I/C control is used in the following manner. The microphone socket type is normally mated with the " I/C only " plug, type 62, so that all microphones are in parallel. The I/C control switch is maintained in the " I/C and W/T " position, in order that the radio operator may obtain good strength radio signals, while remaining on the I/C circuit. To receive radio signals free from I/C interference he may place the I/C control switch to " W/T ", but must revert to " I/C and W/T " as soon as possible, since no I/C warning circuit is fitted for calling purposes.

29. The position " I/C, W/T and pilot " may be employed while obtaining a D/F bearing. Both operator and pilot receive full strength radio signals and are in intercommunication with each other, but isolated from the I/C circuit. The " I/C " position is rarely required, but allows I/C to be employed in the presence of strong interfering radio signals.

PRECAUTIONS AND MAINTENANCE

30. Since all microphones are connected in parallel, care must be taken that the switch fitted to each is normally maintained in the " off " position, and is switched " on " only when it is necessary to speak. If this is not done, the speech level will be low and the noise level high. Efficient working cannot be expected unless this practice is strictly adhered to.

31. The I/C amplifier must be switched on prior to any flight and continuously maintained in this position. Care must be taken to switch off before leaving the aeroplane. The L.T. battery should be recharged after each flight, and the H.T. battery should be tested at the same time. It should be replaced when the voltage, on discharge, has fallen to 100 volts.

32. The anode current may be checked by removing the plug, type 64 (H.T. +), from the H.T. battery and connecting a suitable milliammeter in series. On switching on the I/C amplifier the no-signal anode current should be of the order of 7 mA. If it differs greatly from this, the valves may be tested separately as follows. Switch off the amplifier and withdraw the triode. The no-signal anode current, i.e. that of the Class B valve alone, should be about 4 mA. A similar test on the triode alone should give a no-signal anode current of about 3 mA. The total anode current during loud speech should be of the order of 12–15 mA.

33. The valves may also be tested by means of a valve tester, type 2, if available. The adjustments of the valve tester, and the meter readings to be expected, are given in the instruction card supplied with the instrument.

34. The grid-bias voltage may be tested *in situ* as follows. Disconnect the amplifier battery plug and withdraw the triode valve. Connect a high resistance voltmeter, reading not less than 0–10 volts, between the L.T.-point on the battery socket and the grid socket of the triode valve-holder, the latter point being connected to the negative terminal of the voltmeter. Switch on the amplifier; the voltmeter should register the voltage of the grid-bias battery. If this is less than 7·5 volts a new grid-bias battery should be fitted.

APPENDIX

NOMENCLATURE OF PARTS

The following list of parts is issued for information only. In ordering spares for I/C purposes, the appropriate sections of AIR PUBLICATION 1086 should be used.

Ref. No.	Nomenclature.	Quantity.		Remarks.
		Type B.	Type C.	
10A/9130 ..	Amplifier, I/C, type B	1	—	
10A/11268 ..	Amplifier, I/C, type C	—	1	
	Principal components :—			
10A/9132 ..	Case	1	1	
10A/9138 ..	Transformer, L.F., type F	1	2	
10A/9139 ..	Transformer, L.F., type G	1	nil	
10A/7916 ..	Transformer, microphone, type G	1	1	
10A/9135 ..	Resistance, type 232	1	1	Variable, 0–1,790 ohms.
10A/9134 ..	Resistance, type 231	1	1	50,000 ohms.
10A/7952 ..	Resistance, type 99	1	1	200 ohms.
10A/9133 ..	Condenser, type 260	2	nil	0·001 μF, tone control.
10A/9629 ..	Condenser, type 234	nil	2	0·05 μF, tone control.
10A/8064 ..	Switch, type 70	1	1	
10A/9137 ..	Switch, type 94	1	1	
10A/9131 ..	Box, battery (grid-bias)	1	nil	
10A/11338 ..	Box, battery (grid-bias)	nil	1	
10A/9136 ..	Socket, type 45	1	1	
10A/7280 ..	Plug, type 33	1	1	
	Fitted with :—			
10A/7281 ..	Disc, indicating, type B	1	1	
10A/7987 ..	Spigot, instrument suspension, type B ..	4	4	
	Accessories :—			
10A/9140 ..	Case, transit, for I/C amplifier	1	1	
5A/1387 ..	Accumulator, 2-V, 20Ah	1	1	
5A/1387 or 5A/1615	Battery, dry, 120-V	1	1	
5A/1548 ..	Cells, dry, 3-V	3	3	
10A/7846 ..	Valve, VR.19	1	1	
10A/9141 ..	Valve, WR.32	1	1	