

Chapter 2

WEATHERPROOFING OF ELECTRICAL EQUIPMENT ON AIRCRAFT

LIST OF CONTENTS

	Para.		Para.
Introduction	1	Push-switch, Type B	13
Description of weatherproofing materials		Push-switch, Type C	14
Washers and similar items	2	Firing switch	15
Rubber sleeves and rubber taping	4	Dimmer switches	16
P.V.C. conduit	5	Magnetic relay switches	17
Weatherproofing caps	6	Micro switches	18
Protective insulating compound	7	General purpose switchboxes, Type B	19
Preparation of equipment for weatherproofing treatment	9	Terminal blocks, Type B	20
Application of weatherproofing materials	10	Electric horn, Type C	21
Breeze type plugs and sockets	12	2-pole sockets, B.T.H., Types E1 and E2	22
		Inertia switches	25
		Fire detectors	26
		General care of equipment	27

LIST OF ILLUSTRATIONS

	Fig.		Fig.
Push-switch, Type B	1	Micro switch	6
Push-switch, Type C	2	General purpose switchbox, Type B	7
Firing switch	3	Terminal block, Type B	8
Dimmer switch	4	Electric horn, Type C	9
Magnetic relay switch	5	2-pole socket, B.T.H., Type E1	10

Introduction

1. Corrosion resulting either from condensation or from the penetration of moisture is occasionally experienced in the electrical equipment of aircraft. Items of equipment which have been found to be most susceptible to this defect are now being improved in manufacture to obviate the trouble. In the meantime, however, it is possible to reduce the defect to a minimum on existing equipment, when specific cases arise, by approved methods of weatherproofing. The following paragraphs give details of these measures and of the materials required.

DESCRIPTION OF WEATHERPROOFING MATERIALS

Washers and similar items

2. Rubber washers or gaskets are available and should be used wherever possible on flat joints. Ordinary soft rubber is suitable for

most purposes, but where oil or gasoline is present, oil-resisting synthetic rubber or Langite should be used. If neither of these two last materials is available, it is permissible to use a rubber washer well coated with dope. The washer or gasket should be in one piece if possible; otherwise, it will be necessary to seal the joints between the various pieces. Where the use of a washer is impracticable, exposed joints should be covered with doped cotton tape or with rubber tape (Stores Ref. 5F/457, $\frac{1}{2}$ in. wide). Such a case arises with suppressors, where electrical continuity between the metal box and its lid is essential; here, cotton bands should be wrapped twice round the joint of lid and box, and sealed with dope. A suitable dope for this purpose is special fungicide varnish (Stores Ref. 33B/937), which resists gasoline. Small rubber washers, used with

brass washers, will make a weatherproof seal for the screws holding down the lids of suppressors and other metal boxes.

3. The following special weatherproof washers and gaskets are available for specific items of equipment.

Item	Equipment for which supplied	Stores Ref.
Laminated cork washer ...	Magnetic relay switches, Types J and K ...	5CW/3044
Synthetic rubber gasket ...	Magnetic relay switches, Types J and K ...	5CW/3045
Impregnated felt washer ...	2-pole sockets, B.T.H., Types E1 and E2 ...	5CY/3054

Rubber sleeves and rubber taping

4. Cables entering equipment or terminal studs running through holes in equipment often make a loose fit; this can be improved by the use of an appropriate synthetic rubber sleeve (Stores Ref. 5K/2576 to 5K/2582). These sleeves can be slipped over the cable end or terminal screw with the help of the Hellermann tool which expands the sleeve while the cable or screw

is inserted. Alternatively, to avoid dismantling the equipment, rubber tape (Stores Ref. 5F/457) may be wrapped round the cable entry, tied with thin cord, and painted over with the dope mentioned in para. 2. Slight heating will encourage the rubber taping to stick in place. The following special sleeves are available for weatherproofing specific items of electrical equipment.

Item	Equipment for which required	Stores Ref.
Terminal lug cover, No. 4 ...	2-pole socket, B.T.H., Types E1 and E2 ...	5CZ/3057
Weatherproofing sleeve, No. 1 ...	Push-switch, Type C ...	5CW/3041
Weatherproofing sleeve, No. 1 ...	Firing switch ...	5CW/3041

P.V.C. conduit

5. Cables, particularly "met" covered cables, which are exposed to weathering or splashing, should be protected by P.V.C. conduit. P.V.C.

sleeves may also be used for weatherproofing cable entries or for covering unavoidable cable jointing. The following sizes of P.V.C. conduit are held in service for replacement:—

Item	Stores Ref.
P.V.C. conduit—internal diameter 0.25 in. ...	5F/2143
0.375 in. ...	5F/2034
0.5 in. ...	5F/2035
0.625 in. ...	5F/2036
0.75 in. ...	5F/2037
0.875 in. ...	5F/2047
1 in. ...	5F/2038
1.25 in. ...	5F/2039
1.5 in. ...	5F/2040

Weatherproofing caps

6. Rubber weatherproofing caps have been

designed for specific items of equipment and are available as follows:—

Item	Equipment for which required	Stores Ref.
Weatherproofing cap, No. 1 ...	Push-switch, Type B ...	5CW/2908
Weatherproofing cap, No. 2 ...	Push-switch, Type C ...	5CW/3040
Weatherproofing cap, No. 2 ...	Firing switch ...	5CW/3040
Weatherproofing cap, No. 3 ...	2-pole sockets, B.T.H., Types E1 and E2 ...	5CY/3055

RESTRICTED

Protective insulating compound

7. Some types of electrical equipment cannot be weatherproofed by the use of rubber washers, sleeves, or taping alone, and in these cases a Protective Insulating Compound (P.I.C.) is recommended. Two types of such compounds are available; each has its specific use, and they are not interchangeable.

8. The types available are:—

- (1) P.I.C. No. 1 (Stores Ref. 33C/810 in $\frac{1}{2}$ lb. tubes with extruding nozzle and ejector key, and 33C/811 in 1 lb. tins). This is rather like dark yellow Lanoline in appearance; it should be used for lightly smearing switches and other pieces of equipment where easy movement or disconnection of the parts is essential.
- (2) P.I.C. No. 2 (Stores Ref. 33C/887) is a plasticine-like substance, and is used for sealing terminals in electrical equipment which is not normally required to be opened in use, such as switchboxes, terminal boxes, terminal joints in push-button and dimmer switches, and cable entries into all types of equipment.

PREPARATION OF EQUIPMENT FOR WEATHERPROOFING TREATMENT

9. Before work is started on the weatherproofing of any equipment, the battery must be disconnected at both poles on a two-wire system, and at the live pole on an earth return system. No engine-driven generator must be running. The equipment itself must be thoroughly dry before it is treated; this is best ensured by drying it in an oven at a temperature of 50 deg. C. (112 deg. F.) for 16 hours, but failing this, some drying can be effected by leaving the equipment in a warm dry room. If this is not possible, the part should be carefully dried with a clean dry rag. If a hot air blower is available, this will greatly assist in the drying. When it is thoroughly dry, the equipment should be inspected for any signs of corrosion. Any part affected should be renewed if possible, but if no new components are available, great care must be taken to ensure that all signs of corrosion are removed from the equipment before it is treated.

APPLICATION OF WEATHERPROOFING MATERIALS

10. It is unnecessary to describe in detail every item of electrical equipment which may

be found to require safeguarding against corrosion. The following instructions and diagrams, while dealing with specific cases, will indicate the general principles to be followed, and the uses to which the various types of weatherproofing materials may be applied.

11. It is important that P.I.C. No. 1 should never be allowed to come into contact with rubber, since it is liable to cause deterioration of the insulation; it should not, therefore, be used on plugs and sockets. Any P.I.C. No. 1 which has previously been applied in positions where it is in close contact with rubber should be removed by wiping with a clean cloth and afterwards washing the surface with gasoline. Since gasoline also attacks rubber, it must be wiped off as soon as possible, and the surface thoroughly dried, preferably by air blast.

Breeze type plugs and sockets

12. When Breeze type plugs and sockets repeatedly show signs of severe corrosion due to the ingress of moisture, the pins should be lightly smeared with insulating silicone compound MS4 (Stores Ref. 33C/1172). P.I.C. No. 1 should no longer be used for this purpose.

Push-switch, Type B

13. There are several similar types of push-switch, but whether they are single or double-pole, the treatment for weatherproofing follows the same lines (fig. 1). The base plate should be removed, and P.I.C. No. 2 should be pressed well into the terminal space and around the wires. Enough P.I.C. No. 2 should be used to allow for some of the compound to be squeezed out when the base plate is replaced, thus forming a thin film which acts as a waterproof washer between the base

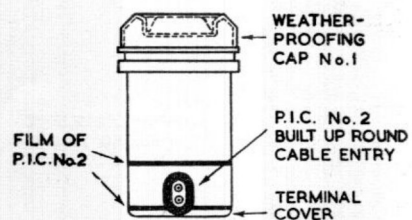


Fig. 1. Push-switch, Type B

plate and the body of the switch. The sheathing over the cores of the cable should enter the terminal space as far as possible, and the cable entries should be well packed with P.I.C. from the outside. Finally, a rubber weatherproofing cap, No. 1, is stretched over the top of the switch, completely covering the push-button, which may be operated through it.

Push-switch, Type C

14. The pear-shaped Type C push-switch should, if possible, be weatherproofed as it is connected to the cable. Otherwise, to make a satisfactory job of it, it must be disconnected and re-assembled according to these instructions (fig. 2). The cable ends should be prepared with as little of the sheathing removed as possible. It should be enough to bare the wires completely for 0.10 in. and to cut the outer sheathing back for a further 0.10 in. Put a weatherproofing sleeve of suitable size (para. 4) over the cable end, and over this a moulded weatherproofing sleeve, No. 1, which is large enough to go over the lower part of the switch body. Thread the cable through the lower part of the switch body and solder the cable ends to the contacts in the adapter. Press P.I.C. No. 2 round the contacts and leads fairly liberally, and slide the outer sleeve (larger diameter) over the lower part of the switch body, squeezing the compound up, around and between the two cables, as shown in fig. 2. Roll up the smaller diameter sleeve to cover and grip the end of the larger sleeve. If suitable rubber sleeves are not available, bind the cable for $\frac{3}{4}$ in. on both sides of the point of entry with rubber tape. Assemble the top cover, push-button and spring, and put a weatherproofing cap, No. 2, over the assembly, easing it down as far as possible.

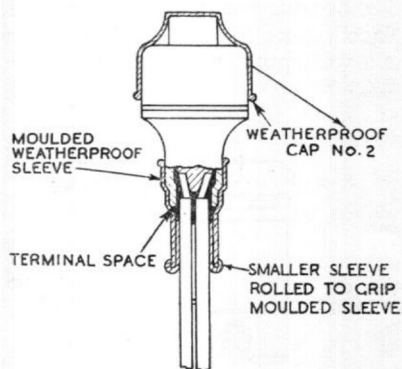


Fig. 2. Push-switch, Type C

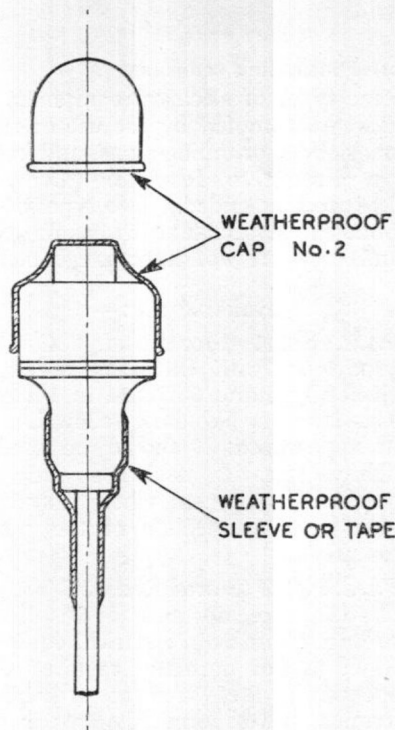


Fig. 3. Firing switch

Firing switch

15. This type of switch (fig. 3) is similar to the Type C switch described in para. 14. The only weatherproofing advised in this case, however, is the fitting of a weatherproofing cap, No. 2, eased down over the press-button to grip the switch body, and a moulded weatherproofing sleeve, No. 1, to cover the cable entry to the switch body. To avoid dismantling a switch which is already installed, the junction of the switch body and cable may be bound with rubber tape for a distance of $\frac{3}{4}$ in. either side of the cable entry point.

Dimmer switches

16. There are several types of dimmer switch with small variations in construction, but the measures advised for weatherproofing are applicable to all types. First remove the cover and knob from the base, and apply P.I.C. No. 2 liberally around the jointing faces of the base. Replace the cover, squeezing out excess compound. Next remove the base plate and press P.I.C. No. 2 firmly over the terminals and into the cable channels, working it well into all corners and completely filling all cavities, until the compound covers the whole moulding. The

RESTRICTED

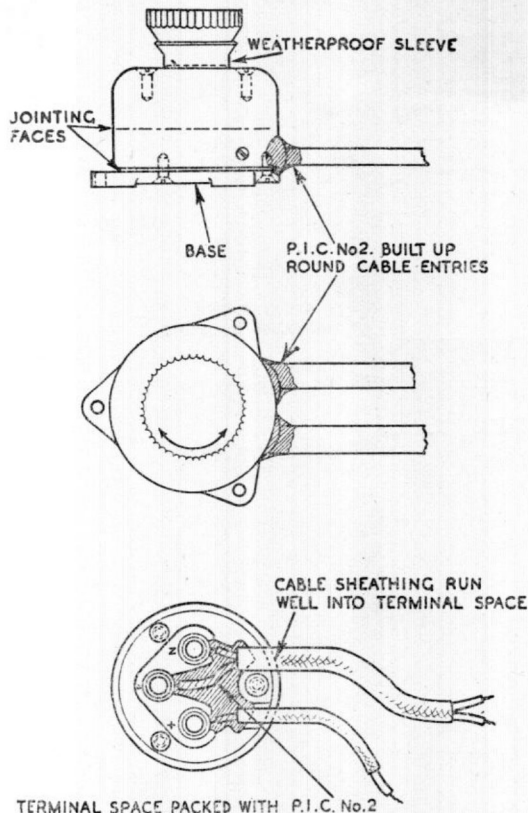


Fig. 4. Dimmer switch

excess will be squeezed out as the base plate is replaced, and some more P.I.C. No. 2 should be built up round the cable entries. Finally, take a black rubber insulating sleeve (Stores Ref. 5K/133) and cut it to a length of $\frac{3}{8}$ in. Expand the sleeve, and put it over the knob, working it well down the joint between the knob and cover. Fig. 4 shows the points at which weatherproofing treatment should be applied, and also emphasizes the importance of having the cable sheathing long enough to run well into the terminal space. In the type of switch in which the main body is split, it is permissible to use a P.V.C. or rubber washer, $\frac{1}{32}$ in. thick, in place of the film of P.I.C. No. 2.

Magnetic relay switches

17. The magnetic relay switches, Types J and K (fig. 5) are similar in construction, and the same weatherproofing instructions apply to both. Remove the top cover and the base plate, disconnect the coil wires at the terminals, and withdraw the armature.

Roll some P.I.C. No. 2 into strips approximately 3 in. by $\frac{1}{16}$ in. Place the strips of P.I.C. on both sides of the top of the Bakelite moulding supporting the large terminals, following the shape of the moulding, i.e., the shape of the cut-away portion at the top of the metal container. Fill the side channels, housing the coil wires from the coil terminals, with P.I.C. See that the P.I.C. is pressed firmly round the wires, and that any excess is cleaned off flush with the edges of the channels. Insert the armature assembly into the metal container and apply pressure to the base of the coil housing, squeezing the P.I.C. on the Bakelite moulding at its point of contact with the metal container. Replace the existing paper and cork washers at the base of the relay and fit a further laminated cork washer. A synthetic rubber gasket should be placed on the seating of the case with its holes corresponding to those in the case. When re-fitting the cover, the existing fixing screws must be replaced by three 6 B.A. $\times \frac{3}{8}$ in. screws which should be screwed down evenly and tightly. Any excess P.I.C. exuded from the top of the relay must be removed. Finally, apply P.I.C. to the coil wire and terminal channels flush with the top of the moulded Bakelite, and build up flush with the outside of the metal container round the incoming coil supply cables. Ensure that there is no possibility of water penetrating into the side channels.

Micro switches

18. The standard micro switches, Types 1 and 4, are already designed to prevent the ingress of oil, dust, spray, etc., through the push-switch connection, but weatherproofing protection may be required for the terminals and leads after they are wired up. Remove the terminal cover in the base, and press P.I.C. No. 2 into all the channels, round the leads and over the terminals. When the terminal cover is replaced and screwed down, enough excess compound should be squeezed out to form a thin layer between the terminal cover and body of the switch. Build up with P.I.C. No. 2 round the cable entries, as shown in fig. 6. Micro switches are usually fitted in positions exposed to weathering and splashing, so it is essential that weatherproofing treatment should be carried out with care to ensure that it is effective.

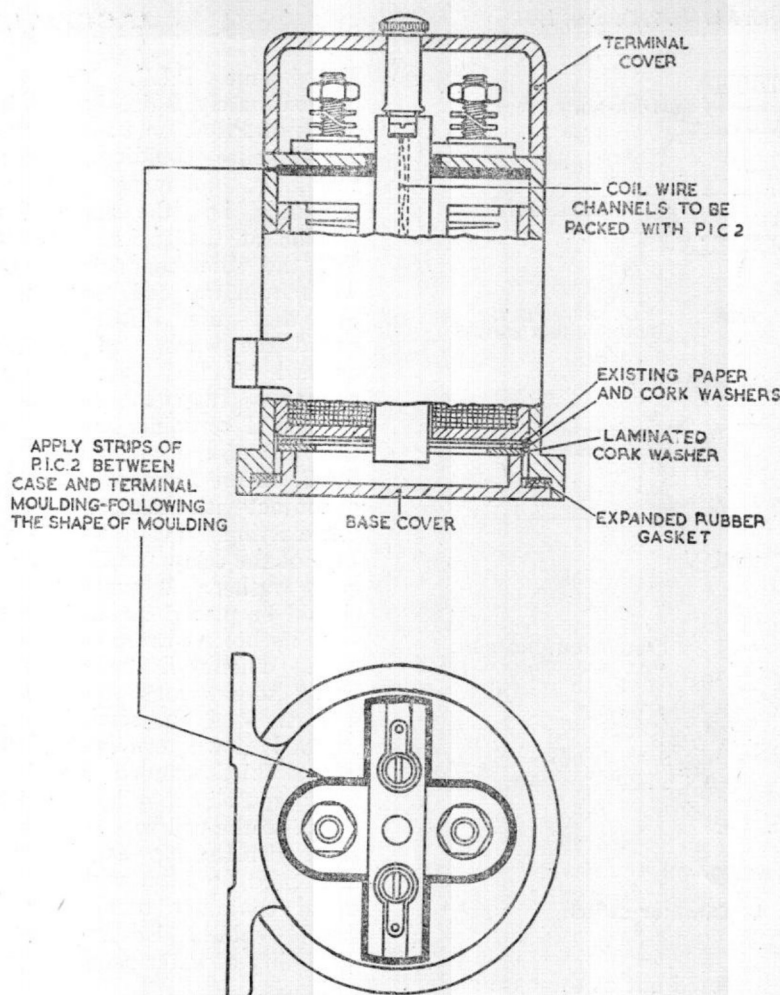
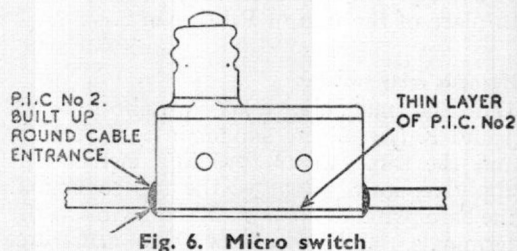
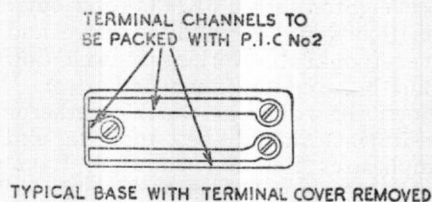


Fig. 5. Magnetic relay switch

General purpose switchboxes, Type B

19. General purpose switchboxes may be of 1, 2, 3, or 5 units, but in each case the treatment for weatherproofing is the same. The instructions will also apply to boxes in which the switches are linked externally. The cover should be removed and the switch body smeared liberally with P.I.C. No. 1. A thin layer should also be smeared over the jointing faces of the cover and body. Next, take off the terminal cover on the base of the switchbox and fill the terminal spaces with P.I.C. No. 2, pressing it well round the wires and over the terminal screws. Enough of the compound should be used to allow for the surplus to be squeezed out when the terminal cover is screwed down. On the outside, build up with P.I.C. No. 2 round and between the cable entries, as shown in fig. 7. It is of course essential that the



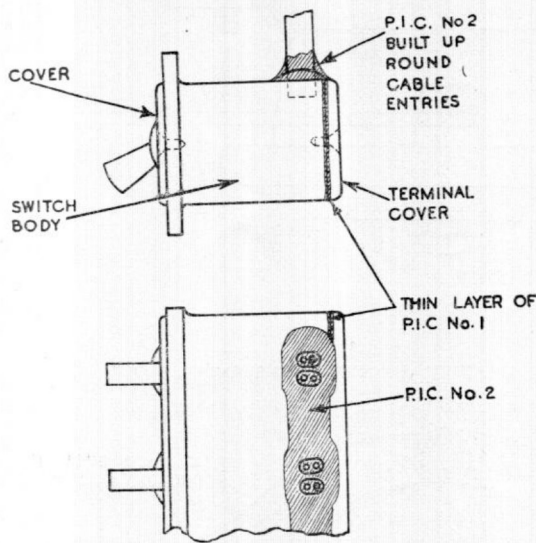


Fig. 7. General purpose switchbox, Type B

sheathing over the cable cores should run as far as possible into the terminal space.

Terminal blocks, Type B

20. There are several sizes of these Type B terminal blocks, but the method of weatherproofing is the same for each. Remove the terminal cover and see that the sheathing of the cables runs as far as possible into the terminal space. Press P.I.C. No. 2 liberally over the terminals, round the cable leads and into all corners. Use enough compound to ensure that when the terminal cover is replaced, and the excess is squeezed out, there will be a thin film of P.I.C. No. 2 between body and cover to act as a weatherproof washer. Finally, build up with compound round each cable entry, as shown in fig. 8.

Electric horn, Type C

21. Horns of this type are now being weatherproofed in manufacture by the use of P.I.C. No. 1, and all horns already treated in this way are marked with the letter "W" in white paint. Horns not marked in this way may be weatherproofed in the following manner. Unscrew the six front cover fixing screws and remove the cover. Smear both faces of all the shims with P.I.C. No. 1. Squeeze the shims back into position, replace the front cover, and paint the letter "W" in white paint on the body of the horn. Next remove the terminal cover and see that the

sheathing of the cable cores runs as far as possible into the terminal space. Press P.I.C. No. 2 over the terminals and round the leads, filling all the available space. Replace the terminal cover, squeezing out the surplus compound, and build up with P.I.C. No. 2 round the cable entry, as in fig. 9. When a horn in service is treated in this way, make sure that it is correctly adjusted after re-assembly.

2-pole sockets, B.T.H., Types E1 and E2

22. These two external supply sockets are somewhat different in construction, but much of the instructions for weatherproofing will apply to both types. Some of the sockets have already been partially weatherproofed in manufacture by the fitting of an impregnated felt washer. If this has been done, the socket will be marked with a "W" in white paint on the front cover. If the socket is not so marked and it is required to be weatherproofed, remove the nuts and washers below the base and take out the screw running through the assembly. Remove the moulded socket cover with great care, so that the spring does not fly out. Take out the old felt washer in the groove on the base of the socket and press an impregnated felt washer in the groove instead. Place the spring against the stops in base and cover and, with the cover in the right hand, turn in a clockwise direction, compressing

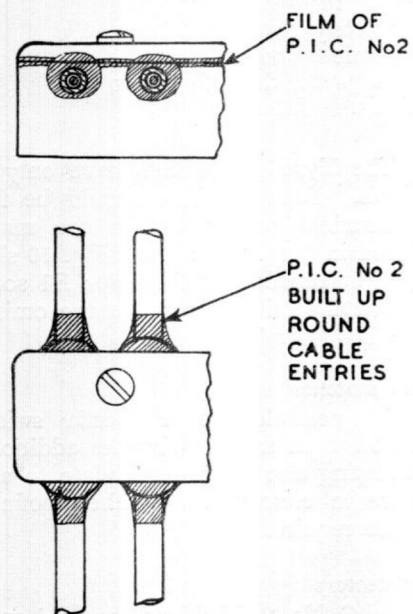


Fig. 8. Terminal block, Type B

the spring until it allows the cover to seat on the new felt washer. Replace the through-screw, the washers and the nuts, adjusting the tension until the cover returns easily to its original position, when it is released after being turned in a clockwise direction to expose the socket holes. Tighten up the screw sufficiently to prevent slackness on this return spring movement. Fit a weatherproofing cap, No. 3, over the socket cover. When this has been done, mark the socket with a "W" in white paint on the front cover.

23. On the Type E1 sockets it will be seen that the base insulation at the terminal marked B— is below the level of the other two terminals. To correct this, remove the nut, washers and terminal lug, and fit a terminal extension bush (Stores Ref. 5CY/3056). Before re-fitting the terminal lug, pass a terminal lug cover, No. 4, over it, and well back on to the cable. Replace the terminal lug, washers and nut, and finally pull the terminal cover well down on to the terminal insulation, so that it completely covers the bush. Fit terminal covers in the same way to the other two terminals.

24. The Type E2 sockets have only two terminals. Both of these should be fitted with terminal lug covers in the manner described in para. 23 above. Fig. 10 shows the weatherproofing of the Type E1 socket. Type E.2 is similar except for the omission of the B— terminal.

Inertia switches

25. All pendulum type inertia switches have now been modified by the addition of a ventilating slot in the end plate to allow moisture to escape; no weatherproofing is therefore required.

Fire detectors

26. P.I.C. No. 2 should not be used on fire detector assemblies, since it is possible for

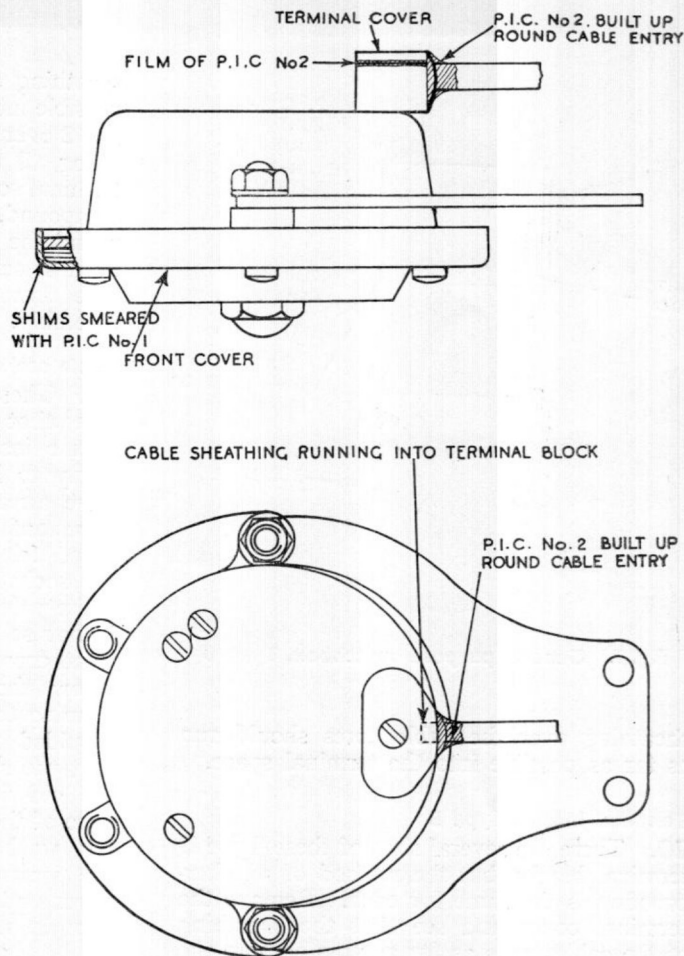


Fig. 9. Electric horn, Type C

the fire detector to be rendered useless by the application of the compound. In addition, the compound is inflammable, and weatherproofing of the detectors is not necessary.

GENERAL CARE OF EQUIPMENT

27. Much condensation, which is one of the chief causes of corrosion, can be prevented if care is taken to keep the inside of the aircraft as dry as possible. Weatherproof covers are provided for the cockpit, engine, turret and other vents, and these should be used, particularly when the aircraft is at dispersal point in damp cold weather. When the weather is fine and dry, the aircraft should be allowed to air thoroughly, with covers off and all vents open to promote good air

RESTRICTED

circulation. On some stations, heater vans are available for drying out aircraft, and regular treatment will do much to keep down condensation.

28. It has been estimated that as much as a pint of water could be collected from inside a large aircraft from the condensation caused by a cool night following a warm day, and it will be realised from this that constant care and attention is necessary if a high standard of electrical serviceability is to be maintained.

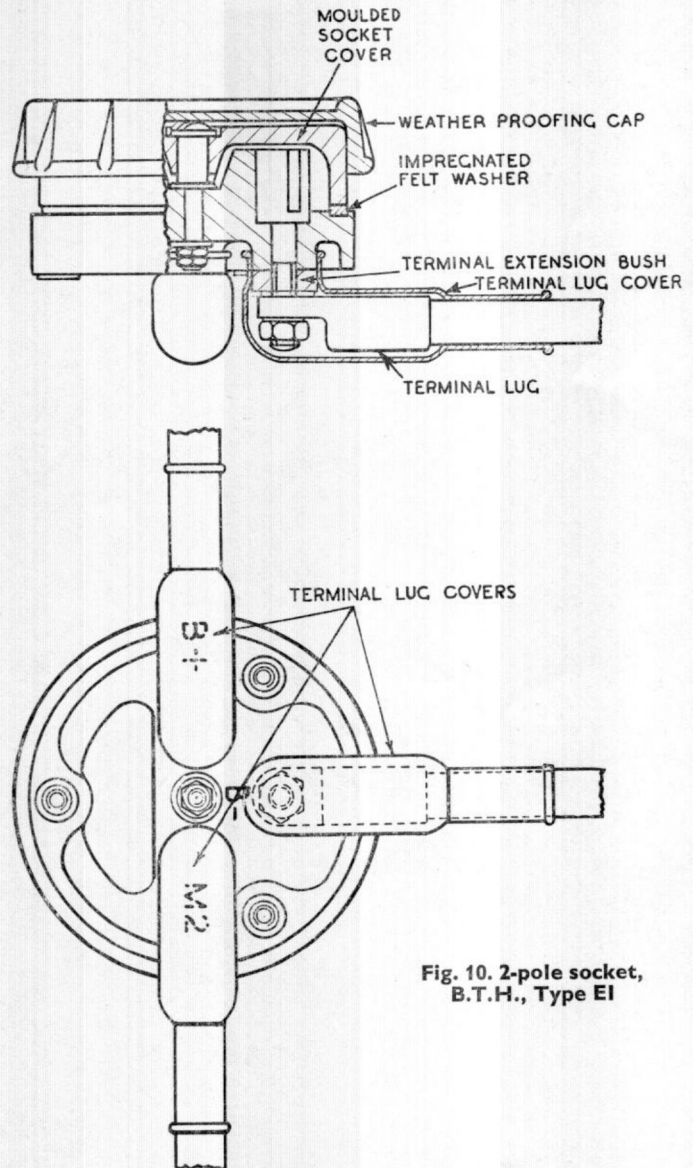


Fig. 10. 2-pole socket, B.T.H., Type EI

RESTRICTED

(A.L.83, June, 55)

