

**SECTION 5**  
**MINOR REPAIRS**  
**LIST OF CHAPTERS**

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

- 1 General information and servicing tools**
- 2 Oil system and blower unit**
- 3 Fuel system**
- 4 Ignition and electrical system**
- 5 Fire prevention system**
- 6 Cartridge starter system**
- 7 Nacelle**
- 8 Oxygen system**

**RESTRICTED**



## Chapter 1

## GENERAL INFORMATION AND SERVICING TOOLS

## LIST OF CONTENTS

	Para.		Para.
Introduction .. .. .	1	Use of anti-corrosive paste .. .. .	11
Flexible pipes .. .. .	4	Marking hot end components .. .. .	14
Use of molybdenum disulphide .. .. .	8		

## Introduction

1. This chapter gives a list of all the special purpose and standard tools required to service the power plant; general information is also provided

relating to standard practices to be observed whilst carrying out servicing operations and minor repairs.

## 2. Tools required for removal of a.a.p.p. from the aircraft

Description	Quantity
Spanner, O.J.D.E., $\frac{3}{16}$ in. $\times$ $\frac{1}{4}$ in. Whit	1
Spanner, O.J.D.E., $\frac{5}{16}$ in. $\times$ $\frac{3}{4}$ in. Whit	2
Spanner, O.J.D.E., $\frac{7}{16}$ in. $\times$ $\frac{1}{2}$ in. Whit	1
Spanner, ring, $\frac{7}{16}$ in. $\times$ $\frac{1}{2}$ in. a/f	1

## 3. Tools required for routine maintenance and minor repairs

## SPECIAL TOOLS

Ref. No.	Part No.	Description	Quantity
64AF/3	421482	Ring spanner, air intake nuts	1
64AF/4	421483	Spanner, combustion chamber socket screws	1
64AF/5	421493	Spanner, cartridge start barrel	1
64AF/6	421494	Socket spanner, harness adapter	1
64AF/7	421495	Socket spanner, harness adapter	1
64AF/8	421496	Socket spanner, harness adapter	1
64AF/9	421497	Socket spanner, harness adapter	1
64AF/10	421498	Socket spanner, harness adapter	1
64AF/1	421499	Extractor, cartridge start quill tube	1
64AF/2	422019	Overflow pipe, compressor washing	1

## STANDARD TOOLS

Ref. No.	Description	Quantity
1C/6473	Spanner, flare nut, $\frac{1}{4}$ in. $\times$ $\frac{5}{16}$ in. Whit	2
1C/6516	Spanner, flare nut, $\frac{3}{8}$ in. $\times$ $\frac{7}{16}$ in. Whit	2
1C/6418	Spanner, O.J.D.E., $\frac{9}{32}$ in. $\times$ $\frac{25}{32}$ in. a/f	1
1C/6347	Spanner, O.J.D.E., $1\frac{1}{16}$ in. $\times$ $1\frac{1}{8}$ in. a/f	1
1C/6348	Spanner, O.J.D.E., $1\frac{1}{8}$ in. $\times$ $1\frac{1}{4}$ in. a/f	1
1C/6249	Wrench, Allen key, $\frac{1}{4}$ in. a/f	1
1L/223	Spanner, ring 2BA $\times$ 4BA	1
1L/31	Spanner, ring $\frac{1}{8}$ in. $\times$ $\frac{3}{16}$ in. Whit	1
1L/32	Spanner, ring $\frac{1}{4}$ in. $\times$ $\frac{5}{16}$ in. Whit	1
1L/33	Spanner, ring $\frac{3}{8}$ in. $\times$ $\frac{7}{16}$ in. Whit	1
1L/138	Spanner, ring $\frac{1}{2}$ in. $\times$ $\frac{9}{16}$ in. Whit	1
1L/79	Spanner, ring $\frac{5}{8}$ in. $\times$ $\frac{7}{16}$ in. a/f	1
1L/80	Spanner, ring $\frac{1}{2}$ in. $\times$ $\frac{9}{16}$ in. a/f	1
1L/147	Spanner, ring $\frac{19}{32}$ in. $\times$ $\frac{11}{16}$ in. a/f	1
1L/59	Spanner, O.J.D.E. $\frac{9}{16}$ in. $\times$ $\frac{5}{8}$ in. Whit	1
1L/76	Spanner, O.J.D.E. $\frac{7}{8}$ in. $\times$ 1 in. Whit	1

RESTRICTED

## MISCELLANEOUS

<i>Description</i>	<i>Quantity</i>
5X/1564 Strap wrench	1
1C/6249 in. Allen key (long shank 4½ in. to 5 in. short shank ¾ in. max.)	1
1H/11 pliers, long snipe nose	1
Pliers, combination 6 in.	1
Feeler gauges, set	1
Straight edge, 12 in.	1
Hammer, ball pein, ½ lb.	1
Mallet, raw hide, 1 lb.	1
Screwdriver, large	1
Screwdriver, medium	1
Screwdriver, small	1
1B/4235 Spirit level, adjustable, approx. 6 in. long	1
1B/5071 Vernier depth gauge	2
Diagonal cutting nippers	1
Hammer, ball pein 1 lb.	1
271A/1253 syringe, nylon, 20 c.c. (for re-oiling Plannair blower)	1

### Flexible pipes

4. Whenever the power plant access doors are removed for servicing or inspection the flexible pipes must be visually inspected to ensure that none of the following defects are present:—

- (1) Signs of distortion; especially for signs of the flexible pipe being pulled sharply away from coupling.
- (2) Abrasion between the pipe and adjacent members, or denting of the pipe.
- (3) Signs of twisting of the assembly, usually visible as a distortion of the regular pattern of the overbraid in a helical direction.
- (4) Corrosion on the coupling components.
- (5) Visible cracks or other unusual conditions pertaining to the end couplings.

5. When removing or refitting flexible pipes great care must be taken to ensure that they are not stressed. Particular care must be exercised when manipulating pipes within a confined space.

6. When fitting flexible pipes loosely couple each end of the assembly, check the pipe run, then tighten gradually to avoid applying tension to the pipe and to maintain the assembly in a free and unstressed condition. Where provision is made for the use of two spanners, one on the coupling body and one on the swivel nut, one should always be used on the coupling portion to prevent torsion being applied to the pipe.

7. Care should always be exercised in the tightening of swivel nuts and banjo bolts to avoid distortion of nipples, banjo faces and threads. Except where spanners of special design are called for, standard spanners of the correct length must be used.

### Use of molybdenum disulphide

8. Where a dry film lubrication is required to prevent 'scuffing', for example on lightly loaded components and components to be operated at

elevated temperatures, molybdenum disulphide compound ZX-28 should be used.

9. The compound should be applied to the working surfaces of the component with a brush. Care must be taken to apply only a small amount and to brush it well into the whole of the working surface.

10. The following components must be treated with molybdenum disulphide before final assembly:

<i>Description</i>	<i>Detailed in chapter</i>
Jet pipe clamping ring bolts	7
Cartridge start outlet pipe union nuts	6
Thermocouple union nuts	4
Igniter suspension plug retaining bolts	3, 4
Burner retaining nuts	3
Temperature control mercury boiler retaining bolts	3
Combustion chamber socket head screws	3
Fuel pump retaining bolts	3
Fuel drain valve	3

### Note . . .

*Great care must be exercised when treating the fuel drain valve to ensure that the compound does not enter the valve body otherwise the assembly may fail to function.*

### Use of anti-corrosive paste

11. Anti-corrosive paste (Ref No 33C/1264) should be used to prevent electrolytic corrosion wherever dissimilar metals are brought into contact.

12. The surfaces to be brought into contact should be coated with the paste and the joint made whilst the surface is still tacky. Surplus paste squeezed out of joints may be wiped off, but care must be taken not to draw the filler out of the joint. The



paste will dry on the surface where exposed to the air, but within the joint will remain plastic almost indefinitely, forming a perfect air and water-tight joint.

**Marking hot end components**

13. When marking components which are subjected to high temperatures, the use of lead pencils, wax crayons, or any medium which will leave a carbon deposit, may result in carburisation and

embrittlement of the affected area: blackboard or common chalk produces a deep etched effect when subjected to heat. The use of these materials for marking the hot end components is therefore forbidden.

14. When it is necessary to make a temporary marking on any component which is subjected to high temperatures, use either tailor's chalk or french chalk (talc).



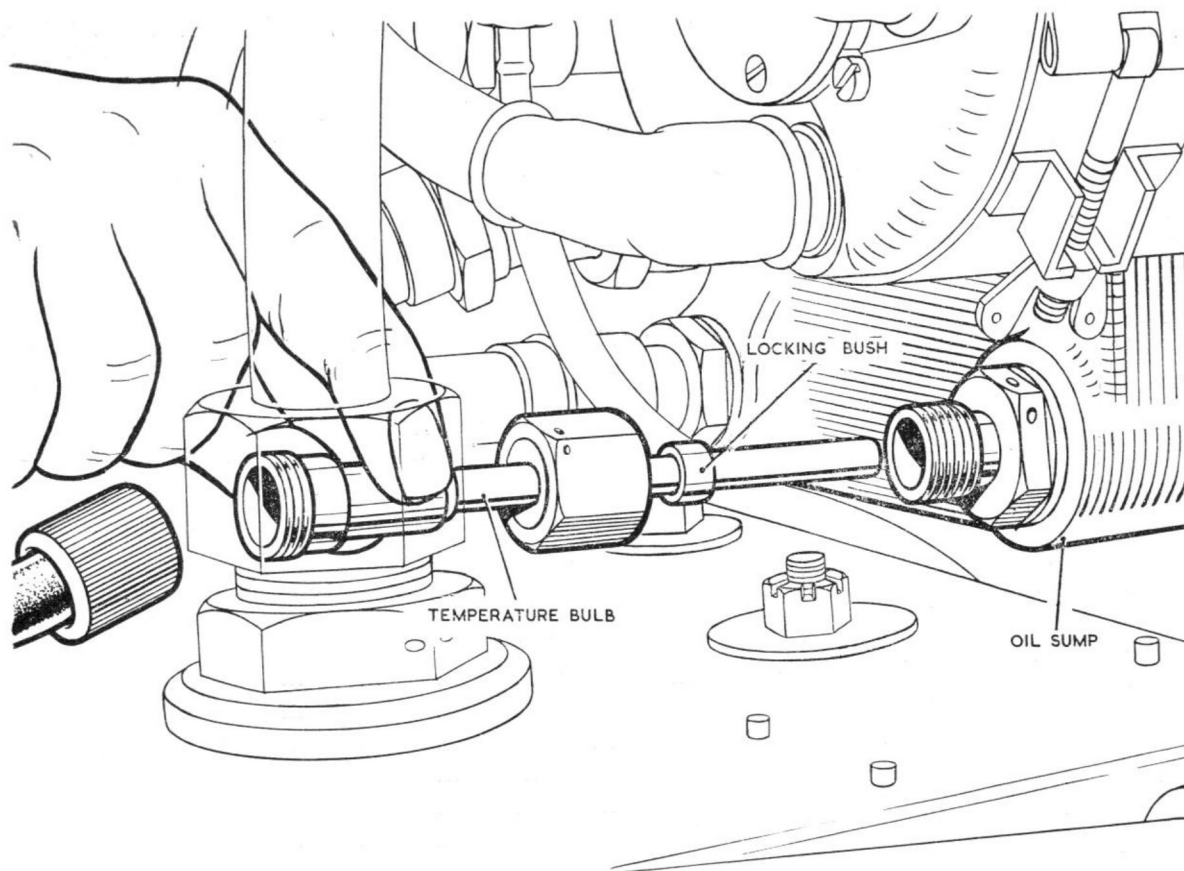
**Chapter 2****OIL SYSTEM AND BLOWER****LIST OF CONTENTS**

	<i>Para.</i>
<i>Draining the oil sump</i> ... ..	1
<i>Removing the sump temperature bulb</i> ... ..	2
<i>Fitting a temperature bulb</i> ... ..	3
<i>Removing the sump heater unit</i> ... ..	4
<i>Fitting a sump heater unit</i> ... ..	5
<i>Removing the pressure re-oiling valve</i> ... ..	6
<i>Fitting a pressure re-oiling valve</i> ... ..	7
<i>Removing the oil pressure transmitter</i> ... ..	8
<i>Fitting an oil pressure transmitter</i> ... ..	9
<i>Removing the oil cooler</i> ... ..	10
<i>Dismantling and re-assembling the oil cooler</i> ... ..	11
<i>Fitting an oil cooler...</i> ... ..	14
<i>Removing the blower unit</i> ... ..	16
<i>Fitting a blower unit</i> ... ..	17

**LIST OF ILLUSTRATIONS**

	<i>Fig.</i>
<i>Sump temperature bulb</i> ... ..	1
<i>Sump heater connection and pipe clips</i> ... ..	2
<i>1.B.3 cable assembly</i> ... ..	3
<i>Disconnecting cable assemblies to provide access to blower unit</i> ... ..	4
<i>Blower unit drive coupling</i> ... ..	5

**RESTRICTED**



**Fig. 1. Sump temperature bulb**

#### **Draining the oil sump**

**1.** The engine oil sump can be drained only through the pressure re-oiling valve, using tool number 421567. If this tool is not available, the female half of a standard Lockheed-Avery coupling with a suitable length of pipe attached can be used. The procedure for draining the sump is as follows:—

- (1) Remove the protective cap from the Lockheed quick release coupling on the underside of the pressure re-oiling valve. The cap is secured with a bayonet fixing.
- (2) Place a suitable container close to the unit; insert the hose from the draining tool into the container, then secure the tool with the bayonet fixing to the Lockheed quick release coupling.
- (3) When secured to the Lockheed quick release coupling, the draining tool opens the spring loaded plunger within the coupling and permits oil to escape from the engine sump through the input side of the re-oiling valve.
- (4) When satisfied that the sump has drained completely, disconnect the draining tool and refit the protective cap over the Lockheed coupling. For details of the correct method of refilling the sump, reference should be made to Sect. 4 of this volume.

#### **Removing the sump temperature bulb**

**2.** The sump oil temperature bulb is located on the rear face of the engine oil sump and for removal

purposes is best approached from the port side of the unit.

- (1) Drain the engine oil sump (para. 1).
- (2) Unscrew the knurled nut securing the harness connection to the temperature bulb.
- (3) Release the locking wire; then unscrew the temperature bulb clamping nut, and withdraw the bulb from the union, carefully noting the locking bush which may be loose on the bulb.

#### **Fitting a temperature bulb**

- 3.** (1) Insert the temperature bulb into the union in the wall of the engine sump making quite certain that the locking bush is in position on the bulb. Tighten the clamping nut and secure with locking wire.
- (2) Insert the harness connection into the temperature bulb and tighten the knurled securing nut.
- (3) Refill the engine oil sump. For details of this operation refer to Sect. 4.

#### **Removing the sump heater unit**

**4.** The sump heater unit forms the engine oil sump side plate and is readily accessible from the port side of the power plant. The procedure for removing the heater unit is as follows:—

- (1) Commence by draining the engine oil sump (para. 1).

- (2) Cut the locking wire and disconnect the harness connection at the heater unit.
- (3) Cut the locking wire and release the eight socket head screws and plain washers securing the heater unit to the compressor housing, noting that one of the screws retains a clip for the P<sub>2</sub> pipe (Pre Mod. M182).
- (4) Carefully withdraw the heater unit complete with the sealing joint washer.

#### Fitting a sump heater unit

5. (1) Carefully place the sump heater gasket in position on the flange of the compressor housing; insert the heater unit into the sump and secure with eight socket head screws; then secure the two pipe clips and wire-lock the screws in pairs (fig. 2).
- (2) Reconnect the wiring harness and secure the wire locking.
- (3) Refill the sump (Sect. 4).

#### Removing the pressure re-oiling valve

6. The pressure re-oiling valve is mounted on the port side of the bottom rail at the rear end of the unit. The removal procedure is as follows:—

- (1) Drain the engine oil sump (para. 1).
- (2) Cut the locking wire and release the overflow and supply pipes at the unions on the re-oiling valve.
- (3) Release the four bolts, self locking nuts and plain washers securing the valve to the bottom rail, and withdraw the valve assembly upward from the aperture in the bottom rail.

#### Fitting a pressure re-oiling valve

7. (1) Lower the valve assembly into the aperture in the bottom rail and secure with four bolts, plain washers and self locking nuts.
- (2) Reconnect the overflow and supply pipes from the engine oil sump to the respective unions on the valve body, and secure the locking wire in the approved manner.
- (3) Refill the engine oil sump (Sect. 4).

#### Removing the oil pressure transmitter

8. The oil pressure transmitter complete with the anti-vibrational mounting is secured to the oil cooler on the starboard side of the unit (fig. 3). The procedure for removing the oil pressure transmitter is as follows:—

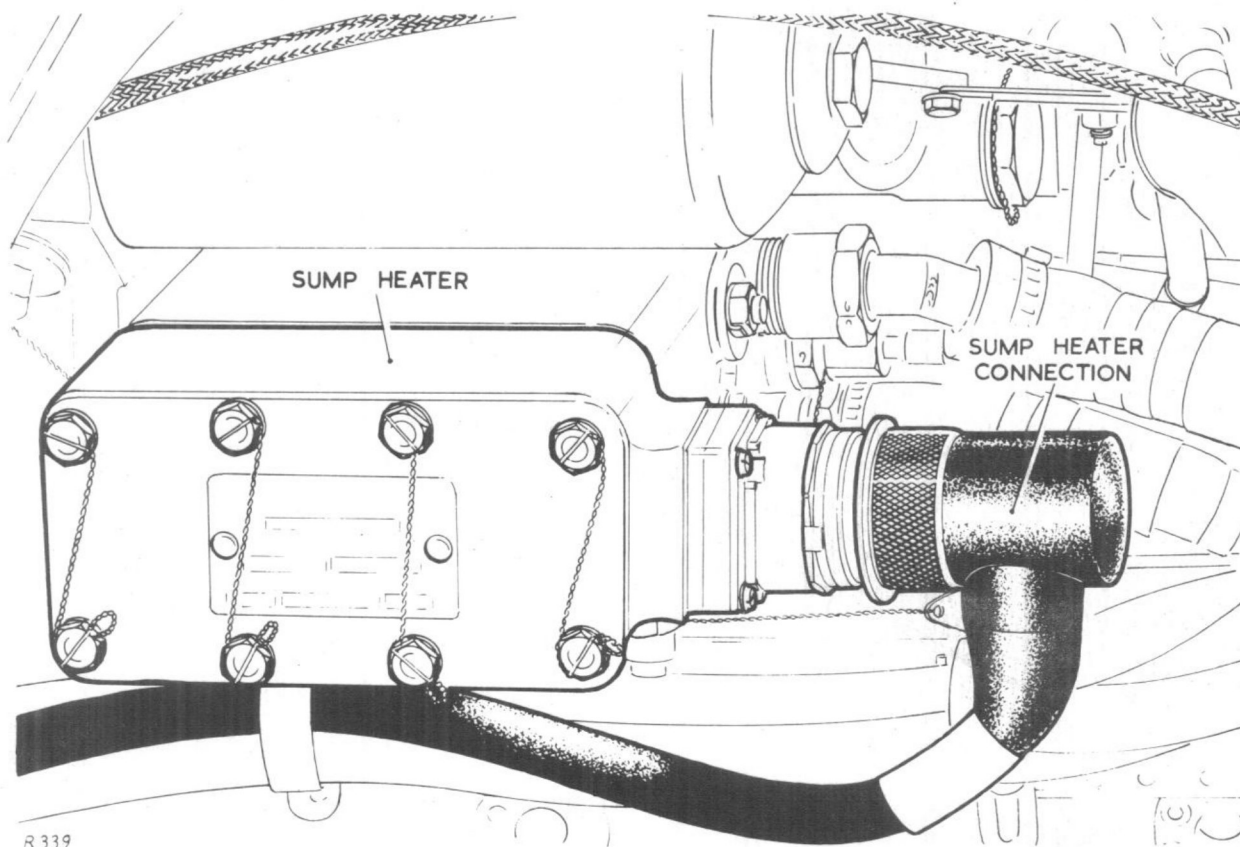


Fig. 2. Sump heater connection and pipe clips

- (1) Cut the locking wire and uncouple the oil pipe from the oil cooler at the transmitter.
- (2) Unscrew the knurled retaining nut and break the harness connection at the other end of the transmitter.
- (3) Release the four self-locking nuts and plain washers securing the transmitter and the anti-vibrational mounting to the oil cooler, then withdraw the transmitter over the studs.

#### Fitting an oil pressure transmitter

9. (1) Place the transmitter complete with the mounting in position on the oil cooler and secure with four self-locking nuts and plain washers.
- (2) Recouple the oil pipe and harness connections to the transmitter and wire-lock the oil pipe.

#### Note . . .

*The transmitter oil pipe may tend to pull the transmitter askew on the rubber mountings and if so, the pipe should be carefully preformed to enable the assembly to sit squarely on the mounting.*

#### Removing the oil cooler

10. The oil cooler is located on the starboard side of the power plant, secured to the body of the a.c. generator by a metal strap. For removal purposes, access to both sides of the unit is required. To remove the oil cooler proceed as follows:—

- (1) Drain the engine oil sump (para. 1).

- (2) Cut the locking wire and disconnect the 1.B.3 cable assembly at the bulkhead plug, at the oil cooler actuator, and at the oil pressure transmitter. Release the two clips securing the cable to the base of the oil cooler and remove the cable assembly complete.
- (3) Cut the locking wire and disconnect the inlet and outlet pipes at the oil cooler.
- (4) Release the two hose clips securing the blower unit connecting tube to the blower unit and the a.c. generator inlet.
- (5) Release the locking wire and unscrew the socket head screw retaining the oil cooler strap round the body of the a.c. generator.
- (6) Disengage the connecting tube from the a.c. generator inlet.
- (7) Ease the oil cooler out of the nacelle, simultaneously freeing the strap from the a.c. generator and the connecting tube from the blower unit.

#### Dismantling and re-assembling the oil cooler

##### Removing and refitting the oil cooler actuator

11. For a description of the method of removing and refitting the oil cooler actuator, refer to Chap. 4 of this section.

##### Removing and refitting the oil pressure transmitter

12. The method of removing and refitting the oil pressure transmitter is given in para. 8 and 9 of this chapter.

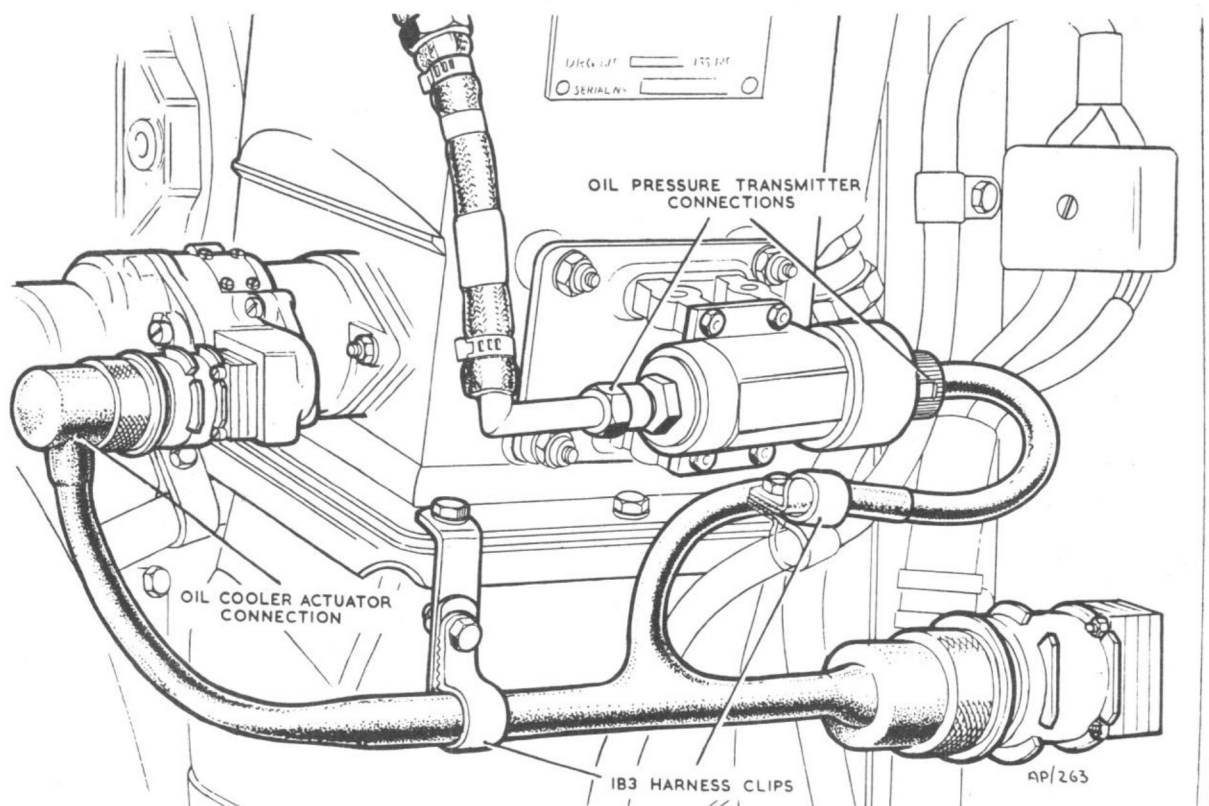


Fig. 3. 1.B.3. cable assembly

*Removing and refitting the blower connecting tube*

13. Release the five bolts and plain washers securing the oil cooler flange to the connecting tube clamping plate and part the two components. To refit the connecting tube, place the rubber flange of the tube in position at the base of the oil cooler with the clamping plate immediately behind the flange, and secure with five bolts and plain washers. Note that two of these bolts are utilized to retain wiring harness clips.

**Fitting an oil cooler**

14. The oil cooler will normally be assembled to the power plant complete with the actuator, the pressure transmitter with the connecting pipe, the connecting tube, and the oil cooler unions, and it is assumed in the following paragraphs that this is so.

15. Fitting an oil cooler is mainly a reversal of the removal procedures, but care must be exercised in two respects: never hold the actuator body whilst jockeying the cooler into position, and make quite certain that the wire locking has been refitted when the work is completed.

(1) Position the two hose clips on the connecting tube, place the oil cooler in position with the retaining strap round the body of the a.c. generator and loosely connect the two halves of the strap with a socket head screw.

(2) Manoeuvre the connecting tube over the blower unit outlet and when satisfied that the cooler is correctly positioned, securely tighten the socket head screw retaining the two halves of the cooler strap.

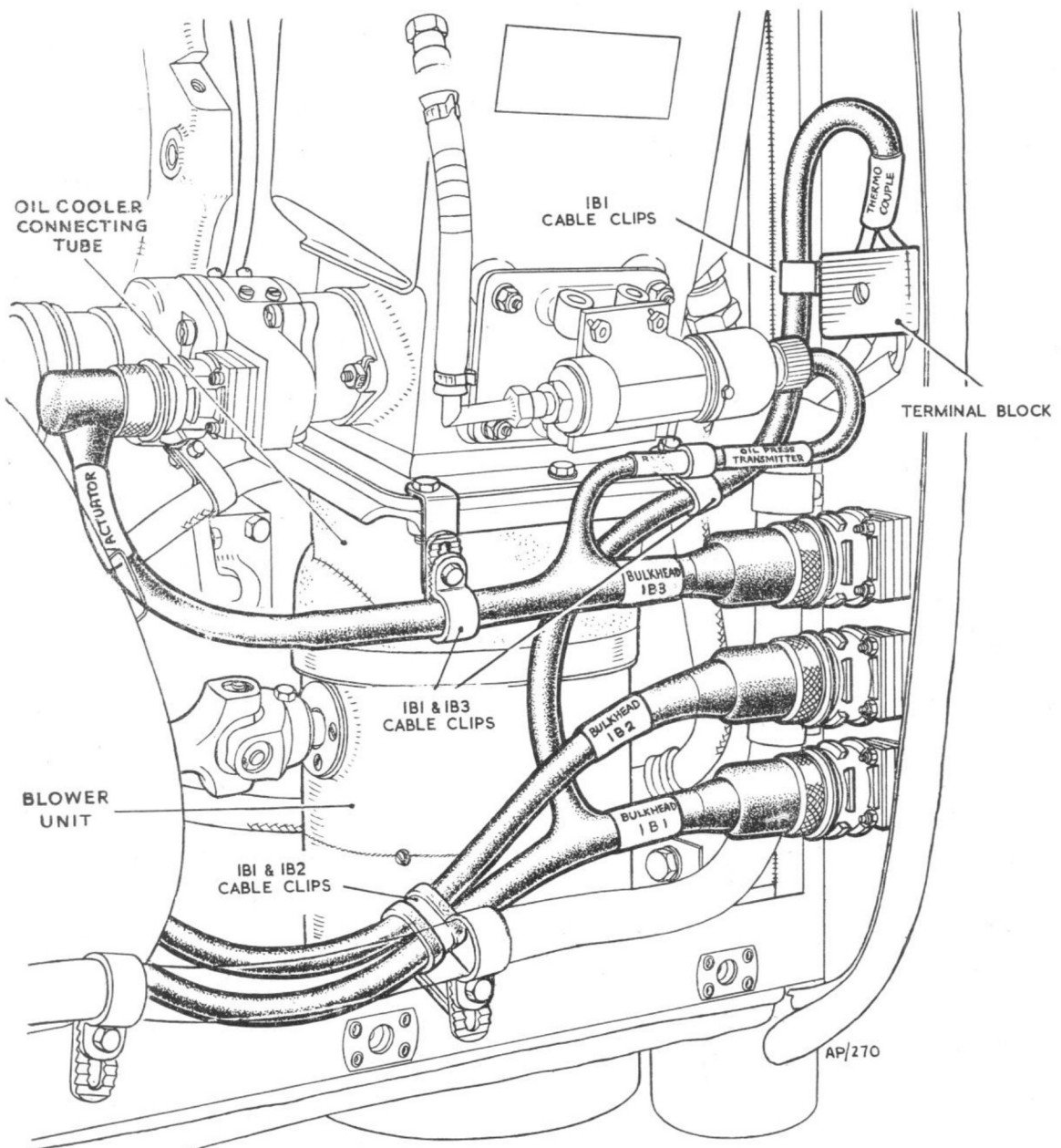


Fig. 4. Disconnecting cable assemblies to provide access to blower unit

RESTRICTED



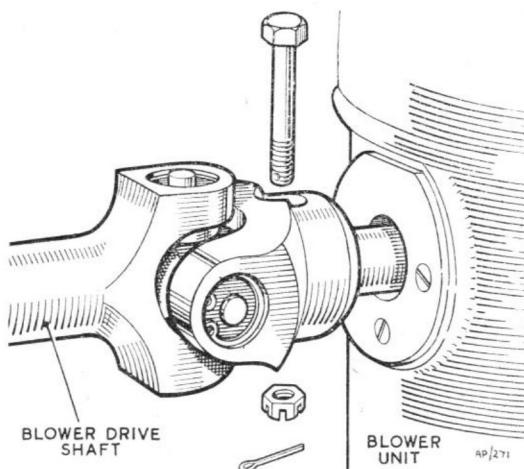
- (3) Correctly position and securely tighten the two hose clips round the connecting tube.
- (4) Reconnect the inlet and outlet pipes at the oil cooler.
- (5) Reconnect the 1.B.3 cable assembly at the bulkhead plug, the oil cooler actuator, and the oil pressure transmitter not forgetting to refit the two harness clips at the oil cooler base
- (6) When completely satisfied that all the connections are secure and correctly wire-locked, refill the engine oil sump (Sect. 4).

#### Removing the blower unit

**16.** To remove the blower unit mounted on the bottom rail at the front end of the unit, access is required to the starboard and underside of the unit. The removal procedure is as follows:—

- (1) Sever the wire locking and disconnect the 1.B.1, 1.B.2 and 1.B.3 cables at the bulkhead plugs.
- (2) Cut the locking wire and release the 1.B.3 cable connections at the oil cooler actuator and the oil pressure transmitter. Release the three cable clips securing the 1.B.1 and the 1.B.3 cables to the oil cooler base, and remove the 1.B.3 cable complete.
- (3) Release the three cable clips securing the 1.B.1 and 1.B.2 cables to the bottom rail, and the front end panel. Disconnect the 1.B.1 cable at the junction box on the front end panel, and draw both cables toward the rear of the nacelle until they are clear of the blower unit.
- (4) Remove the split pin, then release the bolt and castellated nut securing the drive shaft to the blower input shaft.
- (5) Release the six bolts, plain washers and self-locking nuts securing the blower and the attachment piece to the bottom rail, then remove the blower attachment piece from the underside of the bottom rail.
- (6) Release the hose clip securing the oil cooler connecting tube to the blower outlet.
- (7) Ease the blower unit from under the connecting tube and draw the complete assembly toward the front end panel to free the drive shaft; then cant the blower to starboard and withdraw the assembly from the

nacelle. Note the gasket interposed between the blower unit and the bottom rail.



**Fig. 5. Blower unit drive coupling**

#### Fitting a blower unit

**17.** Fitting a blower unit is a reversal of the removal procedure.

- (1) Place the blower unit in position on the bottom rail; then locate the drive shaft on the blower input shaft, and ease the oil cooler connecting tube over the blower unit outlet, making sure that the hose clip is in position.
- (2) Raise the blower unit sufficiently to enable the gasket to be interposed between the blower unit and the bottom rail.
- (3) Place the blower unit attachment piece in position on the underside of the bottom rail, and secure both the unit and the attachment piece with six bolts, plain washers and self-locking nuts.
- (4) Secure the drive shaft to the blower input shaft with the bolt, castellated nut and split pin.
- (5) Correctly position and securely tighten the oil cooler connecting tube hose clip.
- (6) Reconnect the 1.B.1, 1.B.2 and 1.B.3 cables, taking particular care to ensure that all the re-made connections are securely wire-locked and that the cable clips are correctly refitted.



## Chapter 3

### FUEL SYSTEM

(Completely Revised)

#### LIST OF CONTENTS

	Para.		Para.
Introduction ... ..	1	Burner 'sit-back' ... ..	13
<b>Removing the fuel system assembly</b>		Assembling the combustion chamber to the engine ... ..	14
Removing the fuel system pipes... ..	2	Fitting the metering valve (Pre Mod. M182) ... ..	15
Removing the combustion chamber and burner assembly ... ..	3	Fitting the air fuel ratio unit and non-return inhibiting valve (Pre Mod. M182) ... ..	16
Dismantling the combustion chamber ... ..	4	Fitting the fuel system pipes and electrical connections ... ..	17
Examining the flame tube ... ..	5	<b>Low pressure fuel filter</b>	
Removing the metering valve (Pre Mod. M182) ... ..	6	Removing the low pressure fuel filter ... ..	18
Removing the air fuel ratio unit and non-return inhibiting valve (Pre Mod. M182) ... ..	7	Fitting the low pressure fuel filter ... ..	19
Removing the fuel pump, governor and temperature control assembly (Pre Mod. M182) ... ..	8	<b>Fuel pressure warning switch</b>	
Removing the fuel pump (Mod. M182) ... ..	9	Removing the fuel pressure warning switch ... ..	20
<b>Fitting a replacement calibrated fuel system assembly</b>		Fitting the fuel pressure warning switch ... ..	21
Fitting the fuel pump, governor and temperature control assembly (Pre Mod. M182) ... ..	10	<b>Fuel drain manifold</b>	
Fitting the fuel pump (Mod. M182) ... ..	11	Removing the fuel drain manifold ... ..	22
<b>Fitting the combustion chamber and replacement burner</b>		Fitting the fuel drain manifold ... ..	23
Assembling the combustion chamber ... ..	12	<b>Fuel drain valve</b>	
		Removing the fuel drain valve ... ..	24
		Fitting the fuel drain valve ... ..	25

#### LIST OF ILLUSTRATIONS

	Fig.		Fig.
Fuel system pipes and clips (Pre Mod. M182)... ..	1	Unacceptable damage to the flame tube skirt ... ..	6
Fuel system pipes and clips (Mod. M182) ... ..	2	Fuel pump securing bolts (Pre Mod. M182) ... ..	7
Burner securing nuts (Pre Mod. M182) ... ..	3	Fuel pump (Mod. M182) ... ..	8
Removing the burner (Mod. M182) ... ..	4	Burner 'sit-back' adjustment ... ..	9
Unacceptable damage to the flame tube primary zone ... ..	5	Burner nozzle position ... ..	10

#### Introduction

1. The fuel system is a complete calibrated system, the individual parts of which are not interchangeable. Should one of the individual components require renewal then the complete fuel system must be renewed as detailed in the following paragraphs.

#### Note . . .

*When a replacement fuel system has been fitted to an engine, the temperature control must be adjusted to suit the particular engine characteristics. This adjustment can only be made with the power plant installed and run on a test stand. Instructions for carrying out this operation are given in Section 6, Chap. 2 of this volume. Under no circumstances is a power plant to be installed in an aircraft until this adjustment has been made and in the event of facilities not being immediately available, the unit must be clearly labelled to the effect that the temperature control requires adjustment.*

#### REMOVING THE FUEL SYSTEM ASSEMBLY

##### Removing the fuel system pipes

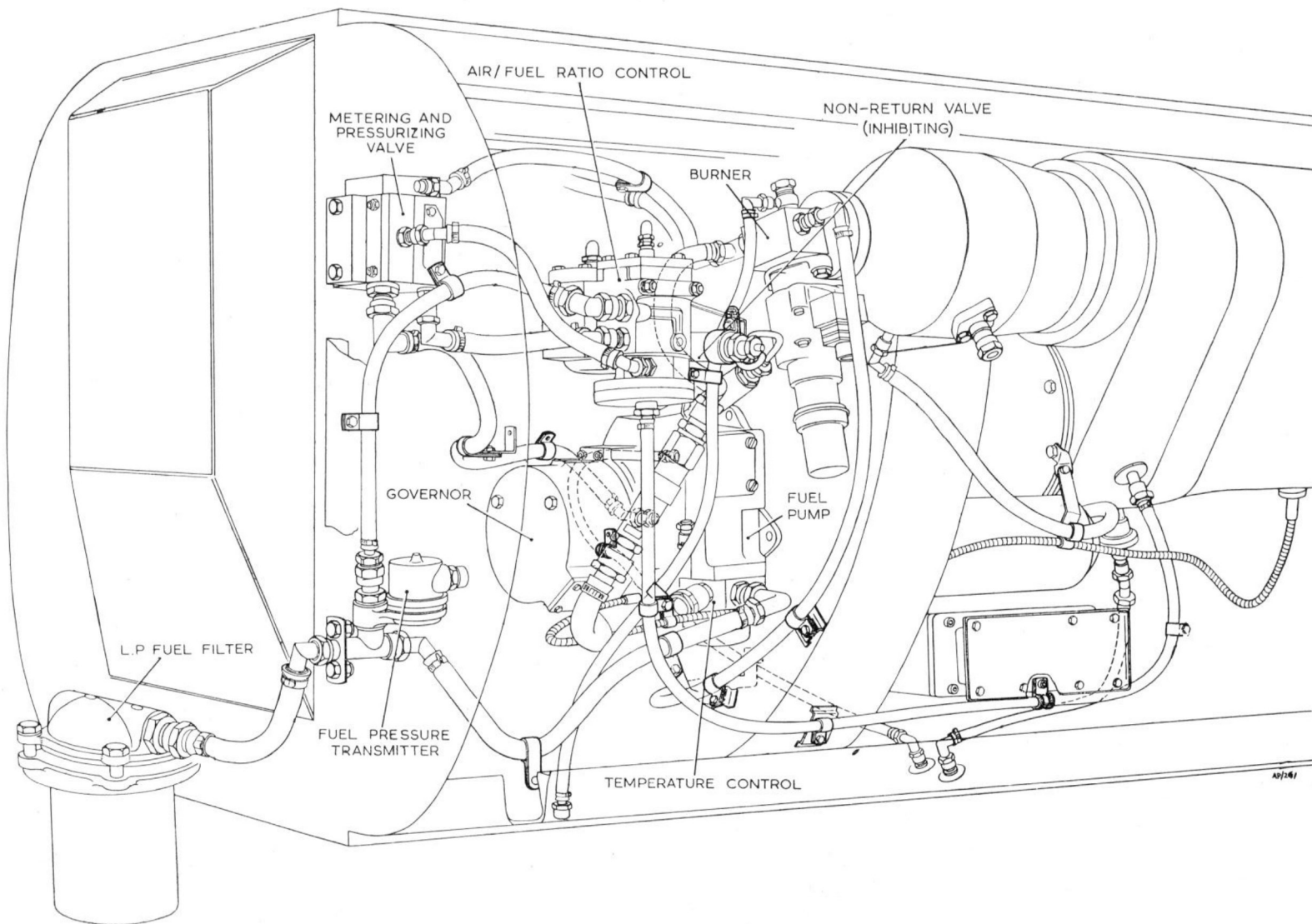
2. (1) Release the appropriate pipe clips, cut the locking wire where necessary, and remove the flexible pipes connecting the component parts of the fuel system.
- (2) Carefully examine and blank the flexible pipes removed from the unit (Chap. 1).
- (3) Fit suitable blanking caps to all open connections of the fuel system components.

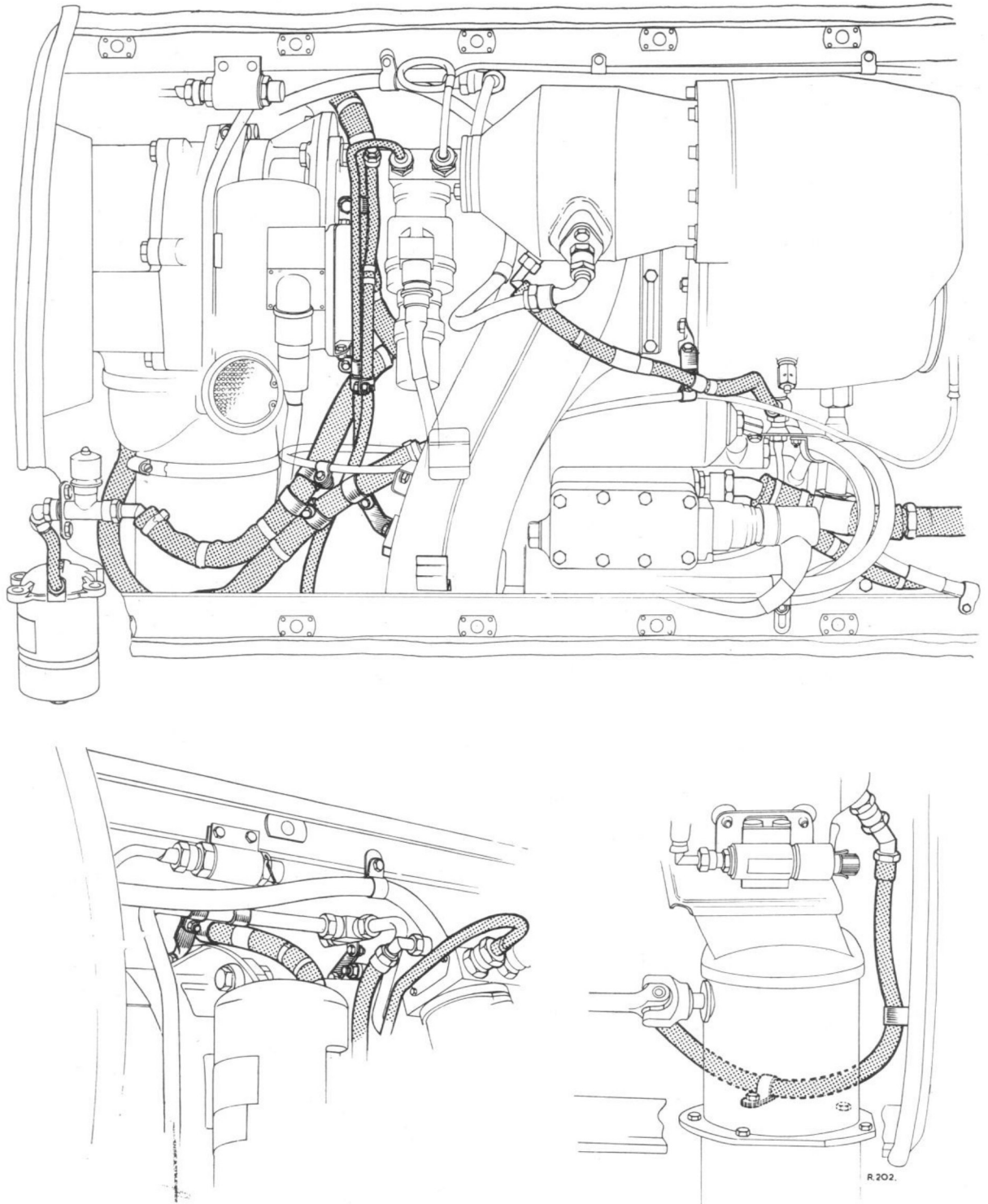
##### Removing the combustion chamber and burner assembly

##### WARNING . . .

**Before undertaking any work on the ignition system, ensure that all electrical services to the power plant are switched OFF, and affix a warning notice to the appropriate switch.**

Fig. 1. Fuel system pipes and clips (Pre Mod. M182)





**Fig. 2. Fuel system pipes and clips (Mod. M182)**

3. (1) Disconnect the igniter cable at the igniter plug.
- (2) Cut the locking wire and release the pipes at the burner. Release the oxygen pipe at the bulkhead connection on the rear end panel and the burner high pressure fuel pipe (Mod. M182) at the fuel pump. Blank all the open pipe joints and swivel the oxygen supply pipe and the burner high pressure fuel pipe (Mod. M182) away from the combustion chamber.
- (3) Cut the locking wire and disconnect the I.B.I harness at the burner actuator.
- (4) Cut the locking wire and release the two nuts securing the combustion chamber support bracket to the a.c. generator support casing.
- (5) Cut the locking wire and release the two nuts securing the combustion chamber support bracket and the burner flange to the combustion chamber; then remove the support

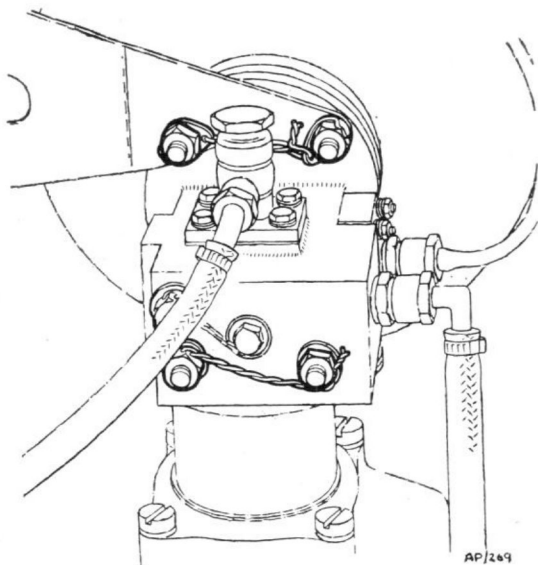


Fig. 3. Burner securing nuts (Pre Mod. M182)

bracket. Note the locking wire tabwasher (fig. 3 or fig. 4).

(6) Cut the locking wire and remove the two remaining nuts securing the burner to the combustion chamber (fig. 3 or fig. 4); then withdraw the burner assembly complete with the actuator, carefully noting the gaskets between the burner flange and the combustion chamber.

**Note . . .**

*Some difficulty may be experienced in withdrawing the burner if the gaskets have fused, and in such cases it may be necessary to lightly tap the burner body. Under no circumstances however should any attempt be made to free the burner by tapping or exerting any leverage on the actuator body.*

(7) Release the twelve socket head screws and spring washers securing the combustion chamber to the main air casing; then withdraw the combustion chamber complete with the igniter plug, carefully noting the gasket between the mounting flange of the combustion chamber and the main air casing.

**Note . . .**

*Three of the socket head screws on the starboard side of the combustion chamber are only accessible with special tool Ref. No. 64AF/4.*

**Dismantling the combustion chamber**

**WARNING . . .**

**Before undertaking any work on the ignition system ensure that all electrical services to the power plant are switched OFF, and affix a warning notice to the appropriate switch.**

4. (1) Release the gland nut from the suspension plug in the outer air casing of the combustion

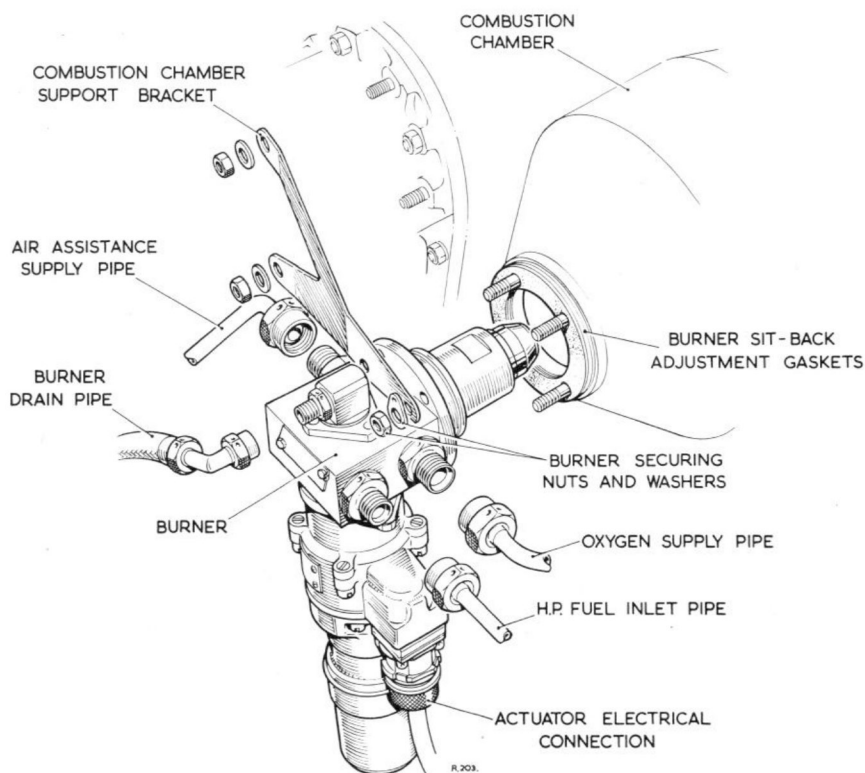


Fig. 4. Removing the burner (Mod. M182)

chamber, and withdraw the igniter plug complete with the sealing washer. Where Mod. M101 is incorporated, unscrew the igniter plug complete with the sealing washer.

(2) Knock down the ears of the retaining tabwashers, and release the two set-bolts securing the suspension plug to the combustion chamber outer air casing. Note the wire locking tabwasher beneath one of the set-bolts.

(3) Withdraw the suspension plug from the combustion chamber outer air casing, noting the gasket between the flange of the suspension plug and the casing. The flame tube can now be extracted from the outer air casing for examination.

#### Examining the flame tube

5. Fig. 5 and 6 show the type of distortion or buckling which should be looked for when examining the flame tube. Fig. 5 shows typical buckling in the region of the primary zone; fig. 6 illustrates the type of buckling which may be expected around the skirt of the flame tube. It must be emphasized, however, that any visible degree of buckling will render the flame tube unfit for further service.



Fig. 5. Unacceptable damage to the flame tube primary zone

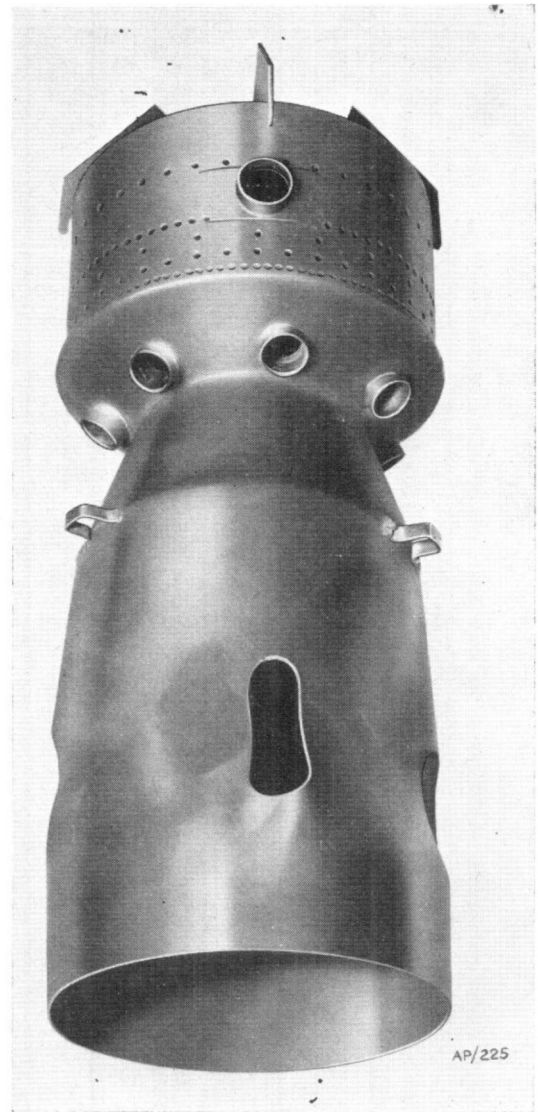


Fig. 6. Unacceptable damage to the flame tube skirt

#### Removing the metering valve (Pre Mod. M182)

6. (1) Release the two bolts and plain washers securing the metering valve to the front end panel, and remove the valve complete with the mounting bracket.
- (2) Release the four self-locking nuts securing the mounting bracket to the metering valve, then part the two components.

#### Removing the air fuel ratio unit and non-return inhibiting valve (Pre Mod. M182)

7. (1) Cut the locking wire and release the union nut securing the pipe from the fuel pump strainer to the air fuel ratio control unit.
- (2) Remove the split pins and release the two bolts and castellated nuts securing the air fuel ratio mounting bracket to the a.c. generator support casing. The air fuel ratio unit and the non-return inhibiting valve,



together with the respective mounting brackets, can now be withdrawn from the power plant as a complete unit.

(3) Release the bolt, plain washer and self-locking nut securing the non-return inhibiting valve support clip to the mounting bracket.

(4) Unscrew the banjo bolt securing the inhibiting valve to the air fuel ratio unit, and remove the valve, noting the bonded seals positioned on either side of the valve banjo. Blank the exposed orifice in the air fuel ratio unit.

(5) Release the four self-locking nuts and plain washers securing the two mounting brackets to the air fuel ratio unit.

#### Removing the fuel pump, governor and temperature control assembly (Pre Mod. M182)

8. (1) Drain the engine oil sump (Chap. 4).  
(2) Cut the locking wire and disconnect the oil cooler supply and return pipes at the respective unions on the engine auxiliaries mounting plate.  
(3) Remove the blower unit (Chap. 5).  
(4) Cut the locking wire and remove the two securing bolts, and the temperature control mercury boiler can then be withdrawn from the exhaust cone, complete with the plain and slotted retaining plates and aluminium gasket.

#### Note . . .

*Should any difficulty be experienced in releasing the mercury boiler retaining bolts, spray each bolt with penetrating fluid and allow to soak for half an hour before attempting to unscrew.*

(5) Free the temperature control capillary tube completely by releasing the three retaining pipe clips.

#### Note . . .

*Care must be taken during all these operations to ensure that the temperature control capillary tube is not bent unnecessarily, otherwise the tube may be fractured.*

(6) With the fuel pump adequately supported and the locking wire severed, release the single long set-bolt and plain washer which passes through the starboard side of the fuel pump body; then using a 'crow's foot' 'tee' handled spanner, release the two short set-bolts and plain washers securing the port side of the pump (fig. 7).

(7) Withdraw the fuel pump, governor and temperature control assembly from the port side of the power plant, taking care not to damage the gasket between the fuel pump and the engine auxiliaries mounting plate. If the fuel pump drive coupling centre piece is not withdrawn on the pump drive coupling, it should be removed from the oil pump driving gear dog.

#### Removing the fuel pump (Mod. M182)

9. (1) Drain the engine oil sump (Chap. 4).  
(2) Cut the locking wire and disconnect the oil cooler supply and return pipes at the respective unions on the engine auxiliaries mounting plate.  
(3) Remove the motorised air pump (Sect. 5, Chap. 4).  
(4) Cut the locking wire and remove the two securing bolts, and the temperature control mercury boiler can then be withdrawn from the exhaust cone, complete with the plain and slotted retaining plates and aluminium gasket.

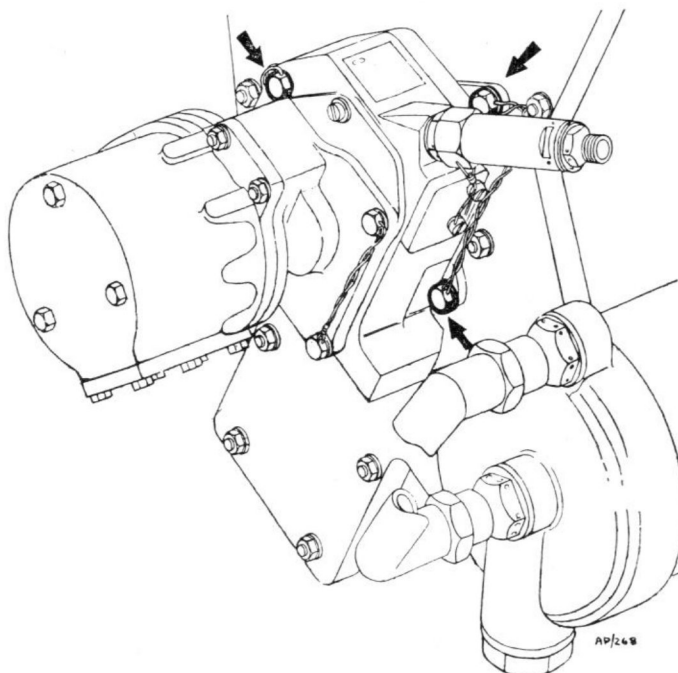


Fig. 7. Fuel pump securing bolts (Pre Mod. M182)

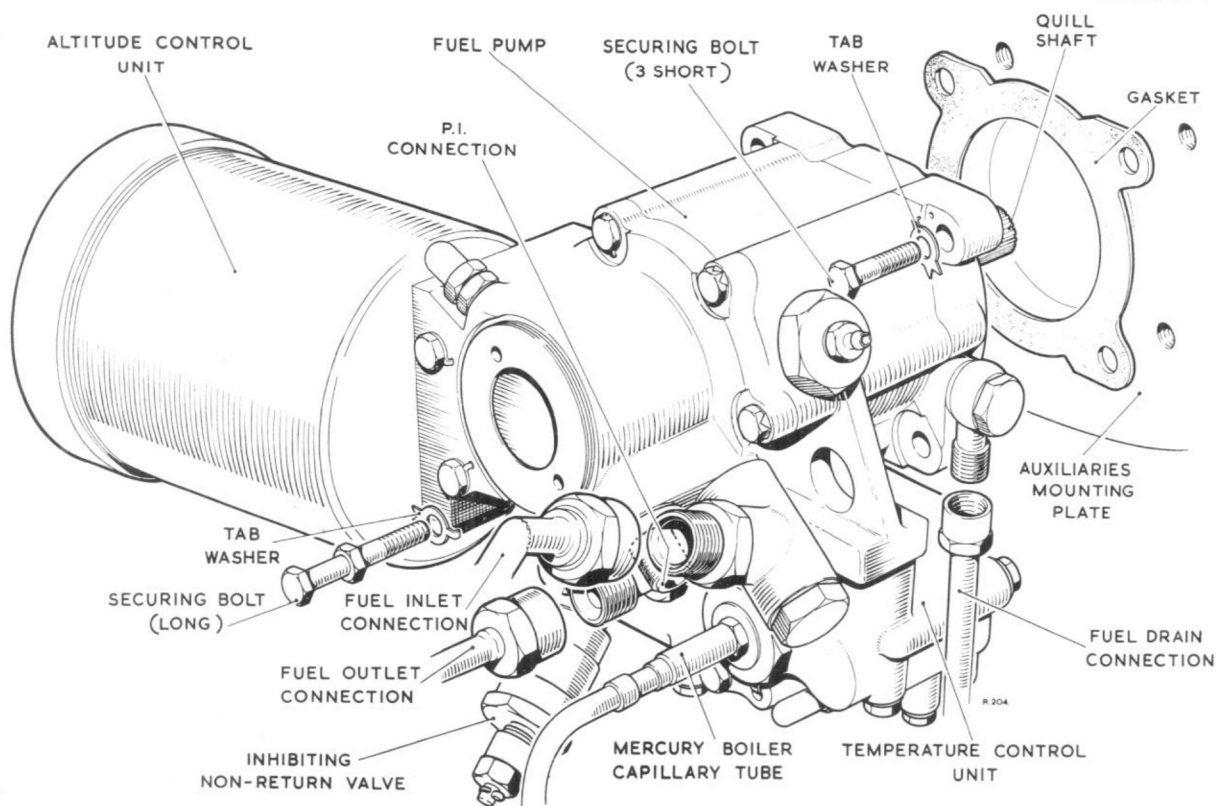


Fig. 8. Fuel pump (Mod. M182)

**Note . . .**

*Should any difficulty be experienced in releasing the mercury boiler retaining bolts, spray each bolt with penetrating fluid and allow to soak for half an hour before attempting to unscrew.*

- (5) Free the temperature control capillary tube completely by releasing the three retaining pipe clips.

**Note . . .**

*Care must be taken during all these operations to ensure that the temperature control capillary tube is not bent unnecessarily, otherwise the tube may be fractured.*

- (6) Disconnect the fuel pipes at the fuel pump and blank the openings of the pipes. Support the fuel pump and remove the four bolts and tabwashers that secure the fuel pump. Withdraw the fuel pump from the port side of the power plant, taking care not to damage the fuel pump gasket.

### FITTING A REPLACEMENT CALIBRATED FUEL SYSTEM ASSEMBLY

Fitting the fuel pump, governor and temperature control assembly (Pre Mod. M182)

10. (1) Position the fuel pump drive coupling centre piece on the oil pump driving gear dog.  
(2) Place the gasket, between the fuel pump and the engine auxiliaries mounting plate, in position on the fuel pump mounting face.

- (3) Carefully align the fuel pump drive coupling with the centre piece on the oil pump driving gear dog, place the fuel pump in position on the engine auxiliaries mounting plate, and evenly tighten the three retaining bolts and plain washers. It is most important, however, to ensure that the fuel pump drive coupling and the centre piece are correctly engaged before securing the fuel pump to the auxiliaries mounting plate.

- (4) Lay the temperature control capillary tube in position and assemble the plain and slotted retaining plates to the mercury boiler.

- (5) It is vitally important that the shank of the boiler lies parallel to the exhaust stream. To ensure that any deviation is kept to a minimum hold the boiler in the correct position and carefully mark the body of the boiler and the exhaust cone with 'Talc', i.e. metal soapstone or french chalk.

- (6) Place the aluminium washer in position on the exhaust cone and insert the boiler complete with the retaining plates; carefully align the two chalk marks, and when satisfied that the boiler is correctly positioned within the exhaust cone, smear the retaining bolts with a little molybdenum disulphide ZX-28 (Ref. No. 34B/9437518) and securely tighten.

**Caution . . .**

*Lead pencils, wax crayons, grease pencils and similar media must not be used to mark the exhaust cone, or any other component subject to high operating temperatures, owing to the possibility of a carbon*

*deposit being formed, which could lead to deterioration of the metal in that particular area.*

- (7) Check that the run of the capillary tube is free and without tension, then fit the three retaining pipe clips.
- (8) Finally check that the wire locking has been correctly fitted.

#### Fitting the fuel pump (Mod. M182)

11. (1) Position the fuel pump drive coupling centre piece on the oil pump driving gear dog.
- (2) Place the gasket, between the fuel pump and the engine auxiliaries mounting plate, in position on the fuel pump mounting face.
- (3) Carefully align the fuel pump drive coupling with the centre piece on the oil pump driving gear dog, place the fuel pump in position on the engine auxiliaries mounting plate, and evenly tighten the four retaining bolts and tabwashers. It is most important, however, to ensure that the fuel pump drive coupling and the centre piece are correctly engaged before securing the fuel pump to the auxiliaries mounting plate.
- (4) Lay the temperature control capillary tube in position and assemble the plain and slotted retaining plates to the mercury boiler.
- (5) It is vitally important that the shank of the boiler lies parallel to the exhaust stream. To ensure that any deviation is kept to a

minimum hold the boiler in the correct position and carefully mark the body of the boiler and the exhaust cone with 'Talc', i.e. metal soapstone or french chalk.

- (6) Place the aluminium washer in position on the exhaust cone and insert the boiler complete with the retaining plates; carefully align the two chalk marks, and when satisfied that the boiler is correctly positioned within the exhaust cone, smear the retaining bolts with a little molybdenum disulphide ZX-28 and securely tighten.

#### Caution . . .

*Lead pencils, wax crayons, grease pencils and similar media must not be used to mark the exhaust cone, or any other component subject to high operating temperatures, owing to the possibility of a carbon deposit being formed, which could lead to deterioration of the metal in that particular area.*

- (7) Check that the run of the capillary tube is free and without tension, then fit the three retaining pipe clips.
- (8) Connect the fuel pipes to the fuel pump.
- (9) Secure the tabwashers and the wire locking.

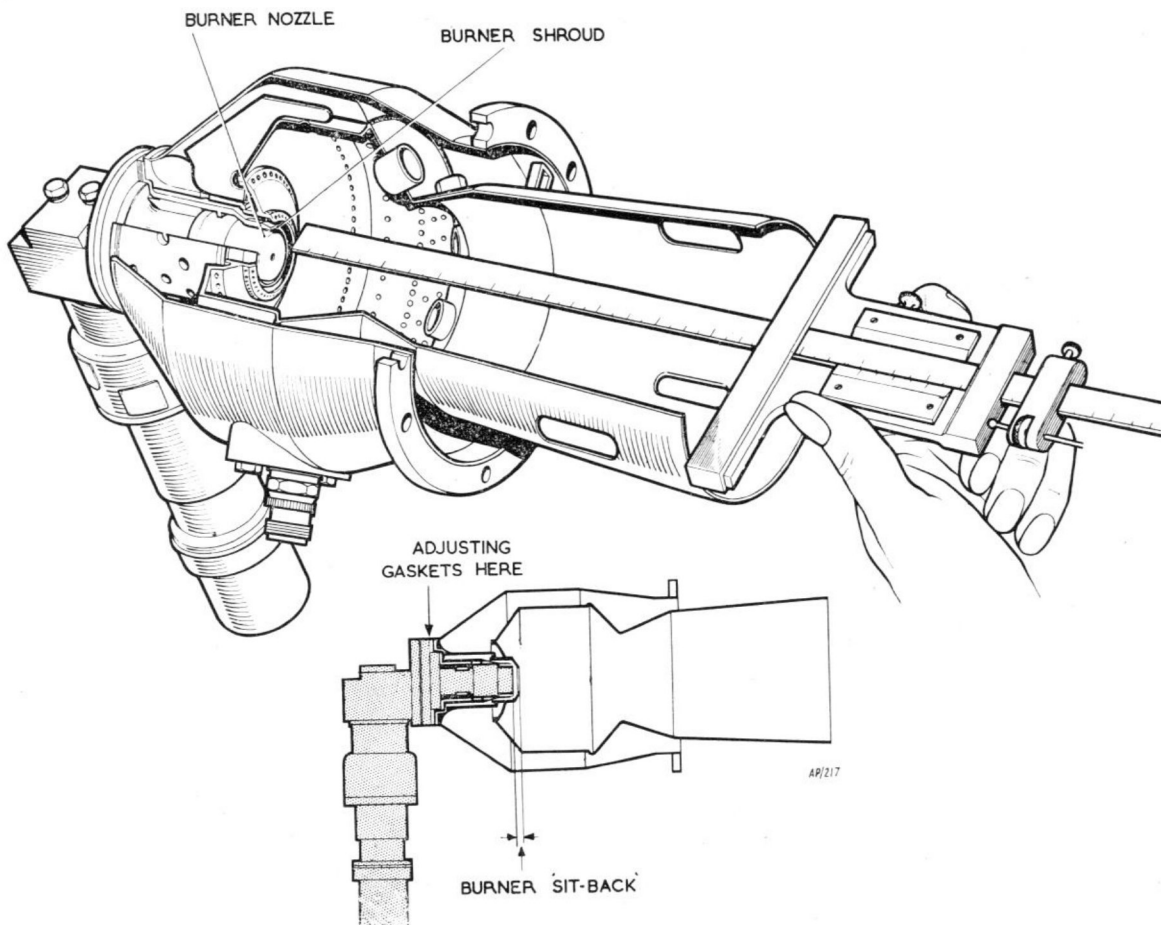


Fig. 9. Burner 'sit-back' adjustment



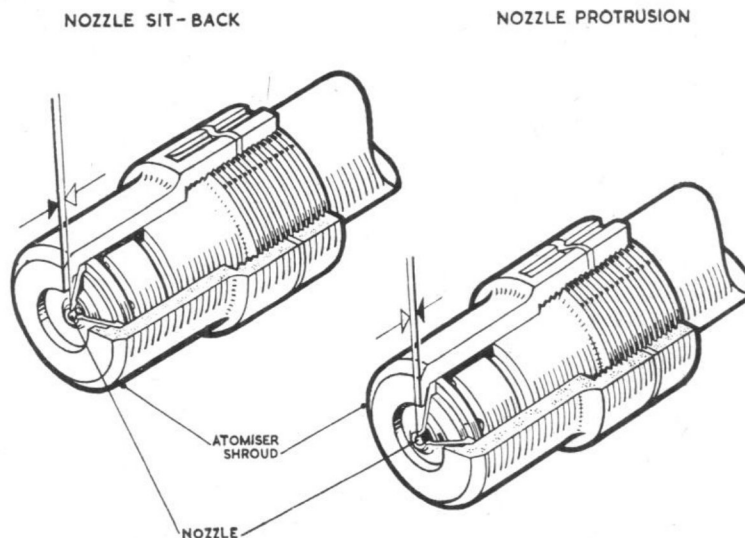


Fig. 10. Burner nozzle position

### FITTING THE COMBUSTION CHAMBER AND REPLACEMENT BURNER

#### Assembling the combustion chamber

12. (1) Position the flame tube concentrically within the outer air casing, making sure the igniter suspension plug apertures in each casing are in alignment.
- (2) Place the suspension plug gasket in position on the outer air casing, then insert the suspension plug, taking care to ensure that the plug locates in the aperture in the flame tube.
- (3) Lightly smear the two suspension plug retaining bolts with molybdenum disulphide; place a locking tabwasher beneath the head of each bolt and secure the suspension plug to the outer air casing.

#### Note . . .

*An additional wire-locking tabwasher must be placed beneath the head of the left-hand bolt, to enable the combustion chamber fuel drain pipe to be wire-locked.*

#### Burner 'sit-back' (fig. 9)

13. When fitted to the engine, the burner nozzle must 'sit-back'  $0.065 \pm 0.005$  in. behind the burner shroud in the flame tube. The burner 'sit-back' is determined by the number of gaskets interposed between the burner flange and the flange of the combustion chamber outer air casing. The number of gaskets required to obtain the correct relationship can be determined by the use of a vernier depth gauge as described in the following sub-paragraphs.

#### Note . . .

*The adjusting gaskets are supplied in the following thicknesses:—Ref. No. 36AF/350 is 0.015 in.; Ref. No. 36AF/605 is 0.030 in. It should be noted however that these dimensions, which are only approximate, will tend to vary*

*slightly from gasket to gasket and it is advisable to take a micrometer reading when selecting them for use.*

- (1) Place the burner in position in the combustion chamber assembly, and temporarily secure with four nuts.
- (2) Insert the vernier depth gauge into the flame tube, and measure and record the distance between the mouth of the flame tube and the burner shroud.
- (3) With the depth gauge, take a second reading measured from the flame tube mouth to the burner nozzle and record the dimension obtained.
- (4) Subtract the dimension obtained in sub-para. (2) from that established in sub-para. (3) and the resulting figures will give an indication of the number of adjusting gaskets required to obtain the correct burner 'sit-back'.

#### Note . . .

- (1) *On some burner assemblies, the nozzle may lie below the face of the atomizer shroud, thereby preventing an accurate reading being taken when the burner is mounted in the combustion chamber. In such cases a separate reading should be taken from the face of the atomizer shroud down to the burner nozzle and the resultant figure added to the dimension obtained in sub-para. (3) (fig. 10).*
- (2) *If, on the other hand, the nozzle protrudes beyond the atomizer shroud, a further reading will not be necessary as it will then be possible to obtain a correct reading with the burner in the combustion chamber.*
- (3) *On all replacement fuel systems, the position of the nozzle is clearly indicated on a label secured to the burner unit.*

- (5) Having established the number of adjusting gaskets required, remove the burner from the combustion chamber, then refit with the gaskets in position.
- (6) Repeat the operations detailed in subpara. (2), (3) and (4) until the correct burner 'sit-back' is obtained, then securely tighten and wire-lock the two lower burner retaining nuts, leaving the two upper nuts finger-tight.

#### Assembling the combustion chamber to the engine

14. (1) Position the combustion chamber gasket on the main air casing mounting flange, then offer up the combustion chamber complete with the burner and actuator assembly: the portion of the flame tube skirt that extends beyond the combustion chamber outer air casing should slide into the volute casing within the main air casing.
- (2) The correct position for the combustion chamber can easily be determined by the flat on the mounting flange of the outer air casing which must correspond with a similar flat on the compressor housing.
- (3) Secure the combustion chamber to the main air casing with twelve socket head screws and spring washers. Note that the screws on the starboard side of the combustion chamber are only accessible with tool Ref. No. 64AF/4.

#### Note . . .

*If at any time the combustion chamber has to be removed and refitted with the remainder of the fuel system 'in situ', the burner unit must be removed before the combustion chamber is offered up to the main air casing, otherwise the burner body will tend to foul the air fuel ratio unit or the motorised air pump.*

- (4) Remove the two uppermost burner retaining nuts, unscrew the two nuts on the a.c. generator support casing adjacent to the combustion chamber, and position the combustion chamber support bracket over the support casing studs.
- (5) Secure the support bracket to the flange of the burner with the two burner retaining nuts, not forgetting to position a wire locking tabwasher beneath the head of one of the nuts. Fit and securely wire-lock the two nuts securing the support bracket to the a.c. generator support casing.
- (6) Assemble the igniter plug together with the sealing washer into the suspension plug, and secure with the gland nut, if fitted.

#### Fitting the metering valve (Pre Mod. M182)

15. (1) Position the metering valve mounting bracket over the studs on the valve body and secure with four self-locking nuts.
- (2) Place the metering valve and bracket assembly in position on the front end panel and secure with two bolts and plain washers.

#### Fitting the air fuel ratio unit and non-return inhibiting valve (Pre Mod. M182)

16. (1) Position the air fuel ratio and non-return inhibiting valve mounting brackets over the studs on the air fuel ratio unit and secure with four self-locking nuts and plain washers.
- (2) Remove the appropriate blanking cap from the air fuel ratio unit and secure the inhibiting valve to the unit with the banjo bolt. Do not forget to position a bonded seal on either side of the inhibiting valve banjo.
- (3) Position the inhibiting valve support clip round the body of the valve, and secure the clip to the inhibiting valve support bracket with a bolt, plain washer and self-locking nut.
- (4) The air fuel ratio and inhibiting valve assembly can now be secured to the a.c. generator support casing with two bolts, castellated nuts and split pins.

#### Fitting the fuel system pipes and electrical connections

17. (1) Remove the blanking caps from the fuel system pipes and components and fit the fuel pipes and clips (fig. 1, Pre Mod. M182 or fig. 2, Mod. M182).
- (2) Connect the electrical connections to the appropriate components or accessories.
- (3) Connect the oil cooler supply and return pipes to the respective unions on the engine auxiliaries mounting plate and securely wire-lock.
- (4) Securely wire-lock all disturbed components and check each component and accessory for security.
- (5) Refill the engine oil sump (Sect. 4, Chap. 1).

#### Cautions . . .

- (1) *After fitting a replacement fuel system, the temperature control unit must be adjusted to suit the individual engine characteristics. This adjustment can only be made with the power plant installed in a test stand. Full instructions for carrying out this operation are given in Sect. 6.*
- (2) *Under no circumstances must a power plant be installed in an aircraft until this adjustment has been made, and in the event of facilities not being immediately available, the unit must be clearly labelled to the effect that the temperature control requires adjustment.*

#### LOW PRESSURE FUEL FILTER

##### Removing the low pressure fuel filter

18. (1) Cut the locking wire and disconnect the flexible pipe from the outlet side of the filter to the fuel pressure warning switch.
- (2) Sever the locking wire and release the two bolts, plain washers and the backing plate securing the fuel filter assembly to the front end panel.
- (3) Instructions for removing the filter element will be found in Sect. 4, Chap. 1.

**Fitting the low pressure fuel filter**

19. (1) Position the filter on the front end panel, then place the backing plate in position on the interior of the panel, and secure the filter with two bolts and plain washers.
- (2) Connect the flexible pipe from the fuel pressure warning switch to the outlet side of the filter, and securely wire-lock all the disturbed components.

**FUEL PRESSURE WARNING SWITCH****Removing the fuel pressure warning switch**

20. (1) Unscrew the knurled locking ring and disconnect the I.B.I harness at the fuel pressure warning switch.
- (2) Sever the locking wire and disconnect the flexible pipe from the air fuel ratio unit to the inlet union.
- (3) Unscrew the banjo bolt securing the pressure warning switch to the inlet union, and withdraw the switch carefully, noting the bonded seal either side of the banjo.

**Fitting the fuel pressure warning switch**

21. (1) Before attempting to fit a pressure warning switch, the instrument to be fitted must be checked to ensure that it will operate within the prescribed limitations which are 4 to 5 lbf/in<sup>2</sup>. Full details of this operation will be found in A.P.1275A, Vol. 1, Sect. 24, Sub-Sect. A, Chap. 17.
- (2) Secure the pressure warning switch to the fuel inlet union with the retaining banjo bolt, taking care to ensure that the bonded seals are correctly positioned, one on either side of the banjo.
- (3) Connect the flexible pipe from the air fuel ratio unit to the fuel inlet union and securely wire lock.

- (4) Connect the I.B.I harness at the pressure warning switch, and securely tighten the knurled locking ring.

**FUEL DRAIN MANIFOLD****Removing the fuel drain manifold**

22. (1) Cut the locking wire and disconnect the manifold pipe at the drain pockets on the underside of the bottom rail, at the union on the forward support bracket, and at the fuel drain valve.
- (2) Release the pipe clip securing the manifold pipe to the central support bracket and remove the manifold pipe complete.

**Fitting the fuel drain manifold**

23. (1) Connect the manifold pipe to the respective unions and securely wire-lock.
- (2) Position the supporting pipe clip on the manifold pipe and secure the clip to the central support bracket with a bolt, plain washer and self-locking nut.

**FUEL DRAIN VALVE****Removing the fuel drain valve**

24. (1) Cut the locking wire and release the drain pipe at the drain valve.
- (2) Unscrew the drain valve assembly from the bottom rail and withdraw the valve from the power plant complete with the sealing washer.

**Fitting the fuel drain valve**

25. (1) Place the sealing washer on the valve and screw the complete assembly into the bottom rail.
- (2) Connect the fuel drain pipe and securely wire lock.



## Chapter 4

## IGNITION AND ELECTRICAL SYSTEMS

## LIST OF CONTENTS

	Para.		Para.
<i>Removing the oil cooler actuator</i> ... ..	1	<i>Removing the igniter cable and bulkhead con-</i>	
<i>Fitting an oil cooler actuator</i> ... ..	2	<i>nectors</i> ... ..	19
<i>Fitting a splined coupling</i> ... ..	3	<i>Fitting an igniter lead and bulkhead connector</i>	20
<i>Removing the burner actuator</i> ... ..	4	<i>Removing the exhaust thermocouples</i> ... ..	21
<i>Fitting a burner actuator</i> ... ..	5	<i>Testing the exhaust thermocouples</i> ... ..	22
<i>Removing the 7-way terminal block</i> ... ..	6	<i>Fitting the exhaust thermocouples</i> ... ..	23
<i>Fitting a 7-way terminal block</i> ... ..	7	<i>Removing the a.c. generator</i> ... ..	24
<i>Removing the bulkhead plug and cable connec-</i>		<i>Fitting an a.c. generator</i> ... ..	25
<i>tions</i> ... ..	8	<i>Removing the starter motor</i> ... ..	26
<i>Fitting bulkhead plug and cable connections</i> ...	9	<i>Fitting a starter motor</i> ... ..	27
<i>Removing the bulkhead plugs</i> ... ..	10	◀ <i>Removing the motorised air pump</i> ... ..	28
<i>Fitting a bulkhead plug</i> ... ..	11	<i>Fitting a motorised air pump</i> ... ..	29
<i>Removing electrical cables</i> ... ..	12	<i>Removing the hours counter</i> ... ..	30
<i>Fitting electrical cables</i> ... ..	17	<i>Fitting the hours counter</i> ... ..	31
<i>Removing and refitting the igniter plug</i> ... ..	18	<i>Removing the starts counter</i> ... ..	32
		<i>Fitting the starts counter</i> ... ..	33 ▶

## LIST OF ILLUSTRATIONS

	Fig.		Fig.
<i>Fitting the oil cooler actuator</i> ... ..	1	<i>Bulkhead plug and cable connections</i> ... ..	4
<i>Fitting the burner actuator</i> ... ..	2	<i>Fitting the exhaust thermocouples</i> ... ..	5
<i>Terminal block cable connections</i> ... ..	3	<i>Fitting the starter motor</i> ... ..	6

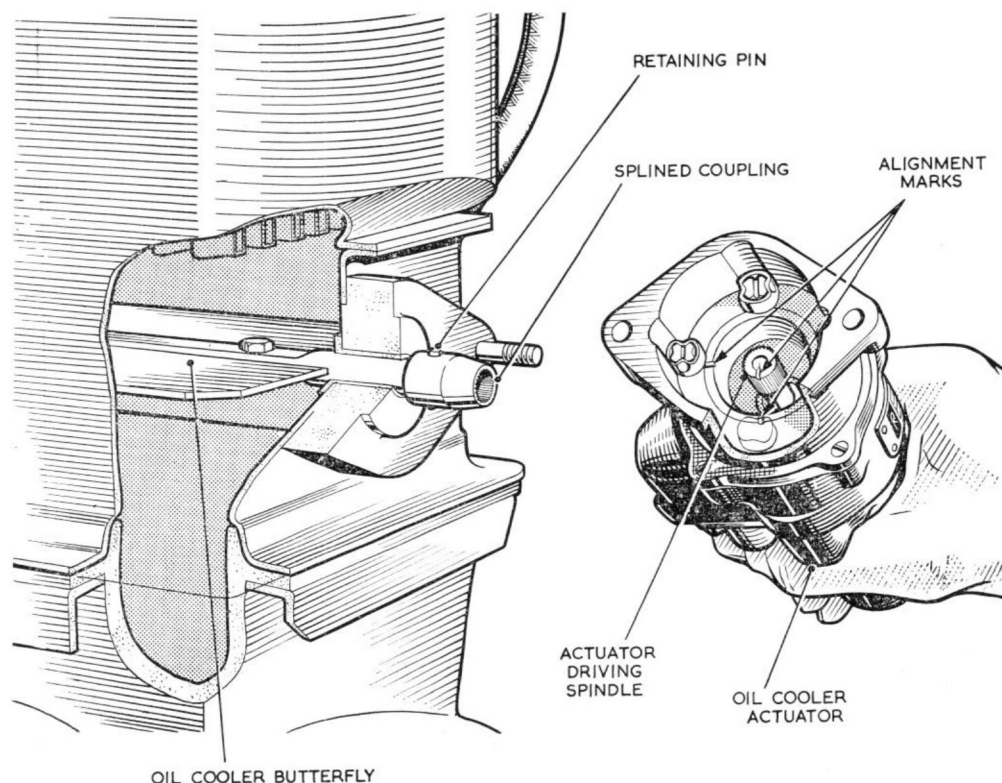


Fig. 1. Fitting the oil cooler actuator

#### Removing the oil cooler actuator

1. (1) Cut the locking wire and disconnect the electrical cable from the actuator.
- (2) Knock down the tabwashers and release the two nuts securing the actuator to the oil cooler body.
- (3) The actuator can now be withdrawn rearward over the mounting studs until it is clear of the oil cooler (fig. 1).

#### Fitting an oil cooler actuator

2. (1) Release the two screws, nuts and plain washers securing the protective rubber cover to the replacement actuator and withdraw the splined coupling from the actuator spindle.

#### Note . . .

*It should not normally be necessary to renew the splined coupling which is pinned to the oil cooler butterfly spindle. If the occasion should arise, the procedure given in para. 3 should be followed.*

- (2) Check the operational traverse and reversing of the actuator spindle and set the spindle to the assembly position as follows:—

(a) Hold the actuator, and using a 24 volt electrical supply, attach one electrical cable to the common terminal pin 'A' and the other to pin 'B'. Allow the actuator to motor until it cuts out, then check that the inscribed mark on the actuator drive spindle coincides with one of the inscribed marks on the actuator body (fig. 1).

#### Note . . .

*The identification letters of the terminal pins are moulded at the base of the pins in the electrical socket. Pin 'D' is for the location of the electrical plug only.*

- (b) Transfer the cable from pin 'B' to pin 'C', which will motor the actuator spindle in the opposite direction until the motor cuts out. Check that the inscribed mark on the spindle now coincides with the second inscribed mark on the actuator body.
- (c) When the conditions in (a) and (b) are satisfied, hold the actuator in the position in which it will be fitted to the oil cooler, and motor the actuator until the inscribed mark on the drive spindle coincides with the mark in the 9 o'clock position on the actuator body.
- (3) Turn the oil cooler butterfly spindle until the pin that secures the splined coupling to the spindle is in the vertical position.
- (4) Position the actuator over the studs on the oil cooler body, carefully engaging the splined drive with the splined coupling on the butterfly spindle. Secure the actuator to the oil cooler with two nuts and tabwashers.
- (5) Reconnect the electrical cable and securely wire-lock.
- (6) Carry out a functional test of the actuator.

#### Fitting a splined coupling

3. When fitting a replacement oil cooler actuator,



it may be found necessary to renew the splined coupling on the oil cooler butterfly spindle; proceed as follows:—

- (1) Remove the oil cooler assembly from the power plant complete (Chap. 4).
- (2) Remove the connecting tube from the oil cooler (Chap. 4).
- (3) Knock down the ears of the locking strip, and release the two bolts and nuts securing the butterfly plate to the spindle. The plate can now be withdrawn downwards from the throat of the cooler.
- (4) Withdraw the butterfly spindle complete with the splined coupling from the oil cooler body. Using a suitable punch, drive out the pin securing the splined coupling to the spindle, then part the two components.
- (5) Position the coupling on the spindle so that the pilot drilling in the coupling is exactly aligned with the hole in the spindle. Using a No. 32 drill, open out the pilot drilling in the coupling to 0.116 in. internal diameter. Care must be taken during this operation to ensure that as little material as possible is removed from the hole in the butterfly spindle.
- (6) With the spindle end coupling correctly aligned, drive home the securing pin.
- (7) Insert the spindle complete with the coupling into the bushes in the oil cooler body; position the butterfly plate on the spindle, and secure with two bolts, nuts and a locking strip.
- (8) Refit the connecting tube (Chap. 4).
- (9) Secure the oil cooler assembly to the a.c. generator (Chap. 4).

#### Removing the burner actuator

4. (1) Cut the locking wire and release the electrical cable at the socket connection on the burner actuator.
- (2) Release the two nuts, plain and spring washers and withdraw the actuator downward, carefully noting the splined coupling on the actuator spindle.
- (3) Remove the splined coupling from the actuator spindle.

#### Fitting a burner actuator (fig. 2)

5. Check the operational traverse and reversing of the actuator spindle as follows:—

(1) Energize the terminal pins 'A' and 'B' in the actuator connection socket to traverse the actuator spindle in a clockwise direction, and check that the mark inscribed on the spindle coincides with the appropriate mark on the actuator body. Now energize terminal pins 'A' and 'C' to reverse the spindle in a counter-clockwise direction, and check that the in-

scribed mark coincides with the second mark on the actuator body.

#### Note . . .

*The identification letters of the terminal pins are moulded at the base of the pins in the electrical socket. Pin 'D' is for the location of the electrical plug only.*

- (2) Turn the burner valve spindle until the inscribed mark on the spindle coincides with the lines inscribed on the burner body and end plate.
- (3) Motor the actuator in a clockwise direction until it cuts out; position the splined coupling on the actuator spindle, and offer the actuator up to the burner, carefully engaging the coupling with the burner valve spindle. Ensure that the burner valve spindle is not displaced during this operation.
- (4) Secure the actuator to the burner with two plain and spring washers and two nuts.
- (5) Re-connect the electrical cable to the actuator socket connection and securely wire-lock.

#### Removing the 7-way terminal block

6. (1) Release the five bolts, plain washers and self-locking nuts securing the terminal block cover to the interior of the front end panel and withdraw the cover.
- (2) Release the two screws, plain and spring washers securing the terminal block cover plate; then unscrew the self-locking nuts retaining the cable terminals, and draw the cables clear of the block.
- (3) Release the eight bolts, plain washers and self-locking nuts securing the terminal block to the front end panel, and withdraw the terminal block complete.

#### Fitting a 7-way terminal block (fig. 3)

7. (1) Release the two retaining bolts, plain and spring washers, and remove the terminal block cover plate.
- (2) Position the terminal block in the front end panel and secure with eight bolts, plain washers and nuts. Note that the bolts are inserted from the exterior of the panel.
- (3) Refit the a.c. generator and starter motor cables, and secure with the self-locking nuts. For the correct cable sequence refer to fig. 3.
- (4) Secure the terminal block cover plate with two screws, plain and spring washers.
- (5) Place the terminal block cover in position and secure with five bolts, plain washers and self-locking nuts. Note that the bolts are inserted from the interior of the power plant.

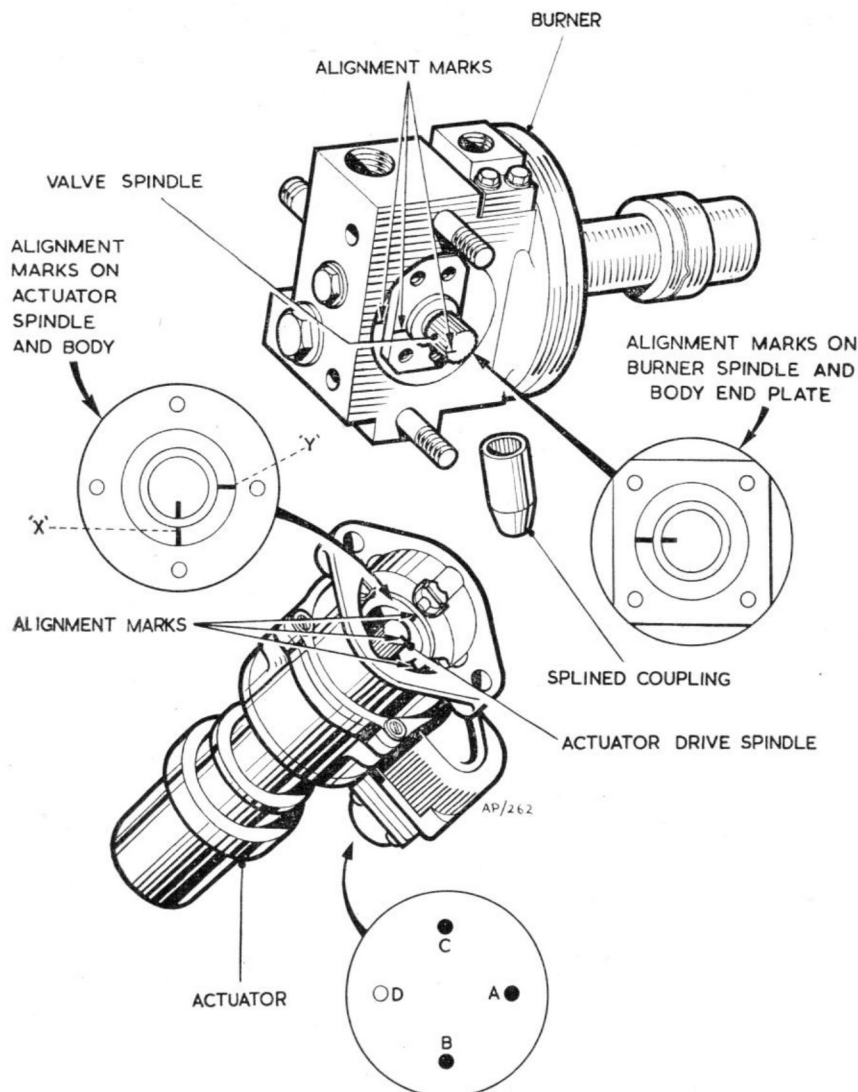


Fig. 2. Fitting the burner actuator

#### Removing the bulkhead plug and cable connections

8. The bulkhead plug and cable connections, utilized in the power plant, although not necessarily interchangeable, are all identical in construction and can be dismantled in the following manner:—

- (1) Cut the locking wire, unscrew the knurled locking ring and withdraw the cable socket assembly complete.
- (2) Screw the socket spanner on to the plug adapter; tighten the hexagon locking bolt in the head of the spanner; then utilizing the flats on the socket spanner, unscrew the adapter from the socket connection. The locking washer and ring can now be withdrawn.

#### Note . . .

*A range of special socket spanners number 64AF/6, 64AF/7, 64AF/8, 64AF/9 and 64AF/10 is available to deal with all the bulkhead plug and cable connections utilized in the power plant.*

#### Fitting bulkhead plug and cable connections (fig. 4)

9. (1) Position the locking ring and washer over the bulkhead plug or socket connection.
- (2) Screw the plug adapter into the socket spanner and securely tighten the locking hexagon in the head of the spanner.
- (3) Screw the plug adapter complete with the socket spanner into the socket connection and securely tighten, utilizing the flats on the spanner. Release the locking hexagon and unscrew the socket spanner leaving the adapter in position.
- (4) Using a suitable punch, lightly crimp the flange of the locking washer into one of the two indentations in the collar on the plug adapter.
- (5) Push the cable socket assembly into the socket connection; run the knurled locking ring on to the adapter, and securely tighten and wire-lock.

#### Removing the bulkhead plugs

10. (1) Remove the electrical cable socket assembly and the bulkhead plug locking ring, locking washer and adapter (para. 8).

RESTRICTED



- (2) Release the four securing screws, spring washers and nuts and remove the plug from the power plant.

#### Fitting a bulkhead plug

11. (1) Position the plug on the panel and secure with four screws, spring washers and nuts.  
(2) Refit the locking ring, locking washer and adapter, then refit the cable socket assembly (para. 9).

#### Removing electrical cables

12. The electrical cables are made up in six harnesses numbered from 1.B.1 to 1.B.6 respectively. The harnesses, which cannot be dismantled, are

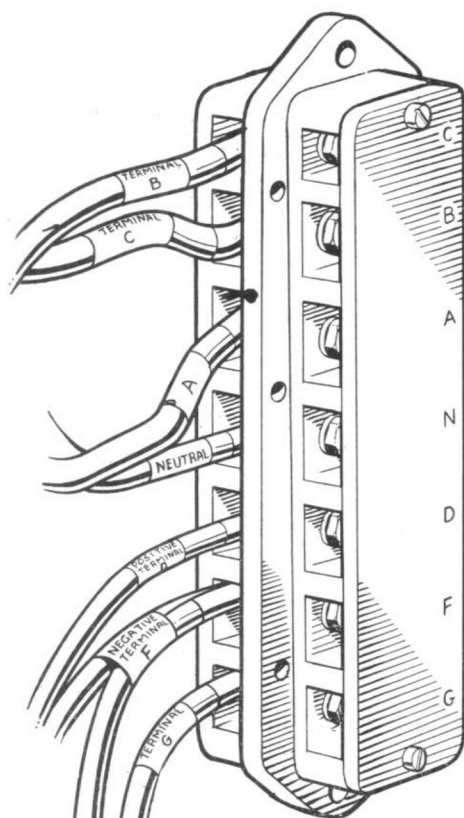


Fig. 3. Terminal block cable connections

secured to the interior of the power plant with cable clips.

13. Remove a defective harness as follows:—

- (1) Release the appropriate cable clips.
- (2) Disconnect the harness electrical connections from the appropriate accessory or component.
- (3) Disconnect the harness electrical connection from the bulkhead plug.
- (4) Remove the harness.

14. Examine each harness as follows:—

- (1) Examine the cable outer sheathing for damage, chafing, perishing and oil saturation. Reject the harness if it has any of these defects.
- (2) Check the sockets and knurled nuts for damage and the condition of the mating threads.

15. Check the continuity of each harness as follows:—

- (1) Subject the serviceable harnesses to a lamp and battery test. Flex the cable throughout its length while testing; reject the cable if the lamp flickers or if there is a drop in light intensity.

16. Check the insulation resistance of each harness as follows:—

- (1) Use a 500 volt Megger for this test and set the rotary switch to 'Insulation Resistance': the reading obtained should not be less than 2 Megohms.

#### Fitting electrical cables

17. Check the harness continuity and insulation resistance (para. 15 and 16), and assemble into the power plant as follows:—

- (1) Lay the harness in position in the power plant and connect the electrical connections to the appropriate accessories or components.

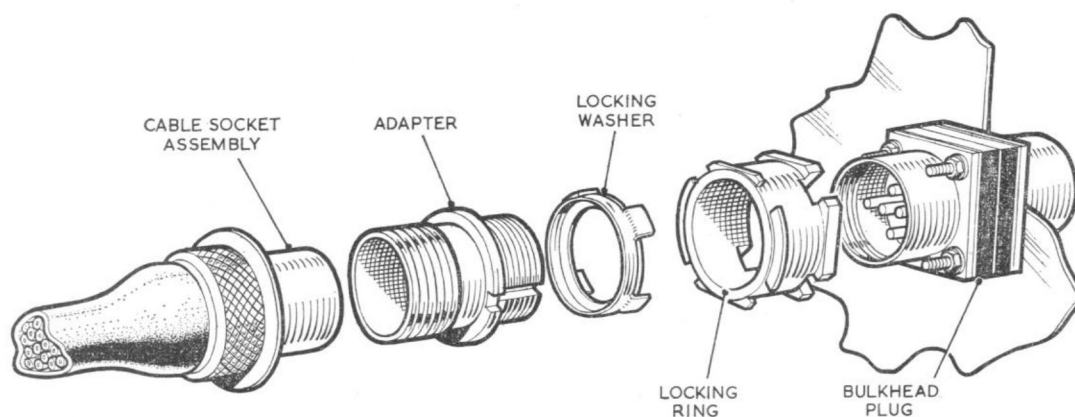


Fig. 4. Bulkhead plug and cable connections

(2) Retain the harness loosely with the appropriate cable clips. If the installation is particularly difficult, it may prove helpful to assemble the clips to the harness before laying it in position.

(3) Check that the harness is evenly distributed through the clips, then securely tighten each clip.

(4) Examine the assembly for the correct positioning of the harness, and check the security of all harness clips.

(5) Carry out a functional test of the components fitted to the disturbed harnesses, using the power plant test stand.

#### Removing and refitting the igniter plug

18. The procedure for removing and refitting the igniter plug is given in ◀Sect. 5, Chap. 3▶

#### Removing the igniter cable and bulkhead connector

##### WARNING . . .

**Before undertaking any work on the ignition system ensure that all electrical services to the power plant are switched OFF, and affix a warning notice to the appropriate switch.**

19. (1) Cut the locking wire and disconnect the igniter cable at the bulkhead connector and the igniter plug.
- (2) Release the cable clip on the top rails and the second clip on the air intake duct, and withdraw the igniter cable complete.
- (3) Release the four securing bolts, plain washers and self-locking nuts and withdraw the bulkhead connector complete. Note the wire locking tab underneath one of the nuts and another beneath the head of one of the bolts.

#### Fitting an igniter lead and bulkhead connector

20. (1) Position the connector on the front end panel and secure with four bolts, plain washers and self-locking nuts. Note that the bolts, with plain washers beneath the heads, are inserted from the exterior of the panel. Do not forget to position a wire-locking tab beneath one of the nuts, and another beneath the head of one of the bolts.
- (2) Thread the igniter cable into position.
- (3) Connect the cable to the bulkhead connector and the igniter plug. Secure the bulkhead connections with locking wire.
- (4) Secure the cable loosely with the cable clips; then adjust the cable evenly through the clips, and tighten the clips securely.
- (5) Carry out a dry motoring cycle to test the operation of the cable.

#### Removing the exhaust thermocouples

21. (1) Using Tool No. 421492, release the union nuts securing the thermocouples to their bosses on the exhaust cone and carefully withdraw each thermocouple from the cone. The harness arrangement does not make it practical to remove the thermocouples individually.

##### Note . . .

*Should any difficulty be experienced in releasing the thermocouple nuts, spray each boss and nut with penetrating fluid (oil OM-21 plus 10% kerosine, Grade B), and allow to soak for half an hour before attempting to unscrew.*

(2) Disconnect the thermocouple harness at the junction box on the front end panel. Release the twelve cable clips securing the harness to the bottom rail and the end panels, and remove the harness complete with the thermocouples.

(3) Withdraw the four thermocouple leads from the oil resistant sheath.

(4) Under no circumstances should the thermocouples be dismantled or the leads interfered with or reduced in length. Each thermocouple and lead should be examined for damage, and if in good condition, checked for continuity and insulation.

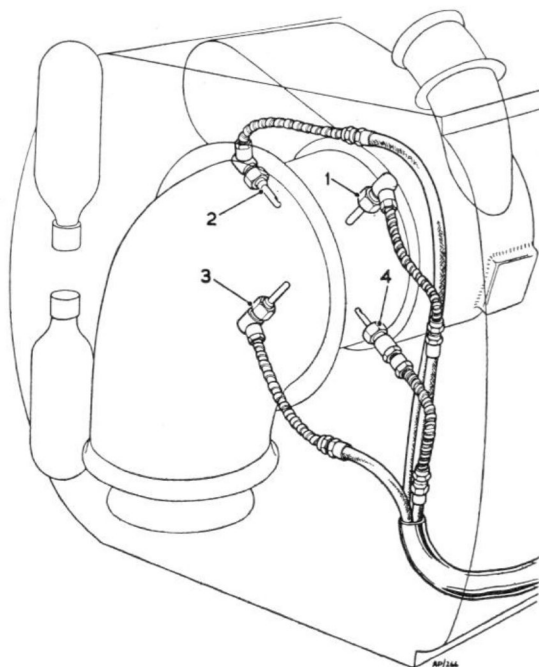


Fig. 5. Fitting the exhaust thermocouples

#### Testing the exhaust thermocouples

22. (1) The resistance value of each thermocouple measured from the 1.B.1 bulkhead

plug to the contact end must be as shown in the following list.

#### Pre Mod. M104

Thermocouple (Ref. No.)	Resistance (ohms)
F1079/6	2.01 $\pm$ 0.11
F1079/7	2.35 $\pm$ 0.12
F1079/8	1.97 $\pm$ 0.11
F1079/9	1.80 $\pm$ 0.10

#### Mod. M104

Thermocouple (Ref. No.)	Resistance (ohms)
F1210	1.79 $\pm$ 0.11
F1211	1.98 $\pm$ 0.12
F1238	2.02 $\pm$ 0.12
F1212/1	2.36 $\pm$ 0.14

#### Note . . .

*Identification of the thermocouples can be obtained from the reference number engraved on the body of each thermocouple.*

- (2) The insulation resistance of each thermocouple measured between the wires and the sheath by a 250 volt megger must not be less than 100 ohms at  $650^{\circ}\text{C} \pm 50^{\circ}\text{C}$ .

- (3) Thermocouples which become damaged or fail to pass the above tests should be considered unserviceable. Do not attempt to service a defective thermocouple; discard it and install a new one.

#### Fitting the exhaust thermocouples

23. (1) Lay the four thermocouple leads together and bind the ends together with a suitable length of locking wire.
- (2) Powder the interior of the protective hose with french chalk; then thread the lock-wire through the hose, and draw the four thermocouple leads into the hose.
- (3) Smear the threads of the thermocouple bosses on the exhaust cone with a little molybdenum disulphide ZX-28, and insert the couples into the respective bosses. It is most important to ensure that the locating key on each couple is correctly located in the slot in the thermocouple bosses.
- (4) When satisfied that each thermocouple is correctly located within the boss, securely tighten the retaining union nut.
- (5) Lay the thermocouple harness in position in the power plant and loosely secure the retaining cable clips.

- (6) Connect the harness to the junction box on the front end panel, and distribute the harness evenly through the clips; when satisfied that it is correctly positioned, securely tighten each clip.

- (7) Examine the assembly for correct positioning of the harness and the security of all cable clips; then carry out the checks described in para. 22.

#### Removing the a.c. generator

24. (1) Disconnect all the electrical cables, fuel pipes and clips secured to the front end panel, and remove the panel complete with the fire extinguisher equipment, low pressure fuel filter and the 7-way terminal block (Chap. 2).
- (2) Remove the oil cooler complete (Chap. 4).
- (3) Remove the two split pins, castellated nuts, plain washers and bolts securing the a.c. generator and the support bracket to the a.c. generator support casing. Securely wire the air/fuel ratio unit (Pre Mod. M182) to the top rail to obviate the possibility of any strain being placed on the fuel pipes.
- (4) Ensure that the a.c. generator is properly supported; then release the six remaining bolts and withdraw the a.c. generator forward until it is clear of the power plant. Note that two of the bolts are secured with nuts, and four are secured directly into the support casing. Note also the fibre joint washer between the a.c. generator and the support casing.

#### Note . . .

*The drive coupling between the a.c. generator and the engine stub shaft may either be withdrawn with the a.c. generator or remain on the stub shaft.*

#### Fitting an a.c. generator

25. (1) Position the drive coupling on the engine stub shaft and offer up the a.c. generator to the support casing with the fibre joint washer in position.
- (2) Carefully engage the splined a.c. generator drive shaft in the drive coupling, and secure the a.c. generator to the support casing with six bolts, two nuts and six plain and spring washers.
- (3) Correctly position the air/fuel ratio support bracket on the a.c. generator support casing; then insert the two remaining bolts, and secure with two plain washers, castellated nuts and split pins.
- (4) Refit the oil cooler and connecting tube (Chap. 4).

(5) Refit the front end panel (Chap. 2); re-make all broken connections, and securely wire-lock all disturbed components.

**Note . . .**

*The sequence in which the a.c. generator cables should be secured to the 7-way terminal block is shown in fig. 3.*

**Removing the starter motor**

**WARNING . . .**

**Before undertaking any work on the electrical system ensure that all electrical services to the power plant are switched OFF and affix a warning notice to the appropriate switch.**

26. (1) Disconnect the electrical connections at the starter motor.
- (2) Remove the four split pins, then unscrew the five cap-screws securing the starter motor to the gearbox. Note particularly the position of the cap-screw carrying the anchor nut.
- (3) Ease the starter motor out of engagement with the gearbox and discard the O-ring seal.

**Fitting a starter motor**

27. (1) Position a new O-ring seal on the starter motor spigot, then ease the starter motor into engagement with the gearbox.
- (2) Place a plain washer on each of the five cap-screws, then assemble the one cap-screw without a split pin hole with the plain washer and anchor nut in the position shown in fig. 6. Place the four remaining cap-screws and plain washers in position, and fit the plain washers, spring washers, castle nuts and split pins.
- (3) Re-connect the electric start cables to the starter motor terminals, ensuring that correct polarity is maintained; then switch the electrical services ON, and remove the warning notice.

**Removing the motorised air pump (Mod. M182)**

28. Disconnect the I.B.6 harness at the motorised air pump and the air assistance pipe at the pump and non-return valve, then remove the four bolts, washers and stiffnuts that secure the air pump to the mounting bracket.

**Fitting a motorised air pump (Mod. M182)**

29. Position the air pump on its mounting bracket and secure it with the four bolts, washers and stiffnuts. Reconnect the I.B.6 harness at the motorised air pump, and the air assistance pipe at the pump and non-return valve.

**Removing the hours counter**

30. Disconnect the leads at the back of the instrument; remove the two stiffnuts and the fixing bracket, then push the counter through the front of the mounting bracket.

**Fitting the hours counter**

31. Pass the counter through the hole in the mounting bracket, fit the fixing bracket over the two studs in the counter, and fit the two stiffnuts, not milled edge nuts. Connect the leads to the appropriate terminals on the counter.

**Removing the starts counter**

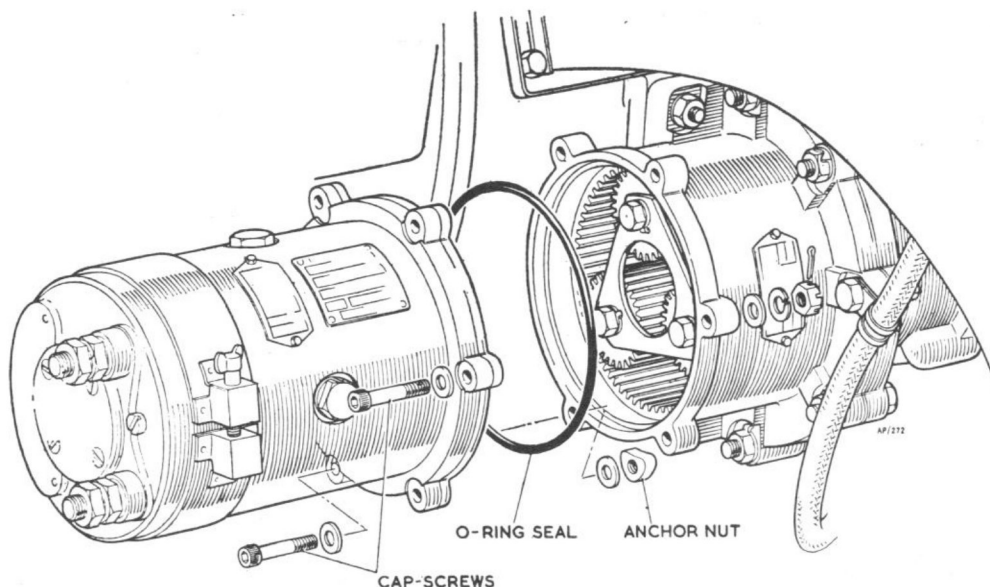
32. (1) Disconnect the leads at the back of the counter.
- (2) Remove the two screws and plain washers securing the counter to the mounting bracket and remove the counter.

**Fitting the starts counter**

33. (1) Position the counter behind the mounting bracket and align the screw holes.
- (2) Fit a plain washer on each screw and fit the screws through the mounting bracket into the counter.
- (3) Connect the leads at the back of the counter.

**Note . . .**

*When fitting a replacement counter, remove and discard the reset knob.*



**Fig. 6. Fitting the starter motor**

## Chapter 5

## FIRE PREVENTION SYSTEM

## LIST OF CONTENTS

	Para.
Removing the fire extinguisher bottle ... ..	1
Fitting a fire extinguisher bottle ... ..	2
Removing the extinguisher bottle adapter, banjo and banjo bolt ...	3
Fitting an adapter, banjo and banjo bolt ... ..	4
Removing the extinguisher bottle carrier and support bracket ...	5
Fitting a carrier and support bracket ... ..	6
Removing the extinguisher nozzles ... ..	7
Fitting extinguisher nozzles ... ..	8
Removing the fire detectors ... ..	9
Fitting fire detectors ... ..	10

## LIST OF ILLUSTRATIONS

Extinguisher bottle and adapter ... ..	1
Detector harness fastening ... ..	2

## Removing the fire extinguisher bottle

1. The fire extinguisher bottle mounted on the rear end panel can be removed from the carrier bracket in the following manner:-

- (1) Disconnect the electrical plug from the fire extinguisher
- (2) Cut the locking wire and disconnect the two discharger pipes at the extinguisher outlet banjo union.
- (3) Cut the locking wire and release the screw securing the halves of the extinguisher bottle retaining strap.
- (4) Lift the extinguisher bottle clear of the carrier bracket.

## Fitting a fire extinguisher bottle

2. When fitting an extinguisher bottle, particular care must be taken to ensure that the bottle and operating head are correctly positioned in relation to the front end panel, otherwise it is possible for chafing to occur against the air scoop hydraulic pipe.

- (1) Remove the adapter from the neck of the original extinguisher bottle, and transfer the adapter, banjo and banjo bolt to the replacement unit (para.3).
- (2) Place the bottle in the carrier bracket, making quite sure that it is correctly positioned (fig.1), and fasten the halves of the retaining strap with the securing screw.
- (3) If the operating head and electrical socket are not in correct alignment, loosen the retaining strap.



(4) Loosen the operating head lock nut.

(5) Slacken the banjo bolt and rotate the banjo union until the front flexible pipe connection is  $20^{\circ}$  above the horizontal position. Retighten the banjo bolt.

◀ (6) Rotate the extinguisher bottle until the electrical socket is  $45^{\circ}$  to starboard of the fore and aft position then tighten and wire lock the bottle retaining clamp.

(7) (a) Connect the two discharge pipes to the banjo union, do not fully tighten, and turn the operating head rearwards until the minimum clearance is obtained between the rear discharge pipe and the front end panel.

(b) Secure the operating head lock nut and the discharge pipe connections.

(c) Check that the forward discharge pipe does not protrude more than 3 inches forward of the dished face of the front end panel, measured in the horizontal plane.

(8) Fully tighten the operating head locknut.

(9) Fully tighten and wire lock the two discharge pipe connections and the banjo bolt. ▶

(10) Ensure that the electrical plug is electrically safe and reconnect to the extinguisher bottle.

Removing the extinguisher bottle adapter, banjo and banjo bolt

3. (1) Cut the locking wire and disconnect the two discharge pipes at the banjo union.

(2) Release the banjo bolt, withdraw the banjo union and unscrew the adapter from the neck of the bottle. Discard the three bonded washers.

Fitting an adapter, banjo and banjo bolt.

4. (1) If the extinguisher bottle is a replacement unit, it will first be necessary to remove the union in the neck of the bottle. The adapter complete with a new bonded washer can now be screwed into the bottle neck followed by the banjo and the banjo bolt.

(2) Do not forget to fit a new bonded washer between the adapter and the banjo, and the banjo and the banjo bolt.

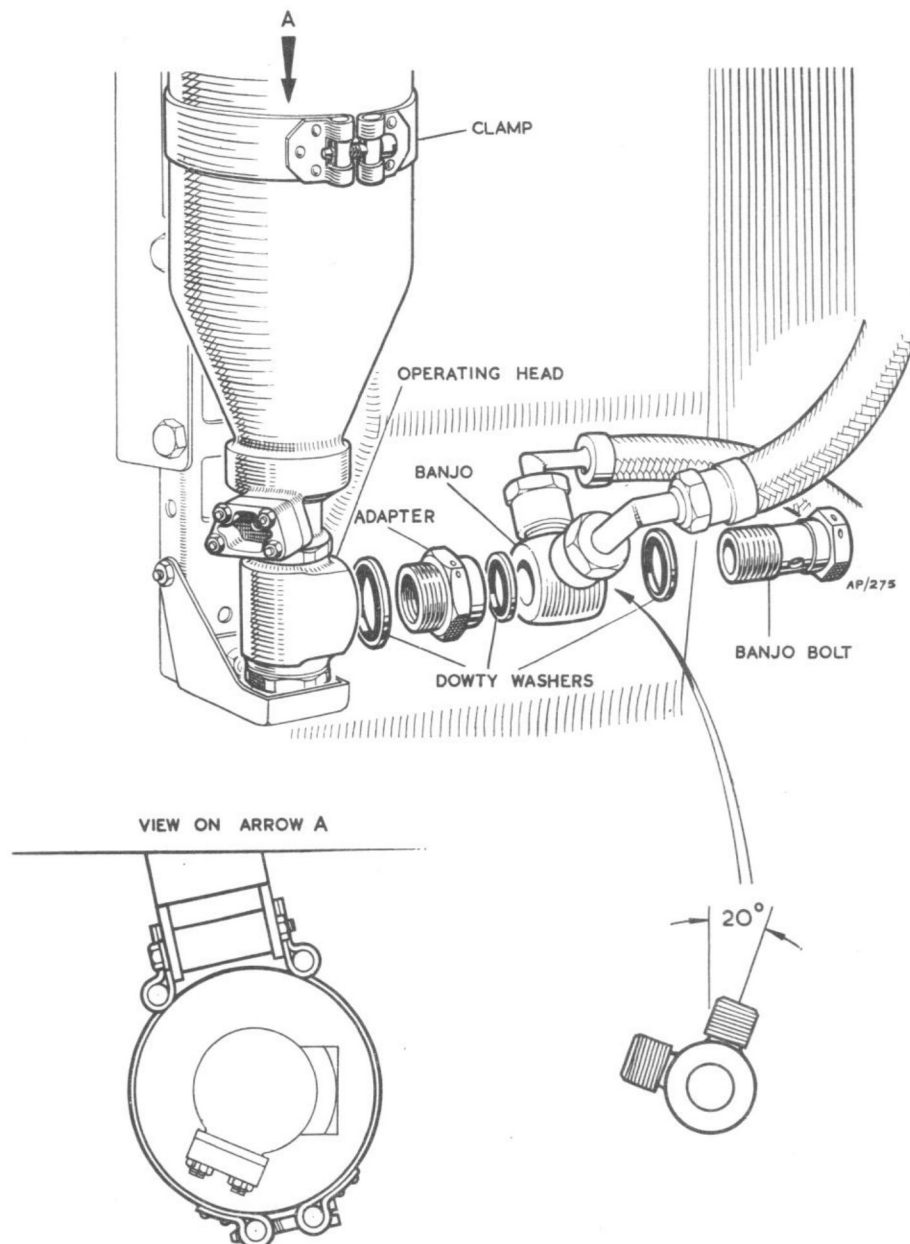


Fig. 1. Extinguisher bottle and adapter

**Removing the extinguisher bottle carrier and support bracket**

5. (1) Remove the fire extinguisher bottle (para. 1).
- (2) Release the three bolts, plain washers and self-locking nuts securing the carrier to the support bracket, and remove the carrier bracket complete.
- (3) Release the three bolts, plain washers and self-locking nuts securing the support bracket to the front end panel and remove the support bracket. Note the large diameter plain washer beneath the head of each bolt and the smaller washer between the nut and the panel.

**Fitting a carrier and support bracket**

6. (1) Place the support bracket in position on

the front end panel and secure with three bolts, six plain washers and three self-locking nuts. The large diameter plain washer should be fitted beneath the head of each bolt, and the smaller washers interposed between the nuts and the front end panel.

- (2) Position the carrier in the support bracket and secure with three bolts, plain washers and self-locking nut.

**Removing the extinguisher nozzles**

7. The two extinguisher nozzles are located in the front end panel. The removal procedure is as follows:—

- (1) Cut the locking wire and disconnect the two extinguisher discharge pipes at the extinguisher nozzles.





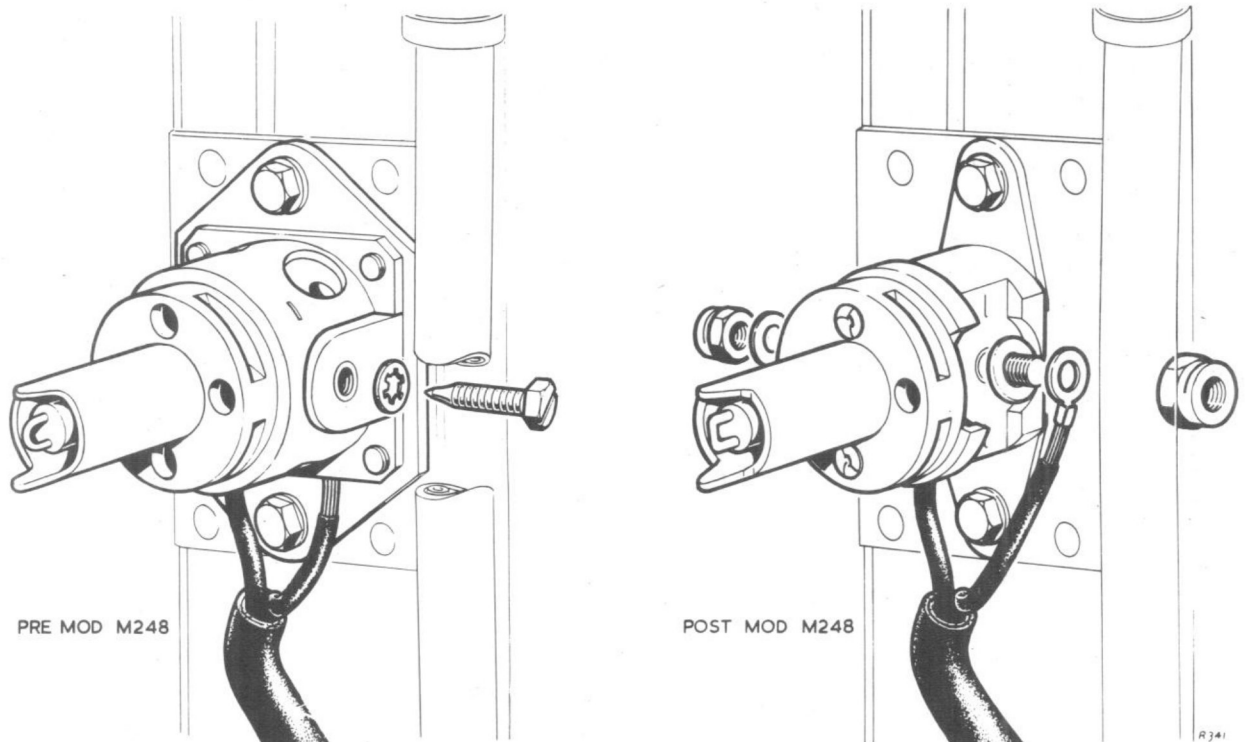


Fig. 2. Detector harness fastening

(2) Release the three bolts, plain washers and self-locking nuts securing each nozzle to the front end panel, and withdraw the nozzles from the panel.

(3) Note the locking wire tab on each nozzle; each tab is retained by one of the securing bolts.

#### Fitting extinguisher nozzles

8. (1) Place the nozzles in position from the outside of the front end panel and secure each nozzle with three bolts, plain washers and self-locking nuts.

(2) Place a wire locking tab under the head of one of the bolts on each nozzle, and finally recouple the discharge pipes to the nozzles and securely wire-lock in the approved method.

#### Removing the fire detectors

9. ◀ Four detector heads are fitted to each unit; three are located on the rear end panel and the fourth on the top rail immediately above the support casing. Detector heads to Pre Mod. M248 standard retain the harness by means of a grub-screw clamping the cable within a bore (Fig. 2). Heads to the post modification standard retain ring terminals, fitted to the ends of the harness, on a stud and are secured with a plain washer and stiff nut. Different size studs are fitted to the head to make it impossible for the positive and negative leads to be connected in reverse. ▶

(1) Disconnect the harness leads from the detector heads either by slackening the grub screw or by removing the stiff nut and plain washer as applicable.

(2) Release the two bolts and plain washers securing each of the three detectors to the rear end panel, and remove the detectors complete. The fourth detector head on the top rail can be removed after releasing the two retaining bolts and self-locking nuts.

Fitting fire detectors

10. (1) Secure the three detectors to the rear end panel with two bolts and plain washers to each detector and reconnect the harness leads.

(2) Secure the fourth detector to the top rail immediately above the support casing with two bolts and self-locking nuts, and reconnect the harness leads.

## Chapter 6

CARTRIDGE STARTING EQUIPMENT  
(Completely Revised)

## LIST OF CONTENTS

	Para.
General ... ..	1
Removing the connection housings ... ..	2
Fitting a connection housing ... ..	3
Removing the cartridge thermostats and clips ... ..	4
Fitting the thermostats and clips... ..	5
Removing the cartridge barrel from the breech block... ..	6
Fitting a cartridge barrel ... ..	7
Removing the top inlet pipe ... ..	8
Fitting the top inlet pipe ... ..	9
Removing the bottom inlet pipe ... ..	10
Fitting the bottom inlet pipe ... ..	11
Removing the tie rods... ..	12
Fitting tie rods ... ..	13
Removing the barrel and breech block assembly... ..	14
Fitting a barrel and breech block assembly ... ..	15

## LIST OF ILLUSTRATIONS

	Fig.
Installation of cartridge starting equipment ... ..	1
Cable and pipe connections ... ..	2
Measuring the inlet pipe expansion gap ... ..	3

## General

1. The power plant is equipped with two cartridge start barrel assemblies which differ only in so far as the harness runs and inlet pipes are concerned and the following instructions with the foregoing exceptions apply to either barrel.

## Removing the connection housings

2. (1) Remove the breech cap assembly (Sect. 4).
- (2) Turn down the ears of the tabwashers and remove the two nuts and bolts securing the connection housing halves.
- (3) Remove the breech cap joint washer and withdraw the two connection housing halves.

## Note . . .

When removing the breech cap joint washer or the connection housing halves particular care must be taken to ensure that the contact spring (fig. 1) on the connection housing is not bent or disturbed.

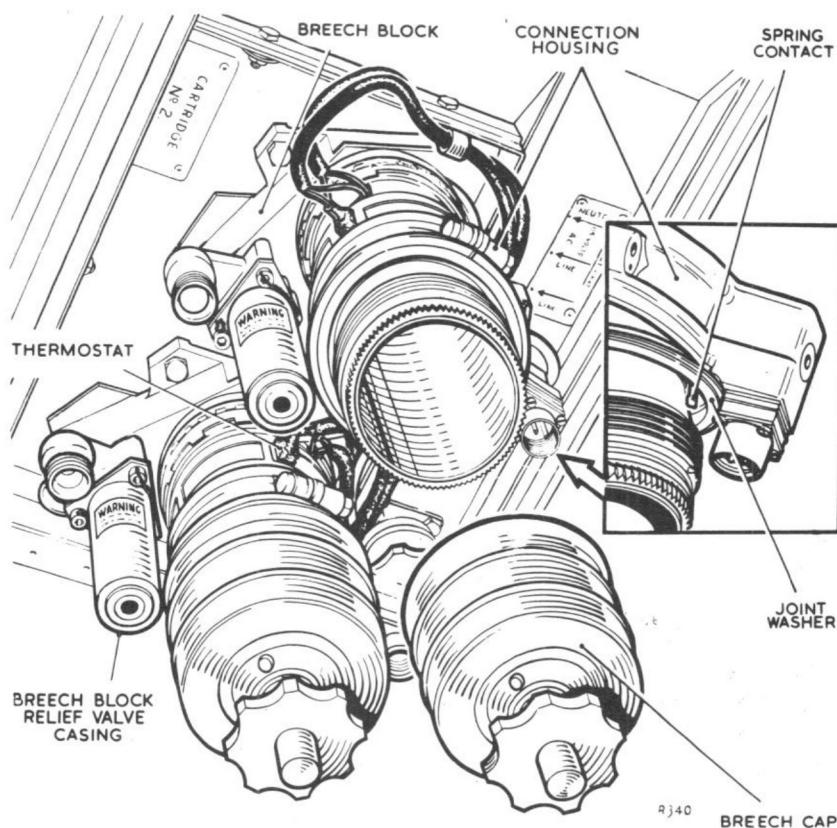


Fig. 1. Installation of cartridge starting equipment

#### Fitting a connection housing

3. (1) Place the plain half of the connection housing in position on the barrel
- (2) Position the breech cap joint washer on the barrel making quite certain that it fits snugly into the groove in the connection housing half.
- (3) Offer the other half of the connection housing up to the barrel, ensuring that the contact spring is inside the breech cap joint washer and secure the two connection halves together with two bolts, nuts and tabwashers.

#### Removing the cartridge thermostats and clips (fig. 2)

4. (1) Unscrew the knob to release the cartridge junction box cover, remove the cover and disconnect the heater mat and thermostat lead from within the box.
- (2) Remove the clips securing the leads to the bottom rail and withdraw the sheathing enclosing each set of cables.
- (3) Turn down the ears of the locking strip and remove the two bolts and nuts securing the thermostat clip, withdraw the packing piece and locking strip, discard the locking strip.
- (4) Spring the clip from around the barrel and remove the thermostat complete with leads, sheathing and rubber boot.

- (3) Position the special tool Ref. No. 64AF/5 on the barrel serrations and securely tighten until the locking ring can be fitted snugly into the serrations on the breech block.
- (4) When satisfied that the barrel is correctly tightened, position the locking ring and secure by snapping the barrel retainer into position.
- (5) Refit the cartridge thermostat and clip (para. 5).
- (6) Refit the breech cap (Sect. 4).

#### Removing the top inlet pipe

8. (1) Cut the locking wire and unscrew the large nut securing the top inlet pipe to the breech block outlet connection.
- (2) Cut the locking wire and unscrew the nut securing the pipe to the main air casing connection.
- (3) The top inlet pipe together with the quill tube, distance tube and copper sealing washer, can now be withdrawn from the unit.
- (4) Insert the quill tube extractor (special tool Ref. No. 64AF/1) into the main air casing connection and turn until the dogs on the shank of the tool engage in a recess in the quill tube. The tube can then be withdrawn.

#### Fitting the top inlet pipe (fig. 5)

9. (1) Insert the quill tube into the orifice in the main air casing making sure that it is properly seated and then insert the distance tube behind it.
- (2) With a vernier depth gauge measure the distance between the mouth of the orifice and the distance tube and carefully record the dimension so obtained.
- (3) Now turn to the inlet pipe to be fitted, slide the top union nut back until the collar integral with the pipe is exposed and, with a vernier depth gauge, measure the distance between the end face of the pipe and the upper face of the collar.
- (4) Select the new copper sealing washer to be fitted with the inlet pipe, and take a micrometer reading of the thickness.
- (5) Subtract the thickness of the washer from the dimension obtained in sub-para. 3, then subtract the resulting figure from that established in sub-para. 2.
- (6) The final figure, which represents the gap allowed for expansion between the distance tube and the inlet pipe, must be 0.050 in. Variance from this figure may be caused by the quill tube seating incorrectly.
- (7) When satisfied that the expansion gap between the distance tube and the inlet pipe is correct, assemble the inlet pipe to the unit, tighten down the two union nuts and finally secure with locking wire.

Removing the bottom inlet pipe

10. (1) Cut the locking wire and release the two union nuts securing the bottom inlet pipe to the breech block and main air casing connections.
- (2) Cut the locking wire and release the union nut securing the top inlet pipe to the breech block outlet connection.
- (3) Remove the two retaining split pins and withdraw the clevis pins securing the tie rods to the cartridge breech tray and push both rods sideways until they are clear of the fixing brackets.
- (4) Slacken, but do not remove, the ten bolts and self locking nuts securing the cartridge breech tray to the bottom rail.
- (5) The elongated bolt holes in the tray will permit the entire tray assembly to be depressed sufficiently to enable the inlet pipe to be withdrawn.
- (6) Before withdrawing the inlet pipe, cup one hand underneath the main air casing orifice to catch the distance tube.
- (7) Insert the quill tube extractor (Ref. No. 64AF/1) into the main air casing connection and turn until the dogs on the shank of the tool engage in a recess in the quill tube: the tube can then be withdrawn.

Fitting the bottom inlet pipe (fig. 5)

11. (1) Refit the quill tube and distance tube, then check that the expansion gap between the distance tube and the inlet pipe is correct (para. 9).
- (2) Place the bottom inlet pipe in position not forgetting the new copper joint washer and loosely couple the two union nuts to the respective connections.
- (3) Swivel the inlet pipe until satisfied that the lower end is properly seated on the breech block outlet connection, then securely tighten the two nuts.
- (4) Tighten down the union nut securing the top inlet pipe to the breech block outlet connection.
- (5) Securely tighten the ten bolts and self locking nuts holding the cartridge breech tray in the bottom rail.
- (6) Swing the two tie rods into position over the respective brackets, check that the rods are correctly tensioned (para. 13), insert the retaining clevis pins and secure with split pins.
- (7) Check and ensure that all disturbed components are correctly wire-locked where necessary.

Removing the tie rods

12. (1) Withdraw the split pins from the top and bottom clevis pins.
- (2) Cut the locking wire and slacken the locknuts at each end of the rods, and turn the adjusters sufficiently to release any tension. Note that the bottom locknut has a left-hand thread in each case.



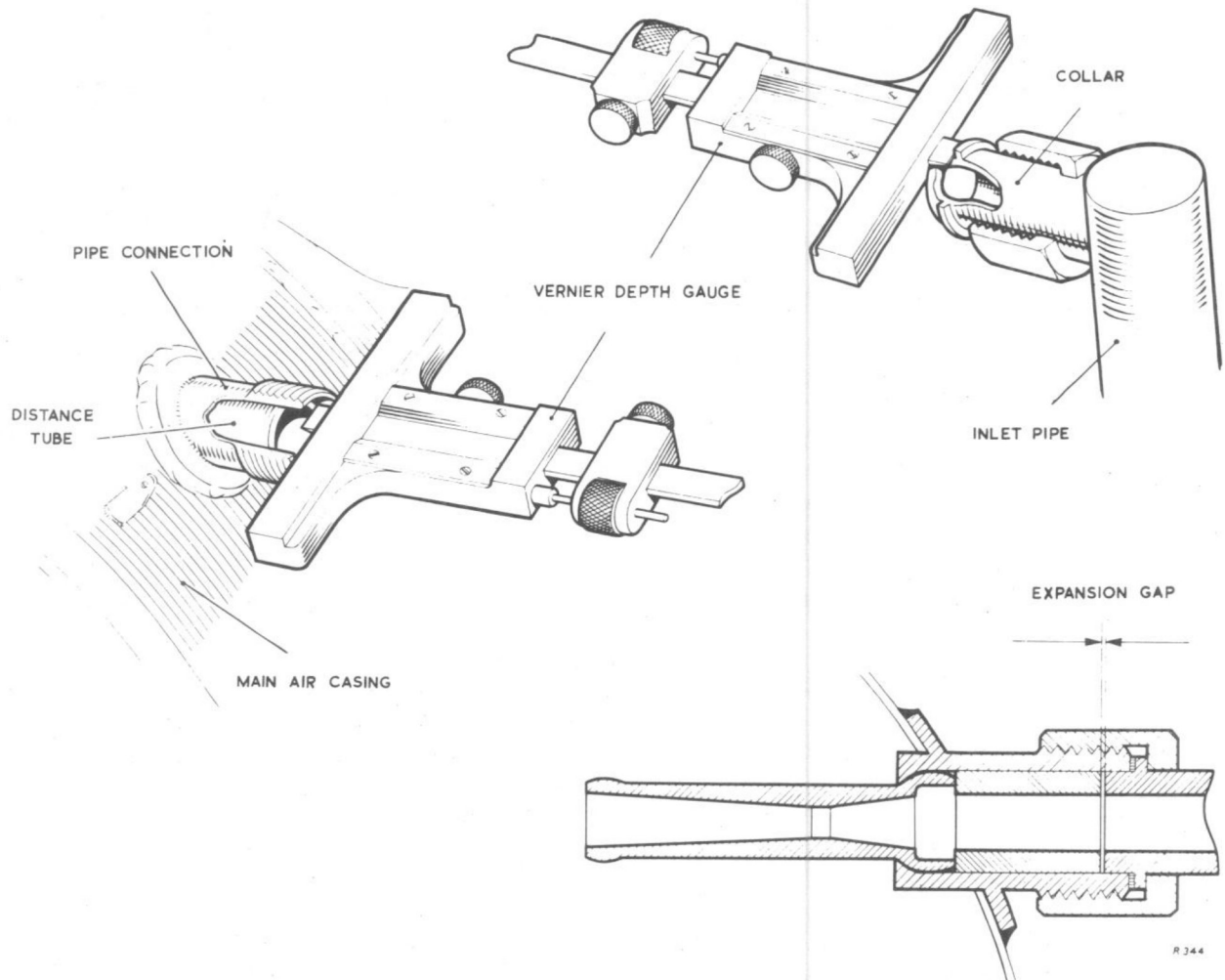


Fig. 3. Measuring the inlet pipe expansion gap

#### Fitting tie rods

13. (1) Place the top fork-end of each tie rod in position over the bracket on the underside of the main air casing and secure with clevis and split pins.
- (2) Pivot each rod until the lower fork-ends are astride the brackets on the cartridge breech tray.
- (3) It is not the purpose of the tie rods to carry the entire weight of the cartridge breech tray, but rather to assist in the distribution of weight; it is important therefore that the tension is carefully adjusted as follows.
- (4) Turn the adjusting hexagon to shorten each rod until the holes in the fork-end and the holes in the brackets slightly overlap each other.
- (5) The overlap should be such that the retaining clevis pins are a light push fit with the thumb.
- (6) When satisfied that the tension is correct, tighten down the locknuts on each rod remembering that the bottom locknut in each case has a left hand thread and secure with locking wire.

- (7) Finally insert the retaining clevis pins and secure with split pins.

Removing the barrel and breech block assembly

14. (1) Disconnect the heater mat and thermostat leads at the junction box (para. 4).
- (2) Remove the cable securing clips.
- (3) Cut the locking wire and release the union nut securing the inlet pipe to the breech block outlet connection.
- (4) Remove the locknut from the breech block outlet connection and withdraw the large recessed washer and the asbestos sealing washer. Discard the asbestos washer.
- (5) Remove the split pins from the three castellated nuts securing the breech block to the tray, support the breech block and barrel assembly, remove the three castellated nuts, large plain washer and bolts and withdraw the assembly from the unit.
- (6) Remove and discard the asbestos sealing washer from the neck of the breech block outlet connection.

Fitting a breech block and barrel assembly

15. (1) Place a new asbestos sealing washer on the neck of the breech block outlet connection and locate the assembly in position on the underside of the breech tray, secure with the three bolts, inserted from the underside, large plain washers and castellated nuts. Fit new split pins to lock the castellated nuts.
- (2) Place a second asbestos sealing washer followed by the large recessed washer over the outlet connection, fit the locknut and securely tighten.
- (3) Connect the inlet pipe to the outlet connection, tighten the union nut and wire lock.
- (4) Connect the heater mat and thermostat leads to the junction box (para. 5), and re-fit the cable clips.

## Chapter 7

## NACELLE

## LIST OF CONTENTS

	Para.		Para.
<i>Introduction</i> ... ..	1	<i>Removing the front end panel</i> ... ..	10
<i>Removing the exhaust cone heat shields</i> ...	4	<i>Fitting the front end panel</i> ... ..	11
<i>Fitting heat shields</i> ... ..	5	<i>Removing the bottom rail</i> ... ..	12
<i>Removing the jet pipe and shroud</i> ... ..	6	<i>Fitting the bottom rail</i> ... ..	13
<i>Fitting a jet pipe and shroud</i> ... ..	7	<i>Fitting bedding tape</i> ... ..	14
<i>Removing the rear end panel</i> ... ..	8	<i>Fitting access door locking peg fasteners</i> ...	15
<i>Fitting the rear end panel</i> ... ..	9		

## ILLUSTRATION

	Fig.
<i>Fitting a jet pipe and shroud</i> ... ..	1

**Introduction**

1. This chapter details the operations for removing and refitting the detachable parts of the power plant nacelle for servicing and repair and also as a means of providing access to the engine unit and attached components.

2. Other chapters in this section giving instructions for the removal and replacement of the equipment contained within the power plant assume that the appropriate panels of the nacelle have been removed as described in this chapter.

3. It should be noted that it is not possible to remove the top rail of the nacelle without completely dismantling the power plant and removing the engine unit. Any significant damage to the top rail requires the power plant to be returned for major repair.

**Removing the exhaust cone heat shields**

4. (1) Remove the two thermocouples numbered /6 and /7 (Pre-Mod M104) or F1210 and F1211 (Post Mod M104) from the bosses in the upper half of the exhaust cone (Chap. 4).

(2) Release the four bolts and plain washers securing the top heat shield to the left-hand shield and the right-hand shield, and withdraw the shield from the port side of the power plant.

(3) Release the six bolts and plain washers securing the left and right hand heat shields to the rear end panel. Note that four of the bolts pass through the flange of the jet pipe shroud.

**Fitting heat shields**

5. (1) Position the left-hand heat shield and the right-hand shield on the rear end panel and

secure each shield with three bolts and plain washers.

Note that all six bolts with plain washers beneath the head are inserted from the exterior of the power plant.

(2) Position the top heat shield over the left-hand and the right-hand shields, and secure with four bolts and plain washers.

(3) Refit the thermocouples (Chap. 4).

**Removing the jet pipe and shroud**

6. (1) Remove the exhaust cone heat shields (para. 4).

(2) Release the eight remaining bolts and plain washers securing the jet pipe shroud to the rear end panel, and draw the shroud downward until it is clear of the jet pipe.

(3) Knock down the ears of the locking tabwashers, and release the two bolts and nuts securing the jet pipe clamping ring halves. The jet pipe can now be withdrawn through the rear end panel.

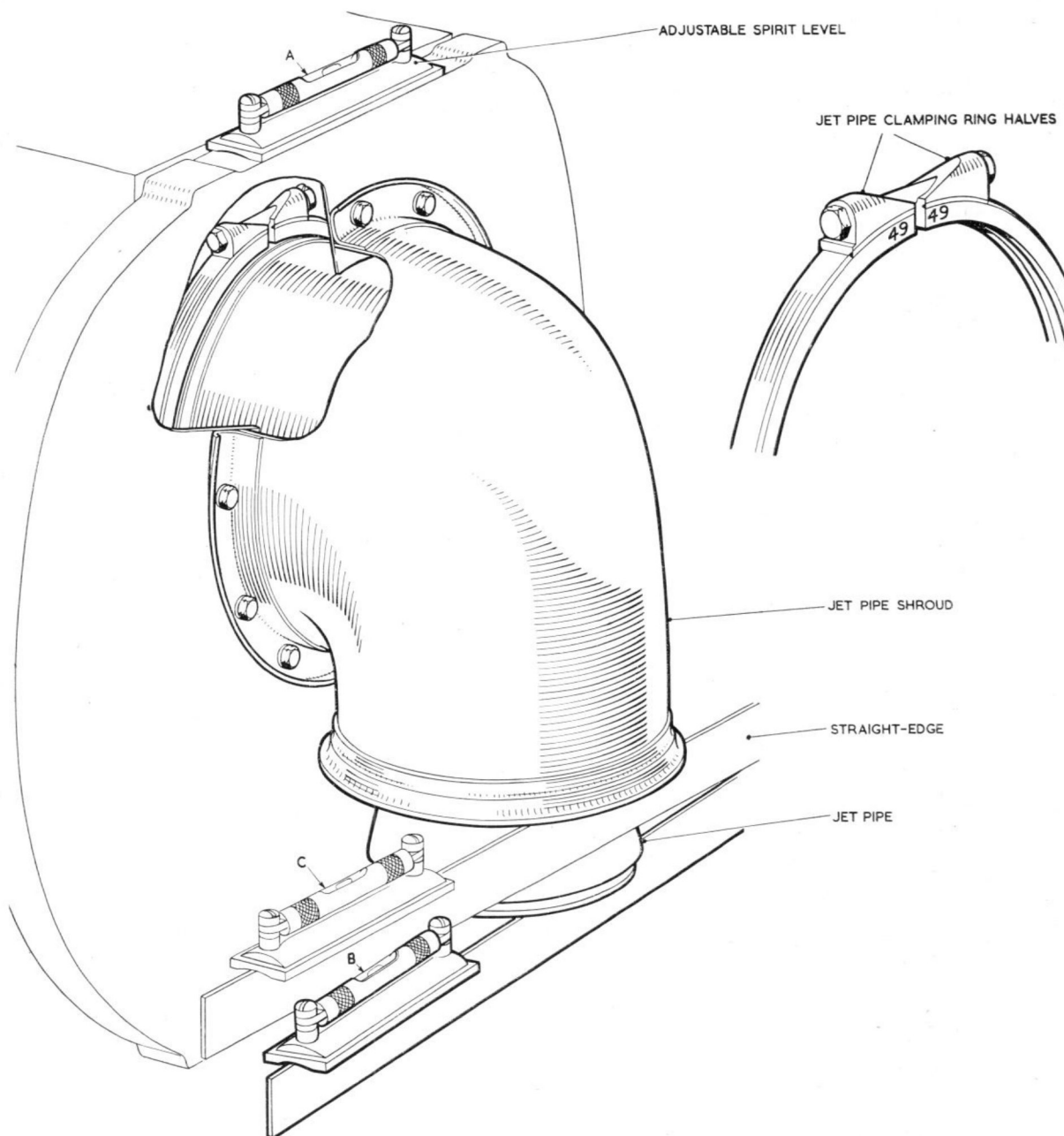
**Fitting a jet pipe and shroud (fig. 1)**

7. (1) Place the jet pipe in position on the exhaust cone; position the clamping ring halves over the flanges of the jet pipe and exhaust cone and secure with two bolts, nuts and tabwashers, but do not, as yet, knock down the ears of the tabwashers.

**Note . . .**

*The jet pipe clamping ring halves are manufactured in matching pairs and must be fitted as such. Each ring half has a number engraved on one face, and when the*

RESTRICTED



**Fig. 1. Fitting a jet pipe and shroud**

*halves are assembled the two faces must correspond (fig. 1). The halves can be secured together in any position round the joint, but for ease of accessibility it may be found more convenient to position the securing bolts at three o'clock and nine o'clock respectively, and not necessarily at top and bottom as shown in the illustration.*

(2) Loosely secure the jet pipe shroud in position with eight bolts and plain washers.

(3) Place an adjustable spirit level across the top rail (position 'A') and adjust the tube level until the bubble is central. Now lay a straight-edge across the bottom of the jet pipe, and transfer the spirit level from the top rail to the

outer end of the straight-edge (position 'B') and, after slackening the clamping ring halves, adjust the position of the jet pipe until the bubble has centralized.

(4) When satisfied that the position of the jet pipe is correct, securely tighten the clamping ring bolts and knock down the ears of the locking tabwashers.

(5) Transfer the straight-edge and spirit level to the bottom of the jet pipe shroud (position C), and adjust the shroud until the bubble has once again centralized. The eight bolts and plain washers retaining the shroud can now be securely tightened.

(6) Finally fit the heat shields (para. 5).

**RESTRICTED**

## Removing the rear end panel

8. The rear end panel may be removed complete with the ancillary equipment mounted on it, and in the following paragraphs, it is assumed that this will be the normal procedure. If, however, it becomes necessary to remove any item of equipment beforehand, reference should be made to the appropriate chapter.

- (1) Remove the exhaust cone heat shields (para. 4).
- (2) Remove the jet pipe and shroud (para. 6).
- (3) Disconnect the oxygen pipe to the burner at the bulkhead connector, and blank the open pipes.
- (4) ◀ Disconnect the two cable terminals on each of the three fire detectors. ▶
- (5) Disconnect the fire detector harness at the terminal box on the rear end panel.
- (6) Release the cable clips securing the thermocouple, fire detector and 1.B.4 harness to the rear end panel.
- (7) Release the four bolts, plain washers and self-locking nuts securing the rear end panel at the corners of the top and bottom rails.
- (8) Release the ten bolts and plain washers securing the flanges of the rear end panel to the top and bottom rails and withdraw the rear end panel complete. Note that one of the bolts secures the air bleed valve actuator cable clip and that two of the bolts secure the fuel drain connection bracket.

## Fitting the rear end panel

9. (1) Position the rear end panel over the top and bottom rails, and secure with four corner bolts, plain washers and self-locking nuts.
- (2) Fit the ten bolts and plain washers securing the top and bottom flanges of the panel, not forgetting that one of these bolts retains the air bleed valve cable clip, and that two of the bolts secure the fuel drain connection bracket.
  - (3) Position the 1.B.4, the thermocouple and the fire detector harness on the rear end panel, and secure with the cable clips.
  - (4) ◀ Connect the fire detector cables either by inserting the cable ends into the connection and retaining with the terminal screws, or by fitting the terminal rings at the cable ends to the studs on the detector and retaining with the washers and locknuts, dependant upon the modification standard. ▶
  - (5) Reconnect the detector harness at the terminal box on the rear end panel.
  - (6) Remove the blanking caps, and reconnect the oxygen pipe to the burner at the bulkhead connector.

- (7) Fit the jet pipe and shroud (para. 6).
- (8) Fit the exhaust cone heat shields (para. 5).

#### Removing the front end panel

10. The front end panel, with the exception of the metering valve and the fuel pressure warning switch, may be removed complete with the ancillary equipment mounted on it, and in the following paragraphs it is assumed that this will be the normal procedure. If however, it becomes necessary to remove any item of equipment beforehand, reference should be made to the appropriate chapter of this section.

- (1) Cut the wire-locking and disconnect the cables at the bulkhead plugs.
- (2) Disconnect the thermocouple and I.B.I harnesses at the terminal block on the starboard side of the front panel.
- (3) Disconnect the cables at the front end panel 7-way terminal block (Chap. 4).
- (4) Cut the locking wire and disconnect the igniter plug cable at the bulkhead connector.

#### WARNING . . .

BEFORE STARTING WORK WHICH INVOLVES HANDLING COMPONENTS OF THE IGNITION SYSTEM, ENSURE THAT ALL ELECTRICAL SERVICES TO THE POWER PLANT ARE SWITCHED OFF AND AFFIX A WARNING TO THE APPROPRIATE SWITCH.

- (5) Cut the locking wire and disconnect the pipe from the low pressure warning switch. Do not forget to blank the pipe.
- (6) Release the two bolts and self-locking nuts securing the fuel pressure warning switch tee junction to the front end panel. Draw the switch clear of the panel and blank the union. Note that there is a locking tabwasher beneath the head of one of the bolts, and another beneath one of the nuts.
- (7) Release the two bolts and plain washers securing the metering valve (Pre Mod. M182) to the front end panel. Securely wire the valve to the top rail to obviate the possibility of any undue strain being placed on the flexible fuel pipes.
- (8) Release all the pipe and cable clips securing the several harnesses and flexible pipes to the front end panel.
- (9) Release the four bolts, plain washers and self-locking nuts securing the front end panel at the corners of the top and bottom rails.
- (10) Release the ten bolts and plain washers securing the flanges of the front end panel to the top and bottom rails, and remove the front end panel complete.



## Fitting the front end panel

11. (1) Position the front end panel over the top and bottom rails, and secure with four corner bolts, plain washers and self-locking nuts.
- (2) Fit the ten bolts and plain washers securing the top and bottom flanges of the panel.
- (3) Fit the pipe and cable clips securing the various harnesses and flexible pipes to the front end panel.
- (4) Position the metering valve (Pre Mod. M182) complete with the mounting bracket on the front end panel, and secure with two bolts and plain washers.
- (5) Place the fuel pressure warning switch tee junction in position on the front end panel, and secure with two bolts and self-locking nuts. Do not forget to position a wire-locking tab beneath the head of one of the bolts and another beneath one of the nuts.
- (6) Remove the blanking caps; reconnect the pipe from the low pressure filter, and securely wire lock.
- (7) Reconnect the igniter plug at the bulkhead connector and securely wire-lock.
- (8) Reconnect the cables at the 7-way terminal block (Chap. 4).
- (9) Reconnect the thermocouple and I.B.I harnesses at the terminal block on the starboard side of the front end panel.
- (10) Finally reconnect the cables to the respective bulkhead plugs, and securely wire-lock.

## Removing the bottom rail

12. (1) Drain the engine oil sump (Chap. 2).
- (2) Remove the rear end panel complete with the ancillary equipment (para. 8).
- (3) Remove the front end panel complete with the ancillary equipment (para. 10).
- (4) Disconnect and remove the harnesses from the unit (Chap. 4).
- (5) Remove the split pin and release the bolt and castellated nut securing the drive shaft to the blower input shaft.
- (6) Release the hose clip securing the oil cooler connecting tube to the blower outlet.
- (7) Release all the pipe clips securing those flexible pipes to the bottom rail, which are still connected to the engine unit.
- (8) Cut the locking wire and disconnect the three fuel drain pipes at the unions on the bottom rail.

(9) Cut the locking wire and release the overflow and supply pipes at the unions on the re-oiling valve.

CAUTION . . .

From this point onward, the bottom rail must be independently supported.

(10) Cut the locking wire and unscrew the large union nuts securing the top and bottom cartridge inlet pipes to the breech block connections.

(11) Remove the two retaining split pins; withdraw the clevis pins securing the tie rods to the cartridge breech tray, and push both rods sideways until they are clear of the fixing brackets.

(12) Release the eight bolts and plain washers securing the engine air intake ducts to the bottom rail. The bottom rail complete with the blower unit, the cartridge start breech tray assembly and the pressure re-oiling valve can now be withdrawn from the power plant. A note should be made of the synthetic rubber gasket positioned between the air intake ducts and the bottom rail.

Fitting the bottom rail

13. (1) Position the synthetic rubber gasket round the air intake aperture in the bottom rail; place the bottom rail in position on the underside of the power plant, and secure the air intake ducts to the rail with eight bolts and plain washers. Before securing the air intake ducts, the drive shaft must be correctly positioned on the blower input shaft.

CAUTION . . .

The bottom rail must be independently supported until the cartridge start tie rods and inlet pipes have been reconnected.

(2) Check that the two inlet pipes are properly seated on the respective breech block outlet connections, then securely tighten and wire-lock the two union nuts.

(3) Swing the two tie rods into position over the respective brackets, then insert the retaining clevis pins and secure with split pins.

(4) Manoeuvre the oil cooler connecting tube over the blower outlet, and securely tighten the securing hose clip.

(5) Fit the front and rear end panels complete with the ancillary equipment (para. 8 and 10).

(6) Fit the electrical harnesses (Chap. 4).

(7) Reconnect the overflow and supply pipes to the respective unions on the pressure re-oiling valve, and securely wire-lock

(8) Reconnect the three fuel drain pipes to the respective unions on the bottom rail, and securely wire-lock.

(9) Fit the bolt, castellated nut and split pin securing the drive shaft to the blower input shaft.

(10) Refill the engine oil sump (Sect. 4).

## Fitting bedding tape

14. The power plant access doors are insulated from the other nacelle panels by strips of bedding tape, pop riveted to the top and bottom rails and both end panels. If it is necessary to renew the bedding tape the following procedure must be observed.

- (1) Using a  $\frac{1}{8}$  in. diameter drill, remove the heads of the retaining pop rivets and strip the tape from the panel.
- (2) Cut a suitable length of tape and lay in position along the edge of the panel.
- (3) With a suitable tool, pierce a series of holes in the tape to correspond with the existing holes in the panel and secure the tape to the panel with  $\frac{1}{8}$  in. pop rivets and plain washers.

## Fitting access door locking peg fasteners

15. The two access doors are secured to the power plant casing by twenty-four locking peg fasteners. Each fastener consists of a male and female half: the male halves are pop riveted into pockets recessed in the access doors, and the female halves are pop riveted into recesses in the top and bottom rails.

16. (1) To renew the locking peg fasteners proceed as follows :-

- (1) Using a  $\frac{1}{8}$  in. diameter drill, remove the heads of the four pop rivets retaining each half of the fastener, and withdraw the defective fastener from the recess.
- (2) Fit the replacement halves of the fastener in the appropriate recesses, and secure with four  $\frac{1}{8}$  in. pop rivets



## Chapter 8

OXYGEN SYSTEM  
(Completely Revised)

## LIST OF CONTENTS

	Para.
Removing the oxygen equipment assembly ... ..	1
Fitting oxygen equipment ... ..	2
Removing the oxygen non-return valve and charging union bracket...	3
Fitting the oxygen non-return valve and charging union bracket ...	4

## ILLUSTRATION

	Fig.
Non-return valve ... ..	1

## WARNING . . .

Oil, grease or moisture must not be used on any part of the oxygen system. These, when in contact with oxygen may cause an explosion. The only lubricant which may be used is ZX-24, Fluid, aqueous colloidal graphite.

## Removing the oxygen equipment assembly

1. The oxygen equipment is mounted on the rear end panel close to the jet pipe shroud. Remove the equipment as follows :-

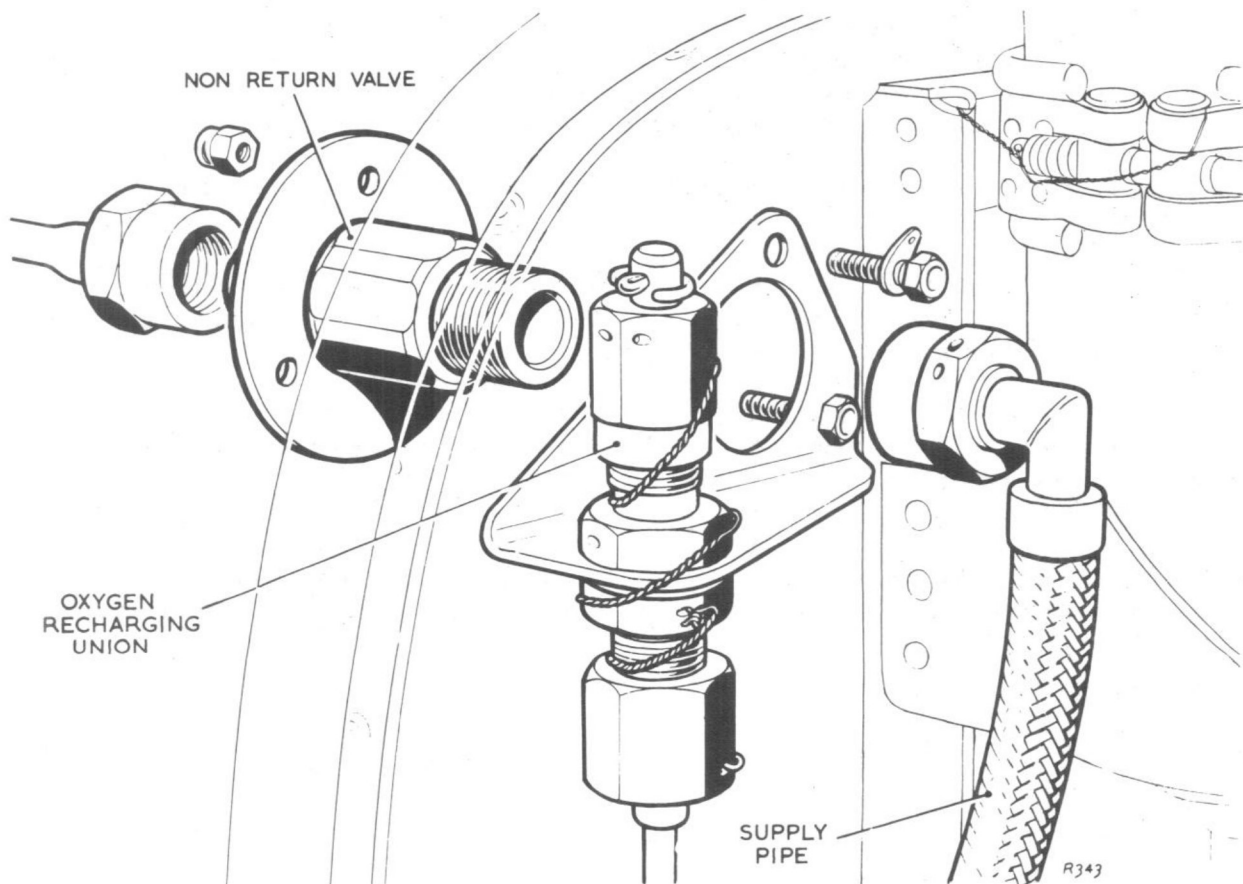


Fig. 1. Non-return valve

(1) Cut the locking wire and disconnect the oxygen supply pipe at the base of the oxygen equipment.

(2) Cut the locking wire and disconnect the oxygen charging pipe at the neck of the lower oxygen bottle.

(3) Cut the locking wire and disconnect the oxygen gauge pipe from the S.O.C.

(4) Release the six bolts and large diameter plain washers retained by self-locking nuts, and release the two bolts and small diameter plain washers retained by captive nuts; then lift the oxygen equipment clear of the rear end panel.

#### Fitting oxygen equipment

2. (1) Position the oxygen equipment on the rear end panel on the port side of the jet pipe and secure with eight bolts, plain washers and six self-locking nuts. Note that the large diameter washers are associated with the bolts retained by self-locking nuts, and the smaller diameter washers are positioned beneath the head of the bolts held by captive nuts.

(2) Reconnect the oxygen gauge, supply and charging pipes at the respective unions and ensure that the couplings are securely wire-locked.

#### Removing the oxygen non-return valve and charging union bracket

3. (1) Cut the locking wire and disconnect the oxygen supply pipe at the non-return valve; disconnect the oxygen charging pipe at the charging union bracket, and the oxygen supply pipe at the bulkhead union.

(2) Release the securing locknut and remove the charging union from the bracket.

(3) Release the three bolts, self-locking nuts and plain washers securing the non-return valve and charging union bracket to the rear end panel, and remove both components.

#### Fitting the oxygen non-return valve and charging union bracket

4. (1) Position the non-return valve and charging union bracket on the rear end panel and secure with three bolts, plain washers and self-locking nuts.

(2) Refit the charging union on the bracket; reconnect the oxygen charging and supply pipes, and finally securely wire-lock all disturbed components.