

Chapter Twenty-three

DISMANTLING TO SUB-ASSEMBLIES

Contents

	Page		Page
General	2	Turbine disc	15
Ghost 48 Mk. 1 and 48 Mk. 2		Turbine disc rear cooling air pipes ..	17
Assembling engine to erecting stand ..	3		
Removing engine from transit case ..	2	Ghost 48 Mk. 2	
Removing M.V.P. bag	2	Air-intake	33
Unpacking the engine	2	Centre casing	33
Ghost 48 Mk. 1		Centre housing	32
Air compressor housing assembly ..	13	Combustion chambers	32
Air-intake	21	Draining the sump	23
Bottom wheelcase and sump	14	Engine mounting brackets	32
Centre casing	18	Fuel manifold feed and spill assembly ..	33
Centre housing	14	Generator drive casing	32
Combustion chambers	16	Ignition equipment	23
Draining the sump	3	Impeller pivot nut removal	33
Engine mounting brackets	15	Insulating plate and cooling muff ..	32
Ignition equipment	3	Main shaft assembly	33
Impeller pivot nut removal	16	Nozzle ring assembly	33
Insulating plate and cooling muff ..	16	Principal pipes and accessories ..	24
Main shaft assembly	21	Sealing plate	33
Nozzle ring assembly	17	Starter drive assembly	32
Principal pipes and accessories ..	6	Sump	32
Sealing plate	20	Top wheelcase	32
Starter drive assembly	13	Turbine disc	32
Top wheelcase	13	Turbine disc rear cooling air pipes ..	33

Illustrations

	Fig.		Fig.
Erecting stand T.79047, lifting sling T.72797, and drip tray T.73072	1	Removal of turbine disc cooling air pipes	17
High energy ignition attachments and fittings on port side of engine	2	Lifting nozzle ring assembly from engine ..	18
Disposition of pipes on port side of 48 Mk. 1 engine	3	Rear bearing pipe connections	19
Disposition of pipes on starboard side of 48 Mk. 1 engine	4	Lifting handle fitted to front flange of front cone	20
Disposition of pipes on underside of 48 Mk. 1 engine	5	Removing an inspection cover from the sealing plate	21
Air-fuel ratio control unit and attachment brackets	6	Lifting sealing plate from diffuser casing rear cover	22
Rear bearing oil drain pipe	7	Lifting main shaft assembly from diffuser casing	23
Vokes low pressure fuel filter and attachment bracket	8	Lifting air-intake	24
High pressure fuel filter and brackets ..	9	Torch igniter high energy ignition equipment	25
Fuel control valve assembly	10	Disposition of pipes on underside of 48 Mk. 2 engine	26
Fuel distributor; the pipes will have been removed as described on page 9 ..	11	Disposition of pipes on port side of 48 Mk. 2 engine	27
Drain box	12	Disposition of pipes on starboard side of 48 Mk. 2 engine	28
Bottom wheelcase and sump	13	Tecalemit low pressure fuel filter and attachment bracket	29
Removing turbine disc with combined lifting and extracting fixture T.74810	14	Spanner for nuts securing circulating pump unit	30
Clearance rig T.72783 and cross bar T.72784 fitted to hub shaft and the turbine shroud	15	Drain box	31
Removing impeller pivot nut	16	Burner connection	32
		Internal nuts and tab washers which secure the top wheelcase to the air-intake ..	33
		Oil sump	34

Revised by Amendment No. 127
October, 1956

THIS CHAPTER which is applicable to both the Ghost 48 Mk. 1 and Ghost 48 Mk. 2, describes the unpacking of the engine from its transit case, its removal from the case, assembly to the erecting stand, and the dismantling of components to the sub-assembly stage. The instructions for removing the engine from its transit case and assembling it

to the erecting stand are common to both engines; but as the 48 Mk. 1 and 48 Mk. 2 are not identical, a separate sequence of operations for dismantling the engine to sub-assemblies, is given for each engine. The general information contained in chapter 22 should be referred to as necessary.

GHOST 48 Mk. 1 and 48 Mk. 2.

UNPACKING THE ENGINE

The engine will be received in a wooden transit case and the exhaust cone and fireguard will be in a separate wooden case. The wooden cases are fitted with four lifting rings.

Remove the bolts from the base of the wooden case. Attach a four-piece chain sling to the lifting rings or eyes at the top of the container and lift off the top portion. This operation should be carried out carefully to avoid damaging the engine which will remain attached to the stand which is mounted on the base of the wooden case.

The log book, appropriate copies of the relevant advice and despatch or release notes will be with the engine. Carefully check the engine and any loose components and equipment for shortages, which should be recorded in the relevant advice and despatch or release notes.

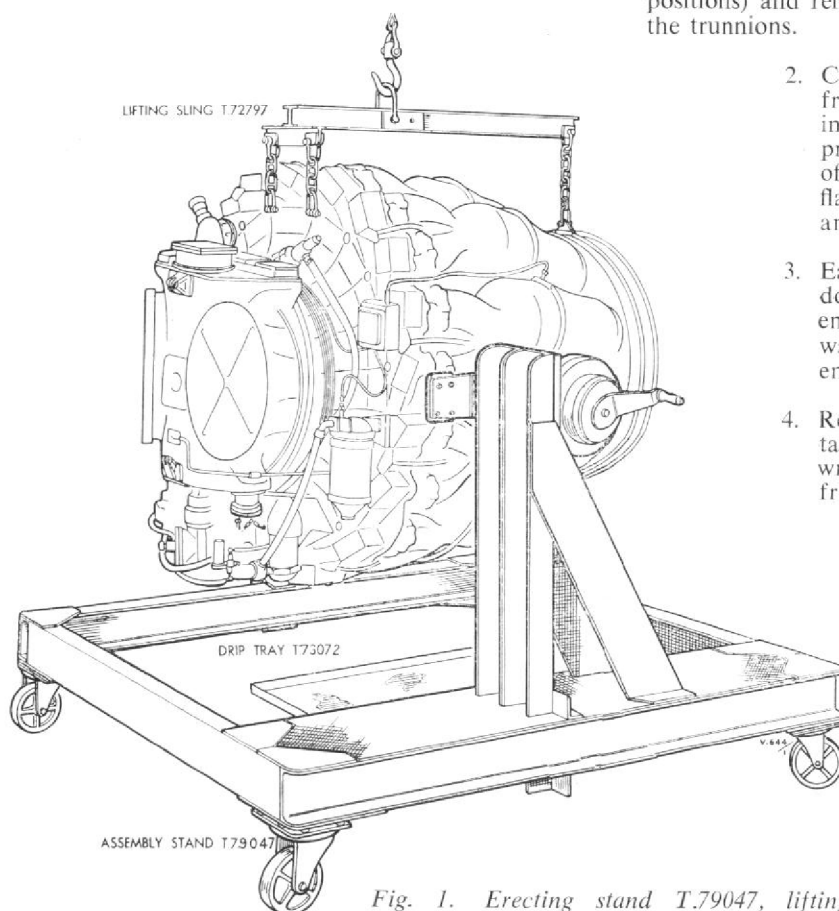


Fig. 1. Erecting stand T.79047, lifting sling T.72797, and drip tray T.73072.

REMOVING ENGINE FROM TRANSIT CASE

1. Attach lifting sling T.72797 to the crane and secure the legs of the sling to the eyes on the front of the diffuser casing and the nozzle and turbine shrouds.
2. Take the weight of the engine on the crane and remove the trunnion-bush caps, one on each side of the diffuser casing and one at the rear of the turbine from the stand.
3. Hoist the engine slowly, ensuring that it does not swing and sustain damage by contact with the stand.

Removing the MVP Bag

1. Whilst the engine is suspended from the crane, unscrew the twelve 7/16 in. B.S.F. set-bolts which secure the three mounting trunnions to the diffuser casing (at the 3, 6, and 9 o'clock positions) and remove the spring washers and the trunnions.
2. Cut off a strip $\frac{5}{8}$ inch wide from the outer part of the sealing flap on the moisture vapour proof (MVP) bag for the whole of its length. Separate the flaps, remove the sealing tape and open the zip fasteners.
3. Ease the bottom of the bag downwards off the front of the engine, and then draw it rearwards lifting it clear of the engine.
4. Remove the bandoliers containing the desiccant, and all wrapping paper and padding from the engine.

ASSEMBLING ENGINE TO ERECTING STAND

1. Place the arms of erecting stand T.75592 (pre-mod. 665) or T.79047 (mod. 665) in a horizontal position and pointing forwards to maintain the balance of the engine, when on the stand, Fig. 1. Place drip tray T.73072 in position to receive the free oil that will drain as dismantling proceeds.

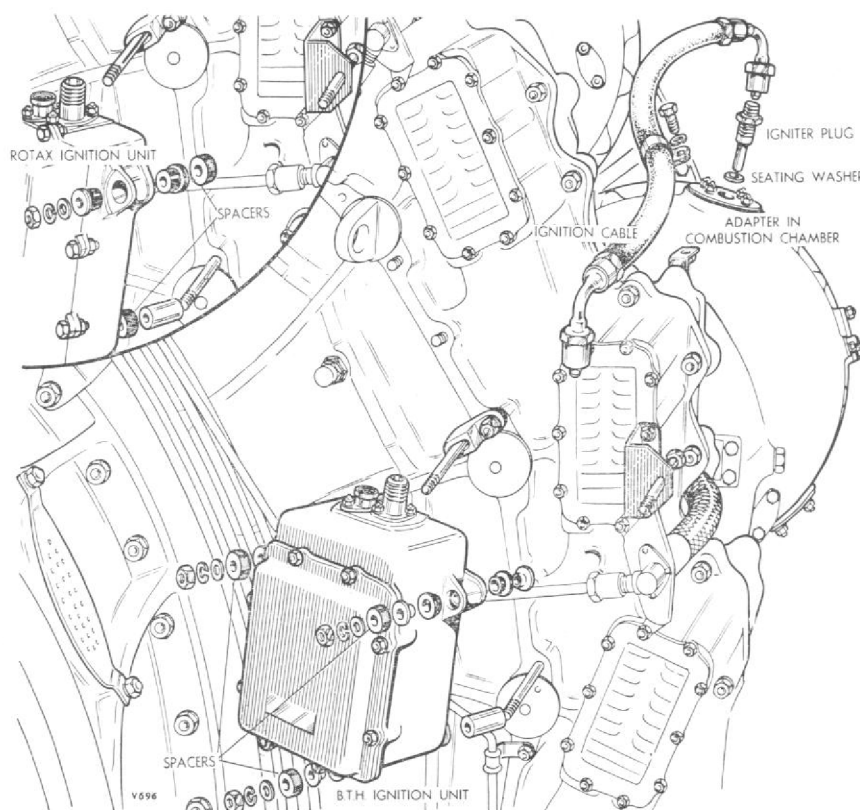


Fig. 2. High energy ignition attachments and fittings on port side of engine.

2. Carefully lower the engine into the erecting stand until the trunnion mounting faces at the 3 and 9 o'clock positions on the diffuser casing are in line with the drilled locations on the stand arms.
3. Secure the engine to the erecting stand by

screwing eight bolts T.72766 through the four holes in each stand arm into the tapped holes in the diffuser casing. *The length of bolts T.72766 is critical and the use of other similar 7/16 in. B.S.F. bolts is not permissible. If longer bolts are used there is danger of fracturing the diffuser casing.*

GHOST 48 Mk. 1.

During dismantling of the engine, carefully note the position of any spacers or washers and whenever possible, reassemble all such mounting details to their respective parts with the existing nuts and bolts.

DRAINING THE SUMP

1. Place a receptacle of at least 2 gallons capacity beneath the drain plug which is situated at the rear starboard corner of the underside of the sump.
2. Release the locking tab and using a standard 11/16 in. B.S.F. ($\frac{3}{8}$ in. Whitworth) box or ring spanner, unscrew and remove the drain plug and allow the oil to drain completely.

IGNITION EQUIPMENT

The high energy ignition units which are mounted on the front of the diffuser casing, are illustrated in Fig. 2.

1. Unscrew the union nut at each end of the ignition cable on the port side of the engine.
2. Remove the 2 B.A. bolt which secures the cable clip to the bracket on the port side of the diffuser casing, and remove the ignition cable from the engine.
3. Remove the $\frac{1}{4}$ in. B.S.F. plain nut and spring washer from the stud which passes through the lug at the bottom of the ignition unit on the port side of the diffuser casing.

Revised by Amendment No. 127
October, 1956

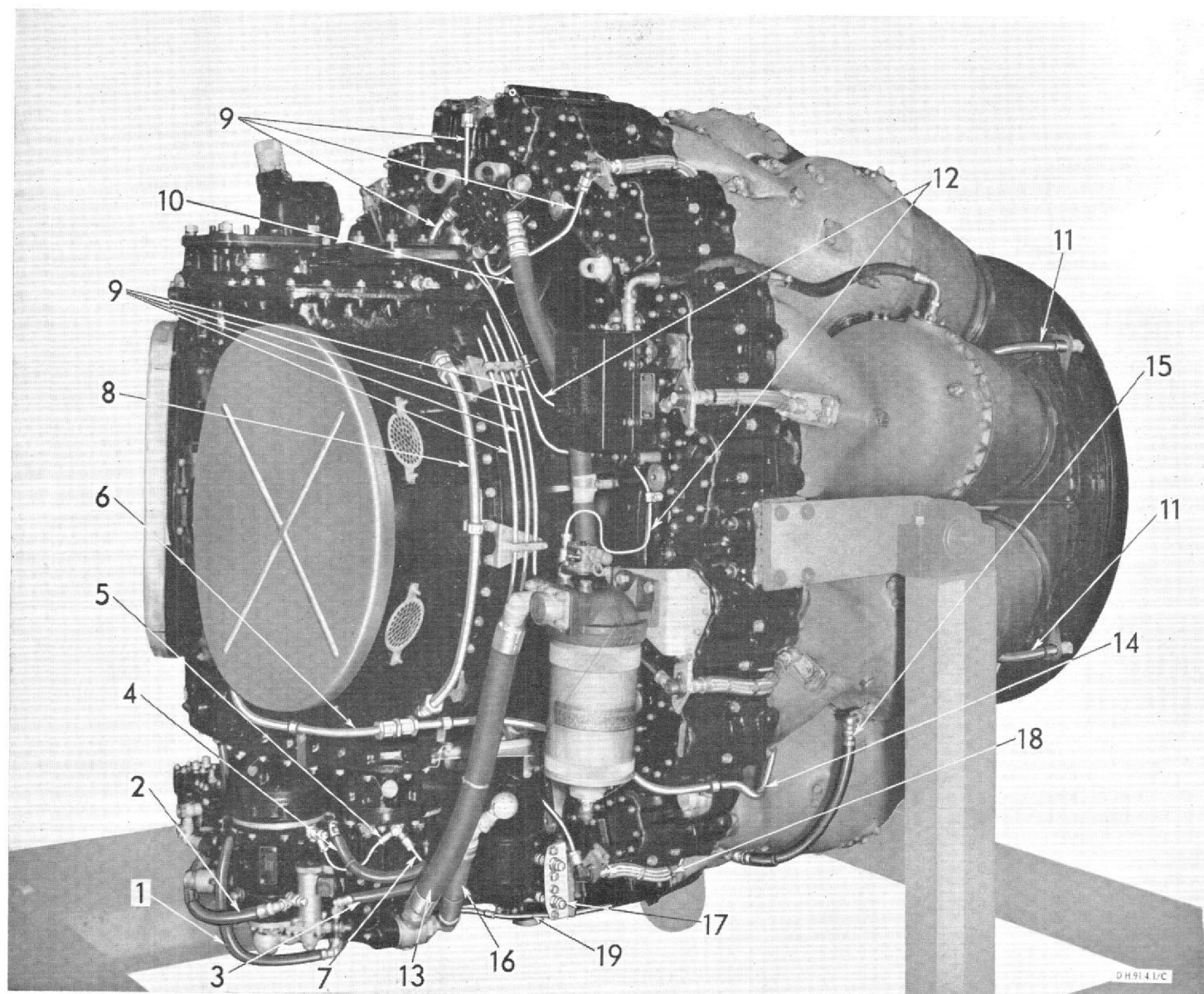


Fig. 3. Disposition of pipes on port side of 48 Mk. 1 engine.

- | | |
|---|--|
| 1. Servo pipe, front pump to B.P.C. | 11. Turbine disc air cooling pipe |
| 2. High pressure fuel pipe, pump to B.P.C. | 12. Spill pipe, distributor to low pressure filter |
| 3. Servo pipe, pump to pump | 13. Low pressure pipe, L.P. fuel filter to fuel pump |
| 4. Air bleed pipe, front pump | 14. Cooling oil pipe, rear section |
| 5. Seal drain pipe, front pump to rear pump | 15. Combustion chamber drain pipes |
| 6. Cooling oil pipe, front section | 16. High pressure filter to control valve |
| 7. Seal drain pipe, rear pump to drain box | 17. Air bleed valves |
| 8. Oil drain pipe, air-intake (Port) assembly | 18. Burner feed pipes |
| 9. Fuel feed pipes, distributor to burners | 19. Metering pump to centre casing |
| 10. Control valve to distributor | |

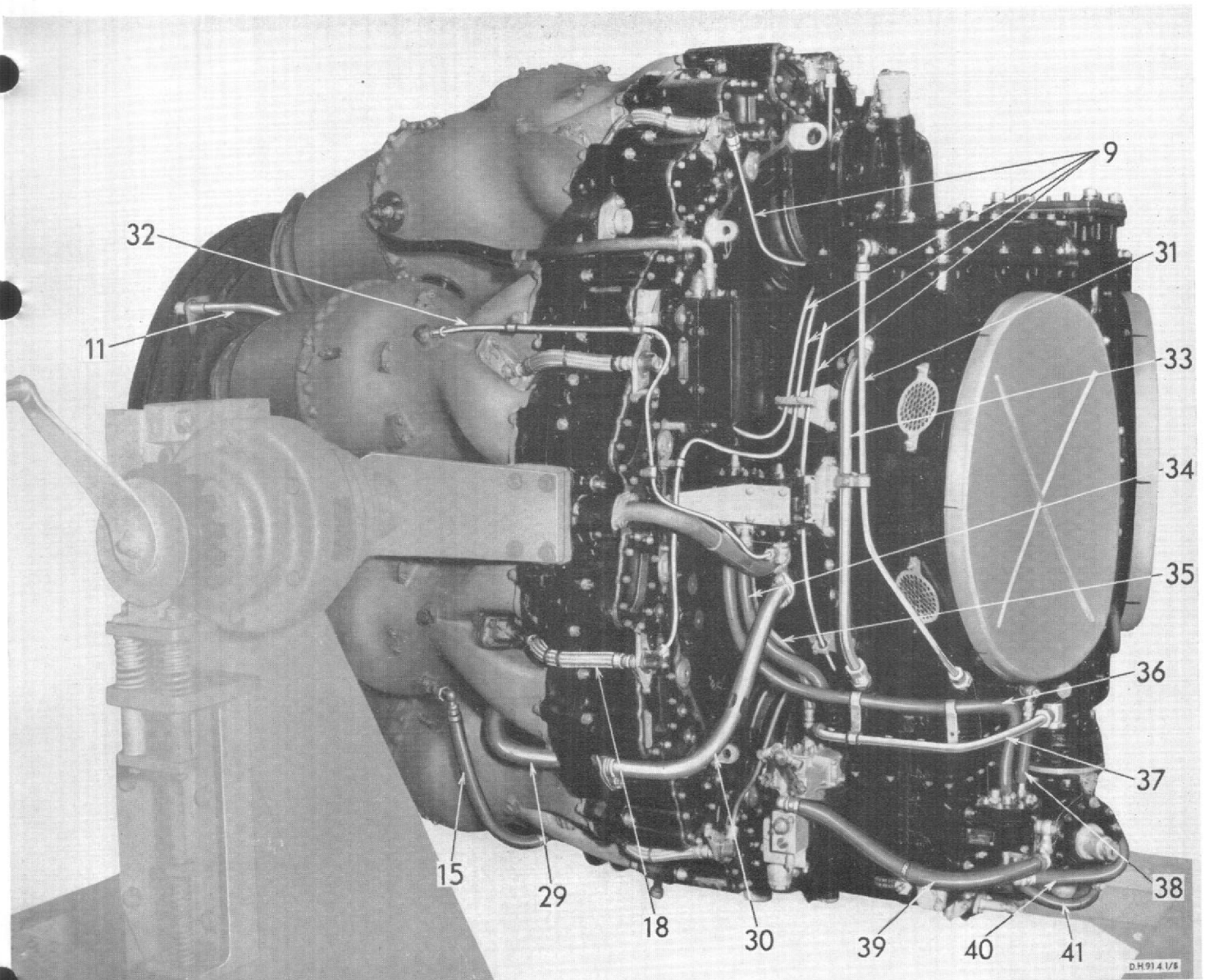


Fig. 4. Disposition of pipes on starboard side of 48 Mk. 1 engine.

- | | |
|---|---|
| 9. Fuel feed pipes, distributor to burners | 33. Oil drain pipe, air-intake (Starboard) assembly |
| 11. Turbine disc air cooling pipes | 34. High pressure pipe, control valve to A-F.R.C. |
| 15. Combustion chamber drain pipes | 35. Spill pipe, A-F.R.C. to control valve |
| 18. Burner feed pipes | 36. Servo pipe, B.P.C. to A-F.R.C. |
| 29. Cooling air pipe, rear cover to air filter | 37. Breather pipe |
| 30. Cooling air pipe, cooler to casing | 38. Oil feed pipe to front bearing |
| 31. Oil supply pipe, air-intake to top wheelcase | 39. Spill pipe, control valve to B.P.C. to front pump |
| 32. Air pressure pipe, No. 9 combustion chamber to A-F.R.C. | 40. High pressure pipe, front pump to B.P.C. |
| | 41. Servo pipe, front pump to B.P.C. |

4. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers from the bolts which secure the lugs at each side of the port ignition unit to the brackets on the diffuser casing and lift the ignition unit off the engine.

Two rubber-lined mounting ferrules are fitted in each ignition-unit mounting lug and care should be taken that these are not displaced and lost.

5. Remove the distance piece from the stud in the diffuser casing which secured the lug at the bottom of the ignition unit.
6. Unscrew the screen tube and withdraw the igniter plug and seating washer from the igniter mounting adapter in No. 3 combustion chamber.

Pre-mod. 966 the igniter plug assembly is similar to the centre electrode of a normal detachable type sparking plug. When mod. 966 or 1157 is embodied the screen tube is integral with the igniter plug. The seating washer with the mounting adapter tends to remain in the latter and should be removed.

7. Repeat the foregoing operations to remove the ignition cable and ignition unit from the starboard side of the engine and the igniter plug from No. 10 combustion chamber.

PRINCIPAL PIPES AND ACCESSORIES

To facilitate the removal of certain pipes it will occasionally be necessary to interrupt the sequence of pipe removal to remove an accessory. The majority of the pipe connections, support clips and brackets are readily accessible and removal of the sub-assemblies is greatly simplified with the pipes removed. To assist in the identification of the various pipes in relation to the text, the item numbers appearing in parenthesis at the commencement of each paragraph describing pipe removal, correspond to the numbers given to the pipes in Fig. 3, 4 and 5.

Low pressure pipe—L.P. fuel filter to the fuel pump (13)

1. Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure this pipe to the L.P. filter outlet.
2. Unscrew the union nut which connects the lower end of the pipe to the fuel pump inlet connection and remove the pipe.
3. Remove the Klingerit joint washer at the L.P. filter end of the pipe.

Air pressure pipe—No. 16 diffuser bolt to A-F.R.C. pre-mod. 1139

Unscrew the union nuts at each end of this $\frac{1}{4}$ in. rigid pipe, remove the pipe and the loose nipple at the air-fuel ratio control end.

Air pressure pipe—No. 9 combustion chamber to A-F.R.C. mod. 1139 (32)

Unscrew the union nut at each end of the rigid pipe which connects the air-fuel ratio control to the banjo on No. 9 combustion chamber. Release the three clips securing the pipe; remove the pipe and the loose nipples at both ends.

Cooling air pipes—cooler to casing (30)

Remove the two $\frac{1}{4}$ in. B.S.F. bolts and nuts, spring and plain washers from each attachment flange of the two short air pipes which connect the cooling belt to the diffuser casing on the starboard side of the engine and remove the two pipes. Remove the aluminium washers under each flange.

Servo pipe—B.P.C. to A-F.R.C. (36)

1. Remove the 2 B.A. bolt and spring washer which secures the breather pipe clip to the servo pipe clip, just above the fuel control valve assembly.
2. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the two servo pipe clips to the starboard side of the air-intake/bottom wheelcase joint.
3. Unscrew the union nut which connects this pipe to the B.P.C.
4. Unscrew the union nut which secures the pipe to the A-F.R.C. and remove the pipe.

Spill pipe—control valve to B.P.C. to front pump (21)

1. Remove the banjo bolt which secures the pipe at the front fuel pump.
2. Unscrew the union nut to disconnect the pipe at the B.P.C.

Due to the inaccessibility of the pipe connection on the fuel control valve it is advisable to leave this connection until the fuel control valve has been removed.

Spill pipe—A-F.R.C. to control valve (35)

1. Remove the banjo cap-nut which secures the pipe to the A-F.R.C.
2. Unscrew the union nut at the control valve end and remove the pipe.

High pressure pipe—Control valve to A-F.R.C. (34)

Unscrew the union nut at the A-F.R.C. end of the pipe. Due to its inaccessibility, the lower connection should be released when the con-

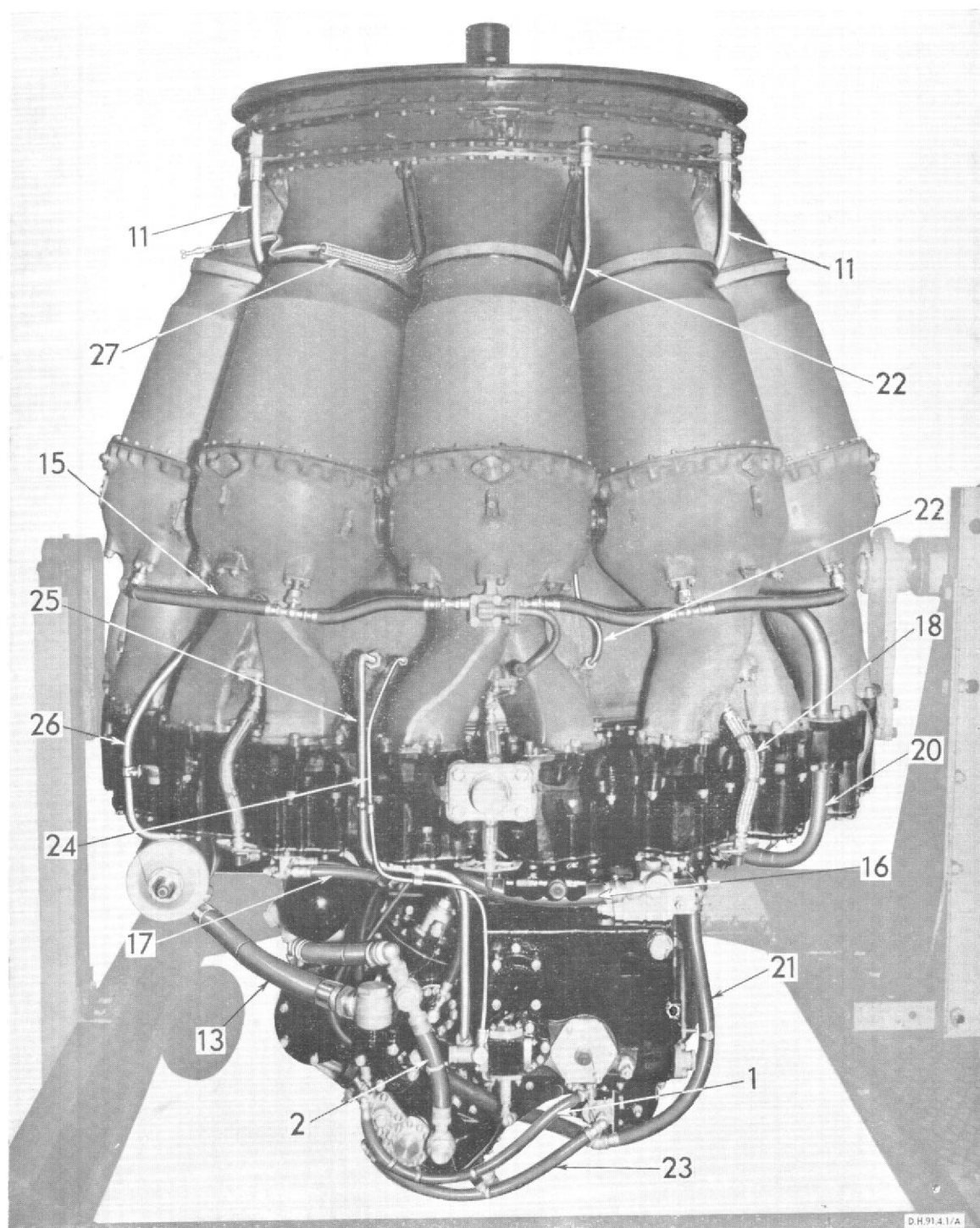


Fig. 5. Disposition of pipes on underside of 48 Mk. 1 engine.

- | | |
|--|--|
| 1. Servo pipe, front pump to B.P.C. | 20. Air cooling pipes |
| 2. High pressure fuel pipe, pump to pump | 21. Spill pipe control valve, B.P.C. to pump |
| 13. Low pressure pipe, L.P. fuel filter to fuel pump | 22. Rear bearing oil drain pipe |
| 15. Combustion chamber drain pipes | 23. Pump delivery to B.P.C. |
| 16. High pressure pipe, H.P. filter to control valve | 24. Metering pump to rear bearing |
| 17. Air bleed pipes | 25. Cooling oil feed pipe |
| 18. Burner feed pipes | 26. Cooling oil return pipe |
| | 27. Thermocouple |

Revised by Amendment No. 127
October, 1956

trol valve assembly has been removed from the engine.

Servo pipe—front pump to B.P.C. (1)

Unscrew the union nut at each end and remove the pipe.

High pressure pipe—front pump to B.P.C. (40)

Unscrew the union nut at each end and remove the pipe.

Air bleed pipes—front and rear pumps (4 & 17)

1. Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers from the bolts which secure the pipe flanges to the support bracket on No. 10 deflector cover.

If mod. 767 has not been embodied the outer ends of the air bleed pipes will be attached by four $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers to a bracket secured by three of the wheelcase retaining nuts.

2. Remove the bolts and withdraw the outer end of each pipe from its location in the bracket, leaving each pipe attached to its respective pump.

Servo pipe—pump to pump (3)

Unscrew the union nut at each end and remove the pipe.

High pressure pipe—rear pump to H.P. filter

Unscrew the union nut at each end and remove the pipe

High pressure pipe—H.P. filter to control valve (16)

1. Unscrew the union nut which secures the pipe to the control valve assembly.
2. Remove the banjo bolt from the H.P. filter casing and remove the pipe.

High pressure fuel pipe—pump to pump

Remove the two cap-nuts, from the banjo pillar at each end, and remove the pipe.

Oil feed pipe—metering pump to centre casing (19)

1. Unscrew the nut which secures the pipe to the centre casing adapter.
2. Remove the bolt from the banjo connection at the metering pump.

Oil feed pipe—centre casing to rear bearing

Unscrew the union nuts at both ends of the pipe and remove the pipe.

Oil feed pipe to front bearing (38)

1. Remove the cap-nut which secures the banjo connection on to the lower starboard side of the air-intake casing.
2. Remove the union nut which secures the other end of the pipe to the oil feed restrictor, and remove the pipe.

Pipe control valve assembly to the fuel flow distributor (10)

1. Unscrew the union nut which connects this pipe to the distributor inlet.
2. Unscrew the $\frac{1}{4}$ in. B.S.F. plain nuts which secure the pipe clip to the stud in the casing in line with No. 6 diffuser bolt.
3. Remove the spring washer, ease the clip off the stud and remove the spacer.
4. Unscrew the two $\frac{1}{4}$ in. B.S.F. plain nuts which secure the second pipe clip to the H.P. fuel filter bracket.
5. Remove the spring washers and top and bottom halves of the pipe clip.

The lower end of this pipe is disconnected after the control valve assembly has been removed.

Spill pipe—distributor to low pressure filter (12)

1. Remove the 2 B.A. bolt and spring washer which secures one of the clips on this pipe to one of the burner pipe brackets.
2. Remove the plain nut and spring washer which secures the second pipe clip to the stud just below No. 6 diffuser bolt.
3. Unscrew the union nut at each end and remove the pipe complete with clips and their rubber sleeves. Retain the two nipples which are fitted, one at each end of the pipe.

Breather pipe (37)

Unscrew the union nut at each end and remove the pipe complete with clip and rubber sleeve.

The breather pipe clip will have been detached previously during the removal of the B.P.C. to A-F.R.C. servo pipe.

Cooling oil supply pipe—sump to centre casing (14)

1. Remove the plain nut and spring washer from the stud in the diffuser casing adjacent to No. 11 deflector cover to which this pipe bracket is secured.
2. Unscrew the union nut at each end of the pipe and remove the pipe complete with bracket, clip and rubber sleeve.

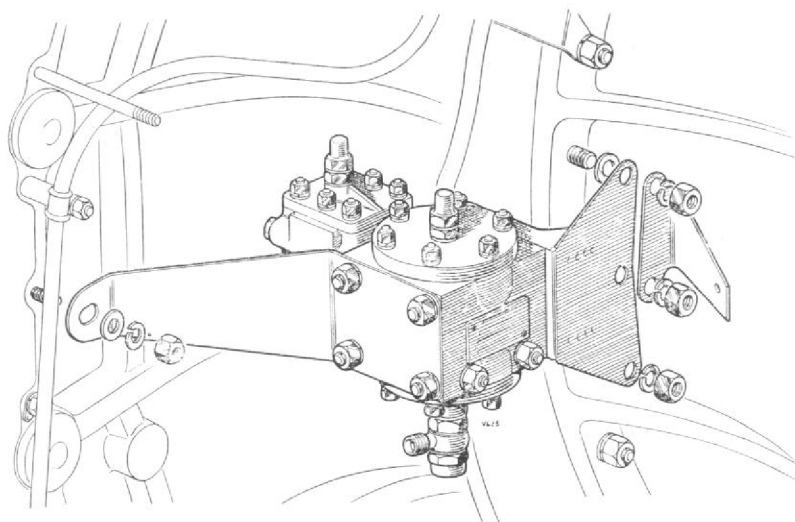


Fig. 6. Air-fuel ratio control unit and attachment brackets.

Cooling oil pipe—centre casing to oil spray (6)

1. Remove the plain nut and spring washer from the stud in the diffuser adjacent to No. 8 deflector cover to which this pipe clip bracket is secured.
2. Remove the four $\frac{1}{4}$ inch B.S.F. plain nuts, spring and plain washers from the studs on the front of the air-intake casing to which the square attachment plate on the forward end of the pipe is attached just below the centre housing.
3. Unscrew the union nut at the other end of the pipe and remove the pipe complete with bracket, clip and rubber cleat.
4. Remove the Klingerit washer fitted between the square attachment plate and the air-intake casing.

Oil drain pipe—air-intake (starboard) assembly (33)

1. Remove the 2 B.A. bolt and spring washer which secures the two halves of the bridge cleat, situated on the starboard side of the air-intake casing adjacent to the A-F.R.C. and remove the top half of the cleat.
2. Unscrew the union nut at each end and remove the pipe. Retain the two nipples which are fitted one at each end of the pipe.

Oil supply pipe—air-intake to top wheelcase (31)

Unscrew the union nuts at each end and remove the pipe. The top half of the bridge cleat which supports this pipe will have been removed previously during removal of the oil drain pipe.

Oil drain pipe—air-intake (port) assembly (8)

1. Unscrew the union nut at each end of the pipe.

2. Remove the air-intake securing nut and spring washer from the stud on which the drain pipe clip is fitted and remove the pipe complete with the clip and the rubber sleeve. Retain the two nipples which are fitted one at each end of the pipe.

Air-fuel ratio control

1. Ensure that all pipes have been disconnected.
2. Remove the three $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers from the three studs situated on the diffuser casing between No. 16 and No. 17 diffuser bolts to which the A-F.R.C. bracket is attached. Where mod. 393 has been embodied the outboard bracket is secured to the diffuser casing by only one $\frac{1}{4}$ in. B.S.F. nut, spring and plain washers (Fig. 6).
3. Remove the three air-intake casing retaining nuts and spring washers from the three studs to which the A-F.R.C. inboard bracket is attached.
4. Remove the A-F.R.C. complete with its two brackets, and the three distance pieces from the air-intake casing studs from which the inboard bracket has been withdrawn. Removal of the foregoing nuts will release the starboard oil drain pipe and the oil supply pipe bracket which can now be removed.

Fuel feed pipes—distributor to burner pipe connections (9)

1. Unscrew the union nuts that connect the ten rigid fuel pipes to the burner pipe connections on the diffuser casing, using spanner T.75556.
2. Unscrew the two 2 B.A. bolts securing the four burner pipes to the bracket which is just behind the top wheelcase, remove the two spring washers and one of the bridge cleats. Slide the second bridge cleat along the pipes

until it is clear of the bracket and remove the bridge cleat and the four heat-resisting rubber sleeves which encircle the pipes.

3. Unscrew the two 2 B.A. bolts securing the three burner pipes to the bracket which is mounted on the air-intake studs in line with No. 17 diffuser bolt. Remove the two spring washers and one of the bridge cleats. Slide the second bridge cleat along the pipes until it is clear of the bracket and remove the bridge cleat and the three heat-resisting rubber sleeves which encircle the pipes.

When mod. 393 has not been embodied, the clip which secures this pipe to one of the studs in the diffuser casing, in line with No. 17 diffuser bolt, will have been previously released during the removal of the A-F.R.C. When mod. 393 has been embodied, remove the $\frac{1}{4}$ in. B.S.F. plain nut, spring and plain washers and release the pipe clip.

4. Remove the 2 B.A. bolt and spring washer which secures the pipe clip on No. 7 burner pipe to the bracket which is mounted on the air-intake studs in line with No. 15 diffuser bolt.
5. Unscrew the $\frac{1}{4}$ in. B.S.F. plain nut and remove the spring washer from the stud in the bottom wheelcase flange to which the pipe clip on No. 6 burner pipe is secured.
6. Remove the 2 B.A. bolt and spring washer securing the two burner pipes to the bracket which is mounted on the air-intake studs in line with No. 8 diffuser bolt. Remove one of the bridge cleats and slide the second cleat along the pipes until it is clear of the bracket and can be removed. Remove the two heat-resisting rubber sleeves which encircle the pipes.
7. Remove the two 2 B.A. bolts and spring washers which secure the three burner pipes to the bracket mounted on the air-intake studs in line with No. 7 diffuser bolt. Remove one of the bridge cleats. Slide the second bridge cleat along the pipes until it is clear of the bracket and can be removed with the three heat-resisting rubber sleeves which encircle the pipes.
8. Remove the remaining 2 B.A. bolt and spring washer securing the four burner pipes to the bracket which is mounted on the air-intake studs in line with No. 5 diffuser bolt. Remove one of the bridge cleats. Slide the second bridge cleat along the pipe until it is clear of the bracket and can be removed with the four heat resisting rubber sleeves which encircle the pipes.
9. Using spanner T.75461, and working in the following order—6, 7, 5, 8, 4, 9, 3, 10, 2, 1—unscrew the union nuts connecting the fuel pipes to the distributor and remove the pipes.

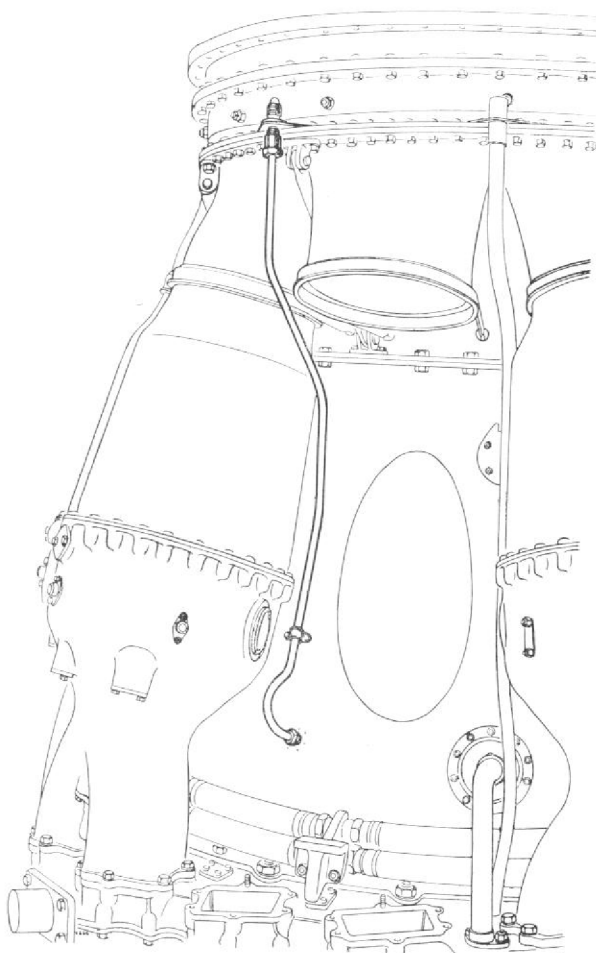


Fig. 7. Rear bearing oil drain pipe.

Rear bearing oil drain pipe—No. 13 diffuser bolt to drain box (pre-mod. 1088)

Unscrew the union nuts at each end and remove this short rigid pipe. Retain the nipple which is fitted at the diffuser end of the pipe.

Rear bearing oil drain pipe—centre casing to exhaust cone (Fig. 7) (mod. 1088)

1. Unscrew the union nuts at the nozzle shroud support and the centre casing adapter.
2. Release the pipe clip and remove this long rigid pipe.

Seal drain pipe—front pump to rear pump (5)

Unscrew the union nut at each end and remove the pipe.

Seal drain pipe—rear pump to drain box (7)

Unscrew the union nut at each end; remove the $\frac{1}{4}$ in. B.S.F. nut, the spring washer, the lockwire tab and the pipe clip from the stud

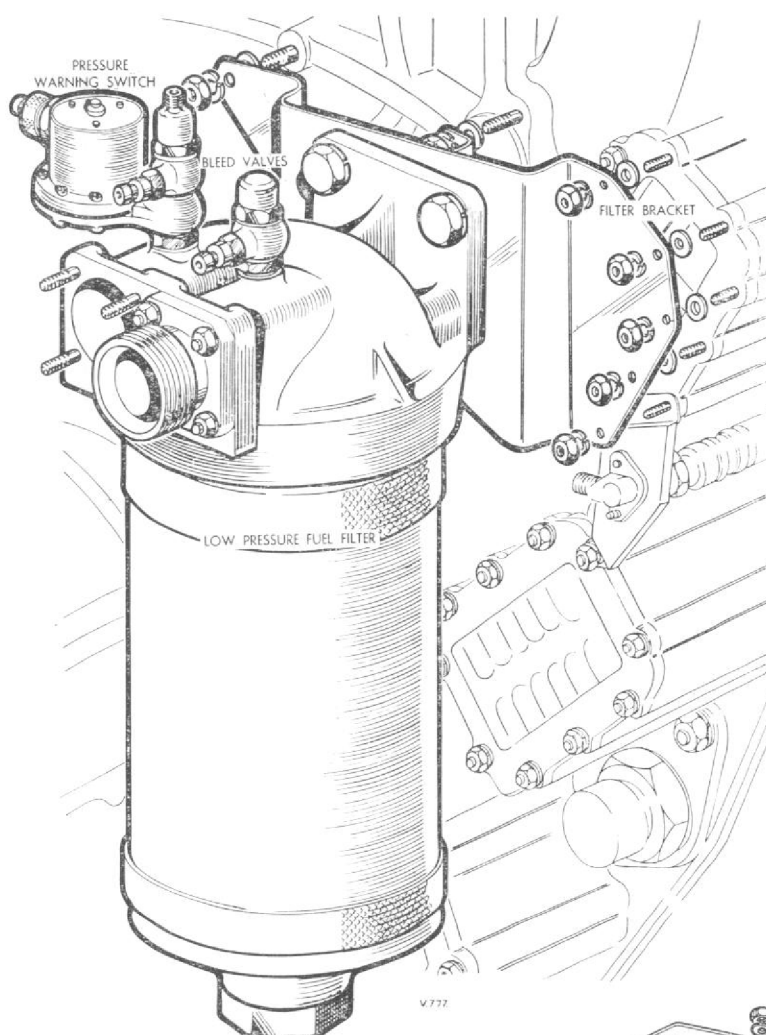


Fig. 8. Vokes low pressure fuel filter and attachment bracket.

in the diffuser casing adjacent to No. 11 diffuser bolt, and remove the pipe.

Barometric pressure control

Remove the $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers from the four B.P.C. mounting studs in the oil sump and remove the B.P.C.

Low pressure fuel filter and attachment bracket (Fig. 8)

1. To facilitate final dismantling of the filter assembly after it has been removed from the engine, loosen the filter case, using the small end of box spanner T.73692 with tommy bar T.73693 whilst the filter is attached to the engine. Similarly, other nuts and unions should also be loosened with appropriate spanners.
2. Remove the $\frac{1}{4}$ in. B.S.F. plain nut and spring washer from the stud in the diffuser casing

which secures the lug welded to the centre of the filter bracket.

3. Remove the five 2 B.A. nuts and spring washers which secure the outboard edge of the bracket and remove the filter complete with the bracket.
4. Remove the six spacing washers from the studs in the diffuser casing.

High pressure fuel filter and brackets (Fig. 9)

The high pressure fuel filter is removed together with the smaller of the two sheet-metal brackets.

1. To facilitate final dismantling of the filter assembly after it has been removed from the engine, loosen the filter bowl, using the large end of box spanner T.73692 with tommy bar T.73693 whilst the filter is attached to the engine. Similarly, other nuts and unions should also

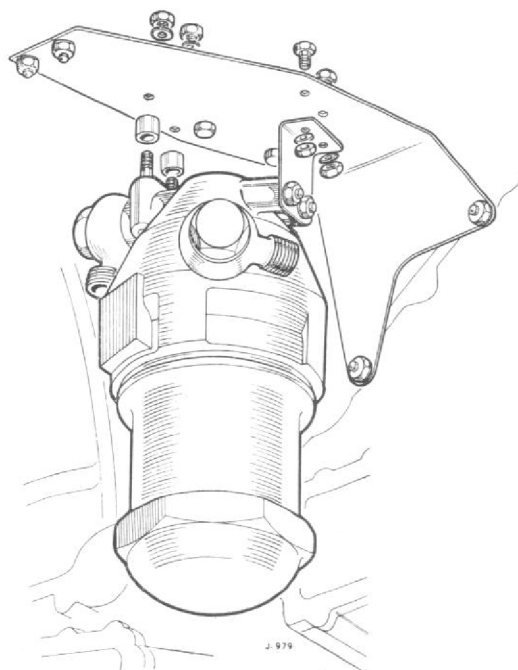
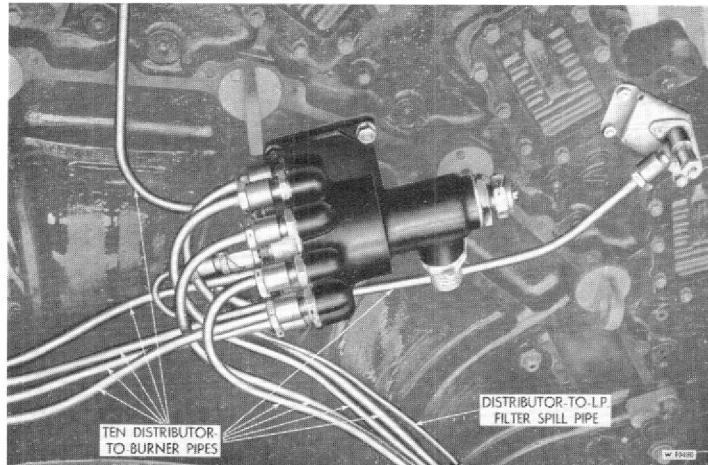


Fig. 9. High pressure fuel filter and brackets.

be loosened with appropriate spanners.

2. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers from the vertical studs in the filter head which project through the large sheet-metal bracket.
3. Supporting the filter which will be free to fall as soon as this operation has been completed, remove the two $\frac{1}{4}$ in. B.S.F. plain nuts, spring washers and bolts, which secure the smaller sheet-metal bracket to the larger bracket.



4. Remove the filter with the small bracket attached to it.

Fig. 11. Fuel distributor; the pipes will have been removed as described on page 9.

5. Remove the two plain nuts and spring washers which secure the large bracket to the two studs which are located adjacent to No. 9 and No. 10 diffuser bolts.
6. Remove the two plain nuts and spring washers which secure the front end of the bracket to the bottom wheelcase just behind the hydraulic pump drive housing and remove the bracket.

the distributor, and the spill pipe from the control valve to the B.P.C. to the front fuel pump are still connected to the control valve assembly. Remove the assembly complete with these pipes.

1. Support the control valve assembly and unscrew the four $\frac{1}{4}$ in. B.S.F. mounting bolts until they are clear of the threads in the oil sump.
2. Lower the control valve assembly and the three pipes attached to it clear of the engine.
3. Remove the four bolts and the spring and plain washers.

Fuel control valve assembly (Fig. 10)

The high pressure pipe from the control valve assembly to the air-fuel ratio control, the pipe which connects the control valve assembly to

Distributor (Fig. 11)

Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers from the studs in the diffuser casing to which the distributor is secured; remove the distributor.

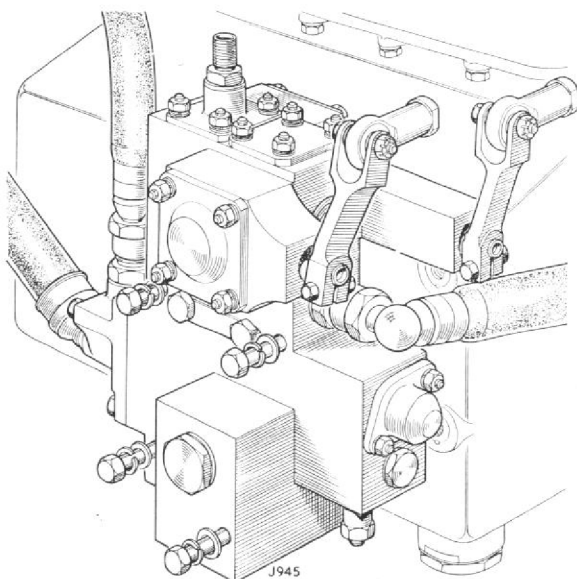


Fig. 10. Fuel control valve assembly.

Pump to pump connection

Remove the four $\frac{1}{4}$ in. B.S.F. nuts, spring and plain washers from the studs retaining the pump to pump connection and remove the connection.

Fuel pumps

1. Ensure that all union nuts, etc., have been disconnected and that there is nothing to hinder withdrawal of the pump.
2. Remove the eight $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers from the studs in the bottom wheelcase.
3. Carefully draw the pump down until its flange is clear of the studs and the drive is disengaged.

4. Withdraw the rear fuel pump in a similar manner.

Drain box (Fig. 12)

1. Unscrew the three 2 B.A. plain nuts and remove the spring and plain washers from the three deflector cover studs to which the drain box is secured on the bottom front face of the diffuser casing.
2. Withdraw the drain box and remove the three aluminium spacing washers from the studs.

Burner feed pipes (18)

Unscrew the union nuts at both ends of the ten burner feed pipes and remove the pipes.

Burner connection brackets

Each of these ten brackets is attached to the diffuser casing by three of the deflector cover securing studs. Remove the three 2 B.A. plain nuts and spring washers securing each bracket and remove the bracket complete with burner connection.

Fire extinguishing pipes (pre-mod. 1087)

Mod. 799 deleted the rear fire extinguisher ring; mod. 1087 deleted the front fire extinguisher ring.

1. Unscrew the two union nuts on the aircraft connection pipe Tee-piece.
2. Remove the plain nut and spring washer from the clip attached to one of the four cooling air pipe flange studs on the rear cover.
3. Remove the aircraft connection pipe complete with the Tee-piece and clip.
4. Remove the eight plain nuts and spring washers from the studs to which the three sections of the extinguisher pipe are attached and remove the pipe complete with the clips.

AIR COMPRESSOR HOUSING ASSEMBLY

1. Remove the plain nuts, spring and plain washers from the six studs that retain the compressor housing to the top wheelcase.
2. Lift off the housing complete with the drive, ensuring that the vertical quill shaft does not drop as the housing is removed.

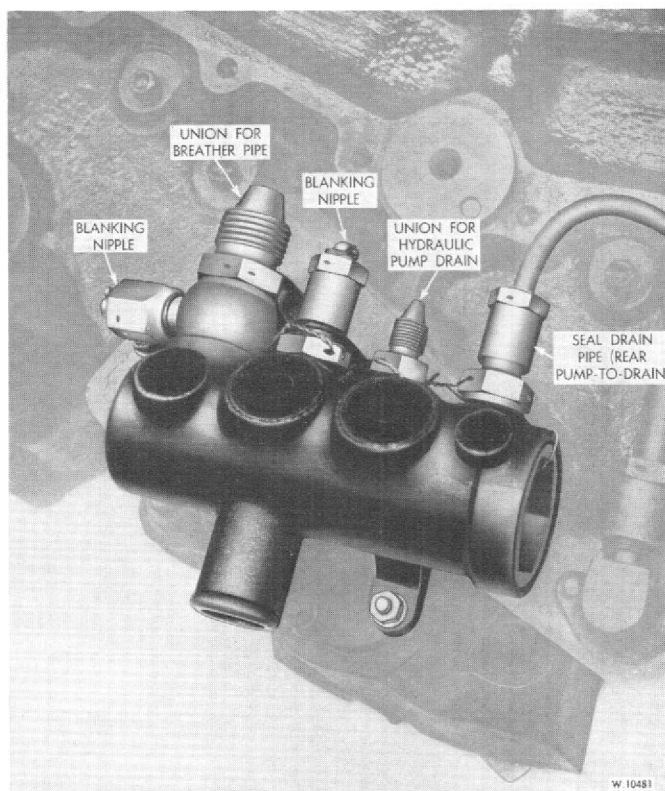


Fig. 12. Drain box.

STARTER DRIVE ASSEMBLY

1. Remove the four 7/16 in. B.S.F. plain nuts and spring washers which secure the transport blank to the upper attachment flange of the starter drive casing.
2. Remove the two 1/4 in. B.S.F. plain nuts, spring and plain washers from the studs in the counterbores inside the starter drive gear casing.

All securing nuts are accessible through holes in the top cover.

3. Remove the plain nuts and spring washers from the six studs situated at the base of the starter drive gear casing and remove the complete starter gear assembly from the wheelcase.
4. Tie the adjusting shim to the starter drive.

TOP WHEELCASE

1. Remove the external 1/4 in. B.S.F. plain nuts, spring and plain washers from the twenty-eight studs that secure the top wheelcase to the air-intake, together with the distributor pipe bracket situated at the rear of the wheelcase.
2. Carefully lift the wheelcase off the engine.
3. Remove the top vertical drive retaining circlip.

*Revised by Amendment No. 127
October, 1956*

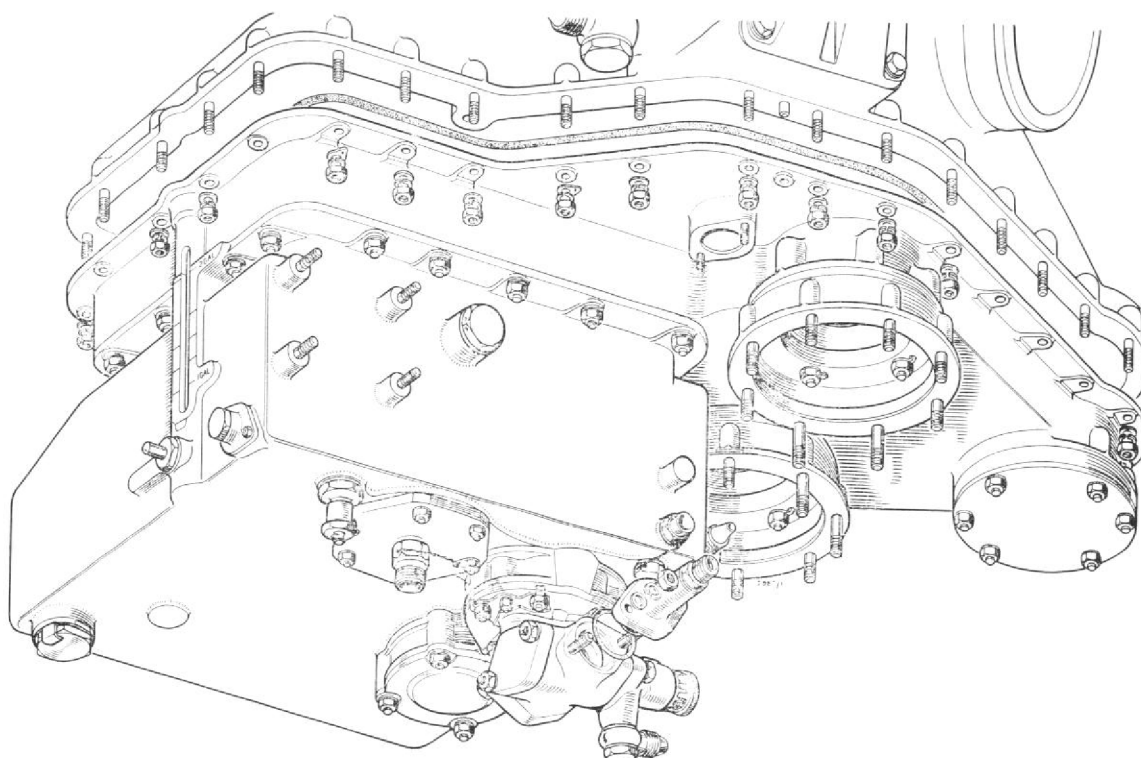


Fig. 13. Bottom wheelcase and sump.

4. Screw a slave $\frac{1}{2}$ in. B.S.F. stud or bolt into the threaded hole in the upper end of the top vertical drive shaft and lift the shaft out through the upper driving gear and the air-intake.

bracket which was secured by three of the wheelcase retaining nuts. This bracket should now be removed.

BOTTOM WHEELCASE AND SUMP (Fig. 13)

1. Turn down the tabs of the tandem locking washer and remove the two $\frac{1}{4}$ in. B.S.F. nuts that secure the vertical drive shaft support to the bottom wheelcase.
2. Remove the tab washer and withdraw the support and bottom vertical drive shaft. When the support is removed care must be taken to ensure that the bottom vertical drive shaft does not drop to the floor and sustain damage.
3. Remove the Klingerit washer.

The bottom wheelcase and the sump are removed as a unit by removing the remaining plain nuts, spring and plain washers that secure the bottom wheelcase to the air-intake casing. Twenty-two of the securing nuts are located on the outer flange of the wheelcase, a further one being attached to the wheelcase support stud which projects through the centre of the wheelcase. Carefully lift the wheelcase and sump assembly away from the engine.

(Pre-mod. 767 only) Removal of the bottom wheelcase will release the fuel pump air bleed

CENTRE HOUSING

Remove the plain nuts, spring and plain washers from the twelve studs on the front of the air-intake casing to which the centre housing is secured. The centre housing complete should withdraw readily from the air-intake. If, however, there is difficulty in withdrawing it, use extractor T.78314 as follows.

1. Remove the four nuts and tab washers which secure the front bearing housing.
2. Remove the front bearing retaining cover.
3. Turn the tommy bar of the extractor screw anti-clockwise until the centre pad is within the bridge.
4. Position the bridge of the extractor vertically and place the two fibre-protected pads of the bridge on the air-intake with the centre pad over the front bearing housing studs; turn the tommy bar until the face of the centre pad touches the front bearing housing flange.
5. Fit slave washers and nuts to the four front bearing housing studs thus securing the extractor centre pad to the front bearing housing.
6. Turn the tommy bar in a clockwise direction

and extract the centre housing assembly.

7. Unscrew the four slave nuts and remove the washers and the extractor from the front bearing housing studs.
8. When the centre housing has been removed, remove the retaining circlip and withdraw the horizontal accessory drive shaft from the pivot shaft.

ENGINE MOUNTING BRACKETS

1. Cut and remove the locking wire from the eight bolts which secure the top and bottom engine mounting brackets.
2. Remove the two engine mounting brackets complete with their laminum washers and secure each laminum washer to its particular engine mounting bracket.

It is of paramount importance to keep the engine mounting brackets with their particular engine, and to keep each laminum washer with its own mounting bracket. The centre line of the bolt holes will be incorrect on installation should these precautions be ignored.

TURBINE DISC

The turbine disc is secured to the hub shaft by ten bolts, eight of which utilise nuts behind the turbine disc rear face. The remaining two bolts are positioned 180 deg. apart and are inserted from the opposite side through the turbine disc, to screw into threads in the hub shaft flange.

1. Using the stand turning handle, rotate the engine until the turbine disc is uppermost.
2. Turn down the tabs of the locking washers.
3. *Pre-tool-mod. 687*, place the two $\frac{1}{4}$ in. B.S.F. studs of disc locking fixture T.76718 through two holes in the turbine shroud; simultaneously position two holes in the bar over the two bolt heads in the turbine disc. Using slave washers and nuts, secure the fixture to the turbine shroud.

The bar of the fixture is marked for both GHOST 50 and GHOST VENOM; ensure that the GHOST VENOM mark is uppermost when fixing.

4. *Tool mod. 687*, engaging the holes at the centre of locking bar T.79209 with the turbine disc bolts, use four $\frac{5}{16}$ in. B.S.F. slave bolts and nuts to secure the locking bar to the turbine shroud.
5. Using a suitable ring spanner, loosen the eight securing nuts.
6. Remove the two $\frac{1}{4}$ in. B.S.F. slave nuts and washers and lift the locking fixture clear of the disc; replace the bar over two of the

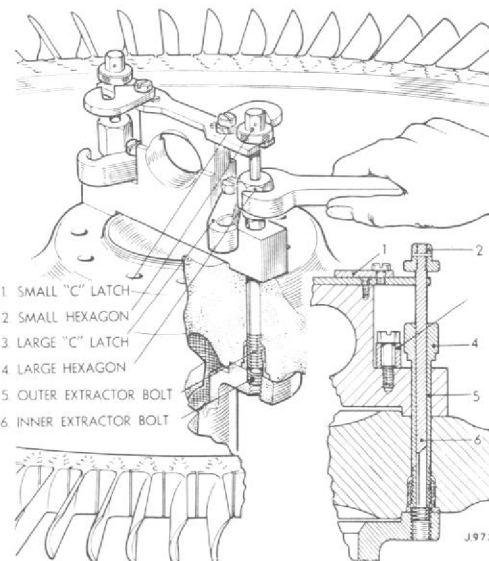


Fig. 14. Removing turbine disc with combined lifting and extracting fixture T.74810.

loose nuts and secure it to the turbine shroud as before.

7. Use the ring spanner to loosen the two bolts which were previously shielded by the locking bar.
- Where the locking bar introduced by tool mod. 687 is being employed, the impeller pivot nut should be removed at this stage, as described in op. 3 to 7 on page 16.*
8. Remove the locking bar.
9. Remove the eight nuts, the two bolts and all tab-washers.
10. Position combined extractor and lifting fixture T.74810 on the disc, Fig. 14.
11. Swing the large 'C' latches clear of the extractor bolts and, with a suitable spanner, turn the upper, smaller hexagons, to engage the threads of the inner extractor bolts in the hub shaft until the smaller, upper, 'C' latches prevent further engagement of the bolt threads.
12. Unscrew the inner bolts half-a-turn and swing the upper 'C' latches out of engagement.
13. Using a suitable spanner on the lower, larger hexagons, screw in the outer extractor bolts, applying half-a-turn to each alternately to release the disc.
14. When the disc has been released from the hub shaft, unscrew the outer bolts sufficiently to enable the large 'C' latches to be swung into engagement with the extractor bolts, which are then re-tightened to hold the latches in position, and unscrew the inner bolts until they are clear of the hub shaft threads.
15. Connect the hook of the lifting tackle to the

lifting eye of the extractor and lift the turbine disc clear of the engine. Place the disc in felt-lined transport box T.72575.

COMBUSTION CHAMBERS

Combustion chambers, burners, diffuser bolts, etc., are all numbered in a clockwise direction when the engine is viewed from the front. The numerical position of each combustion chamber is cast on the diffuser casing and it is desirable to keep the components from each assembly in sets, so that upon re-assembly, flame tubes and head assemblies are fitted in their original expansion chambers and outer casings. Each combustion chamber should be removed complete with its burner.

1. Remove the ten $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers which secure the combustion chamber fuel drain assembly to No. 4, 5, 6, 7 and 8 combustion chambers, refer to Fig. 25, chapter 16. Carefully draw the drain assembly off the studs and remove the Klingerit washer from each drain boss.
2. Remove the ten interconnector nut circlips and using spanners T.72178 and T.72170, refer to Fig. 4, chapter 16, unscrew the slotted nut from the slotted interconnector plug which is between each adjacent combustion chamber.

From this stage, removal of each combustion chamber is identical, therefore the operation of removing one only is described.

3. Using swivel spanner T.74280, unscrew the $\frac{1}{4}$ in. B.S.F. plain nuts which secure the two entry flanges of the expansion chamber to the diffuser casing rear cover.
4. Using as necessary swivel spanner T.74279, refer to Fig. 5, chapter 16, remove the five $\frac{5}{16}$ in. B.S.F. bolts, spring and plain washers which also secure each expansion chamber entry flange to the diffuser casing rear cover.
5. Ease the combustion chamber away from the face of the diffuser casing rear cover; the rear end will slide into the nozzle ring, then draw the expansion chamber outwards until its entry flanges are just clear of the diffuser casing and withdraw the rear end of the combustion chamber from the nozzle ring.
6. Blank off the apertures in the diffuser casing rear cover with blanking plates T.72764.

INSULATING PLATE AND COOLING MUFF

1. Turn down the locking tabs of the six tandem tab washers.
2. Using spanner T.75715, remove the twelve bolts, locking washers and plain washers which secure the insulating plate to the rear bearing flange.
3. Turn the insulating plate circumferentially to

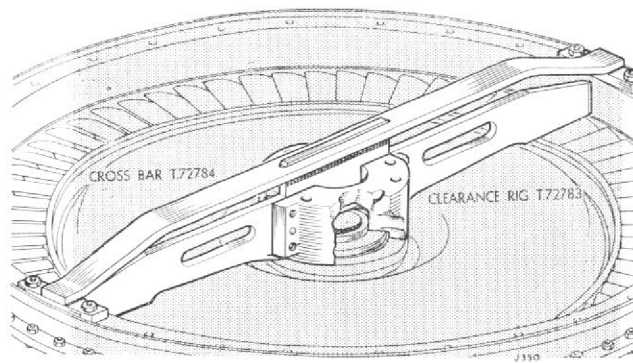


Fig. 15. Clearance rig T.72783 and cross bar T.72784 (pre-tool mod. 687) fitted to the hub shaft and the turbine shroud, for the purpose of locking the main shaft assembly.

clear the locking lugs of the baffle ring and lift it clear of the engine.

4. Remove the cooling muff which is secured by the same twelve bolts.

IMPELLER PIVOT NUT REMOVAL

The following operations are correct when pre-tool mod. 687 tools are used to hold the main shaft stationary. Where locking bar T.79209 introduced by tool mod. 687, is employed, op. 1 and 2, and the last part of op. 7 should be ignored, and op. 3 to 6 completed immediately after op. 7 in the sequence of operations for removal of the turbine disc.

1. Place turbine disc clearance rig T.72783 on the hub shaft and secure it in position with four of the turbine disc securing nuts previously removed.
2. Fit cross bar T.72784 over the clearance rig and secure the bar to the turbine shroud with four $\frac{5}{16}$ in. B.S.F. slave bolts and nuts, Fig. 15.
3. Turn the engine to a horizontal position and open up the impeller pivot-nut cup locking washer.
4. Insert box spanner T.72785 through the centre housing aperture in the front of the air-intake casing and engage the castellations of the box spanner with the serrations in the impeller pivot nut. Lightly tap the front end of the box spanner to ensure that engagement is positive.
5. Position spanner guide plate T.74791 (48 Mk. 1) or T.77451 (48 Mk. 2) on the centre housing attachment studs with the shank of the box spanner protruding through the large centre hole in the guide plate. Secure the plate in position with four of the centre housing retaining nuts.
6. Insert the $\frac{3}{4}$ in. square drive of wrench T.73936 into the square hole in the forward end of the box spanner; unscrew and remove

the pivot nut, cup locking washer and spacer, Fig. 16.

7. Remove the guide plate, restore the engine to a vertical position with the rear end uppermost, and remove the cross bar and clearance rig.

TURBINE DISC REAR COOLING AIR PIPES (Fig. 17)

Each of the four pipes is similarly attached and the removal of only one is described.

1. Remove the 2 B.A. set bolt and spring washer which secures the central pipe clip to the front cone.
2. Remove the two $\frac{1}{4}$ in. B.S.F. nuts and spring washers which secure the cooling air pipe flange to the studs on the front cone front flange.
3. Push the pipe into the sleeve attached to the nozzle shroud until the pipe flange clears the securing studs, then draw the pipe forwards and downwards until it is clear of the sleeve. Discard the Klingerit washer under the flange. Remove the remaining three pipes in a similar manner.

NOZZLE RING ASSEMBLY

1. Remove the nineteen $\frac{5}{16}$ in. B.S.F. bolts and locking washers which secure the diaphragm to the rear bearing housing assembly.
2. Draw back the thermocouple support bracket and spring; remove the two halves of the split insulating sleeve and withdraw the solid insulating sleeve and thermocouple end from the bush in the rear bearing housing.

A screwdriver or other tool must not be used

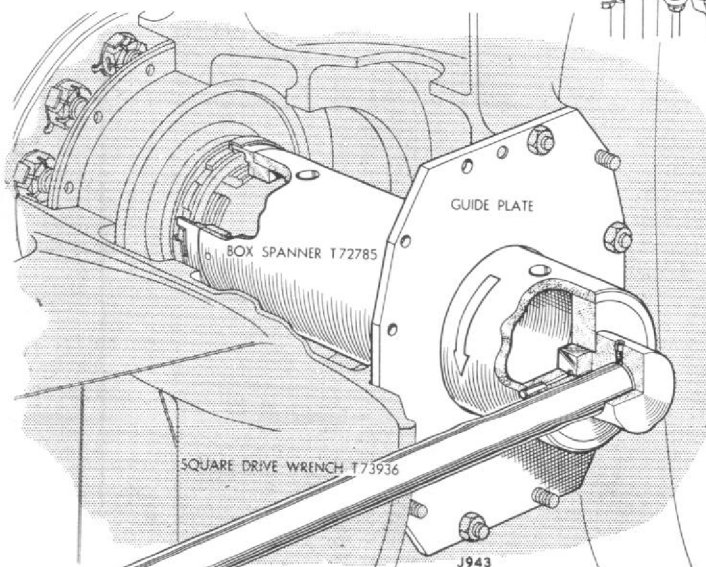


Fig. 16. Removing the impeller pivot nut, using box spanner T.72785, guide plate T.74791 (48 Mk. 1) or T.77451 (48 Mk. 2), and square drive wrench T.73936.

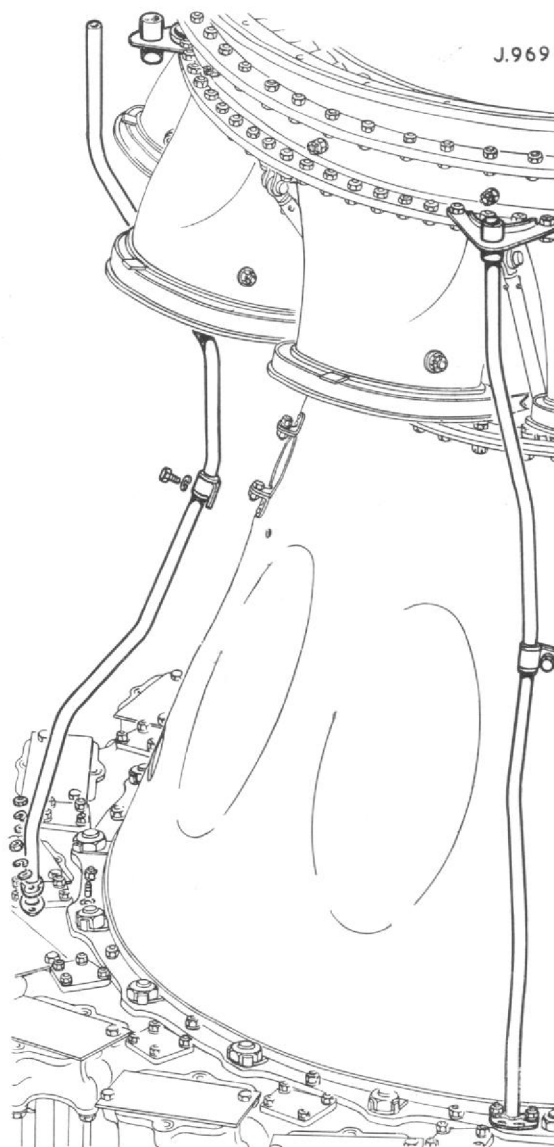


Fig. 17. Removal of the turbine disc cooling air pipes.

to extract the thermocouple solid insulating bush out of the bush in the rear bearing housing, as the former will be in a brittle state and easily broken.

3. Remove the twenty $\frac{3}{8}$ in. B.S.F. nuts from the bolts which secure the ten support struts to the centre casing/support cylinder attachment flanges.
4. Using the existing bolts and nuts replace the strut adjusting shims to the strut brackets.
5. Remove the plain nuts and locking washers from the twenty bolts which secure the nozzle strut brackets to the

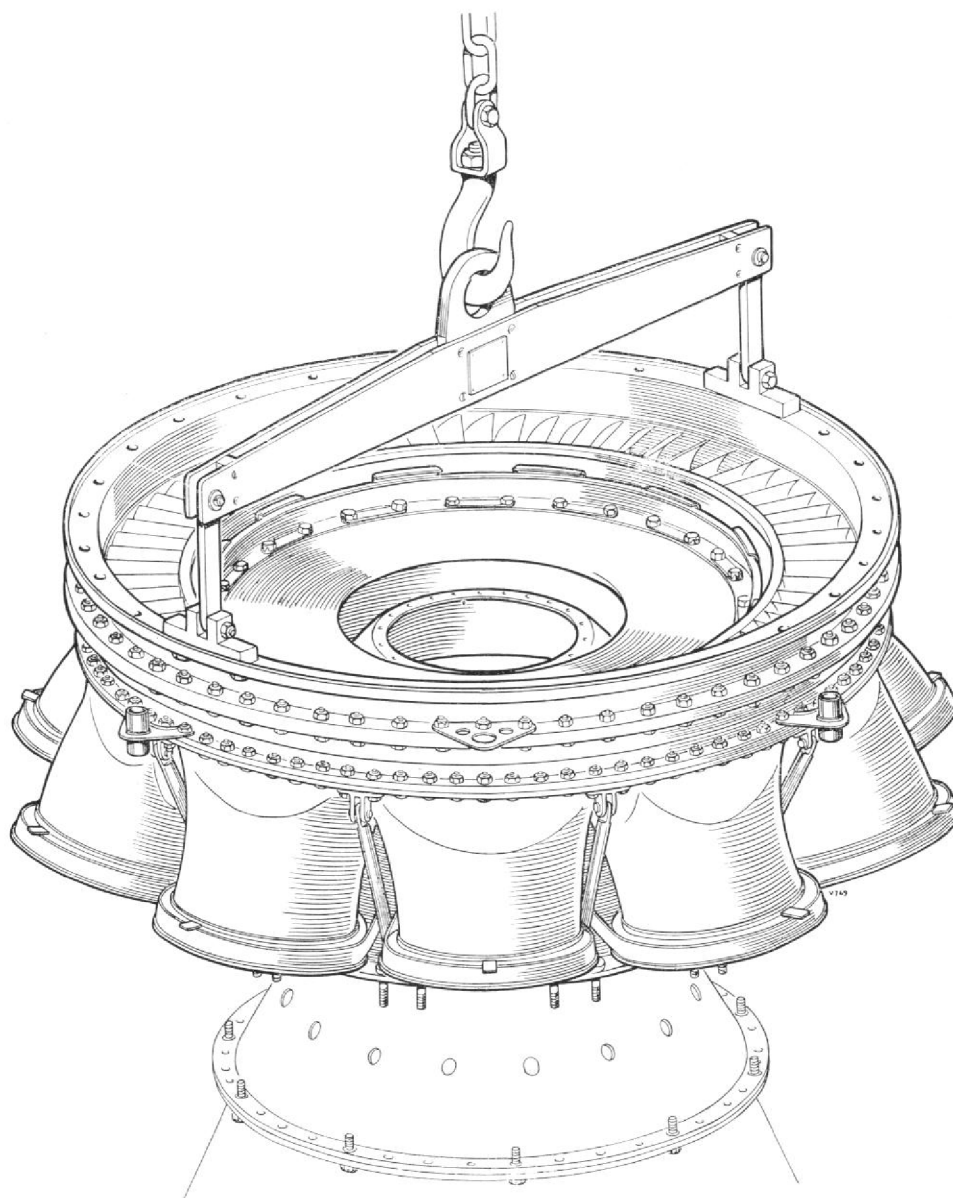


Fig. 18. Lifting nozzle ring assembly from engine.

nozzle shroud. Remove the struts complete with brackets, shims and spacing washers, replace the shims on their respective strut bolts and retain with the nuts.

6. Remove the ten 5/16 in. B.S.F. nuts, spring washers and bolts which secure the support cylinder to the rear cone.
7. Remove the nuts and spring washers from the ten studs which secure the rear cone to the front cone.
8. Attach lifting sling T.79239 to the turbine shroud, engage the hook of the lifting tackle with the lifting eye of the sling and lift the nozzle ring assembly clear of the engine,

Fig. 18. Lower the assembly on to table T.72852.

CENTRE CASING

Removal of the rear cone will permit access to the various pipe connections to the rear bearing assembly, Fig. 19.

1. Using two $\frac{1}{4}$ in. B.S.F. slave bolts in the threaded holes provided in the rear flange of the rear cone, separate the latter from the front cone.
2. Remove the two plain $\frac{1}{4}$ in. B.S.F. nuts and tab-washers which secure the air-cooling pipe

Revised by Amendment No. 127
October, 1956

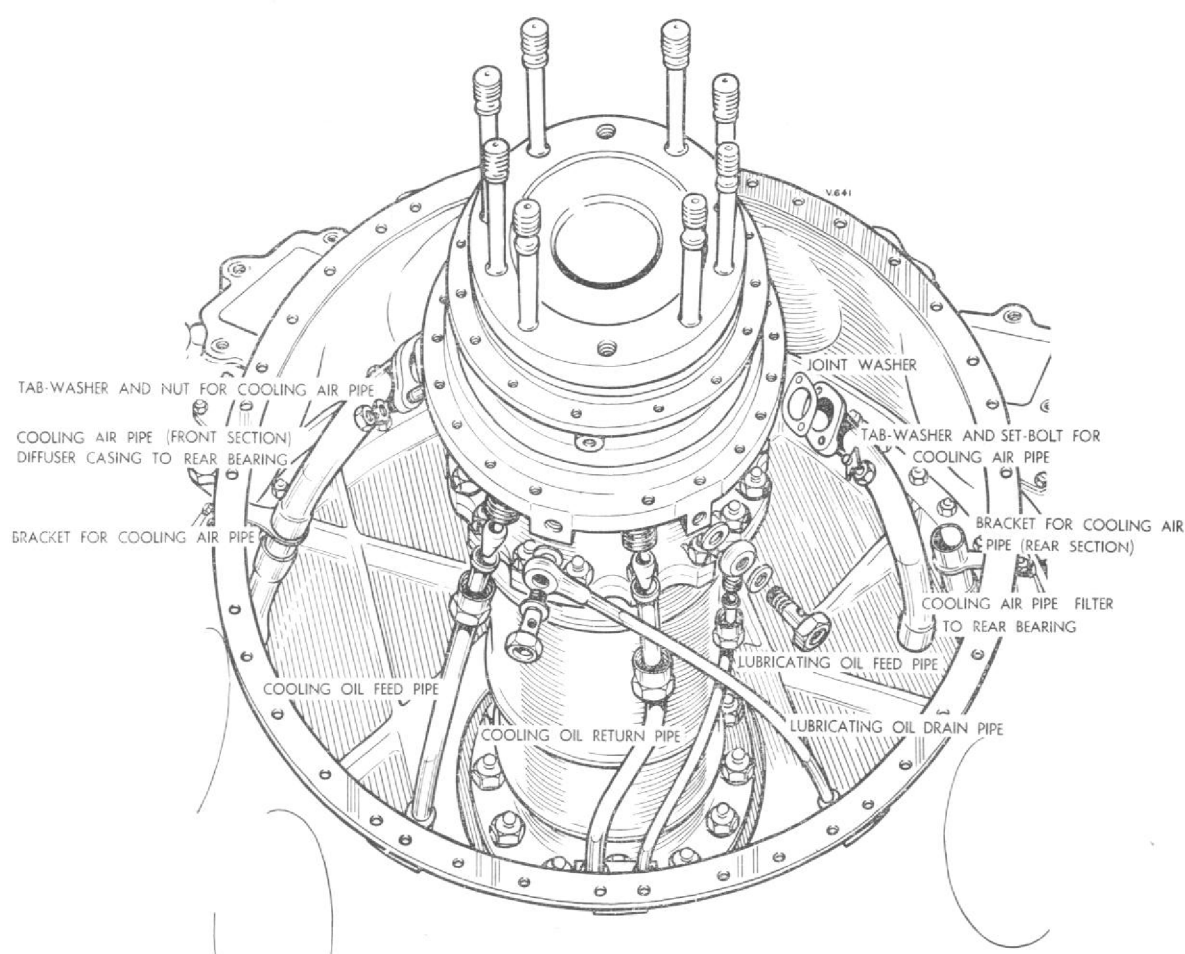


Fig. 19. Rear bearing pipe connections.

to the cooling air block; remove the two $\frac{1}{4}$ in. B.S.F. set screws and tab washers which secure the air cooling pipe to the rear bearing housing. Remove the Klingerit washer from each pipe attachment flange.

3. Remove the two $\frac{1}{4}$ in. B.S.F. nuts, spring washers and bolts from the fixing lugs of each of the two circular blanking plates in the centre casing and remove the blanking plates. The upper bolt on each blanking plate also secures a cooling air pipe bracket and removal of the blanking plates will release the pipe sleeves attached to the brackets.
4. Slide the pipe sleeves downwards and remove the upper sections of the air pipes.
5. Unscrew the respective union nuts and remove one banjo bolt to disconnect the lubricating oil feed pipe, the lubricating oil drain pipe, the cooling oil feed pipe and the cooling oil return pipe from the rear bearing housing assembly.
6. Using spanner T.76565, unscrew the union nut at the air filter. Remove the two set bolts, spring and plain washers from the pipe attach-

ment flange on the diffuser rear cover and remove the cooling air pipe; remove the Klingerit washer from the flange joint.

7. Unscrew the union nuts and disconnect the rear bearing lubricating oil supply and drain pipes from No. 10 (pre-mod. 1095) and No. 13 (pre-mod. 1088) diffuser bolts. Similarly (pre-mod. 483), disconnect the rear bearing cooling oil supply and return pipes from No. 11 and No. 8 diffuser bolts; unscrew the union nuts which secure these four pipes to their connections on the front cone and remove the pipes.
8. Release the Jubilee clip from the sleeve on the cooling air feed pipe to the static assembly. The clip is clamped to the pipe just where the pipe emerges from the inside of the front cone on the opposite side of the engine to the air filter.
9. Remove the four plain nuts, spring and plain washers from the studs to which the pipe flange is attached on the rear cover.
10. Slide the cover plate forwards until the pipe flange can be lifted clear of the studs and the

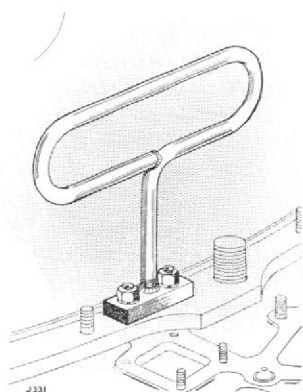


Fig. 20. Centre casing lifting handle T.72775 fitted to front flange of front cone.

whole lower section withdrawn from the front cone. When mod. 408 is embodied, the circular cover plate on the air pipe is transferred to the inside of the front cone and the pipe must be removed by drawing it upwards out of the front cone, past the rear bearing assembly.

11. Remove the four 2 B.A. plain nuts and spring washers from the studs which secure each air annulus cover; in two instances, remove also the lockwire tab. When mod. 507 is embodied the air annulus covers are secured by forty long 2 B.A. bolts which pass through the diffuser casing, together with forty 2 B.A. studs located in the rear cover. Remove the covers.

It is most important that these 2 B.A. nuts are removed before removing the larger nuts from the diffuser bolts. Should the order of removal be reversed, great stress may be applied to the 2 B.A. studs or bolts directly the nuts are removed from the diffuser bolts, due to spring in the diffuser casing. This stress can result in the failure of the 2 B.A. studs or bolts as soon as an attempt is made to remove the 2 B.A. nuts.

12. Remove the twenty securing nuts and tab-washers from the diffuser bolts at the centre casing/diffuser cover attachment flange.
13. Remove the twenty 5/16 in. B.S.F. plain nuts and spring washers and, when mod. 378 is embodied, the four lockwire tabs from the centre casing studs in the diffuser cover.
14. 48 Mk. 1 only. Fit four lifting handles T.72775, Fig. 20, to the cooling air pipe attachment studs on the centre casing/rear cover flange, and using a rubber or raw-hide mallet to assist in breaking the joint, lift the front cone clear of the rear cover.

When mod. 567 is embodied, four hardened steel inserts are fitted at equidistant positions circumferentially in the rear cover flange. At corresponding positions in the front cone flange 5/16 in. B.S.F. tapped holes are pro-

vided, so that four slave bolts may be used to break the joint between the front cone and the rear cover.

15. 48 Mk. 1 only. Remove the four lifting handles from the front cone flange.

SEALING PLATE

(Pre-mod. 897) The three sealing plate inspection covers should be removed first; each plate is secured by two studs in the sealing plate, with $\frac{1}{4}$ in. B.S.F. plain nuts and tab-washers. When mod. 897 is embodied a lightened sealing plate without inspection covers is fitted.

1. Remove the nuts and tab-washers.
 2. Place extractor T.76563 in position so that the main bar straddles the inspection cover with the ends registering on the inner and outer machined surfaces of the sealing plate, Fig. 21.
- The legs of the extractor are not of equal length; it is important to ensure that the bridge is correctly positioned as shown in Fig. 21; serious damage to both the extractor and the inspection cover will occur if these instructions are ignored.*
3. Engage the threaded tip of the extractor bolt with the tapped hole in the inspection cover and tighten the nut on the extractor to withdraw the cover.
 4. Remove the sixty plain nuts, thirty tandem tab washers and sixty plain washers from the studs which secure the sealing plate to the diffuser rear cover.
 5. Attach the three-cable sling T.75118 to the inspection cover studs using the cover retaining nuts previously removed; connect the hook of the lifting tackle to the lifting eye of

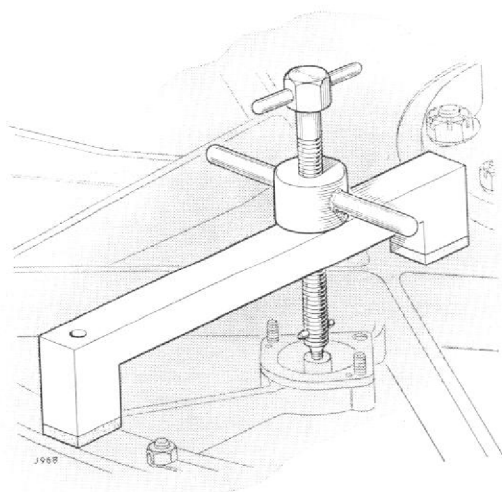


Fig. 21. Removing an inspection cover from the sealing plate, using extractor T.76563.

the sling and lift the sealing plate away from the rear cover, Fig. 22.

6. Remove the shims used to adjust the impeller labyrinth clearance and tie them together.

MAIN SHAFT ASSEMBLY

1. Using spanner T.77360, secure pilot mandrel T.77359 to the impeller pivot. This mandrel will obviate damage to the pivot threads and safety bearing.
2. Attach lifting fixture T.74809 to two of the turbine disc retaining bolts by means of the two captive nuts provided, and secure the other two legs of the fixture to two of the threaded holes in the rear bearing housing flange by means of the two captive bolts, Fig. 23 overleaf.
3. Engage the hook of the lifting tackle with the lifting eye of the fixture; ensure that the lifting tackle is positioned directly above the centre line of the main shaft.
4. Carefully lift the main shaft assembly out of the diffuser casing, supporting and guiding the impeller past

the rear cover/sealing plate attachment flange to prevent the assembly from swinging and damaging the flange or the impeller, Fig. 23.

5. Using spanner T.77360, remove the mandrel from the pivot; lower the main shaft assembly on to table T.75876 or secure it in transport stand T.72419.

AIR-INTAKE

Rotate the remaining engine assembly in the stand until the air-intake is uppermost.

There are forty air-intake securing studs in the diffuser casing, some of which are utilised for the attachment of brackets and therefore some of the nuts may have been removed previously.

1. Remove the twelve external securing nuts, spring washers and three brackets from the port side of the air-intake.
2. Remove the ten external securing nuts, spring washers and two brackets from the starboard side of the air-intake.
3. Turn down the tabs of the two triple tab washers and cut and remove the locking

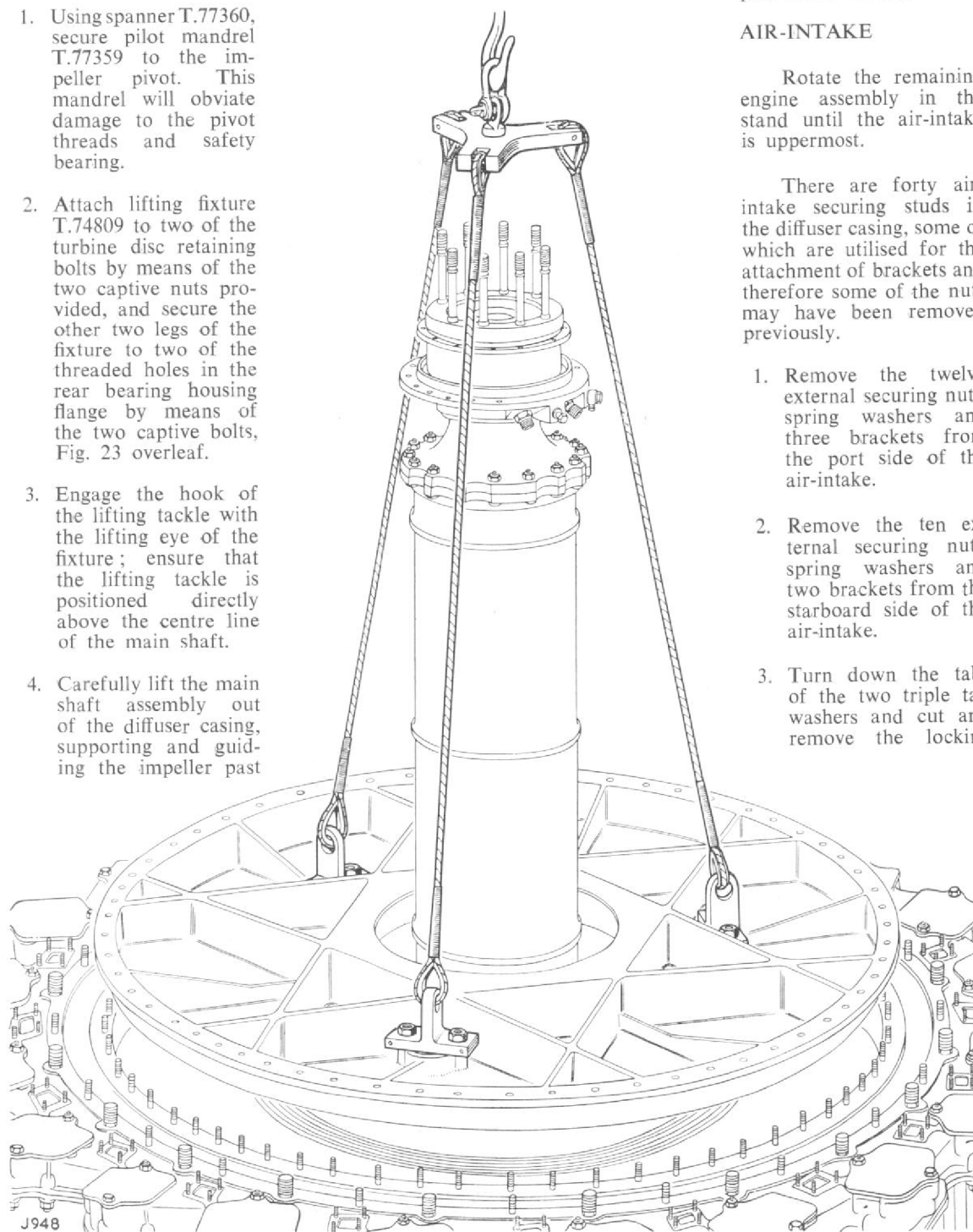
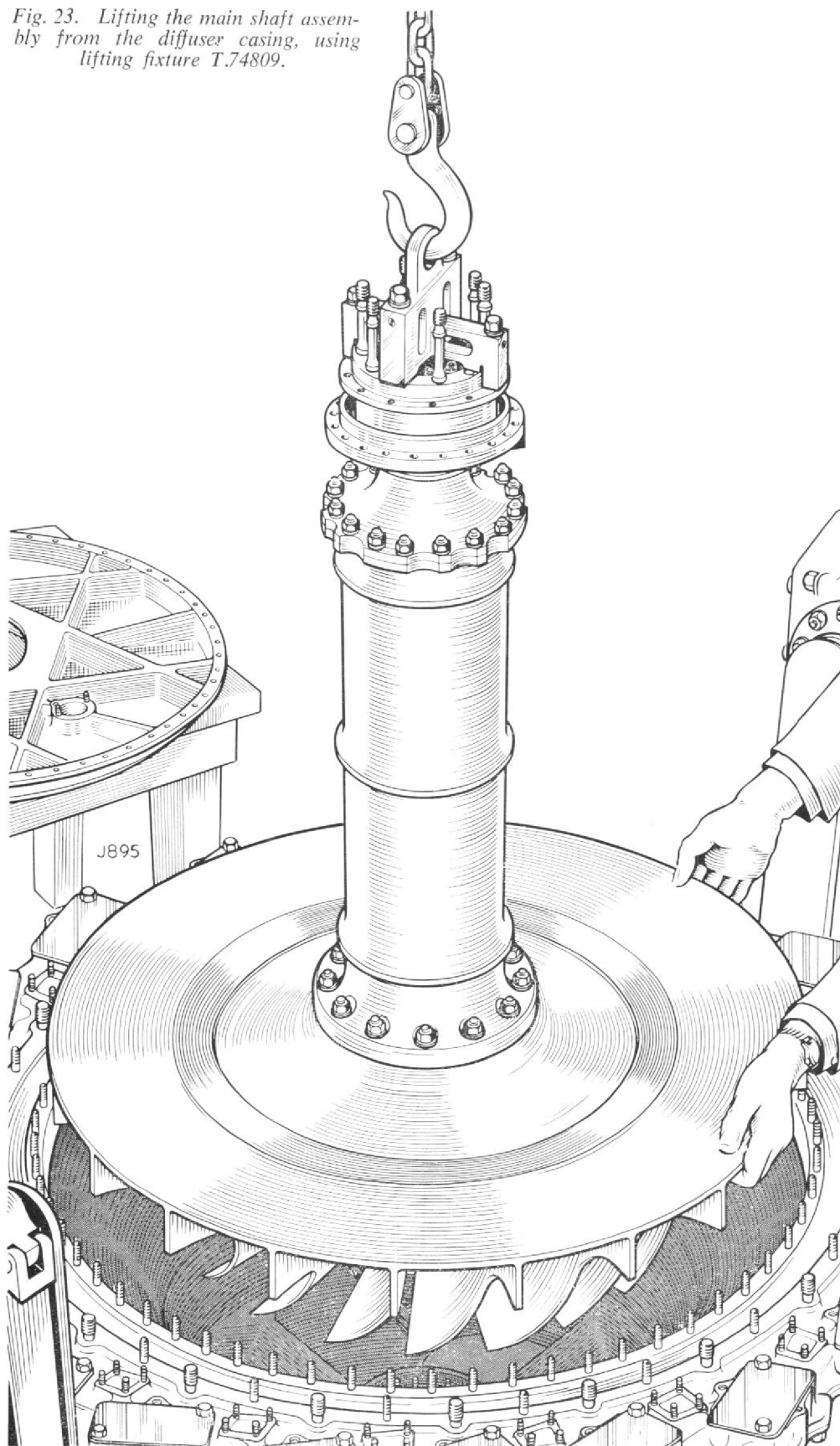


Fig. 22. Lifting the sealing plate from the diffuser rear cover using cable sling T.75118.

Fig. 23. Lifting the main shaft assembly from the diffuser casing, using lifting fixture T.74809.



wire from the four centre nuts. Remove the ten internal securing nuts from the top of the air-intake and remove the tab washers and six spacing washers from the studs.

4. Remove the eight internal securing nuts, four tandem tab washers, four thick and four thin spacing washers, from the studs in the bottom of the air-intake.
5. Attach lifting sling T.70454 to the front of the air-intake; engage the hook of the lifting gear with the sling and lift the air-intake away from the diffuser casing, Fig. 24, and place it on a flat surface.

GHOST 48 Mk. 2.

During dismantling of the engine, carefully note the position of any spacers or washers and whenever possible, reassemble all such mounting details to their respective parts with the existing nuts and bolts.

DRAINING THE SUMP

1. Place a receptacle of at least $2\frac{1}{2}$ gallons capacity beneath the drain plug which is situated in the base of the low pressure (suction) oil filter.
2. Cut and remove the locking wire which secures the drain plug to one of the six nuts which secure the base of the low pressure (suction) oil filter.
3. Using a standard 11/16 in. B.S.F. ($\frac{5}{8}$ in. Whitworth) box or ring spanner, unscrew and remove the drain plug and aluminium washer and allow the oil to drain completely.

IGNITION EQUIPMENT

The high energy ignition units, which are mounted on each side of the air-intake, are illustrated in Fig. 25, overleaf.

1. Unscrew the union nuts which connect the ignition cable elbows to the port ignition unit and the igniter plug screen respectively.
2. Remove the 2 B.A. set-bolt and spring washer which secures the cable to the bracket fastened to one of the 5/16 in. B.S.F. diffuser casing/rear cover studs.
3. Slacken the $\frac{1}{4}$ in. B.S.F. plain nut which clamps the two halves of the second ignition cable clip until the top half of the clip can be swivelled clear without damaging the cable.
4. Lift the cable clear of the engine.
5. Slacken each of the three $\frac{1}{4}$ in. B.S.F. set bolts which pass through the lugs at the top and on each side of the unit into threaded bosses cast on the air-intake.

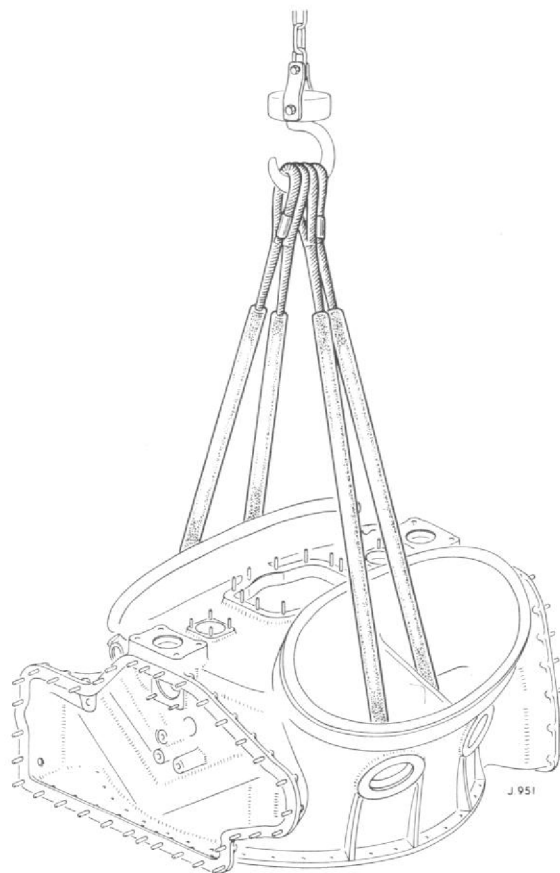


Fig. 24. Lifting the air-intake casing by means of sling T.70454.

6. Supporting the unit with one hand, remove the three set bolts together with the three spring and plain washers, and lift it clear of the engine.
7. Repeat the foregoing operations to remove the ignition cable and ignition unit from the star-board side of the engine.

Torch igniters and fuel supply pipes

1. Cut and remove the locking wire which secures the fuel pipe union to the banjo union on No. 10 and No. 3 combustion chambers.
2. Unscrew the fuel pipe union nuts of the torch igniter in No. 10 combustion chamber and at the 'T' piece.
3. Remove the 2 B.A. set bolt and spring washer which secures this pipe to the diffuser casing; remove the pipe.
4. Unscrew the fuel pipe union nuts which secure the fuel pipe to the torch igniter in No. 3 combustion chamber and the valve group and circulating pump unit respectively.
5. Remove the six 2 B.A. nuts and spring washers which secure this fuel pipe to the

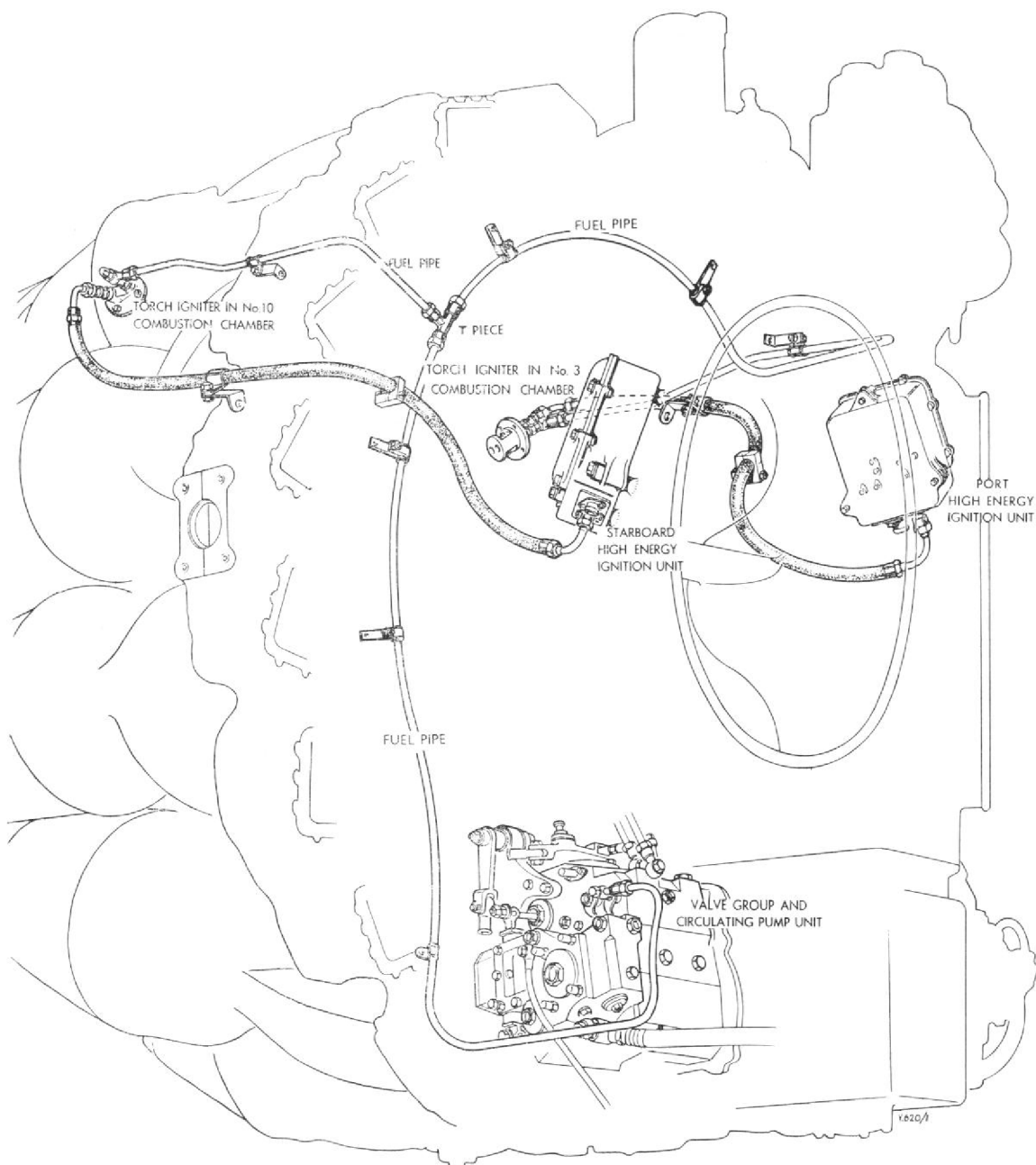


Fig. 25. Torch igniter high energy ignition equipment.

engine; remove the pipe complete with the 'T' piece.

6. Remove the four 2 B.A. nuts, plain and spring washers which secure each torch igniter body to its combustion chamber. Remove the two torch igniter bodies and their Klingerit joint washers.

PRINCIPAL PIPES AND ACCESSORIES

To facilitate the removal of certain pipes it will occasionally be necessary to interrupt the sequence of pipe removal to remove an accessory. The majority of the pipe connections, support clips

and brackets are readily accessible and removal of the sub-assemblies is greatly simplified with the pipes removed. To assist in the identification of the various pipes in relation to the text, the item numbers appearing in parenthesis at the commencement of each paragraph describing pipe removal, correspond to the numbers given to the identical pipes in Figs. 26, 27, and 28. Before commencing to remove the pipes, wire locking should be cut and removed from all unions and adapters which have been locked in this manner.

Fuel cooling return pipe—circulating pump to fuel pump (20)

1. Remove the $\frac{1}{4}$ in. plain nuts and spring

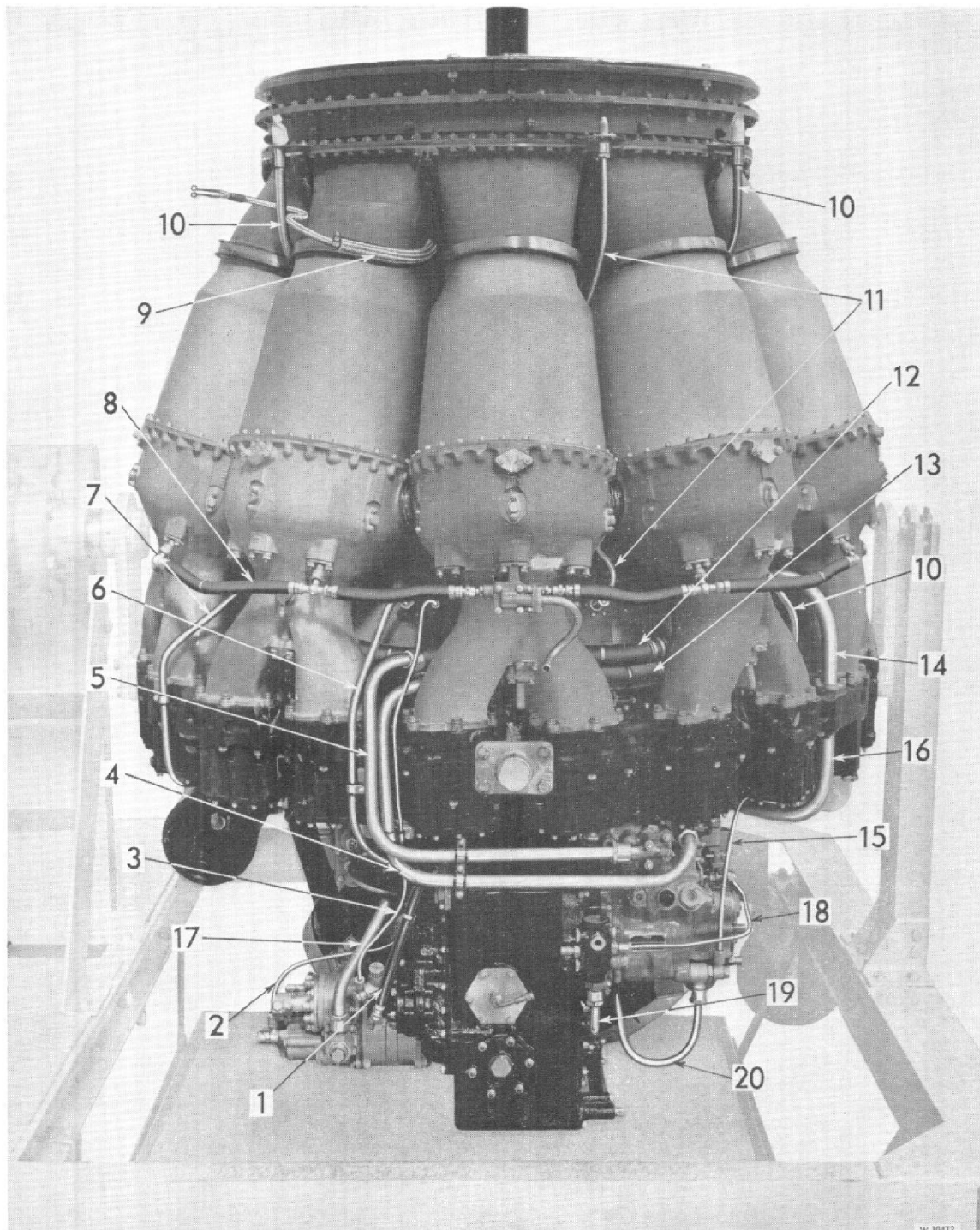


Fig. 26. Disposition of pipes on underside of 48 Mk. 2 engine.

- | | |
|--|--|
| 1. Metering pump feed pipe, restrictor to oil pump cover | 11. Rear bearing oil drain pipe |
| 2. Servo fuel pipe, pump to A-F.R.C. pre-mod. 1145 | 12. Fuel manifold, spill pipe |
| 3. Oil metering pump to centre casing pipe | 13. Fuel manifold, feed pipe |
| 4. Fuel feed pipe, circulating pump to manifold | 14. Cooling air pipe, rear cover to air filter |
| 5. Spill pipe, manifold to circulating pump | 15. Spill pipe, flow control unit to circulating pump |
| 6. Cooling oil pipe, oil sump to centre casing | 16. Cooling air pipe, cooler to casing |
| 7. Cooling oil pipe, centre casing to oil spray | 17. Fuel feed pipe, fuel pump to A-F.R.C. |
| 8. Combustion chamber drain pipe | 18. Circulating pump to drain box pipe |
| 9. Thermocouple | 19. Breather pipe to drain box |
| 10. Turbine disc air cooling pipe | 20. Cooling return pipe, circulating pump to fuel pump |

Issued by Amendment No. 127
October, 1956

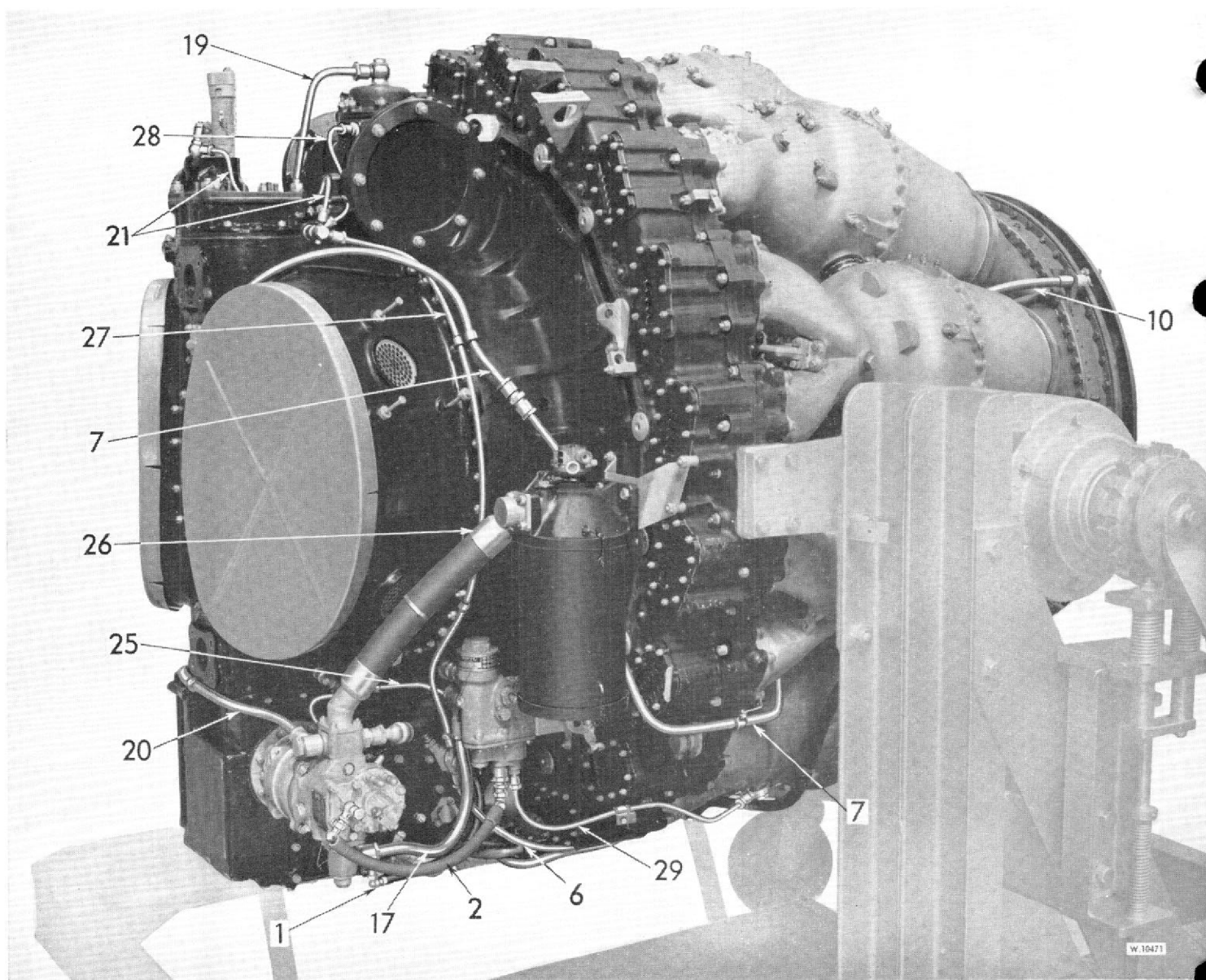


Fig. 27. Disposition of pipes on port side of 48 Mk. 2 engine.

- | | |
|--|--|
| 1. Metering pump feed pipe, restrictor to oil pump cover | 20. Cooling return pipe, circulating pump to fuel pump |
| 2. Servo fuel pipe, pump to A-F.R.C. | 21. Oil pipe, top wheelcase to air compressor housing |
| 6. Cooling oil pipe, oil sump to centre casing | 25. Spill pipe, A-F.R.C. to fuel pump |
| 7. Cooling oil pipe, centre casing to oil spray | 26. L.P. pipe, L.P. fuel filter to fuel pump |
| 10. Turbine disc air cooling pipe | 27. Oil pipe, oil sump to top wheelcase |
| 17. Fuel feed pipe, fuel pump to A-F.R.C. | 28. Oil pipe, top wheelcase to generator casing |
| 19. Breather pipe to drain box | 29. Air pipe, expansion chamber to A-F.R.C. |

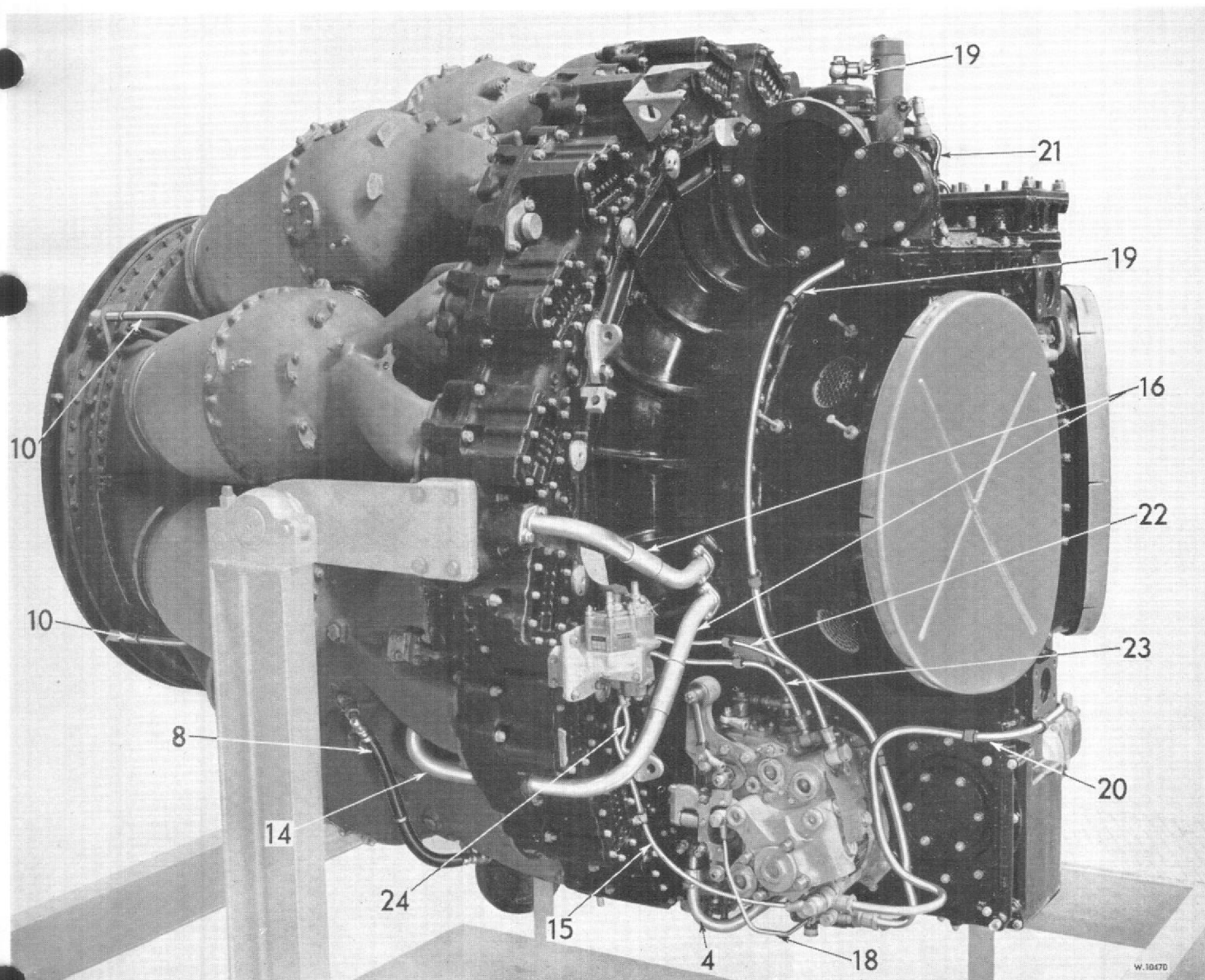


Fig. 28. Disposition of pipes on starboard side of 48 Mk. 2 engine.

- | | |
|---|--|
| 4. Spill pipe, manifold to circulating pump | 20. Cooling return pipe, circulating pump to fuel pump |
| 8. Combustion chamber drain pipe | 21. Oil pipe, top wheelcase to air compressor housing |
| 10. Turbine disc air pipe | 22. Downstream throttle, flow control unit to circulating pump, pipe |
| 14. Cooling air pipe, rear cover to air filter | 23. Upstream throttle, circulating pump to flow control pipe |
| 15. Spill pipe, flow control unit to circulating pump | 24. A-F.R.C. to flow control pipe |
| 16. Cooling air pipes, cooler to casing | |
| 18. Circulating pump to drain box pipe | |
| 19. Breather pipe to drain box | |

washers from the two clips securing the pipe to the sump flange.

2. Unscrew the union nut at each end and remove the pipe.

Fuel spill pipe—flow control unit to circulating pump (15)

1. Remove the 2 B.A. nut and spring washer from the clip on No. 14 deflector cover.
2. Unscrew the union nuts at each end and remove the pipe.

Upstream throttle pipe—circulating pump to flow control unit (23)

1. Remove the 2 B.A. bolt and spring washer securing the clip to the bracket which is located over two air-intake studs.
2. Unscrew the union nuts at each end and remove the pipe.

Cooling feed pipe—fuel pump to circulating pump

1. Unscrew the union nut at the fuel pump end.
2. Unscrew and remove the banjo bolt and washer which secures the pipe to the circula-

ting pump; remove the pipe.

3. Refit the banjo bolt and washer to the circulating pump.

Downstream throttle pipe—flow control unit to circulating pump (22)

1. Remove the 2 B.A. bolt and spring washer securing the clip to the bracket which is located over two air-intake studs.
2. Unscrew the union nuts at both ends and remove the pipe.

Flow control unit

1. Unscrew the union nut which connects the servo pipe to the flow control unit.
2. Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers, and bolts securing the flow control unit to the bracket and remove the unit.
3. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers which secure the inner portion of the bracket adjacent to No. 15 diffuser bolt.
4. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts, spring

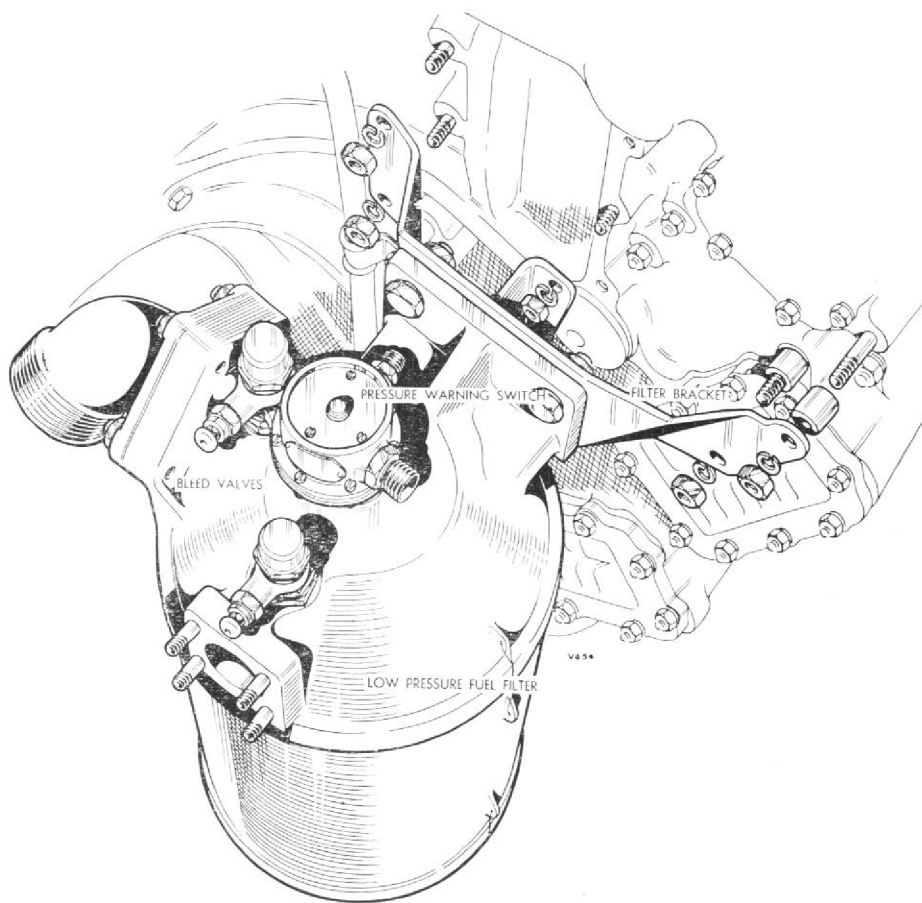


Fig. 29. Tecalemit low pressure fuel filter and attachment bracket.

and plain washers which secure the outer portion of the bracket to the diffuser casing, and remove the bracket.

Feed pipe—low pressure filter to fuel pump (26)

1. Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the pipe to the top of the fuel pump.
2. Unscrew the union nut at the low pressure filter end and remove the pipe.

Low pressure fuel filter and attachment bracket (Fig. 29)

1. Ensure that all pipes are disconnected.
2. Remove the $\frac{1}{4}$ in. B.S.F. plain nut and spring washer from the stud in the diffuser casing which secures the lug welded to the centre of the filter bracket.
3. Remove the two $\frac{5}{16}$ in. B.S.F. plain nuts and spring washers which secure the outboard edge of the bracket to studs adjacent to No. 6 and 7 deflector assemblies.
4. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the inboard edge of the bracket to the diffuser casing and remove the filter complete with the bracket.
5. Remove the two distance pieces from the studs in the diffuser casing.

Feed pipe—fuel pump to A-F.R. control unit (17)

Unscrew the union nuts at each end and remove the pipe.

Feed pipe—A-F.R. control unit to circulating pump

1. Unscrew the union at the A-F.R. control end.
2. Unscrew the banjo bolt which secures the pipe to the circulating pump.

Air-pipe—expansion chamber No. 5 to A-F.R. control unit (29)

1. Remove the 2 B.A. bolt and spring washer securing the clip to the diffuser casing near No. 10 deflector.
2. Unscrew the union nuts at each end and remove the pipe.

Servo pipe—fuel pump to A-F.R. control unit (2)

Unscrew the union nut at both ends of this pipe and remove it.

Spill pipe—A-F.R. control unit to fuel pump (25)

Unscrew the union nut which connects the spill pipe to the inboard face of the A-F.R.C. unit.

Air-fuel ratio control unit

1. Unscrew the union nut which connects the servo pipe to the A-F.R.C.
2. Remove the three $\frac{1}{4}$ in. B.S.F. plain nuts, spring and plain washers from the three studs situated inboard on the port side and adjacent to No. 9 diffuser bolt to which the A-F.R.C. bracket is attached.
3. Remove the A-F.R.C. complete with its bracket.
4. Remove the four $\frac{1}{4}$ in. B.S.F. nuts and spring washers securing the A-F.R. control to the bracket and separate the two.

Cooling air pipes—cooler to casing (16)

Remove the two $\frac{1}{4}$ in. B.S.F. bolts and nuts, spring and plain washers from each attachment flange of the two short air pipes which connect the cooling belt to the diffuser casing on the starboard side of the engine and remove the two pipes. Remove the aluminium washers under each flange.

Servo pipe—A-F.R. control unit to flow control unit

Remove the three $\frac{1}{4}$ in. B.S.F. plain nuts which secure the pipe to the diffuser casing, and remove the pipe.

Breather pipe to drain box (19)

1. Unscrew the union nut which secures the pipe to the breather banjo at the top of the generator drive cover.
2. Remove the three $\frac{5}{16}$ in. B.S.F. nuts and spring washers which secure the three clips to air-intake studs.
3. Unscrew the union nut securing the pipe to the drain box.

Cooling oil pipe—centre casing to oil spray (7)

1. Remove the $\frac{5}{16}$ in. B.S.F. plain nut and spring washer which secures the front section clip of the pipe to the air-intake.
2. Remove the four bolts and spring washers which secure the pipe flange to the front of the air-intake.
3. Unscrew the union nut at the joint between the front and rear sections and remove the front section of the pipe.
4. Remove the $\frac{1}{4}$ in. B.S.F. plain nut and spring washer which secures the upper rear section clip of the pipe to the fire extinguisher pipe bracket adjacent to the low pressure oil filter.
5. Remove the $\frac{1}{4}$ in. B.S.F. plain nut and spring washer which secures the rear section centre clip of the pipe to the air-intake adjacent to No. 8 diffuser bolt.

6. Remove the 2 B.A. bolt and spring washer which secures the bottom clip to the bracket bolted to the lower leg of No. 4 combustion chamber expansion chamber.
7. Unscrew the union nut securing the pipe to the centre casing adapter and remove the pipe.

Before removing further pipes and accessories, the engine should be adjusted in the stand until the underside of the engine is exposed and those pipes which pass under the sump are in the most convenient working position.

Cooling air pipes—rear cover to air filter (14)

1. Remove the two $\frac{1}{4}$ in. B.S.F. bolts, spring and plain washers from the attachment flange connecting the pipe to the rear cover.
2. Unscrew the union nut at the air filter end and remove the pipe.

Fuel spill pipe—manifold to circulating pump (5)

1. Remove the three 2 B.A. nuts, spring and plain washers and bolts which secure the double clip.
2. Using spanner T.77453 unscrew the ring nut at the manifold end of the pipe.
3. Unscrew the union nut which secures the pipe to the circulating pump and remove the pipe.

Fuel feed pipe—circulating pump to manifold (4)

1. Remove the $\frac{1}{4}$ in. B.S.F. nut and spring washer, also the 2 B.A. nut, spring and plain washer and bolt securing the pipe from the metering pump to the centre casing.

The 2 B.A. bolt, washers and nut are utilized to secure one side of the circulating pump to manifold clip and the small metering pump to centre casing clip.

2. Unscrew the union nut securing the pipe to the circulating pump.
3. Using spanner T.77453 unscrew the ring nut at the manifold end of the pipe and remove the pipe.

Oil pipe—metering pump to centre casing (3)

Unscrew the union nut at each end and remove the pipe.

Cooling oil pipe—sump to centre casing (6)

1. Unscrew the 2 B.A. nut and remove the spring

and plain washers securing the clip to the bracket situated on the diffuser casing near No. 10 deflector.

2. Unscrew the union nut at each end and remove the pipe.

Fuel drain pipe—circulating pump to drain box (18)

1. Unscrew the union nut at the drain box end.
2. Unscrew and remove the banjo bolt and washer which secures the pipe to the circulating pump and remove the pipe.
3. Refit the banjo bolt and washer.

Oil pipe—sump to top wheelcase (27)

1. Remove the two $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the pipe to the air-intake studs.
2. Unscrew the union nuts at both ends and remove the pipe.

Oil pipe—top wheelcase to compressor housing (21)

Unscrew the union nuts at both ends and remove the pipe.

Oil pipe—top wheelcase to generator housing (28)

Unscrew the union nuts at both ends and remove the pipe.

Circulating pump and valve group unit

All pipes should have been disconnected and removed at this stage but a check should be made to ascertain that nothing will impede withdrawal of the unit. The weight of the unit is 68 lb. dry; two men will be necessary to manhandle it clear of the engine.

Twelve $\frac{1}{4}$ in. B.S.F. nuts, spring and plain washers secure the unit to the sump. Five of these are located behind the cover plate flange and are not easily accessible; removal of these is facilitated by using a standard $\frac{1}{4}$ in. B.S.F. semi-universal box spanner in conjunction with extension T.76451 as follows. Remove the tommy bar from the spanner and fit it to the end of the extension furthest away from the spring-loaded pin; push the tommy bar end of the spanner into the bore of the extension and using the spring-loaded pin lock them together, Fig. 30.

1. Using the extended box spanner remove the five nuts and washers from the studs behind the cover plate flange.
2. Remove the spring-loaded pin to separate the extension and the box spanner; remove the

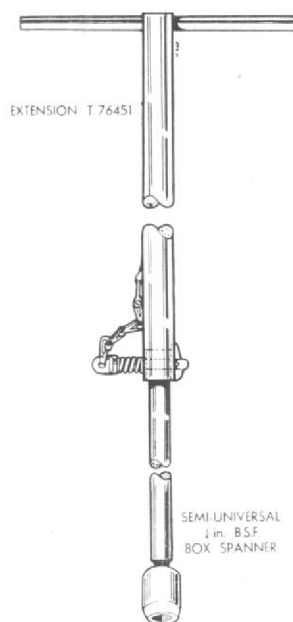


Fig. 30. Spanner for nuts securing circulating pump unit.

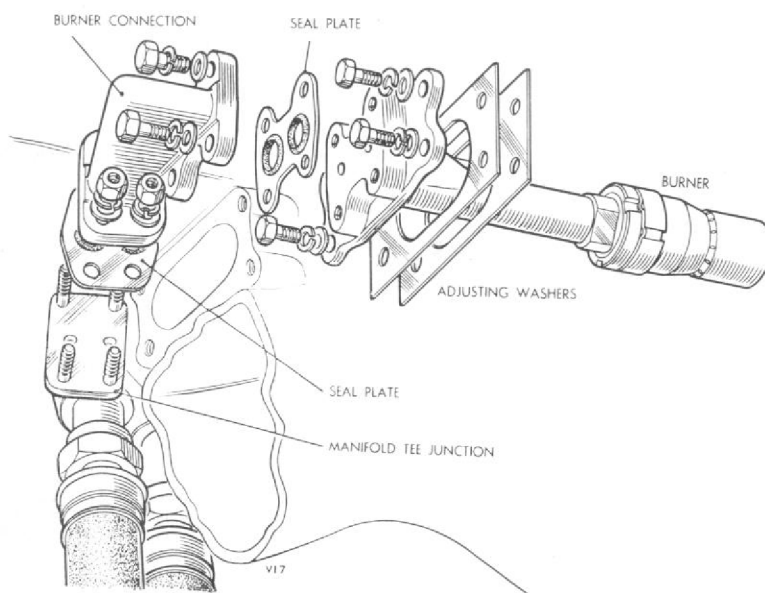


Fig. 32. Burner connection.

tommy bar from the extension and replace it in the box spanner.

3. Using the box spanner remove the nuts, plain and spring washers, from the seven studs located at the front of the unit mounting flange.
4. Using a suitable sling, carefully draw the unit clear of the studs and its drive.

Fuel pump

1. Unscrew the union nut which connects the

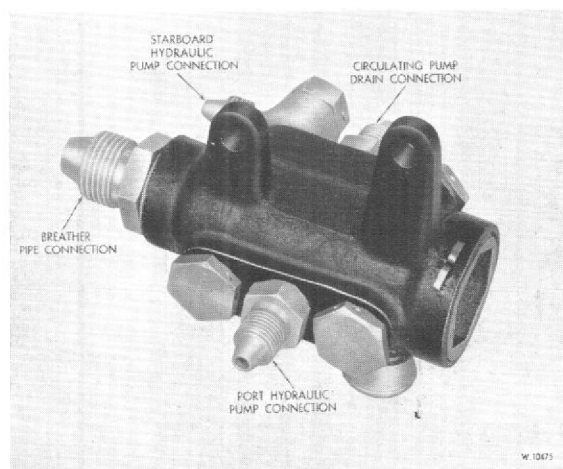


Fig. 31. Drain box.

A-F.R.C. spill pipe to the pump, and remove the pipe.

2. Remove the eight $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the pump to the port side of the oil sump, immediately forward of the hydraulic pump mounting face.
3. Carefully withdraw the pump clear of the studs and its drive.

Drain box (Fig. 31)

1. Remove the $\frac{1}{4}$ in. B.S.F. nuts and spring washers which secure the two lugs of the drain box to two valve box mounting plate/sump studs.
2. Remove the drain box.

Burner connections (Fig. 32)

1. Remove the four $\frac{1}{4}$ in. B.S.F. set bolts, and the spring and plain washers, which secure the burner connection to the burner.
2. Remove the four $\frac{1}{4}$ in. B.S.F. plain nuts, and the spring and plain washers from the studs in the manifold 'T'-junction which project through the second flange on the burner connection; lift off the burner connection and the seal plate.
3. Blank off the manifold junction face to pre-

vent foreign matter entering the manifold.

Fire extinguisher pipes (pre-mod. 1087)

Remove the fire extinguisher pipes in accordance with the instructions given for the 48 Mk. 1 engine.

GENERATOR DRIVE CASING

1. Ensure that all union nuts, etc., have been disconnected.
2. Remove the plain $\frac{1}{4}$ in. B.S.F. nuts and the tab washers from the six studs which secure the port generator drive.
3. Remove the port drive; ensure that the adjusting washer is over the securing studs and secure in place with slave nuts.
4. Remove the $\frac{3}{8}$ in. B.S.F. plain nut and tab washer adjacent to the port drive housing.
5. Repeat op. 2 to 4 to remove the starboard drive.
6. Remove the three $\frac{3}{8}$ in. and the six $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the generator drive casing to the top wheelcase.
7. Lift off the generator drive casing complete with the vertical drive.

STARTER DRIVE

Remove the starter drive in accordance with the instructions given for the 48 Mk. 1 engine on page 13.

TOP WHEELCASE

1. Remove the nine $\frac{1}{4}$ in. B.S.F. nuts and spring washers from around the curved perimeter of the top wheelcase.
2. Remove the plain nuts and tab washers which secure the wheelcase to the two studs in the generator drives wheelcase recess, Fig. 33.
3. Carefully lift the wheelcase off the engine.

SUMP (Fig. 34)

1. Remove the sixteen $\frac{1}{4}$ in. B.S.F. plain nuts and spring washers which secure the sump to the air-intake.
2. Ease the sump off the two dowels and carefully remove it from the engine as a unit complete with the valve box mounting plate, the fuel pump driving gear and the circulating pump gear.

CENTRE HOUSING

1. Remove the circlip in the bore of the starter

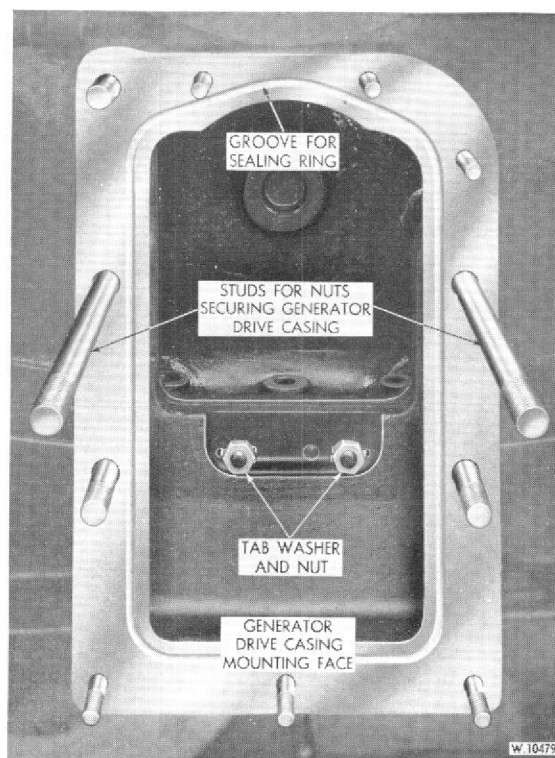


Fig. 33. Internal nuts and tab washers which secure the top wheelcase to the air-intake.

dog in the air-intake and withdraw the upper vertical drive shaft.

2. Remove the circlip in the bore of the lower drive gear in the air-intake and withdraw the lower vertical drive shaft.
3. Remove the centre housing in accordance with the instructions given for the 48 Mk. 1 engine on page 14.

ENGINE MOUNTING BRACKETS

Remove the engine mounting brackets in accordance with the instructions given for the 48 Mk. 1 engine on page 15.

TURBINE DISC

Remove the turbine disc in accordance with the instructions given for the 48 Mk. 1 engine on page 15.

COMBUSTION CHAMBERS

Remove the fuel drain assembly (8) and combustion chambers in accordance with the instructions given for the 48 Mk. 1 engine on page 16.

INSULATING PLATE AND COOLING MUFF

Remove the insulating plate and cooling muff in accordance with the instructions given for the 48 Mk. 1 engine on page 16.

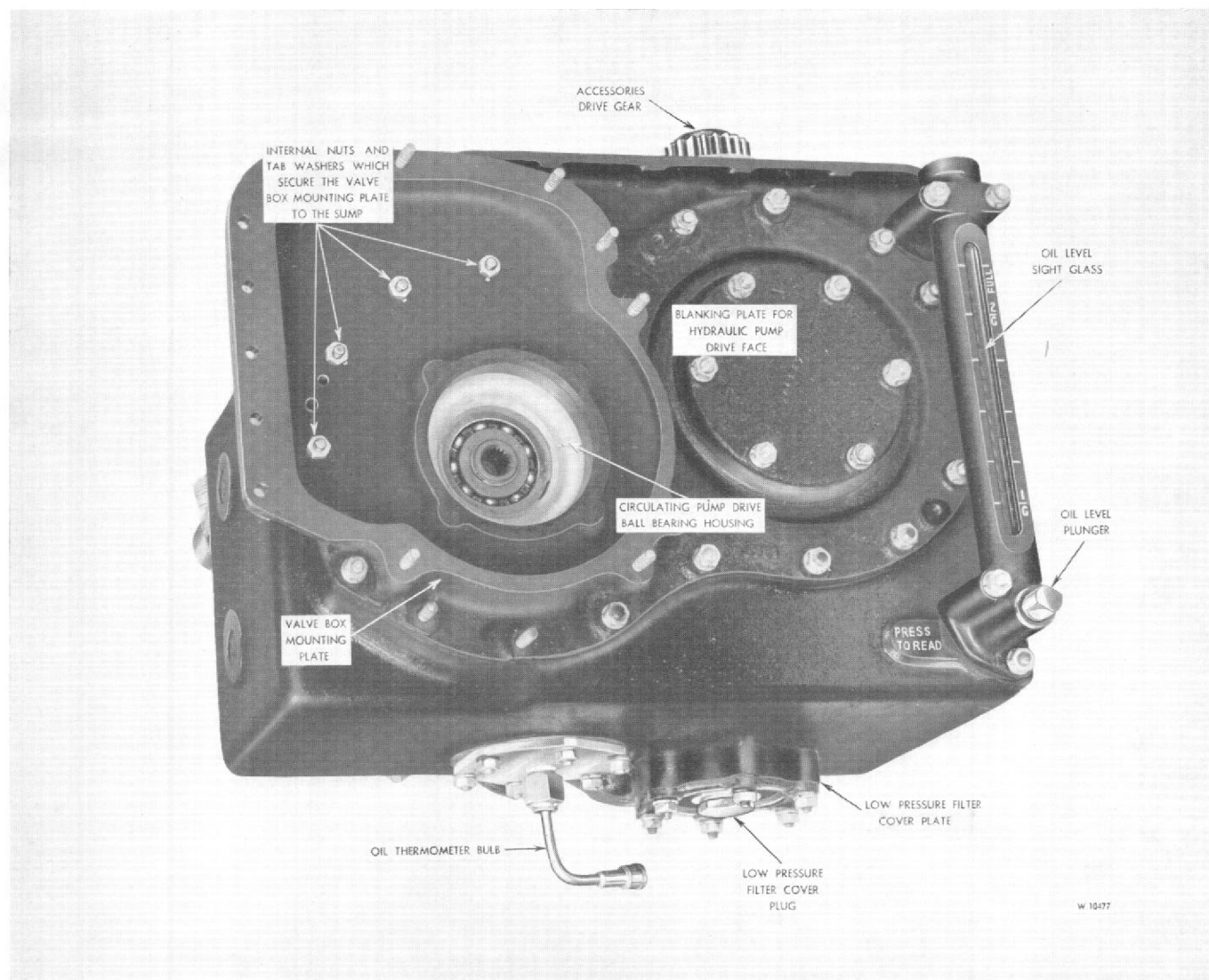


Fig. 34. Oil sump.

IMPELLER PIVOT NUT REMOVAL

Remove the impeller pivot nut in accordance with the instructions given for the 48 Mk. 1 engine on page 16.

TURBINE DISC REAR COOLING AIR PIPES

Remove the four turbine disc rear cooling air pipes in accordance with the instructions given for the 48 Mk. 1 engine on page 17.

NOZZLE RING ASSEMBLY

Remove the nozzle ring assembly in accordance with the instructions given for the 48 Mk. 1 engine on page 17.

FUEL MANIFOLD FEED AND SPILL ASSEMBLY (12 and 13)

When all the external rigid pipes have been

removed from the centre casing the fuel manifold feed and spill assembly can be lifted off.

CENTRE CASING

Remove the centre casing in accordance with instructions given for the 48 Mk. 1 engine on page 18.

SEALING PLATE

Remove the sealing plate in accordance with the instructions given for the 48 Mk. 1 engine on page 20.

MAIN SHAFT ASSEMBLY

Remove the main shaft assembly in accordance with the instructions given for the 48 Mk. 1 engine on page 21.

AIR-INTAKE

Rotate the remaining engine assembly in the

stand until the air-intake is uppermost.

There are forty air-intake securing studs in the diffuser casing, some of which are utilised for the attachment of brackets and, therefore, some of the nuts may have been removed previously.

1. Remove the thirty-seven external nuts, spring washers and remaining brackets from the air-

intake.

2. Remove the top three internal nuts and tab-washers.
3. Attach lifting sling T.70454 to the front of the air-intake; engage the hook of the lifting gear with the sling and lift the air-intake away from the diffuser casing, and place it on a flat surface.

This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.

