

Chapter I POWER UNIT  
(Completely Revised)  
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DESCRIPTION

General  
1. The aircraft is powered by a Goblin Mk. 3, single-stage, gas turbine engine which is supported on a tubular steel mounting at the rear

of the fuselage.

2. This chapter refers only to the installation of the power unit as regards mounting, controls, instruments, cowlings etc. Detailed information on the engine is contained

in A. P. 4121B and C, Vol. 1, and the oil system which is self-contained within the engine is also described in that publication. The procedure for filling and the removal and cleaning of the oil filter, is covered in Sect. 2, Chap. 2, of this volume.

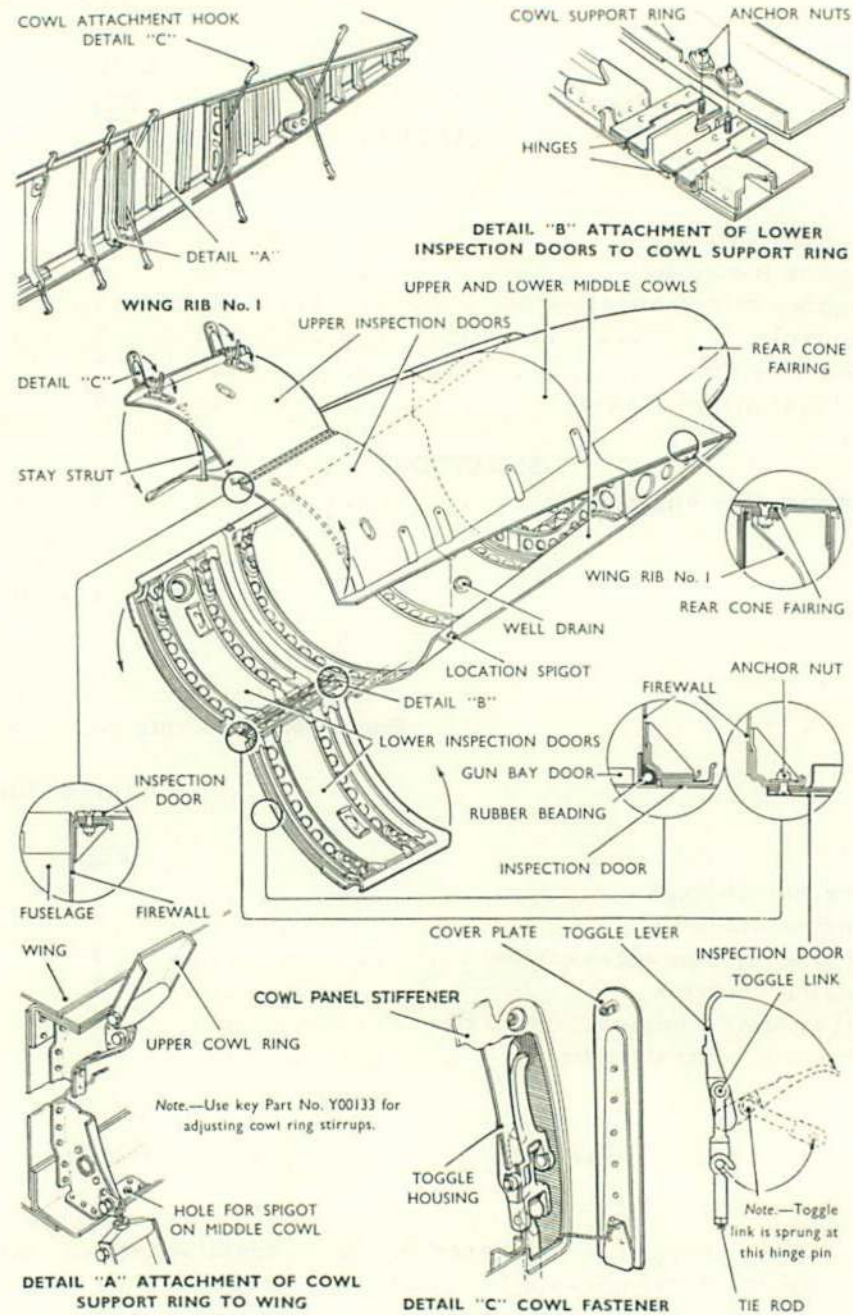
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**Engine cowlings (Fig. 1)**

3. All the engine accessories and controls are accessible through the four hinged inspection doors. Access to the combustion chambers is gained by releasing the toggle fasteners and removing the upper and lower middle cowlings. The rear cone fairing is also detachable and gives access to the jet pipe. To obtain the correct tension on each of the toggle fasteners when assembling the cowlings, each attachment hook must be adjusted on its tie-rod so that it is just possible to disengage the hook from the link by pulling the toggle lever with the finger. The attachment hook should then be screwed on to the rod one complete turn and locked. It should now only be possible to disengage the hook by applying slight leverage behind the toggle lever using an 8 in. screwdriver. The use of anything but hand force to relock the fasteners is prohibited. When all the fasteners of an individual panel have been adjusted, check the tension of each fastener independently, with the remaining fasteners closed. When engine cowlings are refitted, the touch points relevant to cowlings (para. 16) must be checked for adequate clearance.

**Engine mounting (Fig. 2)**

4. The engine mounting frame is a tubular steel structure bolted to the wing spar cross tubes at No. 4 bulkhead. This bulkhead serves as a firewall and separates the engine bay from the fuselage fuel tank. The



**Fig. 1 Engine cowlings**

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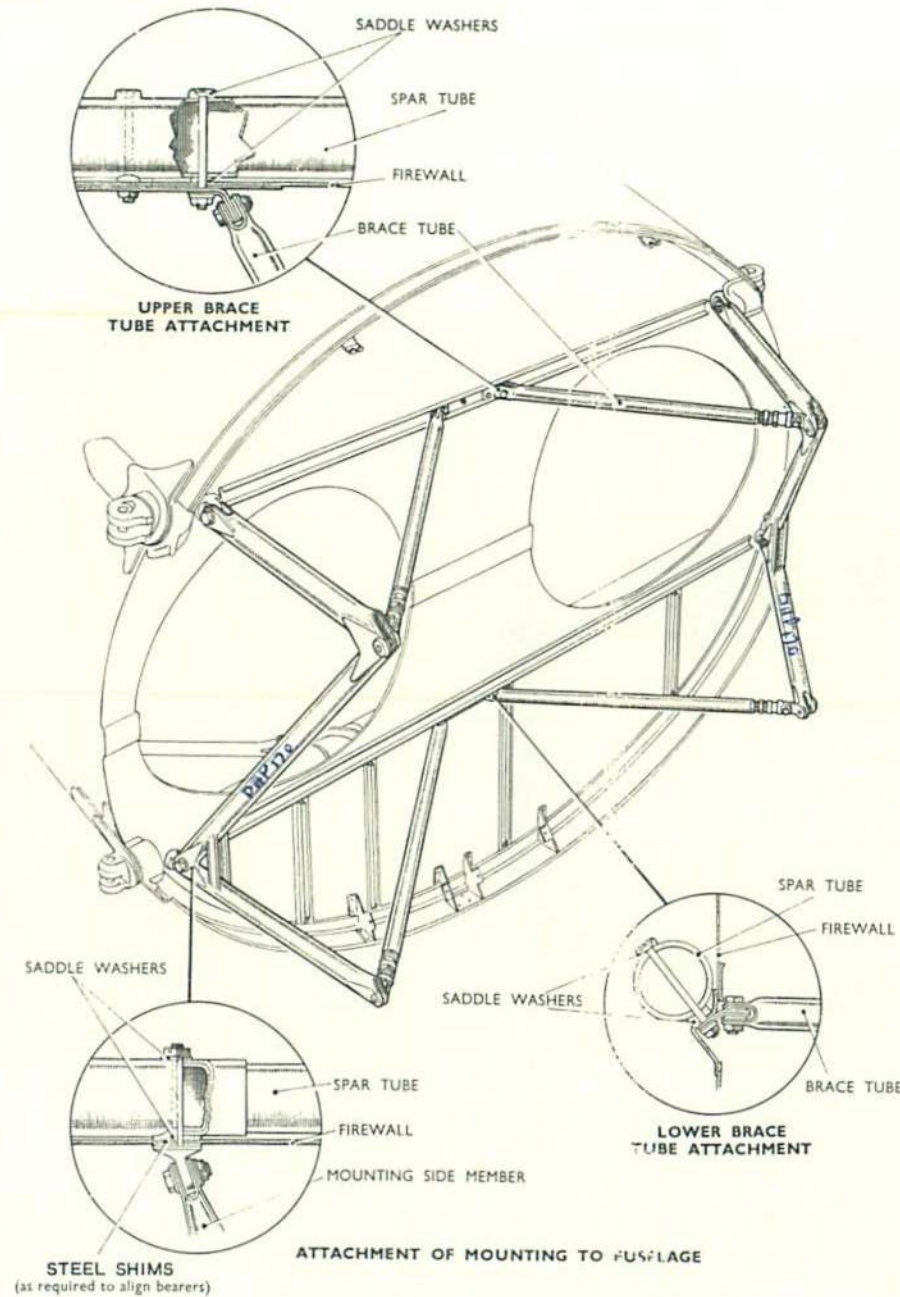


Fig. 2 Engine mounting

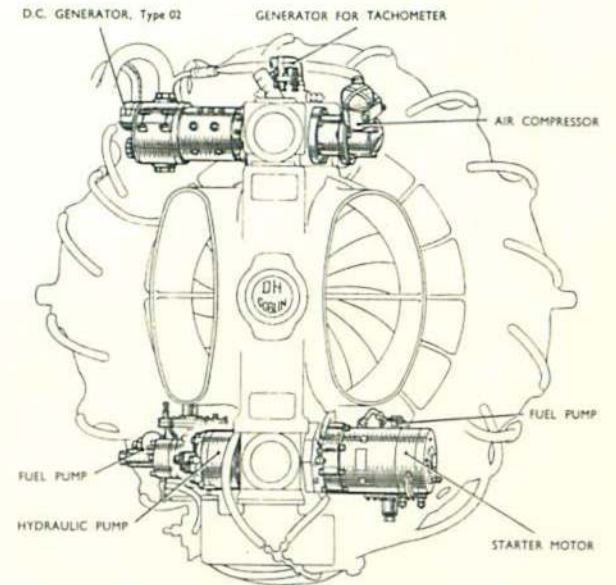
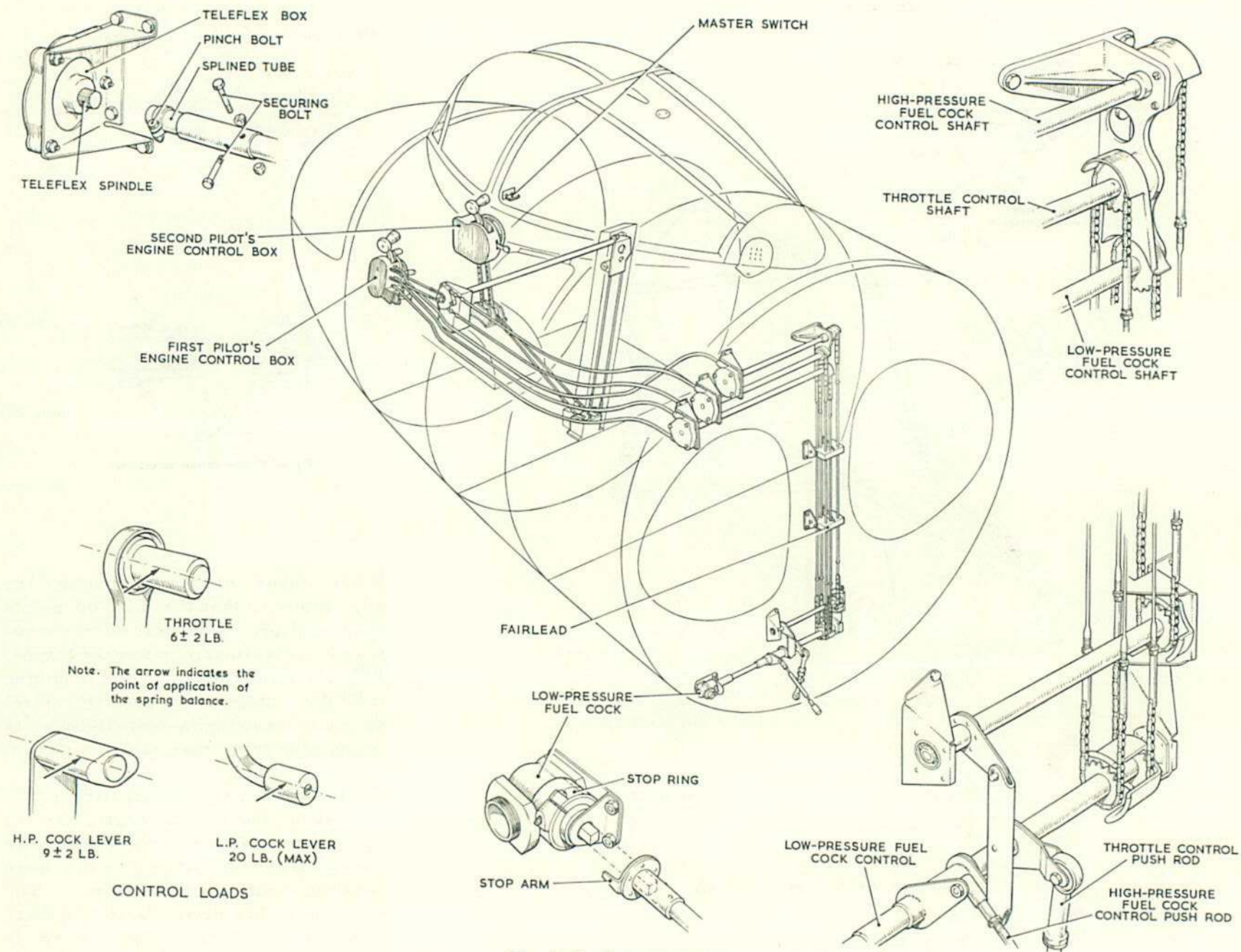


Fig. 3 Engine-driven accessories

brace tubes of the mounting are adjustable so that the pick-up points may be aligned with their corresponding eye-bolt attachments on the engine. Further adjustments of the mounting may be obtained by inserting steel shims at the four eye-bolt attachments to the wing spar cross tubes as shown.

Engine-driven accessories (Fig. 3) 5. At the front of the engine are the upper and lower accessory gear boxes, which are driven by the main rotating shaft of the engine. The upper gear box drives a d.c. generator, a compressor and a small generator for the tachometer. The

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Fig. 4 Engine controls  
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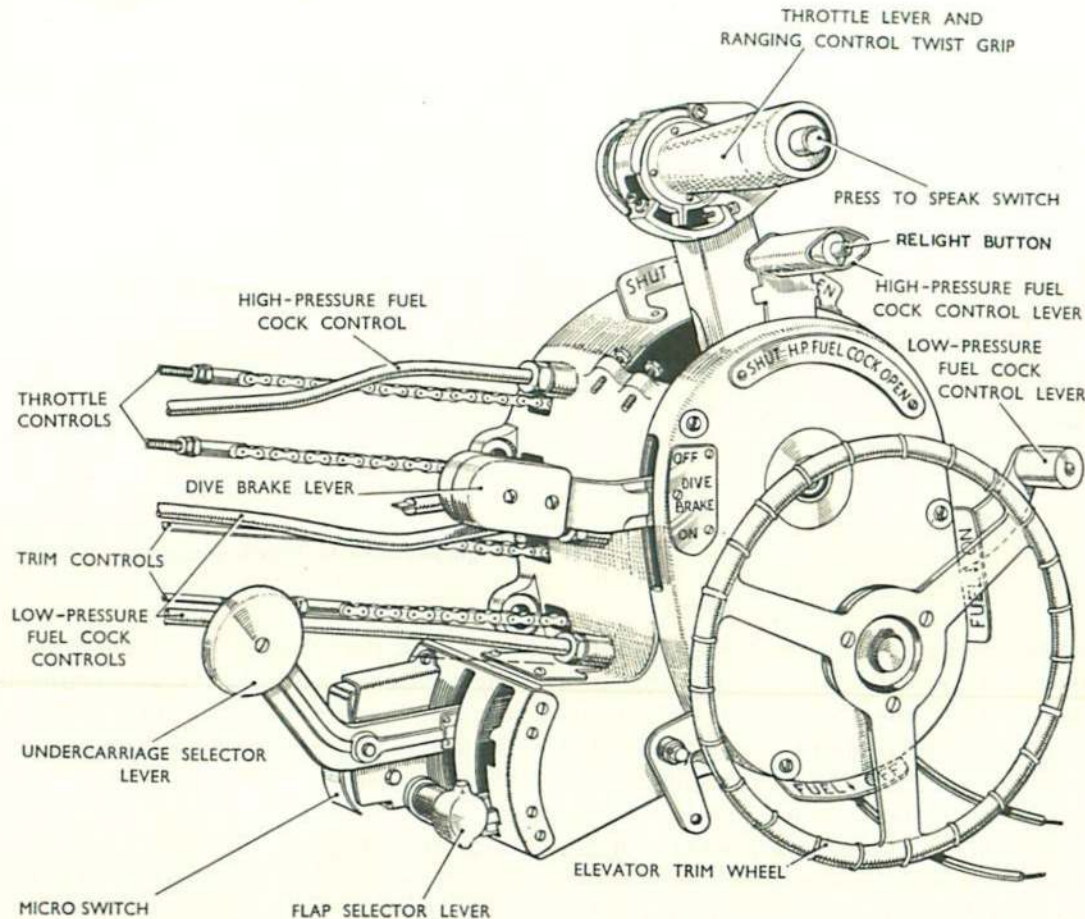


Fig. 5 First pilot's engine control box

lower box drives the hydraulic pump and two fuel pumps and carries the starter motor. The generator and compressor are cooled by air from the intake duct in the leading edge of the starboard wing. A branch of the same duct extends aft through the heater muff in the tail cone, from which it is ducted to heat the gun bay.

#### Controls (Fig. 5)

6. There are three engine control levers on the first pilot's control box in the cockpit, a throttle, a high-pressure fuel cock which incorporates the relight switch (Sect. 1, Chap. 3), and a low-pressure fuel cock. The throttle is also operated by a control lever on the second pilot's control

box, through a common torque tube and Teleflex cable. Movement of the operating levers is transmitted to the firewall by chain and sprocket and Teleflex cables, and thence by torque tube and push rod to their respective units. The run of the controls is shown in Fig. 4. It will be noted that a double Teleflex cable is used for the throttle and the low-pressure fuel cock and a single push-pull Teleflex cable for the high-pressure fuel cock.

#### Instruments

7. A tachometer and a jet pipe temperature gauge are fitted in the cockpit for recording the engine performance. Test points on the engine (para. 14 and 15) are provided for checking the oil temperature and pressure and the burner ring fuel pressure, when ground running the engine.

#### Cockpit air pressure

8. The air supply for pressurising the cockpit is obtained from the engine impeller. A number of tappings from the rear face of the impeller casing lead into a gallery pipe. The control cock for the supply is in the engine bay. Details of the system are contained in Sect. 3, Chap. 8.

#### SERVICING

##### Starting the engine

9. After observing the precautions outlined in Sect. 2, Chap. 2, regarding the ground running of the engine, the

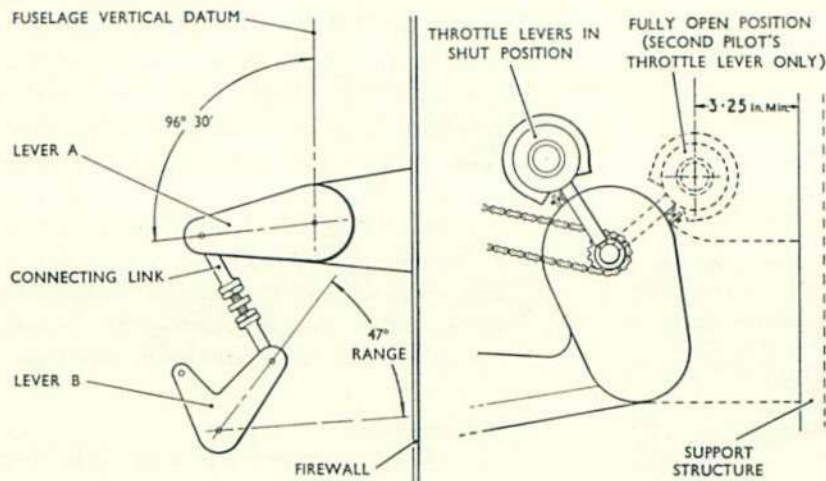


Fig. 6 Throttle control setting

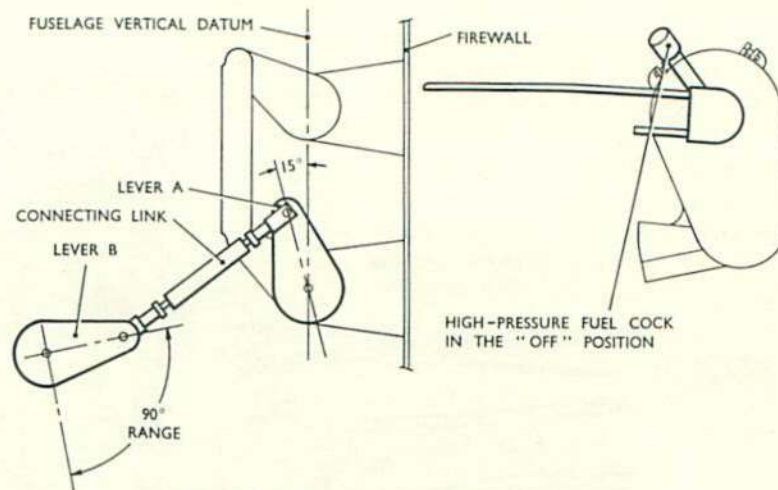


Fig. 7 High-pressure fuel cock setting

procedure detailed in A. P. 4121B and C, Vol. 2, Part 3, Sect. 2, should be followed for starting and ground checking the engine.

#### Setting the controls

10. The transverse control shafts on the firewall which are for the throttle, the high-pressure and the low-pressure fuel cock controls, are interconnected by chains and adjustable tie-rods (Fig. 4). The setting of the chains is such that, with the engine control levers in the cockpit at the mid-travel position, the chains should be equally disposed about their sprockets. It is possible to alter the position of the cockpit control levers, relative to the upper transverse control shafts, by releasing the pinch bolt and removing the two securing bolts from the splined tube which con-

nects the upper control shaft to the Teleflex box, and then sliding this connecting tube to clear the Teleflex spindle. This operation should only be necessary when alterations or replacements have been made to the Teleflex or torque tube assemblies. The sequence of operations for setting the individual controls is given after the appropriate diagram. It should

be noted that the angular movement of the levers which are taken from the fuselage vertical datum may be measured in relation to the aft face of the firewall.

#### Throttle (Fig. 6)

11. Screw in the stopbolts on the first and second pilot's throttle quadrants. Set lever 'A' in the mid-position of its

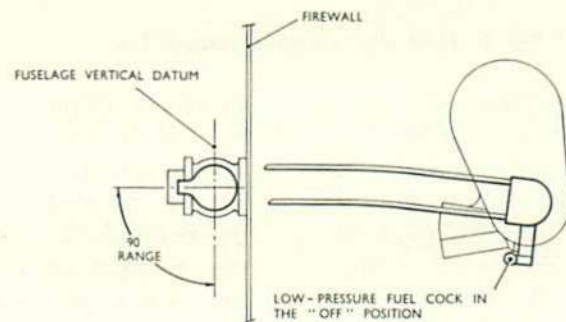


Fig. 8 Low-pressure fuel cock setting

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travel and check that the throttle levers are in the corresponding mid-position of the quadrant. Small adjustments to the tie-rods between the upper and lower torque tubes may be made to obtain this setting. Place levers 'A' and 'B' in the position shown (lever 'B' should be against its full travel stop), then adjust the connecting link to suit these positions. The first and second pilot's quadrant stop bolts should now be adjusted so that with lever 'B' in the shut and in the fully open positions, the appropriate stops just contact the throttle levers, then screw in half a turn and lock. Check the throttle levers for

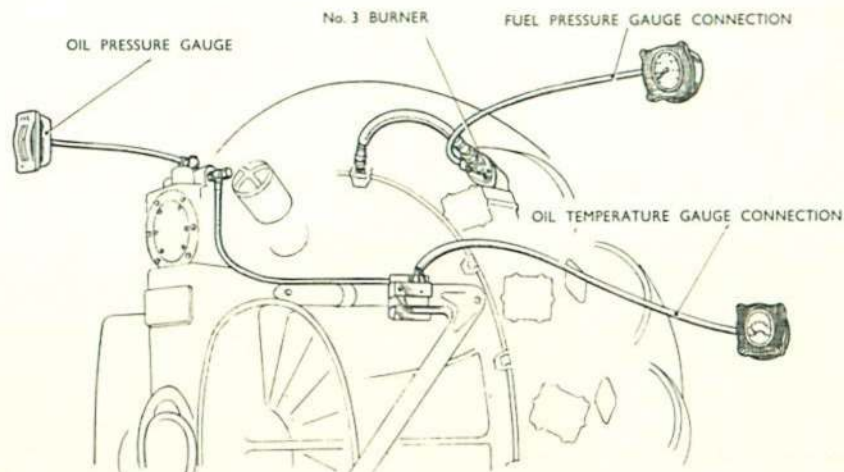


Fig. 9. Oil and fuel pressure check points

synchronization, and that the loading on each lever is to the limits given in Fig. 4.

High-pressure fuel cock (Fig. 7)  
12. Screw in the stop bolts on the high-pressure fuel cock quadrant and check that the mid-position setting of the control lever corresponds with the mid-position of lever 'A'. Adjustments similar to those outlined in para. 11 may be made to obtain the correct setting. Place lever 'A' in the position shown and lever 'B' in the shut position also as shown (i.e. against its full travel stop), then adjust the connecting link to suit these positions. The quadrant stop bolts should now be adjusted, so that when lever 'B' is in the shut and in the fully open position the respective stop just contacts the fuel cock control lever, then screw in half a turn and lock. Check that the loading on this lever is

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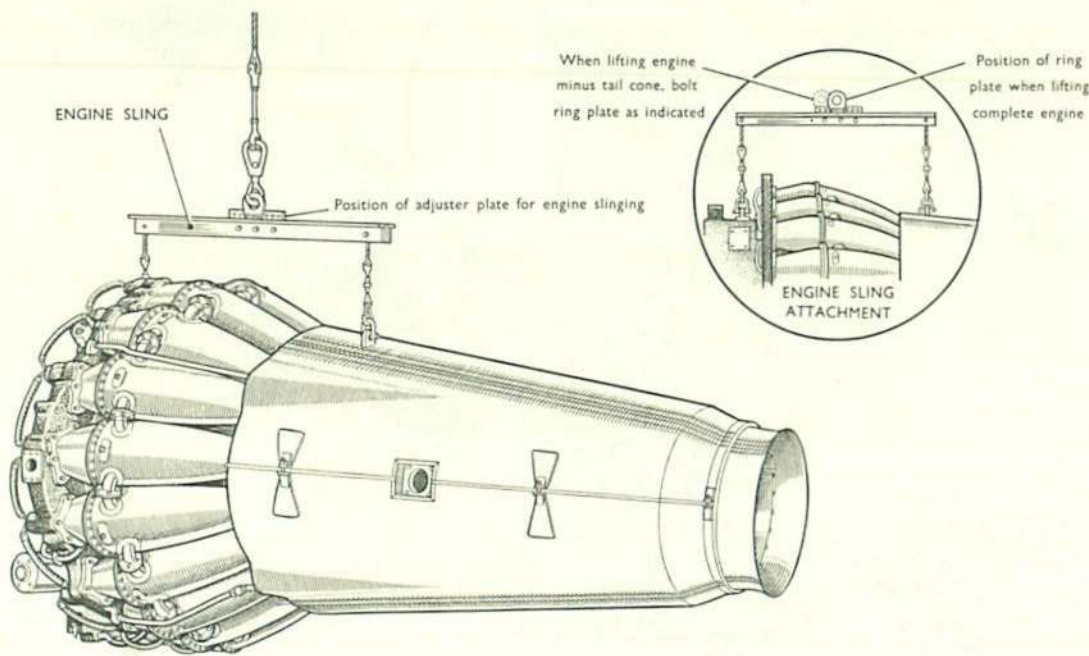


Fig. 10 Power unit slinging

1. AIR CONDITIONING
2. AIR COMPRESSOR
3. DROP TANK PRESSURE VENT HOSES (Port and Starboard)
4. IGNITOR PLUG LEADS
5. GENERATOR LEADS
6. R.P.M. GENERATOR
7. FIRE EXTINGUISHER HOSE (Port mainplane connection)
8. AIR-INLET DUCT TO HEATER MUFF
9. GENERATOR AND COMPRESSOR COOLING DUCT
10. STARTER MOTOR LEADS
11. TOTAL HEAD CONNECTION TO BAROMETRIC PRESSURE CONTROL
12. HYDRAULIC PUMP
13. GUN HEATING DUCT
14. SOLENOID VALVE LEAD (Port fuel pump only)
15. JET PIPE THERMOCOUPLE LEAD
16. REAR BEARING TEMPERATURE LEAD Deleted on later aircraft
17. LOW-PRESSURE FUEL FEED HOSES
18. HIGH-PRESSURE FUEL COCK CONTROL
19. THROTTLE CONTROL
20. FUEL CONNECTION TO OUTBOARD WING TANKS

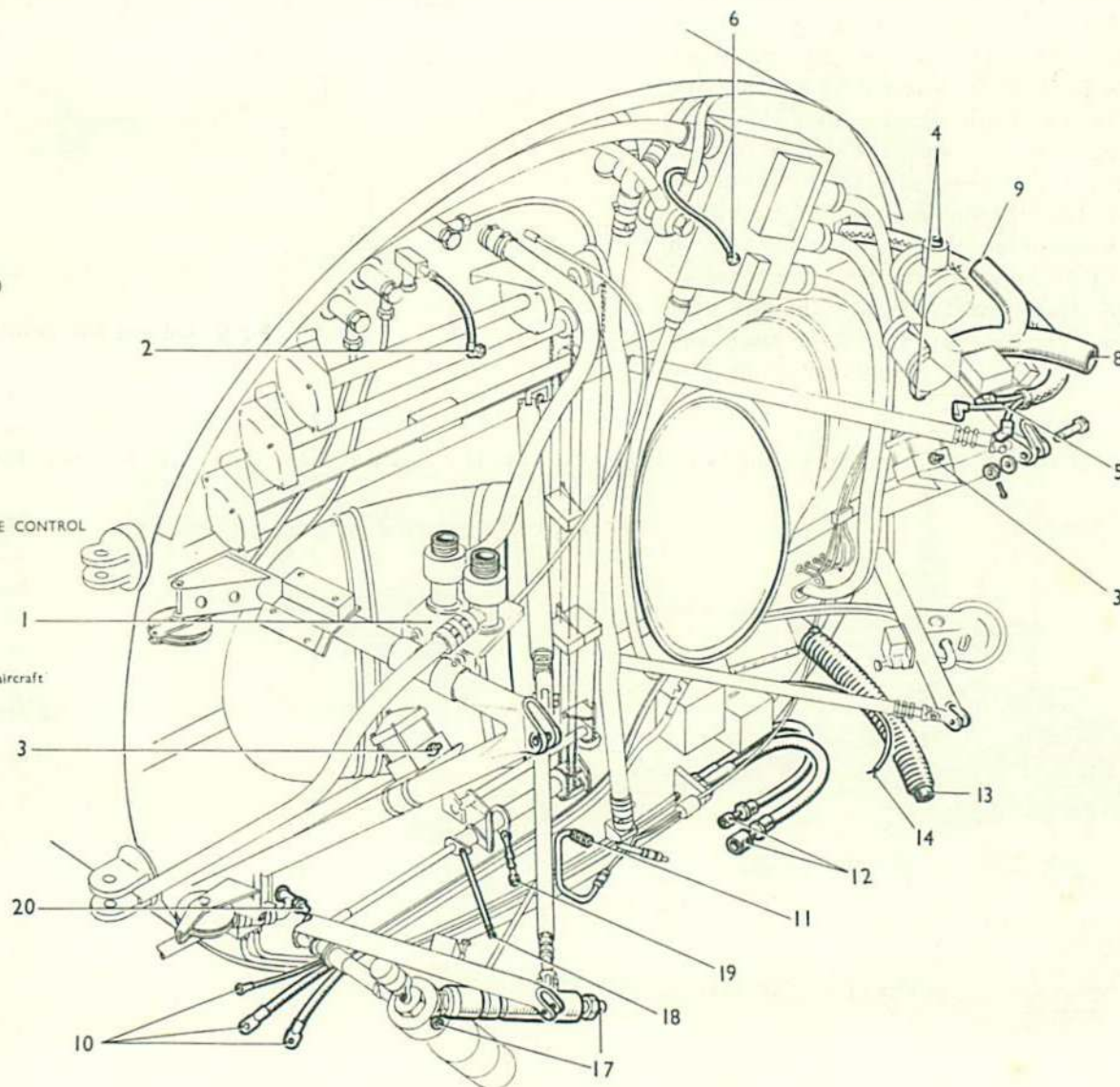
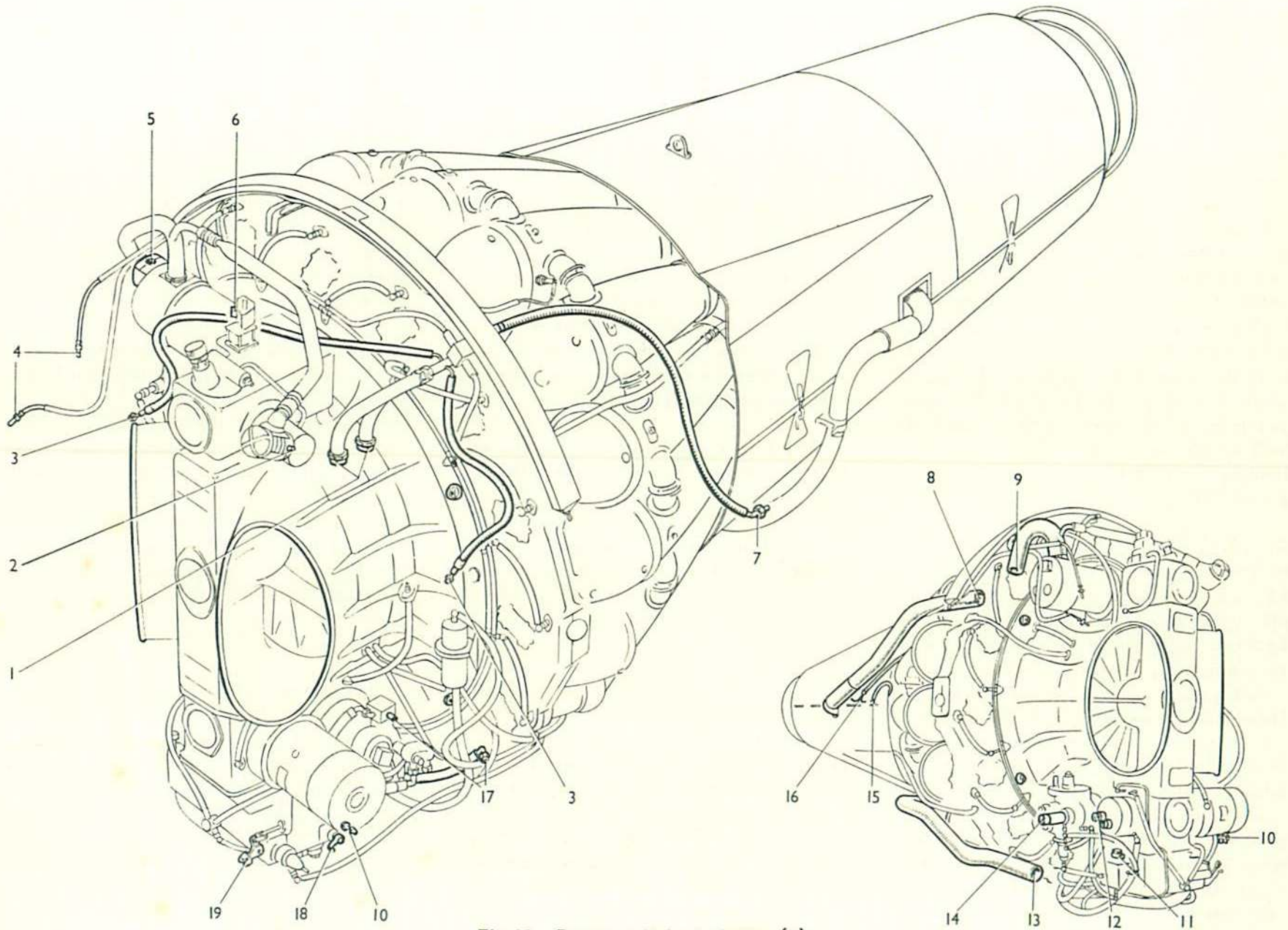


Fig. II. Power unit installation (I)

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Fig. 12. Power unit installation (2)

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to the limits given in Fig. 4.

#### Low-pressure fuel cock (Fig. 8)

13. Screw in the stop bolts on the low-pressure fuel cock quadrant and check that the mid-position of the control lever corresponds with the mid-position of the cock. Adjustments similar to those outlined in para. 11 may be made to obtain the correct setting. Move the cock to the fully open position as viewed through the cock outlet, and if necessary adjust the stop ring (Fig. 4) until it contacts the stop arm and lock it in this position. The quadrant stop bolt should now be adjusted so that the stop just contacts the lever when the cock is in the fully open position, then screw in the stop bolt half a turn and lock. Check that the loading on this lever is to the limits given in Fig. 4.

#### Checking oil pressure and temperature.

14. As there are no oil pressure or oil temperature gauges fitted on the cockpit instrument panel, provision is made for ground checking these readings and Fig. 9 shows the points from which readings can be obtained. To record the oil pressure, release the blanking cap and connect an adapter pipe leading to an oil pressure gauge. The pipe leading to the gauge must be primed in the normal way. The oil pressure gauge should read 40-45 p. s. i. in. at an engine speed of 8,700 r. p. m. After removing the gauge, refit the blanking cap

and wire-lock. The oil temperature gauge should be wired to the terminal block indicated in Fig. 9. The oil temperature must not exceed 70 deg.C.

#### Checking the burner ring fuel pressure

15. The procedure for checking the fuel pressure is the same as that given in the preceding paragraph for the oil pressure. The attachment point for the gauge is shown in Fig. 9.

#### Engine touch point checks

16. The engine touch point checks listed in Table 1 are to be carried out on the following occasions :-

- (1) When a new engine is fitted or the old engine re-installed.
- (2) When engine cowlings are refitted (those touch points relevant to cowlings).
- (3) When engine vibration is reported. The minimum acceptable clearance at each point is 0.125 in. but where possible this should be 0.25 in.

#### REMOVAL AND INSTALLATION

##### Power unit removal

17. Before removal from the airframe, the power unit must be prepared in accordance with the instructions given in A. P. 4121B and C, Vol. 2, Part 3, Sect. 1. It is recommended that the power unit be removed with the tail pipe assembly attached, as this not only gives protection to the turbine blades but is also useful for

handling the engine during the slinging operations. The correct method of applying the slinging gear is shown in Fig. 10. Remove the middle cowlings, the tail cone fairing and the hinge supports of the upper and lower inspection doors (Fig. 1), then release the fork ends of the cowl support rings from the attachments on No. 1 rib. Reference should be made to A. P. 4121B and C, Vol. 2, Part 3, Sect. 1, and to Fig. 11 and 12, and the key thereon which lists the various connections between the engine and the airframe.

18. When all these connections have been separated, release the clip from the seal on each air-intake duct on the engine and fold the seal back on to the intermediate portion of the air-intake duct. After taking the weight of the engine on the sling, remove the four bolts securing the engine to the mounting and lift the engine clear of the airframe. As soon as there is clearance, fit the metal covers on to the air-intakes.

##### Installing the power unit

19. Before installation, the power unit must be prepared in accordance with the instructions given in A. P. 4121B and C, Vol. 2, Part 3, Sect. 1, Chap. 1. Ensure that the air-intakes are free from foreign matter and that the sealing rings on the air-intake ducts are undamaged, and folded back to clear the engine ducts when the power unit is offered up.

20. When the unit has been slung into position, remove the air-intake covers and engage the eye-bolts on the engine casing with the fork ends of the engine mounting. Align the two upper bolt holes with a tapered drift and insert the attachment bolts, and follow with the two lower bolts. Release the weight of the power unit from the sling and check the alignment and clearance of the air-intake ducts. The gap between the mating faces should be between 0.10 and 0.20 in. at all points. The maximum permitted radial mal-alignment of the ducts is 0.20 in. provided that the direction of air flow is down and not up the resulting step. Secure the

joint sealing rings with the large Jubilee clips. Tighten and split pin the four mounting bolts, and then proceed with the connections between the engine and the air-frame which are listed in the key in Fig. 11. Details of the final preparations for engine run are given in A. P. 4121B and C, Vol. 2, Part 3, Sect. 2.

NOTE...

- (1) Bullets (Section 2, Chapter 4) should be used to facilitate the insertion of the engine attachment bolts.
- (2) H. P. cock ball joints may give false indications of security owing

to the springs or caps jamming on threads or shoulders during assembly, and, in some assemblies, this risk is increased by excessive internal thread length in the body or by badly formed springs. To obtain the correct setting when the ball joint is assembled, the threaded cap must be screwed into the joint body until the ball fitting is clamped tight, and then screwed back for not more than 1/8 of a turn to the nearest split pin position.

21. On completion of installation carry out the touchpoint checks listed in Table 1. Refer to para. 16 for minimum clearances.

(Table 1 overleaf)

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TABLE 1 ENGINE TOUCH POINTS

| ITEM | COMPONENT  | ITEM | COMPONENT   |
|------|--|------|---|
| 1    | Rear bearing bundy pipe, front half on cowling former                                | 15   | Inter-connectors on flame switch brackets on wing root.                             |
| 2    | Rear bearing bundy pipe, rear half on cowling rail.                                  | 16   | Low-pressure filter bowl on butterfly cowl when in closed position.                 |
| 3    | Rear bearing metering pipes, banjo bolt on cowling hinge.                            | 17   | Fuel pressure warning light switch on transfer pipe.                                |
| 4    | Front bearing metering pump, union nut on bundy pipe on cowling hinge stiffeners.    | 18   | Top cowling, rear half of igniter plugs.  |
| 5    | Cannon heater pipe, touching screen box of igniter plug on No.14 combustion chamber. | 19   | Heat shield incorrectly fitted in bracket.  |
| 6    | Cannon heater pipe, touching No.15 combustion chamber.                               | 20   | Tailpipe fireguard, lower half touching bottom can.                                 |
| 7    | Cannon heater pipe, port and starboard on former of rear engine cowling cone.        | 21   | Check that clearance exists between centre air duct and engine intake casing.       |
| 8    | Cowling stirrup fastener on cannon heater pipe upper starboard.                      | 22   | Check louvre on top starboard cowling for chafing on generator cooling duct.        |
| 9    | Fire extinguisher pipe on diffuser casing.   | 23   | Cowling former adjusting screws screwed in too far and touching diffuser casing.    |
| 10   | Rear bearing cooling pipe, flange joint on fuel line, port lower.                    | 24   | Oil feed to top accessory box chafing on fuel tank vent pipe in front of oil sump.  |
| 11   | Engine sump, starboard, front total head line.                                       | 25   | Cannon heater pipe touching cowling stirrup on lower starboard engine cowling rail. |
| 12   | Cabin air line from collector ring on No.2 combustion chamber.                       | 26   | Cannon heater pipe touching interconnector between No.10 and 11 cans.               |
| 13   | Fire extinguisher pipe on generator.   | 27   | 'P' clips on thermocouple fitted incorrectly.                                       |
| 14   | Diffuser casing on drain box in lower cowling rail.                                  | 28   | Starboard upper gun heater jubilee on diffuser casing.                              |

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TABLE 1 ENGINE TOUCH POINTS - continued

| ITEM | COMPONENT  | ITEM | COMPONENT  |
|------|--|------|--|
| 29   | Immediate duct on top of X-port member.                        | 43   | Fuel transfer pipes on fire extinguisher ring.   |
| 30   | Immediate duct on top of X-starboard member.                   | 44   | Check clearance between intermediate air intake and the oil bottle attached to the dipstick tube of the cold air unit. |
| 31   | Can flanges on flame switch brackets.                          | 45   | Avimo coupling bracket touching starboard bottom butterfly cowl when closed.   |
| 32   | Total head line drain on port lower cowl.                      | 46   | Flying control cable guards port and starboard on fire guard and combustion cans (mod. 3312).                          |
| 33   | Starter on L.P. filter.  | 47   | Upper butterfly cowl support strut bracket on cowl port and starboard.   |
| 34   | Cannon heater pipe on cowling cans 10 and 11.                  | 48   | Lower filter bowl stay touching starter motor.   |
| 35   | Front starboard cowling stirrup - top rear cowl - on gun pipe. | 49   | Lower filter bowl stay touching isolation switch.  |
| 36   | Top rear cowling on fire ext. hose clip.                       | 50   | No. 15 burner pipe connection to burner ring touching generator.   |
| 37   | Cannon pipe on lower starboard cowl.                           | 51   | Fire extinguisher pipe touching ignitor boxes.   |
| 38   | Transfer pipes on heat shields.                                | 52   | Pipe from cockpit temperature control valve to fireproof bulkhead touching Hymatic compressor.                         |
| 39   | Thermocouple on rear cowling former.                           |      |  |
| 40   | Heat shield rear clips on rear of tail cone.                   |      |  |
| 41   | Heat shield centre clips on tail cone former.                  |      |  |
| 42   | Jet pipe front drain cowling cover on gun heater pipe.         |      |  |

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