CHAPTER 6

FUEL SYSTEM

LIST OF CONTENTS

ILLUSTRATIONS

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GENERAL

1. Refer to Sect.1 for list of the special tools available, and to Chap.1 for the precautions to be observed when working on the engine. Torque loading data and the lubricants to be used during assembling are also given in Chap.1.

FUEL CONTROL UNIT

2. This unit includes the throttle valve, the high pressure (h.p.) cock, the pressurizing valve, the barometric pressure control (b.p.c.) and the low pressure (l.p.) filter. The components are calibrated together and, with the exception of the l.p. filter should not be changed seperately. In a single-engined aircraft however, where renewal of the fuel control unit (f.c.u.) complete, would entail removing the engine from the aircraft, it is permissible, as an emergency measure only, to change a defective throttle valve assembly seperately. A b.p.c. may be exchanged seperately only when it is essential for an aircraft, for example, to return to base for an exchange of the complete f.c.u.

Removing

CAUTION...

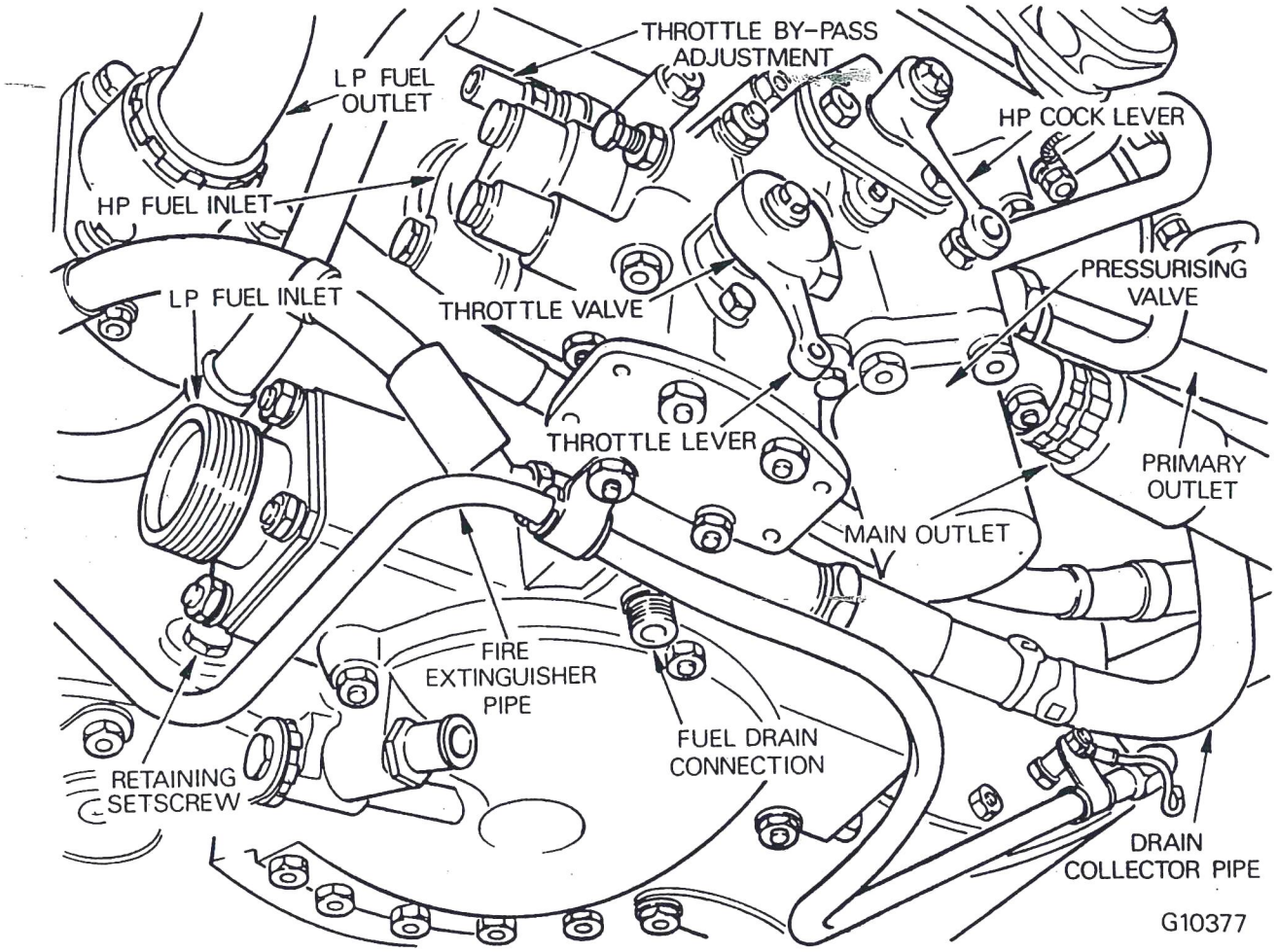
Whenever the c.f.c.u. has been disturbed, or after fitting a replacement c.f.c.u., ensure that the split pins securing the nuts at the throttle valve operating shaft and h.p. cock spindle and at the throttle valve lever hub pinch bolt, are correctly in position.

3. To remove the fuel control unit (fig.1) from the engine:-

(1) Remove the fire extinguisher pipe clipped to the unit.

(2) Disconnect the throttle and h.p. cock control rods.

(3) Disconnect the fuel drain collector pipe from the unit, the main and primary fuel delivery pipes from the pressurizing valve, the servo fuel and the intake air pipes from the b.p.c. and the inlet pipe to the throttle valve.



Fuel control unit
Fig.1

(4) Disconnect the l.p. fuel outlet pipe from the filter casing by removing the screws at the connection. Remove the screws securing the l.p. filter casing to the oil sump and withdraw the complete unit, disengaging the gland connections from the rigid pipes.

(5) Inhibit the unit as instructed in AP 102C-1512 to 1517-7, before return to store.

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Replacing

4. Replacing is the reverse of removing; note the following:-

(1) Engage the rigid pipes as the unit is offered up to the engine casing.

(2) Avoid any twisting of the main burner pipe as it is connected; some pipes have a lengthwise line which assists in this. Ensure that the supporting clip attaching the main burner pipe to the oil pump is correctly aligned and therefore not in a position to cut into the pipe.

(3) Ensure that the angular setting of the throttle valve lever is similar to that of the original unit, and that the aircraft controls are suitably adjusted to allow full travel of the throttle and h.p. cock levers. The aircraft stops limit control movement where a top temperature control is fitted (Mk.115, 121 and 122). The engine stops are to limit movement in the Mk.109 installation.

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THROTTLE VALVES

Removing

5. If it is necessary to remove a throttle valve seperately (para.2) proceed as follows (fig.1):-

(1) Remove the screws from the fuel inlet connection and detach the fuel pipe.

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(2) Remove the fire extinguisher pipe clip and the throttle valve assembly securing nuts; withdraw the assembly from the fuel unit casing.

Replacing

6. Replacing is the reverse of removing. Stiff valve operation can result from incorrect tightening of the assembly securing nuts; first fit each nut finger-tight then, tighten them, a half turn each time in a diagonal sequence, until all are fully tight. Check that the valve operates smoothly and freely (para.7) then, check for serviceability (para.11.).

Throttle valve friction check

7. If, at any time the throttle valve (fig.1) is suspected of being stiff in operation, disconnect the aircraft throttle control from the f.c.u. throttle lever then, using a spring balance applied at right-angles to the lever, ascertain the force required to open and close the throttle (engine static and booster pump(s) off). Reject the f.c.u. if the required pull is in excess of 3.5 lbf.

Pressurizing valve

8. These instructions are given to assist in removing the pressurizing valve (fig.1) for inspection only; renewal of the valve is not permitted (para.2).

Removing

9. Unscrew the nuts from the flange of the domed cover and withdraw the cover together with the valve guide.

Replacing

10. Replacing is the reverse of removing; note the following points:-

(1) Ensure that all sealing rings are correctly positioned; this is especially important as it applies to the internal sealing ring that abuts the upper end of the valve guide. When fitting the spring retaining ring in the valve cover, ensure the spigotted part is uppermost; if the ring is incorrectly fitted, the loading of the pressurizing valve spring will be altered, resulting in incorrect flow and pressure distribution in the burner manifolds.

(2) Avoid sluggish valve operation caused by excessive nip on the upper sealing ring (which can distort the valve guide slightly) by selecting a sealing ring to give a nip of 0.025 to 0.027 in. Measure the nip by inserting the guide into the casting with the upper sealing ring fitted but not the lower ring; the clearance between the guide flange and the casting, when the guide is held against the upper sealing ring, represents the nip.

(3) With the selected upper sealing ring and the lower sealing ring fitted, fit the valve guide into the casting. Using suitable distance pieces, tighten the guide flange against the casting and check the valve for freedom in its operating positions, before final assembly. Check for serviceability (para.11.).

Serviceability check

11. After replacing a fuel control unit or an f.c.u. component, ground run the engine, checking for fuel leaks, and make the full set of checks specified in Vol.1, Part 2, Sect.2, Chap.2. Check the fuel pressure (para.23) if necessary and, make the appropriate adjustments.

Adjusting ground idling rev/min

12. Adjust ground idling rev/min (Vol.1, Part 2, Sect.2, Chap.2) at the throttle by-pass adjuster (fig.1). Turn the adjuster, using the tool listed in Sect.1, clockwise to decrease the idling rev/min and vice-versa. One complete turn of the adjuster alters idling rev/min by approximately 250.

Bleeding the fuel system

13. Although provision for bleeding the fuel system includes two bleed points on the intake guide vane ram and one on the h.p. pump, it is necessary to bleed the system from the pump only as follows:

(1) Remove the domed cap from the h.p. fuel pump bleed point (fig.8) then, retracting the bleed tool plunger by turning the knurled screw, attach the bleed tool and hose assembly to the pump.

(2) Check the h.p. cock is closed and the ignition switch is OFF.

(3) Turn the l.p. cock and switch on the tank pumps; each tank pump must be run, in turn, to clear air from all feed pipes.

(4) Place the end of the bleed tool hose in a suitable receptacle and depress the bleed tool plunger by turning the knurled screw. If the engine has been inhibited, oil will flow out first, followed by air and fuel.

(5) When the flow from the bleed tool hose is clear and free from air bubbles, retract the bleed tool plunger; detach the bleed tool then, refit and lock the fuel pump bleed point cap, using 22 S.W.G. wire (Ref.30A/3399).

14. If the rev/min fluctuates during the initial ground run, it may be necessary to bleed the system again.

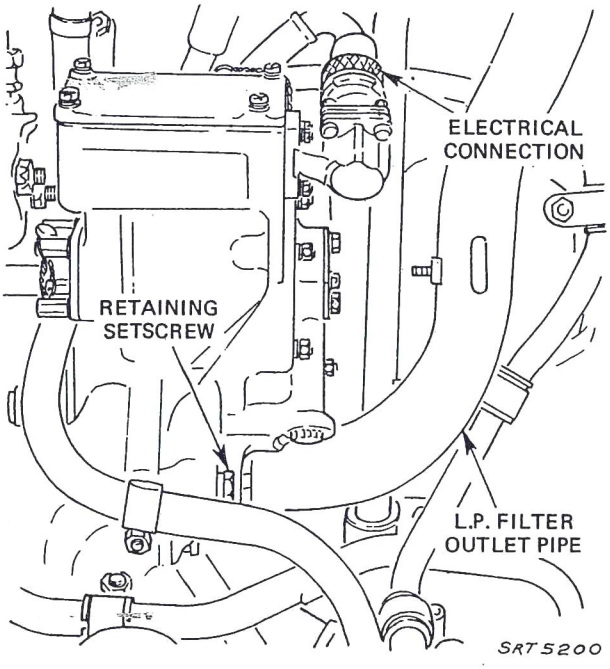
FUEL FILTER DE-ICING SWITCH

Removing

15. To remove the fuel filter de-icing switch (fig.2) proceed as follows:

(1) Remove the locking wire from each end of the l.p. filter outlet pipe then, unscrew the nuts, detach the bonding, and remove the pipe.

(2) Disconnect the electrical lead from the switch; remove the setscrews securing the switch to the l.p. filter outlet elbow then, withdraw the switch.



De-icing switch
Fig.2

Replacing

16. Replacing is the reverse of removing; fit a new jointing between the switch and the outlet elbow. Using 22 S.W.G. wire (Ref.30A/3339) relock the pipe.

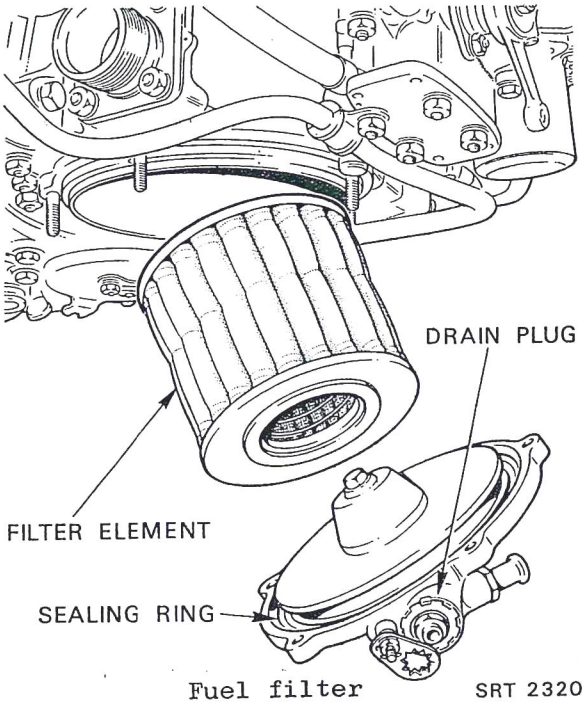
Serviceability check

17. Ground run the engine (Vol.1, Part 2, Sect.2, Chap.2) and check for leaks.

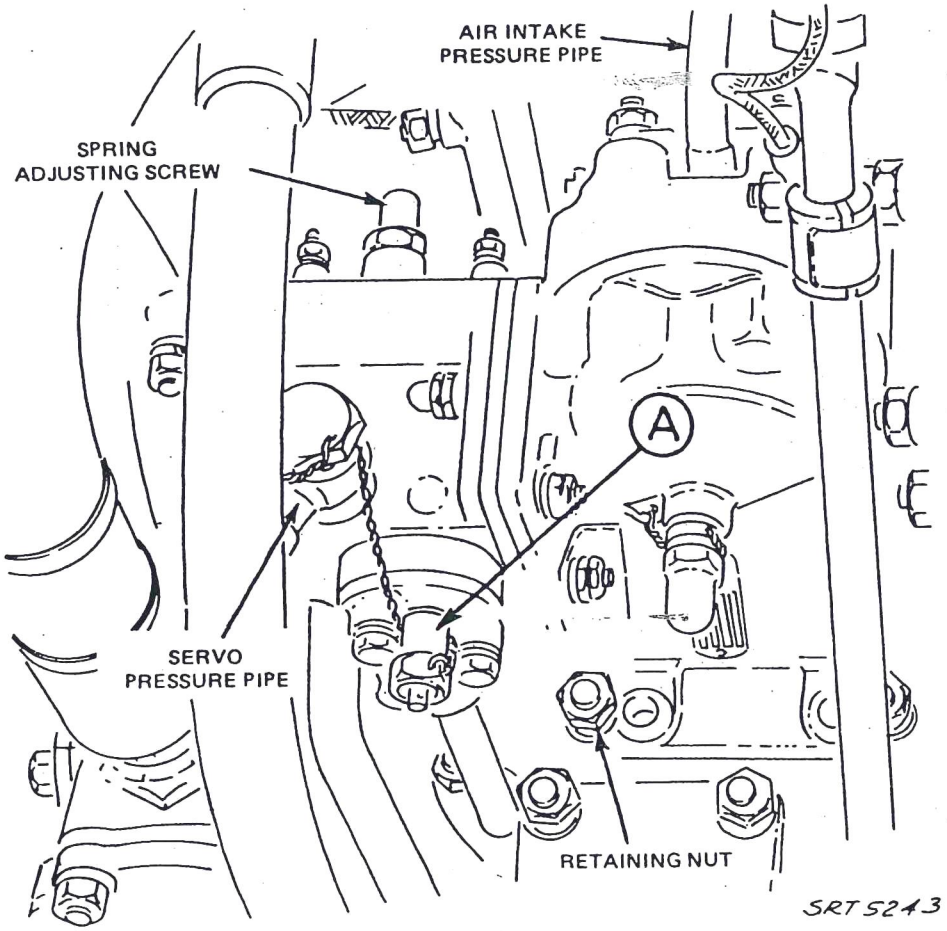
FUEL FILTER

Removing

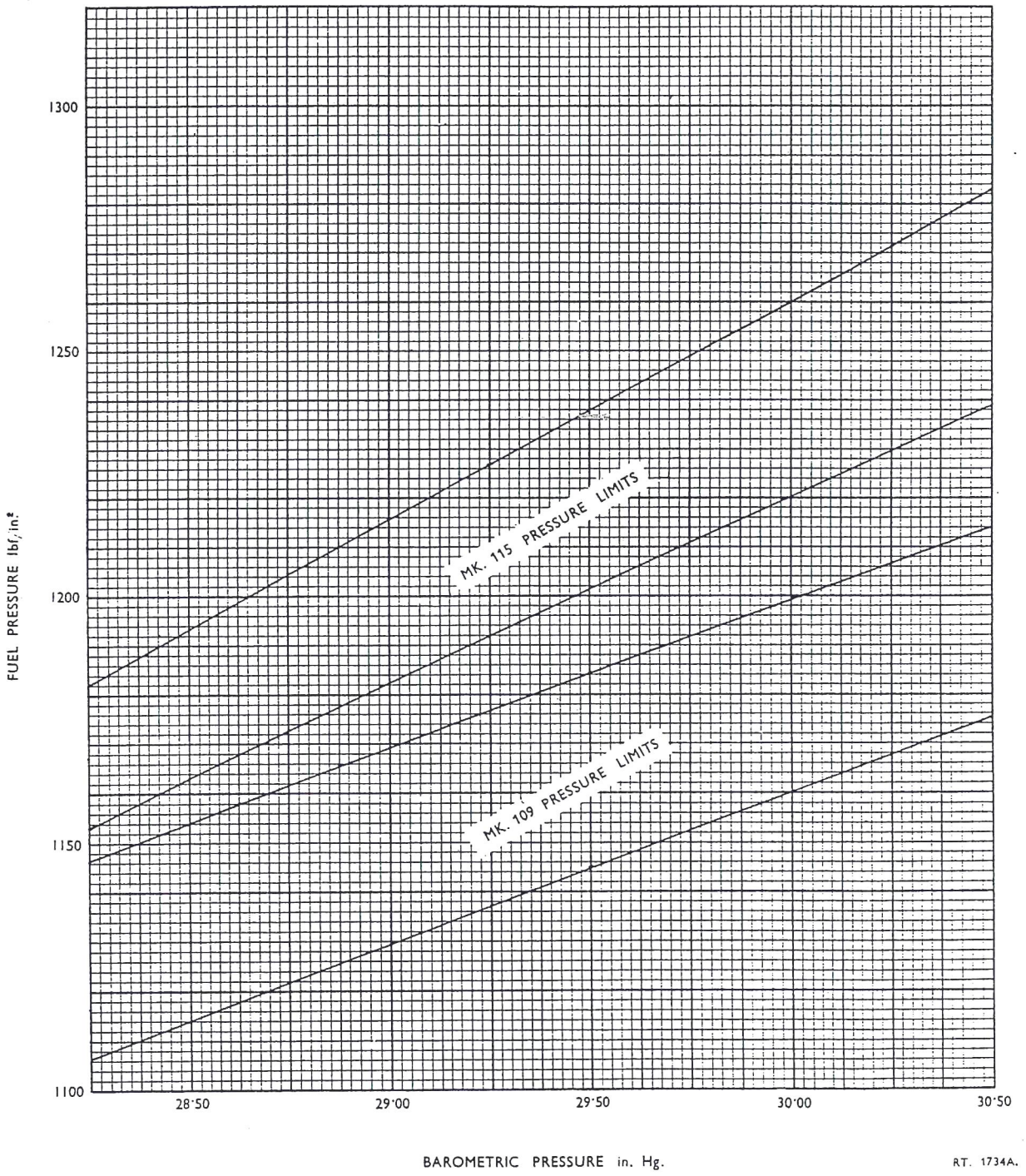
18. Check that the h.p. and l.p. cocks are closed then, drain the filter by removing the drain plug (fig.3). Remove the nuts securing the cover then, withdraw the cover and element. Detach the lower plate from the cover by unscrewing the captive screw. Discard the element and the cover to housing sealing ring; clean the remaining parts.



Fuel filter
Fig.3



Barometric pressure control
Fig.4



Correction of fuel pump delivery pressure
Fig.5

Replacing

CAUTION ...

It is important to ensure that the element support plate is free to compress its spring and that the threads of the captive screw are not engaged with those of the cover. Before offering up the cover to the filter casing, turn the element support plate 'clockwise' and check that it is operating against the spring.

19. Replacing is the reverse of removing; use a new element and a new cover to housing sealing ring. Do not unwrap the element until immediately before it is fitted. Tighten and lock the drain plug. Bleed the fuel system (para.13).

BAROMETRIC PRESSURE CONTROL

Note...

Before attempting to renew a b.p.c. separately, refer to para.2.

Removing

20. Remove the servo pressure pipe connecting the b.p.c. to the h.p. fuel pump (fig.4) and the nuts securing the air intake pressure pipe to the top of the capsule chamber.

Replacing

21. Replacing is the reverse of removing.

Serviceability check

22. Ground run the engine and check for fuel leaks.

Checking h.p. pump delivery pressure

23. Fuel pump delivery pressure is to be checked at the pressure tapping on the b.p.c. ('A' in fig.4).

24. The pressure check should be made at 3000 rev/min, using a fuel pressure gauge, reading to 2000 lbf/in^2. The pressure measured should be within the limits in fig.5 (Mk.109 and 115) when read against the barometric pressure at the time of the check. If the fuel pressure is not within the limits, adjust the b.p.c. (para.25). On Mk.109 engines, pressures up to 50 lb/in^2 in excess of the upper limit are acceptable without adjustment provided the b.p.c. servo fuel strainer is clean. The fuel pressure setting on Mk.121 and 122 engines is very critical if the engine is to remain surge-free under fast acceleration conditions at altitude; the nominal

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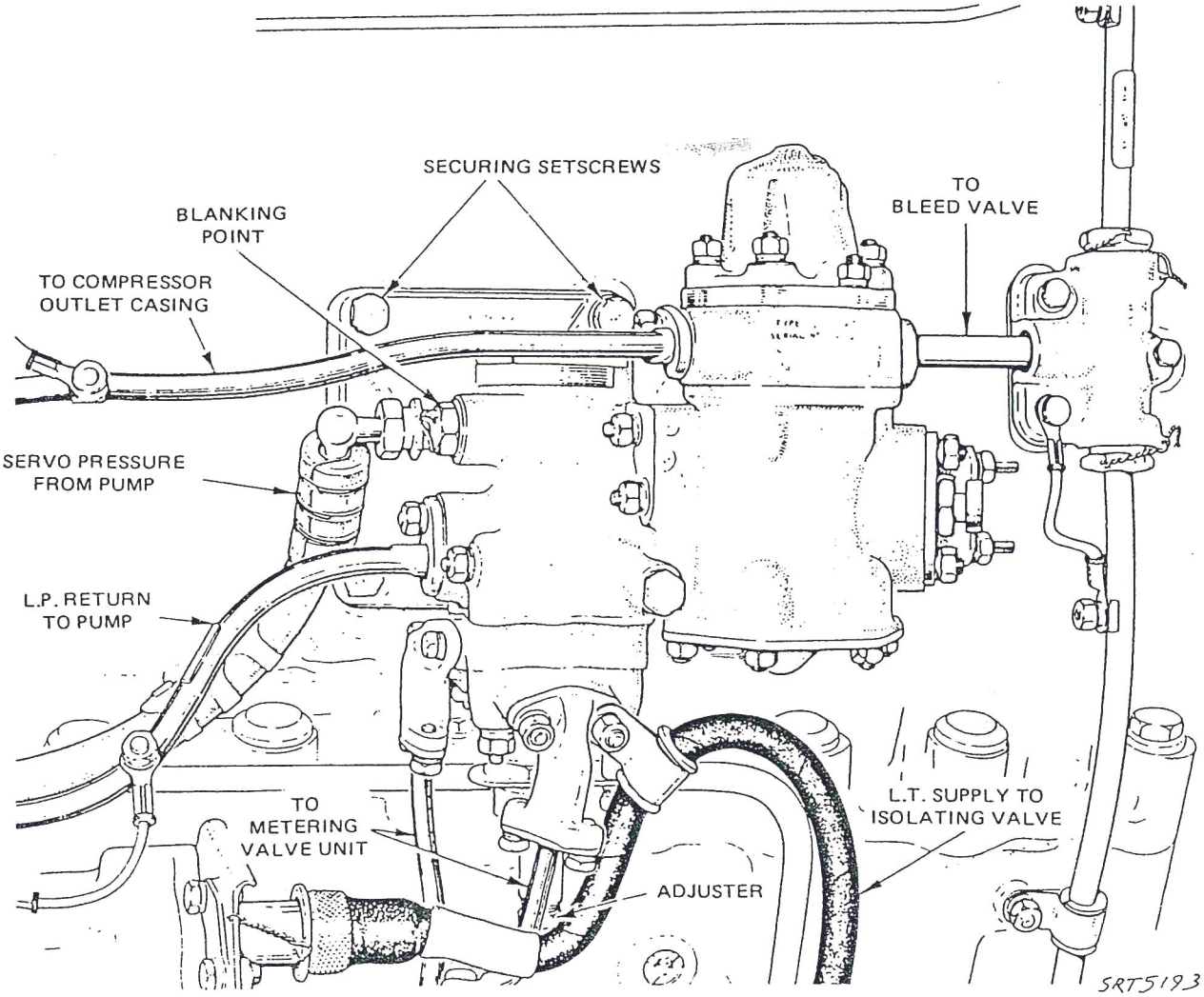

Acceleration control unit
Fig.6

pressure is 1250 lbf/in^2, but some engines handle better at relatively lower or higher pressures; therfore, no definite limits are imposed. The fuel pressure need not be checked or reset provided the b.p.c. does not take over from the fuel pump governor at altitude and prevent the engine reaching maximum permissible rev/min or jet pipe temperature, or that the maximum positive creep does not exceed 350 rev/min with the engine free from surge. It may, however, be necessary to reduce the fuel pressure to maintain the creep below 350 rev/min if the range of the top temperature control is insufficient at high altitude, as would be indicated by the Maximum jet pipe temperature being exceeded at full throttle, above heights of 40,000 ft.

Adjusting the b.p.c.
Pre-Mod.5327

25. Remove the domed cover from the adjuster (fig.4), slacken the locknut and turn the adjuster clockwise to increase fuel pressure and vice versa. One quarter of a complete turn of the adjuster will alter the fuel pressure by approximately 60 lbf/in^2 and alter the engine speed by approximately 75 rev/min.

26. When the fuel pressure is correct, lock the adjuster and refit and lock the domed cover, using 22 S.W.G. wire (30A/3339).

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26A. Using the special spanner (Sect.1) turn the adjuster clockwise to increase the fuel pressure and vice versa, (12 clicks is equivalent to 1 full turn). One click of the adjuster will alter the fuel pressure by approximately 20 lbf/in^2 and alter the engine speed by approximately 25 rev/min.

M lr Isolate the b.p.c.

26B. In certain instances, i.e. when the engine fails to achieve self-sustaining or ground idle rev/min or, incorrect idle or maximum rev/min or, rev/min fluctuation, refer to Vol.1, Part 3, Sect.1, it may be necessary to isolate the b.p.c. as follows:

(1) Disconnect the servo pressure pipe at the h.p. fuel pump end (fig.8) then, fit pressure blanks to the pipe and h.p. fuel pump connection.

ACCELERATION CONTROL UNIT AND METERING VALVE UNITS

27. The acceleration control unit (a.c.u.) and metering valve unit are calibrated together and are not to be changed separetely. The two units are supplied as spares, under a single reference number.

Remove the a.c.u.

28. Disconnect the pipes from the unit (fig.6); rigid pipes are to be disconnected at both ends and removed from the engine. The l.p. fuel return pipe may be disconnected from the a.c.u. and then pushed, a sufficient distance to clear the a.c.u., into the pump connection block. Remove the securing setscrews and detach the a.c.u. from the compressor casing.

Removing the metering valve unit

29. Disconnect the two pipes connecting the unit (fig.7) with the a.c.u., the rigid pipe to the upper pump outlet and the combined outlet pipe to the cooler. Unscrew the securing setscrews, withdraw the unit (upwards and outwards to clear the combined outlet pipe) from the fuel pump. Inhibit the unit (AP 102C-1512 to 1517-7 and 1522-7).

Isolate the a.c.u.

CAUTION...
When the a.c.u. is isolated, the throttle must be opened slowly; do not allow j.p.t. to approach the maximum limit.

29A. In certain instances, i.e. when the engine fails to achieve self-sustaining or ground idle rev/min or, incorrect idle or maximum rev/min or, rev/min fluctuation, refer to Vol.1, Part 3, Sect.1, it may be necessary to isolate the a.c.u. as follows:

(1) Disconnect the servo pressure line to the unit then, fit pressure blanks to both the pipe and the connection on the unit (fig.6).

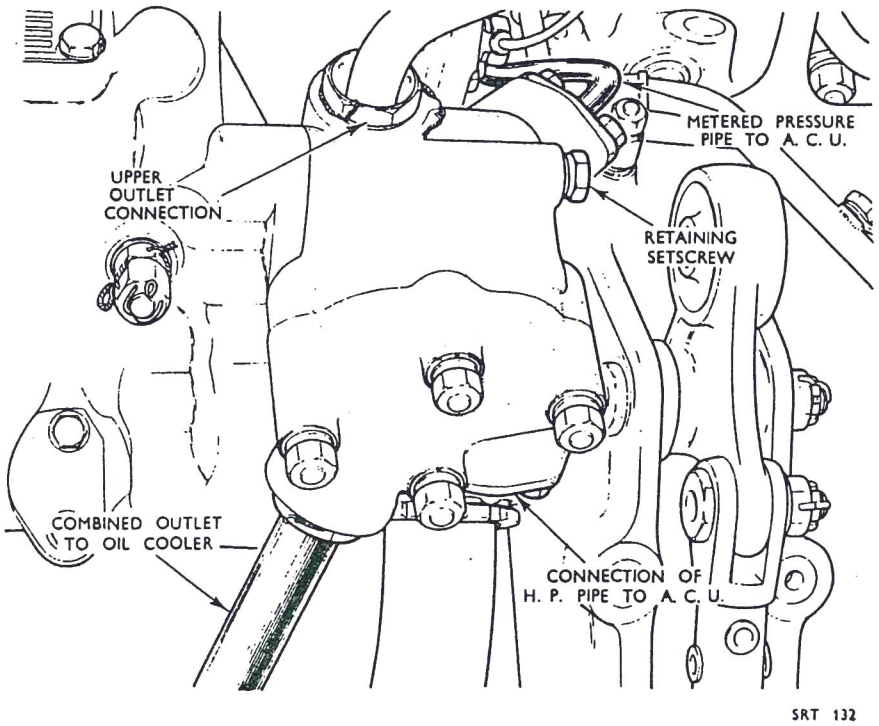

Fig.7 Metering valve unit

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Replacing

30. Replacing the units is the reverse of removing. Renew jointings and sealing rings.

CAUTION: FIT THE INTERCONNECTING FUEL PIPE, BETWEEN THE METERING BLOCK AND FUEL COOLED OIL COOLER, AS INSTRUCTED IN A. TO Q., TO OBVIATE INITIAL STRESSES WHICH CAN RESULT IN FATIGUE FAILURES.

A. Fit the clip and bush assemblies onto the pipe.

B. Fit the pipe into the F.C.O.C. end connection and engage the thread of the gland nut. Do not tighten the gland nut.

C. Fit the clips to their respective studs and fit the nuts. Do not tighten the nuts.

D. Assemble the metering block onto the pipe and finger tighten the gland nut.

E. Fit the upper outlet connection to the ~~I.G.V. ram pipe~~ METERING VALVE. Do not tighten the gland nuts.

F. Fit the upper outlet connection to the fuel pump. Do not tighten the bolts.

G. Fit the pipe between the upper outlet connection and the metering block. Do not tighten the gland nuts.

H. Fit the 3 fitted bolts to the metering block. Do not tighten the bolts.

J. Tighten the upper outlet connection bolts.

K. Tighten the metering block fitted bolts.

L. Torque tighten the gland nuts, on the pipe between the upper outlet connection and the metering block; refer to Chap.1, para.15.

M. Torque tighten the gland nut at the metering block end of the pipe between the metering block and the F.C.O.C.; refer to Chap.1, para.15.

N. Tighten the nuts securing the clips.

O. Torque tighten the gland nut at the F.C.O.C. end of the pipe between the metering block and the F.C.O.C.; refer to Chap.1, para.15.

P. Tighten the gland nuts on the pipe between the I.G.V. ram and upper outlet connection.

Q. Bleed the fuel system; refer to para.13.

Serviceability check

31. Ground run the engine and check all disturbed pipes for leaks. Check the intake guide vane ram, the air bleed valves, the governed rev/min. and acceleration times, as described in Vol.1, Part 2, Sect.2, Chap.2. If acceleration times are not within the limits, adjust the a.c.u. (para.32).

Adjusting acceleration time

32. To adjust engine acceleration time, insert the T-spanner into the slot of the 'clicker' adjuster in the base of the a.c.u. (fig.6). Turn the adjuster clockwise to decrease the time taken to accelerate, and vice versa. A turn through four clicks of the adjuster alters acceleration time by approximately 1 second.

33. Do not turn the adjuster more than four clicks before checking engine response. Repeat the procedure until acceleration is satisfactory.

34. If after adjusting by a total of thirty clicks (a complete turn of the adjuster), in the appropriate direction, the acceleration time is not approaching acceptable limits, renew the a.c.u. Refer to Vol.1, Part 3, Sect.1, for additional information on adjusting.

FUEL PUMP

Removing

CAUTION...

(1) Do not change the servo isolating valve on its own, as the setting of the isolating valve has been adjusted to suit the characteristics of the pump to which it is fitted.

(2) If a pump is being rejected for investigation of a suspected defect, the isolating valve must not be removed from the pump.

35. Withdraw the multi-pin plug from the isolating valve solenoid (Mk.122) or storage point (Mk.109). Detach the connection block, with the pipes, from the top of the pump, and withdraw the two transfer bobbins for renewal of the rubber sealing rings.

36. Disconnect the a.c.u. servo pipe from the top of the pump and the b.p.c. servo and drain pipes from the bottom of the pump.

37. Disconnect the pipes from the upper outlet connection and the metering valve unit (which serves as the combined outlet), then detach these parts from the pump, drawing the metering valve unit away from the combined outlet pipe. Detach the twin inlet connection, disconnecting the smaller pipe at the connection on the intake guide vane ram.

38. Using the spanners listed in Sect.1, unscrew the retaining nuts and setscrews, leaving one nut at the top. Support the pump, with a sling if possible, and remove the remaining nut; withdraw the unit from the engine. Do not attempt to detach the gears from the pump spindles.

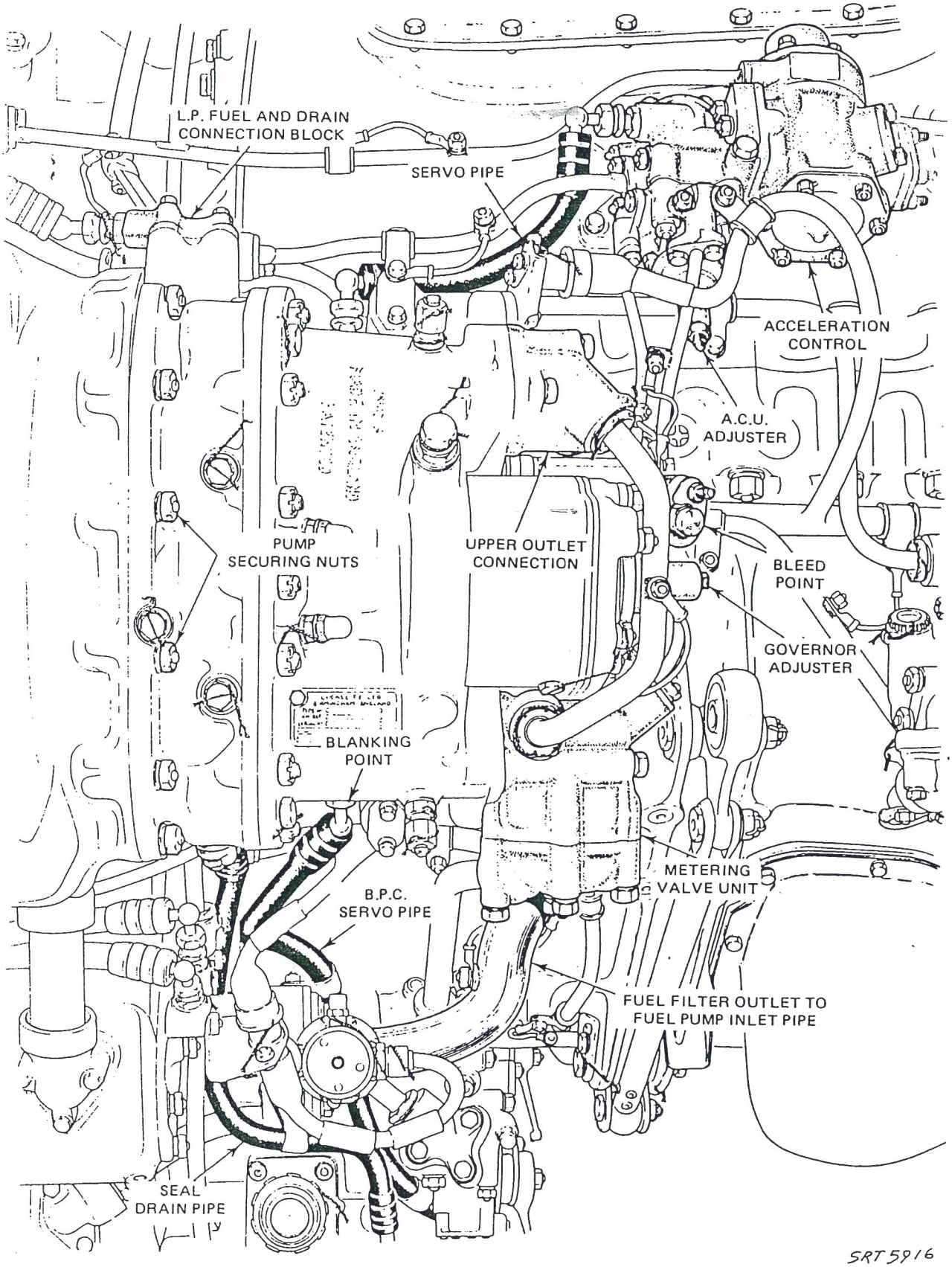


Fig.8 H.P. fuel pump

Inhibiting

39. Before storing, fill the pump with clean oil OM-11 (34B/9105055) through the inlets, turning the spindle in the normal direction of rotation to draw oil into the plunger bores. Each orifice should then be topped up and blanked (A.P.102C-1512 to 1517-7).

Replacing

40. Replacing is the reverse of removing. It may be necessary to turn the engine by hand to mesh the driving gears. Renew the joint washers between the pump body and the wheelcase.

41. It is essential that the interconnecting h.p. fuel pipe, between the upper pumping unit outlet connection and the metering valve unit, is correctly fitted to obviate initial stresses which could result in fatigue failure of the pipe.

42. Fit the pipe in the following manner:

A. Loosely assemble the pipe to the upper pump outlet connection.

B. Insert the lower end of the pipe into the metering block and screw up the gland nut finger tight.

C. Insert the three upper connection retaining screws and tighten down the connection, ensuring that the rubber sealing ring is correctly positioned, then 'nip' the lower gland nut.

D. Check that the pipe can move slightly in an inward and outward direction within the upper connection and at the same time make the upper gland nut finger-tight. Fully tighten the upper and lower gland nuts, at once investigating any undue resistance.

Serviceability check

43. Bleed fuel system (para.13)

43A. Ground run engine and check for fuel leaks.

43B. Check fuel pump isolation on Mk.122 engines (Vol.1, Part 2, Sect.2, Chap.2.)

43C. Check and, if necessary, adjust rev/min governor (para.44).

Adjusting governed rev/min

44. To adjust governed rev/min (Vol.1, Part 2, Chap.2), use the tool (Sect.1) to turn the governor adjuster (fig.8) clockwise to increase governed rev/min and vice versa. Turning the adjuster by 1 turn clockwise increases the rev/min by approximately 200 rev/min.

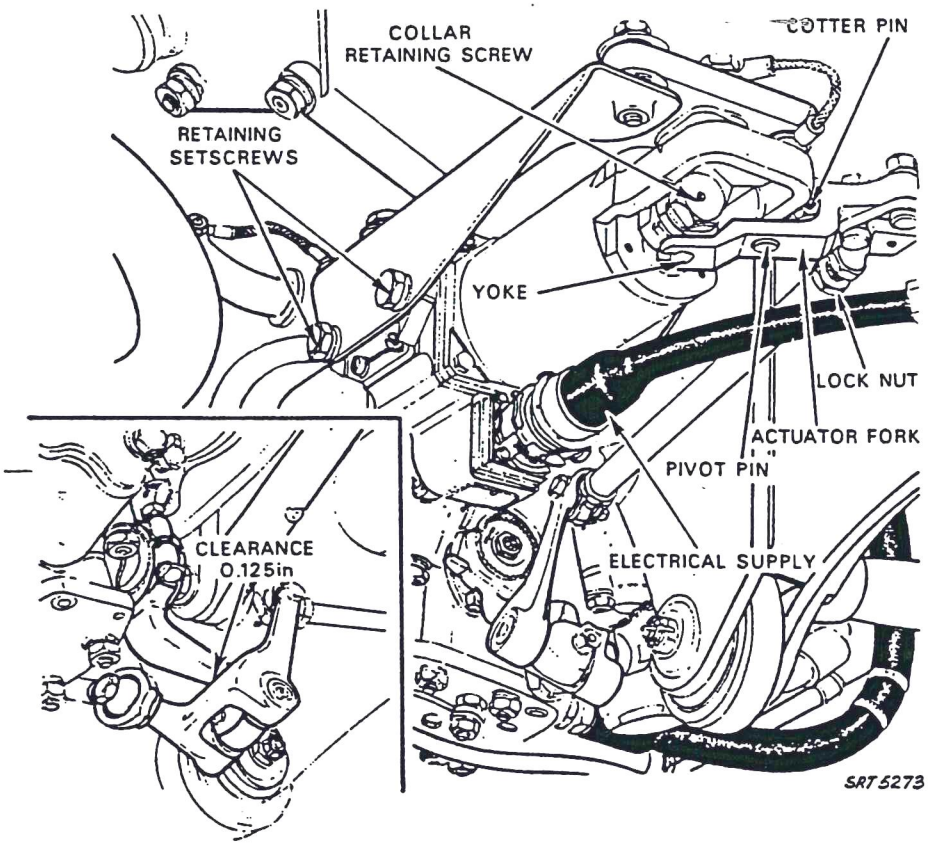
TOP TEMPERATURE CONTROL
(Mk.115, 121 and 122)

CAUTION: TO AVOID OVERSTRESSING THE ROD AND LEVERS WHEN SLACKENING AND TIGHTENING THE TOP TEMPERATURE CONTROL ROD LOCKNUT, IT IS ESSENTIAL THAT THE ROD IS HELD USING THE SPANNERING FLATS PROVIDED ON THE CONTROL ROD.

45. The top temperature control actuator (Fig.9) is mounted forward of the throttle valve and connected to it by a rod and levers.

Removing

46. Disconnect the electrical supply plug. Provide a datum for assembling by slackening the locknut on the adjustable rod sufficiently to release the nip, then unscrew the ball joint until clear of the rod.



Top temperature control
Fig.9

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47. Remove the setscrews which retain the unit to the two mounting brackets and remove it from the engine.

48. If the actuator failed with the shaft in the extended position, remove the cotter pin, push out the pivot pin and swing the actuator fork over the overrun guard, disengaging it from the yoke. Slide the yoke from below the collar.

49. Retain the actuator fork, the yoke, the pivot pin and the cotter pin for fitting to the new unit.

50. Where the actuator has failed with the shaft retracted, remove the unit from the engine.

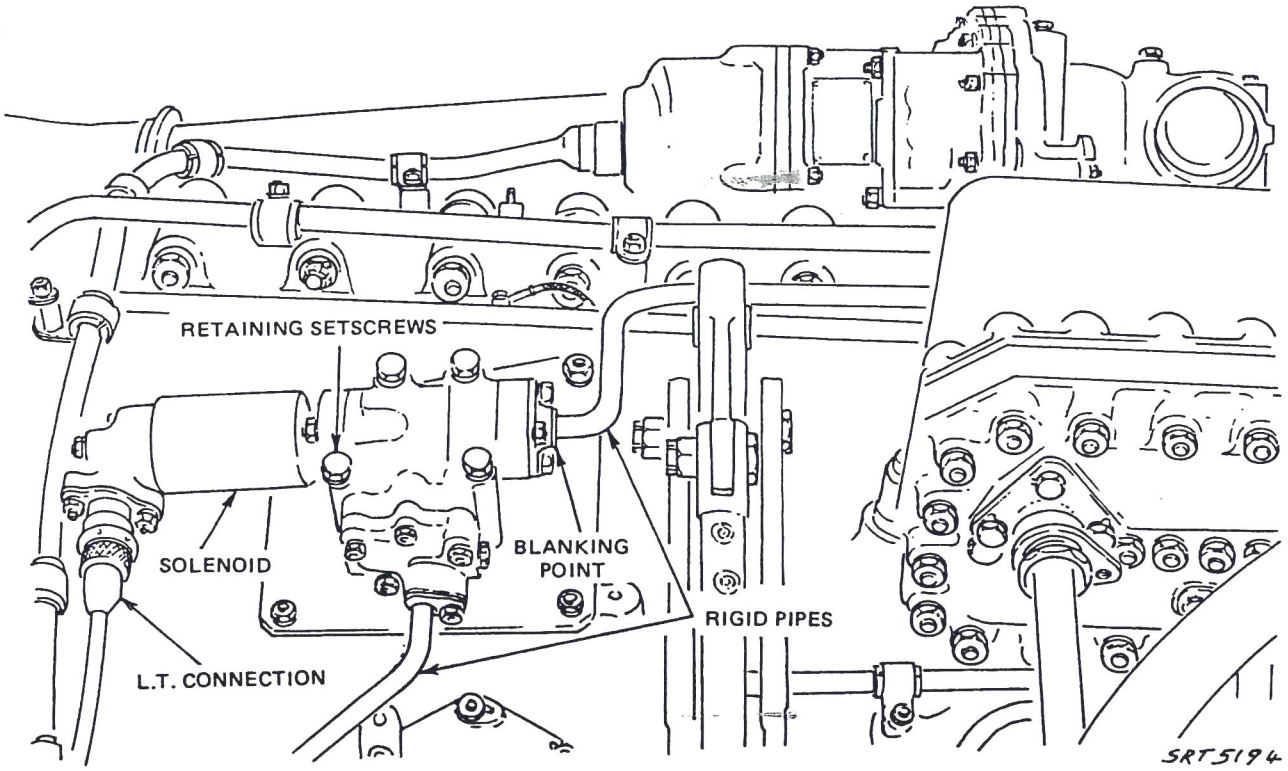

Fig.10 Fuel dip unit

as described in para.46 and 47. Support the unit in a soft-jawed vice and unscrew the collar retaining screw on the end of the shaft until the yoke collar can be raised sufficiently to allow angular movement of the actuator arm. This permits access to the nut on the cotter pin and enables the arm to clear the overrun guard.

51. The remainder of the removing procedure is then as previously described.

Replacing

52. Using an external electrical supply, extend the shaft and fit the yoke with the gap on the opposite side to the actuator fork.

53. Fit the fork, the pivot pin and the cotter pin and retract the shaft.

54. Fit the unit to the mounting brackets on the engine, connect the ball joint to the adjustable rod, then screw in as far as the locknut. With the throttle fully closed, adjust the rod to give a clearance of 0.125 in (fig.9), at the recess between the bell-crank lever and the throttle lever arm, then tighten the locknut, refer to Chap.1, para. 6 (Special torque loads).

55. With the cockpit throttle control in the full throttle position, ensure that the engine throttle lever is clear of the full throttle stop, on the fuel control unit, in accordance with the procedure instructed in the appropriate aircraft Air Publication.

56. After completion of the adjustments, ensure that all controls are in safety, correctly locked and that control rods and levers do not foul when operated throughout their full range of movement.

56A. Reconnect the electrical supply plug and check operation of the top temperature control actuator.

56B. Ensure that the split pin securing the control rod to relay lever nut is correctly in position.

FUEL DIP UNIT

(Mk.121 and 122)

57. The fuel dip unit (fig.10) and solenoid are calibrated together and must be changed as a single unit.

Removing

58. Disconnect the l.t. connection from the solenoid and the two rigid pipes at their seal housing joints. Remove the securing screws and lift off the unit.

Inhibiting

59. Before storing the unit, fill all fuel passages with oil OM-11 (34B/9105055) and blank all connections.

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Replacing

60. Replacing is the reverse of removing.

Serviceability

WARNING...
Ensure that the guns are unloaded before making this check.

61. Run the engine and check the unit connections for leaks. Ensure that the maximum and ground idling rev/min conform with Operating Limitations (Vol.1). Check that the a.c.u., bleed valve control unit, air bleed valves and intake guide vane ram are functioning correctly then, check as described in Vol.1, Part 2, Sect.2, Chap.2.

Isolate the fuel dip unit

61A. In certain instances, i.e. when the engine fails to achieve self-sustaining or ground idle rev/min or, incorrect idle or maximum rev/min or, rev/min fluctuation, refer to Vol.1, Part 3, Sect.1, it may be necessary to isolate the fuel dip unit as follows

(1) Disconnect the rigid pipe from the fuel dip unit to the pilot manifold then, fit a pressure blank to the unit and the pipe (fig.10).

BURNERS

62. Burners may be changed individually; they differ only in the side on which the primary fuel connection is made (fig.11).

Removing

63. Remove the combustion chamber from the engine and the flame tube from the chamber, as described in Chap.3.

64. Unscrew the retaining nuts on the outside of the expansion chamber and withdraw the burners.

65. Fit a protective sleeve over the burner head and blank the connections .

Replacing

66. Do not attempt to rectify an unserviceable burner, it may affect the flow characteristics.

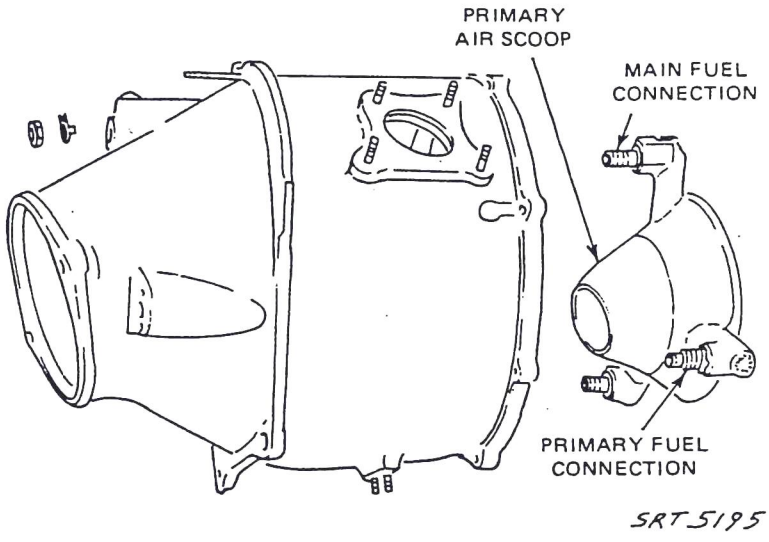

Fig.11 Expansion chamber and burner

67. Place the burner into position in the expansion chamber, arranging the main fuel connection towards the outise of the engine. Fit and tighten the burner retaining nuts then, using the extension spanner, torque tighten the nuts to the loading specified in Sect.2, Chap.1, para.6. Check that the primary airscoop is central in the expansion chamber then, assemble the combustion chamber to the engine.

68. Connect the pilot burner fuel manifold connections to the pilot burner connections then, using the extension spanner, torque tighten the connections to the loading specified in Sect.2, Chap.1, para.6. Connect the main fuel manifold connections to the main burner connections then, using the extension spanner, torque tighten the connections to the loading specified in Sect.2, Chap.1, para.6.

Serviceability Check

69. Run the engine to a maximum rev/min to check that the j.p.t. is within the permissable limits and afterwards, examine the combustion chambers externally for local overheating and blowing joints.

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