Chapter 6

HIGH PRESSURE FUEL PUMPS, TYPE GB.116 and GB.200 SERIES

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LIST OF ILLUSTRATIONS

Introduction

1. The GB.116 and GB.200 series fuel pumps are similar in construction and operation. The GB.116 has its stall pressure uprated, is fitted with a slightly different type of carbon face seal, and also has grooves formed on the inlet and outlet ports to reduce pressure variation.

2. Other differences are in the bleed points and in the installation connections, e.g. the GB.116 has the inlet and outlet connections on the same side of the pump body. The installation standard of the GB.200 series is identified by a suffix letter, for instance, on a GB.222/3AU, the /3 denotes its particular installation features; the letters AU indicate the calibration code to which the pump must be tested.

3. On some early types of installation, which employ dual pumps, a solenoid operated isolating valve is fitted in place of the end cover on the servo control cylinder of one or both pumps. This is a safety factor which enables a defective pump or control unit to be isolated and thus maintain the fuel supply to the burners.

4. Although each pump incorporates its own servo control mechanism and overspeed governor, their use together with a common delivery, necessitates the hydraulic inter-connection of the servo control systems. Also, the overspeed control on one pump is set to govern at a higher engine speed than the other, to prevent inter-action between the two pumps for control.

5. A non-return valve is fitted in the outlet connection of each pump to prevent the fuel being pumped back into a failed pump, causing it to motor, and thereby reducing the effective pressure of the operating pump.

Description (*fig.* 1)

6. The pumping element consists of a rotor (24) supported at each end by carbon bearings (5 and 29) which are retained by circlips. In the rotor are seven inclined cylinders into which are fitted the hardened steel plungers (4). The ends of the plungers are ball shaped to accommodate socketed slippers (30) which contact an appropriately shaped camplate (1). The camplate is formed in a control ring which pivots on the trunnions (26). The angle of inclination of the camplate can be varied, by a servo piston (8), piston rod and link (3), from zero plunger stroke (when at 90° to the rotor axis) to maximum plunger stroke (when moved through approximately 15°).

7. An auxiliary camplate (2) which is drilled to take the slipper shanks, supports the slipper head (30) in position against the camplate face. At its centre it runs on a hemispherical thrust bearing (27) which is spring-loaded upon the stem of the rotor to allow slight fore and aft play.

8. From the underside of each plunger a central hole is drilled through the ball-shaped end, to provide a cooling film of fuel to the underside of the slipper. A small hole through the slipper permits a gradual leakage of fuel to the bearing surfaces of the slipper and camplate for the same purpose.

9. The cylinder bores in the rotor are stepped in diameter, the smaller ends terminating in seven ports in the flat face of the rotor. This face makes contact with the insert (23) in which are kidney-shaped inlet and delivery ports (22).

10. A pressure tight seal is made by the rotor being pressed against the insert by the force exerted by the seven rotor plunger return springs and by the fuel pressure acting on the annulus formed by the stepped portion in the rotor cylinder bores; at normal pressure this force is the predominant one and gives a sealing effect approximately proportional to the fuel pressure.

11. During the inlet stroke, the outward force on the plunger is provided both by the return spring and by centrifugal force acting along the inclined axis of the plunger.

Overspeed governor

12. The overspeed governor control consists of a diaphragm (15), interposed between the pump housing flange and the cover plate, to which is attached a forked member and a spring. At the other end of the spring is a similar forked member secured to an adjusting screw (17) mounted in the spring housing.

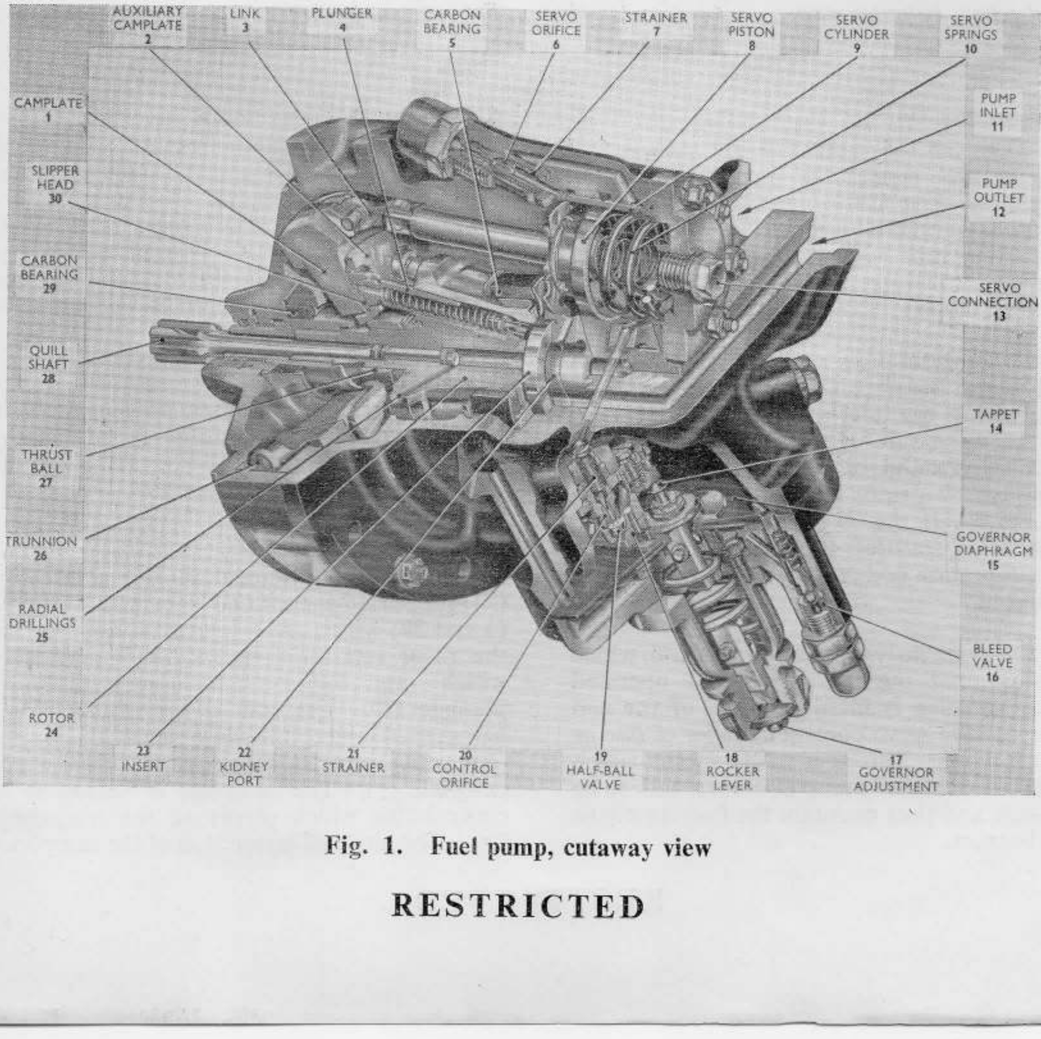

Fig. 1. Fuel pump, cutaway view

13. In the centre of the inner face of the diaphragm is a hardened steel tappet (14) which contacts the end of a spring-loaded rocker lever (18) mounted in two pairs of cross-torsional springs. The opposite end of the lever accommodates a half-ball valve (19) which seats on an orifice (20) in the base plate of the overspeed governor control; this orifice is in direct communication with the outer end of the servo control piston cylinder.

Operation

14. The rotor is driven by the splined quill shaft which engages with an engine accessory drive. The plungers are maintained in contact with the camplate by their helical return springs, and due to the inclination of the camplate, movement of the rotor imparts a reciprocating motion to the plungers in the rotor cylinders to produce a pumping action.

15. Fuel is supplied to the inlet connection of the pump from the aircraft supply. It enters the rotor cylinders via the kidney-shaped inlet port of the insert, and also passes to the underside of the diaphragm of the overspeed governor control. As the rotor revolves, the plunger into which fuel is fed moves outward to the extremity of the inlet stroke as set by the inclination of the camplate. On completion of the inlet stroke, the plunger motion is reversed and fuel at high pressure is ejected from the rotor cylinder via the delivery port of the insert to the pump outlet. This cycle of operations is repeated in turn for each of the seven plungers, and each plunger will complete one inlet and one delivery stroke for the complete rotation of the rotor.

Servo system

16. The control of the pump is effected by its servo or relay-operated system. This system comprises a piston (8) operating in a cylinder (9) against the pressure of a pair of helical springs (10). The piston is coupled to the control ring to incline the camplate by means of a piston rod and link (3). The springs are so arranged to move the camplate into a position corresponding to maximum delivery.

17. Fuel under pressure from the delivery side of the pump is supplied to the underside of the servo piston and via a restricting orifice (6) to the upper side of the piston.

18. Movement of the servo piston is controlled by one or more control orifices which are responsive to measured conditions which define the pump output. When the orifices are closed, the pressures on each of the piston equalise by way of the restricting orifice. The spring force, assisted by the fuel pressure acting on the area above the piston, now moves the piston and, through the piston rod and link, adjust the camplates angle to give maximum plunger stroke.

19. The opening of any one of the control orifices allows fuel from the upper side of the servo control piston to flow from the cylinder and reduce the pressure on the piston. The piston is then moved against spring pressure to alter the inclination of the camplate and reduce the pump output. The rate of movement of the servo piston is controlled by the bleed from the orifice.

20. Only one control orifice is provided in the pump itself, and this functions as a relief valve and as a part of the overspeed governor control.

Relief valve

21. Excessive pressure in the delivery line, caused by a blockage or the inadvertent closing of a cock, is communicated to the servo cylinder on the upperside of the piston and to the overspeed governor control orifice. This overcomes the loading of the half-ball valve and allows fuel to bleed from the servo cylinder on the upper side of the piston. The reduced pressure allows the piston to return, and alters the inclination of the camplate, to lower the fuel delivery and pressure.

Overspeed governor

22. The overspeed control is controlled by a force dependent on the rotational speed of the pump. With the rotor in motion, a centrifugal pressure rise is created by a series of radial drillings (25) in the rotor, this pressure is transmitted through ducts in the pump casing to the chamber above the overspeed governor diaphragm.

23. At a certain speed the centrifugal pressure is sufficient to overcome the spring-loading of the diaphragm. This causes the central tappet of the diaphragm to depress the spring-loaded rocker lever and lift the half-ball valve clear of the control orifice.

Fuel is then allowed to bleed to the return side of the pump thereby reducing the pressure on the upper side of the servo piston, allowing the piston to return, and move the camplate to reduce the rotor plunger stroke and prevent any further increase in speed.

Isolating valve (dual pump installation)

24. The solenoid isolating valve is fitted to the end cover of the servo control cylinder. It incorporates connections for the servo cylinder of the second pump and an outlet to the barometric pressure control. An electrical plug is also mounted to the solenoid.

25. The valve comprises an orifice in communication with the pump servo cylinder through which fuel is fed at servo pressure to the barometric pressure control. The closing member of the orifice is a steel plate valve which is kept clear of the orifice by a spring.

26. When the solenoid is energised, the plate valve is moved by the solenoid plunger and push rod to seal off the orifice, thus isolating the servo system of one pump from any exterior bleed. The isolated fuel pump will continue to deliver fuel as controlled by its own servo system, i.e. maximum stroke is operating correctly; the other pump will deliver fuel as controlled by its own servo control system in conjunction with the barometric pressure control.

27. As the combined pump delivery pressure acts on the barometric pressure control, any change in pressure will cause the barometric pressure control to attempt to compensate for that change by increasing or decreasing the fuel flow of the only pump it controls. Operation of the isolating valve will thus separate the control of the two pumps, making one available in the event of defective operation of the other servo system. With no defect in the fuel system, full combined pump delivery is available.

Installing and servicing

28. Instructions for installing the fuel pump are given in the engine Air Publication.

29. No servicing of the unit is necessary except for an examination of the pipes and connections for leaks, and the pump mounting for security.

30. If any connections are disturbed during servicing operations, the whole fuel system must be bled to remove any air.

31. To inhibit the pump, inject oil OM-11 or OM-13 into the inlet connection, then fit blanking covers to all apertures.

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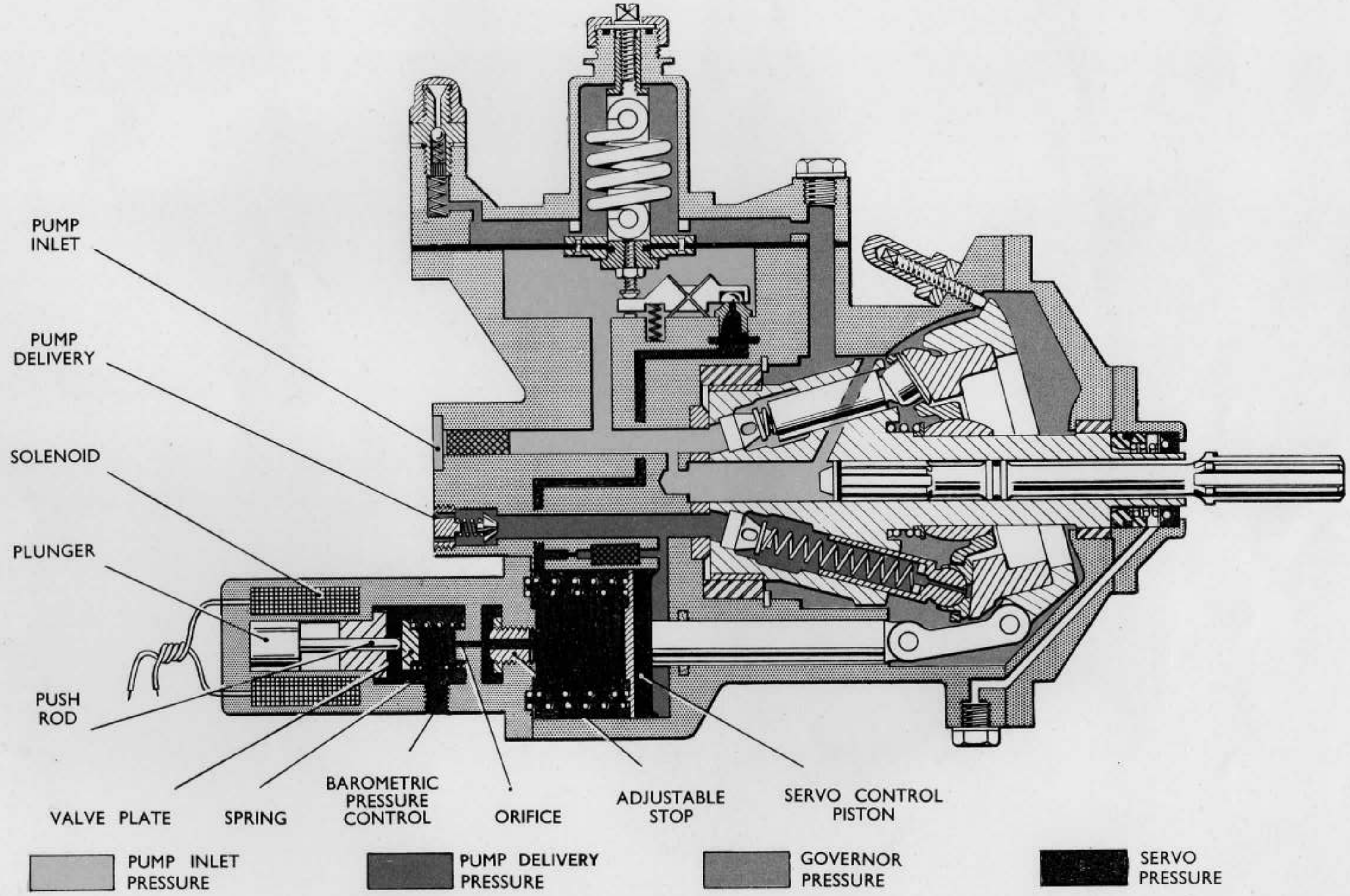

Fig. 2 Functional Diagram

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