Chapter 13

HIGH-PRESSURE FUEL PUMP, TYPE GDS.9/1A

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Description

1. The fuel pump is of the positive displacement, multi-plunger type with variable stroke control. The delivery of fuel is regulated by an overspeed governor and a pressure control valve.

2. The pump is housed within three light-alloy castings. The main casting is the body, which contains the pump element. The second is the camplate cover which is secured to the body and also provides the mounting face for the attachment of the pump to the engine. The third houses the overspeed control; gaskets are fitted between the joint faces of the three castings.

3. The pump is driven from the engine by a gearwheel and a quill shaft. In mesh with the gearwheel is a second gear which transmits the drive for a hydraulic pump.

4. One end of the pump rotor is supported in the body by a large carbon bearing, and at the other end an extension of the rotor together with the drive shaft is supported in the camplate cover by a smaller carbon bearing.

5. In the camplate cover the aperture through which the drive shaft passes is fitted with a spring-loaded carbon-faced seal and a moulded garter seal; these prevent the leakage of fuel from the rotor to the engine drive and also stop any oil entering the pump in the other direction. Internal leakage of fuel along the rotor shaft is prevented by two rubber rings in grooves on the shaft.

6. The rotor has seven equally-spaced inclined bores, each housing a spring-loaded beryllium-copper plunger. The heads of the plungers are ball-shaped and accommodate plated slipper heads which form a socketed joint to permit a free swivelling movement.

7. The slipper heads are located against a shaped non-rotating camplate which pivots on two trunnion bearings and allows the angle of inclination to be varied.

8. An auxiliary camplate supports each slipper head against the camplate face. It turns with the rotor and is mounted upon a spherical thrust ball which is spring-loaded against the rotor extension. The camplate assists the inlet stroke of the plungers and also prevents chatter.

9. A small central hole, drilled through the ball-shaped head from the hollow interior of each plunger, feeds a cooling supply of fuel to the underside of the slipper heads. The latter are similarly drilled to allow a graduated supply of fuel to reach the bearing surface of the camplate for lubrication and cooling.

10. The rotor plunger bores are plated to resist wear and have annular grooves to retain fuel and reduce frictional contact. These bores terminate as seven ports in the flat face of the rotor which is located against a hardened port-insert. The latter is positively retained and has two kidney shaped ports which communicate with the fuel inlet and delivery ports. A pressure tight seal is made by the rotor being pressed against the insert by the seven plunger return springs.

Operation

11. The fuel is supplied to the inlet port at a pressure of up to 15 lb/in^2. It then passes to the kidney-shaped fuel port. The fuel inlet passage is also ducted to the amplifier valve chamber beneath the governor diaphragm.

12. With the rotation of the pump, the inlet stroke of the plungers is provided by their outward movement, due to the centrifugal force acting along their inclined axes, together with the loading of the plunger return springs. The pump, therefore, is capable of satisfactory operation under an inlet depression, but this is not desirable for long periods.

13. Further rotation of the pump rotor with the slippers in contact with the inclined camplate face reverses the motion of the plungers which then move inwards to eject fuel through the kidney-shaped outlet port. Each plunger will thus make one inlet and one delivery stroke for each complete revolution of the rotor.

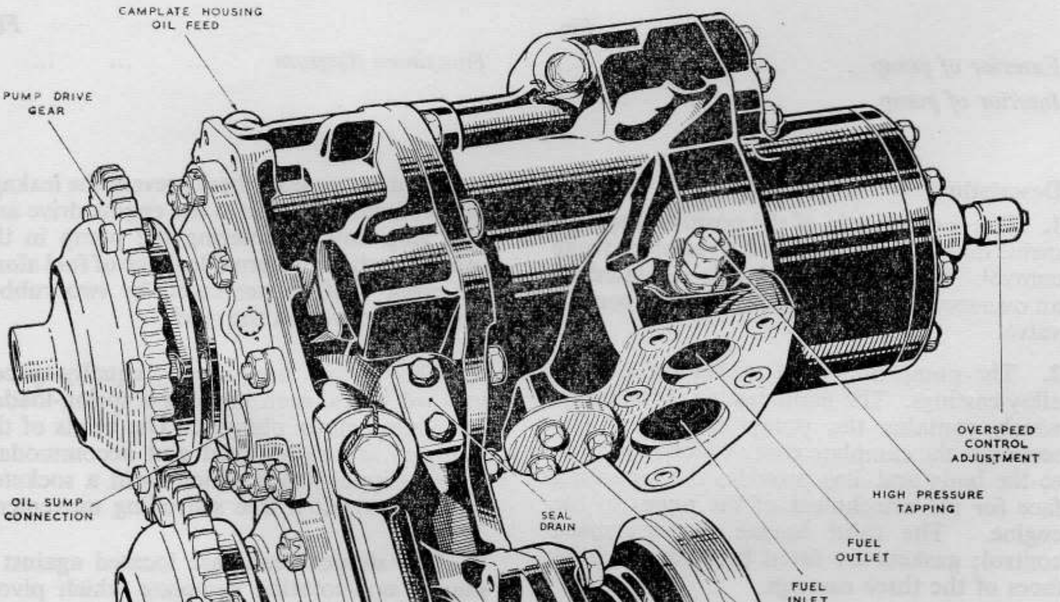

Fig. 1. Exterior of pump

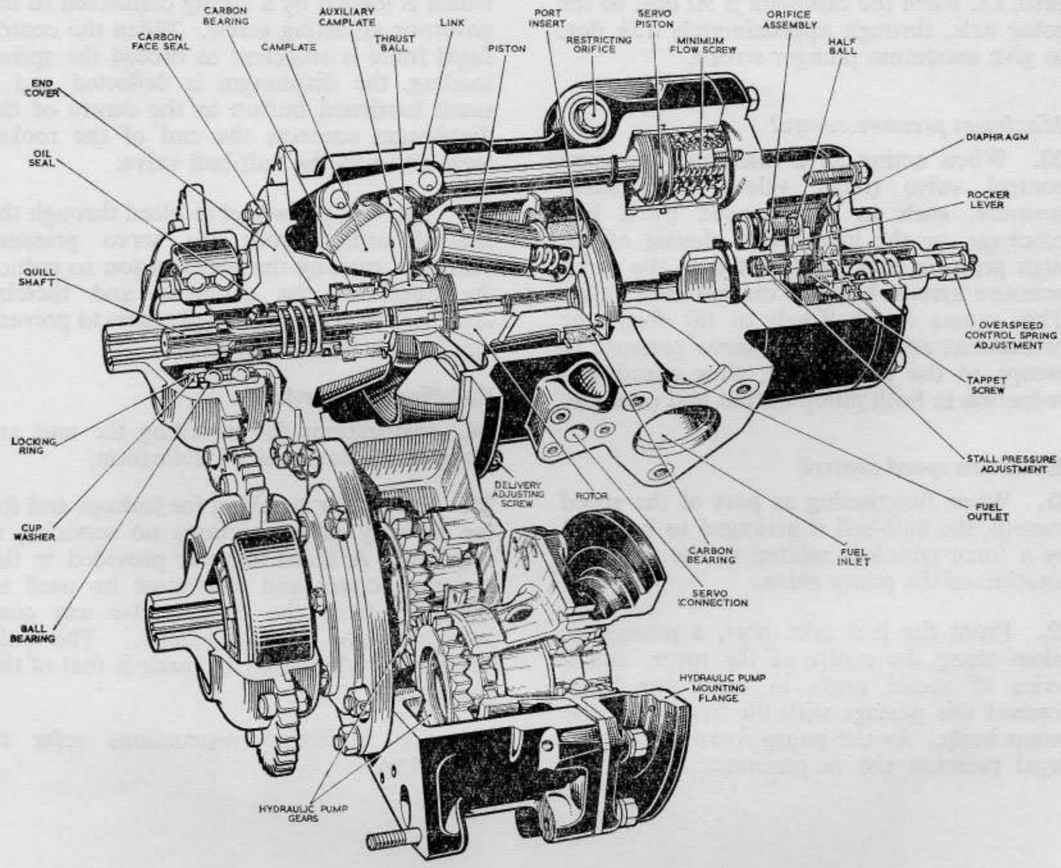

Fig. 2. Interior of pump

14. The length of stroke of the plungers, and therefore the output of the pump, is varied by altering the angle of the camplate. This angle is controlled through a rod and link by a servo piston.

Servo system

15. Fuel at pump delivery pressure is supplied to the underside of the servo piston and also, via a servo pressure restricting orifice, to the head of the servo piston. Three compression springs located at the head of the piston move this assembly to position the camplate at its maximum angle; this angle is set by a screw during calibration tests.

16. A bleed of servo pressure from the chamber above the piston head, passes through a control orifice and varies the pressure on the underside of the piston. This causes movement against the spring loading and progressively reduces the camplate angle.

17. The amplifier valve controls the bleed of servo pressure according to an excess speed or pressure signal. This assembly consists of a rocker lever with a half-ball valve at one end sealing a passage in communication with the servo pressure at the head of the piston. The other end of the rocker lever is depressed and deflected by the action of the speed control. The rocker lever is mounted on two pairs of cross torsional hinges.

18. During steady running conditions, the control orifice is just open, thus permitting a leakage of fuel at the same rate as the pressure is made up through the restricting orifice. This allows the servo piston to remain stationary and maintain a constant pump output.

19. Movement of the servo piston is arranged to control the camplate angle from zero, i.e. when the camplate is 90 deg. to the rotor axis, through approximately 15½ deg. to give maximum plunger stroke.

Maximum pressure control

20. When acting as a maximum pressure control valve (relief valve), any excess pressure, such as that caused by a line blockage, or the inadvertent closing of the high pressure cock, will be felt in the servo pressure system beneath the half-ball valve. This causes the half-ball to lift from the orifice seat and allows the servo pressure to escape to the pump inlet, thus effecting a reduction in both pump output and pressure.

Maximum speed control

21. When functioning as part of the speed control, the half-ball is arranged to be lifted by a force which is related to the speed of rotation of the pump rotor.

22. From the fuel inlet port, a passage is taken along the centre of the rotor, and a series of radial ports in the rotor body connect this passage with the interior of the pump body. As the pump rotates, a centrifugal pressure rise is generated within the pump body. This force is transferred through a drilling to one side of a flexible diaphragm which is loaded by a spring connected to the governor adjusting screw. When the centrifugal force is sufficient to exceed the spring loading, the diaphragm is deflected and a small hardened button in the centre of the diaphragm contacts the end of the rocker lever and lifts the half-ball valve.

23. This will allow fuel to bleed through the control orifice from the servo pressure chamber, causing the servo piston to reduce the angle of the camplate and thereby decrease the stroke of the plungers to prevent any further increase in speed.

Installing and servicing

24. Instructions for installing the unit are given in the engine Air Publication.

25. Except for checking for leakage and for the security of connections no servicing is required. A bleed valve is provided in the governor cover and this must be used to expel air from the system after any connections have been disturbed. The only adjustment which may be made is that of the governor.

26. For inhibiting instructions refer to A.P.4471A.

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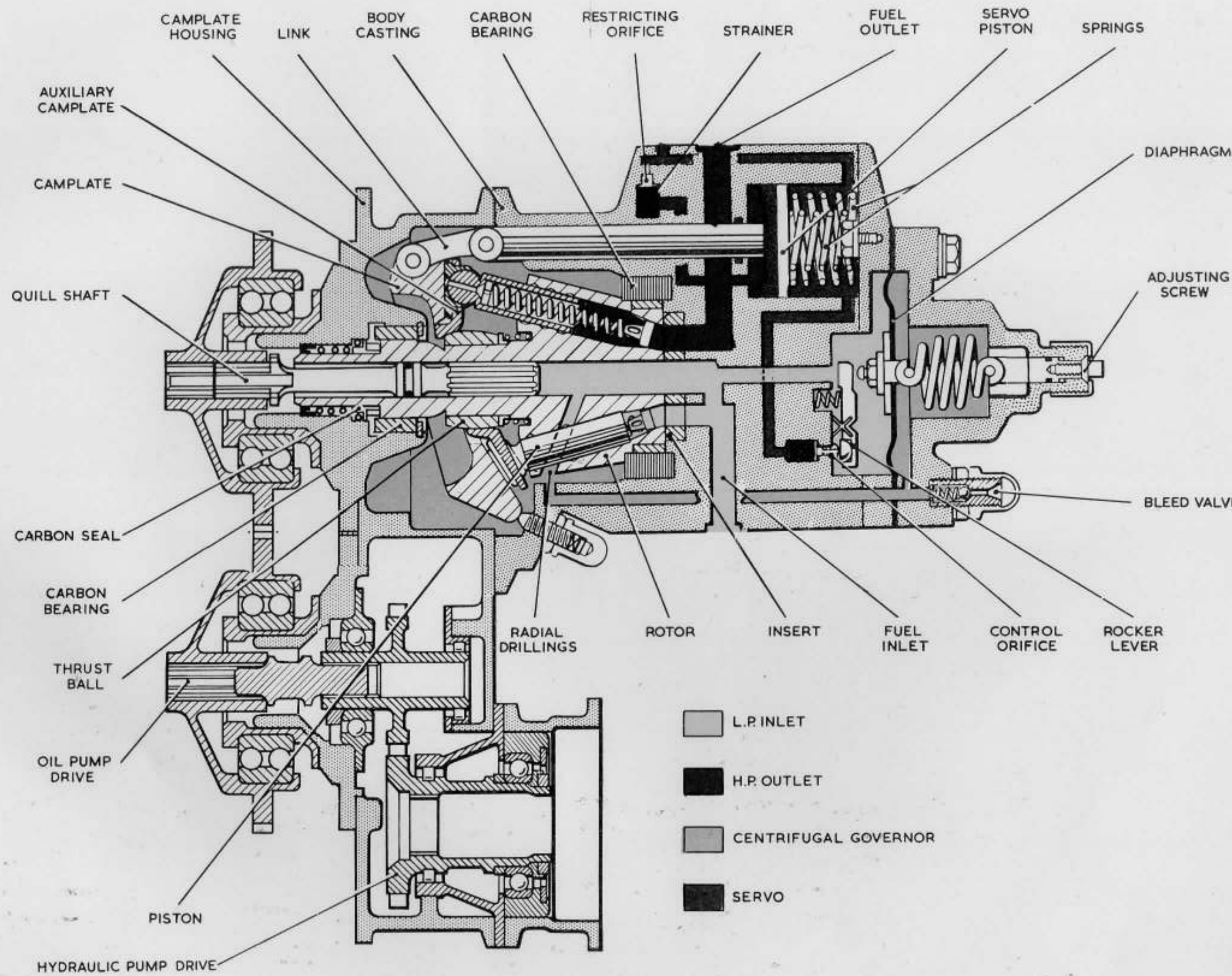

Fig.3 Functional diagram