Chapter 12

HIGH-PRESSURE FUEL PUMPS, TYPE MGBB SERIES

LIST OF CONTENTS

TABLE

LIST OF ILLUSTRATIONS

General

1. Whilst retaining the same working principles as the GBB type, this pump provides automatic governor control at increasing altitude and also, as the governor is of the hydro-mechanical type, it is unaffected by the fuel density.

2. To identify a pump by its type number and, using the MGBB.22/AZ as an example, MGBB.22 is the basic type number, the suffix number /11 indicates the particular installation requirements, and the letters AZ are the calibration code to which the pump must be tested after being repaired. Later units are given type numbers in the 100 range, e.g. MGBB.107. These do not have suffix numbers or letters but the installation and calibration changes are indicated by Mod. numbers on a modification plate attached to the pump unit. The major differences in the various types of MGBB pumps are given at the end of the chapter.

DESCRIPTION AND OPERATION

Pump

3. The body houses a rotor which is driven by a quill shaft and is supported at each end in carbon bearings. There are seven inclined cylinders in the rotor into which are fitted hardened steel plungers. The ends of the plungers protrude from their bores and are ball-shaped to fit the socketed slipper heads which engage a camplate. The camplate pivots in trunnions in its housing and its angle of inclination can be varied by a servo piston and linkage, from zero to maximum plunger stroke.

4. An auxiliary camplate, drilled to take the slipper shanks, supports the slippers in position against the camplate face. At its centre this camplate is pivoted on a hemispherical bush or thrust ball which is spring-loaded upon the stem of the rotor to absorb slight fore-and-aft play. The auxiliary camplate assists the plunger stroke, whilst its spring-loaded thrust ball eliminates chatter.

5. From the hollow interior of each plunger, a small hole is drilled through the ball-shaped head, to allow a cooling film of fuel to pass to the underside of the slipper. A fine hole in the centre of the slipper admits this graduated leakage to the bearing surface between slipper and camplate.

6. The plunger bores in the rotor terminate as seven ports in the flat face of the rotor, this face engages with a hardened insert, in which are kidney-shaped inlet and delivery ports. A pressure-tight seal is made by the rotor being pressed against the insert by the force exerted by the seven plunger return springs and by the fluid pressure acting upon

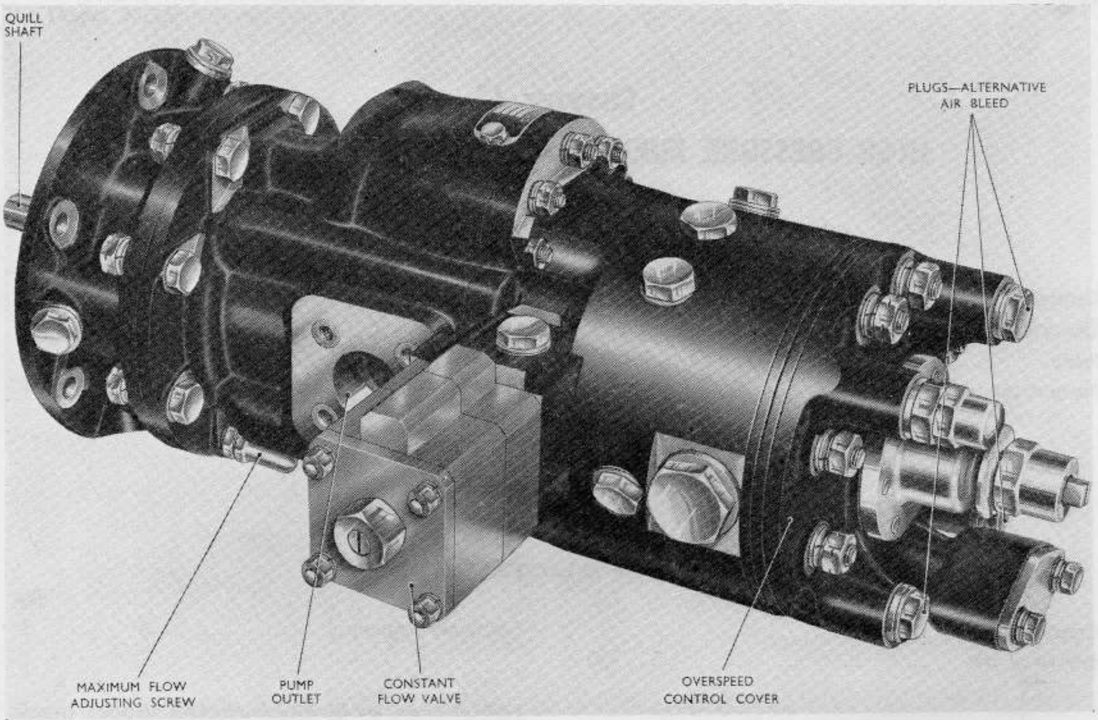

Fig. 1. Exterior of unit

the annulus formed by the stepped portion in the plunger bores. At normal pressure this force is the predominant one and gives a sealing force roughly proportional to the fluid pressure handled.

7. On the inlet stroke, the outward force upon each plunger is provided by both the return spring and auxiliary camplate and by centrifugal force acting along the inclined axis of the plunger. The pump is thus capable of functioning satisfactorily under an inlet depression.

Pump stroke control mechanism

8. Control of the pump is effected by a servo or relay-operated system. It comprises a piston operating in a cylinder against the loading of two helical springs. The piston rod is connected to the camplate and the springs are arranged to move the camplate into the position corresponding to maximum delivery. High pressure fuel from the delivery side of the pump is supplied to the underside of the control piston and via the restricting orifice to the chamber above the piston.

9. Movement of the piston is controlled by one or more control orifices, which are responsive to measured conditions defining engine requirements. When all control orifices are closed, the pressures on each side of the piston equalise by way of the restricting orifice. The spring force, assisted by the fluid pressure upon the extra area above the piston head now moves the piston to produce maximum plunger stroke, and thereby, maximum pump output. The opening of any control orifice allows fluid to escape from the chamber above the piston and the piston is moved against the spring loading to reduce pump delivery. During steady uniform running, the control orifices are just open, permitting a total leakage flow at the same rate as the slow rate through the restricting orifice, so that the servo control piston remains stationary.

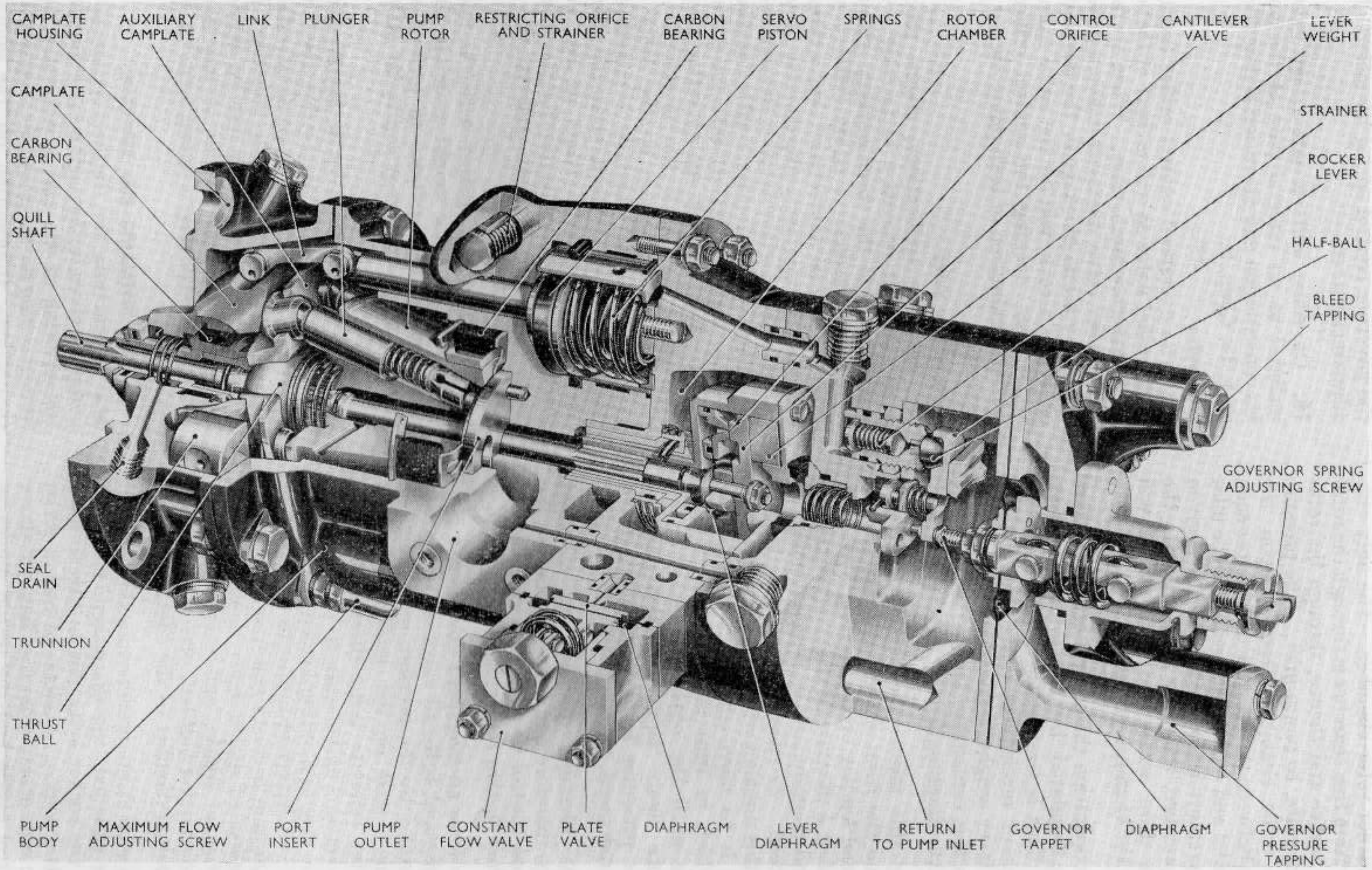

Fig. 2. Interior of unit

Hydro-mechanical governor

10. Fuel at pump delivery pressure is fed to the governor rotor chamber. The only outlet flow from this chamber is through the rotor control orifice and thence, through the rotor and face plate, to pump inlet. The pressure in the rotor chamber depends upon the balance between the pressure drop across each of the inlet and outlet orifices and as the inlet orifice pressure drop is constant for a given pump pressure, then any adjustment to the pressure drop across the rotor orifice will modify the chamber pressure.

11. In operation the control orifice pressure drop is regulated by the rotor cantilever valve. This is sensitive to speed under the influence of mechanical centrifugal loading on the lever weight. The chamber pressure opposes this centrifugal loading through the rotor lever diaphragm.

12. By this means the chamber pressure acting on the rotor diaphragm balances the centrifugal loading of the lever; the pressure is therefore a measurement of the centrifugal force and consequently is a measurement of rotor speed. As speed varies so the loading varies; this unbalances the forces on the lever causing it to move and modify the orifice flow, which in turn modifies the chamber pressure until the opposing forces on the lever are again equalised; the modified chamber pressures being a measurement of the altered speed.

13. The chamber pressure is a speed reference therefore and this is applied to the overspeed control or any other control unit in the fuel system requiring a speed term.

14. To form an overspeed governor, a control orifice and half-ball valve is arranged to be controlled by the pressure measuring the rotational speed of the hydro-mechanical rotor, this pressure being directed through drillings in the unit casing to exert a force upon one side of a spring-loaded flexible diaphragm. A hardened tappet in the centre of the diaphragm is set to rest upon the end of a spring-loaded rocker lever mounted upon cross-torsional hinges and carrying at the other extremity a half-ball plate valve which is the sealing member of the control orifice.

15. As soon as the predetermined maximum speed is attained, the diaphragm is moved against the rocker lever, tilting this to open the control orifice. Leakage of fuel at servo pressure now occurs from the chamber above the control piston and the piston moves to reduce the pump stroke, thus preventing any further increase in speed. The governor setting is adjusted by altering the loading of the governor control spring by means of the adjustment screw.

16. On some units a rate re-set valve is included as an integral part of the pump. Its construction and operation is described in Sect. 14, Chap. 3.

Relief valve

17. The overspeed control orifice functions as the relief valve as well as part of the overspeed governor mechanism. When operating as the relief valve, excessive delivery pressure caused by a line blockage or the inadvertent closing of a cock, will lift the valve from the orifice seat, opening the control orifice to effect a diminution of both pump output and pressure.

Constant flow valve

18. In some applications, engine requirements make it necessary to provide a constant flow into the rotor pressure governor chamber, regardless of pump delivery pressure. It will be appreciated that a common fixed orifice supplying pump delivery pressure to the rotor chamber will obey the square law, i.e. pressure consciousness with consequent pressure variations at altitude due to pump pressure changes. By incorporating a valve controlled by a fixed orifice on one side and pump delivery pressure on the other, the supply to the rotor chamber is regulated so that as pressure falls with increasing altitude the supply remains constant at any given speed setting, thus compensating for reduced pump delivery pressure effects on the governor characteristic.

19. This feature, together with the hydro-mechanical governor weight assembly which is insensitive to variations in fuel density, provides steady governor control at altitude conditions.

20. The valve comprises a small, spring-loaded diaphragm and plate valve, the setting of which is altered by the spring adjustment screw. As well as affecting governor characteristic the constant flow may be used as a means of operating a ram or any engine accessories requiring a speed term in their operation.

INSTALLING AND SERVICING

21. Instructions for the installation of the pump are given in the engine Air Publication. No servicing of the unit is necessary, apart from checking for leaks and for security of the connections. Information on the inhibiting of the pump is contained in A.P. 4471A.

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TABLE 1

Types of MGBB fuel pumps

Type	Remarks
MGBB 20	Basic MGBB pump.
MGBB 21	Integral shroud in governor, twelve serration quill-shaft and repositioned seal drain and air bleed.
MGBB 22	Kinetic valve replaced by half-ball.
MGBB 23	Modified bleed valve, shimmed trunnion blocks and no constant flow valve.
MGBB 24	Rate reset valve, integral shroud, twelve serration quill shaft and higher rated governor spring. No constant flow valve.
MGBB 25	Rate reset valve but no constant flow valve.
MGBB 26	Integral shroud, twelve serration quill shaft and kinetic valve replaced by half-ball.
MGBB 32	Pin-hinge in place of strip-hinge in governor.
MGBB 39	Changes in material for sealing rings and governor diaphragm to withstand higher fuel temperatures.
MGBB 100	Worm wheel self-locking adjuster for overspeed governor. Revised servo restricting orifice size. Deletion of governor pressure connection. Wire inserts inlet and outlet flange stud holes in pump body.
MGBB 104	Larger capacity pump. Integral rate-reset valve. Clicker type adjustment to overspeed governor. Modified double banjo to second seal drain connection.
MGBB 105	Integral rate reset valve. Higher rate stall valve spring with six slotted adjusting screws.
MGBB 107	Revised position of bleed with longer banjo pillar. Revised servo restricting orifice size. Worm wheel self-locking adjuster for overspeed governor. Steel wire inserts in inlet and outlet flange stud holes in pump body.
MGGB 108	As for MGBB 107 with different calibration details.
MGBB 110	Re-designed balance and governor weight. Deletion of governor pressure connection. Modified camplate housing face for engine attachment.
MGBB 115	Repositioned overspeed governor adjustment. Sliding joint connections.
MGBB 124	New carbon face seals together with lead in for seal in half-ball valve housing. C.F. tapping introduced into pump body.
MGBB 125	As for MGBB 124 with different calibration details.

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Table 1

Types of MGBB fuel pumps

Type	Remarks
MGBB.20	Basic MGBB pump.
MGBB.21	As MGBB.20 but with integral shroud in governor, twelve serration quill-shaft and repositioned seal drain and air bleed.
MGBB.22	As MGBB.21 but with kinetic valve replaced by half-ball.
MGBB.23	As MGBB.20 but with modified bleed valve, shimmed trunnion blocks and no constant flow valve.
MGBB.24	As MGBB.20 with rate reset valve, integral shroud, twelve serration quill shaft and higher rated governor spring. No constant flow valve.
MGBB.25	As MGBB.20 with rate reset valve but no constant flow valve.
MGBB.26	As MGBB.25 with integral shroud twelve serration quill shaft and kinetic valve replaced by half-ball.
MGBB.32	As MGBB.22 but with pin-hinge in place of strip-hinge in governor.
MGBB.39	As MGBB.23 but with changes in material for sealing rings and governor diaphragm to withstand higher fuel temperatures.
MGBB.100	As MGBB.26 with modified high pressure and rate reset valve connections.
MGBB.107	As MGBB.26 but with installation differences and mod. plate.
MGBB.108	As MGBB.26 but with installation differences and mod. plate.
MGBB.115	As MGBB.100 and installation features of MGBB.26 rate reset valve moved through 180°. Maximum pump-speed increased.

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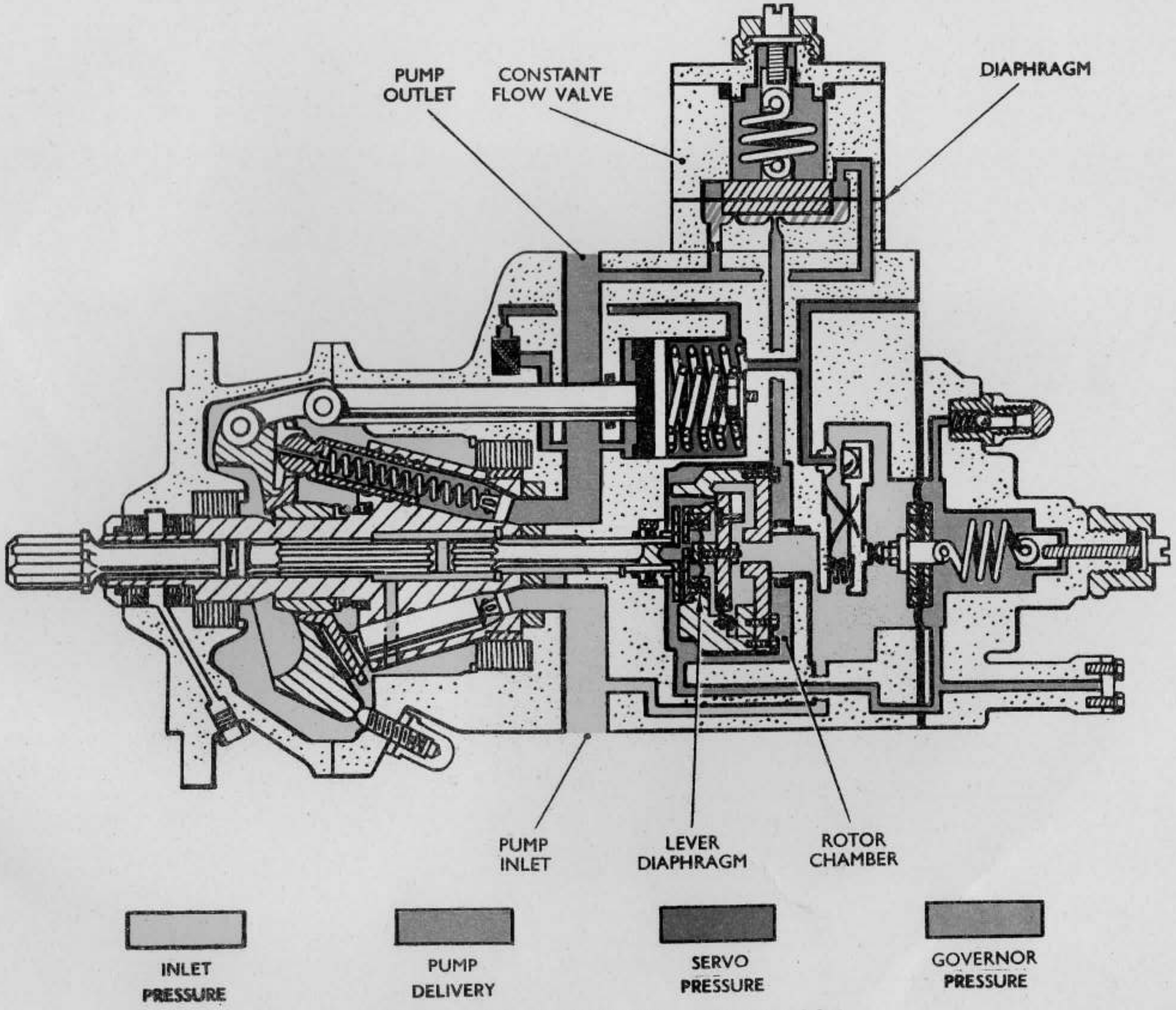

FIG.3 FUNCTIONAL DIAGRAM

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