Chapter 26

PUMP FUEL, FP3 SERIES

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Introduction

1. This chapter gives a general description of a typical pump in the FP3 series; information on particular marks of the pump is given as appendices at the end of this chapter. All the pumps are similar in design and are electrically driven by a 24V d.c. fractional horse-power motor through a gearbox giving a 4:1 reduction ratio. They are designed for in-line installation and can be used for various services including engine priming, throttle de-icing, and torch ignition for gas turbine engines.

2. The pump is of the positive displacement, sliding vane type and incorporates a relief valve which can be adjusted through a wide range of pressures; the delivery pressure settings for relief valves will vary for each mark of pump. The figures given in the appendices to this chapter are for general information only, the actual relief valve sett-

ings must be obtained from the relevant Aircraft Handbook.

DESCRIPTION

General

3. The pump comprises two main sub-assemblies, the motor unit, and the pump unit which includes the gearbox. A motor drive-end plate forms the lower end of the motor casing and is spigoted into the gearbox casing. Four 2 B.A. studs are screwed into the motor drive-end plate, and the pump unit is secured to the studs by 2 B.A. nuts and lockwashers. The lower end of the motor armature shaft extends through the drive-end plate, into the gearbox, and a driving pinion, which is pinned to the end of the shaft, engages an idler gear in the gearbox.

4. A mounting bracket and saddle assembly is clamped to the motor frame, by hinged straps and a clamp screw, to enable the pump to be mounted at any attitude between horizontal and vertical, provided the motor is above the gland level; the disposition of the pump inlet and outlet ports can be varied by rotating the pump or moving it longitudinally in the saddle.

Motor unit

5. The motor is a totally enclosed, flame-proof type, and has a long-shunt compound winding. It develops $\frac{1}{6}$ h.p. on 22 volts d.c. at 13000 r.p.m. and will operate satisfactorily under load at any voltage between 16 and 29 volts, with a maximum current consumption of 8 amp. The motor should not be run continuously under load for periods of more than 15 minutes.

6. The main body of the motor comprises four main parts, the driving-end plate, the yoke and field assembly, the commutator-end plate, and the brush gear with the brush gear cover. Two pillar bolts, which pass through the yoke, hold the end plates in position and at the commutator end, the pillar ends of the bolts are tapped to receive the screws securing the clamp plate and brush gear cover.

7. The armature is supported at each end in ball bearings which are housed in the motor end plates. The driving-end bearing is retained by a bearing washer secured to the driving-end plate by three countersunk screws and the inner race is clamped to the bearing seat on the armature shaft by a bearing nut. At the commutator-end, the bearing is retained by a washer, secured by a countersunk screw which is screwed into the end of the armature shaft. Both bearings are sealed types which are pre-packed with lubricant during manufacture; they cannot be re-lubricated during service.

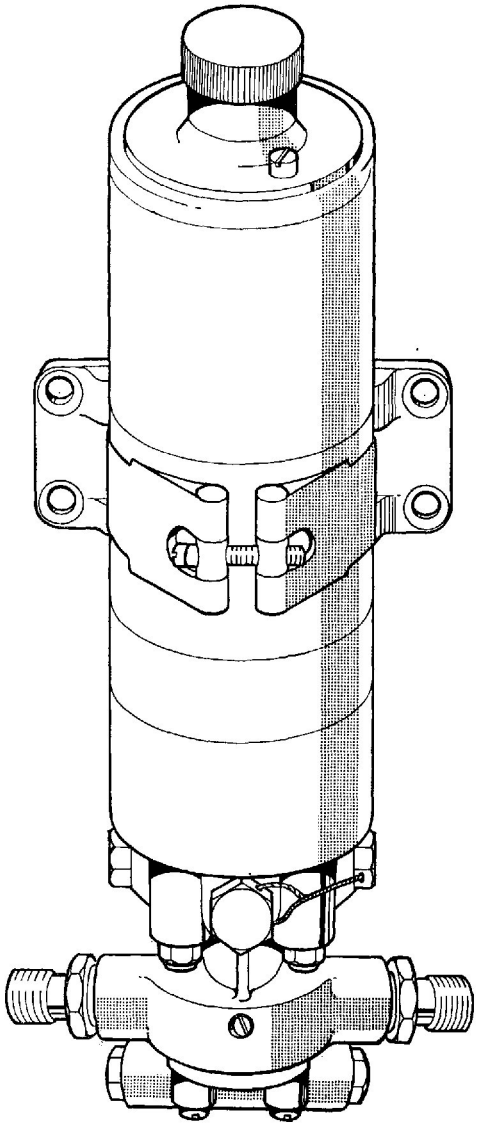

Fig. 1. General view of typical FP3 pump

8. The brush gear is designed as a complete unit and is secured by two screws which hold a Bakelite insulator to lugs formed on the commutator-end plate. Electrical connection to the motor is made through a four pin plug which projects from the centre of the brush gear cover; the plug moulding assembly is secured by two screws to the motor commutator-end plate.

Pump unit

9. The pump unit consists of the gearbox and a bearing housing, the gland seal, the pump, and the relief valve assembly ; on Mk.7 and Mk.13 pumps a filter assembly is fitted to the inlet port on the pump body.

Gearbox

10. The gearbox is positioned between the pump body and the motor. A bearing housing is located in the lower end of the gearbox casing to house the pump drive shaft bearing, and the lower bush of the idler gear assembly ; the upper idler gear bush is housed in a lug formed at the top of the gearbox casing. The idler gear is a compound gear which is used as an intermediate gear between the motor drive pinion and the drive shaft gear to provide a 4:1 reduction in the gear train.

11. A locating dowel is fitted between the bearing housing and the gearbox casing to ensure the correct alignment of the shafts. Self lubricating bushes are used for the idler gear, and a shielded type of bearing is used for the drive shaft ; gears and bearings are impregnated with lubricant during manufacture and require no lubrication during service.

Gland seal

12. Leakage from the pump into the gearbox is prevented by a face seal which is designed for use where a pressure feed to the inlet port is desirable, but the seal is equally effective under suction conditions and functions satisfactorily with inlet pressures between -6 lb/in^2 and $+20$ lb/in^2.

13. The inlet pressure assists the gland spring by imposing a small hydraulic load on the sealing face, and the seal is made between a rotating steel thrust plate and a stationary carbon washer ; the mating surfaces being lapped to a smooth, flat finish. The rotating steel thrust plate is driven by projections on the gland sleeve which is attached to the pump drive shaft ; the stationary carbon washer is located in the pump body.

14. The gland sleeve also houses the gland spring, a gland plate and a gland seal which seals the bore of the gland sleeve and prevents leakage past the back of the thrust washer. A drain port with a $\frac{1}{8}$in. B.S.P. connection is provided to drain away fluid that may leak past the seal.

Pump

15. The pump consists of an aluminium housing with an eccentric bore which is fitted with a hardened meehanite sleeve. A rotor with four equally spaced sliding vanes is rotated within the sleeve by the pump driving shaft, driven by the motor through the reduction gearbox. A centre pin retains the inner ends of the vanes in position within the rotor.

16. An inlet, and an outlet port in the pump body are both tapped to receive pipe connection unions; on Mk. 7 and Mk. 13 pumps a filter assembly is fitted to the inlet port. Above the inlet and outlet connections, four tapped bosses are provided in the body casing, surrounding the gland seal. A drain union and pipe can be fitted to any one of these bosses, according to the installation attitude of the pump, and the remainder are blanked off.

17. Four studs, which are screwed into the motor drive-end plate, pass through the gearbox casing and upper part of the pump body, and four 2B.A. nuts with lockwashers are fitted to the studs, external to the pump body, to secure the pump unit to the motor unit.

Relief valve assembly

18. The spring-loaded relief valve is contained in an end cover secured to the lower end of the pump body by four cheese-head 4 B.A. screws; two dowels are fitted between the relief valve body and the pump body to ensure correct alignment between the two parts. A housing is formed in the relief valve body for a bush which supports the lower end of the rotor and a drilling connects the bush housing with the relief valve housing. In the event of excessive build up of inlet pressure, the pressure of fluid on the valve causes it to open and allows fluid to flow through the drilling to the relief valve housing and then through another drilling to the outlet port in the pump body.

19. The relief valve consists of a valve, valve spring, adjusting screw, an adjuster and a locknut. The adjuster which is provided with a screwdriver slot, has a small flange which locates against the relief valve housing ; a stem on the adjuster engages the adjusting screw which is screwed into a threaded part of the valve housing. When the adjuster is turned, the adjuster stem screws the adjusting

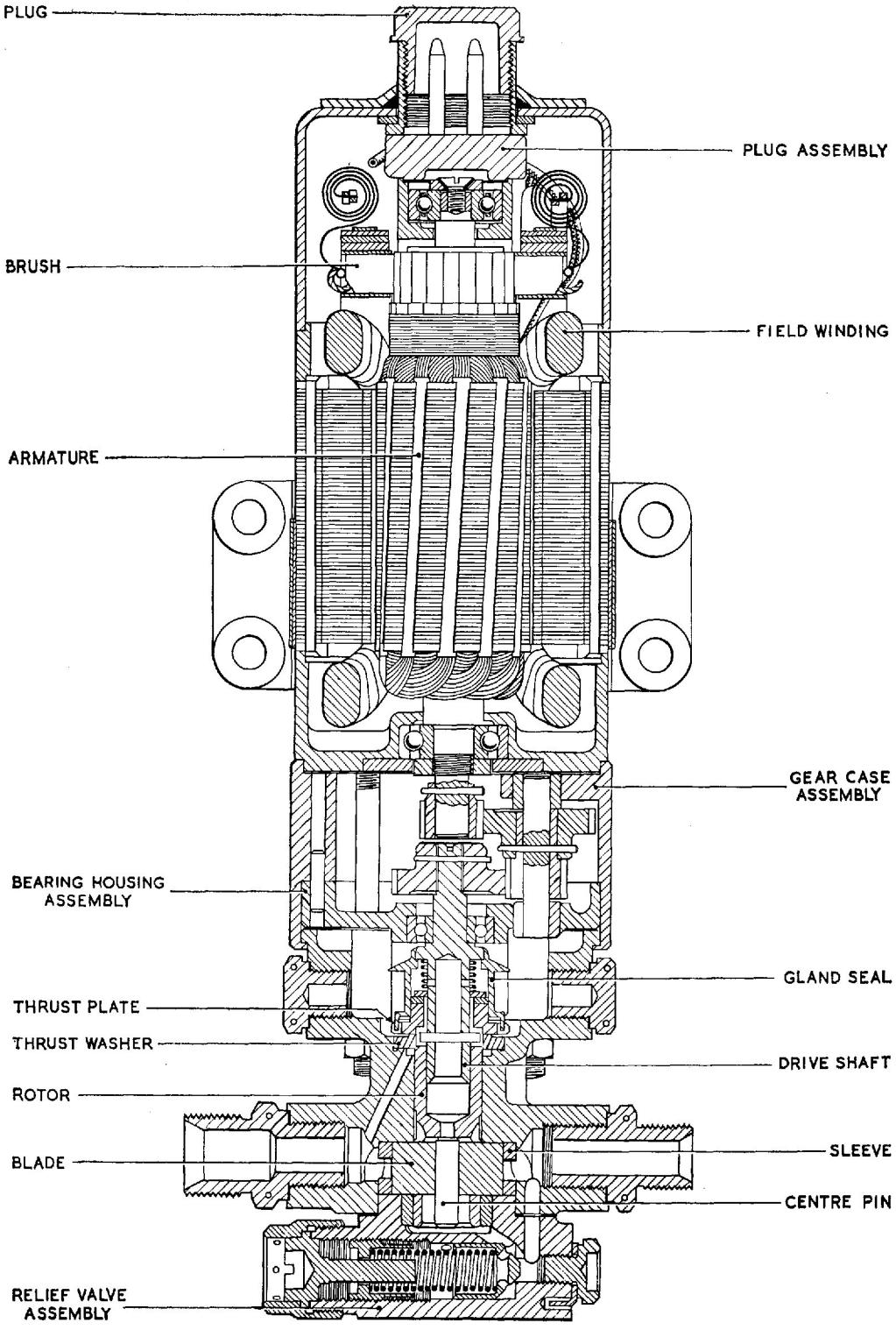

Fig. 2. Sectional view of typical FP3 pump

screw in the housing and increases or decreases the pressure of the spring on the valve, according to the direction in which the adjuster is turned. When correctly set, the locknut is tightened to clamp the flange of the adjuster against the valve housing and prevent further rotation ; a gasket is fitted between the adjuster flange and the relief valve housing to prevent leakage of fluid past the adjuster.

INSTALLATION

Preparation

20. Remove the dust covers from the inlet and outlet unions, the drain connection and the electrical connection. Check the position of the drain union and the size of the inlet and outlet unions to ensure that they agree with the requirements for the particular installation ; the relevant Aircraft Handbook should be studied for details of the requirements.

21. Check the pump for operation by connecting the motor temporarily to a 24V d.c. supply and taking a reading of the current consumption. A few drops of engine oil should be injected into each port before switching on the motor ; the pump should start instantly and the current consumption should not exceed 8 amp. If the pump does not operate freely, it must be rejected as unsatisfactory.

Note . . .

Pumps that have been inhibited should be flushed out with gasoline before being subjected to a starting test.

Installation

22. Determine the attitude required for the pump, by referring to the relevant Aircraft Handbook, and, if necessary, slacken the clamping screw on the mounting saddle strap, then turn the pump in the saddle bracket or move it longitudinally to obtain the correct setting for the mounting bracket. The pump should be mounted so that the motor is always above the level of the seal gland.

23. Ensure that the bore of the inlet and outlet piping is correct for the service for which the pump is required ; the correct size unions should be fitted as standard according to the Mark of pump. Connect the drain pipe to the lowest drain connection union and ensure that the remaining drain outlets are fitted with blanking plugs.

Electrical connections

24. The electrical connection plug is provided with two sizes of pins, two large and two small, which are commonly connected internally to permit the use of either size. Breeze sockets CZ 10340/2 or 3 (Ref. No. 5X/108), or, CZ 10340A/2 or 3 (Ref. No. 5X/167) must be used for the connection.

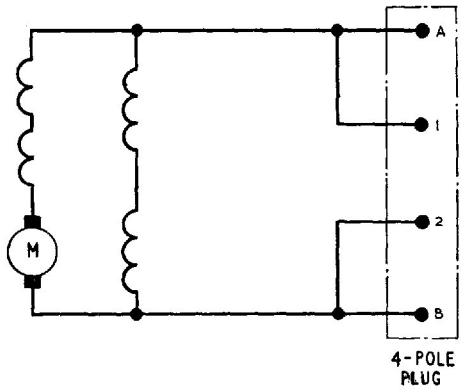

Fig. 3. Circuit diagram

Delivery pressure adjustment

25. If the delivery pressure is not correct, unlock and slacken the locknut on the pressure relief valve, then use a screwdriver to turn the adjuster ; clockwise rotation increases the pressure and counter-clockwise rotation reduces the pressure. The pressure must not be adjusted while the pump is running.

Final checks

26. When the installation of the pump has been completed, a final check should be made to ensure that the electrical connections are made correctly, all pipe connections are tight, the mounting saddle clamping screw is tight, the relief valve locknut is tight, and that all locking wires are secured correctly.

SERVICING

General

27. The following information is of general nature only and overriding instructions may be issued by orders, or by instructions in relevant Aircraft Servicing Schedules. The periods for inspections of the pump will de-

pend largely upon the nature of the operational service on which the aircraft is engaged, and the services for which the pump is installed.

28. Any failure of internal mechanism will be indicated immediately by erratic performance of the pump or excessive leakage from the gland, and there is no need to dismantle any part of the pump for internal examination as long as it functions satisfactorily. In the event of excessive current consumption, low delivery or delivery pressure failure, the pump should be removed and forwarded to an appropriate repair depot for complete servicing.

29. Inspection of the pump in situ should be confined to an electrical test to check current consumption and visual examination for leaks, security of connections and locking devices. If there is an indication of leakage from the inlet or outlet connections the fault may be rectified by tightening the connections or renewing the inlet or outlet union gaskets.

REMOVAL

General

30. Each pump is fitted with a mounting bracket and strap which is part of the pump. After removing a pump from an aircraft, the mounting bracket must be secured to the pump to ensure that the parts remain together during transit in the event of the pump being despatched for servicing.

Prevention of corrosion

31. Pumps which are to be left in a drained condition for more than three days, including pumps that are being forwarded to Stores or to Servicing bays, must be inhibited to prevent corrosion and subsequent failure resulting from corrosion. The inhibiting procedure is as follows :—

(1) Disconnect the inlet and outlet pipes.

(2) Flush the pump with gasoline.

(3) Run the pump for four or five seconds whilst injecting inhibiting oil, DEF.2181 (OX.275) in the inlet port.

(4) Screw dust covers on to the inlet and outlet unions.

(5) Protect the motor plug with the special plug cap provided for this purpose.

Note . . .

Before pumps, that have been inhibited, are re-issued for use, they should be flushed out with gasoline.

Appendix 1

PUMP FUEL, FP3, Mk.3 AND Mk.7

LEADING PARTICULARS

FP3, Mk.3	**Ref. No. 5UE/4698**
FP3, Mk.7	**Ref. No. 5UE/5057**
Application	*Engine priming*
Nominal voltage	24 *volts d.c.*
Nominal current	6 *amp.*
Delivery pressure	75 *lb/in²*
Delivery rate	1,600 *c.c./min.*
Fuel	*Gasoline*
Motor unit	*CV* 7305
Brushes	
Length new	0·335/0·375 *in.*
Length (min. permissible worn)	0·250 *in.*
Weight of complete unit	
FP3, Mk.3	4¼ *lb.*
FP3, Mk. 7 (with filter)	4½ *lb.*
Operating limitation	*Maximum operating period under full load* 15 *min.*
Dimensions	
Overall length	10·00 *in.* (25·4 *cm.*)
Pump casing (diameter)	2·56 *in.* (6·50 *cm.*)
Overall width (inlet to outlet unions)	3·95 *in.* (10·03 *cm.*)
Length of filter (Mk.7 only)	3·11 *in.* (7·90 *cm.*)

General

1. Both Mk.3 and Mk.7 pumps are used for engine priming They are identical in design and performance, with the exception that Mk.7 pumps have through-flow, low-loss filters fitted to the inlet unions.

2. The data given above is based on a nominal performance, Aircraft specifications may require different relief valve settings and the actual settings must be obtained from the relevant Aircraft Handbook.

Appendix 2

PUMP FUEL, FP3, Mk.4

LEADING PARTICULARS

FP3, Mk.4	**Ref. No. 5UE/4699**
Application	*Torch igniter*
Nominal voltage	24 *volts d.c.*
Nominal current	6 *amp.*
Delivery rate	4,000 *c.c./min.*
Fuel	*Kerosine*

General

1. The FP3, Mk.4 pump is intended for torch ignition of gas turbine engines. It is similar to the pump described in the basic chapter and the Leading Particulars, except for the data given above, are the same as given under App.1 for Mk.3 pumps

2. The pressure figures given are for information only; actual settings must be obtained from the relevant Aircraft Handbook.

Appendix 3

PUMP FUEL, FP3, Mk.5

LEADING PARTICULARS

FP3, Mk.5	**Ref. No. 5UE/4700**
Application	*Throttle de-icing*
Nominal voltage	24 *volts d.c.*
Nominal current	6 *amp.*
Delivery rate	4,100 *c.c./min.*
Delivery pressure	15 *lb./in²*
Fuel	*Alcohol*

General

1. The FP3, Mk.5 pump is used for throttle de-icing of gas turbine engines. It is similar to the pump described in the basic chapter and the Leading Particulars are the same as the Mk.3 given under App.1, except for the data given above.

2. The pressure figures given are nominal figures, for information only; actual settings must be obtained from the relevant Aircraft Handbook.

Appendix 4

PUMP FUEL, FP3, Mk.9

LEADING PARTICULARS

FP3, Mk.9	**Ref. No. 5UE/6294**
Application	*Engine filter de-icing*
Nominal voltage	24 *volts d.c.*
Nominal current	6 *amp.*
Delivery pressure	75 *lb./in²*
Delivery rate	1,000 *to* 1,200 *c.c./min.*
Fuel	*Methanol*

General

1. The FP3, Mk.9 pump has been designed for engine filter de-icing and is basically a Mk.3 pump with a modified relief valve. It is similar to the pump described in the basic chapter and the Leading Particulars, except for the data given above, are the same as in App.1 for Mk.3 pumps.

2. The pressure figures given are nominal figures for information only; actual settings must be obtained from the relevant Aircraft Handbook.

Appendix 5

PUMP FUEL, FP3, Mk. 13

LEADING PARTICULARS

FP3, Mk.13	**Ref. No. 5UE/**
Application	*Fuel filter de-icing*
Nominal voltage	24 *volts d.c.*
Nominal current	6 *amps.*
Delivery pressure	39 *lb./in²*
Delivery rate	2385 *c.c./min.*
Fuel	*Methanol*

General

1. The FP3, Mk.13 has been designed for fuel filter de-icing and has been fitted with the same type of inlet filter as used on Mk.7 pumps. The relief valve is the same as used on Mk.4 pumps and in all other respects it is similar to the pump described in the basic chapter ; the general data will be the same as given in App.1 for Mk.7 pumps.

2. The performance figures given above are nominal figures for information only ; actual settings must be obtained from the relevant Aircraft Handbook.

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