Chapter 6

PUMP, FUEL, PUL 2001, Mk. 1

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Pump, fuel, PUL 2001, Mk. 1	Stores Ref. 5UE/5546
Fuel delivery rate	2,000 gallons per hour
Fuel delivery pressure	11 lb. per sq. in.
Nominal voltage	26 volts d.c.
Voltage limits	22 to 29 volts d.c.
Nominal load	22 amp.
Weight	20 lb.
Breeze plug CZ2750/2 (2-19 amp. pins)	Stores Ref. 5X/4007

Introduction

1. The PUL 2001, Mk. 1 fuel booster pump is of the immersed type, arranged for side mounting within the drop tank for certain types of aircraft.

2. The pump, which is electrically driven, and self contained, operates at 26 volts d.c., and is designed to maintain the fuel supply from the aircraft fuel tanks, to the inlet side of the engine driven pump, under all conditions of fuel temperature, rate of climb, altitude, etc., which can be experienced in flight.

3. The whole of the pump is immersed in the fuel, except the electrical connection gland drain connector and the ventilation inlet and outlet for circulating cooling air to the motor.

DESCRIPTION

4. A general view of the pump is shown (*fig.* 1), and consists mainly of 4 parts, i.e., the motor fuel sealing canister, the pump body, or portway casting, the pump base, and the special fuel delivery outlet. These main units, with their assemblies, when fitted together, form the complete pump.

5. The driving motor is supported in the upper end of the pump, and is protected from the ingress of fuel by a flanged, inverted canister, which, with its fuel tight washer, is secured to the upper flange of the portway casting, by twelve screws, and spring washers. The lower flange of the portway casting is secured to the upper flange of the pump base casting by eight

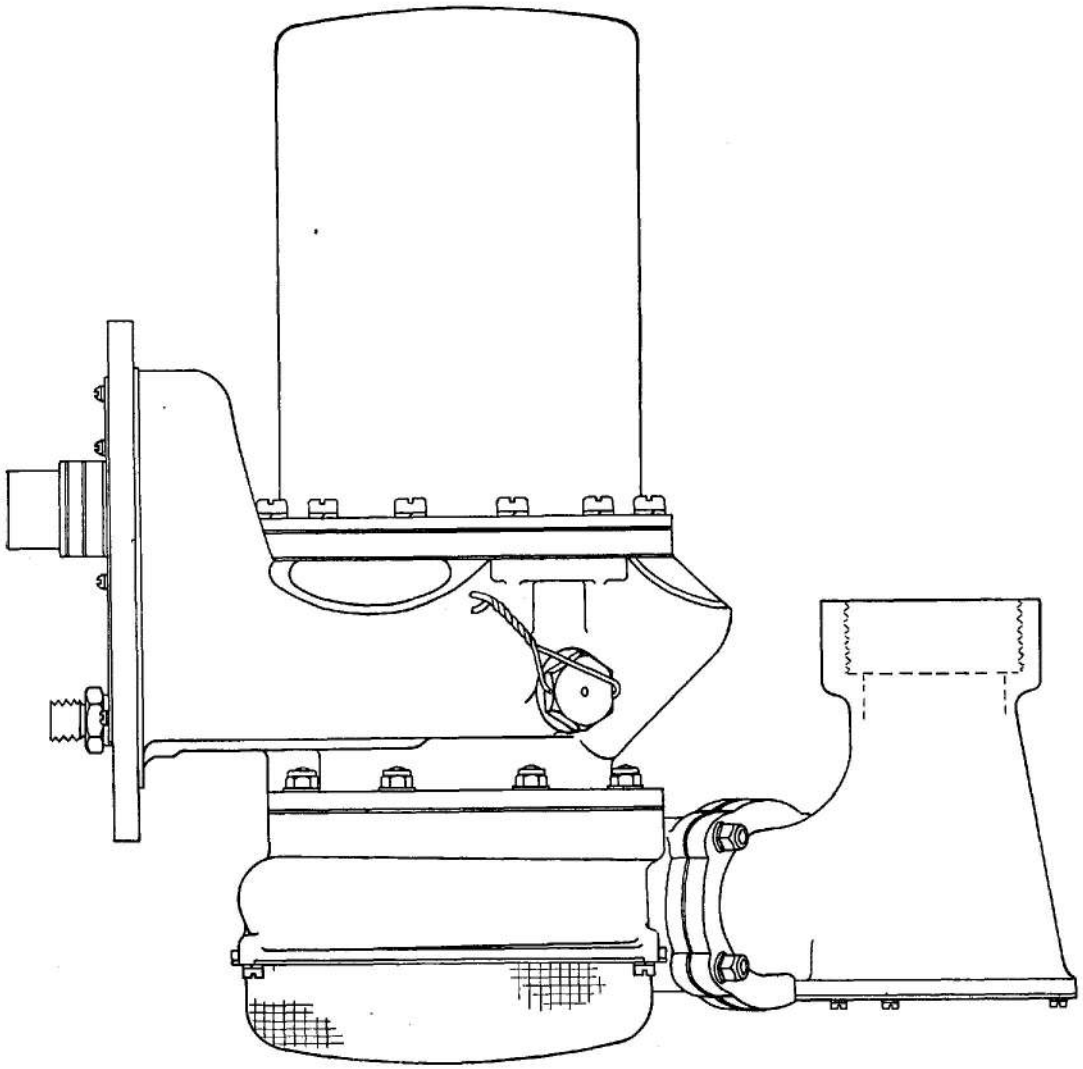

Fig. 1. General view of pump

nuts and spring washers, together with a fuel-tight washer.

6. The portway casting has a side flange; this flange, which supports the complete pump, is secured to the flanged hole in the side of the tank, sixteen $\frac{7}{32}$ in. clearance holes being provided for this purpose. Two $\frac{1}{4}$ in. tapped holes, diametrically opposite, in the side flange, are also provided for starting screws, when it is necessary to remove the pump from the tank wall.

7. A machined boss in the pump base side flange orifice holds the electrical plug connection for input to the motor.

Motor

8. The driving motor is a two-pole, series wound, flame-proof, and fan-cooled machine, designed to operate on 26 volts d.c.

9. The motor comprises an armature and commutator of the high speed type, the shaft of which, is supported at each end in grease shielded ball bearings, lubricated with high melting /low freezing point grease. The bearings are housed in their respective end frames of the motor body; the centre, or yoke, contains the motor field windings. The end frames together with the yoke are held together by two through bolts, which pass, via the yoke, from one end frame to the other.

10. The commutator-end frame houses the commutator and brush-gear, twin sets

of special high altitude brushes being fitted. A six-bladed ventilating fan, which circulates cooling air through the interior of the motor, is pegged to the commutator-end of the motor shaft, and is locked to the shaft, together with the commutator-end frame, by a self-locking nut, and locking washer.

11. The drive-end is secured to the motor shaft by a twiclip, which is sprung into a groove, the tension on the twiclip being adjusted by two distance washers. A slinger, or special shaped washer, is provided, to prevent fuel seeping to the motor lower bearing.

Portway casting

12. The portway casting, upon which the motor is mounted, comprises two circular ends, separated by cored-out pillars, which act as ducts for the fuel delivery outlet, gland drain, and ventilation to and from the motor.

13. A circular side flange, formed in the design of the casting, secures the pump to the mounting orifice in the side of the tank, also providing the pump fittings, which extend to atmosphere (para. 3).

Pump base casting

14. The pump base is designed to hold the

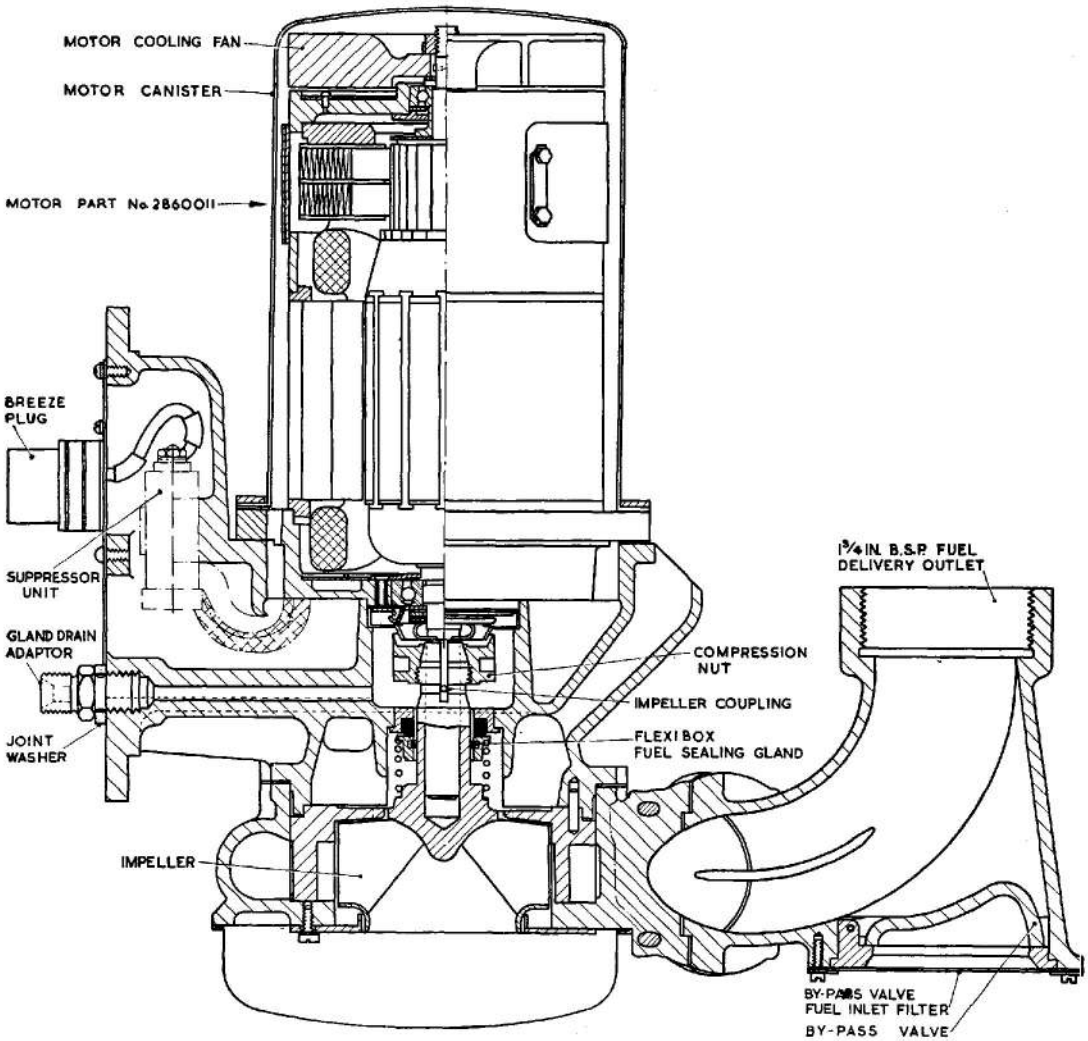

Fig. 2. Sectional view of pump

impeller, which is secured to the lower end of the motor shaft extension. The pump casting is shaped at its centre to form a volute chamber, in which the impeller rotates. A special fuel delivery outlet, is secured to a machined boss, which is an extension in the side of the pump base.

Fuel delivery outlet

15. The special $1\frac{3}{4}$ in. B.S.P. fuel delivery outlet casting which also contains the by-pass valve, is so designed to take the pump outlet, through the top of the tank.

Flexibox fuel sealing gland

16. This type of fuel sealing gland is an improvement on the bellows gland, its sealing qualities being based on a carbon ring, fitted to the rotating impeller sleeve. The carbon ring, as it rotates, rubs against a stationary steel lapped face of the valve interior, and is held by a spring at a predetermined pressure, thus preventing fuel from seeping through to the motor lower bearing. The valve is located around the armature shaft, immediately between the motor and the impeller.

By-pass valve

17. The fuel inlet for the by-pass valve is separate from the main fuel inlet, and is located in the base of the special fuel delivery outlet casting. When the pump is idle, the by-pass valve opens, allowing fuel to pass through the delivery outlet, from the tank, to the inlet side of the engine driven pump, without passing through the main fuel inlet to the pump.

Filter

18. A domed, gauze filter is fitted at the fuel inlet, in the pump base, to prevent the ingress of foreign matter from the tank, to the interior of the pump.

Suppressor unit

19. A suppressor unit, comprising two $2\mu F$ capacitors, to combat radio interference is fitted on a small bracket, immediately behind the electrical plug connection, for ease of maintainance.

Impeller

20. A new type impeller, of light alloy, designed to give maximum performance at high altitudes, and having ample provision for vapour dispersion, is used in conjunction with a fuel diffuser surrounding the impeller vanes. The impeller is secured to the motor shaft by means of a slotted cone nut collet coupling device, similar to a chuck in operation, which, when tightened up, grips the driving shaft. To avoid the possibility of the impeller slipping round the shaft, the coupling is provided with a small shouldered pin, passing through a hole bored at right angles to the shaft (*fig.* 2). When the impeller is assembled over the shaft, the pin passes down any one of the four slots cut in the impeller hub, until the impeller is in its correct axial position, i.e., when the tips of the impeller blades are flush with the suction cover. The motor extension shaft enters a blind hole in the impeller hub, to prevent fuel by-passing the gland from the inlet side. The periphery of the impeller runs in the bore of the suction cover with a coarse running clearance, to reduce pressure leakage, but, at the same time, to permit the escape of vapour and air back to the suction space.

OPERATION

21. The impeller, driven at motor speed, accepts fuel from the tank, and, as the pressure builds up, forces it by way of the impeller chamber to the pump delivery outlet, and thence to the fuel line.

22. Under conditions when the pump is supplying fuel in excess of engine requirements, the impeller continues to rotate, but the pressure is maintained within predetermined limits.

23. The type of impeller used in the pump ensures maximum performance of the pump, under conditions of sudden, and rapid de-aeration, due to high rates of climb, and other manoeuvres. It also assists in quick recovery from vapour locking, caused by the temporary removal of fuel from the vicinity of the impeller.

INSTALLATION

24. When fitting a new pump, ensure that the fuel tank has been emptied, before removing the old pump, by easing off the joint of the fuel delivery pipe. If there is any fuel left in the tank, it will have a free passage through the by-pass valve, which is open when the pump is idle.

25. When it is certain that the tank is empty, disconnect the fuel delivery pipe, and the electrical supply from the Breeze plug connection. Next, remove the studs and associated nuts and washers securing the pump to its seating on the side of the

fuel tank, and carefully withdraw the pump from the tank. Suitable bolts screwed into the two $\frac{1}{4}$ in. B.S.F. tapped extractor holes provided in the pump flange will assist in this operation.

26. Before fitting the new pump, make sure that it is clean externally, and that any adhesive tape or plugs serving as protection over the pump apertures have been removed. In addition, ensure that the jointing ring on the mounting flange of the pump is in good condition. Insert the pump through the reinforced flanged hole in the fuel tank, and tighten up the securing nuts, with their associated washers, to the studs which are provided for securing the pump to the tank.

27. To ensure that the pump is free from foreign matter, prior to finally connecting the fuel supply pipes, the electrical supply cable should be connected to the pump, and the motor switched on. A small quantity of fuel put into the tank will be delivered by the pump into a suitable receptacle, and in passing through the pump the fuel will carry any impurities with it. When this has been done the pump outlet may be connected with the fuel supply line.

28. When received from Stores the gland drain exit will be fitted with a plug. When the pump has been installed, and tested, this plug should be removed, and a drain pipe fitted. This pipe should be installed in such a manner that the level of the pipe is at no point higher than the connection, when the aircraft is on the ground, or in level flight. The outlet end of this pipe must be external to the aircraft, and should terminate in a low pressure area. The end of the pipe should be cut at 45 degrees with the chamfer facing aft. Failure to fit this pipe may result in fuel, which may have seeped through the flexibox gland, washing away the grease from the motor lower bearing, and may cause possible failure of the bearing.

Note . . .

In all instances where any doubt exists with regard to the method of installing or removing a pump from the aircraft, reference should be made to the appropriate Aircraft Handbook.

SERVICING

Electrical test

29. A routine electrical test must be made

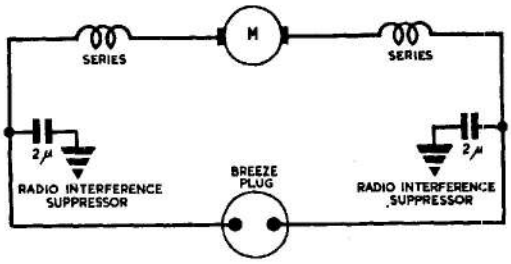

Fig. 3. Circuit diagram

to ascertain that the motor of the fuel pump is operating correctly. ENSURE THAT THE PUMP IS IMMERSED IN FUEL, WHEN THESE TESTS ARE IN PROGRESS.

30. Having ascertained the position of the aircraft fuel pump test socket and switches, by reference to the appropriate Aircraft Handbook, proceed as follows :—

(1) Close all fuel cocks between pumps and engines to ensure that no fuel can flow.

(2) Connect a suitable portable ammeter to the socket on the test panel.

(3) Switch on the pump by pressing the switch on the test panel, NOT THE NORMAL FUEL PUMP SWITCH, for a period of not less than half a minute.

During this period the current consumption of the motor should be noted, and the readings, as registered by the ammeter, should be interpreted as follows :—

(a) A steady reading of not more than 24 amp. indicates that the motor is satisfactory.

(b) A reading in excess of the figure given in (1) indicates that the pump motor is faulty.

(c) A fluctuating reading indicates faulty contacts, defective brushes, or faulty commutator.

(d) A zero reading is consistent with, either a blown fuse, defective wiring or switch, or complete motor failure.

31. When these tests have been satisfactorily completed, release the test switch, and disconnect the ammeter from the test socket.

Operational test

32. When the electrical tests have been completed, the pump should be tested to observe the pressure of fuel being delivered. The pressure should be 10 lb. per sq. in. minimum. If this pressure is not obtained, the fault may probably be traced to a damaged impeller, or incorrectly loaded flexibox gland.

Routine inspection

33. When examining the pump at the appropriate inspection periods, care must be taken to conform with the following points :—

(1) Examine the fuel outlet pipe coupling, and Breeze plug connection for fuel tightness.

(2) Test the pump as detailed in para. 29 to 32. If the pump is found to be faulty it must be returned to Stores, and a replacement fitted.

(3) Ensure that the by-pass valve is functioning correctly. To do this, turn on the tank selector cock and the appropriate engine master cock. then switch on the pump and observe the fuel pressure, as indicated by the fuel pressure gauge or fuel pressure warning light. Very low pressure, or failure to extinguish the warning light, indicates that the by-pass valve is not operating correctly. In certain installations the fuel pressure warning light is set to operate at a pressure higher than that which the pump can deliver. Therefore, observe the light setting before rejecting a suspected pump. The pump is unlikely to be defective if it delivers fuel at a pressure in excess of 10 lb. per sq. in.

34. At the periods laid down in the appropriate Servicing Schedules, all faulty pumps are to be replaced by new, or reconditioned pumps drawn from Stores. Old pumps are to be returned to the Manufacturers for reconditioning.