Chapter 4

PUMP, FUEL, FB 6, Mk. 3

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Pump, fuel, FB 6, Mk. 3	Stores Ref. 5UE/4986
Delivery rate	200 gallons per hour
Delivery pressure	10 lb. per sq. in.
Operating voltage	24 volts d.c.
Normal current	7 amp.
Cable connection (Breeze 2-pole plug CZ76498)	Stores Ref. 5X/6720
Weight	7½ lb.

Introduction

1. The Type FB6, Mk. 3 pump is electrically operated and is used to maintain the supply from aircraft fuel tanks to the inlet of the engine-driven fuel pumps during aerobatics or when fuel temperatures are high. Although primarily intended for use as booster pumps they may also be used to transfer fuel from an auxiliary to a main fuel tank.

DESCRIPTION

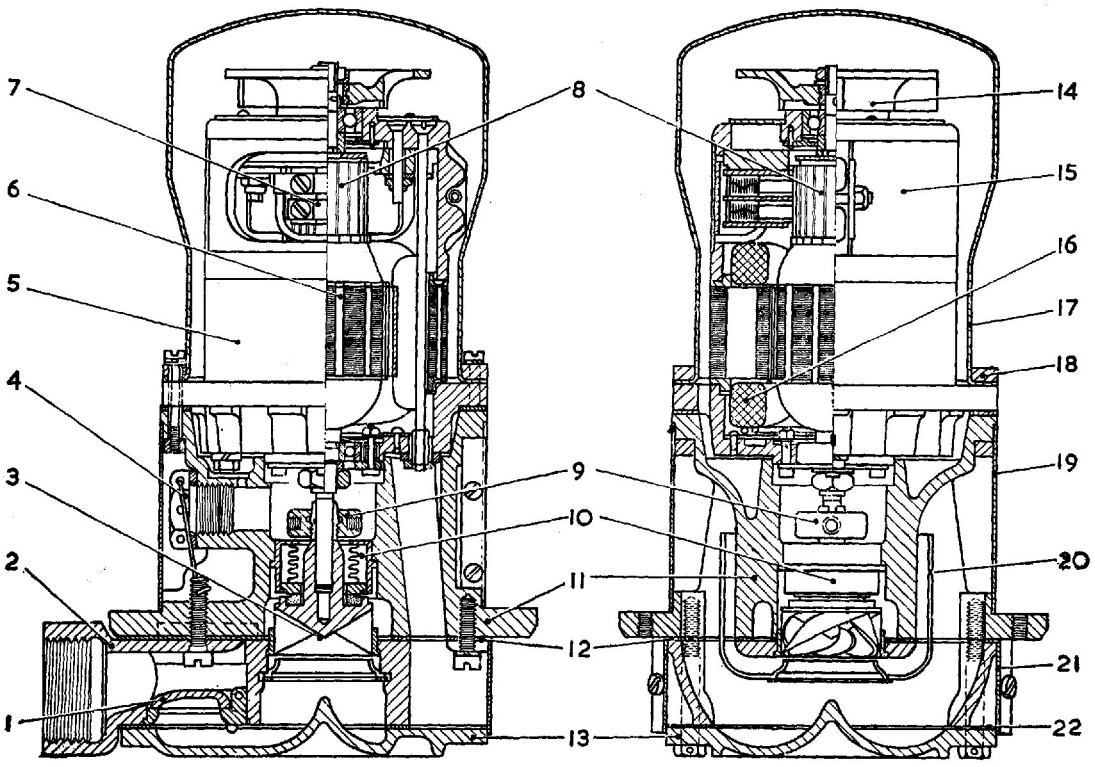
2. The complete pump (*fig.* 1) consists essentially of an electric motor mounted on a pump assembly which has a flange to permit the unit as a whole to be secured to the underside of the aircraft fuel tank. When fitted to the tank the portion of the unit above the flange extends within the fuel tank and when operating is immersed in fuel. The motor is rendered fuel tight by a metal cover or canister which is tightened on to a gasket seating at the upper end of the pump body assembly. A cylindrical filter, fitted round the pump body within the tank prevents foreign matter entering the pump, and a filter, fitted over the air inlet on the portion of the pump outside the fuel tank, prevents ingress of foreign bodies to the motor.

3. A metal bellows type of fuel gland is used in the Mk. 3 pump to prevent fuel passing from the pump inlet to the motor.

4. In the Mk. 3 pump the seal ring of the bellows gland rubs on a carbon ring shrunk into a recess at the upper end of the impeller.

Driving motor

5. The driving motor of the FB pump is a compound wound machine designed to operate on a supply of 24 volts d.c. It has a power output of approximately ⅛ B.H.P.



1 BY-PASS VALVE
2 PUMP CASING, LOWER
3 IMPELLER
4 IMPELLER ADJUSTMENT PLUG
5 MOTOR BODY
6 ARMATURE
7 BRUSH ASSEMBLY
8 COMMUTATOR
9 IMPELLER COLLET NUT
10 FUEL GLAND
11 PUMP CASING, UPPER
12 GASKET
13 BOTTOM COVER
14 COOLING FAN
15 COVER BAND
16 FIELD WINDING
17 MOTOR OUTER CASING
18 SEAL CLAMPING RING
19 FUEL FILTER
20 VAPOUR BAFFLE
21 AIR FILTER
22 GASKET

Fig. 1. Sectional view of Mk. 3 pump

The armature is of the high speed type, the shaft of which runs in ball-bearings lubricated with high melting-point, low freezing point grease. The lower or driving end of the shaft is of a length sufficient to extend down through the upper casing of the pump body and is machined to receive the impeller (*para.* 16). The upper and lower motor end frames, house the bearings for the commutator and impeller ends of the armature shaft, and are secured to the motor body by bolts which pass through from one end frame to the other. The body is made up from laminations which, together with the field windings comprise the motor field assembly.

6. The lower end frame forms the base for the motor, and seats on to a machined recess at the upper end of the pump body. It is provided with gauze-covered apertures which allow air to be drawn into the motor interior. In addition, there are a number of slots around the flanged portion of the frame. These slots which serve as air outlets are disposed between the lower edge of the motor body and the seating for the fuel tight cover enclosing the motor.

7. The upper end frame encloses the commutator and twin sets of brushes. Apertures in the frame permits access to the brushes for adjustments and inspection. A fan is fitted to the end of the armature shaft, externally to the upper end frame. This draws air through the motor from the apertures in the lower end frame and exhausts it down the outside of the motor body through the slots in the flange of the lower end frame. Finally, the air passes through two passages in the pump body and is expelled through the perforated strainer around the base of the pump.

8. The motor is secured to the pump body by screws fitted with spring-lock washers and is completely enclosed by a metal

canister or cover. This cover is flanged at the bottom, where a fuel-tight joint is maintained by clamping the cover down on a gasket interposed between the cover and the flange on the lower end frame. The motor is thereby isolated from the fuel in which it is immersed when the pump is in operation.

Pump body assembly

9. The pump body assembly consists of three light alloy castings, viz., (a) the lower casing, which projects outside the fuel tank and has provision for fuel delivery, gland drain and electrical connections; (b) the bottom cover, which seals off the bottom of the pump; and (c) the upper or main casing, which locates within the aircraft fuel tank and provides the seating for the electric driving motor.

Lower casing

10. The lower casing has a central cavity which is fitted with a brass slip-ring at its upper end and forms the lower section of a chamber in which the pump impeller rotates. This chamber communicates directly with the fuel delivery outlet passage, in the lower wall of which, is fitted a hinged-flap type or by-pass valve to allow fuel to be drawn through the pump when it is idle.

11. Located to one side of the fuel delivery outlet is another, but smaller, outlet which connects with a passage from the upper end of the fuel gland. This is the gland drain outlet which allows any fuel that may have seeped through the fuel gland to drain away. A Breeze type 2-pole plug, fitted over another hole in the periphery of the casing, provides the electrical connection for the driving motor, the hole communicating with a cored out passage in the upper casting is to take the wiring from the plug to the motor.

12. A perforated strainer, fitted to the periphery of the casing, serves to prevent foreign matter being drawn through to the motor. Suitable dividing walls in the casing separate the incoming and outgoing air streams when the pump is in operation.

Bottom cover

13. The casting which forms the bottom cover of the pump is machined on its upper face to acommodate the gasket interposed between the cover and the lower casing. It is secured, together with the lower casing by bolts which pass through the cover and lower casing into tapped holes in the upper casing.

Upper casing

14. The upper casing consists of two circular ends separated by a cored out portion of somewhat smaller diameter. The cylindrical hole in the centre of the casting is machined to provide a housing for the impeller and for the fuel gland, within which the impeller sleeve rotates. A tapped hole in the side of the casting communicates with a chamber over the fuel gland, and allows for the insertion of a tool to tighten the collet nut which secures the impeller to the motor driving shaft. A plug, with sealing washer, screwed into the hole, prevents fuel entering to the upper side of the fuel gland. There are cored passages in the casing to carry circulating air for the motor and also to act as breathers. The wiring from the Breeze plug in the lower casing to the motor passes through one of these passages. The leakage of air and vapour around the impeller inlet clearance is separated from incoming fuel when the pump is working by a sheet aluminium baffle. This baffle, held in position by a circlip at its lower end, extends into both suction passages to a point about half way up the suction filter. The filter is in the form of a gauze cylinder fitted round the periphery of the upper casing.

Metal bellows gland

15. The metal bellows type of gland used in the Mk. 3 pump has a central hole in which the impeller sleeve rotates. The assembly consists of a brass cylindrical housing in which is sweated a brass bellows, with a bronze seal ring sweated at the lower end of the bellows. The seal ring is guided within the open lower end of the housing by four splines on its perimeter engaging with four lugs on the inner surface of the housing. The seal ring is polished on its lower surface to provide a working face which is maintained in rubbing contact with the carbon ring on the upper surface of the impeller. The whole assembly is pressed into the central hole in the main casting of the pump body.

Impeller

16. The impeller is of the single shrouded, single-entry, end-suction type and has vanes of helicoidal shape designed to give the maximum performance at high altitude. It

is secured on the lower end of the motor shaft by a slotted cone-nut collet coupling device, similar to a chuck in operation.

17. To prevent the impeller slipping on the motor shaft the coupling is provided with a small shouldered pin passing through a hole at right angles to the axis of the shaft. When the impeller is assembled on the shaft the pin passes down any one of the four slots in the impeller sleeve until the impeller is in its correct axial position, i.e., to bring the tips of the blades flush with the end of the slip-ring in the lower casing of the pump body (*para.* 11).

18. The impeller rotates in the bore of the slip-ring with a coarse running clearance sufficient to reduce pressure leakage but at the same time to permit the escape of air and vapour back to the suction space.

Operation

19. When the pump is switched on, the impeller draws fuel from the interior of the pump and forces it, via the impeller chamber to the pump outlet. During the period when the pump is in operation the flap of the by-pass valve is maintained on its lapped seating by the pressure of the fuel in the outlet channel, but when the pump is idle the pressure is relieved. The pressure exerted on the underside of the valve, due to the weight of the fuel in the tank, is then sufficient to lift the flap and allow fuel to be drawn through the pump by the aircraft engine-driven pump.

INSTALLATION

20. When fitting a new or reconditioned pump in place of an existing pump, it is essential to ensure that the fuel tank is empty before attempting to remove the old unit. When this has been checked, disconnect the fuel delivery pipe, the fuel gland drain pipe, and the electrical supply cable from the Breeze plug. Next remove the nuts securing the pump to the fuel tank and carefully withdraw the pump from its seating, taking care not to damage the securing studs in the process.

21. Remove any blanking plugs which may be present in any of the pump orifices and ensure that the pump unit is externally clean. Also ensure that the gasket is interposed between the pump mounting flange and that the seating on the tank is quite clean and in good condition. Offer the new pump to, and carefully insert it through, the pump aperture in the base of the tank. Next secure the pump by screwing on and tightening up the securing nuts around the mounting flange.

22. Before putting the new pump into operation ensure that it is internally clean in the following manner. Connect the supply cable to the Breeze plug, temporarily plug the fuel outlet and pour a small quantity of fuel into the tank after placing a receptacle (sufficiently large to receive the fuel in the tank) below the fuel outlet. Then switch on the pump and remove the plug from the fuel outlet. The pump will thus be flushed and any foreign matter in the pump will be carried away. When this has been done the pump should be switched off and the fuel supply line connected to the pump outlet.

23. Ensure that there is no obstruction in the gland drain outlet or in the drain pipe before finally connecting them. Failure to do this may result in fuel, which may have seeped through the fuel gland, accumulating and washing away grease from the motor lower bearing, thereby possibly causing serious damage.

SERVICING

Electrical test

24. Periodic tests for correct functioning of the pump should only be undertaken with the unit on load. Therefore ENSURE THAT THE PUMP IS IMMERSED IN FUEL.

25. Ascertain the position of the aircraft fuel pump test panel by reference to the appropriate Aircraft Handbook and proceed as follows :—

(1) Close all fuel cocks between the pump and engines so 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 and note the current consumption as registered by the ammeter.

26. The readings obtained from the test given in the previous paragraph should be interpreted as follows :—

(1) A steady reading of approximately 7 amp. shows that the pump motor is satisfactory.

(2) A reading in excess of 7 amp. is an indication of a fault in the unit.

(3) A fluctuating reading is caused by intermittent connection, probably due to faulty contacts, brushes or commutator. It may, alternatively, be an indication that the fuel gland is defective or that the impeller is fouling the casing.

(4) A zero reading is consistent with a blown fuse, defective wiring or switch, or, in extreme cases, complete motor failure.

Functional test

27. When the electrical test has been satisfactorily completed the pump should be tested for fuel output pressure and rate of delivery. The pressure should be approximately 10 lb. per sq. in. at a rate of 3·3 gallons per minute. Failure to obtain these results will probably be an indication of a faulty fuel gland or impeller. In addition the gland drain should be checked for leakage. If the rate of leakage exceeds two drops per minute when the pump is idle or five drops per minute when the pump is operating, it will indicate that the fuel gland is faulty.

Faulty pumps

28. In the event of a pump failing to satisfy requirements (*para.* 24-27) it should be removed and replaced by a pump of known serviceability. Faulty pumps must not be dismantled by Service Units, but must be returned to a Repair Depot for appropriate action.

Periodic inspection

29. At the periods specified in the relevant Aircraft Servicing Schedule the pump will be inspected in accordance with the following instructions :—

(1) Remove the pump from the tank, inspect the gauze filter around the inlet and clean it if necessary.

(2) Check that the fuel drain pipe is free from obstruction. A convenient method of doing this is to blow through the pipe whilst it is disconnected from the pump.

(3) Replace the pump in the tank, taking care to ensure the tightness of all connections and securing nuts. Also ensure that the filter over the air inlets and outlet is free from obstruction.

(4) Test the pump as detailed in para. 24 to 27.

(5) Ensure that the by-pass valve is functioning correctly by adopting the following procedure. Turn on the tank selector cock and the appropriate engine master cock. Then, after ensuring that there is sufficient fuel in the tank to immerse the pump, switch on the pump and observe the fuel pressure as indicated by the aircraft fuel pressure gauge or fuel pressure warning lamp. It should be noted that in certain installations the warning lamp may be set to operate at a higher pressure than that at which a single pump is rated. It is unlikely that the pump is faulty if it delivers fuel at a pressure of more than 9 lb. per square inch.

Note . . .

It is important that the idle/cut-off control should be in the cut-off position throughout the functional test when it is applied to installations incorporating engines which are fitted with Bendix or similar type injection carburettors.

Lubrication

30. During manufacture the motor bearings are packed with sufficient grease to last the normal life of a pump. No additional lubrication or attention should therefore be necessary.