Chapter 39

PUMP, FUEL, TYPE PDC.909

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Introduction

1. The PDC. 909 electrically driven fuel pump is designed for vertical mounting in the base of the aircraft fuel tank, collector box or sump. The pump is designed for use on a 26V d.c. aircraft supply in a system in which the electrical switching is such that the pump speed can be varied automatically according to the requirements of the tank balancing controls and the aircraft operating altitude. Five pump speeds are available and these will be referred to throughout this chapter as follows :— (1) slow speed, (2) low altitude medium speed (LAMS), (3) low altitude fast speed (LAFS), (4) high altitude medium speed (HAMS) and (5) high altitude fast speed (HAFS).

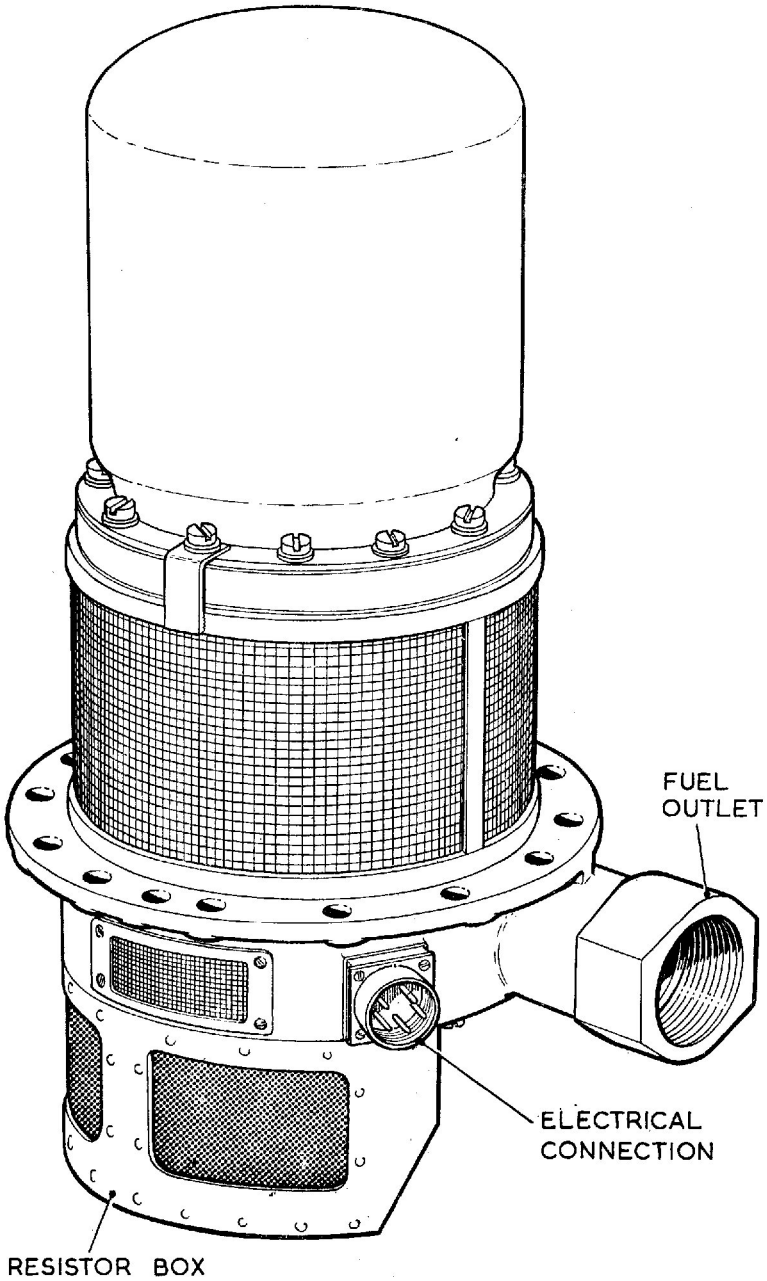

Fig. 1. External view of typical PDC.909 fuel pump

2. Details of the differences between the various PDC.909 mark numbers, together with leading particulars, are given in an appendix to this chapter.

DESCRIPTION

Motor Unit

3. A typical pump assembly is illustrated in Fig. 2. The motor unit is a totally enclosed compound wound, flameproof, air ventilated machine designed to operate on a 26V d.c. supply. It is located in the pump body casting and a flange on the lower motor casing is secured by screws to the pump body. The armature is supported by shielded bearings, both of which are pre-packed with an anti-freeze/high melting point grease during manufacture and cannot be re-lubricated.

4. Brush gear is of unit construction, to facilitate assembly, comprising four brushes, two on each side in pairs, producing two brush tracks. Radio interference noise suppressors are included in the internal electrical circuit of the pump. The pump motor shunt field is fitted with three speed control trimming resistances enclosed in a ventilated box. These resistances enable the five motor speeds, detailed in para. 1, to be selected automatically according to flight requirements.

Pump unit

5. The pump unit comprises a single-entry, end-suction type impeller of rose pattern rotating in an enclosed shroud and a duct of involute form which is an integral part of the lower pump body casting. A seal assembly, which prevents fuel ingress into the motor unit is housed in the upper base casting and any slight fuel seepage past this seal gland will drain to atmosphere through cored channels in the castings.

6. The fuel entry to the impeller is protected by a wire mesh filter against ingress of tank sediment into the main fuel delivery line. Air and fuel vapour which may be evolved are directed out of the main fuel stream by a formed vapour guide cone around the inlet to the impeller system. A by-pass flap valve at the delivery end of the integral cast volute passage in the pump body casting enables fuel to be drawn from the tank by the engine driven fuel pump when the booster pump is idle. This valve is normally held closed by pump delivery pressure.

7. All external connections to the pump are made to unions and plugs on the pump base casting. These connections comprise a $1\frac{1}{4}$ in. B.S.P. tapped delivery outlet, $\frac{1}{4}$in B.S.P. gland drain tapping and a 5-pin electrical connection socket.

OPERATION

8. When the pump motor unit is energised by a 26V d.c. current, fuel from the tank is drawn into the eye of the impeller and then forced through the volute duct in the pump base casting to the fuel outlet connection and to the delivery line.

9. Under conditions in which the flow from the pump is low, due to reduced engine requirements, the impeller continues to rotate at approximately the selected speed without causing any excessive increase in fuel delivery pressure.

10. When the pump is idle, fuel delivery pressure on the by-pass flap valve is relieved and the valve opens to enable the engine driven fuel pump to draw fuel direct from the tank, without passing through the impeller system.

REMOVAL AND INSTALLATION

Removal

11. Before attempting to remove a pump, ensure that the tank has been drained of fuel by easing the central drain plug in the pump base casting. Switch off the electrical supply to the pump.

12. The precise method of removing a PDC. 909 fuel pump from a particular installation is detailed in the appropriate Aircraft Handbook. In general terms it will consist of disconnecting the fuel delivery and gland drain pipes and disconnecting the electrical supply plug from the socket on the pump base. The pump can then be withdrawn by removing the fourteen nuts securing the pump to the tank stud ring. Two $\frac{1}{4}$in. B.S.P. screws can be used if necessary in the mounting flange tapped holes to assist in breaking the joint with the tank mounting ring. Take care to support the weight of the pump during this operation.

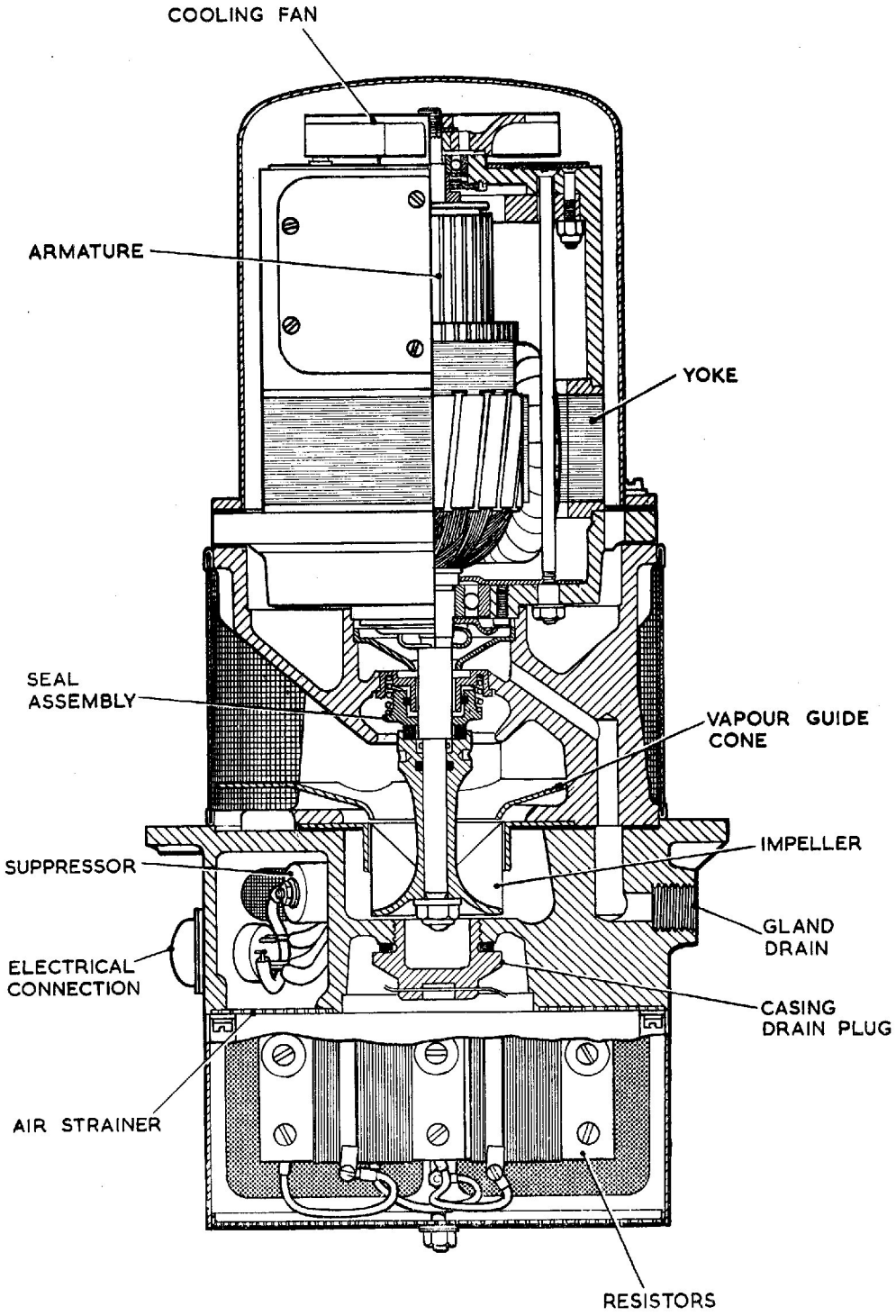

Fig. 2. Sectional view of P.D.C.909 Mk X fuel pump

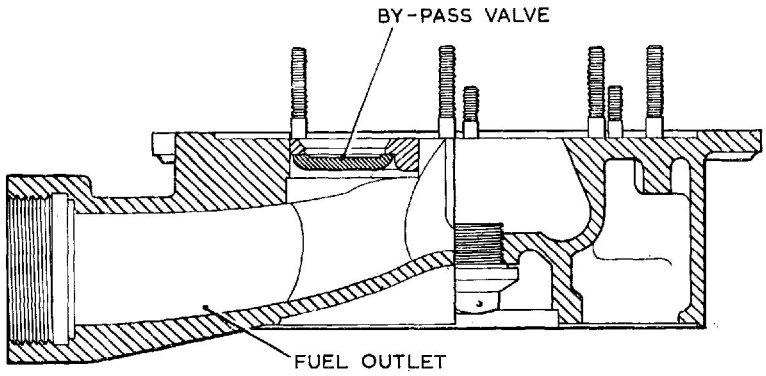

Fig. 3. Sectional view of fuel pump outlet

Pre-installation checks

13. The installation of a new pump should be preceded by the following checks:—

(1) Ensure that the pump has not been stored for longer than the specified maximum period (i.e. 12 months in the original packing and carton as supplied by the manufacturer or 3 years where special packing has been provided). Pumps stored for periods in excess of these maxima must not be used without being dismantled, examined and tested as detailed in Vol. 6.

(2) Inspect the exterior of the pump for evidence of damage, security of locking wires, general cleanliness and corrosion. Blend out slight areas of corrosion and apply an approved protective fiinish (e.g. chromic acid solution) to the unprotected areas.

(3) Check that transit plugs have been removed from the delivery outlet and gland drain tappings and from the electrical connection socket and remove tape or any other protective material from the inlet filter and breather gauzes.

(4) It is advisable to make a starting check on the motor unit before installation. Join leads 1 and 5 together (App. 1, fig. 1), connect them to the positive terminal of a 26V d.c. electrical supply, and connect lead 2 to the negative terminal to test the slow speed circuit. The pump must start immediately. Repeat the test several times, and if the pump fails to start, it must be returned to a repair unit for further testing, using approved equipment. Carry out starting tests for each of the remaining four motor speeds, with the leads connected in the following manner:—

LAMS—pins 2 (-ve) and 1 and 4 joined (+ve).
LAFS—pins 2 (-ve) and 1 (+ve).
HAMS—pins 2 (-ve) and 1, 3 and 4 joined (+ve)
HAFS—pins 2 (-ve) and 1 and 3 joined (+ve).

Installation

14. The above pre-installation checks apply to all aircraft installations of these pumps. For detailed procedure covering installation in a particular aircraft, reference should be made to the relevant Aircraft Handbook.

15. As a general example, installation in the aircraft will comprise the following operations:—

(1) Fitting a new joint washer between the pump mounting flange and the tank stud ring, using an approved jointing compound on both faces of the washer.

(2) Securing the pump to the tank stud ring with fourteen nuts and lockwashers.

(3) Reconnecting the fuel delivery and gland drain pipes, ensuring when relevant that the open end of the latter emerges in a low pressure area to avoid the possiblity of pressurisation in flight.

(4) Re-connecting the electrical supply plug to the pump socket.

(5) Wire-locking all pipe connections, union nuts, etc.

SERVICING

Routine inspection

16. At routine inspections the following procedure applies :—

(1) Inspect all the pipe connections and wire locking to the pump. Check the joint between the fuel pump and the tank for leakage. Rectify as necessary.

(2) Test the pump as detailed in para. 18-24. If the pump performance is found to be unsatisfactory in any way, the pump must be removed from the aircraft and a new or reconditioned unit fitted. No in-situ maintenance is possible.

(3) Ensure that the by-pass valve is functioning correctly by completing any relevant tests detailed in the appropriate Aircraft Handbook.

17. At the periods laid down in the appropriate Servicing Schedules all pumps are to be replaced by new or reconditioned units drawn from Stores. Faulty or time expired pumps must be returned to a Maintenance Unit or to the manufacturer for repair.

Electrical test

18. A routine electrical test in accordance with the appropriate Servicing Schedule should be made to ascertain that the motor unit is functioning satisfactorily. These tests must be made with the motor unit on load - i.e. with the pump unit immersed in and pumping fuel at the motor speed automatically selected by the tank balancing controls. The pump must be replaced by a new or reconditioned unit if there is any indication of erratic performance (e.g. excessive current consumption).

"No fuel flow" test

Note . . .

The following "no fuel flow" electrical test is only applicable to aircraft with the necessary instrumentation. Where no test panel is provided, particular attention should be paid to the electrical test (para. 18) and to the operational test (para. 22).

19. Ascertain the position of the aircraft test socket and switches by reference to the relevant Aircraft Handbook. Proceed as follows :—

(1) Close all fuel cocks between the pump and engine to ensure that no fuel can flow.

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

Note . . .

When using a clip-on type ammeter the tongs should be opened and closed smartly prior to use to reduce the hysteresis error.

(3) Apply a 26V d.c. supply and switch on the pump by depressing the switch on the test panel. Observe the ammeter reading for a period of not less than 30 seconds.

20. Interpret the readings obtained as follows :—

(1) A steady reading not exceeding that specified in the appropriate appendix to this chapter indicates that the motor is functioning satisfactorily.

(2) Current consumption in excess of that specified in the appropriate appendix indicates either a faulty motor unit, a rise in torque loading due to the obstruction of moving parts, or a restriction of the fuel flow.

(3) A fluctuating reading indicates faulty contacts, defective brushes, faulty commutation or that bearings or other rotating parts are binding.

(4) A zero reading indicates an open circuit and is consistent with a blown fuse, defective switch, faulty wiring or a complete motor failure.

21. When all the above tests have been completed, release the test switch and disconnect the ammeter.

Operational test

22. Subject to the electrical test being completed satisfactorily the pump should be tested where possible for proof of performance and checked against the performance figures quoted in the appropriate appendix to this chapter. Refer to the relevant Aircraft Handbook for procedure details. Possible causes of failure, to obtain the required performance are given in Table 1.

Gland leakage

23. During the above tests an examination should be made of the gland drain exit for fuel leakage. The leakage must not exceed a rate of 2c.c. per hour while the pump is

running, or 1c.c. per hour while stationary. Any leakage in excess of these figures will necessitate removal of the pump from the aircraft.

Insulation resistance test

24. Using a 250V constant pressure insulation resistance tester, measure the insulation resistance between the socket pins and earth. When a new pump is drawn from Stores, the insulation resistance must be not less than 2 megohms. After installation, due to the humidity conditions prevalent at aircraft dispersal points, the minimum permissible insulation resistance is 50,000 ohms.

TABLE 1

Faults, possible causes and rectification

Fault	Possible cause	Rectification
Gland leakage	(1) Bad finish between gland seal faces. (2) Insufficient pressure between gland seal faces.	All these conditions require that the pump is removed from the aircraft and returned to a Maintenance Unit or to the pump manufacturer for reconditioning.
Excessive current consumption	(1) Excessive gland loading. (2) Faulty motor unit. (3) Fouling of impeller by foreign matter.	
Low delivery pressure	(1) Faulty motor unit.	
Pressure surge	(1) Tight or pre-loaded bearings. (2) Excessive gland loading.	
Low insulation resistance	Dampness in motor windings.	

Appendix 1

PUMPS, FUEL, TYPE PDC.909 MK. 1, 2, 3 AND 4

Pump, fuel, Type PDC.909 Mk. 1	**Ref. 5UE/6350**
Pump, fuel, Type PDC.909 Mk. 2	**Ref. 5UE/6350**
Pump, fuel, Type PDC.909 Mk. 3	**Ref. 5UE/6671**
Pump, fuel, Type PDC.909 Mk. 4	**Ref. 5UE/6845**
Voltage limits	22.0/28·0*V d.c.*
Rated voltages	*26V d.c.*
Rated output (LAMS) at 26V d.c.	1100 *gal./hr.*
Delivery pressure at LAMS (26V d.c.)	10·5 *lb.in²* *min.*
Minimum "no fuel flow" delivery pressure	9·0 *lb. in².*
Maximum "no fuel flow" current consumption	19·0 *amp.*
Delivery outlet tapping	$\frac{1}{4}$*in. B.S.P.*
Weight of unit	14·0 *lb.*

Type differentiation

1. Basic differences between the various marks of PDC.909 series pumps covered by this appendix are as follows :—

PDC.909 Mk. 1 — As originally designed.

PDC.909 Mk. 2 — Generally identical with PDC.909 Mk. 1 but fitted with an improved commutator, field and armature assembly to reduce motor running temperature.

PDC.909 Mk. 3 — Basically similar to PDC.909 Mk. 2 pump but brush rocker plate strengthened by adding flats to the bore of the plate. Stainless steel throat washers added to the resistance unit assemblies.

PDC.909 Mk. 4 — Generally similar to PDC.909 Mk. 3 but both the drive-end and the commutator-end bearings are of double shielded pattern.

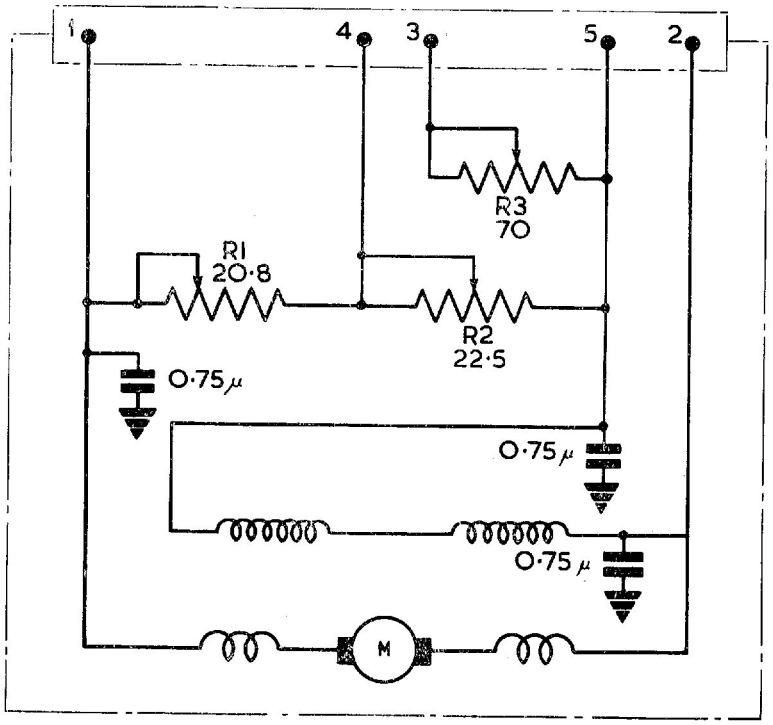

Fig. 1, Circuit diagram PDC.909 fuel pump