Chapter 12

PUMP, FUEL, SPE 1200 SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The SPE 1200 series covers a range of electrically driven, submerged, fuel booster pumps capable of maintaining the required fuel supply to the aircraft engine driven pump under the varying fuel temperature conditions, rates of climb, altitudes, etc., which can be experienced in flight.

2. This range of pumps has been produced to meet the latest aircraft installation requirements, where the fuel tank depth is restricted within thin wing sections, and is available in either 24 volt or 112 volt d.c. versions, all having the same nominal performance of 1200 gallons per hour at 11 lb. per sq. in. minimum pressure.

3. The whole range of these pumps include built-in radio noise suppressors.

DESCRIPTION

General

4. The units comprise a pump chamber assembly and an electric motor mounted horizontally, but at right angles to the pump shaft, which is mounted vertically, the transfer of the drive from motor shaft to pump shaft being established through suitable reduction bevel gearing.

5. Fuel is prevented from entering the gearbox and motor by a sealing gland housed in the main pump casting, thus any slight leakage is drained to atmosphere.

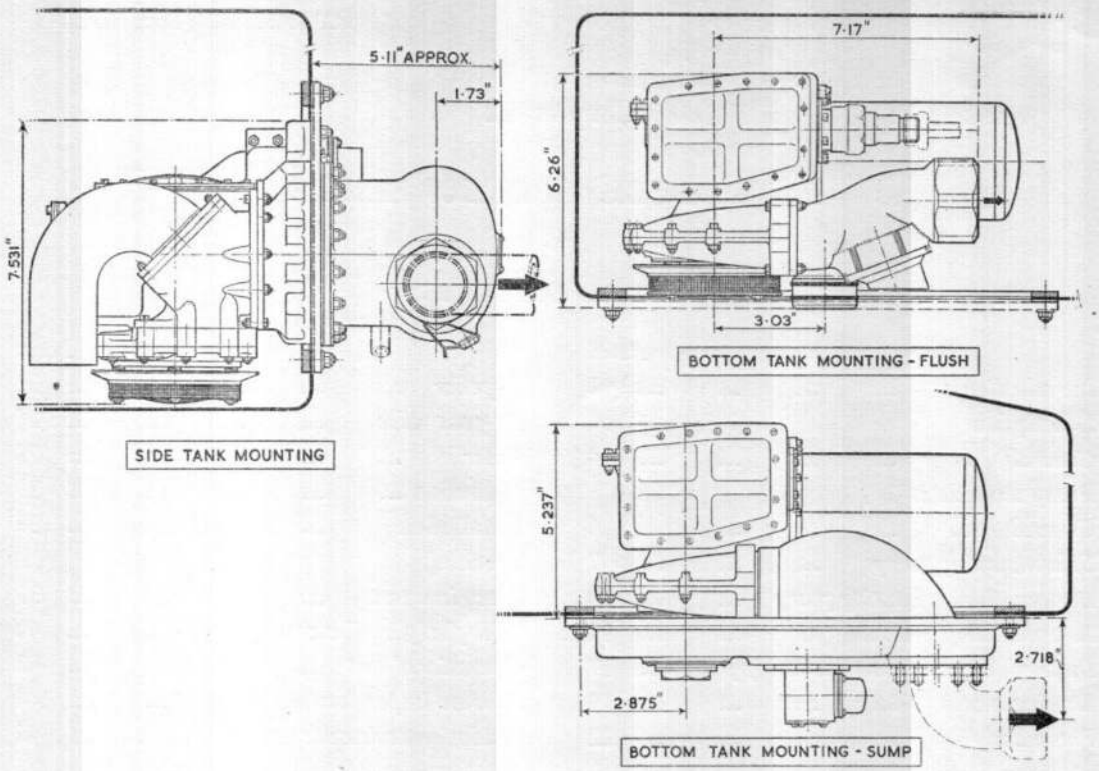


Fig. 1. Typical fuel tank pump mountings

PUMP MOUNTINGS

General

6. A view of typical pump mountings are shown in fig. 1. There are three main types of pump mountings, the side, or, hanging mounting, the bottom flush mounting, and the bottom sump mounting. The bottom sump mounting may be inclined to suit the configuration of the aircraft.

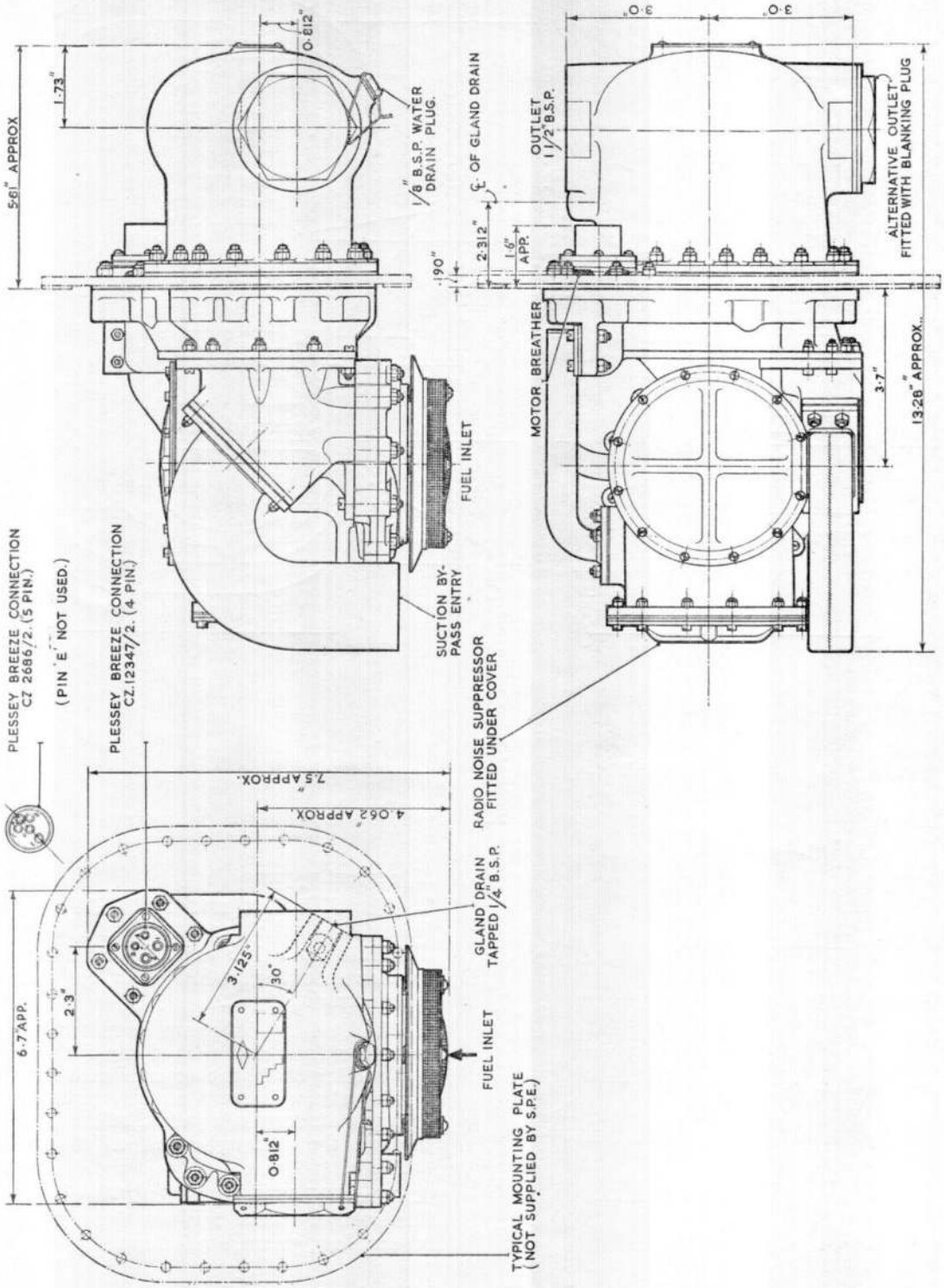
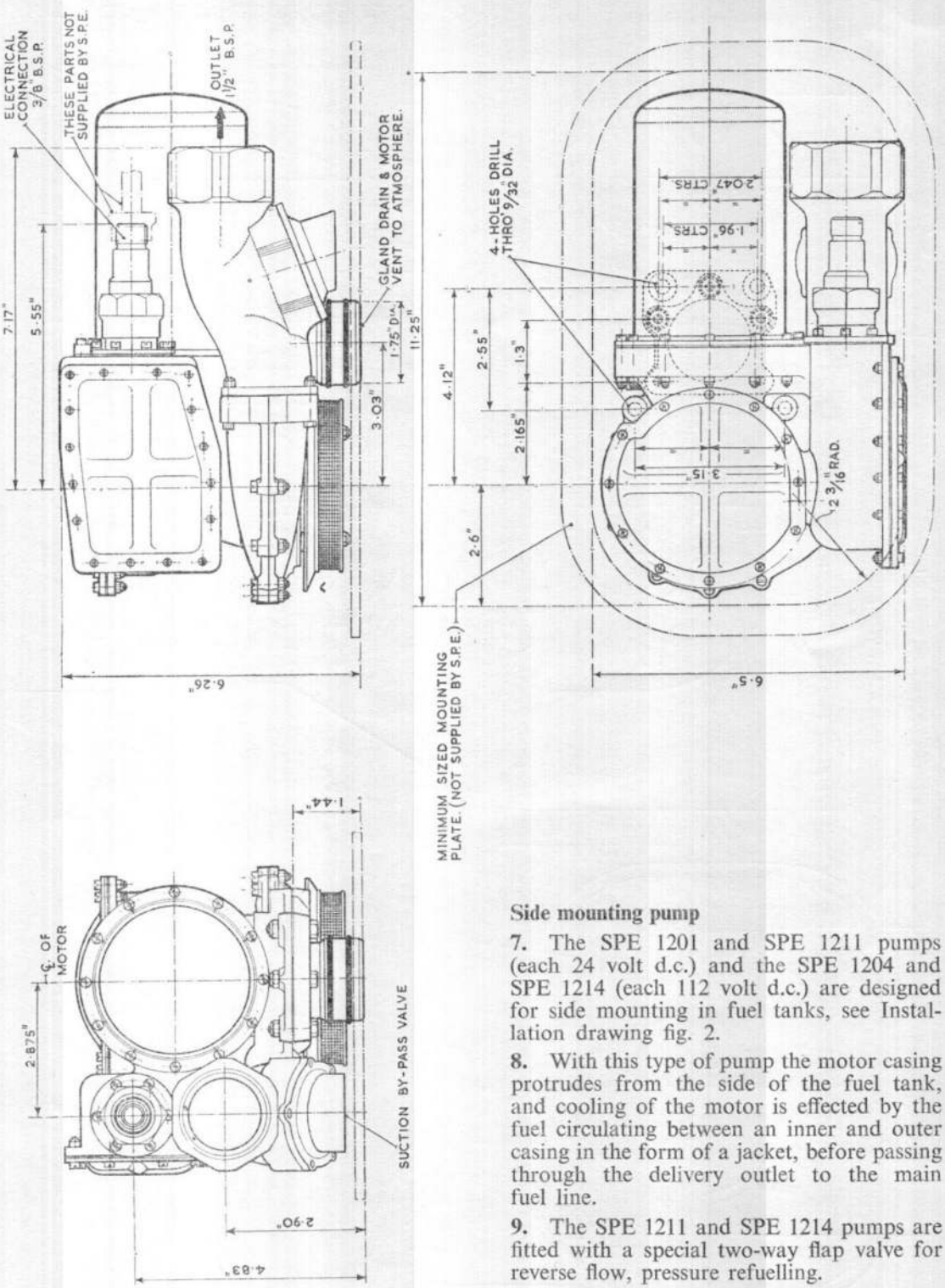


Fig. 2. Installation drawing of fuel-tank pump mounting (side)



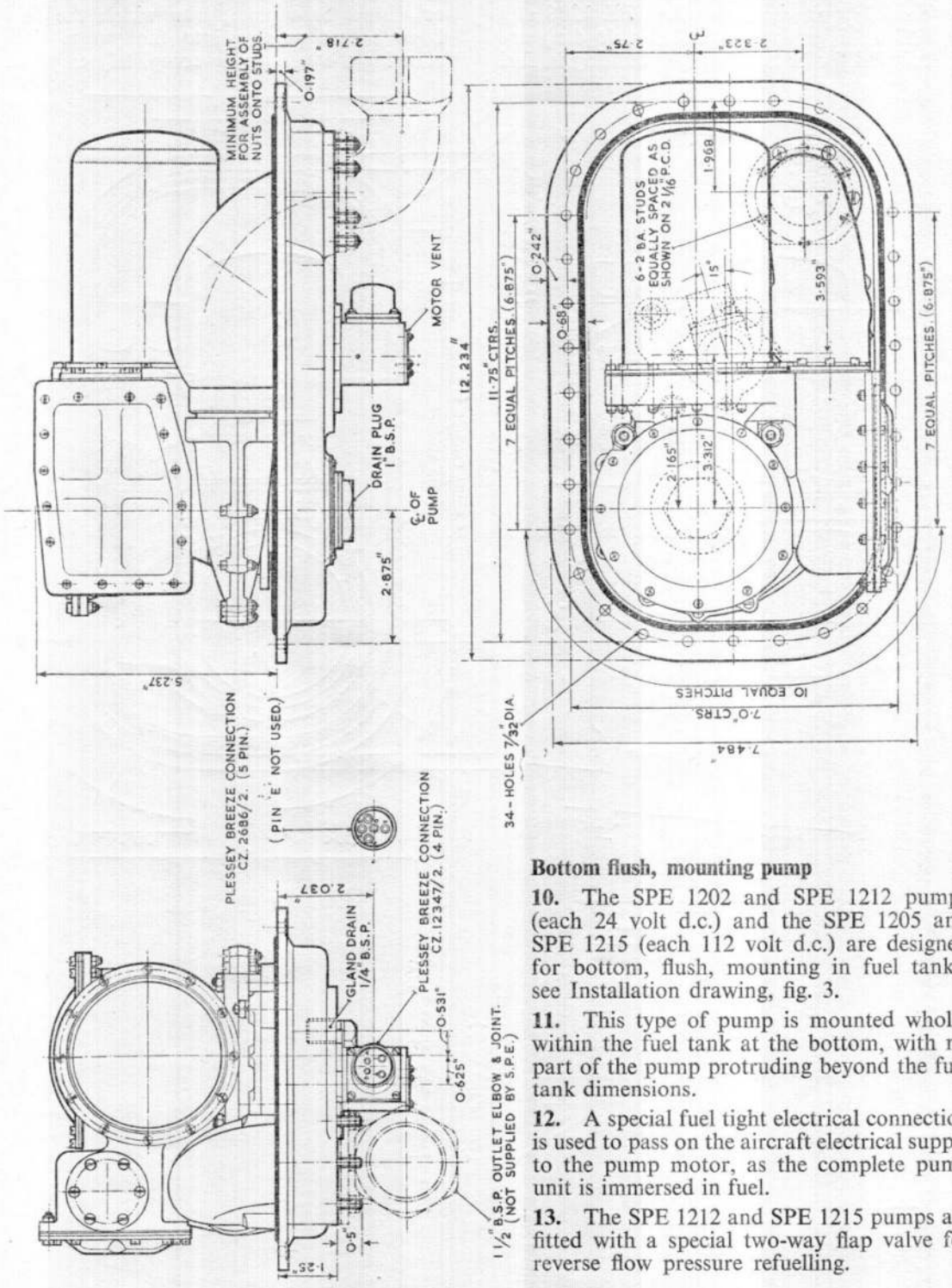
Side mounting pump

7. The SPE 1201 and SPE 1211 pumps (each 24 volt d.c.) and the SPE 1204 and SPE 1214 (each 112 volt d.c.) are designed for side mounting in fuel tanks, see Installation drawing fig. 2.

8. With this type of pump the motor casing protrudes from the side of the fuel tank, and cooling of the motor is effected by the fuel circulating between an inner and outer casing in the form of a jacket, before passing through the delivery outlet to the main fuel line.

9. The SPE 1211 and SPE 1214 pumps are fitted with a special two-way flap valve for reverse flow, pressure refuelling.

Fig. 3. Installation drawing of bottom fuel-tank pump mounting (flush)



Bottom flush, mounting pump

10. The SPE 1202 and SPE 1212 pumps (each 24 volt d.c.) and the SPE 1205 and SPE 1215 (each 112 volt d.c.) are designed for bottom, flush, mounting in fuel tanks, see Installation drawing, fig. 3.

11. This type of pump is mounted wholly within the fuel tank at the bottom, with no part of the pump protruding beyond the fuel tank dimensions.

12. A special fuel tight electrical connection is used to pass on the aircraft electrical supply to the pump motor, as the complete pump unit is immersed in fuel.

13. The SPE 1212 and SPE 1215 pumps are fitted with a special two-way flap valve for reverse flow pressure refuelling.

Fig. 4. Installation drawing of bottom fuel-tank pump mounting (sump)

Bottom sump mounting pump

14. The SPE 1203 and SPE 1213 pumps (each 24 volt d.c.) and the SPE 1206 and SPE 1216 pumps (each 112 volt d.c.) are designed for bottom sump mounting in fuel tanks, see Installation drawing fig. 4.

15. This type of pump is fitted with a sump or dished base plate, into which the fuel flows before passing into the pump, thus allowing the tank to be completely emptied,

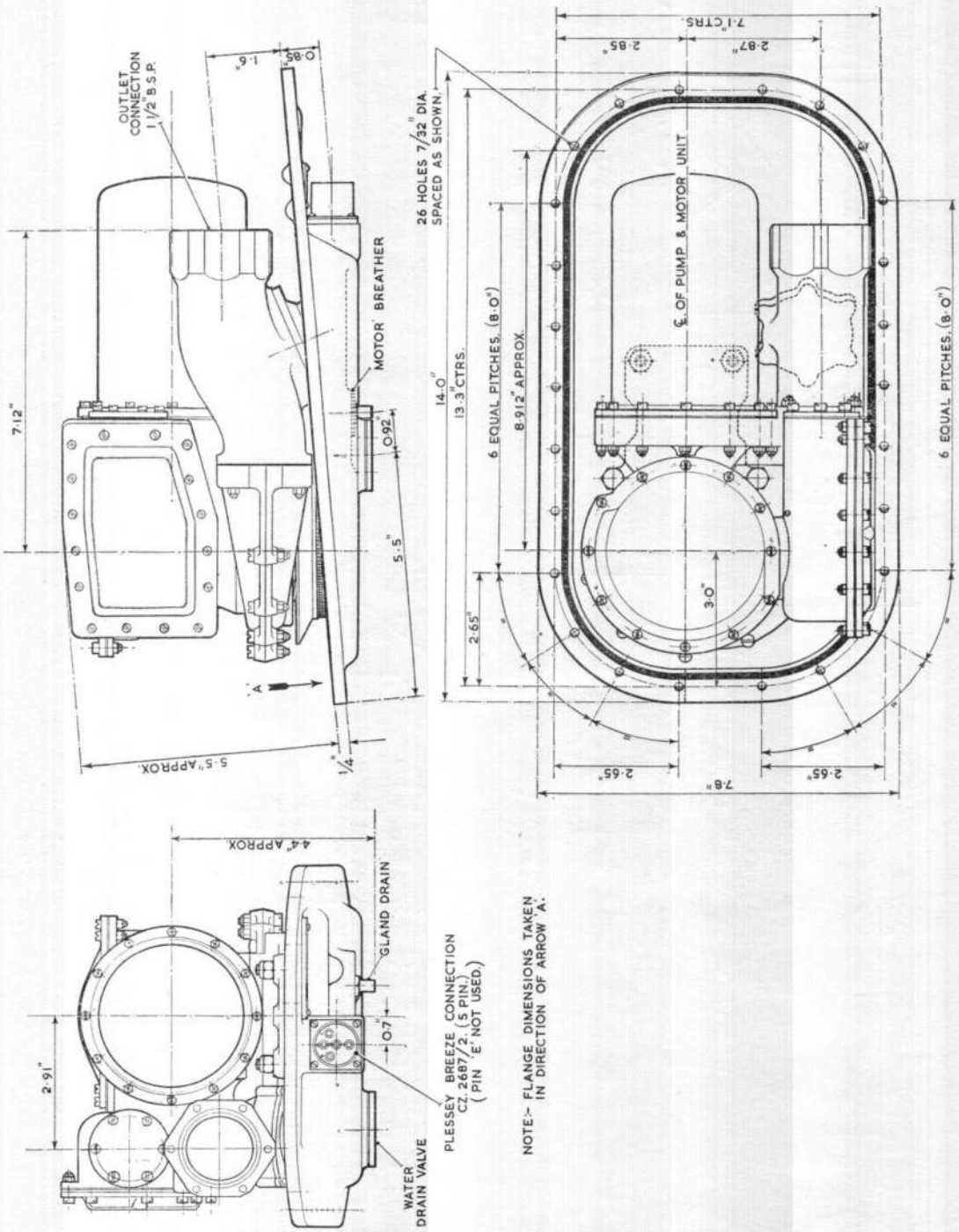
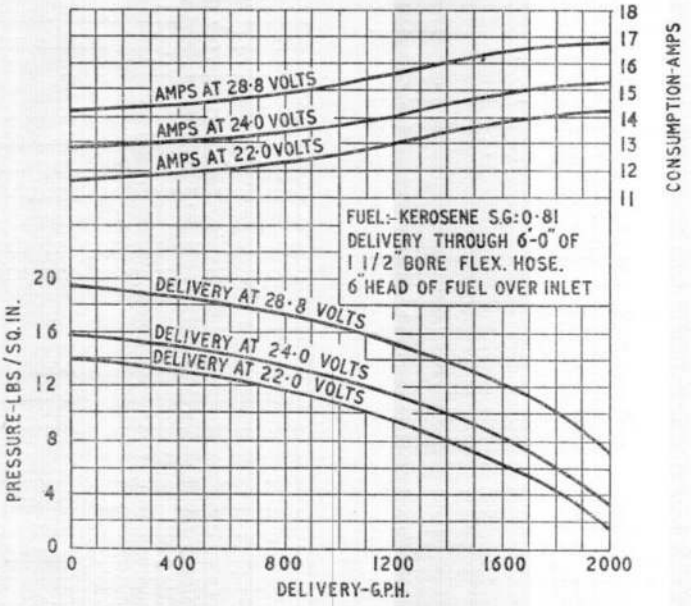


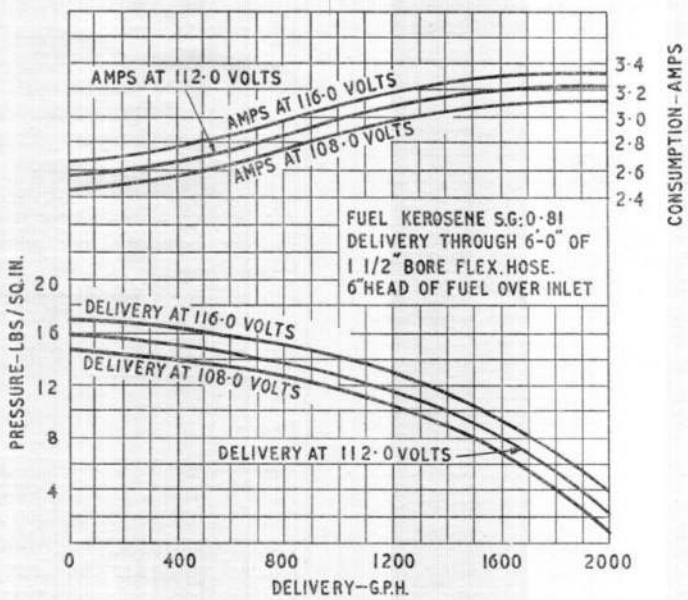
Fig. 5. Installation drawing of inclined, bottom fuel-tank pump mounting (sump)

either by the action of the pump, or, by the removal of the drain plug located in the base plate.

16. The SPE 1213 and SPE 1216 pumps are fitted with a special two-way flap valve for reverse flow, pressure refuelling.



GROUND LEVEL PERFORMANCE OF :-
TYPES:SPE.1201 MK.I,1202 MK.I & 1203 MK.I (24 VOLTS)
SPE.1211 MK.I,1212 MK.I & 1213 MK.I (24 VOLTS)



GROUND LEVEL PERFORMANCE OF :-
TYPES:SPE.1204 MK.I,1205 MK.I,1206 MK.I & 1207 MK.I (112 VOLTS)
SPE.1214 MK.I,1215 MK.I & 1216 MK.I (112 VOLTS)

Fig. 6. Ground level performance curves

Inclined, bottom sump mounting pump

17. Pumps fitted with this type of mounting are designed for use in fuel tanks where the tank bottom is angled to suit the configuration of the aircraft, this type of mounting serves the same purpose as the horizontal bottom sump mounting pump.

18. The SPE 1207 pump (112 volt d.c.) is fitted with the inclined bottom sump mounting, see Installation drawing fig. 5.

Driving motor

19. The armature fitted to the motor which is used to drive the SPE 1200 series pumps is wound for 24 volt or 112 volt d.c. supply. The motor is a totally enclosed compound-wound, two pole machine, provided with two 0·5 μF capacitors for radio noise suppression. In addition, provision is made for varying the speed by switching the shunt leads, where a change of motor speed is desirable. Under normal operating conditions, the motor speed is 10,000 ± 100 r.p.m., with a current consumption of 15 amperes at 24 volt, d.c. or 3·3 amperes at 112 volt d.c.

20. The armature shaft is supported in shielded bearings with a self-locking nut at the commutator end to secure it in position. The shaft drive which is fitted with a bevel pinion, engages with a suitable bevel gear on the pump shaft which is at right angles to the motor shaft, providing a reduction of 2 : 1.

21. The SPE 1200 series of pumps are completely immersed in fuel, with the exception of the side mounting type, where the pump motor is clamped to the side of the tank so that the motor unit protrudes horizontally from the pump body to atmosphere. The motor for this type of pump is fitted with an inner and outer casing, allowing fuel to circulate between the two casings and materially assists in holding the temperature of the machine within pre-determined limits. This pump has two alternative fuel delivery outlet connections horizontally opposed at its end. Between the two outlets at the bottom is a $\frac{1}{8}$ in. B.S.P. water drain plug.

Pump body

22. The main casing or pump body carries the vertical pump spindle which is supported by a plain carbon bearing at its lower end and at its upper end by a shielded ball bearing.

23. The larger spiral bevel gear is keyed at the top of the pump spindle and secured with a self-locking nut. The central bore of the casting contains a bush which locates the fuel sealing gland and the carbon bearing housing. The bush assembly may be removed complete and is retained in position by a series of screws.

24. Located in a recess off the pump body casting are two capacitors for radio noise suppression. An inspection cover at this location provides access to the electrical connections. A second inspection cover situated on the top of the casting provides access to the gear components.

Impeller

25. Below the carbon bearing is a spiral volute formed by two castings, the flanges of which are bolted together and secured to the base of the main casting. Fitted to the lower end of the pump spindle in the volute chamber is a combined helico-centrifugal impeller. The impeller consists of a triple bladed helix, surmounted by a five vaned centrifuge and is secured to the pump spindle with a self-locking nut.

By-pass valve

26. The by-pass valve comprises a machined seating to which is hinged a flap valve. The valve assembly is fitted into the pump base, adjacent to, or connecting with, the delivery outlet. When the pump is in operation the flap is kept closed on its seating by the pressure of fuel in the delivery outlet, but opens when the pump is idle, due to lack of booster pump pressure.

27. Some pumps of this type, as described in this Chapter are fitted with a special double-acting by-pass valve. This valve functions as described in para. 26 and in addition, allows fuel to be fed into the tank via the pump when the aircraft is being pressure refuelled.

Filter

28. To prevent the entry of foreign matter to the pump, a wire gauze filter surrounds the fuel intake below the impeller and in the side mounting types (where there is no sump extending under the filter) it is mounted on springs as a precaution against possible damage in handling. A vapour guide cone surrounds the inlet to the pump and assists in the separation of air bubbles from the main fuel stream.

OPERATION

29. Fuel from the tank enters the pump through the gauze filter, where the impeller helix, driven by the motor (through right angle reduction bevel gearing), draws the fuel stream into the centrifuge at the lower end of the impeller, into the spiral volute and, via the delivery outlet, to the fuel line.

30. 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.

31. When the pump is idle the pressure on the underside of the by-pass valve is relieved. As a result the by-pass valve opens, allowing fuel to be drawn from the tank directly into the outlet duct, by the action of the engine driven pump.

32. Under conditions of sudden de-aeration, due to high ratio of climb and other manoeuvres, the temporary removal of fuel from the vicinity of the impeller is quickly overcome by the action of the centrifuge.

INSTALLATION

33. When it is necessary to fit a new pump, it is important to ensure that the tank has been emptied of fuel and that the electrical supply to the motor has been disconnected. In the flush and sump bottom mounting pumps where a drain plug is supplied, the latter should be eased off to ensure complete drainage. With the side mounting pump, removal of the drain plug in the fuel tank will empty the tank leaving a small quantity of fuel in the fuel jacket casing of the motor; this remaining fuel can be emptied after the pump has been removed from the tank.

34. Having ensured that the fuel tank is empty, disconnect the fuel delivery pipe, the gland drain pipe and the electrical cable from the Breeze plug.

35. The bottom flush mounting pump is drained direct to atmosphere through the flush motor vent, and has no pipe connections, the fuel delivery and electrical connections are inside the fuel tanks, and provision is made for access to these connections, either by using suitable lengths of flexible piping to allow the pump to be removed from the tank from below, before uncoupling these joints, or by the provision of a large aperture in the side or the top of the tank to permit the insertion of tools, etc.

36. Remove the securing nuts from the studs protruding through the pump flange, and, taking care to support the weight of the pump during the operation, carefully remove the pump through the pump aperture.

37. The precise method of mounting and dismantling the bottom, flush mounting type of pump will normally be at the discretion of the aircraft manufacturer and instructions for this operation will be found in the appropriate Aircraft Handbook.

38. Examine the new pump to be fitted and ensure that it is clean externally. Remove all transit covers and any protective material which may be present when the pump is received from Stores and insert the pump carefully through the fuel tank aperture, locating the mounting studs through the holes in the flange, making sure that a gasket or jointing compound is fitted between the two flanges before tightening the nuts on the studs. Screw on and tighten the securing nuts equally all round. After attaching the delivery pipe, gland drain pipe and electrical connection, ensure that all unions, union nuts, etc., are locked, employing wire locking where appropriate.

Note . . .

In all instances where any doubt exists as to the methods of installing or removing a pump from the aircraft, reference should be made to the relevant Aircraft Handbook.

SERVICING

Electrical test

39. A periodic electrical check in accordance with the appropriate Servicing Schedule, should be made to ascertain that the motor is functioning satisfactorily. The pump must be renewed if there is any indication of erratic performance, such as excessive current consumption or low insulation resistance. These tests are to be made only with the motor on load. It is essential therefore that the pump is immersed in fuel.

" No fuel flow " electrical test

40. Before applying the electrical test at " no fuel flow ", ascertain the position of the aircraft pump test socket and switches, by reference to the relevant Aircraft Handbook. When this has been done, 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 test socket on the test panel,

depending on whether the pump is to be tested from a 28 or 112 volt d.c. supply.

(3) Switch on the pump by depressing the test push-switch on the test panel and note the reading of the ammeter for a period of not less than half a minute.

41. The interpretation of the readings obtained from the test given in the previous paragraph are as follows:—

(1) A steady reading not exceeding 3·3 amperes at 112 volt d.c. or 15 amperes at 24 volt d.c. indicates that the pump motor is satisfactory.

(2) A reading in excess of those given in the previous paragraph indicates a faulty motor or a rise in torque loading due to the obstruction of the moving parts, or of the fuel flow.

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

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

42. When these tests have been completed, release the test push switch on the test panel and disconnect the ammeter from the test socket.

Operational test

43. Subject to the electrical tests being satisfactory, the pump should be tested for pressure and rate of fuel delivery. The pressure at 20 gallons per minute should be 11 lb. per sq. in. Failure to obtain this pressure and rate of fuel delivery could be caused by a faulty motor, a damaged impeller, or any incorrect loading on the fuel sealing gland and measures should be taken to ascertain the cause of failure.

Routine inspection

44. At routine inspections, care should be taken to conform to the following points:—

(1) Inspect all pipe connection points to the pump and tighten them if necessary; also examine the joint between the pump and fuel tank for leakage, correcting the fault if necessary.

(2) Test the pump as detailed in para. 38 to 42. If the pump is found to be defective it must be removed.

(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. Switch on the pump and observe the fuel pressure as indicated by the aircraft fuel pressure gauge or warning light. Very low pressure on the gauge, or failure to extinguish the warning light indicates that the by-pass valve is not functioning efficiently. In certain installations the fuel pressure warning light may be set to operate at a higher pressure than that at which the pump is rated. The warning light setting for the particular installation should therefore be checked before rejecting a suspected pump.

45. At the periods laid down in the appropriate Servicing Schedules, all pumps are to be replaced by new or reconditioned pumps drawn from Stores. Faulty pumps must be returned to a Maintenance Unit, or to the manufacturers for reconditioning.

Insulation resistance test

46. Using a 250 volt insulation resistance tester for a 24 volt pump, or a 500 volt one for a 112 volt pump, measure the insulation resistance between the live parts and the frame; these tests can best be effected at the Breeze plug. When a pump is received from the makers and initially installed in the aircraft the insulation resistance must not be less than 2 megohms. After installation for operational service, due to the humidity prevalent in aircraft at dispersal points, the minimum insulation resistance permissible is 50,000 ohms.

(81090) Gp.375/1. D.4502/Wt.35719/347726/L.P.S. Ltd. 3250/12/58