CANCELLED Do NOT DESTROY

ADMIRALTY
AIR MINISTRY

ELECTRICAL MANUAL, ROTARY CONSUMER EQUIPMENT (AIRBORNE)
This is A.L. No. 15 to A.P.4343D, Vol. 6

Section 7. List of Chapters: *delete* "*(to be issued later)*" after the title of Chapter 6 and *write* "(A.L.15)" in the outer margin against the deletion. *Insert* this Chapter 6 to follow Chapter 4. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

Chapter 6

PUMP, FUEL, FB60, Mk. 4

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LEADING PARTICULARS

Stores Ref. No.	*5U/5386*
Normal delivery rating	*200 G.P.H. at 10 lb. per sq. in. at 24 volt*
Motor speed	*8,400 r.p.m. at 24 volt* *10,000 r.p.m. at 29 volts*
Impeller periphery clearance	*0·003 in. (min.)*
Maximum consumption at	*22 volt .... 6·5 amp.* *24 volt .... 7·0 amp.* *29 volt .... 7·5 amp.*

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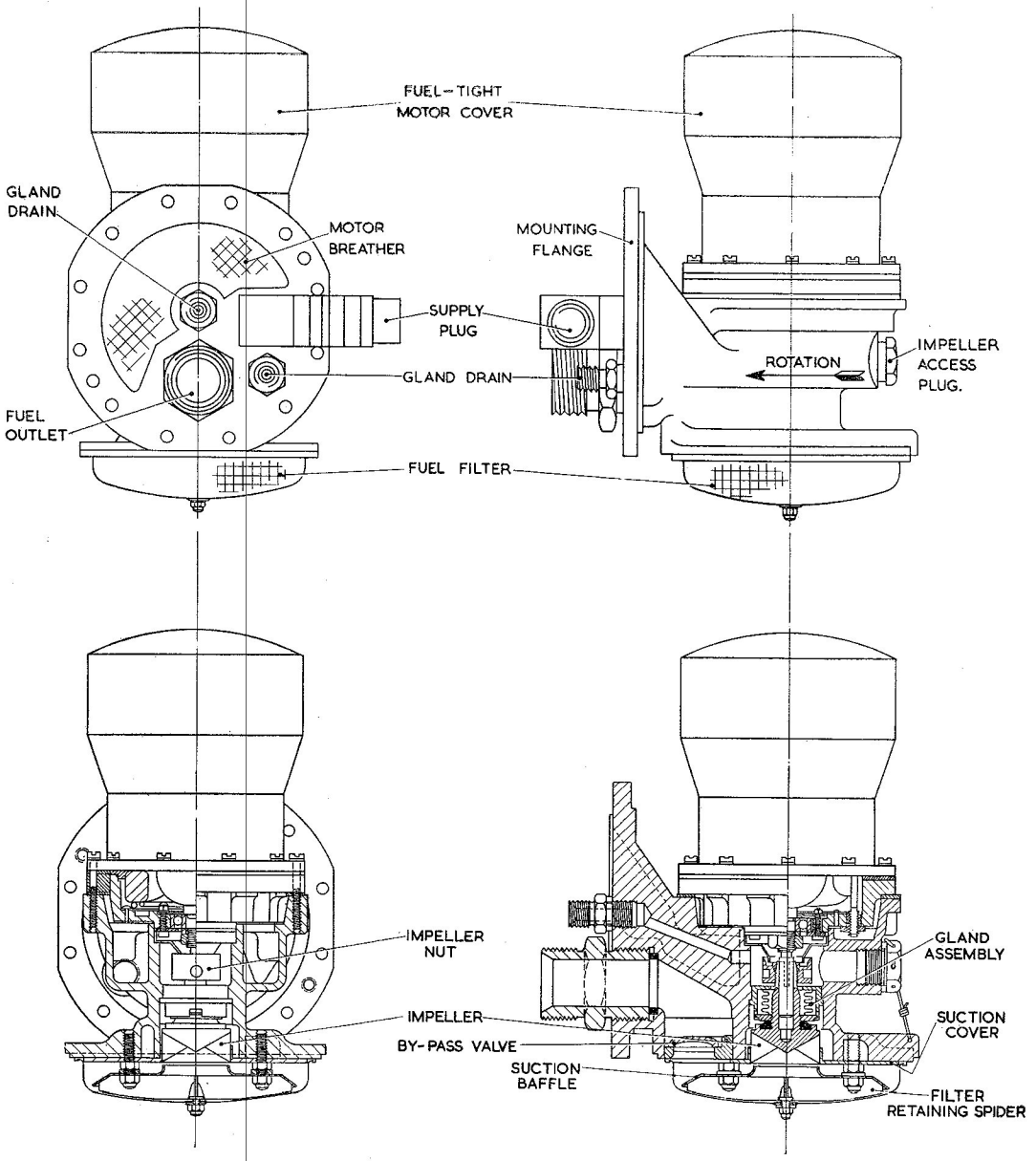

Fig. 1. General and part section view of FB 60 pump

Introduction

1. Although the FB60 Mk. 4 pump is basically similar to others in the FB group, the body of the pump is different in that the mounting flange is on the side of the unit, to permit mounting internally on the side of the fuel tank. The only portion of the unit to be presented to the outside of the tank is that on which are mounted the fuel outlet, motor breathing aperture, gland drains and the electrical supply plug.

2. The general instructions for repair and reconditioning (A.P.4343, Vol. 6, Sect. 16, Chap. 1, and Appendix 1 thereto) are applicable unless otherwise stated in the following paragraphs.

RECONDITIONING

3. In addition to the normal tools and workshop equipment the following demandable items will be required for reconditioning the FB60 Mk. 4 pump; pending allocation

of Stores Ref. numbers, the manufacturer's part numbers are quoted.

	Part No.
Tool for gripping impeller	92911
Impeller nut tommy bar	92915
Tool for pressing gland into housing	00407

4. Another tool, for gripping the armature shaft, may be manufactured locally from brass or gunmetal to the dimensions given in fig. 3. It is essential that a good finish be obtained in the 7·00/7·002 mm. hole in order to avoid damage to the armature shaft, and it is advisable to round off all corners to provide a comfortable grip.

DISMANTLING

5. When dismantling the pump, the precautions set out in A.P.4343, Vol. 6, Sect. 16, Chap. 1 must be observed, especially with regard to cleanliness, avoiding damage to the impeller, marking mating parts, and safe retention of screws, clips, etc.

Filter and baffle cone

6. Remove the filter at the base of the pump by unscrewing the securing nut in centre of the base and put the filter in a safe place so that it may, if undamaged, be used again. Undo the five nuts which secure the suction baffle cone (*fig.* 1) and remove the cone, taking care not to lose the nuts or the spacing washers which lie immediately behind the cone.

Suction ring

7. Mark the suction ring and the body of the pump so that the ring may be correctly replaced and remove the five nuts, as well as the hexagon headed screw, which secure the ring. Carefully remove the ring from its seating in order to avoid damaging the impeller.

Impeller

8. Remove the impeller access plug and turn the impeller with the fingers until one of the holes in the impeller securing nut can be seen through the access aperture. Then insert one end of the tommy bar, Part No. 92915 (*fig.* 2) into the hole in the impeller nut. This will enable the nut to be held stationary whilst using the impeller gripping tool (Part No. 92911) as described in the next paragraph.

9. Hold the gripping tool (*fig.* 2) in one hand and with the other hand turn the brass tightening screw by means of its short tommy bar until the jaws of the tool open sufficiently to pass over the impeller. Turn the wing screw well back to ensure that it will not foul the end of the impeller and so prevent the tool being pushed right over the impeller. Push the tool over the impeller till it covers the blades and rotate the short tommy bar until the jaws close on the impeller. Then tighten the wing screw until the lip at the edge of the jaws engages on the back of the impeller (*fig.* 2). When this has been done, carefully tighten the jaws just sufficiently to grip the impeller; do not use force or the impeller will be damaged. Now remove the impeller from the shaft by turning the tool whilst, at the same time, holding the impeller nut stationary, afterwards pulling the impeller squarely off the shaft.

10. Examine the impeller and if its condition is unsatisfactory return it to

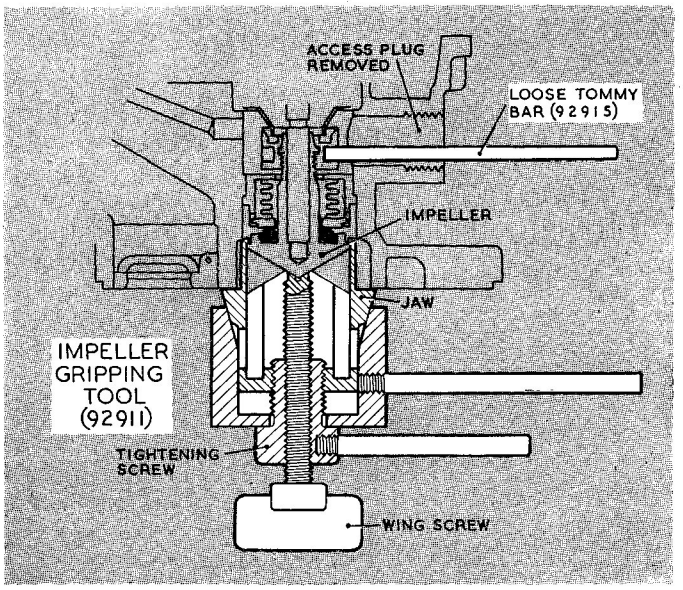

Fig. 2. Tool for gripping impeller

stores with a demand for a new one. Alternatively, if the circumstances warrant such procedure, treat it as described in A.P.4343, Vol. 6, Sect. 16, Chap. 1, App. 1.

Motor

11. Remove the ten screws around the motor flange, taking care to mark the motor flange, securing ring and pump body to ensure correct re-assembly. Ease away the joints at the sealing surfaces of the motor cover and motor flange and remove the cover and motor from the pump body. Care must be taken during this operation in order to avoid damage to the bellows gland. Do not lose the small driving pin in the motor shaft ; it will be required when re-assembling. Check the motor shaft for possible eccentricity (which must not be in excess of ± 0·001 in.), remove and examine brushes and remove the cooling fan, taking care not to lose its driving pin.

12. Unscrew the motor through bolts, but do not remove the brush-holder clamping bolts, and separate the commutator end-frame from the field yoke, leaving the drive end-frame in position. Unscrew the nut on the drive end of the armature shaft by gripping the commutator end bearing seating of the shaft with the special tool (*fig.* 3) whilst turning the nut. Remove the nut and its neighbouring slinger ring and extract the armature from the motor. Unscrew the retaining plates securing the drive end bearing, and extract both the drive end and the commutator end bearing. These bearings may be extracted by gently tapping the inner race, using a soft brass or an aluminium drift.

13. Check the commutator for truth with a dial indicator and vee blocks. The total permissible eccentricity is 0·001 in. (i.e., ± 0·0005 in.). Also check fits and clearances in accordance with the details given in Appendix 1 to this chapter.

14. The cleaning and examination of the field and armature coils, as well as the other motor components, are to be carried out in accordance with the instructions in A.P.4343, Vol. 6, Sect. 16, Chap. 1 and Appendix 1 thereto, especially with regard to the instructions pertaining to the non-removal of the brush holder.

Bellows gland

15. Whilst the motor is separated from the pump body, examine the bellows fuel gland. In instances where the bronze

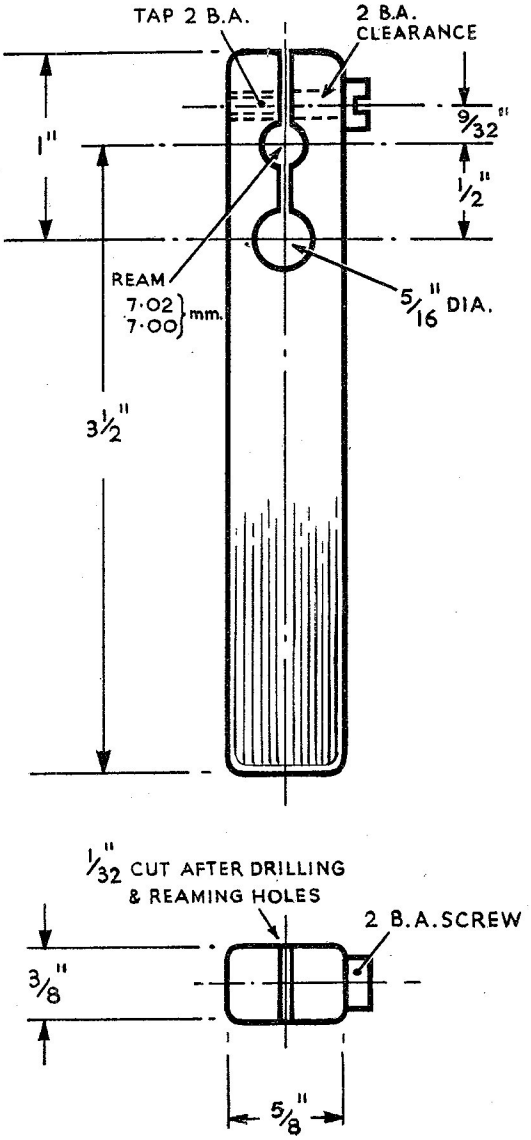

Fig. 3. Tool for gripping armature shaft

sealing face is damaged or worn, a new gland must normally be fitted. Instructions for fitting a new gland as well as temporary expedient measures, are given in A.P.4343, Vol. 6, Sect. 16, Chap. 1, App. 1. (The pressing tool for the gland is Part No. 00407).

ASSEMBLING

Motor

16. Fit new ball bearings in both the motor end frames, ensuring before doing so that the bearings are a satisfactory fit on the appropriate ends of the armature shaft.

Fit the retaining plates on both sides of the drive end bearing, using a small amount of gasoline proof jointing compound to seal the retaining plate on the pump side of the drive end frame. Care must be taken to ensure no compound entering the interior of the bearing.

17. Assemble the armature into the motor body, ensuring that the driving end of the shaft is correctly seated into its bearing and then fit the insulation washer, followed by the distance piece on the commutator end of the shaft. Fit the commutator end frame and brush assembly to the motor body and tighten the motor through-bolts as evenly as possible, gently tapping the end frames around their peripheries, with a rawhide mallet, to ensure that the frames bed home fully. Whilst this is being done, check that the armature turns freely and that the motor leads have been fed through the end frame without any possibility of fouling moving parts.

18. To prevent the motor through-bolts turning, lock them by peening the metal surrounding the heads of the bolts into the slots in the heads. Alternatively, on types where locking tabs are fitted, the tabs must be secured under the heads of adjacent brush gear screws. The brush gear screws must be left loose until the through-bolts are fitted and tightened. Swing the locking tabs into position over the heads of the through-bolts, tighten the brush gear screws and push one tag of each of the locking tabs into the screwdriver slot of the adjacent through-bolt.

19. Replace the slinger ring and apply two or three drops of gasoline proof jointing compound to the shaft at the centre of the ring. Fit the spring washer and tighten its associated nut by hand, or fit the " Twicklip " where this alternative method of securing is used. Fit the driving pin, fan, tab washer, and fan securing nut, employing spacing washers when necessary to ensure clearance between the motor end frame and the fan. Tighten the fan nut with a box spanner whilst holding the drive end nut of the shaft with another box spanner. When this has been done, ascertain that the armature will still spin freely.

Armature truth

20. After fitting the fan, check the armature for truth; eccentricity must not exceed $\pm$ 0·001 in. Also check the spigot on the drive end frame for concentricity. This may be done by supporting the armature on lathe centres and gently rotating the motor body on the armature bearings, checking the truth by bringing a dial indicator to bear on the spigot. The total range of movement must not exceed 0·002 in. Unless the through-bolts have been tightened evenly, the drive end frame will not run true. If necessary, remove the fan, check that the frames are fully bedded home on the motor body, make sure that the through-bolts have been tightened and again test for truth.

Brushes

21. Fit the numbered brushes the correct way round in their respective holders. In instances where new brushes are necessary, make sure that they are properly bedded in on the commutator before assembling the motor to the pump assembly. Then fit a small pulley (*para.* 22) to the shaft and run the motor for a short while on a light load, at a suitable 24-volt supply. During this trial run, the current consumption should not exceed 3·0 amp.

Torque test

22. Test the motor for power output on 24 volts and on 29 volts, using a torque test rig similar to that described in A.P. 4343, Vol. 6, Sect. 16, Chap. 1, App. 1. On 24 volts, a torque of 10 oz. in. should be obtained with a minimum speed of 8,400 r.p.m., whilst with a 29-volt supply, a torque of 14 oz. in. should be obtained with the motor running at a minimum speed of 10,000 r.p.m. With the test rig referred to, the recommended size of pulley to be fitted on the shaft will be 1-inch radius, whilst weights totalling 16 ounces should cover the requirements of both tests.

Fitting motor to pump body

23. Place the impeller driving pin in its position on the impeller shaft and slip the impeller nut on to the shaft prior to presenting the motor to the pump body; this cannot be done subsequently. Feed the motor leads through the passage leading to the electrical supply plug on the pump body and carefully fit the motor to the pump body, using a new gasket, if necessary, between the motor and the pump. Make sure that the impeller shaft does not foul and damage the bellows gland during this

operation. Also ensure that the motor takes up its correct angular relationship to the pump body. When this has been done, assemble the electric leads to the supply plug, and secure the latter in position.

24. Fit the motor and its clamping ring, interposing a new gasket between the ring and the upper edge of the pump body. Fit the ten screws round the periphery of the cover and tighten them evenly to ensure a fuel tight joint between the cover and pump body.

Impeller

25. Take particular care to ensure that the gland sealing face and impeller carbon ring are absolutely clean before fitting the impeller. Grip the impeller in the gripping tool (*para.* 9) and feed the impeller on to the impeller shaft, engaging the driving pin on the shaft in one of the four slots in the impeller. Whilst this is being done, guide the impeller nut on to the tapered neck of the impeller chuck by means of a suitable soft metal implement inserted into the impeller access aperture. When the face of the impeller gripping tool touches the forward face of the impeller chamber, the impeller will be in its correct axial position on the shaft and the impeller nut must then be tightened by holding it with the tommy bar (*fig.* 2) whilst the impeller is rotated by means of the gripping tool. Care must be taken not to bend the impeller shaft during this operation.

Inlet end components

26. Press the by-pass valve into its housing, check that the valve is absolutely clean and that the valve flap operates freely to sit squarely on its seating when it is in the closed position. Fit the suction cover in position, ensuring that the by-pass valve inlet is not covered and that the tips of the impeller blades are flush with the outer face of the suction cover. Run on the cover securing nuts to finger tightness and carefully turn the impeller with the fingers to ensure that there is clearance between the impeller and the throat of the suction cover. This clearance, tested with a narrow feeler gauge, should not be less than 0·003 in. at any point. When this condition is satisfied, tighten the nuts with a spanner and place a spacing washer (*para.* 6) next to each of the nuts on each of the five securing studs. Also insert and tighten the hexagon headed securing screw. Fit the suction baffle cone on the studs and, having made certain that there is a small clearance between the outer edge of the impeller and the inner end of the suction baffle, screw on and tighten up the baffle securing nuts. Finally, insert a wire through the holes in the baffle and hexagon headed screw.

Clearance and running tests

27. At this stage connect a d.c. supply to the motor through a circuit similar to that used for the torque test (*para.* 22). Set the variable resistor to its maximum value, in order to ensure a very low voltage being applied to the motor, and switch on. Then very slowly adjust the voltage till the motor commences to turn, noting very carefully whether there is any indication of the impeller fouling. If there is the slightest indication of fouling the current must be switched off immediately and the cause investigated.

28. Assuming that the test in the previous paragraph has been satisfactory, adjust the resistance in the supply circuit gradually to increase the voltage across the pump motor terminals from 12 up to 24 volts. Allow the pump to run for not more than five minutes at 24 volts, then switch off and disconnect from the supply circuit. At no time during this test must the current exceed 5 amp.

29. When the foregoing tests have been completed, make sure that the domed fuel filter is perfectly clean and secure it to the spider in the baffle cone by means of the central nut and spring washer.

TESTING

General

30. A test rig is being developed on the lines of that shown in fig. 4. Whilst the ultimate design may differ in details, it will be basically similar and will be described in A.P.4343S, Vol. 1, Sect. 16 when finalized.

Performance test

31. Secure the FB60 pump by its mounting flange to the adapter plate so that when the plate is secured to the test tank the pump will be inside the tank and have its delivery and gland outlets, as well as the electric supply plug presented to the exterior of the tank. Make sure that the bolts securing the adapter plate are tightened to ensure that there will be no

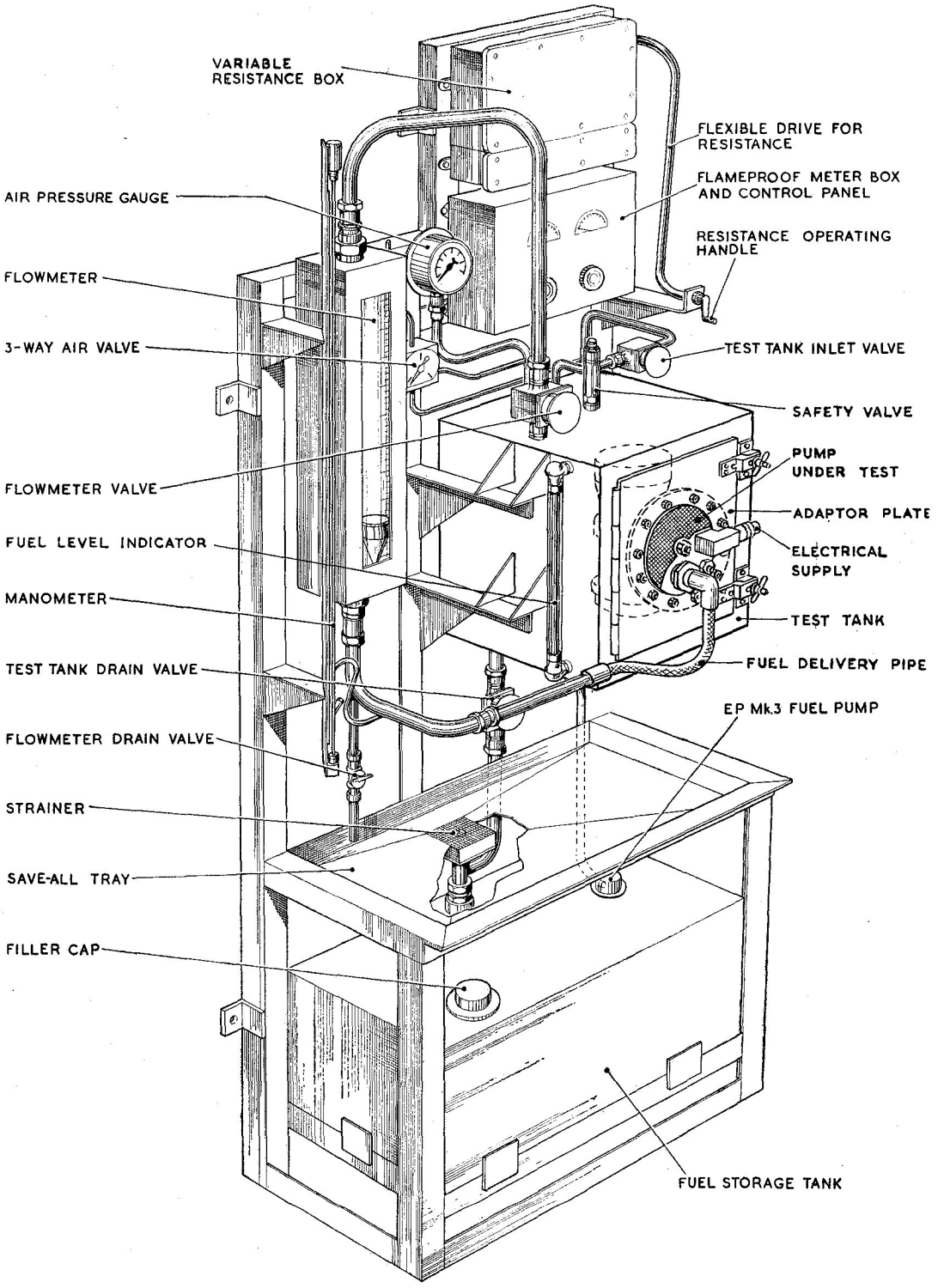

Fig. 4. Typical test rig

fuel leakage, and couple up the fuel delivery pipe of the rig to the pump delivery outlet.

32. Open the test tank inlet valve and the flowmeter valve ; also close the test tank drain valve. In addition make sure that the flowmeter drain valve is closed. Then switch on the electric supply to the E.P. pump in the storage tank and run the pump till the fuel level indicator on the test tank shows that the fuel level is sufficient to immerse the pump under test. Switch off the E.P. pump and close the test tank inlet valve. The test rig will now be ready for tests as described in the following paragraphs.

33. Connect the electric supply to the FB60 pump, switch on and adjust the input to 22 volts. Adjust the flowmeter valve till a fuel pressure of 8 lb. per sq. in. is recorded on the manometer and record the rate of flow as well as the current consumption. Allow the pump to run under these conditions for one hour and again record the rate of flow and current consumption. In the event of any appreciable change of performance, repeat the test run until steady results are obtained.

34. Repeat the above test with the input voltage raised to 29 and the flowmeter valve re-adjusted to give a pressure of 8 lb. per sq. in.

Gland leakage

35. Close the flowmeter valve and again run the pump on 29 volts for a short while, to permit the pump to be examined for gland leakage. With gasoline (or a test substitute, such as an approved distillate) the permissible leakage from the gland is two drops per minute when the pump is running, or one drop when stationary. If tested with kerosine the permissible leakage is four drops per minute when running and two drops per minute when stationary. In instances where the leakage is only slightly in excess of these limits, a cure may often be effected by running the pump on load for a period until bedding in of the rubbing surface of the gland is effected. In instances where the leakage is excessive, the test must be discontinued and the cause of leakage investigated.

Fuel delivery

36. When the tests detailed in para. 33 to 35 have been satisfactorily completed, check the performance of the pump to the following requirements, with the flowmeter valve open.

Volts	lb. per sq. in.	G.P.H. (*min.*)	amps. (*max.*)
22	5	400	6·5
24	9-12	200	7·0
29	10	450	7·5

Insulation

37. The insulation resistance of the motor must be tested prior to starting and after completing the performance tests (*para.* 31 *to* 36), while the motor is still warm. The insulation resistance must not be less than 2 megohms, measured on a 250 volt insulation resistance tester.

Protection

38. In all instances when the pump is not to be put into immediate service, protective caps must be fitted on the drain and the delivery connections. As an alternative, where suitable caps are not available, pieces of clean rag or other suitable material may be tied over the connections to prevent the ingress of foreign matter. In addition precautions must be taken to avoid the possibility of damage to either the fuel filter or the motor breather gauze.

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APPENDIX I — **SCHEDULE OF FITS, CLEARANCES, AND REPAIR TOLERANCES (FB.60, Mk. 4 FUEL PUMP)** — **(All dimensions in inches)**

Ref. No. on Diagram 1 (1)	Part and Description (2)		Dimension, New (3)	Permissible Worn Dimension (4)	Clearance, New (5)	Permissible Worn Clearance (6)	Remarks (7)
	MOTOR ASSEMBLY						
1	BRUSH LENGTH	Measured to centre of radius	0·4275 / 0·4475	0·330	—	—	Brush shortens approximately 0·010 in 250 hours
2	BRUSH SPRINGS	Free length	0·875	—	—	—	Pigtail is not taut at the permissible worn dimension quoted. Actual length of pigtail in spring 0·70
		Compressed length	0·375	0·482	—	—	
		Load in position	4·0 oz.	3·0 oz.	—	—	
3	BRUSH CLEARANCE AND GUIDES		—	—	0·007	0·013	
4	COMMUTATOR		0·990 / 1·002	0·970	—	—	Diameter reduces approx. 0·001 in 250 hours.
5	BALL BEARINGS	End float between inner and outer races	—	—	0·002	0·004	
	PUMP ASSEMBLY						
6	IMPELLER CHAMBER	Bore of bush	1·250 / 1·252	1·255	0·0145	0·022	Should not be worn by contact but may be scratched by abrasives in fuel. Minimum radial clearance (allowing for impeller eccentricity) should not be less than 0·003
	IMPELLER	Diameter	1·2345 / 1·2355	1·233	0·0175		
7	IMPELLER	Maximum eccentricity	0·004	—	—	—	Indicator reading

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A.P.4343D, Vol. 6, Sect. 7, Chap. 6, App. I

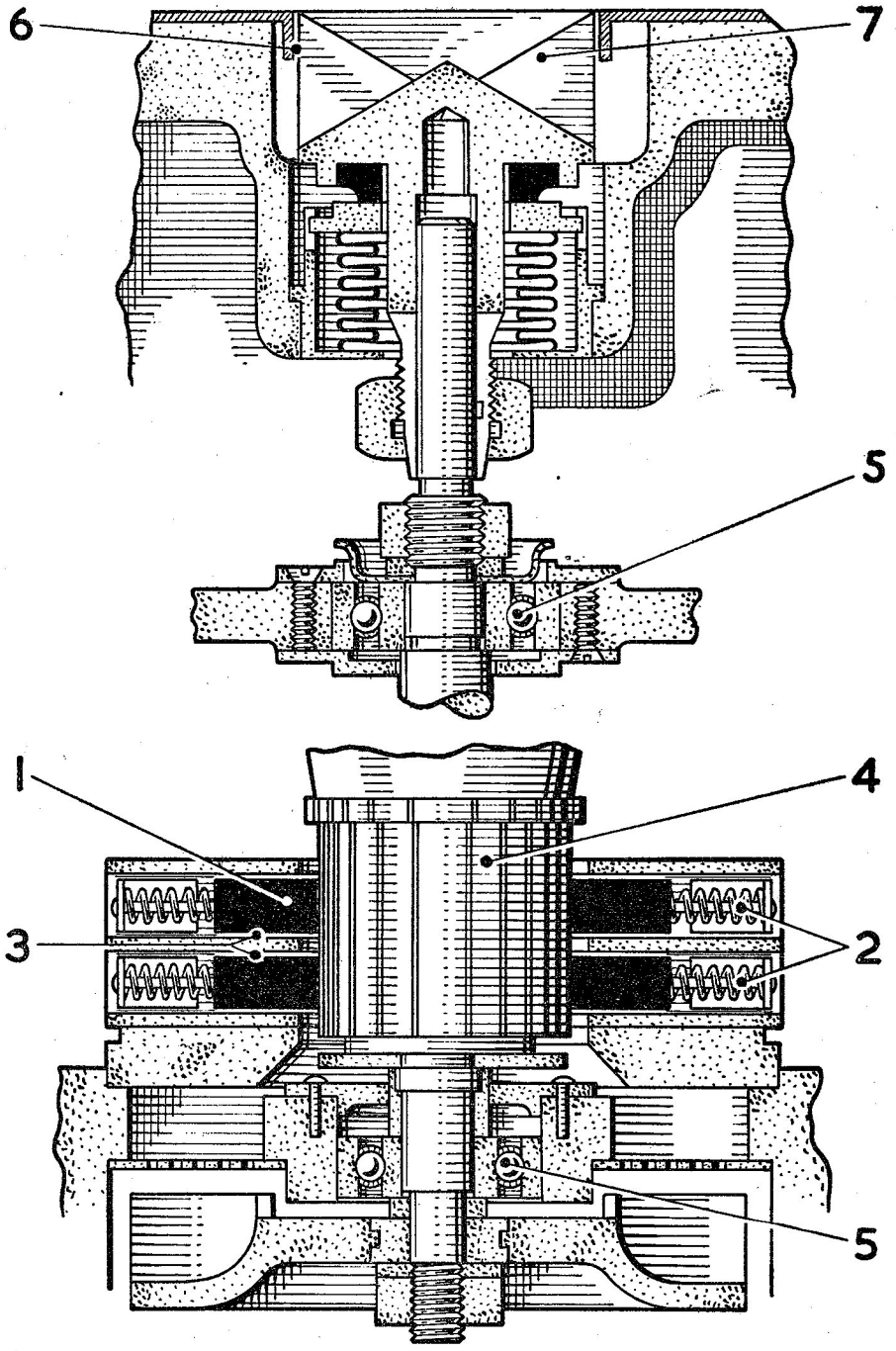

Diagram 1. Pump, fuel, F.B. 60, Mk. 4

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