Chapter 1

(Completely revised)

DESCRIPTION

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STARTER MOTOR

Introduction

1. The basic motor, plus installation fittings, is identified in a group which forms part of the starter system used in a particular aircraft, for example: starter system group 5/1 consists of two engine groups 5/E1, which is the basic motor, plus engine installation components, and airframe groups 5/A7 and 5/A8 for No. 1 and No. 2 engines respectively. This group 5/1 is used in Lightning F1, F1A and T4 aircraft.

2. Each type of starter motor is a single-stage, axial-flow, impulse turbine unit actuated by high pressure gases generated by the combustion of iso-propyl nitrate (AVPIN) fuel and directed on to the blades of a turbine rotor. The rotor drives an output shaft via epicyclic reduction gears.

3. The rotor can reach maximum speed, Table 1, at which speed control switch, connected electrically to the external control box, automatically shuts down the motor and the starter system. The gearbox reduces the maximum speed of the output drive shaft (*fig.* 16) to approximately 10100 rev/min (Group 5E and 23E), and 12000 rev/min all other groups.

4. The starter system groups, and aircraft in which each is installed, are listed in the appendices to Sect. 1, Chap. 3.

5. The principal component parts of the starter motor and the function of each are described in the following paragraphs and illustrated as shown, atomizer (*fig.* 5 *and* 7), combustion chamber (*fig.* 13), turbine unit (*fig.* 15), layshaft gear unit assembly (*fig.* 14) and the mounting flange assembly (*fig.* 16) which houses the output shaft; the output shaft carries the annulus for the gear train.

6. A detailed description of the starter motor and mechanical components is contained in the following chapter. Electrical components are described in the Air Publications referred to in Sect. 1, Chap. 3.

Identification of LTSA starters

7. The various types of LTSA starters are described in para. 5 to 8 and may be identified by reference to the following table:—

unit assembly, and an anchorage for the leads to the igniter plugs located opposite to each other near the smaller end of the combustion chamber. A vent tube from the gearbox terminates at the end plate where it is blanked off with a plug as it is no longer used. Two safety disc assemblies are inserted in the combustion chamber near the larger end. Flexible fuel and air hoses are used on the starter.

LTSA 70 starter (*fig.* 2)

9. The LTSA 70 starter, pre Mod. S276, Part No. CK.12175 is used in starter Groups 5E and 23E. This starter has a six hole nozzle plate and a side entry type atomizer. The combustion chamber is the same diameter as the LTSA 150 type, but it is shorter and has no end plate fitted. As this is a smaller capacity combustion chamber a smaller capacity fuel pump is used, although with the same 3 h.p. electric motor. The fuel pump delivery is 230 cm^3/sec compared with 360 cm^3/sec in the LTSA 150. An exhaust outlet with an external screw thread is located on the turbine casing instead of an exhaust manifold. This starter has rigid fuel and air pipes of $\frac{1}{2}$ in. and $\frac{5}{8}$ in. diameter respectively. The $\frac{1}{2}$ in. diameter fuel pipe is fitted into a larger $\frac{5}{8}$ in. diameter elbow in the fuel and air connecting block in the Group 23E starter only.

10. The LTSA 70 starter to Mod. S276 and S393 standard, Part No. 750/1/00622, used in group

TABLE 1

Identification of LTSA starters

Starter	LTSA 70 Group 5E and 23E (Pre Mod. S276)	LTSA 70 Group 5/E1 (Mod. S276 and S 393)	LTSA 140 Group 5/E2 (Mod. S405)	LTSA 150 Group 7E
Atomizer type	Side entry	Side entry	Side entry	Forward entry
Swirl chamber orifice dia.	0·225 in.	0·238 in.	0·238 in.	0·238 in.
Rotor speed rev/min	38000	44000	44000	44000
Combustion chamber length	8·84 in.	8·84 in.	8·84 in.	11·15 in.
Nozzle plate	6 hole	8 hole	8 hole	9 hole
Exhaust type	Outlet adapter	Outlet adapter	Outlet adapter	Manifold
Fuel pipe	Rigid $\frac{1}{2}$ in. dia.	Rigid $\frac{1}{2}$ in. dia.	◄ Rigid $\frac{1}{2}$ in. dia. ►	Flexible $\frac{5}{8}$ in. dia. (Group 8A)
Air pipe	Rigid $\frac{5}{8}$ in. dia.	Rigid $\frac{5}{8}$ in. dia.	◄ Rigid $\frac{5}{8}$ in. dia. ►	Flexible $\frac{5}{8}$ in. dia. (Group 8A)

LTSA 150 Starter (*fig.* 1)

8. The LTSA 150 starter, Part No. CK.12176 is used in the starter Group 8. It has a nine hole nozzle plate fitted in the larger end of the combustion chamber, and an end plate and forward entry type atomizer fitted to the smaller end. The end plate acts as a bracket to support the end of the exhaust manifold which is bolted to the turbine

5/E1, is a modified Group 5E starter with an 8 hole nozzle plate. This has a 2 h.p. electric motor but a fuel pump of the same capacity as the LTSA 150 starter and gives the same rotor speed of 44000 rev/min. This starter has rigid fuel and air pipes of $\frac{1}{2}$ in. and $\frac{5}{8}$ in. diameter respectively. The fuel pipe has an expanding joint at the mounting block end (*fig.* 12).

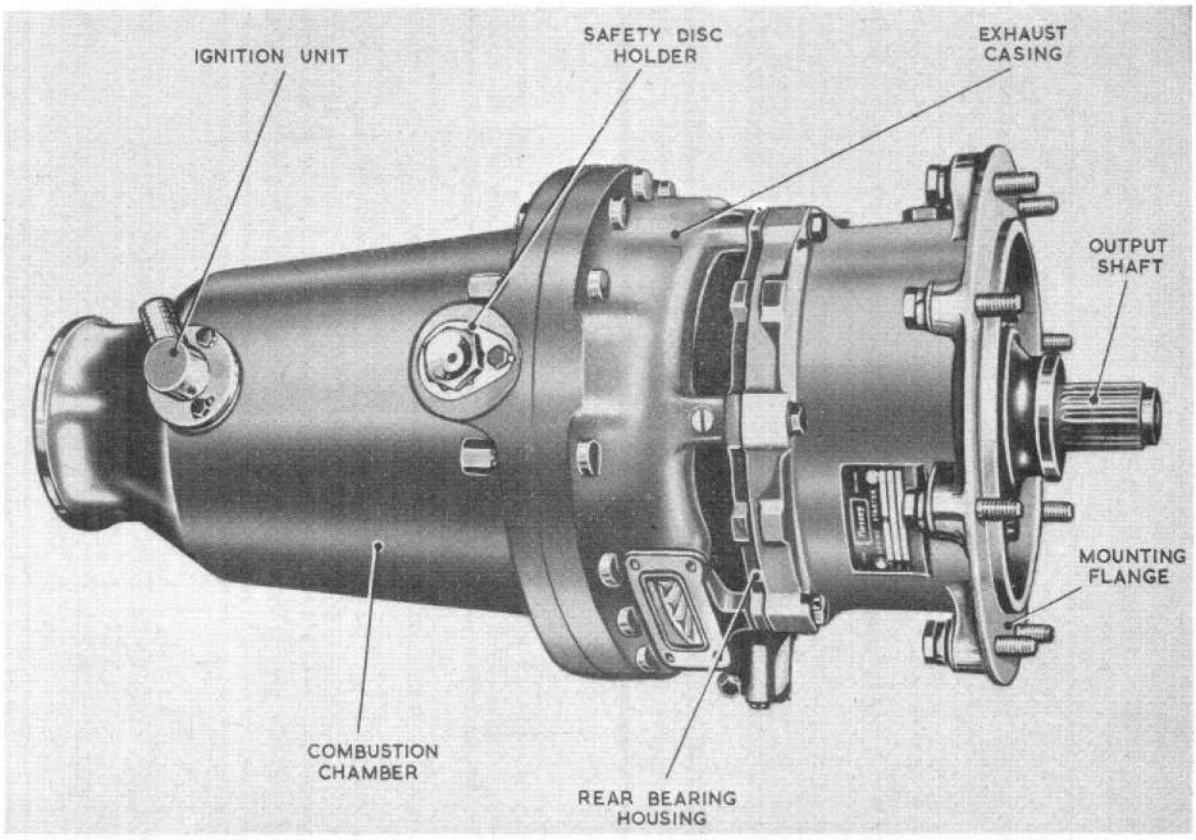


Fig. 1. LTSA 150 I.P.N. turbo-starter

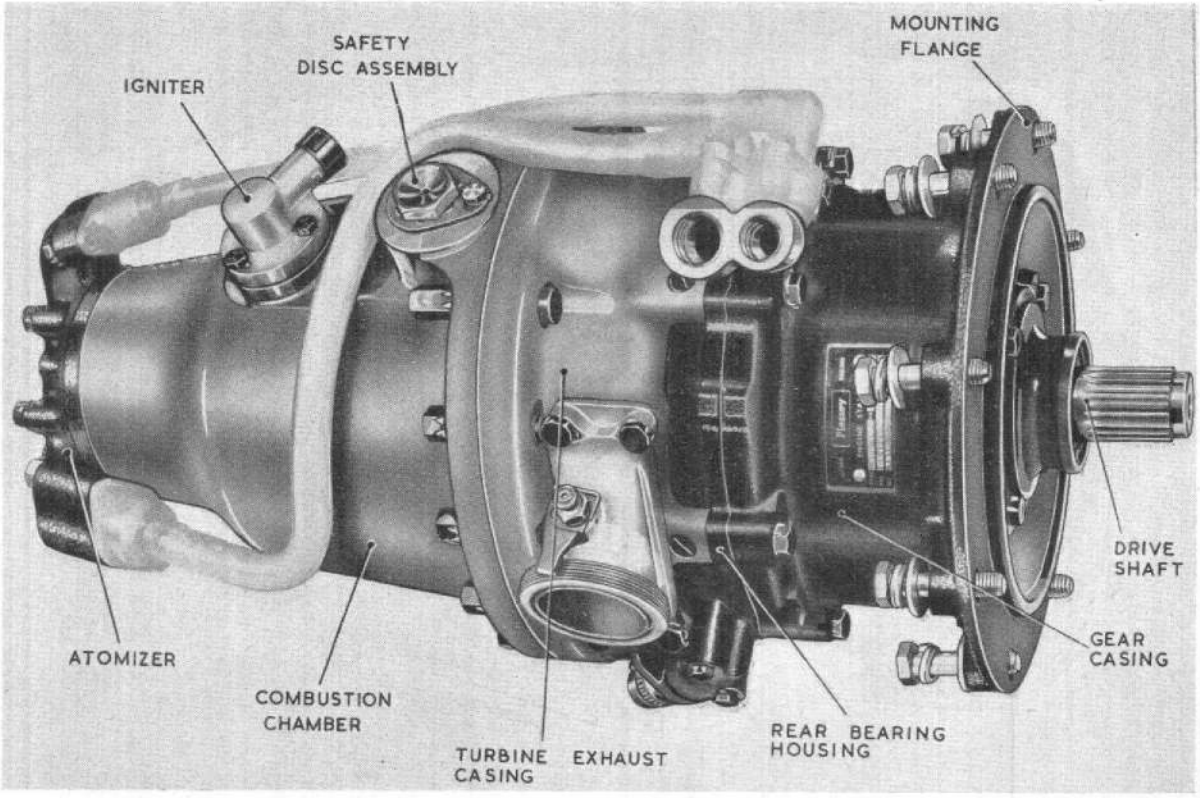


Fig. 2. LTSA 70 I.P.N. turbo-starter

LTSA 140 starter (*fig.* 3)

11. The LTSA 140 starter, Part No. CK.20142, used in starter Group 5/E2 is similar to the LTSA 70 starter to Mod. S276 standard, but with different connections to the atomizer ◄ and shorter pipes ► : flange joints with ◄ aluminium clad asbestos (a.c.a.) ► seals are used instead of synthetic rubber O-rings.

Atomizer

12. The atomizers used in all groups are of similar basic design, but, whereas the Group 7E type has direct entry ports for the fuel and air lines (*fig.* 5), the others have side entry ports (*fig.* 7).

13. The atomizer is bolted to the narrow end of the combustion chamber. It has two functions:—

(1) to supply the combustion chamber with air for scavenging, and

(2) with atomizer fuel ready for combustion.

The flow paths of fuel and air within the atomizer are illustrated in fig. 4 and 6.

14. Atomizer assemblies consist of: housing body, fuel and air valves, fuel distribution sleeve and swirl chamber. Air and fuel-tight seals between the various components of the assembly are provided by PTFE and synthetic rubber O-rings.

15. The air valve assembly is a conventional poppet valve consisting of a valve plunger, guide and spring, spring retaining plate and washer. The valve plunger is located in the guide, the top lip of which forms the valve seat, and the plate and washer retain the spring on the stem of the valve plunger.

16. Air valves are secured in atomizers by one of the following methods:—

(*a*) Group 7E—screwed sleeve and locking plate (*fig.* 5).

(*b*) Group 5E, 5/E1 and 23E—grooved sleeve with O-rings (*fig.* 7).

(*c*) Group 5/E2—flanged sleeve (*fig.* 8).

17. During the scavenging and injection cycle, air from the blower unit enters the atomizer via the air valve which opens at a pressure of 2 to 3 lb/in². The air passes into the combustion chamber through holes disposed radially around the fuel nozzle.

18. The fuel valve assembly is similar in construction to the air valve, with the valve guide forming the valve plunger seat; the two valves are not, however, interchangeable. During the injection, ignition and combustion cycles, fuel enters the atomizer via the fuel valve which opens at a pressure of approximately 25 lb/in². The fuel then passes through holes in the distribution sleeve and is directed through two tangential holes into the swirl chamber where it rotates and atomizes, being finally ejected through the swirl chamber nozzle into the combustion chamber of the starter. The size of the swirl chamber orifice is varied; in Group 5E and 23E starters it is 0·225 in. and, in all other groups, 0·238 in.

Fuel and air delivery pipes and hoses

19. On Group 5, 5/E, 8A and 23E starters the fuel and air delivery pipes/hoses are inserted into the atomizer and bolted to the housing, O-rings being used to make the joints fuel and air tight (*fig.* 9 *and* 10). On Group 5/E2 starters similar connections are made but without O-rings; a flange joint is used with an internal seal made of

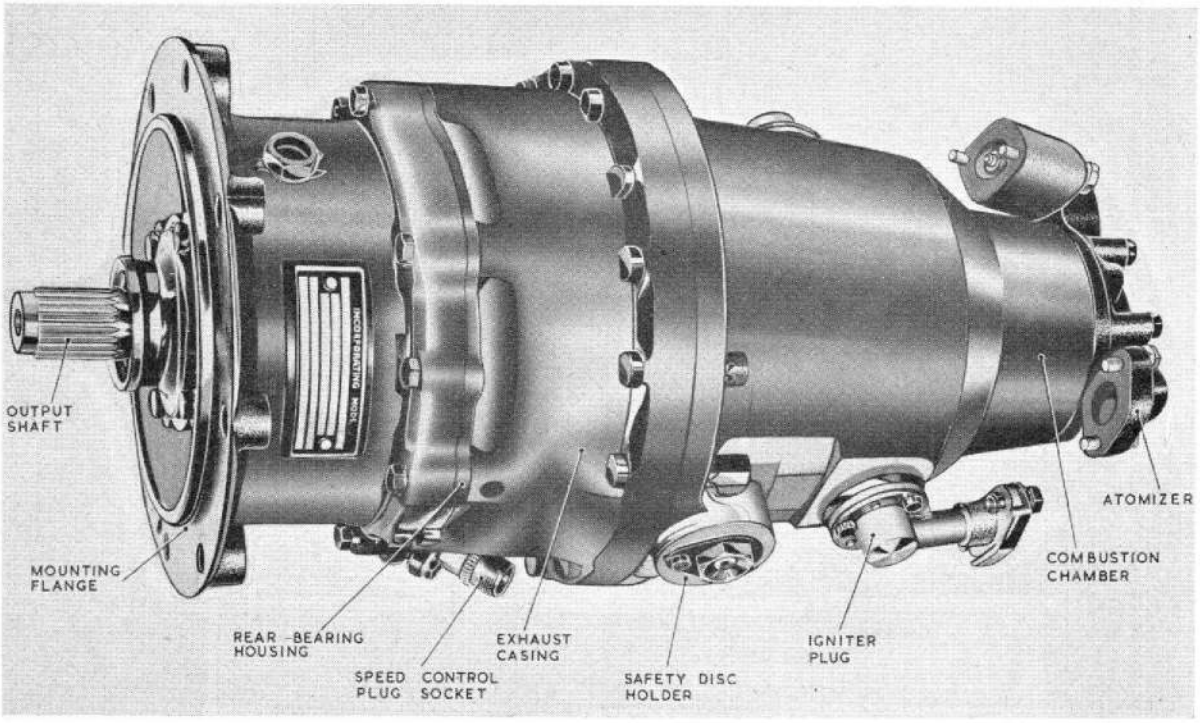


Fig. 3. LTSA 140 I.P.N. turbo-starter (pre-Mod. S368)

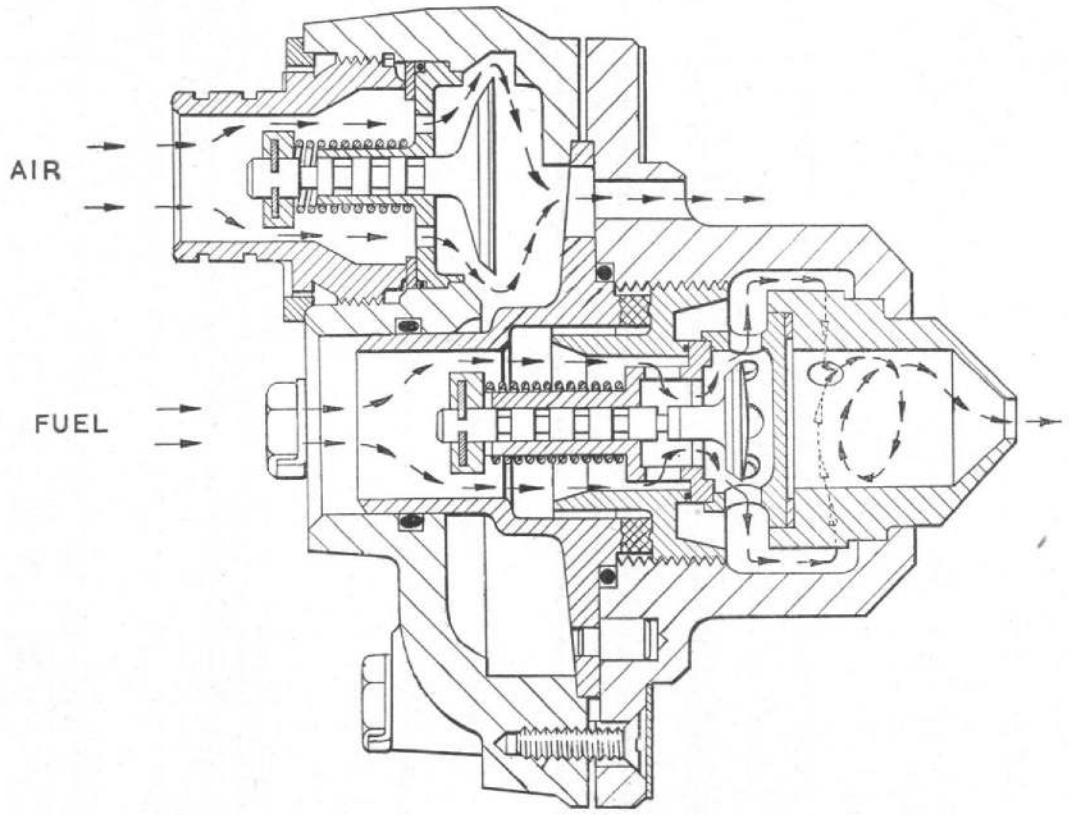
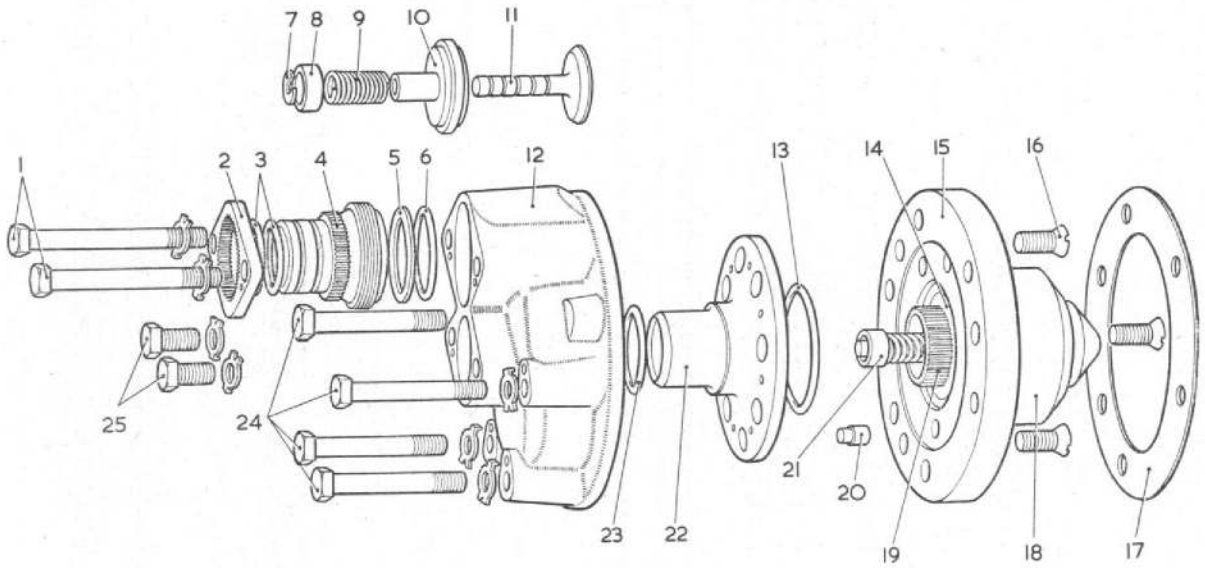


Fig. 4. Atomizer, forward entry type showing flow paths



1 AIR HOSE SECURING BOLTS AND MAIN ATTACHMENT BOLTS (LONG)
2 LOCK PLATE
3 O-RINGS
4 AIR VALVE SLEEVE
5 ALUMINIUM BACKING WASHER
6 O-RING
7 SPRING RETAINING WASHER
8 DISTANCE WASHER
9 SPRING
10 AIR VALVE GUIDE
11 AIR VALVE PLUNGER
12 ATOMIZER HOUSING
13 P.T.F.E. O-RING
14 P.T.F.E. SEALING RING (RECTANGULAR SECTION)
15 ATOMIZER BODY
16 RETAINING SCREWS (ATOMIZER BODY TO HOUSING)
17 GASKET
18 SWIRL CHAMBER
19 FUEL VALVE RETAINING NUT
20 LOCATING PIN
21 FUEL VALVE
22 FUEL VALVE SLEEVE
23 O-RING
24 MAIN ATTACHMENT BOLTS (SHORT)
25 FUEL HOSE SECURING BOLTS

Fig. 5. Atomizer, forward entry type

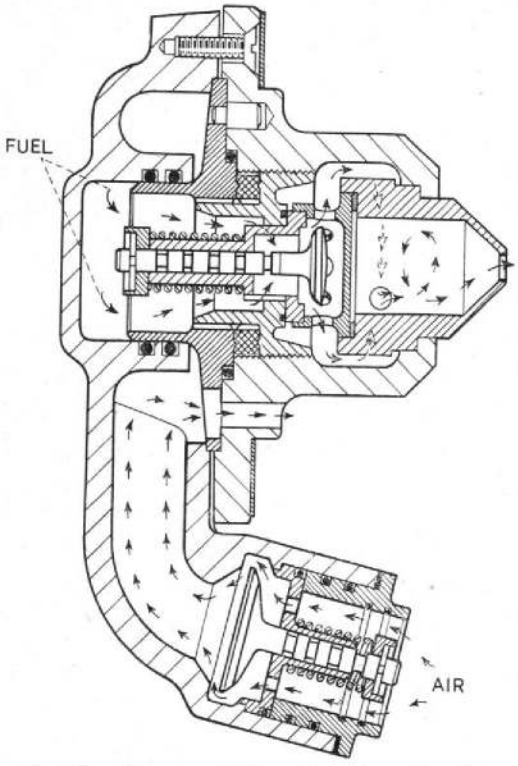


Fig. 6. Atomizer, side entry type, showing flow paths

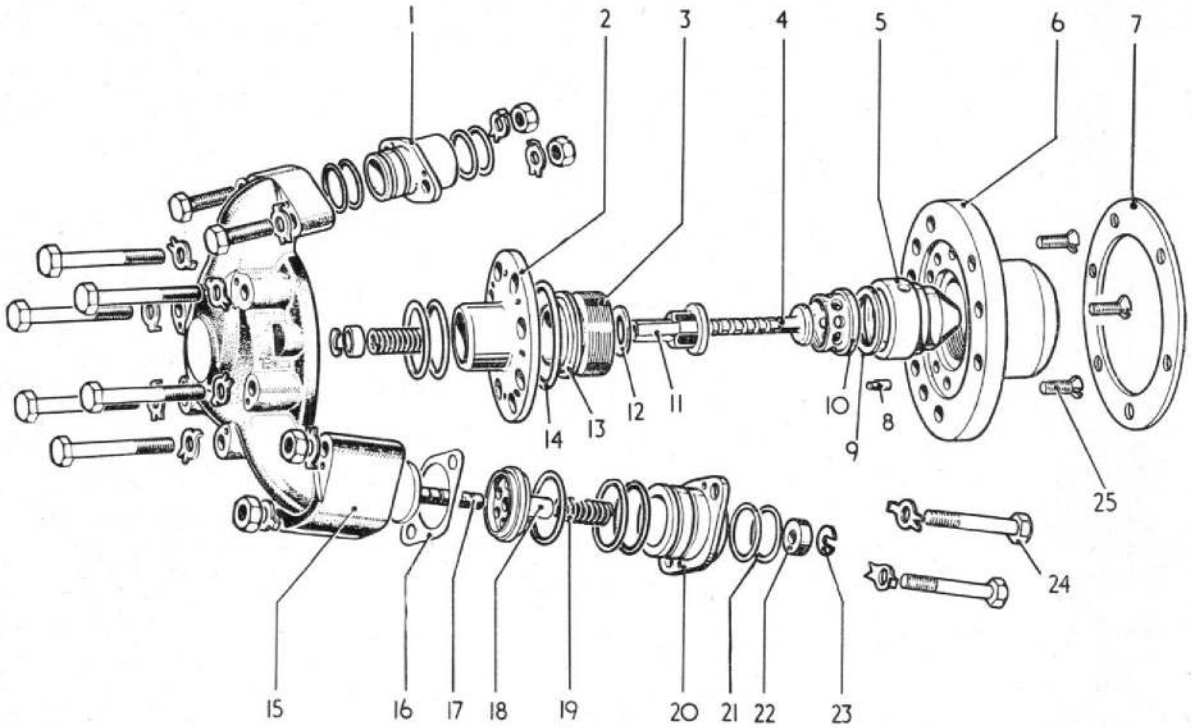
◄ aluminium clad asbestos (a.c.a.) ► positioned in a recess in the ◄ atomizer housing (*fig.* 12) the other end of the pipes being inserted into a muff on the combustion chamber, in which the pipes are free to move but are sealed with synthetic rubber O-rings. ► On Group 5/E1 starters with Mod. S393 incorporated the air pipe is sealed by O-rings. The fuel delivery pipe is secured to the atomizer by a bolted flanged joint and is sealed by a washer; the other end of the pipe has an expanding joint sealed by O-rings (*fig.* 12).

Combustion chamber (*fig.* 13 *and* 14)

20. The combustion chamber is essentially the same in each type of starter. The Group 7E chamber is larger than the others but of the same diameter. The combustion chamber is bolted to the rear bearing housing; clamped between these two components is the nozzle plate which forms the end wall of the combustion chamber. A series of convergent/divergent nozzles, drilled tangentially near the outer edge of the nozzle plate directs the gases on to the blades of the rotor which is positioned within the turbine unit. The number of nozzles varies with the type of starter. A bleed hole in the nozzle plate permits the fuel to flow from the combustion chamber to the exhaust system in the event of combustion failing to occur.

Igniter plugs

21. The atomized fuel enters the combustion chamber in a cone-shaped spray of approximately 90° angle. The edge of the cone of fuel just



1 FUEL PIPE SLEEVE
2 FUEL VALVE SLEEVE
3 FUEL VALVE RETAINING NUT
4 FUEL VALVE PLUNGER
5 SWIRL CHAMBER
6 ATOMIZER BODY
7 ATOMIZER GASKET
8 LOCATING PIN
9 ALUMINIUM GASKET
10 FUEL DISTRIBUTION SLEEVE
11 FUEL VALVE GUIDE
12 P.T.F.E. FACE SEAL
13 P.T.F.E. SEALING RING
14 O-RING
15 ATOMIZER HOUSING
16 SHIM
17 AIR VALVE PLUNGER
18 AIR VALVE GUIDE
19 AIR VALVE SPRING
20 AIR PIPE SLEEVE
21 O-RINGS
22 SPRING COLLAR RETAINING PLATE
23 SPRING RETAINING WASHER
24 AIR PIPE SLEEVE BOLT
25 COUNTERSUNK HEAD SCREWS

Fig. 7. Atomizer, side entry type ◄ (pre-Mod. S 393) ►

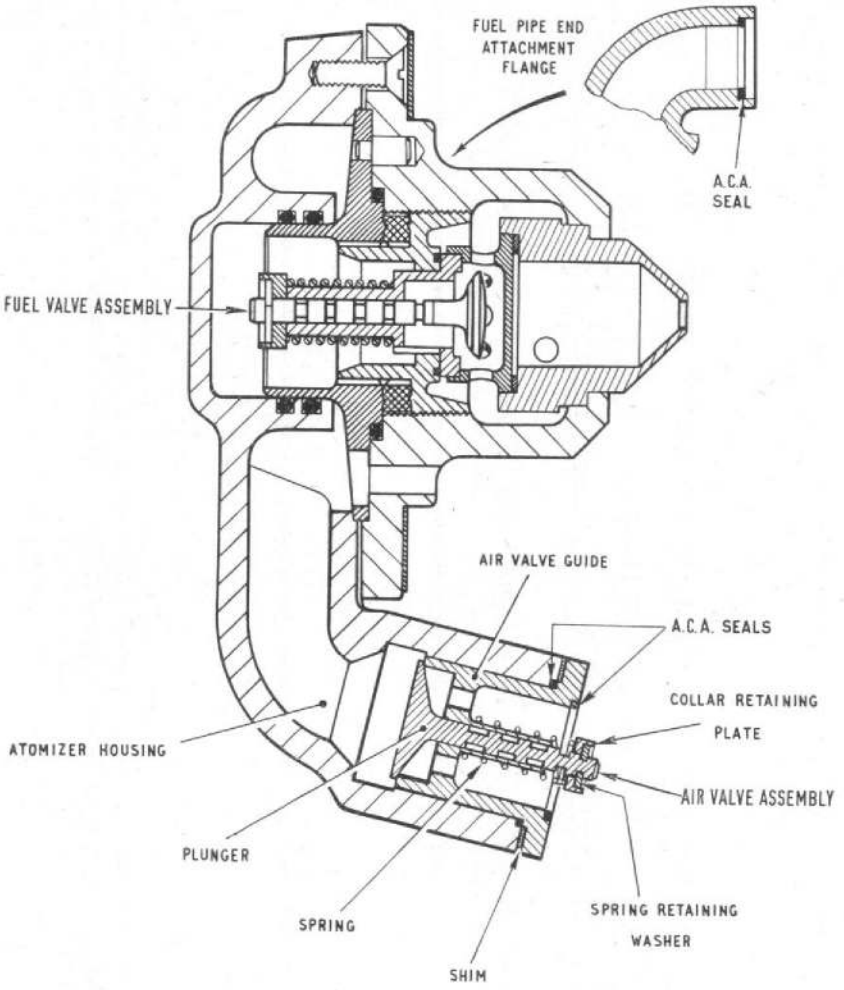


Fig. 8. Atomizer, side entry type (LTSA 140 starter)

immerses the electrodes of the two diametrically opposed igniters. The igniters provide a continuous timed and controlled, sparking discharge from the h.f. ignition unit.

Safety disc assembly

22. Two safety disc assemblies are fitted in the combustion chamber casing; each assembly contains a sheet metal diaphragm which ruptures if the gas pressure in the chamber rises excessively above the normal combustion pressure. On rupturing, the disc shears around its circumference and allows the gases to by-pass the nozzle plate and rotor, and to escape internally through the turbine exhaust volute to atmosphere.

Turbine unit assembly (*fig.* 15)

23. The turbine unit assembly is situated between the combustion chamber and the layshaft gear unit assembly. The principal components are the exhaust casing, the turbine wheel, the labyrinth assembly, the bearings, the rotor gear and the governor unit.

24. The steel rotor is an integral shaft and disc with 37 turbine blades screwed to the periphery of the disc. The exhaust volute casing is bolted to the combustion chamber and carries the bearing housing in which are located the ball and roller bearings. The rotor shaft is a press fit in the bearings and carries the rotating labyrinth component, the rotor gear and the governor unit.

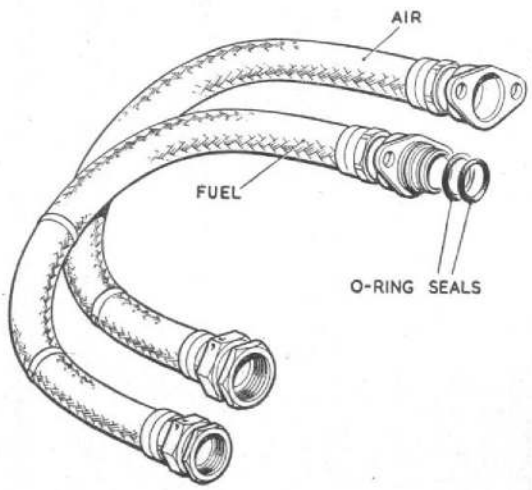


Fig. 9. Fuel and air delivery hoses, LTSA 150 Group 8/A

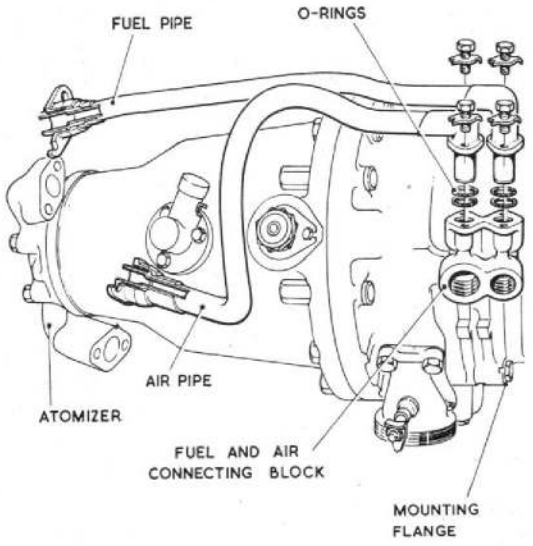


Fig. 10. Fuel and air delivery pipes, LTSA 70 Group 5/E and 23/E

25. The static labyrinth component is assembled to the exhaust volute casing; the correct axial clearance between the two labyrinth components is obtained by selective shimming. The labyrinth prevents, as far as possible, the spent gases passing into the gear compartment, and is shielded from the exhaust gas by a guide plate bolted to the exhaust casing. A further seal is provided by two piston rings positioned in a ring carrier on the rotor shaft which is in contact with the inner diameter of the cast iron clamp screw.

26. The rotor gear is splined on to the rotor shaft and forms a housing for the governor unit.

27. The governor unit (*fig.* 15) contains a cage in which are arranged three steel balls; under centrifugal action, the balls move outwards against the chamfered lip of an operating plunger. The plunger is thus forced, against the pressure of a spring, along the governor spigot towards the operating shaft of the speed control switch. At a rotor speed stated in the Leading Particulars in Sect. 1, Chap. 3, the plunger moves the speed control switch shaft sufficiently to open the switch contacts and shut down the starter system.

Layshaft gear unit assembly (*fig.* 16)

28. The three main components of the layshaft gear unit assembly are the layshaft bearing housing, the rear bearing housing and the speed control switch.

29. The layshaft bearing housing comprises an aluminium alloy casting in which are located three ball bearings, each carrying a planetary gear. The rear ends of the planetary gear shafts locate in roller bearings in the rear bearing housing which is bolted to the layshaft bearing housing. The planetary gears mesh with the gear on the rotor shaft.

30. The speed control switch (*fig.* 18), is bolted to the layshaft bearing housing, and is actuated by the plunger of the governor unit on the end of the rotor shaft. The switch arrangement comprises a moving bridge which in the normal, i.e. closed, position makes contact with studs on the contact plate. Connections from the contact studs are taken to a 2-pin plug which forms part of the speed control switch assembly. The plug mates with a socket in the rear bearing housing, through which the connections are taken to an external plug.

31. A vent tube (*fig.* 1) is fitted to the rear bearing housing to carry away any gas which has leaked past the labyrinth system in the turbine unit. (Mod. 148—LTSA 150 starter motor groups only).

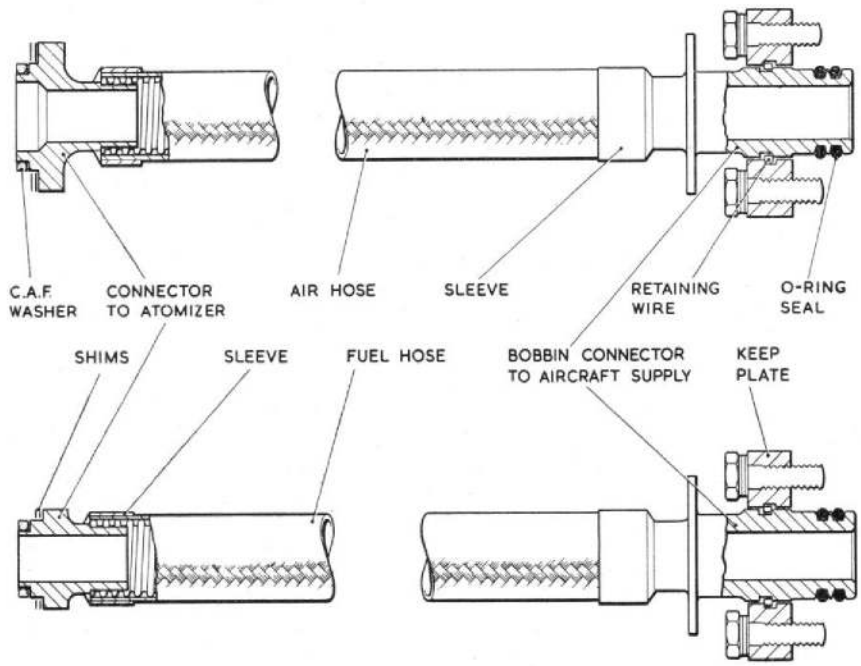


Fig. 11. Fuel and air delivery hoses, LTSA 140 Group 5/E2 ◂ (pre-Mod. S 405) ▸

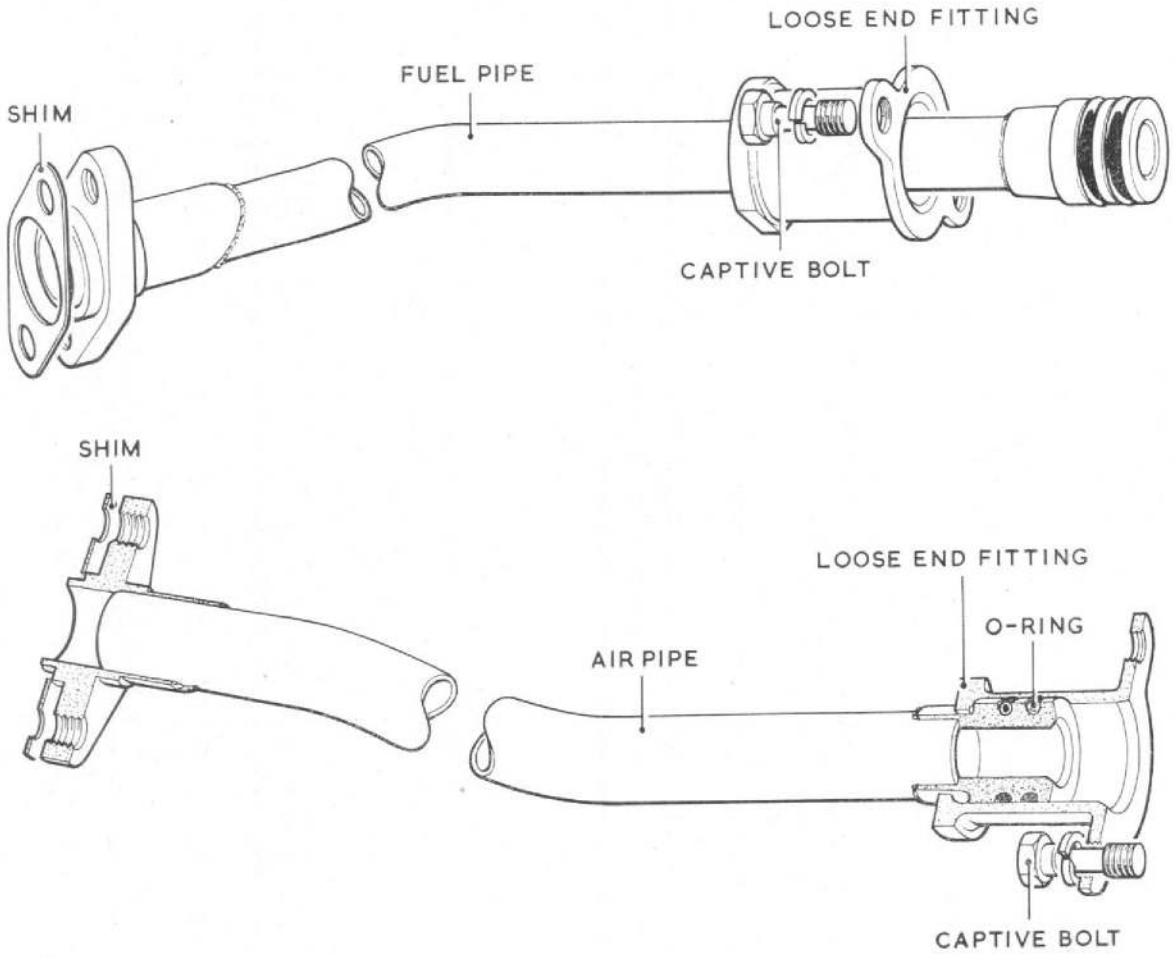


Fig. 11A. Rigid fuel and air pipes LTSA 140 Group 5/E2 (Mod. S405)

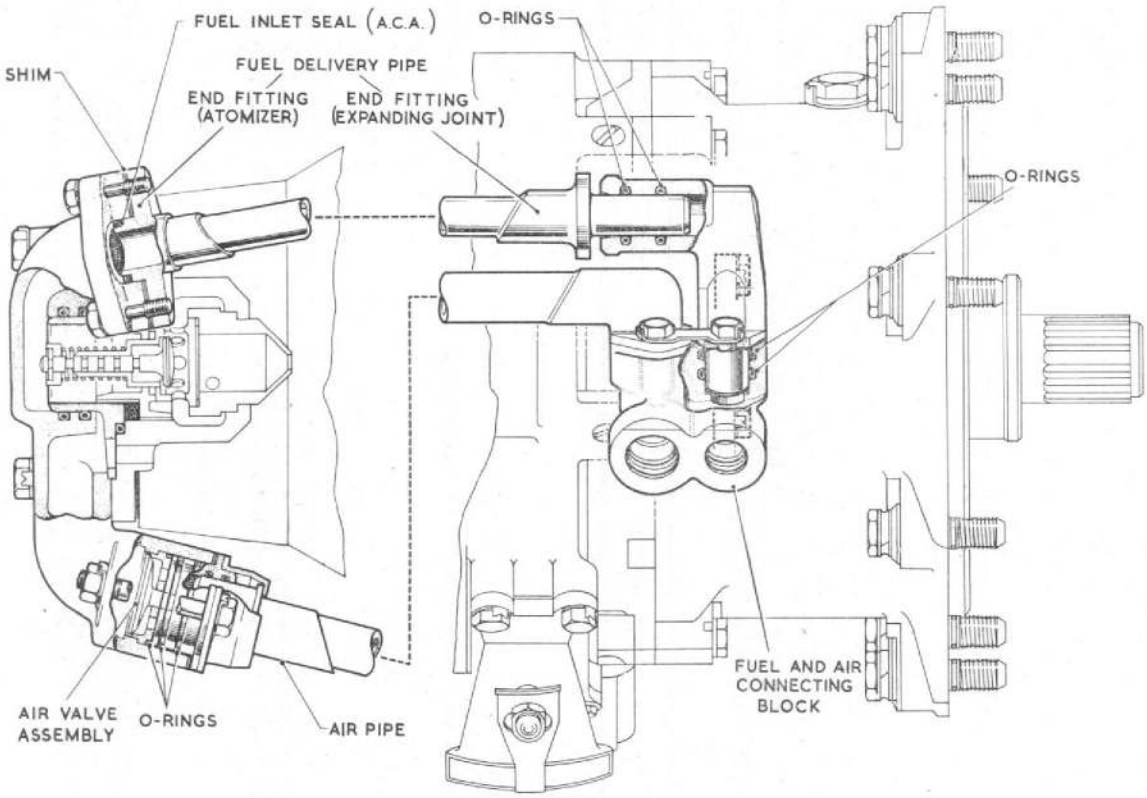


Fig. 12. Fuel and air delivery pipes, LTSA 70 Group 5/E1 ◄ (Mod. S 393 and S 505) ►

Mounting flange assembly (*fig.* 19)

32. The mounting flange assembly comprises an annulus gear and output shaft bolted together and located in a self-aligning ball bearing within the mounting flange casting. The casting is bolted to the exhaust volute casing, thus securing the rear bearing housing, and meshing the annulus gear with the planetary train in the gearbox.

33. When the starter is mounted on the engine, the starter output shaft locates in the reduction gearbox of the engine and the starter is held in position by eight captive bolts which form part of the mounting flange assembly. An oil filler plug is provided in the mounting flange casting.

MOTOR UNIT

Fuel pump, air blower and motor (*fig.* 20 *and* 21)

34. The fuel pump and air blower are driven by a 25V electric motor, the three units being bolted together to form one complete assembly. Different capacity pumps and motors are used in the various groups listed in Table 2 below. The fuel pumps and air blower are described in the following paragraphs; the motors are described in Air Publication 4343D, Vol. 1, Sect. 20.

Fuel pump

35. The purpose of this component is to pump fuel from the tank to the starter motor via the high pressure switch and the ignition switch.

36. The pump is of the spur gear type and is driven by the motor via a driving sleeve located in the air blower housing. The sleeve engages with a drive block which is keyed to the driving shaft of the pump. The driving and driven shafts run in pressure-loaded carbon bearings; a relief plate is incorporated in the assembly to maintain the correct balance of the hydraulic forces acting upon the bearings.

TABLE 2

Capacity of pumps and motors

Unit	Group 5/A5 & 5/A6	Group 5/A7 & 5/A8	Group 5/A9 & 5/A10	Group 8A	Group 23/A
3 h.p. motor	CZ 75300	—	—	CZ 75300	CZ 75300
2 h.p. motor	—	CZ 75280	CZ 75280	—	—
Large pump	—	CK 12162	CK 12162	CK 12162	—
Small pump	CZ 15167	—	—	—	CZ 15167

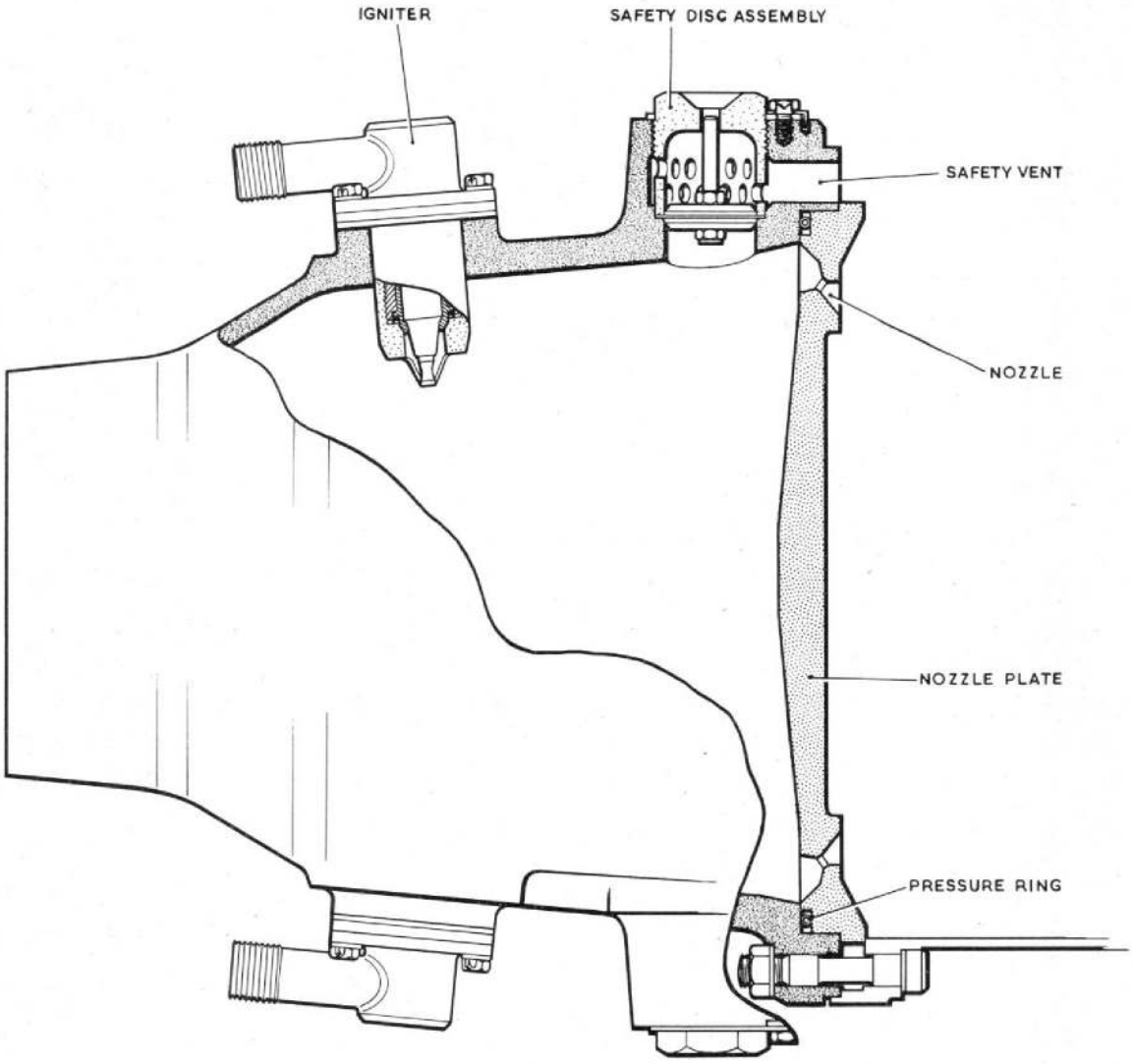


Fig. 13. Combustion chamber

37. The pump gear and bearing assembly is contained within a cylindrical cartridge which is retained in the pump housing by a locking ring. O-rings provide fuel-tight seals between the various components of the pump.

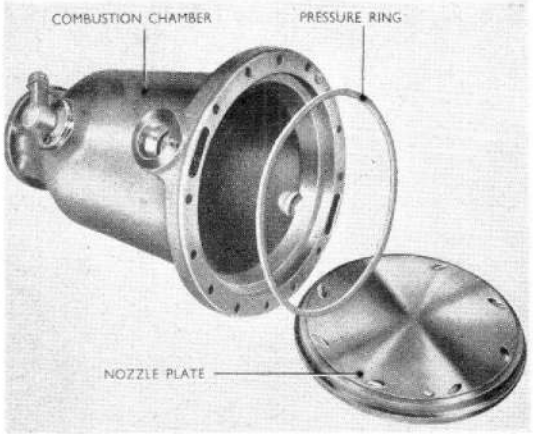


Fig. 14. Combustion chamber, with nozzle plate removed

38. A drain is provided to dispose of any fuel which has leaked past the O-rings. The drain union is fitted in one of four alternative positions depending upon the particular installation.

39. Air pumped from the blower to the starter passes along a duct within the fuel pump housing. Positioned on the side of the duct is the air dump valve which opens to release the air to atmosphere during the ignition and combustion stages of the starting cycle. The valve is of the normal poppet type with its stem projecting through the air duct into the pressure side of the fuel pump body. When the fuel pressure increases the pressure acting on the foot of the valve stem is correspondingly increased and the valve opens. An O-ring on the stem of the valve prevents fuel leaking into the air passage.

40. Also fitted to the pump housing is the fuel relief valve which opens should a blockage in the system cause the fuel pressure to exceed 800 lb/in^2. The valve is of the spring-loaded ball type; valve adjustment is obtained by inserting shims between the valve spring and the spring cap.

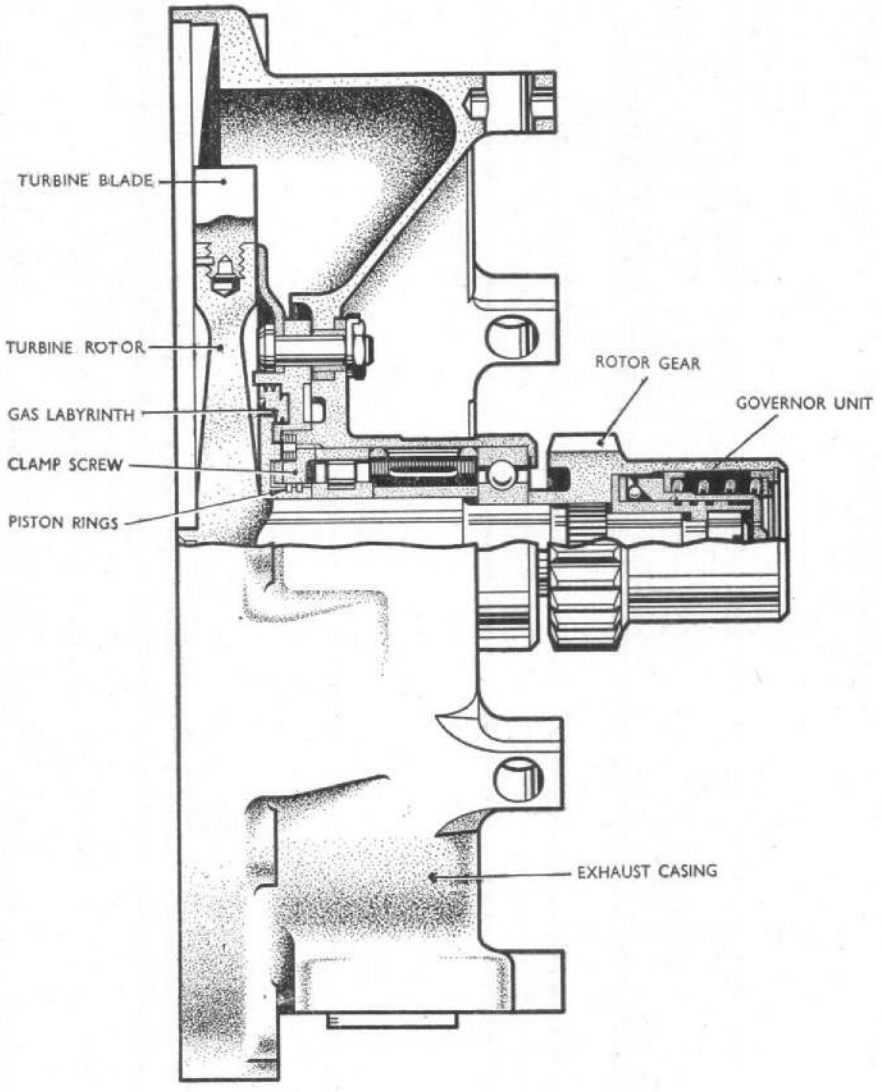


Fig. 15. Turbine unit

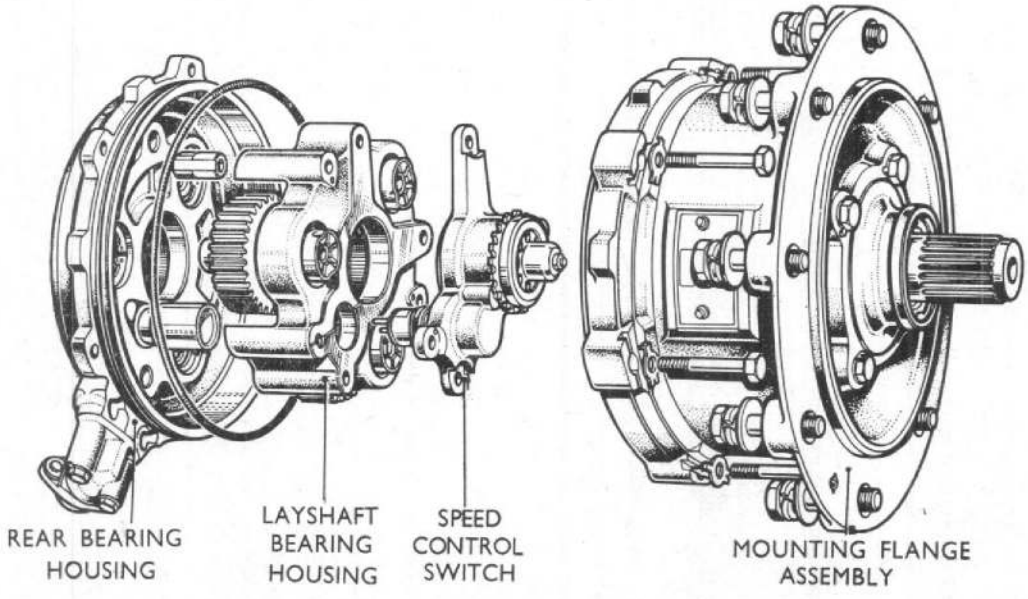


Fig. 16. Layshaft gear unit and mounting flange

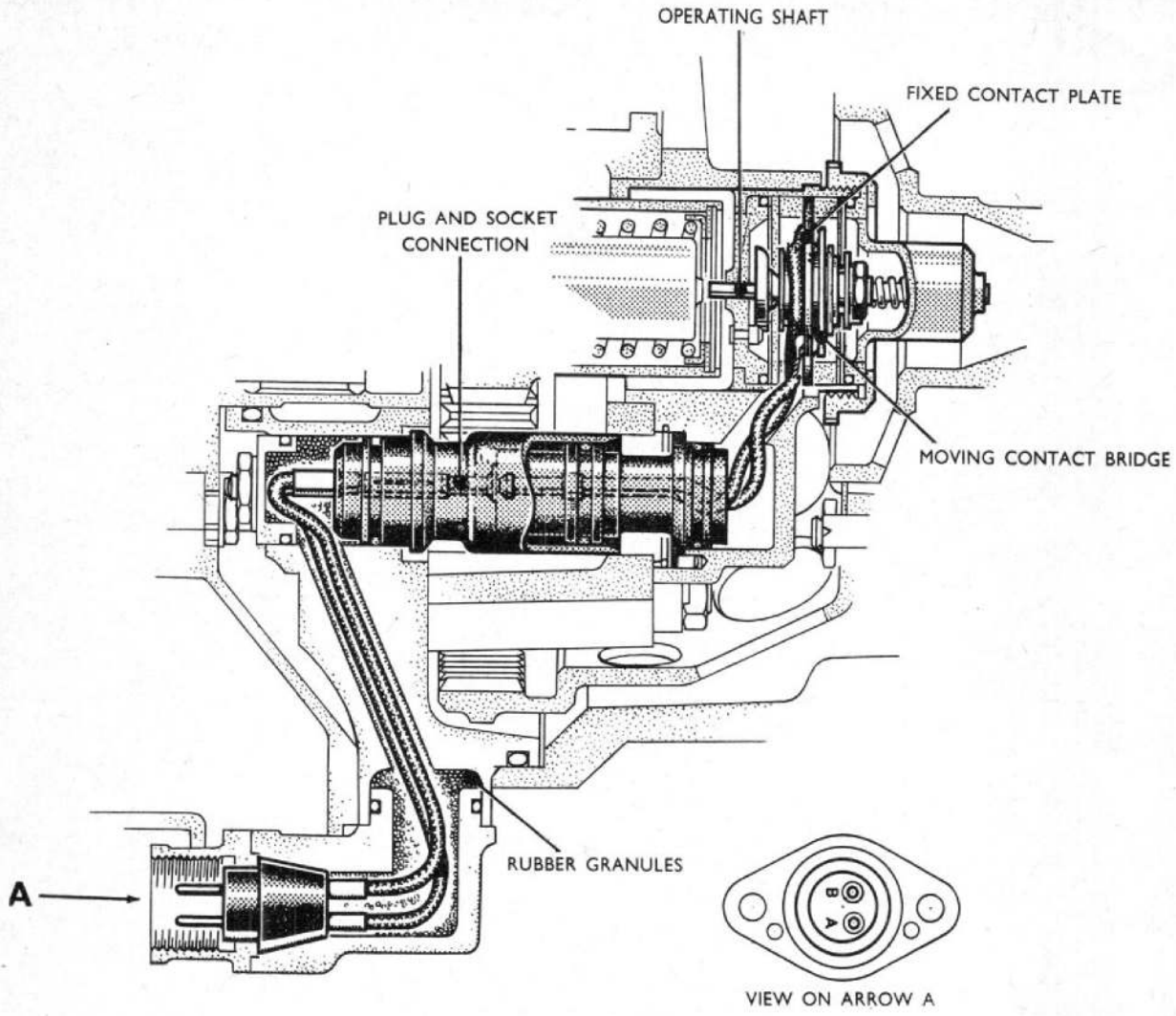


Fig. 17. Speed control assembly

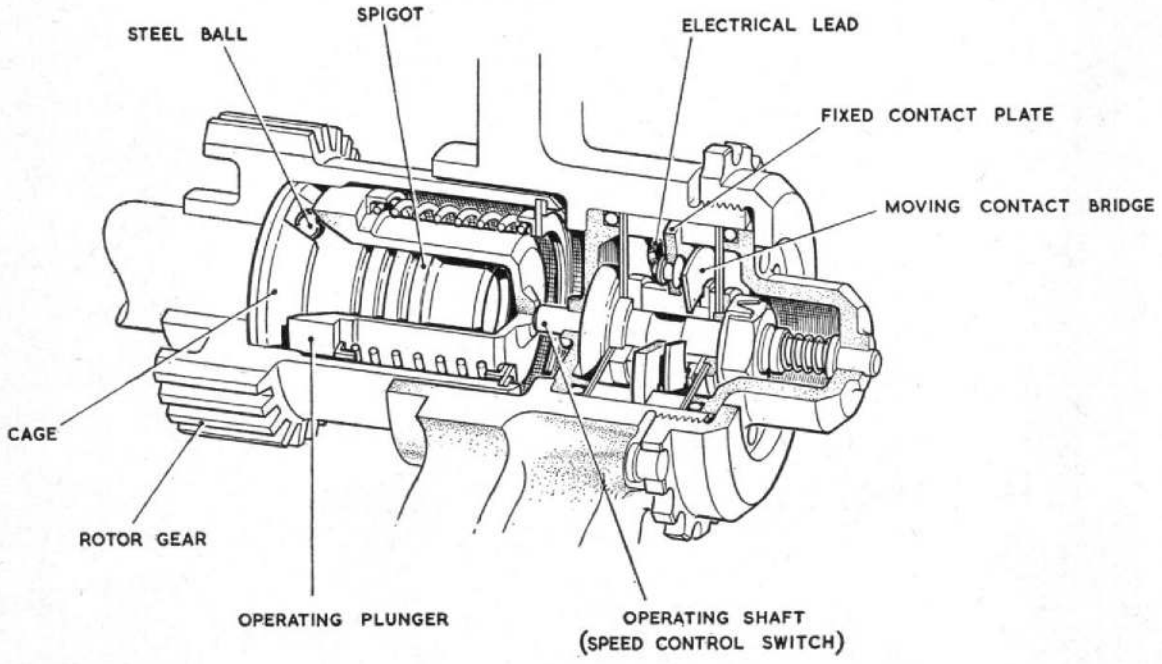


Fig. 18. Governor and speed control switch

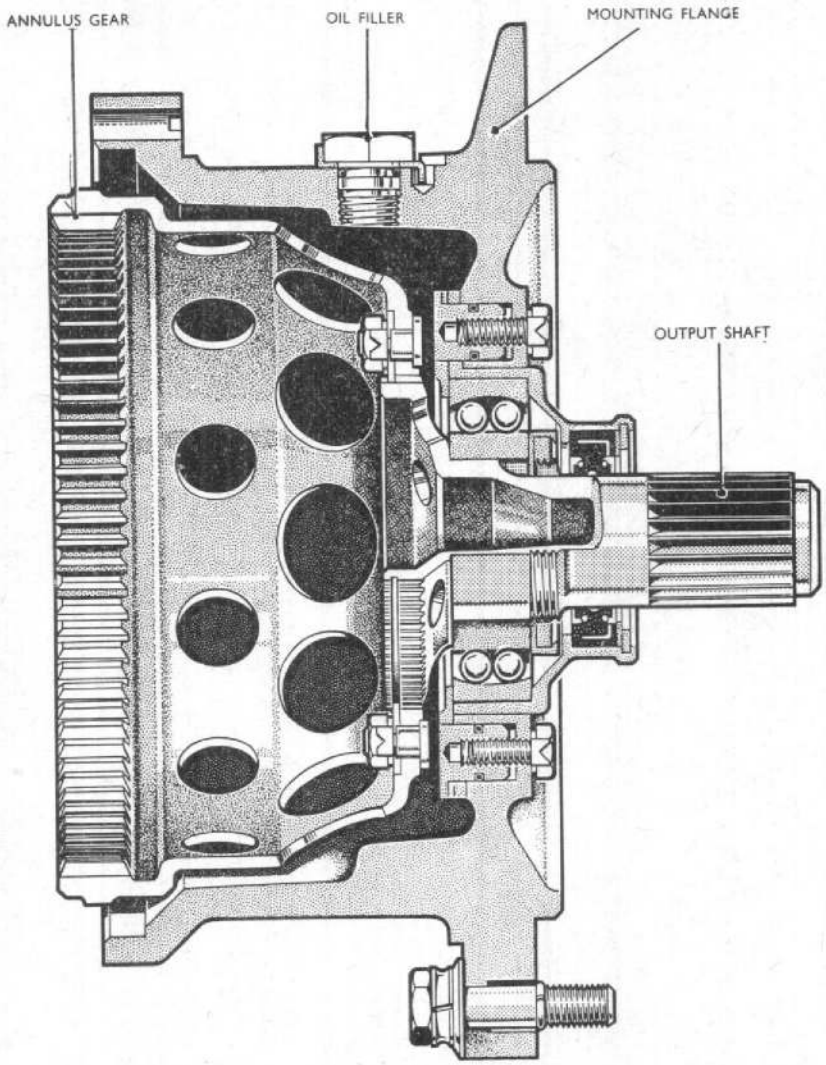


Fig. 19. Mounting flange assembly

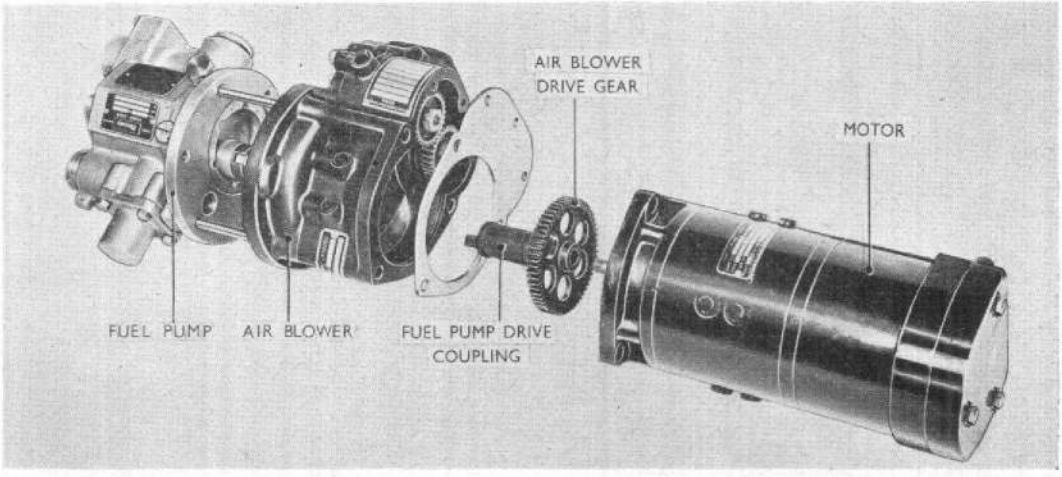


Fig. 20. Motor unit

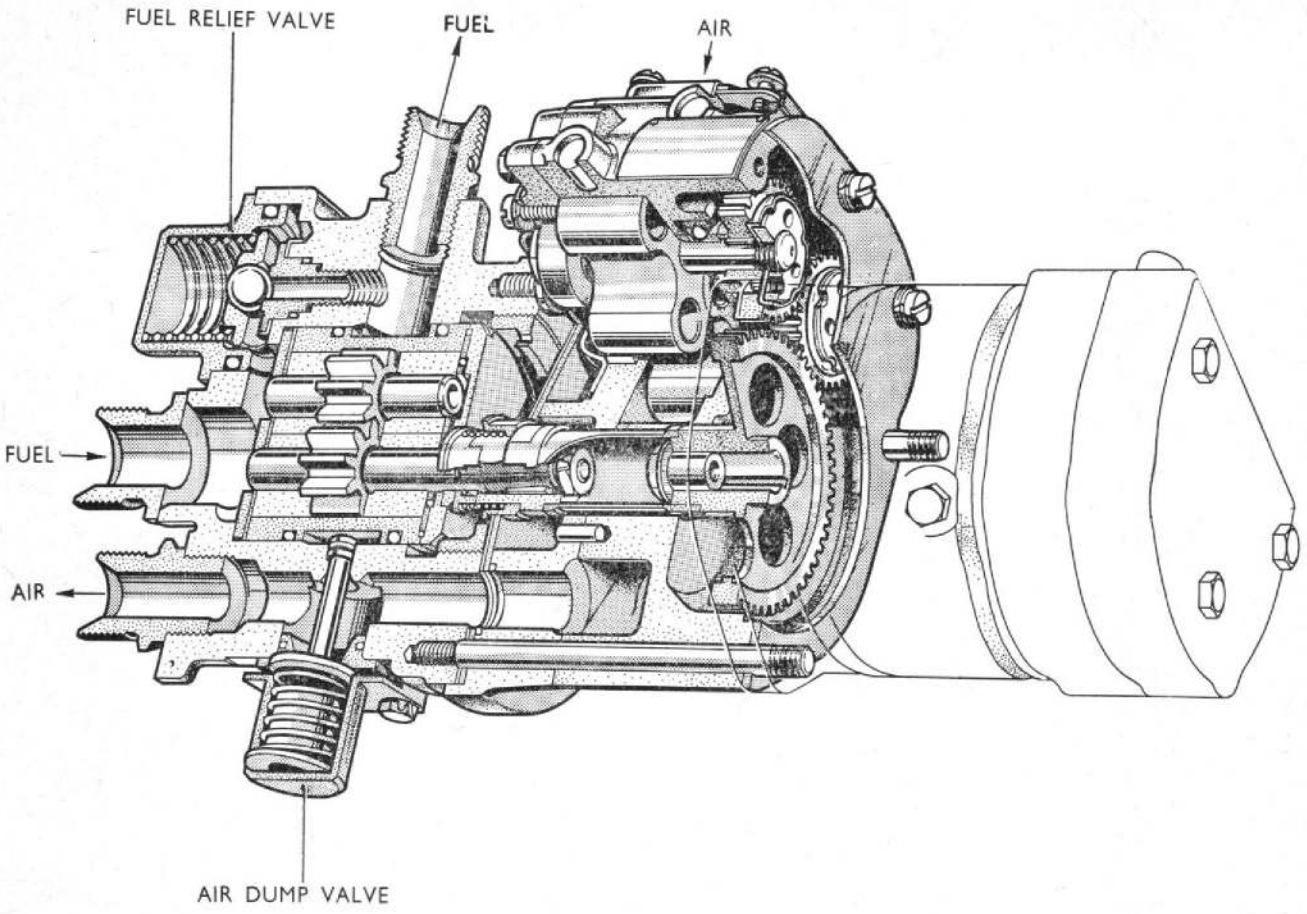


Fig. 21. Fuel pump and air blower

Air blower

41. The air blower comprises two rotor assemblies and the air blower housing. The housing comprises a casing and a rear housing located by dowels and bolted together. Located in the casing and rear housing are the ball bearings for the driving and driven rotor shafts. Each shaft carries a gear wheel and, within the working chamber, a three-lobed steel rotor. The two rotors do not make contact with each other or with the casing, hence lubrication is not required within the working chamber. Air is drawn through the inlet port and expelled under pressure through the outlet port. To prevent the ingress of foreign matter a brass gauze filter, protected by a perforated steel guard, is fitted over the inlet port.

42. The motor is located on the blower by a mounting flange and is secured by nuts and washers and three studs which pass through the blower casing to the fuel pump housing. A large gear wheel mounted on the motor drive shaft meshes with one of the rotor drive gears to drive the blower and also engages with the fuel pump driving sleeve (*para.* 36).

H.P. SWITCH/SOLENOID VALVE

43. The unit (*fig.* 22) consists of two principal, interdependent, parts: (*a*) the h.p. switch and anti-dribble valve, and (*b*) the solenoid valve. Each of these two parts somprises a casting containing a valve assembly and a case containing the associated electrical components. The cases are attached to their respective castings and the two castings are bolted together to form a complete unit. Corresponding passages in the castings permit the flow of fuel between the two components.

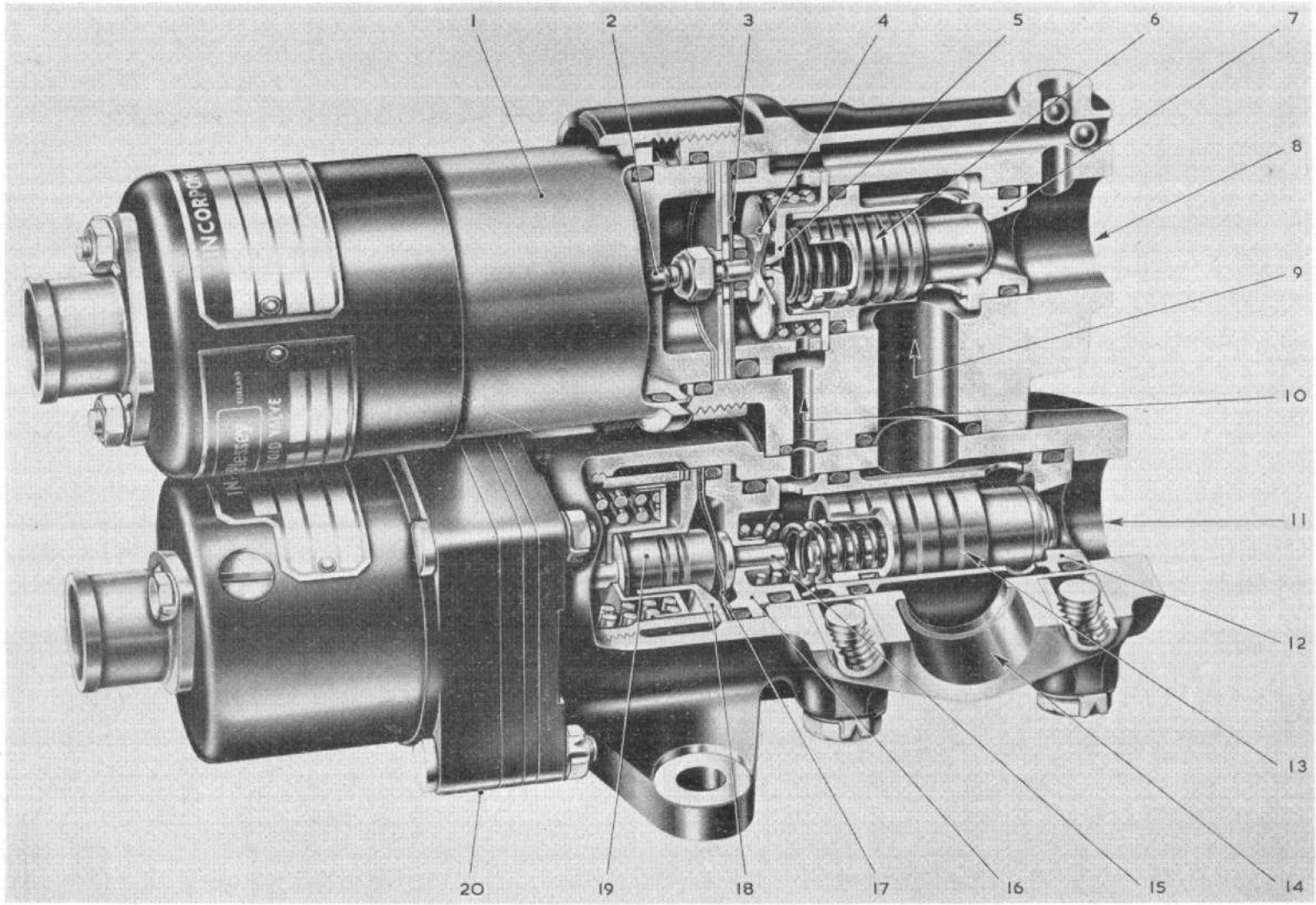
44. The purpose of the unit is to receive fuel from the fuel pump and to pass it either to the starter motor, or back to the supply tank, as required by the sequence of starting operations, and also to switch the electrical supply from the h.f. ignition unit to the speed control relay in the control box once combustion has commenced.

Anti-dribble valve

45. The anti-dribble valve, in its normally closed position, prevents fuel from passing into the starter motor when the system is standing idle, as well as during the scavenging cycle when the fuel is passing round the valve and back to the supply tank via the open solenoid valve.

46. The anti-dribble valve assembly comprises a valve located in a guide which in turn is secured within the body casting. The valve is maintained in its normally-closed position by an internal spring, the chamfered head of the valve seating on a mating surface in the valve guide.

47. Any fuel which escapes between the valve body and the guide passes to the return outlet via a secondary passage formed in both castings.



1 SOLENOID CASING
2 SOLENOID THRUST PIN
3 DIAPHRAGM
4 SEALING DISC
5 VALVE SEAT
6 SOLENOID VALVE
7 VALVE GUIDE
8 OUTLET TO TANK
9 MAIN PASSAGE
10 SECONDARY PASSAGE
11 OUTLET TO STARTER
12 VALVE GUIDE
13 ANTI-DRIBBLE VALVE
14 INLET FROM TANK
15 PUSH ROD
16 SUPPORT PLATE
17 DIAPHRAGM
18 DIAPHRAGM SUPPORT PLATE
19 SWITCH PLUNGER
20 H.P. SWITCH CASING

Fig. 22. High pressure switch, anti-dribble valve and solenoid valve

48. At the end of the air cycle, the solenoid valve closes, causing fuel pressure to be built up against the shoulder of the anti-dribble valve. The valve opens against the pressure of its retaining spring and permits fuel to pass to the starter via the outlet in the end of the anti-dribble valve casting.

49. The foot of the valve spring seats on a support plate, in the centre of which is located a push rod. The push rod butts against a rubber and terylene diaphragm assembly which isolates the fuel from the switch components. The switch plunger, which is a sliding fit in the diaphragm support plate, is maintained in contact with the switch side of the diaphragm by a double spring within the diaphragm retaining sleeve. Located between the support plate and the retaining sleeve are two washers which prevent the support plate rotating and causing damage to the diaphragm when the retaining sleeve is screwed into the housing.

50. The plunger extends to within 0·010 to 0·015 in. of the operating pin of the switch, correct adjustment being obtained by the use of shims between the switch mounting plate and the switch bracket.

51. When combustion occurs, the rapid rise in pressure in the combustion chamber is reflected back along the fuel line, lifting the anti-dribble valve further off its seating. The actuating rod within the valve bears against the push rod which transmits the movement via the diaphragm and plunger to the h.p. switch. When the pressure reaches approximately 300 to 340 lb/in^2 the valve will have moved sufficiently to operate the switch. A spring adjustment ring is provided to obtain the correct pressure setting.

High pressure switch

52. The switch is of the change-over type with one moving and two fixed contacts; it is operated by the movement of the anti-dribble valve via the push rod and plunger, as described in para. 51. Operation of the switch interrupts the supply to the h.f. ignition unit thus terminating the sparking at the igniters, and in addition maintains an electrical supply to the coil of the speed control relay in the control box.

53. The switch is described in detail in A.P.4343E, Vol. 1, Sect. 1.

Solenoid valve

54. The solenoid valve is made up of two sub-assemblies: a solenoid, and an aluminium alloy casting containing the valve assembly, diaphragm and fuel connections. The two sub-assemblies are secured together by a clamping ring.

55. The purpose of the solenoid is to close the valve at the commencement of the injection cycle. A detailed description of the solenoid is provided in A.P.4343E, Vol. 1, Sect. 1.

56. The valve assembly comprises a valve located in a guide which is secured within the main casting. The valve is maintained in its normally-closed position by an internal spring, the chamfered head of the valve seating on a mating surface in the valve guide.

57. Fuel flowing through the internal passage from the anti-dribble valve passes through four large holes in the solenoid valve guide. Pressure of fuel against the shoulder of the valve overcomes the spring pressure and the valve opens, permitting the fuel to pass back to the tank.

58. Fuel also passes into the valve itself through a small hole in the valve wall, the fuel escaping to the main return passage through an orifice in the valve seat.

59. A fuel seal between the valve and the electrical portion of the component is provided by a diaphragm assembly and its associated support plate. A spring located on the valve seat maintains the centre shaft of the diaphragm assembly in contact with the solenoid thrust pin, the necessary adjustment being provided by shims placed between the support plate and the fixed core of the solenoid.

60. When the solenoid is energized, the solenoid thrust pin actuates the diaphragm assembly causing a sealing disc to close the orifice in the valve seat. Fuel pressure builds up within the valve, assisting the internal spring to close the valve.

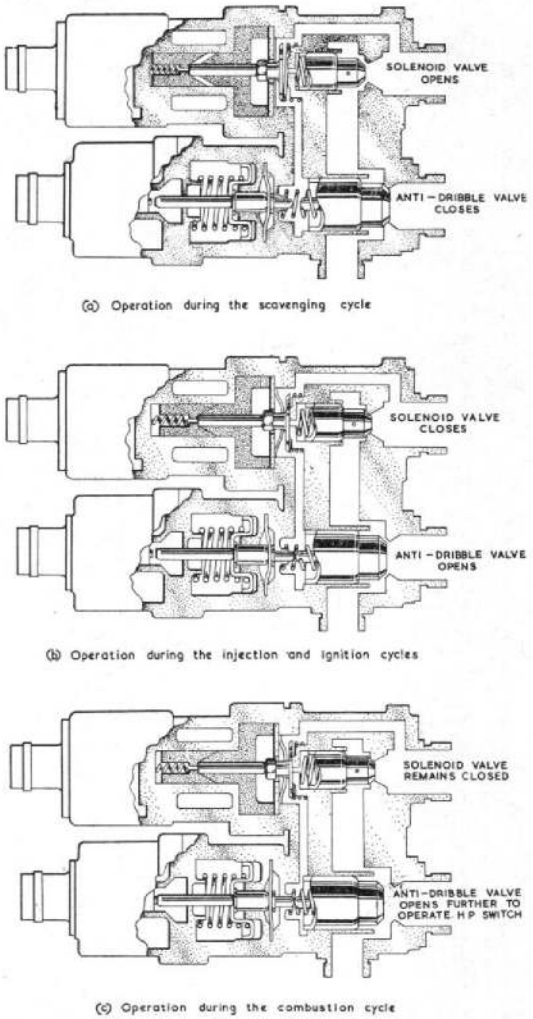


Fig. 23. Operating positions of anti-dribble valve and solenoid valve

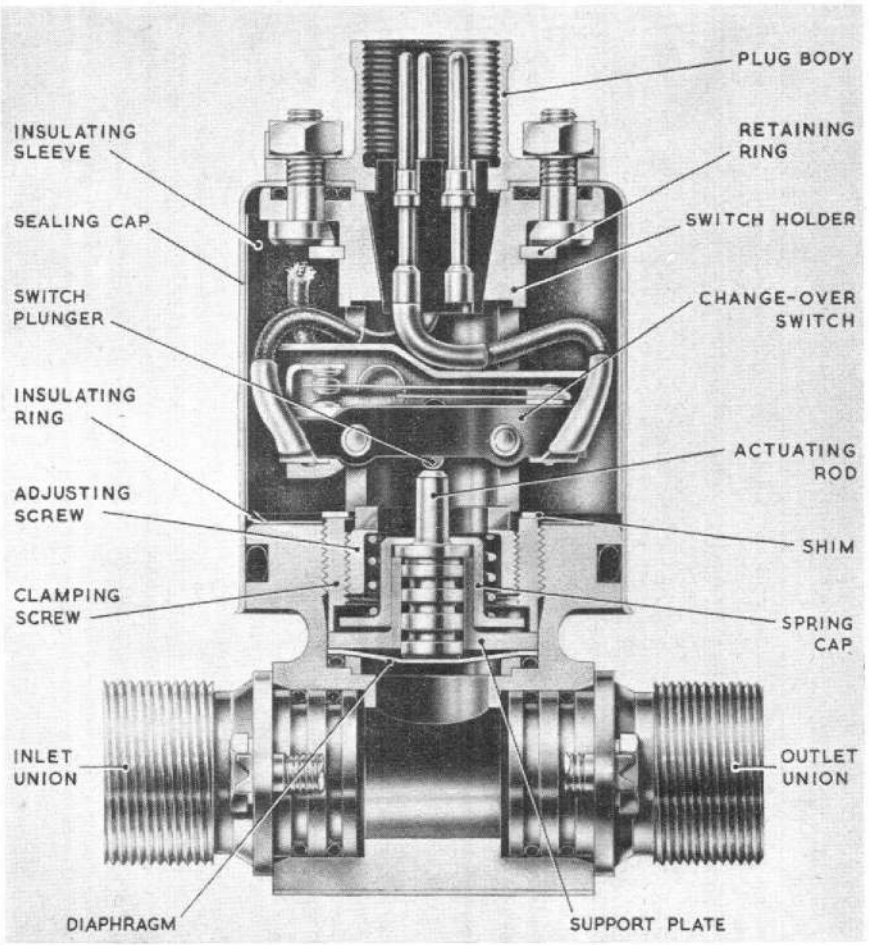


Fig. 24. Ignition switch

IGNITION SWITCH

61. The ignition switch (*fig.* 24), is installed in the fuel line of the starter system between the high pressure switch and the starter motor. The switch comprises two aluminium alloy castings bolted together and houses the fuel connections, the switch actuating mechanism, the switch assembly and the connecting plug.

62. The actuating mechanism comprises a spring-loaded switch-actuating rod in contact with a diaphragm. The diaphragm assembly consists of two discs, one rubber and one terylene, clamped at the edges by a support plate which also serves as a bearing for the actuating rod.

63. Variations in the pressure of the fuel flowing through the component act on the diaphragm, causing movement of the actuating rod which butts against the switch plunger. The switch is of the change-over type with two fixed contacts and a central moving contact, the arm of the latter being moved by the plunger. An internal adjusting screw is provided to vary the pressure on the spring which should permit operation of the actuating rod at 40 to 45 lb/in².

64. The switch assembly is protected by an aluminium cover which has an internal bakelite insulating sleeve. O-rings are provided to prevent fuel from reaching this part of the switch. Leads from the switch contacts are taken to the three small pins of the connecting plug. The large pin is a dummy employed to ensure the correct location of the mating socket.

CONTROL BOX

65. A control box (*fig.* 25) is used in the system to govern the sequence of operations which are described in Section 1, Chapter 3. Three operating components are mounted side by side in the box, which is covered by an aluminium alloy lid and sealed with a silicone rubber gasket. The three components are:—

1. Time switch
2. Slugged relay, K.3000
3. Speed control relay

Sequence of operations

66. The control box and its components are fully described in A.P.4343C, Vol. 1, Book 2, Sect. 3, Chap. 6, and Book 3, Sect. 10, Chap. 6.

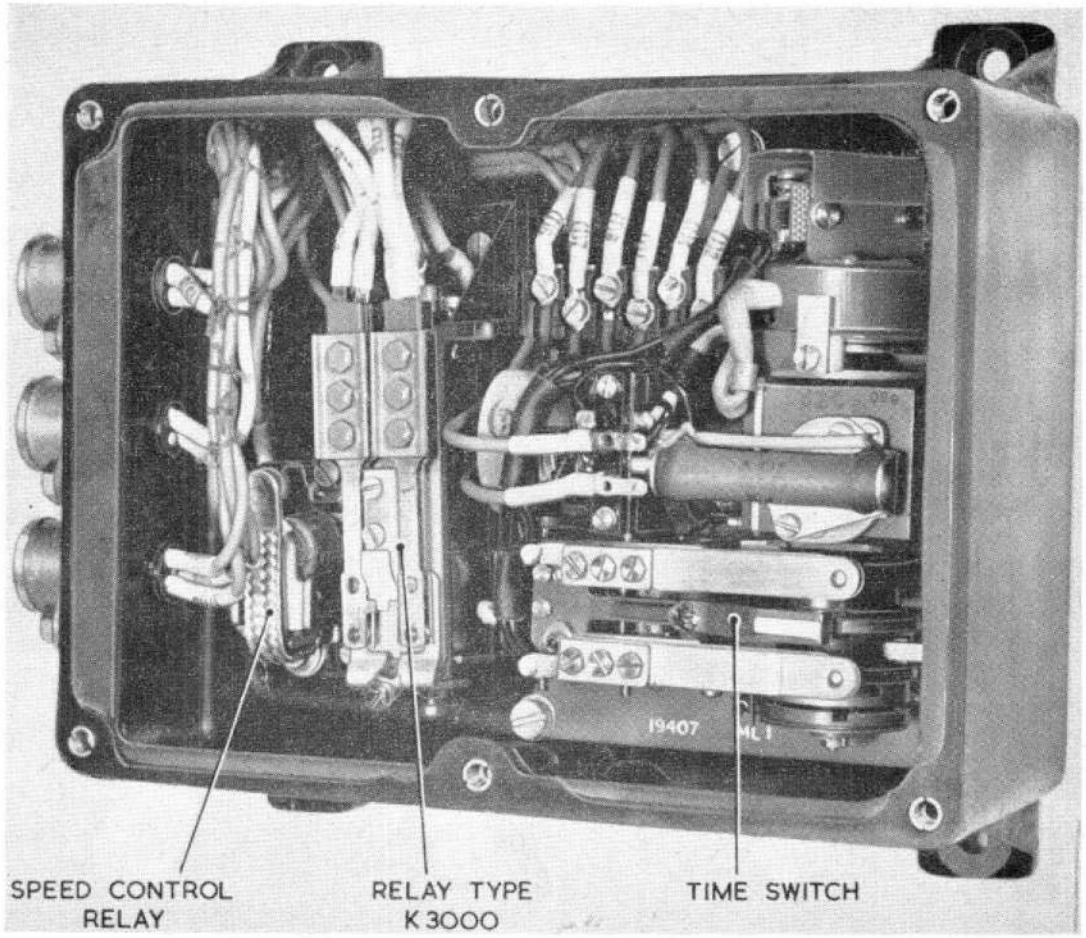


Fig. 25. Control box Mk. 8