

Chapter 4

SOLENOID VALVE, TORCH IGNITER AND STARTING ATOMIZERS

(Python Mk. 2 & 3 aero-engines)

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ILLUSTRATION

Fig.

Solenoid valve, torch igniter and starting atomizer,
showing fuel supply 1

INTRODUCTION

1. The solenoid valve, torch igniter and starting atomizer, described in this chapter, are fitted to the Python Mk. 2 and 3 aero-engine. The function of the solenoid valve is to control the supply of fuel from the high-pressure fuel pump and high-pressure shut-off cock to the two torch igniters and nine starting atomizers during the starting cycle. The L.T. current to the solenoid valve, also the H.T. current to the torch igniters is controlled from the ignition switch in the pilot's cockpit. This chapter should be read in conjunction with the description of the complete fuel system given in Section 1, Chapter 1.

DESCRIPTION

Solenoid valve

2. The solenoid valve is situated below the accessory drive box cover, and is mounted on a bracket forward of the accessory drive box and engine bulkhead (refer to Sect. 1, Chap. 1, fig. 2). The unit (fig. 1)

consists of a cylindrical body incorporating a solenoid coil and a steel bobbin. The bobbin has a central bore within which the solenoid bolt operates, the bolt being loose-coupled to the solenoid valve. A return spring, around the stem of the bolt, returns the solenoid valve to the closed position when the ignition switch governor cuts off the electric current, whilst a longitudinal groove on the bolt prevents it from becoming hydraulically locked in the closed position. The valve seat is screwed into the base of the body, and an extension at the inner end forms a guide for the valve stem. Two rows of radial holes, one row above the seat, and one row below, permit the passage of fuel through the valve system. The outer end of the valve seat is slotted to permit adjustment of the valve seat position and is sealed by a cap-nut and washer.

3. The base of the body contains the securing lugs for the unit and also the fuel

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inlet assembly and fuel outlet union. The inlet union is connected by a passage to the upper side of the valve seat, whilst the lower row of holes in the valve communicates with the fuel outlet union. The inlet union assembly embodies a banjo and pivot also an adapter containing a small gauze filter sack. The direction of flow through the unit is indicated by an arrow which is engraved externally on the body between these union assemblies.

4. The solenoid coil windings in the upper portion of the body are connected to a 24-volt two-pin socket connector mounted on the extreme end face of the unit.

Torch igniter

5. The torch igniter is a combined fuel atomizer and H.T. spark plug and is provided solely to initiate fuel combustion during the starting cycle. Two torch igniters are fitted to the engine, one in No. 2 and one in No. 8 combustion chambers. Each torch igniter consists of two main assemblies, the igniter unit adapter and the igniter plug head; these assemblies are connected by a tungum pipe through which the fuel flows and which also transmits the H.T. electric current from the electrodes in the adapter to the electrode in the plug head.

6. Each torch igniter adapter unit is attached to an adapter plate which, in turn, is fitted to a facing provided on the diffuser elbow. The adapter plate contains an elliptical hole through which the igniter head is passed to reach the combustion chamber flame tube head. The igniter plug head locates in a shroud attached to the flame tube head, where it is free to slide and permit expansion of the combustion chamber assembly.

7. The igniter unit adapter, containing the upper and lower electrode units and the fuel feed union, is a phosphor-bronze casting. A flange is formed at the base for attachment to the adapter plate. The upper electrode unit is retained in position against a shoulder in the bore by the H.T. screened adapter, the lower electrode unit being retained against a shoulder and brazed in position. The electrical connection between the upper and lower electrode units is made through a spring contact. The H.T. screened adapter which retains the upper electrode unit in position in the union adapter, consists of a steel sleeve lined with insulating material. The inner end is threaded where it enters

the igniter adapter, whilst the outer end is externally threaded to receive the screened harness connector of the H.T. lead. Fuel for the igniter is fed through the combined feed union and filter in the side of the adapter unit, and then through internal passages to the electrode units. The lower electrode is hollow, and fuel passes through the centre of the electrode into the tungum fuel pipe and then to the igniter plug head.

8. The tungum fuel pipe has a ferrule at each end, the upper ferrule being integral with the lower electrode in the adapter, whilst the lower ferrule is threaded where it screws into the central electrode of the igniter plug head. Both ferrules are sealed at their joints by copper washers.

9. The igniter plug head houses the central electrode. The igniter plug body is cylindrical, an internally threaded portion accommodating the body lock-nut. The body contains six radial holes at its inner end to allow air to pass into the plug body. Two earth points are fixed diametrically opposite each other in the bore of the body, and when the plug head is in position, one of these points is positioned radially at 30 degrees from the atomizer hole in the central electrode. The central electrode is hollow, the electrode bore being blanked at the outer end. A small radial hole is drilled near the blank end at an angle of 60 degrees to the centre line for directing the atomized fuel over the earth points. The central electrode with its insulator is retained in position by the body lock-nut and sealing washer.

10. The insulation in the torch igniter assembly is ceramic, each central electrode being permanently fitted with its own insulator.

11. A slightly different torch igniter is introduced by Mod. P.83. This igniter differs from the one described above in that it incorporates a two-piece electrode, a glass seal and an additional fuel filter. The two-piece electrode is housed in the lower electrode insulator, and between the upper portion of the two-piece electrode and the inner wall of the insulator is fitted the glass seal. The glass seal is introduced to overcome the possibility of fuel leakage between the electrode and the insulator of the lower electrode unit. The additional fuel filter is a brass gauze disc, which is fitted into the head of the igniter plug itself.

Starting atomizers

12. The nine starting atomizers are of the Kigass fixed orifice type, atomization of the fuel taking place in a fuel spinner, and a disc containing the spray orifice. Fuel is fed to each atomizer by separate feed pipes from suitably spaced junctions on the starting manifold.

13. Each atomizer (*fig. 1*) consists of a stainless steel body having an integral shoulder externally threaded for attachment to the boss in the combustion chamber nose piece, a hexagonal flange is provided to accommodate a spanner for tightening the unit. The fuel pipe is connected to the head of the atomizer by a banjo pivot screwed into the outer end of the main bore. At the inner end of the pivot is a fine gauze filter. At the inner end of the body are the spinner and disc, the latter being peened into position. The spinner has a recess in its underside, a small tangential hole connecting this recess to the outer diameter which imparts a swirl motion to the fuel prior to its flowing through the orifice in the centre of the disc.

14. Each atomizer body stem is surrounded by a shroud, located by a dowel in the boss of the combustion chamber nose piece. The shroud has an oval hole in its side wall which admits a predetermined quantity of air for mixing with the atomized fuel at the inner end of the atomizer.

PRINCIPLE OF OPERATION

15. Fuel for starting is delivered from the H.P. shut-off cock to the solenoid valve (*fig. 1*). Operating the cockpit ignition switch to the START position causes the solenoid to actuate and open the solenoid valve. The opening of this valve permits fuel to pass to the starting manifold and thence to the two torch igniters in No. 2 and 8 combustion chambers and to the nine starting atomizers.

16. Fuel that passes through the central electrode of the torch igniters is injected as a fine spray into their respective combustion

chambers. A high tension spark from a booster coil ignites this fuel to form a torch flame that is directed toward the flame tube mixing chamber. Simultaneously, fuel as a finely divided spray is injected into the nine combustion chambers from each of the nine starting atomizers. The initial burning, started by the torch igniters, spreads rapidly through the combustion chamber inter-connectors to the other nine chambers. This action is maintained until the starting cycle is complete.

17. When the engine has attained a speed of approx. 2,700 r.p.m., the ignition switch governor automatically cuts off the electric current to the solenoid coil and the torch igniter booster coil; the solenoid valve then closes and isolates the starting fuel system from the main fuel system. At the same time the current having been cut off from the booster coil the H.T. spark discontinues at the torch igniters.

INSTALLATION

18. The starting solenoid valve is mounted on a bracket beneath the accessory drives box cover, and a second solenoid valve, for excess fuel bleed, is also attached to the same bracket. Check the fuel inlet filter for cleanliness, clean if necessary. Fit the filter into the adapter and assemble the adapter to the inlet banjo. Place the banjo on its pivot with a soft aluminium washer each side. Fit and tighten the banjo pivot nut. Connect the fuel pipe from the high-pressure shut-off cock to the banjo inlet union on the solenoid valve. Connect the pipe from the burner manifold to the solenoid valve outlet union; make certain that these two pipes are correctly assembled and not interchanged. Wire-lock all pipe unions after connection. Fit the screened harness connector of the H.T. lead to the screened adapter.

SERVICING

19. The procedure for servicing the three units described in this chapter is detailed in A.P.4293A, Vol. 1, Section 2. Chapter 1.

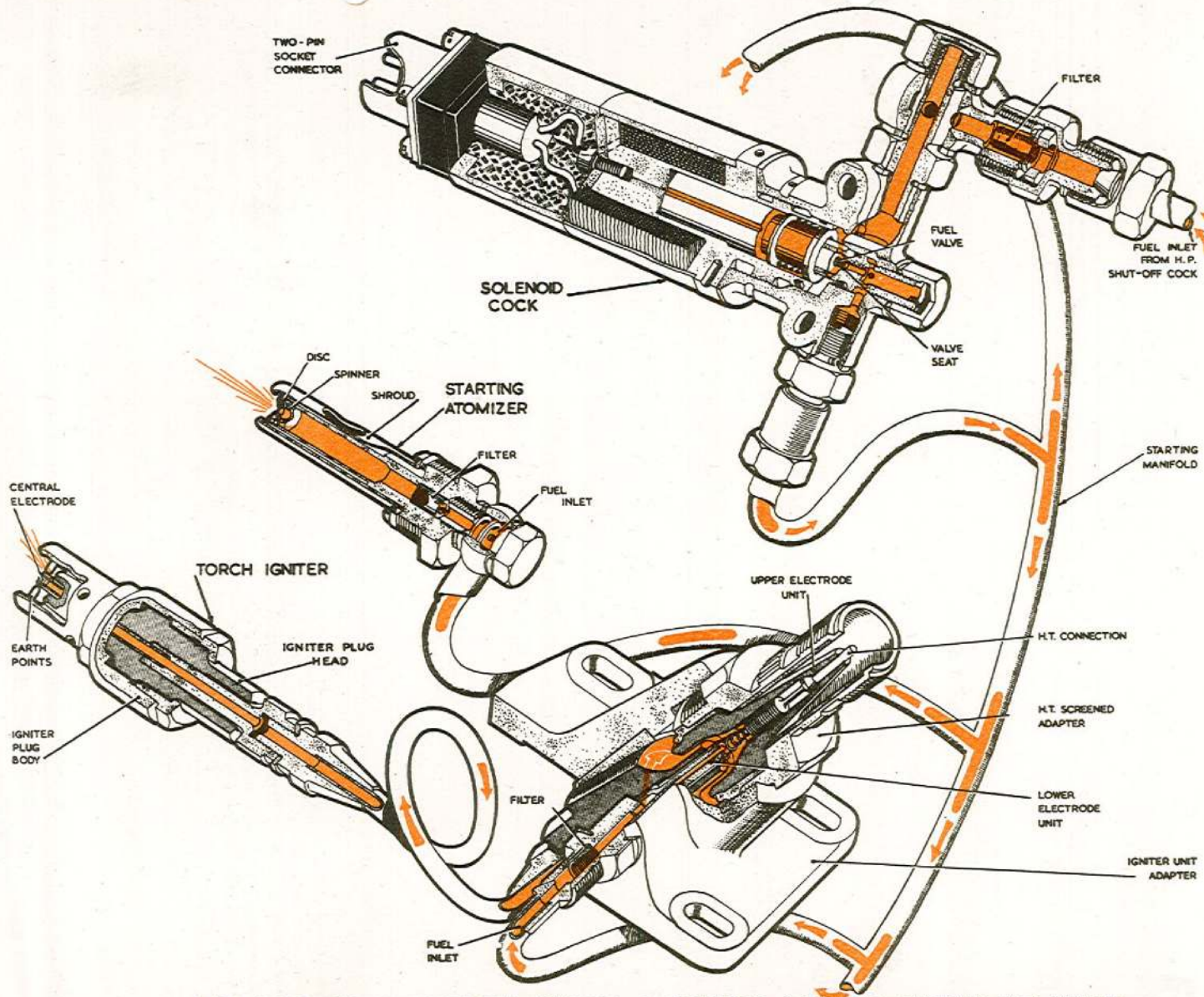


FIG. 1. SOLENOID VALVE TORCH IGNITER & STARTING ATOMIZER SHOWING FUEL SUPPLY

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