# Chapter 2

# TORCH IGNITER

**(Derwent and Nene aero-engines)** H L 32

TYPE BK5409

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## LIST OF ILLUSTRATIONS



### INTRODUCTION

**1.** The torch igniter described in this chapter serves to initiate the main combustion process of a gas-turbine aero-engine and operates only during the engine starting cycle. The main parts are the igniter body, the type M.8523 combined electro-hydraulic valve and atomizer, and the type BK.5409 igniter plug. The igniter body holds the other parts in relation to each other in such a manner that a spray from the atomizer and a spark from the igniter plug are brought together within a mixing chamber enclosed by the air shroud, so producing an intense flame.

**2.** Supply lines to the torch igniter consist of pressure fuel, low-tension electrical current and high-tension electrical current. Two torch igniters are normally fitted to each engine.

### IGNITER BODY

**3.** The igniter body is a machined forging designed for mounting on an engine combustion chamber with its air shroud projecting through the air casing and communicating with the interior of the flame tube. The igniter body air shroud shelters the mixing chamber from the full blast of cooling air in the air casing but is provided with radial drillings which allow a restrained air flow to enter the mixing chamber to support the torch igniter combustion.

**4.** Two earth electrodes are positioned in the mixing chamber of the igniter body directly below the igniter plug bore and are high temperature brazed into drillings from the outer face of the igniter body main flange. These electrodes are placed diametrically opposite each other, and are bent as necessary to adjust their gaps in relation to the central electrode.

### ELECTRO-HYDRAULIC VALVE AND ATOMIZER

**5.** The electro-hydraulic valve and the atomizer have the respective functions of controlling the flow of fuel and effecting a fine mist discharge which provides a readily combustible mixture in the mixing chamber.

**6.** The fuel flows to the interior of the combined atomizer and valve housing through four radial drillings, having entered the solenoid casing through the fuel inlet union, and a wound-wire filter which prevents fouling of the atomizer by foreign matter. Flow of fuel can only take place when the needle valve is lifted from its seat in the valve housing by an upward movement of the solenoid armature, to which the needle valve is loosely pinned. The armature is spring-loaded to hold the needle valve on its seating when the solenoid is not energized. When the valve is open, fuel will pass down the bore of the valve housing to the annular space surrounding the atomizer. The atomizer is of the swirl type with two tangential drillings feeding into a conical swirl chamber and thence to a single final orifice giving a spray angle of about 90 degrees. The orifice flow factor is 0·3, giving a delivery of approximately 125 cc. per minute under a pressure of 25 lb. per sq. in. The flow factor combines the constant values of orifice area, coefficient of discharge, and fuel density and provides a convenient method of expressing the nozzle characteristics.

**7.** Washers are provided where necessary to prevent fuel or gas leakage, and two locking devices are employed; the atomizer and valve

housing is held in the solenoid housing by a slotted nut which is locked by a spring retained locking washer, and the atomizer sleeve nut is locked by a circlip.

**8.** The low-tension electrical supply to the solenoid is connected to the electrical two-pin socket on the solenoid cover from which internal connectors are taken to the coil. The coil is wrapped with varnish-impregnated tape, and joints between the solenoid body and cover are sealed by brushing with a weatherproofing varnish.

**9.** In some versions of the electro-hydraulic valve the cavity between the electrical socket and the solenoid is packed with a filling compound to reduce vibration and consequent fracture of the connectors. This compound may have either a bitumastic base or a rubber base, depending on the operating temperatures experienced with the type of engine. The rubber base compound has the higher melting point. A more secure attachment of the solenoid cover is provided by a modification, which substitutes a hexagon headed screw in place of the cheesehead screw and a countersunk screw in place of the cover locating pin.

Another modification introduces a longer solenoid coil former to avoid trapping the connectors when assembling. The relative positions of the fuel inlet and the electrical connections may vary to suit installation requirements; for example some engines use left-hand and right-hand units.

### IGNITER PLUG

**10.** The igniter plug carries the high-tension current which provides the spark at the electrodes and ignites the atomizer spray. The plug consists of an insulated central electrode held in position by the gland nut and sealed by a gland washer. The gland nut is locked to the igniter body by a locking ring, and is provided with a screw thread and ring of serrations for locking the high-tension connector.

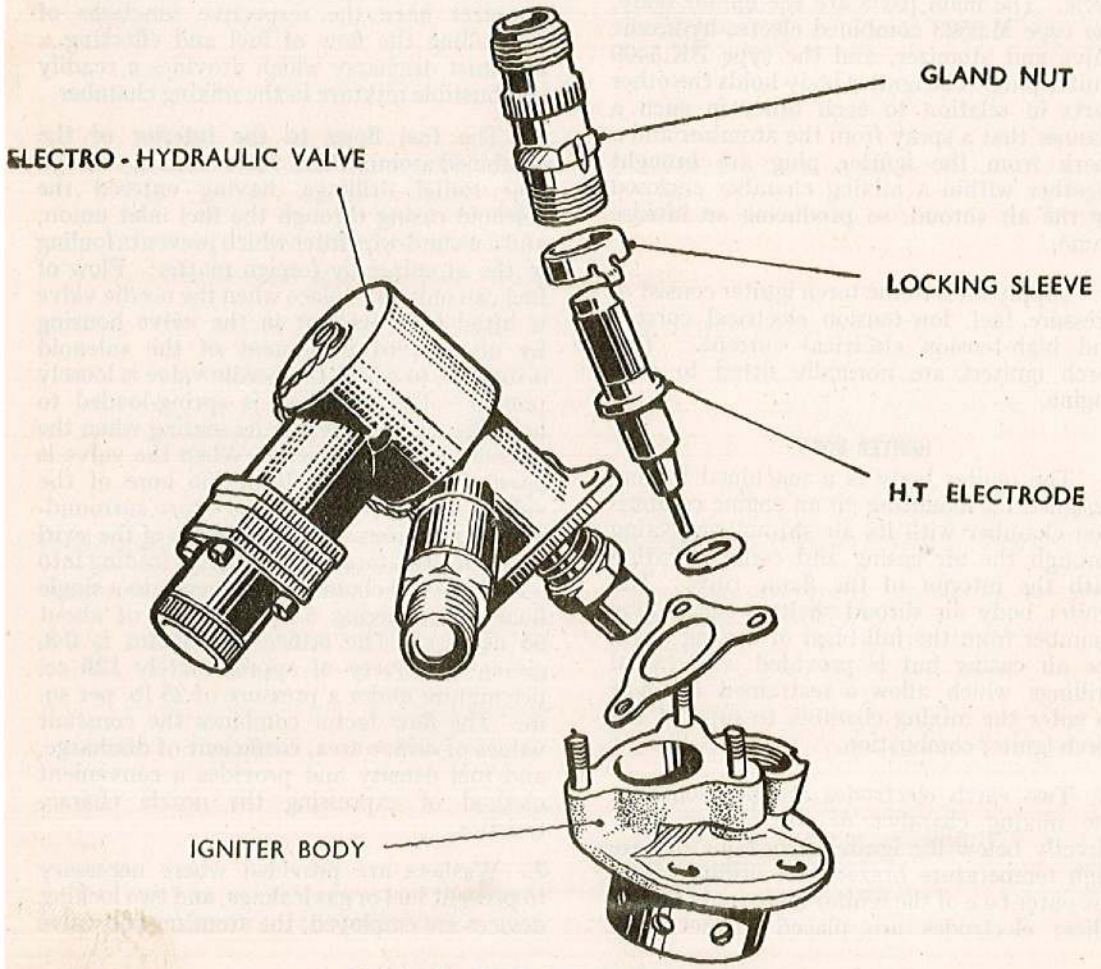


**Fig. 1. Torch igniter (exploded view)**

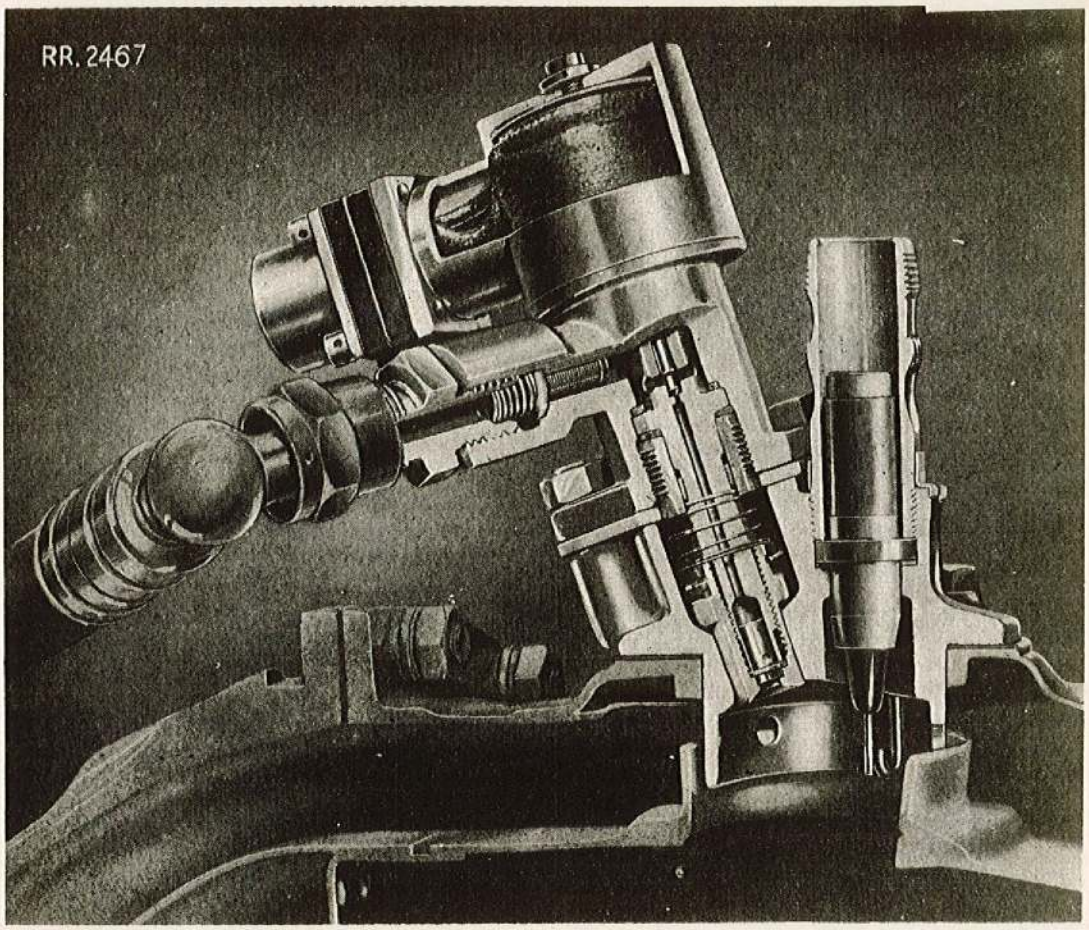


**Fig. 2. Torch igniter (cutaway showing construction)**

**11.** The insulating material of the central electrode may be of mica or ceramic material. Mica has been superseded on later electrodes as it is not hard enough to prevent embedding of carbon particles in its surface; this would encourage the building-up of carbon deposits and cause subsequent electrical breakdown of the plug. The inner lining of the gland nut is of laminated mica.

### OPERATION

**12.** During the process of engine starting the torch igniter is simultaneously supplied with low-tension and high-tension current and with fuel under pressure from the torch igniter feed pump. The low-tension current is taken to the solenoid coil, and the high-tension current to the igniter plug central electrode.

**13.** Energization of the solenoid lifts the armature and needle valve, thus permitting fuel to flow under pressure to the atomizer from which it issues as a fine mist, to be ignited by the high intensity spark between the central and earth electrodes. The flame propagates directly into the spray zone of the combustion chamber main burner, and burns continuously while the engine starting cycle is in operation, thus giving the engine ample opportunity to light up and start.

**14.** On termination of the starting cycle, which is normally of about 30 seconds duration, all services to the torch igniter are cut off. The spark stops and the solenoid ceases to attract the armature so that the armature spring forces the needle valve on to its seat. Current supply to the torch igniter feed pump is also cut-off, so that the torch igniter is no longer supplied with fuel.

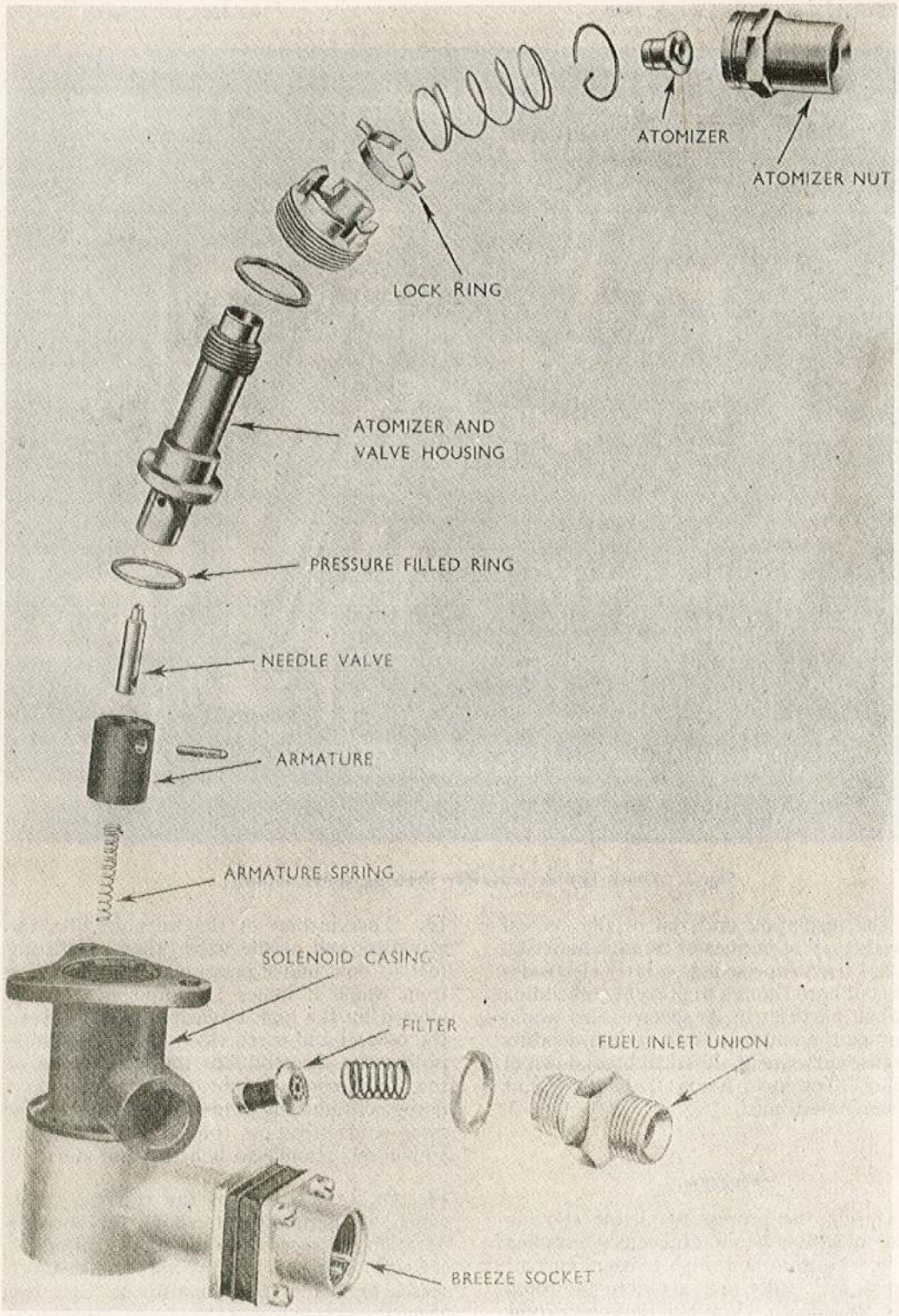


**Fig. 3. Electro-hydraulic valve (exploded view)**