ADMIRALTY
AIR MINISTRY

FUEL SYSTEM COMPONENTS (GENERAL) FOR GAS-TURBINE AERO-ENGINES

This is Amendment List No. 19 to Air Publication 4282, Volume I

Section 7. List of Chapters: *delete* "*(to be issued later)*" after the title of Chapter 5 and *write* "(A.L. 19)" in the outer margin against the deletion. *Insert* this Chapter 5 to follow Chapter 4. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

ENGINEER

Chapter 5

TORCH IGNITER ANTE-CHAMBER

~~(Derwent and Nene engines)~~ AL 32

TYPE BL 9064 & 9BK, 15617

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LIST OF ILLUSTRATIONS

1. The ante-chamber torch igniter is a development of the type described in Chapter 2 and performs a similar function in a more efficient manner, particularly under low air density conditions, thus permitting 'relighting' to be performed at higher speeds and altitudes than was possible with the earlier type.

Torch igniter unit

2. The unit is of composite construction and consists of an atomizer housing, which also provides a mounting for the electro-hydraulic valve unit, a body assembly, and an air shroud. The interior of the unit forms the ante-chamber in which the torch igniter functions. Provision is made, by suitable ducts and connections, to receive the supplies of high and low tension current, fuel, and air necessary for operation. Jointings or seals are fitted where necessary to prevent leakage.

3. The atomizer housing provides a seating for the atomizer, and also houses a fine mesh filter in the fuel inlet to prevent the entry of foreign matter. The fuel is supplied through two tangential drillings in the atomizer boss, which impart swirl to the fuel on its passage to the atomizer and so assist in producing a hollow conical spray in the ante-chamber. The atomizer is set at an angle in the top of the ante-chamber to direct the spray to the required position in relation to the igniter electrodes.

4. The body assembly incorporates a conical air diffuser which is positioned around the atomizer and forms an annular space between itself and the top of the ante-chamber. Air entering from the air duct must therefore pass through the holes in the diffuser to mix with the atomised spray. Two bosses on the exterior of the body provide securing points for the detachable positive electrode, and the fixed earth electrode of the igniter plug.

5. The base of the torch igniter unit connects the ante-chamber with the interior of the flame tube on the engine. The perforations in the air shroud provide an entry for secondary air from the engine to assist in spreading the flame to meet the primary burner spray in the flame tube.

6. An exterior air pipe is fitted between the atomizer housing air duct and the combustion chamber suspension tube. A slot machined in the suspension tube faces the air stream and acts as an air scoop, to ensure an adequate supply of air to the ante-chamber.

7. Two torch igniter units are normally fitted to each engine and are mounted on separate combustion chambers. The units are left- and right-handed and, to avoid incorrect assembly, dowel pins are fitted to component parts.

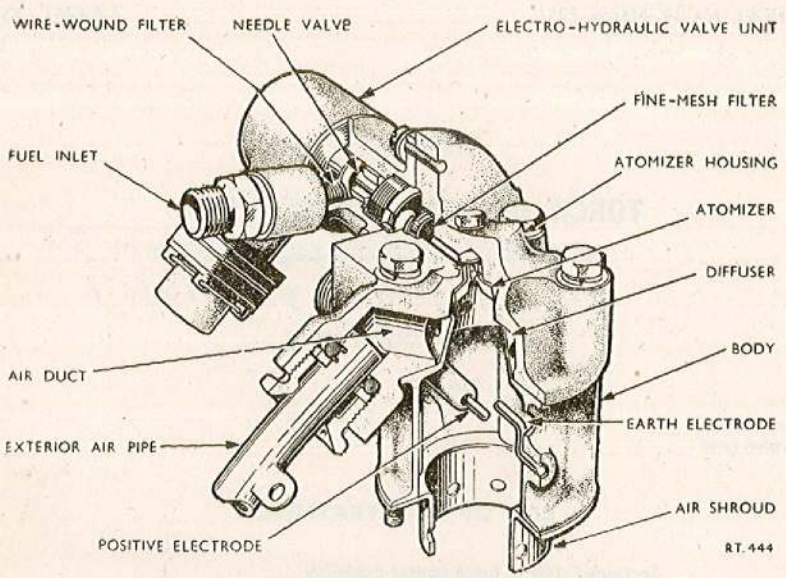

Fig. 1. Sectioned view of torch igniter assembly

Electro-hydraulic valve unit

8. The electro-hydraulic valve unit fitted to the ante-chamber torch igniter is basically similar in construction and operation to that described in Chapter 2, with the exception that the atomizer is not incorporated in the valve unit. The fuel inlet connection is, however, incorporated in the valve unit and houses a filter to prevent particles of matter from fouling the needle valve.

Operation

9. The function of the torch igniter unit is to initiate the combustion process of the engine during the starting cycle.

10. When the starting cycle of the engine is commenced, the following occur simultaneously:—

(1) The engine compressor commences to rotate and causes air to flow through the engine, and fuel is supplied to the primary burners by the engine fuel pumps.

(2) Low tension current is supplied to the electro-hydraulic valve and, energizing the solenoid, lifts the needle valve from its seating.

(3) The torch igniter feed pump delivers fuel to the atomizer through the electro-hydraulic valve.

(4) Air enters the ante-chamber through the air pipe and diffuser.

(5) High tension current causes a high intensity spark across the igniter plug electrodes.

11. These processes lead to the highly combustible mixture in the ante-chamber becoming ignited, and the resulting flame spreading rapidly to the engine flame tube. Additional air is supplied through the air shroud and further accelerates the flame to meet the fuel spray from the engine primary burners. At this stage the engine 'lights-up', the flame spreads to all combustion chambers, and the engine accelerates until it becomes self-sustaining.

12. When the starting cycle is completed, the services to the torch igniter unit are automatically discontinued and the torch igniter ceases to function.

26. To prevent hydraulic locking and the escape of fuel which leaks past the plunger, an internal passage connects the spring chamber to the L.P. fuel filter outlet.

27. To facilitate adjustment of the plunger spring loading during rig test, an adjusting washer forms the spring seating in the base of the valve cover.

28. The plunger incorporates a spring-centralizing seat; this consists of a shallow recess formed in the end of the plunger which mates with a rounded pin shrunk in the spring seating cup.

Low pressure fuel filter

29. The low pressure fuel filter shown in fig. 2 prevents particles of foreign matter entering the fuel system. To provide the necessary high degree of filtration a felt element is used, and special provision is made to seal the end faces.

30. Fuel entering the inlet connection passes to an annular chamber formed between the element and the wall of the housing, then inwards through the element to its centre bore and to the outlet connection.

31. To position the element and provide end face sealing the self-locating end plate, spring loaded against the cover, presses the element up to the internal face of the housing; a captive screw retains the end plate to the cover, when the cover is withdrawn from the housing.

32. A drain cock is fitted to the filter cover and consists of a valve which screws inwards on to its seating to close the passage to the outlet drain connection. The hexagon-headed valve is secured by a lock-plate.

33. Filter casings may vary slightly in shape and may have threaded union, gland washer, or flanged-type connections. These differences do not in any way affect the functioning of the unit.

Filter icing warning switch

34. The fuel control unit, type BA.81149, incorporates a fuel filter icing warning switch which is attached to the filter outlet connection. The switch indicates, by a warning light, that the fuel filter is blocked and that the fuel heater must be switched on.

35. Under low temperature conditions, filter blockage is most likely to be due to ice formation. This results in a pressure drop across the filter which is sensed by a bellows in the icing warning switch, causing the bellows to compress, move a contact arm to close a micro-switch and operate a warning light in the cockpit.

INSTALLING AND SERVICING

36. The fuel control unit, comprising the B.P.C., L.P. fuel filter, throttle valve, H.P. cock and pressurizing valve, is calibrated on rig test and stored as one unit.

37. Instructions for removing, installing and inhibiting the unit and also details of the limited adjustments permissible in service are contained in Vol. 6, Part 1, Sect. 2 of the relevant engine Air Publication.

38. No servicing of the unit is necessary except for a check that pipe connections and unions are tight.

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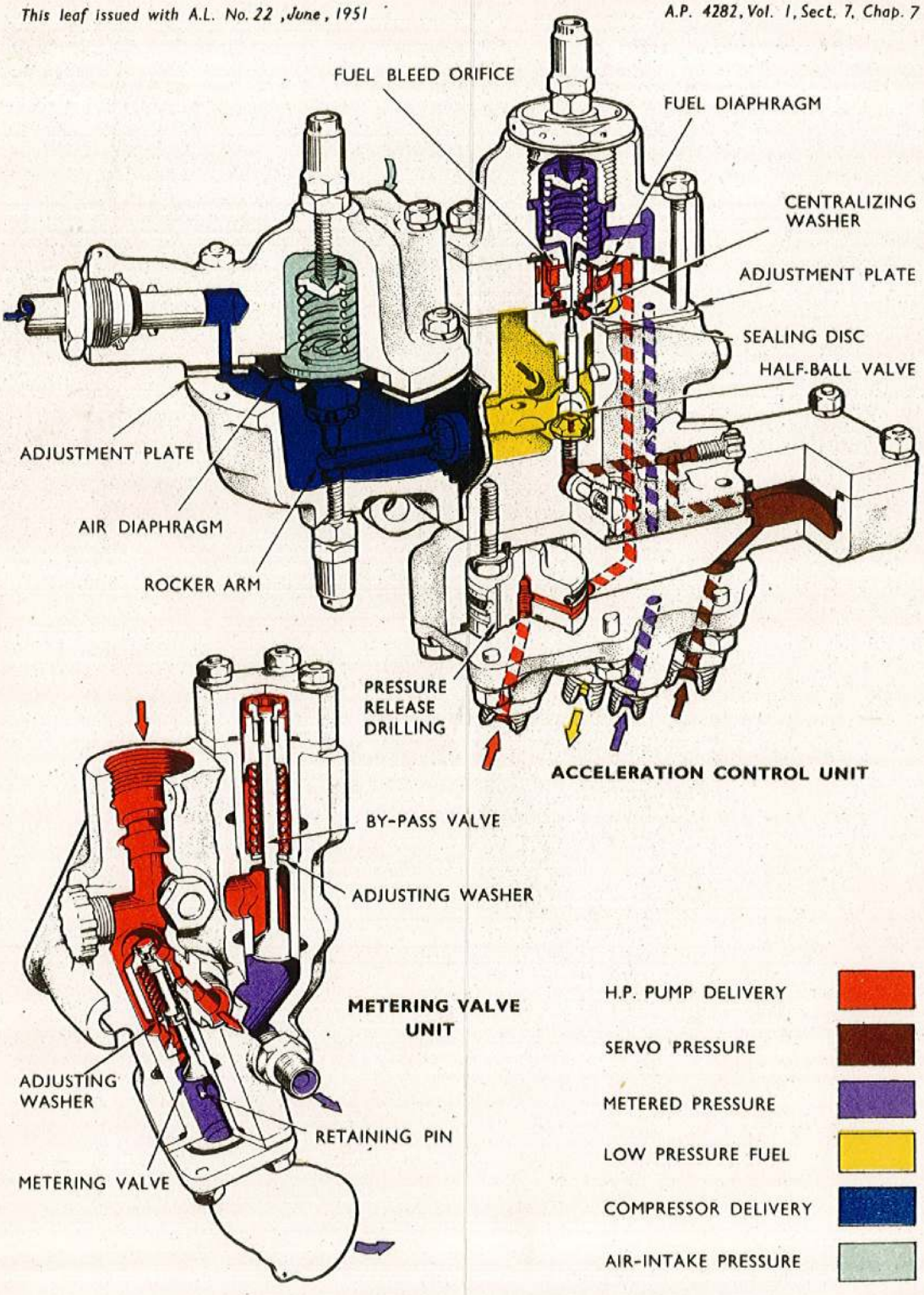

FIG. 3 Acceleration control and metering valve units (Cutaway showing flows)

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