

Chapter 4

TORCH IGNITER

(Avon engines) *AL 32*

BA 220 61

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1. The torch igniter unit of the type fitted to Avon engines is similar in function and operation to that described in Chapter 2. The physical features are, however, different and the component parts are therefore not interchangeable. The igniter body has been deleted and the parts of the unit are mounted on a combustion chamber interconnector specially designed to accommodate them, as illustrated in fig. 1.

Electro-hydraulic valve and atomizer

2. The electro-hydraulic valve unit is similar to that described in Chapter 2, with

the exception that the fuel inlet has been repositioned to accommodate the pipe layout on the Avon engine. As previously described the unit houses a filter and the atomizer.

Igniter plug

3. The igniter plug is of the single-electrode detachable type as described in Chapter 2, but to improve mechanical strength the earth electrodes are welded to the air shroud at both ends, instead of only one end as formerly.

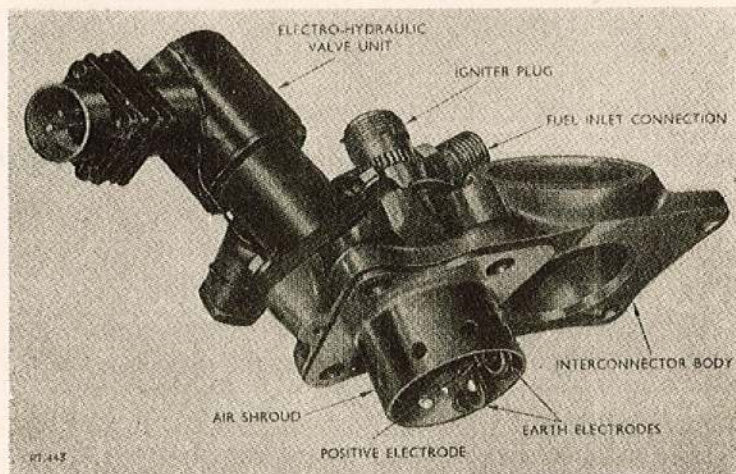


Fig. 1. Torch igniter and interconnector assembly

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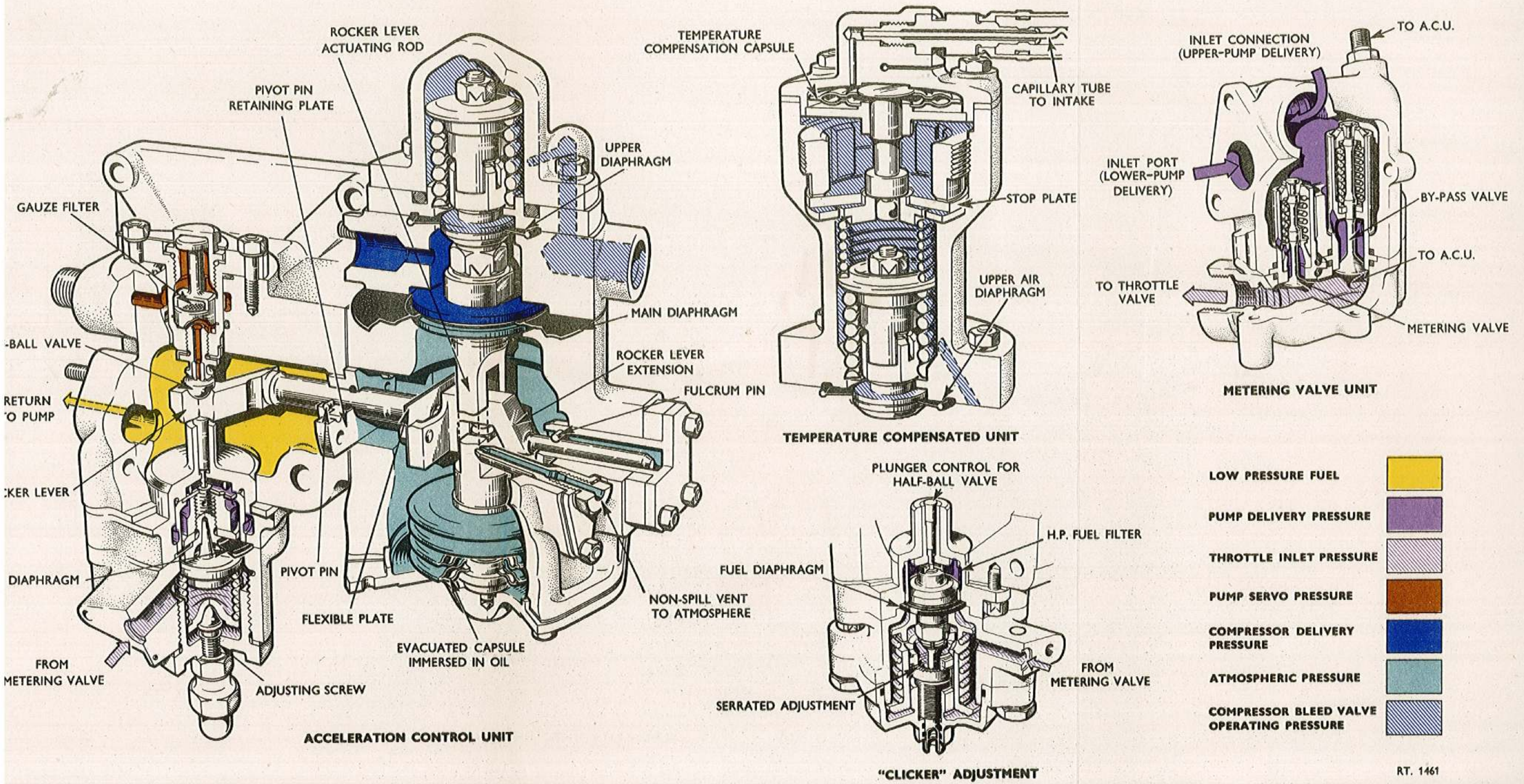


Fig. 1. A.C.U., metering valve, "clicker" adjustment and temperature compensated unit

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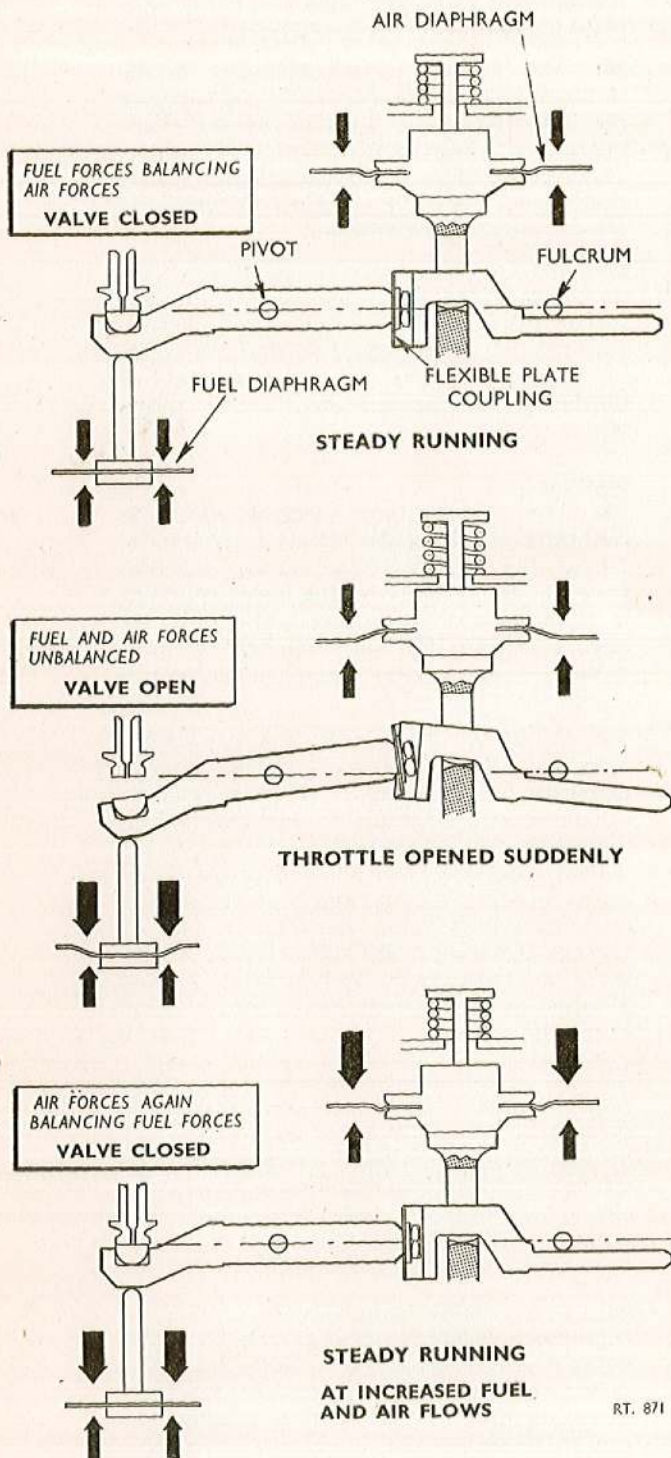


Fig. 2. Lever assembly movement

of metals forming the A.C.U. housing and internal mechanism have been overcome on later types by the use of metals having similar coefficients of expansion.

Fuel metering unit

17. The fuel metering valve unit is designed for mounting on the H.P. fuel pump and comprises a housing and cover with a screw-type union for fuel inlet (upper-pump delivery) on the upper side and a similar union for fuel outlet (to throttle valve) on the lower side. A platform within the lower half of the housing separates the unit into inlet and outlet chambers. This platform is furnished with two circular orifices of unequal diameter, which form seatings for two spring loaded poppet valves. The valve springs are of unequal strength, the smaller metering valve being the more lightly loaded. The valves operate in sleeve housings and are held in position by valve caps and collets with adjusting washers inserted under the lower spring carriers. Four rubber sealing rings around the valve housings prevent leakage between the inlet and outlet chambers. Pressure tapings to the A.C.U. are fed from the inlet chamber by means of a screw-type union and from the outlet chamber through a banjo connection and cap-nut.

18. On some units, the screw-type union which taps fuel pressure from the inlet chamber of the metering unit, was fitted with an attenuator. The attenuator has now been replaced by a banjo connection, which together with a longer A.C.U. pipe connection is sufficient to damp sudden fuel pressure fluctuations and permit correct functioning of the A.C.U.

A.C.U. fuel section

19. The fuel section of the A.C.U. consists of the fuel diaphragm loaded from below by an adjustable spring. Two main fuel passages are incorporated accepting fuel to both sides of the diaphragm from the metering valve unit. The diaphragm is connected on its upper side to a vertical sliding plunger which is in direct contact with the half-ball valve end of the lever.

20. To ensure that all air is expelled from the system on starting, a permanent bleed across the fuel diaphragm is provided and a seal above the diaphragm prevents leakage of high pressure fuel past the sliding

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plunger. On later type units, the fuel section includes a cylindrical gauze filter to prevent blockage of the permanent bleed. The plunger is lubricated by low pressure fuel through a drilling which also acts as a hydraulic pressure release.

21. To ensure positive axial movement of the diaphragm assembly without lateral displacement, the assembly is centralized by a diaphragm stabilizer at its upper end and accurate location of the spring at its lower end. Spring loading can be varied by an adjusting screw to provide adjustment of acceleration time.

22. Later units incorporate a 'clicker' adjustment (*fig. 1*) to simplify adjustment of acceleration time. The screw head incorporates an internally squared socket for turning and the shank is integral with a serrated ring which is sprung to engage with a fixed ring. As the screw is turned, the serrations re-engage with those of the fixed ring, each click or single tooth movement corresponding to an adjustment of acceleration time.

23. A large joint washer seals the fuel section from the air section.

A.C.U. air section

24. An actuating rod in the air section carries the two diaphragms with the smaller diaphragm uppermost; the arrangement producing three separate air chambers. The diaphragms are spring loaded by a compression spring mounted in the topmost chamber around the upper end of the control spindle assembly. Spring tension is adjustable by adjusting washers placed under the spring locating plate on assembly. The lower end of the spindle is in contact with the capsule face.

25. The capsule is mounted in the capsule chamber cover by a screwed adjusting stem and secured by a locknut. The chamber is partially filled with oil to damp out vibration and is vented to atmosphere through a filtered standpipe designed to prevent spillage of oil from the chamber.

Rocker arm and half-ball valve

26. The lever assembly controlling the half-ball valve comprises a rocker lever and lever extension. These two levers are attached end to end through a flexible plate coupling, allowing independent rocking movement by a knuckle action.

27. The rocker lever pivots about its centre within a retaining plate which is sealed with a rubber ring to prevent leakage from the

low pressure fuel chamber into the lower air chamber. One end of the rocker lever carries the half-ball valve, the other end the flexible plate for the rocker lever extension.

28. The rocker lever extension passes through a slot in the actuating rod carrying the air diaphragms and makes contact with a fulcrum pin located in a horizontal sleeve. The position of the sleeve can be adjusted by shims to allow variation in the position of the pivot for test-rig calibration.

29. The half-ball valve is self-centering in its hemispherical mounting and its accurate surface finish ensures instantaneous control. Half-ball valve movement is small, the total lift being under 0.003 in. The operation of the lever assembly is shown diagrammatically in *fig. 2*.

Operation

30. The acceleration control unit is calibrated so that under steady running conditions the forces exerted on the air diaphragm balance those on the fuel diaphragm in the valve closed position. This prevents any spill from the fuel servo system and, therefore, exercises no control of fuel pump stroke.

31. When the throttle is opened rapidly, increased pressure difference across the fuel metering unit produces a greater pressure difference across the A.C.U. fuel diaphragm. Since there is no immediate rise in compressor delivery pressure, due to inertia of the rotating assembly, the forces acting on the A.C.U. lever system become temporarily out of balance, resulting in the half-ball valve opening. Sufficient servo system spill is thus induced to limit pump stroke and prevent overfuelling.

32. As engine speed increases, the consequent steady rise in compressor delivery pressure is felt on the upper side of the main air diaphragm resulting in a downward force on the actuating rod. This force progressively closes the half-ball valve and allows the engine to run efficiently at the correct fuel/air ratio for the higher r.p.m. selected.

33. In the higher r.p.m. range, however, the engine can accept a much greater fuel flow without over-heating and it becomes necessary to reduce the sensitivity of the A.C.U. to ensure that sufficient fuel is available to guarantee the normal acceleration requirements. At 240 g.p.h., therefore, the by-pass valve in the metering unit opens. This action provides the required increase in fuel

flow and a reduced pressure difference across the metering unit. This reduced difference is also felt on the A.C.U. fuel diaphragm which in turn effectively reduces movement of the half-ball valve.

34. At high altitudes and in the high r.p.m. range, maximum engine speed is obtainable at a much reduced fuel flow and the rate of flow is insufficient to open the by-pass valve. To compensate for this the half-ball valve is closed further by the action of the smaller air diaphragm actuated by bleed valve operating pressure exerting an extra force on the air section of the lever assembly. The required increase in fuel/air ratio for acceleration in the higher r.p.m. range at altitude is, therefore,

always available irrespective of the actual values of fuel or airflow.

Installing and adjusting

35. The acceleration control unit and the metering valve unit are calibrated together and must not be changed independently. Full instructions for removing and installing are contained in Volume 6, Part 1, Section 2 of the relevant aero-engine Air Publication. This section also contains instructions relating to the limited adjustments which are permissible in service.

Inhibiting

36. Refer to A.P.4471A, Vol. 1.

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