Chapter 7

COMBINED CONTROL UNITS, TYPE CCU.31 SERIES

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LIST OF ILLUSTRATIONS

Description and operation

1. The unit consists of a barometric pressure control, a torque limiter, a throttle valve and a high pressure fuel shut-off cock, the latter being operated by an electric actuator attached to the side of the unit.

2. The throttle valve and fuel shut-off cock are housed in a common body to the rear face of which the barometric pressure control and torque limiter are attached. Internal passages link the two assemblies and where the passages interconnect, rubber seal rings form a fuel-tight joint.

Barometric pressure control

3. This component maintains a fuel pressure which is proportional to the atmospheric pressure by controlling the pump delivery to suit the engine requirements according to altitude or atmospheric conditions. A decrease in atmospheric pressure due to increased altitude will produce a decrease in pump delivery.

4. The body is divided into a capsule chamber and a valve chamber. A rocker lever is pivoted on a needle roller housed in a bush at the division of the two chambers. Seals on the lever and bush isolate the two chambers. The inner end of the rocker lever is recessed and carries a half-ball servo valve which seats on the orifice in the base of the valve chamber and is balanced against fuel delivery pressure and atmospheric pressure by a spring which is compressed by an adjusting screw in the valve chamber cover. The underside of the valve orifice is linked by an external pipe to the spring-loaded side of the main fuel pump servo piston, and a strainer is inserted into the passage in the control body.

5. The rocker lever is controlled by fuel at pump delivery pressure taken from the inlet of the control unit. The fuel pressure acting on a diaphragm, actuates a piston and push rod which, together with the diaphragm, are housed in an adjusting sleeve located in the base of the valve chamber. The upper end of the push rod operates against an adjusting screw in the rocker lever. The bore of the adjusting sleeve is off-centre to enable the push rod to be moved across the face of the adjusting screw by turning the sleeve in the chamber base, and thereby increasing or decreasing the distance of the push rod from the fulcrum point of the lever.

6. The capsule chamber end of the rocker lever is socketed to receive the lower pivot

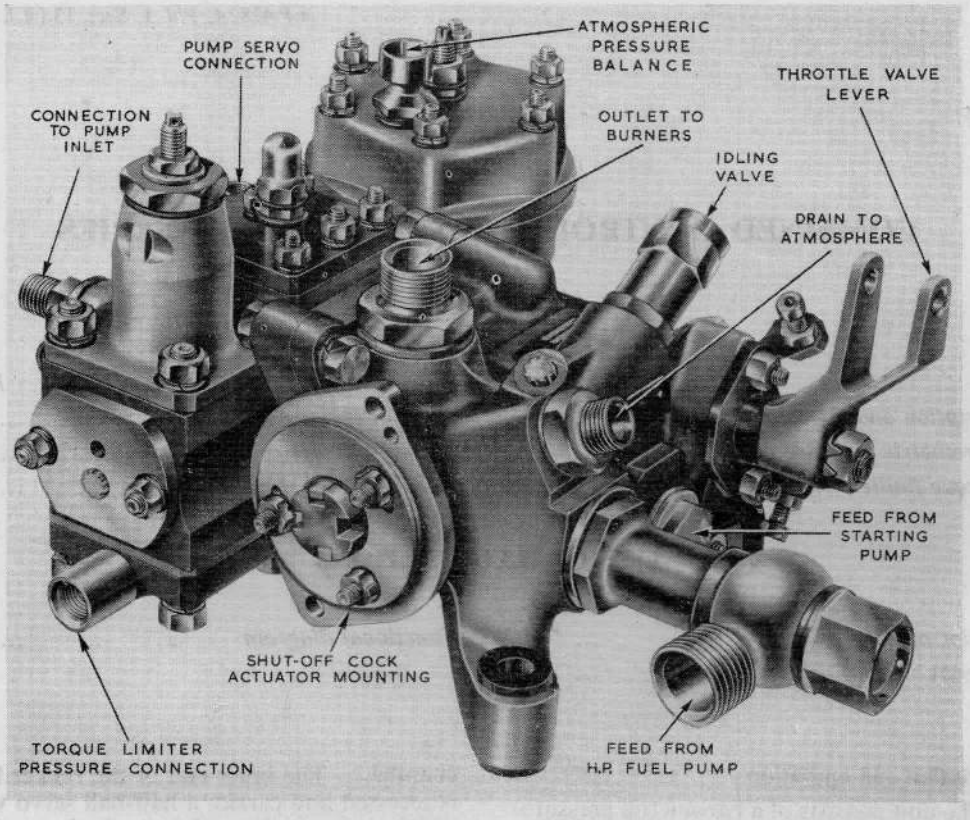

Fig. 1. Exterior of unit

point of the barometric capsule stack, the upper pivot point of the stack being located by an adjusting screw in the capsule chamber cover. A stop screw in the base of the chamber limits the downward movement of the rocker lever.

7. To damp out vibration and prolong the life of the capsules, the capsule chamber contains sufficient silicone fluid to cover the capsule stack. A water trap vent is fitted on top of the cover. Through this vent atmospheric pressure is in direct contact with the capsule chamber; fluid is prevented from escaping from this connection during abnormal flight by the inkwell type of cover.

8. H.P. fuel pump pressure acting on the diaphragm, and atmospheric pressure acting on the capsule stack, exert movements in opposite directions about the rocker lever pivot. The screw in the valve chamber cover is so adjusted that the loading of the spring on the rocker lever is sufficient to balance the combined opposing load of these two pressures.

9. Under normal conditions of operation the system is in equilibrium, with the half-ball valve slightly off its seat on the orifice. As the servo orifice is relatively very small, the effect of servo pressure on the rocker lever can be ignored. The fuel spilled by the servo valve returns from the valve chamber to the inlet side of the main fuel pump via an external pipe.

10. On opening the throttle valve at a given atmospheric pressure, the pump delivery pressure will be reduced. Through the medium of the diaphragm, this also reduces the pressure on the rocker lever, permitting the spring to close the servo orifice. The pressures on either side of the servo piston in the fuel pump become balanced and the piston moves to increase the pump stroke until the

pressure is restored. Conversely, a rise in pump delivery pressure, as a result of closing the throttle valve, will cause the servo orifice to be further opened and the pump servo piston moved to decrease the pump stroke until normal operating conditions are restored.

11. With a decrease in atmospheric pressure at a given throttle opening, the capsule stack will expand and move the rocker lever to open the servo orifice, thus causing a reduction in pump stroke. An increase in atmospheric pressure will have the reverse effect.

Torque limiter

12. Normally the torque limiter operates up to an altitude of approximately 20000 feet; above this the B.P.C. will control the fuel flow. On take-off and during climb the unit receives a hydraulic signal from a propeller

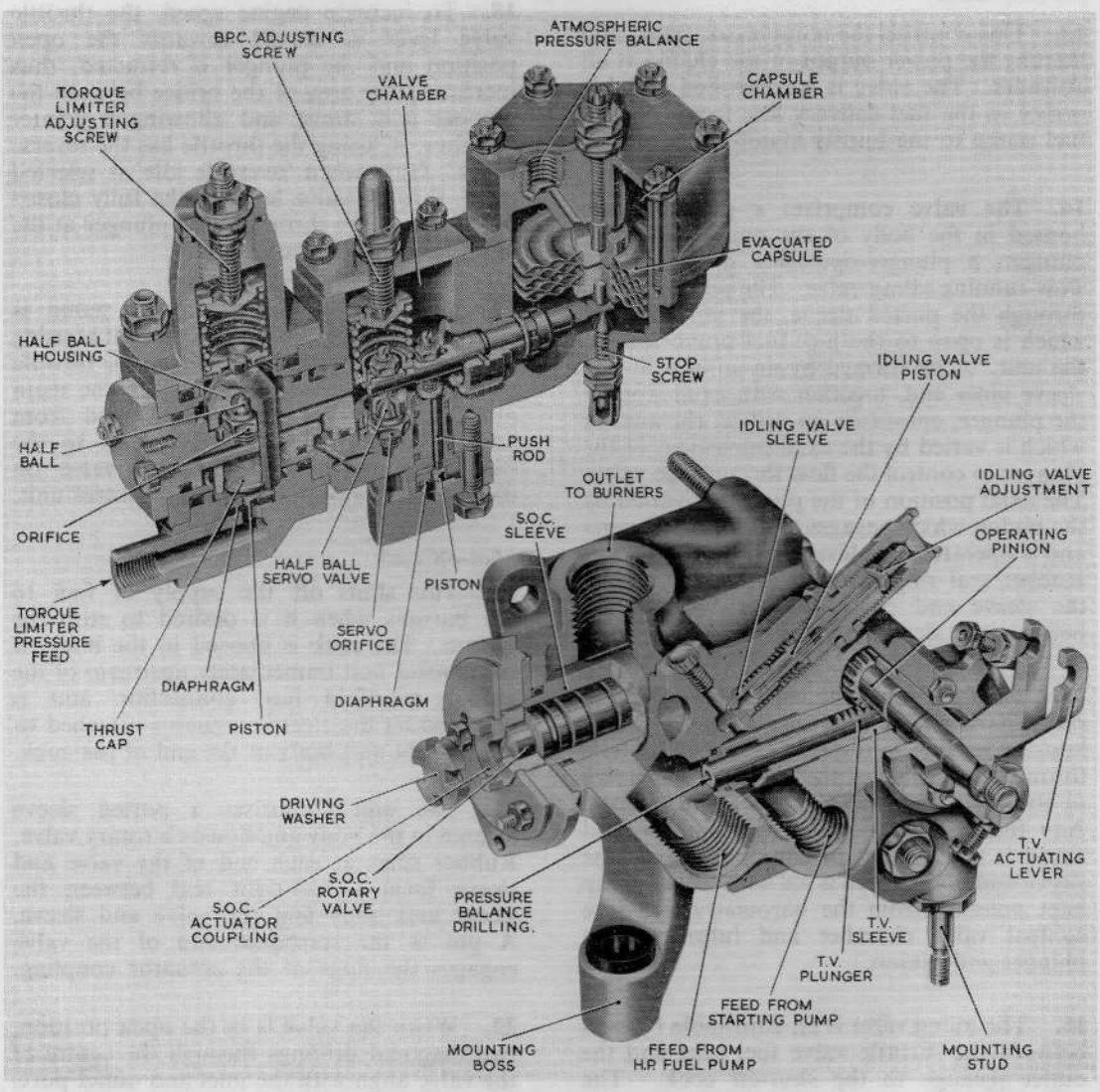

Fig. 2. Cut-away view of unit

torque metering device. This pressure acting on a diaphragm or operating disc, actuates a piston and thrust cap, all of which are housed in the base of the torque limiter. A bell-shaped housing situated between the thrust cap and a spring, carries a half-ball valve which seats on an orifice, this orifice being in communication with the fuel pump servo control cylinder. At a pre-determined torque limiting pressure, the orifice will be opened to permit pump servo pressure to be spilled from the unit to the pump inlet with a consequent reduction in pump stroke to achieve the required delivery flow.

Throttle valve

13. This controls the compressor speed and thereby the power output of the engine at all altitudes. The valve is a controlled variable orifice in the fuel delivery line from the h.p. fuel pump to the burner manifold.

14. The valve comprises a ported sleeve housed in the body of the unit, a metering plunger, a plunger-operating pinion and a slow-running idling valve. The plunger slides through the ported sleeve, the inner end of which is open to the h.p. fuel pump feed to the unit. A lip formed by an annulus in the sleeve inner end, together with axial slots in the plunger, constitute an orifice, the area of which is varied by the axial movement of the plunger to control the flow through the valve. The axial position of the plunger is varied by the pinion which engages teeth in the plunger and is operated by a lever on the pinion shaft. Rubber seal rings around the sleeve and in the sleeve end cover prevent fuel leaking between the sleeve and housing.

15. The fuel leaves the valve sleeve through radial ports which align with a passage in the housing leading to the shut-off cock. A hole through the centre of the plunger carries fuel to its outer end and ensures axial balance. Any fuel leaking between the plunger and sleeve is received by an annulus between the sleeve and body which is fed with fuel at pump inlet pressure from the barometric pressure control valve chamber and lubricates the plunger and pinion.

16. The idling valve is an adjustable by-pass between the throttle valve fuel inlet and the outlet passage to the shut-off cock. The spring-loaded control orifice body has a slot for the fuel inlet and a circular orifice for the outlet. A piston slides in the orifice body, its position varies the amount of inlet slot exposed and therefore the fuel flow; it is adjusted by a screw which is secured by a locknut.

17. When starting the engine, fuel is delivered to the main fuel inlet; a proportion of the flow passes through the idling valve to the outlet passage while the remainder flows through the orifice between the plunger and sleeve and out through the sleeve ports to the outlet passage. At this condition, the area of the orifice allows sufficient fuel for engine idling conditions.

18. To increase engine speed, the throttle valve lever is moved towards the open position and the plunger is retracted, thus increasing the area of the orifice between the plunger and sleeve and allowing a greater fuel flow. Closing the throttle has the reverse effect. Only when 'override idle' is selected is the throttle valve lever in the fully closed position and the throttle valve plunger at the closed end of its stroke.

19. The feed from the starting pump is delivered through a drilling in the unit housing to the outlet passage leading from the throttle valve to the shut-off cock. When the main pump takes over, fuel is prevented from flowing from the control unit back to the starting pump by a non-return valve on the starting pump feed into the control unit.

Shut-off cock

20. This shuts off the supply of fuel to the burners when it is desired to stop the engine. The cock is housed in the body of the control unit immediately upstream of the burner manifold feed connection and is operated by the electric actuator attached to the control unit body at the end of the cock.

21. The unit comprises a ported sleeve located in the body and houses a rotary valve. Rubber rings at each end of the valve and sleeve form a fuel-tight seal between the sleeve and body and the valve and sleeve. A pin in the starboard end of the valve engages the dogs of the actuator coupling.

22. When the valve is in the open position, two diagonal drillings through the centre of the valve align with the inlet and outlet ports of the sleeve and link the outlet passage from the throttle valve to the burner manifold feed

connection. Rotation of the valve through 90 deg. by the actuator shuts off this flow but causes two smaller drillings in the valve to align with the inlet and outlet ports and link these with two further ports in the outer ends of the sleeve. One of these drillings allows fuel to drain from the burner manifold to atmosphere through the drain connection on the control unit body. The other drilling by-passes fuel from the throttle valve outlet passage back to the inlet side of the fuel pump via a passage in the control unit, the barometric pressure control valve chamber and an external pipe.

Installing and servicing

23. Two drilled bosses and a stud adapter provide a means of securing the unit to the engine, each of the three mounting points being supplied with special rubber grommets. Details of installing and servicing are contained in the relevant engine Air Publication.

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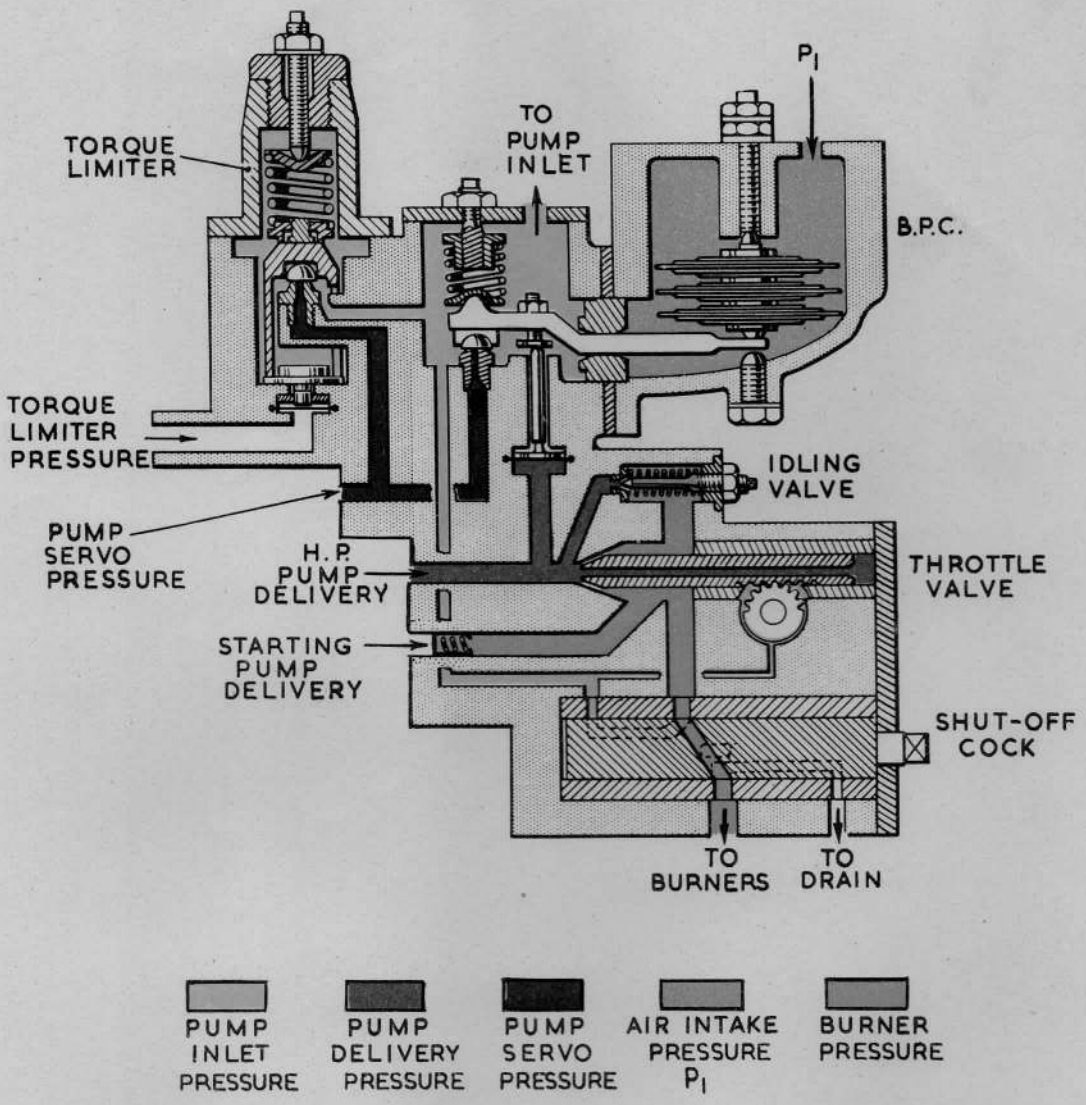

Fig. 3 Functional diagram

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