

Chapter 2

COMBINED CONTROL UNITS, TYPE C.C.U. 11 AND 20 SERIES

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GENERAL

1. In the combined control unit, the throttle valve, shut-off cock, low pressure filter and altitude-responsive flow control are grouped together. The difference in the two types of unit covered in this chapter is that the C.C.U.20 has a later type of filter element, and also has a modified orifice cover and blanking plate to allow a flexible servo pipe to be fitted.

2. An important feature of the simple flow control embodied in this unit is the reduction in pump pressure at part throttle openings, the pump pressure being never more than 200 lb. per sq. in. above burner pressure.

3. The engine requirement can be reasonably matched at full or any predetermined throttle opening up to approximately 30,000 feet, and the unit will handle flows up to about 500 gallons per hour with a suitably-sized filter. The flow control is practically unaffected by the pressure characteristics of other components of the fuel system, e.g., the burners.

4. The control of pump output is effected by a servo valve connected to the pump servo system. The valve plate is carried in a cantilever, the position of which is governed by a piston sensing the pressure drop across the throttle valve and by a capsule assembly responsive to changes in altitude, atmospheric conditions and aircraft speed.

DESCRIPTION

5. From the illustrations fig. 1 and 3 it will be seen that the throttle valve plunger is manually controlled to move in or out of an orifice in the fuel delivery line between the pump and burners. A hole is drilled axially through the plunger to ensure a balance of pressure at either end and grooves are provided around the circumference which give radial pressure balance and promote ease of operation.

6. Movement of this plunger is effected by rack and pinion, rack teeth being cut in the side of the plunger; the pinion is carried on a spindle rotated by a lever connected to a manual control in the pilot's cockpit. By moving the throttle valve plunger, the metering area is varied and, correspondingly, the pressure drop is also varied. This difference in pressure is made to act upon a control piston operating in a cylinder, into which fuel is supplied at pump delivery pressure to the control needle side of the piston and at burner pressure to the other side. Movement of the piston is transmitted through a control needle to a cantilever, which incorporates a half ball to form a valve over an orifice communicating with the pump servo system. The lever is spring-mounted at one end and inserted freely at the other end into a stirrup connecting the capsules. One capsule is open to intake air (barometric) pressure and the other is evacuated, thus rendering the system responsive to *absolute* atmospheric pressure.

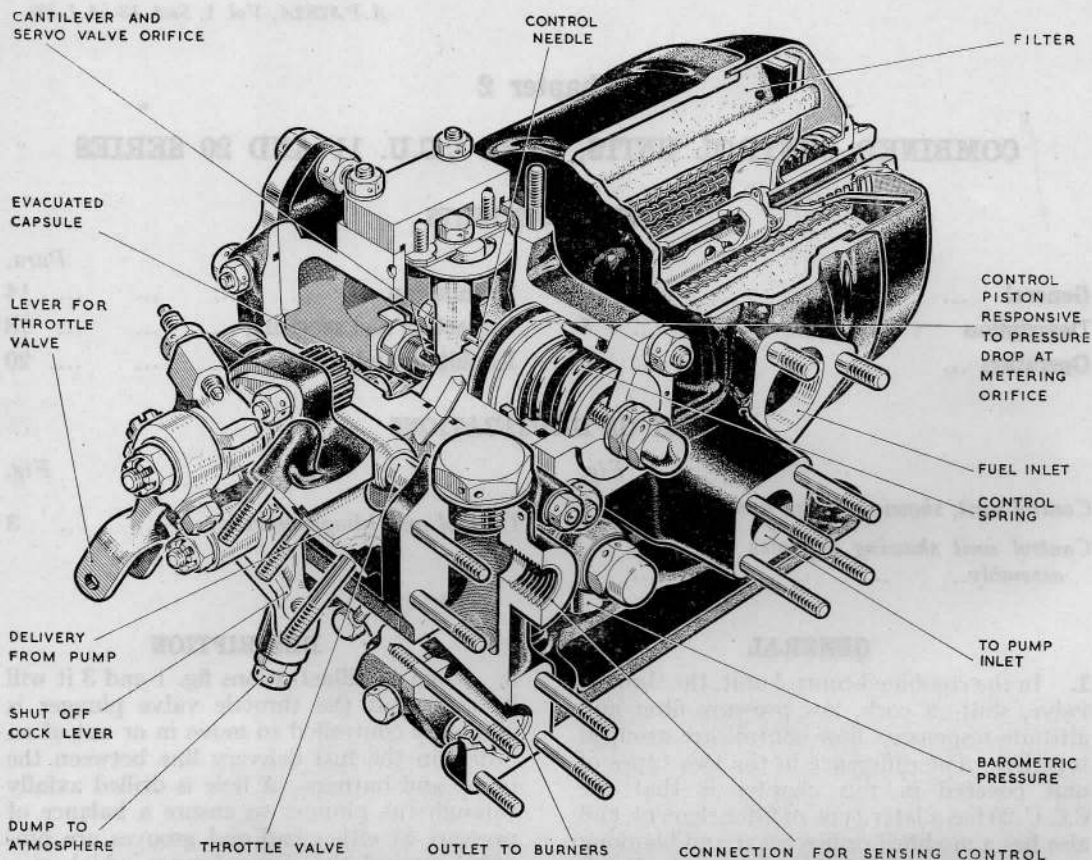


Fig. 1. Control unit, showing piston and levers

7. The control piston is pre-loaded by means of a spring, which has a screw adjustment to enable the desired loading to be achieved; the piston is thus arranged to move against its spring when a given pressure difference is exceeded. As a result, the control needle will also move and the cantilever will be permitted to lift to increase the spill from the servo valve orifice, thus reducing the pump servo pressure. This will cause the pump servo system to come into operation and reduce the delivery of fuel from the pump thus compensating for the alteration in pressure drop.

OPERATION

8. The operation of the control unit is illustrated diagrammatically in fig. 3. When the engine is idling at ground level, that is, with the throttle valve metering orifice very small, the fuel supplied to the engine is dependent upon the flow creating a pressure drop across the metering orifice that is just sufficient to balance the control piston against

its spring loading and maintain the servo valve, communicating with the pump servo system, just floating. Any tendency for the pump to deliver an increase in fuel will result in an increase in pressure drop; the pressure on the control needle side of the control piston will exceed the proportional pressure on the other side and cause the piston to move against its spring loading. This will permit the cantilever to lift to increase the spill from the servo valve and hence reduce the delivery of the pump, as described in para. 7, until the exact quantity of fuel required by the engine is again being delivered by the pump.

9. When the throttle is opened, increasing the area of the metering orifice, the pressure drop across the control piston will be reduced, the pressure on the control needle side being only slightly less than that on the spring side. This will cause the piston to move under the pressure of its spring and the control needle will thus exert a greater pressure on the cantilever, reducing the servo valve spill and

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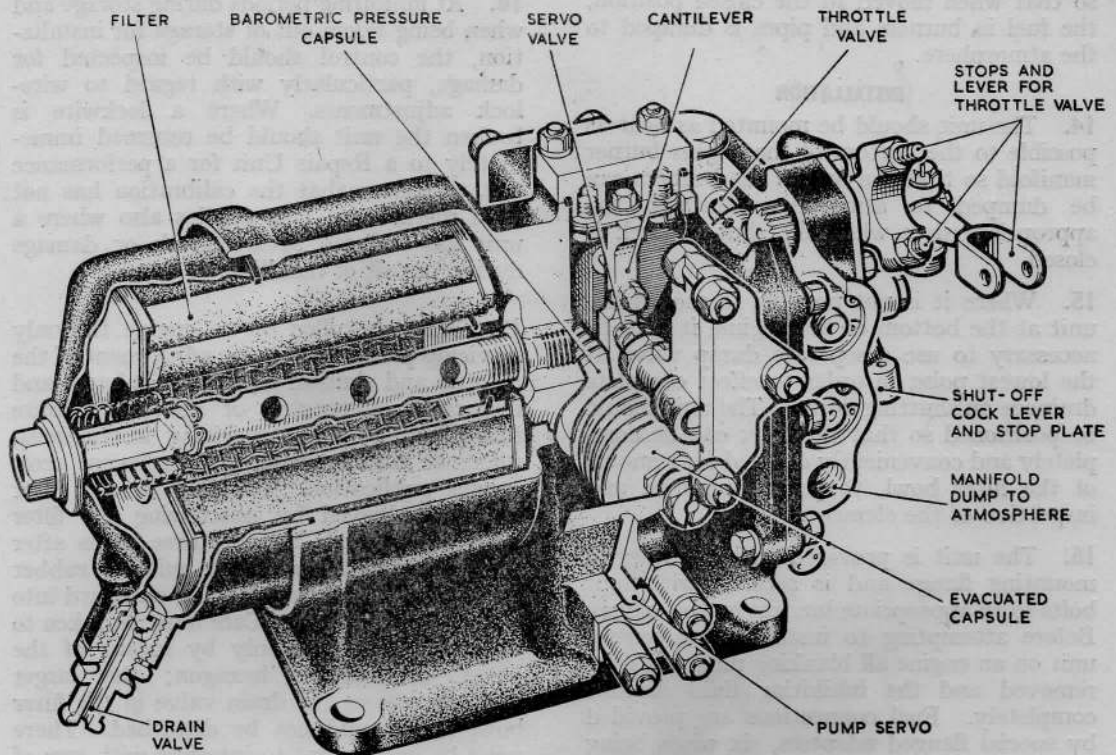


Fig. 2. Control unit showing capsules and filter assembly

thereby influencing the pump servo system to move to increase delivery from the pump until the pressure drop across the throttle valve is again built up sufficiently to cause the flow control piston to move to its balanced position and restore the servo valve to its normal floating state.

10. Should there be an increase in intake air pressure, due to an increase either in aircraft speed or atmospheric density, the barometric capsule will be caused to expand and will permit the free end of the cantilever, resting on the capsule striker pin, to move and close the servo valve, resulting in a decrease in servo spill and therefore an increase in pump delivery. The consequent increased pressure at the inlet to the throttle valve will be sensed by the flow control piston, which will move to restore the pressure balance by influencing the cantilever to restore the servo valve to its floating position, thus balancing the pump servo piston in its new position to provide the larger flow demanded by the barometric capsule.

11. Conversely, if the intake air pressure is reduced, due to slower aircraft speed or a reduction in atmospheric pressure, the barometric capsule will contract and exert a pull on the end of the cantilever, deflecting it sufficiently to increase the servo valve spill and consequently unbalancing the pump servo system to reduce the pump delivery. The reduction in delivery pressure will influence the flow control piston to restore the system to equilibrium under the new conditions. The pressure drop necessary to overcome the spring loading of the piston is therefore reduced and the servo valve orifice opened, resulting in a decrease in the fuel delivered by the pump to restore the state of equilibrium.

12. Adjustable stops are provided at each end of the throttle valve lever travel to enable the idling and maximum flows to be set on the engine.

13. The high pressure shut-off cock is the means of completely shutting off the supply of fuel to the burners to stop the engine when

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desired. It is of the by-pass type, designed so that when moved to the closed position, the fuel in burners and pipes is dumped to the atmosphere.

INSTALLATION

14. The unit should be mounted as near as possible to the bottom of the engine burner manifold so that the fuel in the burners can be dumped to atmosphere through the appropriate slots when the shut-off cock is closed.

15. Where it is not possible to mount the unit at the bottom of the engine, it may be necessary to use a separate dump valve at the lowest point in order to effect complete drainage on shutting down. The unit should be positioned so that the filter can be completely and conveniently drained for removal of the filter bowl, to permit removal and inspection of the element.

16. The unit is provided with an integral mounting flange and is secured with four bolts to an appropriate bracket on the engine. Before attempting to instal a new control unit on an engine all blanking plugs must be removed and the inhibiting fluid drained completely. Fuel connections are provided by special flanged adapters, six pipes being necessary; these are connected as follows:—

Inlet from tank to low-pressure fuel filter

Filter outlet to pump suction

Pump servo system to servo valve

Pump delivery to throttle valve

Shut-off cock outlet to burner manifold

Burner manifold drain from shut-off cock.

17. The throttle valve and shut-off cock levers should be connected to the pilot's operating levers as described in the relevant aircraft Air Publication.

INSPECTION AND SERVICING

18. At inhibiting periods during storage and when being taken out of storage for installation, the control should be inspected for damage, particularly with regard to wire-lock adjustments. Where a lockwire is broken the unit should be returned immediately to a Repair Unit for a performance test to ensure that the calibration has not been disturbed. This applies also where a unit has suffered severe shock or damage during transit or handling.

19. When installed on an engine the only servicing permissible is the adjustment of the throttle and shut-off cock lever linkages and inspection or renewal of the low-pressure fuel filter; for these servicing instructions, reference must be made to the relevant aero-engine publication. Draining of the filter bowl is achieved by unscrewing the filter bowl drain nozzle two or three turns after connecting to the nozzle a suitable rubber pipe with its other end leading outboard into a suitable receptacle. Care must be taken to unscrew the nozzle only by means of the outer, or smaller, hexagon; the larger hexagon retains the drain valve in the filter bowl and should not be disturbed. There must be no attempt to interfere with any of the wire-locked adjustments on the control unit in service and these adjustments must be inspected regularly to ensure that their locking wires are intact and secure.

INHIBITING AND STORAGE

20. The control unit must be inhibited and stored in accordance with the detailed information contained in A.P.4471A, 'The preservation of aero-engines, engine change units, accessories, propellers and associated equipment.'

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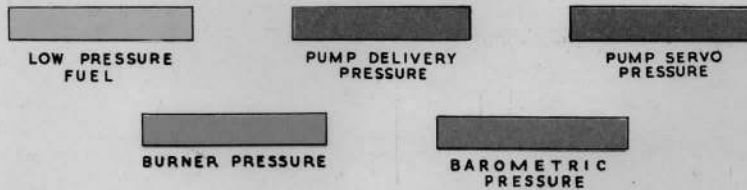
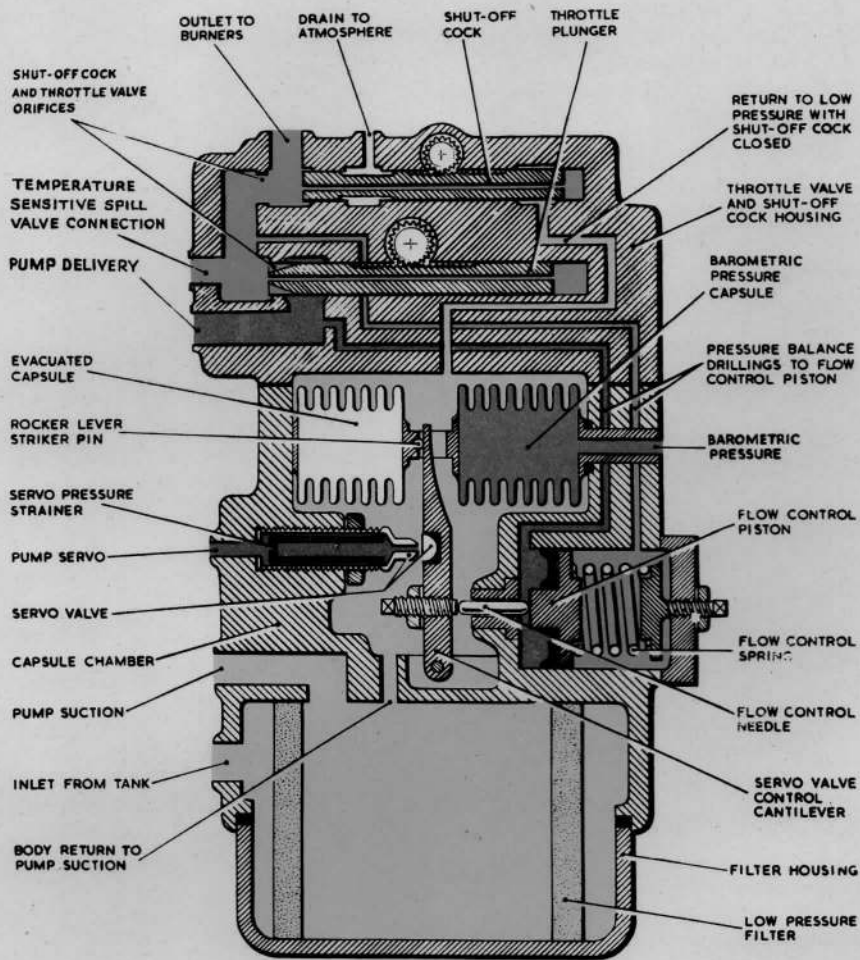


FIG.3. CONTROL UNIT (DIAGRAMMATIC)



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