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CONTROL DEVICE

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Fig. 1.

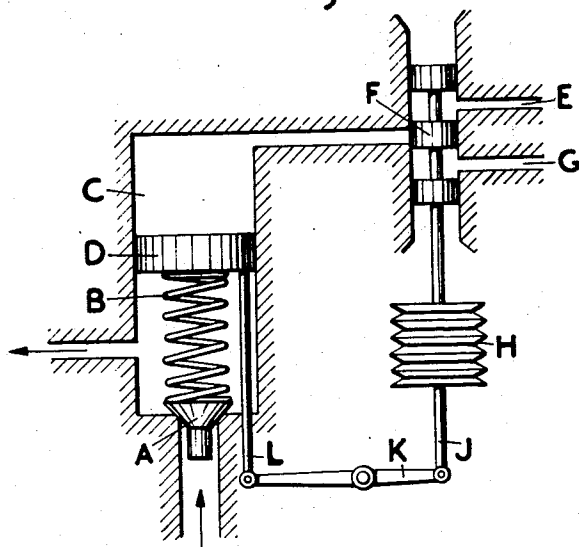
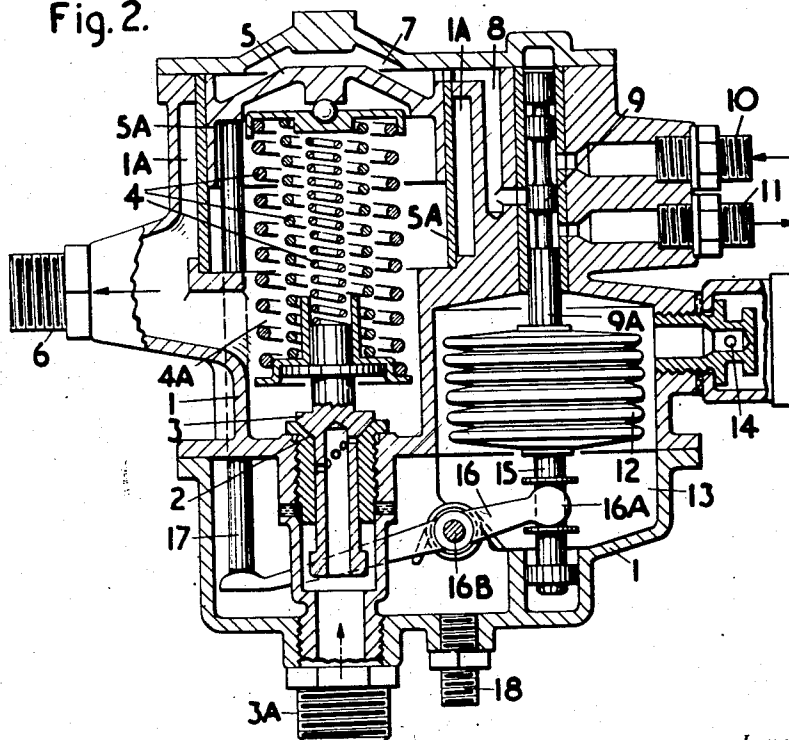


Fig. 2.



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CONTROL DEVICE

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3 Claims. (Cl. 137-81)

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The invention relates to a valve device for certain control purposes. It seeks to provide a pressure-controlled valve which may have various applications but which is primarily intended to be sensitive to changes in a relatively low pressure, such as changes in atmospheric pressure whilst controlling a relatively high pressure, say in the order of tens or even hundreds of atmospheres. The invention more especially though not exclusively, seeks to provide apparatus for the control of pressure fuel supply to engines—and especially aero-engines—which have characteristics such that for a given performance the fuel consumption must be varied in a relationship with ambient air pressure.

There are at present being developed, aero-engines comprising in essence a compressor in the output of which combustion of liquid fuel is arranged for, and a gas turbine driving the compressor; the exhaust gas from which may constitute a propulsion jet. Such engines are self-adjusting as regards mixture strength when running stably. Their fuel consumption for a given speed in R. P. M. varies greatly with the ambient atmospheric pressure. For example, in one case, at a certain speed an engine will use about 1700 lbs. of hydrocarbon fuel per hour in "standard atmosphere, sea level" conditions, and only 300 lbs. per hour at a certain operational altitude. If the fuel supply were maintained at a constant rate, it follows that the engine speed would progressively increase with altitude. There are, of course, certain safety limits to permissible speed. Therefore it is desirable that some expedient be adopted to cut down the fuel supply as height is increased. It is not regarded as practicable to do this manually, and even if it is done manually, the phenomenon results that a throttle range of movement which may be reasonable and adequate at sea-level is progressively diminished as altitude increases, with obvious disadvantages. It is an object of the invention to afford means for adjusting the fuel supply automatically with variations of altitude.

It should perhaps be added that present practice with engines of the kind stated, is to provide a fuel pump of a positive type driven directly by the engine and operating in a comparatively high pressure range, say 30-450 lbs. per sq. in.; some of the output from this pump is allowed to return to the fuel source through a relief valve, which valve controls the operative fuel pressure. Such a valve obviously has to pass back to source a quantity of fuel which increases pro rata with altitude, and an uneconomical amount of work done by the pump is thus wasted. A secondary

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advantage sought by the invention is to minimise this waste and incidentally to avoid unnecessary heating of the fuel.

The invention consists broadly in such a device, comprising a resiliently loaded relief valve controlling the pressure of the first fluid (i. e., that fluid which is to be controlled) the resilient load of which is variable by variation of the effective fluid pressure of a third fluid and means controlled by variations of pressure of the second fluid to vary the resilient loading on the relief valve by varying the effective fluid pressure of the third fluid. Thus in the case of the aero engine indicated, the first fluid is the actual liquid fuel being supplied to the engine, and the second fluid is the atmosphere, the pressure of which either by itself or as affected by pitot head due to forward speed, is regarded as the ambient pressure and acts upon the device. The third fluid is conveniently servo fluid, for example, lubricating oil, or some of the pumped fuel diverted and pressure controlled so as to be usable as a servo fluid.

Somewhat more specifically the invention comprises a valve device for controlling the pressure of a first fluid in accordance with variations in pressure of a second fluid, comprising a resiliently loaded relief valve controlling the pressure of the first fluid, a second valve set by variations of pressure of the second fluid, and a fluid pressure system such that changes of setting of the second valve permit more or less pressure from a servo source of pressure fluid to be applied so as to vary the resilient load on the relief valve. Preferably there is provided also means whereby the changes of resilient loading on the relief valve involve movement of an appropriate part, which movement is transmitted to an element of the servo valve so as to affect its setting, whereby a follow-up effect is achieved in the device. Further and more constructional features of the invention will become apparent from the following description of an example in which a valve device comprises a relief valve for the controlled pressure, a spring or spring-pack loading the relief valve, a servo, a servo piston or an equivalent such as a diaphragm moveable to vary the spring load under the influence of servo-fluid pressure, a servo-valve controlling the servo fluid pressure on the servo piston, and a barometric capsule or equivalent pressure-sensitive device susceptible to the controlling pressure (e. g., atmosphere) for its deflections and setting the servo valve by such deflections and mechanical action between the servo piston and servo valve, whereby this valve is also settable in accordance

with movement of the servo piston. Preferably in this follow-up arrangement the whole capsule is moved bodily as will be described.

The invention will now be described by way of example, by reference to the accompanying drawing in which Figure 1 is a simple diagram to illustrate function, Figure 2 is a sectional view illustrating one construction of a complete valve device according to the invention, as applied in a gas turbine aircraft fuel system.

In Figure 1, A represents a relief valve, loaded by a compression spring B the compressive stress in which is determined by servo fluid pressure acting in chamber C on top of servo piston D. The servo fluid is admitted to chamber C from a connection E, when the servo valve F is moved downwards, and is released for egress through an escape connection G when the valve F is moved upwards. The valve F is moved by the deflections of a pressure-sensitive capsule H (of the aneroid barometer kind) the overall length of which is changed by pressure-caused deflections. The bottom of the capsule H is held by a rod J which is mechanically movable, through a rocker K and pushrod L in accordance with movements of piston D.

Lessening of atmospheric (or ambient) pressure expands the capsule H, thus raising valve F, reducing the pressure in C and therefore the resilient load on valve A which consequently controls the pressure below it to a lower value. Meanwhile, piston D rises and the capsule H is consequently dropped, restoring valve F to an equilibrium position. With increase of ambient pressure the converse action takes place. The connection E is deemed to be supplied with servo fluid at constant pressure, and G may, conveniently, return servo fluid to a reservoir provided therefor.

The function of the valve device shown in Figure 2 is the same.

The valve device comprises a casing or body I having a relief-valve seat 2, and relief valve 3 which is on a stem and spring-urged towards the seat by a pack of springs 4 selected to give the required rate. The spring pack 4 is housed in a cylindrical chamber 4A and reacts on the underside of a servo piston 5 sliding in a cylinder 5A. To the underside of the valve 3 is supplied the fuel entering the body I under pressure by the union 3A at the full pressure of the fuel pump. Fuel rising and passing the valve 3 is collected in the spring chamber 4A and escapes through a union 6 to return to the fuel source e. g., a tank. The load of the spring pack 4 on the valve 3 is determined by the position of the piston 5. Servo fluid pressure acts above this piston in the space 7, which communicates by a duct 8 with a slide valve port controlled by a slide servo valve 9 which either admits servo fluid (which is supplied through union 10 to the space 7 or emits it from the space through union 11). The valve 9 is preferably so dimensioned in relation to its port that when the valve is balanced it allows a very small flow from 10 to 11, maintaining the servo pressure in space 7.

The valve 9 is moved through a stem 9A by the deformations of a flexible barometric capsule 12 which is evacuated and acts as a pressure sensitive device. The ambient pressure communicates with the interior of a chamber 13 through a vent 14 which is suitably protected to prevent ingress of foreign matter. The capsule 12 housed in the chamber 13, is mounted at its lower end on a guided rod 15 which is en-

gaged by the forked end 16A of a rocker 16 borne at 16B, the tail of which rocker is acted upon by a pushrod 17 slidable in structure of the body I, the upper end of the pushrod abutting against the underside of the piston 5. This push and rocker mechanism acts as a follow-up device, because the position of the piston 5 determines the location of the capsule 12 within its chamber 13, thus when an expansion of the capsule 12 causes valve 9 to rise, emitting servo-fluid from the space 7, the piston 5 rises (by influence of the spring pack 4) thereby reducing the fuel pressure required to open the valve 3, and simultaneously the pushrod 17 rises, dropping the whole of the capsule 12. This train of action corresponds with a fall in ambient pressure in 13, i. e., with an increase of altitude (or decrease of forward speed in a case where pitot pressure is a factor). Its result in the fuel system is to reduce the supply pressure for a given set of conditions, thus to reduce the fuel supply to the engine. The body I is formed with jacket spaces as at 1A in which relieved fuel circulates to maintain the temperature of the working parts, especially the cylinder 5A.

A drain connection at 13 may be provided for any leakage of servo fluid, or condensate, which might otherwise accumulate in the chamber 13.

I claim:

1. A valve device for controlling the pressure of a first fluid flow in accordance with variations in pressure in a second fluid, comprising a resiliently loaded relief valve for adjusting the pressure of the first fluid, pressure fluid operated means for adjusting the resilient loading of said relief valve to any desired value over a range of values and a fluid pressure system of which the effective pressure is controlled by variations in the pressure of the second fluid for operating said adjusting means, and a body containing the main operative parts of said device, said body having jacket spaces therein for the circulation of one of said fluids for the purpose of maintaining required temperature conditions.

2. A valve device for controlling the pressure of a first fluid flow in accordance with variations in pressure in a second fluid, comprising a resiliently loaded relief valve for adjusting the pressure of the first fluid, a pressure fluid operating device having a cylinder with a piston therein separate from said relief valve but directly engaging said resilient load of said relief valve for adjusting the loading to any desired value over a range of values and a fluid pressure system of which the effective pressure is controlled by variations in the pressure of the second fluid for operating said adjusting piston.

3. A relief valve device for controlling the pressure of a first fluid flow in accordance with variations in the pressure in a second fluid comprising a relief valve with resiliently loading means for loading it towards its closed position, servo system means including a cylinder with a power piston separate from said relief valve but directly engaging said resiliently loading means for loading it, servo valve means for controlling the loading of said power piston to any desired value over a range of values, a follow-up device mechanically linking said piston and said servo valve means and a pressure sensitive means in the linkage sensitive to variations in the pressure of said second fluid for varying it.

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