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HYDRAULIC GOVERNOR

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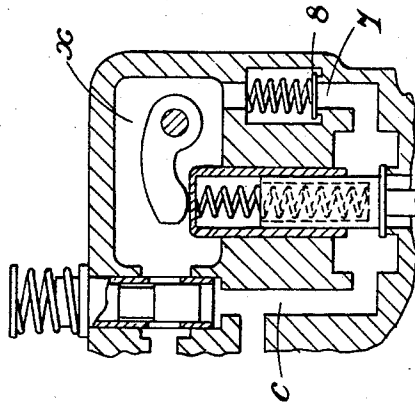


Fig. 2

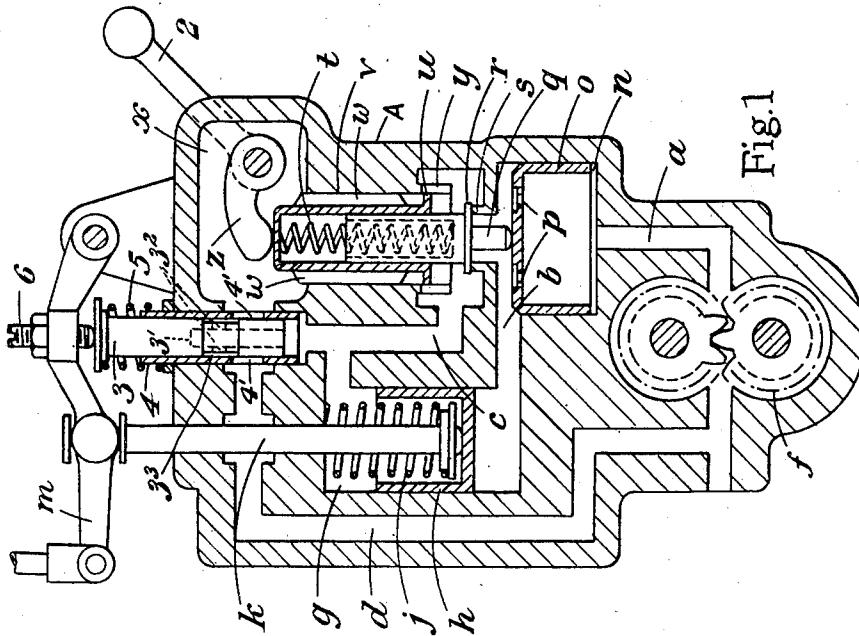


Fig. 1

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HYDRAULIC GOVERNOR

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This invention has for its object to provide improved hydraulic governors for controlling the rate of supply of liquid fuel to an internal combustion engine in response to variations in the speed of the engine.

The invention comprises the combination of a fluid-circulating pump adapted to be driven by the engine, a circulatory system associated with the pump, a movable member responsive to the fluid pressure in the system for actuating the regulating means of a pump for supplying liquid fuel to the engine, a control valve loaded by a manually variable spring for controlling the flow in the said system, a variable choke for controlling the pressure in the system when governing below a predetermined speed, the choke being automatically variable in response to movement of the said movable member, and a valve adapted to by-pass the choke when governing above the said predetermined speed.

In the accompanying sheet of explanatory drawing:

Figure 1 is a diagrammatic sectional side view of a hydraulic governor constructed in accordance with the invention.

Figure 2 is a fragmentary sectional view of a modified detail.

In carrying the invention into effect as shown in Figure 1, I employ a body part A having formed in it a plurality of passages *a*, *b*, *c* and *d*, these passages forming parts of a circulatory system through which liquid can flow under the action of any convenient rotary pump, such as a gear-pump *f*, adapted to be driven by an internal combustion engine. In the system is formed a cylindrical chamber *g* which communicates at one end with the passage *b*, and at the other end with the passage *c*. The chamber *g* contains a piston *h* (hereinafter referred to as the regulating piston) which is loaded by a spring *j*, and from which extends a rod *k* having its outer end connected to a lever *m*, the latter being adapted to actuate the usual regulating means of another pump (not shown) which supplies liquid fuel to the engine. Also between the circulating pump *f* and the chamber *g* is formed a second cylindrical chamber *n* which at one end is connected by the passage *a* to the delivery-side of the pump *f*, and at the other end is connected by the passage *b* to the corresponding end of the first chamber *g*. The second chamber *n* contains a hollow piston *o* having in its end an orifice or orifices *p* through which the liquid from the circulating pump *f* can flow with an appropriate pressure drop which is a function of speed, and on the end of this piston

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rests the stem *q* of a valve *r* which serves by co-operation with a seating at one side of a port *s* to control communication between the passages *b*, *c*, and thus to control the flow of liquid in the system. The valve *r* is loaded by a spring *t* which is contained within a hollow extension of the valve and the interior of another and coaxial hollow valve *u* which serves as a guide for the first valve, and which controls a by-pass between the passage *c* and the passage *d*, the latter passage being in communication with the suction-side of the pump *f*. The by-pass above mentioned is formed in part by a passage *v* in which the by-pass valve *u* is slidably supported by longitudinal ribs *w* on this valve, and in part by a chamber *x* between the last mentioned passage and the passage *d*. The by-pass valve *u* co-operates with a slotted skirt *y* at one end of the by-pass passage *v* to control communication between this passage and the passage *c*, and is loaded by the same spring *t* as the first valve *r*, this spring tending to move the by-pass valve to its closed position. Movement of the by-pass valve *u* against the action of the spring *t* is effected by a cam-like lever *z* mounted in the by-pass chamber *x*, this lever being adapted to act on the adjacent end of the by-pass valve, and being operable by a hand lever *2*. Also in parallel with the by-pass *v*, *x* is arranged a variable choke consisting of a piston valve *3* which is slidable in a sleeve *4* and is loaded by a spring *5*. The piston valve *3* is formed with an axial bore *3¹*, and with lateral ports *3²* interconnecting the bore and a circumferential groove *3³* around the exterior of the valve, the bore being closed at one end and being in free communication at the other end with the passage *c*. The sleeve *4* in which the piston valve *3* is slidable, is formed with lateral ports *4¹* for connecting the groove *3³* in the piston to the passage *d* and chamber *x*, in contact with an adjustable abutment *6* on the above mentioned lever *m* which transmits movement to the regulating means of the fuel pump. The variable choke serves to control communication between the passages *c*, *d*. Further I may provide between the passages *b*, *d* a spring-loaded relief valve (not shown) to limit the pressure developed in the system.

The arrangement and mode of operation of the hydraulic governor above described are as follows:

On starting the engine (by for example, a starting motor) the driver moves the cam-like lever *z* in a counter-clockwise direction to a position in which it imposes a maximum closing pressure on the first valve *r* through the medium of the by-pass valve *u* and the spring *t*, this movement

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of the lever serving also to open the by-pass valve. The circulating pump *f* now causes liquid under pressure to pass through the orifice or orifices *p* of the aforesaid hollow piston *o* to the lower side of the regulating piston *h* and moves the latter, in opposition to its spring *j*. As the quantity of liquid delivered by the circulating pump *f* during starting of the engine is small, the pressure drop across the orifice or orifices *p* is also small, and in consequence no appreciable end thrust is exerted through the hollow piston *o* on the valve *r* which remains closed. However, the liquid pressure at the lower side of the regulating piston *h* is sufficient to move this piston against the action of its loading spring *j* for actuating the fuel pump regulating means so as to cause the fuel pump to give its maximum discharge. When the engine begins to rotate under its own power, the liquid pressure acting on the first valve *r* through the medium of the hollow piston *o* increases sufficiently to open this valve, thereby allowing access to liquid to the upper side of the regulating piston *h* through the passage *c*, and also allowing liquid from the circulating pump *f* to return to the suction-side of this pump past the by-pass valve *u* and through the passage *d*. If the cam-like lever *z* is now released, the by-pass valve *u* closes under the action of the spring *t*, and the consequent rise of pressure on the upper side of the regulating piston *h* assists the spring *j* to return the regulating piston to a new position of equilibrium, in which the rate of supply of fuel from the fuel pump is reduced to an amount corresponding to the idling requirements of the engine. This movement of the regulating piston *h* causes opening movement to be simultaneously transmitted to the piston valve 3 of the variable choke through the lever *m*, and the consequent liquid flow past this valve controls the liquid pressure acting on the upper side of the regulating piston when the engine is idling. To obtain an increase of the speed of the engine, the cam-like lever *z* is again moved by the driver in a counter-clockwise direction so as to open the by-pass valve *u* and simultaneously increase the spring pressure on the first valve *r*, the amount of movement given to the cam-lever being dependent on the speed increase required. This action causes the fluid pressure at the lower side of the regulating piston *h* to be increased and that on the other side to be decreased, with consequent movement of the regulating piston in the direction for increasing the fuel pump delivery. When the speed of the engine has increased sufficiently to produce a pressure drop through the orifice or orifices *p* of the aforesaid hollow piston *o* such as to cause the latter to open the control valve *r*, the difference in the liquid pressures at opposite sides of the regulating piston *h* will decrease sufficiently to allow the spring *j* to move the regulating piston *h* into a new position of equilibrium.

Instead of employing the by-pass passage *v* and the associated valve *u* which is operable by the cam-like lever *z*, I may employ the modification shown in Figure 2. In this modification I provide between the passage *c* and the chamber *x* a by-pass passage 7 which is controlled by a spring-loaded valve 8, the latter being adapted to open automatically when the pressure in the passage *c* reaches a predetermined limit.

By this invention I am able to obtain sensitive and stable governing of the fuel pump in a very convenient manner.

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The invention is not, however, restricted to the examples above described, as subordinate mechanical or constructional details may be modified. Thus, instead of the said hollow piston with an orifice or orifices for opening the control valve, I may employ an equivalent centrifugal mechanism, or any other convenient means by which there can be exerted on this valve a force proportional to the speed of the engine.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A hydraulic governor comprising a liquid circulating pump having an inlet and an outlet, a delivery passage communicating with said outlet, a return passage communicating with said inlet, a third passage forming with said delivery passage and said return passage a liquid circulatory path between said inlet and outlet, a main valve responsive to the speed of said pump for establishing communication between said delivery passage and said third passage, a manually variable loading spring opposing opening movement of said main valve, a chamber communicating at opposite ends with said delivery passage and said third passage respectively, a spring loaded movable member arranged in said chamber so as to be responsive to liquid pressures in said delivery passage and third passage, a variable choke for establishing communication between said third passage and said return passage, means for varying said choke in response to movement of said movable member, and a by-pass valve for establishing communication between said third passage and said return passage independently of said choke.

2. A hydraulic governor as claimed in claim 1 and having manually operable means for actuating said by-pass valve.

3. A hydraulic governor as claimed in claim 1, in which said by-pass valve is spring-loaded, and is operable by liquid pressure in said third passage.

4. A hydraulic governor as claimed in claim 1 and having means for exerting on said main valve a force proportional to the speed of said pump.

5. A hydraulic governor as claimed in claim 1 and having a piston arranged to act on said main valve under liquid pressure in said delivery passage, said piston being provided with at least one orifice through which liquid in said delivery passage can flow.

6. A hydraulic governor as claimed in claim 1 and having manually operable means for actuating said by-pass valve, and a loading spring arranged between and acting on both said by-pass valve and said main valve, said by-pass valve and said main valve being arranged coaxially with each other.

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