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MEANS FOR CONTROLLING THE SUPPLY OF LIQUID
FUEL TO INTERNAL-COMBUSTION PRIME MOVERS

2 Sheets--Sheet 1



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2 Sheets-Sheet 2

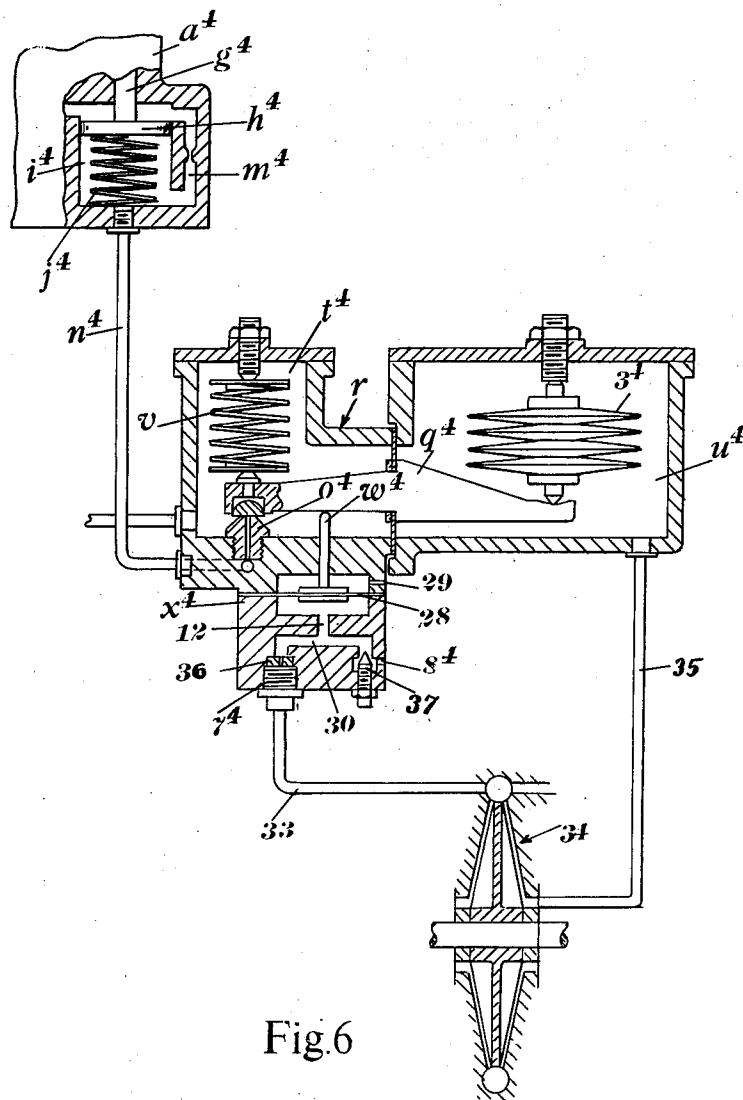


Fig. 6

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MEANS FOR CONTROLLING THE SUPPLY OF
LIQUID FUEL TO INTERNAL-COMBUSTION
PRIME MOVERSErnest Ansley Watson, Birmingham, England,
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6 Claims. (Cl. 103—11)

1

This invention relates to systems in which liquid fuel is supplied to an internal combustion prime mover by a variable-delivery pump, the means which control the output of the pump being responsive at least in part to fluid pressure dependent on the speed of the prime mover.

The object of the invention is to enable any desired part of the available fluid pressure to be used for actuating the output controlling means of the pump.

In the accompanying sheets of explanatory drawings:

Figure 1 is a diagrammatic part sectional side view illustrating one form of the invention applied to a variable delivery pump, and Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a sectional side view illustrating a modified feature.

Figures 4 and 5 are similar sectional views illustrating respectively two modified forms of the invention.

Figure 6 is a similar view to Figure 1 illustrating another modified form of the invention.

In Figure 1 *a* indicates a variable-delivery pump of the swash plate type which is adapted to be driven in any convenient manner by the internal combustion prime mover (not shown) to be supplied with liquid fuel by the pump, the output of the pump being controlled in known manner by an angularly adjustable swash plate *b*. Liquid fuel is supplied from a tank *c* to the pump *a* by a pipe *d*, and is delivered by the pump to the jets *e* of the prime mover through another pipe *f*.

The swash plate *b* is connected by a rod *g* to a piston *h* which is slidable in a cylindrical chamber *i* formed in the stationary part of the pump *a*, the piston being loaded by a spring *j*. The end of the chamber *i* towards which the piston *h* is movable by the spring *j* is connected by a pipe *k* to the delivery pipe *f* of the pump *a*, and this end of the chamber also communicates with the other end of the chamber through a restricted passage *m*. The latter end of the chamber *i* is connected by a pipe *n* to a vent *o* which at its outer end forms a seating for a closure member *p* on one end of a lever *q* in a chamber *r*.

The lever *q* is secured at a position intermediate its ends to a diaphragm *s* which serves as a fulcrum for the lever, and divides the chamber *r* into two compartments *t*, *u*. The vent *o* is adapted to communicate with the compartment *t* under the control of the closure member *p* on the lever *q*, and this compartment contains a compression spring *v* adapted to act on the adjacent end of the lever in the direction for closing the

2

vent. The compartment *t* also contains a plunger *w* which is adapted to act on the lever *q* in opposition to the spring *v*, the plunger being responsive to fluid pressure in a sub-chamber *x* on the chamber *r*. Moreover, the compartment *t* is connected by pipes *y*, *z* to the tank *c* at the supply side of the pump *a*. The other compartment *u* is provided with an opening 2 leading to the atmosphere, and contains an evacuated capsule 3 adapted to act on the lever *q* in opposition to the spring *v*.

Adjustment of the swash plate *b* of the pump *a* to vary the pump output is effected automatically by the piston *h* in response to movement of the lever *q*.

In carrying the invention into effect as shown in Figures 1 and 2, I provide a by-pass device having a hollow body part 4 adapted to form a shallow cylindrical chamber in which is mounted a rotatable disc 5 having a plain outer periphery, the latter and the inner periphery of the chamber forming a narrow annular space 6 through which liquid fuel can flow. At diametrically opposite positions the body part 4 is formed with a pair of ports 7, 8 which communicate with the annular space 6. The port 7 serves as a connection for one end of a pipe 9 which at its other end is connected to the pump delivery pipe *f*. The other port 8 serves as a connection for one end of the pipe *y* which at its other end is connected to the compartment *t* of the chamber *r*, and which at an intermediate position is connected by the pipe *z* to the tank *c* at the supply side of the pump *a*. When the pump *a* is in action the annular space 6 in the body part 4 forms a by-pass by which some of the liquid in the delivery pipe *f* can constantly be returned to the supply side of the pump *a*, and the dimensions of the annular space are made such as will set up a convenient pressure gradient between the two ports 7, 8.

The rotatable disc 5 is formed with a radial passage 10 leading from the periphery of the disc to an axial passage 11 in the disc. The axial passage 11 communicates with a third port 12 in one end of the hollow body part 4, this port serving as a connection for one end of a pipe 13 which at its other end is connected to the sub-chamber *x* on the chamber *r*. Consequently pressure fluid can flow from the annular space 6 in the body part 4 to the sub-chamber *x* where it acts on the adjacent end of the plunger *w* which forms a part of the mechanism for controlling the pump output. Also the disc 5 is rotatable manually or under manual control (through the

3

medium of an axial stem 14 on the disc and a lever 15 on the stem) to move the outer end of the radial passage 10 to any desired position between the ports 7, 8 and so vary the fluid pressure acting on the plunger w .

As an alternative to the disc 5 shown in Figures 1 and 2 I may employ a peripherally toothed disc as indicated by 5¹ in Figure 3.

Instead of having the form above described the by-pass device may have any of a variety of forms two of which are illustrated in Figures 4 and 5.

In the example shown in Figure 4 I employ a chambered body part 4² having a pair of cylindrical ports 7², 8² at its opposite ends, the outer ends of the ports serving respectively as connections for the pipes 9, y previously described. In each of the ports 7², 8² is arranged a slidable flow-controlling plug 5² which may be of tapered form or of cylindrical form with one or more tapered grooves as 6² along its length. The two plugs 5² are interconnected by and may be integral with a part 16 adapted to receive linear movement from a crank or like mechanism including a pin 17 engaging a slot 18 in the said part, the said mechanism being operable manually or under manual control. By operating the crank or like mechanism the plugs 5² are moved so as simultaneously to increase the effective area of one of the ports 7², 8² and decrease the other. Alternatively two separate plugs may be used, these being actuated by a rotatable cam situated between their adjacent ends. In one side the body part 4² is provided with a third port 12² which serves as a connection for the previously described pipe 13 whereby pressure fluid is conducted to the output controlling mechanism of the pump. By varying the effective areas of the two first mentioned ports 7², 8² the pressure of the liquid in the body part 4² (and consequently the pressure acting on the pump controlling mechanism) is also varied.

In the example illustrated by Figure 5 I employ a body part 4³ provided with three ports 7³, 8³ and 12³ which serve respectively as connections for the pipes 9, y and 13 previously described. The ports 7³, 12³ communicate respectively with passages 19, 20 in the body part 4³, and these passages are interconnected by a third passage 21 in the body part. Also the third passage 21 is connected at one end to the port 8³ by a fourth passage 22 in the body part 4³. Moreover, fluid flow from the passage 19 to the passage 21 is restricted by an adjustable member 23, and fluid flow from the passage 22 to the port 8³ is likewise restricted by an adjustable member 24. Further, fluid flow from the passage 21 to the passage 22 is controllable by a flow-restricting member 25, the latter being adjustable by rack-and-pinion mechanism 26 from a lever 27 which is operable manually or under manual control. By adjusting the flow-restricting member 25, the fluid pressure in the passage 21 (and consequently the pressure acting through the port 12³ on the pump controlling mechanism) is varied.

Instead of employing the pressure of fluid delivered by the pump for actuating the plunger w of the pump controlling mechanism shown in Figure 1, I may employ the delivery pressure of a blower driven by the prime mover. An example of this modification is illustrated in Figure 6 in which parts similar or analogous to those shown in Figure 1 are indicated by the same reference characters suffixed by 4.

In the example illustrated in Figure 6 the sub-

4

chamber x^4 is divided by a diaphragm 28 into two compartments one of which is provided with an air vent 29, and the other of which is connected by the port 12⁴ and a passage 30 to a pair of ports 7⁴, 8⁴. The diaphragm 28 serves to actuate the plunger w^4 . The port 7⁴ serves as a connection for one end of a pipe 33 which at its other end is connected to the outlet of the compressor 34, the inlet of the compressor being connected by a pipe 35 to the compartment u^4 containing the evacuated capsule 3⁴. Also the port 7⁴ is provided at its inner end with a member 36 for restricting fluid flow from the compressor 34 to the passage 30. The port 8⁴ serves as a fluid vent, and the flow of fluid through this vent is controllable by a second flow-restricting member 37, the latter being adjustable manually or under manual control. When the compressor 34 is in action a portion of the air delivered by it is constantly discharged to the atmosphere through the port 7⁴, passage 30, and port 8⁴, and the first mentioned flow-restricting member 36 sets up a convenient pressure drop between the compressor outlet and the passage 30 leading to the diaphragm 28. By adjusting the second flow-restricting member 37, the fluid pressure acting on the diaphragm 28 (and consequently on the plunger w^4) can be varied.

By this invention the control of the liquid fuel supply to an internal combustion prime mover can be effected in a very satisfactory manner. The invention is not, however, restricted to the examples described, as its essential features may be embodied in a variety of forms.

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

1. A liquid fuel supply system comprising a variable delivery pump and a member responsive to fluid pressure for controlling the output of the pump, a by-pass device having in combination a pressure fluid inlet, a pressure fluid outlet, a restricted passageway interconnecting the inlet and outlet, a port which communicates with the passageway at a position between the inlet and outlet, and means through which the pump control member is exposed to the fluid pressure at the said position within the passageway, and adjustable means for establishing a variable pressure drop in the passageway to vary the fluid pressure acting on the said member.

2. A liquid fuel supply system as claimed in claim 1, in which the by-pass device comprises in combination a shallow cylindrical chamber provided at diametrically opposite positions with the inlet and outlet, and at one side with the port, a rotatable disc mounted within the chamber so as to leave a narrow annular space between the outer periphery of the disc and the inner periphery of the chamber, the disc being formed with a passageway through which the said space communicates with the port, and manually controllable means for imparting rotational adjusting movement to the disc.

3. A liquid fuel supply system as claimed in claim 1, in which the by-pass device comprises in combination a shallow cylindrical chamber provided at diametrically opposite positions with the inlet and outlet, and at one side with the port, a rotatable and peripherally toothed disc mounted within the chamber so as to leave a narrow annular space between the periphery of the disc and the inner periphery of the chamber, the disc being formed with a passageway through which the said space communicates with

5

the port, and manually controllable means for imparting rotational adjusting movement to the disc.

4. A liquid fuel supply system as claimed in claim 1, in which the by-pass device comprises in combination a hollow body part provided at opposite ends with the inlet and outlet, and at one side with the port, a pair of slidable flow-controlling plugs mounted respectively in the inlet and outlet, and manually controllable means for imparting simultaneous adjusting movements to the plugs.

5. A liquid fuel supply system as claimed in claim 1, in which the by-pass device comprises in combination a body part provided with passages interconnecting the inlet and outlet and the port, a member for restricting fluid flow from the inlet to the port and the outlet, another member for restricting fluid flow through the outlet, a third member for restricting fluid flow between the port and the outlet, and manually controllable means for varying the position of the third member.

6

6. A liquid fuel supply system as claimed in claim 1, in which the by-pass device is provided at its inlet with a member for restricting fluid flow between the inlet and outlet and the port, and at its outlet with an adjustable member for restricting fluid flow through the outlet.

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