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PRESSURE GOVERNOR FOR PUMPS

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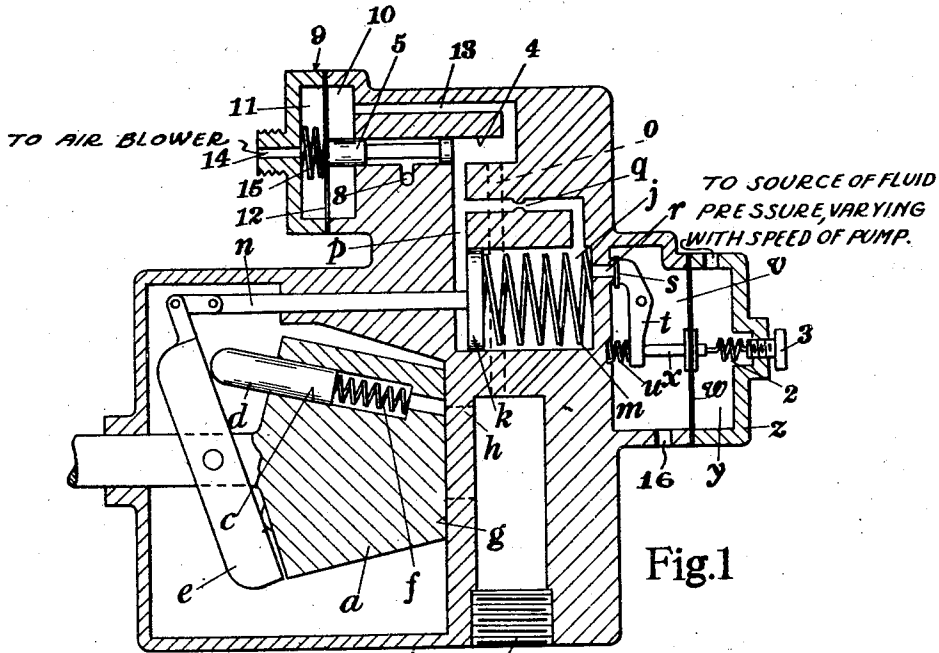


Fig.1

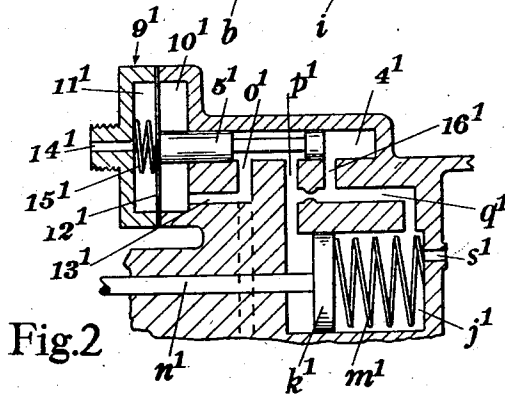


Fig.2

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PRESSURE GOVERNOR FOR PUMPS

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In the specification of Patent No. 2,403,371 there is described and claimed an invention relating to variable-output pumps of the swash plate type. The said invention comprises the combination with such a pump, of a cylinder which at one end is adapted to communicate with the delivery side of the pump, a fluid vent at the other end of the cylinder, a spring-loaded piston slidable in the cylinder under fluid pressure and adapted to vary the position of the swash plate of the pump, means for effecting a restricted communication between the two ends of the cylinder, a movable closure member for controlling the vent, and means responsive to fluid pressure for actuating the closure member. The said specification also describes and claims means for enabling the pump to operate automatically as a constant-delivery pump in the event of the fluid pressure acting on the said piston falling below a predetermined pressure, the said means in one form comprising a fluid-operable and spring-loaded valve adapted to interrupt communication between the delivery side of the pump and the cylinder.

The invention forming the subject of the present specification is concerned with a modification of the invention above mentioned, and consists broadly of means whereby the loading on the valve depends not only on a spring but also on the fluid pressure in a part of the system with which the pump is associated.

In particular the modification consists of the combination with the valve, of a chamber, a valve-actuating diaphragm which divides the chamber into two compartments, and a spring in the compartment remote from the valve, the latter compartment being adapted to be connected to a supplementary source of fluid pressure, and the other compartment being adapted to be connected to the delivery side of the pump.

In the accompanying sheet of explanatory drawings—

Figure 1 is a diagrammatic sectional side elevation of a variable-output liquid fuel pump embodying the invention.

Figure 2 is a fragmentary sectional view illustrating a modified application of the invention.

The pump shown in Figure 1 comprises a rotary body *a* arranged in a casing *b* and having formed around its axis a plurality of bores as *c*. In each of the bores *c* is arranged a reciproca-

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tory plunger as *d* which at one end is adapted to project from the body *a*. The latter is adapted to be driven in any convenient manner by a prime mover to be supplied with liquid fuel by the pump. During rotation of the body *a* the plungers *d* are moved in one direction by an angularly adjustable swash plate *e* acting on the outer ends of the plungers, and in the opposite direction by springs as *f*, the latter being situated in the bores *c*, and serving to hold an end face of the body in contact with a flat seating *g* in the casing *b*. The seating *g* is formed with an inlet port (not shown) communicating with a liquid inlet (also not shown) in the casing *b*, and is also formed with an outlet port *h* communicating with a liquid outlet *i* in the casing.

At the end remote from the swash plate *e* the casing *b* is provided with a cylinder *j* having closed ends. Arranged in the cylinder *j* is a controlling piston *k* loaded by a spring *m*, and extending from one side of this piston and through a bore in the inner end of the cylinder is a rod *n* connected to the swash plate *e*. The inner portion of the cylinder *j*, that is the portion at the piston-rod side of the piston *k* is adapted to communicate freely with the outlet *i* through passages *o*, *p* in the casing *b*, and this portion of the cylinder is in communication with the other or outer portion of the cylinder (which contains the spring *m*) through a restricted passage *q*. The outer end of the cylinder *j* is provided with a small vent *r* which at its outer end forms a seating for a closure member *s* provided on one end of a lever *t*, the latter being loaded by a spring *u* which tends to hold the closure member on its seating. The lever *t* is mounted in a chamber *v* which is provided at the outer end of the cylinder *j*, and which communicates through a port *16* with the pump inlet or with a sump. The outer side of the chamber *v* is bounded by a diaphragm *w* having at its centre an abutment *x* which is adapted to bear on the end of the lever *t* remote from the closure member *s*. At the outer side of the chamber *v* is another chamber *y* which is bounded in part by the diaphragm *w* and in part by an end cover *z*, this latter chamber being supplied in any convenient manner with fluid under a pressure which varies with the speed of the pump. The diaphragm *w* is loaded by a spring *2* which at one end is connected to the

diaphragm and at the other end is connected to any convenient member such as a screw 3, whereby the effect of the spring on the diaphragm can be varied.

Assuming the swash plate *e* to be in the position of maximum output as shown, it will remain in this position so long as the pressure in the chamber *y*, and thus acting on the diaphragm *w*, is below some predetermined amount. In this condition the vent closure member *s* is in its closed position and the liquid pressures at the two sides of the controlling piston *k* are equal. But when the pressure acting on the diaphragm *w* exceeds the predetermined amount the diaphragm (in response to the pressure acting on it) will move the closure member *s* off its seating. The liquid pressure in the outer portion of the cylinder *j* will now fall and the piston *k* will be moved by the fluid pressure in the inner portion of the cylinder against the action of the spring *m*, so moving the swash plate *e* in the direction for reducing the pump output until a new condition of equilibrium is reached. When it is required to vary the speed at which the pressure acting on the diaphragm *w* becomes effective, the screw 3 can be appropriately actuated by the attendant.

In applying the invention as shown in Figure 1 to the pump above described I provide in the casing *b*, and at a position adjacent to the cylinder *j*, a bore 4 (herein termed the valve chamber) in which is situated a slidable piston-type valve 5. Near one end of the valve chamber 4 is connected by the passage *o* to the pump outlet *i* and by the passage *p* to the inner end of the cylinder *j*, the other end of the cylinder being connected by the above described restricted passage *q* to the passage *p* and thus to the said end of the valve chamber. The valve 5 is adapted to control communication between the passages *o*, *p* and also between the passage *p* and another passage 8 leading to the pump inlet or a sump. In association with the end of the valve chamber 4 remote from the passages *o*, *p*, I arrange another chamber 9 which is divided into two compartments 10, 11 by a diaphragm 12, and the adjacent end of the valve 5 abuts against or is attached to this diaphragm. The compartment 10 containing this end of the valve 5 is connected by a passage 13 and the passage *o* to the pump outlet *i*, and the other compartment 11 is provided with an opening 14 for connection to an air blower associated with the prime mover to be supplied with liquid fuel by the pump. The compartment 11 also contains a spring 15 adapted to act on the valve 5. The actuation of the valve 5 therefore depends on the pump delivery pressure acting on one side of the diaphragm 12, and on the joint action of the spring 15 and blower pressure acting on the other side of the diaphragm. In the event of the fluid pressure acting on the controlling piston *k* falling below a predetermined amount the valve 5 is moved by the joint action of the spring 15 and the blower pressure to the position in which it interrupts communication between the passages *o*, *p* and connects the passage *p* to the passage 8. In this position of the valve 5 the piston *k* is moved by its loading spring *m* towards the position in which the pump gives its maximum output. By arranging for the valve 5 to be dependent on the joint action of spring 15 and blower pressure I am able to obtain certain desired relations between the fuel and air supplied to the prime

mover more conveniently than when a spring alone is used.

Instead of serving as above described to connect the cylinder to the pump inlet or a sump when the pressure acting on the controlling piston falls below a predetermined amount, the valve may be adapted in this condition to provide unrestricted communication between opposite ends of the cylinder, an example of this alternative being illustrated in Figure 2 in which parts similar or analogous to those shown in Figure 1 are indicated by the same reference characters suffixed by 1. As shown in Figure 2 the valve 5¹ is adapted to control communication between the passages *o*¹, *p*¹ and also between the passage *p*¹ and another passage 16¹ leading from the valve chamber 4¹ to the restricted passage *q*¹ at the side of its restriction adjacent to the cylinder *j*¹. Also the passage *o*¹ is connected by the passage 13¹ to the compartment 10¹ of the chamber 9¹. As in the previously described example the actuation of the valve 5¹ depends on the pump delivery pressure acting on one side of the diaphragm 12¹, and on the joint action of the spring 15¹ and blower pressure in the compartment 11¹ at the other side of the diaphragm. In the event of the fluid pressure acting on the controlling piston *k*¹ falling below a predetermined amount the valve 5¹ is moved by the joint action of the spring 15¹ and the blower pressure to a position in which it interrupts communication between the passages *o*¹, *p*¹ and connects the passage *p*¹ to the passage 16¹, thus establishing unrestricted communication between the two ends of the cylinder *j*¹, and permitting the piston *k*¹ to be moved by its loading spring *m*¹ towards the position in which the pump gives its maximum output.

If desired the compartment 11 (Figure 1) or 11¹ (Figure 2) may be connected to any appropriate source of fluid pressure other than blower pressure. Also subordinate constructional details may be varied to suit different requirements. Thus, a piston instead of a diaphragm may be employed for actuating the valve.

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

1. The combination of a cylinder which at one end is adapted to be supplied with pressure fluid, a fluid vent at the other end of the cylinder, a spring-loaded piston slidable in the cylinder under fluid pressure, means for effecting a restricted communication between the two ends of the cylinder, a movable closure member for controlling the vent, means responsive to fluid pressure for actuating the closure member, a spring-loaded valve for interrupting the supply of pressure fluid to the cylinder, means for enabling the spring loading of the valve to be opposed by the said pressure fluid, and means for enabling the spring loading of the valve to be supplemented by a pressure fluid other than that supplied to the cylinder.

2. The combination of a cylinder which at one end is adapted to be supplied with pressure fluid, a fluid vent at the other end of the cylinder, a spring-loaded piston slidable in the cylinder under fluid pressure, means for effecting a restricted communication between the two ends of the cylinder, a movable closure member for controlling the vent, means responsive to fluid pressure for actuating the closure member, a valve for interrupting the supply of pressure fluid to the cylinder, a chamber associated with the valve, a valve-actuating diaphragm which divides the

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chamber into two compartments and a spring in the compartment remote from the valve, the latter compartment being adapted to receive a pressure fluid other than that supplied to the cylinder, and the other compartment being adapted to receive the same pressure fluid as that supplied to the cylinder.

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