

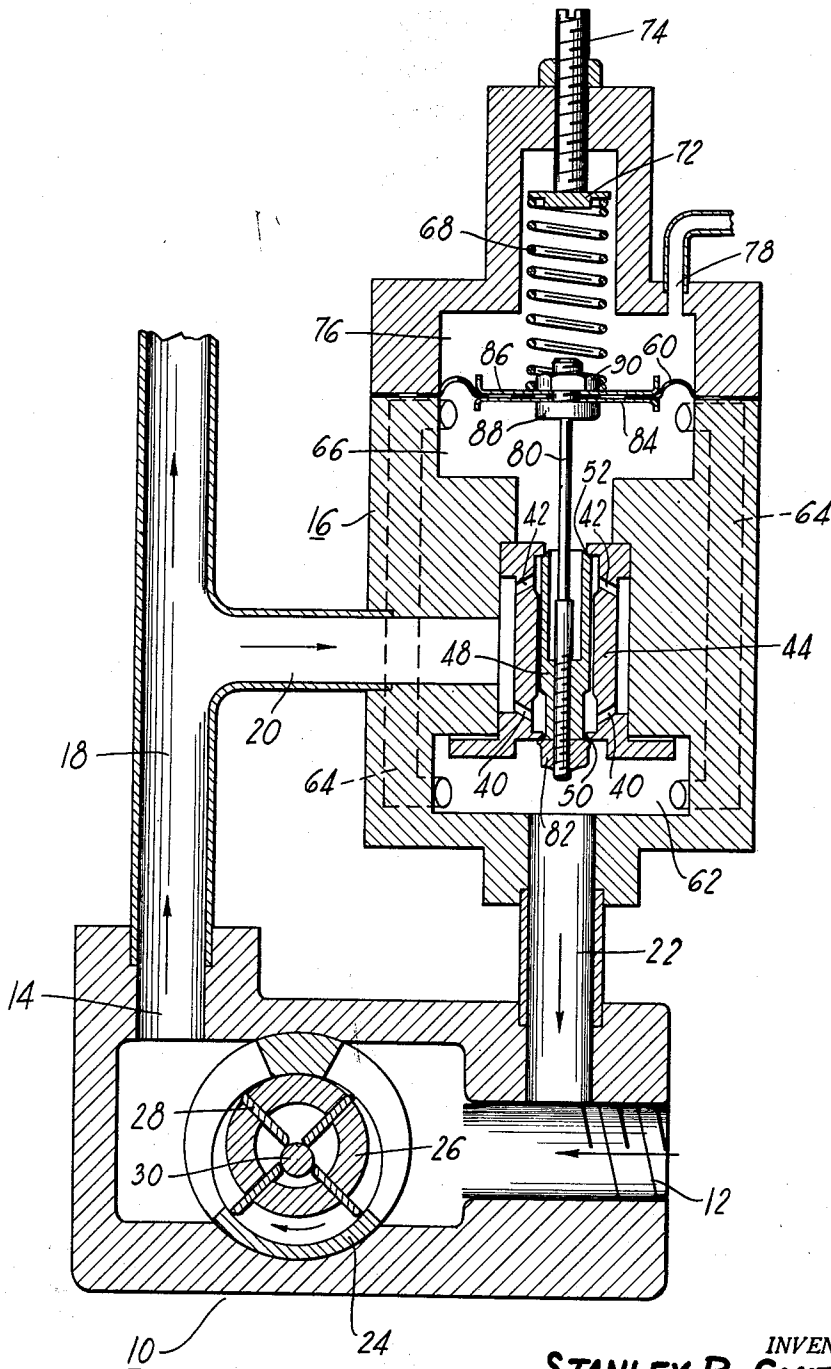
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PUMP

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1

The present invention relates to pumps and more particularly to fluid pumps of the type having an automatic release or by-pass valve.

In fuel supply systems for internal combustion engines and the like, it is usually desirable to meter the fuel at relatively low pressures in order to minimize line or joint failures and fuel leakage and permit the use of comparatively light sections in the several elements of the system. However, in fuel systems of the type in which the fuel is discharged directly into the combustion chamber of the cylinders or into the intake manifold adjacent the intake valves of the cylinders, it is necessary to discharge the fuel under high pressures which are much higher than normally desirable or feasible in fuel metering systems, in order to overcome the pressure in the cylinders for direct injection and to obtain good atomization of the fuel as it is discharged from the nozzle in either direct injection or manifold injection. It is, therefore, one of the principal objects of the present invention to provide in a low pressure fuel metering system a means for increasing the pressure of the metered fuel sufficiently to overcome the high compression in the combustion chamber of the cylinders for direct injection of the fuel and to obtain good atomization of the fuel as it leaves the discharge nozzle in either direct injection or manifold injection.

Another object of the invention is to provide in a pressure fuel system a pump means adapted to vary its delivery in accordance with the quantity of metered fuel supplied to the pump inlet.

Still another object of the invention is to provide a pump means of general utility adapted to so regulate the pump delivery that a substantially constant pressure or a predetermined variable pressure of the fluid is maintained at the pump inlet.

Further objects and advantages of the invention will become apparent from the following description with reference to the accompanying drawing, wherein one specific embodiment of my pump means is shown schematically. From the detailed description which follows, modifications of and additions to the present invention will become apparent to those skilled in the art, and it is to be understood that although only one embodiment of the invention is disclosed in detail, many variations employing the fundamental features of the invention are possible and it is contemplated to use any such variations in structure, arrangement and mode of operation that may properly fall within the scope of the invention.

The invention in its broadest aspect includes a

2

fluid passage, a pressure creating means for receiving fluid from a source, and for delivering the fluid through the passage at a substantially increased pressure and a by-pass around said means so constructed and arranged as to maintain a constant or otherwise predetermined inlet pressure for said means irrespective of the quantity of fluid supplied thereto. Referring specifically to the drawing, numeral 10 designates generally a conventional positive displacement pump of the vane type, 12 a fluid inlet passageway for the pump, 14 a fluid outlet passage, 16 a fluid by-pass unit, said unit being connected to the pump outlet by the main fluid outlet conduit 18 and a branch conduit 20 and to the pump inlet by a conduit 22. The pump 10, which may be of any other suitable type, such as for example a gear, centrifugal or reciprocating piston type pump, consists of a pump sleeve 24, a rotor 26 having, as shown in the drawing, four vanes 28 abutting against a floating pin 30 and contacting the internal surface of the sleeve, said rotor being adapted to revolve in the sleeve in a clockwise direction.

The fluid is discharged from pump 10 through the main fluid conduit 18 and is divided at branch conduit 20 into two portions, one portion of the fluid continuing through the main discharge conduit 18 and the other portion flowing to the by-pass unit and thence through conduit 22 to the pump inlet 12. The fluid inlet of the by-pass unit is connected to conduit 20 and thus to the pump inlet by passageways 40 and 42 disposed in a sleeve 44 in which a valve 48 is adapted to reciprocate and to seat over orifices 50 and 52 located at opposite ends of said sleeve. Since both the upper and lower ends of valve 48 are of substantially the same area and are subjected to substantially the same pressures, the operation of the valve is unaffected by variations in pressure in the by-pass unit.

Valve 48 is controlled by a flexible diaphragm 60 subjected on one side to the pump inlet pressure transmitted through conduit 22, chamber 62 and a plurality of passages 64 to chamber 66 and on the other side to the force of a coil spring 68 calibrated and adjusted to maintain a predetermined pump inlet pressure, said spring reacting between the diaphragm and a spring retainer 72 on the end of an adjustment screw 74. The chamber 76 in which spring 68 is located is shown vented to the atmosphere through a port 78; however, for certain purposes it may be desirable to subject diaphragm 60 to a variable pressure to obtain certain desired variations in the pump

3

inlet pressure, as will be more fully explained hereinafter.

The diaphragm and valve 48 are rigidly connected by a rod 80 threaded into the valve and locked in place by a nut 82. The diaphragm at the marginal edge thereof is clamped between two sections of the unit housing and is given support in the central portion by stiffening members 84 and 86 clamped to either side of the diaphragm between a shoulder 88 and a nut 89 on the upper end of rod 80.

In the operation of the present pump and by-pass unit, with the inlet pressure initially at a predetermined value, fluid is pumped continuously from inlet 12 through conduit 18, a portion of said fluid being by-passed back through unit 16 to the pump inlet and the remainder continuing on through conduit 18. If, during the operation, the quantity of fluid supplied to the pump diminishes, the pressure at the pump inlet decreases. The lower pressure thus created is transmitted through conduit 20, chamber 52, conduits 64, to chamber 66 adjacent diaphragm 68 which moves downwardly, as shown in the drawing, in the valve opening direction so that sufficient fluid is returned to the inlet side of the pump to re-establish the original predetermined pressure at the inlet. If, on the other hand, there is an increase in the quantity of fluid supplied to the inlet of a pump, a temporary rise in the fluid inlet pressure results. This increased pressure is transmitted to chamber 66 adjacent diaphragm 68 which moves upwardly in the valve closing direction so that a smaller quantity of fluid is by-passed back to the pump inlet and a greater quantity is delivered through the main discharge conduit 18 and the original predetermined pressure is re-established. It is thus seen that, regardless of the quantity of fluid supplied to the pump, the pump and by-pass unit operate to maintain a constant or otherwise predetermined pressure of the fluid at the inlet of the pump.

The present pump and by-pass are especially adapted for use in a fuel metering system wherein low fuel pressures for metering are preferred but high pressures at a distributor or at the discharge nozzle are thereafter required. In some fuel metering systems, the fuel pressure downstream from the metering orifice must be maintained at a substantially constant value while the upstream pressure and/or the effective size of the metering orifice must be varied with variations in air flow to the engine. The present invention is adapted to maintain the downstream pressure at a constant value and at the same time provide a relatively high pressure for fuel delivery. A fuel metering system incorporating the foregoing features is disclosed and claimed in my copending application Serial No. 49,967 filed on September 18, 1948, now Patent No. 2,633,187.

As previously pointed out herein, chamber 76 may be vented to some pressure other than atmospheric pressure. For example, in a fuel system for an internal combustion engine, chamber 76 may be connected by a conduit with a venturi in the induction passage of the engine so that on an increase in air flow to the engine, the pressure in chamber 76 will become lower, causing diaphragm 68 to move in the valve closing direction. With the valve in a more nearly closed position, less fuel is by-passed back to the pump inlet, thus resulting in a greater delivery of fuel to the engine and a slightly lower metered

4

fuel pressure at the inlet of the pump. With this condition prevailing, a greater differential across the metering orifice and thus a greater flow of fuel through the system are established for high power output.

Various modifications and arrangements may be made in the present pump and by-pass. For example, the pump may be any one of a number of well-known types provided the pump used is capable of delivering at all times a greater quantity of fluid than is delivered to the pump from the source of supply. Further, the pump and by-pass may be constructed as an integral unit. Many other modifications may be made in the present pump and by-pass to suit requirements.

I claim:

1. A fluid pressure control device comprising a fluid passage, a fluid pressure creating means in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pressure creating means, a valve in said conduit for regulating the flow of fluid therethrough, and a means actuated principally by variations in the pressure in said passage anterior to said pressure creating means for controlling said valve.

2. A fluid pressure control device comprising a fluid passage, a pump in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pump, a valve in said conduit for regulating the flow of fluid therethrough, said valve being substantially balanced against fluid pressure fluctuations in the passage posterior to the pump, and a means actuated principally by variations in the pressure at the inlet passage of said pump for urging said valve toward closed position.

3. A fluid pressure control device comprising a fluid pressure creating means having a fluid inlet passage and a fluid outlet passage, a by-pass means having a conduit communicating with said inlet passage and outlet passage, a valve in said conduit for regulating the flow of fluid therethrough, said valve being substantially balanced against pressure fluctuations in the fluid outlet passage, and a diaphragm subjected on one side to a fluid pressure substantially equal to the pressure in said inlet passage for controlling said valve in response to variations in said pressure.

4. A fluid pressure control device comprising a fluid passage, a fluid pressure creating means in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pressure creating means, a valve in said conduit for regulating the flow of fluid therethrough, said valve being substantially balanced against pressure fluctuations in the passage posterior to said fluid pressure creating means, and a diaphragm subjected on one side to a fluid pressure substantially equal to the pressure in the passage anterior to said pressure creating means for urging said valve toward closed position.

5. A fluid pressure control device comprising a fluid passage, a pump in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pump, a substantially balanced valve in said conduit for regulating the flow of fluid therethrough, a diaphragm subjected on one side to a fluid pressure substantially equal to the pressure in said passage anterior to said pump for urging said valve toward closed position and on the other

5

side to the force of resilient means for urging said valve toward open position.

6. A fluid pressure control device comprising a fluid passage, a fluid pressure creating means in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pressure creating means, a valve in said conduit for regulating the flow of fluid therethrough, and a diaphragm for controlling said valve responsive on one side to the pressure in said passage anterior to said pressure creating means for urging said valve toward closed position and on the other side to a variable fluid pressure.

7. A fluid pressure control device comprising a fluid passage, a pump in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pump, a valve in said conduit for regulating the flow of fluid therethrough, a diaphragm for controlling said valve responsive on one side to the pressure in said passage anterior to said pump for urging said valve toward closed position and on the other side to a variable fluid pressure and a spring for urging said valve toward open position.

6

8. A fluid pressure control device comprising a fluid passage, a pump in said passage, a by-pass means having a conduit communicating with said passage anterior and posterior to said pump, a valve in said conduit substantially balanced against variations in pressure in the passage posterior to said pump, a diaphragm responsive on one side to variations in pressure in said passage anterior to said pump for urging said valve in a closing direction and on the other side to a variable fluid pressure, and an adjustable resilient member for urging said valve in the opening direction.

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