

[54] **AUTOMATIC PRESSURE CONTROL
SYSTEM FOR PUMPS**

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[22] Filed: **June 1, 1973**

[21] Appl. No.: **366,033**

[52] U.S. Cl. 417/28, 417/43, 417/300,
417/310, 417/311

[51] Int. Cl. **F04b 49/02**

[58] Field of Search 417/307, 310, 311, 300,
417/43, 28

[56] **References Cited**
UNITED STATES PATENTS

3,266,426 8/1966 Brunson 417/310 X

3,266,425 8/1966 Brunson 417/310 X

Primary Examiner—Carlton R. Croyle

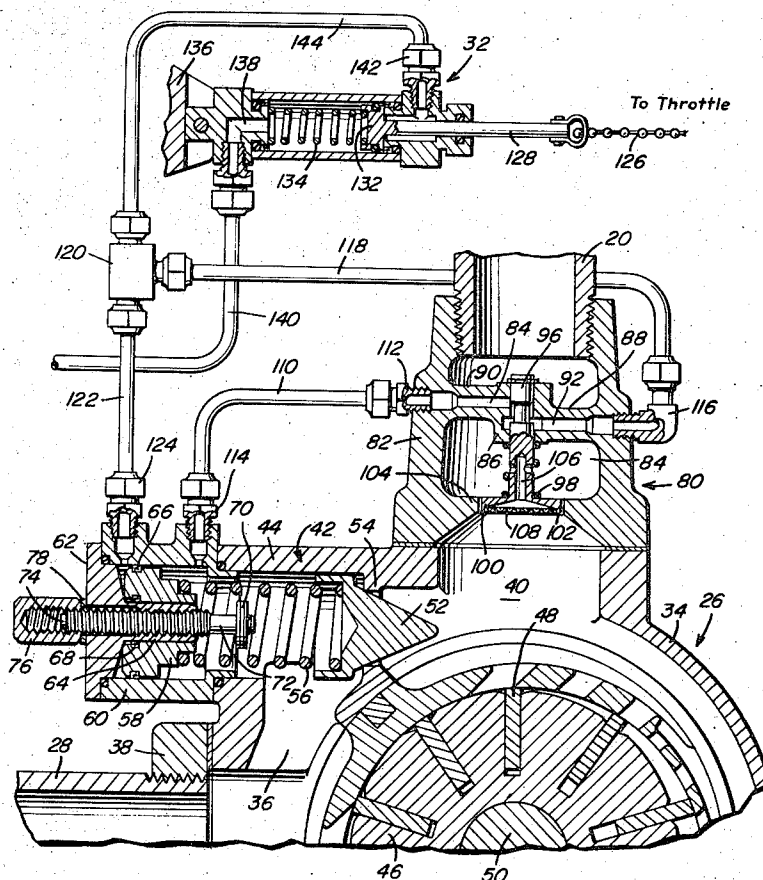
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[57] **ABSTRACT**

The discharge pressure of a positive displacement pump is increased from a low regulated value to a higher value in response to outflow through a valve-controlled delivery conduit, by flow responsive control of a by-pass valve, the bias of which may be adjustable during pump operation to change the regulated discharge pressure. Flow in the delivery conduit is detected by displacement of a flow reaction disc from a position within the pump outlet port through which continuous fluid communication is established.

14 Claims, 3 Drawing Figures



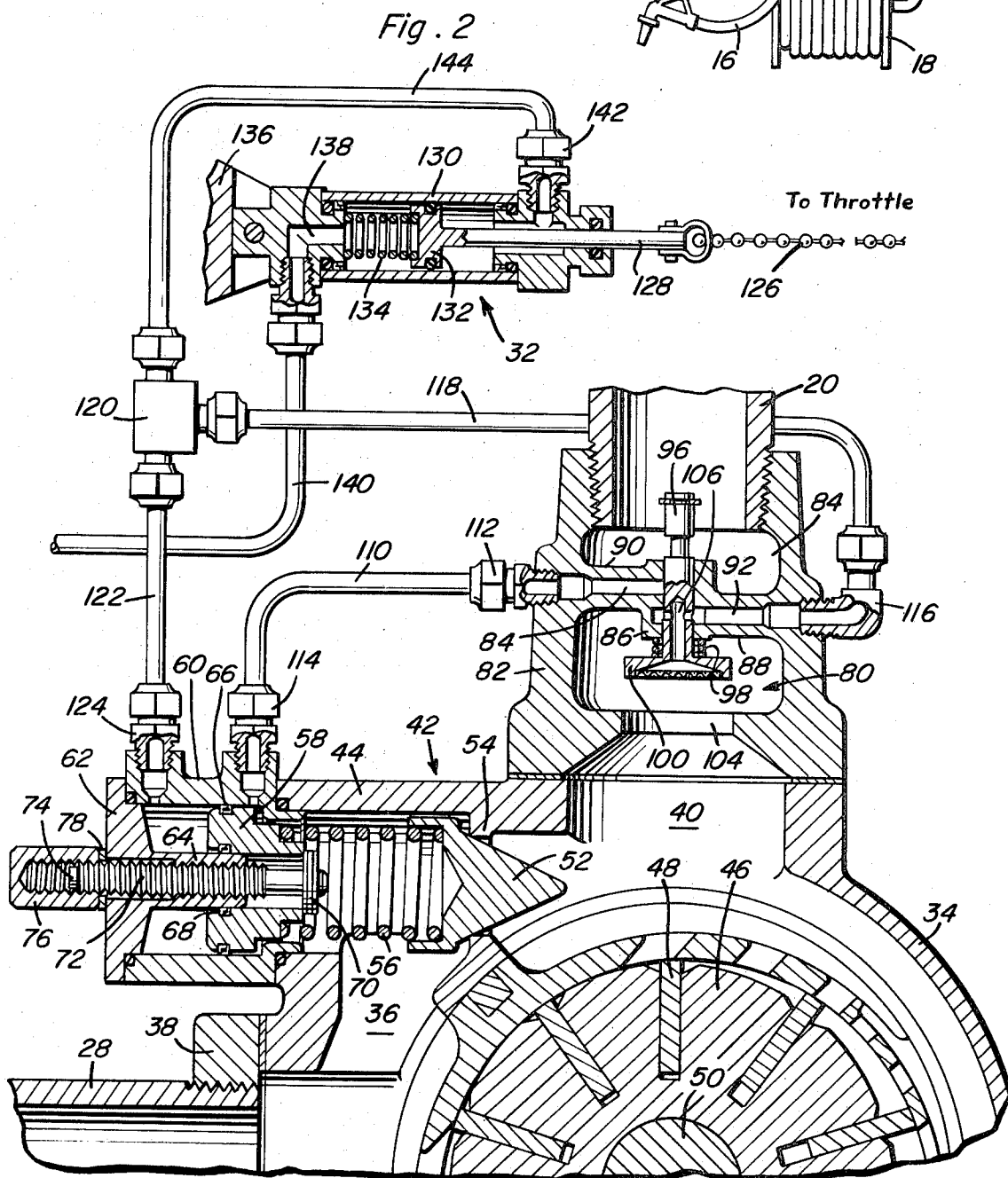
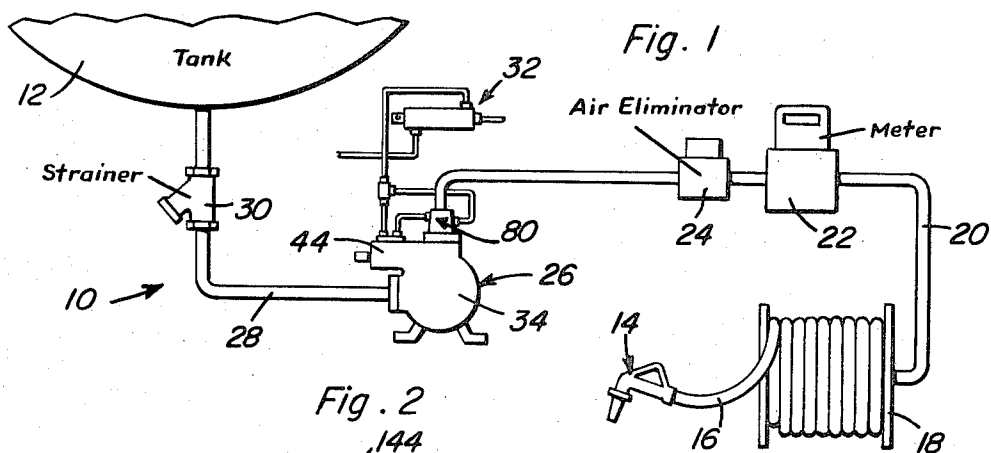
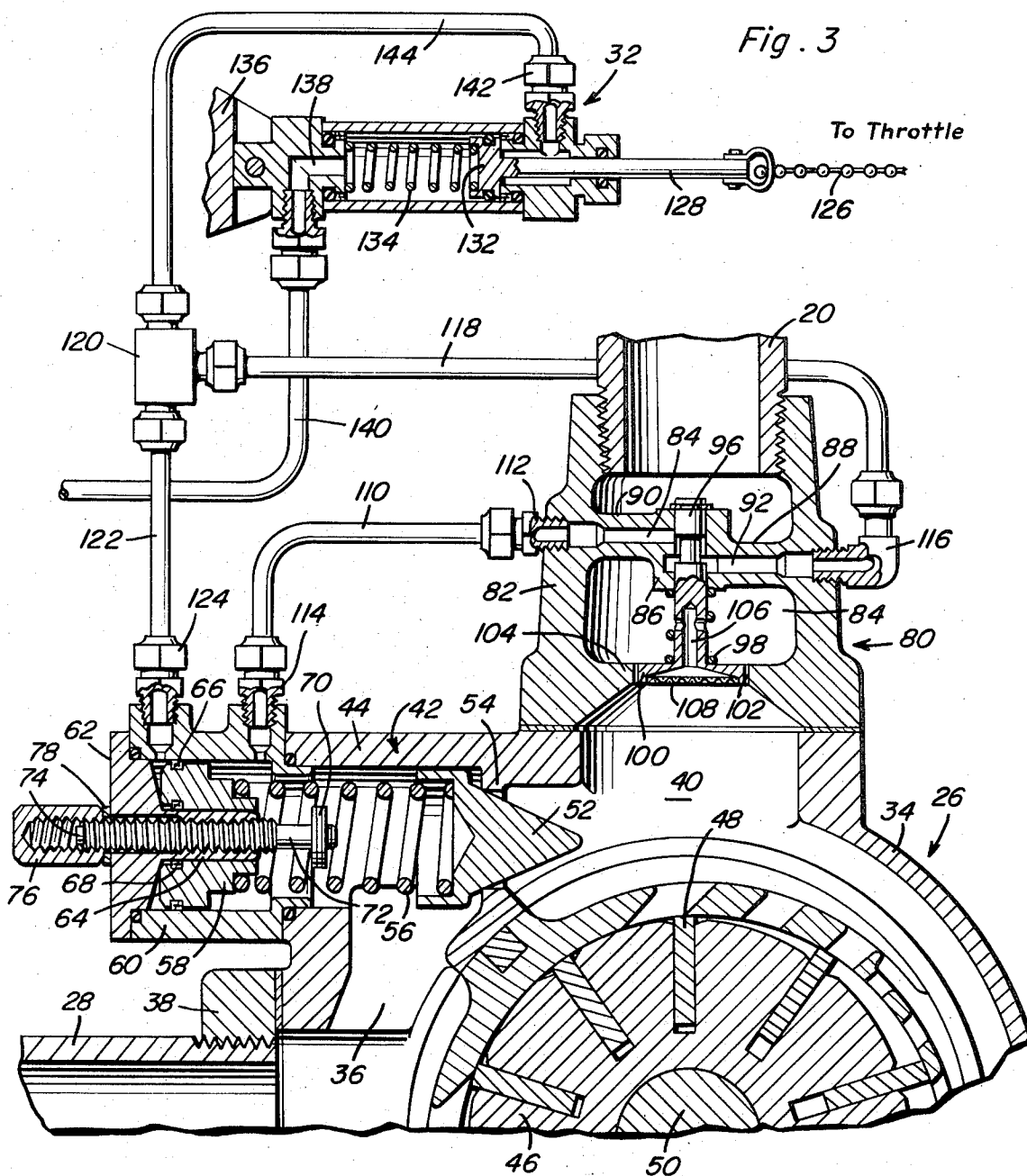


Fig. 3



AUTOMATIC PRESSURE CONTROL SYSTEM FOR PUMPS

This invention relates to control of the discharge pressure from a positive displacement so as to automatically increase pump pressure when out-flow from a delivery conduit occurs.

Outflow responsive control systems for increasing the regulated discharge pressure of a positive displacement pump by utilizing fluid under discharge pressure to increase the closing bias of a by-pass valve, is already known as disclosed in U.S. Pat. No. 3,266,426 to Brunson. This type of pressure control system is particularly useful in dispensing liquid fuel through a flexible delivery hose unwound from a reel, the hose being connected to the outlet of the pump which is continuously driven by an internal combustion engine. Although the pump may continue to operate under low discharge pressure conditions while no fluid is being dispensed, in the foregoing type of pressure control system, adjustment of the regulated discharge pressure could not be effected during pump operation without excessive leakage flow. Thus, a special sealed fluid retainer is required to enclose the adjustment means for preventing leakage, as well as to preclude adjustment, during pump operation according to the disclosure in the Brunson patent aforementioned. Further, such prior pump pressure control systems are apt to malfunction as a result of solid particles entrained in the fluid being handled, because of restricted orifice flow critical to automatic pressure control operation. It is therefore an important object of the present invention to provide a pressure control system of the aforementioned type, which may be adjusted during pump operation and which is less likely to malfunction because of clogging caused by particles in the fluid being handled.

In accordance with the present invention, the outlet chamber of the pump is in continuous fluid communication with a delivery hose through a port dimensioned to receive therein a flow reaction disc with radial clearance. The flow disc forms part of a flow sensing valve through which filtered flow of fluid from the outlet chamber is conducted when the disc is displaced from the outlet port in response to outflow or metered delivery of fluid through the delivery hose. This filtered flow of pressure control fluid is conducted to one side of a piston through which the closing bias on a by-pass valve is increased to increase the maximum pressure at which the by-pass valve is opened to relieve pressure in the outlet chamber of the pump. The pressure control fluid may also be conducted to a speed control device, if desired, to increase the speed of the pump from idling speed under the high pressure operating conditions for more efficient operation under all conditions.

The regulated pressure may be adjusted by axial shift of an adjusting stem to which a stop is connected within the inlet chamber of the pump, to change the limit position to which the piston is urged by the pressure control fluid aforementioned. The adjusting stem is threadedly engaged internally with a sleeve on which the piston is slidably supported to minimize leakage flow from the low pressure inlet chamber, while an internal seal in the piston prevents any leakage from that side of the piston chamber receiving the pressure control fluid.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully

hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

FIG. 1 is a schematic view of a pressure controlled, fluid delivery system with which the present invention is associated.

FIG. 2 is a partial sectional view through those components of the system illustrated in FIG. 1, which form part of the present invention.

FIG. 3 is a partial sectional view similar to FIG. 2, but showing the system is another operational mode.

Referring now to the drawings in detail, FIG. 1 illustrates a pressure controlled, fluid delivery system generally denoted by reference numeral 10. This system is adapted to dispense a fluid such as liquid fuel stored in tank 12 through a valve-controlled delivery nozzle 14 connected to one end of a delivery conduit such as a flexible hose 16 adapted to be unwound from a reel 18 on which the hose is stored. The other end of hose 16 is connected within the reel to a pump outlet line 20 through which flow of fuel is metered by meter 22. An air eliminator 24 is also placed in the line, which is connected to the outlet of an engine driven pump assembly 26. The inlet to the pump assembly is connected through conduit 28 and strainer 30 to the tank 12 from which the liquid fuel is withdrawn. By means of a speed control device 32, connected to the pump assembly, the speed of the engine and the pump driven thereby is varied as will be explained hereafter. The foregoing equipment may be mounted, for example, on a fuel delivery truck and is designed to increase pump pressure from a low value to a higher value while the pump is in operation, whenever the delivery nozzle 14 is opened causing flow of fluid from the outlet of the pump.

As shown in FIGS. 2 and 3, the pump assembly includes a housing 34 enclosing an inlet chamber 36 to which the inlet conduit 28 is connected by fitting 38, and an outlet chamber 40 separated from the inlet chamber by a by-pass valve assembly generally referred to by reference numeral 42. The valve assembly includes a valve body extension 44 of the pump housing 34 in the illustrated embodiment. A pump rotor 46 having radially displaceable vanes 48 is rotatably mounted within the pump housing for positive displacement of fluid from the inlet to the outlet chamber when driven by an engine operatively connected to the pump shaft 50.

The discharge pressure of the fluid in the outlet chamber 40 is regulated by the by-pass valve which includes a conical valve member 52 engaged with the valve seat 54 under the bias of a spring 56 engaging the valve member on the side exposed to the pressure of the fluid in the inlet chamber. When the pressure of the fluid in the outlet chamber exceeds the valve closing bias exerted on the valve member 52, the valve member is unseated to by-pass fluid back to the inlet chamber and thereby limit the maximum pressure developed by drive of the pump rotor. By controlling the closing bias exerted on the valve member 52, the regulated pump pressure may be changed from a relatively low value to a relatively high value. Toward this end, the spring 56 seated at one axial end in the valve member 52, reacts against a piston actuator 58 at its opposite axial end. The piston is slidably supported within a pressure chamber enclosed by a cylinder 60 which is sealingly secured to the valve body extension 44 of the pump housing. Thus, one axial side of the piston 58 en-

gaged by spring 56 is exposed to the pressure of the fluid in the inlet chamber 36 while the other axial side of the piston is exposed to a control pressure in the pressure chamber adjacent the end wall 62 sealingly secured to the cylinder 60. The piston is slidably supported on a sleeve 64 projecting inwardly from the end wall in coaxial relation to the cylinder. Radially outer and inner O-ring seals 66 and 68 are seated in annular grooves formed in the piston and wipingly engage the cylinder wall internally and the external surface of the sleeve, respectively, so as to substantially prevent any leakage flow into the inlet chamber.

The piston 58 is displaceable between positions shown in FIGS. 3 and 2 to change the valve closing spring force exerted on the by-pass valve member 52 in order to increase the regulated outlet pressure of the pump from a low value to a high value determined by the position of a stop disc 70 limiting inward movement of the piston in a direction increasing the compression of spring 56. The stop disc, which is located within the inlet chamber and surrounded by the spring 56, is connected to one end of an adjusting stem 72 that extends through the support sleeve 64. The adjusting stem is externally threaded for threaded engagement with an internally threaded portion of the support sleeve whereby it may be axially adjusted by rotation of the stem at an end 74 externally of the end wall 62. Threaded engagement between the sleeve and the adjusting stem not only accommodates adjustment of the position of the stop disc 70 but also minimizes leakage flow by forming a labyrinth seal between the low pressure region of the inlet chamber and atmosphere. Thus, adjustment of the regulated high pressure may be effected during pump operation since there will be a limited amount of leakage during adjustment, that does not change regardless of the change in discharge pressure. The adjusting stem may be locked in an adjusted position by an internally threaded cap 76 in axial abutment with a washer 78 against the external surface of end wall 62 to seal off any leakage.

Displacement of the piston 58 is controlled by a flow sensing valve assembly 80 interconnected between the outlet chamber 40 of the pump housing and the outlet conduit 20. The valve assembly 80 includes a valve casing 82 sealingly secured to the pump housing and enclosing a connecting passage 84 through which continuous fluid communication is established between the outlet chamber 40 and the conduit 20. A valve body 86 is centrally fixed within the valve casing 82 by axially spaced tubular connecting arms 88 and 90 through which passages 92 and 94 extend from ports formed in the valve body 86. A spool valve element 96 is slidably mounted within the valve body for displacement between a position establishing fluid communication between the passages 92 and 94 and a position blocking flow therebetween as respectively shown in FIGS. 3 and 2. The valve element is biased to the position shown in FIG. 3 by a spring 98 reacting between one axial end of the valve body and a flow reaction disc 100 connected to the lower end of the valve element. The disc 100 is received with radial clearance 102 within an outlet port formation 104 dimensioned so as to require a relatively small outflow from the outlet chamber to axially displace the valve element 96 against the bias of spring 98 by impingement of fluid on the flow reaction disc 100. The valve element is internally formed with a passage 106 through which unrestricted fluid commu-

nication is established between the outlet chamber and the passage 84 when the valve element is in the position shown in FIG. 3 with the disc 100 substantially occupying the port 104. A filter element 108 is carried by the disc so as to filter any flow of fluid through the passage 106. In the flow blocking position shown in FIG. 2, to which the valve element is displaced during outflow of fluid from the outlet chamber, the passage 106 conducts filtered fluid under discharge pressure into the passage 92 from which the passage 94 is blocked. The passages 92 and 94 are interconnected, on the other hand, and isolated from the outlet chamber when the valve element is in the position shown in FIG. 3 corresponding to no-flow conditions.

A conduit 110 interconnects passage 94 with the cylinder 60 on the inlet chamber side of piston 58 through fittings 112 and 114. The other passage 92 is connected to the cylinder 60 on the control pressure side of piston 58 by fitting 116, conduit 118, T-coupling 120, conduit section 122 and fitting 124. Accordingly, in the position of valve element 96 shown in FIG. 3, the pressure in cylinder 60 on both sides of piston 58 is equalized at the low pressure of the inlet chamber resulting in the positioning of piston 58 against end wall 62 for low pressure control through the by-pass valve 52. This corresponds to the no-flow condition aforementioned. When the valve element 96 is displaced to the flow detecting position shown in FIG. 2, the low pressure of inlet chamber 36 on one side of piston 58 is opposed by the higher discharge pressure of the filtered control fluid conducted to the other side of piston 58 from passage 92 in the flow sensing valve assembly. The piston 58 is then displaced to its adjusted limit position as shown in FIG. 2, for high pressure control of the discharge pressure.

The discharge pressure of the pump assembly, controlled as hereinbefore described, will not be affected by any change in speed of the pump driving engine. However, a change in engine speed may be desirable in order to obtain greater efficiency, less wear, and quieter operation as well as reduced fuel consumption. This change in speed is automatically effected by the speed control device 32 connected by chain 126 to the engine throttle control. The chain is connected to a piston rod 128 extending from a cylinder 130 within which the piston rod is connected to a piston 132. The piston is biased to an idle speed position by a spring 134 within the cylinder 130, pivotally anchored to a suitable frame 136 in operative relation to the engine. One end of the cylinder on one side of the piston 132 is vented to atmosphere through passage 138 and conduit 140. The cylinder chamber on the other side of the piston is connected to the source of filtered control pressure fluid aforementioned, through fitting 142 and conduit 144 connected to the T-coupling 120. Thus, the same pressurized fluid displacing piston 58 to the high pressure control position also displaces piston 132 in the speed control device from the idle speed position to a higher operating speed position.

It will be apparent from the foregoing description that the by-pass valve assembly 42 is controlled by a piston actuator 58 having a greater travel distance and lower spring rate bias as compared to diaphragm types of valve controllers without leakage problems. Leakage is confined to the low pressure region of the inlet chamber thereby permitting adjustment during pump operation. The cap 76 will function both as a lock for the ad-

justing stem 72 and as a seal against any leakage flow.

The flow sensing valve assembly 80 operates as hereinbefore described without clogging by avoiding bleed connections and by filtering flow to the pressure control chamber for piston actuator 58. Also, since the flow reaction disc 100 is not seated on the outlet port formation 104, any excess fluid trapped in the delivery hose upon closing of the valve-controlled nozzle 14 may be returned to the outlet chamber 40 of the pump housing through the port formation 104.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination with a positive displacement pump having a low pressure inlet chamber and a high pressure outlet chamber connected to a valve controlled, fluid delivery conduit, flow responsive pressure control means, comprising by-pass valve means responsive to a regulated outlet pressure for regulating fluid pressure in the outlet chamber at relatively low and high pressure values, said bypass valve means including means for adjusting the valve closing bias thereof, passage means through which continuous fluid communication is established between the delivery conduit and the outlet chamber under both said low and high pressure values and flow sensing means within said passage means for establishing substantially unrestricted fluid communication between the outlet chamber and the adjusting means of the by-pass valve means in response to flow through the delivery conduit to increase the regulated pressure in the outlet chamber to said high pressure value.

2. The combination of claim 1 wherein said passage means includes a valve casing enclosing a connecting chamber between the outlet chamber and the delivery conduit, means for supporting the flow sensing means within said connecting chamber and a flow port formation internally mounted within said connecting chamber into which the flow sensing means is biased under substantially no-flow conditions within the delivery conduit.

3. The combination of claim 2 wherein said flow sensing means includes a valve element through which a flow passage is formed, a flow reaction disc connected to said valve element dimensioned to be received with clearance within said flow port formation, and means biasing said disc to a position within the flow port formation for completely blocking flow between the outlet chamber and the adjusting means of the by-pass valve means through said flow passage in the valve element.

4. The combination of claim 3 including filter means mounted on the flow reaction disc for conducting filtered flow of fluid into the flow passage of the valve element to the adjusting means of the by-pass valve means when the disc is displaced from the flow port formation.

5. The combination of claim 4 wherein said by-pass valve means comprises a valve member biased to a position blocking flow between the inlet and outlet chambers, said adjusting means including slidable piston means exposed to pressures in the inlet chamber and the passage means for controllably biasing the valve member to said flow blocking position and adjustable stop means for limiting movement of the piston means in a valve closing direction.

6. The combination of claim 5 wherein said adjustable stop means comprises a support sleeve on which the piston means is slidable, a stem projecting through the piston means in threaded engagement with said sleeve, a stop element connected to said stem within the inlet chamber against which the piston means abuts, and means connected to the stem externally of the by-pass valve means for axially displacing the stem to reposition the stop element.

7. The combination of claim 6 including seal means engageable with the sleeve of the adjustable stop means for limiting leakage to flow from the inlet chamber between the stem and the sleeve.

8. The combination of claim 7 including speed control means connected to the flow passage in the valve element of the flow sensing means for increasing the speed of the pump in response to flow of fluid through the delivery conduit.

9. The combination of claim 3 including speed control means connected to the flow passage in the valve element of the flow sensing means for increasing the speed of the pump in response to flow of fluid through the delivery conduit.

10. The combination of claim 1 wherein said by-pass valve means comprises a valve member biased to a position blocking flow between the inlet and outlet chambers, said adjusting means including slidable piston means exposed to pressures in the inlet chamber and the passage means for controllably biasing the valve member to said flow blocking position and adjustable stop means for limiting movement of the piston means in a valve closing direction.

11. The combination of claim 10 wherein said adjustable stop means comprises a support sleeve on which the piston means is slidable, a stem projecting through the piston means in threaded engagement with said sleeve, a stop element connected to said stem within the inlet chamber against which the piston means abuts, and means connected to the stem externally of the by-pass valve means for axially displacing the stem to reposition the stop element.

12. The combination of claim 11 including seal means engageable with the sleeve of the adjustable stop means for limiting leakage to flow from the inlet chamber between the stem and the sleeve.

13. The combination of claim 10 including seal means mounted on the piston means for confining leakage flow to the adjustable stop means from the inlet chamber.

14. The combination of claim 1 including speed control means connected to the flow sensing means for increasing the speed of the pump in response to flow of fluid through the delivery conduit.

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