

Dec. 1, 1970

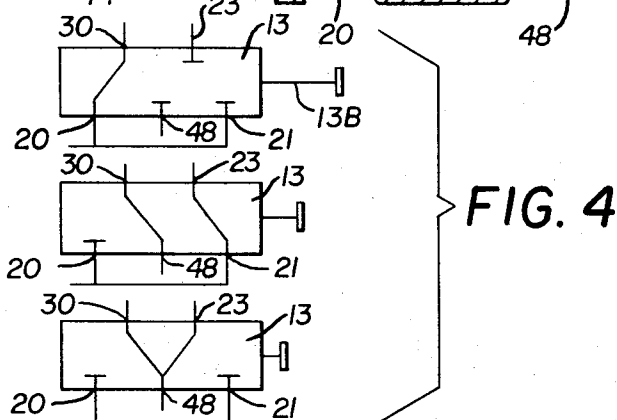
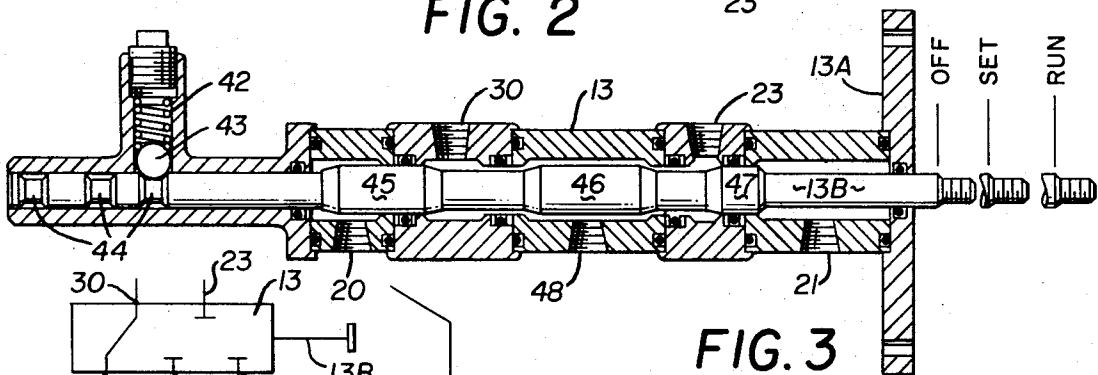
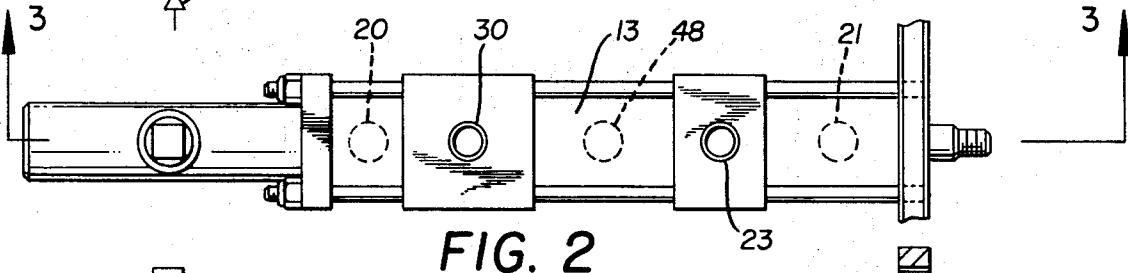
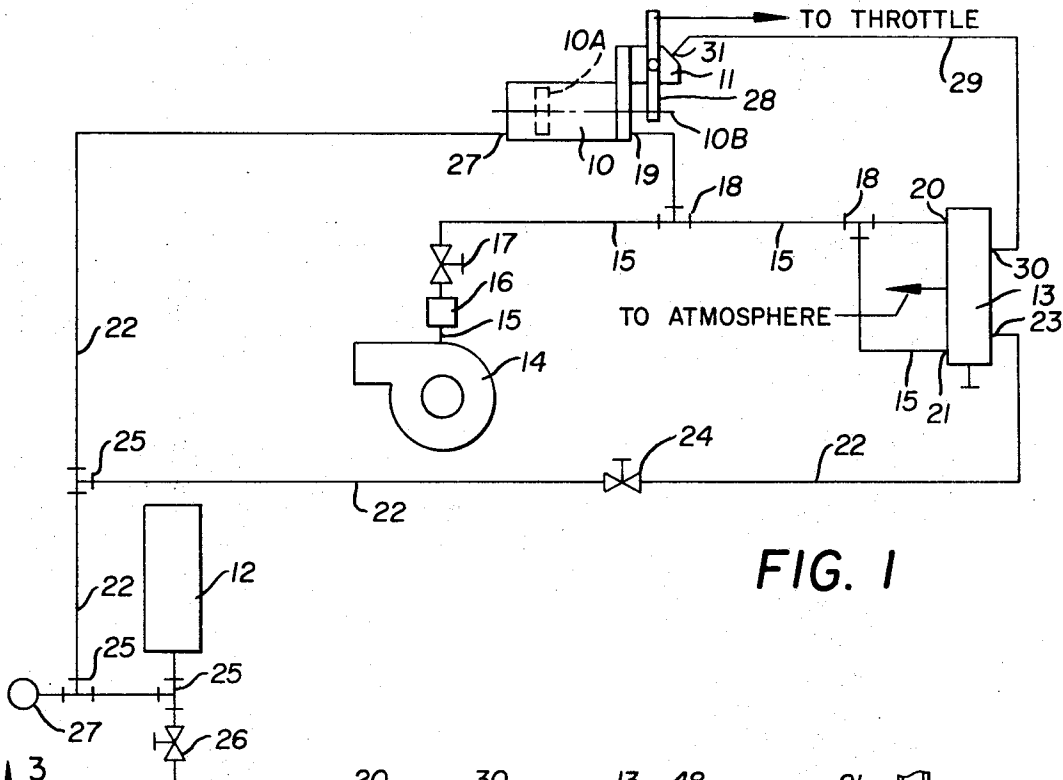
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3,544,235

CONTROL MECHANISM FOR FIRE PUMP

Filed March 28, 1969

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

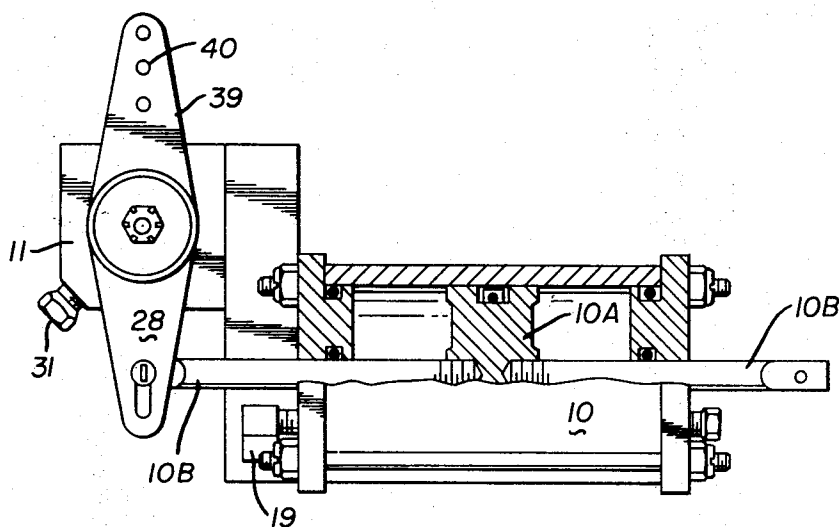


FIG. 5

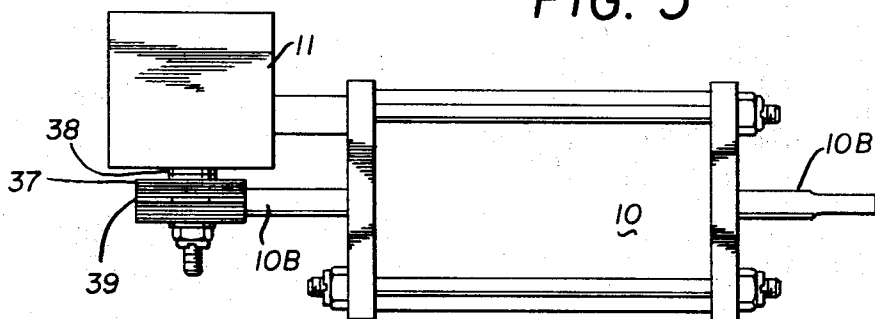


FIG. 6

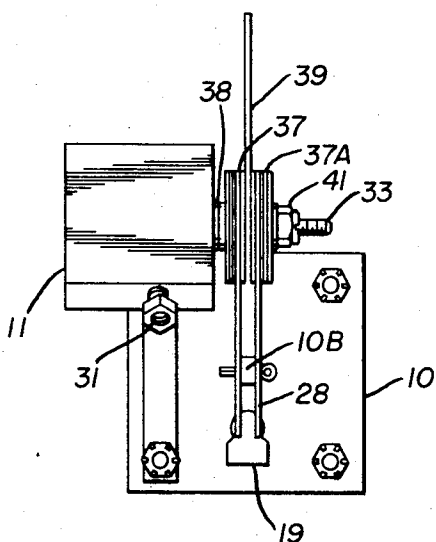


FIG. 7

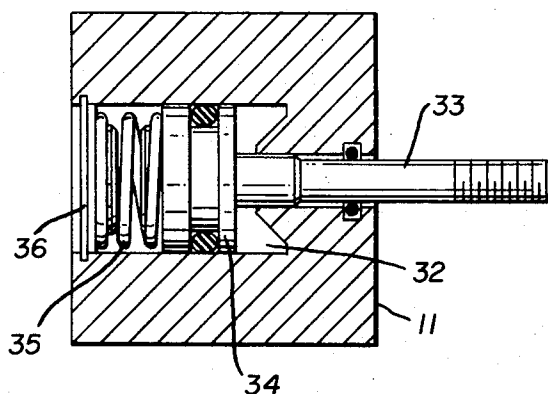


FIG. 8

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CONTROL MECHANISM FOR FIRE PUMP

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Int. Cl. F04b 49/00

U.S. Cl. 417—18

5 Claims

ABSTRACT OF THE DISCLOSURE

A control mechanism for fire pumps driven by a variable speed engine operates by the fire pump establishing a reference pressure in an accumulator which is then balanced with the output pressure of the fire pump in a balancing piston and cylinder assembly, the reference pressure being in communication with the cylinder on one side of the piston and the pump output pressure being in communication with the cylinder on the other side of the piston, the piston and its piston rod being movable responsive to fluctuations in the pump pressure as compared with the reference pressure in the accumulator. The movement of the piston and piston rod controls the engine throttle by way of a clutch which is pressure actuated by the pump pressure and is thus responsive in operation to fluctuations in the pump pressure whereby cavitation in the pump disengages the clutch and permits the throttle to move toward an engine idling position.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to pump discharge pressure control mechanisms as applied to fire pumps driven by engines and wherein the speed of the engine is controlled by the pump pressure.

Description of the prior art

Prior mechanisms of this type have utilized pump pressure and reservoir pressure in attempting to control the throttle of an engine driving a fire pump, see for example Pat. No. 3,116,694. Still others use pressure regulators and motor speed controls having variable sensing means such as described for example in Pats. 2,771,843, 2,996,120, 3,123,005 and 3,249,053.

This invention automatically throttles the engine to vary the speed of the fire pump impellers to maintain a constant pump pressure from 90 p.s.i. to 300 p.s.i. as preset by the operator when the volume of water required is changed by the nozzles on the various hose lines being opened, closed or metered.

This invention also disengages the throttle mechanism allowing the engine to return to idle speed when the water supply becomes insufficient to meet the demands of the discharge lines causing pump cavitation. Such action protects the hose line operators from the severe surge and nozzle reaction that occurs during cavitation. It also protects the engine and the pump from possible damage by runaway condition.

SUMMARY OF THE INVENTION

The control mechanism for fire pumps comprises a reference pressure reservoir or accumulator, a balancing piston and cylinder assembly and a pressure actuated clutch connecting the piston rod thereof to the throttle of the engine driving a fire pump. A control valve is included to operate the system wherein the pump pressure establishes a reference pressure in the accumulator which is then isolated from the pump output, which in turn

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communicates with the balancing piston and cylinder and with the clutch.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of the control mechanism for fire pumps.

FIG. 2 is a side elevation of the control valve used in the system.

FIG. 3 is a horizontal section on line 3—3 of FIG. 2.

FIG. 4 is a composite schematic diagram showing the three operating positions of the control valve seen in FIGS. 1, 2 and 3.

FIG. 5 is a side view with parts broken away and parts in cross section illustrating the balancing piston and cylinder assembly and the clutch mechanism.

FIG. 6 is a top plan view of the mechanism of FIG. 5.

FIG. 7 is an end view thereof.

FIG. 8 is an enlarged cross sectional detail of the clutch mechanism seen in FIGS. 5, 6 and 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the form chosen for illustration and description the control mechanism for fire pumps comprises four components communicating with one another and specifically the balancing piston and cylinder assembly 10, the throttle linkage clutch 11 directly actuated thereby, the reference pressure accumulator 12 and the control valve 13.

In FIG. 1 of the drawings these four components are placed in communication with one another and with a fire pump 14 by pipes as follows. A pipe 15 leads from the fire pump 14 through a filter 16, a control mechanism shut off valve 17 and by way of T fittings 18 communicates with one side of the balancing piston and cylinder assembly 10 as at port 19 thereof and with ports 20 and 21 of the control valve 13. A pipe 22 establishes communication between port 23 of the control valve and the pressure accumulator 12 by way of an accumulator valve 24 and T fittings 25. The reference pressure accumulator 12 is also provided with a drain valve 26 and a pressure gauge 27 and by still referring to FIG. 1 of the drawings it will be seen that pipe 22 extends to the reference pressure side of the balancing piston and cylinder assembly 10 as by way of a port 27.

The balancing piston and cylinder assembly 10 and specifically the piston 10A thereof moves the piston rod 10B which engages an arm 28 on the clutch 11. A pipe 29 establishes communication between a port 30 of the control valve 13 and a port 31 in the clutch 11 which communicates with a cylinder 32 therein, as best seen in FIG. 8 of the drawings.

By referring to FIGS. 5 through 8 it will be seen that the clutch 11 is mounted on one end of the balancing piston and cylinder assembly 10 and that it includes a shaft 33 positioned therein for axial movement with respect thereto and having a secondary piston 34 on an inner end thereof and movable in the cylinder 32 therein, as best seen in FIG. 8 of the drawings. A spring 35 positioned in the cylinder 32 by retainer means 36 normally urges the piston 34 and the shaft 33 outwardly of the clutch body 11 and pressure from the fire pump 14 communicating by way of the pipe 15 and 29 under control of the control valve 13 is normally present in the cylinder 32 in opposition to the spring 35 so that it will move the piston 34 and shaft 33 inwardly of the clutch body 11.

In FIG. 7 it will be seen that the arm 28 is bifurcated and is pivoted to the shaft 33 and spaced with respect to the clutch body 11 by disc 37 and a low friction thrust washer 38. A secondary arm 39 is also pivoted to the shaft 33 and extends upwardly therefrom in opposite direction to the arm 28 and has apertures 40 therein by means of which it may be connected to a flexible linkage

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(not shown) which controls the throttle of the engine (not shown) driving the pump 14. Secondary discs 37A are positioned between the upper end of the bifurcated arm 28 and the lower end of the secondary arm 39 and between the bifurcated arm 28 and a fastener 41 which is engaged on the shaft 33.

It will thus be seen that the arrangement of the washers 38, discs 37 and 37A and the bifurcated arm 28 and secondary arm 39 is such that when they are under tension they form a rigid assembly so that motion imparted to the bifurcated arm 28 by the piston rod 10B will impart corresponding but opposite motion to the secondary arm 39 and thereby provide a motion suitable for controlling the throttle of the engine driving the fire pump 14. Conversely at such time as the arrangement is in loose relation, the secondary arm 39 which is connected with the throttle of the engine driving the fire pump 14 is free to move the throttle to a normal idling position as occasioned by springs in the throttle mechanism (not shown).

The reference pressure accumulator 12 is a cylindrical member closed except for an inlet port in one end with which the pipe 25 communicates. Those skilled in the art will observe that it functions by reason of water under pressure being introduced into the same so as to trap a quantity of air in the closed end. The air upon being compressed provides a reference pressure which is then useful in the operation of the control mechanism for fire pumps as hereinafter described.

The control valve 13 is a spool valve having three operative positions. The control valve body is a composite assembly of units sealed to one another and secured to a base plate 13A. The spool 13B therein extends out of the valving section at both ends and one of the ends comprises an indexing mechanism including a spring 42 urging a ball 43 into one of several areas of smaller diameter 44 formed on the spool 13B. The valving elements on the spool 13B are indicated by the numerals 45, 46 and 47 respectively and by referring to the schematic diagram on FIG. 4 it will be observed that when the spool is in the position illustrated in FIG. 3 fluid pressure from the pump 14 communicating with the ports 20 and 21 is blocked by the valve elements 45 and 47 respectively and the valve is in off position with the ports 30 and 23 thereof which communicate with the clutch 11 and the reference pressure accumulator 12 are open to atmosphere through port 48.

When the spool is in the intermediate position as seen in the middle figure of the schematic diagram of FIG. 4, the pump pressure in communication with port 21 will flow through the control valve and through the port 23 and to the reference pressure accumulator 12. When the spool 13B is in its outermost position, that indicated as run in the indicia appearing with FIG. 3 of the drawing, the pump pressure in communication with the port 20 will communicate by way of the port 30 with the clutch 11 and more specifically the cylinder 32 therein so as to actuate the clutch 11 moving the piston 34 against the spring 35 and moving the shaft 33 with its assembly of arms, discs and washers thereon so that the same become an integral unit capable of transmitting motion from the piston rod 10B of the balancing piston and cylinder assembly 10 to the throttle of the engine running the fire pump 14 by way of the bifurcated arm 28 and the secondary arm 39 as hereinbefore described.

Assuming the engine is operating and the fire pump 14 engaged, a minimum discharge line from the fire pump 14 is opened and the hand throttle on the engine (not shown) is advanced to attain a slight pressure as will be understood by those skilled in the art. The accumulator control valve 24 is opened and the control valve 13 is moved to intermediate or set position as seen in FIG. 3 of the drawings and in the middle portion of the diagram comprising FIG. 4 of the drawing. This action will direct pump pressure from the pipe 15 to the pipe 22 and charge the reference pressure accumulator 12. At the same time,

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the pressure will enter the port 27 on the balancing piston and cylinder assembly 10 and move the piston 10A to the opposite end of the cylinder. The speed of the engine driving the fire pump 14 is then advanced with the hand throttle until the desired pump pressure is attained. This will raise the pressure in the entire control mechanism as disclosed herein with the exception of the pipe 29 which communicates with the clutch 11. At such time as the desired pressure is attained the accumulator control valve 24 is closed which results in establishing a reference pressure in the pressure accumulator 12 and which reference pressure is also present in the balancing piston and cylinder assembly 10 on the side of the piston 10A adjacent the port 27.

The control valve 13 is then moved to run position where the spool 13 is in its outermost position as hereinbefore described and as illustrated in the uppermost one of the diagrams comprising FIG. 4 of the drawing. Pump pressure flows through the ports 20 and 30 and the pipe 29 to the clutch body 11 and specifically the cylinder 32 therein whereupon the piston 34 moves to the left as seen in FIG. 8 compressing the spring 35 and moving the shaft 33 to the left which tightly engages the disc and washer assembly including the bifurcated arm 28 and the secondary arm 39.

At this time the hand throttle on the engine running the fire pump is closed as the piston 10A in the balancing piston and cylinder assembly 10 now has control of the engine throttle by way of the linkage connecting the same with the secondary arm 39 as hereinbefore described. As additional discharge lines in communication with the pump 14 are opened, the piston 10A in the balancing piston and cylinder assembly 10 moves to increase the engine speed and maintain the balance of pump pressure to reference pressure. The piston 10A will impart lineal motion to the engine throttle linkage, thereby changing the pump speed as required to correct any imbalance that occurs between the reference pressure side and the pump pressure side of the cylinder 10. The action is very fast and acts to prevent any surge in pressure either up or down from being transmitted through the hose line and resulting in severe nozzle reaction.

If during operation the pump cavitates causing a momentary drop in pressure below, for example 50 p.s.i. the pressure in cylinder 32 in the clutch 11 drops and the spring 35 moves the piston 34 and shaft 33 to the right as seen in FIG. 8 whereupon the clutch assembly on the shaft 33 is released and the secondary arm 39 is freed to permit the normal throttle mechanism to become active and move the same to engine idle. Simultaneously, the reference pressure in the accumulator 12 moves the piston 10A against the pump pressure side thereof and resets the same so that when pressure is re-established and the clutch 11 is again actuated the original setting is restored.

Those skilled in the art will observe that cavitation in the fire pump occurs when the water supply becomes insufficient to meet the demands of the discharge lines. Those skilled in the art will observe that the reference pressure accumulator 12 accumulates the pressure desired from the fire pump which is then trapped in the accumulator 12 and in the communicating side of the cylinder of the balancing piston and cylinder assembly 10. The air compressed in the top of the accumulator acts as a spring to impart movement to the piston 10A to maintain a balance of reference and pump pressures which increases engine speed when the discharge volume is increased. Conversely, if the discharge volume is decreased the balancing of the reference and pump pressures decreases engine speed.

The dissipation of heat by the water entering the reference pressure accumulator 12 when setting the reference pressure as hereinbefore described results in a condition of isothermal compression. This eliminates the readjustment of the reference pressure after temperature stabilization that would be necessary with adiabatic compression.

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In the embodiment chosen for illustration and description herein, the control mechanism for fire pumps is described as being placed in operation while the minimum volume is being discharged by the fire pump. It is possible, however, with the same components to arrange the mechanism to be placed in operation while the maximum pump volume is being discharged.

Although but one embodiment of the present invention has been illustrated and described it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention.

I claim:

1. In combination, a pump, means for driving the pump, a throttle for regulating the means for driving the pump and control mechanism comprising a balancing piston and cylinder assembly, the piston of which is reciprocally mounted in the cylinder and divides the cylinder into separate sections, means establishing communication between one of said separate sections and the discharge side of said pump, means for establishing a predetermined reference pressure in the other of said separate sections, means including a clutch connecting said piston to said throttle whereby said piston and throttle may move together as a unit when said clutch is engaged and are free for independent movement when said clutch is disengaged, means for actuating said clutch comprising a pressure responsive device in communication with said pump.

2. The combination of claim 1 and wherein the means

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establishing a reference pressure comprises a reference accumulator and a valve controlled communication line connecting said reference pressure accumulator with said pump.

3. The combination of claim 1 and wherein the means including a clutch consists of a secondary piston and cylinder assembly, a pair of arms pivoted on the piston rod of said piston and cylinder assembly, a spring normally urging said piston in one direction and arranged for pressure from said pump to move said piston in the other direction whereby said pair of arms are held in rigid relation on said piston rod when pressure moves said piston, and in loose relation when said spring moves said piston.

4. The combination of claim 1 and wherein a control valve is located in said mechanism controlling the communication between said section of said balancing piston and cylinder assembly and said reference pressure means and pump.

5. The combination of claim 4 and wherein said control valve is a multiple element spool valve.

References Cited

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U.S. Cl. X.R.

417-34, 36