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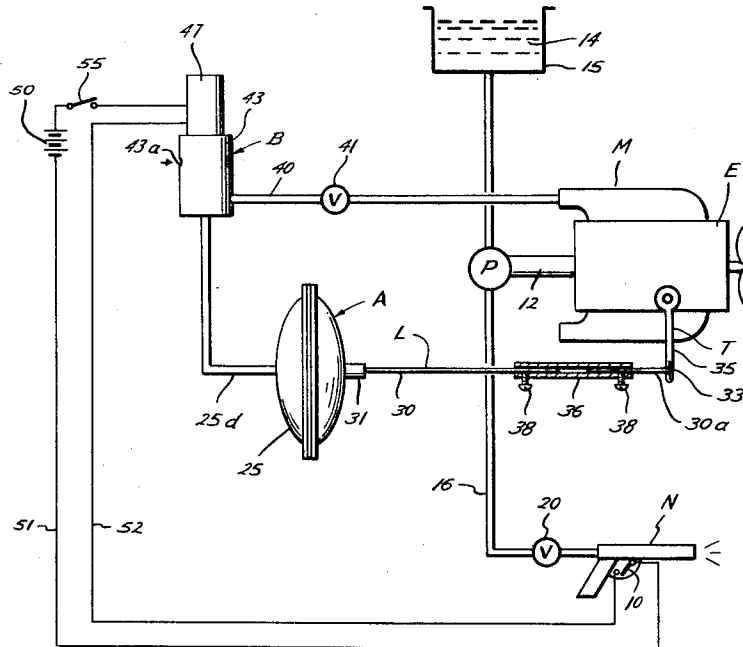
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UNITED STATES PATENTS
 3,147,767 9/1964 Goss 137/608
 3,332,406 7/1967 Perry et al. 123/102
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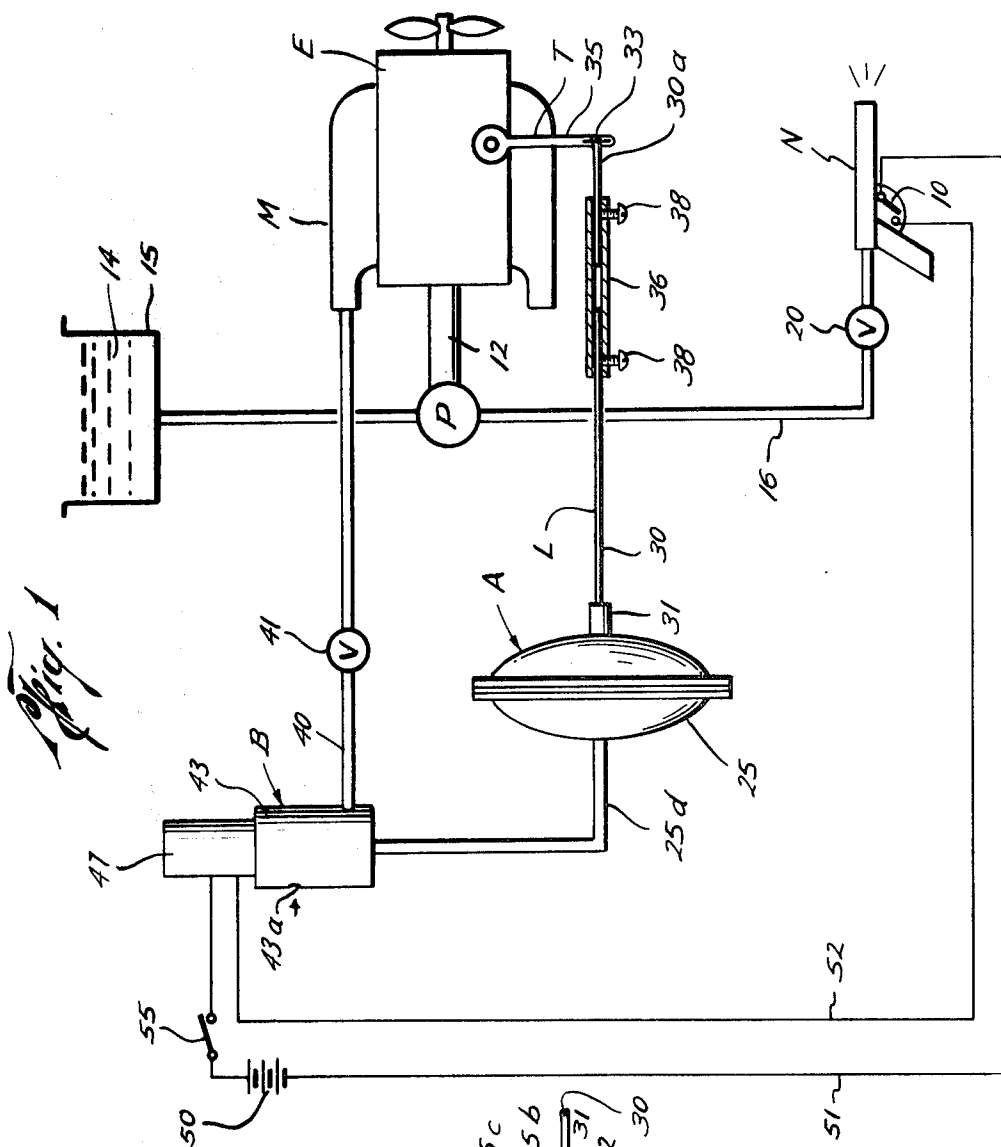
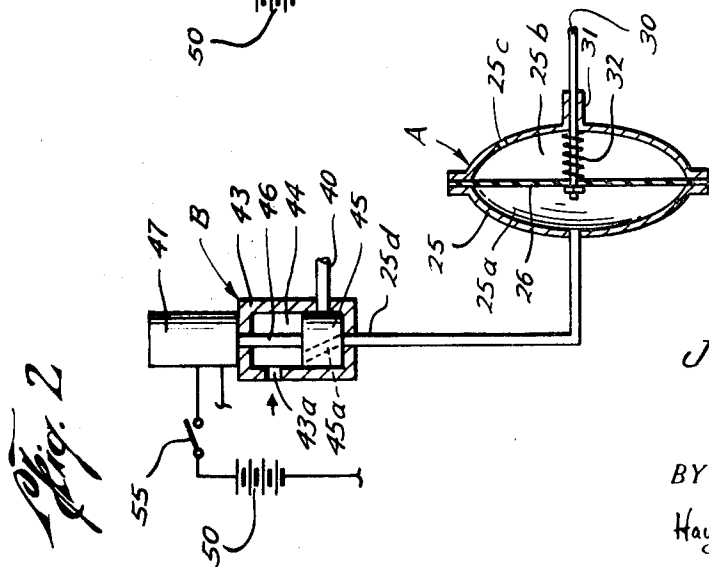
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[54] **CONTROL APPARATUS FOR HIGH-PRESSURE WATER SYSTEM**
9 Claims, 2 Drawing Figs.

[52] **U.S. Cl.**..... **239/302,**
239/526, 137/608, 123/102
 [51] **Int. Cl.**..... **F02d 11/08**
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124, 127, 332; 123/102, 140, 140.2, 140.3;
137/608; 239/302, 526

ABSTRACT: Control apparatus for a pump powered by a gasoline engine or the like wherein means are connected to the exhaust manifold of the engine for increasing the pump speed and the fluid delivered by such pump to a nozzle at a point remote from the pump.





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CONTROL APPARATUS FOR HIGH-PRESSURE WATER SYSTEM

BACKGROUND OF THE INVENTION

The field of this invention is control apparatus for a system in which water or other fluid is discharged at high pressure from a nozzle.

Heretofore, high-pressure water systems for cleaning and the like have been controlled using electrical solenoid controls and also hydraulically controlled valves. See, for example, U.S. Pat. Nos. 3,147,767 and 3,335,962. When the throttle of a gasoline engine is directly operated by an electrical solenoid, the power available for moving the throttle is very low, and therefore is sometimes inadequate, especially for the heavy duty gasoline engines and the like. Also, such solenoid control has a fixed length or distance of travel so that it operates the throttle control between an idle speed and a fixed operating speed which results in unnecessary speed at times and a consequent waste of the engine fuel.

Compared to such solenoid controls, the hydraulically controlled valves such as shown in U.S. Pat. No. 3,335,962 may be adjusted for different operating speeds so that there is a saving of fuel in operating the engine at lower speeds when such lower speeds are adequate. However, such control valves are limited as to use at relatively low operating pressures in the neighborhood of 7,000 p.s.i., whereas it is often desirable to use controls with fluid pressures in the neighborhood of 50,000 p.s.i., or even higher.

SUMMARY OF THE INVENTION

With the present invention, a control apparatus is provided which controls the discharge of water or other liquid from a nozzle at high pressures up to 50,000 p.s.i. or even higher. The control apparatus may be adjusted to set the operating fluid pressure discharged from the nozzle so as to be at the desired pressure level, whereby the fuel for operating the pump engine is not in excess of that needed.

The control apparatus of this invention is operated by a partial vacuum created in the exhaust manifold of an engine used for driving a pump which delivers fluid under pressure to a nozzle. The operator at the nozzle simply closes an electrical circuit to effect an automatic increase in the speed of the engine with a resultant increase in the fluid pressure delivered by the pump. When the switch is opened, there is an instantaneous cutoff of the high fluid pressure at the nozzle to thus prevent whipping of the nozzle if the operator accidentally drops or otherwise loses control of the nozzle.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is schematic view illustrating the control apparatus of this invention; and

FIG. 2 is a detailed sectional view illustrating the preferred form of the control assembly of this invention or actuating assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter A designates generally the actuating assembly or control assembly of this invention which has therewith a solenoid actuated or controlled valve B, and a linkage L which connects the assembly A to the throttle T of an engine E. As will be explained in detail hereinafter, the solenoid actuated valve B is adapted to be opened and closed by the closing of an electrical circuit switch 10 on a high-pressure liquid discharge nozzle N. The valve B establishes communication or closes off communication between the exhaust manifold M of the engine E and the actuating assembly. Thus, by the control of the switch 10 by an operator at the nozzle N, the speed of operation of the engine E is automatically regulated and liquid such as water is pumped by a pump P and discharged at the nozzle N at high pressure when such pressure is desired.

The engine E is schematically illustrated as an internal combustion engine such as a gasoline engine, although other types of prime movers may be employed. The engine E has the conventional exhaust manifold M therewith, which is utilized in the operation of the actuating assembly A of this invention, as will be more evident hereinafter. The engine E is connected by any suitable mechanical drive shaft 12 to a pump P, which is schematically shown so that the pump P may pump water or other liquid 14 from a supply or reservoir 15 through line 16 to the nozzle N. When the throttle T is at its low speed position, the pump P discharges only a small amount of the liquid and it may either be returned by a bypass (not shown) to the reservoir 15 or it may be dumped by a conventional dump valve 20 disposed in the line 16 at or near the nozzle N. When the throttle T is moved to its high-speed position for which it is set, the pump P delivers the liquid 14 from the reservoir 15 through the line 16 and discharges same at the nozzle N at extremely high pressures. These pressures may be of the magnitude of 50,000 p.s.i. or even higher in some applications.

By way of example, the actuating assembly A illustrated in FIGS. 1 and 2 is formed with a housing 25 of metal or other similar material which is divided into two chambers 25a and 25b by a flexible diaphragm 26 formed of rubber or other suitable flexible material. The lower chamber 25b is preferably in communication with the atmosphere through an opening 25c formed in the wall of the housing 25. The upper chamber 25a is in communication with the solenoid actuated valve B through a port 25d, as will be explained.

The flexible diaphragm 26 is connected to a rod 30 which extends through a guide sleeve 31 secured to the housing 25.

Preferably, the rod 30 is urged to a neutral or inactive position with the diaphragm 26 substantially unflexed or distorted from its normal intermediate position as shown in FIG. 2. The spring utilized for such purpose is illustrated in FIG. 2 and is identified with the numeral 32. Thus, as the diaphragm 26 is urged to the left as viewed in FIG. 2, the spring 32 is extended since its ends are connected to the diaphragm 26 and also to the housing 25 and this results in a stretching of the spring 32 so that when the pressures acting on the diaphragm 26 return to an equalized condition on each side thereof, the spring 32 returns the rod 30 to the position shown in FIG. 2.

The rod 30 may be a single piece which is pivotally connected at 33 to the lever for the throttle T, such lever being indicated at 35. However, it is preferable to provide for an adjustment in the linkage L in any suitable manner, such as by forming the rod 30 in two sections which are joined together by a tube or sleeve 36 and suitable connecting elements such as set screws or locking screws 38 which extend through the sleeve 36 and engage both ends of the rod 30. The portion of the rod 30 which is directly connected to the pivot 33 in FIG. 1 is designated 30a, but because of the sleeve 36 connecting same to the other portion of the rod 30, it in effect is the same as the rod 30.

An adjustment in the length of the rod 30 can thus be effected by a loosening of the screws 38 and a movement of the rod 30 to lengthen same within the sleeve 36. Such lengthening of the rod 30 results in a movement of the diaphragm 26 to the left as viewed in FIGS. 1 and 2 to thus reduce the stroke of the operating linkage L so as to limit the extent of the high pressure which can be developed by the pump P.

A fluid pressure communication means which includes the valve B, the port 25d and a pipe or flow line 40 extending from the exhaust manifold M to the valve B serves to establish communication between the exhaust manifold M of the engine E and the actuating assembly A for creating a fluid pressure differential in such actuating assembly A. An orifice valve 41 having a fixed or variable size orifice therein is disposed in the line 40 for controlling the vacuum which is created in the actuating assembly A by the manifold M when the valve B is in the open position, as will be explained. The valve B may take different forms, and the one illustrated in FIG. 2 is merely exemplary. Thus, the valve B has a valve housing 43 with an internal valve chamber 44 in which is disposed a movable valve

element 45. The valve element 45 is operably connected to a solenoid stem 46 which is a part of a conventional electric solenoid 47. The valve element 45 is provided with a port 45a which establishes communication from the passage or port 25d to an opening 43a in the housing 43. The valve element 45 has the inlet 40 closed when communication is established from the inlet 40a through the passage 45a to the port or passage 25d. Since the opening 43a is in communication with the atmosphere, the upper chamber 25a in the actuating assembly A is thus exposed to atmospheric pressure and therefore the pressures on each side of the diaphragm 26 are equalized when the valve 45 is in the position shown in FIG. 0.

However, when the solenoid 47 is actuated, the stem 46 is moved upwardly within the solenoid 45 to cause the valve element 45 to move upwardly so that its lower end is above the inlet line 40. When such occurs, the port 43a is closed by the valve element 45 and communication is established from the line 40 through the valve chamber 44 to the port or line 25d and thus to the upper chamber 25a to thereby create a reduced pressure or partial vacuum within the chamber 25a. Such reduction in pressure in the chamber 25a causes the diaphragm 26 to move upwardly as viewed in FIG. 2, due to the differential in pressure created across the diaphragm 26. It will be appreciated that the movement of the diaphragm 26 also effects a movement of the rod 30 and this shifts the lever 35 of the throttle T for changing the speed of operation of the engine E and therefore the extent of the pressure of the water of the liquid developed by the pump P, as will be more evident hereinafter.

The solenoid 47 is connected into any suitable electrical circuit with a source of electrical energy such as a battery 50 which has electrical wires 51 and 52 extending therefrom to the switch 10 at the nozzle N. Also, an additional safety switch 55 is preferably incorporated in the electrical circuit. The solenoid 47 is a part of the electrical circuit also so that when the switches 10 and 55 are closed, the battery or other source of electrical energy 50 supplies energizing electrical current to the solenoid 47 for causing the solenoid stem 46 to move upwardly and to thus move the valve element 45 upwardly to open communication between the actuating assembly A and the exhaust manifold M.

Preferably, the switch 10 is a switch which will automatically open when an operator releases his contact therewith. This serves to open the system in the event the operator loses control of the nozzle so that the fluid pressure is immediately cut off at the nozzle N if this occurs and this prevent a whipping action at the nozzle N due to the high pressure of the liquid being discharged when the man has lost control of same. This is an important safety feature because the nozzle being whipped around at high pressure is a very dangerous thing and can cause injury or even loss of life.

In the operation or use of the apparatus of this invention, the switch 55 is normally closed after the equipment has reached the job site. The switch 10 is open until the operator closes same. During the operation of the engine at idle speed, which is the position indicated in FIGS. 1 and 2, the pump P discharges a relatively small amount of liquid and this is either dumped through the dump valve 20 which is open at that time, or it is returned by any suitable return line (not shown) to the reservoir 15. When it is desired to discharge fluid at high pressure from the nozzle N, the dump valve 20 is closed and then the switch 10 is closed. The closing of the switch 10 completes the electrical circuit to the solenoid 47 which moves the valve element 45 upwardly and establishes the communication between the exhaust manifold M and the upper chamber 25a of the actuating assembly A to thus create a differential in pressure across the diaphragm 26 which moves the rod 30 to the left as viewed in FIG. 1. Such movement of the rod 30 shifts the lever 35 of the throttle T to move same to the high-speed position, depending upon the length of stroke of the linkage L, which may be adjusted as previously explained. When the throttle T is shifted to its predetermined high-speed position, the pump P thus is operated at the selected high

speed and this pumps the water from the reservoir 15 through the line 16 for discharge through the nozzle N at high pressure.

When the operator desires to stop the discharge of the water or other liquid from the nozzle N, the operator simply releases the switch 10 so that the solenoid 47 becomes deactivated which causes the valve element 45 to return to the position shown in FIG. 2 by spring action in the solenoid 47, gravity, or any other suitable means. In such position, the upper chamber 25a is exposed to the atmospheric pressure which enters through the opening 43a, and this occurs almost instantaneously upon the release of the switch 10, so as to prevent an inadvertent whipping action of the nozzle N in the event the nozzle N is dropped or the control of it is lost by the operator during usage. The opening 43a is large as compared to the orifice in the valve 41 so that equalization of the pressure on each side of the diaphragm 26 upon a release of the switch 10 is substantially instantaneous and this assures an instantaneous cutoff of the discharge of high-pressure fluid from the nozzle N. The dump valve 20 is then opened, if such is used, for the discharge of any fluid pumped by the pump at idle speed.

I claim:

1. Control apparatus for a high-pressure fluid system having a fluid pump driven by an engine and wherein the pump supplies liquid under high pressure through a flow line to a nozzle at a location remote from the pump, comprising:

a. an actuating assembly mounted separately from said flow line and operable by a differential in gas pressure acting thereon;

b. means connecting said actuating assembly to a throttle for the engine for controlling the speed of the engine;

c. gas pressure communication means establishing communication between the exhaust manifold of the engine and said actuating assembly for creating a gas pressure differential in said actuating assembly; and

d. valve means included in said fluid pressure communication means for opening and closing communication between the exhaust manifold and said actuating assembly.

2. The apparatus set forth in claim 1, wherein:

a. said actuating assembly includes a housing separated into two chambers by a flexible diaphragm; and

b. said means connecting said actuating assembly to a throttle includes a linkage operably connected to said flexible diaphragm and the throttle.

3. The apparatus set forth in claim 1, including:

a. electrical solenoid means operably connected to said valve means for opening and closing same; and

b. an electrical circuit including said solenoid means and having a switch and an electrical energy source for supplying electrical energy for operating said solenoid means upon a closing of said switch.

4. The apparatus set forth in claim 1, wherein:

a. said actuating assembly includes a housing separated into two chambers by a flexible diaphragm; and

b. said means connecting said actuating assembly to a throttle includes a linkage operably connected to said flexible diaphragm and the throttle; said linkage being adjustable to regulate the extent of movement of the throttle to thereby adjust the pressure of the fluid discharged at the nozzle.

5. The structure set forth in claim 1, including: means for communicating said actuating assembly with atmospheric pressure when said valve means has closed communication between the exhaust manifold and said actuating assembly for instantaneously shifting the throttle to its low speed.

6. The apparatus set forth in claim 1, including:

a. electrical solenoid means operably connected to said valve means for opening and closing same;

b. an electrical circuit including said solenoid means and having a switch and an electrical energy source for supplying electrical energy for operating said solenoid means upon a closing of said switch;

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- c. said actuating assembly including a housing separated into the two chambers by a flexible diaphragm; and
d. said means connecting said actuating assembly to a throttle including a linkage operably connected to said flexible diaphragm and the throttle. 5
7. The apparatus set forth in claim 1, including:
a. electrical solenoid means operably connected to said valve means for opening and closing same;
b. an electrical circuit including said solenoid means and having a switch and an electrical energy source for supplying electrical energy for operating said solenoid means upon a closing of said switch; 10
c. said actuating assembly including a housing separated into the two chambers by a flexible diaphragm;
d. said means connecting said actuating assembly to a throttle including a linkage operably connected to said flexible diaphragm and the throttle; and 15
e. said valve means establishing communication between the exhaust manifold and one of the chambers in said actuating assembly to create a reduced pressure on one side of said diaphragm as compared to the pressure on the other side thereof for thereby effecting a movement of said linkage to move said throttle to its high speed. 20
8. The apparatus set forth in claim 1, including:
a. electrical solenoid means operably connected to said valve means for opening and closing same; 25
b. an electrical circuit including said solenoid means and having a switch and an electrical energy source for supplying electrical energy for operating said solenoid means upon a closing of said switch; 30

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- c. said actuating assembly including a housing separated into the two chambers by a flexible diaphragm;
d. said means connecting said actuating assembly to a throttle including a linkage operably connected to said flexible diaphragm and the throttle;
e. said valve means establishing communication between the exhaust manifold and one of the chambers in said actuating assembly to create a reduced pressure on one side of said diaphragm as compared to the pressure on the other side thereof for thereby effecting a movement of said linkage to move said throttle to its high speed; and
f. said valve means also including means for closing communication between the exhaust manifold and said one of the chambers and establishing communication with atmosphere to substantially equalize the pressure on each side of the diaphragm for thereby moving the linkage to return the throttle to its low speed.
9. The apparatus set forth in claim 1, including:
a. electrical solenoid means operably connected to said valve means for opening and closing same;
b. an electrical circuit including said solenoid means and having a switch and an electrical energy source for supplying electrical energy for operating said solenoid means upon a closing of said switch; and
c. said switch being disposed on the nozzle and having means for automatically opening same upon a release of the switch by an operator to thereby open said electrical circuit and effect a return of the throttle to its low speed.

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