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[54] **VEHICLE-MOUNTED SPRAY APPARATUS**

[75] Inventors: **Jackson Decker**, Oregon; **Harding M. Russell**, Rockford, both of Ill.

[73] Assignee: **E. D. Etnyre & Co.**, Oregon, Ill.

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[52] **U.S. Cl.** **239/155**, 239/551, 417/390

[51] **Int. Cl.** **B05b 9/06**

[58] **Field of Search** 239/155, 156, 157, 551; 417/375, 379, 390

[56] **References Cited**

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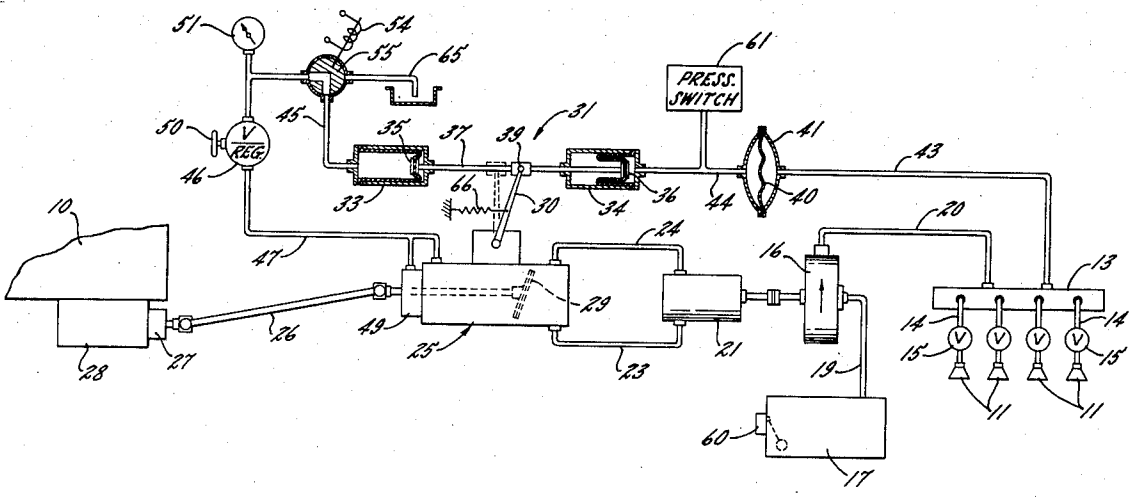
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Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Michael Y. Mar
Attorney, Agent, or Firm—Wolfe, Hubbard, Leydig, Voit & Osann, Ltd.

[57] **ABSTRACT**

A street flusher in which the water pump is driven by a hydraulic motor which, in turn, is operated by pressure fluid supplied by a variable displacement hydraulic pump driven by the transmission of the truck. In order to maintain a substantially constant water pressure at all times, means are provided for automatically adjusting the delivery of the hydraulic pump in response to changes in truck speed and in response to a change in the number of spray nozzles in operation.

3 Claims, 2 Drawing Figures



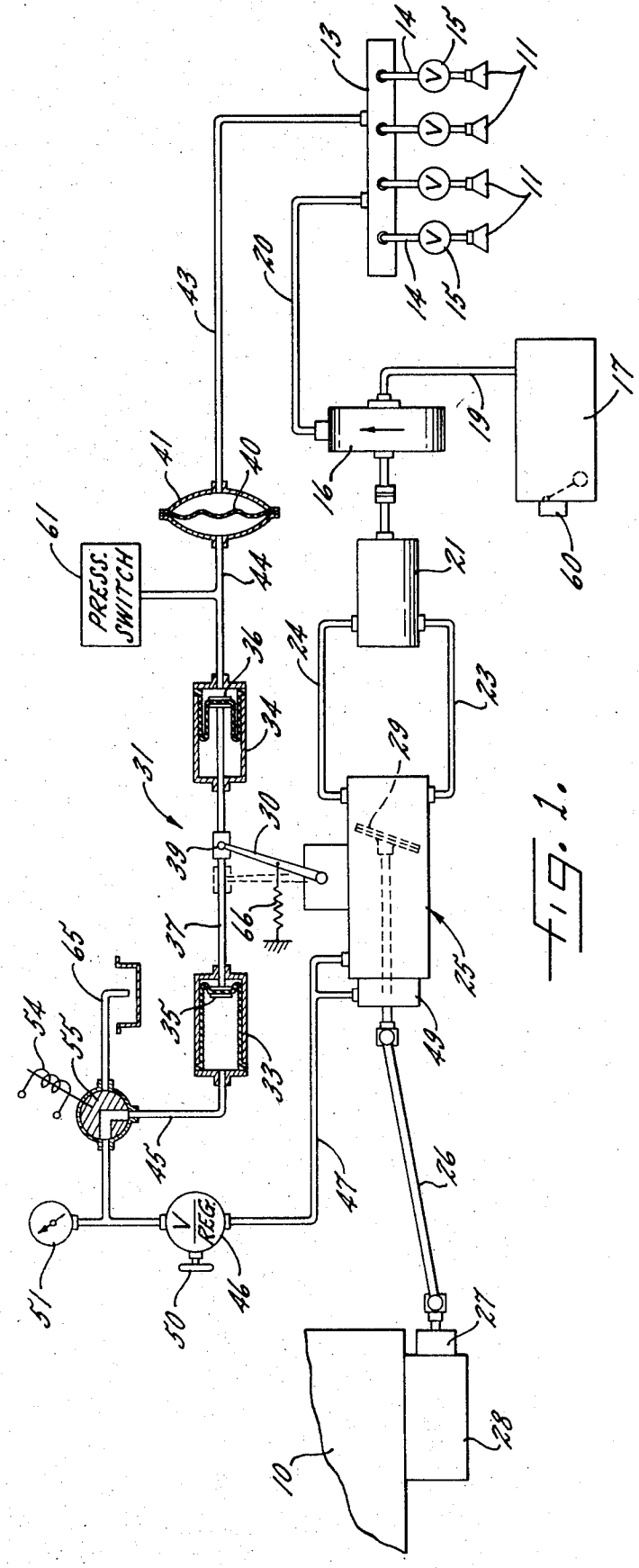


FIG. 1.

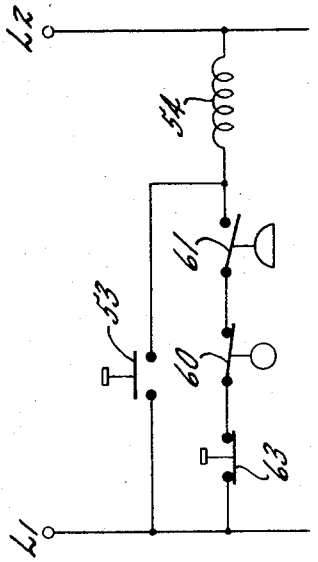


FIG. 2.

VEHICLE-MOUNTED SPRAY APPARATUS

BACKGROUND OF THE INVENTION

This invention relates generally to spray apparatus and more particularly to vehicle-mounted spray apparatus used for flushing streets or the like with water or other liquid. Such apparatus usually comprises a series of spray nozzles carried on a self-propelled vehicle and supplied with water under pressure by a pump which draws the water from a tank mounted on the vehicle.

Even more particularly, the invention relates to spraying apparatus of the type in which the water pump is driven by a hydraulic motor which, in turn, is operated by pressure fluid supplied by a variable displacement hydraulic pump whose output may be changed by adjusting a control associated with the pump. The hydraulic pump is driven from the drive train of the vehicle and thus, with the pump control at a given setting, the output of the hydraulic pump is dependent upon the speed of the vehicle. When the output of the hydraulic pump changes, the speed of the hydraulic motor changes and hence the discharge pressure of the water pump is changed. The discharge pressure of the water pump also is changed if the vehicle speed and pump control are fixed and some of the spray nozzles are shut off.

SUMMARY OF THE INVENTION

The general aim of the present invention is to provide new and improved spraying apparatus of the above general character in which the pressure of the water is automatically maintained at a substantially constant value regardless of variances in vehicle speed and/or regardless of variances in the number of spray nozzles in operation.

A more detailed object is to achieve the foregoing by sensing changes in the water pressure and by automatically adjusting the control of the hydraulic pump in response to such changes so that the hydraulic pump will cause driving of the water pump in such a manner as to maintain a substantially constant water pressure when the vehicle speed and/or number of operating nozzles is changed.

A further object is to use the water pressure to adjust the pump control and to provide unique means which act on the control in opposition to the water pressure and with substantially constant force regardless of the setting of the control.

Still another object is to enable the vehicle driver to easily and remotely adjust the magnitude of the constant pressure with which the water is discharged from the spray nozzles.

These and other objects and advantages of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of new and improved spraying apparatus embodying the novel features of the present invention and showing the apparatus during normal operation.

FIG. **2** is a diagram of an electrical circuit for controlling the spraying apparatus and showing the circuit prior to starting of the spraying apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the invention is embodied in apparatus adapted for mounting on a truck **10** or other vehicle and used for spraying water on streets or the like for the purpose of flushing the streets during travel of the truck. The flushing apparatus includes a series of spray nozzles **11** located at various positions on the truck and communicating with a common header **13** by way of lines **14.** Shut off valves **15** are located in the lines **14** and are adapted to be individually opened and closed by the driver from the cab of the truck so that the driver can change the number of nozzles which are in operation and thus direct water to selected locations along the street.

To supply water to the nozzles **11,** a centrifugal pump **16** sucks water from a storage tank **17** on the truck **10** through a line **19** and delivers the water under pressure to the header **13** through a line **20.** The water pump is connected to and driven by a fixed displacement hydraulic motor **21** operated by pressure fluid supplied through lines **23** and **24** by a hydraulic pump **25** which, in turn, is driven by a drive line **26** extending from a power-take-off assembly **27** connected to the truck transmission **28.** The transmission, of course, forms part of the drive train of the truck and is driven by the truck engine (not shown). Thus, the speed of the input drive **26** to the hydraulic pump **25** changes when engine speed changes.

The hydraulic pump **25** is of the variable displacement type and includes a swash plate **29** which is adjustable by a control lever **30** to vary the output rate of the hydraulic pump for a given speed of the input drive **26,** the output rate of the pump being increased when the control lever is pivoted in a clockwise direction from a neutral or zero output position shown in dotted lines in FIG. **1.** Accordingly, the output rate of the hydraulic pump changes both in response to a change in the speed of the input drive **26** when the control lever **30** is stationary and in response to a change in the position of the control lever when the speed of the input drive is constant. When the output rate of the hydraulic pump changes, the speed of rotation of the hydraulic motor **21** and the water pump **16** will change and, if the number of spray nozzles **11** which are open remains constant, the discharge pressure of the water pump will change so that the water will be sprayed out of the nozzles at a different pressure. In addition, the discharge pressure of the water will change if the output rate of the hydraulic pump remains constant but a different number of nozzles are open. It is desirable, however, for the discharge pressure to remain substantially constant so that each nozzle will spray water at approximately the same pressure regardless of the number of nozzles which are open and regardless of the speed of the input drive **26** to the pump **25.**

In accordance with the present invention, the water pressure is detected and is uniquely used to automatically adjust the output of the hydraulic pump **25** in such a manner as to keep the water pressure at a substantially constant value even when the speed of the input drive **26** is changed or when a different number of nozzles **11** are open. As a result, the driver may operate the truck at different speeds and may selectively open and close different ones of the nozzles without need of mak-

ing manual adjustments to keep the discharge pressure from each open nozzle at a constant value.

To enable automatic adjustment of the output of the hydraulic pump **25**, a fluid operated actuator **31** is connected to the control lever **30** for the pump and is operable to pivot the control lever in opposite directions. Preferably, the actuator includes a pair of cylinders **33** and **34** disposed on opposite sides of the control lever and slidably receiving bellows-type pistons **35** and **36**. The pistons are connected to the ends of a rod **37** which, in turn, is pivotally connected between its ends to the upper end of the control lever **30** by a pin-and-slot connection indicated by the reference numeral **39**. Thus, as the rod **37** is moved to the right or the left, the control lever **30** is pivoted to increase or decrease, respectively, the output rate of the hydraulic pump.

In order to utilize the water pressure to adjust the output rate of the pump **25**, the pressure is transmitted to the cylinder **34** of the actuator **31**. It is not desirable, however, to introduce water into the cylinder because the water could damage the bellows-type piston **36** and could freeze during cold weather. Accordingly, the water pressure is transmitted to the cylinder by means of an intermediate pressure transfer bellows **40** which divides an enclosure **41** into two compartments. As shown, the right hand compartment communicates with the header **13** by way of a line **43** and thus the right side of the bellows **40** is subjected to water pressure. The left compartment is filled with oil and communicates through a line **44** with the head end of the cylinder **34**. As the water pressure in the header **13** changes, the oil pressure in the cylinder **34** is changed proportionately so as to change the rightwardly directed force exerted on the control lever **30**.

In carrying out the invention, the force applied to the control lever **30** by the water pressure is resisted by a force which is of constant magnitude regardless of the position of the lever and which is applied to the lever in a novel manner. For this purpose, the head end of the cylinder **33** communicates via a line **45** with a constant pressure regulating valve **46** which communicates via a line **47** with a source **49** of pressure fluid. Advantageously, the pressure source **49** employed herein is a small charge pump which is conventionally associated with the hydraulic pump **25** for the purpose of supplying make-up oil for replenishing the losses from the circuit between the pump and the motor **21**. The charge pump **49** is powered by the input drive **26** and supplies pressure fluid to the pressure regulator at all times when the pump **25** is being driven. The pressure regulator is located in the cab of the truck **10** and includes an adjustable control **50** with which the driver may regulate the magnitude of the constant pressure supplied to the cylinder **33**, such magnitude being indicated on a pressure gage **51** in the cab.

Let it be assumed that the truck **10** is traveling along a street at a given speed, that the control lever **30** is in its neutral or zero output position and that the driver adjusts the pressure regulator **46** such that pressure fluid at a predetermined constant pressure will be delivered to the head end of the cylinder **33**. Now, by momentarily closing a switch **53** (FIG. 2) in the truck cab, the driver may energize a solenoid **54** across lines L-1 and L-2 and cause a valve **55** (FIG. 1) in the line **45** to shift to the position shown so as to admit pressure fluid from the regulator into the cylinder **33**. With the control lever **30** in its neutral position, there is no input drive to the water pump **16** and thus there is no pressure in the cylinder **34**. Accordingly, the pressure in the cylinder **33** forces the control lever to its far right position so that the hydraulic pump **25** supplies pressure fluid at full rate to the motor **21** which, in turn, begins driving the water pump **16**.

As the water pressure in the header **13** builds up, such pressure acts by way of the cylinder **34** to force the control lever **30** to the left. When the pressure in the cylinder **33** balances that in the cylinder **34**, the control lever stops and, in the stopped position of the lever, the output of the pump **25** is established at such a rate that the water pump **16** maintains the header **13** a pressure which is substantially equal to the constant pressure in the cylinder **33**.

If the truck **10** increases speed, the increased output of the pump **25** will cause the pressure in the header **13** to increase. As an incident thereto, the pressure in the cylinder **34** is increased to cause the control lever **30** to shift to the left until the hydraulic pump **25** causes driving of the water pump **16** at a reduced speed effective to lower the water pressure back to its original value at which the pressures in the two cylinders **33, 34** are again balanced. Conversely, the decrease in truck speed along with a reduction in water pressure causes the pressure in the cylinder **33** to shift the control lever to the right and speed up the pump **16** until the water pressure is restored to its set value. Thus, a substantially constant water pressure is maintained regardless of changes of the speed of the truck.

The control lever **30** is automatically adjusted in a similar manner if the driver changes the number of nozzles **11** which are open. That is, if the driver closes off one or more nozzles, the pressure in the header **13** rises and causes shifting of the control lever to the left until the output of the pump **25** is reduced sufficiently to cause driving of the pump **16** at a rate which will reestablish the set pressure. If the closed nozzles are reopened, the reduced pressure in the cylinder **34** results in the control lever being shifted to the right until the water pressure increases to a value to balance the pressure in the cylinder **33**.

Thus, it will be seen that the present invention brings to the art new and improved spraying apparatus in which a substantially constant water pressure is automatically maintained. Because the force which opposes and balances the water pressure is derived from pressure fluid under constant pressure, such force remains substantially constant regardless of the position of the control lever **30** and thus more accurate and reliable positioning of the lever can be achieved than would be the case if the biasing force were provided by springs or the like. Moreover, the driver can easily change the water pressure to a different value and within a wide range simply by adjusting the setting of the pressure regulator **46** and thus the use of fluid pressure as the biasing force enables the convenient establishing of different selectable pressures while still biasing the control lever constantly in all positions of the lever.

Means are provided to cause automatic shifting of the control lever **30** to its neutral position in the event the tank **17** runs low on water or in the event oil pressure is lost in the line **44**. Herein, these means comprise a float switch **60** and a pressure switch **61** connected in series with one another and the solenoid **54** and connected in parallel with the manually actuated start switch **53**. The float switch is associated with the tank

17 and is closed as long as the water in the tank is above a predetermined level. The pressure switch is responsive to the oil pressure in the line 44 and closes when such pressure increases to a predetermined value.

When starting up, the driver holds the start switch 53 closed until the oil pressure in the line 44 builds up and closes the pressure switch 61. The solenoid 54 then is maintained in an energized state by way of the float switch 60, the presure switch 61 and a normally closed, manually actuated stop switch 63 so the driver may release and open the start switch. If the tank 17 should run low on water or if oil pressure in the line 44 should be lost, the float switch 60 or the pressure switch 61 will open and cause de-energization of the solenoid 54. When the solenoid is de-energized, the valve 55 is shifted to a position blocking the flow of pressure fluid from the regulator 46 and venting the cylinder 33 to drain through a line 65. With the pressure in the cylinder 33 relieved, the control lever 30 is shifted to the left to its neutral position by a contractile spring 66; the force exerted by such spring being so light as to be negligible in normal operation when the position of the control lever is governed by the pressures in the cylinders 33 and 34.

We claim as our invention:

1. Apparatus comprising a hydraulic pump, a variable speed input drive connected to said pump, control means associated with said pump and adjustable to different positions, the delivery rate of said pump changing when the speed of said input drive changes and said control means are in a fixed position and also changing when the speed of said input drive is constant and said control means are adjusted in first and second directions, a hydraulic motor connected to be driven by the delivery of said pump, a second pump connected to be driven by said motor and operable when driven to discharge liquid under pressure, and a series of spray nozzles connected to receive the liquid discharged from said second pump and adapted to be selectively opened or closed, the discharge pressure of said second pump changing when the delivery rate of said hydraulic pump changes and a certain number of said nozzles are open and also changing when the delivery rate of said hydraulic pump is constant and a different number of nozzles are open, the improvement in said apparatus comprising, a reversible fluid-operated actuator connected to adjust said control mmeans, a source of pressure fluid at constant pressure and acting on said actuator to bias said control means in said first direction, the discharge pressure of said second pump acting on said actuator to bias said control means in said second direction whereby said control means seek a position in which said actuator is balanced by said constant pressure and said discharge pressure and in which the discharge pressure is at a substantially constant magnitude determined by the magnitude of said constant pressure, and means selectively operable to adjust the magnitude of said constant pressure.

2. Apparatus as defined in claim 1 in which said spray nozzles are supported on a power-driven vehicle and are used for flushing streets, said input drive being derived from the drive train of said vehicle.

3. Apparatus as defined in claim 2 in which said source of pressure fluid is derived from the delivery of a charge pump associated with said hydraulic pump and adapted to supply make-up oil to the hydraulic system which includes said hydraulic pump and motor, said last-mentioned means comprising a constant pressure regulator connected in the fluid system between said charge pump and said actuator and adjustable to different settings to adjust the magnitude of said constant pressure.

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