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R. R. CURTIS ET AL
PLURAL SOURCE CLEANING APPARATUS HAVING FLUID
ACTUATED DIAPHRAGM-TYPE PROPORTIONING VALVE

3,369,705

2 Sheets-Sheet 1

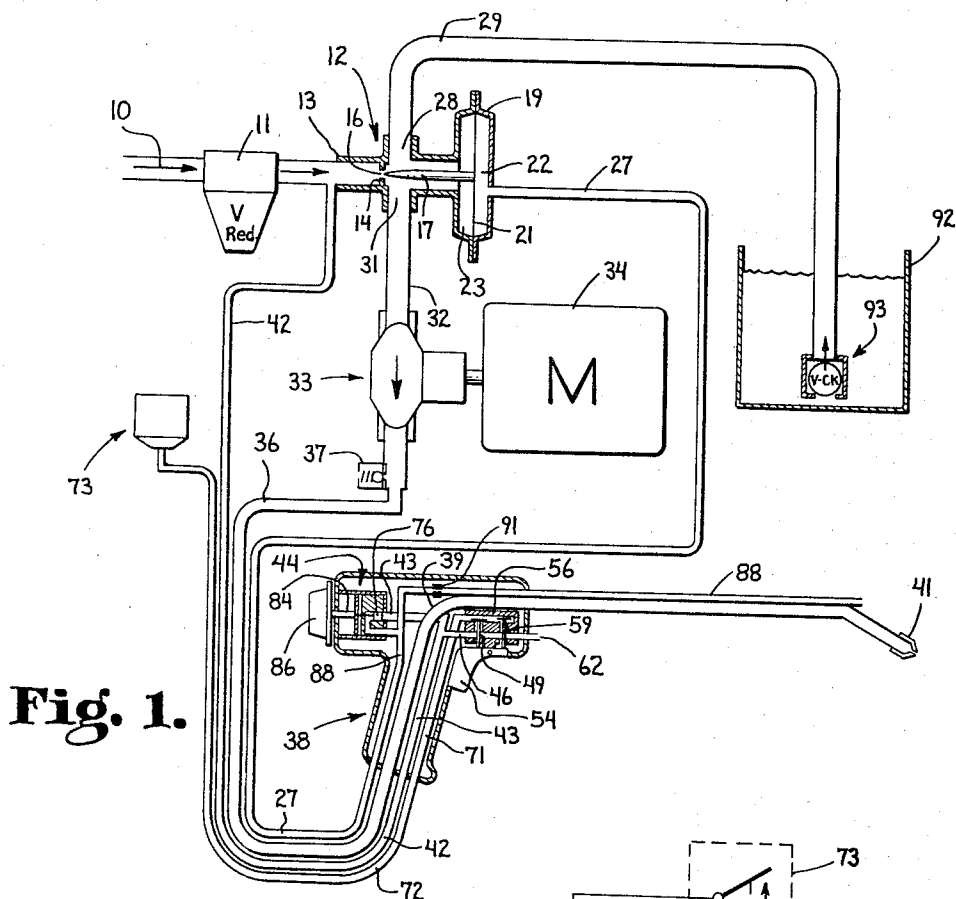


Fig. 1.

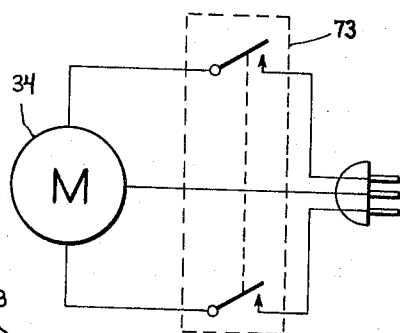


Fig. 2.

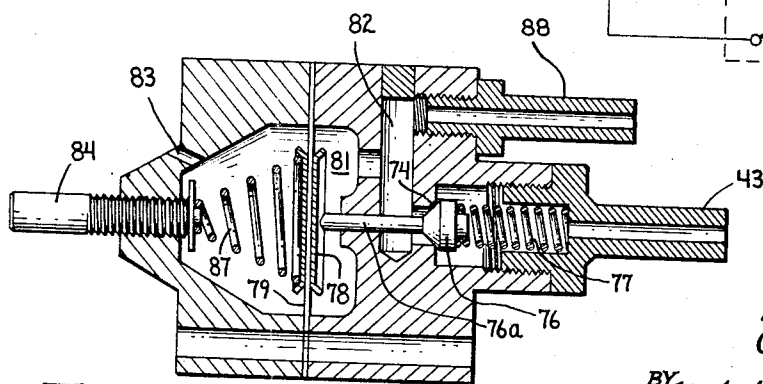


Fig. 3.

INVENTORS
RUSSELL R. CURTIS and
CONRAD D. MCGINNIS

BY *Woodard, Wickert, Emhardt & Moughton*
Attorneys

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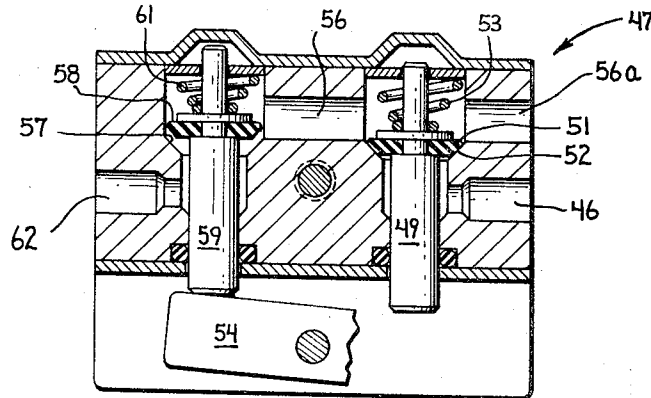


Fig. 4.

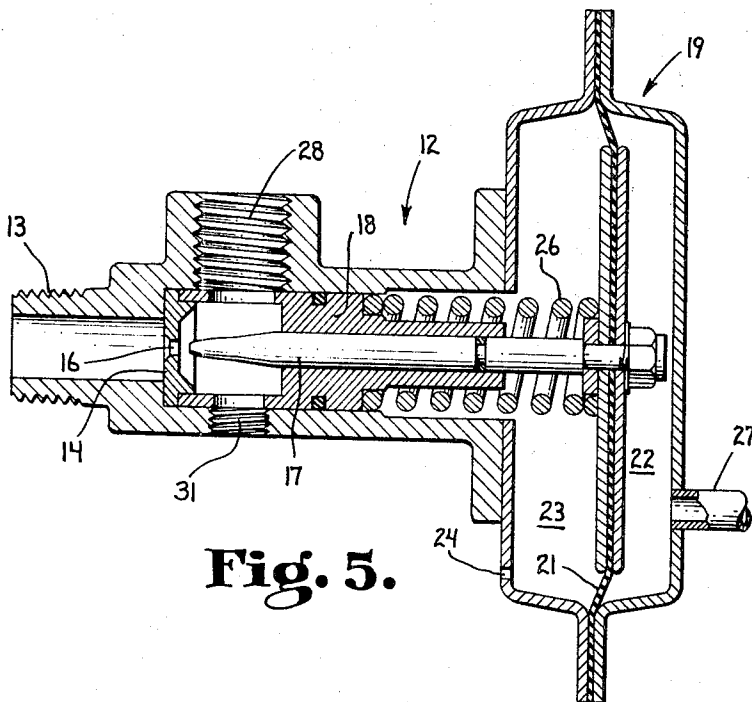


Fig. 5.

INVENTORS
RUSSELL R. CURTIS and
CONRAD D. McGINNIS

BY
Woodard, Wickert, Emhardt & Naughton
Attorneys

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3,369,705

PLURAL SOURCE CLEANING APPARATUS HAVING FLUID ACTUATED DIAPHRAGM- TYPE PROPORTIONING VALVE

Russell R. Curtis and Conrad D. McGinnis, Indianapolis, Ind., assignors to Curtis Dyna-Products Corporation, Westfield, Ind., a corporation of Ohio

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7 Claims. (Cl. 222-57)

This invention relates generally to cleaning apparatus using fluids ejected at relatively high pressure and in particular to cleaning apparatus which selectively delivers two cleaning fluids, in a proportion adjusted at the point of application, for cleaning auto exteriors, engines, machinery and the like.

High pressure cleaning apparatus of the type here considered is known in the prior art and used in automobile washing and similar applications. An example of prior art devices can be found in Harnes et al. U.S. Patent 3,058,668. These prior art structures are subject to certain limitations with regard to reliability of the proportioning adjustment and with regard to operator safety because they require electrical circuits and switches in the hand-held, fluid-discharging gun or nozzle. Further, in those prior art devices having adjustability of the proportions of multiple fluids moving through their discharge nozzle, the adjustment cannot be made at the hand-held discharge nozzle or gun but must be made at the pump or main valve complex which is, normally, remote from the point of application of the cleaning fluids.

It is an object of the present invention to provide a cleaning apparatus requiring only the availability of conventional 110 volt A.C. electrical power and a water supply at conventional distribution pressure of 45-55 pounds per square inch for its operation.

It is a further object of the present invention to provide a cleaning apparatus having a wide range of control of the proportions of two cleaning fluids to be discharged by the apparatus with the adjustment for selecting the desired proportion being readily available at the discharge nozzle or point of application of the fluids.

It is a further object of the present invention to provide a cleaning apparatus having an accurate means for controlling the ratio of one cleaning fluid to another introduced into the apparatus from separate fluid supply sources.

It is a further object of the present invention to provide a cleaning apparatus which eliminates the danger of electrical shock to the operator by eliminating all electrical wiring at the operator-manipulated discharge nozzle.

A further object of the present invention is to provide a cleaning apparatus of the type referred to in which the pump, which raises the pressure of the cleaning fluids to elevated, discharge pressure, cannot be operated unless a supply of fluid is available at its intake.

These and other objects will become apparent as the description proceeds with reference to the accompanying drawings in which:

FIG. 1 is a schematic view of the apparatus of the present invention when operatively interconnected.

FIG. 2 is a schematic electrical wiring diagram of the apparatus.

FIG. 3 is a side sectional view of one of the valve components shown schematically in FIG. 1.

FIG. 4 is an enlarged, side sectional view of a further component of the apparatus schematically shown in FIG. 1.

FIG. 5 is an enlarged side sectional view of a further component of the apparatus schematically shown in FIG. 1.

Referring initially to FIG. 1, the apparatus of the pres-

ent invention includes a first source of pressurized cleaning fluid which may take the form of the conventional tap-water supply pipe 10, within which water is available at conventional distribution pressures of 35 to 55 pounds per square inch. The water pressure available at the line 10 is reduced by the reducing valve 11, the outlet side of the reducing valve being connected to one inlet of a throttling or proportioning valve indicated generally at 12. The inlet of the valve 12 receiving water from the valve 11 is identified at 13 in FIG. 1 and in the more detailed showing of the valve 12 in FIG. 5. The valve 12 contains an orifice plate 14 and a flow aperture 16 extends through the plate. Cooperating with the aperture 16 is a valve member or stem 17 which extends through a central bore in an insert 18 (FIG. 5) in the valve body.

The end of the body of the valve 12 carries a diaphragm housing 19 which is divided by a flexible diaphragm 21, functioning as a movable wall, into a pressure chamber 22. The chamber 23, on the opposite side of the diaphragm 21 is vented to atmosphere through the vent aperture 24 (FIG. 5). The valve stem 17 extends through the diaphragm 21 and is secured thereto as shown in FIG. 5. A compression spring 26 (FIG. 5) biases the stem 17 rightwardly as viewed in FIG. 5.

A fluid conduit or tube 27 communicates with the pressure chamber 22. The valve body of the valve 12 carries a second inlet aperture 28 which, as shown in FIG. 1, communicates with a fluid conduit 29. The valve body is further provided with an outlet 31 which communicates with a fluid conduit 32 (FIG. 1). The valve member 17, cooperating with the aperture 16, controls the flow from the valve inlet 13 to its outlet 31, however, the communication between the valve inlet 28 and its outlet 31 is unobstructed.

The fluid line 32 is connected to the intake of a positive displacement pump indicated generally at 33 in FIG. 1. The drive means for the pump is provided by a motor 34 coupled to the pump, the output of the pump being such that, for example, 2 gallons of fluid per minute can be delivered at 500 pounds per square inch pressure. The output side of the pump is connected to a fluid line 36 having a conventional, spring-loaded relief valve 37 therein. The conduit 36 is flexible, formed of rubber for example, and is attached to a fluid discharge member indicated generally at 38 in FIG. 1. The member 38 is adapted for manipulation at a location remote from the pump 33. The fluid line 36 communicates with a tube 39 within the discharge member 38 and the tube 39 extends from the discharge member and terminates in a discharge nozzle 41. The discharge member 38 thus acts as a means for controlling and directing the fluid output of the pump.

A flexible tube or fluid line 42 extends from a point upstream of the inlet 13 of the valve 12 to the discharge member 38. The tube 42 communicates with a tube 43 located within the interior of the discharge member. The tube 43 communicates with one side of an adjustable orifice metering valve indicated generally at 44 and shown in detail in FIG. 3. A fluid passage 46 communicates with the passage 43 and with a trigger operated valve 47 which is shown schematically in FIG. 1 and in detail in FIG. 4.

As may best be seen in FIG. 4, the valve 47 includes a reciprocable stem 49, carrying a valve member 51 which cooperates with a seat 52. A compression spring 53 urges the valve member 51 into closed position with respect to the seat 52. A finger-operated trigger 54 on the fluid discharge member 38, when depressed, functions to move the stem 49 upwardly opening the valve 51 and permitting fluid communication between the passage 46 and the passage 56. The passage 56 communicates with a valve seat 57 which cooperates with a valve 58 carried by a

stem 59 reciprocable in the same fashion as valve stem 49. A compression spring 61 urges the valve stem 59 into a position such that valve 58 closes against the seat 57. The valve stem 59 is also operated by the trigger member 54 and when the trigger is depressed the valve stem 59 is moved to closed position. When the valve 58 is opened it permits communication between the passage 56 and the vent passage 62, the passage 62 opening to atmosphere as shown in FIG. 1. The opposite end of the passage 56 (indicated at 56a in FIG. 4) communicates with a tube 71 within the member 38, and the tube 71 is connected to a flexible fluid line 72 which extends to a pressure responsive switch indicated generally at 73 as viewed in FIG. 1.

The schematic electrical wiring diagram for the motor and the pressure switch 73 is shown in FIG. 2. The switch 73 controls the energization of the motor 34 and prevents operation of the motor unless, when the trigger 54 is actuated, fluid under pressure is available at the supply and in the line 42 leading from it.

As previously mentioned the tube 43, communicating with the line 42, is connected to one side of an adjustable orifice formed in a metering valve 44, the valve 44 being shown in detail in FIG. 3. The adjustable orifice is formed by a valve seat 74 and a valve member 76. The valve member 76 is urged against the seat 44 by a compression spring 77. The spring 77 holds the end of the valve stem 76a against a diaphragm plate 78 carried by a flexible diaphragm 79. The chamber 81 beneath the diaphragm 79 communicates with the passage 82 and the chamber on the opposite side of the diaphragm 79 communicates through the vent aperture 83 with atmosphere. The position of the diaphragm, and hence the position of valve member 76 with relation to seat 74 is adjusted by manual rotation of a stem 84 threaded into the body of valve 44. The stem 84 carries an adjusting knob 86 (FIG. 1) and rotation of the knob 86 adjusts the position of the stem 84 and hence the pressure exerted by compression spring 87 on the diaphragm 79, this positioning the valve member 76 and thus adjusting the orifice formed by the valve 76 and seat 74.

The passage 82 (FIG. 3) communicates with a tube 88 within the discharge member 38. Communicating with the tube 88 is the flexible fluid line 27 (FIG. 1). Fluid may thus flow through the line 42, tube 43, adjustable orifice 76-74 and through tube 88 to line 27. Since the chamber 81 is in communication with the passage 82 (FIG. 3) the chamber 81 will reflect any slight changes in supply pressure and will compensate for these by holding the stem 76a (FIG. 3) in position such that the pressure drop across the orifice 76-74 will remain relatively constant once it has been adjusted by rotation of the knob 86 (FIG. 1).

As will be evident from FIG. 1 the flexible line 27 provides communication between the pressure chamber 22 of the proportioning valve 12 and the outlet side 88 of the valve 44. The tube 88 within the discharge member 38 extends past its entry into the valve 44 and carries a restriction 91. Within the discharge member, tube 88 parallels the extending portion of the tube 39 and discharges to atmosphere. It will be evident that the function of the venting to atmosphere of the tube 88 is to maintain flow through the adjustable orifice in the valve 44 so that the pressure drop across the orifice will determine the static pressure in the line 88 and hence in the pressure chamber 22 of the valve 12. The venting of tube 88 to atmosphere further serves to relieve pressure in line 27 should the adjustable orifice in the valve 44 be set at closed position. The line 29 communicating with the inlet 28 of valve 12 extends to a point adjacent the bottom of a second source of cleaning fluid such as a cleaning concentrate, the source of cleaning fluid taking the form of a tank 92. The extremity of the line 29 within the tank 92 is provided with a check valve 93 which prevents the flow of fluid from the valve 12 into the tank but freely permits flow from the

tank to the valve 12. The supply of concentrate within the tank 92 is not pressurized and withdrawal of fluid from the tank through the line 29 to the valve 12 is accomplished only when a sub-atmospheric or suction pressure exists at the valve inlet 28.

Operation

In operation, the operator manipulates the discharge member 38, initially pressing the trigger member 54. This opens valve 49 and closes valve 59. Fluid under pressure can then flow through the line 42, tube 43 and past valve stem 49 into tube 71 and line 72. Pressure responsive switch 73 is thus pressurized and actuated to closed position starting the pump motor 34. The pump 33 draws fluid through its inlet 13 and, depending upon the adjusted position of the valve member 17, also draws fluid through its inlet 28. The discharge of the pump moves through the line 36 and tube 39 to be discharged through the nozzle 41. Fluid flow through line 42, tube 43 and the adjustable orifice of the metering valve 44 serves to establish a pressure in the pressure chamber 22 of the valve 12 which is dependent upon the pressure drop across the adjustable orifice of the valve 44. Should the operator wish to alter the proportion of fluid entering the system through the inlet 13 with relation to the proportion of fluid entering the system through the inlet 28 of the valve 12, he may reset the knob 86 changing the pressure drop across the adjustable orifice in the valve 44 and hence the pressure within the pressure chamber 22 of the valve 12. This alters the position of the valve member 17 with respect to the orifice 16 and hence alters the amount of fluid which the pump can draw through the inlet 13 of the valve 12. If this amount is reduced, the pump 33 will then exert a proportionally larger suction at the inlet 28 of the valve 12 and the component of the fluid mix coming from the concentrate in the tank 92 will be increased in proportion to the reduction of fluid taken through the inlet 13 of the valve 12.

From the foregoing it will be evident that the apparatus of the present invention provides a means whereby two cleaning fluids can be selectively mixed, with the proportions of the mix being determined at the discharge member which may be remote from the pump and fluid supply. The pump cannot be operated unless fluid is available at its inlet since the motor driving the pump cannot be energized unless its controlling pressure switch is actuated. The discharge member may be manipulated without danger of electrical shock since no electrical wiring proceeds to the discharge element from any electrical component of the apparatus. The apparatus, thus, at its control point is completely hydraulic, rather than electrical, and the apparatus can be operated, when used as a washing apparatus, from a source at conventional tap water pressure.

While the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being made to the appended claims.

The invention claimed is:

1. A pressure cleaning apparatus comprising in combination: a source of a first cleaning fluid under pressure, a fluid pump and drive means therefor, a source of a second cleaning fluid, and a fluid discharge member adapted for use at a location remote from said pump, fluid conduits connecting both of said fluid sources to the intake of said pump, a throttling valve in the conduit connecting said first fluid source with the pump intake for determining the flow from said first fluid source to the pump, said throttling valve including a pressure chamber having a moveable wall and a valve member positioned by said moveable wall for establishing the rate of flow through said throttling valve in response to the

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pressure in said pressure chamber, a flexible fluid conduit connecting the discharge side of said pump to said fluid discharge member for discharging the pump output therethrough, a manually adjustable orifice carried by said discharge member, a first flexible tube connecting said source of pressurized cleaning fluid with one side of said orifice, means venting the other side of said orifice to atmosphere and a second flexible tube connecting said other side of said orifice to said throttling valve pressure chamber, whereby the pressure drop across said orifice determines the pressure in said pressure chamber and adjustment of said orifice determines the relative proportions of said cleaning fluids discharged by said fluid discharge member.

2. A pressure cleaning apparatus as claimed in claim 1 in which the drive means for the pump takes the form of an electric motor with a pressure responsive switch controlling energization of the motor, a conduit connecting said source of pressurized cleaning fluid to said pressure responsive switch and extending through said fluid discharge member, and a valve carried by said fluid discharge member normally blocking said last mentioned conduit but adapted to be manually actuated to open position to cause actuation of said pressure switch and energization of said pump drive motor.

3. A pressure cleaning apparatus as claimed in claim 1 in which said source of first cleaning fluid under pressure is a water supply pipe and said source of second cleaning fluid is a supply of a cleaning concentrate such as a soap solution.

4. A pressure cleaning apparatus as claimed in claim 1 in which said pump is of the positive displacement type.

5. A pressure cleaning apparatus as claimed in claim 1 in which said throttling valve includes a flow aperture and said valve member comprises a valve stem having a portion cooperating with said flow aperture to determine the rate of flow therethrough, said valve stem portion having a contour such that the rate of flow through said aperture and the position of said valve stem with relation to said aperture have a substantially linear relationship.

6. A pressure cleaning apparatus as claimed in claim

1 in which said fluid discharge member is adapted for manipulation and said manually adjustable orifice can be adjusted by means of an adjusting member accessible on the exterior of said fluid discharge member.

7. An apparatus for adjusting the relative proportion of first and second fluids in a fluid mixture ejected under pressure, said apparatus comprising a source of a first fluid under pressure, a pump and drive means therefor, a source of a second fluid, and a fluid mixture discharge member adapted for operation remote from said pump, means connecting both of said fluid sources to the intake of said pump, a throttling valve controlling flow between said first fluid source and the pump intake, said throttling valve including a pressure chamber having a moveable wall and a valve member positioned by said moveable wall for establishing the rate of flow through said throttling valve in response to the pressure in said pressure chamber, means connecting the discharge side of said pump to said mixture discharge member for discharging the pump output therethrough, an adjustable orifice carried by said mixture discharge member, means connecting said source of pressurized cleaning fluid with one side of said orifice, means venting the other side of said orifice to atmosphere and additional means connecting said other side of said orifice to said throttling valve pressure chamber, whereby pressure drop across said orifice determines the pressure in said pressure chamber and adjustment of said orifice determines the relative proportions of said fluids discharged by said fluid discharge member.

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M. HENSON WOOD, JR., *Primary Examiner.*

V. C. WILKS, *Assistant Examiner.*