United States Patent

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[54] **ACID ASPIRATOR SYSTEM**
22 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **239/310,** 137/101.11, 137/604, 239/318
[51] **Int. Cl.** **B05b 7/26**
[50] **Field of Search** 239/304, 305, 310, 317, 318; 137/101.11, 604

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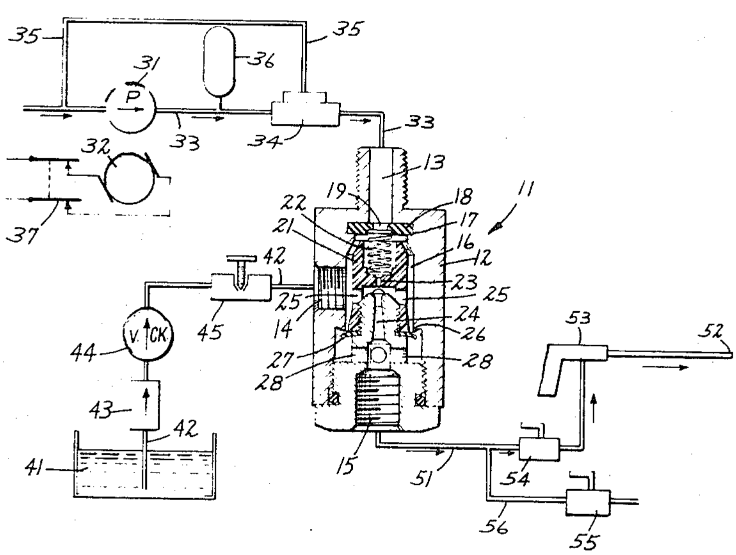
ABSTRACT: A hydraulic system which receives and pumps water at high pressure to a spray nozzle for washing and cleaning purposes. The system includes an aspirator-transfer valve downstream of the pump which functions to receive water from the pump and direct it to the spray nozzle under one cycle of operation, and, under a second cycle of operation, to block the major flow of water from the pump and aspirate cleaning acid from a separate source to be mixed with water in the valve and on to the nozzle without passing through the pump.



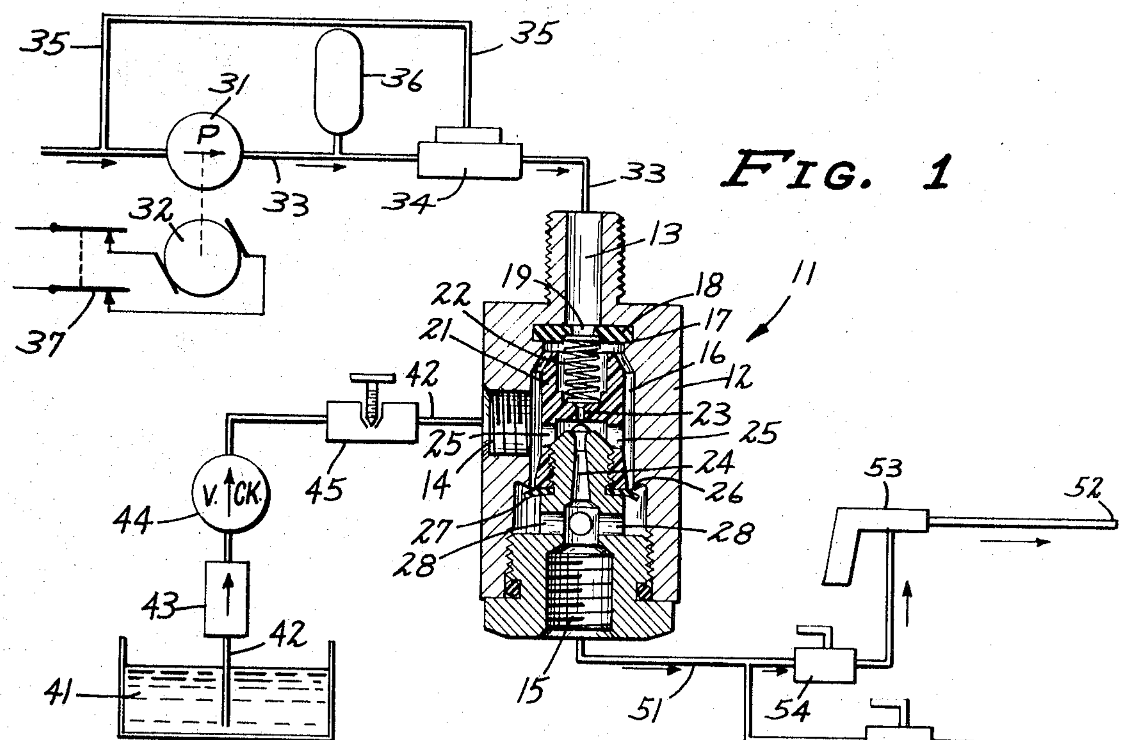


FIG. 1

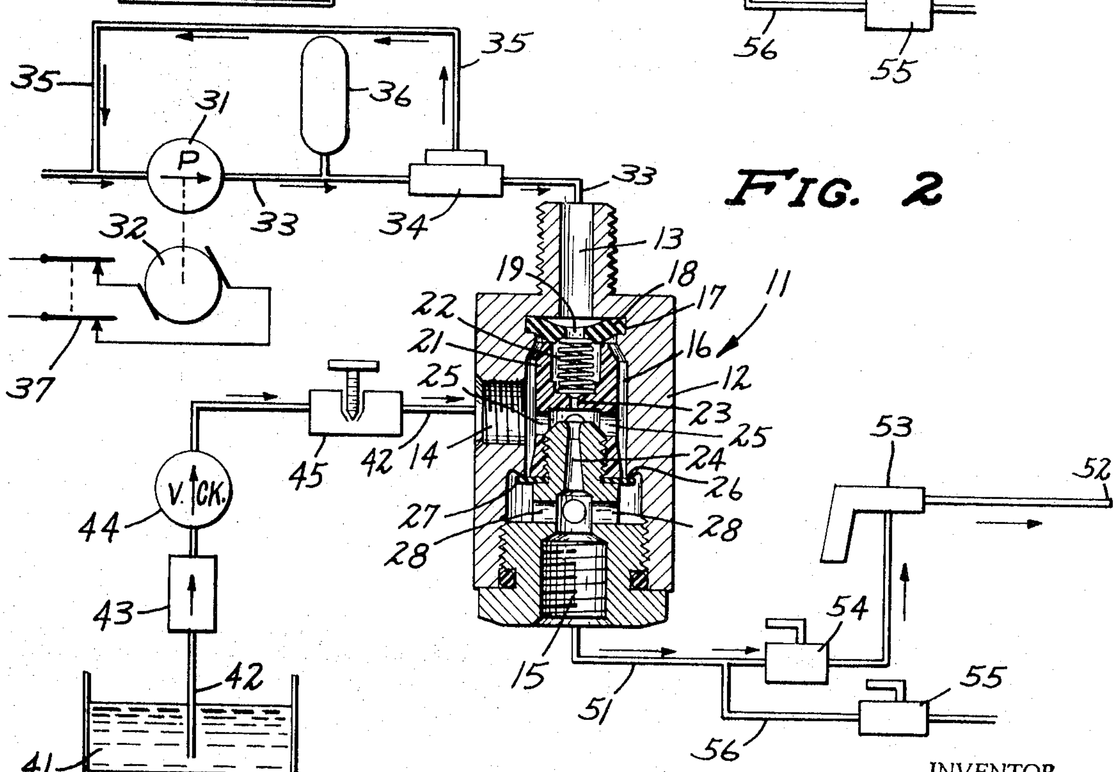


FIG. 2

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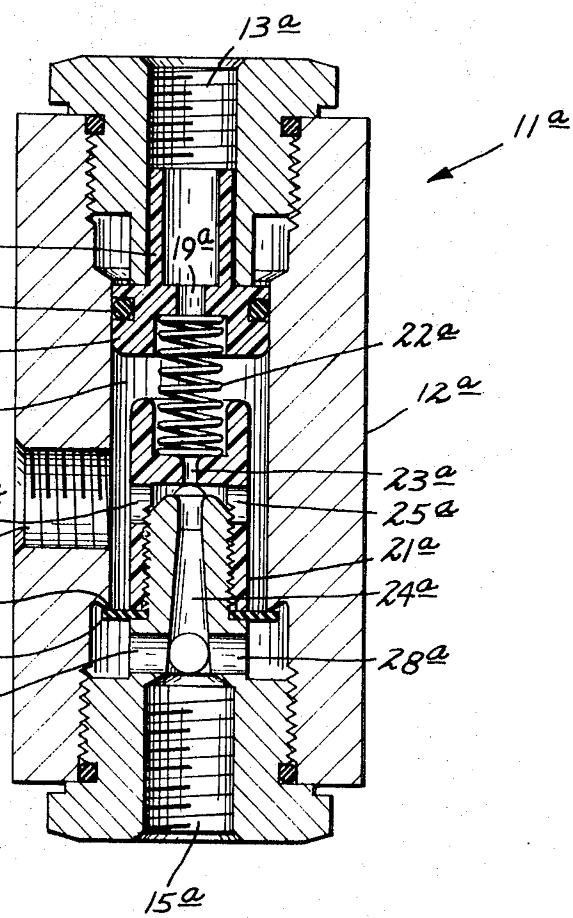
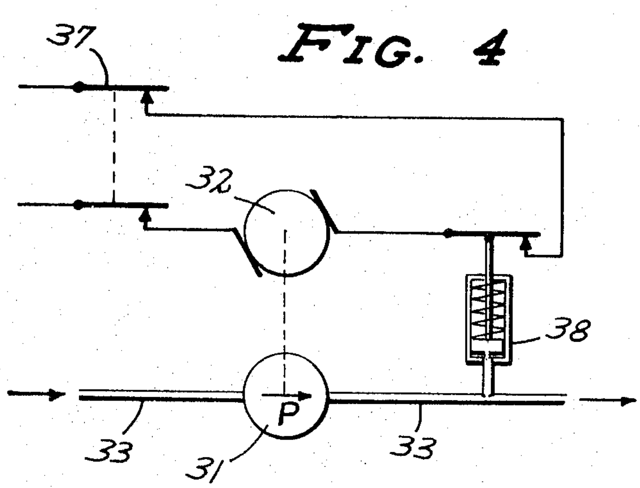


FIG. 3

FIG. 4



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ACID ASPIRATOR SYSTEM

The invention relates to hydraulic systems which generate high pressure for spray cleaning, and to a valve therefor which responds to pressure in the system and selectively delivers either a large flow of hydraulic fluid or a mixture of hydraulic fluid and cleaning solvent or acid to an outlet nozzle.

The use of high-pressure spraying equipment is a well accepted practice in cleaning and washing. Conventional pressure washers ordinarily receive a continuous supply of liquid which is pumped to a predetermined pressure level within the system and thereafter directed through a spray nozzle against the object to be cleaned. The use of water alone or with a detergent or mild solvent is greatly successful for most applications. However, a number of cleaning jobs require the use of an extremely strong solvent or acid to clean satisfactorily. For example, hydrochloric acid is often used in cleaning an area in which mortar has been used.

Although an acid-water mixture is successful in its cleaning task, the acid usually has a detrimental affect on the hydraulic pump. I have found this to be true even where the exposed parts of the pump are made from a more acid resistant material, such as bronze, and the pressure washing system is purged with water after each use.

My invention is the result of an endeavor to solve this problem, and consists of an aspirator-transfer valve disposed downstream of the pumping device which delivers a full flow of water to the spray nozzle under one cycle of operation, and, under a second cycle of operation, aspirates acid from a separate supply vessel for mixture with low flow water for dispersion through the spray nozzle.

The aspirator-transfer valve is bistable in operation, having a fixed position for each cycle of operation. The valve can be moved to each of the respective positions by varying the flow rate within the system.

Through use of the hydraulic system and aspirator-transfer valve, acid and liquids of similar strength can be used for cleaning purposes without damaging the pump. Control of the valve is extremely simple, and can be effected by control devices mounted on the nozzle itself.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a pressure washing system which includes an axial sectional view of an aspirator-transfer valve shown in detail, the system and valve being in a first cycle of operation;

FIG. 2 discloses a pressure washing system and aspirator-transfer valve of FIG. 1 in a second state of operation;

FIG. 3 is an enlarged axial sectional view of an alternative embodiment of the aspirator-transfer valve; and

FIG. 4 is an alternative disclosure of apparatus for controlling the pump.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 discloses a hydraulic pressure washing system having two sources of hydraulic fluid, the flow of which is controlled by an aspirator-transfer valve represented generally by the numeral 11. Valve 11 has a body 12 in which is formed a first inlet 13, a second inlet 14 and an outlet 15.

Inlet 13 receives a supply of water or a similar hydraulic cleaning fluid from a source not shown, the fluid being pumped to a predetermined pressure level by a pump 31 which is driven by an electric motor 32. Pump 31 and inlet 13 are connected by a conduit 33 having a conventional unloader valve 34 disposed therein, the purpose of which is to divert hydraulic fluid through a bypass conduit 35 when downstream pressure reaches a predetermined level. As shown, bypass conduit 35 is connected upstream of pump 31.

Also communicating with conduit 33 is an accumulator 36 which serves to dampen the pulsations of pump 31 and also stores an extra volume of water for use in operating valve 11 as described below.

Inlet 14 is connected to an acid bath 41 by means of a conduit 42 which also includes a flowmeter 43, a check valve 44 and a variable restriction 45.

Outlet 15 of valve 11 delivers either water or a water-acid mixture through a conduit 51 to a spray nozzle 52 embodied in a gun 53. A shutoff valve 54 disposed in conduit 51 and a dumping valve 55 connected to conduit 51 by a conduit 56 are used to control aspirator-transfer valve 11, as will be described in further detail below.

In the preferred embodiment, inlets 13 and 14 and outlet 15 of valve 11 commonly communicate in a cylindrical chamber 16 formed within body 12. Disposed in an annular groove 17 near the top of chamber 16 adjacent inlet 13 is a resilient transfer disc 18 having an opening 19. Spaced below disc 18 is a fixed aspirator nozzle 21 the upper edge of which defines a mouth and cooperates with disc 18 in valving relation. A spring 22 is received in recesses formed in disc 18 and in the base of nozzle 21 and provides an upward biasing force against disc 18. Nozzle 21 has a restricted opening 23 in its base which is aligned with opening 19 of disc 18.

An aspirator throat 24 is disposed immediately below nozzle 21 in alignment with restricted opening 23. Cross-drilled holes 25 disposed between restriction 23 and throat 24 permit fluid communication with chamber 16.

Chamber 16 is enlarged below aspirator throat 24, the enlargement being defined by a stepped portion 26 in valve body 12. A resilient collar member 27 encircling the member defining throat 24 operates in association with stepped portion 26 to provide a check valve between the smaller and larger portions of chamber 16. Cross-drilled holes 28 establish fluid communication between the enlarged section of chamber 16 and outlet 15.

Under normal operating conditions (with disc 18 undeflected as shown in FIG. 1), water entering inlet 13 can take one of two passages. The first passage is defined by opening 19 in disc 18, the lateral space between disc 18 and nozzle 21, the annular passage defined by nozzle 21 and valve body 12, the check valve formed from stepped portion 26 and resilient collar 27, the enlarged section of chamber 16 and cross-drilled holes 28 leading to outlet 15. The first passage is generally unrestricted, with the opening 19 presenting the greatest single fluid resistance upstream of spray nozzle 52.

The second passage is defined by opening 19, the mouth of nozzle 21, restriction 23, aspirator throat 24 and outlet 15.

With disc 18 undeflected, approximately 80 percent of the flow entering inlet 13 passes through the first passage, with the remaining 20 percent passing through the second passage. This defines the first cycle of operation, as represented by the arrows along conduit 33 and 51, in which water is received into the system, pumped to approximately 500 p.s.i. and delivered through aspirator-transfer valve 11 to gun 53 and spray nozzle 52 for spray cleaning.

The second cycle of operation, in which acid is aspirated into the system through valve 11, is shown by the arrows in FIG. 2. The second cycle is brought about by the opening of dumping valve 55, which creates a pressure differential across disc 18 by virtue of the restricted opening 19. Accumulator 36 assists in this movement by maintaining high-pressure upstream of disc 18. This pressure differential causes disc 18 to be deflected downward until it engages the upper edge of nozzle 21, thereby sealing off the first passage and limiting the entire flow of water entering inlet 13 to the second passage. When this happens, restriction 23 and aspirator throat 24 give rise to a vacuum in chamber 16 which draws acid from bath 41 and causes it to flow through conduit 42 and valve 11 to gun 53 and spray nozzle 52. The acid is mixed with the water leaving restriction 23. After aspiration has begun, dumping valve 55 can be closed since the combination of water pressure on the upper surface of disc 18 and vacuum on its lower surface overcomes the biasing force of spring 22. Similarly, the vacuum keeps resilient collar 27 drawn tight against stepped portion 26. Most of the output of pump 31 is recirculated back to the pump inlet from unloader 34 and conduit 35 during the second cycle, and a low volume, low pressure spray of dilute acid is delivered from spray nozzle 52.

Variable restriction 45 controls concentration of the acid-water mixture during the aspiration cycle. Meter 43 measures the flow of acid into the system, and can be calibrated to represent the percentage of acid in the acid-water mixture. Check valve 44 prevents the feedback of water to acid bath 41 during the rinse cycle.

Transfer from the aspiration cycle back to the rinse cycle is effected by equalizing pressure across resilient disc 18. In the preferred embodiment this is done by closing shutoff valve 54, which allows pressure downstream of disc 18 to increase until equal with the upstream pressure. At that point, spring 22 returns disc 18 to its normal position, and the rinse cycle beings again with reopening of shutoff valve 54. Alternatively, pump 31 can be shut off by means of a switch 37, which also permits pressure to equalize across disc 18. Restarting pump 31 after equalization initiates the rinse cycle.

An alternative aspirator-transfer valve 11*a* is shown in FIG. 3. The parts of valve 11*a* which are similar to or identical with like parts in valve 11 are numbered the same with prime letter *a* added. Rather than a resilient transfer disc which seats on the mouth of a nozzle, however, valve 11*a* comprises a piston-cylinder arrangement to perform the pressure responsive transfer function. A piston 18*a* having a sealing O-ring 20 is slidably disposed in chamber 16*a*. Piston 18*a* has an upwardly projecting cylindrical portion 30 which extends into inlet 13*a* for guiding purposes. An opening 19*a* is formed in the center of piston 18*a*.

A fixed nozzle 21*a* is spaced below piston 18*a*, and includes a restricted opening 23*a* aligned with opening 19*a*. A spring 22*a* offers an upper biasing force to piston 18*a*.

Operation of valve 11*a* is essentially the same as that of valve 11. Under normal operating conditions, piston 18*a* is held in its upward position by virtue of the biasing force of spring 22*a*. However, a decreasing of liquid pressure downstream of opening 19*a* gives rise to a pressure differential across piston 18*a*, thereby moving it downwardly to sealably engage the mouth of nozzle 21*a*.

FIG. 4 discloses an alternative embodiment to the pumping portion of the system. Again, pump 31 is driven by a motor 32 which is controlled by a switch 37. Additionally, however, a pressure responsive switch 38 communicating with conduit 33 is connected in series with motor 32. Thus, when shutoff valve 54 is closed, pressure in the entire system builds up until the switch 38 is actuated to stop motor 32 and pump 31. After pressure has equalized in the system so that the transfer disc 18 or piston 18*a* has returned to its normal position, shutoff valve 54 can be opened to reinitiate the rinse cycle. Pump 31 starts up automatically as soon as pressure in the system drops below the switching limit of switch 38.

What is claimed is:

1. An aspirator-transfer valve, comprising:

a. a valve body having first and second fluid inlets and a fluid outlet;

b. first and second separate fluid passages connecting the first inlet and the outlet;

c. valve means responsive to fluid flow in the first inlet for establishing fluid communication between the first inlet and the first passage in response to a first flow condition, and for establishing fluid communication between the first inlet and the second passage in response to a second flow condition;

d. the first passage including check valve means disposed downstream of the flow responsive valve means;

e. the second passage including fluid restriction means downstream of the flow responsive valve means and aspirating throat means downstream of the fluid restriction means;

f. and a third passage connecting the second inlet with the second fluid passage at a point between the fluid restriction means and the aspirating throat means.

2. The aspirator-transfer valve as defined by claim 1, wherein the third passage is connected with the first passage upstream of the check valve means.

3. The aspirator-transfer valve as defined by claim 1, wherein the flow responsive valve means comprises:

a movable closure member disposed in fluid communication with the first inlet and movable in response to the fluid flow therethrough, the closure member having an aperture formed therein through which fluid from the first inlet passes, the aperture being of lesser fluid resistance than the second passage fluid resistance means;

a stationary seating member disposed to be sealably engaged by the closure member in valving relation, the seating member constructed and arranged to establish flow from said aperture to the first passage when not engaged by the closure member, and to establish flow from said aperture to the second passage when engaged by the closure member;

and means for normally biasing the closure member away from the seating member.

4. The aspirator-transfer valve as defined by claim 3, wherein the movable closure member comprises a resilient flexure member peripherally supported by the valve body.

5. The aspirator-transfer valve as defined by claim 4, wherein the movable closure member comprises a piston slidably and sealably received in a cylindrical chamber in the valve body.

6. The aspirator-transfer valve as defined by claim 1, wherein the flow responsive valve means establishes fluid communication between the first inlet and the first and second passages in response to the first pressure condition.

7. The aspirator-transfer valve as defined by claim 3, wherein:

a chamber is formed in the valve body;

and the stationary seating member comprises a nozzle disposed in the chamber and having a mouth opening toward the closure member, the lip of the nozzle mouth being engageable by the closure member;

the nozzle mouth forming a portion of the second passage;

and a portion of the first passage being defined by the space between the chamber wall and the nozzle.

8. The aspirator-transfer valve as defined by claim 7, wherein the second passage fluid restriction means is formed in the nozzle mouth and disposed in alignment with the closure member aperture.

9. The aspirator-transfer valve as defined by claim 8, wherein the aspirating filter means comprises a fixed member with an aspirating throat passage formed therein, the fixed member being disposed in the valve body chamber with the aspirating throat passage in alignment with the second passage fluid restriction means, and a portion of the first passage is defined by the space between the chamber wall and the fixed member.

10. The aspirator-transfer valve as defined by claim 9, wherein the check valve means comprises a resilient collar encircling the fixed member and arranged for sealable engagement with the chamber wall in valving relation therewith.

11. A fluid pressure washing system comprising:

a. first conduit means adapted for connection to a first source of fluid, the first conduit means including pumping means;

b. second conduit means adapted for connection to a second source of fluid;

c. third conduit means terminating in a spray nozzle;

d. aspirator-transfer valve means having a first inlet connected to the first conduit means, a second inlet connected to the second conduit means and an outlet connected to the third conduit means, the valve means being responsive to flow in the system to establish fluid communication between the first and third conduit means for a first flow condition and to aspirate fluid from the second conduit means to the third conduit means for a second flow condition;

e. first means for controlling flow in the system to effect said first flow condition;

f. and second means for controlling flow in the system to effect said second flow condition.

12. The pressure washing system as defined by claim 11, wherein the first conduit means further comprises unloader valve means disposed downstream of the pumping means and connected to the inlet side of the pumping means through a bypass conduit, the unloader means constructed and arranged to divert fluid to the pumping means inlet when pressure in the first conduit means downstream of the pumping means reaches a predetermined upper limit.

13. The pressure washing system as defined by claim 11, wherein the first conduit means further comprises fluid accumulator means disposed between the pumping means and the first inlet of the aspirator-transfer valve means.

14. The pressure washing system as defined by claim 11, wherein fluid restriction means are disposed in the second conduit means.

15. The pressure washing system as defined by claim 14, wherein the restriction means is adjustable.

16. The pressure washing system as defined by claim 11, wherein the second conduit means further comprises check valve means arranged to permit fluid flow toward the second inlet of the aspirator-transfer valve means.

17. The pressure washing system as defined by claim 11, wherein the second conduit means further comprises a flowmeter.

18. The pressure washing system as defined by claim 11, wherein the first flow control means comprises a blocking

valve disposed in the third conduit means.

19. The pressure washing system as defined by claim 11, wherein the second flow control means comprises dumping valve means operably connected to the third conduit means.

20. The pressure washing system as defined by claim 11, wherein:

the pumping means is driven by an electric motor adapted for connection to a source of electric power;

and further comprising pressure-electric switch means arranged to sense pressure in the first conduit means downstream of the pumping means and disconnect the electric motor from the source of electric power when pressure in in the first conduit means reaches a predetermined upper limit.

21. The pressure washing system as defined by claim 11, wherein the first flow control means comprises means for halting operation of the pumping means.

22. The pressure washing system as defined by claim 21, wherein:

the pumping means is driven by an electric motor adapted for connection to a source of electric power;

and the means for halting operation of the pumping means comprises a manually operated switch operatively connected to the electric motor.