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(54) **LIQUID DETERGENT DISPENSING SYSTEM FOR AUTOMATIC WASHER**

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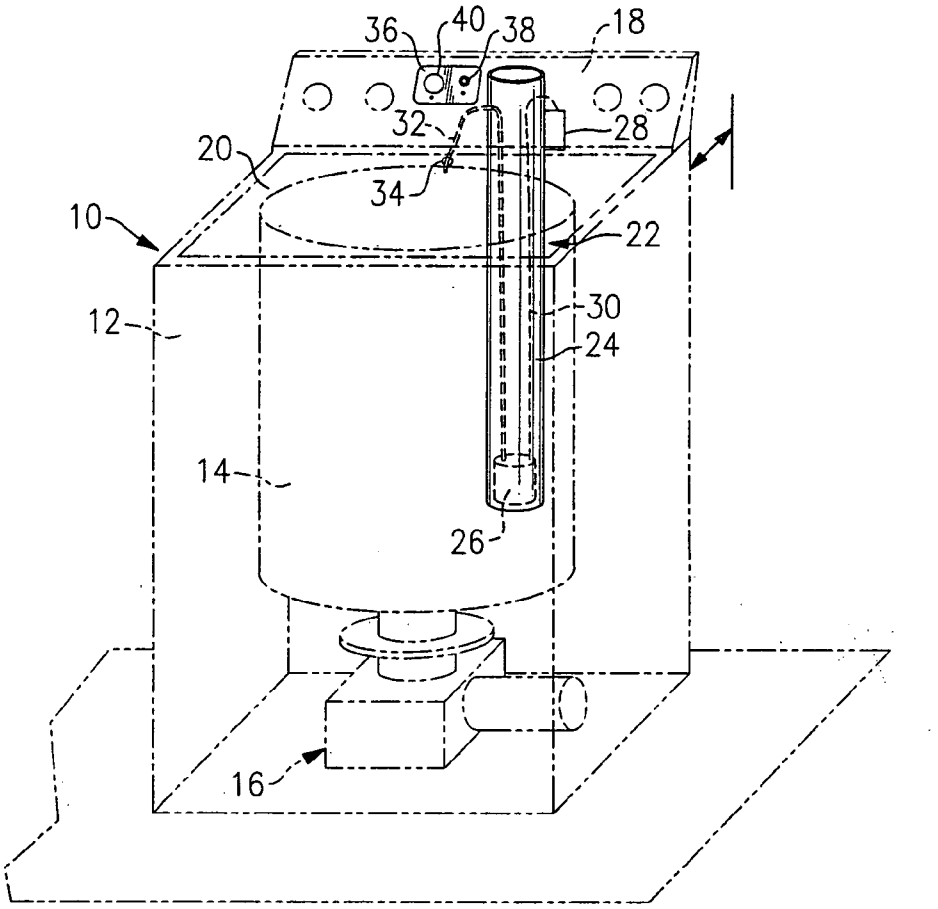
(57) **ABSTRACT**

A liquid laundry detergent dispenser for an automatic washing machine employs a reservoir that holds a quantity of the detergent sufficient for numerous wash cycles. An air/fluid chamber fills through a check valve from the base of the reservoir. To commence a dispense cycle, a timer circuit is actuated to run an air pump that supplies air under pressure through an air hose to the air/fluid chamber, and this displaces the detergent from the chamber and through a detergent dispense hose into the tub or drum of the washing machine. At the end of the dispense cycle, a bleed valve opens to relieve pressure on the air hose and the air/fluid chamber. The automatic detergent dispenser can be attached to existing washers or built in. A multiple arrangement can be used with a bank of washers at a commercial laundry.



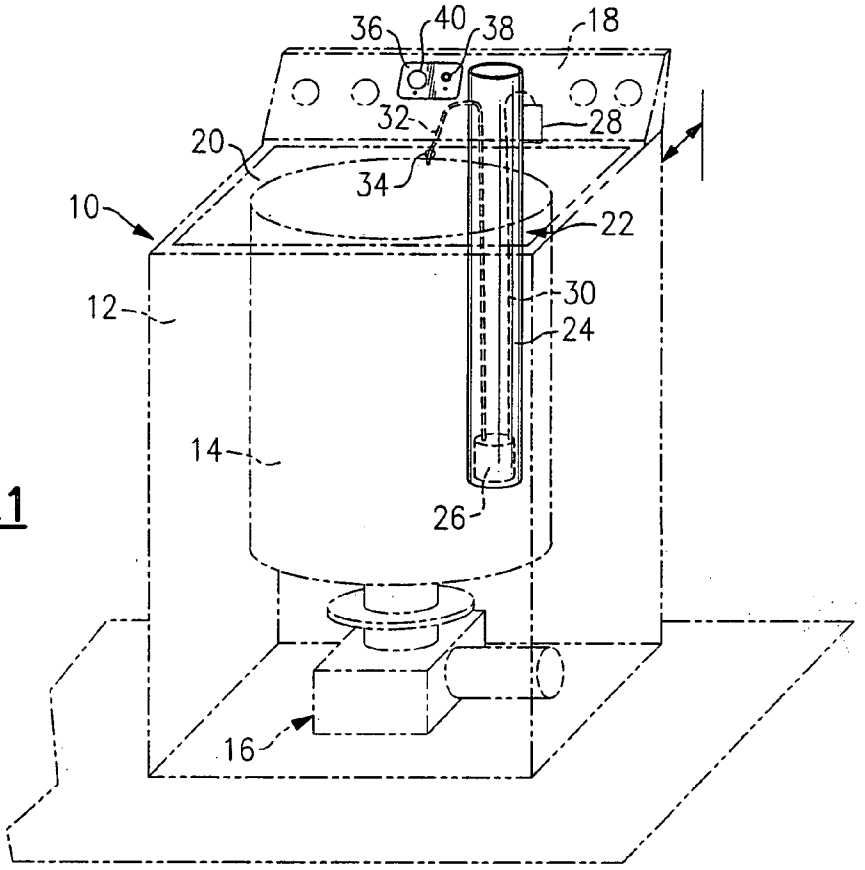

36
40
38
18
32
28
20
34
10
22
30
12
24
14
26
16

FIG.1

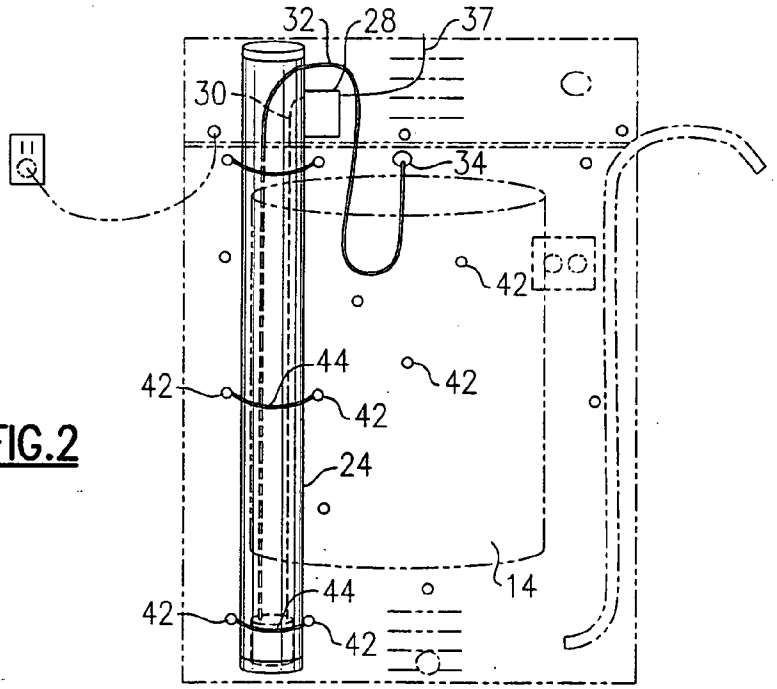

32
28
37
30
34
42
42
44
42
42
24
14
44
42
42

FIG.2

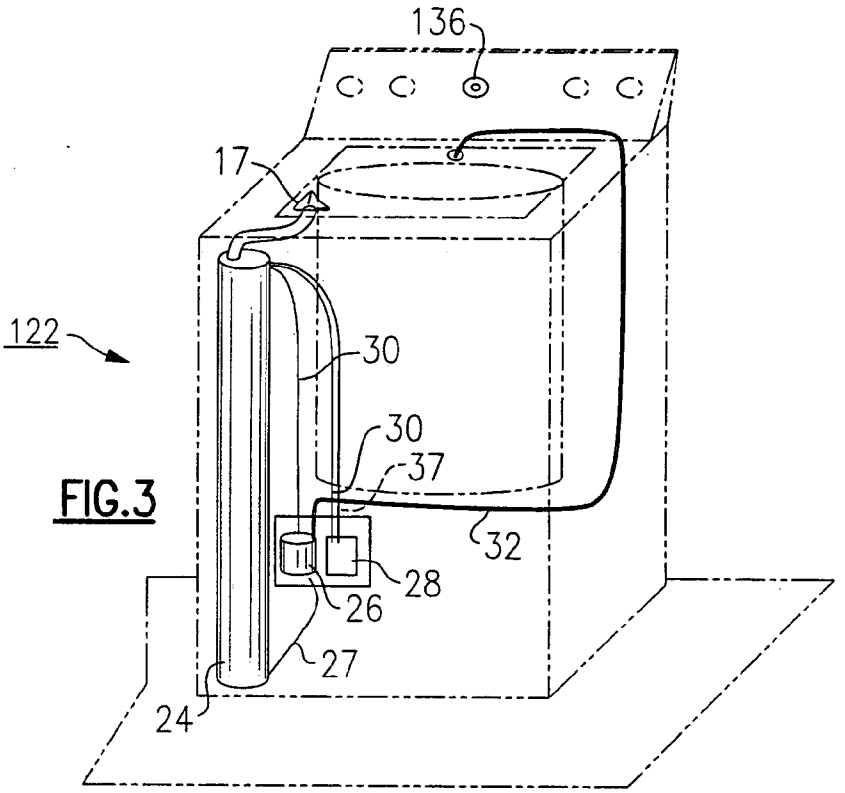


FIG.3

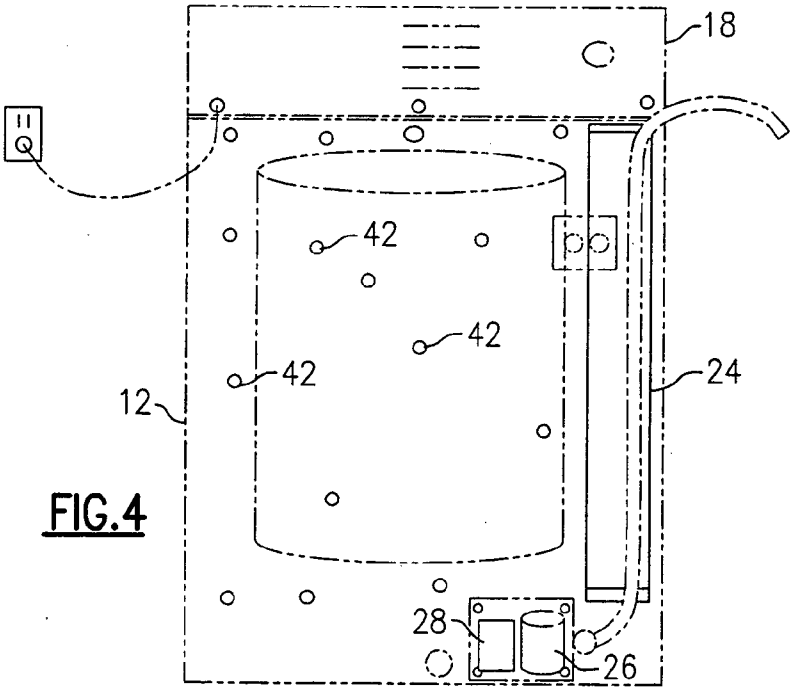


FIG.4

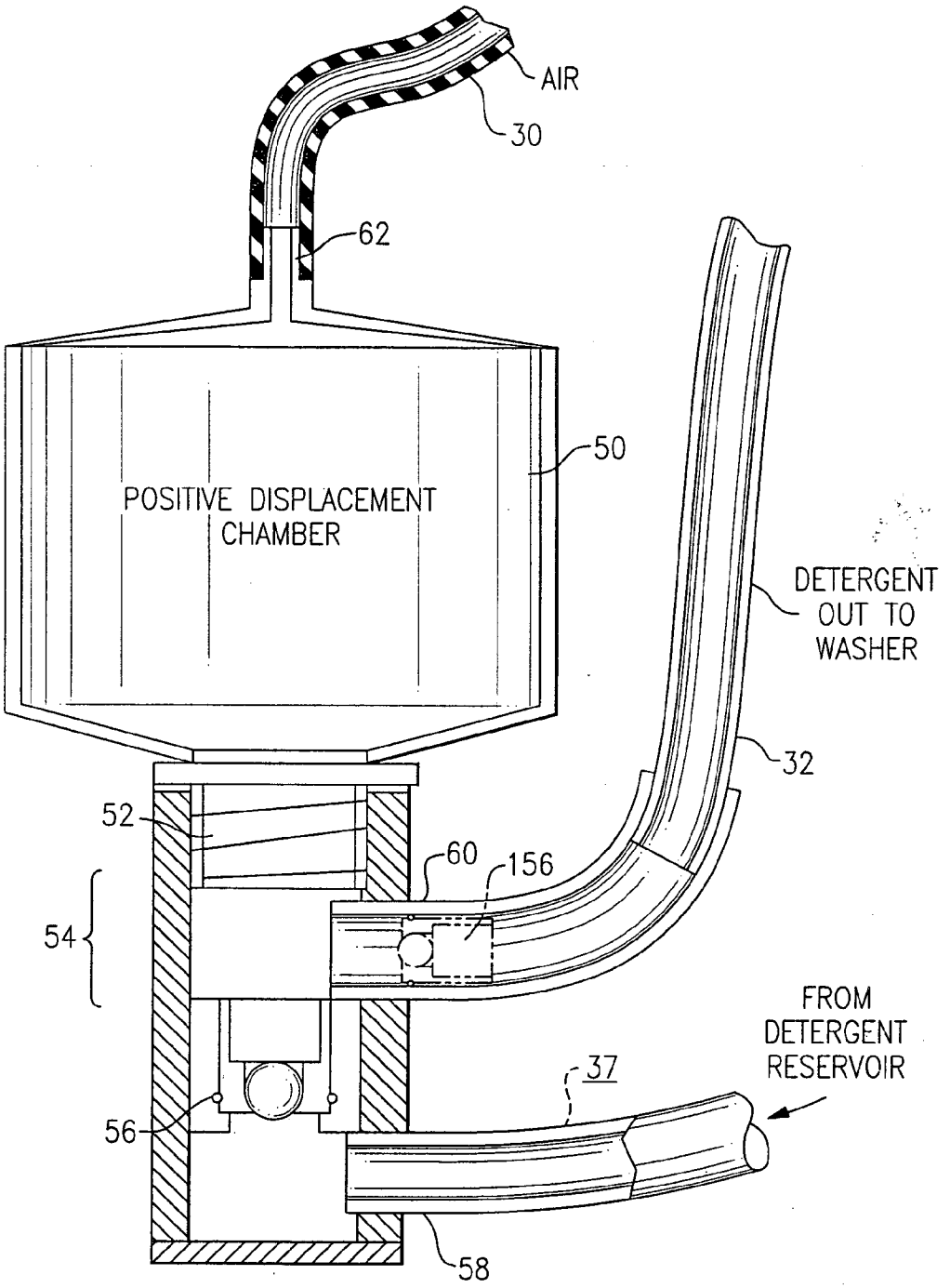

AIR
30
62
50
POSITIVE DISPLACEMENT CHAMBER
DETERGENT OUT TO WASHER
32
52
60
156
54
FROM DETERGENT RESERVOIR
37
56
58

FIG.5

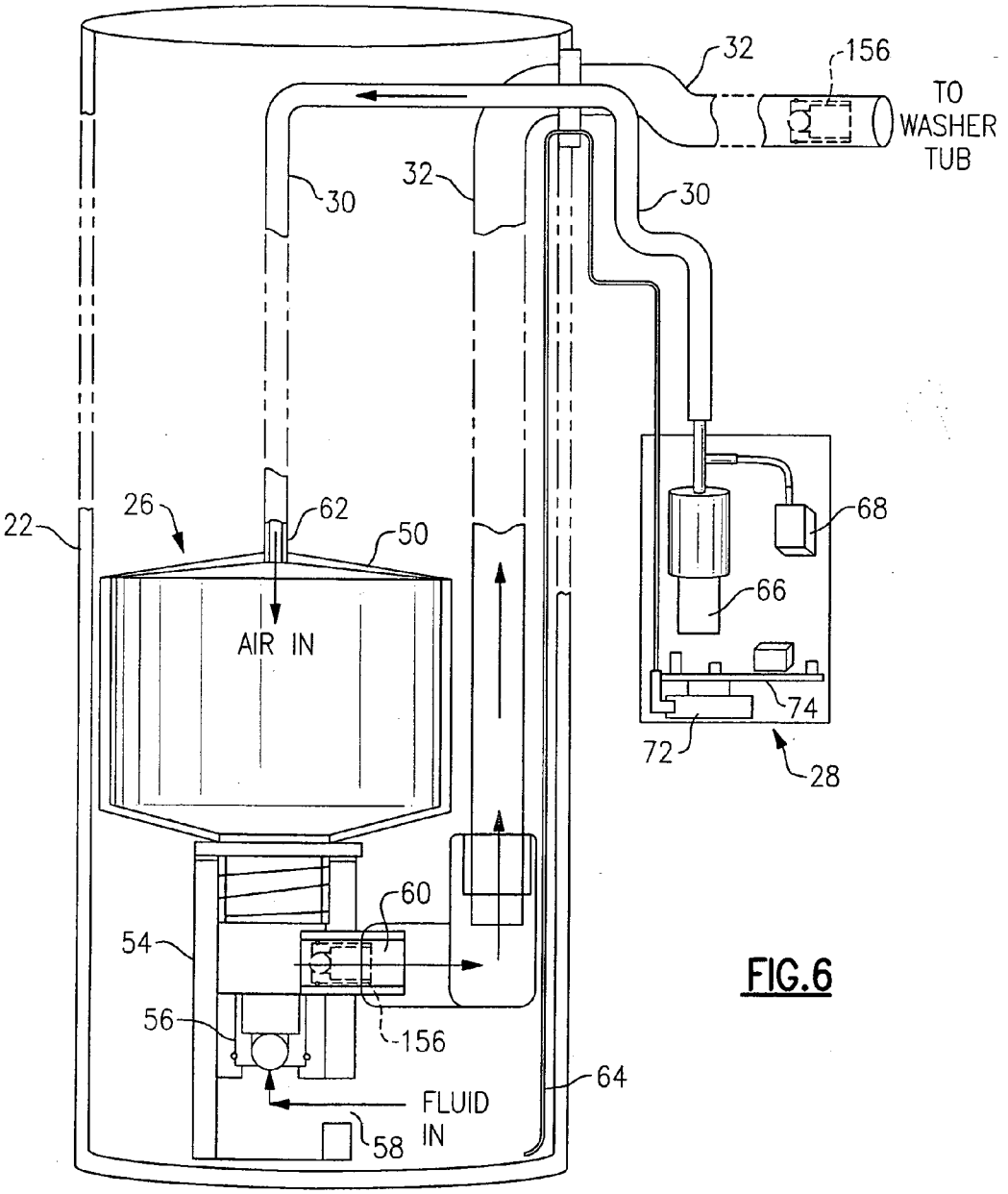

32
156
TO WASHER TUB
30
32
30
22
26
62
50
68
AIR IN
66
74
72
28
60
54
56
156
64
FLUID IN
58

FIG.6

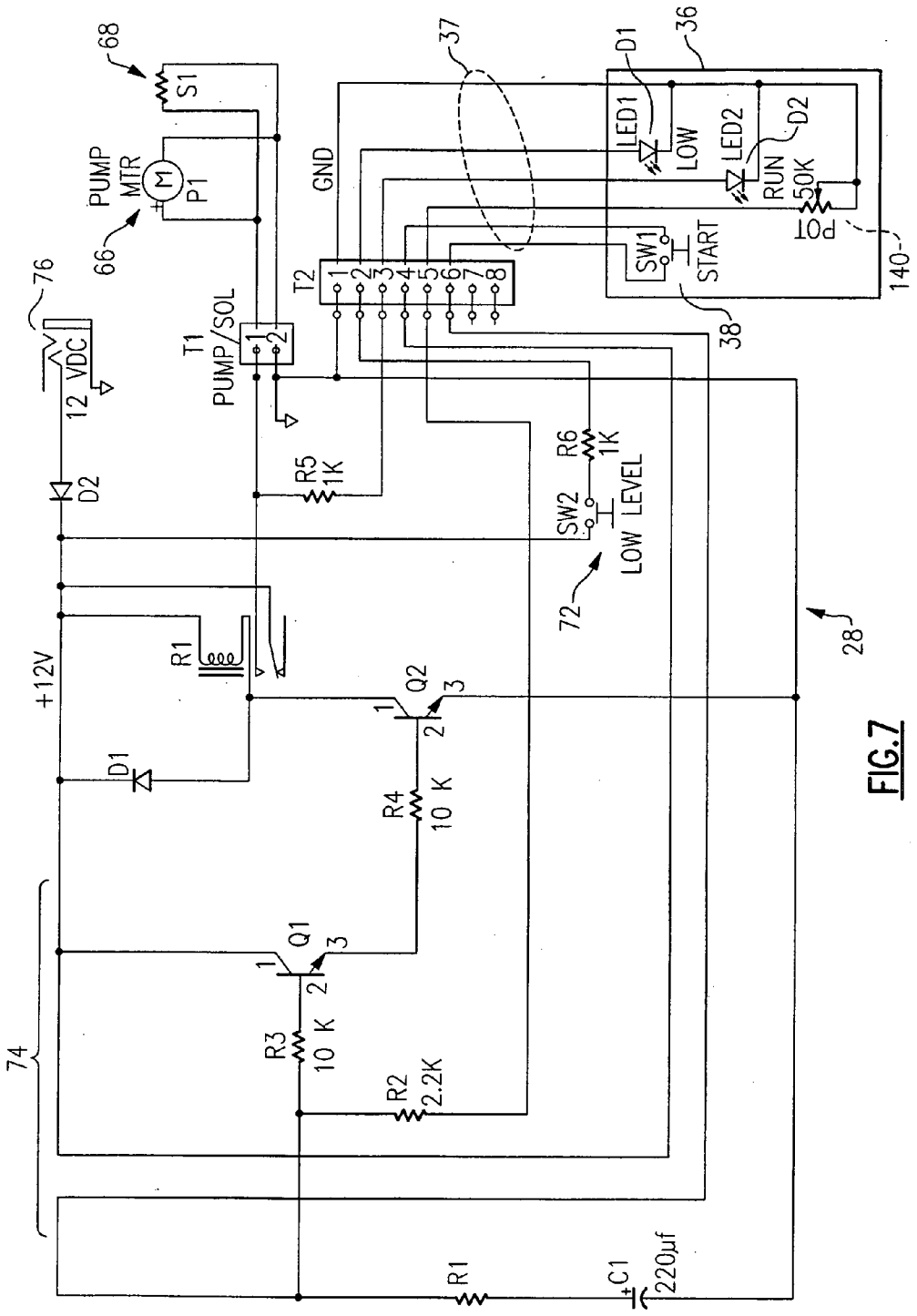

68
S1
PUMP MTR
P1
66
76
12 VDC
D2
T1
PUMP/SOL
GND
37
T2
1 2 3 4 5 6 7 8
D1
36
LED1
LOW
LED2
D2
RUN
50K
POT
140
SW1
START
38
R5 1K
R6 1K
SW2
LOW LEVEL
72
28
+12V
R1
Q2
D1
R4 10 K
Q1
R3 10 K
R2 2.2K
74
R1
C1
220µf

FIG.7

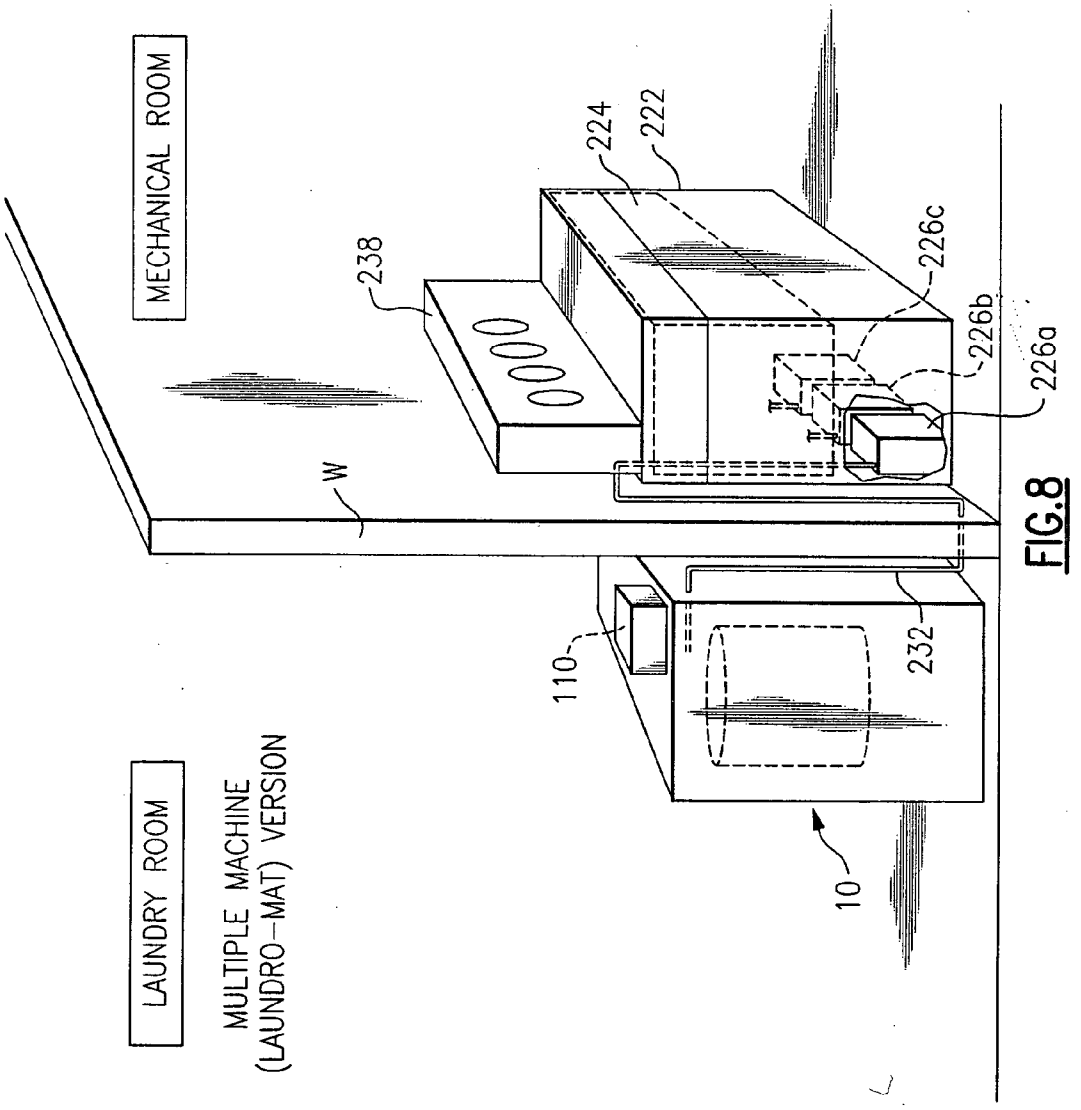
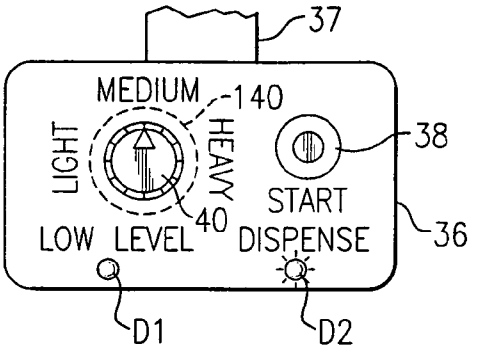

MECHANICAL ROOM
LAUNDRY ROOM
MULTIPLE MACHINE
(LAUNDRO-MAT) VERSION
W
238
224
222
226c
226b
226a
110
232
10

FIG.8

FIG.9


37
MEDIUM
140
LIGHT
HEAVY
38
40
START
DISPENSE
LOW LEVEL
36
D1
D2

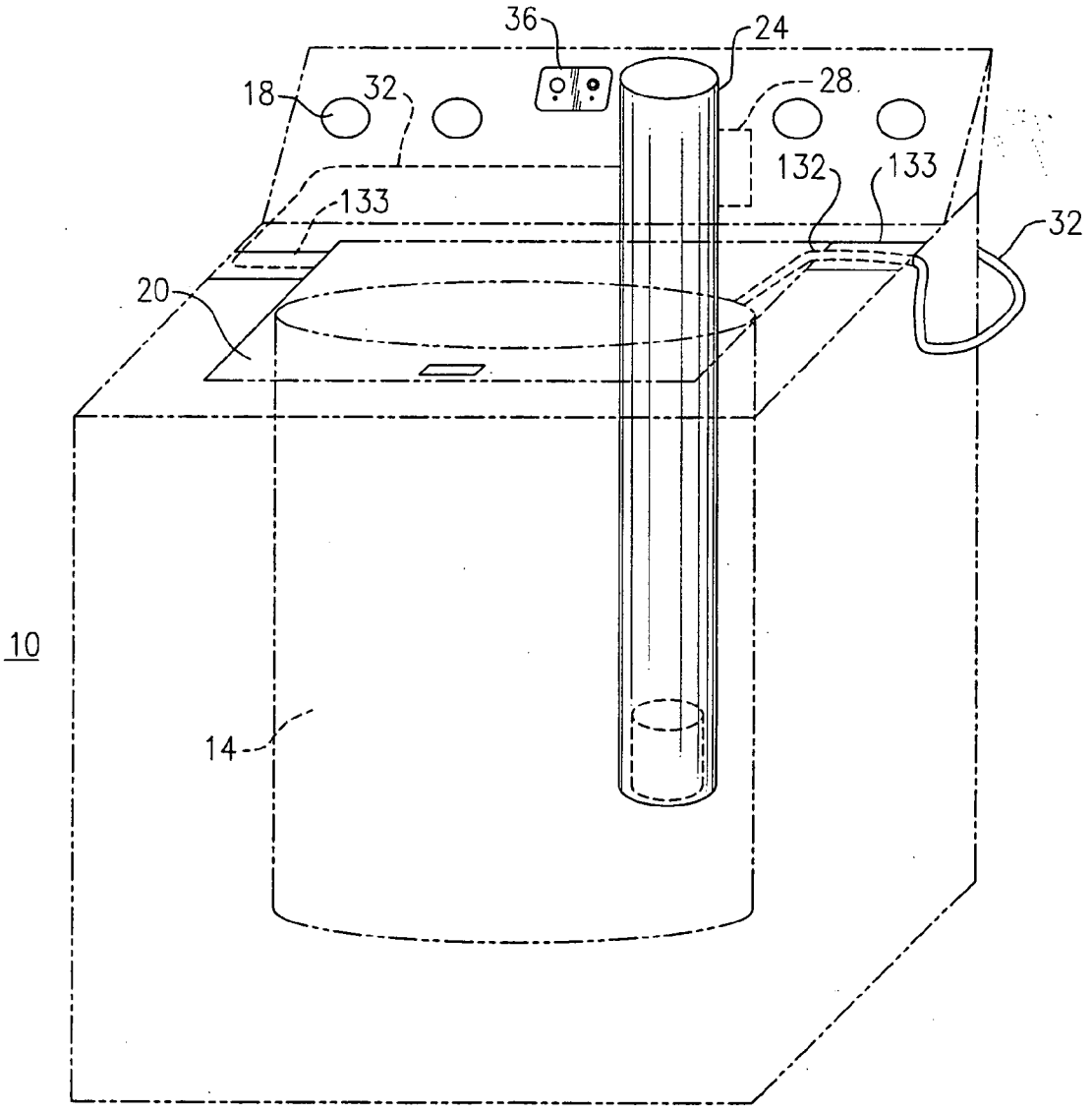

36
24
18
32
28
132
133
133
32
20
10
14

FIG.10

LIQUID DETERGENT DISPENSING SYSTEM FOR AUTOMATIC WASHER

[0001] Applicant claims priority of Provisional Application 60/633,321, Dec. 6, 2004. The disclosure of such provisional application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] This invention is directed to the automatic washing machines, e.g., for clothes washing and laundry, although the principles could be applied to dishwashers and other automated washing or cleansing systems. The invention is more particularly concerned with systems and devices for automatically injecting a measured amount of detergent and moving it from a storage tank or container into the washing machine.

[0003] Automatic washing machines have been used commercially and in homes for many decades. In each case, the user has to measure and dispense a quantity of detergent into the machine at the commencement of a wash cycle. There is always human error in administering the detergent to the machine, and often too much detergent is dispensed. Further, it is inconvenient for the user to have to measure and pour in the detergent. Additionally, there is a need to keep bottles of laundry detergent on hand, and these have to be stored somewhere.

[0004] Detergent manufacturers have devised many improved methods of pouring and measuring detergent from the respective container. Also, washing machine manufacturers have introduced built-in dispensers into some washing machines. However, these only hold enough detergent for a single wash cycle.

[0005] When using liquid detergent for a wash cycle, it is important to look carefully at the detergent manufacturer's instruction and marking(s). Different amounts are recommended for different size washer loads. Typically, the cap of the detergent container is marked for full and partial loads, but many people find it difficult to fill the cap up to a partial level. More typically, in the case of a medium or light load, the person will simply fill the cap to the "full load" level, even when that is not necessary, e.g., for a medium or light load, resulting in wasted detergent, and creating an environmental burden by injecting unnecessary amounts of the detergent into the fluid waste stream. Also, for most persons, guesswork is involved in the measuring of the detergent. It is desired to create an automated system which avoids any need for human measuring of the amount of detergent, and avoids need for handling or transfer of detergent. It is also desired for a system to match the amount of detergent used to the size of the load of laundry (or other items to be washed).

OBJECTS AND SUMMARY OF THE INVENTION

[0006] Accordingly, it is an object of this invention to provide a simple and cost effective system for automatically dispensing liquid laundry detergent directly into a washing machine, that avoids the drawbacks of the prior art.

[0007] It is another object to provide a system which dispenses detergent from a bulk tank or container into the drum or tub, i.e., the wash chamber of the washing machine, without need for the user to pour detergent into a measuring device.

[0008] It is a further object to provide a system that permits the amount of detergent injected to be adjustable so that the amount of detergent will match the size of the load.

[0009] The general purpose and principle behind the invention, as will be described below in greater detail, involves storing the liquid detergent in large quantities in a tank or reservoir, which can be attached onto the washing machine or built-in and located inside the cabinet. A low pressure air pump system or a source of low pressure compressed air (e.g., 5 to 10 psi) is employed to transport the liquid detergent from the reservoir into the washer.

[0010] According to one aspect of this invention, an automatic liquid detergent dispensing arrangement dispenses a controlled amount of detergent, during a dispense cycle, into an automatic washing machine. A reservoir or tank, which can either be mounted on the back side of the machine or situated in an available space inside the cabinet, stores a quantity of liquid detergent sufficient for a multiplicity of wash cycles of the automatic washing machine. A positive displacement air/fluid chamber either is situated within the reservoir at the bottom, or else is connected to the lower part of the reservoir. This air/fluid chamber has capacity to hold an amount of detergent sufficient for at least one detergent dispense cycle. A one-way check valve admits detergent by gravity flow from the reservoir tank into the captive air/fluid chamber. A detergent discharge or dispense hose extends from the captive air/fluid chamber to a discharge point for dispensing the liquid detergent from the air/fluid chamber into the washing machine. This can be just above the drum or tub of the washing machine. An air pump is energized for pressurizing the captive air/fluid chamber with sufficient air pressure (e.g., 5 to 10 psi) so as to drive the liquid detergent from the captive air-fluid chamber through said discharge hose. A control circuit is coupled to the air pump for selectively energizing the air pump means, e.g., for a period of time after a switch is pushed to initiate the detergent dispense cycle or discharge cycle. A knob or other selector is provided so the user can select the volume of detergent to be discharged during this cycle. Preferably, the control circuitry employs a variable timer circuit with a manual adjustment for selecting a length of operation of the air pump during the detergent dispense cycle. This can be an RC discharge timer circuit including a variable resistor serving as manual adjustment. The air pump can operate at low voltage DC, e.g., 6 to 12 volts, and is capable of delivering about 2 liters/minute of air at 5 to 10 psi. The air pump can be powered from a battery source or from a small 12-volt transformer-rectifier, which can plug into a standard wall outlet.

[0011] Preferably, a small, flexible air hose extends from the air pump to the air/fluid chamber, and a solenoid bleed valve is present on the air hose for bleeding or venting pressure when the dispense cycle ends. The solenoid valve is normally open to vent the air hose when the air pump is not being energized, but closes to shut off venting when the air pump means is pumping, so that the pressure is directed to the captive air/fluid chamber.

[0012] The one way valve can be a check valve, e.g., ball type or flap type, disposed at a lower end of the captive air/fluid chamber. A first port receives fluid detergent from the tank or reservoir, a second port connects to the discharge hose, and a third port connects with the air/fluid chamber for

filling said chamber after a detergent dispense cycle and for transmitting the detergent from the captive air/fluid chamber, during the dispense cycle, through the discharge hose and into the washing machine drum or tub. In the case of a dishwasher, for example, the wash chamber would not be in the form of a drum or tub, but the detergent dispenser would operate on the same principle.

[0013] In an after-market or add-on version, the reservoir tank can be mounted onto a back panel of the cabinet of the washing machine, and the detergent discharge hose passes through a port on a back panel of the cabinet. A rubber grommet may be used to hold the hose in this opening. An end portion of the hose extends over the drum or tub. In an alternative after-market version, the reservoir tank is mounted onto a back side of the washing machine, as before, but the detergent discharge hose passes outside a cabinet and over the back or one side of washing machine. There is a flat flexible hose portion that extends under the lid of said washing machine, and allows the detergent to be discharged into the drum or tub.

[0014] For a front-loading washer, the detergent dispensing hose can be inserted into the detergent receptacle of the unit, rather than injecting the liquid detergent directly into the tub or drum.

[0015] In a preferred embodiment, the reservoir tank can take the form of a tall vertical cylinder e.g., a tube, which can have a nominal diameter of about four inches. This provides sufficient capacity to hold at least two gallons of liquid detergent. In this case, the one way valve can take the form of a ball-type check valve disposed at the bottom of the captive air/fluid chamber. The check valve has a first port to receive fluid detergent from the tank or reservoir, a second port onto which the detergent discharge hose is attached, and a third port that connects with the air/fluid chamber for filling the chamber, e.g., by gravity feed, after a detergent discharge cycle. The check valve transmits the detergent from the air/fluid chamber to the detergent discharge or dispense hose during the dispense cycle.

[0016] In a built-in version, the cylindrical reservoir tank can be situated within washing machine cabinet in an available space, e.g., at a corner. In an after-market or add-on version, the cylindrical reservoir tank can be strapped onto the back panel of the washing machine, using bungee cords and/or cable ties, for example. There are normally holes or openings in the back panel which are normally used only during shipping of the washing machine, and these can be used to accept the strapping. There is typically an existing hole on the back panel which can be used for inserting the detergent hose, but if not it is a simple matter to drill or bore a hole of about ¼ inch diameter for that purpose. The captive air/fluid chamber may be situated within the cylindrical tank at the bottom. Alternatively, e.g., in a built-in version, the tank may be connected by a tube or hose to the check valve of the captive air/fluid chamber which may be positioned at a convenient space within the machine.

[0017] Rather than a tubular cylindrical tank, the reservoir could be oblong or cuboid in shape.

[0018] A commercial laundry version of the automatic liquid detergent dispensing arrangement allows the detergent to be dispensed automatically to any of a number of automatic washing machines. The principle is the same as discussed previously for dispensing a controlled amount of detergent during a dispense cycle, with the detergent going into a selected one of the washing machines. Here, a large reservoir tank stores a quantity of liquid detergent sufficient for a multiplicity of wash cycles for an entire bank of automatic washing machines. For each of the washing machines, there is an associated captive air/fluid chamber, which operate on the same principle as the ones discussed before. Each of these chambers is adapted for holding an amount of detergent sufficient for at least one detergent dispense cycle, and each has an associated one-way valve that admits detergent from the reservoir tank, e.g., by gravity flow. For each washing machine there is an associated detergent discharge hose, each extending from a respective one of said captive air/fluid chambers to the washing machine for discharging a charge of liquid detergent from the captive air/fluid chamber into the washing machine. There is also an air pump or pumps for selectively pressurizing one or another of the captive air/fluid chambers to drive the liquid detergent in the respective captive air-fluid chambers through the associated discharge hose. A control circuit, which can have a panel or mechanism on each of the washing machines, is coupled to air pump or pumps to control the energizing the air pump(s). This can include a provision for initiating a detergent discharge cycle, and a timer to limit the amount of air provided by the pump to the particular chamber. The period of the timer can be adjusted (manually or automatically) so that the proper amount of detergent is dispensed for the load of laundry to be washed.

[0019] The above and many other objects, features, and advantages of this invention will present themselves to persons skilled in this art from the ensuing description of preferred embodiments of this invention, as described with reference to the accompanying Drawing.

BRIEF DESCRIPTION OF THE DRAWING

[0020] **FIG. 1** is a front perspective view of a top loading clothes washing machine on which is mounted a liquid detergent dispensing device according to an embodiment of this invention.

[0021] **FIG. 2** is a rear view of the washing machine with the detergent dispensing device of this embodiment.

[0022] **FIG. 3** is a front perspective view of a washing machine showing a second embodiment of this invention.

[0023] **FIG. 4** is a rear view of the washing machine showing this second embodiment.

[0024] **FIG. 5** is a schematic elevation of a positive displacement chamber and one-way fluid valve assembly which can be employed as components of the embodiments of the invention.

[0025] **FIG. 6** is a schematic view showing a reservoir, positive displacement chamber assembly, and associated tubes and hosing, air pump, solenoid bleed valve, and control components, according to an embodiment of the invention.

[0026] **FIG. 7** is a circuit schematic diagram of timer and associated components of an embodiment of this invention.

[0027] **FIG. 8** is a schematic view illustrating an embodiment of the invention configured for multiple-washing machine use.

[0028] **FIG. 9** is a front view of the control module employed in this invention.

[0029] **FIG. 10** is a perspective view of an alternative embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0030] With reference to the Drawing, **FIG. 1** shows an embodiment of the present invention in conjunction with a top-loading clothes washing machine **10**. It should be understood that this is an example of one practical application, and that the liquid detergent dispensing arrangement of this invention could be employed with other automatic washing devices, e.g., a front-loading clothes washer, a dish washer, etc. **FIG. 2** shows the same arrangement from the rear of the washer **10**.

[0031] Here, the washing machine **10** has a cabinet or housing **12**, in which there is a tub or drum in which the clothes undergo wash, rinse, and spin cycles. A mechanism **16** for rotating and oscillating the drum **14** and any associated clothes agitator (not shown) is represented schematically. A console or control panel **18** is situated at the back of the top deck of the cabinet, behind a lid or cover **20**. The lid **20** is hinged or pivoted at the back so it can be lifted for access the drum **14**.

[0032] In this embodiment, which concerns an after-market arrangement, the add-on dispenser mechanism or automated liquid detergent injection system **22** is mounted externally on the back of the cabinet or housing **12**. There is a reservoir or tank **24** in the form of a cylinder of four inches diameter and nominally forty-two inches high. The tank **24** has a capacity of two gallons or more, and holds enough detergent to last for a few dozen wash cycles. Detergent may be added by pouring it into the top of the cylindrical reservoir or tank, and a cover or closure may be provided to fit the top end of the reservoir or tank.

[0033] A positive displacement chamber and check valve arrangement **26** is situated within the reservoir **24** and at the base or lower end thereof. The positive displacement chamber arrangement **26** fills with detergent by gravity feed through a check valve, which is discussed in detail later. In this embodiment, the positive displacement chamber arrangement **26** is situated within the cylindrical tank or reservoir, but in other embodiments, the arrangement **26** can be located elsewhere, with a tube or conduit supplying the detergent from the reservoir **24**.

[0034] A pump module **28** is mounted on the back of the washer cabinet **12**, and includes a low voltage air pump that supplies air through a small-diameter air hose **30** to the positive displacement chamber arrangement **26** to push the detergent from there, through a detergent dispense hose **32** or detergent discharge hose. In this embodiment, the hose **32** fits through a pre-existing opening **34** in the back of the washing machine, and extends to a point over the tub or drum **14**. The pump module **28** is also coupled through a multiple conductor electrical wiring harness or cable **37** to a control module **36** that is mounted on a convenient location on the front of the console panel **18**.

[0035] As shown in more detail in **FIG. 9**, the control module has a start button **38** which is pushed to commence a detergent dispense cycle, and an volume adjustment knob **40** which is rotated by the user to adjust the amount of detergent dispensed during a cycle, here marked with "light", "medium", or "heavy" corresponding to the size of the laundry load to be washed. The knob **40** adjusts a variable resistor **140** (shown in ghost) within the module **36**.

[0036] As shown in more detail in **FIG. 2**, the reservoir or tank **24** is affixed onto the back panel of the washing machine **10**, using some of the numerous holes or apertures that are present. These holes **42** are typically used for attaching protective pads during shipping of the washing machine, but are not used once the machine is installed. One of these is the hole **34** that is situated just above the level of the top of the drum **14**, and this one is selected for insertion of the hose **32**. For securing the cylindrical tank **24**, straps **44** pass around the tank and through selected ones of these openings **42**, **42**. The straps **44** can take the form of wires, bungee cords, cable ties, or other sufficiently strong strapping material. Also shown on the back of the washer are its water drain tube and an electrical cord, which are not numbered. Typically, a clearance of four inches or more between the washing machine **10** and the wall is needed for the hot and cold water hoses, electrical cord, and drain hose, and this same clearance is sufficient for the cylindrical tank **24** plus other parts of the detergent dispensing arrangement **22**.

[0037] Another embodiment of the invention is illustrated in **FIGS. 3 and 4**, in which the elements of a detergent dispensing arrangement **122** are built into the cabinet of the washing machine. Here, the elements that are the same as used in the first embodiment are identified with the same reference numbers. The tank or reservoir **24**, which here is in the form of a cylinder of about four inches in diameter and forty-two inches in height, is installed within the cabinet **12** at one corner. A detergent fill port **17** is connected with the tank **24**, and detergent is poured in here rather than pouring the liquid detergent into the tank or reservoir directly. Also in this embodiment the positive displacement chamber arrangement **26** is situated within the cabinet **12** but outside the reservoir, and is connected by means of a fill tube **27** to the base or bottom of the reservoir **24**. The pump module **28** is also located near the positive displacement chamber arrangement. The air hose **30** extends within the cabinet **12** from the module **28** to the top of the positive displacement chamber arrangement **26**, and the detergent dispensing hose **32** extends from the latter, within the cabinet **12** to a dispensing point located above the drum or tub **14**. Both these hoses loop upwards above the level of maximum fill of the reservoir **24**, so as to avoid unwanted siphoning of the liquid detergent between dispense cycles. The wiring harness or cable **37** is also shown extending from the pump module **28**, in this case to a control module located within the console panel **18**. Here a single control knob **136** is shown which combines the functions of the switch **38** and knob **40**. The knob **136** can be turned to adjust the amount of detergent dispensed, and can be depressed to start the dispense cycle.

[0038] **FIG. 5** shows details of the positive displacement chamber arrangement **26**, which includes a holding chamber and a fluid valve assembly **26**. In this preferred embodiment, there is a detergent holding chamber **50**, which has an inside diameter of about two and one-half inches and a height of about three inches, giving the chamber **50** a capacity sufficient for holding about eight fluid ounces. At a lower end of

the chamber **50** is a threaded neck **52** to which a flow control valve assembly **54** is attached by means of mating female threads. At the mid level of the assembly **54** is a check valve **56** arranged for admitting flow of the liquid detergent in the upward direction. Below the check valve is an inlet port **58** to admit the liquid detergent by gravity flow from the tank or reservoir **24**. Above the check valve **56** is an outlet port **60** that connects to the detergent dispensing hose **32**. The air hose **30** connects to an air hose fitting **62** at the top of the chamber **50**. Another optional check valve **156** can be located in the hose **32** to block reverse flow and keep the hose **32** primed for the next use. This additional check valve **156** can be installed in the discharge hose **32** at the catptive fluid/air chamber **26** or more preferably at the distal end of the hose. This keeps the hose full and keeps the detergent in the hose from draining into the washer after the end of a detergent dispense cycle.

[**0039**] The assembly of **FIG. 5** operates generally as follows. Normally, i.e., between dispense cycles, there is a neutral pressure in the air hose **30**, so the chamber **50** vents to the atmosphere, and the liquid detergent can flow past the check valve **56** into the chamber **50** until the chamber is full. At the appropriate time during a wash cycle, the pump module **28** applies air under pressure via the hose **30** into the chamber **50**, and this closes the check valve and displaces the detergent within the chamber. The liquid detergent then proceeds up through the dispensing hose **32** and into the tub or drum **14** of the washing machine. After a period of time, the pump module **28** stops pumping air, and then the pressure in the air hose **30** is relieved. This causes flow of the detergent to cease up through the dispensing hose, and allows the chamber **50** to begin to refill, by gravity flow from the reservoir **24**. In this embodiment, the length of time that the pump module **28** is energized to supply air under pressure is adjusted for controlling the amount of detergent dispensed. However, other embodiments could control other parameters to adjust the amount of detergent dispensed.

[**0040**] In the preferred arrangement as shown in **FIG. 5**, the air hose **30** is favorably a quarter-inch diameter vinyl tubing, and the detergent dispense hose **32** is half-inch diameter vinyl tubing. The check valve **56** in this embodiment is a ball-type check valve, with tubular housing made of polypropylene, a ball guide formed of acetal, and the ball being made of a suitable thermoplastic. Other check valve constructions could also serve this function, e.g., a flap valve.

[**0041**] **FIG. 6** illustrates details of the embodiment of **FIGS. 1 and 2**, in which the positive displacement chamber assembly **26** is situated within the cylindrical reservoir or tank **24** and at the base of bottom thereof. Also shown here, the pump module **28** is shown in more detail. The module **28** includes a small, low-volume 6-volt to 12-volt DC powered air pump **66**, with a volume flow of about two liters per minute at a pressure of about 5 to 10 psi. The pump **66** can be energized by means of a variable timer for periods from about ten seconds to about thirty seconds to control the amount of detergent for small to full loads.

[**0042**] A solenoid bleed valve **68** is connected to the air hose **30**. The bleed valve **68** closes when the air pump **66** is energized so that the air under pressure is directed to the chamber **50**. The bleed valve **68** opens when the pump cycle ends to relieve pressure from the air hose **30** and from the chamber **50**, so that the chamber **50** is allowed to refill from the reservoir **24** through the check valve **56**.

[**0043**] A printed circuit board **70** carries the necessary control electronics, and a diaphragm pressure switch **72**, communicating via a pressure sensor tube **64** with the base of the reservoir **24**, turns on when a low pressure is detected, indicating the level of the detergent in the reservoir **24** is below a refill level.

[**0044**] **FIG. 7** illustrates schematically the general circuitry employed for controlling the dispensing of detergent according to the above-described embodiments. The pump module **28** is generally illustrated, and this schematic also shows the multi-conductor harness or cable **37** connecting the control module **36** to an eight-pin connector T**2** on the pump module. There is a power socket **76** for accepting a connector (not shown) from a suitable 12-volt power supply, and providing DC power to an RC variable timer circuit **74**. In the latter, a timing capacitor C**1**, nominally about 220 microfarads capacity, is disposed in series with potentiometer or variable resistance **140** (e.g., 50 kilohms), with the variable resistance **140** being situated in the control module **36** and having a stem that is rotated by the knob **40** (shown in **FIG. 9**). The timing capacitor C**1** charges up when the start switch **38** is depressed, and the high voltage on this capacitor turns on a timing transistor Q**1**, which in turn turns on a transistor Q**2**, which then draws current through the coil of a relay R**1**. This relay R**1** closes and supplies current to the motor of the air pump **66** and to the solenoid of the bleed valve **68**. The capacitor C**1** gradually discharges through the variable resistance **140**, and when its voltage falls below a threshold for the transistor Q**1**, the transistors Q**1** and Q**2** shut off, terminating current through the relay coil, and shutting off the pump **66** and bleed valve **68**. As also shown here, the pressure switch **72** is arranged to open upon detecting a low level, which turns off an indicator LED D**1** on the control module **36**. This LED D! Is ont to indicate sufficient detergent is present in the tank **24**, and goes off to indicate a refill is needed. Alternatively, the LED D**1** could be configured to be normally off and would come on to indicate a low level of detergent. The closed condition of the relay R**1** provides current to a run indicator LED D**2** on the module **36**, indicating that a detergent dispense cycle is taking place.

[**0045**] While the timing and control circuitry shown in this embodiment are made of traditional and inexpensive analog parts, such as capacitors, NPN transistors, relays, and resistors, the same functions could be carried out using available digital timing and control elements. In this embodiment, control of the amount of detergent dispensed is carried out by timing the actuation of the air pump **66**; however other possible embodiments could employ other means for metering the liquid detergent.

[**0046**] **FIG. 8** generally shows an alternative embodiment for use with multiple washing machines, e.g., in a commercial laundry or a coin laundromat. Here, an automated detergent dispensing system **222** has a large tank or reservoir **224** feeding a number of positive displacement chamber arrangements **226***a*, **226***b*, **226***c*, etc., each being connected via a respective detergent dispense hose **232** to an associated washing machine **10** of a bank of washing machines. A master console **236** on the system **222** provides for adjustment and control over timing and volume. Here, a wall W is

shown dividing the laundry space between a laundry room where the washing machines **10** are located and a mechanical room where the multiple-washing machine dispensing system **222** is positioned. In this embodiment, a coin-operated station **110** (or other cash or card vend station) is positioned atop the washing machine **10**. This enables the user or customer can purchase an amount of liquid detergent by inserting coins (or other form of payment). This enables the system **222** to dispense detergent at the appropriate time into the associated one of the washing machines **10**. A source of pressurized air, which may comprise one or more of the air pumps **66** described earlier, may be employed with associated control means for selectively pressurizing one or another of the chamber arrangements **226***a*, ww**6***b*, **226***c*, etc., and displacing the detergent from the positive displacement pressure chambers to supply the washing machines with the appropriate amount of detergent. Other sources of air pressure may be employed, with associated valving.

[**0047**] **FIG. 10** shows a variation of the embodiment of **FIGS. 1 and 2**, or the type in which the reservoir or tank **24** and pumping module **28** are mounted on the back of the washing machine **10** and the control module **36** is mounted on the console **18**, as discussed previously in connection with **FIGS. 1 and 2**. However, this embodiment provides for an alternative means of placement of the detergent dispensing hose **32**. Not all washing machines have a suitable hole, such as hole **34**, in the back panel for insertion of the dispensing hose **32**. In those that do not, it may be possible to bore a ⅞-inch hole in the back panel above the drum or tub, and then insert a rubber grommet to support the hose **32**. However, the owner or serviceman may not want to do that for one reason or another. Thus an alternative routing of the detergent dispensing hose can be achieved as shown here. The hose **32** is routed from where it emerges from the reservoir **24** to one side or the other of the washing machine **10**. The hose is shown here as passing around the right side. A flat, flexible hose portion **132** traverses an upper edge of the cabinet and then goes below the lid or cover **20**. This flat portion **132** is only a small fraction of the thickness of the tubular hose **32**, so it does not interfere with the closing of the lid. However, during a dispense cycle, the flat portion **132** will expand sufficiently to allow the detergent to flow. There is normally enough clearance between the lid **20** and the top opening of the cabinet **12** to allow the detergent to flow. However, it may be convenient for the user to press the start button **38** to commence the start cycle before closing the lid.

[**0048**] The flat, flexible hose portion **132** can be covered with a U-channel **133** of appliance white plastic to conceal the hose for a more aesthetic appearance. The U-channel **133** can be attached by a suitable cement or by a Velcro™ fastener.

[**0049**] An alternate routing to the left side of the hose **32**, with an associated U-channel **133**, is indicated in ghost lines.

[**0050**] While the foregoing embodiments have shown the system used with top-loading washing machines, it would not be difficult to adapt the system of this invention for automatic dispensing of detergent into front-loading washers. In that type of machine, there is typically a detergent receptacle, and the detergent dispensing hose **32** could be placed there. Alternatively, the hose **32** can be routed to an upper portion of the wash chamber of the machine.

[**0051**] Similar arrangements can be adapted for automatically dispensing other laundry products, such as fabric softener or bleach.

[**0052**] While the invention has been described and illustrated in respect to a few selected preferred embodiments, it should be appreciated that the invention is not limited only to those precise embodiments. Rather, many modifications and variations would present themselves to those of skill in the art without departing from the scope and spirit of this invention, as defined in the appended claims.

I claim:

1. An automatic liquid detergent dispensing arrangement for dispensing a controlled amount of detergent during a dispense cycle into an automatic washing machine, comprising

a reservoir tank for storing a quantity of liquid detergent sufficient for a multiplicity of wash cycles of the automatic washing machine;

an air/fluid chamber adapted for holding an amount of detergent sufficient for at least one detergent dispense cycle;

one-way valve means for admitting detergent from said reservoir tank into said air/fluid chamber;

a detergent discharge hose extending from the air/fluid chamber to a discharge means for discharging the liquid detergent from the air/fluid chamber into the washing machine;

air pump means for applying air under pressure to the air/fluid chamber so as to drive the liquid detergent in said air-fluid chamber through said discharge hose; and

control means coupled to said air pump means for selectively energizing the air pump means, including a switch for initiating a detergent discharge cycle.

2. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said control means also includes a selector for selecting the volume of detergent to be discharged during such cycle.

3. An automatic liquid detergent dispensing arrangement according to claim 2 wherein said control means includes a variable timer circuit having a manually adjustable arrangement for selecting a length of time of operation of said air pump means during said detergent discharge cycle.

4. An automatic liquid detergent dispensing arrangement according to claim 3 wherein said variable timer circuit includes an RC discharge circuit including a variable resistor serving as said manually adjustable arrangement.

5. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said air pump means includes a low volume air pump capable of delivering about 2 liters/minute of air at about 5 to 10 psi.

6. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said air/fluid chamber is disposed within said reservoir tank at a bottom thereof.

7. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said an air hose extends from said air pump means to said captive air/fluid chamber, and further comprising a solenoid valve on said air hose which is normally open to vent said air hose when said air pump means is not actuated, and which closes to shut off venting of said air hose when the air pump means is actuated.

8. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said reservoir tank includes a cylinder oriented vertically and having a capacity sufficient to hold at least one gallon of said liquid detergent.

9. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said one way valve means includes a check valve disposed at a lower end of said captive air/fluid chamber and having a first port to receive said fluid detergent from said tank reservoir, a second port onto which said discharge hose is attached, and a third port that connects with said air/fluid chamber for filling said chamber after a detergent discharge cycle and for transmitting said detergent from the air/fluid chamber to said discharge hose.

10. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said reservoir tank is situated within a cabinet of said washing machine.

11. An automatic liquid detergent dispensing arrangement according to claim 6 wherein said reservoir tank is mounted onto a back side of said washing machine, and said detergent discharge hose passes through a port on a back side of a cabinet of said washing machine.

12. An automatic liquid detergent dispensing arrangement according to claim 11 wherein said discharge means includes a portion of said hose that extends over a tub of said washing machine.

13. An automatic liquid detergent dispensing arrangement according to claim 6 wherein said reservoir tank is mounted onto a back side of said washing machine, and said detergent discharge hose passes outside a cabinet of said washing machine, and said discharge means includes a flat flexible hose portion that extends under a lid of said washing machine.

14. An automatic liquid detergent dispensing arrangement according to claim 13 further comprising a cosmetic cover disposed over said flat flexible hose portion.

15. An automatic liquid detergent dispensing arrangement according to claim 1 wherein said one-way valve means admits said detergent from said reservoir tank into said air/fluid chamber by gravity flow.

16. An automatic liquid detergent dispensing arrangement according to claim 1 comprising a sensor in said tank for detecting low detergent level, and an indicator on said control means actuated by said sensor.

17. An automatic liquid detergent dispensing arrangement for use with a plurality of automatic washing machines and adapted for dispensing a controlled amount of detergent during a dispense cycle into a selected one of said automatic washing machines, comprising

a reservoir tank for storing a quantity of liquid detergent sufficient for a multiplicity of wash cycles of the automatic washing machines;

a plurality of air/fluid chambers, each adapted for holding an amount of detergent sufficient for at least one detergent dispense cycle;

a plurality of one-way valve means, each associated with a respective one of said air/fluid chambers, for admitting detergent from said reservoir tank into the associated captive air/fluid chamber by gravity flow;

a plurality of detergent discharge hose, each extending from a respective one of said air/fluid chambers to a discharge means for dispensing the liquid detergent from the air/fluid chamber into a respective one of said washing machines;

air pump means for selectively pressurizing one or another of said air/fluid chambers with air under pressure so as to drive the liquid detergent in said air-fluid chambers through the associated discharge hose; and

control means coupled to said air pump means for selectively energizing the air pump means, including means for initiating a detergent discharge cycle.

18. An automatic liquid detergent dispensing arrangement according to claim 17, said control means further comprising a selector for selecting the volume of detergent to be discharged during such cycle.

19. A process of automatically injecting a measured amount of liquid detergent into an automatic washing machine including

filling a detergent tank with a supply of liquid detergent sufficient for a multiplicity of wash cycles;

permitting gravity flow of the liquid detergent from said tank into an air/fluid chamber to fill said chamber;

supplying compressed air to said air/fluid chamber during a detergent dispense cycle, such that the compressed air drives the detergent from said air/fluid chamber through a detergent dispense hose into a wash chamber of said washing machine; and

relieving air pressure in said air/fluid chamber after a dispense cycle to permit the air/fluid chamber to refill with said detergent.

20. A process according to claim 19, wherein said supplying of compressed air includes powering an air pump for a timed interval.

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