Dec. 29, 1959 P. ARANT 2,919,070

METHOD OF STEAM CLEANING AND LIQUID RINSING

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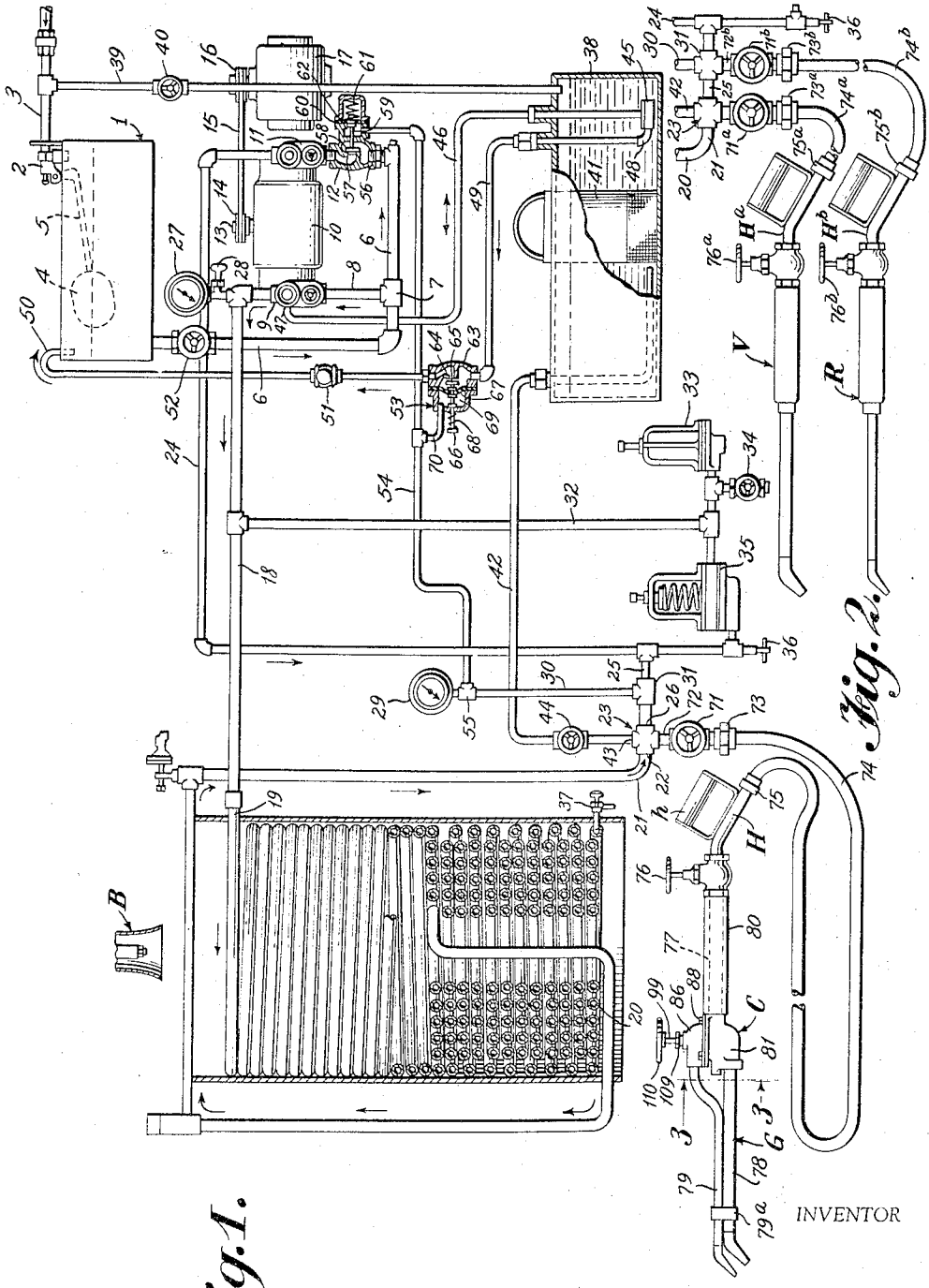

Fig. 1.



Fig. 2.

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Fig. 3.

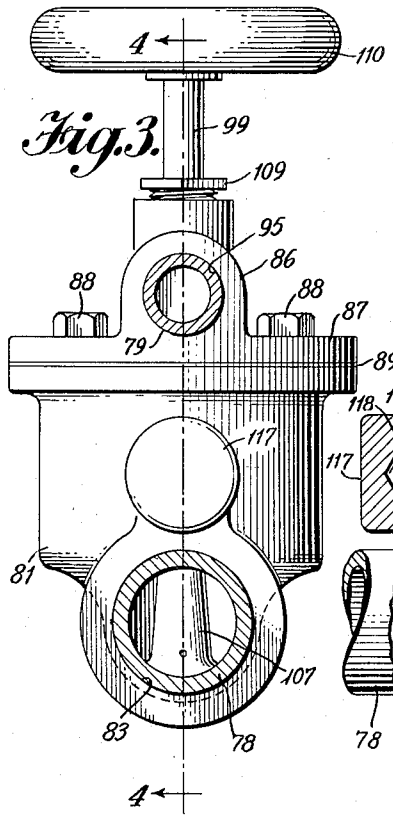


Fig. 4.

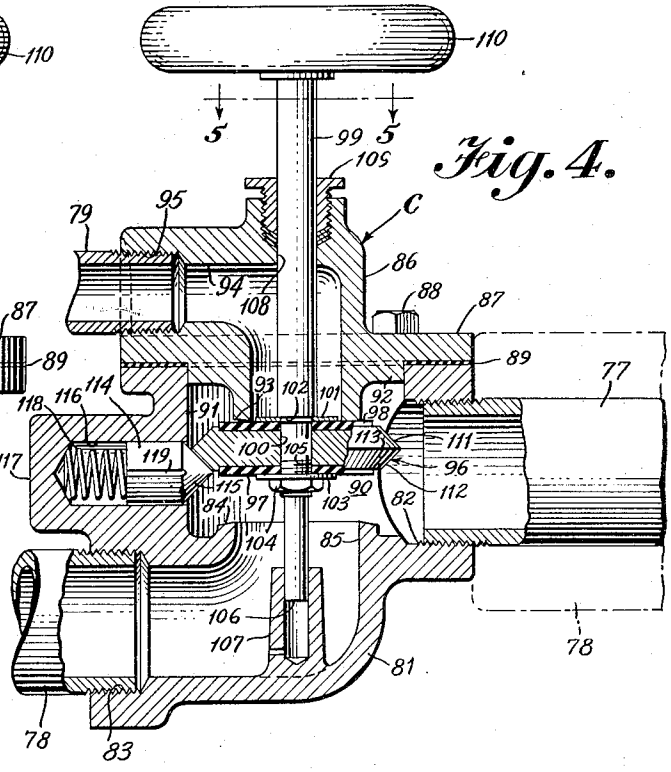


Fig. 5.

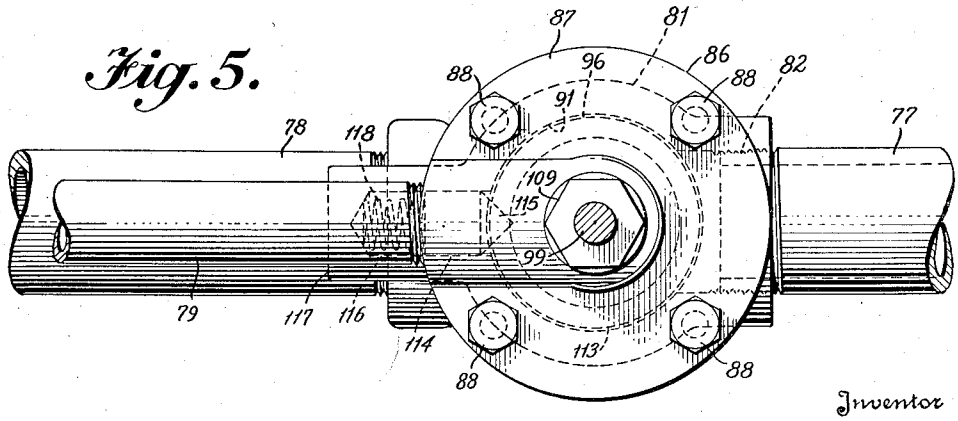


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Fig. 8.

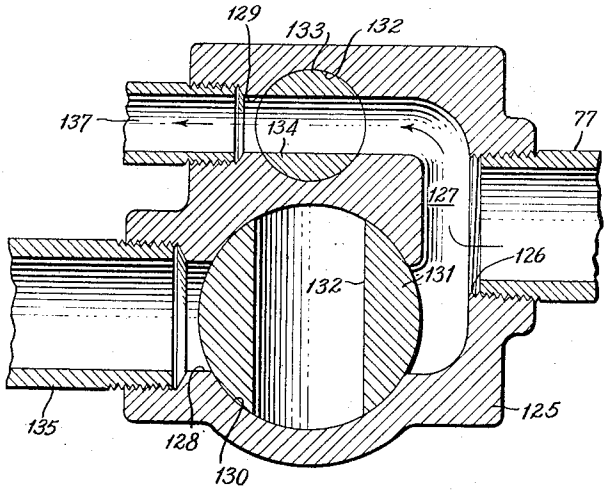



Fig. 7.

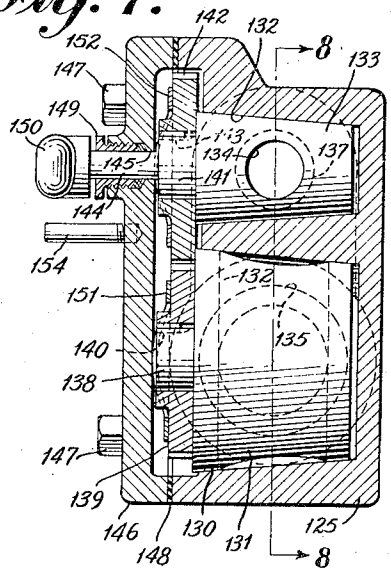



Fig. 6.

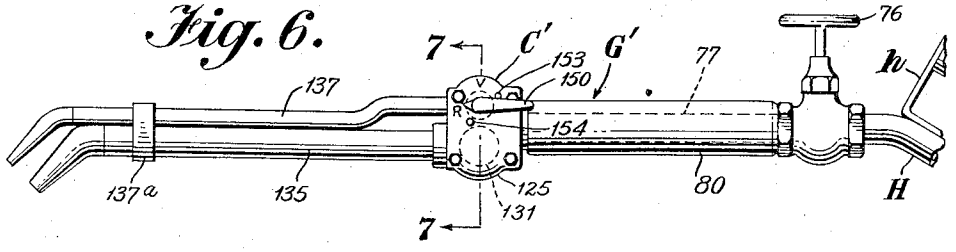
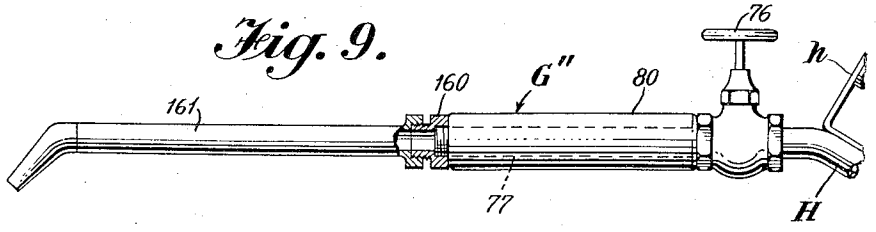



Fig. 9.



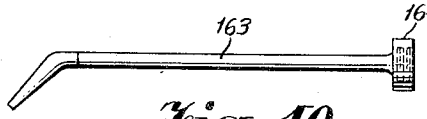




Fig. 10

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2,919,070

# METHOD OF STEAM CLEANING AND LIQUID RINSING

Perry Arant, San Gabriel, Calif.

Application December 16, 1955, Serial No. 553,548

5 Claims. (Cl. 239—10)

The invention relates to a method of converting a vapor spray into a liquid rinse and to the conversion of a liquid rinse back into a vapor spray.

It has been customary, heretofore, in steam cleaning and rinsing machines, to employ two separate discharge hoses, one having a cleaning gun with a vapor nozzle at the discharge end thereof, and another having a cleaning gun with a rinse nozzle at the discharge end thereof, together with separate manually operable valves connected with each discharge hose for controlling the flow through the respective hoses. It has also been customary to employ various additional valves on the machine itself that must be opened or closed by the operator to convert the machine from one type of spray operation to another. Obviously, such prior apparatus has the disadvantage of requiring the operator to successively handle two cleaning guns and hoses, and to return to the machine to adjust various valves whenever a change from a vapor spray to a rinse spray is desired, and vice versa. Moreover, the presence of two discharge hoses and two cleaning guns renders the apparatus somewhat cumbersome to use and handle and results in a waste of time, particularly in cases where the hoses are of substantial length and the operator is working on a ladder or scaffold, or a substantial distance from the machine, and must descend to the ground and walk over to the machine in order to adjust the machine to effect the desired conversion. The duplication of hoses and cleaning guns also renders the apparatus initially more costly and involves an increased maintenance cost.

Briefly, and by way of contrast, the present invention contemplates the use of an improved steam cleaning machine having a single discharge hose communicating at one end with a heating coil and with a source or supply of rinse water to be blended with the liquid from said coil, and a dual purpose cleaning gun connected with the opposite end of the discharge hose, the cleaning gun having separate vapor and rinse nozzles adapted to be selectively placed into service by the operator. In a preferred form of construction, the cleaning gun includes "conversion" valve means built into the cleaning gun itself for effecting conversion of the discharge from vapor to rinse, and vice versa, as working conditions may require. The actuation of the conversion valve means results in varying the pressure conditions in the system, and a pressure responsive rinse control valve on the machine is connected in the system to automatically open to permit flow of relatively unheated water to the discharge hose to blend with the liquid from the heating coil to produce a liquid rinse only after the conversion valve means has been adjusted for discharge through



the rinse nozzle and a predetermined back pressure has been built up in the system. A pressure responsive soap control valve on the machine is also connected in the system to automatically decrease or terminate the flow of a cleaning agent to a water supply tank for the system at the time that the rinse valve is opened. Readjustment of the conversion valve means to change from a rinse operation to a vapor spray, will result in a pressure drop in the system which permits the rinse control valve to automatically close and the soap control valve to automatically open. Thus, the operator, by merely actuating the conversion valve means at the cleaning gun can easily and quickly convert the system from one type of spray to another, and can do so without discontinuing or shutting off flow through the cleaning gun.

The pressure responsive rinse control valve disclosed herein can be employed to advantage with or without the soap control valve even in prior cleaning machines having separate vapor and rinse hoses and separate vapor and rinse guns, inasmuch as the rinse control valve will automatically respond to closing of the shut-off valve on the vapor gun and opening of the shut-off valve on the rinse gun in the same manner that it responds to the conversion valve means on the dual purpose cleaning gun embodied in the improved machine, as will be explained more fully hereinafter.

The principal object of the present invention therefore is to provide a method for converting a vapor spray into a rinsing spray, and vice versa.

Another object of the present invention is to provide a method of vapor cleaning and rinsing wherein a single, dual purpose cleaning gun may be employed, and wherein the operator can convert the gun discharge from one type of spray to another, as working conditions require, simply by manipulation of control means at the cleaning gun itself.

Another object of the invention is to provide a method of vapor cleaning and rinsing which may employ a fluid heating and distribution system which is automatically conditioned to add liquid to the fluid discharging from a heating coil when a predetermined pressure condition is attained in the system.

Another object of the invention is to provide a vapor cleaning and liquid rinsing method which may employ means automatically operable in response to conditioning of the cleaning gun for a rinsing operation for permitting the flow of relatively unheated water to the cleaning gun, for admixture with heated fluid from a heating coil connected with said gun, to provide a hot rinse.

Another object of the invention is to provide a vapor cleaning and rinsing method wherein unheated liquid for rinse purposes cannot be admixed with the liquid discharging from the heating coil until after a predetermined back pressure has been attained in the system.

Another object of the invention is to provide a vapor cleaning and rinsing method which may employ means automatically operable in response to conditioning of the cleaning gun for a rinsing operation for interrupting the addition of a cleaning agent to the liquid being introduced into the heating coil.

Still another object of the invention is to provide a vapor cleaning and rinsing method which may employ a system wherein the addition of a cleaning agent to the system is automatically interrupted substantially simul-

taneously with the addition of relatively cool rinse liquid to the discharge from the heating coil during a rinsing operation.

Still another object of the invention is to provide a vapor cleaning and rinsing method which may employ a system that can be automatically converted from one type of operation to another in response to manual actuation of conversion valve means associated with the vapor and rinse nozzles.

A further object of the invention is to provide a method of steam cleaning and liquid rinsing which may employ a cleaning gun having separate vapor and rinse nozzles adapted to be selectively placed into service by manual actuation of conversion valve means for converting the issuing spray from vapor to rinse, and vice versa, and without shutting off flow through the cleaning gun.

A still further object of the invention is to provide a method of steam cleaning and liquid rinsing which may employ a cleaning gun having vapor and rinse nozzles permanently mounted thereon and having built-in valve means for selectively directing flow to one of said nozzles while preventing flow to the other.

Other objects and features of the invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 diagrammatically illustrates a cleaning machine or system embodying the principles of the present invention;

Fig. 2 is a fragmentary, diagrammatic view showing how a vapor hose and gun, and a rinse hose and gun can be connected with the system shown in Fig. 1, if desired;

Fig. 3 is a view partly in section taken on the line 3—3 of Fig. 1 and particularly illustrating, in end elevation, the conversion valve of the cleaning gun;

Fig. 4 is a vertical sectional view through the conversion valve taken on the line 4—4 of Fig. 3;

Fig. 5 is a view partly in section taken on the line 5—5 of Fig. 4;

Fig. 6 is an elevational view of a second form of cleaning gun having a different type of built-in conversion valve from that shown in Fig. 1;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a vertical sectional view taken on the line 8—8 of Fig. 7;

Fig. 9 is a view partly in section of a third type of cleaning gun including a coupling adapted to have different kinds of nozzles interchangeably connected thereto; and

Fig. 10 is an elevational view of a nozzle adapted to be connected with the coupling of the gun shown in Fig. 9.

Referring now to Fig. 1 of the drawings, the numeral 1 identifies a liquid storage tank 1 of small capacity adapted to contain a cleaning solution comprising water and a cleaning agent, such as soap or a detergent. A conventional float-operated valve 2 is mounted upon the tank 1 and has the inlet thereof connected with one end of a water supply pipe 3. A float 4 is connected to an arm 5 pivotally mounted upon the valve 2 for effecting operation thereof, in a manner well understood, to allow opening of said valve when the liquid in the tank 1 drops below a predetermined level and to effect closing of said valve when the water level rises above said predetermined level. A pipeline 6 has one end thereof connected with the bottom of the tank 1 and contains a pipe-T 7, which is joined by a section of pipe 8 to the inlet side of a feed water pump head 9 of a multiple head positive displacement pump 10. The pump 10 also includes a rinse feed head 11 whose inlet is connected with the pipeline 6 through a conventional, normally closed, pressure-responsive valve 12 so connected in the system that it is caused to open automatically when a back pressure of about 125 pounds per sq. inch is created in the system, as when the cleaning gun is converted from a vapor cleaning operation to a liquid rinsing operation, as will be explained more fully hereinafter. The pump 10 has a shaft 13 carrying a pulley 14 continuously driven by a belt 15, which passes over a pulley 16 mounted upon the drive shaft of a conventional electric motor 17.

The discharge outlet of the feed pump head 9 is connected by a pipe 18 with the inlet end 19 of a conventional heating coil 20. The heating coil 20 has an outlet end 21 which is connected to one branch 22 of a four-way pipe fitting 23.

The outlet of the rinse pump head 11 has one end of a pipeline 24 connected thereto and is, in turn, connected by a branch pipe 25 to another outlet 26 of the four-way fitting 23. A pressure gauge 27 and a gauge cock 28 are connected with the feed pipe 18 to indicate the pressure of the liquid being pumped into the inlet 19 of heating coil 20. A similar pressure gauge 29 is connected by a pipe 30 to a pipe-T 31 disposed in the branch pipe 26 for indicating the pressure at the discharge end 21 of the heating coil 20.

In order to avoid excess pressure in the feed pipe 18, a branch pipe 32 is connected therewith and communicates with a pressure relief valve 33, which may be set to open at any selected pressure, for example, 175 pounds per sq. inch. A blow down valve 34 is connected in the pipeline 32 between the relief valve 33 and the feed pipe 18. A water pump discharge snubber 35 is also connected with the pipe 32 and with the rinse feed line 24 at a point beyond the connection of the branch pipe 25 therewith. A snubber drain valve 36 is mounted at the end of the rinse feed line 24 for draining the snubber 35. The pressure relief valve 33, the blow down valve 34, the snubber 35 and the drain valve 36 are conventional, and, therefore, their function and operation in the system need not be explained. It may be added that a drain valve 37 is connected with the lowermost portion of the heating coil 20 to permit draining of the coil when desired.

A storage tank 38 for a cleaning agent is arranged so that relatively cold water may be introduced thereinto through a pipe 39, one end of which is connected with the supply pipe 3 and the other end of which communicates with the interior of said tank. A manually operable valve 40 is connected in the pipe 39 for controlling the flow of water from the supply pipe 3 to the tank 38. A perforated basket or container 41 is adapted to have a predetermined quantity of a suitable powdered soap or other soluble cleaning compound placed therein and then inserted into the tank 38. The term "soap" as used herein is to be understood as meaning any suitable detergent or cleaning agent. Hot water or steam can be introduced into the tank 38 through a pipe 42 having one end thereof connected with a branch 43 of the four-way fitting 23, and its opposite end positioned in the tank 38 to provide a jet discharging adjacent the basket 41 for effecting rapid dissolution of the cleaning agent therein and thorough mixing thereof with the liquid in the tank. A valve 44 is connected in the pipe 42 to control the flow of the heated fluid from the coil 20 to the tank 38. The tank 38 may be filled to one-third of its capacity by the hot fluid introduced through the pipe 42, and then substantially completely filled by relatively cold water introduced through the pipe 39.

A conventional pulsating type soap pump 45 is disposed adjacent the bottom of the tank 38 and is connected to one end of a tube 46 whose other end is connected as indicated at 47 with the discharge side of the pump head 9. The tube 46 is normally filled with water to provide a somewhat static water column, and as the pump head 9 is operated to force water into the inlet 19 of the heating coil 20, each pump impulse is transmitted through the water column in tube 46 to effect actuation of the soap pump 45. The soap pump 45 has intake ports (not shown) through which the concentrated soap

from the tank 38 is admitted and also has an outlet fitting 48 connected to one end of a soap pipe 49, the opposite end of which is bent into a generally inverted U-shape, as indicated at 50, in order to discharge soap into the tank 1. A manually adjustable valve 51 is connected in the pipe 49 for controlling the rate at which soap can flow through said pipe to the tank 1. The soap thus added to the tank 1 mixes with the water introduced into said tank to form a cleaning solution which is delivered to the heating coil 20 through the pump head 9. A manually operable shut-off valve 52 is connected in the pipeline 6 to control the flow of cleaning solution from the tank 1 to the inlet side of the feed pump head 9. A conventional normally open, pressure-responsive valve 53 is connected in the soap pipe 49 between the soap pump 45 and the valve 51, and is constructed to close automatically when the system or cleaning gun is adjusted for a rinsing operation, as will be pointed out more fully hereinafter.

The motor 17 operates continuously, and it is to be understood that the pump heads 9 and 11 include a by-pass (not shown) for by-passing liquid at a time when the apparatus is not being used for cleaning or rinsing purposes. Normally, however, the cleaning solution is continuously pumped from the small capacity tank 1 and introduced into the heating coil 20, and water is continuously introduced through the float valve 2 into the tank 1, simultaneously with the continuous proportionate addition of soap through the pipe 49. The liquid in the heating coil 20 is heated by an inverted burner B as it flows in continuous stream form through said heating coil.

The pressure-responsive rinse water control valve 12 and the pressure-responsive soap control valve 53 both derive operating fluid under pressure from a pipe 54 having one end thereof connected to a pipe-T 55 connected in the pipe 30 so that said valves are subject to the pressure adjacent the outlet of the heating coil.

Referring more particularly to the valve 12, this valve comprises a body 56 provided with a seat 57 and a closure member 58 for controlling the flow from the inlet to the outlet side of the valve through said seat. A valve stem 59 has one end thereof connected with the closure member 58 and its opposite end connected with a flexible diaphragm 60 whose opposite side is engaged by a spring 61 tending to maintain the closure member 58 seated to obstruct flow from the pipe 6 to the inlet side of the pump head 11. The spring 61 is a compression spring which will yield when a back pressure of about 125 pounds per sq. inch is produced in the system. The valve body 56 includes a pressure chamber 62 connected with one end of the pipe 54 so that when the pressure in said pipe exceeds that required to overcome the force of the spring 61, the diaphragm 60 will be flexed toward the right to move the closure member 58 away from the seat 57 to permit flow from the pipe 6 to the pump head 11.

Similarly, the soap control valve 53 includes a body 63 containing a seat 64 and a closure member 65 for controlling the flow of soap through the soap pipe 49 to the tank 1. A stem 66 is connected with the closure member 65 and also with a flexible diaphragm 67. A spring 68 surrounds the stem 66 and exerts force in a direction to normally maintain the closure member 65 out of contact with the seat 64 to thus permit flow of soap through the valve 53. The spring 68 is designed so that it will yield and permit closing of the valve 53 when the back pressure in the system reaches a pressure of about 125 pounds per sq. inch. A pressure chamber 69 is formed in the valve 53 between the diaphragm 67 and the spring 68 and communicates with the pipe 54 through a pipe connection 70. When a back pressure of about 125 pounds per sq. inch is produced in the system, the force of the spring 68 will be overcome by the pressure in the chamber 69 to effect flexing of the diaphragm 67 toward the right and movement of the closure member 65 into engagement with the seat 64 to obstruct flow through the valve 53. Either the seat 64 or the closure member 65, or both, may be notched to permit some flow of soap to the tank 1 even when the closure member 65 is seated, if desired.

It will be noted from the foregoing that the pressure in the pipe 54 acts simultaneously upon the diaphragm 60 of the rinse control valve 12, and on the diaphragm 67 of the soap control valve 53, but in the case of the valve 12 the pressure acts to open the valve; whereas, in the case of the valve 53 the pressure acts to close the valve, so that the valve 12 is opened substantially simultaneously with the closing of the valve 53, all for a purpose which will be explained later.

A manually operable discharge control valve 71 has the inlet side thereof connected by a pipe nipple 72 with one branch of the four-way fitting 23. The outlet of the valve 71 is connected by a conventional pipe union 73 with one end of a flexible hose or discharge conduit 74 that may be of any desired length. The opposite end of the hose 74 is connected by a coupling 75 to a tubular handle portion H, which in turn is connected to the inlet of a manually operable gun shut-off valve 76. The handle H includes a grip portion *h* adapted to be held by the operator. The handle H and the valve 76 comprise elements of a dual purpose cleaning gun generally identified by the letter G. The gun G may include a section of pipe 77 having one end thereof connected to the outlet of the valve 76 and its other end connected to the inlet of a manually operable conversion valve generally identified by the letter C. A vapor discharge tube and nozzle assembly 78 and a rinse discharge tube and nozzle assembly 79 are both connected with the conversion valve C. The nozzle assemblies are firmly held together at their free ends by a band 79*a*. A handle portion or sleeve 80 of non-heat conducting material surrounds the pipe 77 and is adapted to be held by the operator. The shut-off valve 76 is conveniently located at the gun to enable the operator to shut off all flow through the gun and avoids the necessity of the operator walking back to the machine to close the valve 71 whenever use of the gun G is to be discontinued. However, the valve 76 need not be closed to convert the machine from one type of spray to another, as will be apparent hereinafter.

The details of the conversion valve C are best illustrated in Figs. 3, 4 and 5. Thus, the valve C comprises a body portion 81 having a threaded inlet opening 82 to which one end of the pipe 77 is connected. The body portion 81 also has a threaded outlet 83 into which one end of the tube of the vapor nozzle assembly 78 is threaded. A seat 84 surrounds a passageway 85 in the body 81 and is disposed between the inlet 82 and the outlet 83.

The valve C further comprises a cover section 86 having a flange portion 87 secured to the body portion 81 by a plurality of cap screws 88, a suitable gasket 89 being interposed between said cover and body. The body 81 has a chamber 90 defined by a cylindrical wall 91 and communicates at all time with the inlet 82. The cover 86 is provided with a circular boss 92 adapted to engage with the wall 91 for centering the cover 86 relative to the body 81. A seat 93 depends from the boss 92 and surrounds a passage 94 leading to a threaded outlet opening 95 which is of substantially smaller diameter than the outlet opening 83. One end of the tube of the rinse nozzle assembly 79 is threaded into the opening 95.

A valve disc 96 is disposed between the seats 84 and 93 and is recessed to receive sealing members 97 and 98 adapted to engage the respective seats. A valve stem 99 extends through an opening 100 in the valve disc 96 and a washer 101 is interposed between the sealing member 98 and a shoulder 102 formed on said valve stem. A similar washer 103 is engaged with the other sealing member 97 and a nut 104 is mounted upon a threaded

portion 105 of said valve stem for securing the valve disc 96, etc. in assembled relation with said valve stem. The valve stem 99 is reduced in diameter at its lower end 106 and is slidably received in a vented boss 107 in the body portion 81. The upper portion of the stem 99 extends through an opening 108 in the cover section 86 and is guided for sliding movement in a conventional stuffing box 109 which is also adapted to provide a seal around said stem. A knob 110 is carried by the upper extremity of the stem 99 and is adapted to be grasped by the operator to shift the position of the valve disc 96 from one seat 93 to the other seat 84.

The valve disc 96 has a periphery defined by two beveled surfaces 111 and 112 each disposed on an angle of about 45° with respect to a plane passing through a ridge 113 formed on said disc. The beveled surfaces 111 and 112 are adapted to cooperate with a plunger or detent member 114 having a conical end 115 adapted to engage with either the beveled surface 111 or the beveled surface 112. The plunger 114 is slidably received in a recess 116 formed in a boss 117 axially aligned with the inlet opening 82. A spring 118 is disposed between the bottom of the recess 116 and the plunger 114 for yieldably urging the plunger toward the valve disc 96. A groove 119 is formed in the plunger 114 to permit any fluid entrapped in the recess 116 to escape and not interfere with the retracting movement of the plunger 114.

The valve disc 96 is shown in Fig. 4 in the position it assumes during a vapor cleaning operation and it is maintained in such position by the engagement of the spring-pressed plunger 114 with the beveled surface 112, the pressure of the fluid in the chamber 90 of the body 81 also aiding in maintaining the disc seated. Assuming that the shut-off valves 71 and 76 are open, heated fluid from the heating coil 20 can readily flow through the discharge conduit 74 and pipe 77 into the inlet 82 of the valve C, thence through passage 85 and outlet 83 into the vapor nozzle assembly 78 from which it is discharged into the atmosphere in the form of a vapor spray to effect a cleaning operation. Should the operator desire to change from a vapor spray to a rinse operation, the knob 110 of the conversion valve C need only be depressed to shift the disc 96 toward the seat 84. As the stem 99 slides in its guides 107 and 109, the beveled surface 112 of the disc 96 will cause the plunger 114 to be retracted until after the ridge 113 passes the point of the cone 115, whereupon the beveled surface 111 will be engaged by the plunger and the spring 118 will then act upon the plunger 114 to urge the disc 96 toward the seat 84 to obstruct flow through the opening 85 while at the same time permitting flow through the opening 94 and outlet 95 for flow through the rinse nozzle assembly 79.

It will be apparent from the foregoing that the disc 96 has only two operative positions: one at one extreme end of its movement, in which it obstructs flow through the outlet 95 and permits flow through the outlet 83 as illustrated in Fig. 3; and another position at the other extreme end of its movement in which it obstructs flow through the seat 84 and outlet opening 83 and permits flow through the seat 93 and outlet opening 95. The plunger 114 functions to maintain the valve disc 96 in one or the other of its extreme positions of rest, while preventing said valve disc from assuming any intermediate position of rest, so that the cleaning gun G must be adjusted for either a vapor cleaning operation or a rinsing operation.

In the normal operation of the apparatus described above, the valve 52 is open and cleaning solution (water and cleaning agent) flows from the tank 1 through the pipe 6, pipe-T 7 and pipe nipple 8 into the inlet of the feed pump head 9. The pump head 9 discharges the solution into the pipe 18 from whence it flows into the inlet end 19 of the heating coil 20. Simultaneously with the pumping of cleaning solution into the coil 20, the pump pulsations are transmitted through the liquid column in the tube 46 to actuate the soap pump 45, as aforedescribed, to proportionately pump soap from the tank 38 through the pipe 49, and open valves 53 and 51 into the tank 1 for admixture with the water entering said tank through the valve 2. The pump head 9, of course, includes a by-pass (not shown) for by-passing solution at a time when the gun G is not in use, whereby to prevent an excessive pressure from being built up in the system. However, should an excess pressure condition occur, the relief valve 33 will automatically open to relieve such pressure when it reaches about 175 pounds per sq. inch.

Assuming that the gun G is in use and that a vapor cleaning spray is being discharged at a pressure of about 50 to 100 pounds per sq. inch (and preferably at about 90 pounds per sq. inch), the rinse control valve 12 is closed, the soap control valve 53 is open, and the conversion valve C has the valve disc 96 thereof engaged with the seat 93, thereby blocking the discharge of fluid through the rinse nozzle 79. The cleaning solution is heated, of course, by the burner B during its passage through the heating coil 20 to a temperature such that it will be converted into vapor upon discharge into the atmosphere through the vapor nozzle 78. The operation of the burner B may be automatically controlled to modulate the supply of fuel in accordance with variations in pressure and/or temperature conditions, by conventional control devices. It will be understood that make-up water and soap are continuously added to the tank 1 to compensate for the solution discharged from the system through the gun G, so that the heating coil 20 is always maintained full of liquid. Normally, the discharge capacity at a solution discharge pressure of about 90 pounds per sq. inch is 150 gallons per hour. The charge or supply of soap or detergent in the tank 38 may be replenished whenever necessary in order to assure a vapor cleaning spray of the desired strength to accomplish the particular cleaning operation at hand.

Should it be desired to flush the cleaning solution from the surface previously cleaned by the vapor spray, the operator need only shift the valve disc 96 of the conversion valve C from the position it is then in (engaging seat 93), into its other extreme position (engaging seat 84) and this will automatically divert flow to the rinse nozzle 79 and convert the gun G from a vapor cleaning spray to a high velocity, high pressure, hot water rinse. This is accomplished by the fact that, since the rinse nozzle 79 is smaller in size than the vapor nozzle 78, the discharge will be restricted and a back pressure will be set up in the system resulting in a corresponding pressure quickly being built up in the pipes 30 and 54, with the result that when the pressure in the system is increased to about 125 pounds per sq. inch, the diaphragm 60 of the rinse control valve 12 will be actuated to move the closure member 58 from its seat 57 and allow liquid from the pipe 6 to flow into the inlet of the rinse pump head 11, whereby relatively cool liquid from the tank 1 is made available for pumping by the pump head 11 into pipes 24 and 25 to the four-way fitting 23 where it becomes admixed with the discharge from the heating coil 20 and flows into the hose 74 for ultimate discharge through the rinse nozzle 79. Meanwhile, the same pressure which effected opening of the rinse control valve 12, also acts upon the diaphragm 67 of the soap control valve 53, causing the soap valve to automatically close to interrupt the addition of soap to the tank 1, whereby soap is conserved and an excess of soap in the rinse jet is avoided. A normal rinsing operation is effected with the present apparatus at a working pressure in the system of about 150 pounds per sq. inch, and with a flow rate of about 275 gallons per hour.

Should the operator desire to convert back from a rinse spray to a vapor cleaning spray, it is only necessary to pull the knob 110 to shift the valve stem 99 so that the

valve disc 96 will be returned to its initial position in engagement with the seat 93 to block flow to the rinse nozzle 79. The pressure will then quickly drop in the system due to the removal of the flow restriction which had increased the back pressure (the relatively larger vapor discharge nozzle 78 offering less restriction than the rinse nozzle 79) so that as soon as the back pressure drops below 125 pounds per sq. inch, the rinse control valve 12 will automatically close, thereby shutting off the flow from the pipe 6 to the rinse pump head 11, and the soap control valve 53 will automatically open, to permit resumption of soap addition to the tank 1 from the tank 38. The pressure in the system continues to drop quickly until it returns to the vapor cleaning pressure for which the machine has been set.

Thus, the present system eliminates the necessity for separate hoses and guns for vapor cleaning and rinsing operations heretofore considered necessary, and at the same time makes it extremely easy for the operator to condition the system so that it will automatically convert itself from a vapor cleaning operation to a rinsing operation, solely through the manipulation of the conversion control valve C.

Should a cold rinse be desired, such rinse can be obtained at any time by discontinuing the operation of the burner B.

Fig. 2 diagrammatically illustrates the manner in which two discharge hoses and two cleaning guns, such as have been employed heretofore in cleaning machines, may be used with the improved system illustrated in Fig. 1 in lieu of the single hose 74 and gun G and still obtain very desirable advantages by virtue of the fact that the new system lends itself to conversion control by adjusting means at the cleaning guns themselves, and which advantages could not be obtained with any prior steam cleaning and rinsing systems. Thus, a vapor gun V and a hose 74*a* are shown connected with a shut-off valve 71*a* by a coupling 73*a*. A shut-off valve 76*a* at the cleaning gun is connected to a handle portion H*a* which is connected to the hose 74*a* by a coupling 75*a* and is adapted to be opened to provide a vapor cleaning spray.

The pipe-T 31 is replaced by a four-way pipe fitting 31′ and a shut-off valve 71*b* is connected with said fitting by a conventional pipe nipple 72*b*. A rinse hose 74*b* is connected by a coupling 73*b* with the discharge side of the shut-off valve 71*b* and a rinse gun R including a shut-off valve 76*b* is shown connected with a handle portion H*b*, which in turn is connected to the opposite end of the rinse hose 74*b* by a coupling 75*b*. The valve 76*b* is opened when a rinse spray is desired.

Assuming that the cleaning machine is in operation and the shut-off valves 71*a* and 71*b* at the machine are both open, then opening of the valve 76*a* while the valve 76*b* is closed will condition the system for the discharge of vapor through the vapor cleaning gun V, in the same manner as adjustment of the conversion valve C for vapor operation, as described hereinbefore. On the other hand, closing of the valve 76*a* and opening of the valve 76*b* for effecting a rinse operation will inherently result in restricting the discharge from the system so that a back pressure is created sufficient to effect opening of the pressure-responsive rinse control valve 12 and closing of the pressure-responsive soap control valve 53, in the same manner described hereinbefore in connection with the adjustment of the conversion valve C for effecting a rinse operation.

The important fact to be noted here is that the use of the presure-responsive valves 12 and 53, even in prior systems employing separate vapor and rinse guns, provides the advantage of enabling the operator to condition the system for automatic conversion from one type of spray to another by manipulation of the valves 76*a* and 76*b*, at the cleaning guns, without requiring the operator to return to the machine to open or close valves to convert the system from one type of spray to another. However, the system shown in Fig. 1 is preferred for obvious reasons.

It will be apparent, once the principles of the present system are understood, that conversion valve means different from the valve C may be embodied in a cleaning gun for effecting automatic conversion of the system from vapor to rinse operation, and vice versa, at the will of the operator. By way of further example, in Figs. 6 to 8, a cleaning gun G′ is shown provided with a conversion valve C′ embodying rotary plug valve elements instead of the reciprocable valve disc 96 shown in Figs. 3 to 5. Thus, the valve C′ includes a body 125 having a threaded inlet 126 for mounting the same upon the pipe 77. The inlet 126 communicates with a chamber 127 which merges into two outlet passages, a vapor outlet passage 128 and a rinse outlet passage 129. The outlet passage 128 is intersected by an enlarged generally cylindrical bore 130 provided for the reception of a correspondingly shaped plug valve 131 having a port 132 adapted to be placed in alignment with the outlet passage 128. The outlet passage 129 is also intersected by an enlarged generally cylindrical bore 132 adapted to receive a plug valve 133 of similar shape. The plug valve 131 has a port 134 adapted to be placed in alignment with the passage 129, as shown in Fig. 8. The plug valves 131 and 133 and the bores 130 and 132 associated therewith are preferably slightly tapered to insure a tight fit. However, these plug valves and bores may be made truly cylindrical, if desired, provided that a close tolerance is maintained between the plugs and bores to prevent leakage.

The vapor outlet opening 128 is threaded at its outer end and a conduit comprising part of a vapor discharge nozzle assembly 135 is mounted therein. The outer end of the rinse passage 129 is also threaded and a conduit member of a rinse nozzle assembly 137 is threaded therein. The free ends of the nozzle assemblies 135 and 137 are secured together by a band 137*a*.

The plug valve 131 has an axial hub 138 upon which a spur gear 139 is mounted and non-rotatably secured thereto by a key 140 received in complemental keyways in said hub and gear. The plug valve 133 has a similar hub 141 upon which a spur gear 142 is non-rotatably secured by a similar key 143. The hub 141 includes a projecting stem portion 144 of reduced diameter that extends through an opening 145 formed in a cover 146, secured to the valve body 125 by a plurality of cap screws 147, a gasket 148 being interposed between said valve body and cover. The stem 144 also extends through a conventional stuffing box 149 which forms a seal around the same. An operating handle 150 is secured to the outer extremity of the stem 144 and serves as an operating means for the valve C′. An annular corrugated spring 151 is interposed between the cover 146 and the gear 139 to maintain the plug valve 131 in intimate contact with the walls of its bore 130. A similar spring 152 is interposed between the cover 146 and the gear 142 to likewise maintain the plug valve 133 in intimate contact with its bore 132. The gears 139 and 142 have the same pitch diameter, so that any degree of angular rotation imparted to the plug valve 133 will necessarily result in rotation of the plug valve 131 through exactly the same angle. Thus, it will be apparent that by manually rotating the handle 150 through an angle of 90°, the port 131 in the plug valve 133 will be rotated to a vertical position and the port 132 in the plug valve 131 will be rotated to a horizontal position. The aforesaid angular movement of the handle 150 is limited by stop pins 153 and 154 mounted on the cover 146. In Fig. 6, the handle 150 is shown engaged with the pin 153, and the letter "R" appears on the cover 146 opposite a pointed indicator on the end of said handle to indicate that the valve C′ is adjusted for a rinse operation. The position of the plug valves 131 and 133 corresponding to a rinse

operation is illustrated in Figs. 7 and 8. Should the operator wish to convert the system from a rinse operation to a vapor spray operation, then the handle **150** need only be rotated clockwise, as viewed in Fig. 6, until it engages with the pin **154**. The indicator end of the handle **150** will then lie in registration with the letter "V" appearing on the cover **146**, to indicate to the operator that the gun has been conditioned for a vapor spray. The valve **76** need not be closed to enable conversion to be effected from one type of spray to another. Thus, the operation of the system incorporating the gun G', with the built-in conversion valve C', is exactly the same as that described hereinbefore in connection with the gun G.

Fig. 9 illustrates an extremely simple and relatively inexpensive form of cleaning gun G'' that can be used with the system shown in Fig. 1 in lieu of the cleaning guns G or G', and still afford some but not all of the advantages of the preferred form of cleaning machine and gun shown in Fig. 1. In Fig. 9, a coupling **160** is threaded onto one end of the pipe **77** and is preferably permanently fixed thereto by means of welding or otherwise, to prevent rotation thereof relative to said pipe. A conduit **161** comprising part of a vapor nozzle assembly is threaded onto the coupling **160**. In Fig. 10, a rinse nozzle assembly **163** is shown having an enlarged internally threaded portion **164** at one end thereof which is adapted to be threaded onto the coupling **160** in lieu of the vapor nozzle assembly **161**.

It will be apparent that the nozzle assemblies **161** and **163** are interchangeable and that one may be used in lieu of the other by mounting the same on the coupling **160**. However, in using the gun G'', whenever a change in type of spray is desired, the operator must close the shut-off valve **76** to terminate the discharge from the system. The nozzle then connected with the coupling **160** can be removed by the operator and replaced by another type of nozzle.

Assuming that the operator has removed the vapor nozzle assembly **161** and has replaced it with the rinse nozzle assembly **163**, when the valve **76** is opened, it is very likely that the apparatus will already have been conditioned for a high pressure rinse spray by virtue of the fact that the closing of the valve **76** caused pressure to build up in the system. However, if the closing of the valve **76** did not result in increasing the back pressure in the system sufficient to effect opening of the rinse control valve **12** and closing of the soap control valve **53**, then the restriction to discharge from the system offered by the rinse nozzle **163** will soon create a back pressure sufficient to effect operation of the valves **12** and **53**, the same as when conversion is effected by manipulation of the conversion valves C or C', in the systems previously described. Thus, when the gun G'' is used, conversion of the system from one type of spray to another can still be effected by the operator, at the gun, and without requiring the operator to return to the machine to open or close any valves. A separate conversion valve is not necessary in the gun G'', but the omission of such valve results in the disadvantage that the operator must close the valve **76** and change nozzles whenever a different type of spray is desired.

It will be understood that various types of conversion valves can be designed for use with the dual purpose cleaning guns G and G' disclosed herein and still obtain all of the advantages afforded by the present system embodying the automatic rinse control valve **12** and/or the automatic soap control valve **53**. For example, the pipe **24** could be connected to the pipe **18** instead of the pipe-T **31**, so that the rinse water would pass through the heating coil with the feed water, in lieu of mixing with the heated stream at the 4-way fitting **23**. In this event a single diaphragm snubber would be used in lieu of the double diaphragm snubber **35** and would be connected only with the pipe **32**.

It will also be understood that various changes may be made in the arrangement and details of construction of the system and the various cleaning guns disclosed herein, and that the various operating ranges and pressures for steam cleaning, back pressure and rinse pressure given by way of example can reasonably be varied without departing from the principles of the invention or the scope of the annexed claims. Certain improvements in cleaning machines of the type disclosed herein are embodied in my co-pending application, Serial No. 311,297, filed September 24, 1952, now Patent No. 2,790,678.

I claim:

1. The method of creating a vapor cleaning spray and a liquid rinsing spray, comprising: heating a stream of liquid in a closed system under superatmospheric pressure to a temperature sufficient to convert the same into a vapor cleaning spray upon discharge to the atmosphere; restricting the vapor discharge from said system to substantially increase the back pressure in said system to a predetermined pressure; and adding relatively cool liquid to said heated stream under a pressure in excess of said predetermined pressure produced by said back pressure and in sufficient volume to convert the discharge from a vapor cleaning spray to a hot liquid rinse.

2. The method of creating a vapor cleaning spray and a liquid rinsing spray, comprising: heating a stream of liquid in a closed system under superatmospheric pressure to a temperature sufficient to convert the same into a vapor cleaning spray upon discharge to the atmosphere; restricting the vapor discharge from said system to substantially increase the back pressure in said system to a predetermined pressure; adding relatively cool liquid to said heated stream under a pressure in excess of said predetermined pressure produced by said back pressure and in sufficient volume to convert the discharge from a vapor cleaning spray to a hot liquid rinse; reducing said back pressure to produce a pressure in said system corresponding substantially to the original vapor discharge pressure; and discontinuing the addition of said relatively cool liquid to said heated stream to convert the discharge from a hot liquid rinse back to a vapor cleaning spray.

3. The method of creating a vapor cleaning spray and a liquid rinsing spray, comprising: heating a stream of liquid in a closed system under about 50 to 100 lbs. per sq. inch pressure to a temperature sufficient to convert the same into a vapor cleaning spray upon discharge to the atmosphere; restricting the vapor discharge from said system to increase the back pressure in said system to about 125 lbs. per sq. inch pressure; and adding relatively cool liquid to said heated stream under a pressure of about 125 to 150 lbs. per sq. inch and in sufficient volume to convert the discharge from a vapor cleaning spray to a hot liquid rinse.

4. The method of creating a vapor cleaning spray and a liquid rinsing spray, comprising: adding a cleansing agent to a liquid storage tank; continuously withdrawing liquid from said tank and heating a stream of the same in a closed system under superatmospheric pressure to a temperature sufficient to convert the same into a vapor cleaning spray upon discharge to the atmosphere; adding water to said tank to maintain a substantially constant volume of liquid therein; restricting the discharge from said system to substantially increase the back pressure in said system; and discontinuing the addition of said cleansing agent to said tank after said back pressure in said system has reached a predetermined amount in excess of said vapor discharge pressure.

5. The method of creating a vapor cleaning spray and a liquid rinsing spray, comprising: adding a cleansing agent to a liquid storage tank; continuously withdrawing liquid from said tank and heating a stream of the same in a closed system under superatmospheric pressure to a temperature sufficient to convert the same into a vapor

cleaning spray upon discharge to the atmosphere; adding water to said tank to maintain a substantially constant volume of liquid therein; restricting the discharge from said system to substantially increase the back pressure in said system; discontinuing the addition of said cleansing agent to said tank after said back pressure in said system has reached a predetermined amount in excess of said vapor discharge pressure; and then withdrawing additional liquid from said tank and admixing it with said heated stream under a pressure greater than said back pressure and in sufficient volume to convert the discharge from a vapor cleaning spray to a hot rinse.



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