April 30, 1957 P. ARANT 2,790,678

STEAM CLEANING MACHINE

Filed Sept. 24, 1952 4 Sheets-Sheet 1

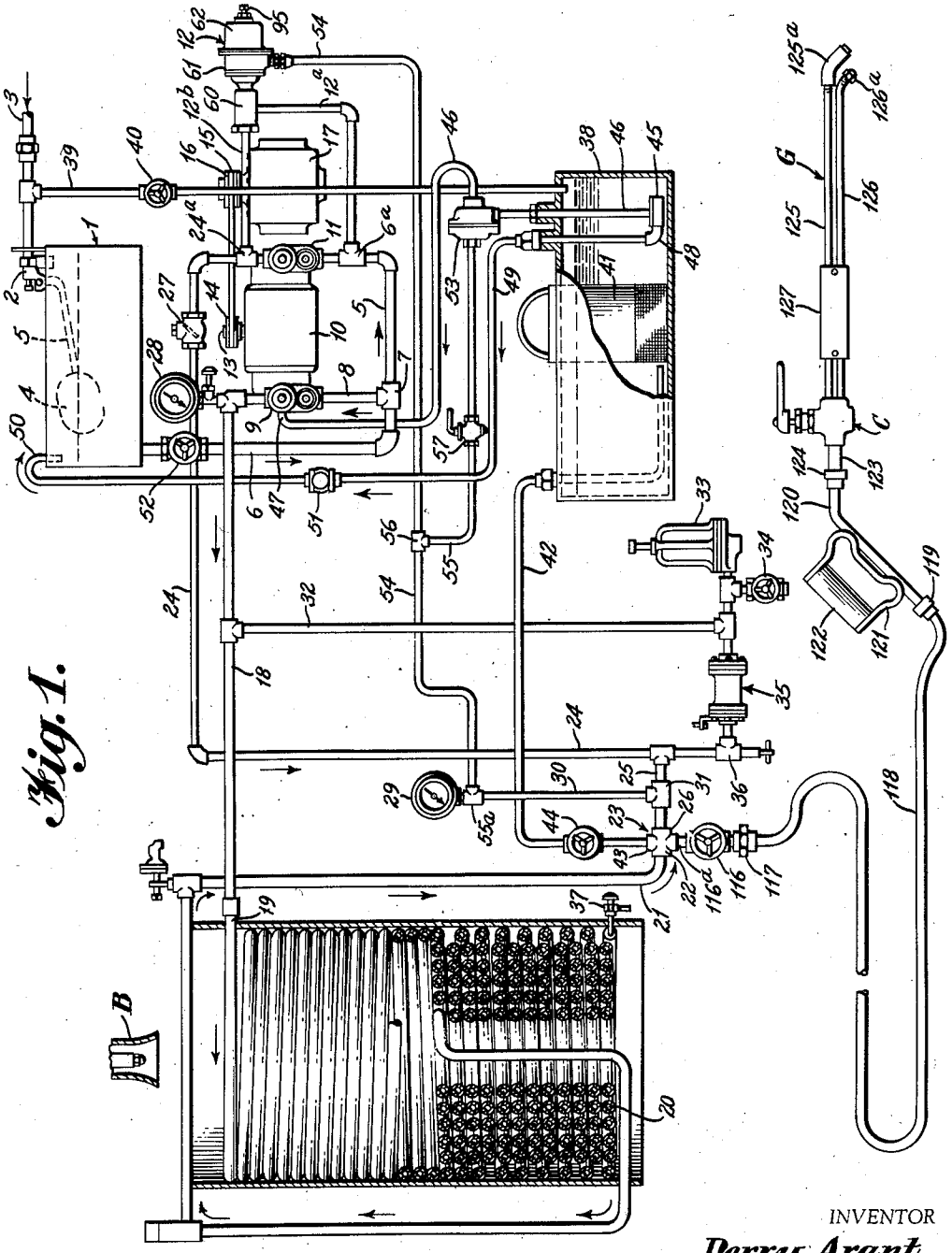


Fig. 1.

INVENTOR
Perry Arant

BY Bacon + Thomas

ATTORNEYS

April 30, 1957 P. ARANT 2,790,678

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Filed Sept. 24, 1952 4 Sheets-Sheet 2

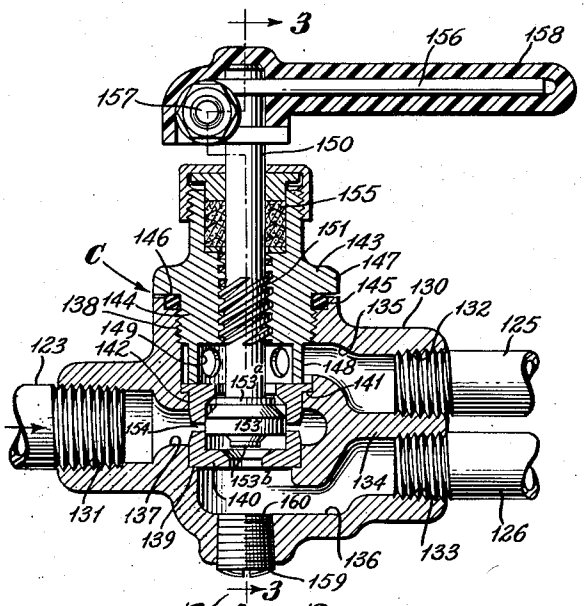


Fig. 2.

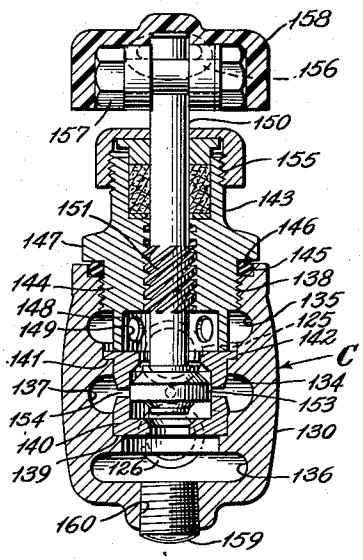
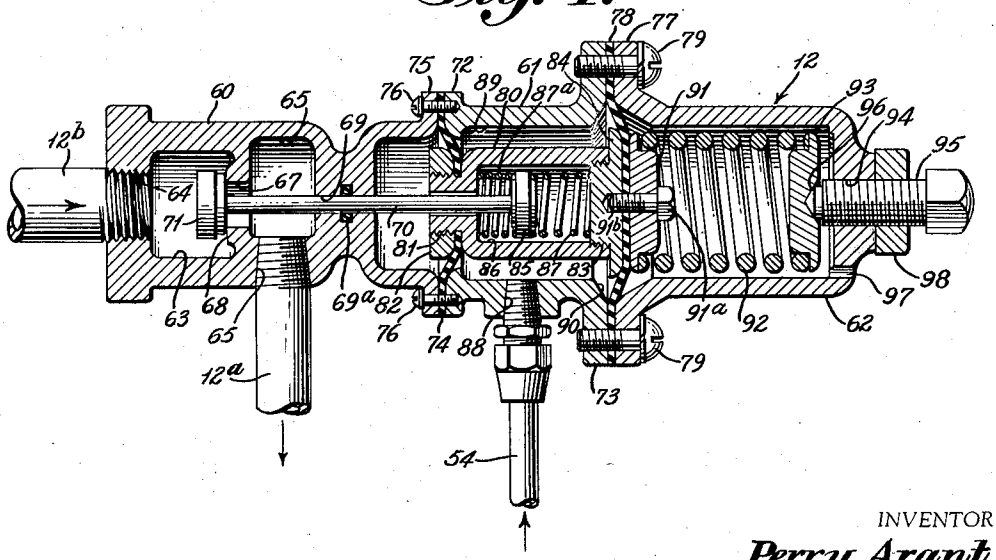


Fig. 3.

Fig. 4.



INVENTOR

Perry Arant

BY Bacon & Thomas

ATTORNEYS

April 30, 1957 P. ARANT 2,790,678

STEAM CLEANING MACHINE

Filed Sept. 24, 1952 4 Sheets-Sheet 3

Fig. 5.

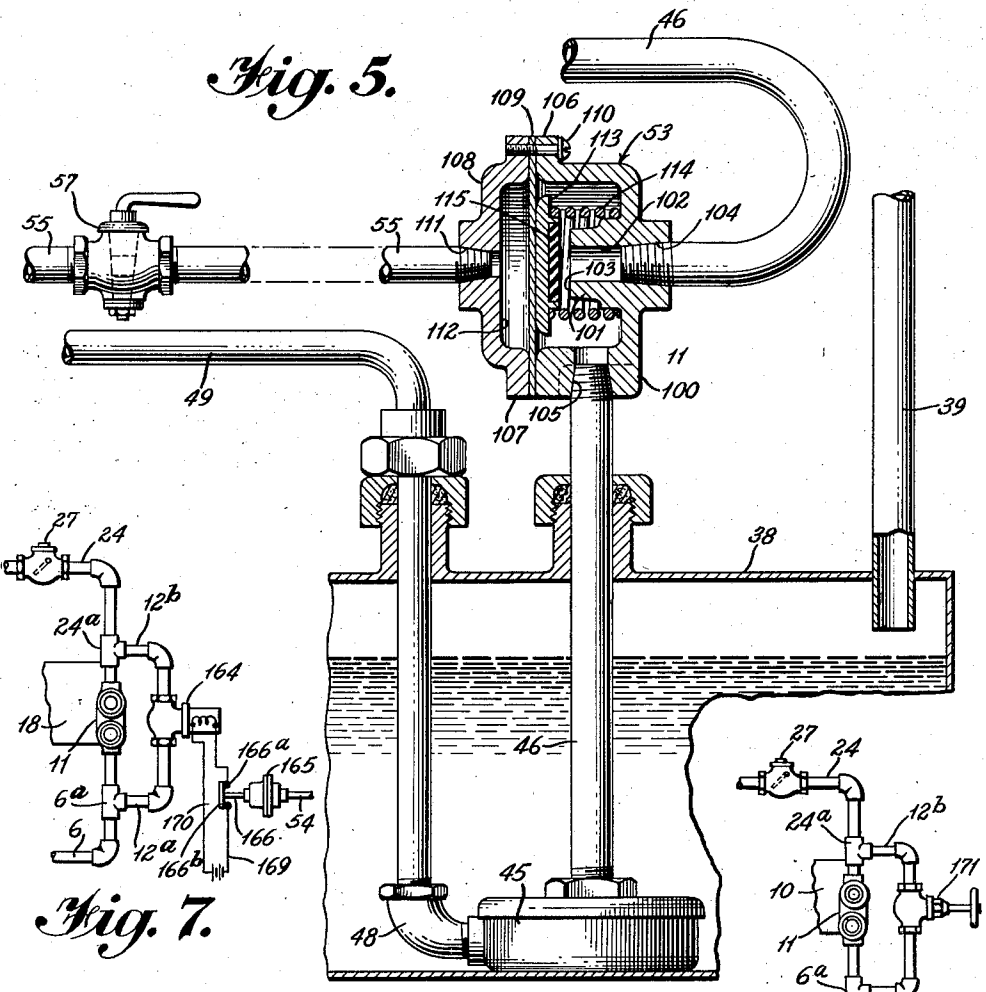
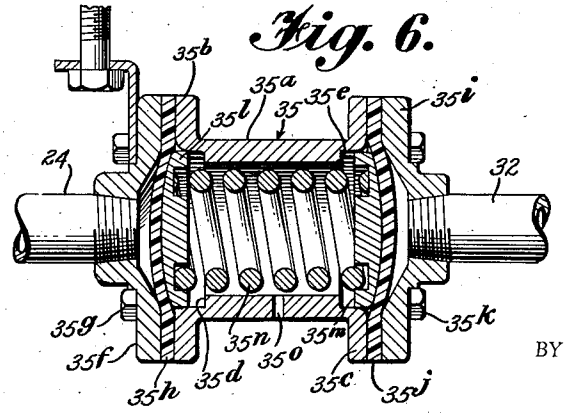


Fig. 7.

Fig. 8.

Fig. 6.



INVENTOR
Perry Arant

BY Bacon + Thomas

ATTORNEYS

April 30, 1957 P. ARANT 2,790,678

STEAM CLEANING MACHINE

Filed Sept. 24, 1952 4 Sheets-Sheet 4

Fig. 10.

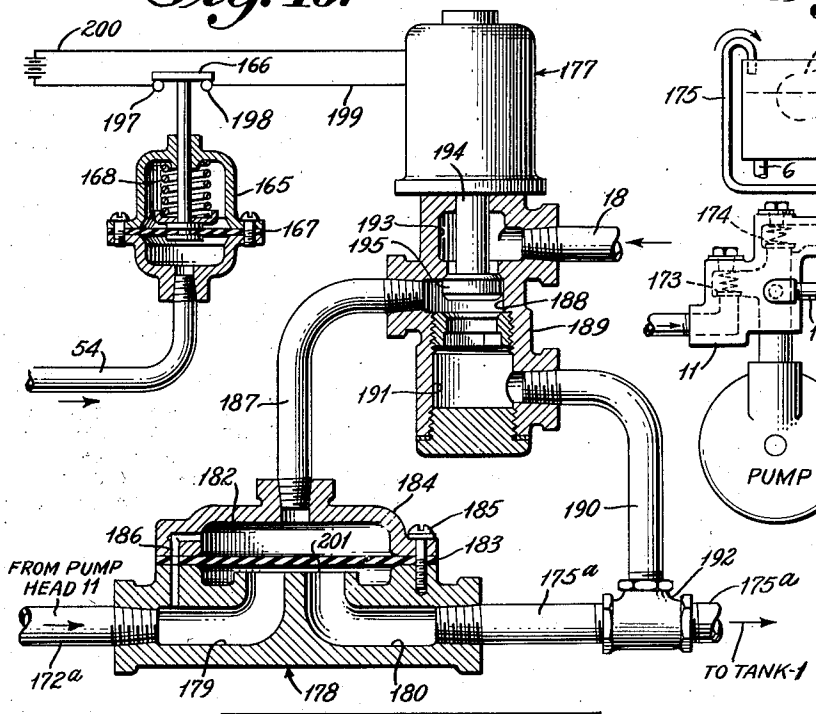


Fig. 9.

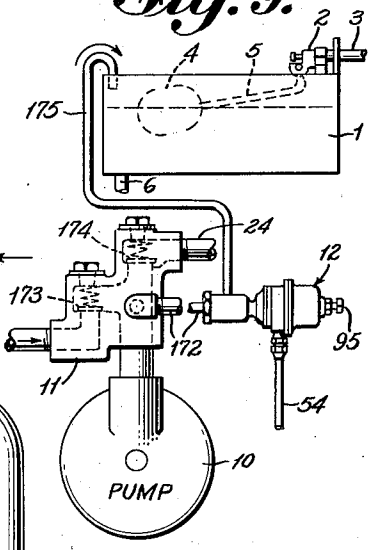


Fig. 11.

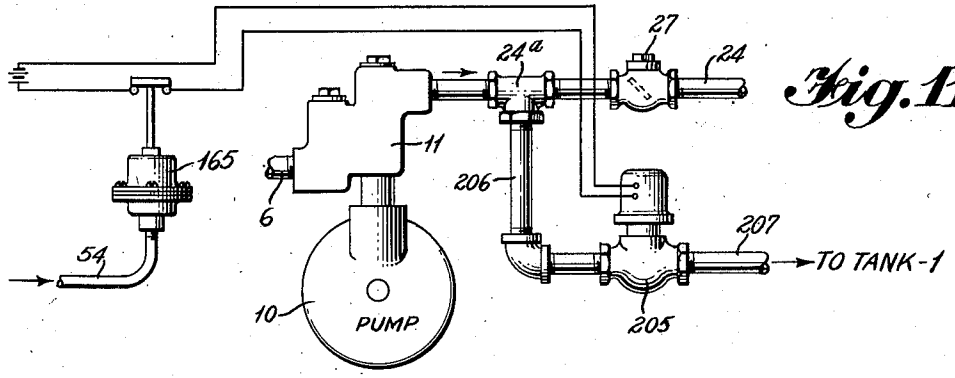
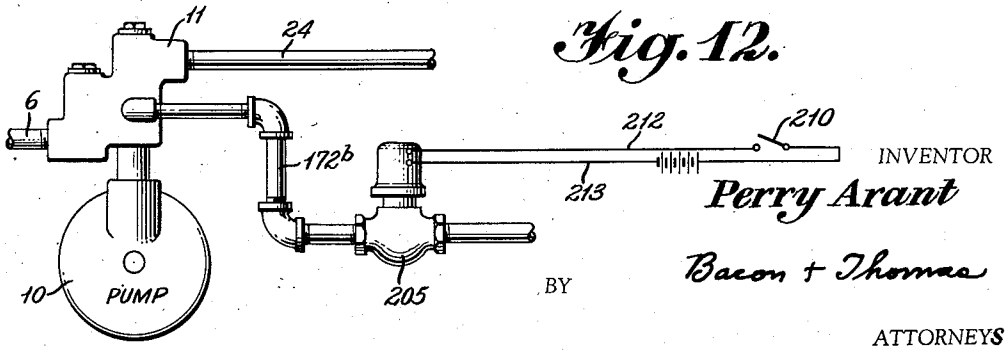


Fig. 12.



INVENTOR
Perry Arant

BY Bacon + Thomas

ATTORNEYS

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2,790,678

STEAM CLEANING MACHINE

Perry Arant, San Gabriel, Calif., assignor to Clayton Manufacturing Company, El Monte, Calif., a corporation of California

Application September 24, 1952, Serial No. 311,297

28 Claims. (Cl. 299—84)

The present invention relates to cleaning machines and more particularly to certain improvements in steam cleaning machines of the type designed to provide a vapor cleaning spray and a relatively high pressure liquid rinse, either hot or cold.

The invention further relates to a new type of cleaning gun having permanently associated vapor and rinse tubes and replaceable nozzle elements at the ends of such tubes, together with valve means for shutting off the gun or rendering one nozzle operative while rendering the other inoperative.

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 comprises an improved steam cleaning machine having a single discharge hose communicating at one end with a heating coil and with a source of 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 in one form of the invention a pressure-responsive, normally open, rinse pump by-pass valve is connected in the system and arranged to automatically close to non-by-passing position to cause flow of relatively unheated water to the system, or to the discharge hose, to blend with the liquid in or

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.

Other embodiments of the invention contemplate the use of a manually operated by-pass valve, pressure-responsive and manually operated switches to control solenoid-operated by-pass valves, etc., as will appear more fully hereinafter.

A pressure-responsive soap pump 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 control by-pass valve is closed. 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 by-pass valve and the soap pump control valve to automatically open. If desired, the system may include means for allowing the soap pump control valve to stay open during a rinsing operation.

Thus, in one form of the invention, the operator, by merely actuating the conversion valve means at the cleaning gun, can easily and quickly effect convertion of the system from one type of spray to another, and can do so without necessarily discontinuing or shutting off flow through the cleaning gun. In other forms of the invention, conversion can be effected by a manually operated switch, or a single manually operated valve, as will be pointed out later.

The by-pass control valves disclosed herein can be employed to advantage (with or without the soap pump control valve) even in prior cleaning machines having separate vapor and rinse hoses and separate vapor and rinse guns, inasmuch as the automatic by-pass control valves will 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 they respond 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 is to provide a vapor cleaning and rinsing machine embodying a single, dual purpose cleaning gun, 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 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 system embodying 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 system 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 system embodying 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 system wherein the addition of a cleaning agent to the system is automatically interrupted substantially simultaneously 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 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 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 necessarily shutting off flow through the cleaning gun.

A still further object of the invention is to provide 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, or for shutting off flow through both nozzles.

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 and cleaning gun embodying the principles of the present invention, the parts being spread apart and shown interconnected by pipes or conduits of greater length than necessary in actual practice in order to facilitate illustration;

Fig. 2 is a vertical sectional view through the conversion valve of the cleaning gun shown in Fig. 1;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a longitudinal sectional view through the by-pass valve for the rinse pump head shown in Fig. 1;

Fig. 5 is a fragmentary sectional view illustrating the soap pump of the system of Fig. 1 and the valve for controlling the operation thereof;

Fig. 6 is a longitudinal sectional view through the snubber shown in the system of Fig. 1;

Fig. 7 diagrammatically illustrates a modified system in which a solenoid-operated by-pass valve and a pressure switch are shown substituted for the automatic fluid pressure operated by-pass valve in Fig. 1;

Fig. 8 illustrates another modification of the system wherein a manually operable by-pass valve has been substituted for the automatic by-pass valve shown in Fig. 1;

Fig. 9 illustrates a further modification of the system of Fig. 1 wherein an automatic pressure-responsive by-pass valve is arranged to return by-passed liquid from the rinse pump head to the supply or storage tank;

Fig. 10 is a diagrammatic view illustrating a pressure-actuated switch and a three-way solenoid-operated valve connected with a hydraulically operated by-pass valve adapted to be substituted for the by-pass valve shown in either Figs. 1, 7, 8, or 9;

Fig. 11 illustrates a further modification embodying a pressure-operated switch and a solenoid-operated by-pass valve arranged to return liquid to a supply tank; and

Fig. 12 illustrates a still further modification in which the pressure-responsive switch of Fig. 9 for controlling the solenoid-operated by-pass valve has been eliminated and a manually controlled switch substituted therefor.

Referring now to Fig. 1 of the drawings, the numeral 1 identifies a liquid storage tank 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 pipe line 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 opposite end of the pipe line 6. A normally open, pressure-responsive valve 12 is so connected in the system in by-passing relation to the rinse pump 11 that it is caused to close automatically to non-by-passing position when a back pressure of about 125#/sq. in. 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 pipe line 24 connected thereto and is, in turn, connected by a branch pipe 25 to another outlet 26 of the four-way fitting 23. The by-pass valve 12 is connected in a pump by-pass line comprising sections 12^a and 12^b. The by-pass conduit has one end thereof secured to a pipe-T 6^a connected in the pipe line 6 and its opposite end secured to a pipe-T 24^a connected in the pipe line 24. A one-way check valve 27 is connected in the pipe line 24 between the pipe-T 24^a and the branch pipe 25.

A pressure gauge 28 and a conventional gauge cock are connected with the feed pipe 18 to indicate the pressure of the liquid being pumped into the inlet 19 of the heating coil 20. A similar pressure gauge 29 is connected by a pipe 30 to a pipe-T 31 disposed in the branch pipe 25 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#/sq. in. A blow down valve 34 is connected in the pipe line 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, 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. The snubber 35 is shown in cross-section in Fig. 6 and will now be described in detail.

The snubber 35 comprises a cylindrical housing 35^a having flanges 35^b and 35^c at the opposite ends thereof. The cylinder 35^a is counterbored inwardly from its opposite ends to provide shoulders 35^d and 35^e. A head 35^f is secured to the flange 35^b by a plurality of screws 35^g, a diaphragm 35^h being interposed between said head and flange. One end of the pipe line 24 is connected with the head 35^f. A similar head 35^i overlies a diaphragm 35^j and is secured to the flange 35^c by a plurality of cap screws 35^k. One end of the pipe line 32 is connected to the head 35^i. A disk 35^l engages the inner side of the diaphragm 35^h and a similar disk 35^m engages the inner side of the diaphragm 35^j. A compression spring 35^n is

disposed in the housing 35a with its opposite ends seated in suitable recesses formed in the respective disks 35l and 35m. A port 35o vents the interior of the housing 35a to the atmosphere.

In the normal operation of the system, the pumping impulses of the feed pump 9 act upon the discharge 35j, and the pumping impulses of the rinse pump 11 act upon the diaphragm 35h, the impulses of both pumps being yieldably opposed by the compression spring 35n. Thus, the pumping impulses are independently absorbed to provide for smooth flow of liquid to and through the system. At the same time, the snubber is so constructed that in the event of failure of either one of the diaphragms 35h or 35l, there is no possibility of communication being established between pipes 18 and 24. A further advantage is that failure of either diaphragm will be revealed by leakage through the vent port 35o.

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 pipe line 6 to control the flow of cleaning solution from the tank 1 to the inlet side of the feed pump head 9. A normally open, pressure-responsive valve 53 is connected in the tube 46 between the soap pump 45 and the pump head 9, and is constructed to close automatically to render the pump 45 ineffective when the system or cleaning gun is adjusted for a rinsing operation, as will be pointed out more fully hereinafter. The valve 53 is shown in cross-section in Fig. 5 and will be described in detail later.

The motor 17 operates continuously, and it is to be understood that the pump head 9 includes a built-in by-pass (not shown) for by-passing liquid at a time when the pump is operating but the apparatus is not being used for cleaning or rinsing purposes. On the other hand, the valve 12 functions as a by-pass for the pump head 11, as will be explained later. 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 or by-pass valve 12 and the pressure-responsive soap pump control valve 53 both derive operating fluid under pressure from a pipe 54 having one end thereof connected to a pipe-T 55a connected in the pipe 30 and its opposite end connected with the valve 12. One end of a branch pipe 55 is connected to a pipe-T 56 in the pipe 54 and its other end is connected with the valve 53, so that said valves are subject to the pressure adjacent the outlet of the heating coil 20. A conventional plug cock 57 is connected in the branch pipe 55 and may be closed to render the valve 53 immune to pressure conditions in the pipe 54, as will be explained hereinafter.

Referring more particularly to Fig. 4, the by-pass valve 12 comprises a body including an end, seat-containing section 60, an intermediate section 61 and a third or spring housing section 62. The section 60 has an inlet chamber 63 to which access is gained through a threaded opening 64. One end of the section 12b of the by-pass line is connected with the opening 64 and the opposite end thereof is connected with the pipe-T 24a, as previously pointed out. The valve section 60 also has an outlet chamber 65 which communicates with a threaded opening 66. One end of the pipe section 12a of the by-pass line is connected with the opening 66 and its opposite end is connected with the pipe-T 6a, as previously explained. The inlet chamber 63 and the outlet chamber 65 communicate with each other through an opening 67 surrounded by a valve seat 68. The section 60 is provided with a bore 69 in which a valve stem 70 is slidably mounted and sealed by an O-ring packing 69a. A disk 71 is mounted upon one end of the rod 70 and is received in the chamber 63. The disk 71 is adapted to cooperate with the seat 68 to control the flow of liquid through the valve section 60. The disk 71 is shown engaged with the seat 68 in Fig. 4 and this corresponds to a rinse operation at which time by-passing of liquid around the pump head 11 is prevented by the closed condition of the valve 12. The movement of the valve stem 70 for controlling the opening and closing of the valve 12, is automatically controlled by means which will now be described.

The intermediate valve section 61 is generally cylindrical and has flanges 72 and 73 formed at the opposite ends thereof, the flange 73 being greater in diameter than the flange 72. A diaphragm 74 is interposed between the flange 72 and a flange 75 formed on the adjacent end of the valve section 60. A plurality of screws 76 extend through the flange 75 and are threaded into suitable openings in the flange 72, and serve to secure the valve sections 60 and 61 together with the diaphragm 74 tightly clamped therebetween. The valve section 62 has a flange 77 which confronts the flange 73 of the valve section 61 and a diaphragm 78 is disposed between the two flanges. A plurality of screws 79 extend through the flange 77 and are threaded into suitable openings in the flange 73 and secure the valve sections 61 and 62 together with the diaphragm 78 clamped therebetween.

The valve stem 70 projects into a hollow housing member 80 disposed in the valve section 61. The housing 80 has an externally threaded projection 81 which extends through a central opening in the diaphragm 74 and

a ring 82 is threaded onto the extension 81 to tightly clamp the diaphragm 77 against the adjacent shoulder on the housing 80. The opposite end of the housing 80 is internally threaded, as indicated at 83, for the reception of a threaded boss projecting from a diaphragm-supporting plate 84 mounted thereon. A head 85 is mounted upon the end of the rod 70 within a chamber 86 in the housing 80. Compression springs 87 and 87a are disposed in the chamber 86 and engage opposite sides of the head 85, for a purpose which will be explained later.

The valve section 61 has a threaded side opening 88 to which one end of the pressure conduit 54 is connected. The opening 88 communicates with a pressure chamber 89 in the valve section 61, said pressure chamber surrounding the member 80 and being defined at its opposite ends by the diaphragms 74 and 78. The valve section 61 is chamfered, as indicated at 90, so that a greater area of the diaphragm 78 is subject to the pressure in the chamber 89.

A circular plate 91 is disposed in the valve section 62 and engages one side of the diaphragm 78. A cap screw 91a extends through aligned openings in the disk 91 and diaphragm 78 and into a threaded opening 91b in the plate 84 and serves to secure the disk 91 and plate 84 in sealing contact with the opposite sides of the diaphragm 78. One end of a compression spring 92 is seated upon the disk 91 and the opposite end of said spring is engaged by a somewhat similar disk 93. A threaded opening 94 is formed in the valve section 62 and an adjusting screw 95 is mounted therein. The inner end of the screw 95 engages a central recess 96 in the disk 93 and is adjustable to vary the spring load imposed on the diaphragm 78 tending to maintain the valve disk 71 unseated. The screw 95 carries a locknut 96 for retaining the same in adjusted position relative to the valve section 62. A vent opening 97 is formed in the end of the section 62 to vent the space within said section to the atmosphere.

The spring 92 is adjusted so that it will yield when a pressure of about 125#/sq. in. is attained in the system. Such pressure is communicated to the chamber 89 through the pressure conduit 54, so that when the pressure in the system exceeds that required to overcome the force of the spring 92, the diaphragms 74 and 78 will be flexed toward the right, as shown in Fig. 4, with the valve disk 71 engaged with its seat 68 to interrupt the flow or by-passing of liquid through the valve 12.

During normal vapor operation, the pressure in the system is about 50 to 100#/sq. in. and the spring 92 will maintain the valve stem 70 moved toward the left as viewed in Fig. 4, so that by-passing of the liquid discharged from the pump head 11 will take place, without any of the liquid pumped by said pump getting past the one-way check valve 27. In other words, the rinse pump 11 idles without forcing any water into the system. The check valve 27 prevents the pressure in the system or the pulsations of the pump 9 from acting against the discharge of the pump 11, at this time.

Automatic closing of the by-pass valve 12 can be effected by positioning a conversion valve C on a cleaning gun G (both of which will be described later) so that a back pressure will be created in the system and communicated through the conduit 54 to the pressure chamber 89 in the by-pass valve 12. Such pressure, when it exceeds the set pressure of the spring 92, will cause the valve stem 70 to be moved toward the right to thereby engage the disk 71 with the valve seat 68 to cause the by-pass valve to close, with the result that the pump 11 will then be caused to discharge into the pipe 24. When the disk 71 is seated the spring 87a is compressed to less than its normal length and positively holds the disk 71 seated. When the pressure in the chamber 89 drops to less than that required to overcome the force of the spring 92, the latter will flex the diaphragms 74 and 78 toward the left, but the system pressure acting on the valve disk 71 will maintain the same seated until sufficient force is applied to move the disk off its seat. As the diaphragms flex toward the left, the spring 87a extends itself and the spring 87 is correspondingly compressed until a point is reached when the disk 71 is about to unseat, whereupon the spring 87 then expands causing the disk 71 to unseat with a snap action. A further function of the springs 87 and 87a is to prevent "fluttering" or slapping of the valve disk 71 against its seat 68 under the effect of pump pulsations acting upon the diaphragms 74 and 78 through the pressure conduit 54.

Referring now to Fig. 5, the soap pump control valve 53 includes a generally cup-shaped body 100 having a centrally projecting boss 101 provided with a central passage 102 and terminating in a valve seat 103. The valve body 100 has a threaded inlet opening 104 communicating with the central opening 102 and one end of a portion of the tube 46 is connected with the opening 104. The body 100 has a threaded outlet opening 105 to which the lower portion of the tube 46 is connected to transmit impulses to the soap pump 45.

The valve body 100 has a flange 106 disposed in confronting relation with a similar flange 107 formed on a cover 108. A diaphragm 109 is interposed between the flanges 106 and 107, and a plurality of screws 110 secure the cover to the body 100 with the diaphragm 109 tightly clamped therebetween. A threaded opening 111 is formed in the cover 108 and communicates with a pressure chamber 112 within said cover. One end of the pressure conduit 55 is connected with the opening 111, so that changes in pressure in the system are communicated through the conduit 55 to the chamber 112 to act against one side of the diaphragm 109. A plate 113 is centrally engaged with the opposie side of the diaphragm 109 and is supported by a compression spring 114 disposed therebetween and snugly engaging the base of the boss 101. A valve disk 115 is carried by the plate 113 and is cooperable with the seat 103 to control the transmission of pumping impulses from the feed pump 9 to the soap pump 45.

The spring 114 urges the disk 113 away from the seat 103, so that the soap pump control valve 53 is normally open. The spring 114 is selected so that it will yield and permit closing of the valve 53 when a back pressure of about 100#/sq. in. is produced in the system which is substantially less than the pressure which normally prevails when the apparatus is automatically converted from a vapor spray operation to a liquid rinse operation. Hence, the spring 114 exerts sufficient force to keep the pump tube 46 open so long as the pressure in the conduit 55 does not exceed about 100#/sq. in.

When the system is conditioned for conversion and the pressure increases to about 125#/sq. in. or above, the spring 114 will be compressed and the valve disk 115 will engage the seat 103 to prevent the pump impulses generated by the feed pump 9 from being transmitted to the soap pump 45. Closing of the valve 53 thus prevents operation of the soap pump 45, so that no soap will be delivered to the tank 1 during a rinse operation. However, should it be desired to render the soap pump control valve 53 ineffective or immune to changes in pressure in the system, then the clock 57 is manually closed at a time when the valve 53 is open. Closing of the clock 57, under the conditions specified, will prevent pressure being communicated to the valve chamber 112, so that the valve 53 will then remain open and the pump 45 will continue to function to deliver soap to the tank 1, even during a rinsing operation, and changes in pressure in the system will have no effect whatever upon the feeding of soap to the tank 1.

One of the important features of the valve 53 is that the diaphragm 109 is not subjected to flexing action at a time when delivery of soap to the tank 1 is not desired.

In other words, when the valve 57 is open, the valve 53 operates automatically in accordance with pressure changes in the system. During a rinsing operation, under such conditions, the disk 115 simply seats and remains seated, thereby preventing the transmission of any impulses in the liquid column in the tube 46 beyond the valve 53. Thus, the life of the diaphragm 109 is substantially prolonged.

It will be noted from the foregoing that the pressure in the pipes 54 and 55 acts simultaneously upon the diaphragms 74 and 78 of the by-pass control valve 12, and upon the diaphragm 109 of the soap pump control valve 53 to normally effect closing of both valves under predetermined pressure conditions such as exist during a rinsing operation.

A manually operable discharge control valve 116 has the inlet side thereof connected by a pipe nipple 116a with one branch of the four-way fitting 23. The outlet of the valve 116 is connected by a conventional pipe union 117 with one end of a flexible hose or discharge conduit 118 that may be of any desired length. The opposite end of the hose 118 is connected by a conventional swivel coupling 119 to a conduit 120 constituting a part of the cleaning gun G. A bracket 121 is welded or otherwise mounted upon the conduit 120 and has a hand grip 122 secured thereto adapted to be held by one hand of the operator when using the cleaning gun.

The cleaning gun G is designed to provide the dual function of vapor spraying or rinsing, at the will of the operator, and to this end includes the manually operable conversion valve C. The valve C is connected to the conduit 120 by a pipe nipple 123 and a conventional coupling 124. A vapor discharge tube and nozzle assembly 125, and a rinse discharge tube and nozzle assembly 126 are both connected with the valve C. The nozzle assemblies 125 and 126 are held together by a handle portion 127 mounted thereon and preferably made of non-heat-conducting material to facilitate handling of the gun G by the operator while performing a cleaning or rinsing operation.

The conversion valve C has a shut-off position, as will be explained more fully hereinafter, thereby enabling the operator to shut off all flow through the gun, at the gun itself, thus eliminating the necessity of the operator walking back to the machine to close the valve 116 whenever use of the gun G is to be temporarily discontinued.

The details of construction of the conversion valve C are shown in Figs. 2 and 3. Thus, the valve C comprises a body portion 130 having a threaded inlet opening 131 in which one end of the pipe nipple 123 is mounted. The body portion 130 also has a threaded outlet 132 into which one end of the tube of the vapor nozzle assembly 125 is threaded. The body 130 has another threaded outlet opening 133 into which one end of the tube of the rinse nozzle assembly 126 is threaded.

The threaded openings 132 and 133 are respectively disposed above and below a horizontal partition 134 within the valve body 130 wherein it provides outlet chambers 135 and 136. The partition 134 lies in the same horizontal plane as the threaded inlet opening 131 and is cored out as indicated at 137 to provide an inlet chamber communicating with the pipe nipple 123. The valve body 130 has a threaded opening 138 disposed between the inlet and outlets thereof and which affords ready access to the interior of the valve. The partition 134 is adapted to be counterbored through the opening 138 in order to form a shoulder 139 thereon for supporting a valve seat 140. The partition 134 is also counterbored on a larger diameter to provide a second shoulder 141, above the shoulder 139, which serves as a support for a second valve seat 142. The valve seats 140 and 142 are preferably formed of stainless steel and are tightly fitted into the counterbores which receive the same.

A bonnet 143 has a threaded portion 144 screwed into the threads 138 to mount the same on the body 130. The body 130 is recessed as indicated at 145 for the reception of a conventional O-ring packing 146, which is compressed in the recess by a shoulder 147 formed on the bonnet 143. The bonnet 143 carries a downwardly projecting cylindrical portion 148 which engages the upper side of the valve seat 142 to maintain the same in assembled relation with the partition 134. A plurality of ports 149 extend through the cylindrical portion 148 to establish communication between the inlet chamber 137 and the outlet chamber 135. A valve stem 150 is mounted in the bonnet 143 and both parts are provided with multiple pitch threads 151 for effecting substantial axial movement of the valve stem 150 incident to rotation of said stem through a relatively short arc. The stem 150 carries a disk 153 which lies between the valve seats 140 and 142 and is adapted to selectively cooperate with one seat or the other to obstruct flow to either the outlet chamber 135 or 136, depending upon the type of operation desired. The valve seats 140 and 142 have a space 154 therebetween which communicates with the inlet space 137. The disk 153 is of sufficient axial width to obstruct the space 154, so that all flow through the gun can be shut off by adjusting the disk to its intermediate position. This avoids the necessity and cost of providing a separate shut-off valve adjacent the gun G and aids in building up back pressure to effect conversion from vapor to rinse operation, as will be pointed out more fully later.

The valve stem 150 is sealed against leakage therealong by a conventional stuffing body structure generally identified by the numeral 155. The handle 156 is fastened to the upper end of the valve stem 150 by a clamping bolt 157. The handle 156 is preferably enclosed in a covering 158 of heat insulating material thereby to enable the handle 156 to be manipulated without danger of the operator burning his hand.

A plug 159 is mounted in a threaded opening 160 formed in the body 130, in axial alignment with the valve stem 150. Should it be desired to disassemble the valve C, it is only necessary to unscrew the bonnet 143 from the body 130, and this operation will automatically effect removal of the valve seat 142, by engagement therewith of the valve disk 153, as the stem is withdrawn from the body 130. Thus, a subassembly of the bonnet 143, valve stem 150, valve seat 142 and valve disk 153 is provided which facilitates rapid assembly and disassembly of the valve C. The plug 159 can be removed and a tool inserted through the opening 160 to force the valve seat 140 out of the counterbore 139, should it become necessary to remove or replace this valve seat.

The valve disk 153 has a cylindrical portion 153a which is of substantially the same diameter as the opening in the valve seat 142 so that as the disk 153 is raised, it will clean off any soap or foreign matter that may have become lodged on the wall of the opening of said valve seat. The valve disk 153 also has a depending cylindrical portion 153b of substantially the same diameter as the opening in the valve seat 140 for similarly cleaning said valve seat. In this way, the passages in the valve seats 140 and 142 are always maintained clean.

The vapor nozzle assembly 125 includes a bent or angular, threaded, nozzle element 125a that can be removed and interchanged for any other suitable nozzle element to provide a spray of any desired character or shape. The rinse nozzle assembly 126 also has a threaded nozzle element 126a secured thereto which can also be interchanged, if desired. The vapor nozzle assembly 125 is positioned above the rinse nozzle assembly 126 in order to facilitate replacement of the vapor nozzle element 125a. It will be apparent from Fig. 1 that the nozzle element 125a can readily be rotated to mount or remove the same without any interference from the

rinse nozzle assembly **126**. It will be understood that the rinse nozzle element **126a** has a smaller size discharge orifice than the vapor nozzle element **125a** so that the pressure in the system can be automatically increased as a result of the restriction of the discharge preparatory to a rinsing operation.

The valve disk **153** is shown in Fig. 2 in its intermediate or shut-off position. Assuming that a vapor cleaning operation is desired, the handle **156** is rotated to cause the valve disk **153** to move downwardly into engagement with the seat **140** to obstruct flow between the inlet chamber **137** and the outlet chamber **136** and to permit flow from said inlet chamber into the outlet chamber **135** to the vapor nozzle assembly **125**. Assuming also that the shut-off valve **116** is open, heated fluid from the heating coil **20** can readily flow through the discharge conduit **118**, pipe **120** and pipe nipple **123** into the inlet **137** of the valve C, thence through the valve seat **142**, the openings **149** in the bonnet **143**, through outlet chamber **135** and into the vapor nozzle assembly **125** from which it is discharged into the atmosphere from the nozzle element **125a** 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 handle **156** of the conversion valve C need only be rotated through about one complete turn in order to shift the disk **153** from engagement with the valve seat **140** into engagement with the valve seat **142**. The flow of fluid then takes place through the valve seat **140**, outlet chamber **136** and rinse nozzle assembly **125** for ultimate discharge through the rinse nozzle element **126a**.

It will be apparent from the foregoing that the valve disk **153** has three operative positions: one at one extreme end of its movement, in which it obstructs flow through the valve seat **140** while permitting flow through the valve seat **142** to effect a vapor cleaning operation; another position at the other extreme end of its movement in which it obstructs flow through the seat **142** and the outlet opening **135** while permitting flow through the seat **140** and outlet opening **136** to effect a rinse operation; and an intermediate position in the plane of the space **154** between the valve seats **140** and **142** in which flow is obstructed to both valve seats to shut off the cleaning gun G.

In the normal operation of the apparatus described hereinbefore, 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 **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** through the valve **53** to actuate the soap pump **45**, as aforedescribed, to proportionately pump soap from the tank **38** through the pipe **49** and valve **51** into the tank **1** for admixture with the water entering said tank through the valve **2**. The feed pump head **9** includes a by-pass, as previously stated, for by-passing solution at a time when said pump head is in operation, but the gun G is not in use. Should an excess pressure condition occur, the relief valve **33** will automatically open to relieve such pressure when it reaches about 175#/sq. in.

Assuming that the gun G is in use and that a vapor cleaning spray is being discharged from the nozzle element **125a** at a pressure of about 50 to 100#/sq. in. (and preferably at about 90#/sq. in.), the by-pass control valve **12** is then open and the rinse pump **11** merely idles without forcing any liquid into the system. At this time, the soap pump control valve **53** is also open enabling the soap pump **45** to operate and add soap to the tank **1**. The handle **156** of the conversion valve C is adjusted so that the valve disk **153** engages the seat **140**, thereby blocking the dischareg of fluid through the rinse nozzle assembly **126**.

The cleaning solution is heated 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 element **125a**. 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 (not shown). 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#/sq. in. is 150 gal. 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 rotate the handle **156** to shift the disk **153** of the conversion valve C from the position it is then in (engaging seat **140**), into its intermediate, or its other extreme position in engagement with the seat **142**, and this will automatically convert the system or gun G from a vapor cleaning spray to a high velocity, high pressure, hot water rinse. The conversion of the system from one type of spray to another is automatically effected by increasing the back pressure therein sufficiently to cause closing of the pressure-responsive by-pass valve **12** in the manner already explained. The back pressure in the system can be most quickly increased by positioning the valve disk **153** in its intermediate position blocking all flow through the valve C, and this is the preferred mode of operation for effecting conversion. However, automatic conversion can also be effected, but less rapidly, by shifting the valve disk **153** from engagement with the seat **140** directly into engagement with the seat **142**, the back pressure then being built up in the system as a result of the restriction to discharge offered by the orifice of the rinse nozzle element **126a**. Irrespective of which adjustment of the valve C is utilized to effect conversion, the discharge from the system will be restricted thereby and a back pressure will be set up in the system resulting in a corresponding pressure being quickly built up in the pipes **30**, **54** and **55**, with the result that when the pressure in the system is increased to about 125#/sq. in., the diaphragms **74** and **78** of the by-pass valve **12** will be actuated to move the valve disk **71** from its open to its closed position and thereby direct liquid discharged from the pump head **11** into the 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 **118** for ultimate discharge from the rinse nozzle element **126a**. Meanwhile, the same increased pressure condition which effected closing of the by-pass valve **12** also acts upon the diaphragm **109** of the soap pump control valve **53**, causing the valve disk **115** to seat and remain seated to thereby prevent the transmission of pumping impulses through the tube **46** to the soap pump **45**. Soap is thus conserved and the presence of soap in the rinse jet is avoided. However, should it be desired to continue the supply of soap to the tank **1** during a rinsing operation, then valve **57** is manually closed to render the soap pump control valve **53** immune to changes in pressure conditions in the system. A normal rinsing operation is effected with the present apparatus at a working pressure in the system of about 150#/sq. in., and with a flow rate of about 275 gal. per hour.

Should the operator desire to convert back from a rinse spray to a vapor cleaning spray, it is only necessary to rotate the handle **156** back to its original position to shift the valve disk **153** into engagement with the valve seat

140 to thus block flow to the rinse nozzle assembly 126. The pressure in the system will then quickly drop and settle to about 90#/sq. in., due to the removal of the flow restriction which had increased the back pressure in the system (the relatively larger orifice of the vapor discharge nozzle element 125a offering less restriction than the orifice of the nozzle element 126a) so that as soon as the back pressure drops below 125#/sq. in., the by-pass control valve 12 will automatically open, thereby effecting by-passing of the discharge from the pump head 11; and the soap pump control valve 53 will automatically open, to permit resumption of soap addition to the tank 1 from the tank 38.

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, and vice versa, 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. 7 is a fragmentary view diagrammatically illustrating a modification of the system shown in Fig. 1 wherein a solenoid-operated valve 164 is interposed in the by-pass line comprising the pipe sections 12a and 12b. A conventional pressure-responsive switch 165 (shown in cross-section in Fig. 10) is connected to one end of the pressure conduit 54 and includes a movable element 166 connected with a diaphragm 167 and urged by a spring 168 to a position bridging a pair of contacts 166a and 166b arranged in a conductor 169 having one end thereof attached to the coil of the solenoid valve 165; a second conductor 170 is attached to the opposite end of the coil. The switch 165 is normally closed when the machine is in operation so that the circuit to the solenoid-operated valve 164 is completed and the valve is energized to maintain the same in open, by-passing condition for by-passing liquid pumped by the pump head 11, in the same manner described in connection with the pressure-responsive by-pass valve 12. However, when the pressure in the system increases to about 125#/sq. in., the force of the spring 168 is overcome by the hydraulic pressure acting on the diaphragm 167 and the movable element 166 is actuated thereby to disengage the contacts 166a and 166b and interrupt the circuit and de-energize the valve 164 so that it automatically closes to discontinue by-passing of liquid around the pump 11. Liquid discharged from the pump 11 then enters the pipe line 24, flowing through the check valve 27 for admixture with the liquid being discharged from the heating coil 20, at the region of the four-way fitting 23.

Fig. 8 diagrammatically illustrates a further modification of the system shown in Fig. 1 wherein a conventional, manually operable shut-off valve 171 is connected in the by-pass line 12a—12b. The shut-off valve 171, being non-automatic, does not afford the advantages that are obtained with automatically operated valves such as the hydraulically operated by-pass valve 12 and the electrically operated by-pass valve 164, since the use of the manual valve 171 requires the operator to return to the machine to open or close said valve whenever conversion from one form of spray to another is desired. However, the manually operated by-pass valve constitutes an improvement over prior systems wherein separate hoses and cleaning guns were required for vapor cleaning and rinsing operations and, therefore, this is of value.

Fig. 9 diagrammatically illustrates another modification of the system shown in Fig. 1, wherein the by-pass valve 12 has the inlet thereof connected by a pipe 172 with the pump head 11 at a point between an inlet check valve 173 and an outlet check valve 174 of the pump. The outlet of the valve 12 is connected to a pipe 175 arranged to discharge or return liquid to the tank 1. The valve 12, of course, has its pressure chamber connected with the pressure conduit 54 to effect automatic operation thereof in the same manner previously described. However, the advantage of the modified construction is that it eliminates the necessity for using a one-way check valve 27 in the pipe line 24 and at the same time prevents the pulsations of the pump head 11 from being imposed upon the remainder of the system.

Fig. 10 diagrammatically illustrates a further modification employing the pressure-actuated switch 165 in combination with a three-way solenoid-operated valve 177, and a hydraulically operated valve whose operating fluid is controlled by said solenoid-operated valve. Thus, a conventional diaphragm-type valve 178 has the inlet chamber 179 thereof connected with the pump head 11 by a pipe 172a, similar to the pipe connection 172 shown in Fig. 9, and its outlet 180 connected with a pipe 175a arranged to return liquid to the storage tank 1, in the same manner as the pipe 175. The valve 178 has a pressure chamber 182 disposed between a diaphragm 183 and a cover 184. A plurality of screws 185 secure the diaphragm 183 and cover 184 to the body of the valve 178. Passage means 186 establish constant communication between the inlet chamber 179 and the pressure chamber 182. A tube 187 connects the pressure chamber 182 with a chamber 188 formed in the body 189 of the solenoid-operated valve 177. Another tube 190 connects an outlet chamber 191 in the body 189 with a pipe-T 192 connected in the pipe line 175a. The valve body 189 has an inlet chamber 193 connected with the pipe line 18 to provide a source of operating fluid under pressure for effecting closing of the valve 178. A valve stem 194, actuated by the coil of the solenoid-operated valve 177, carries a disk 195 for controlling communication between the tube 187 and the pipe line 18, on the one hand, and the tubes 187 and 190, on the other hand.

During a vapor cleaning operation, when by-passing of the pump head 11 is desired, the movable element 166 of the switch 165 is engaged with contacts 197 and 198 arranged in a conductor 199 so that a circuit to the coil of the solenoid valve 177 is completed through the conductor 199 and a conductor 200 to energize the valve 177 and position the valve disk 195 in the position shown in Fig. 10, wherein communication is established between the pressure chamber 182 and the pipe 175a through the tube 187, the chamber 191 in the body 189 and the tube 190, to exhaust operating fluid from the chamber 182 and thus allow the valve 178 to remain open under the discharge pressure of the pump head 11. Any fluid entering the pressure chamber 182 through the port 186 escapes from the chamber 182 so that insufficient pressure exists in the chamber 182 to urge the diaphragm 183 into contact with its seat 201. Thus, the liquid pumped by the pump head 11 is by-passed from the system and returned to the storage tank 1, in the same manner described in connection with Fig. 9.

During a rinse operation, sufficient pressure is applied to the diaphragm 167 through the conduit 54 to overcome the force of the spring 168 and to move the switch element 166 out of engagement with the contacts 197 and 198, and the valve 177 is then de-energized. The valve disk 195 will then move downwardly and assume a position in which it obstructs flow between the tubes 187 and 190, but establishes communications between the pipe line 18 and the tube 187, thereby permitting operating fluid under pressure from the pipe line 18 to flow through the tube 187 into the pressure chamber 182 to act upon the diaphragm 183 to effect closing of the valve 178, whereupon by-passing of liquid from the pump head 11 is discontinued and the discharge from said pump head is forced to enter the system through the pipe 24.

Fig. 11 diagrammatically illustrates a further modifi-

cation in which a solenoid-operated by-pass valve **205** (similar to the by-pass valve **164**, Fig. 7) has its inlet connected by a pipe **206** with the pipe-T **24**[a] and its outlet connected with a pipe **207** for returning liquid pumped by the pump head **11** to the tank **1**. A pressure-operated switch **165** is connected with the solenoid-operated valve **205** in the same manner described in connection with Fig. 7, so that when a rinse operation is desired, and the pressure rises in the system to a point where it is great enough to effect opening of the switch **165**, the solenoid valve **205** is de-energized to allow closing thereof, and thereby interrupt the return of liquid to the storage tank **1**. Liquid then discharged from the pump head **11** must flow past the check valve **27** into the system through the pipe line **24**.

Fig. 12 diagrammatically illustrates a system similar to that shown in Fig. 11, except that the check valve **27** has been omitted, a manually operated switch **210** has been substituted for the automatic pressure-responsive switch **165**, and the solenoid-operated valve **205** has its inlet connected with the chamber in the pump head **11**, as in Fig. 9, by a pipe **172**[b]. The outlet of the valve **205** is connected with a pipe **175**[b] for returning by-passed liquid to the tank **1**. The manually operated switch **210** may be conveniently mounted on the cleaning gun G to enable the operator to open the same to interrupt the circuit to the solenoid-operated valve **205** and effect de-energizing and closing of said valve through conductors **212** and **213**, without the operator putting down the cleaning gun. Of course, a cable containing the conductors **212** and **213** must of necessity extend from the valve **205** to the cleaning gun. In this manner, the solenoid-operated valve **205** can be remotely, manually controlled, to effect conversion of the system from one type of spray to another, by controlling by-passing of the liquid from the pump head **11**, as previously described.

It will be understood that any of the by-pass systems disclosed herein in which the inlet of the by-pass valve is connected with the pipe-T **24**[a] can be connected with the pump head **11** instead and return by-passed liquid to the tank **1**, as in Fig. 9, for example; and that alternatively, any of the by-pass valves having the inlet thereof connected with the pump head **11** at a point between the two check valves **173** and **174**, as contemplated by Figs. 9, 10 and 12, may in lieu thereof have its inlet connected with the pipe-T **24**[a].

It will also be understood that various changes may be made in the arrangement and details of construction of the various valves, by-pass systems and the cleaning gun 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.

I claim:

1. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil inlet for pumping liquid into said heating coil; additional pump means havng an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heatng coil; a by-pass valve normally connecting said additional pump means in by-passing relation and arranged when closed to direct flow of liquid from said additional pump means to said discharge conduit; and pressure-responsive means for controlling the operation of said by-pass valve, said pressure-responsive means closing said by-pass valve upon increase of liquid pressure beyond a predetermined value in said discharge conduit.

2. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil inlet for pumping liquid into said heating coil; additional pump means having an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; and a normally open, fluid pressure operable by-pass valve connected in the system and arranged to automatically close to cause flow of liquid from said additional pump means to said discharge conduit only after a predetermined pressure has been attained in said system.

3. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil inlet for pumping liquid into said heating coil; additional pump means having an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a normally open, fluid pressure operable by-pass valve connected in the system and arranged to close to cause flow of liquid from said additional pump means to said discharge conduit only after a predetermined pressure is attained in said system sufficient to effect closing of said by-pass valve; and means for restricting the discharge from said discharge conduit to create a back pressure in the system sufficient to cause closing of said by-pass valve.

4. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet connected with said storage tank and having an outlet connected with said heating coil inlet for pumping liquid from said tank into said heating coil; additional pump means having an inlet connected with said storage tank and having an outlet communicating with said discharge conduit for pumping relatively unheated liquid from said storage tank into said discharge conduit for admixture with the liquid from said heating coil; and a normally open, fluid pressure operable valve connected in by-passing relation with said additional pump means for effecting flow of said relatively unheated liquid from said outlet of said additional pump means to said discharge conduit only after a predetermined pressure is attained in said system sufficient to effect closing of said valve.

5. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil inlet for pumping liquid into said heating coil; additional pump means having an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a normally open by-pass valve connected in the system in by-passing relation to said additional pump means and arranged when closed to direct flow of liquid from said additional pump means to said discharge conduit; and fluid pressure operable means subject to the pressure in said system controlling the operation of said by-pass valve.

6. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a normally open, solenoid-operated, by-pass valve connected in the system to by-pass liquid from said additional pump means and prevent its introduction into said discharge conduit and arranged to close to cause flow of liquid from said additional pump means to said discharge conduit; and a pressure-responsive switch connected in a circuit with said solenoid-operated valve and

actuatable to effect closing thereof, said pressure-responsive switch being connected with said discharge conduit and responding to liquid pressure changes therein.

7. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; pump means having an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a normally open, solenoid-operated, by-pass valve connected in the system in by-passing relation to said additional pump means and arranged when closed to direct flow of liquid from said additional pump means to said discharge conduit; and a pressure-responsive switch connected in circuit with said solenoid-operated by-pass valve and actuatable to effect closing of said by-pass valve when a given pressure is attained in the system.

8. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet connected with said storage tank and an outlet connected with said heating coil inlet for pumping liquid from said storage tank into said heating coil; additional pump means having an inlet communicating with said storage tank and an outlet communicating with the system for pumping relatively cool rinse liquid into the system; a by-pass valve connected in the system to return liquid from said additional pump means to said storage tank when said valve is in its open position and thus prevent its introduction into the system; and means for controlling the closing of said by-pass valve to discontinue said return and cause liquid from said additional pump means to enter the system, said last-named means including a device responsive to an increase of liquid pressure beyond a predetermined pressure in said discharge conduit.

9. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet communicating with said storage tank and an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an inlet communicating with said storage tank and an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a by-pass valve having the inlet thereof open and communicating with said additional pump means and having its outlet communicating with said liquid storage tank for returning liquid thereto; and means for controlling the operation of said by-pass valve, said last-mentioned means being operable in response to an increase in pressure in said discharge conduit beyond a predetermined value to effect closing of said by-pass valve to thereby interrupt the return flow of liquid to said tank and cause the same to be introduced into said system.

10. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet communicating with said storage tank and an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an inlet communicating with said storage tank and an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a one-way check valve connected in the system to permit flow only from said outlet of said additional pump means toward said discharge conduit; a by-pass valve having the inlet thereof open and communicating with said additional pump means and having its outlet communicating with said liquid storage tank for returning liquid thereto; and means for controlling the operation of said by-pass valve, said last-mentioned means being operable in response to an increase in pressure in said discharge conduit beyond a predetermined value to effect closing of said by-pass valve to thereby interrupt the return flow of liquid to said tank and cause the same to be introduced into said system.

11. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet communicating with said storage tank and an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an inlet communicating with said storage tank and an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a one-way check valve connected in the system to permit flow only from said outlet of said additional pump means toward said discharge conduit; a by-pass valve having the inlet thereof open and communicating with the outlet of said additional pump means at a point ahead of said check valve and having its outlet communicating with said liquid storage tank for returning liquid thereto; and means for controlling the operation of said by-pass valve, said last-mentioned means being operable in response to an increase in pressure in said discharge conduit beyond a predetermined value to effect closing of said by-pass valve to thereby interrupt the return flow of liquid to said tank and cause the same to be introduced into said system.

12. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet communicating with said storage tank and an outlet connected with said heating coil for pumping liquid into said heating coil; additional pump means having an inlet communicating with said storage tank and an outlet communicating with said discharge conduit for pumping relatively cool liquid into said discharge conduit for admixture with the liquid from said heating coil; a one-way check valve connected in the system to permit flow only from said outlet of said additional pump means toward said discharge conduit; a normally open by-pass valve having the inlet thereof communicating with the outlet of said additional pump means at a point ahead of said check valve and having its outlet communicating with said liquid storage tank for returning liquid thereto; and means responsive to pressure conditions in said system controlling the operation of said by-pass valve, said last-mentioned means being operable to effect closing of said by-pass valve when a predetermined pressure condition is attained in said system, to thereby interrupt the return flow of liquid to said tank and cause the same to be introduced into said system.

13. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said coil outlet; a liquid storage tank; pump means having an inlet and an outlet; a conduit connecting said storage tank with the inlet of said pump means; a conduit connecting the outlet of said pump means with the inlet of said heating coil, so that said pump means can pump liquid from said tank into said heating coil; additional pump means having an inlet and an outlet; means connecting the inlet of said additional pump means with said storage tank; a conduit connecting the outlet of said additional pump means with said discharge conduit so that relatively unheated liquid from said storage tank can be pumped into said discharge conduit for admixture with the heated liquid from said heating coil, said last-mentioned conduit having a check valve connected therein between the outlet of said additional pump means and said discharge conduit permitting flow only in a direction toward said discharge conduit; a normally open fluid-pressure operable valve having an inlet connected with the outlet of said additional pump

means at a point between said additional pump means and said check valve, and having an outlet connected with the inlet of said additional pump means, whereby said pressure-responsive valve is connected in by-passing relation with said additional pump means; and pressure-responsive means for controlling said by-pass valve operable in accordance with changes in pressure in said system arranged to effect closing of said by-pass valve when a predetermined pressure condition is attained in said system.

14. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet connected with said storage tank and having an outlet connected with said heating coil for pumping liquid from said tank into said heating coil to be heated in said heating coil; additional pump means having an inlet connected with said storage tank and having an outlet communicating with said discharge conduit for pumping relatively unheated liquid from said storage tank into said discharge conduit for admixture with the heated liquid from said heating coil; a normally open, solenoid-operated valve having its inlet communicating with the outlet of said additional pump means and having its outlet connected with said storage tank for by-passing liquid from said additional pump means back to said storage tank; and a pressure-responsive switch connected in a circuit with said solenoid-operated valve operable to effect closing of said valve to thereby discontinue by-passing of liquid back to said tank, said pressure-responsive switch being connected with said discharge conduit and responding to liquid pressure changes therein.

15. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet connected with said storage tank and having an outlet connected with said heating coil for pumping liquid from said tank into said heating coil to be heated in said heating coil; additional pump means having an inlet connected with said storage tank and having an outlet communicating with said discharge conduit for pumping relatively unheated liquid from said storage tank into said discharge conduit for admixture with the heated liquid from said heating coil; a normally open fluid pressure operable valve having its inlet communicating with the outlet of said additional pump means and having its outlet connected with said storage tank for by-passing liquid from said additional pump means back to said storage tank; and means responsive to pressure conditions in the system operable to effect closing of said by-pass valve to thereby discontinue by-passing of liquid back to said tank when a predetermined pressure condition is attained in said system.

16. A fluid heating and distribution system, comprising: a heating coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a liquid storage tank; pump means having an inlet connected with said storage tank and having an outlet connected with said heating coil inlet for pumping liquid from said tank into said heating coil to be heated in said heating coil; additional pump means having an inlet connected with said storage tank and having an outlet communicating with said discharge conduit for pumping relatively unheated liquid from said storage tank into said discharge conduit for admixture with the heated liquid from said heating coil; a normally open, fluid-pressure operable valve connected in by-passing relation with said additional pump means for preventing flow of said relatively unheated liquid from said outlet of said additional pump means to said discharge conduit unless a predetermined pressure is attained in said system sufficient to effect closing of said valve; and means for restricting the discharge from said discharge conduit to create a back pressure in the system sufficient to cause closing of said valve.

17. A cleaning machine, comprising: a coil having an inlet and an outlet; a discharge conduit communicating with said outlet; a cleaning gun connected with said discharge conduit having a vapor nozzle adapted to be selectively placed in communication with said discharge conduit and having a rinse nozzle of relatively smaller size than said vapor nozzle adapted to be selectively placed in communication with said discharge conduit; pump means connected with said inlet for introducing liquid into said coil; additional pump means communicating with said discharge conduit for pumping liquid into said discharge conduit for admixture with the liquid from said coil; and automatic means for by-passing liquid at said additional pump means for preventing flow of liquid to said discharge conduit from said additional pump means unless discharge is taking place through said rinse nozzle.

18. A cleaning machine, comprising: a heating coil having an inlet and an outlet; means for heating said coil; a discharge conduit communicating with said outlet; a cleaning gun connected with said discharge conduit and including a vapor nozzle adapted to be placed in communication with said discharge conduit to provide a vapor spray and a rinse nozzle of relatively smaller size than said vapor nozzle also adapted to be placed in communication with said discharge conduit to provide a high pressure liquid rinse spray; pump means connected with said inlet for introducing liquid to be heated into said heating coil; additional pump means communicating with said discharge conduit for pumping relatively unheated liquid into said discharge conduit for admixture with the heated liquid from said heating coil; manually operable conversion valve means in said gun for selectively diverting flow from one nozzle to the other; and automatic means for by-passing liquid at said additional pump means for preventing flow of said relatively unheated liquid to said discharge conduit from said additional pump means unless discharge is taking place through said rinse nozzle.

19. A cleaning machine, comprising: a heating coil having an inlet and an outlet; means for heating said coil; a first pump connected with said inlet of said heating coil for pumping liquid into said coil to be heated; a second pump for pumping liquid for admixture with the discharge from the outlet of said heating coil; a flexible conduit having one end thereof connected with the outlet of said heating coil; a cleaning gun having an inlet connected with the opposite end of said flexible conduit and including a vapor discharge nozzle and a rinse discharge nozzle; and conversion valve means at said gun operable to selectively permit flow to one nozzle while obstructing flow to the other, said rinse nozzle having a passage smaller in size than the passage of said vapor nozzle, whereby to restrict flow and create a back pressure in said flexible conduit; and a pressure-responsive by-pass valve controlling flow of liquid from said second pump means to said flexible conduit arranged to automatically close and interrupt by-passing when the pressure in the system exceeds a predetermined amount, and to automatically open and resume by-passing when the pressure in said system is below a predetermined amount.

20. A cleaning machine, comprising: a heating coil having an inlet and an outlet; feed water pump means connected with said inlet for pumping cleaning liquid into said heating coil; means for heating the cleaning liquid in said coil; a discharge conduit connected at one end thereof with the outlet of said heating coil; a cleaning gun having an inlet connected with the opposite end of said discharge conduit, said cleaning gun having a rinse nozzle and a vapor nozzle and outlets respectively communicating with said nozzles, said rinse nozzle having a passage of smaller size than said vapor nozzle, whereby to automatically build up a back pressure in the system when a rinsing operation is desired; rinse water pump

means connected with said discharge conduit for pumping relatively unheated rinse liquid into said discharge conduit for admixture with the heated liquid from said heating coil; valve means cooperable with said outlets for selectively effecting flow through one or the other of said nozzles; and pressure-responsive by-pass valve means arranged in said system to by-pass relatively unheated rinse water at said rinse water pump means until a predetermined back pressure is attained in said system.

21. A cleaning machine, comprising: a heating coil having an inlet and an outlet; feed water pump means connected with said inlet for pumping cleaning liquid into said heating coil; means for heating the cleaning liquid in said coil; a discharge conduit connected at one end thereof with the outlet of said heating coil; a cleaning gun having an inlet connected with the opposite end of said discharge conduit, said cleaning gun having a vapor nozzle normally operable at a pressure of about 50 to 100#/sq. in., and a rinse nozzle normally operable at a pressure of about 125 to 150#/sq. in., the latter nozzle having a passage of smaller size than the former, whereby to automatically build up a back pressure in the system when a rinsing operation is desired; rinse water pump means connected with said discharge conduit for pumping relatively unheated liquid into said discharge conduit for admixture with the heated liquid from said heating coil; valve means for selectively effecting flow through one or the other of said nozzles; and pressure-responsive by-pass valve means connected in said system in by-passing relation to said rinse water pump means for preventing flow of relatively unheated water from said rinse water pump means to said discharge conduit until a predetermined back pressure of about 125#/sq. in. is attained in said system.

22. A cleaning machine, comprising: a heating coil having an inlet end and an outlet end; means for heating said coil; a liquid storage tank; a first pump means; a first pipe line connecting said storage tank with said pump means and connecting said pump means with said inlet end of said coil; a discharge conduit connected with the outlet end of said coil; a second pump means; a second pipe line connecting said first pipe line with said second pump means and connecting said second pump means with said discharge conduit; a normally open pressure-responsive valve connected with said second pipe line in by-passing relation to said second pump means and actuatable to closed position in response to a predetermined pressure in said discharge conduit; a cleaning gun connected with said discharge conduit and having vapor and liquid discharge nozzles of different sizes; and a conversion valve for controlling flow to one or the other of said nozzles, whereby when flow is directed through the smaller of said discharge nozzles a back pressure is created in said conduit effective upon said pressure-responsive valve to interrupt by-passing and direct flow from said second pump means to supply liquid to said discharge conduit in addition to the liquid delivered thereto from said heating coil.

23. A cleaning machine, comprising: a heating coil having an inlet and an outlet; means for heating said coil; a liquid storage tank; means for automatically maintaining a predetermined minimum liquid level in said storage tank; feed pump means having an inlet communicating with said liquid tank and having an outlet communicating with the inlet of said heating coil for pumping liquid from said liquid tank into said heating coil at a given pressure to be heated to a temperature sufficient to cause vaporization upon discharge into the atmosphere; additional liquid pump means having an inlet communicating with said liquid tank and having an outlet communicating with the outlet of said heating coil, whereby relatively cool liquid can be mixed with the heated liquid at the outlet of said heating coil; a normally open fluid pressure operable rinse control valve connected in by-passing relation with said additional liquid pump means, said valve having a pressure chamber; conduit means connecting said pressure chamber of said valve with the system at a point adjacent said heating coil outlet so that said valve is automatically operable in response to changes in pressure conditions in said system; a discharge conduit communicating with said heating coil outlet for discharging fluid from said heating coil, said fluid pressure operable rinse control valve being operable to close at a predetermined pressure above said given pressure, whereby to discontinue by-passing and cause pumping of liquid by said additional liquid pump means to said discharge conduit whenever said predetermined increased pressure is attained in said system; a cleaning gun connected with said discharge conduit, said cleaning gun having a vapor nozzle and a relatively small rinse nozzle; and means for selectively directing flow for discharge through either said vapor nozzle or said rinse nozzle, said rinse nozzle restricting the discharge from said cleaning gun to create a back pressure in said system corresponding to said predetermined increased pressure to effect automatic actuation of said fluid pressure operable by-pass valve, as aforesaid.

24. A cleaning machine, comprising: a heating coil having an inlet end and an outlet end; means for heating said coil; a liquid storage tank; means for automatically maintaining a predetermined minimum liquid level in said storage tank; a liquid soap storage tank; feed pump means having an inlet communicating with said liquid tank and having an outlet communicating with the inlet of said heating coil for pumping liquid from said liquid tank into said heating coil at a given pressure to be heated to a temperature sufficient to cause vaporization upon discharge into the atmosphere; soap pump means for pumping soap from said soap tank to said liquid tank; conduit means interconnecting the outlet of said feed pump means with said soap pump means for transmitting operating impulses to said soap pump means; a normally open fluid pressure operable soap pump control valve interposed in said impulse transmitting conduit between said soap pump means and said feed pump means, said valve having a pressure chamber; conduit means connecting said pressure chamber of said valve with the system at a point adjacent said heating coil outlet so that said valve is automatically operable in response to changes in pressure conditions in said system; a discharge conduit communicating with said heating coil outlet for discharging fluid from said heating coil, said fluid pressure operable soap pump control valve being operable to close at a predetermined pressure above said given pressure to terminate operation of said soap pump means, whereby to interrupt the flow of soap from said soap tank to said liquid tank whenever said predetermined increased pressure is attained in said system; a cleaning gun connected with said discharge conduit, said cleaning gun having a vapor nozzle and a relatively small rinse nozzle; and means for selectively diverting flow from said rinse nozzle to said vapor nozzle to thus restrict the discharge from said cleaning gun to create a back pressure in said system corresponding to said predetermined increased pressure to effect automatic actuation of said fluid pressure operable valve, as aforesaid.

25. A cleaning machine as defined in claim 24, including a valve in the conduit means connected with the pressure chamber of the soap control valve operable to block communication of pressure from the system to said pressure chamber.

26. A cleaning machine, comprising: a heating coil having an inlet and an outlet; means for heating said coil; a liquid storage tank; means for automatically maintaining a predetermined minimum liquid level in said storage tank; a liquid soap storage tank; feed pump means having an inlet communicating with said liquid tank and

having an outlet communicating with the inlet of said heating coil for pumping liquid from said liquid tank into said heating coil at a given pressure to be heated to a temperature sufficient to cause vaporization upon discharge into the atmosphere; soap pump means for pumping soap from said soap tank to said liquid tank; additional liquid pump means having an inlet communicating with said liquid tank and having an outlet communicating with the outlet of said heating coil, whereby relatively cool liquid can be mixed with the heated liquid at the outlet of said heating coil; a normally open, fluid pressure operable rinse control valve connected in by-passing relation with said additional liquid pump means; conduit means interconnecting the outlet of said feed pump means with said soap pump means for transmitting operating impulses to said soap pump means; a normally open fluid pressure operable soap pump control valve interposed in said impulse transmitting conduit between said soap pump means and said feed pump means, each of said valves having a pressure chamber; conduit means connecting said pressure chambers of said valves with the system at a point adjacent said heating coil outlet so that said valves are automatically operable in response to changes in pressure conditions in said system; a discharge conduit communicating with said heating coil outlet for conducting fluid from said heating coil to a cleaning gun, said fluid pressure operable rinse and soap pump control valves being operable to close substantialy simultaneously at a predetermined pressure above said given pressure, whereby to discontinue by-passing and allow flow of liquid from said additional liquid pump means to said discharge conduit and to discontinue operation of said soap pump to interrupt the flow of soap from said soap tank to said liquid tank whenever said predetermined increased pressure is attained in said system; a cleaning gun connected with said discharge conduit, said cleaning gun having a vapor nozzle and a relatively small high pressure rinse nozzle; and means for selectively directing flow for discharge through either said vapor nozzle or said rinse nozzle, said rinse nozzle restricting the discharge from said cleaning gun to create a back pressure in said system corresponding to said predetermined increased pressure to effect automatic actuation of said fluid pressure operable valves, as aforesaid.

27. A vapor cleaning and rinsing gun, comprising: a body having an inlet, adapted to be connected to a fluid source under pressure, and having two outlets each provided with a valve seat, said valve seats including confronting and substantially parallel portions, spaced longitudinally apart, and communicating with said inlet; nozzles having discharge passages of differenet size connected with the respective outlets; a movable flow control member in said body, said flow control member being selectively movable to engage one or the other of said valve seats to permit flow through one outlet to one nozzle while obstructing flow through the other outlet to the other nozzle, said flow control member being movable to a position to obstruct entrance of fluid into said space between said valve seats to thereby obstruct flow to both outlets and their associated nozzles.

28. A vapor cleaning and rinsing gun, comprising: a body having an inlet adapted to be connected to a fluid source under pressure and having two outlets each provided with a valve seat, said valve seats being disposed in confronting relation to each other and having passage means therebetween communicating with said inlet; a vapor nozzle having a passage of a given size connected with one of said outlets; a rinse nozzle having a passage of a relatively smaller size connected with the other of said outlets; a movable valve disk in said body disposed between said valve seats; a stem connected to said valve disk for selectively engaging said valve disk with one or the other of said valve seats to permit flow through one outlet to one of said nozzles while obstructing flow through the outlet to the other of said nozzles, said valve disk being movable to an intermediate position in which it obstructs said passage means and obstructs flow to both of said nozzles.

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