April 4, 1944. J. F. MALSBARY ET AL 2,345,614

CLEANING MACHINE

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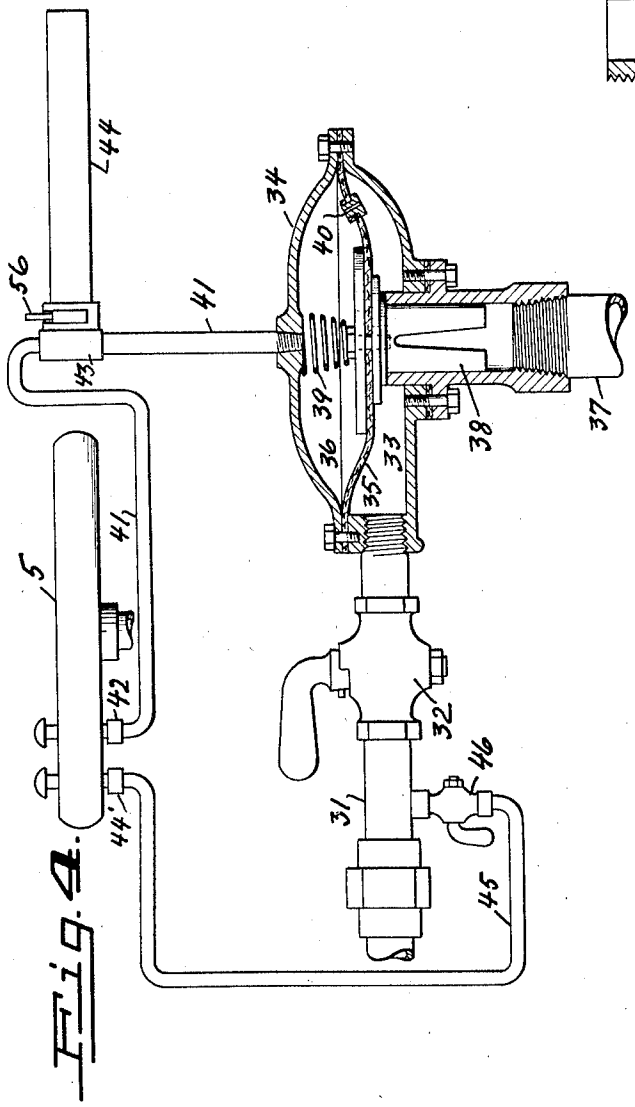


Fig. 4.

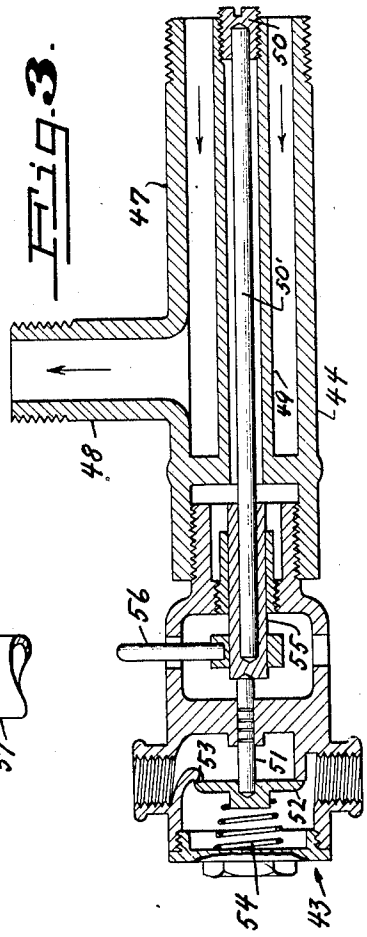


Fig. 3.

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CLEANING MACHINE

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Fig. 1.

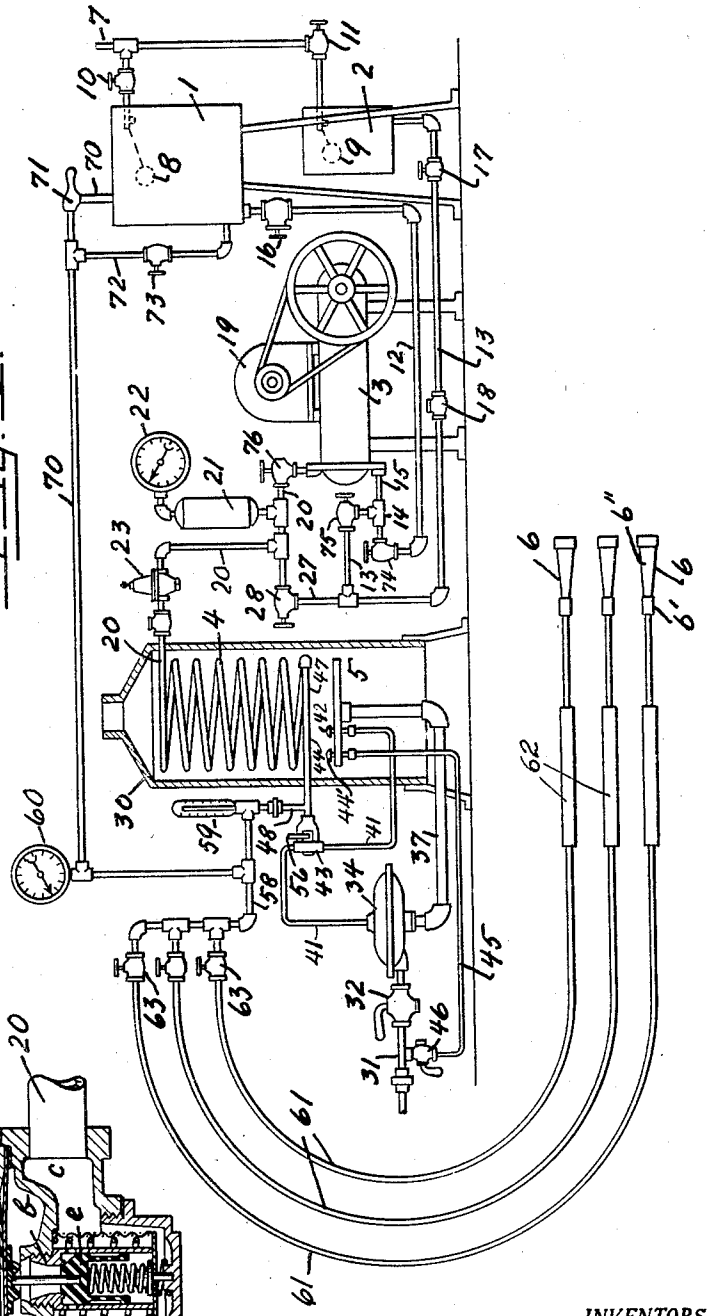
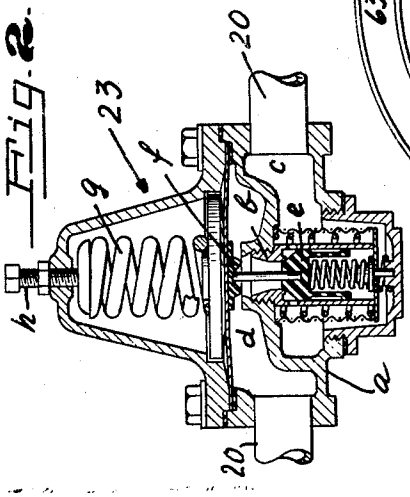


Fig. 2.



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UNITED STATES PATENT OFFICE

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CLEANING MACHINE

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Application April 24, 1942, Serial No. 440,314

9 Claims. (Cl. 299—84)

The present invention relates to improvements in cleaning machines of the type which use a spray of liquid or cleansing fluid usually at relatively high temperatures, for cleaning an object, such as the frame of an automobile or the like, by the combined action of the impact and the cleaning and dissolving effect of the liquid or fluid. It may also be used for chemical spraying of trees or the like, and other applications such as paint removing, disinfecting or heat treating of liquids.

This invention is an improvement on our invention of a cleaning machine described in our co-pending application, Ser. No. 249,184, and this application is a continuation in part of the latter which has matured into Patent No. 2,295,228.

The general objects of the invention were fully discussed in the co-pending application, and may be briefly summarized as follows:

1. To provide a machine for producing a wide range of different kinds of sprays, from an almost solid spray of liquid to a spray of superheated steam;

2. To feed from a source of pressure greatly in excess of the pressures required and of the capacity of the heater so as to provide for ample reserve pressure;

3. To provide independent control for heat and pressure;

4. To utilize excess pressure for recirculation and agitation; and

5. To provide automatic heat control means and special spray control means to insure a concentrated spray.

The machine of the present invention is built along similar principles, but differs from the former machine principally in the control elements.

The principal object of this, our present invention, is to provide a machine of the character described in which, as in the other machine, a wide range of sprays may be produced, but in which a selected spray remains substantially constant regardless of the demands made on the machine.

In machines of this type, it often is desirable that the same machine be made available for different operators working on the same or different jobs. It is desirable, therefore, that the machine be equipped with a plurality of discharge nozzles adapted to be picked up by different operators as the need arises.

When one operator has adjusted the machine for a desired spray and a second operator picks up a second nozzle for his use, it is desirable, of course, that the spray be made to remain the same, and it is the principal object of the present invention to provide control, elements which allow the spray to remain substantially the same, regardless of whether one, two, or more nozzles are in use at the same time.

Further objects and advantages of our invention will appear as the specification proceeds and the novel features of the same will be fully set forth in the claims hereto attached.

The preferred form of our invention is illustrated in the accompanying drawings, in which:

Figure 1 shows a partly diagrammatic assembly view of our apparatus in elevation;

Figure 2, a vertical section through a control valve used in our cleaning machine;

Figure 3, a longitudinal section through a thermostat; and

Figure 4, a side view of a gas valve arrangement, parts being shown in section.

While we have shown only the preferred form of our invention, we wish to have it understood that various changes or modifications may be made within the scope of the claims hereto attached without departing from the spirit of the invention.

In its principal features, our apparatus, as illustrated in Figure 1, comprises two containers 1 and 2, a high pressure pump 3 for pumping liquids from the containers through a coil 4, heating means 5 for the coil 4, a plurality of outlet nozzles 6 for the coil, and suitable control means which will be discussed in their special relationships as the specification proceeds.

The container 1 is intended to accommodate a soap solution or other chemical or cleansing agent, and it receives its water supply from the pipe 7, a float control 8 insuring a constant level shut-off of the liquid in the container. The container 2 is intended to accommodate water and is also fed from the pipe 7 and provided with a suitable float control 9 for maintaining a desired water level. Valves 10 and 11 are provided for shutting off the supply going to the containers.

Both containers are provided with outlet pipes 12 and 13 which join, as at 14, into a single pipe 15, the relative proportions of liquid flow being subject to control by means of valves 16 and 17. The container 1 is disposed at higher elevation than container 2 so that the soap mixture is added to the water under pressure. A check valve 18 prevents the mixture from flowing backward into the water container when the liquids are recirculated and a pressure exists within the pump passages and chambers.

The pipe 15 connects to the intake side of the high pressure pump 3 which may be operated by the motor 19 and which discharges through the pipes 20 into the coil 4. The intake valves of the pump are shown at 74 and 75 and the delivery valve at 76. One of the pipes 20 is provided with a compression chamber 21 for absorbing fluctuations and surges due to pump action and a pressure gauge 22 is provided. The capacity of the pump should be sufficient to maintain the reading of the pressure gauge at about 300 pounds during operation. It can be increased or decreased by adjusting valve 28.

The pressure and volume provided by the pump is intended to be far in excess of the highest pressure required by the coil under working conditions. The object of the high excess pressure is to insure sufficient volume to flow through the coil at all working pressures and under all working conditions and to give the operator absolute control over the pressure and volume desired even though leaks may develop or part of the surplus pressure be used up in recirculating the liquid within the pump. It is apparent that any other source of high pressure might be substituted for the pump.

The flow of the liquid through the pipes 20 into the coil 4 is controlled by the valve 23 which is illustrated in detail in Figure 2. This valve is of the pressure reducing and regulating type, its principal object being to maintain a pressure differential between the pump conduit and the coil under working conditions, and to maintain the pressure within the coil substantially constant regardless of changes in the demands on the machine, that is, regardless of whether one, two, or more nozzles are used at the same time.

The valve itself is of more or less standard construction and no novelty is claimed for its specific construction. It comprises a valve housing *a* having a valve seat *b* dividing the same into a high pressure side *c* and a low pressure side *d*. The valve *e* is operated by a diaphragm *f*, the bottom face of which is subjected to the pressure prevailing in the low-pressure side of the system, and the upper face of which is subjected to the pressure of a spring *g*, the tension of which may be adjusted by means of a screw *h*.

When the pressure in the low-pressure side of the system rises above that of the spring *g*, the valve closes and shuts off further supply. When the pressure in the low-pressure side drops below that of the spring *g*, the valve opens and admits further supply, with the result that the pressure in the low-pressure side remains substantially constant. The principles are well known in the art.

As applied to the machine of the present invention, it will be understood that the pump presents the high-pressure side and the coil the low-pressure side and that the valve serves to maintain the pressure in the coil substantially constant, regardless of the demands made on the machine, as long as there is sufficient reserve pressure available on the high-pressure side to fill the demand.

Since the pump provides a pressure of about 300 pounds, which under any circumstance of adjustment exceeds the pressure and volume required in the coil, a by-pass pipe 27 is provided to connect the pipes 15 and 20 and to provide a circulatory path 20—27—13—15, permitting a portion of the mixture ejected from the pump to re-enter at the intake and to thereby cause additional agitation and more perfect mixing of the solution. The effective by-pass area may be controlled by an automatic, spring-loaded relief valve 28 capable of manual adjustment.

The coil 4 is suitably mounted in the housing 30, and a heater 5 is mounted underneath the coil, the latter being arranged so that the liquid flows downward in the coil toward the heater and is thus progressively subjected to increasing heat as it advances. The heater is here illustrated as a gas burner, but it is apparent that an oil burner or any other suitable means of heat might be substituted. The details of the heater unit are illustrated in Figures 3 and 4.

The gas enters at 31 and passes through a manually-operated valve 32 into the lower compartment 33 of a valve housing 34 which has a diaphragm 35 separating the upper compartment 36 from the lower compartment 33. From the latter compartment the gas enters the pipe 37 leading to the burner 5, subject to the control of a valve 38 operated by the diaphragm 35, which latter is urged toward valve closing position by a spring 39 and by whatever gas pressure prevails in the upper compartment 36, while the main gas pressure in the lower compartment urges the valve toward valve opening position. An orifice 40 is provided in the diaphragm and tends to equalize the pressure between the two compartments. It is sufficiently small, however, to make time a factor in the equalizing process.

The upper compartment is connected, through a pipe 41, with a by-pass burner 42, and this pipe 41 has a valve 43 operated by the thermostat 44 connected with the discharge end of the coil 4. It is apparent that when the valve 43 is wide open, gas will flow freely from the upper compartment 36 of the diaphragm housing to the by-pass burner, relieving the pressure on the upper side of the diaphragm and permitting the pressure in the lower compartment to lift the valve 38 so as to permit of free flow of gas to the main burner. The exchange of gas between the two compartments is not sufficiently fast to balance the pressures. When the valve 43 closes or moves toward closing position, the flow of gas through pipe 41 to the by-pass burner lessens or ceases altogether with the result that the pressures on opposite sides of the diaphragm approach or reach a state of balance which permits the spring 39 to move the diaphragm and the valve 38 toward or into closing position so that feed of gas to the main burner is lessened or checked.

A conventional pilot burner 44' may be connected to the main gas supply 31 ahead of the valve 32, through pipe 45 having a pilot valve 46.

The thermostat control 44 for the valve 43 is illustrated in detail in Figure 3 and comprises a pipe 47 threadedly connected to the lower end of the coil so as to form a continuation thereof, and formed, on the outside of the housing 30, with a discharge pipe 48. The pipe 47 is formed with an internal tube 49 made of metal which expands and contracts in response to temperature changes. To the inner end of this tube is secured, as at 50, a rod 50' of non-expansible material, such as invar steel, which rod extends through the tube to within operative proximity of a push pin 51 which is active on a valve disc 52 for lifting the same off its seat 53 over the opposition of the spring 54. The valve disc 52 and the seat form the valve 43. The operative length of the rod 50' may be adjusted by increasing or lessening the engagement therewith of a threaded extension sleeve 55 which operation may be performed through the handle 56.

The thermostat operates as follows: The liquid passing through pipe 47 toward the outlet pipe 48 travels around the tube 49 and causes the latter to expand and contract in response to temperature changes. As the tube expands, the invar steel rod, which does not expand accordingly, retracts and allows spring 54 to move the valve disc toward its seat. As the tube 49 contracts, the invar steel rod moves toward the valve and lifts the same off its seat.

It will be seen, therefore, that a rise in the temperature of the liquid beyond a certain degree causes the valve to move toward closing position, reducing the gas flowing through pipe 41 to the by-pass burner 42 and thereby reduces the main gas feed to the main gas burner. A fall in temperature of the liquid below the desired degree will cause the valve 43 to open, thereby increasing the flow through pipe 41 and effecting a corresponding increase in the flow of gas through the main valve 38.

To adjust the thermostat to different temperatures, it is only necessary to turn the handle 55 one way or the other, whereby the overall length of the invar steel rod 50' with cap 55 is changed and the desired valve operation effected at higher or lower temperatures.

Thus, with one nozzle in operation, the valve 23 will automatically maintain a constant pressure in the coil and the thermostat control will maintain a desired temperature, both pressure and temperature being subject to the control of the operator to suit the spray to the kind of work to be done.

If now a second operator picks up a second nozzle and opens the valve, the demand on the machine is, of course, intensified. But the reducing and regulating valve 23 takes care of this situation and automatically sends more liquid through the coil in order to meet the increased demand.

An increased amount of liquid passing through the coil naturally tends to cool the same, but the thermostat control automatically takes care of this tendency to change. As soon as the liquid in the pipe 47 cools, the invar rod 50' effects a further opening of the valve 43, which in turn, effects a wider opening of the main gas supply valve 34, with the result that additional heat is applied to return the temperature to the degree desired.

Thus, upon any increase in demand, the reducing valve 23 and the thermostat control cooperate to immediately reproduce the same pressure and temperature conditions in the coil, with the result that the spray of the first operator will not be affected by the operation of the second nozzle.

The outlet pipe 48 of the thermostat connects with a pipe 58 which latter is provided with a thermometer 59 and a pressure gauge 60, and connects with several lengths of hose 61, each having a nozzle 6 at the end thereof. A suitable handhold 62 is provided near each nozzle, and each length of hose is controlled by a suitable shut-off valve 63.

The nozzle 6 is preferably of the particular type described in our co-pending application. For the purposes of the present invention, it will suffice to say that it has a relatively small orifice located at its inner end as at 6', and an expanding outlet 6'' adapted and dimensioned to turn the expansion force of liquid emanating from the orifice into velocity, as fully explained in the co-pending application. The orifice of the nozzle should, of course, bear a certain relation to the opening of the reducing valve and the remainder of the machine to build up desired pressures within the coil.

While we have principally discussed the pressure capacity of the pump as being in excess of any pressure required in the system, it should be understood that the volume capacity of the pump should also be such that it feeds a quantity of liquid considerably in excess of the heater capacity of the system.

The operation of our apparatus will be readily understood from the foregoing description. The entire apparatus is under perfect control by the operator who may regulate temperature and pressure within the coil by observation of the thermometer 59 and the pressure gauge 60, and by operation of the thermostat adjusting handle 56 and adjustment of the pressure reducing and regulating valve 23. Ample pressure and volume is available since the high pressure pump supplies pressure at 300 pounds or about 100 pounds more than the maximum needed for the coil. This excess in pressure and volume takes care of possible leaks that may develop, pressure losses, recirculation through the by-pass 28, and at the same time, insures smooth and steady flow into or through the coil at any pressure desired.

The independent temperature and pressure controls allow a wide variety of changes to be made, and a number of particularly characteristic adjustments may be outlined as follows:

1. *Pressure (at gauge 60) of 200 pounds within the coil and temperature (at thermometer 59) of 220° F.*—This is relatively high pressure and low temperature and results in a really wet spray with a minimum of vapor present. The pressure is amply sufficient to keep the liquid in solid mass or shape in the coil and a forceful stream of liquid issues from the nozzle, with a minimum of steam vapor present and slugs of water resembling in size No. 5 buckshot of about one-eighth inch diameter, and maintaining its concentrated form for a long distance, say, ten to twenty feet. This adjustment is particularly adapted for the cleaning of tractors having a heavy coating of mud or solid deposit of grease.

2. *Pressure of 125 pounds within the coil and temperature of 300° F.*—This pressure is still sufficient to maintain a solid body of liquid in the coil, but the spray issuing from the nozzle shows smaller subdivisions of particles, comparable to No. 11 buckshot or about one-sixteenth of an inch in diameter; the spray will still be mostly water, but will be accompanied by a certain amount of steam, more than in No. 1. This spray would be particularly useful for washing an automobile having a coating of car grease deposited thereon in a heavy, gummy layer.

3. *Pressure of 100 pounds and temperature of 330° F.*—This results in a fine liquid spray of particles similar in size to bird shot (one thirty-second of an inch in diameter). The column of liquid in the coil is still solid and the stream issuing from the nozzle is still more water than vapor, but there will be more vapor than under 1 and 2. This spray would be sufficient for the cleaning of an automobile having but light grease and ordinary traffic film, not very difficult to remove.

It will be noted that in the three adjustments discussed thus far, a solid body of liquid is maintained in the coil and this insures a smooth operation, free from jerking, even without soap or chemicals added. An operator holding the handle 62 will feel a steady and smooth flow and may

operate the nozzle for a long time without tiring. Where steam is allowed to form in the coil and is passed on to the nozzle along with the liquid, the operation becomes jerky, steam alternating with liquid in crowding through the orifice, and the nozzle becomes difficult and tiresome to operate, although the operation is smoothed to some extent through the presence of soap in the liquid. A spray of this type would be obtained as follows:

4. *Pressure of 100 pounds and temperature of 338° F.*—At this adjustment the coil will contain steam and water, and as a result, a rather spasmodic intermittent spray of steam and water will emanate, sputtering out of the nozzle with a rather jerky vibrating sensation to the hands of the operator. A spray of this type would be particularly useful for the steaming out of a tank for the removal of volatile vapors.

5. *Pressure of 75 pounds and temperature of 350° F.*—This results in superheated steam adapted for industrial uses; steam cleaning of clothes, dry steam for heating and vulcanizing, house heating, running machinery, etc.

While thus our machine performs all of the functions of the machine described in our copending application, and is adapted to produce a wide range of sprays characteristic of our other machine, it has the additional advantage of automatically maintaining the spray to which it has been adjusted, regardless of changes in the demands made on the machine. When, for instance, a second, or even a third nozzle is opened, the pressure reducing and regulating valve **23** will automatically feed an additional amount of liquid through the machine, commensurate with the demand, and will maintain the same pressure in the coil. At the same time the thermostat control will automatically supply additional heat units to take care of the additional load and will maintain the temperature in the coil constant.

To relieve excess pressure in the coil **4**, we provide a pipe connection **70** having a pressure relief valve **71** discharging into the tank **1**. The pipe **70** may also be connected to the tank **1** through a pipe **72** leading to the bottom portion of the tank and being controlled by a valve **73**. This connection is used when it is desired to agitate the solution or to stir a new mixture.

We claim:

1. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a restricted discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, means for heating the coil, a thermostat control for maintaining the coil temperature constant at a given setting, the pressure-maintaining means in the first conduit having a coil feeding capacity in excess of the coil requirements and the heater capacity under normal operating conditions, and the valve and the thermostat control cooperating in maintaining the pressure and the temperature in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

2. A cleaning machine comprising a conduit, means for pumping a liquid thereinto under high pressure, control means for the conduit to maintain the pressure substantially constant and comprising a compression chamber attached to the conduit and a manually-controlled valve operable to establish a desired pressure in said conduit, a second conduit including a coil connected to the first conduit and having a restricted discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, means for heating the coil, a thermostat control for maintaining the coil temperature constant at a given setting, the pressure-maintaining means in the first conduit having a coil-feeding capacity in excess of the coil requirements and the heater capacity under normal operating conditions, and the valve and the thermostat control cooperating in maintaining the pressure and the temperature in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

3. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a restricted discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, means for heating the coil, a thermostat control for maintaining the coil temperature constant at a given setting, and the valve and the thermostat control cooperating in maintaining the pressure and the temperature in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

4. A cleaning machine comprising a conduit, means for pumping a liquid thereinto under high pressure, control means for the conduit to maintain the pressure substantially constant and comprising a compression chamber attached to the conduit and a manually-controlled valve operable to establish a desired pressure in said conduit, a second conduit including a coil connected to the first conduit and having a restricted discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, means for heating the coil, a thermostat control for maintaining the coil temperature constant at a given setting, and the valve and the thermostat control cooperating in maintaining the pressure and the temperature in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

5. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, and means for heating the coil, the valve operating to maintain the pressure in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

6. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a discharge orifice, a pressure-responsive regulating valve between the first conduit and the coil, and means for heating the coil, the pressure-maintaining means in the first conduit having a coil-feeding capacity in excess of the coil requirements and the heater capacity under normal operating conditions, and the valve operating to maintain the pressure in the coil substantially constant regardless of increases and decreases in the demand on the coil within the range of the machine.

7. A cleaning machine comprising a conduit, means for maintaining a liquid therein under

high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a plurality of discharge nozzles, a pressure-responsive regulating valve between the first conduit and the coil, and means for heating the coil, the valve operating to maintain the pressure in the coil substantially constant regardless of changes in the number of nozzles used, within the range of the machine.

8. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a plurality of discharge nozzles, a pressure-responsive regulating valve between the first conduit and the coil, and means for heating the coil, the pressure-maintaining means in the first conduit having a coil-feeding capacity in excess of the coil requirements and the heat capacity under normal operating conditions, and the valve operating to maintain the pressure in the coil substantially constant regardless of changes in the number of nozzles used within the range of the machine.

9. A cleaning machine comprising a conduit, means for maintaining a liquid therein under high and substantially constant pressure, a second conduit including a coil connected to the first conduit and having a plurality of discharge nozzles, a pressure-responsive regulating valve between the first conduit and the coil, means for heating the coil, a thermostat control for maintaining the coil temperature constant at a given setting, the pressure-maintaining means in the first conduit having a coil-feeding capacity in excess of the coil requirements and the heater capacity under normal operating conditions, and the valve and the thermostat control cooperating in maintaining the pressure and the temperature in the coil substantially constant regardless of changes in the number of nozzles used within the range of the machine.

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