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CLOSED SYSTEM DRY CLEANING APPARATUS
UTILIZING VOLATILE SOLVENT
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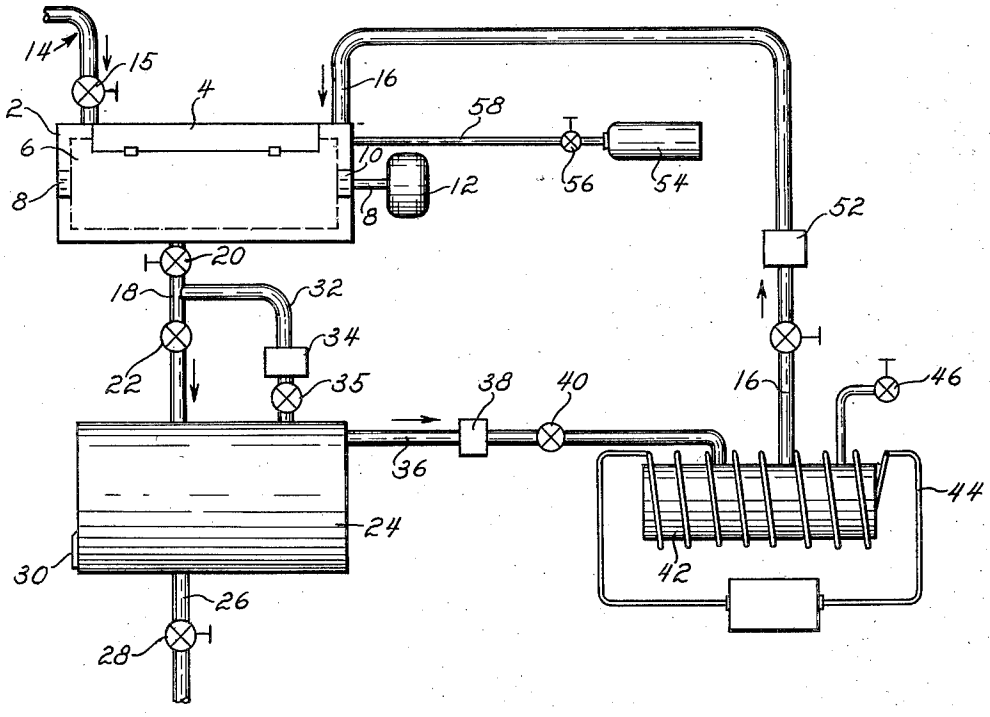

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CLOSED SYSTEM DRY CLEANING APPARATUS UTILIZING VOLATILE SOLVENT

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6 Claims. (Cl. 68—18)

1

This invention relates to a dry cleaning process and apparatus and, more particularly, to a closed system utilizing a volatile solvent.

The primary object of this invention is to provide a dry cleaning system embodying one or more of the volatile solvents which vaporize at or near room temperature while at atmospheric pressure, but which condense to liquid state when cooled below the room temperature or when placed under pressure greater than atmospheric. Generally speaking, it is intended to utilize the superlative cleaning characteristics of these volatile solvents and, further to capitalize on the substantially complete removability of the solvents from the work, while achieving substantially complete recovery of the solvents.

Still another object of the invention is to provide dry cleaning system in which a relatively volatile solvent is utilized selectively with or without a liquid soap solution or a solution containing other disbursing agents but wherein, during the recovery and recycling of the solvent it is separated from the soap solution or dispersing agent and, further, wherein any residual dirt is removed from both the soap solution or dispersing agent and the solvent. These soap solutions and dispersing agents are well known in the art, and will be referred to hereinafter as soap solutions.

Yet another object is to introduce safety factors at the critical points in the process so as to avoid explosions and to cut down the danger of leakage due to excessive pressures.

These and other objects will be apparent in the following specification and drawing in which the sole figure diagrammatically represents the process and apparatus.

Referring now to the drawing in which like reference numerals denote similar elements, a pressure vessel in which the cleaning step is carried out is illustrated at 2, it being understood that the vessel is of standard construction except for the inlet and outlet connections and also in that it is suitably re-enforced and seamed so as to withstand both internal and external pressures. Vessel 2 is provided with a sealable access door 4 for inserting and removing the clothes or other work to be dry cleaned. Within vessel 2 there is tumbler 6, also having an access door (not shown), conventionally supported on double stub shaft 8 rotatably mounted on gas-tight bearings 10 in the ends of pressure vessel 2. Shaft 8 is rotatably driven by motor 12 or other suitable source of motive power.

At the start of the operation work is introduced in the tumbler 6, access door 4 is closed and sealed

2

and a volatile liquid is pumped through line 16 to the interior of the vessel so that when motor 12 is operated the work will be agitated and cleaned by transfer of dirt or other impurities to the solvent. In addition, a soap solution may be introduced into the vessel via pipe 14 connected to a suitable source. The invention is concerned primarily with the remainder of the system.

Leading from the bottom of vessel 2 there is shown a drain pipe 18 having a manually controlled drain valve 20 in its immediate connection with vessel 2. During the cleaning operation drain valve 20 is closed, but when the cleaning is finished it is opened so as to permit passage of the soap solution and the liquid solvent in vessel 2 through drain pipe 18 and check valve 22 to a liquid receiving tank 24. Tank 24 is at least as large as vessel 2 so that all of the fluids of vessel 2 may be received.

Branching from drain pipe 18 between drain valve 20 and check valve 22 is line 32 intended primarily for vapors, and including a pump 34 driven by a suitable source of power (not shown) so as to pump fluids, and especially vapors, from vessel 2 into receiving tank 24. In the description of the operation of this portion of the system it is assumed that the cleaning has been completed with a soap solution and a volatile liquid solvent. Manual drain valve 20 is opened and most of the solution and most of the solvent will have passed freely through check valve 22 into receiving tank 24. Thereafter, while valves 15 and 30 are closed and drain valve 20 is opened, pump 34 is operated so as to draw all possible fluids into receiving tank 24. If desired, motor 12 may be continued in operation during this phase of the cycle so as to rotate tumbler 6 and facilitate the dispersal and vaporization of the volatile solvent from the work and centrifugally remove the liquid soap solution or dispersing agent. Once the fluids are drained and pumped into receiving tank 24 they are prevented from returning directly to vessel 2 by check valves 22 and 35. Check valve 22, of course, also prevents pump 34 from drawing fluids upwardly through drainpipe 18. It should be noted that when pump 34 is operated, the pressure within vessel 2 is reduced greatly below that which prevailed during the cleaning of the work. Thus, a solvent selected from the group listed below will vaporize readily because of the reduction in pressure. The amount of "pumping down" of vessel 2 will depend upon the particular solvent used, and also on the ambient temperature of the work room in which the system is installed.

Leading from the upper portion of receiving tank **24** is a vapor line **36** also containing the vapor pump **38** and check valve **40** so that when pump **38** is operated by a suitable source of motive power not shown, vapor is withdrawn from the upper portion of receiving tank **24** and pumped to a vapor receiver **42** which is maintained at a reduced temperature by an adjacent refrigerating mechanism diagrammatically illustrated by cooling coil **44**. It will be understood that the refrigerating system which includes cooling coil **44** is conventional and that the block illustration will suffice to denote it.

In the operation of this portion of the system, after the fluids in vessel **2** have been drained and pumped into receiving tank **24**, drain valve **20** is closed, and valves **50** and **46** described below are also closed. As the pressure in receiving tank **24** is reduced by operation of pump **38** the solvent vaporizes and is withdrawn from receiving tank **24**. Upon reaching vapor receiver **42**, the solvent may be chilled by pipes **44** and thereby reduced to liquid phase. Even without chilling, pressure in vapor receiver **42** resulting from operation of pump **38** will be sufficient to cause liquification of the vapor therein. Thereafter, the soap solution or dispersing agent is drained out through drain pipe **26** in the bottom of receiving tank **24** by opening drain valve **28**. This liquid is returned to a suitable storage vessel from which it can be re-used by introduction back through line **14**. Receiving tank **24** contains a conventional sealable cleanout **30** so that all residual dirt or solid matter may be removed.

After the volatile solvent has been returned to storage vessel **42** and chilled, the manually controlled air relief valve **46** may be opened for exhausting air that may have leaked into the system. After the solvent has been chilled, any air that accompanied it into storage vessel **42** will be trapped in the upper part of storage vessel **42** under greater than atmospheric pressure due to the action of pump **38**. By carefully opening relief valve **46**, the entrapped air may be bled off. The solvent is ready for re-use by opening manual control valve **50** and by operation of pump **52** so as to pass the solvent from storage vessel **42** via line **16** back to work vessel **2**.

After work has been cleaned and the fluids withdrawn from vessel **2** there will remain in the work slight traces of the volatile solvent which, if brought into direct and free contact with the atmosphere, might contribute to an explosion. In order to preclude this danger, there is provided a source **54** of inert gas, preferably one of the noble gases such as neon, argon, freon, or xenon which, by opening valve **56**, may be passed via tube **58** into receiver **2** so as to intermingle with the volatile gases and thereby inhibit explosion. Thereafter access door may be opened and the work safely removed.

While any one of the number of volatile volvents may be utilized, the following, or mixtures of the following are suitable.

Butane	Carbon tetra chloride
Propane	Freon 11
Pentane	Freon 12
Benzene	Trichlorethylene

Throughout the specification and claims, it will be understood that the definition of a solvent which is vaporous while substantially at room temperature and atmospheric pressure is based or assumed as normal operating temperatures of the workroom of a dry cleaning plant. The important characteristics of the solvent are that when the pressure in vessel **2** is reduced by operation of pump **34**, that the residual solvent in the work will vaporize and be drawn off into the receiving tank **24**. If desired, moderate amounts of heat may be applied to facilitate the vaporization and removal of the solvent from the work and vessel **2** and, later on in the process, moderate heat may be applied to the liquid receiving tank **24** to assist in the removal of the solvent from the impurities and the soap solution. In the claims, the term "textiles" is meant to include the various articles of clothing, household articles such as rugs, linens, and all other fabrics of this general nature which may be dry cleaned. The term "dirt" is intended to mean all of the foreign substances such as grease, food, dust, earth, paint, and the like which customarily are removed by dry cleaning.

While the processing system detailed above constitutes one embodiment of the invention, it will be understood that various modifications, substitutions may be made without departing from the scope of the following claims.

I claim:

1. A closed dry cleaning system comprising a sealable work vessel, means for agitating work in said work vessel, a sealable receiving vessel, first conduit means connecting said work and receiving vessels whereby to pass said solvent from the work vessel to the receiving vessel, a vapor pump in said first conduit means for pumping vapor from the work vessel to the receiving vessel, valve means in said first conduit means for preventing back flow from said receiving vessel to said work vessel, a closed storage vessel, a second conduit means connecting said receiving and storage vessels, a vapor pump in said second conduit means for pumping vapor from said receiving vessel to said storage vessel, means for transferring solvent through said second conduit means from said storage vessel to said work vessel and valve means in said second conduit means for preventing back flow of liquid from said storage vessel to said receiving vessel.

2. In the combination claimed in claim 1, means for introducing a liquid detergent into said work vessel, and drain means for draining said detergent from said receiving vessel.

3. A closed dry cleaning system comprising a sealable work vessel, a tumbler in said vessel for agitating work therein, means for driving said tumbler, a sealable receiving vessel below said work vessel, a drain pipe extending downwardly from said work vessel to said receiving vessel, a manually operable shut-off valve in said drain pipe, a check valve in said drain pipe below said manually operable valve for preventing passage of fluids upwardly therepast, a vapor conduit connected at one end to said drain pipe between said valves and connected at its other end to said receiving vessel, a vapor pump in said vapor conduit for pumping vapor from said work vessel via said drain pipe and manually operable valve into said receiving vessel, a closed storage vessel, a second vapor conduit connecting the upper portion of said receiving vessel to said storage vessel, a second vapor pump in said second vapor conduit, valve means in said second vapor conduit for preventing back flow of liquid from said storage vessel to said receiving vessel, a supply conduit connecting said storage vessel and said work vessel and manually operable valve means in said supply conduit.

4. The combination claimed in claim 3, and means for cooling said storage vessel.

5. The combination claimed in claim 4, and air relief valve means in the upper portion of said storage vessel.

6. In the combination claimed in claim 3, valve means in said second vapor conduit for preventing backflow of fluid from said storage vessel to said receiving vessel, and manually operable valve means in said supply conduit.

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