Aug. 21, 1962 B. RAND 3,049,904

DRY CLEANING MACHINE

Filed Aug. 14, 1961 2 Sheets-Sheet 1

Fig. 1

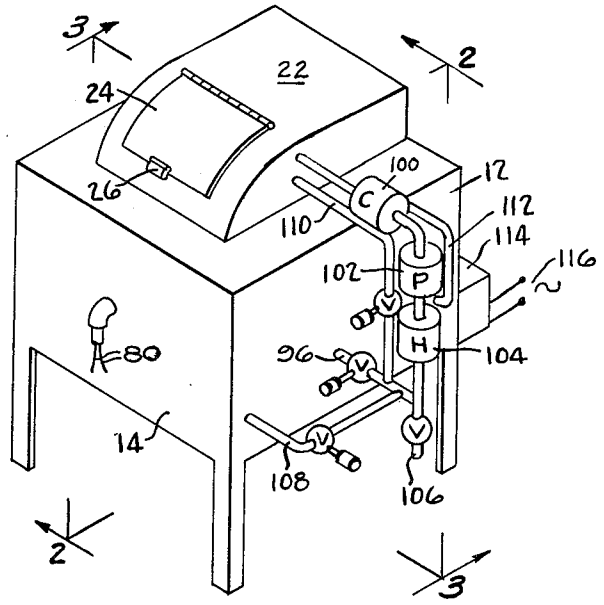
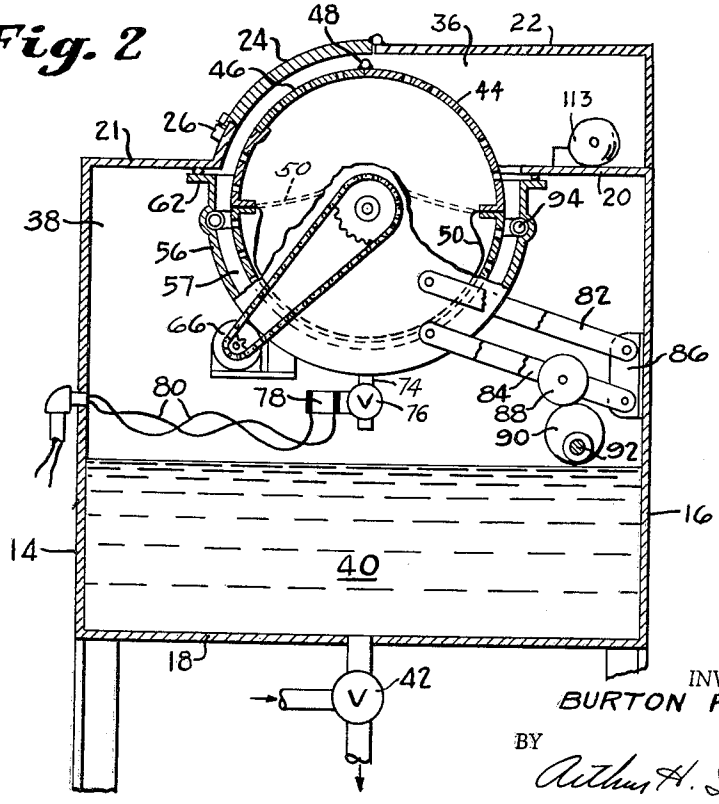


Fig. 2



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Filed Aug. 14, 1961 2 Sheets-Sheet 2

Fig. 3

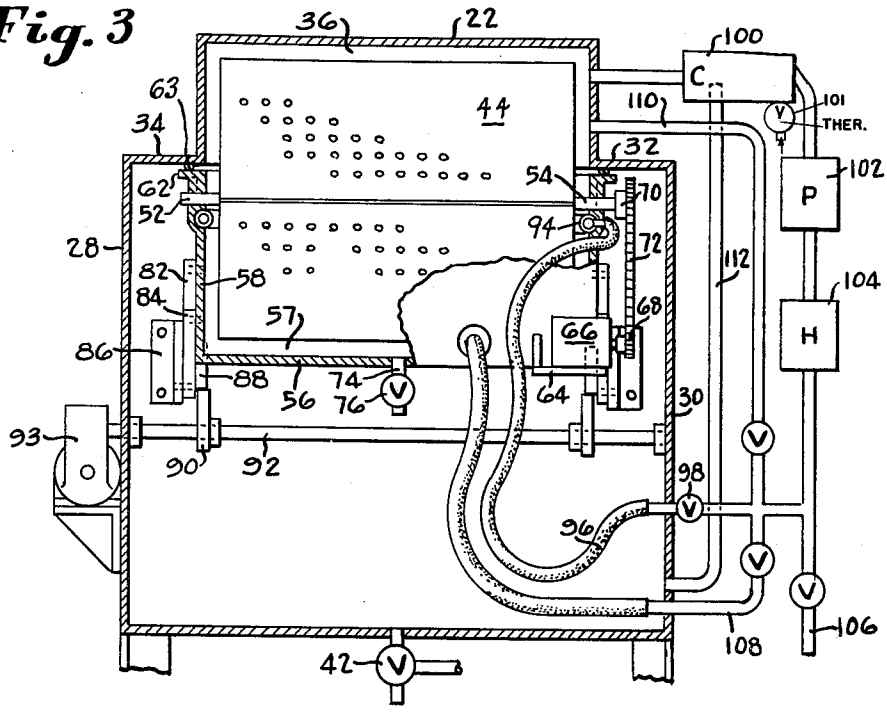
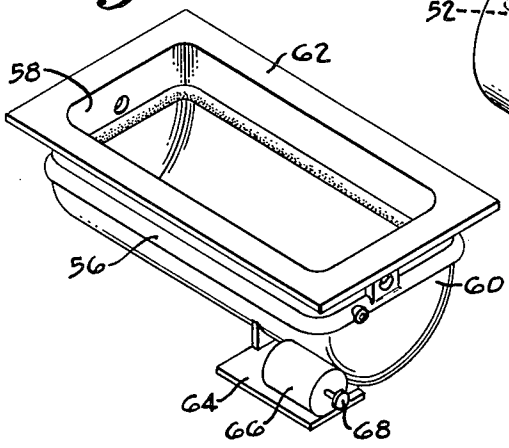


Fig. 4



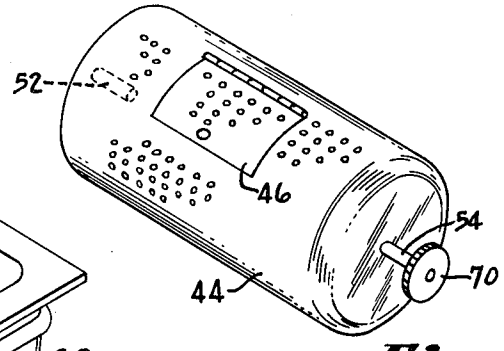


Fig. 5

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3,049,904
Patented Aug. 21, 1962

3,049,904

DRY CLEANING MACHINE

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Filed Aug. 14, 1961, Ser. No. 131,378
9 Claims. (Cl. 68—18)

This invention relates to a dry cleaning machine, and more particularly to a cleaning machine adapted to operate through a predetermined cycle to dry clean textile articles.

The dry cleaning machine of the present invention, if desired, may be provided with a coin-operated mechanism for controlling the operation of the same. In this manner, the dry cleaning machine of the present invention may be utilized in laundromats, self-service laundries, etc. If a coin-operated mechanism is not provided, the dry cleaning machine is adapted to be utilized by dry cleaning establishments and lends itself to mass production for use as a home appliance.

In dry cleaning machines utilizing a volatile liquid such as chlorinated hydrocarbons, trichlorethylene, perchlorethylene, etc., it is necessary to have a housing which is hermetically sealed. When the door providing access to the interior of the machine is open, the vapors from within the machine are permitted to escape to the atmosphere. The vapor lost to the atmosphere with each batch of material is an inevitable loss in presently designed machines and represents a major factor in solvent consumption. The dry cleaning machine of the present invention reduces the vapor loss to the atmosphere by approximately fifty percent. The loss of vapor to the atmosphere is substantially reduced in accordance with the present invention by providing a novel bladder or diaphragm which is responsive to a novel evaucation system whereby the volume of air within the machine which communicates with the atmosphere when the door is open is substantially reduced.

The dry cleaning machine of the present invention includes a rotatable perforated drum in which the articles to be dry cleaned are disposed. The drum is provided with a bladder which is secured at diametrical points on the inner periphery of the drum and overlies approximately one-half of the inner peripheral surface of the drum. The drum is rotatably supported by a novel pan which is in the nature of a trough which supports a motor for rotating the drum. The pan and drum are mounted for reciprocation into and out of a supply of dry claning fluid. Also, in the uppermost position of the drum and pan, the drum is disposed in a chamber which is sealed with respect to the chamber containing the dry cleaning liquid.

A fan means is provided in the upper chamber for operation during a portion of the cleaning cycle when the upper chamber is sealed with respect to the chamber containing the dry cleaning liquid. The fan means is of substantial capacity so that it may create turbulence in the upper chamber. Such turbulence of the air within the upper chamber increases the rate of drying. Also, it enables the heavy fabrics such as quilted blankets, padded portions of garments, etc, to be more effectively cleaned since solvent is often entrained in these fabrics. Simple tumbling and low air movement often does not suffice to remove such entrained solvent.

It is an object of the present invention to provide a novel dry cleaning machine.

It is another object of the present invention to provide a novel dry cleaning machine having a rotatably mounted reciprocably supported perforated drum and means for substantially reducing the volume of said drum when desired.

It is another object of the present invention to provide a novel dry cleaning machine adapted to utilize highly volatile solvents such as the DuPont Company's Freon dry cleaning liquid.

It is another object of the present invention to provide a novel dry cleaning machine wherein two separate hermetically sealed compartments are provided, wherein one of said compartments is adapted to be placed in communication with atmosphere when an access door is opened and includes means for removing vapors from the air within said one chamber prior to the opening of the access door.

It is still another object of the present invention to provide a dry cleaning machine with means for creating air turbulence to remove entrained solvent from heavy fabrics while such fabrics are tumbling in a sealed chamber.

It is still another object of the present invention to provide a novel dry cleaning machine which is simpler and more economical than comparable machines proposed heretofore.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a perspective view of the dry cleaning machine of the present invention.

FIGURE 2 is a transverse sectional view taken along lines 2—2 of FIGURE 1.

FIGURE 3 is a longitudinal sectional view taken along lines 3—3 of FIGURE 1.

FIGURE 4 is a perspective view of the drum pan.

FIGURE 5 is a perspective view of the rotary drum adapted to retain the articles to be dry cleaned.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 a perspective view of a dry cleaning machine designated generally as 10.

The drying cleaning machine 10 of the present invention includes a housing designated generally as 12. The housing 12 is comprised of spaced substantially parallel side walls 14 and 16, a bottom wall 18 extending between the side walls, spaced top wall sections 20 and 21, and a housing extension 22. The housing extension 22 is substantially rectangular and is disposed above the top wall section 20.

The extension 22 is provided with an access door 24 pivotably secured thereto by means of a hinge along one side of the door. A solenoid actuated lock 26 is provided so that the access door 24 may not be opened until the dry cleaning cycle has been completed.

As shown more clearly in FIGURE 3, the housing 12 is provided with end walls 28 and 30. The end wall 30 is provided with an inwardly directed flange 32. The end wall 28 is provided with an inwardly directed flange 34. The flanges 32 and 34 are disposed in the same horizontal plane as the top wall sections 20 and 21.

The flanges 32 and 34 cooperate with the extension 22 to define an upper chamber 36 within the housing 12. The remainder of the housing 12 disposed below the flanges 32 and 34 is designated as a lower chamber 38. A supply of dry cleaning solvent 40 is disposed within the lower chamber 38. The dry cleaning solvent 40 may be any one of a plurality of solvents such as perchlorethylene. Preferably, the dry cleaning solvent 40 is DuPont Company's Freon. Freon is the preferred solvent because it is substantially less toxic than other solvents such as perchlorethylene and may be utilized in the dry cleaning of synthetic fabrics which are damaged when perchlorethylene is utilized as the solvent. In addition, Freon re-

duces considerably the drying time so that the total cycle is less than one-half the time cycle when using perchlorethylene.

The use of a Freon solvent facilitates the provision of structural elements within the housing 12 which may be immersed within the solvent without any adverse effect thereon. Freon is an extremely volatile liquid and as will be made clear hereinafter, means are provided to minimize the loss of the volatile vapors to the atmosphere when the access door 24 is opened. The solvent 40 is supplied to the housing 12 and withdrawn therefrom by means of a supply and exhaust valve 42 connected to a short conduit depending from the bottom wall 18 of the housing 12.

A perforated cylindrical drum 44 having an access door 46 pivotally secured thereto is provided for retaining the fabrics to be dry cleaned in the machine 10 of the present invention. It will be noted that the access door 46 is of smaller configuration than the access door 24 and is pivotably secured to the drum 44 by means of a hinge 48, see FIGURE 2. The relative disposition of the access doors 24 and 46 are as shown in FIGURE 2 at the beginning and end of any dry cleaning cycle.

A bladder 50 is disposed within the drum 44. The peripheral edges of the bladder 50 are fixedly secured to the inner periphery of the drum 44 at diametrically opposite points so that the bladder 50 overlies approximately one-half of the inner peripheral surface of the drum 44. The bladder 50 is preferably made from a flexible readily deformable material such as rubber, plastic, etc.

The drum 44 is provided with axles 52 and 54. The drum 44 is supported within the housing 12 by means of a pan 56. The drum 44 is spaced from the pan 56 to define a chamber 57. As shown more clearly in FIGURE 4, the pan 56 is semi-cylindrical in shape with aligned holes being provided in end walls 58 and 60 of the pan 56. Thus, the axle 52 extends through the hole in the end wall 58 with a seal being provided therebetween. The axle 54 extends through the hole in the end wall 60 with a seal being provided therebetween. The pan 56 is provided with an outwardly directed peripheral flange 62.

A readily deformable seal means is provided on the upper surface of the flange 62. Such seal means may, for example, be an O-ring seal 63. As shown more clearly by a comparison of FIGURES 2 and 3, the seal on the flange 62 cooperates with the flanges 32 and 34 and the top wall sections 20 and 21 to selectively isolate the upper chambers 36 from the lower chamber 38.

A mounting plate 64 is fixedly secured to the periphery of the pan 56 in any convenient manner such as by welding, bolts, etc. A motor 66 is fixedly secured on the mounting plate 64 offset from the longitudinal axis of the pan 56. The output shaft of the motor 66 is provided with a pulley 68. A pulley 70 is fixedly secured to one end of the axle 54 on the drum 44. An endless belt 72 extends around the pulleys 68 and 70. Accordingly, the motor 66 is disposed in a manner so that it may selectively rotate the drum 44.

A short flow conduit 74 extends through the pan 56 at its lowermost point as shown more clearly in FIGURE 2. A valve 76 is disposed within the conduit 74. A solenoid is provided for selectively operating the valve 76, with electric wires 80 being provided to operate the solenoid 78.

A pair of lever arms 82 and 84 are pivotally secured to the end walls 58 and 60 of the pan 56. The ends of the lever arms 82 and 84 remote from the pan 56 are pivotably secured to a mounting bracket 86. The mounting bracket 86 is fixedly secured on the inner periphery of side wall 16 of the housing 12. A rotatably mounted cam follower 88 is secured to the lever arm 84. The cam follower 88 is in abutting contact with a cam 90 which in turn is fixedly secured to a rotatably mounted cam shaft 92. Cam shaft 92 is rotated by means of motor 93.

An inflatable seal 94 is fixedly secured within an annular groove on the inner periphery of the pan 56 adjacent the point where the bladder 50 is secured to the drum 44. The inflatable seal 94 is selectively supplied with pressurized air by means of conduit 96 having a solenoid operated valve 98 therein. The valve 98 is preferably of the supply and exhaust type whereby the supply of air to the inflatable seal 94 causes the same to expand into contact with the outer peripheral surface of the drum 44. The purpose of the inflatable seal 94 will be made clear hereinafter.

Means are provided for withdrawing the solvent laden air within the chamber 36 so as to remove the solvent and thereafter return such air to speed chamber 36, or to the lower chamber 38, or to atmosphere. Thus, a condenser 100 is provided as shown more clearly in FIGURES 1 and 3.

Thus, a conduit extends between the upper chamber 36 and the inlet side of condenser 100. The outlet side of the condenser 100 is connected to the inlet side of a pump or fan 102. The pump or fan 102 has a very low capacity such as thirty cubic feet per minute in a small model of the present invention. The pump capacity will vary with the size of the machine. The outlet side of the pump or fan 102 is connected to a heater 104. Since the pump capacity is small, the power rating of heater 104 may be low. The outlet side of the heater 104 is provided with branch conduits 106, 108, and 110.

The branch conduits 106, 108 and 110 are provided with solenoid operated valves for controlling flow therein. Conduit 106 communicates with the atmosphere. Conduit 108 communicates with the lower chamber 38. Conduit 110 communicates with the upper chamber 36. A conduit 112 extends from the condenser 100 to a point slightly below liquid level in the lower chamber 38.

A blower or pump 113 is disposed within the chamber 36 for creating a turbulence therein. Such turbulence cooperates with the tumbling movement of the clothes and fabrics to remove entrained solvent in heavy fabrics such as blankets, padded shoulders on clothing, etc. while pump 102 may have a capacity of about 30 cubic feet per minute, pump 113 will have a capacity of about 300 cubic feet per minute or more.

In a prototype of the present invention, substantial amounts of solvent were lost when the machine was not in use. This observation was particularly noticeable when the solvent was Freon. I discovered that vapor pressure would build up in the machine and would escape through the smallest pinhole, around gasket seals, etc. This problem was avoided by making the condenser 100 large enough to accommodate about one gallon of the solvent with the upper end of conduit 112 disposed at liquid level. A thermostatic valve 101 was provided to maintain the quantity of solvent in the condenser 100 at about —30° F. by controlling the flow of coolant in the condenser in accordance with the temperature of the solvent. In this manner, no vapor pressure was able to build up since the vapors were liquefied by the cold solvent in the condenser 100. Likewise, loss of solvent was eliminated.

A control device 114 is provided. The control device 114 is connected to a source of current 116. The control device is a commercially available controller which selectively operates the various motors, pumps and solenoids so that the machine 10 of the present invention has a predetermined operating cycle.

The operation of the machine 10 of the present invention is as follows:

The respective elements of the machine 10 assume a disposition as shown in FIGURE 2. The access door 24 is manipulated to an open position and then the access door 46 is manipulated to an open position. Thereafter, the articles to be cleaned such as fabrics, clothing, etc. are disposed within the drum 44. Thereafter, the access doors 46 and 24 are closed. A button for initiating the operating cycle is thereafter manipulated. Then, the solenoid 26 locks the access door 24 in its closed dispo-

sition so that the machine **10** may not be opened until the cycle has been completed. This prevents the upper chamber **36** from being placed in communication with atmosphere so as to prevent a loss of vapors therefrom. Thus, the access door **24** is disposed so as to provide a vapor tight seal with respect to the housing extension **22**.

The vacuum pump **102** will evacuate the upper chamber **36** so as to attain a pressure therein comparable with the pressure which existed at the time of completion of the previous batch, and before unloading the previous batch. The valves in conduits **110** and **98** are actuated to a position wherein the pressure in inflatable seal **94** is exhausted into chamber **36**, thereby equalizing the pressure on both sides of the bladder **50** at atmospheric pressure.

Thereafter, control device **114** operates the motor **93** so that the cam **90** is disposed in a position to cause the drum **44** to descend and at the same time opens valve **76** to equalize the pressures in the upper and lower chambers **36** and **38** respectively. The drum **44** is lowered to a position wherein a portion of the drum **44** is disposed below the level of solvent **40**. Simultaneously, the motor **66** causes the drum **44** to rotate slowly. At all times, the drum **44** is disposed within the pan **56** with the solvent entering the pan **56** through the valve **76**.

The drum **44** continues to rotate within the solvent for a predetermined period of time controlled by the control device **114**. Upon completion of the immersion stage, and while still revolving, the drum **44** is raised to an intermediate position whereby the flange **62** is spaced slightly from the plane of the flanges **32** and **34**. In this intermediate position, the solvent within chamber **57** drains out through the valve **76** which is above liquid level. In addition, the drum **44** is rotated rapidly in this position so as to permit centrifugal extraction of solvent from the articles of fabric and clothing disposed therein.

Thereafter, the rate at which the drum revolves is decreased and the cam **90** causes the lever arms **82** and **84** to raise the pan **56** and the drum **44** until the flange **62** is sealed with respect to the top wall sections **20** and **21** and the flanges **32** and **34**. In this position, the drum continues to revolve slowly, thereby tumbling the clothing and fabrics disposed therein.

Simultaneously, the pump **113** creates a turbulence in chamber **36** to remove entrained solvent. At the same time, valve **76** is closed and the pump **102** begins to recirculate the air of the upper chamber **36**. The solvent laden air disposed within chamber **57** and the upper chamber **36** passes through the condenser **100** which separates the same into cool air and liquid solvent. The liquid solvent is returned to the lower chamber **38** by way of conduit **112**. The cool air passes through the pump **102** and is heated by the heater **104**.

The heated air is returned from the heater **104** to the upper chamber **36** by way of conduit **110**. This process continues for a predetermined period of time so as to accentuate the drying of the clothes and at the same time remove as much solvent vapor from the upper chamber **36** as possible.

Following the drying cycle, the rotation of the drum **44** is halted and the drum **44** is indexed to a preset unloading position as illustrated in FIGURE 2 wherein the access doors **24** and **46** are in alignment with one another. Thereafter, the inflatable seal **94** is inflated by pump **102** through conduit **96** so as to hermetically isolate the upper chamber **36** from the interior of the pan **56**. The inflatable seal **94** expands until it is in contact with the periphery of the drum **44**. Then the valve in conduit **96** is closed, locking air in seal **94** which remains in its expanded condition.

Thereafter, the control device **114** closes the valve in conduit **110** and opens the valve in conduit **108**. In this position of the elements of the machine **10** and during this portion of the cycle, the air is being directed into the pan **56**. The air in pan **56** expands the bladder **50** to the phantom position illustrated in FIGURE 2. While the vacuum created in the upper chamber **36** is too slight so as to cause the bladder **50** to raise to the phantom position shown in FIGURE 2, such vacuum does cooperate with the pressurized air being directed in chamber **57** to accomplish this result.

The bladder **50** is pressurized to the phanton position shown in FIGURE 2 so as to substantially reduce the volume of the upper chamber **36**. While the bladder **50** is being pressurized, the heater **104** may be turned off.

Thus, a combination of pressure and vacuum causes the bladder **50** to assume the phantom position shown in FIGURE 2 thereby reducing the volume of the upper chamber **36** and at the same time placing the dried articles adjacent the access door **46**. When the access doors **24** and **46** are opened, it will be seen that a very small portion of the volume of chamber **36** will be exposed to the atmosphere. Accordingly, only the solvent vapors remaining in this volume of the chamber **36** will be lost to the atmosphere. In this manner, I am able to reduce the loss of solvent to the atmosphere by more than fifty percent as compared with machines proposed heretofore. Thus, the machine **10** of the present invention loses less solvent per batch of clothes than those proposed heretofore while at the same time is designed to utilize Freon as a solvent which is less toxic and faster drying than machines utilizing perchlorethylene.

At the end of the drying cycle, the control device **114** deactivates the solenoid lock **26**, stops pump **113** and pump **102**, closes the valve in conduit **108**, and opens the valve in conduit **106**.

When a new batch of clothes are disposed within the drum, the control device will close the valve in conduit **106**. Thereafter, the cycle will be repeated in the manner set forth above.

While the drum **44** has been illustrated with an actuating mechanism comprising lever arms, it is within the scope of the present invention to provide an equivalent device which reciprocates the drum vertically in a direction substantially perpendicular to the flange **32** and **34**.

It will be appreciated that the normal accessories such as filter, solvent recovery still, etc. are not illustrated since they form no part of the present invention.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. A dry cleaning machine comprising a housing, said housing having an upper chamber, said housing having a lower chamber adapted to have a cleaning solvent disposed therein, a perforated drum mounted for movement from a first position wherein said drum is disposed in said lower chamber to a second position wherein said drum is at least partially disposed within said upper chamber, means selectively isolating said drum and upper chamber from communication with said lower chamber in said second position of said drum, means for selectively causing said movement of said drum and for selectively rotating said drum, means for selectively creating air turbulence in said upper chamber, means for selectively removing volatile vapors from said upper chamber, and selectively operable means for reducing the volume of said drum exposed to said upper chamber.

2. A machine in accordance with claim 1 wherein said selectively operable means for reducing the volume of said drum includes an inflatable flexible bladder disposed within said drum and secured to the inner periphery of said drum.

3. A machine in accordance with claim 1 wherein said means selectively isolating said drum and said upper chamber from communication with said lower chamber includes a semi-cylindrical pan disposed beneath said drum and mounted for movement therewith, said pan having a

peripheral flange adapted to sealingly contact a portion of said housing which partially defines said upper chamber.

4. A machine in accordance with claim 1 wherein said means for selectively removing volatile vapors from the upper chamber includes a condenser in communication with said upper chamber, means for maintaining liquefied solvent in said condenser, a pump in communication with the outlet side of said condenser, a heater in communication with the outlet side of said pump, a conduit from the outlet side of said heater being in communication with said upper chamber, and a drain conduit extending from the level of the solvent in said condenser to said lower chamber, whereby a mixture of volatile vapors and air are withdrawn from such upper chamber into said condenser and separated into liquid condensate and air, with such air being returned to said upper chamber by said conduit connected to the outlet side of said heater.

5. A dry cleaning machine comprising a housing, said housing having an upper chamber, said housing having a lower chamber adapted to have a dry cleaning solvent therein, a perforated drum disposed within said housing, said drum being rotatably supported by a semi-cylindrical pan, means mounting said pan and drum for movement from a first position wherein said drum and pan are disposed within said lower chamber to a second position wherein said drum is at least partially disposed within said upper chamber, wall means selectively cooperating with said pan in said second position of said drum to isolate said drum and said upper chamber from communication with said lower chamber, means for selectively rotating said drum, means for selectively creating air turbulence in said upper chamber, and means in communication with said upper chamber for selectively removing a mixture of air and volatile vapors from said upper chamber and returning thereto only air removed from said upper chamber.

6. A cleaning machine comprising a housing adapted to contain a quantity of vaporizable solvent, means within said housing for supporting elements to be cleaned, and a means connected to said housing to prevent loss of vaporized solvent, said last mentioned means including a condenser connected to said housing and in communication with the interior of said housing, means for maintaining a predetermined amount of liquefied solvent in said condenser at a temperature below the vaporizing temperature of said solvent, a first conduit extending from the liquid level in said condenser for conveying liquefied solvent to a suitable receptacle, and a second conduit extending from a point above liquid level in said condenser to convey air away from said condenser.

7. A machine in accordance with claim 6 including a pump for forcing solvent laden air in said housing to flow through said condenser.

8. A dry cleaning machine comprising a housing, means mounted a perforated drum for rotation about its longitudinal axis within said housing, an access door on said housing, a first pump in said housing for selectively creating air turbulence in said housing and said drum, means separate and apart from said first pump for withdrawing a mixture of vaporized solvent and air from said housing and returning air to said housing in a condition wherein the returned air is substantially free from solvent, said last mentioned means including a second pump in communication with a condenser means, said condenser means being adapted to separate the solvent laden air into liquid solvent and air, and conduit means connected to said condenser means for conveying liquid solvent from said condenser means to a desired point.

9. A machine in accordance with claim 6 including a heater in said second conduit, the end of said second conduit remote from said condenser being connected to said housing, whereby warm air substantially free from vaporized solvent may be returned to said housing.

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