Dec. 14, 1965 I. SCHNEIDER 3,222,896

DRY CLEANING MACHINE

Filed Aug. 12, 1963

FIG. 1

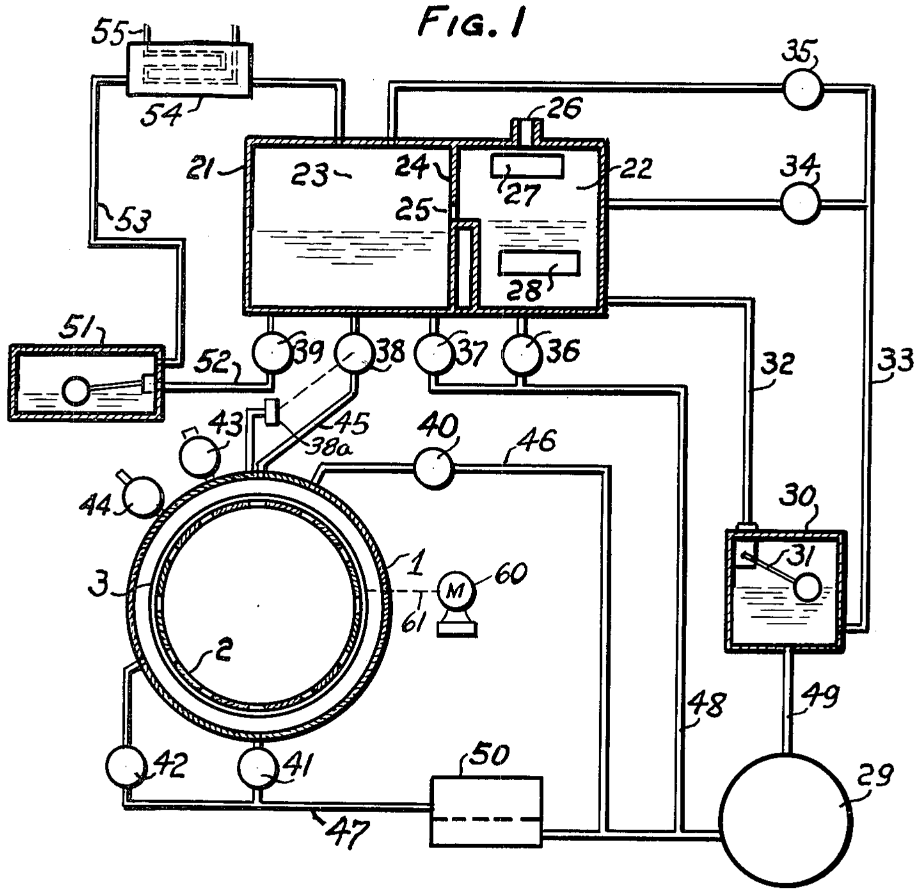
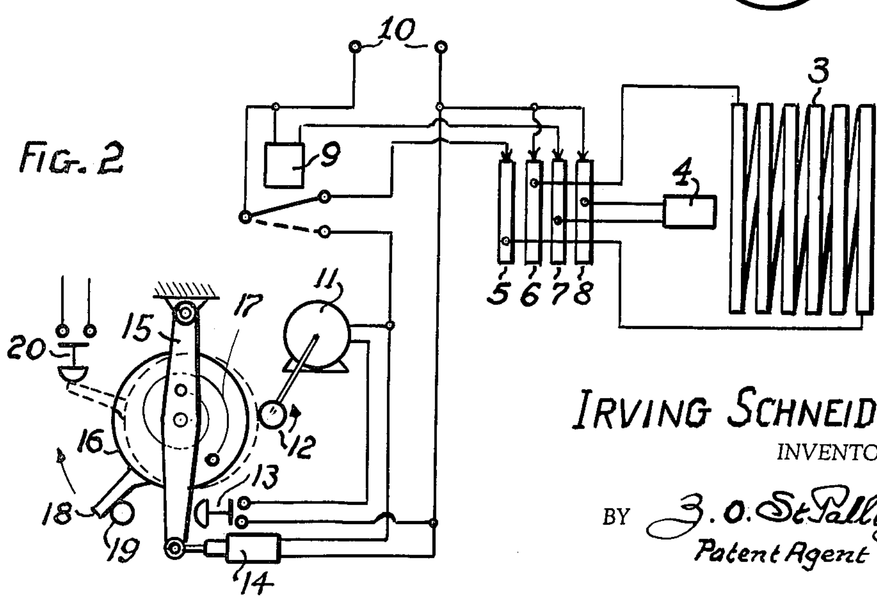



FIG. 2

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3,222,896
DRY CLEANING MACHINE

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This application is a continuation-in-part of my prior application Serial No. 242,694 filed on December 6, 1962, and now abandoned.

My invention relates to dry cleaning machines and has particular utility in the efficient and economical application of dry cleaning solvents having low boiling temperatures.

In dry cleaning machines the length of time required for a cleaning cycle is of great significance as it determines the output capacity of the machine. A short operating cycle is particularly desirable in coin operated dry cleaning machines, where it means not only greater earning power but also greater consumer appeal. In recent years considerable progress has been made in reducing the duration of the dry cleaning cycle by the introduction of new, low boiling point solvents. For instance, the fluorocarbon based solvent, commercially known as "Valclene" has reduced the time of the solvent removal to 7 minutes from the customary 30 minutes required for the removal of the perchlorethylene solvents generally used in the dry cleaning industry. The utilization of these low boiling point solvents, however, has a serious obstacle; their cost is several times higher than that of the customary perchlorethylene solvents. For this reason, these new solvents cannot be used economically in the existing dry cleaning machines due to their high solvent loss.

The principal object of my invention is to provide a dry cleaning machine in which the solvent loss is reduced to such a low value as to make the utilization of these expensive, low boiling point solvents commercially practicable and thereby obtain the advantages of a considerably shortened dry cleaning cycle.

Another important object of my invention is to provide a drying machine which utilizes a novel drying technique for reducing the solvent loss, characterized by the employment of vacuum and controlled heat creating pressure and temperature conditions in which the solvent will boil out of the wash load, combined with a novel application of a liquid ring seal pump which mixes the resultant vapor with cold liquid solvent causing its rapid and complete condensation.

A further important object of my invention is to provide a dry cleaning machine in which the imperfect drying of the wash load and the resultant solvent loss are eliminated by the use of a novel, electrically operated, dry-sensor, which will automatically extend the drying time until the wash load is thoroughly dry.

Other objects and advantages of my invention will be apparent during the course of the following description.

In the accompanying drawing, forming a part of this application, wherein for the purpose of illustration is shown a preferred form of my invention,

FIGURE 1 is a schematic view of the preferred form of my dry cleaning machine,

FIGURE 2 is a diagrammatic view of the heater and the dry-sensor equipment.

Referring to FIG. 1 of the drawing, the numeral **1** designates the wash chamber, which is cylindrical and is designed to stand vacuum. It is provided with a seal tight



frontal door. Mounted within this wash chamber **1** is the wash basket **2** having perforated cylindrical wall and being rotatably supported by a shaft passing through the back wall of the wash chamber **1**. A driving mechanism is provided to rotate the wash basket **2**, selectively, at three predetermined speeds. In the preferred form of my invention these selective speeds are: tumbling speed, at which the centrifugal force acting on the wash load is less than the gravitational force; distributing speed, at which the centrifugal force measured at somewhat smaller radius than that of the wash basket is equal to the gravitational force; extracting speed, at which the centrifugal force is considerably greater than the gravitational force acting on the wash load. As the seal tight frontal door of the wash chamber **1** and the driving mechanism of the wash basket **2** are of conventional construction, known in the art, they are not illustrated in the drawing.

An important element of this invention is the electric heater **3** which, in the preferred form consists of a metallic strip helically wound on the exterior surface of the wash basket **2** and is electrically insulated from the wash basket. Mounted on the wash basket **2** also a thermostat **4**, the function of which is the control of the drying temperature in the wash chamber. The electrical connections of the heater **3** and the thermostate **4** are shown in FIG. 2 of the drawing. The shaft supporting and rotating the wash basket **2** is partially hollow and its outside end portion is provided with four insulated electric slip rings, of which **5** and **6** are connected to the heater **3**, and **7** and **8** are connected to the thermostat **4**, by means of insulated and sealed wires passing through the interior of the hollow shaft. These slip rings receive electrical energy from the supply terminals **10** as controlled by the relay **9**, which is so constructed that, when the thermostat closes the circuit, due to low temperature, between the rings **7** and **8** the relay **9** will be energized assuming the full line position of its contacts and thereby causing the energization of the heater **3**. When the maximum temperature is reached in the wash chamber, the thermostat **4** will open the circuit between the slip rings **7** and **8**, deenergizing the relay **9** and causing the relay contacts to assume the dotted line position, as a result of which, the heater **3** will be deenergized and the cooling period of the wash chamber is started.

Another important element of the present invention is the dry-sensor, a schematic view of which is shown in FIG. 2. The principal part of this is a wheel **16** rotatably mounted on a pivoted lever **15**, the free end of which is connected to a solenoid **14**. When this solenoid **14** is deenergized the wheel **16** is in the full line position. The energization of the solenoid **14** will swing the wheel into the dotted line position. Spiral spring **17**, inserted between the lever **15** and the wheel **16**, tends to turn the wheel **16** counter clock-wise until the finger **18** secured to the wheel **16** rests on the stationary stop **19**. The driving wheel **12** rotated by the motor **11** is so positioned that it has a driving contact with the wheel **16** in the dotted line position of the latter and it releases the wheel **16** in the full line position of the latter. Switch **13** serves to close the motor circuit when depressed by the pivoted lever **15** moved by the energized solenoid **14**. Switch **20** is connected into the control circuit of the dry cleaning machine and serves to terminate the drying period when depressed by the advancing finger **19**. The wheels **12** and **16** may have the form of gears with fine teeth, or may constitute a friction drive of conventional construction. The speed ratio of these wheels must be such as to advance the finger **18** from the full line position to the dotted line position in a predetermined time.

The operation of the dry-sensor is based on the following principle. During the cooling period the temperature of the wash load is reduced from the maximum, or opening temperature to the minimum, or closing temperature of the thermostat setting, and the heat energy corresponding to this temperature drop is consumed principally by the evaporation of the solvent contained in the wash load. As the drying of the wash load is progressing, the rate of the heat dissipation due to evaporation will be less and less, consequently, the duration of the cooling period will gradually increase to a maximum value which corresponds to the satisfactory dry condition of the wash load. The dry-sensor is so constructed that the finger **18** (see FIG. 2) requires this maximum duration to move from the full line position into the dotted line position, when, due to the energization of the solenoid **14** and the closing of the motor switch **13**, the well **16** is in driving contact with the rotating motor drive wheel **12**. If the cooling is rapid, due to the wetness of the wash load, the thermostat **4** will terminate the cooling period before the finger **18** reaches the dotted line position, causing the deenergization of the solenoid **14** and the separation of the wheels **12** and **16**; after which the spring **17** returns the finger **18** to the stop **19**. When, however, due to the dryness of the wash load the cooling will be so slow that the moving finger **18** will reach its dotted line position, it will close the switch **20** and thereby will terminate the drying cycle.

The other basic element of my invention is the storage tank **21** which is divided into two compartments: the cold compartment **22** and the warm compartment **23**. They are separated by the partition **24**, the lower portion of which has a double wall with an air chamber for better heat insulation. The partition **24** is provided with small holes **25**, which serve as overflow from the cold compartment into the warm compartment and also as an exit for the vapor from the warm compartment into the cold compartment, which is provided with an exhaust port **26**, open to the atmosphere, for the exit of the air from the system. In order to reclaim the solvent vapor from the air before its exit, a refrigerating coil **27** is provided adjacent to the exhaust port **26**. Another refrigerating coil **28** is located in the lower part of the cold compartment for the effective condensation of the solvent vapor entering this compartment.

Another important element of my invention is the pump **29**, which is of the liquid ring seal type, able to handle liquid, vapor and air in any proportions and also to produce vacuum. The construction of this pump is known in the art, therefore, no detailed description is necessary, in the present invention, however, this pump has also a novel function, the effective coindensation of the solvent vapor.

Connected to the outlet of the pump **29** is the air separator **30**, having a float valve **31** so constructed that in the lowest position of the float the air liberated from the solvent can pass through the pipe **32** into the cold compartment **22**, and, after the condensation and reclaiming of any solvent vapor carried by the air, the air will escape into the atmosphere through the exhaust port **26**.

Thus, my dry cleaning machine has four essential operating elements: a closed wash chamber, operating under vacuum, an open storage tank, under atmospheric pressure, a liquid ring seal type pump, having the double function of the transfer of the liquid solvent, vapor and air and also the condensation and reclaiming of the solvent vapor by mixing it with cold liquid solvent, an air separator, having the function of reclaiming the solvent carried by the air liberated during the dry cleaning process.

As shown in FIG. 1, these four principal elements are operatively interconnected in the following manner: The connection between the storage tank and the wash chamber consists of pipe **45**, used for supplying solvent for the wash load, as controlled by the valve **38**. This valve **38** is provided with a vacuum switch **38*a*** which delays the introduction of the solvent into the wash chamber at the start of the cycle until the pump has created a negative pressure in the wash chamber. This is an important safety feature to prevent dangerous leaks due to damaged door gasket.



The intake of the pump **29** has two connections with the wash chamber **1**: pipe **46** and valve **40** connect to the upper portion of the wash chamber and are used to transfer solvent vapor to the pump **29**. Pipe **47** connects to the lower portion of the wash chamber **1**, valve **42** being used to maintain a solvent level in the wash chamber, and valve **41** is used for the complete draining of the wash chamber. As an optional feature, the pipe **47** is provided with a filter **50** for retaining solid objects, like buttons. In alternative forms this filter may be embodied in the wash chamber or in the pump.

The outlet of the pump **29** is connected to the air separator by the pipe **49**. From the air separator the air is conducted through the pipe **32** into the cold compartment **22**, and the solvent through the pipe **33** either to the cold compartment **22** or to the warm compartment **23**, as controlled by the valves **34** and **35**.

Pipe **48** and valves **36** and **37**, connecting the intake of the pump **29** to the cold and warm compartments of the storage tank **21**, respectively, is a very important feature of the present invention as it supplies the cold solvent to be mixed by the pump **29** with the hot solvent vapor drawn from the wash chamber **1** during the drying cycle, thereby making the effective condensation and reclaiming of the solvent vapor possible.

The valve **43** mounted on the wash chamber has an important function in the reclaiming of the solvent vapor remaining in the wash chamber at the end of the drying cycle. Through this valve, having a small orifice, atmospheric air is introduced slowly into the top of the wash chamber while the pump **29** draws out the vapor from the bottom of the wash chamber and the rotation of the wash basket is stopped. The lighter air coming in through the valve **43** acts as a piston pushing the heavier vapor into the pump, where it is mixed with cold solvent causing the complete condensation of the vapor.

Valve **44** of the wash chamber is used to break the vacuum before opening the frontal door of the wash chamber.

A further important element of the present dry cleaning machine is the still **51** used for the purification of the used solvent by distillation. This still **51** has a float valve for controlling the inflow of the solvent from the storage tank **21** through the pipe **52** and valve **39**. Here the solvent is vaporized by the application of heat and through the pipe **53** the vapor passes into the heat exchanger **54** where, due to the action of the water cooling coils **55** is condensed and returned to the storage tank **21**.

The operation of my dry cleaning machine is as follows: The wash load is deposited in the wash basket **2**, the door of the wash chamber is closed and the pump started to create a negative pressure in the wash chamber. At predetermined negative pressure the vacuum switch opens the solenoid valve **38**, which admits solvent into the wash chamber and the wash period is started. During this wash period the wash basket is rotated at the tumbling speed by motor **60** through a conventional power transmission path diagrammatically indicated by the dotted line **61** interconnecting wash basket **2** and motor **60**, and a constant circulation of the solvent is maintained, the solvent leaving the wash chamber through valve **42**, maintaining a shallow level of solvent in the wash chamber. From here the solvent passes through the filter **50**, enters the pump **29**, then, through the air separator **30**, pipe **33** and valve **35** returns to the storage tank **21**, and any vapor or air carried by the solvent is returned by the float valve **31** through the pipe **32** into the cold compartment **22**, where the vapor is condensed and reclaimed and the air is discharged through the exhaust port **26**. During this period, solvent is supplied to the pump **29** through valve **37** and line **48**.

This is followed by the drain period, during which the solvent is drained from the wash chamber through the valve **41** and the wash basket is rotated at the distribution speed causing the distribution of the wash load. Valve **38** is closed during this period and the solvent drained is returned by the pump **29** into the storage tank **21** in the manner described above.

The next period is the extraction period in which the major portion of the solvent absorbed by the wash load is extracted by the centrifugal force produced by the fast rotation of the wash basket. The solvent thus collected is returned by the pump into the storage tank in the manner described above.

The next is the drying period, during which the wash basket is rotated at tumbling speed, which may be interrupted for short intervals by distribution speed. During this period the pump creates a vacuum in the wash chamber and the electric heater **3** is energized, as controlled by the thermostat **4**, thereby creating a temperature and pressure condition at which the solvent will boil out of the wash load. During this period valve **37** is closed and the pump receives cold solvent from the cold compartment **22** through the valve **36** and pipe **48** to form the liquid ring seal and this cold solvent, when mixed with the hot vapor within the pump, condenses the vapor received from the wash chamber very effectively.

The operation of the heating control of the wash chamber, illustrated in FIG. 2, is as follows: As long as the temperature of the wash load is below the maximum temperature of the thermostat setting, the thermostat **4** will close the circuit between the rings **7** and **8**, energizing the relay **9** and keeping it in the full line position, in which position of the relay the current will flow from the electric supply terminals **10** through the slip rings **5** and **6** into the heater **3**. When the wash load reaches the maximum temperature of the thermostat setting the thermostat will open, deenergizing the relay **9** and thereby causing it to move into the dotted line position, which will deenergize the heater **3**, starting the cooling period. During this cooling period the solenoid **14** is energized, causing the coupling of the wheels **12** and **16** and the closing of the motor switch **13**, as a result of which, the wheel **16** will rotate in the direction of the arrow, carrying the finger **18**.

If, due to the wetness of the wash load, the cooling is rapid, so that the minimum temperature of the thermostat is reached before the finger **18** has contacted the switch **20**, the thermostat will close and will energize the relay **9**, moving it into the full line position. As a result of this, the heater will be energized and the solenoid **14** of the dry-sensor will be deenergized, stopping the motor **11** and releasing the wheel **16** which, due to the action of the spring **17**, will rotate counter clock-wise until the finger **18** will rest on the stationary stop **19**.

These alternate heating and cooling periods will continue until, due to the dryness of the wash load, the cooling will be so slow that the advancing finger **18** will reach the switch **20** before the thermostat has terminated the cooling period. In this case the finger **18** of the dry-sensor will close the switch **20** and thereby terminates the drying cycle.

After the termination of the drying cycle the next step is the reclaiming of the low pressure solvent vapor remaining in the wash chamber. This is accomplished by stopping the rotation of the wash basket and admitting air slowly through the valve **43**, while the vapor is drawn out by the pump through the valve **41** and is condensed in the pump by mixing it with cold liquid solvent received through the valve **36** and pipe **48**.

After this purging operation is completed the valve **44** is opened to end the vacuum in the wash chamber. Then, the door of the wash chamber may be opened for the removal of the dry-cleaned wash load.

It is to be understood that the form of my invention herein described and illustrated is only an example of the same, and that various changes in the size, shape, and arrangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

I claim:

**1.** A dry cleaning machine comprising a storage tank containing cleaning solvent and having a cold compartment and a warm compartment separated by a partition provided with a hole for communication, said cold compartment having an exhaust port open into the atmosphere, and having refrigerating means adjacent to said exhaust port and also in contact with the solvent; a washer chamber communicating with said warm compartment by means of a pipe connection and a valve which is closed and is operated under vacuum; a wash basket having perforated wall rotatably mounted within said wash chamber; driving means adapted to rotate said wash basket, selectively, at three predetermined speeds; electric heating means mounted on said wash basket; an electric supply for energizing said heating means as controlled by a thermostat, creating alternating heating and cooling periods so as to maintain the temperature in the wash chamber between predetermined limits; a dry-sensor, consisting of an electric timer energized during said cooling period and being adapted to actuate a switch if the energization is maintained for a predetermined length of time and to reset to zero if the energization is terminated, due to the ending of the cooling period, before said predetermined length of time; a pump adapted to create vacuum and to handle mixtures of liquid solvent, solvent vapor and air, thereby causing the condensation of said vapor effectively, the intake of said pump having a pipe connection with the lower portion of said wash chamber for the transfer of liquid solvent from said chamber, a second pipe connection with the upper portion of said wash chamber for the transfer of vapor and air from said chamber, and a third pipe connection with the storage tank for receiving liquid solvent for mixing with vapor received from said wash chamber for the transfer and condensation of said vapor; an air separator communicating with the outlet of said pump and having a float valve and pipe connections adapted to deliver air and vapor into said cold compartment at the low position of the float, and to deliver liquid solvent into the storage tank at the high position of said float.

**2.** The dry cleaning machine of claim **1** in which the valve connecting the storage tank with the wash chamber is provided with a vacuum switch adapted to prevent the opening of said valve and the transfer of solvent from the storage tank into the wash chamber unless there is a vacuum of predetermined magnitude within said wash chamber.

**3.** The dry cleaning machine of claim **1** in which said wash chamber is provided, at its upper portion, with a valve adapted to introduce air slowly into the top of said chamber, while the pump draws out vapor from the bottom of said chamber, in order to condense and reclaim the solvent vapor remaining in the wash chamber at the end of the drying cycle.

**4.** A dry cleaning machine comprising a storage tank operated under atmospheric pressure for holding cleaning solvent and having a cold compartment and a warm compartment separated by a partition provided with a hole for communication, said cold compartment having an exhaust port and refrigerating means adjacent to said exhaust port and also in contact with the solvent; a wash chamber communicating with said warm compartment by means of a pipe connection and a valve, which is closed and operated under vacuum; a wash basket rotatably mounted within said wash chamber and having perforated wall; driving means adapted to rotate said wash basket, selectively, at predetermined speeds; electric heating means, mounted on said wash basket, with thermostatic control; an electric supply for said heating means; a pump adapted to create vacuum and to transfer mixtures of liquid solvent, solvent vapor and air, thereby causing the condensation of said vapor, the intake of said pump having a pipe connection with the lower portion of said wash chamber for the transfer of liquid solvent from said chamber, a second pipe connection with the upper portion of said chamber for the transfer of vapor from said chamber, and a third pipe connection with the storage tank for receiving liquid solvent for mixing with vapor received from said chamber for the transfer and condensation of said vapor; an air separator communicating with the outlet of said pump and having a float valve and pipe connections adapted to deliver air and vapor into said cold compartment at the low position of the float, and to deliver liquid solvent into the storage tank at the high position of said float.



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