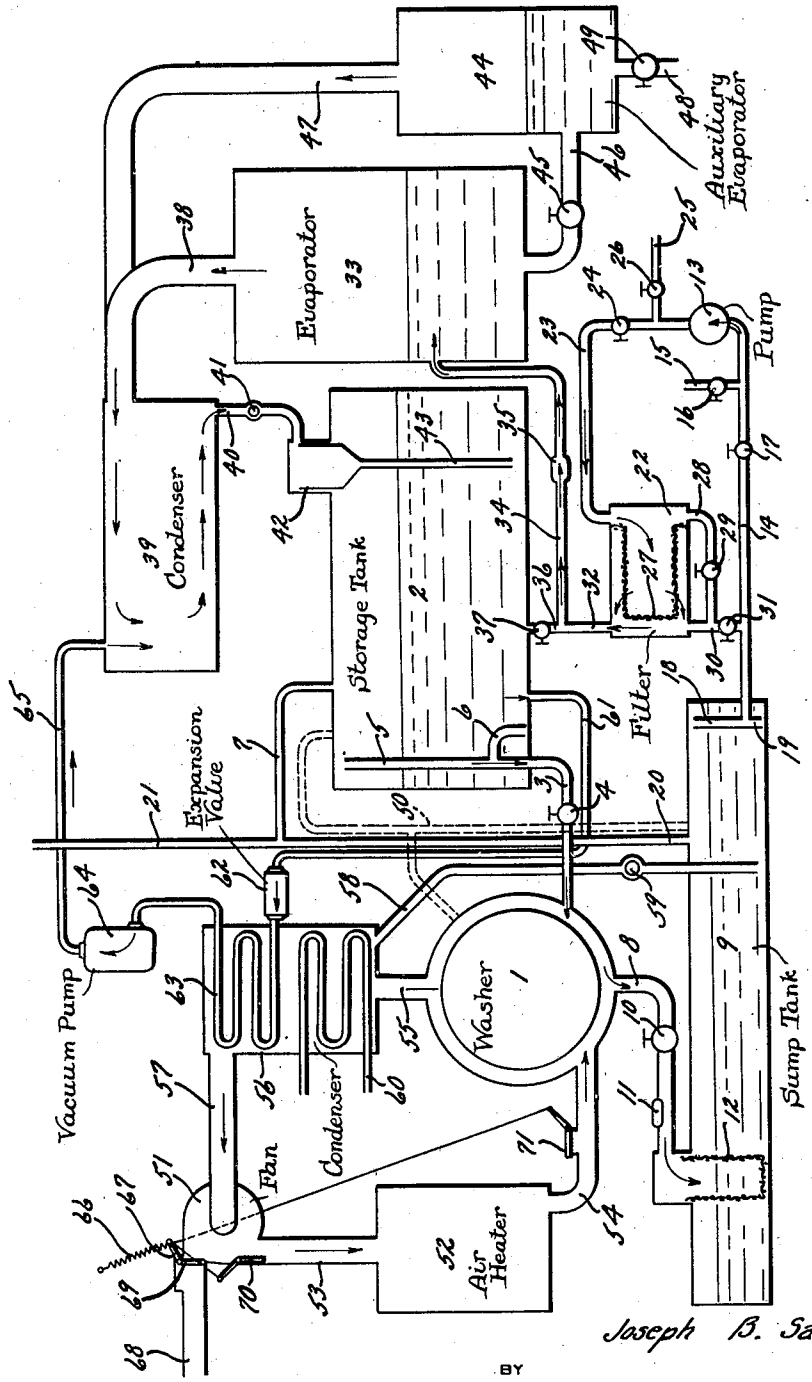
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APPARATUS FOR CLEANING FABRICS

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APPARATUS FOR CLEANING FABRICS

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My invention relates to method and apparatus for treating fabric and, particularly, to a method of treating fabric with a volatile detergent having a low boiling point; to apparatus for removing the foreign matter from detergent after the treating operation whereby the same detergent may be used in subsequent operations with but little loss in the volume thereof; and to a method and apparatus for increasing the reclamation of volatile detergent in the drying step that forms a part of the treating operation whereby the operating cost may be reduced, this last named means taking the form of a refrigeration apparatus in conjunction with the treating system.

In fabric treating machines, it is desirable to be able to repeatedly use the same detergent and to have the detergent equally effective in each operation or to use the same supply of detergent over and over again in rapid succession. It is also desirable to have the entire circulating system closed as nearly as possible to the outside atmosphere and, in some instances, entirely closed in order to prevent excess loss of volatile detergent by passage into the atmosphere. However, means must necessarily be provided in some parts of the apparatus for providing a sufficient access to the atmosphere to prevent formation of excess vacuum or pressure conditions within the apparatus. In addition, it is extremely desirable to reduce the operating cost of such method and apparatus by an increased reclamation of the volatile detergent in the drying process.

The method of treating fabric disclosed herein consists in employing a volatile solvent or detergent having a low boiling point, for instance, carbon tetrachloride and agitating the fabric within a pool of such solvent to remove dirt and foreign matter from the fabric and cause its transfer to the solvent whereupon the used solvent or detergent is drained off and the fabric is first dried and then deodorized. The method of recovering the solvent or detergent as a treating operation consists in evaporating the solvent or detergent at a temperature insufficient to evaporate animal and vegetable oils and removing all of the moisture therefrom which may have been extracted from the fabric being treated, then condensing the solvent or detergent only and then collecting it in a storage tank from which it may be transferred to the treating point as desired, all of these operations taking place in apparatus that is partially if not wholly closed to the outside atmosphere.

The apparatus for carrying out the method comprises a storage circuit including a storage tank for holding a supply of treating solvent or detergent; a fabric cleaning circuit including a fabric treating compartment wherein the treating operation takes place, a fan for circulating air through the treating compartment and thence through a condenser and an air heater and means for selectively employing such air heater or for passing relatively cold atmospheric air through the apparatus; a means for reducing the temperature in the above named condenser by supplying a refrigerant thereto; and a sump circuit including a sump tank in which the solvent or detergent is collected after the fabric treating operation and means for extracting all foreign matter, including moisture and oils, from the solvent or detergent after the treating operation, all of the circuits being operatively interconnected.

The refrigerating system forming a part of this invention is, as shown, the vacuum pump process and employs carbon tetrachloride as the refrigerant. However, it will be understood that any suitable process of refrigeration may be used as well as any desired refrigerant. Carbon tetrachloride for the refrigerating system is taken from the storage tank of the unit and passes through a suitable expansion valve and thence into the cooling coils of the carbon tetrachloride vapor condenser and the vaporization of the liquid carbon tetrachloride with a consequent reduction in temperature is accomplished by a power driven vacuum pump located between the cooling coil in the condenser and a main condenser for forming a part of the sump circuit or carbon tetrachloride reclamation apparatus. Cold carbon tetrachloride vapors passing through the cooling coil of the condenser cool and condense detergent vapors out of the air passing through the shell of the condenser and over the outside of the cooling coils. The vacuum pump maintains the negative pressure required to vaporize the liquid carbon tetrachloride flowing from the storage tank and serves to return the same to the main condenser, previously mentioned, where the refrigerant will be condensed and returned to the clean storage tank. Thus, a closed system is provided for the refrigerant which will require only a small part of the total quantity of liquid in the clean storage tank and will, in no way, affect the supply of the clean liquid required for the cleaning process.

Various objects and advantageous features of

my invention will be seen in the following description and one embodiment thereof may be seen in the accompanying drawing wherein similar characters of reference designate corresponding parts, and wherein the figure is a diagrammatic view of the apparatus employed for carrying out the method for treating fabric and showing a refrigerating apparatus as forming a part thereof.

Referring to the drawing, I have shown an apparatus for treating fabric embodying a cleaning circuit, a storage circuit, a sump circuit, and a refrigerating apparatus for a condenser cooling means, the various circuits making up a means for supplying a volatile detergent to a treating compartment, means for removing the detergent from the treating compartment after the treating operation and then removing the foreign matter from the detergent and transferring it to a supply tank ready for use in subsequent operations, comprising a fabric treating compartment 1 provided on its interior with the usual rotatable goods container which may be rotated in alternately reverse directions by any suitable power means. A storage tank 2 is located adjacent the treating compartment 1 to provide a means for supplying the volatile liquid used in the treating operation to the treating compartment, the liquid being preferably, although not necessarily, carbon tetrachloride. As shown, a conduit or pipe 3 connects the bottom of the storage tank 2 with the treating compartment 1, the conduit or pipe being provided with a valve 4 for regulating the quantity of treating medium which passes from the storage tank to the treating compartment.

The storage tank 2 and its connections with the treating compartment 1 form the storage circuit and in order to prevent any water or moisture which may collect or float on the surface of the treating medium within the storage tank 2 from gravitating into the treating compartment 1 through the conduit 3, the portion of the conduit disposed within the storage tank is provided with two branches, one of these branches, branch 5, extends upwardly to a position adjacent the top of the storage tank 2 whereby it is always above the level of the top surface of the treating medium within the storage tank. The other branch 6 preferably takes the form of a 90° elbow having its lowermost end but slightly above the bottom of the storage tank whereby the medium flowing out of the storage tank through the conduit or pipe 3 always flows from the lowermost part of the storage tank. A small vent pipe 7 is connected to the top of the storage tank 2 and preferably extends to the exterior of the building in which the cleaning plant is located, the pipe being open to permit air to enter the storage tank when treating medium is withdrawn therefrom and to permit escape of air from the tank when treating medium is supplied thereto. It will be understood that the vent pipe may be valve controlled as desired.

A conduit 8 leads from the bottom of the treating compartment 1 which, of course, during the treating operation is air tight, to a sump tank 9 located below the treating compartment and forming a part of the sump circuit, the conduit being provided with a valve 10 for controlling the flow of treating medium from the compartment to the sump tank and a sight glass 11 for determining when all of the medium has been drained from the compartment and has passed into the sump tank.

The outlet end of the conduit 8 discharges into a strainer basket 12 that is conveniently located within the confines of the sump tank 9 and is made removable therefrom through a top opening that is preferably closed by an air tight cover. Such basket 12 is made of suitable wire mesh material and may be provided with means whereby it may be easily removed or replaced, for instance, a handle. Thus, a means is provided for catching and retaining any small particles of foreign matter over a given size that may have become separated from the goods in the treating compartment, the size of the particles depending on the size of the wire mesh, as well as a means for preventing such foreign matter from lodging in the sump tank or other parts of the apparatus and possibly transferring with the proper operation thereof.

In order to recirculate the treating medium and renovate the used medium prior to its return to the storage tank 2 from which it is supplied to the treating compartment 1 for subsequent treating operations, the sump circuit embodies a pump 13 for which suitable operating means may be provided. The intake side of the pump is connected to the sump tank 9 by a conduit 14 provided with a branch conduit 15 under the control of a valve 16 and terminating in a free end to provide a pipe or hose connection. Conduit 14 is provided with a control valve 17 for regulating the flow of medium from the sump tank 9 to and through the pump 13, the valve 17 being normally open while the valve 16 is normally closed. However, when a fresh supply of treating medium from some outside source is to be supplied to the apparatus, the valve 17 is closed and the valve 16 is opened, at which time a pipe or hose may be attached to the pipe or hose connection and the fresh supply of medium drawn into the apparatus by operation of the pump 13.

As shown, the portion of the conduit 14 extending within the sump tank 9 terminates in a vertically extending T-connection whose upper end 18 is adjacent the bottom thereof. The purpose of a T-connection of this type is to provide a means for having the intake of treating medium from the sump tank to the connected apparatus at a point adjacent the bottom of the tank to thus eliminate the drawing of water into the apparatus and to provide a means for regulating the lowest level of the treating medium in the sump tank which will be at the point where the conduit 14 joins the T-connection. This is highly important in that it will maintain a seal for the lower end of the pipe 19. A vent 20 extends upwardly and outwardly from the top of the sump tank to the outside atmosphere. As shown, this vent pipe may join the vent pipe 7 leading from the storage tank 2, the two vent pipes extending to the atmosphere in a common vent pipe 21.

As a first step in the recirculation of the treating medium from the sump tank 9 to the storage tank 2, the medium is passed into a filter 22 by way of a conduit 23 leading from the discharge side of the pump 13 and under the control of a valve 24. A pipe or conduit 25 under the control of a valve 26 leads from the pump discharge side of the conduit 23 and terminates in a pipe or hose connection. Normally, when the apparatus is operating, the valve 26 is closed and the valve 24 is open.

However, if for any reason it becomes necessary to empty the system of treating medium, the valve 24 is closed and the valve 26 is opened and a suitable hose or pipe is attached to the pipe 25 whereby the medium may be discharged from the system and to any desired point.

As shown, the filter 22 embodies a filter bag 27 and the inner end of the shell of the filter adjacent the inner side of one end of the filter bag is cored out to provide passageways connecting the interior of the filter bag with the conduit 23 and with a conduit 28 under the control of a valve 29. Such conduit 28 connects the interior of the filter bag 27 with a conduit 30 under the control of a valve 31 which, in turn, connects the interior of the filter bag with the sump tank 9 through the conduit 14. A pipe or conduit 32 connects the filter with an evaporator mechanism 33 by way of a conduit 34 which is provided with an automatically operating valve 35 for preventing return of fluid or medium from the evaporator to the filter. It will be noted that the conduit 28 is adapted to drain the medium from the interior of the filter bag 27 while the conduit 30 is adapted to drain the medium from the outside of the filter bag. Therefore, both of these conduits are disposed at and connected to the bottom side of the filter shell. A branch pipe 36 under the control of a valve 37 connects the filter shell outside of the filter bag 27 with the storage tank 2 through the conduit 32.

In the operation of this part of the apparatus which is substantially all of the sump circuit, when the system is in operation, the valve 24 is open and the valves 29, 31 and 37 are closed whereby the treating medium may be pumped from the sump tank 9 by the pump 13 and through the pipe or conduit 23 into the interior of the filter bag 27, and thence through the conduits 32 and 34 into the evaporator 33 where the filtered medium will be converted into vapor which thereafter rises and passes into a conduit 38 and thence into a condenser 39. Within this condenser, the vapor is converted into liquid which gravitates through a conduit 40 provided with a sight glass 41 and into the storage tank 2, the medium passing through a waste trap 42 and into the storage tank by way of a conduit 43 that extends downwardly into the storage tank to a point a short distance above the bottom thereof whereby a liquid seal for the conduit 43 is provided to permit the formation of a circulating unit that is closed to the atmosphere and also to prevent any agitation of the contents of the storage tank by the liquid entering through the conduit 43. Skimming valves may be provided in the storage tank as desired.

At times, it becomes necessary to clean out the filter 22 and at such time the valve 24 and conduit 23 is closed and the valves 29 and 31 are opened which will permit the treating medium within the filter to gravitate through the conduits 28 and 30 and a part of the conduit 14 into the sump tank 9 whereupon the filter bag may be removed and cleaned. After cleaning, the filter bag may be replaced in the filter shell whereby the filter is again in condition to properly function.

While the capacity of the evaporator 33 is preferably sufficient to supply treating medium to the storage tank 2 so as to permit continuous operation of the apparatus and, at the same time, maintain a generous supply of medium within the storage tank 2, an auxiliary evaporator 44 is provided to remove the medium from the sludge taken out of the main evaporator 33. This auxiliary evaporator is preferably positioned at a lower level than the main evaporator 33 so that it is only necessary to open a valve 45 in a conduit 46 that leads from the bottom of the evaporator 33 and into the evaporator 44 to supply the sludge to the auxiliary evaporator. A vapor discharge pipe or conduit 47 leads from the top of the auxiliary evaporator 44 and into the discharge conduit 38 leading from the main evaporator 33 to the condenser 39 whereby vapor from the auxiliary evaporator will pass to the condenser 39. This condenser may be cooled by cold circulating water. For auxiliary evaporator cleaning out purposes, a drain pipe 48 under the control of a valve 49 is provided at the bottom of the auxiliary evaporator and it will be understood that both evaporators and the condenser will be provided with suitable heating and cooling pipes connected thereto and a means may be provided for automatically controlling the supply of heating and cooling medium.

In some plants, it may be preferable to connect the top of the treating compartment 1, the storage tank 2, and the sump tank 9 by suitable piping 50 as shown by the dotted lines. In this event, the vent pipe 21 would either remain open so that the entire system would be open to the atmosphere or the vent pipe could be closed after the apparatus is once filled with treating medium whereby the system would be closed to the atmosphere during the treating operation.

In addition to the hereinbefore described apparatus for recirculating and renovating the treating medium or, the sump circuit, suitable apparatus forming a part of the cleaning circuit has been provided for deodorizing and drying the fabric as a part of the treating operation and before removal of the fabric from the washing compartment, as well as a means for reducing the operating cost of the method and apparatus by increasing the reclamation of the volatile detergent or treating medium in the drying process. As shown, a fan 51 is located near the treating compartment 1, the fan being driven by any suitable power means. One discharge of the fan is connected to an air heater 52 by means of a duct 53, the air heater being, in turn, connected to the treating compartment 1 by a duct 54. A duct 55 connects the compartment 1 with a condenser 56 and air discharge of this condenser is connected to the intake side of the fan 51 by a duct 57. The liquid discharge from the condenser 56 passes through a pipe or conduit 58 to a point within and close to the bottom of the sump tank 9. Such pipe or conduit is provided with a sight glass 59 for determining when liquid is flowing from the condenser 56 to the sump tank.

In accordance with my invention, a means is provided for supplying a refrigerant, which may be of any suitable nature but in this instance is the carbon tetrachloride used in the treating operation, to the condenser 56 whereby the temperature within the condenser will be reduced to such extent that condensation of the carbon tetrachloride vapor passing upwardly from the treating compartment will take place much more rapidly and the vapor will be more thoroughly condensed. Such means for supplying a refrigerant to the condenser may entirely take the place of the usual cooling coils 60 disposed within the condenser and through which a cooling

medium such as water is passed or the means for supplying the refrigerant may be used in combination with such cooling medium pipes as shown. The apparatus for supplying the refrigerant to the condenser consists of a pipe or conduit 61 leading from the storage tank 2 to a suitable expansion valve 62, the pipe or conduit continuing onwardly through the condenser shell as a coil 63 and leading to the intake side of a suitable vacuum pump 64. The discharge side of the vacuum is connected to the main condenser 39 by way of a pipe or conduit 65.

In the operation of this part of the apparatus, the supply of carbon tetrachloride for the refrigerating system is taken from the storage tank 2 and passes by way of the conduit 61 into the expansion valve 62, the expansion valve being of any well known type. Thence, the carbon tetrachloride passes into the coil 63, the vaporization of the liquid carbon tetrachloride with the consequent reduction in temperature being accomplished by the power driven vacuum pump 64 located between the cooling coil in the condenser 56 and the main condenser 39 as shown. The cold carbon tetrachloride vapors passing through the cooling coil 63 condense out carbon tetrachloride vapors from the air passing through the shell of the condenser and over the outside of the cooling coils. The vacuum pump 64 will maintain the negative pressure within the refrigerating system which is necessary to vaporize the carbon tetrachloride therein, and will return the refrigerant to the condenser 39 through the conduit 65. Thus, a closed refrigerating system is provided for cooling the air and carbon tetrachloride vapors passing through the condenser 56, the closed system for the refrigerant, namely, carbon tetrachloride, requiring only a small part of the total quantity of the liquid in the storage tank and in no way affecting the supply of clean liquid which is required for the cleaning process. While the refrigerating system has been described as being interconnected with the storage tank of the apparatus and although it has been described as using carbon tetrachloride as a refrigerating medium, it will be understood that the refrigerating apparatus may be entirely separate from the storage tank or any part of the actual cleaning apparatus and that any type of refrigerant may be used.

In the drying operation, the fan 51 is placed in operation whereby air from the heater 52 will be forced through the compartment 1 and will gather vapor from the goods therein and carrying such vapor through the conduit 55 to and through the condenser 56 where the vapors are condensed in passing over the normal cooling coil 60 through which may flow cold circulating water or refrigeration coils 63, or both, the air passing onwardly through the duct 57, fan 51, duct 53 and heater 52 back through the compartment 1 to pick up more cleaning medium while the medium removed therefrom by condensation passes through the conduit 58 to the sump tank 9. It will be understood that the air is reheated at each passage through the heater 52 and is continuously circulating through the compartment 1 until the treating medium picked up thereby and later condensed in the condenser 56 ceases to pass through the pipe or conduit 58, that is, until there is no more treating medium in the goods to be picked up by the moving air.

Means are also provided for deodorizing the fabric in the treating compartment 1 after the treating operation has passed the drying stage. To do this, suitable air valves 69, 70 and 71 are provided at convenient places in the various parts of the air circulating system and are operable simultaneously by a single means and held in normal closed position by a spring 66. After the drying operation, the refrigerating system may be shut down, the air valves 69 and 71 are opened and the air valve 70 is closed by moving a suitable lever 67 which will permit atmospheric air to be drawn into the system through the port controlled by the valve 71, passed through the dried goods in the compartment 1, and thence discharged through the duct 55, condenser 56, duct 57, fan 51, the port controlled by valve 69, and duct 68 to the atmosphere, it being understood that the suction created by the fan 51 will cause such circulation and that the passage of air through the heater 52 is prevented by closing of the valve 70. Such forced circulation of atmospheric air through the treated fabric is continued until the fabric is thoroughly deodorized after which the fabric may be removed from the compartment and a fresh batch to be treated introduced in its place.

A part of this method of treating fabrics consists in the provision of an apparatus of such construction that the treating medium does not have free communication to the atmosphere during the treating operation up to the deodorizing step as does the treating medium in the storage tank 2 which has free communication with the atmosphere at all times through the vent pipe 7. As hereinbefore described, the vent pipe 20 for the sump tank 9 has its lower end above the surface of the medium in the sump tank but the inlet to the sump tank from the compartment 1 may be closed off by the valve 10 while the connection between the condenser 56 and sump tank has its delivery end below the liquid in the sump so that a liquid seal is provided against any free communication between the treating compartment 1 and the atmosphere when the apparatus is in operation. It is understood, of course, that the valves 69 and 71 are maintained in closed position up to the deodorizing step and the valve 70 is maintained in open position.

With the above construction, a method and apparatus for treating fabrics is provided which includes a fabric cleaning circuit, a storage circuit, and a sump circuit including means for renovating used cleaning medium, all of which are operatively connected, and a cleaning circuit that is sealed against free communication with the atmosphere throughout all steps with the exception of deodorizing step, as well as one in which the cleaning medium is reclaimed whereby it may be used over and over again. In addition to this, a method and apparatus is provided that is of a nature to substantially increase the reclamation of cleaning medium after the cleaning operation. This is accomplished by providing a means for bringing about a decreased temperature in the condenser shell, the means taking the form, in this instance, of a closed refrigerating system employing the treating medium as a refrigerant. Various other advantageous features will be readily apparent.

What I claim is:

1. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a condenser operatively connected

with said treating compartment for recovering liquid detergent from the vapor leaving said treating compartment during a cleaning operation, and means for passing a part of the volatile detergent used in fabric treating operations through said condenser as a refrigerant to thereby render said condenser effective as a condensing means.

2. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a liquid detergent supply means connected to said treating compartment, a condenser operatively connected with said treating compartment for recovering liquid detergent from vapor leaving said treating compartment during a cleaning operation, and means for passing volatile detergent through said condenser as a refrigerant to thereby render said condenser effective as a condensing means, said last named means comprising a connection, between said volatile detergent supply and said condenser.

3. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a liquid detergent supply means connected to said treating compartment, a condenser operatively connected with said treating compartment for recovering liquid detergent from vapor leaving said treating compartment during a cleaning operation, and means for passing volatile detergent through said condenser as a refrigerant to thereby render said condenser effective as a condensing means, said last named means comprising a connection between said detergent supply and said condenser and an expansion valve in said connection to vaporize the detergent flowing from said supply to said condenser.

4. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a liquid detergent supply means connected to said treating compartment, a condenser operatively connected with said treating compartment for recovering liquid detergent from vapor leaving said treating compartment during a cleaning operation, and means for passing volatile detergent through said condenser as a refrigerant to thereby render said condenser effective as a condensing means, said last named means comprising a connection between said detergent supply and said condenser and an expansion valve in said connection to vaporize the detergent flowing from said supply to said condenser, and a condenser for liquefying said vaporized detergent and returning it to said supply means.

5. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a liquid detergent supply reservoir, a condenser communicating with said treating compartment for recovering liquid detergent from the vapor leaving said treating compartment during a cleaning operation, means for supplying volatile detergent from said treating compartment supply means to said conderser as a refrigerant to thereby render said condenser effective as a condensing means, and means for liquefying the detergent used as a refrigerant.

6. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein the fabric is subjected to liquid detergent, a liquid detergent supply reservoir, a condenser communicating with said treating compartment for recovering liquid detergent from the vapor leaving said treating compartment during a cleaning operation, means for supplying volatile detergent from said treating compartment supply means to said condenser as a refrigerant to thereby render said condenser effective as a condensing means, and means for liquefying the detergent used as a refrigerant and returning such detergent to the supply reservoir.

7. Apparatus for treating fabric with a volatile detergent, comprising a fabric treating compartment wherein fabric is subjected to the detergent in a liquid form, a detergent supply means communicating with said treating compartment, a two stage condenser communicating with said treating compartment for recovering liquid detergent from vapor leaving said compartment during a treating operation, and means for passing volatile detergent through said condenser as a refrigerant at one of its condensing stages to thereby render said condenser effective as a condensing means.

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