This invention relates to liquid separating devices and more particularly to a device for separating liquids of different densities and to a cleaning apparatus in which the liquid separating device is usable.

An object of this invention is to provide a new and improved dry cleaning apparatus for cleaning garments and the like having means for vaporizing the cleaning solvent from the garments upon the completion of the cleaning operation and then recovering the solvent by condensing, which apparatus includes a liquid separating device which separates the condensed solvent from water intermixed therewith.

Another object is to provide a dry cleaning apparatus wherein the garments to be cleaned are placed in a closed tub through which solvent is continuously circulated to dissolve and extract foreign substances, such as dirt, grease and the like from the garments, wherein the solvent is drained from the tub upon completion of the cleaning operation, wherein the apparatus has means for establishing upon completion of the cleaning operation a closed air flow passage through the tub and past a cooling means for condensing the solvent vapors from the air moving from the tub, the cooling means condensing the solvent vapor, and wherein the condensed solvent is passively separated from the liquid separating device which separates the condensed solvent from any water mixed therewith prior to a succeeding use of the solvent in cleaning garments.

Still another object is to provide a dry cleaning apparatus wherein the mixture of condensed solvent and water is continuously delivered during the condensation process to the liquid separating device which has means for automatically permitting flow of the separated solvent from the separating device to a reservoir at a predetermined stage in the cycle operation of the cleaning apparatus.

Still another object is to provide a dry cleaning apparatus having means for automatically removing the solvent and the water from the liquid separating device of different predetermined stages of the cycle of operation of the apparatus.

A further object is to provide a liquid separating device for separating liquids of different densities from one another.

A still further object is to provide a liquid separating device having a tank or vessel into which the liquids of different densities are introduced and separated therein according to their relative densities and siphon means for removing the heavy liquid from the bottom of the vessel wherein the siphon means is provided with automatic means for interrupting the siphoning of the heavy liquid when the level of the heavy liquid in the vessel drops to a predetermined level in the vessel.

A still further object is to provide a new and improved liquid separating device having a vessel into which the mixed liquids are introduced and in which they separate according to their densities having a siphon tube opening adjacent the bottom of the chamber for siphoning off the heavy liquid from the vessel and valve means for placing the siphon tube in operative condition when the level of the heavy liquid rises to a predetermined height in the vessel and for placing the siphon tube in inoperative condition when the level of the heavy liquid drains below the predetermined height.

Another object is to provide a liquid separating device having means for removing the light liquid from the vessel to a level spaced above the predetermined height in order that a layer of the light liquid is always disposed on top of the heavy liquid in the vessel to prevent evaporation of the heavy liquid.

Additional objects and advantages of the invention will be readily apparent from the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a schematic view of the liquid separating device embodying the invention;

FIGURE 2 is a top view with some parts broken away of a liquid separating device embodying the invention;

FIGURE 3 is a side view with some parts broken away of the liquid separating device illustrated in FIGURE 2;

FIGURE 4 is a fragmentary sectional view with some parts broken away, taken on line 4—4 of FIGURE 3;

FIGURE 5 is a schematic view of the dry cleaning apparatus employing the liquid separating device; and

FIGURE 6 is a schematic prospective view of a timer motor and cam control means for the switches of the electric control system of the dry cleaning apparatus.

Referring now particularly to FIGURE 1 of the drawings, the liquid separating device 700 embodying the invention includes a closed tank or vessel 701 having an inlet duct 702 adjacent its upper end through which a mixture of liquids of different densities, for example, a cleaning solvent with small quantities of water intermixed therewith, is introduced into the vessel, the solvent being of greater density than the water. A siphon tube 703 has an inner vertical leg section 704 through which its lower opening adjacent the bottom thereof, an intermediate horizontal upper portion 705 which extends outwardly from the container between the inlet duct 702 and an outlet duct 706, and an external section 707 which extends downwardly to any suitable reservoir in which the solvent is to be stored or used. The upper intermediate portion 705 of the siphon tube has a T-fitting 708 connected therein by means of which one end of a vent tube 710 is in communication with the upper portion of the siphon tube. The other end portion 711 of the vent tube has a valve seat 712 which is engageable by a needle valve 713 to close the vent tube. The valve is movable upwardly to engage the seat when a float 715, which floats in the solvent but which sinks in water, moves the valve upwardly when the level of the solvent rises to a first predetermined level in the vessel. When the level of the solvent drops below a second predetermined level, which is lower than the first predetermined level, for a reason to be explained below, the siphon vent tube 710 is opened and no siphoning of the solvent from the vessel can take place.

In use, the mixture of the solvent and water is introduced through the inlet duct 702 and siphoned with the solvent collecting at the bottom of the vessel and the water floating on the solvent. The float moves upwardly as the upper level of the solvent rises until the valve engages the seat and closes the siphon vent tube. Continued introduction of the mixture of solvent and water, with water ordinarily constituting only a small percentage of the mixture, causes the solvent to rise in the vessel through inner section 704 of the siphon tube to the upper intermediate portion. The siphon tube is thus filled and, if the lower end of the outer siphon tube section 707 is open, the siphoning action thus initiated causes the solvent to flow from the vessel. As such siphoning action continues, the level of the solvent drops and, when it descends to the second predetermined level in the vessel, the valve 713 moves out of sealing engagement with the seat 712, and air is introduced into the upper portion 705 of the siphon
tube 703 thus stopping the siphoning of the liquid. Since a condition of reduced pressure is present in the intermediate upper section of the siphon tube when siphoning of the solvent is taking place, and in the vent tube 710 when the vent tube is closed, causing an upward pressure differential to be exerted across the valve tending to hold it in its closed position, the valve moves to its open position only when the body of solvent drops to the second predetermined level which is lower than the first predetermined level at which the valve closes the vent tube.

The liquid separating device 700 thus functions automatically to siphon off the heavy solvent from the vessel while leaving the relatively lighter water therein. The outlet duct 706 is provided with a suitable valve 717 which may be opened to remove the water from the reservoir at any desired time. The outlet duct 706 is disposed above the second predetermined level so that when the valve 717 is opened the upper portions of the water are drained off leaving a thin layer thereof over the solvent in the bottom portion of the vessel to prevent its evaporation and also to prevent removal of any of the heavy liquid from the reservoir. The valve 717 of course is opened only when the float 715 is in its lowestmost position and the siphoning of the heavy liquid is not taking place.

The outer siphon tube section 707 of the siphon tube may be provided with a suitable valve, such as a valve 700 controlled by a solenoid 99, which is opened at any desired time to cause the removal of the solvent from the vessel in the event a sufficient volume of the solvent is in the vessel to raise its level to or above the first predetermined level at which the valve 717 closes the vent tube.

It will now be apparent that the liquid separating device separates the liquids of different densities, such as a solvent used in dry cleaning apparatus whose density is greater than that of the water, introduced over a substantial period of time into the vessel 701 while the siphon tube section 707 and the outlet duct 706 are closed. The water separates from the solvent and floats on its upper surface. As the level of the solvent rises in the reservoir, the float 715 is moved upwardly and closes the vent tube 710. As the solvent in the vessel continues to accumulate, the solvent continues to rise in the vessel and through the intermediate portion 705 of the siphon tube until it rises to the level of the intermediate portion 705 of the siphon tube whereupon the solvent continues the flow through to the siphon tube and its outer section 707. The vent duct 719 which opens into the outer siphon tube section between the lower end of the inner siphon tube section 703 and the valve 98 permits the solvent to escape from the vessel so that the valve 98 may be held open to allow such movement of the solvent. The flow of solvent from the vessel continues until the solvent in the vent duct 719 rises to the top level of the solvent in the vessel.

When the valve 98 is opened, the siphoning action of the siphon tube now moves the solvent from the bottom of the vessel through the siphon tube until the level of the solvent drops to a second predetermined level and the float 715 causes the valve 713 to move out of sealing engagement with the seat 712 of the siphon vent tube 710 thus permitting air to enter into the intermediate upper section 707 of the siphon tube and the solvent in the vent duct 706 is removed. The water separates from the solvent and floats on its upper surface.

A pair of vertically spaced brackets 738 and 739 are secured to the cylindrical wall 731 by means of which the vessel may be secured to any suitable fixed structure. The cylindrical wall 731 has a vertical elbow aperture 740 about which extends a substantially rectangular window 741 which is suitable secured to the cylindrical wall. The window mounting has an external annular flange 743. The aperture of the window is closed by a pane 744 of glass or other suitable transparent substance held in seat tight relation with the flange 743 by a rectangular cover plate 746 which is secured to the flange by means of screws 747 which extend through suitable apertures in the cover plate and the rectangular gasket 748 interposed between the rectangular flange 743 and the outer peripheral portions of the pane 744, into suitable threaded apertures in the flange. The outlet duct 706 is provided with any suitable valve or drain cock 717.

The inner section 708 of the siphon tube has an upper end secured in one end 750 of the T coupling 708 and its lower end opens adjacent the bottom 730 of the vessel. The upper siphon tube section 705 includes a section 755 one of whose ends is secured to the outlet 756 of the T coupling while the other end is secured to a suitable union coupling 760 by means of the nut 761. The inner end portion of the union coupling extends into the vessel through a suitable aperture in the cylindrical wall of the vessel. The siphon vent tube 710 includes a vertical duct 763 whose lower end is secured to the end 764 of the T coupling and whose upper end is connected the U-shaped vent tube section 766 whose upper end is enlarged to receive the valve seat 712 which is engageable by the needle valve 713. The stem of the needle valve extends slidably through suitable apertures in the guide brackets 711 and 712 rigidly secured to the vent tube section 763 and the inner siphon section 704 in any suitable manner, as by welding. The lower end of the valve stem is secured to the substantially ring shaped float 715. The float has a U-shaped bracket 775 rigidly secured thereto whose legs 776 and 777 extend radially outwardly from the float and between the arms 778 and 779 of a substantially U-shaped bracket 790 rigidly secured to the inner siphon tube section 704. The arms of the bracket 790 are provided with inwardly extending horizontal legs 782 which limit downward movement of the float bracket. The arm 783 of the siphon tube is rigidly secured to the arms of the bracket 790 by a suitable pin 784 which extends through the suitable apertures in the arms 776 and 779 and through vertical slots in the arms of the float brackets so that the float is free to move vertically relative to the bracket 790 through a predetermined distance. The brackets 780 and 775 control the vertical movement of the float 715 and prevent its lateral displacement while the guide brackets 771 and 772 guide the vertical movement of the needle valve 713 and prevents its misalignment with its valve seat 712 of the siphon vent tube 710.

It will now be seen that a new and improved liquid separating device has been illustrated which is of very simple construction and which may be used to separate a heavy liquid from a light liquid. Referring now particularly to FIGURES 2, 3, and 4 of the drawing, which show the actual structure of the liquid separating device 700, the vessel 701 has a bottom 730 and a cylindrical wall 731 provided at its upper end with an external annular flange 732. The upper end of the vessel is closed by a circular cover 733 secured to the ex-
A solvent reservoir 30 is disposed below the tub and has an outlet 31 connected to the inlet of a pump 32 which outlet is connected to the condit 33 which goes into the tub 21 adjacent the upper end thereof. A valve 35 operated by a solenoid 36 is provided for closing the condit.

The tub has a drain or outlet conduit 38 provided with the valve 39 which is operated by the solenoid 40. An overflow duct or conduit 41 connects the drain conduit 38 downstream of the valve 39 with the duct 42 which communicates with the interior of the tub. The overflow duct is provided with a check valve 43. It will be apparent that whenever the level of the solvent within the tub tends to rise above a predetermined level, the fluid flows out through the overflow duct 41 and to the drain conduit 38, the check valve preventing reverse flow of fluid into the tub through the overflow conduit. The drain conduit opens into a trap 44 which prevents movement of the large objects, such as buttons and the like, to the drain pump 46 whose inlet is connected to the outlet of the trap by the conduit 46 and whose, in turn, is connected by conduit 47 to the inlet of a mechanical filter 50, provided with a suitable cartridge having a porous material which filters out all particles of dirt and debris from the solvent passing through the filter. A check valve 48 is provided in the conduit 47 to prevent reverse flow of fluids through it.

A suitable pressure gauge 51 is connected to the filter 50 to indicate the pressure therein. The filter 50 is provided with a cover 52 which may be removed to replace the mechanical porous filtering cartridge disposed therein. The outlet duct 53 of the filter 56 is connected to the inlet of the absorbent filter 55 by a conduit 56. A cartridge of activated charcoal or similar absorbent substance is disposed within the filter 55. The activated carbon of the filter 55 absorbs the fatty acids or other compounds into which the solvent converts the greasy fats and other substances removed from the garments so that clean solvent flows from the outlet of the filter 55 into the inlet conduit 58 which opens into the upper portion of the reservoir 30. The filter 55 may also be provided with a gauge 59 to show the upstream fluid pressure therein and a blowoff or bleed valve 60 for obtaining fluid samples and for relieving the pressure therein before the cover 61 of the filter 55 is removed for removal or replacement of the absorbent substance or cartridge of the filter. The outlet conduit 53 of the mechanical filter 50 is also connected to the inlet conduit 58 of the reservoir 30. A valve 63 downstream of the point at which the duct 56 communicates with the outlet duct 53 controls flow of solvent through the outlet conduit 53 into the inlet conduit 58. The valve 63 may be opened when it is desired to drain the mechanical filter of the solvent preparatory to removal or replacement of the mechanical filter cartridge therein.

The duct 42 extends upwardly at one side of the tub and opens into a housing 66 in which is disposed a lint trap or screen 68, the cooling coils 69, and the heating coils 70. The housing has an outlet 72 connected to the inlet of a blower 73 whose outlet 75 opens into an air conduit 76 having a pair of valves 78 and 79. The valves 78 and 79 are moved to the full line positions illustrated in FIGURE 1 wherein they close the inlet and outlet ducts 80 and 81 of the valve housing when the solenoids 82 and 83 which operate the valves are energized. The inlet duct 80 may be provided with a screen 85 while the outlet duct 81 may open to the atmosphere exteriorly of the building in which the dry cleaning apparatus is located. The valves, when solenoids 82 and 83 are de-energized, are moved by suitable springs (not shown) such as the usual well known hinge springs associated with the hinges or pivots 76a and 79a by means of which the valves are hinged to the air valve housing 76. The solid line positions illustrated in FIGURE 5 wherein they close the aperture or passage 84 in the diagonally extending partition 85 of the housing and open the inlet and outlet ducts 80 and 81. When the valves 78 and 79 are in the full line positions illustrated in FIGURE 1, and the blower is operating, air may be circulated by the blower through the closed flow path or passage which includes the tub, the duct 42, the housing 66, the blower 73, the air valve housing 77 and back to the tub. When the valves are in their broken line positions illustrated in FIGURE 5, closing the passage 84 of the partition 85, and the blower is operating, air is drawn into the tub through the inlet duct 80, or through the door opening of the tub if the door is open, and expelled from the tub through the duct 42, the housing 66, the blower 73, the air valve housing 77 and the outlet or exhaust duct 81. The blower 73 is driven by any suitable motor 92.

The housing 66 is provided with a sump 95 below the cooling coils 69 into which flows the solvent condensed by the cooling coils 69. The drain conduit 97 connects the sump 65 to the inlet duct 702 of the vessel 701. The outer section 707 of the siphon tube is connected to the reservoir 30 and is provided with the valve 98 which is operated by the solenoid 99. A vent duct 109 has its lower end connected to the outer section 707 of the siphon duct below the lower end of the inner siphon tube section and its upper end to the conduit 97 immediately below the sump 95 so that the condensate draining from the sump 95 will not flow into the vent duct 129 but will flow through the conduit 97 and the inlet duct 702 of the vessel 702 into the vessel 700.

The valves 35 and 98 are normally closed so that no vapors or evaporated solvent from the reservoir may flow into the tub. These valves are provided both to prevent loss of the solvent and also to prevent accumulation of vapors within the tub. In addition, the blower 73 is energized and the solenoids 82 and 83 are de-energized and the valves 78 and 79 moved to the broken line positions indicated in FIGURE 2 whenever the door 24 is opened so that air is drawn into the tub through the door opening and expelled from the tub whenever the door is open.

The cooling coils 69 are connected to the inlet of a suitable compressor 103 by the conduit 104 and connected to the outlet 105 of the compressor through a conduit 107 having a valve 108 which is controlled by the solenoid 109. The heat dissipating coils 110, a receiver 112 into which the compressed and cooled refrigerant passes, the conduit 113, to which are connected a dryer 114 for the refrigerant and a sight glass 115, the conduit 117 having the valve 118 controlled by the solenoid 119 and the usual expansion valve 120.

It will be apparent that the compressor 103, the heat dissipating coils 110, the receiver 112, the dryer 114, the sight glass 115 and the expansion valve 120 constitute a conventional refrigeration system employing a gas which is first compressed and cooled and then allowed to expand in the cooling coils to absorb heat.

A conduit 125 is also connected to the conduit 113 and supplies compressed refrigerant to the cooling coil 126 disposed in the reservoir 30. The conduit 125 has a valve 128 controlled by the solenoid 129 and an expansion valve 130. The outlet of the cooling coils 126 is connected by the conduits 131 and 104 to the inlet 125 of the compressor.

It will now be apparent that when the solenoid 119 is energized, refrigerant gas which has been compressed by the compressor 103 and cooled by the passage through the heat dissipating coils 110, flows through the cooling conduit 69 to expand therein and to absorb heat from the air and solvent vapors which may be circulating in the conduit.

One end of the heating coils 70 is connected to the outlet 105 of the compressor 103 by the conduit 107 and the conduit 133 which has a valve 134 controlled by the solenoid 135. The other end of the heating coils 70 is connected by the conduit 136 to the conduit 107 downstream of the valve 108. A check valve 137 in the conduit 135 prevents reverse flow through the conduit.
It will be apparent that when the valve 108 is closed and the valve 134 is open the hot refrigerant gas from the compressor first flows through the heating coils 70 to heat the air passing through the housing 66 which has been cooled by passing past the cooling coils and by the condensation of the solven vapor from there.

An additive tank 140, in which a reserve supply of the solvent is stored, is disposed above the reservoir 30. The tank has an outlet conduit 142 which opens into the reservoir 30 and has a valve 144 connected therein which is controlled by the solenoid 145 so that an additional amount of solvent may be added to the reservoir upon the completion of each cycle of operation of the apparatus to make up for any loss of the solvent during such cycle. The solvent used may be of the type commercially available under the name Valcene and may include some detergent in solution in the solvent.

The valve 117 may be operated by a solenoid 790 if it is desired that the draining of the water from the vessel 701 be performed automatically. The operation of the various electric motors and the various solenoids may be controlled by a timer motor 350 on whose shaft 351 are mounted a plurality of switches 352 which operate the several motors and switches 353 which in turn control the operation of the various solenoids and motors. The switches cam moves their respective switches either between two positions in one of which the switches is in open position and in the second of which the switch is in closed position or between two positions in one of which the switches is in one position and in the second of which the switches is in the other position.

Under the condition of the cycle of operation of the apparatus the tub is empty of the solvent and the valves 98, 717 and 35 are closed. The solenoid 790 which controls the operation of the valve 717 is now de-energized and the valve is closed. The solenoids 82 and 83 are now de-energized so that the valves 78 and 79 are in the broken line position shown in FIGURE 5 wherein they close the passage 84 of the partition 85. The valves 118 and 134 are now closed so that the refrigerant is not flowing through either the cooling coil 69 or the heating coil 70 of the reclaimer housing 65. The valves 136 and 108, however, are open so that the tub is drained through the drain pipe 105 and the cooling coils 126 in the reservoir and is maintained at a low temperature which is set by the usual thermostats 105a, 105b which control the operation of the compressor 103.

When the door of the tub is opened to permit placement of any load of soiled garments, or the like, into the drum, the motor 92 is immediately energized to operate the blower 73 so that air is now drawn in through the open door of the tub as well as through the inlet duct 80 and is moved through the duct 42, the reclaimer housing 65, the blower 73, the outlet 75, the air valve housing 77, and the vent duct 81 to the atmosphere. When the door is closed and the control circuit is energized by a suitable clock operated switch, the drive motor of the drum 22 is immediately energized and causes rotation of the drum at a low speed. Simultaneously, the solenoids 82 and 83 are energized to open the fill valve 35 and the condensate return valve 98. If the valve 713 is now in its upper position the solvent in the vessel 701 will siphon flow into the reservoir 30 until its upper level reaches its second predetermined level and the valve 713 opens stopping the siphoning action of the siphon tube. Simultaneously, the solenoids 82 and 83 are also energized at this time to move the valves 78 and 79 to the positions where they close off the conduits 80 and 81 and open the aperture or passage 84 in the partition 85 of the air valve 77. The electric motor (not shown) which drives the fill pump 32 is also energized and pumps the solvent from the reservoir 30 into the tub 21. Since the valve 98 is open, the air displaced from the tub by the solvent being pumped into the tub may flow into the reservoir 30 and replace the solvent being pumped from the reservoir.

After the fill pump has operated for a predetermined period of time sufficient to fill the tub to a level above the overflow conduit 41 so that the solvent passes through the check valve and fills the trap 44, the electric motor (not shown) which drives the drain pump 45 is energized and the drain pump to pump liquid from the trap 44 and back to the reservoir 30 through the mechanical and absorbent filters 59 and 55, respectively.

The motors of the fill and drain pumps 32 and 45 continue to operate for a predetermined period of time to cause circulation of the solvent through the tub and through the filters. During this circulation of the solvent, the dirt, oil, greases and other foreign matter are removed from the garments by the solvent, since the lower portion of the drum is now immersed in the solvent and the garments therein are tumbled and periodically immersed in the solvent as the drum rotates due to the vanes 154 and 155 of the drum. The oils and greases are dissolved by the solvent and become part of the soiled garments. The dirt and the fatty acids are removed by the mechanical and adsorbent filters so that clean solvent is circulated back into the tub and the solvent carrying any foreign matter is moved from the tub during the operation of the fill and drain pumps.

This cleaning fluid is drained from the tub, the filters and the reservoir continues for a predetermined period of time sufficiently long to extract all foreign matter from the soiled garments.

When this predetermined period of time elapses, the solenoid 36 of the valve 35 is de-energized and the motor which drives the fill pump 32 are de-energized. As a result, no solvent may now flow into the tub. Simultaneously, the solenoid 46 of the drain valve 39 is energized to open the drain valve 46 so that all solvent in the tub now drains into the trap 44 and, since the motor of the drain pump is still energized, will be pumped back into the reservoir 30. The drain pump and the drain valve remain energized for a predetermined period of time sufficiently long to drain all the solvent from the tub.

Toward the end of this period of energization of the drain pump and the drain valve, a solenoid which controls the actuator is de-energized to increase the speed of rotation of the drum. The increased speed of rotation or spinning of the drum causes most of the liquid solvent to be thrown out by centrifugal force from the garments. The drum is spun or rotated at this increased speed of rotation for a predetermined period and then its rotation is stopped. The solenoid which controls the operation of the two-speed transmission is de-energized and the two speed transmission reverts to its former condition causing the tumbler to rotate at the initial slow speed.

During the period of time that the transmission control solenoid is energized, the solenoid 145 of the valve 144 may also be energized to open the valve 144 so that a predetermined amount of solvent flows from the storage tank 140 into the reservoir 30. This amount of solvent is added to make up for any loss of the solvent during each cycle of operation of the apparatus.

At the end of the period of spinning or increased speed of rotation of the drum, the drain valve solenoid 40 and the motor 156 are de-energized, the motor 92 of the blower 73 is energized and the solenoids 109 and 99 are de-energized so that the valve 108 closes while the solenoid 134 is energized to open the valve 134 so that the hot compressed refrigerant gas is now caused to flow through the heating coil 70 of the housing 66 prior to its passage to the heat dissipation coils 110 and the valve 98 is closed. At the same time, the solenoid 129 is de-energized so that the valve 128 is closed while the solenoid 119 is energized to open the valve 118. As a result,
all of the compressed and cooled refrigerant gas now passes through the expansion valve 120 and into the cooling coils 69 to cool them and cause condensation of the solvent in gaseous state which is now moved past the cooling coils by the blower 73.

The condensate from the sump 95 flows through the conduit 97 into vessel 701 of the liquid separating device wherein the water separates from the solvent and floats thereon.

The air which has been cooled due to the evaporation of the liquid solvent from the garments, the condensation of the solvent from its gaseous state, and also by its passage over the cooling coils 69, is heated by the heat dissipated by the coils 70 so that the blower moves air back into the tube which is hot enough to cause further evaporation of the liquid solvent still in the garments. The air is now continuously circulated through the closed path which includes the cooling and heating coils for a predetermined period of time necessary to cause evaporation of all the liquid from the garments. At the end of this period of time, the solenoid 135 is de-energized and the solenoid 109 is energized to close the valve 134 and open the valve 108. The heating coils 70 are then no longer supplied with hot compressed refrigerant gas. The air in the closed path is now only cooled so that all the air throughout the chamber path is cooled to all wall surfaces thereof so that any additional remaining solvent in the gaseous state will condense on the walls of the tubes and of the closed path and flow downwardly to the bottom of the tub. During a short interval of time toward the end of the period of time during which the refrigerant gas is passing through the cooling coils 69, the drain valve and the drain pump are again energized for a short period of time to cause pumping of such condensed solvent from the tub through the filters and back to the reservoir 50. The drain pump and the solenoid connected in parallel are now de-energized and simultaneously the valve solenoid 119 is de-energized and the valve solenoid 129 is energized to close the valve 118 and open the valve 128 so that the refrigerant gas will now circulate only through the cooling coils 126 in the reservoir 30 and the heat dissipating coils 110. The refrigerant system, therefore, is no longer operative to cool any air which might be moved past the cooling coils. The solenoids 82 and 83 are then de-energized so that the valves 78 and 79 take the broken line positions indicated in FIGURE 1 wherein they close the passage 84 in the partition 85 of the air valve 77. The blower no longer operates for a predetermined period of time to circulate fresh air from the duct 80 through the tub and out to the atmosphere after which the motor which drives the pump is de-energized to stop rotation of the tub.

The door may now be opened to permit removal of the now clean and dried garments from the tub. The blower of course will commence operation when the door is opened. The apparatus is now in condition for another cycle of operation. The condensate which has now flowed from the sump 95 and separates or stratifies and remains in the vessel until the initiation of another cycle of operation of the apparatus which causes the valve 98 to be opened, and, if at this time the level of the solvent is above the first predetermined level and the valve 713 closes the siphon tube vent 710, the solvent will be siphoned from the bottom of the vessel and into the reservoir 30.

The cam disc 362 which is associated with the switch which controls the operation of the solenoid 790 may be set to energize the solenoid 790 to open the valve 717 for a predetermined short period of time to permit the excess water in the vessel 701 to drain out through the outlet duct 706 to a suitable waste line immediately after the valve 98 closes. The cam disc 362 may be manually operable and is then opened at any suitable time to drain the water.

It will now be seen that a new and improved dry cleaning apparatus has been illustrated and described which includes a tumbler or drum disposed in a closed tub through which solvent is continuously circulated during a dirt extraction stage of the cycle of operation of the apparatus to extract foreign matter such as dirt, grease, or the like, from the soiled garments and through filters which remove such foreign matter carried by the solvent from the tub prior to recirculation of the solvent back to the tub, a means establishing a closed air passage through which air may be moved and heating and cooling coils disposed in the closed air path so that the air carrying the solvent in a gaseous state passes the cooling coils which causes condensation of the liquid separator 700 to which the condensate flows where-in the small amounts mixed with the solvent separate from the solvent since it is of less density than the solvent.

It will further be seen that upon the initiation of a cycle of operation of the apparatus, the outer siphon tube section 707 of the vessel 701 is opened and permits the solvent in the vessel if it has accumulated above a first predetermined level, to flow into the reservoir leaving the water behind in the vessel 701.

It will further be seen that the provision of the vent duct 719 between the water siphon tube section 707 and the sump, which of course opens to the closed air flow path of the apparatus, facilitates the flow of air to the reservoir as the solvent is pumped therefrom and to the tub since the effective orifice of the siphon tube and of its vent tube is limited, then flow of the solvent from the vessel 701 normally taking place at a much slower rate than the rate of pumping of the solvent from the reservoir as long as the level of the solvent in the vessel is above the predetermined level. Flow of air through the vessel and the siphon vent tube and the siphon tube is possible and the valve 713 moves to its open position, but this flow, due to the relatively small orifice of the siphon tube is not appreciable.

It will further be seen that only the solvent may flow out of the vessel and into the reservoir since the siphoning action of the siphon tube is interrupted whenever the solvent falls or drops to a second lower predetermined level in the vessel.

It will further be seen that a top layer of water is permitted to remain on the top of the solvent at all times in the vessel so that the solvent can not evaporate from the vessel since the outlet duct 706 is disposed above the second predetermined level and the valve 717 is opened sufficiently to maintain the level of the solvent in the vessel is below the outlet duct.

It will further be seen that the liquid separation device, as long as the valve 717 is closed, does not provide any opening from the closed air flow path of the dry cleaning apparatus.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. An apparatus for dry cleaning soiled garments and the like, including: means providing a closed chamber into which garments and the like may be introduced; a solvent reservoir; filter means; conduit means connecting said reservoir to said chamber and to said filter means; means operatively associated with said conduit means for circulating said solvent from said reservoir through said closed chamber, said filter means and back to said reservoir; means for providing a closed air flow path including said chamber; vent means operatively associated with said last mentioned means; valve means for selectively connecting said chamber to said vent means and to said air flow path to cause said chamber to constitute a
section of said closed flow path; means for moving air through said closed flow path; a cooling means disposed in said means providing said closed air flow path for cooling air flowing from the chamber through said closed air flow path; heating means for heating the air previously cooled by said cooling means and moving through said closed air flow path back into said chamber; a liquid separator device; condensate conduit means connected to said closed air flow path and said device for causing liquid condensate condensed by said cooling means to flow to said device wherein is separated from extraneous liquids; conduit return means connected said device to said reservoir for returning separated solvent from said device to said reservoir; and valve means connected in said conduit return means for selectively closing said conduit return means to flow in either direction therethrough, said liquid separator device including a vessel, said condensate conduit means opening to said vessel adjacent its upper end; a siphon tube having an inner section open adjacent the bottom of said vessel, an upper intermediate section, and an outer section extending downwardly from said intermediate section and connected to said conduit return means; a siphon vent tube communicating with said intermediate section and opening to the interior of said vessel above said upper section; and valve means for closing said siphon vent tube when the solvent in said vessel rises to a first predetermined level and for opening said vent tube to interrupt the siphoning action of said siphon tube when the solvent in said vessel drops below a second predetermined level.

2. The device of claim 1 wherein said vessel has outlet means opening above said second predetermined level; and valve means for closing said outlet means.

3. The apparatus of claim 1, and vent duct means connected to said condensate return means for permitting fluid circulation between said closed air flow path and said reservoir past said liquid separator device when said valve means in said conduit return means is open.

4. A liquid separator device for separating a first liquid of one density from a second liquid of a density smaller than the density of said first liquid, said device including: a vessel into which mixture of said first and second liquids is introduceable; a siphon tube having inner and outer sections connected by an upper intermediate section, said inner section opening to the interior of said vessel adjacent the bottom thereof and said outer section being disposed exteriorly of the vessel and extending below the lower end of said inner siphon tube section; a vent tube connected to said inner intermediate section, said vent tube having one end opening into said intermediate section and its other end opening downwardly in said vessel above said intermediate section and being provided with valve seat means; valve means responsive to the level of said first liquid in said vessel for closing said vent tube to permit siphoning action of said siphon tube when the level of said first liquid in said vessel rises above a first predetermined level and opening to communicate the upper section of said siphon tube to the atmosphere when the level of said first liquid in said vessel drops below a second predetermined level lower than said first predetermined level, said valve means including a needle valve engageable with said valve seat means, float means connected to said needle valve for moving said needle valve upwardly to engage said valve seat means when said first liquid rises in said vessel to said first predetermined level, and means connecting said float means movably to said inner section; outlet means opening into said vessel above said second predetermined level; and valve means for closing said outlet means.

5. The liquid separator device of claim 4, wherein said valve means include a float which does not float in said second liquid and floats in said first liquid.

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WILLIAM I. PRICE, Primary Examiner.
WALTER A. SCHEEL, Examiner.