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DRYCLEANING MACHINE WITH SOLVENT RECOVERY MEANS

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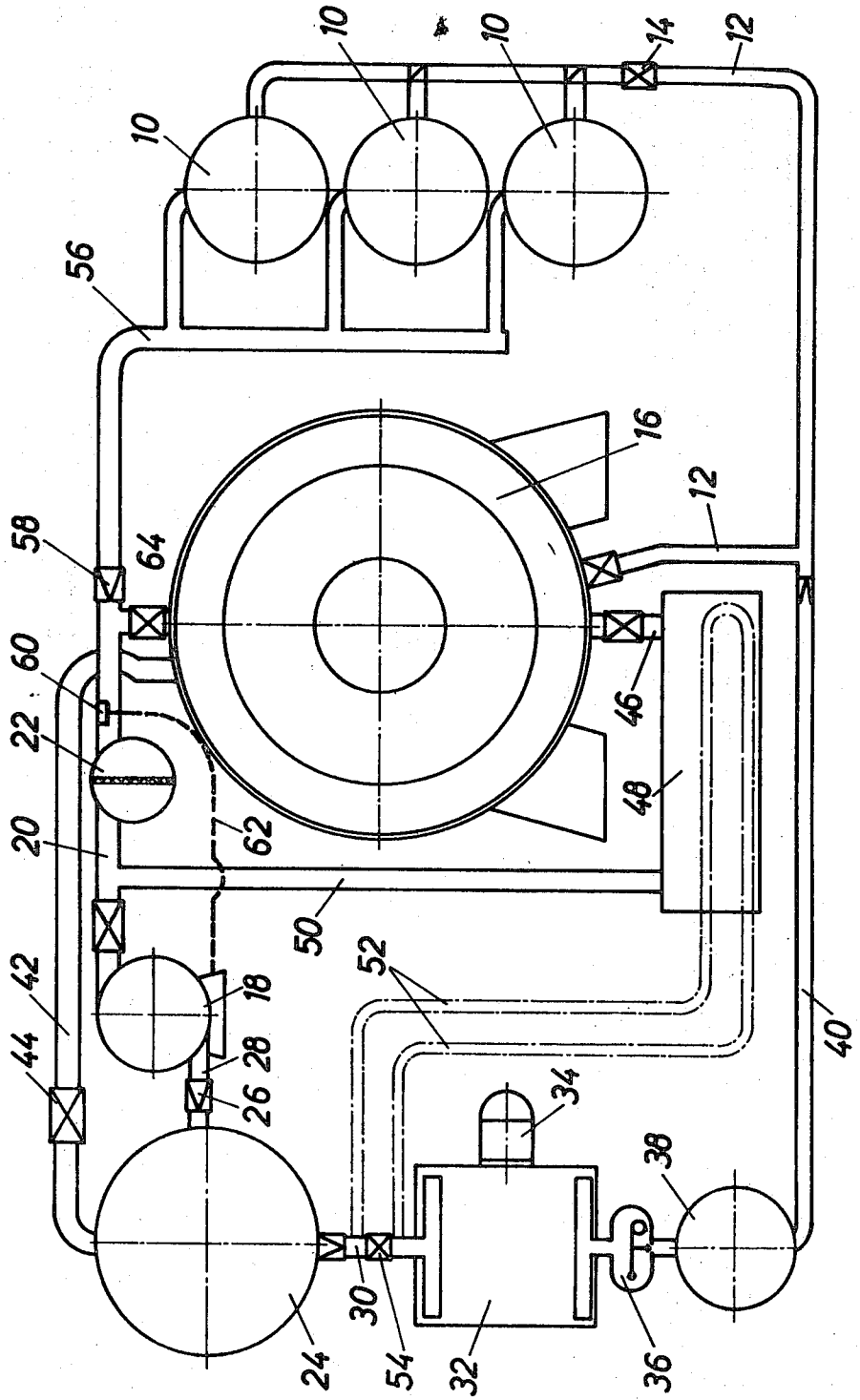

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DRYCLEANING MACHINE WITH SOLVENT RECOVERY MEANS

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ABSTRACT OF THE DISCLOSURE

An apparatus for cleaning wearing apparel and the like, in which, after starting the cleaning operation, a mixture of air and vaporized cleaning fluid is exhausted by a compressor from a tightly closed cleaning drum, compressed, and separated into its components. The vaporized cleaning fluid is then condensed and recirculated to the cleaning drum or a storage tank; the compressor being automatically actuated by pressure control means dependent upon the pressure in the cleaning drum and/or the storage tank. Air from the separating vessel can be recirculated to the cleaning drum at the end of the cleaning operation for pressure equalization. During the cleaning operation, cleaning liquid can be distilled in a distiller, vaporized and exhausted by the compressor.

This invention relates to apparatus for cleaning fabrics, articles of apparel, furs, leather, and the like.

Certain hydrocarbons, particularly those marketed under the trademark "Freon," are known to possess good cleaning properties. However, these materials have not heretofore been used for cleaning purposes, despite their relatively low cost, because the cleaning fluid vaporizes at atmospheric pressure in the range of average ambient temperature, and in a pressurized container excessive pressure is quickly built up, while in a non-pressurized container the vapor escapes into the atmosphere. In addition to the fact that this causes substantial loss, there is also the danger that the vapor of this type of material may come into contact with heated bodies and, upon decomposition, produce chemically active substances.

It is an object of the invention to provide an apparatus for cleaning fabrics, wearing apparel, furs, leathers, and the like, in which materials of the type mentioned above are employed as cleaning media.

It is a further object of the invention to provide apparatus adapted to carry into practice the method disclosed.

In the practice of the method, a cleaning medium is used which vaporizes at atmospheric pressure within a range of average ambient temperature. A mixture of air and the vapor produced by the cleaning medium is evacuated by suction from the cleaning area, compressed, and subsequently separated into its air and vapor components. The vapor, by heat exchange with cooling water or ambient air, is condensed, and the condensate is supplied to the cleaning area directly or collected in intermediate supply tanks.

The advantage of the invention resides in the fact that the vapor produced in the cleaning area is immediately drawn off, so that no undesirable excess pressure can be built up. The exhausted vapor has a temperature at atmospheric pressure on the order of the average internal temperature of the cleaning area. With the use of a cooling system, the vapor of the cleaning medium can be condensed and returned as a fluid to the cleaning area. In accordance with the invention, the pressure of the vapor is increased in the simplest manner to such an extent and the vaporization temperature is such that,

upon contact of the vapor with normal surrounding air, heat can be withdrawn from the vapor to thereby liquefy it. In this manner the use of a cooling system is rendered unnecessary.

The single figure in the drawing illustrates apparatus provided by the invention for carrying into practice the method disclosed.

Refering now to the drawing, cleaning fluid is supplied from tanks **10** through a supply line **12**, which includes a check valve **14**, to a cleaning drum or vat **16**. The tanks **10** are insulated, in accordance with temperature conditions. A cycle of operations is started when the lid of the cleaning drum is closed.

In accordance with the invention, the cleaning medium used is such that it vaporizes at atmospheric pressure in the range of average ambient temperature, that is to say that through heat transfer from without and the heat generated within the drum **16**, a certain vaporization of the cleaning fluid takes place. This vapor is then evacuated, in accordance with a feature of the invention, by means of a compressor **18**, which is connected by an exhaust line **20** to the interior of the drum **16**, preferably to the uppermost portion thereof. A filter **22** is provided in line **20** to prevent the admission of foreign matter to the compressor.

A preferred cleaning medium employed in the practice of the method is selected from the group of fluorochloromethanes and ethanes known commercially under the trademark "Freon," more particularly "Freon 11," which is a trichloromonofluoromethane (CCl_3F).

The compressor **18** compresses the evacuated cleaning medium and subjects it to pressure in a reservoir or container, herein shown in the form of a separator vessel **24**. It is not generally possible to evacuate cleaning medium vapor alone from the drum **16**. At least at the beginning, the evacuated medium consists of a mixture of vapor and air. This mixture is separated into its components in the vessel **24**. The air is collected above, while the lower portion of the vessel is filled with cleaning medium vapor. Backflow is prevented by a check valve **26** in a pressure line **28** of the compressor **18**.

The compressed vapor is carried from the separator vessel **24** through a connecting pipe **30** to an air cooler **32** provided with air blowers **34**. The compression pressure of the mixture adapts itself to the condition of the mixture. In any case, it is essential that the partial pressure of the cleaning medium vapor be such that the appropriate vaporizing temperature is sufficiently high in relation to the surrounding air. When "Freon 11" is used as a cleaning medium, a partial pressure of about 29 p.s.i.a. is adequate, which corresponds to a vaporization temperature of about 113° F. With ambient air at about 77° F. or about 86° F., the cleaning medium vapor in the cooler **32** can be readily liquefied.

The cooler **32** is controlled by a high pressure floater valve **36**, from which the cleaning fluid is conducted through an accumulator **38**, a connecting line **40**, and supply line **12**, to the drum **16**, or back to the tanks **10**. Air present in the separator vessel **24** may be returned to the drum **16** through a return line **42**, which is closed by a shutoff valve **44**. Such air return is necessary when too high a vacuum is created in the drum, as, for example, on completion of a cleaning operation, in order to prevent too low pressure, since under such conditions the drum hatch cannot be opened.

The cleaning fluid within the drum **16** must be regenerated from time to time or continually, to free it of impurities. For this purpose, the cleaning fluid is conducted from the drum **16** through a pipe **46** to a distiller **48**. The distiller is heated so that the cleaning fluid is converted into vapor which is exhausted through a line **50**,

which empties in the line 20 of the compressor 18. The vapor is compressed by the compressor in the same manner as the vapor withdrawn from the drum, and is then condensed in the cooler 32 and returned to the tanks 10 through lines 40 and 12.

The distiller 48 may be heated electrically. This is advantageous from the standpoint of the economics of the electrical installation, provided that no unusual heating is required. The distiller 48 may be conveniently heated by heating means, as illustrated in the drawing, through lines 52 leading from the connecting pipe 30 between the separator vessel 24 and the cooler 32. When a valve 54 in the line is closed, the compressed cleaning fluid vapor flows out of the separator vessel 24 through the distiller 48, where it gives up heat and is then carried into the cooler 32. To avoid complicating the drawing, a corresponding coil, connected to the air return line 42, is not shown. By means of such a coil, the distiller 48 may be heated very effectively by the heat withdrawn from the warm, compressed air. Whether the distiller is heated by warm air or warm cleaning fluid vapor depends largely upon the ratio of air and cleaning fluid vapor in the mixture in the separator vessel 24.

It is essential to protect the tanks 10 against the building up of undesirable high pressure as a result of the admission of heat. To this end, the tanks are connected by a vapor exhaust line 56, provided with a check valve 58, to the exhaust line 20 of the compressor 18. Vapor building up in the tanks 10 is thus exhausted by the compressor through the lines 56 and 20.

In the exhaust line 20 there is provided a pressure control device 60 which, through an electrical connection 62, automatically renders the compressor operative or inoperative when the pressure in the exhaust line 20 exceeds or falls below a predetermined value. The compressor 18 accordingly need not be set in operation immediately upon starting a cleaning operation. It is sufficient to open a valve 64 in the line 20 connected to the drum 16. If, during a cleaning operation, a portion of the cleaning fluid vaporizes, a pressure is built up which passes into the exhaust line 20. If the pressure increases, the pressure control device 60 becomes operative to actuate the compressor 18. The valve 64 is closed when no cleaning operation is taking place in the drum, particularly when the drum is entirely out of operation, as for example, when its hatch is opened. It is important that the vapor developed in the tanks 10 should not escape through the line 56 and return valve 58 into the interior of the cleaning drum 16 but should flow into the exhaust line 20 of the compressor 18. Exen a slight pressure build-up puts the pressure control device 60 into operation to actuate the compressor 18 which, the valve 64 being closed, simply withdraws the vapor from the tanks 10.

What I claim is:

1. Apparatus for cleaning wearing apparel and the like, said apparatus comprising at least one supply tank, a cleaning drum, a compressor, an exhaust line connecting the cleaning drum and the compressor, a vessel, a pressure line connecting the compressor to the vessel, a cooling device, a vapor line connecting the vessel to the cooling device, means connecting the cooling device to the supply tank and to the cleaning drum, valve means in said connecting means controlling the return of the cleaning fluid to the cleaning drum or the supply tank, and pressure control means for automatically actuating the compressor when the pressure exceeds an adjustable value and for shutting off the compressor when the pressure falls below said value.

2. Apparatus for cleaning wearing apparel and the like, comprising at least one supply tank, a cleaning drum, a compressor, an exhaust line connecting the cleaning drum and the compressor, a vessel, a cooling device, a vapor line connecting the vessel to the cooling device, means connecting the cooling device to the supply tank and to the cleaning drum, valve means in said connecting means controlling the return of the cleaning fluid to the cleaning drum or the supply tank, and a vapor exhaust line which connects the supply tank to the exhaust line of the compressor and includes a return valve which remains open when the pressure in the supply tank exceeds a determined value until the pressure drops to said determined value and valve means for cutting off communication between the cleaning drum and the exhaust line of the compressor.

3. Apparatus for cleaning wearing apparel and the like, comprising at least one supply tank, a cleaning drum, a compressor, an exhaust line connecting the cleaning drum and the compressor, a vessel, a pressure line connecting the compressor to the vessel, a cooling device, a vaporline connecting the vessel to the cooling device, means connecting the cooling device to the supply tank and to the cleaning drum, valve means in said connecting means controlling the return of the cleaning fluid to the cleaning drum or the supply tank, an air return line connecting the upper end of the vessel to the cleaning drum and including valve means, said vapor line connecting the vessel to the cooling device opening into the lower end of the vessel to separate air from vapor in the vessel.

4. Apparatus as claimed in claim 3, further comprising a distiller, including heating means, connected via a liquid line to the cleaning drum; said liquid line having valve means and said distiller being connected via a vapor line to the exhaust line between the cleaning drum and the compressor.

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