Aug. 5, 1969 H. FÜHRING ET AL 3,459,490

METHOD AND APPARATUS FOR THE DISINFECTION OF TEXTILES AND OTHER DRYCLEANABLE ARTICLES DURING DRYCLEANING

Filed April 13, 1964 4 Sheets-Sheet 1

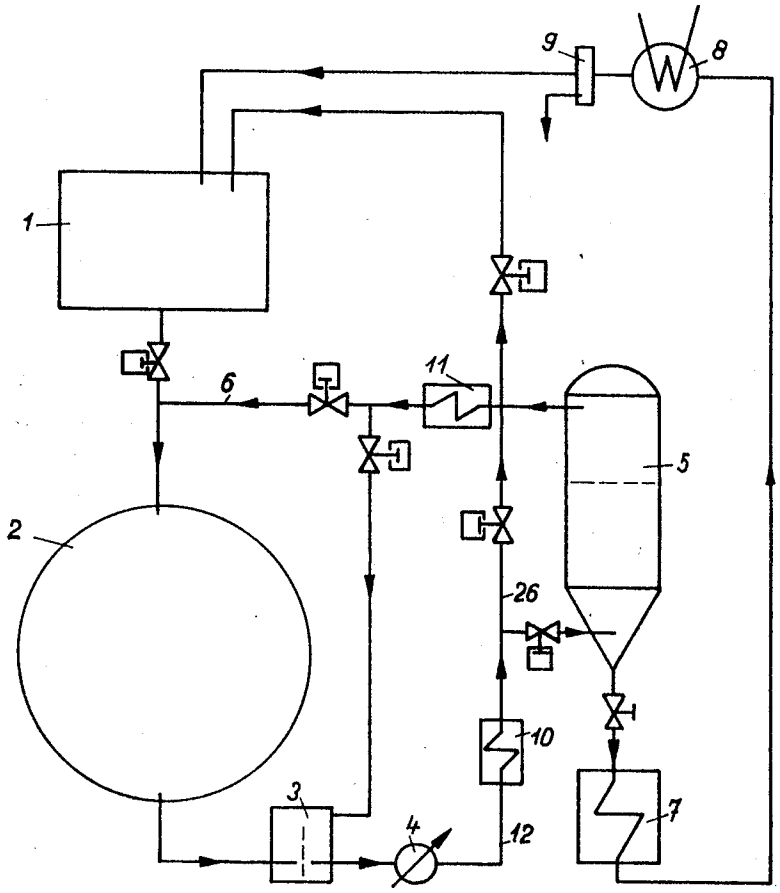


Fig. 1

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METHOD AND APPARATUS FOR THE DISINFECTION OF TEXTILES AND OTHER DRYCLEANABLE ARTICLES DURING DRYCLEANING
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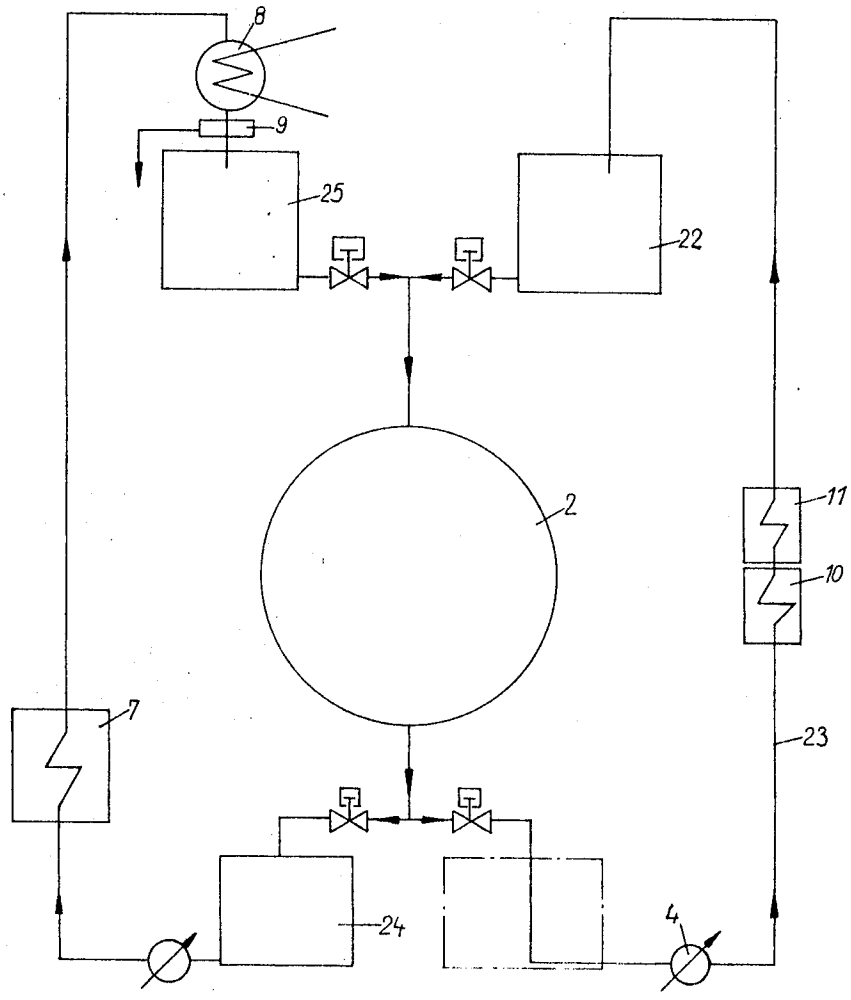


Fig. 2

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METHOD AND APPARATUS FOR THE DISINFECTION OF TEXTILES AND OTHER DRYCLEANABLE ARTICLES DURING DRYCLEANING
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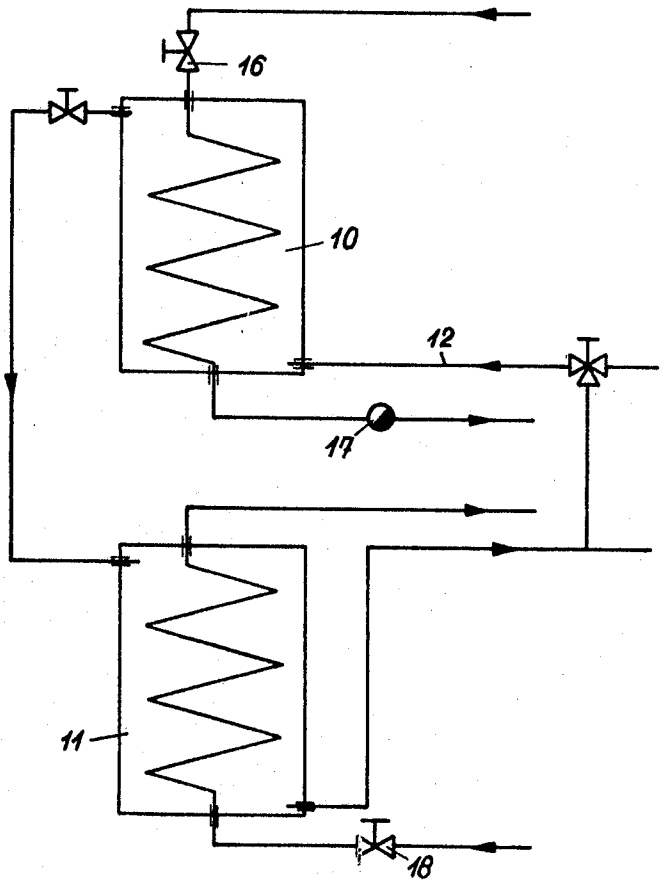


Fig. 3

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METHOD AND APPARATUS FOR THE DISINFECTION OF TEXTILES AND OTHER DRYCLEANABLE ARTICLES DURING DRYCLEANING

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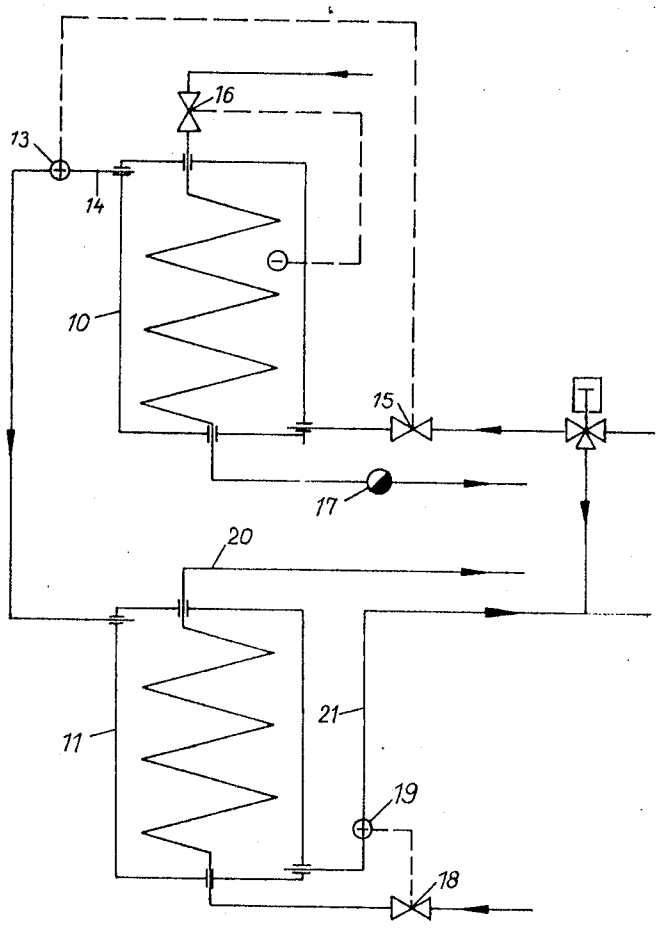


Fig. 4

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3,459,490

METHOD AND APPARATUS FOR THE DISINFECTION OF TEXTILES AND OTHER DRYCLEANABLE ARTICLES DURING DRYCLEANING

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Int. Cl. D06l *1/00;* A61l *3/00*
U.S. Cl. 8—142 4 Claims

The invention concerns a method and apparatus for the disinfection of textiles during drycleaning; in particular, the invention applies to the drycleaning of infected hospital textiles and also is applicable to normal professional drycleaning. The problem in drycleaning biologically contaminated fabric consists in the fact that the garments or other textiles contain pathogenic germs, as for instance bacteria, spores, etc., which infect the drycleaning solvent, so that considerable danger exists that germ-free textiles will become infected during the next drycleaning cycle by these germs. It is an essential aspect of the invention that on the one hand infected particles are disinfected and on the other hand a cross-infection by microorganisms of uninfected articles is avoided.

It has already been recommended to heat solvent in drycleaning machines and to conduct this solvent in the hot state to the goods to be cleaned. It is quite probable that success can be achieved with respect to the disinfection by this method, yet considerable difficulties have to be expected in regard to the cleaned goods. Prolonged observations have clearly shown that the fibers of the processed textiles suffer considerable damage when treated with hot solvents, which become so noticeable that customer complaints must be anticipated.

Therefore it is one of the aims of the invention over and above a solution of the problems mentioned to avoid detrimental effects on the goods to be cleaned during the process of disinfection. In a particular mode of realization of the invention these problems are solved by heating the solvent to a temperature which is sufficient to kill the germs after the solvent has left the cleaning cage during at least a portion of the actual cleaning process and by immediate subsequent recooling. Such a measure has the effect that the infected solvent is disinfected during the heating process and that it is returned to the cleaning machine free of germs. However, in order to avoid damaging the goods, the subsequent cooling of the solvent during the same cycle is particularly advantageous.

In drycleaning it is well known to cool or to heat solvent. Cooling is usual during the summer when, on account of high ambient temperatures and of continuous processing, a certain accumulation of heat takes place in the machine. The solvent is brought back to the desired original temperature by cooling.

The heating of the solvent is preferably done in the winter at the beginning of a cleaning operation in order to bring the originally cold solvent up to the desired cleaning temperature of, for instance, 86° F. (i.e. 30° C.).

In none of these cases, however, is heating and cooling carried out in this sequence and the degree of temperature change with the well-known methods is also not so large that it would effect a disinfection.

However, pursuant to our present invention it is further provided that the degree of heating and cooling shall be mainly progressive, for instance by the arrangement of proportional regulating valves in the solvent heater and cooler which control in dependence upon preselectable temperatures. The effect of these proportional control valves is to be understood in such a way that their sensing bulbs will only then give an impulse for the opening of the control valve when a certain temperature has been reached in the vicinity of this bulb. The bulb for the heater control valve is, therefore, preferentially situated in the heater outlet connection. Only solvent which has reached a certain temperature can then leave the heater. The same goes for the cooler, where the bulb for the control valve may be mounted either in the cooler inlet or in the solvent outlet in order to control the solvent-outlet temperature.

Another mode of temperature control according to the invention may consist in the regulation of the solvent feed to the heat exchangers and the steam supply to the heater by means of fully automatic on/off valves via the automatic program control of the cleaning machine.

It is recommended to heat the solvent when using perchloroethylene to a temperature between 212° F. (100° C.) and 248° F. (120° C.) and to subsequently cool it down to approximately 86° F. We have, however, found quite surprisingly that, with the addition of disinfecting or germ-killing chemicals to the solvent, the solvent heating can be reduced to lower values. This makes it, therefore, possible to reduce the energy costs, or with the same energy costs to reduce the required processing time.

Thus the method of disinfecting textiles and other drycleanable articles during drycleaning in accordance with a more specific feature of our invention consists in the addition to the cleaning solvent of disinfecting chemicals, which may be either insoluble or only partially soluble in it and which may in themselves be well known, together with filter powders whereby the disinfection of the solvent is effected during the passage of the solvent through the filter. The germ-retaining filter medium has a particle size such that the germs cannot penetrate through the fine pores of the filter.

According to the invention, the cleaning solvent can also be conducted over a normal precoat filter with a bacteria filter of known design in parallel or after the primary filter, advantageously with pre-cycling of the solvent several times over through the normal filter in order to deposit the soil and then to pass the more or less clean solvent for the purpose of germ filtration through the bacteria filter.

The invention further provides for a method of disinfecting textiles and other drycleanable articles during drycleaning in which, during the drying process or subsequent to it, a distinfecting medium of known composition is conducted through the cleaning articles in the form of a gas. The cleaning solvent can in this case also be heated and cooled. The disinfecting chemical can be introduced into the air-circulating system of the drycleaning machine and, if necessary, can be preheated. The disinfecting chemical may be blown into the air-circulating system by means of compressed air or steam, injected in liquid form or vaporized by additional heating with

hot air. It is also advantageous to mix the disinfecting gas from a compressed-gas cylinder directly into the drying-air stream.

Finally the invention involves a method for the disinfection of textiles and other drycleanable articles during drycleaning which comprises the step of raising the articles during the latter part of the drying process to a germ-destroying temperature with the use of an air heater by closing the water supply to the air cooler until the temperature adjusted on a thermostat is reached and until the time period for maintaining the machine at this disinfection temperature by means of the automatic control has elapsed.

An advantageous apparatus for the execution of the method of the invention includes a heater and a cooler in the solvent pipe line which leaves the cleaning drum of a drycleaning machine. This arrangement enables the disinfection before the solvent is returned to the cleaning drum in its recooled condition.

The heater and cooler can be arranged in the case of a filterless drycleaning machine between the cleaning drum and the prewash tank. Further it is advantageous to fit a solvent by-pass line with its corresponding valves around a heater and cooler, allowing at least a portion of the cleaning process to take place without disinfection.

In a system according to the invention it is also advantageous if the heater and cooler are coupled with a preportional temperature control, for instance in the form of proportional regulating valves, the sensing bulbs of which regulate the temperatures in the outlet of the heater or the cooler and control the through-put in dependence upon the preselectable temperatures.

An automatic operation can, however, also be arranged by the fitting of fully automatic on/off valves in the supply lines to the heater and cooler which are controlled by the program control of the cleaning machine.

Another arrangement according to the invention provides for the use of a dispenser for disinfecting chemicals mainly in combination with the filter-powder dispenser. In a typical example illustrating the invention, the usual button trap of a drycleaning machine can be used for this purpose. It is also advantageous to arrange a bacteria filter in the drycleaning machine which is either in parallel with or behind the normal precoat filter.

The invention also provides a dispenser for liquid or gaseous disinfecting chemicals in the vicinity of the air-circulation system of a drycleaning machine, for instance in the form of an injector, a jet or an entrance pipe. In the area of this dispenser there can also be arranged a heater.

Finally a further arrangement for the execution of the method according to the invention comprises a heater with a regulating device in connection with a controllable valve in the water inlet to the cooler, the arrangement being such that the heating of the drying air with discontinued or reduced cooling during a selectable period of time can be performed above the normal heating temperature.

Investigations about the behavior of pathogenic microorganisms, as for instance bacteria or spores, have proved that the chlorinated hydrocarbons are able to kill these when a certain solvent temperature has been reached. The temperature level depends on the fact whether the solvent also contains disinfecting chemicals which are soluble in it or insoluble. Without disinfecting additions for instance with perchloroethylene a solvent temperature between 212° and 248° F. is advantageous, according to the concentration of the disinfecting additives, yet the same results may be achieved in a temperature range of 86° to 212° F.

The invention makes it possible to kill germs with or without additives to the solvent by heating and subsequent cooling of the used solvent, so that the disadvantage of garment heating is avoided. The solvent entering the cleaning drum is, therefore, always free of germs and can be thermostatically controlled as to its inlet temperature. A disinfection of the goods is achieved at normal temperature merely by the addition of disinfecting chemicals to the solvent.

Alternatively the apparatus also permits the use of a method by which the treatment time may be considerably shortened with normal concentrations of disinfecting solvent additives and with an increase of the solvent temperature in the feed to the cleaning drum.

With this method the solvent is preferentially, and for short periods, heated just under its boiling point, in order to supply only germ-free solvent to the goods, so that no cross-contamination by germs may take place, since even with the use of disinfecting additives to the solvent the time factor plays an important part.

With the other described methods according to the invention it has been found that certain disinfecting chemicals which are not readily soluble in the treatment fluid can be added together with the filter powders, so that these either remain on the filter and develop their disinfecting effect during the passage of the cleaning solvent, or are only very slowly dissolved by the cleaning solvent and, in this condition, kill the germs on the goods and in the bath.

Further it was found that the filter of the cleaning machine for the precoating of the filter powder, which is intended to filter out the bacteria, can be used alone or together with conventional filter powders, so that a disinfection of the treatment solvent is effected.

Since the solvent which is in the cleaning drum is filtered approximately once per minute during the cleaning time and on account of the mechanical treatment of the cleaning goods—supported by the addition of drycleaning soaps and possibly water—the germs which are adhering to the cleaning goods are removed together with the insoluble dirt and retained on the filter which is impermeable to bacteria.

A disinfection may also be achieved by in inclusion, in parallel or in series with the conventional filter, of a special bacteria filter. This filter can be of a type well known per se but may also be designed to retain the insoluble or hardly soluble disinfecting chemicals which may be added to the cleaning solvent, so that the conventional drycleaning filter functions in the usual way and is used only for the filtration of insoluble substances, while the filter in series therewith exclusively serves for disinfection.

It was further found that a disinfection of the cleaning articles can be achieved during or after the drying process for introducing the same disinfecting chemical into the cleaning drum or the air-circulating system.

For the following neutralization or deodorization a neutralizing agent may be similarly admixed with the air stream.

The disinfecting medium may be introduced by various means. With the aid of an injector, air which is enriched with a disinfecting gas can be drawn into the air-circulating system and thereby brought into contact with the goods to be cleaned. For this purpose a storage vessel for the disinfecting chemical is required which, if necessary, may also be heatable. From the storage vessel the disinfecting chemical can be conveyed by means of compressed air, available for pneumatic valve control, or by means of steam when in the gaseous state, or by means of spray jets if liquid. Finally a compressed-gas bottle may be used to admix the disinfecting chemicals with the drying air as a secondary stream.

Should the disinfecting chemical have an undesirable odor, then by one of the described methods a deodorization with a neutralizing chemical may be performed. As a receiver for the neutralizing chemical a vessel similar to that used for the disinfecting chemical may be employed.

The neutralization may, if desired, also take place with steam. In this case dry steam is introduced into the air-circulating system upstream or downstream of the air heater.

It is known that one can achieve the killing of germs by high temperatures, for instance in disinfecting chambers. In the case described, however, the disinfecting process is supported and accelerated by the presence of small quantities of solvent—perchloroethylene or trichloroethylene—in the circulating air and these are found to have a synergistic effect. In order to achieve disinfection, the water supply to the air cooler is closed and the drying thermostat of the machine must be set to the disinfecting temperature. The automatic control of the machine can be utilized to control the treatment time at the disinfecting temperature.

The invention is illustrated schematically and by way of example in the drawing, in which:

FIG. 1 is a schematic view of a drycleaning machine with a precoat filter;

FIG. 2 is a schematic view of a filterless drycleaning machine; and

FIGS. 3 and 4 are schematic representations of a heater and a cooler with hand control and automatic control, respectively.

The illustrated embodiment of the invention represents a normal drycleaning machine in which solvent is introduced into a cleaning drum **2** from a storage tank **1**. The solvent drawn by a pump **4** through a button trap **3** reaches a precoat filter **5** after filter powder has been added to it in trap **3**. In the filter circuit the already partially cleaned solvent is returned to the cleaning drum by means of a pipe **6** until settling has been achieved. The filter cake which in time collects in filter **5** is steamed out by well-known means. The recovered condensate is evaporated in a still **7** and reliquefied in a condenser **8**. During this process any germs present are killed on account of the distillation. In a water separator **9** the solvent is parted from the water before being conducted to the storage tank **1** as a pure chemical.

In accordance with our invention we provide a twin heat exchanger **10**, **11** with a fully automatic control system; this unit may be fitted at various locations into the solvent-circulating system of the machine.

The individual heat exchangers correspond in their design to common engineering practice and their detailed construction is of no importance. In the present embodiment, the heat exchangers **10**, **11** consist each of a cylindrical vessel with a solvent inlet and outlet and with a heat-exchange coil of large surface area and the corresponding inlet and outlet connections.

It is immaterial whether the solvent is conducted on the inside or the outside of the coil.

The solvent coming from pump **4** is brought up to the first heat exchanger **10** of the twin unit via a pipe **12**. In the following we shall also refer to FIGS. 3 and 4. The solvent now rises in container **10** whose outlet connection **14** contains a sensing bulb **13** (FIG. 4). Bulb **13** is connected to a regulating valve **15** by means of a capillary. Steam is fed from the top into the heat exchanger **10** through an isolating and regulating valve **16** and leaves downwardly through a steam trap **17**.

On account of the automatic control of the drycleaning machine, pump **4** operates during the cleaning process and the isolating valve **16** is opened. The solvent entering is cold, so that bulb **13** records a low temperature. Since the regulating valve is set for an outlet temperature of approximately 212° to 248° F., it now opens. Through the admission of steam by the actuation of a pneumatic steam valve, solvent heating takes place. The regulating valve **15**, however, opens only far enough to ensure the exit of the solvent at the predetermined temperature. Should the outlet temperature rise too high, then the regulating valve **15** closes a little.

This control measure prevents the feeding of solvent from pump **4** though heat exchanger **10** at less than the desired minimum temperature.

The heat exchanger **11** carries out the second step of the processing method which is the cooling of the solvent to the desired working temperature.

The solvent enters heat exchanger **11** from above and leaves it from underneath. Cooling water or some other cooling medium flows from below through a regulating valve **18** and then through the heat-exchanger coil to the drain. The regulating valve **18** is adjusted in such a way that a solvent outlet temperature of approximately 86° F. (i.e. 30° C.) to 104° F. (40° C.) is maintained under normal circumstances, although this temperature may be increased or lowered at will. The control of the regulating valve **18** takes place by means of a bulb **19** which may be situated either in the cooling-water outlet **20** or in the solvent outlet **21**.

The described arrangement may be applied in various ways to a machine with a solvent circuit adapted for drycleaning, solvent milling or finishing of textiles.

The main feature of the operating method according to our invention is to be seen in the elimination of possible transfer of germs from one cleaning cycle to another and in the provision of means for the disinfection of the goods to be cleaned during a certain operating phase of the cleaning process by chemical and thermal means.

With a filterless drycleaning machine according to FIG. 2 the cleaning process starts at a prewash tank **22** which contains the rinse solvent of the previous cleaning cycle. This solvent was disinfected during the refilling of this tank by traversing the pump **4** through a connecting pipe **23** and heat-exchanger battery **10**, **11** on the way to the prewash tank.

The prewash solvent is moved via a dirty-solvent tank **24** to still **7**, where it undergoes a complete elimination of germs by boiling. The regenerated, sterilized solvent then collects in a clean-solvent tank **25**, from where it is drawn for the rinsing of the goods. The used rinse solvent is pumped again via pump **4** and heat-exchange battery **10**, **11** to the prewash tank **22**. With this arrangement a cross-infection is completely eliminated.

If, however, the textiles are also to be disinfected, this is possible with or without addition of disinfecting chemicals during the prewash operation with a predetermined setting of the temperature of the solvent.

With a filter machine according to FIG. 1 several additional manipulations may be performed. It is for instance possible to separate heat exchangers **10** and **11** and to include filter **5** in the disinfection system by closing a connecting pipe **26** and passing the heated solvent through precoat filter **5**, cooling it only afterwards. Filter **5** can then be isolated and the solvent may be pumped into the storage tank from heat exchanger **10** via bypass **26** without further cooling. The heat exchanger **10** may, however, also be turned off towards the end, so that cooled and already disinfected solvent is returned to the storage tank.

We claim:

1. A method of drycleaning fabric infected with micro-organisms, comprising the steps of agitating said fabric at a temperature below about 40° C. in contact with a liquid organic drycleaning solvent consisting essentially of perchloroethylene and having a boiling point above the temperature at which said micro-organisms upon entrainment in said solvent are destroyed; leading away at least a portion of the solvent upon its contamination with said micro-organisms; briefly heating said portion of said liquid solvent to a temperature of about 100° C. to 120° C. and sufficient to destroy said micro-organisms and substantially immediately thereafter cooling the heated solvent to a temperature below about 40° C.; and subsequently contacting soiled fabric with the solvent thus treated.

2. The method defined in claim **1** wherein said solvent is agitated in contact with the soiled fabric at a temperature of about 30° to 40° C., only a portion of said solvent being removed from contact with said fabric, heated to a temperature of about 100°C . to 120° C., and cooled to said temperature of about 30° to 40° C., prior to return of the disinfected portion into contact with said fabric.

3. The method defined in claim 1, further comprising the step of admixing with said portion of said solvent a disinfecting agent adapted to promote the thermal destruction of said micro-organisms.

4. The method defined in claim 1, further comprising the step of passing said portion of said solvent through a filter of pore size retaining the micro-organisms.

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