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AIR RECIRCULATION SYSTEM FOR CLEANING APPARATUS

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FIG. 1

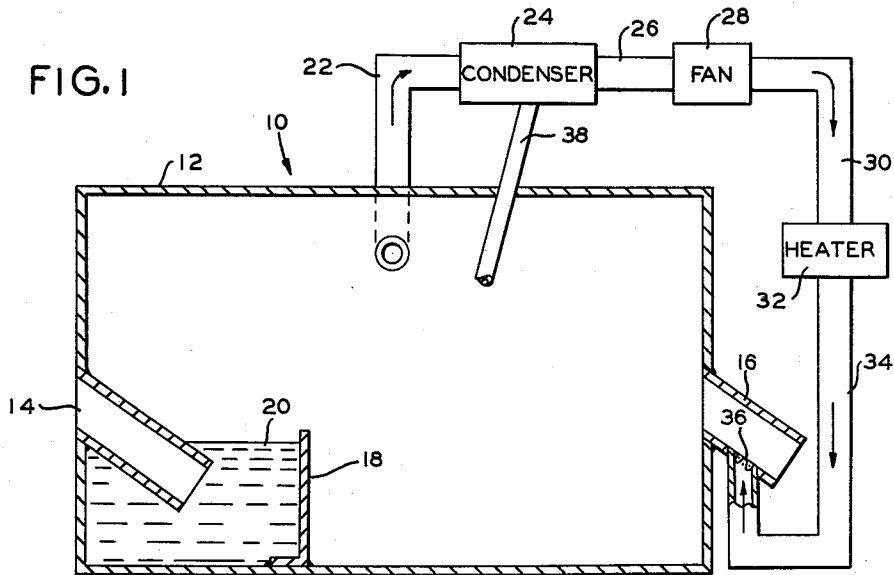
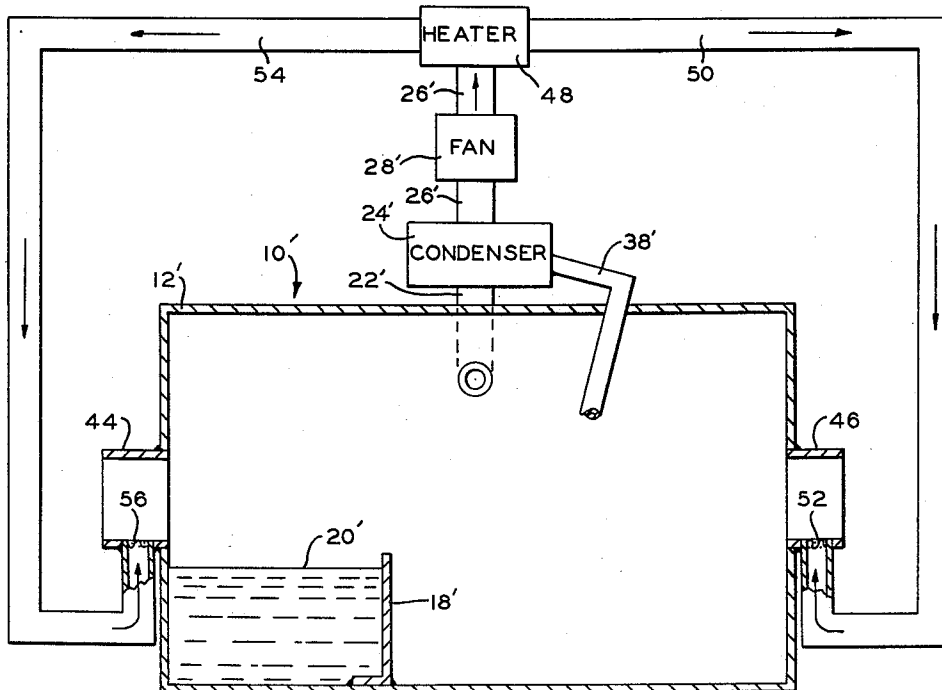


FIG. 2

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1

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AIR RECIRCULATION SYSTEM FOR
CLEANING APPARATUSBurton Rand, Bala-Cynwyd, Pa., assignor to Autosonics
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6 Claims. (Cl. 68-18)

This invention relates to an air recirculation system for a cleaning apparatus, and more particularly, a closed air recirculation system for a cleaning apparatus utilizing a cleaning solvent subject to being vaporized during the cleaning action. Such solvents are of the type commonly used in dry cleaning apparatus, degreasing apparatus, etc. and including fluorinated hydrocarbons, chlorinated hydrocarbons, such as trichlorethylene, etc.

The present invention is not limited in its use with any particular type of cleaning apparatus. The cleaning apparatus may be a degreasing apparatus wherein machined parts are conveyed through the apparatus by means of a conveyor belt, a conveyor chain, a spoked wheel, rotatably mounted wheels, etc. Also, the cleaning apparatus may be of the type used for dry cleaning of wearing apparel. In cleaning apparatus for dry cleaning wearing apparel, the cleaning apparel is placed within a housing having an atmosphere laden with vaporized solvent.

It is conventional in many types of degreasing apparatus to provide a chamber of solvent which is subjected to heat so as to provide a zone of vapor above the level of liquefied solvent or rinse bath of solvent within the cleaning apparatus. It is objectionable to have vaporized solvent above the vapor zone in such a degreasing apparatus.

The present invention is directed to a closed circuit air recirculation system for withdrawing a mixture of air and vaporized solvent from within the cleaning apparatus with the air being returned to the cleaning apparatus free from vaporized solvent. In this manner, the present invention is capable of controlling the amount of vaporized solvent within the apparatus and preventing escape of the same from an inlet or outlet to the cleaning apparatus. Accordingly, the present invention enables cleaning apparatus to be provided with a substantially open inlet and/or outlet. That is, the inlet or outlet to the cleaning apparatus is not provided with means for closing the same such as a door, window, etc.

The present invention enables a cleaning apparatus to be included in a continuous cleaning system without escape of vaporized solvent to the atmosphere. Escape of vaporized solvent to the atmosphere is objectionable because it depletes the source of liquefied solvent within the cleaning apparatus, the solvent is generally toxic and therefore harmful to persons working within the area adjacent to the cleaning apparatus, and interferes with areas desired to be provided with a controlled atmosphere.

It is an object of the present invention to provide a novel air recirculation system for a cleaning apparatus.

It is another object of the present invention to provide a novel air closed recirculation system which prevents vaporized solvent from escaping to the atmosphere surrounding the cleaning apparatus.

It is another object of the present invention to provide a novel air recirculation system for a cleaning apparatus whereby the amount of vaporized solvent within the cleaning apparatus may be controlled.

It is still another object of the present invention to provide a novel cleaning apparatus which lacks a closure at the inlet and outlet thereof, thereby enabling the cleaning apparatus to be installed in a continuous cleaning process.

It is still another object of the present invention to provide a novel cleaning apparatus having an air re-

2

circulation system for controlling the amount of vaporized solvent within the cleaning apparatus and providing a blanket or barrier of warm air at the inlet and/or outlet of the cleaning apparatus.

It is a further object of the present invention to provide a novel cleaning apparatus with an air recirculation system wherein the movement of the air is barely perceptible.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a schematic view of the present invention, partly in section.

FIGURE 2 is a schematic view of the present invention, partly in section.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is shown in FIGURE 1 a schematic view of the present invention, partly in section, designated generally as 10.

The cleaning apparatus 10 of the present invention includes a housing 12 of a cleaning apparatus having an inlet chute 14 and an outlet chute 16. It will be appreciated that the housing 12 of the cleaning apparatus is merely schematic and therefore representative of substantially all types of cleaning apparatus. Since the present invention is of general application to substantially all types of cleaning apparatus, the means for conveying the elements to be cleaned are not shown in the drawing.

Substantially any type of conventional means for conveying the elements to be cleaned through the cleaning apparatus housing 12 may be provided. For example, the means for causing the elements to be cleaned to move from the inlet 14 to the outlet 16 may be of the type set forth in my copending application Serial No. 95,183 entitled Automatic Ultrasonic Cleaning Device, filed on March 13, 1961. Alternatively, the means for moving the elements to be cleaned through the housing 12 may be of the type shown in U.S. Patents 1,422,309; 2,118,480; 2,714,574; and 2,802,758.

Alternatively, the means for moving the elements to be cleaned from the inlet to the outlet may be of the type set forth in my copending applications Serial Nos. 59,066, entitled Cleaning Apparatus, filed on September 28, 1960, now Patent No. 3,019,800, and 60,106, entitled Cleaning Apparatus, and filed on October 3, 1960.

For purposes of illustration, the housing 12 is provided with an upright wall 18 which cooperates with a side wall of the housing 12 to form a chamber within which a cleaning solvent 20 is disposed. The cleaning solvent 20 may be any one of a plurality of well known cleaning solvents including fluorinated hydrocarbons. It will be noted that the outlet end of the inlet chute 14 is disposed below the level of the cleaning solvent 20 thereby illustrating one manner in which means may be provided for preventing the escape of vaporized solvent to the atmosphere.

A conduit 22 is provided with one end of this conduit being in communication with the interior of the housing 12. For purposes of illustrating, the conduit 22 extends through a side wall of the housing 12. The other end of the conduit 22 is connected to a condenser 24 shown schematically in FIGURE 1. Any one of a plurality of commercially available condensers may be utilized. Accordingly, it is not deemed necessary for the purposes of the present invention to explain in detail the structural interrelationship of the condenser 24. A conduit 26 extends from an outlet port in the condenser 24 to the inlet side of a fan 28 shown schematically in FIGURE 1.

3

A conduit 30 extends from the outlet side of the fan 28 to the inlet port of a heater 32 shown schematically in FIGURE 1. A conduit 34 extends from the outlet port of the heater 32 to the outlet chute 16 on the housing 12. The conduit 32 is in communication with the interior of the outlet chute 16 with a screen 36 disposed therebetween as shown in FIGURE 1. For purposes of illustration, the conduit 34 is connected to the outlet chute 16 at the bottom of the chute 16. It will be appreciated that the conduit 34 will be connected to a top wall of the outlet chute 16 when the means for conveying the elements to be cleaned comprises an imperforate conveyor belt. A conduit 38 extends from the condenser 24 to any convenient receptacle such as a rinse bath disposed within the housing 12.

The cleaning apparatus 10 of the present invention is utilized in the following manner:

The elements to be cleaned will enter the housing 12 of the cleaning apparatus 10 by way of the inlet chute 14. A means will convey the elements to be cleaned through the various stages of the cleaning process to the outlet chute 16. During the cleaning process, a heating means will cause solvent within the housing 12 to be vaporized. The vaporized solvent will be prevented from escaping to the atmosphere through the inlet chute 14 because the end of the inlet chute 14 is disposed below the level of the solvent 20.

The closed air recirculation system will control the amount of vaporized solvent within the housing 12 and prevent escape of the same through the outlet chute 16 in the following manner. The suction of fan 28 causes a mixture of vaporized solvent and air disposed within the upper portion of the housing 12 and clinging to the elements being cleaned to be drawn into the condenser 24 by way of conduit 22. The condenser 24 separates the vaporized solvent and air into liquid solvent and cool air. The cool air passes from the condenser 24 into the inlet side of the fan 28 by way of the conduit 26. The cool air is forced by the fan 28 to pass through the conduit 30 to the heater 32, through the conduit 34, into the inlet chute 16. The cool air is warmed by the heater 32 as it passes therethrough.

The screen 36 in the outlet chute 16 precludes the possibility of elements being cleaned within the apparatus 10 from entering the conduit 34. Since the warm air is at a temperature higher than that of the atmosphere at the outlet end of the chute 16, the warm air rises up the chute 16, thereby sealing the chute 16 with a warm air barrier. Since the discharge end of the chute 16 is lower than the level of the inlet end of the chute 16, and since the warm air delivered to the chute 16 is the same air which was sucked out of the housing 12 by the fan 28, a closed circuit air recirculation system has been provided.

The condensate of liquid solvent formed in the condenser 24 is conveyed by conduit 30 to any convenient receptacle such as rinse bath within the housing 12. Preferably, the end of the conduit 38 remote from the condenser 24 should be positioned below the level of liquid within the receptacle. In this manner, the vaporized solvent and air cannot be drawn out the conduit 38.

The fan 28 need only have a delivery capacity which produces the waft of air in the chute 16. The term "waft" of air is to be interpreted as movement of air which is barely perceptible. The amount of air movement varies with the size of the cleaning apparatus. In a cleaning apparatus having a 60 gallon supply of solvent, the fan capacity need only be approximately 5 cubic feet per minute. The waft of air in the chute 16 is too insignificant to aspirate atmospheric air in through the discharge end of the chute 16. Further, the waft of air delivered to the chute 16 has a drying effect on the elements being cleaned. In actual use, I have found that only twelve ounces of solvent were lost from the 60 gallon supply of solvent after eight hours of continuous use. In the absence of the closed air recirculation system of

4

the present invention, the 60 gallon supply of solvent would have been depleted by an amount substantially greater than twelve ounces.

It will be understood that the condenser 24, the fan 28, and the heater 32 are only shown schematically outside of the housing 12 for purposes of illustration. These elements may be mounted in other positions relative to the housing 12. Also, it will be understood that conventional details such as wiring and so on for these elements have not been shown in the drawing.

The closed air recirculation system described above enables the cleaning apparatus 10 to be more efficient than those proposed heretofore since it prevents depletion of the supply of solvents within the housing of the cleaning apparatus, prevents escape of vaporized solvent to the atmosphere in those circumstances where such escape of vaporized solvent would be objectionable, and enables a cleaning apparatus to be a component of a continuous cleaning process.

FIGURE 2 discloses an alternative embodiment of the present invention designated generally as 10'. The cleaning apparatus 10' is identical with the cleaning apparatus 10 except as will be made clear hereinafter. Accordingly, like elements in the apparatus 10' and 10 are designated with primed numerals. Accordingly, it is deemed necessary to further explain the structure and significance of those elements which are common to the cleaning apparatus 10 and 10'.

The cleaning apparatus 10' differs from the cleaning apparatus 10 by the provision of a horizontally disposed inlet passageway 44 and a horizontally disposed outlet passageway 46. The inlet and outlet passageways 44 and 46 need not be aligned with each other. A heater 48 is provided having a pair of outlet ports. A conduit 50 is connected to one of the outlet ports in the heater 48. The end of the conduit 50 remote from the heater 48 is connected to the outlet passageway 46 with a screen 52 disposed therebetween.

A conduit 54 is connected to the other outlet port of the heater 48. The end of the conduit 54 remote from the heater 48 is connected to the inlet passageway 44 with a screen 56 disposed therebetween. In view of the above description relating to apparatus 10 of the present invention, it will be appreciated that the ends of the conduits 50 and 54 remote from the heater 48 may be connected to the upper wall of the inlet and outlet passageways 44 and 46 respectively.

The apparatus 10' of the present invention operates in the same manner as the apparatus 10. However, the inlet and outlet passageways 44 and 46 are horizontally disposed. Accordingly, the barrier of warm air which is provided in the inlet and outlet passageways 44 and 46 are prevented from escaping to the atmosphere surrounding the housing 12' because of the slightly negative pressure induced in the housing 12' by the fan 28'. Accordingly, it is not necessary for the outlet passageway to be angled as shown in FIGURE 1, nor is it necessary for the end of the inlet passageway to be immersed below the level of a liquefied solvent. Since the air delivered to the inlet passageway 44 is warmer than the atmospheric air, there is a slight preheating of the elements to be cleaned within the housing 12'. In like manner, the warm air delivered to the outlet passageway 46 provides a slight drying effect on the cleaned elements.

In certain special installations, it may be desirable to provide the cleaning apparatus with a combined inlet and outlet passageway. It will be appreciated by those skilled in the art that the closed air recirculation system of the present invention is equally adaptable for use with such apparatus.

It will be appreciated by those skilled in the art that the present invention may be used in apparatus other than cleaning apparatus. For example, the present invention may be used in a painting apparatus or the like wherein a flammable, toxic or costly thinner is being used.

5

Such use of the present invention is within the scope of the claims.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. In a cleaning apparatus comprising a housing, a wall of said housing having an inlet for receiving elements to be cleaned providing communication into said housing, a wall of said housing having an outlet through which cleaned elements will emerge from said housing, means within said housing for defining a receptacle, said receptacle being adapted to contain a cleaning solvent susceptible to being vaporized during the cleaning operation, and a means providing for a closed circuit air recirculation system for said housing connected at its inlet end to the housing and connected at its discharge end with said outlet for said housing in a manner so that the pressure within said housing is maintained slightly below atmospheric pressure, said means including a fan adapted to provide a waft of air to said outlet for said housing.

2. In a cleaning apparatus in accordance with claim 1 wherein said means includes apparatus for withdrawing a mixture of air and vaporized solvent from within said housing and feeding said withdrawn air back into said discharge end of said housing in a warm state substantially free from vaporized solvent.

3. In an apparatus in accordance with claim 2 including a condenser disposed between said housing and said fan, said fan being in communication with said housing through said condenser, a heater in communication with the outlet port of said fan, a conduit connecting the outlet port of said heater with a portion of the outlet for said housing, and said condenser having a return conduit connected thereto for conveying liquid condensate away from said condenser to a suitable receptacle.

4. In a cleaning apparatus comprising a housing, a wall of said housing having an inlet providing communication into said housing for receiving elements to be cleaned, a wall of said housing having an outlet through which cleaned elements will emerge from said housing, means within said housing for defining a receptacle adapted to contain a cleaning solvent susceptible to being vaporized during the cleaning operation, means providing for a closer circuit air recirculation system for said housing, said last-mentioned means including apparatus for withdrawing a mixture of air and vaporized solvent from within said housing and feeding said withdrawn air back into said housing in a warm state substantially free from vaporized solvent, said withdrawing means including a

6

fan, a condenser disposed between said housing and said fan, said fan being in communication with said housing through said condenser, a heater in communication with the outlet port of said fan, a conduit connecting the outlet port of said heater with a portion of the outlet for said housing, said fan having a capacity for delivering only a waft of air to said outlet of said housing, and said condenser having a return conduit connected thereto for conveying liquid condensate away from said condenser to a suitable receptacle, and a second conduit connected to a second outlet port on said heater, said second conduit being connected to a portion of said inlet for said housing.

5. In a cleaning apparatus comprising a housing, a wall of said housing having an inlet for receiving elements to be cleaned providing communication into said housing, a wall of said housing having an outlet through which cleaned elements will emerge from said housing, means within said housing for defining a receptacle, said receptacle being adapted to contain a cleaning solvent, said solvent being susceptible to being vaporized during the cleaning operation, and a means providing for a closed circuit air recirculation system for said housing in a manner so that pressure within said housing is maintained slightly below atmospheric pressure, said means providing for a closed circuit air recirculation system including a conduit for delivering warm air free from vaporized solvent to each of said inlet and outlet, and said last mentioned means also including a conduit connected to an intermediate portion of said housing between said inlet and outlet for withdrawing a mixture of air and vaporized solvent.

6. In a cleaning apparatus comprising a housing having an inlet for receiving elements to be cleaned and an outlet through which cleaned elements will emerge from said housing, means within said housing for defining a receptacle adapted to contain a vaporizable solvent, means for withdrawing a mixture of air and vaporized solvent from said housing at a point between said inlet and outlet, said last mentioned means including a condenser for separating the mixture into air and a liquid, means connected to the outlet side of said condenser for heating said air and returning the same to each of said inlet and outlet.

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