

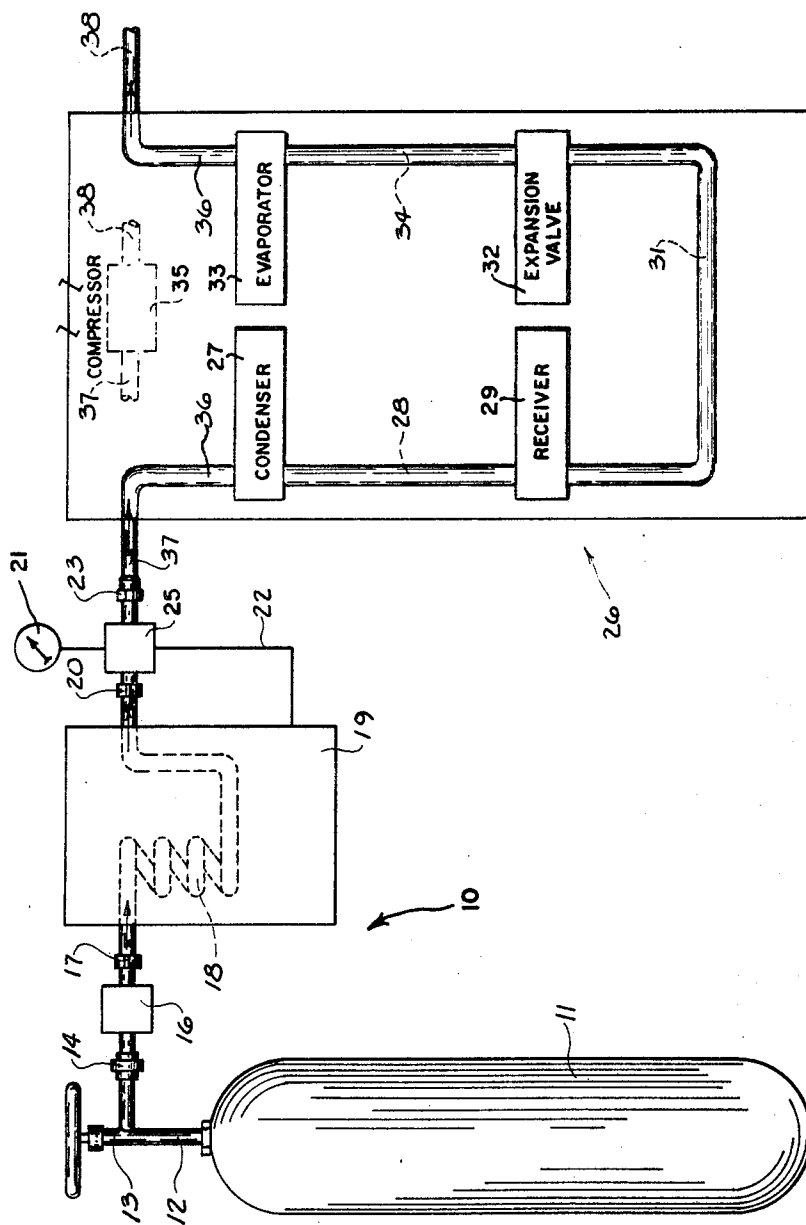
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DEHYDRATION, CLEANING AND STERILIZATION METHOD AND APPARATUS

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1

2

3,503,221 DEHYDRATION, CLEANING AND STERILIZATION METHOD AND APPARATUS

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ABSTRACT OF THE DISCLOSURE

This invention pertains to a method and apparatus for dehydrating, cleaning and sterilizing of electrical, refrigeration and air conditioning systems by heating a non-combustible, non-corrosive gas to at least the boiling point of water and allowing the heated gas to pass through the system thus vaporizing the moisture therein and blowing the vapor and other foreign objects therefrom. The apparatus comprising a cylinder adapted to contain a gas under pressure, a control valve, a heating device, a thermostatic control and visible gauge, and fittings.

BACKGROUND OF THE INVENTION

Field of the invention

The field of art to which this invention pertains is generally the art of cleaning, dehydrating and sterilization and in particular to a method and apparatus for cleaning, dehydration and sterilization of internal refrigeration systems.

Description of the prior art

As currently practiced in the art, the method of cleaning and dehydrating refrigeration systems is extremely involved and costly. Moisture and foreign objects in a closed refrigeration system can appreciably affect the operation of same by either freezing in the expansion valve or other valves in the system, or by impeding the flow of refrigerant through the system.

The method, previous to this invention, for removing moisture and foreign objects included the following steps; disconnecting the compressor and the expansion valve from the system; installing a bypass line between the lines where the expansion valve was connected; allowing the refrigerant in the system to escape from the system; connecting a cylinder of pressurized nitrogen gas, combination of gases, or the like, to the system at one of the lines left unconnected by the disconnecting of the compressor; allowing the gas to flow through the system, wherein the gas exits at the other of the lines left unconnected by the disconnecting of the compressor; disconnecting the cylinder; cleaning the expansion valve and compressor; reconnecting the compressor and the expansion valve to the system; attaching a vacuum pump to the system, pulling a vacuum on the system by the vacuum pump to 5 to 6 microns; removing the vacuum pump; recharging the system with refrigerant.

Not only does this involved process require a considerable length of time, but it is not always effective. If not effective, dehydrating liquids may be added to the refrigerant to absorb the moisture, or additional moisture-trapping filters may be installed in the system to, hopefully, complete the dehydration process.

A search of the new method was conducted, however no references were uncovered which teach this new dehydration technique. The prior art is replete with patents using a specific compound in powder form as a dehydrating agent, but is devoid of any teaching of heating a non-combustible gas to above the boiling point of water for dehydrating and cleaning an internal refrigeration system.

Although this invention relates principally to the clean-

ing and dehydration of refrigeration systems, it is also believed to be extremely effective in other areas. For example, many electrical systems are assembled in sub-assembled forms and later installed in complex machines. However, even though the sub-assemblies may be assembled under laboratory conditions of controlled humidity and atmosphere, perfect dehydration is impossible and they are not kept under these controlled conditions prior to final assembly. Corrosive and humidity control cannot be maintained if the sub-assembly is not sealed or if, prior to actual use, the seal is broken.

For example, in our space effort, the component parts of the space craft are manufactured at several locations, assembled and then shipped to the point of launching. From the original component manufacture to assembly, perfect dryness and sterility is impossible, and to the launching, months and possibly years may elapse. During this period, the equipment can be subjected to extremely high humidity and corrosive conditions which may adversely affect the operational characteristics thereof. Conduits carrying electrical wiring are excellent retainers of moisture and corrosive elements and should be subjected to cleaning and drying, particularly if they are introduced into an oxygen atmosphere. The moisture and corrosive elements, if not removed, may damage the insulation around the wires, the wires and electronic components and connections to an extent that shorting may occur when an electrical current is carried, thus causing sparking which, under an oxygen condition, may cause an explosion.

In the medical field, sterilization is of primary importance. The sterilization of surgical equipment is normally accomplished by either immersing the equipment in a wet solution, hot beads or molten metal, or by placing the equipment in an autoclave. The autoclave subjects the equipment to steam under pressure thus sterilizing same. Steam is utilized because the vapor will reach into areas that wet solutions cannot reach, such as grooves, hollow areas and the like. The equipment can also be placed in protective bags or wraps before placement in the autoclave. The wrap does not impair the sterilization process and permits the sterilized equipment to be stored therein after removal from the autoclave.

SUMMARY OF THE INVENTION

In brief, this invention relates to a method of dehydration and cleaning of a refrigeration system and entails the following steps: passing a pressurized non-combustible, non-corrosive gas through a temperature-controllable heating element, thus heating the gas to a temperature above the vaporizing temperature of water; introducing the heated gas directly into the system to be dehydrated and cleaned; allowing the heated gas to pass through the system and to exit therefrom; continuing the latter step until the temperature of the internal walls of the system reaches or exceeds the vaporizing temperature at which point the moisture in the system will vaporize and, as a vapor, join the flow of heated gas exiting from the system; increasing the pressure of the heated gas periodically, thus allowing the heated gas to flush through the system at a greater velocity so as to carry from the system all foreign particles disposed therein; and checking the moisture content of the exiting gas until the exiting gas is dry and contains no foreign particles.

In the case of surgical instruments, open electrical systems or even a space capsule, the system, or the like, should be encased in a bag or wrap having an inlet and outlet opening formed therein and substantially the same process as outlined above, with possibly the exception of the flushing step, would be performed. Upon the completion of the process, the inlet and outlet openings would be sealed until the system is used.

The object of this invention is to provide a process for removing moisture, foreign objects and corrosive atmosphere from refrigeration systems by the use of a heated, pressurized, non-combustible, non-corrosive, super dry gas.

Another object of this invention is the provision of a process for sterilizing surgical instruments, or the like, wherein solutions, steam, hot beads of metal, or molten metal are not required.

A further object of this invention is to provide an apparatus for the cleaning, dehydration and/or sterilization of refrigeration systems, electrical systems, surgical instruments and the like.

Yet another object of this invention is to provide a cleaning, dehydration and/or sterilization process which is extremely simple and effective in practice.

A still further object of this invention is the provision of an apparatus which is effective in use, compact, and simple in construction.

These objects and other features and advantages of this invention will become more readily apparent upon reference to the following description when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings, as hereinafter described, a preferred embodiment of the invention is depicted, however, various modifications and alternate constructions can be made thereto without departing from the true spirit and scope of the invention.

The drawing is a fragmentary elevational view, partly in schematic, of the apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, the dehydration, cleaning and sterilization apparatus of this invention is indicated generally at 10. The apparatus includes a cylinder 11 adapted to contain a non-combustible, non-corrosive, super dry gas under pressure. To permit or prevent the flow of gas from the cylinder 11, an outlet line 12 having an angle valve 13, or the like, connected thereto, is threadably secured to the cylinder. A flanged coupling 14 is interconnected between the angle valve 13 and an adjustable pressure reducing valve 16. The pressure reducing valve 16 is provided to both reduce and to regulate the pressure of the gas flowing therethrough. Secured to the discharge end of the reducing valve 16 at a fitting 17 is a coiled pipe 18 which is disposed in a heating unit 19. Connected by a coupling 20 to the downstream end of the coiled pipe 18 is an adjustable thermostatic control and visible gauge 21. The thermostatic control 21, electrically connected to the heating unit by a wire 22, is operable, in response to manual adjustment and the temperature of the gas flowing therethrough, to regulate the quantity of heat supplied by the heating unit 19 to the coiled pipe 18. Connected to the discharge end of the control 21 is a fitting 23.

A refrigeration system, indicated generally at 26 in the drawing, comprises a condenser 27 connected by a high pressure liquid line 28 to a receiver 29. The receiver 29 is connected by a high pressure liquid line 31 to a refrigerant control device, or expansion valve 32. Interconnected between the expansion valve 32 and an evaporator 33 is a low pressure gas line 34. A compressor 35 is normally connected between the evaporator 33 and the condenser 27 by a low pressure gas line 36. However, in the drawing, the compressor is depicted as being disconnected from the system and one end 37 of the line 36 is shown connected between the fitting 23 and the condenser 27 and the other end 38 of the line 36 is shown connected between the evaporator 33 and the atmosphere. The valves in the compressor 35 require a greater pressure to open and therefore the compressor could be cleaned and dehydrated separately from the remainder of

the system 26, thus requiring less gas from the apparatus 10.

In the event the refrigeration system 26 is to be cleaned and dehydrated, the apparatus 10 is connected at the fitting 23 to any one of the lines 28, 31, 34 or to 36, as shown in the drawing. When the connection is made, the refrigerant is allowed to escape into the atmosphere. The angle valve is opened and the non-combustible gas is allowed to flow into the coiled pipe 18 in the heating unit 19. The heating unit 19 is engaged and allowed to heat the flowing gas to a predetermined temperature as manually set on the adjustable thermostatic control 21. If the temperature of the gas flowing through the control 21 exceeds the preset condition, a signal is sent by the control 21 to the heating unit to adjust the heat output thereof. The heated gas then passes or is pushed through the refrigeration system and exhausts at the other end 38 of the line 36.

The flow of the heated gas through the system continues until the temperature of the internal walls of the refrigeration system reaches 212° F. or the boiling point of water. When this latter condition is reached, the moisture in the system vaporizes and, as vapor, joins the flow of heated gas exiting at the open end 38. The pressure of the heated gas, as set at the pressure reducing valve 16, must be sufficient to flow through the system with sufficient velocity to carry off the water vapor. In some systems, this pressure can be less than 1 p.s.i. while in others a slightly higher pressure is required. The pressure is dependent to some extent on the valving, length of pipe in the systems, fittings, etc. The compressor requires a greater pressure of gas to open the valves and in some instances a pressure of 10 p.s.i. has been necessary to effectively dehydrate same.

At periodic intervals, the adjustable pressure reducing valve 16 should be regulated to allow the gas to flush through the system at an increased pressure, thus allowing the hot gas to carry dirt particles and other foreign material therefrom. After the temperature of the internal walls of the system reach the desired temperature, the moisture content of the exiting gas should be checked continuously by any of the known conventional methods, i.e. litmus paper test. When the exiting gas is found to be dry, the apparatus is disconnected and the system is resealed and charged with a refrigerant.

In the event that electrical conduits are to be dehydrated, all openings and joints except for the inlet and outlet opening are sealed and the apparatus 10 is connected to the inlet opening. The operator should seal the fitting 23 to prevent the escape of gas prematurely. The same process as described hereinabove, with possibly the exception of the flushing operation, is then accomplished.

If an open system, or the exterior of a system is to be dehydrated, the system is placed in a container, i.e. a plastic bag, having an inlet opening and an outlet opening. The outlet opening may be controlled by a one-way valve that permits the heated gas to escape, and that is activated by a very light pressure of the gas, thus assuring that the heated gas will envelop the entire system. Heated gas is then allowed to flow into the bag under the same steps as described hereinabove, with the exception of the flushing operation, until the system reaches the required temperature and the exiting gas is dry. The apparatus 10 is then removed and the inlet and outlet openings of the bag are sealed until the system is installed or used.

To sterilize an open system, or the exterior of a system, or surgical instruments, the steps described for dehydrating an open system are followed. The temperature of the dry gas, however, may be increased to that condition which is necessary, possibly as high as 400° F. or higher, to kill all bacteria, etc.

Although a preferred embodiment of this invention has been disclosed and described hereinbefore, it is to be remembered that various modifications and alternate constructions can be made thereto without departing from

5

the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. A method for dehydrating and cleaning a system, and the like, having an inlet opening and an outlet opening, the method comprising:
 - heating a gas;
 - introducing said heated gas into the system at the inlet opening;
 - allowing said heated gas to flow through the system;
 - exhausting said flowing gas from the system through the outlet opening;
 - checking the moisture content of said exhausting gas; and
 - continuing said flow of said heated gas until said exhausting gas is dry;
 - said exhausting gas carrying off the moisture in the system.
2. A method for dehydrating and cleaning a system as defined in claim 1 wherein the temperature of said heated gas is increased at least to the vaporizing temperature of water, thus vaporizing the moisture in said system and the moisture as vapor joins the heated gas exhausting from the system.
3. A method for dehydrating and cleaning a system as defined in claim 2 wherein the gas is pressurized before entering the system.
4. A method for dehydrating and cleaning a system as defined in claim 3 wherein said flow of said heated gas through the system is continued until the temperature of the internal walls of the system through which the heated gas is flowing reaches at least the temperature at which water vaporizes.
5. A method for dehydrating and cleaning a system as defined in claim 3 wherein the temperature of the gas is increased to a temperature sufficient to kill bacteria and the like.
6. A method for dehydrating and cleaning a system as defined in claim 4 including the step of increasing the pressure of the gas at least once to allow the gas to flush through the system, thus causing the gas to carry foreign particles therefrom.

6

7. A dehydrating and cleaning apparatus for dehydrating and cleaning a refrigeration system and the like having an inlet opening and an outlet opening therein the apparatus comprising:

- a cylinder for containing gas;
- valve means fluidly connected to said cylinder, said valve means operable to allow the gas to flow from said cylinder;
- heating means fluidly connected to said valve, said heating means operable to increase the temperature of the gas; and
- a connecting element secured on one end to said heating unit; said element adapted to be fluidly connected on the other end thereof to the inlet opening of the system, the outlet opening of the system being left open to allow the escape of gas therefrom.

8. A dehydrating and cleaning apparatus as defined in claim 7 wherein said heating means includes a heating unit and thermostatic control, said control operable to regulate the temperature of the gas.

9. A dehydrating and cleaning apparatus as defined in claim 8 wherein said valve means includes a valve for releasing the gas from said cylinder and a pressure reducing valve fluidly interconnected between the outlet end of said valve and said heating unit for reducing and regulating the pressure of the gas flowing therethrough.

10. A dehydrating and cleaning apparatus as defined in claim 9 including a visible gauge fluidly interconnected between said control and said element, said gauge operable to indicate the temperature of the gas flowing there-through.

References Cited

UNITED STATES PATENTS

1,799,201	4/1931	Von Platen et al.	62—77
2,916,889	12/1959	Sattler	62—55
3,110,156	11/1963	Niemann	62—45
3,230,729	1/1966	Eber	62—195
3,299,524	1/1967	Jacobs	62—77
3,313,116	4/1967	Nonnecke et al.	62—55

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