March 31, 1964 E. J. KOCHER 3,126,715

DEFROSTING OF REFRIGERATION SYSTEMS

Filed June 18, 1962

FIG. 2

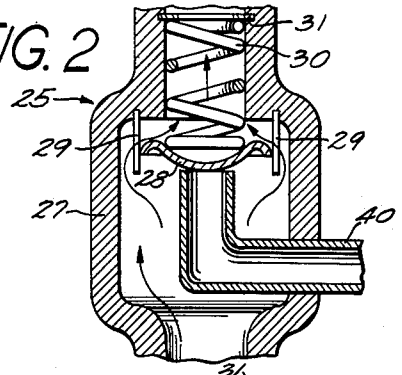


FIG. 3

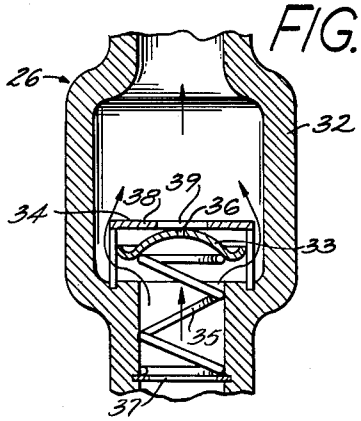


FIG. 4

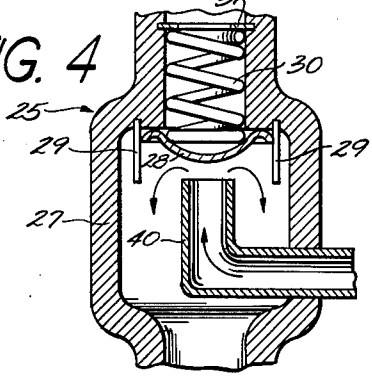
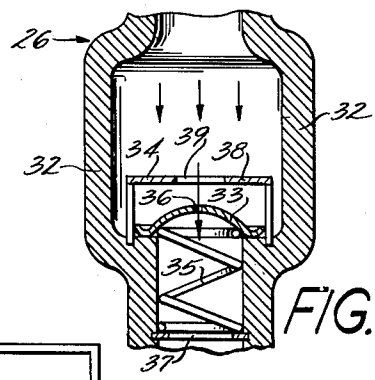


FIG. 5



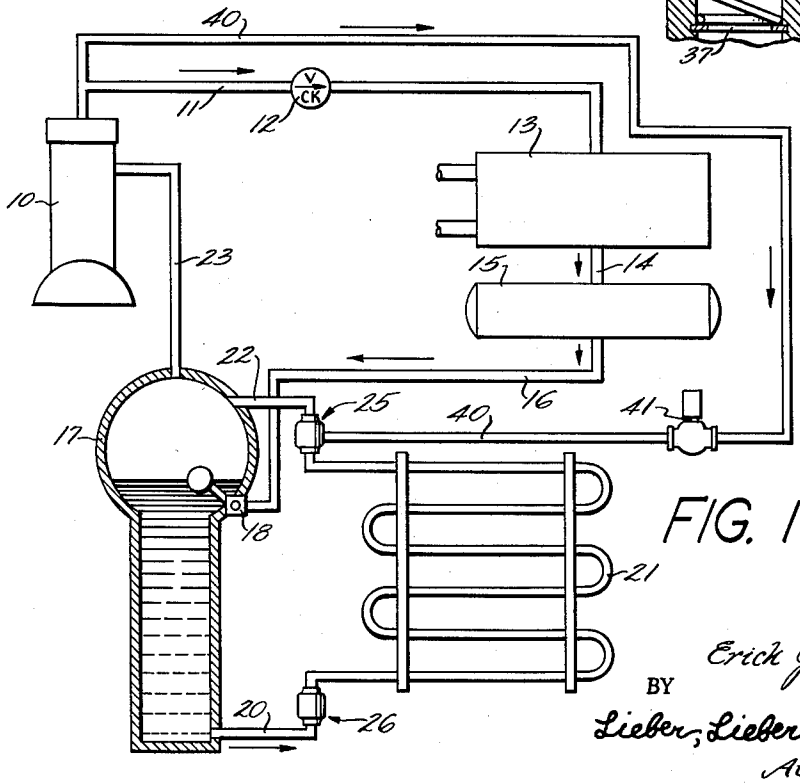


FIG. 1

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DEFROSTING OF REFRIGERATION SYSTEMS

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The present invention relates generally to improvements in the art of refrigeration, and relates more particularly to the provision of an improved hot gas defrosting system which embodies novel automatically operable valves.

A primary object of the invention is to provide an improved defrosting arrangement for refrigeration systems which is extremely simple yet highly efficient in operation, and wherein hot gas from the discharge side of the compressor is used for defrosting the refrigeration coils.

Various arrangements have heretofore been proposed for defrosting the cooling coils or evaporators in refrigeration systems by means of hot gas conducted to the coils from the high pressure side of the compressor, and such prior systems have likewise embodied diverse types of flow control valves for regulating and selectively controlling the flow of refrigerant and/or hot gas to the evaporator. However, as exemplified in United States Patents No. 2,596,036, dated May 6, 1952 to F. M. MacDougall, No. 2,632,303, dated March 24, 1953 to V. W. Smith, No. 2,762,206, dated September 11, 1956 to C. M. Ashley, and No. 2,823,691, dated February 18, 1958 to G. N. Chatham et al., the valving means heretofore proposed in these hot gas defrosting systems all require mechanical connections or the like between the valve and the actuating element or elements, thus rendering such systems undesirably complicated and costly.

It is therefore a further object of the present invention to provide an improved hot gas defrosting means for refrigeration systems which obviates the objections and disadvantages attendant prior systems and devices.

Another important object of this invention is to provide an improved defrosting system in which the hot gas from the high pressure side of the compressor is used for directly actuating the valves controlling flow through the cooling coils.

Another object of the invention is to provide a defrosting system embodying a flow and valving arrangement wherein the velocity of the hot gas itself actuates the valves controlling flow through the evaporator, thereby effectively eliminating the need for separate valve actuators.

Still another object of the present invention is to provide improved valve assemblages for the evaporator coils in a refrigeration system which are completely self-contained and controlled entirely by the action of hot gas used for defrosting and conducted thereto at controlled intervals from the high pressure side of the compressor.

These and other more specific objects of the invention will be apparent from the following detailed description.

A clear conception of the features constituting the present improvement and of the construction and operation of a typical system embodying the invention may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the several views.

FIG. 1 is a more-or-less diagrammatic view illustrating a typical refrigeration system provided with the improved defrosting means for one set of coils and showing the accumulator in section;

FIG. 2 is an enlarged fragmentary vertical section through the hot gas controlled check valve at the upper or

discharge end of the evaporator or cooling coil and showing the valve in normally open position;

FIG. 3 is a likewise enlarged fragmentary vertical section through the lower inlet end of the cooling coil housing the refrigerant inlet valve and likewise showing the same in normally open position;

FIG. 4 is a section similar to FIG. 2 but showing the upper valve in closed position for the defrosting operation; and

FIG. 5 is a sectional view corresponding to FIG. 3 but with the lower valve in its closed defrosting position.

While the invention has been shown and described herein as being embodied in a simple refrigerating system having but a single evaporator or cooling coil in which the defrosting cycle is controlled by a solenoid valve operated by a timer or the like, it is not intended to thereby unnecessarily limit the scope or utility of the improvements since they may be employed with equal effectiveness in a system embodying a multiplicity of cooling coils adapted for defrosting in any desired order and timed relationship. It is also contemplated that certain specific descriptive terminology used herein shall be given the broadest possible interpretation consistent with the disclosure.

Referring to the drawing, the refrigeration system shown therein comprises, in general, a compressor 10 for distributing hot gas under compression through a conduit 11 past a check valve 12 to a condenser 13 from which the condensed high pressure liquid refrigerant is delivered to a receiver 15 through a connection 14, the liquid refrigerant being supplied from the receiver 15 to an accumulator 17 via a conduit 16 under the control of a float valve 18. Connected with the lower interior of the accumulator 17 as by means of a conduit 20 is an evaporator or cooling coil 21, the upper end of which is connected with the upper interior of the accumulator above the float valve 18 by a conduit 22, it being understood that the system may include any desired number of cooling coils 21 connected with the accumulator 17 in like fashion.

In normal operation during cooling, the compressor 10 withdraws the vapor or refrigerant gas from the upper interior vapor space of the accumulator 17 via conduit 23. The relatively hot compressed gas is then conducted through conduit 11 under control of the check valve 12 to the condenser 13 wherein it is condensed. From the condenser, the high pressure liquid refrigerant is delivered by way of the connection 14 to the receiver 15 from which it is conducted via conduit 16 as required, under the control of the float valve 18, to the accumulator 17. The liquid refrigerant is then delivered from the lower interior of the accumulator 17 through conduit 20 to the evaporator coil 21 to perform its cooling function as it boils within the coil, the vapor being discharged through the conduit 22 to the upper interior of the accumulator 17 to complete the cycle.

To periodically remove ice formations from the evaporator tube or cooling coil 21, the present invention uses hot gas discharged from the compressor 10 under pressure, and while this concept by itself is old, a pair of novel and unique check valves are employed in the present system which are automatically operable in response to the velocity of the hot gas conducted thereto during the desired periods of the defrosting operations. These valves are located at the upper or discharge end of the cooling coil 21 and at the lower inlet end thereof and are designated generally by the numerals 25, 26 respectively.

Referring particularly to FIGS. 2 and 4 of the drawing, the valve 25 comprises a generally tubular body 27 secured in a convenient manner between the coil 21 and conduit 22 and housing a valve disk 28 guided for recip-

rocable movement as by means of a plurality of annularly spaced positioning and guide pins 29, the valve disk 28 being resiliently urged toward open position, as shown in FIG. 2, as by means of a relatively heavy spring 30 held against displacement by a split ring 31 or the like.

As shown in FIGS. 3 and 5, the valve 26 comprises a similar tubular body 33 likewise secured in a convenient manner between the lower end of the coil 21 and the conduit 20, the valve body 32 also housing a valve disk 33 retained within and guided for movement by a cage 34 having an apertured stop plate and a plurality of annularly spaced guide legs. In the case of the valve 26, the valve disk 33 is resiliently urged toward its open position and into seated contact with the apertured plate of the cage 34 as in FIG. 3 by means of a relatively light spring 35 merely sufficient to augment the flow of refrigerant from the accumulator 17 and conduit 20 in holding the valve disk 33 in its open position, the valve disk 33 being provided with a bleed aperture 36 axially alined with the aperture 39 in the stop plate 38 of the cage 34 for reasons which will hereafter become apparent. The spring 35 employed in the valve assemblage 26 may likewise be effectively seated on and retained against axial displacement by means of a split ring 37 or the like.

During the cooling or refrigerating cycle heretofore described, the valve disk 28 of the valve 25 is normally effectively maintained unseated and open by the action of the relatively heavy spring 30 permitting the flow of refrigerant to continue from the coil 21 to the conduit 22 as shown by the arrows in FIG. 2. At the same time, the valve disk 33 of the valve 26 is caused to remain open by the combined action of the lighter spring 35 and the flow pressure of the liquid refrigerant conducted to the coil 21 by way of the conduit 20 from the bottom of the accumulator, the flow of liquid refrigerant during such cooling cycle being illustrated by means of arrows in FIG. 3.

To close the valves 25, 26 and cause hot gas to be conducted to the cooling coil 21 for the defrosting operation, a conduit 40 is provided between the discharge or high pressure side of the compressor 10 and the lower side of the disk 28 of the valve 25, the conduit 40 terminating immediately below the valve disk 28 so as to act as a stop for the valve disk and prevent displacement thereof as a result of the action of the spring 30. Interposed in the conduit 40 is a suitable flow control valve shown in the drawing as being in the form of a solenoid valve 41, and this valve may be actuated as desired by a timer or other suitable means to open the conduit 40 at desired time intervals and initiate the defrosting operation as follows. When the valve 41 is opened to admit hot gas through the line 40 from the high pressure side of the compressor 10 to the lower face of the valve link 23, the velocity of the hot gas acts on the valve disk 28 and causes the same to close against the action of the spring 30. Upon closing of the valve 25 by the seating of the valve disk 28 as shown in FIG. 4, the pressure in the evaporating or cooling coil 21 builds up sufficiently to overcome the force of the relatively light spring 35 cooperating with the flow of liquid refrigerant to hold the valve disk 33 in its open position, and the valve disk 33 will consequently seat and close the valve 26 as shown in FIG. 5. The hot gas thereby replaces the refrigerant in the coil 21, and as long as the valves 25, 26 remain closed as shown in FIGS. 4 and 5, the hot gas defrosting operation will continue and the cooling cycle will again be commenced upon closing of the valve 41 to shut off flow of hot gas to the valve 25. To permit escape of entrapped refrigerant from the evaporator and allow operation of the valve 33 while preventing over-pressurization within the coil 21 during the defrosting operation, aperture 36 in the valve disk 33 is provided for bleed-off.

The improved hot gas defrosting system thus eliminates need for mechanical connections and actuators for the valves 25, 26, and these valves may be of extremely simple and economical construction. The valves 25, 26 are also capable of ready installation, and the defrosting cycles may be conveniently automatically timed as desired. While the valve disks 28, 33 have been illustrated as being generally of dish-shape, they have been so designed primarily for convenience in retaining the respective springs in seated position thereagainst. Also, as already heretofore indicated, a plurality of evaporator or cooling coils may likewise be effectively defrosted at timed intervals in a manner similar to that described herein.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A refrigerating system comprising, a compressor, a condenser, conduit means for conducting refrigerant gas under compression from said compressor to said condenser, an evaporator having an inlet end and an outlet end provided with a coaxial tubular valve body, conduit means for delivering liquid refrigerant from said condenser to the inlet end of said evaporator, an expansion device in said conduit, other conduit means from said tubular valve body to said compressor, a reciprocable disk-shaped valve housed within said valve body and peripherally spaced therefrom for controlling flow of refrigerant through said evaporator, resilient means acting on one face of said valve in opposition to the normal flow of refrigerant through said evaporator for normally maintaining said valve in open condition for the refrigerating cycle, separate conduit means extending from the discharge side of said compressor into said valve body coaxially thereof and terminatnig therein immediately adjacent the opposite face of said valve to provide a seat therefor when said valve is in open condition, and flow control means in said separate conduit for periodically delivering gas under compression therethrough and directly against said valve in opposition to said resilient means to close the same in response to the velocity of said gas delivered thereto and thereby interrupt normal flow of refrigerant through said evaporator to cause defrosting thereof.

2. A refrigerating system according to claim 1, wherein guide means are provided in the valve body for guiding the valve in its reciprocable movement to maintain the same peripherally spaced from the side wall of said body.

3. A refrigerating system according to claim 1, wherein the inlet end of the evaporator is also provided with a coaxial tubular valve body housing a disk-shaped valve peripherally spaced from the body within which it is housed.

4. A refrigerating system according to claim 3, wherein resilient means are also provided acting on one face of the inlet valve in the direction of normal flow of refrigerant through the evaporator for normally maintaining said inlet valve in open condition.

5. A refrigerating system according to claim 4, wherein the resilient means acting on the outlet valve is a relatively heavy spring and the resilient means acting on the inlet valve is a relatively light spring.

References Cited in the file of this patent

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