April 20, 1948. I. KRAMER 2,440,146

DEFROSTING MECHANISM IN REFRIGERATING APPARATUS

Filed Nov. 7, 1944

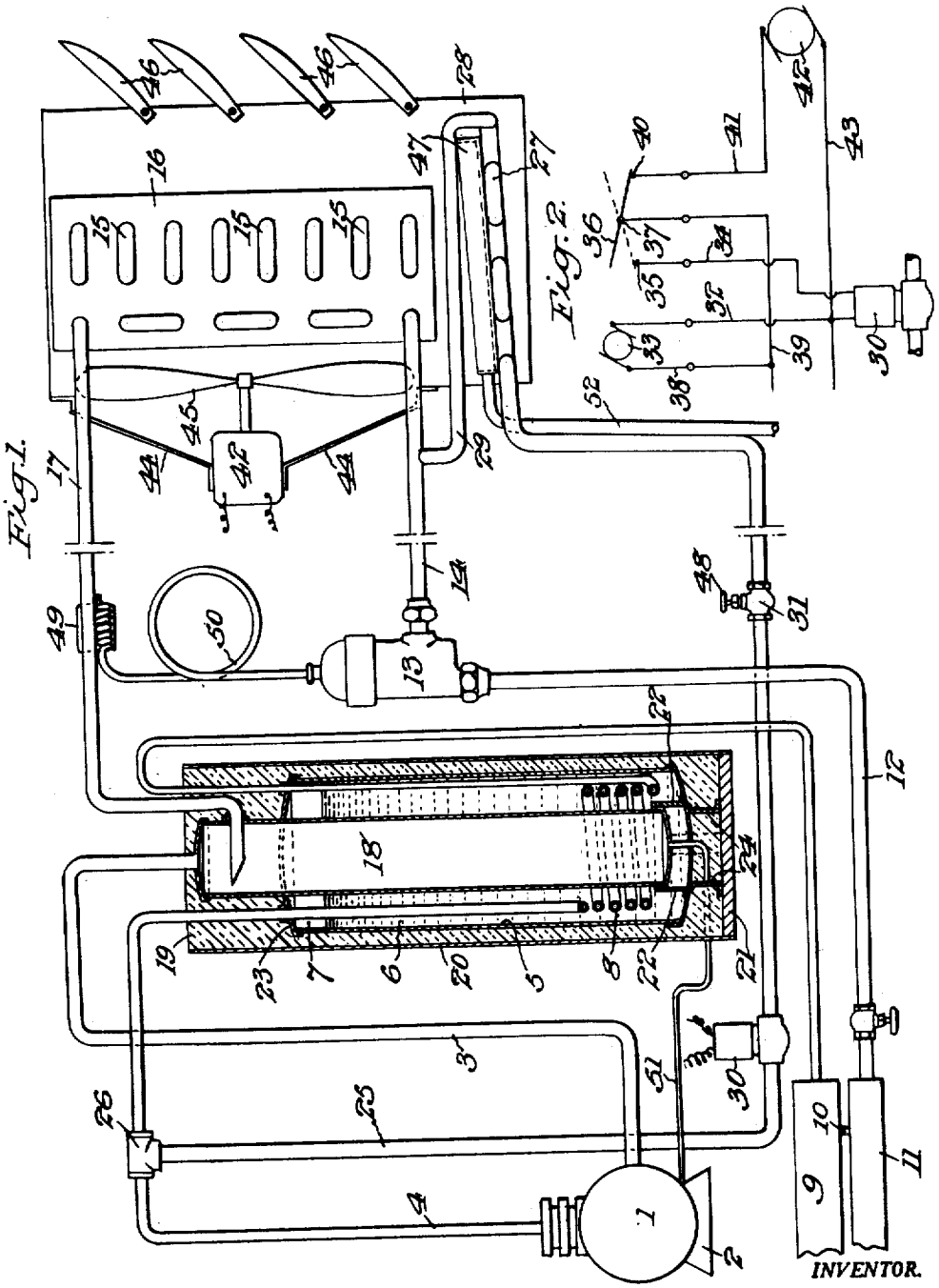

Fig. 1.

Fig. 2.

INVENTOR.

Israel Kramer

BY

Bright Brody

his attorneys

Patented Apr. 20, 1948 2,440,146

UNITED STATES PATENT OFFICE

2,440,146

DEFROSTING MECHANISM IN REFRIGERATING APPARATUS

Israel Kramer, Trenton, N. J., assignor to Kramer Trenton Company, Trenton, N. J., a corporation of New Jersey

Application November 7, 1944, Serial No. 562,299

23 Claims. (Cl. 62—115)

1

This invention relates to refrigerating apparatus and, more particularly, to the provision in such apparatus of means for automatic periodic defrosting of the evaporating or chilling unit.

It is well known that refrigerating apparatus, particularly if designed for creating temperatures below freezing, when in operation accumulates a layer of ice on the evaporating or chilling unit which is commonly in the form of a pipe coil having fins thereon. This accumulation of ice reduces the operating efficiency of the apparatus so seriously as to require periodic removal of the ice which is known in this art as "defrosting." In the past, this defrosting has been left to the activity of an attendant who initiated the same at more or less regular intervals by the manual operation of a switch or valve for melting the ice by the action of electricity or tap water, or in some other appropriate manner. This procedure necessarily involved the disadvantages which inevitably arise when the performance of a step is left to operational attention instead of being automatically performed by suitable mechanism or device, with the result that, in many cases, refrigerating apparatus has frequently, if not generally, been operated with a degree of efficiency far below its designed and desired capacity.

The difficulty arising from the icing up of the evaporator unit is very pronounced in the compact, unit type of refrigerating apparatus wherein the coils of the evaporator unit are very close together and the fins on the coils are closely spaced, because this small clearance between coils and fins accelerates the pace at which the ice accumulates and thereby gives rise to pronounced decreases in efficiency of operation at frequent intervals.

My invention contemplates the elimination of these previously existing disadvantages, and others inherent in conditions arising from the icing up of the evaporator unit, by providing for the defrosting of the evaporator unit by automatic action brought into effect at regular and automatically-spaced intervals; whereby the refrigerating apparatus is constantly maintained at substantially peak efficiency insofar as the above-named factor of ice coating on the evaporator unit is concerned. While my invention is adapted to refrigeration apparatus in general, it is especially adapted to and beneficial for the unit type of refrigerators herein above mentioned.

An object of my invention is to provide refrigerating apparatus which includes means for automatically controlling the initiation of, spacing between, and duration of defrosting operations.

2

Another object consists in providing such an apparatus in which a defrosting agent generated in the normal operation of the apparatus is employed for the periodic defrosting.

Another object consists in providing such an apparatus in which heat generated in the normal operation of the apparatus is employed for the periodic defrosting.

Another object consists in providing such an apparatus in which the normal operation accumulates a defrosting agent in sufficient amount to compensate for the loss of said agent during periodic defrosting.

Another object consists in providing such an apparatus in which the normal operation accumulates heat in sufficient amount to compensate for the loss of heat during periodic defrosting.

Another object consists in providing such an apparatus which includes means for the storing of a fluid and the heating of said fluid during normal operation, whereby said heated fluid is operable to gasify liquid resulting from the condensation of gas during periodic defrosting.

Another object consists in providing such an apparatus which includes a compressor and an evaporator, and in which an element is arranged in communication with the compressor and evaporator, which element is substantially functionless during the bulk of normal operation but actuates following each periodic defrosting to compensate for the loss of heat occasioned by defrosting.

Another object consists in providing such an apparaus in which the evaporator acts as a condenser during periodic defrosting, and in which an element is included to act as an evaporator to compensate for the periods during which the evaporator is acting as a condenser.

Another object consists in providing such an apparatus which includes a liquid-containing vessel having a tank therein in communication with the compressor and the evaporator, whereby heat from the compressor stores heat in the liquid so that the latter is functional to heat the tank and gasify liquid which has been condensed by the evaporator acting as a condenser during defrosting.

Another object consists in providing apparatus as described in the last paragraph, in which the construction and arrangement are such that gas from the evaporator passes through the tank without being materially affected by the heat thereof during normal operation.

Another object consists in providing such an apparatus in which a device controlled by auto-

matic timing mechanism periodically initiates and terminates defrosting.

Another object consists in providing such an apparatus in which a valve or the like controlled by automatic timing mechanism periodically permits the flow of heated gas from the compressor to the evaporator to initiate defrosting.

Another object consists in providing an apparatus as described in the last paragraph in which there is means for controlling the amount of heated gas flowing from the compressor to the evaporator.

A further object consists in providing certain improvements in the form, construction and arrangement of the several parts whereby the above-named and other objects may effectively be attained.

A practical embodiment of the invention is represented in the accompanying drawing, in which

Fig. 1 represents a somewhat diagrammatic side elevation of the apparatus, partly in section and partly broken away, and

Fig. 2 represents a diagrammatic detail view of the means for automatically controlling periodic defrosting.

The apparatus includes a compressor, denoted by 1, which may be of any well-known or approved form adapted for the compressing and supplying of a refrigerating agent such, for instance, as ammonia gas, in a manner known to those skilled in this art. The said compressor is preferably provided with the usual oil sump 2, and driven by the usual motor, not shown.

A pipe 3, commonly known as a suction pipe, supplies the gas to the intake of the compressor 1 and another pipe 4 serves to supply the compressed gas from the compressor to other parts of the apparatus. The said pipe 4 enters at the top of a vessel or container 5 which may be composed of any suitable material, such as sheet steel, and is largely but not entirely filled with a suitable liquid 6 such, for instance, as a solution of alcohol and water or prestone and water; whereby a space 7 remains above the liquid 6 in the vessel 5.

The pipe 4 is arranged in the form of a coil 8 in the lower part of the vessel 5, and then extends upwardly through the top of the vessel from which it follows a downward and lateral course to a condenser 9 which may be of any well-known or approved construction that need not be described herein because the same is within the knowledge and practice of those skilled in this art. The condenser serves to liquify the gas which then drops through a tube 10 into a receiver 11 which may also be of any well-known or approved form familiar to this art.

From the receiver 11 the liquid, still under compression, passes through a pipe 12 to a thermostatic expansion valve 13 which, like the compressor, condenser and receiver, is an element the construction and functioning of which are well known to those versed in the manufacture of refrigerating apparatus, and hence need not be detailed herein. A pipe 14, illustrated as broken because of the close arrangement of parts set forth in the drawing, leads to the lower end of the coil 15 of an evaporator 16 which, again, may be of any well-known or approved construction.

From the upper end of the said coil 15, a pipe 17, also illustrated as broken, leads into the upper part of a tank 18 which is located within the vessel 5 so as to be surrounded by the liquid 6

therein, and extends upwardly through the top of the said vessel. The suction pipe 3 is connected to the top of the tank 18; thus completing the circuit from the compressor 1 to the vessel 5, to the condenser 9, to the receiver 11, to the expansion valve 13, to the coil 15 of evaporator 16, to the tank 18, and back to the compressor. In this circuit or cycle of the gas it is compressed and condensed into a liquid, which latter passes through the evaporator for producing the desired refrigerating effect in a well understood manner. But an added function results from this circulation or cycle in that the passage of the hot compressed gas through that portion of pipe 4 and its coil 8 which are immersed in the liquid 6 contained in the vessel 5, serves to heat the said liquid which latter thereupon heats the tank 18 and maintains the latter at an elevated temperature sufficient for an evaporation step, to be hereinafter explained.

The tank 18 is composed of suitable material such as sheet steel, while it and the vessel 5 are surrounded by a suitable heat-cold insulating material 19 which is confined within a surrounding casing 20 that has a bottom 21; said casing and bottom being composed of any appropriate material, such as steel or iron. The tank 18 is vertically supported within the vessel 5 by legs 22, and held against lateral movement therein by engagement with the top 23 of the vessel 5 through an aperture in which the tank 18 passes. The vessel 5 is, in turn, vertically supported in the casing 20, 21 by legs 24, and is held against lateral movement therein by insulation 19. The casing 20, 21 may be properly mounted and supported in any desired and appropriate manner by means not shown.

A branch pipe 25 is connected to pipe 4 at 26, and runs to a drip pan coil 27 that is set in the lower part of a housing 28 which surrounds the evaporator 16, the said coil 27 being connected by a pipe 29 with pipe 14 that leads from the thermostatic expansion valve 13 to the evaporator coil 15. A solenoid valve 30 is fitted in the pipe 25, as is also a metering valve 31, which latter is located between the solenoid valve and the drip pan coil 27. In the drawing, the pipe 25 is illustrated as broken for the same reason as in the case of pipes 14 and 17.

When the solenoid valve 30 is closed, no gas from the compressor 1 can pass to the drip pan coil 27 and through pipes 29 and 14 to the evaporator coil 15; but, when the solenoid valve is open, the hot gas from the compressor 1 can take the course just described and thereby enter the drip pan coil 27 and the evaporator coil 15 in the form of a hot gas, instead of as a liquid which is the case when the gas is caused to pass through condenser 9 and receiver 11. The hot gas thus entering the coils 27 and 15 will, by its heat, serve to melt the ice which has collected upon the said coils, and more especially upon the evaporator coil 15, thus eliminating this deterrent to efficient operation of the apparatus as a whole. At the same time that the heat of the gas is melting the ice on the said coils, and especially on the evaporator coil 15, the chilling effect of the ice in turn condenses the gas into a liquid. In other words, at this period, the evaporator 15, 16 acts as a condenser so that the fluid which entered the evaporator as a hot gas to perform the defrosting operation, leaves the evaporator, through the pipe 17, in the form of a liquid. This liquid passes through the pipe 17 and into the hot tank 18 and, as it drops into the said tank, the heat of

the latter evaporates or flashes the liquid back into the form of gas, which gas enters the compressor 1 through the pipe 3 to be compressed and again forced through the apparatus.

This defrosting operation should take place at evenly-spaced periods or intervals while the apparatus is in operation, such as several times a day; and my invention includes means for automatically initiating the defrosting step at predetermined intervals, and for automatically regulating the duration of each periodic defrosting.

The said automatic controlling means is diagrammatically shown in Fig. 2 where it will be seen that the solenoid valve 30 is connected by one wire 32 with one brush of an electric timer 33; and by another wire 34 with one end terminal 35 of a double switch 36 which is centrally pivoted at 37. The other brush of electric timer 33 is connected by a wire 38 to another wire 39 which runs to the central pivot 37 of switch 36. The other end terminal 40 of switch 36 is connected by a wire 41 with one brush of an electric motor 42, the other brush of which is connected by a wire 43 with the wire 32. Two positions of the switch 36 are shown in the drawing, one in full lines and one in dotted lines. When the switch is thrown to the full line position a circuit is established through the motor 42 and timer 33 with one wire 32 that leads to the solenoid valve 30; and the arrangement is such that, in this condition, the said valve is closed. When, however, the switch 36 is thrown to the dotted position shown in Fig. 2, the motor 42 is cut out of circuit, and a circuit is established between both brushes of timer 33 and both wires, 32 and 34, leading to the solenoid valve 30; in which condition the said valve opens and permits the hot compressed gas to pass through branch pipe 25 for the defrosting operation hereinabove described.

The timer 33 may be any one of a number of commercial electric timers embodying clock-like mechanism which can be set so as to activate other mechanism at predetermined lengths of time. For instance, such a timer could be set so as to become active every three hours and to remain active each time for fifteen minutes. As applied to the present invention, the manufacturer and/or operator can estimate from the size of the refrigerating apparatus and the results desired therefrom the periods at which it should be defrosted and the length of time required for each defrosting operation, and can thus determine the selection and setting of a proper timer. With such a timer connected in this apparatus, its automatic clock-like operation will periodically throw the switch 36 from the full-line position to the dotted-line position shown in Fig. 2, and maintain the switch in said dotted position for the correct period of time. As heretofore mentioned, when the switch 36 is in the full-line position, the solenoid valve 30 is closed and no defrosting can take place; but, when the timer 33 causes the switch 36 to be thrown to the dotted-line position, the effect is to open the solenoid valve 30 and permit defrosting to begin and to continue as long as the switch 36 remains in the dotted position. It will be understood that the switch 36 is spring controlled so as normally to take one position, and that it is moved to the other position by electric impulse against the action of the spring. Also that the wires 39 and 43 lead to a suitable source of electric current supply.

The electric motor 42 is mounted in brackets 44 that are secured to housing 28; and the said motor serves to drive the usual fan 45 which blows air through the evaporator 16 to provide the refrigerating effect in the desired direction and location.

Louvers 46 are pivotally mounted in the housing 28 and may be adjusted, in a well-known manner, for directing the current of chilled air as circumstances or conditions appear to dictate.

A drip pan 47 is located below the evaporator 16 to receive the water resulting from the melting of the ice during the defrosting periods, which water will be carried to the sewer, or other suitable disposal outlet, by a pipe. Unless a preventive step is taken, this water will freeze on the drip pan and, to obviate this difficulty, the drip pan coil 27 is provided, which coil receives the hot gas during defrosting periods and serves to melt the ice on the drip pan at the same time that the ice is being melted on the coil 15 of the evaporator 16.

The metering valve 31 is preferably of the needle type which may be manually controlled or adjusted by hand wheel 48; while the thermostatic expansion valve 13 is automatically controlled, in a well-known manner, by a temperature-actuated device, such as a feeler bulb 49 which embraces the pipe 17 and is connected to the valve 13 by a capillary pipe 50. The effect of the said device 49 is to control or regulate the amount of refrigerant liquid supplied to the coil 15 of evaporator 16 in conformity with the output demand upon the refrigerating apparatus.

A pipe 51 connects the bottom of tank 18 with the oil sump 2 of the compressor 1 in order to drain off from the tank 18 such oil as may be deposited therein from the circulating fluid and, to this end, the bottom of the tank 18 should be located slightly higher than the point at which pipe 51 enters sump 2, while the pipe should be of such small diameter as to permit the flow of the oil but prevent the passage of any substantial amount of refrigerant liquid from the tank 18 to the compressor 1 during defrosting.

In normal operation, the switch 36 is in the full-line position shown in Fig. 2 and the solenoid valve 30 is closed. Gas supplied to the compressor 1 is compressed and forced through the pipe 4, the coil 8, and into the condenser 9 where it is changed into a liquid. This liquid drops into the receiver 11 and is forced through the pipe 12 and expansion valve 13, which latter, in permitting expansion, decreases the temperature of the liquid. This liquid then passes through the pipe 14 and into the coil 15 of the evaporator 16 where it performs its work and is, at the same time, vaporized into a gas by the heat extracted from the substances being refrigerated. This gas then passes through pipe 17 and feeler bulb 49 into the upper part of the tank 18, from which it passes through the pipe 3 to the compressor 1 for repetition of this cycle of operation. During this procedure the hot gas passing through that portion of the pipe 4 which is immersed in the liquid 6 and, particularly, through the coil 8, serves to heat the liquid 6 which later, in turn, heats the tank 18. However, it will be observed that the upper part of the tank 18 extends above the heated liquid 6 so as not to be greatly affected thereby, and that, consequently, the passage of the gas from the pipe 17 into the tank 18 and thence into the pipe 3 is not in any way affected by the tank 18. Thus it may be said that, in normal operation, the gas from the evaporator in

effect bypasses the tank 18 even though it passes through the upper part thereof.

At the time which had been predetermined and set for defrosting of the evaporator to take place, the timer 33 actuates the switch 36 so as to move it to the dotted position and break the electric circuit to the motor 42. This permits the solenoid valve 30 to open, whereupon the hot compressed gas leaving the compressor 1 passes from the pipe 4 into the branch pipe 25 and thence to the coils 27 and 15 of the evaporator to initiate the defrosting of the said coils, as hereinabove described. The hot gas, which turns into a liquid during the defrosting operation, passes through the pipe 17 and into the tank 18. Inasmuch, however, as this fluid is now in the form of a liquid rather than a gas, it will not, in effect, bypass the tank 18 and move immediately into the pipe 3, but will drop down into the tank 18 and be vaporized or flashed by the heat of the tank into a gas which then rises to pass through the pipe 3 and be sucked into the compressor 1 at its intake. This defrosting step will last only as long as the time allowed for its continuance by the setting of the timer or time clock 33; after which the switch 36 will be permitted to return to its full-line position and the normal operation of the apparatus, previously described, will be resumed. By suitable adjustment of the metering valve 31, the supplying of an excessive amount of hot gas to the evaporator during defrosting can be prevented.

From the foregoing, it will be observed that, while defrosting is taking place, the evaporator 15, 16 is acting as a condenser and that, during the same period, the hot liquid 6 in the vessel 5 provides the necessary heat when there is no other source of heat available in the apparatus. This liquid 6 is preferably hermetically sealed in the vessel 5 in order to prevent loss thereof by evaporation or otherwise; while the points at which the pipe 4 enters and leaves the vessel 5, and the point at which the pipe 17 enters the tank 18, are sealed with suitable stuffing boxes or the like. It will further be seen that, whether the apparatus is in normal operation or undergoing defrosting, the gas or liquid from the evaporator passes through the tank 18 to the compressor without encountering any substantial obstruction, thereby avoiding difficulties, such as frictional loss and heat pick-up, which would be expected if the fluids passed through a comparatively restricted mechanical element such, for instance, as a coil, in contradistinction to a tank.

It has been hereinabove mentioned that the drip pan 47 is connected by a drain pipe, or the like, to a sewer or other appropriate disposal outlet, and it will be observed that the said drain pipe, denoted by 52, is arranged to lie closely adjacent a part of branch pipe 25 which supplies the hot gas for the defrosting operation, whereby the heat in said pipe 25 serves to warm drain pipe 52 and defrost the latter in case of the accumulation of ice thereupon.

The arrangement and construction embodied in this invention eliminate all the uncertainties of manual attention and insure thorough periodic defrosting at the most desirable times and without disturbing interruption in the operation of the refrigerating apparatus; whereby the latter is automatically maintained at, or substantially at, its peak of efficiency with the inherent attendant economic advantages.

While I have described the invention in connection with a continuously operating apparatus or system, it is equally applicable to the intermittent operation type, in which the compressor is stopped and started through the actuation of an electric switch connected to the compressor motor and controlled by a pressure switch in the suction or supply line to the compressor; the arrangement serving to stop the motor when the pressure is low and re-start it when the pressure is high; all as is known to and understood by those skilled in this art. My invention will cause defrosting to occur in the intermittent type of apparatus, because the opening of the solenoid valve, as described, will at once raise the pressure in the compressor suction line and thus cause the suction pressure switch to re-start the compressor motor, if it has been stopped, and force the hot gas to the evaporator for the initiation of the defrosting cycle hereinbefore explained.

When, in the claims, I refer to the substance in the vessel 5 as a liquid, I intend to use that word in its broad significance and to include not only low but also high viscosities of the nature of pastes or jellies which may even solidify at certain temperatures.

I desire it to be understood that various changes may be resorted to in the form, construction, material and arrangement of the several parts, without departing from the spirit and scope of my invention; and hence I do not intend to be limited to details herein shown or described except as they may be included in the claims or required by disclosures of the prior art.

What I claim is:

1. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing heat, means for conducting gas from the compressor to said element to accomplish the storage of said heat, means for conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by the stored heat of said element, and means for conducting said gas to the compressor.

2. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing heat, means for conducting gas from the compressor to said element to accomplish the storage of said heat, means for periodically conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by the stored heat of said element, and means for conducting said gas to the compressor.

3. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing heat, means for conducting gas from the compressor to said element to accomplish the storage of said heat, automatically controlled means for periodically conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by the stored heat of said element, and means for conducting said gas to the compressor.

4. Apparatus of the character described comprising, a gas compressor, an evaporator, a liquid containing vessel, a heatable element immersed in said liquid in said vessel, means for normally conducting gas from the compressor

so as to pass in heat exchange relation with said liquid to heat it and the element therein, means for conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid for defrosting the evaporator, and means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby.

5. Apparatus of the character described comprising, a gas compressor, an evaporator, a liquid containing vessel, a tank immersed in said liquid in said vessel, means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank therein, means for conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid for defrosting the evaporator, and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

6. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a heatable element; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said element to heat it, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass in contact with said heated element, and return to the compressor; means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said heated element or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby.

7. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a heatable tank; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said tank to heat it, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through said heated tank, and return to the compressor; means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said tank or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

8. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a liquid containing vessel; a tank immersed in said liquid; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank therein, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through said heated tank, and return to the compressor; means for periodically conducting gas from the compressor to the evaporator without passing through said liquid or in heat exchange relation with said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

9. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a heatable element; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said element to heat it, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass in contact with said heated element, and return to the compressor; automatically controlled means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said heated element or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby.

10. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a heatable tank; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said tank to heat it, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through said heated tank, and return to the compressor; automatically controlled means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said tank or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

11. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a liquid containing vessel; a tank immersed in said liquid; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank therein, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through said heated tank, and return to the compressor; automatically controlled means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

12. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a liquid containing vessel; a tank partly immersed in said liquid; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank partly immersed therein, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through the unimmersed part of said heated tank, and return to the compressor; automatically controlled means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into the immersed part of said heated tank to be vaporized thereby.

13. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing and for transferring heat, means for conducting gas from the compressor

to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by heat transferred from said element to said condensed gas, and suction means for conducting said gas to the compressor.

14. Apparatus of the character described comprising, a gas compressor, an evaporator, a tank for storing and for transferring heat, means for conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said tank to be vaporized by heat transferred from said tank to said condensed gas, and suction means for conducting said gas to the compressor.

15. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing and for transferring heat, means for conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by heat transferred from said element to said condensed gas, suction means for conducting said gas to the compressor, and means for returning oil from the said element to the compressor.

16. Apparatus of the character described comprising, a gas compressor, an evaporator, a tank for storing and for transferring heat, means for conducting gas from the compressor to the evaporator for defrosting the evaporator, means for conducting gas after it has been condensed in the evaporator during defrosting to said tank to be vaporized by heat transferred from said tank to said condensed gas, suction means for conducting said gas to the compressor, and means for returning oil from the said tank to the compressor.

17. Apparatus of the character described comprising, a gas compressor, an evaporator, a liquid containing vessel, a heatable element immersed in said liquid in said vessel, a conduit in said liquid, means for normally conducting gas from the compressor through said conduit to heat said liquid and the element therein, means for conducting gas from the compressor to the evaporator without passing through said conduit for defrosting the evaporator, and means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby.

18. Apparatus of the character described comprising, a gas compressor, an evaporator, a liquid containing vessel, a tank immersed in said liquid in said vessel, a conduit in said liquid, means for normally conducting gas from the compressor through said conduit to heat said liquid and the tank therein, means for conducting gas from the compressor to the evaporator without passing through said conduit for defrosting the evaporator, and means for conducting gas which has been condensed in the evaporator during defrosting to said tank to be vaporized thereby.

19. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a liquid containing vessel; a tank immersed in said liquid; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank therein, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through said heated tank, and return to the compressor; means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into said heated tank to be vaporized thereby.

20. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a liquid containing vessel; a tank partly immersed in said liquid; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said liquid to heat it and the tank partly immersed therein, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass through the unimmersed part of said heated tank, and return to the compressor; means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said liquid or through said condenser for defrosting the evaporator; and means for conducting gas which has been condensed in the evaporator during defrosting into the immersed part of said heated tank to be vaporized thereby.

21. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing heat, means for conducting gas from the compressor to said element to accomplish the storage of said heat, means for conducting gas from the compressor to the evaporator for defrosting the evaporator, a drip pan and drain for the water generated by the defrosting of the evaporator, means for conducting the defrosting gas also to the said drip pan and drain, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by the stored heat of said element, and means for conducting said gas to the compressor.

22. Apparatus of the character described comprising, a gas compressor, an evaporator, an element for storing heat, means for conducting gas from the compressor to said element to accomplish the storage of said heat, automatically controlled means for periodically conducting gas from the compressor to the evaporator for defrosting the evaporator, a drip pan and drain for the water generated by the defrosting of the evaporator, means for conducting the defrosting gas also to the said drip pan and drain, means for conducting gas after it has been condensed in the evaporator during defrosting to said storing element to be vaporized by the stored heat of said element, and means for conducting said gas to the compressor.

23. Apparatus of the character described comprising, a gas compressor; an evaporator; a condenser; a heatable element; means for normally conducting gas from the compressor so as to pass in heat exchange relation with said element to heat it, pass through said condenser to be condensed, pass through said evaporator to accomplish refrigeration and be vaporized, pass in contact with said heated element, and return to the compressor; automatically controlled means for periodically conducting gas from the compressor to the evaporator without passing in heat exchange relation with said heated element or through said condenser for defrosting the evaporator; a drip pan and drain for the water generated by the defrosting of the evaporator; means for conducting the defrosting gas also to the said

drip pan and drain; means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby; and means for conducting said gas to the compressor.

ISRAEL KRAMER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,827,410	Warren	Oct. 13, 1931
2,049,625	Rupprickt	Aug. 4, 1936
2,128,386	Warren	Aug. 30, 1938
2,281,770	Hoesel	May 5, 1942
2,384,210	Sunday	Sept. 4, 1945

Certificate of Correction

Patent No. 2,440,146. April 20, 1948.

ISRAEL KRAMER

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 9, line 67, claim 8, strike out the words "through said liquid or"; line 68, same claim, before "condenser" insert *liquid or through said*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of June, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

drip pan and drain; means for conducting gas which has been condensed in the evaporator during defrosting to said heated element to be vaporized thereby; and means for conducting said gas to the compressor.

ISRAEL KRAMER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,827,410	Warren	Oct. 13, 1931
2,049,625	Rupprickt	Aug. 4, 1936
2,128,386	Warren	Aug. 30, 1938
2,281,770	Hoesel	May 5, 1942
2,384,210	Sunday	Sept. 4, 1945

Certificate of Correction

Patent No. 2,440,146. April 20, 1948.

ISRAEL KRAMER

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 9, line 67, claim 8, strike out the words "through said liquid or"; line 68, same claim, before "condenser" insert *liquid or through said*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of June, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.