

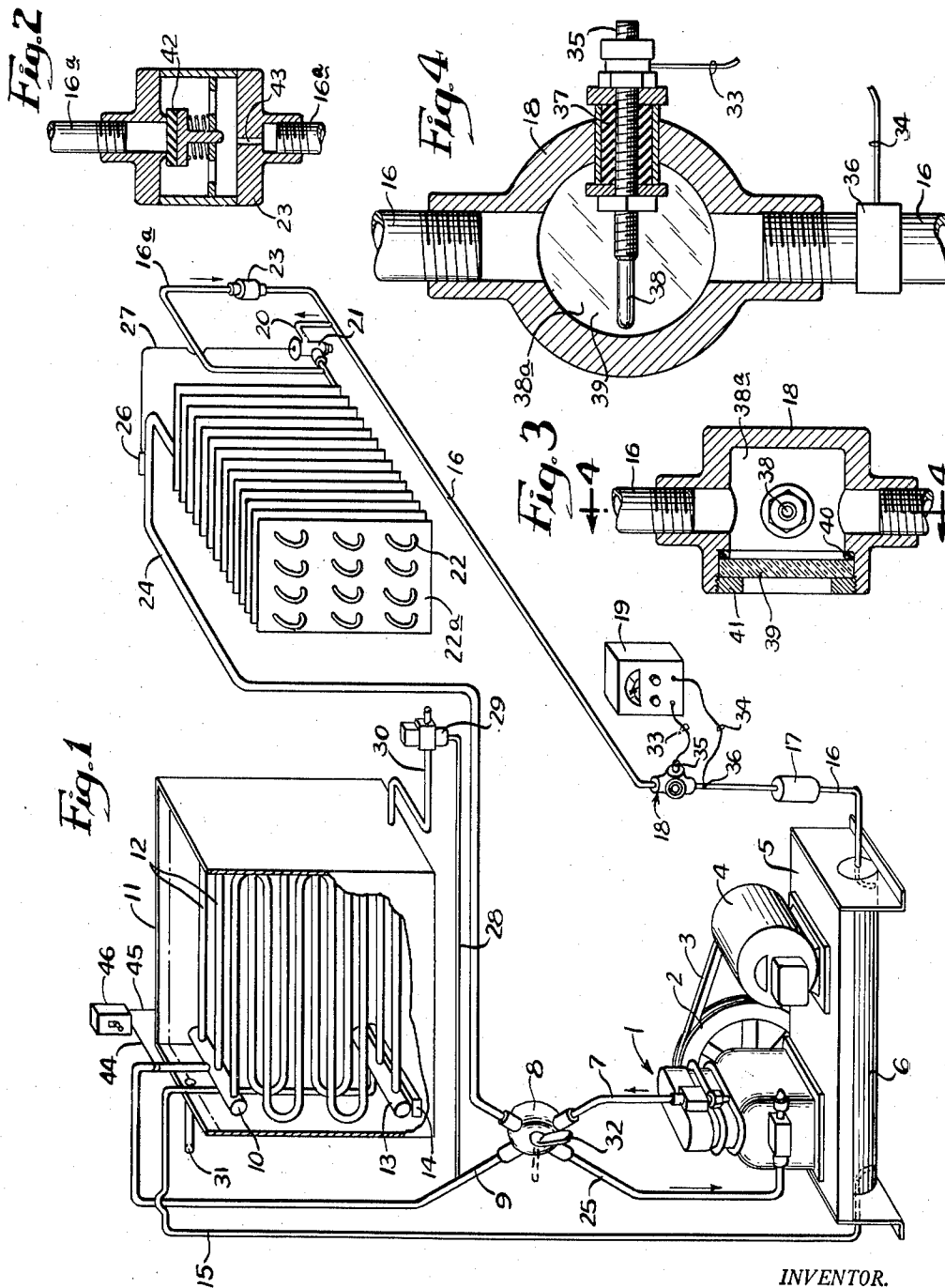
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2,863,299

Filed April 28, 1955

2 Sheets-Sheet 1



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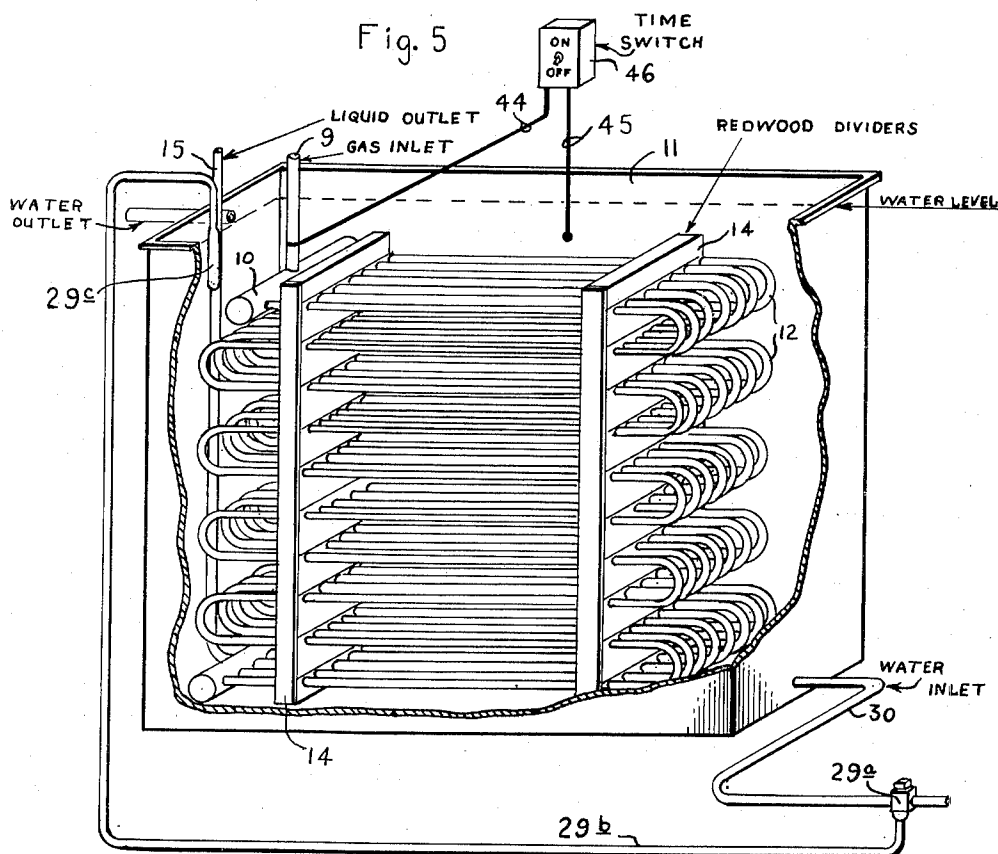
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REFRIGERATION SYSTEMS

Joseph L. Ammons, Amarillo, Tex.

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5 Claims. (Cl. 62—157)

This invention relates to improvements in refrigeration systems, and more particularly to a refrigeration system which uses a water-cooled condenser with a scale eliminator, and also to a system which utilizes hot gases in defrosting the condenser coils without the danger of freezing these coils, with the incident hazard of bursting same. The refrigeration system also has an ohm meter therein, which is of high sensitivity, to make possible the determining of the moisture content of the refrigerant.

Various refrigerant systems have been proposed heretofore, but these, for the most part, use a relatively large volume of water, either by recirculation or wasting, to cool the hot refrigerant gases within the condenser coils, however, in the present system the condenser is so constructed as to give a maximum area of heat radiation surface of the condenser coils, to enable a minimum amount of water to be used in the cooling of the condenser coils.

An object of this invention is to provide a refrigeration system with a cooling tank surrounding the condenser coils, which will provide the fullest use of the water, thereby using less water than is the general practice in other systems.

Another object of this invention is to provide a refrigeration system which will prevent the collection of lime or other insoluble scale on the coils of the condenser.

Still another object of this invention is to provide a refrigeration system in which the refrigerant gas is reversibly deployed so as to use the hot compressed gas to defrost the refrigeration coils, as desired.

A further object of this invention is to provide for the utilization of a water cooled condenser with a reversible cycle for the refrigerant gas, so that the water cooled condenser will be free of the danger of bursting during the defrosting cycle, and enabling the latent heat to be stored in the form of ice or chilled water, for future use for condensation, when the refrigeration system is moved back to the normal cycle of operation.

A still further object of this invention is to provide an arrangement whereby the refrigerant gas can be reversed, which will utilize a relatively large body of water as a source of latent heat to enable the defrosting of the system, despite adverse conditions, such as low ambient temperatures and the like.

Yet another object of the invention is to provide a refrigeration system which provides an accurate and visible means for determining the moisture and acid content of the refrigerant.

With these objects in mind, and others which will manifest themselves as the description proceeds, reference is to be had to the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

Fig. 1 is a diagrammatic, perspective view of the refrigeration system, with parts broken away and shown in section to illustrate the details of construction;

Fig. 2 is an enlarged vertical, sectional view through a check valve within the system;

Fig. 3 is a vertical sectional view through a sight glass

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and moisture indicator device, and showing an electrode therein;

Fig. 4 is an enlarged sectional view taken at right angles thereto, on the line 4—4 of Fig. 3, looking in the direction indicated by the arrows;

Fig. 5 is an enlarged, detailed, perspective view of the condenser coils, with a portion of the condenser coil tank broken away and shown in section, and showing scale eliminator electrodes attached thereto;

With more detailed reference to the drawing, the numeral 1 designates generally a refrigerant compressor having a drive pulley 2, which is of the character to utilize V-belts 3 for driving the compressor 1 by a motor 4. The compressor 1 and motor 4 are mounted on a base 5, in which base a refrigerant receiver tank 6 is preferably housed. A refrigerant gas discharge line 7 leads from the compressor 1 to a four-way valve 8. The four-way valve 8 has a line 9 leading therefrom which, under normal operation, is the refrigerant gas discharge line. The line 9 leads to a header 10 within a condenser tank 11. The header 10, as shown diagrammatically in Fig. 1, has three coils of condenser pipe 12 leading therefrom in a return bend fashion, with the longitudinal reaches of the pipe being on a slight "down grade," so as to convey the condensed refrigerant gas into a lower header 13. The condenser coils 12 and the headers 10 and 13 are supported on non-metallic insulating supports 14, as will best be seen in Fig. 5, so as to support the condenser coils and headers in spaced relation with respect to tank 11, as will be more fully explained hereinafter.

A condensed liquid return line 15 leads from header 13 and discharges into receiver tank 6. The condensed refrigerant liquid flows from receiver tank 6 through pipe 16, which leads through a dryer unit 17, thence through a sight glass and electrode unit 18, to which electrode and to which pipe is attached an ohm meter 19. The refrigerant continues to flow through pipe 16 to a branch pipe 20, in which a thermo-actuated expansion valve 21 is positioned. The branch conduit leads into evaporator coil unit 22. The line 16a has a check valve 23 therein within the by-pass between the evaporator coil 22 and the normal suction side of expansion valve 21. The normal suction line 24 returns to one side of the four-way valve 8, and with the valve 8 positioned, as shown in full lines in Fig. 1, the line 24 is in communication with a line 25 leading to the suction side of compressor 1.

A thermo element 26 is in heat transfer relation to pipe 24 and is connected thereto by the usual capillary tubing 27 which leads to expansion valve 21, so as to actuate the expansion valve 21, in accordance with the temperature requirements. A pipe 28 is connected to the normal refrigerant discharge line 9 at one end, and to a water control valve at its opposite end, which water control valve is within a water supply line 30 which leads to the bottom of the condenser coil tank 11 at one end thereof. A water outlet pipe 31 is fitted within condenser tank 11 near the top in the opposite end thereof, so as to define a water level above the condenser coils 12 and headers 10 and 13.

The valve 8 is normally of the four-way manually actuated type, and which valve has a lever 32 thereon, which may be moved from the position as indicated in full outline in Fig. 1, to the dotted outline position in the same figure. However, it is to be understood that this valve may be time-clock controlled to move from one position to another for a predetermined length of time, and then move back to the original position.

The ohm meter 19 has wires 33 and 34 leading therefrom which wires connect respectively to electrode 35 and clamp 36, the clamp 36 being secured about the pipe 16, through which pipe 16 the refrigerant flows. The electrode 35 is insulated from the body of the electrode unit 18 by insulation 37, so that the probe 38, of

the electrode, will be immersed within the refrigerant gas liquor, which liquors are usually of the trichloromonofluoromethane, dichloromonofluoromethane group or other refrigerants of the general character of these materials. The probe 38 is screw threaded and upon tightening of the nuts, the insulation 37, which is of rubber-like material, is expanded so as to form a fluid tight seal with the body of the electrode unit 18. The probe 38 may be adjustably positioned within the chamber 38a so as to enable the correct reading to be obtained from ohm meter 10.

One side of the body 18 is open for the insertion of a sight glass 39. A sealing gasket 40 is positioned intermediate the glass 39 and the body 18, and a screw threaded ring 41 threadably engages the body of the electrode unit 18, so as to cause the sight glass 39 to bindingly engage gasket 40 to form a seal therebetween. While any ohm meter of high sensitivity may be used, it has been found that a vacuum type ohm meter gives excellent results in determining the difference in resistance between a refrigerant liquid containing water, acids, or the like, and a refrigerant liquid without adulterants therein.

The line 16 has a check valve 23 therein, which is in by-pass relation to thermo actuated expansion valve 21 and is so arranged as to prevent flow of refrigerant liquid from storage tank 6 through the check valve 23 into the evaporator coils 22, but will permit the flow of hot refrigerant gas from the evaporator coils 22 through spring pressed valve member 42 and through a restricted orifice 43 into line 16, when the handle 32 of the valve 8 is moved into the position indicated in dashed outline, which will direct the gas outward from pipe 7 through four-way valve 8 into pipe 24.

The tank 11 surrounds coils 12, which coils and the pipe connected thereto are spaced from the sides, ends and bottom of the tank by means of insulating members, such as wooden support members 14, so that no part of the pipe or the metal portion of the headers or coils is in contact relation with the tank. The tank is then filled with water, which water usually contains impurities which will normally form scale on and cause corrosion of the condenser coils. Such water will attack the metal and cause deterioration thereof, unless steps are taken to prevent such occurrence.

The coils 12 and headers 10 and 13 are preferably made of an electrolytic metal, such as copper, and the tank 11 is usually made of a negative metal, such as galvanized iron, or the like. Electric connector wire 44 connects to the pipe 9, which pipe leads to the coils 12, the connector wire 45 connects to the tank 11. The opposite ends of the wires 44 and 45 preferably connect with a time switch 46. The time switch 46 may be of a character which will close a circuit through these wires periodically, or which may be manually controlled, if desired.

The circulation of chemically pure water, for cooling the condenser coils and pipes, would be expensive, and furthermore is usually not so satisfactory, as water containing some mineral solids is inclined to inhibit corrosion, but which impurities in the water forms a scale on the condenser pipes which insulates same and retards the cooling action of the water on the condenser coils. Therefore, it is desirable to remove the mineral solid deposit which collects on the condenser coils therefrom by electrolytic action. The lime and mineral deposits that accumulate on the condenser coils are transferred, by electrolytic action, to the walls of the tank 11, where the lime deposit may be readily removed at periodic intervals, thus maintaining the coils at peak efficiency at all times.

However, if a continuous electric current, generated by electrolytic action of the dissimilar metals of the tank and coils, is allowed, metal will be removed from the coils and be deposited on the wall of the tank, until the

copper would be disintegrated. Therefore, the time switch 46 is set to open the circuit between wires 44 and 45 at periodic intervals, for the correct amount of time to remove the solids from the coils and to close the circuit at the proper time to prevent injury to the condenser coils, by by-passing the electrolytic current generated in the tank directly from the coils to the tank.

As shown in Fig. 5, a thermo-actuated valve 29a, having capillary tubing 29b leading into a thermo-bulb, is placed in contact relation with refrigerant line 9 at a point near the condenser coils 12, or within the water within the condenser coil tank 11, so as to be responsive to the temperature of the fluid within the condenser system, that is, either the fluid within the refrigerant line 9, or the cooling fluid within the condenser coil tank 11.

In this manner, the valve 29a will be actuated to let water into condenser coil tank 11 through water inlet pipe 30, when the water or refrigerant gas rises above a predetermined setting of temperature during the refrigeration cycle of the system, however, upon reversal of the flow of refrigerant through the condenser, the chilling of the water will result in the closing of the valve 29a, which valve will remain closed until the normal refrigerant cycle is restored and the temperature of the water or of the refrigerant gas reaches a predetermined temperature, usually about 125 degrees to 135 degrees.

By having a refrigerant system wherein a relatively large body of water is used for supplying sensible and latent heat, the use of this heat is made possible both during the refrigerant cycle and the defrosting cycle to an advantage in each case, that is, the normal inlet water temperature will usually be about 60 degrees, so in raising the temperature from 60 degrees to the operating temperature of about 125 degrees, sixty five degrees of sensible heat is given up from the water in cooling the hot refrigerant gas, and since, the gas enters at substantially 125 degrees, this enables the maintaining of a lower and constant head pressure, and since the temperature surrounding the refrigerant coil tank, is lower than that of the incoming refrigerant, and the outgoing cooling water, considerable heat is picked up from the surrounding atmosphere, both by radiation and evaporation.

However, on the defrosting cycle, the chilling of the water in the condenser coil tank and the frosting up and freezing of the water within the tank to a certain extent, enables the transfer of heat from the evaporator coil to the water within the condenser coil tank, whereby, upon initiation of the refrigerant cycle, the head pressure is lowered and since the changing of one pound of water at 32 degrees temperature to one pound of ice at thirty-two degrees temperature requires 144 B. t. u., the latent heat of fusion stored within the ice, together with the sensible heat, enables the system to start refrigeration quickly without loss of efficiency, after defrosting.

Operation

Normal refrigeration cycle.—The compressor, which is driven by motor 2, compresses the refrigerant gas which flows into line 7 through valve 8 into line 9, thence into header 10 and through condenser coils 12, with the refrigerant gas condensing into a refrigerant liquor by the cooling action afforded by the water passing inward through pipe 30, pressure control valve 29 and into the bottom of tank 11. The cool water passing into the bottom of the tank, passes first in heat exchange relation with the lower ends of the coils 12, and as the water is forced into the tank by pressure, it rises by both pressure and thermo action, and the outgoing hot water is in heat exchange relation with the incoming hot gas from header 10. When the water has performed its most efficient cooling action, it passes outward through pipe 31, to be wasted, as the cooling of the water to a low temperature for reuse would generally be more expensive than the wasting of the heated water. As the hot gas is condensed into liquor, by heat exchange relation with the cold wa-

ter, the liquor accumulates in header 13 and is carried through line 15 into receiver tank 6.

The refrigerant liquor flows through line 16, dryer 17, electrode unit 18 to and through thermo actuated expansion valve 21, and with suction being exerted on evaporator coil 22, by the suction line 24, connected through four-way valve 8 to suction line 25 which connects with the suction side of compressor 1, the liquid is vaporized and expands in the evaporator 22, whereupon it picks up heat and changes into a gas. This refrigerant gas is drawn through normal suction line 24, valve 28, through suction line 25 into compressor 1, whereupon, the gas is again compressed and is directed out through discharge pipe 7 to complete the cycle of operation.

As the cycle of circulation of the refrigerant medium within the system continues, the heat given up by the chilling of the evaporator coils is dissipated by the condenser coils into the water within the tank 11. As the pressure in line 9 rises to a predetermined pressure, it will cause the pressure actuated water control valve 29 to open, due to the connection of a pipe 28 between the pressure valve 29 and the line 9. The valve 29 is preferably of the graduated flow type, so that, as the pressure increases, the valve will open to such degree as to allow more water to pass through conduit 30, through tank 11, and out through over-flow pipe 31 so as to maintain the coils 12 at a given temperature. As the water cools the coils 12, the pressure therein is reduced and the valve will close proportionately, until the water may be maintained in the tank at a temperature at which the system is set to operate. The valve 29 will remain closed until such time as the water warms to a temperature which will necessitate the introduction of additional cool water. By the introduction of cool water at the bottom of the tank at one end thereof, and withdrawing it from the top at the opposite end of the tank, a natural flow, by both thermo-circulation and by pressure, will move the heated water out at the point where the incoming hot gases enter the coils. Therefore, greater efficiency of cooling is had, with the minimum of heat loss in the heat exchange.

The method just described requires less water than is used by other systems, as the present system allows no water to overflow until it has reached the required temperature.

In actual practice, it is not necessary to use a cooling tower or other recirculation method, since this system uses less water in the cooling of the condenser coils than is lost through evaporation and bleeding off of warm water in a cooling tower. This not only cuts down the original cost of the equipment, it reduces operational costs, and also conserves water, which is particularly desirable in areas where water is not plentiful.

As a comparison of refrigeration capacity of the present device, a condenser tank of a three ton capacity refrigerating unit, the tank of which is preferably ten inches wide, thirty inches long and 24 inches high and has a capacity of 20 to 25 gallons of water, after the coil is in place, which condenser coil 12 is approximately 150' of $\frac{3}{8}$ inch tubing. It is preferable to have multiple tubes 12 lead from a header, as indicated at 10 and shown in Fig. 5, and shows seven coils leading therefrom to a header 13 so as to minimize back pressure. Due to the length of travel of the refrigerant gas within the coils, and counter to the flow of the water, the refrigerant passing into the header 13 is substantially the same temperature as the cooling water being admitted into tank 11 through pipe 31. In condensing the refrigerant, the head pressure is determined by the lowest temperature to which the refrigerant drops before it leaves the condenser. In the present instance the head pressure will correspond substantially to the temperature of the entering water, because sufficient condensing surface and enough water are provided to absorb all the heat from the refrigerant before it reaches the header 13. A further advantage of the use of a large volume of water, as used in the present device, is the fact that considerable cooling is had by radiation

from the tank and evaporation of the water into the surrounding air.

Conventional systems of three ton capacity usually utilize about 50' of $\frac{3}{8}$ " tubing, holding in most instances, not more than one-half gallon of water. The water consumption of a commercial refrigeration system, is theoretically based on one gallon of water per ton of refrigeration per minute. In actual practice, the consumption more nearly approximates one and one-half gallons per ton per minute, with the temperature of the water rising to a maximum of 95 degrees, whereas, in the present instance, the water is permitted to attain a temperature of 125° to 135° F., the water overflows through pipe 31, which overflow is controlled by the incoming water control valve 29. The evaporation from the surface of the water and the overflow usually does not exceed one pint per ton per minute. By being able to carry the heat so much higher, a much greater loss of heat through evaporation is possible, as 1 pound of water will absorb 750 B. t. u. in changing into steam. This condition is accelerated by the fact that the water is much warmer than the surrounding atmosphere.

Refrigerant systems are usually designed for intermittent operation and the present system takes advantage of this fact by using hold over heat from the off cycle, that is, while the unit is off, the water cools to normal temperature and considerable heat is absorbed in bringing the temperature of the water back to 125° to 135° F., the normal operating temperature.

Collection of lime and scale deposit.—When using cooling water, within the system, which has impurities therein, such as lime and various salts, the heat within the condenser coils 12 will normally cause incrustation of the pipes with a scale, which is the deposit of the impurities within the water. This scale, as the coating thereof on the condenser pipes becomes thicker, increases the insulation effect between the cooling water within the condenser tank 11 and the condenser coils 12, which results in loss of efficiency within the system, and at the same time, the chemical reaction of the lime, salts, or other inorganic matter, which forms the scale, will attack the surface of the metal and cause deterioration thereof, and eventually failure.

With the condenser coil pipes 12 spaced from the walls and bottom of the tank 11 by insulating spacer members 14, the heat differential between the top and the bottom of the water within the tank 11, will set up a thermocouple, when a wire 44 is connected to the coils and a wire 45 is connected to the tank, which wires are disconnected from the switch 46, which will result in a small but measurable amount of current flowing from the top of the coils to the tank and from the base of the tank back to the coils 12. The coils thus become an anode and the tank a cathode, which receives the electrolytic ions carrying the impurities and depositing them on the walls and bottom of the tank, whereupon, at periodic intervals, a time or manually actuated switch 46 is closed, which short circuits the current and consequently the flow of electrolytic ions from the anode to the cathode, which prevents the removal of metal from the anode by the electrolytic action, but the switch may be allowed to remain closed a sufficient length of time to permit a slight accumulation of scale of the coils 12, whereupon the process is repeated.

After a long interval of time, the water may be removed from the tank, and the accumulation of scale and electrolytic deposits, which form on the walls of the tank as a fine powder, may be removed by mechanical means, such as a wire brush, or the like. The removal of the scale deposit from the coils, not only prolongs the life of the condenser coils 12 almost indefinitely, but it keeps them free of such encrustation which acts as insulation and impedes the efficiency of the system.

Defrosting by means of hot gas.—When it is desired to defrost the refrigeration unit, the valve lever 32 is turned

from the position shown in full outline in Fig. 1 to that indicated in dotted outline, to reverse the flow of refrigerant gas, that is, the hot refrigerant gas is discharged into line 7, through valve 8 into line 24, whereupon this gas flows through evaporator coil 22 where it is condensed, thereby liberating heat which melts the frost or ice which has formed on coils 22 and on radiation fins 22a. The condensed liquid refrigerant will then flow through bypass loop 16a, through check valve 23, and orifice 43, thereby by-passing the expansion valve 21; thence the liquified refrigerant is expanded by passing through orifice 43, thence the refrigerant gas flows through line 16 into receiver tank 6, and the liquid refrigerant is drawn through line 15, by the suction on coils 12. Whereupon, the liquid refrigerant enters header 13 and as it passes upward through coils 12, heat is picked up from the water within the tank 11 vaporizing the refrigerant into gas, which gas passes out through pipe 9, through valve 8, into pipe 25 to the suction side of the compressor 1. In so doing the heat generated by the hot gas defrosts evaporator coils 22.

The water in tank 11 is chilled by the expansion of refrigerant into a gas during the reversing of the cycle of defrosting, thereby actually causing a heat transfer, which, upon reversal of the cycle, that is, the switching of valve handle 32 from the dotted line position to that shown in full lines in Fig. 1, the normal refrigeration cycle will be restored, so as to direct refrigeration gas outward from compressor 1 through valve 8, through pipe 9 into header 10 and condenser coils 12 in the manner set out above, and the normal refrigeration cycle is repeated.

For the reasons as explained above, no additional water is fed into tank 11 until the ice is melted from the coils and the temperature of the water has been raised until normal condensing temperature is reached or exceeded. Furthermore, this arrangement of the reverse defrosting cycle, enables sensible heat to be drawn from the water and used to heat the coils to be defrosted. As the temperature of the water is lowered below freezing, a tremendous amount of latent heat of fusion is liberated from the water, and since the volume of water in the tank is large, as compared to the area of the coils, a large amount of heat may be used in defrosting without materially icing up the water within the condenser tank 11.

Moisture indicator.—One of the most difficult problems connected with refrigeration, is the presence of moisture within the refrigerant. Moisture within the refrigerant system combines with the refrigerant gases and oil to form corrosive substances and/or acids which attack the internal parts of the refrigeration system, thereby materially shortening the life of the materials used, and the efficient operation of the system.

Should the moisture contained within the refrigerant be of sufficient volume, it will freeze out of the refrigerant into the expansion valve 21, thereby plugging this valve, and thus causing the cessation of the refrigeration.

Heretofore, no means has been provided for determining the amount of moisture in the refrigerant during the normal operation of the system. However, the moisture content of the refrigerant frequently becomes excessive, and freezes in the valve, before precautionary measures can be taken. The presence of excessive moisture in the refrigerant also causes corrosion of the internal parts of the system and may cause serious damage thereto.

In the present refrigeration system, an ultra-sensitive ohm meter 19, which is preferably of the vacuum tube type, is provided, which makes it possible to measure the resistance of the refrigerant by the passage of an electrical current from an electrode, through the refrigerant, to the wall of the pipe, which pipe wall acts as a second electrode. Thus by measuring the resistance of unadulterated refrigerant, and by measuring the resistance of moisture contaminated refrigerant, an indicia on the scale of the ohm meter 19, can be provided, which, by showing the amount of resistance, will indicate the

amount of moisture present. The indicia on the ohm meter scale may have the extremes indicated by red and green, so that the pointer of the ohm meter will immediately indicate whether or not dangerous proportions of moisture contaminate the refrigerant fluid within the system. If a dangerous amount of moisture is found to be present, proper steps can be taken, such as replacing the dryer 17, or such other measures as are found to be desirable to correct the condition. The vital point here is to be able to determine that the condition exists.

As the moisture content of the refrigerant increases, the electrical resistance becomes less, the higher the ratio of water, the less the resistance of refrigerant, in direct proportion. With this knowledge, the proportion of water within the refrigerant can be determined, and a dryer of the correct size, to remedy the situation, may be installed, so as to eliminate the harmful effects of too much moisture within the refrigerant. Instead of the indicia of the ohm meter being calibrated in ohms of resistance, the indicia may be prepared to indicate wet, damp, dry or the like, for the information of the non-technical operator, in addition to having the red and green indicia on the dial.

While a preferred embodiment of the invention, including the accessory elements, have been shown and described herein, it is to be understood that changes may be made in the minor details of construction, without departing from the spirit of the invention, or the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. In a condenser unit for a refrigeration system having a compressor therein, a condenser coil tank, a condenser coil in said tank, said condenser coil being connected to said compressor in fluid communication to admit refrigerant gas from said compressor into said condenser coil in said tank near the top and at a side thereof, said condenser coil having a downwardly meandering path to a point near the bottom of said tank, a refrigerant outlet pipe connected to said condenser coil near the discharge end thereof, a receiver tank, said refrigerant pipe interconnecting said condenser coil with said receiver tank of said refrigeration system, a water outlet pipe connected in fluid communication to said condenser tank near the top thereof adjacent said inlet pipe for said refrigerant gas, a water inlet pipe connected in fluid communication with said condenser coil tank on the side thereof opposite said water outlet and near the bottom of said tank, a valve within said water inlet pipe, a pipe connected with the pipe leading from said compressor to said condenser coil and to a pressure responsive element of said water inlet valve so as to admit water into said tank in direct proportion to the pressure within said pipe leading from said compressor to said condenser coil, said condenser coil being in spaced relation from and out of electrical metallic contact with said condenser coil tank, and electrical conductor means connected to said coil and to said tank, and switch means within said electrical conductor for selectively interrupting the passage of electrical current through said electrical conductor.

2. The device as set forth in claim 1, wherein; electrical insulating elements are positioned intermediate said tank and said condenser coil so as to insulate against direct electrical contact between said coil and said tank.

3. In a refrigeration system having a compressor, a condenser, an evaporator, a refrigerant receiving tank, and an expansion valve, conduits leading from said compressor and connected to a four-way valve, conduits leading from said four-way valve and connected with the upper side of said condenser, and with one side of said evaporator, a conduit connected with the lower side of the coil of said condenser and said receiving tank, a conduit connected with said receiving tank, and with the other side of said evaporator unit, an expansion valve within said conduit intermediate said receiving tank and said

evaporator unit, control means on said four-way valve for directing compressed gas from said compressor unit to said condenser unit and for directing a suction on one side of said evaporator unit, or directing discharged gas outward from said compressor to said evaporator unit and drawing a suction on the upper side of said condenser coil, and a by-pass conduit abridging said expansion valve, a check valve within said by-pass conduit to permit the flow of refrigerant through said evaporator counter to the normal flow therethrough during the refrigeration cycle, said check valve being positively closeable in a direction counter to the flow of the refrigerant fluid through said expansion valve, which check valve body has a constricted orifice therein so as to form an expansion valve for said refrigerant in the direction opposite said first mentioned expansion valve.

4. The device as set forth in claim 1, wherein; said switch means is a time switch means.

5. In a refrigeration system having a compressor unit, a condenser tank, a condenser unit within said condenser tank, an evaporator unit, an expansion valve, and a refrigerant receiving tank, a conduit connecting said compressor unit and a header, which header is positioned at the upper side of said condenser tank, a plurality of conduits within said condenser tank and passing downwardly therein, said conduits being connected to a second header positioned at the lower side of said tank, an outlet pipe, one end of which is connected to said second header and the other end of which outlet pipe is connected in fluid communication to said receiver tank, a conduit leading from said receiver tank to said evaporator unit, said expansion valve being positioned within

said last mentioned conduit intermediate said receiver tank and said evaporator unit, which expansion valve permits the passage of a refrigerant from said receiver tank to said evaporator unit, a conduit leading from said evaporator unit to the suction side of said compressor unit, a by-pass conduit leading from said evaporator unit to said receiver tank in abridging relation with respect to said expansion valve, a positive closing check valve positioned within said by-pass conduit, which check valve positively closes on flow of said refrigerant in one direction but permits restricted reverse flow of said refrigerant with respect to the normal flow thereof through said conduit leading from said receiver tank to said evaporator unit, said by-pass conduit having an orifice formed therein intermediate said check valve and said receiving tank, which orifice is of reduced cross-sectional area with respect to the cross-sectional area of said by-pass conduit, and valve means within said conduits leading from said compressor to said condenser and to said evaporator for reversing the normal flow of refrigerant through said condenser and said evaporator.

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