

May 11, 1937.

H. C. HAYES

2,080,387

REFRIGERATING COIL FOR REFRIGERATING MACHINES

Filed Feb. 9, 1931

3 Sheets-Sheet 1

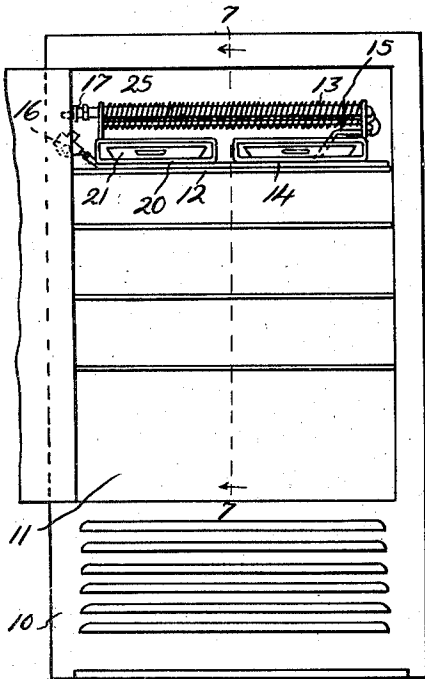


Fig. 1.

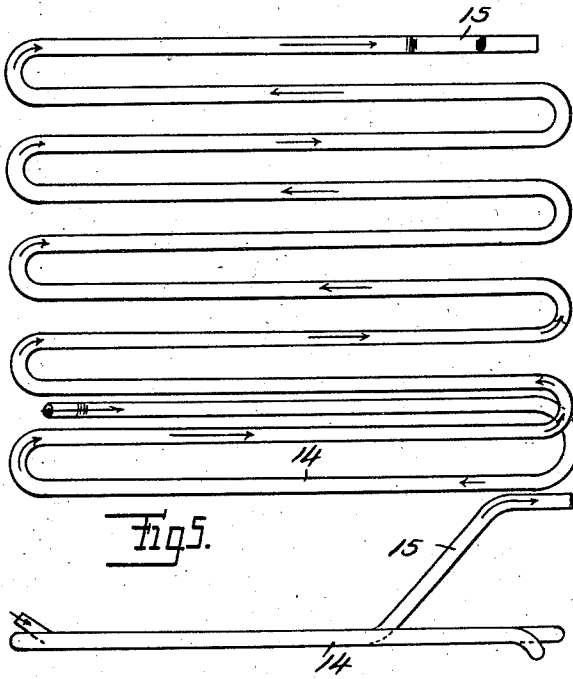


Fig. 5.

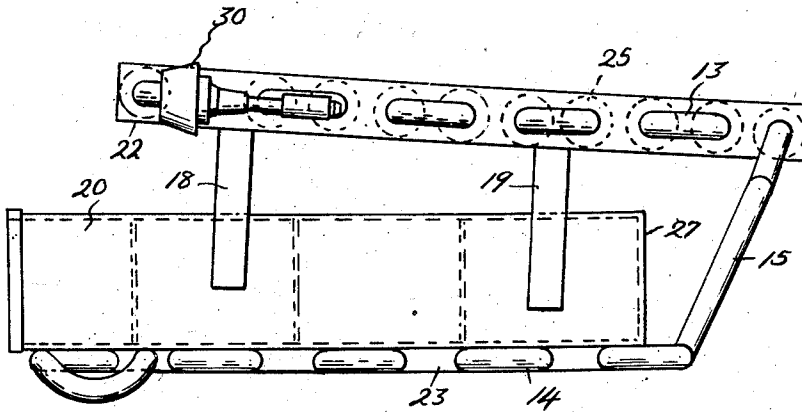


Fig. 6.

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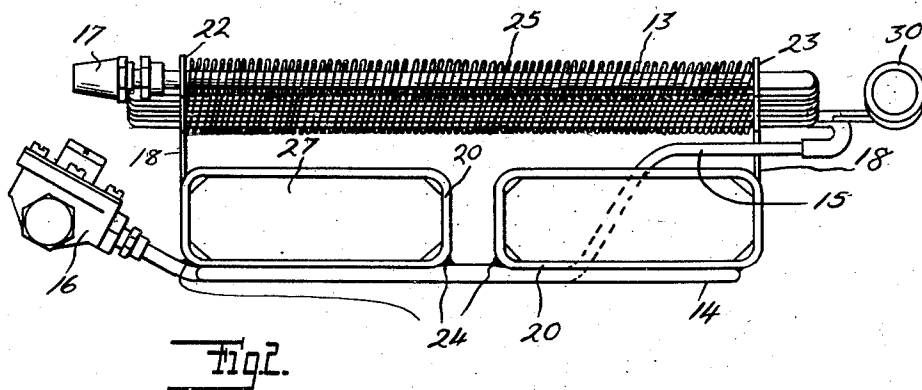
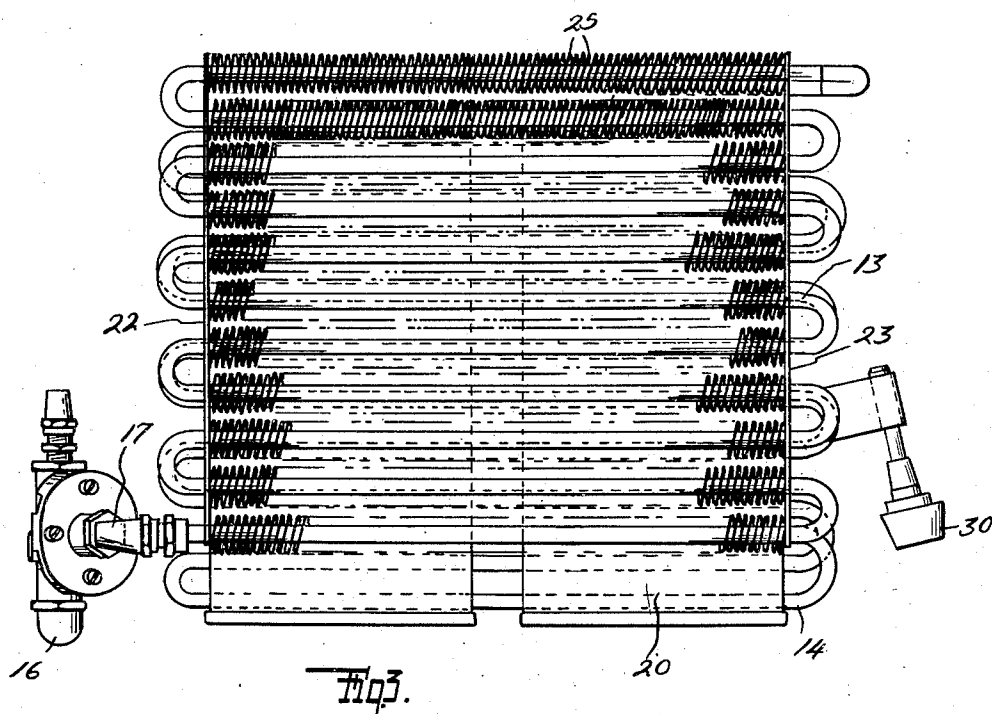
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

Fig. 8.

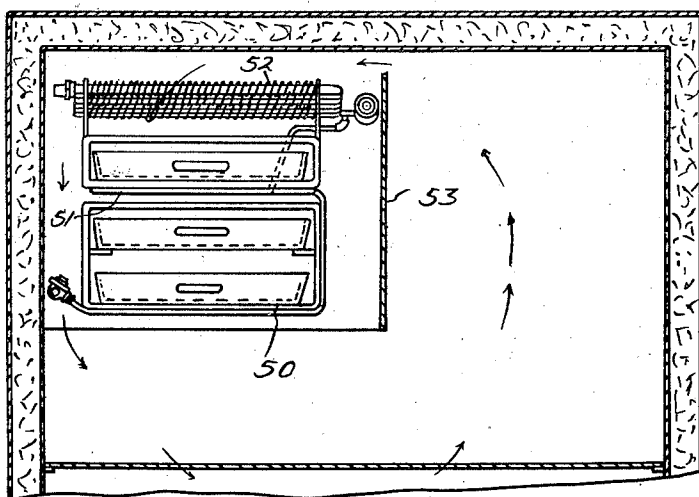


Fig. 7.

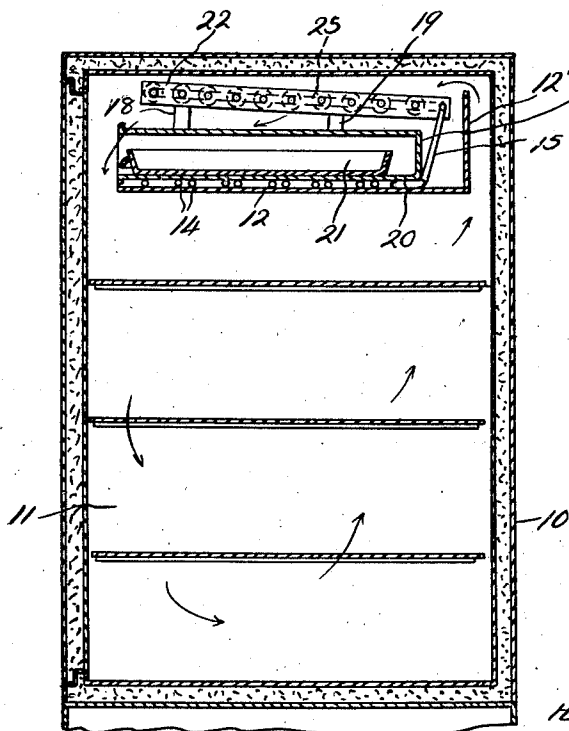
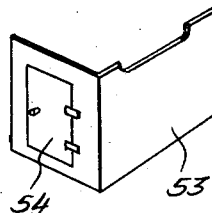


Fig. 9.



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REFRIGERATING COIL FOR REFRIGERATING MACHINES

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Application February 9, 1931, Serial No. 514,421

22 Claims. (Cl. 62-8)

This invention relates to mechanical refrigeration machines, and is more particularly directed to an improvement in the refrigerating or expansion coils thereof.

One of the disadvantageous or undesirable features common to all mechanical refrigeration machines as at present constructed is the necessity of periodically, and quite frequently, defrosting the expansion coils to remove the unwanted layer of frost which accumulates upon them. An important object of my invention is the provision of an expansion coil which will be self-defrosting to so high a degree as to eliminate, or render very infrequent, the necessity of defrosting the expansion coils by shutting off the compressor. The common necessity for frequent defrosting presents a number of other undesirable aspects which my invention completely removes, such as the gradual diminution of efficiency of the evaporator due to the insulating characteristics of the accumulating frost, and the enforced idleness of the refrigerator during defrosting.

In mechanical refrigerators as now commonly constructed, the continuous formation and gathering of frozen moisture upon the expansion coils (which necessitates the above-mentioned frequent defrosting) not only periodically reduces the effectiveness of the evaporator and so of the refrigerator toward zero, but continuously reduces the humidity of the air within the refrigerator, toward the point where it does not contain sufficient moisture to insure the most efficient and healthful preservation of foods, by accumulating upon the evaporator, in the form of frost, the moisture theretofore carried by the air in the box. For this reason, in some refrigerators, closed moisture-containing compartments are provided, from which the circulating air within the refrigerator cannot remove the moisture, such compartments being designed for the preservation of foods from which the removal of moisture is especially undesirable. Such compartments, however, must of necessity be limited in size, and cannot prevent the continuation of the undesirable drying-out process which goes on within the remainder of the box. It is an important advantage of my improved expansion coil that it maintains a sufficient moisture-content in the air throughout the entire interior of the refrigerator.

Another object of my invention is the production of an expansion coil or evaporator system having a distinct refrigerating zone of maximum coldness, which is in direct and very efficient engagement with the water trays, thereby resulting

in quick freezing of ice. I further provide controlling means for the compressor (which causes circulation of the refrigerant), which controlling means is so positioned relatively to the expansion coil as to be of unprecedented sensitivity and accuracy of response to variances of temperature, thereby enabling freezing of water within the ice trays within a known, fixed and predetermined time. In my improved system also the controlling device keeps the compressor running until the ice is frozen, which occurs in less time than is ordinarily possible, because the coldest parts of the evaporator system cannot do much of the work of absorbing heat from the air in the box until the heat contained in the trays and water has been absorbed. Automatic cold control is thus achieved by my invention without the disadvantage of overdehydration of the refrigerated area, which is a common fault of refrigerators provided with manually operable cold controls and conventional evaporator systems.

A further important object of this invention is to provide an expansion coil which effectively prevents passage of refrigerant in a liquid state completely through the coil and to the compressor. Since refrigerant reaching the compressor while still in a liquid state is one of the chief sources of noise and trouble with mechanical refrigeration machines of the smaller sizes as commonly constructed, the importance of the elimination of this difficulty will be appreciated.

Other objects and advantages will be apparent from the following description, wherein reference is made to the accompanying drawings illustrating a preferred embodiment of my invention and wherein similar reference numerals designate similar parts throughout the several views.

In the drawings:

Figure 1 is a front elevational simplified view of a mechanical refrigerator embodying my invention, the door being open and only fragmentarily shown.

Figure 2 is an enlarged detail front elevational view of my improved expansion coil, showing also the ice tray receptacles, thermostat, and expansion valve.

Figure 3 is a top plan view of the same.

Figure 4 is a side elevational view of the same, taken from the thermostat side.

Figure 5 is a plan view of the lower horizontal coil layer.

Figure 6 is a front elevational view thereof.

Figure 7 is a vertical cross-sectional view taken substantially on the line 7-7 of Figure 1, and looking in the direction of the arrows.

Figure 8 is a fragmentary front elevational view of a refrigerator and a somewhat modified form of my invention installed therein, and

Figure 9 is a detail perspective view of a baffle and enclosing partition member for the evaporator unit I employ with the modified form of my invention.

Referring now to the drawings:

Reference character 10, Figures 1 and 7, designates a refrigerator box, which may be of any type, or if desired my refrigerating coil may be used in a system for any other cooling purpose. The box is equipped with mechanical refrigerating mechanism, which, with the exception of the evaporating or expansion system, may be of any desired design and construction, this other mechanism not being shown, since it forms no part of my invention. In these views, 11 is the refrigerated area, or compartment within which food is commonly stored. The expansion coil, comprising the construction and parts now to be described, is secured within the compartment 11 in any suitable manner, although I preferably employ the combined supporting bracket and baffle 12. The support and baffle 12 may extend across the box and be secured at the sides, as shown in Figure 1, but stop short of both the front and back of the box to allow circulation of air generally as indicated by the arrows in Figure 7. A portion 12' of the baffle extends up behind the coils and spaced from the rear wall, to form an air duct, as shown in Figure 7, and this, in combination with the horizontal portion of the baffle which extends beneath the evaporator and associated parts, prevents localized air circulation.

The coils themselves I preferably form in a plurality of layers or sections, being shown in Figures 1 through 7 as comprising two, an upper and a lower layer. The lower layer, which is substantially horizontal, is designated 14. The upper layer, designated 13, which also occupies a substantially plane surface, preferably slopes somewhat toward the rear. The two may be connected at their rear extremities, as by the tube 15.

The refrigerant enters the lower coil through the expansion valve 16. This valve being of conventional and well known construction, its details are not shown. Upon emerging from the expansion valve, the liquid refrigerant boils, under normal operating conditions, by absorption of heat from the air and articles in the refrigerated area, until such area is sufficiently cooled. The path of the refrigerant through the lower horizontal coil is substantially sinuous, and is clearly indicated by the arrows in Figure 5. Having traversed the lower coil to the rear extremity, the refrigerant must rise through the connecting tube 15 to the upper coil, where it pursues a similar but reverse zig-zag course toward the outlet coupling 17, (Figure 2), whence, in the usual household refrigerator construction, it is conducted to the compressor (not shown). It will be seen that the lower layer or coil of tubing is plain, while the upper is equipped with fins (25) to increase its radiating and heat-absorbing surface, and that the upper coil is somewhat spaced from the lower, as by its supporting brackets 18-19, in a manner not providing for rapid heat conduction between the sections.

Suitably secured to and resting upon the lower layer or coil 14 are one or more sleeve-like receptacles 20, within which ice trays 21, (Figure 1) of the usual or any desired form, may be slid or placed in the conventional manner. The

sleeves are preferably formed with a back wall, as 27. I preferably increase the heat conduction between the sleeves 20 and the lower coil by sweat soldering the surfaces of the sleeves directly to the tubing of the coil throughout its entire length, and thus provide for as efficient heat conduction as possible between them. Most of the solder is necessarily invisible, but that which can be shown is designated 24. The supporting brackets 18-19 are secured to the sleeves 20, as by sweat soldering, their upper extremities being similarly secured to the supporting frame 22 for the upper coil of tubing. The supporting brackets which are preferably provided for both upper and lower coils may be of like construction. I find it convenient to use a flat metallic strip, suitably apertured, through which the tube may be passed at suitable points, for this purpose, in the manner shown at 22 and 23, Figures 3 and 4.

A temperature-responsive thermostat (30), to control the compressor through its driving motor, is preferably affixed to the upper coil substantially at the point shown, (Figures 2, 3, and 4) and is adapted to shut off the compressor when the temperature of that portion of the expansion coil to which it is attached reaches a predetermined minimum, and to turn it on when the temperature rises to another desired fixed point. The thermostat itself forms no part of this invention, and may be of any desired type, many forms being purchasable upon the open market. The details of its construction are accordingly not shown.

The structural arrangement shown results in the lower coil cooling more rapidly and to a lower temperature, when the refrigerating mechanism to which it is attached is in operation, than the upper coil. The upper coil, however, presents a much greater heat-absorbing area, by reason of its fins 25. Accordingly, any of the refrigerant which does not gasify upon emerging from the expansion valve, and which still remains liquid after traversing the entire length of the lower coil, if it succeeds in entering the upper coil, is in an area of such efficient heat absorption that its complete gasification is assured. The natural influence of gravity, moreover, tends to retain the liquid refrigerant in the lower section.

The efficient heat conductive connection between the sleeves 20 and the coldest tubes of the refrigerating coil, and their proximity, results in very rapid freezing of ice within the trays. The positioning of the thermostat to be responsive to the forward portion of the upper coil moreover, results in the thermostat not shutting off the compressor until the temperature of the (generally gaseous) refrigerant in that portion of the upper coil falls to the set minimum. This it cannot do while the water in the ice trays contains an appreciable quantity of heat, that is, so long as it remains unfrozen. The efficient absorption of heat units from the ice trays by the lower coil, which as remarked above is in very efficient heat-conductive relation with them, causes almost complete vaporization of the refrigerant while in the lower coil as long as it can absorb heat from the ice trays. Therefore the refrigerant reaching the upper coil at this time is principally gaseous, and its remaining heat absorbing capacity is there utilized in absorbing heat from the air circulating in the refrigerated area. It retains sufficient heat absorbing capacity when entering the upper coil (at the rear) to adequately refrigerate the air, aided by the fins, but it will be understood that the water in

the ice trays is therefore always frozen before the compressor is shut off, and in the least possible time.

When the water in the trays has been frozen by absorption of heat therefrom by the lower coil, the liquid refrigerant in that coil no longer has a source from which it can absorb sufficient heat to vaporize. It accordingly gradually fills up with liquid refrigerant, which rises to the upper coil, where it is immediately vaporized, as it is then in a relatively warmer area of tubing which is capable of rapidly absorbing heat from the air in the box through the fins. The vaporization in the upper coil which thus commences, rapidly lowers the temperature of the upper coil, and as soon as the point at which the thermostat is positioned reaches a sufficiently low temperature, it shuts off the compressor, and as the thermostat is spaced from the outlet of the upper coil, and because of the continuous evaporation which is taking place, the rise of the liquid refrigerant is stopped before it can approach the outlet, and before the entire upper coil is reduced in temperature to this lowered point.

It will be seen that the greater share of cooling of the air in the refrigerator is performed by the finned upper coil, since the air circulates freely over it, while the lower coil is protected. Since the finned coil accomplishes this cooling of the air at a minimum difference of temperature, moreover, (which is possible because of its great area) the accumulation of moisture upon the finned coils which takes place while the compressor is being operated, ceases almost at once when the compressor stops, and a reverse process begins, due to the rapid dissipation from the fins, and the moisture from the small amount of melting frost returns to the air in the refrigerated area by evaporation, which is greatly aided by the large surface presented by the fins, and by the quickness with which the temperature of the finned coil can rise to approach that of the air in the box by reason of its relative isolation from the lower section and ice trays, and because it contains principally gaseous refrigerant.

As explained above, when the compressor is shut off, and the temperature of the system is rising, principally gas being within the upper coil as a general rule, and since it is relatively separated from the lower coil, the temperature of the upper coil rapidly rises to approach that of the air within the box, and as soon as the temperature of the upper coil rises sufficiently, its greatly enlarged finned surface promotes rapid melting and evaporation of the condensate, which returns to the air within the refrigerator. The constantly increasing accumulation of frozen condensate upon the colder portions of the expansion system, which is generally regarded as unavoidable, is thus effectively prevented from taking place upon the upper or box-cooling coil. Accumulation of frost upon the lower coil and associated portions of the evaporator is not only unobjectionable, but is desirable rather than not, as since the lower coil is used only for cooling the ice trays, and its heat-conductive connection thereto is a positive metallic one, the insulating characteristics of the frost accretion increase rather than interfere with the heat absorption from the trays by the lower coil. Moreover once a sufficient quantity of frost has gathered upon the lower portions, no dehydration of the air in the box takes place, as the layer of frost upon the lower coil maintains itself in

equilibrium at the maximum thickness possible at the temperature, the layer can absorb no more moisture, and is moist at its surface as long as the air is above the freezing point, which it normally always is. It thus acts as a humidifier, rather than as a dehumidifier as do conventional evaporator constructions, as moisture absorption from the surface can take place whenever the air can accommodate the additional moisture.

A convenient method of applying the principles of my invention to trays positioned one above the other in a manner which is perhaps more conventional, is shown in Figure 8. For this purpose the expansion coil may be divided into three sections isolated from each other in a manner similar to that in which the two sections are separated in the embodiment previously described. The two lower sections may be positioned horizontally and efficiently connected by metallic connection of relatively great area to water trays, as in the previous embodiment. The lower-most section is designated 50, the middle section 51, and the uppermost, which alone is finned, 52. A baffle 53, together with the door 54 (Figure 9) closing the front, forces air convection around the evaporator to take place in the manner indicated by the arrows in Figure 8. The functioning of the unit is substantially the same as in the former embodiment, and need not be again described.

While it will be apparent that the illustrated embodiments of my invention herein disclosed are well calculated to adequately fulfill the objects and advantages primarily stated, it is to be understood that the invention is susceptible to variation, modification and change within the spirit and scope of the subjoined claims.

I claim:

1. In a mechanical refrigerating device, an expansion system including a pair of expansion chambers spaced from each other and so interconnected that fluid within the system must of necessity traverse one before reaching the second, said second chamber being spaced from the coldest portions of the expansion system and provided with a proportionately much more effective heat conducting surface area exposed to the air than the first chamber, said surface portion being in short and direct metallic heat-conductive connection with the interior of the chamber, being also positioned to be more readily engaged by the air to be refrigerated than the first chamber, and means for controlling the operation of the refrigerating device directly and entirely in response to temperature variations in the second chamber whereby moisture condensing upon the second chamber while the system is being maintained at a lowered temperature tends to rapidly evaporate therefrom when its temperature is allowed to rise.

2. In a refrigerant expansion system, a continuous elongated evaporator system incorporating an upper portion having a metallic wall provided with irregularities to increase its effective heat-conductive surface, and a lower portion without such provision, and means responsive to temperature changes of the upper section for starting and stopping refrigerant flow within the system.

3. In an expansion system for refrigerant, a continuous elongated channel within which vaporization may take place, and means for maintaining one portion thereof at a higher temperature than another in operation, comprising

a section relatively protected against direct conductive material heat interchange with the remainder of the system, finned to increase the relative heat conductive surface area thereof, and means responsive to the temperature of such section for controlling the refrigerant flow there-through.

4. In an expansion system for refrigerant, a continuous channel within which boiling of refrigerant may occur, and means for maintaining one portion thereof at a higher temperature than another in operation, comprising a section relatively restricted against material direct conductive heat interchange with the remainder of the system, said section having an air-exposed refrigerant-confining outer wall, means artificially increasing the effective heat-conductive surface area of said outer wall, and means responsive only to the temperature of such section for controlling the refrigerant flow through the entire system.

5. In a mechanical refrigerator, an expansion system comprising a continuous channel within which vaporization may take place, and means for maintaining one portion thereof at a higher temperature than another in operation, comprising a section relatively protected against material direct conductive heat interchange with the remainder of the system, said section having an air-exposed refrigerant-confining outer wall, means artificially enlarging the effective heat-conductive surface area of said outer wall, and means directly connected to and responsive to temperature variations of such section for controlling the flow of refrigerant through the entire system.

6. In a refrigerating system, an expansion system comprising a continuous channel within which vaporization may take place, and means for maintaining one portion thereof at a higher temperature than another in operation, comprising a section relatively protected against material direct conductive heat interchange with the remainder of the evaporating system, means for preventing liquid refrigerant from flowing thereinto under gravity, means for forcing gaseous refrigerant flowing into such section to travel an irregular path, thereby tending to remove therefrom liquid entrained therewith, and means carried by said section and responsive to the temperature of said section for controlling the flow of refrigerant through the entire expansion system.

7. In a mechanical refrigeration apparatus, an expansion valve, an expansion system comprising an elongated expansion chamber disposed substantially horizontally and connected at one end to the expansion valve, a second expansion chamber having a portion arranged higher than the first, and connected to the opposite end of the first chamber from that to which the expansion valve is connected, said second expansion chamber being provided with a surface portion arranged for more effective heat transference between contained refrigerant and the air than the first expansion chamber, and said second chamber also being removed from material heat conductive relation with the first, and thermostatic controlling means directly connected to and responsive to temperature changes of the second chamber but not of the first chamber.

8. In mechanical refrigeration apparatus, an expansion valve, an expansion system comprising an elongated expansion chamber disposed substantially horizontally and connected at one end

to the expansion valve, a second expansion chamber having a portion arranged higher than the first, and connected to the opposite end of the first chamber from that to which the expansion valve is connected, said second expansion chamber having a refrigerant-confining outer wall portion provided with a more effective heat-conducting surface than the first chamber, relatively isolated therefrom with respect to direct heat-conductive connection, and so disposed that the influence of gravity upon fluid contents of the system tends to maintain the fluid in the first chamber, and thermostatic controlling means directly connected to the second chamber and responsive to variances of temperature thereof.

9. In a mechanical refrigerating machine, an expansion system comprising an inlet for refrigerant, an expansion chamber appurtenant said inlet, a second expansion chamber spaced from the first and so connected thereto that fluid within the system must of necessity traverse the first chamber before reaching the second, the surface of said first chamber being shielded against the direct engagement therewith of circulating air, while said second chamber is provided with an outer refrigerant-confining wall having a more effective heat-conducting surface area than the first and disposed in the path of the circulating air, whereby moisture condensing upon the second is disposed over a relatively large area provided by a receptacle normally containing only gaseous refrigerant, thereby tending to encourage rapid evaporation of the condensate from its surface when its temperature is permitted to rise, and thermostatic controlling means for the machine directly connected to and quickly responsive to temperature changes of the second chamber.

10. In a mechanical refrigerating apparatus, a unitary expansion system including a plurality of separate expansion chambers between which only a relatively slight heat conduction can take place, one portion being arranged for quick and efficient heat interchange between its contents and the surrounding atmosphere, and another shielded thereagainst, and a controlling member directly connected to and quickly responsive to changes of temperature in said first mentioned portion.

11. In a mechanical refrigerating machine, an expansion system including a plurality of expansion chamber portions between which heat conduction is relatively restricted and so interconnected that gravity tends to maintain liquid refrigerant in one, the other being arranged for quick and efficient heat interchange between the surrounding atmosphere and its contents while the first is shielded to limit heat transference to and from the air, and a controlling member arranged to be quickly responsive to changes of temperature in said more liquid-free portion only.

12. In a mechanical refrigerating machine, an expansion system including an elongated evaporating receptacle, a portion thereof having appurtenant the same and in direct metallic connection with its interior a relatively much greater proportionate heat absorbing surface area exposed to the air than the rest, and means for controlling the operation of the machine entirely in response to temperature variations taking place in that portion having the greater surface area, thereby rendering said portion self-defrosting.

13. In a mechanical refrigerating machine, a refrigerating system including an inlet for refrigerant, an expansion chamber appurtenant

said inlet, a second expansion chamber, fluid-conductive connection between said chambers including a portion so arranged that gravity tends to maintain liquid refrigerant in the first chamber, ice tray receptacles appurtenant the first chamber, the second being positioned to permit ready engagement between its refrigerant-confining walls and the air to be refrigerated, while the first is shielded to prevent efficient heat transference between the air to be refrigerated and itself, and means connected to the second chamber for controlling the operation of the machine entirely in response to temperature changes thereof.

14. In a mechanical refrigeration machine, an expansion system comprising a pair of interconnected expansion coils having portions spaced vertically from each other, one of said coils presenting to the air a more effective heat-conductive surface portion than the other, an inlet for refrigerant opening into the coil having the less effective heat-conductive surface, and temperature responsive controlling means directly responsive to changes of temperature in the coil having the more effective heat-conductive portion only.

15. In a mechanical refrigeration apparatus, an expansion system comprising a pair of receptacles within which vaporization may take place, said receptacles being so interconnected that fluid within the system must of necessity traverse one before the other, the second of the receptacles traversed by the fluid being provided with a more effective heat-conductive surface relatively to the air than the other, and controlling means for the refrigeration apparatus directly and quickly responsive to variances of temperature in the second receptacle, and independent of temperature conditions in the first.

16. In a mechanical refrigeration apparatus, an expansion valve, an expansion chamber system comprising an elongated receptacle disposed substantially horizontally and connected at one end to the expansion valve, a second expansion chamber having a portion spaced vertically from the first, connected to the opposite end of the first chamber from that to which the expansion valve is connected, said second expansion chamber being provided with a more effective air-exposed heat-conducting portion than the first and removed from material heat-conductive relation with said first portion, and controlling means responsive relatively quickly to changes of temperature in the second chamber only.

17. In a mechanical refrigeration apparatus, an expansion valve, an expansion system comprising an elongated expansion chamber disposed substantially horizontally and connected at one end to the expansion valve, a second expansion chamber having a portion arranged higher than the first, and connected to the opposite end of the first chamber from that to which the expansion valve is connected, said second expansion chamber being provided with a relatively much greater air-exposed heat-conducting surface than the first in proportion to its normally contained quantity of liquid refrigerant, said conducting surface being in direct metallic heat-conductive communication with the interior of the chamber, and a thermostat connected to and quickly controllable by changes of temperature in the second chamber.

18. In a mechanical refrigerating machine, an expansion system comprising an inlet for refrigerant, an elongated expansion chamber, a sec-

ond expansion chamber spaced from the first and so connected therewith that fluid in the system must of necessity traverse the first before reaching the second, said second expansion chamber being farther from the inlet and presenting a more effective heat-conducting surface area to the surrounding atmosphere in proportion to its normally contained quantity of liquid refrigerant than the first chamber, said surface portion being in direct metallic heat-conductive communication with the interior of the second chamber, whereby moisture condensing upon its exterior surface tends to disperse over a relatively great area while the chamber is at a relatively lowered temperature, and to evaporate rapidly therefrom when such temperature rises, and controlling means for the refrigerating machine directly coupled to the second chamber and independent of the first.

19. In a mechanical refrigerating machine, an expansion system comprising an inlet for refrigerant, an expansion chamber portion, a second expansion chamber portion spaced from and positioned substantially higher than the first, and so connected therewith that while refrigerant within the system must of necessity pass through the first before reaching the second, direct heat-conductive connection between them is greatly restricted, and that gravity tends to maintain liquid within the system in the first chamber portion, said second chamber portion being also provided with a relatively much more effective heat conducting surface portion exposed to the air than the first, said surface portion being in short and direct metallic heat conductive connection with the interior of the chamber, thereby tending to spread over a relatively greater proportionate area moisture condensing thereon while it is being maintained at a lowered temperature by operation of the machine, and also tending to encourage rapid evaporation of the same when its temperature rises, and temperature-responsive controlling means directly connected to the second chamber portion.

20. A combined sharp freezing and air cooling evaporator for domestic refrigerators, comprising a continuous coil for conducting the refrigerant from and back to the refrigerating unit, the portion of said coil closest the condenser of the refrigerating system being arranged in direct contact with only the bottom wall of each of a plurality of sharp freezing compartments whereby to prevent air circulation over the top of said coil portion, a continuation of said coil being formed into an air cooling unit of relatively great surface area compared to the sharp freezing portion of the coil, said air cooling unit being positioned above the sharp freezing compartments and being open to free circulation of air therethrough, and means directly responsive to the temperature of the air cooling unit for controlling the flow of refrigerant.

21. A combined sharp freezing and air cooling evaporator for domestic refrigerators, comprising a continuous coil for conducting the refrigerant from and back to the refrigerating unit, a plurality of sharp freezing compartments each defined by a separate shell, the portion of said coil closest the condenser being positioned in contact with the bottom portion of each shell, the vertical sides of the shells being left free and substantially all of the portion of the coil in contact with the shells exposed to the air in the refrigerator, a continuation of said coils

being formed into an air cooling unit of such relatively great surface area compared to the sharp freezing portion of the coil as to cool the air in the refrigerator without material frosting of the coils, said air cooling unit being positioned above the sharp freezing compartments and being open to free circulation of air therethrough, and means positioned in direct contact with a portion of the air cooling unit for controlling the flow of refrigerant.

22. A refrigerating system for domestic refrigerating units of the type having a food compartment and a sharp freezing compartment positioned within the food compartment, comprising in combination means for conducting a refrigerant in direct heat exchange relation with one or more walls of the sharp freezing compartment, said means being substantially exposed to the air in the food compartment but said direct

conduction allowing only a relatively small heat exchange between the refrigerant and the air in the food compartment, means for conducting the refrigerant to a point above the sharp freezing unit and including a heat exchange unit of relatively large surface capacity, the surface capacity for effecting heat exchange between the refrigerant above the sharp freezing unit and the air in the food compartment being such that the temperature of the unit of large surface capacity is considerably higher than the temperature of the conducting means in direct heat conductive relation with the sharp freezing unit, and means for regulating the flow of refrigerant, said last named means being directly and solely responsive to the temperature of the refrigerant in the conducting means above the sharp freezing unit.

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