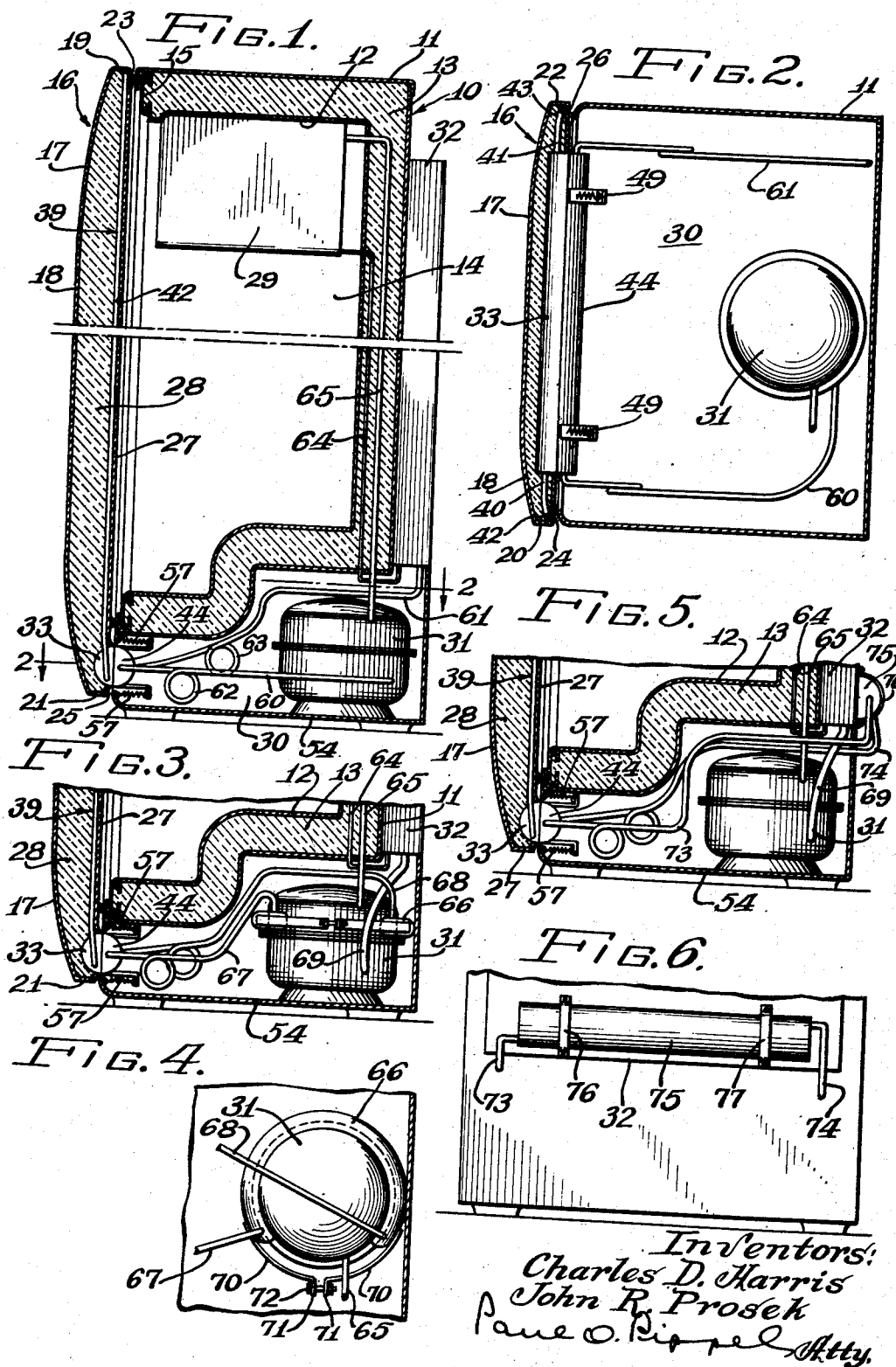


Sept. 8, 1953
 C. D. HARRIS ET AL
 REFRIGERATING APPARATUS HAVING MEANS FOR PREVENTING
 CONDENSATION OF MOISTURE ON THE DOOR
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FIG. 7.

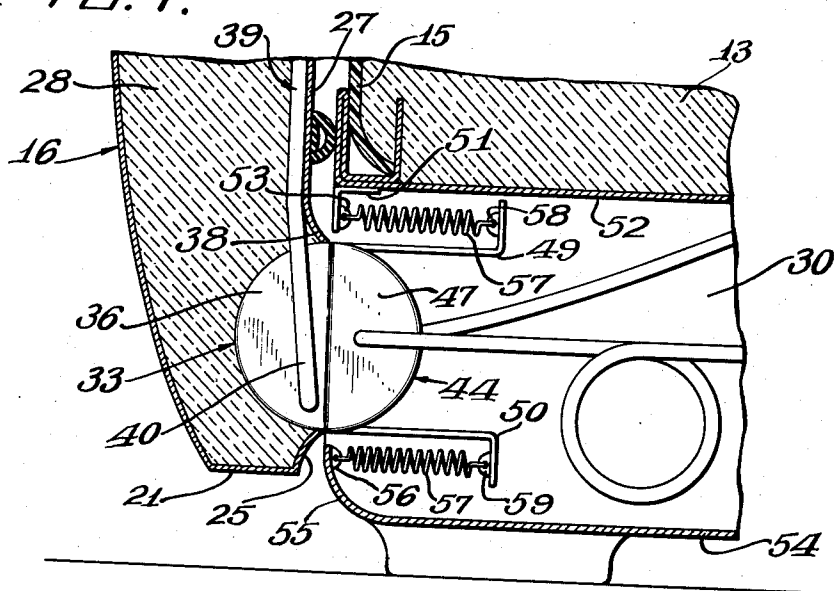


FIG. 8.

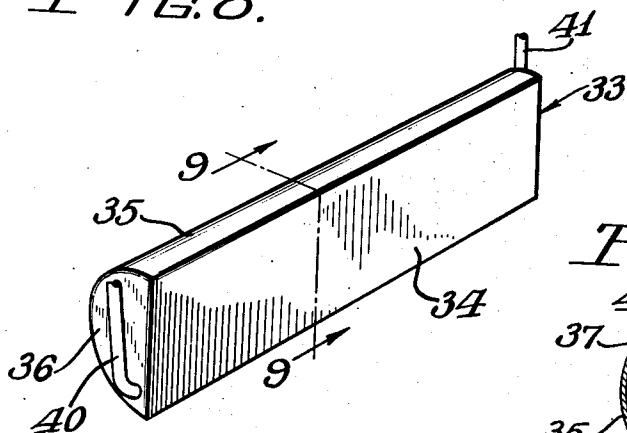
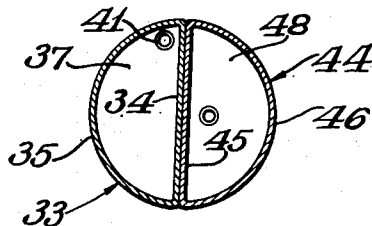


FIG. 9.



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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS HAVING
MEANS FOR PREVENTING CONDENSATION
OF MOISTURE ON THE DOORCharles D. Harris and John R. Prosek, Evansville,
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This invention relates to refrigeration apparatus and more particularly to a refrigerator cabinet having means for preventing condensation of moisture on the compartment door thereof.

Refrigerator cabinets are in many cases constructed in such a manner that the outer surfaces of a compartment door will be cooled to temperatures below the dew point of the surrounding air whereby moisture carried by the air will be cooled and condensed on the door surfaces. This is an undesirable situation since the moisture must be removed from the door periodically in order to prevent damage to the finish of the door and to prevent drippage onto the floor below the cabinet. Such condensation is frequently encountered on the storage type refrigerator cabinet having a vertically disposed door, as well as the low temperature freezer type cabinet having a horizontally disposed door. The present invention provides a means for preventing condensation on the compartment door of either type of cabinet as will be disclosed hereinafter.

One object of the present invention is to provide a refrigerated cabinet with means for preventing the outer surfaces of a compartment door from being cooled to the dew point of the surrounding air.

Another object of the invention is to provide the cabinet with a secondary coil which is attached in heat exchange relation with the portions of the door which would normally be cooled to the dew point of the surrounding air.

A further object of the invention is to provide a boiler which is connected to said secondary coil and is adapted to be heated by the refrigeration system of the cabinet.

A still further object is to charge the boiler and secondary coil with a volatile fluid which will circulate therethrough as heat is added to the boiler.

A still further object of the invention is to provide a heat exchange element which is disposed in heat exchange relation with said boiler and is heated by the hot compressed gases of said refrigeration system.

A still further object of the invention is to secure said boiler to said door and to secure said heat exchange element to said cabinet in such a manner that the door can be opened and closed.

A still further object of the invention is to provide means for biasing said heat exchange element into contact with said boiler when the door is closed.

Further objects and advantages of the present invention will be apparent from the following de-

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scription, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical sectional view of a refrigerated cabinet showing a preferred embodiment of the invention.

Fig. 2 is a horizontal sectional view taken along line 2-2 of Fig. 1.

Fig. 3 is a vertical sectional view of the lower portion of the refrigerated cabinet showing a modification of the invention.

Fig. 4 is a plan view of the compressor shown in Fig. 3.

Fig. 5 is a vertical sectional view of the lower portion of the refrigerated cabinet showing another modification of the invention.

Fig. 6 is a rear elevational view of the cabinet shown in Fig. 5.

Fig. 7 is an enlarged fragmentary view of the lower portions of the door and cabinet of Fig. 1.

Fig. 8 is a perspective view of the boiler of Fig. 7.

Fig. 9 is a cross-sectional view of the boiler and heat exchanger of Fig. 7.

Referring to the drawing for a detailed description of the invention, Fig. 1 is a sectional view of a refrigerator cabinet 10 in which the invention is incorporated. The cabinet 10 comprises an outer shell 11 and an inner liner 12 which is disposed within the outer shell 11 in spaced relationship. The space between the walls of the inner liner 12 and the outer shell 11 is filled with a suitable insulating material 13 whereby the heat leakage therebetween is reduced to a minimum. The inner liner 12 encloses a food storage compartment 14 in which shelves may be secured for the purpose of supporting food articles. The front edges of the outer shell 11 and the inner liner 12 are joined by a breaker strip member 15 and a compartment door 16 is pivotally hinged to the cabinet. The door 16 comprises an outer metallic pan 17 having a front curved portion 18, top wall 19, side wall 20, bottom wall 21, and side wall 22. These walls are provided with inturned flanges 23, 24, 25, and 26 respectively. An inner door pan 27 extends across the back side of the outer door pan 17 with the edges thereof being secured to the inturned flanges 23, 24, 25, and 26. Insulating material 28 fills the space between the outer pan 17 and the inner pan 27 in order to reduce the transfer of heat therebetween.

A plate type evaporator 29 is positioned in the upper portion of the compartment 14 and may

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be secured to the inner liner in any suitable fashion. A machinery chamber 30 is positioned below the food storage compartment 14 and a hermetically sealed motor-compressor unit 31 is secured therein. A flue type plate condenser 32 is secured to the rear wall of the outer shell 11 whereby cooling air will circulate upwardly between the outer shell 11 and the condenser 32. Suitable means may be provided for controlling the operation of the motor-compressor unit 31 when cooling of the food storage compartment 14 is required. The evaporator 29, the condenser 32 and the compressor unit 31 are connected by refrigerant carrying conduits in order to complete the refrigeration system.

The lower portion of the inner door pan 27 is provided with an opening therethrough into which a boiler member 33 is positioned. The boiler 33 is a hollow member formed in the shape of a half cylinder having a vertical side wall 34, a curved side wall 35, and end walls 36 and 37. The boiler extends horizontally across the door 16 and is permanently secured to the lower intumed flange 25 of the outer door pan 17 and to the lower edge 38 of the inner pan 27 by welding or the like. A continuous coil 39 has one end 40 connected into the lower portion of the end wall 36 of the boiler 33 and the other end 41 connected into the top portion of the end wall 37. The coil has a first leg or vertical portion 42 which extends upwardly along side wall 20 of the door pan 17 and is secured in heat exchange relation to the flange 24 and side wall 20. The coil 39 then runs across the top of the door and is secured in heat exchange relation to the flange 23 and top wall 19. A second vertical portion 43 of the coil turns and extends downwardly between side wall 22 and flange 26 to which it is secured in thermal contact.

The front wall of the machinery chamber 30 is open and a heat exchanger 44 is positioned therein. It is contemplated that the heat exchanger 44 be constructed in the form of a hollow half cylinder with substantially the same dimensions as the boiler 33. The heat exchanger 44 is provided with a vertical wall 45, curved wall 46, and two end walls 47 and 48. Two spaced apart brackets 49 are secured to the top portion of wall 46 and two other spaced apart brackets 50 are secured to the lower portion of wall 46. Two mounting brackets 51 are secured to the lower wall 52 of the outer shell 11 and each one is provided with an inwardly extending eyelet or projection 53. The bottom wall 54 of the machinery chamber 30 is provided with an upwardly inclined edge portion 55 which has two spaced apart projections 56 extending therefrom. The heat exchanger 44 is mounted in place by four coiled springs 57, two of which have their outer ends fastened to the projections 53 of brackets 51 and their inner ends fastened in projections 58 provided in brackets 49. The outer ends of the other two springs are secured to the projections 56 of bottom wall 54 whereas their inner ends are secured in projections 59 provided in brackets 50. When the door 16 is in closed position, the springs 57 will bias heat exchanger 44 toward boiler 33 so that their vertical walls 45 and 34 respectively will be held tightly together. When the door 16 is opened the boiler 33 will be moved away from the heat exchanger 44 and the springs 57 will bias the heat exchanger 44 forwardly. As the door 16 is then closed, the springs 57 will again bias the heat exchanger 44 against the boiler 33.

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In the embodiment shown in Figs. 1, 2, 7, 8, and 9, the outlet of the compressor unit 31 is connected by conduit 60 to end 47 of the heat exchanger 44 and the inlet of the condenser 32 is connected to the end 48 of the heat exchanger 44 by conduit 61. The conduits 60 and 61 are provided with looped portions 62 and 63 which will bend without damage thereto whenever the heat exchanger 44 is moved by the springs 57. During the operation of the refrigeration system, compressed refrigerant gas from the motor-compressor unit 31 will be conveyed to the heat exchanger 44 by conduit 60, then passed to the condenser 32 by the conduit 61 where it will be cooled and condensed by cooling air surrounding the condenser 32. The liquefied refrigerant is then metered by a capillary tube 64 into the evaporator 29 where it will absorb heat from the food storage compartment 14 and be vaporized. After circulating through the evaporator 29, the refrigerant is returned to the compressor 31 by conduit 65 to again be compressed and passed through the refrigeration system.

As the hot compressed refrigerant gases flow through the heat exchanger 44, it will be heated to a high temperature and part of the heat will be conducted to boiler 33. The boiler 33 is partially filled with a liquid refrigerant, or other volatile liquid, which will be heated by the heat exchanger 44 to its boiling point. As the refrigerant boils, the vapors therefrom will flow upwardly through the vertical portion 43 of the coil 39, then across the top portion thereof from which it will be returned by the vertical portion 42 to the boiler 33. The side walls 22, 19, and 20 and the intumed flanges 26, 23, and 24 are all disposed in close proximity to the refrigerated compartment 14 of the cabinet. Even though the outer door pan 17 is insulated from the refrigerated compartment 14, it has been found that the side walls and flanges of the outer door pan 17 will sometimes be cooled below the dew point of the surrounding air and moisture will condense thereon if this temperature is maintained. This is prevented by the present invention by the secondary coil 39 which is held in thermal contact with the outer door pan 17. As the refrigerant vapors circulate therethrough, they will absorb heat from the cold portions of the outer door pan 17 and be condensed. This will heat the door pan 17 above the dew point of the air whereby condensation of the moisture from the air will be prevented. The condensed refrigerant will circulate back to the boiler 33 where it will again be vaporized by the heat from the heat exchanger 44 and be recirculated through the coil 39. The secondary coil 39 is illustrated in but one form, but it is to be understood that it could be bent into any number of forms and positioned in heat exchange relation with any other portion of the door 16 upon which moisture might condense.

Another embodiment of the invention is illustrated in Figs. 3 and 4 of the drawing. The heat exchanger 44 is not connected directly into the refrigeration system but is connected to a hollow circular shaped boiler 66 by conduits 67 and 68. The motor-compressor unit 31 is connected to the condenser 32 by a conduit 69. The boiler 66 fits around the motor-compressor unit 31 and is provided with a pair of straps 70 which are fastened to the ends of the boiler 66. The straps 70 are provided with offset end portions 71 having apertures therethrough into which a nut and bolt assembly 72 is fastened. By tightening the as-

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sembly 72, the boiler 66 will be held in contact with the motor-compressor unit 31 and will be heated thereby. The boiler 66 is partially filled with a volatile liquid or liquid refrigerant which will absorb heat from the compressor unit 31 and be vaporized. This refrigerant will be conveyed by the conduits 67 and 68 through heat exchanger 44 where it will be condensed by emitting heat to the boiler 33 and then returned to boiler 66 to repeat the cycle. The refrigerant within boiler 33 will be vaporized and will circulate through the secondary coil 39 in the manner explained heretofore. The other elements of this embodiment are the same as those shown in Figs. 1, 2, 7, 8, and 9 and are designated by like reference numerals.

A third illustration is shown in Figs. 5 and 6 of the drawings. The heat exchanger 44 is connected by conduits 73 and 74 to a boiler 75 which is fastened to the back of the condenser 32 by a pair of straps 76 and 77. The boiler 75 comprises a hollow elongated casing which is partially filled with a liquid refrigerant or other volatile fluid. During operation of the refrigeration system, the condenser 32 will heat the liquid within the boiler 75 and cause it to boil. The vapors generated within the boiler 75 will be conveyed by the conduits 73 and 74 through the heat exchanger 44 where they will be cooled by the emitting heat to the boiler 33. From the heat exchanger 44, the liquid will be returned to the boiler 75 and will repeat the cycle. The refrigerant within boiler 33 will circulate through the secondary circuit as explained heretofore.

From the above description, it is readily seen that the secondary coil 39 will operate to heat portions of the refrigerator door 16 which are subjected to low temperatures whereby condensation of moisture from the surrounding air will be prevented. The heat required for the operation of the secondary coil 39 is absorbed from the high side of the refrigeration system so that no external heat supply is necessary. The secondary coil 39 will also improve the efficiency of the refrigeration system since the refrigerant within boiler 33 will absorb heat from the hot compressed gases within the heat exchanger 44 so that the high side pressure and temperature will be maintained within a lower range.

While the invention has been shown in three forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible to various changes and modifications without departing from the spirit thereof, and it is therefore desired that only such limitations be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What is claimed is:

1. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a refrigeration system for cooling said compartment, a first heat exchange unit fixedly secured to said door, a coil positioned in heat exchange relation to said door with the ends thereof connected to said first heat exchange unit, said first heat exchange unit being partially filled with a volatile liquid, a second heat exchange unit movably secured to said cabinet and being associated with said refrigeration system so that it is heated thereby, and means for biasing said second heat exchange unit into contact with said first heat exchange unit so that said volatile liquid will be vaporized and circulated through said tube.

2. In a refrigerated cabinet having a storage

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compartment, a door for closing said compartment, a refrigeration system for cooling said compartment, a boiler fixedly secured to said door, a coil positioned in heat exchange relation to said door with the ends thereof connected to said boiler, said boiler being partially filled with a volatile liquid, a heat exchange element movably secured to said cabinet by resilient mounts whereby it is held in contact with said boiler when the door is in closed position, and means for heating said heat exchange element so that the volatile liquid in said boiler will be vaporized and circulated through said tube.

3. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a refrigeration system for cooling said compartment, a boiler fixedly secured to said door, a coil positioned in heat exchange relation to said door with the ends thereof connected to said boiler, said boiler being partially filled with a volatile liquid, a heat exchange element movably secured to said cabinet by resilient mounts whereby it is held in contact with said boiler when the door is in closed position, and means for transferring heat from said refrigeration system to said heat exchange unit, said boiler being heated by said heat exchange unit whereby said volatile liquid will be vaporized and circulated through said tube.

4. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a refrigeration system for cooling said compartment, a boiler fixedly secured to the lower portion of said door, a coil positioned in heat exchange relation to said door with the ends thereof connected to said boiler, said boiler being partially filled with a volatile liquid, a heat exchange element movably secured to said cabinet below said compartment, means for biasing said heat exchange element into contact with said boiler when the door is in closed position, and means for transferring heat from said refrigeration system to said heat exchange element, said boiler being heated by said heat exchange unit whereby said volatile liquid will be vaporized and circulated through said tube.

5. In a refrigerated cabinet having a storage compartment, a compartment door comprising an outer pan and an inner pan, said inner pan having an opening therethrough, a boiler secured within said opening, a coil positioned in heat exchange relation to a portion of said outer pan with the ends thereof connected to said boiler, said boiler being partially filled with a volatile liquid, a heat exchange unit secured to said cabinet, means for biasing said heat exchange element and said boiler together when the door is in closed position, and means for supplying heat to said heat exchange unit so that the volatile liquid within said boiler will be vaporized and circulated through said tube.

6. In a refrigerated cabinet having a storage compartment, a compartment door comprising an outer pan and an inner pan, the outer marginal edges of said outer pan formed to form side walls extending thereabout, said inner pan having an opening therethrough, a boiler secured within said opening, a coil positioned in heat exchange relation to said side walls of said outer pan with the ends thereof connected to said boiler, said boiler being partially filled with a volatile liquid, a heat exchange unit secured to said cabinet, means for biasing said heat exchange element and said boiler together when the door is in closed position, and means for trans-

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ferring heat from said refrigeration system to said heat exchange unit, said boiler being heated by said heat exchange unit whereby said volatile liquid will be vaporized and circulated through said tube.

7. In a refrigerated cabinet having a storage compartment, a compartment door comprising an outer pan and an inner pan which has an opening through the lower portion thereof, a boiler fixedly secured within said opening, a coil positioned in heat exchange relation to the outer marginal edges of said outer pan, said coil being connected to said boiler which is partially filled with a volatile liquid, a heat exchange element movably secured to said cabinet below said compartment, means for biasing said heat exchange element against said boiler when said door is in closed position, and means for transferring heat from said refrigeration system to said heat exchange unit, said boiler being heated by said heat exchange unit whereby said volatile liquid will be vaporized and circulated through said tube.

8. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a coil positioned in heat exchange relation with said door, a refrigeration system for cooling said compartment, said coil being connected to a boiler which is secured to said door and partially filled with a volatile liquid, a heat exchange unit movably secured to said cabinet and being connected into the high side of said refrigeration system whereby the high pressure refrigerant will flow therethrough, and means for biasing said heat exchange unit into contact with said boiler so that said volatile fluid will vaporize and circulate through said tube.

9. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a coil positioned in heat exchange relation with said door, a refrigeration system comprising a compressor, condenser and evaporator, said

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coil being connected to a first boiler which is secured to said door and partially filled with a volatile liquid, a heat exchanger movably secured to said cabinet, said heat exchanger being connected to a second boiler which is fastened in heat exchange relation to said compressor, said second boiler being partially filled with a volatile liquid which will be vaporized by heat from the compressor and circulated through said heat exchanger, and means for biasing said heat exchange unit into contact with said first boiler so that the liquid in said first boiler will be vaporized and circulated through said tube.

10. In a refrigerated cabinet having a storage compartment, a door for closing said compartment, a coil positioned in heat exchange relation with said door, a refrigeration system comprising a compressor, condenser and evaporator, said coil being connected to a first boiler which is secured to said door and partially filled with a volatile liquid, a heat exchanger movably secured to said cabinet, said heat exchanger being connected to a second boiler which is fastened in heat exchange relation to said condenser, said second boiler being partially filled with a volatile liquid which will be vaporized by heat from the condenser and circulated through said heat exchanger, and means for biasing said heat exchange unit into contact with said first boiler so that the liquid in said first boiler will be vaporized and circulated through said tube.

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