March 16, 1937. H. A. WHITESEL 2,074,137

EVAPORATOR

Filed Dec. 1, 1932

Fig. 1.

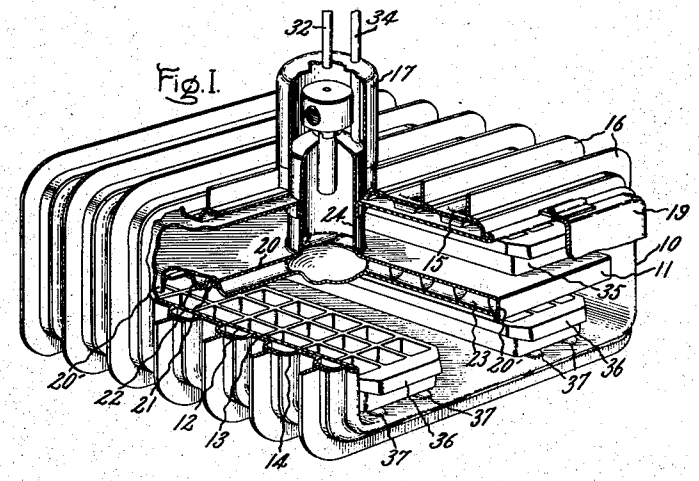


Fig. 2.

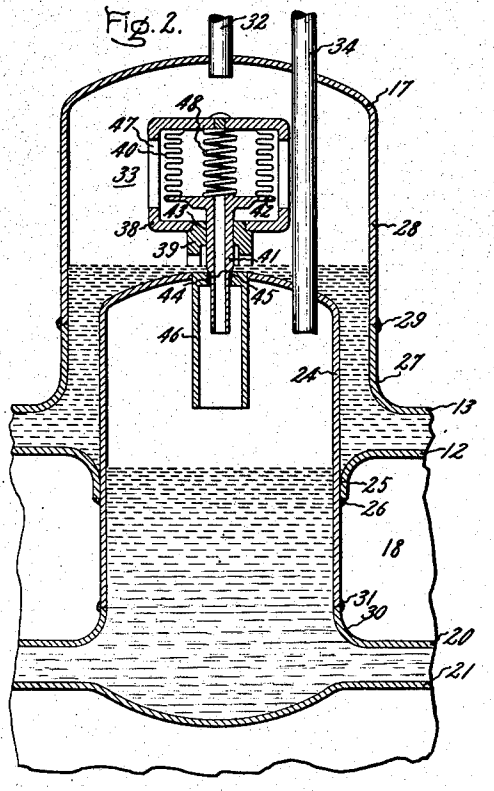
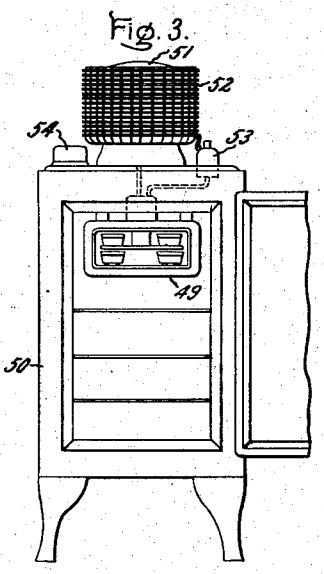


Fig. 3.



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Patented Mar. 16, 1937 2,074,137

UNITED STATES PATENT OFFICE

2,074,137

EVAPORATOR

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Application December 1, 1932, Serial No. 645,255

9 Claims. (Cl. 62—126)

My invention relates to evaporators or cooling units for refrigerating machines.

In household refrigerators the cabinet is maintained below 50° F. and above 32° F. and a range of operating temperatures within these limits is selected according to the requirements of the particular refrigerator. Refrigerating machines are ordinarily equipped with a single evaporator for cooling the cabinet, and this evaporator is also provided with a compartment in which are placed freezing trays. It is desirable that the temperature of the evaporator within the compartment be low enough to freeze quickly the substances placed therein and it is therefore necessary to maintain the evaporator at a temperature considerably below the freezing point. As the air is chilled in passing over the surface of the evaporator it moves downwardly and the warmer air moves in an upward current which produces a continuous circulation of air in the cabinet. This air current absorbs moisture from food in the cabinet, and as the current rises moisture is carried up to the evaporator. Here the temperature is lower than the dew point of the rising air and as a result moisture is condensed on the evaporator. This moisture freezes and in a short period of time the evaporator is covered with frost which continues to accumulate as the cabinet is operated. Frequent defrosting is required in order to keep the evaporator in its best operating condition. In addition to this, there is another objection in that the air circulating in the cabinet is maintained at such low humidity that the food is dried.

It is an object of my invention to provide a cooling unit which will eliminate the necessity of frequent defrosting.

Another object of my invention is to provide a cooling unit which will maintain a substantially uniform cabinet temperature under varying operating conditions.

A further object of my invention is to provide a cooling unit which will not cause undue drying of the food in the refrigerator cabinet.

A still further object of my invention is to provide a simple and compact cooling unit having separate portions operating at different temperatures and having automatic means for maintaining a predetermined temperature difference between the separate portions of the evaporator.

Further objects and advantages of my invention will become apparent as the following description proceeds and the novelty which characterizes my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing, Fig. 1 of which is a perspective view, partly in section, of a cooling unit embodying my invention; Fig. 2 is a detailed sectional view of the evaporator headers connected through a constant pressure differential valve; and Fig. 3 is a side elevation of a refrigerator cabinet having a refrigerating machine employing my improved cooling unit.

Referring to the drawing, in Fig. 1, I have shown a cooling unit embodying my invention and comprising an outer hollow evaporator 10 forming a freezing compartment containing an inner freezing evaporator 11 in the form of a shelf. These evaporators are of the flooded type and are operated at different pressures in order to maintain the desired temperature difference between the two evaporators. Evaporator 10 is formed of inner and outer shells 12 and 13, respectively. The outer shell 13 is formed with corrugations 14 communicating at the top with a transverse corrugation forming a manifold 15, and is closely fitted about the shell 12. Contacting parts of the shells are connected by some suitable means such as brazing or line welding. The outer shell 13 is provided with a plurality of flanged fins 16 secured to the corrugations 14 to increase the effective heat absorbing surface of the evaporator. A cylindrical header 17 is provided on the shell 13 opening into the space formed by the corrugations 14 and 15. The rear end of this hollow evaporator is closed by a plate 18, shown in Fig. 2, and the front end may be provided with a door a part of which is shown at 19 to prevent circulation of air from the refrigerator cabinet through the ice freezing compartment. The inner or low pressure evaporator 11 is supported from the upper inside wall of the outer evaporator and is formed by upper and lower sheets 20 and 21, respectively, the lower sheet 21 being provided with corrugations 22 and a transverse corrugation forming a manifold 23 closed at their ends by downwardly bent edges 20' of the upper sheet 20. These sheets are connected around their edges and along the contacting corrugations in a manner similar to that used in connecting the shells 12 and 13 of the hollow evaporator 10. The upper sheet 20 of the inner evaporator is provided with a cylindrical header 24 communicating with the corrugations 22 and 23 and which is secured in an opening 25 in the shell 12 of the evaporator 10 as shown at

26 and extends partially into the header 17. The construction of the cylindrical headers 17 and 24 can be seen by referring to Fig. 2 of the drawing. Flanged base 27 of the header 17 is formed in the wall 13 of the evaporator 10, and the top 28 of the header 17 is joined to the side wall as shown at 29. The header 24 is joined to an upturned flange 30 on the sheet 20 as shown at 31. These joints may be made by welding, brazing, or in any other suitable manner. Liquefied refrigerant is supplied to the header 17 through a conduit 32. In order to maintain a difference in pressure between the evaporators 10 and 11, I provide a differential pressure valve 33 which admits liquid and gaseous refrigerant to the header 24. During the refrigerating cycle the evaporator 10 is preferably operated over a range of pressure such that during a portion of the cycle it is at a temperature above 32° F.; this provides defrosting of the evaporator surface during each cycle, and sufficiently minimizes drying of the air in the cabinet. It will be apparent, however, that under certain required conditions of temperature and humidity it may be desirable to operate the outer evaporator entirely above or entirely below 32° F. If the temperature of the evaporator 10 does not rise above the freezing point, nevertheless it is operated at a much higher temperature than is the case in the single pressure evaporator, and consequently there is a minimum frosting effect. Moreover, since the evaporator 10 has a larger surface than that of the single pressure evaporators, and since it is regulated for a higher temperature, the cabinet air temperature with this evaporator will be much less affected by variations in room temperature or by opening of the cabinet door. The evaporator 11 is maintained at a lower pressure than the evaporator 10 such that the temperature of the evaporator 11 will be low enough to freeze substances placed therein within a short time. The refrigerant which is vaporized in the evaporator 11 passes through the suction conduit 34 back to the compressor of the refrigerating machine. Evaporators 10 and 11 are spaced apart to accommodate freezing trays 35 supported on the evaporator 11 and freezing trays 36 supported in close relation to the under side of evaporator 11 by ribs 37 formed in the bottom portion of the shell 12 of the evaporator 10. Although the evaporator 11 and the ice trays 35 and 36 are maintained at a temperature considerably below the freezing point of water, there will be practically no formation of frost around these parts of the cooling unit because there is no substantial circulation of air over the surface of the evaporator 11, particularly when the door 19 is provided.

The constant pressure differential valve 33 shown in Fig. 2, which maintains the desired difference in pressure between the evaporators 10 and 11 includes a cylindrical casing 38 secured to a body 39 on top of the header 24 and a bellows 40 mounted within the casing and arranged to actuate a hollow valve stem 41 having a flange 42 sealed to the bellows. The valve stem 41 is slidably mounted in a guide 43 in the body 39 and a valve 44 formed on the stem 41 rests on a seat 45 in the end of a sleeve 46 which is fitted into and sealed to the header 24. Openings 47 are provided in casing 38 and the valve stem 41 is made hollow so that the bellows will be subject to the pressure of evaporator 10 externally and to the pressure of evaporator 11 internally. A compression spring 48 biases the bellows to its expanded position to seat the valve 44. This spring is calibrated so that the desired pressure difference will be maintained between the evaporators.

In the operation of this valve mechanism as long as the pressure within the bellows 40 in addition to the force of the compression spring 48 is sufficient to overcome the external pressure in the header 17 the valve 44 will remain closed, but as soon as the pressure in the header 17 becomes too great the valve will open and permit the refrigerant to flow from the header 17 into the header 24 to re-establish the desired pressure difference and close the valve.

In Fig. 3 I have shown a cooling unit 49 of the construction above described as employed in a household refrigerator cabinet 50. This refrigerator cabinet is provided with a compression type refrigerating system including a motor and compressor arranged within a casing 51 secured to a removable top of the cabinet. During operation of this compression system refrigerant is compressed within the casing whence it flows through the cooling coil of condenser 52, is liquefied and flows to a float valve chamber 53. When a predetermined amount of liquid refrigerant has collected in the float valve chamber, a float rises and the liquid refrigerant flows down through the conduit 32 into the header 17 of the cooling unit 49. The liquid refrigerant is vaporized in the evaporators 10 and 11 and is then withdrawn therefrom by the compressor through suction conduit 34. This cycle is continuously repeated during the operation of the machine, the motor of which is controlled by an automatic switch mechanism 54 in response to a thermostatic device arranged within the cabinet 50. The thermostatic device is arranged to start the motor at an upper temperature limit and to stop the motor at a lower temperature limit. When the upper limit is above 32° F. and the lower limit below 32° F., the refrigerating system operates so that the evaporator is defrosted during each cycle. The pressure difference between the evaporators 10 and 11 is selected so that the evaporator 10 will maintain the compartment of the cabinet 50 at a proper temperature, and so that the inner evaporator 11 will be maintained at a sufficiently low temperature for freezing purposes.

Although I have shown a particular embodiment of my invention in connection with a compression refrigerating machine, I do not desire my invention to be limited thereto, and intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. A cooling unit for refrigerators comprising two evaporators one within the other and spaced apart, and means for maintaining a higher pressure within the outer evaporator than within the inner evaporator during normal operation.

2. A cooling unit for refrigerating machines comprising an outer evaporator, a flat evaporator within and spaced from said outer evaporator, a header on each of said evaporators, means including a differential pressure valve and providing communication between said headers for maintaining said outer evaporator at a higher pressure than said flat evaporator during normal operation.

3. A cooling unit for refrigerating machines comprising an outer evaporator and an inner evaporator spaced from said outer evaporator,

means for maintaining the temperature of said outer evaporator periodically above and below 32° F., and means including a valve and dependent upon the pressures in said evaporators for maintaining the temperature of said inner evaporator sufficiently low for freezing purposes.

4. A cooling unit for refrigerating machines comprising an outer evaporator, a second evaporator arranged within and spaced from said outer evaporator, headers on said evaporators, a portion of the header on said second evaporator forming a common wall between said evaporators, and means including a differential pressure valve in said common wall for maintaining a higher pressure in said outer evaporator than in said second evaporator during normal operation.

5. A cooling unit for refrigerating machines comprising an outer evaporator, a second evaporator within and spaced from said outer evaporator, means for supplying refrigerant to said outer evaporator, means for removing vaporized refrigerant from said second evaporator, and means including a differential pressure valve and providing communication between said headers for maintaining said outer evaporator at a higher pressure than said second evaporator during normal operation.

6. In combination, a refrigerator cabinet and a cooling unit within said cabinet and comprisng two evaporators one within the other and spaced apart, and means for maintaining a higher pressure within the outer evaporator than within the inner evaporator during normal operation.

7. In combination, a refrigerator cabinet and a cooling unit, said cooling unit comprising an outer evaporator, a flat evaporator within and spaced from said outer evaporator, a header on each of said evaporators, and means including a differential pressure valve and providing communication between said headers for maintaining said outer evaporator at a higher pressure than said flat evaporator during normal operation.

8. In combination, a refrigerator cabinet and a cooling unit arranged therein, said cooling unit comprising an outer evaporator and an inner evaporator spaced from said outer evaporator, means for maintaining the temperature of said outer evaporator periodically above and below 32° F., and means including a valve and dependent upon the pressures in said evaporators for maintaining the temperature of said inner evaporator sufficiently low for freezing purposes.

9. A cooling unit for refrigerators comprising an outer flooded evaporator and an inner flooded evaporator spaced from said outer evaporator, and means including a valve providing communication between said evaporators and dependent upon the pressures in said evaporators for maintaining a predetermined difference of temperature between said evaporators during normal operation.

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