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TEMPERATURE CONTROL APPARATUS FOR REFRIGERATORS

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FIG. 1.

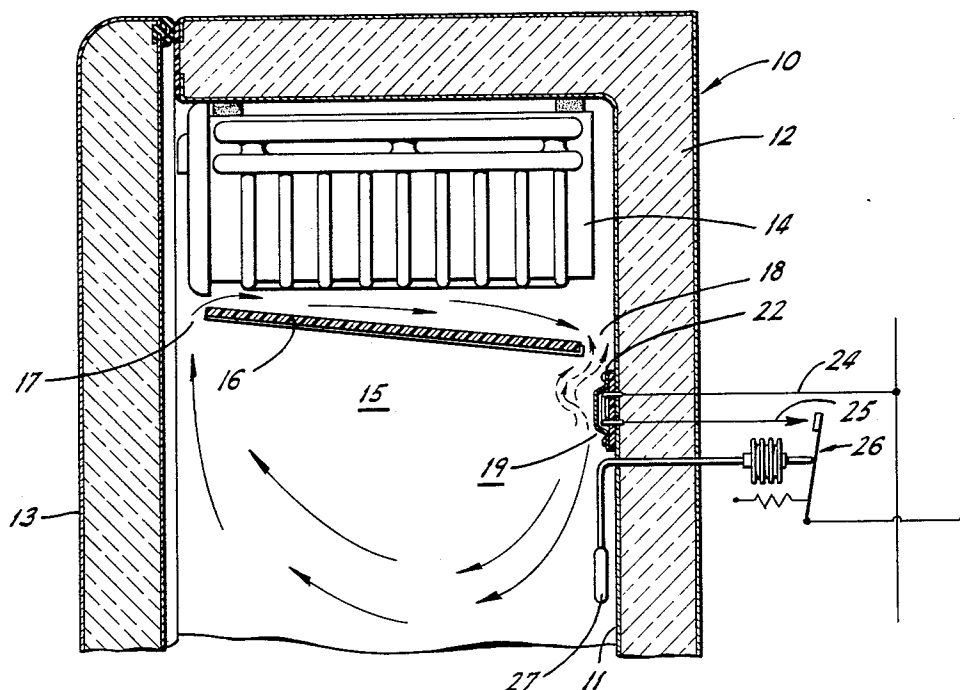


FIG. 2.

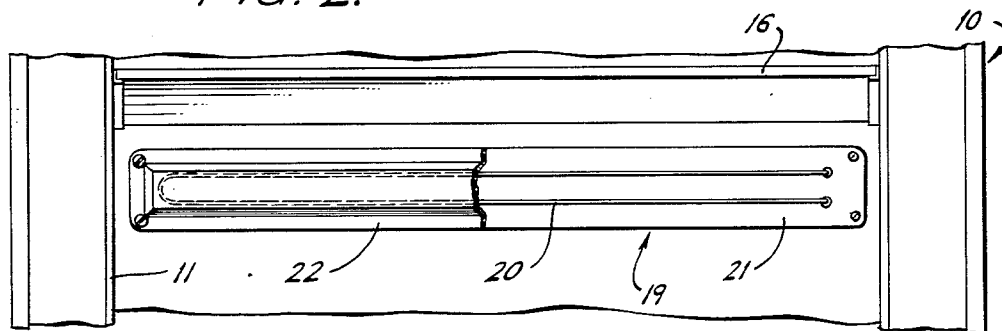
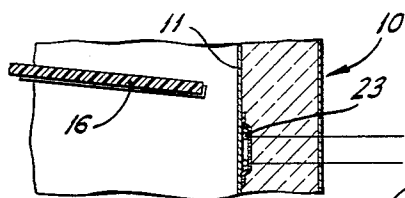


FIG. 3.



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TEMPERATURE CONTROL APPARATUS FOR REFRIGERATORS

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3 Claims. (Cl. 257—3)

My invention is concerned with refrigeration apparatus and, more particularly, with control of temperatures within the cabinets of household refrigerators. The apparatus of the invention is particularly applicable to refrigerators of the type in which a single cooling element, or evaporator, provides refrigeration within each of a pair of adjacent compartments.

In considering the invention it is to be borne in mind that it has proven desirable to provide within a refrigerated cabinet not only a freezer compartment, but also a compartment maintained at a temperature above the freezing point of water, and in which may be preserved fresh fruits, vegetables, or other foodstuffs which should not be subjected to sub-freezing temperatures. A relatively simple and inexpensive way of constructing such a refrigerator comprises dividing the space defined by the inner liner of the cabinet into upper and lower compartments by means of a generally horizontal partition or baffle which limits, but does not eliminate, circulation of air between said upper and lower compartments. The partition is so shaped and disposed within the cabinet as normally to provide for limited circulation of cooling air between the two compartments, and this may be accomplished most readily by spacing the front and rear edges of the partition from the adjacent walls of the cabinet. Commonly the refrigeration system is responsive to the temperature of the evaporator which cools (and the walls of which may define) the freezer compartment, and this invention has to do with refrigerators of the foregoing type in which at least the major portion of the cooling within the higher temperature compartment is accomplished by circulating air from the latter compartment around or through said baffle or partition and in heat exchange relation with the evaporator of the freezer compartment.

While refrigerators of the foregoing kind are well known and are advantageous, they have been found, in practice, to be subject to a difficulty particularly in that a reduction in the ambient temperature frequently results in over-cooling of the fresh food compartment and may even result in freezing of foods therein. If attempts are made to meet this problem by raising the temperature of the evaporator of the freezer compartment, a limit is soon reached beyond which it is not possible to preserve certain types of foods without deterioration.

Accordingly, and with the foregoing in mind, it is the primary object of the present invention to overcome the above-mentioned difficulties and disadvantages by providing a novel mode of control of the circulation of air through or around the baffle which separates the two compartments aforesaid. The apparatus of the invention, without resort to movable dampers or the like, makes it possible to restrict or to eliminate the circulation of air about the baffle.

To these general ends heat is applied to the cabinet in such a location, as respects the disposition of the baffle within the cabinet and the manner in which air normally circulates therein, that the heat functions as control means

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restricting or eliminating circulation of air which normally takes place between the two compartments. It is a feature of the invention that heat is applied in the region of that edge or portion of the baffle about which downflow of cooled air normally takes place. I have found that application of a relatively small quantity of heat, in the region of the current of air which normally flows downwardly past the baffle and into the lower compartment, is sufficient to accomplish the purposes of the invention. Specifically, it is of advantage that heat be applied adjacent to the edge of the baffle about which such downflow of air occurs. I have found that applying a relatively small quantity of heat in this manner results in an upward current of warmed air which is in opposition to the downward flow of air normally effective to cool the lower compartment. When heat is applied in this way the quantity of heat required to prevent undue reduction of the temperature within the lower compartment is considerably less than the quantity which would be required if the heat were to be applied at a location remote from the baffle. As is more fully set forth hereinafter, such application of heat creates what might be referred to as a "heat block" impeding or substantially preventing the normal circulatory flow of air around the baffle and, consequently, reducing the effectiveness of the upper evaporator in cooling the lower compartment.

The manner in which the objects and advantages of my invention may best be achieved will be understood from a consideration of the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a fragmentary, vertical, sectional illustration of a refrigerator embodying apparatus in accordance with the invention;

Figure 2 is a front elevational view of a portion of the refrigerator of Figure 1, the view showing particularly the baffle and the heating means; and,

Figure 3 is a fragmentary, sectional view, similar to Figure 1, and illustrating a modified form of heating means.

Now making more detailed reference to the drawing, it will be seen that the invention is therein illustrated as embodied in a domestic refrigerator comprising an outer shell 10 and an inner shell or liner member 11 spaced inwardly of and insulated from the outer shell 10 by means of any suitable insulation, shown at 12. A door 13 seats against the forward face of the cabinet and provides access thereto. It will be understood that the refrigerator also includes a compressor-condenser unit of any desired type, but illustration of this portion of the apparatus is not necessary herein since the present invention is not concerned therewith.

As clearly appears in the drawing the space within the inner liner 11 is sub-divided into an upper relatively low temperature storage compartment which, in the embodiment shown, is defined by an evaporator 14, and a lower food storage compartment 15, division being effected by means of a tray-like partition or baffle designated by the reference character 16. As is clear from Figure 2, the baffle 16 spans the width of the space defined by the inner liner, and is so shaped and disposed within the cabinet as to provide an upflow zone or space 17 at the forward portion of the cabinet and a downflow zone 18 at the rear of the box (see Figure 1).

As indicated above, and in particular accordance with this invention, the normal circulation of air within the cabinet, upwardly through space 17 and downwardly through space 18 (see arrows shown in solid lines in Figure 1), can be eliminated or terminated by the application of heat to the cabinet. The heating means indicated, generally, by the reference numeral 19 comprises a loop 20 of relatively high resistance wire mounted in

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any convenient manner upon the rear wall of inner liner 11, as through the agency of a mounting block 21 of low thermal conductivity and a metallic plate or cover member 22. In the illustrated embodiment the heater is adjacent the rear edge of the partition 16, being at the general level of said edge, and is therefore in the region of the downflow gap or aperture. It will be observed that the heater substantially spans the width of the compartment, thereby insuring that the applied heat will be effective along the entire back edge of the baffle 16.

As shown in Figure 3, the heater may, if desired, comprise a loop of wire 23 secured in convoluted arrangement along the outside of the back surface of inner liner 11 and, again, at the general level of the rear edge of the partition 16. Due to the high thermal conductivity of inner liner 11, a heater mounted as shown in Figure 3 functions in substantially the same manner as does the interiorly mounted heater shown in Figures 1 and 2. A heater arrangement of this modified type is described and claimed in the co-pending disclosure of H. W. Schaefer, bearing Serial No. 277,947, filed March 22, 1952, now Patent No. 2,700,532 granted Jan. 25, 1955 and assigned to the assignee of the present invention.

The heater is adapted to be connected to any suitable source of power, by being placed across a line through conductors 24 and 25 and through the agency of a temperature-sensitive switch device 26 (Figure 1). This switch device is of known syphon bellows type and includes a bulb 27 disposed within the compartment 15. When the temperature within said compartment reaches a predetermined lower limit the blade of switch device 26 moves to closed position and the heater is energized, the circuit to the heater being broken when the temperature has again risen to a desired predetermined value. Broadly, and as will be understood, the invention contemplates other forms of control, it being evident that the heater may for example be energized throughout certain seasons of the year, if that is desired.

In any event, energization of the heater 19 not only adds directly to the heat load normally resulting from leakage through the cabinet insulation, but also creates turbulence at the vicinity of the rear edge of baffle 16 and, ultimately creates a zone or column of warm air tending to flow upwardly around the rear edge of the baffle, as is indicated by the broken-line arrows applied to Figure 1. This turbulence and upward flow of warmed air is in opposition to the normal circulatory flow of air within the cabinet and constitutes the "heat block" referred to hereinabove. Such a heat block, together with the resultant direct addition to the cabinet heat load, serves very effectively to prevent excessive cooling of the lower compartment 15. In practice it has been found that an input of about twelve watts, for example, is sufficient to accomplish the purposes of the invention, and it will be appreciated that application of wattage as low as this is not sufficient to interfere appreciably with maintenance of proper temperatures within the evaporator 14 which is of course provided with the usual temperature control device (not shown).

I have found that energization of the heater sharply limits the normal circulatory flow of air between the two compartments, although a relatively slow circulatory flow of air continues to take place within the lower compartment 15 and beneath the baffle.

From the foregoing description it will be understood that my invention provides improved refrigeration apparatus in which undue reduction in the temperature of the frozen food compartment is prevented by the simple expedient of utilizing heat as a means for controlling the circulatory flow of air within the refrigerated cabinet.

The invention, in its broader aspect, contemplates location of the heater in positions other than those shown and

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described herein; for example the heater might be situated at a level well below the baffle 16, but in a position such that it lies in the path of air which normally flows downwardly into the lower compartment. As is the case with the preferred apparatus described above, a heater mounted in such a way creates a rising current of air which is in counterflow relation with respect to the circulation which obtains under normal operating conditions. It will be recognized, however, that the foregoing, and such other changes as may come within the scope of the appended claims, are contemplated by the invention.

I claim:

1. In refrigeration apparatus, a cabinet, a baffle or partition disposed within said cabinet and separating the space therein into upper and lower compartments, the upper of said compartments having cooling means in heat exchange relation therewith, and said baffle being so shaped and disposed within said cabinet as normally to provide for limited circulation of cooling air between said two compartments, the construction and arrangement being such that the circulating air normally flows upwardly past one portion of said baffle into heat exchange relation with said cooling means and thereafter flows downwardly into the lower compartment past another portion of said baffle spaced from the said one portion, and means preventing over-cooling of said lower compartment, comprising: means adapted to add heat to the cabinet in the path of the current of air which normally flows downwardly past the stated other portion of the baffle; and means responsive to temperature conditions prevailing within said lower compartment to control operation of said heating means.

2. In refrigeration apparatus, a cabinet, a baffle or partition disposed within said cabinet and separating the space therein into upper and lower compartments, the upper of said compartments having cooling means in heat exchange relation therewith, and said baffle having a first edge portion spaced from a wall portion of the cabinet and another edge portion spaced from another wall portion of the cabinet, whereby to provide for limited circulation of cooling air around said baffle and between said two compartments, and means preventing over-cooling of said lower compartment comprising, an electrical resistance heater extending along the said other wall portion of the cabinet in adjacency to the said other edge portion of said baffle, said heater being of a length substantially equal to the length of the said other edge portion of the baffle.

3. In refrigeration apparatus, a metallic inner liner member defining a storage compartment, a substantially imperforate baffle mounted generally horizontally within said inner liner member and having edge portions disposed in spaced adjacency with respect to interior surface portions of the inner liner member, the construction and arrangement being such that air normally circulates across edge portions of said baffle downwardly to the region beneath the baffle and thence returns across edge portions of said baffle upwardly to the region above the baffle; and means for impeding such normal circulation of air, comprising an electrical resistance heater mounted in the path of circulating air in a region where said air is flowing downwardly across edge portions of said baffle.

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