July 12, 1955 R. L. DILLS 2,712,731

AIR CIRCULATION CONTROLLING ARRANGEMENT

Filed Sept. 8, 1954

FIG. 1

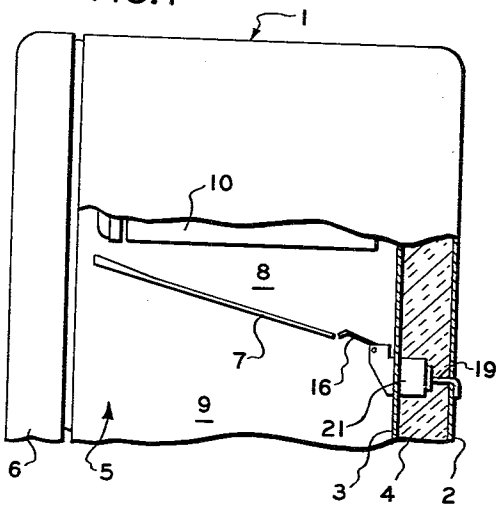


FIG. 2

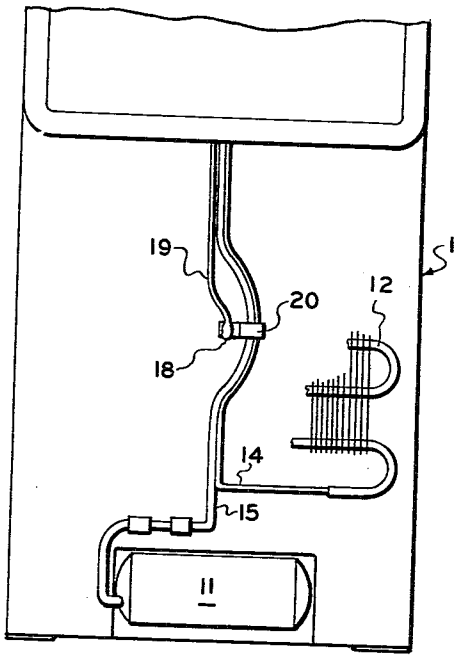
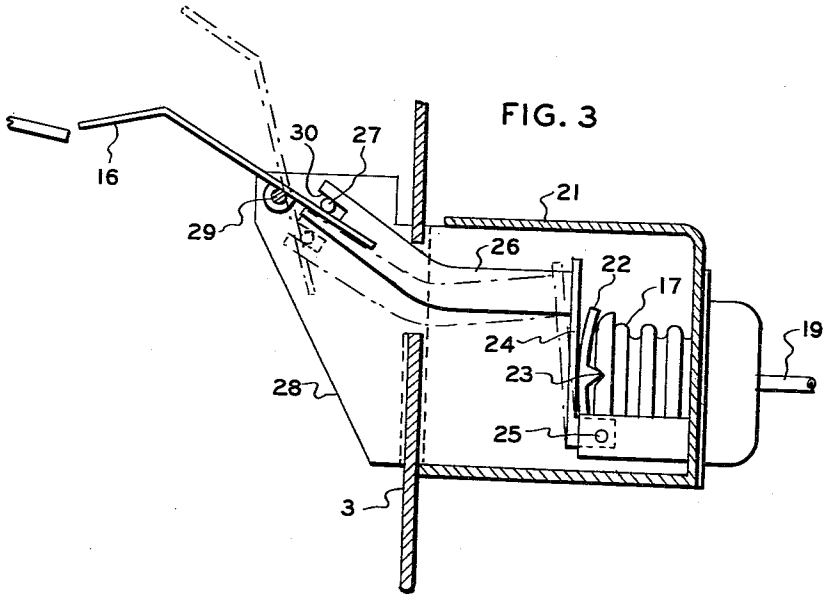


FIG. 3



INVENTOR.
RAYMOND L. DILLS

BY Sheridan & Ross

HIS ATTORNEY

United States Patent Office

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AIR CIRCULATION CONTROLLING ARRANGEMENT

Raymond L. Dills, Erie, Pa., assignor to General Electric Company, a corporation of New York

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8 Claims. (Cl. 62—3)

This invention relates to refrigerators and, more particularly, to arrangements for controlling air circulation within refrigerator cabinets.

Household refrigerators of the single-door type which have both a fresh food compartment and a frozen food compartment, are usually cooled by a single evaporator forming part or all of the wall structure of the frozen food compartment. The fresh food compartment is cooled by the circulation of air over the evaporator and through the fresh food compartment and the temperature of the fresh food compartment can be varied by regulating the air flow over the evaporator. One means for controlling this air flow comprises disposing a baffle and damper arrangement between the evaporator and the fresh food compartment. Movement of the damper with respect to the stationary baffle varies the amount of air flow between the evaporator and fresh food compartment and therefore the temperature of the fresh food compartment.

A primary object of the present invention is to provide an improved arrangement for automatically controlling the flow of air in a refrigerator cabinet.

Another object of this invention is to provide a device for controlling air circulation in a refrigerator cabinet in accordance with the load on the refrigerator.

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

In accordance with this invention, there is provided a refrigerator cabinet including a food storage compartment, which has cooling means therein to maintain it at the desired temperature. The cooling means is part of a refrigerating system that includes a compressor connected to the cooling means by a suction line which has a portion thereof disposed outside the cabinet. The flow of air over the cooling means and through the fresh food compartment is controlled by suitable means, which in turn is governed by means responding to the temperature of the portion of the suction line disposed outside the cabinet. To minimize the transmission to the responsive means of violent temperature drops in the suction line, means is interposed between the responsive means and the suction line.

For a better understanding of the invention reference may be had to the accompanying drawing, in which:

Fig. 1 is an elevational view partly in section of a refrigerator cabinet partly broken away to illustrate the present invention;

Fig. 2 is an elevational view of the back of a refrigerator cabinet embodying the present invention; and

Fig. 3 is an enlarged side elevational view of a portion of Fig. 1.

Referring to the drawing and particularly to Fig. 1, there is shown a refrigerator cabinet 1 having an outer case 2 and an inner liner 3 with a suitable insulation 4 disposed therebetween. The food storage compartment 5 formed by the inner liner 3 has an access opening that

is closed by a door 6. A sloping baffle 7 is mounted in the storage compartment 5 to divide the compartment into an upper portion 8 and a lower portion 9. It will be understood that this baffle could be horizontal rather than sloping, if desired. An evaporator 10 defining a frozen food compartment is disposed in the upper portion 8 of the compartment 5.

Refrigerant is supplied to the cooling means 10 from a compressor 11. The compressor 11 is connected by suitable means (not shown) to a condenser 12 that is disposed on the back of the refrigerator cabinet 1. The refrigerant flows in a well-known manner from the condenser to the cooling means 10 through a restriction 14 such as a capillary tube. The refrigerant returns to the compressor 11 from the cooling means 10 by the suction line 15. As shown in Fig. 2, the restriction 14 and the suction line 15 are placed in heat exchange relation in order to increase the efficiency of the system.

A damper 16 cooperates with the stationary baffle 7 to control air flow in the refrigerator. The baffle 7 is spaced from the door 6 to provide an air passage between the door 6 and the baffle 7 and the baffle 7 is also spaced from the back wall of the inner liner 3 to provide a passage between the back wall of the inner liner 3 and the baffle with the damper 16 retarding air flow through the latter passage. Since the area near the door 6 is warmer than the area near the back wall of the inner liner 3, the normal air flow is down the back wall of the fresh food compartment and up the area adjacent the door 6 and across the cooling means 10.

When the damper 16 is in the position shown in Fig. 1, air circulation is substantially retarded to prevent the fresh food compartment 5 from falling below a predetermined minimum temperature that would freeze the contents of the compartment 5. When the damper 16 is in the phantom line position shown in Fig. 3, the air may circulate freely through the fresh food compartment 5 over the evaporator 10 to provide the maximum cooling effect to the fresh food compartment 5 from the evaporator 10.

In order to prevent the damper 16 from freezing in place against the baffle 7, it will be observed that the edge of the damper 16 never makes physical contact with the baffle 7 but is spaced slightly therefrom. Whether the damper 16 is in an open or closed position, it will be seen that it is always on a slope so that any water deposited thereon will run off and not freeze on the damper 16.

The damper 16 is actuated by a closed control system including a bellows 17, a temperature responsive bulb 18, and a connecting tube 19. The bulb 18 is located in a fin 20 that is fastened to the portion of the suction tube 15 of the refrigerating system outside the cabinet 1. The bulb 18 is spaced from the suction line 15 a predetermined distance with a portion of the fin disposed therebetween. The distance between bulb 18 and the suction line 15 is determined by the rate of heat transmission desired from the suction line 15 to the bulb 18.

The temperature of the gas passing through the suction line varies depending on the load on the refrigerator; a heavy load on the refrigerator resulting in a high temperature and a light load resulting in a low temperature. The control system for the bellows is designed so that the damper 16 is actuated to an open position when the suction line 15 has a high temperature and to a closed position when the suction line has a low temperature.

Thus, it will be seen that the bulb 18 could ordinarily be placed in direct contact with the suction line 15 to reflect the temperature thereof to move the damper to its desired position. However, there is an occasional surge of liquid refrigerant through the suction line 15 resulting in a violent temperature drop. If the bulb 18 were placed in direct contact with the suction line 15, it will be readily

observed that the violent temperature drop in the suction line 15 would be transmitted to the bulb 18 whereby the damper 16 would be moved to a closed position even though conditions required the damper 16 to be in its open position. Thus, the fin 20 serves to prevent this undesired surge actuation of the damper 16, and yet permits the general suction line temperature to govern the position of the damper 16.

To obtain this desired action, the fin or bracket 20 can, for example, be made of steel .060" thick with the bulb 18 being spaced 1½" from the suction tube 15 in the fin 20. This arrangement permits heat to be transmitted from the suction line 15 to the bulb 18 at the desired rate to cause the bellows 17 to actuate the damper 16 in response to general suction line temperatures but prevents the violent temperature drops in the suction line resulting from liquid refrigerant momentarily flowing therethrough from being transmitted to bulb 18 actuating the damper 16. Thus, the spacing obtained by the fin prevents the undesired movement of the damper to its closed position when a surge of liquid refrigerant passes through the suction line but does cause the bulb 18 to sense normal or continuing changes in the suction line temperature so that the damper will close when the temperature of the suction gas passing through the suction line drops due to a decrease in load on the refrigerator.

As the purpose of the fin is to control the rate at which the heat in the suction line 15 is transmitted to the bulb 18, it will be obvious that the fin may be made of any of a number of heat conducting materials provided the dimensions thereof including cross-sectional area and length between tube 15 and bulb 18 are varied accordingly to permit the proper rate of heat transfer therebetween. For example, when aluminum is employed instead of steel, the thickness of the fin between the tube 15 and the bulb 18 would be reduced to approximately .020" for the same spacing of 1½". It will be seen that by maintaining the same rate of heat transmission regardless of the material of the fin that the bellows will be moved the same distance by the same temperature change in the suction line. The use of the fin 20 results in the damper 16 opening when the refrigerator is under a heavy load and closing when the refrigerator is under a light load.

The bellows 17 is positioned within a casing 21 that is disposed between the inner liner 3 and the outer case 2 of the refrigerator cabinet. The bellows 17 is connected to a member 22 at a raised portion 23 of the member 22. The member 22 is secured to a second member 24, which is pivotally mounted at 25 on the casing 21. An arm 26 is connected to the second member 24 at a point remote from the pivot point 25 and extends through an opening in the inner liner 3. The damper 16 has a stud 27 which fits in the slot 30 in the end of the arm 26 as shown in Fig. 3. A pair of brackets 28 are connected to the inner liner 3 and have a stud 29 therebetween that serves as a pivot for the baffle. The open and closed positions of the baffle are controlled by the mechanical leverage ratio between the bellows 17 and arm 26. This ratio could be varied to provide the desired opening and closing positions.

Considering the operation of the apparatus, the damper 16 is in its closed position when the bellows 17 is contracted. Under conditions of relatively light load on the refrigerator, the temperature of the suction line will be at a low point in its range and the bellows 17 will accordingly be contracted so that the damper 16 will be in its closed position. As the load on the refrigerator increases, the temperature of the suction line 15 increases and causes an expansion of the charge in the closed system resulting in an expansion of the bellows 17. The expansion of the bellows 17 results in the second member 24 pivoting about point 25 to move the arm 26 whereby the damper 16 is moved to the phantom line position. This produces an increased amount of air circulation through the refrigerator. This increased circulation of air over the cooling means 10 and through the fresh food compartment 5 provides more effective cooling of the compartment 5 and enables the maintenance of a substantially constant temperature therein despite the increase in the load. The opposite shifting of the bellows occurs upon a decrease in load resulting from a decrease in the suction line temperature, which is transmitted through the fin 20. This contraction of the bellows 17 results in a reduction in the amount of air circulated over the cooling unit and through the compartment 5 so that the danger of freezing fresh food stored within the fresh food compartment 5 is minimized.

The present invention has the advantage of controlling the circulation of air within the fresh food compartment in response to the suction line temperature, which is the temperature that will indicate an increased load more quickly than any other portion of the refrigerating system. The fin of proper thermal conductivity permits the minimization of the surging temperature of the suction line so that the suction line temperature may be employed to control the amount of air circulated through the fresh food compartment.

While the present invention has been described by reference to a particular embodiment thereof, it will be understood that modifications may be made by those skilled in the art without actually departing from the invention. Therefore, the appended claims are intended to cover all such variations as come within the true spirit and scope of the invention.

I claim:

1. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means for said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, means for controlling flow of air over said cooling means and through said compartment, means responsive to the temperature of the portion of said suction line disposed outside said cabinet for controlling the position of said air controlling means, and means disposed between said responsive means and said suction line and in heat exchange relation with said responsive means and said suction line to minimize the transmission to said responsive means of violent momentous temperature fluctuations in said suction line.

2. A refrigerator including a refrigerating unit, a food storage compartment and cooling means for said compartment, a suction line connecting said cooling means and said refrigerating unit, means within said compartment defining a passage for air circulating over said cooling means and through said compartment, means for controlling flow of air through said passage, means responsive to the temperature of said suction line for controlling the position of said air controlling means, and means disposed between said responsive means and said suction line and in heat exchange relation with said responsive means and said suction line to minimize the transmission to said responsive means of violent temperature drops in said suction line.

3. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means disposed in the upper portion of said compartment, a baffle spaced from the bottom of said cooling means and extending across the width of said compartment, said baffle extending substantially the entire depth of said compartment, and being spaced from the back of said compartment to provide a passage for air circulating within said compartment and over said cooling means, a damper disposed within said passage for controlling the circulation of air therethrough, means responsive to the temperature of the suction line of said refrigerating system for controlling the position of said damper, and means disposed between said responsive means and said suction line and in heat exchange rela-

tion with said responsive means and said suction line to minimize the transmission to said responsive means of violent temperature drops in said suction line.

4. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means disposed in the upper portion of said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, a baffle spaced from the bottom of said cooling means and extending across the width of said compartment, said baffle extending substantially the entire depth of said compartment and being spaced from the back of said compartment to provide a passage for air circulating within said compartment and over said cooling means, a damper disposed within said passage for controlling the circulation of air therethrough, means responsive to the temperature of the portion of said suction line disposed outside said cabinet for controlling the position of said damper, and means disposed between said responsive means and said suction line and in heat exchange relation with said responsive means and said suction line to minimize the transmission to said responsive means of violent temperature drops in said suction line.

5. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means for said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, means within said compartment defining a passage for air circulating over said cooling means and through said compartment, a damper for controlling the flow of air through said passage, a bellows connected to said damper to actuate said damper, temperature responsive means connected to said bellows, and a fin disposed in heat exchange relation with said portion of said suction line disposed outside said cabinet, said temperature responsive means being disposed in heat exchange relation with said fin, said temperature responsive means being responsive to the suction line temperature to cause the bellows to actuate the damper to control the flow of air through said passage, said fin minimizing the transmission to said temperature responsive means of violent temperature drops in said suction line.

6. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means for said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, means within said compartment defining a passage for air circulating over said cooling means and through said compartment, a damper for controlling the flow of air through said passage, a bellows connected to said damper to actuate said damper, temperature responsive means connected to said bellows, and a fin disposed in heat exchange relation with said

portion of said suction line disposed outside said cabinet, said fin having a low thermal conductivity, said temperature responsive means being disposed in heat exchange relation with said fin, said temperature responsive means being responsive to the suction line temperature to cause the bellows to actuate the damper to control the flow of air through said passage, said fin minimizing the transmission to said temperature responsive means of violent temperature drops in said suction line.

7. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means for said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, means within said compartment defining a passage for air circulating over said cooling means and through said compartment, a damper for controlling flow of air through said passage, temperature responsive means connected to said damper to actuate said damper, and a fin disposed in heat exchange relation with said portion of said suction line disposed outside said cabinet, said temperature responsive means being disposed in heat exchange relation with said fin, said temperature responsive means being responsive to the suction line temperature to actuate the damper to control the flow of air through said passage, said fin minimizing the transmission to said temperature responsive means of violent temperature drops in said suction line.

8. In a refrigerator having a cabinet providing a food storage compartment, a refrigerating system including cooling means for said compartment and a compressor, a suction line connecting said cooling means and said compressor, a portion of said suction line being disposed outside said cabinet, means within said compartment defining a passage for air circulating over said cooling means and through said compartment, a damper for controlling flow of air through said passage, temperature responsive means connected to said damper to actuate said damper, and a fin disposed in heat exchange relation with said portion of said suction line disposed outside said cabinet, said fin having low thermal conductivity, said temperature responsive means being disposed in heat exchange relation with said fin, said temperature responsive means being responsive to the suction line temperature to actuate the damper to control the flow of air through said passage, said fin minimizing the transmission to said temperature responsive means of violent temperature drops in said suction line.

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