United States Patent

McLean

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[54] REFRIGERATOR-FREEZER WITH FAST CHILL ARRANGEMENT

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[52] **U.S. Cl.** **62/157,** 62/180, 62/419

[51] **Int. Cl.** **F25d 17/00**

[58] **Field of Search** 62/419, 157, 179, 180

[56] **References Cited**

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[57] **ABSTRACT**

The titled apparatus in which a fast chill space is provided in the upper portion of the refrigerator compartment by providing an auxiliary fan in communication mainly with the refrigerator space and to a substantially lesser degree with the passage through which chilled air is received from the cooling means of the freezer compartment. The auxiliary fan is energized independently of the cooling means for a time period corresponding to the time typically required to chill the particular articles undergoing chilling.

7 Claims, 5 Drawing Figures

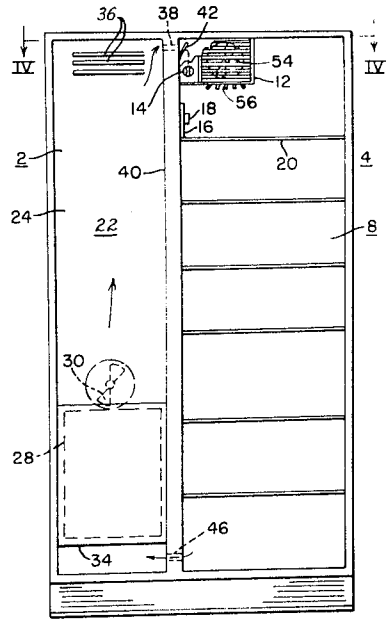


FIG. 2

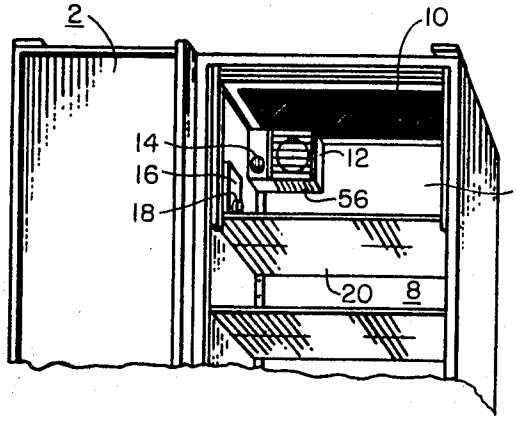
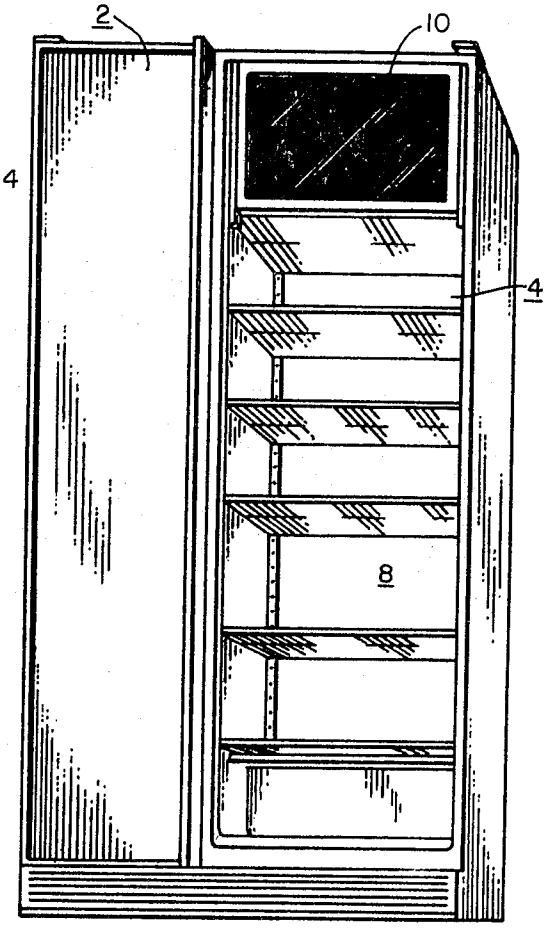


FIG. 1



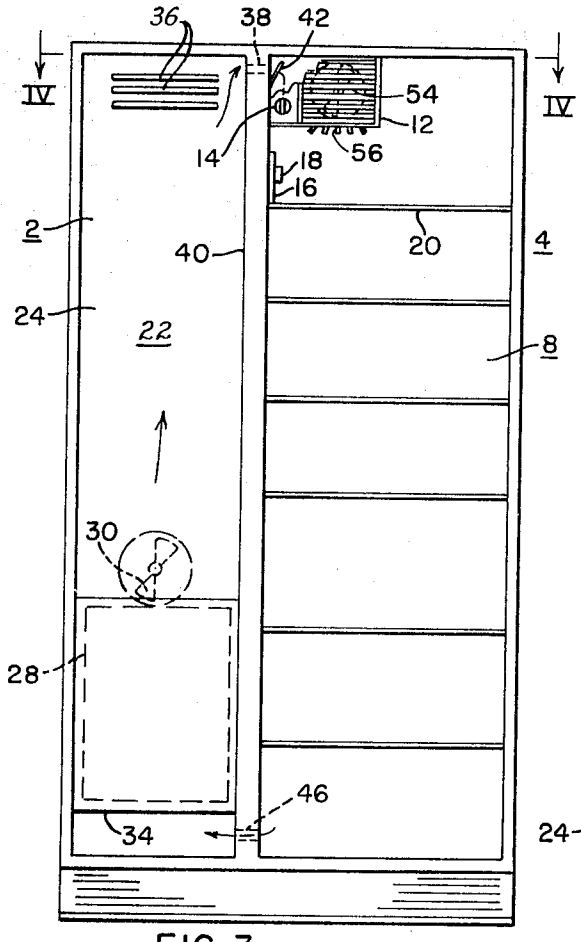


FIG. 3

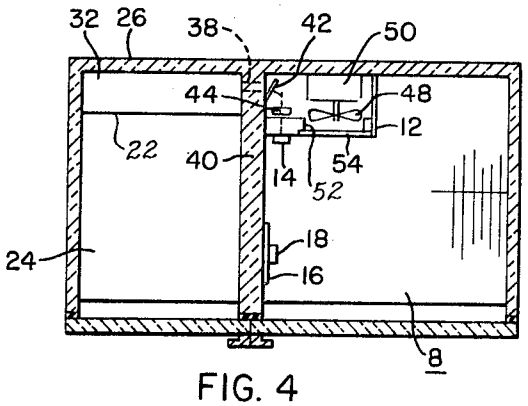


FIG. 4

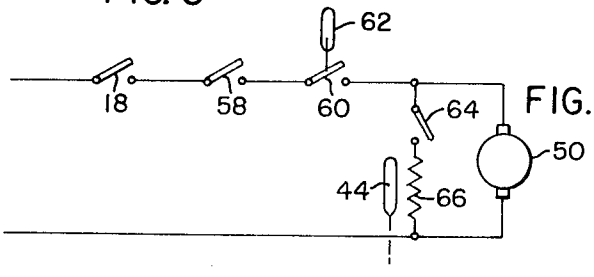


FIG. 5

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REFRIGERATOR-FREEZER WITH FAST CHILL ARRANGEMENT

CROSS REFERENCE TO RELATED APPLICATIONS

U.S. Design Patent application Ser. No. D-41181, filed Mar. 25, 1970, is directed to the appearance of one refrigerator-freezer in which my invention may be employed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to refrigerator-freezers, and particularly to air flow systems utilized therein.

2. Description of the Prior Art

No prior art of particular pertinence to this invention is known to me. However, a general description of a common air flow system for a typical side-by-side refrigerator freezer may be useful in understanding how my invention is employed therein, and the relationship between the improvements which constitute my invention and what is known to be old in such refrigerator-freezers.

One common cooling and air flow arrangement for a side-by-side refrigerator-freezer has a single refrigerant evaporator located behind a vertical panel forming the liner rear wall of the freezer compartment. That panel forms the front wall of a vertical passageway containing the evaporator and a main fan for drawing air from the freezer compartment into the lower end of the passageway. The air is chilled and moisture removed as it passes through the evaporator. Most of the air is directed into the upper end of the freezer compartment for recirculation therein, while a small part is directed through or around the common insulating wall between the freezer and refrigerator compartment to the upper portion of the refrigerator compartment. A return air passage is also provided through or around the insulating wall between the refrigerator and freezer compartments. A damper, either manually or thermostatically controlled, is typically provided for the inlet passage. The foregoing description is that of a common prior art cooling system and air flow arrangement for a side-by-side refrigerator-freezer.

SUMMARY OF THE INVENTION

My invention is intended to provide a fast chill space in the refrigerator compartment in the vicinity of the inlet passage through which chilled air is delivered to the refrigerator space. Thus, in a side-by-side refrigerator where the inlet passage is adjacent the top of the refrigerator space, an auxiliary fan which is energized independently of the main fan for the main cooling system is provided. Preferably the fan is timer controlled so that in energizing the fan a selected time period of fan operation is also established. Housing means for the fan is provided so that the extent of communication of the suction side of the fan with the space in the refrigerator compartment relative to the inlet passage for chilled air from the freezer space can be established. The relationship of the communication between the refrigerator space and the inlet passage from the freezer side favors that of the refrigerator space to a substantial degree to limit the temperature of the air discharged by the auxiliary fan to a value of about freezing when the cooling system of the freezer side is operating. Accordingly, during operation of the auxiliary fan when the cooling system of the freezer side is not operating the temperature of the air discharged by the auxiliary fan will be substantially that of the temperature of the air as a whole in the refrigerator space.

DRAWING DESCRIPTION

FIG. 1 is a perspective view of a side-by-side refrigerator-freezer embodying my invention with the door for the refrigerator compartment omitted and an auxiliary door at the front of the fast chill space in its closed position;

FIG. 2 is a fragmentary perspective view of the upper portion of the refrigerator compartment with the auxiliary door raised and in retracted position underlying the top wall of the refrigerator compartment;

FIG. 3 is a front elevational view of a diagrammatic character for illustrating one example of the general relationship of the main parts of the system according to my invention;

FIG. 4 is a horizontal section, also of diagrammatic character, corresponding to one taken along the line IV—IV of FIG. 3; and

FIG. 5 is a simplified schematic of one example of an electrical circuit for energizing the auxiliary fan.

BRIEF DESCRIPTION OF ONE EMBODIMENT

The side-by-side refrigerator-freezer shown in FIG. 1 includes a freezer side space 2 and a refrigerator side space 4 in a common cabinet. The fast chill space 6 is located at the upper end of the refrigerator compartment 8. An auxiliary door 10 comprising a perimetric frame and a translucent panel is adapted to be moved to its position in FIG. 1 to close the front of the fast chill space 6 when the fast chill operation is to be carried out. The door is retractable to a position in which it underlies the top wall of the refrigerator compartment (as shown in FIG. 2) when the fast chilling operation is not being carried out and the upper part of the compartment is to simply be used for general purpose storage.

As may be seen in FIG. 2 an auxiliary fan housing 12 is provided in the upper, left rear corner of the refrigerator compartment 8. The housing may also be used to mount the temperature control and adjusting knob 14 for the compartment. A timer panel 16 is shown mounted on the left wall of the fast chill space and carries a timer switch knob 18. The timer panel may also conveniently carry a list of different food items which typically may require chilling, and the particular time periods suggested for accomplishing the chilling of each particular food article. An ordinary open-work refrigerator shelf 20 is provided at the generally lower boundary of the fast chill space to support articles to be fast chilled, and to support general articles when a fast chill operation is not being carried out.

Turning now to FIGS. 3 and 4, the general arrangement of parts in a side-by-side refrigerator-freezer of one type with which the invention may be utilized, and the general air flow system, will now be described. A vertically disposed panel 22 forming the rear liner wall of the freezer compartment 24 is spaced forwardly from the insulated rear wall 26 of the cabinet sufficiently to accommodate the thickness of a refrigerant evaporator 28 and the main fan means 30, and to form a vertically extending passage 32 at the rear of the freezer compartment. The air flow through this passage is in an upward direction with the air being admitted to the open lower end 34 from the lower portion of the freezer space. Openings 36 at the upper end of the panel 22 permit most of the air forced up the passage to be discharged into the freezer compartment 24. A minor portion of the air flowing at the upper end of the passage is directed through the inlet passage 38 extending through the common insulated wall 40, separating the freezer compartment 24 from the refrigerator compartment 8, to the interior of the auxiliary fan housing 12. Typically a damper 42 is provided for the inlet passage 38 to control the amount of air admitted to the refrigerator compartment 8 through the inlet passage. While the damper may be arranged to be manually adjusted it is indicated in FIG. 4 as being thermostatically controlled, as is also conventional, by the provision of a temperature responsive means 44. The means 44 senses the temperature in the refrigerator compartment and moves the damper toward open and closed positions in accordance with the differential between the temperature at which the means 44 is set and the refrigerator compartment air temperature. The knob 14 (FIG. 2) is used to set the thermostatic control means 44 to maintain the refrigerator compartment at a warmer or cooler temperature. The return of air from the lower part of the refrigerator compartment 8 to the lower part of the freezer compartment 24 is through the passage 46 in the lower portion of the common wall 40.

The auxiliary fan 48 driven by motor 50 is located in the auxiliary fan housing 12. The arrangement may be a simple

propeller type fan in a fan ring arrangement **52** which also defines the opening through which air is discharged when the fan is operating. Inclined louvers **54** at the discharge opening direct the air partly downwardly. A number of openings **56** are provided in the bottom face of the auxiliary fan housing **12** to place the interior of the fan housing in relatively open communication with the space in the refrigerator compartment **8**.

While the interior of fan housing **12** is in communication with both the inlet passage **38** and the space in refrigerator compartment **8**, it is noted that the communication with the refrigerator space is substantially less restricted than the communication with the inlet passage **38**. The communicating relationships may conveniently be arrived at empirically, and are such that when the auxiliary fan **48** is operated in the absence of a cooling operation occurring in the freezer side, the temperature of the air circulated by the auxiliary fan is only slightly depressed from the existing refrigerator compartment temperature. For example, if the refrigerator space is at about 38° F. in the upper portion thereof, the auxiliary fan will typically draw only sufficient air through the restricted communication with the inlet passage **38** (which in turn is in communication with the freezer passage **32**) to depress the temperature a degree or two at most. However, when a cooling operation is occurring in the freezer side so that the main fan **30** is operating to draw air through the refrigerant evaporator **28** and force it up through the freezer passage **32**, the air being discharged by the auxiliary fan **48** may be at, say, 32° F. with a 0° F. compartment setting and a refrigerator compartment setting of about 38° F. This is the currently preferred arrangement with respect to the relationship of the communication between the refrigerator compartment and the inlet passage **38**, although it would be appreciated that this relationship may be changed by changing the communicating relationships.

Some of the considerations which bear on the relationship are as follows. When the fast chill space is not being used for chilling (i.e., the upper part of the refrigerator compartment is simply being used for general purpose cooling), there must be sufficient openings in the auxiliary fan housing that without the auxiliary fan **48** running, the portion of air directed through the inlet passage **38** is not unduly restricted by the auxiliary fan housing and internal parts. In other words, the openings should be sufficient that there is negligible resistance to that air flow exiting from the fan housing without the auxiliary fan operating. On the other hand, to obtain as sufficiently rapid chilling as is practically advisable when the auxiliary fan **48** is operating, some portion of the air drawn by the fan **48** should be through the inlet passage **38**, particularly if the articles to be fast chilled introduce a substantial load in the refrigerator space. However, this portion of air should not be more than a quantity which, mixed with the refrigerator compartment air, will ordinarily depress the exiting temperature from the auxiliary fan to much below freezing. The reason for ordinarily limiting the fast chill temperature is that some of the articles to be chilled, such as salads, gelatin, fresh fruit and the like, should not be frozen by the discharge of the air. Thus, as an example, air which is too cold directed upon lettuce will cause it to freeze rapidly with a subsequent browning of the lettuce.

It is to be understood that in a normal use of the fast chill operation, the auxiliary fan **48** will be operating part of the time while a cooling operation is occurring in the freezer side, and part of the time in the absence of a cooling operation. For example, with a stabilized load condition in the freezer side, the compressor will perhaps run two or three times per hour with, say, a 40 percent run time at a 70° F. room temperature and, say, a 60 percent run time at a 90° F. room temperature. If a load is introduced into the freezer side when the fast chill operation is to occur, the compressor may run continuously for an hour to bring the temperature in the freezer side down and to cool the articles which created the load. Of course, a heavy load may be introduced into the refrigerator compartment by the articles themselves, and this will tend to raise the air temperature of the compartment as a whole, including the temperature of the air being circulated in the fast chill. However, the chilling will still be faster than if the air were not being circulated. Also, as soon as a cooling operation has started (if it is not already going on when the fast chill operation is started), the added heat due to the fast chill operation will raise the temperature of air returning to the freezer side and thereby prolong the cooling operation.

Some of the suggested times for articles which typically are to be fast chilled are as follows: Instant puddings and cold cuts — 15 to 30 minutes; fresh fruits and salads — 30 to 60 minutes; gelatin — 45 to 90 minutes; cooked puddings — 60 to 90 minutes; and beverages — 90 to 120 minutes. Thus it will be appreciated that in most of the fast chill operations it may be expected that a cooling operation in the freezer side will occur at some time during the fast chill operation. However, even when a cooling operation is not occurring, an increased rate of chilling is attained, as compared to still air, as a result of the increased heat transfer obtainable with an increased velocity of air of a given temperature moving past an article to be chilled.

A schematic for the electrical circuit for operating the fast chill arrangement, including optional controls therein, is shown in FIG. **5**. The switch **18** indicates a manually set, mechanical timer switch for energizing the fan motor **50**. A door switch **58**, which is closed when the main door for the refrigerator compartment is closed, is also ordinarily advisable. An optional switch **60**, controlled by thermostatically responsive means **62** in the fast chill space, may be provided to serve as a low temperature limit switch which is normally closed and will open with a drop in temperature in the fast chill space to a preselected temperature such as 31° F. Additionally, an accelerated fast chill may be provided at the option of the user through a switch **64** for energizing a low wattage heater **66** located close to the thermostatic element **44** controlling the damper **42**. The optional arrangement of the switch **64** and heater **66** would be used only when an accelerated and deeper chill would not damage the articles being chilled, or other articles in the refrigerator compartment. Closing of switch **64** will result in heating of the element **44** so that the damper **42** will open beyond its normal position and thereby additional air can be admitted through the inlet passage **38** to the fan housing to decrease the temperature of the air discharged by the auxiliary fan **48**.

It will be appreciated that while the description of one preferred embodiment has been in connection with a side-by-side refrigerator-freezer, the concept of the invention is not limited in application to only such units but may also be applied in other units such as either top or bottom mounts as well.

I claim as my invention:

1. In a refrigerator-freezer:

a freezer compartment;

a refrigerator compartment;

cooling means including an evaporator and main fan means for recirculating air over said evaporator and through said freezer compartment;

inlet passage means for admitting a portion of said recirculating air to said refrigerator compartment;

outlet passage means for returning air from said refrigerator compartment to said cooling means;

second fan means in major communication with said refrigerator compartment and in minor communication with said inlet passage for drawing air from both said inlet passage and said refrigerator compartment and discharging said drawn air into said refrigerator compartment for promoting the chilling of articles placed in said compartment adjacent the discharge of said second fan means; and

manually operated means for controlling the periods of operation of said second fan means independently of operation of said main fan means, and independently of temperature variations in said refrigerator compartment, so that said second fan means can be operated regardless of whether or not said main fan means is operating.

2. In a refrigerator-freezer according to claim 1:
said control means for said second fan means includes adjustable timer means.

3. In a refrigerator-freezer according to claim 1 including:
thermostatically controlled damper means for said inlet passage means; and
means for selectively changing the control of said damper means in accordance with operation of said second fan means.

4. In a refrigerator-freezer according to claim 1 wherein:
said second fan means is located in the upper portion of said refrigerator compartment.

5. In a refrigerator-freezer:
a freezer compartment;
a refrigerator compartment;
cooling means including an evaporator and main fan means for recirculating air to said refrigerator compartment;
outlet passage means for returning air from said refrigerator compartment to said cooling means;
second fan means for circulating air in said refrigerator compartment independently of operation of said main fan means, said second fan means being in communication with both said refrigerator compartment and said inlet passage, said communication with said refrigerator compartment being to a substantially greater extent than with said inlet passage so that the temperature of said independently circulating air in the absence of operation of said cooling means is approximately the temperature of said refrigerator compartment, and during the operation of said cooling means is reduced in accordance with the ratio of air admitted through said inlet passage to air drawn from said refrigerator compartment space; and
manually operated means for controlling the periods of operation of said second fan means independently of operation of said main fan means, and independently of temperature variations in said refrigerator compartment, so that said second fan means can be operated regardless of whether or not said main fan means is operating.

6. In a side-by-side refrigerator-freezer of the frost-free type and having cooling means associated with the freezer compartment and including an evaporator and main fan means for recirculating air mainly through said freezer compartment and to a lesser extend through an inlet to said refrigerator compartment when said cooling means is operating, the improvement comprising:
a housing for a second fan means in said refrigerator compartment to receive air admitted to said refrigerator compartment from said freezer compartment;
second fan means in said housing;
said housing having an outlet for said second fan means for directing air upon articles placed in the upper part of said refrigerator compartment, said housing being sufficiently open to the air in said refrigerator compartment, relative to its communication with the inlet from said freezer compartment, that the temperature of the air circulated by said second fan means in the absence of operation of said cooling means is approximately the temperature of the air in said refrigerator compartment, and during operation of said cooling means is reduced in accordance with the increased quantity of air drawn from said inlet passage; and
manually operated means for controlling the periods of operation of said second fan means independently of operation of said main fan means, and independently of temperature variations in said refrigerator compartment, so that said second fan means can be operated regardless of whether or not said main fan means is operating.

7. In the refrigerator-freezer according to claim 6:
said control means for said second fan means includes adjustable timer means for setting the duration of operation of said second fan means.

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