Feb. 9, 1971 W. M. WEBB 3,561,231

COMBINATION REFRIGERATOR WITH ICE SERVICE IN FRESH COMPARTMENT DOOR

Filed April 3, 1969

3 Sheets-Sheet 1

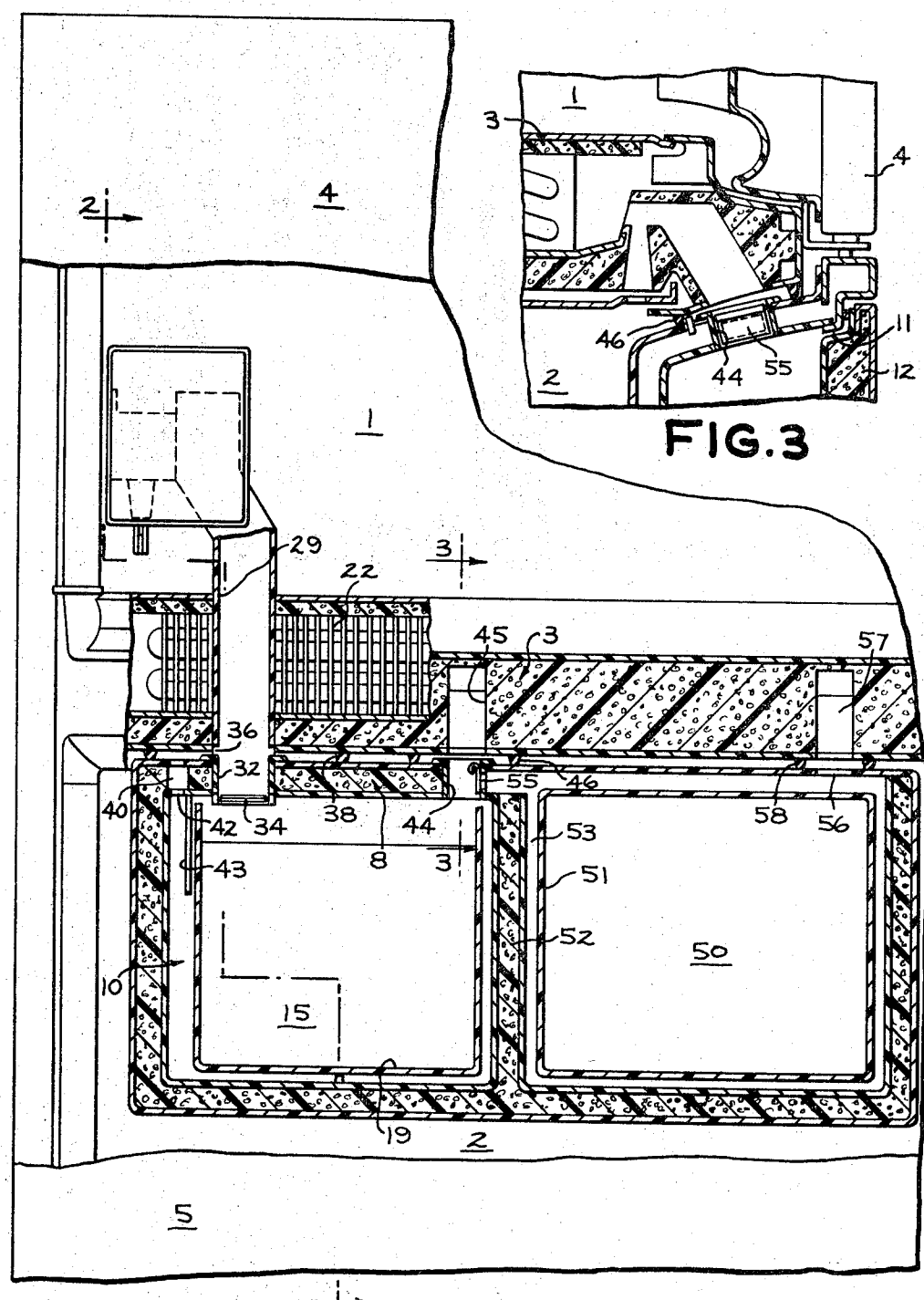

FIG. 1

FIG. 3

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COMBINATION REFRIGERATOR WITH ICE SERVICE IN FRESH COMPARTMENT DOOR

Filed April 3, 1969 3 Sheets-Sheet 2

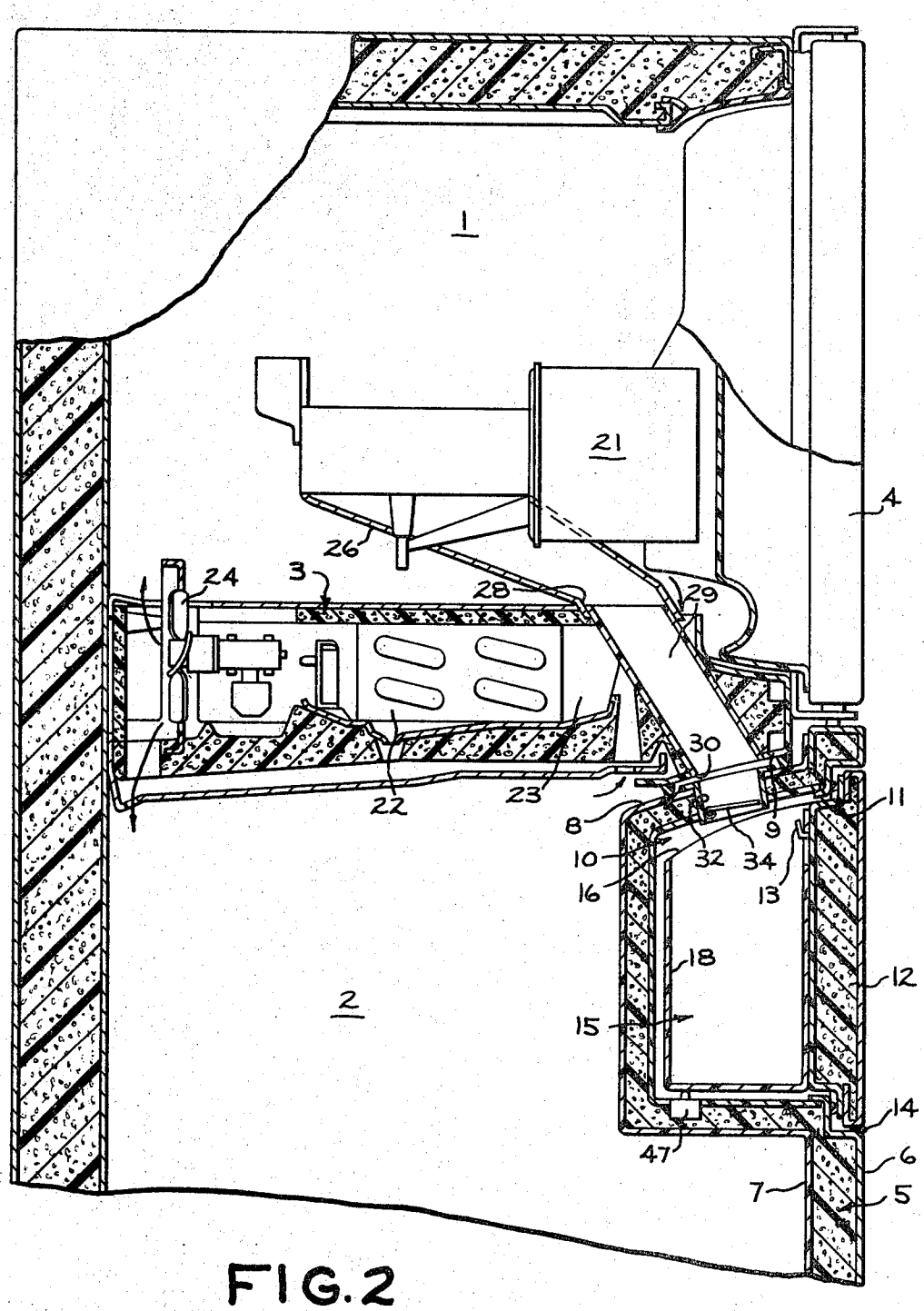

FIG. 2

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COMBINATION REFRIGERATOR WITH ICE SERVICE IN FRESH COMPARTMENT DOOR

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FIG.4

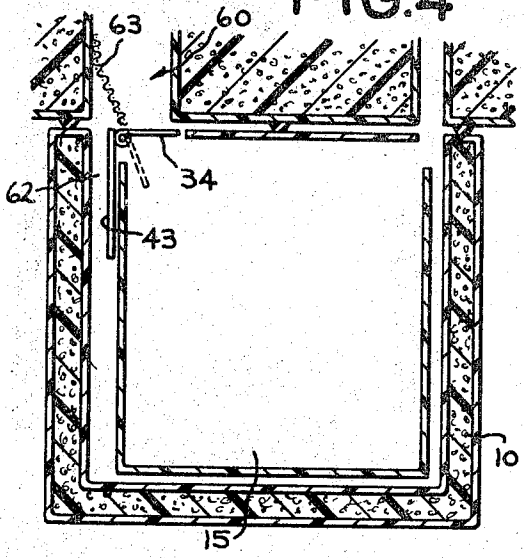
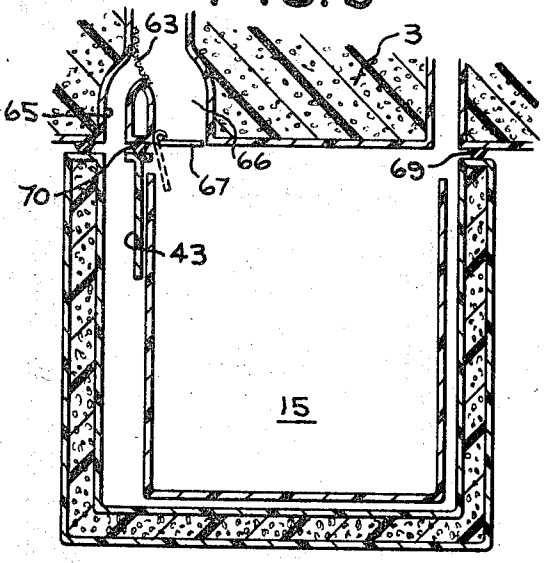


FIG.5



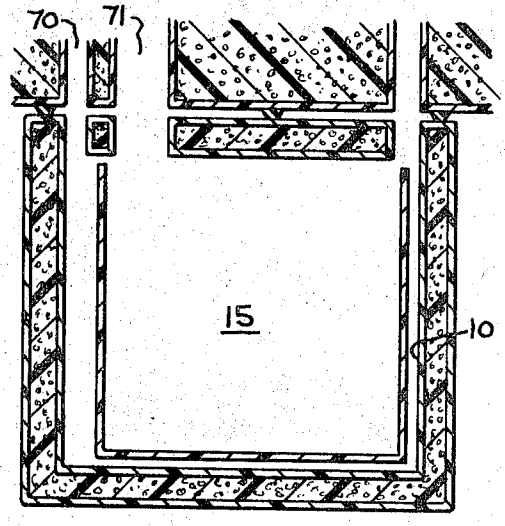
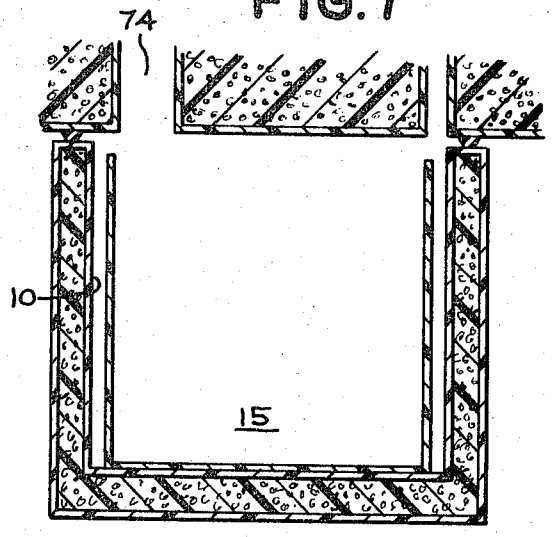


FIG.6

FIG.7



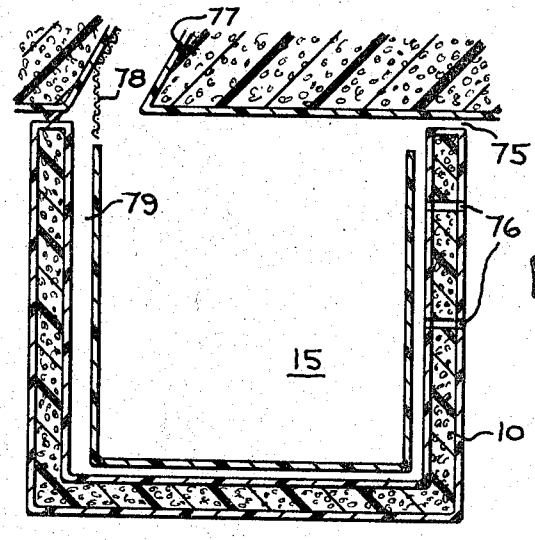


FIG.8

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3,561,231

COMBINATION REFRIGERATOR WITH ICE SERVICE IN FRESH COMPARTMENT DOOR

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Filed Apr. 3, 1969, Ser. No. 813,222
Int. Cl. F25d 17/08, 23/02
U.S. Cl. 62—344 11 Claims

ABSTRACT OF THE DISCLOSURE

A combination refrigerator comprising a freezer compartment and a fresh food compartment separated by a partition includes an automatic ice maker in the freezer compartment and an insulated ice storage compartment containing an ice receptacle forming part of the fresh food compartment door structure. Passage means are provided for conducting both ice pieces produced by the ice maker and below freezing air to the ice storage compartment.

BACKGROUND OF THE INVENTION

Household refrigerators containing automatic ice makers include a receptacle for receiving the ice pieces produced by the ice maker and storing these ice pieces in a freezer compartment at below freezing temperatures. Most of the commerically available refrigerators including this feature require opening of the freezer compartment door to obtain access to the stored ice pieces. Each door opening results in entrance of moist air into the compartment served by that door and loss of refrigerated air from that compartment.

There is presently available on the market one refrigerator including a "through-the-door" ice service by means of which ice pieces can be obtained without opening of a main compartment door. This refrigerator, as described and claimed in the copending application of Dwight W. Jacobus et al. Ser. No. 669,254, filed Sept. 20, 1967 and assigned to the same assignee as the present invention, features an ice maker and an ice piece dispensing receptacle mounted within the freezer compartment of the refrigerator and a normally closed passage in the freezer compartment door through which ice pieces from the dispenser are conveyed to a dispensing recess in the face of the freezer door.

Another refrigerator, specifically a side-by-side combination refrigerator-freezer providing exterior ice service is disclosed and claimed in the copending application Ser. No. 866,832, filed Oct. 16, 1969, by Philip J. Drieci, entitled "Refrigerator Including Through-the-Door Ice Service" and assigned to the assignee of the present invention. Certain features of this earlier invented Drieci ice service are incorporated within the subject matter of the present application.

For maximum user convenience, an exterior or through-the-door ice service, should make the ice pieces available to the user at a reasonable height, for example, at about countertop level. In a combination refrigerator including an upper freezer compartment and a lower fresh food compartment, the desirable ice delivery level is within the area of the fresh food compartment door. A combination refrigerator of this type including automatic exterior ice service is described and claimed in the copending application Ser. No. 756,746, filed Sept. 3, 1968 in the name of R. J. Alvarez and assigned to the same assignee as the present invention. This service includes an automatic ice maker and a combination storage and dispensing receptacle mounted in the upper freezer compartment and means for conveying ice pieces automatically dispensed by the dispenser through the dividing partition and the upper portion of the fresh food compartment door to a service area in the face of the fresh food compartment door. In this service, the ice dispenser occupies valuable space in the freezer compartment and also requires a motor driven dispensing means for discharging ice pieces from the storage receptacle so that they can be delivered through the passages to the service area.

SUMMARY OF THE INVENTION

The present invention has as its general object the provision of a lower cost exterior ice service in the fresh food compartment door of a combination refrigerator. It is more particularly concerned with a combination refrigerator including an upper freezer compartment and a lower fresh food compartment including an automatic ice maker in the freezer compartment and means associated with the fresh food compartment door for both storing ice pieces produced by the automatic ice maker and making these ice pieces available to the user without opening of the fresh food compartment door.

In accordance with the present invention, the refrigerator comprises an upper freezer compartment and a lower fresh food compartment separated by a horizontal partition with the door for closing the access opening to the fresh food compartment having a storage area on the inner side thereof below the front portion of the partition when the door is closed. Means including a plurality of insulated walls define an ice storage compartment within the upper part of the fresh food compartment door and insulated from the fresh food compartment. The ice storage compartment also includes an opening in the face of the door, normally closed by a closure member mounted on the door, through which ice pieces stored in an ice receptacle positioned within the ice storage compartment can be manually removed. Means for conducting ice pieces produced by an ice maker positioned in the freezer compartment to the storage receptacle includes a passage in the partition arranged to discharge ice pieces directly into the receptacle. At least a portion of the passage extending through the partition may also be used to convey below freezing air, which may be freezer compartment air, to the ice storage compartment to maintain this compartment at below freezing temperatures. In accordance with one embodiment of the invention, the freezer compartment air stream is prevented from coming in direct contact with the stored ice pieces and causing sublimation thereof and to this end means are provided for diverting the air stream around one or more sides of the receptacle rather than directly into the receptacle.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing:

FIG. 1 is a front elevational view, partly in section, of a combination refrigerator including an ice service of the present invention;

FIG. 2 is a vertical sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view of a portion of the refrigerator taken generally along line 3—3 of FIG. 1;

FIG. 4 is a sectional view of one modification of the ice service;

FIG. 5 is a sectional view of a further modification thereof;

FIG. 6 is a sectional view illustrating an ice service with separate air and ice passages;

FIG. 7 illustrates, in section, a low cost version of the ice service; and

FIG. 8 is a view showing alternative air return means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be specifically described in its application to a household refrigerator including an upper freezer compartment **1** and a lower fresh food compartment **2** separated by a horizontal partition **3**. The front access openings to these compartments are respectively closed by a freezer compartment door **4** and a fresh food compartment closure member in the form of a door **5**.

The fresh food door **5** comprises an outer panel **6** forming the face of the door and an inner panel or door structure **7** spaced from the outer panel with the space between the panels generally filled with suitable heat insulating material. At least a portion **8** of the inner panel **7** extends rearwardly in overlapping relation to a front portion **9** of the partition **3** when the door is in its closed position.

The fresh food door **5** also includes insulated walls which define an ice storage compartment **10** on the inner surface of the door **5** insulated from the fresh food compartment. Access to this ice storage compartment **10** without opening door **5** is provided by a relatively small passage or opening **11** extending through the face of the door and this opening **11** is normally closed by an insulated secondary or ice service door **12**. In the illustrated embodiments of the invention the lower edge of the secondary or ice service door **12** is hingedly supported as indicated at **14** on the main door **5** for tilting movement about its hinged axis from a closed position to a tilted open position.

An ice storage bin or receptacle **15** is suitably supported on the inner surface of the ice service door **12** as by means of hooks **13** as illustrated in FIG. 2 of the drawing in such a position that when the door **12** is tilted to its open position, access to the contents of receptacle **15** can be obtained through the open top **16** thereof. In the embodiment of the invention shown in FIGS. 1, 2 and 3 the receptacle **15** is preferably somewhat smaller than the interior of the compartment **10** with the result that its opposed side walls **17**, its rear wall **18** and its bottom wall **19** are spaced from the adjacent walls of the compartment **10**.

An automatic ice maker **21** for manufacturing ice pieces is mounted within the freezer compartment **1** above the partition **3**. This ice maker may be of any of the well known types, the one illustrated in the drawing being of the type described and claimed in Pats. 3,163,017, Baker et al.; and 3,163,018 Shaw, issued Dec. 29, 1964.

Both the freezer compartment **1** and the fresh food compartment **2** are maintained at the desired operating temperatures by the circulation of air from these compartments over an evaporator **22** positioned in an evaporator chamber **23** within the partition **3**. This circulation of air is effected by a fan **24**. The duct work for withdrawing air from the front ends of the two compartments and returning the cooled air to the rear areas of the compartments is preferably, for reasons which will become evident hereinafter, so designed that a slightly higher pressure is maintained in the freezer compartment **1** than in the chamber **23**.

Means for conveying ice pieces periodically discharged from the ice maker **21** to the receptacle **15** comprises an inclined chute **26** having an open top end **27** supported along one side of the ice maker and a lower end **28** connected to the upper end of a passage **29** extending downwardly through the forward edge portion **9** of the partition **3**. The lower end **30** of the passage **29** opens in the lower surface of the front portion **9** of the partition above the door portion **8** and the compartment **15**. In the embodiment of FIGS. 1, 2 and 3, portion **8** is insulated and a second vertical passage **32** in the edge portion **8** in alignment with the passage **29** provides means for conveying the ice pieces from the passage **29** through the edge portion **8** and into the open top **16** of the receptacle **15**.

The passage **29** also forms part of the air flow means for conveying air from the freezer compartment **1** to the ice storage compartment **10** to maintain the temperature in the ice storage compartment below freezing. To prevent this air stream from directly entering the top of the receptacle **15**, and impinging on the stored ice with a possible sublimation of the ice pieces, the lower end of the passage **32** is provided with a trap door **34** which is spring biased to its illustrated position for substantially closing the lower end of the passage **32** but which will be pivoted downwardly to an open position by the weight of the ice pieces dropping through this passage.

In this embodiment, most of the freezer air flowing downwardly through the passage **29** is prevented from directly entering the receptacle **15**. Instead it passes through the space **36** between the lower end **30** of the passage **29** and the upper end of the passage **32** into the space between the lower surface **9** of the partition and the edge portion **8** of the fresh food compartment door. An annular sealing gasket **38** carried on the lower surface **9** of the partition in cooperation with an air passage **40** extending through the lower edge portion **8** within the confines of the gasket **38** serve to direct this bypass flow of air downwardly into the compartment **10** at a point to one side of the receptacle **15**. Specifically the lower end **42** of passage **40** enters compartment **10** at a point between a side wall **17** of the receptacle and the adjacent side wall of the compartment **10**. A partition **43** between the outlet end **42** of the duct **40** and the side wall **17** of the receptacle aids in preventing this freezer compartment air from passing over the top of the receptacle and into the interior thereof.

The freezer compartment air thus conveyed to the ice storage compartment **10** passes around the side and bottom walls of the receptacle **15** and then flows back to the evaporator chamber **23** through an air return passage **44** in the door edge portion **8** and a cooperating passage **45** in the partition communicating with the chamber **23**, these passages being on the opposite side of the receptacle from the inlet passage **40**. A gasket **46** surrounding the adjacent ends of passages **44** and **45** prevents leakage of air into the fresh food compartment.

This air flow through the ice storage compartment **10** is preferably effected by the pressure differential maintained between the freezer compartment and evaporator chamber. It will be obvious of course that a separate fan associated with the ice storage compartment air flow circuit may be used to assure circulation of below freezing air from the freezer compartment or from the evaporator chamber into and through the ice storage compartment.

In operation of the refrigerator shown in FIGS. 1, 2 and 3, whenever the fan **24** is running to circulate air from the two compartments **1** and **2** through the evaporator chamber **23** a portion of the below freezing air in the freezer compartment **1** flows downwardly through the passage **29** into the ice storage chamber compartment **10**. After circulating around the side walls and beneath the bottom wall of the receptacle **15**, this air flows to the evaporator chamber **23** through the passages **44** and **45**. This air flow path is open at all times but trap door **34** is closed. Whenever the ice maker operates to discharge a plurality of ice pieces into the duct **26**, these ice pieces slide downwardly along the duct **26** into the passage **29** and the passage **32**. Engagement of the ice pieces with trap door **34** effects an opening of this trap door to permit the ice pieces to drop into the open top **16** of the receptacle **15**. Access to these stored ice pieces, without opening of the fresh food compartment door **5**, is obtained through the door **12**. A switch **47** may be provided for stopping the fan **24** and hence the flow of air into the ice storage compartment **10** whenever the ice service door **12** is opened.

It will be understood, of course, that the automatic operation of the ice maker may be stopped by an suitable weight or level sensing means when the bin is filled. A preferred means for this purpose employing

a photoelectric sensor is described and claimed in the copending application Ser. No. 812,922, filed concurrently herewith in the names of William M. Webb and Daniel N. Toma and assigned to the same assignee as the present invention.

If desired there may also be provided a second storage compartment on the inner surface of the door **5** for operation at either a below freezing temperature or at a temperature above freezing but lower than the temperature maintained in the fresh food compartment **2**. Such a compartment **50**, as illustrated in FIG. 1 of the drawing, may be adjacent one side of the compartment **10**. It is preferably of a double walled construction including inner walls **51** spaced from outer walls **52**, which may or may not be insulated, the spaces **53** between these walls forming air flow channels for the circulation of air from the ice storage compartment around the compartment **50**. The amount of air passing through the spaces **53** and hence the temperature maintained within the compartment **50** is controlled by positioning of a bypass vane **55** in one side wall of the air return duct **44**. When this vane **55** is in the position illustrated in FIG. 1 of the drawing all of the air which has passed through the ice storage compartment **10** is returned directly to the evaporator chamber as previously described. The vane **55** may be partially or completely opened to divert part or all of this return air into the spaces or passages **53** for maintaining a desired temperature within the storage compartment **50**. Such air is then returned through a passage **56** and the passage **57** to the evaporator chamber **23**, these passages **56** and **57** having the same design and function as passages **44** and **45**. A gasket **58** encircling or surrounding the adjacent ends of the passages **56** and **57** prevents this return air from entering the fresh food compartment **2**. It will be understood of course that an access door (not shown) to the compartment **50** may be provided on either the inner or outer sides thereof.

If desired, separation of the ice and air delivery paths may occur within the passage in partition **3** as illustrated somewhat schematically in FIGS. 4, 5 and 6. In the modification of FIG. 4, at least the lower end of the combined ice and air passage, indicated by numeral **60**, is relatively wide with the lower or outlet end **61** thereof overlying both one end of the ice receptacle **15** and an air flow space **62** adjacent that end. A slanting perforated ice deflector **63** within the passage deflects ice pieces into the receptacle through trap door **34** but permits most of the below freezing air to flow through the deflector **63** directly towards space **62**.

In the modification of the invention illustrated in FIG. 5, the air and ice are separated within the partition **3** using, if necessary, a perforated ice deflector **63** so that the air stream and ice leave the partition **3** through separate outlets **65** and **66** with the air outlet **65** above the space **62** and the ice outlet **66** above the receptacle **15**. This design also permits the location of the trap door, indicated by numeral **67**, on the partition **3** instead of on the upper door edge. Also, in this design, the top of the ice service compartment **10** is open so that the ice stored in the receptacle **15** is also accessible when the fresh food door is opened. Leakage of below freezing air to the fresh food compartment is prevented by a gasket **69** surrounding the open top of the ice storage compartment. If desired, a gasket **70** above partition **43** may be used to prevent short circuiting of the air stream across the top of the bucket to the air return passage **45**.

In the embodiment of FIG. 6 the partition includes separate air and ice passages respectively indicated by numerals **70** and **71**. This construction may also be employed for conducting, by means of suitable ducts, below freezing air to the ice storage compartment **10** from the evaporator chamber rather than from the freezer compartment.

Where possible sublimation of stored ice is not considered important, no precautions need be taken to prevent air circulation within the receptacle **15**.

Means for separating the air and ice can then be omitted. A relatively low cost ice storage and service such as that illustrated in FIG. 7 is possible. In this service both the air stream and ice are introduced into the ice storage compartment **10** through a passage **74** above receptacle **15** and, like the modification of FIG. 5, the top of the compartment **10** is open for access to the receptacle **15** when the fresh food door is opened.

Also if desired, the return air from the ice storage compartment **10** can be directed or released into the fresh food compartment **2** either by omitting portions of the sealing gasket between the fresh food door **5** and the partition **3** as indicated by the numeral **75** in FIG. 8 or by providing one or more air return passages **76** in one or more side walls of compartment **10** communicating with the fresh food compartment.

The modification of FIG. 8 also features an air and ice piece passage **77** to the compartment **10** assuring a substantial separation of air and ice entering that compartment. Specifically passage **77** slants in a direction to discharge most of the air stream through ice deflector **78** and into the space **79** adjacent one side of receptacle while the ice deflector turns ice pieces into the receptacle **15**.

While there has been shown and described a number of embodiments of the invention, it is to be understood that the invention is not limited thereto and it is intended by the appended claims to cover all modifications falling within the spirit and scope of the invention.

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

1. In a refrigerator comprising a freezer compartment and a fresh food compartment separated by a partition and a door for closing the access opening to the fresh food compartment:

an automatic ice maker in said freezer compartment;

means defining an insulated ice storage compartment within said door;

said door including an opening in the face thereof communicating with said ice storage compartment and normally closed by a closure member mounted on said door;

means for conducting ice pieces produced by said ice maker to said ice storage compartment comprising an ice passage extending from said freezer compartment through said partition;

air flow means for circulating a stream of below freezing air through said ice storage compartment; and

a receptacle positioned in said ice storage compartment to provide a space between said receptacle and an adjacent wall portion of said ice storage compartment; said air flow means including air flow directing means for directing most of said air stream into said space.

2. In a refrigerator comprising an upper freezer compartment and a lower fresh food compartment separated by a partition and a door for closing the access opening to the fresh food compartment having an upper edge overlapping said partition:

an automatic ice maker in said freezer compartment;

means defining an insulated ice storage compartment within and adjacent the upper edge of said door and below said partition when said door is closed;

said door including an opening in the face thereof communicating with said ice storage compartment and normally closed by a closure member mounted on said door;

means including a passage in said partition for conducting ice pieces produced by said ice maker to said ice storage compartment; and

air flow means in said partition for circulating a stream

of below-freezing air to said ice storage compartment.

3. The refrigerator of claim 2 including a receptacle positioned in said ice storage compartment to provide a space between said receptacle and an adjacent wall portion of said ice storage compartment and said air flow means includes air flow directing means for directing most of said airstream into said space.

4. The refrigerator of claim 2 in which said ice storage compartment has an ice access opening thereto in said upper door edge and including sealing means between said portion and upper door edge for preventing below freezing air being conducted to said ice storage compartment from escaping to said fresh food compartment when said door is closed.

5. The refrigerator of claim 2 in which said air flow means includes means for conducting air from said ice storage compartment to said fresh food compartment.

6. In a refrigerator comprising an upper freezer compartment and a lower fresh food compartment separated by a horizontal partition, a door for closing the access opening to the fresh food compartment and having a rearwardly extending edge portion in overlapping relation to a front portion of said partition when said door is in its closed position:

an automatic ice maker in said freezer compartment;

means including said door edge portion defining an ice storage compartment on the inner side of said door insulated from said fresh food compartment;

said door including an opening in the face thereof communicating with said ice storage compartment and normally closed by a closure member mounted on said door;

an ice receptacle positioned in said ice storage compartment with walls thereof spaced from the adjacent walls of said ice storage compartment;

means for conducting ice pieces produced by said ice maker to said receptacle comprising a first passage extending downwardly from said freezer compartment through said partition and having an outlet in said front portion of said partition and a second vertically extending passage in said edge portion for receiving ice pieces from said first passage and discharging them into said receptacle;

means including said first passage for circulating a stream of air from said freezer compartment into said ice storage compartment; and

air flow directing means for preventing most of said air stream from flowing directly into said receptacle.

7. The refrigerator of claim 6 in which said air flow directing means directs the flow of most of said air stream into the space between the said walls of said receptacle and the adjacent walls of said ice storage compartment.

8. The refrigerator of claim 7 in which said air flow directing means includes a trap door in said second passage.

9. In a refrigerator comprising an upper freezer compartment and a lower fresh food compartment separated by a horizontal partition, a door for closing the access

opening to the fresh food compartment and having a rearwardly extending upper edge portion in overlapping relation to a front portion of said partition when said door is in its closed position, an evaporator chamber in said partition separate from said compartments and containing an evaporator operating at below freezing temperatures and means for circulating air from said freezer compartment through said chamber and back to said freezer compartment:

an automatic ice maker in said freezer compartment;

means including said door edge portion defining an insulated ice storage compartment on the rear side of said door;

said door including an opening in the face thereof communicating with said ice storage compartment and normally clased by a closure member mounted on said door;

an ice receptacle positioned in said ice storage compartment to form a space between the walls thereof and the adjacent walls of said ice storage compartment;

means for conducting ice pieces produced by ice maker to said receptacle comprising a first passage extending from said freezer compartment downwardly through said partition and having an outlet in said front portion of said partition and a second passage in said edge portion for receiving ice pieces from said first passage and discharging them into said receptacle;

means including said first passage for circulating a stream of air from said freezer compartment through said ice storage compartment and to said evaporator chamber;

and air flow directing means for directing most of said air stream into the space between said receptacle and said ice storage compartment walls.

10. The refrigerator of claim 9 in which said air flow directing means includes a trap door in said second passage openable by ice pieces passing therethrough and a third passage in said edge portion directing air from said first passage directly to the space between said receptacle walls and said ice storage compartment walls.

11. The refrigerator of claim 9 including an additional storage compartment adjacent said ice storage compartment and means for selectively directing the flow of air from said ice storage compartment to said evaporator chamber into cooling relationship with said additional compartment.

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WILLIAM E. WAYNER, Primary Examiner

U.S. Cl. X.R.

62—377, 424