

[54] REFRIGERATION APPARATUS

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[58] Field of Search 62/186, 187, 408, 419, 190

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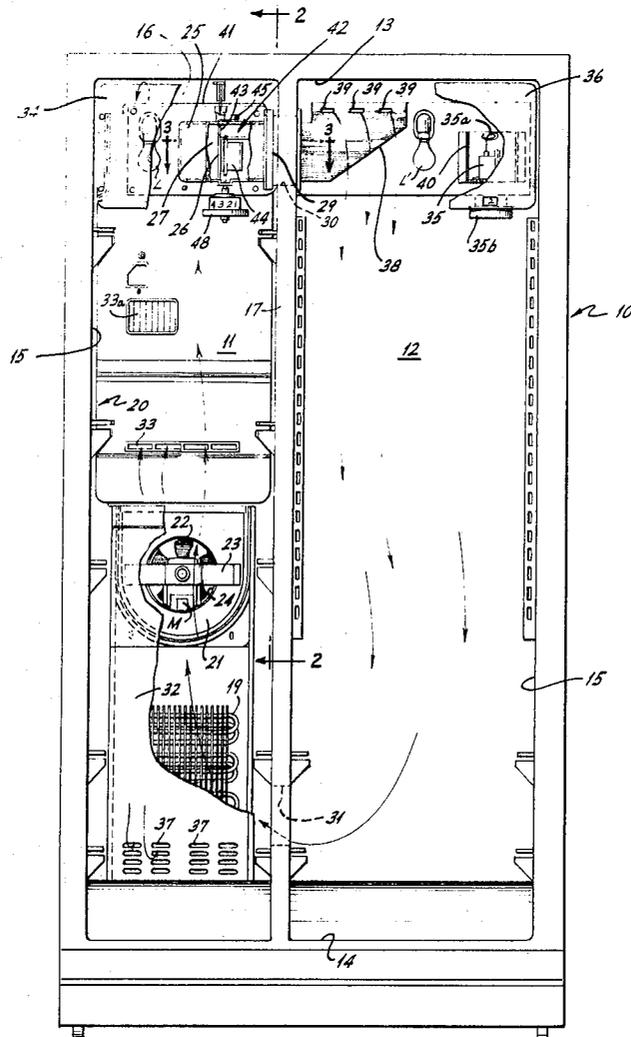
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[57] ABSTRACT

A dual-compartment refrigerator having a single evaporator, a single fan, and ducts associated therewith for directing air from within each compartment over the evaporator, and for returning the air to the compartments. Operation of the evaporator is under the control of a thermostat in the warmer, food storage compartment, and temperature of the colder, frozen storage compartment is established and maintained by a manually adjustable, compound damper effective to proportion air flow between the compartments and the evaporator. The compound damper includes a first portion adjustable to establish the desired temperature differential as between the compartments, and a second portion adjustable according to season, or to extremes of usage, to maintain desirable temperature levels within each compartment.

12 Claims, 5 Drawing Figures



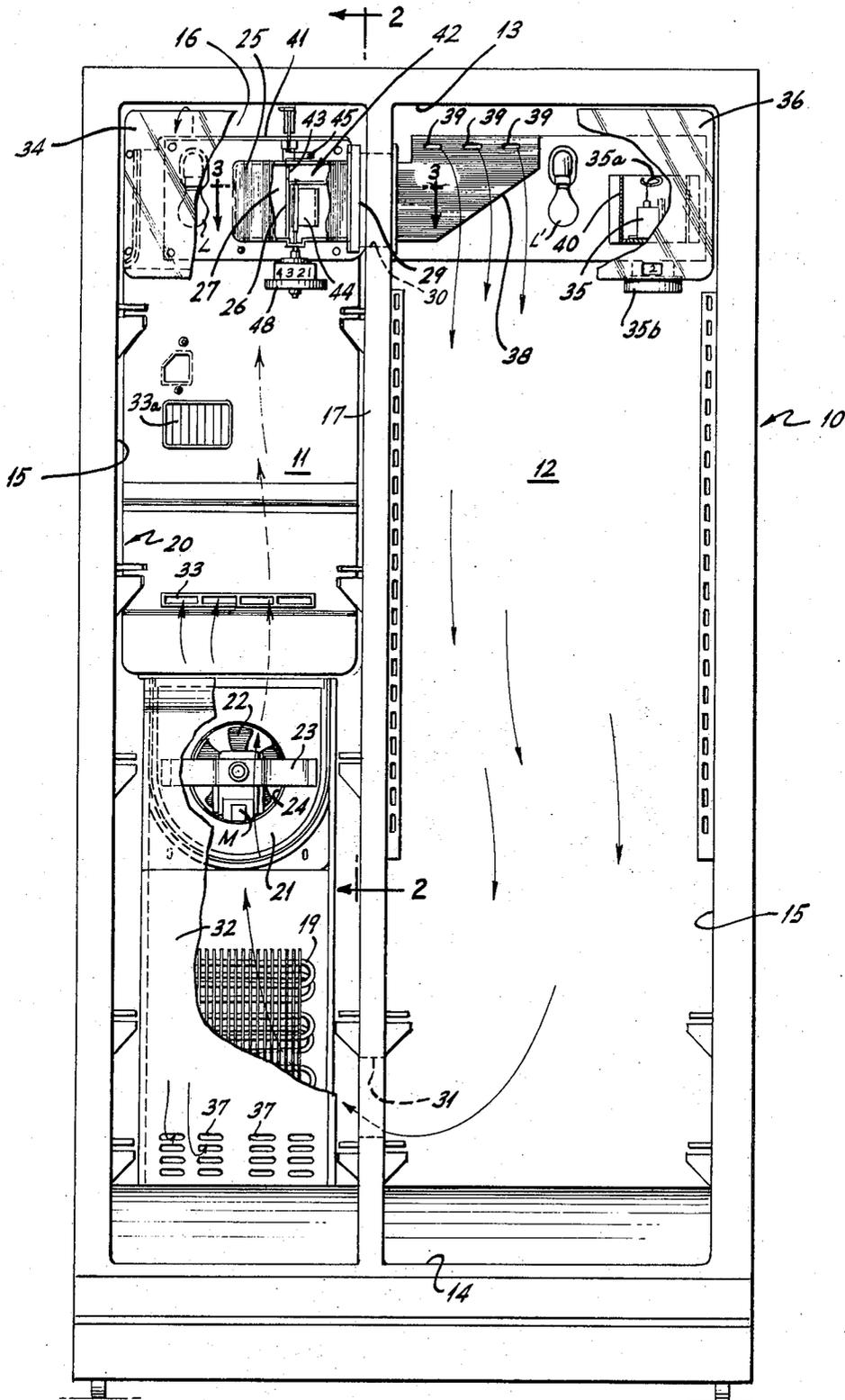


FIG. 1.

FIG. 3.

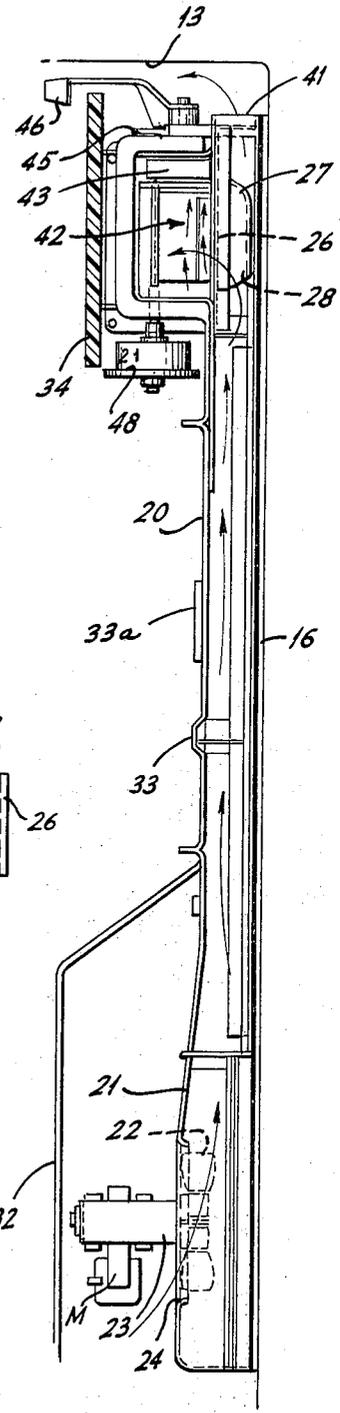
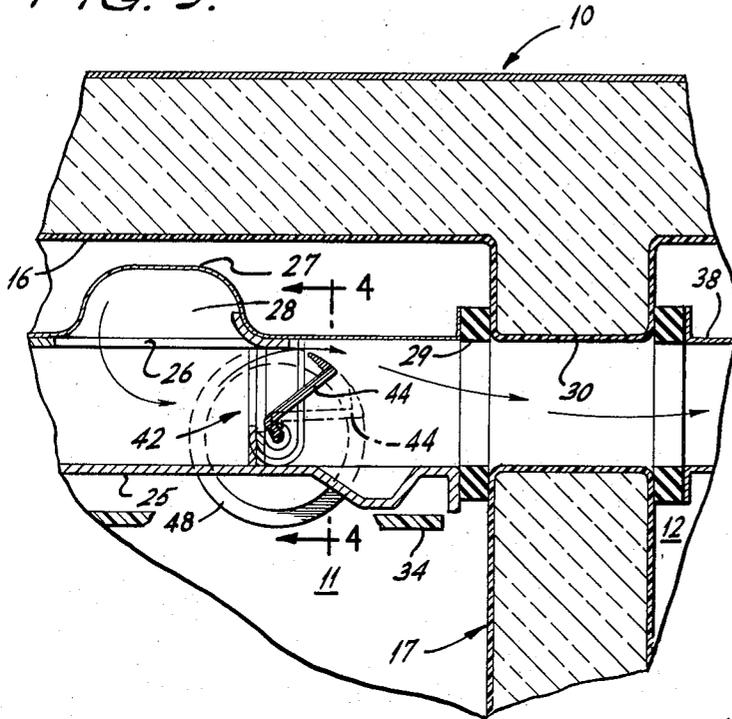


FIG. 5.

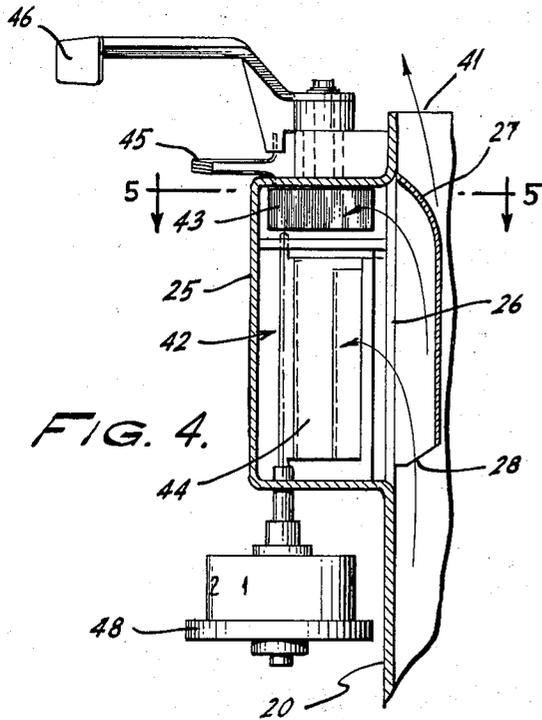
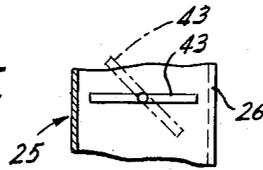


FIG. 2.

REFRIGERATION APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to refrigeration apparatus, and more particularly to temperature control means for plural compartment refrigerator cabinets.

More particularly, the invention has to do with improvements in the temperature control of plural compartment refrigerators of the forced air circulation type having a single fan and a single evaporator.

In a dual compartment, single-fan, single-evaporator refrigerator of one known type, thermostatic control of the evaporator is achieved using an air-temperature sensing element in the warmer food storage compartment. An adjustable air flow divider proportions the flow of air cooled by the evaporator, through the frozen storage and the food storage compartments, in provision of a desired temperature differential between these storage compartments.

If the air flow divider be adjusted, however, for a particular ambient atmosphere condition, for example 70° F., then satisfactory control may not be achieved at a higher ambient atmosphere temperature, for example 110° F., due to unequal rates of heat flow into the food storage and the frozen storage compartments. In the higher ambient temperatures, the refrigerating unit will tend to operate for longer periods of time, causing the frozen storage compartment to become colder than necessary, since operating temperatures of the unit are a function of the temperature sensed in the food storage compartment. Excessive operation of the refrigerating unit may also occur under conditions of extreme usage, characterized by a large number of door openings per day, or by insertion of substantial quantities of warm foods in the refrigerator.

It is an objective of this invention to provide improved air flow divider means for proportioning the flow of air between a pair of storage compartments and the region of an evaporator, or like means forming part of the cooling unit, whereby to achieve uniformity of storage temperatures over a range of ambient temperatures.

It is a further objective of the invention to provide more flexible control of single-thermostat, two-compartment refrigerators.

A still further objective of the invention is to provide improved control means for dual-compartment, single-evaporator, single-fan refrigerators, ensuring rapid restoration of storage temperatures under extreme conditions of thermal loading.

SUMMARY OF THE INVENTION

In achievement of the foregoing as well as other objectives and advantages, the invention contemplates provision, in a dual compartment refrigerator cabinet of the type including an evaporator, a fan, ducts leading to and from said evaporator and said compartments, and a temperature control for said evaporator, of improved flow divider means for proportioning air flow through said air ducts and into said compartments, comprising compound damper means in one of said air ducts including a first adjustable portion operable to establish a desired temperature differential as between said compartments, and a second adjustable portion operable to establish desired temperature levels within each compartment in accordance with ambient atmospheric temperatures.

The manner in which the foregoing as well as other objectives of the invention may best be achieved will be more fully understood from a consideration of the following description, taken in light of the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational showing of a two-compartment refrigerator cabinet embodying the invention, with doors removed and parts broken away for convenience of illustration;

FIG. 2 is a sectional showing, on a larger scale, taken along the line indicated by arrows 2—2 applied to the cabinet seen in FIG. 1, and illustrating details of air handling means to which the invention is particularly directed;

FIG. 3 is a sectional showing of the air handling means seen in FIG. 1, taken generally along the line indicated by arrows 3—3 applied to the latter figure;

FIG. 4 is a sectional showing of a portion of the air handling means seen in FIG. 3, taken generally along the line indicated by arrows 4—4 applied to FIG. 3; and

FIG. 5 is a sectional showing of a portion of the air handling means as shown in FIG. 4, taken generally along the line indicated by the arrows 5—5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With more detailed reference to FIG. 1, a refrigerator cabinet 10 includes a pair of compartments 11 and 12 disposed in side-by-side relation and defined by insulated top, bottom, side and rear walls 13, 14, 15, 16, respectively, in cooperation with an insulated central wall 17 integrally formed with walls 13, 14 and 16. The liner of this refrigerator may be and preferably is of the type disclosed and claimed in the copending disclosure of John A. Scarlett bearing Ser. No. 311,722, filed Dec. 7, 1972, and assigned to the assignee of this invention. Access to compartments 11 and 12 is afforded by doors of conventional design (not shown) which may be hinged to cabinet 10 along their respective outer vertical edges and held closed by conventional means, both to seal and to latch the doors against the frontally facing surfaces of cabinet 10.

Cooling is afforded by an electrically defrostible evaporator 19, preferably of the fin-and-tube type, disposed in the lower region of left-hand compartment 11. Evaporator 19 is connected in conventional series refrigerant flow circuit with a compressor, a condenser, and a capillary tube restrictor, none of which elements is shown. The compressor and condenser conveniently are disposed in a compartment provided in the lower region of cabinet 10, and operation of the compressor, to establish desired temperatures, is under the control of an adjustable thermostat 35 provided with a knob 35b and having its sensing element 35a in right-hand compartment 12 so that it is responsive to temperature of air therein.

In especial accordance with the invention, and with further reference to FIGS. 3 and 4, an air flue 20 extends in spaced, substantially parallel, relation to the rear wall of compartment 11. The lower end of flue 20 is disposed above evaporator 19, and defines a shroud 21 for a fan 22 supported by its motor M on suitable bracket means 23 affixed to the shroud. Motor M is so positioned that fan 22 is aligned with an intake opening

24 formed in the shroud, for reasons to be described herein in more detail. A baffle 32 overlies evaporator 19 and fan motor M, and extends upwardly from a lower region of the rear wall of compartment 11 that defines a drain trough (not shown) for evaporator 19. Louvers 37 are provided in baffle 32 to serve as an air intake opening from compartment 11. Air discharge openings 33, 33a to compartment 11 are provided in flue 20, above the level of evaporator 19.

The upper end of flue 20 includes an air damper housing 25 provided with an upwardly presented opening 41 (FIGS. 1 and 4), and a rearwardly facing opening 26, over which extends a downwardly facing air deflector 27. The vertically extending air passage defined by flue 20 is aligned with an opening 28 defined by the lower region of deflector 27. The right hand side of damper housing 25 has another opening 29 aligned with a first opening 30 provided in an upper rear portion of center wall 17, and affording air-flow communication, between housing 25 and the upper region of compartment 12. A decorative baffle 34 overlies housing 25 and adjacent structure, such as light L, and is spaced from the liner walls to accommodate air circulation thereabout. A second opening 31 is provided in wall 17, in a lower portion thereof, and is positioned to afford air-flow communication between lower regions of compartment 12 and the region of the enclosed evaporator 19.

A tapered air duct 38 in compartment 12 communicates at its larger end with opening 30, and includes openings 39 in an upper region thereof for distributing cooled air into compartment 12. The sensing element 35a for thermostat 35 is disposed in a housing 40 adjacent duct 38, and in which location it is shielded from relatively cold air leaving openings 39. By virtue of this arrangement, thermostat 35 is fully responsive to temperatures within compartment 12. Also, a decorative baffle 36 overlies duct 38, thermostat 35, and compartment light L', and is spaced from the liner walls to accommodate circulation of air thereabout.

construction and arrangement of the elements thus far described is such that closure of thermostat 35, upon predetermined elevation of temperature within compartment 16, energizes the compressor and fan motor M. This reduces the temperature of the evaporator and drives fan 22 to withdraw air, in accordance with flow arrows seen in FIG. 1, from compartment 11 through the intake openings 37, for flow over the evaporator. After flowing over evaporator 19, the cooled air is drawn through fan shroud opening 24, and is directed upwardly through the flue. Some of this air is discharged through openings 33, 33a and the remainder continues to flow upwardly for discharge of one portion through opening 41 and for deflection of another portion by deflector 27 into opening 26 (see also flow arrows, FIGS. 3 and 4). The air discharged through opening 41 is directed into freezer compartment 11, and mixes with air discharged through openings 33, 33a, which air is returned to flue 20 through air intake 37.

In further and more particular accordance with the invention, air is caused to flow from damper housing 25, under the control of a compound damper device 42, through opening 30, into duct 38, and outwardly thereof through openings 39. Air from openings 39 flows through compartment 12, and leaves the latter through lower opening 31 for flow over evaporator 19.

The damper device comprises an upper damper 43 and a lower damper 44 each pivotally mounted for independent movements about vertically extending axes. Upper damper 43 is pivotal between an open and a closed position (see FIG. 5) by operation of a manual lever 46 (FIG. 2), and is held in one or the other position through urging of an overcenter spring 45. Lower damper 44 is movable between a fully opened and a substantially fully closed position (see FIG. 3), with intermediate partially opened and closed positions, by means of a manually operable wheel or knob 48.

The disclosed refrigerator has, in effect, three controls comprising thermostat 35, upper damper 43, and lower damper 44. Thermostat 35 controls operation of the motor compressor to maintain a preferred food compartment temperature of about 37° F., as may be selected by adjusting knob 35b, and lower damper 44 is in effect an air-splitting means which proportions the evaporator cooled air between refrigerator compartment 12 and freezer compartment 11, in order to afford desired temperature differentials (e.g., about 37° F.) between these compartments.

If damper 44 is adjusted to a setting corresponding to a particular ambient temperature, say 70° F., to afford about 0° F. freezer compartment for about a 37° F. food compartment temperature (i.e., 37° F. differential), then this same setting is not likely to afford desirable compartment temperature balance at 110° F. ambient atmospheric temperature, due to unequal rates of heat leakage into the compartments at the different ambient temperatures. For example, freezer compartment 11 will become considerably colder than necessary (e.g., less than 0° F.) in higher ambient temperatures, if the proportioning of air flow is not regulated, in view of the fact that compressor operation (hence evaporator operation) is under the control of temperatures sensed in compartment 12.

The present invention affords a solution to this problem by its provision of composite damper structure including upper damper 43 and its selective adjustability to open position for warmer seasonal temperatures (e.g., 110° F.) to decrease the flow of cold air into freezer compartment 11, and to increase the flow of cold air into food compartment 12 during the high ambient temperatures or periods of extreme usage, to compensate for increased heat leakage into food compartment 12 at these conditions.

Upper damper 43 is adjustable to closed position (full line, FIG. 5), as desired for a cooler seasonal temperature (e.g., 70° F.), to increase the flow of cold air into freezer compartment 11 and to decrease the flow of cold air into food compartment 12, thus compensating for decreased heat leakage into compartment 12 at the lower temperatures.

It is a still further feature of the invention that upper damper 43 can be moved to open position (broken line, FIG. 5) to increase the refrigeration effect in the food compartment 12 under such additional conditions as follows: when replacing foods that have been removed for the purpose of cleaning the refrigerator; when placing warm, recently purchased foods and beverages in food compartment 12; or when the door of the food compartment is to be opened more than one hundred times per day.

It will of course be understood that for any of the conditions requiring upper damper 43 to be open, the lower damper 44 should be in at least its closed or sub-

stantially closed position as is provided by rotation of knob 48 to an appropriate setting. For example, knob 48 is provided with indicia reading "1, 2, 3, Coldest" in providing temperature control for freezer compartment 11. Setting No. 1 of knob 48 affords full open position of damper 44, whereas the "Coldest" setting of knob 48 affords substantially closed position of damper 44. Lever 46 will therefore be moved to, or kept at, its "Off" position to close damper 43 when control knob 48 is set at its No. 1 or No. 2 position.

In view of the foregoing it will be appreciated that the invention affords improved control means for dual-compartment, single-evaporator, single-fan refrigerators, ensuring rapid restoration of storage temperatures under extreme conditions of thermal loading.

We claim:

1. In a refrigerator of the type comprising an insulated cabinet, an insulated divider wall in said cabinet providing separate, adjacent fresh food and frozen food compartments, means forming an air duct extending along a wall of said frozen food compartment, said duct having an inlet opening and an outlet opening, an evaporator within said insulated cabinet and positioned in said duct, a fan for moving air through said duct over said evaporator from said inlet opening to said outlet opening, air passage means for delivering a portion of the air moved by said fan to said fresh food compartment, passage means for returning air from said fresh food compartment for flow over said evaporator, and a thermostat in said fresh food compartment for controlling energization of said evaporator to maintain a predetermined temperature in said fresh food compartment, the improvements which comprise: first and second damper means extending across the path of air caused to flow through said air passage means, for controlling the air flow therethrough, said first damper means being selectively movable either to an open or to a closed position to control one portion of the flowing air, and said second damper means being selectively movable to one of a plurality of positions between substantially open and substantially closed positions to control another portion of the flowing air.

2. Improvements in a refrigerator as set out in claim 1 being further characterized in that said first and second damper means are disposed in substantially side-by-side relation in said air passage means.

3. Improvements in a refrigerator as set forth in claim 2, being further characterized in that said first damper means is of lesser area than said second damper means.

4. In a refrigerator of the type comprising an insulated cabinet, an insulated vertical divider wall in said cabinet providing separate, vertical side-by-side fresh food and frozen food compartments, means forming an air flue extending vertically along a wall of said frozen food compartment, said flue having a lower inlet opening and an upper outlet opening, an evaporator within said insulated cabinet and positioned in said flue, a fan for moving air through said flue over said evaporator from said inlet opening to said outlet opening, air passage means for delivering a portion of the air moved by said fan to the upper portion of said fresh food compartment, passage means for returning air from the lower portion of said fresh food compartment to said flue in the region of said evaporator, and a thermostat in said fresh food compartment for controlling energization of said evaporator to maintain a predetermined temperature in said fresh food compartment, the im-

provements which comprise: first and second damper means disposed in side-by-side relation in said air passage means for controlling the air flow therethrough, said first damper means being selectively movable either to an open or to a closed position, and said second damper means being selectively movable to one of a plurality of positions between substantially open and substantially closed positions.

5. Improvements in a refrigerator as set out in claim 4, being further characterized: in that said first and second damper means are mounted for pivotal movements about vertically extending, individual axes; by the inclusion of a lever for operating said first damper means, said lever being movable between a pair of positions corresponding to the open and closed positions of said first damper means, and overcenter spring means for maintaining said positions of said damper means; and by inclusion of a manually rotatable wheel for operating said second damper means.

6. Refrigerator cabinet structure including a pair of side-by-side compartments separated by a vertically extending divider wall, said wall having a first air passage therethrough in an upper region thereof and a second air passage therethrough in a lower region thereof, an evaporator in one of said compartments and including a portion disposed in the region of said second air passage, means defining a vertically extending flue in said one compartment and arranged to enclose said evaporator, an inlet air passage in a lower region of the flue, an outlet air passage in the upper region of the flue, a fan arranged to draw air through said inlet air passage, over said evaporator, and to direct said air through said outlet air passage to cool said one compartment to below-freezing temperatures, said flue communicating with said first air passage whereby a portion of the fan-forced air flows into said other compartment through said first air passage and out of said other compartment through said second air passage, thermostatic control means responsive to predetermined temperature levels in said other compartment for establishing and maintaining cyclic operation of said evaporator, and improved air flow divider means associated with said flue for proportioning air flow through said air outlet and said first passage means into said compartments, said divider means comprising a compound damper extending across said first air passage and including a first adjustable portion operable to a position establishing desired temperature levels within each compartment in accordance with ambient atmospheric conditions, and a second adjustable portion operable to a position establishing a desired temperature differential between said compartments.

7. Refrigerator cabinet structure according to claim 6, and further characterized in that: said first adjustable damper portion comprises a first vane selectively movable either to a closed position blocking off air flow through a corresponding section of said first air passage, or to an open position affording substantially full air flow through said corresponding section; and said second adjustable damper portion comprises a second vane selectively movable between a plurality of positions including substantially open and closed positions affording varying quantities of air flow as well as substantially no air flow through a corresponding portion of said air passage.

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8. Refrigerator cabinet structure according to claim 7, and further characterized in that said first vane is of lesser area than said second vane.

9. Refrigerator cabinet structure according to claim 8, and further characterized by the provision of over-center spring means operable to maintain either open or closed position of said first vane.

10. Refrigerator cabinet structure according to claim 7, and characterized further in that said air flow divider means is disposed in an upper region of said flue, and includes a deflector extending into said flue and effective to direct a portion of the air flowing in the flue through said first air passage.

11. Refrigerator cabinet structure according to claim 10, and further characterized by the inclusion of additional outlet air passage means in said flue, in a region thereof intermediate said first recited inlet and outlet passages.

12. Refrigerator cabinet structure according to claim 10, and further characterized in that said first air passage extends horizontally, in that said first and second vanes are disposed for pivotal movements about vertically extending axes, and in that said first vane is disposed at a level above the level of said second vane.

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