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REFRIGERATOR STRUCTURE

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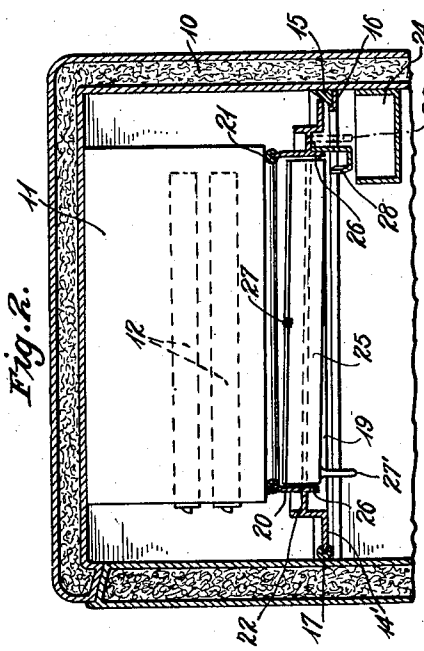


Fig. 2.

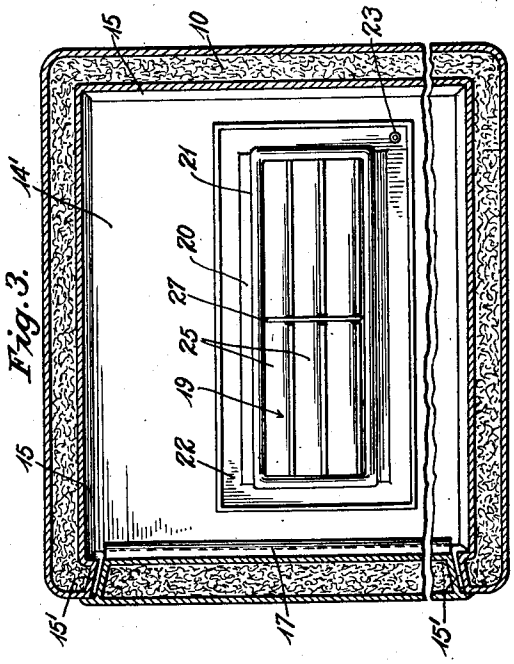


Fig. 3.

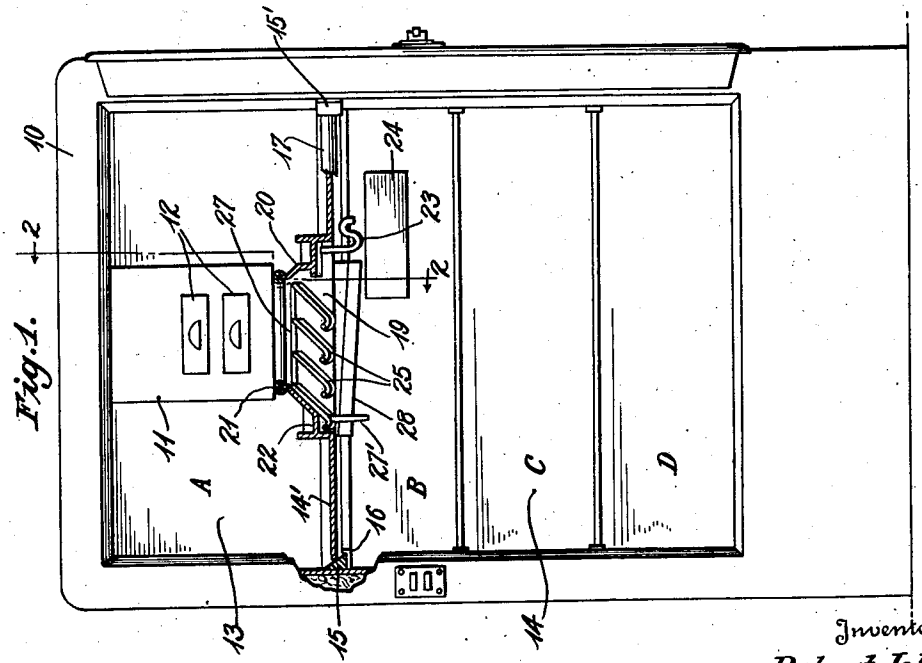


Fig. 1.

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REFRIGERATOR STRUCTURE

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32 Claims. (Cl. 62—89)

This invention relates to refrigerators of the mechanically operated type, whether continuous or intermittent, and to the process of refrigeration in which heat removal is effected by means of the evaporation of a liquid refrigerant. It has, as an object, the prevention of the transference of food odors and flavors from one food to another, and from various foods to the ice cubes and flavored ices which may be frozen, by conventional means, within the food compartments of such refrigerators. Another object of the invention is to provide means for retarding the rapid moisture-loss which occurs disadvantageously to foods stored in all known existing types of mechanically operated refrigerators. A further object of the invention is to provide a plurality of compartments within such refrigerators, which compartments may be adjustably maintained at different temperatures, whereby, if desired, the air in one of said compartments may be held at a temperature permitting of rapid freezing of ice cubes by the evaporator and quick chilling of bottled liquids, as for example 35° F., while in another of said compartments the air may be maintained at a higher temperature, such as one merely sufficient to prevent food deterioration, for example, 45° F. as against, for example, an actual air temperature of 40° F. throughout a single food compartment. A still further object of the invention is to provide means for accomplishing the foregoing results which shall be capable of easy and inexpensive installation in existing refrigerators, and which shall be economical in operation.

In a simple form of the practice of this invention the refrigerator is divided into two compartments by means of a horizontal partition or shelf made of metal possessing high thermal conductivity, and so constructed as to prevent the flow of air from one compartment to another when the refrigerator door is closed. Referring to the drawing in which like reference letters indicate corresponding parts:

Figure 1 represents a cross-sectional front view of a conventional electrically operated refrigerator in which my novel partition has been installed;

Figure 2 represents a partial cross-sectional side view of the same refrigerator, on lines 2—2 of Fig. 1;

Figure 3 represents a plan view of the metal shelf.

Referring more particularly to the drawing, 10 indicates the casing of a mechanical refrigerator in which is enclosed a conventional evaporator 11 in a refrigerator compartment. The evaporator may be of any desired type and is usually constructed to contain ice freezing trays 12 within its walls. In the form of the invention shown, the refrigerating compartment is divided into two smaller compartments 13 and 14, the upper one 13 containing the evaporator 11, by means of a shelf 14', which is preferably made of metal possessing high thermo-conductivity as, for example, tinned copper, sheet aluminum or rustless iron. This shelf is constructed to effectively seal the upper compartment 13 from the lower compartment 14 and for this purpose is positioned upon compressible gaskets 15 which support the shelf at the back and sides of the refrigerator.

The gaskets 15 have preferably a right angled triangular cross section and rest upon shelves or ledges 16 secured to the back and side walls of the refrigerator compartment. The front edge of the shelf is provided with a compressible rubber gasket 17 of sufficient thickness to form an air seal, by compression, between the shelf 14' and the door of the refrigerator 18 when the door is in closed position.

Also gaskets 15' are provided between the door and the front wall of the refrigerator to prevent passage of air between the upper and lower compartments 13 and 14 respectively through the opening usually found in conventional refrigerators. These gaskets 15' are positioned in the plane of the gasket 15 and may conveniently be continuations thereof.

The shelf is further provided with a central flue 19 formed by upstanding walls 20, which preferably slope inwardly and terminate adjacent the bottom of the evaporator 11. The upper edge of the walls 20 is provided with a compressible rubber gasket 21 which bears against the bottom of the evaporator. The shelf is so constructed that when positioned in the refrigerator the gaskets 15 between the shelf 14' and the refrigerator walls, and the gaskets 21 between the shelf and the evaporator 11, are compressed to form an effective seal between the compartments 13 and 14.

The walls 20 of the flue 19 are constructed to position the gasket 21 somewhat inwardly of the edges of the bottom portion of the evaporator and the upper portion of the shelf 14' is provided with a flange 22 surrounding the flue 19 to form a catch basin for water flowing down the sides of the evaporator when the refrigerator is defrosted. As shown in Figures 1 and 3, the shelf is so formed that the bottom of this catch basin slopes downwardly and to the rear. At the lowermost point of this catch basin an S-shaped tube 23 is provided which extends through the shelf 14' and empties into a water receptacle 24 positioned in the lower compartment 14. The S-shape of the tube forms a water trap which prevents a passage of air between the two compartments 13 and 14 but which allows water to flow from the catch basin into the receptacle 24.

Within the flue 19 are placed a series of J-

shaped dampers 25 which extend forwardly and rearwardly of the refrigerator and are mounted to rotate about their lower edges in bearings 26 carried by the front and rear walls 20 of the flue 19. The dampers 25 are connected together for simultaneous movement by means of a rod 27 pivotally connected to their upper edges. The dampers may be set in any desired position between complete closure and a position in which the top of one damper is slightly overlapping with relation to the bottom of the next and are shown in open position in Figure 1. They may be conveniently operated by a handle 27' extending from one of the dampers into the lower compartment 14.

As shown in Figure 2, the bottom edges of the damper vanes 25 slope rearwardly and terminate above a trough 28 carried by the shelf 14'. The trough 28 slopes downwardly toward the receptacle 24 and empties therein. It will be seen that water dripping from the bottom of the evaporator 11 during defrosting will be collected by the damper vanes 25, irrespective of their position, will be delivered to the trough 28, and thereby into the receptacle 24.

From the foregoing structure it will be seen that shelf 14', when the refrigerator door is closed, forms an air-tight seal between the upper compartment 13 of which it is the floor, and the lower compartment 14 of which it is the ceiling; and that the upper compartment is chilled by the side walls of evaporator 11, while the lower compartment is chilled by the bottom of evaporator 11 and by conduction through shelf 14'. It will further be seen that the natural air flow from the lower compartment to the bottom of evaporator 11 may be increased or decreased according to adjustment of dampers 25. By reason of said adjustment, it is possible to vary the relative temperatures of the two compartments by opening said dampers to their full limits, the temperature of the two compartments being maintained more closely together thereby, while by closing said dampers, the temperature of the lower compartment rises, while that of the upper compartment falls. It will also be seen that while the catch basin formed by the flanges 22 receives and discharges the defrosting drippings from the sides and top of evaporator 11 by means of the tube 23 and the dampers 25, by reason of their contour, will receive the drippings from the bottom of evaporator 11, all of which drippings are deposited by gravity in receptacle 24.

In loading my novel refrigerator, as shown in Figure 1, I place the water which is to be formed into ice cubes in the trays 12, located within the walls of evaporator 11 and in compartment 13, I place such foods as butter, milk, hard-boiled eggs, etc., which are inodorous themselves, but have the characteristic of rapidly absorbing odors from other foods. In this compartment I also place bottled liquids and other inodorous foods and packages which are desired to be quickly chilled. In compartment 14, below shelf, I place odoriferous foods, as onions, cucumbers, melons, cheese, fruits, salads, meats and left-over dishes.

It has been observed that the transference of food odors within a refrigerator is accomplished by the subtraction of moisture from foods through the process of refrigeration, said moisture serving as a carrier for the various odoriferous substances through the period of its suspension in the air of the food compartment, but that said transference ceases when said moisture is condensed and frozen upon the evaporator. It has likewise been observed that one odoriferous food does not noticeably transfer its flavor to another odoriferous food, but that the objectionable transfer occurs between odoriferous foods and those which are non-odoriferous as above explained. By loading my refrigerator as above described, the odoriferous moisture formed in the bottom compartment is carried through flue 19 to the bottom of evaporator 11, said bottom being the coldest part thereof, upon which it is almost instantly condensed and congealed in the form of ice. By reason of the air-tight seal formed by shelf 14', transference of odors and flavors from the lower compartment to the upper is completely and effectively prevented.

When my improved refrigerator is loaded as above described, it materially reduces the evaporation rate of moisture in vegetables, fruits, and other foods, retarding the moisture-loss which such foods would suffer if stored in the conventional single compartment refrigerator. The reasons for this will be evident upon consideration of the following facts: In the conventional single compartment refrigerator, the moisture of the air of the entire compartment is continually being subtracted and deposited in the form of ice upon the evaporator and the returning stream of cold air proceeding from the evaporator as it becomes warmer when in contact with food contains a relatively low moisture content and consequently is more active in subtracting moisture from food, than if it were at a higher point of moisture saturation. In my refrigerator only a small portion (less than one-fourth) of the evaporator coil is exposed to the area of the lower compartment and a considerable proportion of the chilling of the air of the lower compartment is effected through the metallic shelf, which shelf, is inevitably at a temperature higher than that necessary to congeal water. The result is that a film of moisture condenses upon the underside of said shelf, and the chilled air descending therefrom is practically at its moisture-saturation point. The entire air of the lower compartment is kept in a highly moist state, the only moisture-subtracting means within said compartment being represented by the relatively small portion of the evaporator coil which is exposed thereto.

As to the improved temperature conditions brought about through the use of my novel structure, the results of actual tests are tabulated below. Thermometers were positioned within a refrigerator embodying this invention at the points designated A, B, C and D on Figure 1. Thermometers were also positioned at corresponding points in a conventional refrigerator of the same size and type but without my improved shelf and damper construction. In an actual test made under comparative conditions, the following observations were made over a 72-hour period.

Average temperatures

	Improved refrigerator	Conventional refrigerator
	° F.	° F.
A	37.7	44.6
B	41.4	40.2
C	42.2	39.6
D	43.1	38.7
Average temperature	41.1	40.775

From the foregoing it will be observed that in the conventional single compartment refrigera-

tor structure, the coldest air is at the bottom of the food compartment and the temperature gradually rises until the warmest air is found near the top of the compartment. With my improved structure, the temperature range is exactly reversed, the coldest air being near the top of the refrigerator, while the successive layers of air become warmer and warmer until the warmest is found at or near the floor of the food compartment. The advantages of this reversal of temperature distribution are obvious, providing faster freezing of ice cubes, quicker chilling of bottled beverages and lower temperatures for butter and milk which should be stored in the upper food compartment. Fruits and vegetables, usually stored on the floor of the refrigerator are kept unnecessarily cold in the conventional design, at the expense of speed in freezing ice cubes, etc., whereas in my improved refrigerator they are kept at a safe temperature, with the minimum of expense.

As to the economy of operation of my improved refrigerator, it may be pointed out that if an automatic cut-out is used, as is the conventional practice in refrigerators of the intermittent type, the cut-out acts more quickly in my structure than in that of the conventional structure, such cut-outs being commonly, if not necessarily, located adjacent to the evaporator coil and operating, in the case of my improved structure, when the upper compartment has reached a predetermined temperature level as against, in the conventional structure, operating when the whole food compartment has reached such an average predetermined level. It has been shown in many actual tests that in my structure, as employed in this type of refrigerator, the running time of the compressor is reduced from 10 to 20% over the running time necessary to produce the same average temperature in the conventional one-compartment structure.

Having described my invention, I claim:

1. In a refrigerator, an evaporator, an ice freezing compartment, a thermally conducting shelf providing upper and lower food compartments in said refrigerator, sealed against air movement from one compartment to the other, said evaporator positioned partly in said upper compartment and partly in said lower compartment.

2. In a refrigerator, a shelf providing upper and lower compartments sealed against air movement from one compartment to the other, a single cooling means having a chilling surface exposed to the air of said upper compartment and a chilling surface exposed to the air of said lower compartment, and means to control the amount of air contacting a chilling surface in one of said compartments.

3. In a refrigerator, a shelf providing upper and lower compartments sealed against air movement from one compartment to the other, a single cooling means having a chilling surface exposed to the air of said upper compartment and a chilling surface exposed to the air of said lower compartment, and means to control the amount of air contacting a chilling surface in one of said compartments, said means comprising adjustable dampers.

4. In a refrigerator, a shelf providing upper and lower compartments sealed against air movement from one compartment to the other, a single cooling means having a chilling surface exposed to the air of said upper compartment and a chilling surface exposed to the air of said lower compartment, and means to collect water from both said surfaces during defrosting and deliver it to a common receptacle.

5. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment, an upper food compartment and a lower food compartment, said food compartments being isolated from each other to prevent the passage of air therebetween, said single evaporator being exposed to the atmosphere within each of said food compartments whereby to separately cool the same.

6. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment, a plurality of food compartments provided by said cabinet, and means to isolate the said food compartments from each other to prevent the passage of air from one to the other, said single evaporator having different areas thereof exposed to the atmosphere in each of said compartments whereby to separately cool the same.

7. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment adapted to be cooled by said evaporator, an upper food compartment and a lower food compartment provided by said cabinet, means for isolating said food compartments whereby to prevent the passage of air from one to the other, said single evaporating means being adapted to be exposed to the atmosphere of each of said food compartments whereby to separately cool the same and being constructed and arranged to maintain a lower temperature in the upper of said food compartments than in the lower thereof.

8. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment, a plurality of food compartments provided by the cabinet, means for isolating the food compartments from each other whereby to prevent the passage of air from one to another, said single evaporator means being directly exposed to the atmosphere of each of said plurality of food compartments whereby to separately cool the same and being constructed and arranged to provide a lower temperature in one of said food compartments than in another of said food compartments.

9. In a refrigerator, a cabinet, a freezing compartment, a thermally conducting shelf providing upper and lower food compartments in said cabinet, sealing means for isolating said food compartments from each other whereby to prevent the passage of air from one of said food compartments to the other, and an evaporator positioned partly in said upper food compartment and partly in said lower food compartment whereby to separately cool the air within said food compartments.

10. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment disposed within the cabinet and cooled by the evaporator, a thermally conducting shelf dividing the cabinet into an upper and a lower food compartment, means for thermally insulating the said metal shelf from the walls of the cabinet, said single evaporator being independently exposed to both of said food compartments whereby to separately cool the same.

11. A refrigerator comprising a cabinet, a single evaporator disposed therein, an ice freezing compartment disposed within the cabinet and cooled by the evaporator, a thermally conducting shelf dividing the cabinet into an upper and a lower food compartment, means for ther-

mally insulating the said metal shelf from the walls of the cabinet, said single evaporator being independently exposed to both of said food compartments whereby to separately cool the same, and said single evaporator being adapted to maintain a lower temperature in the upper of said food compartments than in the lower food compartment.

12. A refrigerator comprising a cabinet, a plurality of food compartments therein, one disposed above another, means for separating said food compartments from each other, an ice freezing compartment disposed within said cabinet, evaporating means for cooling said compartments, said evaporating means being exposed to the atmosphere in each of said food compartments whereby to separately cool the same, and being constructed to cool the uppermost of said food compartments at a temperature lower than the lower of said food compartments.

13. A refrigerator comprising a cabinet provided with a plurality of food compartments therein, said food compartments being separated from each other by a thermally conductive partition for preventing air passage between said food compartments, an ice freezing compartment disposed within the cabinet, evaporating means exposed to the atmosphere of each of said food compartments whereby to separately cool the same.

14. A refrigerator comprising evaporating means, an ice freezing compartment cooled thereby, an upper food compartment and a lower food compartment defined by a thermally conductive partition, said partition being provided with sealing means insulated at all its points of connection with the walls of said cabinet whereby to prevent thermal conduction from said walls to said partition.

15. In a refrigerator comprising a cabinet, an upper compartment and a lower compartment defined by a partition, extending across the cabinet, an ice freezing compartment, an evaporator, said partition being thermally insulated at all of its points of connection to the walls of the cabinet and constituting a seal to prevent the passage of air from one of said food compartments to the other of said food compartments, and additional sealing means provided by the jamb of the door.

16. A refrigerator comprising a cabinet, a partition dividing the cabinet into two compartments, a single door for said compartments, said partition having means for preventing passage of air between the compartments when the door is closed, said means including a compressible member against which the door abuts when closed and including means extending between the door and the door jamb provided by the cabinet at substantially the elevation of the partition.

17. In a refrigerator, in combination, a cabinet, a partition provided by the cabinet for dividing the same into separate compartments, each isolated from the other to prevent the passage of air from one to the other, a door, and means for air-sealing the space between the door and the door jamb provided by the cabinet at the elevation of the partition whereby to prevent the flow of air through the spaces between the door and said jamb when the door is in closed position.

18. A refrigerator comprising a cabinet, an evaporator disposed therein, an ice freezing compartment, a metal shelf dividing the cabinet into an upper and a lower food compartment, an opening provided by the metal shelf, a portion of said evaporator being disposed to close said opening whereby the evaporator is exposed to both the lower and upper food compartments without permitting the passage of air from one food compartment to the other.

19. A refrigerator comprising a cabinet, a partition separating the cabinet into upper and lower food compartments and adapted to prevent the passage of air therebetween, an ice freezing compartment disposed substantially centrally of the upper food compartment and an opening in said diaphragm communicating with a portion only of the evaporator whereby the upper and lower food compartments are independently cooled by said evaporator without permitting the passage of air from one of said compartments to the other.

20. A refrigerator comprising a cabinet, a metal partition dividing the cabinet into an upper and lower food compartment for isolating the same from each other to prevent the passage of air therebetween, an opening in said partition, an evaporator positioned in the uppermost of said food compartments and having a relatively small portion thereof exposed to said opening whereby to cool the air in the lowermost of said compartments to an extent relatively small as compared with the degree of cooling by the relatively large area of the evaporator exposed to the upper food compartment.

21. A refrigerator comprising a cabinet, an evaporator disposed therein, an ice freezing compartment, an upper food compartment and a lower food compartment, said food compartments being isolated from each other to prevent the passage of air therebetween, said evaporator having differential areas thereof exposed to the upper and lower food compartments whereby to maintain the temperature in one of said compartments lower than the temperature maintained in the other of said food compartments.

22. A refrigerator comprising a cabinet provided with a plurality of food compartments therein, said food compartments being separated from each other by a thermally conductive partition for preventing the passage of air between said food compartments, means for thermally insulating the partition at its points of connection with the walls of the cabinet, an ice freezing compartment disposed within the cabinet, and evaporating means exposed to the atmosphere of each of said compartments whereby to separately cool the same.

23. A refrigerator comprising a cabinet, a plurality of food compartments therein, one disposed above the other, means for separating said food compartments from each other, an ice freezing compartment disposed within said cabinet, evaporating means for cooling said compartments, said evaporating means being exposed to the atmosphere in each of said food compartments whereby to separately cool the same, and the capacity of the evaporating means exposed to one of said food compartments being different from that exposed to the other of said food compartments whereby one of the compartments is maintained cooler than the other.

24. A refrigerator comprising a cabinet, a partition dividing the cabinet into upper and lower food compartments and adapted to prevent passage of air from one of the compartments to the other, an ice freezing compartment, evaporating means adapted to separately cool the atmosphere in said food compartments and being constructed to cool the uppermost of said food compartments to a greater extent than the lowermost thereof, and a single door for closing the upper and lower food compartments.

25. A refrigerator comprising a cabinet, an evaporator disposed therein, an ice freezing compartment, a metal heat conductive shelf dividing the cabinet into isolated food compartments, means for thermally insulating and sealing said heat conductive shelf, said means extending around all portions of the shelf, including the side and back walls of the cabinet, and the door, whereby to prevent the transference of odors from one food compartment to the other food compartment.

26. A refrigerator comprising a cabinet, an evaporator disposed therein, an ice freezing compartment, a partition for forming a plurality of food compartments, said food compartments being isolated from each other to prevent the passage of air therebetween, said evaporator being adapted to cool one of said food compartments to a temperature lower than the other of said food compartments, and a thermally responsive control disposed to be affected by the colder of said food compartments.

27. A refrigerator comprising a cabinet, an evaporator disposed therein, an ice freezing compartment, an upper food compartment and a lower food compartment, said food compartments being isolated from each other to prevent the passage of air therebetween, and adjustable means for regulating the temperature of the food compartments by controlling the natural flow of air in the lower food compartment.

28. A refrigerator comprising a cabinet, evaporating means disposed therein, an ice freezing compartment, an upper food compartment and a lower food compartment, said food compartments being isolated from each other to prevent the passage of air therebetween, said evaporator being constructed to cool the uppermost of said food compartments to an extent greater than the lowermost of said food compartments, and means for varying the differential of the temperatures maintained in the upper and lower food compartments respectively.

29. A refrigerator comprising a cabinet, evaporating means disposed therein, an ice freezing compartment, an upper food compartment and a lower food compartment, said food compartments being isolated from each other to prevent the passage of air therebetween, said evaporator being constructed to cool the uppermost of said food compartments to an extent greater than the lowermost of said food compartments, and means for varying the differential of the temperatures maintained in the upper and lower food compartments respectively, said means being adjustable to vary the exposure of the atmosphere of the lowermost of said food compartments to said evaporating means.

30. A refrigerator comprising a cabinet, evaporating means disposed therein, an ice freezing compartment, a thermally conductive shelf dividing the cabinet into an upper and lower food compartment whereby to prevent the passage of air therebetween, an adjustable damper associated with said shelf and constructed to regulate the air flow between the air above said damper and the air below said damper.

31. A refrigerator comprising evaporating means, an ice freezing compartment cooled thereby, an upper food compartment and a lower food compartment defined by a thermally conductive partition, said partition being provided with sealing means, insulated at all of its points of connection with the walls of the cabinet whereby to prevent thermal conduction from said walls to said partition and to seal the same to prevent the passage of air from one of said food compartments to the other of said food compartments, said sealing means including means disposed between the front edge of the partition and the door when the door is closed.

32. A refrigerator comprising a cabinet, an upper food compartment and a lower food compartment defined by a partition, an ice freezing compartment, an evaporator, said partition being thermally insulated at all its points of connection to the walls of the cabinet and constituting a seal for preventing the passage of air from one of said food compartments to the other of said food compartments, a door, and sealing means disposed between the door and the jamb thereof whereby to seal the cabinet opening provided for said door.

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