HINGED CLOSURE MEMBER FOR LOW TEMPERATURE COOLING COMPARTMENTS

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This invention relates to refrigeration, and more particularly to hinged closure members for low temperature cooling compartments of household refrigerators.

In recent years low temperature cooling compartments have been provided in refrigerators of the household type which are suitable not only for producing ice cubes but also for freezing vegetables, fruits and meat and maintaining such foods at a low temperature below the freezing temperature of water. Many household refrigerators of this type are provided with a single door to gain access to the interior of the cabinet and a separate hinged door or closure member within the cabinet to gain access to the low temperature freezer section. Due to formation of frost or ice on the hinge structure and in the gaps between the closure member and regions of the cooling unit immediately adjacent thereto, the closure member often cannot only be opened with an exceptionally strong pull. This is objectionable because, at the least moment when the bond effected by the frost or ice is broken, the entire force of the pull is transmitted to the hinge structure and subjects the latter to undue stress which may cause parts of the hinge structure to meet out of alignment or otherwise damage the hinge structure, so that the closure member will not pivot properly.

It is an object of my invention to provide an improved hinge structure for closure members of low temperature cooling compartments which will effectively stand up and always operate properly under all operating conditions encountered, especially when the closure members can only be opened with an exceptionally strong pull due to formation of frost or ice.

Another object of the invention is to provide such an improved hinge structure having a normal point about which the closure member pivots when moved between its open and closed positions, and also a second point about which the closure member pivots and which comes into play to protect the hinge structure from being damaged when a rather heavy pull is exerted on the closure member when the closure member does not open freely.

The above and other objects and advantages of the invention will be more fully understood upon reference to the following description and accompanying drawings forming a part of this specification, and of which:

Fig. 1 is a fragmentary front view of the interior of a refrigerator embodying the invention;

Fig. 2 is an enlarged vertical sectional view taken at a right angle to the rear wall of the interior of the refrigerator shown in Fig. 1;

Figs. 3 and 4 are fragmentary perspective views of parts shown in Figs. 1 and 2 to illustrate details more clearly.

Fig. 5 is a fragmentary view, partly broken away and in section, taken at line 5—5 of Fig. 2; and

Fig. 6 is a vertical sectional view of parts like those shown in Fig. 2 illustrating another embodiment of the invention.

Referring to Figs. 1 and 2, the invention is embodied in a refrigerator cabinet 10 having an inner metal shell 12 and insulated therefrom with any suitable insulating material 14. The inner metal shell 11 defines a thermally insulated storage space 15 having an opening 16 at the front of the cabinet and into which access may be had by a door (not shown) hinged to the cabinet from the right side.

Within the thermally insulated space 15 is arranged a cooling unit or evaporator 17 formed of piping and including piping 17a at one level which forms a low temperature cooling section extending between the lateral side walls of the space 15, and piping 17b at a lower level which is centrally disposed in the space and forms a higher temperature cooling unit section. Although not shown, the pipes forming the low and higher temperature cooling unit sections are connected to other parts of a refrigeration system by conduits which extend through a removable wall section in the rear wall of the cabinet 10.

This manner of positioning a cooling unit in the thermally insulated interior of a household refrigerator cabinet is particularly well suited for absorption refrigeration systems in which an auxiliary pressure equalizing gas is employed. In a system of this type a refrigerant fluid, such as ammonia, is introduced into the cooling compartments which will effectively stand up and so that the closure member 11 will not pivot properly.

A plate 18 is heat conductively connected in any suitable manner (not shown) to the top portions of the piping 17a. The plate 18 extends across the insulated interior of the cabinet 10 and forms the bottom horizontal wall of a freezing compartment 19 located in the upper part of the space 15 immediately beneath the ceiling of the inner liner 11. A door or closure member 20, which is hinged at the bottom horizontal edge thereof in a manner which will be described presently, is provided at the front access opening of the freezing compartment 19.

As shown in Figs. 1 and 2, the upper part of the door 20 is provided with a suitable hand grip 21 to facilitate opening thereof. In its upright closed position the door 20 is arranged to bear against a pair of rollers 22 provided at each lateral side wall of the inner liner 11, as shown in Fig. 2. Each roller 22 desirably is formed of a suitable resilient material like rubber, for example, which is eccentrically mounted on a pin 23, thereby permitting the roller to be turned or rotated to adjust the closed position of the door 20.

A plurality of fins or plates 24, which are parallel to the rear wall of the space 15, are fixed to the lower pipe section 17b to provide a relatively extensive heat transfer surface for cooling air in the lower or bottom compartment 25. An inclined drainage plate 26 is positioned at each side of the higher temperature cooling unit section 17b, as shown in Fig. 1, and a tray or vessel 27 is removably held in position beneath the piping 17b and plates 24 by slides 28. The drainage plate 26 serves to collect moisture which forms on cooling unit 17 and falls from different parts thereof, as during defrosting, for example. The vessel or tray 27 in turn is arranged to receive all moisture falling from the higher temperature cooling unit section 17b as well as the moisture conducted to such section by the drainage plates 26.

The cooling unit 17 is provided with a front shield plate or baffle 29 to conceal the piping 17a and 17b and fins 24 when the door of the refrigerator cabinet 10 is opened to gain access into the interior thereof. The baffle 29 is removably secured by screws 30 to a flat member or strap 31 which extends across the interior of the refrigerator at the vicinity of the access opening 16.

The strap 31 at the ends thereof is anchored in any suitable manner to the walls of the liner 11, as indicated...
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at 32 in Fig. 5. If desired, the strap 31 may be employed to support the forward part of the cooling unit 17. This may be accomplished by securing to the strap 31 with screws 34 regions of the downwardly extending flange or front lip 33 of the plate 18 which are removed from the lateral side walls of the liner 11 and bear against the sides of the strap, as shown in Fig. 5. The lower edge of the baffle 29 is bent back upon itself to form a groove 35 which receives the lower ends of vertical guide members or supports 36, the upper ends of which are secured at 37 to the strap 31. While the slide rails 28 for the tray 27 may be secured in any suitable manner to the opposing sides of the higher temperature cooling unit section 17b, as to the lower edges of the fins 24, for example, the forward upright portions of the rails 28 may also be fixed at 38 to the vertical supports 36, as by welding, for example.

In accordance with my invention, the closure member 20 for the freezing compartment 19 is provided with a hinge structure 49 having a normal point about which the closure member pivots when moved between its open and closed positions, and also a second point about which the closure member pivots and which comes into play to protect the hinge structure from being damaged when a heavy pulling force is imparted to the closure member to open the latter, especially when the closure member does not open freely due to formation of ice at the normal pivot point of the hinge structure and in the gaps between the closure member and other parts of the cooling unit. This structure includes a housing 41 at the bottom edge of the closure member 20 and a pair of levers 42 having the forward thereof pivotally connected to the opposing ends of the housing 41 and the rear ends thereof pivotally connected to angle members 43. As best shown in Fig. 4, one angle member 43 is secured by screws 45 to the rear face of the strap 31, the other arm thereof projecting rearward from the strap 31. The rear ends of the levers 42 are pivotally connected at 46 to the angle members 43, as best shown in Figs. 3, 4 and 5.

The housing 41, which is hollow and open at both ends thereof, is fixed to the lower edge of the closure member 20 by screws 47, a reinforcing bar 48 being provided at the rear face of the closure member through which the screws 47 pass. Within the housing 41 and at each side thereof is provided a threaded opening to receive the inner ends of the screws 47. Accordingly, the screws 47 pass successively through openings in the reinforcing bar, bottom edge of the closure member 20, flat side of the housing 41 and hinge plates 49, as best seen in Figs. 2 and 5.

The hinge plates 49 are bent at the outer ends thereof to form flanges 50 serving as end walls for the housing 41, one of which is shown in Fig. 5. The forward end of each lever 42 is provided with an elongated pin 51 which passes through an opening formed in the flange 50 of one of the hinge plates 49, as best shown in Fig. 5. Each pin 51 is formed with an enlarged head 52 which bears against the outside face of the lever 42, a square shaped portion 53 which snugly fits within a similarly shaped opening in the forward end of the lever and an elongated section which passes through an opening in an end flange 54 and extends into the housing 41, such elongated section having a slot 54 formed therein.

Within each end of the housing 41 is disposed an elongated helical spring 55 having one end thereof connected to the slot 54 in one of the pins 51 and the opposite end thereof connected to a prong 56 which may be stamped out from one of the hinge plates 49. In order to place the springs 55 under tension to bias the closure member 20 to its closed upright position, the pins 51 may be pulled outwardly such a distance that the square-shaped portions 53 thereof are out of engagement with the similarly shaped openings in the forward ends of the levers 42. Under these conditions, the pins 51 can be turned to place the springs 55 under tension after which the pins 51 can again be moved axially to allow the square-shaped portions 53 thereof to pass into engagement with the similarly shaped openings in the forward ends of the levers 42 and maintain the springs under tension.

When the hinge structure 49 and closure member 20 are relatively free of any ice formation and the latter can be readily moved from its closed position to gain access into the freezing compartment 19, the closure member normally pivots about the pins 51 at the forward ends of the levers 42 and the levers 42 remain stationary. Under these conditions, when the hand grip 21 is grasped and the arm of an individual is extended horizontally to open the closure member 20, a downward force is imparted to the closure member and the elbows 57 at the undersides of the levers 42, at regions intermediate the ends thereof, remain snugly in position against the top edge of the strap 31. Stated another way, the downward force imparted to the closure member 20 at the hand grip 21 effects pivotal movement of the closure member about an axis passing through the pins 51 and at the same time imparts a downward force on the levers 42 to cause the latter to remain stationary against the top edge of the strap 31. When the closure member 20 is released, the springs 55 immediately become operable to cause the closure member 20 to move from its open position to its closed position shown in Figs. 2 and 3.

In the event of ice formation in the gap 63 between the bottom of the housing 41 of the hinge structure and a horizontal trough portion 59 of the baffle 29, the closure member 20 may not open readily when the normal pull is imparted to the hand grip 21. Under such conditions, an exceptionally heavy pull may be exerted on the hand grip 21 to open the closure member and break the ice bond in the gap 63 tending to keep the closure member in its closed position. When such a condition arises and the arm of an individual is extended horizontally, the pull exerted on the closure member is usually quite horizontal with the pulling force having substantially no downward vertical component. When the closure member 20 becomes free to move from its closed position upon the application of such an exceptionally heavy pull on the hand grip 21 in the manner just explained, the pulling force is transmitted to the closure member 20 in plate 49 having a pivot bolt 44 on one arm thereof provided about the pivot points at 46, as illustrated in Fig. 4. Hence, when an exceptionally heavy pull is exerted on the closure member 20 and the ice bond is initially broken between the bottom of the housing 41 and the ice which may have formed in the gap 63 above the trough 59, all of the pulling force is not taken up and completely resisted at the first hinge point about which the closure member normally pivots at the pins 50. Instead, the instant the ice bond is broken, the closure member 20 can move upwardly in a direction from the ice which may have formed in the trough 59 and the pulling force is transmitted through the levers 42 and second pivot points 46 directly to the supporting strap 31. The relative position the different parts assume when this occurs is best illustrated in Fig. 4, it being noted that the housing 41 has been moved upwardly from the position shown in Fig. 3 which represents the normal position of the housing 41 when the closure member 20 is closed.

However, the instant the second pivot point at 46 comes into play, the heavy pulling force is no longer being applied to the hand grip 21 because such heavy pulling force often is terminated during the interval of time that a lost motion effect occurs when the closure member is opened. Consequently, the closure member 20 is still held in its closed position and is automatically returned to the position shown in Fig. 3 to the position shown in Fig. 4. In effect, the levers 42 form suitable linkage which permits the axis of the pins 51 to shift vertically about an arc the instant an ice bond is broken, for example, in the act of opening the closure member 20, thus enabling the closure
member to move freely about the pins 51 without substantial interference by the frost or ice which may be in the gap 63.

While the closure member 20 and housing 41 may be formed of any suitable material, I have found that a closure member formed of transparent plastic material and a housing formed of opaque plastic material are quite satisfactory because very little condensation of water takes place on such material. Since the levers 42 and angle members 43 extend rearwardly from the strap 31, a narrowed portion must be provided for these parts of the hinge structure 40 at each lateral side wall of the inner liner 11 at the vicinity of the cooling unit 17. Also, the rearwardly extending arms of the angle members 43 extend upwardly a substantial distance to provide a surface over which the levers 42 can ride, thus improving the stability of the hinge connection of the strap 31. It will also be noted that when the levers 42 are in their raised positions, as shown in Fig. 4, the screws 30 for fastening the baffle plate 29 in position are accessible at such times.

In Fig. 2 it will be noted that the baffle 29 is provided with a top flange 58 which rests on top of the strap 31 and partially supports the baffle while the bottom grooved edge thereof is held in the feet of the vertical supports 36. In addition, the baffle 29 is shaped to provide the trough 59 between the top and bottom regions thereof which forms the housing 41 of the closure member 20, as explained above. When water falls from the housing 41 and parts of the hinge structure 40 immediately above the trough 59, as during defrosting, for example, such water collects in the trough which may be formed with drain openings 60 to conduct the water into the tray or vessel 17.

In Fig. 6 I have illustrated another embodiment of the invention which differs from the embodiment just described in that the housing 41a is more or less U-shaped rather than in the form of a hollow tubular member. In Fig. 6 the hinge plates 49a are formed with flanges 43a at the top and bottom edges thereof which are at an acute angle to the front face of the closure member 20. The flanges 61 form gaps at the underside thereof to receive the inwardly bent tabs 62 formed at the outer ends of the spaced apart arms of the housing 41a. With this construction the parts within the housing 41a are easily accessible and the latter, which may be formed of suitable sheet metal, can be so dimensioned that it will be resiliently held in position on the hinge plates 49a. In other respects, the embodiment of Fig. 6 is generally like the first-described embodiment of Figs. 1 to 5 inclusive.

In view of the foregoing, it will now be understood that the hinge structure 40 includes a pair of levers or elements 42 in spaced apart relation for mounting the closure member 20 for pivotal movement about a second horizontal axis at the region of the pins 51, and for mounting the levers or members 42 for pivotal movement about a second fixed horizontal axis at the pivotal regions at 46 of the levers. The strap 31, against which said first axis is essentially unobstructed in the act of gaining access to said compartment, and said structure being operable to effect pivotal movement of said closure member about said second horizontal axis when a pulling effort greater than normal is required to open said closure member, especially when parts of said closure member at the vicinity of said first axis may be subject to formation of frost or ice which builds up in the gap 63 between the trough 59 and the bottom of the housings 41 and 41a of the closure members.

In Fig. 3 it will be seen that the levers 42 straddle the strap 31 and rest by gravity on the latter when the first horizontal axis, at the region of the pins 51, is located at the substantially definite position referred to above. By securing the downwardly depending front flange 33 of the plate 18 to the strap 31, the latter serves as a support for the cooling unit 17 at the forward part of the space 15 of the cabinet 10. However, the manner in which the plate 18 is fastened to the strap 31 provides a more or less poor heat conductive connection which restricts the transfer of cooling effect from the parts of said unit 17 to the strap or elongated element 31, thereby reducing to some extent the formation of frost or ice on the hinge structure 40.

Although I have shown and described several embodiments of my invention, I do not desire to be limited to the particular arrangements set forth, and I intend in the following claims to cover all modifications which do not depart from the spirit and scope of the invention.

What is claimed is:

1. In a refrigerator comprising a cabinet including a thermally insulated interior providing a compartment having an access opening, cooling means for cooling said compartment below the freezing temperature of water to maintain the latter as a freezing space, a closure member in the thermally insulated interior for closing the access opening, structure including a plurality of elements in spaced apart relation for mounting said closure member for pivotal movement about a first horizontal axis passing through first regions of said elements and for mounting said elements for pivotal movement about a second fixed horizontal axis passing through second regions of said elements removed from said first regions, resilient means for effecting pivotal movement of said closure member about said first axis at a substantially definite position when pivotal movement of said closure member about said first axis is essentially unobstructed in the act of gaining access to said compartment, and said structure being operable to effect pivotal movement of said closure member about said second horizontal axis when a pulling effort greater than normal is required to open said closure member, especially when parts of said closure member at the vicinity of said first axis may be subject to formation of frost or ice which builds up in the gap 63 between the trough 59 and the bottom of the housings 41 and 41a of the closure members.

2. Apparatus as set forth in claim 1 in which said locating means includes an elongated strap against which parts of said elements, at regions intermediate the ends thereof, bear when said first horizontal axis is located at the substantially definite position.

3. Apparatus as set forth in claim 1 in which includes an elongated housing carried by said closure member at the vicinity of a horizontal edge portion thereof, said resilient means comprising at least one spring disposed in said housing.

4. Apparatus as set forth in claim 1 in which said locating means comprises a horizontal strap against which parts of said elements, at regions intermediate the ends thereof, bear when said first horizontal axis is located at the substantially definite position, and means carried by said horizontal strap for mounting said elements for pivotal movement about said second fixed horizontal axis.

5. Apparatus as set forth in claim 1 in which said cabinet includes spaced apart lateral side walls defining the insulated interior thereof, an elongated strap which extends across the axis of the body of said cabinet, means for securing the ends of said strap to said lateral side walls, said locating means including said elongated strap against which parts of said members, at regions intermediate the ends thereof, bear when said first horizontal axis is located at the substantially definite position.

6. Apparatus as set forth in claim 5 in which said elements straddle said elongated strap and rest by gravity
7. Apparatus as set forth in claim 6 which includes an elongated housing extending lengthwise of said closure member along the bottom edge portion thereof, said resilient means including at least one spring disposed in said housing, first horizontal axis about which said closure member pivots passing through said housing.

8. Apparatus as set forth in claim 7 in which said cooling means is disposed in the interior of said cabinet, and means including said elongated strap to provide support for said cooling means, said last-mentioned means providing a heat conductive connection restricting the transfer of cooling effect from said cooling means to said elongated strap.

9. Apparatus as set forth in claim 8 including a front baffle for said cooling means, and means for supporting said baffle on said elongated strap.

10. Apparatus as set forth in claim 9 including a vessel for collecting moisture from said cooling means, as during defrosting, for example, said baffle having a trough portion beneath said elongated housing which is formed with openings to drain moisture, said baffle beneath said trough serving to conduct moisture to said vessel.

11. Apparatus as set forth in claim 10 which includes stop members against which said closure member bears when in its upright closed position at the access opening, said stop members being of cylindrical shape and having an outer peripheral surface formed of resilient material, and means including pins for mounting said stop members at the sides walls of the cabinet interior, said stop members being eccentrically disposed on said pins and turnable on the latter to adjust the closed position of said closure member.

12. In a refrigerator comprising a cabinet including a thermally insulated interior providing a compartment having an access opening, cooling means for cooling said compartment below the freezing temperature of water to maintain the latter as a freezing zone, a wall member for closing the access opening, hinge means for pivotally mounting said wall member at the bottom part thereof for movement toward and from its closed upright position at the access opening, hinge means including linkage, means for pivotally mounting said linkage for movement about a first horizontal axis, means for pivotally mounting said wall member at the bottom part thereof for movement toward and from its closed upright position at the access opening, hinge means including linkage, means for pivotally mounting said linkage for movement about a first horizontal axis, means for pivotally mounting said wall member at the bottom part thereof for movement toward and from its closed upright position at the access opening, hinge means including linkage, means for pivotally mounting said linkage for movement about a first horizontal axis.

13. Apparatus as set forth in claim 12 in which said locating means includes an element in the path of movement of a region of said linkage intermediate the first and second horizontal axes, said element serving as a stop to limit downward movement of said linkage and said wall member pivotally mounted thereon.

14. In a refrigerator comprising a cabinet including a thermally insulated interior providing a compartment having an access opening, cooling means for cooling said compartment below the freezing temperature of water to maintain the latter as a freezing zone, a wall member for closing the access opening, hinge means for pivotally mounting said wall member for movement toward and from its closed vertically disposed position at the access opening, said hinge means including movable structure, means for pivotally mounting said wall member for pivotal movement about a second horizontal axis, means for pivotally mounting said wall member for pivotal movement about a second horizontal axis further removed from the rear of said compartment than the first horizontal axis, resilient means for effecting pivot movement of said wall member about the second horizontal axis to bias said wall member to its closed upright position, locating means operable to maintain the second horizontal axis at an essentially definite position when movement of said wall member about the second axis is substantially unobstructed in the act of gaining access to said compartment, said locating means comprising a stationary part in the path of movement of said wall member about the second axis.

15. Apparatus as set forth in claim 14 in which said locating means comprises a stationary part in the path of movement of a region of said structure intermediate the first and second horizontal axes, said locating means including said stationary part serving as a stop to limit vertical movement of said structure about the first horizontal axis and maintain the second horizontal axis at the essentially definite position.

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