Feb. 2, 1965 J. G. BRYSON 3,167,931

CABINET CONSTRUCTION

Filed Aug. 22, 1963 2 Sheets-Sheet 1

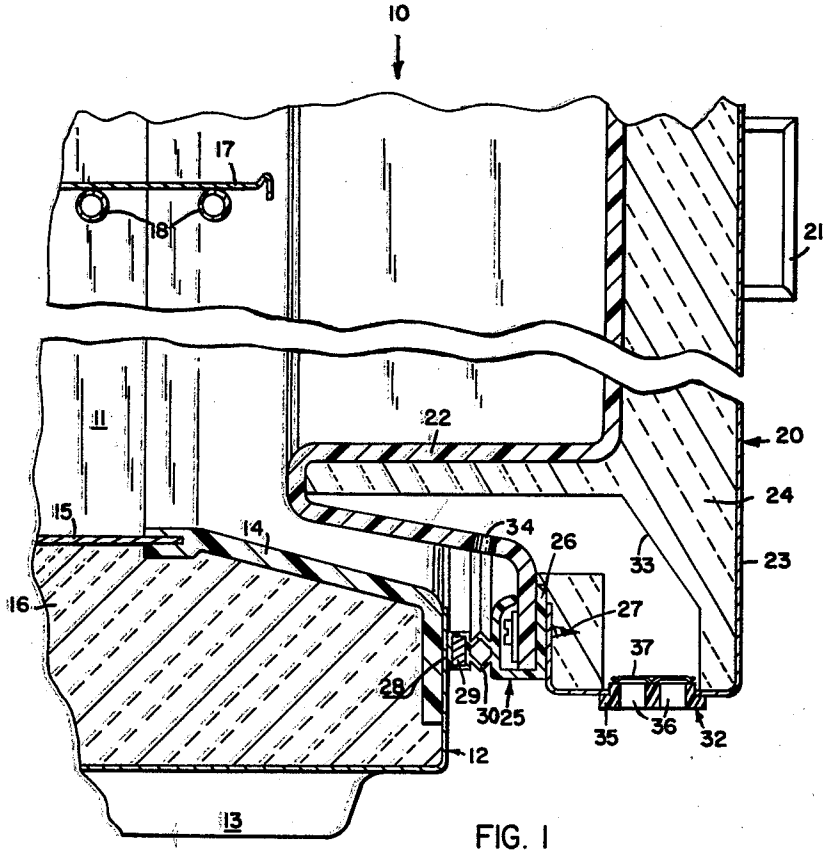


FIG. 1

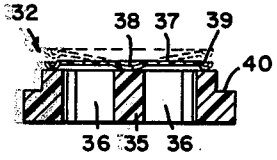


FIG. 2

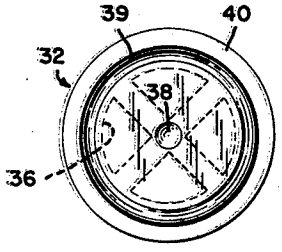


FIG. 3

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CABINET CONSTRUCTION

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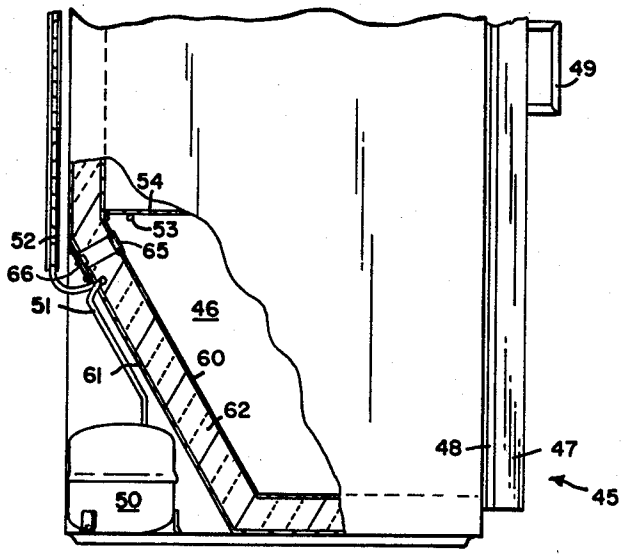


FIG. 4

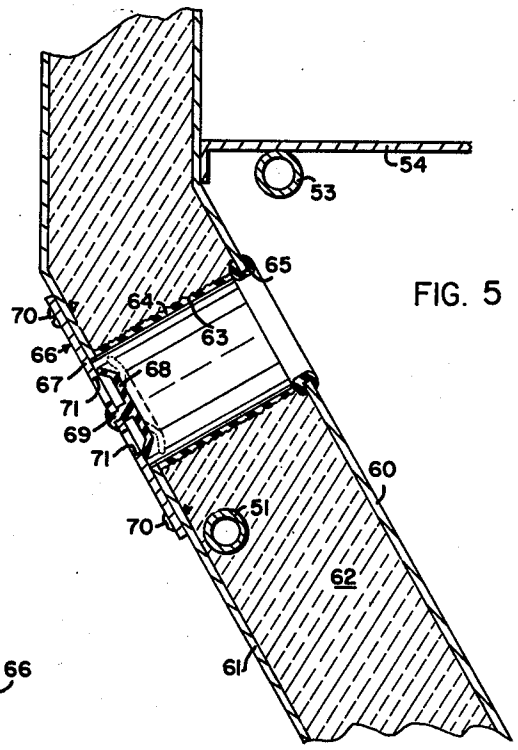


FIG. 5

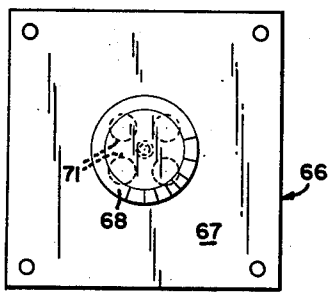


FIG. 6

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3,167,931

CABINET CONSTRUCTION

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6 Claims. (Cl. 62—273)

This invention relates to cabinets, and, more particularly, it relates to facilitating the opening of the access door to a cabinet such as a refrigerated cabinet.

Refrigerated cabinets generally comprise a box section having an access opening covered by a hingedly mounted access door. It is frequent practice to provide an airtight seal between the access door and the box section by means of a suitable gasket which is often of the magnetic type. Such gaskets usually have a first edge portion fixedly secured to one of the members such as the access door, a second edge portion which carries one or more magnets designed to temporarily sealingly engage the second edge portion to a metal flange on the box section, and an extensible web portion between the first and second edge portions of the gasket. The extensible web portion allows the gasket to accommodate itself to the shape of the access opening of the refrigerator box and to the clearance which exists between the box and the access door sections. The extensible web portion of the gasket is also desirable because the portion of the access door closest to the hinges may approach the access opening of the box section more closely than the portion of the door remote from the hinges. This type of construction has found wide application in household refrigerators, including food freezers and frozen food storage cabinets. Refrigerators of this type are usually also provided with a rigid handle on the access door which the user pulls to break the adhesion between the magnetic portion of the gasket and the box section in order to gain access to the refrigerator.

Even though the force exerted by the magnetic gasket tending to maintain the refrigerator door closed is relatively small, users often complain that an excessive pull is required in order to open the access door. This problem is particularly acute with low temperature refrigerators such as food freezers and arises for two reasons. First, when the refrigerator door is opened and then closed, ambient air at room temperature escapes into the interior of the box section. This relatively warm air is rapidly cooled in the interior of the refrigerator after the door is closed. As the air inside the refrigerator is cooled, it is reduced in volume giving rise to a materially lower pressure inside the refrigerator than that of the ambient air on the exterior of the door. This difference in pressure across the access door results in a force tending to keep the door closed, which must be overcome in order to pull the door open. It has been found that for a typical household freezer, having an interior temperature of about 0° F., the difference in pressure across the access door due to the cooling of warm air admitted into the box section may be on the order of about two inches of water. Such a refrigerator typically has a door area of about thirteen square feet and, consequently, this difference in pressure may result in a force of about three hundred pounds tending to keep the door closed. This force, tending to oppose opening of the door, will exist until the pressures are equalized by leakage of ambient air into the refrigerator, which may take several minutes or longer. The user may find, therefore, that it is exceedingly difficult or impossible to reopen the door for a period of time after it has been closed. Second, as the user initially pulls on the door handle to open the door, the expansible web portion of the gasket extends sufficiently to slightly increase the internal volume of the refrigerator. Even though the pressures across the door are equal, this increase in internal volume of the refrigerator results in a

reduction in the pressure of the air therein which gives rise to another force tending to maintain the door closed. It has been found that this latter force typically may be on the order of about forty pounds in a household refrigerator. Not only is the necessity of overcoming this force inconvenient to the user, but it may make escape difficult in the event that a small child becomes entrapped in the interior of an abandoned cabinet.

It will be apparent, therefore, that in order to open the refrigerator door the user must overcome not only the magnetic pull exerted by the gasket which is relatively nominal, but must also overcome the force tending to keep the door closed by reason of the pressure difference across the door due to the difference in internal and external pressures acting on the door.

It is therefore the principal object of this invention to facilitate the opening of a cabinet door.

It is a further object of this invention to provide a means and method for reducing the difference in pressure across a cabinet door so as to facilitate opening thereof.

It is a further object of this invention to provide a means for admitting ambient air into the interior of a refrigerated enclosure upon the occurrence of an excessively great pressure difference tending to resist opening of its access door.

It is a still further object of this invention to provide an improved cabinet construction.

These and other objects of this invention are achieved in the illustrated preferred embodiments thereof by providing a refrigerator cabinet, such as a frozen food storage compartment, having valve means responsive to a predetermined pressure difference between the interior and the exterior of the cabinet. The valve means serves to admit ambient air into the interior of the cabinet to prevent an excessive pressure difference from occurring across the access door.

In one embodiment of this invention the valve is disposed in the access door section of the refrigerated enclosure and is disposed on the outer wall thereof so that the valve is warmed by ambient air to prevent the accumulation of frost thereon which might cause malfunction in the operation of the valve. In another embodiment of this invention the valve is located in the cabinet section of the refrigerated enclosure and means may be provided to supply heat to the valve from the hot gas line of the refrigeration system to maintain the temperature of the valve sufficiently high to prevent moisture from freezing thereon.

The foregoing and other objects of this invention will become more apparent by reference to the following specification and attached drawings, wherein:

FIGURE 1 is a fragmentary cross-sectional view through a portion of refrigerated cabinet embodying the instant invention;

FIGURE 2 is a cross-sectional view through the valve shown in FIGURE 1;

FIGURE 3 is a plan view looking downwardly on the valve shown in FIGURE 1;

FIGURE 4 is a fragmentary view, partly broken away and in cross-section, of a refrigerated enclosure utilizing another embodiment of applicant's invention;

FIGURE 5 is a fragmentary cross-sectional view showing the detail of the view illustrated in FIGURE 4; and

FIGURE 6 is a plan view of the valve shown in FIGURE 5.

Referring particularly to FIGURE 1, there is shown a cabinet or enclosure 10 which may be a household refrigerator, such as a food freezer or a frozen food storage compartment, although it will be appreciated that this invention is applicable broadly to other types of cabinets. Cabinet 10 comprises a box section 11 having an outer wall including a metal flanged portion 12 defining

an access opening to the interior of the cabinet. Box section 11 is provided with a base 13 which rests on the floor to support the refrigerator. Suitable inner wall members 14 and 15 cooperate with outer wall 12 to form a double wall construction for the reception of insulation 16. A refrigerator shelf 17 is provided in the interior of box section 11 and may be cooled by tubes 18 which form part of the evaporator of a conventional refrigeration system.

An access door section 20 is hingedly mounted by hinges (not shown) to box section 11 and serves to substantially cover and close the access opening defined in the box section. A suitable rigid handle 21 is provided to open the access door. Access door section 20 comprises an inner wall 22 and an outer wall 23 having suitable insulation 24 disposed therebetween.

A gasket or sealing means 25 is provided to make a substantially airtight seal between access door section 20 and box section 11 when the door is in a closed position. Gasket 25 suitably comprises a first edge portion 26 which is fixedly secured to outer wall 23 of access door section 20 by one or more sheet metal screws 27. Gasket 25 has a second edge portion 28 carrying magnetic means 29 such as a magnet which is attracted to metal flange 12 to make temporary relatively airtight engagement with box section 11. An extensible impervious web portion 30 extends between first edge portion 26 and second edge portion 28 of gasket 25. Extensible portion 30 compensates for any non-uniformity in the distance between access door 20 and box 11 and permits the gasket to adapt itself to the shape of the cabinet with which it is used.

In accordance with this invention a check valve 32 extends through outer wall 23 of one of the members such as access door 20. A suitable vent passage 33 is provided through insulation 24. One or more suitable vent passages 34 are provided through inner wall 22 of access door 20. Vent passage 34 is preferably provided at a location on door 20 that is of relatively high temperature, above the dew point of the ambient air, and is desirably at a location which is above 32° F., if possible, so that the vent passage will not become clogged by ice formation due to condensation of moisture from the air in contact therewith. It will be appreciated that in the location shown valve 32 is in heat exchange relation with, and receives heat from the relatively warm ambient air to assist in preventing frost formation thereon. Other means, such as those to be subsequently described may be used to supply heat to valve 32, if desired.

Valve 32 may suitably comprise a base member 35 of plastic or metal having a shouldered portion 40 to adapt it to be secured to outer wall 23 of door 20 by any suitable means, such as an epoxy glue. Base portion 35 has one or more ports 36 formed therein. A flexible plastic or metal diaphragm member 37 is suitably secured as by heat sealing or riveting at 38 to base member 35. Diaphragm member 37 may be provided with a slightly bossed peripheral edge portion 39 to make sealing engagement about the contacting edge of base member 35. It has been found that for the purposes of this invention diaphragm member 37 may suitably have sufficient flexibility so that a pressure difference of approximately 1/10 inch of water, which is equivalent to about ½ lb. per square foot pressure, acting on the underside thereof, as shown in FIGURE 2, is sufficient to open the valve. Preferably, valve 32 is located on the underside of the exterior surface of door 20 so that it is concealed from view but is exposed to the heat of the ambient air thereby inhibiting the accumulation of ice thereon, which might impair the operation of the valve.

In operation, warm ambient air is admitted into the interior of box 11 upon closing of door 20. This air is quickly cooled by evaporator coil 18 and contracts in volume resulting in a difference in pressure across door 20. When this difference in pressure exceeds the pressure at which check valve 32 opens, additional ambient air is automatically admitted into the interior of the refrigerator through check valve 32 and vent passages 33, 34, so as to increase the pressure in the interior of box 11. By designing check valve 32 to open at a suitably low pressure difference, the corresponding difference in internal and external pressures across door 20 may be reduced to an extent that only a small force is necessary to open the door. Likewise, as the user begins to open door 20 and the pressure in box 10 is reduced by expansion of gasket 25, check valve 32 admits additional ambient air into the interior of the box to facilitate the opening of the door. Using the example previously discussed, valve 32 may open at a pressure difference of about ½ lb. per square foot thereby limiting the force due to the pressure difference across a thirteen square foot door to only about 6½ lbs. Consequently, the force required to open the door is limited to only 6½ lbs. more than that normally required to overcome the force of attraction of the magnetic gasket.

It will be appreciated that a permanently open vent passage could be employed to equalize the pressures between the interior and exterior of the cabinet. This solution, however, is not satisfactory because in the case of a refrigerated enclosure there is a measurable pressure fluctuation due to cycling of the refrigeration equipment from an operating to a non-operating condition. This cyclic fluctuation may produce a pressure difference across the door on the order of +.02 to —.05 inch of water. If a permanently open vent passage were provided from the exterior into the interior of box 10, a considerable amount of cooled air would escape from the box when the refrigeration equipment cycled off and a considerable amount of warm air would be admited to the box each time the refrigeration equipment cycled on. This loss of refrigerated air and intake of warm air would undesirably require providing increased cooling capacity and would result in poor control of temperatures in the refrigerated enclosure. To prevent this, applicant's valve is arranged so that a minimum pressure difference greater than that normally experienced due to cycling of the refrigeration equipment is necessary before check valve 32 opens.

Referring now particularly to FIGURE 4, there is shown another embodiment of applicant's invention as applied to a typical household refrigerator, such as a frozen food storage compartment or freezer. In this embodiment, refrigerator 45 is provided with a box section 46 having an access opening therein which is closed by an access door section 47 and gasket 48, similar to that described with reference to the preceding embodiment of this invention. A suitable rigid handle 49 is provided to open door 47. A compressor 50 having a hot gas line 51 leading to a condenser 52 is mounted on the exterior of box section 46 as shown in the drawing. Evaporator tubes 53 of the refrigeration system are disposed beneath shelf 54 to cool the interior of the refrigerator. Box section 46 has an inner wall 60 and an outer wall 61 between which is disposed insulation 62.

An opening 65, which may have a suitable grommet about it, is formed in inner wall 60 of box section 46 and connects with a vent passage 63 through insulation 62. In order to prevent the entrance of moisture into insulation material 62 a wax or other coating 64 is preferably applied about the periphery of vent passage 63. A valve assembly 66 is secured by fastening means 70 about a suitable opening formed in outer wall 61 connecting with vent passage 63.

Valve assembly 66 comprises a base member 67 which may be of metal or other material having one or more ports 71 formed therein. A flexible diaphragm 68, which may be formed of plastic or metal, is secured by suitable means 69 to base member 67. As in the preceding embodiment, valve 66 is preferably designed to operate at

a suitably low pressure difference such as ½ lb. per square foot difference in pressure so as to facilitate opening of door **47** by admitting ambient air into the interior of box **46**. On the other hand, valve **66** is also designed as in the preceding embodiment so that it will not normally be opened by the differences in pressure encountered by cycling of the refrigeration system, so as to prevent unwarranted reduction in control and effective capacity of the refrigeration system. It will also be apparent that valve **66**, like valve **32** previously described, is a check valve which operates in only one direction so that air may be admitted into box **46** but is not permitted to escape from the box to the exterior.

Means are provided to supply heat to valve **66** in order to prevent malfunction of the valve due to ice formation about it. As shown in FIGURE 5, the means to heat valve **66** may comprise hot gas line **51** leading from compressor **50** to condenser **52** placed in heat exchange relation with the valve. In effect, heat absorbed by evaporator coil **53** from the box is rejected from hot gas line **51** to supply the heat required to keep valve **66** above the freezing point or at least above the dew point of both ambient air and the air contained in box **46**. This effectively prevents the condensation of moisture on valve **66** and eliminates ice formation thereon which might otherwise prevent proper operation of the valve.

Other methods of heating valve **66** may be employed, if desired, and as illustrated in FIGURE 4, the valve may be placed in heat exchange relation with the relatively warm compressor **50** or condenser **52**, as well as hot gas line **51** in order to achieve the desired heating. It will be appreciated that in a particular situation, any one of these means of supplying heat to valve **66** or any combination of them may be employed thereby enabling considerable flexibility in the location of the valve. In many situations the heat of the ambient air alone may be sufficient to maintain the valve above the desired temperature so that additional heating means is not required.

Many modifications and embodiments of this invention will be readily perceived from the foregoing description. For example, the valve member employed may be of the ball and seat variety rather than being of the flapper valve type as shown in the drawings. The entire valve may, if desired, be made of plastic or other material and may be located at any suitable point on either the box or door section. In addition, while the invention has been described with reference to a refrigerated enclosure, other applications can be envisioned to reduce the force required to open the access door, an enclosure or other device whether or not a gasket of the type herein described is employed. It is preferred, however, to use a valve which senses a pressure difference between the exterior and interior of the cabinet with which it is employed, and automatically opens to admit ambient air therein upon the occurrence of a pressure exceeding a predetermined maximum desired pressure which is below that which gives rise to an inconveniently high force necessary to open the door.

Accordingly, other embodiments, modifications and applications of this invention within the scope of the following claims will become apparent to those skilled in the art.

I claim:

1. A refrigerated cabinet comprising:
- a box section having means defining an access opening therein,
- an access door section adapted to substantially close said access opening,
- said cabinet including sealing means providing a seal between said access door and said box section to substantially prevent the passage of air between the interior and exterior of said box section when said access door is closed, said sealing means comprising a gasket secured to one of said sections, said gasket having magnetic means associated therewith to retain it in sealed engagement with the other of said sections, said gasket including an expansible web portion tending to initially increase the internal volume of said cabinet upon attempting to open said access door,
- a refrigeration system associated with said cabinet to refrigerate the interior thereof, and
- a pressure operated check valve associated with said cabinet, said check valve,
  - being disposed at a location on said cabinet such that it normally receives sufficient heat to inhibit the accumulation of frost thereon, so that the operation of said valve is not normally impaired by frost, and
  - being constructed so as to automatically open in response to a predetermined difference in pressure between the interior and the exterior of said cabinet, thereby facilitating the opening of said access door by admitting ambient air into said cabinet to prevent a pressure difference from existing across said door in excess of said predetermined difference caused by an initial increase in volume of said cabinet due to expansion of said gasket upon attempting to open said door.

2. A refrigerated cabinet as defined in claim 1 wherein said check valve is designed to open at a pressure greater than the differences in pressure across said door due to cycling of the refrigeration system and less than a predetermined maximum pressure across said door which would give rise to an excessively high force opposing opening of said door.

3. A refrigerated cabinet comprising:
- a box section having means defining an access opening therein,
- an access door section adapted to substantially close said access opening,
- said cabinet including means providing a seal between said access door and said box section to substantially prevent the passage of air between the interior and exterior of said box section when said access door is closed, and
- a pressure operated check valve associated with one of said sections, said valve comprising:
  - a ported base member disposed between the interior and exterior of said cabinet,
  - a diaphragm member secured to said base and covering the port in said base member on the side of said base member adjacent the interior of said cabinet, said diaphragm being flexible and arranged to flex away from said base to uncover said port and to admit air automatically into said cabinet upon the occurrence of a predetermined difference in pressure between the exterior and the interior of said cabinet, so as to facilitate opening of said access door.

4. A refrigerated cabinet comprising:
- a box section having an access opening therein;
- an access door section adapted to close said access opening;
- said cabinet including means adapted to provide an air seal between said access opening and said access door;
- cooling means including a refrigeration system disposed so as to cool air in said cabinet;
- valve means automatically operable upon the existence of a pressure difference in excess of a maximum desired difference in pressure between the interior and the exterior of said cabinet, for admitting air into said cabinet to reduce the pressure difference to a pressure not exceeding said maximum desired pressure difference;
- means to supply heat from a portion of said refrigeration system to the region of the location of said valve

means to reduce impairment of the operation of said valve by inhibiting the accumulation of frost thereon; and

said means to supply heat from said refrigeration system to the region of the location of said valve means comprising a compressor of said refrigeration system disposed in heat exchange relation with said valve means.

5. A refrigerated cabinet compring:

a box section having an access opening therein;

an access door section adapted to close said access opening;

said cabinet including means adapted to provide an air seal between said access opening and said access door;

cooling means including a refrigeration system disposed so as to cool air in said cabinet;

valve means automatically operable upon the existence of a pressure difference in excess of a maximum desired difference in pressure between the interior and the exterior of said cabinet, for admitting air into said cabinet to reduce the pressure difference to a pressure not exceeding said maximum desired pressure difference;

means to supply heat from a portion of said refrigeration system to the region of the location of said valve means to reduce impairment of the operation of said valve by inhibiting the accumulation of frost thereon; and

said means to supply heat from said refrigeration system to the region of the location of said valve means comprising a condenser of said refrigeration system disposed in heat exchange relation with said valve means.

6. A refrigerated cabinet comprising:

a box section having an access opening therein;

an access door section adapted to close said access opening;

said cabinet including means adapted to provide an air seal between said access opening and said access door;

cooling means including a refrigeration system disposed so as to cool air in said cabinet;

valve means automatically operable upon the existence of a pressure difference in excess of a maximum desired difference in pressure between the interior and the exterior of said cabinet, for admitting air into said cabinet to reduce the pressure difference to a pressure not exceeding said maximum desired pressure difference;

means to supply heat from a portion of said refrigeration system to the region of the location of said valve means to reduce impairment of the operation of said valve by inhibiting the accumulation of frost thereon; and

said means adapted to provide an air seal comprising a gasket secured to one of said sections, said gasket having magnetic means associated therewith to retain it in sealed engagement with the other of said sections, said gasket including an expansible web portion tending to initially increase the internal volume of said cabinet upon opening of said access door.

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