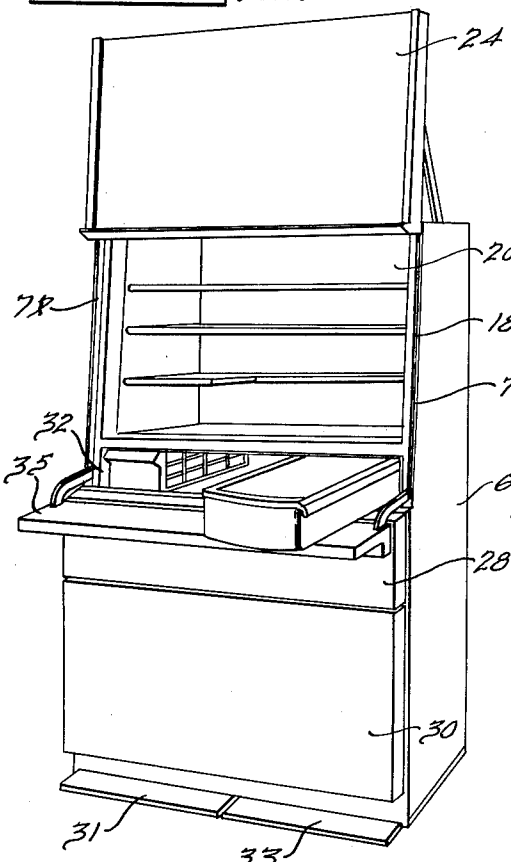
Oct. 23, 1962 F. G. PECK 3,059,985

REFRIGERATED CONTAINER WITH VERTICALLY MOVABLE DOORS

Filed April 21, 1960 4 Sheets-Sheet 1

FIG. 1.



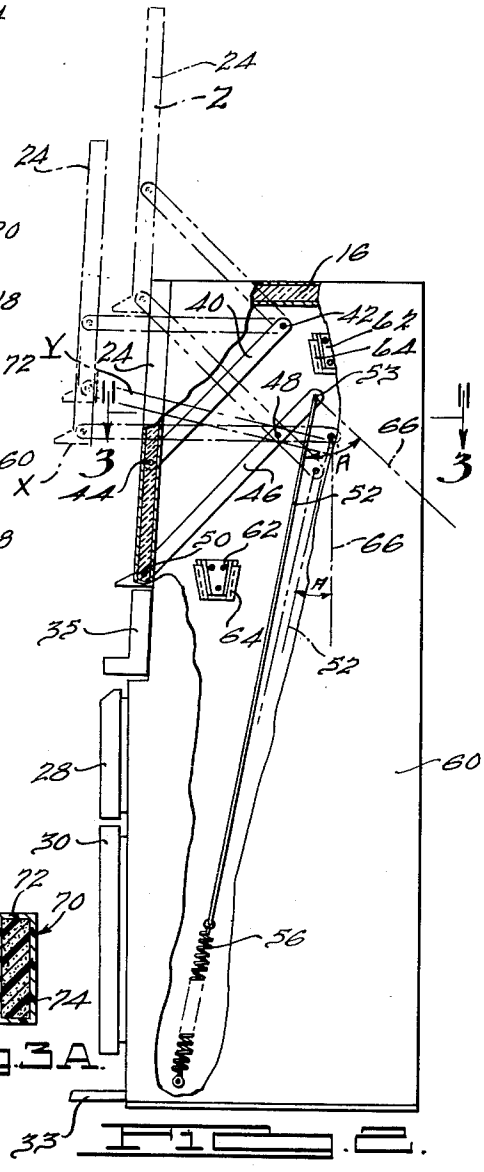
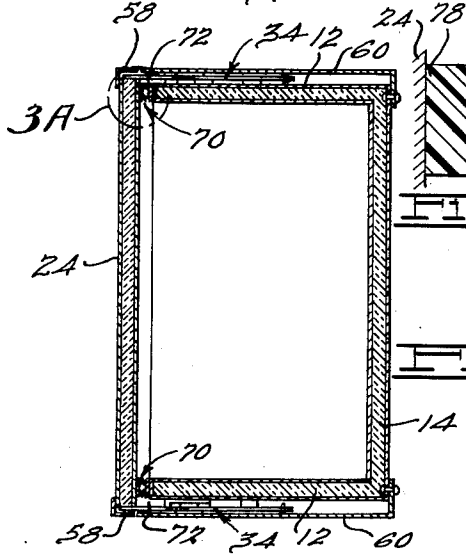


FIG. 2.



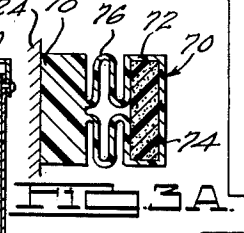


FIG. 3A.

FIG. 3.

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REFRIGERATED CONTAINER WITH VERTICALLY MOVABLE DOORS

Filed April 21, 1960 4 Sheets-Sheet 2

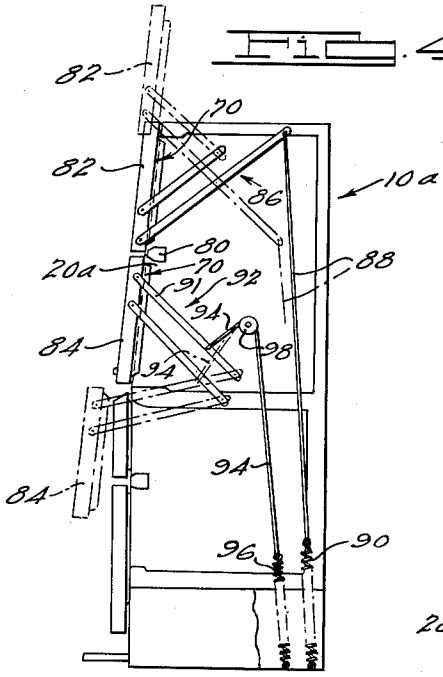


Fig. 4.

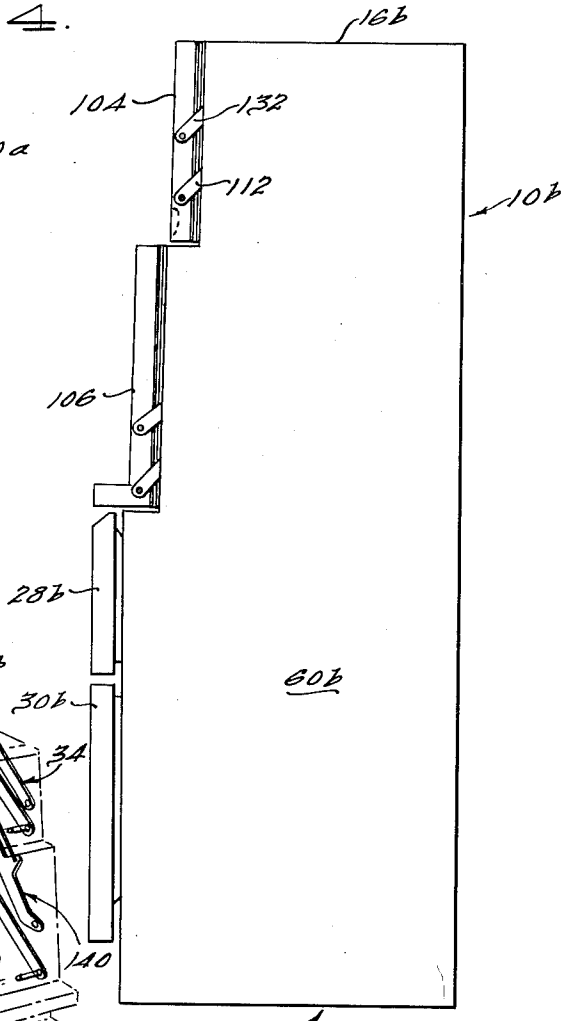


Fig. 5.

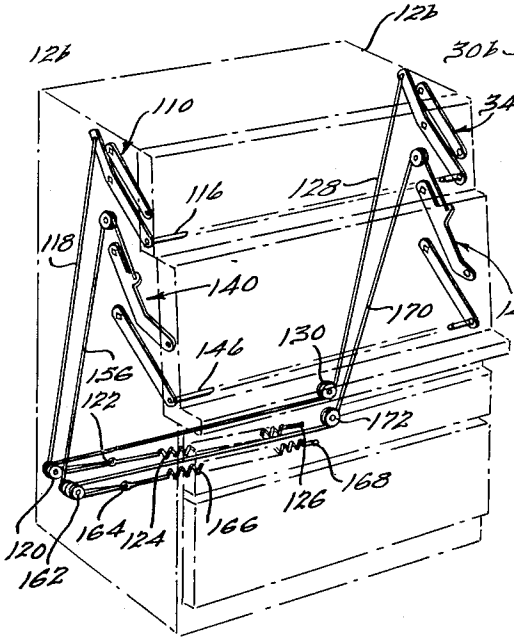


Fig. 6.

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REFRIGERATED CONTAINER WITH VERTICALLY MOVABLE DOORS

Filed April 21, 1960 4 Sheets-Sheet 3

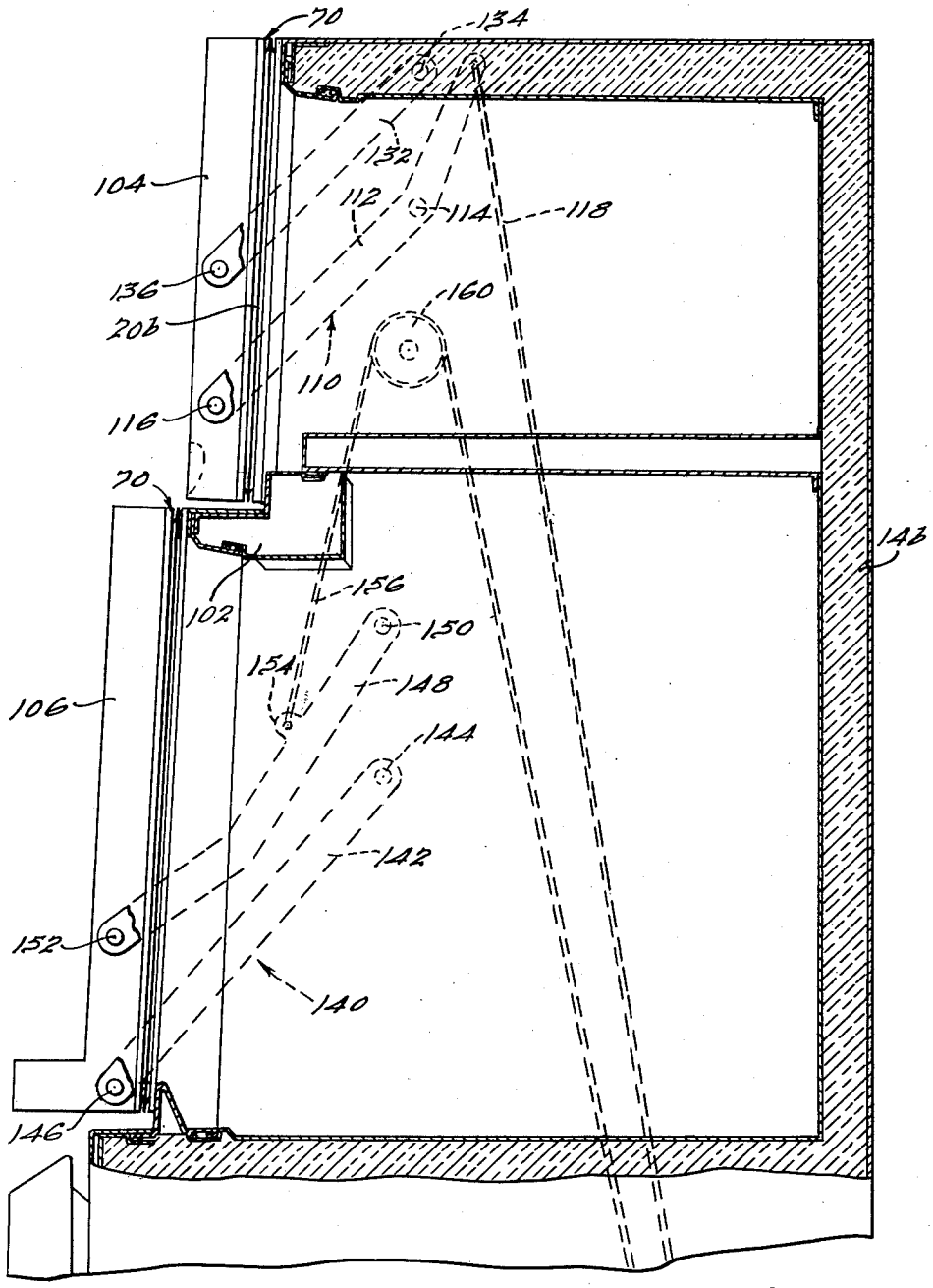


FIG. 3.

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REFRIGERATED CONTAINER WITH VERTICALLY MOVABLE DOORS

Filed April 21, 1960 4 Sheets-Sheet 4

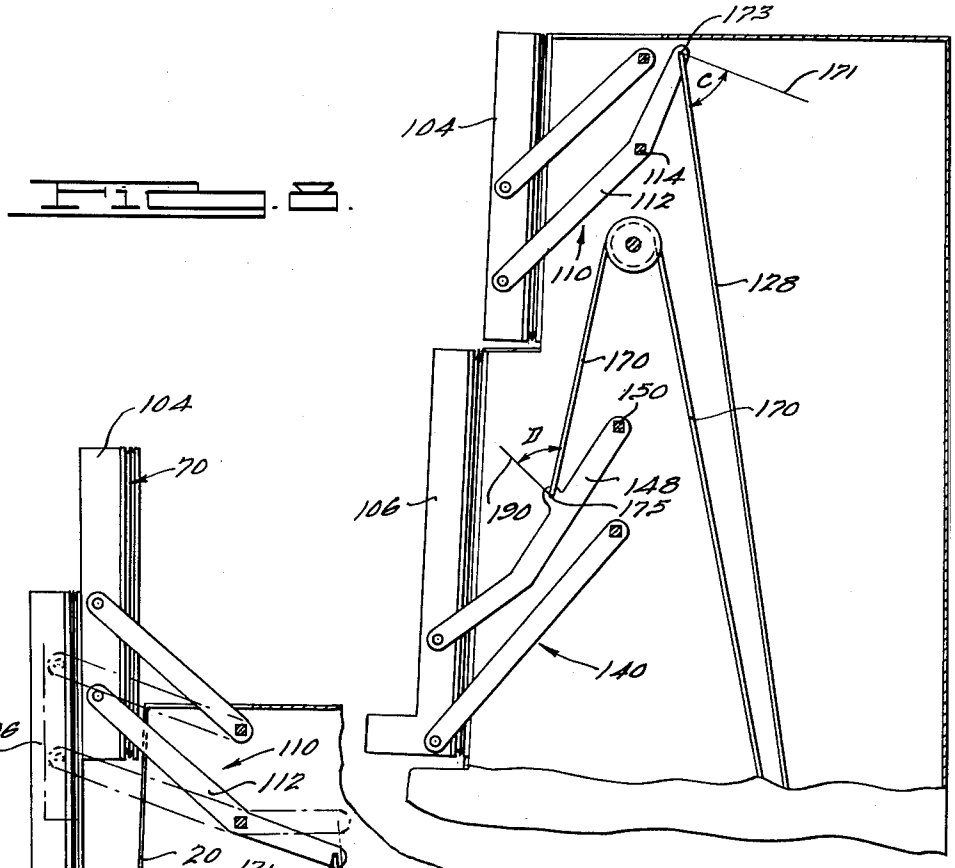


Fig. 2.

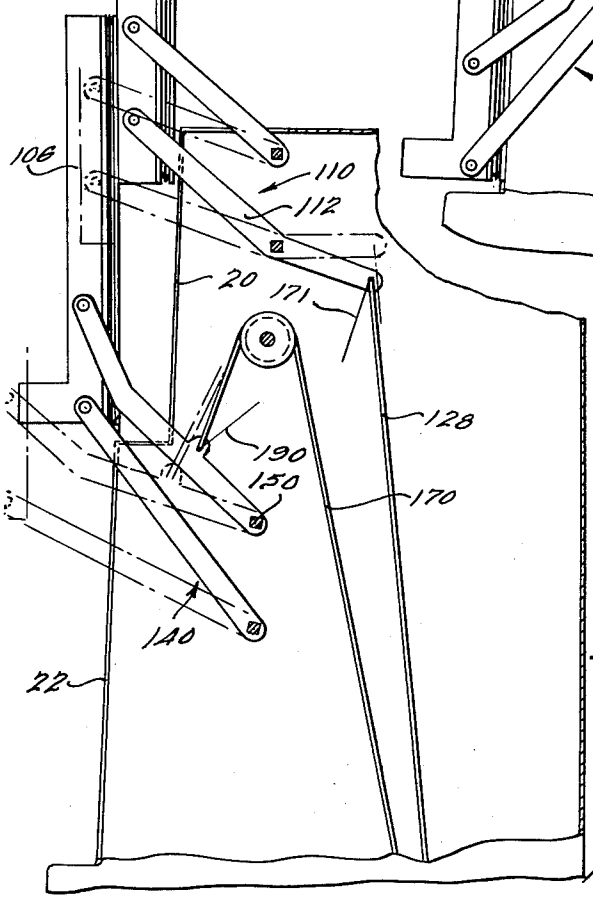


Fig. 3.

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3,059,985
REFRIGERATED CONTAINER WITH VERTICALLY MOVABLE DOORS

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Filed Apr. 21, 1960, Ser. No. 23,827
4 Claims. (Cl. 312—279)

This invention relates generally to refrigerated containers such as refrigerators and freezers and more particularly to a refrigerated container having one or more doors which move vertically between open and closed positions.

Most refrigerators and freezers, of both household and commercial variety have hinged doors which swing either about a horizontal axis or a vertical axis and require considerable clearance space in front of the refrigerator or freezer through which the door must move during opening and closing. This is objectionable since this space can then not be put to any useful purpose and in installations such as supermarkets, this type of space is very valuable. For these reasons, a refrigerated container having vertically movable doors which require very little movement in a horizontal direction during opening and closing of the doors is desirable. It is an object of this invention, therefore, to provide a refrigerated container with vertically movable doors which are readily opened and closed by application of a small and substantially constant force to the door. It has been found that doors which open and close in this manner are objectionable if they are difficult to move during any portion of their travel between open and closed positions or if they are spring-biased so that they tend to move by themselves out of the operator's hand at any time during their opening or closing movement. In other words, the primary object of this invention is to divide a door mounting which during opening and closing movement has a desirable "feel" for the operator.

A further object of this invention is to provide a parallel link assembly for mounting a vertically movable door on a refrigerated container so that the door is readily moved, with a desirable "feel" for the operator, between open and closed positions.

Further objects, features and advantages of this invention will become apparent from a consideration of the following description, the appended claims and the accompanying drawing in which:

FIGURE 1 is a perspective view of a refrigerated container provided with a vertically movable door mounted in accordance with this invention;

FIGURE 2 is a side elevational view of the container shown in FIG. 1, with some parts broken away for purposes of clarity;

FIGURE 3 is a horizontal sectional view of the structure shown in FIG. 2, looking along the line 3—3;

FIGURE 3A is an enlarged view of the portion of FIG. 3 enclosed within the circle 3A;

FIGURE 4 is a diagrammatic side view of a refrigerated container provided with a modified form of the door mounting of this invention;

FIGURE 5 is a side elevational view of a refrigerated container having another modified form of door-mounting of this invention;

FIGURE 6 is a perspective view of the parallel link assemblies employed in the refrigerated container shown in FIG. 5 for mounting the doors on the container;

FIGURE 7 is a vertical sectional view of a portion of the refrigerated container shown in FIG. 5 provided with the vertically movable doors of this invention; and

FIGURES 8 and 9 are side elevational views of the

container shown in FIG. 5, showing the vertically movable doors in closed and open positions, respectively.

With reference to the drawing, the refrigerated container of this invention, indicated generally at 10 in the form of a home refrigerator, is illustrated in FIGS. 1, 2 and 3 as including insulated side, rear and top walls 12, 14 and 16, respectively. The front side 18 of the container 12 is formed with an enlarged opening 20 which is adapted to be closed by a vertically movable door 24. The container 12 is illustrated as being provided with a lower storage area and access to this storage area may be provided by a pair of sliding trays or boxes 28 and 30 which are latched in closed positions by latches (not shown) which may be released by operation of floor pedals 31 and 33 mounted on the lower end of the container 10. A refrigerated section 32 of the container 10 located between the upper opening 20 and the lower boxes 28 and 30 is closed by a short hinged door 35.

A pair of parallel link assemblies 34 are mounted on the side walls 12 and connected to opposite ends of the door 24 for mounting the door for up and down movement between open and closed positions. Each link assembly 34 includes an upper link 40 which has one end connected by a pivot 42 to the container side wall 12 and the opposite end connected by a pivot 44 to one end of the door 24 at a position intermediate the top and bottom sides of the door. A link 46, disposed below the corresponding link 40 is connected intermediate its ends by a pivot 48 to a container side wall 12 and is connected at one end by a bar 50 to the door 24. The bar 50 extends through the door and is connected at its opposite end to the other link 46 so as to insure a substantially unison up and down movement of the links 46.

A cable 52 is connected at one end to the opposite end of the link 46 and extends downwardly from the link 46 along the container side wall 12 for connection of its opposite end to a spring 56 mounted on the side wall 12. If desired, the springs 56 may be connected in a suitable manner to insure an equalization at all times of the spring forces applied to the links 46. End caps 58 are mounted on opposite ends of the door 24 for covering the links 40 and 46 and side panels 60 are mounted on the side walls 12 for the same purpose. Each side panel 60 carries a plurality of wedge shape brackets 62 on its inner side which slide into similarly shaped receptacles 64 on the side wall 12 to attach the panel 60 to the wall 12 when the panel 60 is moved downwardly relative to the side wall 12 so as to force the brackets 62 downwardly into the receptacles 64. The panel 60 is then in a position spaced from the wall 12.

Each of the cables 52 is arranged relative to the link 46 to which it is connected so that when the door 24 is in its closed position shown in FIG. 2, the cable 52 is angularly spaced with respect to a line, indicated at 66, which is perpendicular to a radius for the axis of rotation of the link 46 and extends through the point 53 of connection of cable 52 to link 46. This axis of rotation extends through the pivot member 48. Furthermore, during movement of the door 24 from its closed position shown in FIG. 2, to an upwardly moved substantially open position, indicated at Y, the angular spacing between the cable 52 and the line 66, is continually decreased. This is illustrated in FIG. 2 which shows that angle A between the cable 52 and the line 66 when the door is closed is substantially greater than when the door is in position X in which it exerts a maximum resistance to opening movement. As the door 24 is moved further in an opening direction, the angle between the cable 52 and the line 66 continues to decrease until at some location of the door 24, shown in broken lines at Y in FIG. 2, the

cable 52 is perpendicular to a radius for the axis of rotation of the link 46 passing through point 53. Stated otherwise, the moment arm for the pulling force exerted by the cable 52 increases as the door is moved from position X toward position Y.

The rate and preloading of the springs 56 are chosen so that the tensile forces exerted on the cables 52 by the springs 56 during opening movement of the door 24 toward the position shown in broken lines at Y in FIG. 2 decrease at a rate relative to the rate of decrease of angle A such that the moment, consisting of the product of the component of the spring force lying on the line 66 and the distance between pivot 48 and point 53, exerted on the links 46 by the springs 56 is substantially constant during movement of the door 24 between the closed position and its broken line substantially open position shown at Y in FIG. 2. As a result, the lifting force which must be applied to the door 24 to move it from its closed position to a substantially open position is also substantially constant and the springs 56 are of a selected strength such that this lifting force is very small. The distance between the center of gravity of the door 24 and the pivot 48 varies but this is compensated for by the fact that the distance between the lifting force applied to the door and the pivot 48 varies in the same manner. It has been found that opening of the door 24 under these circumstances, namely, by application of a very small and constant lifting force to the door 24, is a pleasing experience and is much more desirable to the person opening the door 24 than when the required force is a variable one. If the door 24 must be moved further upwardly from the position Y, to the full open position Z for example, to provide complete access to the upper shelf in the refrigerator 10, the added force which must be applied to the door 24 since the force of the spring 56 is decreasing and so is the distance perpendicular to the cable 52 between the cable and the pivot 48, is not under most circumstances objectionable, since it is more of a pushing than a lifting force because of the position of the door 24. The force of the springs 56 and the frictional forces in the link assemblies 34 which resist rotation of the assemblies are sufficient in substantially all moved positions of the door 24 to maintain it in that position against the force of gravity.

As shown in FIGS. 3 and 3*a*, the door 24 is provided on its inner side with a sealing gasket 70 which extends around the inner side of the door so that it will engage the front side 18 of the container 10 at a position surrounding the front opening 20 and inwardly of the front slots 72 which are formed between the side walls 12 and the panels 60 and through which the link assemblies 34 extend. The gasket 70 is preferably of the type which includes a hollow flexible body 72 formed of a plastic or rubber material, and having a member 74 which possesses magnetic properties disposed therein. A foldable bellows portion 76 is formed integral at one end with the body 72 and at the opposite end with a base 78 which is suitably secured to the inner side of the door 24. The bellows portion 76 is foldable and unfoldable to permit movement of the body 72 toward and away from the base 78 to insure a seal between the front side 18 of the container 10 and the inner side of the door 24 when the door is closed, since the metallic portion of the container 10 surrounding the door opening 20 attracts the magnetic member 74 so as to pull the body 72 tightly against the front side of the container 10. When the door 24 is to be opened, the parallel link assemblies 34 provide for an initial movement of the door 24 in a somewhat horizontal direction away from the front side of the container 10 so as to initially disengage the body 72 from the container 10.

In the modified container 10*a* shown in FIG. 4, the opening 20*a* in the front side of the container has a horizontal median divider strip or mullion 80 extending thereacross and a pair of doors 82 and 84 are mounted on the container 10*a* for closing the portions of the opening 20*a* above and below the mullion strip 80, respectively. A pair of parallel link assemblies (only one of which is shown) are secured to opposite ends of the door 82 and to opposite side walls of the container 10*a* for mounting the door 82 on the container 10*a* for up and down movement between open and closed positions, in the same way the door 24 is mounted on the container 10. Cables 88 are connected to the parallel link assemblies 86 and to springs 90 secured to the container side walls for assisting in the opening of the door 82. The cables 88 are arranged relative to the parallel link assemblies 86 in the same manner that the cables 52 are arranged relative to the link assemblies 34, and the springs 90 are of a rate and a preloading as previously described, so that a substantially constant force of small magnitude is required to move the door 82 from its closed to its open position illustrated in broken lines in FIG. 4. The springs 90 and the friction in the link asemblies 86 are sufficient to maintain the door 82 in its open position without the application of any additional force to the door 82.

A pair of parallel link assemblies 92 (only one of which is shown) are connected to opposite ends of the door 84 and are pivotally mounted on opposite side walls of the container 10*a* for mounting the door 84 on the container. The door 84 is movable downwardly from its closed position to its open position shown in broken lines in FIG. 4. A cable 94 is secured to each of the parallel link assemblies 92 and to a spring 96 mounted on the container side wall for normally urging the door 84 toward its upper closed position. The cable 96 extends over a pulley 98 and is positioned relative to the parallel link assembly 92 so that a substantially constant force is required to move the door 84 from its closed position to its open position and vice versa.

It should be noted that the springs 96 operate in a reverse manner to the springs previously described since during opening movement of the door 84 the springs 96 are extended, rather than contracted, so that the pulling forces exerted on the cables 94 by the springs 96 are increased rather than decreased during opening movement of the door 84. For this reason, each cable 94 is arranged so that it exerts a force which is perpendicular to the link 91 to which it is attached in the closed position of the door. As the door is moved toward its open position, the perpendicular distance between the portion of the cable 94 which extends between the pulley 98 and the link 91 and the pivot support for the link 91 on the container 12*a* continually decreases. Each spring 96 is preloaded and its rate is selected so that the pulling force exerted by the cable increases at substantially the same rate that its moment arm relative to the pivot support for link 91 decreased. As a result, the total force required of the person moving the door 84 between its open and closed positions is substantially constant as is the case with the doors 24 and 82 previously described.

It can thus be seen that the doors 82 and 84 are mounted similarly to the mounting of the door 24 so that the doors are movable up and down between open and closed positions by the application of substantially constant forces thereto. In each case, a torsion bar, or the like, such as the bar indicated at 50 in FIG. 2, extends through the door and connects the parallel link assemblies to insure a unison operation of the assemblies and to preclude any twisting of the door during up and down movement. The gaskets 70 are provided on the doors 82 and 84 for providing the necessary seal between these doors and the container 10*a* in the closed positions of the doors.

In the modified container 10*b* shown in FIGS. 5–9, inclusive, the opening 20*b* in the front side of the container is provided with a mullion strip 102, like the mullion strip 80 shown in FIG. 4, and a pair of doors 104 and 106 are mounted on the container 10*b* for closing the parts of the opening 20*b* above and below the mullion strip 102, re-

spectively. Since the container 10*b* is identical in all respects to the container 10, except for the provision of the mullion strip 102, like parts on the containers are indicated by like numerals, with the numerals on the container 10*b* having the letter suffix "*b*" added thereto.

Two parallel link assemblies 110 are mounted on opposite ends of the upper door 104 and are secured to opposite side walls 12*b* of the container 10*b*. The parallel link assembly 110 includes a lower link member 112 which is secured intermediate its ends by a pivot 114 to the container side wall 12*b*. At one end, the link 112 is secured by a torsion bar 116 to one end of the door 104, adjacent the lower side thereof, and the torsion bar 116 is also connected to the link 112 in the assembly 110 at the opposite end of the door 104. At its opposite end, the link 112 is connected to one end of a cable 118 which extends downwardly from the link 112 along the side wall 12*b* and is trained about a pulley 120 mounted on the container rear wall 14*b*. The opposite end of the cable 118 is connected at 122 to a spring 124 which is connected at 126 to the container rear wall. A similar cable 128 for the parallel link assembly 110 on the opposite side of the container 10*b* is trained about a pulley 130 on the container rear wall 10*b* and thence around the pulley 120 for connection at 122 to the spring 124. With this arrangement, the forces exerted on the parallel link assemblies 110 by the spring 124 are equalized.

Each parallel link assembly 110 also includes an upper link member 132 which is mounted at its upper end on a pivot 134 carried by the container side wall 12*b* and is connected by a pivot 136 at its opposite end to one end of the door 104 intermediate the upper and lower sides of the door 104. When the door 104 is moved up and down, the parallel link assemblies 110 act to maintain it in substantially a vertical position at all times.

The door 106 is mounted on the container 10*b* by a pair of parallel link assemblies 140 connected to opposite ends of the door and mounted on opposite sides of the container 10*b*. Each of the parallel link assemblies 140 consists of a lower link 142 which is pivotally connected by means of a pivot 144 at one end thereof to the container side wall 12*b* and by a torsion bar 146 at its opposite end to one end of the door 106 at a position adjacent the lower side of the door. The assembly 140 also includes an upper link 148 which is pivotally connected at one end by a pivot member 150 to a container side wall 12*b* and at its opposite end by a pivot member 152 to one end of the door 106 intermediate the upper and lower ends thereof. The link 148 is provided intermediate its ends with an upwardly projecting ear 154 to which one end of a cable 156 is connected. The cable 156 extends upwardly from the ear 154 and is trained about a pulley 160 mounted on a container side wall 12*b*, and from the pulley 160, the cable 156 extends downwardly along the side wall 12*b*. The cable 156 is then trained about a pulley 162 mounted on the back side of the container 108 and has its opposite end attached at 164 to one end of a spring 166 which is attached at its opposite end 168 to the container rear wall 14*b*. The parallel link assembly 140 at the opposite side of the container 10*b* is provided with a similar cable 170 which extends downwardly along the side of the container and is trained about a pulley 172 on the container rear wall and thence around the cable 162 for attachment at the point 164 to the spring 166. With this arrangement, the spring 166 exerts equal forces on the cables 156 and 170.

It is to be noted that in each of the assemblies 140, a line extending between the pivots 150 and 152 is parallel to the pivots 144 and 146 so that a true parallel link assembly is provided even though the link 148 is bent intermediate its ends. The link 148 is of the shape illustrated so that the ear 154 which connects the cable 156 or 170 to the link is in a predetermined position with respect to the cable 170. This position is such that the relationship between the cable and the parallel link assembly is the same relationship described between the cable 52 and the parallel link assembly 34 in FIG. 1. This relationship is also true for each of the parallel link assemblies 110 and is the reason why each link 112 is of an angular shape. As illustrated in FIG. 8, the angle C between the cable 128 and a line 171 perpendicular to a radius for the axis about which the link member 112 rotates, which axis extends through the pivot member 114, and extending through the point 173 of connection of the cable to the link is such that when the door 104 is initially moved from its closed position toward an open position, only a portion of the total pulling force exerted on the cable 128 by the spring 124 is effective to assist the door movement. In other words, the component of the cable force which is parallel to line 171 is the only portion of the cable force effective to rotate the link 112. This component continually increases, in relation to the component perpendicular thereto, but at the same time the total cable pulling force is decreasing because the spring 124 is contracting. The rate and preloading of the spring is selected so that the component of the force of the cable parallel to line 171 is substantially constant. As a result, a small constant force exerted by the operator on the door 104 is effective to move the door 104 from its closed position shown in FIG. 8 to its broken line position shown in FIG. 9. Slight additional force is required to continue the upward movement of the door 104 to its full open position shown in FIG. 9. The spring 124 and the friction in the parallel link assemblies 110 maintain the door 104 in an open position without the application of further force to the door. Likewise, when the door 104 is being returned to its closed position shown in FIG. 8, the moment exerted on the door by the spring 124 is substantially constant so that application of a constant force to the door is effective to close it.

As shown in FIG. 8, the angle D between the end of the cable 170 which is attached to the link 148 and a line 190 which is perpendicular to a radius of the axis of rotation of the link 148 and extends through the point 175 of connection of the cable 170 and link 148, is such that only a component of the total force exerted by the cable 170 on the link 148 is effective to urge the door 106 upwardly. During movement of the door 106 between its closed position shown in FIG. 8 and its substantially open position shown in broken lines in FIG. 9, the angle D progressively decreases until it is nonexistent in the broken line position of the door 106. Consequently, the component of the cable force is continually being increased and the rate and pre-loading of the spring 166 are selected so that the total force of the spring is at the same time being decreased at substantially the same rate. Consequently, a small constant force applied to the door 106 is effective to move it from its closed position to its open position. The friction in parallel link assemblies 140 is sufficient to maintain the door in an open position when added to the spring force on the cables tending to hold the door open.

In one embodiment of the form of the invention shown in FIGS. 5–9, inclusive, the spring 124 is pre-loaded to fourteen and one-quarter pounds and is loaded to twenty-one and a quarter pounds in the closed position of the door 104. The spring 166 is pre-loaded to about twenty-seven pounds and closing of the door 106 loads the spring 166 to thirty-eight pounds. The moment arm for each of the cables 118 and 128 relative to the pivots 114 in the closed position of door 104 is about two and one-quarter inches and the moment arm for the center of mass of the door 104, which weighs about ten pounds, is about five and five-eighths inches. The moment arm for each of the cables 156 and 170, in the closed position of door 106, relative to the pivots 150, is about two and a half inches, and the moment arm for the center of mass of the door 106, which weighs about sixteen pounds is about seven and seven-sixteenths inches. The spring 124 compresses about five and three-sixteenths inches dur-

ing opening of the door **104** and the spring **106** compresses about five and thirteen-sixteenths inches during opening of the door **106**. About a six pound pull is required on each door to initially break the seal between the gasket **70** and the container **10**, so the initial opening force required on each door must be increased to this extent.

From the above description, it is seen that this invention provides refrigerated containers **10**, **10***a* and **10***b*, which are provided with various forms of vertically movable doors. In the container **10**, a single vertically movable door is provided which can readily be moved between open and closed positions without occupying at any time a substantial amount of space in front of the container **10**. The doors **82** and **84** on the front side of the container **10***a* are likewise readily moved between open and closed positions with these doors moving in opposite directions to open positions. The doors **104** and **106** are similarly mounted but they move in the same direction, namely, upwardly, to open positions. In all cases, the forces tending to move the door in a direction opposite to the force of gravity thereon are located so that only a small substantially constant force is required to open a door.

It will be understood that the specific constructions of the refrigerated containers with vertically movable doors which are herein disclosed and described are presented for purposes of explanation and illustration and are not intended to indicate limits of the invention, the scope of which is defined by the following claims.

What is claimed is:

1. A cabinet structure for a refrigerator or the like having a back wall and laterally spaced side walls defining a container area and a front opening subdivided horizontally into upper and lower front opening portions, the side walls being shallower, considered in the front-to-back direction, in the area of the upper opening portion than in the area of the lower opening portion, a pair of doors, one for each of said opening portions, a pair of parallel link assemblies, one link assembly connected to each end of each door, said link assemblies for both doors comprising links extending angularly upward and rearwardly from the doors when the doors are closed and being pivoted at their inner ends to the cabinet structure and at their outer ends to the doors, whereby both doors move forwardly and upwardly in moving away from the closed position.

2. A cabinet structure as defined in claim 1 wherein the front edges of said side walls in the area of the upper opening portion are parallel to but rearwardly offset with respect to the front edges of the sidewalls in the area of the lower opening portion, whereby when the doors are closed the upper door is correspondingly offset rearwardly with respect to the lower door.

3. A cabinet structure as defined in claim 1 wherein the front edges of said side walls in the area of the upper opening portion are parallel to but rearwardly offset with respect to the front edges of the sidewalls in the area of the lower opening portion, whereby when the doors are closed the upper door is correspondingly offset rearwardly with respect to the lower door, and separate counterbalancing springs for said doors connected to said links in such manner that as the springs relax during opening movements of the doors, the links move to positions more nearly perpendicular to the direction of exertion of opening force thereupon, whereby the effective proportional component of the remaining spring force transmitted to the doors in an opening direction increases during opening movement of the doors, and vice versa.

4. In a refrigerated container having an opening in one side, a horizontal mullion strip dividing said opening into upper and lower portions, a pair of door members for said portions, a pair of parallel link assemblies connected to opposite ends of each of said door members and pivotally mounted on said container so that said door member is movable between a first upright position in substantially horizontal alignment with and closing said door opening and a second upright position displaced vertically from said first position, each of said door members being movable upwardly to an open position, each of said assemblies including a pair of parallel link members, a cable connected to one of the links in each assembly, said cable being arranged so that a pulling force thereon is transmitted to the link assembly therefor in a direction to move the door on said link assembly upwardly, spring means connected to each of said cables so as to exert a pulling force thereon, said spring means being connected to said cables and said cables being connected to said links at positions such that said spring means exerts substantially constant moments on said door members urging said door members upwardly during movement thereof between said positions.

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