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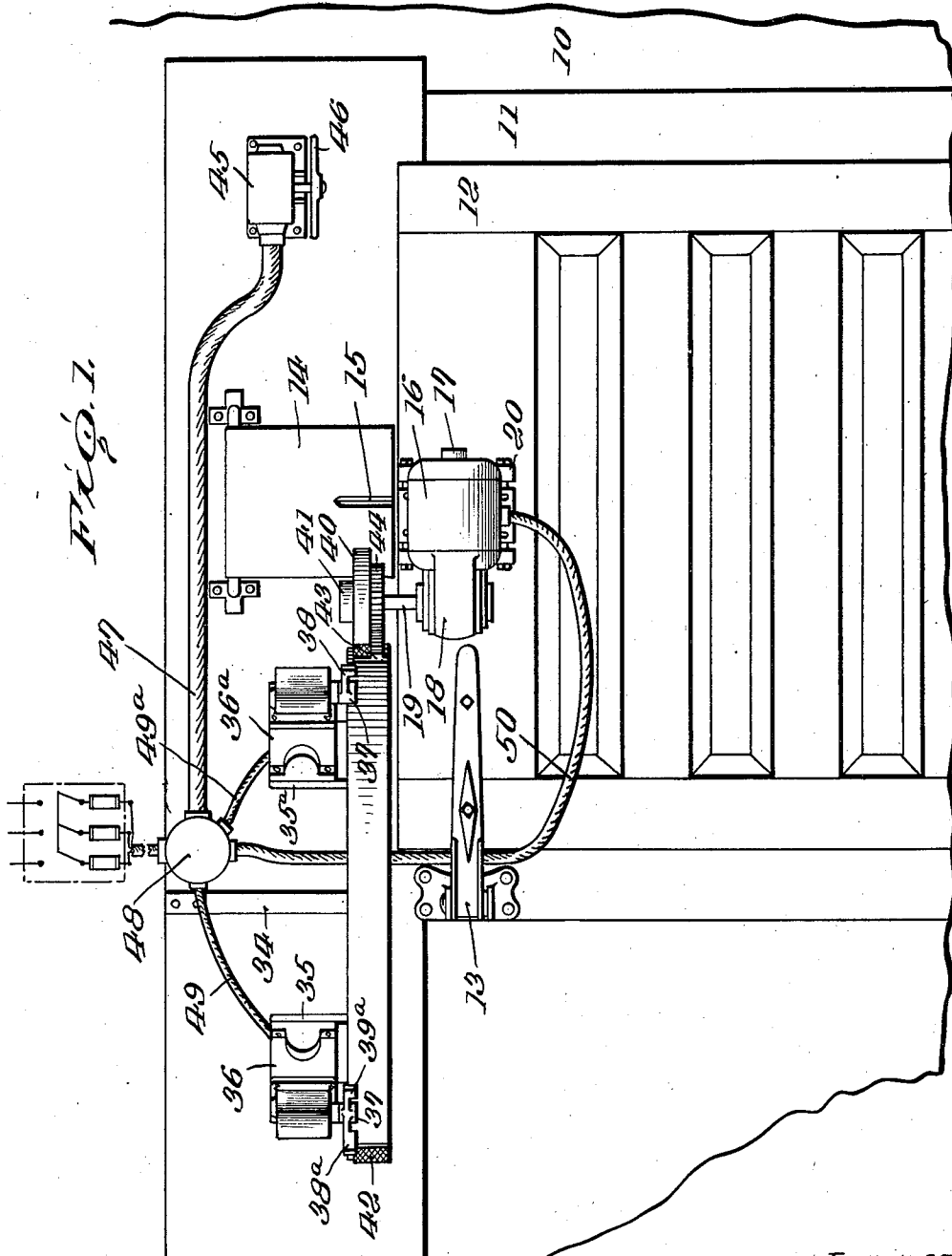
D. K. MIMS

2,294,041

DOOR OPERATING MECHANISM

Filed Oct. 21, 1940

3 Sheets-Sheet 1



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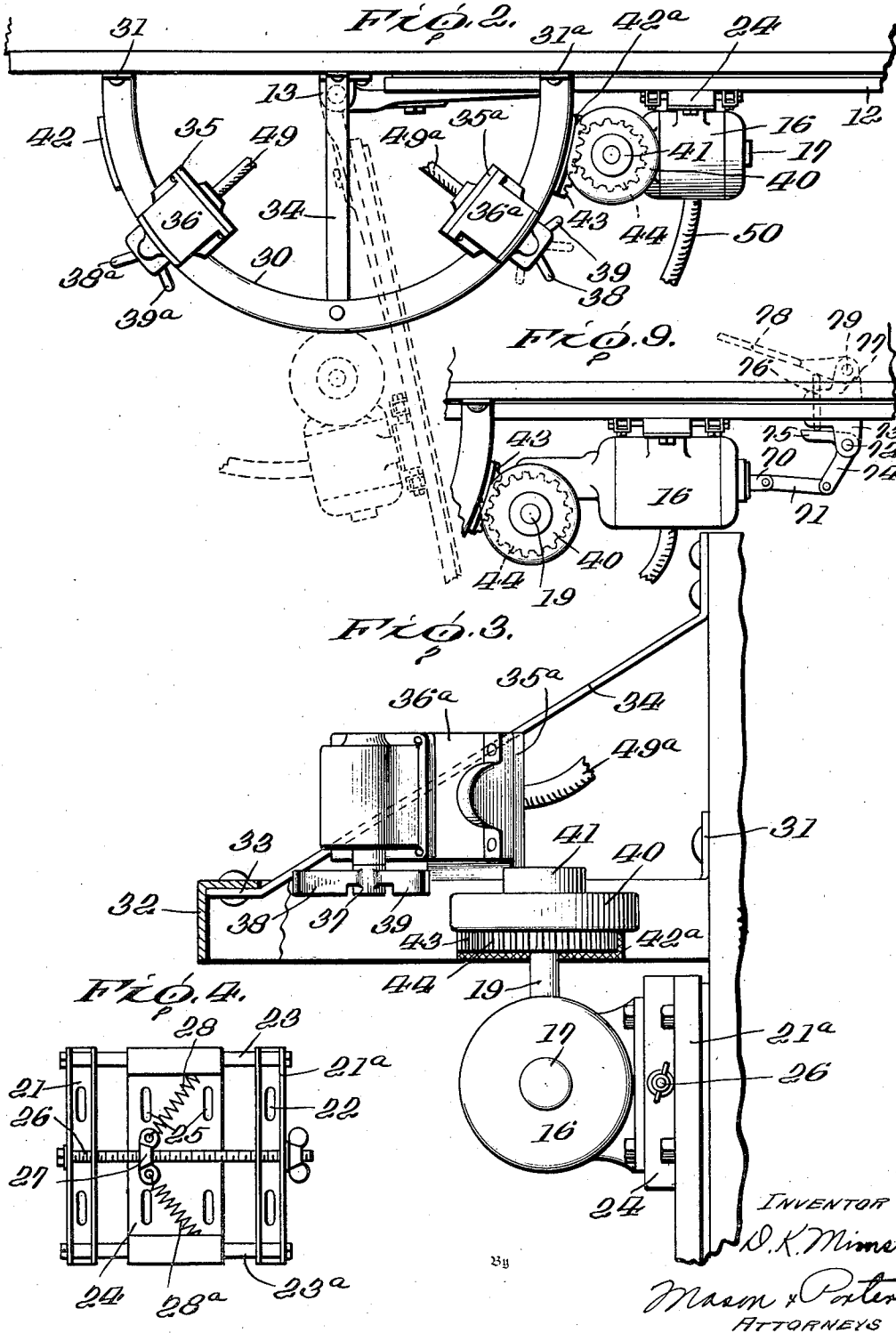
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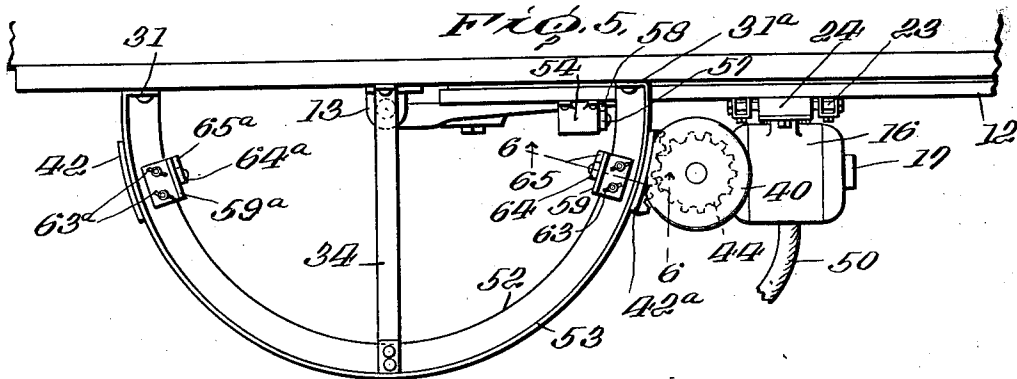
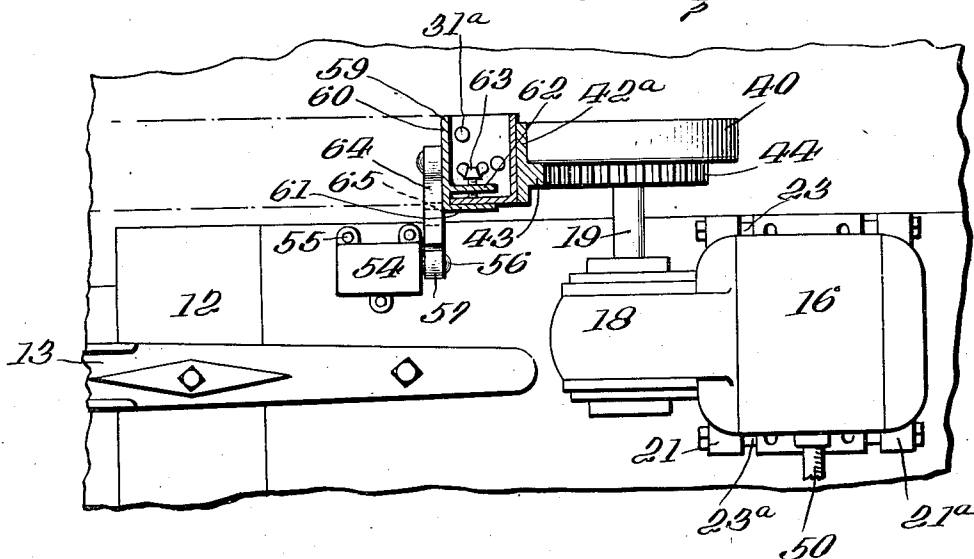
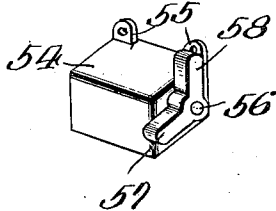


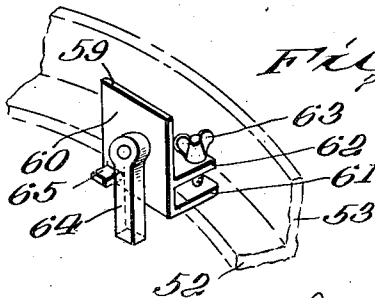
Fig. 6.



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FLÖ. 8.



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DOOR OPERATING MECHANISM

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5 Claims. (Cl. 268—65)

The present invention relates to new and useful improvements in a closure operating mechanism, and more particularly to improvements in a mechanism for opening and closing doors by means of an electric motor.

A door of this type is generally employed for closing an opening to a chamber which is to be maintained at a temperature different from normal atmospheric temperature, such as for instance, a cold storage or refrigerator chamber, a heated chamber, or even a chamber which is to be maintained at a moderate variation in pressure. The door may be of any suitable type, as for instance, an interfitting or overlapping type, for closing the opening in the door frame, and suitable sealing strips or gaskets may be provided for compression between the door frame and the door so that a tight seal is established when the door is closed. The door is hingedly mounted on the door frame for swinging movement and, although the door may be used in various instances, the invention is particularly concerned with the provision of such a door for use as refrigerator doors which swing about vertically disposed hinge axes. The electric motor may be mounted on the door for movement therewith, in which case a trackway is mounted on the door frame. The electric motor is adapted to drive a wheel or pulley having a friction surface which is adapted to frictionally engage the trackway so as to cause opening and closing movements of the door. The motor may be operated from a remote control and suitable switches are employed for reversing the motor to effect the desired movements of the door.

An object of the present invention is to provide a door operating mechanism which is constructed and arranged so as to insure proper opening and closing movements of the door from a stationary full open or full closed position, and which may be arranged so as to arrest and reverse the direction of travel of the door at any predetermined point within the full open and closed positions of the door.

A further object of the invention is to provide a door operating mechanism of the above type wherein increased frictional resistance is provided between the motor operated wheel and the trackway when the door is in its full open or full closed position.

A still further object of the invention is to provide a door operating mechanism of the above type wherein positive engagement between the motor operated wheel and the trackway is provided when the door is in a closed position so as to cause opening of the door regardless of its being frozen or otherwise stuck in a closed position.

A still further object of the invention is to provide a door operating mechanism of the above type wherein the motor is resiliently mounted so that it is constantly urged with the driven wheel toward the trackway so as to cause proper en-

gagement between the wheel and the trackway.

The invention still further aims to provide a door operating mechanism of the above type wherein suitable switch means are provided for automatically effecting reversing of the motor at proper places so that the door can be automatically opened and closed by manipulation of the remote control.

The above and other objects of the invention will in part be obvious and will be hereinafter more fully pointed out.

In the accompanying drawings:

Figure 1 is a fragmentary front elevation showing the door operating mechanism with the door in a closed position.

Figure 2 is a top plan view of Figure 1 showing the door operating mechanism, the door being shown by dotted lines in a partially open position.

Figure 3 is an enlarged end view of the door operating mechanism showing the motor and trackway.

Figure 4 is a bottom plan view showing the details of the resilient motor mounting.

Figure 5 is a top plan view similar to Figure 2, showing a modified form of switch control mechanism.

Figure 6 is an enlarged partial sectional view, taken along the line 6—6 of Figure 5.

Figure 7 is a detail of the switch mechanism shown in Figure 5.

Figure 8 is a detail of the switch operating mechanism which is mounted on the trackway.

Figure 9 is a fragmentary top view, partly in section, showing a manual control mechanism operable from the inside of the door for opening the same.

Referring more in detail to the accompanying drawings, and particularly to Figures 1 through 4, a wall 10 of a suitable chamber is provided with a door frame 11 which defines an opening into the cold storage chamber. The refrigerator door 12 may be of any suitable insulated type and one edge of the door is connected to the door frame by hinge means 13 which permit the door to swing about a vertical hinge axis. Above the door 12, there may be provided an additional opening which is closed by a member 14 which has a slot 15 through which a trackway (not shown) may extend, if so desired.

An electric motor 16 is mounted near the top of the door 12 substantially centrally with respect to the vertical edges thereof and the motor shaft 17 extends transversely of the door. The motor may be of any suitable type and is provided with a housing 18 in which gearing mechanism (not shown) is provided for effecting the driving of a vertical shaft 19 from the motor shaft 17. The motor 16 is resiliently carried by a base structure 20, the details of which are clearly shown in Figure 4. This supporting base 20 includes end members 21, 21a which are disposed verti-

cally with respect to the door 12 and are secured to the door by bolts or the like extending through slots 22 which permit slight adjustment of the supporting base on the door. Upper and lower shaft members 23, 23a are secured to the ends of the members 21, 21a and extend transversely of the door. A bracket member 24 is slidably mounted on the shaft members 23, 23a and is provided with slots 25 through which bolts or the like may extend for adjustably mounting the motor 16 thereon. A central threaded bolt 26 is secured centrally across the end members 21, 21a and has an adjustable nut 27 threadedly mounted thereon. This nut 27 is connected by springs 28, 28a to opposite sides of the sliding bracket 24 and the springs are disposed so as to normally force the sliding bracket 24 toward the hinged edge of the door.

An arcuate trackway 30 has the ends thereof secured to the door frame, as at 31, 31a above the upper edge of the door. This trackway extends outwardly from the door frame and the center thereof substantially coincides with the vertical hinge axis of the door. The trackway is provided with a downwardly extended outer skirt portion 32 and an upper horizontal portion 33 which is secured by arms 34 or the like to the door frame so as to strengthen the same. On the horizontal portion 33 of the trackway, a pair of brackets 35, 35a are suitably mounted. The bracket 35 is mounted near the full open position of the door, while the bracket 35a is mounted near the full closed position of the door. Each bracket 35, 35a carries a switch housing 36, 36a respectively, within which are mounted a suitable form of limit switches. The switch housing extends outwardly from the rear part of the brackets so that operating levers for the switches may be disposed on the outside of the trackway and in the path of movement of an operating member which is movable with the door. Thus, the switch housing 36a includes a vertical shaft 37 disposed outside of the trackway and carrying a pair of switch operating levers 38, 39. Similarly, the switch housing 36 carries operating levers 38a, 39a.

The vertically disposed motor shaft 19 extends upwardly outside of the trackway and carries a wheel which is provided with a soft rubber friction surface or the like. This soft rubber friction surface may be in the form of a pneumatic tire 40 so as to provide a friction pulley which is adapted to cooperate with the vertically disposed surface 32 of the trackway. Above the wheel 40, there is provided a hub portion 41 which serves as a switch operating member in that it actuates the switch levers during movement of the door in a manner to be hereinafter more fully pointed out. The resilient mounting of the motor serves to maintain the friction pulley 40 in frictional engagement with the trackway so as to effect the desired opening and closing movements of the door. When the door is in a stationary closed or open position, it may be desirable to increase the frictional contact between the wheel 40 and the trackway. For this purpose, the vertically disposed surface of the trackway may be provided with outwardly extending knurled surfaces 42, 42a with which the friction pulley 40 is adapted to contact when the door is in its full open or full closed position. Thus, as shown in Figure 2, the outwardly extending knurled surface 42a causes a slight flattening of the tire 40 when the door is in a closed position in order to increase frictional resistance

between the tire and the trackway during initial opening movement of the door. The outwardly extending friction surface 42 at the opposite end of the trackway serves the same purpose when the door is in a full open position.

In addition to the surfaces 42, 42a which provide increased frictional resistance during initial opening and closing movements of the door, there may be provided a rack 43 on the surface 42a. This rack is adapted to cooperate with a gear 44 carried by the shaft 19 below the friction pulley 40. When the door is closed, the gear 44 will engage the rack 43 so as to provide a positive engagement between the operating shaft 40 and the trackway. Thus, if the door becomes frozen or otherwise stuck in a closed position, the rack and gear connection will insure positive opening of the door. Furthermore, the positive engagement between the gear 44 and the rack 43 provides a means for effecting positive closing of the door to compress the sealing gaskets so as to effect a tight seal around the door.

As shown in Figure 1, there is provided a control switch 45 which includes a lever 46 which may be operated from a remote control device. Electric conductors extend from the switch 45 through a conduit 47 to the terminal plugs 48 which may be connected to the main source of electric supply. The conductors for the switches 36, 36a extend through conduits 49, 49a, respectively, and the conductors for the motor 16 extend through a conduit 50.

In operation from the fully closed position of the door, as shown in Figures 1, 2 and 3, the remote control switch 45 is actuated to supply current to the motor 16. The setting of the switches is such that the shaft 19 will be operated so as to effect opening movement of the door. If the door is frozen or otherwise stuck in a closed position, engagement between the gear 44 and the rack 43 will cause positive opening of the door. As opening movement of the door continues, the hub portion 41 on the shaft 19 will pass the free end of the lever arm 39 and will engage the lever arm 38. Since both lever arms are fixed to the shaft 37 on the switch housing 36a, these lever arms will be shifted to their opposite positions, as shown in dotted lines, in Figure 2, with the lever arm 39 disposed outwardly in the path of the hub portion 41 and with the lever arm 38 in a retracted position. Further opening movement of the door will cause the hub portion 41 to pass the lever 39a and to engage the lever 38a so that these levers will also be shifted in unison to their opposite positions with the lever arm 38a retracted and with the lever arm 39a disposed in the path of movement of the hub portion 41.

During movement of the door from a closed to an open position, shifting of the lever arms 38, 39 by the switch operating hub portion 41 merely serves to set the switch mechanism so that it will function during the return closing movement of the door, that is, with the lever arm 39 in the path of movement of the hub portion 41. However, movement of the second pair of switch arms 38a, 39a during opening movement of the door serves to stop the motor 16 and to also reverse the current preparatory to the subsequent closing of the door. The switch mechanism within the housing 36 is positioned on the trackway so that the motor will be stopped as the door approaches its full open position. After the door has reached its full open position and it is desired to close the same, the control switch

45 is actuated so as to supply current to the motor for reverse movement since the current was reversed by movement of the lever arms 38a, 39a during opening movement of the door. As the door begins its closing movement, the hub portion 41 will pass the end of the lever arm 38a and engage the lever arm 39a so as to set the lever arms for operation during subsequent opening of the door. As the door continues its closing movement, the hub portion 41 will pass the free end of the lever 38 and will engage the lever 39 so as to shift these lever arms to the full line position shown in Figure 2. This operation of the lever arms 38, 39 during closing movement of the door will stop the motor and effect a reversal of current for subsequent opening movement of the door.

As previously pointed out, increased traction between the friction roller 40 and the trackway is afforded by the raised surfaces 42, 42a at the limits of movements of the door so as to insure proper opening or closing movements of the door from a stationary position. Engagement between the gear 44 and the rack 43 when the door is in a closed position will insure positive opening of the door even though it may have become frozen or otherwise stuck and it will also insure positive closing of the door. The resilient mounting of the motor is such that the motor and the friction roller 40 are normally urged toward the trackway during movements of the door so as to maintain sufficient traction between the roller and the trackway at all times.

In Figures 5 through 8, a modified form of the invention is shown. In this form of the invention, the motor 16 is secured to the base 24 which is slidably mounted on the shaft members 23, 23a, as previously pointed out. Identical spring means may be employed for normally forcing the motor toward the trackway. The motor shaft 17 drives the vertical shaft 19 through suitable gearing enclosed within the housing 18. The shaft 19 carries a similar gear 44 and a friction roller 40. The gear 44 meshes with a rack 43 which may be attached to or formed as a part of the raised surface 42a adjacent the closed position of the door. The trackway is provided with an inwardly extending horizontal portion 52 and with an outer vertical portion 53 and the ends of the trackway are secured to the door frame on opposite sides of the hinge connection 13, as at 31, 31a. A brace member 34 may be provided for strengthening the trackway.

In this form of the invention, there is employed a suitable form of limit switch which may be of a conventional double-acting type which is mounted within the housing 54 which, in turn, is secured to the door by bolts 55 or the like. This switch unit is disposed within the horizontal portion 52 of the trackway and the switch shaft 56 extends toward the trackway and has secured thereto a forked lever having arms 57, 58. A pair of bracket members 59, 59a are mounted on the horizontal portion 52 of the trackway. The bracket 59a is disposed at one end of the trackway substantially in the same position as the switch housing 36 (Figure 2) and the bracket 59 is disposed near the opposite end of the trackway substantially in the position of the switch housing 36a (Figure 2). Both bracket members are substantially identical and the details of the bracket 59, as shown in Figures 6 and 8, will now be described. The inner wall portion 60 of the bracket 59 is disposed within the edge of the

horizontal portion 52 of the trackway and is provided with outwardly extending spaced flange portions 61, 62 between which the horizontal portion 52 of the trackway is disposed. The bottom flange portion 61 is disposed beneath the trackway and the upper flange portion 62 is disposed thereabove. Wing bolts 63 or the like threadedly pass through the upper flange portion 62 and engage the horizontal portion 52 of the trackway so as to secure the bracket in any desired position thereon between the ends of the trackway so as to limit movements of the door between any desired points. A depending lever 64 is pivotally mounted on the inner face of the wall portion 60 which is provided with an inwardly extending stop portion 65. This stop portion 65 is disposed adjacent the door frame and serves as a stop for limiting movement of the lever 64 toward the door frame. However, the lever 64 is free to swing away from the door frame. The bracket 59a is also provided with a stop portion 65a which is disposed adjacent the door frame. A lever 64a is fixed to the bracket 59a and is free to swing away from the door frame although the stop portion 65a limits movement thereof toward the door frame. A suitable conduit for the electric conductors may be provided for the switch mechanism which is enclosed within the switch housing 54.

In operation of this form of the invention, the remote control switch may be actuated for starting the motor to effect opening of the door. As the door begins its opening movement, the switch mechanism within the housing 54 will be moved therewith. The switch lever arms 57, 58 are in the position shown, that is, with the arm 58 extending upwardly in the path of the pivot lever 64 and with the lever arm 57 disposed horizontally and out of the path of the end of the lever 64. Since the depending lever 64, is free to swing outwardly with respect to the door frame, the lever arm 58 will cause such swinging movement of the lever 64 without shifting the position of the switch lever arms 57, 58. As the door nears its full open position, the lever arm 58 will engage the depending lever 64a which is prevented from moving inwardly toward the door frame by the stop portion 65a. Therefore, the switch lever arm 58 will be moved with the switch actuating shaft 56 downwardly to a substantially horizontal position and the switch lever arm 57 will be simultaneously elevated to a vertical position. This movement of the switch actuating shaft 56 will stop the motor and effect the reversal of the current for the subsequent closing movement of the door. The remote control switch 45 may then be actuated to effect closing movement of the door. The lever 64a is free to pivot outwardly from the door frame so that the lever arm 57 will pass thereby without rotating the switch actuating shaft 56. As the door approaches its closed position, the switch lever arm 57 will engage the lever 64 which is prevented by the stop portion 65 from swinging inwardly toward the door frame. Thus, the switch lever arm 57 will again assume the position shown in Figure 7, that is, a substantially horizontal position and the lever arm 58 will assume a substantially vertical position. This movement of the switch actuating shaft 56 will stop the motor and effect a reversal of current for subsequent opening of the door.

The elevated surfaces 42, 42a on a vertical portion 53 of the trackway engage the surface of the friction roller 40 so as to increase traction

between the trackway and the roller when the door is in its full open or full closed position. As pointed out in connection with Figures 1 through 4, the positive engagement between the gear 44 and the rack 43 serves to effect positive opening of the door against any tendency of the same to become frozen in a closed position.

It is, of course, obvious that the switch device and controls, together with the wiring arrangement, may be selected and arranged so that a single operation of the remote control switch will effect opening and closing movements of the door. For instance, a simple form of reversing switch may be located at any desired point on the trackway or a suitable form of remote control switch may be employed for automatically closing the door. In other words, a suitable form of such an arrangement may be employed for automatically reversing the current and effecting closing of the door after the initial opening operation.

Because of the possibility of a person becoming locked within the closed chamber after the current is interrupted by closing of the door, a safety release mechanism has been shown in Figure 9 of the accompanying drawings. The motor 16 has secured to the rear end thereof a suitable form of bracket 70 to which one end of a link 71 is pivoted. The opposite end of the link 71 is pivotally connected to an arm 74 of a lever which is pivotally mounted as at 72, to a bracket 73 on the outer face of the door. Another arm 75 movable with arm 74 is adapted to contact with one end of a sliding bolt or pin 76 which extends through the door. A bracket 77 is mounted on the inside of the door and has a lever 78 pivotally mounted thereon, as at 79. This lever 78 is accessible to any one within the chamber which has been closed by the door so that movement of the lever 78 toward the inner surface of the door will cause outward sliding movement of the pin 76 which, in turn, will cause counterclockwise movement of the levers 74 and 75 so as to shift the entire motor assembly toward the right (see Figure 9). This movement of the motor will disengage the gear 44 from the rack 43 and relieve traction between the roller and the trackway so that the door may be opened from within the closed chamber.

From the foregoing description, it will be seen that the present invention provides an efficient and simple mechanism for automatically opening and closing a door upon operation of a remote controlled switch. The invention is illustrated in connection with a door, particularly a refrigerator door, of the type which is hinged for swinging movement about a vertical axis. The trackway is arcuate with its center coinciding with the hinge axis so that the trackway extends an equal distance on both sides of the hinge axis. In order to overcome the dead load of the door in a stationary closed or open position, the trackway is shaped so as to increase the traction with the friction roller, and the motor and friction roller are constantly urged by spring means toward the trackway so as to maintain the necessary frictional contact for operating the door. The switch mechanism, whether a pair of switches are mounted on the trackway or whether a single double-acting switch is carried by the door, serves to automatically stop the motor as the door reaches its full open or full closed position or at any predetermined position depending upon the seating

of the cooperating switch operating devices, and at the same time causes a reversal of current preparatory to subsequent movement of the door.

It is to be clearly understood that various changes in the details of construction and arrangement of parts may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. A mechanism for opening and closing a door which is adapted to control an opening through a door frame, comprising a motor carried by the door, a trackway carried by the frame, a friction roller operated by the motor and in contact with the trackway whereby to effect opening and closing of the door upon operation of the motor, and means for effecting increased traction between the friction roller and the trackway when the door is in a full open or full closed position.

2. A mechanism for opening and closing a door which is adapted to control an opening through a door frame, comprising a motor carried by the door, a trackway supported by the frame, a friction roller operated by the motor and in contact with said trackway whereby to effect opening and closing of the door upon operation of the motor, and means for positioning the adjacent surface of the trackway closer to the axis of said friction roller when the door is in a full open or full closed position whereby to increase the traction therebetween.

3. A mechanism for opening and closing a door which is adapted to control an opening through a door frame, comprising a motor carried by the door, a trackway supported by the frame, a friction roller operated by the motor and in contact with said trackway whereby to effect opening and closing of the door upon operation of the motor, and means providing outwardly extending surfaces on said trackway adjacent the ends thereof and in the path of said friction roller whereby to increase the traction between the trackway and said friction roller when the door is in a full open or full closed position.

4. A mechanism for opening and closing a door which is hinged to a door frame to control an opening therethrough, comprising a motor carried by the door, an arcuate trackway secured to the frame on opposite sides of the hinge axis, a friction roller operated by the motor and in contact with the trackway for effecting opening and closing of the door upon operation of the motor, spring means for normally forcing the motor and the friction roller toward the trackway, and means for increasing traction between the trackway and the roller at least when the door is in a full open or full closed position.

5. A mechanism for opening and closing a door which is adapted to control an opening through a door frame, comprising a motor carried by the door, a trackway carried by the frame, a roller operated by the motor and having a soft rubber friction surface in contact with the trackway for effecting opening and closing of the door upon operation of the motor, and means for effecting increased traction between the door and the trackway when the door is in a full open or full closed position without shifting of the door toward or away from the trackway.

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