

DESCRIPTION

Title of the Invention: DOOR OPENING DEVICE AND REFRIGERATOR

Technical Field

[0001] This invention relates to a door opening device for opening a door pivoted on a pivot shaft, and to a refrigerator incorporating such a door opening device.

Background Art

[0002] Patent Document 1 discloses a conventional refrigerator incorporating a door opening device. The refrigerator includes a main body and a door. The main body is a heat-insulated box filled with foam heat insulating material and has an opening face at its front face. The door is filled with foam heat insulating material. The door is pivoted on the main body with a pivot shaft and opens and closes the opening face.

[0003] The door opening device includes a plate cam in an oval shape arranged on the top face of the main body and a pin arranged on the top face of the door. The plate cam rotates about a vertical rotary shaft, and the pin slides on a cam surface on the circumferential surface of the plate cam.

[0004] In the refrigerator as described above, when a predetermined operation is performed, the plate cam rotates and the pin slides between a start point and an end point on the cam surface. As the distance between the position where the pin slides on the cam surface and a rotation center of the plate cam increases, the door is opened. After the pin has left from the plate cam at the end point of the cam surface, the door is opened manually. It is thus possible to reduce a load involved in opening the door.

List of Citations

Patent Literature

[0005] Patent Document 1: JP-A-2001-317864

Summary of the Invention

Technical Problem

[0006] According to the conventional refrigerator described above, at the end point of the

cam surface, the direction tangential to the cam surface aligns with the rotation direction of the plate cam. Thus, near the end point, the amount of movement of the pin with respect to the rotation angle of the plate cam is small, and it is thus impossible to thrust the door forward swiftly when the plate cam leaves the pin. This leaves a wide range in which the door needs to be opened manually, resulting in poor usability.

[0007] An object of the present invention is to provide a door opening device with improved usability and a refrigerator incorporating such a door opening device.

Means for Solving the Problem

[0008] To achieve the above object, according to one aspect of the present invention, a door opening device includes a main body having an opening face, a door pivoted on the main body with a pivot shaft and opening and closing the opening face, a rotary member arranged on the main body and rotating about a rotary shaft, a slider arranged on the rotary member, and a cam surface arranged on the door and guiding the slider, the slider sliding between a start point and an end point on the cam surface and thereby opening the door. Here, at the end point, the tangent line to the cam surface is inclined with respect to the movement direction of the slider and the slider rotates in the direction away from the pivot shaft.

[0009] According to another aspect of the present invention, in the door opening device structured as described above, preferably, the angle formed by the straight line connecting between the rotary shaft and the slider at the end point and the straight line connecting between the pivot shaft and the slider at the end point is a right angle or an obtuse angle.

[0010] According to another aspect of the present invention, in the door opening device structured as described above, preferably, at the end point, the inclination angle of the tangent line to the cam surface with respect to the movement direction of the slider is 45 degrees or more.

[0011] According to another aspect of the present invention, in the door opening device structured as described above, preferably, the slider rotates at a uniform speed.

[0012] According to another aspect of the present invention, in the door opening device structured as described above, preferably, at the front face of the main body, two doors

are arranged side by side in the left-right direction and the pivot shafts of the doors are respectively arranged at opposite end parts of the main body. Here, one door can be opened with the forward rotation of one rotary member and the other door can be opened with the reverse rotation of the one rotary member.

[0013] According to another aspect of the present invention, in the door opening device structured as described above, preferably, on one of the top and bottom faces of the door, the cam surface is arranged and a concave part is formed. The concave part can be arranged frontward of the cam surface and can be open to face the neighboring door.

[0014] According to another aspect of the present invention, in the door opening device structured as described above, preferably, a plurality of sliders are provided on the rotary member.

[0015] According to another aspect of the present invention, preferably, a refrigerator includes the door opening device each structured as described above. Here, the slider can be arranged on a top face of the main body and the cam surface can be arranged on the top face of the door.

Advantageous Effects of the Invention

[0016] According to the present invention, at the end point of the cam surface, the tangent line to the cam surface is inclined with respect to the movement direction of the slider and the slider rotates in the direction away from the pivot shaft. This permits the door to be thrust forward swiftly and it is thereby possible to reduce the range in which the door needs to be opened manually. It is thus possible to improve the usability of the door opening device and the refrigerator.

Brief Description of Drawings

[0017] [Fig. 1] is a front view showing a refrigerator according to a first embodiment of this invention;

[Fig. 2] is a top view showing a state where doors are closed in the refrigerator according to the first embodiment of this invention;

[Fig. 3] is a top view illustrating the operation of opening a door in the refrigerator according to the first embodiment of this invention;

[Fig. 4] is a top view illustrating the operation of opening a door in the refrigerator

according to the first embodiment of this invention;

[Fig. 5] is a top view illustrating the operation of opening a door in the refrigerator according to the first embodiment of this invention;

[Fig. 6] is a top view illustrating a state near an end point of a door in the refrigerator according to the first embodiment of this invention;

[Fig. 7] is a top view illustrating a state near an end point of a door in a refrigerator according to Comparative Example;

[Fig. 8] is a top view showing a state where doors are closed in a refrigerator according to a second embodiment of this invention;

[Fig. 9] is a top view showing a state where doors are closed in a refrigerator according to a third embodiment of this invention;

[Fig. 10] is a top view illustrating the operation of opening a door in the refrigerator according to the third embodiment of this invention;

[Fig. 11] is a top view illustrating the operation of opening a door in the refrigerator according to the third embodiment of this invention; and

[Fig. 12] is a top view showing a state where a door is closed in a refrigerator according to a fourth embodiment of this invention.

Description of Embodiments

[0018] <First embodiment>

Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings. Fig. 1 is a front view showing a refrigerator 1 according to a first embodiment. The refrigerator 1 has a refrigerating compartment 3, a freezing compartment 5, and a vegetable compartment 7 formed in this order from top down in a main body 2 which is a heat-insulated box.

[0019] At the front face of the refrigerating compartment 3, doors 4a and 4b are arranged side by side in the left-right direction. The doors 4a and 4b are respectively pivoted on vertical pivot shafts 4c and 4d arranged at opposite end parts of the main body 2, and open and close an opening face 3a (see Fig. 2) of the refrigerating compartment 3 at its front side. An opening face of the freezing compartment 5 at its front side is opened and closed with a sliding door 6. An opening face of the vegetable compartment 7 at its front side is opened and closed with a sliding door 8.

- [0020] The doors 4a, 4b, 6, and 8 are provided, in a peripheral part of their respective rear faces, with gaskets (unillustrated) which prevent cold air from leaking. The gaskets are provided with magnets (unillustrated) which attach to the main body 2 at its front face.
- [0021] Fig. 2 is a top view of the refrigerator 1. On the top face of the main body 2 and the door 4a, a door opening device 50 is provided which opens the door 4a. Likewise, on the top face of the main body 2 and the door 4b, a door opening device 50 is provided which opens the door 4b. The door opening device 50 includes a driver 58 and a guide portion 60.
- [0022] The driver 58 is arranged on a supporting member 51 attached to the top face of the main body 2. The driver 58 includes a motor 52, a worm 53, a worm wheel 54, a reduction gear 55, and a reduction gear 56 (rotary member). The worm 53 is attached to a shaft of the motor 52 and meshes with the worm wheel 54. The reduction gear 55 is attached concentrically with the worm wheel 54. The reduction gear 56 meshes with the reduction gear 55. The reduction gear 56 is provided with a slider 59 protruding downward.
- [0023] A rotary shaft 56a (see Fig. 6) of the reduction gear 56 forms the rotation center of the slider 59 and is arranged rearward of the pivot shafts 4c and 4d.
- [0024] The guide portion 60 is provided on the top face of the doors 4a and 4b and has a cam surface 60a, with a curved surface, which guides the slider 59 to slide. Two sliders 59 each slide between a start point Ps and an end point Pe on the cam surface 60a and open the doors 4a and 4b.
- [0025] Next, with reference to Fig. 2 to 5, the operation of the door opening device 50 opening the door 4a at the left side will be described. When a predetermined operation button is operated while the door 4a is closed as shown in Fig. 2, the driver 58 rotates the slider 59 at a uniform speed. Here, the rotation direction B1 of the slider 59 is the direction away from the pivot shaft 4c at the front side (the counter-clockwise direction in Fig. 2 to 5).
- [0026] When the slider 59 rotates through a predetermined angle (for example, 45 degrees) and makes contact with the start point Ps on the cam surface 60a, the slider 59 and the cam surface 60a start to slide. Thus, the slider 59 idles until the door 4a in a closed state makes contact with the start point Ps; that is, an idling period is provided. Owing to the idling period, it is possible to stabilize the torque of the motor 52 before

the start of opening operation, when opening the door 4a involves a heavy load due to the adhesive force of the gasket.

[0027] When the door 4a is closed, the start point Ps is arranged frontward of a straight line connecting between the pivot shaft 4c and the rotary shaft 56a (see in Fig. 6) of the reduction gear 56 with respect to the movement direction of the slider 59. Thus, the guide portion 60 can be reliably arranged on the top face of the door 4a so as not to protrude behind the door 4a. This helps prevent lowering of the strength of the guide portion 60 and degradation of the design of the door 4a as a result of the guide portion 60 extending to over the main body 2.

[0028] When the slider 59 rotates farther away from the start point Ps of the cam surface 60a, as shown in Fig. 4, the door 4a is opened. As shown in Fig. 5, the slider 59 reaches the end point Pe of the cam surface 60a, and then leaves the cam surface 60a. Then, the door 4a is opened wider by a biasing force as the slider 59 leaves the cam surface 60a. It is thus possible to reduce the load involved opening the door 4a.

[0029] The end point Pe of the cam surface 6a is arranged close to the rear face of the door 4a. Thus, when the slider 59 is arranged at the end point Pe, the door 4a can be arranged farther frontward. The movement direction D1 of the slider 59 at the end point Pe aligns with the straight line L2 (see Fig. 6) connecting between the slider 59 and the pivot shaft 4c. That is, the straight line L1 (see Fig. 6) connecting between the rotary shaft 56a of the reduction gear 56 and the slider 59 at the end point Pe and the straight line L2 (see Fig. 6) connecting between the pivot shaft 4c and the slider 59 at the end point Pe are perpendicular to each other. Thus, when the slider 59 is arranged at the end point Pe, the door 4a can be arranged even farther frontward.

[0030] Instead, the straight line L1 and the straight line L2 may be arranged so as to make a slightly obtuse angle rather than a right angle. For example, the angle formed by the straight line L1 and the straight line L2 may be 95 degrees instead of 90 degrees. In this case, when the slider 59 is arranged at the end point Pe, the angle at which the door 4a is open is slightly smaller than with a right angle, and the slider 59 is released earlier than with a right angle. This helps prevent the release of the slider 59 from delaying as a result of a manufacturing tolerance between the guide portion 60 and the reduction gear 56 or a displacement of the door 4a during long-term use. That is, it is possible to prevent the slider 59 from continuing to slide on the cam surface 60a

beyond the angle at which the straight line L1 and straight line L2 are perpendicular to each other.

[0031] At the end point Pe, the tangent line to the cam surface 60a is inclined at an inclination angle θ (see Fig. 6) with respect to the movement direction D1 of the slider 59. Thus, it is possible to thrust the door 4a forward swiftly with the rotating slider 59. Setting the inclination angle θ at 45 degrees or more is preferable because doing so gives a high angular velocity of the door 4a that is thrust forward; setting the inclination angle θ at 70 degrees or more is further preferred.

[0032] At the end point Pe, the slider 59 rotates in the direction away from the pivot shaft 4c, and thus, as will be described later, it thrusts the door 4a forward more swiftly.

[0033] Likewise, the door 4b is opened as the slider 59 rotates in the rotation direction B2 (the clockwise direction in Fig. 2).

[0034] Fig. 6 is a top view illustrating a state where the slider 59 is arranged close to the end point Pe. Fig. 7 is a top view illustrating a state where the slider 59 of the door opening device 50 according to a Comparative Example is arranged close to the end point Pe. In Comparative Example, the rotation direction B1' of the slider 59 and the inclination direction of the cam surface 60a at the end point Pe are opposite to those in this embodiment. Figs. 6 and 7 show the cam surface 60a only around the end point Pe.

[0035] In Figs. 6 and 7, the inclination angle θ of the cam surface 60a at the end point Pe is the same. Compared with the slider 59 in a state arranged at the end point Pe, the slider 59, in a state where the door 4a is closed through a very small angle β , comes to be arranged at a point Pn close to the end point Pe.

[0036] The pivot shaft 4c of the door 4a is arranged leftward the rotary shaft 56a. As the slider 59 moves from the point Pn to the end point Pe, the door 4a swings in the opening direction (the clockwise direction in the drawings). Since the movement angle of the door 4a is a very small angle β , the cam surface 60a can be regarded as a plane between the point Pn and the end point Pe, and the cam surface 60a also rotates through the angle β in the clockwise direction. Thus, the inclination angle of the cam surface 60a with respect to the straight line L2 is larger when the slider 59 is in contact with the cam surface 60a at the point Pn in Fig. 6 than when the slider 59 is in contact with the cam surface 60a at the end point Pe. In contrast, the inclination angle of the cam surface 60a with respect to the straight line L2 is smaller when the slider 59 is in

contact with the cam surface 60a at the point Pn in Fig. 7 than when the slider 59 is in contact with the cam surface 60a at the end point Pe. Thus, the angle γ of the tangent line to the cam surface 60 with respect to the movement direction D2 of the slider 59 at the point Pn in Fig. 6 is larger than the angle γ' in Fig. 7. Thus, in this embodiment, the distance over which the door 4a moves forward with respect to the rotation of the slider 59 per unit time is larger than in Comparative Example.

[0037] Thus, the center angle α between the slider 59 at the end point Pe and the slider 59 at the point Pn in this embodiment is smaller than the center angle α' in Comparative Example. That is, near the end point Pe, the slider 59 rotating at a uniform speed can rotate the door 4a through the angle β in a shorter time than in Comparative Example, and accordingly the door 4a has a high angular velocity. Thus, rotating the slider 59 at the end point Pe in the direction away from the pivot shaft 4c permits the door 4a to be thrust forward more swiftly than rotating the slider 59 in the direction approaching the pivot shaft 4c.

[0038] According to this embodiment, at the end point Pe of the cam surface 60a, the tangent line to the cam surface 60a is inclined with respect to the movement direction D1 of the slider 59, and thus the rotating slider 59 can thrust the door 4a forward swiftly. Also, rotating the slider 59 in the direction away from the pivot shaft 4c at the end point Pe can achieve a high angular velocity of the door 4a near the end point Pe, and permits the door 4a to be thrust forward more swiftly. Accordingly, with the swift thrust, it is possible to open the door 4a wider, and it is thereby possible to improve the usability of the door opening device 50 and the refrigerator 1.

[0039] The straight line L1 connecting between the rotary shaft 56a and the slider 59 at the end point pe and the straight line L2 connecting between the pivot shaft 4c and the slider 59 at the end point Pe are perpendicular to each other. Thus, when the slider 59 is arranged at the end point Pe, the door 4a can be arranged frontward; it is thus possible to reduce the range in which the door 4a opens after being thrust forward.

[0040] Arranging the slider 59 on the top face of the main body 2 and arranging the cam surface 60a on the top face of the door 4a make it possible to easily improve the usability of the refrigerator 1.

[0041] <Second embodiment>

Next, Fig. 8 is a top view showing a refrigerator 1 according to a second

embodiment. For the sake of convenience of description, such components as find their counterparts in the first embodiment shown in Fig.1 to 6 are identified by the same reference signs. This embodiment differs from the first embodiment in that the doors 4a and 4b are opened with one driver 58. Otherwise, the second embodiment is similar to the first embodiment.

[0042] On the top face of the main body 2, one driver 58 is arranged, in which reduction gears 55, reduction gears 56, and worm wheels 54 are provided in left-to-right pairs respectively. The worm 53 is attached to a shaft of the motor 52 and meshes with a middle gear 57. The middle gear 57 meshes with the two worm wheels 54.

[0043] In the refrigerator 1 structured as described above, when the door 4a is opened, as the worm 53 rotates, the middle gear 57 and the reduction gear 56 at the left side in the drawing rotate in the same rotation direction B1. Thus, the slider 59 slides on the cam surface 60a of the door 4a, and the slider 59 leaves the cam surface 60a at the end point Pe, thereby letting the door 4a open. On the other hand, when the door 4b is opened, as the worm 53 rotates in the opposite direction compared to when the door 4a is opened, the middle gear 57 and the reduction gear 56 at the right side in the drawing rotate in the same rotation direction B2. Thus, the slider 59 slides on the cam surface 60a of the door 4b, and the slider 59 leaves the cam surface 60a at the end point Pe, thereby letting the door 4b open. As described above, changing the rotation direction of the motor 52 permits one of the doors 4a and 4b to open selectively.

[0044] According to this embodiment, it is possible to obtain an effect similar to that in the first embodiment. The doors 4a and 4b arranged side by side in the left-right direction are opened with one motor 52. Accordingly, it is possible to share the driver 58 and thereby reduce the cost of the door opening device 50 and of the refrigerator 1.

[0045] <Third embodiment>

Next, Fig. 9 is a top view showing a refrigerator 1 according to a third embodiment. For the sake of convenience of description, such components as find their counterparts in the first embodiment shown in Fig.1 to 6 are identified by the same reference signs. This embodiment differs from the first embodiment in that the doors 4a and 4b are opened with one driver 58. Otherwise, the third embodiment is similar to the first embodiment.

[0046] On the top face of the main body 2, one driver 58 is arranged, and the rotary shaft

56a of the reduction gear 56 is arranged substantially rearward of the boundary between the doors 4a and 4b. The reduction gear 56 is provided with sliders 59a and 59b. The sliders 59a and 59b are arranged so as to protrude downward from the reduction gear 56 and face each other across the rotary shaft 56a. The reduction gear 56 is configured to be switchable between forward rotation in the rotation direction B1 and reverse rotation in the rotation direction B2.

[0047] On the top face of the doors 4a and 4b, guide portions 60 are provided respectively. The guide portions 60 each have a cam surface 60a, with a curved surface, which guides the sliders 59a and 59b to slide. The sliders 59a and 59b reach the end point Pe of the cam surface 60a and leave the cam surface 60a, thereby letting the doors 4a and 4b be biased in the opening direction respectively.

[0048] The end point Pe of the cam surface 60a in the door 4a side is arranged close to the rear face of the door 4a. Thus, when the slider 59a is arranged at the end point Pe, the door 4a can be arranged farther frontward. The end point Pe is configured such that the straight line L1 connecting between the rotary shaft 56a of the reduction gear 56 and the slider 59a at the end point Pe and the straight line L2 connecting between the pivot shaft 4c and the slider 59 at the end point Pe intersect at a right angle or at a slightly obtuse angle.

[0049] In addition, the end point Pe is set to be frontward of the pivot shaft 4c. Concave parts 65a and 65b each with an open top are formed in the guide portions 60 arranged on the top face of the doors 4a and 4b. The concave parts 65a and 65b are arranged frontward of the cam surface 60a. The concave part 65a has an open side at which it faces the neighboring door 4b, and the concave part 65b has an open side at which it faces the neighboring door 4a.

[0050] In the refrigerator 1 structured as described above, when the door 4a is opened, the reduction gear 56 rotates in the rotation direction B1. Thus, the slider 59a slides on the cam surface 60a of the door 4a, and as shown in Fig. 10, the slider 59a leaves the cam surface 60a at the end point Pe, thereby letting the door 4a open. At this time, at the end point Pe, the tangent line to the cam surface 60a is inclined with respect to the movement direction of the slider 59a, and the slider 59a rotates in the direction away from the pivot shaft 4c. It is thus possible to thrust the door 4a forward swiftly.

[0051] It is difficult to quickly stop the motor 52 immediately after the slider 59a has

passed the end point Pe. Thus, as shown in Fig. 10, the end point Pe in contact with the slider 59a is set to be frontward of the pivot shaft 4c. In this way, when the end point Pe is set at a position where the straight line L1 and the straight line L2 are substantially perpendicular to each other, the end point Pe can be located on the pivot shaft 4c side of the boundary between the door 4a and the door 4b. This helps prevent the slider 59a from colliding with the guide portion 60 provided on the neighboring door 4b immediately after the slider 59a has passed the end point Pe.

[0052] Since the concave parts 65a and 65b are provided, as shown in Fig. 11, after the slider 59a passes the end point Pe, before it stops, the slider 59a enters the concave part 65b, with its side and top open, provided in the neighboring door 4b. This helps more effectively prevent the slider 59a from colliding with the door 4b.

[0053] When the slider 59a stops, it rotates in the reverse direction to rotate in the rotation direction B2, and then the slider 59a is arranged at the position where it was before the door is opened.

[0054] Likewise, when the door 4b is opened, the reduction gear 56 rotates in the rotation direction B2 (see Fig. 2), and the slider 59b slides on the cam surface 60a of the door 4b. Thus, the door 4b is opened, and the slider 59b having passed the end point Pe enters the concave part 65a provided in the neighboring door 4a, thereby preventing the slider 59b from colliding with the door 4a. Here, damping members may be provided on the rear wall of the concave parts 65a and 65b.

[0055] According to this embodiment, it is possible to obtain an effect similar to that in the first embodiment. The doors 4a and 4b arranged side by side in the left-right direction are opened with the sliders 59a and 59b, respectively, provided on one reduction gear 56 (rotary member). It is thus possible to share the driver 58 and thereby reduce the cost of the door opening device 50 and of the refrigerator 1.

[0056] The concave parts 65a and 65b formed on the top face of the doors 4a and 4b are arranged frontward of the cam surface 60a and are open to face the neighboring doors 4b and 4a. This helps prevent the slider 59a from colliding with the door 4b, and helps prevent the slider 59b from colliding with the door 4a.

[0057] On the reduction gear 56, a plurality of sliders 59a and 59b are provided. The doors 4a and 4b may be opened with one slider. In this case, since both the doors 4a and 4b open swiftly, the slider, when it is in a standby state before the door is opened,

is arranged at the farthest position away from the opening face 3a.

[0058] In contrast, providing the sliders 59a and 59b as in this embodiment permits the sliders 59a and 59b to be closer to the opening face 3a. This helps reduce the time taken for the sliders 59a and 59b to make contact with the cam surface 60a, and makes it possible to open the doors 4a and 4b more speedily. It is thus possible to improve the usability of the refrigerator 1.

[0059] <Fourth embodiment>

Next, Fig. 12 is a top view showing a refrigerator 1 according to a fourth embodiment. For the sake of convenience of description, such components as find their counterparts in the first embodiment shown in Fig.1 to 6 are identified by the same reference signs. This embodiment differs from the first embodiment in that one door 4b (See Fig. 2) and the door opening device 50 corresponding to it are omitted. Otherwise, the fourth embodiment is similar to the first embodiment.

[0060] According to this embodiment, it is possible to obtain an effect similar to that in the first embodiment.

[0061] In the first to fourth embodiments, when the doors 4a and 4b pivoted on the main body 2 open a lower part of the main body 2, the door opening device 50 may be arranged on the bottom face of the main body 2 and the bottom face of the doors.

Industrial Applicability

[0062] The present invention finds applications in refrigerators provided with a door opening device that opens a door.

List of Reference Signs

[0063]	1	refrigerator
	2	main body
	3	refrigerating compartment
	3a	opening face
	4a, 4b, 6, 8	door
	4c, 4d	pivot shaft
	5	freezing compartment
	7	vegetable compartment

50	door opening device
51	supporting member
52	motor
53	worm
54	worm wheel
55	reduction gear
56	reduction gear
56	rotary member
56a	rotary shaft
57	middle gear
58	driver
59, 59a, 59b	slider
60	guide portion
60a	cam surface
65a, 65b	concave part
B1, B2	rotation direction
D1, D2, D3	movement direction
L1, L2	straight line
Pe	end point
Pn	point
Ps	start point
α	center angle
β, γ	angle
θ	inclination angle

CLAIMS

- [Claim 1] A door opening device comprising:
- a main body having an opening face;
 - a door pivoted on the main body with a pivot shaft, the door opening and closing the opening face;
 - a rotary member arranged on the main body, the rotary member rotating about a rotary shaft;
 - a slider arranged on the rotary member; and
 - a cam surface arranged on the door, the cam surface guiding the slider, the slider sliding between a start point and an end point on the cam surface and thereby opening the door,
- wherein
- at the end point, a tangent line to the cam surface is inclined with respect to a movement direction of the slider, and
 - the slider rotates in a direction away from the pivot shaft.
- [Claim 2] The door opening device according to claim 1, wherein
- an angle formed by a straight line connecting between the rotary shaft and the slider at the end point and a straight line connecting between the pivot shaft and the slider at the end point is a right angle or an obtuse angle.
- [Claim 3] The door opening device according to claim 1 or 2, wherein
- at the end point, an inclination angle of the tangent line to the cam surface with respect to the movement direction of the slider is 45 degrees or more.
- [Claim 4] The door opening device according to any one of claims 1 to 3, wherein
- at the front face of the main body, two of the doors are arranged side by side in a left-right direction and the pivot shafts of the doors are respectively arranged at opposite end parts of the main body, and
 - one door is opened with forward rotation of one rotary member and an other door is opened with reverse rotation of the one rotary member.

- [Claim 5] The door opening device according to claim 4, wherein
 on one of top and bottom faces of the door, the cam surface is arranged and a
 concave part is formed, and
 the concave part
 is arranged frontward of the cam surface, and
 is open to face the neighboring door.
- [Claim 6] The door opening device according to claim 5, wherein
 a plurality of the sliders are provided on the rotary member.
- [Claim 7] A refrigerator comprising:
 the door opening device according to any one of claims 1 to 6,
 wherein
 the slider is arranged on a top face of the main body, and
 the cam surface is arranged on a top face of the door.