US 20050258724A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0258724 A1

Hwa Kim (43) Pub. Date: Nov. 24, 2005

(54) REFRIGERATOR

(75) Inventor: **Dong Hwa Kim**, Gwangju-City (KR)

Correspondence Address:
STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005 (US)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(21) Appl. No.: **11/090,276**

(22) Filed: **Mar. 28, 2005**

(30) **Foreign Application Priority Data**

May 21, 2004 (KR) 2004-36260

Publication Classification

(51) **Int. Cl.**[7] **A47B 96/00**

(52) **U.S. Cl.** **312/405**

(57) **ABSTRACT**

A refrigerator comprising a housing, a pair of doors, link devices, and damping devices. Each of the damping devices includes a casing defining the appearance of the damping device, a cam member, a piston, a sealing member fitted around the piston, a spring, a guide rod, and a cap member connected to the guide rod so as to be positioned inside the casing. Since the damping device of the present invention is reducible in size, and is vertically mountable by virtue of its reduced operating space, it can be installed inside a refrigerator door or refrigerator housing, rather than the bottom surface of the refrigerator. Especially, the damping device can be mounted inside the lower end portion of a front panel of the refrigerator door, resulting in ease in exchange and repair thereof.

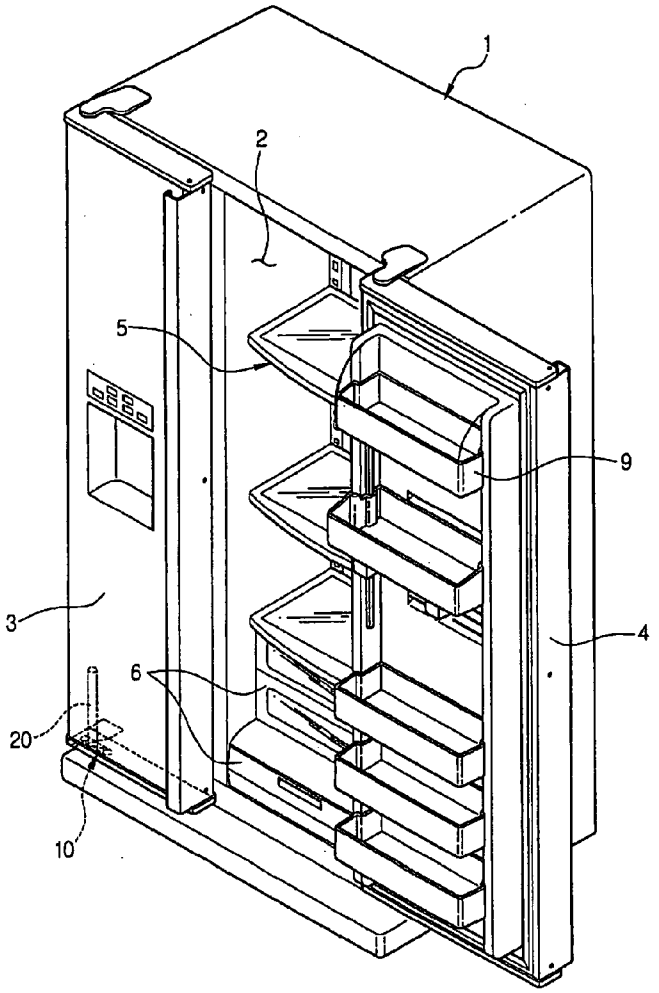


FIG. 1

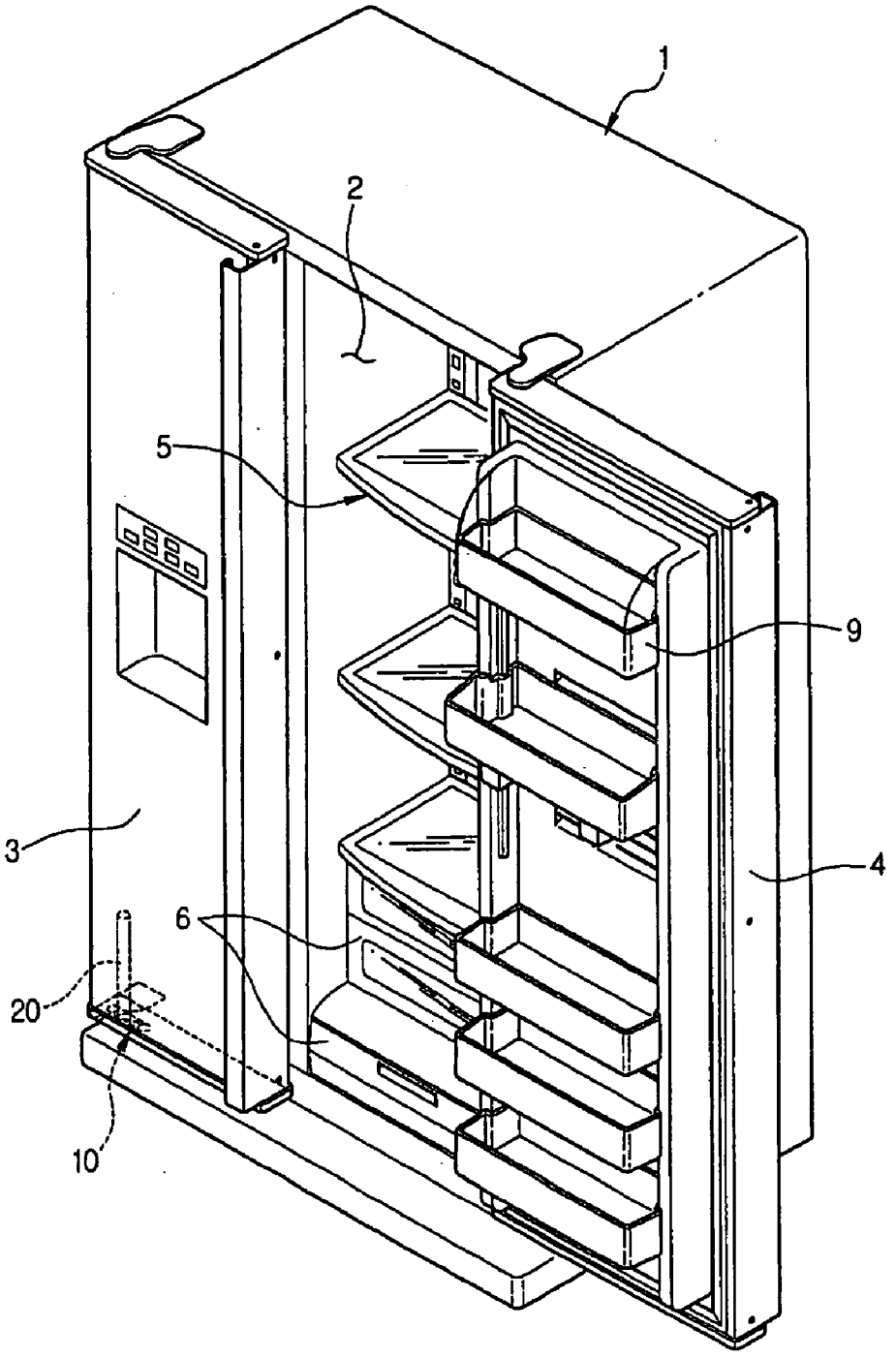


FIG. 2

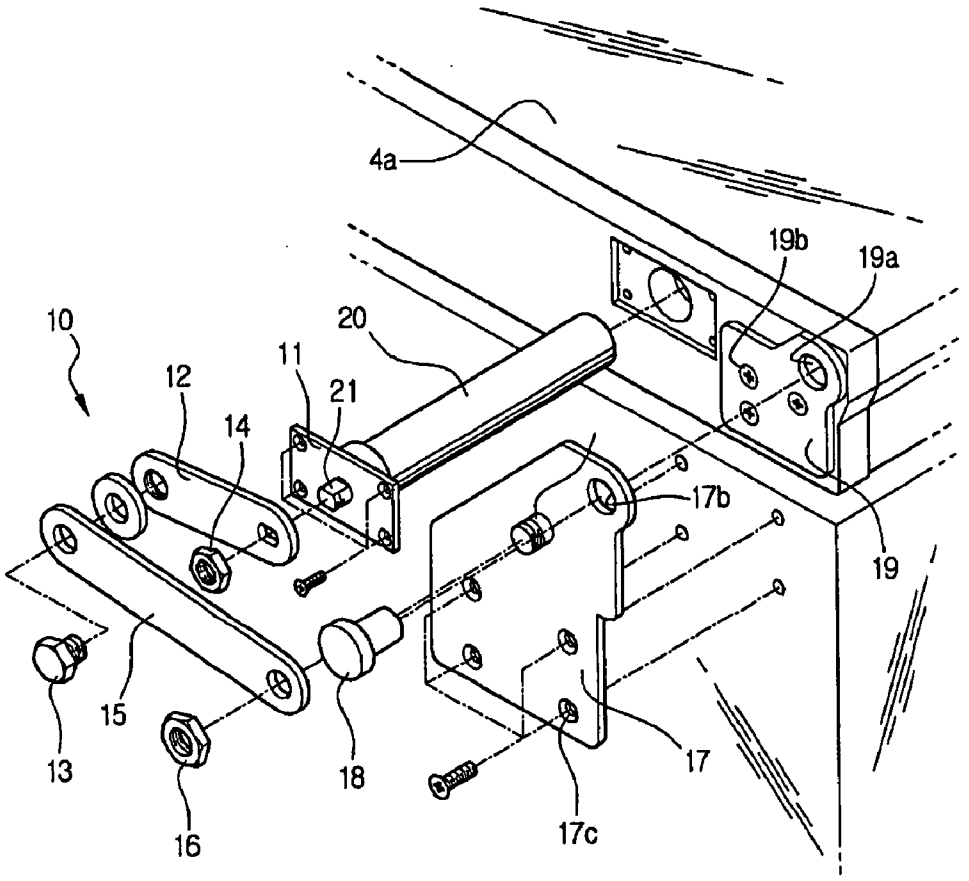


FIG. 3

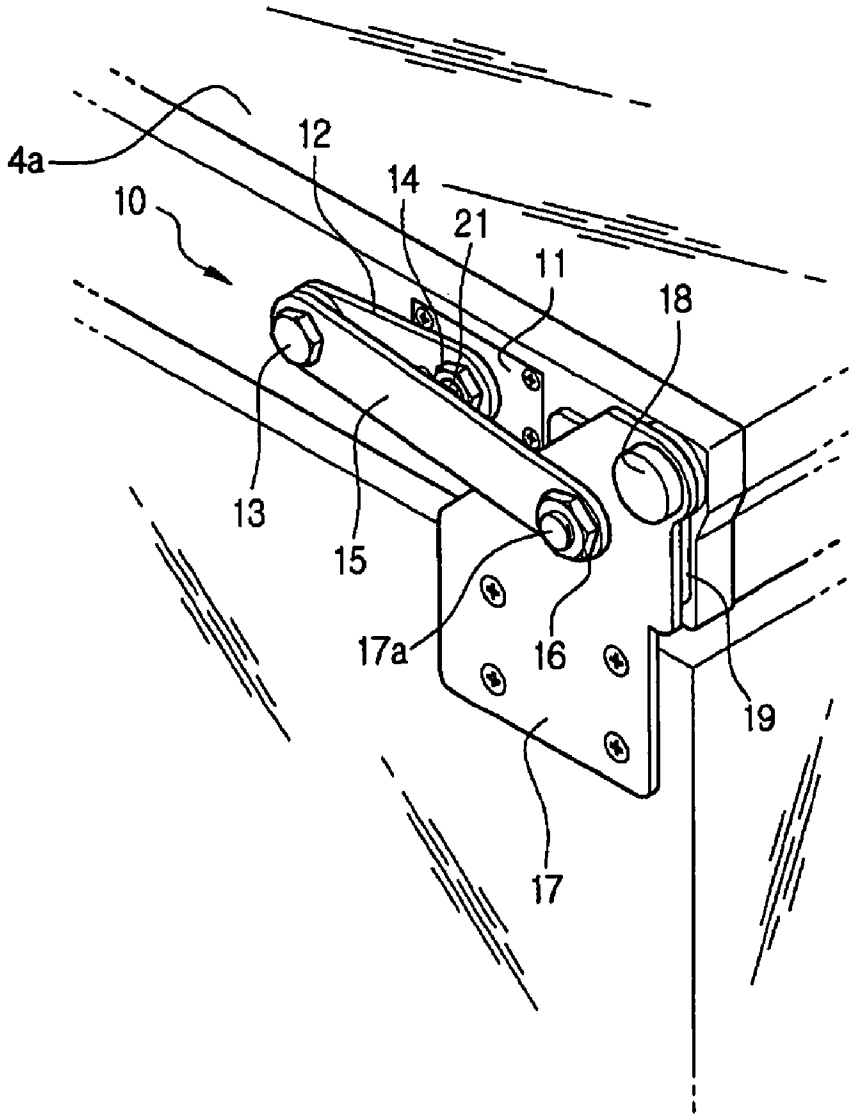


FIG. 4

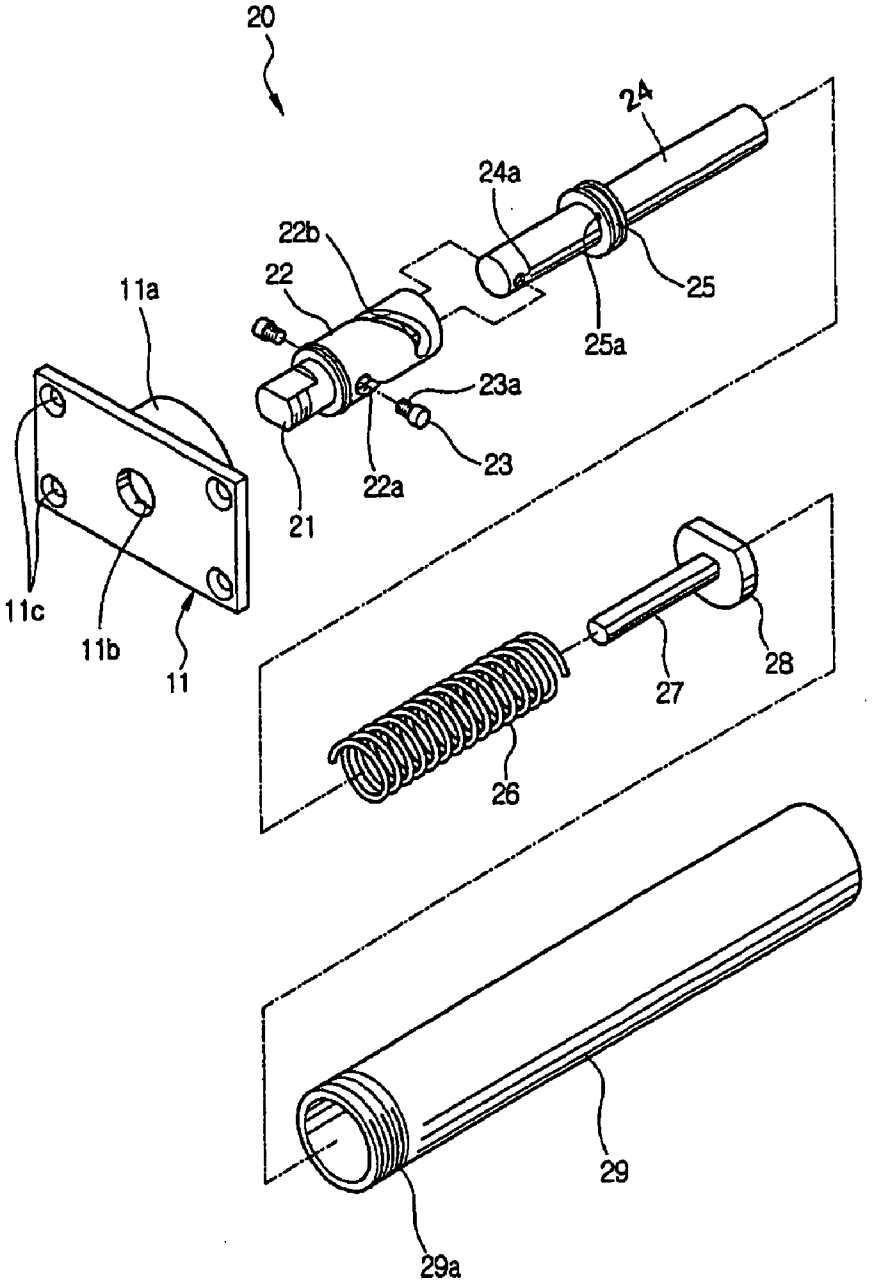


FIG. 5

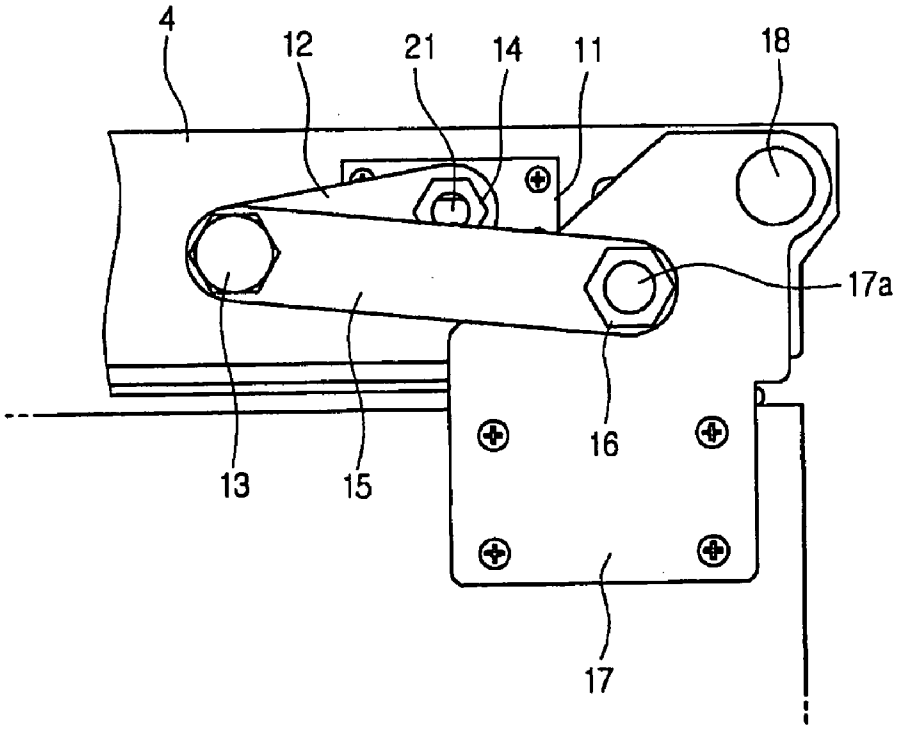


FIG. 6

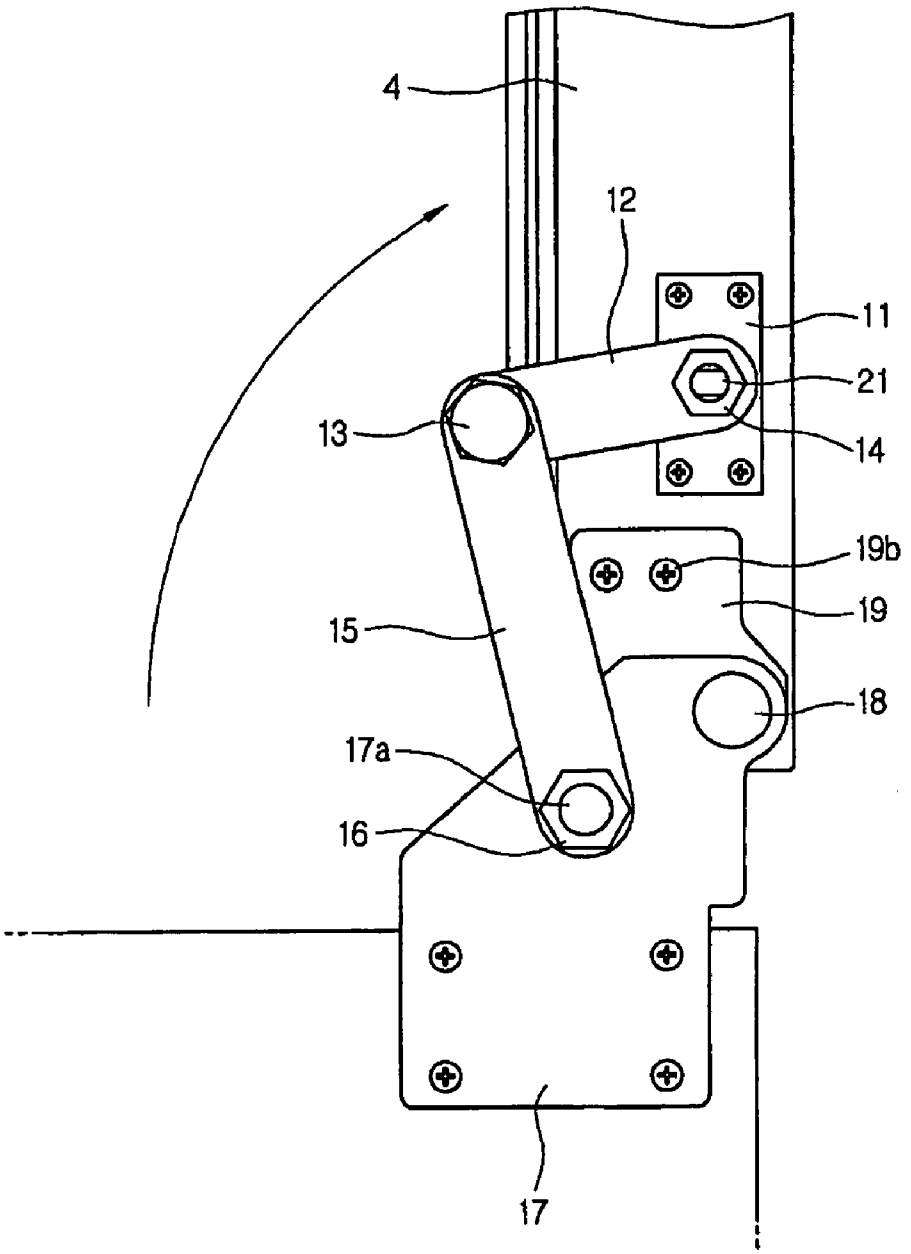


FIG. 7

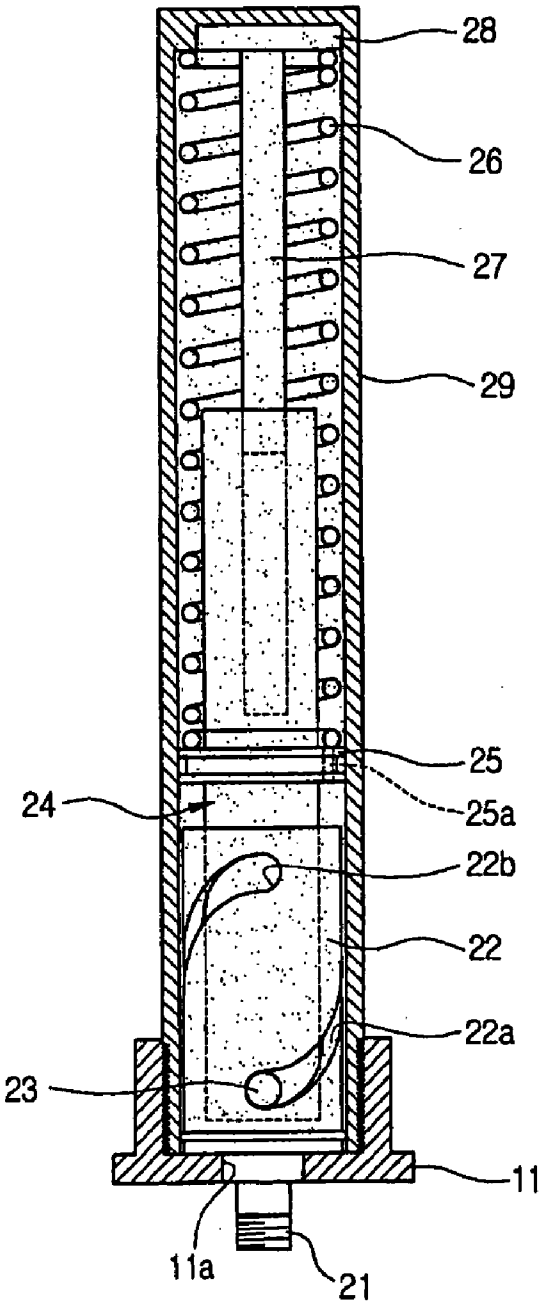
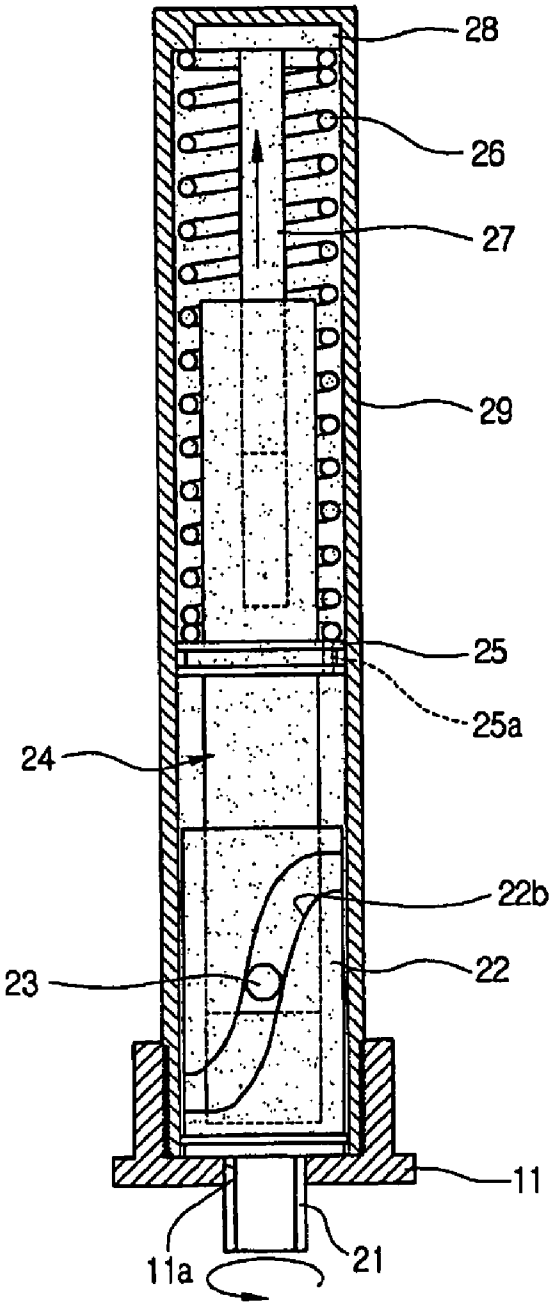


FIG. 8



REFRIGERATOR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2004-36260, filed on May 21, 2004 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a refrigerator, and, more particularly, to a damping device of a refrigerator which reduces an operating space thereof, and a simplified link device to realize the damping device.

[0004] 2. Description of the Related Art

[0005] Generally, in order to protect a refrigerator as well as various foods stored therein, the refrigerator is provided with damping devices, which serve to absorb shock generated upon a closing of refrigerator doors so as to secure a smooth closing operation of the doors. As such, a damping device has conventionally been a device using oil. This kind of damping device, however, has a problem in that a sealing member thereof is often worn due to rectilinear reciprocation of a rod provided in a link device of the damper. Here, the link device is horizontally mounted at the bottom of a refrigerator. To achieve the rectilinear reciprocation of the rod, the link device must have disadvantageously long links.

[0006] Another problem of the conventional damping device is that the damping device requires a separate structure to be used in the protection of an oil damper as well as the links of the link device.

[0007] In such a conventional damping structure of refrigerator doors as stated above, further, since the links of the link device tend to bend due to an external force applied to the refrigerator door, there exists the need for a wide operating space to avoid interference of the links.

[0008] In most cases, furthermore, since the conventional damping device is provided at the bottom of a refrigerator housing so that the conventional damping device connects the refrigerator housing to a refrigerator door by cooperating with the link device, to repair of the damping device, the refrigerator housing has to be laid down on the ground after all foods therein are taken out, resulting in extreme trouble in repair and exchange thereof.

SUMMARY OF THE INVENTION

[0009] Therefore, an aspect of the present invention provides a refrigerator comprising a damping device of a refrigerator door, which is mountable even in a narrow space by virtue of a reduced operating space of the damping device, and a simplified link device, which enables the damping device to be mounted to the refrigerator door without interference of other members.

[0010] Another aspect of the invention is to provide a refrigerator comprising a damping device, which is designed to be mounted in a separate space defined in a refrigerator door, resulting in simplicity in repair and exchange thereof.

[0011] Accordingly, the present invention provides a refrigerator comprising a housing, and a pair of doors coupled to the housing in a hingedly rotatable manner, and further comprising: link devices to be used in the transmission of a rotating force of the doors relative to the housing; damping devices, each of which is coupled to one end of the respective link devices, to absorb shock applied to the doors, and/or to allow the doors to be automatically closed.

[0012] Each of the damping devices may include: a casing to define the appearance of the damping device; a cam member to convert a rotating motion of an associated one of the doors into a linear motion thereof: a piston coupled to the cam member inside the casing so as to linearly move; and oil charged inside the casing to exert damping operation through a volume constriction or expansion thereof, which is caused by the linear motion of the piston.

[0013] The damping device may be mounted in a separate mounting space that is vertically defined inside the door.

[0014] The cam member of the damping device may take the form of a hollow shaft having spiral grooves, and the piston may be coupled to the cam member so as to linearly move along the spiral grooves. As a result, the cam member may serve to convert the rotating motion of the door, transmitted through an associated one of the link devices, to the linear motion of the piston.

[0015] The cam member may be positioned inside the cylindrical casing so that a link connecting portion that is provided at one end thereof protrudes outwardly to allow the link device to be rotatably fitted therearound.

[0016] The damping device may further include a sealing member, which is fixed around the piston to seal the oil charged around the piston inserted inside the casing.

[0017] The cam member and the piston may be coupled to each other by means of guide pins so that the piston is linearly movable within a range of the spiral grooves formed at the cam member.

[0018] The guide pins may be located close to a lower end of the cam member in a closed state of the door, and slide upward along the spiral grooves toward an upper end of the cam member by receiving an external force when the door is opened, so as to allow the oil to be compressed by a sealing member. As a result, the guide pins may serve to allow the door to be smoothly closed or be automatically closed as they are returned toward the lower end of the cam member by making use of a repulsive force of the oil.

[0019] Further, the present invention also provides a refrigerator comprising a housing, and a pair of doors coupled to the housing in a hingedly rotatable manner, and further comprising: damping devices provided at the doors or the housing; and link devices to connect the housing and the respective doors in order to transmit a rotating force of the doors to the damping devices.

[0020] Each of the link devices may include a first link member and a second link member.

[0021] Each of the first and second link members may have rotatably connectable joint portions at both ends thereof.

[0022] The first and second link members may partially overlap each other while forming a small angle therebe-

tween in a closed state of an associated one of the doors, whereas they may be spaced apart from each other by a certain large angle when the door is opened.

[0023] Fasteners to rotatably connect the first and second link members to each other may be coupled to respective joint portions.

[0024] The link device may be positioned adjacent to a center axis of rotation of an associated one of the doors relative to the housing.

[0025] The link device may include a hinge member and a hinge shaft, and one end of the hinge member is fixed to the housing, and the other end of the hinge member is coupled to associated one of the doors by means of the hinge shaft so as to secure rotation of the door.

[0026] Additional and/or other aspects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0028] **FIG. 1** is a perspective view illustrating the mounting position of a damping device of a refrigerator in accordance with the present invention;

[0029] **FIG. 2** is an exploded perspective view illustrating a link device, to which the damping device of a refrigerator in accordance with the present invention is coupled;

[0030] **FIG. 3** is a perspective view illustrating an assembled state of the link device in accordance with the present invention;

[0031] **FIG. 4** is an exploded perspective view illustrating the structure of the damping device in accordance with the present invention;

[0032] **FIG. 5** is a front view illustrating the structure of the link device in accordance with the present invention, in a state in which a refrigerator door is closed;

[0033] **FIG. 6** is a front view illustrating the structure of the link device in accordance with the present invention, in a state in which the refrigerator door is opened;

[0034] **FIG. 7** is a sectional view illustrating the operation of the damping device in accordance with the present invention, in a state in which the refrigerator door is closed; and

[0035] **FIG. 8** is a sectional view illustrating the operation of the damping device in accordance with the present invention, in a state in which the refrigerator door is opened.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0036] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below to explain the present invention by referring to the figures.

[0037] A preferred embodiment of the present invention will now be described in detail with reference to the annexed drawings. **FIG. 1** is a perspective view illustrating the mounting position of a damping device for a refrigerator in accordance with the present invention.

[0038] The refrigerator, according to the present invention, comprises a rectangular housing **1** that is open at a front side thereof, and doors **3** and **4** which are coupled to the housing **1** in a hingedly rotatable manner. The doors **3** and **4** open or close the open front side of the housing **1**. The doors **3** and **4** are coupled to the housing **1** via link devices **10** provided at an upper or lower end thereof. Damping devices **20**, to which the link devices **10** are connected, are provided at an upper or lower end of the housing **1**. The damping devices **20** secure smooth opening and closing operations of the doors **3** and **4**. Consequently, the damping devices **20** prevent shock from being applied to the housing **1**. In a "side by side type refrigerators," two damping devices **20** are provided inside the doors **3** and **4** in a one to one ratio.

[0039] The interior of the refrigerator is divided into a left freezing chamber, and a right refrigerating chamber, which are both designated by reference numeral **2**. A plurality of shelves **5** and storage containers **6** to store foods are provided inside the freezing and refrigerating chambers **2**. Shelves **7** to store beverages or small containers are provided at the inner surfaces of the doors **3** and **4**.

[0040] **FIG. 2** is an exploded perspective view illustrating the link device **10**, to which the damping device **20**, in accordance with the present invention, is coupled. In the present embodiment, the damping devices **20** are provided inside the doors **3** and **4** in a one to one ratio, and each of the damping devices **20** is mounted in a separate mounting space defined in the respective doors **3** and **4** so as to achieve convenience in repair and exchange thereof. Such a separate mounting space is defined in the lower portion of a front panel of the respective doors **3** and **4**, but a position thereof is not limited thereto,. As such, the position of the mounting space may be defined in other portions of the doors **3** and **4**, or in the housing **1** since the damping device **20** of the present invention has substantially fewer of the spatial problems encountered when using a conventional link device, which requires a wide horizontal space.

[0041] Such a damping device **20** includes a link connecting portion **21** formed at one end thereof. The link connecting portion **21** is inserted through a cylindrical guide portion **11***a* that is provided at a rectangular plate-shaped support member **11** so as to protrude out of the support member **11**. The support member **11** is further provided with a center opening **11***b* to be used in the insertion of the link connection portion **21**, and a plurality of bolt fastening holes **11***c* to be used in the fastening of the support member **11** to the door **3** or **4**.

[0042] A first link member **12** is coupled to the link connecting portion **21**, which was inserted through the support member **11** so as to protrude out of the support member **11**. The first link member **12** has a bar shape, and is formed at one end thereof with a first hole to be used in the coupling of the link connecting portion **21**, and at the

other end thereof with a second hole to be used in the coupling of a second link member **15**.

[**0043**] The second link member **15** has a bar shape that is similar to the first link member **12**. However, the second link member **15** is longer than the first link member **12**. By using fasteners **13**, **14** and **16**, such as bolts, pins, nuts, etc., one end of the second link member **15** may be coupled to the first link member **12**, and the other end of the second link member **15** is coupled to a hinge member **17**. In consideration of such a bar shape, the first and second link members **12** and **15** are made of a metallic material having strength and durability that is sufficient to endure the load of the refrigerator door.

[**0044**] The hinge member **17** has a plate shape, but a shape thereof is not limited thereto. As such, the hinge member **17** may have other appropriate shapes in consideration of the coupling relationship between the door **3** or **4** and the housing **1**. In the present embodiment, the hinge member **17** is fixed at one end thereof to the refrigerator housing **1**, and is fixed at the other end thereof to the refrigerator door **3** or **4** by means of a hinge shaft **18**. The hinge member **17** has an area that is sufficient to support the load of the refrigerator door.

[**0045**] The hinge member **17** is formed with a threaded protrusion **17***a* to be used in the coupling of the second link member **15**, and an opening **17***b* to be used in the coupling of a hinge shaft coupling member **19**. The hinge shaft coupling member **19** is fastened to the end of the bottom surface of the door **3** or **4**. The hinge member **17** further includes a plurality of threaded holes **17***c* to allow the hinge member **17** to be firmly fastened to both of the refrigerator doors **3** or **4** and the housing **1** in order to connect the hinge member **17** with the refrigerator doors **3** or **4** and the housing **1**.

[**0046**] **FIG. 3** is a perspective view illustrating an assembled state of the link device **10** in accordance with the present invention.

[**0047**] The link device **10**, having the link members, is coupled to the damping device **20**, as shown in **FIG. 3**. The damping device **20** is mounted inside the door **4**. The support member **11** is bolted to the lower end of the door **4** so that the link connecting portion **21** of the damping device **20** protrudes out of the support member **11** through the center opening **11***b*. The first hole of the first link member **12** is fitted to the link connecting portion **21**. A nut is then fixedly fastened therearound.

[**0048**] The second link member **15** is bolted to the first link member **12**. The two link members **12** and **15** move according to opening and closing operations of the refrigerator door. Therefore, in order to relieve friction between the first and second link member **12** and **15** that occurs during rotation of the doors **3** or **4**, a washer is interposed between the first and second link members **112** and **15**. The second link member **15** is fixedly coupled to the hinge member **17** having a large area as one of the holes thereof is fitted around the protrusion **17***a* of the hinge member **17**, and a nut is fastened therearound.

[**0049**] The hinge shaft **18** is fitted through the opening **17***b* of the hinge member **17**. The hinge shaft **18** is further fitted in a hinge shaft opening **19**a of the hinge shaft coupling member **19**, which would have been previously fastened to the end of the bottom surface of the refrigerator door so as to fix the hinge member **17** to the door. The threaded holes **17***c* of the hinge member **17** are respectively aligned with and bolted to holes formed at the refrigerator housing **1** so as to allow the hinge member **17** to be firmly fastened to the refrigerator housing **1**. The hinge shaft coupling member **19**, having the hinge shaft opening **19***a,* which is provided at the end of the bottom surface of the refrigerator door, simplifies the coupling of the hinge member **17** to the refrigerator door.

[**0050**] **FIG. 4** is an exploded perspective view illustrating the structure of the damping device **20** in accordance with the present invention.

[**0051**] Referring to **FIG. 4**, the damping device **20** comprises a cam member **22** to be coupled to the support member **11**. A casing **29** is threaded into the cylindrical guide portion **11***a* of the support member **11**. The link connecting portion **21** of the cam member **22**, having an elliptical shape, is inserted through the center opening **11***b* of the support member **11**. As a result, the motion of the link members, which are coupled to the support member **11**, is transmitted to the cam member **22** to induce the operation of the damping device **20** in correspondence to the opening and closing operations of the refrigerator door.

[**0052**] The cam member **22** is coupled to the support member **11** through the link connecting portion **21** provided at one end thereof. The diameter of the cam member **22** is larger than that of the link connecting portion **21**. Spiral grooves **22***a* and **22***b* are formed at the outer periphery of the cam member **22**. Both ends of the respective spiral grooves **22***a* and **22***b* are rounded, and have a diameter larger than that of the remaining portion of the respective spiral grooves **22***a* and **22***b*.

[**0053**] Rotatably fitted guide pins **23** extend through the one-side ends of the spiral grooves **22***a* and **22***b*. The guide pins **23** serve to momentarily keep the refrigerator door in a completely opened position so as to secure a smooth damping operation, as well as to stably keep a closed state of the door. The diameter of the guide pins **23** is substantially the same as that of the remaining portion of the respective spiral grooves **22***a* and **22***b* to allow the guide pins **23** to slide along the spiral grooves **22***a* and **22***b,* respectively, without separation.

[**0054**] Each of the guide pins **23** has a threaded portion **23***a* at one end thereof to secure an easy assembly thereof, as well as a pin head at the other end thereof. Where a piston **24** is inserted in the cam member **22**, the threaded portions **23***a* of the guide pins **23** are fitted in two coupling holes **24***a* that are formed at the lower end region of a piston **24** by passing the threaded portions **23***a* of the guide pins through the spiral grooves **22***a* and **22***b* of the cam member **22**.

[**0055**] A sealing member **25** is provided around the circumference of the piston **24**. The sealing member **25** seals oil that is charged around the piston **24** between the sealing member **25** and a cap member **28**. The cap member **28** is located at the distal end of a guide rod **27**. The sealing member **25** is formed with a small through-hole **25***a* to allow the oil to be supplied to the cam member **22** so as to achieve a smooth operation of the cam member **22**. The sealing member **25** also supports a spring **26**, which is fitted around the piston **24**. To this end, the sealing member **25** is fixedly coupled around the piston **24** so as not to move along the piston **24**.

[0056] The piston **24** is hollow, and the guide rod **27** may be inserted therein in a vertically movable manner. The insertion of the guide rod **27** into the piston **24** is possible because the guide rod **27** has a diameter that is smaller than an inner diameter of the piston **24**. The cap member **28**, provided at the distal end of the guide rod **27**, has a disk shape, and contacts with an upper end of the piston **24** according to the motion of the guide rod **27**.

[0057] The cross-sectional shapes of the guide rod **27** and the cap member **28** are not perfectly circular, and may instead be partially cut-away circles. Such a shape is effective to allow the guide rod **27** to linearly move inside the piston **24** without rotation when the cam member **22** is rotated upon an opening of the refrigerator door. Of course, the cross sectional shapes of the guide rod **27** and the piston **24** are not limited to partially cut-away circles and may be freely selected from among a square and other shapes so long as the shaped of the guide rod **27** and the piston **24** may prevent rotation of the guide rod **27**.

[0058] That is, the guide rod **27** and the piston **24** are designed to only linearly move inside the casing **29**. Meanwhile, the cam member **22** is designed to rotate around the piston **24**.

[0059] The spring **26**, interposed between the guide rod **27** and the piston **24**, has a length that is equal to the sum of the length of the guide rod **27** and the length from the upper end of the piston **24** to the sealing member **25** that is fixed around the piston **24**. As the cap member **28** vertically moves according to linear motion of the guide rod **27** coupled thereto, the spring **26** contracts or extends.

[0060] The interior of the casing **29** is charged with the oil in he region of the casing **29** that extends from the sealing member **25** to the cap member **28** when the cap member **28** is coupled to the guide rod **27**. Part of the oil is supplied into the cam member **22** along the spiral grooves **22***a* and **22***b* by passing through the through-hole **25***a* formed at the sealing member **25**, resulting in smooth driving of the cam member **22**. One end of the casing **29** is blocked, and the other end thereof is formed with a threaded portion **29***a* to allow the casing **29** to be threaded to the cylindrical guide portion **11***a* of the support member **11**.

[0061] **FIG. 5** is a front view to illustrate the structure of the link device **10** in accordance with the present invention, in a state in which the refrigerator door **4** is closed. In such a state, the first link member **12** and the second link member **15** of the link device **10** are angled with respect to each other rather than completely overlapped. Such an arrangement is effective to support the load of the refrigerator door in rotation as well as a stationary state.

[0062] **FIG. 6** is a front view to illustrate the structure of the link device **10** in accordance with the present invention, in a state in which the refrigerator door **4** is opened to the right by an angle of 90 degrees compared to **FIG. 5**. In general, the refrigerator door is openable through an angle of approximately 135 degrees.

[0063] As the refrigerator door **4** is opened, the support member **11** that is fixed to the door **4** is displaced to the right and rotated along with the door **4**, and accordingly, a joint portion between the first link member **12** coupled to the support member **11** and the second link member **15** is displaced to the right. Thereby, the second link member **15** is hingedly rotated in a rotating direction of the door **4**.

[0064] Upon opening the door **4**, the link connecting portion **21**, which was rotatably mounted to the door **4**, is rotated. Such a rotation of the link connecting portion **21** is converted into linear motion of the piston **24** by the cam member **22**.

[0065] **FIG. 7** is a sectional view to illustrate the operation of the damping device **20** in accordance with the present invention, in a state in which the refrigerator door is closed. The configuration of the damping device **20** is previously explained in the above description in relation with **FIG. 4**. In a closed state of the door, the guide pins **23** are located at the lower ends of the spiral grooves **22***a* and **22***b* of the cam member **22**.

[0066] The support member **11** is coupled at the lower end of the damping member **20** so that the link connecting portion **21** is inserted through the support member **11** so as to protrude out of the support member **11**. In this case, the casing **29** of the damping device **20** is seated in the cylindrical guide portion **11***a* having a certain height.

[0067] The cam member **22**, the piston **24**, and the guide rod **27** are successively inserted inside the casing **29**, seated in the support member **11**. The spring **26** is interposed between the guide rod **27** and the piston **24**. The cam member **22** has a hollow structure so that the piston **24** may be inserted therein. The piston **24** is linearly movable inside the cam member **22** as the guide pins **23** slide along the spiral grooves **22***a* and **22***b* of the cam member **22**.

[0068] The sealing member **25** is coupled around the piston **24** at a height that is sufficient to allow the sealing member **25** to be spaced apart from the upper end of the cam member **22** by a certain distance in the lowermost position of the piston **24**. As stated above, the sealing member **25** is fixed to the piston **24** to support the spring **26** upon an extension or a contraction of the spring **26**. In this way, the sealing member **25** serves not only as an oil sealing member, but also as a spring support member.

[0069] In a closed state of the refrigerator door, the guide pins **23** are positioned at the lower ends of the spiral grooves **22***a* and **22***b* of the cam member **22**. Thus, the piston **24**, being connected to the guide pins **23**, is in the lowermost position inside the hollow cam member **22**. In this case, since no pressure is applied to the guide rod **27**, the cap member **28** connected to the guide rod **27** is positioned at an upper end of the casing **29** by the elasticity of the spring **26**. That is, the spring **26** is in a completely extended state.

[0070] **FIG. 8** is a sectional view to illustrate the operation of the damping device **20** in accordance with the present invention, in a state in which the refrigerator door is opened. Where the refrigerator door is opened by receiving an external force, the link connecting portion **21**, which was connected to the refrigerator door so as to protrude out of the support member **11**, is rotated by the link members (not shown) connected to the refrigerator door to force the guide pins **23** to slide upward along the spiral grooves **22***a* and **22***b* of the cam member **22**. Such an upward movement degree of the guide pins **23** depends on the opening degree of the refrigerator door. In a completely opened state of the refrigerator door, the guide pins **23** are positioned at the upper ends of the spiral grooves **22***a* and **22***b*.

[0071] As a result, the piston **24**, which was coupled to the guide pins **23** so as to vertically move inside the cam member **22**, compresses the oil and the spring **26** by making use of the sealing member **25** sealably coupled around the piston **24**. Since the oil and the spring **26** have a tendency to restore their original states by their shock absorbing and elastic properties, the door may be smoothly closed, and may automatically close when the door is opened within a range that is not more than a predetermined angle.

[0072] When the refrigerator door is closed, a force, applied to the guide pins **23**, is released. Thus, the guide pins **23** slide downward along the spiral grooves **22***a* and **22***b* due to gravity and the elasticity of the spring **26**. As a result, the guide pins **23** become seated in the lower ends of the spiral grooves **22***a* and **22***b* as shown in **FIG. 7**. In this case, even if the refrigerator door is closed with an extremely strong external force, the resulting shock may be absorbed by the elastic spring **26** and the oil charged in the casing **29**. As a further result, since the guide pins **23** slowly slide downward along the spiral grooves **22***a* and **22***b* by a restoration force of the spring **26** and a repulsive force of the oil against the volume constriction thereof, the link connecting portion **21** connected thereto is accordingly slowly rotated, the refrigerator door is smoothly closed.

[0073] Now, the operation and effects of the preferred embodiment of the present invention will be explained in detail. The present invention includes a feature in that the damping device **20** and the link device **10** connected thereto are mounted at the lower end of the front panel of the door.

[0074] Different from the conventional damping device and by virtue of a reduced operating space, the damping device **20** may be mounted vertically inside the refrigerator door or the refrigerator housing within a narrow space, without requiring to be horizontally installed along the lower end of the housing **1**. In this way, the overall structure of the link device **10** is simplified. Further, the device may be sufficiently operable by only two link members.

[0075] Now, the rotation of the damping device **20** using the hinge member **17** will be explained in detail.

[0076] In a closed state of the refrigerator door, the damping device **20** is in a state as shown in **FIG. 7**, and the link device **10** connected thereto is in a state as shown in **FIG. 5**. If an external force causes the door to be opened, the first link member **12** and the second link member **15** are hingedly rotated so that they are spaced apart from each other. Thus the link connecting portion **21** of the cam member **22** mounted in the door is rotated to cause the guide pins **23**, fitted in the lower end of the piston **24**, to slide upward along the spiral grooves **22***a* and **22***b* of the cam member **22**. As a result, the piston **24** is moved upward so that the sealing member **25** fixed therearound compresses the spring **26** and the oil, while allowing the guide rod **27** to be inserted therein. Since a rotating angle of the link connecting portion **21** is variable according to an opening angle of the door, the position of the guide pins **23** as well as the compression of the spring **26** and the oil are correspondingly variable.

[0077] When the door begins to close again, the guide pins **23** are positioned at the upper ends of the spiral grooves **22***a* and **22***b*. As the closing operation of the door progresses, the first and second link members **12** and **15** are moved toward each other, and the link connecting portion **21** is rotated in an opposite direction of the opening direction of the door. At the moment when the link connecting portion **21** begins to rotate, the guide pins **23** are momentarily immobilized, and then slide downward to the lower ends of the spiral grooves **22***a* and **22***b* due to their gravity, the restoration force of the spring **26**, and the repulsive force of the oil.

[0078] Even if a relatively strong external force closes the door, the spring **26** and the oil are slowly returned to their original states, resulting in damping effect.

[0079] As is apparent from the above description, since the damping device of a refrigerator in accordance with the present invention is reduced in size, and is vertically mountable by virtue of the reduced operating space thereof, the damping device may be installed inside a refrigerator door or refrigerator housing, rather than the bottom surface of the refrigerator. Further, the damping device may be mounted inside the lower end portion of a front panel of the refrigerator door, resulting in an ease of an exchange and repair thereof.

[0080] Further, according to the present invention, the damping device may reduce the number of elements and the volume of a space required for the installation of a link device, resulting in enhancement in simplicity and easy assembly of the link device.

[0081] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A refrigerator, including a housing and a pair of doors that are coupled to the housing in a hingedly rotatable manner, the refrigerator comprising:

sets of link devices to respectively transmit a rotating force of each of the doors relative to the housing;

a damper, associated with each of the doors, coupled to the respective link devices, to absorb a shock to each of the doors and to allow each of the doors to be automatically closed.

2. The refrigerator according to claim 1, wherein each damper includes:

a substantially cylindrical casing;

a cam member coupled to each of the link devices so as to convert the rotating motion of the associated one of the doors into linear motion;

a piston, coupled to the cam member inside the casing, to move linearly; and

a spring anchored to the casing and oil charged inside the casing to dampen the linear motion of the piston.

3. The refrigerator according to claim 2, wherein the damper is mounted vertically inside the door.

4. The refrigerator according to claim 2, wherein the cam member of the damper comprises a substantially hollow shaft having spiral grooves, wherein

the piston is coupled to the cam member to linearly move along the spiral grooves, and

the cam member converts the rotating motion of the door, transmitted through an associated one of the link devices, to the linear motion of the piston.

5. The refrigerator according to claim 2, further comprising link connection portions to couple the cam members to the respective link devices, wherein each cam member is positioned inside each cylindrical casing so that the link connecting portion is provided at one end of each cylindrical casing and protrudes outwardly to allow the link device to be rotatably fitted therearound.

6. The refrigerator according to claim 5, wherein the damping device further includes a sealing member, which is fixed around the piston to seal the oil charged around the piston inserted inside the casing.

7. The refrigerator according to claim 4, wherein the cam member and the piston are coupled to each other by guide pins so that the piston is linearly movable within a range of the spiral grooves formed at the cam member.

8. The refrigerator according to claim 7, wherein the guide pins are located close to a lower end of the cam member in a closed state of the door, and slide upward along the spiral grooves toward an upper end of the cam member by receiving an external force when the door is opened, so as to allow the oil to be compressed by a sealing member.

9. The refrigerator according to claim 8, wherein the guide pins allow the door to be smoothly and/or automatically closed as they are returned toward the lower end of the cam member by making use of a repulsive force of the spring and/or the oil.

10. A refrigerator comprising a housing, and a pair of doors coupled to the housing in a hingedly rotatable manner, the refrigerator further comprising:

damping devices provided at the doors or the housing; and

link devices to connect the housing and the respective doors and to transmit a rotating force of the doors to the damping devices.

11. The refrigerator according to claim 10, wherein each of the link devices includes a first link member and a second link member.

12. The refrigerator according to claim 11, wherein each of the first and second link members has rotatably connectable joint portions at both ends thereof.

13. The refrigerator according to claim 11, wherein the first and second link members partially overlap each other while forming a small angle therebetween in a closed state of an associated one of the doors, whereas they are spaced apart from each other by a certain large angle when the door is opened.

14. The refrigerator according to claim 12, wherein fasteners to rotatably connect the first and second link members to each other are coupled to the respective joint portions.

15. The refrigerator according to claim 10, wherein each link device is adjacent to a central axis of rotation of an associated one of the doors.

16. The refrigerator according to claim 10, wherein each link device includes a hinge member and a hinge shaft, wherein one end of the hinge member is fixed to the housing, and the other end of the hinge member is coupled to the associated one of the doors by the hinge shaft so as to secure rotation of the door.

17. The refrigerator according to claim 2, wherein the damper is mounted vertically inside one of the doors.

18. A damping device to dampen to absorb shock applied to a refrigerator door and to automatically close the refrigerator door, comprising:

a hinge to rotably connect the door to the refrigerator so as to allow the door to rotate from a first position in which the door closes the refrigerator to a second position in which the refrigerator is open;

a damper including a cylindrical casing, a cam to translate the rotational movement of the door to linear movement, a piston coupled to the cam to move linearly in accordance with the translated rotational movement, and a spring anchored to the casing to oppose the movement of the piston in one direction and aid the movement of the piston in the other direction; and

a link system to connect the hinge with the damper so as to actuate the damper.

19. The damping device according to claim 18, wherein the damper is coupled to the door via a support member having a cylindrical guide portion into which the piston is inserted and a circular center opening.

20. The damping device according to claim 19, further comprising a link connecting portion to integrally protrude from the end of the cam, the link connecting portion having a cylindrical section to extend through the circular center opening of the support member and a rectangular section to cooperate with the link system.

21. The damping device according to claim 19, wherein the link system comprises:

a first link member having a rectangular hole to cooperate with the rectangular section of the link connecting portion at a first end thereof; and

a second link member to be coupled to a second end of the first link member at a first end thereof and to be coupled to the hinge at a second end thereof.

22. The damping device according to claim 19, wherein the second link member is longer than the first link member.

* * * * *