

TITLE OF INVENTION: BI-FOLD DOOR LOCKING MECHANISM**FIELD OF INVENTION**

The present invention generally relates to an improvement of a locking mechanism for foldable doors, and more particularly, to a double-sided locking mechanism for bi-folding doors.

BACKGROUND ART

Bi-fold doors work on a concertina principle, folding together hinged frames and panels for compact storage. Unlike traditional doors, bi-fold doors are made up of panels that are hinged together and slide on runners. In general, this opens up a room and makes small rooms appear more spacious without having to accommodate traditional doors.

Conventionally bi-fold doors are locked by way of elongated vertical rods that project from the door into the surrounding frame so as to anchor the door at its top and bottom. The rods are typically connected to a central lock unit and are operatively coupled to a rotator within the central lock unit which is adapted to rotate between a locked position and an unlocked position by linearly moving the rods in opposite directions.

In indoor bi-fold doors applications such as for connecting bathrooms and lavatories, there are unique challenges in meeting the demands of such applications. This is because in most bi-fold doors applications, it is desirable to have a locking mechanism on only one side of the door (the interior side) in order to leave the other side (the exterior side) unobstructed. This allows the door panels to lay flat against each other when the door is fully open. In indoor bi-fold doors applications for typical bathrooms and lavatories, locking mechanism is provided for only the interior side of the door to avoid any user from getting inadvertently locked inside, by someone on the outside of the bathroom.

Some commercially available locking mechanism for indoor bi-fold doors applications consists of a single-sided locking mechanism that translates any rotational motion of the actuator portion (to effect locking or unlocking of the mechanism) to a linear motion of the locking bolt.

For example, United States patent no. 9,428,259 B2 discloses a door module that includes a bi-fold door having a first panel and a second panel that are secured together and pivotable with respect to one another by a central hinge. A track guide that slides within a track trim allows the door to move between the open and closed positions. The central hinge includes a hinge member connecting the first and second panels at their respective securing members. The securing member at the first panel is provided with a cavity or tunnel having an elongated locking bolt therein, which is operationally associated with a latching assembly. The latching assembly can be operated by the user in a horizontal or vertical manner, which in turn moves the attached bolt up and down to extend or retract the bolt into a locked or unlocked position.

In addition, United States patent no. 4,998,757 B2 discloses a bar closure for sheet metal cabinet doors. The bar closure includes a lock having a lock nut carrying a pinion and bearing means for rotatably supporting the lock nut. There is at least one bar attached to the pinion in the region of the lock, displaceably supported in this region, and at least on one site, outside of the lock, on the door panel attached to the bar. A locking device attached on the door frame is also attached to the bar, which upon displacement of the bar, engages each other. The lock nut can be rotated via an externally accessible actuation device such as a handle or the like, with the pinion which engages the bar, sliding the bar up and down.

In another prior art example, United States patent publication no. 2012/0006081 A1 discloses a lock for a sliding door or window. The lock includes a controlling locking plate for locking and unlocking and a locking dish for the locking assembly to hook thereon. The controlling locking plate acts as a handle and includes a disk and a knob which can be used to rotate a driving element. This prior locking assembly may also include an operating mechanism having a button rotatably connected to a connecting element which is slidably received in a cavity. The button and part of the connecting element extend out of the door panel. The button can be rotated for controlling the locking and unlocking of the sliding door or window.

Further, some of the commercially available locking mechanisms for indoor bi-fold door applications that convert rotational motion of the actuator into linear motion of the locking

bolt utilizes a rack and pinion gear system, which can gradually become more difficult to rotate over time due to wear and tear and as debris fouls the gears. Other normal wear and tear signs may include misalignment of the circular gear and the linear gear (rack), which can cause the locking mechanism to become dysfunctional.

As home sizes decrease especially in urban areas, many newly-built homes have, for example, connecting bathrooms for multiple people to share, in which there are two or more separate entrances. In connecting rooms, it is desirable for both sides (the interior and exterior side) of the bi-fold doors to have locking mechanisms for privacy as well as security purposes. Therefore, there is a need for a simple but durable double-sided locking mechanism for indoor bi-fold door applications.

This invention thus aims to alleviate some or all of the problems of the prior art.

SUMMARY OF INVENTION

In accordance with an aspect of the invention, there is provided a bi-fold door locking mechanism. The mechanism comprises a central locking body having a linear slot, an actuator having a slide guide and a connector, a linkage assembly and a pair of rods. The slide guide has a linear aperture, the connector securable to the actuator and slidable across the linear aperture. The linkage assembly includes a linkage arm, a central lever and a pair of linking levers, the linkage arm having a first end pivotably linked to the connector and slidable across the linear slot. The pair of rods operably coupled to the pair of linking levers, wherein a second end of the linkage arm is pivotably coupled to one end of a first linking lever and one end of the central lever, the other end of the central lever being pivotably coupled to a second linking lever. The pair of rods is extendable or retractable in response to sliding motion of the actuator when the actuator is moved between a locked and an unlocked position.

In an embodiment, the sliding movement of the first end of the linkage arm is accommodated by the central locking body through the linear slot.

In another embodiment, the actuator is suitably shaped such that it may be used as a handle to pull open the bi-fold door.

In a further embodiment, the central locking body has two sides, each side facing one of an interior and one of an exterior of the bi-fold door, respectively, and having one set of locking mechanism on each side.

In yet another embodiment, opposing linear motion of the first and second rods is guided within a cavity or tunnel.

According to an embodiment, the central lever is pivotably coupled to the central locking body by the fixed pivot point at midpoint of the central lever.

In another embodiment, the locking mechanism is disposed at a central hinge of a bi-fold door connecting at least two door panels.

The present invention suggests a solution for the problems of the prior art by integrating separate single-sided locking mechanisms into a double-sided locking mechanism. Further, the present invention has improved robustness of the locking mechanism for indoor bi-fold doors by utilizing an improved reverse-motion linkage system in the bi-fold door locking mechanism. With proper installation, the improved reverse-motion linkage system is less prone to breakage.

The bi-fold door locking mechanism of this invention has an improved mechanical reverse-motion linkage system. In a typical reverse motion linkage system, a single central lever with a fixed pivot point at its centre reverses the direction of movement for the linking levers pivotably joined at both ends of the central lever. The locking mechanism of the present invention comprises a linkage arm which is pivotably connected to one of the moving pivots of the typical reverse-motion linkage system to effect locking and unlocking.

The locking mechanism as provided in the present invention is also more durable compared to those of the prior art.

Furthermore, a preferred embodiment of the present invention provides for double-sided application of said improved mechanical reverse-motion linkage system in the locking mechanism.

Various other advantages of the locking mechanism of this invention will be further elaborated in the following pages.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the invention will now be described by way of example only, and with reference to the accompanying drawings in which:

Figure 1a illustrates a partially exploded perspective view of a double-sided locking mechanism in the unlocked position, for both interior and exterior sides, in accordance with an embodiment of the present invention;

Figure 1b illustrates a partially exploded perspective view of a double-sided locking mechanism in a locked position for exterior side and an unlocked position for interior side, in accordance with an embodiment of the present invention;

Figure 1c illustrates a partially exploded perspective view of a double-sided locking mechanism in a locked position for both interior and exterior sides, in accordance with an embodiment of the present invention;

Figure 2a illustrates an inner side view of an actuator disposed on either side of a double-sided locking mechanism;

Figure 2b illustrates an outer side view of an actuator disposed on either side of a double-sided locking mechanism;

Figure 3 is a front view of the locking mechanism showing two different rest positions of the actuator.

Other features and aspects of the disclosed invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the features in accordance with embodiments of the

disclosed invention. The summary is not intended to limit the scope of any invention described herein, which are defined solely by the claims attached hereto.

DETAILED DESCRIPTION OF INVENTION

The present invention generally relates to an improvement of a locking mechanism for foldable doors, and more particularly, to a double-sided locking mechanism for bi-folding doors.

Hereinafter, the bi-fold door double-sided locking mechanism according to the present invention will be described in detail with reference to Figure 1a through Figure 3 according to the preferred embodiments. It is to be understood that limiting the description to the preferred embodiments of the invention is merely to facilitate discussion of the present invention and the preferred embodiments is described without deviating from the scope of the appended claims.

Referring now to the drawings, there is shown a bi-fold door locking mechanism operable from both sides of the bi-fold door (the interior and exterior side), especially for indoor connecting rooms with two or more separate entrances, which may be used to provide privacy and security.

According to Figure 1a, the double-sided locking mechanism for bi-fold door 100 comprises a central locking body 102 having a linear slot 103. The central locking body 102 is a vertically oriented rectangular body having two sides, each side facing interior and exterior sides of the bi-fold door, respectively. For each side of the central locking body 102, there is one set of locking mechanism. One set of locking mechanism located on one side of the central locking body 102 comprises the linear slot 103, an actuator 104, a slide guide 105, a linkage assembly 109, a connector 107 and a pair of rods 112a and 112b.

The linkage assembly 109 comprises a linkage arm 106, a central lever 110, a pair of linking levers 108a and 108b, and a fixed pivot point 114 pivotably coupling the central lever 110 to the central locking body 102.

According to a preferred embodiment, the actuator 104 takes the form of a rectangular bar which is slidable vertically between a first rest position (unlocked position) and a

second rest position (locked position). There are at least two linear slots on the actuator 104, each of which may be fastened by any suitable fastening means such as a screw, to a slide guide 105 to guide the sliding motion of the actuator 104 from the first rest position to the second rest position and from the second rest position to the first rest position. The slide guide 105 is a rectangular plate disposed within the actuator 104 having a shorter length relative to the actuator 104 in order to allow for sliding motion. The slide guide 105 acts like a stopper for the slidable actuator 104. The slide guide 105 has a linear aperture 105a disposed mid-length and fastened to the central locking body 102 by fastening means.

The actuator 104 has a connector 107 protruding from an outer side of the slide guide 105 to engage or grasp the first end 106a of the linkage arm 106. The connector 107 is securable to the actuator 104 and slidable across the linear aperture 105a. When the actuator 104 is slid to the locked position, the connector 107, being securable and fixed to the actuator 104, slides across the linear aperture 105a while grasping the first end 106a of the linkage arm 106 and moves the linkage arm 106 to the locked position.

The slidable actuator 104 is coupled to the first end 106a of the linkage arm 106 via the connector 107. The first end 106a of the linkage arm 106 is also operably coupled to the central locking body 102. A second end 106b of the linkage arm 106 is pivotably coupled to one end of a first linking lever 108a and one end of the central lever 110. The other end of the first linking lever 108a is operably coupled to a first rod 112a. In the unlocked position, the rod 112 is retracted and does not protrude out of the bi-fold door frame. In a preferred embodiment, linear movement of the rods 112 is guided within a cavity or tunnel.

As shown in Figure 1a, the first end 106a of the linkage arm 106 is directly coupled to the actuator 104 and the central locking body 102. The central locking body accommodates sliding movement of the first end 106a of the linkage arm 106 by the actuator 104 through the linear slot 103. The sliding movement of the first end 106a of the linkage arm 106 corresponds to the sliding movement of the actuator 104 between the first rest position and the second rest position.

As shown in Figure 1b, the double-sided locking mechanism for bi-fold door 100a is in the locked position for exterior side (right side of the drawing) and the unlocked position for

interior side (left side of the drawing). To be in the locked position, the slidable actuator 104 is moved from a first rest position to a second rest position. In a preferred embodiment shown in Figure 1b, the slidable actuator 104 is slid upwards to be in the locked position but depending on the arrangement of the components, the slidable actuator 104 may also be slid downwards to be in the locked position. As the first end 106a of the linkage arm 106 is operably coupled to the slidable actuator 104 via the connector 107, the first end 106a of the linkage arm 106 is directly moved from one end of the linear slot 103 to the other end. In turn, the second end 106b of the linkage arm 106, which is pivotably coupled to the first linking lever 108a and one end of the central lever 110, moves the first linking lever 108a towards the same upwards direction to linearly move the first rod 112a upwards in the cavity or tunnel.

As the central lever 110 is pivotably coupled to the central locking body 102 by the fixed pivot point 114 at midpoint, movement of the linkage arm 106 from the unlocked position to the locked position turns the central lever 110 about the fixed pivot point 114. Consequently, the direction of the movement of the first linking lever 108a is reversed in the second linking lever 108b, which is pivotably coupled to the other end of the central lever 110.

The locking mechanism adopts an improved principal of reverse-motion linkage, which allows the rods 112 to move in opposite directions, as shown by the direction of arrow in Figure 1b, by moving the linkage arm 106. In the locked position, the rods 112 are extended and protrude out of the cavity or tunnel into the recesses of the door frame to lock the bi-fold door at top and bottom points.

As shown in Figure 1c, the double-sided locking mechanism for bi-fold door 100b is in the locked position, for both interior and exterior sides. In the locked position, the rods 112 of both interior and exterior sides extend and protrude out of the cavity or tunnel into the recesses of the door frame. The double-sided locking mechanism of this invention can be operable from both sides of the bi-fold door (interior and exterior) as there are two sets of locking mechanism attached to the central locking body 102.

In a preferred embodiment, the double-sided locking mechanism 100 is located at a central hinge of the bi-fold door and in between two door panels, connecting the door panels.

An inner side view of the actuator 104 is shown in Figure 2a. The actuator 104 has a connector 107 protruding from the outer side of the slide guide 105 to engage or grasp the first end 106a of the linkage arm 106. The connector 107 is securable to the actuator 104 and slidable across the linear aperture 105a. When the actuator 104 is slid to the locked position, the connector 107, being securable and fixed to the actuator 104, slides across the linear aperture 105a while grasping the first end 106a of the linkage arm 106 and moves the linkage arm 106 to the locked position.

The slide guide 105 as shown in Figure 2a is a rectangular plate disposed within the actuator 104 having a shorter length relative to the actuator 104 in order to allow for longitudinal sliding motion within the actuator 104. The slide guide 105 acts as a stopper for the slidable actuator 104. The slide guide 105 has a linear aperture 105a disposed mid-length and fastened to the central locking body 102 by fastening means at secure points 116.

Figure 2b illustrates an outer side view of the actuator 104. There are at least two linear slots 118 on the actuator 104, each of which may be fastened by any suitable fastening means such as screws 119, to the slide guide 105. The slide guide 105 is in turn securable to the central locking body 102 to guide the sliding motion of the actuator 104 from the first rest position to the second rest position and from the second rest position to the first rest position. The actuator 104 is provided with a cover 120 to protect the inside components of the actuator 104 from humidity and debris.

Figure 3 is a front view of the double-sided locking mechanism showing the first rest position and the second rest position of the slidable actuator 104. The actuator 104 is slid towards B direction (upwards direction) to lock the locking mechanism and slid towards A direction (downwards direction) to unlock the locking mechanism. The actuator 104 is suitably shaped such that it may also be used as a handle to pull open the bi-fold door.

All directional statements such as interior/inner side, exterior/outer side, vertical, upwards, downwards, made herein are relative to the orientation of the locking mechanism, in use.

Although a preferred embodiment of the present invention has been described in detail by way of examples with reference to the accompanying drawings, it should be understood that various changes, substitutions, and modifications can be made herein without departing from the scope of the invention as defined by the appended claims.

CLAIMS**[Claim 1]**

A bi-fold door locking mechanism (100), comprising:
a central locking body (102) having a linear slot (103);
an actuator (104) having a slide guide (105) and a connector (107),
the slide guide (105) having a linear aperture (105a)
the connector (107) securable to the actuator (104) and slidable across said linear aperture (105a);
a linkage assembly (109) including a linkage arm (106), a central lever (110) and a pair of linking levers (108), the linkage arm (106) having a first end (106a) pivotably linked to the connector (107) and slidable across the linear slot (103); and
a pair of rods (112) operably coupled to the pair of linking levers (108),
wherein a second end (106b) of the linkage arm (106) is pivotably coupled to one end of a first linking lever (108a) and one end of the central lever (110), the other end of the central lever (110) is pivotably coupled to a second linking lever (108b), wherein the pair of rods (112) is extendable or retractable in response to sliding motion of the actuator (104) when the actuator is moved between a locked and an unlocked position.

[Claim 2]

The locking mechanism as claimed in claim 1, wherein the sliding movement of the first end of the linkage arm (106a) is accommodated by the central locking body (102) through the linear slot (103).

[Claim 3]

The locking mechanism as claimed in claim 1, wherein the actuator (104) is suitably shaped such that it may be used as a handle to pull open the bi-fold door.

[Claim 4]

The locking mechanism as claimed in claim 1, wherein the central locking body (102) has two sides, each side facing one of an interior and one of an exterior of the bi-fold door, respectively, and having one set of locking mechanism on each side.

[Claim 5]

The locking mechanism as claimed in claim 1, wherein opposing linear motion of the first and second rods (112a, 112b) is guided within a cavity or tunnel.

[Claim 6]

The locking mechanism as claimed in claim 1, wherein the central lever (110) is pivotably coupled to the central locking body (102) by the fixed pivot point (116) at midpoint of the central lever (110).

[Claim 7]

The locking mechanism as claimed in claim 1, wherein the locking mechanism (100) is disposed at a central hinge of a bi-fold door connecting at least two door panels.