Dec. 7, 1971 E. R. MARR 3,624,864

DOOR CLOSER

Filed Nov. 6, 1969 3 Sheets-Sheet 1

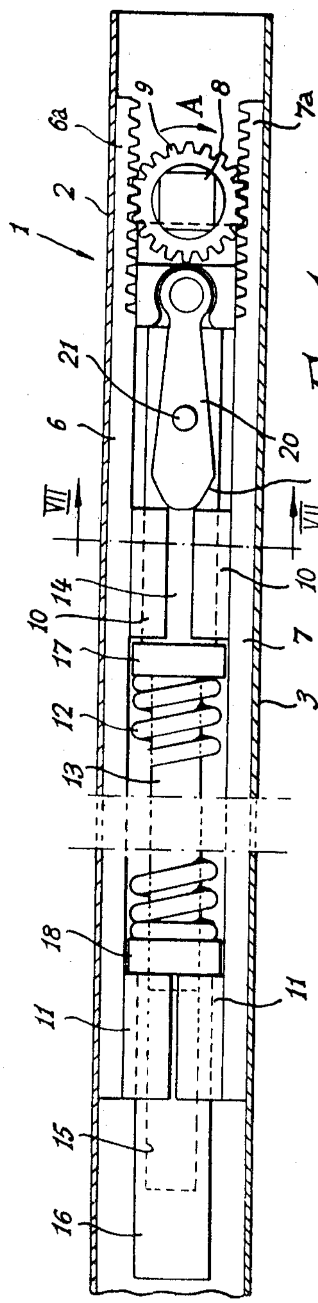

Fig.1.

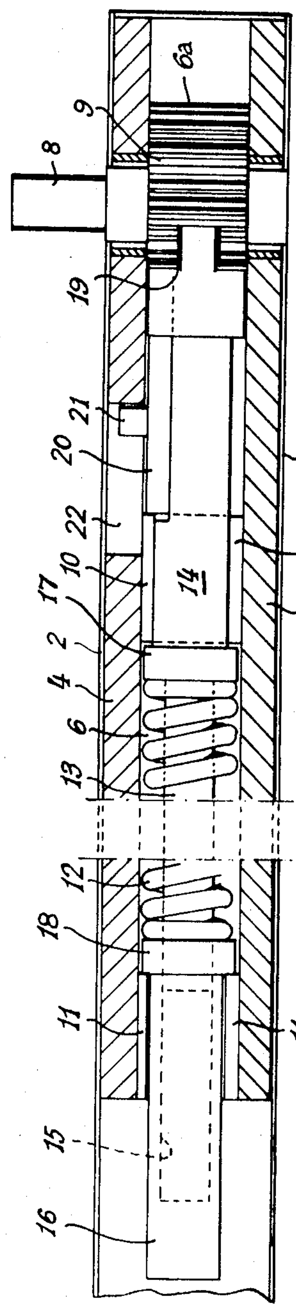

Fig.2.

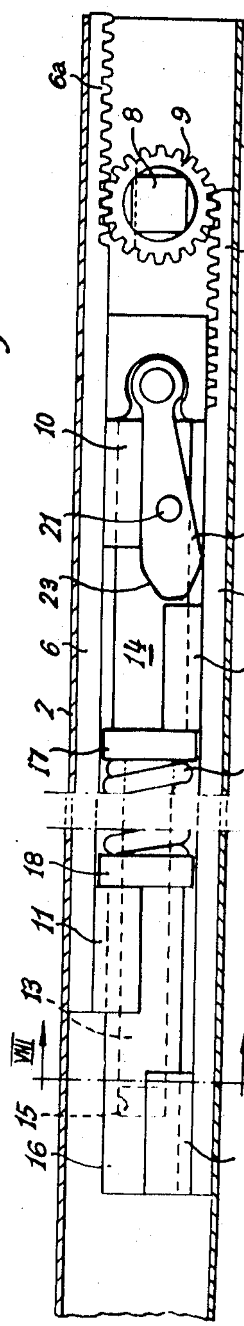

Fig.3

Inventor
E. ROBERT MARR

By Michael C. Stocker
Attorney

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DOOR CLOSER

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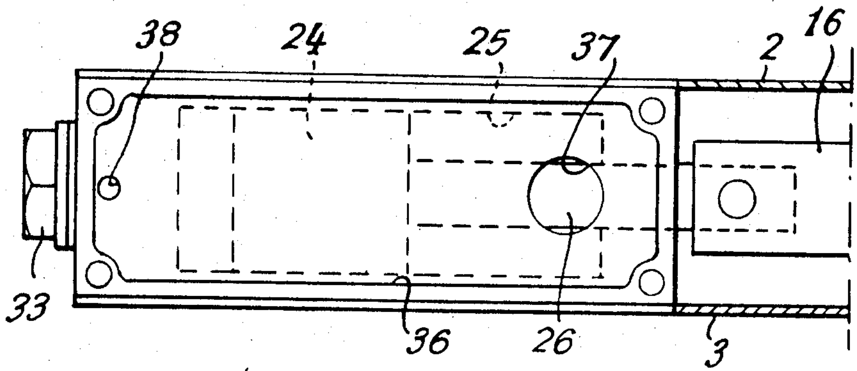

Fig. 4.

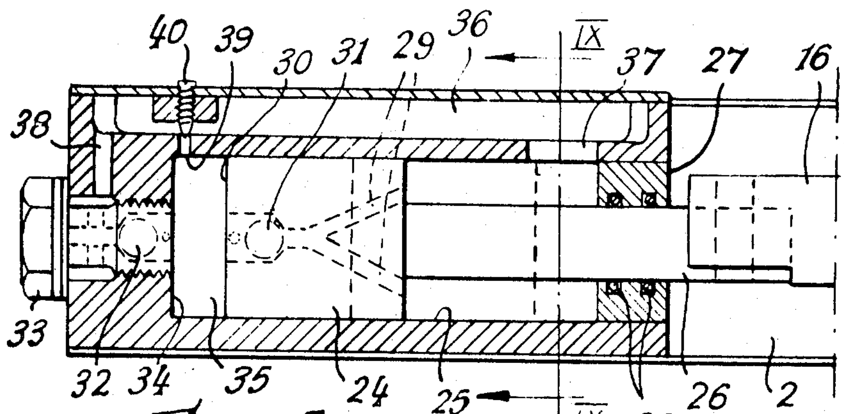

Fig. 5.

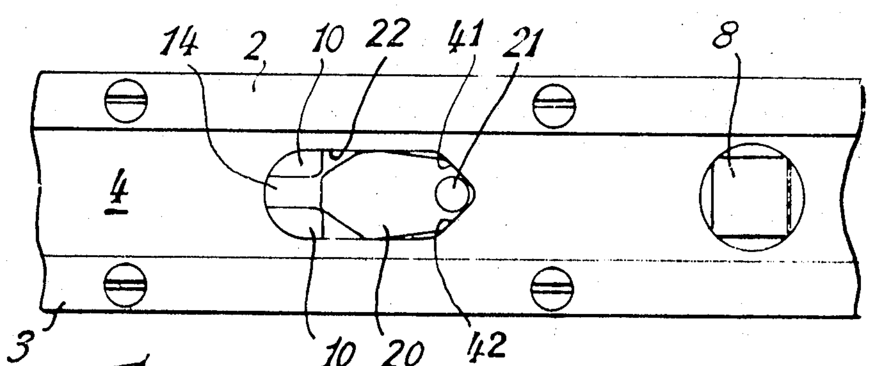

Fig. 6.

Inventor
E. ROBERT MARR

By [signature]
Attorney

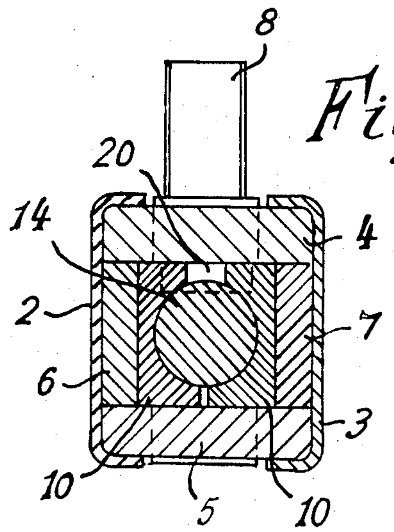

Fig. 7.

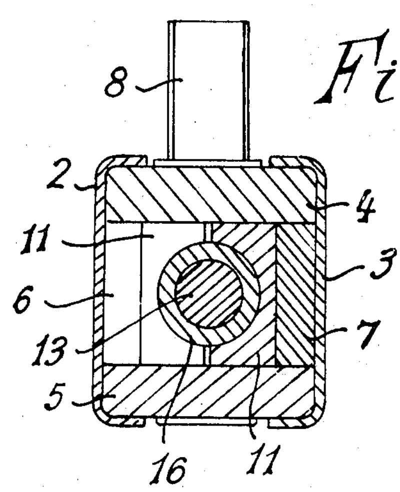

Fig. 8.

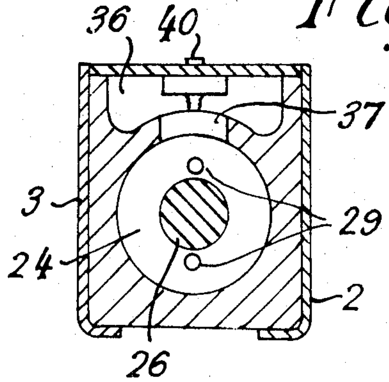

Fig. 9.

Inventor
E. ROBERT MARR
By
Attorney

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3,624,864
DOOR CLOSER

Eric Robert Marr, London, England, assignor to Brent Metal Works Limited, London, England

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Int. Cl. E05f *3/00*
U.S. Cl. 16—62 4 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a door-closer mechanism (particularly for stackable double-swing doors) which comprises a turnably mounted actuating member, first and second thrust members connected to the actuating member to move in opposite directions when the actuating member turns in either direction from a rest position, and a coil spring engaged by the thrust members with its axis parallel to said opposite directions, whereby turning the turnable member in either direction from its rest position increases the stored energy of the coil spring. To control closing of the door damping means providing differential resistance to movement in two directions are provided so that movement of the actuating member from its rest position in either direction is less damped by the damping means than return of the actuating member to its rest position under the influence of the coil spring.

This invention relates to an improved door of the kind which can swing through at least 90° in either direction from its closed position. Such doors are referred to hereinafter as double-swing doors.

It is known to close a wide entrance to a building, for example the entrance to a supermarket, with a plurality of pairs of double-swing doors, which doors, when closed, are disposed on one plane. Two common requirements of such an installation of double-swing doors are:

(1) That each door shall be returned automatically from each of its open positions to the closed position, and

(2) That the doors shall be stackable in their open position as compactly as possible at one or both sides of the entrance, so that a practically unobstructed entrance to the building may be provided.

Requirement (1) above necessitates the provision of a door closer mechanism and with double-swing doors it is customary to conceal such a mechanism either in the transom of the door frame or in the floor beneath the door and to arrange for the actuating spindle of the door closer mechanism to act as one of the vertical hinge pins for the door. The door closer mechanisms at present available for this purpose have a length of at least 12 inches and a width of at least 3¾ inches.

When double-swing doors provided with door closer mechanisms of the kind mentioned above have to satisfy requirement (2) above, it will be appreciated that provision must be made for moving the door closer mechanism with the doors in a suitably dimensioned channel formed in the transom or in the floor. Since the doors must stack compactly at the side of the entrance, the door closer mechanisms must be oriented in a dirction so that they interfere as little as possible with this compact stacking. This means in practice that the door closer mechanisms have to be oriented with their longest dimension disposed substantially at right angles to the doors when the latter occupy their closed positions. This involves providing a channel along the transom, or in the floor, having a width of at least 12 inches in which the door closer mechanisms can slide when the doors are moved to a side of the entrance. In the case of transom-mounted door closer mechanisms this leads to the disadvantage that a very wide and unsightly transom must be provided, while in the case of floor-mounted door closer mechanisms it leads to the disadvantage that the cost of the installation is considerably increased by the additional work which has to be carried out in covering the wide channel in the floor.

An object of the present invention is to provide a door-closer mechanism for a double-swing door which does not give rise to the disadvantages referred to above.

According to the present invention a door-closer mechanism comprises a turnably mounted actuating member, first and second thrust members connected to the actuating member to move in opposite directions when the actuating member turns in either direction from a rest position, a coil spring engaged by the thrust members with its axis parallel to said opposite directions whereby turning the turnable member in either direction from its rest position increases the stored energy of the coil spring, damping means providing differential resistance to movement in two directions and means for coupling said damping means to the actuating member so that movement of the actuating member from its rest position in either direction is less damped by the damping means than return of the actuating member to its rest position under the influence of the coil spring.

The construction of door-closer mechanism described in the foregoing paragraph can be dimensioned so that it can be secured to, or embedded in a door and contained wholly between two planes in which the front and rear surfaces of the top or bottom rail of the door lie.

The actuating member on the door-closer mechanism would cooperate, when the door is erected in a doorway, with a further member in the transom or in the floor of the doorway. One of the members would be a pin (normally of non-circular cross-section) and the other member would be a recess to receive the pin. It would be usual to make the actuating member on the door in the form of a projecting pin and to form the further member in the transom or floor as a socket member. It will be appreciated however that the actuating member on the door could be in the form of a plate recessed to receive the end of a pin projecting down from the transom or projecting up from the floor.

Conveniently the actuating member of the door closer mechanism serves as one of the pivots for the door.

When a double-swing door employing a door-closer mechanism in accordance with the invention is used in a multiple door installation of the kind described above, the door closer mechanism does not have to be moved in a channel in the transom or in the floor. Instead it is only necessary to move the further member (normally a small socket member, in which a projecting spindle—forming the actuating member of the closer mechanism—engages), along said channel. Accordingly a much narrower channel can be provided in the transom or floor.

We prefer to mount the door-closer mechanism on or in the top rail of the door and, in order that the door shall have the neatest possible appearance, we prefer to embed the mechanism in the top rail. In this case the door-closer mechanism must have a maximum width which is less than the thickness of the top rail of the door. If, however, the door-closer mechanism is mounted on the upper edge of the top rail of the door, we prefer to house the mechanism in a casing having parallel side walls and a width substantially equal to the thickness of the door.

Where the door-closer mechanism is located in the top or bottom rail of the door, a self-closing double-swing door can be provided without a hinge stile, a design of door particularly favoured for stackable glass doors for wide entrances.

The standard thickness of the top and bottom rails of doors installed in the entrances to buildings such as supermarkets is 1¾ inches. If such a door is made in accordance with the present invention with a door-closer mechanism embedded in the top or bottom rail, it will be appreciated that the width of the door closer mechanism must be less than 1¾ inches, for example 1½ inches. On the other hand the door-closer mechanism can have a length which is almost equal to the width of the door.

One preferred embodiment of the door-closer mechanism in accordance with the invention, for employment with a double-swing door, will now be described, by way of example, with reference to the accompanying drawings, in which

FIG. 1 is a sectional plane of part of the door-closer mechanism shown with its actuating member in the rest position,

FIG. 2 is a sectional side elevation of the door-closer mechanism of FIG. 1,

FIG. 3 is a sectional plan corresponding to FIG. 1 but showing the actuating member rotated through 90°,

FIG. 4 is a plan of the hydraulic damping device used in conjunction with the door-closer mechanism of FIG. 1,

FIG. 5 is a sectional side elevation of the device of FIG. 4,

FIG. 6 is a scrap plan of part of the casing of the door-closer mechanism, and

FIGS. 7, 8 and 9 are sections on the lines VII—VII, VIII—VIII and IX—IX, respectively.

Referring first to FIGS. 1, 2, 7 and 8, the door-closer mechanism comprises a casing **1** formed by two elongated channel sections **2** and **3** held in spaced relationship by an upper plate **4** and a lower plate **5** so that the webs of the two channel sections are parallel to one another and the flanges of one channel section are aligned with and directed towards the flanges of the other channel section. Adjacent to the web of each channel section is a slide bar **6** and **7**, the bars having toothed racks ***6a*** and ***7a*** respectively, formed at one end thereof, with the teeth of one rack facing the teeth of the other rack. Between said racks ***6a*** and ***7a*** an actuating spindle **8** of the door-closer mechanism is rotatably mounted, the axis of the spindle **8** being disposed midway between the two racks and at right angles to the flanges of the casing sections. A toothed pinion **9** is secured to the actuating spindle **8** and meshes with the teeth of both racks, the upper end of the spindle projecting from the casing in a portion of square cross-section. From the description so far given, it will be appreciated that rotation of the actuating spindle **8** relative to the casing **1** in the direction of the arrow A in FIG. 1 causes the bar **6** to slide to the right (as shown in the drawing) in its casing section and the bar **7** to slide to the left. FIG. 3 shows the relative positions of the bars **6** and **7** after a 90° rotation of the actuating spindle **8**.

Each bar supports two spaced apart, inwardly-projecting lugs **10** and **11** each lug on one of the bars being opposite to, and projecting towards, a lug on the other bar to provide two spaced-apart pairs of opposed lugs.

A helically-coiled spring **12** is disposed within the casing with its longitudinal axis parallel to and disposed substantially midway between the bars. The spring **12** surrounds a rod **13** which is secured to a block **14** at that end closest to the actuating spindle **8** and which is slidably received in a bore **15** in a second block **16** at its other end. One end of the spring **12** bears against an enlarged end **17** of the block **14** and the other end of the spring **12** bears against an enlarged end **18** of the second block **16**. The spacing apart of the lugs **10** and **11** on the bars **6** and **7** and the length of the spring **12** are chosen so that the spring is slightly compressed and tends to maintain the two bars in the position shown in FIGS. 1 and 2 (i.e. a position in which the lugs of one bar are opposite to the lugs of the other bar). This position (referred to herein as the "rest position") represents the position of the spindle **8** corresponding to the minimum stored energy of the spring **12**. If, with the two bars in the rest position, the actuating spindle **8** is rotated in either direction, the two bars will be moved in opposite directions and the lugs of each of said pairs of opposed lugs will become separated, in the direction of the axis of the spring **12** by a distance equal to twice the distance each bar moves. Consequently rotation of the spindle **8** in either direction compresses the spring between one lug **10** and one lug **11** by an amount equal to twice the distance moved by each bar.

The stored energy of the spring is increased in this way and the spring exerts a restoring force on the lugs **10** and **11** tending to restore them to the rest position. This in turn exerts a restoring torque on the actuating spindle **8** of the mechanism via the racks ***6a*** and ***7a*** and the pinion **9** meshing therewith.

FIG. 3 shows the most stressed condition of the spring that would be met with in practice (i.e. a position corresponding to the door in the "fully open" position) and it will be seen that the rod **13** has penetrated the block **16** almost to the full depth of the bore **15**.

To provide a positive hold to the door in the rest position of the door-closer mechanism, the pinion **9** may be provided with a groove **19** (see FIG. 2) in which a narrowed end of the block **14** can locate.

To provide a positive hold for the door in intermediate positions between the fully open and closed positions, a locking lever **20** is pivotally mounted on the upper surface of the block **14**, the lever **30** having an upstanding peg **21** which projects into a camming recess **22** (see FIG. 6) formed in the upper plate **4** of the casing. The end of the lever **20** adjacent to the lugs **10** is contoured to provide a cam surface **23** which serves to deflect the lever **20** to that side of the casing opposite to the side against which that bar is located which moves to the right during rotation of the spindle **8**. FIG. 3 shows the lever **20** after it has been deflected by the lug **10** on the bar **6** into a position in which it can bear against the lug **10** on the bar **7** when the door is released. The engagement between the lever **20** and the appropriate lug **10** prevents the spindle becoming free to rotate when the restoring force of the spring **12** is countered by a hydraulic damper in the manner now to be described.

The door-closer mechanism as described would effect a very rapid closing of the door which, in practice, could be dangerous. In order to slow down the rate at which the spring **12** restores the mechanism to the rest position, a damper is employed and one suitable design for such a damper is shown in FIGS. 4 and 5. When referring to these figures, it should be understood that the door-closer mechanism would be located to the right, but for convenience only the outer end of the block **16** of the door-closer mechanism has been shown. The damper illustrated is of the hydraulic kind and comprises a piston **24** slidably received in a cylinder **25** and connected, via a piston rod **26**, to the end of the block **16**. The piston rod **26** extends through one end **27** of the cylinder and is surrounded by oil seals **28** to prevent leakage of hydraulic fluid from the cylinder **25**.

The piston **24** contains through-bores **29** which communicate with a cavity formed in the leading face **30** of the piston **24**. A captive ball **31** located in the cavity provides a non-return valve to close the bores **29** when the piston **24** moves to the left in FIG. 5, but which opens the bores for free passage of hydraulic fluid when the piston **24** is moved to the right. A second ball **32** is provided in a second cavity formed in a screw **33** tapped into the end face **34** of the cylinder **25** which confronts the leading face **30** of the piston **24**, the ball **32** closing the cavity in the screw **33** when the pressure in the chamber **35** (formed between the end face **34** of the cylinder and the leading face **30** of the piston) is increased and the ball **32** allowing flow into the chamber **35** when said pressure is reduced. A by-pass passage **36** is formed above the cylinder **25**, communication between the cylinder **25** and the passage **36** being via a large opening **37** at the end of the cylinder adjacent to the end **27**, a smaller opening **38** at the other end and an even smaller opening **39** adjacent to the face **34** of the cylinder **25**. It will be appreciated that the opening **39** (which is the only one available for hydraulic fluid to flow out of the chamber **35**) controls the rate of flow of hydraulic fluid from the chamber **35** when the piston **24** is moving to the left (i.e. when the balls **31** and **32** are closing their appropriate bores). The rate of flow of hydraulic fluid through the opening **39** is controlled by a bleed valve **40** which can be adjusted to suit the requirements of any particular installation.

If we now consider the hydraulic damper in conjunction with the door-closer mechanism, it will be seen that as the door-closer mechanism moves from the rest position shown in FIG. 1 to the fully open position shown in FIG. 3, the piston **24** will be moved from the position shown in full lines in FIG. 5 to the position shown in dotted lines in FIG. 5. As the piston makes this move, hydraulic fluid flows freely through the bores **29** and past the ball **32** into the chamber **35**. Thus the damper does little to restrict the opening movement of the door. When the door is released, however, the spring **12** attempts to return the lugs **10** and **11** to their rest position and this implies a movement of the block **16** (and thus a movement of the piston **24**) to the left in FIG. 5. Movement of the piston in this direction, however, can only occur at the rate at which hydraulic fluid can escape from the chamber **35**. As has already been explained, this rate of flow is determined by the setting of the bleed valve **40**.

Since the block **16** is prevented from moving to the left by the hydraulic damper, the spring **12** is prevented from expanding by the hydraulic pressure in the compression chamber and therefore (referring to FIG. 3) the bar **6** would be free to move to the left and the bar **7** to move to the right independently of the spring **12**. In order to prevent this free movement, the locking lever **20** is provided. This lever, by virtue of its engagement with one of the lugs **10** and by virtue of the interconnection of the bars **6** and **7** through the pinion **9**, positively holds the door so that it can only return to the closed position under the control of the restoring action of the damper.

The camming recess **22** in the upper plate **4** has surfaces **41** and **42** formed on that surface adjacent to the actuating spindle **8** and these surfaces **41** and **42**, by virtue of their engagement with the peg **21**, return the lever **20** into its central position as the closer mechanism slowly returns to its rest position.

The above described door-closer mechanism may, for example, be embedded in the top rail of a double-swing door with the two opposed flanges of the channel sections **2** and **3** flush with the upper edge of the top rail and with the actuating spindle **8** projecting from said upper edge. The projecting end of the spindle **8** can then be received in a square hole formed in a suitable socket member which is non-rotatably mounted in the transom above the door. A pivot pin projecting from the lower edge of the bottom rail of the door, the axis of this pin being aligned with the axis of the spindle **8**, can then be received in a suitable socket member disposed in the floor beneath the door. The orientation of the square end of the spindle **8** and the socket member which receives it are chosen so that the door is in its closed position when the door-closer mechanism is in its rest position. If the door is now opened in either direction from its closed position, the actuating spindle **8** is prevented from turning by its socket member and consequently the casing **1** of the door-closer mechanism rotates about the spindle. This rotation results in the compression of the spring **12** previously described causing an increase in the stored energy of the spring and a subsequent controlled return of the door to the closed position when the door is released.

It will be appreciated that the embodiment described is just one example of a door-closer mechanism in accordance with the invention and that many modifications to details of the construction can be made within the ambit of the following claims.

In a modified construction of door-closer mechanism, the lever **20** can be moved towards the damper end of the casing **1** and the lugs **10** removed. The lugs **11** are then sandwiched between the enlarged end **18** (which is now slidably mounted on the rod **13**) and an abutment which is screwed to the end of the rod **13**. In a manner similar to that already described, rotation of the spindle **8** in either direction will cause compression of the spring **12** by an amount equal to twice the distance moved by each bar **6** and **7**, the rod **13** being drawn to the left by engagement of one lug **11** with the abutment and the end **18** being moved to the right along the rod **13** by the other lug **11**.

The repositioned lever **20** may control movement of a bolt across the casing **1** so that it either engages in an aperture in the bar **6** or a similar aperture in the bar **7** allowing for controlled return of the door to the closed position under the influence of the damper.

What is claimed is:

1. A door-closer mechanism comprising a turnably mounted actuating member, first and second thrust members connected to the actuating member to move simultaneously in opposite directions when the actuating member turns in either direction from a rest position, a coil spring engaged by the thrust members with its axis parallel to said opposite directions whereby turning the turnable member in either direction from its rest position increases the stored energy of the coil spring, damping means providing differential resistance to movement in two directions and means for coupling said damping means to the actuating member so that movement of the actuating member from its rest position in either direction is less damped by the damping means than return of the actuating member to its rest position under the influence of the coil spring.

2. A door-closer mechanism as claimed in claim **1** in which the actuating member is coupled to a pinion engaging diametrically disposed racks, the racks being coupled to spaced apart opposed pairs of lugs between which the coil spring is disposed.

3. A door-closer mechanism as claimed in claim **1** in which the coil spring is mounted so that on a turning movement of the actuating member from its rest position, the spring is compressed by twice the distance either of the thrust members moves.

4. A door-closer mechanism as claimed in claim **1** in which the damping means comprises a piston slidable within a liquid-filled cylinder, valves being provided to allow easy movement of the piston in one direction but slower movement of the piston in the other direction and means to couple the piston to that one of the thrust members moving in the easy-movement direction of the piston when the actuating member turns from its rest position and means to retain the coupling between said one thrust member and the piston until the actuating member is substantially back in its rest position.

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J. KARL BELL, Primary Examiner

U.S. Cl. X.R.

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