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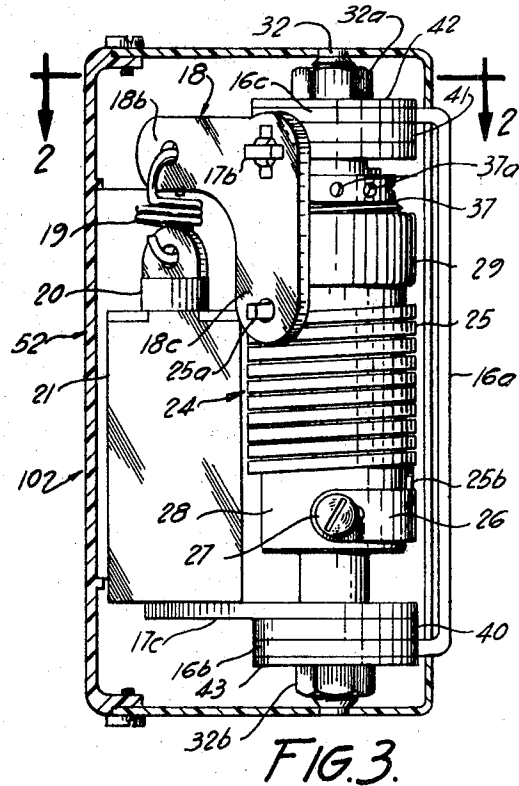
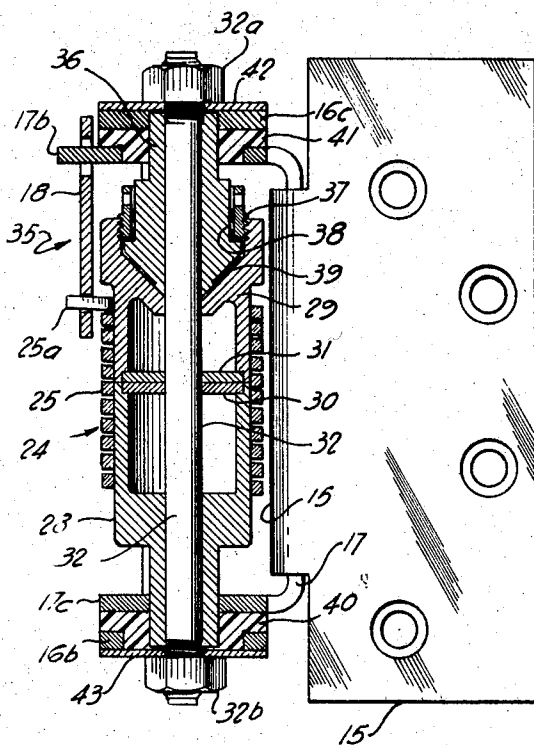
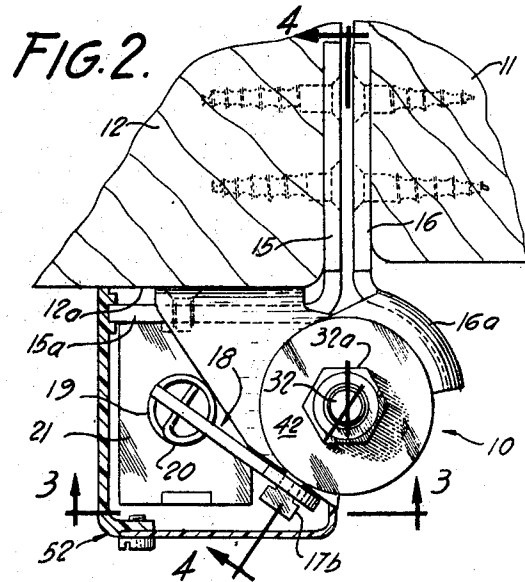
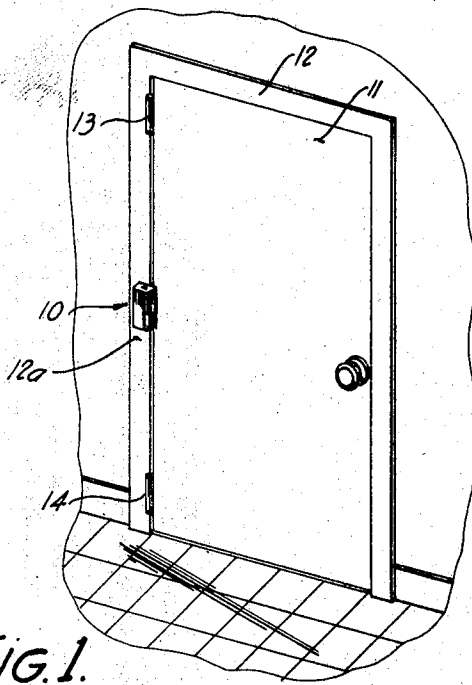
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3,559,232

ELECTRICALLY ACTUATED DOOR HOLDER WITH MANUAL OPENING
AND CLOSING OVERRIDE, AND AUTOMATIC RELEASE
TO EFFECT CLOSURE

Filed March 21, 1969

2 Sheets-Sheet 1



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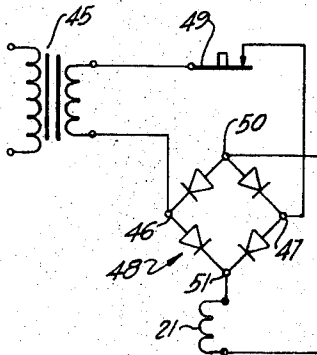


FIG. 6.

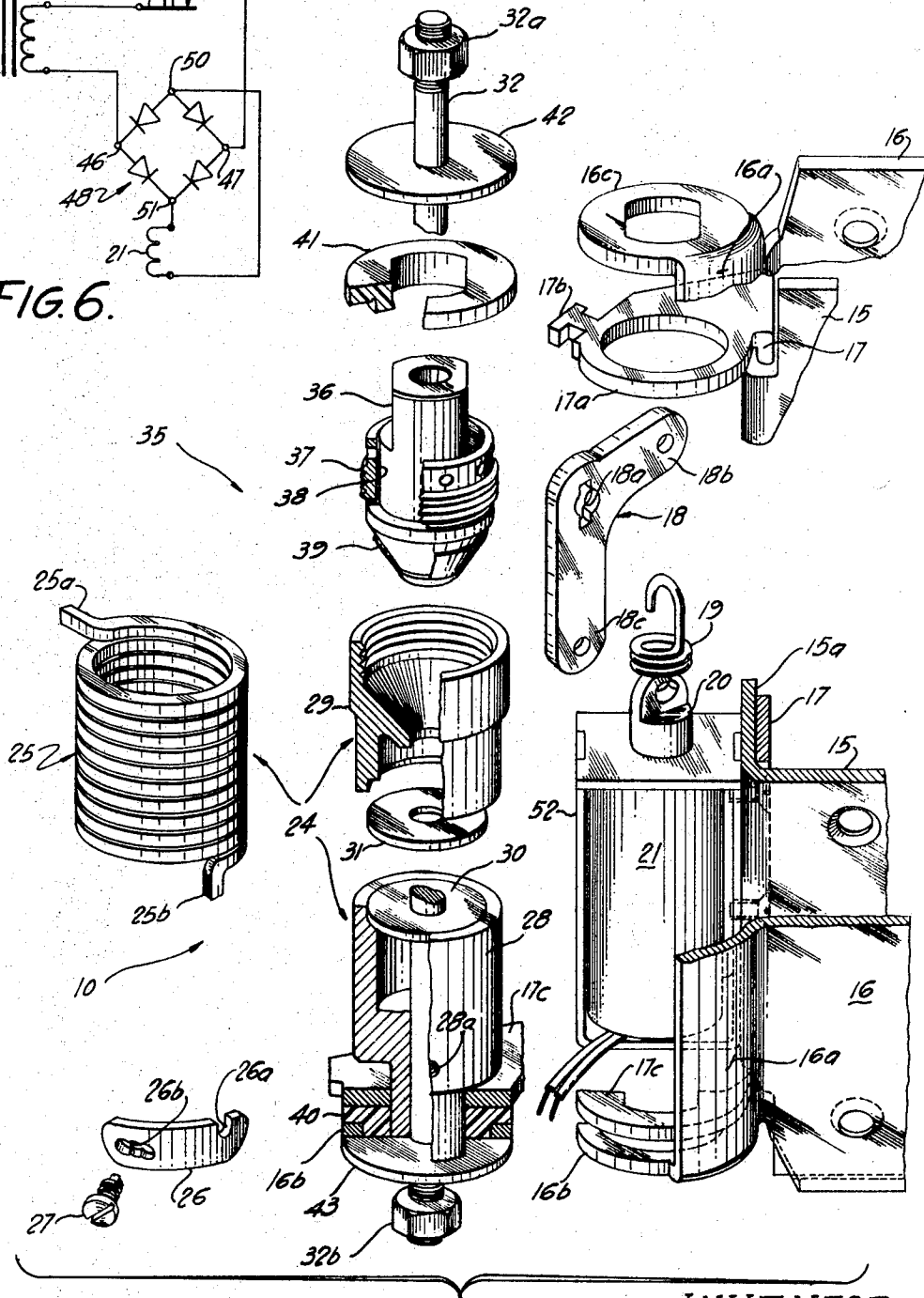


FIG. 5.

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ELECTRICALLY ACTUATED DOOR HOLDER WITH MANUAL OPENING AND CLOSING OVERRIDE, AND AUTOMATIC RELEASE TO EFFECT CLOSURE

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10 Claims

ABSTRACT OF THE DISCLOSURE

An electrically actuated door holder applied to a hinged door having a closer. The door holder may be manually overridden and also automatically released.

Functionally, the door is held open at any desired angular position when a solenoid is energized to cause a helical spring torque clutch to lock in engagement two relatively rotatable clutch shafts enveloped by the spring. Each clutch shaft is mechanically coupled to a different hinge leaf. In the door opening direction, the spring is unwound relative the clutch shafts to permit manual enlargement of the door opening.

A second cone or torque limiting clutch is mechanically connected in series with the helical spring clutch to enable manual closing of the door when sufficient door closing torque is applied to disengage the cone clutch, even though this closing torque is insufficient to disengage the helical spring clutch in the door closing direction.

Deenergization of the solenoid by the manual operation of a switch, or by an automatic fire detector, for example, disengages the helical clutch and permits the closer to close the door automatically.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to door holders; and in particular to that class of devices in which the holder is electrically releasable, and is to be used in conjunction with door closing means to automatically close the door upon command.

The present invention arises from the functional requirement for a holder which maintains a door open at any desired angular opening by simply placing the door manually at that position. At the same time, circumstances arise during which the door position must be manually reset to either an enlarged or smaller opening, or even closed, without operating the electrical release mechanism which may be remotely located.

Other circumstances may arise, such as the rendering of a fire or security alarm, during which the door should automatically close without the application of a manual force to the door.

A primary object of this invention is to provide a simple, but effective, structure for attaining the foregoing mode of operation.

Description of the prior art

The door holder structure of this invention features a serially connected combination of a helical spring clutch and a friction cone clutch. The helical spring clutch is

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engaged by actuating a lever in response to energization of a solenoid.

The use of a helical spring clutch acting on a hinge pin or pintle is old (see U.S. Pats. 2,865,045; 2,890,477; 2,964,781). This latter group of patents include means to effect a manual override. Likewise the use of cone clutches in door hinges is old (see U.S. Pats. 1,610,404; 1,816,834; 1,960,505; 2,051,428).

None of the prior art door holders employing these clutch elements use a solenoid to engage the helical spring clutch to hold the door open at any desired angular position, and still obtain manual override in both the door opening and closing directions together with automatic door release.

SUMMARY OF THE INVENTION

The invention in its most elementary and preferred aspect is described in the abstract.

DESCRIPTION OF THE DRAWINGS

In order that all of the structural features for attaining the objects of this invention may be readily understood, reference is herein made to the drawings, wherein:

FIG. 1 is a view showing the application of the door holder to a door supported on a door frame by two spring closer hinges;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 3, and which shows generally from a top view the application of the door holder to a door and its supporting jamb;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2, and which shows generally from a side view the helical spring clutch and the solenoid and linkage for tightening the helical spring;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 2, and which shows in full section the serially connected helical spring clutch and the mechanical cone clutch together with the jamb leaf;

FIG. 5 is an exploded view showing the structural detail of the clutch components, the solenoid and its linkage, and the hinge leaves; and

FIG. 6 is a schematic electrical circuit for energizing the solenoid of the door holder.

Referring now to FIG. 1 of the drawings, door holder 10 of this invention may be typically substituted for the middle butt hinge in an installation by which the door is supported on three hinges. For example, in FIG. 1 door 11 is supported relative door frame 12 by means of spring hinge 13, holder 10, and spring hinge 14.

Spring hinges 13 and 14 may be constructed in accordance with any of the several prior art designs which employ springs within the hinge housing to apply a closing force to door 11. As previously outlined in the introductory portion of this specification, door holder 10 of this invention must be employed with auxiliary closer means. Spring hinges 13 and 14 are merely illustrative examples of one type of closer that may be associated with holder 10.

As is shown in FIG. 2 (see also FIGS. 4 and 5), door holder 10 is mounted on the left jamb of frame 12 by means of jamb leaf 15. Door holder 10 also is attached to door 11 by door leaf 16.

As is best shown in FIG. 5, door leaf 16 includes a curved cover portion 16a which carries lower support flange 16b and upper support flange 16c. Lower support flange 16b is formed with a circular hole (see FIG. 5),

and upper support flange 16c is formed with a sectorcd circular hole to permit assembly of the components as hereinafter outlined.

Jamb leaf 15 is a right angle having a leg 15a (see FIGS. 2 and 5).

Leg 15a of jamb leaf 15 is separated from direct contact with face 12a (see FIG. 2) of frame 12 by means of lever pivot support 17. Lever pivot support 17 has an upper support flange 17a formed with a circular hole and a lower support flange 17c formed with a sectorcd circular hole (see FIG. 5). Upper support flange 17a carries a projecting T-pivot 17b.

Spring locking lever 18 is formed with an elongated hole 18a which receives T-pivot 17b so that the locking lever can pivot thereon.

Spring locking lever 18 has a generally horizontal arm 18b and a generally vertical arm 18c. The horizontal arm 18b carries solenoid spring 19 (see FIGS. 3 and 5). Solenoid spring 19 in turn carries rod-like armature 20 which is housed to reciprocate within the bore of solenoid winding 21 (see FIG. 5).

The vertical arm 18c of locking lever 18 engages upper projecting tip 25a of helical spring 25 (see FIG. 3).

The lower projecting tip 25b of helical spring 25 is engaged and held fixedly by notch 26a of spring catch 26 (see FIG. 5). Spring catch 26 is formed with an elongated adjustment hole 26b; and set screw 27 passes through adjustment hole 26b to engage mating threaded hole 28a in jamb shaft 28 (see FIG. 5).

Jamb shaft 28 and lower door shaft 29 form a mandrel which carries helical spring 25 (see FIG. 4). Components 25, 28 and 29 form a helical spring torque clutch 24. The upper peripheral edge of jamb shaft 28 is formed with a circular notch which carries spacer washer 30, and the lower peripheral edge of lower door shaft 29 is formed with a corresponding circular notch which carries a spacer washer 31.

Spacer washers 30 and 31 are formed with central bore holes, as are also jamb and lower door shafts 28 and 29, so that tie bolt 32 properly aligns these components on a common axis.

When solenoid 21 is energized by the typical power supply circuitry of FIG. 6, armature 20 is drawn into the bore of the solenoid, thereby exerting a downwardly pulling force on horizontal arm 18b of locking lever 18 through spring 19. This force causes locking lever 18 to pivot about T-pivot 17b thus moving vertical arm 18c of locking lever 18 to the right (see FIG. 3), and tightening helical spring 25 about the mandrel formed by jamb and lower door shafts 28 and 29. This action causes engagement of helical spring torque clutch 24.

Spring catch 26 is adjusted by means of set screw 27 so that the energization of solenoid 21 effectively tightens spring 25 about jamb and lower door shafts 28 and 29. In a preferred embodiment constructed by the inventor, these shafts are locked sufficiently tight so that a torque of 600 inch pounds is required to disengage (or possibly break the spring of) the torque clutch in the "spring winding direction."

It is a characteristic of a helical spring torque clutch, if the movable component of the mandrel (lower door shaft 29) is moved in such a direction as to wind the spring about its mandrel, the clutch is engaged to prevent relative movement of the shaft parts unless an excessive or destructive torque is applied. On the other hand, if the movable mandrel element (lower door shaft 29) is rotated in such a direction as to tend to unwind helical spring 25, a relatively small torque is required to cause disengagement of the helical spring clutch. Thus, a helical spring torque clutch is characterized by uni-directional clutch engagement.

As will be outlined hereinafter in detail, when solenoid 21 is energized, the application of forces responsive to door opening and closing to jamb and lower door shafts 28 and 29 enables the door to be readily opened man-

ually to any desired angle, but the door cannot be closed readily (unless torque limiting clutch 35 is disengaged). In other words, opening the door tends to unwind helical spring 25, whereas closing the door tends to wind helical spring 25.

The functional result of this particular application of a helical spring torque clutch to couple door 11 to its frame 12 is such that door 11 may be manually set to any angular opening, which opening may be readily enlarged by the application of a further relatively small opening force. Hinge closers 13 and 14 do not exert sufficient closing torque to overcome the holding torque created by engagement of clutch 24.

Helical spring torque clutch 24 is serially connected with torque limiting clutch 35. Torque limiting clutch 35 includes the upper half of lower door shaft 29 whose inner bore is formed with a generally cylindrical portion which leads into a conical portion. This complex bore contour receives upper door shaft 36.

Threaded screw 37 (FIGS. 4 and 5) is fixedly coupled relative lower door shaft 29 so that upper door shaft 36 is retained within the mating bore of lower door shaft 29. Screw 37 is formed with a plurality of wrench holes 37a which receives a wrench (not shown) so that relative adjustment can be effected between the lower door shaft 29 and screw 37.

The degree of this relative adjustment determines the frictional force which must be applied between the bearing surface of upper door shaft 36 and lower door shaft 29. These bearing surfaces are separated from direct contact with one another by cylindrical sleeve bearing 38 and frusto-conical clutch facing 39 (Raybestos).

When door holder 10 is properly adjusted, torque limiting clutch 35 disengages in the sense that element 36 is free to rotate with respect to element 29, at a torque intermediate the "winding" and "unwinding" torque values set for helical spring torque clutch 24.

With such an adjustment of torque limiting clutch 35, when door 11 is moved relative frame 12 in the opening direction (since spring 25 is being unwound in this direction), torque limiting clutch 35 is maintained in engagement; however, when the door is manually driven in a closing direction, helical spring 25 is driven in a winding direction. Therefore, torque limiting clutch 35 will disengage before the maximum torque limit or breakdown torque of clutch 24 is attained. Consequently, the series combination of clutches 24 and 35 enables door 11 to be opened and set to any desired opening point in opposition to the closer spring for hinges 13 and 14. Additionally, the open position of door 11 may be manually enlarged and set to any desired larger opening position.

However, in the event solenoid 21 remains energized, the application of a manual closing force to door 11 will cause disengagement of clutch 35, thus overriding a holding effect of clutch 24. Clutches 24 and 35 and their constituent components are retained by lower flange 16b and upper flange 16c of door leaf 16 by means of plastic (Delrin) bearings 40 and 41 (see FIGS. 4 and 5). The upper nut 32a of tie bolt 32 is tightened upon upper tie bar washer 42; and the lower nut 32b of tie bolt 32 supports lower tie bar washer 43.

FIG. 6 shows a conventional AC to DC power supply for energizing solenoid 21. In particular, line voltage, such as 110 AC, is applied to the primary winding of transformer 45; and the voltage developed by the secondary winding of this transformer is applied to terminals 46 and 47 or full-wave bridge rectifier 48 through normally-closed switch contact 49. The rectified direct voltage appearing at terminals 50 and 51 (typically 24 DC volts) is applied directly to solenoid winding 21 which acts upon armature 20 and locking lever 18 as previously explained.

In a typical installation of the door holder of this invention contact 49 may be manually operated by a

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switch toggle for example; or, alternatively, contact 49 may be operated by a fire alarm or other detection system. In the latter situation the function of the fire alarm or the detection system would be to deenergize the solenoid and thus effect door closure.

Housing 52 contains all of the components except the power supply circuitry which is preferably remotely located.

The detailed operation of the hereinbefore described structure is as follows:

Assuming that contact 49 (FIG. 6) is connected to a fire detection system which generates no output due to the absence of a fire, a direct-current voltage is applied to solenoid 21, thereby drawing armature 20 into the bore of the solenoid.

This armature action pulls arm 18b of locking lever 18 in a downward direction through spring 19, and at the same time arm 18c of locking lever 18 is driven to the right, thus winding (or, in other words, tightening) helical spring 25 about the mandrel formed by elements 28 and 29. Thus, torque clutch 24 is engaged in the winding direction of the spring.

When door 11 is manually opened with respect to frame 12, hinge leaf 16 acting through upper support flange 16c rotates upper door shaft 36. Inasmuch as torque limiting clutch 35 is in engagement, lower door shaft 29 rotates in a direction relative spring 25 so that the tendency is to unwind spring 25. Accordingly, helical spring clutch 25 is effectively disengaged and door 11 may be manually opened to the desired position.

When manual force is removed, the door is retained in the position inasmuch as closer hinges 13 and 14 exert a force upon door 11 in such a direction as to tend to cause lower door shaft 29 to wind spring 25 about the mandrel formed by elements 28 and 29. This application causes engagement of the helical spring clutch and retains the door in its set position, as previously explained.

In the event it is desired to reset door 11 to a greater open position, manual force need only be applied to the door in the proper direction. This causes lower door shaft 29 to tend to unwind helical spring 25, thus causing disengagement of the clutch and enabling a new door position to be reestablished.

In the event it is desired to lessen the opening angle of door 11 with respect to its frame 12, or to close the door entirely, a properly directed manual force upon door 11 will exert sufficient torque upon upper door shaft 36 to cause the torque limiting clutch 35 to disengage, thus permitting the door to be partially or entirely closed, as desired.

In the event door 11 is in an open position and the fire detector (not shown) detects a fire, contact 49 is opened, thereby removing the energizing potential from solenoid 21. When solenoid 21 is deenergized, armature 20 is withdrawn from the bore of the solenoid, and locking lever 18 permits helical spring 25 to unwind. This unwinding of helical spring 25 causes helical spring torque clutch 24 to disengage. With this disengagement, the closer spring of hinges 13 and 14 close door 11 relative its frame, thus confining the products of combustion to one side of the door.

The particular door holder shown in the drawings is designed for control up to a 90° angle. It is obvious, however, that with minor modifications larger door opening angles can be controlled.

What is claimed is:

1. A door control operator comprising a pair of hinge leaves rotatably movable relative one another, a solenoid, an armature actuated by energization of the solenoid, a linkage movably responsive to armature actuation, support means, a pair of relatively rotatable shafts carried by the support means in an end-to-end relationship with each shaft coupled to a different hinge leaf, a helical spring enveloping both shafts to form therewith a helical

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spring torque clutch with one end of the spring fixed to one of the shafts and the other end of the spring coupled to the armature actuated linkage whereby energization of the solenoid attracts the armature to thereby actuate the linkage to tighten the helical spring about both shafts to increase substantially the torque required to rotate the leaves in one relative direction as compared to the reverse direction.

2. The combination of claim 1 in which a friction torque limiting clutch couples one of the shafts to its associated leaf to thereby effect an override which reduces the torque required to rotate the leaves with respect to one another in the one relative direction.

3. The combination of claim 2 in which one of the shafts is common to both clutches.

4. The combination of claim 3 in which the friction torque limiting clutch is a cone clutch.

5. A door operator for controlling the relative open position of a door with respect to a door opening defined by a frame in which a first hinge leaf is attached to the door and a second hinge leaf is attached to the frame to enable the door to pivot relative to the frame, and in which a closer is used to close the door, the improvement comprising a helical spring torque clutch and a mechanical friction torque limiting clutch connected in series with one another, the clutch subcombination having an input to one clutch and an output to the other clutch, means coupling one of the hinge leaves to the clutch input and the other hinge leaf to the clutch output, and electrically energized means actuating the helical spring to thus hold the door at a desired relative open position with respect to the frame with the mechanical friction clutch providing a manual override in the direction of door operation tending to wind the spring more tightly.

6. The combination of claim 5 in which the helical spring clutch includes a mandrel having two relatively rotatable elements with the spring closely enveloping the mandrel elements, the mechanical friction clutch is a cone clutch, and the spring clutch when tightened by the electrical means holds the door in any desired open position and the cone clutch effects override of the spring clutch to effect door closure.

7. The combination of claim 6, in which the helical spring torque clutch remains engaged at a maximum value of applied torque in one direction of relative motion of the door with respect to the frame and disengages at a minimum value of applied torque in the opposite direction of relative motion of the door with respect to the frame, and the cone clutch disengages at a value of applied torque intermediate said maximum and minimum values.

8. A door operator for controlling the relative open position of a door with respect to a door opening defined by a frame in which a first hinge leaf is attached to the door and a second hinge leaf is attached to the frame to enable the door to pivot relative to the frame, and in which a closer is used to close the door, the improvement comprising a solenoid assembly and a clutch assembly supported adjacent the hinge leaves on the frame, the solenoid assembly including a solenoid, an armature reciprocating within the bore of the solenoid, a lever linkage, and a spring connecting the lever linkage to the armature, and the clutch assembly includes a tie bolt, first and second mandrel shafts carried by the tie bolt with the first shaft fixed relative the frame and the second shaft movable responsively to the door, a helical spring having two terminal ends enveloping the first and second mandrel shafts with one of said ends being fixed to the first shaft and the other end coupled to the linkage to thereby wind and unwind the helical spring responsively to movement of the linkage caused by energization of the solenoid, a third shaft element carried on the tie bolt in friction engagement with the second shaft and this element being movable responsively to the door.

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9. The combination of claim 8, in which the helical spring and the first and second mandrel shaft form a helical spring torque clutch which upon energization of the solenoid remains engaged at a maximum value of applied torque in the door closing direction and disengages at a minimum value of applied torque in the door opening direction, and the second mandrel shaft and the third shaft element form a friction torque limiting clutch which disengages at a value of applied torque intermediate said maximum and minimum values to provide override in the door closing direction.

10. The combination of claim 9 in which said friction torque limiting clutch is a cone clutch.

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