United States Patent

Martin

[15] **3,696,462**

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[54] COMBINED DOOR CHECKING AND DOOR HOLD OPEN MECHANISM

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[73] Assignee: **Republic Industries, Inc.,** Chicago, Ill.

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[21] Appl. No.: **105,331**

[52] **U.S. Cl.**.....**16/49 HO,** 16/55, 49/2

[51] **Int. Cl.** **E05f 3/22,** E05f 15/20

[58] **Field of Search** .....49/2, 21, 28; 16/48.5, 58, 16/66, 68, 49 HO, 49, 51, 52, 53, 55; 292/273

[56] **References Cited**

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1,849,417	3/1932	Bassett	16/49 HO X
2,024,472	12/1935	Norton	16/49 HO
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2,396	7/1899	Denmark	16/51

Primary Examiner—Donald A. Griffin

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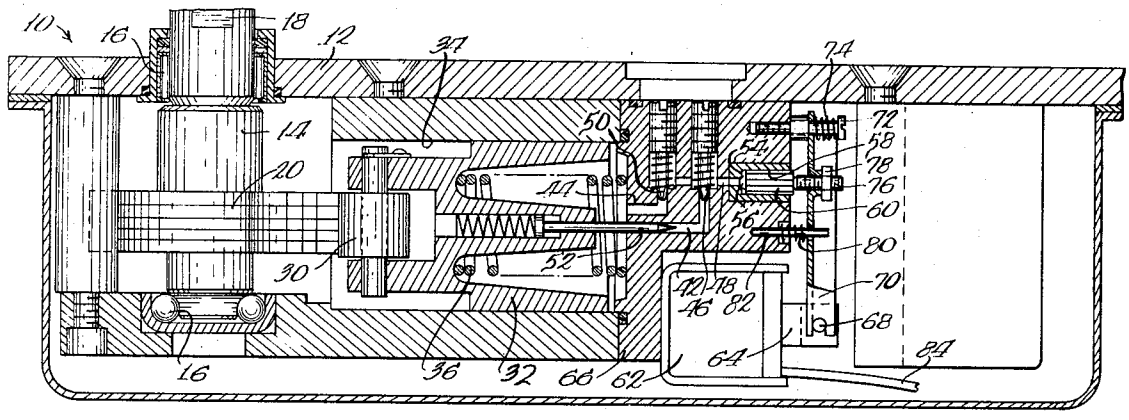
[57] **ABSTRACT**

A hydraulic door checking mechanism which otherwise may be considered as of essentially conventional type is provided with a remotely actuated valve in the fluid return line from the checking cylinder to the reservoir. By closing this valve the hydraulic fluid cannot escape from the checking cylinder, thus preventing closing movement of the door from whatever position it has been opened to until the valve is unseated. Preferably, the valve is of the electromagnetic type which responds to the conditions in as associated control circuit. During opening movement of the door, the hydraulic fluid fills the checking cylinder through passages or porting which bypasses the hold open valve. The system is shown as applied to checking door hinges and to door closers of the surface mounted type.

11 Claims, 8 Drawing Figures



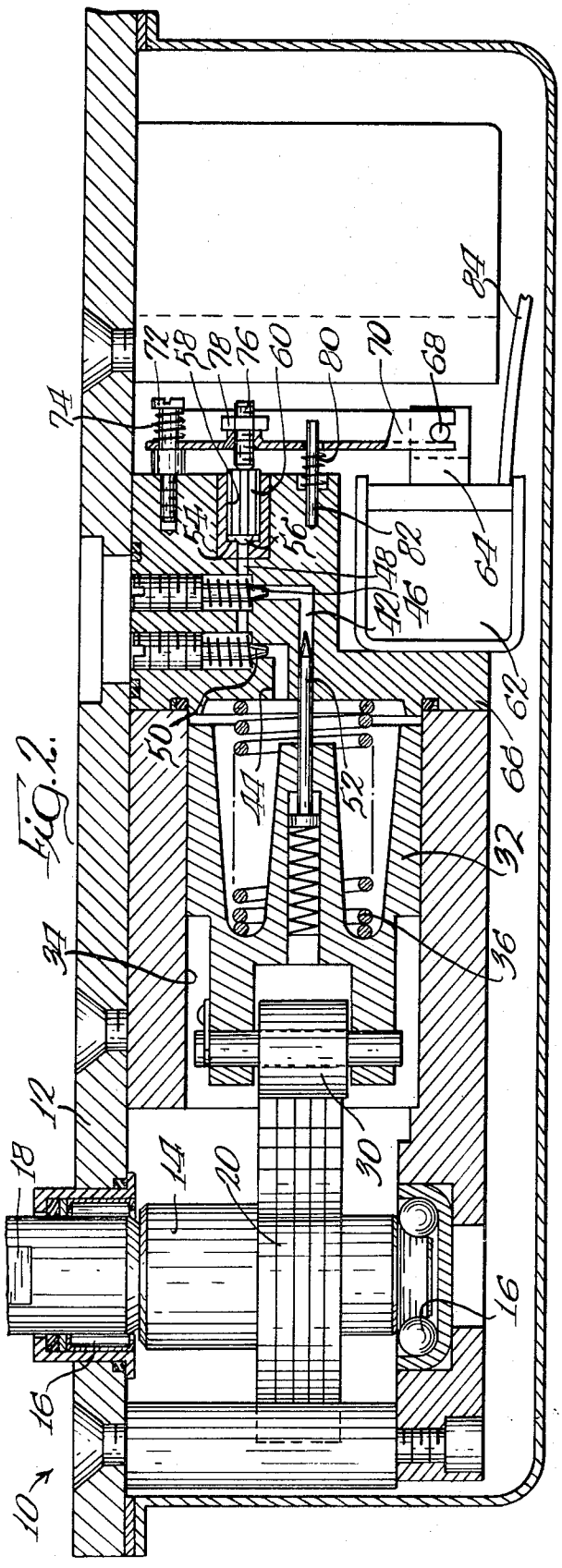


Fig. 2.

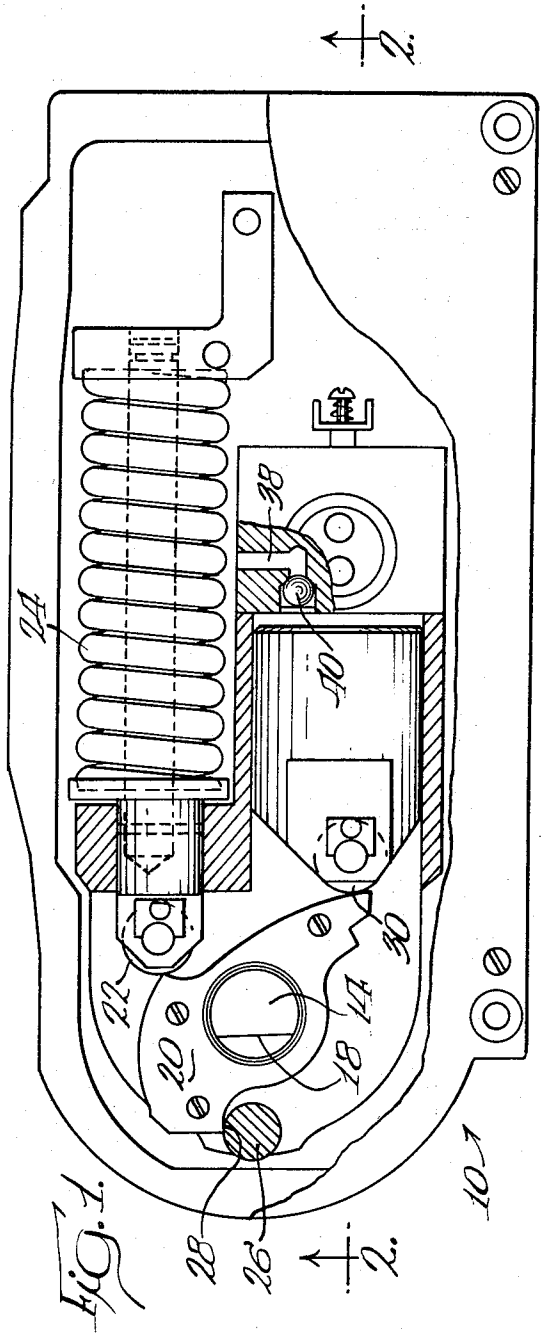


Fig. 1.

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Fig. 3.

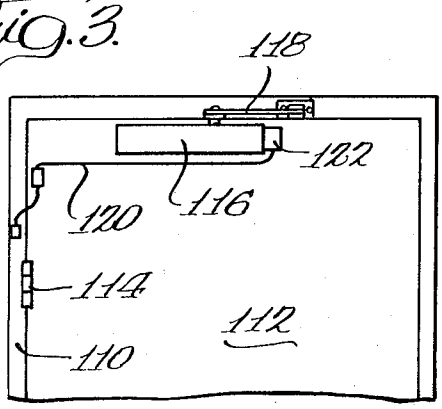


Fig. 4.

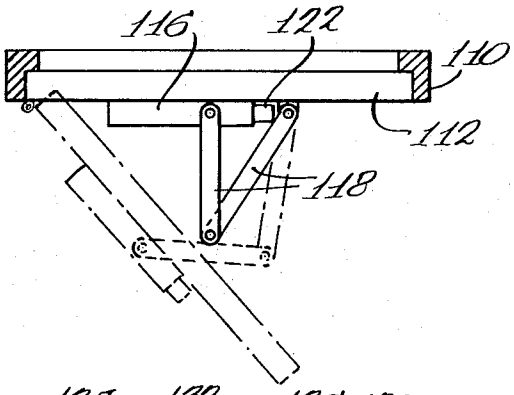


Fig. 5.

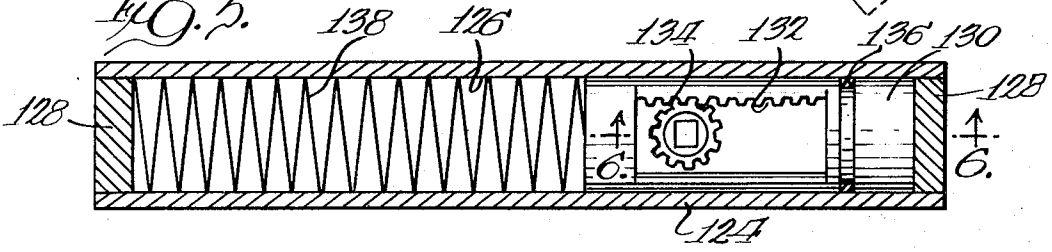


Fig. 6.

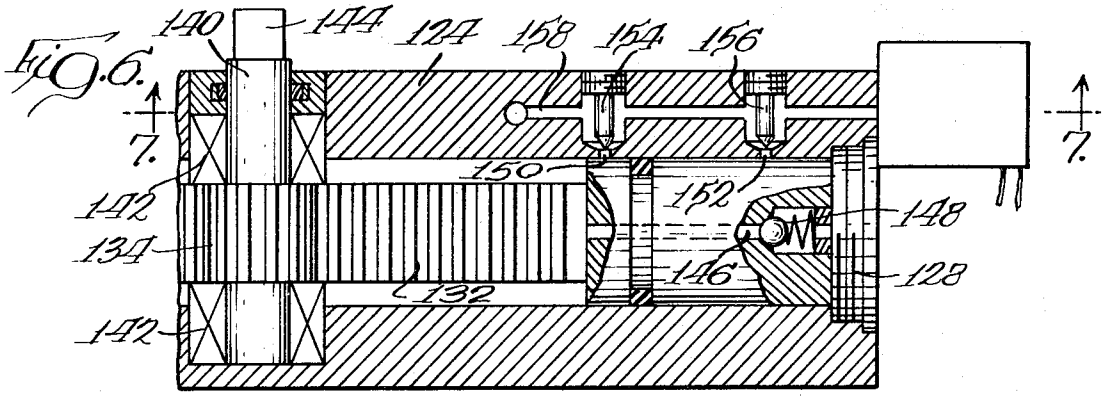


Fig. 7.

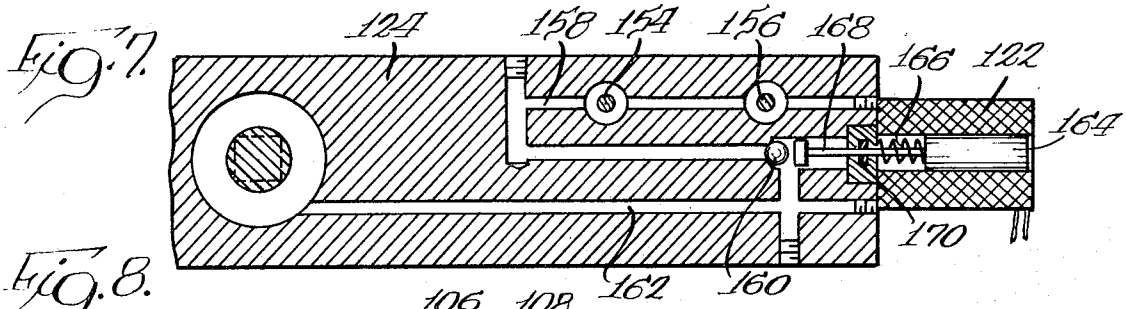
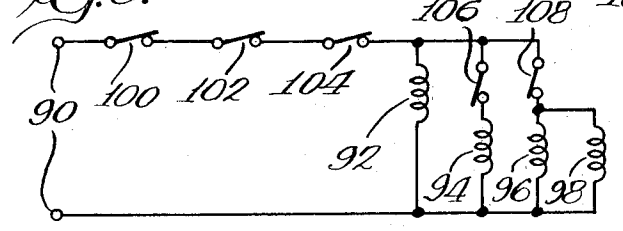


Fig. 8.



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COMBINED DOOR CHECKING AND DOOR HOLD OPEN MECHANISM

BACKGROUND OF THE INVENTION

1. Field of the Invention

Hydraulic door closers and safety doors of the type used to prevent or inhibit the spread of fire, smoke or heat rise.

Description of the Prior Art

It is well known to provide swinging doors with hydraulic door checks, either of the hinge type, usually mounted in the floor beneath the door, or of the surface mounted type which are secured to the face of the door near the top edge. With either type, opening the door compresses a spring mechanism and expands a hydraulic piston and cylinder combination which fills from a hydraulic fluid reservoir. Sometimes the fluid reservoir is simply a portion of the cylinder on the other side of the piston. In any event, when the opened door is released, the spring urges the door toward closed position and the rate of movement of the door is regulated by controlling the rate at which the cylinder can empty. This is accomplished by causing the fluid to flow through passages controlled by one or more adjustable flow restricting valves. Doors controlled by such mechanisms normally are retained in the closed position although in some mechanisms there is provision for holding the door open by such expedients as detents which engage if the door is pushed open beyond its normal fully open position. Sometimes actuated bolts at the bottom edge of the door are provided which when pushed down can engage the floor and prevent its closing. None of these arrangements, however, provide for automatic or remote control closing of the door.

Fire doors also are common in which the door tends to run downhill on a track to closed position or normally tends to close under the influence of weights suspended from a cable attached to the door. Typically, such doors are held in open position by a fusible link which melts when overheated and permits the door to close.

It has also been proposed to use an ordinary door closer mechanism and to provide a powerful electromagnet on the wall to hold the door open until the circuit of the electromagnet is interrupted. Another proposal is to hold a door open by a pneumatic cylinder connected to a high pressure air line, the arrangement being such that a remotely controlled mechanism can drop the pressure in the pneumatic cylinder so that weights can close the door.

Of interest as showing the state of the art of safety doors which normally are held open, but which close automatically under certain conditions are the following United States Pat. Nos. 350,451 to Tucker; 3,284,840 to Ulman; 3,470,652 to Forbes; 1,993,224 to Moore.

SUMMARY OF THE INVENTION

The purpose of this invention is to provide a door closing mechanism combined with a door hold open system which has novel valuable features at an expense and complexity only slightly greater than that involved in the hydraulic door closing mechanism alone. The system can be operated as a normal hydraulic door checking mechanism such that the door normally is closed, is manually opened, and returns to closed position automatically at a controlled rate.

Alternatively, the system can be operated such that the door can be manually opened to any desired position and will remain there when released. When the door s operated in this mode, there is provision for releasing the door so that it will close automatically in the normal fashion. This releasing mechanism is preferably actuated by interrupting an electrical control circuit, and provision for this can be located remotely and can respond by means of well known devices to any desired condition such for example as high temperature, low temperature, smoke, wind conditions, manual or timer controlled switching or a combination. Any switching device which can make and break an electrical circuit can be adopted for control purpose.

Combinations of series and parallel controls which are apparent can arrange a system such that, as an example, all of the doors in a building can be closed at night. In the morning or during the day whenever someone first opens any door it will remain open, or if desired, it can be arranged to reclose. Thereafter, during the day, all or a group of doors will remain open or partially open as seems appropriate. At the end of the day a single remote manual or time switch can be actuated to close all of the doors in the building which happen to be open or partially open at that time. Thereafter, during the night, any doors which are opened, by building service personnel, for instance, will reclose when released. Other control systems to fit a variety of circumstances will, of course, be apparent.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawing:

FIG. 1 is a somewhat diagrammatic horizontal, sectional view looking downwardly illustrating the principal structure of a typical floor mounted checking door pivot modified to include the invention;

FIG. 2 is a vertical sectional view which may be considered as taken in the direction of the arrows substantially along the line 2—2 of FIG. 1;

FIG. 3 is a diagrammatic elevation of the top portion of a door with a surface mounted door closer incorporating the invention mounted thereon;

FIG. 4 is a diagrammatic top view of the structure of FIG. 3 showing the linkage connecting the closer mechanism proper to the door frame;

FIG. 5 is a diagrammatic horizontal sectional view through the piston and cylinder portion of the surface mounted closer of FIG. 3;

FIG. 6 is a fractional vertical sectional view to larger scale through a portion of the piston and pinion and valving portion of the closer of FIG. 5. It is taken in the direction of the arrows substantially along the line 6—6 of FIG. 5;

FIG. 7 is a fractional horizontal sectional view which is taken in the direction of the arrows substantially along the line 7—7 of FIG. 6; and

FIG. 8 is an illustrative electrical control circuit for the devices of FIGS. 1 through 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2, the door closer there shown is sufficiently conventional so that only a generalized description is required for the major portion of the structure.

It comprises a case 10 including a cover plate 12 and is mounted in a recess in the floor beneath a door at the hinged edge. Near the left end as shown, a vertical spindle 14 is journaled in top and bottom bearings 16 and extends through the cover plate 12 where it is provided at its end with flat surfaces 18. This spindle 14 serves as the bottom pivot for the door, the top end of the door having a freely rotating pivot, not shown, in alignment therewith. Because of the flat surfaces 18 and engaging complementary surfaces in a control arm located in a recess in the bottom edge of the door, the door and spindle 14 rotate together. The door, the control arm, the top pivot and the floor and door frame are not shown since their elements is not necessary to an understanding of the invention.

The spindle 14 is provided with a disc-type cam element 20 which rotates therewith. At one side, the top in FIG. 1, a cam following roller 22 is urged into engagement with the cam edge by a relatively heavy coil spring 24 and the cam periphery is so contoured that action of the spring 24 and cam follower 22 rotates the door to closed position. This is the position shown in FIGS. 1 and 2. In the example illustrated, swinging the door to open position rotates the spindle 14 and cam 20 in the clockwise direction as seen in FIG. 1. Movement of the door to the closed position is limited by a stop pin 26 engaged by a surface 28 of the cam 20.

A second cam following roller 30 is carried at the end of a checking piston 32 within a hydraulic cylinder 34, and this roller 30 engages the cam edge at a portion which is so contoured that as the door is opened, the piston moves to the left as seen in FIGS. 1 and 2 so as to expand the enclosed volume of the cylinder. Conversely, closing the door under the influence of spring 24 reduces the volume of the checking cylinder. During expansion of the cylinder, which occurs when the door is opened, a light spring 36 causes the piston 32 to move outwardly with the roller 30 following the cam face. Although not shown, since the arrangement is conventional, the piston will normally be provided with a pliable O-ring, lip seal, piston ring or similar seal to prevent leakage between the piston and the cylinder wall.

When the door is opened, and the cylinder volume expands, hydraulic fluid is drawn from the reservoir, constituted by the clearance volume within the case 10 around the operating mechanism just described, into the cylinder through a passage 38 which includes a one way check valve 40. This check valve of the ball type permits free flow of fluid into the cylinder, but prevents outflow therefrom.

Flow from the cylinder is through parallel passage 42 and 44. Passage 42 is at the cylinder axis and leads through needle valve 46 to a common exhaust passage 48. The other passage 44 leads through its needle valve 50 to the common passage 48. In the customary arrangement, the common passage 48 is exhausted directly to the reservoir.

Under the usual conditions, with the door open and the piston 32 to the left as seen in FIG. 2, the portion of the cylinder to the right of piston 32 will be full of hydraulic fluid. When the door is released, it swings toward closed position, the fluid flowing out through passages 42 and 44 through regulating valves 46 and 50. The valve 46 is adjusted so that the major portion of the flow is therethrough until the door approaches the closed position. At that point, a tapered pin 52 carried by the piston 32 enters the passage 42 and largely blocks flow therethrough. Thereafter, almost all of the flow is through passage 44 and needle valve 50. This system permits the door to swing rapidly toward closed position until it is almost closed and thereafter to slow down and move slowly into its final position, the rate of fast movement and slow movement being determined by the settings of the valves 46 and 50.

The door closer as so far described is essentially conventional and is similar to the mechanism shown and described in U. S. Pat. Nos. 2,595,187, 2,603,818 and 2,752,627.

In the present arrangement, however, the common passage 48 is not exhausted directly to the reservoir. Instead it leads to a valve seat 54 engaged by a ball valve 56 in a passage 58 leading to the reservoir. A triangular or squared or fluted stem 60 in the passage 58 holds the ball 56 against the seat 54 when this stem 60 is pushed to the left as seen in FIG. 2 so as to prevent fluid flow from the cylinder 34. When the stem 60 is released, it can move slightly to the right and connect the passage 48 to the reservoir so as to permit the door check to operate in the customary fashion.

A solenoid 62 having an armature 64 is secured to the end of the door closer valve body 66 and has its armature pivoted by a pin 68 to a lever 70. This lever extends upwardly over the end of the stem 60 and has its opposite end pivotally secured by a screw 72 and coil spring 74 in customary solenoid actuator fashion. Where the lever 70 passes over the end of the stem 60, an adjustment screw 76 is threaded through the lever so that its inner end can engage the outer end of the stem 60. When adjusted, its position can be fixed by a lock nut 78. When the electric power is off, the lever 70 is rocked outwardly about the pivot point 72 by a light coil spring 80 surrounding a pin 82 fixed in the valve body 66. Under these conditions, the armature 64 is partially withdrawn from its coil and the valve ball 56 is loose relative to its seat 54. The door check then operates in the usual manner such that when a door is opened and released, it swings closed under control of the hydraulic checking system.

When it is desired to have the door held open, it is necessary merely to energize the solenoid coil 62. This pulls the armature 64 and the lower end of lever 70 to the left and causes the inner end of adjustment screw 76 to engage the stem 60 and push it to the left so as to clamp the ball 56 against its seat 54. The spring loading of the lever pivot at 72 is for the purpose of permitting slight overtravel of the armature 64 and determining the pressure under which the ball 56 is held against its seat. It also prevents any slight vibration of the lever 70 produced by alternating current operation of the solenoid from causing the ball 56 to vibrate in its seat 54. Leads 84 for the solenoid can be brought out through the case wall in any convenient manner such as by way of a conventional terminal box not shown for instance.

With the mechanism as described, when the solenoid is not energized, the door operates conventionally. In fact, its operation cannot be distinguished from that of a standard checking door hinge. When, however, the solenoid is energized, the door can be swung open normally, but will not reclose. It will remain in whatever position it has assumed when released. At any time thereafter if the power circuit to the solenoid is interrupted, the door will swing shut in the normal fashion.

If desired, the loading of the solenoid on the ball **56** can be adjusted by properly proportioning the mechanism, such as by adjusting the pressure exerted by the spring **74**, so that the door is held open when the solenoid is energized, but can manually be pushed or pulled shut hard enough to develop sufficient pressure in the checking cylinder to unseat the ball **56**. It is usually more convenient, however, to provide a local switch to interrupt the circuit to a particular door closer if it is desired that it sometimes keep the door closed excepting when someone is passing through. As a protective measure for the mechanism, the adjustment conveniently can be such that a closing force about three times the normal opening force will unseat the ball. This prevents some unusual force in the closing direction from damaging the mechanism, but does not influence normal operation.

FIG. **8** illustrates the features of a typical electrical control system for hold-open door checks as described above. In this figure, the electric power is connected to the terminals **90**. The solenoid coils for several door closers are indicated at **92**, **94**, **96** and **98**. Switches **100**, **102** and **104** are in series with each other and with all of the solenoids. Additionally, switch **106** is in series with solenoid **94** only and switch **108** is in series with solenoids **96** and **98** in parallel.

To be specific, switch **100** can be a remote manual control or a timer actuated switch which can be used to close all of the doors in the building by simply opening the switch contacts. Switches **102** and **104** can be temperature sensitive or smoke sensitive and designed to open the circuit to all of the solenoids **92**, **94**, **96** and **98** whenever there are indications of fire in the building. Switch **106**, in series with solenoid **94** only, is an example of a local switch along side a particular door for instance which can be opened so as to permit its door to open when a person passes therethrough and to reclose thereafter. The door having solenoid **94**, therefore, can optionally be held open, subject to the remote control system, or it can be normally closed. Switch **108** acts like switch **106**, but optionally can close a group of doors, such as indicated by the solenoids **96** and **98**, rather than just a single door as with switch **106**. Such a group might, for instance, constitute the exit doors of a public building where a crowd leaves together, such as after a basketball or hockey game, for example. These examples are not intended to be limitative, but are included to illustrate the simplicity and flexibility of a door control system which makes use of this invention. The switches shown are, of course, representative of simple switches, relay contacts or electronic controls or any arrangement that can cause an electrical circuit to be broken under conditions where it is desired to have one or more doors close.

It might be thought that normal leakage in the checking mechanism would result in slow closing of a door it was desired to hold open, thus defeating the objectives of this invention. Test on various closer designs indicate, however, that ordinary closer manufacturing practice when incorporating this invention does not result in a product having such weakness. Usually, when this invention is applied to an ordinary closer design manufactured with the customary tolerances, a door with which it is used will not close appreciably during a time span of a day or two. Furthermore, if the door does creep toward the closed position slightly, the next person to pass therethrough will reestablish the desired open position by simply pushing or pulling the door more open during the act of passing.

FIGS. **3** to **7** illustrate adaptation of the invention to a surface mounted door closer of otherwise substantially conventional design.

In FIGS. **3** and **4** a door frame **110** has a door **112** hinged at **114**. A hydraulic door closer **116** is secured to the face of the door at the top and is connected by linkage **118** to the door frame above the door, all in the customary manner. A flexible electric lead **120** is connected from the door frame **110** to a solenoid **122** attached at the end of the door closer body.

Referring to FIGS. **5** to **7**, the device there shown largely follows typical design practice. A housing **124** provides a cylinder **126** having end closures **128**. The cylinder encloses a piston **130** provided with a rack extension **132** which meshes with a pinion **134**. Thus, linear movement of the piston is accompanied by rotation of the pinion and vice versa. The piston is sealed to the cylinder wall by an O-ring **136** and is urged to the right by a door closing spring **138**. The pinion **134** is integral with a shaft **140** which is journaled as at **142** in the housing and which extends outside the housing at the top. At its upper end the shaft is provided with a flat surface **144** which prevents relative rotation between the pinion shaft and the linkage **118** connected thereto.

As the piston **130** moves within the cylinder under the influence of the spring **138** or opening movement of the door, hydraulic fluid is transferred from one side of the piston to the other. During door opening movement this transfer of fluid is free by way of a passage **146** through the piston. A ball check valve **148** in this passage permits flow of fluid through the piston to the right, during movement of the piston to the left, but prevents flow in the reverse direction. The door, therefore, opens freely excepting as restrained by the spring **138**.

During closing movement of the door, fluid flows through cylinder side wall ports **150** and **152** and thence through adjustable flow restricting needle valves **154** and **156** respectively to a common passage **158** which in the usual arrangement exhausts to the cylinder on the left side of the piston. When the door is open, the piston uncovers both ports **150** and **152** and thus at the start of closing movement, fluid flows through both ports **150** and **152** and both restricting valves **154** and **156**. Near the end of the door closing movement the piston covers the port **150** such that thereafter all fluid flow must be by way of port **152** and control valve **156**. Normally the valve **154** is adjusted to give rather rapid closing movement of the door until the port **150** is covered. Thereafter, movement of the door is slow as it creeps to final closed position, the valve **156** usually being adjusted to achieve this result.

With the present invention applied to the door closer, the passage **158** does not exhaust directly to the reservoir portion of the cylinder, the portion to the left of piston **130**, as is customary. Instead, the passage **158** leads to a ball valve **160** and thence by way of a passage extension **162** to the reservoir or sump portion of the cylinder. Normally, the ball valve **160** is open and so the door check operates in the customary fashion. That is, the door opens freely and recloses at a controlled rate when released.

The previously mentioned solenoid **122** at the end of the door check housing **124** has an armature **164** urged toward the right by a light spring **166**. When energized, the solenoid pulls this armature to the left, a stem **168** passes through a fluid seal **170** and is so positioned that when the armature **164** moves to the left it engages the end of the stem **168** and pushes the stem to the left. Under these conditions, the opposite end of the stem **168** holds the ball **160** against its seat and prevents the escape of hydraulic fluid from the checking cylinder and, therefore, prevents the door closing after it once it has been opened. As in the previous example, deenergizing the solenoid opens the valve **160** and permits the door to close in customary fashion.

The embodiment of FIGS. **3** to **7** may use the circuits of FIG. **8** excepting that as illustrated, the solenoid **122** is of the D.C. type, but, of course, an A.C. solenoid may be substituted if desired and similarly, D.C. solenoids may be used in the embodiment of FIGS. **1** and **2**, the two types of solenoids being interchangeable so far as the function they perform is concerned. As with the first described embodiment, the door can be manually closed when the solenoid is energized if the door is pushed or pulled toward closed position hard enough to unseat the ball **160**.

Although two embodiments of the invention have been shown and described, it will be appreciated that they are for the purpose of showing the substantially universal application of the invention to hydraulic door closers of diverse types and are not intended to be considered in a limitative sense.

Having described the invention, what is claimed is:

1. In a hydraulic door closer system, means for biasing a door toward closure, means connected to said door providing an expansible and collapsible hydraulic chamber for restraining and controlling the rate of closure of said door, said chamber expanding upon opening said door and collapsing upon closure thereof, means providing a restricted venting passage for said hydraulic chamber, an electrically actuated valve for closing said venting passage when energized to prevent collapse of said chamber and to open said venting passage when deenergized, electric circuit means connected for energizing said valve to prevent escape of hydraulic fluid from said chamber to hold said door against closing under the influence of said biasing means and to deenergize said valve to permit said biasing means to collapse said chamber and close said door, and passage means for supplying hydraulic fluid to said chamber when said chamber is expanded by opening the door.

2. The door closer system of claim **1** in which the valve is adapted to be urged in the opening direction by fluid under pressure in said chamber and to be held closed by electrical energized means with a force great enough to seal said valve against the pressure developed by said biasing means, and in which forceful closing of the door is adapted by developing an excess of pressure in said chamber to overrule said electrically energized means and open said valve.

3. The door closer system of claim **2** in which the expansible and collapsible hydraulic chamber means is a piston and cylinder combination.

4. The door closer system of claim **3** in which said electric circuit means includes switching means adapted to deenergize said valve in response to a condition present in the event of fire.

5. The door closer system of claim **2** in which said electric circuit means includes switching means adapted to deenergize said valve in response to a condition present in the event of fire.

6. The door closer system of claim **1** in which the expansible and collapsible hydraulic chamber means is a piston and cylinder combination.

7. The door closer system of claim **6** in which said electric circuit means includes switching means adapted to deenergize said valve in response to a condition present in the event of fire.

8. The door closer system of claim **1** in which said electric circuit means includes switching means adapted to deenergize said valve in response to a condition present in the event of fire.

9. In a hydraulic door closer system, means for biasing a door toward closure, means providing an expansible and collapsible hydraulic chamber for restraining and controlling the rate of closure of said door, means providing a fitting for connecting said chamber forming means and said biasing means to a door to swing said door toward closed position under the influence of said biasing means as said hydraulic chamber is collapsed and to expand said hydraulic chamber as said door is swung toward open position, means providing a fluid venting passage leading from said hydraulic chamber, an electrically actuated valve for closing said fluid venting passage to prevent collapse of said chamber or alternatively to open said fluid venting passage depending upon the state of energization of said valve, and means providing a one way filling passage connected to said chamber and oriented to supply hydraulic fluid to said chamber when said chamber is expanded.

10. The door closer system of claim **9** in which the expansible and collapsible hydraulic chamber means is a piston and cylinder combination.

11. A system for holding a swinging door stationary in any desired position within its total arc of swing or optionally for closing said door comprising biasing means connected for tending to swing the door toward closed position, a hydraulic door check including a cylinder and piston combination and means defining a restricted passage to limit the rate of escape of fluid ahead of said piston in the door-closing direction of travel, associated with said biasing means to control the rate of closure of said door, valve means for closing said passage to prevent the flow of fluid therethrough, electrically energized valve operating means connected for preventing closing movement of the door or alternatively for freeing the door for closing under the influence of said biasing means depending upon the state of energization of said valve operating means, and electrical circuit means connected for oprationally energizing or de-energizing said valve operating means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,462 Dated October 10, 1972

Inventor(s) Paul W. Martin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 31, "Sometimes actuated bolts" should read -- Sometimes also, foot actuated bolts --. Column 2, line 7, "s" should read -- is --. Column 3, line 22, after "their" insert -- structure and use is well known and illustration of these --.

Signed and sealed this 3rd day of July 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

Rene Tegtmeyer
Acting Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
★ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.