Aug. 13, 1968 F. J. RUSSELL ETAL 3,396,424

DOOR CLOSER

Filed June 19, 1967 4 Sheets-Sheet 1

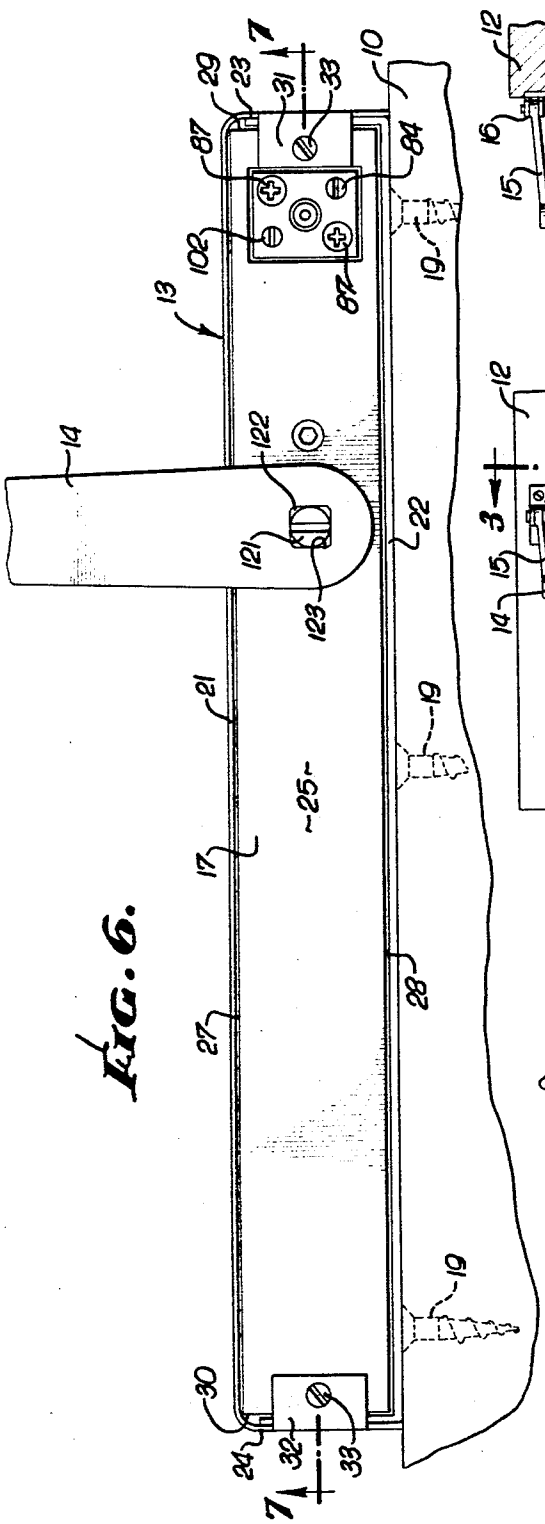

FIG. 6.

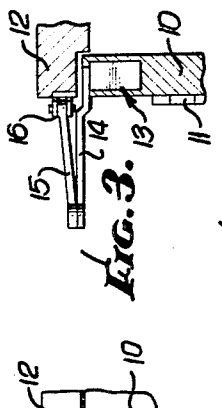

FIG. 3.

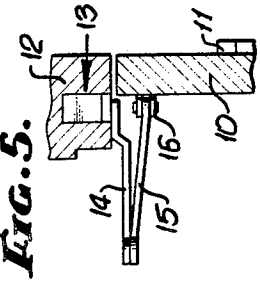

FIG. 5.

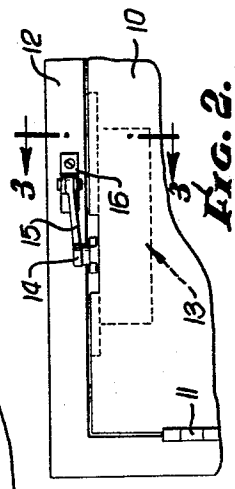

FIG. 2.

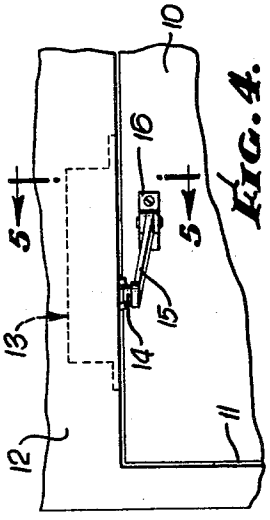

FIG. 4.

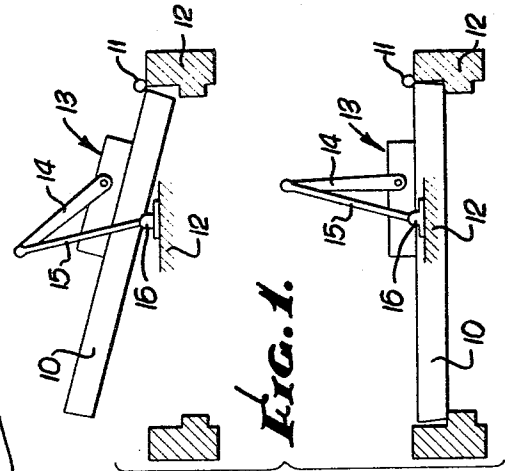

FIG. 1.

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DOOR CLOSER

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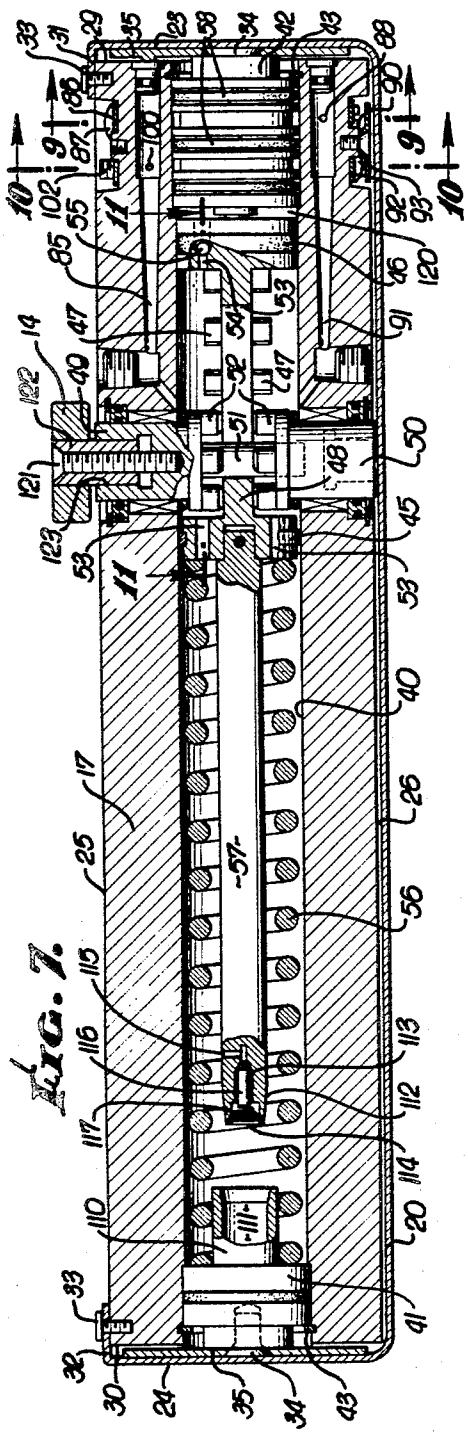

FIG. 7.

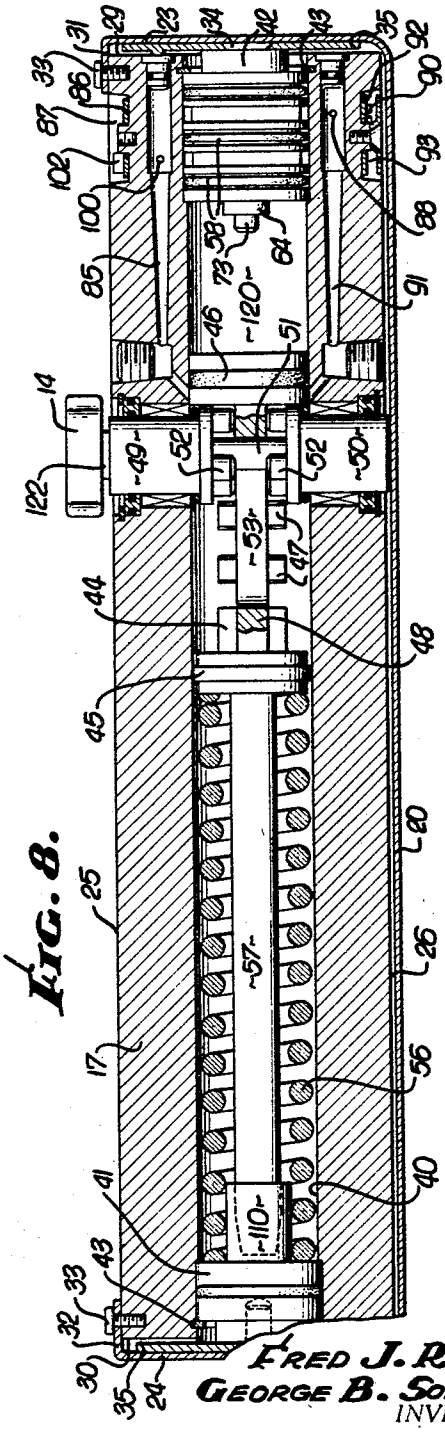

FIG. 8.

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DOOR CLOSER

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FIG. 9.

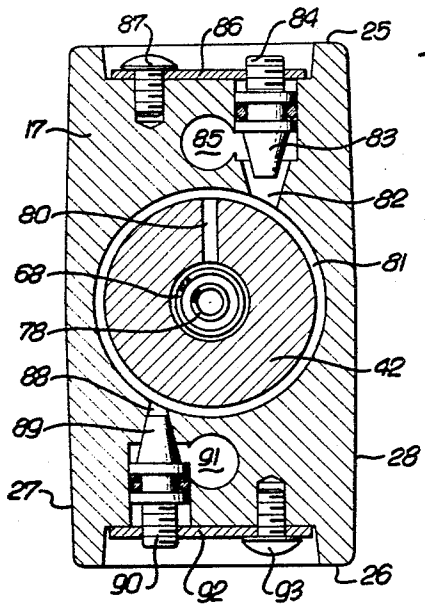


FIG. 10.

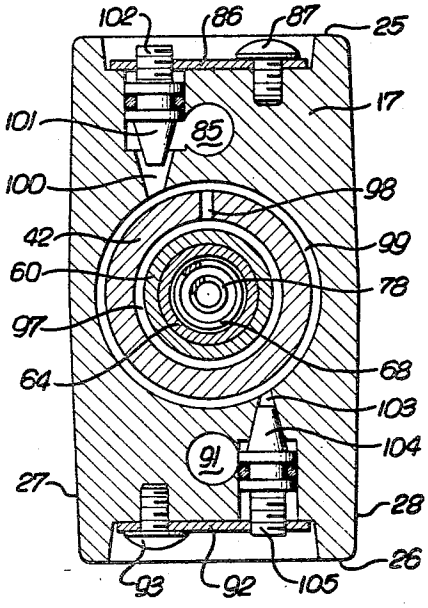


FIG. 7a.

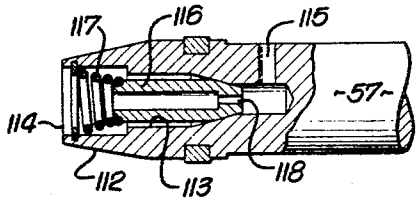
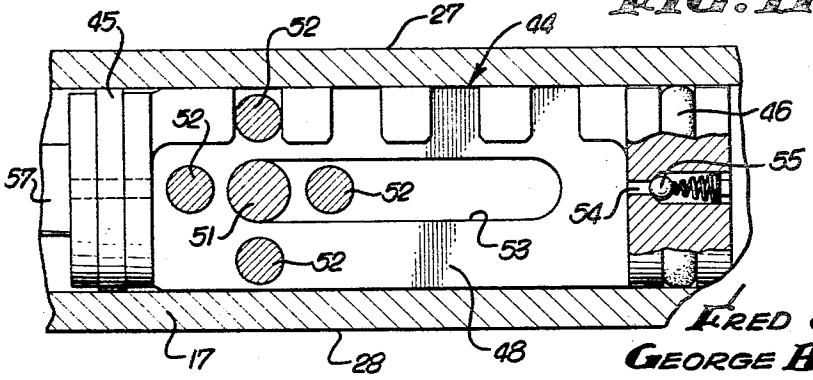


FIG. 11.



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DOOR CLOSER

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FIG. 12.

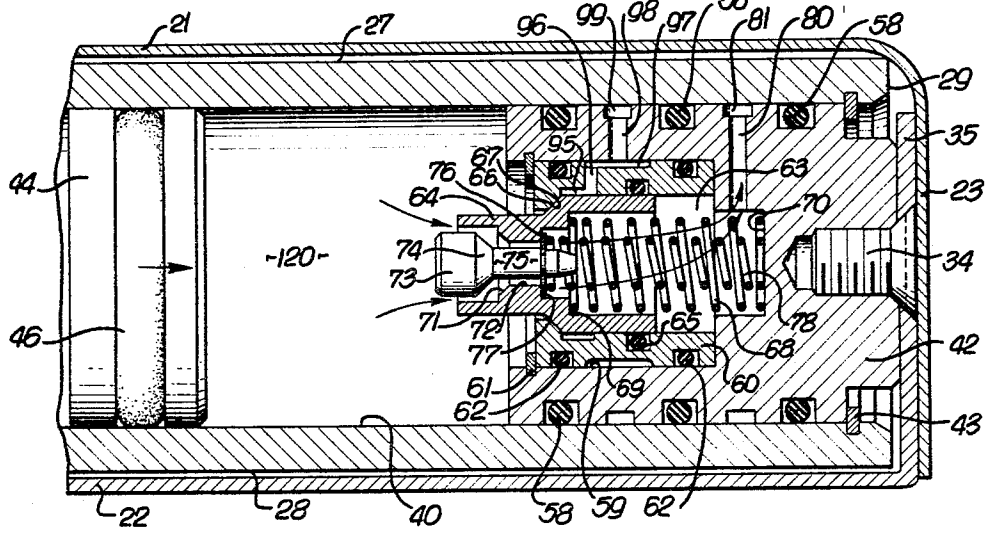
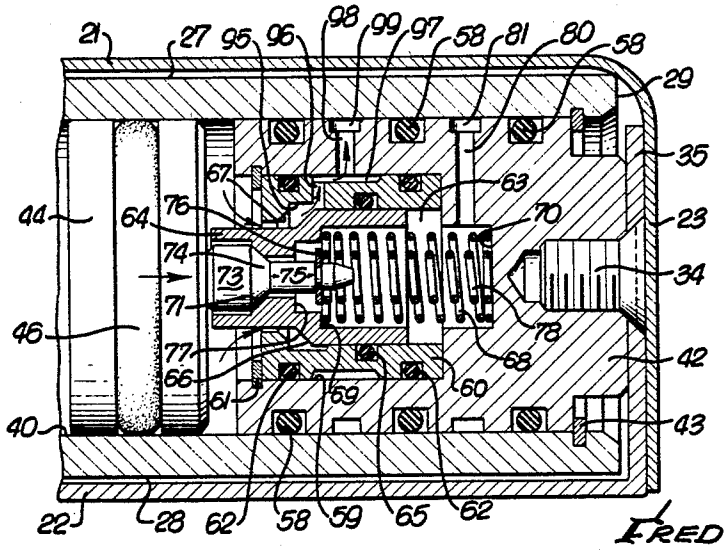


FIG. 13.



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3,396,424

DOOR CLOSER

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Filed June 19, 1967, Ser. No. 646,931
12 Claims. (Cl. 16—62)

ABSTRACT OF THE DISCLOSURE

The disclosure concerns a spring-actuated, hydraulically controlled door closer which has two different closing speeds. There is an initial controlled closing speed and a final controlled latching speed. Also included is a backcheck which operates at the full open swing of the door to prevent damage to the mechanism and which releases immediately when the door starts to close.

When the door is swung into open position, a drive element is moved against spring pressure, and hydraulic fluid filling the interior of the chamber passes freely from one side of the drive element to the other. When the door is released, the drive element is returned by spring pressure, but the hydraulic fluid is trapped on one side and forced to pass through a multiple valve device from which the fluid flows, first through an adjustable restriction and then through a bypass, back to the opposite side of the drive element. Initially, the hydraulic fluid passes through the inner of two concentric valve elements, while the other valve element is closed. As the door approaches a latching position, the drive element presses against the inner valve element, moving it to closed position, and, at the same time, moves a second valve element surrounding it to open position, thereby diverting the flow of hydraulic fluid through a second adjustable restricted passage. In addition to the fundamental phases of the operation, the structure is so constructed that it is readily reversible in position on a door to fit either right-hand swinging or left-hand swinging doors, without need for any substantial rearrangement of the parts.

Although door closers, namely control for governing the closing speed of a swinging door, have been in use for many years, they have been to a large degree rather bulky mechanisms which protrude appreciably from the door and the related door frame. Some of them are not reversible to accommodate doors of opposite swing. Some, which are intended to be capable of a reversible mounting, are of such inherent construction that the parts need to be rearranged appreciably in order to operate in an opposite direction. In addition, most of them contain a relatively large number of somewhat intricate parts which contribute unnecessarily to the cost, adjustment, and servicing.

Among the objects of the invention is to provide a new and improved door closer having more than one closing speed, so constructed that all speeds are readily adjustable from the exterior of the device, the adjustments being separate so that either speed can be adjusted independently of the other.

Another object of the invention is to provide a new and improved multiple speed, hydraulically controlled door closing device which has a simple, compact arrangement of moving parts and valves and restriction adjustments. The valves and adjustments are compactly arranged in one locality, readily adjustable, removable and interchangeable, and wherein moving parts, to which access is required from the exterior, are kept in a substantially flush arrangement with respect to the housing, so that the device is compact and easily mounted either on or in the door or the door frame upon which the door is mounted.

Still another object of the invention is to provide a new and improved multiple speed, hydraulically controlled door closing device which is provided with a safety, direct actuating backcheck which provides positive assurance against damage to the device in case the door is swung too violently to open position and which releases immediately upon release of the door, permitting the multiple closing operation of the closer to continue uninterruptedly and without disturbance.

Still further among the objects of the invention is to provide a new and improved multiple speed, hydraulically controlled door closing device wherein the parts are substantially concentrically and axially aligned so as to be capable of a simple, compact arrangement, thereby to minimize the number of parts, the manufacturing and assembly operations, and the adjustment and control.

With these and other objects in view, the invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims, and illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is an exploded view showing a right-hand bevel door mounted in a frame, with a door closer attached thereto, and showing the door in two positions of adjustment.

FIGURE 2 is a fragmentary elevational view of a door in a frame, showing a door closer mounted in the door itself.

FIGURE 3 is a transverse sectional view on the line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary elevational view of a door mounted in a frame and showing the door closer mounted in the frame and attached to the door.

FIGURE 5 is a transverse sectional view on the line 5—5 of FIGURE 4.

FIGURE 6 is a plan view of a fragment of door, showing the door closer mounted thereon and a fragment of the operating arm.

FIGURE 7 is a longitudinal sectional view on the line 7—7 of FIGURE 6, showing the position occupied by the parts when the door is closed.

FIGURE 7*a* is an enlarged fragmentary sectional view of the back check valving.

FIGURE 8 is a view similar to FIGURE 7, showing the position of the parts with the door in open position.

FIGURE 9 is a cross-sectional view on line 9—9 of FIGURE 7.

FIGURE 10 is a cross-sectional view on the line 10—10 of FIGURE 7.

FIGURE 11 is a fragmentary longitudinal sectional view on the line 11—11 of FIGURE 7.

FIGURE 12 is a fragmentary longitudinal sectional view, revealing the interior of the valve device with parts in the position occupied during initial closing swing of the door.

FIGURE 13 is a fragmentary longitudinal sectional view similar to FIGURE 12, showing the parts of the valve device in the positions occupied during the final latching movement of the door.

In an embodiment of the device chosen for the purpose of illustration, there is shown a door **10** mounted to swing on hinges **11** in a door frame **12**. In FIGURE 1, a door closer, indicated generally by the reference character **13**, is shown mounted directly upon the door **10**, with closing arms **14** and **15** so mounted that the closing arm **15** is attached by means of a bracket **16** to the door frame **12**. The door closer **13** is encompassed within a housing **17**, the housing **17**, in turn being contained by a casing **18**, with the casing **18** attached to a base plate **18'** which, in turn, is attached to the door **10** by means of screws **19**.

In the chosen embodiment, the casing **18** consists of a bottom **20**, respective front and rear side walls **21** and **22**, and end walls **23** and **24**.

The housing **17** is of generally rectangular shape in cross section, having edge surfaces **25** and **26**, side surfaces **27** and **28**, and end surfaces **29** and **30**. Lugs **31** and **32** on the casing **18** overlie the interior of the casing **18** and are attached to the housing **17** by means of screws **33**. Screws **34** extend inwardly through end portions **35** of the base plate **18'** to engage respective ends of the housing **17**.

Within the housing **17** is a longitudinally extending chamber **40**, closed at the left end, as viewed in FIGURES 7 and 8, by a sealing plug **41**, and at the right-hand end, as viewed in FIGURES 7, 8, 12, and 13, by means of a valve plug **42**. Snap rings **43** hold the plugs **41**, **42** in place.

Slidably mounted within the chamber **40** is a drive element **44**. Extending around one end of the drive element **44** is a wear ring **45**, and around the other end is a sealing ring **46**. A ratchet, consisting of ratchet teeth **47** on a central flange **48**, extends between opposite ends of the drive element **44**. Pinions **49** and **50**, in axial alignment and on opposite sides of the ratchet, are interconnected by means of a shaft **51**. Teeth **52** on the pinions **49**, **50** engage the ratchet teeth **47**. An elongated opening in the central flange **48** accommodates the shaft **51**. There are free flowing passages **53** at the left end of the drive element **44**, as viewed in FIGURE 7. At the right-hand end is a passage **54** in which is a check valve element **55** which closes toward the left, as viewed in FIGURE 7. A return spring **56** surrounds a plunger **57** on the drive element **44**. One end of the return spring **56** acts against the drive element **44**, and the other end of the return spring **56** acts against the sealing plug **41**.

Details of the valve structure are shown more particularly in FIGURES 12 and 13, wherein the valve plug **42** is shown held in position against the snap ring **43** by the screw **34** and wherein there is a series of O-rings **58** sealing the valve plug **42** in the end of the chamber **40**. Within the valve plug **42** is a recess **59** within which is located a sleeve **60**, held in place by means of a snap ring **61**. Smaller O-rings **62** at axially spaced locations seal the exterior of the sleeve with respect to the recess **59**. Within the sleeve **60** is a valve chamber **63**, and slidably mounted in the valve chamber **63** is an annular composite valve member **64**. An O-ring **65** provides a sliding engagement for the composite valve member **64**. An annular valve element **66**, forming part of the composite valve member **64**, is adapted to seat upon an annular valve seat **67** which is part of the sleeve **60**. A spring **68**, bearing against a shoulder **69** at one end and resting upon a bottom wall **70**, serves normally to bias the annular valve element **66** to seated or closed position. The composite valve member **64** additionally carries an annular valve seat **71** which opens into a port **72** communicating with the valve chamber **63**. A centrally disposed valve element **73** carries an annular valve **74** which is adapted to seat upon the annular valve seat **71**. A valve stem **75** extends through the port **72** and has fastened on its inner end an open spider **76** which bears against an appropriate shoulder **77**. To hold the valve element **73** in its proper position, a spring **78** of diameter smaller than the spring **68** bears at one end against the open spider **76** and at the other end against the bottom wall **70**, and is biased normally to urge the valve element **73** toward open or unseated position, as shown in FIGURE 12.

The valve chamber **63** is in communication with a passageway **80** which feeds into an annular recess **81** on the exterior of the valve plug **42**. By reference to FIGURE 9, it will be noted that the annular recess **81** is also in communication with a restricted passageway **82** in which is located a needle valve **83** adjustable by means of a screw **84** from the exterior. The restricted passageway **82** communicates with a bypass **85** which, in turn, is in communication with the chamber **40** at a location intermediate opposite ends of the drive element **44**, as shown to good advantage in FIGURES 7 and 8. A plate **86** fastened to the housing **17** by screws **87** serves as a mounting for the screw **84**.

On the opposite side of the housing **17** is a second restricted passageway **88** in which is a needle valve **89** adjustable in a similar fashion by means of a screw **90**. The restricted passageway **88** is adapted to communicate with a second bypass **91**, similar to the bypass **85** when the needle valve **89** is open. A similar plate **92**, held to the housing by screws **93**, serves to mount the screw **90**. In this way, one or another of the needle valves **83**, **89** can be adjusted to control flow from the valve chamber **63** into the respective bypass **85**, **91**.

Between the composite valve member **64** and the interior of the sleeve **60** is a secondary valve chamber **95**, as shown in FIGURES 12 and 13. This last identified secondary valve chamber **95** communicates with a passageway **96**, which in turn feeds into an annular recess **97** in the exterior of the sleeve **60**. Another passageway **98** communicates between the annular recess **97** and an annular recess **99** in the exterior of the valve plug **42**. From the annular recess **99**, there is a restricted passageway **100** which is adapted to communicate with the bypass **85**, past an adjustable needle valve **101**. On the needle valve **101** is a screw **102** mounted in the plate **86** and available from the exterior for adjusting the needle valve **101**. An alternate restricted passageway **103** on the diametrically opposite side of the housing **17** is adapted to communicate with the bypass **91** when an adjustable needle valve **104** is open. Forming part of the needle valve **104** is a screw **105**, mounted in the plate **92**, to which access can be had from the exterior for adjustment of the needle valve **104**. By this means, one or another of the needle valves **101** or **104** can be manipulated to adjust the restriction in the flow of hydraulic fluid from the secondary valve chamber **95** around the right-hand end of the drive element **44** back into the chamber **40**. The restricted passageways **100**, **103**, and accompanying needle valves **101**, **104**, and the restricted passageways **82**, **88** and accompanying needle valves **83**, **89** (all as previously described), provide the means for adjusting the different speeds at which the door is closed upon release.

To check the opening swing of the door, there is provided a backcheck device consisting of a cup **110** forming part of the sealing plug **41**, as shown in FIGURES 7 and 8, the cup **110** being provided with a piston chamber **111**, tapered at the outer end. At the adjacent end of the plunger **57** is a piston **112**, having a taper substantially corresponding to the taper at the entrance of the piston chamber **111** although smaller in diameter. A restricted bypass **113** communicates between an open end **114** of the piston **112** and a lateral passage **115** at the side of the plunger **57**. In the restricted bypass **113** is a restricted check valve element **116** held upon the adjacent valve seat by means of a spring **117**. The restricted check valve element **116** has a passage **118** therethrough, even when seated, so that when the piston **112** enters the piston chamber **111**, hydraulic fluid trapped in the piston chamber **111**, although damping and restricting the final movement of the plunger **57** by what is frequently described as a dashpot effect, does not completely trap fluid in the piston chamber **111**. In order to effectively break such partial vacuum as might be created when the plunger **57** starts to move in the opposite direction, a reverse flow through the lateral passage **115** and the restricted bypass **113** unseats the restricted check valve element **116**, moving it against tension of the spring **117**, thereby to open the restricted bypass **113** wider and to permit immediate release of the plunger **57** from the cup **110**.

In operation, let it be assumed that when the door **10** is in closed position, as suggested by the lower diagram of FIGURE 1, the drive element **44** will be in the position of FIGURE 13. As promptly as the door **10** is swung

toward open position, as suggested by the upper diagram of FIGURE 1, the drive element 44 proceeds to move in a direction from right to left, as viewed in FIGURES 7, 8, 12, and 13. As this motion progresses, there is created a pocket 120 at the right-hand end of the chamber 40. Hydraulic fluid, which entirely fills the chamber 40 between its opposite ends, readily flows through the passages 53 on the left-hand end of the drive element 44, thence past the intermediate portion of the drive element 44, and into the passage 54 at the right-hand end of the drive element 44, where the flow unseats the check valve element 55 and proceeds to fill the pocket 120. This continues for as long as the door 10 is moved in an opening-swinging position until the piston 112 and the plunger 57 enters the backcheck cup 110.

Following release of the door 10, tension built up in the return spring 56 during the opening motion takes over and proceeds to move the drive element 44 toward the right from a position like that illustrated in FIGURE 12. During initial movement of the drive element 44, as described, hydraulic fluid flows from the pocket 120, past the valve element 73 and annular valve seat 71, through the port 72, and into the valve chamber 63. From the valve chamber 63, the fluid flows outwardly through the passageway 80 and from there through the annular recess 81, into the restricted pasageway 82, and from there to the bypass 85, and ultimately back to the chamber 40 on the side of the check valve element 55 opposite from the pocket 120. Flow, as just described, is controlled by the needle valve 83, which can be adjusted as desired and in that way control the speed of closing of the door 10 as long as the valve element 73 remains unseated by pressure of its spring 78. Certain recommended specifications require a closing speed to continue up to a point within approximately five inches of closed position, after which a second speed becomes effective. Under the first adjustment, the door 10 closes smoothly and uniformly. Under the second adjustment the checking action is increased or decreased as desired until the door 10 is closed.

To accomplish this in applicants' device, the right-hand end of the drive element 44, as shown in FIGURES 7, 8, 12, and 13, is brought into engagement with the exposed end of the valve element 73 and continued movement of the drive element 44 moves the valve element 73 to the seated position of FIGURE 13, against tension of its spring 78. Continued movement of the drive element 44 thereafter moves the entire composite valve element 64 in a direction from left to right, as viewed particularly in FIGURES 12 and 13, against tension of the spring 68, thereby to effect unseating of the annular valve element 66 from its annular valve seat 67. The balance of the hydraulic fluid remaining in the pocket 120 then is forced to pass into the secondary valve chamber 95 through the passageway 96 to the annular recess 97, then to the passageway 98 into the annular recess 99, and finally into the restricted passageway 100, where the flow is restricted by the needle valve 101 before fluid enters the bypass 85, returning it to the chamber 40. The needle valve 101 can be set to vary restriction of flow of hydraulic fluid and in that way vary the final closing or latching motion of the door 10.

The valve adjustments and motion just described presume a swing of the door 10 as shown in FIGURE 1. Should the door 10 be mounted to swing from the opposite side, then the door closer should be reversed in its mounting and operation. To accomplish this, a screw 121 holding the closing arm 14 is withdrawn to release the closing arm 14 from the pinion 49. The closing arm 14 is then reapplied to the pinion 50 and the screw 121 used to hold it in its new association. A square projection 122 on the clossing arm 14 may be provided to fit in a corresponding square hole 123 in the respective pinion. In this way, the outer end of the pinion can be kept flush with the exterior of the housing 17.

The foregoing shifting in position of the closing arm 14 assumes that the housing 17 has been withdrawn from the casing 18. This is accomplished initially by withdrawing the screws 33 in order to permit the casing 18 to be slid free. Screws 34 then may be removed to the housing 17. The housing 17 can then be reversed, end for end, and rotated 180 degrees after which it is ready to be reapplied to the casing 18 to be secured in place by screws 34. Before reapplying the housing 17, however, the respective needle valves 83 and 101 must be closed, and the respective alternate needle valves 89 and 104 must be opened. In the new position, the needle valves 89 and 104 become accessible from the exterior without need for withdrawing the housing 17 from the casing 18 in order to readjust the closing speeds for the new mounting.

While the invention has herein been shown and described in what is conceived to be a practical and effective embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described the invention, what is claimed as new in support of Letters Patent is:

1. A multiple speed closer for door elements comprising a door and a frame, said closer comprising a housing having an axially extending chamber therein, a ratchet drive element slidably mounted in said chamber and having an initial position and a second position in the chamber, a seal between the wall of said chamber and the drive element, forming a reservoir for hydraulic fluid on one side of the drive element and a pocket for hydraulic fluid on the other side of the drive element a spring in said chamber acting between the drive element and the housing, a passage through the drive element communicating between said reservoir and said pocket and having a check valve therein providing outflow from said reservoir as said drive element moves toward said second position, a bypass around said check valve between said pocket and said reservoir, a multiple control device in communication with said pocket comprising a valve chamber in axial alignment with said drive element, said control device comprising a first restricted passageway between said pocket and said bypass having an adjustable restriction therein including a valve seat and a first reciprocating valve element for said seat yieldably biased to open position, said first valve element being responsive to movement by said drive element to closed position, a second restricted passageway between said pocket and said bypass having an adjustable restriction therein including a valve seat and a second reciprocating valve element on said last identified valve seat yieldably biased to closed position, said second valve element being responsive to movement by said drive element to open position simultaneously with movement of said first valve element to closed position, said restrictions being adjustable to different amounts, whereby the return stroke speed of said drive element from said second position thereof to initial position is changed from one speed to another.

2. A multiple speed closer according to claim 1, wherein one of said valve seats and the respective valve element is mounted upon and carried by the other valve element in concentric relationship.

3. A multiple speed closer according to claim 1, wherein there is a plug removably mounted in said housing and both valve seats and valve elements are mounted on said plug.

4. A multiple speed closer according to claim 1, wherein there is a pair of adjustable restrictions in each of said restricted passageways in parallel relationship, one adjustable restriction of each pair being accessible from one lateral side of the housing and the other restriction of each pair being accessible from the diametrically opposite side of said housing.

5. A multiple speed closer according to claim 1, where-

in said ratchet drive element has a ratchet thereon having elements extending in diametrically opposite directions, a drive pinion on each diametrically opposite side in operable relationship with portions of the ratchet elements, and a drive arm nonrotatably engageable alternatively with either of said pinions.

6. A multiple speed closer according to claim 1, wherein said ratchet drive element has a ratchet thereon having elements extending in diametrically opposite directions, a drive pinion on each diametrically opposite side in operable relationship with portions of the ratchet elements, each pinion having a female socket therein, and a drive arm nonrotatably engageable alternatively with the socket of either of said pinions.

7. A multiple speed closer according to claim 1, wherein there is an exterior jacket enclosing sides and ends of said housing, means for mounting said jacket on a door element, and means releasably securing said housing in said jacket in either direct or reverse position to accommodate respective right-hand and left-hand doors.

8. A multiple speed closer according to claim 1, including a backcheck device at the end of said chamber opposite said multiple control device, said backcheck device including a cup in said chamber, a plunger on said drive element having a piston thereon insertable in said cup when said drive element is at a location corresponding to open position for the door element, a restricted bypass in said piston between a portion thereof insertable in said cup and a portion thereof in communication with said chamber, a spring loaded restriction check element having a closed position while the drive element is moving to open position for the door element, and a released position upon reversal of movement of the drive element.

9. A closer for door elements comprising a door and a frame, said closer comprising a housing having an axially extending chamber therein, a ratchet drive element slidably mounted in said chamber and having an initial position and a second position in the chamber, a seal between the wall of said chamber and the drive element forming a reservoir for hydraulic fluid on one side of the drive element, and a pocket for hydraulic fluid on the other side of the drive element, a spring in said chamber acting between the drive element and the housing, a passage through the drive element communicating between said reservoir and said pocket and having a check valve therein providing outflow from said reservoir as said drive element moves toward said second position, a bypass around said check valve between said pocket and said reservoir, a control device in communication with said pocket comprising a valve chamber in axial alignment with said drive element, said control device comprising a restricted passageway between said pocket and said bypass having a restriction therein including a valve seat and a reciprocating valve element for said seat yieldably biased to open position, said valve element being responsive to movement by said drive element to closed position, whereby the return stroke speed of said drive element from said second position thereof to initial position is changed from one speed to another, said ratchet drive element having members extending in diametrically opposite directions, a drive pinion on each diametrically opposite side in operable relationship with said members of the drive element and a drive arm nonrotatably engageable with either of said drive pinions.

10. A closer for door elements according to claim 9, wherein each drive pinion has a female socket therein and said drive arm has a nonrotatable engagement with the socket of either of said pinions.

11. A closer for door elements according to claim 9, wherein there is an exterior jacket enclosing sides and ends of said housing, means for mounting said jacket on a door element and means releasably securing said housing in said jacket in either direct or reverse position to accommodate respective right-hand and left-hand doors.

12. A closer for door elements according to claim 9, including a backcheck device at the end of said chamber opposite said control device, said backcheck device including a cup in said chamber, a plunger on said drive element having a piston thereon insertable in said cup when said drive element is at a location corresponding to open position of the door element, a restricted bypass in said piston between a portion thereof insertable in said cup and a portion thereof in communication with said chamber, and a spring loaded restriction check element having a closed position while the drive element is moving to open position for the door element, and a released position upon reversal of movement of the drive element.

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