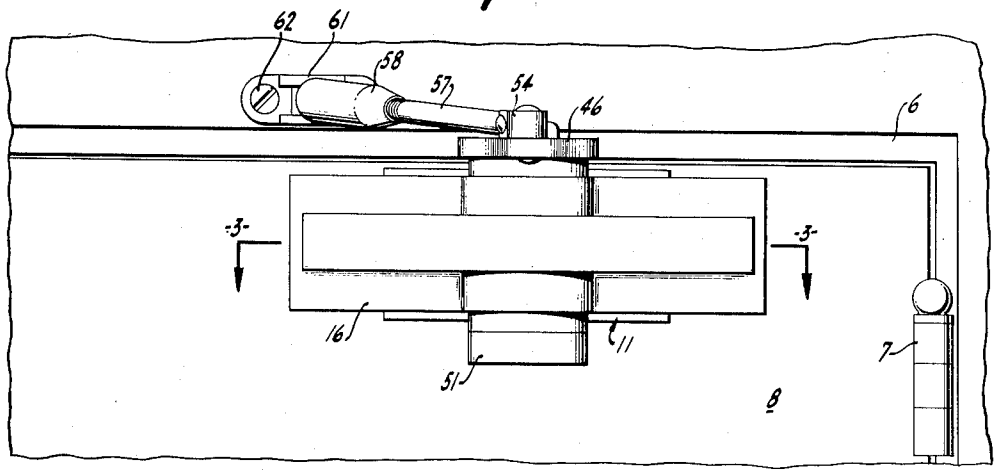
Nov. 15, 1955 E. L. SCHLAGE 2,723,416

DOOR CHECK AND CLOSER

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FIG. 1



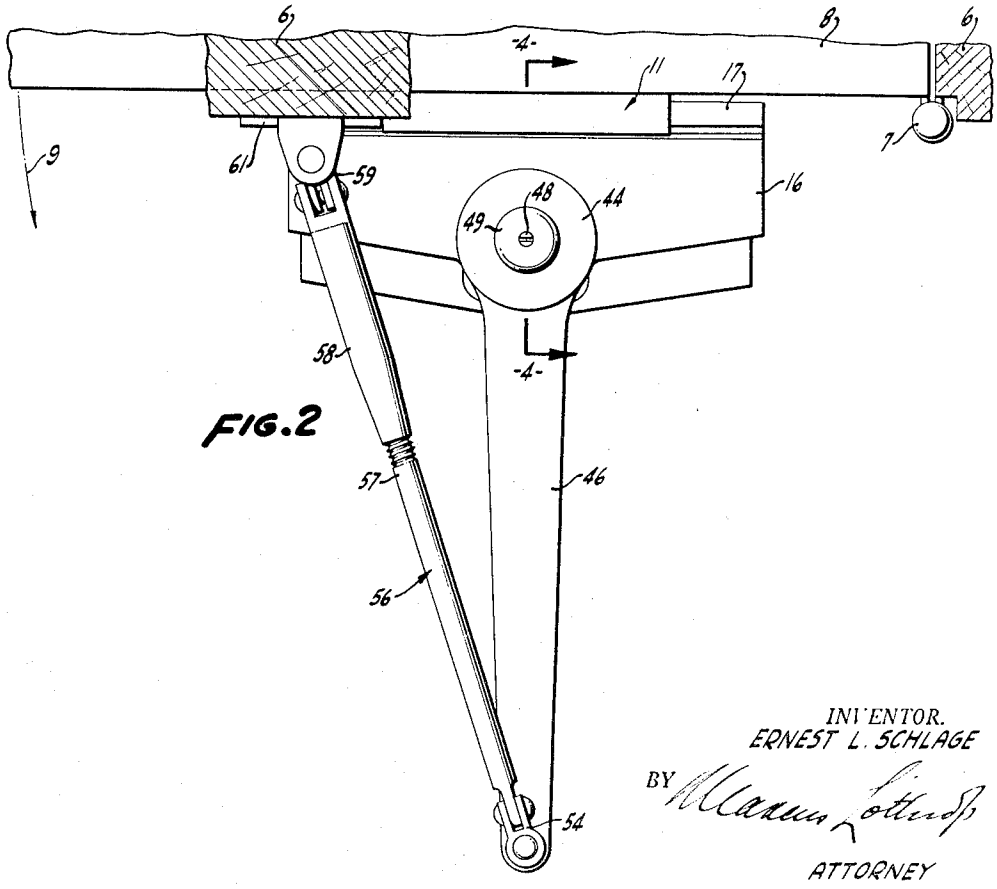


FIG. 2

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DOOR CHECK AND CLOSER

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FIG. 3

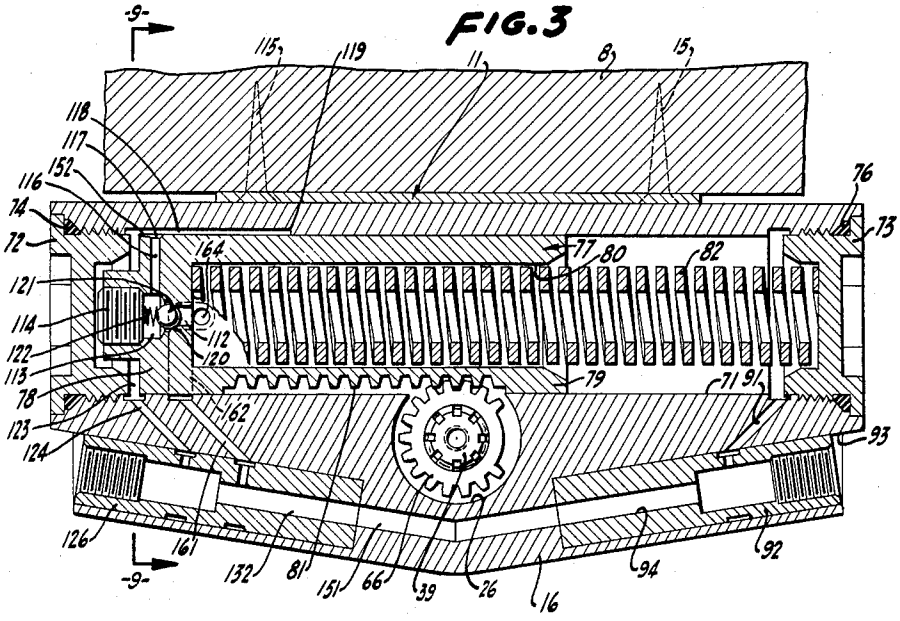


FIG. 4

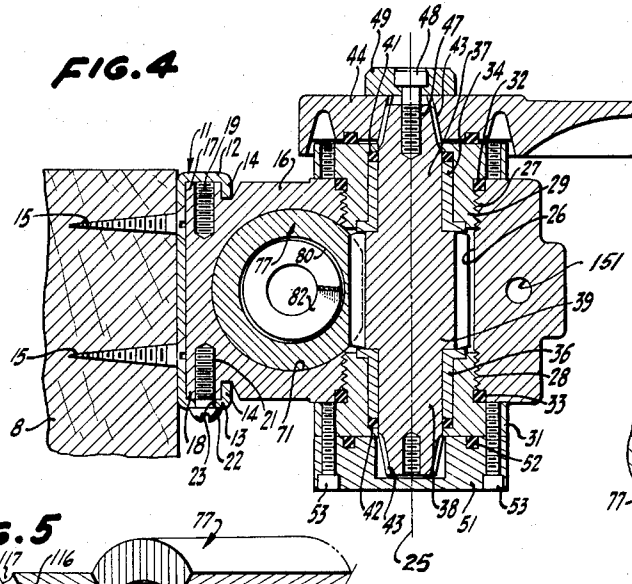


FIG. 5

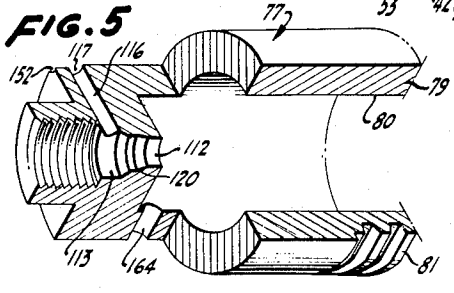
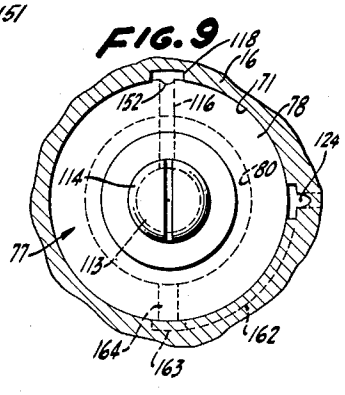


FIG. 9



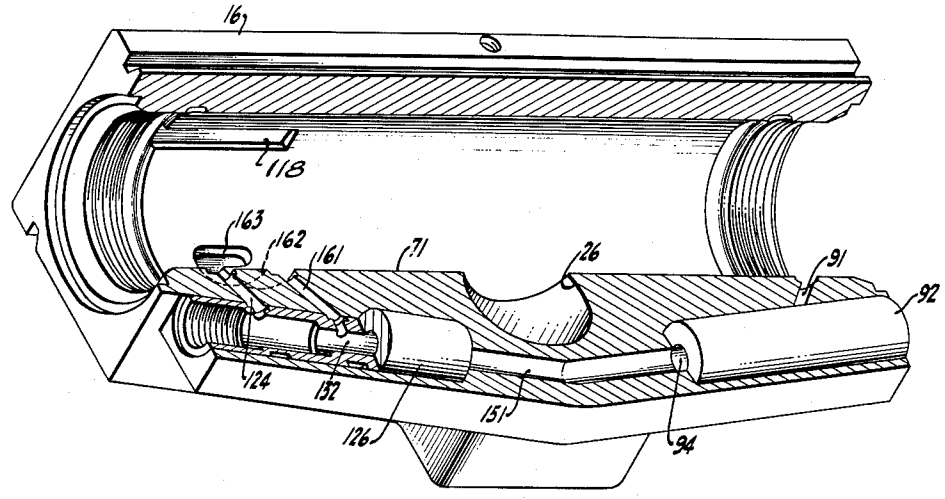
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Nov. 15, 1955 E. L. SCHLAGE 2,723,416

DOOR CHECK AND CLOSER

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FIG. 6



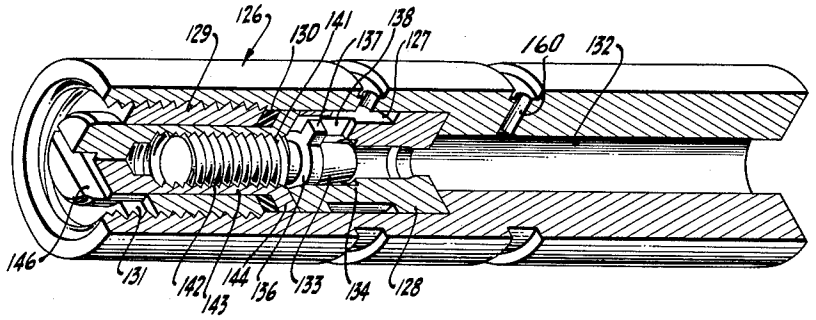


FIG. 7

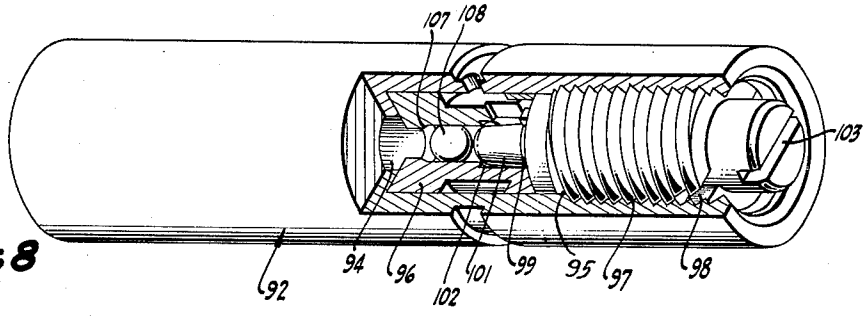


FIG 8

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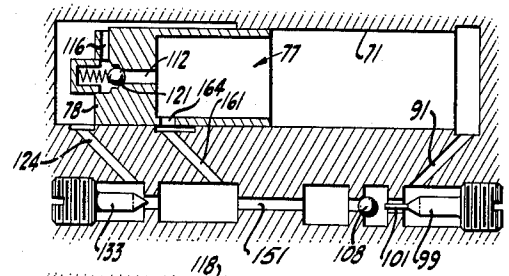


FIG. 10

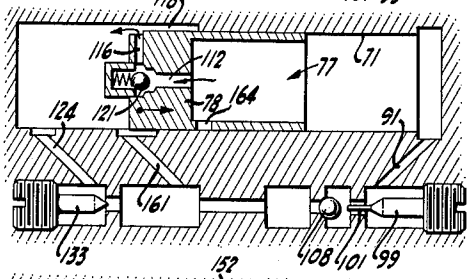


FIG. 11

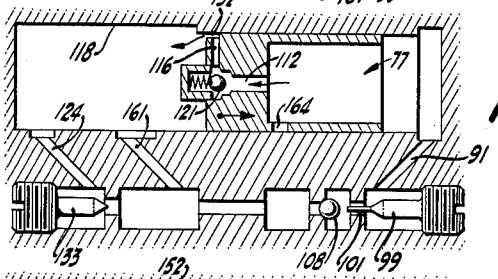


FIG. 12

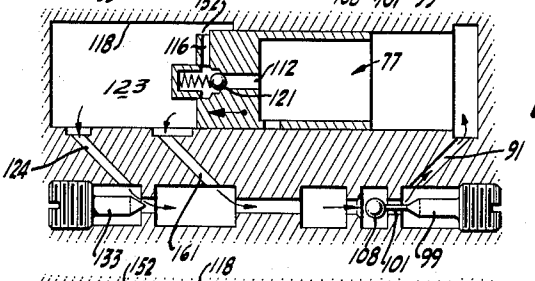


FIG. 13

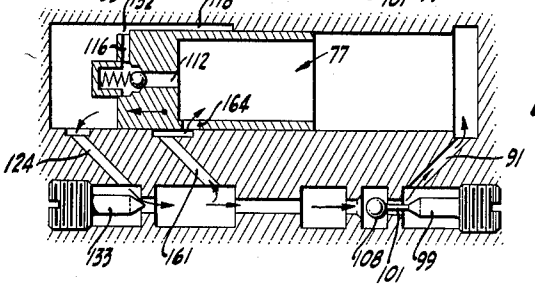


FIG. 14

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United States Patent Office 2,723,416 Patented Nov. 15, 1955

2,723,416

DOOR CHECK AND CLOSER

Ernest L. Schlage, Burlingame, Calif., assignor to Schlage Lock Company, a corporation

Application June 29, 1951, Serial No. 234,362

8 Claims. (Cl. 16—52)

My invention relates to means for controlling the movement of a door with respect to its mounting or casing both in the opening direction and in the closing direction and is particularly concerned with a device especially adapted for use on doors which require to be arrested in their motion toward extreme open and extreme closed positions and likewise require a mechanism for propelling the door toward closed position at a selected rate or rates after the door has been manually opened. Such a device is called a door closer herein although it also includes door checking functions.

It is an object of my invention to provide a door closer of generally improved characteristics.

Another object of my invention is to provide a door closer that can be installed on a right-hand or a left-hand door without difficulty.

Another object of my invention is to provide a door closer that will readily propel a door toward closed position yet will control the motion of the door throughout its travel and especially adjacent its latching location.

Another object of my invention is to provide a door closer effective to retard the movement of the door toward and near its extreme open position; that is, to provide a back check.

Another object of my invention is to provide a door closer that can readily be mounted at selected positions relative to the hinge axis in order to provide the desired moment arm.

A still further object of the invention is to provide a door closer free from leakage even though it utilizes a hydraulic fluid under pressure.

A still further object of the invention is to provide a door closer having means for readily varying the performance to suit the user.

A still further object of the invention is to provide a door closer that can be readily and economically manufactured.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawings, in which

Figure 1 is an elevation of a door closer installed upon a door, portions of the figure being broken away to reduce its size.

Figure 2 is a plan of the structure shown in Figure 1, a portion of the door frame being disclosed in cross section.

Figure 3 is a cross section, the plane of which is indicated by the line 3—3 of Figure 1.

Figure 4 is a cross section, the plane of which is indicated by the line 4—4 of Figure 2.

Figure 5 is an isometric view illustrating in both vertical and horizontal sections a portion of one end of the piston.

Figure 6 is an isometric view with parts broken away in sections on vertical and horizontal planes through the cylinder of the door closer.

Figure 7 is an isometric view, portions being broken out in section on vertical and horizontal planes showing a regulator mechanism and its attendant cartridge.

Figure 8 is an isometric view of another regulator cartridge having portion broken away to show sections on both vertical and horizontal planes.

Figure 9 is a cross section on the line 9—9 of Figure 3 through a portion of the main body.

Figure 10 is a diagram illustrating in cross section the position of the mechanism of the door closer when the door is closed and latched.

Figure 11 is a diagram similar to Figure 10 but showing the position of the mechanism as the door is undergoing an opening movement.

Figure 12 is a view similar to Figure 10 but with the door near its fully opened position and especially illustrating the function of back checking.

Figure 13 is a diagram similar to Figure 10 but showing the position of the mechanism as the door is undergoing the main part of its closing movement.

Figure 14 is a view similar to Figure 10 but showing the position of the mechanism as the door is in its latching position.

While the door closer of my invention can be embodied in a number of different ways depending upon the particular features which are to be emphasized and depending upon various constructional requirements, it has been successfully incorporated substantially as shown herein for installation in the usual environment. In these surroundings there is usually provided a stationary door frame **6** having one or more hinges **7** supporting a door leaf **8** for swinging movement in the direction of the arrow **9** in Figure 2 about the axis of the hinge from a closed position, as shown in Figures 1 and 2 toward an open position.

Mounted on the door leaf **8** is a mounting bracket **11**, preferably a metallic sheet member bent into the form of a channel having an upper run **12** and a lower run **13** defined by flanges **14** directed toward or to face each other. Suitable fastening devices, such as screws **15**, secure the channel to the door at an appropriate distance from the axis of the hinge **7** and with the channel flanges **14** substantially parallel to the top edge of the door.

The door closer includes a main body **16**, preferably of cast metal contoured with grooves to provide flanges **17** and **18** symmetrical about a horizontal plane and designed for sliding engagement endwise with the runs **12** and **13** of the mounting bracket. By this means it is possible for an installer easily to mount the channel **11** since it is light and readily handled. He need not be exact but can mount it only approximately at the appropriate distance from the hinge **7**. Then the body **16** is engaged in either upright or inverted position by endwise sliding within the channel so that the weight of the closer body is readily borne by the door. The closer body can then be carefully positioned in the channel in the exact location desired relative to the axis of the hinge **7**. Additionally, the body **16** can be varied in its distance from the hinge from time to time depending upon the performance required of the closer. The body **16** is provided with a pair of opposed tapped holes **19** and **21** into either of which a fastening screw **22** passing through a suitable aperture **23** in the lower run **13** may be engaged. The aperture is elongated so that the screw **22** can be clamped in any location desired within wide limits.

Since the mounting channel **11** is symmetrical about a horizontal plane, since the cooperating portion of the body **16** including the tapped holes is likewise symmetrical, the body **16** is readily installed either in its upright or in its inverted position, these terms being relative, so that the same closer is suitable for use either on a right-hand door or a left-hand door. Also, the same mounting technique can be used with the body **16** on the door frame as an alternative location. Furthermore, the body can

be arranged in a vertical direction with its "upper" portion on the right or on the left.

The body 16 is provided with a through bore 26 concentric with a generally vertical axis 25. At its opposite ends, the bore 26 is formed with threaded terminals 27 and 28 into which journal sleeves 29 and 31 are tightly screwed. Gaskets 32 and 33 preclude leakage at the intervening joint. The sleeves 29 and 31 carry anti-friction bushings 34 and 36 within which the journal portions 37 and 38 of a driving spindle 39 are mounted. Packing rings 41 and 42 are interposed to preclude leakage. The spindle 39 is symmetrical about a horizontal plane and is long enough to project at its opposite ends beyond the sleeves 29 and 31. The spindle is driven from one end only at a time although either end may be utilized alternatively. The spindle ends are finished with serrations 43 engageable with mating serrations in a hub 44 included in a driving arm 46 and are provided with tapped holes 47 to receive a fastening screw 48 for a washer 49. The arm 46 can be installed on one end of the spindle in any one of a number of rotated positions with respect to the spindle and is firmly held thereon by the positioning of the washer and of the screw. If the body 16 is installed in an inverted position with respect to the bracket 11, the same arm 46 is similarly located on and fastened to the other end of the spindle. The end of the spindle not in use at any one time is preferably closed by a cap 51 having an interposed packing 52 to preclude leakage and held in place by a number of machine screws 53.

The arm 46 is connected by an articulation 54 allowing several degrees of freedom to a pitman 56 preferably comprised of a pair of members 57 and 58 screwed together in order to afford a variable length for the pitman and to allow some rotational freedom. The end of the member 58 is provided with an articulation 59, also affording several degrees of freedom and carried by a bracket 61 connected by fasteners 62 to the frame 6 of the door.

By the provision of the foregoing mechanisms, there is afforded a mounting for a door closer at various distances from the hinge 7 in several senses of orientation, that is, upright, intermediate, or inverted, with various lengths of the pitman 56 and with an appropriate location of the bracket 61 with respect to the door frame. The entire assembly can be therefore mounted in any one of a number of selected positions and when mounted, is readily locked in the selected location by the screw 22.

In any of the several possible mountings, when the door leaf 8 is opened, the arm 46 is revolved and produces a corresponding rotation of the spindle 37 within and with respect to the body 16. This relative motion is utilized to afford the desired closing and checking functions.

Symmetrically disposed between the ends of the spindle and preferably formed integrally therewith is a pinion 66 having a full or preferably a partial set of gear teeth of a standard contour and at least of sufficient angular extent to be available for considerably more than a half turn rotation and for approximately three quarters of a turn rotation of the pinion.

Within the body 16 and partially intersecting the bore 26 is a transverse circular cylindrical bore 71. This bore extends entirely through the body 16 and is symmetrical with respect to the central horizontal plane of the body. The opposite ends of the bore 71 are closed by identical plugs 72 and 73 threaded into position and confining sealing rings 74 and 76 to preclude leakage. Designed to operate within the cylinder or bore 71 is a piston 77 having a head 78 at one end and formed with a skirt 79 defining a cavity 80 opening to the other end. Along one side, the piston skirt 79 is provided with a plurality of gear teeth 81 constituting a rack in engagement with the pinion 66 so that upon rotation of the pinion, the rack and the piston are correspondingly reciprocated. The piston, despite its motion, always overlies the bore 26 so that the bore 26 is isolated from the ends of the bore 71. A separate supply of lubricant always under atmospheric pressure can therefore be provided if desired, within the bore 26.

Normally, the piston is urged toward one extreme position by a helically coiled compression spring 82 formed of rectangular stock. The spring bears at one end on the plug 73, passes through the cavity 80 and at the other end bears against the head 78 of the piston 77. The strength of the spring 82 is sufficient to urge the door leaf 8 toward closed position against all ordinary forces which tend to oppose such closing movement. When the door is opened manually by the latch knob (not shown), the linkage is such that the piston 77 is translated toward the right (in Figures 3 and 11) and the spring 82 is compressed. When the door is released, the spring through the linkage impels the door toward closed position and is sufficiently forceful to move the door through its latching cycle into its fully closed location.

In order to control the movement of the door in both opening and closing directions, a body of hydraulic fluid, such as oil or an oil substitute, is disposed within the cylinder 71. This hydraulic fluid may be the same or a different material than that within the bore 26. The oil lies within the variable chambers at opposite ends of the cylinder partly bounded by the interposed piston, and only by leakage can flow into the bore 26.

At the right end of the cylinder 71 is a passageway 91 leading into a cartridge 92 cast within a duct 93 extending inwardly from the right end of the body 16. The cartridge 92, especially as illustrated in Figure 8, comprises a hollow body tightly gripped in position and having a central channel 94. An apertured seat 96 has a press fit in the cartridge and is sealed by a washer 95 clamped by a screw sleeve 97 having a diametrical slot 98 so that the sleeve can be firmly set up. A central adjusting screw 99 has a tapered needle 101 adapted to occupy a part of a throttling orifice 102 in the channel, depending upon the adjusted position of the needle. A sleeve 103 having an exposed screw driver slot provides a means for adjusting the needle. A suitable cap, not shown, can be threaded into the cartridge 92 to block access to the duct 93 once the needle is adjusted.

Additionally, the channel 94 is provided with a valve seat 107 spaced from the needle 101, to accommodate a ball check 108. The ball check in one extreme rests against the seat 107 and in the other extreme rests on the end of the needle 101. The ball is sufficiently small in diameter not to block the channel but to permit flow except when it is seated. With this arrangement, flow in one direction is permitted in an amount regulated by the position of the needle 101, but flow in the other direction is precluded.

When the piston 77 moves toward the right in an opening direction, it tends to displace oil from the contracting chamber at the right end of the cylinder 71. Any actual flow through the passageway 91 is prevented since any resulting pressure differential causes the ball 108 to seat and to block flow from the cylinder 71. It is impossible for the piston 77 in moving toward the right to displace liquid through the passageway 91.

If the liquid were completely trapped, the piston could not be moved toward the right. An escape is afforded in the head 78 of the piston by a central bore 112 leading to a chamber 113 closed by a screw plug 114 and leading through a radial conduit 116 to a port 117 on the margin or periphery of the piston 77. The port 117 opens into a longitudinal channel 118 extending for a part only of the length of the cylinder 71 and terminating abruptly at a predetermined point 119. A ball check 121 coacts with the seat 120 in response to differential pressure. In most cases a spring 122 augmenting seating pressure is interposed between the ball and the screw plug 114. The check 121 is effective to permit fluid flow during opening movement and to block flow during closing movement of the piston.

As soon as the piston 77 starts translational movement toward the right in an opening direction, the fluid in the right hand chamber, being unable to escape otherwise, rises slightly in pressure and unseats the ball 121 to open the passageway for hydraulic flow. The oil displaces through the passageway 116 into the channel 118 and then occupies a position on the other side of the piston head 78. It becomes a part of the body of oil within the head chamber 123 in the cylinder 71. This oil body extends also into a passageway 124 leading into a cartridge 126 suitably disposed within the body 16. Within the cartridge 126 the passageway opens into a space 127 formed as an external groove in a plug 128 having a press fit in the cartridge and sealed by a locking sleeve 129 abutting a packing 130. The sleeve is provided with a slot 131 so that it can be screwed tightly into position.

Flow from the channel 127 into a central passageway 132 is controlled by a needle 133 adapted to be variably spaced from a seat 134 formed in the plug 128 to vary the area of the aperture therebetween. The needle 133 is designed to translate without rotation and hence carries a ring 136 having a radial projection 137 thereon designed to slide in a longitudinal slot 138 formed in the plug 128. The remaining part of the needle body 133 is externally provided with threads 141, preferably left-handed, in engagement with similar internal threads 142 in an adjusting screw 143 seated within the sleeve 129 and carrying an abutting flange 144 adjacent the plug 128. An externally available screw driver slot 146 affords means for rotation of the member 143 to translate the needle body axially to open or close the orifice adjacent the seat 134. If desired, a suitable cap, not shown, can be engaged with the outermost ones of the threads over the sleeve 129 to mask the projecting end and the screw driver slot 146. In this fashion, the area available for flow through the passageway 132 is established. The passageway 132 communicates through the bore with a narrow passage 151 centrally disposed within the closer body and communicating with the passageway 94 so that there can be shunt flow from one end to the other of the cylinder 71 if this path is not otherwise blocked.

Since the only restriction on the flow relative to the piston during opening is the resistance of the various passages such as 112 and 116 near the ball check 121, and since this resistance is very small, there is virtually no retarding force imposed by the closer upon the door during the initial or principal opening movement. When the door has been opened for 90 degrees, approximately (although such value is not absolutely fixed), the passageway 116 comes near the end 119 of the channel 118. When the passageway 116 runs past the end of the channel 118; that is, when the port 117 completely overruns the end 119 of the channel, it is blanked or closed by the adjacent wall of the cylinder 71 and no more hydraulic flow through it is permitted. Under those circumstances, fluid is trapped within the right-hand end of the cylinder 71 and the door comes to an abrupt check or stop without possibility of further opening movement.

In accordance with my invention, I provide means for permitting further opening movement of the door but at an arrested rate. A very small notch 152 is provided in a longitudinal direction between the port 117 or the channel 116 and the end of the piston head 78. The size of this notch permits only a small liquid flow even though a substantial pressure difference across such notch exists. The effect of this structure is to check promptly the rapid opening movement of the door after the port 117 has been otherwise blanked off. Since flow can continue through the notch at a slow, regulated rate, the door decelerates into its open position. If the door is flung open rapidly, it is checked or substantially so, say between the 90 degree position and the 130 or 140 degree position, depending upon the length of the channel 118 and the size of the notch 152. After the door has reached equilibrium, the spring 82 becomes dominant and the door starts toward its closed position.

When the closing movement begins, the reversed movement of the piston 77 reverses the direction of the pressure differential immediately. This causes the check 121 to seat and to block flow into the right-hand chamber from the chamber 123 through the orifice 120. Since, however, the tendency of the piston is to increase the pressure of the fluid within the chamber 123, flow occurs through the passage 124 and past the restricted seat 134 into the shunt passage 151. A parallel flow also occurs through a passageway 161 communicating with the chamber 123 at some distance from the plug 72 and communicating directly through a passage 160 with the passageway 132. The amount of oil coming through the substantially unrestricted passage 161 is greater than that coming through the restricted passage 124, but both flows combine in the passageway 151 to unseat the ball 108 and to lodge it against the end of the needle 101. The combined flow around the ball is checked only by the orifice around the needle 101 since the return is then through the passageway 91 into the chamber at the right hand end of the cylinder 71. The return movement of the door for the most part is thus regulated by the particular position of the needle 101 and that is adjusted to suit the installation and the user.

As the door approaches its final closing or latching position, the edge of the piston head 78 overrides the opening into the passageway 161 and cuts off that egress for the fluid from the chamber 123. The passage 124 is still open so that the last part of the flow is solely past the needle 133 and through the orifice 134. The latching or final closing movement of the door is thus regulated by adjustment of the area of the orifice 134.

The area for flow through the orifice 134 can be set at a value greater than the value selected for flow through the orifice 102. In that case, the needle 133 is substantially ineffective and the desired regulation cannot occur. The shunt passageway 161 performs an additional function and is utilized as an escape path under these conditions. The passageway 161 communicates with a partial peripheral groove 162 cut in the body and opening throughout substantially a quadrant into the chamber 123, when the piston is partly retracted. The end of the channel 162 merges with a longitudinal channel 163 located so as to register with an aperture 164 cut through the wall of the piston 77 and opening into the cavity 80.

During the final closing movement of the door, after the piston head 78 has cut off the passageway 161 from the chamber 123, communication is still possible with the cavity 80. Flow occurs through the passageway 124 past the orifice 134 and then outwardly from the cartridge through the shunt passageway 161. It then continues through the channel 162 and the channel 163 and finally through the port 164 onto the low pressure side of the piston. The position of the needle 133 therefore establishes the final latching speed of the door independently and without relationship to the position of the needle 101.

The length of the groove 163 and the position of the aperture 164 govern the path or paths of the fluid around the piston. They can be arranged to cut off the groove 162 prior to or after registry of the port 164 with the groove 163. The groove can be made long enough directly to shunt the piston with flow between opposite sides thereof through the port 164.

In accordance with my invention therefore, I have provided an improved door closer which attains the objects of the invention.

What is claimed is:

1. A door closer comprising a body having a cylindrical bore therein, a piston reciprocable in said bore and dividing said bore into chambers, a gear rack incorporated in said piston, a pinion shaft journalled in said body, a gear on said pinion shaft meshing with said

rack, connections for relatively moving said body and said pinion shaft in accordance with the relative movement of a door and door frame, closures on said body for both ends of said bore, a spring interposed between one of said closures and said piston, a head on said piston having a passage terminating at one end in an opening into one of said chambers and terminating at its opposite end in a radially outwardly directed opening in one side of said piston, there being a groove in said bore registering with said side opening and communicating with the other of said chambers, a check valve in said head for opening and closing said passage, and a conduit in said body communicating with said chambers.

2. A door closer comprising a body having a cylindrical bore therein, a piston reciprocable in said bore and dividing said bore into chambers, connections for relatively moving said body and said piston in accordance with the relative movement of a door and door frame, closures on said body for both ends of said bore, a spring interposed between one of said closures and said piston, a head on said piston having a passage terminating at one end in an opening into one of said chambers and terminating at its opposite end in a radially outwardly directed opening in one side of said piston, there being a groove in said bore registering with said side opening and communicating with the other of said chambers, a check valve in said head for opening and closing said passage, and a conduit in said body communicating with said chambers.

3. A door closer comprising a body having a cylindrical bore therein, a piston reciprocable in said bore and dividing said bore into chambers, connections for relatively moving said body and said piston in accordance with the relative movement of a door and door frame, closures on said body for both ends of said bore, a head on said piston having a passage with an opening into one only of said chambers and with an opening onto one side of said piston, there being a groove in said bore registering with said side opening and communicating with the other of said chambers, and there being a notch in said head opening into said passage and into said other chamber.

4. A door closer comprising a body having a cylindrical bore therein, a piston dividing said bore into chambers and reciprocable in said bore with a predetermined stroke, connections for relatively moving said body and said piston in accordance with relative movement of a door and door frame in amounts up to said predetermined stroke, closures on said body for both ends of said bore, a head on said piston having a passage with an opening into one only of said chambers and with an opening onto one side of said piston, there being a groove in said bore registering with said side opening for part only of said predetermined stroke, and there being a notch in said head opening into said passage and into said other chamber, and a check valve in said head controlling flow through said passage.

5. A door closer comprising a mounting channel having parallel facing flanges, a body having a cylindrical bore therein and having parallel longitudinal grooves for slidably receiving said flanges, means for holding said body against sliding movement with respect to said channel, a piston reciprocable in said bore and dividing said bore into chambers, means for damping fluid flow between said chambers, a shaft projecting at both ends from said body, means for transmitting motion between said piston and said shaft, and connections engageable with either one of said ends for relatively moving said body and said shaft in accordance with the relative movement of a door and door frame, said means for holding said body comprising a fastener carried by said channel and releasably securing one of said flanges to said body.

6. A door closer comprising a body having a cylindrical bore therein, a piston reciprocable in said bore and dividing said bore into chambers, a conduit in said body establishing communication between said chambers, a first cartridge in said conduit, said first cartridge having a first axially disposed orifice therein, a first needle valve in said first cartridge for controlling flow through said first orifice, a second cartridge axially disposed in said conduit and having a second orifice therein, a second needle valve in said second cartridge for controlling flow through said second orifice, and a check valve in said first cartridge for blocking flow therethrough in one direction.

7. A door closer comprising a body having an elongated cylindrical bore therein, a piston reciprocable in said bore and dividing the same into chambers, connections for relatively moving said body and said piston in accordance with the relative movement of a door and door frame whereby said piston moves toward one of said chambers when the door is opening and moves toward the other of said chambers to compress the liquid therein when the door is closing, a head on said piston arranged to prevent axial movement of liquid therethrough, a passageway in said head communicating at one end with said one chamber and at its opposite end with a radially outwardly directed opening in the peripheral sidewall of said piston, said bore being provided with a groove registering with said opening and communicating with said other chamber, a check valve intermediate the ends of said passageway for closing the same when said door is closing and for opening said passageway when said door is opening.

8. A door closer comprising a body having an elongated cylindrical bore therein, a piston reciprocable in said bore and dividing the same into chambers, connections for relatively moving said body and said piston in accordance with the relative movement of a door and door frame whereby said piston moves toward one of said chambers when the door is opening and moves toward the other of said chambers to compress the liquid therein when the door is closing, a head on said piston arranged to prevent axial movement of liquid therethrough, a passageway in said head communicating at one end with said one chamber and at its opposite end with a radially outwardly directed opening in the peripheral sidewall of said piston, said bore being provided with a groove registering with said opening and communicating with said other chamber, a check valve intermediate the ends of said passageway for closing the same when said door is closing and for opening said passageway when said door is opening, the travel of said piston being sufficient to move said radially outwardly directed opening out of registration with said groove when said door is fully open.

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