

Sept. 18, 1962

E. L. SCHLAGE ETAL

3,054,136

DOOR CLOSER

Filed Oct. 6, 1958

4 Sheets-Sheet 1

FIG_1

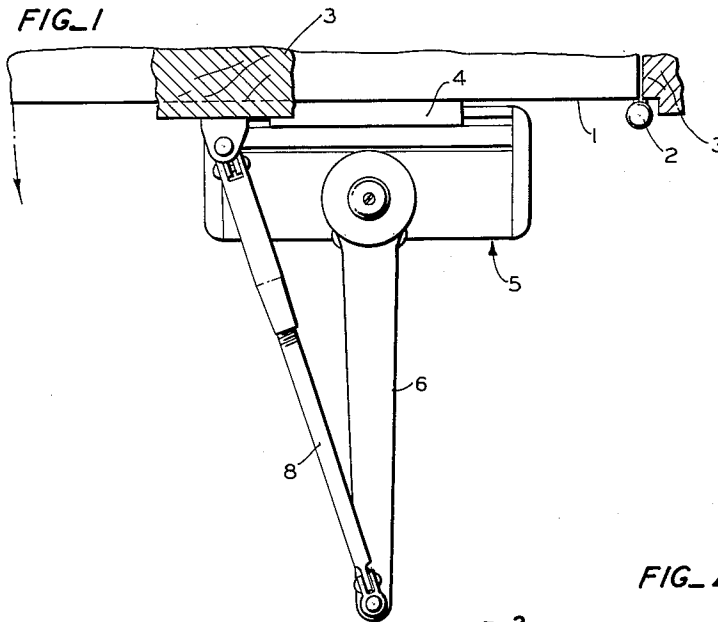


FIG_2

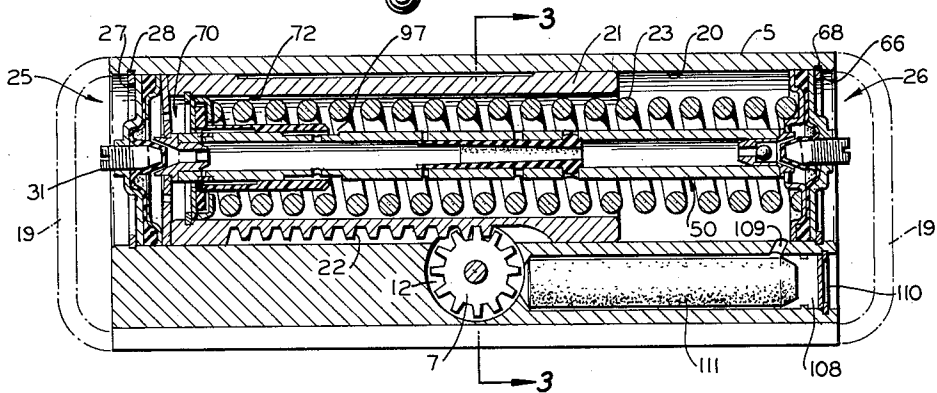
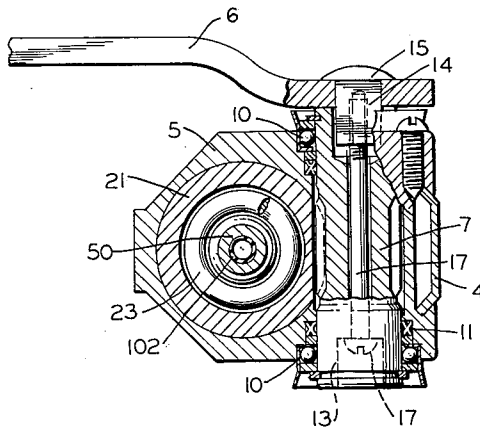


FIG_3



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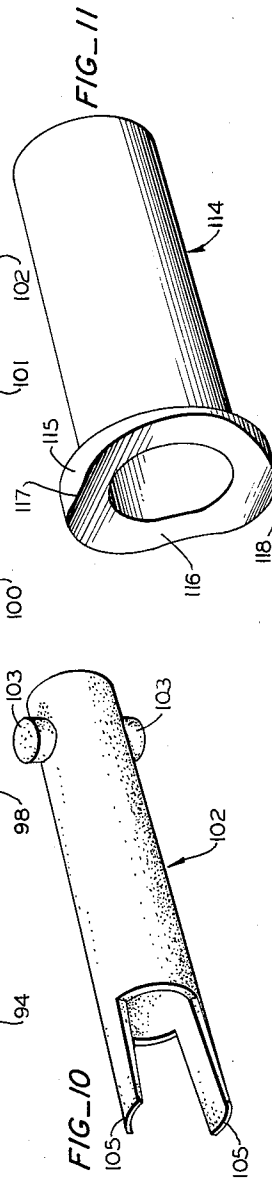
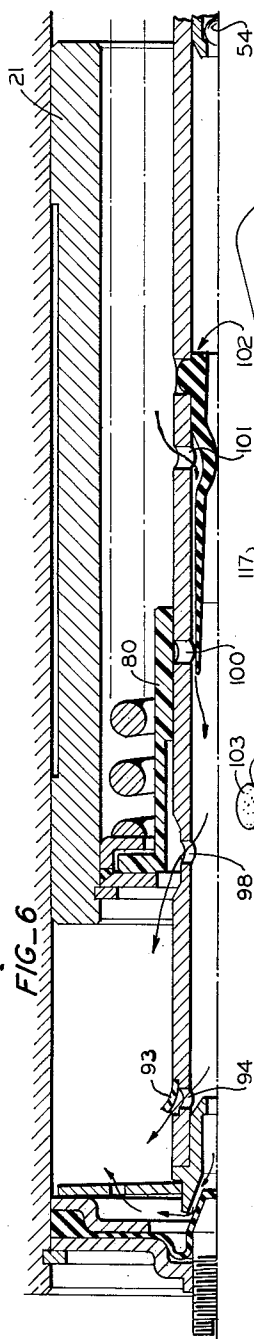
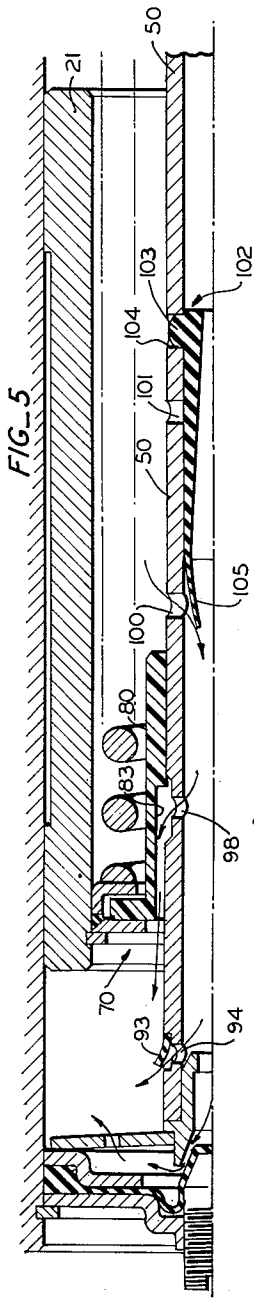
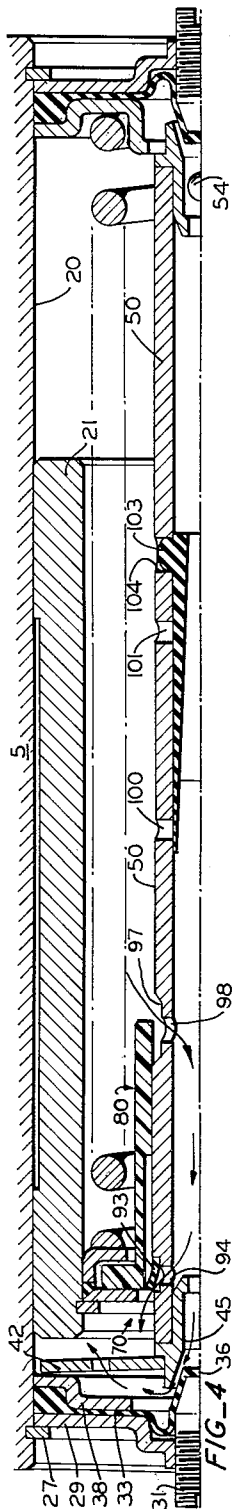
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4 Sheets-Sheet 2



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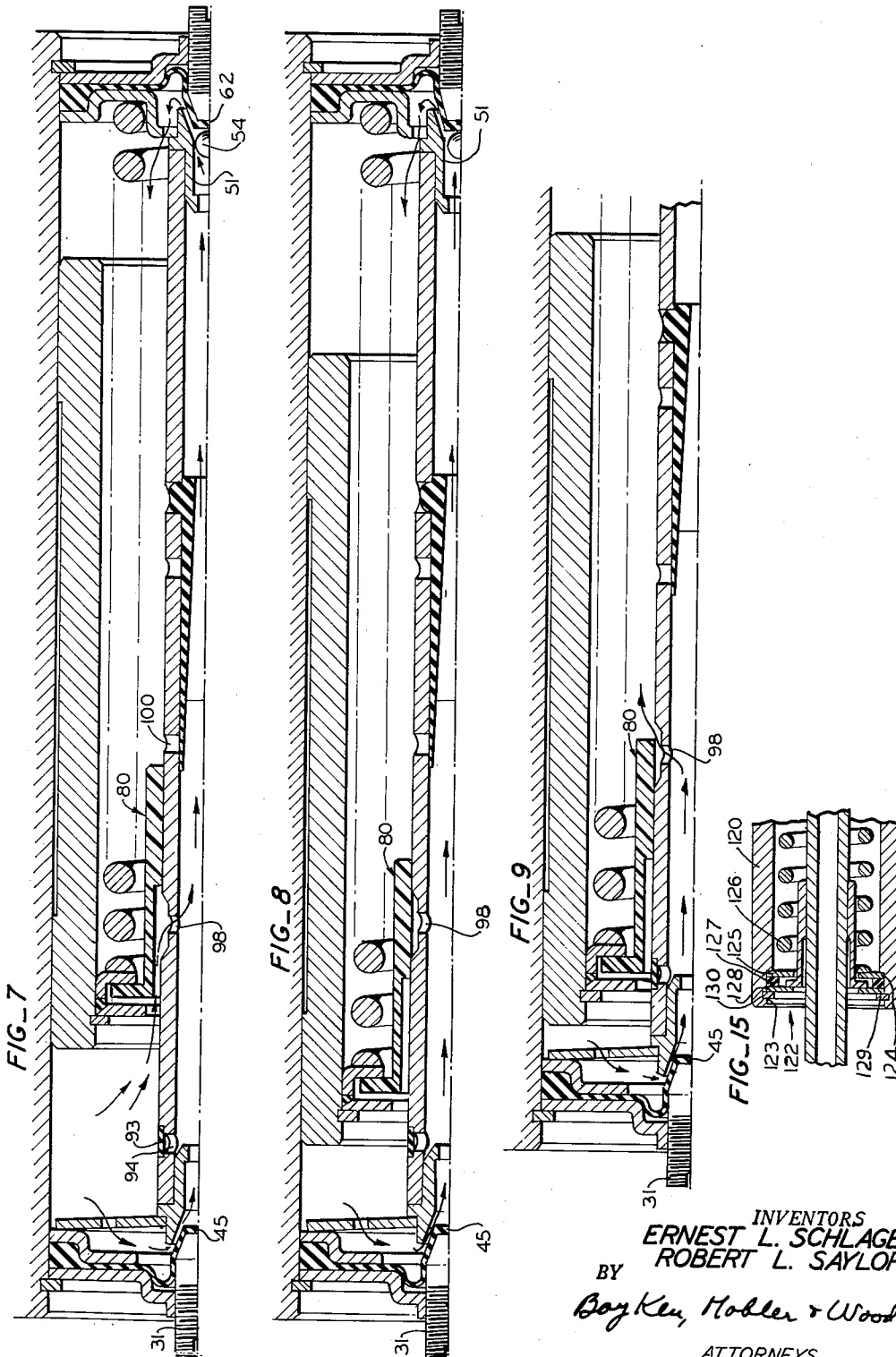
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4 Sheets-Sheet 4

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3,054,136

DOOR CLOSER

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13 Claims. (Cl. 16—62)

This invention relates to a door closer for controlling the opening and closing movement of a door with respect to its mounting or casing. The invention also contemplates the provision of a door closer having certain checking functions.

The main object of the invention is the provision of an improved door closer which is relatively inexpensive to make and assemble, and which incorporates all of the features that exist in more expensive devices of like nature.

Another object of the invention is the provision of a simple door closer that is rugged and dependable in construction.

Still another object of the invention is the provision of a door closer that lends itself to use with either left or right-hand doors.

Yet another object of the invention is the provision of a door closer in which the speed of closing at latching position is adjustable.

Another object of the invention is the provision of a door closer of simple design that is effective in preventing leakage of the oil therefrom.

Another object of the invention is the provision of a novel adjustable valve means in a door closer to permit variations in the performance to suit the particular installation.

Other objects and advantages will be apparent from the following specification and from the drawings.

FIG. 1 is a top plan view of a typical installation of the door closer of the present invention.

FIG. 2 is a longitudinal cross section of the door closer.

FIG. 3 is a vertical cross section of the door closer as taken along lines 3—3 of FIG. 2.

FIG. 4 is a semischematic fragmentary longitudinal section of the door closer showing the position of parts and indicating the flow of oil at the start of the opening movement of the door.

FIG. 5 is a view similar to FIG. 4 with the door opened to a greater extent.

FIG. 6 is a view similar to FIG. 4 with the door in a widely open position.

FIG. 7 is a view similar to FIG. 4 during the first phase of the closing movement of the door.

FIG. 8 is a view similar to FIG. 4 at a farther point in the closing movement of the door.

FIG. 9 is a view similar to FIG. 4 during latching movement of the door.

FIG. 10 is a perspective of the flap valve.

FIG. 11 is a perspective of a modified form of the piston valve.

FIG. 12 is an exploded sectional view of the elements of the left-hand head of FIG. 2.

FIG. 13 is an exploded view of the piston valve and head.

FIG. 14 is an exploded sectional view of the elements of the right-hand head of FIG. 2.

FIG. 15 is a fragmentary longitudinal view showing a modified form of piston head.

In detail, and with reference to FIG. 1, the door closer in its typical installation is mounted on a door 1 supported by hinges 2 on a door frame 3.

A suitable bracket 4 is employed to secure the door closer body or housing 5 to said door 1. The usual linkage includes an arm 6 secured at one end to the pinion 7 (FIG. 3) of the door closer and at its other end to the

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outer end of a link 8 which in turn is secured at its inner end to the frame 3 of the door.

As best seen in FIGS. 2, 3 the pinion 7 extends transversely through the housing 5 of the door closer and is rotatably supported at its opposite ends in bearings 10. Seals 11 are provided to prevent the escape of oil from the pinion chamber 12. The ends of pinion 7 are identical and each is formed with a square recess 13 for receiving therein the square shank 14 of a headed pin 15 which in turn extends through a square hole in arm 6 and is secured to the pinion 7 by a relatively long screw 17 (FIG. 3) extending axially through the pinion 7 from the opposite end thereof.

The above described structure permits the door closer to be installed on either right or left hand doors because of the symmetrical form of pinion 7.

Referring now to FIG. 2 the housing 5 is provided with an axially extending through bore 20 in which is reciprocally received a hollow piston 21 which is formed along one side with a rack 22 meshing with pinion 7. The arrangement of the door closer is such that upon opening movement of the door the pinion 7 rotates and translates the piston 21 from left to right as seen in FIG. 2. A compression spring 23 acts to urge the piston 21 to the left at all times as will be pointed out in detail later on.

The opposite ends of bore 20 are closed by left and right-hand heads generally designated 25 and 26 respectively. These heads are substantially identical except for certain minor differences to be hereinafter explained. Decorative cover plates 19 indicated in dotted lines in FIG. 2 may be secured to the ends of body 5 if desired.

Head 25 comprises a split retainer ring 27 (FIG. 12) preferably of spring steel which may be snapped into a complementarily formed radially inwardly opening groove 28 (FIG. 2) formed in housing 5 at the left-hand end of bore 20 (FIG. 2).

Received within bore 20 in abutment with retainer ring 27 is an end plate 29 (FIG. 12) provided with an axially outwardly projecting central portion 30 which in turn is centrally apertured and threaded to receive an adjustment screw 31.

Bearing against end plate 29 is a diaphragm seal 33 which includes an enlarged peripheral portion 34 which is relied on to prevent escape of oil from bore 20. Adjacent its central portion seal 33 is provided with an annular convolution 35 adapted to fit within the inwardly opening recess formed by the central portion 30 of end plate 29. The central portion 36 of seal 33 is formed complementarily to the inner end of adjustment screw 31 so that said central portion, as influenced by the position of screw 31, acts as a valve stem in a manner that will subsequently be understood.

A seal retainer 38 is applied against the opposite side of seal 33 from end plate 29 so that said retainer and said plate cooperate to compress seal 33 therebetween and urge the peripheral enlarged portion 34 of said seal outwardly into sealing engagement with bore 20 of housing 5. To this end retainer 38 is formed complementarily to seal 33 except that it is provided with a central aperture 39 for receiving therein the central valve portion 36 of seal 33.

In order to impress an axially directed compressive load on the seal 33 a spring steel washer 42 is provided. This washer is formed to a shallow conical shape so that axial pressure is applied on retainer 38 adjacent the periphery of bore 20 to afford effective compression of seal 33.

Washer 42 is provided with a central aperture 43 that is adapted to receive therein one end of a hollow valve seat member generally designated 45. Said member 45 is generally cylindrical and is provided with a radially outwardly extending annular flange 46 for abutting the

central portion of the washer 42 (FIG. 2). Member 45 flares outwardly at its end adjacent washer 42 to provide a valve seat 47 formed complementary to valve portion 36 of seal 33. At this point it may be noted that passage of oil through member 45 may be effectively regulated by turning adjusting screw 31 to move valve portion 36 axially relative to valve seat 47.

Extending between heads 25, 26 of the body 5 is an elongated tube 50 which is adapted to snugly receive within its left hand end a portion of valve seat member 45. Tube 50 butts against the side of annular flange 46 opposite the washer 42 so that said tube is firmly anchored relative to the washer 42.

By the above structure it can be seen that oil may pass from the tube 50 through the valve seat member 45 and into the left hand end of the cylinder (FIG. 2). Control of the rate of such flow is effected by means of adjusting screw 31. Oil may pass from one side to the other of washer 42 through an annular row of holes 48 in said washer.

The right hand end of door closer body is provided with substantially the same type of structure as the left hand end. In other words heads 25, 26 are similarly assembled from substantially the same elements.

A valve seat member 51 (FIG. 14), similar to member 45, is adapted to receive against its annular flange 52 the right hand end of tube 50 (FIG. 2). However, the inner bore of member 51 is formed to provide a check valve seat 53 which, in cooperation with a ball 54, prevents flow of oil through member 51 into tube 50.

Adjacent member 51 is a retainer disk 56 corresponding to disk 38 but formed with an annular depression 57 adapted to act as a seat for the right hand end of compression spring 23 (FIG. 2). Disk 56 is centrally apertured as at 58 to receive valve seat member 51 therein up to the flange 52 so as to provide an anchor for the right hand end of tube 50. At spaced points around the aperture 58 are a plurality of openings 59 to permit passage of oil between opposite sides of said disk 56.

Disk 56 is adapted to bear against the outer side of a seal 61 (FIG. 14) identical to seal 33 in the opposite head member 25. Seal 61 is provided with a central valve portion 62 that is adapted to cooperate with the complementarily formed valve seat 55 formed in valve member 51. An end plate 65 identical to end plate 29, a split ring 66 identical to split ring 27 and an adjusting screw 67 identical to screw 31 complete the right hand head 26. Split ring 66 is received within a complementary groove 68 (FIG. 2) for holding the right hand head assembly in place.

In order to assemble heads 25, 26 and tube 50 it is merely necessary to assemble the parts in the order above described and then, placing the body 5 in a press, exert sufficient pressure on end plate 65 to permit insertion of split ring 66. Conical washer 42 (FIG. 12) is thus deflected sufficiently to resiliently secure heads 25, 26 and tube 50 relatively rigid relative to the body 5. At this point it should be noted that no screws or bolts are required to assemble the door closer.

As stated above, the door closer piston 21 is hollow but is provided with a head generally designated 70 (FIG. 2), the elements of which are detailed in FIG. 13. A split ring 71 is received in a complementarily formed groove 69 in the central bore 72 of piston 21 and acts as a retainer for an annular end plate 73 (FIG. 13) slidably received in said bore 72. End plate 73 is bevelled as at 74 to engage the slanting side of an annular gasket 75 of triangular cross section (FIG. 13) made from rubber or the like. Gasket 75 is clamped between said end plate 73 and a spring urged retainer plate 76 provided with an axially extending annular flange 77. The axially directed end of said flange 77 bears against gasket 75 and the radially extending portion of said plate 76 serves as a seat for the end of compression spring 23 whereby the gasket 75 is compressed between the plate

73 and 76 by the pressure of said spring. The bevelled line of engagement between plate 73 and gasket 75 causes the latter to be urged outwardly into sealing engagement with the bore 72 of piston 21.

Slidably supported on outer cylindrical sidewalls of the axially extending tube 50 is a piston valve generally designated 80 (FIG. 13) which may be of rubber or yieldable plastic and which is provided with a radially outwardly extending flange 81 at the left-hand end thereof. Flange 81 is received within the annular space between end plate 73 and retainer plate 76 (FIG. 2). The elongated cylindrical wall 82 of piston valve 80 is slidably carried by said tube 50 and is provided with an increased inner diameter at the left-hand end thereof to provide an enlarged portion 83 so as to leave clearance between tube 50 and piston valve wall 82 except for the right-hand end 84 which is snugly but slidably received on said tube.

The axial spacing between disk 73 and disk 76 is greater than the thickness of flange 81, and the outer diameter of flange 81 is less than the inner diameter of flange 77 of disk 76. This is of considerable importance as the piston valve 80 is slidable on the tube 50 in unison with the main piston. Tube 50 may not always be in the exact center of the cylinder and piston, or in other words, the tube might be slightly eccentric with relation to the cylinder and piston. If it should be slightly off center it would make no difference as flange 81 fits loosely between the disks 73 and 76 and therefore the piston valve 80 is permitted free radial movement with relation to the piston, and as this is the case no excessive friction or binding action can take place.

In order to provide control over the movement of the door in its various positions of swing a plurality of ports are formed in tube 50.

Referring again to FIG. 12, the left-hand end of tube 50 is provided with a relatively wide peripheral groove 92 at a point adjacent valve member 45 and a sleeve 93 of rubber or resilient plastic is snugly received within said groove (FIGS. 4-9). One or more holes 94 are formed in tube 50 at said groove 92 constituting ports for the passage of oil radially outwardly therethrough.

At this point it may be noted that the head of piston 21 divides the door closer bore into left and right-hand chambers (FIG. 2) so that upon movement of piston 21 to the right oil in the right-hand chamber must flow into the left-hand chamber to permit such movement. With respect to the ports 94 it will be apparent that oil under pressure in tube 50 will flow radially outwardly through said ports deflecting sleeve 93 outwardly to permit such flow. However, flow in the opposite direction is effectively prevented by sleeve 93 which thus acts as a check valve.

As best seen in FIGS. 2, 4, a second peripherally extending groove 97 is formed at about the right-hand end of piston valve 80 when piston 21 is at the left-hand end of its stroke corresponding to closed position of the door 1. However, at such position the piston valve 80 does not entirely cover said groove 97, it being required that the door be swung partly open before piston valve 80 completely covers groove 97. One or more ports 98 are formed in tube 50 at said groove 97 so as to permit flow of oil through ports 98 from the right-hand chamber into tube 50 as indicated by the arrow in FIG. 4. Upon initiating the opening movement of the piston 21 oil thus flows freely from the right-hand chamber to the left-hand chamber through said ports 98 and hence through ports 94 against the resiliency of the sleeve check valve 93 (FIG. 4). As seen in FIG. 4 flow from tube 50 to the left-hand chamber may also take place through valve member 45, the amount of such flow being regulated by the position of valve portion 36 of seal 33.

Upon further movement of piston 21 to the right from the position of FIG. 4 to the position of FIG. 5 piston valve 80 covers ports 98 thereby preventing flow into

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tube 50 from the right-hand chamber of the door closer.

To permit flow of oil when the piston 21 is in the position of FIG. 5 one or more ports 100 are provided in tube 50 at a point about centrally between the ends of tube 50. To the right of ports 100 is another set of similar ports 101. Flow through both ports 100 and 101 is influenced by a flap valve generally designated 102 and illustrated in FIG. 10.

Valve 102 is a generally cylindrical hollow member made from rubber or a resilient plastic and adapted to be received within tube 50. Adjacent one end valve 102 is formed with two or more outwardly projecting bosses 103 which are adapted to be received within complementarily formed holes 104 (FIG. 5) in the sidewalls of tube 50. By compressing valve 102 it is thus possible to slide the same into tube 50 from one end thereof until bosses 103 snap outwardly into holes 104 thus securely positioning said valve 102 in said tube 50.

At the end of flap valve 102 opposite bosses 103 the sidewalls are cut away to provide a pair of axially extending flaps 105. Flaps 105 register with ports 100 in tube 50 and of course the number of such flaps is not critical so long as there is a flap 105 corresponding to each port 100.

With the piston 21 in the position of FIG. 5 movement of said piston to the right causes flow of oil radially inwardly through ports 100 against the slight resistance of flaps 105. Movement of oil in the reverse direction is of course effectively prevented by the flap valve 102. It will be noted when the piston is in the position of FIG. 5 that flow of oil may take place through ports 98 from the tube 50 into the left-hand chamber. This flow is permitted by the clearance between the enlarged portion 83 of piston valve 80 and the tube 50.

In order to create a positive resistance to further opening movement of the door when the latter is wide open, piston valve 80 covers ports 100 when the piston 21 approaches its right-hand position shown in FIG. 6. In such a position if one attempts to suddenly force the door further open the substantially higher than normal oil pressure thus created in the right-hand chamber is sufficient to deflect the cylindrical sidewalls of flap valve 102 and permit flow of oil axially along the tube 50 toward the left-hand chamber. In order to insure such action the thickness of the sidewalls of flap valve 102 is gradually increased from the left-hand end to the right-hand end thereof (FIGS. 4-6). The flap valve 102 in such a case constitutes a relief valve preventing damage to various parts of the door closer.

Operation

Commencing with the initial opening movement of the door (FIG. 4) the piston 21 moves to the right as indicated in FIG. 4 and very little resistance is offered to the flow of oil into tube 50 through ports 98 and out of ports 94 and past valve 36. The resistance to flow of oil past valve 36 is of course adjustable by means of adjusting screw 31.

Further opening movement of the door may be effected without much resistance because, although piston valve 80 covers ports 98 flow of oil into tube 50 is permitted through ports 100 and past flaps 105. In such case, and as seen in FIG. 5, little resistance is offered to the flow of oil out of tube 50 through ports 98.

When the door 1 has been opened about 90 degrees, although not necessarily this exact amount, piston 80 covers ports 100 and passage of oil into tube 50 is effectively retarded, and a definite checking effect occurs. However, as noted above, the yieldability of the sidewalls of flap valve 102 prevents the build up of dangerously high pressures by permitting high pressure oil to escape past the flap valve into tube 50.

It will be understood that the ball check valve 54 prevents flow of oil into tube 50 from the right-hand end thereof during the above described opening movement of the door.

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The behavior of the door closer during closing movement of the door is illustrated in FIGS. 7-9.

Between the wide open position of FIG. 6 and the closing position shown in FIG. 7 flow of oil from the left-hand chamber to the right-hand chamber is readily permitted through ports 98, tube 50, flap valve 102, ball check 54 and past valve 62 as indicated by arrows in FIG. 7. Such closing movement is of course caused by the compressed spring 23 and the speed of such closing may be effectively regulated by valve 62.

It is desirable to slow the speed of the door down considerably before it undergoes its final movement when the door latch is depressed and the door closes completely. This slowing down occurs as illustrated in FIG. 8 at which point piston valve 80 covers ports 98. Flow of oil to the right-hand end of the cylinder is thus under the complete control of adjustable valves 45 and 51.

As the door further approaches its latching position it is desirable that the speed of closing be solely controlled by valve 45. This object is achieved because at the point of latching, piston valve 80 uncovers ports 98 permitting free flow therethrough and thereby rendering valve 51 ineffective.

A modified form of piston valve 114 is shown in FIG. 11. In this case the same construction as shown in FIG. 13 is employed except that the radially outwardly extending flange 115 corresponding to flange 81 of FIG. 13 is provided with an axially outwardly directed curved surface 116 in lieu of the plane surface of FIG. 13. Said curved surface 116 may be formed by feeding a milling cutter of relatively large radius diametrically across the end of flange 115 so that the resulting shape of flange 115 is such that it engages end plate 73 (FIG. 13) at two diametrically opposite points 117, 118 (FIG. 11).

By this modified structure if fluid pressure is applied to the right-hand side (FIG. 11) of flange 115 the latter will tend to deflect to a position flat against plate 73. In other words, under a relatively large pressure a seal is established between flange 115 and plate 73 whereas at lower pressures leakage is permitted around said flange and through the central opening 89 in plate 73.

It has already been mentioned that flap valve 102 acts as a relief valve if one attempts to suddenly force the door further open from its back checking position. However, with the modified form of piston valve shown in FIG. 11, if it is desired to open the door further beyond the position of FIG. 6 it is merely necessary to gradually urge the door further open. If this is done slowly the leakage around the flange 115 (FIG. 11) of piston valve 114 is sufficient to permit further opening movement if this is desired to hook the door to a wall or for some other purpose. However, if the door is forcibly opened past its back checking position flange 115 of piston valve 114 flattens out from the pressure and leakage past the same is prevented. In such a case flap valve 102 acting as a relief valve (FIG. 6) permits further opening movement without injury to the door closer.

The piston valve 80 provides an additional safety feature which prevents dangerously high pressures from building up in the left-hand end of the cylinder in the event a person attempts to forcibly close the door during its closing movement. In such a case excessive pressure causes circumferential expansion of the portion 84 of the piston valve thereby permitting escape of oil from the left-hand chamber into the right-hand chamber. Thus the piston valve itself acts as a safety or relief valve when closing the door, and valve 102 through port 101 functions as a relief valve when opening the door.

Another safety feature is shown in FIG. 2 wherein it is seen that a longitudinally extending bore 108 is formed in the body 5 of the door closer communicating with pinion chamber 12. A passageway 109 connects said bore 108 with the right-hand chamber of the door closer and sealing means 110 is employed to close the end of said bore 108. A cartridge 111 is provided in bore 108. This

cartridge is of material such as rubber or yieldable plastic which consists of cells filled with an inert gas such as nitrogen. Each of the cells of said cartridge thus constitutes a compression member for absorbing oil pressure and which at the same time does not absorb oil.

Since the door closer is completely filled with oil, cartridge 111 thus provides a means for holding the pressure on the door closer to reasonable limits against fluctuations in pressures due to variations in temperature which might otherwise cause leakage.

It is not essential that the piston head be movable within the piston in the manner shown in FIGS. 2, 13. Nor is it essential that a resilient seal such as seal 75 be provided. However the structure shown provides still another safety feature. If an extremely high pressure is reached in the left-hand chamber the head 25 will slide relative to the piston against the urgency of spring 23, thereby reducing the likelihood of damage to the mechanism.

FIG. 15 illustrates a piston head structure that is somewhat simpler than that shown in FIG. 2. In this case the head 122 of the piston 120 is received within an enlarged diameter portion 123 of said piston providing an axially outwardly directed shoulder 124. A washer 125 is inserted against said shoulder to provide an abutment for the adjacent end of spring 126. An annular packing ring 127 of compressible material such as rubber is interposed between said washer 125 and a similar washer 128 and the above described assembly is held in place by a split retainer ring 129 which is snapped into a complementarily formed peripheral groove 130 in the enlarged bore portion 123 of the piston 120.

It will be noted that the compressible ring 127 is compressed as the split ring 129 is inserted in groove 130 so that the various parts are securely but releasably held in place relative to piston 120.

From the above description it will be apparent that the present invention not only provides an inexpensive door closer that is simple to manufacture and assemble but one that is dependable and safe in operation in addition to incorporating all of the operational features desirable in a door closer.

It will be noted that the construction is such that inaccuracies in manufacture do not critically affect the operation of the door closer. For example, the radial clearance between the piston valve 80 and the retainer 76 of the piston head permits radial shifting of the valve and the axis of the cylinder without affecting the operation. Close tolerances in the associated parts are therefore not required.

The particular embodiments herein described in detail should not be taken as restrictive of the invention as various modifications in design may be resorted to without departing from the spirit of the invention as defined in the following claims.

We claim:

1. In a hydraulic structure, a cylinder, a head at each end thereof, a piston slidably mounted in the cylinder, a tube extending from end to end of the cylinder, a sleeve-like valve slidably on the tube, said valve having a collar of readily deformable material, a radially inwardly opening annular groove formed in the piston into which the collar extends whereby movement of the piston is imparted to the valve, said collar having a flat surface on one side thereof and a concave surface on the opposite side thereof for respectively engaging the opposed faces of said groove, said concave surface permitting fluid flow between the same and the associated side of said groove when said piston moves in a direction to apply fluid pressure to said opposite side, but preventing such fluid flow when the pressure on said one side of said collar is sufficient to flatten said concave surface.

2. In a structure of the character described, a cylinder, a head at each end thereof, a piston within the cylinder, a tube extending through the cylinder and piston between the heads and provided with a port to permit

radial flow into and out of said tube, a tubular flexible valve within the tube and adapted to overlie said port to prevent flow radially outwardly thereof, and means for maintaining the valve in a fixed position within the tube, said means comprising a lug on the exterior surface of the valve extending radially outwardly of said valve and extending circumferentially thereof for less than the circumference of said valve and a recess in the tube into which the lug extends.

3. In a hydraulic structure, a cylinder closed at its opposite ends, a piston slidable in said cylinder and dividing the latter into a pair of chambers adjacent said opposite ends respectively, a tube extending through the length of the cylinder and supported at said opposite ends and passing through said piston, sealing means for limiting passage of fluid from one chamber to another through said piston, and means permitting flow of fluid from one chamber to the other through said tube, a plurality of ports formed in the tube permitting passage of fluid therethrough from one chamber to the other, a sleeve valve carried by the piston adapted to cover and uncover said ports for changing the flow of fluid in relation to the position of said piston, a valve at each end of the tube, and a check valve in one end of the tube for preventing flow of fluid to said other chamber through said check valve.

4. In a structure of the character described, a cylinder, a head at each end of the cylinder, a piston in the cylinder, a tube extending through the cylinder and piston between the heads through which fluid flows from one side of the piston to the other, an adjustable valve at each end of the tube for controlling flow of fluid from said one side to said other side of the piston, first, second, third and fourth ports formed in said tube, a valve movable in unison with the piston and adapted to open and close the second and third ports successively for varying the flow of fluid in relation to the position of the piston, a tubular flexible valve within the tube covering the third and fourth ports, and permitting fluid to flow from the cylinder inwardly through the port and into the tube, and a tubular flexible valve on the exterior of the tube and covering the first port, said flexible valve permitting flow from the tube and out through said port.

5. In a hydraulic cylinder having similar heads at opposite ends thereof each including a compressible sealing ring interposed between an end plate and a washer plate for preventing leakage from said cylinder, a tube extending the length of said cylinder, a piston slidably carried on said tube, said tube having a length slightly greater than the normal distance between the inner sides of said washer plates when said sealing rings are not compressed, whereby said tube is under compression and exerting equal outwardly directed forces on said inner sides and on said sealing rings when said tube is in abutment at its opposite ends with said inner sides.

6. In a hydraulic cylinder having similar heads at opposite ends thereof each including a compressible sealing ring interposed between an end plate and a washer plate for preventing leakage from said cylinder, a tube extending the length of said cylinder, a piston slidably carried on said tube, said tube having a length slightly greater than the normal distance between the inner sides of said washer plates when said sealing rings are not compressed, whereby said tube is under compression and exerting equal outwardly directed forces on said inner sides and on said sealing rings when said tube is in abutment at its opposite ends with said inner sides, one of said washer plates being cone shaped, converging inwardly of said cylinder and in engagement with the adjacent end of said tube.

7. A door closer comprising: an elongated cylinder closed at its opposite ends, a piston slidable in said cylinder and dividing the latter into first and second chambers adjacent corresponding first and second ends of said

cylinder, resilient means for urging said piston toward said first end at all times, means operatively connecting said piston and said door for moving said piston from a closed position adjacent said first end and corresponding to the closed position of the door toward an open position nearer said second end and corresponding to an open position of the door, an elongated tube extending between said opposite ends and providing a conduit communicating at its first and second ends with said first and second chambers respectively, said tube passing through said piston and slidably supporting the latter thereon, a seal carried by said piston and cooperating with said tube to prevent flow of fluid past said piston from one chamber to the other except through said tube, a first opening in the periphery of said tube adapted to permit fluid flow from said second chamber into said tube when said piston moves away from said closed position in response to opening movement of the door, said first opening being adapted to be closed by said piston after a predetermined opening movement to prevent further flow through said first opening, a second opening in the periphery of said tube intermediate said first opening and said other end, and adapted to permit fluid flow from said second chamber into said tube, check valve means adjacent said second end of said tube for permitting flow of fluid from said tube into said second chamber at said second end and preventing reverse flow, and a check valve means preventing flow out of said tube at said second opening.

8. A door closer comprising: an elongated cylinder closed at its opposite ends, a piston slidable in said cylinder and dividing the latter into first and second chambers adjacent corresponding first and second ends of said cylinder, resilient means for urging said piston toward said first end at all times, means operatively connecting said piston and said door for moving said piston from a closed position adjacent said first end and corresponding to the closed position of the door toward an open position nearer said second end and corresponding to an open position of the door, an elongated tube extending between said opposite ends and providing a conduit communicating at its first and second ends with said first and second chambers respectively, said tube passing through said piston and slidably supporting the latter thereon, a seal carried by said piston and cooperating with said tube to prevent flow of fluid past said piston from one chamber to the other except through said tube, a first opening in the periphery of said tube adapted to permit fluid flow from said second chamber into said tube when said piston moves away from said closed position in response to opening movement of the door, said first opening being adapted to be closed by said piston after a predetermined opening movement to prevent further flow through said first opening, a second opening in the periphery of said tube intermediate said first opening and said other end, and adapted to permit fluid flow from said second chamber into said tube, check valve means adjacent said second end of said tube for permitting flow of fluid from said tube into said second chamber at said second end and preventing reverse flow, and a check valve means preventing flow out of said tube at said second opening, a third opening in said tube at said first chamber to permit flow at all times from said tube into said first chamber, and check valve means at said third opening preventing flow from said first chamber into said tube.

9. A door closer comprising: an elongated cylinder closed at its opposite ends, a piston slidable in said cylinder and dividing the latter into first and second chambers adjacent corresponding first and second ends of said cylinder, resilient means for urging said piston toward said first end at all times, means operatively connecting said piston and said door for moving said piston from a closed position adjacent said first end and corresponding to the closed position of the door toward an open

position nearer said second end and corresponding to an open position of the door, an elongated tube extending between said opposite ends and providing a conduit communicating at its first and second ends with said first and second chambers respectively, said tube passing through said piston and slidably supporting the latter thereon, a seal carried by said piston and cooperating with said tube to prevent flow of fluid past said piston from one chamber to the other except through said tube, a first opening in the periphery of said tube adapted to permit fluid flow from said second chamber into said tube when said piston moves away from said closed position in response to opening movement of the door, said first opening being adapted to be closed by said piston after a predetermined opening movement to prevent further flow through said first opening, a second opening in the periphery of said tube intermediate said first opening and said other end, and adapted to permit fluid flow from said second chamber into said tube, check valve means adjacent said second end of said tube for permitting flow of fluid from said tube into said second chamber at said second end and preventing reverse flow, and a check valve means preventing flow out of said tube at said second opening, adjustable valve means for controlling the flow of fluid from said tube into said first chamber.

10. A door closer comprising: an elongated cylinder closed at its opposite ends, a piston slidable in said cylinder and dividing the latter into first and second chambers adjacent corresponding first and second ends of said cylinder, resilient means for urging said piston toward said first end at all times, means operatively connecting said piston and said door for moving said piston from a closed position adjacent said first end and corresponding to the closed position of the door toward an open position nearer said second end and corresponding to an open position of the door, an elongated tube extending between said opposite ends and providing a conduit communicating at its first and second ends with said first and second chambers respectively, said tube passing through said piston and slidably supporting the latter thereon, a seal carried by said piston and cooperating with said tube to prevent flow of fluid past said piston from one chamber to the other except through said tube, a first opening in the periphery of said tube adapted to permit fluid flow from said second chamber into said tube when said piston moves away from said closed position in response to opening movement of the door, said first opening being adapted to be closed by said piston after a predetermined opening movement to prevent further flow through said first opening, a second opening in the periphery of said tube intermediate said first opening and said other end, and adapted to permit fluid flow from said second chamber into said tube, check valve means adjacent said second end of said tube for permitting flow of fluid from said tube into said second chamber at said second end and preventing reverse flow, and a check valve means preventing flow out of said tube at said second opening, a third opening in said tube at said first chamber to permit flow at all times from said tube into said first chamber, and check valve means at said third opening preventing flow from said first chamber into said tube, adjustable valve means for controlling the flow of fluid from said tube into said first chamber.

11. In a hydraulic structure, a cylinder, a head at each end thereof, a piston slidably mounted in the cylinder and dividing said cylinder into a pair of chambers, a tube extending from end to end of the cylinder, a port in said tube permitting flow therethrough from one chamber to the other, a sleeve valve of yieldable material carried by the piston and slidable on the tube and adapted to cover and uncover said port upon movement of said piston along said cylinder, said sleeve valve adapted to expand circumferentially to permit release of fluid from said one chamber to the other when a predetermined pressure is established at one end of the cylinder, said

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sleeve valve normally functioning as a valve and as a seal to prevent leakage of fluid through the piston.

12. In a structure of the character described, a cylinder, a retainer at one end of the cylinder, an outer circular disk seating against the retainer, an inner circular disk, a compressible annular sealing ring disposed between the disks and at the outer peripheries thereof, a diaphragm formed centrally of and integral with said ring to provide a fluid tight end for said cylinder, a valve seat member within said cylinder for permitting flow of oil therethrough to said one end, means outwardly of said diaphragm engageable with the same to move it towards the valve seat for regulating such flow, and means within the cylinder for exerting pressure on the disks to force the compressible ring into sealing engagement with the interior surface of the outer circular disk.

13. In a hydraulic structure, a cylinder, a head at each end thereof, each head comprising an outer circular disk, a retainer at each end of the cylinder against which said disks are seated, an inner circular disk disposed behind each outer disk, a tube extending through the length of the cylinder and between the inner disks, a compressible annular sealing ring disposed between each pair of disks and at the outer periphery thereof, and a pair of abutments respectively engaging said inner disks

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centrally of the same, said tube being of a length to apply equal and opposite forces at its ends to said abutments for holding said abutments against said rings to thereby compress the latter.

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