April 25, 1939. A. O. WILLIAMS 2,156,005

DOOR OPERATING MECHANISM

Original Filed April 20, 1936 2 Sheets-Sheet 1

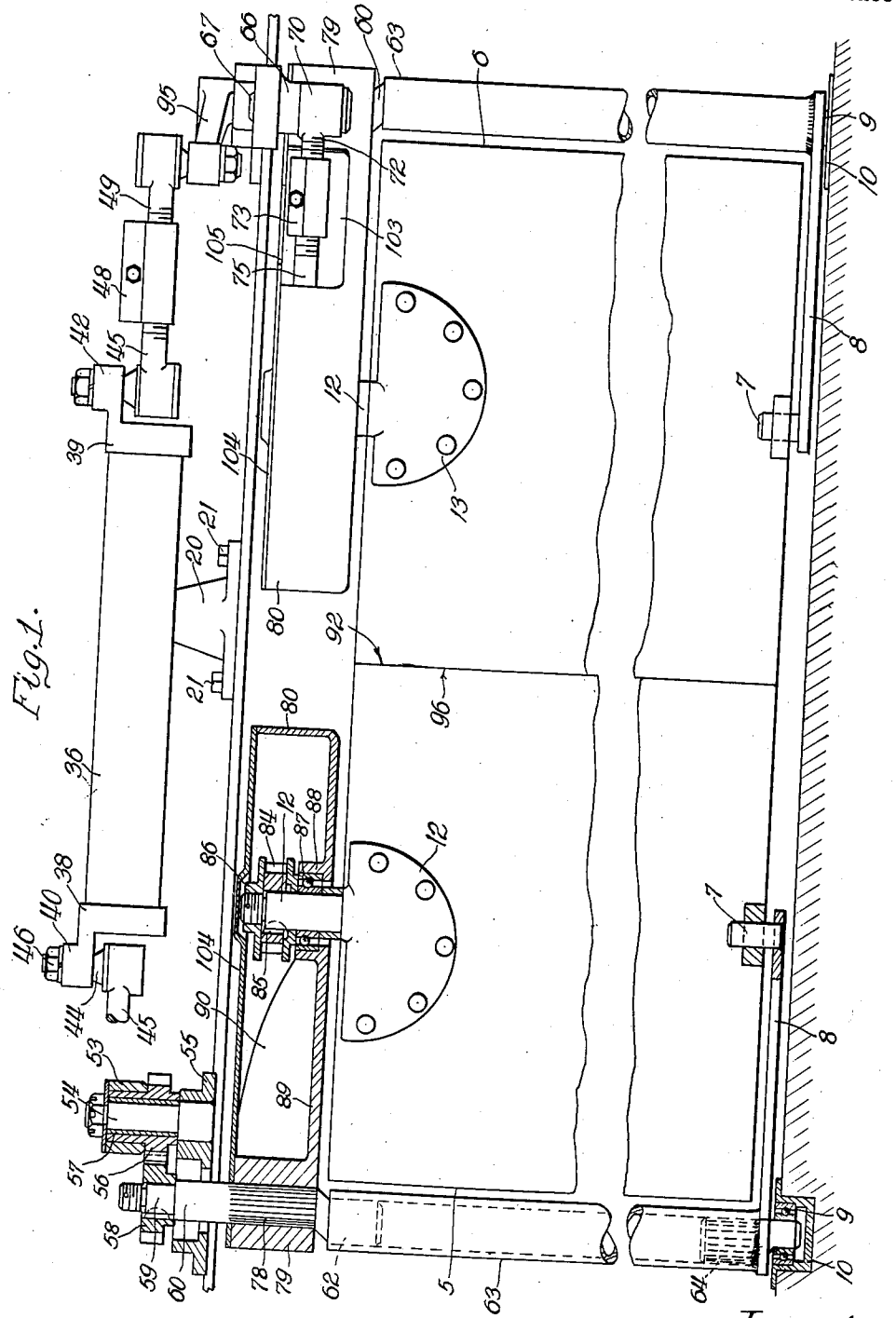


Fig. 1.

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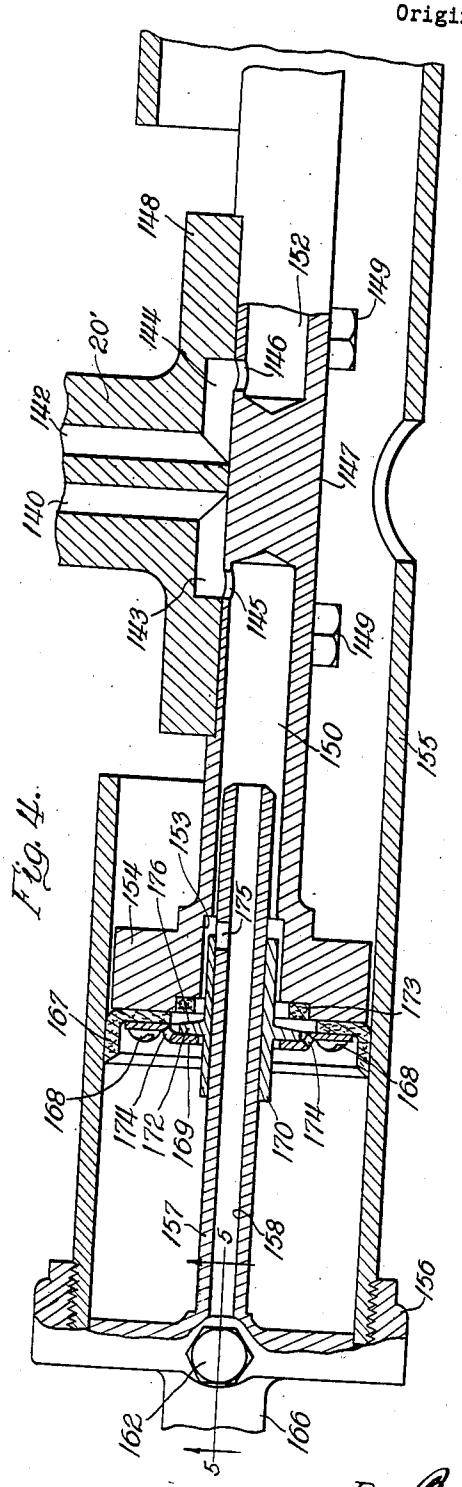


Fig. 4.

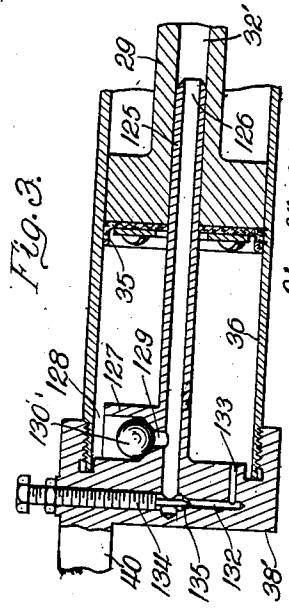


Fig. 3.

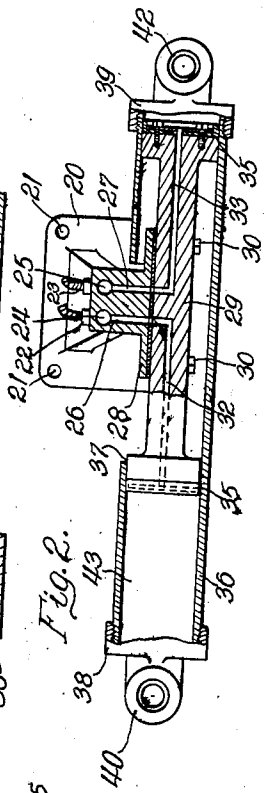


Fig. 2.

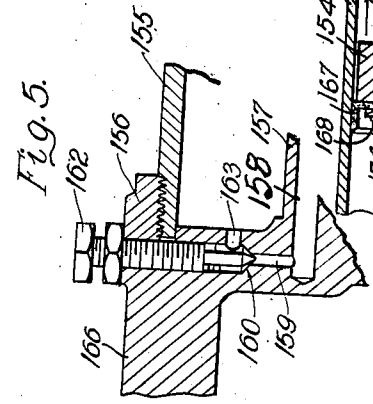


Fig. 5.

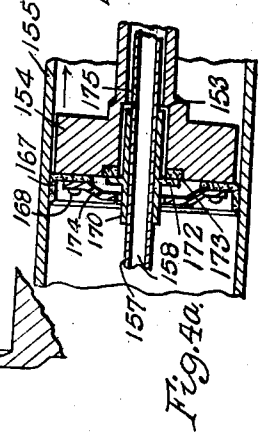


Fig. 4a.

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# UNITED STATES PATENT OFFICE

2,156,005

## DOOR OPERATING MECHANISM

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Original application April 20, 1936, Serial No. 75,503. Divided and this application October 23, 1936, Serial No. 107,159

11 Claims. (Cl. 121—44)

This invention relates to operating mechanisms for doors and the like, and is directed particularly to the actuating means for operating a pair of doors for vehicles such as buses, street cars, rail cars and the like.

The present invention is a division of my copending application, Serial No. 75,503, filed April 20, 1936.

Broadly, the present invention comprises an actuating mechanism adjacent the door well and operated in such manner as to produce simultaneous bodily movement and rotation of the doors into position at the sides of the well during door opening movement, and to bring the doors together in door closing movement.

The present actuating mechanism can be installed in a vehicle of the class described either for operating doors at the front or rear of the vehicle or doors midway between the ends thereof, since the underlying principles of operation are the same in all cases. Primarily, it comprises an actuating member which may take the form of a longitudinally moving member having connection at opposite ends to links which are in turn rotated by the longitudinal movement of this member to effect rotation of carrier brackets supporting the doors. While the present mechanism is described in connection with a specific form of door mechanism for purposes of illustration, it is to be understood that the actuating means can be employed for the operation of other types of door mechanisms without in any way departing from the present invention.

One object of the present invention is to provide means which will actuate the doors by the unidirectional movement of a single actuating member and which returns the doors to closed position upon reverse movement of this member. This provides a simplified type of operating and actuating mechanism.

Another feature of the present invention is the provision of a construction wherein the doors are cushioned for movement adjacent their extreme positions so that they will operate with the minimum of noise and, in case of obstructions, will not damage the mechanism. This also prevents the doors from slamming into opened or closed positions.

Another feature of the present invention is the simplified construction of the actuating mechanism requiring only the movement of one member to secure operation of both of the doors or of a series of doors connected thereto, the moving member being guided upon a stationary member which also acts as a means for transmitting the actuating force to the moving member.

Other objects and advantages of the present invention will appear more fully from the following detailed description which, taken in conjunction with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of the preferred form of the present invention.

In the drawings:

Figure 1 is a side elevational view, partly in section, showing one form the present invention;

Figure 2 is a sectional view through one form of the actuating cylinder;

Figure 3 is an enlarged sectional view through a modified form of actuating cylinder;

Figure 4 is a sectional view through a preferred form of the actuating cylinder, taken on an enlarged scale;

Figure 4a is a partial sectional view corresponding to Figure 4 showing the operating cylinder in its other direction of movement; and

Figure 5 is a sectional view taken substantially on line 5—5 of Figure 4.

Referring now in detail to the drawings, I have disclosed in Figure 1 a pair of doors **5** and **6** supported at their lower ends on studs **7** carried by the extending arms **8**, which arms at their opposite ends are pivoted on suitable thrust bearings **9** carried within the bearing supports **10**.

At their upper ends, the doors **5** and **6** are provided with offset pivot studs **12** mounted in fixed position above the upper edge of the door by the supporting plates **13**, which may be riveted or otherwise suitably secured to the doors. It will be noted that the studs **7** and **12** serve to support the doors for rotation about the vertical plane extending centrally through each of the door members.

Mounted on a defining portion of the door well and disposed above the door opening within the outer wall of the vehicle, I provide a suitable bracket **20** having means **21** receiving bolts or the like for securing the bracket to the supporting surface, which preferably comprises a horizontal plate. The bracket **20** is provided with a central offset portion containing a pair of inlet ports connected to the conduits **22** and **23**. These inlet ports communicate with vertical passageways **24** and **25** which, intermediate their ends, open into horizontally extending passageways **26** and **27** as shown in Figure 2. The inner face portion of the offset boss is provided with a flanged surface

28 to which is secured a stationary piston member 29, as by means of bolts 30.

The member 29 is provided with longitudinally extending passageways 32 and 33 communicating respectively by normally extending passageways with the transverse passageways 26 and 27. It will thus be apparent that fluid under pressure admitted through conduit 22 to the port 24 will pass outwardly from the member 29 through the passageways 26 and 32. Similarly, fluid under pressure admitted through the conduit 23 will pass outwardly of the outer end of the member 29 through passageways 27 and 33. No communication between the conduits 22 and 23 is provided.

Each end of the member 29 is provided with a cup-shaped gasket member 35 secured thereto and having a central opening aligned with the respective passageways 32 and 33. Disposed about the member 29 and reciprocatory with respect thereto, I provide the cylinder 36 having the cutaway portion 37 providing for clearance of the upstanding portion of the bracket 20. The cylinder 36 is closed at its ends by the cap members 38 and 39, preferably threaded thereover, which members are provided with extending collar portions 40 and 42 preferably formed integral therewith and having vertical passageways extending therethrough.

It will be apparent that upon admission of fluid under pressure from the conduit 23 into the passageway 33, the cylinder 36 will move from the position shown in Figure 2 toward the right under the influence of the pressure built up in the right hand end of the cylinder. At the same time fluid will be exhausted from within the space 43 at the left hand end of the cylinder, through the passageway 32 and the conduit 22 to allow movement of the cylinder. To effect movement in the opposite direction, the conduit 23 will be open to exhaust and fluid under pressure will be supplied from conduit 22 through passageway 32 to the space 43 to move the cylinder 36 to the left.

I have found that it is advantageous to provide an operating mechanism in which a cushioning effect is provided as the doors approach fully opened and fully closed position. The present invention attains this feature by the construction shown in Figure 3.

Considering Figure 3 in detail, it will be noted that the passage 32' in the piston 29 is enlarged in diameter and is adapted to receive the pilot 125 of the modified cap member 38', which pilot is provided with an axial passage 126. At its outer end, the pilot is provided with an offset extension 127 which has a slight clearance, indicated at 128, with respect to the internal surface of the cylinder 36.

A radial passageway 129 extends from the passage 126 outwardly through the extension 127 and is provided with a valve seat normally engaged by the ball check valve 130. The ball 130 cannot escape from the passage by reason of the relatively small clearance 128 with respect to the cylinder. The end of the cap member 38' is provided with the radial passage 132 extending from passage 126 outwardly to the normally extending bore or passage 133 communicating with the interior of the cylinder 36. A suitable needle valve member 134 carried by the cap member 38' is adjustable toward and away from valve seat 135 in passage 132 to meter the flow of fluid therethrough. Except for these modifications, the cap member 38' corresponds to the cap member 38. A similar construction is provided at the opposite end of the cylinder 36 in place of cap member 39.

In operation, upon movement of cylinder to the right as viewed in Figure 3, the fluid between the cap member and the stationary piston will be exhausted through passages 133, 132 and past valve seat 135 into passage 126. However, any fluid from the interior of cylinder 36 which attempts to escape through passage 129 to passage 126 will serve to hold valve 130 on its seat and, consequently, the exhaust of fluid pressure will be metered by valve 134.

As the cylinder nears the end of its movement in this direction the fluid pressure in this end of the cylinder will restrain and cushion its movement so as to prevent the doors from being forcibly slammed into their full open position.

In door closing movement, fluid under pressure is admitted to passage 32' and hence to passage 126. Under such conditions, however, the pressure unseats ball check valve 130 and this fluid can therefore escape directly into the interior of the left hand end of cylinder 36. A portion of the fluid will also pass into the cylinder through passages 132 and 133. Thus there is no substantial restriction to the entrance of fluid under pressure into the actuating end of the cylinder. However, the doors are cushioned against abrupt movement into fully closed position by the restraining action at the opposite end of the cylinder corresponding to that previously described.

The operation of the actuating mechanism in opening and closing can be described, for purposes of illustration only, in connection with the door mechanism shown in my above mentioned copending application. Secured in collar 40 at the left hand end of the cylinder 36 is the stud portion 44 of a link 45, the stud portion being held in position within suitable bearing means in the collar by means of the nut 46. The link 45 is threaded at its opposite end and is received within a suitable adjustable clamp which connects it with link means connected in turn to the crank arm 53 mounted on a fixed pivot member 54 carried by a bracket 55 mounted in fixed position above the door opening. The arm is keyed to a sprocket, gear, or pinion 56 mounted for rotation about stud 54 and preferably, a bushing or bearing sleeve 57 is provided to facilitate rotation of the pinion with respect to the stud.

This pinion or similar gear meshes with a second gear 58 keyed to the reduced portion 59 of a shaft 60 whereby longitudinal movement of the link 45 caused by movement of the cylinder 36 to the right will effect rotation of arm 53 and pinion 56 in a counterclockwise direction, and will thus produce clockwise rotation of shaft 60.

The shaft 60 at its lower end is provided with an offset portion 62 receiving a portion of the upper end of the member 63 that carries the bracket 8 at its lower end by means of the stud 64 pressed or otherwise suitably secured in the member 63 for conjoint rotation with shaft 60.

The right hand end of the cylinder 36 has the collar portion 42 thereof connected by links 45 and 49 to a crank arm 95 keyed to a vertically extending rotatable shaft member 63 corresponding to the shaft 63. The bracket 55 is provided with an offset portion 66 which carries a depending stud member 67 receiving the hub 70 of a laterally extending stud 72. A split clamp nut 73 is threaded over the end of the stud 72 and also over the threaded end 74 of a rack arm 75

which has rack teeth 76 formed along one vertical surface thereof.

The shaft 60 is provided with the roughened portion 78 adapted to receive a bracket member 79 mounted for conjoint rotation therewith. The bracket 79 is provided with a peripheral wall portion 80 forming a housing in which is disposed a roller member 82 mounted for free rotation on a stud shaft 83 carried on the bottom wall of the bracket. The roller has bearing engagement with the flat surface opposite the tooth portion of the arm 75 to maintain the teeth of this arm in engagement with the pinion 84 carried by the stud 12 forming the upper door pivot. The pinion 84 is keyed to the stud and a suitable cap plate 86 is secured over the top of the pinion to prevent the rack 75 from moving out of engagement vertically with respect to the pinion. The stud 12 is mounted for rotation relative to the bracket 79 by means of suitable bearings 87 carried in a boss portion 88 formed in the bottom wall of the bracket 79. A reenforcing rib 99 extends from the boss 88 to the hub portion of the bracket 79. Due to the lateral displacement between shaft 60 and the stud 67, any horizontal swinging movement of the bracket 79 will result in rotation of the pinion 84 which will rotate stud 12 to cause corresponding rotation of the door 5. By the spacing between the pivot points, the degree of rotation of the door relative to the arcuate movement of the bracket can be determined, and this may be readily adjusted by varying the relative diameter of the pinion with respect to the rack, or by the spacing of the pivots.

In the operation of the mechanism thus far described, admission of fluid under pressure to the right hand end of the piston 35 will result in movement of the cylinder 36 to the right, producing counterclockwise rotation of the arm 53. This results in clockwise rotation of the pinion 58, in turn producing counterclockwise rotation of the bracket 79. This tends to move the pinion 84 carried by the door stud 12 inwardly along the rack arm 75, resulting in the rotation of this pinion in a clockwise direction to produce corresponding rotation of the door. The meeting edge 92 of the door will therefore move laterally away from the middle of the door opening and slightly outwardly, and will then rotate into final open position with the edge 92 disposed at the side of the opening and at the front edge thereof.

For closing the door, the arm 79 merely reverses its pivotal movement about pivot 60 and the door returns from its position against the wall 15 into a position closing the corresponding half of the door opening. Rotation of the shaft 60 produces corresponding rotation of the member 63 and likewise rotates arm 8 which has pivotal connection with the door. Thus the door rotates about a central vertical plane in a direction opposite to the arcuate rotative movement of the brackets 79 and 8.

The operation for opening door 6 is similar except that countershaft 54 may be omitted since the motion of the cylinder 36 effects the proper direction of rotation of the shaft 60, which carries the bracket 79 supporting this door. Similar parts are indicated by corresponding reference numerals for the two actuating mechanisms.

In Figures 4 and 5 I have disclosed a preferred embodiment of a construction for cushioning the movement of the doors into and out of closed and opened position. The supporting bracket 20', corresponding to the bracket 20 of Figure 1, is provided with the two ports 140 and 142 which terminate in laterally extending openings 143 and 144, respectively, communicating with the ports 145 and 146 of the stationary piston 147 which is bolted to the face 148 of the bracket 20' by means of a plurality of bolts 149.

The piston 147 is of a form similar to that shown in Figure 3 but is provided with enlarged axially extending passageways 150 and 152 directed toward opposite ends of the piston and provided adjacent the opposite ends with enlarged portions 153. Each end of the piston 147 is provided with a radially extending flange portion 154 which is of a diameter slightly less than the diameter of the interior of the cylinder 155. The cylinder 155 is provided at each end with a threaded cap member 156 closing the end and having an axially projecting stem portion 157 which is centered for reciprocal movement in the passageways 150 and 152. The stem 157 is axially bored to provide the passageway 158 which terminates in a radially extending passageway 159, as shown in detail in Figure 5, having a valve seat 160 controlled by the metering valve member 162 threaded radially into the cap member 156. The flow of fluid from the passageway 158 through the passageway 159 and past the valve seat 160 is controlled by the valve 162 which meters the escape of fluid through the opening 163 into the interior of the cylinder 155. Each of the cap members 156 is provided with an extending arm portion 166 corresponding to the arms 40 and 42 of the members 38 and 39 of Figure 2.

Secured to the outer face of the piston flanges 154 is a leather cup gasket 167 adapted to have sealing engagement with the internal surface of the cylinder 155 and held in position by a plurality of screws 168 which also serve to position a platelike spider member 169 in position.

Slidably mounted on the external surface of the stem 157 is a sleeve valve member 170 having a radially extending flange 172 which is locked between the inner end of the spider member 169 and the face of the piston. A suitable resilient gasket member 173 seated in an annular recess formed at the outer end of the enlarged portion 153 of the passageway 150 limits the reciprocal movement of the slide 170 with respect to the end of the piston. The spider member 169 is provided with a plurality of circumferentially spaced openings 174 which provide communication between the interior of the cylinder 155 between the piston and the cap 156 and the passageway 150.

In the operation of the structure shown in Figures 4 and 5, when fluid under pressure is admitted through the passageway 140 and port 145 into the passage 150, this fluid escapes through the enlarged passage 153 and the ports 174 into the interior of the cylinder between the cap member and the piston. A portion of the fluid also passes through the stem 157 and past the needle valve 162 into the interior of the cylinder. The increase of pressure in the interior of the cylinder forces the cylinder 155 to the left as viewed in Figure 4, and results in movement of the stem 157 axially outwardly of the passage 150. This results in the sleeve member 170 closing off the port 175, which closes off communication between the passageway 158 and the enlarged portion 153 of the passageway 150, and consequently reduces the amount of fluid

escaping around the stem 157, thereby reducing the amount of fluid admitted to ports 174 into the end of the cylinder. The passage of fluid into the interior of the cylinder 155 between the gasket 167 and the cap 156 then moves the cylinder into a position to open the doors to their full open position, but this latter movement is at a reduced rate due to the blocking of passageway 175 by sleeve member 170.

In closing the doors, the passageway 142 is supplied with fluid under pressure which produces a corresponding flow of fluid through the passageway 152 at the opposite end of the piston and tends to move the cylinder 155 to the right. This results in inward movement of the stem 157 within the passageway 150 and produces an increase in pressure of the fluid confined between the gasket 167 and the cap member 156 within the left hand end of the cylinder. The sleeve member 170 moves with stem 157 and after predetermined movement of stem 157 moves into position against the gasket 173 and, due to the tapered surface 176, a sealing engagement between the flange 172 and the gasket 173 is provided. This prevents escape of fluid from the ports 174 past the flange 172 and the enlarged portion 153 and into the passage 150. As a result the fluid confined between the end of the cylinder and the piston must escape through the port 163 and past the needled valve 162 and into the passage 158. Since this path of flow is metered, it will be obvious that the fluid can escape only at a given rate and consequently, the cylinder will be cushioned against abrupt closing movement by reason of the body of fluid confined in the end at which it escapes at a slow rate into the passage 150 into the stem 157. By adjusting the position of the valve 162, any desired cushioning effect can be provided in accordance with the rate of closing which is to be effected.

It is obvious that during door opening movement, the same type of cushioning action is produced at the right hand end of the cylinder 155 and consequently, the doors cannot be moved abruptly into their full open position, but are cushioned so as to at first move at a relatively fast rate in their opening movement until the sleeve member 170 closes the passageway 175 at the forward end of the cylinder and seats against gasket 173 at the rearward end of the cylinder. The doors then slow down to any given movement as they near their full open position.

It is also to be pointed out that since the sleeve member 170 closes the port 175 atfer a predetermined movement of the cylinder in door opening position, the full fluid pressure is not transmitted as rapidly to the head of the cylinder after the cylinder has reached a position such that the member 170 covers the port 175 and thus, the effective force tending to open the doors is reduced as the doors near their full open position. A similar action occurs at the opposite end of the cylinder during door-closing movement.

It is therefor apparent that I have provided an effective mechanism for cushioning the doors as they move into fully opened and fully closed positions whereby their operation is accomplished with the least amount of strain on the mechanism, while yet maintaining an efficient rate of movement during the major portion of each operation.

I am aware that various changes in construction and details of operation can be made in the present invention without departing from the underlying features thereof, and I therefore do not intend to be limited, except as defined by the scope and spirit of the appended claims.

I claim:

1. Means for actuating doors and the like comprising a cylinder support having separate oppositely extending axial passageways, a cylinder enclosing said support and reciprocatory thereon, and means carried by the ends of said cylinder including tubular pilots extending into said passageways and having valve means therein for metering the exhaust of fluid from the interior of said cylinder through each of said pilots and the associated passageways.

2. Means for actuating doors and the like comprising a cylinder support having enlarged ends and a reduced intermediate portion, separate axial passageways extending from said intermediate portion to each end, a cylinder enclosing said support and guided for reciprocation on said enlarged ends, end caps on said cylinder having axially directed tubular pilots extending into said passageways, valve means carried by said pilots and cooperating with said enlarged ends of said support to control flow of fluid from said passageways around said pilots into said cylinder, and means for alternately introducing fluid under pressure through each of said passageways into the corresponding ends of said cylinder and exhausting fluid from said cylinder through the other of said passageways.

3. Operating means for doors and the like comprising a bracket, a support secured to said bracket adjacent its center and having oppositely extending ends, separate fluid passageways extending from said bracket to said opposite ends, a cylinder having closed ends mounted for reciprocatory movement on said enlarged ends, pilots on the ends of said cylinder extending into said passageways and control valve means between said enlarged ends and said pilots and operable to control passage of fluid from said passageways into said cylinder at said enlarged ends.

4. Operating means for doors and the like, comprising a support, a cylinder mounted for reciprocatory movement on said support, oppositely extending passageways in said support for delivering fluid under pressure to opposite ends of said cylinder, end caps on said cylinder having tubular pilots guided in said passageways, and valve means carried by each end cap of said cylinder including a metered exhaust valve and a ball check inlet valve for controlling the exhaust of fluid therefrom through said pilots upon admission of fluid under pressure to the opposite end of said cylinder.

5. Operating means for doors and the like, comprising a support having oppositely extending radially flanged ends, a cylinder enclosing said support and piloted for reciprocatory movement on said ends, separate passageways leading through said support and opening axially into the opposite ends of said cylinder, end caps carried by said cylinder and having axially extending tubular pilots guided for reciprocation in said passageways, and means carried by said end caps for metering exhaust of fluid from each end of said cylinder through said pilots and passageways.

6. Operating mechanism for doors and the like comprising a stationary bracket having an offset cylindrical portion, independent passageways extending through said bracket axially into each end of said cylindrical portion, a cylinder closed

at both ends and mounted for reciprocatory movement with respect to said cylindrical portion of said bracket in accordance with admission of fluid pressure into said passageways, tubular pilots loosely fitting in said passageways and supported for reciprocatory movement with said cylinder, and valve means about said pilots at the ends of the cylindrical portion of said bracket whereby fluid passageways are provided into the cylinder from within the pilots and also externally about said pilots through said valve means.

7. In combination, a bracket, a cylinder support carried by said bracket, a pair of separate fluid ports in said bracket, axially extending passages in said support communicating respectively with said ports, a cylinder mounted for reciprocation on said support, end caps on said cylinder having axially inwardly directed pilots extending into said passages and reciprocatory therein during reciprocation of said cylinder, passageways in said pilots and end caps for conducting fluid under pressure from said passages through said end caps into the interior of said cylinder, and means for metering return flow of fluid from said cylinder through said end caps and pilots to said passages.

8. A fluid operated motor comprising a stationary member having oppositely directed cylindrical supports provided with separate axially opening fluid passageways, a cylindrical member mounted for reciprocation on said supports, end caps closing said member and having inwardly extending tubular pilots guided in said passageways, said passageways having enlarged bores adjacent said supports, a valve seat formed about said bores, and valve means carried by said pilots and adapted to selectively engage said seats upon alternate movements of said cylinder.

9. A fluid operated motor comprising a stationary member having oppositely directed cylindrical supports provided with independent axially directed passageways having enlarged bores at the outer faces of said supports, a cylindrical member enclosing said supports and mounted for reciprocatory movement thereon, end caps on said cylindrical member having tubular pilots extending into said passageways, and means carried by said pilots and cooperating with said enlarged bores providing for closing of the exhaust end of said cylinder against fluid discharge about the periphery of said pilot into said passageway after predetermined movement of said cylinder.

10. In combination, a stationary support having two spaced supporting flanges having independent axial passageways, a cylindrical member reciprocatory on said flanges and having end closure means including tubular pilots guided in said passageways and having metered exhaust valves opening into the ends of said member, said pilots being movable relative to said passageways upon reciprocation of said member.

11. The combination of claim 10 wherein means is provided for sealing the passageways against discharge of fluid therethrough about said pilots.

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