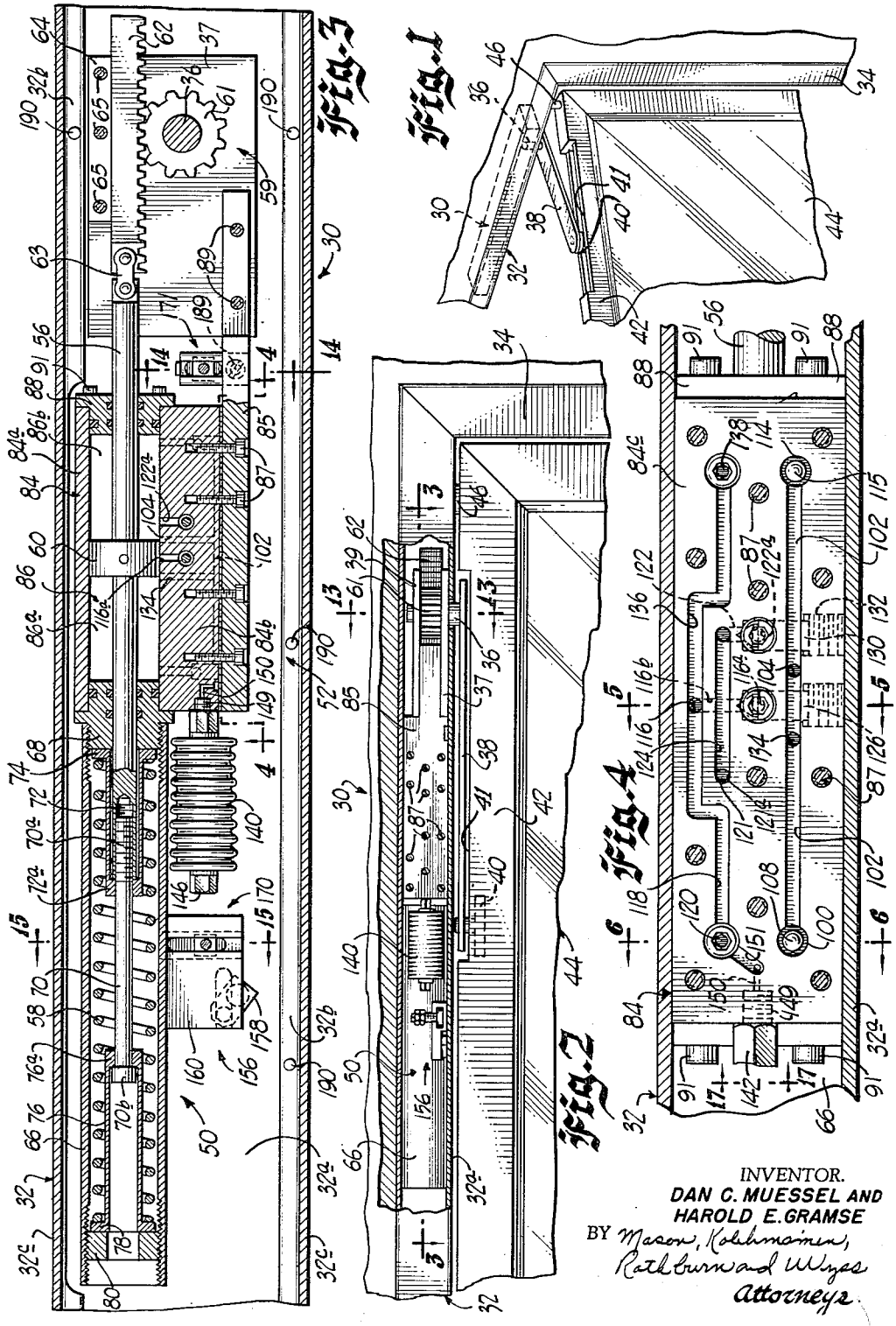
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DOOR CLOSER

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Fig. 5

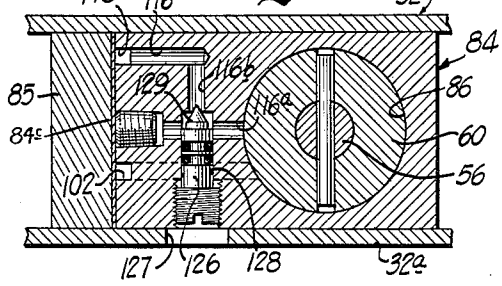


Fig. 6

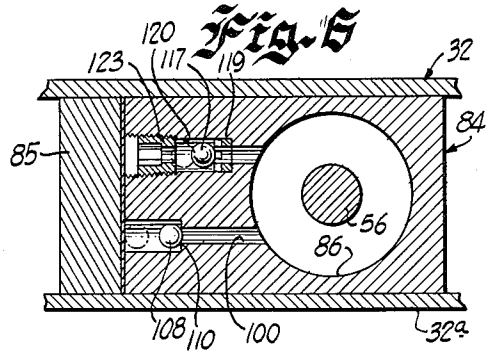


Fig. 7

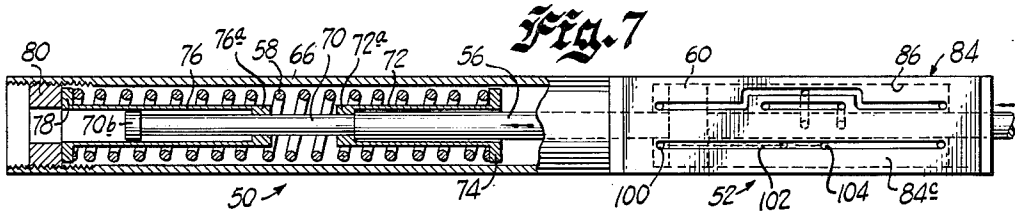


Fig. 8

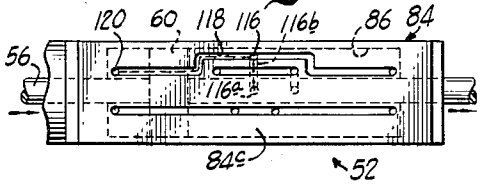


Fig. 9

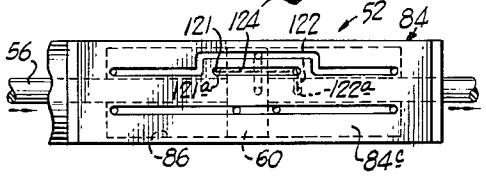
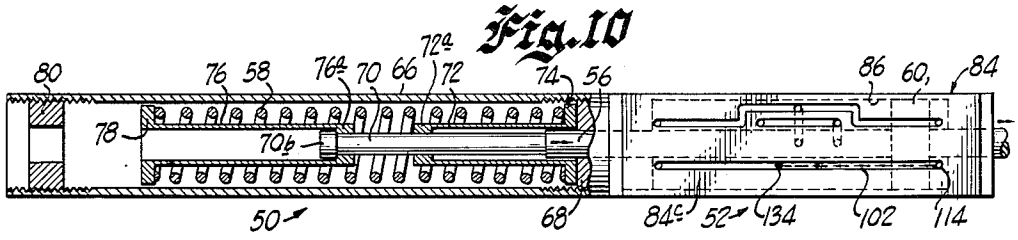
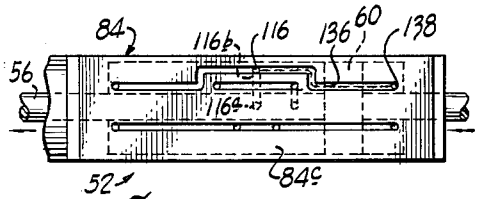


Fig. 10





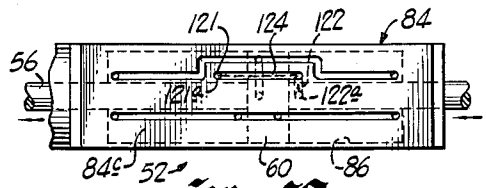


Fig. 11

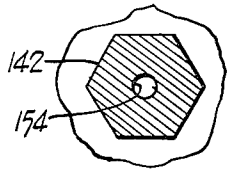


Fig. 12

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Fig. 17

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DOOR CLOSER

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Fig. 13

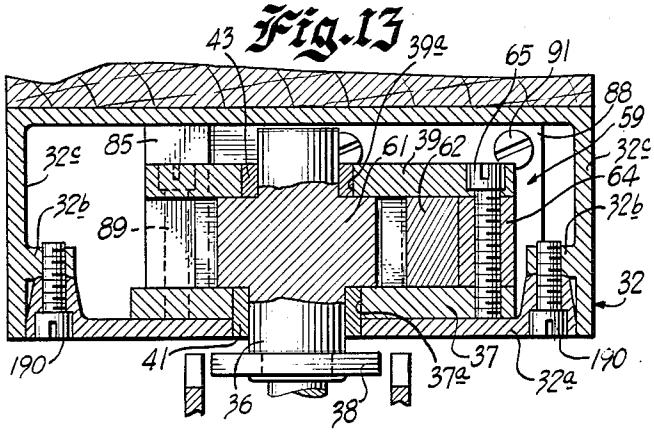


Fig. 14

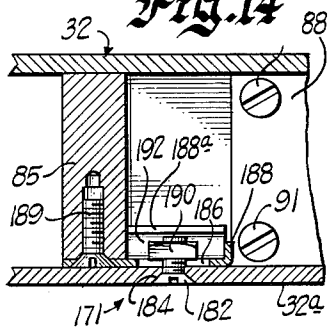


Fig. 15

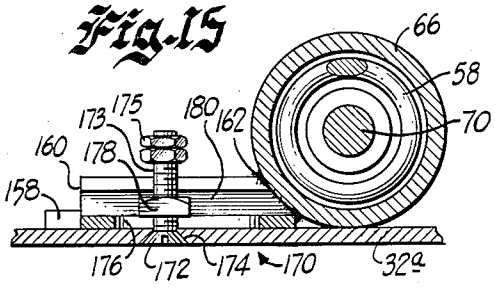


Fig. 16

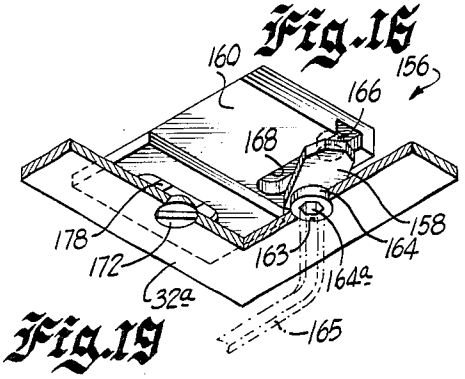


Fig. 18

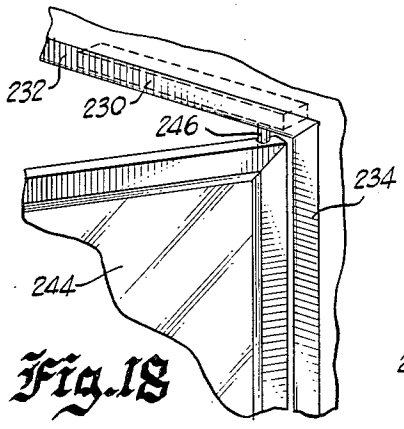


Fig. 19

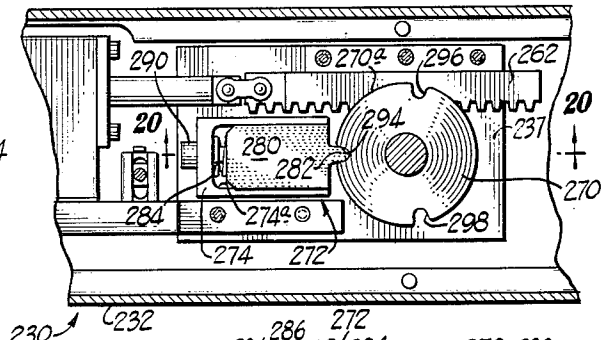


Fig. 20

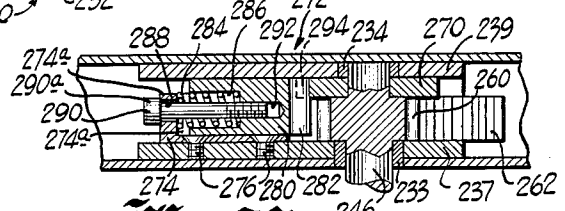
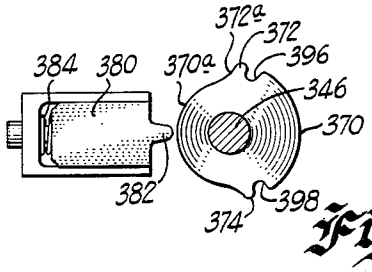


Fig. 21



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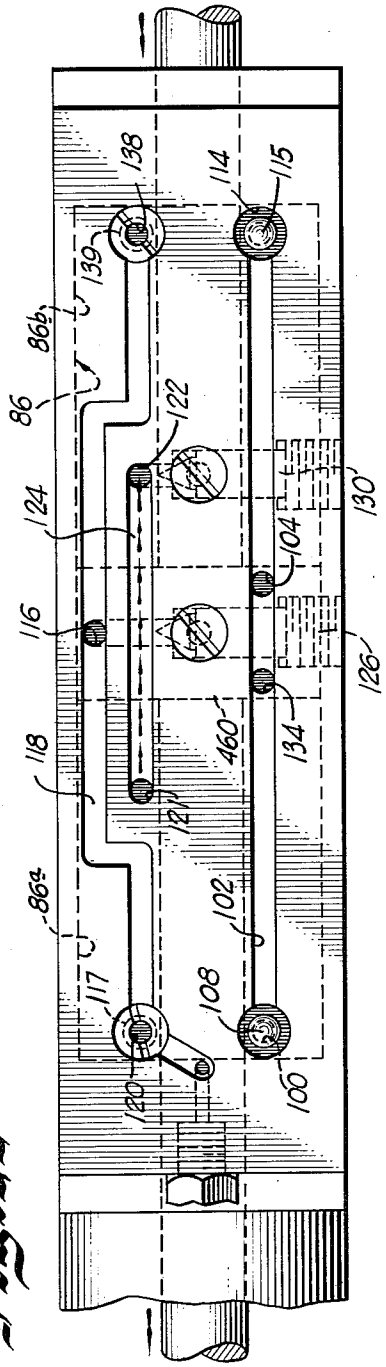


Fig. 22

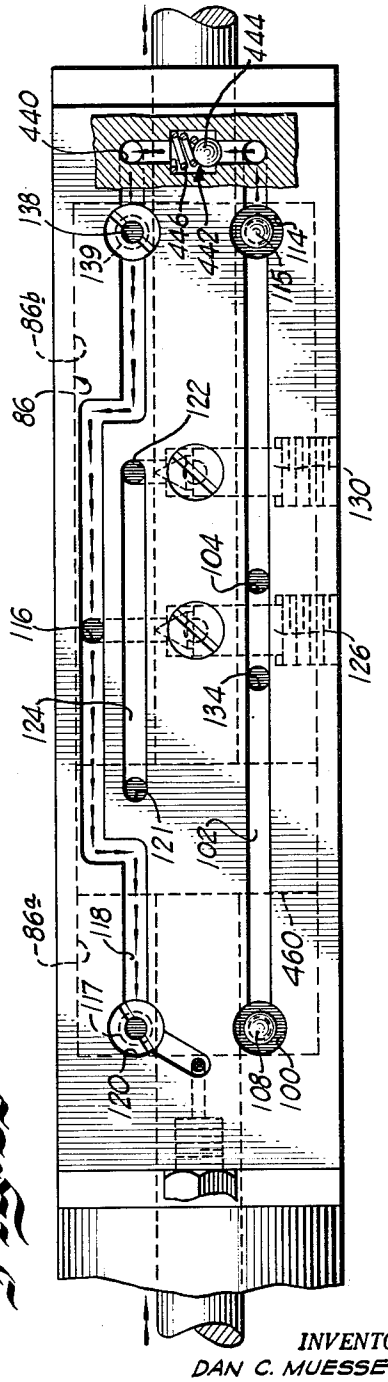


Fig. 23

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3,042,957

DOOR CLOSER

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Filed Nov. 2, 1959, Ser. No. 850,494
7 Claims. (Cl. 16—62)

The present invention relates to a door closer and, more particularly, to a double-acting door closer for positively controlling the opening and closing movements of a door. This application is a continuation-in-part of the copending application Serial No. 743,844, filed June 23, 1958, now abandoned, and assigned to the same assignee as the present invention.

It is an object of the present invention to provide a new and improved door closer for developing a door closing force which causes the door to be closed at a normal closing speed and then at a slower or faster latching speed.

It is an object of the present invention to provide in a door closer a new and improved hydraulic check mechanism having separate sets of opening and closing passageways in a single member for positively controlling the opening and closing movement of a door.

It is another object of the present invention to provide in a door closer a hydraulic check mechanism having different opening passageways, different normal closing passageways and a common latching passageway for controlling the movements of a door on either side of a door frame.

Another object of the present invention is to provide in a door closer a hydraulic circuit which assists in holding the door in a closed position.

Another object of the present invention is to provide in a door closer a hydraulic pressure release means to permit forcible closing of the door against the checking action of the closer without a damaging build-up of pressure within the closer.

Another object of the present invention is to provide in a door closer a hydraulic check mechanism having a "printed circuit" passageway construction defined on a surface of a component of the mechanism.

It is yet another object of the present invention to provide a door closer embodying a hydraulic check mechanism having a "printed circuit" passageway construction defined on a surface of a support block and a plate cooperating with said surface for providing a plurality of passageways comprising part of the hydraulic circuit.

It is yet another object of the present invention to provide a new and improved door closer embodying a hydraulic check mechanism wherein provision is made for replacement of fluid leakage, thereby to avoid introduction of air into the hydraulic system with the attendant undesirable consequences.

It is a further object of the present invention to provide in a door closer a hydraulic check mechanism embodying a variable volume reservoir for replacing leaked liquid in a hydraulic system and for maintaining the pressure of the hydraulic system substantially constant.

It is yet another object of the present invention in accordance with the previous object to eliminate hydraulic surging between the hydraulic system and the variable volume reservoir.

It is still a further object of the present invention to provide a door closer which is adjustably mounted in a transom tube for the purpose of aligning the door with the door frame.

It is another object in accordance with the previous object to provide for positional adjustment of the closer exteriorly of the transom tube without removal from the tube.

Briefly, the door closer embodying the features of the present invention is used to control the closing movement of either a double or single acting door member movably supported from a door frame member. It is supported from one of the members and is operatively connected to the other of the members. In one illustrated embodiment, the closer is concealed within a transom tube of the door frame member and is operatively connected to and actuated by a slide connection engageable with the door member and, in another illustrated embodiment, is operatively connected directly to and actuated by a door spindle. In both embodiments, the door closer includes a double-acting spring closer mechanism for creating a force to close the door after the door is manually opened and a hydraulic double-acting check mechanism for providing a normal door closing speed and a slower or faster door latching speed. A gear and rack unit is driven by a spindle when the door is moved and the rack is linearly moved to reciprocate a rod located within both of the closer and check mechanisms. The rod selectively engages spaced sleeves which compress a single spring housed within the closer mechanism and supports a double-acting piston located centrally of the fluid chamber in a hydraulic check mechanism.

The door closer is also preferably provided with a hydraulic hold to retain the door in a closed position and to produce a uniform final latching speed closure of the door.

The door closer may be provided with a hydraulic pressure bypass means to permit the door to be forcibly closed against the checking action of the closer without a build-up of damaging pressure within the closer.

The hydraulic check mechanism embodies a hydraulic circuit including a "printed circuit" passageway construction defined in a wall of a support block and a cooperative cover plate. The "printed circuit" passageway construction cooperates with the fluid chamber connecting passageways to provide two separate groups of passageways which transport fluid when the door is opened on different sides of the doorway. One group of passageways includes a first set of opening cycle passageways in which are located suitable one-way check valves, for permitting the transfer of fluid in the fluid chamber from a first side to the other side of the piston during opening of the door in a first direction. A first set of closing speed-closing cycle passageways, in which a one-way check valve is employed, provides for a normal closing door speed by returning the fluid to the first side of the piston at an optimum rate and a separate latching speed-closing cycle passageway provides for a latching speed adjacent the normally closed door position by returning the fluid to the first side of the piston at a lower or faster selected rate, the speed of the door being decreased or increased to its latching speed by simultaneously blocking the normal, closing speed passageways and uncovering the latching speed passageway. The other group of passageways includes a second set of opening cycle passageways, a second set of closing speed-closing cycle passageways and the latching speed-closing cycle passageway, and is used when the door is opened in a second direction.

To compensate for fluid leakage in the hydraulic check mechanism, a variable volume reservoir is connected at all times to the hydraulic fluid system of the check mechanism. The variable volume reservoir comprises a bellows which causes the fluid within the variable reservoir to flow into the hydraulic system, thereby to prevent entry of air into the hydraulic system with the attendant spongy operation of the closer. An orifice construction is provided in the connection between the bellows and the hydraulic system for eliminating hydraulic surges be-

tween the reservoir and the hydraulic circuit caused by movement of the piston.

The closer and check mechanisms comprising the closer are integrally connected together to be adjustably positioned within the transom tube, thereby to permit alignment of the door within the door frame. The entire closer is slidably seated on a lower transom plate to be pivotally movable relative to a spindle extending through the tube by an alignment means accessible from outside of the transom tube. A pair of spaced bolt assemblies is employed to fixedly secure the closer to the tube in a selected position and, similar to the alignment means, is accessible from outside of the transom tube. By this construction, the door may be quickly realigned without disassembling and/or removal of the closer from the transom tube.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a new and improved door closer shown located in a transom tube of a doorway and operatively connected by a slide connection to a back-check and/or hold open mechanism in the upper rail of a door;

FIG. 2 is a fragmentary elevational view, shown partially in section, of the door and doorway construction of FIG. 1;

FIG. 3 is an enlarged sectional view taken along line 3—3 of FIG. 2, illustrating a closer mechanism and a hydraulic check mechanism embodied in the closer of FIG. 1;

FIG. 4 is an enlarged sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4, assuming that the entire check mechanism is shown;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 4, assuming that the entire check mechanism is shown;

FIG. 7 is a diagrammatic view of the closer of FIG. 1, illustrating the position of the components of the closer mechanism, the position of the piston of the check mechanism, and the fluid flow in the hydraulic system of the check mechanism when the door opens on one side of the doorway;

FIG. 8 is a diagrammatic view illustrating the position of the piston and the fluid flow in the hydraulic system of the check mechanism when the door closes at its normal closing speed on one side of the doorway;

FIG. 9 is a diagrammatic view illustrating the position of the piston and the fluid flow in the hydraulic system of the check mechanism when the door closes at its latching speed on one side of the doorway;

FIG. 10 is a diagrammatic view of the closer of FIG. 1 illustrating the position of the components of the closer mechanism, the position of the piston in the check mechanism, and the fluid flow in the system of the check mechanism when the door opens on the other side of the doorway;

FIG. 11 is a diagrammatic view illustrating the position of the piston and the fluid flow in the hydraulic system of the check mechanism when the door closes at its normal closing speed on the other side of the doorway;

FIG. 12 is a diagrammatic view illustrating the position of the piston and the fluid flow in the hydraulic system of the check mechanism when the door closes at its latching speed on the other side of the doorway;

FIG. 13 is an enlarged sectional view taken along line 13—13 of FIG. 2;

FIG. 14 is an enlarged view taken along line 14—14 of FIG. 3;

FIG. 15 is an enlarged sectional view taken along line 15—15 of FIG. 3;

FIG. 16 is an enlarged perspective view of the door aligning means illustrated in FIG. 3;

FIG. 17 is an enlarged sectional view taken along line 17—17 of FIG. 4 illustrating a small outlet bore of the variable volume reservoir of FIG. 3;

FIG. 18 is a perspective view of another embodiment of the new and improved door closer shown located in the transsom tube of the doorway, the closer being of the type which is drivingly connected directly to the door pivot and embodies its own hold open mechanism;

FIG. 19 is a fragmentary top plan of the embodiment of FIG. 18 illustrating the hold open mechanism in detail;

FIG. 20 is a sectional view taken along line 20—20 of FIG. 19;

FIG. 21 is an elevational view of a modified form of the mechanism of FIG. 19 wherein both a back-check and hold open function are performed;

FIG. 22 is an enlarged sectional view of another embodiment of the new and improved door closer including an arrangement to provide a hydraulic hold and uniform closure of the door in its closed position; and

FIG. 23 is an enlarged sectional view of yet another embodiment of the new and improved door closer including a hydraulic pressure release means to allow for the forcible closing of the door against the checking action of the hydraulic system.

Referring now to the drawings, one embodiment of the new and improved door closer is illustrated in FIGS. 1 through 17 and has a closer spindle operatively connected through a connection to a back-check and/or hold open mechanism located in the upper rail of the door, while a second embodiment of the present invention, which includes its own hold open mechanism, is illustrated in FIGS. 18 through 21 as being operatively connected directly to a door pivot. Referring now to the FIG. 1 embodiment, the door closer 30, as shown in FIGS. 1, 2 and 3, is mounted in a hollow transom tube 32 comprising a part of a door frame 34. The closer 30 includes an operating spindle 36 operatively connected by a slide connection comprising an operating arm 38 and a slide or roller 40 to a back-check and/or hold open device 41, located in the upper rail 42 of a door 44. The device 41 may be of the type disclosed and claimed in the application of Jack M. Roehm and Victor W. Damm, Serial No. 743,930, filed June 23, 1958, now Patent No. 2,958,089, issued November 1, 1960, and assigned to the same assignee as the present application. The door 44 swings horizontally relative to the door frame 34 and, to this end, is pivotally supported adjacent one of its vertical edges from the door frame 34 by an upper pivot pin 46 and a lower pivot pin (not shown). The door is double-acting in the sense that it swings on both sides of the door frame 34, i.e., is opened and closed on a first or left side of the doorway as illustrated in FIG. 1 and is opened and closed on a second or right side of the doorway as viewed in FIG. 1. It will be appreciated that the double-acting closer 30 may alternatively be used with a single-acting door, i.e., a door which is opened and closed on a left or right side of the door frame.

The new and improved door closer 30 comprises a double-acting closer mechanism 50 for providing a force to close the door 44 after it is manually opened and further includes a hydraulic check mechanism 52 for controlling the opening and closing movements of the door and, specifically, for providing variable normal closing and slower or faster latching speeds. Both the closer mechanism and hydraulic check mechanism house a portion of a rod 56 which cooperates with a coiled spring 58 in the closer mechanism and supports a piston 60 within the check mechanism. The rod 56 is moved axially in a first or second direction by a rack and gear assembly 59 when the door is opened on one or the other side of the door frame and is moved in an opposite di-

rection under the control of the closer mechanism 50 to return the door to its closed position.

Considering now the rack and gear assembly best illustrated in FIGS. 3 and 13, the spindle 36 is provided with an integral gear portion 61 which continually meshes or drivingly engages a rack 62, the rack 62 being connected by a linkage 63 to the right end of the rod 56, thereby to effect reciprocal movement of the rack when the spindle is rotated incident to movement of the door 44. The rack 62 is supported in engagement with the gear 61 by a pair of spaced horizontal spindle plates 37 and 39 assembled to and spaced apart by a horizontal bar 64 by a plurality of fasteners 65. The plates 37 and 39 are provided with apertures 37*a* and 39*a* for accommodating suitable bearings 41 and 43 which rotatably receive the spindle 36. As shown in FIG. 13, the lower plate 37 slidably abuts or seats on the bottom member 32*a* of the transom tube 32 but is not fixedly secured to the member 32*a* to permit the closer 30 to be adjustably positioned within the transom tube 32, as described in greater detail hereinafter.

The closer mechanism 50, which itself embodies no novel features is illustrated in detail in FIG. 3 and comprises a hollow cylindrical housing 66 the right end of which is threadedly secured to a plug 68 supported from the left end of the check mechanism 52, as described below. It further includes a headed rod 70 having an end 70*a* threadedly received within the left end of the rod 56 extending through the plug 68 and into the right end of the housing 66, which rod 70 extends axially through and lies partially within a pair of spaced sleeves 72 and 76. When the door 44 is in its closed position, an inner shoulder 72*a* of the sleeve 72 seats on the extreme left end of the rod 56 and an outwardly extending flange 74 of the sleeve 72 abuts against the left end of the plug 68, while an inner shoulder 76*a* of the sleeve 76 seats against the head 70*b* of the headed rod 70 and an outwardly extending flange 78 of the sleeve 76 abuts against a plug 80 threadedly received within the left end of the housing 66. The sleeves 72 and 76 are selectively movable toward one another in response to the door opening on either side of the door to provide the required door closing force by compressing the spring 58 which is supported between the flanges 74 and 78. By the above construction, when the door is opened to the right of the doorway 34 (as viewed in FIG. 1) and the rod 56 is moved to the right (see FIG. 10), the left end of the rod 56 slides out of the sleeve 72 which remains seated against the plug 68, while the head 70*b* of the rod 70 engaging the inner shoulder 76*a* moves the sleeve 76 to the right, with the result that the spring 58 is compressed to provide the required door closing force. On the other hand, when the door is opened to the left of the doorway 34 (as viewed in FIG. 1) and the rod 56 is moved to the left (see FIG. 7), the head 70*b* of the stem 70 slides into the sleeve 76 which remains seated against the plug 80, while the extreme left end of the rod 56 engaging the inner shoulder 72*a* moves the sleeve 72 to the left, thereby to compress the spring 58 and provide the necessary force for returning the door to its closed position. The magnitude of the door closing force for a particular sized door at a particular open position may be selected in accordance with the demands of the installation by adjusting the position of the plug 80 in the housing 66 and by using different springs having different compressive characteristics.

Referring now to the hydraulic check mechanism 52 in greater detail, it comprises a support block 84 and a plate 85 fixedly secured to one another by a plurality of fasteners 87, which plate is also fixedly secured to the spindle plates 37 and 39 by fasteners 89. The support block 84 comprises first and second sections 84*a* and 84*b*, the first of which has defined longitudinally therethrough a bore 86 for accommodating the piston 60, and the second of which includes a passageway contruction. The piston 60 is slidably received within the bore 86 while the rod 56 is slidably supported centrally of the bore by the plug 68 and a second plug 88 inserted within the respective ends of the bore 86. The plugs 68 and 88 are secured to the block 84 by a plurality of fasteners 91 (see FIG. 4), and in cooperation with the bore provide a piston chamber adapted to be filled with hydraulic fluid. The piston chamber actually comprises a variable chamber 86*a* between the plug 68 and the piston 60 and a variable chamber 86*b* between the plug 88 and the piston 60, it being understood that as the piston moves in the bore 86 one of the chambers increases in size and the other chamber decreases in size and during this movement fluid is transferred from one of the chambers to the other of the chambers through the passageway construction provided in the second section of the support block 84. It is the passageway construction which provides for the double-acting operation of the door and it includes two sets of opening cycle passageways and two sets of closing cycle passageways entirely separate from the opening cycle passageways. Each set of closing cycle passageways further includes a normal closing speed passageway and a latching speed passageway for positively controlling the door closing movement of the door.

In accordance with a feature of the present invention, a so-called "printed circuit" passageway construction is defined on the vertical left surface 84*c* (as viewed in FIG. 5) of the support block 84, the surface 84*c* being hereinafter referred to as a passageway surface 84*c*. The "printed circuit" passageway construction shown best in FIG. 4 cooperates with the plate 85 to provide a plurality of surface passageways which transport fluid incident to movement of the piston 60 from one of the chambers 86*a*, 86*b* to the other of the chambers 86*a*, 86*b* through selected connecting passageways defined in the second section of the support block 84. It will be appreciated that the piston 60, the chambers 86*a*, 86*b*, the connecting passageways, and the surface passageways comprise the hydraulic system of the hydraulic check 52.

Assuming the door 44 opens on the left side of the doorway 34, as shown in FIG. 1, and the rod 56 and piston 60 move to the left as seen in FIG. 3, fluid flows to the right as illustrated in FIG. 7 from the chamber 86*a* to the chamber 86*b* through a first set of open cycle passageways. Specifically, the fluid flow is out of the chamber 86*a* through a connecting passageway 100 (see FIGS. 3 and 4) to a surface passageway 102 defined by a groove on the passageway surface 84*c* and the plate 85. The fluid flows to the right through only approximately the left half of the surface passageway 102 into a connecting passageway 104 which has a port in communication with the chamber 86*b*. As shown in FIG. 6, a ball check valve arrangement is located within the passageway 100 to permit flow of fluid out of the chamber 86*a* but not into the chamber 86*a*. Specifically, the arrangement includes a ball 108 movable by the fluid to seat against an annular valve seat or shoulder 110 defined in the passageway 100 itself to prevent passage of fluid into the chamber 86*a* and also movable by the fluid to engage the groove 102 in the plate 85 to permit passage of fluid out of the chamber 86*a*. During opening movement of the door, the ball assumes the position shown in dotted lines against the groove 102 with the result that fluid flows from the chamber 86*a* to chamber 86*b* through the passageway 100, while during closing movement of the door the ball valve moves into the position shown in solid lines. Although the surface passageway 102 communicates with the chamber 86*b* through a connecting passageway 114, fluid does not flow through the passageway 114 into the chamber 86*b* because of a ball check valve arrangement 115 similar to the ball check valve arrangement in passageway 120 shown in FIG. 6 and described hereinbelow. The ball in the passageway 114 seats against a valve seat to prevent the flow of the fluid from the passageway 114 into the chamber 86*b*.

The positions of the sleeves 72 and 76, the spring 58, and the headed rod 70 of the closer mechanism 50 and the position of the piston 60 of the hydraulic check mechanism 52 when the door is adjacent to its maximum open position is illustrated in FIG. 7. Specifically, the small rod 70 is telescoped within the sleeve 76 and the extreme left end of the rod 56 in engagement with the inner shoulder 72*a* is moved to the left thereby to displace the sleeve 72 to the left and effect the compression of the spring 56. As shown, the sleeve 76 remains seated against the plug 80 while the sleeve 72 is spaced from the plug 68.

When the force applied to the door is removed, the spring 58 acting through the sleeve 72 urges the rod 56 to the right thereby to apply to the spindle 36 a torque which acts through the operating arm 38 and slide connection 40 to close the door 44. The door 44 closes and the rod 56 and piston 60 move to the right, as viewed in FIG. 3, under the control of the closer mechanism 52 which causes the door to move throughout substantially its entire closing movement at an optimum preselected closing speed and to move adjacent to its normally closed position at a slower or faster latching speed. While the door is closing at its optimum closing speed, fluid flows through a first set of closing speed-closing cycle passageways from the chamber 86*b* to the chamber 86*a* as shown in FIG. 8. Specifically, the fluid flows from the chamber 86*b* through a port 116*a* into an angulated connecting passageway 116, shown in FIG. 5, to a surface passageway 118 defined by a groove provided in the passageway surface 84*c* of the support block 84 and the cover 85. The left end of the passageway 118 communicates with a connecting passageway 120 which is parallel to the passageway 100 and which is in fluid communication with the chamber 86*a*. A ball check valve arrangement is provided in the passageway 120 and includes, as shown in FIG. 6, a ball valve 117 movable by the fluid between a continuously open stop 119 which permits passage of fluid therethrough and a valve seat or shoulder 123 which prevents passage of the fluid when the ball valve 117 is seated thereon. The stop 119 and seat 123 are spaced apart within the passageway 120 to permit movement of the ball 117 therebetween, the ball 117 being illustrated in solid lines in the position it assumes when the door is closing and in dotted lines when door is opening.

The speed of the closing door is changed from its optimum closing speed to its latching speed by the piston 60 simultaneously blocking the port 116*a*, thereby to stop the flow of fluid through the first set of closing speed-closing cycle passageways 116, 118 and 120, and uncovering another port 121*a* of a connecting passageway 121, thereby to open a latching speed-closing cycle passageway which transports fluid from the chamber 86*b* to the chamber 86*a* as shown in FIG. 9. The latching speed passageway includes an angulated connecting passageway 122 which interconnects the fluid chamber 86*b* with a straight surface passageway 124 defined by the passageway surface 84*c* and the plate 85. As shown, the left end of the passageway 124 communicates with the connecting passageway 121 to complete the path between the chambers 86*a* and 86*b*. Fluid flows through the latching speed passageways 121, 122 and 124 until the door 44 is closed under the control of the closer mechanism 50 and the piston 60 is returned to its door closed position equidistant the plugs 68 and 88, as shown in solid lines in FIG. 3.

The normal closing speed of the door is controlled by adjusting the rate of fluid flow through the normal closing speed passageways. To this end, a needle valve 126 shown in FIG. 5 is threadedly received within an opening 128 defined vertically in the block 84 and communicating with the connecting passageway 116. The valve 126 is accessible from beneath the closer through an opening 127 in the transom plate 32*a* and includes an oversized conical head 129 movable longitudinally into and out of the intermediate leg 116*b* of the angulated passageway 116 by a screw driver or the like (not shown), thereby to change the cross sectional area of the passageway and vary the amount of fluid flow therethrough.

In order to provide for a latching speed which is substantially slower or faster than the normal closing speed of the door, a needle valve 130, similar in construction to the needle valve 126 illustrated in FIG. 5, is threadedly received within an opening 132 defined vertically in the block 84 and communicating with the angulated connecting passageway 122. The opening 132 is parallel to the opening 128 and is also accessible from beneath the transom plate 32*b* through an opening not shown. The needle valve 130 is adjustable by a screw driver to move its conical head into and out of the intermediate leg 122*a* of the passageway as described above. When the closer is used with either a single-acting or double-acting door the needle valve 130 may be set to restrict the flow of fluid through the latching speed passageways 121, 122 and 124 to a lower rate than the rate of flow of the fluid through the closing speed passageways 116, 118 and 120. On the other hand when the closer is used with a single-acting door of the type adapted to cooperate with a latch mechanism in its closed position, the needle valve 130 may be set so that the fluid flows through the passageways 121, 122 and 124 at a faster rate than the flow of fluid through the passageways 116, 118 and 120, with the result that the door moves at an increased speed to assure latching by the latching mechanism. It will be appreciated from the foregoing discussion that a substantial difference in the closing and latching speeds of the door is readily obtainable and that the particular closing and latching speeds are adjustable in accordance with the specific demands of the installation.

Assuming the door 44 opens to the right as viewed in FIG. 1 and the rod 56 and piston 60 move to the right, the left end of the rod 56 slides to the right within the sleeve 72 and the extreme left end of the rod 56 moves away from the inner shoulder 72*a* while the head of the stem 70 which engages the inner shoulder 76*a* moves the sleeve 76 to the right, thereby to cause the spring 58 to compress. Now, in contrast to the previously described movement of the sleeves 72 and 76, the sleeve 76 moves away from the plug 80 and the sleeve 72 remains seated against the plug 64. The position of the components of the closer mechanism 50 when the door is adjacent its maximum open position is illustrated in FIG. 10.

With the piston 60 moving to the right as the door opens, the fluid flows to the left from the chamber 86*b* to the chamber 86*a* through a second set of open cycle passageways (see FIG. 10). Particularly, fluid flows from the fluid chamber 86*b* through connecting passageway 114, through approximately the right half of the surface passageway 102, and through a connecting passageway 134 which communicates with the fluid chamber 86*a*. The ball check valve 108 located in the connecting passageway 100 seats against the shoulder 110 to prevent fluid from flowing into the fluid chamber 86*a* through the passageway 100 so that the fluid must flow through the passageway 134 into chamber 86*a*. It will be appreciated that the first and second set of open cycle passageways are not entirely separate but have a common surface passageway, i.e., the central portion of the passageway 102 lying between the passageways 104 and 134. However, fluid does not flow through the central portion of the passageway 102 in the same direction when the door is opened on the left and right side of the passageway but flows in opposite directions as clearly illustrated in FIGS. 7 and 10.

When the door is manually released, the closer mechanism 50 acts to apply a force through the operating arm 38 to close the door 44. With the door 44 closing on the right side of the doorway 34, the piston 60 moves to the left and the fluid flows to the right from the chamber 86*a* to the chamber 86*b* through a second set of closing speed-closing cycle passageways. The fluid specifically flows

from the chamber 86*a* through the connecting passageway 116, a surface passageway 136, and a connecting passageway 138 communicating with the fluid chamber 86*b*. The passageway 138 includes a ball check valve arrangement similar to the arrangement 117, 119 and 123 located in the passageway 120 and, accordingly, only transports fluid into chamber 86*b*. Therefore, during opening movement of the door to the right of the doorway, fluid would not be able to flow out of the chamber 86*b* and would only be able to flow through passageways 114, 102, and 134, as described above. The normal closing speed of the door when closing on the right side of the doorway is identical to the speed of the door when closing on the left side of the doorway because of the location of the needle valve 126 in the passageway 116 as described above. Hence, it will be understood that the first and second set of closing speed-closing cycle passageways are not entirely separate but have a common passageway, i.e., the connecting passageway 116, through which fluid flows in opposite directions incident to closing of the door 44 on the left and right side of the doorway 34.

In a manner similar to that described above, the speed of the closing door is changed from its optimum closing speed to its latching speed by the piston 60 simultaneously blocking the port 116*a*, thereby to stop the flow of fluid through the second set of closing speed-closing cycle pasasgeways 116, 136 and 138, and uncovering the port 122*a* of the connecting passageway 122, thereby to open the latching speed-closing cycle passageways which, as described above, include passageways 121, 122 and 124. The latching speeds of the door when closing on the left and right sides of the doorway are the same and are controlled by the needle valve 130 in the passageway 121, as described above. Fluid flows through the latching speed passageways 121, 122 and 124 until the door 44 is closed under the control of the closer mechanism 50 and the piston 60 is returned to its door closed position equidistant the plugs 68 and 88.

In accordance with another feature of the present invention, there is provided an auxiliary, variable volume reservoir for preventing the entry of air into the hydraulic system of the check mechanism 52 incident to fluid leakage or the like. The presence of air in the hydraulic system causes a "spongy" operation of the check mechanism, i.e., a poor responsive, time delayed type of action. Specifically, the reservoir comprises an elastic elongated bellows 140 of cylindrical accordion configuration made from metal, for example brass. The bellows 140 expands and contracts along its longitudinal axis and is supported solely at its right end by a sleeve 142 threadedly received within an opening 149 in the block 84. The left end of the bellows 140 has an opening for accommodating a plug 146, the opening being used to fill the bellows 140 with hydraulic fluid. The sleeve 146 transports fluid from the bellows 140 to the juncture of the connecting passageway 120 and the surface passageway 118 through an L-shaped passageway 150 and a surface passageway 151, as shown in FIGS. 3 and 4. Hence, whenever fluid leakage occurs in the hydraulic system in the check mechanism 52, the bellows 140 contracts and forces fluid into the hydraulic system through passageways 150 and 151 with the result that the fluid lost by leakage or the like is immediately replaced. Alternatively, the reservoir could comprise an elastic tube made of rubber or the like material and provided with suitable biasing means for changing the volume of the tube.

For the purpose of avoiding hydraulic surging resulting from the movement of the piston 60 incident to door movement, a small bore 154 is provided longitudinally of the sleeve 146, which bore 154 extends throughout the entire length of the sleeve, as best seen in FIG. 17. By this construction, hydraulic fluid is unable to quickly pass through the passageway 150 into the bellows 140 when the piston 60 moves within the bore 86 because of the relatively small sized opening 154. However, hydraulic fluid is able to slowly pass through the opening 154 from the bellows 140 into the fluid system to replenish the lost liquid in the hydraulic system. It should further be noted that hydraulic surging is also minimized by feeding the fluid from the bellows 140 into the passageways 118 and 120 in which is located the ball check arrangement 117, 119 and 123. Since the check arrangement prevents fluid flow at any time out of the chamber 86*a*, the increased fluid pressure on the lead side of the piston 60 is never applied directly to the bellows or, expressed another way, the fluid from the bellows always is supplied to that portion of the hydraulic system exposed to the trailing side of the piston, for example, when the piston moves to the left, through passageways 150, 151, 118, 136 and 138 or passageways 150, 151 118 and 116 into chamber 86*b*, when the piston moves to the right through passageways 150, 151 and 120 directly into chamber 86*a*.

In order that the door 44 may be aligned with the door frame 34, i.e., the door 44 may be centrally disposed relative to the door frame 34 when returned to its closed position, the door closer 30 is adjustable positioned within the transom tube 32. Specifically, the closer mechanism 50, the check mechanism 52 and the spindle plate 37 are fixedly secured to one another in the manner described above so that the components of the closer 30 move as an integral unit. Inasmuch as the plate 37 is journaled about the spindle 36, the closer 30 is pivotally movable about the spindle 36, thereby to change the angular position of the rack 62 and rod 56 relative to the transom plate 32*a* and, thus, the angular position of the door 44 relative to the door frame 34.

For the purpose of pivoting the closer 30 about the spindle 36 into selected positions within the transom tube 32, there is provided a door aligning means 156. The aligning means, as best seen in FIG. 16, specifically comprises a cam 158 rotatably supported from the transom plate 32*a* for cooperation with a plate 160 fixedly secured by welding 162 to the housing 66. More specifically, the cam 158 is of the lever type and has depending from one end a stud 164 which is located within an oversized opening 163 defined in the plate 32*a*. The stud 164 has a socket 164*a* for accommodating the end of an Allenhead wrench 165, indicated in dotted lines, which wrench 165 is turned to effect circular movement of a lug 166 provided at the other end of the cam 158. Particularly, the lug 166 is slidably received within a slot 168 provided in the plate 160 such that when the cam 158 is rotated by the wrench 165 the lug 166 coacts with the slot 168 to pivot the closer 30 about the spindle 36. In an aligning operation, the closer is pivoted by the aligning means 156 until the door 44 is aligned centrally of the doorway 34.

The closer 30 is held in its selected position by a pair of spaced apart bolt assemblies 170 and 171 which are manually operable to fixedly secure the closer 30 to the transom plate 32*a*. Specifically, and as shown in FIGS. 3 and 15, the bolt assembly 170 includes a bolt 172 having a head 172*a* and a stem 172*b* loosely seated within an oversized opening 174 of the transom plate for extension through a slot 176 defined in the plate 160. The bolt 172 cooperates with a nut 178 which is seated in a recessed track 180 defined adjacent to the slot 176 in the plate 160. Hence, when the bolt 172 is tightened, the nut 178 draws the plate 160 toward and into frictional engagement with the transom tube 32. A pair of lock nuts 175 are threaded on the stem 172*b* of the bolt to prevent disassembly of the bolt 172 from the plate 160.

In a similar manner, the bolt assembly 17, as shown in FIGS. 3 and 14, includes a bolt 182 having a head 182*a* and stem 182*b* located within an opening 184 of the transom tube 32 for extension through a slot 186 defined in a bracket 188 fixedly secured to the undersurface of the cover 85 by a fastener 189. The bolt 182 cooperates with a nut 190 which is located in a slot 192

defined by the upturned sides 188*a* of the bracket 188. Similar to the bolt assembly 170, when the bolt 182 is tightened, the nut 190 draws the plate 188 toward and into frictional engagement with the transom tube 32. It should be appreciated that by the above described construction, the closer 30 is fixedly secured to the transom tube at two spaced points thereby assuring that the closer 30 and the door 44 remain in the selected position. However, in the event the door becomes misaligned during use as a result of a change in the characteristic of the closer mechanism 50, the position of the door may be adjusted by untightening or unlocking the bolt assemblies 170 and 171 and rotating the stud 164 until the door 44 assumes the desired aligned position, whereafter the assemblies 170 and 171 are retightened to retain the closer 30 in its new position within the tube 32. It should be observed that it is unnecessary to completely remove, disassemble and reinstall the closer unit in order to make the alignment adjustment since each of the assemblies 170 and 171 and the aligning means are accessible from the undersurface of the transom tube 32.

In this connection, the closer 30 is readily disposable within and removable from the transom tube 32 in order to facilitate repair or replacement of the closer 30. Specifically, the transom plate 32*a*, on which the closer 30 is adjustably mounted, is secured by a plurality of spaced fasteners 190 to horizontal, inwardly extending flanges 32*b* of the vertical sides 32*c* of the tube 32. In installing the closer 30, it is first mounted on the plate 32*a* and then the plate is nested within the sides 32*c* and the fasteners 190 tightened. This construction is highly desirable since it permits a single person, i.e., installer, repairman or the like, to easily and quickly install and replace the closer.

Referring now to the embodiment illustrated in FIGS. 18 through 20, a door closer 230, only partially illustrated, is located within a transom tube 232 of a door frame 234 and is substantially identical to the above described door closer 30. It differs principally from the door closer 30 in that (1) its rack assembly is driven by a door pivot 246 and not by a closer spindle separate from the door pivot and (2) it embodies a hold open mechanism 232 for retaining the door in its normally closed position and for holding the door in its maximum open positions, for example, 105 degrees on either side of the doorway. As shown in FIG. 18, a door 244 swings horizontallyy within the door frame 234 and is supported by the upper door pivot 246 and a lower door pivot (not shown). The upper end of the door pivot 246 extends upwardly through the bottom of a transom tube 232 and is journaled in a bearing 233 supported from the transom plate 232*a* and a lower spindle plate 237 and another bearing 234 supported from an upper spindle plate 239. The door pivot 246 includes an integral spur gear 260, shown only in FIG. 20, in driving engagement with a rack 262 of a rack and gear assembly similar to the assembly described above in connection with the closer 30.

The closer hold open mechanism 232 includes a hold open cam 270 fixedly secured by suitable means to the door pivot 246 and is located between the integral spur gear 260 and the upper spindle plate 239. The cam 270 cooperates with a resilient holder device 272 which comprises, as best shown in FIG. 20, a block 274 suitably secured to the plate 237 by a pair of fasteners 276. The block includes a large recess 278 for accommodating a plunger 280 having a pointed projection 282. The plunger 280 slidably moves within the recess 278 and is resiliently biased to the right, as viewed in FIGS. 19 and 20, by a coiled spring 284 seated between the bottom of a recess 286 defined in the plunger 280 and the end wall 274*a* of the block 274. The plunger 280 and block 274 are maintained in assembled relation by a screw 290 disposed through an oversized opening 288 in the wall 274*a* and threadedly received within a bore 292 of the plunger 280. The plunger 280 is thus resiliently urged to the right by the spring 284 and is maintained in its rightmost position in cooperative engagement with the cam 270 by the coaction of the head 290*a* of the screw 290 on the wall 274*a* of the block 274.

The cam 270 has a central notch 294 defined on its periphery for holding the door in its door closed position irrespective of forces resulting from drafts, winds or animals each of which act to partially open the door 244. The cam 270 further has a pair of spaced notches 296 and 298 defined in its periphery for holding the door in a maximum door open position on either side of the doorway 234. These notches 294, 296 and 298 cooperate with the projection 282 of the resilient plunger 280 to restrain the movement of the door pivot 246 and hence the door 244. Specifically, the sides of the notches are curved to permit the plunger 282 to be cammed out of the notches 294, 296 and 298 when the door is manually moved. However, when the door is not manually moved, the force of the spring 284 is adequate to maintain engagement between the projection 282 and the notches 296 and 298 in the door pivot 246 even though the force of the closer mechanism acts through the door pivot 246 to return the door to its closed position.

The operation of the hold open mechanism 232 is as follows: The door is maintained in its door closed position by the force of the spring 284 urging the projection 282 into the notch 294. However, when the door is manually opened to the left side of the door frame 234, as shown in FIG. 18, the cam 270 is rotated in a counterclockwise direction, whereupon the projection 282 rides out of the notch 294 and along the periphery 270*a* of the cam 270. During opening movement of the door, the notch 296 of the cam 270 is moved counterclockwise toward the projection 282 until the door reaches its hold open position, for example 105 degrees, whereupon the projection 282 is urged into the notch 296 by the spring 284. Actually, the door is manually placed into its hold open position and once the projection 282 is moved into the notch 296 by the force of the spring 284, the manual force of the door is removed. The door does not close after the manual force is removed because the force of the spring 284 acting through the projection 282 and the notch 296 is greater than the force developed by the door closer 30. Accordingly, the projection 282 and the notch 296 are maintained in cooperative engagement until a manual force is applied to the door, which manual force overrides the hold open mechanism 232 and causes the projection to be withdrawn from or ride out of the notch 296. Once the projection 282 is on the camming surface 270*a*, the closer mechanism acts to rotate the pivot 246 in a clockwise direction back into its original position wherein the projection 282 again engages the notch 294 thereby to retain the door in its door closed position. When the door 244 is opened on the side of the doorway opposite to that illustrated in FIG. 18, the projection 282 cooperates with the notch 298 in the same manner as it does with the notch 296, described above.

A modified form of the hold open mechanism 232, and in particular a modified form of the cam 270, is illustrated in FIG. 21. As shown, the cam 370 is mounted on a door pivot 346, identical in construction to the pivot 246, and cooperates with a resilient plunger 380, identical in construction with the plunger 280 described above. The cam 370 differs principally from the cam 270 in that it provides both a back-check and a hold open function, as contrasted with the cam 270 which performs only a hold open function. In addition, the cam 370 retains the door in maximum door open positions on either side of the doorway, but does not hold the door in its door closed position.

Considering now the configuration of the cam 370, it includes an intermediate circular peripheral portion 370*a* which lies between a pair of outwardly extending back-check peripheral extensions 372 and 374. Immediately

adjacent to the extensions 372 and 374 are a pair of hold open notches 396 and 398, respectively. The circular peripheral portion 370*a* is at all times spaced from the projection 382 such that during movement of the door between its extreme open positions no engagement between the projection 382 and the cam 370 is effected. Accordingly, there is no means provided on the cam 370 for holding the door in its door closed position.

During opening movement of the door in the left side of the doorway as viewed in FIG. 18, the cam 370 is rotated in a counterclockwise direction. The back-check extension 372 is, accordingly, moved counterclockwise toward the plunger 382 until the back-check extension 372 engages the projection 382 thereby to offer a resistive, back-checking force to the opening movement of the door. The leading edge 372*a* of the extension 372 is inclined to permit the projection 382 to ride over the extension 372 into the notch 396. It should be observed that as the projection 382 rides over extension 372 there is developed an increasingly greater resistive force to the door opening movement because of the progressive compression of the plunger spring 384. This resistive force is adequate to overcome an average door opening force and thus effectively back-checks the opening movement of the door. In the event that it is desired to retain the door in its hold open position an adequate force is applied to the door so that the projection 382 rides over the extension 372 and seats in the notch 396 under the control of the plunger spring 384. The coaction of the plunger 380 and the notch 396 retains the door in this hold open position until a manual force is applied to overcome the force offered by the modified hold open mechanism. When it is desired to close the door, the door is manually moved toward its closed position, whereby the extension 372 rides out of the notch 396 and rides over and out of engagement with the projection 382. Thereafter, the door is closed under the control of the door closer and is aligned relative to the doorway by the closer mechanism and not the hold open mechanism.

In accordance with another feature of the present invention, FIG. 22 illustrates an embodiment including a hydraulic hold of the door in its closed position, and providing a controlled and substantially uniform latching speed as the door approaches the closed position. The hydraulic holding is provided by a piston of a length sufficient to close both the passageways in the opening cycle passageway when the door is substantially at the door closed position. The arrangement of the closer mechanism and the hydraulic mechanism of the embodiment of FIG. 22 is similar to that of the embodiment earlier described and it has thus been shown only partially, with earlier described elements identified by the same reference characters. As heretofore described, a hydraulic piston 460 divides the bore 86 into the pair of chambers 86*a* and 86*b*. A set of opening cycle passageways comprises the surface passageway 102 connected with the bore 86 through connecting passageways 100, 104, 134, and 114. The passageways 100 and 114 each contain the check valves 108 and 115 respectively, which prevent the flow of fluid into the chambers 86*a* and 86*b* respectively. A closing speed-closing cycle set of passageways includes the surface passageway 118 connected to the bore 86 by the central connecting passageway 116 and the end passageways 120 and 138. The connecting passageways 120 and 138 each contain the check valve 117 and 139 respectively, which prevent the flow of fluid out of the chambers 86*a* and 86*b* respectively. A latching speed-closing cycle set of passageways includes the surface passageway 124 and connecting passageways 121 and 122. The closing speed is regulated by the throttling of flow in the connecting passageway 116 with the needle valve 126; the latching speed is controlled by the throttling of flow in the surface passageway 124 through the needle valve 130. The piston 460 is sufficiently long to close both connecting passageways 104 and 134 when the door is in a closed position as is clearly shown in FIG. 22. With the increased piston length, a hydraulic hold is provided in that during the initial door opening movement, the initial fluid flow from one side of the piston to the other side is through the passageways 121, 122, and 124 and is controlled by the needle valve 130 in the latching speed circuit. For example, if the door is opened in a direction to move the piston 460 to the left, fluid cannot flow in the passageways 134 and 104 as they are closed by the piston; fluid cannot flow in the open cycle passageways including passageway 102 since the ball check valve arrangement 115 prevents the discharge of fluid in chamber 86*b*; likewise, fluid cannot flow through the closing speed-closing cycle passageway including the passageway 118 because of the action of the ball check valve arrangement 117 which prevents the flow of fluid out of chamber 86*a*. Fluid will then flow through the latching speed-closing cycle passageways 121, 122 and 124 and past the needle valve 130 in the latching circuit, as indicated by the arrows in FIG. 22, to provide a hydraulic hold of the door in its closed position. Once the piston 460 has moved to the left sufficiently to clear the passageway 104 in the open cycle passageways, the fluid flow is substantially as illustrated in FIG. 7.

The construction illustrated in FIG. 22 also provides closing at the controlled latching speed to the door closed position because the passageways 104 and 134 are closed to prevent flow from one side of the piston 460 to the other through the passageways 104, 134 and part of passageway 102, or otherwise through the passageways 100 or 114 and 102. Accordingly, the flow from one side of the piston 460 to the other during both the initial door opening and the final door closing or latching is through the latching circuit so that there is a uniform controlled latching and closure of the door; checking control is effectively maintained.

The embodiment of FIG. 23 is similar to that described above except that in order to prevent the development of excessive hydraulic pressures in the closer due primarily to possible forcible closing of the door against the checking action of the closing speed-closing cycle and latching speed-closing cycle circuits, pressure relief means have been included in the hydraulic system which permits fluid to flow between the chambers when a predetermined high pressure is generated in one of the chambers.

The arrangement includes a piston 460 in the bore 86 and dividing the bore 86 into the pair of chambers 86*a* and 86*b*. A set of opening cycle passageways includes the surface passageway 102 and connecting passageways 100, 134, 104 and 114. The connecting passageways 100 and 114 contain ball check valves 108 and 115, which prevent the flow of fluid into chambers 86*a* and 86*b* respectively. A set of closing speed-closing cycle passageways include the surface passageway 118 and connecting passageways 120, 116 and 138. Connecting passageways 120 and 138 contain ball check valves 117 and 139, which prevent the flow of fluid out of chambers 86*a* and 86*b* respectively. A set of latching speed-closing cycle passageways includes the surface passageway 124 and connecting passageways 121 and 122. The rate of fluid flow in the connecting passageway 116 is regulated by the needle valve 126. The rate of fluid flow in the surface passageway 124 is regulated by the needle valve 130. The bypass circuit includes a passageway 440 including a check valve 442 having a ball 444 biased by a spring 446 to permit the passage of fluid in one direction only. The passage 440 communicates between the opening cycle passageways 100, 102 and 113, and the closing speed cycle passageways 138, 118 and 120, with the spring biased ball check valve 442 arranged to permit the flow of fluid from the opening cycle passageways to the closing speed cycle passageways only. The spring 446 exerts sufficient bias against the ball 444 so that an appreciable force is necessary to unseat the ball 444 and permit the flow of fluid. However, if the door is forcibly closed, for ex-

ample, if an attempt is made to forcibly close the door so as to move the piston **460** to the right as viewed in FIG. 23, due to the restriction of the needle valve **126** in the passageway **118** excessive pressure will be built up in the chamber **86***b*. Such pressure will then act against the spring biased ball **444** of the pressure relief valve **442** unseating the ball **444** and permitting the discharge of fluid through passageways **140**, **118** and **120** around the check valve arrangement **117** into the chamber **86***a* as indicated by the arrows in FIG. 23. During such abnormal operation, the fluid is thus permitted to bypass the closing speed control needle valve **126**, avoiding a build-up of pressure in chamber **86***b* which could cause leakage or damage to the closer itself and the door is permitted to be forcibly closed against the action of the closer.

While the present invention has been described in connection with illustrative embodiments thereof, it should be understood that many modifications will be apparent to those skilled in the art and it is therefore intended in the appended claims to cover all such modifications falling within the true spirit and scope of the invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A door check for use with a double-acting door and movable between a door open and a door closed position and comprising a casing, a fluid chamber in said casing, a piston reciprocably movable in said fluid chamber in response to movement of said door and located centrally of said fluid chamber when in its door closed position, a first opening cycle passageway provided in said casing and extending from one end of the chamber to the other side of the piston when the door is in its door closed position, check valve means in said passageway for permitting fluid flow through said passageway only when said door is opening in a first direction, a first closing speed-closing cycle passageway provided in said casing and extending from said one end of said chamber to a point opposite said piston when in its door closed position, check valve means in said closing speed passageway for permitting fluid flow through said closing speed passageway only when said door is closing in a first direction, a second opening cycle passageway provided in said casing and extending from the other end of said chamber to the other side of said piston when the door is in its door closed position, check valve means in said second opening cycle passageway for permitting fluid flow through said second opening cycle passageway only when said door is opening in a second direction, a second closing speed-closing cycle passageway provided in said casing and extending from said other end of said chamber to a point opposite said piston when in its door closed position, check valve means in said second closing speed-closing cycle passageway for permitting fluid flow through said second closing speed-closing cycle passageway only when said door is closing in a second direction, a latching speed-closing cycle passageway provided in said casing and extending between points adjacent said piston when said door is in its door closed position, said closing speed passageways being blocked simultaneously with the opening of said latching speed passageway by said piston during closing movement of the door.

2. The door check of claim 1 wherein said latching speed-closing cycle passageways cooperate with said piston to control the latching speed of the door regardless of which side of the doorway the door is when closing, and wherein portions of said closing speed-closing cycle passageways are common and wherein portions of said opening cycle passageways are common.

3. A double-acting door check for use with a door supported in a doorway, said check comprising a casing, a fluid chamber provided in said casing, a piston reciprocably and movably mounted in said fluid chamber and located centrally of said chamber when said door is in its closed position, means adapted to operatively interconnect said door and piston, said piston being movable in a first direction when said door is opened on a first side of the doorway and being movable in a second direction when said door is opened on a second side of the doorway, a first opening cycle passageway having a first port located adjacent to and on a first side of said piston when the door is in its closed position and further having a second port at a second end of said chamber on a second side of said piston, a second opening cycle passageway having a first port located adjacent to and on the second side of said piston when the door is in its closed position and further having a second port at the first end of said chamber on said first side of said piston when the door is in its closed position, a first closing speed-closing cycle passageway having a first port blocked by said piston when in its door closed position and a second port at said second end of said chamber, a second closing speed-closing cycle passageway including said last-mentioned first port and having a second port at the said first end of said chamber, said last-mentioned first port forming a common port for both of said closing speed-closing cycle passageways, a latching speed-closing cycle passageway having first and second ports adjacent to said piston on opposite sides respectively thereof when the door is in its closed position, the last above-mentioned first and second ports and said common port being so located relative to one another that said piston as it moves toward its door closing position simultaneously blocks said common port and unblocks either of said last above-mentioned first and second latter ports, and check valve means in said opening cycle and said closing speed-closing cycle passageways to provide during an opening and closing movement of the door sequential flow of fluid through said open cycle passageway and closing speed-closing cycle passageway respectively in a direction opposite the direction of movement of said piston.

4. The door check of claim 3 wherein portions of said closing speed-closing cycle passageways are common to each other and wherein portions of said open cycle passageways are common to each other.

5. The door check of claim 4 wherein portions of said passageways are formed by grooves defined in a surface of said casing and a cover engageable with said casing surface.

6. A double-acting door check for use with a door supported in a doorway, said check comprising a casing, a fluid chamber provided in said casing, a piston reciprocably and movably mounted in said fluid chamber and located centrally of said chamber when said door is in its closed position, said piston being movable in a first direction when said door is opened on a first side of the doorway and being movable in a second direction when said door is opened on a second side of the doorway, a first opening cycle passageway having a first port located under one end of said piston when the door is in its closed position and further having a second port at a second end of said chamber on a second side of said piston, a second opening cycle passageway having a first port located under the other end of said piston when in its door closed position and further having a second port at the first end of said chamber on said first side of said piston, a first closing speed-closing cycle passageway having a first port blocked by said piston when in its door closed position and a second port at said second end of said chamber, a second closing speed-closing cycle passageway including the last-mentioned first port and having a second port at the first end of said chamber, said last-mentioned first port forming a common port for both of said closing speed-closing cycle passageways, a latching speed-closing cycle passageway having first and second ports adjacent to and on opposite sides respectively of said piston when in its door closed position and spaced sufficiently from said piston so as to be open while both

of said first ports of said opening cycle passageways are closed by said piston, the last two-mentioned ports and said common first closing speed-closing cycle first port being so located relative to one another that said piston as it moves toward its central position simultaneously blocks said common first port and unblocks either of said last two-mentioned ports, and check valve means in said opening cycle and said closing speed-closing cycle passageways to provide during an opening and closing movement of the door sequential flow of fluid through said open cycle passageways and closing speed-closing cycle passageways respectively in an opposite direction to the direction of movement of said piston.

7. A double-acting door check according to claim 6 above and including pressure relief means between said opening cycle passageways and said closing speed-closing cycle passageways permitting the passage of fluid only from said opening cycle passageways to said closing speed-closing cycle passageways.

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