Aug. 26, 1930. F. C. GARRISON 1,773,988

DOOR CLOSER AND CHECK

Filed May 7, 1929 2 Sheets-Sheet 1

Fig. 1.

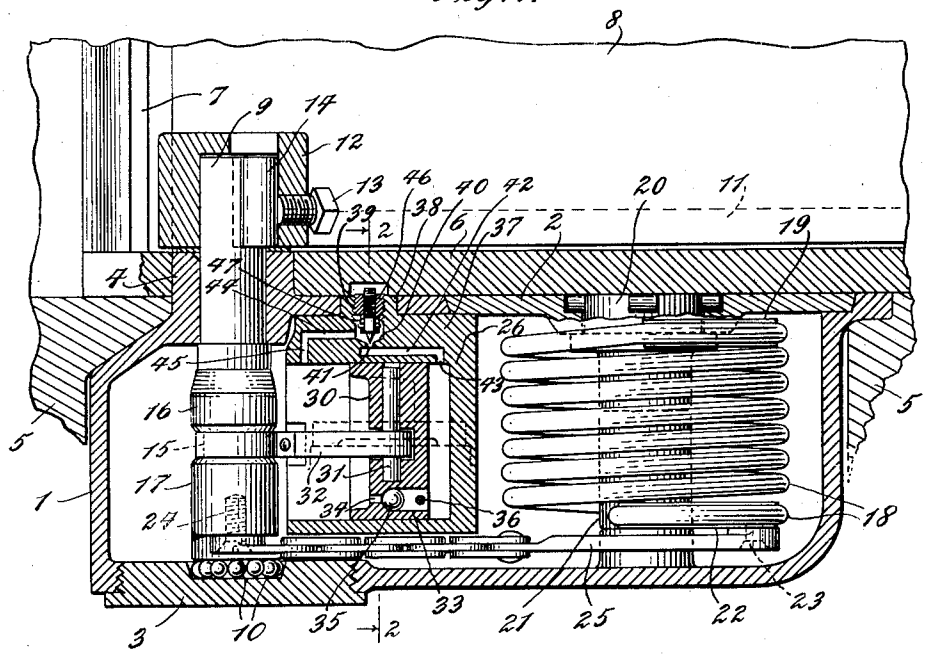


Fig. 2.

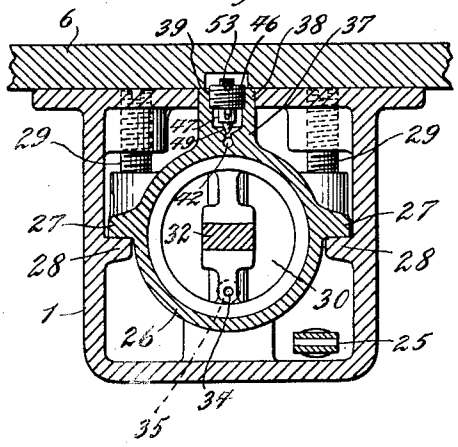


Fig. 3.

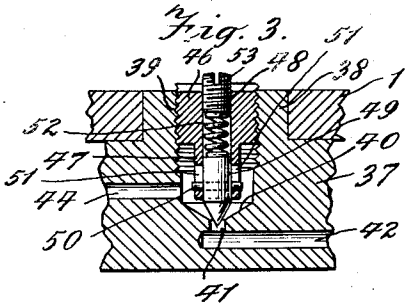
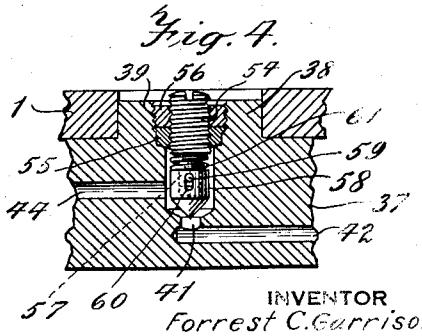


Fig. 4.



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DOOR CLOSER AND CHECK

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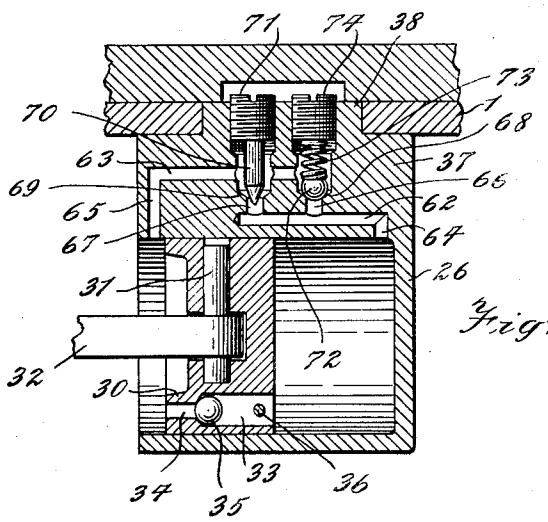


Fig. 5.

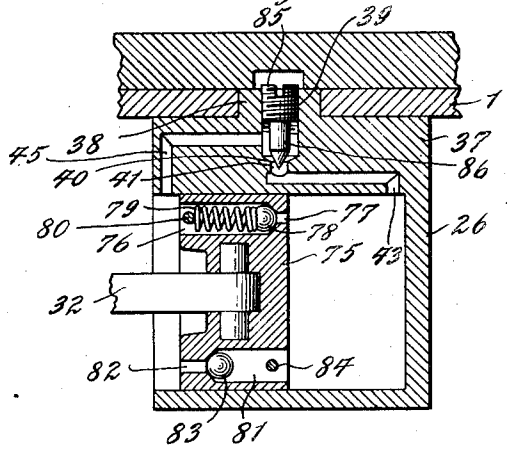


Fig. 6.

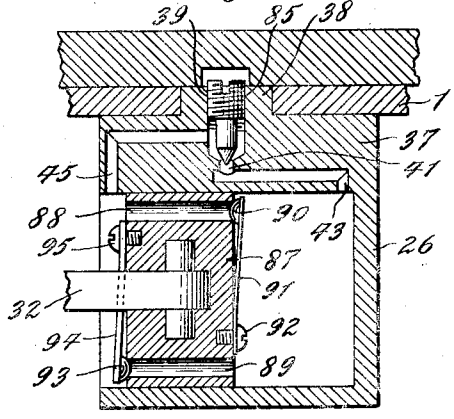


Fig. 7.

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UNITED STATES PATENT OFFICE

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DOOR CLOSER AND CHECK

Application filed May 7, 1929. Serial No. 361,135.

The automatically acting mechanisms for closing and checking the closing movement of doors and the like are commonly known as door checks. These mechanisms are most commonly of the fluid pressure type, that is, in the door-closing movement of the relatively movable parts of the mechanism, a suitable fluid such as air or oil is employed as a checking medium, by forcing it through a restricted passageway, a suitable valve being employed for adjusting the amount of such restriction, and a freely opening one-way relief valve being provided to afford free door-opening relative movement of the parts of the mechanism, such mechanism also commonly including a door-closing spring to which the checking action is opposed. With this arrangement the door of course will be gradually closed at the rate of speed provided for by the adjustment of the checking device, and with a force dependent upon the adjustment of the spring.

It is often desirable to be able to close a door quickly, for various reasons. In many instances this is attempted in the case of doors equipped with door checks. In such case the speed of the closing movement of the door can only be slightly accelerated or increased, but the pressure upon the checking fluid is abnormally increased, so that thereby a great strain is placed upon the checking mechanism as well as upon the hinges of the door with the likelihood of breaking some part of the mechanism or of tearing it loose, and similarly with respect to the hinges of the door.

An object of this invention is to eliminate the possibility of the checking mechanism being broken in this way, as well as also to provide for quickly or more speedily closing the door when desired without liability of damage. Other objects of the invention are dependability in operation, simplicity of construction, durability, and convenience and economy of manufacture. Other objects and advantages will hereinafter appear.

According to the invention a yieldable relief device is provided which yields only under an abnormal or excessive strain applied to the door closing and checking mechanism in the door-closing direction of movement of its relatively movable parts in their checking operation. This relief device becomes operative to relieve the strain when the door-closing force exceeds that of the door-closing spring and provides such relief within an ample margin of safety. In carrying out the invention means are provided for relieving excessive pressure of the checking fluid by providing a freer flow or less restricted passage thereof from one side of a checking piston to the other in the checking movement of the piston in its cylinder.

Such pressure relief means comprise a spring-pressed valve member the spring of which is maintained under a normal initial tension so that the spring will not yield under normal conditions of checking movement of the piston, but will yield only under abnormal or excessive pressure, thereby to provide additional space for the passage or flow of the checking fluid, while such pressure is still within the limits of safety. More desirably, adjusting means are provided for this spring for varying its normal or initial tension in order that thereby a more accurate determination for affording relief may be obtained, as well as accommodation to various conditions of use and different installations. The invention further includes various features of construction and combinations of parts, as will appear from the following description. It is obvious that the invention may be carried out in various ways by means of more or less different or varying constructions.

The several more or less variant embodiments of the invention which are shown in the accompanying drawings will now be described and thereafter the invention will be pointed out in claims, reference now being had to the drawings, in which:

Fig. 1 is a vertical central longitudinal section of a door closer and check embodying the invention shown as installed at the bottom of a door.

Fig. 2 is a vertical transverse section on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged partial section similar to Fig. 1, more particularly showing the com-

bined checking and pressure relief device which appears at the top in Fig. 1;

Fig. 4 is a view similar to Fig. 3 showing a somewhat modified form of the construction appearing in Figs. 1, 2 and 3;

Fig. 5 is a partial longitudinal vertical section similar to Fig. 1 but showing a somewhat modified embodiment of the invention as compared with that shown in Figs. 1, 2 and 3;

Fig. 6 is a view similar to Fig. 5 but showing a modification in which the pressure relief valve device is carried by the piston, and

Fig. 7 is a view similar to Fig. 6 illustrating a variant form of construction as compared with that shown in Fig. 6.

In the accompanying drawings the invention is shown as embodied in a door closer and check mechanism which in other respects is of substantially a usual construction heretofore commonly employed. The door closer and check shown in the drawings is what is known as a single-acting door check, that is to say, it is designed for single-acting doors and adapted to be applied at the bottom thereof. A door closer and check of substantially similar general construction is disclosed in the patent to Rixson No. 1,064,255 of June 10, 1913, and is also shown in the Rixson catalogue No. 2, of the Oscar C. Rixson Co., Chicago, Ill., issued January 1, 1926, on pages 46 and 47 thereof. However, it is to be understood as obvious that the present invention may as well be embodied in door closers and checks of which the operating mechanism is in general otherwise constructed, regardless of whether it is double-acting or single-acting and similarly regardless of whether it is designed or adapted to be installed at the bottom or at the top of the door, that is, whether it may be a floor check or an overhead check. Also while the particular construction shown in the drawings is designed to utilize a suitable liquid as a checking fluid, the construction and manner of operation so far as the present invention is concerned would be substantially similar in the case of a door closer and check designed to employ air, for example, as the checking fluid.

The particular construction of the embodiment of the invention shown in Figs. 1 to 3 inclusive of the drawings will now be described, and in this connection the parts of the operating mechanism which remain substantially unchanged by the embodiment of the invention therein will be described first in order that the features of the invention may be more readily understood. A substantially hermetically sealed or liquid-tight casing box comprises a main body part 1, a top cover plate 2 at the right hand end (Fig. 1) and a bottom closure 3 at its other end. Above this bottom closure 3 the top of the body part 1 is provided with an upwardly projecting neck or tubular boss 4 forming a journal bearing. This casing box is set into the floor 5 and is shown as covered by a carpet strip or threshold 6 through which the journal bearing 4 projects. This casing box is shown as located adjacent to the door jamb 7 and adjacent to the hinge edge and forward or inner side of the door 8.

A crank shaft is journaled in and projects above the top of the bearing 4 and at its lower end is provided with a step bearing in the bottom closure 3, including bearing balls 10. The lower end of the door 8 carries a door plate or leaf 11 the end of which adjacent the hinge edge of the door is provided with a forwardly projecting knuckle portion 12 which is provided at its lower side with a socket to receive the upper end portion of the crank shaft 9. This knuckle 12 is locked to the crank shaft 9 for rotating the latter therewith by means of a set screw 13 which adjustably engages a cylindrical key pin 14 which is set into the crank shaft 9. Obviously, as the door 8 is swung inward it will rotate the crank shaft 9 in a clockwise direction as viewed from above in Fig. 1. The crank shaft 9 is provided with a crank comprising an eccentric or pin portion 15 which connects together upper and lower crank arms 16 and 17 on the crank shaft 9, it being understood from Fig. 1, as will presently more clearly appear, that this crank projects towards the inner or visible side of the door 8, in the line of sight with the axis of the crank shaft 9.

A door-closing spring shown as a vertically arranged coiled torsion spring 18 is mounted in the other end of the casing box with its upper end anchored to a plate 19 carried by the cover plate 2 to be rotatively adjustable by means of a capstan 20 for adjusting the resilient resistance or tension of the spring. The spring 18 surrounds a core 21 on which is pivoted a swinging plate or lever arm 22 to which the lower end of the spring 18 is connected. On its lower side and rear edge (Fig. 1), this spring-connected swinging plate 22 carries a pivot screw 23, while the end of the lower crank arm 17 of the crank shaft 9 on its lower side carries a similar pivot screw 24, and these two pivot screws 23 and 24 are connected together by means of a pull member 25 comprising pivotally jointed links as shown. It should now be evident that the spring 18 resists or opposes the opening of the door 8 and that when the door 8 is opened this spring will be further tensioned or wound, whereupon when the door 8 is released such spring will become effective for closing the door. The closing of the door is controlled by the checking mechanism now to be described.

A cylinder 26 is rigidly fixed in the body part 1 of the casing box, for example, by means of lateral flanges 27 on the cylinder

resting upon shelves 28 in the casing box and firmly held in place by means of screws 29. The end of this cylinder adjacent to the crank shaft 9 is shown as fully open into the casing box while the other end of the cylinder is closed. A piston or plunger 30 in the cylinder 26 carries a vertically arranged pivot pin 31 on which is pivoted the inner end of a connecting rod or pitman 32 the other or outer end of which is pivoted on the crank or eccentric pin 15 of the crank shaft 9. It should now be clear that opening movement of the door 8 will withdraw the piston 30 towards the open end of the cylinder 26 while closing movement of the door will move the piston 30 towards the closed end of the cylinder 26. In the construction shown the hermetically sealed casing box is to be filled or substantially so with a suitable checking liquid, which advantageously also may be a lubricant for the moving parts of the mechanism.

The checking mechanism may be provided with usual means to permit free opening movement of the door, which of course is against the resistance of the spring 18. In the construction shown, a bore is provided through the piston 30 having an inner enlarged portion 33 and an outer reduced portion 34 forming a valve seat for a usual valve ball 35 loosely contained in the enlarged portion 33 of this bore and prevented from escaping therefrom by means of a usual cross-pin 36, so that thereby the valve ball 35 forms a freely movable one-way escape valve which affords substantially free or unobstructed passage of the checking fluid through the piston 30 in the outward or door-opening movement of the latter, while as the piston moves inward in its door-closing or checking movement, this valve 35 will be closed by the pressure of the checking fluid to prevent the outward passage thereof from the inner closed end of the cylinder 26 through the piston 30.

The door closer and check construction as so far described is substantially the same as that heretofore employed and as disclosed in the two above mentioned prior publications. There yet remains to be described the feature by which the usual checking action is secured, that is, by which the inward or door-closing movement of the checking piston 30 is checked by restricting the passage of the checking fluid around this piston, and also the feature, in accordance with this invention, by reason of which under excessive or abnormal pressure of the checking fluid in its checking action, a less restricted or larger opening or passageway is provided for this fluid around the piston, which prevents the accumulation of excessive pressure in such fluid and thus relieves the operating parts of the checking mechanism from excessive strain, so as to safeguard them from breakage, while at the same time permitting the door 8 to be closed much more quickly than otherwise. In the particular embodiment of the invention now being described these two features are combined in a single construction which serves both of these functions, but in which the normal checking action takes place in substantially the same way as heretofore in a usual construction.

The wall of the cylinder 26, for example conveniently the side wall at the top, is thickened to provide a longitudinal ridge or lug 37, intermediate of the length of which a projection or boss 38 extends through the top wall of the casing body 1, against the inner side of which the lug 37 fits. A rather large bore or socket 39, the outer portion of which is screw-threaded, extends down through the boss 38 and into the thickened wall portion 37 and has a tapering or conical bottom wall 40 which is provided centrally with a reduced aperture or bore 41 forming an inlet opening. A longitudinal bore 42 opens at one end into the lower end of the inlet aperture 41 and a short vertical bore 43 opens into the other end of this longitudinal bore 42 and forms an outlet from the cylinder 26 adjacent its closed inner end and inward from the limit of travel of the piston 30, as shown in Fig. 1. A longitudinal exit bore 44 extends from the inner end portion of the large vertical bore or socket 39 towards the open end of the cylinder 26 and is shown as connected therewith by a short vertical bore 45 which is beyond the outward limit of travel of the piston 30.

So far as results are concerned, the exit bore 44 could open outwardly at any place within the casing box, such for example as straight outwardly or laterally through one of the sides of the cylinder ridge or lug 37, as will be clear from Fig. 2, the essential thing being only that a passageway or bypass is formed around the piston 30, beyond its limits of travel in each direction of its movement. It will be noted that the connecting bores 43, 42, 41, 39, 44 and 45, form such a bypass or passageway around the piston 30 from within the inner closed end of the cylinder 26 into its open outer end.

The outer or upper end of the large vertical bore or socket 39 is closed and hermetically sealed by an inwardly and outwardly adjustable externally screw-threaded tubular valve-carrying plug 46, which is shown as grooved across its outer end for the reception of a screw-driver. This valve plug 46 has an inner reduced portion 47 which provides an annular space within the socket 39 for the flow of the checking fluid and at the same time provides for the inward and outward adjustment of this screw-threaded plug. A bore 48, which is shown as of uniform diameter throughout, extends from end to end centrally through the valve plug 46.

A cylindrical valve member 49, having a conical inner end, is mounted for sliding

movement in the inner end of the plug bore 48, with its conically pointed end portion normally projecting beyond the inner end of the reduced plug extension 47. This slidable valve member 49 is maintained in place by means of a small transverse pin 50 carried thereby, the projecting ends of which may move in longitudinal slots 51 in the sides of the tubular plug extension 47. The ends of these slots 51 form stops which limit the sliding movement of the valve member 49 and which, as will presently clearly appear, are of particular utility in limiting the extent of projection of the conical inner end of this valve member at the inner or downward limit of movement of the latter.

A strong coiled thrust or compression spring 52 is contained in the plug bore 48 with its inner end seated against the outer end of the slidable valve member 49, while its outer end is engaged by an inwardly and outwardly adjustable screw-threaded abutment plug 53 which is screwed into the outer end of this bore 48 and has its outer end provided with a screw-driver groove as shown. The valve spring 52 is normally maintained by the screw plug 53 under a condition of more or less compression or intial tension, so that at all times it will oppose the desired amount of resilient resistance to the outward sliding movement of the valve member 49 and will normally maintain the conical valve end of this member at its maximum extent of projection beyond the inner end of the valve plug extension 47, with the ends of its cross-pin 50 abutting against the stops formed by the lower ends of the limiting slots 51.

The valve member 49 constitutes a needle valve for opposing resistance to and thereby restricting the passage or flow of the checking fluid and at the same time constitutes a pressure relief valve for permitting a freer flow or passage of the checking fluid in its checking flow under an abnormally high pressure of this fluid, such abnormally high pressure being understood to mean a pressure greater than would normally be applied by the door-closing spring 18 in the door-checking movement of the piston 30 towards the closed end of the cylinder 26. This valve member 49 is independently adjustable as to each of its above noted functions.

This valve member 49 is normally maintained in a position, as shown in the drawings, in which its conically pointed end extends slightly into the short bore or aperture 41 which connects and forms the inlet opening from the passage or bore 42 into the lower funnel-shaped end of the large vertical bore or socket 39, which latter, as above described, has a free outlet through the exit bore 44. It will be noted that a restricted annular space is left open between the conical surface of the valve member 49 and the obtusely angular shoulder which the upper end of the inlet opening 41 forms with the conically inclined bottom 40 of the socket 39. According to well understood principles and in a well known manner this restricted opening impedes the passage of the checking fluid at this point and reduces its rate of flow around the piston 30, through the passageway formed by the above described connected or inter-communicating bores.

In the outward or door-opening movement of the piston 30 such flow is of course only incidental and negligible, but the inward movement of the piston 30 will be checked in the usual manner by the restricted flow of the checking fluid upwardly through the valve-controlled inlet opening 41. By reason of the normal initial tension of the valve spring 52, the area of this restricted checking opening will remain constant in the normal checking operation, but should the pressure of the checking fluid within the cylinder rise to an abnormal maximum extent, the slidable valve member 49 will be forced upwardly against the resistance of its spring, thereby to provide a checking opening of larger area which will relieve abnormal pressure and maintain it at a safe maximum, thereby at the same time providing for a more rapid closing movement of the door 8. Thus this single unitary valve device performs effectively the pressure-relieving strain-preventing operation in accordance with the invention and also at the same time effectively functions in the normal checking operation.

By turning the valve-carrying plug 46 inward or outward the reduced opening past the conical inner end of the valve member 49 may be further reduced or enlarged as desired for thereby regulating or adjusting the checking action to which the door 8 is subjected as it is closed by the spring 18. In this operation it will be noted that the valve member 49 functions as a needle valve in substantially the usual manner. It should be obvious that this adjustment of the valve member 49, by adjusting the valve carrying plug 46, has no effect whatever upon the relief spring 52, since the valve member 49, its spring 52 and abutment plug 53 are all mounted in and carried by the valve-adjusting plug 46.

By turning the smaller screw plug 53 inward or outward as may be desired, the normal resistance or initial tension of the relief spring 52 may be increased or decreased, by which it may be made to oppose more or less resistance as desired to the outward or upward sliding pressure-relief movement of the valve member 49, for thereby affording relief when the strain on the checking mechanism in its door-closing operation has reached the desired maximum and, by reason of such relief, providing also for a more rapid door-closing movement. It should be obvious that

this adjustment of the relief spring 52 by means of its adjustable abutment plug 53 makes no change whatever in the size or area of the restricted checking opening past the inner conical end of the valve member 49 and thus has no effect upon the normal checking operation. There is such an interrelation in the general operation, however, that an adjustment of the size of the checking opening by means of the larger plug 46 may require a readjustment of the relief spring 52 by means of the abutment plug 53.

It will be noted of the construction shown that it is possible to screw the valve-carrying plug 46 sufficiently inward that the conical end of the valve member 49 will entirely close the checking opening at the upper end of the short vertical bore 41. In such case the normal checking function or operation would of course be lost or eliminated, although the valve device would still continue to function in substantially the same manner as a pressure relief device, and it is obvious that the valve device shown could be thus utilized if so desired, although for performing this single function of pressure relief the construction could be somewhat simplified, as will hereinafter more clearly appear.

The construction of the valve device shown in Fig. 4 is slightly modified and somewhat simplified as compared with that described with reference to Figs. 1 to 3 inclusive. The feature of adjustability of the pressure relief spring is omitted from the construction shown in Fig. 4, but in other respects the construction in general and its manner of operation are substantially the same as in the above described construction shown in Figs. 1, 2 and 3, and similar reference numerals have been applied to corresponding parts. In this particular construction as shown, the outer or upper end portion of the bore or socket 39, for a somewhat modified valve carrying plug 54, is enlarged and screw-threaded to form a shoulder for a sealing gasket 55 which is clamped down by means of a ring 56 which is screwed into the threaded end portion of this socket, this clamping ring 56 being also internally screw-threaded for receiving the screw-threaded valve-carrying plug 54, the screw-threaded portion of which also passes through the gasket 55, as shown.

This valve-carrying plug 54 has at its inner end a reduced shoulder-forming stem portion 57 over the end of which there slidably fits a valve member 58 having a closed conically pointed lower end, this valve member or valve tip being in general of cup shape, forming an inverted cap for the lower end of the stem 57. A small pin 59 carried by and passing through the stem 57 engages at its ends in vertical slots 60 in the sides of the valve member 58. This small pin 59 in cooperation with the slots 60 retains the cup-shaped valve tip 58 in place on the stem 57 and limits its sliding movement. A strong coiled compression spring 61 surrounds the stem 57 between the top of the valve member 58 and the shoulder formed by the stem 57 with the larger screw-threaded plug portion 54. This spring 61 is originally given the desired predetermined normal resistance or initial tension for holding the slidable valve member 58 at its innermost or lowermost position with the desired force.

The remaining parts of the mechanism of the complete door-closer and check not illustrated in Fig. 4 may be the same as that hereinbefore described with reference to Figs. 1, 2 and 3, or could be of some other suitable construction, similarly in that respect to what is shown in Figs. 1, 2 and 3. The operation of this modified construction shown in Fig. 4 is substantially the same as with the valve device shown in Figs. 1, 2 and 3, both in its normal checking operation and in its strain-preventing pressure-relieving operation. The sealing gasket 55 with its clamping ring 56 might in some instances be dispensed with, and on the other hand if desired they could be utilized in the construction shown in Figs. 1 to 3 inclusive, for the valve-carrying plug 46, as well as also for the smaller screw plug 53.

Fig. 5 shows a variant or modified form of the invention as compared with that shown in Figs. 1 to 3 inclusive. In the construction shown in Fig. 5 the restricting valve or needle valve and the pressure-relief valve are separate from each other, but in other respects throughout, the construction may be considered as the same as that shown in Figs. 1, 2 and 3, and the general manner of operation is substantially the same. Overlapping lower and upper longitudinal bores 62 and 63 are provided in the thickened portion 37 of the wall of the cylinder 26; the lower bore 62 communicatin with the inside of the cylinder 26 adjacent to its closed end by means of a short vertical bore 64, while the upper bore 63 is shown as opening by means of a vertical bore 65 into the cylinder near its open end outwardly from the piston or plunger 30, which in Fig. 5 is shown at its outer or withdrawn position of travel.

Two short vertical bores 66 and 67 extend upwards from the lower horizontal bore 62, of which the bore 67 leads from the adjacent closed end of this longitudinal bore 62. The upper end of the bore 66 opens into the conical or funnel-shaped bottom or lower end of a vertical socket bore 68 from which the upper longitudinal bore 63 leads, while the other short vertical bore 67 opens upwardly into the conical or funnel-shaped bottom of a similar vertical socket bore 69 which intersects the upper longitudinal bore 63, so that thereby this upper longitudinal bore 63 communicates with both of the vertical socket

bores 68 and 69. Each of the socket bores 68 and 69 extends downward from the outside of the casing box body part 1 through the cylinder boss 38, and is provided with screw threads in its upper end portion. These two vertical socket bores 68 and 69 are shown as duplicates of each other, and each may be substantially the same as the socket bore 39 shown in Figs. 1, 2 and 3.

Either one of these socket bores 68 and 69 may contain a needle valve for restricting the flow of the checking fluid in the normal checking operation, while the other one of these socket bores contains a pressure relief valve for relieving abnormal or excessive pressure of the checking fluid, thereby to prevent undue strain on the checking mechanism, while permitting a more rapid closing of the door, such as 8. A needle valve 70 having a conical end for cooperating with the opening 67 is carried by and forms an inner reduced extension of a screw-threaded plug 71 which is adjustably screwed into the outer or upper end of the left hand socket bore 69, so that by turning this valve plug 71 inward or outward the size of the fluid-restricting opening around the inner conical end of the needle valve 70 may be reduced or enlarged as desired.

The conically inclined bottom of the right hand socket bore 68 forms a valve seat for a valve ball 72 which normally closes the upper end of the short vertical bore 66 as shown. This valve ball or valve member 72 is seated by a strong coiled compression spring 73 located above it in the socket bore 68 and maintained under compression or normal initial tension by means of an abutment plug 74 adjustably screw-threaded into the outer or upper end of the socket bore 68. By turning this abutment plug 74 inward or outward the resistance of the spring 73 to upward opening movement of the valve member 72 may be increased or decreased as may be desired, so that thereby there may be obtained the desired relief of abnormal or excessive pressure in the checking fluid together with prevention of undue strain on the checking mechanism, while the door such as 8 may be more rapidly and easily closed. Also the resilient resistance of the relief valve spring 73 to the unseating of the valve ball 72 may be adjusted relatively to the different adjustment of the needle valve 70 for securing the desired cooperating relation in operation between the relief valve device and the needle valve.

In the further modified embodiment of the invention shown in Fig. 6, the relief valve device is carried by the piston 75, the construction in other respects being similar to that shown in Fig. 5 and the general operation being substantially the same as in all of the above described constructions, the adjustment of the pressure-relief spring, however, as shown in Fig. 5, being omitted from the construction shown in Fig. 6. In this construction a bore extends entirely through the piston 75, comprising a long enlarged outer socket-forming portion 76 and a short inner reduced portion 77 which forms an annular conical valve seat with the enlarged portion 76 of this bore. A ball relief valve 78 is normally held against this seat by a strong coiled compression spring 79 contained within the socket 76 and maintained under the desired degree of compression or initial tension by a cross-pin 80 which extends across the socket 76 adjacent to its outer end and forms an abutment for the outer end of the spring 79.

The piston 75 differs from the piston 30 shown in the preceding figures of the drawings only in the respect that this piston 75 is provided with the above described pressure-relief valve device. The piston 75, similarly to the piston 30, also is provided with a freely opening one-way relief valve which affords free outward or door-opening movement of this piston 75. This one-way valve deivce comprises a large bore 81 extending from the inner end of the piston and forming a conical valve seat with a smaller and shorter bore 82 at the outer end of this piston. A freely movable valve ball 83 in the large bore 81 seats on the valve seat provided by the small bore 82 in the inward or checking movement of the piston. This valve ball is prevented from escaping by a small cross pin 84 across the bore 81 and spaced sufficiently from the valve seat to provide ample clearance for the valve ball 83, which is contained loosely in the large bore 81.

In this construction shown in Fig. 6 the passageway in the cylinder 26 around the piston 75 may be and is shown as the same as above described with reference to Figs. 1, 2 and 3, and the same reference numerals have been applied. The upwardly-opening socket bore 39 contains a needle valve of the same construction as that described with reference to Fig. 5 and operating in the same way. This needle valve in Fig. 6 similarly comprises an outer plug 85 adjustably screw-threaded into the upper end of the socket 39 and carrying at its inner end a reduced needle valve extension or stem 86, the inner conical end of which cooperates with the upper end of the short vertical bore 41 through the annular conical bottom 40 of the large bore 39.

In the operation of this construction as shown in Fig. 6 the checking fluid passes through the connected or intercommunicating bores in the checking action only, entering this checking passageway through the short vertical bore 43 at the closed end of the cylinder 26 and emerging at the open end of the cylinder through the vertical outlet bore 45 beyond the outward limit of travel of the piston 75. In the relief action, under abnor-

mal or excessive pressure of the checking fluid the spring-pressed ball valve member 78 yields away from its seat and provides an additional flow of the checking fluid, which passes through the piston 75 from the inner to the outer side thereof.

In Fig. 7 there is shown a slightly variant form of the embodiment of the invention from that shown in Fig. 6 just described, and the parts that remain unchanged have been given the same reference numeral and require no further description. In this construction shown in Fig. 7 a piston or plunger 87 has through it two medium sized bores 88 and 89 of uniform diameter. The inner end of one of these bores, shown as the upper bore 88, forms a valve seat for the rounded side of a hemispherical valve member 90 which is carried by a straight flat leaf spring 91, the other end of which is secured to the inner end of the piston 87 by means of a screw 92. This leaf spring 91, it will be noted, is thin and weak, so that thereby it does not offer any appreciable resistance to the opening movement of the valve member 90 in the outward or door-opening direction of movement of the piston 87, thus affording a free flow of the checking fluid from the outer to the inner side of the piston 87, while in the inward or checking movement of the piston this spring assists the pressure of the fluid in closing the valve member 90 against its seat. This valve member 90 of course corresponds to and operates in substantially the same way and with substantially the same amount of freedom of movement as the hereinbefore described valve balls, such as the relief valve ball 35 shown in Fig. 1.

The pressure-relief valve device shown in Fig. 7 operates in substantially the same way as that described with reference to Fig. 6. As shown in Fig. 7 a hemispherical valve member 93 seats at its rounded side on the outer end of the other bore 89 in the piston 87 and is carried by the end of a leaf spring 94 the other end of which is secured to the outer side of the piston 87 by means of a screw 95. It will be noted that this latter leaf spring 94 is rather thick and strong, so that thereby as the piston 87 is moved inward into the cylinder 26 the spring 94 will hold the valve member 93 firmly seated in the normal checking operation. However, abnormal or excessive pressure of the checking fluid during the checking movement of the piston, will force the valve member 93 away from its seat against the resistance of its spring 94, thereby permitting the checking fluid to flow away from the closed end of the cylinder 26 through the bore 89 to the other or outer side of the piston 87.

It is obvious that various modifications may be made in the constructions shown in the drawings and above particularly described, within the principle and scope of the invention as defined in the appended claims.

I claim:

1. In a door check, a piston, a cylinder in which said piston moves, said cylinder having a by-pass formed therein around the piston, a valve seat in said by-pass, a valve movable toward and from the valve seat and held in adjusted spaced relation to the valve seat to regulate normal flow through said by-pass, and yieldable means pressing against said valve and permitting abnormal flow of liquid from one end of the cylinder to the other by opening movement of said valve under excessive pressure conditions.

2. In a door check, a piston, a cylinder in which said piston moves, said cylinder having a by-pass formed therein around the piston and having a valve chamber extending laterally from said by-pass and into which respective ends of the by-pass opens, a valve seat at the opening of one end of the by-pass into the chamber, a valve supporting member screwed into the end of the chamber remote from the valve seat to move toward and from said seat, a valve carried by said member to move therewith toward the valve seat, said valve being normally spaced from said seat, a spring urging the valve away from said member toward said seat, and means to limit movement of the valve away from said member.

3. In a door check, a piston, a cylinder in which said piston moves, said cylinder having a by-pass formed therein around the piston and having a valve chamber extending laterally from said by-pass and into which the by-pass opens, a valve seat at the opening of the by-pass into the chamber, a valve supporting member screwed into the end of the chamber remote from the valve seat to move toward and from said seat, a valve carried by said member to move therewith toward the valve seat, said valve being normally spaced from said seat, a spring urging the valve away from said member toward said seat, means to limit movement of the valve away from said member, and means to regulate the tension of said spring.

In witness whereof, I hereunto subscribe my signature.

FORREST C. GARRISON.