(No Model.)

E. C. LE BOURGEOIS.

LIQUID DOOR CHECK.

No. 548,881. Patented Oct. 29, 1895.

Fig. 1

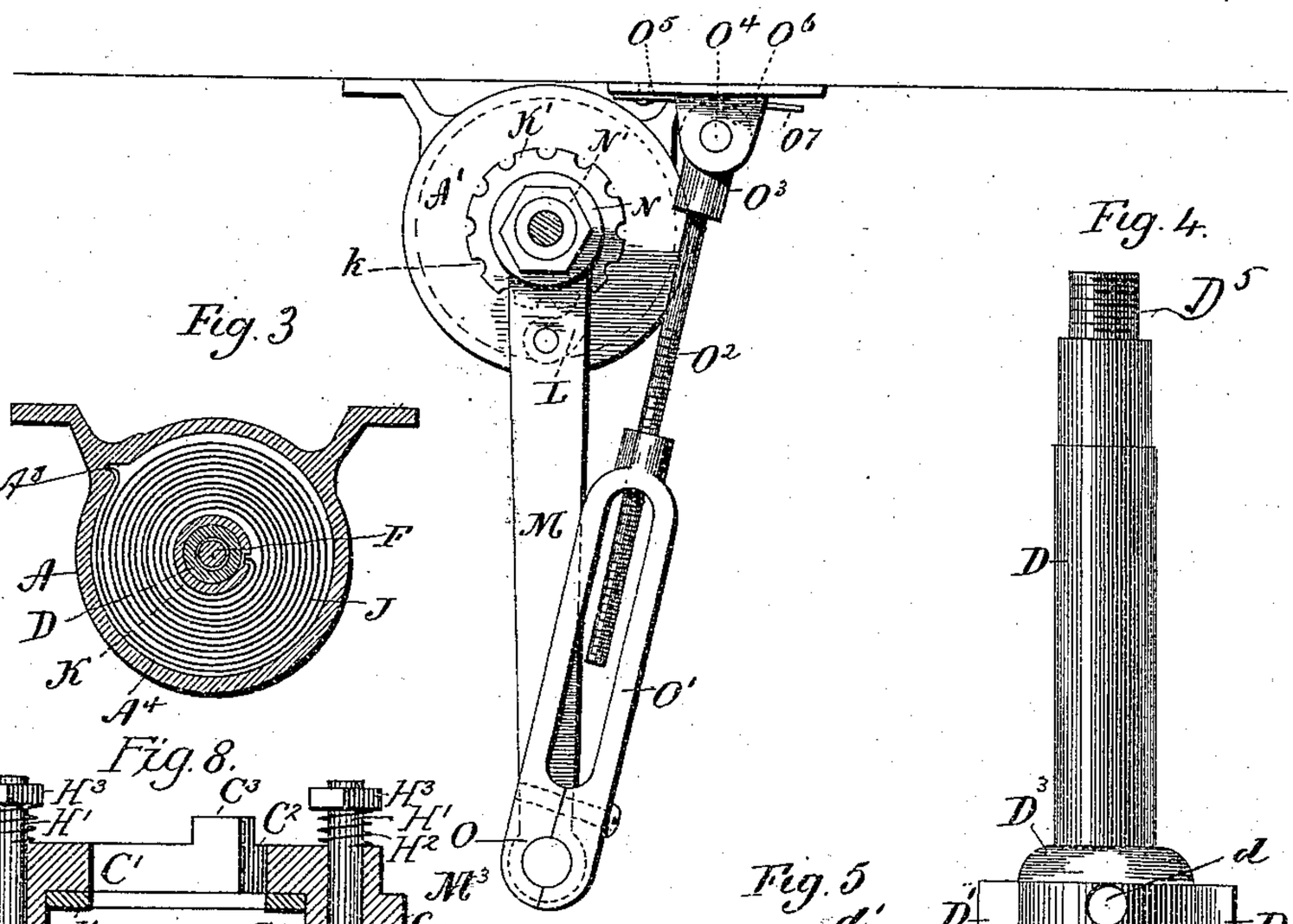
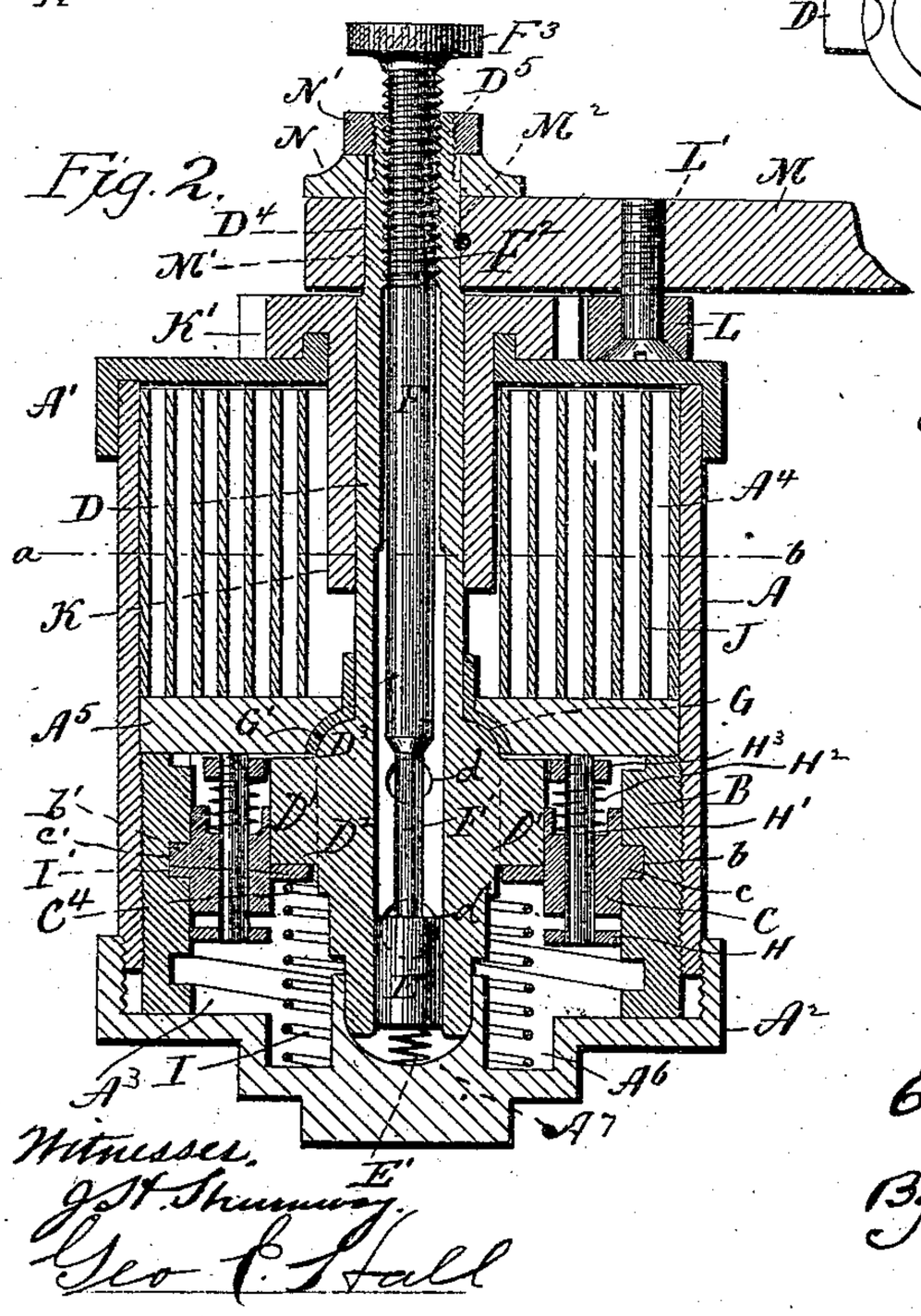


Fig. 3

Fig. 8.

Fig. 2.



Witnesses.
J. H. Shumway.
Geo. C. Hall

Fig. 5

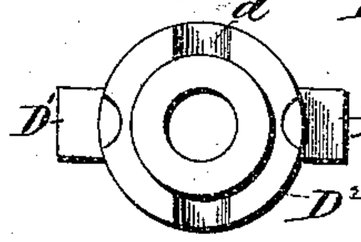


Fig. 4.

Fig. 7

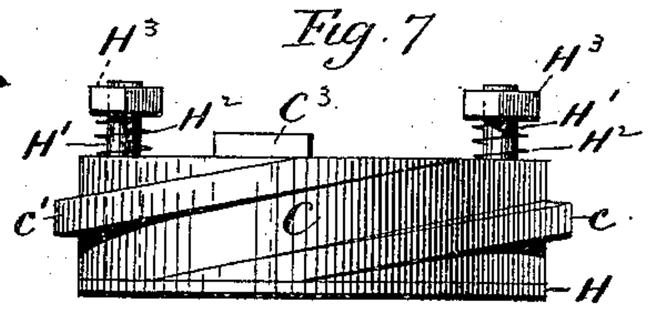
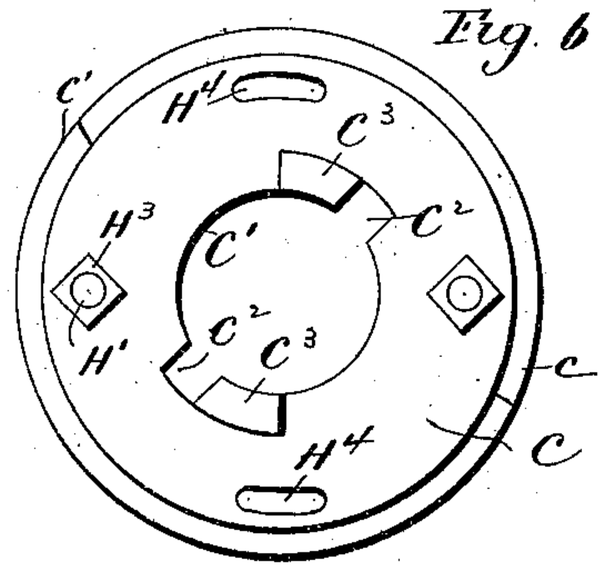


Fig. 6



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UNITED STATES PATENT OFFICE.

EDWARD C. LE BOURGEOIS, OF NEW HAVEN, CONNECTICUT.

LIQUID DOOR-CHECK.

SPECIFICATION forming part of Letters Patent No. 548,881, dated October 29, 1895.

Application filed August 21, 1894. Serial No. 520,942. (No model.)

To all whom it may concern:

Be it known that I, EDWARD C. LE BOURGEOIS, of New Haven, in the county of New Haven and State of Connecticut, have invented a new Improvement in Fluid Door-Checks; and I do hereby declare the following, when taken in connection with the accompanying drawings and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a plan view showing a door-check constructed in accordance with my invention; Fig. 2, a view in vertical longitudinal section of one form which my improved device may assume; Fig. 3, a view of the device in transverse section on the line *a b* of Fig. 2; Fig. 4, a detached view, in side elevation, of the shaft; Fig. 5, an end view thereof; Fig. 6, a plan view of the plunger; Fig. 7, a view thereof in side elevation; Fig. 8, a detail view of the plunger in vertical central section, showing also the washer which is located in the recess formed in its lower face.

My invention relates to an improvement in that class of door-checks in which a fluid is employed to resist the power of the spring and the inertia of the door, so that the same will close softly, the object being to produce a simple and compact device composed of few parts and not liable to derangement or leakage nor to burst under the great pressure imposed upon the fluid during the closing of the door.

With these ends in view my invention consists in a fluid door-check having certain details of construction and combinations of parts, as will be hereinafter described, and pointed out in the claims.

In carrying out my invention as herein shown I employ a heavy cylinder A, adapted in the usual manner to be applied to a door, furnished at its upper end with a cap A′ and at its lower end with a threaded adjustable cap A^2 and divided into a fluid-chamber A^3 and a spring-chamber A^4 by means of a diaphragm A^5, located about midway of its length and formed integral with it or made independent of it and secured in place in any approved manner. Into the fluid-chamber A^3, which is located below the diaphragm A^5, I introduce a heavy bushing B, externally threaded, as shown, for being secured within the cylinder. If preferred, however, I may secure the bushing within the cylinder in some other manner. The inner periphery of the bushing has formed in it two spiral grooves *b b′*, which receive two corresponding ribs *c c′*, formed upon the outer periphery of a plunger C, substantially corresponding in external diameter to the internal diameter of the bushing and designed to be moved from one end to the other of the fluid-chamber through the fluid therein contained.

For the purpose of rotating the plunger and moving it back and forth, as described, I employ a hollow shaft D, which extends throughout the length of the cylinder and projects above the upper end thereof. This shaft passes through a central circular opening C′, formed in the plunger, with which the shaft is connected and disconnected by means of two oppositely-projecting shoulders D′ D′, formed upon a head or enlargement D^2, located at the lower end of the shaft. These shoulders take into slots C^2 C^2, located opposite each other and leading out of the central circular opening C′ of the plunger, and also engage with lugs C^3 C^3, located opposite each other on opposite sides of the said slots. I thus provide for connecting and disconnecting the plunger and shaft on the clutch principle so far as the rotation of the plunger by the shaft is concerned.

It will be understood that the fluid-chamber is filled with some heavy fluid, which in the opening and closing of the door passes under control from one side of the plunger to the other, and so performs its work. This fluid may be oil, glycerine, or any other heavy fluid which may be found to be suitable for the purpose. In place of a fluid I may employ a paste of sufficient mobility to act in the manner required.

For the purpose of permitting the fluid or paste to pass from one side of the plunger to the other I form two transverse ports *d* and *d′* in the head D^2 of the shaft, both of the said ports intersecting the hollow interior of the shaft and being separated from each other by a distance greater than the thickness of the plunger. When the plunger is moved upward in the fluid-chamber the fluid will enter the

opposite ends of the transverse upper port *d* at a point above the plunger and flow downward through the head of the shaft and emerge at a point below the plunger through the opposite ends of the lower transverse port *d'*, while, on the other hand, when the plunger is moved downward in the chamber the fluid will enter the opposite ends of the transverse port *d'* of the shaft and flow upward therein and emerge therefrom at a point above the plunger through the opposite ends of the transverse port *d*.

For the purpose of controlling the flow of the fluid back and forth through the ports *d* and *d'* and through the hollow shaft, as described, I locate a valve E in the extreme lower end of the shaft at a point where its inner end intersects the transverse port *d'*. This valve is in part controlled in position and in operation by means of a spiral spring E', the inner end of which enters a counterbore formed in the outer end of the valve, while the outer end of the spring impinges against the bottom of the step A^7, formed in the center of the cap A^2 to receive and constitute a bearing for the lower end of the shaft. The valve is regulated in position against the tension of the spring E' by means of a long valve-rod F, extending nearly throughout the length of the shaft and projecting beyond the upper end thereof. The inner end of this rod is reduced in diameter, as at F', so as to obstruct as little as possible the passage of the fluid between the two transverse ports *d* and *d'*, while the outer end of the rod is screw-threaded, as at F^2, to adapt it to take into the internally-screw-threaded upper end of the shaft, the extreme upper end of the rod being provided with a knurled operating-button F^3, by means of which the rod is rotated to regulate the position of the valve.

For the purpose of forming a bearing for the shaft, which rotates in the cylinder, although it has no endwise movement therein, I locate a bushing G in the diaphragm A^5, this bushing having an annular recess G' formed in its lower face to receive an annular convex wearing-surface D^3, formed at the upper end of the head D^2 of the shaft D.

I may mention here that all the high pressure of the fluid takes place between the bottom of the plunger and the lower cap A^2, so that normally there is no tendency of the fluid to work around the shaft into the spring-chamber; but should there be any tendency of the fluid to move upward into the spring-chamber it will be resisted by the fit between the bushing and the convex wearing-surface D^3, formed at the upper end of the head of the shaft.

Although the transverse ports *d* and *d'* will be found to be sufficient for the passage of the fluid from one side of the plunger to the other, I by preference employ a safety or relief valve H, which facilitates the transference of the fluid from the upper to the lower end of the fluid-chamber during the upward movement of the plunger. This valve H is annular in form and placed directly against the lower face of the plunger, to which it is yieldingly attached by means of two pins H' H', extending upward through the plunger and encircled at their projecting upper ends by springs H^2 H^2, regulated in tension by nuts H^3 H^3, applied to the extreme upper ends of the pins, which are threaded, the said springs exerting a constant effort to draw the valve against the lower face of the plunger, and so close two vertical ports H^4 H^4, formed in the plunger and extending clear through the same. Of course I may, if preferred, employ more than two pins and more than two ports. I also prefer to employ a spiral spring J, the outer end of which is seated in a recess A^6, formed to receive it in the cap A^2, while its inner end impinges against a washer I', located within a recess C^4, formed in the lower face of the plunger, the washer resting against the top of the said recess C^4, except when the plunger is in its raised position, at which time the shoulders D' D' of the head D^2 of the shaft D will extend so far through the slots C^2 C^2, formed in the plunger, as to lift the washer away from the top of the recess C^4 and carry the washer, at which time the whole tension of the spring will be exerted in forcing the convex wearing-surface D^3 of the head D^2 against the concave surface G' of the bushing. The spring I will therefore be seen to have a twofold function, for when the washer bears against the top of the recess in the plunger the force of the spring will be exerted in helping to lift the plunger, and hence in diminishing its resistance to rotation and facilitating its upward movement, while, on the other hand, when the force of the spring is exerted directly against the shaft it seats the wearing-surface D^3 more firmly in the bushing and helps to prevent the escape of any fluid into the spring-chamber when the device is laid on its side. Owing to the position of the cylinder when in use gravity will naturally keep the fluid away from the joint between the shaft and the bushing; but when the device is, for instance, in stock or being transported and is laid on its side the spring, if employed, will come into play for preventing the leakage of the fluid into the said spring-chamber, as stated.

Having now described those parts of my device relating more directly to the fluid-chamber, I will proceed to describe the remaining portions of the device, as herein shown, although I would have it understood that they may be varied as required.

Within the spring-chamber A^4, which is located above the diaphragm A^5, I place a heavy coiled spring J, the outer end of which is bent to form a hook taking into a slot A^8 in the upper end of the cylinder A, while its inner end is bent to form a hook taking into a long groove formed in the sleeve K of a rotary head K', which bears upon the outer face of the

cap A'. The upper portion of the hollow shaft D has bearing, it will be observed, in the said sleeve K and head K'. The head K' is furnished with a circular series of peripheral notches *k*, which receive a pawl L, secured by a screw-bolt L' to the under face of the inner end of the door-lever M, the inner end of which is constructed with an opening M', adapting it to fit over a bearing D^4, formed by reducing the projecting outer end of the shaft, upon which the said door-lever is retained by means of a washer N and a nut N', the latter being applied to the extreme upper end of the shaft, which is threaded, as at D^5. A pin M^2 is employed to key the door-lever to the shaft, the said door-lever and shaft being thereto grooved to receive the pin.

The outer end of the door-lever M is provided with a ball M^3, forming one member of a ball-and-socket joint, the other member of which consists in a socket O, formed in the outer end of a swivel O', which is applied to the outer end of a long screw-threaded rod O^2, entering at its inner end into a head O^3, pivotally secured by a stud O^4 to a bracket O^5, adapted to be applied to the casing. The said swivel O', screw-threaded rod O^2, and head O^3 form what I shall term, for convenience, the "casing-lever." The extreme inner end of the head O^3 has a flattened surface O^6 for co-operation with a spring O^7, located within the bracket and designed to exert a constant effort to throw the casing-lever into the position due to it when the door is closed.

Having now described in detail the construction of one form which a fluid door-check constructed in accordance with my invention may assume, I will proceed to describe the operation of the device.

Let it be assumed that the door is closed. At this time the plunger will be located at the bottom of the fluid-chamber, with the fluid above it. At this time, also, the oppositely-projecting shoulders D' D' of the head D^2 of the shaft D will be located entirely above and out of line with the slots C^2 C^2 of the plunger. Now when the door begins its opening movement the shaft will be turned through the medium of the door-lever, so that the shoulders will be caused to move over the said slots and engage with the lugs C^3 C^3. The shaft continuing to rotate, the coaction of the said shoulders and lugs will cause the shaft to pick up the plunger, so to speak, and begin its rotation and consequent elevation, for on account of the spiral ribs upon the outer periphery of the plunger and the grooves in the inner periphery of the bushing the plunger will move up or down, according to the direction in which it is turned. Therefore as the plunger begins to rotate during the opening movement of the door it will rise, its slots C^2 C^2 moving upward over the shoulders D' D'. As the plunger moves upward the fluid above it is placed under pressure and forced through the transverse port *d*, thence downward and out through the transverse port *d'*, which is below the lower face of the plunger. As the fluid moves downward through the shaft it impinges against the inner end of the valve E and forces the same downward to a greater or less degree, according to the pressure of the fluid and the tension of the spring E' below the valve; but when the safety-valve H is employed the fluid above the plunger will for the most part escape into the lower part of the fluid-chamber through the ports H^4 H^4 in the plunger, the fluid entering the said ports and impinging against the valve H, the springs H^2 H^2 controlling which are lighter than the spring E' controlling the valve E. Then just before the plunger reaches the limit of its upward movement the upper ends of the pins H' H' will engage with the lower face of the diaphragm A^5 and positively open the valve H, so that all of the fluid remaining above the plunger will then be allowed to freely flow down into the lower part of the fluid-chamber. It will thus be seen that at the time when the door is in its fully-opened position the shaft will have raised the plunger to the upper end of the fluid-chamber and all the fluid will have been transferred to the lower portion of the said chamber at a point below the plunger. Now when the closing movement of the door begins the shaft will be rotated in the opposite direction and the plunger rotated and positively moved downward. As the pins H' H' are gradually cleared from engagement with the diaphragm during the beginning of the downward movement of the plunger the valve H will close. This will take place before or after the fluid in the fluid-chamber has been placed under pressure, according as the volume of fluid in the chamber is great or small. In any event from the time the valve H is closed the downward movement of the plunger places the fluid in the lower portion of the chamber under pressure, whereby the downward movement of the plunger is resisted, and hence the rotation of the shaft and the movement of the door-lever and the closing of the door. The downward movement of the plunger is not, however, checked, but controlled, for the fluid, being placed under pressure, is forced slowly upward through the transverse port *d'* over the top of the valve E, thence upward through the hollow head D^2 of the shaft D, and thence out into the upper portion of the fluid-chamber through the transverse port *d*.

I may say here that the resistance to the downward movement of the plunger and the closing movement of the door will be exactly proportional to the rapidity with which the fluid is allowed to escape from the lower portion of the chamber and flow thence through the shaft into the upper portion of the chamber, where there is relief from pressure. It will be seen at once that the position of the valve E controls the flow of the fluid from the lower portion of the fluid-chamber to the upper por-

tion thereof, and it has already been pointed out that the spring E′ and the regulating valve-rod F are provided for shifting the position of the valve as required.

In case I dispense with the safety-valve H, which I may do, as I have already indicated, the door will be checked in its closing movement from the very beginning thereof, provided there is enough fluid in the chamber, for in that case just as soon as the plunger begins its downward movement it will place the fluid under pressure and force it to begin its gradual transference into the upper portion of the chamber through the shaft, whereas when the safety-valve is employed a portion of the fluid is suffered to gush back into the upper portion of the chamber through the ports H^4 H^4 of the plunger before any substantial amount of pressure is developed in the fluid. Just before the door reaches its closed position the plunger lets go, so to speak, of the shaft. In other words, the plunger, being drawn positively downward by means of the grooves in the bushing and the ribs upon its periphery is pulled away from the shoulders D′ D′ of the shaft, which emerge from the slots in the plunger entirely, the lower ends of the said shoulders being then located in a plane between the upper face of the plunger and the tops of the lugs thereupon, for it will be understood that the plunger is never moved downward so far but what the shoulders will, when the reverse rotation of the shaft takes place, engage with the lugs for picking up the plunger again; but when the plunger lets go of the shaft the same is free for rotation within the space represented by the separation of the lugs. The restraining influence of the plunger being thus removed from the shaft, the door-spring reasserts itself with full force for closing the door to without any resistance from the fluid. It will thus be understood that the fluid checks and restrains the closing of the door from or near the beginning of its closing movement to a point near the termination thereof. The inertia acquired by the door in closing and the power of the door-spring are thus resisted and restrained and the door prevented from slamming.

I may here mention that the spring O^7, located within the bracket O^5, also comes into play for assisting the closing of the door, inasmuch as when the casing-lever approaches its normal position, which I assume to be the position it has when the door is closed, the spring will exert an effort to make it take that position, and this effort of the spring will be transmitted to the door through the casing-lever and door-lever, so that the spring in question will really assist the main door-spring in closing the door to. Of course it follows that this spring resists the opening of the door up to a certain point, at which the casing-lever changes the direction of its movement, after which it will assist the opening of the door until the lever again changes the direction of its movement, after which the spring will again resist the opening of the door. The intermediate action of the spring O^7 is not particularly significant, its chief value lying in the assistance it offers at the time of closing the door.

I may explain the varied action of this spring by stating that in opening and closing the door the casing-lever is caused to move first in one direction and then in the other as the door takes different positions. The particular character of these movements will depend upon the particular way in which the check is applied to the door and does not need detailed description.

I would call attention to the fact that in my improved device the pressure of the fluid is distributed over the bottom of the plunger, the cap closing the bottom of the fluid-chamber and so much of the bushing as is exposed at any one time below the plunger. I thus reduce the chance of bursting the cylinder to the minimum, whereas that has been a great objection to fluid-checks as generally constructed, in which the pressure has been localized upon some particular point in the wall of the fluid-chamber, with the effect of very frequently breaking away the wall at that point or else springing a leak at some other point. By the use of a bushing, as described, I am enabled to reinforce the cylinder at the point where reinforcement is required without making it heavy throughout. By the use of a bushing, also, I secure a wide and tight joint for the cap closing the fluid-chamber, and thus prevent leakage.

It is obvious that in carrying out my invention some variations from the details herein shown and described may be made, and I would therefore have it understood that I do not limit myself to the exact construction herein set forth and illustrated, but hold myself at liberty to make such changes and alterations as fairly fall within the spirit and scope of my invention. Thus I may, if I choose, dispense with the safety-valve H. Furthermore, instead of employing two ribs on the plunger and two grooves in the bushing I may employ one rib and one groove or three ribs and three grooves, or even more, according to the size of the parts and the work to be demanded of the device, it being desirable to have the pitch of the ribs very coarse, so that the plunger may be caused to move up and down, as required, under a partial rotation of the shaft, which never makes a complete revolution.

I am aware that a fluid door-check having a plunger, in combination with means for raising and lowering the same in a body of fluid through the medium of the shaft or spindle of the check, is old, and I do not claim such a construction broadly.

I am also aware that fluid door-checks have been provided with valves and relief-passages

arranged to permit a body of fluid to flow freely in one direction and under restraint in the opposite direction.

I do not, therefore, broadly claim either a movable plunger or a construction for permitting the fluid to flow freely in one direction and under control in the other.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A fluid door-check having a cylinder containing a fluid chamber, a shaft extending into the said fluid chamber, and a plunger adapted to be rotated by the said shaft, and constructed with a peripherally arranged spiral rib taking into a corresponding groove in the chamber so that as the plunger is rotated it will be also moved up and down, substantially as set forth.

2. A fluid door-check having a fluid chamber, a shaft extending thereinto, and a plunger adapted to be moved back and forth in the said chamber, the said shaft and plunger being constructed to form the respective members of a clutch for the connection of the shaft with, and its disconnection from, the plunger, substantially as set forth.

3. A fluid door check having a fluid chamber, a hollow shaft extending thereinto, and constructed with two ports separated from each other and intersecting its hollow interior, a plunger located within the chamber and adapted to be connected with the shaft for movement back and forth in the chamber, and constructed with one or more vertical ports, a valve located in the shaft to control the passage of fluid through the ports formed in it, a spring for moving the valve in one direction, a regulating valve-rod located in the shaft and engaging with the valve for moving it in the opposite direction against the tension of the said spring, a safety or guard valve applied to the lower face of the plunger for cooperation with the vertical port or ports thereof, means for positively opening the said guard valve, and one or more springs for the same, substantially as described.

4. A fluid door check, having a fluid chamber, a hollow shaft extending thereinto and provided with laterally projecting shoulders, a plunger located in the said chamber and constructed with a central opening to receive the said shaft and with slots leading out of the said opening to receive the said shoulders, a spring located within the said chamber in position to act upon the plunger or upon the said shoulders of the shaft, according to the position of the plunger in the fluid chamber, and a washer interposed between the spring, and the plunger and shoulders, substantially as set forth, and whereby the spring assists the movement of the plunger in one direction and holds the shaft in position.

5. A fluid door check, having a cylinder, a stationary diaphragm located therein and dividing it into a spring chamber and a fluid chamber, a hollow shaft extending through the said chambers and diaphragm and constructed at its lower end with an enlargement or head, which is located in the fluid chamber and takes a bearing in the said diaphragm, a spring located in the spring chamber and connected with the shaft, and a plunger located in the fluid chamber and adapted to be connected with the shaft for movement back and forth in the said chamber, substantially as set forth.

6. A fluid door-check comprising a cylinder containing a diaphragm which divides the cylinder into a spring-chamber and a fluid chamber, a bushing located in the center of the said diaphragm, a shaft extending through the said chambers, and constructed with an enlarged head one end of which takes a bearing in the said bushing, a spring located in the spring chamber, means for transmitting the power of the said spring to the said shaft, and a plunger located in the fluid chamber and adapted to be connected with the shaft for movement back and forth in the said spring-chamber, substantially as described.

7. A fluid door-check having a fluid-chamber, a shaft extending thereinto and constructed with two oppositely extending shoulders, and a plunger located in the said chamber, having a central opening to receive the shaft, two slots to receive the said shoulders, two lugs to coact with the said shoulders, and a spiral rib taking into a corresponding groove located in the said chamber, the said parts being constructed with ports or passages to permit the fluid to pass from one side of the plunger to the other, substantially as described.

8. In a door-check the combination with the casing-bracket thereof, of a spring located in the said bracket, and a casing-arm pivoted in the said bracket and having its extreme inner end flattened for coaction with the spring, substantially as described.

9. A fluid door-check having a cylinder containing a spring-chamber and a fluid chamber, a spring located in the fluid-chamber, a shaft connected with the door and also with the said spring, and a plunger located in the fluid chamber and adapted to be moved back and forth therein by the said shaft, the said shaft and plunger forming the respective parts of a clutch which operates to uncouple just before the door closes, substantially as and for the purpose described, and whereby the resistance of the plunger and fluid is entirely removed just before the door closes to permit the spring to reassert itself and do that work.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EDWARD C. LE BOURGEOIS.

Witnesses:
GEO. E. HALL,
GEORGE D. SEYMOUR.