H. A. JOHNSON AND F. T. ETHEREDGE.

DOOR OPERATING MECHANISM.

APPLICATION FILED MAR. 19, 1920.

1,375,219.

Patented Apr. 19, 1921.

2 SHEETS—SHEET 1.

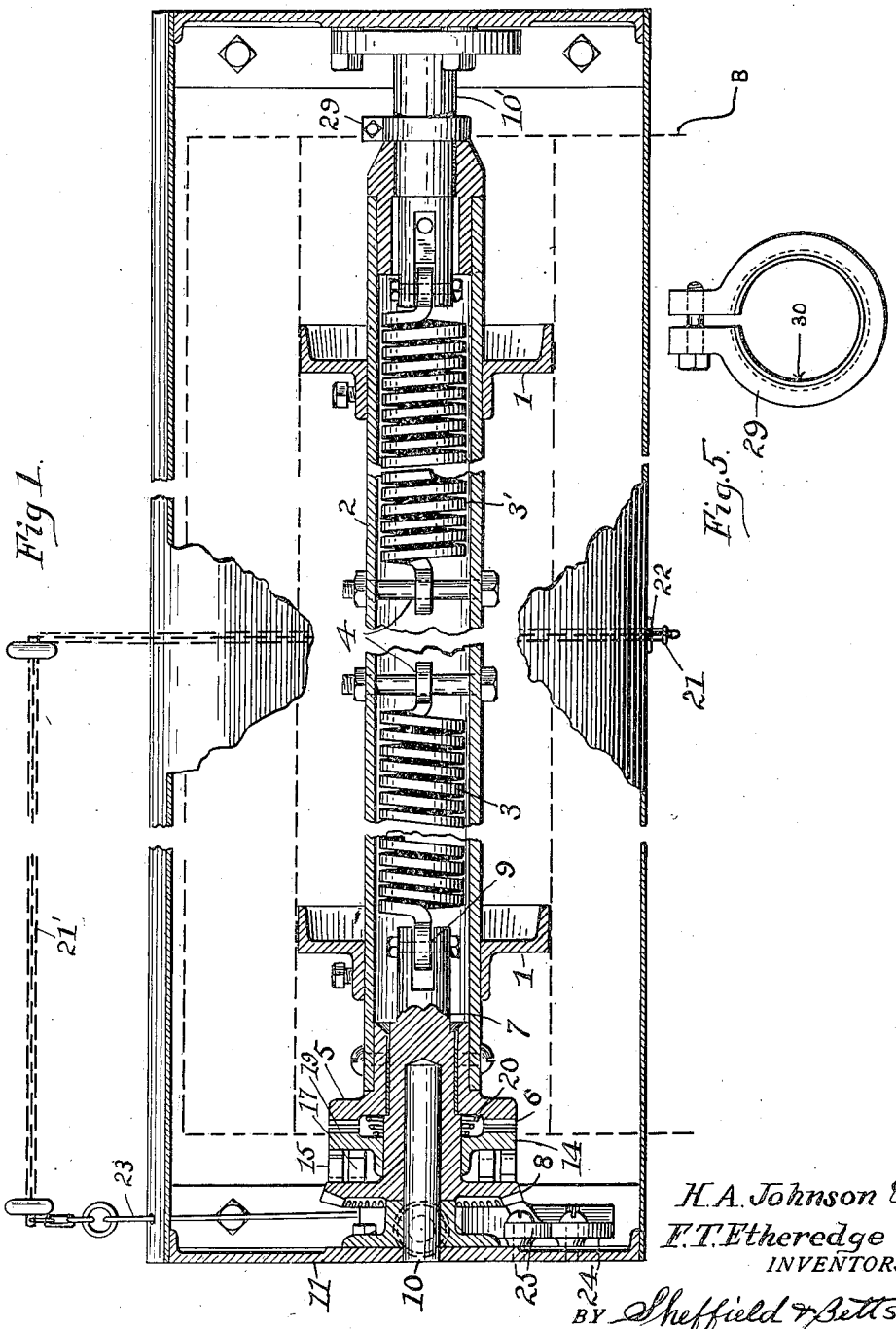


Fig 1.

Fig 5.

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2 SHEETS—SHEET 2.

Fig. 4.

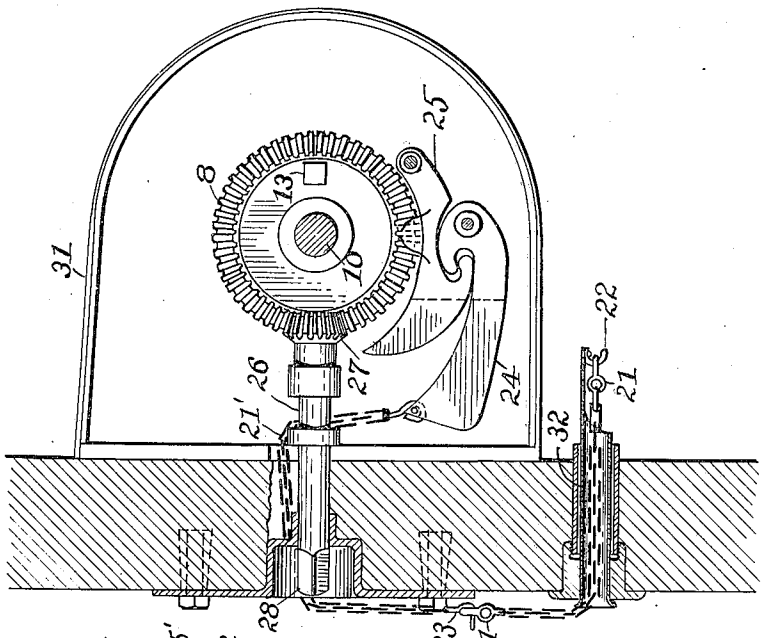


Fig. 3.

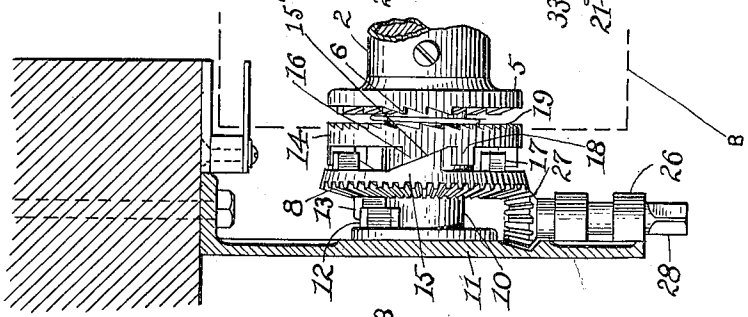
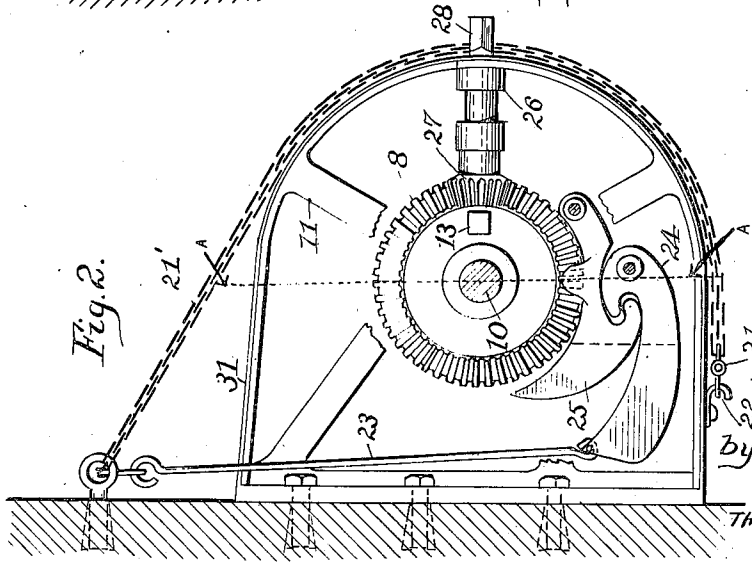


Fig. 2.



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UNITED STATES PATENT OFFICE.

HOWARD A. JOHNSON AND FRANCIS T. ETHEREDGE, OF NORFOLK, VIRGINIA.

DOOR-OPERATING MECHANISM.

1,375,219. Specification of Letters Patent. Patented Apr. 19, 1921.

Application filed March 19, 1920. Serial No. 367,230.

To all whom it may concern:

Be it known that we, HOWARD A. JOHNSON and FRANCIS T. ETHEREDGE, both being citizens of the United States, and residing in Norfolk, county of Norfolk, State of Virginia, have invented certain new and useful Improvements in Door-Operating Mechanism, of which the following is a specification.

Our invention relates to apparatus that is particularly adapted for use with emergency doors. Its principal object is to provide apparatus which will automatically close such doors when the apparatus is released in any emergency, as when it is subjected to unusual heat, which will be reliable in action and which will permit of the doors being opened or closed without interfering with the automatic mechanism. Other objects and advantages of our invention will be apparent to those skilled in the art by reference to the following description taken in connection with the appended drawing, in which—

Figure 1 is a sectional elevation of the preferred form of our mechanism, the section being taken on the line A—A of Fig. 2, looking in the direction of the arrows;

Fig. 2 is an end elevation; shaft housing and support removed;

Fig. 3 is a plan view;

Fig. 4 is an end elevation of a modified form of our invention; and

Fig. 5 is a detail view of one element of our invention.

Throughout the drawings, similar reference characters refer to similar parts.

The mechanism illustrated is intended for use in connection with a flexible door or curtain B (shown in the drawing in dotted lines), particularly one made of metal and of considerable weight and which is adapted to be rolled or wound upon a shaft or tube placed at the top of the doorway. As shown in the drawings, the door is attached to and wound upon rings, flanged disks, or barrels 1, rigidly connected to a hollow shaft 2. The door is counterbalanced by helical springs, 3, 3′, disposed within the hollow shaft 2, one end of the springs being connected to the shaft, as at 4, so as to be rotated with it. One end of the shaft terminates in a flange 5, the face of which is provided with ratchet teeth 6. The end of the shaft is journaled on a boss 7, projecting from a bevel gear 8. One end of the spring 3 is also attached to the boss 7 as at 9. The bevel gear 8 is in turn journaled on a flanged bearing stud 10, affixed to the door frame 11. A tooth 12 projects from the flange of the stud 10, and is adapted to engage a tooth 13 projecting from the bevel gear 8, and prevents the latter from rotating more than one turn. A floating clutch ring 14 surrounds the boss 7, between the bevel gear 8 and the flange 5 of the shaft. The bevel gear on the side facing the floating ring is provided with wedge-shaped lugs 15, one side of said lugs being provided with a sloping or beveled cam surface, as shown; the floating ring, on the side facing the bevel gear, is also provided with similar lugs 16, having corresponding sloping or beveled faces. The bevel gear is also provided on the same face with teeth 17, adapted to engage corresponding teeth 18 on the face of the floating ring; the teeth 17 are so placed with relation to the teeth 18 that when the bevel gear 8 is rotated away from the observer, the floating ring 14 will be pushed away from the bevel gear before the teeth 17, 18 cause the former to rotate with the latter.

The face of the floating ring opposite the bevel gear is provided with ratchet teeth 19, adapted to engage the ratchet teeth 6 on the flange of the shaft. A small spring, 20, is placed between the flange 5 and the floating ring 14 to keep the ratchet teeth out of engagement when the mechanism is not in operation.

The mechanism is provided with a fusible link 21 in a chain 21′; attached at one end to the frame 11, as at 22; the other end of the chain is connected to one of a pair of levers, 24, or the chain may be connected directly to the lever, as shown in Fig. 4. The other lever 25 operates as a pawl engaging the teeth of the bevel gear 8 to hold it against rotation. A pinion shaft 26 is also provided, having a pinion gear 27 adapted to engage the bevel gear; the opposite end of the pinion shaft is squared as shown at 28, to permit the use of a wrench or crank thereon.

At the other end of the shaft 2 we provide a split (expansion) ring or collar 29, which is lined with Babbitt or other fusible metal, as at 30; this lining is preferably more difficultly fusible than that of which the ring 21 is composed.

The door is so arranged that it may be

raised or lowered, being wound, when raised, upon the rings 1; the free end hanging back of the shaft 2 in Fig. 1, at the right in Figs. 2 and 4, and at the top in Fig. 3. The weight of the door is counterbalanced by the springs 3, 3′, which wind up when the door is lowered and unwind when it is raised. This is effected by anchoring one end of each spring to the shaft, as at 4, the other end of spring 3′ being fastened to the bearing stud 10′, and that of spring 3, boss 7, of the bevel gear 8, as shown at 9 and heretofore described. In normal operation, the bevel gear is locked against rotation by the lever 25, as stated above. Thus the door may be raised or lowered at will, with only slight effort, and without interfering in any way with the automatic closing mechanism.

When the door is open, the various elements of our automatic closing mechanism are associated as shown in the drawings. In case of fire, this mechanism operates as follows: The fusible link 21 melts, thus allowing the levers 24, 25, to drop, thereby leaving the bevel gear 8 free to rotate. Although the door is open, the springs are nevertheless kept under a certain amount of tension because of the fact that it is desired that the lowest portion of the door be not wound on the rings, and this must be counterbalanced. The bevel gear 8, as well as the boss 7 which connects it to the spring 3, being now free to turn, the gear is given an impetus by the spring which causes it to rotate in the direction taken by the shaft 2, when the door is being lowered, *i. e.*, over and to the left in Figs. 2 and 4. As the gear commences to rotate, the cam surfaces 15′, as shown in Fig. 3, operate to move the floating ring 14 to the right and toward the flange 5 on the shaft 2,—the ratchet teeth 19 on the former coming into engagement with the corresponding teeth 6 on the flange, so that the tension of the spring 3 is transferred temporarily to the flange 5. The teeth 17 on the bevel gear coöperate with the teeth 18 on the floating ring to limit the relative rotation of the bevel gear and floating ring to prevent wedging the ring 14 too strongly against collar 5. At this instant, the spring 3 does not have any retarding effect on the shaft since both anchors of the spring 4 and 9 engage the tube 2 and rotate together in the same direction. The weight of the door, therefore, together with the impetus given the shaft, through the floating ring by the bevel gear as it started to rotate, cause the door to commence to descend, shaft, floating ring, and bevel gear all turning with it until the tooth 13 strikes the tooth 12. Then the bevel gear, having completed one turn, is stopped and held against further rotation. The spring 20, as well as the form of the lugs 15 and 16, then operate to throw the teeth 19 of the floating ring 14 out of engagement with the teeth 6 of the flange 5. The transfer of the tension of the spring 3 to the flange 5 and then to the tooth 12 after one revolution of the gear 8 prevents the latter from rotating suddenly for a whole revolution, and consequently prevents one or the other of the teeth 12 or 13 being broken off under the shock caused by the release of one end of the spring 3. Furthermore, the transfer of the tension of the spring 3 to the flange 5 throws said spring out of action and permits the door to descend under the force of gravity until the tooth 13 strikes the tooth 12 when the spring 3 again becomes active but under reduced tension or torsional effect. On account of the momentum acquired by the descending door, as well as because of the fact that the spring 3 has made one turn without winding up (thus disturbing its balancing effect upon the door), the door will continue to descend until it is completely closed, both springs being wound up while this operation is going on.

Fire doors, such as our invention may be used with, often weigh as much as 500 or 600 pounds. If they are so arranged that, in case of fire, they close without winding up the springs, they are objectionable in two ways which we overcome with the mechanism described herein. In the first place, our invention prevents the door from falling too rapidly when it is automatically released; since the door, as is closes, winds up the springs, the latter have a cushioning effect, thereby preventing the door from striking the floor hard enough to cause injury to itself or the guideways; further, the tension of one of the springs having been somewhat released by making one turn without winding up, the rebound of the door is reduced to a minimum. Also, if anyone should happen to be trapped by the automatic closing of the door, the door may be lifted by one person in spite of its great weight; the springs being wound up nearly enough to counterbalance the door, the latter may be lifted without too great effort, and, since the counterbalancing effect is not complete, will drop again of its own weight.

The expansion collar 29 is provided to hold the shaft 2 in place so that automatic closing mechanism will always be in operative condition. The shaft and closing mechanism are inclosed in a metal hood 31, to protect them from undue heat; the fusible link, however, is placed outside of the hood, being exposed to the heat so that it will fuse as soon as the temperature in the neighborhood of the door mechanism is sufficiently high. Since the collar 29 is protected by the hood, there is no danger that its fusible lining will melt and permit lat-

eral motion of the shaft prior to the operation of the automatic mechanism; also the fact that this lining is not so fusible as the link operates to prevent such an occurrence. If, however, after the door has closed, the heat within the hood 31 should become sufficient to cause the shaft to expand, the lining of the collar 29 will fuse, thus permitting of lateral expansion of the shaft.

After the automatic closing mechanism has operated and the door is closed, the mechanism may be reset so that the springs will properly counterbalance the door and the mechanism will be ready to operate again. This is accomplished by first replacing the fusible link 21. Then a socket wrench or crank is applied to the pinion shaft 26, and the bevel gear 8 rotated through one turn in the direction which is the reverse of that in which the gear turned during the commencement of the operation of closing the door; in this manner the spring 3 is rewound one turn so that the door is then accurately counterbalanced—as it was before the automatic release. After the bevel gear has been rotated as aforesaid, the levers 24, 25, are raised so as to engage and hold the bevel gear and the chain 21′, and fusible link fastened at 22. The expansion collar 29 should also be replaced if necessary. The door is then in normal operative condition and the mechanism ready to operate automatically again in case of need. As hereinbefore explained, the door may now be raised and lowered at will without interfering in any way with the automatic mechanism,—the end 9 of the spring 3 being held against rotation (since the bevel gear is locked by the lever 25), and the floating ring 14 being thrown out of engagement with the flange 5 by the spring 20. The springs 3, 3′, are so designed that they counterbalance the weight of the door almost exactly, and therefore only slight effort is required to raise or lower the door.

In case the door is used as a shutter or is outside of the building, the mechanism may be arranged as shown in Fig. 4. In such case, the pinion shaft 26 runs through the wall of the building, the squared end 28 being on the inside. The chain 21′ is also carried into the building and out again, through a tube 32 to a place outside of both building and hood 31. Fusible links may be placed both inside and outside as shown in the drawing. In case the door has been automatically released, by the fusing of one of the outside links, the mechanism may be reset from within the building in the following manner: The chain 21′ is disconnected at 33 and the tube 32 drawn into the building; the link is then replaced and the tube reinserted; the bevel gear 8 is then rotated by means of the pinion shaft 26, the levers 24, 25, raised into engagement with the gear, and the chain 21′ connected again at 33. All of these operations may be performed from within.

Although we have described only one form of the mechanism for accomplishing the results sought, we are aware that various modifications in details and in the arrangement and combination of parts of our mechanism may be made by those skilled in the art without departure from our invention, and we desire protection for all modifications of our application that come within the scope of our invention as defined in the appended claims.

For instance, it will be obvious, that, while we have shown and described a counterbalance arrangement having two springs, one or more could be used.

It will be understood, moreover, that in the following claims we have used the word "door" in a broad sense to include any of the aperture closing means such as are commonly referred to by the names: "doors", "windows", or "shutters".

Having thus described our invention, what we claim is:

1. A counterbalance for flexible doors and the like, comprising in combination, a rotatable hollow shaft or tube, a torsion spring having one end fixed to said tube for producing a counterbalancing force on said tube, a rotatable sleeve to which the other end of said spring is attached, means for fixing the normal position of said sleeve, devices for releasing said fixing means to allow said sleeve to rotate under the force of said spring, means for transferring the force of said spring and sleeve when released to said tube to cause the sleeve to rotate in unison, and means to stop the rotation of said sleeve at a predetermined point to apply a reduced counterbalancing force.

2. A counterbalance for flexible doors and the like, comprising in combination, a rotatable hollow shaft or tube, fixed bearing studs for the ends thereof, a sleeve on one of said studs and on which said tube rotates, a torsion spring fixed to said tube and to one of said studs, a second torsion spring fixed to said tube and attached to said sleeve, means for fixing the position of said sleeve to determine the normal counterbalancing action, means for releasing said sleeve, and a stop to limit the rotation of said sleeve through a predetermined angle to apply a reduced counterbalancing force.

3. A counterbalance for flexible doors and the like, comprising in combination a rotatable hollow shaft or tube, fixed bearing studs for the ends thereof, a sleeve on one of said studs and on which said tube rotates, a torsion spring fixed to said tube and to one of said studs, a second torsion spring

fixed to said tube and attached to said sleeve, means for fixing the position of said sleeve to determine the normal counterbalancing action, means for releasing said fixing means to allow said sleeve to rotate under the force of said spring, cams for transferring the force of said spring and sleeve when released to said tube to cause the same to rotate in unison, and means to stop the motion of said sleeve at a predetermined point.

4. A counterbalance comprising a shaft adapted to be connected to a flexible door, a spring one end of which is secured to said shaft and the other end of which is normally fixed, bearing studs for the ends of said shafts and a collar normally secured by fusible metal to one of said studs in juxtaposition to one end of the shaft whereby said shaft is permitted to expand longitudinally at a predetermined temperature.

5. The combination with a wall of a counterbalance fixed on one side of said wall and having a normally wound spring therein, of means normally holding said spring whereby said spring is permitted to at least partially unwind in an emergency, and means whereby said spring may be rewound and said means reset from the other side of said walls.

6. In combination with a fire door or similar device, a member connecting with said device for retaining the same in normal position, a fusible link therein, and an anchorage for said member comprising a tube normally seated in a hole or socket at right angles to the direction of pull of said member, and means for attaching the end of said member to the inner portion of said tube.

7. A counterbalance for flexible doors and the like comprising, in combination a rotatable hollow shaft or tube, a torsion spring having one end fixed to said tube for producing a counterbalancing force on said tube, a rotatable sleeve to which the other end of said spring is attached, means for normally preventing the rotation of said sleeve, devices for releasing said means to allow said sleeve to rotate under the force of said spring, said sleeve having a flange thereon, a flange fixed to said tube adjacent said flange, a floating ring intermediate said flanges, means whereby said ring quickly clutches said flanges together upon the release of said sleeve, stop means for limiting the movement of said sleeve, and means whereby said ring unclutches said flanges upon engagement of said sleeve with said stop means.

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