MEANS FOR CONTROLLING THE OPERATION OF DOORS OR THE LIKE

Inventors: Wesley S. Pattison; Edward B. Hawthorne;

by [Signature]
Their Attorney.
This invention relates to improved means for controlling the operation of a door which is biased to return to a predetermined position.

Our invention is applicable to any door which is biased to return to an original position, for example, to open or closed position, and we propose an improved spring-biased linkage in which the effectiveness of the spring is affected by a changing mechanical advantage resulting from relatively changing linkage pivot points during door operation. With the door in what may conveniently be called its "inherently biased" position the spring is ineffective to overcome the bias even through the spring is at maximum operating tension, whereas with the door in its other position a substantially relaxed spring will oppose the effort of the door bias to return it to its first position. It is thus a general object of our invention to provide improved means for holding a door open or closed against mutually opposing biases.

It is another object of our invention to provide a novel operating linkage employing spring means in such fashion as to assist in moving the door from one to another position, and even though in said second position the spring means may be substantially relaxed to maintain the latter position against an inherent bias tending to restore the door to original position.

It is still another object of the invention to provide door movement controlling means of the spring-biased type which will interpose resistance to the free fall of a gravity biased door so as to provide a safety factor in the event of spring failure.

It is a still further object of the invention to provide door movement control means which is inexpensive to manufacture and install and which will retain its effectiveness over a long operating life.

We accomplish these and other objectives of our invention by a spring-biased linkage comprising, in effect, three pivotally interconnected links of which one is directly engaged by a spring to urge the linkage system into rotation opposite that accompanying door movement from its said inherently biased position. For example, assuming that the door bias urges it to closed position, the spring means is acting to move the door to open position. Another of said links comprises an arm operatively associated with the door for movement thereby, and the third link is connected to the other two to convert spring bias into turning movement available at the said arm. The linkage arrangement is such that with the door in closed position the spring bias is substantially at a peak and yet the power exerted thereby at the arm is ineffective to overcome the door bias. At the other extreme of movement, however, when the door bias may be at a maximum, the spring is under substantially maximum tension and yet able successfully to oppose said bias and hold the door open. We produce this relative change of biasing effect by arranging the links in zig-zag fashion with their respective pivot points so positioned relative to each other as to obtain a changing mechanical advantage influencing the respective biasing strengths according to the direction of motion of the door and the desired condition at the end of movement.

The invention will be better understood from the following detailed description taken in connection with the accompanying drawings in which Fig. 1 is a perspective of an application of our invention in which the control means are disposed above the door which swings upwardly to open position; Figs. 2 and 3 are top plan views of the operating device of Fig. 1 respectively showing the relative position of the linkages and spring bias at the closed and at the full open position of the door; Fig. 4 is a sectional elevation taken through one of the control devices; Fig. 5 is a side elevation thereof; Fig. 6 is a side elevation partly in section of a form of our control device adapted for mounting on the side wall of the cabinet; and Fig. 7 is a front elevation of Fig. 6 with the right-hand portion being in section on lines 1—1 of Fig. 6.

It should be mentioned that because we preferably use the control devices in pairs, their respective operating parts are oppositely arranged, and to avoid confusion when referring to directions of rotation, we have applied reference characters in detail only to the left-hand devices of Figs. 2 and 3. Said devices will be those referred to in the following description.

In Fig. 1 an embodiment of our invention is shown as applied to a cabinet having a front door 2. The cabinet may be, for example, an overhead kitchen cabinet in which the door is gravity biased to closed position. The gravity bias, which may be supplemented by spring means, latches or the like, if desired, will be hereinafter referred to as the "inherent" bias. As illustrated, the door is supported for upward opening about the hubs 3, 3 which comprise extensions of shafts rotatably mounting the gears 4 of the identical but opposite-hand control devices 5 disposed adjacent the sides of the top panel of the cabinet. The said gears are advan-
tageously supported on a flange 6 extending upwardly from a base plate 7 which may be suitably affixed to the cabinet. The door is carried by the hubs 3 through the agency of the rigid angular arms 8 which extend from the side walls of the door. Ends of said arms preferably encircle the hubs 3 and are additionally affixed to the gear box by means such as the rivet 9 so that rotation of the door about the hubs 3 produces an accompanying rotation of the gears 4.

It will be noted that in the Fig. 1 embodiment the door is relatively narrower than the cabinet to permit the control device 5 to be offset inwardly from the sides of the cabinet and thus permit adjacent cabinets to be placed in abutting relation in a multiple installation. It will be appreciated, however, that the doors may be made full width of the cabinet by suitably offsetting the arms 8 without alteration in operation of the control device.

Referring now to Figs. 2 and 3, the basic operating structure of the control device 5 is a spring-biased linkage system comprising an arm 10 mechanically associated with the door to be rotated thereby means such as the rivet 9, and a lever 12 which controls the position of the link 11 relative to arm 10 and thereby affects the turning moment exerted on said arm by a coil spring or equivalent 14. Lever 12 is advantageously pivoted on the base plate 7 by a stud 13 for manufacturing economies, although the operation later described. Although the use of springs individual to each control device has some advantages, for example, to guard against the breakage of one of said springs, we prefer to use a spring common to the devices. We associate the arm 10 with the door 2 by means of a gear segment 16 permanently meshing with gear 4; preferably the segment 16 and arm 10 are unitary with each other and mounted upon the pivot 11 common to both. The use of gears or equivalent is essential in the Fig. 1 embodiment because of the rectangular relationship with the gear axes 3 and 11, but it will be understood that except where they may be employed to give a mechanical advantage, their function is merely to transmit motion between the door and the arm 10 and that in some arrangements the arm 10 may be directly affixed to the door, or a part thereof, as will be apparent to those skilled in the art. There is, therefore, a spring-biased linkage system consisting of three links: the arm 10 pivoted at 11, the lever 12 pivoted at 13, and the arm 10 at 18. The mechanical advantage of such a linkage system derives from the turning moment exerted by link 11 on arm 10, and this is dependent on the spacing between pivot 17 and link 11, as represented by a line from said pivot normal to a line extending between pivots 17 and 11. At a closed door position, said line of link 11 is desirably only slightly off-center with respect to the pivot 17 so as to reduce said moment arm to a practical minimum, and we therefore relieve the central portion of the link 11 so as to avoid conflict with said pivot, as clearly appears.

With the door in its closed position the rotation of the gear 4 has rotated gear 16 clockwise of Fig. 2 (considering the left-hand device) to bring the link 11 into the position aforementioned and rotate lever 12 about its pivot so that the spring 14 is under maximum operating tension. It will be noted, however, that the length of lever 12 and the disposition of pivot 13 are such with respect to link 11 and its pivot 18 that lever 12 is at substantially 45° with respect to the line of effort of spring 14 so as to reduce the force exerted by the spring 14 on lever 12 to rotate the same but to bias link 11 for movement upwardly of Fig. 2. The very short turning moment exerted by the link 11 on the arm 10 makes the spring ineffective to overcome the inherent bias of the door even when the spring is then at maximum operating tension. Generally speaking, pivot 13 should always be above pivot 18 so that lever 12 will always tend to lift link 11. As the door is raised manually, the mechanical advantage of the linkage system changes steadily until, on passage through a mid-position, the lever 12 comes into a more advantageous mechanical relation with the spring 14 and the turning moment exerted by the link 11 on arm 10 consistently increases so that the spring 14 becomes effective to draw link 11 upwardly and rotate lever 12 about its pivot 18 in a clockwise direction.

The residual spring tension on the door is being used to best advantage, as shown in which it has decreased in value it maintains said open position against the inherent bias of the door even though the other is at a maximum since the turning moment exerted by link 11 on lever 12 is at a maximum. Link 11 and lever 12 are in an acute angle effecting the bias in which the pivot 15 is beyond the pivot 13 (considered relative to pivot 18) with the result that the tendency of the door bias to rotate arm 10 clockwise against the pull of link 11 on lever 12 is largely expended in the direction of pivot 13, and such component acting to the left of lever 12 is overcome by the spring tension.

To limit the rotation of the respective linkages in their open position and thus establish the upper limit of door movement, we provide means such as the stop screw 20 for engagement with the stop arm 22 of the respective gear segment 16.

The embodiment of Figs. 6 and 7 is substantially identical with that previously described except that the control means 5e are arranged for side wall mounting and the respective gear elements may conveniently be of the spur type. The common or equivalent elements have been appropriately numbered for ready comparison. The springs 14e are of necessity individual to each bracket and, if desired, suitable tensioning screws 14b may be provided so that the effort of each spring may be equalized. It should also be noted that Fig. 6 might also represent a cabinet in which the door 2a swings on a vertical pivot, for example, the conventional floor cabinet with an outwardly swinging door. In such an arrangement, of course, there would be no gravity bias and, therefore, we provide a stop arm 22 of opening 14c anchored at the cabinet wall and to the door mounting arm 8a to return the door to closed position. Failure of one of the springs 14a, of course, prevent the door from being maintained in its open position, but will not prevent manual raising if another spring should break while the door is open, the fall of the door will be slowed by the remaining spring plus the inherent functional resistance of the several pivotal connections and gears.
It will be understood that in the side mounted types of Figs. 6 and 7, suitable masking devices may be used between adjacent cabinets, and on the exposed end walls, to conceal the operators.

What we claim as new and desire to secure by Letters Patent of the United States is:

Means for controlling the opening and closing of a door biased to one extreme of movement, comprising a gear pivotally mounted at a fixed location relative to said door; an arm member extending radially from said gear; a second gear; means for pivotally securing said second gear for permanent meshing relationship with the first gear; means fixed to said second gear and extending between said gear and said door to move thereto upon rotation of said second gear; and spring biasing means opposing the bias of the door, comprising a lever pivotally fixed relative to said arm member; spring means for urging said lever into rotation; and a link pivotally interconnecting said arm member and said lever whereby the door bias and the spring exert opposite rotational influences on said lever, the position of said link relative respectively to said first named gear pivot and to said lever changing during opening movement of the door from a condition wherein the rotational influence of the link on said gear is small and on said lever is large enough to rotate the lever to place the spring under maximum tension, to a condition wherein the rotational influence of the link on the lever is so small that the tension of said spring withstands the counter-rotative effort exerted by said link under the influence of the door bias.

WESLEY S. PATTISON.
EDWARD B. HAWTHORNE.

References Cited in the file of this patent

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,409,857</td>
<td>Hillson</td>
<td>Mar. 14, 1922</td>
</tr>
<tr>
<td>1,582,504</td>
<td>Bird</td>
<td>Apr. 27, 1926</td>
</tr>
<tr>
<td>2,244,182</td>
<td>Allen</td>
<td>June 3, 1941</td>
</tr>
</tbody>
</table>