

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) IMPROVEMENTS RELATING TO A DOOR CLOSING DEVICE

(71) I, YOSHITAKA NAKANISHI, a citizen of Japan, of No. 12-9, 5-chome, Yawata, Ichikawa-shi, Chiba-ken, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improvement in a device for attaching a swing door to a door frame, the device including a door check, and more specifically relates to a device provided with a means for closing the door automatically, for attaching the upper part of a swing door supported by a pivot shaft.

When a swing door is to be attached to a door frame, a method in which the lower part of the door is supported by the pivot shaft and the upper shaft is supported by the bearing, has been usually adopted. Various door checking means where the door may be closed automatically have been used widely. However, such methods are not economic, and such door checks detract considerably from the appearance.

An object of this invention is to provide an improved door check means by which a door can be opened easily, and the acceleration of the door which occurs on closing is checked so that no shock occurs when the door finally closes.

According to the present invention there is provided, a door closing device for attaching a swing door to a door frame, comprising an outer cylinder attachable to the door; an inner cylinder about which the outer cylinder is freely rotatable, the inner cylinder being located within the outer cylinder and spaced therefrom; a shaft for connecting an upper part of the door, disposed within the inner cylinder and engageable with a bearing in the door frame; a first coil spring means urging the door to a closed position, the first coil spring means being positioned in the space between the outer cylinder and the inner cylinder; and a second coil spring means also positioned in the space between

the inner and outer cylinders for urging the door to an open position the springs being such that the net effect in use is to urge the door to a closed position.

Further detailed explanation of this invention will become clear by the following explanation referring to the accompanying drawings showing one embodiment.

Figure 1 is a perspective view of a device according to the invention mounted on a door.

Figure 2 is a perspective exploded view of a device according to the invention.

Figure 3 is a longitudinal sectional view on a substantially enlarged scale of part of Figure 1.

Figure 4 is a graph showing the relation between the operation of the spring and the angle of opening of the door.

Figure 1 shows a door 1 and a door frame 2. The lower part of the door is supported by a pivot shaft 3. To the upper part of the door is attached an outer cylinder 5 which receives a shaft 4. To the door frame is attached a bearing 6 in which the shaft 4 is engaged. The shaft 4 is inserted in an axial hole 7 of the bearing 6, and together with the pivot shaft 3, the door 1 is rotatably attached to the door frame 2.

Referring to Figures 2 and 3, the outer cylinder 5 is open at both ends and attached to the upper edge of the door 1 via an attaching arm 8 formed integrally on the upper part thereof. The arm 8 is composed of a longitudinal part 56 and a part 57 extending at right angles to the part 56. The longitudinal part 56 has holes 59 drilled therein so that it can be attached to the door 1 by screws 9 threaded in the holes. An inner cylinder 10 is inserted in the outer cylinder leaving a space 11 therebetween. The lower part of the outer cylinder rides on a flange 12 of the inner cylinder, and has a groove 13 on the upper part thereof. Steel balls 14 are disposed in the groove 13, the balls being covered by a cover 15.

Screws 17, are threaded into half cut female threads 16a, 16b threaded on the

[Price 25p]

upper end of the cover and the inner cylinder, so that the outer cylinder is rotatable relative to the inner cylinder.

5 In the space 11 between the inner cylinder and outer cylinder, upper and lower coil springs 18 and 19 are disposed. One end 20 and 21 respectively of each spring is slidably engaged in a longitudinal groove 45a. The
10 other ends 23 and 24 of the springs are engaged by the holes 25 and 26 respectively drilled in the cover 15 and the flange 12 of the inner cylinder. The upper spring 18 urges the door towards a closed position, and the
15 lower spring 19 urges the door towards an open position. The relative strengths of the springs is such that the net tendency is to close the door.

The shaft 4 has the female threads 27 therein, and is slidably received in an axial
20 hole 29 in the inner cylinder 10. The external cross section of the shaft 4 is polygonal, for example it may be square or hexagonal. The shaft can be moved up and down by a threaded bar 28. The cross-section of the
25 hole 29 has a polygonal cross-section which corresponds to the cross-section of the shaft 4. The threaded bar 28 has a male threaded part 32 engaged with the female thread 27 of the shaft 4, and it is this threading operation which enables the shaft 4 to be moved
30 up and down.

The threaded bar 28 has a flange 38 at its lower part. Bushes 30 and 35 are disposed respectively above and below the flange
35 38 and they have holes 31 and 31a respectively passing therethrough. The bushes are inserted in the axial hole 29 in the inner cylinder. The bush 30 has a square part 50 and a circular part 51 and a shoulder 52 formed
40 by the junction between these parts. This shoulder 52 is checked by a cylindrical step formed within the inner cylinder 10.

Said bush 35 has a half female thread 36, the half female thread 36a complementing
45 this being provided in the bottom of the inner cylinder 10. A screw 37 is threaded into these female threads to fix the bush in the inner cylinder. Thus said threaded bar 28 can be rotated without its making any
50 axial movement.

A groove 39 is formed in the lower face of said threaded bar so that a screwdriver
55 can be inserted to rotate the bar 28 and thus cause the shaft 4 down to move axially up or down the axial hole 29 of the inner cylinder. In performing this axial movement the shaft 4 can pass in or out of the axial hole 7 of the bearing 6 in the door frame.

60 An attaching arm 40 integral with the bearing 6 comprises a longitudinal part 54 and a part 55 extending at right angles thereto. The bearing 6 is attached to the lower face of the door frame by threading screws 41 through holes 58 drilled in the longitudinal part 54.
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When the door is put in the door frame the shaft 4 is drawn in so that its end is flush with the face of the cover 15, which has an axial hole therein. The cover fits in the axial hole 7 of the bearing. The bearing
70 6 of the door is then placed in position and the threaded bar 28 is rotated to cause the shaft 4 to be inserted into said axial hole 7. The axial hole 7 is of a polygonal cross-section corresponding to the outer shape of the shaft 4 to prevent relative rotation of the shaft 4 and the axial hole 7. In this way, bearing 6, shaft 4, cover 15 and inner cylinder 10 are connected integrally and the
80 outer cylinder 5 rotates around the inner cylinder.

The operational relationship between the opening angle of the door and the two
85 springs 18 and 19 will be explained with reference to Figure 4 which is a graph showing this relation approximately.

Taking the torque (Kg—m) on the vertical axis, and the opening angle along the horizontal axis, line A shows the turning effort of the spring 18 in the closing direction,
90 line B shows the turning effort of the spring 19 in the opening direction, and line C shows the composite turning effort of both springs. When the door is closed (opening angle is 0), the spring 18 exerts a certain
95 torque in the closing direction, and the spring 19 exerts a somewhat lesser torque than the spring means 18 in the opening direction. As the door is opened progressively further, the spring 18 is twisted further, and the spring 19 is twisted back further. The composite turning effort thereof is such that the door can be opened smoothly
100 and when it has been opened nearly through a right angle the door may return slowly and automatically. During the period when the opened door is closing the spring 18 is twisted back, and the spring 19 is twisted.
105 The door beginning to rotate slowly in the closing direction, then tends to increase its rotational speed. However, the spring 19 serves as a brake so that the door closes gently. The strength and degree of twisting of the two springs determines the closing and opening motion of the door. For example, the door can be adjusted in such a way that it closes slowly from being open by
110 90 degrees to being open at angle of 45 degrees, and thereafter it speeds up and snaps shut. This enables one person to open the door and for several following people to pass through the door before it shuts. In order to make the motion of the door adjustable a plurality of holes 25 may then be provided in the cover 15. The end 23 of the spring 18 can then be moved from one of these holes to another of these holes.
115 Other methods of adjustment are to rotate the cover 15 or to provide a plurality of

holes 26 for receiving the end 24 of spring 19.

Another way is to rotate the flange 12. An intermediate element 43 engaging with the inner cylinder is interposed between the two springs. The intermediate element 43 has a protrusion 44 which is axially slidable with respect to the inner cylinder but non-rotatably engaged in a recess 45 cut in the inner cylinder. This has a number of advantages including prevention of eccentricity due to compression of the springs.

Further, the twisting and untwisting of the spring can be performed nearly in the central part of the outer cylinder. Moreover, the intermediate element can be engaged with a shoulder 46 on the inner cylinder, thereby eliminating interference between both springs when the door is closed.

An annular groove 47 formed on the lower face of the outer cylinder has a stop 48. A protrusion 49 provided in the flange 12 of the inner cylinder is rotatable in the grooves 47. These protrusions and the stop in the groove regulate the angle of rotation of the outer cylinder.

The various parts required in the apparatus can be produced by various process, but it is particularly advantageous to use die casting.

WHAT WE CLAIM IS:—

1. A door closing device for attaching a swing door to a door frame, comprising an outer cylinder attachable to the door; an inner cylinder about which the outer cylinder is freely rotatable, the inner cylinder being located within the outer cylinder and spaced therefrom; a shaft for connecting an upper part of the door, disposed within the inner cylinder and engageable with a bearing in the door frame; a first coil spring means urging the door to a closed position, the first coil spring means being positioned in the space between the outer cylinder and the inner cylinder; and a second coil spring means also positioned in the space between the inner and outer cylinders for urging the door to an open position the springs being such that the net effect in use is to urge the door to a closed position.

2. A device as claimed in claim 1 in which a longitudinal groove is provided in an inner wall surface of the outer cylinder, one end of each of the coil springs being fixed to the inner cylinder and the other end of each coil spring is engaged to be freely slidable in the longitudinal groove in the outer cylinder.

3. A device as claimed in claim 2, in

which the coil springs are axially spaced apart by an annular intermediate element which is axially slidable with respect to the inner cylinder.

4. A device as claimed in any preceding claim in which the outer cylinder is fitted with an arm which is attachable to the door.

5. A device as claimed in claim 3 in which the inner cylinder has a stepped part, the intermediate element is received on the said stepped part.

6. A device as claimed in claim 5 in which the inner cylinder has a flange which receives the lower end of the outer cylinder, and the inner cylinder has an upper portion of a lesser external diameter than a lower portion thereof, the said stepped part being formed by the junction between the two inner cylinder portions, the intermediate element being slidably received on the outer surface of the upper portion and being provided with a protrusion which is received in an axial groove in the said outer surface for preventing rotation of the intermediate element.

7. A device as claimed in any preceding claim, in which the said shaft threadably receives a threaded bar situated within the axial hole in the inner cylinder, the threaded bar being provided with a flange at its lower end, the flange being interposed between two bushes which permit the bar to rotate but not to move axially, thereby enabling the shaft to be moved axially.

8. A device as claimed in claim 7 in which the lower of the bushes is fixed to the inner cylinder, and the upper of the two bushes having an inner stepped and an outer stepped part, the inner stepped part bearing on the flange of the threaded bar and the outer stepped part engaging a stepped part formed in the said axial hole in the inner cylinder.

9. A device as claimed in claim 6 in which that part of the inner cylinder flange which faces the space between the inner and outer cylinders is provided with a plurality of holes, in which one end of the lower of the two spring means is selectively engageable.

10. A door closing device for attaching a swing door to a door frame substantially as hereinbefore described with reference to the accompanying drawing.

ELKINGTON AND FIFE,
Chartered Patent Agents,
High Holborn House,
52—54 High Holborn,
London, W.C.1.
Agents for the Applicants.

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