

Nov. 3, 1970

YOSHITAKA NAKANISHI

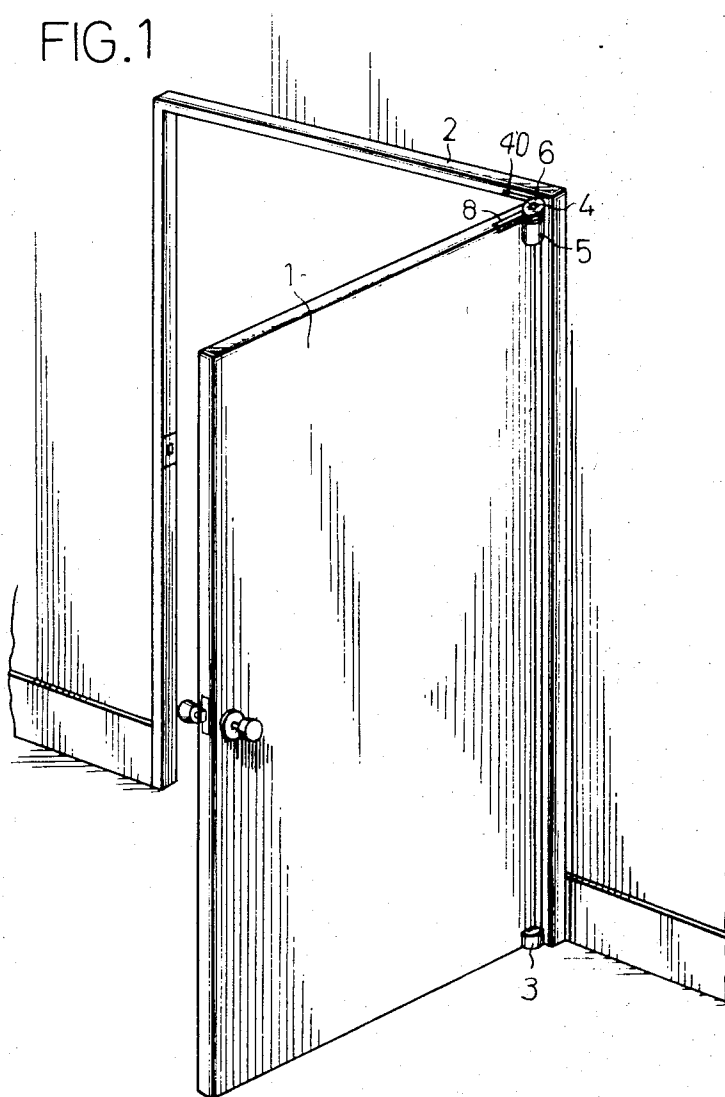
3,537,126

APPARATUS FOR ATTACHING A SWING DOOR PROVIDED WITH A DOOR CHECK

Filed Feb. 6, 1969

3 Sheets-Sheet 1

FIG. 1



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**3 Sheets-Sheet 2**

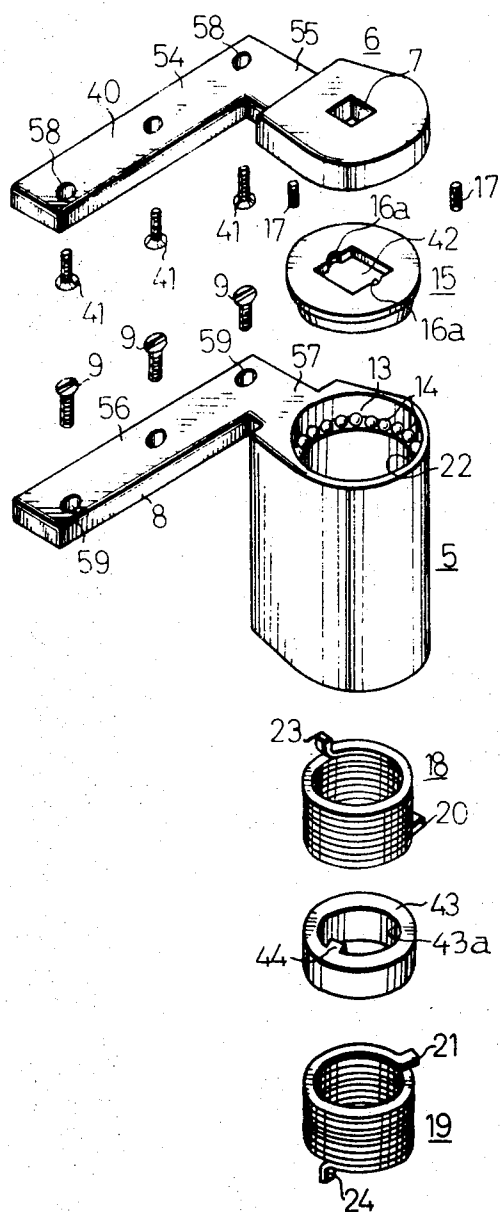
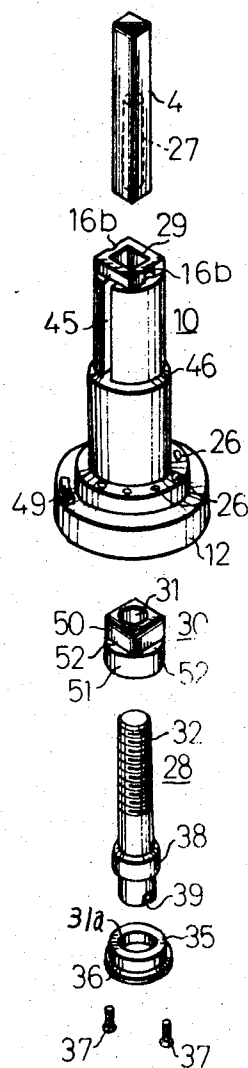


FIG. 2



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3 Sheets-Sheet 3

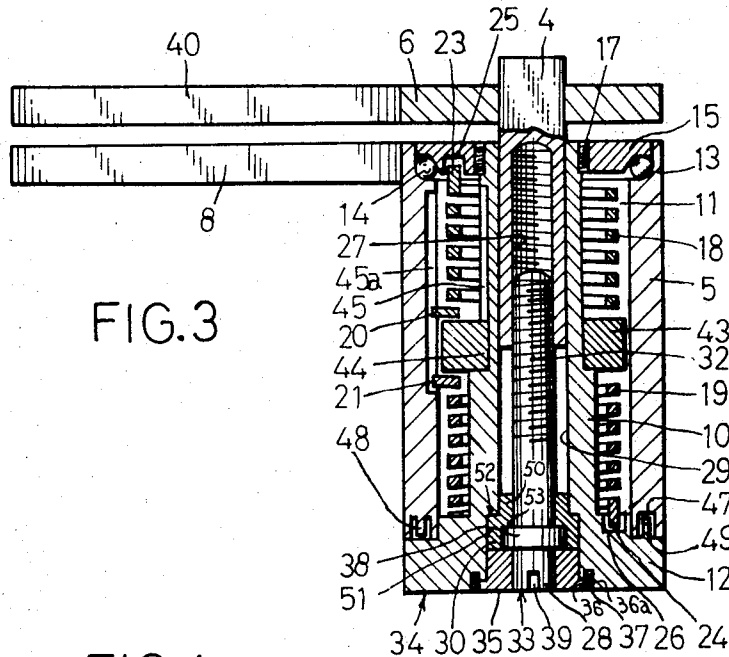


FIG. 3

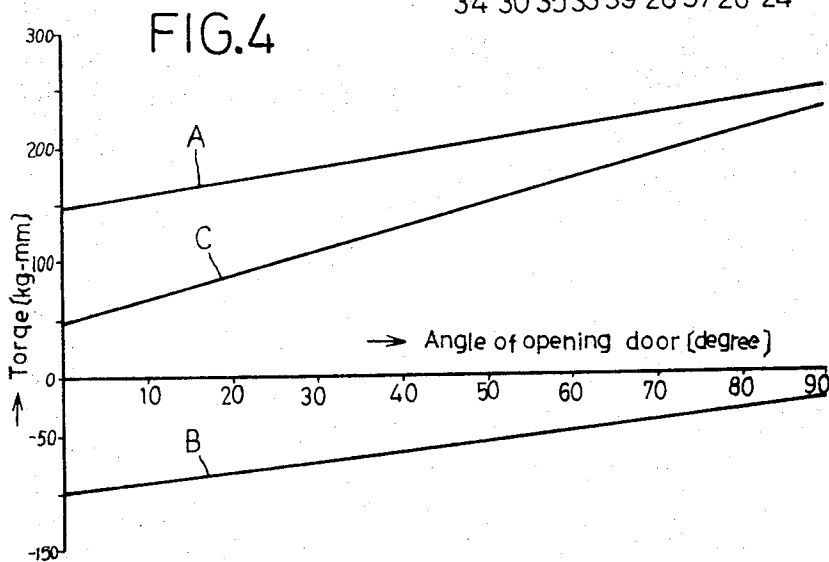


FIG. 4

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3,537,126  
**APPARATUS FOR ATTACHING A SWING DOOR  
PROVIDED WITH A DOOR CHECK**  
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43/7,587  
Int. Cl. E05f 3/20

U.S. Cl. 16—50

9 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus for attaching a swing door provided with a door check comprises an outer cylinder to be attached on the door side, an inner cylinder engaged freely rotatably in said outer cylinder with a space between the cylinders, a shaft for suspending an upper part of the door disposed in an inner part of said inner cylinder freely slidable and engaged with a bearing in a door frame, spring means workable in the direction for closing said door in the space between said outer cylinder and inner cylinder, and spring means workable in the direction for opening said door the spring means working in the direction for opening said door being constructed in such a way that it works more weakly than the spring means working in the direction for closing said door.

This invention relates to the improvement of apparatus for attaching a swing door provided with a door check, and more specifically relates to apparatus provided with the means for closing the door automatically. The apparatus is attached to upper part of the swing door supported by a pivot shaft.

When the swing door is to be attached in suspended state to the door frame, in general, the lower part of the door is supported by the pivot shaft and the upper shaft is supported by a bearing. On one hand, various door checking means whereby the door may be closed automatically have been used widely. However such apparatus are not economical, and such door checks are unattractive in appearance.

The object of this invention is to present novel and improved door check means by which the door can be opened easily, and on closing when the acceleration is applied to the door in the direction of closing, this can be checked so that the shock generated when the door is closed can be eliminated. It works easily and smoothly and has a good appearance and very simple and economical construction. Such apparatus as described above can be obtained by this invention.

In order to attain said various objects the apparatus according to the present invention comprises an outer cylinder to be attached on a door side, an inner cylinder engaged freely rotatably in said outer cylinder with a space between the cylinders, a shaft for suspending an upper part of the door disposed in an inner part of said inner cylinder freely slidable and engaged with a bearing in the door frame, a spring means workable in the direction for closing said door in the space between said outer cylinder and inner cylinder, and another spring means workable in the direction for opening said door, the spring means working in the direction for opening said door being constructed in such a way that it works more weakly than the spring means working in the direction for closing said door.

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

FIG. 1 is a perspective view of a door with a door check in accordance with the invention.

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FIG. 2 is a perspective view of each of the disassembled parts.

FIG. 3 is a substantial enlarged longitudinal sectional view.

FIG. 4 is a diagram showing the relation between the operation of the spring and the angle of opening of the door.

In FIG. 1 are shown the door 1, and the door frame 2. The lower part of said door is supported by the pivot shaft 3. To the upper part of said door is attached the outer cylinder 5 having a shaft 4 free movably in and out. To said door frame is attached a bearing 6 in which said shaft 4 is engaged. Said shaft 4 is inserted in an axial hole 7 of said bearing 6, and through said pivot shaft 3, the door 1 is attached to the door frame 2 so as to be freely rotatable.

Referring to FIGS. 2 and 3, said outer cylinder 5 is opened at both ends and attached to the upper face of the door 1 by an attaching arm 8 formed integrally on the upper part thereof. Said arm 8 is composed of the longitudinal part 56 and the part 57 bent at right angles thereto. Said longitudinal part 56 has a number of holes 59 drilled for said attachment to the door by screws 9 threaded in said holes. The inner cylinder 10 is inserted in said outer cylinder with the space 11 remained. The lower part of said outer cylinder rides on the flange 12 of said inner cylinder, and has the groove 13 on the upper part thereof, in said groove 13 are disposed the steel balls 14, which are covered by the cover 15.

Screws 17, 17 are threaded into the half cut female threads 16a, 16b threaded on the upper end of said cover and said inner cylinder, thereby the outer cylinder is rotatable relative to the inner cylinder.

In the space 11 between said inner cylinder and outer cylinder are disposed the upper and lower coil spring means 18, 19 in two stages, each one end 20, 21 of both said spring means is engaged free movably in the longitudinal groove 45a, and the other ends 23, 24 are engaged by the holes 25, 26 drilled in the cover 15 and the flange 12 of the inner cylinder. The upper spring means 18 is urged in the direction for closing the door, and the lower spring means 19 is urged in the direction for opening the door and each member is designed in such a way that the tendency to close the door is greater than the tendency to open the door.

Shaft 4 has the female threads 27 therein, and is inserted axially in said inner cylinder 10 freely slidably, and the outer shape thereof is formed polygonal, such as square, hexagonal etc., to be moved up and down by the threaded bar 28 in the axial hole 29 of the inner cylinder which is also drilled in corresponding polygonal shape. Threaded bar 28 has the male threaded part 32 engaged with the female thread 27 of the shaft 4, by this threading operation said shaft 4 can be moved up and down.

Threaded bar 28 has the flange 38 at its lower part. Bushes 30 and 35 are disposed respectively above and under said flange 38 and each of them is passed through by the holes 31 and 31a and placed in the hole of said inner cylinder. Said bush 30 has the square part 50 and the circular part 51 and the shoulder 52 formed by them, and at this shoulder 52 it is checked by the cylindrical step of the inner cylinder 10 corresponding to this shoulder.

Said bush 35 has the half female thread 36, the half female thread 36a corresponding to this is provided in the bottom of said inner cylinder 10, into these female threads is threaded the screw 37, thereby said bush is fixed in the inner cylinder. Thus said threaded bar 28 can be rotated at fixed position in the inner cylinder 10 with no up and down sliding motion.

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When the fore end of a screw driver is inserted in the groove 39 formed in the lower face of said threaded bar and rotated left and right, said shaft 4 can slide up and down along the axial hole 29 of the inner cylinder and comes in or out of the axial hole 7 of the bearing 6 in said door frame.

Attaching arm 40 integral with said bearing 6 is composed of the longitudinal part 54 and the part 55 bent at right angle thereto and the bearing is attached by threading the screws 41 into the lower face of the door frame through the holes 58 drilled in said longitudinal part 54.

When the door is put in the door frame, shaft 4 is drawn in until the face of the cover 15 and the axial hole 42 fits in the axial hole 7 of the bearing and then said threaded bar 28 is rotated in the right hand direction thereby the shaft 4 is inserted into said axial hole 7 then the door 1 is put in the door frame 2. The axial hole too is formed polygonal corresponding to the outer shape of the shaft to prevent the relative rotation of said shaft 4 and the axial hole 7. In this way, bearing 6-shaft 4-cover 16-inner cylinder 10 are connected integrally and the outer cylinder 5 rotates around said inner cylinder.

Next, referring to the operational relation of the opening angle of the door and said two spring means 18, 19 will be explained.

FIG. 4 is the 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 means 18 on the closing side, line B shows the turning effort of the spring means on the opening side, and line C shows the composite turning effort of said both springs. Now, in the closing state (opening angle is 0) of the door, to the spring means 18 is given some degree of twist in the closing direction, and to the spring means 19 is afforded the twist somewhat weaker than that of said spring means 18 in the opening direction in opposite to said spring means 18. And on opening the door, following the opening of the door, the spring means 18 is twisted further, and reversely the spring means 19 is untwisted the composite turning effort thereof, is the strength in such a degree that on opening the door it can be opened smoothly, and when it is opened nearly in right angle the door may return slowly and automatically. While, during the period that said opened door comes to the closed state the spring means 18 is untwisted, and reversely the spring means 19 is twisted and the door beginning to rotate gently in the closing direction tends to increase its rotational speed but the spring means 19 serves to brake it thereby the door is closed gently. By means of various combination of the strength and twisting of said two sets of spring means can be obtained the desired slow and fast closing and opening motion of the door. For example, when the door is adjusted in such a way that the door closes slowly from the state opened by 90 degrees to the nearly intermediate 45 degrees opened state, thereafter speeding up, and on closing the door snaps closed on passing of many persons, the foremost person opens the door and until the last person passes, the door is kept opened and closes slowly so that all persons can pass easily. In order to adjust the motion of the door, it is one process to vary the strength of twisting of the spring means 18, 19 in state of the closing of the door, and in this case the side of the spring means 18 may be changed from one hole 25, in which one end 23 thereof is engaged to another hole 25, or the cover 15 may be rotated, and on the side of the spring means 19 too, one hole 26 engaging one end thereof may be changed to another hole as described above, or the flange 12 may be turned.

Intermediate element 43 engaging with the inner cylinder is interposed between the two spring means. Said intermediate element 43 has the protrusion 44 protruded in the hole 43a thereof and engaged slidably up and

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down but unrotatably in the recess 45 cut in the inner cylinder, thereby the eccentricity due to compression of the spring is prevented, further the sum of the height of both springs is kept nearly at average value and prevents the abnormal motion between mutual springs and both opening and closing operation of the door become more smoothly.

Further, the winding operation in on one hand of the spring and the unwinding operation in the other hand can be performed nearly in the central part of the outer cylinder. Moreover, said intermediate element can be engaged with the shoulder part 46 of the inner cylinder, thereby the interference between both springs can be cut off in the closed state of the door and the occurrence of the obstacles such as creep and relaxation can be prevented.

Annular groove 47 formed on the lower face of said outer cylinder has the stopper 48 at one part thereof. The protrusion 49 is rotatable in said groove and provided in the flange 12 of the inner cylinder. These protrusions and the stopper in the groove regulate the angle of rotation of the outer cylinder.

Said each member can be produced by various process, but the manufacturing process utilizing die casting is very advantageous.

Despite some examples of embodiments as described above, it is clear that the present invention is not to be limited to these examples of application, but can be variously modified within the scope of the spirit of invention indicated in the patent claims.

What I claim is:

1. Apparatus for attaching a swing door provided with a door check, comprising an outer cylinder to be attached on the door side, an inner cylinder engaged freely rotatably in said outer cylinder with a space between said cylinders, a shaft for suspending an upper part of the door disposed in an inner part of said inner cylinder freely slidable and engaged with a bearing in a door frame, spring means workable in a direction for closing said door in the space between said outer cylinder and inner cylinder, and a spring means workable in a direction for opening said door, the spring means working in a direction for opening said door being constructed in such a way that it works more weakly than the spring means working in the direction for closing said door.

2. Apparatus for attaching the swing door provided with the door check described in claim 1 in which a longitudinal groove extending axially is provided in an inner wall surface of the outer cylinder, each one end of the spring means including two upper and lower springs is fixed to the inner cylinder side and the each of other ends is engaged free slidably in the longitudinal groove in said outer cylinder.

3. Apparatus for attaching the swing door provided with the door check described in claim 1 in which a ring-formed intermediate element is interposed between the spring means operable in the direction for closing the door attached around the inner cylinder and the spring means operable in the direction for opening the door, said intermediate element being slidable in the axial direction of said inner cylinder corresponding to the operation of said spring.

4. Apparatus for attaching a swing door provided with a door check, comprising a bearing provided in a door frame, an outer cylinder having an arm to be attached to the door, an inner cylinder to be inserted in said outer cylinder freely rotatably, a space area formed between said inner and outer cylinders, a spring assembly wound around said inner cylinder in said space area, and a shaft provided in an inner part of said inner cylinder and engaged with the bearing in said door frame for suspending an upper part of the door, said outer cylinder having a longitudinal groove extending axially in an inner wall thereof, said spring assembly including a spring means operable in a direction for closing said door with said inner cylinder as an axis and a spring means oper-

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able in a direction for opening said door, said spring assembly providing an intermediate element engageable with said inner cylinder between each of said spring means, and in order that at least one and preferably all of said spring means can avoid deforming action even though being subjected to the twisting action:

- (a) one end of said spring means is fixed
- (b) the other end thereof is in free state, and
- (c) said free end is inserted free slidably in said longitudinal groove in said outer cylinder and
- (d) said intermediate element is freely slidable along said inner cylinder between both spring means.

5. Apparatus described in claim 4, in which the inner cylinder has a stepped part, the intermediate element is received in a determined position by said stepped part.

6. Apparatus described in claim 4, in which the inner cylinder has a flange for receiving a lower part of the cylindrical outer cylinder, at least two upper and lower cylinder parts having relative different size are provided above said flange, the stepped part for receiving the ring-formed intermediate element is formed on the border of said both cylinder parts, said upper cylinder part has a sliding surface for said intermediate element on the outer periphery thereof for the purpose of supporting said intermediate element nonrotatably and slidably, and an axial long groove for holding movably a protrusion protruding from said intermediate element directing inward of said surface.

7. Apparatus for attaching a door provided with a door check, comprising a bearing having an arm attached to the door frame and a hole for receiving a shaft inserted as later described, an outer cylinder having an arm disposed opposite to said arm and to be attached to the door, an inner cylinder inserted freely rotatably in said outer cylinder, a flange and cover disposed at opposite ends of said inner cylinder in such a way that said inner cylinder may be held in said outer cylinder, a space formed between said inner and outer cylinders, a shaft being

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inserted in said inner cylinder freely slidably in the axial direction and to be inserted into the hole of said bearing, and a threaded bar lying in said inner cylinder and threading with said shaft and for moving said shaft forward and backward by means of rotation thereof, said threaded bar having the flange at the lower part, two bushes interposing said flange therebetween and fixed in said inner cylinder for holding said threaded bar in such a way that said threaded bar may be permitted only to rotate but unslidably axially, a spring means mounted in said space and for operating said door in the closing direction with said inner cylinder as the axis, and a spring means for operating said door in the opening direction.

8. Apparatus described in claim 7 in which the threaded bar inserted in the axial hole of the inner cylinder has the flange, both upper and lower surfaces of said flange are interposed between two upper and lower bushes, said lower bush is fixed to said inner cylinder, said upper bush having an inner stepped and an outer stepped part formed thereon said inner stepped part restraints the flange of said threaded bar, said outer stepped part is engaged by the stepped part formed in the axial hole in the lower part of said inner cylinder and, the outer side of said inner cylinder has the stepped part for supporting the outer cylinder.

9. Apparatus described in claim 7 in which the inner cylinder is faced to the space surrounded by said inner and outer cylinders and the flange having a suitable number of holes is provided and one end of spring means may be inserted and fixed in said hole selectively.

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