United States Patent [19]

Sato

[11] **3,840,936**

[45] **Oct. 15, 1974**

[54] **HINGE**

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[73] Assignees: **Yutaka Tanaka; Yoshio Kimura,** Ibaraki-ken, Japan

[22] Filed: **Sept. 25, 1972**

[21] Appl. No.: **291,630**

[52] **U.S. Cl.** **16/76,** 16/142

[51] **Int. Cl.** **E05d 11/08,** E05f 1/08

[58] **Field of Search** 16/145, 142, 140, 139, 16/190, 76, 72, 75; 292/77, 79

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Primary Examiner—Paul R. Gilliam
Assistant Examiner—Kenneth J. Dorner
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A hinge for holding a door in an open position and controlling the movement of the door toward its open or closed positions, is disclosed. The hinge includes a fixed leaf having joining parts or knuckles thereof rigidly secured to a hinge pintle, a movable leaf having joining parts or knuckles thereof rotatably connected to the pintle, at least one cam rigidly secured to the pintle, the at least one cam having a curved surface and adapted to control movement of the movable leaf or door, and a spring secured to the movable leaf intermediate its ends and the ends thereof attached to a roller which travels along the curved surface of the cam.

1 Claim, 10 Drawing Figures

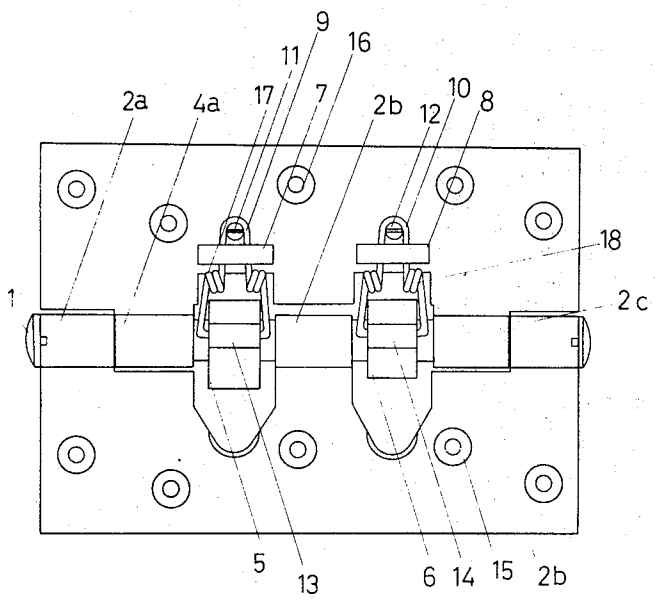


FIG. 2

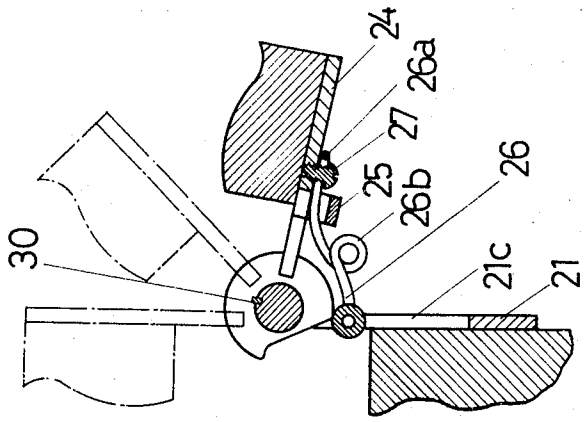

24
26a
27
25
26b
26
30
21c
21

FIG. 1

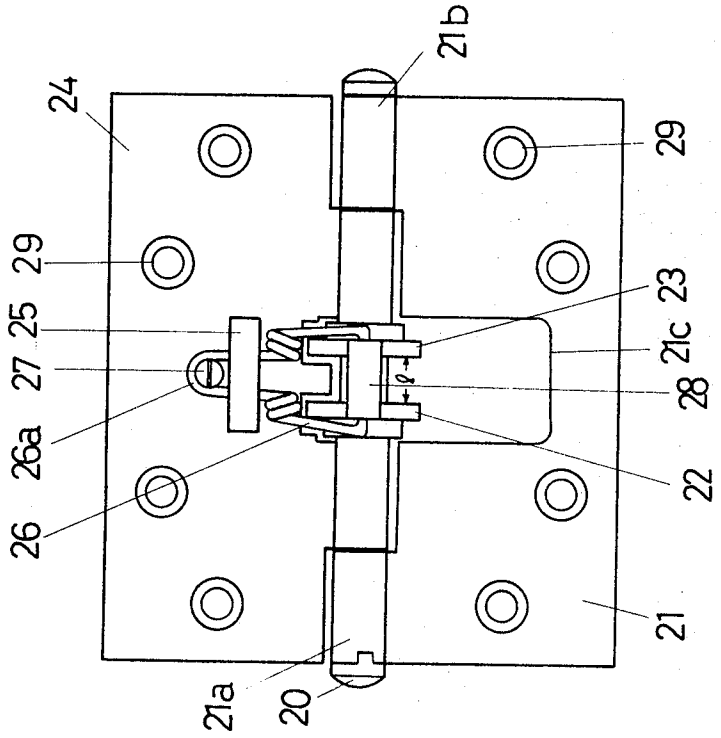

21b
24
29
29
25
23
27
21c
28
26a
22
26
21
21a
20

FIG. 3

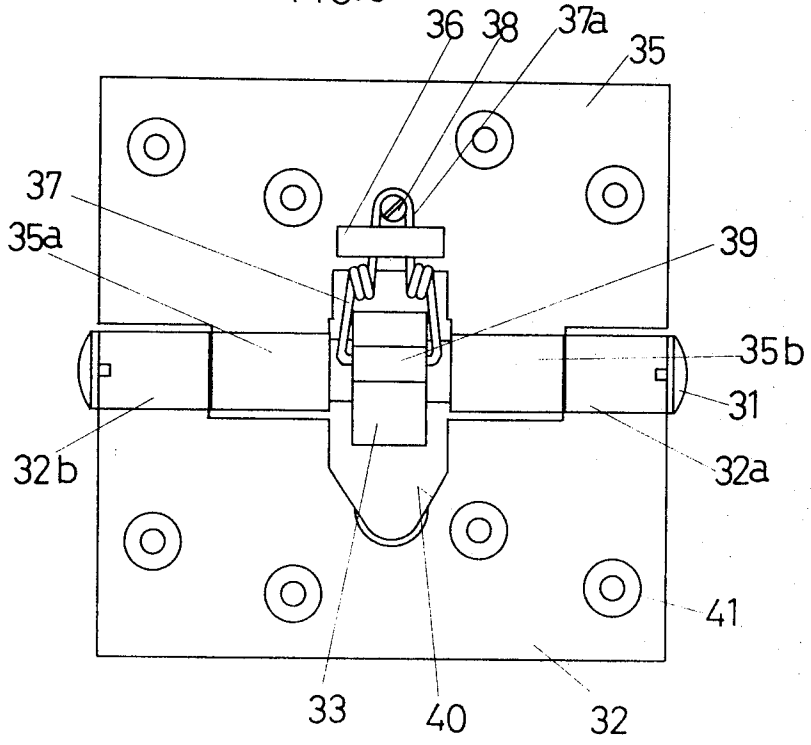

36
38
37a
35
37
35a
39
35b
31
32b
32a
41
33
40
32

FIG. 4

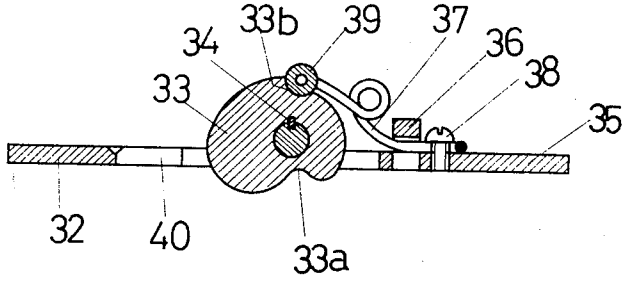

33b
39
37
34
36
38
33
35
32
40
33a

FIG. 5

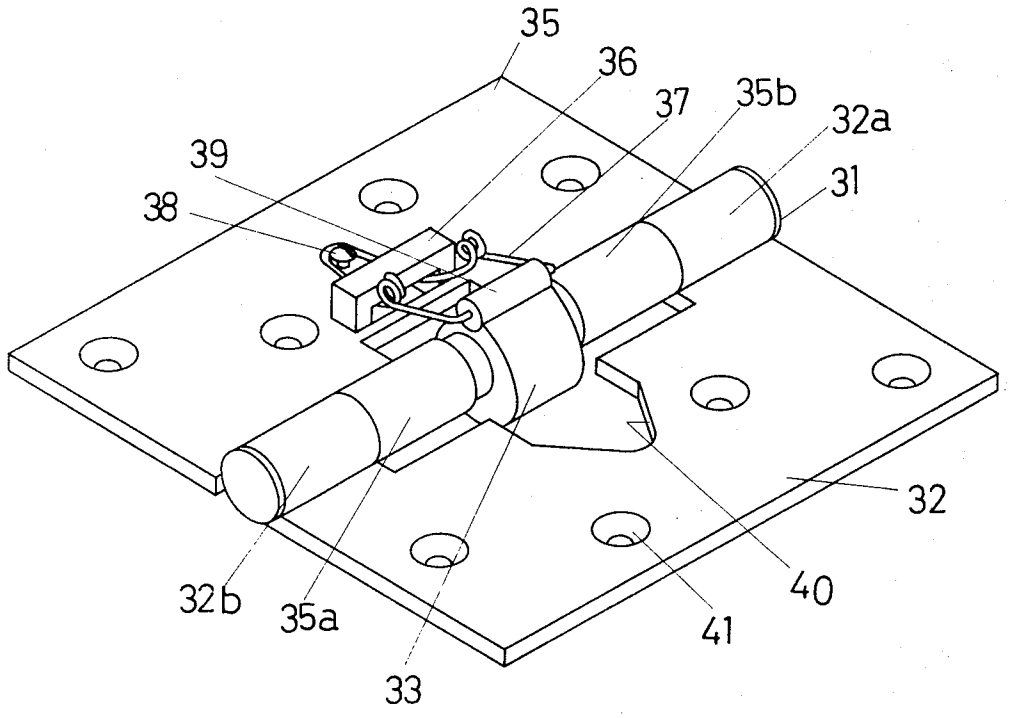


FIG. 6

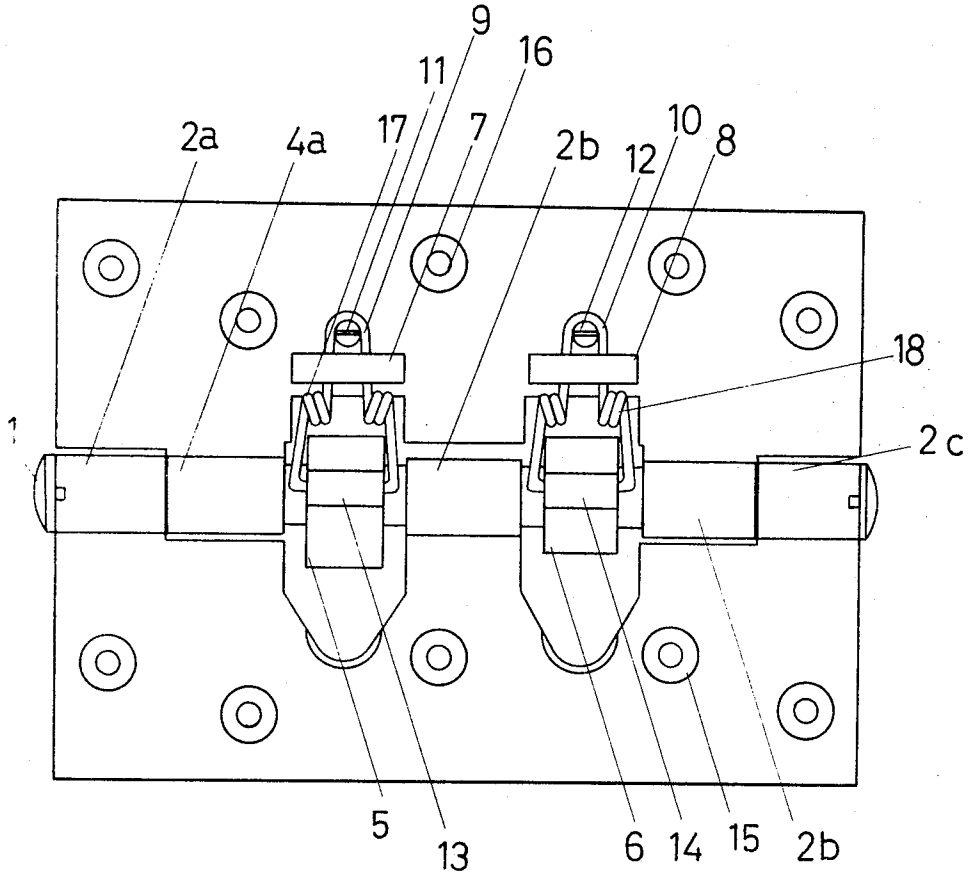


FIG. 7

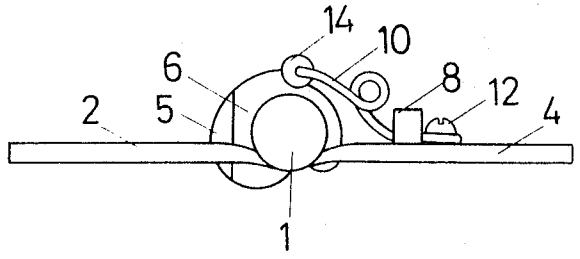


FIG. 8

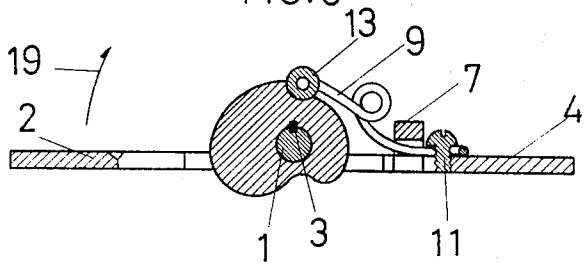


FIG. 9

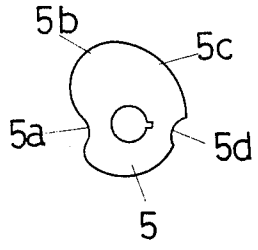
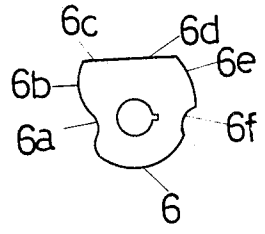


FIG. 10



HINGE

BACKGROUND OF THE INVENTION

Hinges in general are specifically intended for use as fixtures which are fixed on a door leaf and a door frame or a box lid for the opening and closing operations thereof. Accordingly, such hinges provide the only means by which the door leaf or box lid is fixed to the door frame or box edge, and are not intended to control the opening and closing speed of the door or lid and to automate the closing operations thereof. In case of such conventional hinges, therefore, other additional devices must be installed to meet such needs.

The present invention is directed with a device wherein the door which is manually opened and is automatically closed when the door is opened less than a predetermined angle and is kept in an open position when the angle to which it is open exceeds a predetermined angle.

Among prior devices having such functions are door checks (closers) using both a hydraulic resisting means and a spring contracting means or simple devices using a spring means only.

Door checks are usually equipped with a spring contracting means and a hydraulic resisting means for controlling the spring contracting means, and are placed between the top corner of the door and the door frame.

Due to its heavy weight and large dimensions, however, the door check usually must be installed in a very limited area, thus affecting the appearance of the door and also being fairly expensive. Moreover, it reduces the durability of the door itself as it always applies torsion thereto from the top corner.

Automatic door-closing devices using spring means only cause the spring to expand further as the door is forced open more widely, resulting in an increased tension which means an increased force is required for opening the door while the door will close at a speed proportional to the amount it is opened.

When the door is released from its open position, it will abruptly return to the close position, and will often cause noise, damage the door structure and much worse injure the door user therefore such devices have only a very small and limited scope of usage.

The present invention provides a substantially improved hinge over prior door checks or similar devices. The hinge according to the invention comprises a cam rigidly fixed to a hinge pintle, a fixed leaf rigidly secured to the pintle, a movable leaf, pivotally connected to the pintle, and a spring rigidly secured on the movable leaf and provided with a roller adapted to travel along the cam and control movement of a door in closing or opening.

More specifically, the invention has advantages over the prior hinges in that it provides a combination of a hinge proper and a device for controlling the automatic rotation or force of rotation of a door or box lid, preventing the door or box lid from receiving an excessive pressure as the force point is placed in the neighborhood of the hinge pintle and retaining the good appearance of the door.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to a hinge structure comprising a fixed leaf rigidly secured to the hinge pintle, a movable leaf rotatably connected to the pintle, a cam having a curved surface and adapted to control movement of the movable leaf or door, and a spring rigidly secured by screw means on the movable leaf and provided with a roller adapted to travel along the curved surface of the cam.

In this structure, the movable leaf or door, which is released from an open position toward a closed position, can be checked or slowed down by the cam and roller functions.

The curved profile of the cam can be designed as desired, variable in accordance with the first and last positions selected where the movable leaf will receive a force of rotation and the selected position where it will be stopped. The cam may be constructed such that the movable leaf will be stopped at a 0° position and at a 180° position, and the section corresponding to a 30° point to a 0° point may be steeply formed as to increase the door-closing force, and a section corresponding to a an eighty-degree point to a **180**-degree point are so formed with a uniform curvature so as to allow a door to stop at any desired point thereof.

The cam may be made of either metal or synthetic resin. Light steel plate and nylon, for example, are preferable, but other metals or synthetic resins may be used if they are easily formed as desired, agreeable with either a steel roller or a synthetic resin roller and have a sufficient tenacity to resist repeated loads. Synthetic resins are more useful as they are not inclined to gather rust, cause no noise and make it possible to obtain cams of varied thickness.

The cam may be a plate cam or a cylindrical cam, for example, both of which can serve the purposes described herein. The spring should be preferably a powerful steel spring having a strong resilience characteristic and a comparatively small length and which can resist repeated loads within the critical limits of resilience.

According to the present invention, the movable leaf is caused to rotate, and consequently the roller fixed by the free ends of the spring moves along the curved surface of the cam fixed to the hinge pintle, to that the movable leaf is, forced to rotate or to stop by the spring elasticity and a given force of rotation is controlled within comparatively narrow limits of the pintle.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

FIG. **1** is a plan view of a hinge employing a plate cam as a preferred embodiment of the invention.

FIG. **2** is sectional view of the hinge of FIG. **1**, which is installed on a door in an open position.

FIG. **3** is a plan view of a hinge in an open position, employing one cylindrical cam of synthetic resin as a preferred embodiment of the invention.

FIG. **4** is a sectional view of a hinge in which a roller is provided to move or roll along the curved surface of a cam.

FIG. **5** is a perspective view of the hinge of FIG. **3**.

FIG. **6** is a plan view of a hinge in an open position, employing two cylindrical cams as a preferred embodiment of the invention.

FIG. **7** is also a side view of the hinge of FIG. **6**.

FIG. **8** is also a sectional view of the hinge of FIG. **6**.

FIG. **9** is a side view of one of the two cams used in the hinge of FIG. **6**.

FIG. 10 is a side view of the other cam for the hinge of FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be further described to illustrate, for example, three preferred embodiments of the hinge thereof by reference to the accompanying drawings, as follows:

FIGS. 1 and 2 show one hinge structure in which a plate cam is fixed to a hinge pintle and a roller is forced to move and roll along the curved surface of same cam.

FIGS. 3, 4 and 5 show another hinge structure in which a roller is forced to move or roll along the curved surface of a cylindrical cam.

FIGS. 6, 7, 8, 9 and 10 show the other hinge structure in which two cylindrical cams having partially a different curved surface are fixed to the pintle, along which two rollers are forced to move or roll respectively.

The cam used may take different forms and is appropriately designed, depending on the angle to which the door is to be opened and the position when the door will be given a rotational force force as well as the amount of the force given.

Forms of the cam may be available in different profiles as the door leaf or the lid differs in weight or dimensions, and the number of the cams used may be optional according to different purposes.

Now, the hinge structure as shown in FIGS. 6 through 10 will be described in more details, as follows:

Joining parts or knuckles (joining knuckles) 2*a*, 2*b*, 2*c* of a fixed hinge leaf 2 are fixedly mounted to a hinge pintle 1, joining parts or knuckles (joining knuckles) 4*a*, 4*b* of a movable leaf 4 are pivotally connected to the pintle 1 and cylindrical cams 5, 6 are fixed between the knuckles 4*a* and 2*b* and between the knuckles 2*b* and 4*b*, respectively. The cams 5, 6 are fixed to the pintle 1 by means of a key 3. Other means than the key 3 by which the cams are fixed may be available, for example, by forming the pintle in a square cross section and a hole of the cam in the same cross section to register with the pintle.

Any means may be suitable if the cams can be fixed thereby to the pintle 1 to prevent any rotation thereof.

Means 7 and 8 through which a U-shape portion of springs 9 and 10 are respectively inserted are placed on the movable leaf 4 and the U-shape portion is fixed by screws 11 and 12.

Roller 13 and 14 are rotatably fixed by the free ends of the spring 9 and 10 and resiliently contacts and rolls along the curved surface of the cam 5, 6. respectively

The springs 9 and 10 are provided with portions of two or three windings in the middle thereof in order to increase their critical resilience. In FIG. 6, members 15 and 16 are hinge-mounting holes made on the leaves.

The cylindrical cam 5 as shown in FIG. 9 is so formed as to provide a continuous curved surface comprising a slanting portion 5*b* gradually increasing the external diameter of the cam from a recess portion 5*a* for which holds the door in a closed position, a slanting portion 5*c* gradually decreasing the external diameter which is the greatest at about 90° position, and a recess portion 5*d* for locking the roller at a 180° or open position.

The cylindrical cam 6 as shown in FIG. 10 is so formed as to provide a slanting portion 6*b* gradually increasing the external diameter of the cam from a recess portion 6*a* where the door is placed in a closed position, a turning portion 6*c* having the greatest diameter just before reaching a 90° position, a plane portion 6*d* having a smaller diameter to go in a straight line to a 150° position, a portion 6*e* having the uniform diameter and a recess portion 6*f* for locking the roller at a 180° position.

The cylindrical cams 5 and 6 and a portion 6*c* of the cam 6 may be available in different forms and at different angles, respectively, according to desired application of the hinge.

As one of the cylindrical cams 5, 6, for example the cam 5, continues to give a force of rotation until reaching a predetermined angle, and upon reaching said angle, the cams 5, 6 give a combined force of rotation, it follows that the door or the lid will receive double the force of rotation immediately before its closed position, namely at a 70° position according to the invention, and will be closed securely.

The embodiment described above will be further explained, wherein in order to rotate the movable leaf 4 in the direction indicated by an arrow 19 in FIG. 8, it requires a sufficient force of rotation to surpass the resistance arising from the elastic contact of the cylindrical cam with the roller. When the roller contacts the plane portion 6*d* of the cam 6, the force of rotation will be reduced by approximately half and will make it easy to open the door or the lid. When the roller fits in and is locked by the recess portion 5*d*, 6*f*, the movable leaf stops moving.

The placement of the said portions 5*d*, 6*f* is not restricted to a 180° position, but may be anywhere as desired, for example, at a 90° position where the door can be opened to a 90° position and kept at that position. The cam may be structured to provide portions of greater diameter starting from the recess portions 5*a*, 6*a* until approximately the 90° position, and portions of smaller diameter thenafter so that the door can be opened automatically or else portions of uniform diameter thenafter so that the door can be opened very slowly.

Next, the hinge structure as shown in FIGS. 1 and 2 will be described in more details, as follows:

The hinge is equipped with a plate cam instead of the cylindrical cam as referred to earlier, in which joining parts or knuckles 21*a* 21*b* of a fixed leaf 21 are fixed to a pintle 20, metal plate cams 22 and 23 being spaced by 1 are fixedly placed in the middle of the pintle 20. Joining parts or knuckles 24*a* and 24*b* of a movable leaf 24 are pivotally connected to said pintle 20 and the cams 22, 23 are fixed by a key 30 in order to prevent any rotation thereof.

Means 25 through which a U-shape portion of a spring 26 is inserted is provided on the movable leaf 24 and the U-shape portion of the spring is fixed by a screw 27.

A roller 28 is rotatably connected to leaf 24 by the free ends of the spring 26 and resiliently contacts the curved surface of the cams 22, 23.

The two cams 22, 23 are identical in profile and contact the roller on either side resepctively, causing a rotational force when the roller is moving or rolling along the curved surface of the cams 22, 23. In FIG. 1, 29 denotes hinge-mounting holes made on the leaves, 26*b* is a coiled portion of the spring 26 and 21*c* is an

opening made on the fixed leaf to allow the roller to pass.

The two plate cams have a uniform profile as explained above, but the profile of each can be different to provide different angular positions to obtain different forces of rotation.

The hinge structure as shown in FIGS. **3, 4** and **5** will be described in more details, as follows:

Joining parts or knuckles **32***a*, **32***b* of a fixed leaf **32** are fixed to a pintle **31,** and a nylon cylindrical cam **33** is fixed by a key **34** centrally of the pintle **31.** Knuckles **35***a*, **35***b* of a movable leaf **35** are pivotally connected to the pintle **31.** Means **36** through which a U-shape portion **37***a* of a spring **37** is inserted is provided on the movable leaf **35,** the U-shape portion **37***a* being fixed by a screw **38,** and a metal roller **39** is rotatably fixed by the free ends of the spring **37** and resiliently contacts the curved surface of the cam **33. 40** is an opening for the roller passage and **41** is hinge-mounting holes. The cam **33** has a recess portion **33***a* at a 0° position and a recess portion **33***b* at a 180° position along the curved surface thereof. When the roller fits in and is locked by the portion **33***a* or **33***b*, the door can be securely kept in an open position, and can resist any strong wind.

If the position of the portion **33***b* is placed at a certain angle the door can be kept open at such angle. Furthermore, if the cylindrical cam is given a slanting portion between the recess portion **33***a* at a 0° position and the 70° position, the door will be closed automatically when it reaches a 90° position.

According to the invention having been thus described, the hinge can ensure the door will closed automatically by means of the force caused on its pintle, and can also securely hold the door in a position where the roller fits in or is locked by the recess portion made on the face of the cam.

When the cam takes a substantially circular form having no eccentricity, the door can be stopped at any desired position.

While the purposes and specific embodiments of the invention have been described, it will be apparent that changes and modifications can be made within the scope and spirit of the invention in accordance with the definition of the invention as claimed.

What is claimed is:

1. An integral hinge and hinge stop device for holding doors and the like having hinge pintles, comprising a fixed hinge leaf and a movable hinge leaf having joining knuckles pivotally connected to said hinge pintle, a plurality of cams fixed to said pintle, each having a different curved surface, a plurality of springs rigidly secured to the movable leaf intermediate the ends of said springs and a roller means or cam follower attached to each of the spring ends and positioned to move along the curved surfaces of the cams, said cams, said springs and said roller means coacting to control the movement of the movable leaf.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,840,936 Dated October 15, 1974

Inventor(s) JUTARO SATOU

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the Patent, the inventor's name should be correctly shown as JUTARO SATOU, not JUTARO SATO.

Signed and sealed this 3rd day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.