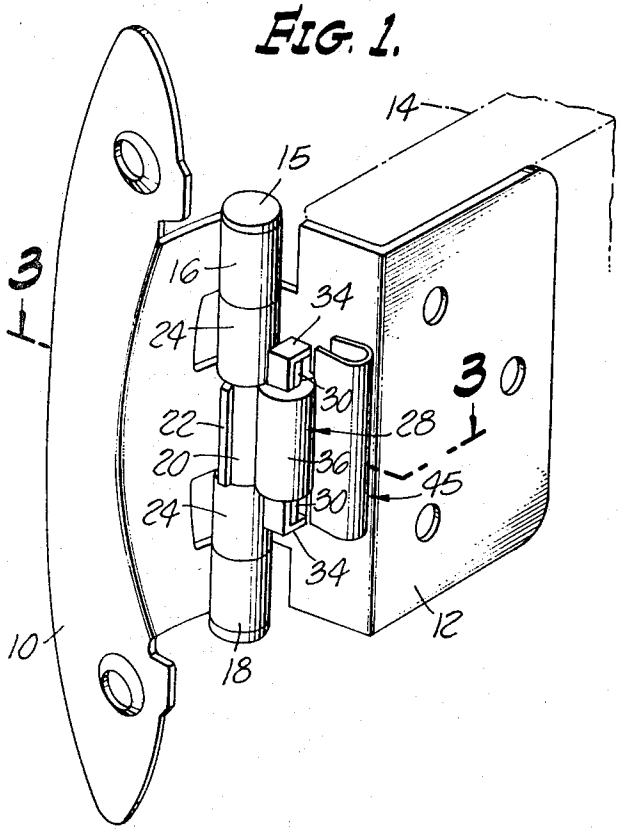
Dec. 29, 1970 D. J. SWARTZ 3,550,187

SNAP ACTING HINGE

Filed Dec. 13, 1968

2 Sheets-Sheet 1

FIG. 1.



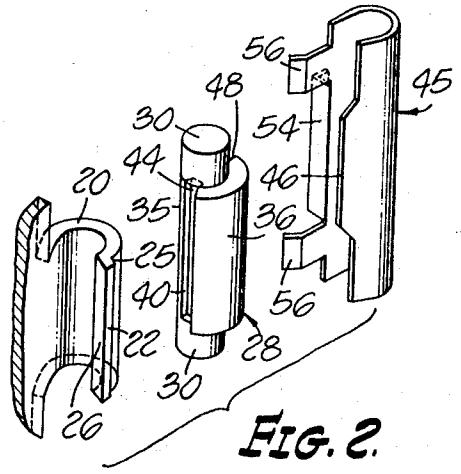


FIG. 2.

FIG. 4.

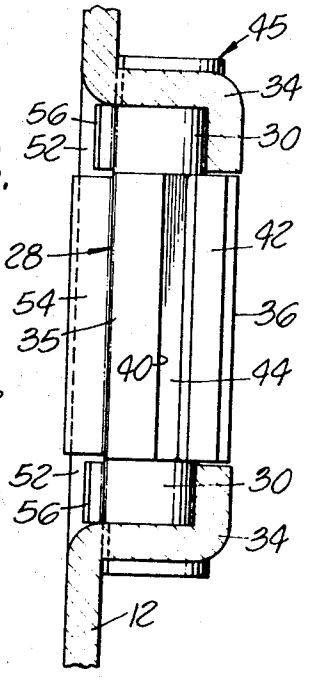
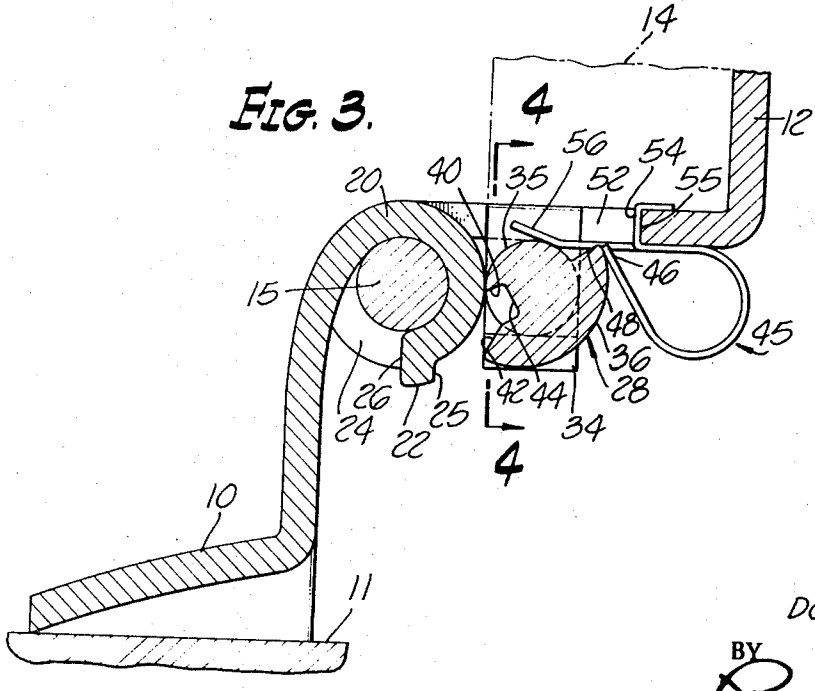


FIG. 3.



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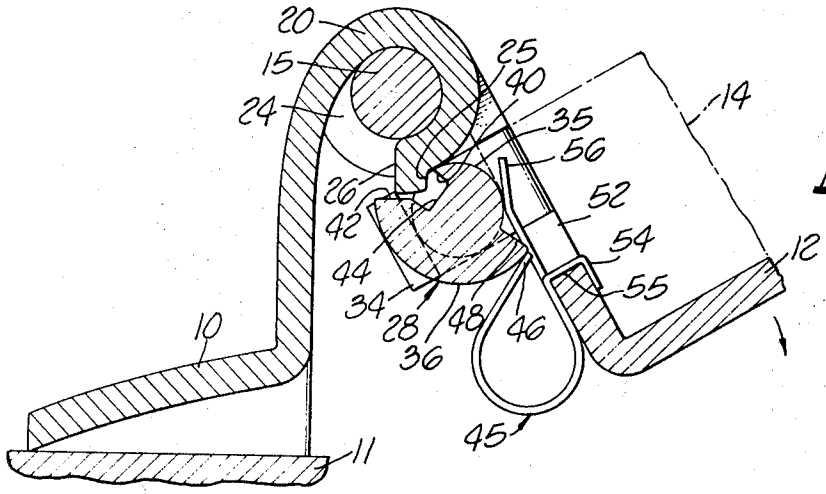

FIG. 5.

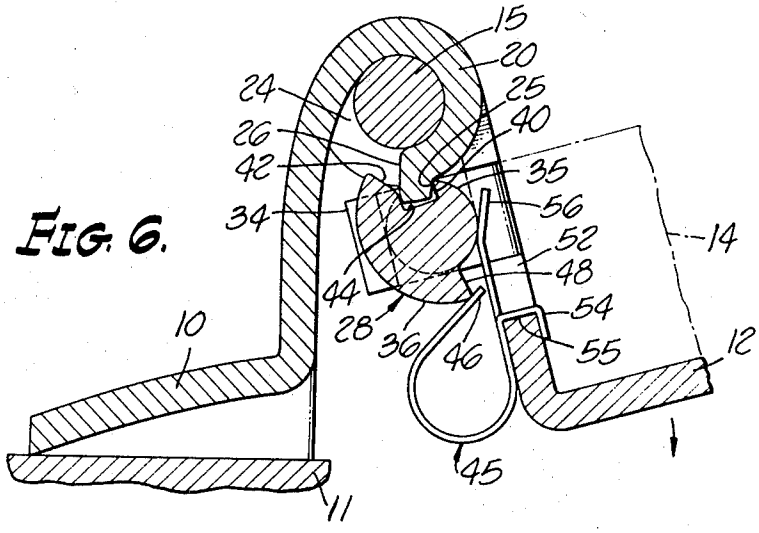

FIG. 6.

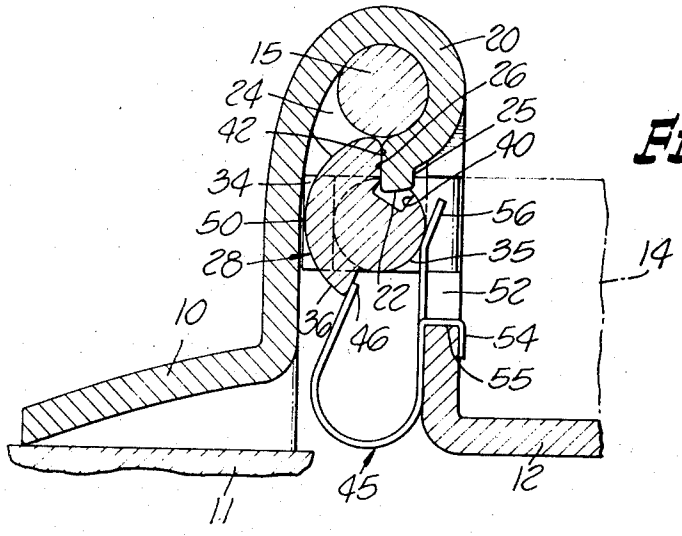

FIG. 7.

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SNAP ACTING HINGE

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U.S. Cl. 16—180 10 Claims

ABSTRACT OF THE DISCLOSURE

A knuckle of a first stationary hinge leaf has a radial projection that serves as a trigger for an actuator that is carried by the second hinge leaf, the actuator being rotatable about an axis that is fixed relative to the second hinge leaf. The swinging of the door towards closed position advances the rotary actuator in an orbit that is divided into three stages. In the first stage the rotary actuator is idle at a starting position. In the second stage the fixed radial projection rotates the orbitally moving actuator and thereby triggers the third stage wherein a bowed leaf spring causes the rotary actuator to act on the stationary hinge leaf to snap the door shut.

BACKGROUND OF THE INVENTION

The invention relates to a self-closing hinge of the type that provides power to snap a door shut as the door swings towards its closed position. Numerous hinges have been devised to serve the same general purpose but the present invention fills the need for a hinge of this character that is of relatively simple and durable construction and may be embodied in a relatively small and relatively lightweight hinge structure.

SUMMARY OF THE INVENTION

A stationary hinge leaf that is intended to be mounted on fixed structure has a knuckle that extends around the hinge pintle and the knuckle has a flange which functions as a fixed triggering projection. The second hinge leaf that supports the door carries a rotary actuator that is advanced along an orbit about the hinge axis as the door swings from a wide open position towards its closed position.

During the first stage of the orbital advance, a bowed leaf spring exerts radial pressure against a concentric surface of the actuator to serve as a friction brake to resist rotation of the actuator out of a first rotary position.

During the second stage of the orbital advance, the stationary triggering projection cooperates with the orbitally advancing actuator to rotate the actuator on its axis to a second rotary position which shifts the pressure of the bowed leaf spring from radial pressure against the periphery of the actuator to nonradial pressure against a shoulder of the actuator. The spring pressure is thereby released for forcible rotation of the actuator against a fixed portion of the stationary hinge leaf to snap the door to its closed position. Thus, the completion of the second stage causes the stationary knuckle projection to trigger the third spring-actuated stage for snapping the door shut.

On the return orbital movement of the actuator back through its third stage when the door is subsequently opened, the stationary knuckle projection returns the actuator to its second rotary position thereby storing energy in the bowed spring and further return orbital movement of the actuator through the second stage returns the actuator from its second rotary position to its first rotary starting posiiton.

The features and advantages of the invention may be understood from the following detailed description together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings which are to be regarded as merely illustrative:

FIG. 1 is a perspective view of the presently preferred embodiment of the hinge in actual use, the door carried by the hinge being at an open position;

FIG. 2 is an exploded perspective view showing the rotary actuator, the associated bowed leaf spring that provides the door closing force, and a radial projection of a fixed hinge knuckle that triggers the door closing action;

FIG. 3 is a transverse section taken along the line 3—3 of FIG. 1 showing the door at a wide open position at the start of a first stage of closing movement of the door;

FIG. 4 is a section taken as indicated by the line 4—4 of FIG. 3 showing how the rotary actuator is journalled on the second hinge leaf;

FIG. 5 is a view similar to FIG. 3 showing the door swung from the position shown in FIG. 3 to near the end of the first stage of orbital advance of the actuator about the axis of the hinge pintle;

FIG. 6 is a view similar to FIG. 5 showing the second stage of orbital advance of the actuator by the closing movement of the door, the view showing how the fixed knuckle projection rotates the actuator out of its normal starting position to trigger the spring-actuated closing of the door; and

FIG. 7 is a view similar to FIG. 6 showing how the orbital advance of the actuator through its second stage triggers the spring action of the third stage that snaps the door to its closed position.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

As best shown in FIG. 1, the presently preferred embodiment of the hinge has a first hinge leaf generally designated **10** for anchorage to fixed structure such as the frame of a doorway that is designated by numeral **11** in FIGS. 3–7. A second hinge leaf **12** for attachment to a door **14** is pivotally connected to the first hinge leaf by the usual pintle **15**. The first hinge leaf **10** has tongues forming an upper knuckle **16**, a lower knuckle **18**, and a central knuckle **20** that is formed with a radial projection or flange **22**. The second hinge leaf **12** has similar tongues forming two knuckles **24** that straddle the central knuckle **20**.

As shown in FIG. 3, the radial flange **22** of the central knuckle **20** provides two oppositely facing peripheral shoulders, namely, a first peripheral shoulder **25** on one side of the radial flange and a second peripheral shoulder **26** on the other side of the radial flange, the second shoulder being formed largely by the end of the tongue that forms the knuckle.

The second hinge leaf **12** carries an actuator, generally designated **28**, which, as shown in FIG. 2, is formed with two trunions **30** by means of which it is journalled in two axially aligned bearings. Each of the two bearings is formed by a small angular bracket **34** which may be brazed or welded to the second hinge leaf **12**.

The two angular bearing brackets **34** are immediately adjacent the respective knuckles **24** of the second hinge leaf, each knuckle closing one side of the bearing bracket. Each of the two bearing brackets **34** is open on an opposite side but, as will be made apparent, spring pressure against the actuator keeps the two trunions from escaping through the opposite sides of the two bearing brackets.

The body of the actuator **28** is of the configuration shown in perspective in FIG. 2, the body having a uniform cross section shown, for example, in FIG. 3. As may be seen in FIG. 3, the body of the actuator has a concentric peripheral surface **35** of the same diameter as the two trunions and has a second concentric peripheral surface

36 of substantially larger diameter. The actuator 28 is further formed with a first longitudinal peripheral shoulder 40 to cooperate with the first shoulder 25 of the stationary central knuckle 20 and the actuator is further formed with a second longitudinal peripheral shoulder 42 to cooperate with the second shoulder 26 of the stationary knuckle. As may be seen in FIG. 3, the actuator 28 has a longitudinal recess 44 which forms the shoulder 40 and forms part of the shoulder 42, the shoulder 42 being angular as shown.

Suitable spring means is provided for the dual purpose of applying pressure to the actuator 28 to immobilize the actuator on its axis during a portion of the operating cycle of the hinge and of applying force to the actuator to cause closing movement of the door during another part of the operating cycle. In the present embodiment of the invention, the spring means is a leaf spring, generally designated 45, which may be made of beryllium copper and which is mounted on the hinge leaf 12 adjacent the actuator 28, as shown in FIGS. 1 and 3.

To provide spring force of relatively high magnitude, the leaf spring 45 is substantially wider than the body of the actuator 28 and a free end of the spring is narrowed to a tongue 46 of substantially the width of the body of the actuator, the free end of the leaf spring, i.e., the tongue 46, cooperating with the actuator throughout the operating cycle. Thus, the leaf spring functions in effect as a spring arm.

It is apparent that as the hinge leaf 12 that carries the door 14 swings between a fully open position and a fully closed position, the actuator 28 is carried in an arcuate orbit that is concentric to the pintle 15 and it is further apparent that the flange 22 of the stationary knuckle 20 lies in the path of orbital movement of the actuator.

As the door swings from a fully open position to a fully closed position, the actuator 28 advances on its orbital path through three stages. At the start of this orbital advance when the door is in its fully open position shown in FIG. 3, the free end or tongue 46 of the leaf spring 45 is in contact with the peripheral surface 36 of the actuator and exerts substantial radially inward pressure against the actuator. Thus, at this point in the operating cycle the leaf spring 45 serves as a brake to frictionally immobilize the actuator 28 on its axis of rotation. Throughout the first stage of the orbital advance of the actuator from an initial position shown in FIG. 3 to a more advanced position shown in FIG. 5, the leaf spring keeps the actuator immobilized.

The first stage of the orbital advance of the actuator 28 by the closing movement of the door terminates and the second stage begins when the first longitudinal shoulder 40 of the actuator encounters the fixed longitudinal shoulder 25 of the stationary knuckle 20. The abutment of the first shoulder 40 of the actuator against the first shoulder 25 of the stationary knuckle causes clockwise rotation of the actuator as viewed in FIG. 5, FIG. 5 showing the actuator at an intermediate point in the second stage of its orbital advance. Thus, the second stage of orbital advance of the actuator 28 rotates the actuator from a first position shown in FIGS. 3 and 5 to a second position at which the clockwise rotation of the actuator brings the second longitudinal shoulder 42 of the actuator into abutment with the second longitudinal shoulder 26 of the stationary knuckle.

As shown in FIG. 3, the concentric peripheral surface 36 of the actuator 28 terminates in a radially inward longitudinal shoulder 48 and the clockwise rotation of the actuator through the second stage from the first rotary position of the actuator shown in FIG. 3 brings the radially inward shoulder 48 into the region of the free end or tongue 46 of the leaf spring 45 with the consequence that the pressure of the leaf spring is shifted from the concentric peripheral surface 36 to the radially inward shoulder 48. The pressure of the leaf spring then forcibly urges continued clockwise rotation of the actuator 28 with the second longitudinal shoulder 42 of the actuator pressing against the longitudinal shoulder 26 of the stationary knuckle, as shown in FIG. 7, to carry out the third stage of orbital advance in which the actuator under the pressure of the leaf spring snaps the door closed. Thus, the second stage of orbital advance of the actuator, in serving to rotate the actuator from its first rotary position on its axis to its second rotary position, triggers the third stage of orbital advance in which the closing movement of the door is actuated by the leaf spring 45. In the preferred practice of the invention, the third stage of the operation begins when the door is at a position of approximately 25° from its fully closed position.

It is to be noted in FIG. 7 that when the door is fully closed, i.e., when the two hinge leaves 10 and 12 are in the same plane, a small clearance 50 exists between the peripheral surface 36 of the actuator 28 and the adjacent surface of the hinge leaf 10. This clearance provides assurance that the door will be snapped to fully closed position. If the hinge leaf 12 were free to swing clockwise beyond the fully closed position shown in FIG. 7, the orbital advance of the actuator 28 would bring the peripheral surface 36 of the actuator against the hinge leaf 10 to limit the closing operation of the hinge. When the hinge is sold across the counter the hinge leaf 12 is at the limit position determined by abutment of the actuator 28 against the hinge leaf 10.

The leaf spring 45 may be mounted on the hinge 12 in various ways in various practices of the invention. In the construction shown, the hinge leaf 12 is cut away to provide a longitudinal slot 52 and, as shown in FIGS. 2 and 3, the leaf spring is formed with an angular flange 54 which embraces the rim 55 of the slot. Adjacent the opposite sides of the angular flange 54, the leaf spring is formed with two slightly angular fingers 56 which, as may be seen in FIG. 3, extend across the slot 52, the two fingers being in contact with the two trunions 30 respectively of the actuator throughout the cycle of operation of the hinge. Thus, the spring fingers 56 keep the actuator 28 from shifting bodily into the slot 52 and at the same time the tongue 46 or free end of the leaf spring keeps the actuator from escaping laterally from the two bearing brackets 34.

It is apparent that the return or opening movement of the leaf hinge 12, in effect, cocks the spring-pressed actuator 28. Thus, in the return orbital movement of the actuator through the third stage of orbital movement from the fully closed position of the door, the actuator 28 is rotated counterclockwise by impingement of the second shoulder 42 of the actuator against the second shoulder 26 of the fixed knuckle, as shown in FIG. 7. The counterclockwise rotation of the actuator continues throughout the return through the second stage of the orbital path, thereby returning the actuator to its normal rotary position.

An important feature of the invention is that the recess 44 of the actuator is dimensioned to clear the radial flange 22 of the fixed knuckle 20. Thus, throughout the second stage of orbital movement of the actuator in which the actuator is rotated by the fixed knuckle, there is no resistance to rotation of the actuator on its axis by frictional contact between the actuator and the radially outward surface of the knuckle flange 22.

My description in specific detail of the presently preferred embodiment of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

What is claimed is:

1. In a hinge of the character described for swingingly supporting a door and for boosting the door as it approaches a limit position in its swinging movement in a particular direction, the combination of:

a first hinge leaf adapted for attachment to fixed structure;

a second hinge leaf adapted for attachment to a door and pivotally connected to the first hinge leaf for rotation relative thereto about a hinge axis;

an actuator journalled on the second hinge leaf for rotation on an axis that is fixed relative to the second hinge leaf,

said actuator being positioned on the second hinge leaf to be moved bodily thereby in an orbit about the hinge axis,

said actuator having a substantially concentric peripheral surface terminating at an inwardly extending shoulder;

a flexed leaf spring fixedly mounted on the second hinge leaf with a free end of the leaf spring normally exerting pressure against said concentric peripheral portion of the actuator to releasably immobilize the actuator at a first rotary position of the actuator on its axis during a first stage of the swinging movement of the second hinge leaf in said particular direction,

cooperative means on the first hinge leaf and the actuator, respectively, to rotate the actuator on its axis from said first rotary position to a second rotary position in response to continued swinging movement of the second hinge leaf through a second range in said particular direction,

said leaf spring being positioned relative to the actuator to shift its pressure from the periphery of the actuator to said inwardly extending shoulder of the actuator when the actuator is rotated to its second rotary position whereupon the leaf spring exerts force against said inwardly extending shoulder for continued rotation of the actuator in said given direction to snap the door shut,

cooperative means on the first hinge leaf and on the actuator respectively to swing the second hinge leaf to said limit position in response to said continued rotation of the actuator.

2. A combination as set forth in claim **1**, in which said leaf spring is of the configuration of an open loop.

3. A combination as set forth in claim **1** in which the two hinge leaves are pivotally interconnected by a pintle and in which a portion of the first hinge leaf extends at least partially around the pintle;

and in which said cooperative means to rotate the actuator from its first rotary position to its second rotary position comprises a shoulder on said portion of the first hinge leaf and a cooperating shoulder on the actuator.

4. A combination as set forth in claim **3** in which said cooperative means to swing the second hinge leaf to its limit position comprises a second shoulder on said actuator and a cooperating second shoulder on said portion of the first hinge leaf.

5. A combination as set forth in claim **4** in which the periphery of the actuator between its two shoulders is dimensioned for the actuator to clear said portion of the first hinge leaf when the second hinge leaf is in its first stage of swinging movement.

6. A combination as set forth in claim **4** in which said portion of the first hinge leaf is a knuckle;

and in which said knuckle has a peripheral flange forming at least part of the first and second shoulders on said portion of the first hinge leaf.

7. A combination as set forth in claim **1** in which the two hinge leaves are pivotally interconnected by a pintle and in which a portion of the first hinge leaf extends at least partially around the pintle;

and in which said cooperative means to swing the second hinge leaf to its limit position comprises a shoulder on the actuator and a cooperating shoulder on said portion of the first hinge leaf.

8. A combination as set forth in claim **1** in which the opposite ends of the actuator are journalled in bearings each of which is open on at least one side for admission of the corresponding end of the actuator to facilitate installation of the actuator;

and in which said leaf spring is shaped and dimensioned to retain the actuator in the two bearings.

9. In a hinge of the character described for swingingly supporting a door and for boosting the door as it approaches a limit position in its swinging movement in a particular direction, the combination of:

a first hinge leaf adapted for attachment to fixed structure;

a second hinge leaf adapted for attachment to a door and pivotally connected to the first hinge leaf for rotation relative thereto about a hinge axis;

cooperative means on said first hinge leaf and said second hinge leaf for applying an increased closing force to swing the second hinge leaf to its fully closed position, including a rotatable actuator member carried by the second hinge leaf and having orbital movement about the hinge axis; and

a flexed leaf spring acting between the second hinge leaf and the actuator member to apply a rotative force thereto.

10. The combination as set forth in claim **9**, wherein rotation of the actuator by said rotative force is controlled by a member carried by said first hinge leaf.

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