Dec. 29, 1970 D. J. SWARTZ 3,550,186

SELF-CLOSING HINGE

Filed Dec. 13, 1968 2 Sheets-Sheet 1

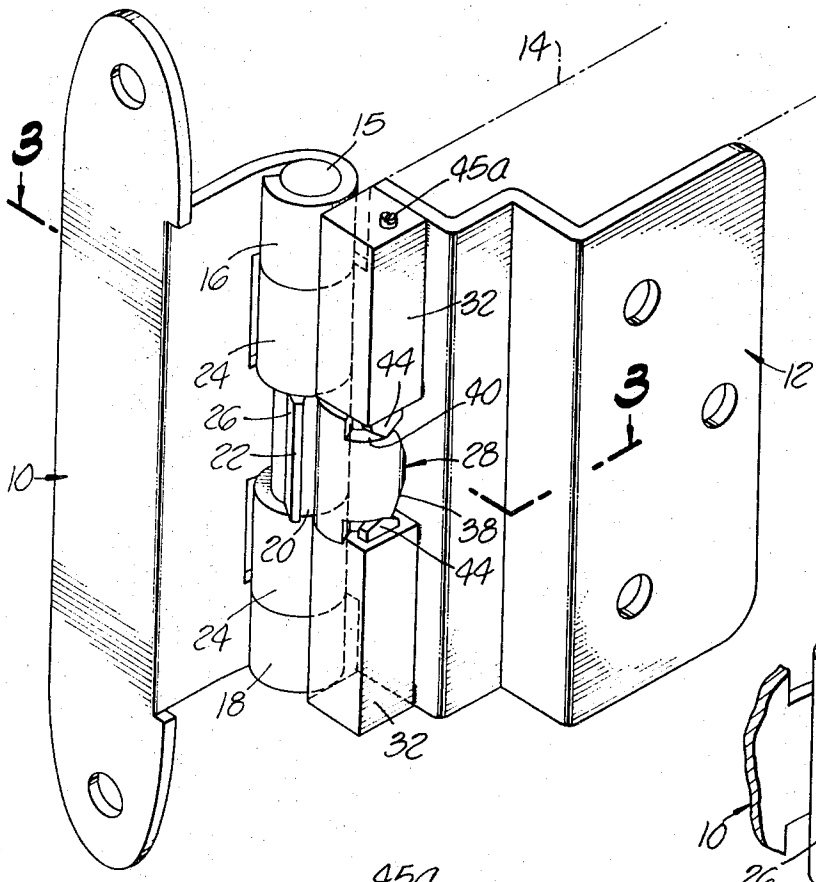


FIG. 1.

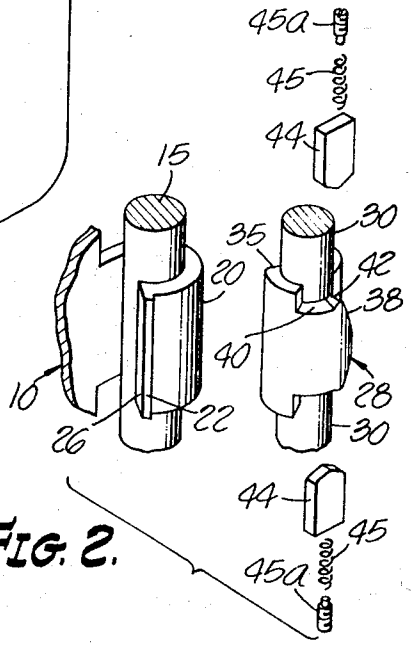


FIG. 2.

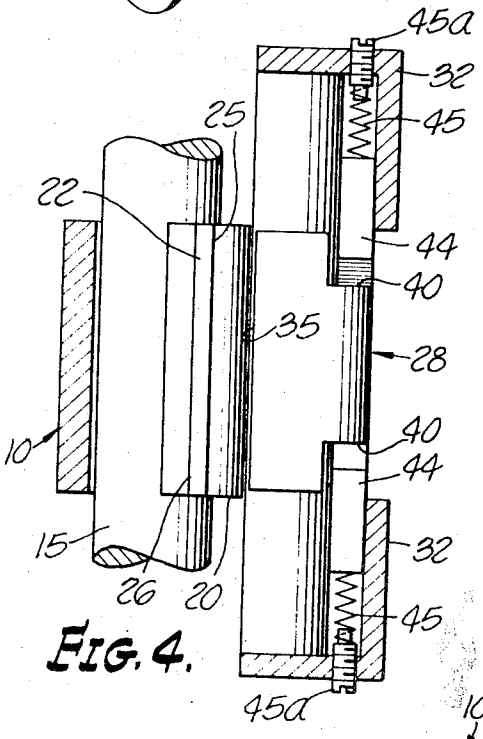
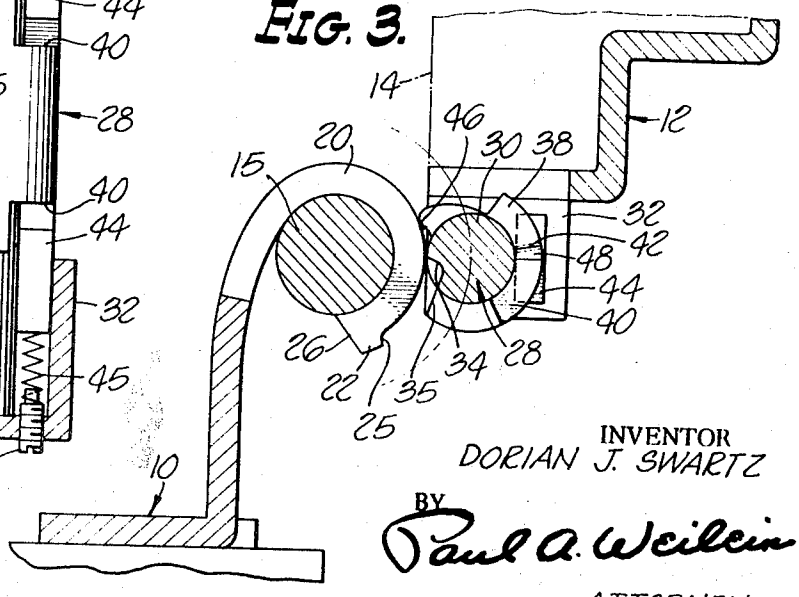


FIG. 4.

FIG. 3.



INVENTOR
DORIAN J. SWARTZ

BY

Paul A. Weilein

ATTORNEY

Dec. 29, 1970 D. J. SWARTZ 3,550,186

SELF-CLOSING HINGE

Filed Dec. 13, 1968 2 Sheets-Sheet 2

FIG. 5.

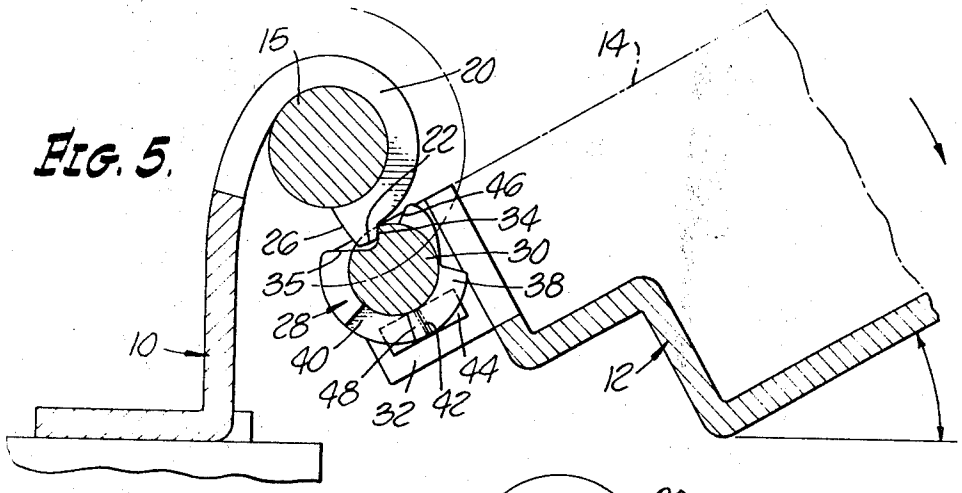


FIG. 7.

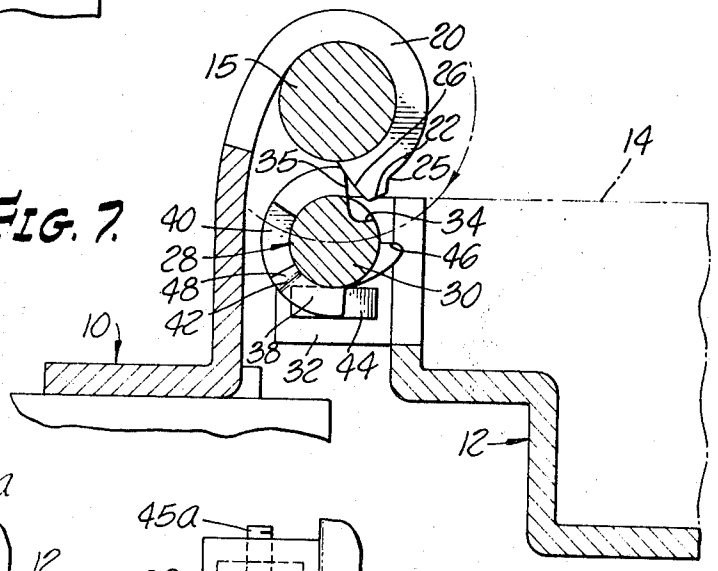
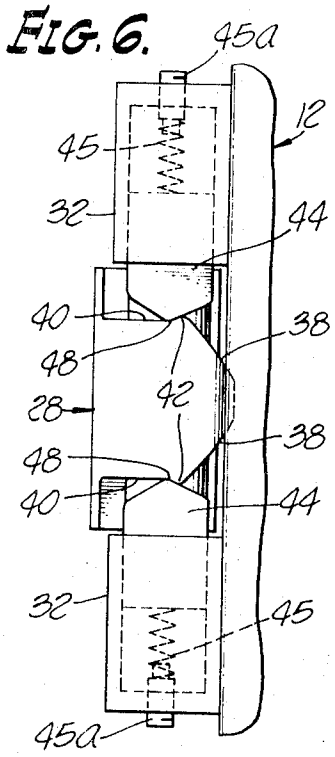


FIG. 6.



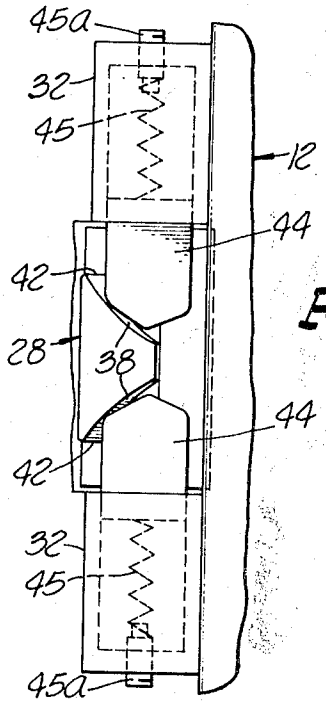


FIG. 8.

INVENTOR
DORIAN J. SWARTZ

BY
Paul A. Weilein
ATTORNEY

United States Patent Office 3,550,186 Patented Dec. 29, 1970

3,550,186

SELF-CLOSING HINGE

Dorian J. Swartz, Yorba Linda, Calif., assignor to Hyer Hardware Mfg. Co., Anaheim, Calif., a corporation of California

Filed Dec. 13, 1968, Ser. No. 783,518
Int. Cl. E05f 1/14
U.S. Cl. 16—180 15 Claims

ABSTRACT OF THE DISCLOSURE

A knuckle of a first stationary hinge leaf has a fixed radial flange to cooperate with 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 rotary actuator has two spaced confronting peripheral shoulders to cooperate with the fixed flange as the actuator is moved in an orbit by the swinging door. First the two shoulders of the actuator move into position to straddle the flange for initial rotation of the actuator by the flange and then spring force is released to continue the rotation of the actuator with one of the shoulders acting against the flange to boost the swinging movement of the door as it approaches its closed position.

BACKGROUND OF THE INVENTION

Although numerous self-contained hinges are to be found in the prior art that boost the swinging movement of a door as the door approaches its closed position, there are, nevertheless, certain needs for improvement yet to be met.

One such need to which the present invention is directed is to provide closing force of sufficient magnitude to operate a relatively large and heavy door such as a door for a doorway of a building as distinguished from a relatively small door for a kitchen cabinet.

Another need is for a hinge that will provide such a force for sustained effect over a relatively wide angle, for example, an angle as much as 30° as a door swings to its closed position.

A further need is to provide such a hinge that is of relatively simple construction and is capable of a long service life without attention.

The object of the present invention is to provide a hinge construction that satisfies these requirements.

SUMMARY OF THE INVENTION

A first hinge leaf and a second hinge leaf are pivotally interconnected in the usual manner by a pintle, the first hinge leaf being adapted for attachment to a fixed structure such as a frame of a doorway and the second hinge leaf being adapted to support a door. A knuckle of the fixed hinge leaf extends around the pintle and is formed with a radial flange that is in the path of a rotary actuator, the rotary actuator being positioned on the second hinge leaf to advance along an orbit as the door swings towards its closed position. A feature of the invention is that the actuator rotates on an axis that is fixed relative to the hinge leaf that carries the door.

With the actuator stationary with respect to rotation about its own axis, the door in swinging towards its closed position reaches an intermediate position at approximately 30° from its closed position where two shoulders of the actuator straddle the knuckle flange to cause initial rotation of the actuator about its own axis. The initial rotation triggers spring action for continued rotation of the actuator with the actuator exerting sufficient force against the knuckle flange to boost the closing movement of the door. The spring action forces follower means on the second

hinge leaf against cam surfaces of the actuator for rotation of the actuator by cam action.

A feature of the preferred embodiment of the invention is that the rotary actuator has two convergently inclined cam surfaces and two corresponding spring-pressed followers cooperate with both cam surfaces simultaneously. One important advantage of this arrangement is, of course, the additive effect of the two cam actions to provide a door closing force of relatively large magnitude. A further important advantage is that the pressures of the two followers are opposite to balance each other. In effect, the pressures of the two followers neutralize each other so that neither pressure tends to dislodge or shift the actuator along its axis of rotation.

The actuator should be substantially stationary on its axis until the actuator advances orbitally sufficiently to contact the radial knuckle flange. A feature of the invention is that the two followers apply brake pressure to the actuator until the actuator reaches the knuckle flange. A further feature in this regard is that the actuator has two spaced radial shoulders that cooperate with the flange knuckle to limit rotation of the actuator on its axis until the actuator reaches the knuckle flange.

The features and advantages of the invention may be understood from the following detailed description and 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, the door carried by the hinge being at an open position;

FIG. 2 is an exploded perspective view showing the rotary actuator together with the cooperative knuckle flange and the two spring-pressed followers for cam action on the actuator;

FIG. 3 is a horizontal sectional view taken as indicated by the line 3—3 of FIG. 1 showing relationships among the parts when the door is at a relatively wide open position;

FIG. 4 is a fragmentary view partly in section and partly in side elevation showing the actuator and cooperating knuckle flange at positions corresponding to the position shown in FIG. 3;

FIG. 5 is a sectional view similar to FIG. 3 showing the rotary actuator advanced orbitally from the position shown in FIG. 3 to a position in initial engagement with the knuckle flange;

FIG. 6 is a fragmentary elevational view showing the positions of the two followers relative to the cam surfaces of the actuator when the door is at the position shown in FIG. 5;

FIG. 7 is a sectional view similar to FIGS. 3 and 5 showing the relationship of the actuator to the knuckle flange at the completion of the door closing action; and

FIG. 8 is a fragmentary elevational view showing the positions of the two followers relative to the cam surfaces of the actuator when the door is fully closed.

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 a frame of a doorway (not shown) and has a second hinge leaf **12** for attachment to a door **14**, the two hinge leaves being pivotally interconnected 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 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 knuckle.

The second hinge leaf **12** carries an actuator generally designated **28**, which may be made of nylon and which, as shown in FIG. 2, is formed with two trunions **30** by means of which it is journalled in two aligned bearing housings **32**, the two bearing housings being mounted on the second hinge leaf by brazing or welding as indicated in FIG. 1. As shown in cross section in FIG. 3, the actuator **28** has a longitudinal recess which forms a first peripheral shoulder **34** and a second peripheral shoulder **35**, the two shoulders facing towards each other circumferentially of the actuator.

The actuator **28** is formed with two convergently inclined cam surfaces **38**, as best shown in FIG. 8, and is further formed with two corresponding adjacent surfaces **40** that are substantially perpendicular to the axis of rotation of the actuator. At the juncture of the cam surfaces **38** and the corresponding surfaces **40**, the actuator is formed with crests **42**, as best shown in FIG. 6.

The two bearing housings **32** serve as linear guides for a pair of followers **44** for cooperation with the actuator **28**, the followers being urged towards the actuator by suitable compression coil springs **45** confined in the housings. The effective spring pressure exerted by each of the springs **46** is adjustable by means of a screw **45***a* engaged with its outer end and having a threaded mounting in the bearing housing **32**. As may be seen in FIGS. 2 and 6 each of the followers has a tapered leading end.

Because of its eccentric position on the second hinge leaf **12**, the actuator **28** is carried along an orbital path about the axis of the pintle **15** as the door swings between its two limit positions and the knuckle flange **22** lies in the orbital path. Beginning with the door in an open position, such as shown in FIGS. 1 and 3, the orbital advance of the actuator **28** is through three stages as the door moves to its fully closed position.

In the first stage of orbital advance of the actuator **28**, as represented by FIG. 3, the actuator is substantially stationary with reference to rotation about its own axis and at the end of this stage the first peripheral shoulder **34** of the actuator moves into abutment with the first peripheral shoulder **25** of the knuckle flange **22** as shown in FIG. 5. During this first stage of orbital advance of the actuator around the axis of the pintle, the two followers **44** exert pressure against the corresponding surfaces **40** of the actuator as shown in FIG. 1 and thus function as brake means to keep the actuator immobilized. In addition, means is provided to limit the rotation of the actuator in a positive manner during this first stage of orbital advance. For this purpose the actuator **28** is further formed with a third peripheral shoulder **46** which, as may be seen in FIG. 3, cooperates with the outer circumference of the central knuckle **20** to limit counterclockwise rotation of the actuator about its axis. In like manner, the second peripheral shoulder **35** of the actuator also cooperates with the outer circumferential surface of the central knuckle **20** to limit clockwise rotation of the actuator on its axis.

In the second stage of orbital advance of the actuator **28**, the actuator is rotated clockwise on its axis by the impingement of the first peripheral shoulder **34** of the actuator against the first peripheral shoulder **25** of the knuckle flange **22**, which clockwise rotation brings the two shoulders **34** and **35** of the actuator into positions at which they straddle the knuckle flange **22** somewhat in the manner shown in FIG. 5. At the same time, the clockwise rotation of the actuator **28** brings the followers **44** up to the two crests **42** as shown in FIG. 6 and causes the two

followers to ride over the crests onto the convergently inclined cam surfaces **38**.

The third stage of orbital advance of the actuator **28** occurs as the two followers **44** act on the two cam surfaces **38** to continue the clockwise rotation of the actuator in a forcible manner, the second peripheral shoulder **35** of the actuator kicking against the second peripheral shoulder **26** of the knuckle flange **22**. The door is propelled in this manner to its fully closed position shown in FIG. 7 where the second peripheral shoulder **35** of the actuator presses against the corresponding second peripheral shoulder **26** of the knuckle flange. Thus, the second stage of orbital advance of the actuator around the axis of the pintle, in effect, triggers the cam action for boosting the door to its fully closed position in the third stage.

When the door is subsequently opened for return orbital movement of the actuator **28**, the return of the actuator through the third stage causes the second peripheral shoulder **26** of the knuckle flange to act on the second peripheral shoulder **34** of the actuator to rotate the actuator counterclockwise against the resistance of the spring-pressed followers **44** with the result that the convergently inclined cam surfaces **38** wedge the followers apart and thus store potential energy in the two coil springs **45**. When the return orbital movement of the actuator **28** reaches the second stage, the two peripheral shoulders **34** and **35** of the actuator **28** again straddle the knuckle flange **22**, as shown in FIG. 5, as the rotation of the actuator continues towards the starting rotary position of the actuator. As the return orbital movement is completed, the actuator **28** returns to its normal position shown in FIG. 1 where the followers **44** exert braking pressure on the surfaces **40** of the actuator.

It is to be noted that in making the transition from the third stage to the second stage in the return orbital movement of the actuator **28**, the two followers **44** are forced to climb over the crests **42** and the short rearward slopes **48** of the crests cooperate with the two followers for a reverse boosting cam action that fully restores the actuator to its normal starting position.

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.

I claim:

1. In a hinge of the character described for swingingly supporting a door and for boosting the closing movement of the door as it approaches its fully closed position, the combination of:

a first hinge leaf adapted for attachment to a fixed structure;

a second hinge leaf for attachment to the 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 relative to the second hinge leaf on an axis that is fixed relative to the second hinge leaf;

means to retain the actuator on its axis substantially at a first rotary position of the actuator when the second hinge leaf is at a wide open position relative to the first hinge leaf;

means to rotate the actuator on its axis in one rotary direction from said first rotary position to a second rotary position in response to swinging movement of said second hinge leaf from said wide open position to a lesser wide open position relative to the first hinge leaf;

means to apply force to the actuator for continued rotation thereof in said one rotary direction in response to rotation of the actuator from its first rotary position to its second rotary position; and

cooperative means on said actuator and said first hinge leaf respectively to swing the second hinge leaf to its

fully closed position in response to said continued rotation of the actuator.

2. In a hinge of the character described for swingingly supporting a door and for boosting the swinging movement of 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 for attachment to the 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 relative to the second hinge leaf on an axis that is fixed relative to the second hinge leaf;

means to limit rotation of the actuator on its axis at a first rotary position of the actuator when the second hinge leaf is at a wide open position relative to the first hinge leaf;

cooperative means on the first hinge leaf and the actuator respectively to rotate the actuator on its axis in one rotary direction from its first rotary position to a second rotary position in response to swinging movement of the second hinge leaf towards said limit position of the door;

means to apply force to the actuator for continued rotation thereof in said one rotary direction in response to rotation of the actuator from its first rotary position to its second rotary position; and

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

3. A combination as set forth in claim 2 in which said force applying means applies pressure to the actuator both to releasably immobilize the actuator at its first rotary position and to cause said continued rotation of the actuator in response to rotation of the actuator on its axis from said first rotary position to said second rotary position.

4. A combination as set forth in claim 2 in which the two hinge leaves are pivotally interconnected by a pintle with a portion of the first hinge leaf extending around the pintle;

and in which the cooperative means to rotate the actuator on its axis from its first position to its second position comprises shoulders on the actuator and on said portion of the first hinge means respectively.

5. 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 pintle;

a first hinge leaf pivotally engaging the pintle and adapted for attachment to fixed structure;

a second hinge leaf pivotally engaging the pintle and adapted for attachment to the door,

the first hinge leaf having a knuckle extending at least partially around the pintle,

said knuckle having a peripheral projection with a first shoulder on one side of the projection and a second oppositely facing peripheral shoulder on the other side of the projection;

an actuator having a first peripheral shoulder to cooperate with said first shoulder of the knuckle and having a second peripheral shoulder to cooperate with said second shoulder of the knuckle, said two shoulders facing each other circumferentially of the actuator;

means on said second hinge leaf journalling said actuator on an axis of rotation that is fixed relative to the second hinge axis and is positioned for orbital advance of the actuator about the axis of the pintle in one direction through a first stage, a second stage,

and a third stage of orbital movement when the second hinge leaf swings in said particular direction,

the shoulders of the actuator being located thereon to be spaced from said knuckle projection in the first stage of orbital advance of the actuator,

said projection and said first shoulder of the knuckle being in the path of orbital advance of said first shoulder of the actuator in the second stage of orbital advance of the actuator to cause the first shoulder of the knuckle to impinge on the first shoulder of the actuator to rotate the actuator in one rotary direction during the second stage of orbital advance until the second shoulder of the actuator abuts the second shoulder of the knuckle at the beginning of the third stage of the orbital advance; and

power means responsive to orbital advance of the actuator through the second stage to rotate the actuator about its axis of rotation in said one rotary direction to cause the second shoulder of the actuator to thrust against the second shoulder of the knuckle to carry out the third stage of orbital advance of the actuator to swing the door to said limit position.

6. A combination as set forth in claim 5 in which said power means includes yielding means to store potential energy in response to rotation of the actuator in the opposite direction by thrust of the second shoulder of the knuckle against the second shoulder of the actuator during return orbital movement of the actuator through said third and second stages of orbital movement by return swinging movement of the door from said limit position.

7. A combination as set forth in claim 5 in which said actuator has a peripheral recess forming its first and second shoulders.

8. A combination as set forth in claim 5 in which said power means is constructed and arranged to apply brake pressure to the actuator to tend to immobilize the actuator on its axis of rotation during said first stage of orbital advance of the actuator.

9. A combination as set forth in claim 8 in which said actuator has at least one peripheral surface in a plane perpendicular to its axis of rotation and the power means applies the brake pressure against said surface.

10. A combination as set forth in claim 9 in which said actuator has two opposite peripheral surfaces in planes perpendicular to its axis of rotation and in which the power means applies brake pressure to both of said surfaces simultaneously.

11. A combination as set forth in claim 5 in which said actuator has at least one helical cam surface;

in which a follower cooperates with said cam surface;

and in which the power means comprises spring means to force the follower against the cam surface to rotate the actuator to cause said third stage of orbital advance.

12. A combination as set forth in claim 11 in which:

said actuator has a second surface perpendicular to its axis of rotation positioned to receive the thrust of the follower for braking action to resist rotation of the actuator during said first stage of orbital advance;

and in which the actuator is formed with a crest at the juncture of said helical surface and said second surface, said crest having a rear slope to cooperate with the follower for a reverse cam action on the actuator.

13. A combination as set forth in claim 5 in which said actuator has a third peripheral shoulder for cooperation with its first peripheral shoulder and for cooperation with said knuckle to limit rotation of the actuator about its axis of rotation during said first stage of orbital advance.

14. In a hinge of the character described for swingingly supporting a door and for boosting the closing movement of the door as it approaches its fully closed position, the combination of:

a first hinge leaf adapted for attachment to a fixed structure;

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

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 spring-rotatable actuator member carried by the second hinge leaf and having orbital movement about the hinge axis.

15. The combination as set forth in claim 14, wherein rotation of the actuator member is controlled by a member carried by said first hinge leaf.

References Cited

UNITED STATES PATENTS

3,381,333	5/1968	Jerila	16—168
3,381,332	5/1968	Jerila et al.	16—145
3,391,420	7/1968	Anderson	16—14?

BOBBY R. GAY, Primary Examiner

D. L. TROUTMAN, Assistant Examiner

U.S. Cl. X.R.

186