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Pierie

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[54] **DOOR RETURN AND CLOSURE MECHANISM**

[76] Inventor: **Charles Gorgas Pierie,** 1460 Creek Rd., Huntingdon Valley, Pa. 19006

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[51] **Int. Cl.** **E05f 1/08**

[58] **Field of Search** 16/63, 65, 71, 72, 80, 16/140, 165, 163

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Primary Examiner—Paul R. Gilliam
Assistant Examiner—Peter A. Aschenbrenner
Attorney, Agent, or Firm—John W. Logan, Jr., Esq.

[57] **ABSTRACT**

A spring powered door closure is disclosed consisting of two primary levers pivotally connected to the door and frame respectively. The outer free ends of the two primary levers are interconnected by a pair of crossed connecting links. The connecting links are pivotally interconnected at their midpoints, have their outer end pivotally connected to the free end of a primary lever and their inner end interconnected with the other primary lever in a manner permitting a sliding connection with the primary lever. A tension spring connected between the inner end of one connecting link and the door frame exerts a closing force on the door. As the door approaches a closed position and the force exerted by the spring decreases, the sliding connection of the connecting links to the primary levers increases the moment arm of the primary levers resulting in a substantially uniform closing force on the door throughout its entire path of travel.

8 Claims, 8 Drawing Figures

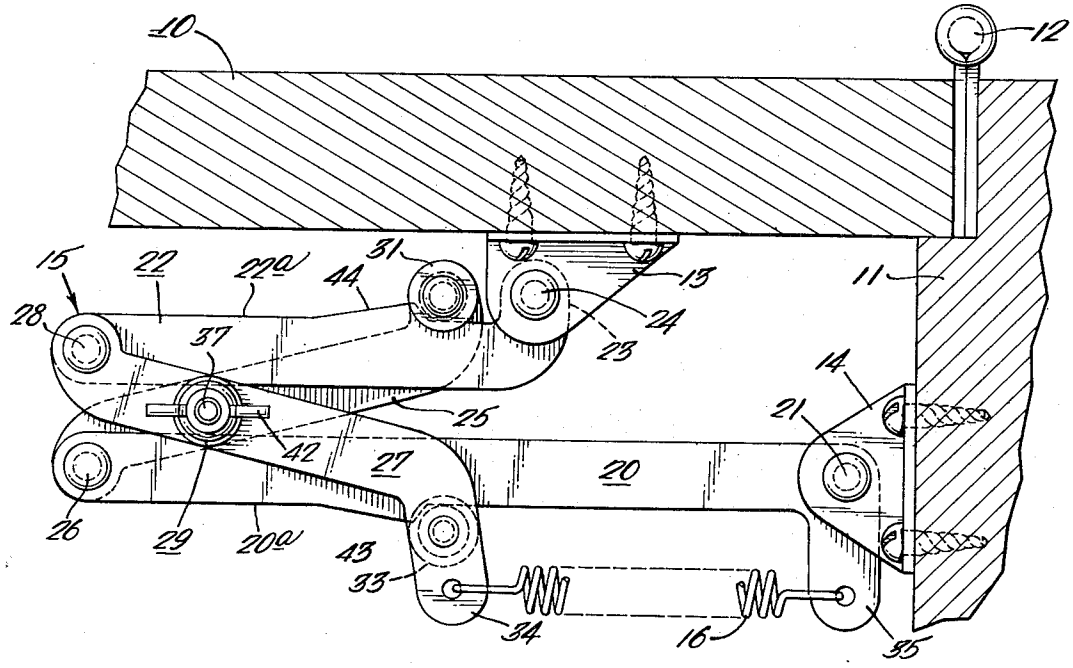


FIG. 1.

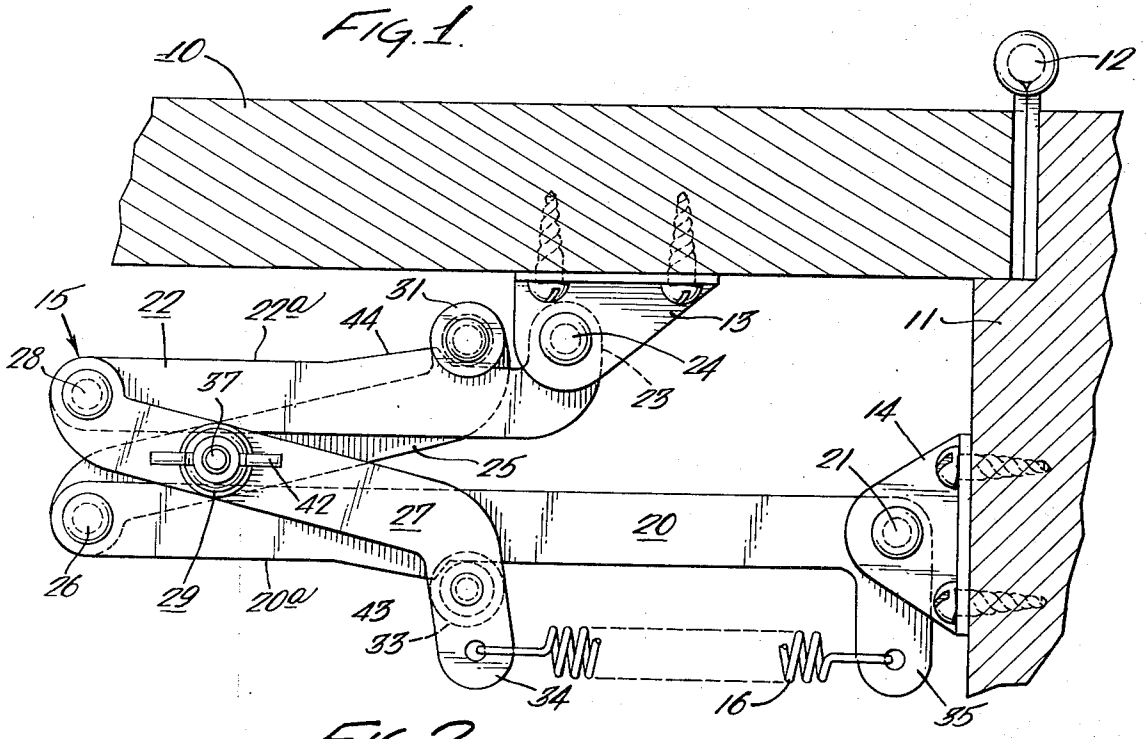


FIG. 2.

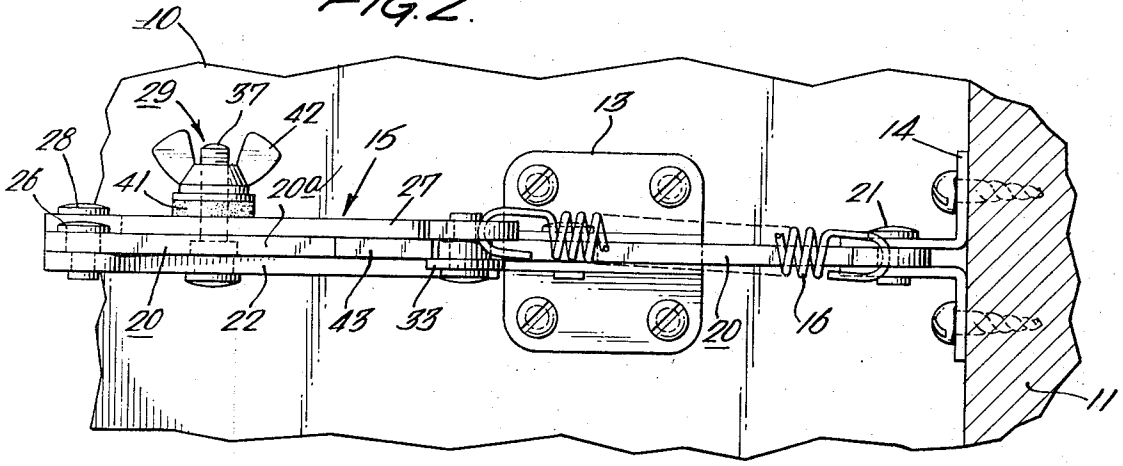


FIG. 4.

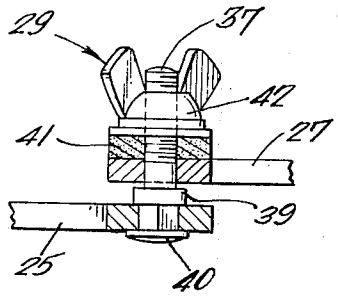


FIG. 7.

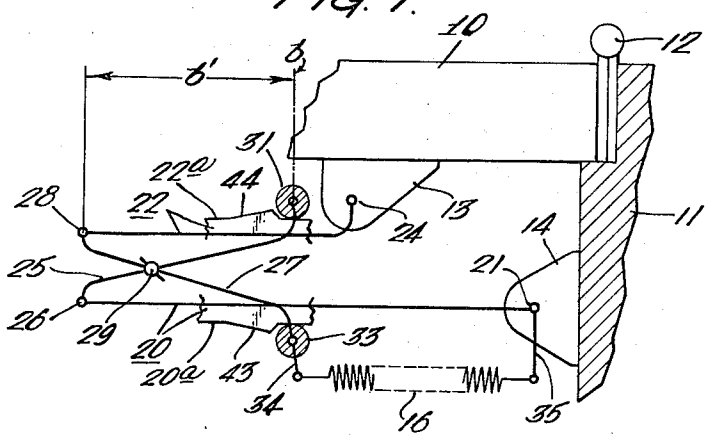


FIG. 3.

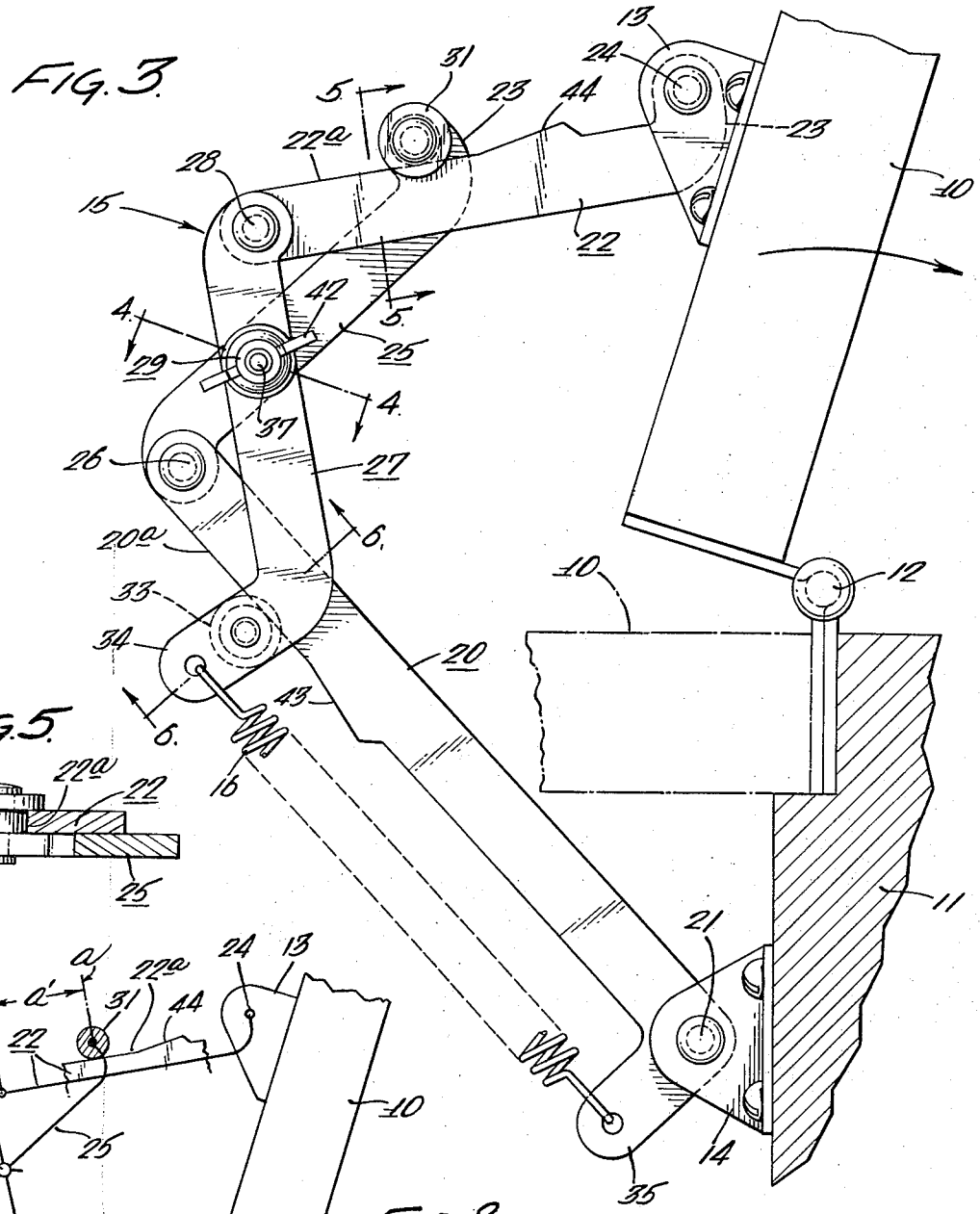


FIG. 5.

FIG. 8.

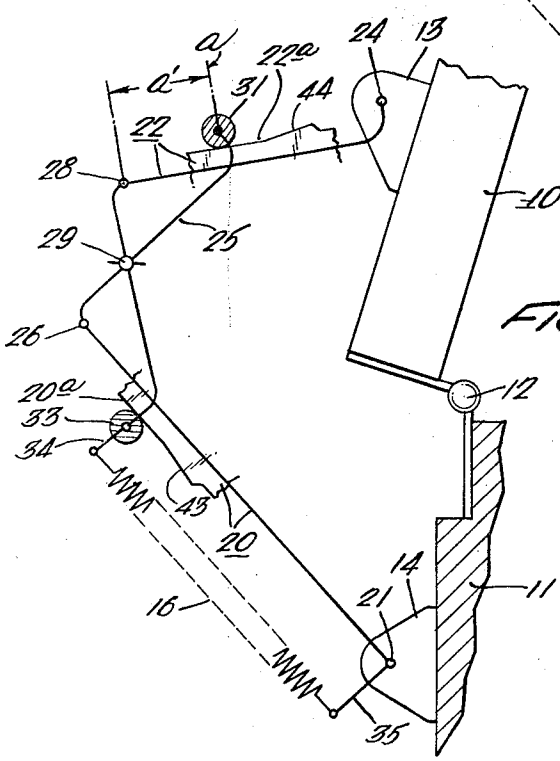
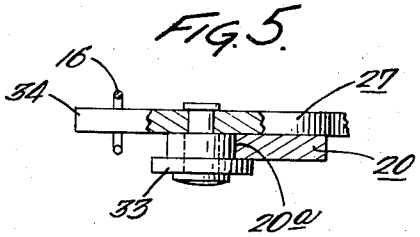


FIG. 5.



DOOR RETURN AND CLOSURE MECHANISM

The present invention relates to new and useful improvements in door return and closure mechanisms of the spring operated type adapted to exert a constant and substantially uniform closing force on a door and also snub or slow down the closing of the door as it reaches its fully closed position to prevent the door from slamming.

A primary object of the present invention is to provide a novel door return and closure mechanism which will exert a continuous substantially uniform closing force on a door from a wide open position of the door to its fully closed position and which will snub or slow down the closing of the door as it reaches its fully closed position.

Another object of the present invention is to provide novel door return and closure mechanism having adjustable snubbing means to control the speed of the closing of the door and wherein the snubbing action increases sharply as the door reaches its fully closed position to prevent slamming of the door.

A still further object of the present invention is to provide a novel door return and closure mechanism which is relatively small and compact and which may be made in a variety of sizes so that it may be adapted to small cabinet doors, household doors and automobile doors and trunk lids.

A further object of the present invention is to provide a novel door return and closure mechanism having the features and characteristics set forth above which will permit the door to swing through an arc of substantially 180° and which will exert force on the door maintaining the door in its fully open position as the door approaches the fully open position.

A still further object of the present invention is to provide a novel door return and closure mechanism which is of relatively simplified construction, is easy to manufacture and install on a door, and is entirely efficient and effective in operation and use.

These and other objects of the present invention and the various features and details of the operation and construction thereof are hereafter more fully set forth and described with reference to the accompanying drawings in which:

FIG. **1** is a plan view of the door return and closure mechanism of the present invention installed on a door with the door in a fully closed position;

FIG. **2** is a front elevational view of the door return and closure mechanism of FIG. **1**;

FIG. **3** is a plan view similar to FIG. **1** with the door approaching its fully open position;

FIG. **4** is a transverse sectional view taken along line **4—4** of FIG. **3** illustrating the snubbing mechanism for controlling the speed of closing of the door;

FIGS. **5** and **6** are transverse sectional views taken along lines **5—5** and **6—6** respectively of FIG. **3**, illustrating the sliding or rolling connection between the connecting links and lever arms of the door closure mechanism;

FIG. **7** is a schematic diagram illustrating the door closure mechanism in its closed position; and

FIG. **8** is a schematic diagram similar to FIG. **7** with the closure mechanism in an open position.

Referring more specifically to the drawings, there is illustrated a door closure mechanism made in accordance with the present invention which is installed in

position on a door **10** mounted in a frame **11**, with the door adapted to swing about the axis of hinge pins **12**. A door anchor element **13** is secured to the inner surface of the door while a frame anchor element **14** is mounted on the frame **11**. The door closure mechanism includes a linkage system designated generally as **15**, which is interconnected with the door and frame anchor elements **13** and **14** respectively. A conventional coiled tension spring **16** is provided between elements of the linkage system **15** as more fully described hereafter to normally exert a closing force on the door.

As set forth in more detail hereafter, the linkage system **15** permits the door to move from the closed position, as shown in FIG. **1**, to an open position, as shown in FIG. **3**, with the spring **16** constantly exerting a closing force on the door between its closed and open positions.

The linkage system also permits the door to move beyond the open position of FIG. **3** in the direction of the arrow to a position in which the door will move through an arc of approximately 180°. When the door reaches a position in which the center of the door anchor element **13** lies to the right with respect to FIG. **3** of an imaginary line drawn through the center of the frame anchor element **14** and the axis of the hinge pin **12**, the spring **16** will then exert a force tending to hold the door in its fully open position.

In accordance with the present invention the linkage system **15** connecting the door and the frame is in the form of compound levers designed to increase the moment arm exerting a closing force on the door as the door closes which offsets the decreasing force of the spring as the door closes to provide a relatively uniform closing force on the door throughout its entire swing. This linkage system consists of a first generally L-shaped primary lever **20** pivotally connected to the frame anchor element **14** as indicated at **21** and a second primary lever **22** having an outwardly offset terminal end portion **23** pivotally connected to the door anchor element **13** as indicated at **24**. The second lever **22** is offset at **23** so that the primary levers **20** and **22** will extend parallel to one another when the door is closed as shown in FIGS. **1** and **5**. In addition, the second lever **22** is shorter than the lever **20** so that the free terminal ends of the levers **20** and **22** lie adjacent one another when the door is closed.

In addition to the primary levers **20** and **22**, the linkage system **15** also includes a first connecting link **25** pivotally connected to the outer free end of the first lever **20** as indicated at **26** and a second connecting link **27** pivotally connected to the outer free end of the second lever **22** as indicated at **28**. These connecting links **25** and **27** extend angularly inward toward one another and toward the door hinge and are pivotally connected to one another at a point near their midpoint by an adjustable snubbing mechanism **29**, more fully described hereafter. The first connecting link **25** extends from its pivot **26** toward the second lever **22** and has its inner free end interconnected with the second lever **22** in a manner permitting movement of the inner end of the first connecting link in a longitudinal direction relative to the second lever **22**. Similarly, the second connecting link **27** extends from its pivot **28** toward the first lever **20** and has its inner end interconnected with the first lever **20** in a manner permitting longitudinal movement of the inner end of the second connecting link **27** relative to the first lever **20**. In the illustrated

embodiment of the present invention, the interconnection between the first connecting link **25** and the second lever **22** includes a roller member **31** which engages the outer edge surface **22***a* of the lever **22** and the second connecting link **27** is interconnected with the first lever **20** by means of a roller member **33** which engages the outer edge surface **20***a* of the lever **20.** If desired, longitudinal slots (not shown) may be provided in the levers **20** and **22** within which pins or rollers carried by the inner ends of the first and second connecting links may be engaged to provide the movable connection between the connecting links and their associated primary levers.

The second connecting link **27** terminates at its inner end in an outwardly projecting extension **34** which, in the closed position of the door, is substantially parallel to and extends in the same direction as the L-shaped end **35** of the first lever **20.** The previously described coil spring **16** is interconnected to the link extension **34** and lever end **35** to provide the desired closing force on the door.

As the door **10** moves from its fully open to its fully closed position, the coil spring **16** is shortened, resulting in the coil spring constantly exerting a smaller force in drawing the link extension **34** and lever end **35** together. If the spring were connected directly between the frame and the door the spring would exert a constantly decreasing closing force on the door as the door closes. However, as set forth above, the moment arm of the linkage system exerting a closing force on the door increases as the door reaches its fully closed position, thereby offsetting the decreasing force of the spring so that a substantially constant uniform closing force is applied to the door during its entire movement toward the closed position. A comparison of the position of the linkage system in FIG. **8** with respect to the linkage system in FIG. **7** will illustrate this increasing moment arm as the door closes. Basically, the spring **16** pulling the free end of the connecting link **27** to the right with respect to FIGS. **7** and **8** will pull the roller **31** of the other connecting link **25** against the lever surface **22***a* causing the lever **22** to pivot clockwise about its pivot **28** and exert a closing force on the door. The roller **31** moves to the right along the lever surface **22***a* during closing of the door from the position a, shown in FIG. **8,** in which the moment arm *a'* of the force exerted by the roller **31** on the lever **22** is relatively small, to the position as shown at *b* in FIG. **7,** in which the moment arm *b'* of the force exerted by the roller **31** on the lever **22** is relatively large. By careful combination of the length of the levers and connecting links and the size of the tension spring **16,** a balance can be reached in which the increasing moment arm of the roller **31** exerting a force on the lever **22** completely offsets the decreasing spring force tending to close the door as the door reaches its closed position so that a constant uniform closing force may be applied to the door in all open positions of the door.

As previously mentioned, adjustable snubbing mechanism **29** is provided to permit a controlled snubbing action on closing the door and provide for control of the speed of the closing of the door. This snubbing mechanism is illustrated in FIG. **4** of the drawings and is provided at the pivot between the two connecting links **25** and **27.** This snubbing mechanism includes an upwardly extending stud **37** which has its lower end fixed to the first connecting link **25** and its upper end projecting through an opening in the second connecting link **27.** The lower end of the stud may be of hexangular shape and be received in a correspondingly shaped opening in the first connecting link **25** to prevent rotation of the stud relative to the link **25.** The stud **37** may be secured in position within the opening of the link **25** by an enlarged body portion **39** engaging the upper surface of the link **25** and a peened or riveted lower head portion **40** engaging the lower surface of the link **25.** The upper end of the stud **37** is threaded and extends through a friction washer **41,** which bears against the upper surface of the link **27** with a wing nut **42** being provided to permit adjustment of the frictional force between the friction washer **41** and the connecting link **27.** During closing of the door the upper connecting link **27** will pivot about the axis of the stud **37** and the friction force exerted on the connecting link **37** by friction washer **41,** will tend to restrain this pivoting and thus exert a snubbing action to control the speed of the closure of the door.

In order to provide even greater snubbing action as the door reaches its fully closed position, outwardly diverging cam surfaces **43** and **44** are provided on the outer edge surfaces **20***a* and **22***a* respectively of the levers **20** and **22** over which the rollers **31** and **33** must pass immediately prior to the door reaching its fully closed position. As the rollers pass over these outwardly diverging cam surfaces, the pivoting action of the connecting links **25** and **27** is increased, permitting the friction washer to exert an increased snubbing force just before the door reaches its fully closed position, thereby further curtailiing the closing movement of the door and preventing the door from slamming.

From the foregoing it will be observed that the present invention provides a novel door return and closure mechanism which exerts a substantially uniform closing force on the door in all open positions of the door and which will also control the speed of closure of the door and prevent the door from slamming.

While a particular embodiment of the invention has been illustrated and described herein, it is not intended to limit the invention to such a disclosure, and changes and modifications may be incorporated and embodied therein within the scope of the following claims.

I claim:

1. In door closure mechanism for closing a door pivoted about an axis by spring force against a frame comprising: a linkage system interconnecting the door and frame; said linkage system including a first primary lever having inner and outer ends with its inner end pivotally connected to the frame, a second primary lever having inner and outer ends with its inner end pivotally connected to the door, said first and second primary levers in the closed position of the door extending generaly parallel to one another with the outer ends therof adjacent one another, and first and second connecting links each having inner and outer ends and being pivotally connected to one another at their midpoints, said first connecting link having its outer end pivotally connected to the outer end of said first primary lever and its inner end in sliding engagement with said second primary lever, said second connecting link having its outer end pivotally connected to the outer end of said second primary lever and its inner end in sliding engagement with said first primary lever; and spring means arranged to normally urge the inner ends of said

connecting links toward the inner ends of said primary levers to exert a closing force on said door.

2. Apparatus in accordance with claim 1 in which said primary levers lie in a plane normal to the pivoted axis of the door and extend generally parallel to the plane of the door when the door is closed with the outer ends of said primary levers lying adjacent one another.

3. Apparatus in accordance with claim 2 in which said spring means comprises a coiled tension spring connected between the inner end of said second connecting link and the inner end of said first primary lever.

4. Apparatus in accordance with claim 1 including adjustable snubbing means connected to said linkage system to apply a friction force to slow down the speed of closing of the door.

5. Apparatus in accordance with claim 4 in which said snubbing means includes a stub fixed to one of said connecting links and extending through the other connecting link to provide the pivotal connection between said connecting links, a friction washer carried by said stud in engagement with said other connecting link, and adjusting means on said stud to forceably engage said friction washer against said other connecting link.

6. Apparatus in accordance with claim 1 in which said first and second primary levers have outer side edge portions facing away from each other, the inner ends of said first and second connecting links each having a roller thereon with the roller of said first connecting link in engagement with the outer side edge of said second primary lever and the roller of said second connecting link in engagement with the outer side edge of said first primary lever.

7. Apparatus in accordance with claim 6 in which the outer side edges of said primary levers have an outwardly projecting cam surface thereon adapted to be engaged by said rollers as said door approaches its closed position to cause outward movement of the inner ends of said connecting links away from one another as the door approaches its closed position.

8. Apparatus in accordance with claim 7 in which said cam surfaces terminate abruptly at the point where said rollers engage the outer side edges of said first and second primary levers when the door is fully closed so that said rollers move abruptly inwardly toward one another as said door reaches its fully closed position.

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