

[54] **AUTOMATIC DOOR CLOSER**
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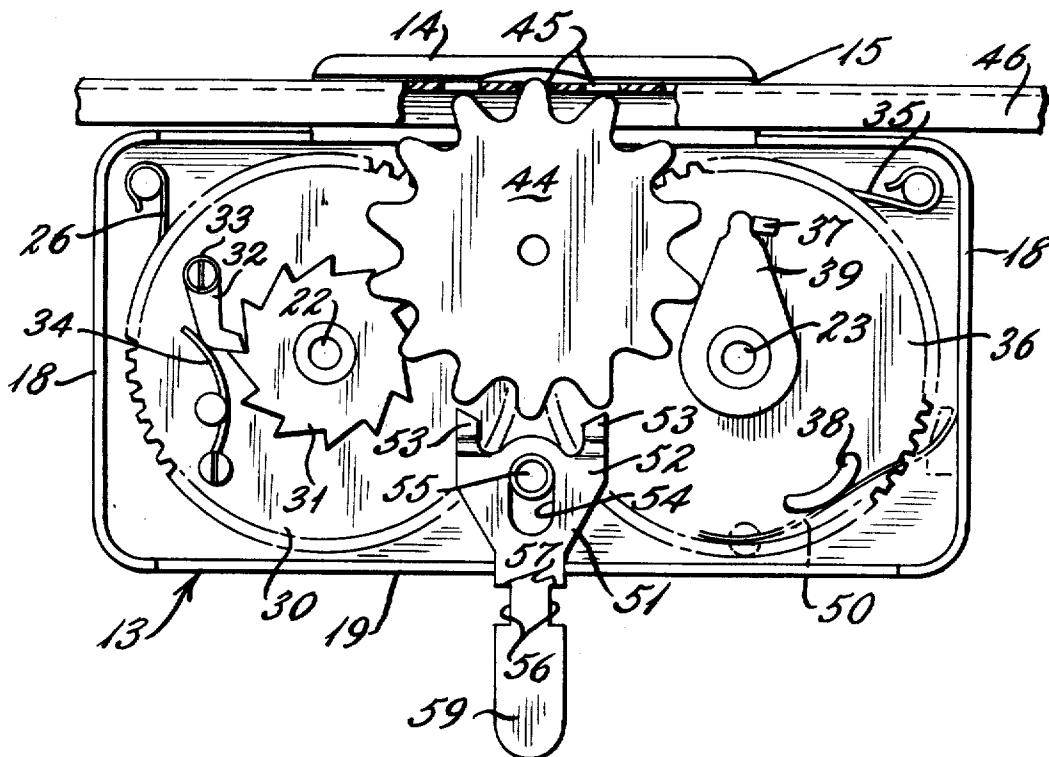
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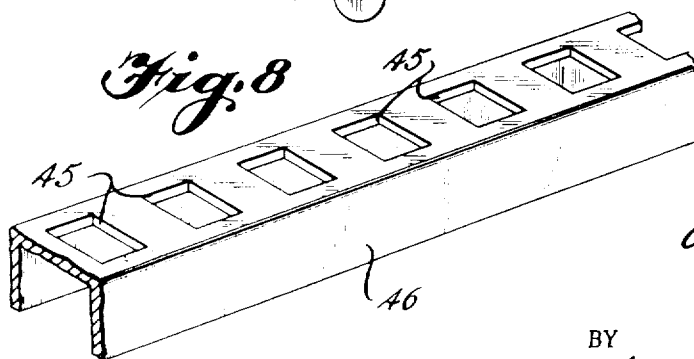
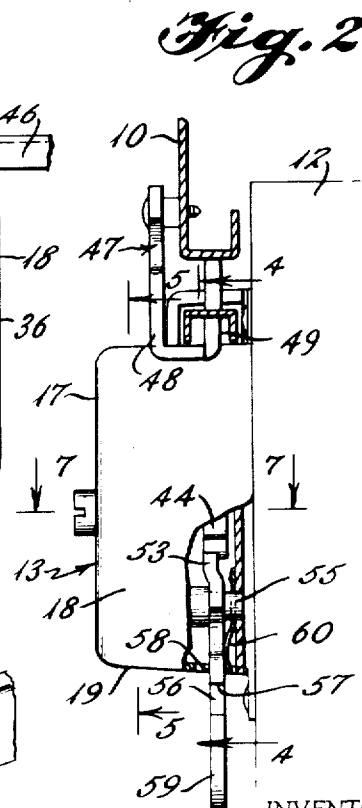
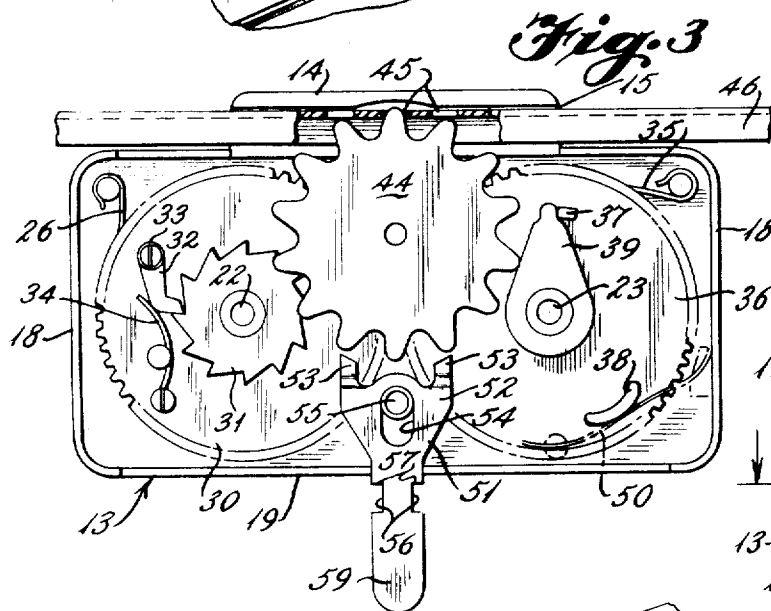
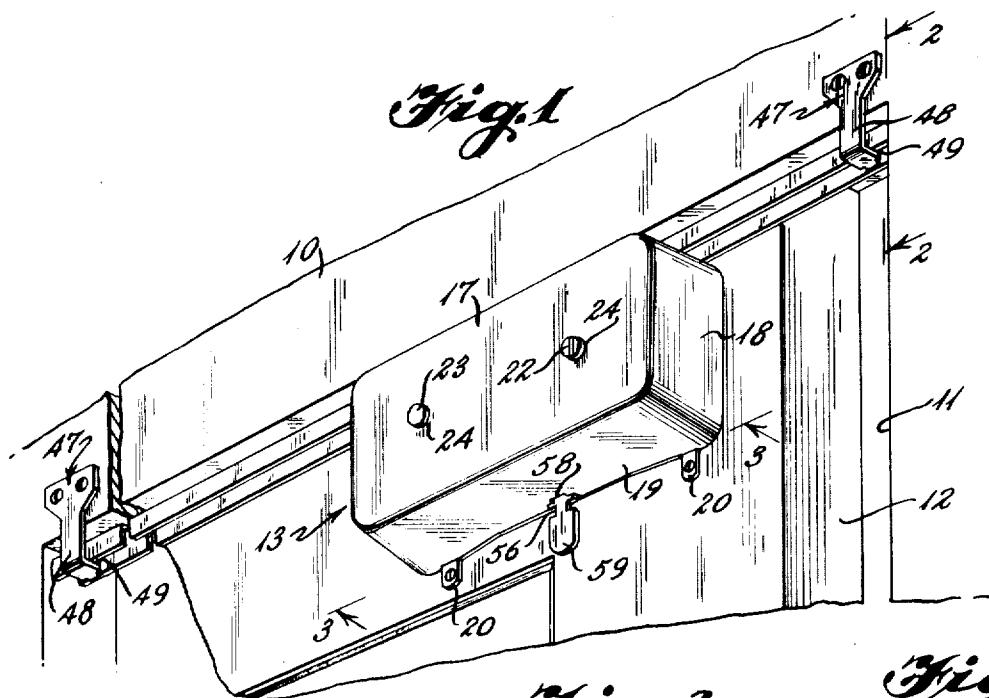
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[57] ABSTRACT

A door closing apparatus having a plurality of springs with a single spring being operable during the first stage of operation of the door, and multiple springs being operable during the second stage of operation of the door, the apparatus being provided with locking mechanism for maintaining the door in fully opened, fully closed, or any intermediate position.

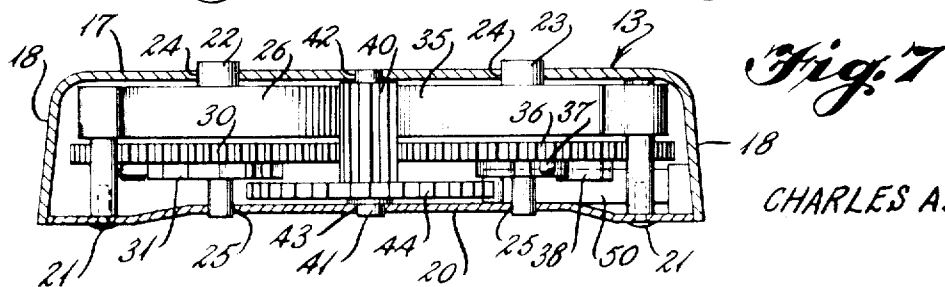
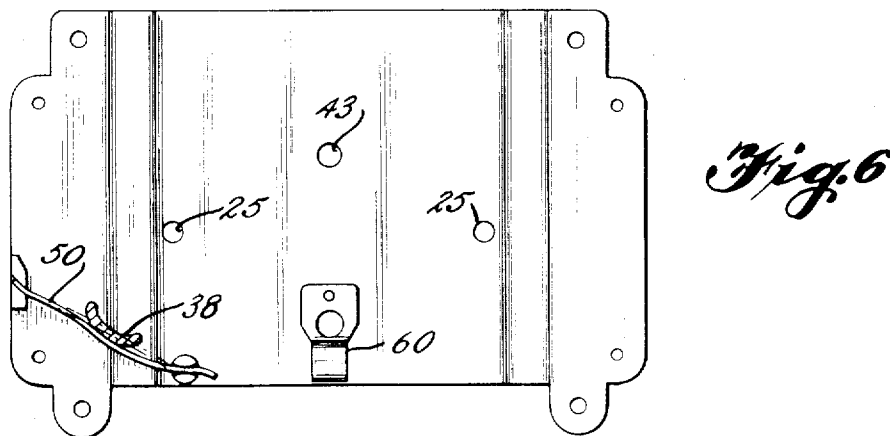
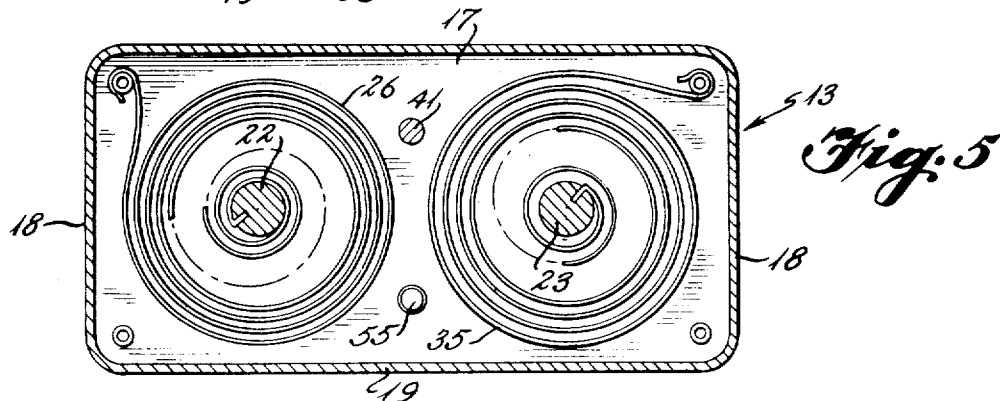
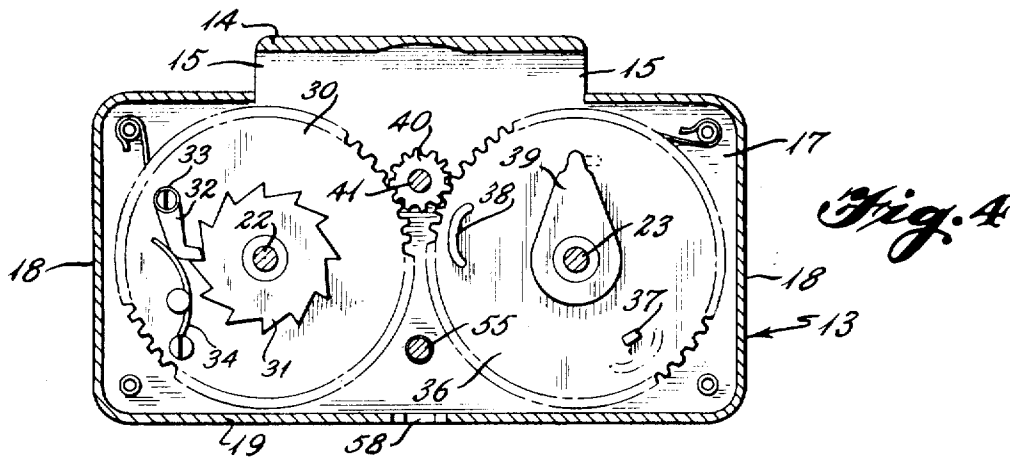
8 Claims, 8 Drawing Figures





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AUTOMATIC DOOR CLOSER

CROSS-REFERENCE TO RELATED APPLICATION

This is an improvement over prior U.S. Pat. No. 3,045,276 granted July 24, 1962.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to building closures of various kinds including doors, windows and the like, and relates particularly to sliding doors and to apparatus for automatically closing such sliding doors.

2. Description of the Prior Art

Heretofore many efforts have been made to provide apparatus for automatically closing doors, windows and the like, and some of these devices have included coil or helical springs to which a tension is applied when the door is opened so that when the door is released the energy stored in the spring will return the door to its closed position. Most of these prior art devices have been complicated and expensive to produce and maintain, have been limited as to the distance that the sliding door would open due to the effective length of the spring in conjunction with the gear ratios of the door closing mechanism. In some instances elongated coil springs have been provided; however, springs which were strong enough to fully close a sliding door have been too strong to permit the door to be fully opened without reaching the elastic limits of the spring.

SUMMARY OF THE INVENTION

The present invention is an automatic two-stage door closer having a first flat spiral spring which is operated during the initial opening of the door and the final closing of the door and a second flat spiral spring operated in conjunction with the first spiral spring during the final opening and initial closing of the door. The first spiral spring is driven by a spur gear from the pinion gear which is driven by a sprocket engaging a track. The second spiral spring is driven by a spur gear from the pinion gear and has a lost motion connection between the second spring and the spur gear. Apparatus is provided for locking the drive mechanism in any desired position, from a fully open to a fully closed position or any intermediate position. The first spring is adapted to operate by itself the first 18 to 24 inches, after which the second spring will become effective to assist in the initial closing of the door. The second spring is provided with a cam mechanism to function as a brake when the second spring becomes inactive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective illustrating one application of the invention applied to a sliding door.

FIG. 2 is a side elevation thereof.

FIG. 3 is an enlarged section on the line 3—3 of FIG. 1 when the door is partially open.

FIG. 4 is a section on the line 4—4 of FIG. 2 showing the position of the gears when the door is fully closed.

FIG. 5 is a section on the line 5—5 of FIG. 2.

FIG. 6 is a front elevation of the back cover of the device.

FIG. 7 is a section on the line 7—7 of FIG. 2.

FIG. 8 is a fragmentary enlarged perspective of the track.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With continued reference to the drawings, a wall 10 is provided with an opening 11 in which a closure member 12 such as a door, window or the like is slidably mounted. Normally the door 12 is freely slidable within the opening and lock means may be provided along the edge of the door for securing the same in closed position.

In order to automatically close the door, a housing 13 having a raised top portion 14 with openings 15 at opposite ends thereof is provided and such housing includes a front wall 17, side walls 18 and a bottom wall 19 in addition to the raised top portion 14. A back plate 20 is adapted to be connected to the housing 13 in any desired manner, as by screws 21 or the like, and such back plate includes outwardly extending projections by means of which the housing is mounted on the door 12. A pair of spaced generally parallel shafts or arbors 22 and 23 are rotatably mounted in openings 24 in the housing 13 and aligned openings 25 in the back plate 20.

Within the housing 13 the shaft 22 is connected to one end of a flat spiral spring 26 and the opposite end of such spring is connected to a post or other fixed structure within the housing. A spur gear 30 is fixed to the shaft 22 and a ratchet wheel 31 is mounted on such shaft adjacent to the spur gear 30. A pawl 32 is swingably mounted on a pivot 33 carried by the spur gear 30 and such pawl is adapted to engage the ratchet wheel 31. A leaf spring 34 is mounted on the spur gear 30 and is adapted to bear against the pawl 32 to urge the pawl into intimate engagement with the ratchet wheel 31. By rotating the gear 30 in a counterclockwise direction in FIGS. 3 and 4, a desired amount of energy is stored in spring 26 and the ratchet and pawl 31 and 32 prevent such energy from being expanded.

A second flat spiral spring 35 is provided within the housing 13 and such spring has one end fixed to the shaft 23. The other end of the second spring is fixed to a post or other fixed structure within the housing 13. A spur gear 36 is freely rotatably mounted on the shaft 23 and such spur gear is provided with an outwardly extending pin 37 as well as an outwardly extending cam 38 for a purpose which will be described later. An arm 39 is fixed to the shaft 23 adjacent to the spur gear 36 on the side opposite the spiral spring 35 and such arm extends outwardly to a position where it will intercept the pin 37 when the spur gear 36 is rotated.

The spur gears 30 and 36 mesh with a pinion gear 40 fixed to a shaft 41 which is rotatably mounted in openings 42 and 43 in the housing 13 and back plate 20, respectively. A sprocket 44 is fixed to the shaft 41 so that rotation of the sprocket will cause rotation of the pinion gear 40 which in turn will rotate the spur gears 30 and 36. The teeth of the sprocket 44 are received within openings 45 of a floating track 46 which is mounted in a manner to prevent longitudinal movement while permitting slight up and down movement. In order to do this a pair of J-shaped brackets 47 are provided, one at each end of the track 46, and each of such brackets has its longer arm 48 secured to the wall 10 in any desired manner, as by fasteners or the like. The shorter arm 49 of each of the brackets 47 slidably receives one of the openings 45 of the track in

such a manner that the track can move up and down freely for a limited distance. As illustrated, a bracket 47 is provided at each end of the track; however, it is contemplated that one end of the track could swingably be supported by a pivot and the other end could be freely floating on a bracket 47. If desired, the track 46 as seen in FIG. 8 could also be made from flat flexible band of steel material.

A leaf spring 50 which may be fixed at one or both ends is mounted on the back plate 20 in a position to engage the cam 38 of the spur gear 36 when such spur gear is rotated.

A lock mechanism is provided for locking the door in fully closed, fully open, or any intermediate position. The locking mechanism includes a latch body 51 having an enlarged head 52 with one or more prongs 53 projecting outwardly therefrom. The latch body 51 is provided with an elongated slot 54 in which a pin 55 carried by the housing 13 and the back plate 20 is slidably received. The lower portion of the latch body 51 is provided with a pair of opposed notches 56 defining a reduced portion with shoulders 57. The latch body 51 extends through a T-shaped slot 58 in the bottom wall 19 of the housing 13 and is provided with an outwardly extending operating tongue 59. Such latch body is slidable up and down the head portion of the slot 58 so that the prongs 53 mesh with the teeth of the sprocket 44 when the latch body is in its upper position to prevent rotation of such sprocket. In the upper position the operating tongue 59 is moved outwardly by means of leaf spring 60 fastened to the back plate 20 causing the notches 56 to move through the body portion of the T-shaped slot so that the shoulders 57 will engage the housing 13 and hold the latch body in locking position.

In the operation of the device, the track 46 is mounted within the opening 11 of the wall 10 and the housing 13 is mounted on the door 12 with the track extending through the openings 15 in the top portion of the housing and the teeth of the sprocket 44 extending through the openings 45 of the track. The door 12 normally is maintained in closed position and when the door is moved laterally the sprocket 44 will be rotated by the fixed track. Rotation of the sprocket will rotate the pinion gear 40 which in turn will rotate the spur gears 30 and 36. Since the spur gear 30 is fixed to the shaft 22, rotation of such spur gear will cause the spiral spring 26 to be wound about the shaft 22 and will increase the energy being stored within the spring. The spur gear 36 is freely rotatably mounted on the shaft 23 and therefore during the initial stages of the door opening process the spur gear 36 will merely rotate on the shaft without coiling the spiral spring 35.

After the door has been opened approximately 18 to 20 inches, the pin 37 on the spur gear 36 will engage the arm 39, as illustrated in FIG. 3, so that further rotation of the spur gear 36 will rotate the shaft 23 by means of the arm 39. When the shaft 23 is rotated, additional energy will be stored in the spiral spring 35 so that in the later stages of the door opening process both the springs will be coiled. When the door is released, initial closing movement will be exerted by both of the spiral springs 26 and 35. However, as the door moves to closed position, energy stored within the spiral spring 35 will be expended so that the final closing movement

will be caused by the spiral spring 26 alone. When the spring 35 becomes inactive, the cam 38 on the spur gear 36 will engage the leaf spring 50 which will act as a brake to reduce the momentum of the door. Thereafter the spiral spring 26 will continue to move the door by itself until the door is completely closed.

In order to lock the sliding door in any desired position, the operating tongue 59 can be moved upwardly so that the latch body 51 moves through the head of the T-shaped slot 58 and the prongs 53 will engage the teeth of the sprocket 44. After the latch body has been raised, it will be moved out of plane of upward movement by means of leaf spring 60. Since the notches 56 will be in alignment with the bottom wall 19 of the housing 13, the reduced portions between the notches will fit in the body portion of the T-shaped slot. In this position the shoulders 57 will engage the bottom wall 19 and prevent retraction of the latch body due to pressure from spring 60. It will be noted that the pressure of spring 60 against the tongue 59 while the latch is in locking position will prevent unlocking of the latch by jarring or shaking the door. To unlock the device, it is necessary only to move the operating tongue into alignment with the head of the T-shaped slot against the pressure of the spring 60 and pull down on the latch body so that the prongs 53 no longer engage the teeth of the sprocket 44. As soon as the prongs are out of engagement with the sprocket, the spiral springs 26 and 35 will move the door to closed position.

It is noted that if desired the housing 13 could be secured to the wall 10 and the track 46 could be mounted on the door 12 so that in effect the housing would remain in fixed position while the track would move through the housing. When installed in this manner, the operation of the sprocket 44, spur gears 30 and 36 and the spiral springs 26 and 35 would be substantially identical as that previously described.

What is claimed is:

1. An automatic door closer for a sliding door located in an opening in a fixed structure, said closer comprising a track mounted on one of said door or fixed structure, track engaging means rotatably mounted on the other of said door or fixed structure and engaging said track so that movement of the door in one direction will rotate said track engaging means, a pinion gear carried by said track engaging means, first and second spur gears meshing with said pinion gear, said first spur gear being fixed to a first rotatable shaft, spring means having one end connected to said first shaft and the opposite end fixed to the structure on which said track engaging means is mounted so that rotation of said first spur gear will increase tension on said spring means, said second spur gear being freely rotatably mounted on a second rotatable shaft, said second shaft having an arm located adjacent to said second spur gear, a projection on said second spur gear adapted to engage said arm when the second spur gear has rotated a predetermined amount, second spring means having one end fixed to said second shaft and the opposite end fixed to the structure on which said track engaging means is mounted, so that rotation of said track engaging means will apply tension to said first spring means as soon as the first spur gear moves and will apply tension to said second spring means after said second spur gear has moved a predetermined

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amount and when the door is released said first and second spring means will rotate said first and second spur gears in a reverse direction to rotate said track engaging means and close said door.

2. The structure of claim 1 including locking means selectively engageable with said track engaging means to prevent rotation thereof.

3. The structure of claim 1 including cam means extending outwardly from one surface of said second spur gear, and brake means carried by the structure on which said track engaging means is mounted and disposed in the path of travel of said cam means to act as a brake when said cam means engages said brake means.

4. Apparatus for automatically closing a closure member slidably mounted in a fixed structure, said apparatus comprising track means mounted on one of said closure member or fixed structure, rotatable means engaging said track means and adapted to be rotated thereby when the closure member is moved in one direction, a pair of rotatable shafts, means for driving one of said shafts directly from said rotatable means, lost motion means for driving the other shaft indirectly from said rotatable means, a first tension applying means connected to said one shaft, a second tension applying means connected to said other shaft, so that moving said closure member in one direction will operate said first tension applying means until the closure member has opened a predetermined distance after which continued opening of the closure member

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will operate both tension applying means and when the closure member is released both tension applying means will initially move the closure member toward a closed position until the closure member passes said predetermined position after which said one tension applying means only will move the closure member to closed position.

5. The structure of claim 4 in which said track means includes an elongated member having a plurality of equally spaced openings, and said rotatable means includes sprocket means having teeth receivable within the openings of said elongated member.

6. The structure of claim 4 in which said means for driving one of said shafts includes pinion gear means mounted on said rotatable means, and spur gear means fixed to said one shaft and meshing with said pinion gear means.

7. The structure of claim 4 in which said lost motion means includes pinion gear means mounted on said rotatable means, spur gear means rotatably mounted on said other shaft, an outwardly extending projection on said spur gear means, an arm fixed to said other shaft in a position to be engaged by said projection after said spur gear means has been rotated a predetermined amount.

8. The structure of claim 4 in which said first and second tension applying means include spiral springs, each having one end attached to an associated shaft and the other end connected to a fixed structure.

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