May 30, 1944. N. MICHELMAN 2,350,286

ROLLING DOOR CONSTRUCTION

Filed March 25, 1943 3 Sheets-Sheet 1

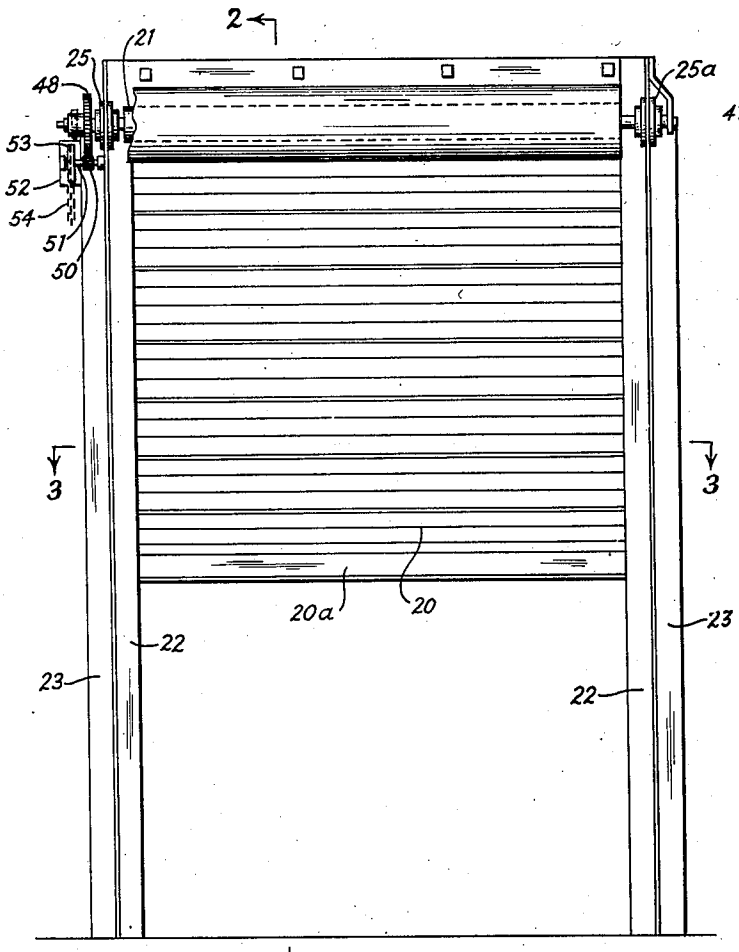


Fig. 1

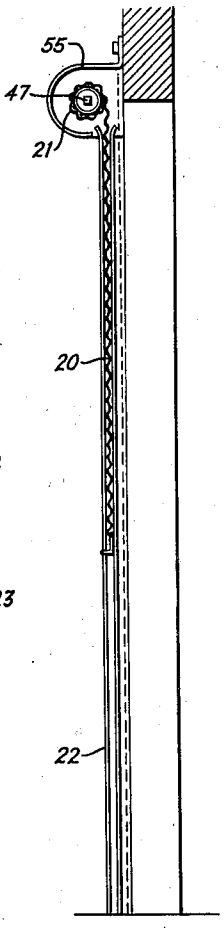


Fig. 2

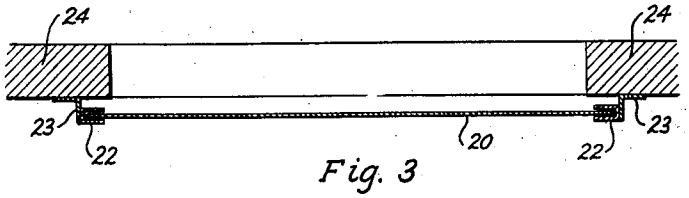


Fig. 3

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ROLLING DOOR CONSTRUCTION

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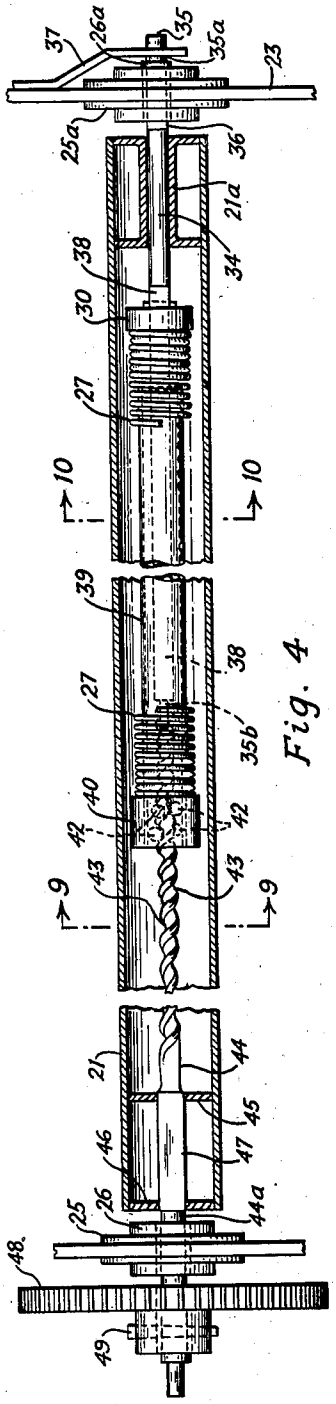


Fig. 4

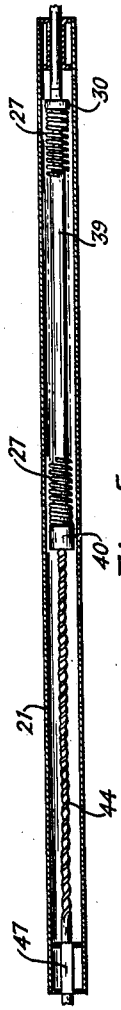


Fig. 5

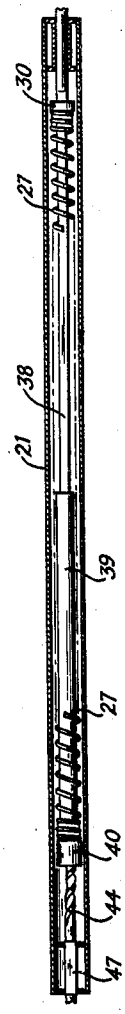


Fig. 6

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ROLLING DOOR CONSTRUCTION

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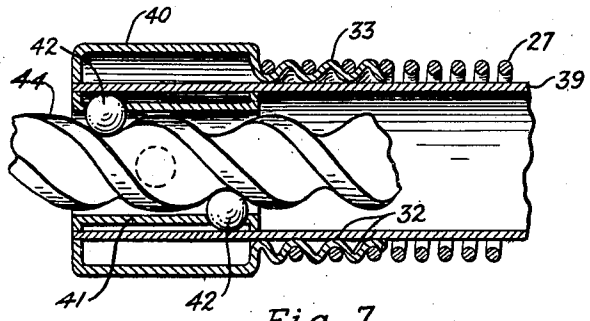


Fig. 7

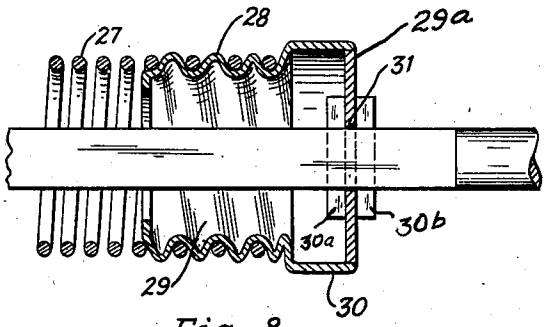


Fig. 8

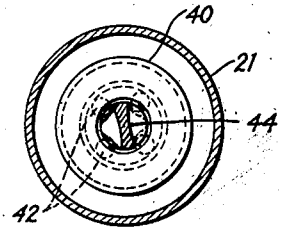


Fig. 9

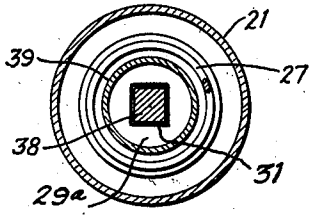


Fig. 10

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Patented May 30, 1944 2,350,286

UNITED STATES PATENT OFFICE

2,350,286

ROLLING DOOR CONSTRUCTION

Nathan Michelman, Brooklyn, N. Y.

Application March 25, 1943, Serial No. 480,555

11 Claims. (Cl. 160—313)

This invention relates generally to doors as used in piers, wharves and other industrial structures and is more particularly directed to the construction and operation of doors of the so-called curtain or rolling types, in which the door is flexible and is adapted to be wound about a shaft or drum at the head of the doorway when raised, to obtain the maximum clearance afforded by the dimensions of the doorway opening.

These rolling doors or curtains are usually composed of a series of metallic strips or so-called slats, which are interconnected for relative hinged movement, the opposite ends of the doors or curtains being movable within vertical guideways at the sides of the doorway opening, in response to the operation of the doors directly by hand or by gearing controlled by a hand actuatable chain, or where the weight of the doors or other conditions require it, by an electric motor or other means. In all of these types of doors, whether hand or power-actuated, counterbalancing mechanism is essential to their operation, this mechanism including one or more torsion springs and devices for initially adjusting the springs in the installation of the doors and for controlling their functioning, all of which add materially to the cost of construction and installation of the doors.

The general object of this invention, therefore, is to simplify the construction of rolling doors, especially as regards the structure of the counterbalancing mechanism, and reduce the cost of production and installation, and, at the same time, provide a lighter and more durable operating assembly for a given type of door, than is possible of attainment with the use of present counterbalancing mechanisms.

More specifically, it is an important object of this invention to provide a counterbalancing mechanism for use in the installation and operation of rolling doors, whereby the use of torsion springs is entirely eliminated, the mechanism possessing characteristics in functioning which renders it more responsive in counteracting the inertia forces, so that the operation of the door is greatly facilitated.

Another important objective of this invention is to provide a counterbalancing mechanism for a rolling door or curtain, in which the load is counterbalanced by a tension spring, the tensioning of the spring being positively controlled by the door in its descent to closed position, to load the spring to exert its maximum effort in overcoming the inertia forces in the initiation of the upward movement of the door and to accelerate its upward travel in response to the lifting effort applied thereto, thereby rendering a door of a given weight operable to raised position with a lesser expenditure of energy than would be required for the operation of a corresponding door embodying a conventional counterbalancing mechanism.

It is also an important object of this invention to provide a counterbalancing mechanism for rolling doors having the aforesaid characteristics and advantages, which is of a simple and rugged construction and in which the components coact with a minimum of wear, insuring efficient operation and greater durability than is obtainable in existing constructions.

Other objects and advantages flowing from the practicing of my invention will become manifest as the description proceeds.

For the purposes of this disclosure, I have elected to show and describe a preferred embodiment of my invention. However, this is merely illustrative, as my invention may take other forms to meet specific requirements of production, installation and operation, within the purview of the appended claims.

In the accompanying drawings—

Figure 1 is a rear elevation of a rolling door conforming to my invention;

Figure 2 is a vertical sectional view on the line 2—2 of Figure 1;

Figure 3 is a horizontal transverse sectional view on the line 3—3 of Figure 1;

Figure 4 is a broken longitudinal sectional view of the hollow shaft on which the door is wound, showing the counterbalancing mechanism contained therein and the means for functioning said mechanism, in the raising and lowering of the door;

Figure 5 is a longitudinal sectional view of the shaft or drum and the counterbalancing mechanism of Figure 4, showing the relative disposition of the parts of the mechanism when the door is raised or wound upon the drum;

Figure 6 is a view similar to Figure 5, illustrating the relative positions of the components of the counterbalancing mechanism when the door is in its extreme lowered position;

Figure 7 is a view partly in section showing the spring seat at the left hand end of the mechanism and the means for effecting the controlled expansion and contraction of the spring;

Figure 8 is a view, partly in section, of the right hand end of the counterbalancing mechanism,

showing the spring seat and supporting means therefor;

Figure 9 is a vertical section on the line 9—9 of Figure 4; and

Figure 10 is a similar view on the line 10—10 of Figure 4.

Referring now to the drawings in detail, in which like characters of reference are employed to designate similar parts in the several views, the door 20, as herein shown, is of the conventional or standard design, being composed of a series of metallic strips or so-called slats of equal length which are interconnected for relative hinged movement, to permit the door or curtain to be wound upon the hollow shaft 21 supported at or above the head of the doorway opening.

The door or curtain travels in guideways 22 mounted at either side of the doorway opening, which, as herein shown, are channel sections bolted or otherwise rigidly secured to suitable lengths of angle iron fixed to the inner surface of the wall 24 defining the doorway opening, the angle iron supports being preferably spaced inwardly of the edges of the sides of the doorway, as shown in Figure 3, so that the marginal portions of the door or curtain will overlap the sides of the opening and provide adequate protection against the weather. Obviously, the guideways for the door may be variously supported, it being evident, also, that in lieu of utilizing channel sections for forming the guideways, satisfactory results may be attained by employing angle sections of different cross-sectional dimensions, with their attaching flanges superposed in bolted engagement with the supports 23 and their web portions relatively spaced to provide for the movement of the door therebetween in its opposite directional operation.

Located at or above the upper end of each guideway, preferably supported from the outwardly projecting flange of the angle section 23, I provide a bracket or mounting for supporting the counterbalancing mechanism which is contained within the aforesaid hollow shaft or drum 21, upon which the curtain or door is adapted to be wound or rolled. Each of these brackets 25, 25*a*, as herein shown, consists of a plurality of concentric discs locatable on the opposite surfaces of the projecting flange of the angle section 23, the discs being centrally apertured for registration with a corresponding opening in said flange, to cooperate for the reception of a sleeve or bushing, as at 26, 26*a*, adapted to function as a bearing for coacting elements of the counterbalancing mechanism, as hereinafter described. As will become apparent, other forms of brackets or bearing members may be employed to function in the operation of the counterbalancing mechanism.

The counterbalancing mechanism includes a tension spring 27, a series of convolutions at one end of which are entered in the complemental grooves 28 of the spring seat 29 embodying a head 30 having an end wall 29*a* provided with a rectangular aperture 31, a similar series of convolutions at the opposite end of said spring similarly mating with the grooves 32 of the spring seat 33, the spring being anchored to the respective seats 29 and 33 by the interengagement of the convolutions and seat grooves for conjoint axial movement, as might obtain in a unitary structure. Obviously, if necessary or desirable, the interconnection of the spring ends with the respective seats may be variously accomplished, as by providing an aperture in the periphery of each seat in which the cooperating end of the spring may be entered and interlocked therewith.

As clearly shown in Figure 4, one end of the shaft or drum 21 is formed with an internal bearing 21*a* for rotation of the shaft on the complemental surface 34 of the rod 35, the end of said rod beyond this bearing being squared or otherwise conformed, as indicated at 36, for entry in the aforementioned complemental sleeve or bearing 26*a* of the bracket 25*a* to render said rod non-rotatable relative to said bracket, axial or longitudinal movemet of the rod being prevented by the offset retainer arm 37 through which the end of said rod projects with its shoulder 35*a* in abutment therewith, said retainer arm being bolted or welded to the flange of the angle support which carries the bracket 25*a*.

Inwardly of the aforesaid bearing surface 34, the rod 35 is squared, as at 38, to enter the aforesaid rectangular aperture 31 in the head of the spring seat 29 and render said rod and said spring seat relatively non-rotatable. The spring seat 29, which is open at one end, is preferably locked against longitudinal movement with respect to the rod 35 by passing locking pins 30*a* and 30*b* through the rod at opposing sides of the end of the head 30. The squared section of the rod is telescoped into a tube or cylinder 39 which carries the spring seat 33 with which it is substantially integrally united, the end of said cylinder or tube in which the rod 35 is entered being formed with an opening complemental to the peripheral contour of the rod, to provide for longitudinal movement of said tube or cylinder relative to said rod, in the manner hereinafter described, while preventing relative rotative movement of the tube and rod, the inner end of the rod being of reduced diameter or undercut, as at 35*b*.

As will be apparent, especially from Figure 7 of the drawings, the aforesaid tube or cylinder 39 is of a diameter to provide for its location within the diameter of the spring 27 and it extends through the spring seat 33 to terminate in registration with the outer vertical surface of the head 40 of said seat, a cage or ball retainer 41 being entered in the end of said tube or cylinder which is provided with races for the reception of anti-friction balls, preferably four in number, as indicated at 42, disposed in staggered relation, to coact with opposite valley surfaces 43 of the spiral actuator 44, the inner end of which is adapted to receive the opposed reduced end 35*b* of the rod 35. The actuator, as shown in Figure 9, provides a limiting surface for contact of the anti-friction balls 42.

It will be observed, especially from Figure 4, that the left hand end of the shaft or drum 21 is provided with an internal partition 45 spaced from the adjacent end wall 46 of said shaft, the partition and end wall both being correspondingly apertured for interlocking said shaft to the actuator for conjoint rotative movement, as by the formation of a squared shoulder 47 on said actuator, the aforesaid shaft apertures, obviously, being of a complemental shape, for engagement therewith.

The actuator 44, beyond the end of the shaft or drum 21, as at 44*a*, is journaled for rotative movement in the bearing provided by the sleeve 26 in the bracket 25 and extends outwardly for

the reception of a gear **48**, pinned thereto, as at **49**, which is in mesh with a pinion **50** mounted on the stub shaft **51**, the latter shaft being supported between the angle section **23** and a suitable bearing member **52** and carrying a sprocket **53** traversed by an actuating chain **54**, whereby the door may be raised and lowered by hand in the usual manner.

As will be manifest from the foregoing, the tension spring **27** is supported longitudinally of the shaft or drum **21** upon the rod **35** and the actuator **44**, the major portion of the spring being in surrounding bearing engagement with the tube or cylinder **39**, while the shaft or drum **21**, to which the door or curtain **20** is connected for winding thereon, is rotatable relative to and on said rod **35** and with said actuator **44**, with the squared portion **47** of which it is interlocked. Therefore, it will be apparent that as the actuator **44** is rotated in one direction, in response to the operation of the chain **54**, the spirally threaded section of the actuator, in the manner of a feed screw, will induce a concurrent axial movement of the adjacent traveling spring seat **33** toward the adjacent end of the shaft or drum **21**, as the valley surfaces of the spiral threads of the actuator progressively engage with the coacting anti-friction guide-forming bearings **42** in the cage **41** of the traveling spring seat.

Since the opposite spring seat **29**, to which the spring is likewise fixed, is anchored to the rod **35**, as described, it necessarily follows that as the spring seat **33** is drawn toward the gear-carrying end of the actuator **44**, in the continued rotation of the latter, the spring **27** will be stretched or expanded and placed in tension, in proportion to the movement of the traveling spring seat along the actuator, while in the opposite directional rotation of the actuator, the concurrent reverse axial movement of the traveling spring seat **33** will permit the spring **27** to contact and reduce the tension in the spring accordingly.

Now, assuming that the structure just described is assembled, with the door connected to and wound or rolled upon the drum or shaft **21** for movement within the guideways **22**, it will be readily seen that as the actuating chain **54** is operated to lower the door, the spring **27** will be loaded or placed in maximum tension, as the base bar **20***a* of the door reaches its lowermost position, in contact with the floor or sill of the doorway, the door being suitably latched in this closed position by any preferred means engageable with the operating chain or with the door itself. Obviously, in lowering the door, the load of the door itself contributes to facilitate the operation, the resulting tensioning of the spring imposing no extra effort on the part of the operator, while, on the other hand, when the door is raised, the energy necessary to initiate the raising operation and overcome the inertia forces, is less than is ordinarily required in the operation of a door of a corresponding weight as now constructed. As the effort is applied to the chain **54**, to rotate the shaft **21** and raise the door, the tensioned spring **27** becomes instantly effective to generate lifting effort in an amount which appreciably reduces the energy that it is necessary to apply to the operation of the actuating chain, so that the raising of the door may be accomplished more expeditiously than heretofore, with the possibility of jamming, as sometimes occurs in the torsion spring type of counterbalance mechanism, being entirely eliminated.

In the installation of a rolling door, conforming to my invention, as just described, any preferred method of assembly of the components of the counterbalancing mechanism within the hollow shaft or drum **21** may be followed, the shaft when supported by the rod **35** and actuator **44**, between the brackets **25**, **25***a*, with the curtain or door attached thereto, being enclosed in a hood or housing **55**, bolted to the wall above the head of the doorway, between the aforesaid brackets. For hand operation, in some cases, the chain **54** may be dispensed with and the door raised and lowered by means of a handle carried by the base bar **20***a* of the door or curtain **20**. In heavier constructions, as will be obvious, the door may be operated by an electric motor or other means, the counterbalancing mechanism in any of these types of installation corresponding structurally and in mode of operation to that herein described, it being understood, of course, that the gauge of the spring **27** may vary to meet specific load requirements and that the other components of the counterbalancing mechanism may be changed in keeping with requirements of production and use.

While I have described my invention more or less specifically in connection with the embodiment shown, it will be manifest that various changes in the details of structure and in the mode of assembly of the counterbalancing mechanism may be effected in attaining the objectives to which this invention is directed, as hereinbefore set forth, my invention broadly comprehending a counterbalancing mechanism in which a tension spring is supported for contraction and expansion in a manner whereby the spring will be elongated or tensioned in the downward movement of a rolling door, to store up energy for generating lifting effort when the movement of the door in the reverse direction is initiated.

I claim:

1. Counterbalancing means for a rolling door, including a shaft for receiving the door in wound condition, a coil spring non-rotatably supported longitudinally of said shaft, means for anchoring one end of said spring in juxtaposition to one end of said shaft and means entered in the other end of said shaft and rotatable therewith connected to the other end of said spring for expanding and contracting said spring in response to reverse directional rotation of said shaft.

2. Counterbalancing means for a rolling door, including a shaft for receiving the door in wound condition, a tension spring non-rotatably supported longitudinally within said shaft, means for anchoring one end of said spring in juxtaposition to one end of said shaft and means entered in the other end of said shaft and rotatable therewith connected to the opposite end of said spring for elongating and retracting said spring in response to reverse rotative movements of said shaft.

3. The combination with a shaft for receiving a rolling door in wound condition, of counterbalancing mechanism adapted to function in the operation of said shaft, said mechanism including a tension spring disposed longitudinally of said shaft, one end of said spring being anchored to a fixed member adjacent one end of said shaft to hold it immovable within said shaft, revoluble means entered in the other end of said shaft connected to said shaft for conjoint rotative movement and non-rotating reciprocable means associated with the other end of said spring

in engagement with said revoluble means, whereby the rotation of said revoluble means in one direction will expand said spring to place it in tension, the opposite rotational movement of said revoluble means permitting said spring to contract.

4. The combination with a shaft for receiving a rolling door in wound condition, of counterbalancing mechanism adapted to function in the operation of said shaft, said mechanism including a tension spring disposed longitudinally of said shaft, one end of said spring being anchored to a fixed member in juxtaposition to one end of said shaft to hold it immovable within said shaft, revoluble means fixed to said shaft for conjoint rotative movement and means connected to the opposite end of said spring formed for engagement by said revoluble means within said shaft for movement axially of said revoluble means, the rotation of said revoluble means with said shaft in one direction effecting the expansion of said spring, the opposite concurrent directional rotative movement of said shaft and said revoluble means permitting the spring to contract.

5. The combination with a shaft for receiving a rolling door in wound condition, of counterbalancing mechanism adapted to function in the operation of said shaft, said mechanism including a tension spring disposed longitudinally of said shaft, one end of said spring being anchored to a fixed member in juxtaposition to one end of said shaft to hold it immovable within said shaft, revoluble means fixed to said shaft for conjoint rotative movement and means connected to the opposite end of said spring formed for engagement by said revoluble means within said shaft for movement axially of said revoluble means, the conjoint rotative movement of said shaft and said revoluble means in one direction progressively increasing the tension of said spring, whereby in the concurrent opposite directional rotation of said shaft and said revoluble means said spring will react to generate torque and facilitate the rotative movement of said revoluble means and said shaft.

6. A rolling door construction, including laterally spaced guideways, a shaft rotatably supported above said guideways, a flexible door fixed to said shaft for winding thereon, opposite marginal portions of said door being entered in said guideways, means for raising and lowering said door in traversing engagement with said guideways and counterbalancing mechanism associated with said shaft, said counterbalancing mechanism embodying a nonrotating tension spring housed within said shaft, means for anchoring one end of said spring to a fixed member adjacent one end of said shaft, a revoluble element extending inwardly of said shaft and fixed thereto for conjoint rotative movement and reciprocable means fixed to the opposite end of said spring engageable by said revoluble element, said revoluble element and said latter means having complemental surfaces in continuous engagement, whereby the rotative movement of said revoluble element will produce movement of said spring in the direction of its axis, the rotative movement of said element in the lowering of said door expanding said spring to increase the tension thereof, said spring reacting in traversing engagement with said revoluble element to generate torque in one directional rotation of said element to counterbalance the inertia and gravitational forces in the raising of the door and facilitate its upward movement to a wound position upon said shaft.

7. Means for generating torque to supplement the operation of mechanism for raising a flexible curtain adapted to be wound upon a shaft when raised, said means including a shaft formed to receive the curtain windings, a spring contained within said shaft, one end of said spring being immovably mounted on a fixed member in juxtaposition to one end of said shaft, a threaded element entered in the other end of said shaft connected to said shaft for concurrent rotative movement and means in engagement with the other end of said spring having surfaces complemental to said threaded element, said latter means being adapted to traverse said element to expand said spring in response to the rotation of said element in one direction and to permit said spring to contract when said element is rotated in the opposite direction, the contraction of said spring being effective upon said element to produce torque to facilitate the action of said raising mechanism.

8. Means for generating torque to supplement the operation of mechanism for raising a flexible curtain adapted to be wound upon a shaft when raised, said means including a hollow shaft formed to receive the curtain windings, a tension spring disposed longitudinally within said shaft, one end of said spring being immovably mounted on a fixed member free of said shaft in juxtaposition to one end of said shaft, a threaded element entered in the other end of said shaft connected to said shaft for conjoint rotative movement and means in engagement with the opposite end of said spring having surfaces conformed for positive engagement with said threaded element, said latter means being adapted to traverse said element in response to the rotation of said element with said shaft, the concurrent rotative movement of said shaft and element in one direction elongating said spring to condition it for generating torque, the conjoint opposite directional rotation of said shaft and said element permitting said spring to retract and simultaneously generate torque effective to facilitate the current rotative movement of said shaft and said element.

9. A rolling door construction, including laterally spaced guideways, a shaft rotatably supported above said guideways, a flexible door fixed to said shaft for winding thereon, opposite marginal portions of said door being entered in said guideways, means for raising and lowering said door in traversing engagement with said guideways and counterbalancing mechanism associated with said shaft, said counterbalancing mechanism embodying a tension spring housed within said shaft, means for anchoring one end of said spring adjacent one end of said shaft and free of said shaft, a revoluble element extending inwardly of said shaft fixed thereto for conjoint rotation, and means connected to the opposite end of said spring adapted for traversing engagement with said revoluble element in response to the rotative movement of said element, the concurrent rotation of said element and said shaft in the door-lowering operation elongating said spring to increase the tension thereof, whereby in the upward operation of the door said spring will react to generate torque effective upon said element and said shaft to facilitate the concurrent rotative movement of said shaft and said element to wind said door upon said shaft.

10. In combination with a door construction in which the door is mounted to be raised and lowered out of and into functioning position, a mech-

anism for counterbalancing the door, said mechanism including a coil spring disposed longitudinally above the head of the door, means for fixedly mounting one end of the spring in juxtaposition to one side of the door, a revoluble element connected to the door and actuatable in the movement of the door to and from closed position, said element rotating in one direction in the lowering of the door and in the opposite direction when the door is raised, and means connected to the opposite end of said spring conformed for engagement with said revoluble element to longitudinally traverse said element when said element is revolved, said conformed means in the actuation of said element in response to the downward movement of said door moving the associated end of said spring along said element to assume an expanded condition, and said spring reacting in the upward movement of said door to generate torque effective upon said revoluble element to counteract the inertia forces and facilitate the actuation of the door to raised position.

11. In combination with a door construction in which the door is mounted to be raised and lowered out of and into functioning position, a mechanism for counterbalancing the door, said mechanism including a tension spring disposed longitudinally above the head of the door, means for anchoring one end of the spring in juxtaposition to one side of the door, a revoluble element in alinement with said spring connected to the opposite side of the door for actuation in the movement of the door to and from closed position, said element rotating in one direction in the lowering of the door and in the opposite direction when the door is raised, and means connected to the opposite end of said spring conformed for positive actuation along said element when said element is rotated, said spring, in the rotative movement of said element in one direction in response to the lowering of the door, being elongated to increase the tension thereof, whereby the contraction of said spring in the opposite rotational movement of said element in the door-raising operation will generate torque effective on said element and communicable to said door to facilitate the movement of said door to raised position.

NATHAN MICHELMAN.