July 26, 1960 M. B. ZOLL ET AL 2,946,377

TEMPERATURE-OPERATED ROLLING STEEL DOORS

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FIG. 1

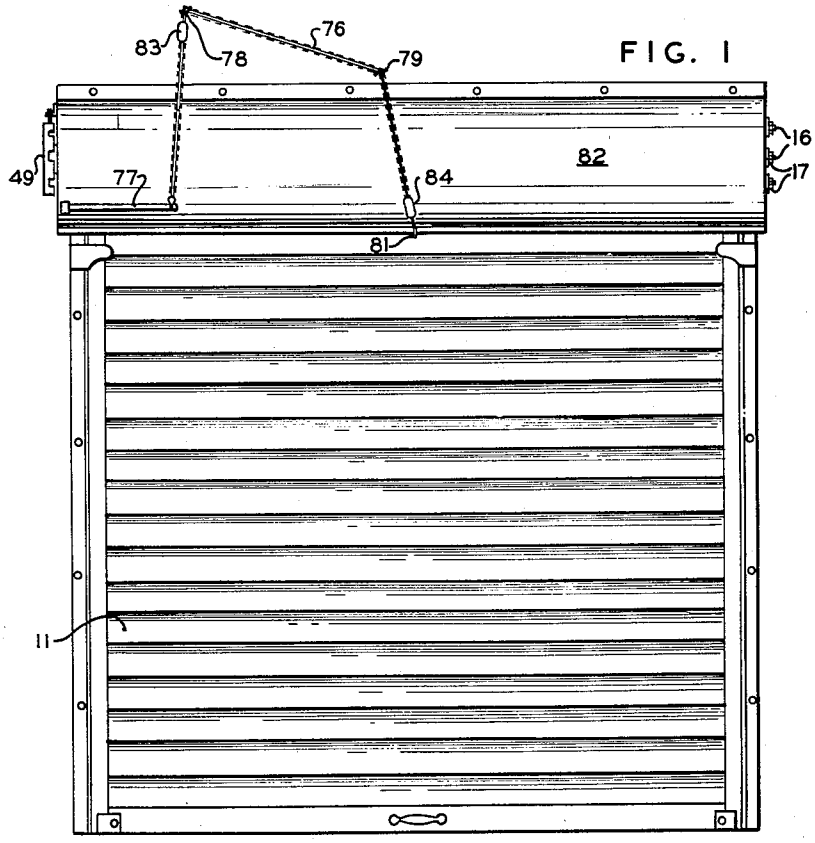


FIG. 1A

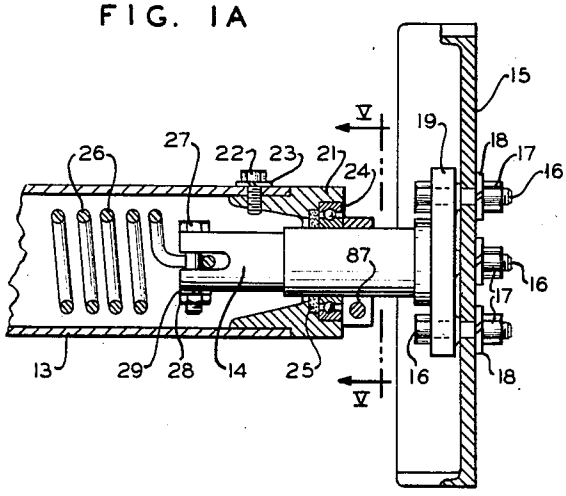
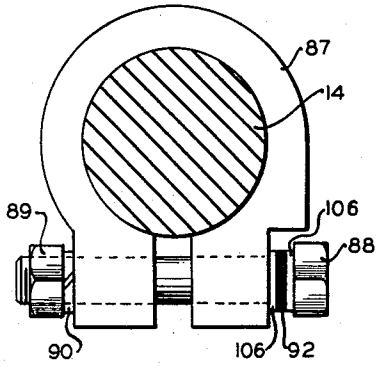


FIG. 5



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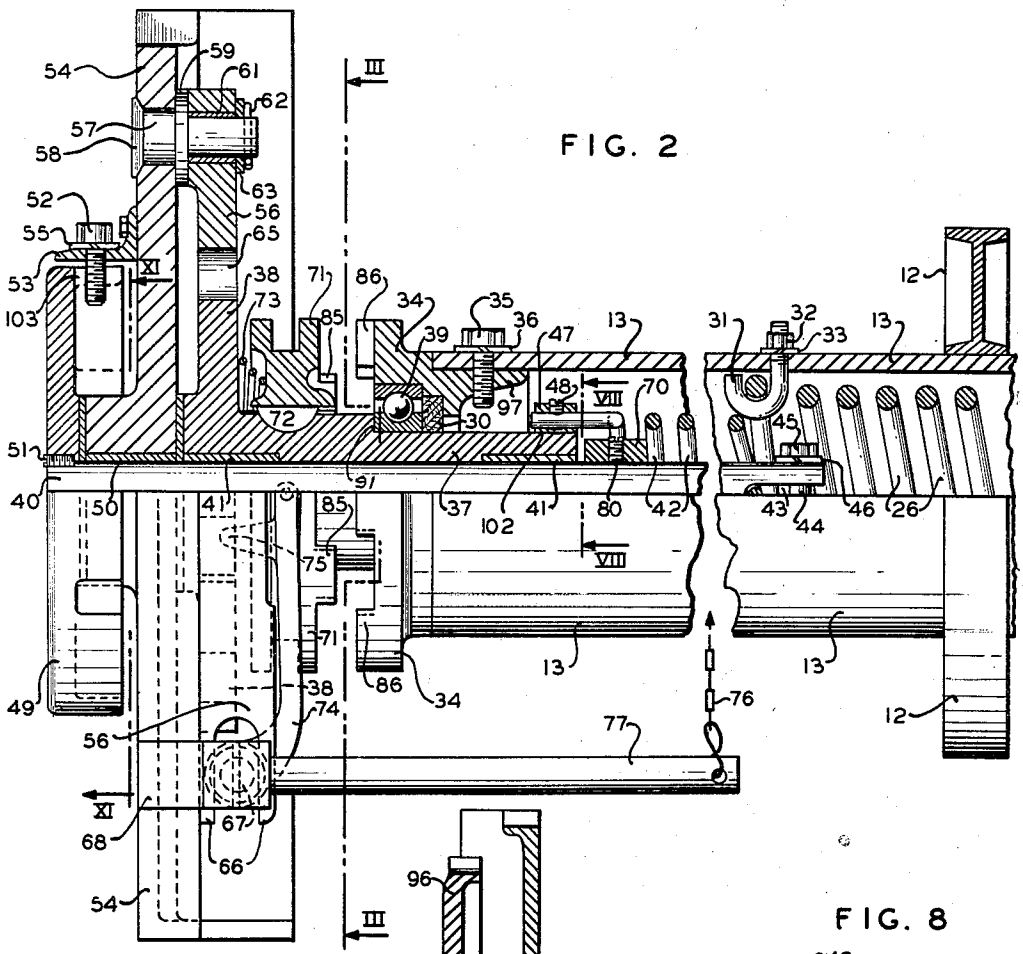
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FIG. 2



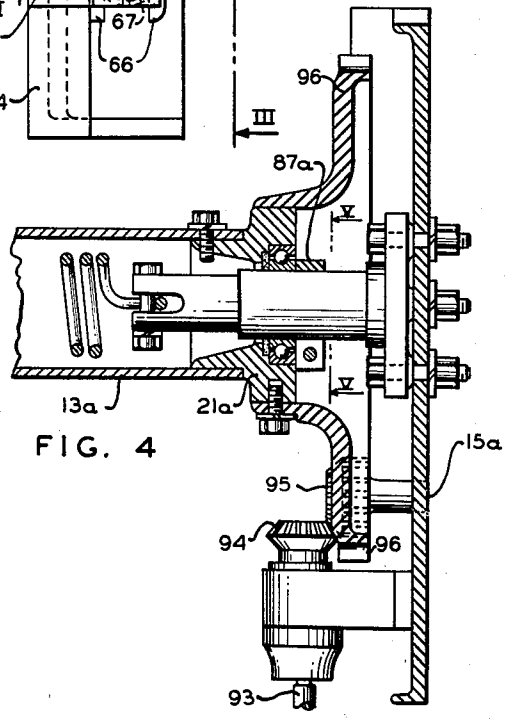
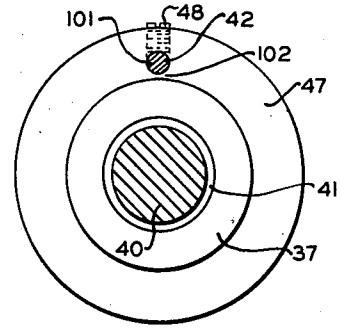


FIG. 4

FIG. 8



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TEMPERATURE-OPERATED ROLLING STEEL DOORS

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FIG. 3

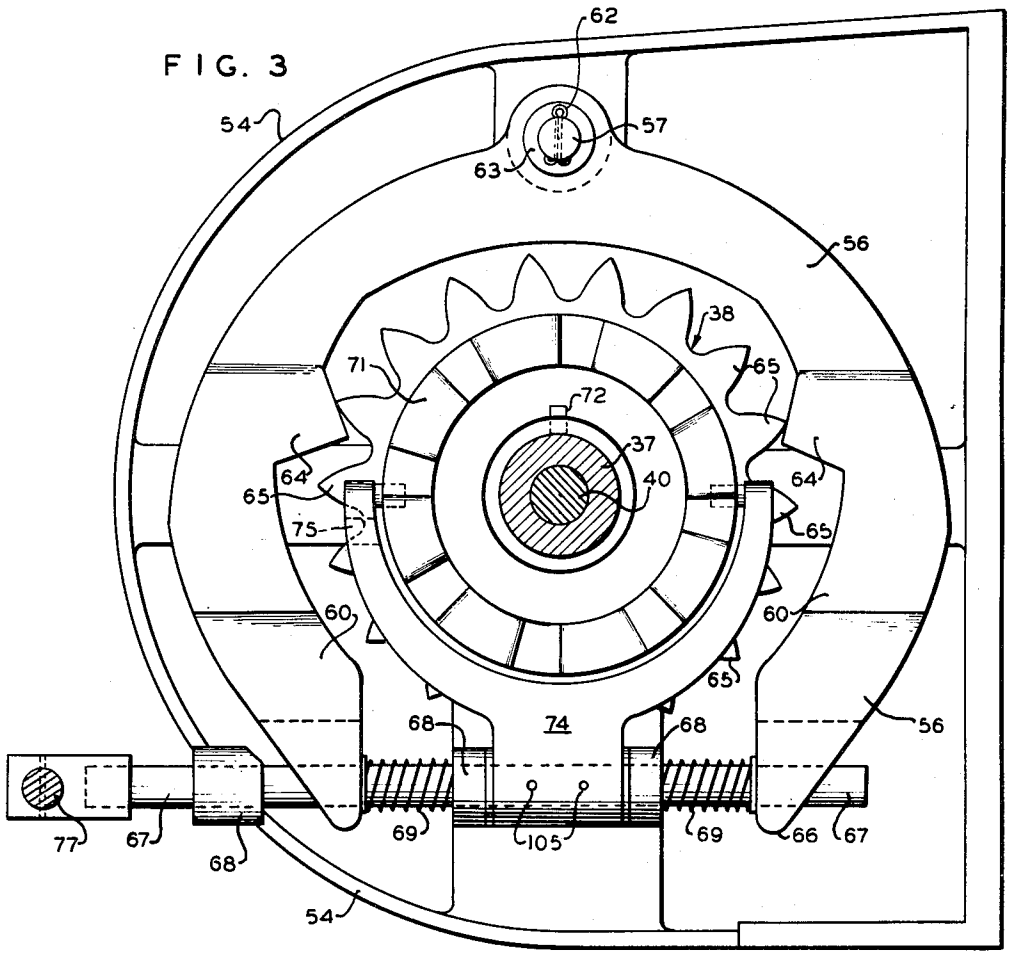


FIG. 7

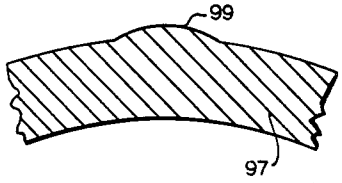
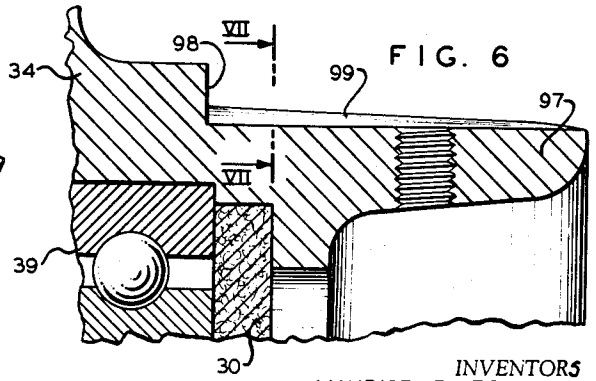


FIG. 6



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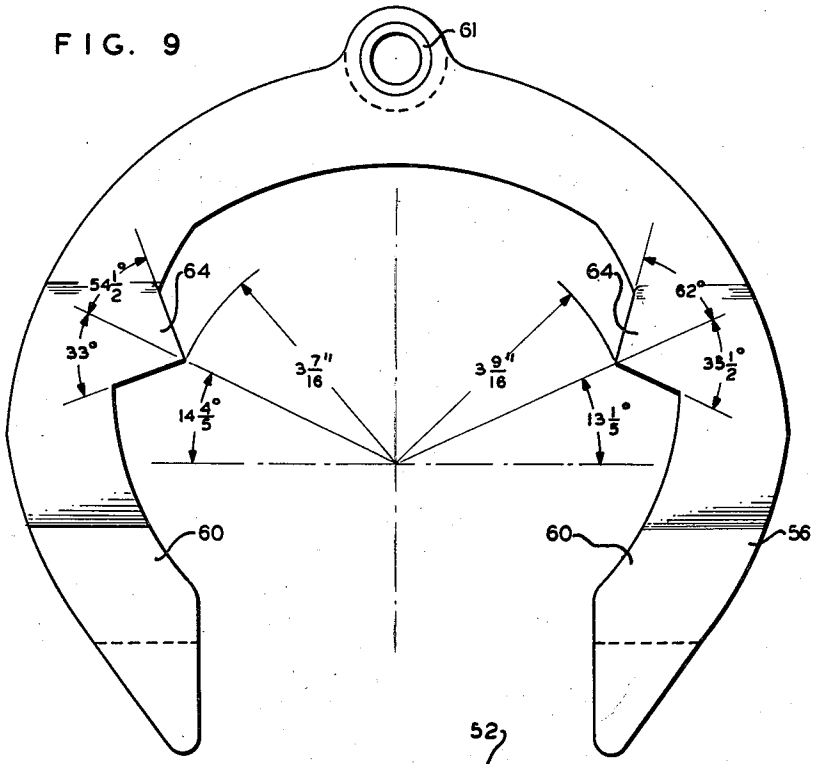
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FIG. 9



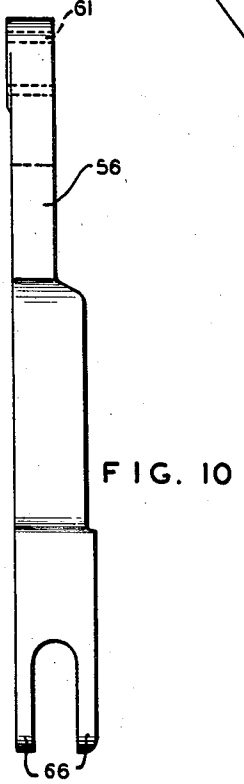


FIG. 10

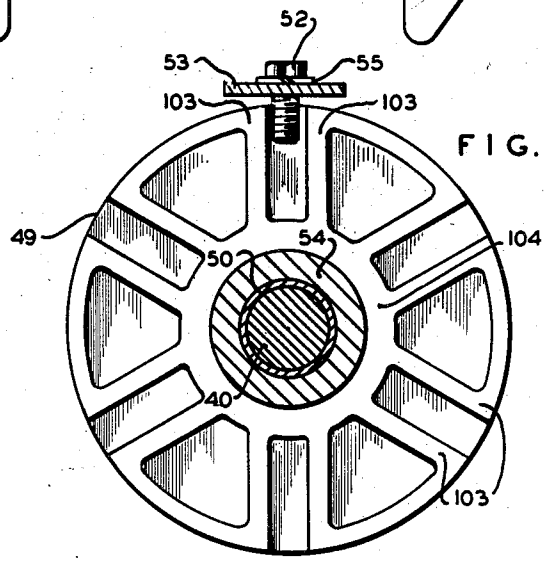


FIG. 11

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United States Patent Office

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TEMPERATURE-OPERATED ROLLING STEEL DOORS

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Filed Mar. 17, 1958, Ser. No. 721,800

12 Claims. (Cl. 160—8)

This invention relates to closures in the form of flexible desirably steel doors which are adapted to be rolled up to an overhead position.

Such closures may be used by themselves or as screen protection for doors, windows and the like. The doors to which this application particularly relates are of the type called "rolling steel fire doors" which are adapted for fire protection and include means for effecting an automatic closing thereof upon the development of a predetermined ambient temperature. There is also means included therewith means to effect a release of parts from one another, desirably upon the development of a still higher temperature, to avoid buckling due to differential expansion of said parts.

The advantage of our doors, as compared with those of the prior art, is that upon automatic release as by the melting of a fusible part, the door closes at a controlled rate of speed, rather than quickly slamming shut, and after such closing it may be manually opened without difficulty, assuming it is not too much damaged by fire.

An object of our invention is to provide an automatic device which, at a selected temperature of say about 160° F., causes a rolling door with which it is associated, to close upon release of such device as by the failure of a fusible metal part included in a control chain or the like.

Another object of our invention is to provide a rolling steel door including a collar on an associated spring journal which, desirably at a higher temperature of say about 500° F., allows the door shaft to freely expand to thereby avoid buckling due to differential heating of the parts.

A further object of our invention is to provide an escapement wheel connected to the closing spring of such a temperature operated door, and an escapement rocker associated with said wheel to provide for a step-by-step closure of the door at a selected speed.

A still further object of our invention is escapement governor mechanism for closure members, more particularly adapted for use with rolling steel fire shutters, and the feature of the provision of a device of this character which will automatically govern the speed of descent of the closure member to prevent injury to anyone who might be caught beneath the lower edge of the door as it lowers.

An additional object of the invention is in the provision of a closure member with an escapement governor for regulating the speed of descent, latching means for holding said member in its open or raised position, and thermally-controlled means whereby the latching means is disengaged to effect a lowering of the closure member in case of fire.

These and other objects and advantages will become apparent from the following detailed description when taken with the accompanying drawings. It will be understood that the drawings are for purposes of illustration and do not define the scope or limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawings, wherein like reference characters denote like parts in the several views:

Figure 1 is an elevational view of a rolling steel door embodying our invention.

Figure 1A is an enlarged fragmentary elevational view, with parts in axial section, showing the right hand portion of the door mechanism.

Figure 2 is an enlarged fragmentary elevational view, with parts in axial section, of the left hand portion of mechanism used for operating the door of Figure 1.

Figure 3 is a transverse sectional view in the direction of the arrows on the line III—III of Figure 1, with parts shown in elevation.

Figure 4 is a fragmentary view, corresponding to Figure 2, but showing the right hand portion of the door mechanism slightly modified as compared with Figure 1A.

Figure 5 is a transverse sectional view on the lines V—V of Figures 1A and 4, in order to show the details of the expansion collar.

Figure 6 is an enlarged fragmentary axial sectional view of a part of the clutch collar and adjacent parts shown in Figure 2, but separated from the door shaft to which it is normally secured.

Figure 7 is a fragmentary transverse sectional view on the line VII—VII of Figure 6, in the direction of the arrows.

Figure 8 is a fragmentary sectional view on the line VIII—VIII of Figure 2, in the direction of the arrows.

Figures 9 and 10 are respectively detailed elevational and side views of the escapement rocker illustrated in Figures 2 and 3.

Figure 11 is a transverse sectional view on the line XI—XI of Figure 2, in the direction of the arrows.

Referring to the drawings in detail, and first considering the embodiment of our invention illustrated in Figures 1, 1A, 2, 3, and 5, there is shown a flexible, preferably steel door **11**, which may be formed of a plurality of interlocking plates, the edges of the same being guided in channels secured to the face of a wall having the opening adapted to be closed by the door. The door **11** may be connected to and rollable on a plurality of reels or barrels **12**, only one of which is illustrated. Each barrel **12** is firmly mounted on a hollow cylindrical shaft **13**, which in turn has means at each end to support it for rotation about its axis. In the present embodiment, the means at the right hand end comprises a spring journal **14**, the outer end of which is secured to a fixed supporting bracket **15** by means of bolts **16**, nuts **17** and lock washers **18**. Said bolts pass through said bracket and the outer or right hand flange **19** of said journal **14**.

The right hand end portion of the shaft **13** has connected thereto a collar **21**, as by bolt means. Only one bolt **22** desirably provided with a lock washer **23** is illustrated. Between the outer or right hand end portion of the collar **21**, is desirably a ball or other antifriction bearing **24** disposed between said collar and the journal **14**. A felt washer **25** is desirably provided between the bearing **24** and collar **21**.

The door **11** is, in the present embodiment, counterbalanced by means of a coil torsion spring **26**. The right hand end portion of said spring is looped around a bolt **27**, held in place in the bifurcated left hand end portion of the spring journal **14** and thereby non-rotatably fixed with respect thereto. A nut **28** and lock washer **29** desirably serve to hold the bolt **27** in place.

The other end portion of the spring **26** is non-rotatably secured to the hollow shaft **13** as by means of a J-shaped or anchor bolt **31**, the straight part being connected as by threading to said shaft **13** and applying a nut **32** and lock washer **33**. The curved portion of the bolt extends around an end portion of the spring **26** and its end portion projects to near the inner surface of shaft

13 and thereby holds the left hand portion of said spring 26 against rotation with respect to said shaft. The foregoing is a description of a so-called "self-coiling" bracket, the spring 26 not being finally connected, as illustrated in Figures 1A and 2, until it is placed under a desired tension to counterbalance the weight of the door 11.

The other end portion of the shaft 13, like the right hand end portion, carries a collar 34 secured thereto as by means of preferably three, equally spaced, retainer bolts 35, and lock washers 36, only one set of which is illustrated. A preferred construction of the collar 34 is illustrated in Figures 6 and 7. As there shown, the outer surface of the part 97 of the collar which is fitted in the left hand end portion of the shaft 13 is slightly tapered toward its end from a shoulder 98 adapted to abut the end of said shaft. On said surface is desirably formed a series of, such as five, outstanding ribs 99, desirably equally spaced circumferentially and rounded, as shown in Figure 7, to merge into the normal frusto-conical surface of said part 97.

The parts of said ribs 99 near the end of said collar part 97 are tapered, as illustrated in Figure 6, to merge into said collar part. This construction allows for tightly fitting the collar 34 to the shaft 13, with the ribs wedged against the inner surface of said shaft, inhibiting relative rotation, and taking operating strains off of the bolts 35. The corresponding parts of the collars 21 and 21*a* may be similarly constructed.

Disposed within said collar 34 is an inner or right hand cylindrical extension 37 from the hub of an escapement wheel 38. A ball or other anti-friction bearing 39, desirably provided with a felt washer 30, serves to mount the shaft 13 with respect to said extension 37. The wheel 38 is, in turn, pivotally mounted on a journal 40 and associated bushings 41. The journal 40 is for the door closing spring 42, which journal corresponds generally with the journal 14 at the right, except that it connects with another spring. Said spring 42 is so constructed that it can, when released from a set tension, overcome the force of the counterbalance spring 26 and close the door 11.

The inner or right hand end portion of the journal 40 is bifurcated to receive in the so formed notch 43 the right hand end portion of the door closing spring 42. Said spring 42 is prevented from undesired disconnection from said journal 40 by means of a bolt 44, nut 45 and lock washer 46, said bolt extending between the journal bifurcations. Undesired leftward movement of the journal 40 is prevented by a thrust collar 70 secured thereto by a set screw 80.

The other or left hand end portion of said spring 42 is connected to the extension 37 by means of a spring anchor ring 47 and a set screw 48. The inner diameter of the ring 47 closely approximates the outer diameter of the extension 37, with very little tolerance, so that there is initially a snug fit therebetween. The end of the spring 42 is snugly received in an aperture 101 which extends parallel to the axis of the ring 47 but does not merge with its opening which receives the extension 37, being separated therefrom by a relatively thin web 102 as shown in Figures 2 and 8. When the set screw 48 is tightened to clamp the spring in place, it at the same time distorts the web 102 inward to a sufficient extent to tightly clamp the ring 47 on the extension 37.

The spring 42 is placed under a desired amount of tension by turning a charging disc 49, connected to the outer end portion of the journal 40, as by a set screw 51, and securing said disc in charging position by means of a retaining bolt 52 provided with a lock washer 55 and extending through an angle iron flange 53 outstanding from a fixed bracket 54. The inner end of the bolt 52 is received between a selected pair of ribs 103, which extend in generally radial directions from a hub-encircling flange 104, as shown in Figure 11. Said bracket 54 is provided with a central bushing 50 in which said journal 40 is turnable.

The escapement wheel 38 is provided with outstanding peripheral teeth 65 and its releasing movement is controlled by an escapement rocker 56 pivoted to a shaft 57 secured to the bracket 54. Such securing may be effected by riveting over the outer end of said shaft, as at 58, to hold an intermediate shaft collar 59 tightly against said bracket 54. The rocker 56 is apertured between a pair of depending arms 60 and provided with a bushing 61 fitting the portion of the shaft 57 inward of the collar 59, or to the right as viewed in Figure 2. The rocker is held in place on said inner shaft portion and in engagement with the collar 59 by suitable means, such as a cotter pin 62 and washer 63.

The escapement rocker arms 60 extend on either side of or straddle the wheel 38, angular lugs 64 integrally formed on and extending rigidly from the inner edges thereof being provided to alternately engage and release corresponding teeth 65 on said wheel to, when the door is released, control the speed of closing thereof. The lower ends of the ams 60 are bifurcated, as indicated at 66, to straddle the portion of the release arm 67 which is pivoted in lugs 68 extending inward of the bracket 54, or to the right as viewed in Figure 2. The lower end portions of the arm 60 are resiliently spaced from the two more central of said lugs 68 by helically coiled centering springs 69 encircling the arm 67.

The escapement wheel 38 is allowed to turn clockwise, as viewed in Figure 3, for closing of the door 11. In order to have the rocker 56 centered when a tooth 65, at the right of Figure 3, is held against movement by the normally lower right lug 64, and a tooth 65, at the left of said figure, has just been released by the normally higher left lug 64, we construct the rocker desirably as illustrated in Figures 9 and 10.

Said figures show the rocker centered and the right hand or here-illustrated holding lug 64 with its tip at an angle of 13⅕° from the horizontal extending through the axis of rotation of the wheel 38. On the other hand, the tip of the here-illustrated releasing lug 64, is at a slightly larger angle, such as 14⅘° from the same horizontal. Such holding and releasing shifts from side to side as the wheel 38 is allowed to turn. Farther, it has been found best to make the right hand lug 64 with the angle at its tip obtuse, such as about 97½°, and the left hand lug with the angle at its tip acute, such as about 87½°.

It will also be seen tht the angles between the sides of the lugs and the respective lines from their tips to the axis of rotation of the wheel are slightly different, as will be seen from Figure 9 of the drawing. Figure 10 shows how the thickness of the rocker is increased at the lugs 64 and again increased at the bifurcations 66, in a preferred embodiment.

The hub of the wheel 38 carries a toothed clutch 71 fixed against rotation with respect thereto by a key 72, desirably of the Woodruff type, and axially slidable on said key, from the release position of Figure 2, to operative engagement with the teeth-provided adjacent end portion of the collar 34 of the shaft 13. Eight equally-spaced teeth are desirably provided on each of the engaging parts, the circumferential dimension of each tooth desirably being about one-half of that between teeth. A spiral spring 73 biases said clutch 71 toward engagement with said collar 34. Normally the clutch 71 is held from such engagement by a clutch shifter fork 74 which is operable by, and fixed with respect to, the release arm 67, as by means of roll-pins 105.

The shifter fork 74 has a pair of arms straddling the lower portion of the clutch 71. The end portions of said arms turn toward one another and are interlockingly received in a peripheral groove in the clutch 71. The fork 74 is provided with a locking lug 75 which is nor-

mally received between two of the escapement wheel teeth 65 to hold said wheel against turning.

The means of the present embodiment holding said fork 74 in the clutch and wheel-retaining position illustrated, comprises an operating chain 76 holding up, to the position of Figure 2, the operating handle 77 of the release arm 67. Said chain 76 desirably passes from its connection with the handle or arm 77 up to a supporting ring or eyelet 78, through said eyelet 78 and over to another ring or eyelet 79, through said eyelet 79 and down to a suitable connection 81 on the hood 82 which covers the mechanism.

This chain 76 includes at least one, but desirably includes a plurality of spaced links 83 and 84 adapted to fail at a selected temperature, such as about 160° F., so as to allow the clutch 71 to release for an engagement between its teeth 85 and corresponding teeth 86 on the collar 34, and a release of the locking lug 75 from the escapement teeth 65, to allow the spring 42 to turn the shaft 13 and unroll the door 11 from raised or open to closed or lowered position.

Operation

As shown in the drawings, the door 11 is in position for normal or manual operation. The clutch 71 is disengaged from the collar 34 by the clutch shifter fork 74. Counterbalance for normal operation is obtained thru the counterbalance spring 26. The torque of the door closing spring 42 is adjusted by turning the charging disc 49 and maintaining such adjustment by the spring charge retaining bolt 52. The locking lug 75 prevents rotation of the eighteen toothed escapement wheel 38.

Upon melting of one of the fusible links 83 and 84 the handle or arm 77 drops or rotates clockwise to release the clutch shifter fork 74, allowing the clutch spring 73 to force the clutch into engagement with the collar. At the same time, the locking lug 75 releases the escapement wheel 38 so that the torque of the closing spring is transmitted thru the clutch 71 to the door shaft 13, forcing the door closed. The speed of closing is controlled by the escapement rocker 56, designed to match the wheel teeth. The oscillation of the rocker 56 in releasing the door 11 is dampened by its own inertia and the centering spring 69. The number of charging turns of the closing spring 42 and the counterbalance spring 26 are correlated so that the door closes with a steady, firm motion without a slamming action against the floor.

With the self-coiling type door of Figures 1, 1A and 2, the counterbalance spring 26 is fastened to the bracket 15 by means of the referred-to spring journal 14. In normal operation, an expansion clamp or collar 87 (Figure 5) is secured on the spring journal 14, as by means of a bolt 88, nut 89, lock washer 90 and fusible washer 92, desirably sandwiched between a pair of standard or steel washers 106, and holds the door shaft 13 in position against undesired movement to the right. Undesired movement to the left is prevented by the shoulder 91 provided where the extension 37 joins the hub of the escapement wheel 38. The diameter of the spring journal 14 is desirably slightly larger, say about .03", than the inner diameter of the expansion of collar 87, so that said collar is slightly expanded on initial application. It may then be set on said journal at the exact position desired before tightening the clamping nut 89. When the shaft assembly is exposed to a given temperature, say about 500° F., the fusible washer 92 melts, allows corresponding expansion and slippage of the collar 87, thus allowing door shaft to expand to the right and avoid distortion of the connected parts.

On the modified crank gear bracket 15*a* of Figure 4, the operation is similar to the self-coiling bracket. The door is operated by a crank on the crank gear box (not shown) thru the shaft 93 to the bevel pinion gear 94; thru the bevel and spur pinion gear 95, to the sleeve gear 96 which is attached to the collar 21*a*. The expansion feature of this assembly is the same as for the self-coiling bracket. The sleeve gear 96 slides along the spur teeth of the bevel and spur pinion gear 95 when the fusible washer 92 in the expansion collar 87*a* fuses and the shaft 13*a* expands to the right. The parts not numbered and not described correspond with those of the first form.

Having now described our invention in detail in accordance with the requirements of the patent statutes, those skilled in this art will have no difficulty in making changes and modifications in the individual parts or their relative assembly in order to meet specific requirements or conditions. Such changes and modifications may be made without departing from the scope and spirit of the invention, as set forth in the following claims.

We claim:

1. In combination, a rolling door, a supporting shaft about which said door may be rolled, means to counterbalance the weight of said door, means to overcome the action of said counterbalancing means comprising escapement means adjacent one end of said shaft, an extension therefrom towards said shaft, a door-closing spring with one end portion connected to said extension, tensioning means for the door-closing spring movable with respect to said shaft and with an inner end portion connected to the inner end of said spring, means normally checking the action of said overcoming means by stopping movement of said escapement means, and means rendering inoperative said checking means and allowing the door to close when the ambient temperature rises to a predetermined extent.

2. In the combination recited in claim 1, wherein the shaft on which said door may be rolled is hollow, means at each end for supporting said shaft for rotating about its axis, and wherein the means to counterbalance the weight of said door is a spring enclosed in, and connected at one end to an intermediate portion of, said shaft, and at its other end to the supporting means at the end of the shaft opposite said escapement means.

3. In the combination recited in claim 2, an expansion collar on one of the shaft supporting means for limiting movement of said shaft, and means separate from but associated with said collar for allowing axial movement upon development of a selected temperature.

4. In combination, a rolling door, a hollow shaft on which said door may be rolled, means at each end for supporting said shaft for rotation about its axis, a collar slidable on one of said supporting means, means securing said collar in place for limiting axial movement between said supporting means and shaft, comprising a tightening bolt, a nut thereon, and fusible means on said bolt for allowing it to release its action on the collar and permit the latter to slide on its supporting means upon the attainment of a selected temperature.

5. In combination, a counterbalanced rolling steel door, a hollow shaft on which said door may be rolled, means at each end supporting said shaft for rotation about its axis, the supporting means at one end of said shaft having a cylindrical extension and an escapement portion, a door-closing spring with its outer end operatively connected to said extension, means for tensioning said closing spring, a clutch mounted for relative axial movement but fixed against relative rotative movement with respect to said extension, a shifter device engaging said clutch for holding it interlocked with respect to said escapement portion, means biasing said clutch toward operative engagement with said shaft, means acting on said shifter device to hold said escapement portion against movement and the clutch immovable with respect thereto and from engagement with said shaft, and means causing said shifter-device-holding means to fail upon the development of a selected temperature to effect a release of the clutch from said escapement portion and an operative engagement thereof with said shaft.

6. In combination, a rolling steel door, a hollow shaft on which said door may be rolled, means at each end supporting said shaft for rotation about its axis, a counterbalance spring enclosed in said shaft and connected at one end to an intermediate portion of said shaft and at its other end to the supporting means at one end of the shaft, the supporting means at the other end of said shaft having an inner cylindrical extension and an outer escapement portion, a door-closing spring with its outer end operatively connected at one end to said extension, spring-tensioning means with an inner end portion connected to the other end of said closing spring, means to turn said tensioning means to place said closing spring under a desired tension, a clutch mounted for relative axial movement but fixed against relative rotative movement with respect to said extension, a shifter device engaging said clutch for holding it interlocked with respect to said escapement portion, means biasing said clutch toward operative engagement with said shaft, means acting on said shifter device to hold said escapement portion against movement and the clutch immovable with respect thereto and from engagement with said shaft, means causing said shifter-device-holding means to fail upon the development of a selected temperature to effect a release of the clutch from said escapement portion and an operative engagement thereof with said shaft, and an escapement rocker acting on said escapement portion to control the closing of said door upon release of said shifter device.

7. In combination, a rolling steel door, a hollow shaft on which said door may be rolled, means at each end supporting said shaft for rotation about its axis, a counterbalance spring enclosed in, and connected at one end to an intermediate portion of, said shaft and at its other end to the supporting means at one end of the shaft, an expansion collar on said supporting means for limiting movement of said shaft thereon, means associated with said collar for allowing axial movement thereof upon the development of a selected temperature, the supporting means at the other end of said shaft having an inner cylindrical extension and an outer escapement portion, a door-closing helically coiled spring disposed inside of said shaft and with its outer end operatively connected to the inner end of said extension and disposed between it and said counterbalance spring, spring-tensioning means encircled by said door-closing spring and with an inner end portion connected to the inner end of said door-closing spring, exterior means to turn said spring-tensioning means and place said closing spring under a desired tension, a clutch mounted for relative axial movement but fixed against relative rotative movement with respect to said extension, a shifter device engaging said clutch for holding it interlocked with respect to said escapement portion, a spring biasing said clutch toward operative engagement with said shaft, means acting on said shifter device to hold said escapement portion against movement and the clutch immovable with respect thereto and from engagement with said shaft, means causing said shifter-device-holding means to fail upon the development of a selected temperature to effect a release of the clutch from said escapement portion and an operative engagement thereof with said shaft, and an escapement rocker acting on said escapement portion to control the closing of said door upon release of said shifter device.

8. An escapement rocker comprising a rigid member having a pair of arms adapted to straddle a rotatably pivoted escapement wheel having outstanding peripheral teeth, a pointed lug extending inwardly from each arm for alternately engaging one of said teeth, one lug being slightly higher than the other and its point subtending a greater angle from the horizontal through the pivot axis of said wheel than the point of the other lug when said rocker is centered, whereby then a tooth at one side may be held against movement by one lug as a tooth at the other side has just been released by the other lug, and such holding and releasing shifts from side to side as the wheel is allowed to turn.

9. An escapement rocker as defined in claim 8, wherein it is adapted for use with an escapement wheel having eighteen teeth by making the angle subtended by one lug about 1⅗° greater than that subtended by the other.

10. In combination, a rolling door, a hollow shaft on which said door may be rolled, means at each end for supporting said shaft for rotation about its axis, the supporting means at one end of said shaft having an inner cylindrical extension and an outer escapement portion, means to counterbalance the weight of said door, means to overcome the action of said counterbalancing means comprising a door-closing helically coiled spring disposed inside of said shaft and with its outer end operatively connected to the inner end of said extension, spring tensioning means encircled by, and with an inner end portion connected to the inner end of, said door-closing spring, means normally acting to check the action of said overcoming means, a clutch mounted for relative axial movement but fixed against relative rotative movement with respect to said inner extension, a shifter device normally engaging said clutch to hold it interlocked with respect to said escapement portion, and means rendering inoperative said checking means and allowing the door to close when the ambient temperature rises to a predetermined extent, comprising means causing movement of said shifter device to release said escapement portion and move the clutch axially to effect turning of said shaft by said door-closing spring.

11. In combination, a rolling door, means to counterbalance the weight of said door, means to overcome the action of said counterbalancing means, means normally checking the action of said overcoming means comprising a clutch mounted for axial movement but normally fixed against relative rotative movement with respect to said door, a shifter device engaging said clutch for holding it immovable, a spring biasing said clutch towards operative engagement for closing said door, means acting on said shifter device to hold said clutch immovable, and means causing said means acting on said shifter device to fail upon the development of a selected temperature to effect release of the clutch to allow the biasing spring to act and effect closing of said door.

12. In combination, a rolling door, means to counterbalance the weight of said door, means to overcome the action of said counterbalancing means, means normally checking the action of said overcoming means, means rendering inoperative said checking means and allowing the door to close, and means allowing such closing of the door to be step by step, comprising door supporting means having an outer escapement portion, an escapement rocker comprising depending arms straddling said escapement portion, and an integral lug extending inwardly from each of said arms and acting on said outer escapement portion to control the closing of said door.

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