Jan. 19, 1965 H. B. CLARK 3,166,155

MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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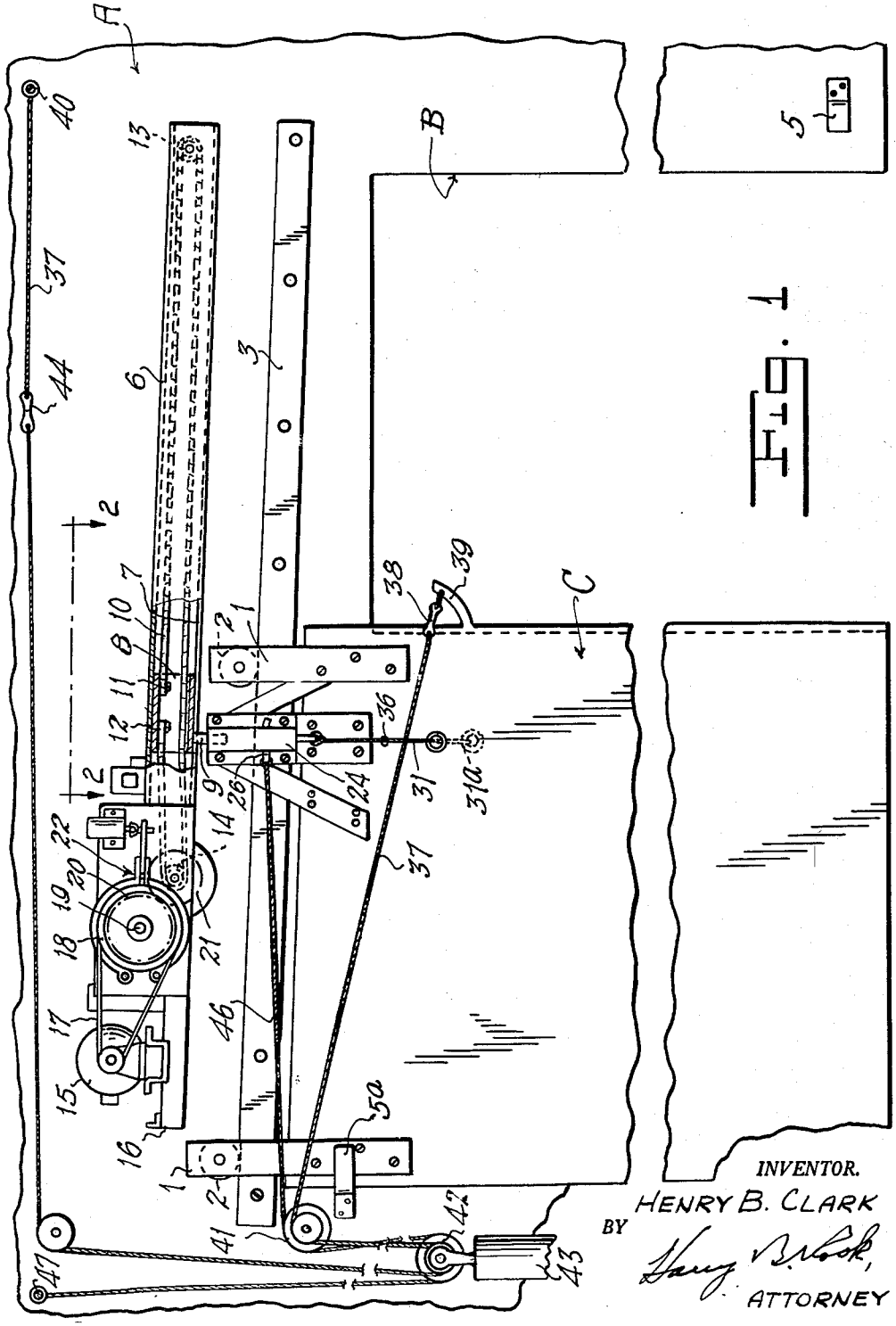


FIG. 1

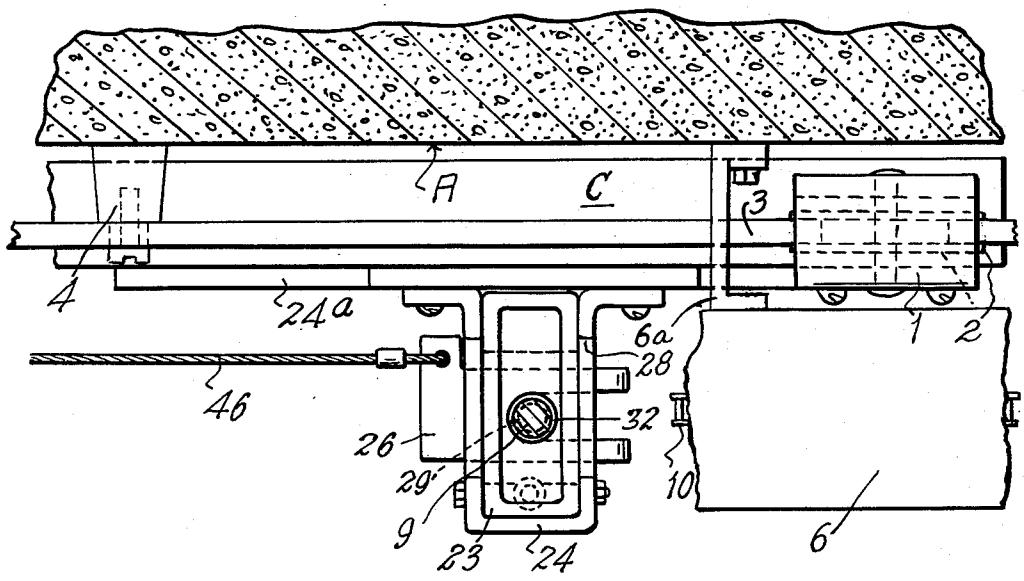
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MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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Fig. 2



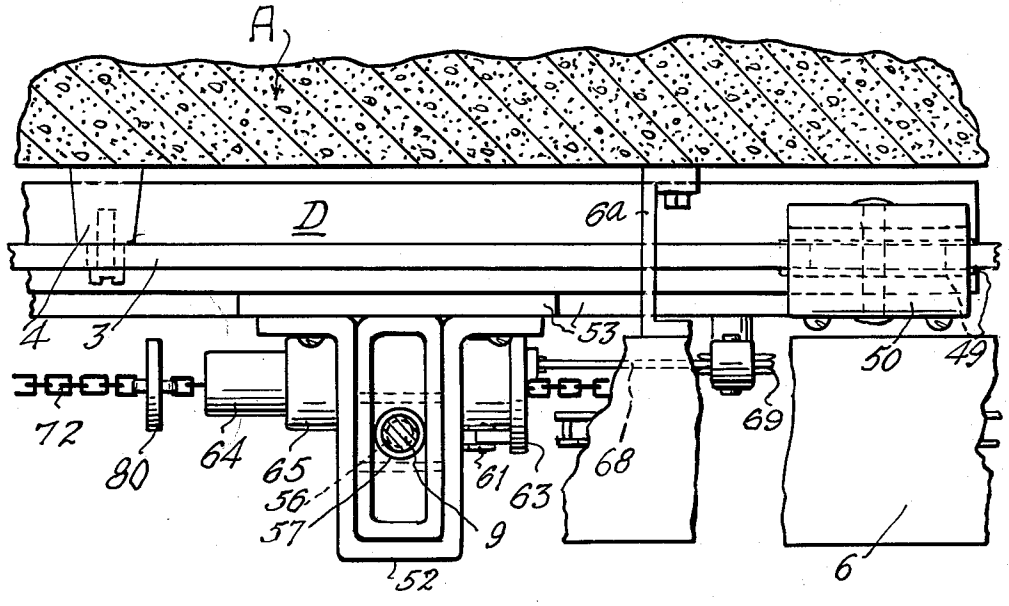


Fig. 7

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MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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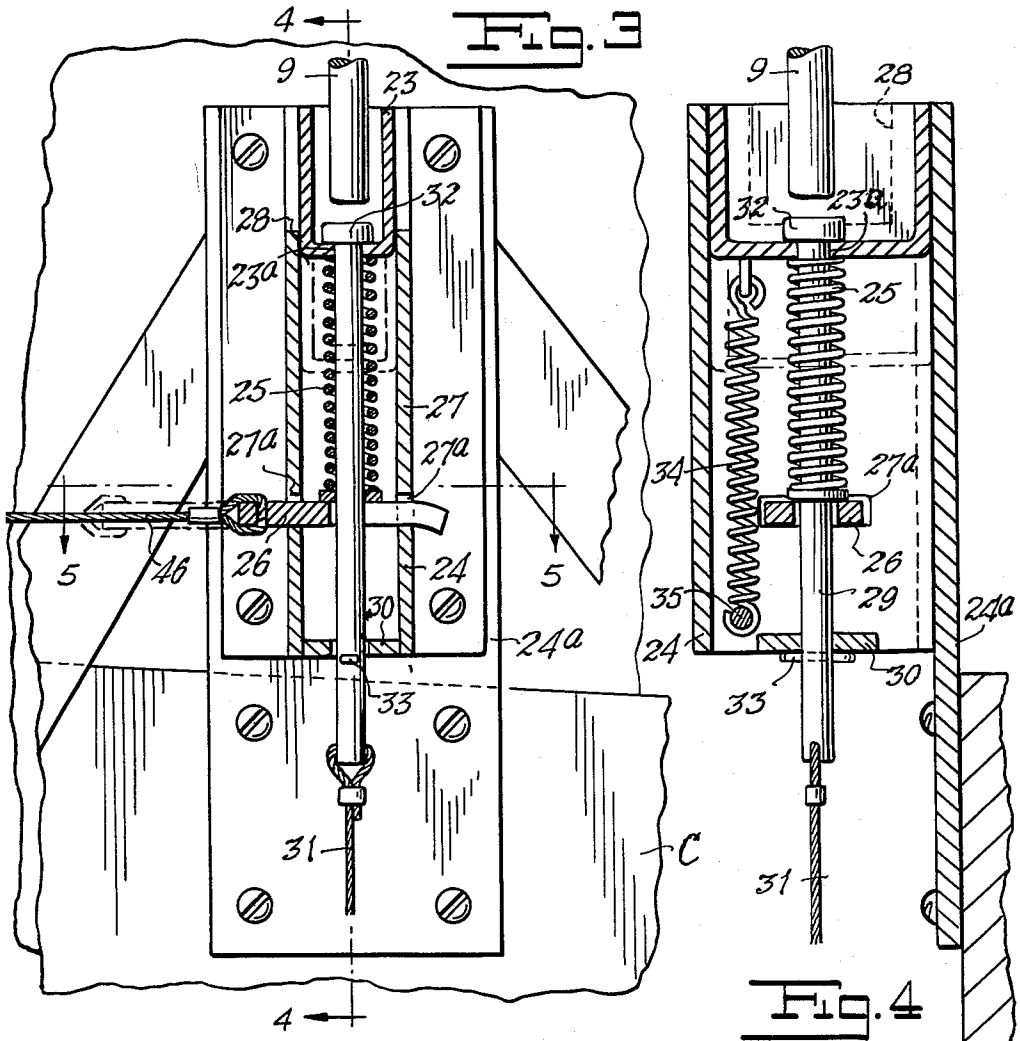


Fig. 3

Fig. 4

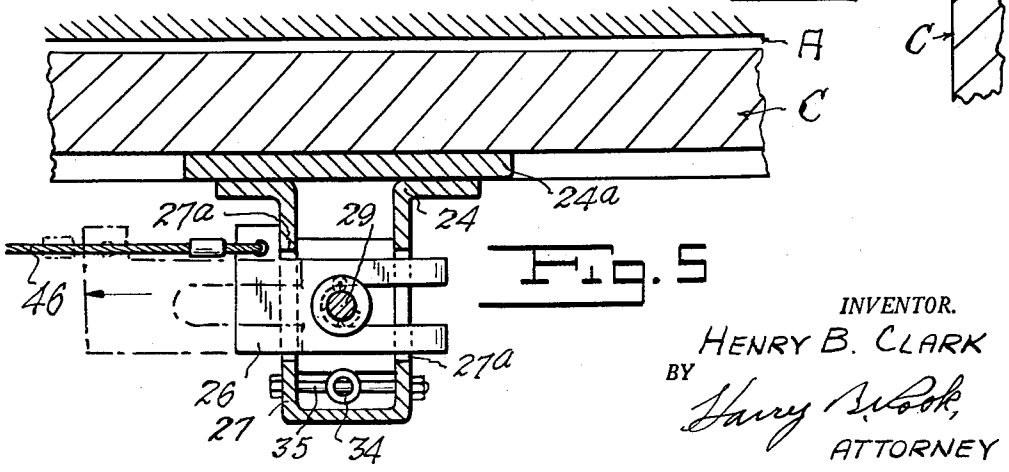


Fig. 5

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MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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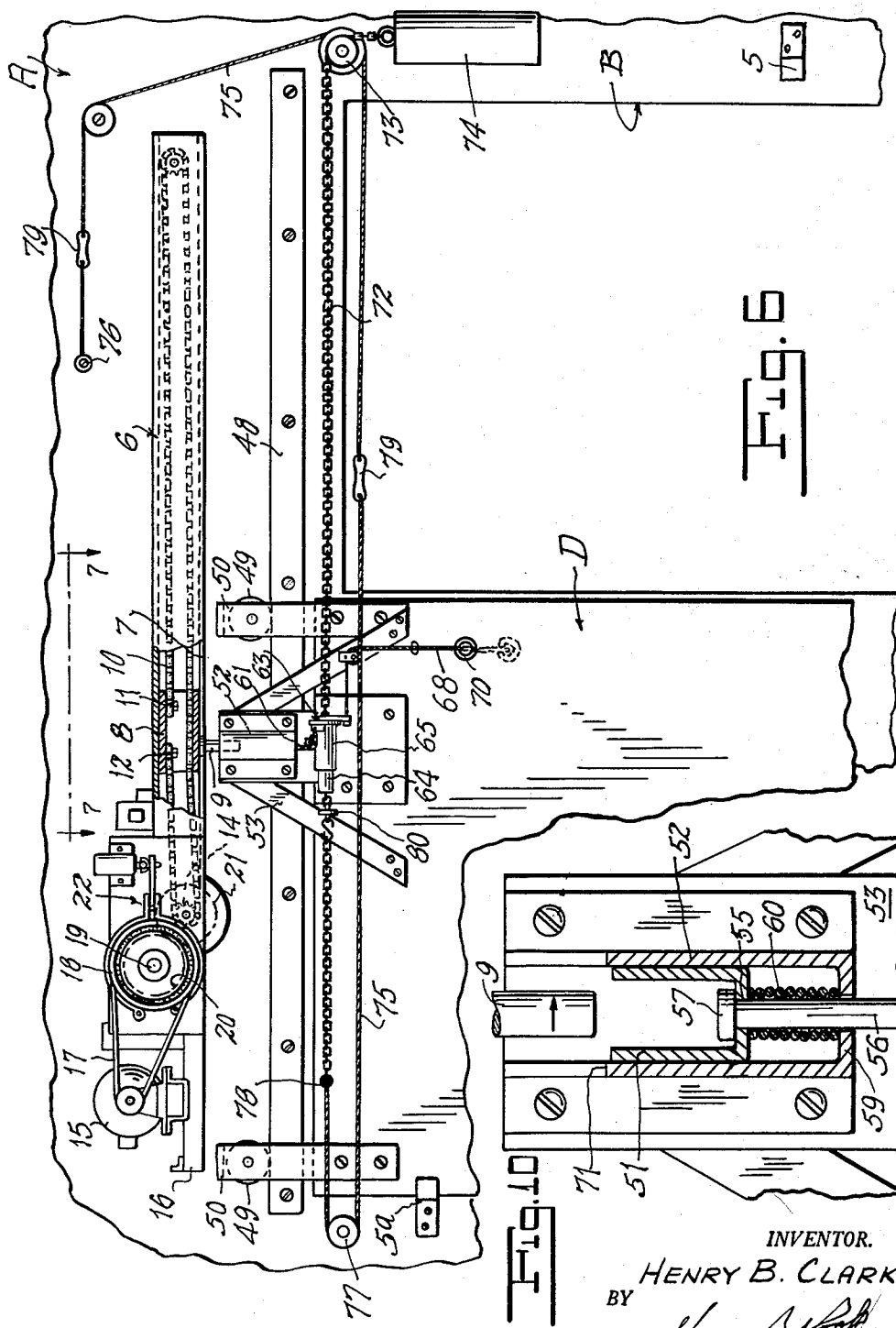


Fig. 6

Fig. 10

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MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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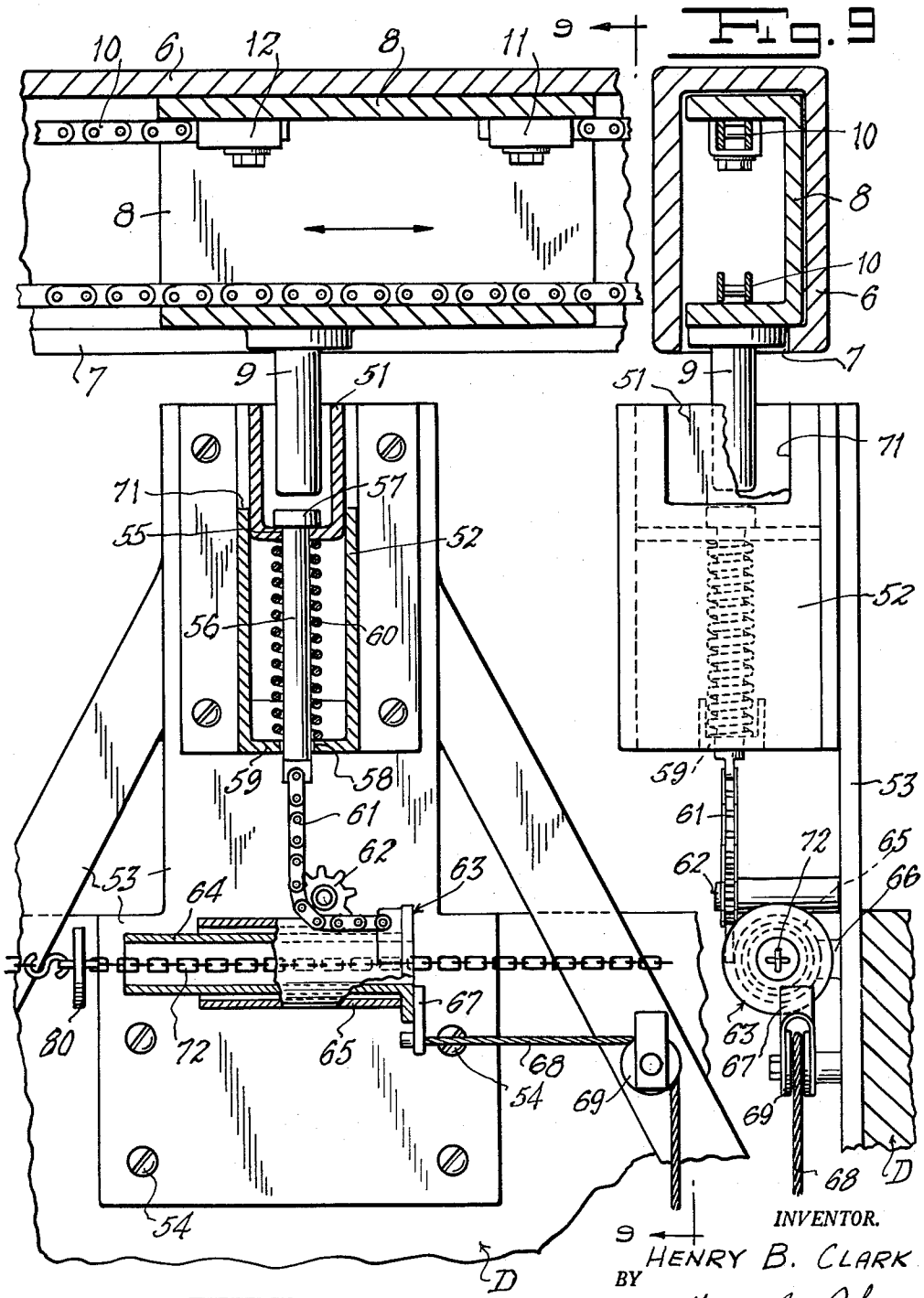


Fig. 8

Fig. 9

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United States Patent Office 3,166,155 Patented Jan. 19, 1965

3,166,155

MOTOR OPERATED FIRE DOORS WITH AUTOMATIC DOOR RELEASE

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Filed May 10, 1961, Ser. No. 109,047
14 Claims. (Cl. 189—47)

This invention relates in general to fire closures hereafter referred to generically as doors of the type wherein the door is mounted to slide or roll on a track, and, in case a fire should occur in the vicinity of the door while the door is open, a fusible link or other heat-responsive element is automatically affected to release the door into closed position.

A primary object of the present invention is to provide a fire door which is motor-operated into both open and closed position and with which is associated means including a motor-driven part mounted on a fixed support such as a wall, and a cooperative door-carried part for automatically disconnecting or releasing the door from the motor-driven part in case of fire at a given zone so that the door may be automatically closed and for permitting manual disconnection of said parts whenever desired, for example, in case a person should become trapped in a room closed by the door.

Another object is to provide a fire door of this character embodying novel and improved features of construction wherein the parts, after automatic closing of the door by fusing of the fusible link, can be easily and quickly restored to their normal operative condition without tools or instruction diagrams.

Still another object is to provide such a motor-operated fire door which shall include novel and improved means for connecting the door to and disconnecting or releasing it from the motor-operated mechanism and whereby the door can be automatically disconnected from the motor-operated mechanism by the action of a heat-responsive element, e.g., a fusible link, in case of a fire in a given location in a building or the like, for example, in a room with which the door communicates.

It is another object of the invention to provide a motor-operated fire door of the character described wherein the door is mounted on a horizontal track, and is automatically disconnected from the motor-operated mechanism and automatically closed by a counterweight, upon response of a fusible link or other heat-responsive element to heat from a fire in a given location.

A further object is to provide a motor operated fire door which is mounted on an inclined track so as to be opened and closed normally by motor-operated mechanism and with which is associated novel and improved means for automatically disconnecting the door from the motor-operated mechanism and for releasing the door for closing by gravitational action in case of the fusing of a fusible link or the activation of a heat-sensitive element in response to heat from a fire at a particular location.

Other objects of the invention are to provide such a door which shall be simple and durable in construction and positive and reliable in operation; and to obtain other advantages and results that will be brought out by the following description in conjunction with the accompanying drawings in which:

FIGURE 1 is a front elevation of a motor-operated fire door which is gravitationally closed in case of fire, with an automatic door release embodying the invention, showing the door in open position and illustrating the motor-driven part and the cooperative door-carried parts in cooperative relation to each other;

FIGURE 2 is an enlarged fragmentary plan view from the plane of the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged fragmentary front elevation

of the door-carried parts and the motor-driven part with portions broken away and shown in vertical section;

FIGURE 4 is a transverse vertical sectional view through the assembly of FIGURE 3 taken on the plane of the line 4—4 of FIGURE 3;

FIGURE 5 is a horizontal sectional view on the plane of the line 5—5 of FIGURE 3;

FIGURE 6 is a view similar to FIGURE 1 showing another form of the invention wherein the door is closed by a counterweight in case of fire, showing the motor-driven part and the cooperative door-carried part in cooperative relation to each other;

FIGURE 7 is an enlarged fragmentary plan view on the plane of the line 7—7 of FIGURE 6;

FIGURE 8 is a front elevational view with portions broken away and shown in section, of the automatic door release, showing the door-carried part in connected cooperative relation to the motor-driven part;

FIGURE 9 is a transverse vertical sectional view approximately on the plane of the line 9—9 of FIGURE 8, showing the door-carried parts in side elevation and with portions broken away; and

FIGURE 10 is a fragmentary view similar to FIGURE 9 but showing the door-carried part disconnected from the motor-driven part.

Specifically describing the embodiment of the invention illustrated in FIGURES 1 through 5, the reference character A designates the wall of a building in which is a door opening B which is closed and opened by a door C. The door is shown as having hanger brackets 1 rigidly secured thereto and projecting upwardly therefrom, which have rollers 2 journalled therein and rollable along a mounting track 3 which is rigidly secured on the wall above the door by bracket bolts 4 in inclined relation to the door so that the door, when released, will roll normally along the track by gravitational action into closed position. Movement of the door into closed and open positions is limited by the usual stops 5 and 5*a*, respectively.

Normally, the door is motor-operated into both open and closed position, and an automatic release is provided for disconnecting the door from the motor-operated mechanism when a fire occurs in a given location, for example, in the vicinity of the door opening.

While the construction of such motor-operated apparatus may be widely varied, for the purpose of illustrating the invention it has been shown as comprising a guide track 6 supported on the wall A above and in line with the rail 3, and preferably formed of a tube of rectangular cross-section having a longitudinal slot 7 in its bottom wall. Slidable within the guide track and movable from one end to the other thereof is a hollow metal guide block 8 (best shown in detail in FIGURES 8 and 9). The outside dimensions of the block are smaller than the inside dimensions of the track so that the block has a free sliding contact with the inner walls of the track so as to freely guide the block in its movement in the track.

Secured to and depending from the bottom wall of the block and projecting from the slot 7 is a motor-driven part that is shown in the form of a pin or stud 9. The block 8 is moved through a pre-determined path along the guide track by a flexible chain 10 that has one end secured to one end of the block 8 as indicated at 11 and its other end secured to the other end of the block as indicated at 12. At one end of the guide track, the chain passes over a sprocket wheel 13 and at is other end the chain passes over a sprocket wheel 14 which is driven so as to move the chain longitudinally upon rotation of the sprocket, it being understood that the two sprockets are journaled in the track 6. The sprocket wheel 14 is

operatively connected to a reversible electric motor **15** mounted on a frame **16** secured to the wall A. The exact construction of the driving mechanism is not material to the invention; it may be of the same general nature as that shown in my Patent No. 2,412,871. For a schematic illustration, the motor **15** is shown as having a belt connection **17** with a pulley **18** on a shaft **19**, the pulley being associated with a friction clutch. On the shaft **19** is a pinion **20** that meshes with a gear **21** on the shaft of the sprocket **14**. The motor may be controlled by a single simple switch (not shown) that may be either manually or automatically operated; and connected in circuit with the motor and the switch may be a magnetic controller for the motor, a selector switch to reverse the motor, and suitable limit switches to stop the operation of the motor at the limits of the opening and closing movements of the door. Also, desirably, an electromagnetic brake **22** is associated with the pulley **18** to brake the movements of the parts as they approach their limits of movement. It will be understood by those skilled in the art that the ratio of the driving gears and sprockets will be determined in accordance with the motor speed and the desired speed of movement of the door. With this construction, it will be seen that upon longitudinal movement of the chain in opposite directions, the guide block **8** will be moved back and forth within the track **6**, and the pin **9** normally will project into a door-carried socket member **23** that forms a part of the automatic release apparatus for disconnecting the door from the motor-driven apparatus in case of fire.

The automatic release apparatus is shown as comprising the socket member **23** that is vertically slidably mounted in a guide casing **24** carried by a bracket **24***a* mounted on the door, the socket member being normally actuated by a spring **25** into a position to receive the motor-driven pin **9** as best shown in FIGURES 3 and 4. As shown, the spring **25** is interposed between the bottom wall of the socket member **23** and a trigger plate **26** that is slidably mounted horizontally and transversely of the casing **24** in slots **27***a* in the side walls of the casing. The side walls **27** of the guide casing have notches **28** in their upper ends that provide clearance for movement of the door away from and past the pin **9** when the socket member is pulled downwardly into the position to release the pin from the socket as indicated by dot and dash lines in FIGURES 3 and 4.

For manually actuating the socket member **23** into its pin-releasing position, a pull rod **29** is connected to the bottom wall of the socket and extends vertically longitudinally of the casing **24** with its lower end portion slidably mounted in a guide plate **30** in the casing and connected to a pull cord **31**. As shown, the rod passes loosely through an opening **23***a* in the bottom wall of the socket and has a head **32** abutting said wall. Connected to the rod **29** is a cotter pin or the like **33** to abut the plate **30** and limit movement of the socket member under the influence of the spring **25**. The trigger plate **26** is bifurcated so that the legs of the bifurcation straddle and provide a clearance for the rod **29**. A tension spring **34** is connected between the socket member and a bolt **35** on the casing to normally bias the socket member downwardly or away from the motor-driven pin **9**.

The pull cord **31** may have a main portion at one side of the door and a branch **31***a* passing through an opening **36** in the door so that the cord can be manipulated from either side of the door to manually release the door from the motor-operated mechanism to permit manual opening of the door from either side thereof when desired, for example, in case of failure of the motor-operated mechanism.

As hereinbefore indicated, the invention provides for automatic disconnection of the door from the motor-driven pin in case of fire in a given location. For this purpose, a flexible cable **37** has one end connected to a heat-responsive element such as a fusible link **38**, the other end of which is connected to a bracket arm **39** on the leading edge of the door, and the other end of the cable is connected to a fixed support such as the wall A at **40** with the intermediate portions of the cable passing around a double pulley **41** journaled on the wall and around another double pulley **42** connected to a weight **43** so that the weight is normally suspended and maintains the cable and the fusible link under tension. If desired, one or more of the heat-responsive elements may be connected in the cable **37** and arranged at other locations, fore example, other rooms, as indicated at **44**.

Associated with the cable **37** is another cable **46**, one end of which is connected to the trigger plate **26** and the other end of which is connected to a fixed support such as the wall at **47** with the intermediate portions passing around the double pulleys **41** and **42**.

With this construction, it will be observed that when the motor-driven pin **9** is connected to the socket member **23** and is actuated alternately in opposite directions by the motor-operated mechanism **6–22**, the door will be alternately opened and closed and the weight will rise and fall under the influence of the cable **37**; and at the same time, the cable **46** will be maintained under only slight tension that is insufficient to withdraw the trigger plate from its normal position shown by solid lines in the drawings. However, should any of the heat-responsive elements be affected by temperature rise beyond a predetermined degree, the cable **37** will be released and permit the weight **43** to descend by gravity, and a pull will be exerted in the cable **46** sufficient to withdraw the trigger plate **26** from beneath the spring **25** (FIGURES 3 and 4) into the broken line position of FIGURES 3 and 5, and thereby permit the socket member to be actuated downwardly by the spring **34** out of engagement with the motor-driven pin **9** as shown by dot and dash lines in FIGURES 3 and 4. At the same time, the door will be released for free rolling along the track **3** by gravitational action into its closed position.

Now referring to the other form of the invention illustrated in FIGURES 6 to 10 inclusive, the motor-operated mechanism including the motor-driven pin **9** is identical with that hereinbefore described and the parts thereof are referred to by the same reference characters that are used in FIGURES 1 through 5. In this form, however, the track **48** is horizontally level instead of being inclined as is the track **3**, but the door D is mounted on the track by rollers **49** journaled in hangers **50** like the hangers and rollers **1** and **2**.

The automatic release includes a socket member **51** that may be identical with the socket member **23** slidably mounted in a casing **52** carried by a bracket **53** that is mounted on the side of the door as by screws **54**. The bottom wall of the socket member has an opening **55** through which extends a pull rod **56** having a head **57** at one end abutting the upper side of said bottom wall of the socket and its other end portion slidable through an opening **58** in a bottom wall **59** of the casing **52**. Interposed between the socket member and said bottom wall **59** of the casing is a compression spring **60** which normally biases or actuates the socket member into engagement with the motor-driven pin **9**. The movement of the socket member under the influence of the spring **60** is limited by a flexible connector such as a chain **61** that is connected at one end to the pull rod, passes around an idler sprocket **62** on the bracket **53**, and has its other end connected to a trigger element **63** that has a tubular portion **64** loosely slidably mounted in a tubular bearing **65** which is rigidly mounted at **66** on the mounting plate **53**, there being an abutment flange **67** at one end of the tube **64** to normally abut the corresponding end of the bearing **65** under the force of the spring **60** as best shown in FIGURE 8.

For manual disengagement of the socket member **51** from the pin **9**, a pull cable **68** may have one end connected to the trigger element **63** and run over a pulley **69**

on the mounting bracket 53 with a hand grip 70 at its other end. Obviously, the spring 60 will normally hold the socket member in position to engage the drive pin 9 as shown in FIGURE 8, and a pull on the cable 68 will be transmitted through the trigger element, the chain 61 and the pull rod 56 to the socket member whereby the latter is pulled downwardly away from the pin 9 as shown in FIGURE 10 so that the door may be moved independently of the drive pin; and the casing 52 is formed with notches 71 in its side walls to provide a clearance for the drive pin when the door is moved manually or otherwise than by the motor-operated mechanism.

In this form of the invention also, means is provided for automatically disengaging the socket member from the motor-driven pin 9 upon the occurrence of a fire or other temperature rise at a given location. When the socket member is disengaged from the motor-driven pin, the door is closed by a counterweight instead of by gravitational action on the door as in the form of the invention shown in FIGURE 1.

In the present case, a flexible connector such as a chain 72 passes loosely through the tubular portion 64 of the trigger element over a double pulley 73 journaled on the wall and has connected to its end a counterweight 74 of a mass or weight sufficient to pull the door into closed position upon descent of the weight. The weight is normally held suspended and against falling by a cable 75 that has one end connected at 76 to the wall, passes around the double pulley 73 and around idler pulleys 77 and has its other end connected at 78 to one end of the chain 72 at the side of the trigger element opposite the counterweight. Connected in the cable 75 are the desired number of heat-responsive elements 79 that may be placed in different locations. In normally spaced relation to the end of the trigger element 64 when the door is fully open and fast connected to the chain 72 is a force-transmitting disc 80 which is intended to engage the end of the trigger element to actuate the latter and disengage the socket member from the motor-driven pin when any one of the heat-responsive elements responds to a predetermined temperature rise, thus permitting the severance of the cable 75 and consequent descent of the counterweight 74.

With this construction, it will be observed that when the socket member 51 engages the motor-driven pin 9, the motor-operated mechanism will move the door alternately in opposite directions between open and closed positions, the trigger element moving along the chain. Upon the response of the heat-responsive element, such as the fusing of a fusible link, to a temperature rise, the weight 74 will fall by action of gravity and thus pull the chain to cause engagement of the force-transmitting disc with the end of the trigger element and thus push the trigger element to the right in FIGURES 6 and 8 so as to pull the socket member 51 out of engagement with the motor-driven pin 9. If this action should occur while the door is in open position as shown in FIGURE 6, the counterweight 74 during its descent will also move the door into closed position.

It will thus be seen that the invention provides a simple, relatively inexpensive, reliable fire door or other closure which is motor-operated into both open and closed position and which can be easily and quickly automatically disengaged from the motor, for example, in case of a temperature rise at a given zone, and also may be easily and quickly manually disconnected from the motor whenever desired, for example, when the motor-operated mechanism fails and a person becomes trapped in a room closed by the door.

It will also be observed that after the door has been automatically operated as the result of a temperature rise, the parts may be easily and quickly restored to their original or normal conditions by simple resetting or replacement of the heat-responsive elements and manual manipulation of the socket member and the door to again connect the door to the motor-driven pin, all without special tools or instruction diagrams.

While I have shown and described two now preferred embodiments of the invention, it will be understood that this is primarily for the purpose of illustrating the principles of the invention and that many modifications and changes can be made in the structural details within the spirit and scope of the invention. Obviously, if desired, the track 3 could be made horizontally level and a counterweight could be employed in known manner to close the door.

I claim:

1. The combination with a wall having a door opening therein, a mounting track to be secured on a wall above the door opening, and a door movable on said track into open and closed positions, of a motor and a connection between it and said door for opening and closing the door including two parts that are normally connected to each other to move together in both of opposite directions but are separable, a guide track along which one part is normally driven by said motor alternately in opposite directions while the other part is carried by said door to open and close the door, respectively, under control of said motor, automatic means including a heat-responsive element connected to one of said parts of said connection to separate said parts upon response of said element to a temperature rise in the vicinity of said heat-responsive element and thereby completely disconnect the door from the motor and prevent operation of the door by the motor in both directions, and means for closing the door upon separation of said parts.

2. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a releasably suspended weight and a connection between the weight and said trigger element for actuating said trigger element upon release of the weight, and a connection between said weight and said heat-responsive element normally holding the weight suspended but releasing the weight upon a temperature rise in the vicinity of the heat-responsive element.

3. The combination as defined in claim 2 with the addition of a connection between said weight and said door for actuating the door into closed position upon release of the weight by the heat-responsive element.

4. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a releasably suspended weight and a connection between the weight and said trigger element for actuating said trigger element upon release of the weight, and means including a connection between said weight and said heat-responsive element normally holding the weight suspended but releasing the weight upon a temperature rise in the vicinity of the heat-responsive element, the last-named means also including a connection between said weight and said door for actuating the door into closed position upon release of the weight by the heat-responsive element.

5. The combination defined in claim 1 wherein said track is inclined providing for movement of the door into closed position by gravitational action after the breaking of the connection between said motor-driven part and the door.

6. The combination defined in claim 2 wherein said track is inclined providing for movement of the door into closed position by gravitational action after the breaking of the connection between said motor-driven part and the door.

7. The combination as defined in claim 2 wherein said trigger element normally releasably holds said part on the door in engagement with the motor-driven part and there is means for spring-biasing the door-carried part away

from the motor-driven part upon actuation of said trigger element by descent of the weight.

8. The combination as defined in claim 2 wherein there is means normally biasing said part on the door into engagement with the motor-driven part and there is a connection between the door-carried part and said trigger element providing for actuation of said door-carried part away from said motor-driven part upon descent of said weight.

9. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a releasably suspended weight and a connection between the weight and said trigger element for actuating said trigger element upon release of the weight, and a connection between said weight and said heat-responsive element normally holding the weight suspended but releasing the weight upon a temperature rise in the vicinity of the heat-responsive element, and wherein the door-carried part is slidably mounted in a casing secured on the door for movement to and from the motor-driven part and spring biased away from the motor-driven part, and said trigger element is mounted in said casing and normally holds said door-carried part in engagement with the motor-driven part for movement away from said motor-driven part.

10. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a releasably suspended weight and a connection between the weight and said trigger element for actuating said trigger element upon release of the weight, and a connection between said weight and said heat-responsive element normally holding the weight suspended but releasing the weight upon a temperature rise in the vicinity of the heat-responsive element, and wherein the door-carried part is slidably mounted in a casing secured on the door for movement to and from the motor-driven part and spring-biased into engagement with said motor-driven part, and there is a connection between said trigger element and said door-carried part providing for actuation of said door-carried part out of engagement with the motor-driven part upon movement of the trigger element by descent of said weight.

11. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a weight, a heat-responsive element, a flexible connector having portions connected by said heat-responsive element with one end of the connector secured to said weight and its other end secured to said wall, pulleys on said wall on which said flexible connector is mounted to suspend said weight, said trigger element being movable along a portion of said flexible connector during opening and closing movements of the door, and a force-transmitting element secured on said flexible connector providing for abutment and movement of said trigger element by said force-transmitting element when the door is in open position and upon response of said heat-responsive element to a temperature rise and consequent release and descent of said weight to permit separation of said door-carried part from the motor-driven part.

12. The combination as defined in claim 11 wherein there is a force-transmitting connection between said force-transmitting element and the door after separation of the door-carried part from the motor-driven part, providing for closing of said door by said descent of the weight.

13. The combination as defined in claim 1 wherein said automatic means includes a trigger element movably mounted on said door and controlling separation of the door-carried part from the motor-driven part, a releasably suspended weight and a connection between the weight and said trigger element for actuating said trigger element upon release of the weight, and means including a connection between said weight and said heat-responsive element normally holding the weight suspended but releasing the weight upon a temperature rise in the vicinity of the heat-responsive element, and the last-named connection is secured to the door at the side of said heat-responsive element opposite the weight, and wherein said mounting track is inclined providing the means for closing of the door by gravitational action after the breaking of the connection between the motor-driven part and the door-carried part.

14. The combination with a wall having a door opening therein, a mounting track to be secured on a wall above the door opening, and a door movable on said track into open and closed positions, of a motor, a connection between said motor and said door for moving the door into open and closed positions including two parts and means for holding said parts connected to each other and movable together during both the opening and closing movements of the door but permitting separation of said parts, one of said parts being carried by the door, a guide track along which the other part is movable, a connection between the second-mentioned part and said motor for driving the second-mentioned part alternately in opposite directions to open and close the door, respectively, under control of the motor during movement of the second-mentioned part in both of said opposite directions with said two parts connected to each other, automatic means including a heat-responsive element to actuate the door-carried part out of engagement with the motor-driven second-mentioned part upon response of said heat-responsive element to a temperature rise in the vicinity of said heat-responsive element and thereby completely disconnect the door from the motor to prevent operation of the door by the motor in either direction and leave the door free for movement into closed position, and means for closing the door upon disengagement of said parts.

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