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Belding

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(54) **FIRE EXIT SYSTEM**

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(51) **Int. Cl.**

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E05F 15/77	(2015.01)
E05F 15/79	(2015.01)
E06C 1/56	(2006.01)
A62B 1/06	(2006.01)
E06C 9/14	(2006.01)

(52) **U.S. Cl.**

CPC ***E05F 15/72*** (2015.01); ***E05F 15/77*** (2015.01); ***E05F 15/79*** (2015.01); *A62B 1/06* (2013.01); *E06C 1/56* (2013.01); *E06C 9/14* (2013.01)

(58) **Field of Classification Search**

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USPC 49/360

See application file for complete search history.

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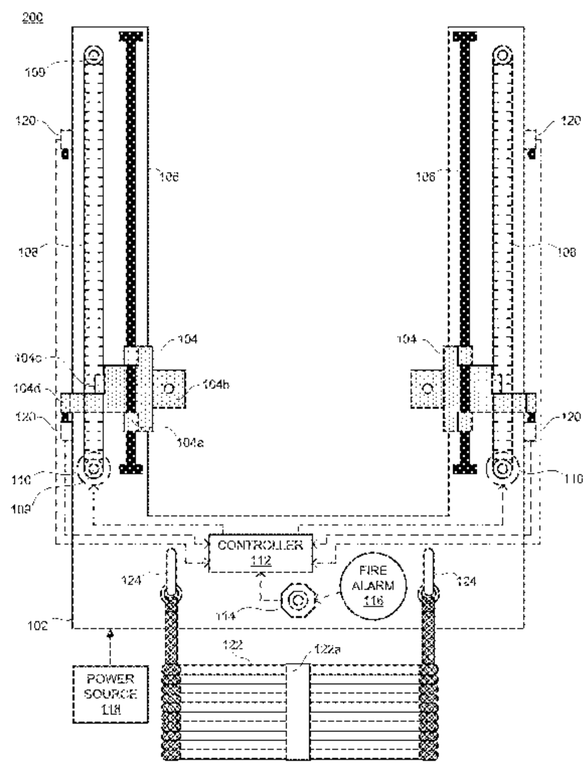
(57) **ABSTRACT**

A fire exit system is disclosed. In one particular embodiment, the fire exit system may include a motor mechanically coupled to a window such that the motor, when turned on, causes the window to open, a controller coupled to the motor, and a switch coupled to the controller. When the switch is activated, the controller is configured to turn on the motor to open the window.

18 Claims, 7 Drawing Sheets



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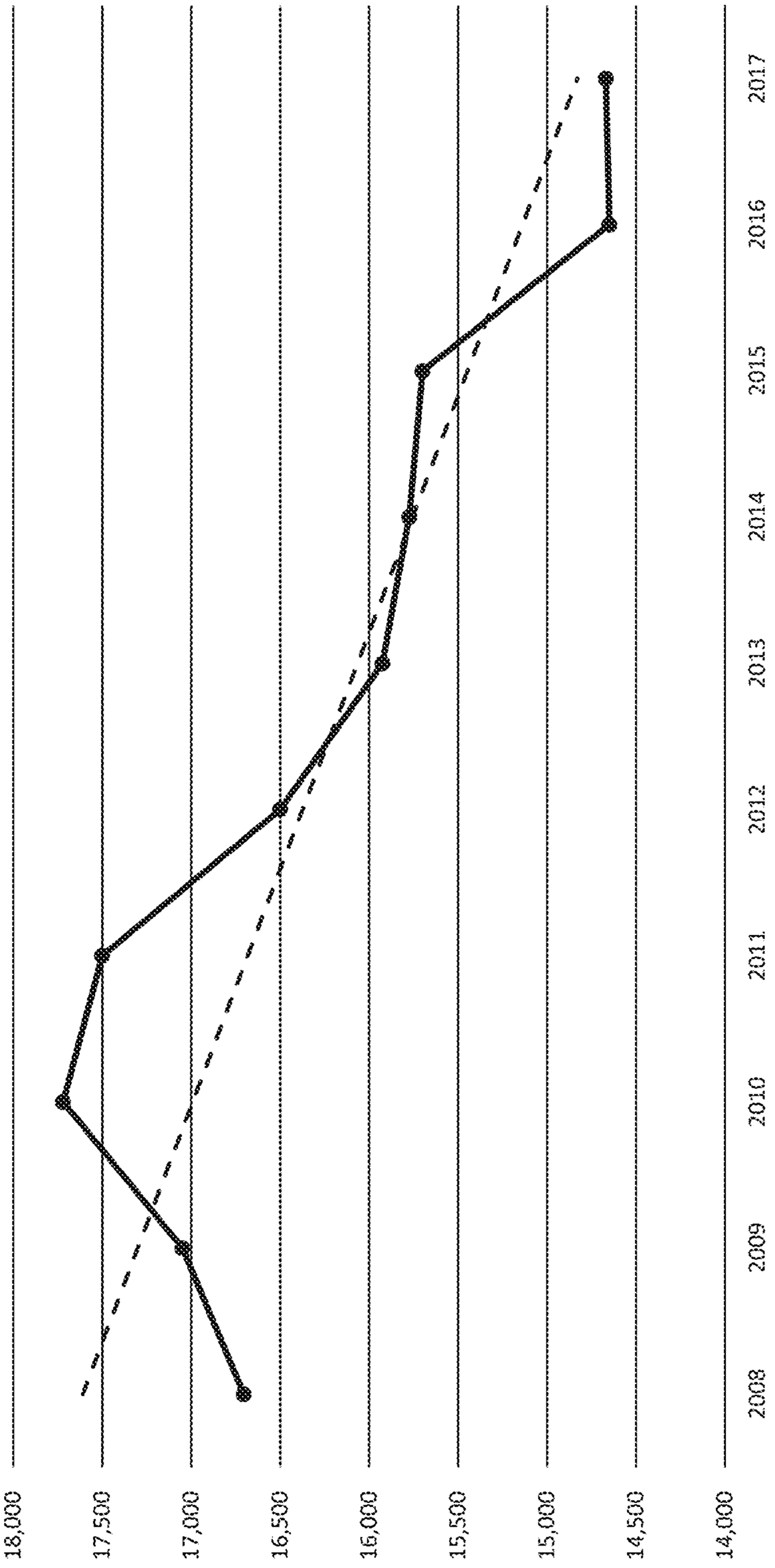
Fire Injuries 2008-2017
18,000
17,500
17,000
16,500
16,000
15,500
15,000
14,500
14,000
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
No. of Injuries
Linear (No. of Injuries)

FIG. 1

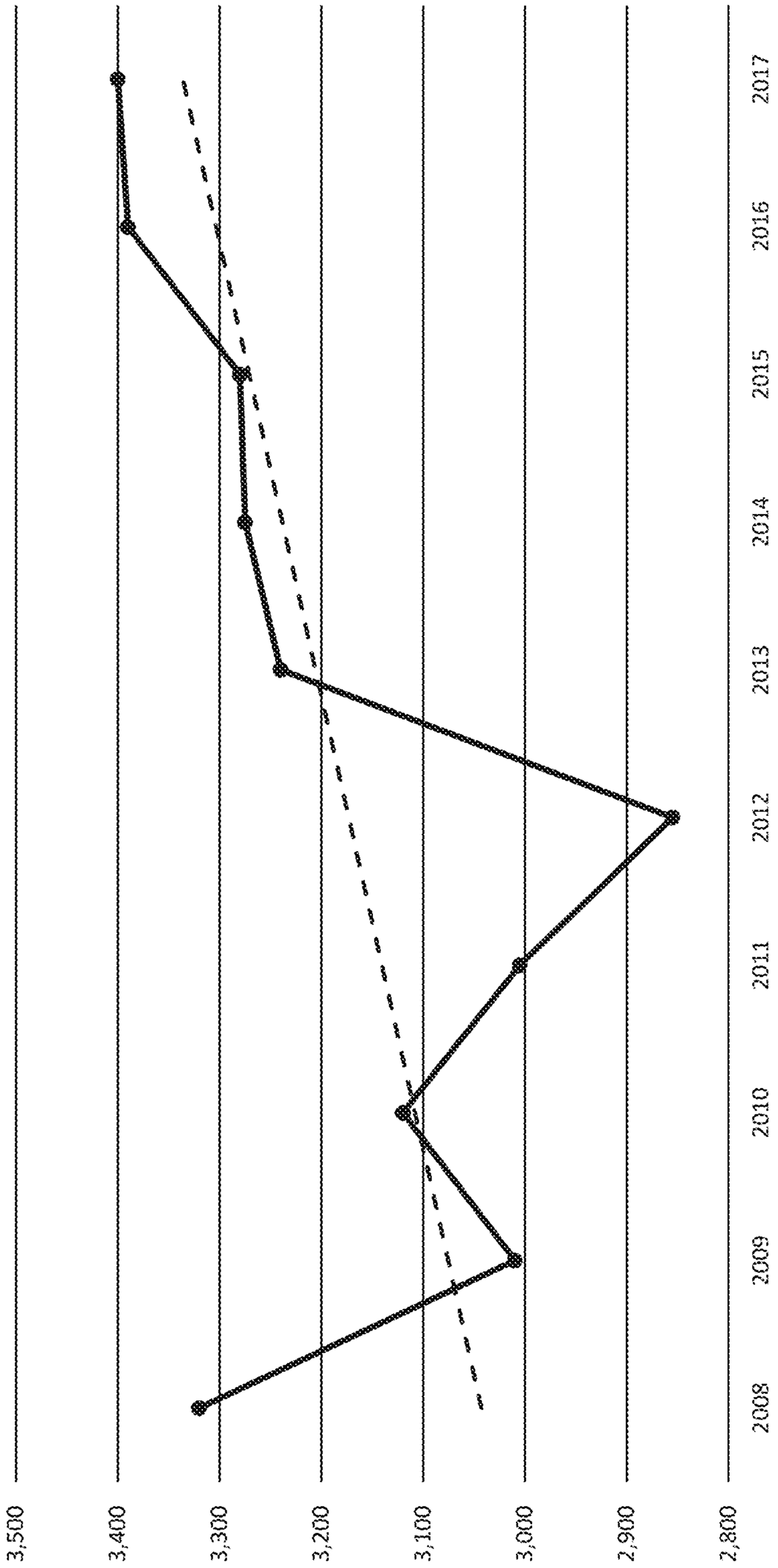
Fire Deaths 2008-2017
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
No. of Deaths
Linear (No. of Deaths)

FIG. 2

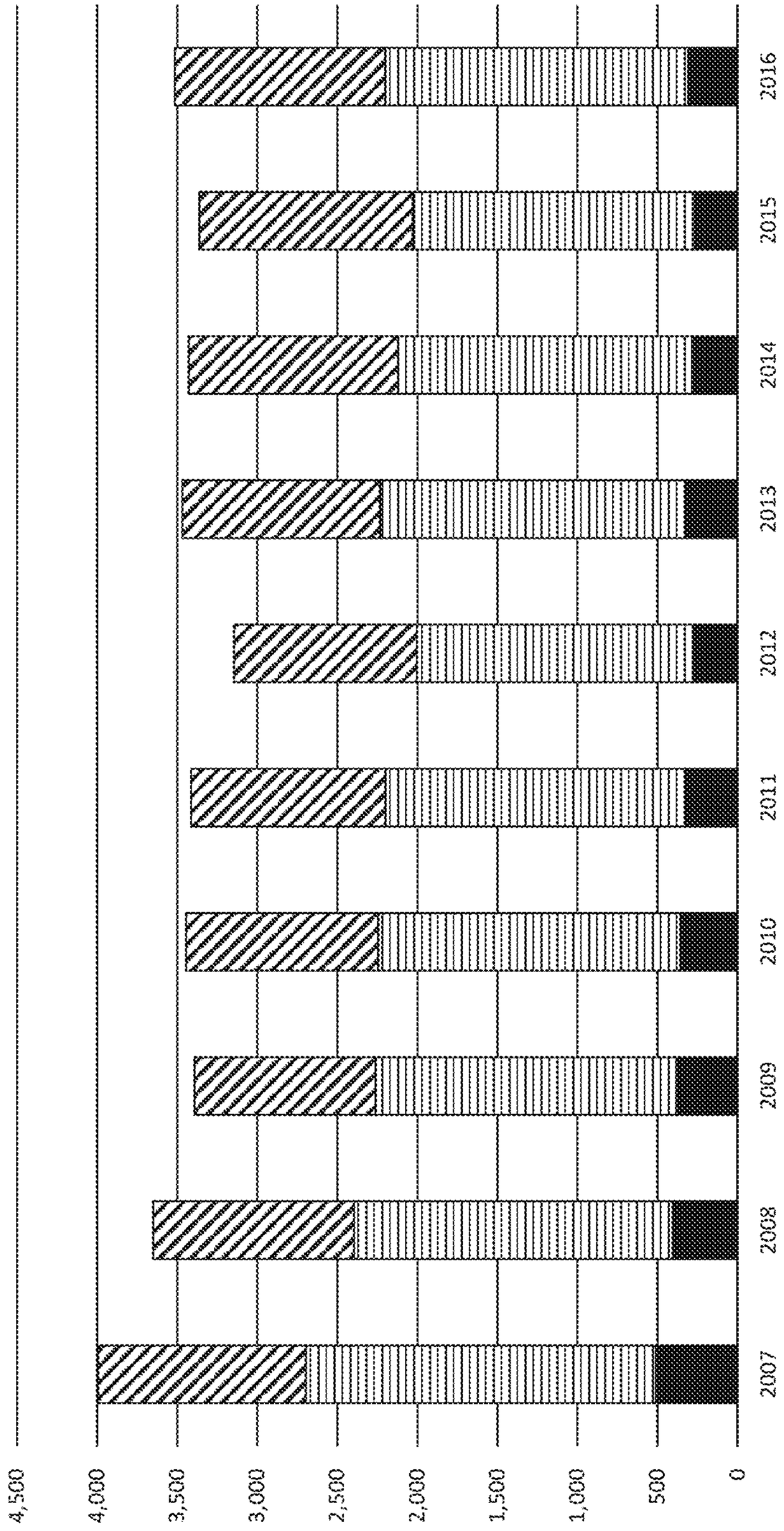
Residential Fire Fatalities by Age and Year
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Ages 0-14
Ages 15-64
Ages 65+

FIG. 3

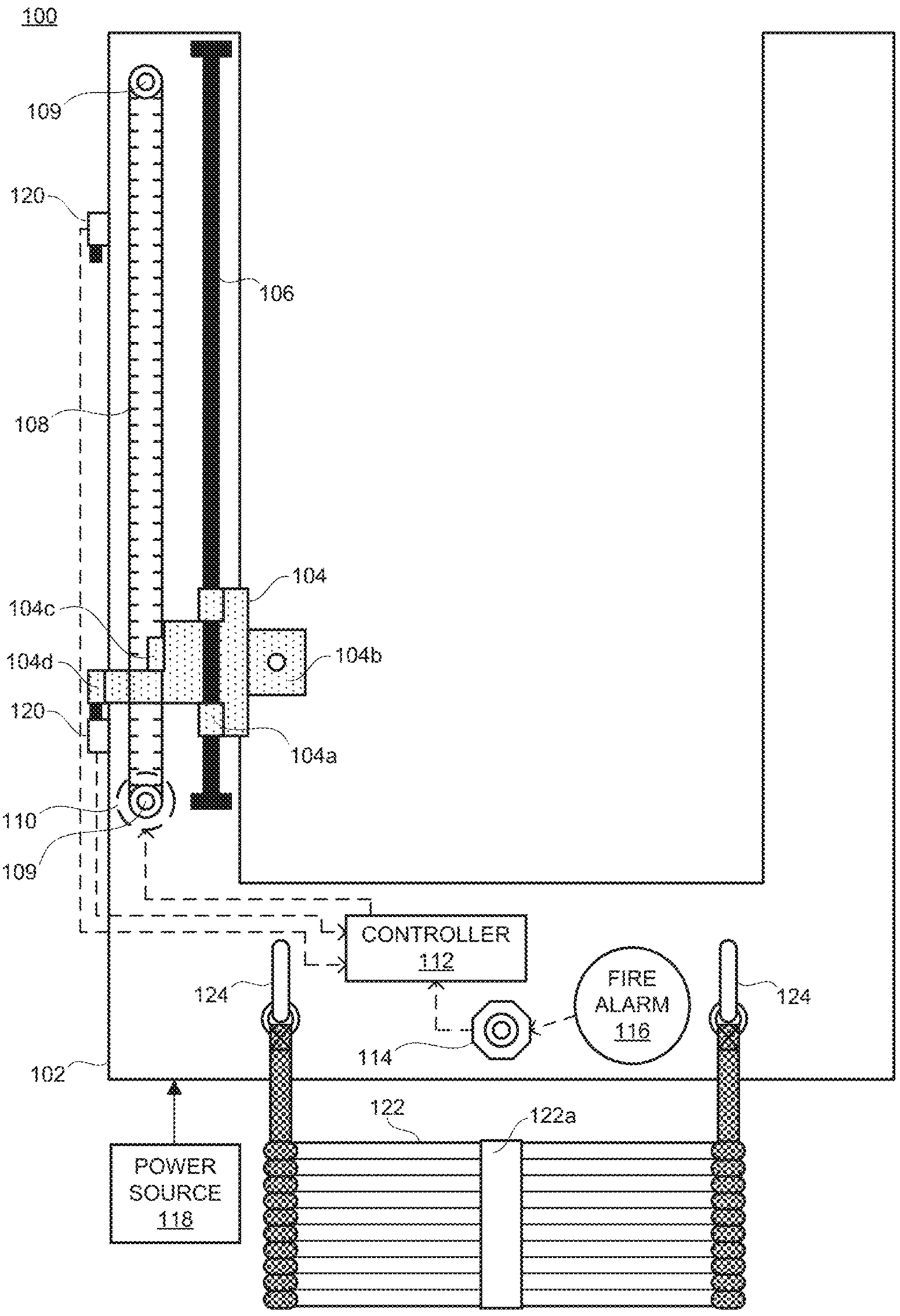
100
109
120
106
108
104
104c
104d
104b
120
104a
110
109
CONTROLLER
112
124
FIRE
ALARM
116
124
114
102
122
122a
POWER
SOURCE
118

FIG. 4

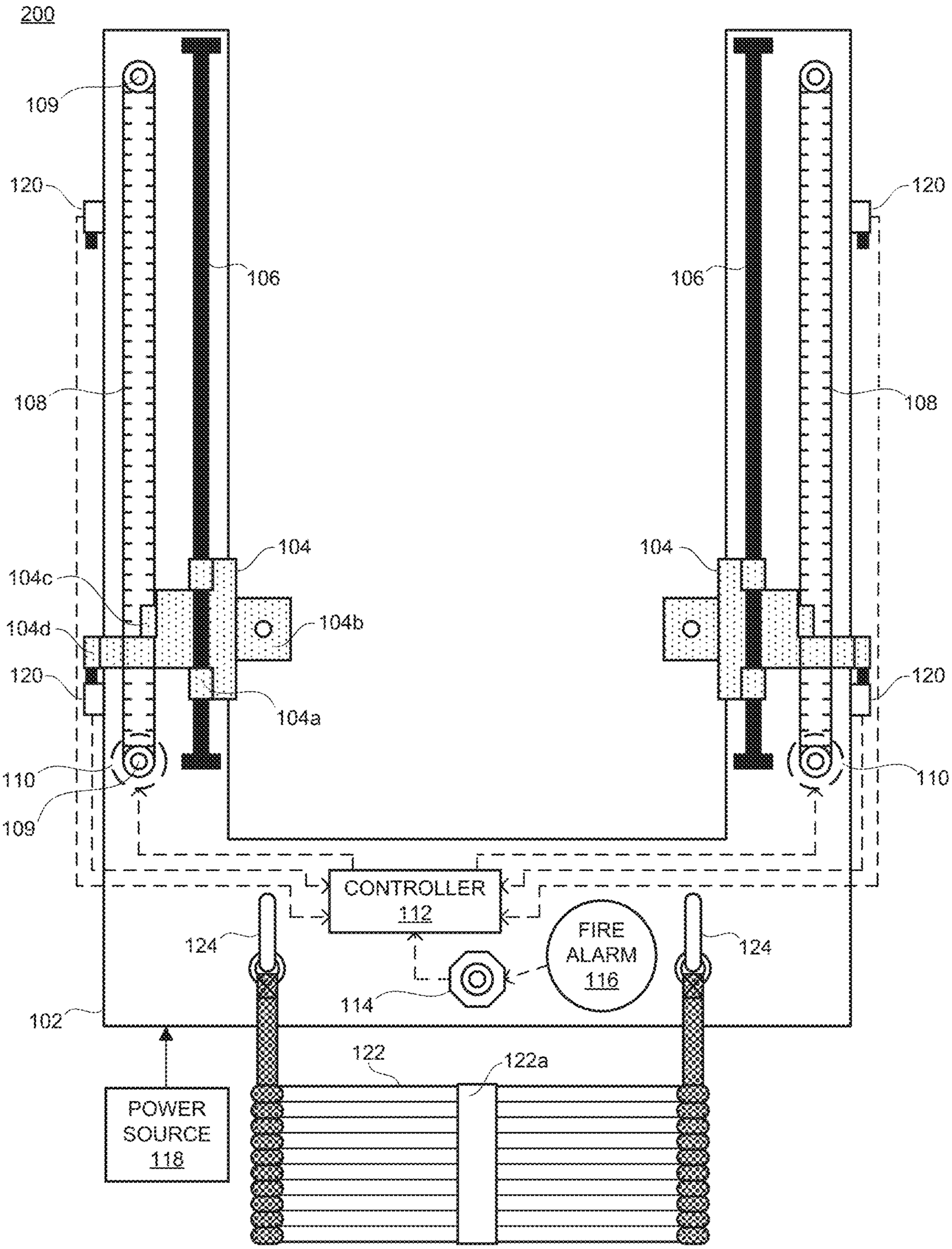
200
109
120
106
108
104
104c
104d
104b
120
104a
110
109
CONTROLLER
112
124
FIRE
ALARM
116
114
102
122
122a
POWER
SOURCE
118

FIG. 5

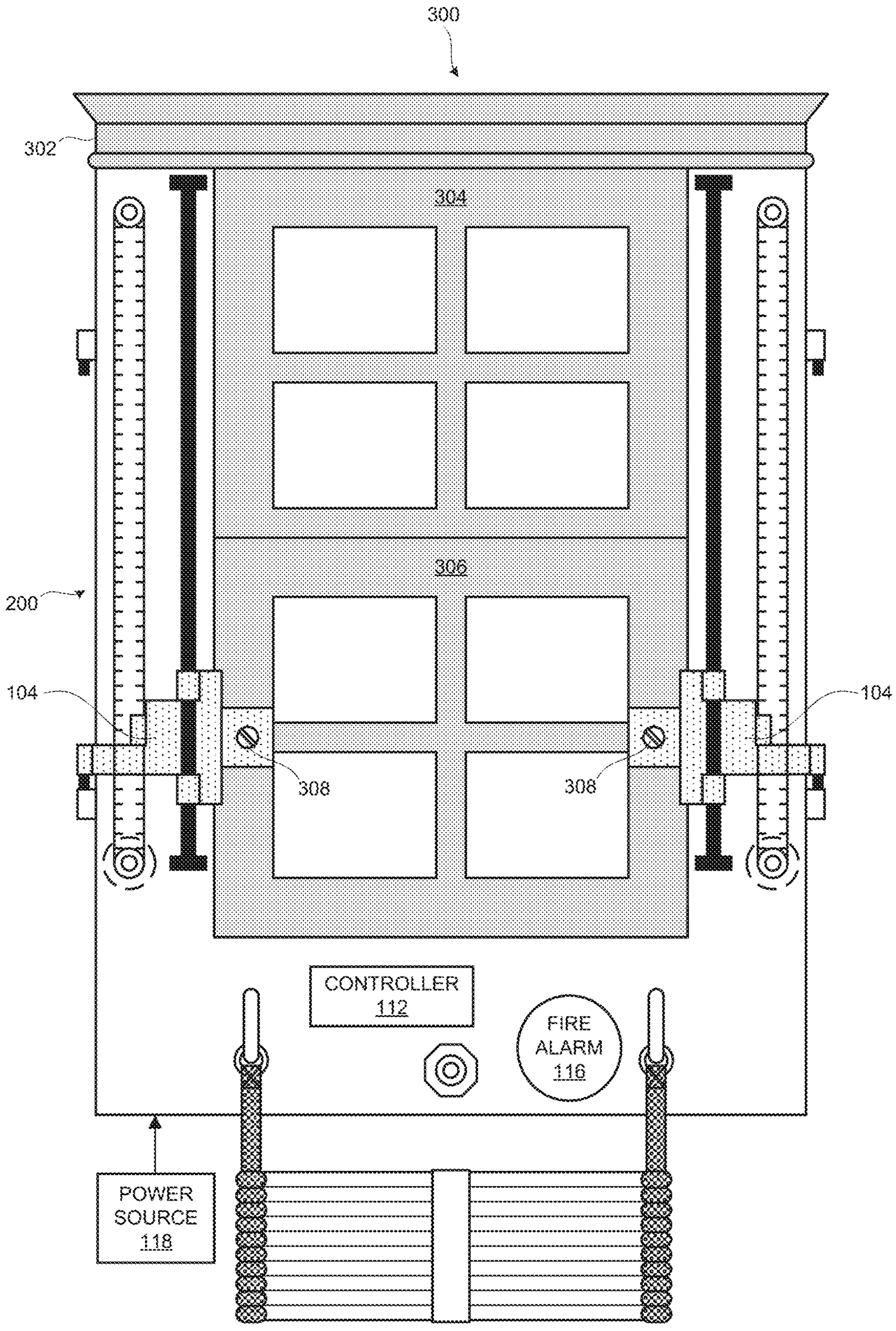
300
302
304
306
200
104
104
308
308
CONTROLLER
112
FIRE
ALARM
116
POWER
SOURCE
118

FIG. 6

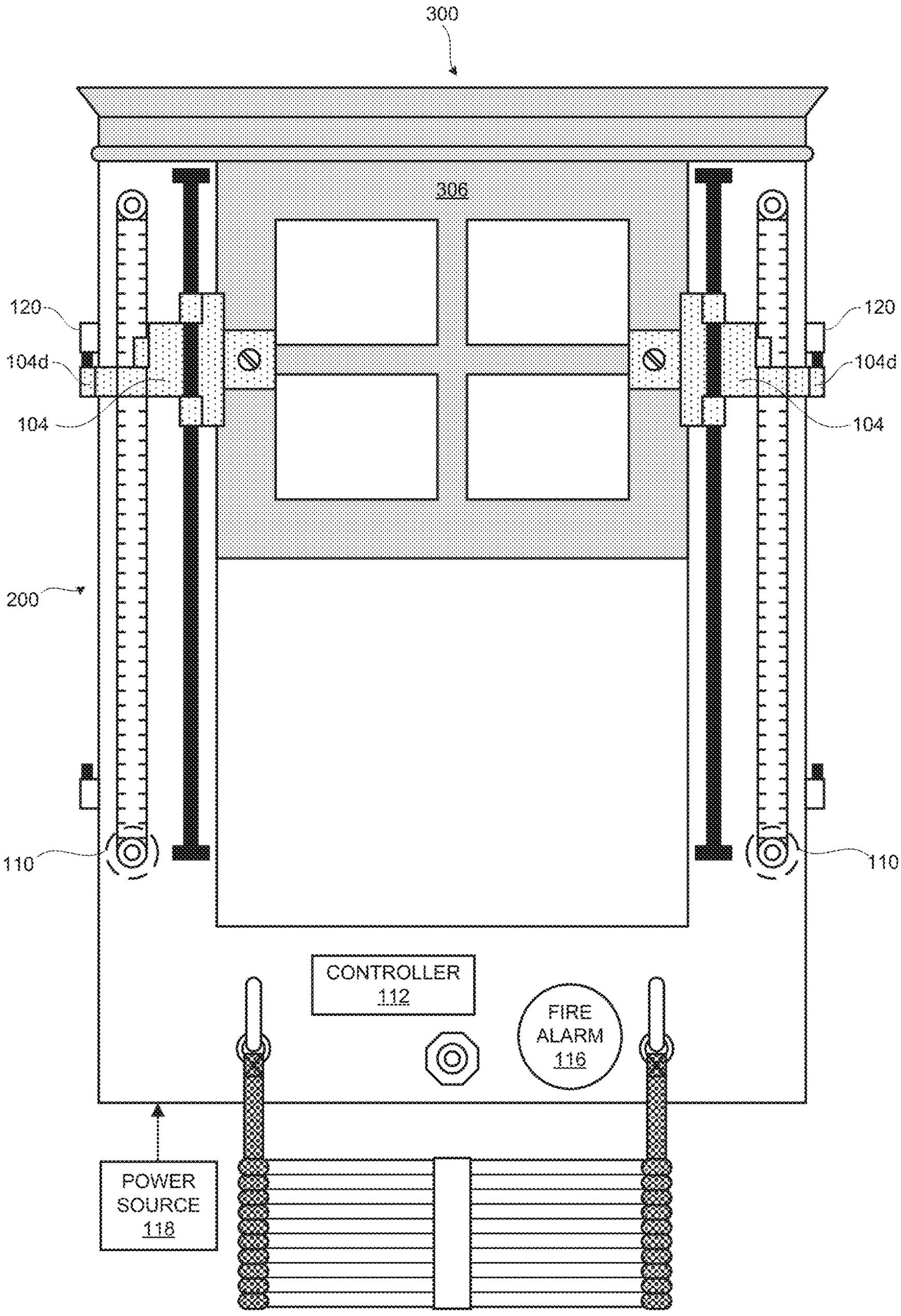
300
306
120
104d
104
200
110
120
104d
104
110
CONTROLLER
112
FIRE
ALARM
116
POWER
SOURCE
118

FIG. 7

FIRE EXIT SYSTEM

FIELD OF THE DISCLOSURE

The present disclosure relates generally to safety exit systems and, more particularly, to a fire exit system that may allow people of all ages to safely exit within a few minutes a house that is engulfed in flames.

BACKGROUND OF THE DISCLOSURE

Every year, there are more than 3,000 deaths and 14,000 injuries related to house fires in the United States. These injuries and fatalities result from around 1.4 million house fires in a year. FIG. **1** illustrates a decreasing trend in fire-related injuries over the years, potentially due to a combination of factors including better safety features. However, this decreasing trend may also be because of the increasing trend in fire-related deaths as illustrated in FIG. **2**. FIG. **3** illustrates yearly fire-related fatalities by age. Based on FIG. **3**, it may be deduced that people who are 65 years of age or older have the highest likelihood of dying in a house fire, which is likely due to their physical limitations. Fourteen-year-old and younger children are also vulnerable and typically rely on other people—because they are not strong and/or tall enough to open windows—to help them escape fires. Regardless of age, FIG. **3** suggests that fires represent a threat to people of all ages.

House fires are daunting. A small flame can turn into a major fire in less than 30 seconds. It only takes minutes for a thick black smoke to fill a house or for the house to be engulfed in flames. In just two minutes, a fire can become life-threatening. In five minutes, a residence may be engulfed in flames and exits may be blocked. Heat from the flames is more threatening than the flames themselves. Room temperatures in a fire can be 100 degrees Fahrenheit at floor level and rise to 600 degrees Fahrenheit at eye level. Inhaling this hot air may scorch the human lungs, and the heat may melt clothes to the skin. Smoke and toxic gases kill more people than flames do. Fire produces poisonous gases that make people disoriented and drowsy. Asphyxiation is the leading cause of fire deaths, exceeding burns by a three-to-one ratio. Moreover, fires start bright, but quickly produce black smoke and complete darkness.

A test by the Underwriter Laboratories—a not-for-profit product safety testing and certification organization—has shown that an average-sized room furnished with modern products takes three minutes to be fully engulfed in flames. The same room furnished with 50-year old items would take 30 minutes to be fully engulfed in flames. Thus, unlike decades ago, people today have only a few minutes to get out of a house in case of a fire emergency. Speed and ease of escaping a fire are of essence, no matter a person's age.

In view of the foregoing, it may be understood that there is need for a fire exit system that allow people of all ages to safely exit within a few minutes a house that is engulfed in flames.

SUMMARY OF THE DISCLOSURE

A fire exit system is disclosed. In one particular embodiment, the fire exit system may include a motor mechanically coupled to a window such that the motor, when turned on, causes the window to open, a controller coupled to the motor, and a switch coupled to the controller. When the switch is activated, the controller is configured to turn on the motor to open the window.

In accordance with other aspects of this particular embodiment, the fire exit system may further include a guide bar, a carriage slidably mounted on the guide bar and attached to a window sash of the window, and a timing belt installed around at least two gears. One of the at least two gears may be mechanically coupled to the motor, and the carriage may be attached to the timing belt.

In accordance with other aspects of this particular embodiment, the carriage may be attached to the window sash using a screw.

In accordance with other aspects of this particular embodiment, the carriage may be attached to the window sash using a removable pin.

In accordance with other aspects of this particular embodiment, the fire exit system may further include a limiting switch coupled to the controller. When the window sash is fully opened, the carriage may activate the limiting switch, and when the limiting switch is activated, the controller is configured to turn off the motor to stop moving the window sash.

In accordance with other aspects of this particular embodiment, the fire exit system may further include a mounting frame. The controller, the switch, the motor, the guide bar, the timing belt, and the limiting switch may be mounted on the mounting frame.

In accordance with other aspects of this particular embodiment, the fire exit system may further include an escape ladder. The escape ladder may be mounted on the mounting frame.

In accordance with other aspects of this particular embodiment, the fire exit system may further include a fire alarm coupled to the switch. The switch may not be activated unless it is enabled. When the fire alarm detects a fire, the fire alarm is configured to enable the switch.

In accordance with other aspects of this particular embodiment, the switch may include a light. The light may flash or strobe when the fire alarm enables the switch.

In accordance with other aspects of this particular embodiment, the fire exit system may further include a power source. The power source may power one or more of the following: the controller, the switch, the fire alarm, and the motor.

In accordance with other aspects of this particular embodiment, the power source may be a battery.

In accordance with other aspects of this particular embodiment, the switch may be wirelessly coupled to the controller.

In accordance with other aspects of this particular embodiment, the fire alarm may be wirelessly coupled to the controller.

In accordance with other aspects of this particular embodiment, the motor may be wirelessly coupled to the controller.

In accordance with other aspects of this particular embodiment, the controller may be programmed to stop the motor after a predetermined amount of time or a predetermined number of revolutions after the motor has been started.

The present disclosure will now be described in more detail with reference to particular embodiments thereof as shown in the accompanying drawings. While the present disclosure is described below with reference to particular embodiments, it should be understood that the present disclosure is not limited thereto. Those of ordinary skill in the art having access to the teachings herein will recognize additional implementations, modifications, and embodiments, as well as other fields of use, which are within the

scope of the present disclosure as described herein, and with respect to which the present disclosure may be of significant utility.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a fuller understanding of the present disclosure, reference is now made to the accompanying drawings, in which like elements are referenced with like numerals. These drawings should not be construed as limiting the present disclosure, but are intended to be illustrative only.

FIG. **1** shows yearly numbers and trend of fire-related injuries from 2008 to 2017 in the United States.

FIG. **2** shows yearly numbers and trend of fire-related deaths from 2008 to 2017 in the United States.

FIG. **3** shows yearly fire-related fatalities by age from 2007 to 2016 in the United States.

FIG. **4** shows a fire exit system in accordance with an embodiment of the present disclosure.

FIG. **5** shows a fire exit system in accordance with an embodiment of the present disclosure.

FIG. **6** shows the fire exit system of FIG. **5** mounted on a window assembly, with a window sash closed, in accordance with an embodiment of the present disclosure.

FIG. **7** shows the fire exit system of FIG. **5** mounted on a window assembly, with a window sash opened, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

Referring to FIG. **4**, there is shown a fire exit system **100** in accordance with an embodiment of the present disclosure. The fire exit system **100** may include a mounting frame **102** that is configured to be mounted (e.g., using bolts) on a window frame of a window assembly. The mounting frame **102** is illustrated as a U-shape member, which may fit onto a window frame without obstructing window sashes. The mounting frame **102** may be designed in other different shapes and sizes to fit different window assemblies. In some embodiments (e.g., in new building constructions), the mounting frame **102** may be integrated into the window frame or may be the window frame itself.

The fire exit system **100** may include at least one carriage **104**, at least one guide bar **106**, at least one timing belt **108**, and at least one motor **110**. The carriage **104** is configured to be attached, at an extended portion **104***b*, to a sliding window sash of the window assembly to which the mounting frame **102** is mounted. The carriage **104** may be slidably installed onto the guide bar **106**, which may be securely mounted at its two ends on the mounting frame **102**. For example, before being mounted on the mounting frame **102**, the guide bar **106** may be fed through hollow portions (e.g., **104***a*) of the carriage **104**. Alternatively, portions (e.g., **104***a*) of the carriage **104** may be bent around the guide bar **106** after the guide bar **106** is mounted on the mounting frame **102**.

The carriage **104** may be securely attached or hooked (e.g., at **104***c*) to the timing belt **108**, which may be installed around at least two gears **109** mounted on the mounting frame **102**, as shown in FIG. **4**. One of the two gears **109** may be mechanically coupled through the mounting frame **102** to the motor **110**, which may be mounted on the back of the mounting frame **102**. When the motor **110** runs, it spins the gear **109** to which it is coupled, causing the timing belt **108** to revolve. As the timing belt **108** revolves around the gears **109**, it moves the carriage **104** linearly onto the guide bar **106**, thereby sliding the window sash to which the carriage **104** is attached.

The fire exit system **100** may further include a controller **112**, a switch **114**, and a fire alarm **116**. The controller **112** may control the motor **110** based on activation of the switch **114**. The controller **112** may be electrically (e.g., via wires) or wirelessly (e.g., via Wi-Fi, Bluetooth, etc.) coupled to the motor **110** and the switch **114**. The controller **112** may be a microprocessor or microcontroller. When the switch **114** is activated, it may transmit a signal to the controller **112**, which in turn may activate the motor **110**. To prevent accidental or unintended activation of the switch **114** and to allow the switch to be activated only in case of a fire emergency, the switch **114** may be electrically or wirelessly coupled to the fire alarm **116**. As such, the switch **114** may remain disabled or inactive when there is no fire. When the fire alarm **116** detects a fire, the fire alarm **116** may transmit a signal to enable the switch **114**. Once enabled, the switch **114** may be activated (e.g., by being depressed or toggled by a person who is trying to escape the fire).

The switch **114** may be in the form of a toggle switch or a push button. Moreover, the switch **114** may include a flashing or strobing light (e.g., a light emitting diode (LED)) that is turned on when the switch **114** is enabled by the signal from the fire alarm **116**. The flashing or strobing light may help attract the attention of distressed and disoriented persons in a fire emergency and clearly identify the location of the switch **114** that is to be activated to open the exit window. The switch **114** may be preferably mounted below the window assembly at a height easily accessible by a child or toddler.

The fire exit system **100** may include a power source **118** to power the motor **110**, the controller **112**, the switch **114**, and/or the fire alarm **116**. The power source **118** may be power supplied from a conventional wall outlet or a battery pack or both. In some embodiments, power may be supplied by hard wiring the fire exit system **100** to the electrical system of a building. It may be desirable for the fire exit system **100** to include battery power in the event that a fire shuts down the main alternative-current (AC) power supply to the building. In some embodiments, the power source **118** may be distributed among the motor **110**, the controller **112**, the switch **114**, and the fire alarm **116**. For example, any one of the motor **110**, the controller **112**, the switch **114**, and the fire alarm **116** may include a separate relative smaller battery source.

The fire exit system **100** may also include at least two limiting switches **120**. The limiting switches **120** may be mounted at two ends of the mounting frame **102**, as shown in FIG. **4**, and may be electrically or wirelessly coupled to the controller **112**. The limiting switches **120** may be activated when depressed by an extended portion **104***d* of the carriage **104**. When either of the limiting switches **120** is activated, the activated limiting switch **120** may transmit a signal to the controller **112**, which in turn may transmit a signal to shut off the motor **110**. As the motor **110** runs to slide the carriage **104** on the guide bar **106** (to either open or close a window sash), when the extended portion **104***d* reaches, depresses, and activates one of the limiting switches **120**, the activated limiting switch **120** transmits a signal to controller **112**, which transmits a signal to shut off the motor **110**. As such, the limiting switches **120** ensure that the fire exit system **100** operates a window sash within its slidable range in a window assembly. In some embodiments, the locations of the limiting switches **120** may be adjustable based on the sizes of the window assembly and the window

sash. In some embodiments, the limiting switches **120** may be omitted when the controller **112** may be, for example, programmed to stop the motor **110** after a predetermined amount of time or a predetermined number of revolutions after the motor has been started.

The fire exit system **100** may further include a fire escape ladder **122**. The fire escape ladder **122** may be attached to the mounting frame **102**, for example, at a pair of anchors **124**, which are mounted on or part of the mounting frame **102**. The fire escape ladder **122** may be a portable fire escape ladder, such as a rolled-up ladder or a ladder with nested rungs, that may be attached to the anchors **124**. The fire escape ladder **122** may be kept rolled up or collapsed with its rungs nested via a strap **122***a*. In a fire emergency, once the fire alarm **116** detects a fire, the switch **114** activated, and the window sash opened, the fire escape ladder **122** may be swung through the opened window sash and unrolled or its rungs otherwise deployed by loosening the strap **122***a*, allowing people to go through the window and down the fire escape ladder **122**.

The mounting frame **102** is preferably made of a material that is strong enough to withstand the weight of the fire escape ladder **122** along with the maximum foreseeable weight of an adult. For example, the mounting frame **102** may be made from a thick metal sheet. Alternatively, as mentioned above, in new building constructions, the mounting frame **102** may be integrated into the window frame or may be the window frame itself, in which case the building structure surrounding the window frame may provide the necessary support for all the expected weight.

In the above embodiments, the motor **110** may be chosen such that its power rating is high enough to slide open a window sash of a window assembly to which the fire exit system **100** is mounted. The power rating of the motor **110** depends on the weight of the window sash and the desired time for the window sash to fully open. The timing belt **108** may be chosen such that it can withstand the force exerted onto it by the window sash. When the window sash is bulky and heavy, a metal link chain (similar to a bicycle chain) may be used instead of the timing belt **108**. On the other hand, if the window sash is light, a plastic or metal bead chain (similar to one in a household roller shade) may be used.

In some embodiments, the motor **110** may be directly coupled to the window sash. For example, the rotor of the motor may include a circular gear and the edge of the window sash may include a linear gear. The teeth of the circular gear may engage with the teeth of the linear gear. In such an embodiment, the fire exit system **100** may not include the carriage **104**, the guide bar **106**, and timing belt **108**.

In some embodiments, the fire alarm **116** may not be mounted on the mounting frame **102**. For example, the fire alarm **116** may be any existing fire alarm on the ceiling of a room in a house. Similarly, the fire escape ladder **122** may be mounted on the wall surrounding the window rather than on the mounting frame **102**.

FIG. **5** shows a fire exit system **200** in accordance with an embodiment of the present disclosure. The fire exit system **200** includes elements with like numerals as those in the fire exit system **100**. The fire exit system **200** differs from the fire exit system **100** in that it includes a second set of carriage **104**, guide bar **106**, timing belt **108**, motor **110**, and pair of limiting switches **120**. For the same window assembly and window sash, the fire exit system **200** may be preferable to the fire exit system **100** because the motors **110** and the time belts **108** may be two times smaller. This is because the motors **110** may each provide half of the total power needed to slide the window sash, and the timing belts **108** may each withstand half the force exerted by the window sash. The fire exit system **200** may provide better control to smoothly open the window sash.

FIG. **6** shows the fire exit system **200** mounted on a window assembly **300**, in accordance with an embodiment of the present disclosure. The window assembly **300** may include a window frame **302**, a fixed window sash **304**, and slidable window sash **306**. FIG. **6** illustrates the slidable window sash **306** in its closed position. The fire exit system **200** is mounted on the window frame **302**. The carriages **104** of the fire exit system **200** may be attached to the slidable window sash **306** with a pair of screws **308**. Alternatively, attachments that are less permanent than the screws **308** (e.g., cotterless hitch pins) may be used such that they may be easily removed when and if the window sash **306** needs to be opened in non-emergency situations.

FIG. **7** illustrates the fire exit system of **200** mounted on the window assembly **300**, with a window sash **306** in its opened position, in accordance with an embodiment of the present disclosure. As can be seen in FIG. **7**, when the window sash **306** is fully opened, the end portions **104***d* of the carriages **104** are in contact with the upper limiting switches **120**. This indicates that these limiting switches **120** have transmitted a signal to the controller **112**, which in turn has transmitted control signals to shut down the motors **110**.

The present disclosure is not to be limited in scope by the specific embodiments described herein. Indeed, other various embodiments of and modifications to the present disclosure, in addition to those described herein, will be apparent to those of ordinary skill in the art from the foregoing description and accompanying drawings. Thus, such other embodiments and modifications are intended to fall within the scope of the present disclosure. Further, although the present disclosure has been described herein in the context of at least one particular implementation in at least one particular environment for at least one particular purpose, those of ordinary skill in the art will recognize that its usefulness is not limited thereto and that the present disclosure may be beneficially implemented in any number of environments for any number of purposes. Accordingly, the claims set forth below should be construed in view of the full breadth and spirit of the present disclosure as described herein.

The invention claimed is:

1. A fire exit system comprising:
a guide bar;
a carriage slidably mounted on the guide bar and attached to a sash of a window;
a motor mechanically coupled to the carriage;
a controller coupled to the motor;
a switch coupled to the controller,
a limiting switch coupled to the controller; and
a fire alarm coupled to the switch, wherein
the switch is inoperative unless the switch is enabled by the fire alarm;
when the fire alarm detects a fire, the fire alarm enables the switch such that the switch is operative;
when the switch is operative and activated, the controller turns on the motor to open the sash; and
when the carriage activates the limiting switch, the controller turns off the motor to stop moving the sash.

2. The fire exit system of claim **1**, further comprising:
a timing belt installed around at least two gears, wherein

one of the at least two gears is mechanically coupled to the motor, and

the carriage is attached to the timing belt.

3. The fire exit system of claim **2**, further comprising:

a mounting frame, wherein

the controller, the switch, the motor, the guide bar, and the at least two gears are mounted on the mounting frame.

4. The fire exit system of claim **3**, further comprising:

an escape ladder attached to the mounting frame.

5. The fire exit system of claim **1**, wherein the carriage is attached to the sash using a screw.

6. The fire exit system of claim **1**, wherein the carriage is attached to the sash using a removable pin.

7. The fire exit system of claim **1**, wherein the carriage activates the limiting switch when the sash is fully opened.

8. The fire exit system of claim **1**, wherein the limiting switch is wirelessly coupled to the controller.

9. The fire exit system of claim **1**, further comprising:

a mounting frame, wherein

the controller, the switch, the motor, the guide bar, and the limiting switch are mounted on the mounting frame.

10. The fire exit system of claim **9**, further comprising:

an escape ladder attached to the mounting frame.

11. The fire exit system of claim **1**, further comprising:

a mounting frame, wherein the controller, the switch, and the motor are mounted on the mounting frame; and

an escape ladder mounted on the mounting frame.

12. The fire exit system of claim **1**, further comprising:

a power source for powering one or more of the following: the controller, the switch, the fire alarm, and the motor.

13. The fire exit system of claim **12**, wherein the power source is a battery.

14. The fire exit system of claim **1**, wherein the switch includes a light, wherein the light flashes or strobes when the fire alarm enables the switch.

15. The fire exit system of claim **1**, wherein the fire alarm is wirelessly coupled to the switch.

16. The fire exit system of claim **1**, wherein the switch is wirelessly coupled to the controller.

17. The fire exit system of claim **1**, wherein the motor is wirelessly coupled to the controller.

18. The fire exit system of claim **1**, wherein, after the motor is turned on, the controller stops the motor after a predetermined amount of time or a predetermined number of revolutions.

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