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BARRIER OPENING SYSTEM FOR EMERGENCY ESCAPE AND RESCUE

Abstract

A barrier opening system for emergency escape and rescue comprises a vertical acting barrier device, an escape device, and a rescue device, the vertical acting barrier device winds a barrier via a winding shaft; a prestressed spring preloaded on the winding shaft for storing a restoring force when the barrier is unwound by the winding shaft; a brake mechanism for stopping the winding shaft from rotating; a brake release mechanism for releasing the winding shaft under an abnormal condition; an escape device comprising an identification unit and a master key for activating the brake release mechanism; the identification unit identifies a rescue personnel's identity before allowing the personnel to use the master key to activate the brake release mechanism; when the emergency button and/or the master key activate(s) the brake release mechanism to release the winding shaft, the barrier can be lifted up by the restoring force.

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Claims

5. The barrier opening system for emergency escape and rescue as claimed in claim 1, further comprising an access control management device electrically connected with the main controller, the access control management device comprises an emergency detection unit having temperature sensors for detecting the temperatures of the environment, smoke sensors for detecting smoke concentrations of the environment, and seismic sensors for detecting seismic waves; and a monitoring unit having a surveillance camera for capturing images of the environment; the database unit is adapted to store temperature security data, smoke concentration security data, and background image data, wherein the data processing unit compares the temperatures of the environment detected by the temperature sensors, the smoke concentrations of the environment detected by the

smoke sensors, the seismic waves of the environment captured by the seismic sensors, and the images of the environment captured by the surveillance camera with the temperature security data, the smoke concentration security data, the seismic wave security data and the background image data stored in the database unit, and after the main controller identifies the type of disaster, the disaster site, and the affected areas based on the comparison result of the data processing unit, the main controller controls the brake release mechanism to release the brake mechanism.

6. The barrier opening system for emergency escape and rescue as claimed in claim 1, wherein the vertical acting barrier device further comprises a barrier bolt device having a linear actuator and a bolt pin, the linear actuator actuates the bolt pin to lock the barrier in a barrier closed position; the linear actuator is operable by at least one of the emergency button or the master key to release the bolt pin.

7. The barrier opening system for emergency escape and rescue as claimed in claim 6, wherein the linear actuator is a solenoid adapted to hold the bolt pin in a lock state when electrically excited and to release the bolt pin when not electrically excited.

8. The barrier opening system for emergency escape and rescue as claimed in claim 1, wherein the key security mechanism comprises a key box for storing the master key and a switch corresponding to the master key, the switch is adapted to activate the linear actuator by means of the master key to release the bolt pin.

9. The barrier opening system for emergency escape and rescue as claimed in claim 1, wherein the identification unit comprises at least one of a card reading device, a keyboard, and an image capture device.

10. The barrier opening system for emergency escape and rescue as claimed in claim 9, wherein the identification data comprise at least one of an authorization code, a user ID and password, or a user image.

11. The barrier opening system for emergency escape and rescue as claimed in claim 1, wherein the access control management device further comprises an alarm and notification unit adapted to release a real-time alarm in sound and light form, and to show an escape route by audio or light.

Description

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

[0002] The present invention relates to a barrier opening system for emergency escape and rescue, through which a barrier can be opened immediately by a prestress/restoring force in the shortest possible time without having to break through the barrier in case of emergency.

[0003] Description of the Related Art

[0004] For access control barriers such as fire-proof barriers, smoke-proof barriers, and emergency exits, a vertical acting barrier is widely used. Current Building/Fire Law has strict regulations for the exits and entrances of a public space where many people gather, especially for stores and multi-family residence that have no escape barrier but only one exit and entrance, and for the safety standards of compartment barriers and/or emergency exits. In case of emergency or imminent danger, a vertical acting barrier must be opened as quickly as possible, even without electricity and external assistances, to prevent the barrier from seizing shut, trapping people, vehicles, or property inside.

[0005] With regard to a conventional vertical acting barrier, a brake mechanism maintains in a brake state when an electric motor does not rotate in normal time, and a barrier bolt device is used to lock the vertical acting

[0006] The above-mentioned vertical acting barrier cannot be opened by intuitive response. In case of emergency, to open the vertical acting barrier, one has to learn the way to operate beforehand, and must be strong enough to operate. Such manual mode operation would be difficult to the elderly, disabled, pregnant women, and children, and would cause a delay in evacuation. Furthermore, from the rescue aspect, police officers/firefighters can not enter the building without a key for such conventional vertically acting barrier if an emergency occurs indoors, and they have to break through the vertical acting barrier by force. Not only is the property damaged, but also a delay in rescue results.

[0008] U.S. Pat. No. 7,537,038 issued to the present inventor proposes a "Release Control Mechanism for Emergency Exit" with the intention to reduce the time and simplify the steps for opening the barrier. Some examples of applications relating to known vertical acting barriers are provided in, for example, U.S. Pat. No. 5,542,460, U.S. Pat. No. 7,448,426, and U.S. Pat. No. 7,610,719.

[0009] In view of the problems and disadvantages of the prior art, the main object of the present invention is to provide a barrier opening system for emergency escape and rescue, wherein in case of emergency or imminent danger, a barrier can be still opened by those trapped indoors in the shortest possible time for safe escape even without power supply and external assistances.

[0011] To achieve the above and other objects, a barrier opening system for emergency escape and rescue according to the present invention mainly comprises: a vertical acting barrier device, winding a barrier to open or unwinding the barrier to close via a winding shaft; and a prestressed spring, preloaded on the winding shaft for accumulating a restoring force when the barrier is unwound using the winding shaft.

[0013] The brake release mechanism comprises a swing arm, an actuator, and a slide bar. The first end of the

[0014] The barrier opening system further comprises an escape device, including a barrier opening unit for activating the brake release mechanism to release the brake mechanism. The barrier opening system further comprises a rescue device, including an identification unit and a key security mechanism. The identification unit is used to input an identification data by the rescue personnel. The key security mechanism is used to store a master key. The master key can activate the brake release mechanism to release the brake mechanism. The emergency barrier opening system further comprises a backup power device, used to supply a backup power for the system to operate when there is a power failure.

[0016] According to the barrier opening system of the present invention, the restoring force of the prestressed spring is greater than the weight of the barrier. When the emergency button or the master key activates a barrier bolt unit to release the barrier, the barrier can be lifted up by the restoring force of the prestressed spring. Preferably, the restoring force of the prestressed spring is preset to be capable of lifting up the barrier at least about 80 inches (203.2 cm).

[0018] Preferably, the identification unit can be, for example, a card reading device, a keyboard, and an image capture device. The card reading device is a device used to read an identification chip (for example, RFID). The identification data comprises, for example, an authorization code, a user ID and its password, a user image, etc. Furthermore, the key security mechanism comprises a key box used to store the master key and a switch matching with the master key. The switch is electrically connected with the linear actuator. The master key can activate the linear actuator to release the bolt pin with the switch.

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plurality of surveillance cameras for capturing environmental images. The database unit of the main controller stores temperature security data, smoke concentration security data, seismic wave data, and background image data. The data processing unit of the main controller compares the environmental temperature detected by the temperature sensor, the environmental smoke concentration detected by the smoke sensor, the seismic wave data detected by the seismic sensors, and the environmental image captured by the surveillance camera with those data stored in the database unit via operation.

[0020] After the main controller further identifies the type of disaster, the disaster site, and the affected areas based on analysis presented by the data processing unit, it controls the brake release mechanism to release the brake mechanism and activates at least one of the escape device or the rescue device. After the identification data inputted to the identification unit by the user is compared and matches with the identification data stored in the database unit, the main controller activates the key security mechanism to allow the user to take the master key. When at least one of the emergency button and the master key activates the barrier bolt unit to release the barrier, the barrier is lifted up by the restoring force of the prestressed spring.

[0021] Preferably, the access control management device further comprises an alarm and notification unit. When the main controller confirms the occurrence of a disaster, a real-time alarm is emitted in an acousto-optic way, and an escape route is shown in an acousto-optic way.

[0022] Accordingly, when an emergency or an imminent danger, for example, a fire, an earthquake, or a flood occurs, even though there is no electricity supplied, with a backup power, the main controller can obtain the user identification data via the card reading device, the keyboard or the image capture device of the identification unit, compares it with the identification data of the database unit through the operation of the data processing unit, and authorizes the user to open the key box of the key security mechanism once the main controller confirms the user's identity is a police officer or firefighter or another authorized person. Then, the user can take the master key from the key box and activate the switch with this master key to release the bolt pin so as to lift up the barrier. Therefore, the police officers/firefighters can enter the building for rescue without breaking through the barrier, causing a property damage, and affecting rescue time. Moreover, with regard to the emergency barrier opening system, people trapped indoors can still open the barrier fast by pressing the emergency button in the shortest time for safe escape even without electricity and external assistances.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is a system framework diagram showing a barrier opening system for emergency escape and rescue according to a preferred embodiment of the present invention;

[0024] FIG. 2 is a schematic view showing a vertical acting barrier device of the present invention, wherein a portion of the vertical acting barrier device is cut off and a portion of the vertical acting barrier device is omitted;

[0025] FIG. 3 is a schematic view showing a barrier operator unit of the present invention, wherein a brake mechanism is shown in a brake state in a partial enlarged cross-sectional view;

[0026] FIG. 3a is a partial enlarged view taken along line 3a-3a of FIG. 3;

[0027] FIG. 4 is a schematic view showing the barrier operator unit of FIG. 3, wherein a brake release mechanism is shown to activate the brake mechanism to release the brake in a partial enlarged cross-sectional view;

[0028] FIG. 4a is a partial enlarged view taken along line 4a-4a of FIG. 4;

[0029] FIG. 5 is a schematic view showing an escape-barrier open state of the emergency barrier opening system of the present invention;

[0030] FIG. 6 is a schematic view showing a rescue-barrier open state of the emergency barrier opening system

of the present invention;

[0031] FIG. 7 is a schematic view showing a key security mechanism of the present invention;

[0032] FIG. 7a is a schematic view showing that the key security mechanism of FIG. 7 is authorized to open a key box, so a master key can be taken;

[0033] FIG. 7b is a schematic view showing a keyhole matching with the master key of FIG. 7a;

[0034] FIG. 8 is a work flow chart of the emergency barrier opening system according to the present invention;

[0035] FIG. 8a follows FIG. 8, and illustrates a work flow chart of the escape device;

[0036] FIG. 8b follows FIG. 8, and illustrates a work flow chart of the rescue device;

[0037] FIG. 8c follows FIG. 8, and illustrates a work flow chart in the automatic closing setting mode,

[0038] FIG. 9 is a schematic view showing a system reset of the barrier operator unit of FIG. 3; and

[0039] FIG. 9a is a partial enlarged view taken along line 9a-9a of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] FIG. 1 schematically illustrates a system framework of a barrier opening system for emergency escape and rescue according to a preferred embodiment of the present invention. FIGS. 2, 3, and 3a illustrate examples of a vertical acting barrier device and barrier operator unit used in the present invention. With reference to FIG. 1, an access control management system 1 is, for example, set up in the management program of a community LAN (local area network) at the user terminal or the management program of a relay node of a security system. The access control management system 1 monitors the access control, personnel activity, and the facility condition at the user terminal (or at the relay node) by means of an access control management device 5 at the terminal such as, an emergency detection unit 51 and monitoring unit 52 to detect any abnormal conditions, and sends a detection signal to a remote control center 2 in real time so as to conduct a complete surveillance.

[0041] The above-mentioned LAN system communicates data and signals via transmission media such as, wire or wireless transmission media. The access control management system 1 comprises a main controller 3 which can take appropriate measures in response to an abnormal signal in the area to ensure the safety of the users in terms of access control, personnel activity, and facility condition. The hardware equipment of the emergency barrier opening system of the present invention primarily comprises a vertical acting barrier device 4, an escape device 6, a rescue device 7, a backup power device 8, etc. The main controller 3 is electrically connected with the vertical acting barrier device 4, the access control management device 5, the escape device 6, the rescue device 7, and the backup power device 8 to form a surveillance network.

[0042] Referring to FIGS. 1, 2, 3, and 3a, the vertical acting barrier device 4 is located at the entrance of a building. It is a safety barrier which can be operated freely indoors (from the inside) and prevent trespassing from outside. The vertical acting barrier device 4 primarily comprises a winding shaft 41, a barrier 42, a barrier operator unit 43, and a prestressed spring 44. The winding shaft 41 is pivotally mounted at the top of the gateway. The barrier 42 which is composed of a plurality of serially connected subpanels can be raised or lowered vertically along the barrier rails 421. The barrier 42 is connected to the winding shaft 41 at one end. The winding shaft 41 winds up the barrier 42 to open or release the barrier 42 to close. The barrier operator unit 43 is controlled to drive the winding shaft 41 to rotate by electric power. The prestressed spring 44 comprises, for example, a plurality of coil springs preloaded on the winding shaft 43 so that the barrier 42 can store a restoring force when the winding shaft 41 is driven to release the barrier 42 to close.

[0043] The barrier operator unit 43 shown in FIGS. 3 and 3a is an illustrative example and is not intended to

[0044] The brake mechanism 432 comprises a sleeve 4321 mounted on the central shaft 4311 and is able to slide axially. An electromagnetic generator 4315 encloses the shaft hub 4312 and is fixedly connected to the partition plate 43a. At the first end of the sleeve 4321 is provided a clutch end disc 4316 having an end face facing the brake disc 4314. An elastic element 4317 is accommodated in between the shaft hub 4312 and the electromagnetic generator 4315, with one end of which abuts the partition plate 43a, and the another end urges against the another end face of the clutch end disc 4316. Under normal condition, when the electric motor 431 rotates, the electromagnetic generator 4315 is excited to attract the clutch end disc 4316, thereby releases the brake disc 4314. The brake mechanism is now under a brake releasing state. When the electric motor 431 stops rotating, the elastic element 4317 urges against the clutch end disc 4316 to brake the brake disc 4313. The brake mechanism is now under a braking state.

[0046] Referring now to FIGS. 4 and 4a, in case of power failure, the actuator 434 deactivates, the spring potential energy of the slide bar 435 is released to actuate the swing arm to move to the offset position. Subsequently, the actuating plate 4331 actuates the sleeve 4321 to slide in the direction to which the swing arm 4332 oscillates, which renders the clutch end disc 4316 to disengage from the brake disc 4314 so as to release the brake. Besides, the barrier operator unit 43 further comprises a pull-chain disc mechanism 46 for manually opening or closing the barrier in case of power interruption.

[0048] The barrier bolt unit 45 is an electronic lock controlled by a circuit, and comprises a linear actuator 450, for example, a solenoid. The linear actuator 450 can be activated to keep the bolt pin 451 in a lock state. At this time, a spring potential energy is accumulated in the bolt pin 451 and can lock the barrier 42 at a predetermined position by means of mechanical force. When the linear actuator 450 is not actuated, the bolt pin 451 is displaced to release the barrier 42. It is to be understood that the linear actuator is not limited to the solenoid, and the bolt pin can be actuated or operated in a number of ways.

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[0050] Referring to FIG. 5, the escape device 6 comprises a barrier opening unit 61 which is disposed inside the emergency exit at a location nearby the barrier 42. The barrier opening unit 61 comprises an emergency button 611 which is designed to be easily accessible and operable by intuition. For example, the emergency button 611 can be a conventional button which, upon simple pressing of the button, can interrupt the exciting circuit of the linear actuator 450 to actuate the bolt pin 451 in order to release the barrier 42. To avoid actuation of the emergency button by mistake, the emergency button 611 is preferably covered with a protective cover which can be uncovered for pressing the button in case of emergency. It is to be noted that the linear actuator and the emergency button are not limited to be electrically driven and other mode of operation such as, driven mechanically can also be used. In case of emergency, such mechanical locking mechanism can be operated manually to release the barrier.

[0052] Preferably, the rescue device 7 is controlled by the main controller 3 and the security system control center 2. The key security mechanism can be opened only after the identification unit 71 confirms the identity of the user. Besides, the main controller 3 and the security system control center 2 are responsible for auditing the key security mechanism 72, and can track date, time, the user ID, etc. Preferably, the key box 721 is recessed in a wall near the entrance of the building, or is disposed within the surveillance range of a property management unit. Preferably, the identification unit 71 is disposed beside the key box 721 or at other suitable locations, and the switch 723 is disposed outside the entrance of the building.

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[0055] When at least one of the emergency detection unit 51 or the monitoring unit 52 shows an abnormal signal, the data processing unit 32 determines whether there is a disaster or accident occurs in the area under surveillance based on the difference in data between the abnormal signal and the security data of the database unit 31. Preferably, the access control management system 1 further comprises an alarm and notification unit 53 which may release a real-time alarm in sound and light form to show the escape route in case a disaster or accident indeed occurs.

[0057] Meanwhile, the data processing unit 32 acquires the authorization code, ID and associated password, or the image data of the user through the identification unit 71, and compares the acquired data with the identification data of the database unit 31. The user will be authorized to open the key box 721 of the key security mechanism 72 once the user is confirmed to be a police officer or firefighter or authorized personnel. Then, the user can get access to the master key 722 and insert the same into the keyhole 724 of the switch 723 to activate the bolt pin 451 so as to release the barrier 42. When the master key 722 or the emergency button 611 actuates the bolt pin 451 to release the barrier 42, the barrier 42 can be lifted up by the restoring force of the prestressed spring 44.

[0069] If the emergency detection unit 51 and the monitoring unit 52 are detected to function abnormally in Step S104, proceed to Step S106 below. [0070] Step S106: The main controller 3 of the system makes use of the data processing unit 32 to detect whether or not the temperature sensors 511, the smoke sensors 512, and seismic sensors 513 of the emergency detection unit 51 transmit the temperatures, smoke concentrations, and seismic wave data of the surrounding environment and detects whether or not the surveillance cameras 521 of the

[0074] If in Step S102, the system detects a power failure, proceed to Step S110 below. [0075] Step S110: Main controller 3 activates the backup power device 8 to supply electric power. [0076] Step S111: The system detects whether the backup power device 8 is functioning normally or not. [0077] Step S112: If the backup power device 8 fails to supply power, the actuator 434 of the brake release mechanism 433 of the barrier operator unit 43 will release the brake (as shown in FIGS. 4 and 4a); meanwhile, the linear actuator 450 of the barrier bolt unit 45 which is not electrically excited, releases the bolt pin 451 so as to release the barrier 42; at this time, the barrier 42 is raised by the action of the prestressed spring 44 to open. [0078] Step S113: Under the condition that the backup power device 8 is normal in supplying power, the main controller 3 of the system further compares the temperatures, the smoke concentrations, and the seismic vibration of the surrounding environment provided by the temperature sensors 511, the smoke sensors 512 and seismic sensors 513 of the emergency detection unit 51 and the surrounding image signals provided by the surveillance cameras 521 of the monitoring unit 52 with the temperature security data, the smoke concentration security data, and the background image data stored in the database unit 31 by means of the data processing unit 32, so as to determine whether a disaster occurs in the area under surveillance or not. If the analysis result confirms that a disaster does not occur, Step S113 is repeated to conduct continuous monitoring. [0079] Step S114: When the main controller 3 of the system confirms the occurrence of a disaster, the type of the disaster, the disaster site, and the affected areas are identified based on the analysis result, and the severity of the disaster is analyzed so as to determine if an emergency rescue is needed. [0080] Step S115: If the main controller 3 of the system determines that it is a minor disaster and no rescue is needed, the barrier 42 is held at the original position and Step S113 is repeated to conduct continuous monitoring. [0081] Step S116: When the main controller 3 of the system determines that it is a major disaster and a rescue is urgently needed, the alarm and notification unit 53 releases a real-time alarm in sound and light form to show the escape route. [0082] Step S117: At the same time, the emergency barrier opening system starts to operate.

[0089] FIG. 8b shows an emergency barrier opening system that is designed to give priority to rescuing. [0090] Step S123: The rescue device 7 operates to help the police officers/firefighters to enter the building in the shortest possible time for rescue without having to break the barrier. [0091] Step S124: the main controller 3 of the system makes use of the data processing unit 32 to acquire the authorization code, ID and associated password, or image data of the user provided by the identification unit 71 (for example, a card reading device, keyboard, or image capture device)(as shown in FIG. 7), and compares the acquired data with the identification

[0102] While the preferred embodiments have been described as above, it is to be noted that the description and accompanying drawings disclosed herein are not intend to restrict the scope of implementation of the present invention. Variations and modifications equivalent to the above embodiments and able to be realized are considered to be within the scope of the present invention.

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