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Primary Examiner: Mitchell; Katherine
Assistant Examiner: Massad; Abe
Attorney, Agent or Firm: Garcia-Zamor; Bui Bui, Esq.; Jessica H.

Claims

What is claimed is:

1. A barrier opening system for emergency escape and rescue, comprising: a vertical acting barrier device having a winding shaft for winding a barrier to open or unwinding the barrier to close; a prestressed spring preloaded on the winding shaft for providing a restoring force to the barrier when the winding shaft unwinds the barrier; a barrier operator unit comprising: a central shaft, an electric motor coupled with the central shaft for rotating the winding shaft, one end of the central shaft is fixedly connected with a brake disc; a brake mechanism comprising: a sleeve mounted on the central shaft so as to be axially slidable thereon; a clutch end disc arranged to face the brake disc and attach to one end of the sleeve, a pair of limit rings being arranged on the other end of the sleeve; an elastic element adapted to urge the clutch end disc to urge against the brake disc so as to brake the central shaft; an electromagnetic generator adapted to retract the clutch end disc to separate the clutch end disc from the brake disc so as to release the central shaft; and a brake release mechanism comprising: a swing arm having a first end arranged between the pair of limit rings, and a second end extending through the barrier operator unit, the swing arm is configured to oscillate between a holding position and an offset position at which the sleeve is actuated to slide axially to thereby separate the clutch end disc from the brake disc; an actuator disposed externally of the barrier operator unit; and a slide bar slidably mounted between the swing arm and the actuator, and is biased by a spring to slidably moved toward the swing arm consistently; wherein the actuator is activated to retract the slide bar when electrically excited, whereby the slide bar stores a spring potential energy therein, and in case of power failure, the actuator releases the slide bar to swing the swing bar toward the offset position, to thereby release the brake so that the winding shaft is rotatable freely; an escape device having a barrier opening unit for activating the brake release mechanism to release the brake mechanism through an emergency button; a rescue device having at least a key security mechanism for storing a master key therein, the master key is adapted to activate the brake release mechanism to release the brake mechanism; a backup power device for supplying a backup power in case of a power failure; a main controller electrically connected with the barrier operator unit, the escape device, the rescue device, and the backup power device; when the main controller activates the electric motor to rotate, the brake mechanism effects a brake release action, and when the controller deactivates the electric motor to cease to rotate, the brake mechanism effects a braking action; and the main controller is adapted to control the key security mechanism to release the master key as needed; wherein the barrier is raised by the restoring force of the prestressed spring when at least one of the emergency button or the master key activates the brake release mechanism to release the brake mechanism.

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

Field of the Invention

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.

Description of the Related Art

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.

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 barrier at lower dead point when the vertical acting barrier reaches the lower dead point. By this vertical acting barrier, in case of emergency, for example, a fire breaks out, an earthquake occurs, or a flood hits, the barrier bolt must be released before a switch can be activated to open the vertical acting barrier. If there is no power supply, a manual mode must be taken, in which a brake release lever has to be actuated to release the brake, and a pull chain has to be pulled to rotate a pull-chain disc in order to open the barrier.

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.

Presently, a new rescue concept is provided. For example, a master key can be used to enter commercial and residential buildings. In North America, it is common practice for building owners to provide the police officers/firefighters with a Knox access. The Knox access is mainly a master key, which can open the automatic barriers or lock gates of all buildings directly or can open a storage box in which a key set is kept. As such, police officers/firefighters can have access to a master key from the storage box, and enter the building for fire rescue without having to break through the barrier, which will cause damage to the property, and result in a fire rescue delay.

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.

SUMMARY OF THE INVENTION

In view of the problems and disadvantages of the prior art, the main object of the present invention is to provide

Another object of the present invention is to provide a barrier opening system for emergency escape, rescue, and vehicle relocation, wherein in case of emergency or imminent danger, rescue personnel can open a barrier for rescue in the shortest possible time without having to break through the barrier.

The barrier opening system further comprises a barrier operator unit, including a central shaft, an electric motor, a brake mechanism, and a brake release mechanism. The electric motor is coupled with the central shaft so as to rotate the winding shaft. One end of the central shaft is fixedly connected with a brake disc. The brake mechanism comprises a sleeve, a clutch end disc, an elastic element, and an electromagnetic generator. The sleeve extends through the central shaft, and can slide axially, but can not rotate with respect to the central shaft. The clutch end disc faces the brake disc and is secured to one end of the sleeve. Another end of the sleeve is provided with a pair of limit rings. The elastic element is used to urge the clutch end disc against the brake disc, thereby braking the central shaft. The electromagnetic generator is used to retract the clutch end disc so as to separate the clutch end disc from the brake disc, thereby releasing the central shaft.

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.

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

Preferably, the vertical acting barrier device further comprises a barrier bolt device which may lock the barrier at a predetermined position by means of a bolt pin after the barrier is closed. The barrier bolt unit comprises a linear actuator for actuating the bolt pin to lock the barrier at the barrier closed position. For example, the linear actuator is a solenoid. When the solenoid is electrically excited, the bolt pin is maintained in a lock state. When the solenoid is not electrically excited, the bolt pin releases the barrier. Also, the barrier opening unit is electrically connected with the linear actuator. The emergency button activates the linear actuator to be able to release the bolt pin.

Preferably, the barrier opening system further comprises an access control management device electrically connected with the main controller. The access control management device includes an emergency detection unit and a monitoring unit. The emergency detection unit comprises a plurality of temperature sensors for detecting environmental temperatures, a plurality of smoke sensors for detecting environmental smoke concentrations, and a plurality of seismic sensors for detecting seismic waves. The monitoring unit comprises a 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.

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.

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BRIEF DESCRIPTION OF THE DRAWINGS

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;

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;

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;

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

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;

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

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

FIG. 6 is a schematic view showing a rescue-barrier open state of the emergency barrier opening system of the present invention;

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

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;

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

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

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

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

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

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

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

DESCRIPTION OF THE PREFERRED EMBODIMENTS

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

In the emergency barrier opening system of the present invention, the restoring force of the prestressed spring 44 is set to be greater than the weight of the barrier 42. Preferably, the restoring force of the prestressed spring is set to be capable of raising the barrier 42 up by at least about 70 inches (177.8 cm). More preferably, it is provided a barrier bolt unit 45 which may lock the barrier 42 at a predetermined position by means of a bolt pin 451 after the barrier is closed.

The access control management device 5 comprises at least an emergency detection unit 51 and at least one monitoring unit 52 for detecting abnormal conditions in the compound under surveillance. The emergency detection unit 51, for example, comprises a plurality of temperature sensors 511 disposed at numerous predetermined indoor locations for detecting the temperatures of surrounding environment around the predetermined locations. The emergency detection unit 51 further comprises a plurality of smoke sensors 512 disposed at numerous predetermined locations for detecting the smoke concentrations of the surrounding environment around the predetermined locations. The emergency detection unit 51 further comprises a plurality of seismic sensors 513 disposed at numerous predetermined locations for detecting the seismic waves in temblor-prone areas. The monitoring unit 52, for example, comprises a plurality of surveillance cameras 521 disposed at numerous predetermined indoor locations for capturing video signals at the predetermined locations. It is to be noted that the access control management device 5 is not limited to the above-mentioned temperature sensors, smoke sensors, and surveillance cameras and other sensors such as, temperature sensitive fusible metal devices can be applied.

Referring to FIGS. 6, 7, 7a, and 7b, the rescue device 7 comprises an identification unit 71 and a key security mechanism 72, and is provided, for example, outside the emergency exit, that is externally of the barrier 42. The identification unit 71 accepts identification data input by a user, while the key security mechanism 72 receives a master key for opening the barrier therein. In particular, the identification unit 71 can be, for example, a card reading device, a keyboard, or an image capture device. The card reading device can be a device used to read an identification chip (for example, RFID). The keyboard can be used to input a password and/or a user ID by the user. The image capture device can be used to obtain the biological features of the user, for example, the fingerprints or facial images. The key security mechanism 72 comprises a key box 721, a master key 722, and a switch 723. The key box 721 has a high security box structure for storing the master key 722 and the plan layout

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.

The backup power device 8 can be, for example, a storage battery or a generator. The backup power device 8 is preferably disposed at a safe location outside the security area range, for example, in a public elevator hoistway or a public pipeline. In general, the backup power device 8 is used to store the electric power, and supplies a backup power to the system in case of power failure.

After the main controller 3 further identifies the type of disaster, the disaster site, and the affected areas based on the analysis result presented by the data processing unit 31, the brake release mechanism 433 is activated to actuate the brake mechanism 432 to release the brake, so that the escape device 6 can be operated freely from the inside of the emergency exit. The main controller 3 assures that the brake mechanism 432 of the barrier operator unit 43 is in a brake release state before actuating the barrier opening unit 61. If the brake is not released, the main controller 3 will disconnect the circuit of the actuator 434 of the brake release mechanism 433 immediately to release the brake. At this time, the barrier bolt unit 45 which is still locked can be actuated by the emergency button 611 to release the bolt pin 451.

FIGS. 8, 8a, and 8b are flow charts of the embodiment of the above-mentioned emergency barrier opening system. For details of the steps illustrated in the figures, reference is made to FIGS. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831,

Step S105b: The system detects if the feedback signals from, for example, the monitor type safety device located at the bottom of the barrier 42 is normal or not. If the feedback signals are abnormal, return to step S105a for next proceeding.

Step S105c: If the feedback signals of the monitor type safety device are normal, a delayed time is set by a timer to be, for example, 10 seconds (may be changed as desired), and voice warning is issued before closing the barrier automatically.

Step S105d: The system controls the barrier operator unit 43 to actuate the winding shaft 41 so as to wind up the barrier 42 for raising the barrier to open.

Given the above description regarding the preferred embodiment of the emergency barrier opening system, once a disaster, for example, a fire, an earthquake, or a flood, occurs, the system can still in function due to the backup power even if the power supply is interrupted. Whenever necessary, after the main controller confirms that at least one of the users is a rescue personnel, the user will be authorized to use the master key to activate the bolt pin so as to release the barrier to open. As a result, the rescue personnel can enter the building in the shortest possible time for rescue without having to break through the barrier and causing a damage of property. Additionally, in case of emergency, those trapped indoors can still open the barrier for safe evacuation in the shortest possible time by pressing the emergency button even without electricity and external assistances. Besides, the above emergency barrier opening system is so designed that, even if the backup power is cut off, the bolt pin of the barrier bolt unit can automatically release the barrier so as to lift up the barrier.

FIGS. 9 and 9a illustrate the resetting of the system for the barrier operator unit 43 of the present invention after the above-mentioned emergency situation has been eliminated and the power supply restored. As shown in the Figures, under electric excitation, the actuator 434 of the brake release mechanism 433 retracts the slide bar 435. The barrier operator 43 further comprises a lever 47 located opposite to the brake release mechanism 433. The lever 47 is pivoted at its center, so it can swing to the right and left. One end of the lever 47 abuts one side of the swing arm 4332 in a direction opposite to the slide bar 435, and the other end of the lever 47 is connected with a hoist rope 48. Another end of the hoist rope 45 is guided to the front end of the barrier operator unit 43 and extends downward. When the hoist rope 48 is pulled at its free end, the lever 47 can restore the swing arm 4332 to its holding position, such that the brake mechanism 432 of the barrier operator unit 43 resumes its operation (as shown in FIG. 3).

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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