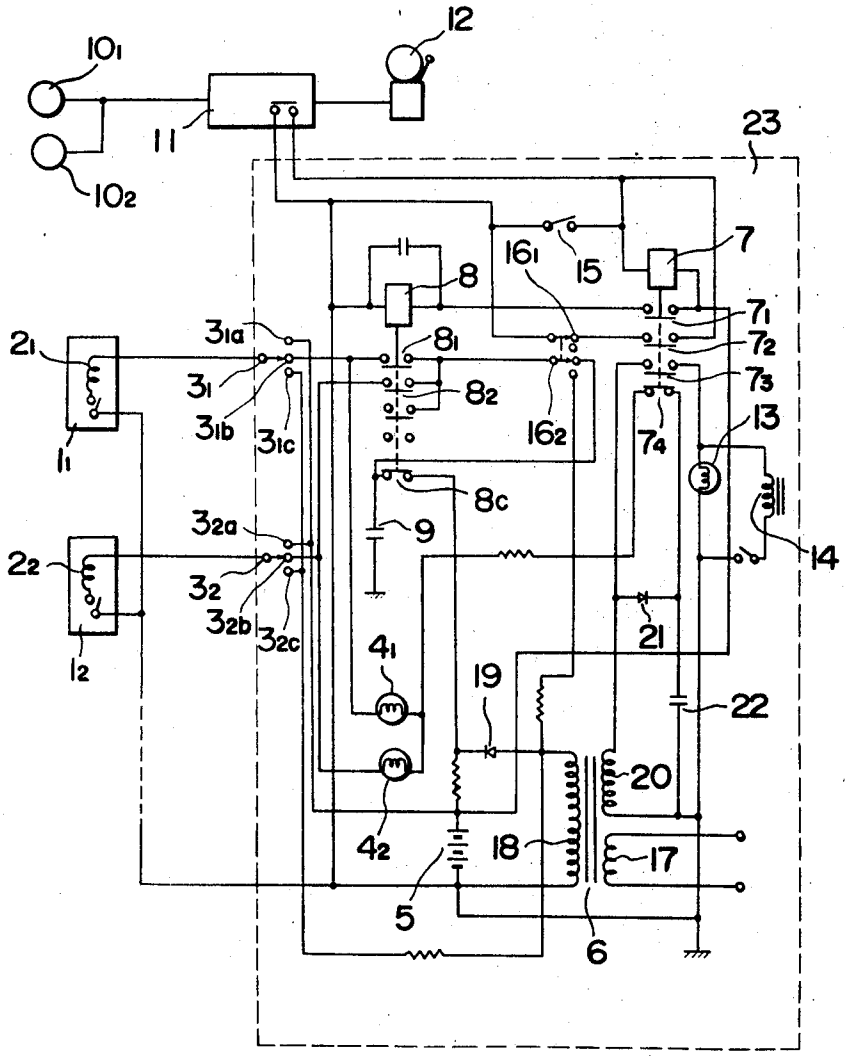
April 21, 1970 KAZUO SUGIYAMA 3,508,233

COMBINATION OF ELECTRICAL LOCK SYSTEM AND FIRE ALARM SYSTEM

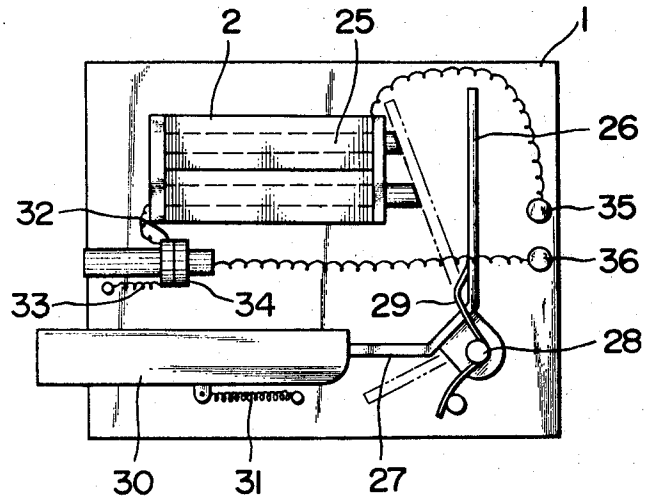
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Fig. 1



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Fig. 2



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COMBINATION OF ELECTRICAL LOCK SYSTEM AND FIRE ALARM SYSTEM

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U.S. Cl. 340—222 1 Claim

ABSTRACT OF THE DISCLOSURE

A combination of electrical locks, especially those of doors for emergency exits, and a fire alarm system. When a fire breaks out, such normally closed locks are simultaneously unlocked by the actuation of the fire alarm system which is functionally connected to a control device for the locks. Each lock can be selectively locked or unlocked by operating the control device. Also, the simultaneous locking and unlocking of all the locks can be effected as occasion demands.

BACKGROUND OF THE INVENTION

In community buildings or other large buildings, there are provided a multiplicity of emergency exits, other than the entrances of usual use. These emergency exits are usually closed and locked. However, the locks for such exists must be unlocked rapidly all together should a fire break out. If such a number of emergency exits are unlocked one after another by hand, it takes a considerable length of time which cannot be permitted in such an emergency. Should the unlocking of any of the emergency exits be forgotten, this could prove fatal for persons who are trying to escape from such exits.

SUMMARY OF THE INVENTION

According to the present invention, electrical locks are adopted for all doors, and are unlocked all together in an emergency, such as a fire, by means of a control or operating device operatively combined with a fire alarm system. At ordinary times, each of these locks can be unlocked selectively.

The main object of this invention is to provide a combination of an electrical lock system and a fire alarm system, which comprises a plurality of electrical locks arranged in doors of a building, especially those for emergency exits, and controlled by an operating device, a fire alarm device operatively and electrically connected to said operating device for effecting the simultaneous unlocking of all the doors when the fire alarm system is actuated by fire.

Other objects and features will be made clear from the following description of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawings show an embodiment of this invention, wherein FIGURE 1 is a cirucuit diagram thereof, and FIGURE 2 is a diagrammatic illustration of an electrical lock to be used with this operating device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The reference numerals 1_1, 1_2 . . . show electrical locks for doors. As shown in FIGURE 2 the electrical lock **1** has an L-shaped iron armature **26** which is pivoted by a shaft **28** for allowing the attraction by an electromagnet **2** having a core **25**. The armature is urged in the clockwise direction by a spring **29**. The other end **27** of the L-shaped armature abuts against a bolt **30** for restraining the retracting movement of the bolt **30** by a weak spring **31**.

A movable contact **32** which is positioned in opposition to a fixed contact **34** controls the conduction of the current of the electromagnet by contacting and separating from the fixed contact according to the opening and closing movement of the door.

Reference numerals **35** and **36** show terminals for the electromagnet.

FIG. 2 shows the lock in locked position, wherein the movable contact **32** is retracted by the closing of the door, energizing the spring **33**, and becomes engaged with the fixed contact **34**. When the lock is unlocked, direct current exceeding a predetermined value is conducted between the terminals **35** and **36**. Then, the electromagnet **2** is magnetized, and the I-shaped armature **26** is attracted thereto. This attraction results in the counter-clockwise rotation of the armature about the axis of the shaft **28** against the force of the spring **29**, and the other end **27** moves to release the engagement with the bolt **30**, allowing the retraction of the bolt **30** by the force of the weak spring **31**. Thus, the lock is unlocked.

The L-shaped armature once attracted to the core **25** is in an intimate contact with the core, it remains in this position owing to the coercive force created in the core **25** even after the current is cut, thereby the unlocked condition is continued.

When the thus unlocked lock is again locked, alternating current is applied between the terminals **35** and **36**. By such conduction of alternating current, the core **25** will be de-magnetized and the coercive force will disappear. Accordingly, the armature **26** will be rotated in the clockwise direction by the force of the spring **29**, the other end **27** pushing out and holding the bolt **30**. Thus the locking operation is finished.

The electrical lock 1_1 or 1_2 . . . as mentioned in the above is mounted on each door, and terminals of the electromagnets 2_1, 2_2 . . . are connected by wires to an operating device **23** positioned in a room. The operating device **23** has three power sources, each grounded. The first one is a direct current source which has a battery **5**, a secondary coil **18** of a transformer **6** whose primary coil is an alternating current source **17** for charging the battery **5**, and a rectifier **19**. The second is a low voltage direct current source comprising another secondary coil **20** of the transformer **6**, a rectifier **21**, and a condenser **22**. The third is an alternating current source formed by the secondary coil **18**.

Terminals opposing the above-mentioned ground terminals of the electromagnets of the electrical locks 1_1, 1_2 . . . are respectively connected to switches 3_1, 3_2. . . . In the respective switch 3_1 there are three contacts *3a*, *3b*, *3c*, the contact *3a* being an unlocking contact to be applied by the voltage of the direct current source of the battery **5**, *3c* being a locking contact to be applied by the alternating current from the secondary coil **18**, and *3b* being a neutral contact for maintaining the unlocked condition when the switch is shifted from the unlocking contact *3a* and for maintaining the locked condition when the switch is shifted from the locking contact *3c*. The switch is always set on this neutral position except during the period of switching. The neutral contact *3b* is connected through respective pilot lamps 4_1, 4_2 . . . to the low voltage direct current source composed of the secondary coil **20**, the rectifier **21**, and the condenser **22**. This source is of a low voltage type merely sufficient for operating the pilot lamps 4_1, 4_2 . . . , and does not actuate the armature **26** which is in the locked position apart from the core **25** since the magnetic force produced by the current flowing through the electromagnet **2** is weak. In the operating device **23**, there is provided a relay **7** to

be conducted by the direct current from the direct current source **5**. The circuit of the relay **7** is connected to a fire alarm **11** which is actuated by a number of fire detectors 10_1, 10_2 . . . arranged in the building outside of the lock operating device **23**. The circuit is closed by the actuation of any of the fire detectors. The relay **7** comprises a contact 7_1 for connecting a relay **8** to the direct current source **5** in parallel with the relay **7**, a contact 7_2 for self-holding the relay **7**, a contact 7_3 for connecting an alarm lamp **13** and a buzzer **14** to the secondary coil **20**, and a contact 7_4 for cutting the low voltage direct current source which is composed of the secondary coil **20**, the rectifier **21** and the condenser **22** and is to be applied to the contact **3***b*. On the other hand, the relay **8** has contacts 8_1, 8_2 . . . for connecting the contacts 3_1b, 3_2b . . . to an emergency condenser **9** which is normally charged, and a contact **8***c* for opening the circuit for charging the condenser **9**.

In these emergency circuits, there are also provided a simultaneous unlocking contact **15** which is arranged in parallel with the contact that is closed by the fire alarm device and normally opened but closed by pushing operation, a simultaneous locking contact **16**, which is arranged in the self-holding circuit of the relay **7** and is normally closed but opened by pushing operation, and a contact 16_2 of the emergency condenser circuit, which is associated with the simultaneous closing contact **16** and normally closed but opened by pushing operation.

Now the function of the device of this invention will be specifically explained.

It is assumed that the relays **7** and **8** are in inoperative condition since the simultaneous unlocking contact **15** is in the normally open condition and the fire alarm device **11** is in the inoperative condition. In this condition, and each door is closed, each of the switches 3_1, 3_2 . . . are maintained in their neutral contacts 3_1b, 3_2b . . . , respectively. Accordingly, the pilot lamps 4_1, 4_2 . . . are lightened from the low-voltage direct current source composed of the secondary coil **20**, the rectifier **21**, and the condenser **22**, for indicating the closing of the doors.

In order to bring the electrical lock of a desired door, for example 1_1, to an unlocked state, the switch 3_1 is shifted to the unlocked contact 3_1a. By this operation, the voltage from the direct current source **5** is applied to the electromagnet 2_1, and the L-shaped armature **26** is attracted by the magnetic force produced by the electromagnet 2_1 and rotated in the counter-clockwise direction against the force of the spring **29**. The other end **27** is therefore freed from the bolt **30** and retracted by the action of the spring **31**. Thus the lock 1_1 is unlocked. Since the core **25** of the electromagnet 2_1 is made of a material having relatively large coercive force, the L-shaped amature **26** is maintained in its attracted state, even when the direct current source **5** is cut by returning the switch 3_1 to the contact 3_1b or even when the voltage for the coil 2_1 is absent by the disengagement of the contacts **32**, **34** due to the opening of the door. Therefore, the bolt **30** can be maintained in its unlocked position. After the switch 3_1 is returned to the neutral contact 3_1b, the contacts **32**, **34** of the door will be opened and closed according to the opening and closing of the door, for turning on and off the pilot lamp 4_1.

In order to again lock the lock 1_1 of this door, the switch 3_1 is shifted to the locking contact 3_1c. By this operation, the alternating current from the secondary coil **18** is conducted to the electromagnet 2_1, and the coercive force remaining in the core **25** is eliminated, thereby the attracting force of the amature is completely lost. Accordingly, the L-shaped amature **26** is rotated in the clockwise direction by the action of the spring **29**. Since the other end **27** of the armature **26** pushes the bolt **30** out it holds and locks it at its projected position. After the bolt has once been locked, the L-shaped armature **26** cannot be attracted against the force of the spring **29** even when the switch 3_1 is shifted to the neutral contact 3_1b, or even when the low voltage is applied to the electromagnet from the lamp lightening source composed of the secondary coil **20**, the rectifier **21** and the condenser **22**. Thus the locked state is maintained.

Now, it is assumed that a fire broke out under the above-mentioned conditions. The fire is detected by any one of the detectors 10_1, 10_2 . . . and the contact of the fire alarm device **11** is closed. By the closing of the contact, the relay **7** is actuated and closes the contacts 7_1, 7_2, 7_3 and opens the contact 7_4. By the closing of the contact 7_1, the relay **8** is actuated, and by the closing of the contact 7_2, the relay **7** is self-held. Also by the closing of the contact 7_3, the alarm circuit composed of the lamp **13** and the buzzer **14** is closed for actuation thereof. By the open- of the contact 7_4, the low-voltage direct current source which has been connected to the neutral contact **3***c* is now cut and the pilot lamps 4_1, 4_2 . . . are turned off. By the action of the relay **8**, the contacts 8_1, 8_2 . . . are closed and the direct current of the emergency condenser **9** is conducted to each of the neutral contacts 3_1b, 3_2b. . . . At the same time, the charging of the condenser **9** is terminated by the opening of the contact **8***c*. Accordingly, the direct current from the emergency condenser **9** which has been charged in the normal state, flows into all the electromagnets 2_1, 2_2 . . . for simultaneously withdrawing all the bolts. Thus, all the electrical locks are unlocked for allowing the free opening of the doors.

Furthermore, there is provided the normally-opened simultaneous unlocking contact **15** in parallel to the aforementioned fire alarm device. By manually closing the contact **15** when an emergency is anticipated prior to the detection thereof by the detectors, such as in the case of a fire in the neighborhood or an earthquake, etc., the relays **7**, **8** are actuated as in the case of actuation of the fire alarm device, for simultaneously unlocking all the electric locks of the doors.

Also, there is provided a normally-closed simultaneous locking contact 16_1 in the self-holding circuit of the relay **7**, and a switching contact 16_2 associated with the contact 16_1 for normally closing the emergency condenser circuit. By pushing the contact 6_1, the self-holding of the relay **7** is released and the associated contact 16_2 is also actuated to switch its circuit to the secondary coil **18** for conducting the alternating current to all the neutral contacts **3***b*. Thus, all the coils **2** of the electrical locks can be simultaneously de-magnetized for simultaneously unlocking the electrical locks. This is very convenient for locking the doors at night after the above-mentioned emergency unlocking has been carried out.

As specifically explained in the above, the present invention provides a device for operating electrical locks mounted on a multiplicity of doors of a building including those of emergency exits, which enables to lock and unlock any one of locks independently of other locks, and also simultaneously unlock all the locks in conjunction with a fire alarm device. Thus the present invention greatly contributes to safety in any occurrence of fire.

In the above-mentioned embodiment, it is illustrated that the lock is unlocked when the armature is attracted to the core by the direct current of a certain voltage above a predetermined value, and is locked when the armature leaves the core by the action of alternating current. However, it will be clear that the lock can be designed to lock when the armature is attracted by the direct current of a certain voltage above a predetermined value, and to unlock when the armature leaves the core by the action of the alternating current.

Of course, this invention should not be construed as being limited by the above-mentioned specific form of embodiment shown and described herein by way of example. The device may be altered or modified within the spirit of the invention.

What is claimed is:

1. The combination of an electrical lock system and a fire alarm system, which comprises a plurality of electrical locks arranged in doors of a building, an operating

device for opening and closing said locks, and a fire alarm device operatively and electrically connected to said operating device for effecting the simultaneous unlocking of all the doors when the fire alarm system is actuated, each of said electrical locks including an electromagnet, a displaceable armature having first and second positions determined by energization and de-energization of said electromagnet and locking means having a locked state or an unlocked state according to the position of said armature, said operating device comprising means for conducting direct current of a certain voltage above a predetermined value to said electromagnet of the electrical lock to displace said armature to one of said positions in which it is attracted to said electromagnet, means for conducting alternating current to said electromagnet to separate said armature therefrom, said armature being maintained in said attracted position when said direct current is cut or a low voltage direct current below a predetermined value is conducted, or in said separated position when said alternating current is cut, three-position switches for the switching of respective of the electromagnets of said respective locks, said switches including first and second respective contacts for both said

means and neutral contacts connected in circuit in said operating device such that no voltage or a low voltage below a predetermined value is applied, and means operatively combined with said fire alarm device for simultaneously connecting said neutral contacts to an unlocking power source.

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