April 14, 1970 KAZUO SUGIYAMA 3,506,883

ELECTRICAL LOOKING DEVICE

Filed Dec. 19, 1966 2 Sheets-Sheet 1

Fig. 1

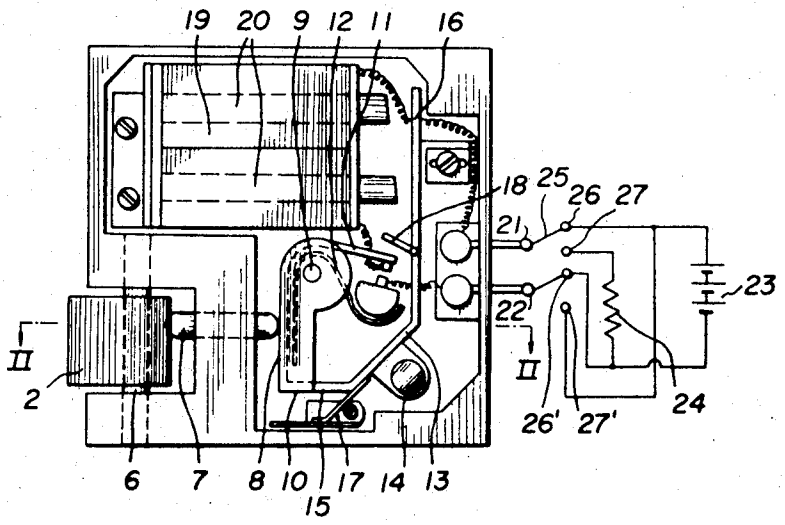
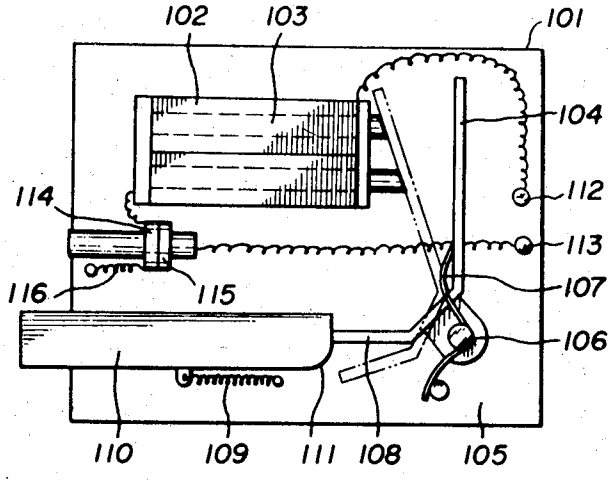


Fig. 4



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Fig. 2

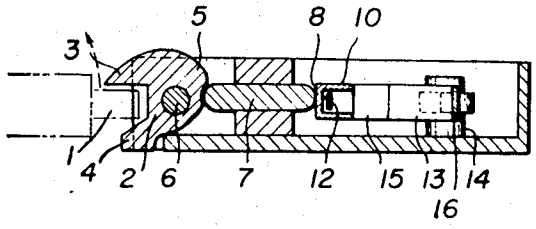
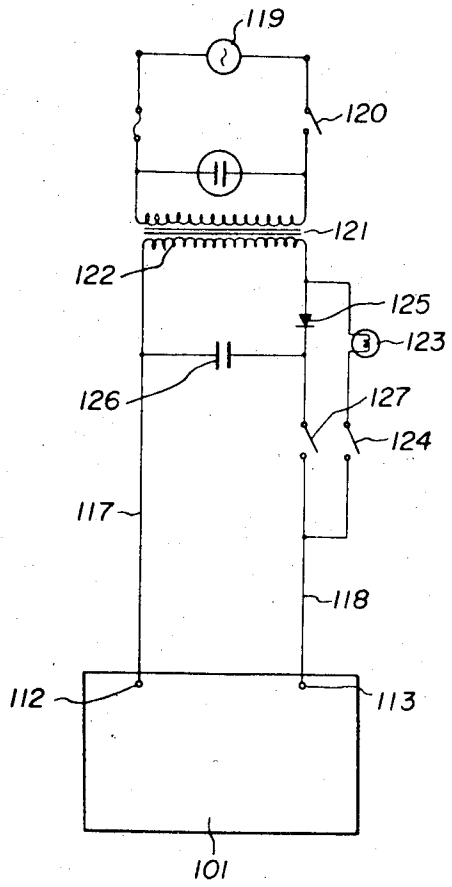


Fig. 3



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3,506,883

ELECTRICAL LOCKING DEVICE

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Int. Cl. H01f 7/10, 7/14; H01h 47/04
U.S. Cl. 317—154 3 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to an electrical device for locking doors or the like which utilizes an attractable member which will carry residual magnetism of such strength so that even with the retractional force of a return spring on the member, that unlocked condition is maintained and electricity can be saved. Also, a unique arrangement of levers within the lock itself achieves both electrical and mechanical locking with respect to the same apparatus.

This invention relates to an electrical locking device for doors or the like, which utilizes the coercive force of an electro-magnetic core.

Conventional electrical locking devices have an ability of controlling only two conditions, namely were closing and opening, since it utilizes "in" and "out" of the electricity for an electromagnet.

Therefore, an object of this invention is to provide a new electrical locking device utilizing the coercive force of an electro-magnetic core other than the normal closing and opening control of an electromagnet circuit, thereby the locking operation is electrically remote-controlled automatically and mechanically, by de-magnetizing said coercive force of the core or giving a motion stronger than said coercive force to an attracted iron piece.

Another object of this invention is to provide an electrical locking device as explained in the above, which can be operated by switching of direct and alternating currents from a common current source.

Further objects and merits of this invention will be made clear from the following explanation with preferred embodiments illustrated in the drawings.

FIG. 1 is a schematic section of an electrical locking device embodying this invention, with an outer power supply circuit;

FIG. 2 is a cross-section taken along line II—II in FIG. 1;

FIG. 3 is a diagram of a power supply circuit for another embodiment; and

FIG. 4 is a section of the locking device to be used in the second embodiment shown in FIG. 3.

In the first embodiment shown in FIGS. 1 and 2, the tip of a locking bolt **1**, which is mounted in the swing side of a door panel and projected therefrom, is entrapped between jaws **3** and **4** of an operating cam **2** rotatably mounted on a shaft **6**. A pushing pin **7** is slidably mounted between the operating cam **2** and an actuating arm **8** pivoted on a shaft **9**. The actuating arm **8** is always urged to the clockwise direction, i.e. to the pushing pin side, by the action of a spring **12**. However, the actuating arm **8** can be rotated in the counter-clockwise direction when the operating cam **2** is rotated clockwise and the pushing pin **7** is pushed rightwards by the crown **5** of the cam **2**. An arm portion **10** of the actuating arm **8** is normally in contact with a stopping rod portion **15** of an L-shaped rod **13** pivoted by a shaft **14**. At the other end of the L-shaped rod **13**, there is provided with an attractable iron piece **16** which is attracted in the counter-clockwise direction by the action of an electromagnet **19**, while it is urged relatively weakly in the clockwise direction by a return spring **17**. The characteristic feature of this invention is to make an iron core **20** of the electromagnet **19**, a material having a large coercive force, such as SK–7. **21** and **22** show terminals of a switch **25** for supplying current to the electromagnet. By selecting the position of a set of movable contacts **25**, the terminals **21** and **22** are respectively connected to power supply terminals **26**, **26'** or to power supply terminals **27**, **27'** having a series resistance **24**.

Further, there are provided with a lever **11** on the actuating arm **8** and another lever **18** on the L-shaped rod **13**. Either one of levers can be turned to a raised position by a suitable means, such as a click mechanism. In the embodiment shown in FIGS. 1 and 2, the lever **18** is the operable one.

Now, the functions and merits of the device shown in FIGS. 1 and 2 will be explained in detail.

By the movement of the locking bolt **1** according to the opening or closing of the door, the operating cam **2** is rotated around the shaft **6** since the locking bolt **1** is in engagement with the jaws **3** and **4** of the cam **2**. The pin **7** is therefore pushed rightwards, resulting in the counter-clockwise rotative force of the actuating arm portion **8**, but such rotation does not take place, since the arm portion **10** is stopped by the stopping rod portion **15** of the L-shaped rod and could not be swung. Thus, the locking bolt **1** is in a "locked" condition.

When the bolt is to be unlocked, the movable contacts **25** are turned to the terminals **26**, **26'** for supplying the electricity to the electromagnet. By this operation, the electromagnet **19** attracts the attractable piece **16**, and accordingly the L-shaped rod **13** is swung around the shaft **14** in the counter-clockwise direction, which results in the disengagement of the arm portion **10** from the stopping rod portion **15**. Under the condition, the actuating arm **8** is movable in the counter-clockwise direction and then the operating cam **2** also movable in the clockwise direction in FIG. 2, allowing the escape of the locking bolt **1** from the jaws **3** and **4** of the operating cam **2**. This is "operable" or "unlocked" condition of the door.

After this condition has been established or the switch has been once turned to the terminals **26**, **26'**, the power source can be cut out. Even if the power source has been cut out, the iron piece **16** of the L-shaped rod will be held in the attracted or "unlocked" position by the coercive force of the electromagnet core **20**, which force is stronger than the force of the return spring **17**.

When the locking operation is desired to function automatically and mechanically, the lever **18** of the L-shaped rod is raised. If the door is opened as shown by an arrow in FIG. 2 up to a predetermined angle by the entrance of a person, the crown **5** of the operating cam **2** will deeply push the pin **7** so that the actuating arm **8** will be rotated to such an extent that the lever **11** pushes the lever **18**. By the pressure applied to the lever **18**, the L-shaped rod **13** will be swung in the clockwise direction against the coercive force. Thus, the piece **16** can be moved from the electromagnet **19**.

Even if the door has been again closed or the pushing force applied to the lever **18** by the lever **11** is released, the attracting force applied to the piece **16** by the coercive force of the electromagnet will not overcome the force of the return spring **17**, since the coercive force working on the spaced iron piece is very weak, and it remains in the position spaced apart from the electromagnet. Therefore, when the door has been completely closed as shown in FIG. 2, it is automatically locked by the re-engagement of the arm portion **10** with the stopping rod portion **15**.

Finally, when the device is to be electrically locked from a remote position, the movable lever is previously brought down. In this condition, even if the door is

opened widely in the direction shown by the arrow, the lever **11** will not contact with the lever **18**, so that the L-shaped rod **13** remains in a position attracted by the coercive force of the core **20** and always in the "unlocked" condition. The contacts **25** are then turned to the terminals **27, 27'** which have opposite polarities in comparison with the terminals **26, 26'**. The weak current is supplied from the terminals **27, 27'** through a resistor **24** to an electro-magnetic core of the electromagnet, and de-magnetized the coercive force existing in the core. Therefore, the L-shaped rod is rotated in the clockwise direction by the action of the return spring **17** for closing the door as shown in FIG. 2, and the arm portion **10** and stopping rod portion **15** are engaged with each other for establishing the "locking" condition.

In the embodiment shown in FIGS. 3 and 4, an electromagnet **102** of an electrical locking device **101** has an iron core **103** made of a material having large coercive force, such as SK–7. An L-shaped piece **104**, which is to be attracted by the core **103**, is rotatably pivoted on a casing **105** by a shaft **106**, and urged to the direction opposite to the core **103** by the spring **107**. The other end **108** of the L-shaped rod can be engaged with the curved bottom **111** of a locking bolt **110** which is urged to retract by a spring **109**.

112 and **113** shows terminals for the electromagnet **102**. The circuit to the electromagnet **102** includes a movable contact **114** and fixed contact **115**, which contacts are actuated according to the opening and closing operation of the door. As shown in FIG. 3, the terminals **112** and **113** are connected to the operation board provided in the room, through wires **117** and **118**.

An alternating current source **119** supplied electricity to a transformer **121** through a main switch **120**. The secondary coil **122** of the transformer supplies a step-down voltage directly to the terminals through a pilot lamp **123** of wire **118** and a de-magnetizing switch **124**. Further, a direct current source formed by a rectifier **125**, and a condenser **126** is connected to the terminals in parallel with the above-mentioned alternating current supply through an energizing switch **127**.

When the electrical locking device **101**, which is in the "locked" condition, is to be unlocked, the energizing switch **27** for the direct current source composed of the secondary coil **122**, the rectifier **125**, and a condenser **126** is turned to "in." Then, the direct current flows to the electromagnet **2** of the electrical locking device **101** and attracts the L-shaped piece **104**. The piece **104** is rotated around the shaft **106** in the counter-clockwise direction, compressing the spring **7**. By the movement of the piece **104**, the other end **108** escapes from the curved bottom **111** and the locking bolt **110** is unlocked by the retracting force of the spring **109**. When the electromagnet **102** has been once brought into the energized condition, the coercive force by the residual magnetism the condition, even if the energization of the electromagnet has been cut out by the switch **127**. Namely, the piece **104** is maintained in its attracted condition, and the "unlocked" condition is continued.

In order to bring the locking device into the "locked" condition again, the de-magnetizing switch **124** of the secondary coil **122** is closed. Then, alternating current flows to the electromagnet **102** and it will not energize the magnet **102** but de-magnetize the residual magnetism remained in the core **103**. Accordingly, the attracting force of the magnet **102** will completely disappear, and the L-shaped piece **104** attracted by the core will move by the stored mechanical force of the spring **107** in the clockwise direction. The other end **108** will push the curved bottom **111** of the locking bolt **110** so that the locking bolt **110** projects and is held not to retract. Thus, the locking is accomplished.

As explained in detail with the preferred embodiments, the characteristic feature of the present invention is the utilization of the coercive force of an electromagnet core. The coercive force in the attracted condition of the iron piece is made stronger than the retational force of the return spring, so that the "unlocked" condition is maintained and the electricity can be saved. The locking can be done either by separating the iron piece from the core or by de-magnetizing the coercive force of the core. Accordingly, automatic and mechanical locking and also electrical locking can be done.

Of course, this invention should not be construed as being limited by the above-mentioned specific forms of embodiment shown and described herein by way of example. The device may be altered or modified within the spirit of the invention. For example, a suitable magnetic shield may be provided within order to prove the device from any unlocking by applying a strong outer magnetic field. The device may be designed to lock by the energization of the electromagnet and unlock by the demagnetizing of the same, just reversely in the embodiments explained in the above.

What I claim is:

1. An electrical locking device comprising an electromagnet having an iron core of large coercive force, a pivotally mounted operating cam having locking jaws, a pushing pin operatively engaging the cam, a pivotally mounted actuating arm engaging the pushing pin, and normally urging the cam through the pin to a locked condition, a pivotally mounted L-shaped rod mounted to effect limit to the rotation of the actuating arm, an attractable iron piece associated with the rod in cooperative relationship with the electromagnet, said iron piece mounted to take a first actuated position by the coercive force and a second retracted position by the action of a return spring on the L-shaped rod, the rotational force of said return spring being made weaker than the attracting force of the energizing electromagnet and than the attracting force by the residual magnetism acting on said iron piece in the first position after power is cut therefrom, the rod retaining the actuating arm pushing pin and cam in locked position in the second retracted position, and releasably allowing pivotal action of the arm, and release of the cam in the first actuated position.

2. An electrical locking device as set forth in claim **1** which includes a lever on the actuating arm and another lever on the L-shaped rod, said levers positioned so as to cooperate with each other, means to adjust the relationship of the levers with respect to the arm and rod, and the operable position of the levers with respect to each other adjusted so that movement of the cam to release from its latched position causes the lever on the arm to engage the lever on the rod and mechanically force the iron piece away from the electromagnet.

3. A device according to claim **1** wherein said electromagnetic is connected to an alternating current source through a de-magnetizing switch, and also to a direct current supply delivered from said alternating current source, through an energizing switch.

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JAMES D. TRAMMELL, Primary Examiner

U.S. Cl. X.R.

317—156; 335—233, 254

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,506,883 Dated April 14, 1970

Inventor(s) Kazuo Sugiyama

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Change the title of the patent on both pages of the drawings from "Electrical Looking Device" to

-- Electrical Locking Device --

Signed and sealed this 18th day of August 1970.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents