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3,231,693

CARD-OPERATED LOCK CONTROLLER

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This invention relates to a security lock. More specifically, the invention provides a lock which can easily be set for unlocking by insertion of a card having a special configuration. The unlocking configuration can be changed at will, quickly and easily, to stop previously used cards from working. The remarkable advantages of such a lock will become apparent as the description unfolds. For the first time, a lock which does not use a "key" in the normally thought-of sense of the word—i.e., a piece of metal of strength designed to operate tumblers—has become available. Yet the lock of this invention has features hitherto impossible with keyed locks; and it can be sold at a competitive price.

Practically all the good quality key-opened locks sold today are variations on the cylinder lock developed by Yale in 1861. During the intervening century, unfortunately, their construction has become so familiar that a skillful burglar with proper tools can open most of them in less than five minutes. In addition to this disadvantage, keys are frequently lost; and although a lost key completely jeopardizes security, few people are willing to undertake the expense of changing their locks merely because a key is lost. A more serious problem arises when all keys to a given lock have been lost. In this event, the choice lies between replacement or re-keying—and both operations are costly.

At first glance, it would appear that combination locks would provide all the answers; yet such locks are expensive, and unless they are in frequent use, their combinations are forgotten. Furthermore, combination locks are a nuisance, because of the slow operation time.

Various attempts have been made to devise satisfactory keyless locks. U. S. Patent 2,931,953 uses cards with magnetized spots in place of conventional keys. It would be at least equally difficult, if not more so, to change the combination of magnetized spots required for unlocking as to change the tumblers in a keyed lock. In consequence, this type of lock often fails to provide the necessary additional security.

Another type of lock using light beams, shown in U.S. Patent 3,029,345, is costly to manufacture, and suffers from the same disadvantages as the magnetic cards. Other similar schemes have been attempted, but as yet none has become sufficiently practical to challenge the conventional keyed lock.

The present invention provides a keyless lock which is safe, easily changed, and practical from the standpoint of both size and cost. It can replace a keyed lock in almost any installation—in doors, automobiles, safe-deposit boxes, file cabinets, and the like, to take just a few examples.

Briefly, the lock of this invention employs a pair of corresponding cards. The first card remains in the lock, and is used for pre-setting it in such a manner that it can be opened only by insertion of the second corresponding card. Within the lock is a plurality of two-element series-connected switches coupling a signal source to an unlocking mechanism operated in response to a signal. Each element in the switches is movable, and may assume at least two different positions. The greater the number of such possible positions, the greater the number of usable unlocking combinations. The position of the first element of the pair in each switch is determined, or "set," by the first card establishing a pattern. Only when the

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second element of all the pairs is set in a corresponding pattern will all the switches become conductive, and only then will the signal pass from the source through the series-connected switches to the unlocking mechanism. The lock is then unlocked.

The first card, which presets the lock in such a manner that it may be opened only by the corresponding second card, should be located in an inaccessible position—either inside the door (if a door is to be locked) or bolted into the lock. However, changing the "set" card need not become a terribly difficult operation—a guest in the house would probably be questioned if spotted while working on the lock with a wrench, but should the home owner wish to change his lock setting, the few-minute job with the wrench would involve far less trouble and expense than that previously required by rekeying or cylinder changing.

The second card corresponds to the first, and is usually fabricated simultaneously. Once the "set" card has been inserted, the second card may be used to operate the lock in the same manner as a key; but since the actual operation of unlocking is electric, no turning or twisting of the card is required. The card is merely inserted in a slot, and the lock automatically unlocks.

An important advantage of the locks of this invention is that each one of them is identical to every other one, and so mass production is made possible. This could never be done with conventional lock cylinders. In addition, all keys are eliminated. Cards may be made of heavy paper, plastic, metal, or any inexpensive material desired. Motels, for example, may imprint their advertising on the cards for guests to retain as souvenirs. The lock setting can be changed immediately upon a guest's departure, so that never again can a guest-thief return to use his card (or a duplicate) to pilfer the motel room or rob its subsequent occupants. The possible number of different card combinations is limitless. Where extreme security is desired, as in the case of safes, a large number of switches may be used, or the locks may be pyramided in series, each with a different card.

Moreover, these locks provide real safety. Even if a thief were in possession of a complete set of 4000 cards, one of each combination, and made trial of one every four seconds, it would require over four hours for him to exhaust all the combinations of a twelve-switch lock. Should a card be lost, all that is necessary is to remove the "set" card, and to insert a new one in the lock and to issue new unlocking cards corresponding to the new set card. The finder of the old card can accomplish nothing with it, for the card no longer operates the lock.

The unlocking card may be kept in a wallet along with credit cards and other valuables without creating a bulge, and without falling of its own weight from the wallet into a pocket.

The above features, as well as the particulars of the locks themselves, will be more fully appreciated from the detailed description of the invention which follows. Reference is made to the drawings, in which:

FIG. 1 is a somewhat schematic plan view of the keyless lock of one embodiment of this invention;

FIG. 2 is a transverse sectional view taken in the plane 2—2 of FIG. 1;

FIG. 3 is the transverse sectional view shown in FIG. 2, showing the insertion of the two cards into the lock;

FIG. 4 is a plan view of one of the cards used in FIG. 3;

FIG. 5 is a somewhat schematic representation, in section, of an arrangement of the switches and cards for another embodiment of the invention;

FIG. 6 is a somewhat schematic representation, in section, of an arrangement of the switches and cards such

that the two corresponding cards bear a reciprocal, rather than a duplicate, relationship to each other;

FIG. 7 is a somewhat schematic representation of another embodiment of the invention using a switch having more than two positions for each element; and

FIG. 8 is a plan view of a card used in the embodiment represented in FIG. 7.

Referring now to FIG. 1, coil 1 represents a solenoid connected with a lock. When powered, this solenoid is actuated to unlock the lock. This unlocking may be permanent (until the lock is reset) or momentary (allowing just enough time, for example, to open a door). The details of the unlocking mechanism depend to such a great extent upon the nature of the lock and its specific application that no attempt is made here to elaborate. However, suffice it to say that all these unlocking mechanisms are done in response to an electric signal to a transducer, such as a solenoid. The lock is powered from a power supply shown as battery 2. This battery should be long-lived, in order that frequent changes may be avoided. Mercury batteries are quite satisfactory for simple installations, and will last many years. Cadmium cells may be used where more power and greater longevity are required. Many other types of power supplies may also be used, but it is preferable that the chosen one be independent of local power failures.

The unlocking mechanism 1 and power source 2 are connected in series with a plurality of switches 4. The current path through the series-connected switches (six are illustrated) is completed only when all are closed simultaneously. The serpentine current path thus achieved is apparent from FIG. 1.

Operation of the individual switches employed in this embodiment of the invention may be seen in FIGS. 2 and 3. In FIG. 2, the switches are seen in the "neutral" position, where neither card has been inserted into the lock. When the elements are metal leaf-springs, they will assume a flat neutral position. In the arrangement shown in FIG. 2, a pair of elements 5 and 6 have upper contacts 7 and 8, and lower contacts 9 and 10, respectively. In the neutral position, both lower contact 9 on element 5, and lower contact 10 on element 6 are in contact with metal contact bar 11. Elements 5 and 6 are thus in electrical contact with each other. Similarly, when there are no cards in the lock, all pairs of elements shown in FIG. 1 above are in electrical contact with each other, and the serpentine current path through battery 2 and coil 1 is complete.

Block 12 in FIG. 2 is part of the lock. Side 13 of block 12 is exposed, exhibiting the slot 14 for insertion of the unlocking card. This slot 14 is preferably curved, to prevent visual ascertainment of the switch element positions and to hinder tampering. Slot 15, which receives the setting card, is not so exposed, and may therefore be straight. This slot 15 is covered by a solid cover 16, which may be fastened to block 12 (as shown) by bolt 17. This bolt should usually be located in such a manner that it is not removable from the outside; if it were, a thief could remove the set card and insert one of his choosing. Being then in sole possession of the corresponding card, he could operate the lock at will.

FIG. 3 shows the same lock illustrated in FIG. 2, but with the duplicate cards now inserted into both slots 14 and 15. In describing the operation of the cards, reference will be made to a single switch, having elements 5 and 6; in practice, however, the card may move any one or any combination of the switch elements of the lock. Card 18, shown in plan view in FIG. 4, has three extensions 19, and so can move the three of the six switch elements shown in FIG. 1 which correspond to those three extensions. Referring again to FIGS. 3 and 4, let it be assumed that element 6 is one of the elements corresponding to an extension 19 of set card 18. With bolt 17 unfastened, the card 18 is inserted into the lock. Extension 19, striking the end of element 6, will cause that ele-

ment to move away from its contact with contact bar 11, and into contact with contact bar 20, breaking the connection between elements 5 and 6. Until these two contacts connect again, the series circuit of the switches will remain open, and the lock will remain locked.

Now, when card 21 (an exact duplicate of card 18) is inserted, element 5 will be similarly shifted from contact with bar 11 to contact with bar 20 by extension 19a. Elements 5 and 6 are now reconnected, and the circuit is again complete, just as if the two elements had remained in the neutral position.

From this description of a single switch, the following conclusion may be reached: when all the elements are in the neutral position (no cards inserted), all the switches will be closed. Each element will have electrical contact with its partner through their respective contact with contact bars 11, and the lock will therefore remain unlocked. To avoid any drain on the battery, a relay may be used to shut off the power upon unlocking. The lock may remain open until the relay is manually reset, or it may be adjusted for automatic reset when the unlocking card is removed, whichever is desired.

Whenever a set card 18 having at least one extension 19 is inserted, at least one corresponding element 6 will be shifted from contact with bar 11 to contact with bar 20. The circuit will be broken, and the lock remains locked. Any number of additional elements 6 may similarly be shifted (by additional extensions 19 on the set card) without affecting the status of the lock. The moved elements 6 are in contact with their respective bars 20; the unmoved ones remain in contact with their respective bars 11.

Circuit connection can be restored only by moving all the corresponding elements 5 by inserting an exact duplicate of card 18 into slot 14. The matching extensions 19a on card 21 will move all elements 5 corresponding to the moved elements 6. The so-moved elements 5 and 6 will then contact each other once more through their respective contact bars 20, while those elements 5 and 6 which were not so shifted will remain in contact with each other through their respective bars 11. Thus, in one way or another, all elements 5 will be in contact with their corresponding elements 6, the series circuit will be complete, and power source 2 can send the required signal through coil 1 to operate the lock.

Referring now to FIG. 4, the cards themselves have several important advantages over conventional keys. For example, they need not be electrically conductive, since no electrical connections are made through them. (However, if buttons 22 shown in FIGS. 2 and 3 were insulators, it would not matter if the cards were conductive.) Where conductive printing on the cards is required to complete a circuit (as has been proposed in the art), greasy fingers can defeat the operation of the lock by coating the circuit with a film. Moreover, conductive cards cost far more than those of paper, or plastic, and cannot be easily reproduced in the home.

Suppose, for instance, that one member of a family has mislaid her card. She could telephone another member (even one out of town), and request the number and spacing of extensions 19. Using a blank card having all extensions present, she need only remove the superfluous ones from the blank. By so duplicating the proper combination she obtains the proper card to unlock her door. This solution is impossible with keys.

Should a card be lost, the owner need only unfasten cover 16 (FIG. 3) (a few-minute operation) and replace the former set card with a different one. The finder of the former card will be absolutely unable to open the lock.

At first glance, the illustration of FIG. 3 might seem to indicate that a thief need only depress all the switches with a smooth card in order to operate the lock. Such an action, however, would merely move all the elements 5 from contact with bar 11 to contact bar 20. No connec-

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tion would be made with any elements 6 not previously moved by the set card 18. The burglar would be successful only when the set card in the lock contained all possible extension 19—but such a card would never be used, for this very reason. The only other way for the burglar to try to open the lock would be to run through an entire deck of cards having all the possible permutations and combinations of extensions 19—a formidable task. Thus the purchaser of this lock can obtain as much security as he desires, limited only by the number of switches and/or locks employed. Using two twelve-switch locks in series, for example, about two years would be needed to try all possible combinations.

The lock illustrated in FIG. 5 operates in the same manner as the previous embodiment, with the arrangement of the switches somewhat altered. Contact bar 30 is the neutral contact, and contact bar 31 is the alternate contact. Without cards in the lock, all the elements 32 and 33 are in contact with each other through neutral contact 30, as shown. When a set card 34 having an extension corresponding to element 32 is inserted, that element is shifted away from bar 30 into contact with bar 31. Element 33 is similarly shifted by the corresponding unlocking card 35. The required cards are identical pairs, of the same kind shown in FIG. 4.

The embodiment shown in FIG. 6 operates somewhat differently. In this lock, the circuit is normally open (and the lock locked) except when a card 36 having extensions corresponding to all of the setting elements 37 is inserted. Such a card will move all the setting elements away from bar 38 (their neutral bar) and into contact with bar 39. Now all the elements will be connected in series, and the switch will conduct.

However, when a set card 36 containing only some extensions motivating elements 37 is used, only those elements 37 which correspond to these extensions will be shifted to contact their corresponding elements 40 through bars 39. The unmoved elements will not make such contact, for they will remain in contact with bars 38, and the lock will remain locked. The unlocking cards 41 will not need to move the group of elements 40 now in contact with their mates through bars 39, but must shift all the other elements into contact. Unlocking card 41 therefore will be the reciprocal of card 36, having extensions where there were spaces, and vice versa. Those elements 40 corresponding to the unshifted elements 37 will be shifted from bar 39 into contact with bar 38, where they will make contact with those unshifted elements 37 to complete the circuit. The relationship between set card 36 and unlocking card 41 is no longer duplicate, but reciprocal or complementary.

A further embodiment of the invention is shown schematically in FIG. 7. This lock makes possible more different combinations without increasing the number of switches or the size of the cards. Set card 40 is inserted in the same manner as set card 18 in FIG. 3; it causes plunger 41 to slide metal brush 42 along bar 43 for a distance corresponding to the length of the extension on the card. A typical card 44 used in the switch of FIG. 7 is shown in FIG. 8. This card has three positions or levels for the extensions on its edge configuration, instead of the two positions previously described. The lowest position 46 corresponds to the low position or "space" on the cards of FIG. 4, and does not affect plunger 41 at all. Brush 42 therefore makes contact with metal contact 48 on bar 43; this is the "neutral" position. The second level or position 47 on edge 45 causes plunger 41 to slide brush 42 along bar 43 to the second metal contact 49. The third position 50 causes plunger 41 to slide brush 42 along bar 43 to the third metal contact 51.

Brushes 42 and 52 will be located at the same contact of bar 43 (and therefore in electrical contact with each other), only when the position of the extensions on set card 40 corresponds to the position of the extensions on

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unlocking card 53. When all the brush pairs 42 and 52 are in contact with each other, the series-connected switches will become conductive, and the lock will be operated.

Since each switch in this embodiment has a choice of three switching positions rather than two, the number of possible combinations is proportional to a power of 3 rather than 2. A twelve-switch lock, for example, would offer over 500,000 combinations instead of about 4000. This embodiment becomes particularly advantageous in situations where safety is of paramount importance, as in safes and the like.

Now that a detailed description of some embodiments of the invention has been presented, some other important advantages of the locks of this invention can more readily be appreciated. All locks of a given type (for instance, the twelve-switch, two-position lock) are identical, and so may be mass produced. One of the 4000 pairs of cards is inserted to set the lock. The card pairs may be stamped from cardboard or plastic at negligible expense, or plastic comb-like cards can be produced in quantity, having all the extensions on each card. By using small pliers, the user may then remove any desired combination of extensions on two of the cards. One card may then be used to set the lock and the other one to operate it. Should the purchaser wish to use the same combination for all his locks, he could then have only a single card to carry in his wallet to operate them all—his front door, his automobile, safe-deposit box, file cabinet, office safe, and any others he might choose. No more bulky keyrings to tear holes in his pockets, no more fumbling for keys on a dark night—one card would operate all. For greater security, the combination could be changed periodically, since this would require only a few minutes for each lock.

The locks of this invention can be set to accommodate related locks with the same card by a very simple procedure. Consider, for example, the situation where each tenant is an apartment building required access to his own apartment, and also needed to be able to open the front door. If a 15-switch lock of this invention were installed on all doors, twelve of the switches could be used to operate the apartment locks, and the other three switches in the apartment locks would be permanently connected in the conductive position. Each apartment card would be designed to use a different combination of the twelve non-connected switches, so that each card would open only one apartment. In the front door lock, the twelve switches corresponding to the apartment locks would be permanently connected, and the remaining three switches set in any desired sequence, which would, of course, match the corresponding positions on all the tenants' cards. The positions chosen need not be consecutive extensions—any three of the fifteen switches, adjacent or not, may be selected, providing an extra security factor. Such a system is termed a mutually inclusive card system.

Mutually exclusive systems are also possible. Assume the apartment building in the above example to have a supply room, for cleaning equipment and the like. The manager will of course need to open both the front door and the supply room, but the tenants would be permitted to open the front door only (in addition to their own apartments, of course). The manager's card may be used for both the front and the supply room, if all the locks were provided with additional switches. These switches would be permanently connected on the apartments and on the front door. Therefore it would make no difference whether or not the tenants' cards had extensions in these positions. However, the manager's card, and only his, would have the necessary extensions to control the additional switches on the supply room lock, and therefore only he could open it.

One more example—the typical master key situation: let it be supposed that the manager desired to have access to all the apartments. For maximum security, two groups of series-connected switches could be connected in

parallel, so that either group, if properly connected, would operate the lock. Two unlocking slots would then be visible. The manager's master card would be such to connect one set of switches, and the tenants' cards would each connect the other in his own apartment. Alternatively, if only one group were desired, a lock having twenty switches might be employed, and so wired that either of two different sets of connections (wired in parallel) would cause the lock to operate. The manager's card would connect one set of switches, and the tenants' cards the other set. Either would again open the lock. If desired, a switch on the inside of the door could disable the master card switches. This would allow a hotel room guest guaranteed privacy, from maids and hotel employees, for example.

Similarly, where a lock is desired necessitating the presence of two persons at the same time for unlocking, two sets of the switches of this invention may be connected in series with each other. One person's card has the extensions required for connecting one set, and the other individual's card has the required extensions for the other set. In this case, the lock will operate only when both cards are inserted.

This invention also makes possible telegraphic operation. If a safe were not to be opened until orders arrived from headquarters, the set card could be inserted and the configuration withheld. At the desired time, a simple coded message could be sent to the effect that "extensions are needed in positions 1, 3, 5, 8, . . . etc." The person in charge of opening the safe could then quickly prepare his card from a blank provided, and the safe would be opened within a few minutes.

From the above description, it is apparent that the applications of the lock of this invention are limitless. Those skilled in the art will find many other uses made possible by modifications and improvements on the above disclosure which are clearly within the scope of the invention. Therefore the only limitations to be placed on that scope are those set forth in the claims which follow.

What is claimed is:

1. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:

(a) a plurality of series-connected, two element mechanical switches, one element of each of which is movable to a predetermined one of alternate positions, and means for setting said one element into said predetermined one position; and a second element of which is movable from one position to an alternate position in response to the receipt of a card inserted into said controller, each such switch being closed only when said second of its elements is in a position which corresponds to the position of said one element; and

(b) card means coded to nonconductively edgewise engage said second element of each of said switches into said corresponding position, thereby, upon receipt of such card, closing all of said switches and forming a series circuit through all of said switches.

2. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:

(a) a plurality of series-connected, two element mechanical switches, a first element of each of which is movable from one position to an alternate position in response to the receipt of a first card inserted into said controller; and a second element of which is movable from one position to an alternate position in response to the receipt of a second card inserted into said controller, each such switch being closed only when said second of its elements is in a

position which corresponds to the position of said first elements; and

(b) a pair of card means coded to nonconductively edgewise engage said first and second elements of each of said switches into said corresponding position, thereby upon receipt of such cards, closing all of said switches and forming a series circuit through all of said switches.

3. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:

(a) a plurality of series-connected, two element mechanical switches, a first element of each of which is movable from a neutral position to a plurality of alternate positions in response to the receipt of a first card into said controller, and a second element of each of which is movable from a neutral position to one of a plurality of alternate positions in response to the receipt of a second card into said controller, each such switch being closed only when said first element is in a position which corresponds to the position of the other;

(b) a first card means having an edge with an extended portion to nonconductively edgewise engage said first element of said switches into a predetermined position; and

(c) a second card means having an edge with extended portions which correspond to those of said first card to edgewise nonconductively engage and move the other element of said switches to the position which corresponds to the position to which said first element has been set, thereby closing all of said switches and forming a series circuit through all of said switches.

4. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:

(a) a plurality of series-connected, two-element mechanical switches, a first element of each of which is movable between two positions in response to the receipt of a first card inserted into said controller, and a second element of each of which is movable between two positions in response to the receipt of a second card into said controller, each such switch being closed only under one of the following two conditions:

(1) when said first element is in a first of its said two positions and said second element is in a position which corresponds to the said first position of said first element, and

(2) when said first element is in the second of its said two positions and said second element is in the other of its said two positions which corresponds to said second position of said first element;

(b) a first card means coded to nonconductively edgewise engage said first element of each of said switches in a predetermined one of said two positions; and

(c) a second card means coded to nonconductively edgewise engage said second element of each of said switches into the position which corresponds to said predetermined position in which said first element is set, thereby closing all of said switches and forming a series circuit through all of said switches.

5. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:

(a) a plurality of series-connected, two-element mechanical switches, a first element of each of which

is movable between a neutral position and an alternate position in response to the receipt of a first card inserted into said controller, and a second element of each of which is movable between two positions in response to the receipt of a second card into said controller, each said switch being closed only when both of the following two conditions are present:

- (1) when said first element is disposed in its neutral position and said second element is disposed in a position corresponding to said neutral position of said first element, and
 - (2) when said first element is disposed in said alternate position and said second element is disposed in the position corresponding to said alternate position;
- (b) a first card means coded to nonconductively edgewise engage said first element into a predetermined position and
- (c) a second card means coded to nonconductively edgewise engage said second element of said switches into the position corresponding to said predetermined position of said first element, thereby closing all of said switches and forming a series circuit through all of said switches.
6. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:
- (a) a plurality of series-connected, two-element mechanical switches, a first element of each of which is movable between a neutral position and an alternate position in response to the receipt of a first card inserted into said controller, and a second element of each of which is movable between two positions in response to the receipt of a second card into said controller, each said switch being closed only when both of said two elements are disposed in the same position;
 - (b) a first card means coded to nonconductively edgewise engage one element of said switches into a predetermined position; and
 - (c) a second card means coded to edgewise nonconductively engage and move said second element of each of the same ones of said switches into said alternate position, thereby closing all of said switches and forming a series circuit through all of said switches.
7. In a lock having an unlocking means adapted in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:
- (a) a plurality of series-connected, two element mechanical switches, a first element of each of which is movable between a neutral position and an alternate position in response to the receipt of a first card inserted into said controller, and a second element of each of which is movable between two positions in response to the receipt of a second card into said controller, each said switch being closed only when both of the following two conditions are present:
 - (1) when said first element is disposed in its neutral position and said second element is disposed in a position corresponding to said neutral position of said first element;
 - (2) when said first element is disposed in said alternate position and said second element is disposed in the position corresponding with said alternate position;
 - (b) a first card means coded to set one element of said switches into a predetermined position;

- (c) a plurality of slidable buttons, one in contact with the second element of each of said switches, said buttons adapted, when caused to slide, to move said second elements from their neutral position to their alternate positions; and
 - (d) a second card means having an edge having at least one extension, the location of said extensions corresponding to the location of said slidable buttons so that when said card is inserted into said controller, each such extension will cause its corresponding slidable button to slide, thereby moving the corresponding element of said switches from its neutral position to its alternate position corresponding to the predetermined settings of each said first elements of each switch, thereby closing all of said switches and forming a series circuit through all of said switches.
8. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a card is inserted therein causing said signal to be passed to said unlocking means, said controller comprising:
- (a) a plurality of sets of series-connected two-element mechanical switches, said sets being connected in parallel to each other, a first element of each of said switches being movable from one position to a predetermined one of alternate positions in response to the receipt of a first card inserted into said controller, and a second element of each of said switches being movable between two positions in response to the receipt of a second card into said controller, each such switch being closed only when one of its elements is in a position which corresponds to the position of the other;
 - (b) a first card means for each set of switches coded to nonconductively edgewise engage said first element of each of said switches in one of its said plurality of positions; and
 - (c) a second card means for each set of switches coded to nonconductively edgewise engage said second element of each of the switches in the set into the position which corresponds to the setting of each of said first elements in said set, thereby closing all of the said switches in such set of switches and forming a series circuit through all of said switches.
9. In a lock having an unlocking means adapted, in response to an electric signal, to unlock said lock, the controller for unlocking said lock when a plurality of cards are inserted therein causing said signal to be passed to said unlocking means, said controller comprising:
- (a) a plurality of sets of series-connected two-element mechanical switches, said sets being connected in series with each other, a first element of each of said switches being movable between a plurality of positions in response to the receipt of a first card inserted into said controller, and a second element of each of which is movable between two positions in response to the receipt of a second card into said controller, each such switch being closed only when one of its elements is in a position which corresponds to the position of the other;
 - (b) a first card means for each set of switches coded to nonconductively edgewise engage said first element of each of said switches in one of its plurality of positions; and
 - (c) a second card means for each set of switches coded to nonconductively edgewise engage said second element of each of said switches in that set in the position which corresponds to the position in which each of said first elements is set, thereby, when cards are inserted into said controller, closing all of the said switches in all of said sets of switches and forming a series circuit through all of said plurality of sets of switches.

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