

April 14, 1959

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2,882,455

ELECTRIC LOCKING ARRANGEMENT

Filed Aug. 17, 1955

FIG. 1

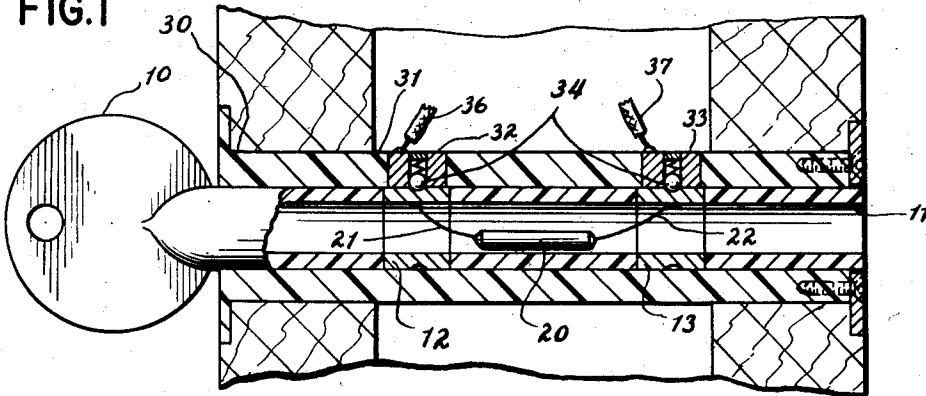


FIG. 2

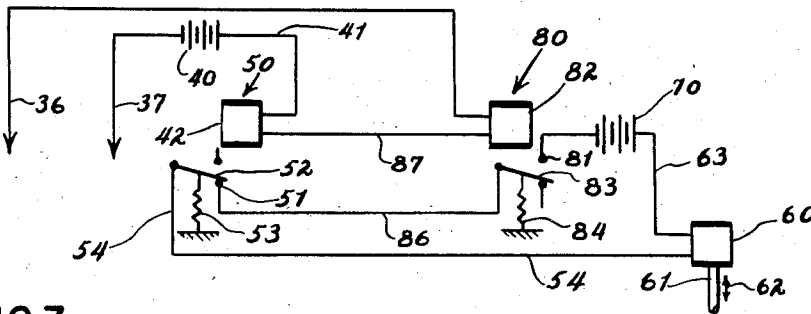


FIG. 3

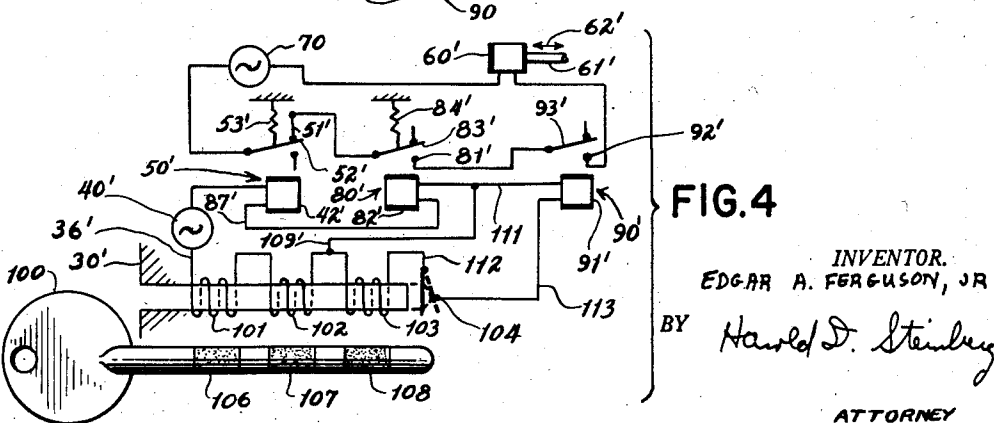
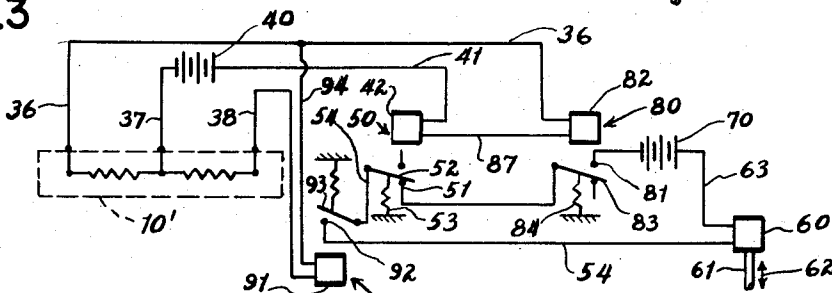


FIG. 4

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ELECTRIC LOCKING ARRANGEMENT

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Application August 17, 1955, Serial No. 528,891

2 Claims. (Cl. 317-135)

The present invention relates to a new and improved method and apparatus for providing an electric locking arrangement. More particularly the present invention relates to a new and improved electric locking arrangement which can be operated only by a unique impedance keying device.

With the conventional locking arrangements in use today it is relatively a simple matter to "pick" the lock, provided sufficient time is available and a certain expertness is used in the lock-picking procedure. To carry this out with a conventional lock, it is merely necessary to arrange the various sleeves and tumblers in the lock until they are aligned in the same manner as they are aligned when the actual key is inserted in the lock and turned.

There have been locks which have been called "pickless." These "pickless" locks merely provide a more complicated arrangement of the tumbler sleeves so that a little more time is necessary before this lock can be picked.

Electric locks have also been made heretofore. These conventional electric locks are very similar to the mechanical variety and consist of a number of cams which use a plurality of microswitches that are actuated by the insertion of the key. That is, the high points of the key make mechanical contact with the microswitches to close the same and thereby energize the lock actuating mechanism of the electric lock. These locks can be picked even more readily because by proper juggling of the various microswitches it is possible to close all of the microswitches at one time.

In all of the previously manufactured locks, either the conventional mechanical lock or the electric lock, it is possible to duplicate the key used for opening the lock. Therefore, if a person obtains the key used for opening the lock, he can duplicate it with any standard key making machine. Thus it can be seen that it is relatively easy for unauthorized duplicates of a key to be made.

On the other hand, the present invention does not use the ordinary type of key. Therefore, it is not possible to make a duplicate key on the standard key making machine, even after the key falls into unauthorized possession. By means of the present invention the key is provided with electric impedance elements. Upon insertion into the lock, the electric impedance elements contained in the key energize the lock actuating mechanism by completing the electric circuit. The electric impedance elements complete the electric circuit in a unique manner so that any other impedance or combination of electric impedances, as the case may be, will not open the electric lock.

It is accordingly an object of the present invention to overcome the disadvantages of prior art locking arrangements.

A second object of the present invention is to provide a new and improved electric locking arrangement using a unique impedance keying device.

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A further object of the present invention is to provide a new and improved electric locking arrangement using a keying device which cannot be duplicated by standard key making machines.

Another object of the present invention is to provide a new and improved electric locking arrangement using a plurality of switching means which are in either circuit-open or circuit-closed position and whose position can be varied in a desired manner by the insertion of the impedance keying device in the lock.

A further object of the present invention is to provide a new and improved impedance keying apparatus for use in an electric locking arrangement.

Yet another object of the present invention is to provide an electric locking arrangement using an impedance keying device including one or more resistances.

Still another object of the present invention is to provide a new and improved electric locking arrangement using an electric impedance keying device having a plurality of ferro-magnetic cores.

With the above objects in view the present invention mainly consists of an electric locking arrangement including lock actuating means movable between lock open and lock closed positions, a source of potential for energizing the lock actuating means, a plurality of switching means connected in circuit between the source of potential and the lock actuating means, each of the switching means being movable between circuit-open and circuit-closed position, and impedance keying means adapted to be connected in circuit between the source of potential and the switching means for determining the amount of current flowing from the source of potential through the switching means and thereby controlling the energization of the lock actuating means.

In another form, the present invention includes an impedance keying apparatus for use in an electric locking arrangement and has an elongated member with a hollow portion and an electrically insulated surface, at least a first and a second electrically conductive contact mounted on the electrically insulated surface, the contacts being electrically insulated from each other, and an electrical impedance disposed in the hollow portion of the elongated member and being connected between the first and second contacts.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantage thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a side view of an electric keying device for use with the present invention and shown partially in section;

Fig. 2 is an electric schematic diagram of an electric locking arrangement which can be operated by the impedance keying device shown in Fig. 1;

Fig. 3 is an electric schematic diagram of a second electric locking arrangement constructed in accordance with the principles of the present invention; and

Fig. 4 is an electric schematic diagram of an electric locking arrangement constructed in accordance with the principles of the present invention shown in conjunction with the ferromagnetic keying device used therewith.

Referring now to the drawings and more particularly to Figure 1, it can be seen that the impedance keying device is mounted within an elongated key-like member 10. The elongated member 10 is tubular in form and has an electrically insulated outer surface 11. Mounted on the electrically insulated surface 11 is a first annular electrically conductive contact 12 and a second annular

electrically conductive contact 13. It can be seen that the contacts 12 and 13 are spaced from each other and electrically insulated from each other.

Disposed within the hollow portions of the tubular elongated member 10 is an electric resistance element 20 which is connected to the contact 12 by a conductor 21 and to the contact 13 by a conductor 22. Shown making electrical contact with the contacts 12 and 13 is a portion of the keyhole of the lock 30. It can be seen that the keyhole 30 is made of electrically insulating material 31 in which is mounted a first electrically conductive contact 32 and a second electrically conductive contact 33. Electrical contact between the contacts 12 and 13 of the keying device 10 and the contacts 32 and 33 of the electric lock keyhole 30 may be made for example by detents 34. It can be seen that when the keying device 10 is inserted within the keyhole 30, in the proper manner, the resistor 20 will be connected between the contacts 32 and 33 of the electric lock. Connected to the contacts 32 and 33 respectively are electric conductors 36 and 37. As will be seen hereinbelow, these conductors 36 and 37 are connected to the electric circuit of the electric locking arrangement.

Referring now to Figure 2, it can be seen that the conductors 36 and 37 are connected to the electric locking arrangement shown therein. The conductor 37 is connected to one terminal of a direct-current source of potential 40, the other terminal of which is connected by a conductor 41 to the energizing coil winding 42 of a relay 50. The relay 50 has a fixed contact 51 which is normally connected to its movable armature 52 and held in that position by a spring 53.

The movable armature 52 is connected by a conductor 54 to one side of the electric lock actuating mechanism 60. In this embodiment the lock actuating mechanism 60 is a solenoid having a movable core 61 axially disposed therein and movable in the direction of the arrows 62 in a conventional manner. That is, when the solenoid 60 is energized, the core may either be attracted into the solenoid core or ejected therefrom depending on the material in the solenoid core and the desired spring arrangement. The other terminal of the solenoid 60 is connected by means of a conductor 63 to one terminal of a second direct-current source of potential 70, the other terminal of which is connected to a contact 81 of a second relay 80 having an energizing coil winding 82. It can be seen that the contact 81 of the relay 80 is normally not connected to the movable armature 83 thereof and the armature 83 is held in this open position by a spring 84. The armature 83 is connected by means of a conductor 86 to the normally closed contact 51 of the relay 50.

One side of the coil winding 82 is directly connected by a conductor 87 to one side of the coil winding 42. The other side of the coil winding 82 is connected to conductor 36.

In operation, it can be seen that the solenoid coil 60 is not normally energized because the circuit is kept in open position by the open contacts of the relay 80. However, if the relay coil winding 82 were energized this winding would attract its movable armature 83 to make contact with the normally open contact 81. This would complete the circuit from the source of potential 70 to the solenoid 60, causing the core 61 of the solenoid to be moved and thereby open the electric lock. It can be seen that the coil winding 82 of the relay 80 will be energized by the source of potential 40 if electrical contact is made between the conductors 36 and 37. If the conductors 36 and 37 were directly connected together the current in the circuit of the potential source 40 would depend upon the resistance of the coil windings 42 and 82 which would be connected in series across the terminals of the potential source 40.

However, if an electrical resistance is connected between these conductors 36 and 37, it can be seen that the

current flowing through the coil windings 42 and 82 will be further limited by the resistance of this electric resistance. If this resistance connected between conductors 36 and 37 is very small, the current drawn from the potential source 40 will be relatively large and will energize both the coil windings 42 and 82. If this happens, the armatures 83 and 52 will be respectively attracted by their energized coil windings. This would prevent the direct-current potential source 70 from energizing the solenoid 60 since the movement of the armature 52 against the action of the retaining spring 53 would open the circuit from the potential source 70 to the solenoid 60.

Conversely, if a very large electrical resistance is connected between the conductors 36 and 37, a comparatively low current will flow in the circuit of the source 40 and the armature 83 will not be attracted by its coil winding 82. That is, the coil winding 82 will not be energized because the current flowing through its winding would be too small to energize it. Accordingly, if too large a resistance is placed between the conductors 36 and 37, the circuit from the source 70 to the solenoid 60 will be kept in open condition by the unenergized relay 80.

On the other hand, if the electric keying device containing the resistance 20 of Figure 1 is inserted in the electric keyhole 30, and this resistance 20 has a predetermined resistance, the current in the circuit of the potential source 40 will be established at a predetermined level which will be sufficient to energize the coil winding 82 of the relay 80 but not sufficient to energize the coil winding 42 of the relay 50.

Therefore, under the last-mentioned condition, the armature 83 will be attracted against the action of its retaining spring 84 into electrical contact with the contact 81 of the relay 80. Meanwhile the armature 52 of the relay 50 will remain in its normal position, namely, making contact with its fixed contact 51. It can be seen that the circuit from the direct-current potential source 70 will now be completed. This circuit is completed from one side of the source 70 to the contact 81, the armature 83, the conductor 86, the fixed contact 51, the armature 52, the conductor 54, the coil of the solenoid 60, and the conductor 63 to the other terminal of the source 70. Therefore, the solenoid 60 will be energized to either attract its core 61 or eject the core 61 depending on how the spring of the conventional solenoid 60 and the materials of the core 61 are arranged. Thus it can be seen that the windings 42 and 82 of the relays 50 and 80 respectively may be chosen initially to have the desired resistance so that the chosen resistance of the impedance keying device will establish a total resistance in the circuit of the potential source 40 which will provide a current of the desired magnitude.

It is apparent that only a single direct-current potential source could be used instead of two separate direct-current potential sources 40 and 70. Also, the relay 80 may be of the conventional time-delay type. That is, a slight time delay can be introduced after the coil 82 is energized and before the armature 83 makes contact with the fixed contact 81. This may be desirable since it can be seen that if too large a current is established in the circuit of the source 40, it is possible for the coil winding 82 to be energized before the energization of the coil 42. Accordingly, the solenoid might be operated by a resistor which is too low in value. However, it can be seen that if the relay 80 has a slight time delay in its operation, it will not be possible for the relay 80 to open before the relay 50 is operated, in the event of too large a current in the circuit of the potential source 40.

Referring now to Figure 3 a second embodiment of the present invention is shown. This embodiment includes the relays 50 and 80 and the solenoid 60 of the circuit of Figure 2. In addition those elements having the same function and location for Figure 3 as for Figure 2 are

numbered with the same numerals. In this embodiment the keying device 10, which is shown only schematically, includes the resistor 20, connected between the conductors 36 and 37, and a second resistor 25 which is connected between the conductor 37 and the conductor 38. It is clear that the conductor 38 may make contact with a third electrical contact in the electric keyhole device 30 arranged in the same manner as shown in Figure 1.

The conductor 38 is connected to one side of an energizing coil winding 91 of a third relay 90. The relay 90 has a fixed contact 92 connected by conductor 54 to one side of the solenoid 60. The relay 90 also has a movable armature 93 connected on conductor 54 to the movable armature 52 of the relay 50. The other terminal of the energizing coil winding 91 is directly connected by a conductor 94 to the conductor 36.

It can be seen that the primary difference between the circuit of Figure 2 and the circuit of Figure 3 is that the conductor 54 of Figure 2 has been opened and the contacts 92 and 93 of the relay 90 inserted therein.

Accordingly, it can be seen that a second circuit has been added to the circuit of the potential source 40. From Figure 3 it is apparent that the current flowing through the energizing coil winding 91 of the relay 90 is the result of two currents. The first current is established by the current flowing from one terminal of the potential source 40 through the conductor 37, the resistor 25, the conductor 38 and the resistance of the coil winding 91. The remaining current is established by the currents flowing through the coil windings 82 and 42 of the relays 80 and 50 respectively.

In operation, the impedance keying device 10' containing the resistors 20 and 25 is inserted in the electric keyhole. The current established in the coil windings 82 and 42 of the relays 80 and 50 is determined as before by the size of the resistor 20. However, even if both relay windings have the proper amount of current established therein the circuit may still not operate. That is even if the relay 80 is energized and the armature 83 is attracted to the fixed contact 81 thereof and the relay 50 remains in its unenergized position, the circuit between the potential source 70 and the solenoid 60 will still not be completed.

It can be seen that this circuit will remain open as long as the relay 90 remains in its normal unenergized condition. Therefore, if the proper resistor 25 is in the impedance keying device and the proper current has been set up through the coil windings 50 and 80 by the resistor 20, a second current will be established in the energizing coil winding 91 of the relay 90. This second current will energize the relay 90 and cause its armature 93 to be attracted to the fixed contact 92.

Accordingly, if the proper resistors 20 and 25 are included in the proper relationship in the impedance keying device, two currents will be set up, the first current will energize the relay 80 and will be insufficient to energize the relay 50. The second current will be sufficient to energize the relay 90. Accordingly, the relays 80 and 90 will be energized and the relay 50 will remain in unenergized condition. Since the relay 50 is normally closed and the relays 80 and 90 are normally open, the energization of relays 80 and 90 will complete the circuit from the potential source 70 to the solenoid 60 thereby operating the lock actuating mechanism.

It is of course apparent that the various retaining springs used with the armatures of the relays are properly tensioned so that the exact amount of current will attract the armature against the retaining pressure of the respective spring. Accordingly, it can be seen that the circuit of Figure 3 provides additional protection which is not available in the circuit of Figure 2. It will be impossible to duplicate the keying mechanism of circuit of Figure 3 since the number of combinations of different resistances 20 and 25 is very large.

Referring now to Figure 4, still another form of ap-

paratus incorporating the principles of the present invention is shown. In this embodiment, alternating current-sources of potential are used rather than the previous direct-current sources of potential. The various elements in Figure 4 having the same function as in Figure 3 are labeled with corresponding numerals. However these numerals contain a prime to indicate that they are A.C.-operated rather than D.C.-operated. That is, the relays 50', 80', 90' and the solenoid 60' are all A.C.-operated relays and the solenoid 60' is also A.C.-operated. The potential sources 40' and 70' are conventional sources of alternating-current potential. It is apparent that these sources 40' and 70' may be conventional oscillators which emit an alternating-current potential at a particular frequency.

In the keyhole portion of the present apparatus three coils are provided. These three coils 101, 102 and 103 are each wound about the tubular opening of the keyhole 30'. It is apparent that this is the tubular opening which is adapted to receive the cylindrical keying device. At the right end portion of the keyhole device 30' is mounted a microswitch 104. It is well known in the art that a microswitch is a switch which is operated by a very slight pressure on its movable contact.

In Figure 4, disposed beneath the keyhole 30' is shown the impedance keying device 100 to be used therewith. As before, the keying device 100 is in the form of an elongated member. However, in this case the body of the elongated member 100 is nonmagnetic and contains three cores 106, 107 and 108 made of ferromagnetic material. It can be seen that the three cores are mounted on the keying device 100 and are spaced from each other by the nonmagnetic portion of the device 100.

When the keying device is inserted in the keyhole 30', the right end portion thereof closes the microswitch 104. This is shown by the dotted lines in the figure. The three cores 106, 107 and 108 are then respectively disposed and aligned within the three coils 101, 102 and 103. All is well known in the art, the insertion of a ferromagnetic core within a coil winding substantially increases the inductance of the coil winding. The amount that the inductance of the coil winding is increased depends upon the saturation of the ferromagnetic core and the type of material used for the core.

The coils 101 and 102 are connected in series between the conductors 36' and 109' respectively, the free end of the coil 101 being connected by conductor 36' to one terminal of the source 40' of the alternating-current potential. The conductor 109' is connected to the conductor 111 which in turn is connected to one side of each of the relay windings 82' and 91'. The other end of the coil 103 is connected by conductor 112 through the microswitch 104 and conductor 113 to the other end of the energizing coil winding 91' of the relay 90'.

As before, it can be seen that the current established by the source 40' of alternating-current potential in the windings of the relays 50' and 80' respectively, is dependent upon the inductance or impedance of the coils 101 and 102.

The current flowing through the winding 91' of the relay 90' is dependent upon two currents, the current previously mentioned and the current flowing through the coil 103. This latter current is of course dependent upon the impedance of the coil 103.

Therefore, in operation, the impedance keying device 100 is inserted in the keyhole 30' and closes the microswitch 104 as illustrated. If the cores 106 and 107 are the proper ones, they will establish the impedance of the coils 101 and 102 to properly establish the current flowing from the source 40' through the relays 50' and 80'. Therefore, the relay 50' will remain unenergized and the relay 80' will be energized. However, this will not complete the circuit from the second source of alternating potential 70' to the solenoid 60' unless the relay 90' is also energized.

The relay 90' will be energized if the core 108 inserted within the coil 103 establishes the impedance of the coil 103 at the desired proper level. This will establish the current flowing through the coil 90' at its proper level. Accordingly, the relay 90' will be energized and the circuit from the source of alternating current potential 70' to the solenoid 60' will be completed.

It is apparent that if too large an impedance or too small an impedance is established in any of the three coils 101, 102 and 193 by any of the cores 106, 107 and 108, respectively, the relays will not operate to close the circuit between the source of potential 70' and the solenoid 60'. Therefore, it can be seen that this arrangement is absolutely fool proof since the saturation of the cores 106, 107 and 108 can be set up one time only when the apparatus is initially assembled. It will be practically impossible to duplicate such a keying device. Therefore, the embodiment shown in Figure 4 is particularly advantageous for use in banks and other locations where it is particularly desirable to have one key and one key only, available.

It is of course apparent also that different combinations of resistances and inductances may be used in the same impedance keying device. It is also clear that capacitors can be used instead of resistors or inductors. It is not absolutely essential to use relays but other types of switching mechanisms which can be operated by currents or voltages may also be used.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of electric locking arrangement differing from the types described above.

While the invention has been illustrated and described as embodied in electric locking arrangements using electric impedance devices, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An electric locking arrangement, comprising in combination, lock actuating means movable between lock open position when energized and lock closed position when deenergized; a source of potential for energizing said lock actuating means; at least a first relay having a first coil winding and a pair of normally closed contacts in circuit between said source of potential and said lock actuating means, said normally closed contacts being opened when said first coil winding is energized; at least a second relay having a second coil winding and a pair of normally open contacts in circuit between said source

of potential and said lock actuating means, said normally open contacts being closed when said second coil winding is energized; actuating means for energizing said first and second coil windings; a plurality of coils connected in circuit between said actuating means and said first and second coil windings each of said plurality of coils having a preselected inductance which is different respectively from any of said other coils; and impedance keying means including a plurality of ferromagnetic cores, each of said ferromagnetic cores being adapted to be simultaneously connected in operable relationship, respectively, with one of said plurality of coils for controlling the energization of said first and second coil windings, the permeability of each of said ferromagnetic cores being respectively different from the permeability of any of said other ferromagnetic cores and co-operating solely with said preselected inductance of its respective coil in a predetermined manner.

2. An electric locking arrangement, comprising in combination, lock actuating means movable between lock open position when energized and lock closed position when deenergized; a first source of potential for energizing said lock actuating means; at least a first relay having a first coil winding and a pair of normally closed contacts in circuit between said source of potential and said lock actuating means, said normally closed contacts being opened when said first coil winding is energized; at least a second relay having a second coil winding and a pair of normally open contacts in circuit between said source of potential and said lock actuating means, said normally open contacts being closed when said second coil winding is energized; a second source of potential, at least said second source of potential being an alternating-current source of potential for energizing said first and second coil windings; a plurality of coils connected in circuit between said actuating means and said first and second coil windings each of said plurality of coils having a preselected inductance which is different respectively from any of said other coils; and impedance keying means including a plurality of ferromagnetic cores, each of said ferromagnetic cores being adapted to be simultaneously connected in operable relationship, respectively, with one of said first and second coil windings, the permeability of each of said ferromagnetic cores being respectively different from the permeability of any of said other ferromagnetic cores and co-operating solely with said preselected inductance of its respective coil in a predetermined manner.

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