May 4, 1954 H. C. MILLER 2,677,814

ELECTRICAL PERMUTATION LOCK

Filed Sept. 5, 1950

3 Sheets-Sheet 1

Fig. 1.

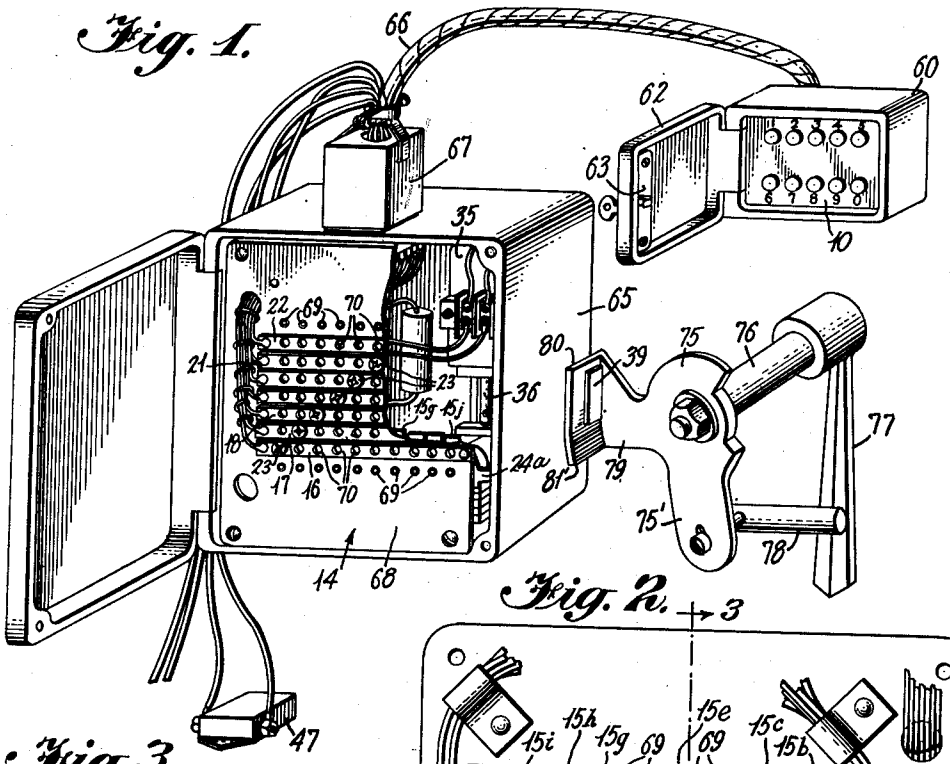


Fig. 2.

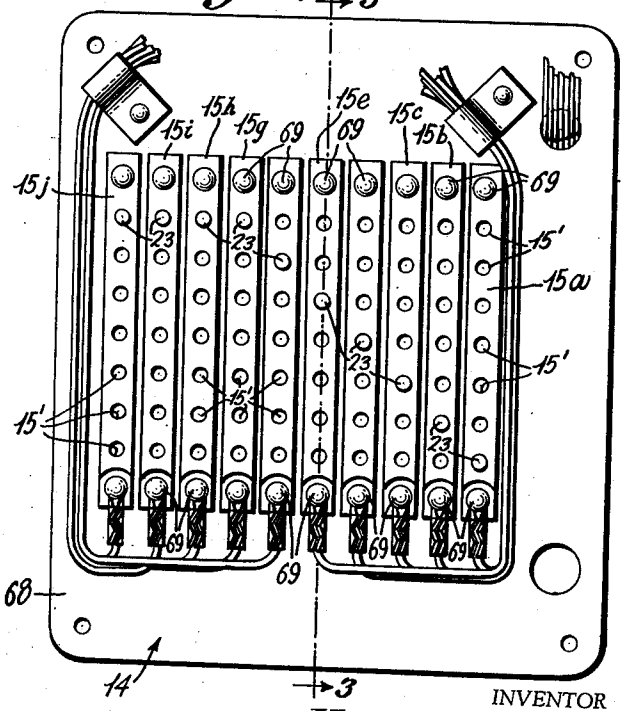
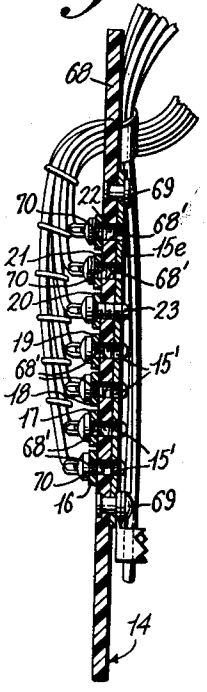


Fig. 3.



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Fig. 4.

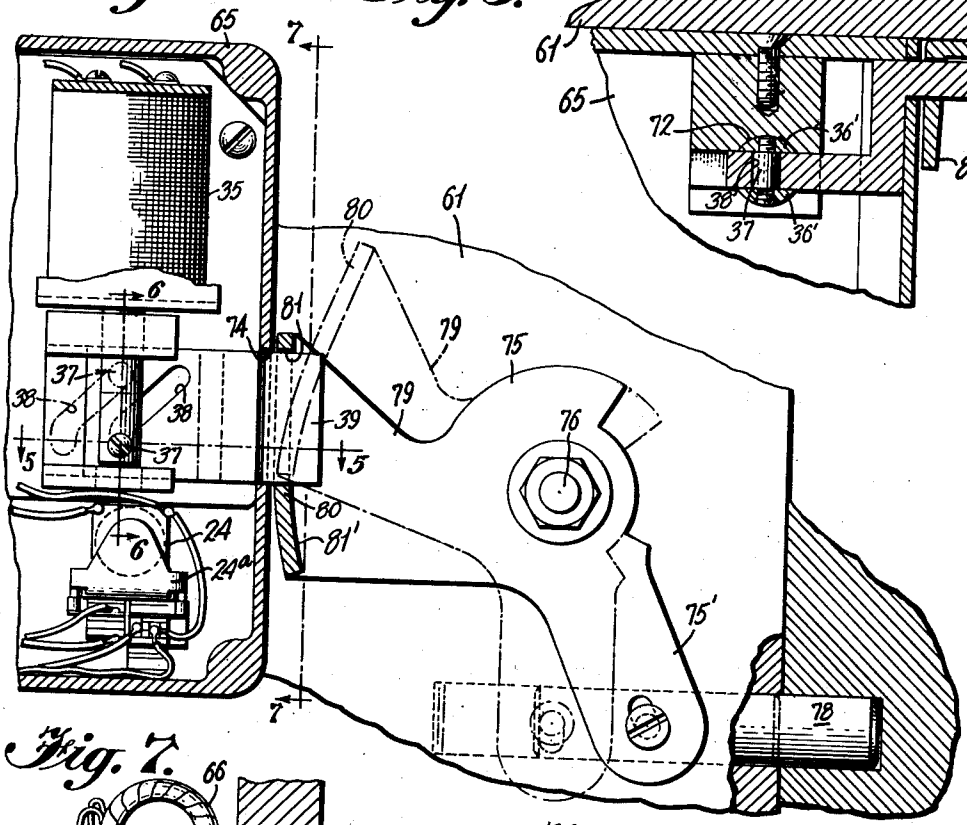


Fig. 5.

Fig. 7.

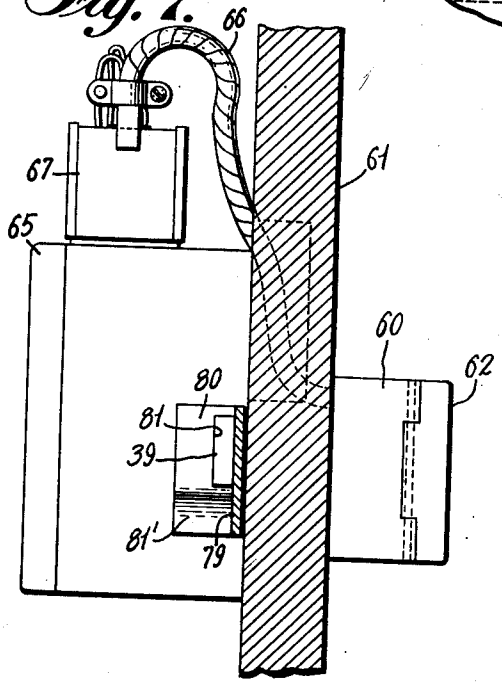
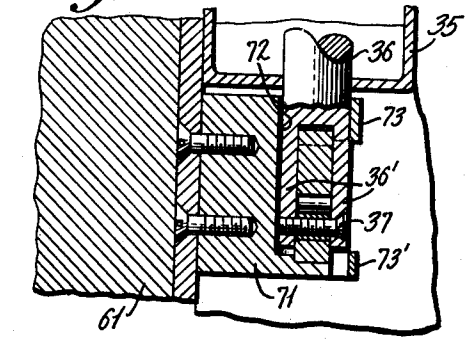


Fig. 6.



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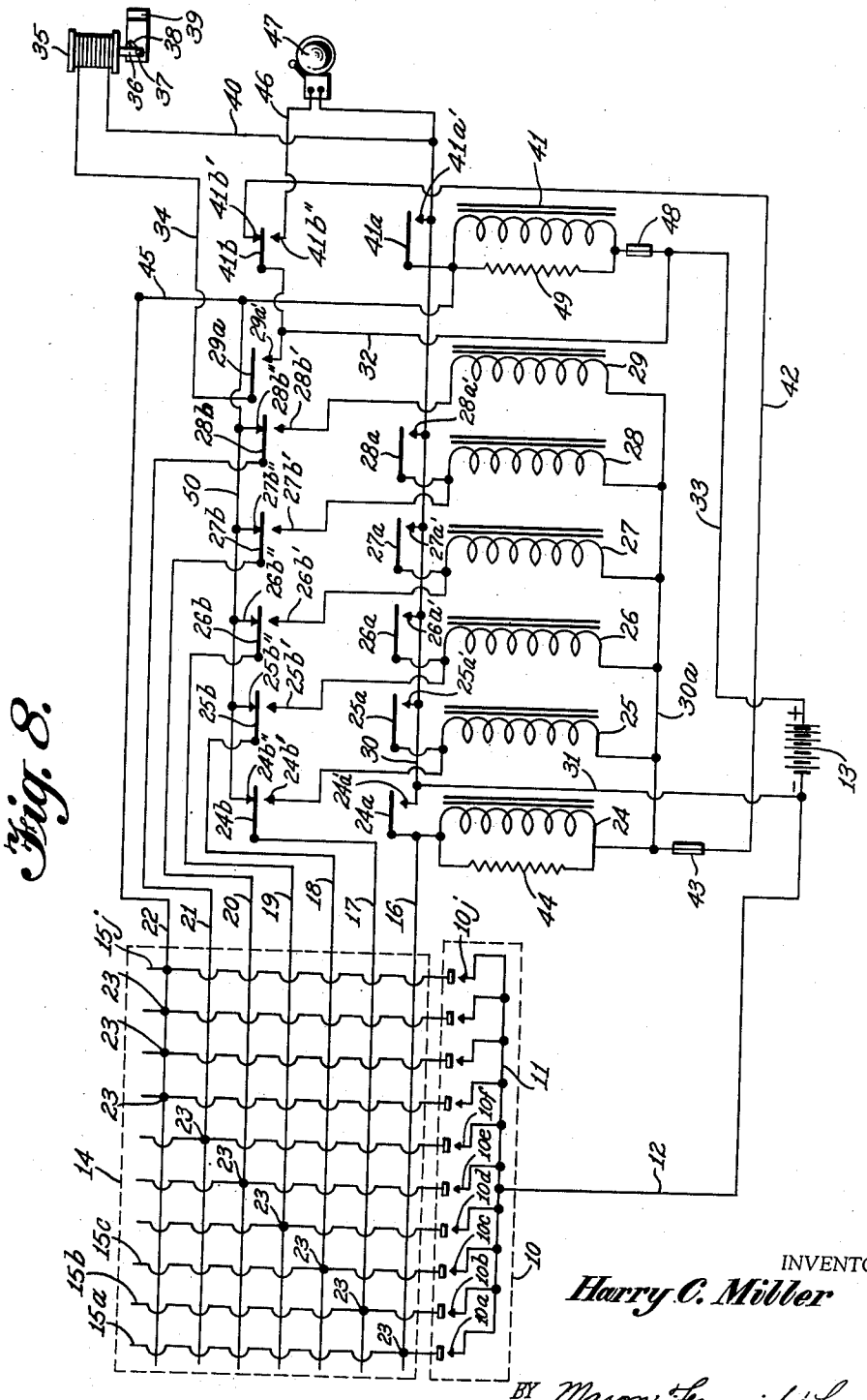


Fig. 8.

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ELECTRICAL PERMUTATION LOCK

Harry C. Miller, Fairfax, Va.

Application September 5, 1950, Serial No. 183,167

2 Claims. (Cl. 340—147)

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The present invention relates in general to permutation locks, commonly referred to as combination locks, and is particularly directed to a permutation lock in which a plurality of electrical relays are operated sequentially to close a final circuit which operates the bolt of the lock.

Permutation locks, commonly referred to as combination locks, are, of course, well known. The majority of these locks in the past have been of the mechanical type, in which a plurality of mechanical elements, usually referred to as tumblers, each having a notch or gate, must be brought into predetermined alignment to receive a fence before the bolt can be withdrawn. The security of such locks is dependent upon the fact that the number of orders or permutations of the possible relative positions of each of these tumblers before all of the gates are brought into proper register to permit the operation of the lock, is so large that the chances of a person not familiar with the combination being able to align the gates and open the lock, is so small as to be negligible. In these previous locks the tumblers are usually operated directly by a manually controlled dial. However, devices are known in which the tumblers or their mechanical equivalents are operated by remote control through appropriate electrical circuits.

These prior art mechanical combination locks, however, have been found to be fairly susceptible to being worked by skilled safe-crackers. Because of the mechanical elements involved in such locks, a faint "click" may be detected when one of the tumblers is rotated into proper aligned relation to receive the fence. Therefore, by working the dial through repeated trials, as the combinations are comparatively few, the dial readings for the aligned positions of the tumblers may be worked out by detecting these mechanical "clicks" to break the combination.

The present invention relates to a permutation lock in which the mechanical elements which might give rise to mechanical "clicks" or noises suggestive of the combination have been eliminated, and in which permutations are obtained by utilizing a plurality of electrical relays which must be operated in a particular sequence in order to energize the final bolt actuating circuit. Such an electrical system provides a marked improvement in the security of the lock, as the tumbler "clicks" above referred to are eliminated. Additionally, electrically controlled elements are provided to energize a remote alarm device, if the manual actuated selector elements, such as pushbuttons and the like, not part of the lock

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combination or in improper sequence, are depressed or manually actuated, and to deenergize the entire system of relays if the proper combination of pushbuttons are not actuated within a preselected time interval. An arrangement is also provided intercoupling the sequentially arranged relays with the pushbutton panel for rapidly and simply selecting and changing the combination. Means are also associated in the instant device for operating the lock from a distance so that the safe may be in one part of a room or building and the controls may be in another part of a building or room which is constantly under the surveillance of a guard or watchman.

An object, therefore, of the present invention is the provision of a novel electrical permutation lock, which readily lends itself to separation of the locking elements from the electrical circuits, and which provides further security in locks for safes and the like.

Another object of the present invention is the provision of a novel electrical permutation lock wherein the permutations for actuating the bolt are obtained by actuating a system of electrical devices, to eliminate mechanical noises from which the combination might be broken.

Another object of the present invention is the provision of a novel electrical permutation lock wherein a plurality of electrical devices must be operated in a particular sequence in order to effect withdrawal of the bolt.

Another object of the present invention is the provision of a novel electrical permutation lock wherein a plurality of manually operable elements controlling a selective system of electrical devices must be operated in proper sequence within a preselected time interval to effect retraction of the bolt.

Another object of the present invention is the provision of a novel electrical permutation lock having a plurality of manually actuated switches, less than the whole number of which must be actuated in a preselected sequence to effect retraction of the bolt, and wherein actuation of switches other than those forming the combination, or actuation of the combination-forming switches in improper sequence, will energize a remote alarm.

Another object of the present invention is the provision of a novel electrical permutation lock having time-limitation means for resetting the system on failure to manually set up the combination within a preselected time interval and having remote alarm means energized when error

is made in attempting to manually set up the combination.

Other objects, advantages and capabilities of the present invention will become apparent from the following detail description taken in conjunction with the accompanying drawings, wherein only a preferred embodiment is shown:

In the drawings:

Figure 1 is a perspective view illustrating the physical assemblage of the components of the permutation electrical lock embodying the present invention, showing the manner in which the components are assembled in their respective housings;

Figure 2 is a rear elevation of the mounting panel supporting the combination selector terminal board, viewed from within the electrical unit housing;

Figure 3 is a vertical section of the combination selector grid supporting panel, taken along the lines 3—3 of Figure 2;

Figure 4 is an elevation of the locking block assembly and bolt latch mechanism, with parts broken away to illustrate the interaction thereof;

Figure 5 is a horizontal transverse section of the locking block and associated operating means therefor, taken along the lines 5—5 of Figure 4;

Figure 6 is a vertical transverse section of the intercoupling between the locking block and solenoid core, taken along the lines 6—6 of Figure 4;

Figure 7 is a vertical transverse section of a safe door, taken along the lines 7—7 of Figure 4, illustrating a preferred manner of mounting the locking assembly housing and pushbutton housing thereon; and

Figure 8 is a schematic circuit diagram of the electrical circuit of the instant electrical permutation lock.

Referring to the drawing, wherein corresponding parts are designated by like reference characters throughout the several figures, particular reference being had to Figure 8 showing a schematic diagram of the electrical circuit, a panel of manually actuated switches or pushbuttons, generally indicated at 10, is provided. The number of these pushbuttons in the pushbutton panel 10 will preferably exceed the number of digits forming the lock combination by a relatively large number of buttons, in order to increase the security and reduce the likelihood of a lock-breaker being able to break the combination. For purposes of these detailed descriptions, only 10 of such pushbuttons are illustrated, these being numbered successively 10*a* through 10*j*. A common lead 11 connects one element of each of the pushbuttons 10*a* to 10*j*, through a lead 12 to the negative side of a battery or other suitable source of direct current voltage, schematically indicated at 13.

The other elements of each of these pushbutton contacts 10*a* to 10*j* are each connected to a grid-like unit forming a combination selector terminal board, generally indicated at 14. This combination selector terminal board comprises a plurality of mutually parallel, vertically arranged, elongated conductor elements or busses indicated at 15*a* to 15*j*. A plurality of mutually parallel generally horizontally arranged elongated conductors 16 to 22, inclusive, are likewise provided, extending in a plane parallel and closely adjacent to the plane of the vertical busses 15*a* to 15*j*, each of the horizontal conductors 16 to 22 extending across the entire series of vertical busses 15*a* to 15*j*. The desired combination may be selected by bridging the points of intersection

of the vertical busses 15*a* to 15*j* and the horizontal conductors 16 to 22, by suitable conductive elements such as those indicated generally at 23, this being operative to set up the combination by the selection of these various bridging points 23, as will be more fully described hereinafter.

Actuation of the lock to release the safe door is effected by means of a plurality of electrical relays, which are intercoupled in a relay system so that the relays must be progressively energized in a preselected sequence, the last relay in the sequence having contact means for actuating the locking bolt. These relays are schematically indicated at 24 to 29 inclusive, the first five of which are provided with two groups of contact elements. The contacts 24*a* to 28*a* form an electrical interlock for locking the relay coil associated therewith in circuit once the coil is energized, and contacts 24*b* to 28*b* form a conditioning relay in the sequence system to condition the next succeeding relay coil in the sequence to be energized.

Referring to the sequence system of relays more specifically, the horizontal conductor 16 in the combination selector grid 14 is coupled directly to the top of the coil of relay 24, and to the movable contact arm of the relay contact group 24*a*. The fixed contact element 24*a*′ of the relay contact element 24*a* is intercoupled by means of a lead 30 with the fixed contacts of each of the relay contact groups 25*a*, 26*a*, 27*a*, 28*a*, and is intercoupled by means of a lead 31 with the negative side of the D. C. voltage source 13. The lower side of the relay coil 24 is intercoupled by means of a lead 30*a* with the lower side of each of the other relay coils 25 to 29 inclusive, which lead is indirectly coupled to the positive side of the D. C. potential source 13 in a manner to be later described.

The movable arm of the other relay contact group 24*b* is coupled directly to the horizontal conductor 17 in the combination selector terminal board 14, and is adapted to be drawn into contact with contact 24*b*′ on energization of relay coil 24, the contact 24*b*′ being coupled directly to the top of the next succeeding relay coil 25 to condition relay 25 to be the next energized. Thus on energization of the relay coil 24 by depressing pushbutton 10*a*, it being assumed that the vertical bus 15*a* coupled thereto is bridged to the lowermost horizontal conductor 16 by bridging conductor 23, the contact group 24*a* coupled thereto will be closed, locking in the circuit through relay coil 24, and the movable arm of the contact group 24*b* will contact the point 24*b*′ to condition the second relay 25 to be energized on depressing the button 10*b*. The pushbutton 10*b*, as illustrated in the drawing, is intercoupled to the horizontal conductor 17 of the combination selector grid 14, by bridging the bus 15*b* thereto.

The relay 25 is likewise provided with two contact groups, the contact group 25*a* forming electrical interlock to lock the coil 25 in current conducting relation through the leads 30 and 31 to the negative side of the D. C. voltage source 13. The movable arm of the other contact group 25*b* is coupled directly to the horizontal conductor 18 of the combination selector grid 14, and is adapted, on energization of the coil 25, to close the circuit through the contact point 25*b*′ coupled to the top of the next succeeding relay coil 26 to condition the same to be energized on depressing the selector button associated with the

vertical bus in the selector grid 14 bridged to the horizontal conductor 18.

Likewise, the next succeeding relay coils 26, 27 and 28, are provided with contact groups 26*a*, 27*a* and 28*a*, the movable arm of which is coupled to the top of its associated coil to close the circuit through the leads 30 and 31 to the D. C. source 13 and lock the respective coils 26, 27 and 28 in energized condition once current has been passed through them. Each of these coils 26, 27 and 28 likewise have contact groups 26*b*, 27*b* and 28*b*, the movable arms of which are coupled directly to the horizontal conductor elements 19, 20 and 21, respectively, in the combination selector terminal board. On closing the contacts 26*b*, 27*b* and 28*b* by energization of the preceding relay coil, the relays 27, 28 and 29, respectively, are conditioned to be energized by depressing the pushbuttons in the pushbutton panel 10 associated with the vertical busses bridged to the conductors 19, 20 and 21. To this end, the movable arms of each of the contacts 26*b*, 27*b* and 28*b* are adapted, when their associated relay coils are energized, to move into electrical contact with fixed contact points 26*b*', 27*b*' and 28*b*', respectively, coupled to the top to the next succeeding relay in the sequence series.

The relay 29, the last in the series of relays forming the relay sequence system, is provided with but one group of contact elements, indicated at 29*a*, having a fixed contact point 29*a*' coupled directly through leads 32 and 33 to the positive side of the D. C. voltage source 13. The movable arm of the contact group 29*a* is coupled through a lead 34 to the coil of a solenoid 35, the solenoid 35 having a plunger 36 intercoupled by means of a lug 37 with the inclined slot 38 of a movable locking block 39 forming the retractable latch elements of the lock. The other side of the solenoid coil 35 is coupled through a lead 40 to the common lead 30, which in turn is connected to the negative side of the D. C. source 13 through lead 31, so that energizing the relay coil 29 closes the contact group 29*a* and passes current through the solenoid coil 35 to retract the locking block 39.

An additional relay, indicated at 41, forming an error alarm relay, is likewise provided, this relay having two groups of contact elements 41*a* and 41*b*. The group of contact elements 41*a* forms an electrical interlock for the relay coil 41, in the same manner as electrical interlock contacts 24*a* to 28*a*, and to this end is provided with a movable arm coupled to the top of the relay coil 41, and a fixed contact element 41*a*' coupled to the lead 30, and thus to the negative side of the D. C. voltage source 13 through leads 30 and 31. The group of contact elements 41*b* constitutes the circuit means normally applying B+ voltage to the lower common lead 30*a* for the coils 24 to 29 inclusive, and to this end comprises a movable arm coupled directly to the lead 32, and through leads 32 and 33 to the positive side of the D. C. voltage source 13. The movable arm of the contact elements 41*b* is normally in closed contact relation with the fixed contact 41*b*', which contact is coupled through lead 42 and through normally closed bimetallic contact 43 to the common lead 30*a* coupled to the lower end of each of the relay coils 24 to 29. In this manner, when no current is flowing through the relay coil 41 and the movable arm of the group of contact elements 41*b* is in closed conductive relation with the fixed contact 41*b*',

B+ voltage is applied from the source 13 through leads 33 and 32, movable arm of the contact group 41*b*, fixed contact 41*b*', leads 42 and bimetallic contact 43 to the common lead 30*a* at the lower end of the relay coils 24 to 29. A resistor 44 is disposed across the relay coil 24 parallel therewith, and in proximate heat exchange relation with the bimetallic contact elements 43, to open the contacts 43 when current has flowed through the coil 24 and resistor 44 for a preselected time interval, the resistor 44 radiating heat sufficient to separate the bimetallic contact 43. This preselected interval is normally set at 15 seconds. It will be apparent, therefore, that due to the radiation of heat from the resistor 44 to the bimetallic elements 43 on energizing coil 24, the entire sequence system of coils must be energized within the preselected time interval in order to energize the solenoid 35 and withdraw the locking block 39, else the circuit will be broken from the lower side of the coils 24 to 29 to the positive side of the D. C. voltage source 13 by opening of the bimetallic contacts 43.

The top side of the relay coil 41 is coupled through lead 45 to the uppermost horizontal conductor element 22 of the combination selector grid 14, this element being bridged by means of conductive elements 23 to each of the vertical busses which are not bridged to the horizontal conductors 16 to 21 and thus forming part of the combination. It will be apparent, therefore, that actuation of any of the pushbuttons, 10*g* to 10*j* inclusive, in the illustrated circuit, will momentarily close the circuit through the lead 45 and relay coil 41, to energize the error alarm relay and break the circuit between the positive side of the voltage source 13 and the common conductor 30*a* at the lower end of the relay coils 24 to 29, thus deenergizing each of these coils.

Energization of the error alarm relay coil 41 likewise moves the movable arm of contact group 41*b* into circuit closing relation with a normally open fixed contact 41*b*'', which is directly intercoupled through lead 46 with an audible alarm device or buzzer 47, which in turn is coupled through the leads 30 and 31 to the negative side of the voltage source 13. Closing of the movable arm of contact element 41*b* with the contact 41*b*'' will close the circuit through the alarm or buzzer 47, preferably located remote from the safe on which the instant lock is mounted, to produce an audible signal indicating that an error has been made in attempting to set up the combination on the pushbutton panel 10.

A suitable bimetallic thermal contact 48 is disposed between the lower end of the coil 41 and the lead 33, the bimetallic contact being disposed adjacent a thermal resistor 49 disposed close to the coil 41 and parallel therewith to open-circuit the error alarm relay coil 41 after energization thereof for a preselected time interval, preferably five minutes.

An additional series of fixed contacts 24*b*'' to 28*b*'' are provided in normally closed relation to the contact arms 24*b* to 28*b*, respectively, and coupled through a common lead 50 to the lead 45. It will be apparent that depression of any of the buttons 10*b* to 10*f* before the prior relays in sequence series are energized, will energize the alarm relay 41 in the same manner as depression of the buttons 10*g* to 10*j* to indicate error.

Assuming that the combination is set up on the combination selector grid 14 in the manner illustrated in Figure 8, that is, with the sequence sys-

tem relay coils 24 to 29, inclusive, coupled to the pushbuttons 10*a* to 10*f* respectively, by bridging the vertical busses 15 connected thereto to the horizontal conductors 16 to 21 respectively, operation of the electrical circuit actuating the locking block solenoid 35 is substantially as follows:

On depression of the pushbutton 10*a*, the negative side of the D. C. potential source 13 is coupled through the lead 12 and horizontal conductor 16, to the top of the first relay coil 24, the bottom side of the coil being coupled through normally closed thermal contact 43, lead 42, fixed contact 41*b*′ and movable contact arm 41*b*, and leads 32 and 33, to the positive side of the voltage source 13. Energizing the relay coil 24 in this manner draws the movable arm 24*a* in the closed circuit relation with the fixed contact 24*a*′, coupled through the lead 31 to the negative side of the D. C. source 13, to lock the relay coil 24 in energized condition. The movable arm of the contact group 24*b* is likewise drawn into circuit closed relation with the fixed contacts 24*b*′, thus closing the circuit between the horizontal conductor 17 on the selector terminal board 14 and the top of the second relay coil 25. Depression of the pushbutton 10*b* in like manner established the circuit through the horizontal conductor 17, the movable arm 24*b*, and fixed contact point 24*b*′ to the top of the relay coil 25, thus coupling the negative side of the D. C. source 13 to the top of the relay coil 25. Since the lower end of the relay coil 25 is coupled through conductor 30*a*, normally closed thermal contacts 43, lead 42, fixed contact 41*b*′ and movable contact arm 41*b*, and leads 32 and 33, to the positive side of D. C. source 13, a closed current path is thereby established through relay coil 25, thus energizing this coil, locking the same in energized condition by closing the contact group 25*a*, and conditioning the next relay coil 26 to be energized by closing the circuit between movable contact arm 25*b* and fixed contact point 25*b*′. In like manner depression of push-buttons 10*c* and 10*d* in proper succession energizes the relay coils 26, 27 and 28, locking the same in energized condition by closing the group of contacts 26*a*, 27*a* and 28*a*, and conditioning the next successive coils to be energized by coupling the top of the same to the next successive pushbuttons in the series. Energizing of the last pushbutton 10*f* in the combination, applies B— to the top of the relay coil 29, energizing the same and closing the contacts 29*a* and 29*a*′ to energize the solenoid 35, and withdraw the locking block 39 from locking position. If the entire combination of pushbuttons 10*a* to 10*f* inclusive are not depressed in the proper sequence and within the preselected time interval required for the thermal contacts 43 to open due to heat evolved from current flow in the resistor 44, the entire system will be reset, as the circuit between the lower ends of the relay coils 24 to 29 inclusive and the positive side of the voltage source 13 are opened by the thermal contacts 43.

Depression of one of the pushbuttons 10 in improper sequence will energize the error relay coil 41, to energize the remote alarm 47. For example, assuming that the pushbutton 10*a* has already been depressed and the operator erroneously depresses the button 10*c* next, the movable contact 26*b* will be in its normally circuit closing relation with the fixed contact point 25*b*″, which is connected through the lead 50 and lead 45 to the top of the error alarm relay coil 41, the coil 25 not having been previously energized, so that the energizing circuit will be established through the coil 41 to move the contact arm 41*b* and energize the remote alarm 47. In like manner, depression of any of the pushbuttons 10*g* to 10*j* inclusive, bridged to the uppermost horizontal conductor 22, will establish the circuit through the alarm relay coil 41 to energize the alarm 47. After the error alarm relay coil 41 has been energized, it is locked in by the interlock contacts 41*a*, 41*a*′, to continuously energize the remote alarm 47 until the bimetallic contacts 48 are opened from heat evolved due to conduction of current through the resistor 49 for the preselected time interval.

The circuit components above described, and the mechanical locking elements, readily adapt themselves to a physical assemblage having the improved security characteristics aforementioned. The electrical components are ideally suited to be arranged into separate units for the pushbutton panel 10, the selector terminal board 14 and associated relays, and the remote alarm unit. These are preferably arranged as illustrated in Figure 1, showing an exploded view of the assembly, and Figure 7, showing the units mounted on a safe door.

The pushbutton panel 10 is disposed in a pushbutton housing 60, arranged on the front of a safe door, indicated at 61 in Figure 7, or the pushbutton housing 60 may be disposed at a position remote from the safe if desired. The housing 60 is preferably provided with a pivoted cover 62 covering the panel mounting the buttons 10*a* to 10*g*, and a suitable lock 63 may be provided on the cover 62 to maintain the housing cover 62 locked and further discourage unauthorized access to the pushbuttons.

This pushbutton housing 60 is interconnected with a bolt actuator assembly housing 65 by means of a multi-conduit lead 66 and a multi-tap plug 67 adapted to be connected to a suitable multi-tap socket, not shown, on top of the actuator assembly housing 65. The actuator assembly housing is adapted to be mounted on the safe door 61 on the inwardly disposed surface thereof, to prevent access to the housing 65, and houses all of the relays 24 to 29 and 41, the bimetallic time delay contact elements 43 and 48, and the bolt actuating solenoid 35.

The actuator assembly housing 65 is provided with a unique arrangement for changing the combination of the electrical lock, that is, changing the interrelation between the sequence series of relays 24 to 29, and the pushbuttons 10*a* to 10*j*. This means comprises a rectangular insulating panel 68, forming a cover panel for the actuator assembly housing 65. The panel 68 is preferably formed of a suitable insulating plastic, and carries on the inwardly disposed face thereof the vertical busses or conductors 15*a* to 15*j* of the combination selector terminal board 14. These vertical busses 15*a* to 15*j* are secured at their upper and lower ends to the insulating panel 68 by means of suitable rivets 69, the lowermost series of rivets 69 forming terminals to which the leads intercoupling the vertical busses 15*a* to 15*j* to the pushbuttons 10*a* to 10*j* are soldered or otherwise secured. The busses 15*a* to 15*j* are each provided with a series of spaced threaded openings 15′, in registry with corresponding openings 68′ in the insulating panel 68. These are arranged in transverse horizontal rows, in alignment with a plurality of horizontal conductors or busses 16 to 22 likewise secured at their ends to the insulating panel 68 by suitable rivets, and disposed on the opposite face of the panel 68 from the busses 15*a* to 15*j*.

The horizontal conductors are coupled to the

various relays 24 to 29 and 41, and are each provided with rows of threaded apertures 70 in registry with the apertures 68' and 15' in the panel 68 and busses 15a to 15j.

The combination desired can, therefore, be set up on the selector terminal board by bridging the horizontal busses 16 to 22 to the vertical busses 15a to 15j through the apertures 68' in the panel 68, by means of threaded screws constituting the bridging elements 23. It will be apparent that the combination may be changed around to any desired sequence relationship between the relays and the pushbutton panel 10 by withdrawing the screws 23 from the threaded openings in the horizontal and vertical busses, and changing their relative positions to bridge different groups of busses.

The locking block actuating solenoid 35 is mounted in the upper right hand corner of the housing 65, as illustrated in Figure 4, and is interconnected to the locking block 39 by means of a lug 37 formed in the armature 36 of the solenoid 35 and extending through an inclined slot 38 in the block 39. As more clearly illustrated in Figures 5 and 6, the solenoid arm 36 is provided with a bifurcated portion at the lower end thereof forming arms 36' adapted to embrace the locking block 39 along opposite sides thereof. A guide block 71 is mounted on the rear of the housing 65, and is provided with a vertically extending concave recess, indicated at 72, to accommodate and aid in defining the movement of the solenoid armature 36, and is provided with apertured forwardly extending flange portions 73, 73', forming a horizontal guide track for the locking block 39. Suitable aperture 74 is formed in the side wall of the housing 65 to permit the locking block 39 to project therefrom.

Cooperating with the locking block is a latch plate 75 mounted on the door 61, on a shaft 76 extending from a manual latch lever 77. The latch plate 75 is provided with a projection 75' to which a bolt 78 is pivotally intercoupled, the bolt riding in a suitable recess provided in the door 61 to guide its movement. The bolt 78 projects from the edge of the door 61 to lock the same when the latch plate 75 is in furthermost counter-clockwise position as viewed in Figure 4. The latch plate 75 is provided with a projection 79 formed with a perpendicular flange 80 at the end thereof adapted to overlie the side of the housing 65 from which the locking block 39 projects, the flange 80 being provided with a rectangular opening 81 extending therethrough adapted to receive the end of the locking block 39 and prevent rotation of the latch lever 77 to withdraw the bolt 78 from locking position when the solenoid 35 is deenergized. A suitable curved flange portion 81' is provided on the flange 80 adapted to abut the outer end of the locking block 39 when the same has been withdrawn to allow the latch plate 75 to be rotated in a clockwise direction as illustrated in Figure 4. This flange portion 81' is adapted to maintain the locking block 39 forced into inwardmost position in the housing 65 to prevent locking the latch plate 75 and bolt 78 when the lock has been released and the safe door open.

From the above description it will be apparent that a novel electrical permutation lock assembly has been devised, which eliminates all mechanical noises which might facilitate a safe-cracker breaking the combination of the lock, which is ideally suited to separation of the lock actuating components and the manual pushbutton components of the lock, which is provided with time delay means for limiting the time interval during which one can operate the pushbuttons in proper sequence to effect unlocking of the lock, and which is provided with remote alarm means which will be energized if pushbuttons not a part of the combination are actuated, or pushbuttons a part of the combination are actuated in improper sequence, to indicate that an error has been made in attempting to set up the combination.

While but one particular embodiment of the invention has been specifically shown and described, it is distinctly understood that the invention is not limited thereto, but that various modifications may be made without departing from the spirit and scope thereof, and it is desired, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and are set forth in the appended claims.

What is claimed is:

1. In a combination-operated electrical lock of the type having a number of manual switches greater than the digits in the combination and a series of relays corresponding to the number of said digits to be energized by said manual switches together with alarm means to be energized on actuation of any of said manual switches decoupled from said series of relays, a combination selector adapted to be electrically interposed between said relays and said switches for establishing the combination of said lock comprising a rectangular grid terminal board having two sets of parallel elongated conductive bars arranged in spaced parallel planes closely adjacent each other with the axis of one set overlying and disposed at right angles to the axis of the other set, each of the bars of said one set extending across all of the bars of said other set, each of the bars of said one set corresponding to and adapted to be electrically coupled directly with one of said manual switches, the bars of said other set corresponding to and adapted to be electrically coupled individually with said relays, removable means for conductively bridging the conductive bars of each set at selected points of crossing of the bars of the two sets for establishing the combination of said lock, an additional elongated conductive bar underlying each of the bars of said one set, and conductive means bridging each of the bars of said one set uncoupled with said other set of bars to said additional conductive bar, said additional bar being adapted to be electrically coupled with said alarm means for energizing the same when any of the switches coupled therewith are actuated.

2. In a combination operated electrical lock of the type having a number of manual switches greater than the digits of the combination coupled to one terminal of a current source and a series of relays corresponding to the number of said digits coupled to the other terminal of said current source together with alarm means coupled to said other terminal, a combination selector to be interposed in series circuit relation between said relays and said switches for establishing the combination of said lock comprising a first series of rigid parallel conductive strips corresponding to and adapted to be electrically coupled with said manual switches, a second series of rigid parallel conductive strips corresponding to and adapted to be independently coupled with said relays, said two series of strips lying in spaced parallel planes closely adjacent

each other with the axes of the strips of said second series being disposed at right angles to the axes of the strips of said first series and each of the strips of said second series underlying all of the strips of said first series, each of the strips of each series having aligned apertures at their points of crossing with other strips, conductive bridging members to be removably inserted through the aligned strip apertures at selected points of crossing to electrically bridge strips of each series and establish the combination of the lock, an additional elongated conductive strip underlying each of the strips of said first series and adapted to be electrically coupled with said alarm means, said additional strip and said strips of said first series having aligned apertures at their respective points of crossing, and conductive bridging members to be inserted through the aligned apertures of said additional strip and each of the strips of said first series uncoupled with the strips of said second series.

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