

Nov. 3, 1936.

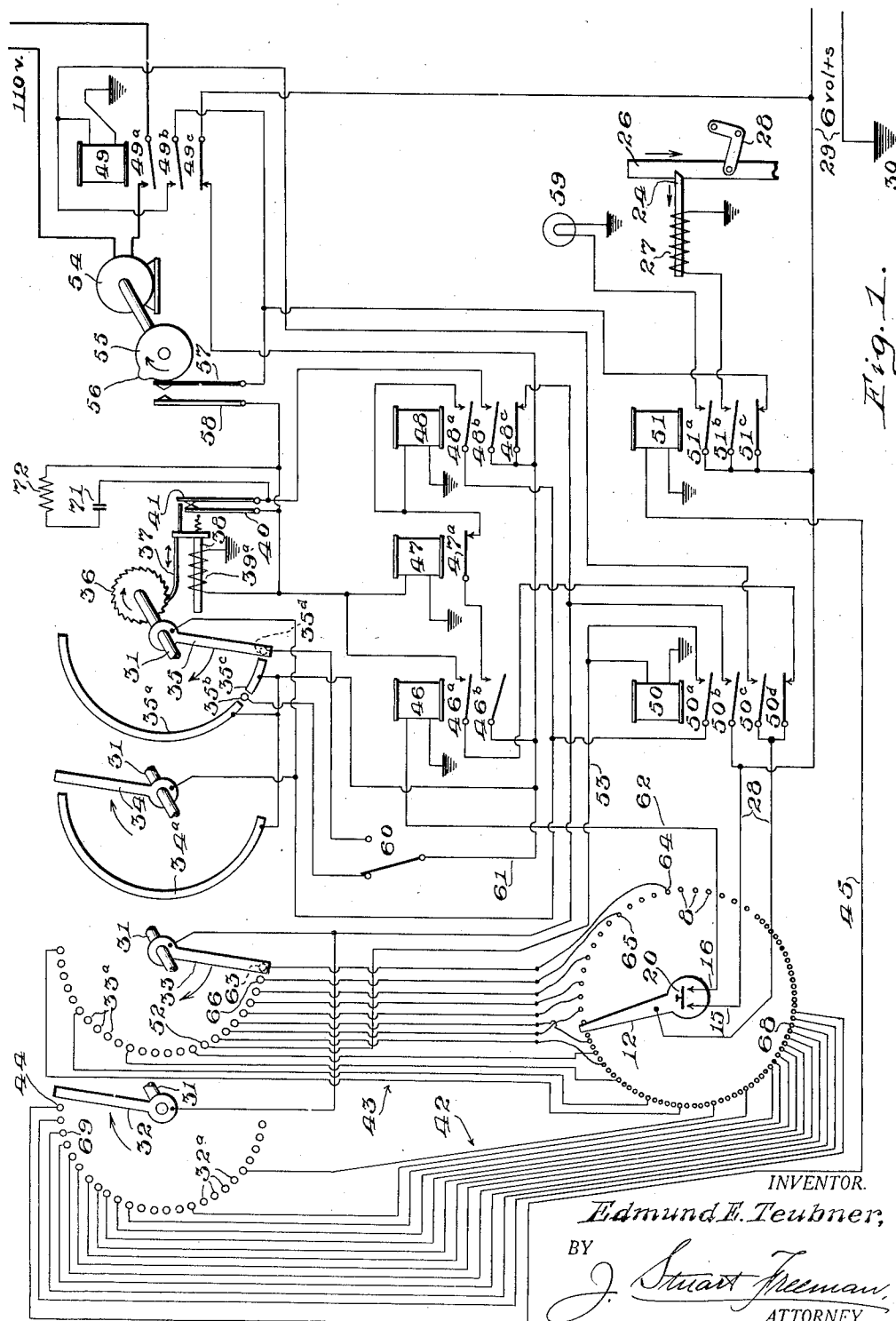
E. E. TEUBNER

2,059,919

ELECTRIC COMBINATION LOCK

Filed Jan. 24, 1936

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

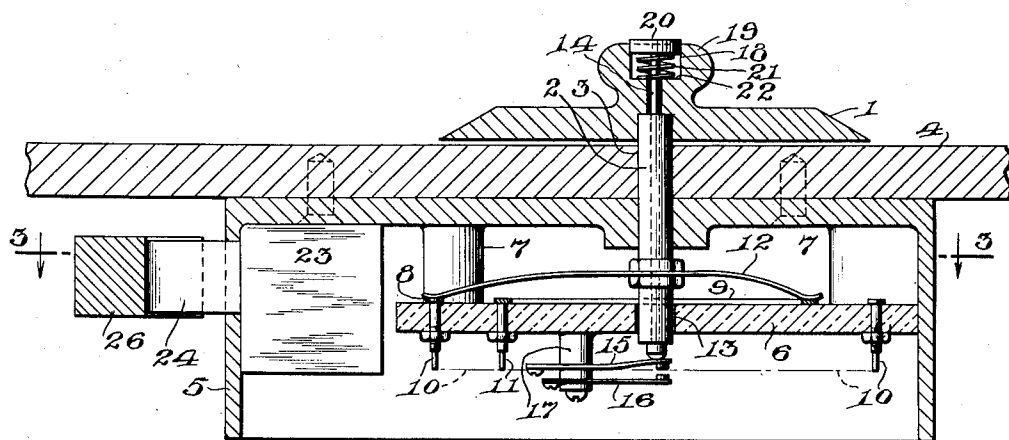


Fig. 2.

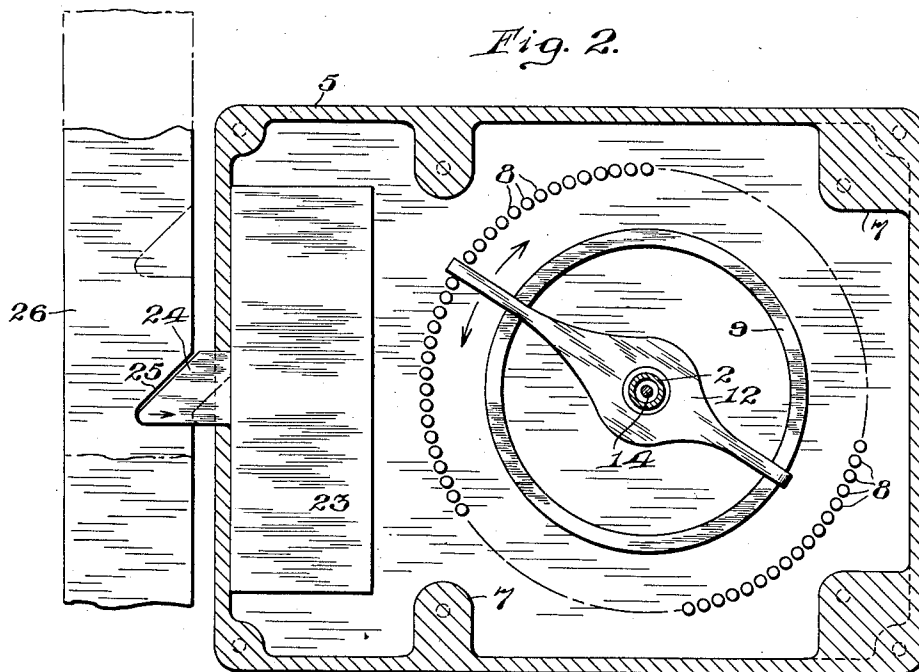


Fig. 3.

INVENTOR,
Edmund E. Teubner,

BY
J. Stuart Freeman,
ATTORNEY

UNITED STATES PATENT OFFICE

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ELECTRIC COMBINATION LOCK

Edmund E. Teubner, Philadelphia, Pa., assignor
to The Hollar Company, Philadelphia, Pa., a
corporation of Pennsylvania

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7 Claims. (Cl. 70—63)

The object of the invention is to provide improvements in electrically controlled locks broadly, and particularly in that type which is especially designed for use as a part of, or in association with, bank lockers, vaults and other forms of receptacles or compartments.

Another object is to provide an improved system of wiring, and in general the assembly of the apparatus, whereby the operation and functioning of the lock is made possible.

A further object is to provide an improved lock mechanism as a part of the lock system, but which might be employed in other systems of construction and operation.

Still another object is to provide a lock by which a predetermined time delay is possible, between the time at which the combination is completed and the mechanism permits the opening of the door or other closure, and also more specifically a lock in which the time delay can be determined or set by the operator at the time of actuating the combination mechanism, as compared with the present arrangements or constructions in which the time delay must have been set before closing of the door.

Still further objects comprise the provision of a lock of this general character, which can be controlled from a remote locality; a lock and associated electro-mechanical system in which the same is automatically re-set to the starting point, immediately upon a mistake being made in the combination; a lock which is particularly adapted to a ready change in the combination with which it is operable; a lock which, while usually subject to a time delay, can be operated to permit opening of the closure almost instantly, irrespective of whether the time delay is or is not functioning; a lock which requires but a single hole through the door or wall of a compartment, and which is therefore adapted for use in place of old lock installations; a lock comprising a single dial and supporting shaft, in combination with a switch which is also carried by said shaft, and is actuatable when the dial has been set at any desired position; together with other improved details of construction and operation, which are hereinafter fully brought out in the following description, when read in conjunction with the accompanying drawings, in which Fig. 1 is a diagrammatic wiring diagram of the improved lock, and the system of which the lock is an integral part; Fig. 2 is a horizontal sectional view through a lock of improved construction; and Fig. 3 is a vertical section on the line 3—3 of Fig. 2.

Referring to the drawings, the lock mechanism will be first described. This device comprises an annular dial 1, carried by a tubular shaft 2, which extends rotatably through an ap-

erture 3 in the vault, locker, or other form of closure 4. To the rear surface of said closure is secured by any suitable means a housing 5, into which the opposite or inner end portion of the shaft 2 extends. Within said housing is positioned a wall 6, supported by means of brackets 7, and carrying a series of electrical contacts 8, which are concentric with an annular contact 9. Suitable terminals 10 and 11 extend from the contacts 8 and 9 through said wall 6, for the connection of wires or other form of conductors, while the single annular contact 9 is connected to the contacts 8 selectively by means of a resilient conductor 12, carried by but preferably insulated from the shaft 2, and providing oppositely extending switch arms, which slidably engage said contacts, as shown in Figs. 2 and 3.

The shaft 2 furthermore extends loosely through an aperture 13 in the wall 6 and serves as a guide for a pin 14, the inner end of which pin engages and is adapted to flex the resilient contact member 15 into engagement with a second contact member 16, both of said contact members being supported by a single post 17 if desired. The outer or opposite end of said pin extends loosely through the dial 1, and into the enlarged axial recess 18 of a centrally positioned knob 19, the outer portion of which recess is substantially closed by a manually engageable pushbutton 20, against which bears a compression springs 21, the opposite end of which spring bears against the inner wall or shoulder 22 of said recess, and normally maintains said button and pin in outermost position, and permits the contact 15 to normally remain separated from the contact 16.

Within the housing 5 is also positioned an auxiliary housing 23, from which extends the reciprocable dog 24, which in turn normally enters the recess 25 of a bolt 26, and thus prevents the recession of said bolt to release and permit opening of the closure 4, until said dog is retracted from said recess by the energizing of the solenoid coil 27, for which the element 24 serves as an armature. (Fig. 1). The interrelation of the dial and latch mechanisms will be hereinafter described, as a part of the electrical system of which they form essential parts.

Electrical system

In Fig. 1 the switch member 12 is shown operatively positioned with relation to the contacts 8, and the pushbutton 20 is shown as being able to connect the leads or terminals 15 and 16, the first of which is connected by a wire 28 to leads from a source 29 of electricity, preferably six volts direct current, the opposite wire from said

source of current being grounded, as indicated at 30.

In Fig. 1 is also represented a single shaft 31, to which are secured switch elements 32, 33, 34 and 35, which are rotatable with said shaft, so as to selectively engage contacts as follows:—element 32 with series of contacts 32a, element 33 with series of contacts 33a, element 34 with the single contact 34a, and the element 35 with the contacts 35a, 35b, 35c and 35d selectively. The shaft 31 also carries a ratchet wheel 36, which is engaged by a pawl 37, said pawl being normally in the left-hand position, as shown in Fig. 1, under pressure by a suitable spring, and being shifted therefrom by the armature 38 when the solenoid coil 39 is energized, such shifting of said armature simultaneously opening or breaking contact between the contact members 40 and 41.

The several contact points 8 of the dial switch, or predetermined portions of the same, are connected by groups of wires 42 and 43 to corresponding contact points 32a and 33a, respectively, with the exception that one of the contact points 44 of the first group is connected by a wire 45 to the last of a series of relay coils 43, 47, 48, 49, 50 and 51, and thence to the ground, while one of the second group of contact points 52 is connected by a wire 53 to the relay coil 50 and thence to the ground, as well as to one side of the relay contact 50a.

In the upper right-hand portion of the drawings, a synchronous motor 54 is indicated as carrying upon its shaft a cam 55, having a radially raised portion 56, which with each rotation of the cam causes the contact member 57 to engage the similar member 58, the period of rotation of said cam being as desired, but in this case geared to be once per minute in a 60-cycle alternating current. This motor and the motor-actuated contacts are included for the purpose of controlling the time delay in the release of the improved lock, following the dialing of the combination, and the setting of whatever period of delay may be desired.

Referring to the several relays, the first relay 46 has two sets of normally open contacts 46a and 46b, the closing of the latter being delayed slightly following closing of the former, due to the latter having a greater distance than the former to move; the relay 47 has a single normally closed contact 47a; the relay 48 has three sets of contacts 48a, 48b and 48c, the first two of which are normally open and the third being normally closed; relay 49 has three sets of contacts 49a, 49b and 49c, the first two of which are normally open and the third being normally closed; the relay 50 has four sets of contacts 50a, 50b, 50c and 50d, the first three of which are normally open and the fourth being normally closed; and the relay 51 has three sets of contacts 51a, 51b and 51c, the first two of which are normally open and the third being normally closed. There is also a pilot light 59 connected between the relay contacts 51a and the ground for a purpose hereinafter described. Also, a two-way switch 60 is adapted to connect either of the two contact points 35b and 35d through the wire 61 and the relay contacts 49c to the source of current 29, depending upon whether the combination is arranged to be operated after four or eight positions of the dial switch 12, as the case may be. Further than the foregoing, it is unnecessary to point out each wire by individual numerals, the interconnection and co-

operative functioning of the various elements involved being described as follows:—

Operation

In accordance with the usual practice, a definite combination of numerals (or other indicia) is dialed by rotation of the dial 1, to represent or determine the proper sequence in which the contact points 8 are engaged by the switch member 12. However, instead of having to alternately reverse the direction of rotation of the dial, as in the case of mechanical combination locks, employing tumblers or other purely mechanical means, the dial in the present case can be turned in the same direction, or in the reverse direction, or as many times as desired in one direction or the other, since no part of the lock mechanism is actuated until the button 20 is manually depressed, and at that the said mechanism operates only if said button is depressed (and the contacts 15—16 closed), when the dial switch 12 is in engagement with the proper contact point at the proper place in a predetermined sequence.

Having these facts in mind, and assuming for the present that the dial is so operated that the proper sequence is followed, the button 20 is depressed, thereby closing relay 46 through the wires 62 and 23. As there is a slight delay between the closing of the contacts 46a and 46b, closing of the former causes current to flow through closed contacts 49c, closed contacts 48c, switch member 33, switch contact 63, and dial switch 12, relay contacts 50d, relay contacts 46a, solenoid 39 and thence to the ground, while also passing from contacts 46a through relay coil 47 and thence to the ground. The armature 38 and pawl 37 of the rotary switch are drawn back, engaging the next tooth of ratchet wheel 36. Relay contacts 47a also operate to open the connection between the contacts 46b and the circuit through the relay coil 48, thus preventing the coil 48 from being energized, when contacts 46b finally close after the delay hereinbefore referred to.

Upon manual release of pushbutton 20, relays 46 and 47 are de-energized, permitting the pawl 37 to return to its normal position under pressure of its spring. This movement of the ratchet wheel 36 one tooth, effects a movement of the switch members 32, 33, 34 and 35, so that they rest upon and in contact with the next adjacent contact point. This process is then repeated, using the next correct number of the combination sequence, which is represented or indicated by the number on the dial 1, which act will complete a connection from the switch member 12 to contact point 65 through contact point 66, and thence through the relay coils and contacts, as hereinbefore described.

When the pushbutton is released, after depressing the same upon dialing the fourth or the eighth number in the combination, as the case may be, the switch member 33 moves to the contact point 52, completing a circuit through contacts 49c, 48c, switch member 33 and said contact point 52 and relay coil 50, energizing and closing the relay 50, which is then maintained in closed position through its contacts 50a, said circuit through contacts 50a being supplied through 49c, contact segment 35a, switch member 35, contacts 50a and said coil 50.

Supposing that a three-minute delay is desired in the release of the lock after completion of the dialing of the combination, switch member 12 is

set on contact point 68, which by pre-arrangement is the number corresponding to this particular period of delay. The pushbutton is then depressed, energizing relay coil 46 and closing contacts 46a and 46b consecutively. There being no circuit through contacts 46a, relay 47 does not operate to open its contacts 47a. Therefore, when contacts 46b close, a circuit is completed through contacts 49c, 46b, 47a and coil 48, closing the contacts 48a, 48b and 48c, current then flowing through contacts 48a to maintain the coil 48 energized and its three sets of contacts closed or open as the case may be. This holding circuit is made through contacts 49c, switch segment 35a, switch member 35, contacts 48a and coil 48. A circuit is then completed through contacts 49c, 48b, interruptor contacts 41—40 and coil 39, causing the armature 38 to operate rapidly to and fro, and rotating the ratchet wheel 36 and the four switch members 32, 33, 34 and 35, until the switch member 32 reaches the contact point 69, a circuit is completed through contacts 50b, switch member 32, contact points 69 and 68, switch member 12, contacts 50c, and coil of relay 49, closing contacts 49a and 49b and opening contacts 49c.

Opening of contacts 49c, breaks the circuit through segments 34a—35a, switch member 34 and contacts 48a, de-energizing coil 48, contacts 48b in opening breaks the circuit through interruptor contacts 40—41 and solenoid coil 39, stopping switch member 32 on contact 69. Contacts 49b complete a circuit through contacts 51c and 49b and maintaining coil 49 energized. Contacts 49a close a 110 volt 60 cycle alternating current circuit through the field coil of the synchronous motor 54, rotating cam wheel 55 at the rate of one revolution per minute. Towards the end of each minute cam 56 closes the contact 57 against contact 58, completing a circuit through contacts 51c, contacts 57 and 58, solenoid coil 39. When the high point 56 of the cam releases contact 57 from contact 58, this circuit is broken, and the switch members are advanced to the next contact points.

This action is repeated each minute until switch member 32 moves upon contact point 44, when a circuit is completed through contacts 50b, switch member 32, contact point 44 and coil 51, closing contacts 51a and 51b, and opening contacts 51c. The opening of contacts 51c breaks the circuit through holding contacts 49b, thereby de-energizing the coil 49 and releasing its contacts, which breaks the circuit through and stops the motor 54, while the closing of contacts 51b completes a circuit through the latch solenoid 27, permitting the door or other closure to be opened. Simultaneously, contacts 51a effect a lighting of pilot light 59, thus visibly indicating that the dog has been released.

Locking of the door is accomplished by depressing the pushbutton, the mechanism functioning the same as when error has been made in dialing the numbers of the correct combination employed. The switch member 32 moves off of contact point 44, breaking the circuit to and releasing the relay 51, which in turn breaks the circuit through the latch solenoid 27 and pilot light 59. The lock is then ready to be re-operated.

Operation involving an error in dialing

Should an error be made in dialing the first number, the mechanism fails to operate. Should, however, the first number be dialed correctly and

a later number dialed incorrectly, the following takes place:—

Pushbutton 20 upon being depressed upon an incorrect number, energizes the relay 46 and closes contacts 46a and 46b, as hereinbefore described. The circuit through contacts 46a being broken at the dial switch member 12, neither the coil 39 nor the coil of relay 47 is energized. Consequently, when the contacts 46b close, a circuit is completed through contacts 49c, 46b, 47a and relay coil 48, thereby closing contacts 48a and 48b and opening contacts 48c. Relay 48 is held in operation by the closing of contacts 48a as above described. A circuit through solenoid coil 39, interruptor contacts 40—41 is also closed, as had also been described above, and the connection to switch members 32 and 33 through contacts 48c is broken, preventing the operator from controlling the device by means of the dial and pushbutton, until the combination is fully ciphered. The rotary switch continues to operate automatically until its switch member 35 reaches the contact point 35d. The connection between the segment 35a and switch member 35 is broken, breaking the circuit through holding contacts 48a and coil 48, which thereby releases the relay 48, and arrests the motion of the rotary switch 36 by breaking the circuit through the interruptor contacts 40—41 and solenoid 39, at the contacts 48b. The switch members of the rotary switch are now again in their respective initial positions, and the combination may be re-dialed as hereinbefore described. For quenching the spark between the contacts 40 and 41, a condenser 71 and choke coil 72 may be used in accordance with common practice, but it is understood that these play no part in the functioning of the improved lock or system as herein described.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:—

1. An electric combination lock, comprising a support, a dial rotatably carried by said support, lock-actuating mechanism, electric contacts also carried by said support and controlling the operation of said lock mechanism, and a pushbutton carried by said dial and operative to be actuated to close said contacts in each position as said dial is shifted through a plurality of predetermined positions in proper sequence.

2. An electric combination lock, comprising a support having an aperture, a tubular member rotatably positioned in and extending thru said aperture, a dial carried by the outer end portion of said member, a plurality of contacts upon the opposite side of said support, a switch element carried by the opposite end portion of said member and adapted to cooperate with said contacts selectively, as indicated by the position of said dial, and a manually actuatable electric switch upon the said opposite side of said support and extending thru said tubular member to the outer side of said support and said dial, and adapted to be closed when said switch element is in engagement with said definite contacts of said plurality in predetermined sequence, to operate said lock.

3. The combination of a locking mechanism, with an electric system comprising means to release said mechanism, a circuit selector mechanism, a series of contacts and a separate switch, a rotatable dial, and a switch member rotatable with said dial and adapted to engage said contacts selectively, said separate switch being man-

ually actuatable in each position as said dial is shifted through a plurality of pre-determined positions in proper sequence to so energize said system as to release said lock mechanism.

- 5 4. The combination of a locking mechanism, with an electric system comprising means to re-
lease said mechanism, a circuit selector mecha-
nism, a series of contacts and a separate switch,
10 a rotatable dial, a switch member rotatable with
said dial and adapted to engage said contacts
selectively, said separate switch being manually
actuatable when said switch member is in contact
with certain of said contacts selectively, to so
15 energize said system as to release said lock me-
chanism, and means in said system to delay the
release of said mechanism, following the comple-
tion of the dialing of the proper combination of
contacts and actuation of said separate switch.
- 5 5. The combination of a locking mechanism,
20 with an electric system comprising means to re-
lease said mechanism, a circuit selector mecha-
nism, a series of contacts and a separate switch,
a rotatable dial, a switch member rotatable with
said dial and adapted to engage said contacts se-
25 lectively, said separate switch being manually
actuatable when said switch member is in con-
tact with certain of said contacts selectively, to
so energize said system as to release said lock
mechanism, and electrical means in said system,
30 operable after the completion of the dialing of
said switch member upon certain of said contacts
in predetermined sequence, and the manual clos-
ing of the separate switch, following each such
dialing, to permit the dialing of a further contact
35 and corresponding closing of said separate switch,
thereby causing a selectively predetermined pe-
riod of delay in the release of said lock mecha-

nism following the completion of the dialing op-
eration.

- 5 6. A delayed electric lock release system, com-
prising a circuit selector mechanism, a dial switch
having a plurality of contact positions, a separate
switch adapted to be actuated following the dial-
ing of each such contact position in its proper
order, a lock release mechanism, and a time de-
10 lay element operative when set in operation by
the dialing of an additional contact position and
the subsequent closing of said separate switch, to
actuate said lock release mechanism after a pre-
determined interval following the completion of
said dialing, as determined by the particular ad-
15 ditional contact position at which said dial is set
for the final closing of said separate switch.

7. A delayed electric lock release system, com-
prising a circuit selector mechanism, a dial switch
having a plurality of contact positions, a separate
switch adapted to be actuated following the dial-
ing of each such contact position in its proper
order, a lock release mechanism, a time delay ele-
20 ment operative when set in operation by the dial-
ing of an additional contact position and the sub-
sequent closing of said separate switch, to actuate
said lock release mechanism after a predeter-
mined interval following the completion of said
dialing, as determined by the particular addi-
25 tional contact position at which said dial is set
for the final closing of said separate switch, and
means in said system to automatically return said
selector mechanism to its initial position, upon
said separate switch being actuated following an
30 incorrect sequence in the dialing of said contact
positions.

EDMUND E. TEUBNER.