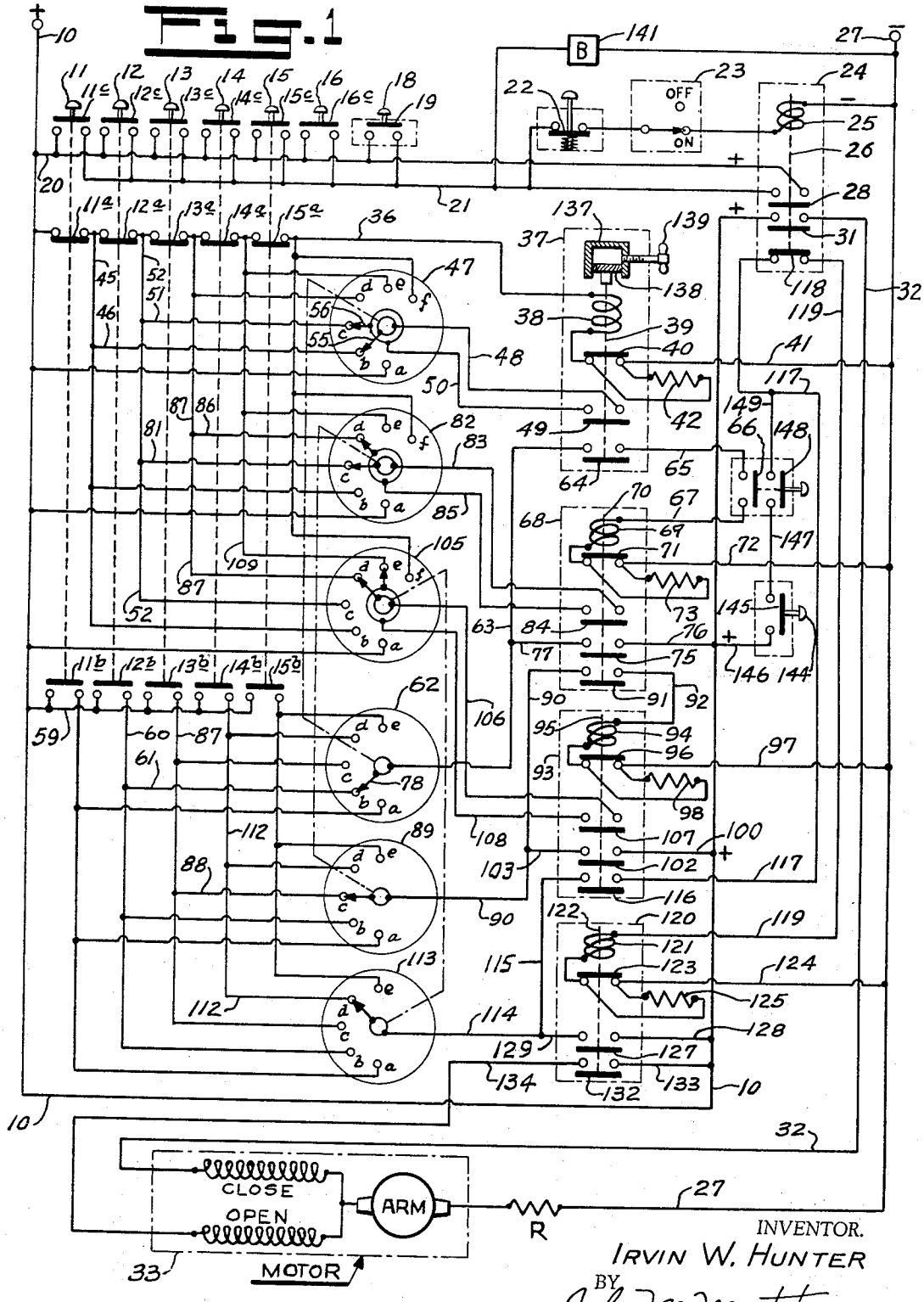
Oct. 22, 1968 I. W. HUNTER 3,407,346

ELECTRIC SEQUENTIAL COMBINATION MECHANISM

Filed Oct. 14, 1965 2 Sheets-Sheet 1

Fig. 1



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ELECTRIC SEQUENTIAL COMBINATION MECHANISM

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Fig. 2

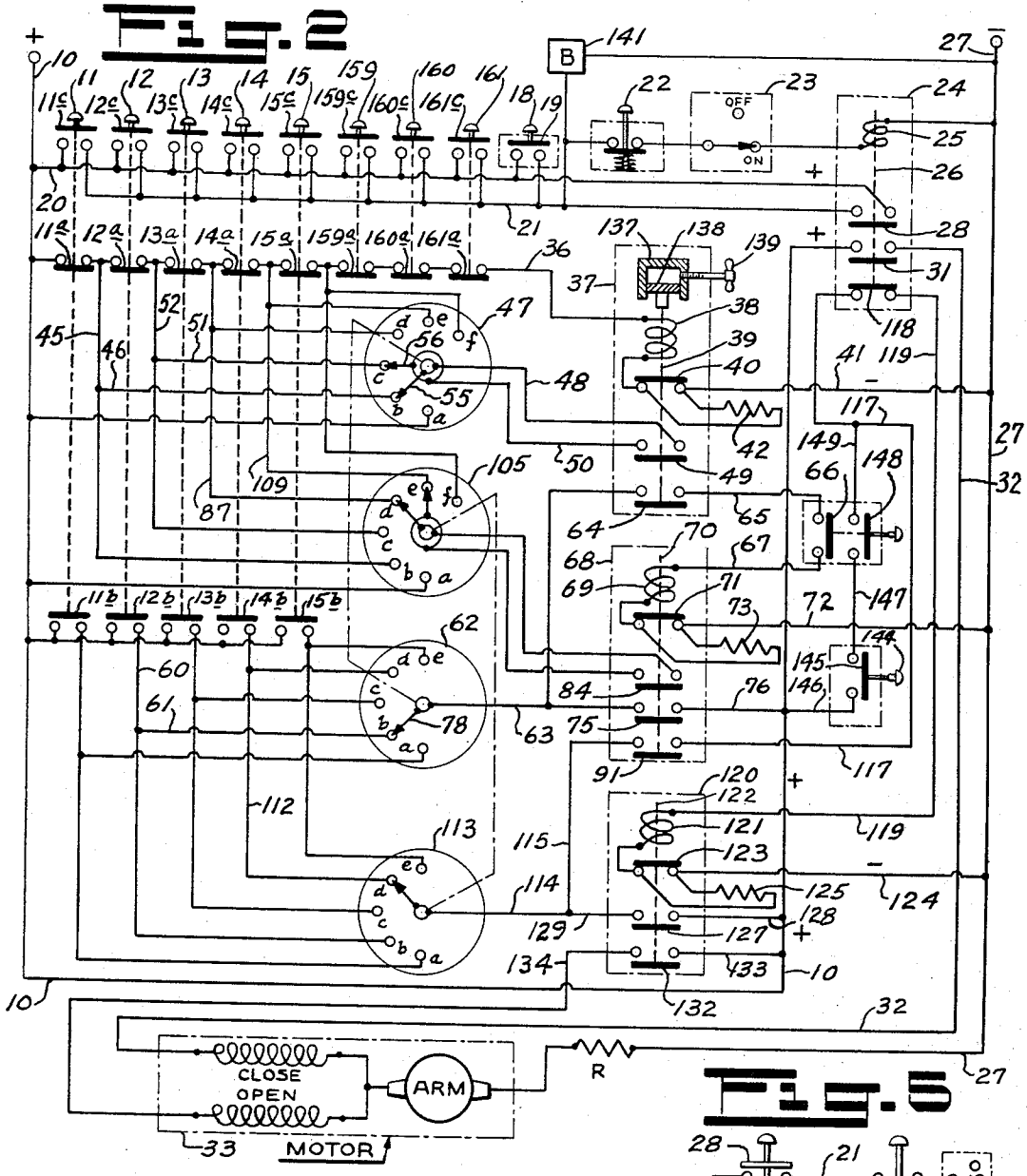


Fig. 5

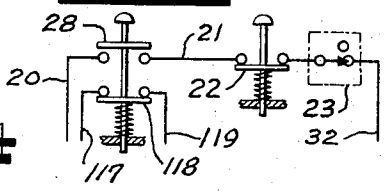


Fig. 3

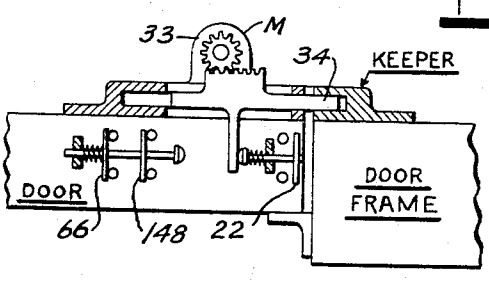
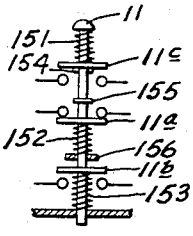


Fig. 4



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3,407,346

ELECTRIC SEQUENTIAL COMBINATION MECHANISM

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Filed Oct. 14, 1965, Ser. No. 495,772
16 Claims. (Cl. 318—446)

The invention relates to an electric sequential operating mechanism for an operated member which moves to and from one of two positions such as a door latch, a door, or could be used for a guessing game and for wagers and the like. The circuit finds its more useful application in connection with the operation of a door latch, and its two positions are "latched" or "closed" and "unlatched" or "open." In this application, the operating circuit provides a combination system such that by operation of the proper ones of a plurality of switch actuators, such as push buttons, as well as operation of the switch actuators in preselected sequence, the latch will be opened. Any unauthorized person seeking entry may operate the proper buttons, but if these are not actuated in the proper sequence, the latch will not open. For example, with five actuators and a numbered button opening combination of **2, 3, 4**, the latch would not open by depressing numbered buttons **3, 2, 4**. Any unauthorized person seeking entry by actuating the actuators in a progressive selection of actuators such as **1, 2, 3; 1, 2, 4; 1, 2, 5; 1, 3, 4; 1, 3, 4; 1, 3, 5; 1, 3, 2; 1, 4, 2**, etc. would consume considerable time before the proper actuators could be selected, as well as their sequence. Again, such person does not know whether he is confronted by a two, three, four or five actuating combination. The difficulty encountered or time consumed by anyone seeking entry would be increased by multiplying the number of dummy or cancellation actuators on the outside of the door. There are other circuit additions, primarily the use of a time delay relay, which enables the number of switch actuators to be reduced and yet render considerably more difficult to determine the correct opening actuators and their proper sequence by progressive operation of the actuators.

It is an object of the invention to construct an electric sequential operating circuit having a plurality of switch actuators to be provided on the exterior of a door, door frame or wall and the like, and requiring not only actuation of the proper or effective actuators, but in addition, requiring that effective actuators to be operated in the proper sequence.

Another object is as in the preceding paragraph, but in addition uses a time delay relay which, after each erroneous depression, delays the return of the circuit to its initial operable condition so that any unauthorized person seeking to open the latch by progressive operation of the actuators renders it more difficult and hence would require so much more time to run through a series of progressive operations of the actuators before the actual combination could be reached or learned.

A further object is as in the preceding paragraph and includes means for selecting the time delay.

Another object is as in each of the two preceding paragraphs and in addition provides a construction in which the number and combination thereof of effective actuators can be changed or selected at any time.

A still further object is as in each of the preceding paragraphs, but in addition thereto includes a buzzer circuit which is operated as each actuator is actuated, so that an unauthorized person cannot seek to learn the combination by listening to or mechanically feeling the operation of the circuit.

Other objects of the invention will be more apparent from the following description when taken in connection

with the accompanying drawings illustrating preferred embodiments thereof in which:

FIG. 1 is a layout of the circuit in its more complex form and requiring operation of three actuators in the proper sequence in order to open the latch.

FIG. 2 is a layout of the circuit in which operation of two switch actuators will actuate the operating member or unlatch the door.

FIG. 3 shows a latch for a door having a pair of limit switches one of which is operated when the latch reaches "open" or a first position, and the other when the latch reaches "closed" or a second position.

FIG. 4 shows a switch actuator which operates switches in succession.

FIG. 5 shows a closing circuit without use of a closing relay.

The sequential operating circuit includes basically two main circuits beginning with the power line or a power bus **10** which is to be connected with a suitable source of direct current electric power. The circuit includes a plurality of switch actuators, five being shown, namely **11, 12, 13, 14**, and **15**, which may be of any type, that illustrated being push buttons. There may be a greater or a lesser number of actuators, as desired. Increasing the number of actuators renders the circuit more difficult as well as requiring more time for an unauthorized person to determine the correct combination by progressive operation of the actuators. In the preferred circuit illustrated, the occupant has ample security with five switch actuators. A latch closing actuator **18** is also provided. These switch actuators are located on the outside of a door, a door frame, an adjacent wall surface, in a remote closet or the like.

On the outside the latch is closed by pressing any one of actuators **11, 12, 13, 14**, or **15** which energizes closing relay **24**. The occupant within the room could close the door manually, however, a latch closing circuit is provided which includes a switch actuator **18** within the room and a normally open closing switch **19** having one contact connected with the power line **10** through a wire **20**, and its other contact is connected with a wire **21**. Closing of the switch **19** closed a latch closing circuit including a latch closed limit switch **22**, and may include a key operated switch **23**, and a latch closing relay **24** having a coil **25** connected to the power line **27**. This relay has an armature **26**. The armature is operatively connected with a generally open latch closing circuit holding switch **28** which is closed upon energizing of the coil **25** to complete a holding circuit from wire **20**, through switch **28**, the limit switch **22**, key switch **23**, and coil **25** to hold the relay **24** energized. When the latch is closed, the limit switch **22** opens to break the closing circuit.

The armature **26** is also operatively connected with a motor switch **31** which is connected with the power line **10** and is connected by a wire **32** to an operating motor means **33** which is operatively connected with the latch **34** so that upon operation of the motor means, the latch is moved to closed position. The motor means preferred is a rotary reversing motor; however, it is clear that it could just as well be a solenoid motor means of the type which may have a solenoid with a known alternate or two position operating mechanism operated thereby, or may be two separate solenoids, one for closing and another for opening the latch.

The sequential operaing circuit includes basically two control circuits for opening the latch although the preferred form in FIG. 1 shows three control circuits. The first control circuit includes a plurality of first control switches **11*a***, **12*a***, **13*a***, **14*a***, and **15*a*** connected in series from the power line **10**. These first control switches are operatively connected with their respective actuators or

push buttons **11, 12, 13, 14,** and **15**. The last of the series switches is connected by a connection **36** to a relay **37** having a coil **38**, an armature **39**, a generally open resistor switch **40** (since in use the coil **38** is energized), which switch has a connection **41** to the power line **27**. Although the resistor switch **40** is shown closed, the relay coil **38** is energized at all times that the power line is connected with a power supply so that the switch is generally open. The circuit is illustrated unconnected with a power supply and hence the resistor switch **40** is shown as being closed. The resistor switch **40** is provided solely to insert the resistor **42** in series with the coil **38** so that the coil does not overheat and also to make the relay a fast opening one.

A shunt circuit is provided for one of the control switches, that shown being provided for control switch **12***a*, one side of which switch is connected by connections **45** and **46**, and preferably a first selector switch **47** and its arm **55**, wire **48** to a first shunt switch **49**, a wire **50**, arm **56**, if provided, wires **51** and **52** to the other side of the first control switch **12***a*. Since the coil **38** is normally energized, the shunt switch **49** is normally closed.

In a simpler form of circuit, the selector switch **47** need not be provided, however, this switch enables selection of the combination of latch opening actuators. To achieve this selection, the selector switch **47** is provided with a plurality of contacts, there being one for each of the first control switches and an additional contact. With five actuators shown, there will be six selector switch contacts; *a, b, c, d, e,* and *f*. The selector switch has one contact arm **55** which is shown as establishing a connection through the arm and contact *b* between connections **46** and **48** and another control arm **56** which establishes a circuit from contact *c* between connections **50** and **51**. By turning the contact arms any one of the control switches, and hence any one of the actuators, may be selected as the first actuator of the combination.

Each of the actuators is provided with, and operates a second control switch, the switches being **11***b*, **12***b*, **13***b*, **14***b*, and **15***b*. Each of these switches is connected in parallel through a connection **59** which is connected with the power line **10** so that one contact of each of these second control switches is connected therewith. Since the first control switch which is shunted by the first shunt switch **49** is **12***a*, the second control switch **12***b* has its output contact connected through wires **60, 61** to a first coding circuit selector switch **62**, a wire **63**, a first coding circuit or first sequential switch **64** which is normally closed (since in use coil **38** is energized), wire **65**, a latch open limit switch **66**, a wire **67** to a first coding relay **68** having a coil **69** and an armature **70**. The first coding relay circuit preferably includes a normally closed resistor switch **71**, wire **72** to the power line **27**, a resistor **73** shunts the opened switch **71**. The first coding circuit includes also a holding switch **75** which is connected by a wire **76** with the power line **10** and by a wire **77** with the wire **63** which is a connection with the first coding relay switch **64**.

The coding selector switch **62** includes a contact for each of the control switches, and since there are five of these, there are five contacts; **62***a, b, c, d,* and *e,* and a contact arm **78**. The selector switches **47** and **62** are ganged together so that in selecting the shunt switch for the first actuator of the combination, the selector switch **62** is turned simultaneously, therewith to connect the corresponding second control switch **12***b* into the desired coding circuit. It is clear that as the selector switch **47** is not essential to a simpler form of circuit, the coding selector switch **62** will not be provided if the selector switch **47** is not provided. These two switches, however, permit the occupant to change the combination whenever he so desires.

The second actuator setting up the second number of the combination is the actuator **13** so that the first control switch **13***a* has a second shunt switch connected across this switch through the wire **52**, wire **81** through a second selector switch **82**, wire **83**, the second shunt switch **84**, wires **85, 86,** and **87** to the other side of the first control switch **13***a*. With five switch actuators, the selector switch **82** is provided with six contacts, **82***a, b, c, d, e,* and *f* with a pair of contact arms identical with arms **55** and **56** for shunting the first control switch **13***a*. In other words, this selector switch **82** is identical in construction with selector switch **47** but is operated independently thereof.

The corresponding coding circuit therefore includes the second control switch **13***b* which is connected by wires **87** and **88** to a second coding circuit selector switch **89**, wire **90**, a second coding circuit switch **91** which is normally opened and operatively connected with the armature **70** of the preceding or first coding relay **68**. The switch **91** is connected by a wire **92** to a second coding relay **93** having a coil **94** and an armature **95**, preferably a resistor switch **96** and a wire **97** to the power line **27**. A resistor **98** is connected across the switch **96**.

A holding circuit is provided for the second coding relay which includes a wire **100** from the power line **10** and connected with a holding circuit switch **102** and wire **103** which is connected with wire **90** and hence the second coding relay switch **91**. Holding circuit switch **102** is normally open and is closed by the coil **94** of the second coding relay.

The sequential circuit illustrated uses a three number combination and hence a last or third shunt switch is provided for the first control switch **14***a*. This circuit includes the wire **87**, a shunt selector switch **105**, wire **106**, third shunt switch **107**, wire **108**, selector switch **105**, wire **109** to the other side or contact of the first control switch **14***a*. The selector switch **105** is identical to the other selector switches and to this end has contacts **105***a, b, c, d, e,* and *f* with its switch arms engaging contacts *d* and *e*.

A last or third coding circuit is connected across the power lines which includes in series the second control switch **14***b* which is connected by a wire **112** to a last or third coding selector switch **113**, wires **114** and **115** to a third coding circuit switch **116** which is operatively connected to, and actuated by the armature **95** of the second coding relay, wire **117**, safety switch **118** which is operatively connected with the armature **26** of the latch closing relay **24**, wire **119** to a third coding relay **120** having a coil **121** and an armature **122**, preferably a resistor switch **123** and wire **124** to the power line **27**. A holding circuit is provided for the third coding relay in a holding switch **127** connected by wire **128** with the power line **10** and wire **129** which is connected with wire **115** and hence with the third coding relay switch **116**. Safety switch **118** is provided so that the latch opening circuit is inoperative so long as the closing circuit is operating.

The armature **122** of the third coding relay **120** has a normally open motor means switch **132** operatively connected therewith which switch is connected through a wire **133** with the power line **10** and by wire **134** to the motor means **33** to operate the motor in a latch opening direction.

Since control switches **11***a* and **11***b*; **15***a* and **15***b* do not have connected shunt switches into the first control circuit or a coding circuit, operation of these switches will not set the sequential circuit into operation. This does not mean that they are merely dummy switches because they do serve a useful function as will appear hereinafter.

The circuit described without more would provide a satisfactory combination sequential circuit but with merely five switch actuators, it would not require too much time nor too much effort to learn the operating combination. It could be made more complex for an unauthorized person who may seek entry by multiplying the number of switch actuators, say providing ten to twenty each with its own first control switch. Also, in order to make the sequential circuit selective, then the selective switches for the shunt switches, namely **47, 82,** and **105** would have contacts equal to the number of first control switches

plus one. Similarly, each of the selective switches for the second control circuit switches, namely **62**, **89**, and **113** would have one contact for each of the second control switches. It would take a considerably longer time for an unauthorized person to seek to learn the combination by progressive operation of ten or more actuators. Again the sequential circuit teaches how the number of active actuators may be increased by providing additional shunt switches and their cooperating relays.

In order to make the combination sequential circuit more difficult to determine the combination with a lesser number of switch actuators, such as the five illustrated in the circuit of FIG. 1, the relay **37** for the first control circuit is provided with a delay means of any suitable form, that illustrated including an air chamber **137** having an air piston **138** and an adjustable leak outlet **139**. This outlet is of that type which offers no resistance in one direction but offers resistance in the other direction such as by a perforated flap valve so that when the first relay coil **38** is deenergized, the switches **49** and **64** operated thereby open immediately but it will take a delay period, for example 10 seconds, before the armature **39** moves back to its normal position with the two switches closed. The operation will be described more fully hereinafter.

In order to offer no assistance to an unauthorized person who may seek to listen to the operation of the circuit and in this manner seek to determine the opening combination, a buzzer means preferably is provided which is operated whenever an actuator is operated. The means shown includes a plurality of buzzer switches **11***c*, **12***c*, **13***c*, **14***c*, and **15***c* or one for each actuator and closed thereby. These switches are connected in parallel across the wires **20** and **21** and each connects a buzzer **141** across the power lines whenever one of the actuators or push buttons is depressed. The buzzer creates enough noise so that one cannot hear or feel the clicking of any relay being operated. Buzzing over a long period of time could alert anyone in an adjacent apartment. Too, a second buzzer in parallel could be located in the lobby to alert a doorman.

Latch opening means are provided and that shown is an electrical circuit. The latch opening circuit preferably is provided by an opening actuator **144** which is located on the inside of the room and this actuator closes a switch **145** connected to the power line **10** by a wire **146** and connected by a wire **147** with a latch open limit switch **148**. A wire **149** is connected with the wire **117**. With the latch closed, the limit switch **148** is closed so that closing of the switch **145** actuates the last or the fourth relay **120** through switch **118**, wire **119**, coil **121** and wire **124** which closes motor switch **132** and connects the motor means **33** across the power lines **10** and **27** for rotation of a latch opening operation or direction.

Preferably, the switches **11***c*, **11***a*, and **11***b* (FIG. 4) are operated in that order so that buzzer switch **11***c* closes first and stays closed, the first control switch **11***a* opens secondly and stays open, and the second control switch **11***b* closes thirdly. The switches for the other actuators are similarly constructed. This can be accomplished by slidably mounting the switches on the actuator and providing springs **151**, **152**, and **153** as shown in FIG. 4 for the respective switches. A stop **154** on the actuator holds switch **11***c* in open position and when the switch is closed the spring yields upon further depression of the actuator. The spring **152** holds switch **11***a* closed until switch **11***c* is closed whereupon stop **155** engages the switch **11***a* to open it and hold it open upon additional depression of the actuator. Spring **153** holds switch **11***b* open until switch **11***a* opens whereupon stop **156** engages switch **11***b* to close it. Upon release of the actuator, the switch **11***b* opens first, switch **11***a* closes secondly, and switch **11***c* opens lastly, or in reverse order. The buzzer, therefore, is sounding throughout the operation of the circuit, thereby precluding listening or feeling relay action.

The operation of the circuit will now be described. The combination set into the sequential circuit illustrated in FIG. 1 is first **12**, second **13**, and third **14**. No other combination or other sequential operation will open the latch. With the latch closed, limit switches **66** and **148** are closed. With power on line **10** and all of the first control switches closed, the first circuit is completed through relay coil **38** so that switch **40** is open, switch **49** is closed, and switch **64** is closed. Actuator **12**, therefore, closes switch **12***c* and operates the buzzer **141**, then opens the first control switch **12***a*, but since it has a closed shunt switch **49** bridging the switch, the opening of the switch **12***a* does not affect relay **37** and it remains operative and hence switch **64** remains closed. Closing of the second control switch **12***b* completes a second control circuit, or first coding circuit through wires **60** and **61**, first coding selector switch **62**, wire **63**, sequential switch **64**, wire **65**, limit switch **66**, wire **67**, relay coil **69** for the second relay **68** so that it is actuated to close the switches **84**, **75**, and **91** which are operatively connected with its armature **70**. A holding circuit is then set up from power line **10** through wire **76**, holding switch **75**, wires **77** and **63**, switches **64** and **66** through relay coil **69**, resistor **73** to hold this second relay actuated upon release of actuator **12**. Closing of sequential switch **91** sets up the third relay **93** for actuation.

Operation of actuator **13** again sounds the buzzer through switch **13***c*, then opens the first control switch **13***a*. However, since this switch is shunted by the now closed shunt switch **84**, the first and second circuits are unaffected by opening of its first control switch **13***a*.

The second control switch **13***b* is closed which completes the third circuit across the power lines and energizes this third circuit including the second control switch **13***b*, wires **87** and **88**, selector switch **89**, wire **90**, closed second sequential switch **91**, wire **92**, coil **94** of the third relay, switch **96** and wire **97** to the power line **27** to energize this relay which opens switch **96** and closes switches **107**, **102**, and **116**. Closing of the third relay holding switch **102** establishes a holding circuit through wire **100**, switch **102**, wire **103**, wire **90**, switch **91**, coil **94**, resistor **98**, and wire **97** to power line **27** so that the third relay stays energized.

Operation of actuator **14** closes the buzzer circuit through switch **14***c* after which the first control switch **14***a* opens; however, the third shunt switch **107** has been closed, bridging switch **14***a* through wire **87**, selector switch **105**, wire **106**, shunt switch **107**, wire **108**, selector switch **105***e*, and wire **109** so that opening of this first control switch **14***a* does not affect the circuits set up as described.

The closing of the second control switch **14***b* completes a last relay circuit through this switch, wire **112**, selector switch **113***d*, wires **114** and **115**, the last sequential switch **116**, wire **117**, switch **118**, wire **119**, the fourth relay coil **122**, switch **123**, and wire **124** to the power line **27**. With the last coding relay energized, switch **123** opens and holding switch **127** and motor switch **132** close. A holding circuit is set up from wire **128** through holding switch **127**, wire **129** to wire **115** and therefore through switch **116**, wire **117**, switch **118**, wire **119**, relay coil **121**, resistor **125** and wire **124** to power line **27**. A motor circuit is set up thereby through wire **133**, motor switch **132**, wire **134**, motor means **33** so that it operates to open the latch. The motor means continues to operate until the latch reaches its open limiting position whereupon the open latch limit switch **66** is opened by the latch and the circuit to the second relay coil **69** is opened and restores relays **68**, **93**, and **120** to unenergized condition.

If an unauthorized person seeks entry by progressive operation of the actuators, suppose that he operates actuator **11**, the buzzer circuit closes through buzzer switch **11***c* and the first control switch **11***a* opens. This switch, however, does not have a shunt switch since the selector switch contact **47***a* is open. Opening of the first control switch **11***a* therefore opens the first control circuit through relay **38** so that it becomes deenergized and opens

switches 49 and 64. The delay means 137, 138, 139 now operate to prevent closing of these switches by the re-energized relay coil 38 so that operation of any of the other actuators results in no action whatever by the entire circuit. If the occupant should operate actuator 11 by mistake, he will know he must wait the prescribed delay period before pressing the proper combination. The same thing happens if actuators 13, 14, and 15 are operated, since their switches at this stage are inactive in any event and actuator 12 is now inactive for the prescribed time delay period. The delay period may be set by the adjustable leak off 139 and a suggested delay period is 10 or more seconds although it could be any time delay within the capacity of the leak adjustment. It will be observed, therefore, that the delay means introduces an unknown element into the circuit to an unauthorized person and materially adds to the time element required to go through all of the combinations of five actuators such that the time involved to make a progressive selection of a combination of three buttons would be much too long for an unauthorized person. To one knowing the combination, a one minute delay presents no difficulty in the event that an inactive actuator has been operated. To an unauthorized person, however, it immeasurably increases the time for a progressive selection of the actuators before the correct combination is determined.

With the latch opened and the occupant within the room, the latch may be moved to latched position.

If the occupant wishes to change the combination, he can do so by adjusting the selector switches 47, 82, and 105 which also properly positions selector switches 62, 89, and 113. The switches are the well known wafer type. Note that the combination may be of two active actuators only, for example, by setting the selector switch 82 and its corresponding selector switch 89 to the same position as selector switches 47 and 62. What this does in effect is to make relays 68 and 93 operate simultaneously as one or its effect may be said to nullify the second coding relay.

A simpler circuit having two active actuators is shown in FIG. 2 with the same elements having the same numerals. In this circuit, relay 93 and its selector switches have been removed and relay 68 has its wire 115 connected with switch 91. Also, wire 117 is connected with switch 91 and shunt switch 84 is connected with selector switch 105.

It is clear, too, that the circuit may be converted into one requiring operation of all five actuators and in the proper sequence by connecting two additional relays into circuit for each of the inactive actuators 11 and 15 in the same manner that the relay 93 is set up between the second relay or first coding relay and the last relay 120.

In the broader aspect of the invention, the latch or operating member may be spring closed, in which event the circuit need be solely one for operation of the operating member in one direction or opening of the closed latch. Also, the circuit would provide considerable protection, which may be ample under some circumstances such as when the occupant is away for short periods only, with one active actuator solely, that is having a shunt switch bridging its first control switch and a larger number of inactive actuators having solely a first control switch. This simpler circuit would need a first and last relay solely with the sequential switch 116 being replaced by sequential switch 64 of the first relay.

In a selective sequential circuit having a relatively large number of actuators, as illustrated in FIG. 2, it is not necessary that all of the first and second control switches be connected with a selector switch. For example, if fifteen switch actuators are provided, such as 159, 160, and 161, each opening a series connected first control switch 159*a*, 160*a*, and 161*a* respectively so that the first relay 38 is deenergized by operation of an inactive actuator but solely five (or less) but less than fifteen of these first and second control switches are connected with a selector switch. Such inactive, non-selective actuators would not have a second control switch. Such circuit will provide selection of a new combination but the selections available will not include all of the actuators provided. The circuit of FIG. 2 provides a two combination sequential circuit set up with switches 12 and 14 as being active.

It is not necessary that a latch closing relay 24 be provided since the latch could be closed by manual operation of the switches 31 and 118; that is switch 19 is replaced by these two switches, FIG. 5. This latch closing means would require that the latch closing actuator be held until the latch is closed and limit switch 22 opens. The circuit shown with a closing relay 24 assures that the latch is always fully closed and requires momentary depression of its actuator in order to complete the closing of the latch.

The mechanism may be set up as a guessing game or a gaming device for the players to guess the buttons or numbers which will operate a signal such as by substituting the latch for a flag which comes into view or indeed a latch comes up from the box housing the mechanism in the same manner it moves out of a door.

Although switches 159*a*, 160*a*, and 161*a* are in a sense inactive switches as far as participating in sequential or selective operation are concerned, they are active in the sense that upon actuation they do activate the delay or first relay and they do cancel out any operation of an active control switch, which would be 12*a* in the two combination circuit of FIG. 2.

This invention is presented to fill a need for improvements in electric sequential combination mechanism. It is understood that various modifications in structure, as well as changes in mode of operation, assembly, and manner of use, may and often do occur to those skilled in the art, especially after benefiting from the teachings of an invention. This disclosure illustrates the preferred means of embodying the invention in useful form.

What is claimed is:

1. An electric sequential combination mechanism for an operated member having a first and a second position, such as open and closed positions of a lock bolt comprising power lines; an operated member; and means to actuate the operated member to its second position; a plurality of switch actuators; switch means operatively connected with each switch actuator including a normally closed first control switch, and a normally open second control switch for at least some of the actuators, the first control switches being connected in series, the second control switches each having an input contact connected with a power line and an output contact; relay means including at least a first relay, a second relay and a last relay, each relay including a coil and an armature; a first circuit connected across the power lines including in series the first control switches, and the first relay coil; shunt switch means including at least a first shunt switch and a last shunt switch, a shunt switch being operatively connected with the armature of each relay exclusive of the last relay, the first shunt switch being normally held in closed position by the normally energized first circuit relay coil, each shunt switch being connected across a first control switch; a second circuit connected across the power lines including in series a second control switch, a normally closed first sequential switch, a first position limit switch, and the second relay coil, and a second relay holding switch connected with the power line and a connection from this switch to the second relay switch providing a holding circuit for the second relay, the second control switch being that one which is operatively connected with the first control switch having the first shunt switch across the same, the second relay switch being operatively connected with the armature of the first relay and the second circuit holding switch being operatively connected with the armature for the second relay; a last circuit connected across the power lines including in series a second control switch, a last sequential switch, a normally closed safety switch, and the last relay coil, and a last relay hold-

ing circuit including a last relay holding switch connected with the power line and with the last sequential switch, the second control switch being that one which is operatively connected with the first control switch having the last shunt switch, and the last relay holding switch being operatively connected with the armature of the last relay; means operatively connecting each sequential switch with the armature of a preceding relay to be closed upon the relay being energized; motor means; the operated member being operatively connected with the motor means to move the operating member at least to its first position, one limit switch being operatively connected with the operated member to be opened when the member is in its first position; and the other limit switch being operatively connected with the operating member to be opened in the second position of the operating member; and a motor circuit connected between the power lines including a motor switch and the motor, and the motor switch being operatively connected with the armature of the last relay and closed thereby.

2. An electric sequential combination mechanism as in claim 1 in which the means to actuate the operated member to its second position includes a second position actuator, and a second position circuit including a second position switch operated by said actuator and connected with the motor means, and a second position limit switch operatively connected with the operated member to be opened upon its reaching second position.

3. An electric sequential combination mechanism as in claim 2 in which the second position circuit includes a relay having a coil and an armature, the second position switch being operatively connected with the said armature, and the second position circuit including the second position switch, the second position limit switch and the coil of the second position relay.

4. An electric sequential combination mechanism as in claim 1 including a plurality of first selector switches one being provided for each shunt switch, each selector switch having a contact for each first controlled switch having a second control switch, the contacts being in adjacent relation, one contact being connected with the input side of switch, each second selector switch having a contact connected with the output side of the last of the series connected first control switches having a second control switch, a pair of switch arms movably mounted and spaced apart to engage adjacent selector switch contacts, one switch arm being connected with one side of a shunt switch and the other being connected to the other side of the shunt switch; a plurality of second selector switches one being provided for each first selector switch, each second selector switch having a contact for each second control switch, one contact being connected with the output side of each second control switch, and a switch arm movably mounted to engage one contact; and the switch arms of each first selector switch and its cooperating second selector switch being ganged together.

5. An electric sequential combination mechanism as in claim 1 including delay means connected with the armature of the first relay to delay return of its switches to initial position and provide rapid opening of its switches.

6. An electric sequential combination mechanism as in claim 4 including delay means connected with the armature of the first relay to delay return of its switches to initial position and provide rapid opening of ts switches.

7. An electric sequential combination mechanism as in claim 1 in which the latch closing means includes a closing actuator and a closing circuit connected across the power lines comprising a motor switch connected with the actuator and connected with the motor means, and a closing limit switch operated to open position by the operating member.

8. An electric sequential combination mechanism as in claim 7 in which the closing circuit includes a closing relay having a coil in series with the closing switch and closing limit switch, the closing relay having an armature, the motor switch and the safety switch and a closing relay holding switch operatively connected with the closing relay armature and connected in shunt across the closing switch.

9. An electric sequential mechanism as in claim 1 including a third relay having a coil and an armature, a normally open shunt switch and a normally open third sequential switch and a normally open third relay holding switch and the last relay sequential switch operatively connected with the third relay armature, the third shunt switch being connected to bridge a first control switch, the third sequential switch being connected in series with the last relay coil, a third circuit connected across the power lines including in series a second control switch, the third sequential switch, and the third relay coil, and the third relay holding switch shunting the second control switch, the second control switch being that one which is connected with the first control switch having the third shunt switch.

10. An electric sequential mechanism as in claim 9 including selector switch means comprising a double arm selector switch for each shunt switch and having a plurality of selector contacts each contact being connected with the input side of a first control switch and an additional contact connected with the output side of the last of the first control switches having an input connection; and a single arm selector switch for each double arm selector switch and operatively ganged therewith and connected in series with a sequential switch, each single arm selector switch having a plurality of selector contacts one being connected with the output side of each second control switch corresponding with the first control switches having the double arm selector switch connected therewith.

11. An electric sequential mechanism as in claim 9 including a delay means operatively connected with the armature of the first relay and operating to delay return of its switches to initial position.

12. An electric sequential mechanism as in claim 10 including a delay means operatively connected with the armature of the first relay and operating to delay return of its switches to initial position.

13. An electric sequential mechanism as in claim 1 in which the number of actuators having a first control switch exceed in number the number of second control switches.

14. An electric sequential combination mechanism as in claim 4 in which there are five second control switches, and in which there are at least two shunt switches and at least two selector switch means.

15. An electric sequential combination mechanism as in claim 14 in which there are five second control switches and in which there are three shunt switches, and three selector switch means.

16. An electric sequential combination mechanism as in claim 14 in which there are five second control switches and the number of first control switches exceeds the number of second control switches, in which there are two shunt switches, and two selector switch means.

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