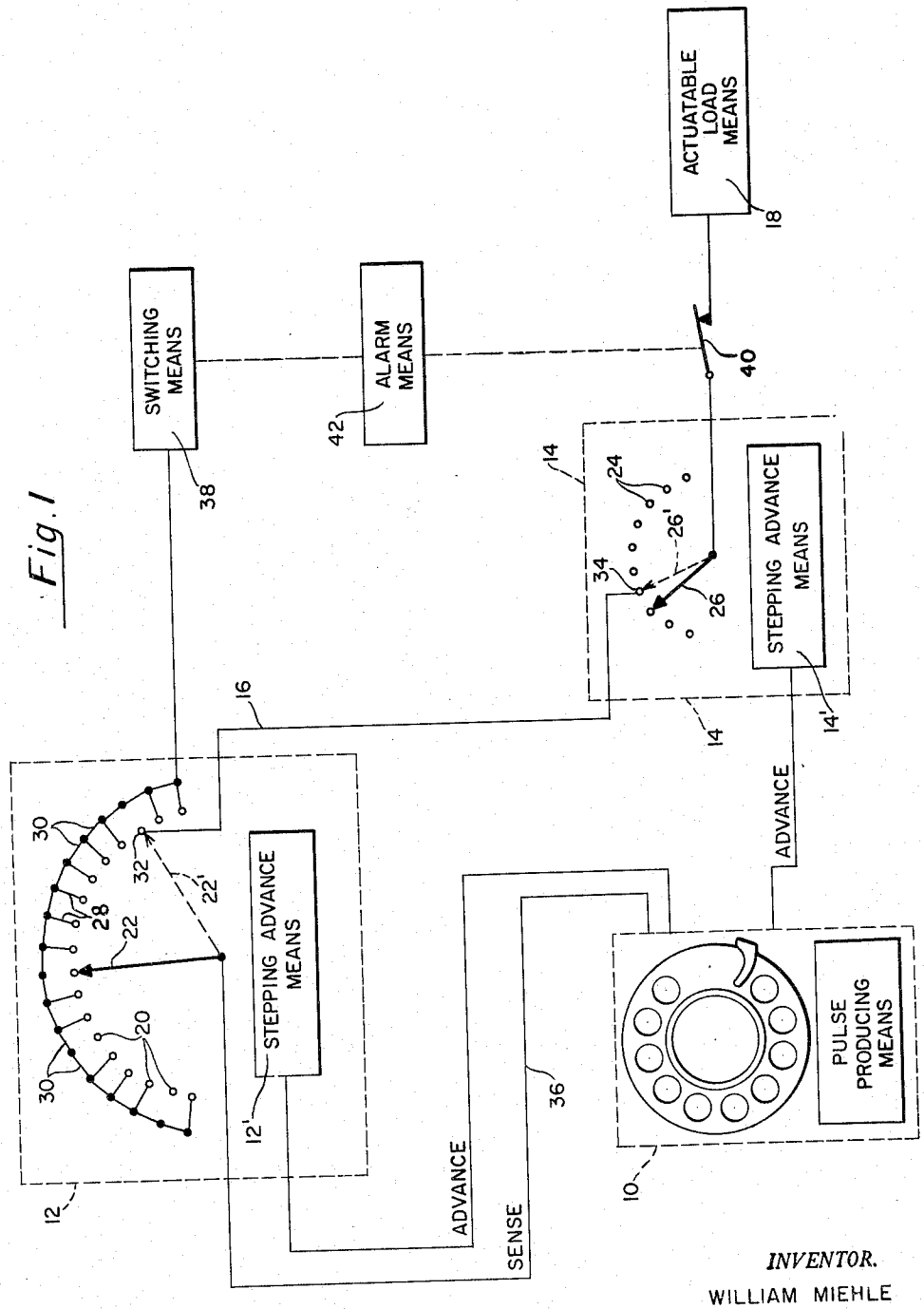
April 7, 1964 W. MIEHLE 3,128,414

PERMUTATION CONTROL DEVICE

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Fig. 1



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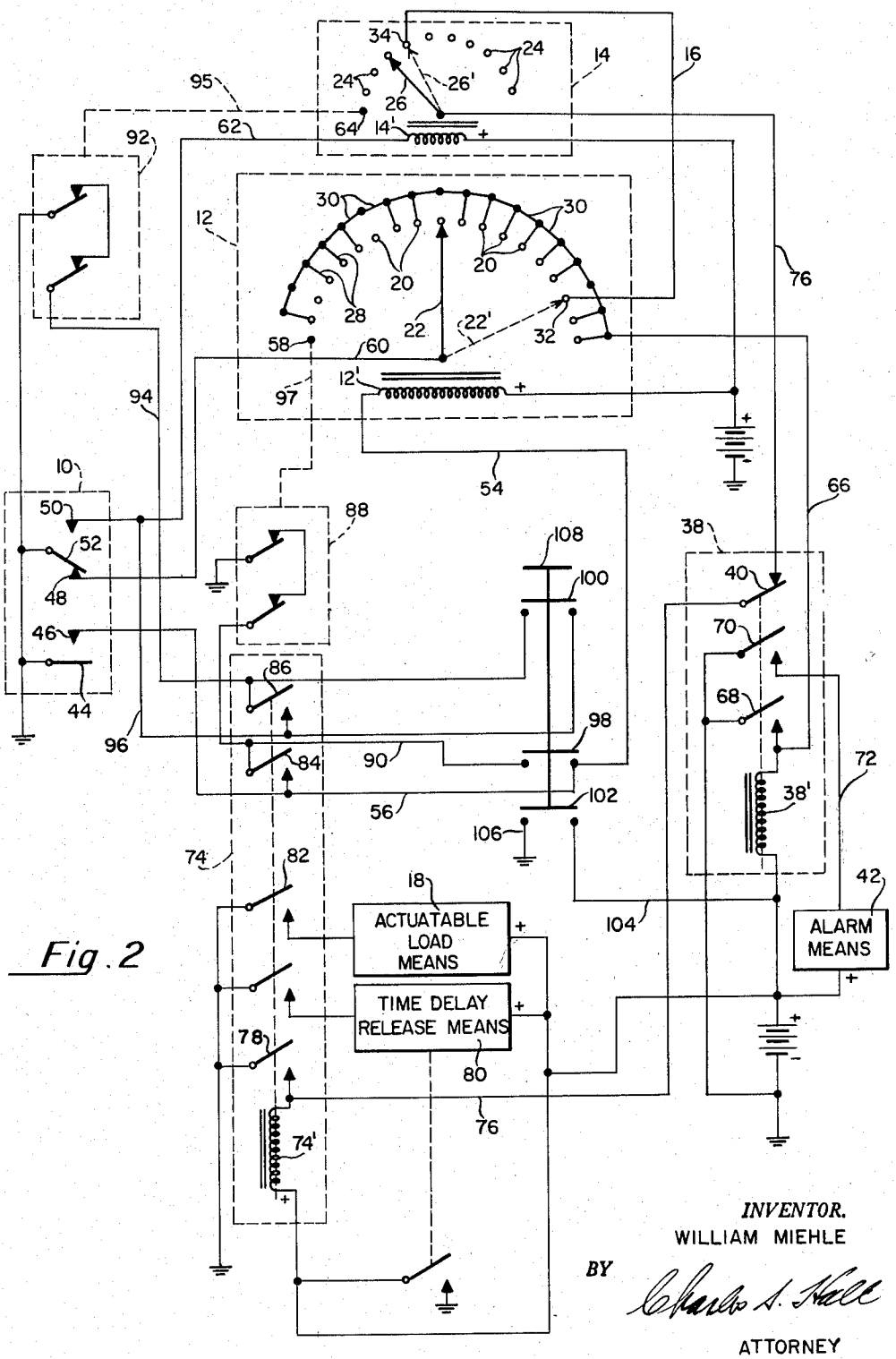


Fig. 2

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3,128,414

PERMUTATION CONTROL DEVICE

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6 Claims. (Cl. 317—134)

This invention pertains to code-controlled devices and more particularly to code-controlled pulse-actuated permutation devices for completing an ultimate circuit.

Permutation code-controlled devices are well known. Such devices in the past, however, have usually consisted of combinations of mechanical tumblers or complicated arrangements of relays to be operated in prearranged sequence. The capacity of these devices, as to variations in code, has been limited by the unwieldiness of adding more mechanical devices or relays. Since protection has depended in the past on the probabilities against chance selection of the code, the capacity of these devices has placed a severe limitation on their measure of protection.

Code-controlled permutation devices are particularly appropriate in circumstances requiring maximum security. It is desirable not only that such devices have capacity for complex and flexible codes, but that they be simple and compact in construction.

In most modern code-controlled devices, the code is composed of a series of actions, the effect of each action being a multiple of some basic unit. It has been possible in the past that the chance operation of the device might be accomplished by two or more consecutive actions, the effect of which equalled the predetermined single code action in the total number of basic units, or that a single chance action might equal two or more coded actions under the predetermined code.

It is very desirable in situations requiring maximum security to have a control device which automatically returns a lock, for example, to its closed position, after the device has been operated.

My invention is applicable to the actuation of any electro-mechanical or electronic device, which is limited to authorized personnel, such as reciprocating or rotary locks and the actuation of switches whether in immediate or remote areas.

An important object of my invention is to include a very wide range of code variations and complexity in a flexible, remotely controllable permutation control device of simple construction and compactness.

Another important object of my invention is to provide a code-controlled permutation device which is operated only when the number of actions performed in actuating the device and the cumulative number of basic code units contained in such actions are both in agreement with the predetermined code.

Another important object of my invention is to include in a permutation control device a means which automatically returns the controlled object to its normal condition after the lapse of a predetermined length of time after the operation of the device.

Another important object of my invention is to provide an improved code-controlled pulse-actuated permutation control device which is rendered inoperable, until reset, by any attempted operation which is not in accordance with the predetermined code.

In carrying out the objects of my invention, a device embodying the invention comprises, in general, two sequential stepping means, one of the stepping means being advanced one step by each pulse in a series of groups of pulses while the other stepping means is advanced one step for each such group of pulses. The stepping means have stationary contacts, selectable ones of which are so connected that an ultimate circuit is closed when, and

only when, pulses are produced in accordance with the predetermined code.

The invention also contains a sensing circuit which renders the permutation device inoperative and operates an alarm, if desired, when pulses are produced which are not in accordance with the code. In the preferred embodiment this circuit operates through selectable contacts of the larger of two stepping switches and a normal contact of a dialing mechanism.

Among the features of my invention is pulse actuation, either from an immediate or remote source.

Another feature of the invention is the avoidance of tumblers or other mechanisms, the sounds or pulsations of which might give a clue that the predetermined code is being complied with.

Various other objects, advantages and meritorious features of the invention will become more fully apparent from the following specification, appended claims and accompanying drawings wherein:

FIGURE 1 is a functional diagram, partly in block form, of one embodiment of the invention showing the connections set to represent a predetermined code, the two sequential stepping means positioned after the production of the third group of pulses by the pulse producing means, in accordance with the code, and

FIGURE 2 is a schematic diagram of the electrical circuit with connections and status as in FIGURE 1.

My invention may be best understood by referring first to its general functions as shown in FIGURE 1. I have included in this embodiment of the permutation control device a means 10 for producing electrical pulses in a series of groups, with selectable numbers of pulses in each group, while producing concurrently a single pulse for each of said groups of pulses. I have connected the pulse producing means to a first sequential stepping means 12 and to a second sequential stepping means 14 having stepping advance means 12^1 and 14^1, respectively. The first sequential stepping means 12 receives series of groups of pulses and the second sequential stepping means 14 receives a single pulse for each of said pulse groups. Each sequential stepping means is provided with step-by-step stationary contacts, a single contact of one means being selectably connectible through a line 16 to a single contact of the other. When the stepping means 12, 14 are advanced by pulses from the pulse producing means 10 and arrive concurrently at the contacts connected by the line 16, an ultimate circuit is completed which actuates a load means 18.

It will be apparent that the number of code combinations which may be used in my invention is limited only by the convenient capacity of the pulse-producing means and the number of stationary contacts of the stepping means.

In the illustrated embodiment, the first stepping means 12 includes the stepping advance means 12^1, eighteen stationary contacts 20 and a stepping arm 22. The second stepping means 14 includes the stepping advance means 14^1, ten stationary contacts 24 and a stepping arm 26.

The device, as illustrated, has been connected to be actuated by pulses produced in accordance with the code expression 2—4—3—7. With reference to the figures, it will be noted that all of the stationary contacts 20, except those upon which the stepping arm 22 of the first stepping means 12 will rest after activation by each successive group of pulses in the selected code expression are connected by leads 28 to a common bus or terminal 30. In other words, when setting up the coded expression 2—4—3—7, those contacts 20 of stepping means 12 corresponding to the second, sixth, ninth and sixteenth positions of the stepping arm 22 are not connected electrically to the common terminal 30 but all of the re-

maining contacts are. The two figures illustrate by the full line showing of the stepping arms 22 and 26 the positions of the stepping means as a result of the first three groups of pulses produced under the illustrative code expression. After the pulse-producing means 10 has been actuated to produce the final group of seven pulses under the selected code, the movable stepping arms 22 and 26 will rest on the stationary contacts 32 and 34, respectively, as shown by the broken line positions 22^1 and 26^1. For the illustrated coded expression stationary contacts 32 and 34 are designated the final contacts and are connected by the line 16. An ultimate circuit, to be described hereinafter in detail, will then be completed to the actuatable load means 18.

The first stepping means 12 is provided with a sensing circuit numbered generally at 36 on FIG. 1 which cooperates with other elements to render the device inoperable in the event the first stepping means 12 is advanced by a group of pulses which is not in accordance with the predetermined code. In such a case, the stepping arm 22 would come to rest on a stationary contact 20 which is connected to the terminal 30. A circuit would then be completed which acts through a switching means 38 to open a switch 40 in the ultimate circuit rendering the device inoperable and, if desired, to operate an alarm 42.

The function of the first stepping means 12 is to advance cumulatively one step for each pulse produced in a series of groups of pulses to the final contact determined by a given code expression. The sensing circuit 36 protects the device against operation when the stepping arm 22 is advanced to any contact connected to the common terminal 30, that is, to any contact on which arm 22 would not come to rest during operation of the device under a predetermined code expression.

However, under the illustrative code expression 2—4—3—7, for example, it would be possible for the stepping arm 22 to be advanced to its final contact 32 by several different series of groups of pulses, none of which would activate the sensing circuit 36. For example, the series of two groups of pulses 9—7, or the series of three groups of pulses 6—3—7, or 2—7—7, would advance the stepping arm 22 to the final contact 32 and the stepping arm 22 would come to rest at the end of any group in these series of groups of pulses on a contact controlled by the chosen code expression. As stated heretofore, this is a problem which in the past has limited the effectiveness of many code controlled devices.

The function of the second stepping means 14 is to advance cumulatively one step for each pulse group in the series to a final contact determined by the given code expression. The code device can only be operated when the two stepping arm 22, 26 are advanced to their respective final contacts 32, 34 concurrently. The incorporation of a second stepping means with the first stepping means and the sensing circuit absolutely limits the operation of the code device to the predetermined code expression. The number of pulses per group, the number of groups and the order of the groups in the chosen code expression must be complied with before the code device will actuate the load means.

These aspects of the invention will be understood more fully from the description of FIG. 2 hereinafter.

In the preferred embodiment of the invention the two sequential stepping means are rotary stepping switches and pulses are produced by a dialing mechanism, such as a standard telephone dial apparatus.

Referring now more particularly to FIG. 2, the dialing mechanism 10 includes the usual rotary dial element, as shown in FIG. 1, a movable grounded pulsing contact 44, a stationary pulsing contact 46, a normal contact 48, an off-normal contact 50 and a movable grounded transfer contact 52. All of these elements are usually incorporated in or associated with a conventional telephone number dialing device. Other portions of the dialing mechanism, such as the governor, etc., which are not required for an understanding of the invention, are not shown.

Production of selectable groups of pulses can be achieved by any other of well-known electro-mechanical or electronic differential means, such as depression of coded buttons or keys, twirling of dials with electrical connections, or emission of electronic pulses by oscillators. A single pulse can be produced concurrently by having any of these activities simultaneously close a switch or cock a spring which will act to complete a circuit and emit a single pulse.

Upon activation of a rotary dial, as in a standard telephone dial apparatus, the transfer contact 52 shifts from the normal contact 48 to the off-normal contact 50, where it remains until the dial returns to its normal position, at which time transfer contact 52 shifts back to the normal contact 48. During the return movement of the dial the pulsing contacts 44, 46 will emit a group of pulses, from one to ten in number, there being one for each unit of the original displacement of the dial. The zero position represents maximum displacement with the emission of ten pulses.

The operating relay 12^1 which operates the arm 22 of the first stepping switch 12 is electrically connected to a source of potential and through lines 54, 56 to pulsing contact 46 of the dialing mechanism 10. The arm 22 has a home position 58 and sweeps a set of spaced stationary contacts 20, one of which is designated as a final contact 32 under the coded expression. The relative position of the final contact 32 in the set of spaced stationary contacts is determined by the total number of pulses to be produced in the series of pulse groups by the dialing mechanism 10 under the predetermined code.

The first stepping switch 12 also has its movable arm 22 electrically connected through line 60 to the normal contact 48 of the dialing mechanism 10. The arm 22 is in step-by-step individual electrical connection with the stationary contacts 20. The common terminal 30 is connected through lines 28 to those of the stationary contacts 20 which are not selected for the dialed coded expression. In the preferred embodiment, terminal 30 has, for convenience, been provided throughout its length with a plurality of stationary contacts, there being one contact for each position of the stepping arm 22. It is recognized that there may be a unitary terminal to which the spaced stationary contacts 20 are selectively connectible and that subdivided terminal connections, if used in an embodiment of the invention, need not be in concentric positions about the axis of the arm 22, but in any position in the device convenient for its construction.

The operating relay 14^1 for the movable arm 26 of the second stepping switch 14 is electrically connected to a source of potential and through the line 62 to the off-normal contact 50 of the dialing mechanism 10. The stepping arm 26 of the switch 14 has a home position 64 and sweeps a set of spaced stationary contacts 24, one of which is designated as the final contact 34 for a selected coded expression.

The relative position of the final contact 34 in the set of stationary contacts 24 is determined by the number of groups of pulses produced by the pulse-producing means 10 under a selected code.

As is well known, stepping switches are advanced by individual pulses, without regard to the length of the pulse involved. This may be accomplished, for example, by having a relay in the stepping switch bias a spring which is released when the flow of current stops. The released spring action then advances the movable arm to the next contact position.

Activation of the dialing mechanism in the preferred embodiment will therefore produce pulses in two circuits.

The movable arm 22 will be advanced step-by-step over the stationary contacts 20 by the operating relay 12^1 according to the number of pulses emitted by the pulsing contacts 44, 46. On the other hand, the movable arm 26 will be advanced only one step over the stationary contacts 24 when the transfer contact 52 shifts from normal contact 48 to off-normal contact 50. The transfer contact 52 returns to the normal contact 48 only when the activated rotary dial returns to its normal position.

Instead of the rotary stepping switches as illustrated, straight line or staggered stepping devices may be used as well known in the art.

My invention, as embodied herein, also includes a first switching assembly generally indicated at 38 which is connected on one side through line 66 to common terminal 30 of the first stepping switch 12, and on the other side to a source of potential. The switching means 38 controls a holding means, consisting in this case of switch 68, and two additional switches one of which 70 is normally open and the other of which 40 is normally closed. Other types of holding means, such as a latching armature, may be used instead of a switch. The movable elements of the three switches 68, 70 and 40 are connected together for joint operation by the armature of a relay 38^1 of the switch assembly 38.

An alarm means 42 may be electrically connected across a source of potential through line 72 to one side of said normally open switch 70, the other side of the switch being grounded.

A second switching assembly generally indicated at 74 (FIG. 2) is provided with a switch operating relay 74^1 which is electrically connected to a source of potential and by way of line 76 to the movable arm 26 of said second stepping switch 14 through the normally closed switch 40 which is controlled by relay 38^1 of the first switching assembly 38. The second switching assembly 74 controls a holding means, consisting in this case of a switch 78, a time delay release means 80, and additional normally open switches 82, 84 and 86. Other types of holding means, such as a latching armature, may be used.

Relays are shown in FIG. 2 as operating mechanisms of the first and second switching assemblies 38 and 74 but the equivalence of thyratron tubes is well known. Many types of time delay release means are well known in the art and no specific embodiment need be shown here.

An actuatable load means 18, shown in block form, is connected between a source of potential and one side of the normally open switch 82, the other side of the switch being grounded. In the illustrated embodiment of my invention, the production of pulses under a predetermined code expression will complete to a source of potential an ultimate circuit to the actuatable load means 18, such as that through the grounded transfer contact 52 and the normal contact 48 of the dialing mechanism, line 60, movable arm 22 and selected final contact 32 of the first stepping switch 12, line 16, selected final contact 34 and movable arm 26 of the second stepping switch 14, line 76 through switch 40, and relay 74^1, thereby closing normally open switch 82 and actuating the load means 18.

The time delay release means 80 is automatically operable to short-circuit the second switching relay 74^1 and release the holding means 78 after a predetermined period of time after completion of the ultimate circuit thereby reopening the normally open switch 82 and the circuit to the load device 18. Under this arrangement, any mechanism, such as a biased lock bolt, controlled by the actuatable load means will remain in inoperable condition except for a brief predetermined period immediately following the completion of the production of the sequence of groups of pulses, in accordance with a predetermined code.

If, on the other hand, a group of pulses is produced which is not in accordance with a predetermined code and the movable arm 22 comes to rest on a stationary contact

20 which is electrically connected to the common terminal 30 by a line 28, a circuit will thereby be completed across a source of potential from grounded transfer contact 52 through normal contact 48, line 60, movable arm 22, the uncoded stationary contact 20 engaged by arm 22, its lead 28, terminal 30 and line 66 to the first switching relay 38^1 which will be actuated to connect the alarm means 42 by closing said normally open switch 70, and at the same time open the normally closed switch 40, thereby making it impossible for the ultimate circuit which includes switch 40 to be completed until the control device is returned to its normal status through means to be described hereinafter.

It is apparent that the sensing circuit will not be closed and thus not function during the production of pulses in accordance with the predetermied code. At such times as movable arm 22 is sweeping contacts 20 which may be connected to terminal 30 by leads 28, transfer contact 52 of the dialing mechanism is in continuous connection with off-normal contact 50. Only when the transfer contact 52 returns to the normal contact 48 at the completion of the emission of a group of pulses is it possible for a circuit to be completed through line 60, movable arm 22 and a stationary contact 20 connected by its lead 28 to terminal 30 and line 66 to the switching relay 38^1.

In the preferred embodiment of my invention a first interrupter identified generally at 88 (shown in the left central portion of FIG. 2) is electrically connectible to the first stepping relay 12^1 by a line 90 through switch 84, and lines 56, 54, said interrupter being open when the movable arm 22 is in its home position 58.

A second interrupter identified generally at 92 (shown in the upper left portion of FIG. 2) is electrically connectible through a line 94 to the second stepping relay 14^1 through switch 86, and lines 96 and 62, said second interrupter being open when the stepping arm 26 is in its home position 64. The result of this arrangement is that upon energization of the second switching relay 74^1 as part of the ultimate circuit, switches 84 and 86 are closed connecting interrupters 88 and 92, respectively, to first and second stepping relays 12^1 and 14^1, respectively, thereby advancing the movable arms 22 and 26 through the full range of the several step-by-step contacts to return the arms 22 and 26 to their respective home positions immediately after the ultimate circuit has been completed.

Many types of interrupters are known in the art and no particular type is required in my device. An induction coil "buzzer" type interrupter could be used, for example, having two switches, one an off-normal switch and the other a pulsing switch. The off-normal switch could be closed by a cam operating off the pivot of the movable arm of its associated stepping switch, when the movable arm moves away from its home position, as indicated generally by the dotted lines 95 and 97. The pulsing switch, when connected to its associated stepping switch through the completion of the ultimate circuit as described above, would advance the movable arm of the stepping switch through its full range of contacts to return the movable arm to its home position, where the interrupter circuit is opened by its off-normal switch.

Activation of switching relay 38^1 by production of a group of pulses not in accordance with the predetermined mode opens switch 40, as previously explained, and renders the device inoperable until it is reset. As a result of this inoperability, the movable arms 22 and 26 of the stepping switches 12 and 14, respectively, will remain on those respective stationary contacts 20 and 24 to which they were advanced by the sequence of pulses not in accordance with the predetermined code.

A reset means 98 is provided between the first interrupter 88 and operating relay 12^1 of the first stepping switch 12. A second reset means 100 is provided between the second interrupter 92 and operating relay 14^1 of the second stepping switch 14.

Activation of the reset means will thus complete circuits between the stepping switches and their respective interrupters, thereby returning the movable arms 22 and 26 to their home positions 58 and 64, respectively.

A release means 102 is also provided for the switching relay 38^1 with its holding means 68. The actuation of the said release means 102 short-circuits the switching relay 38^1 through lines 104 and 106 thereby releasing the holding means 68, opening switch 70 to the alarm means 42 and closing switch 40 in the ultimate circuit. By the activation of the reset means 98 and 100 and the release means 102, the control device is returned to its normal state and prepared for the reception of a proper sequence of pulses.

The said release means and reset means may be placed at some distance from the embodiment of the main control device if desired.

The reset means 98 and 100 and release means 102, as illustrated, are push-button two-point switches and are shown as being actuatable from a common depressible operating member 108. It is evident that such means could be contacts operated by a relay or thyratron tube, or that the device could be returned to its normal status manually.

In a modification of the illustrated embodiment, it could be assumed, for example, that the pulse-producing means has a maximum capacity of ten pulses per group, the first stepping means has fifty stationary contacts and the second stepping means has ten stationary contacts. In such an embodiment a lengthy code expression 8—2—1—9—5—0—6—4—1—3, for example, could be used. Each digit in this code expression represents a numerical group of pulses, the zero accounting for ten. The larger stepping means would be advanced step-by-step through its stationary contacts by the production of pulses in groups, arriving finally at the forty-ninth contact, forty-nine being the selected summation of the digits in the code expression.

Meanwhile the smaller stepping means would be advanced one contact for each such group of pulses. Since there are ten groups of pulses in the assumed code expression, the smaller stepping switch would be advanced to its tenth contact. Under this assumed code, the forty-ninth stationary contact of the larger stepping switch would be electrically connected to the tenth contact of the smaller stepping switch, thereby completing the ultimate circuit to actuate the device.

It is evident that embodiments of my invention can encompass codes from the most simple to the most complex.

I claim:

1. A code-controlled permutation device comprising, in combination, means for producing series of groups of electrical pulses with selectable numbers of pulses in each group, said means also producing a single pulse for each of said groups of pulses, first sequential stepping means including a stepping arm and stationary contacts, said first stepping means being advanced cumulatively by each pulse in said series of groups of pulses under a predetermined code to a final contact, second sequential stepping means including a stepping arm and stationary contacts, said second stepping means being advanced by said single pulses under said predetermined code to a final contact, a direct connection between said final contacts under said predetermined code, and an ultimate circuit through said first sequential stepping means and said second sequential stepping means including said arm of each of said stepping means and said direct connection completed only when said pulse-producing means is actuated in accordance with said predetermined code to the completion of said code.

2. A code-controlled permutation device for completing an ultimate circuit, which is completed only when the control elements are operated in accordance with the code, comprising means for producing series of groups of pulses with selectable numbers of pulses in each group, said means also producing a single pulse for each said group of pulses, first sequential stepping means having contacts and being advanced cumulatively from contact to contact by each pulse of said series of groups of pulses under a predetermined code to a final contact, second sequential stepping means having contacts and being advanced from contact to contact by each of said single pulses under said predetermined code to a final contact, a direct connection between said final contacts under said predetermined code and forming a part of said ultimate circuit, a sensing circuit connected with said first stepping means, said sensing circuit being closed only and automatically at a time when said first stepping means is advanced to any one of said contacts not in accordance with the progressive and cumulative sum of the selected numbers of pulses in each group, and a switch forming part of the ultimate circuit controlled by said sensing circuit.

3. A code-controlled permutation device comprising means for producing a plurality of groups of electrical pulses with selectable numbers of pulses in each group, said means also producing a single pulse for each of said groups of pulses, a first stepping switch having a stepping arm and contacts, said stepping arm being advanced cumulatively contact by contact by each pulse in said plurality of groups of pulses to a final contact under a predetermined code, a second stepping switch having a stepping arm and contacts and being advanced step-by-step by said single pulses to a final contact under said predetermined code, a direct connection between said final contacts under said predetermined code, an ultimate circuit completed through said stepping arm of first stepping switch, said direct connection and said stepping arm of said second stepping switch when said pulse-producing means is actuated in accordance with said predetermined code to the completion of said code, a holding means acting upon said ultimate circuit, a time-delay release means cooperating with said holding means, a sensing circuit connected through the stepping arm and the ones of said contacts of said first stepping switch not in accordance with the progressive and cumulative sum of the selected numbers of pulses in each group, a switching assembly actuated by the closing of said sensing circuit, and a normally closed switch in said ultimate circuit, actuatable to open position by said switching assembly, whereby the ultimate circuit is automatically rendered inoperative, when said stepping arm of said first stepping switch rests on one of said sensing circuit contacts.

4. Apparatus as set forth in claim 3 in which said pulse-producing means is a telephone dialing apparatus.

5. A code-controlled combination lock comprising, in combination, means for producing a series of groups of electrical pulses with selectable numbers of pulses in each group, said means also producing a single pulse for each group of pulses, said pulse producing means having a normal contact, an off-normal contact and a grounded transfer contact, a first stepping switch having a home position, a stepping arm and stationary contacts, said stepping arm being advanced contact by contact by each pulse in said groups of pulses, a common terminal connected to predetermined ones of said stationary contacts, a second stepping switch having a home position, a stepping arm and stationary contacts, said stepping arm being advanced contact by contact by each of said single pulses, an ultimate circuit completed through said first stepping switch and said second stepping switch when said pulse-producing means is operated in accordance with a given code, a sensing circuit connectible through said grounded transfer contact, said normal contact, said stepping arm of said first stepping switch, any one of said predetermined contacts and said common terminal, a switching assembly connected across a source of potential to said common terminal, said switching assembly having a holding means, a normally closed switch in said ultimate circuit, controlled by said switch-

ing assembly, first and second interrupters, connectible to said first and second stepping switches, respectively, each of said interrupters being open when its stepping switch is in its home position, reset means between said first and second stepping switches and first and second interrupters, respectively, and release means for said holding means.

6. A combination lock controlling an electrically actuatable load comprising a dialing apparatus having pulsing contacts, a normal contact, an off-normal contact and a grounded transfer contact, said pulsing contacts being pulsed for each position the dial is displaced, said transfer contact and off-normal contact pulsing once each time the dial is displaced, first and second stepping switches having home positions, stationary contacts, stepping arms and relays, connectible to a source of potential for advancing said stepping arms respectively step-by-step over said contacts, said first stepping switch being pulsed by said pulsing contacts and said second stepping switch being pulsed by said off-normal and transfer contacts, an electrical connection between a selectable contact of said first stepping switch and a selectable contact of said second stepping switch, an electrical connection between said first stepping switch arm and said normal contact, a first switching assembly electrically connected to said stepping arm of said second stepping switch, said switching assembly having a holding means and a plurality of normally open switches, one of said switches being connected to an actuatable load, a time-delay release means cooperating with said holding means, first and second interrupters electrically connectible to said relays of said first and second switching means, respectively, by certain of said normally open switches, each of said interrupters being open when its related stepping switch is in its home position, a terminal connectible to predetermined ones of said contacts of said first stepping switch, a second switching assembly connected across a source of potential to said terminal, said switching assembly having a holding means and a plurality of switches, one being a normally closed switch in the electrical connection between said first switching assembly and the arm of said second stepping switch, and another being a normally open switch connectible to an alarm means, release means for said holding means of said second switching means and reset means between said first and second interrupter and first and second stepping switches, respectively.

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