Aug. 6, 1935. L. STEIN 2,010,570

LOCK

Filed Feb. 12, 1934 3 Sheets-Sheet 1

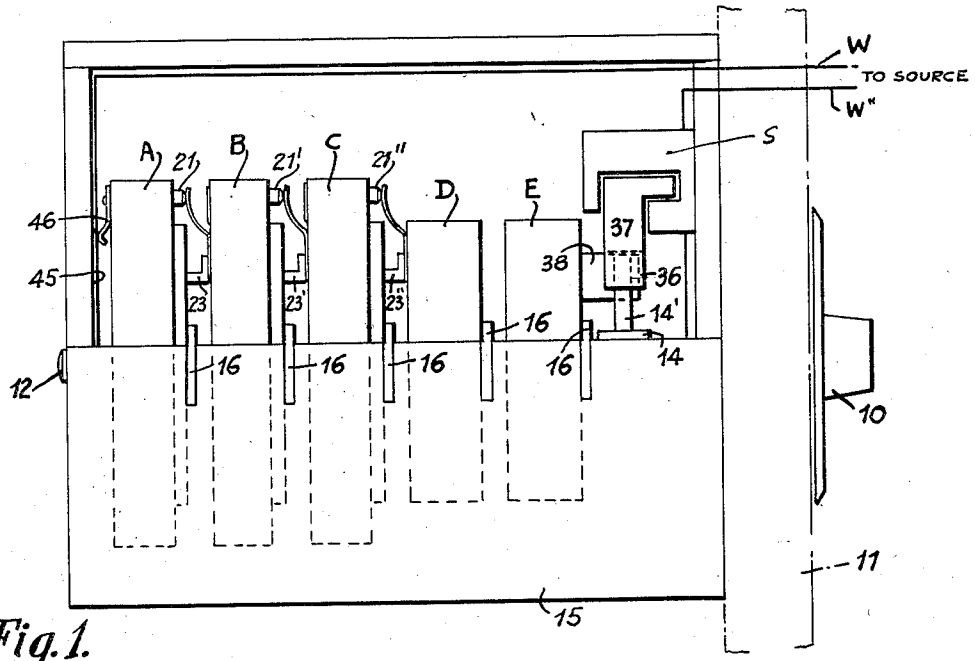


Fig. 1.

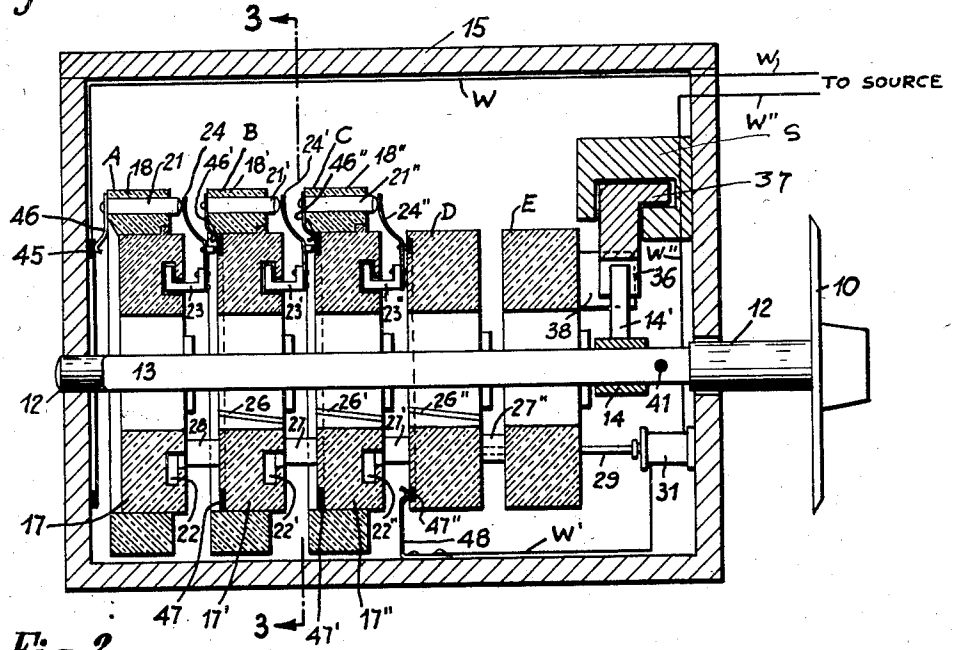


Fig. 2.

INVENTOR.
LOUIS STEIN.

BY Maxwell E. Sparrow

ATTORNEY.

Aug. 6, 1935. L. STEIN 2,010,570

LOCK

Filed Feb. 12, 1934 3 Sheets-Sheet 2

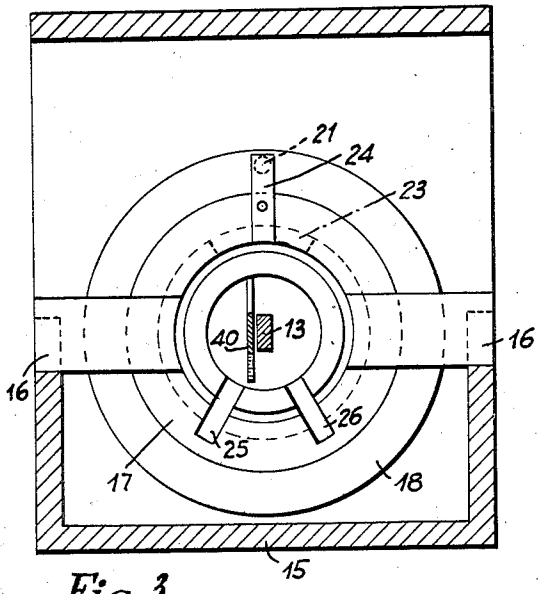


Fig. 3.

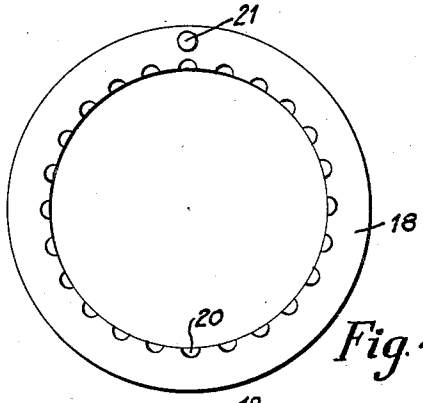


Fig. 4.

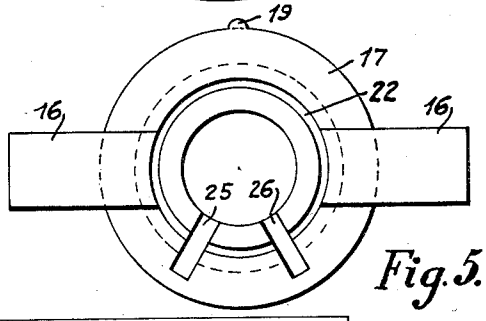


Fig. 5.

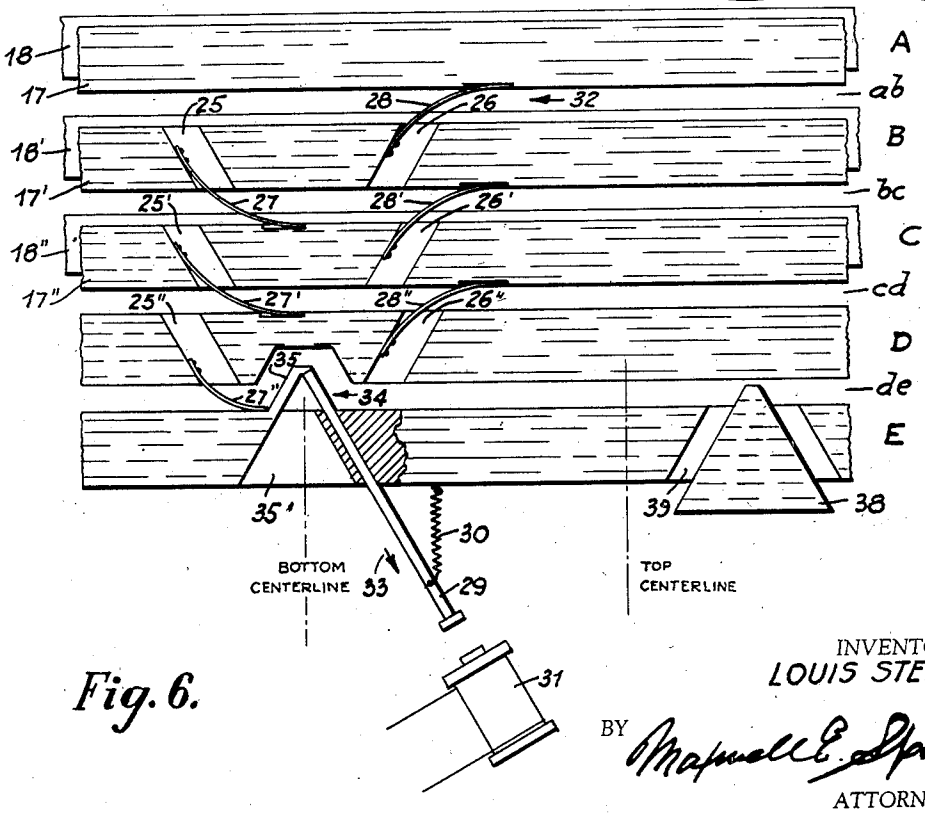


Fig. 6.

INVENTOR.
LOUIS STEIN.

BY Maxwell E. Sparrow

ATTORNEY.

Aug. 6, 1935. L. STEIN 2,010,570

LOCK

Filed Feb. 12, 1934 3 Sheets-Sheet 3

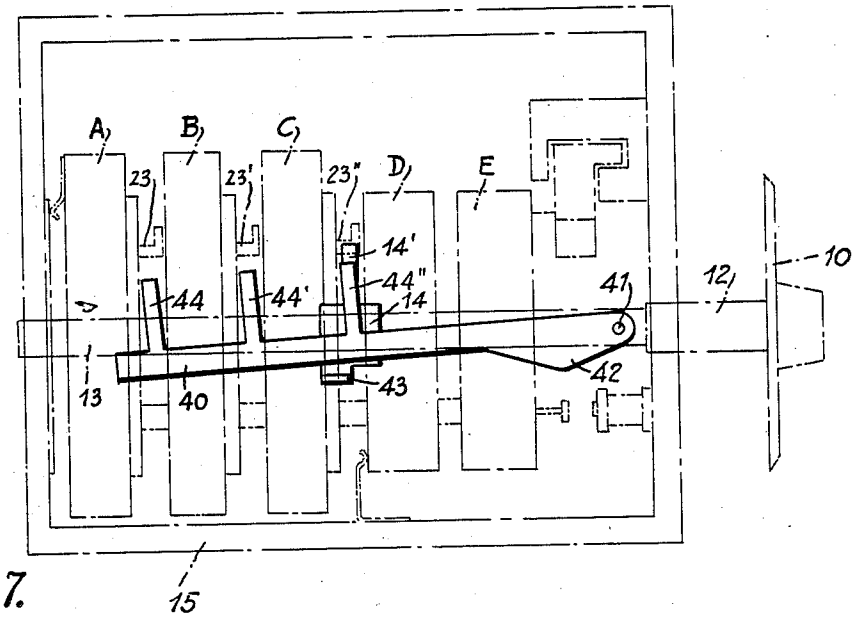


Fig. 7.

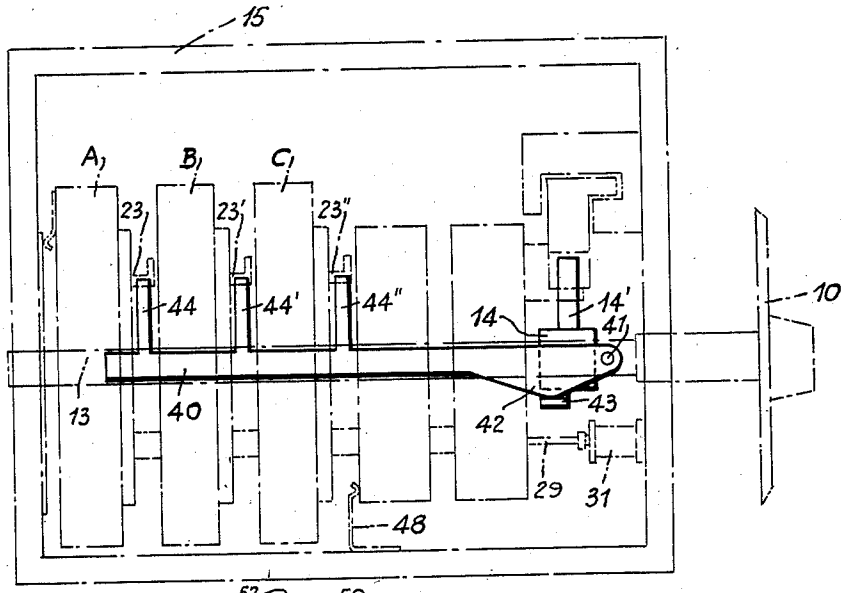


Fig. 8.

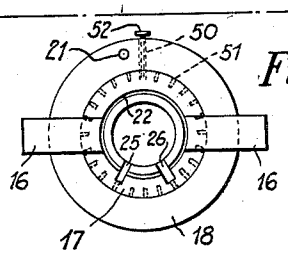


Fig. 9.

INVENTOR.
LOUIS STEIN.

BY Marshall E. Sparrow

ATTORNEY.

Patented Aug. 6, 1935 2,010,570

UNITED STATES PATENT OFFICE

2,010,570

LOCK

Louis Stein, Brooklyn, N. Y., assignor of one-half to Charles M. Hilton, New York, N. Y.

Application February 12, 1934, Serial No. 710,865

14 Claims. (Cl. 70—63)

This invention relates to improvements in combination locks, especially of the electrical type for use in safes, vaults, automobile doors etc., wherein an electrical connection is made, or a normally broken circuit is closed to energize electrical means whereby the latched bolt may be released for manual operation to withdraw the bolt and thereby permit opening of the door which carries the locking device.

It is an object of this invention to provide for a lock of the above-described type, which is simple in its construction and operation and foolproof.

It is another object of this invention to provide for an electrically controlled locking device, which will assure security unless the right combination is used.

It is another object of this invention to provide for an electrically controlled locking means, which will prevent its being opened by the well-known way of "feeling" or "listening" by unauthorized persons in attempting to open the same.

It is the intention of this invention to operate electrically a locking bar or rod, which will prevent an operating trigger from emerging from combination rings. If the electric circuit is not closed by the use of the correct combination, the trigger will remain inside of the combination rings and any further manipulation of the dial will land the trigger finally in its starting position.

This invention accordingly consists in the features of construction, combination of parts and in the unique relations of the members and in the relative proportioning and disposition thereof; all as more completely outlined herein.

To enable others skilled in the art so fully to comprehend the underlying features thereof that they may embody the same by the numerous modifications in structure and relation contemplated by this invention, drawings depicting a preferred form has been annexed as a part of this disclosure, and in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Fig. 1 represents a side elevational view of the device.

Fig. 2 represents a vertical section through the device illustrated in Fig. 1.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 2.

Fig. 4 is a detail view of one of the outside combination rings.

Fig. 5 is a detail view of one of the inside combination rings.

Fig. 6 is a diagrammatic view, in which it is assumed that the combination rings have been cut open and flattened out to illustrate the channels and retaining springs.

Fig. 7 is a side elevational view showing the upsetting arm in inoperative position with trigger making the last combination, and locking rod in locked position.

Fig. 8 is a similar view to Fig. 7 but showing the locking rod in open position, thereby permitting trigger to occupy an operating position, and showing the upsetting arm ready to break the combination.

Fig. 9 illustrates a modified form of the combination rings.

The numeral 10 represents the conventional dial used on safe or vault doors 11. 12 is the operating shaft rotatably mounted in housing 15, and having a flat portion 13. The trigger slide 14 is slidably mounted on this flat portion 13 of shaft 12. A, B and C are the combination ring units while D and E are the auxiliary ring units, the units being spaced apart to form the channels *ab*, *bc*, *cd*, *de*, respectively. The auxiliary rings D and E and inner combination rings 17, 17', 17'' are supported in housing 15 by brackets 16. The outer combination rings 18, 18', 18'' are pressed over the inner rings 17, 17', 17'', respectively, each being held in predetermined combination position by means of a ridge 19 on each inner ring fitting into one of the corresponding grooves 20 in each outer ring. The shaft 12 passes through the center of inner rings 17, 17', 17'' and auxiliary rings D, E. The inner combination rings 17, 17', 17'' are stationary, while the outer rings 18, 18', 18'' are rotatably adjustable thereover so as to bring electrical contact points 21, 21', 21'' arranged respectively in or on outer rings 18, 18', 18'' into locations according to the combination desired. For simplicity contact points 21, 21', 21'' are shown in their highest positions on all three combination rings A, B and C, but the same may be located along any points of the respective diameters of said rings. The inner rings 17, 17', 17'' have the respective circular grooves 22, 22', 22'' in which are secured the respective slides 23, 23', 23'' carrying the respective metal contact springs 24, 24', 24''. The right combination will bring these 3 slide contacts 24, 24', 24'' into the right positions over contact points 21, 21', 21'', and thereby close the circuit as hereinafter more fully described.

Inner combination rings 17' and 17'' have the respective metal contact rings 47 and 47', and metal contact ring 45 is arranged in housing 15.

The contact points 21, 21', 21'' have the respective electrical terminals 46, 46', 46'' for respective engagement with rings 45, 47, 47'. Inner combination rings 17' and 17'' as well as auxiliary ring D are provided with slots 25 and 26, 25' and 26', 25'' and 26'', respectively, as shown in Fig. 6. Spring members 27 and 28, 27' and 28', 27'' and 28'' are fastened on one of the inside walls of the slots respectively. The free ends of said springs extend inside the channels between the combination rings, these channels being designated *ab, bc, cd* and *de*. The function of these springs is to guide the trigger 14', carried by slide 14, from one channel into the other one, preventing at the same time a move in the wrong direction. The trigger 14' is adapted for respective sequential engagement, with the slides 23, 23', 23'', to circumferentially move the same in their respective grooves 22, 22', 22'', when the dial 10 is rotated, in accordance with a predetermined combination. The operation of the device hereinafter described will more fully explain this function. Auxiliary ring E is the locking ring having a stop lug 35. Unless the circuit is closed by the use of the right combination, locking rod 29, which projects through ring E and is in sliding engagement therewith, will be held by compression spring 30 in the position shown in Fig. 6. If the circuit is closed by the placing of contact springs 21, 21' and 21'' in the right positions, electro-magnet 31, secured to housing 15 will be energized, attracting locking rod 29.

Other parts of the device will be described in conjunction with its operation which is as follows:

Assuming that the trigger 14' is still in the position shown in Figure 2, namely, in the space provided for the lock-bolt 36, turning of the knob 10 will finally bring the trigger to stop 38 shown in Figure 6 and force the trigger into the channel 39. The combination rule for each lock will now take care of the return of the trigger 14' into its ultimate channel *ab* by passing the trigger through channel 25'', then past spring 27', reversing the moving of the trigger, through channel 25' into space *bc* turning past spring 27, reversing the movement to pass through channel 25 which brings the trigger into channel *ab* and its starting point. As soon as trigger 14' has reached the outward channel in which the lock-bolt 36 is located, the electric circuit may be broken at any time thereafter, as the trigger 14' does return through slot 39 only. It may be advisable in the manufacturing of the lock to omit any combination electric contact points between the space occupied by the two channels 25 and 26 of the new combination ring 17. This rule will apply to the three combination rings A, B and C. Dial 10 is now turned to a point, at which the trigger 14' will have left contact spring 24 on top of contact point 21. The rotation of dial 10 is thereafter reversed, in direction of arrow 32, whereby trigger 14' will strike spring 28 and be forced through slot 26 into that part of channel *bc* between springs 27 and 28', before striking spring 27. The rotation of dial 10 is now reversed until trigger 14' will have passed spring 28' and will have left contact spring 24' on top of contact point 21'. The movement of dial 10 is again reversed from that point, whereby trigger 14' is forced against spring 28' and forced through slot 26' into channel *cd*. Before striking spring 27', the rotation of dial 10 is reversed until the trigger 14' will have passed spring 28'' and will have left contact spring 24'' on top of contact point 21''. The circuit is now closed, energizing magnet 31. This energizing of the magnet will draw locking bolt 29 in the direction of arrow 33, opening the passage 34.

After having left contact spring 24'' on contact point 21'' the movement of trigger 14 is again reversed while being in channel *cd* by turning dial 10 until the trigger 14' is forced against spring 28'' and forced through slot 26'' into slot *de*, the passage 34 being open on account of closed circuit and the continuation of rotation of dial 10 in the same direction will permit trigger 14' to enter through opening 34 striking against stop 35 and sliding into opening 35', and finally moving into fork 36 of slide bolt 37. Reversing of rotation of dial 10 will now cause trigger 14' to move this slide bolt 37 thereby opening the conventional locking means of vault or safe door 11.

If, however, the combination was not used exactly according to intention, the electric circuit will remain open at one of the contact points 21, 21' or 21'' involved in the wrong manipulation of the dial and trigger 14' will continue its movement within channel *de*, finally finding its way back to the original position. After the slide bolt 37 has been operated, the trigger will leave the fork 36, strike the cone shaped stop 38 within opening 39 and be forced back into channel *de*, ready for its return to the original position. Pivotally fastened to shaft 13 by pin 41 is the upsetting arm 40. This arm 40 has a wedge-shaped projection 42, which will ride on top of shelf 43, when trigger slide 14 is in its final operating position. The shelf 43 is an integral part of trigger slide 14. A slight turn of dial 10 will then force fingers 44, 44' and 44'' of upsetting arm 40 against spring contact slides 23, 23' and 23'', upsetting any combinations that may have been made. As clearly illustrated in Fig. 7 and Fig. 8, this can be done only when arm 40 has been raised by the contacting of projection 42 on shelf 43, otherwise the arm will be in the position shown in Fig. 7, which brings fingers 44, 44' and 44'' below contact slides 23, 23' and 23''.

The electric circuit is closed in the following manner: From wire W to circular contact ring 45, through contact 46 into contact 21, into contact spring 24, from there into circular contact ring 47, from there through contact spring 46' into contact 21', into contact spring 24', then into circular contact ring 47', into contact spring 46'', into contact 21'', into slidable contact spring 24'' and to circular contact ring 47''. Contact spring 48 connects with ring 47'' and through wire W' with magnet 31; from there through wire W'' back to the source.

Any change in the combination of combination rings as illustrated in Figs. 4 and 5 necessitates the dismantling of the device. To facilitate this change of combination, without dismantling, the combination rings may be modified according to Fig. 9. In this case, inner combination rings 17, 17', 17'' are never removed and the outer combination rings are rotatably moved after pin 52 has been lifted from hole 51 in inner combination rings 17. Fig. 9 shows the master hole 50 in the outer combination rings 18 and the combination holes 51 in the inner combination rings 17. This may be reversed, by having a series of combination holes 50 in the outer combination rings 18 and only one combination hole 51 on top of the inner combination rings 17.

It is to be borne in mind that the outer ring is not changed in relation to the inner ring in the operation of the lock. This change only takes place after the lock is dismounted for the purpose of changing the combination. In other words, when a particular combination has been determined, the outer ring and the inner ring will remain in their respective fixed relation throughout the use of the lock until such time that it is desired to change the combination of the lock.

After the operator or any unauthorized person has been rotating the dial in a way so as to leave the finger **14'** or any of the contact points in an undesirable position, the lock will just fail to open after the completion of the turns according to the combination, and as in any present day safe lock, the combination will have to be started all over again. The first half of the combination turns will insure the finger **14'** being returned to the starting position, while the second half of the combination turns will move the finger **14'** leaving the slide members **23, 23', and 23''** in their respective contact position thereby closing the electric circuit and insure the operation of the lock.

This above-mentioned first half of the turns will consist of four turns to one side and four turns to the other side. The combination reading will be such, that the trigger will move only a short distance to either side of the "Bottom center line" indicated in Fig. 6, or just enough movement to slide along the springs **27, 27'** and **27''** but not pass the springs **28, 28'** and **28''**. The location of the trigger **14'** in any of the channels *ab, bc, cd* or *de* has no bearing on the first four double turns, because if the trigger has, for example, been in channel *bc* when the combination is started, the remaining three double turns will just keep it within channel *ab*. In other words, if, for example, the dial reading is from 1 to 100, and dial reading **60** coincides with the "Bottom center line", then the first eight movements of the dial will be: Right to 50, left to 80, right to 50, left to 80, right to 50, left to 80, right to 50, left to 80. Now the trigger **14'** is surely within the starting channel *ab* and the second half of the combination turns will start, the markings arranged such as to move the trigger **14'** within each channel so as to leave the slides **23** in their respective desired location, the next turn moving the trigger **14'** through respective slots forward into the next channel, where the locating of the next slide **23'** takes place and repeating this manipulation until the operation of the lock takes place.

While the invention as disclosed shows a spring guide arrangement in Fig. 6, it is understood and easily visualized, that wedge-shaped members of the type illustrated at **38** may be substituted for the springs **27, 27', 27'', 28, 28'** and **28''**.

It is believed from the above description that those skilled in the art will have no difficulty in understanding the construction, the method of use and operation of the device herein disclosed and a detailed discussion thereof is unnecessary. The invention is of simple and practical construction and is adapted to accomplish among others all of the objects and advantages herein set forth.

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

1. A combination lock comprising a bolt, a source of electric current, an electromagnet; a circuit making device interposed electrically between said source and said electromagnet, comprising a plurality of spaced electric contact carrying units, a rotatable shaft extending through said units, a member longitudinally slidable on the shaft, each of said units having an annular groove, and slots through which said member may be made to pass by rotation of said shaft, means to guide said member to said slots, an electric contact carrying slide operable in each of the annular grooves, and being in the path of said member to be moved thereby for making electrical connection between contacts on adjacent units; an auxiliary unit having a passage therethrough and disposed in alinement with said first-mentioned units, the said shaft extending through said auxiliary unit, a spring operated element slidably operable in said auxiliary unit and projecting to normally provide an obstruction to the passage in said auxiliary unit, said electromagnet, when all the electric contacts between adjacent units have been made, being energized to actuate said element to open said passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt, and means associated with said shaft and said member for upsetting said slides after the said member has passed through said passage, whereby to break the circuit and return said element to its normal position, said auxiliary unit being provided with a passage for return of said member to said device by rotation of said shaft, after said bolt has been operated.

2. A combination lock comprising a bolt, a source of electric current, an electromagnet; a circuit making device interposed electrically between said source and said electromagnet, comprising a plurality of spaced electric contact carrying units, a rotatable shaft extending through said units, a member longitudinally slidable on the shaft, each of said units having an annular groove, and slots through which said member may be made to pass by rotation of said shaft, means to guide said member to said slots, an electric contact carrying slide operable in each of the annular grooves, and being in the path of said member to be moved thereby for making electrical connection between contacts on adjacent units; an auxiliary unit having a passage therethrough and disposed in alinement with said first-mentioned units, the said shaft extending through said auxiliary unit, and a spring operated element slidably operable in said auxiliary unit and projecting to normally provide an obstruction to the passage in said auxiliary unit, said electromagnet, when all the electric contacts between adjacent units have been made, being energized to actuate said element to open said passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt.

3. A combination lock comprising a bolt, a source of electric current, an electromagnet; a circuit making device interposed electrically between said source and said electromagnet, comprising a plurality of spaced electric contact carrying units, a rotatable shaft extending through said units, a member longitudinally slidable on the shaft, each of said units having an annular groove, and slots through which said member may be

made to pass by rotation of said shaft, means to guide said member to said slots, an electric contact carrying slide operable in each of the annular grooves, and being in the path of said member to be moved thereby for making electrical connection between contacts on adjacent units; an auxiliary unit having a passage therethrough and disposed in alinement with said first-mentioned units, the said shaft extending through said auxiliary unit, a spring operated element slidably operable in said auxiliary unit and projecting to normally provide an obstruction to the passage in said auxiliary unit, said electromagnet, when all the electric contacts between adjacent units have been made, being energized to actuate said element to open said passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt, and means associated with said shaft and said member for upsetting said slides after the said member has passed through said passage, whereby to break the circuit and return said element to its normal position.

4. An electrically controlled locking device comprising a source of electric current, an electromagnet having one of its terminals connected to one terminal of said source, a bolt, a plurality of longitudinally spaced units, each carrying an electric contact, means connecting one of said contacts to the other terminal of said source, a rotatable shaft extending through said units, a member longitudinally slidable on said shaft, each of said units having a passage through which said member may be made to pass by rotation of said shaft, means to guide said member to said passages, a circumferentially slidable electric contact between adjacent units and being in the path of said member to be moved thereby for making electrical connection between the contacts of said adjacent units to energize said electromagnet, a slidable element normally obstructing the passage in the last unit, said electromagnet when energized actuating said element for opening said latter passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt, and means for automatically upsetting said circumferentially slidable electric contacts after the said member has passed through said latter passage, whereby to break the circuit and return said element to its normal position, said units being provided with passages through which said member may be returned to its initial starting position by rotation of said shaft.

5. An electrically controlled locking device comprising a source of electric current, an electromagnet having one of its terminals connected to one terminal of said source, a bolt, a plurality of longitudinally spaced units, each carrying an electric contact, means connecting one of said contacts to the other terminal of said source, a rotatable shaft extending through said units, a member longitudinally slidable on said shaft, each of said units having a passage through which said member may be made to pass by rotation of said shaft, means to guide said member to said passages, a circumferentially slidable electric contact between adjacent units and being in the path of said member to be moved thereby for making electrical connection between the contacts of said adjacent units to energize said electromagnet, and a slidable element normally obstructing the passage in the last unit, said electromagnet when energized actuating said element for opening said latter passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt.

6. An electrically controlled locking device comprising a source of electric current, an electromagnet having one of its terminals connected to one terminal of said source, a bolt, a plurality of longitudinally spaced units, each carrying an electric contact, means connecting one of said contacts to the other terminal of said source, a rotatable shaft extending through said units, a member longitudinally slidable on said shaft, each of said units having a passage through which said member may be made to pass by rotation of said shaft, means to guide said member to said passages, a circumferentially slidable electric contact between adjacent units and being in the path of said member to be moved thereby for making electrical connection between the contacts of said adjacent units to energize said electromagnet, a slidable element normally obstructing the passage in the last unit, said electromagnet when energized actuating said element for opening said latter passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt, and means for automatically upsetting said circumferentially slidable electric contacts after the said member has passed through said latter passage, whereby to break the circuit and return said element to its normal position.

7. A combination lock comprising a bolt, a source of electric current, an electromagnet; a circuit making device interposed electrically between said source and said electromagnet, comprising a plurality of longitudinally spaced units, each unit comprising two elements, one adjustable relative to the other, and being electrically connected, a rotatable shaft extending through said units, a member longitudinally slidable on said shaft, each of said units having a passage through which said member may be made to pass by rotation of said shaft, for engagement with said bolt, a circumferentially slidable electric contact between adjacent units and being in the path of said member to be moved thereby for making electrical connection between said adjacent units, to energize said electromagnet, an element providing an obstruction for the passage of said member between said device and said bolt, said electromagnet when energized, actuating said element to permit engagement of said member with said bolt when said shaft is rotated.

8. An electrically-controlled locking device for association with a source of electric current, comprising an electromagnet, a bolt, a plurality of spaced units, each carrying an electric contact, means connecting one of said contacts and said electromagnet to said source, a rotatable shaft extending through said units, a member longitudinally slidable on said shaft, each of said units having a passage through which said member may be made to pass by rotation of said shaft, a circumferentially slidable electric contact between adjacent units and being in the path of said member to be moved thereby for making electrical connection between the contacts of said adjacent units to energize said electromagnet, and a movable element normally obstructing the passage in the last unit, said electromagnet when energized actuating said element for opening said latter passage, whereby said member may be passed therethrough by rotation of said shaft for engagement with said bolt.

9. An electrically-controlled locking device for association with a source of electric current, com-

prising an electromagnet, a bolt, a plurality of electric contact carrying units, one of the contacts and the electromagnet being connected to said source, a rotatable shaft, a member slidable on the shaft, said units having openings for passage of the member by rotation of the shaft, a circumferentially slidable electric contact between adjacent units and being in the path of the member to be moved thereby for making electrical connection between contacts of adjacent units to energize the electromagnet, and means normally obstructing the opening in the last unit, the electromagnet, when energized actuating said means for clearing the latter opening, whereby the member may be passed therethrough by rotation of the shaft for engagement with the bolt.

10. An electrically-controlled locking device for association with a source of electric current, comprising an electromagnet, a bolt, a plurality of electric contact carrying units, one of the contacts and the electromagnet being connected to said source, a rotatable shaft, a member slidable on the shaft, said units having openings for passage of the member by rotation of the shaft, a circumferentially slidable electric contact between adjacent units and being in the path of the member to be moved thereby for making electrical connection between contacts of adjacent units to energize the electromagnet, means normally obstructing the opening in the last unit, the electromagnet, when energized actuating said means for clearing the latter opening, whereby the member may be passed therethrough by rotation of the shaft for engagement with the bolt, and means associated with the shaft and the member for upsetting the slidable electric contacts after the member has passed through said latter opening, whereby to break the circuit.

11. An electrically-controlled locking device for association with a source of electric current, comprising an electromagnet, a bolt, a plurality of electric contact carrying units, one of the contacts and the electromagnet being connected to said source, a rotatable shaft, a member slidable on the shaft, said units having openings for passage of the member by rotation of the shaft, a circumferentially slidable electric contact between adjacent units and being in the path of the member to be moved thereby for making electrical connection between contacts of adjacent units to energize the electromagnet, means normally obstructing the opening in the last unit, the electromagnet, when energized actuating said means for clearing the latter opening, whereby the member may be passed therethrough by rotation of the shaft for engagement with the bolt, means associated with the shaft and the member for upsetting the slidable electric contacts after the member has passed through said latter opening, whereby to break the circuit, and means for the return of the member to one of the units after the bolt has been operated.

12. A combination lock for association with a source of electric current, comprising a bolt, an electrically energizable member; a circuit making device interposed between the source and the member, comprising a plurality of spaced units, each unit comprising two elements, one adjustable relative to the other, and being electrically connected, a rotatable shaft, a slide on the shaft, each of said units having a passage through which the slide may be made to pass by rotation of the shaft, for engagement with the bolt, a circumferentially slidable electric contact between adjacent units and being in the path of said slide to be moved thereby for making electrical connection between adjacent units, to energize said member; an element providing an obstruction, for the passage of the slide between the device and the bolt, the member when energized, actuating the element to permit engagement of the slide with the bolt when the shaft is rotated.

13. A combination lock for association with a source of electric current and a bolt, comprising an electrically-energizable member; a circuit making device between the source and the member, comprising a plurality of spaced units, a rotatable shaft, a slide on the shaft for ultimate engagement with the bolt, movable electric contacts between adjacent units and being in the path of the slide to be moved thereby for making electrical connection between adjacent units, to energize said member; an element providing an obstruction for the passage of the slide between the device and the bolt, the member when energized, actuating the element to permit engagement of the slide with the bolt when the shaft is rotated.

14. A combination lock for association with a source of electric current and a bolt, comprising an electrically-energizable member; a circuit making device between the source and the member, comprising a plurality of spaced units, a rotatable shaft, a slide on the shaft for ultimate engagement with the bolt, movable electric contacts between adjacent units and being in the path of the slide to be moved thereby for making electrical connection between adjacent units, to energize said member; an element providing an obstruction for the passage of the slide between the device and the bolt, the member when energized, actuating the element to permit engagement of the slide with the bolt when the shaft is rotated, and means associated with the shaft and the slide for upsetting the movable contacts after the slide has operated the bolt, whereby to break the circuit.

LOUIS STEIN.