(No Model.)

4 Sheets—Sheet 1.

F. SEDGWICK.

ELECTRO MAGNETIC PERMUTATION LOCK.

No. 347,068. Patented Aug. 10, 1886.

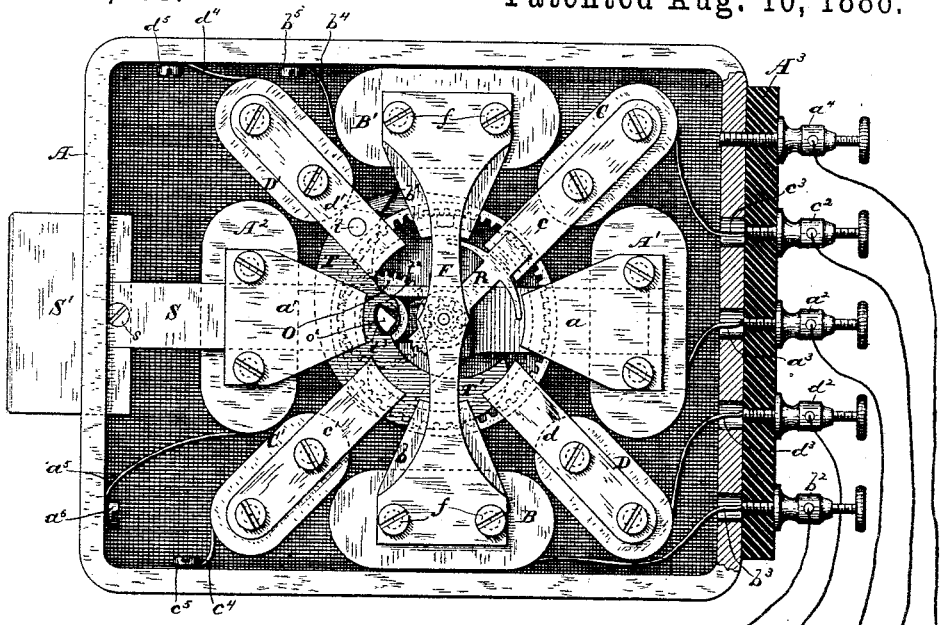


Fig. 1.

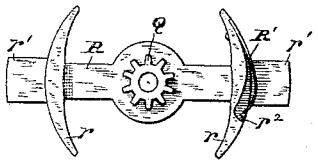
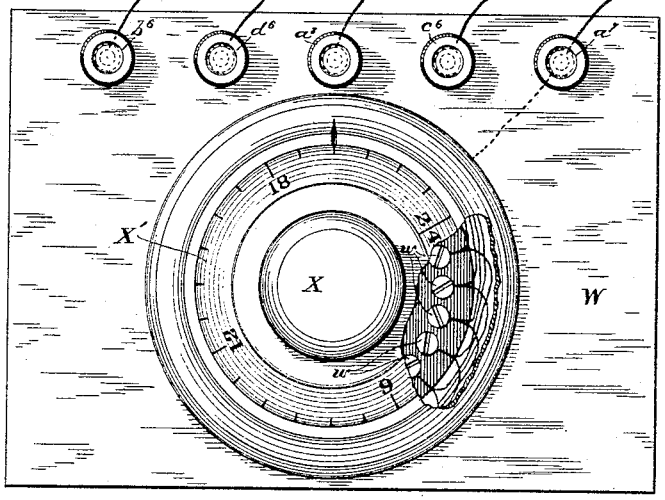


Fig. 2.



Witnesses:

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(No Model.) 4 Sheets—Sheet 2.

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ELECTRO MAGNETIC PERMUTATION LOCK.

No. 347,068. Patented Aug. 10, 1886.

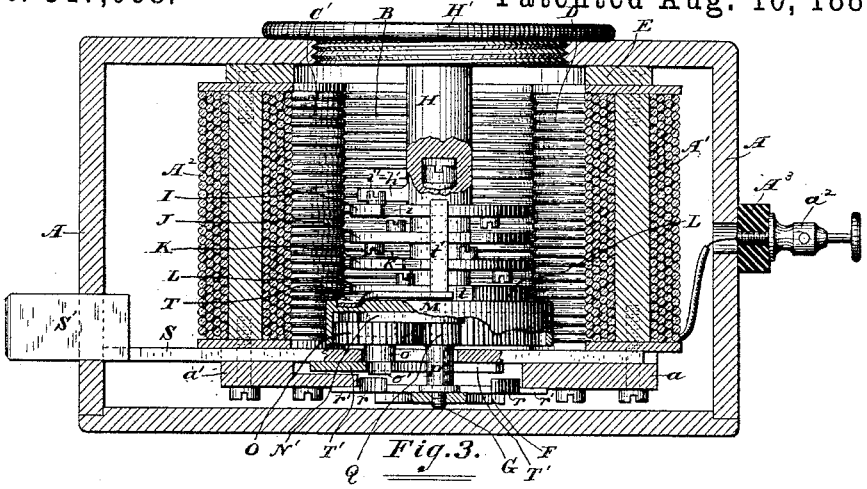

Fig. 3.

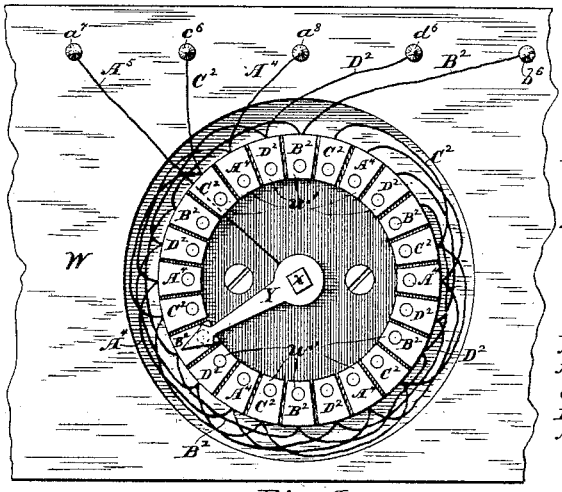

Fig. 4.

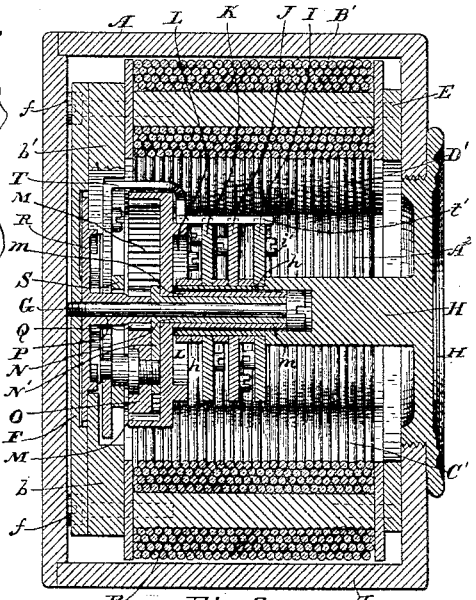

Fig. 5.

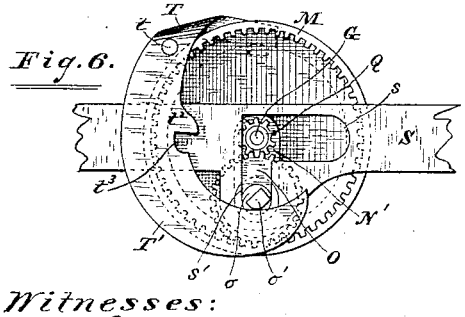

Fig. 6.

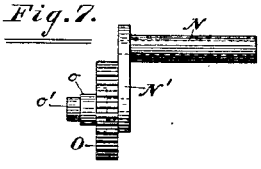

Fig. 7.

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(No Model.)

4 Sheets—Sheet 3.

F. SEDGWICK.

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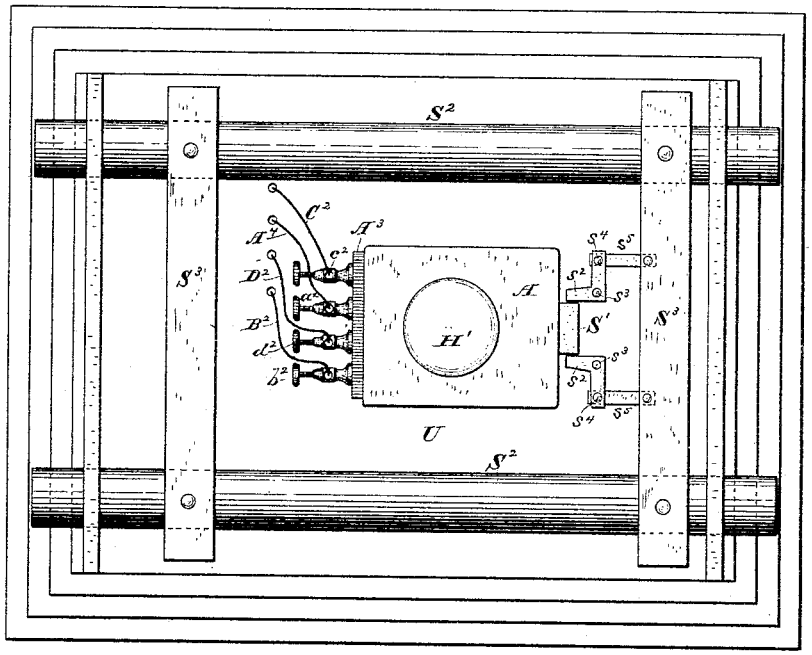

Fig. 8

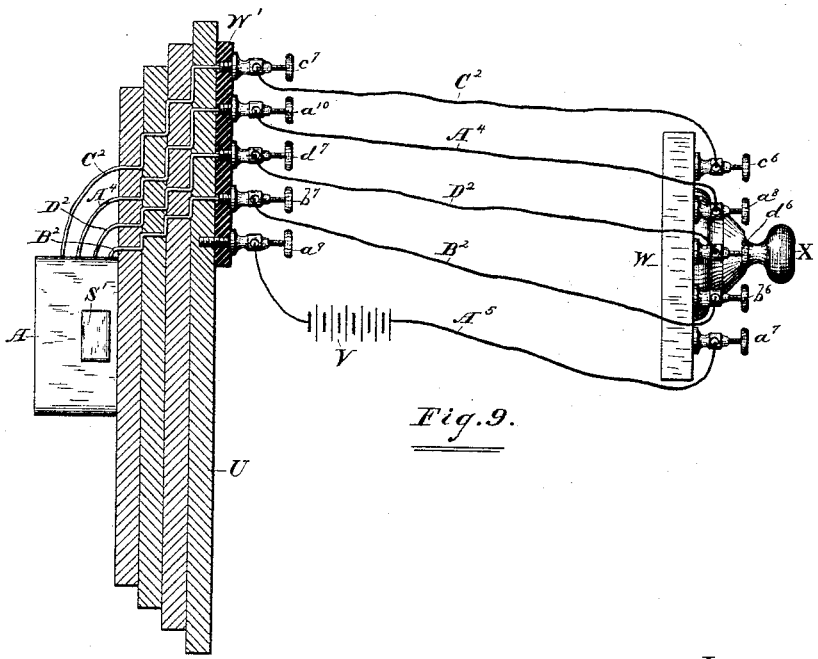

Fig. 9.

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(No Model.) 4 Sheets—Sheet 4.

F. SEDGWICK.

ELECTRO MAGNETIC PERMUTATION LOCK.

No. 347,068. Patented Aug. 10, 1886.

Fig. 10.

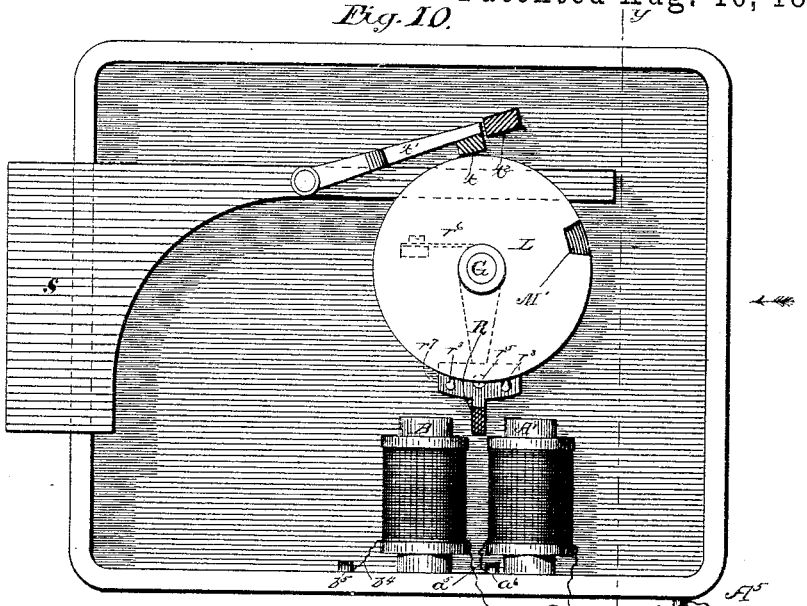


Fig. 11.

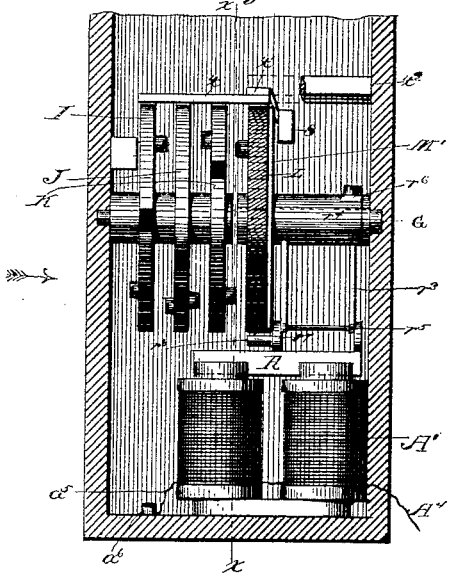
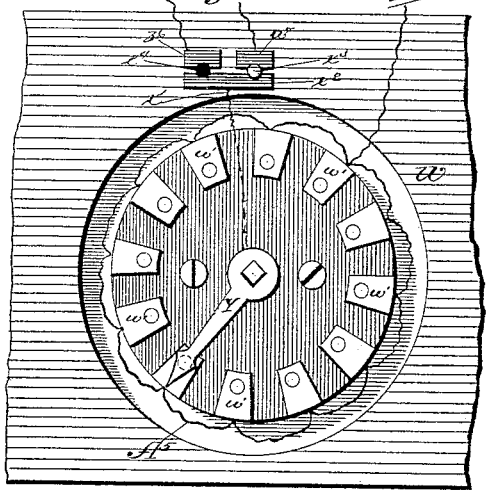


Fig. 12.



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UNITED STATES PATENT OFFICE.

FREDERICK SEDGWICK, OF CINCINNATI, OHIO, ASSIGNOR TO JOHN H. PURDY, OF CHICAGO, ILLINOIS.

ELECTRO-MAGNETIC PERMUTATION-LOCK.

SPECIFICATION forming part of Letters Patent No. 347,068, dated August 10, 1886.

Application filed August 20, 1884. Serial No. 141,010. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK SEDGWICK, of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Electro-Magnetic Permutation-Locks, of which the following is a description, reference being had to the accompanying drawings, in which—

Figure 1 is a front elevation of said lock with the face-plate removed, showing the respective parts in the various positions assumed when the same is locked, the connections being made by suitable wires and binding-posts with a dial. Fig. 2 is a rear view of the revolving armature used therein. Fig. 3 is a central horizontal longitudinal sectional view of said lock. Fig. 4 is a back view of the dial-plate, showing the spindle-connection with the various circuits. Fig. 5 is a central vertical sectional view of said lock. Fig. 6 is a front view, in detail, of a part of said lock, showing the parts in position assumed when the same is unlocked. Fig. 7 is a side view of the crank and pinion interposed between the armature and tumblers for operating the latter. Fig. 8 is a view of the inside of a safe-door, showing said lock attached thereto and its connection with the bolt-work. Fig. 9 is a central vertical sectional view of said door, showing the manner of connecting the magnets with the dial for manipulating the armature and tumblers. Fig. 10 represents a modification of Fig. 1, and is a rear view, the back plate and part of the tumblers being removed, the remaining mechanism being viewed upon the line $x\,x$, Fig. 11, in the direction indicated by the arrow there shown. Fig. 11 is a transverse vertical sectional view of the construction shown in Fig. 10, taken upon the line $y\,y$, and viewed in the direction indicated by the arrow there shown; and Fig. 12 is a modification of the construction shown in Fig. 4.

Like letters of reference indicate like parts in the different figures.

The purpose of my invention is to provide an electro-magnetic permutation or combination lock so arranged and constructed that the tumblers and bolts in ordinary use may be manipulated from without the safe when the safe-door to which the same is attached is closed, and said safe locked or unlocked without the aid of the usual spindle or any direct and positive mechanical connection through the door. A further object is to so construct said mechanism that the dial may be placed either directly upon the safe-door in the usual manner, or in any place and at any distance therefrom, so that the lock mechanism may be manipulated by one knowing the combination, however distantly he may be removed therefrom at the time. A still further object is to enable said dial to be detached at any time, if desired, thus removing all possible and intelligible means of operating said tumblers from without. I accomplish said object by means preferably of a revolving armature surrounded by a series of electro-magnets arranged concentrically to its axis, and having their respective poles upon opposite sides of the same, said magnets numbering three or more, but preferably not more than four, the size and shape of the same being varied as may be found expedient, to obtain as much power as possible consistent with economy of space, one end of each of the wires forming the helix of said magnets, respectively, being alternately connected by suitable wires with a series of segments upon a stationary plate outside the safe, said segments being disconnected from each other and properly insulated, while a circuit-wire with a battery-connection unites the opposite poles of the said magnets with a knob or spindle adapted to revolve upon said plate, and provided with a hand thereon, which, by the revolution of the spindle, alternately makes and breaks the circuit of the respective magnets, and revolves the armature accordingly, a reverse movement of said dial producing a corresponding movement of said armature. I prefer to connect said armature by means of a pinion to a secondary gear having its axis upon the end of a crank, the axis of which is common with that of the armature, said secondary gear engaging in turn with an annular wheel, which is rigid with the first of a series of revolving tumblers operating in the usual manner, said secondary gear having its axis temporarily retained in a fixed position while revolving said tumblers by means of a stud extending there-

from, which engages with a notch in an angle-bar or dog forming a part or extension of the usual gravity "fence," the stud being released from said engagement when the notches of all the tumblers are brought into alignment and the fence has fallen therein. This movement in turn locks the tumblers, and the secondary gear having its axis upon the end of the crank, which is no longer held in a fixed position, as described, the armature-pinion acting thereon, the secondary wheel forms a leverage upon the end of the crank with the teeth of the annular gear for a fulcrum, which causes the crank to revolve upon its axis, and said projecting stud engaging in a slot in the bolt-bar the latter is thereby "shot" or retracted, as may be desired, all of which is hereinafter more fully described, and definitely pointed out in the claims.

In the drawings, A represents the case of the lock, which may be constructed of brass or other metal in the usual manner. Inclosed within said lock, arranged, preferably, in a circular form, and secured to said case by any suitable means are three or more, but preferably four, electro-magnets A' A^2, B B', C C', and D D', the two letters being used in each case to designate the two poles of the respective magnets. I prefer to connect said magnets with each other by means of a ring, E, Figs. 3 and 5, of soft iron, said ring serving as a means of securely attaching said magnets to the case A, while at the same time it forms the base of said magnets. Said magnets, respectively, are provided with pole-extensions *a a'*, *b b'*, *c c'*, and *d d'*, hereinafter more fully described. Extending across from the opposite poles of a magnet, as B B', and rigidly secured thereto by screws *f f*, I place a suitable bar, F, of brass or other non-magnetizable metal, which serves as a support for one end of a screw, G, Figs. 3, 5, and 6. Said screw G is inserted from the rear, and is further supported by having its head introduced into a sleeve or socket, *h*, of a hollow stud, H, Figs. 3 and 5, rigidly secured to and forming a part of a circular screw-plate, H', which is adjusted by means of a screw-thread to the plate A, as clearly shown in the drawings. Said sleeve *h* is intended to form a bearing or axis for the usual permutation-tumblers, and may be made longer or shorter, according to the number employed, a shoulder being formed on said stud to retain them in place. I, J, and K represent three of said tumblers, while the fourth consists, preferably, of an annular ring, L, formed upon or secured rigidly to the back of an annular gear, M, which is provided with and rigidly secured to a sleeve, *m*, within the sleeve *h*, forming a part of the stud H, and having its bearing upon a third sleeve, N, Fig. 5, which is fitted directly to and has its bearing upon that portion of the body of the screw G contained within the sleeve *h*. Upon the front or outer end of the sleeve N, and rigidly secured thereto, is a crank, N', Figs. 3, 5, 6, and 7, to the end of which is loosely secured by means of a suitable wrist-pin a gear-wheel, O, adapted to engage the teeth of the annular gear-wheel, M. Upon that part of the screw G between the bar F and the sleeve N (better shown in Fig. 5) I place a fourth sleeve, P, to which is rigidly attached a small pinion, Q, (better shown in Figs. 2, 3, and 6,) which in turn engages with the wheel O. Each of said sleeves *m*, N, and P are loose, and adapted to revolve independently of each other, with the body of the screw G for a primary bearing. Upon the opposite or outer end of the sleeve P, and rigidly secured thereto, I place a revolving armature, R, preferably provided with segmental arms or cross-bars *r r*, in the form clearly shown in Fig. 2, so as to conform to the shape and enable them to be brought into close proximity to the ends of the pole-extensions *a a'*, *b b'*, *c c'*, and *d d'*, which latter should be made concentric, as shown, with the axis of said armature. I prefer to have the ends *r' r'* of said armature extend somewhat over said pole-extensions, as shown in the drawings. Secured by a rivet or otherwise to one of said arms *r'* is a spring, R', Fig. 2, the normal position of which is even with or within the arc of the circle described by said arm, a notch or recess, r^2, being provided for the reception of said spring. When said armature is attracted by the magnet, said spring is drawn outwardly, as shown, and the same being brought into direct contact with the pole-extension of said magnet it acts as a brake upon said armature, and thus prevents the former from wavering. The circuit being broken, said brake or shoe resumes its normal position, and the armature is again free to revolve without friction.

Extending across lengthwise of the lock between the cross-bar F and the magnets A' A^2, and outside of the wheel O, I place a bolt-bar, S, constructed as shown, with slots *s s'*, Fig. 6, therein, the former of which is made to permit said bar to reciprocate without being obstructed by the sleeve P or screw G, while a pin or stud, *o*, Fig. 6, which is an extension of the wrist-pin or axial bearing of the wheel O, is extended through the slot *s'*, and by its movement, when the crank-arm *h'* is rotated, serves to actuate the bolt-bar S, which, in turn, shoots or retracts the bolt S', which is attached thereto by means of a screw *s*, Fig. 1, or otherwise.

Fig. 8 represents the usual bolt-work upon the safe-door U, S^2 S^2 being the bolts, S^3 S^3 the cross-bars connecting the same, while s^2 s^2 represent the ordinary shears or crank-levers, pivoted at s^3 s^3, between the free ends of which the bolt S' is interposed, as shown, when the safe is locked, said shears having their opposite ends pivoted at s^4 s^4 to links s^5 s^5, which, in turn, are rigidly secured to the cross-bar S^3.

Pivoted to the pole-extension *d'*, Fig. 1, at *t*, is an "angle-bar," T, an arm, *t'*, Fig. 3, of which is extended back across and above the tumblers I, J, K, and L, forming the usual

fence, which is so adjusted as to drop into the usual notches in the periphery of said tumblers, when the same are brought into proper alignment therewith, three of said notches, *i*, *k*, and *l*, being shown in Fig. 3, while the dotted lines in Fig. 6 indicate all in alignment. Said angle-bar T has a downwardly-curved extension, T', formed as clearly shown in Fig. 6, and provided with a lug or shoulder, t^2, and a notch, t^3, Figs. 1 and 6. An extension, *o'*, of the stud *o*, Fig. 7, made to conform in shape to said notch t^3, is caused to project outwardly to a sufficient extent to engage said notch, as hereinafter shown, Fig. 1 representing the same in engagement therewith.

Projecting laterally from the stud H, Fig. 3, and rigidly attached thereto, is a stud or projection, *h'*, in close proximity to the tumbler I. A screw, *i'*, which is intended to abut against said stud *h* in the usual manner, is secured to the tumbler I, thus forming an initial point from which to calculate the permutation of the tumblers. Other screws, the heads of which project in the usual way from the tumblers J, K, and L, as clearly shown in Figs. 3 and 5, enable the tumblers I, J, and K, to be manipulated through the revolution of the annular wheel M and its tumbler L, thus completing the permutation.

A^3, Figs. 1, 3, and 8, represents a plate, of vulcanite or other insulating material, secured to one end of the case A, to which binding-posts a^2, b^2, c^2, and d^2 are secured, the same being insulated by said plate from the lock-case A. A fifth binding-post, a^4, Fig. 1, passes through the plate A^3 and is screwed, as shown, into the case A. One end of each of the helix-wires a^3, b^3, c^3, and d^3, respectively, is connected with one of the binding-posts a^2 b^2 c^2 d^2 in the order named, while one end of all of the helix-wires a^5 b^4 c^4 d^4, Fig. 1, the respective coils of which are designated by the letters A^2, B', C', and D', is secured to the case A by means of the screws a^6 b^5 c^5 d^5, thus enabling a circuit to be formed between any one of the binding-posts a^2, b^2, c^2, or d^2 through the magnet with which the same is connected, the lock-case, and the binding-post a^4. Connected with the binding-posts a^2, b^2, c^2, d^2, and a^4 are insulated wires A^4, B^2, C^2, D^2, and A^5, four of which are carried through the door U, Figs. 8 and 9, of the safe, in the manner clearly shown in said last-named figure, to prevent the plates of said door from being drilled or otherwise penetrated.

In practice I prefer not to use the wire A^5 shown in Fig. 1, as it is obvious that an electric circuit may be completed with equal facility through the walls of the safe and lock-case A. Fig. 9 shows such a construction, the binding-post a^9 therein corresponding to a^4 in Fig. 1, (the latter of which is used in said figure merely to show an operative construction,) in that it connects directly with the metallic plate of the door U.

V, Figs. 1 and 9, is a battery-cup, which is preferably placed outside of the safe. Upon the outside of the safe, also, and secured either to the door of the same or detached therefrom, as may be desired, is a plate, W, Figs. 1, 4, and 9, of vulcanite or like insulating material, provided with binding-posts a^7 a^8 b^6 c^6 d^6, to the opposite side of which is rigidly secured by means of screws or rivets *w*, Fig. 1, a series of metallic blocks or segments, *w'*, Fig. 4, arranged in circular form, an equal number of which are alternately connected with the wires connecting with the binding-posts a^8, b^6, c^6, and d^6, and for the purpose of designating said connection and the various circuits which may be formed thereby said segments or blocks *w'* are also marked with the respective letters used to indicate the wires with which they connect—viz., A^4, B^2, C^2, and D^2. A metallic knob, X, provided with the usual graduated dial, X', Fig. 1, is attached to the opposite side of said insulated plate W by means of a spindle, *x*, Fig. 4, extending through the same. Rigidly attached to the spindle *x* in any well-known manner so as to revolve therewith is a hand, *y*, the end of which is so adjusted as to be brought into metallic contact with the plates *w'* as said spindle is rotated, said blocks or segments *w'* being arranged concentrically with the spindle *x*. The wire A^5 is connected directly with said spindle, so that an electric circuit may be completed through said wire A^5, the spindle *x*, and metallic hand Y, with any one of the four other wires described, accordingly as said hand is brought in contact with any one of the six termini of each of said wires. Thus it is obvious that the revolution of the knob X would alternately make and break the circuit four times with each of said series of magnets in regular succession, while a change in the movement of said dial would produce a corresponding change in the order of said currents. It is obvious that a number of said segments or blocks may be increased or diminished at will; but it should be some multiple of the number of magnets employed, in order to calculate the various permutations or combinations therefrom. A number of segments corresponding to that of the magnets would serve to rotate the armature equally as well as a greater number, the increase tending only to effect the complexity of the permutations.

I have described a circular dial with a rotating switch mechanism or circuit-breaker in connection therewith as the method most approved by me for manipulating the tumblers by electro-magnetic influence; but I do not confine myself to said method, for the reason that I should regard any switch-mechanism or circuit-breaker whereby one would be enabled to excite said magnets in a definite or determined order as a mere variation and inferior substitute for said device.

For convenience in actual practice, I prefer to secure an insulating-plate, W', Fig. 9, to

the outside of the safe-door, to which are attached in the usual way binding-posts a^9 a^{10} b^7 c^7 d^7, thus permitting the wires A^4 A^5 B^2 C^2 D^2 to be detached when desired.

Having described the various parts of said mechanism in detail, I will now proceed to describe the operation of the same.

It is obvious that the armature R may be caused to revolve in either direction by the revolution of the knob X, and, assuming the parts to be in a locked position, as shown in Fig. 1, the angle-bar T is raised, thereby causing the pin o' to engage with the notch t^3, by which it is held in a stationary position until the tumbler-notches are brought into such alignment as to permit the fence t' to fall therein. The axial bearing of the wheel O being thus temporarily held in a fixed position, and said wheel at the same time being revolved by the pinion Q, attached to the armature F, the annular wheel M is thereby caused to rotate, which, in turn, actuates the tumblers I, J, K, and L, according to the direction and extent of its movement. As stated, the stud h' is the initial point from which the permutation is calculated, and hence it follows that said tumblers may be "set up" by revolving said knob a sufficient number of times in one direction to bring the screw i' in contact with the stud h', and the remaining tumbler-screws into engagement with each other in their respective order—allowance being made for the direction of movement of the stud o', in order to finally actuate the bolt-bar S. The tumblers being thus set up, they are then manipulated by the dial in the usual manner, according to the permutation or combination fixed upon, it being understood that in the device as shown a greater number of revolutions of the dial would be required to effect the same result, by reason of the interposed gears O Q, than if the armature were connected directly to and made to revolve in unison with the driving-tumbler, which may be accomplished by providing a different mechanism for actuating the bolt-bar S. When the manipulation of the tumblers is completed and their notches brought into alignment, the dropping of the fence t' therein at the same time causes the stud o' to be released from the notch t^3 by the falling of the lower extension, T', of said angle-bar T. The fence t' being in the notches of said tumblers, the first or "driving" tumbler, L, of which is rigid with the wheel M, the latter is thus held in a fixed position, thus causing the axis of the wheel O to move, said wheel exerting a leverage upon the wrist-pin at the end of the crank N', being impelled by the rotation of the pinion Q, and, having its fulcrum upon the teeth of the annular wheel M, it is caused to assume the position shown in Fig. 6, while the pin o', bearing in the slot s' of the bolt-bar S, retracts the latter, as shown in said figure, at the same time being in positive contact with the extension T' of the angle-bar T, the fence t' is, for the time being, held securely within the tumbler-notches. Said extension also tends by its gravity to insure the dropping of said fence, when desired. A reversal of this movement "shoots" the bolt S', when the stud o' engages with the lug t^2, and after raising the fence out of the notches is arrested in its progress, while the wheel O, continuing to revolve, rotates the tumblers, thus preventing the fence from again falling, and locks the safe.

I do not confine myself to the specific arrangement of said magnets, nor to the use of a revolving armature for rotating said tumblers, as the same may be accomplished by means of a reciprocating armature, R, Figs. 10 and 11, said armature being sustained in a pendent position, as shown in said Fig. 10, by means of a stirrup, r^3, Fig. 11, and shown in dotted lines in Fig. 10, said stirrup being loosely secured to the axis formed by the pin or screw G, by means of a loose sleeve, r^4. In addition to the action of gravity of the armature R, which is loosely hinged to said stirrup at r^5, the latter is normally held in an upright position by means of a spring, r^6, (better shown in dotted lines in Fig. 10,) which bears upon a notch or flat surface upon the sleeve r^4. A cross-arm, r^7, is attached to said armature R, near the extremities of which are projecting teeth or pawls r^8 r^8, adapted to engage with a disk, M', rigidly attached to the tumbler L, said disk being in lieu of the annular wheel M. The periphery of the disk M' may be notched or smooth; but I prefer it as shown, and in lieu of said edged teeth r^8 r^8 reversible pawls may be employed. A' B are electro-magnets, connected by means of wires A^4 B^2 to insulated plates a^7 b^6, attached to the plate W, Fig. 12. The terminal wires or opposite poles of said magnets are connected with the lock-case by wires a^5 b^4 and screws a^6 b^5, respectively, Figs. 10 and 11. Instead of placing the segmental blocks w' close together, as shown in Fig. 4, I separate them, substantially as shown in Fig. 12, and connect them all to the circuit-wire A^5, which is connected with the lock-case at a^8. The spindle x is connected by a wire, x', to an insulated plate, x^2, adjacent to the plates a^7 b^6, and adapted to be connected with one or the other in turn by means of an ordinary switch-pin, x^3, which may be inserted in one or the other of the perforations x^4 x^4, thus completing the circuit with one or the other of the magnets, the lock-case, battery V, blocks w', and hand Y. When the hand Y is in contact with any one of the blocks w', and the pin x^3 is inserted, as shown, the magnet A' is excited and the armature attracted thereto. As said armature is pivotally connected with the end of the stirrup r^3, the former is first moved upon the axis of said pivot, as offering the least resistance, until the tooth r^8 upon the side nearest the magnet A' bears upon the periphery of the disk M', when the axial movement is transferred to the

stirrup-axis, thus actuating the disk M'. As the hand Y (which, in this construction, may be revolved continuously in the same direction, if desired) passes from one block w' to another, the circuit is broken, and the spring r^6, as well as the gravity of the armature, causes it to resume its normal position until the circuit is again made, when it is moved as before. Thus, as long as the pin x^3 remains in one position the moving of the hand Y serves to reciprocate the armature and thus revolve the disk M' in one direction, said direction being reversed upon removing the pin to the other perforation and completing the circuit with the opposite magnet, thereby enabling one to manipulate said tumblers at will according to the number of revolutions of the hand Y and the position of the pin x^3. Moreover, I do not regard myself as confined to the particular mode described for throwing or retracting the bolt-bar, as it may sometimes be found desirable to connect the fence t directly therewith by means of the link t', Fig. 11, in which case the movement of the tumbler L after said fence shall have engaged with the notches in the several tumblers will shoot or retract the bolt as desired, a guard, t^2, being preferably attached to the lock-case to prevent said fence from falling out of the notches in the event of the safe being overturned while locked; or said result may be accomplished in various other ways which would suggest themselves to one skilled in the art, after having familiarized himself with my invention.

In addition the modification above suggested I have also contemplated the use of said lock in connection with a time mechanism located within the safe for switching said magnets out of circuit during a predetermined period, and thus preventing the manipulation of the tumblers at such time by those familiar with the combination. Either my electro-magnetic time mechanism upon which application for Letters Patent is now pending or any mechanical timer may be used and adapted thereto, which matter will form the subject of a future application.

It is apparent from the foregoing that said tumblers may be manipulated and the safe locked or unlocked by a person at any distance therefrom, while the dial may be removed and disposed of as desired, thus preventing any intelligible means of operating the combination (even were it known) by others than those having custody of the dial.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a combination-lock arranged within a safe or other secure receptacle, of a series of electro-magnets having suitable electrical connections from without, an electro-generator and switching device whereby said magnets may be excited from without the safe, and an armature actuated thereby for imparting motion to the tumblers of said lock, substantially as and for the purposes specified.

2. An electro-magnetic permutation or combination lock provided with a series of electro-magnets arranged therein, suitable electrical connections from without, and a battery-cup, whereby said magnets may be excited in regular order from without the safe, and a revolving armature actuated thereby for imparting motion through suitable gearings to a series of tumblers in said lock, substantially as and for the purposes set forth.

3. A permutation-lock in which are arranged a series of electro-magnets which serve to actuate an armature connected by intermediate gears or equivalent means with the driver of a series of tumblers, said magnets being electrically connected with a circuit-breaking mechanism outside of the safe, and a battery-cup, whereby motion may be imparted to said tumblers as desired by successively manipulating currents of electricity in regular successive order through said magnets, respectively, substantially as described.

4. An electro magnetic permutation-lock consisting of suitable magnets arranged therein, an armature in position to be actuated thereby and connected with the driving-tumblers, and a dial-hand and battery electrically connected with said magnets from without the safe, the revolution of said dial serving to alternately bring said hand into electrical contact with the terminal wires of said magnets in regular order successively, substantially in the manner and for the purposes specified.

5. An electro-magnetic permutation-lock provided with suitable electro-magnets arranged in a circular form therein, having their pole-extensions concentric with a revolving armature geared to the driving-tumbler, electrical connections with said magnets, and a battery-cup and revolving dial outside of the safe, said dial being provided with a hand upon its spindle, connected with the circuit-wire, whereby the circuit may be opened and closed with said circuit-wire and either of said magnets in an order to correspond with and be determined by the numbers upon said dial, substantially as described.

6. An electro-magnetic combination or permutation lock provided with a series of revolving tumblers, a revolving armature connected therewith, electro-magnets in electrical proximity thereto, means for connecting the same with a battery and dial outside of the safe, and a system of segments representing the termini of the helix-wires from one pole of said magnets, respectively, said dial being provided with a hand adapted to revolve therewith, the revolution of which serves to make and break the circuit in a regular successive order, accordingly as the same is brought into contact with said segments, respectively, substantially as described.

7. In an electro-magnetic permutation-lock,

the revolving armature R, provided with a spring, R′, constructed and arranged as and for the purposes specified.

8. The combination, in an electro-magnetic permutation-lock, of a series of electro-magnets arranged therein, a revolving armature in electrical proximity thereto, means for connecting said armature to the driver of a series of rotating tumblers, a crank-connection with the bolt-bar, and a dial and segmental switch outside of the safe, with suitable connecting-wires and a battery-cup whereby the blocking device of multiple bolt-work may be manipulated from without the safe, substantially as described.

9. The combination, in a safe provided with the usual multiple bolt-work, with a lock having the usual rotating tumblers, and a series of electro-magnets whose respective poles are electrically connected with the outside of the safe, a battery-cup, and rotary switch-dial, of a revolving armature having a pinion rigidly secured to its axis, said pinion engaging a gear-wheel upon the end of a crank having a common axis with said armature, said gear-wheel engaging in turn with an annular gear attached to the driving-tumbler, a notched angle-bar, T, fence *t′*, extension-stud *o o′*, and bolt-bar S, with a suitable bolt, all constructed and arranged substantially as specified.

10. The combination, in a permutation-lock, of the usual rotating tumblers, electro-magnets arranged concentrically with the axis thereof, a revolving armature, gears Q, O, and M, crank N′, bar S, and crank-pin extension, with angle-bar T, fence *t′*, wires A^4 A^5 B^2 D^2 C^2, a battery-cup, and a rotating dial and switch, substantially as described.

11. In an electro-magnetic permutation-lock, the rotating dial X′, suitably numbered or lettered and provided with hand Y, in combination with a series of segmental blocks forming the electrical termini of a number of electro-magnets within said lock, substantially as described.

12. The combination, with an electro-magnetic permutation-lock, of the segmental blocks *w′*, the metallic hand Y, revolving dial-plate X′, and a battery, substantially as described.

13. An electro-magnetic permutation-lock placed inside of the receptacle to be locked, a series of circuits connecting electro-magnets in proximity to the lock-tumblers, with an electro-generator and a circuit-breaker operated from the outside of said receptacle to move an armature inside thereof and actuate the lock mechanism by manipulating said outside circuit-breaker to bring different magnets in circuit, and thereby move the armature and lock-tumblers, substantially as specified.

14. A lock inclosed within a safe, provided with one or more tumblers and two or more magnets, and an armature in proximity thereto, said magnets being excited by outside circuits, a circuit-breaker, and electro-generator to move the armature, and thus produce a tumbler motion and adjustment, substantially as described.

15. An electro-magnetic permutation-lock inclosed within the receptacle to be locked, and provided with two or more electro-magnets, and an armature having intermediate operating connection with the lock-tumblers, and two or more electric circuits connecting said magnets with a source of electricity, and an outside circuit-breaker connected in serial circuit, whereby an armature is moved by making and breaking circuits, and the tumblers rotated at the will of the operator, substantially as described.

16. The combination, with a permutation-lock having electrically-operated tumblers, of an indicating-dial provided with a hand and a series of blocks forming the termini of the magnet-coils in said lock, the blocks being in the path traversed by said hand, whereby the circuit with said magnets may be made and broken in serial order, substantially as and for the purposes set forth.

17. The combination, with an electro-magnetic permutation-lock arranged within the receptacle to be locked, and having an armature and a series of magnets in proximity thereto, of a series of circuits connecting with the outside of a safe, a source of electricity, and a detachable switch or circuit-breaking dial, substantially as described.

18. The combination of an electric switch or circuit-breaker arranged outside of the safe or vault and electrically connected with magnets arranged within a permutation-lock placed within a safe or vault, said circuit-breaker having means, as a metal hand, for shifting the current at will, and thereby rotating the tumblers of the lock in either direction, as desired, and a dial to indicate the relative positions or movements of the tumblers of said lock, substantially as shown and described.

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Witnesses:

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