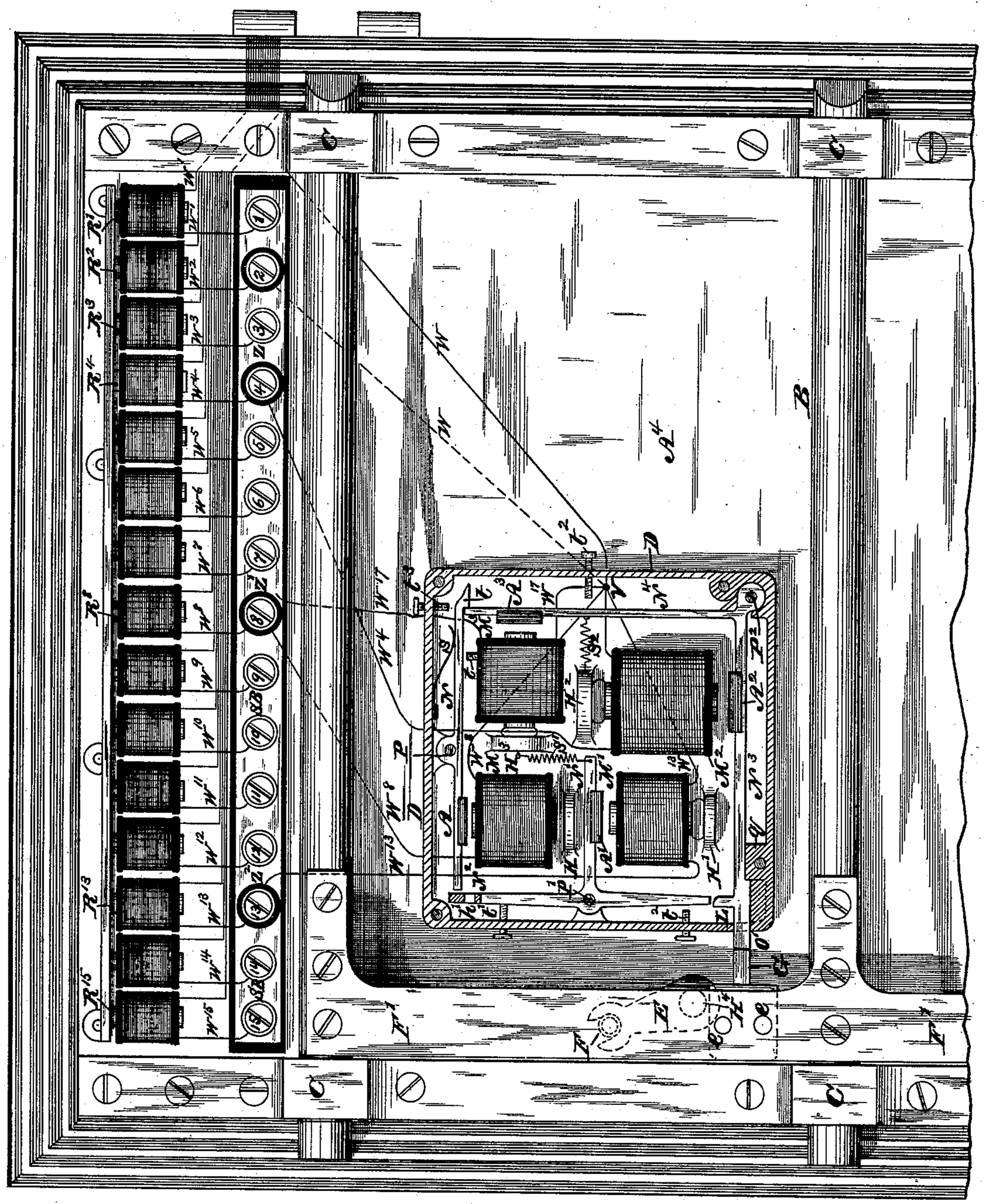
(No Model.) 3 Sheets—Sheet 1.

C. J. KINTNER.

ELECTRICAL SAFE LOCK.

No. 372,026. Patented Oct. 25, 1887.



Witnesses:
J. Wm. Wiedenheim.
L. Bonville

Fig. 1.

Inventor:
Charles J. Kintner

(No Model.) 3 Sheets—Sheet 2.

C. J. KINTNER.

ELECTRICAL SAFE LOCK.

No. 372,026. Patented Oct. 25, 1887.

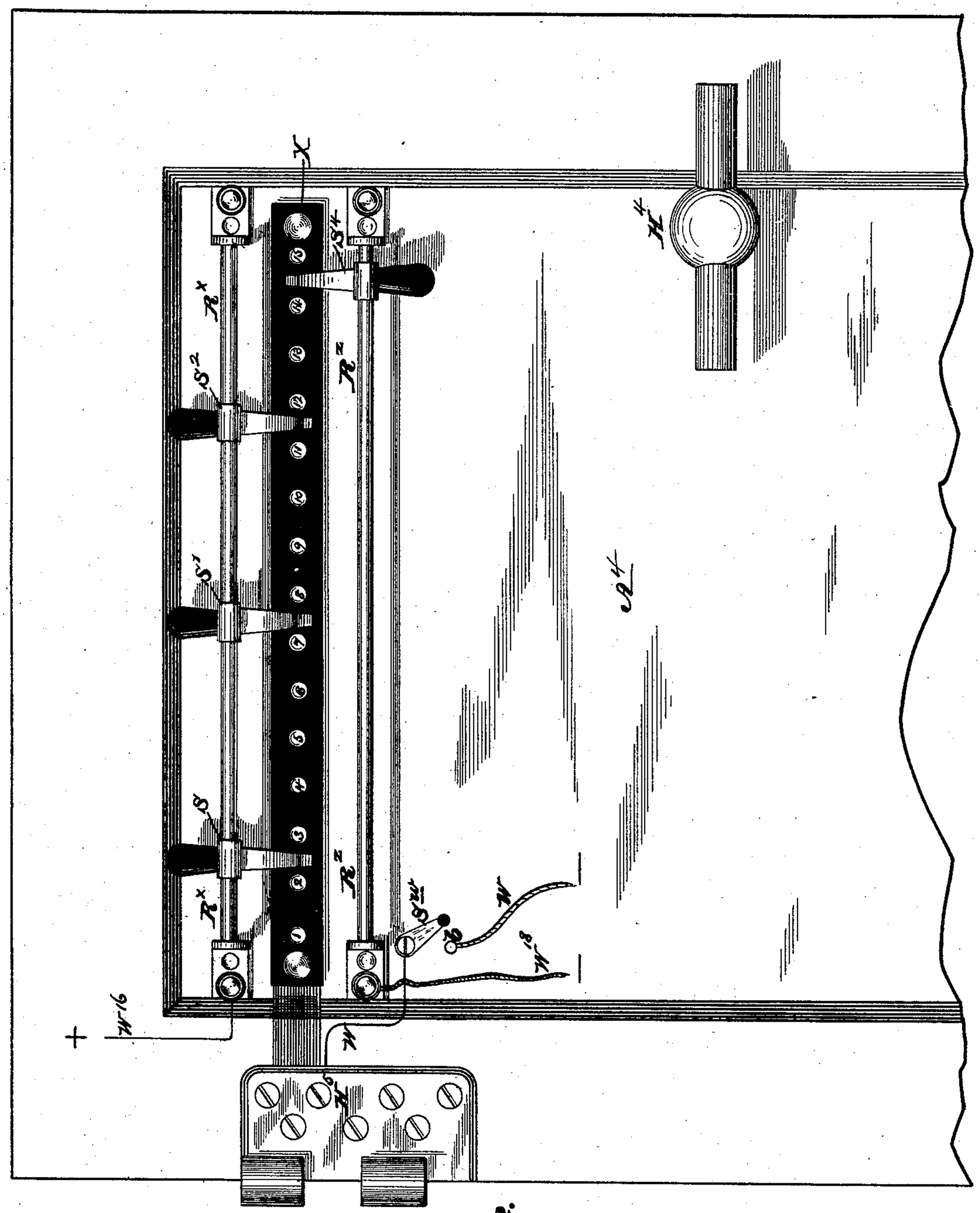


Fig. 2.

Witnesses:
Johnn Diedesheim.
L. Douville

Inventor:
Charles J. Kintner

(No Model.) 3 Sheets—Sheet 3.

C. J. KINTNER.

ELECTRICAL SAFE LOCK.

No. 372,026. Patented Oct. 25, 1887.

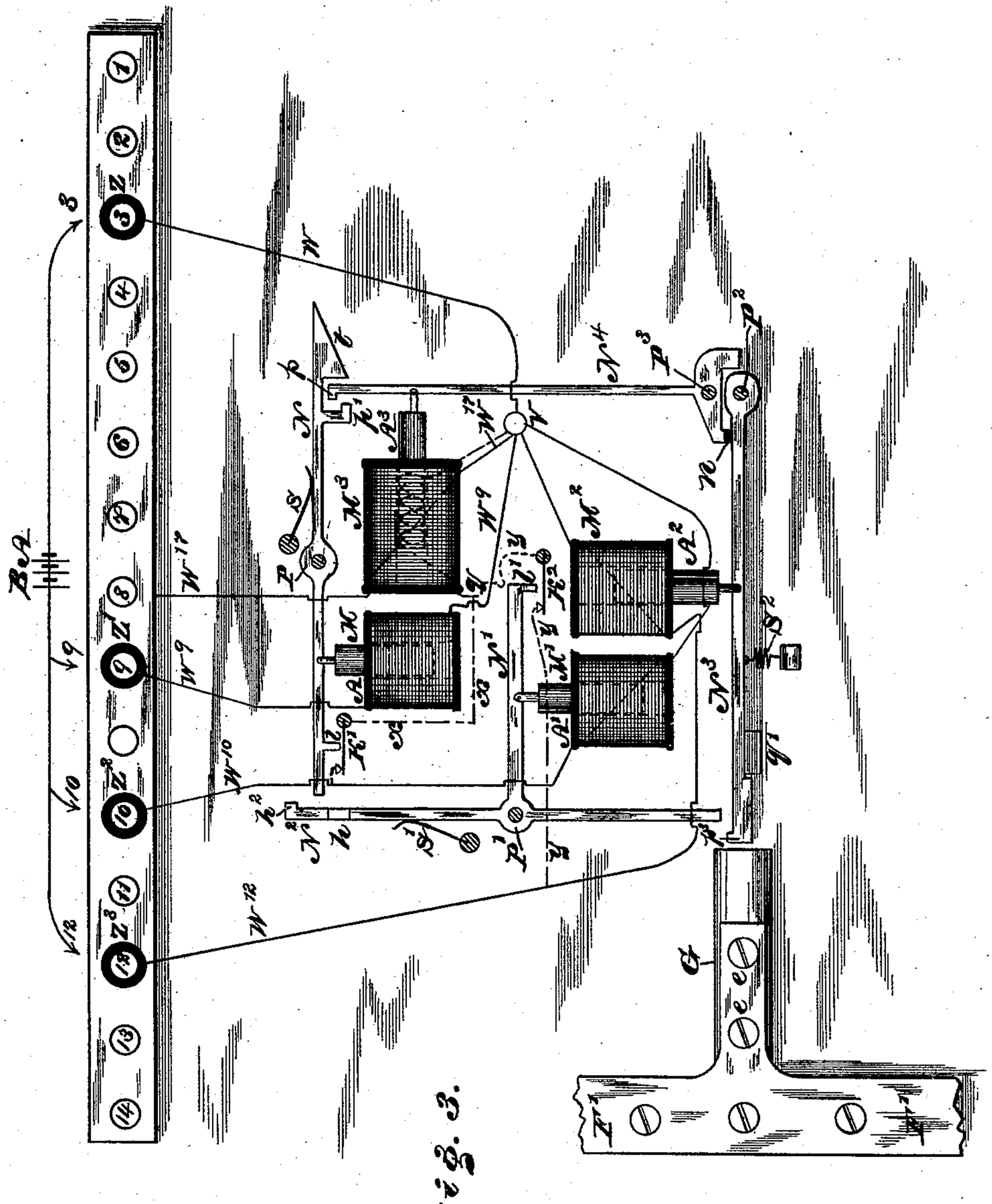


Fig. 3.

Witnesses:
John A. Wiedersheim.
L. Douville

Inventor:
Charles J. Kintner

UNITED STATES PATENT OFFICE.

CHARLES J. KINTNER, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRICAL SAFE-LOCK.

SPECIFICATION forming part of Letters Patent No. 372,026, dated October 25, 1887.

Application filed May 11, 1887. Serial No. 237,803. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. KINTNER, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Safe and other Door Locks, of which the following specification, taken in connection with the accompanying drawings, constitutes a full and exact disclosure.

My invention consists, broadly, in a new form of combination-lock wherein the combinations are actuated or produced by electrical means, and relates to the method and apparatus whereby safe-door and other locks are made secure against the attack of burglars.

Referring to the accompanying drawings, Figure 1 represents a side elevation of a safe-door as seen from the inside, and showing the interior apparatus for controlling the locks. Fig. 2 is an obverse elevation of Fig. 1, showing the exterior mechanism. Fig. 3 is a diagrammatic view of a modified form of my improved lock.

Similar letters of reference indicate corresponding parts in the several figures.

I will first describe the parts of the apparatus in detail, and then the mode of operation.

A^4 is an ordinary safe-door, to the inside of which is fixed, in the usual well-known manner, bolts B B B, sliding in bearings C C C, and moved back and forth into and out of locking position in the usual manner by a hand-hold, H^4, carrying an arm, E, which acts against the pin F, attached to the bolts inside the safe. Fixed to the bolt-frame F′ F′ F′, by screws *e e*, is a lug or projection, G, which serves the function of locking the bolts when in position, as will be explained hereinafter.

D D is a metal case or box, shown in section and having a solid back, to which the magnets M M′ M^2 M^3 are fixed by strong upright posts H H′ H^2 H^3, preferably cast solid with the back.

A A′ A^2 A^3 are armatures fixed, respectively, to levers N N′ N^3 N^4. These levers are, as shown, firmly pivoted to the sides of the box D at P P′ P^2, having screw-tops t' and t^2, &c., to govern their motion or throw, and have the customary retractile springs s s' s^2.

S B is a switch-board of metal insulated from the door by a strip of asbestus, vulcanized fiber, or other fire-proof material, and firmly secured in such insulated condition to the door.

1 2 3 4 5, &c., to 15, inclusive, Fig. 1, are metal washers adapted to make electrical connection between the screw-heads shown and the switch-board, the body of the screws being electrically clear of the switch-board when the screws are partially drawn.

z z' z^2 are insulating-washers adapted when placed under any of the metal washers to insulate them from the switch-board, as shown at 2, 4, 8, and 13.

w' to w^{15}, inclusive, are insulated conducting-wires of platinum or other wire adapted to withstand a high degree of heat in case of fire, and carefully insulated with asbestus or other fire-proof insulating material. These wires run from contacts 1 to 15, inclusive, Fig. 2, under an insulating-board, X, into the interior of the safe by a groove behind the hinge H^5, as shown, to a series of resistance-coils, R′ to R^{15}, inclusive, each coil being of different resistance from its fellow, so that the entire series vary from one to twenty or fifty ohms, as desired. The function of these coils will be explained hereinafter. From the resistance-coils the wires w' to w^{15}, inclusive, all run to the switch-board S B, save those designated to form the combination—in this instance 8, 13, and 4, in sequence.

R^x R^x is a metal rod attached rigidly to the door, and upon which are fixed three sliding metal contact-arms, S S′ S^2. The plus-pole of the battery is attached to the wire w^{16} and the minus-pole to wire w, and hence to switch Sw by contact-points b when the switch is closed.

M, M′, and M^2 are the combination-magnets, and M^3 is the safety-magnet.

It will be seen that the armature-lever N performs two functions—viz., it locks the lever N′ N^2 on the left and also the last or locking armature-lever, N^3 N^4, by the hook t on the right.

I will now proceed to disclose the manner of operating this lock. Suppose the safe to be closed and the bolts in position, as shown, the locking armature-lever N^3 having fallen into its place behind the lug G, the handle H having been turned so as to force the bolts into place. In this position the lever N^3 locks the bolts by its end bearing against the lug G, and a firm lock is had against backward thrust by

reason of the shoulder *q* and socket-bearing at P^2, and is held in this position by spring S^2. In turn the lever $N' N^2$ locks N^3 by resting over the lug L, said armature-lever being under stress against its back-stop, *t'*, by reason of spring *s'*, and this lever is again locked by the lever N under stress of spring *s*. It will also be seen that the lever N locks the arm N^4 of lever N^3 by the hook *t*. Under this condition of affairs the safe is locked and the arms $S S' S^2$ are pushed to either side of rod R^x, or to any part of said rod the operator may desire, so that they are not left adjacent to their combination-numbers. To unlock the safe in this instance, we must use the combination 8, 13, and 4, successively, close the battery-circuit at switch *Sw*, and place the arm S' on contact No. 8. The circuit will then be closed at the plus-pole of the battery, and will pass by wire w^{16}, Fig. 2, to rod R^x, and thence by arm S', contact-point No. 8, to wire w^8, under the insulated bar X, behind the hinge H^5, and through the door to the resistance R^8, thence to washer 8, resting on insulated washer Z', and by wire w^8 to the common binding-post V, to the return-wire *w*, whence it passes outside the door behind the hinge, to switch *Sw*, contact *b*, wire *w*, and the minus-pole of the battery. This energizes magnet M, and causes the armature-lever on it to counteract the effects of spring *s* and to rise against its back-stop, t^3, thus lifting the hook *t* from the path of the lever N^4 and removing the left-hand end of the lever from the path of the second locking-lever, $N' N^2$, at the same time placing the end of lever N opposite the hole *h'*, so that when lever N^2 is drawn to the right it will lock said lever N mechanically. Pass, now, to the second number of the combination and place the arm S^2 on the contact-point 13, and the circuit will now be closed in multiple arc through the path already pointed out, one part going by that route and the second part going from rod R^x, by arm S^2, to point 13, wire w^{13}, behind the hinge, as before, and inside the safe to resistance R^{13}, wire w^{13}, to magnet M', and thence to common binding-post V, when it joins the other current, and goes thence by the return-wire *w*, as before, to the outside of the safe and the negative pole of the battery. This causes magnet M' to draw its armature A' up against the stress of spring *s'* and to bring the hole *h'* over the end of the lever N, said lever being, as already noted, held up by the action of the divisional part of the current upon the magnet M'. Lever $N' N^2$ therefore swings about its pivot P' and carries the lower arm to the left against its back-stop t^2 and out of the path of the lug L of the last or locking lever, N^3. The arm S' may now be moved from the point 8 and placed on the insulating-space next to it, thus breaking that circuit and throwing all the current through wire w^{13}, last described, inasmuch as the lever N is held out of actuating or locking position by the upper end of lever N^2, as explained. Pass, now, to the last number of the combination, No. 4. Close the last arm, S, upon the contact No. 4, when the battery will be closed in multiple arc with the circuit last delineated from the arm S by point 4 to wire w^4, thence behind the hinge inside the door, as before, to resistance-coil R^4, thence by wire w^4 to washer 4, wire w^4, to magnet M^2, and thence to the same common binding-post V, where it joins the other current and passes outside the safe by wire *w* to the other pole of the battery. This magnetizes magnet M^2 and causes the armature A^2 to draw up the last locking-lever N^3, which projects through the box D at O, out of the path of the lug G against the stress of its retractile spring s^2. Now take hold of the handle H^4 and turn it to the left, when the arm E, acting on pin F, causes the bolts to be forced back and the door comes open.

I will now describe the function of the magnet M^3, which I term a "safety-magnet." It will be observed that this magnet is connected by a wire, w^{17}, to the switch-board S B near its center, and to the common return-wire *w* at the binding-post or junction V, and that all the incoming wires *w'* to w^{15}, inclusive, except the combination-wires—in this instance w^8, w^{13}, and w^4, respectively—are connected to the switch-board by metal washers under the screw-heads, as shown. It will therefore be understood that if any of the circuits be closed from 1 to 15, inclusive, by arms S, S', or S^2, except the before-mentioned combination circuits, the circuit will be closed through the safety-magnet M^3 by switch-board and wire w^{17} to the common return-wire *w*. Such a closure will energize the magnet M^3 and cause it to act upon its armature A^3, thus causing it to aid the spring s^2 in holding the locking-armature in locking position, as shown. The armature A^3 lies close to the pole of its magnet M^3, and is near the end of the long arm N^4, while the last or unlocking armature A^2, which acts to raise the locking-lever N^3, is much nearer the fulcrum P^2 and lies out of the immediate magnetic field, so that if all the circuits are closed at once at the points 1 to 15, inclusive, on the outside, and by return-wire *w*, even though the armatures A A' be drawn up under this action of their respective magnets M, M', &c., it must be apparent that the influence of magnet M^2 must be less than that of the conjoint action of spring s^2 and magnet M^3 acting on the long leverage of arm N^4. Furthermore, the magnet M^3 would take the major part of the current, because of the lower path offered by the multiple circuits to the switch-board S B. All of the front and back stops, *t* *t'* t^2, &c., and the top of shoulder *q* should be covered with soft rubber, and every precaution used to deaden the sound of the magnets, so that no noise may be allowed to lead to a detection of the particular combination-circuits by outside tests.

In place of a permanent return-wire, *w*, I may utilize any one of the wires *w'* to w^{15} not already in use as combination-wires as a return-wire, and to provide for this I arrange an ad-

ditional rod, R^z R^z, parallel to R^x R^x, (see Fig. 2,) but below the contact-board X X, as shown, said rod having an additional sliding circuit-arm, S^4, located on it and adapted to be put in contact with any one of the contacts 1 to 15. At the end of this rod I affix a binding-post and connect it to the pole of the battery by a wire, w^{18}. On the inside of the safe I select any one of the wires, not a combination-wire, for the return, and place an insulated washer under its nut, as at 2, Fig. 1, and connect the common binding-post V with this wire w^2, as shown, thus insulating this wire from the switch-board, as in the case of 4, 8, and 13, the combination-numbers. It will be seen that this arrangement gives an additional combination, the return-circuit not being known, and only to be found by placing the arm S^4 on the proper contact—in this instance 2. Of course when this return-circuit is used the fixed return-circuit w is disconnected at binding-post V; or, if desired, the wire w may be neglected entirely and the combination-circuits relied on for advance and return circuits in themselves. To illustrate: Place S^4 on contact 8 and S^2 on contact 13. By tracing these circuits it will be seen that the circuit is closed from the battery through the two magnets M M′ in series, and that armatures A and A′ are drawn up and the lever N^2 out of the path of lug L on lever N^3. Now close S on contact 4 and magnet M^2 will be energized and draw up armature A^2 and locking-lever N^3, when the bolts may be drawn. Either system may be used, as desired.

Fig. 3 shows a modified form of lock, which will be readily understood after the above description. This diagrammatic view illustrates the battery B A and the points of closure, as 3, 9, 10, and 12, on the outside of the safe. In place of electro-magnets I use here solenoids M M′ M^2 M^3, with suction-cores A A′ A^2 A^3. x x and y y are normally-closed low-resistance shunts around the solenoids M′ and M^2, and having contact-spring K′ and K^2 arranged to allow the shunts to be opened when the solenoid-cores A A′ are drawn into their coils, as will be understood by the action of the extended portions l l' of levers N N′, as shown. The lever N^4 is pivoted at P^3 and has a shoulder carrying a rubber cushion, n, which latter bears on the lever N^3. This lever also has a hook, p, at its upper end adapted to take into a corresponding hook, p', on lever N, as shown.

The shunt-circuits x x and y y, of very low resistance, meet at a common point, q, from which a single low-resistance wire is wound about the inner side of the coil or solenoid M^3 in such direction that a current of electricity passing from w^{10} or w^{12} by said shunt x x, point q, wire w^{17}, and out to battery will energize said solenoid M^3. In other words, it is so wound as to aid the main coil of the solenoid in its action. A similar effect is had from a current passing from point 12 by wire w^{12}, shunt y y, and likewise from point 3, wire w, shunt x x, and wire w^{10} to battery. The operation of this modified form is in all essential respects very much like that of the form covered by Figs. 1 and 2, above described, the main difference lying in the function of the shunts x x and y y and the hooks on ends of levers N N′ N^2 N^3 N^4.

It will be seen that if the circuit is closed at 10 and 3 the current takes a short route through shunt x x, the low-resistance coil of solenoid M^3 to binding-post V, and thence by wire w to battery. This actuates solenoid M^3, whereby the core A^3 draws up lever N^4 against the pressure of rubber spring n and hooks its upper end into engagement with the hook p' on the end of lever N, thereby locking said lever positively against any action of solenoid M and its core A. Similarly the closure of any circuit between any two points on the contact-board, except 9 and 3 or 10 and 12, will lock the lever N as long as the circuit remains closed through any two of said points. On closing the circuit at 10 3 or 12 3 short circuits are formed about the solenoids M M′ by way of shunts x x and y y and the low-resistance coil of solenoid M^3, and in closing circuit at 10 and 12 a low shunt is formed. In operating the combinations in their order—in this instance four numbers, 3, 9, 10, and 12—the action is as follows. First close circuit at 3 and 9. This energizes solenoid M by way of wires w^9 and w, and tilts the lever N about its pivot P, causing the projecting lug l on its left-hand end to break the normally-closed shunt to solenoid M′ by forcing the spring K′ away from its contact-point. If, now, the circuit be closed at 10 in multiple arc with that just named, solenoid M′ will be energized and cause lever N′ N^2 to tilt about its pivot P′, bringing the lug l' on its right-hand end into contact with spring K^2 and breaking the circuit of shunt y y to the last or locking solenoid, M^2, and also mechanically locking lever N as it passes into the opening h. The contact-arm may now be removed from contact 9, if desired, and the battery-circuit closed in multiple arc at the last or unlocking combination, No. 12, whereby the divisional part of the circuit passes through wire w^{12}, solenoid M^2, wire w, and out to battery, and lifts the locking-lever N^3, thus releasing the bolts.

I provide hooks p p' h^2 p^3 on the ends of the levers, as shown, to give additional security in the event of a closure of all the circuits at once, and inasmuch as the solenoid M^2 is or should be more sensitive than M′, and M′ more sensitive than M, it will be understood that any accidental or intentional closing of all the circuits, supposing the shunts broken, would draw up all the levers and lock them—lever N′ N^2 by hook p^3 on N^3, and lever N by hook h^2 on N^2, and p to N^4.

I design making the safety-solenoid the most sensitive of all the solenoids, so that a wrong closure of any circuit will always actuate it and mechanically lock both N and N^3, the former by the hooks p p' and the latter by the

compression of the rubber spring *n*, as well as the combined action of levers N N′, and also N^2, at its left hand end.

With the arrangement of circuits shown in Fig. 3, the return-circuit *w* must be used to unlock the circuit, as it will be seen that an attempt to use any other circuits will always result in locking the levers N and N^4, no matter what sequence of circuits be used. It is necessary in order to unlock the safe to employ four combination-numbers—in this instance 3, 9, 10, and 12—and their sequence, in pairs, as disclosed. It will be understood, of course, that the arrangement for closing the circuits on the outside of the safe is the same in this modification as those disclosed in connection with Fig. 2, where the two rods R^x R^x and R^z R^z are used, the contact-arms S^4 acting on rod R^z R^z to close contact 3, and the contact-arms S S′ S^2 acting on the contacts 9, 10, and 12 in the order in which the circuits should be closed, and as above described.

It will be seen that by the use of solenoids I get a greater range of motion for my locking-levers, and I prefer this to magnets with armatures, inasmuch as the adjustment may be such that the greatest pull can be effected at the first closure of the circuit, so as to start the levers, and this, it will be seen, is a very desirable feature in locks where the levers are liable to become stuck.

The resistance-coils R′ to R^{15}, inclusive, are designed to prevent detection of the combination-circuits by exterior tests by the use of a battery between any two of the points on the contact-board X X. If it were not for these resistances one could, by use of a battery and galvanometer or telephone, locate the circuits having the magnets M, M′, M^2, and M^3 in them. I make the resistance vary in any desired ratio—say from three to thirty ohms each—and arrange them above the switch-board in any desired order, being careful not to have them in sequence. It will thus be seen that if the resistance of the magnets M M′ M^2 M^3 is very small—say not to exceed an ohm—it will be impossible by electrical tests to locate them.

The coils R′ to R^{15} may have cores and be in every way similar to the magnets, so that their magnetic action will be so analogous to that of the magnets as to defy detection. The cores may, if desired, be all attached directly to the switch-board by screwing them into it, and the switch-board may be of magnetic material; but this is not deemed material, the essential feature being to have the magnetic action of the coils as near like that of the magnets M M′ M^2 as possible.

I prefer to have the wires *w′* to w^{15} pass directly into the door or over the top side thereof, so as to leave no wire exposed and to have no exterior exposed part other than the contacts. To this end they may pass directly over the upper edge of the door in small grooves, and I do not limit myself to the number or kind of wire, it being of course understood that the greater number the greater the security; nor do I limit myself to any particular manner of locating them. They may enter the safe at any point or points and be within my invention.

It will of course be understood that more combinations may be secured by adding more magnets and circuits with additional locking-armatures, and I only elect three because that is the usual number of combinations now had in existing mechanical locks.

To change the combination, all that is required is to remove the insulating-washers *z z′* z^2, run down the screws until the heads cause the metal washers to contact with the switch-board, and place the insulating-washers under the desired screw-heads. In place of insulating-washers I prefer the metal washers connected to the wires w^{13}, w^8, w^4, and *w* to have insulation on their under side similar to the well-known jack-knife switch-plug in telephone systems; or a switch-board with a jack-knife system might be substituted for the switch-board S B, if desired; but I prefer the board indicated, as it is secure, for the metal washer cannot drop out and thus injure the lock.

It will be understood, of course, for reasons above noted, that one of the arms S S′ S^2 might be dispensed with by making one of these arms serve to close the first and third circuits. If necessary, armatures and armature-levers may be provided for the cores of the resistance-coils R′ to R^{15}, so that they may be entirely analogous in their action to magnets M, M′, M^2, and M^3. In the event of such an arrangement it would be well to arrange the switch-board in a square around the box D, so as to concentrate the magnets and bring them as near to the center of the lock as possible, so that the sounds might issue from a common center. The wires w^4, w^8, and w^{13}, extending from the magnets M M′ M^2, may be of flexible type—such as are used in telephone-cords—and may be provided with take-up rollers and springs located in the box D, so that they can be lengthened and shortened to any desired length to reach any part of the switch-board S B. All the wires should of course be fully protected by insulation and otherwise to prevent possible breakage or short circuits. I prefer to make the armature-levers and their bearings of aluminium, so as to be light, strong, and non-oxidizable. The lever N^3 in particular should be of this material on account of the mass of metal needed to lock the lug G securely. I do not limit myself to aluminium, however, as any desired metal may be used.

I may make the locking-lever N^3 of iron or steel and of sufficiently large dimensions to insure safety by providing a prolongation on the other end of said lever and an adjustable weight to counterbalance the weight of the lever and solenoid-core.

When the door is of iron or steel, the return-wire *w* may be omitted and the common point or binding-post V connected electrically di-

rectly to the door, the switch Sw on the outside being similarly connected, while *b* is insulated therefrom. The switch Sw may be dispensed with and a binding-post substituted therefor, if desired.

I do not claim in this application bolt mechanism and a series of locking-levers therefor, one lever locking the bolts and each successive lever its predecessor in sequence; nor do I claim an alarm-bell in combination with such bolt-controlling mechanism. Said subject-matter I reserve for a separate application filed by me July 6, 1887, bearing Serial No. 243,598.

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

1. Circuits running from the exterior of the safe to electro-magnets within, for controlling successively the combinations, and a safety-circuit to avoid detection of the combination, substantially as described.

2. The method of controlling safe and other combination-locks, consisting in controlling the combinations electrically by dividing an electrical current between selected circuits successively, so that the combinations shall be set in proper sequence and in preventing such control unless the proper sequence is observed by closing a derived or independent circuit through a safety device, substantially as described.

3. In a combination-lock, a series of circuits running from the exterior of the safe, vault, or place to be protected to the interior thereof to a source of common electrical connection, which latter is electrically connected to a single conductor passing through a safety device, as described, to the exterior of the safe, in combination with two or more electric circuits selected at will from the aforesaid series of conductors, both electrically disconnected from the source of common electrical connection and passing, respectively, through electrical devices, as described, which control by their successive action the locking mechanism, substantially as described.

4. In a combination-lock, a series of electrical circuits passing from the exterior of the safe, vault, or place to be protected and electrically connected to a common point within the safe, an additional series of selected circuits chosen at will from the aforesaid circuits, but electrically disconnected from the common point within the safe, a series of electro-magnets and locking-levers therefor, each one of said magnets being in one of the latter circuits, and a common return-circuit for all the aforesaid circuits, said return-wire being connected to the first-named series or their point of connection through a safety electro-magnet, substantially as described.

5. In a combination-lock for safes, vaults, or analogous devices, a series of conductors insulated from each other and passing from the exterior of the safe or vault to the interior thereof to combination mechanism located therein, in combination with a series of circuit-controlling devices located on the outside of the safe or vault and an electrical generator connected thereto, substantially as described.

6. In a combination-lock for safes, vaults, or analogous devices, a series of insulated electrical circuits passing to the interior of the safe or vault to a safety device controlled by a common return-circuit passing to the exterior of the safe or vault, in combination with two or more selected insulated electrical circuits, also passing to the interior of the safe or vault through electro-magnets or analogous devices for controlling the bolts to the common return-circuit, substantially as described.

7. In a combination-lock for safes, vaults, or analogous devices, the combination, with two or more combination electro-magnets or solenoids having locking-armatures, of a safety electro-magnet or solenoid adapted to prevent the action of said combination electro-magnets, substantially as described.

8. In a combination-lock for safes, vaults, or analogous devices, the combination of two or more combination electro-magnets adapted to control the withdrawal of the bolts, with a safety electro-magnet adapted to prevent the action of the aforesaid electro-magnets unless the proper sequence of circuits is operated, substantially as described.

9. In a combination-lock for safes, vaults, or analogous devices, a series of solenoids or electro-magnets located within said safe or vault, a series of electrical circuits leading to the solenoids or electro-magnets in sequence, a shunt or shunts about all of said solenoids or electro-magnets, save the first one of the series, and a safety magnet or solenoid for controlling the action of the aforesaid solenoids or electro-magnets in the event of a wrong closure of the circuits leading to the other solenoids or electro-magnets, said safety magnet or solenoid being under the control of the entire series of circuits leading into the safe, and means, substantially as described, for breaking said shunt or shunts if the proper sequence of circuits be closed.

10. In a safe or analogous device, the combination of a series of electrical circuits leading from the exterior to the interior thereof, with electro-magnetic means for controlling the withdrawal of the bolts, and additional electro-magnetic means for preventing such withdrawal unless the proper sequence of circuits be closed, substantially as described.

11. The within-described method of controlling combination-locks for safes, vaults, or analogous devices electrically by operating a predetermined sequence of circuits selected from a series of circuits passing into the safe or vault, and in preventing the action of the bolt-controlling apparatus unless this proper sequence is observed, substantially as described.

CHARLES J. KINTNER.

Witnesees:
JOHN A. WIEDERSHEIM,
L. DOUVILLE.