4 Sheets—Sheet 1.

M. A. DALTON.

Permutation-Lock.

No. 221,790. Patented Nov. 18, 1879.

Fig. 1.

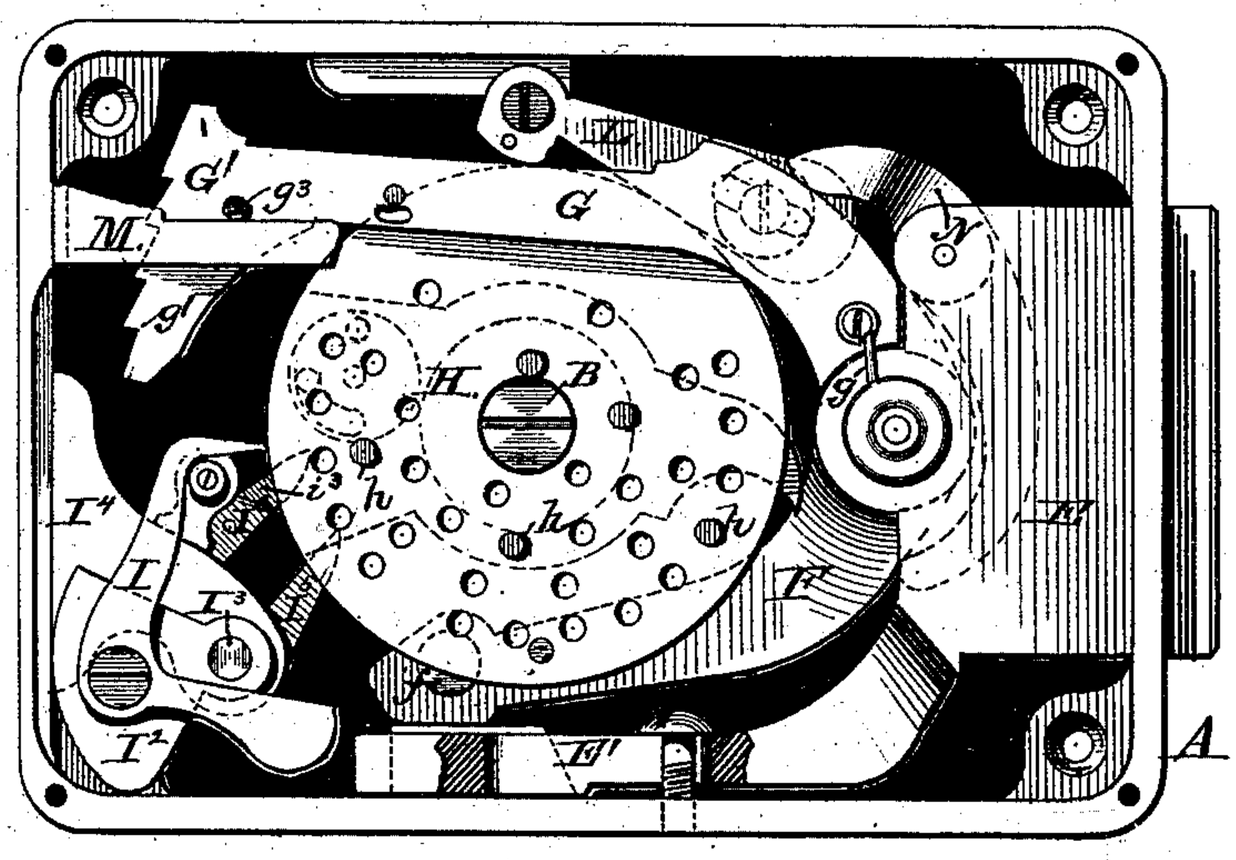


Fig. 2.

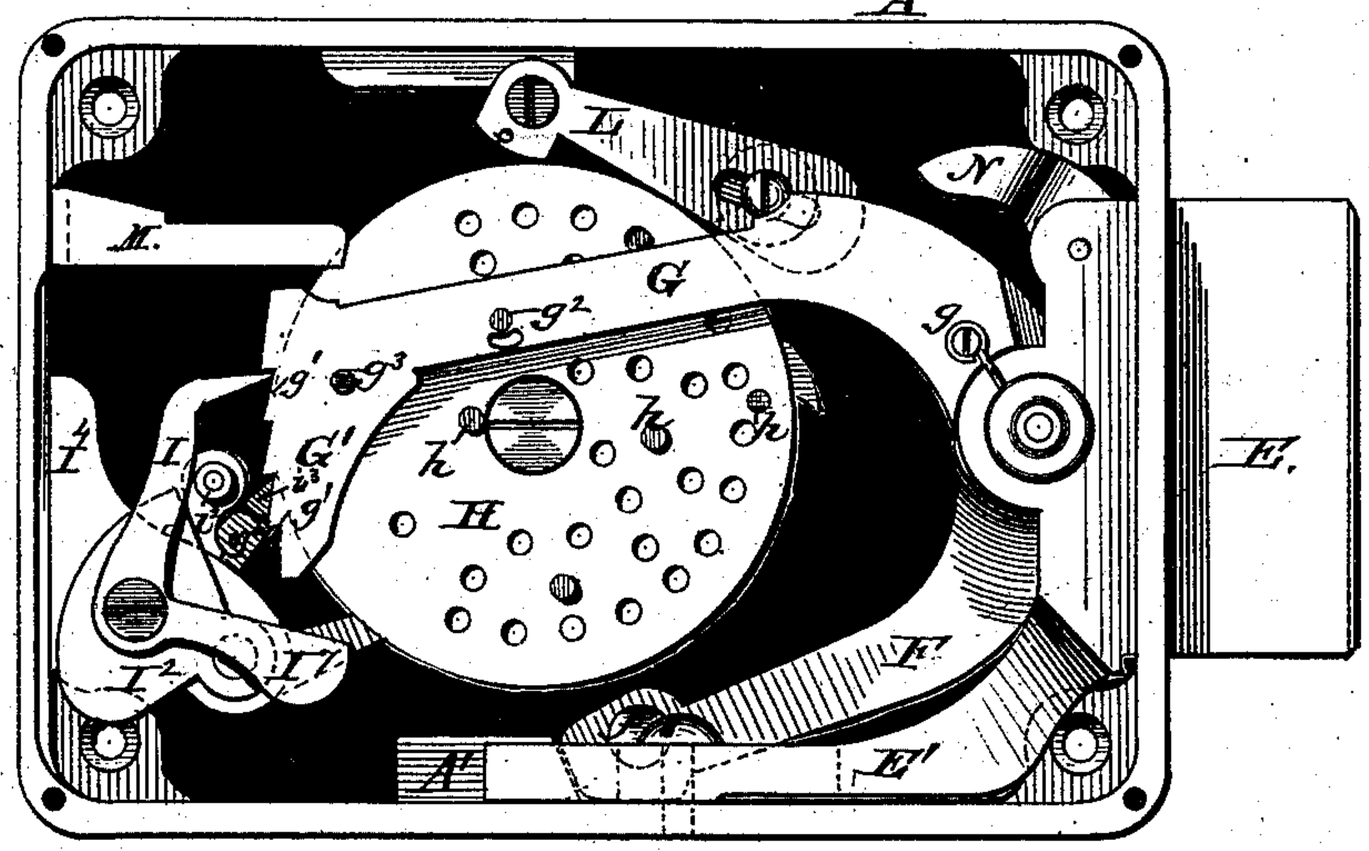


Fig. 6.

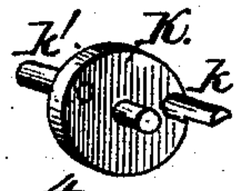
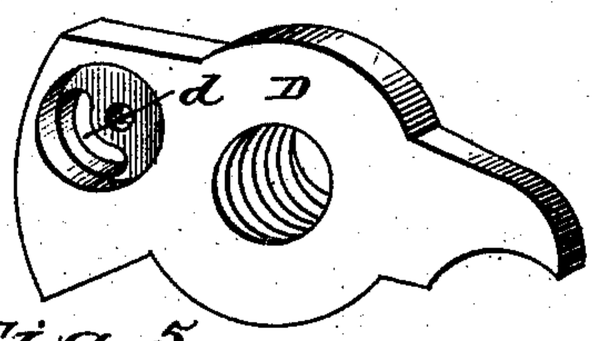


Fig. 5.



Attest:
H. L. Perrin
Chas. H. Keene

Inventor:
Milton A. Dalton
by his attorney
A. H. Evans

4 Sheets—Sheet 2.

M. A. DALTON.
Permutation-Lock.

No. 221,790. Patented Nov. 18, 1879.

Fig. 3.

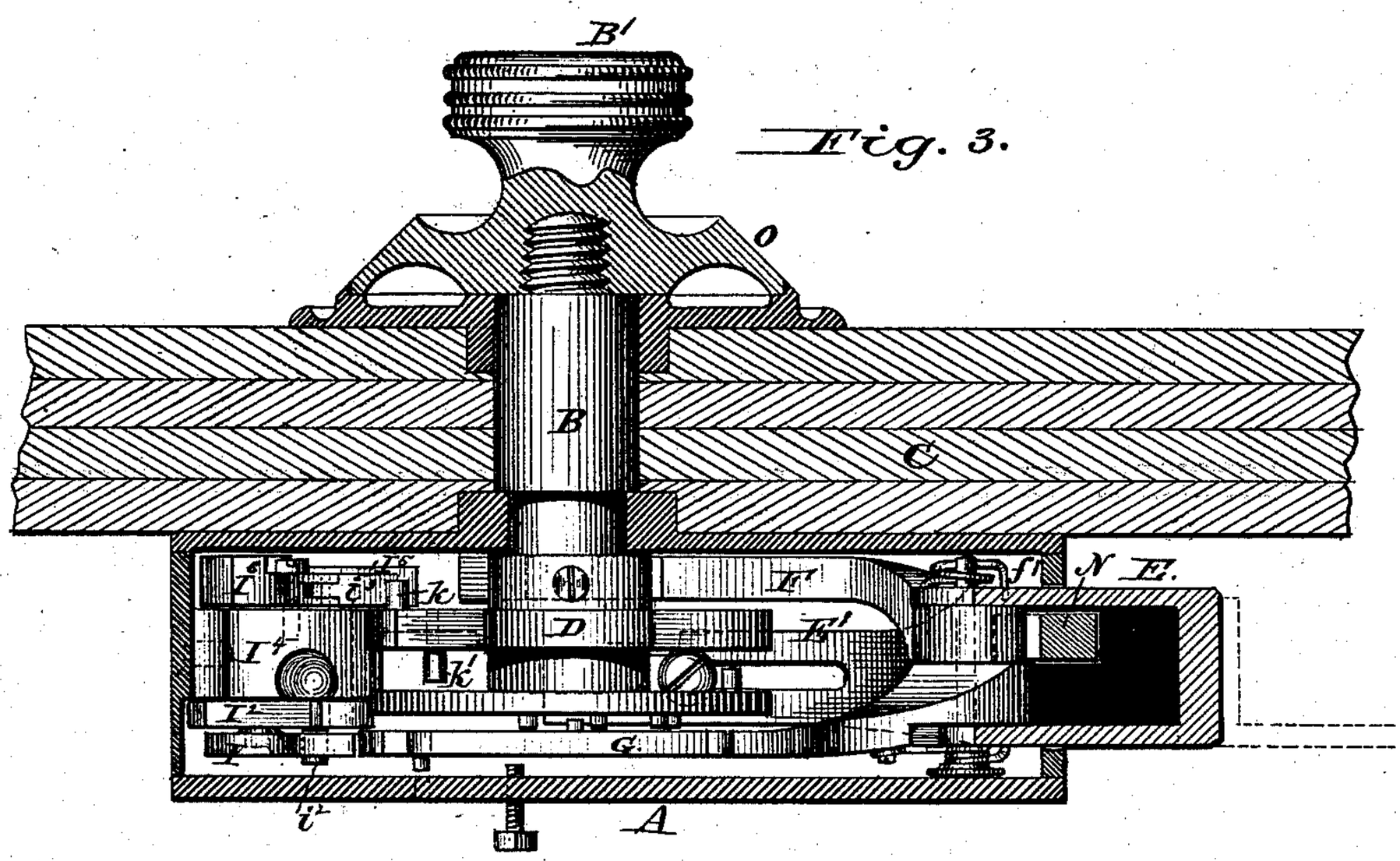
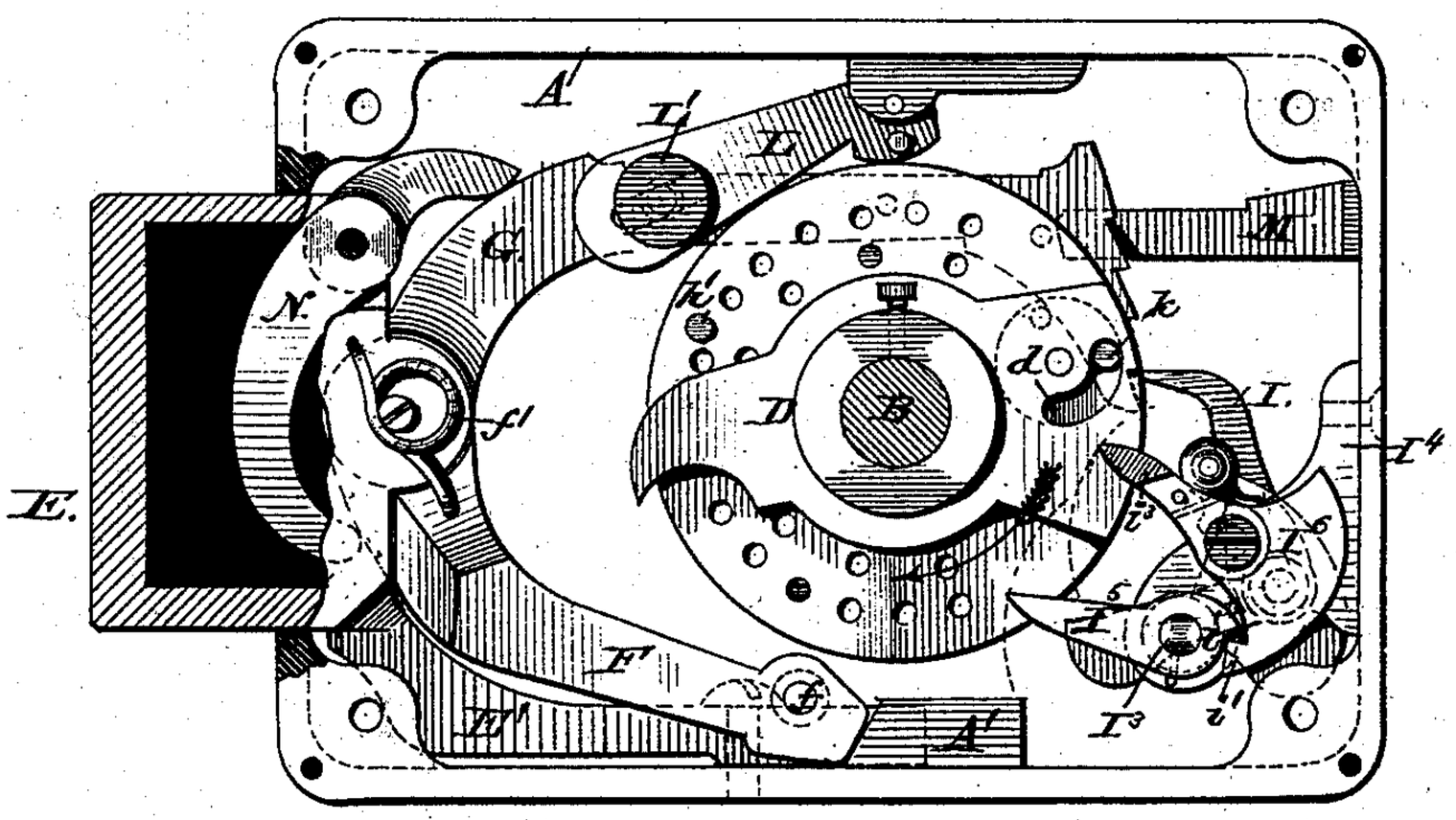


Fig. 4.



Attest:
H. L. Perrine
Chas. A. Neale

Inventor:
Hilton A. Dalton
by his attorney
O. H. Evans

4 Sheets—Sheet 3.

M. A. DALTON.
Permutation-Lock.

No. 221,790. **Patented Nov. 18, 1879.**

Fig. 7.

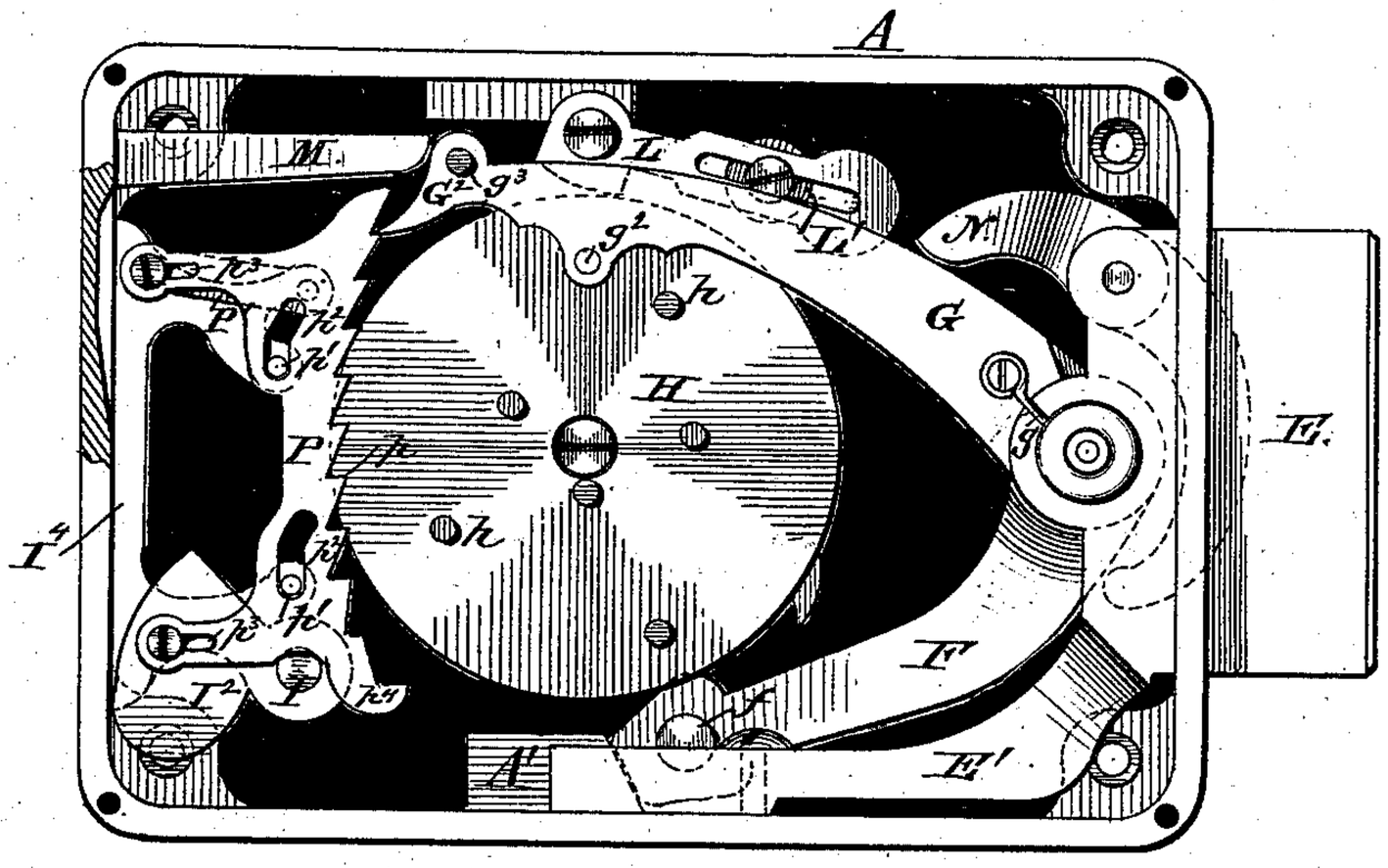
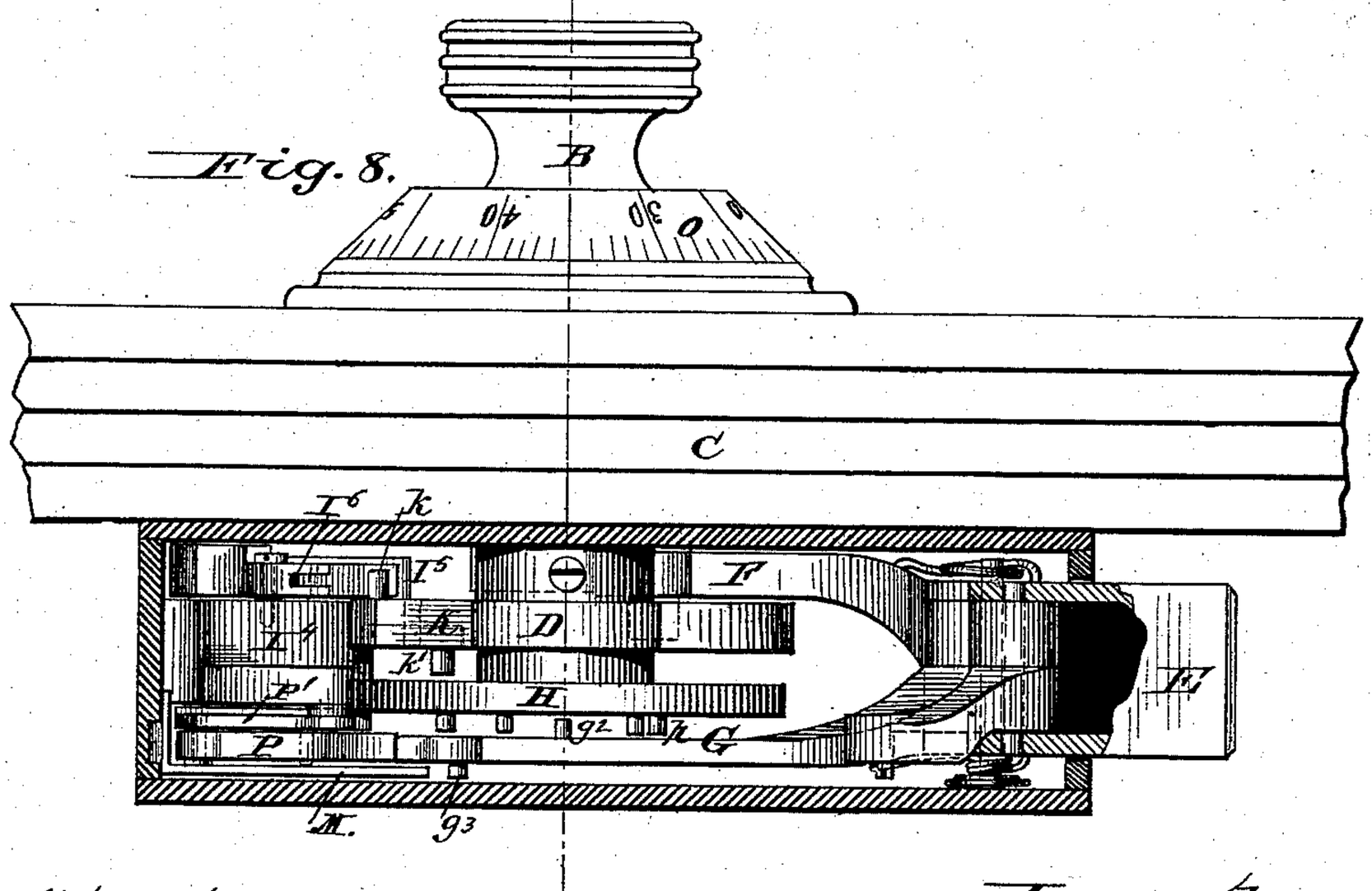


Fig. 8.



Attest:
H. D. Perrine
Chas. A. Neale

Inventor:
Milton A. Dalton
by his attorney
C. G. Siggers

4 Sheets—Sheet 4.

M. A. DALTON.
Permutation-Lock.

No. 221,790. Patented Nov. 18, 1879.

Fig. 9.

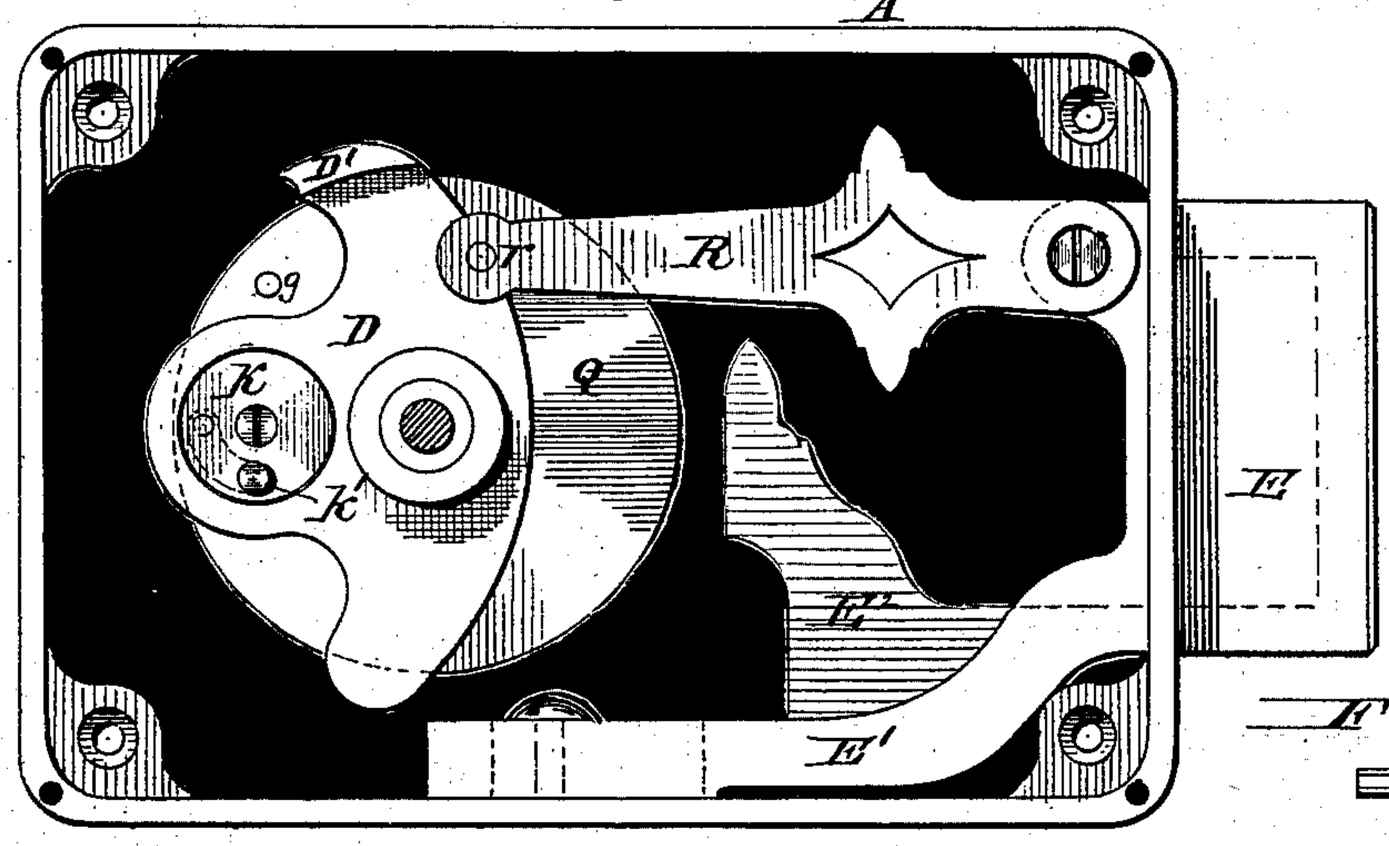


Fig. 13.

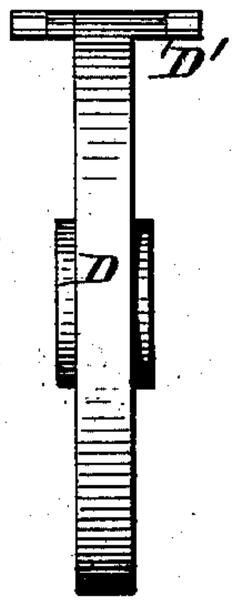


Fig. 14.

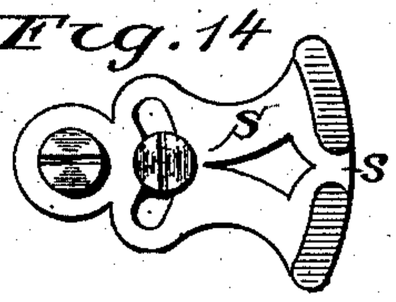


Fig. 10.

Fig. 11.

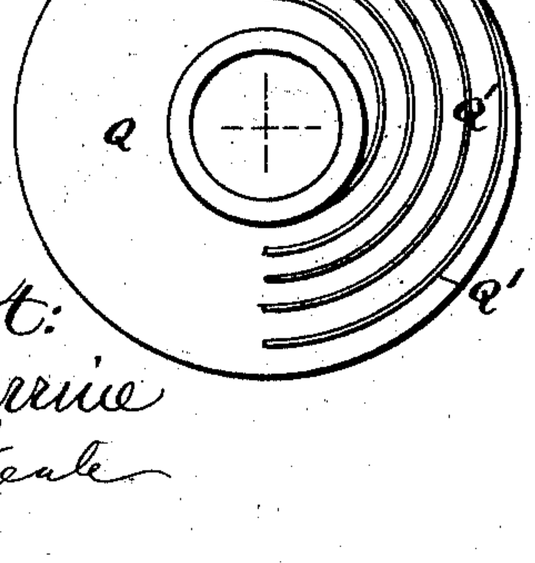
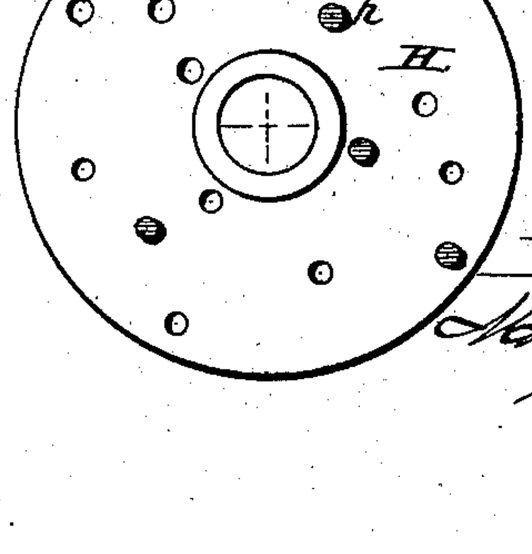


Fig. 12.



Attest:
H. L. Perrine
Chas. A. Neale

Inventor.
Milton A. Dalton
by his attorney
O. G. Bill

UNITED STATES PATENT OFFICE.

MILTON A. DALTON, OF CINCINNATI, OHIO.

IMPROVEMENT IN PERMUTATION-LOCKS.

Specification forming part of Letters Patent No. **221,790,** dated November 18, 1879; application filed May 8, 1879.

To all whom it may concern:

Be it known that I, MILTON A. DALTON, of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Combination-Locks; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The object of this invention is to provide a combination-lock embodying the principles of the permutation mechanism of the dual time-lock described in my application for United States Letters Patent filed November 2, 1878.

To this end the invention consists of the combination of the following mechanical devices, to wit: the bolt of the lock; a driver, which consists of a device fixed on the arbor for throwing and retracting the bolt, and combined with a reversible transmitter enabling said driver to transmit motion from either side according as it is turned in one direction or the other; a self-replacing controller consisting of a device which is movable stepwise from its normal position to the point where it provides for the retraction of the bolt, but which escapes intermittingly from its impelling means; a permuter consisting of a device which requires to be advanced stepwise in working out the combination, to successively support the controller after each advance. The construction of these devices and their association into a mechanical combination may be very much varied without departing from the principle of the invention.

In the accompanying drawings I have represented several forms of my invention, which I will describe separately in order to avoid confusion. The form of my invention first to be described is illustrated on Sheets 1 and 2, where—

Figure 1 is a rear elevation with the plate of the lock-case removed, showing it in its unlocked condition. Fig. 2 is a similar elevation, showing the lock, however, in its locked condition, with the controller partially elevated. Fig. 3 is a sectional plan view of the lock, showing it attached to a safe-door. Fig. 4 is a sectional front elevation. Fig. 5 is a perspective view of the driver without the reversible transmitter. Fig. 6 is a perspective view of the reversible transmitter.

The same letters of reference are used in all the figures to designate identical parts.

The mechanism of the lock is arranged in a suitable case, A, through the front plate of which the lock spindle or arbor B protrudes any required distance, enabling it to reach through a door, C, or other structure to which the lock may be applied.

The arbor B is provided with a suitable handle or with a knob, B′, by which it can be conveniently turned. Within the lock-case the arbor has fixed upon it the driver D, which in this instance is a cross-bar, one end of which terminates in a hook, while the other end is of broad segmental configuration.

The bolt E has a slotted shank, E′, to guide it on a guide-pin fixed to the bottom of the case, and is operated by the driver through a link, F, which is pivoted with one end to the bolt, and reaches with its other end to a fixed stump, A′, on the bottom of the lock-case.

The link has at its free end a laterally-projecting pin, *f*, upon which the driver D has to act in projecting or retracting the bolt. When the bolt is projected—that is, when the lock is locked—then the free end of the link rests on the bottom of the lock-case, in front of the stump A′, so as to dog the bolt. Its pin *f* is then in a position where it cannot be reached by the driver, and the link F has to be first elevated so high that it can move over upon stump A′ before its pin *f* will be in the circuit of the driver.

The stress of a spring, *f′*, is constantly exerted upon the link antagonistically to the lifting of its free end. The elevation of such free end of the link can only be effected through the instrumentality of the controller G, and the action of the controller upon the link is in turn governed by certain means for moving it and by the permuter H, as will be presently explained in detail.

The controller is pivoted at one end to the bolt E, and terminates at its other end in a transverse segment, G′, with a series of ratchet-teeth, *g′*, on its outer edge. It extends across the face of the permuter H, and can be turned on its pivot through a certain range,

but does not begin to actuate the link F until it has nearly reached the extreme limit of its range of motion from its normal position.

The controller is moved stepwise from its normal position by a lifting-pawl, I, which is adapted to alternately engage and disengage the toothed segment G′ of said controller.

Whenever the lifting-pawl I releases it, the controller will, unless it be supported by the permuter, as hereinafter set forth, replace itself in its normal position, and in this self-replacement it may be aided by a spring, *g*.

Pawl I is loosely pivoted on the weighted arm I^2 on one end of shaft I^3, journaled in a bracket, I^4, fixed on the lock-case. The other end of shaft I^3 has a fixed arm, I^5, on the hub of which is a toe, *i*, adapted to engage the catch *i′* of the trigger I^6, which is loosely pivoted on a stud on bracket I^4. The trigger is so balanced on its stud that it constantly tends to throw its catch *i′* toward the hub of arm I^5, for engaging the toe *i* thereof.

Pawl I has a weighted arm, I^7, whereby it is kept in contact with the fixed stud i^2 on bracket I^4. The edge of the pawl bearing against stud i^2 is so formed that in the lowermost position of the pawl the stud i^2 holds the bit of the pawl clear of the ratchet-teeth of the controller, so that then the controller is free to move; but as long as the pawl is elevated above its lowermost position its bit engages, or is in position to engage, the ratchet-teeth of the controller. In the present instance the descent of the pawl is limited by the arm I^2 striking the bottom of the lock-case, as shown in Fig. 1. It is elevated by depressing arm I^5, and is held elevated by the locking of said arm by trigger I^6, which must be tripped before the pawl can again descend.

The trigger I^6 and arm I^5 are operated upon by the driving-pin *k* of the reversible transmitter K of the driver D. The reversible transmitter has here the form of a disk centrally pivoted in a circular recess in the segmental arm of the driver D. Its driving-pin *k* projects through a slot, *d*, in the driver. This slot *d* is concentric with the axis of the reversible transmitter, but one end of it is farther removed from the axis of the driver than the other end. When pin *k* is in the far end of the slot *d* it is in position to operate upon trigger I^6 and arm I^5. Supposing the parts to be in the relative positions shown in Fig. 4, and that the driver be turned in the direction of the arrow, driving-pin *k* will first trip trigger I^6, causing the release of arm I^5 and the immediate descent of the pawl I, in consequence of which arm I^5 is turned up against the trigger I^6, but is at once moved back again by the trigger under the action of driving-pin *k*, so as to again elevate pawl I. As the driving-pin *k* progresses it will first release the trigger, and shortly thereafter the arm I^5, which is at once caught by the trigger, so that the pawl I will be maintained in its elevated position. There is some lost motion between arm I^5 and trigger I^6 at this point, in order that the arm I^5 may turn back a little distance from the extreme point to which it is depressed by the driving-pin *k*, and thus have its extreme end thrown across the circuit of said driving-pin. Hence on reversing the motion of the driver the driving-pin *k* will strike the end of arm I^5 and will be turned some distance in its slot in escaping from said arm.

The trigger I^6 terminates in a pivoted tongue, i^3, adapted to turn one way, and provided to allow the driving-pin *k* to lift and pass it, without having its position changed by such pivoted tongue, when the driver is turned in a direction opposite to that indicated by the arrow in Fig. 4.

The throw of pawl I is equal to the distance between two adjacent teeth of controller G plus the lost motion between the arm I^5 and trigger I^6.

A constant rotation of driver D in the direction of the arrow shown in Fig. 4 would have no other effect than to alternately elevate the controller a distance equal to the length of one of its teeth and its automatic return to its normal position. In order that it may be successively elevated higher and higher the permuter H is provided, from the side of which facing the controller a number of studs, *h*, project, which can be successively brought under a projecting stud, g^2, of the controller, to support it in any position to which it may be lifted by pawl I. The permuter is provided with several concentric series of holes, in which the studs *h* may be inserted, one in each concentric series of holes. By changing the relative positions of the studs the combination for opening the lock may be varied at any time. After each lift of the controller by the pawl I, the permuter is to be turned to bring the appropriate stud *h* under the stud g^2, to support the controller while pawl I descends preparatory to giving another lift to the controller. The permuter is mounted to turn freely on arbor B; but a friction-pawl, L, pivoted on the case, bears on its peripheral edge and prevents it from turning except in one direction—namely, in a direction opposite to that in which the driver requires to be rotated to operate upon pawl I through the intermediate mechanism described.

The force with which the friction-pawl bears against the permuter can be regulated to some extent by anjusting the weight L′ on the pawl.

The permuter is driven by the driving-pin *k′* of the reversible transmitter K acting on a laterally-projecting stud or drive-pin, *h′*, of said permuter. The driving-pin *k′* projects from the reversible transmitter in a direction opposite to the driving-pin *k*.

The pins *k k′* are so placed with reference to each other that when *k* is in position to operate on trigger I^6 and arm I^5, *k′* cannot touch the drive-pin of the permuter, while when *k′* is in position to drive the permuter, then pin *k* cannot reach trigger I^6 and arm I^5.

On turning the driver D in a direction opposite to that of the arrow shown in Fig. 4 arm I^5 will give a partial turn to the reversible transmitter, so that its driving-pin k' will then be in the circuit of the drive-pin h' of the permuter.

The segmental end of the controller has a laterally-projecting stud or pin, g^3, which swings just clear of the end of the rest M on the lock-case, and can move over upon the said rest when the controller has been lifted to its highest position.

In this instance the controller lifts the link F by means of a lever, N, which is located in a cavity of, and is pivoted on, the bolt E, with its short arm overhanging the controller, so as to be struck thereby during the last lift, and its long arm reaching under the link F.

Fig. 2 shows the condition of things when the lock is locked and the controller has been elevated from its normal position a distance equal to the length of two of its teeth in the act of unlocking.

The next step required is to turn the permuter to set one of its studs h under the stud g^2 of the controller. That being done, the movement of driver D is reversed, whereby the pawl I will first be allowed to descend, and will then again be elevated, giving another lift to the controller. Thus the driver is alternately turned in opposite directions to successively lift the controller and turn the permuter to set one of its studs under the stud g^2 of the controller.

The last lift of the controller is accomplished by the bit of the pawl I acting on the lower end of the segment G′, so that the controller may now move endwise over the bit of the pawl and by its pin g^3 find support on rest M. During this last lift link F will be elevated, so that its free end may ride over the stump A′, while its pin f is brought within the circuit of the driver, and pin g^3 assumes a position just above the level of the rest M. On again reversing the driver, its hook end, taking hold of pin f of link F, will retract the bolt, the stud g^3 meanwhile moving over upon rest M to support the controller To lock the lock, the motion of the driver is again reversed, causing its segmental end to project the bolt by pushing against pin f of link F. This will carry the pin g^3 back to a point over that stud of the permuter which was last set for the support of the controller. This projection of the bolt is accompanied by an elevation of the pawl I, which now again stands under the lower end of the segment G′ of the controller. To complete the lock-up, it is necessary to release the controller, first from the pawl and then from the supporting-stud of the permuter, so that the controller may return to its normal position and allow the link F to fall. This is done by a partial reversal of the driver D after it has shot the bolt, and then turning it back again.

It should be observed that in shooting the bolt by the segmental arm of the driver the driving-pin k of the reversible transmitter will depress arm I^5, so as to lift the pawl I, but that the pin k will not pass said arm I^5, but will remain between the arm and the trigger I^6, so that in reversing the driver the driving-pin k will lift the pivoted tongue i^3 of the trigger without having its position changed thereby. The driver is turned just far enough to let the driving-pin k pass beyond the pivoted tongue i^3 of the trigger I^6. The driver is then reversed just far enough to trip the trigger I^6, which causes the descent of the pawl I and the release of the controller therefrom. The controller at once descends, but is arrested by the outermost stud h of the permuter. This partial descent of the controller is sufficient to release lever N and cause the descent of the link F, and nothing remains to be done but to reverse the motion of the driver, in order to turn the permuter to remove its outermost stud h from under the pin g^2 of the controller, which then at once descends to its normal position.

It will be observed that in the lock so far described a definite mode of procedure has to be followed, both in unlocking and in locking the lock—in other words, that a given combination has to be worked out in either case. These combinations can be worked out by the person or persons in possession of the knowledge of them by means of the usual dial-plate O, secured to the arbor B on the outside of the door.

It may be remarked, and it is obvious, that the controller G may act directly on the link F at the proper time by a proper construction of these parts. Modifications to this end will readily suggest themselves to any skilled mechanic. In such case lever N would be dispensed with.

The studs h of the permuter should always be arranged in a somewhat scattering manner, so that no two or more of the studs may simultaneously stand on the line swept over by the pin g^2 of the controller.

A second form of my invention is illustrated on Sheet 3, where Fig. 7 is a rear elevation of the lock with the rear plate of the lock-case removed. Fig. 8 is a sectional plan of the lock, showing it attached to the door of a safe.

Parts of this form of lock identical with parts of the lock illustrated on Sheets 1 and 2 are indicated by the same letters of reference.

This lock, in general construction and operation, is quite similar to the lock heretofore described. It differs therefrom in forming the ratchet-teeth on the device for lifting the controller instead of on the controller, and in modifying the operation of the lifting device to adapt it to the new condition of things. The controller G now terminates at its free end in a bit, G^2, adapted to engage any one of a series of ratchet-teeth, p, on the lifter P. This lifter is hung at its lower end on a pin on the arm I^2 of shaft I, which is operated by the driv-

ing-pin *k* of the reversible transmitter K on driver D through arm I^5, controlled by trigger I^6, the same as in the first form of my invention described. The lifter is guided by studs *p' p'*, fixed on bracket I^4, and engaging slots p^2 p^2 in the lifter. The lower ends of these slots p^2 are about vertical, while their upper ends are a little oblique, sufficiently so to force the lifter, on falling to its lowermost or normal position, laterally away from the bit of the controller and disengage the same.

The upper end of the lifter may be connected to the bracket by a link, P'; and for the lateral motion of the lifter provision is made by slots p^3 in it where it is connected to the arm I^2 and link P', as shown.

The lower end of the link terminates in a toe, p^4, for supporting the bit of the controller in its normal or lowermost position and imparting to it the first lift. At its highest elevation the bit of the controller is on top of the lifter, so that it can move endwise over the same.

The principal advantage of this form of the invention over the form first described consists in the greater possible sweep of the controller in a given lock-case, and the consequent increased number of elements or steps of the combination that may be utilized. This will be apparent on considering that in the first form of lock the controller can only sweep over about one-half of the face of the permuter, while in this modified form the controller may sweep over the entire face of the permuter, the respective sizes of the permuter and the lock-case being the same in both forms of lock.

A third form of my invention is illustrated on Sheet 4, where Fig. 9 is a sectional rear elevation. Fig. 10 is a sectional plan, showing the lock attached to a safe-door. Figs. 11 to 14 are detail views of detached parts.

In the illustrations on this Sheet 4 parts of the lock identical with parts of the first form of lock (shown on Sheets 1 and 2) are also indicated by the same letters of reference.

Instead of a pawl and associated devices for moving the controller stepwise, a cam-disk, Q, is used in this form of lock for that purpose. This cam-disk is mounted to turn loosely on the arbor B on one side of the driver D, while the permuter H turns loosely on a hub-bearing of arbor B on the other side of the driver. The permuter and cam-disk are of about equal diameter, and are respectively combined with friction-pawls (not shown) or other appropriate devices in such manner that each can turn in one direction only—one to the right and the other to the left. The pin *k* of the reversible transmitter K is adapted to drive the cam-disk by acting on a pin, *q*, thereon, while the pin *k'* acts on a pin, *h'*, of the permuter, as heretofore.

The driver has, preferably, the three-winged form shown, one wing extending past the peripheries of the cam-disk and permuter, and terminating in a cross-bar, D'.

The controller consists of two bars, R and R', rigidly connected together and pivoted to the upper inner corner of the bolt E, and acted upon by a spring, R^2, antagonistically to any force applied to lift the controller.

On the face averted from the driver the cam-disk is provided with a series of semi-circular cam-grades, Q', which cover about one-half of its face. The bar R' of the controller lies close to these cam-grades, and has a pin, *r'*, engaged thereby. The bar R of the controller has a pin to rest on any one of the studs *h* of the permuter when brought into proper relative positions.

When the cam-disk is turned by the driver one of the cam-grades Q' will engage pin *r'* and lift the controller to the extent of the throw of such cam-grade. To lift the controller higher it is necessary to stop the motion of the cam-disk at the point where the acting cam-grade has lifted the controller as far as it is able, and to reverse the driver, so as to turn the permuter, to the end of setting one of its studs *h* under the pin *r* of the bar R of the controller. That having been done, the cam-disk may be turned again, when the next cam-grade will pick up pin *r'* of the controller and give it another lift. The outermost cam-grade will lift the controller so high that its pins *r* and *r'* will be brought in the circuit of the driver's cross-bar D', which, by pushing against said pins, will draw upon the controller and retract the bolt of the lock.

On reversing the motion of the driver its back edge will strike a fixed knee, E^2, of the bolt and again shoot the same.

In order to prevent the retraction of the bolt, unless the controller has first been brought to proper position, a dog, S, is fixed on the lock-case in line with a rib, R^3, on the bar R' of the controller. At a point, *s*, a notch or gateway is formed in the dog, through which the rib R^3 of the controller can slide endwise when brought in line therewith, which occurs only when the controller has been lifted to its highest point by the outermost cam-grade of the cam-disk Q. In all other possible positions of the controller its rib R^3 is opposite to the solid edge of dog S, which thus prevents endwise inward movement of the controller and retraction of the bolt until the combination has been worked out first.

This form of lock possesses advantages over the previously-described forms by reason of its greater simplicity of construction. Another important advantage is, that in locking no special combination requires to be worked out, as a few turns of the arbor alternately in opposite directions is sure to complete the lock-up.

While it will be found most convenient to so form the driver that it can both shoot and retract the bolt, yet that is not essential, as a separate device may be provided to perform said functions; but the relations of the driver and the device for operating the bolt must

be such always that the two will constitute, practically, a single device in every case.

I have described several forms of my invention, to show that the general features thereof may vary greatly so far as embodiment is concerned. I could easily multiply modifications of this kind, but deem the foregoing sufficient for the purpose.

What I claim as my invention, and desire to secure by Letters Patent, is—

The combination, substantially as before set forth, of the bolt, the self-replacing controller, the permuter, and the driver adapted to alternately move the controller and the permuter, as well as to shoot and retract the bolt.

In testimony that I claim the foregoing I have hereunto set my hand this 28th day of April, 1879.

MILTON A. DALTON.

Witnesses:
W. T. LOGAN,
R. N. BULLA.