2 Sheets--Sheet 1.

D. K. MILLER.

Permutation-Lock.

No. 167,008. Patented Aug. 24, 1875.

FIG. 1.

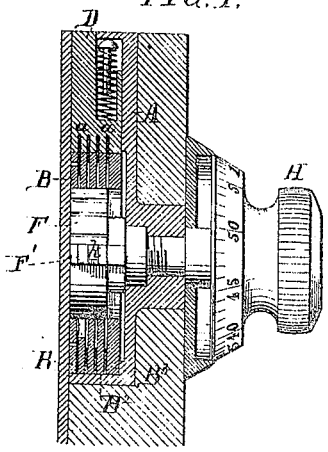


FIG. 2.

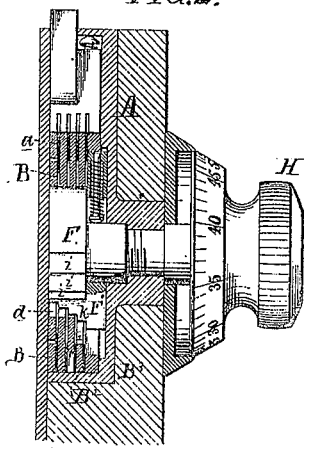


FIG. 3.

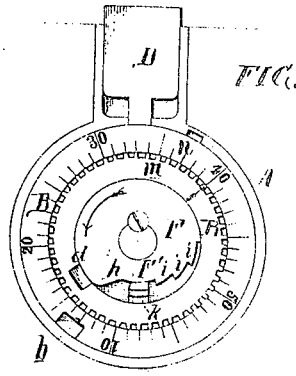


FIG. 12.

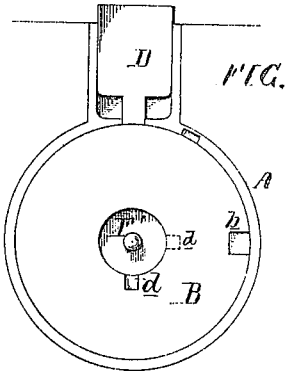


FIG. 10.

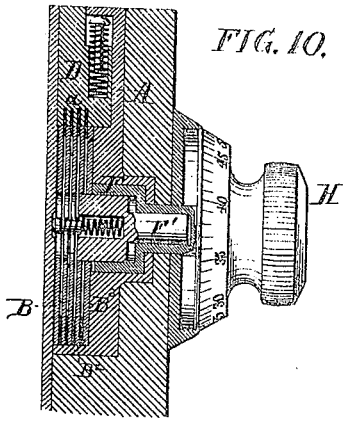
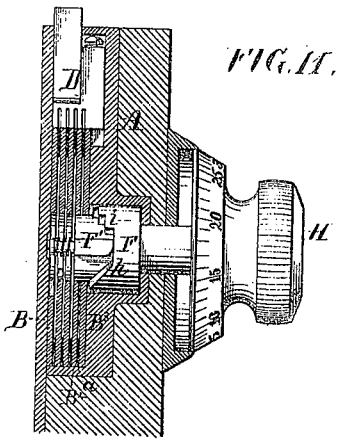


FIG. 11.



Witnesses, Thomas McElvain
Harry Smith

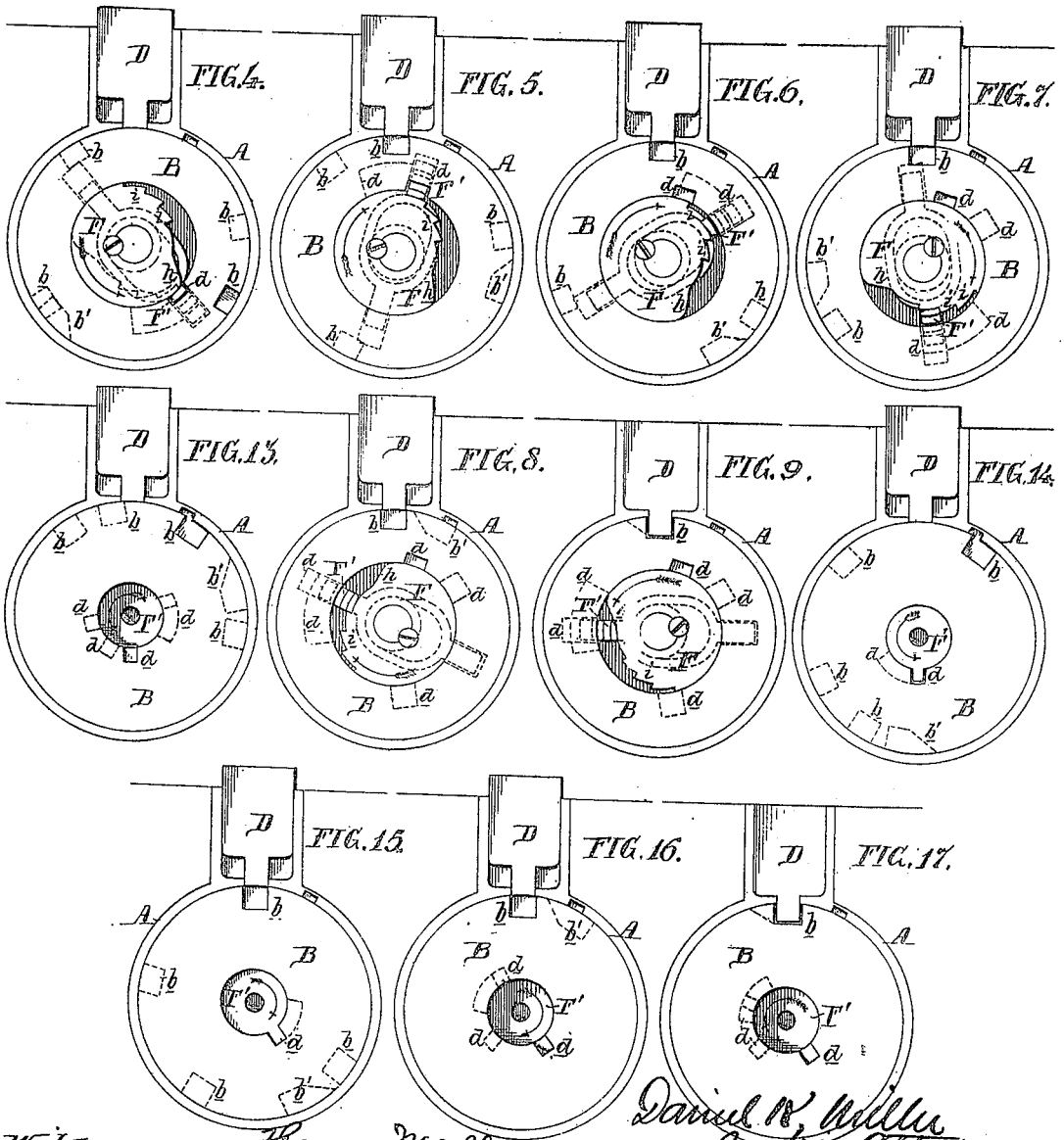
Daniel K. Miller
by his Attys.
Howson and Sons.

2 Sheets--Sheet 2.

D. K. MILLER.

Permutation-Lock.

No. 167,008. Patented Aug. 24, 1875.



Witnesses,
Thomas McElroy
Daniel Smith

Daniel K. Miller
by his attys.
Howson and Sons.

UNITED STATES PATENT OFFICE.

DANIEL K. MILLER, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN PERMUTATION-LOCKS.

Specification forming part of Letters Patent No. **167,008**, dated August 24, 1875; application filed May 15, 1874.

To all whom it may concern:

Be it known that I, DANIEL K. MILLER, of Philadelphia, Pennsylvania, have invented certain Improvements in Permutation-Locks, of which the following is a specification:

The objects of my invention are to simplify the construction and to increase the difficulty of picking permutation-locks, to facilitate the operation of the disks or tumblers, and to permit any desired number of the latter to be used without unduly complicating the movements of the graduated knob which actuates the driver.

I attain these objects, mainly, by making each disk or tumbler entirely independent of the rest of the series, and by placing each directly under the control of a carrier, caused to automatically advance toward, and recede from, said tumblers on the rotation, or partial rotation, of the lock-spindle, as fully described hereafter.

The main features of my invention may be variously modified, and I have shown in the accompanying drawing two locks, in which the said features are embodied, the first, which I will now proceed to describe, being illustrated by the sectional views, Figures 1 and 2, and face views, Fig. 3 to 9, inclusive.

A is the casing of the lock, recessed for the reception of the permutation disks or tumblers B, of which five are used in the present instance, the said disks, instead of turning upon a central hub, being fitted snugly into, and turning within, the trued interior of the casing. Contact of the disks, one with another, is prevented by stationary distance-pieces *a*, and each of the said disks has upon its periphery a notch, *b*, the whole of which, when brought in line beneath a bolt, D, permit the latter to spring back into the case. The lock-spindle, and driver F attached thereto, extend through central openings in the whole of the disks, and the said spindle is secured to, and is arranged to be turned by, a graduated knob, H, of the character commonly used in permutation-locks. The annular tumblers have notches *d* on their inner edges for the reception of a spring carrier or dog, F′, which is used in connection with the driver F. This carrier or dog extends across and slides in a direction at right angles to the axis of the driver F, with which it is maintained in contact by a spring, as best observed in Figs. 2 and 4. The driver F is recessed upon one edge, so as to form an inclined shoulder, *h*, and four abrupt shoulders or steps, *i*, one less than the total number of tumblers, and the dog F′ has also a series of steps or shoulders, *k*, one opposite each tumbler, and is so arranged that, when adjusted outward to its full extent, it shall enter the notches *d* of the whole number of tumblers, while, when permitted to spring inward, it shall release one or more of the said tumblers, beginning with the outermost tumbler B.

In operating the lock to withdraw the bolt, the driver F is first turned in the direction of the arrow, Fig. 3, until the dog F′ has been pushed outward to its full extent by the shoulder *h*, and has entered the notches *d* of all the tumblers, as shown in Fig. 4, and the movement of the driver is continued in the same direction until the dog F′ drops onto its first shoulder *i*, as shown in Fig. 5, when the movement is reversed, and the driver, dog, and whole of the tumblers will be turned in the direction of the arrow until the notch *b* of the first tumbler B has been brought opposite the bolt, which is determined by a number on the knob or case. The movement of the driver is then reversed until the dog drops onto its second shoulder or step *i*, which will release the first tumbler B, as shown in Fig. 6, and the movement of the driver is then continued in the same direction as before, in order to set the second tumbler, and so on through the series, as indicated by the diagrams, Figs. 7 and 8, the spring-bolt dropping into the notches *b* of the tumblers when all of the latter have been brought into line, as shown in Fig. 9.

To shoot the bolt outward, it is only necessary to turn the tumbler B^3 in a direction the reverse of that indicated by the arrow in Fig. 9, when the inclined or beveled edge of its notch *b′* will act upon and push out the bolt, and by continuing the movement of the driver all the tumblers will be thrown out of line with the bolt.

The inclined or beveled shoulder *h* of the driver serves to force the dog outward and into the notches *d* of the tumblers, when the said driver is turned in the direction of the

arrow, Fig. 3, and when the notches *a* are thus brought in line it is a certain indication that the notches *b* for the bolt are out of line.

It will be noted as an essential feature of the above-described lock that the tumblers are entirely independent of each other, and that each is acted on directly by a dog, which is automatically adjusted, in such a manner as to pick up and drop the said tumblers by the simple rotation or partial rotation of the lock-spindle. The lock, consequently, is much less complicated than those of ordinary construction, and a much less extended movement of the driver is required to operate the tumblers, so that the number of the latter can be increased without unduly complicating the movement of the graduated knob.

It will also be noted as an essential feature of the lock, and one in which it differs materially from those of ordinary construction, that the tumblers are set by a nearly continuous movement of the driver in one direction, and that the graduated knob and lock-spindle have simply to be rotated, or partially rotated, to the extent demanded by the combination, without being drawn in or out.

In the lock illustrated in Figs. 10, 11, and 12, a carrier or dog, F′, is used, but the latter, instead of being at right angles to the axis of the driver, slides in a direction parallel with the same, so that the steps *k* on the dog are unnecessary, the latter being perfectly plain, and releasing the tumblers one at a time, after setting them, by descending the steps *i* of the driver, which in this case are upon the end of the latter, and being forced outward so as to engage with all the tumblers by an inclined shoulder, *h*, also on the end of the said driver.

The diagrams, Figs. 13, 14, 15, 16, and 17, illustrate the successive movements of the several parts in operating the lock last described.

The combinations may be changed in either of the modifications described by reversing or altering the relative arrangement of the tumblers, as in ordinary permutation-locks, or each tumbler may consist of two annular-toothed sections, *m* and *n*, fitted together, and rendered adjustable, one upon the other, as shown in Fig. 3, in order to change the relative positions of the internal and external notches *a* and *b*, which will correspondingly effect the combination. I make no claim to this feature, however.

In permutation-locks, as heretofore constructed, it has been possible to open the lock by two entirely different combinations of numbers, one combination to be used when the driver and tumblers are turned in one direction for the first number, and the other combination when the said driver and tumblers are turned in the opposite direction for the first number. This renders the lock much easier to pick than if it could be opened by one combination of numbers only, an objection which I overcome by so constructing the parts that the driver can be turned in such a manner as to set or bring the notches of the tumblers opposite the bolt by a movement of the spindle in one direction only. For instance, when the spindle is turned in the direction of the arrow, Fig. 3, the carrier F′ will simply be moved in and out by the steps *i* and incline *h;* but when the said spindle is turned in the opposite direction, the carrier must also be turned, and must carry with it one or more of the tumblers, and set or bring the notches *b* opposite the bolt.

It will be evident that this same result can be attained without using the incline and steps. A pawl-and-ratchet connection between the spindle and carrier may, for instance, be used in some cases.

The usual plan of picking ordinary permutation-locks is to first set the whole of the tumblers on some imaginary combination, and to then reverse the movement of the carrier and readjust the first tumbler, nearest to the latter, step by step, without disturbing the remaining tumblers of the series until, by some internal clicking or other slight indication, the operator ascertains that he has brought the notch of the first tumbler opposite the bolt. He then proceeds to manipulate the second tumbler in the same manner without disturbing any of the others, and so on through the series until the true combination has been discovered. This experimental manipulation is rendered possible from the fact that any tumbler of the series can be turned by the carrier without disturbing those which are more remote from the latter.

In my improved lock this is rendered impossible by so constructing the carrier and its appliances that the whole of the outermost tumblers must be disarranged before an intermediate tumbler can be readjusted after having been once set. For instance, if it be desired to readjust the tumbler B^2 (Figs. 3, 4, and 5) after the remaining tumblers B, more remote from the carrier, have been set, the dog F′ must be pushed outward by the incline *h* until the whole of the tumblers have been disarranged before the said dog can be brought to a proper position for operating the said tumbler B^2.

Precisely the same feature is embodied in the modified form of lock illustrated in Figs. 10 and 11, it being only essential to the carrying out of this feature that the dog shall be so constructed as to be incapable of independent action on any single tumbler of the series after the whole have been set in respect to the bolt, without disarranging those tumblers which are more remote from the dog than the one which it is desired to readjust.

I claim as my invention—

1. The combination, in a lock, of a driver forming part of or attached to a rotary spindle, a series of tumblers turning independently of each other, and an automatic carrier, which, upon the spindle being turned in one direction, is carried with the spindle and carries one or more tumblers; but when the spindle is turned in the opposite direction, is caused to recede successively from the tum-

blers without turning with the spindle, as set forth.

2. The combination, in a permutation-lock, of a driver atached to or forming part of the spindle and having only a rotary movement, a bolt, an automatic carrier, operated by the driver on the spindle, and a series of independent tumblers, whereby the said tumblers are turned and adjusted in respect to the bolt by a rotary movement of the driver in one direction, for the purpose specified.

3. The combination, in a permutation-lock, of a carrier, a bolt, and a series of rotating tumblers, whereby the tumblers most remote from the carrier after the whole series have been once set by the latter, must be again turned by the carrier before a separate readjustment of any intermediate tumbler, in respect to the bolt, can be effected, for the purpose specified.

4. A permutation-lock in which are combined a driver, F, having a beveled shoulder, *h*, and shoulders or steps *i*, a series of notched tumblers, B, and a carrier or dog, F′, operated by the said driver F and adapted to the notches of the tumblers, all substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

D. K. MILLER.

Witnesses:
WM. A. STEEL,
HARRY SMITH.