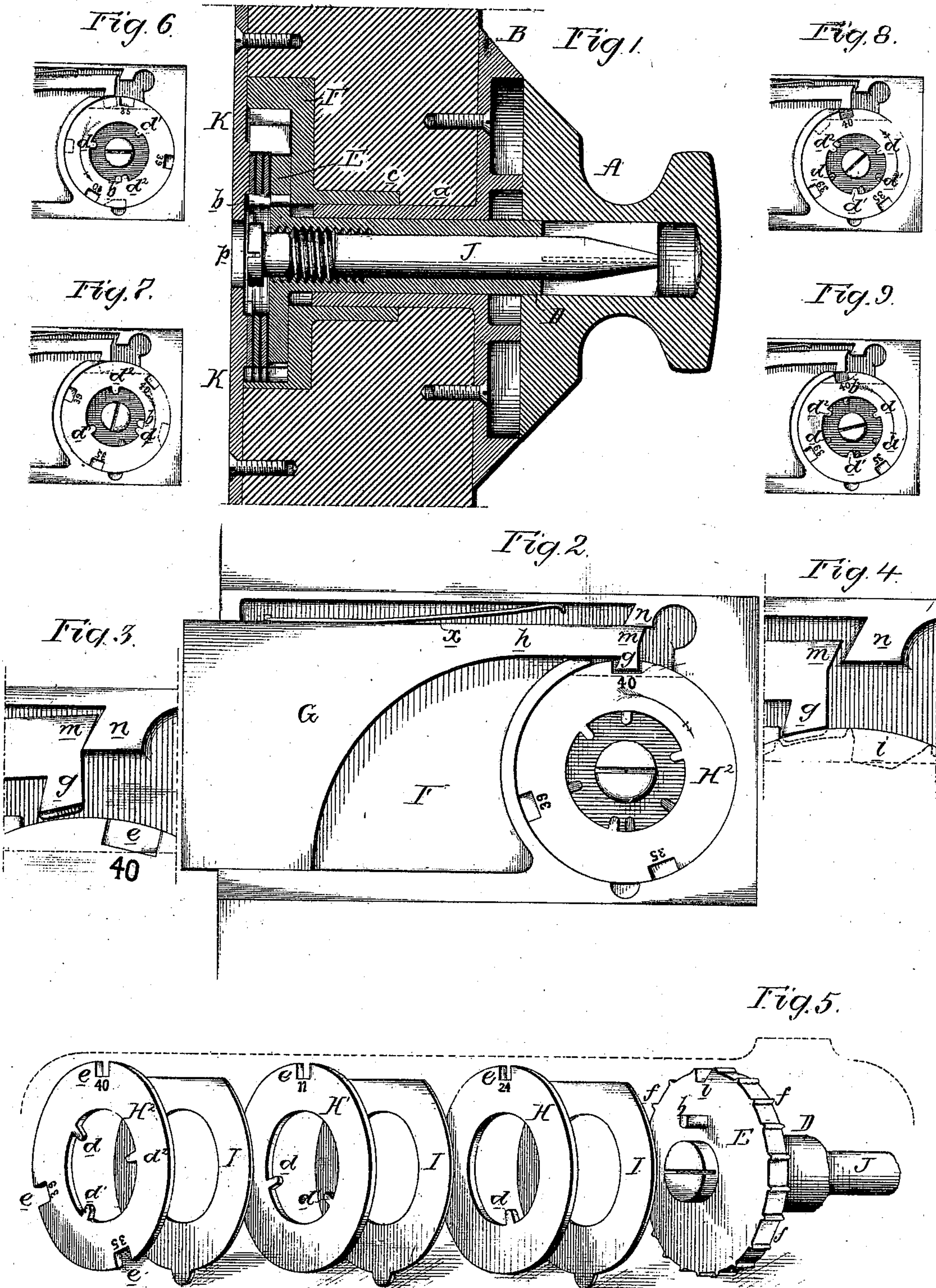


D. K. MILLER.
COMBINATION-LOCK.

No. 176,876.

Patented May 2, 1876.



Witnesses, } John Cleemer.
Harry Smith. Daniel K. Miller.
By his Attorneys
H. W. and Son.

UNITED STATES PATENT OFFICE.

DANIEL K. MILLER, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN COMBINATION-LOCKS.

Specification forming part of Letters Patent No. 176,876, dated May 2, 1876; application filed November 13, 1875.

To all whom it may concern:

Be it known that I, DANIEL K. MILLER, of Philadelphia, Pennsylvania, have invented an Improved Permutation-Lock, of which the following is a specification:

The object of my invention is to construct a simple, cheap, and secure permutation-lock, and this object I attain in the manner which I will now proceed to describe, reference being had to the accompanying drawing, in which—

Figure 1 is a vertical section of my improved permutation-lock; Fig. 2, a rear view of a portion of the same with the cover-plate removed; Figs. 3 and 4, views illustrating one of the features of my invention; Fig. 5, a perspective view of the driver, tumblers, and washers detached from each other; and Figs. 6 to 9, diagrams illustrating the operation of the lock. Figs. 1, 2, 3, 4, and 5 are drawn to an enlarged scale.

A is the knob, and B the dial-ring, of the lock, the latter being secured to the face of the door or other object, and having a central tube, *a*, adapted to an opening in the door. Either the dial-plate or knob, or both, are furnished on their edges with the usual lettered or numbered graduations. D is the tubular knob-spindle, projecting through the tube *a*, and furnished at its inner end with a disk, E, which is provided with a pin, *b*, and acts as a driver, in a manner described hereafter. F is the casing, which carries the working parts of the lock, this casing having an annular projection, *c*, embracing the tube *a*, and being slotted at one edge for the reception of the bolt G, and provided at the opposite end with a recess for the reception of the driver E and a series of annular tumblers, H, H¹, and H², which depend for their lateral position solely on the said recess. Annular washers I are interposed between the tumblers, and between the first tumbler and the driver, for the purpose of isolating the said tumblers, and preventing the movement of one from being communicated to the others, the washers being prevented from turning by means of a lug adapted to an opening in the casing F, and being cut away at the top, so as not to interfere with the operation of the bolt G. Each of the tumblers has on its inner edge one or more lugs, the first tum-

bler, H, having in this instance a single lug, *d*, the second two lugs, *d* *d*¹, and the third three lugs, *d*, *d*¹, and *d*², and in the outer edges of each of the tumblers are formed one or more notches, *e*. In the present instance the tumblers H and H¹ have each one notch, while the tumbler H² has three.

The notches in the outer edges of the tumblers are so arranged, in respect to the lugs and recesses on the inner edges, that none but the proper notches can be brought into line at the top. Thus, supposing the proper notches of the tumblers H and H¹ to be in line, the attempt to bring up any but the proper notch of the tumbler H² will cause the pin of the driver to strike a lug of one of the other tumblers and move the same, so as to turn its notch out of line.

I mark on the tumblers, adjacent to each notch, the number to which it corresponds on the graduated knob or dial when the zero-mark on the knob is brought in line with the driving-pin. By this plan the lock may be fitted together without referring to the dial after the insertion of each of the tumblers.

On the periphery of the disk E are arranged a number of ribs or projections, *f*, these ribs, when the disk is turned, striking the lower edge of a projection, *g*, on the end of an arm, *h*, of the bolt G, and causing a constant elevation and depression of the same. The disk E has also a deep notch, *i*, abrupt at one edge and inclined at the other, for a purpose described hereafter.

It will be observed more particularly in Figs. 3 and 4, that the inner portion of the projection *g*, which is the portion acted upon by the ribs of the disk E, is slightly longer than the front portion, and that the latter is supported by the peripheries of the tumblers, so that the projection *g* is held in such a position that while it is free to be struck and lifted by the ribs *f*, it cannot, when it falls, strike the bottoms of the false notches between the ribs. The object of this arrangement is to prevent the passage of the deep notch *i* of the disk from allowing the projection *g* to fall to a greater extent than is allowed by a false notch, and thus give an indication to any one tampering with the lock as to the position of said deep notch in the driver, while the con-

stant elevation and depression of the projection *g* also prevents the passage of the deep notches of any of the tumblers from producing such a variation in the movement of the projection as would lead to a discovery of the position of said notches. In order to prevent the projection *g* from bearing heavily on the peripheries of the tumblers, owing to pressure applied to the end of the bolt, which is another of the means employed for detecting the positions of the notches, I furnish the inner end of the arm *h* of the bolt with an inclined projection, *m*, which is so arranged in respect to an inclined projection, *n*, on the casing *F*, that, while the latter does not interfere with the free vertical movement of the inner end of the arm *h* when the bolt is in its normal position, any pressure upon the end of the bolt will first bring the two inclined surfaces into contact, and, on continuing the pressure, the inclined surface of one will so act on that of the other that the projection *g* will be lifted clear both of the tumblers and the ribs of the disk *E*, as shown in Fig. 3, thereby preventing any indication of the position of any of the notches.

The knob *A* is not secured rigidly to the spindle *D*, but is held in its place on the same by friction, as shown in Fig. 1. The end of the spindle to which the knob is connected is split for some distance, and its central opening is tapered for the reception of the tapered end of the screw-stem *J*, the threaded portion of which is adapted to an internal thread in the inner end of the spindle *D*. An opening, *p*, is made in the cover-plate *K*, immediately opposite the slotted head of the screw-stem *J*, in order that the latter may be operated without removing the cover-plate. Owing to this arrangement the combination can be changed without removing any of the parts of the lock by simply loosening the screw-stem *J*, so as to reduce the pressure of its tapered end against the split end of the spindle *D*, thereby lessening the friction and allowing the knob to be turned to any desired position, after which the stem *J* is again tightened, so as to firmly hold the knob. Another feature of this improvement is the facility with which the lock can be adapted to doors of different thicknesses, the knob *A* receiving more or less of the end of the spindle *D*, according to the thickness of the door.

I have shown in the drawing a straight recess in the knob for receiving the end of the spindle, but if desired, the recess may be larger at the back than at the front, so that when the end of the spindle has been expanded the knob can not be forced off.

In placing the working parts of the lock together, the spindle *D* is first inserted from the back into the central opening of the sleeve *a*, the disk *E* fitting into the circular recess of the plate *F*. The knob *A* is then slipped on the outer end of the spindle and secured in the desired position by screwing up the stem *J*. The washers and tumblers are then in-

serted into the circular recess of the plate *F*, care being taken that the notch bearing the number desired for the combination is in line with the pin *d* and deep notch of the driver. Should the tumblers be inserted in the position shown in Fig. 5, the combination would be 21 11 40, the number carried by the tumbler with the single lug *d* coming first, that carried by the tumbler with two lugs second, and so on throughout as many tumblers as may be employed in the series. The cover-plate is then applied and the lock is ready for operation.

The operation is as follows: The driver is first turned by the knob in the direction of the arrow, Fig. 6, until its pin *b* strikes the lug *d* of the first tumbler *H*, and turns the same until its recess is directly beneath the projection *g* of the bolt, this point being of course determined by the number on the dial. The movement of the driver is then reversed, as shown in Fig. 7, and continued until the pin *b* strikes the lug *d* of the tumbler *H*¹, which is moved until its recess coincides with that of the recess in the tumbler *H*, when the movement of the driver is again reversed, its pin now striking the lug *d*² of the tumbler *H*², and turning the same so as to bring the recess 40 in line with those of the tumblers *H* and *H*¹, as seen in Fig. 8. The driver is now turned in the direction of the arrow, Fig. 9, to a sufficient extent to bring its deep notch in line with the notches of the tumblers, when the spring *x* of the bolt will cause the projection *g* to enter the notches, so that by partially rotating the driver the bolt can be reciprocated, as shown in Fig. 2. To secure the bolt in a locked position, the driver must be turned in a direction contrary to that shown in Fig. 9, when the inclined edge of its notch *i* will force the projection *g* out of the notches of the tumblers, and on continuing this movement the positions of the tumblers will be changed and the depression of the end of the bolt prevented.

It will be evident that, in a lock of the above character, even with a limited number of tumblers, a large number of combinations can be made, the changes being effected, either by reversing or changing the position of either of the tumblers with respect to the others or the driver, or by altering the position of the knob in respect to the driving-pin.

I do not desire to claim, broadly, a driver with a series of notches on its outer edge, but I claim as my invention—

1. The combination, in a permutation-lock, of two or more tumblers, each of which consists of a single flat ring, having on its inner edge a series of lugs for the action of the pin on the driver, in connection with one or more notches in its outer edge for the entrance of the dog or bolt, so as to operate in conjunction with a like tumbler or tumblers, all substantially as set forth.

2. The combination, in a permutation-lock, of a bolt, *G*, with tumblers having deep

notches only, and a driver, having a deep notch and false notches, which, when the driver is revolved, cause a constant elevation and depression of the inner end of the bolt, all substantially as set forth.

3. The combination of the tumblers, having deep notches only, and a driver, having both a deep notch and false notches, with the projection *g* of the bolt, so constructed that it is prevented from touching the bottoms of said false notches, as set forth.

4. The combination of the lug *g* and inclined projection *m* of the bolt, with the tumblers and with the inclined lug *n* on the lock-case, as and for the purpose set forth.

5. A combination-lock, in which the tum-

blers have their notches for the entrance of the dog or bolt numbered to correspond with a number on the dial, substantially as set forth.

6. The knob *A*, carrying the dial, in combination with the tubular spindle *D* split at its outer end, and provided with a longitudinal taper screw, *J*, all substantially as set forth.

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

DANIEL K. MILLER.

Witnesses:

ELLWOOD T. DEETZ,
HARRY SMITH.