(Model.) 2 Sheets—Sheet 1.

A. W. PAULL & D. L. HEISKELL.

LOCK.

No. 327,715. Patented Oct. 6, 1885.

Fig. 1

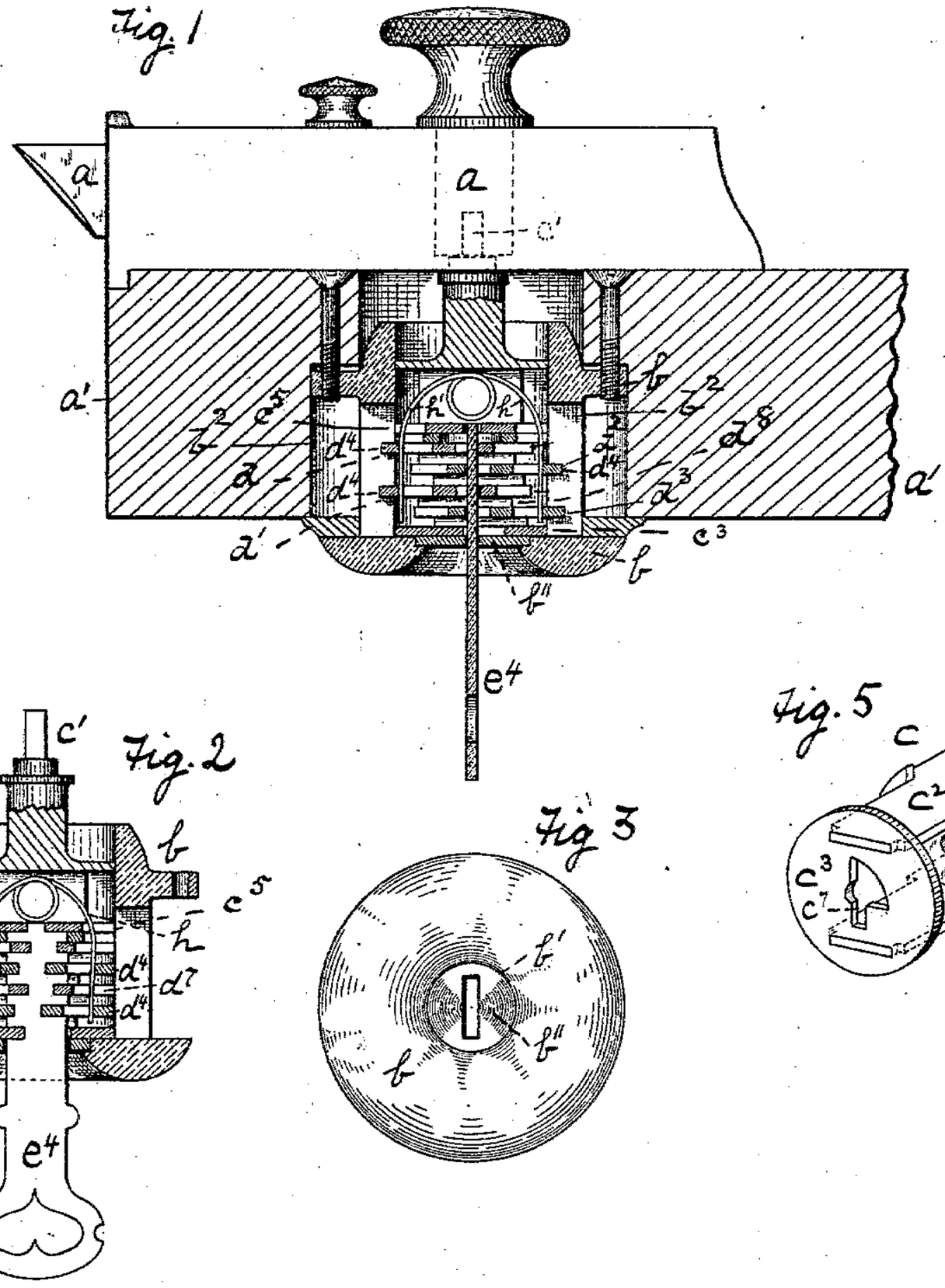


Fig. 4

Fig. 2

Fig. 3

Fig. 5

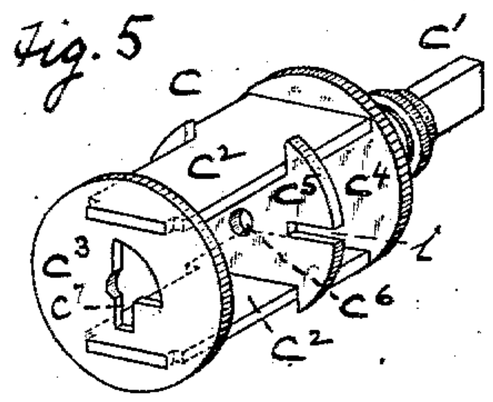


Fig. 6

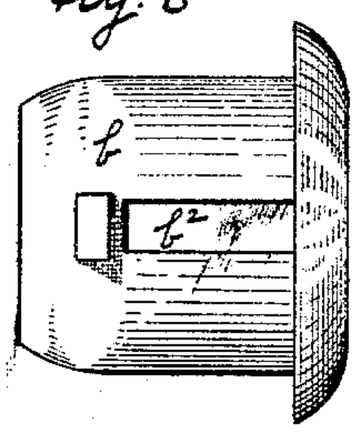


Fig. 7

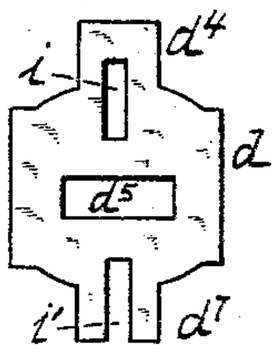


Fig. 8

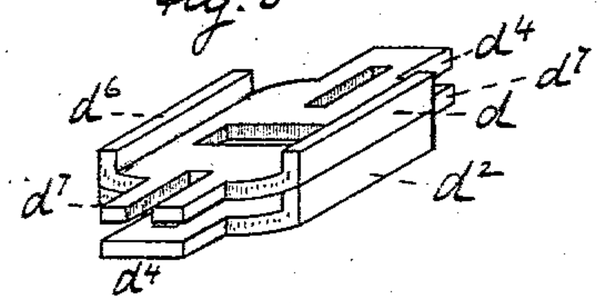
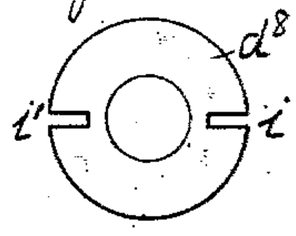


Fig. 9



Witnesses.
J. A. Burns,
J. K. Smith

Inventors.
Archibald W. Paull
Daniel L. Heiskell
by Bakewell & Kerr
their Attorneys

(Model.) 2 Sheets—Sheet 2

A. W. PAULL & D. L. HEISKELL.

LOCK.

No. 327,715. Patented Oct. 6, 1885.

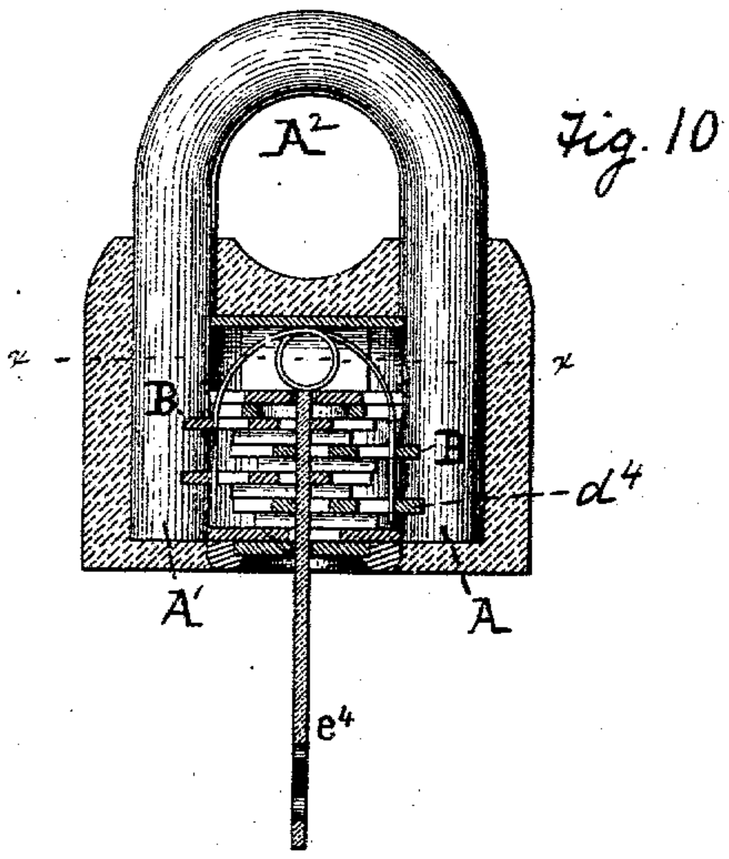


Fig. 10

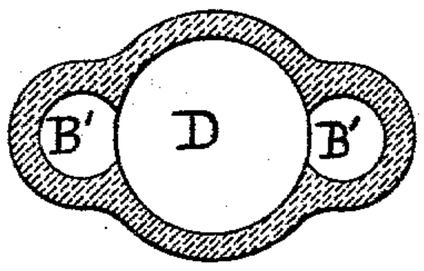


Fig. 11

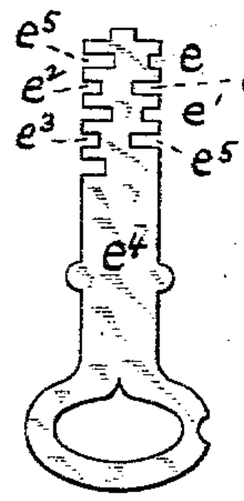


Fig. 12

Witnesses.
J. A. Burns.
J. K. Smith

Inventors
Archibald W. Paull
Daniel L. Heiskell
by Bakewell & Kerr
their attorneys

UNITED STATES PATENT OFFICE.

ARCHIBALD W. PAULL AND DANIEL L. HEISKELL, OF WHEELING, WEST VIRGINIA; SAID HEISKELL ASSIGNOR TO JAMES PAULL, OF WELLSBURG, WEST VIRGINIA.

LOCK.

SPECIFICATION forming part of Letters Patent No. 327,715, dated October 6, 1885.

Application filed January 22, 1885. Serial No. 153,603. (Model.)

To all whom it may concern:

Be it known that we, ARCHIBALD W. PAULL and DANIEL L. HEISKELL, of Wheeling, in the county of Ohio and State of West Virginia, have invented a new and useful Improvement in Locks; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of the lock fitted upon a door and in connection with a bolt, *a*, the bolt being shot and the door locked. Fig. 2 is a similar view of our improvement when unlocked. Fig. 3 is an end view of the lock. Figs. 4, 5, 6, 7, 8, and 9 are views of detached parts. Fig. 10 is a vertical sectional view of a padlock illustrating the application of our improvement to it. Fig. 11 is a horizontal cross-section on the line *x x* of Fig. 10. Fig. 12 is a plan view of the key.

Like letters of reference indicate like parts wherever they occur.

In the drawings, *b* represents a cylindrical metallic case or barrel, which is adapted to be set within a hole in the door *a'*, and to be securely riveted or otherwise fastened therein. The inner end of the barrel is open, and the outer end is closed, except a circular and central hole, *b'*, into which the key is inserted. Within the bore of the barrel *b* is a longitudinal frame, *c*, which we shall denominate the "cylinder." It is revoluble on its longitudinal axis within the case, and has a key or shank, *c'*, projecting through the open end of the case into the bolt *a*, which it operates. A number of tumblers, *d d' d² d³*, are mounted within the cylinder *c*, and are susceptible of lateral movement by action of the key e^4, so that when the door is locked they may project from the sides of the cylinder into opposite slots, *b²*, on the sides of the casing *b*. When in this position, they will hold the cylinder *c*, and will prevent it from turning within the case and from retracting the bolt *a*. In unlocking the door, however, the tumblers are, by turning the key drawn back from the slots *b²*, and placed so that their ends may rest within or flush with the periphery of the cylinder. There is then no obstacle to the revolution of the cylinder, and by turning the key still farther it revolves and acts upon the bolt *a* so as to draw it back.

We will now describe our improvement in detail. The frame of the cylinder *c* consists, preferably, of two opposite parallel plates or rods, *c²*, and on the ends thereof are disks c^3 c^4, to which the side plates are secured by passing them through transverse slots, or one or both of these disks may be cast integral with the plates. The key-shank *c'* is preferably made of one piece with the inner disk, c^4, and placed at right-angles thereto. Both the disks are of the same diameter as the bore of the case *b*, so that they may be rotated therein, yet firmly and without any lost side motion. Between the disks c^3 and c^4 is another disk, c^5, in which is a small hole, c^6, whose purpose is to act as a bearing within which the end of the key e^4 may turn.

The tumblers *d d' d² d³* of the lock are illustrated in Figs. 7 and 8, in which certain of the tumblers are shown. Each of them consists of a flat plate having a projecting tongue, d^4, and they are placed between the side pieces of the cylinder *c* so that when the cylinder is in position their tongues shall extend toward one of the slots in the case *b*. The tumblers are superposed one upon the other in the cylinder so that their tongues shall alternately point to each of the slots *b²*.

Near the middle of each of the tumblers is a transverse slot, d^5, whose length is about the width of the flat key used in turning the lock, and whose width is about one-half of that of the key. The middle of the slot should be situate a little to the side of the middle of the tumbler opposite to that on which is the tongue d^4. The reason for this is that when the tumblers are all in position, with their tongues either flush with the inside of the case *b* or projecting therethrough, there may be a continuous slot through them, and on a line with the axis of the cylinder, into which the key may be inserted through a slot in the outer disk, c^3, and so that when the tumblers are retracted the width of this continuous slot may be about one-half of that of the key, and that when they project into the sides of the case the slot may only equal in width the

thickness of the key. This will be more fully understood hereinafter. Its object is to prevent the insertion of any instrument thicker than the key into the lock, and also to make the movement of the tumblers positive.

The key is of the form shown in Fig. 12, and has on both edges notches corresponding to the situation of the tumblers, so that as the key is turned in the key-hole it may act as a cam to throw the tongues of the tumblers outward, but that as the edges of the tumblers fit into the notches the length of the throw may depend upon the length of the eccentric part of the key at that point. In the drawings there are shown four tumblers, the tongues of two of which, d d', operate toward the left-hand slot, while the others, d^2 d^3, act toward the other side.

The tumblers are for convenience sake separated from each other by interposed washers d^8, or the tumblers themselves may be provided with upturned flanges d^6, upon which the next tumbler sits, thus separating them somewhat from each other. The key e^4 is also provided with the notches e e' e^2 e^3, which correspond in situation with those of the several tumblers—*i.e.*, the notch e is made so that when the key is in the lock and is turned it may embrace the side of the slot d^5 next to the tongue d^4 of the tumbler d. It is evident that the key will then act as a cam, and will move the tumbler laterally for a distance equal to the space between the axis of the key and the end of the notch. The other notch, e', on the same side of the key, and the notches e^2 e^3 on the other side, are made in like manner and of different lengths, so that their tumblers may have unequal lateral motions. Opposite to each of these notches are other deeper notches, e^5, whose depth is such that the intermediate unent parts of the key may be a little less than the width of the key-hole made by the superposition of the slots in the tumblers. The result is that the key will only act on one side of these slots, and that as it is turned its cams will act on a different side of each of an adjacent pair of tumblers, thus causing the tongues of some of the tumblers to move to the right and others to the left. The notch e^5 fits on the side of the slot d^5, and as it (the notch e^5) is deeper than its opposite notch, e^2, the key will not act on the tumbler on that side. The notches e e' e^2 e^3 may be made of any depth desired, and the shorter they are the greater will be the throw of the cam. When the size of the notch is reduced to zero, the cam will have the greatest motion. The notch should not, of course, extend beyond the axis of the key. The key being thus made, the length of each of the tumblers is so constituted that when they are retracted by a partial turn of the key, as shown in Fig. 1, the key then having its flat side in the plane of their line of motion, they may be all flush with the surface of the cylinder c and just within the case b. The cylinder is then free to turn and to unlock the bolt a. Thus, suppose the key to turn a quarter revolution in unlocking, and the length of the several projecting tongues on the tumblers to be, respectively, one thirty-second, one-sixteenth, one-eighth, and one-quarter inch, then the corresponding cams on the key e^4 must be of the same lengths, so as to retract each tumbler the proper distance.

In order to prevent the door from being unlocked by inserting a key each of whose cams has as large a throw as the longest of the tongues d^4, we provide each of the tumblers with an opposite tongue, d^7, which is of such length that when the tongue d^4 is flush with one side of the case b, and just out of the slot therein, the other tongue may occupy the same position with relation to the opposite slot. If, then, the tumbler is given a larger motion than is just sufficient to draw back the tongue d^4 from the slot b^2, the opposite tongue, d^7, will move into its slot, and by engaging the sides thereof will effectually prevent the cylinder c from being turned.

The length of each of the cams on the key must therefore correspond exactly with the lengths of the operative parts of the tongues d^4 on the several tumblers, and the key must be turned for a certain distance in order to put the parts in readiness for opening the lock. Since the situation and number of the tumblers and size of their tongues may be varied at will it is evident that it will be impossible to pick a lock of the kind we have described when carefully made.

In order to secure the proper turn of the key in any lock, the slot c^7 in the inner fixed disk, c^5, is broadened at the top, so that when the key is turned the desired distance to retract the tumblers it may strike the side of the slot and stop. The key at this point may be suitably notched so as to pass over the lower part of the disk; or any other convenient form of stop may be provided, as desirable.

The slotted disk c^5 is covered by a loose disk, b^{11}, which is in contact therewith, and also abuts against the end of the case b, in this manner closing the circular hole therein. The disk b^{11} has a central slot of the size of the key e^4, and when the key is turned in the lock the disk will revolve freely with it.

Thus constructed the operation of the lock is as follows: The key e^4 is inserted through the slotted disk d^8 and through the several slotted tumblers and interposed washers until the point of the key rests within the hole in fixed plate c^5. The key is then given a turn to the right, (a one-fourth turn is shown in the drawings,) and in turning, the cams on one side of the key will act on the tumblers d d', moving them to the left and in from the slots b^2, while the cams on the other side thereof operate the tumblers d^2 d^3, similarly forcing them to the right, thus bringing the parts into positions shown in Fig. 2. When the limits of the proper motions are reached, the flat side of the key will strike against the side of the enlarged

slot c^7. A further turn of the key in the same direction will not cause any motion of the tumblers of the lock, but by bearing against the side of the slot c^7 will turn the cylinder c to the right within the case b, and will thus act upon and retract the bolt a. In locking, the key e^4 is turned to the left, but in order that the tumblers may follow the key and automatically relock themselves they should be provided with suitable springs, which, when the pressure of the key is released, will push the several tumblers outward into their slots b^2. We have found the form of spring shown in the drawings to be the most useful, since it consists of but one part and operates all the tumblers at once. It consists of a continuous bow-spring coiled in the middle. The coil is placed in the cylinder c between the fixed plates c^4 and c^5, and the arms h h' of the spring extend along the cylinder c and through slots i i' in the ends of the tongues d^4 d^7 of the tumblers and on opposite sides of the washers d^8 and of the plate c^5. The slots i in the tongues d^4 are closed, so that as the arms of the spring press outward they may act upon and draw the tumblers with them, while the slots i' on the other ends of the tumblers and on the sides of the other parts are open. The latter therefore simply form passages or ways within which the spring moves, and are not acted upon by it. The action of this spring will, when the key is withdrawn or turned into the position shown in Fig. 1, shoot the tumblers into the slots b^2, thereby locking the cylinder c automatically.

The manner in which the lock hereinbefore described is constructed is somewhat peculiar, and deseryes notice, since its simplicity constitutes one of the chief merits of our invention.

The tumblers d are punched all of the same size and form and slotted as shown in the drawings. They are then adjusted within the cylinder c, and the washers d^8 interposed between them. The key having been made with cams of any desired length on its side, as already described, is them inserted within the slots in the cylinder, and is turned into the position shown in Fig. 2, in this manner retracting the tumblers to their fullest extent. The projecting tongues of the tumblers are then filed or cut off until they are flush with the sides of the cylinder. The lock is then complete and is fitted to the key, for the key being then in the proper position for unlocking, and the tumblers being just within the limits of the cylinder-frame, it is clear that when the cylinder is put in the case and the key turned to the left the tumblers will enter the slots b^2 and will lock the cylinder, while if the key be turned back the tumblers will be drawn exactly out of the slots, as shown in Fig. 2.

The advantages of the lock thus made are very great. Since the lock is fitted to the key, and not the key to the lock, the varieties of locks which no key but their own will work are without limit. The variable elements are the situation and number of the tumblers, the depth of the notches on the key, and the size of the resultant cams, and the arc through which the key must be turned to properly retract the tumblers. A very minute change in any of these particulars will essentially change the lock and its key.

We have described the construction preferably employed by us in making the lock; but it will be apparent to any one skilled in the art that it is susceptible of many modifications without departing from the principle of our invention. For example, all the tumblers may be made to act only on one side of the cylinder, instead of alternately on both sides, or a greater number may act on one side than on the other. The arrangement of the cylinder c and its shape may also be varied.

Fig. 10 illustrates the application of our improvement to a padlock, D, of that form which has a U-shaped link or staple, A^2, secured to the lock by inserting its ends A A′ into two parallel holes, B′ B′, and locking them there. In this case the part which corresponds to the cylinder c, but is not revoluble, is placed within the body of the padlock, and the tumblers arranged so that they may move into and out of notches B on the legs of the link A A′. In locking they are shot into these notches, and in unlocking they are retracted, so as to be flush with the outside of the cylinder. When they are in the notches B, it is evident that they cannot be removed. A too great movement of a tumbler in unlocking causes it to leave its notch in one leg, A, but it will enter an opposite notch in the other leg, A′, so that the staple can only be released when the key is in a certain position and the tumblers are withdrawn to a central position within the frame. The cylinder is riveted or otherwise suitably secured in the body of the padlock. With proper modifications our improvement may be adapted to use in any of the usual forms of lock.

We are aware that sliding tumblers arranged within a slotted case or frame with a spring, so that the tumblers shall engage with the slot of the case in such a manner that they may be disengaged from the slots by the mere insertion of a key, are not new, and we do not desire to claim the same.

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

1. A lock having several superposed slotted tumblers mounted within a frame, whose slots form a continuous passage for the insertion of a key, by the rotation of which the said tumblers may be moved beyond the limits of said frame, or inward within the limits of the same, substantially as and for the purposes described.

2. A lock having several superposed slotted tumblers mounted within a frame, whose slots form a continuous passage for the insertion of

a key, by the rotation of which the said tumblers may be moved beyond the limits of said frame, or inward within the limits of the same, said tumblers being of a length substantially equal to the diameter of the frame, so that a too great inward movement of the tumblers will cause them to project from the opposite side of the frame, substantially as and for the purposes described.

3. The combination, in a lock, of a rotatory cylinder or frame mounted within an outer recessed case, and several superposed slotted sliding tumblers arranged in said cylinder so that their slots will form a continuous passage for the insertion of a key, said key having cams of unequal radii, which in turning the key engage said tumblers and move them out of and into said recesses, the projecting portions of each of said tumblers being of a length proportioned to the throw of the proper cam on the key, substantially as and for the purposes described.

In testimony whereof we have hereunto set our hands this 26th day of November, A. D. 1884.

ARCHIBALD W. PAULL.
DANIEL L. HEISKELL.

Witnesses:
P. B. DOBBINS,
ALFD. PAULL.