H. ISHAM.

PERMUTATION LOCK

No. 15,239. Patented July 1, 1856.

Fig. 2. A, a.

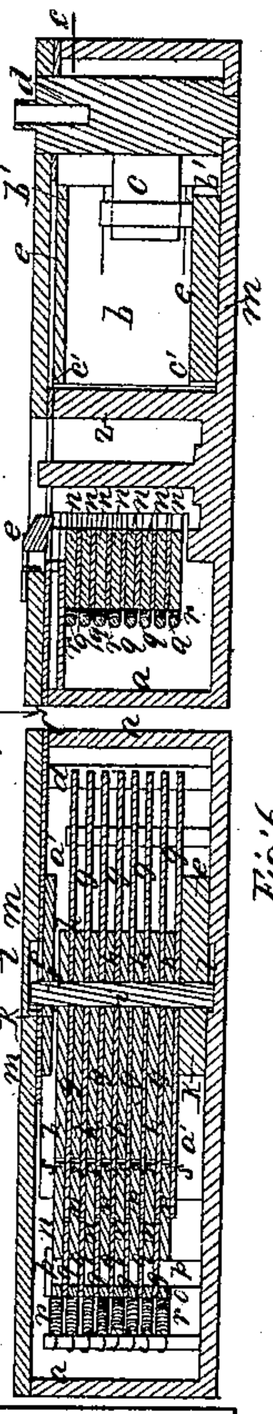


Fig. 3. B, b.

Fig. 5.

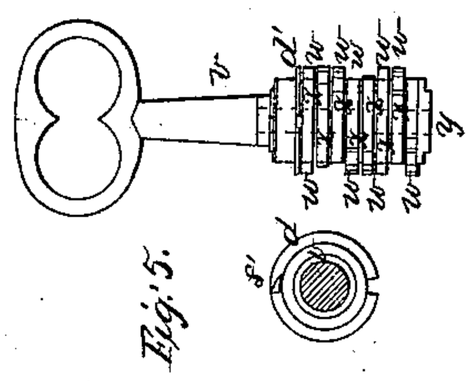


Fig. 6.

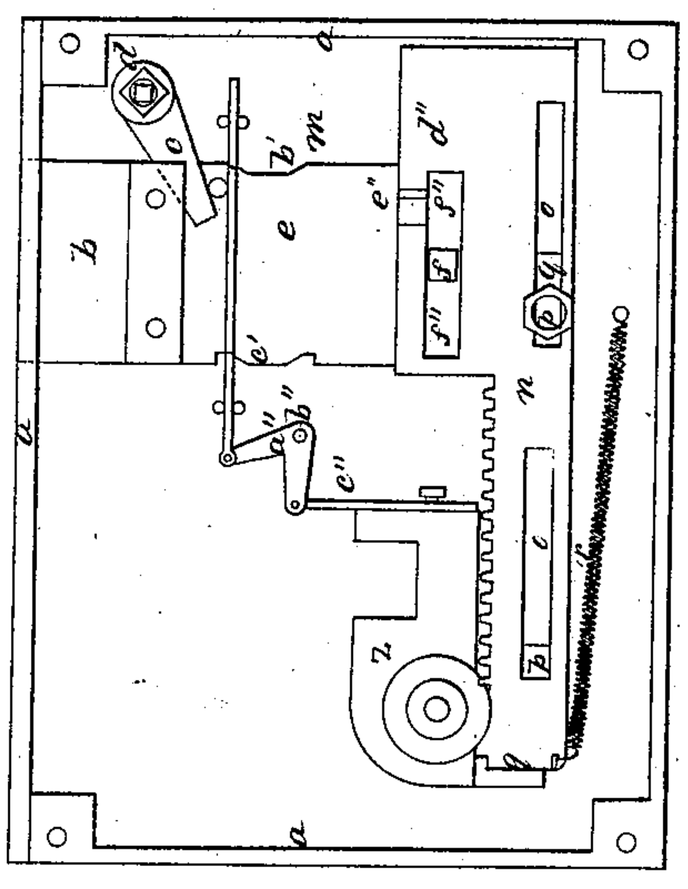


Fig. 1.

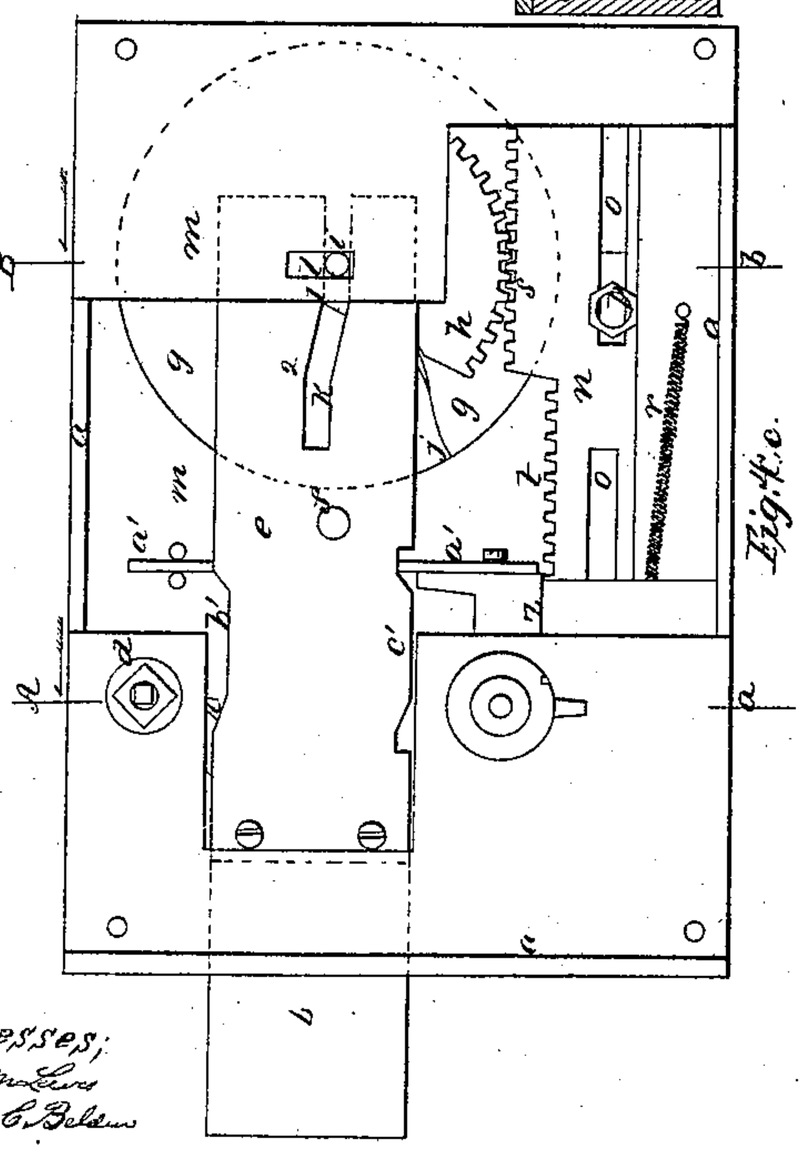
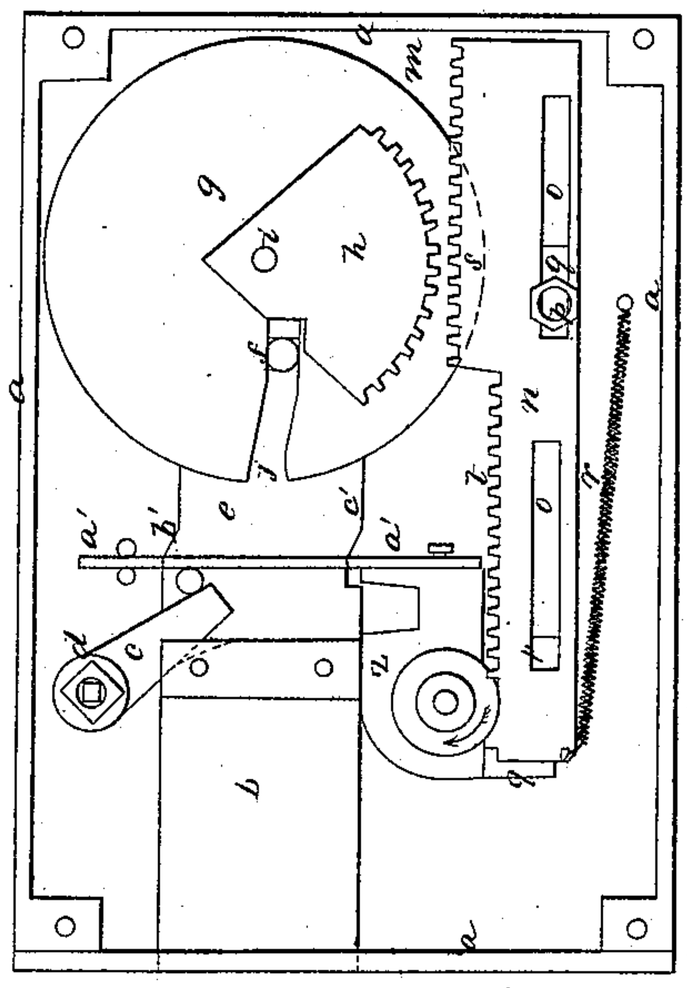


Fig. 4. C.



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HENRY ISHAM, OF NEW BRITAIN, CONNECTICUT.

LOCK.

Specification of Letters Patent No. 15,239, dated July 1, 1856.

To all whom it may concern:

Be it known that I, HENRY ISHAM, of New Britain, in the State of Connecticut, have invented certain new and useful Improvements in Combination or Permutation Locks for Doors, Safes, &c., of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which:—

Figure 1, is a face view of the lock with the cap plate removed, and with the bolt thrown out. Figs. 2 and 3, cross sections taken at the lines A, *a*, and B, *b*, of Fig. 1, and looking in the direction of the arrow. Fig. 4, a section parallel with the face and taken at the line C, *c*, of Fig. 2, with the bolt thrown in. Fig. 5, a separate view of the key. Fig. 6, is a face view of a lock representing a modification of parts of my said invention.

The same letters indicate like parts in all the corresponding views of the said drawings.

In the accompanying drawings *a* represents the case of the lock, which may be of any suitable form and construction, and *b*, the bolt which works in a mortise in the front face of the case, in the usual manner, and between suitable guides that it may move in a straight line when thrown in or out by the lever *c*, on the knob shaft *d* in the usual or any suitable manner. The rear part of the bolt has two parallel cheeks *e*, *e*, which may be formed by attaching two plates to the solid part of the bolt, or by cutting out of the solid metal to form an open space that the rotating tumblers, to be presently described, may be embraced between the two cheeks *e*, *e*, and admit of the working of the bolt as it is thrown in and out. A pin *f* is secured to the two cheeks and extends across from the one to the other, and so located, relatively to the rotating tumblers, that the bolt cannot be thrown back except when the tumblers are in the required position.

The rotating tumblers *y* are composed each of a circular metallic disk, and to one face of each is secured a cogged sector *h*. The whole series of tumblers are mounted on a central shaft *i* on which each one, with its cogged sector, turns freely and independently of the others. And in each tumbler a slot *j* is cut extending from the periphery to within a short distance of the shaft, and this slot must be of a width which will admit the pin *f* to slide in it freely but accurately. The form of this slot, in the direction of its length, is peculiar and will be presently described.

The ends of the shaft *i* of the series of tumblers pass through slots *k* one in each cheek *e* of the bolt, so that the bolt may slide longitudinally on the shaft as it is thrown in and out without moving the tumblers longitudinally. And to prevent the throw of the bolt from moving the tumblers longitudinally the ends of the shaft *i* are fitted to slot *l*, *l*, in two plates *m*, *m*, one on each side of the bolt cheeks and secured to or making part of the lock case; and these slots are at right angles to the line of motion of the bolt. The slots *k k* in the cheeks of the bolt are for a short distance at each end straight and in the direction of the line of motion of the bolt so as not to move the tumblers; but the middle portion from the point 1 to 2 is oblique for the purpose of moving the series of tumblers down as the bolt is thrown out, and to lift them up as the bolt is thrown in. This arrangement is for the purpose of engaging the cogged sectors on the rotating tumblers with a series of sliding cogged racks operated by the key, and to disengage them therefrom. As the slots in the cheeks are partly oblique for the purpose of moving the series of tumblers up and down by the throw of the bolt it follows as a necessity that there must be a corresponding obliquity in the slots of the tumblers in which the pin *f* of the bolt slides, that the said pin may slide therein without turning the tumblers as they are carried up or down to disengage or engage the sector racks.

Below the bolt and series of rotating tumblers, there is a series of slides *n*, corresponding in number with the sector racks on the tumblers. They are slotted as at *o*, to slide longitudinally on two pins *p*, *p*, attached to the lock case. They are kept at the required distance apart to correspond with the sectors by interposed plates *q*, and they are drawn back in the position represented in Fig. 4, by a series of helical springs *r*. The upper edge is provided with cogs to form two cogged racks, one *s*, toward the rear end to engage the cogged sectors on the tumblers, and the other *t*, to be engaged by the cogs of sector pinions on the key.

The stem *u* of the key *v*, is cylindrical and

feathered, and to this stem are fitted a series of sector pinions *w*, corresponding in number with the number of tumblers, and with the cogs adapted to fit the cogs of the racks *t* of the slides, there being washers *x*, interposed between the sector pinions that they may correspond with the series of slides.

The pinions and interposed washers are secured on the stem by a screw nut *y*, tapped on the end of the stem, so that by unscrewing the nut the sector pinions may be shifted to change the combination or permutation. The sector of cogs are of equal length on each pinion, but each sector begins at a different point on the periphery relative to the feather.

The key hole is a hollow cylinder made in a solid block of metal *z*, forming part of the back case, and of such diameter as to receive the series of sector pinions which constitute the bit of the key. The lower part of this block of metal is slotted longitudinally that the racks *t* of the slides *n* may slide therein and have the cogs project sufficiently within the cylindrical key hole to be acted upon by the sector pinion bits of the key.

There is a plate *a'*, termed the stop or holdfast, placed at right angles to the bolt and adapted to slide in suitable ways. This plate is made to embrace the cheeks of the bolt, and the lower edge of the said plate is made of a shape to enter between the cogs of the racks *t* of the slides. The upper edge of the cheeks of the bolt are cut down as at *b'* to form an inclined plane at each end of the depression and a straight plane connecting the two inclined planes, and the lower edge of the cheeks at *c'* are made parallel with the upper edge, so that at the beginning of the operation of throwing the bolt either in or out the stop or holdfast plate is depressed and its lower edge made to enter between the cogs of the slides *n* to hold them fast until toward the end of the motion of the bolt, when it is again lifted to liberate the slides.

By inspection of the key it will be seen that the series of sector pinions are so arranged on the stem that the non-cogged sectors are all on the same side of the axis, although the beginning of the range of cogs of no two of them are in the same line; there is however a noncogged space extending through the whole length of the stem sufficient in width to admit of inserting and withdrawing the key, notwithstanding the cogs of the series of slides project within the key hole. Supposing the bolt to be thrown back, or in the unlocked condition as represented by full lines in Fig. 4, and the series of rotating tumblers to be lifted up so that their cogged sectors are clear of the racks on the slides *n*, with the pin *f* of the bolt inserted in the slots of the rotating tumblers so that they cannot turn, and in that condition the key is inserted and turned in the direction indicated by the arrow, to the extent of half a revolution and there held. Now it will be observed that if the sectors of cogs on the pinions of the key commenced in the same line the semi-revolution of the key would have carried all the cogged slides *n* the same distance, and if the series of tumblers were then let down their cogged sectors would all become engaged with the racks *s* of the slides all in the same position, and to open the lock it would only be necessary to insert a pick to draw all the slides to the same distance to bring the slots of the series of tumblers in the required position to permit the bolt to move back, which could be readily done. But as the sectors of cogs on the key begin at different points the semi-revolution of the key carries the rack slides each to a different distance. Each slide having been thus moved to a different distance by the semi-revolution of the key, the bolt is then thrown out by the turning of the knob. The first outward movement of the bolt depresses the stop or holdfast plate *a'*, the lower edge of which enters between the cogs *t* of the rack slides and secures them. The continued outward motion of the bolt by the form of the slots *k* in the cheeks *e* depresses the series of rotating tumblers and causes the cogs of the sectors *h* on the tumblers to engage the racks *s* on the slides, while the pin *f* of the bolt is still in the slots of the tumblers. In this way the rotating tumblers while their slots are all in line become locked or engaged with the slides which are out of line, that is after each has been carried to a different distance due to the position of the series of sector pinions on the key. In this way the peculiar arrangement of the key is transferred to the tumblers in the act of throwing out the bolt so that the combination or permutation, however it may be varied, will be thus transferred to the tumblers by the act of throwing out the bolt to lock the door. The further outward motion of the bolt carries the pin *f* out of the slots of the tumblers to liberate them and leave them entirely to the control of the rack slides, and at the same time the stop or holdfast plate is drawn out of the cogs of the slides so as to liberate and leave them to the control of the key. The revolution of the key is then completed which in succession liberates the several slides which are drawn back to their original position by the tension of the springs *r*.

As the slides had been moved to different distances by the key at the time the tumblers became connected with them, and as the slots of the tumblers at the same time were all in line, it follows as a necessity that

after the slides are carried back to their original position, that the slots of the several tumblers are all in different positions, so that if any attempt be made to throw back the bolt it will be prevented from moving back by the pin *f* striking against the periphery of the tumblers, and the only way in which it can be permitted to move back is to bring the rack slides to the relative position in which they were at the time the tumblers were engaged with them.

To prevent the unlocking by what is technically termed "feeling" which might be done by forcing back the bolt until the pin *f* bears against the periphery of the tumblers and then in succession moving each tumbler, by the application of a pick, until it is relieved of the pressure, which would indicate that the slot is in the required line to permit the bolt to move back, the pin *f* of the bolt is so located on the bolt relatively to the tumblers that the back movement of the bolt will depress the stop or holdfast plate and make it enter the cogs of the slides to lock them before the pin reaches the periphery of the tumblers. In this way by the very act of moving back the bolt to press the pin against the tumblers the slides and tumblers become locked so that they cannot be moved by any means. The tumblers must be arranged in the required position before the bolt can be moved back, and hence the burglar is left entirely to the chances of getting the combination or permutation of the key by which the bolt was locked; and as the combination is on the key alone, that can be changed every day if desired, which change would be attended with series inconvenience if it had to be made in the tumblers also, as in the generality of permutation, locks heretofore made.

To prevent all access to the stop or holdfast plate, by means of a pick, the key hole is made in a solid block of metal so that the only part of the mechanism which controls the unlocking is the projection of the cogs of the slides within the key hole.

For greater safety the stop or holdfast plate should be put farther from the key hole than the range of motion of the slides, otherwise wax or other substance might be put between the cogs of the racks to leave a mark where the stop or holdfast enters the racks at the time the tumblers are connected with the slides, and thus by inspection and counting the number of cogs in each slide up to the one marked by the stop get the form of key by which the bolt was locked; but by placing the stop farther from the key hole than the range of motion of the slides, the cogs acted upon by the stop cannot be reached for inspection or any other purpose.

It will be seen that for the purpose of locking and unlocking it is only necessary to turn the key half a revolution, and that then it can be turned back again. If this course were pursued for any length of time with the same combination on the key, which might occur from neglect or overweaning confidence in the safety of the lock, each slide would become worn to the extent of its range of motion under the given combination, and then by gently moving each slide with a pick, until the motion became slightly harder, which would be the case on reaching the part not worn, the range of motion of each slide might be determined from which to make a false key. To prevent this the key stem is formed with a collar *d'*, and there is a spring attached to the lock case with a lip *e'* projecting within the periphery of the key hole. To insert the key a notch is cut in the collar to pass the lip of the spring, and beyond the notch there is a cam like projection *f'* on the stem of the key, presenting an inclined face on one side and a radial face on the other, so that by turning the key half a revolution the cam passes the spring lip which prevents the key from being turned back so that it must be turned a complete revolution to bring the notch in the collar to the line of the spring lip in which position alone the key can be withdrawn unless the spring lip is drawn back by hand. In this way all the slides are moved the whole length of their range of motion at each operation that every part may become worn equally.

In Fig. 6 of the accompanying drawings will be found a modified form of parts of my improvements as applied in a more simple and cheap form for house and store doors where safety is not required to so great an extent as in locks for safes and vaults.

The bolt *b* with its cheeks *e* and pin *f* is formed as in the above description, as also the part which operates the stop or holdfast plate; but instead of shaping the lower edge of the plate to fit between the cogs of the racks the lower end is jointed to one arm of a lever *a''* which turns on a fulcrum pin *b''*, the other arm being in turn jointed to another sliding plate *c''*, the edge of which enters between the cogs of the rack slides *n*. The key hole is made in a solid block of metal as before described, and the key is constructed and the combination changed precisely as before described. And the rack slides *n* are constructed, mounted and operated as before described, so far as they are operated by the key; but they are not made with the second rack to connect with the cogged sectors of rotating tumblers; but instead of this they are enlarged at their upper end as at *d''* and slotted as at *e''* to permit the pin *f* on the bolt to move therein, and back of this slot the tumblers are cut out as at *f''* that the slides may regain their

original position when the key is withdrawn.

As the slides in this modification constitute the tumblers instead of being separate from them that the tumblers may be connected after the slides have been set by the key, whatever change is made in the combination of the key by shifting the sector pinions must also be made by shifting the tumblers in the lock. And therefore this modification only differs from the lock before described in the omission of the important feature of my invention which relates to the independent rotating tumblers and the method of connecting them with the slides after they have been set by the key.

It will be obvious to the skilful lock maker that the construction of the several parts and their relative location may be modified without changing the principle or mode of operation of the several characteristic features which distinguish my invention from all other things before known, and therefore I wish it to be distinctly understood that I do not limit myself to the special form, construction or location of the several parts so long as the same results are obtained by equivalent means.

I am aware that locks have been made in which a series of rotating tumblers are carried by the bolt in the direction of its line of motion so as to make cogs on the said tumblers engage cogs on a series of slides previously set by the key, but in such locks the engagement of the tumblers with the key slides can only take place at the end of the throw of the bolt, and therefore I do not wish to be understood as making claim broadly to the engagement of rotating tumblers with the key slides by the throw of the bolt.

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

1. Moving a series of rotating cogged tumblers at right angles to the line of motion of the bolt by means of a slot in the bolt, or any equivalent thereof, operating on the shaft or spindle of the tumblers, substantially as described, whereby the cogs on the said tumblers can be made to engage the cogged racks on the key slides previously set by the key before the stop pin on the bolt leaves the slots in the tumbler, and will so remain engaged while the bolt continues its movement to carry the said stop pin to some distance beyond the periphery of the tumblers so that in any attempt to pick the lock the said stop pin shall not rest against the periphery of the tumblers to admit of feeling, as it is termed, to bring the tumblers in succession to the required position to allow the lock to be picked, as described.

2. And I also claim in combination with the method of operating the tumblers by the throw of the bolt, and giving to the bolt the capacity to move after the tumblers have been engaged with the key slides to carry the stop pin some distance beyond the periphery of the tumblers, substantially as described, the employment of a stop or holdfast operated by the bolt to lock or holdfast the key slides or tumblers before the stop pin on the bolt reaches the periphery of the tumblers, substantially as described, whereby the slides and tumblers if not previously arranged by the proper key, will become locked in their disarranged condition before the stop pin on the bolt can reach the periphery of the tumblers to feel when the tumblers are brought to the required position by a pick.

3. I also claim forming the bit of the key of a series of sector pinions which may be shifted to change the combination or permutation, substantially as described, in combination, with a series of cogged rack slides for operating the tumblers, substantially as and for the purpose specified.

4. And finally I claim the notched collar on the key stem in combination with the lipped spring at the entrance of the key hole, substantially as and for the purpose specified, whereby the key cannot be taken out of the keyhole without turning it entirely around to give to the key slides their entire range of motion every time the lock is opened and shut, and thus avoid the possibility of determining the required position of the key slides by the wear of the moving parts which would be the case if only moved each time to the distance required for unlocking, particularly if the same combination should continue to be used for a considerable length of time.

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