2 Sheets-Sheet 1.

L. Yale, Jr.

Permutation Lock.

No. 82,192. Patented Sep. 15, 1868.

Fig. 2

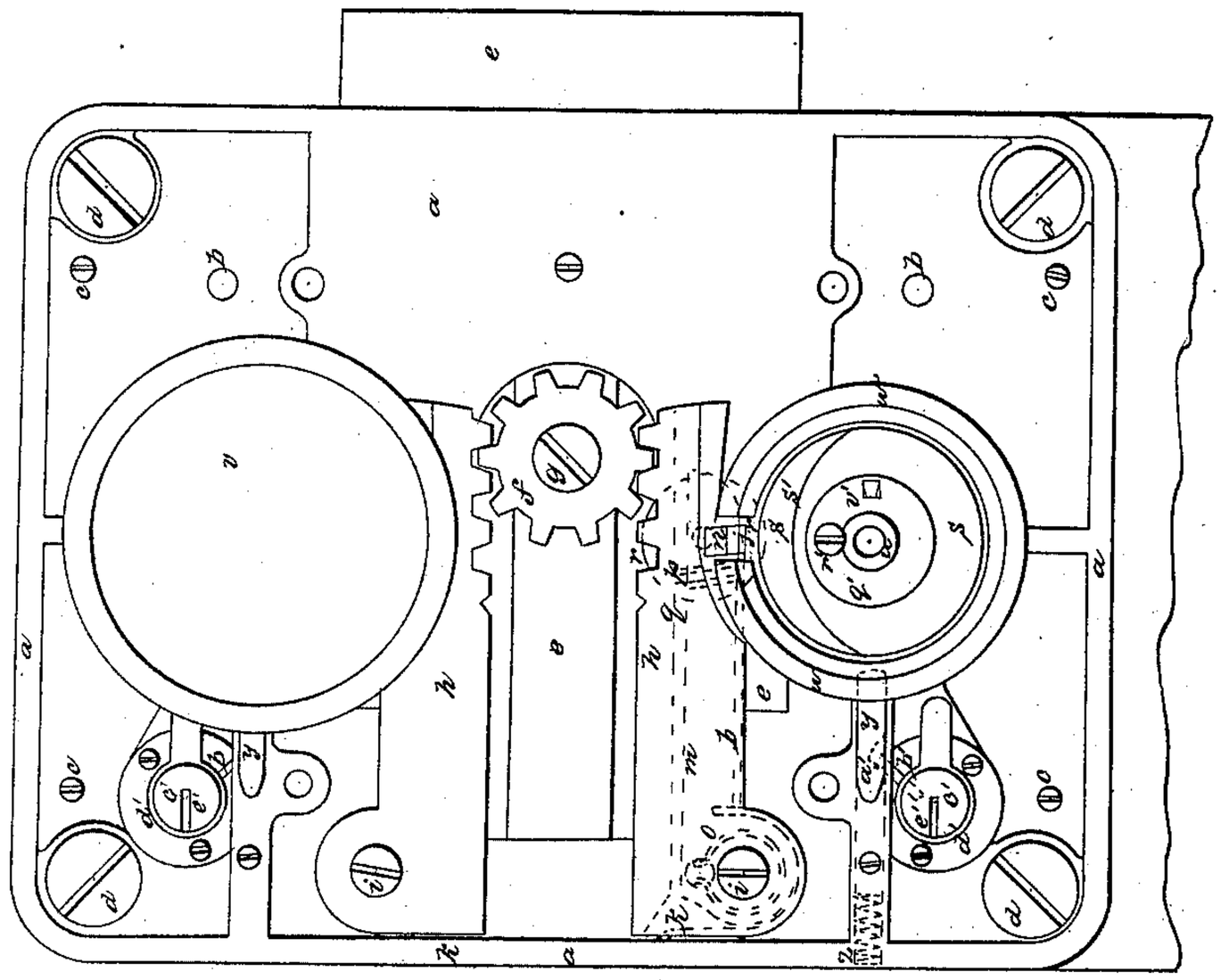
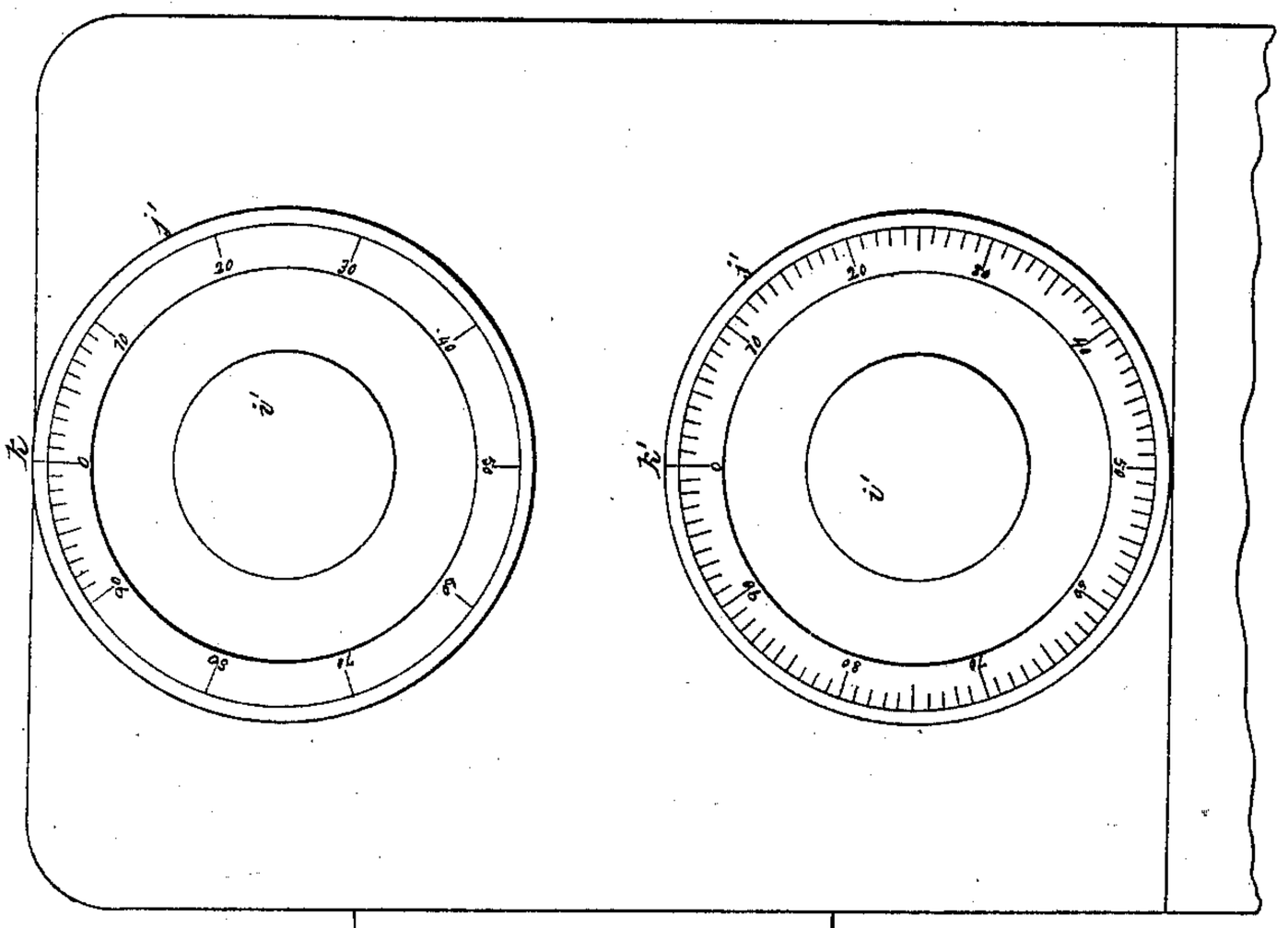


Fig. 1



Witnesses;
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A. D. Lacy

Inventor;
Linus Yale Jr

2 Sheets-Sheet 2.

L. Yale, Jr.

Permutation Lock.

No. 82,192. Patented Sep. 15, 1868.

Fig. 7

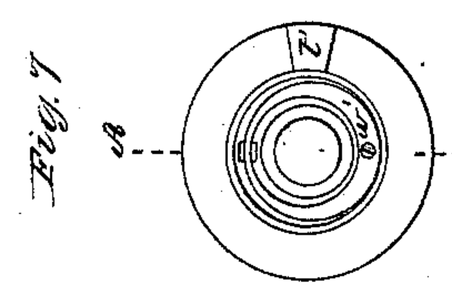


Fig. 8

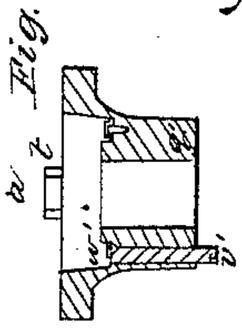


Fig. 3

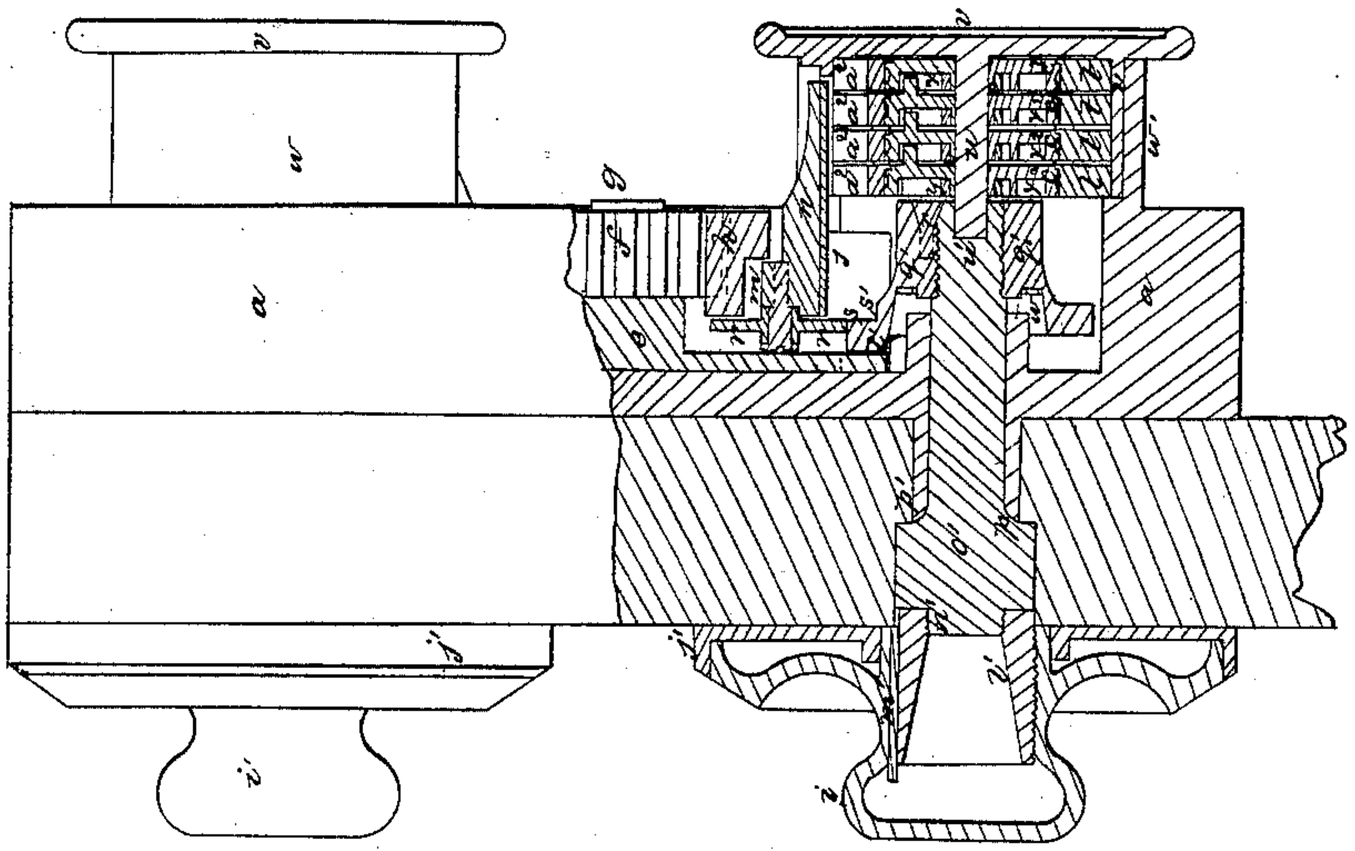


Fig. 11

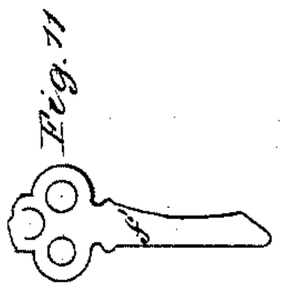


Fig. 10

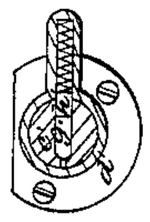


Fig. 9

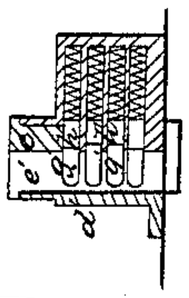


Fig. 6

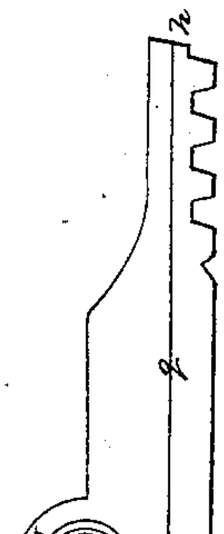


Fig. 5

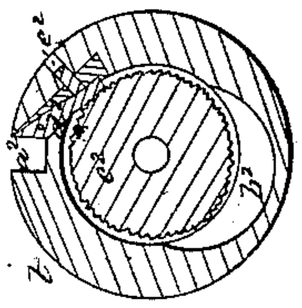
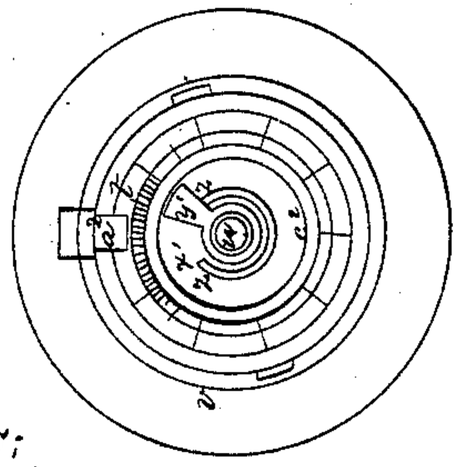


Fig. 4



Witnesses;
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A. de Lacy.

Inventor;
Linus Yale Jr

United States Patent Office.

LINUS YALE, JR., OF SHELBURNE FALLS, MASSACHUSETTS.

Letters Patent No. 82,192, *dated September* 15, 1868.

IMPROVEMENT IN PERMUTATION-LOCKS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, LINUS YALE, Jr., of Shelburne Falls, Franklin county, and State of Massachusetts, have invented certain new and useful Improvements in Locks for Safe, Vault, and other Doors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a front elevation of my improved lock.

Figure 2, a back elevation, with the back plate and one of the tumbler-cases removed, the better to exhibit the other working parts.

Figure 3, a partial elevation and vertical section through the centre.

Figure 4, a plan of one of the tumbler-cases and tumblers.

Figure 5, a horizontal section through one of the tumblers.

Figure 6, a side view of one of the racks and spring *o*.

Figure 7, a face view of the hub *q'*.

Figure 8, a vertical section of the same.

Figure 9, a vertical section of the separate lock.

Figure 10, a horizontal section thereof; and

Figure 11, a face view of the key of this separate lock.

The same letters indicate like parts in all the figures.

In the accompanying drawings—

a represents the lock-case, secured to a door, a portion of which only is represented.

It is very important, in securing a dial-lock to the door, to have the shaft or spindle, by which the tumblers are set, to work freely. If the case is strained or bent in fastening it, by reason of the case not having a fair bearing against the door, the works are liable to bind, instead of working freely, and, as such locks are used on safes, and are necessarily of considerable weight, and the fastening-screws cannot be fitted very accurately, in transportation the lock settles down, and thereby binds the shaft or spindle. All these and other difficulties, not necessary to enumerate, I have avoided by a new method of applying the lock-case to the door.

I employ two cylindrical pins *b b*, which are accurately fitted to holes in the lock-plate. After ascertaining the required position of the lock, these pins, which I term steady-pins, are firmly secured in the door, and the lock slipped on to them. These pins, therefore, not only prevent the lock from settling down or moving laterally on the door, but afford the means of replacing the lock in the same position, when taken off for any needful purpose.

It is also important that the lock-case should have a fair bearing against the face of the door, or else, when the fastening-screws are driven home, the case will be strained, and the shaft or spindle forced out of line, either or all of which will impede the working of the lock. To avoid this, I employ four bearing-screws *c c c c*, one near each corner of the case, and tapped in and passing through the plate of the lock. After the lock-case has been put on the steady-pins, and against the door, and the shaft or spindle put in place, these bearing-screws are turned until they all bear against the door, and bring the lock in such relation to the door that the shaft or spindle will work freely. The lock is then secured to the door by the four fastening-screws *d d d d*.

The lock, as before stated, belongs to the class known as dial-locks, in which the tumblers are set by turning a shaft or spindle by a dial, to a given combination, and, after the tumblers have been set, throwing the bolt by the turning of the same shaft or spindle; and one of the features of my present invention consists in combining, with one lock-bolt, two sets of independent tumblers, and their appendages, and two knobs, each of which sets one set of tumblers, and, when they are properly set, acts on the bolt, so that the bolt can be locked by both, and may be opened by either. In this way, notwithstanding the bolt has been locked by two sets of tumblers, each set under a different combination, if the combination of one set should be forgotten, it can be unlocked by the other knob and its set of tumblers.

For the last-named purpose, the bolt *e*, mounted in the lock-case, as represented, or in any other suitable manner, so as to slide therein properly, carries a cogged pinion, *f*, which is free to turn on a fulcrum-pin, *g*. There are two cogged racks *h h*, one above and the other below this pinion, and connected with the lock-frame by fulcrum-pins *i*, at their rear ends, so that they can be thrown in and out of gear with the pinion *f*. As these racks are on opposite sides of the axis of the pinion, when they are both in gear, it will be obvious that the bolt cannot be moved, and that to admit of throwing the bolt, one or both of the said racks must be thrown out of gear.

As both locks are alike, the description of one will suffice for both.

The rack *h* carries a fence, *j*, which, when the tumblers are properly set, will enter the slots of the tumblers, and permit the rack to be thrown out of gear by the tension of a spring, *k*, connected with the rack, and which bears against the side of the lock-case, but, so long as the tumblers are disconcerted, the periphery of some or all of the tumblers will keep the rack in gear with the pinion.

So far as regards the combination of the two knobs and two series of tumblers with the bolt, the fences might be rigidly connected with and made part of the racks, but, as the tension of the spring tends constantly to bear the fence against the tumblers, that it may enter the slots, when properly set to disengage the rack from the pinion on the bolt, this might afford the means of picking the lock by carefully turning and feeling when the slot of each tumbler in turn is brought opposite to the fence.

To prevent this, I have invented a new mode of application of a mode of operation described in and secured by Letters Patent of the United States granted to me, and bearing date the 14th day of May, 1861, and known as the disconcerter.

That portion of the fence which bears against the tumblers is the continuation of a spring, *l*, attached to a lever, *m*, formed with a projecting arm, *n*, which extends over and in contact with the fence, except when the disconcerting action takes place. This lever *m* turns on the same fulcrum-pin as the rack, and is formed with a sleeve-journal, fitted to turn in the rack, and the lever and rack are connected by a spring, *o*, represented by dotted lines in fig. 2, and by full lines in the section, fig. 6, and the spring *k*, before described, for disengaging the rack from the pinion, is attached to this fence-lever *m*. The spring *o* and its connections with the lever and rack are such as to allow the fence-lever to have a slight play independently of the rack, but not enough to allow the fence to be carried into the slots of the tumblers without throwing the rack out of gear.

The spring-bar *l* of that portion of the fence which bears against the tumblers is provided with a pin, *p*, shown by dotted lines in fig. 2, which passes through a hole in the fence-lever, and bears on the surface *q* of the rack, so that when any force is applied to the fence-lever to move it away from the tumblers and towards the rack, the pin *p* of the spring *l* of the fence being in contact with the rack, prevents the fence from following the lever, so that the lever *m* can be vibrated, to a certain extent, without moving that portion of the fence which acts on the tumblers. The fence-lever, opposite to the fence, is provided with a slightly-eccentric roller or wheel, *r*, and on the spindle of the knob, which rotates the tumblers to be presently described, there is a wheel, *s*, which, when the spindle is in position to act on the tumblers, bears and rolls on the periphery of this eccentric-roller *r*; and, as the wheel *s* on the spindle, and the roller *r* on the lever of the fence, are of different diameters, and the roller is slightly eccentric, it follows that the turning of the knob will slightly vibrate the fence-lever, but without moving that portion of the fence which bears on the tumblers.

As will be presently described, the bolt is thrown by a spur on the same shaft or spindle by which the tumblers are set, the said spur acting directly against the bolt.

By applying to the knob a micrometer, that is, an instrument which multiplies motion, the slightest variation in the position of whatever prevents the bolt from being thrown back can be ascertained.

In the arrangement above described, the rack is what prevents the bolt from being thrown back, and as the cogs are necessarily bevelled, if the rack be lifted in the slightest degree, it will permit the bolt to be forced back, and although to a very slight extent, still to a sufficient extent to be indicated by an instrument which multiplies such motion several thousand times.

Now, as there is a spring or yielding medium between the rack and the fence, and this spring or elastic medium keeps the rack-teeth in the cogs of the pinion, and the fence nearly in contact with the periphery of the tumblers, the position of the rack cannot be varied by any slight change in the position of the fence due to any slight variation either in the diameter or flexibility of the tumblers, and hence no change of position of the bolt can be indicated by the micrometer.

It is well known that, with the utmost skill, all the tumblers of a series cannot be made precisely alike; they will minutely vary either in diameter or elasticity, and by the application of the micrometer to the knob, this very slight difference might be measured by gradually turning the tumblers in succession, and measuring with it, and thus ascertain when the several tumblers are brought to the required position to receive the fence and permit the bolt to be thrown; but this is entirely prevented by the above-described arrangement of the eccentric roller on the lever of the fence, and the connection of the fence with this lever by a spring, which will have the effect of completely baffling every attempt to measure any variation in the tumblers.

The tumblers *t* are circular disks, that turn freely but accurately on a cylindrical stem, *u*, projecting inwards from the head of a cylindrical case, *v*, which is fitted to and inserted in a tubular projection, *w*, from the inner face of the lock-plate, and concentric with the knob, so that the axes of the tumblers shall be in line with the axis of the spindle.

The number of tumblers may vary at the pleasure of the constructor, and in the accompanying drawings four are represented for each lock. The mounting of the tumblers in a removable case is for the purpose of giving ready access to them, to change the combination, and no claim is intended to be made thereto, but it will be obvious that, if inserted so that any one could readily take out the case with the tumblers, an evil-minded person, finding the door open, as in business-hours, might readily take out the tumblers and note the combina-

tion, and thereby acquire the means of unlocking the door. To prevent this I have combined with the removable tumbler-case a means of readily locking the tumbler-case in the tubular projection *w* of the lock-plate, so that it cannot be removed except by violence, or by picking the lock used for that purpose, neither of which expedients could be resorted to in business-hours.

A notch is formed in the outer periphery of the tumbler-case to receive the end of a spring-latch rod, *y*. This rod is cylindrical, with a square end, and is oblique, so that its square end will present an oblique surface, so that, in pushing in the tumbler-case, the latch-rod will be forced out and spring back to lock the case as soon as the notch is brought to the right place, and this will also insure the right position of the tumbler-case. This latch-rod slides in a hole, *z*, (see dotted lines in fig. 2,) and is provided with a helical spring, the tension of which tends constantly to force it into place. Near the other end it is formed with a notch or shoulder, a^1, which can be acted upon by an arm, b^1, from the rear end of a shaft, c^1, fitted to turn in a case, d^1, attached to the lock-frame. This shaft d^1 is formed with a longitudinal slit, e^1, to receive a small flat key, *f'*, (see fig. 11,) one edge of which is formed to act upon a series of tumblers, *g'*, which slide radially in holes in the said shaft, and which, in the normal position, corresponds with other holes in the case *d'*, provided with corresponding tumblers, *h'*, adapted to slide therein, and provided with springs, which tend to force them into the holes of the cylinder, and when extending into such holes completely lock the shaft, so that it cannot be turned to unlock the tumbler-case.

When the key *f'* is inserted, its form is such as to slide the two sets of tumblers *g'* and *h'*, so that the shaft can be turned by the key to draw out the latch-rod *y* to liberate the tumbler-case *v*. The tumbler-case *v* and the tubular projection *w* have mortises through their peripheries to allow the fence *j* to reach the peripheries of the tumblers, and to enter the slots in them when in position for throwing the bolt of the lock.

Each series of tumblers is operated by a knob, *i'*, formed with a large flanch, on which one hundred divisions are marked, and this is surrounded by a ring, *j'*, secured to the outer face of the door, with a mark or pointer at *k'* as the starting-point from which the knob is to be turned to work out the required combination for locking and unlocking the bolt. This knob is cast hollow, of a cylindrical form inside, and tapped to receive the part *l'* of the spindle, which is threaded along so much of its length as to adapt the spindle to doors of various thicknesses.

The threaded part of the spindle and the tubular part of the knob are grooved longitudinally to receive a key, *m'*, which is driven in after the knob has been screwed on to the spindle to the required distance to suit the thickness of the door to which the lock is to be applied, and which acts as a feather.

The portion *l'* of the spindle which is connected directly with the knob, is made of cast iron, or other metal or composition of less strength than steel, of which the other portion of the spindle is made, and the steel portion is connected therewith by a short stem tapped into it, as at *n'*. The object is to make the part of the spindle which is connected directly with the knob, and which can be got hold of if the knob should be removed, so much weaker than the steel portion, that if any violent force be applied, it will break off from the portion which is in connection with the inside of the lock. And to this end I prefer to make the weak portion hollow, as represented.

The portion *o'* of this spindle is made of hardened steel, so that it cannot be drilled to get access to the inside of the lock, and it has been found that the hardening renders it brittle and liable to break at the junction of the journal portion, which is fitted to turn in the lock-plate, and the enlarged portion which is outside the lock, and which is so enlarged to resist any attempt by violence to force it into the lock. The liability of breaking I prevent by rounding off the metal at the junction of the two parts, as at *p'*, instead of making a sharp angle, as heretofore.

The inner end of the spindle is reduced in diameter, and tapped to receive a hub, *q'*, of the wheel *s*, before described, which, when in place, is prevented from turning by a screw, *r'*, which feathers the spindle. On the end of this hub nearest the lock-plate, is formed the wheel *s*, before referred to, which rolls on the eccentric-wheel *r* of the fence-lever. One-half of the thickness of this wheel has the periphery concentric, and the other half of the thickness has half the circumference concentric, and the other half, *s*, eccentric or cam-like. The spindle has an end-play equal to about half the thickness of this wheel, so that when the knob is pushed against the door, the eccentric-roller *r* of the fence-lever will ride on the concentric part of the wheel *s* for the purpose already described, and when the knob is drawn out to the extent of the play of the spindle, the roller *r* will then act on the eccentric part *s'*, so that when the eccentric or cam-like portion *s'* passes over the eccentric-roller *r*, it will permit the fence-lever, and the rack connected therewith, to be thrown up by its spring to liberate the lock-bolt.

On that face of the wheel *s* nearest the lock-plate there is a projecting spur, *t'*, which acts on the lock-bolt to throw it in or out, when the eccentric or cam-like portion of the wheel permits the rack to be disengaged from the pinion on the lock-bolt.

There is a concentric hole, *u'*, in the inner end of the spindle, to receive the end of the arbor *u*, before described, on which the tumblers rotate, so that the axes of the tumblers and of the spindle shall always be in line, whatever freedom of play may be given to the spindle.

The tumblers are rotated by a spur, *v'*, which projects from the inner face of the hub *q'* on the spindle, and the projection of this spur is such that, when the spindle is drawn out by the knob in the position for throwing the lock-bolt, it (the spur) shall clear the tumblers, and only engage them when the spindle is pushed in, and, as in some instances, the spur might be in line with that portion of the tumbler on which it is required to act when rotated; in pushing in the spindle, the spur in such instances would come in conflict with such part of the tumbler and do injury. To prevent this, the spur *v'* is a rod fitted to slide in a hole through the hub, and parallel with the axis of the spindle, and a spring, *w'*, is attached to the hub, and bears against the

end of the spur to keep it in the required position, but so that it shall permit the spur to yield when brought into contact with the tumbler, and to force it out again so soon as, by the rotation, it clears that part of the tumbler on which it is required to act.

The first tumbler in the series nearest the hub of the spindle is the one which is turned and set by the turning of the knob. In that face of it which is nearest the spindle it is formed with an annular recess, x', and on its hub is mounted what I term a fly, y', (see figs. 3 and 4,) which is free to vibrate to the extent limited by the space between two stops z' on the face of the tumbler. The tumbler is turned in either direction, by the spur v' on the hub of the spindle, when rotated, acting against the fly either on one side or the other, according to the direction in which the knob is rotated.

The breadth of the fly, the limit of its range of vibration on the tumbler, and the thickness of the spur v' on the hub of the spindle, must be such, as represented, so that in whichever direction the knob may be rotated, starting from a determined point, and whether turning to the right or to the left, the slot, a^2, of the tumbler will always be brought in line with and so as to receive the fence. It will be observed that if the spur on the hub act on a fixed spur on the tumbler, although the turning of the knob in one direction would give a complete revolution after contact of the two spurs, the turning of the knob one entire revolution in the opposite direction would turn the tumbler as much more than one revolution as would be equal to the thickness of the two spurs, but by giving the required play to the fly or movable spur on the tumbler, the one complete revolution of the knob in either direction will give only the required complete revolution to the tumbler.

As the slot in each tumbler for receiving the fence renders that part of the circumference of the tumbler lighter, and the tumblers are required to be made so as to turn freely in the block, it follows, that by repeated jars and concussions, the tumblers will be caused to rotate until the slots of all the tumblers will be above the axis, and all in line, and from this position a skilled person could readily determine the combination by which to open the lock. To prevent this, I either balance each tumbler by cutting out the metal of the ring, as at b^2, (see fig. 5,) on the side of the axis opposite to the slot for the fence, or I so cut out the metal at other parts of the circle, and at different distances from the slot, for the fence in each of the series. And with reference to the latter case, it is immaterial whether the part so cut out be or be not equal in weight to the metal cut out to form the slot for the fence, as the preponderance of weight in each will bear a different relation to the fence, and the process of knocking or jarring can only have the effect of disconcerting the tumblers instead of getting the slots of all of them in line, if made as heretofore. And it will be obvious from the foregoing that the required result can be obtained either by cutting away the metal to reduce the weight where too heavy, or by adding weight where too light.

Each of the tumblers in the series is provided, like the one described, with a vibrating fly, and each, except the last, is provided with a spur to act on the fly of the next one in the series, so that each sets the one behind it, and the spindle sets the first, in manner well known to persons acquainted with this class of combination-locks.

The face of each of the tumblers is, like the dial on the knob, marked with one hundred divisions, and for the purpose of changing the combination it is necessary that the position of the vibrating fly, or rather the stops which limit its vibrations, should be capable of being shifted to any of the divisions on the face of the tumbler. For this purpose each tumbler is made in two concentric parts.

The part, t, on which the divisions are marked, and in which the slot for the fence is made, is a flat ring, and the part c^2, to which the vibrating fly and its stops are attached, is a disk fitted to its inner periphery, so as to turn in it. The periphery of the inner portion c^2, about the middle of its thickness, is formed with teeth all around, and in the cavity of the ring is placed a small brake, d^2, which bears on the toothed periphery of the inner portion, and is provided with corresponding teeth, the form of which will permit the one part of the tumbler to be turned on the other, for the purpose of changing the combination, and, when the change has been effected, the two parts are set and prevented from turning, the one on the other, by a small set-screw, e^2, which is inserted through the periphery of the ring, and which is made to bear on the brake to force it into contact with the teeth to lock the two parts. This mode of construction admits of readily changing the combination, and, when changed, of holding the parts, so that the combination cannot be accidentally shifted.

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

1. The method of adjusting the lock to and connecting it with the door by means of the steady-pins and bearing-screws, substantially as described, in combination with the fastening-screws, or the equivalent fastening, as and for the purpose described.

2. In combination with the lock-bolt, two sets of rotating tumblers and their appendages, each set operated by one spindle, which also acts upon the bolt and the racks connected with the fence of the tumblers, and capable of being thrown separately in and out of gear with the pinion on the lock-bolt, substantially as and for the purpose specified.

3. The rack, or its equivalent, to stop or liberate the lock-bolt, when combined with the fence of the tumblers, by means of an interposed spring, or equivalent, substantially as and for the purpose specified.

4. Combining the eccentric-roller, which is acted upon by a wheel or equivalent on the spindle, with the fence of the tumblers by a vibrating lever, or equivalent therefor, having a spring or equivalent interposed between it and the fence, substantially as described, and for the purpose set forth.

5. Balancing the tumblers, or, as the equivalent thereof, disconcerting the preponderating weight relatively to the slots for the fence, substantially as and for the purpose specified.

6. A sliding and rotating spindle, which both shoots the bolt and revolves the tumblers, as described, and is provided with a cylindrical cavity, as specified, in combination with a stationary arbor of greater length than

the space occupied by the pack of tumblers, and projecting into the cylindrical cavity of the spindle, the combination being substantially such as hereinbefore set forth.

7. Combining, with the case which contains the tumblers, and which is fitted to the tubular projection from the lock-frame, so that it can be inserted therein and removed therefrom for the purpose of changing the combination, a spring-bolt or latch controlled by a separate lock, substantially as and for the purpose described.

8. Making the knob hollow and threaded on the inside to receive the threaded portion of the spindle to such an extent that it can be fitted to doors of various thicknesses, and then prevented from turning, the one on the other, by a feather-key, as described.

LINUS YALE, JR.

Witnesses:
ANDREW DE LACY,
WM. H. BISHOP.