(Model.)

3 Sheets—Sheet 1.

H. C. FULTON & M. L. ELDRIDGE.

PERMUTATION LOCK.

No. 365,468. Patented June 28, 1887.

Fig. 1.

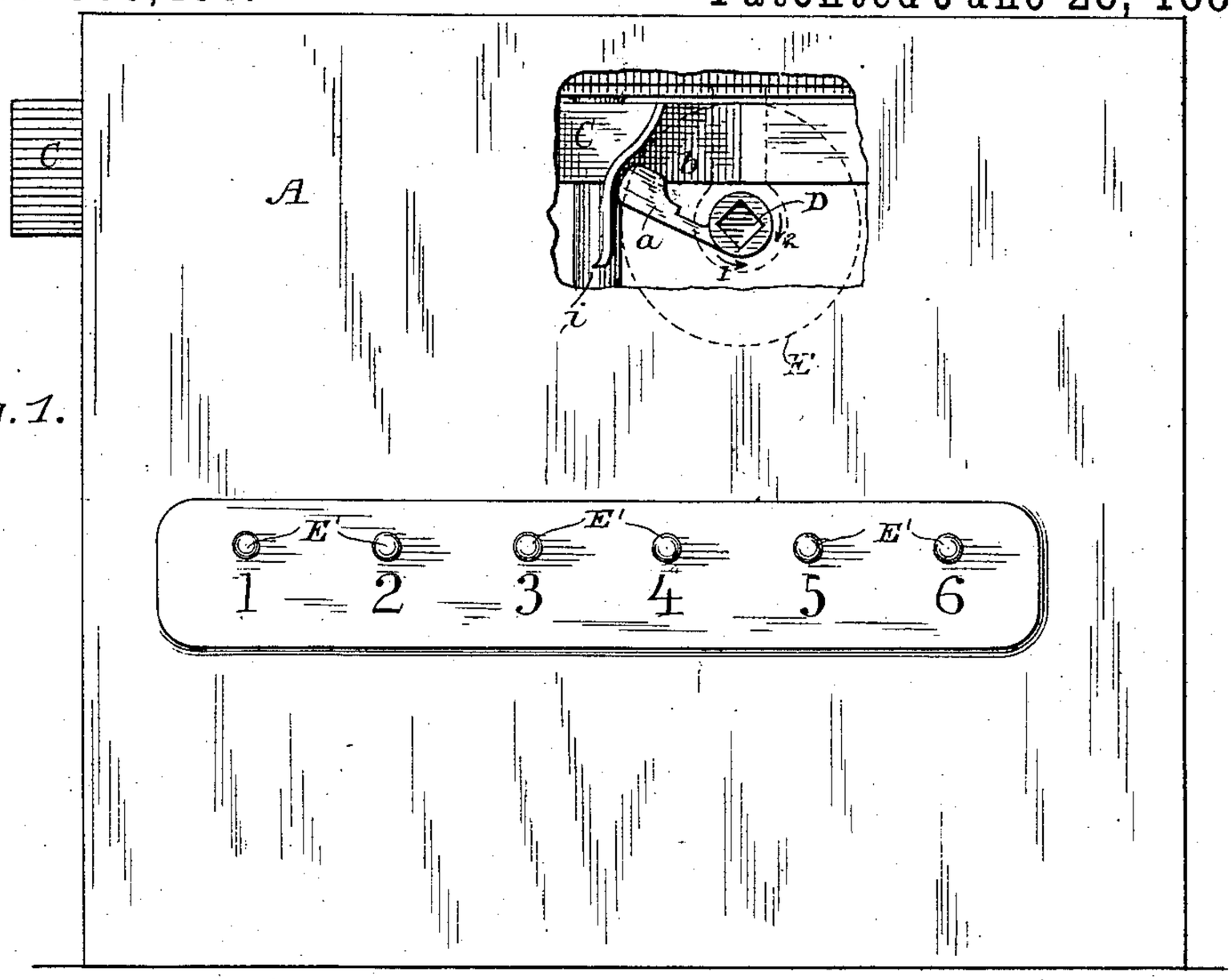
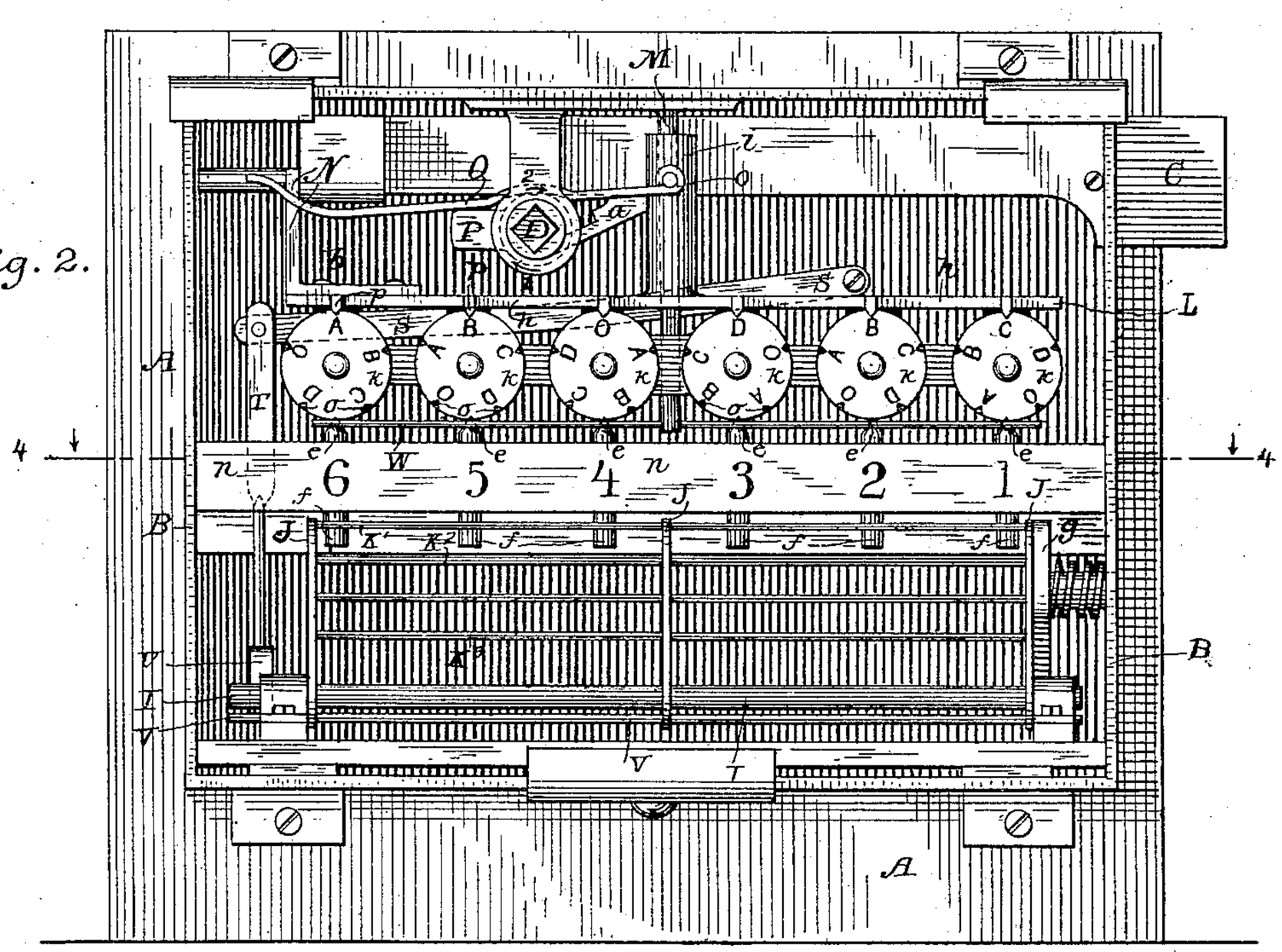


Fig. 2.



Witnesses:

Jos. S. Latimer

A. S. Browne.

Inventors

Harry C. Fulton

M. Lippincott Eldridge.

By their Attorneys

Soule' and Co.

(Model.)

3 Sheets—Sheet 2.

H. C. FULTON & M. L. ELDRIDGE.

PERMUTATION LOCK.

No. 365,468. Patented June 28, 1887.

Fig. 3.

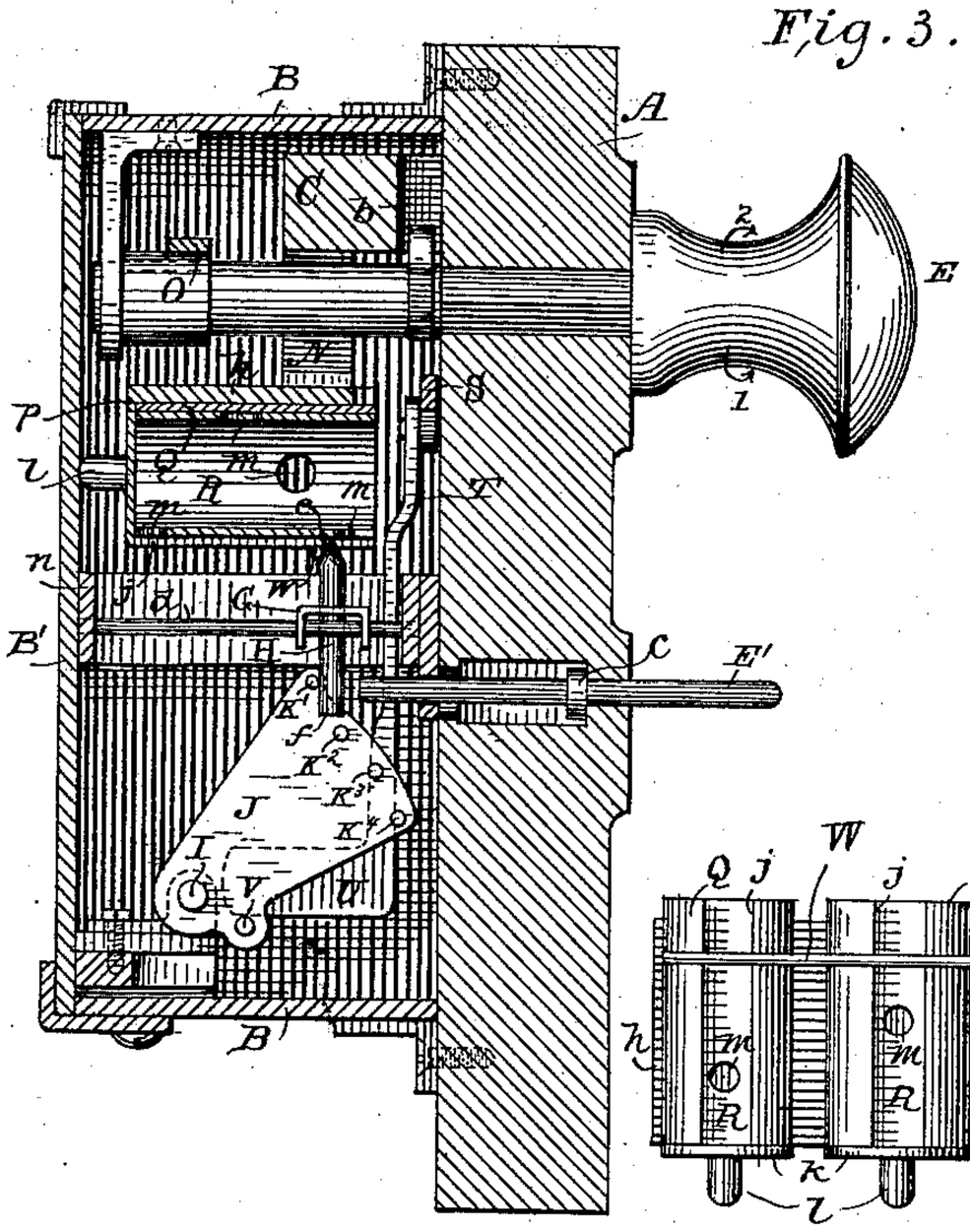


Fig. 6.

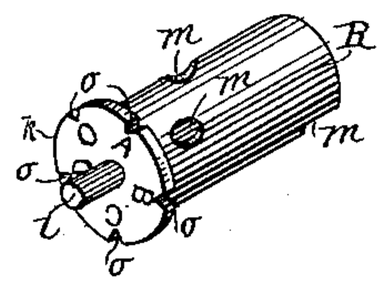


Fig. 5.

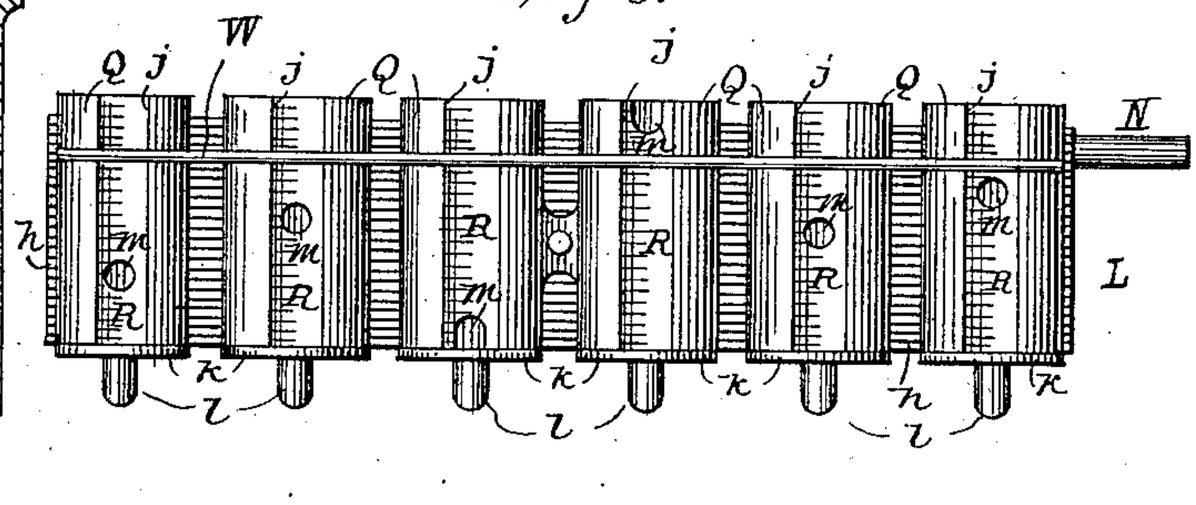
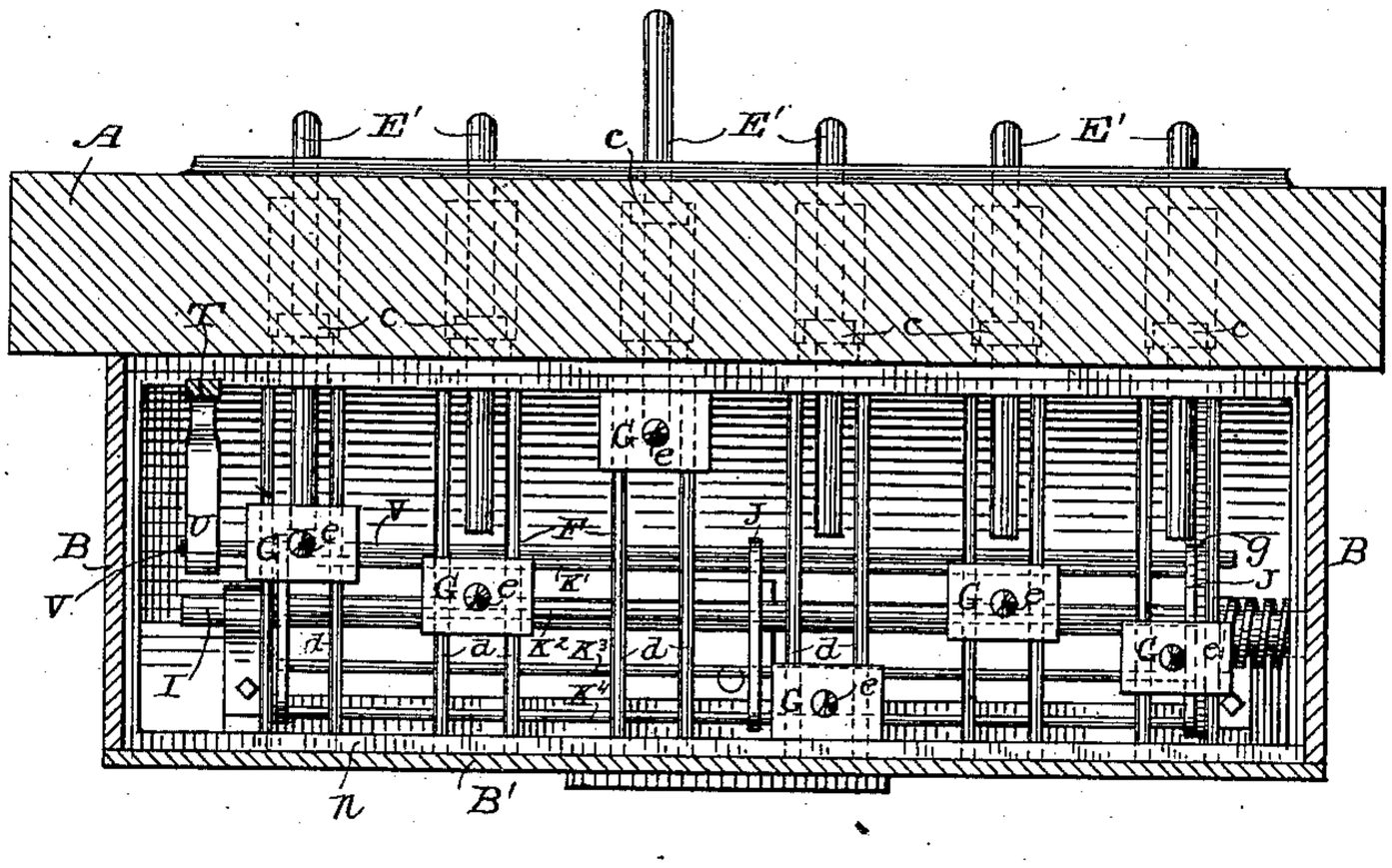


Fig. 4.



Witnesses:

Jos. S. Latimer

A. F. Bonner.

By their Attorneys

Inventors

Harry C. Fulton

M. Lippincott Eldridge.

Soule' and Co.

(Model.) 3 Sheets—Sheet 3.

H. C. FULTON & M. L. ELDRIDGE.

PERMUTATION LOCK.

No. 365,468. Patented June 28, 1887.

Fig. 7.

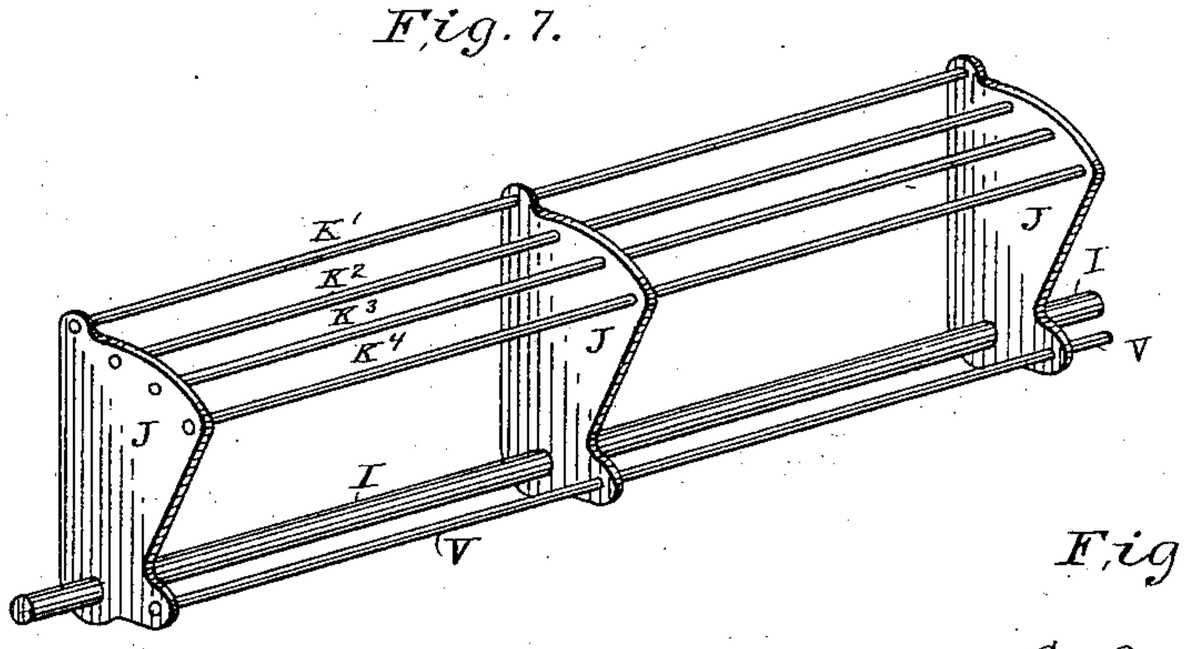


Fig. 8.

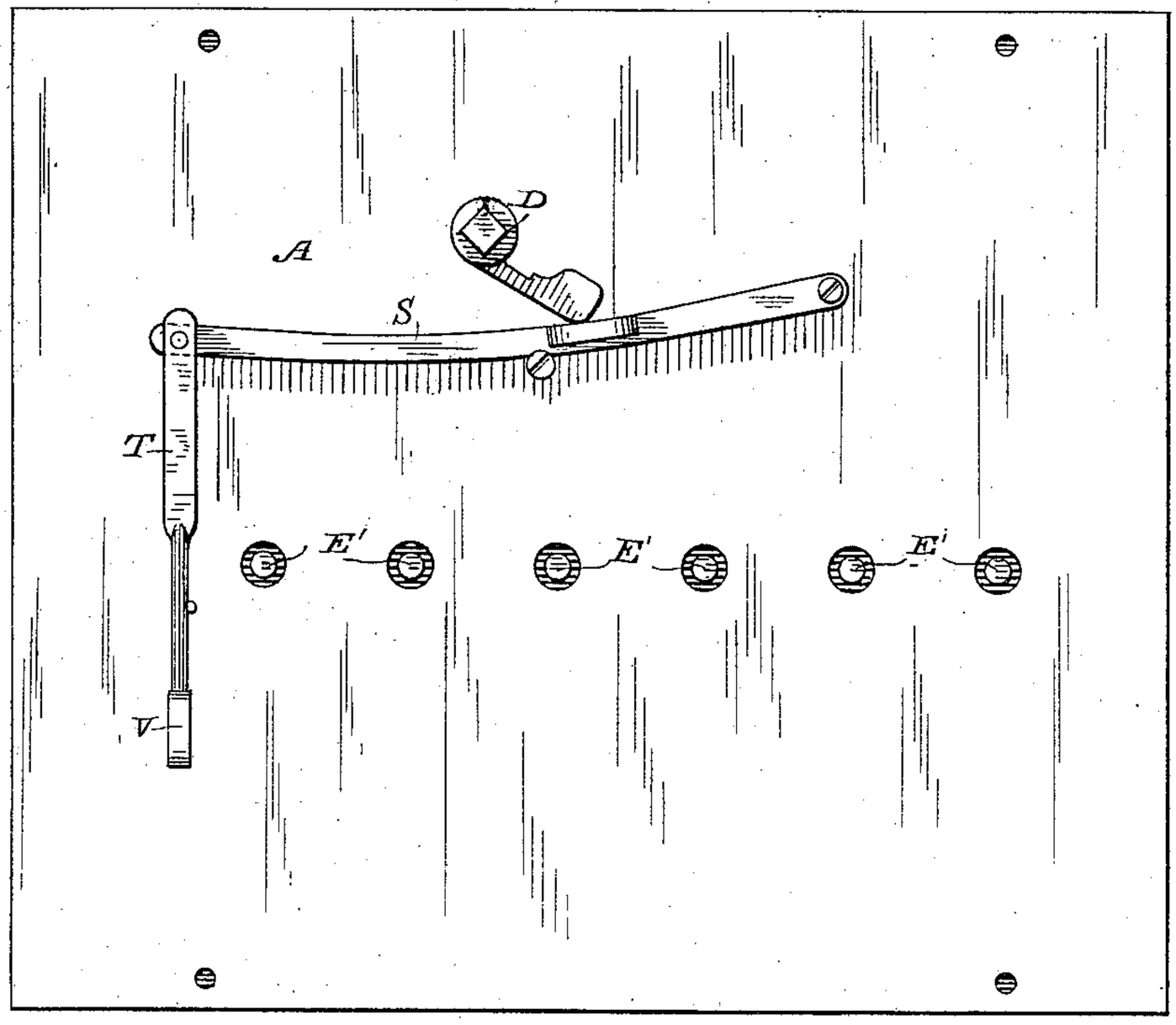
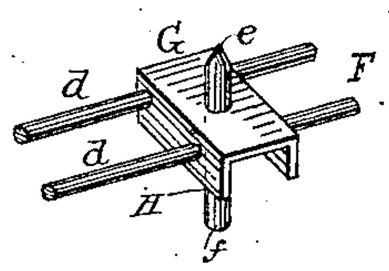


Fig. 9.



Witnesses:
Jos. L. Lahmer
A. B. Browne.

By their Attorneys

Inventors.
Harry C. Fulton
M. Lippincott Eldridge.
Soule and Co.

UNITED STATES PATENT OFFICE.

HARRY C. FULTON AND M. LIPPINCOTT ELDRIDGE, OF DAVENPORT, IOWA.

PERMUTATION-LOCK.

SPECIFICATION forming part of Letters Patent No. 365,468, dated June 28, 1887.

Application filed May 14, 1887. Serial No. 238,180. (Model.)

To all whom it may concern:

Be it known that we, HARRY C. FULTON and M. LIPPINCOTT ELDRIDGE, of Davenport, in the county of Scott and State of Iowa, have invented a new and Improved Permutation-Lock, of which the following is a specification.

The invention is illustrated in the accompanying drawings, in which Figure 1 is a front view of a plate to which is secured the lock mechanism. Fig. 2 is a rear view of the same. Fig. 3 is a central cross-section. Fig. 4 is a horizontal section in a plane indicated by the line 4 4, Fig. 2. Fig. 5 is a detail view of the carrier, being a bottom view thereof. Fig. 6 is a detail view of one of the controlling-shells. Fig. 7 is a detail view of the rack-shaft. Fig. 8 is a view of the mechanism for operating the same; and Fig. 9 is a detail view of one of the sliding carriages.

A is the front plate, to which the lock mechanism is secured. It may be a portion of the door of a safe or similar receptacle, or a plate or panel adapted to be set into a door. To the rear of this plate is secured a suitable frame, B, inclosing the operative parts, which is or may be closed by a back plate, B′, as is usual in such locks.

Mounted in the upper part of the frame is a sliding bolt, C, of any preferred construction, which is reciprocated to lock and unlock the door by a shaft, D, to which an operating-knob, E, is secured on the exterior of the plate A. The shaft D carries an arm, *a*, which enters a recess, *b*, in the bolt as the shaft is turned in one direction or the other. The shaft, however, can be rotated only on a given position of the varions parts of the permutation-lock mechanism, and this position is susceptible of a large number of variations. The various positions of the mechanism are governed by a series of sliding escutcheon-pins, E′ E′, which project through the front plate and are designated by numbers, letters, or other characters. The number of pins shown is six, and they are numbered from 1 to 6, consecutively, from left to right. The mechanism is so arranged that by suitable adjustment it can be operated on the pushing in of any number of the pins in any desired order, either singly or in groups.

It is evident that the number of pins can be increased to any desired extent, and as with even a comparatively few number of pins the number of possible permutations is practically limitless, the chance of the lock being opened by any one not knowing the particular combination is thus practically eliminated. These escutcheon-pins extend through the front plate, and each is formed with a projecting flange, *c*, which prevents its being withdrawn and which prevents its being pushed in beyond a certain fixed distance. Each pin is the exact counterpart of the others, so that all can be pushed in only a certain fixed distance.

On the inner side of the plate A, within the frame B, are fixed a series of horizontal guideways, F, perpendicular to the front plate. Each guideway is preferably composed of two parallel wires or small rods, *d d*. On each of these guideways thus formed there rests and slides a small carriage, G, to which is secured a vertical tooth, H, extending above and below the carriage. The several teeth H on the several carriages are pointed at their upper ends, *e e*, and all extend an equal distance above and below the carriages. The lower ends, *f f*, of the several teeth are directly in line with the escutcheon-pins, so that when one of the escutcheon-pins is pushed in it comes in contact with one of the teeth H, thus sliding one of the carriages G a distance equal to the movement of the pin.

In the rear lower part of the frame A, beneath the guideways, is journaled a rack-shaft, I, parallel with the front plate. At right angles to this shaft, and rigidly secured thereto, are several segment-plates, J. (Three—the number shown—is a proper number.) These plates carry rigidly secured to them a series of parallel rods or wires, K′, K², K³, and K⁴, each parallel to the shaft I. These several rods are arranged in a curve concentric with the shaft I. Any number of these rods can be employed up to the same number of the escutcheon-pins. The number of the rods determines the number of the pins or groups of the pins which can enter the combination. In the drawings four of the rods are shown, and hence only four of the pins or four groups of the pins can be used in a single combination. Any smaller number down to one pin can be employed irrespective of the number of the rods on the rack-shaft.

The rack-shaft is retained in any position

to which it may be moved by a spring-plate, *g*, which bears against one of the segment-plates J and holds the same by frictional contact. The normal position of the rack-shaft when the bolt is thrown is its lowermost position, and in this position the upper or first rod, K′, is in the path of the lower ends, *f*, of the carriage-teeth H. The second rod, K², however, is then below the lower extremities of the teeth. If, now, any one or any number simultaneously of the escutcheon-pins are pushed inward, the teeth H actuated thereby will come in contact with the upper rod, K′, and the rack-shaft I will be turned through an arc determined by the distance the pins are moved.

In operating the lock each pin should, whenever pushed, be pushed in as far as it will go. When the first pin or group of pins has been thus pushed in, the second rod, K², will have been raised so far that it will be in the path of the lower ends of the teeth H; but the third rod, K³, will still be below the lower extremities of the teeth. On pushing in the second pin (or group of pins) of the combination its tooth H will come in contact with the second rod, K², moving it and the rack-shaft a certain distance. The tooth, however, which was first moved in is brought by the movement of the rack-shaft in the path of the second rod, K², owing to its elevation, and hence the first pin moved in is carried by the rod K² ahead of the second tooth. In exactly similar manner the third and fourth rods are moved in by the third and fourth pins of the combination, the pins moved in ahead of them being carried farther and farther in at each movement, and so on, according to the number of the rods. With the rods shown the rack-shaft is only affected by four successive inpushings of the pins. After that further pushing in of the pins will not affect the position of the rack-shaft. After one escutcheon-pin has been used in the combination it cannot again be used, since the movement of the rack moves the carriage controlled by it out of its reach. If four pins are thus moved in in succession, at the end of the movement the four carriages controlled thereby will occupy positions varying in distance from the front plate. In the combination shown in the drawings the pins used are 3 1 2 5 6, the pins being arranged to be pushed in the following order: 3 1 2 5 6—that is, the pins designated by the numbers 2 5 being pushed in simultaneously. Where these pins are thus pushed in, the bolt can then be withdrawn by rotation of the knob E. Carriage 3 will then be moved farthest in, carriage 1 next, carriages 2 and 5 will be moved in next the same distance with each other, and carriage 6 will be moved in the shortest distance. The other carriage, 4, will not be moved at all.

The mechanism connecting the bolt-shaft D with the tooth-carriages, so that the rotation of the former can only be effected when said carriages occupy a predetermined position, is as follows: Located beneath the bolt-shaft and above the tooth-carriages is a vertically-movable carrier, L, consisting of a horizontal plate, *h*, having a vertical sleeve, *i*, secured thereto, which slides vertically along a rod, M, fixed to the frame-work B. This carrier has a stop-arm, N, at one end, which, when the carrier is elevated, is located behind the bolt C, and prevents the bolt being withdrawn. When the carrier is lowered, the stop-arm N is carried below the bolt, so that the same can be freely moved. The carrier has an arm, O, pivoted at one end to the sleeve *i*, which extends over and rests upon a cam, P, upon the bolt-shaft D. By this means the carrier can be lifted by the rotation of the bolt-shaft in the direction of arrow 1. The first effect of the movement of the cam is to lift the free end of arm O into contact with the frame B, and then to lift the carrier. When the carrier has been lifted as high as possible, its weight rests upon the cam and prevents it from accidentally turning down. When the bolt-shaft is turned in the opposite direction, the carrier descends of its own weight until it comes in contact with the teeth H of the sliding carriages, upon which it rests at such a height that the stop-arm N still prevents the withdrawal of the bolt. The carrier can only descend far enough to release the bolt when the tooth-carriages occupy the position indicated by the desired combination.

To enable the carrier to be adapted to cooperate with the tooth-carriages in all possible permutations, it is constructed as follows: Beneath the carrier, and secured thereto, are a series of hollow cylinders, Q Q, corresponding in number with the tooth-carriages and escutcheon-pins, each cylinder being open at both ends and having a longitudinal slot, *j*, extending along its bottom throughout its entire length. Each cylinder is located directly above one of the tooth-carriages, with its slot directly above one of the guideways F, so that at whatever position the tooth-carriage may be its tooth may enter the slot on the descent of the carrier. Fitting within each of these cylinders is a cylindrical hollow shell, R, which can be removed from said cylinder and rotated therein. The shell has a flanged head, *k*, on its rear end, which determines the distance that it can be inserted in the cylinder, and on the center of this head is a stud, *l*, for manipulating the shell. This stud also, when the back plate, D′, is in position, prevents the dislocation of the shell, and the several studs on the several shells prevent by contact with the back plate any oscillation of the carrier on the rod M. The shells R extend inward toward the front plate so far that they extend over the teeth H of the carriages when the latter are in their normal or most forward position, and the shells extend back as far as the carriages can be moved by the escutcheon-pins and the rack-shaft. Consequently, were the shells imperforate or continuous, the carriage-teeth would always encounter the walls of the shells, and thus at all positions the carrier would

rest on the ends of the teeth and prevent the withdrawal of the bolt. Each shell is therefore provided with a series of apertures, *m m*, corresponding in number with the different possible positions of each tooth-carriage. In the lock herein described each carriage has five possible positions—one its normal position close to the front plate, and four to which it may be moved by the escutcheon-pin and rack-shaft. Each shell has therefore five corresponding apertures *m m*, whose positions are so arranged lengthwise of the shell that each aperture corresponds with one position of the carriage, and no other. These apertures are so disposed around the periphery of the shell that only one at a time can coincide with the slot *j* in the bottom of the cylinder. Preferably the five apertures are distributed at equal distances around the periphery of the shell, or at angular distances apart of seventy-two degrees; hence each shell can be so placed in the cylinder that at a given position of each carriage its tooth will be directly underneath one of the apertures. When all of the teeth are thus directly under apertures, the carrier can descend its entire distance, thus releasing the stop from the bolt and permitting the free movement of the bolt; but as long as a single tooth is not in line with an aperture the carrier cannot descend.

In order that the shells can be easily and quickly arranged to adapt them to the desired combination, each shell is numbered to correspond with the number of the escutcheon-pin which controls the movement of the tooth-carriage which co-operates with the particular shell. In the present case the shells are numbered from 1 to 6, the numbers being placed from right to left on a fixed bar, *n*, below the carrier, it being the same bar which supports the rear ends of the guideways F. Each shell is also provided on its flanged head K with a series of notches, *o o*, corresponding in number with the number of apertures in each shell. In the lock shown there are five of these notches seventy-two degrees apart. These notches on each shell are engaged by a projecting lip, *p*, on the carrier, which holds the shell in any position in which it may be placed. The several notches are lettered O, A, B, C, and D in order, the letters being arranged on a dial on the flanged head. When the notch O is engaged by the lip, then the innermost aperture *m* (that is, the one nearest the front plate) coincides with the slot *j*. When the notch A is so engaged, the next innermost aperture coincides with slot *j*, and so on to notch D, which, when engaged by the lip, indicates that the aperture nearest the flanged head coincides with the slot *j*.

The combination of numbers given above for the opening of the lock was 3 1 2 5 6. As carriage 3 will be moved back the farthest, and will be moved four times, its shell must be turned so as to bring the farthest back aperture into coincidence with slot *j*. Shell 3 is therefore placed with its notch D engaged by lip *p*. Shell 1 is placed with notch C so engaged. Shells 2 and 5, which are moved simultaneously, are placed with notches B B so engaged, and shell 6 is placed with notch A so engaged. All shells whose corresponding escutcheon-pins do not enter the combination (in this case shell 4 only) are placed with notches O in engagement with their respective lips. When the shells are so arranged and the escutcheon-pins pushed in in the order named, the carrier can descend its full distance, thus freeing the bolt and permitting its movement in either direction.

To again lock the bolt the carrier is raised its full height by rotation of shaft D in direction of arrow 1, the same movement throwing the bolt. The movement of the shaft is continued in the same direction until the bolt-operating arm *a* encounters a horizontal lever, S, pivoted at one end to the front plate. To the other end of this lever is pivoted the upper end of a vertical rod, T. The lower end of this rod T has rigidly secured to it a horizontal presser-bar, U, which rests upon an eccentric stud, V, carried by the rack-shaft. This eccentric stud, as shown, consists of a rod parallel with the shaft and carried by the segment-plates J.

When the rack shaft is rotated by the escutcheon pins and intermediate mechanism, the eccentric stud is raised, thus lifting the bar U, rod T, and free end of lever S. When the arm *a* of bolt-shaft D encounters the lever S, it depresses the same, and with it rod T and presser-bar U, thus depressing the eccentric stud V and rotating the rack-shaft, turning the rods K′, K², K³, and K⁴ downward and forward. This movement of the rods carries with them all the tooth-carriages, leaving them at their normal position, all in line immediately next the front plate. The bolt-shaft is then turned slightly backward in the direction of arrow 2, permitting the carrier to descend until it rests on the top of the carriage-teeth.

The combinations in permutation-locks are sometimes deciphered by what is termed "feeling"—that is, moving what in this case are the escutcheon-pins and listening to and marking any slight variation in the sound of their movement which may be caused by their coming into proper position for unlocking the bolt. In the present case this feeling is prevented by what is termed an "anti-feeling bar," W, which is mounted on the carrier below the cylinders Q Q. When the carrier is resting on the carriage-teeth, the carriages cannot be pushed in by the escutcheon-pins, since the upper ends of the carriage-teeth encounter the bar W. Before the carriages can be moved in at all the carrier must first be lifted to its position by rotation of the bolt-shaft in direction of arrow 1, which lifts the bar W free from the paths of the carriage-teeth. The carriage can then be moved freely; but there is then no contact between the carriage-teeth and the shells.

It will be observed that a single movement

of the bolt-shaft in the direction of arrow 1 lifts the carrier from the tooth-carriages, locks the bolt, and returns the tooth-carriages to their normal position next the front plate. The escutcheon-pins also, it will be noted, are not connected with the movement of the lock, so that they can be manipulated as much as desired without affecting the lock mechanism.

We claim as our invention—

1. In a permutation-lock, the sliding bolt, the bolt-operating shaft, the vertically-movable carrier operated by said shaft, and a series of apertured rotatable shells carried by said carrier, in combination with horizontally-sliding carriages carrying teeth which co-operate with said apertured shells, and sliding escutcheon-pins which operate said carriages, substantially as set forth.

2. In a permutation-lock, the sliding bolt, the bolt-operating shaft, the vertically-movable carrier operated by said shaft, and a series of apertured rotatable shells carried by said carrier, in combination with a rotatable rack-shaft carrying a series of horizontal parallel rods, horizontally-sliding carriages carrying teeth projecting below and above the same, which co operate with said parallel rods and with said apertured shells, and sliding escutcheon-pins which operate said carriages, substantially as set forth.

3. The escutcheon-pins having a fixed limited sliding movement, and the sliding carriages having vertical teeth which are moved by said escutcheon-pins, in combination with a rotatable shaft, said shaft having a series of parallel rods, the upper of which, when the shaft is in its normal position, is in the path of the carriage-teeth, and the remaining rods of which are brought successively into the path of said teeth by the successive movements of said escutcheon-pins and said tooth-carriages, substantially as set forth.

4. The rotatable shaft carrying a series of parallel rods, in combination with a spring pressure-plate which holds said shaft in any position in which it may be placed.

5. The horizontal guideways, consisting of parallel rods or wires, in combination with the carriages sliding upon said rods, each of said carriages having a tooth extending above and below the same between said parallel rods, substantially as set forth.

6. The sliding bolt and its operating-shaft, in combination with the vertically-movable carrier operated by said shaft, said carrier having a stop-arm which engages said bolt when the carrier is elevated, substantially as set forth.

7. The sliding tooth-carriages, in combination with the vertically-movable carrier, said carrier having a series of open slotted cylinders, and the apertured shells fitting in said cylinders, substantially as set forth.

8. The vertically-movable carrier having a series of slotted open cylinders, in combination with a series of apertured shells fitting in said cylinders, co operating notches and lips on said shells and carrier for fixing the position of said shells, and an indicating-dial for indicating the coincidence of the several apertures in the shell with the slots in the cylinders, substantially as set forth.

9. The vertically-movable carrier having slotted open cylinders, in combination with the apertured shells having flanged heads and studs projecting therefrom.

10. The carrier L, having sleeve *i*, and a fixed rod, M, which supports said sleeve and on which said sleeve slides, in combination with shaft D, having cam P, and an arm, O, pivoted to the carrier and resting on said cam.

11. The rotating rack-shaft having an eccentric stud, and the bolt-shaft having arm *a*, in combination with lever S, rod T, and bar U, connecting said arm *a* with said eccentric stud, substantially as set forth.

12. The sliding tooth-carriages and the vertically-movable carrier, in combination with the anti-feeling bar W, carried by said carrier, which prevent the movement of the carriages, substantially as set forth.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

HARRY C. FULTON.
M. LIPPINCOTT ELDRIDGE.

Witnesses:
ADA H. SANDERS,
JOS. R. LANE.