

(No Model.)

3 Sheets—Sheet 1.

J. D. CRAIG.  
COMBINATION LOCK.

No. 491,158.

Patented Feb. 7, 1893.

Fig. 1.

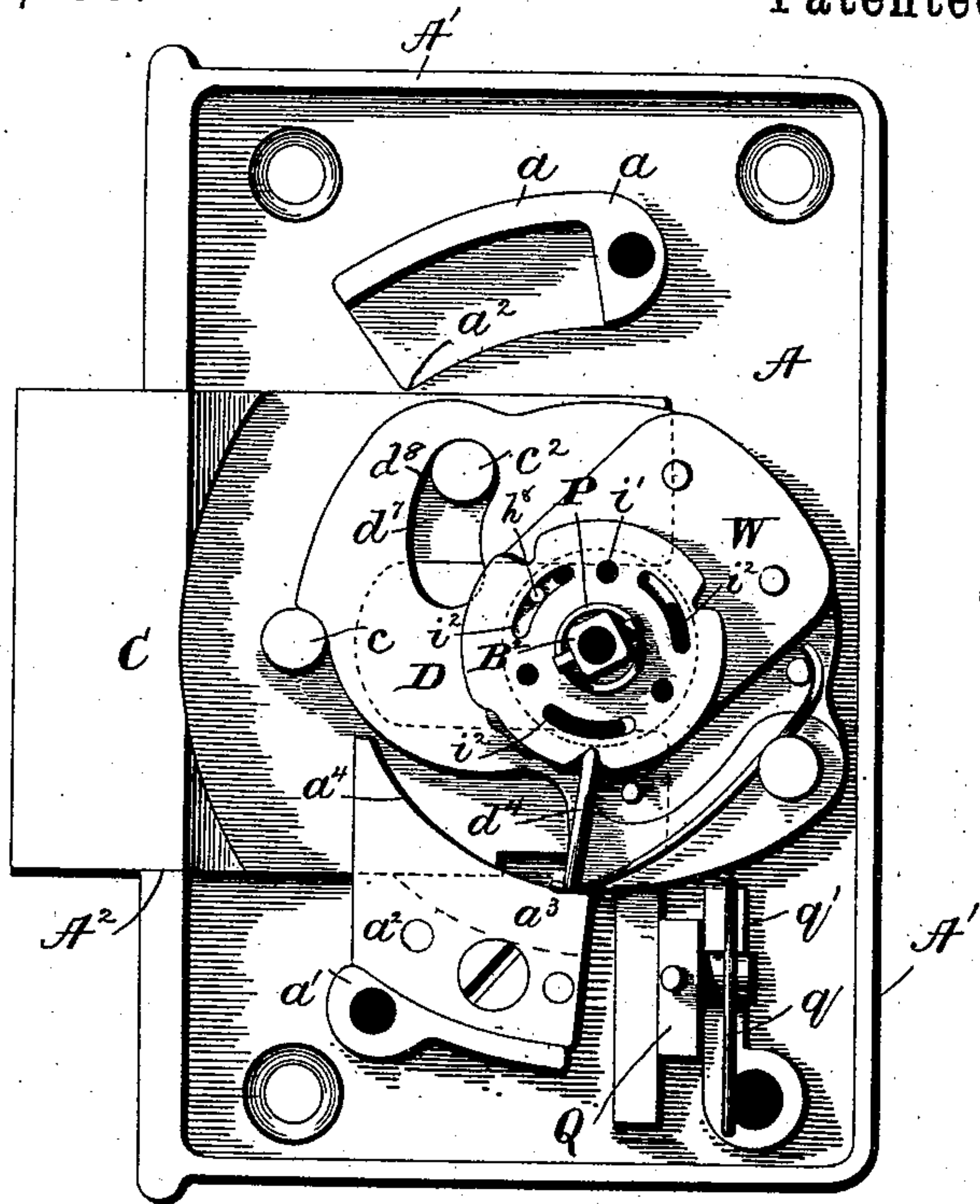
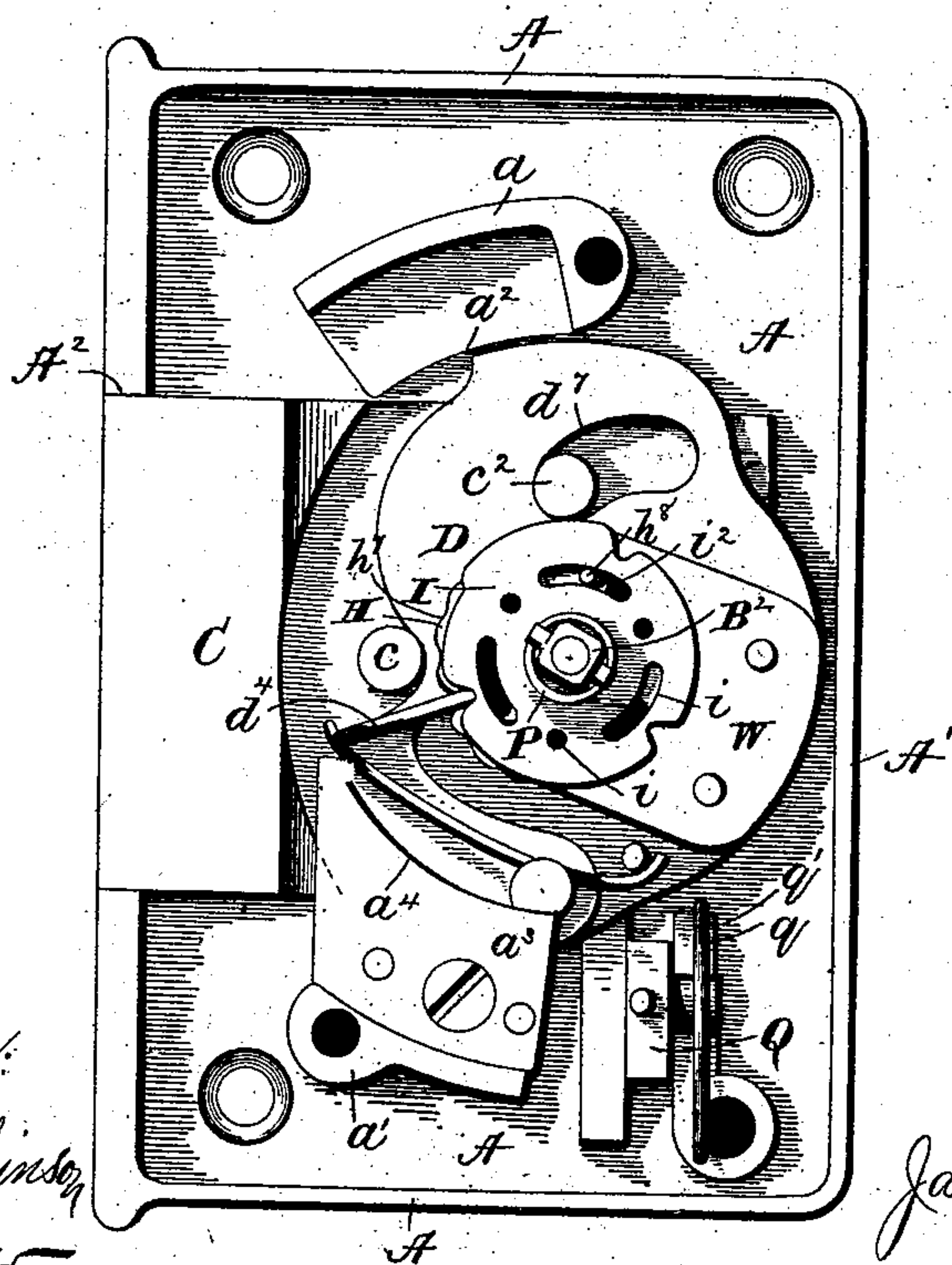


Fig. 2.



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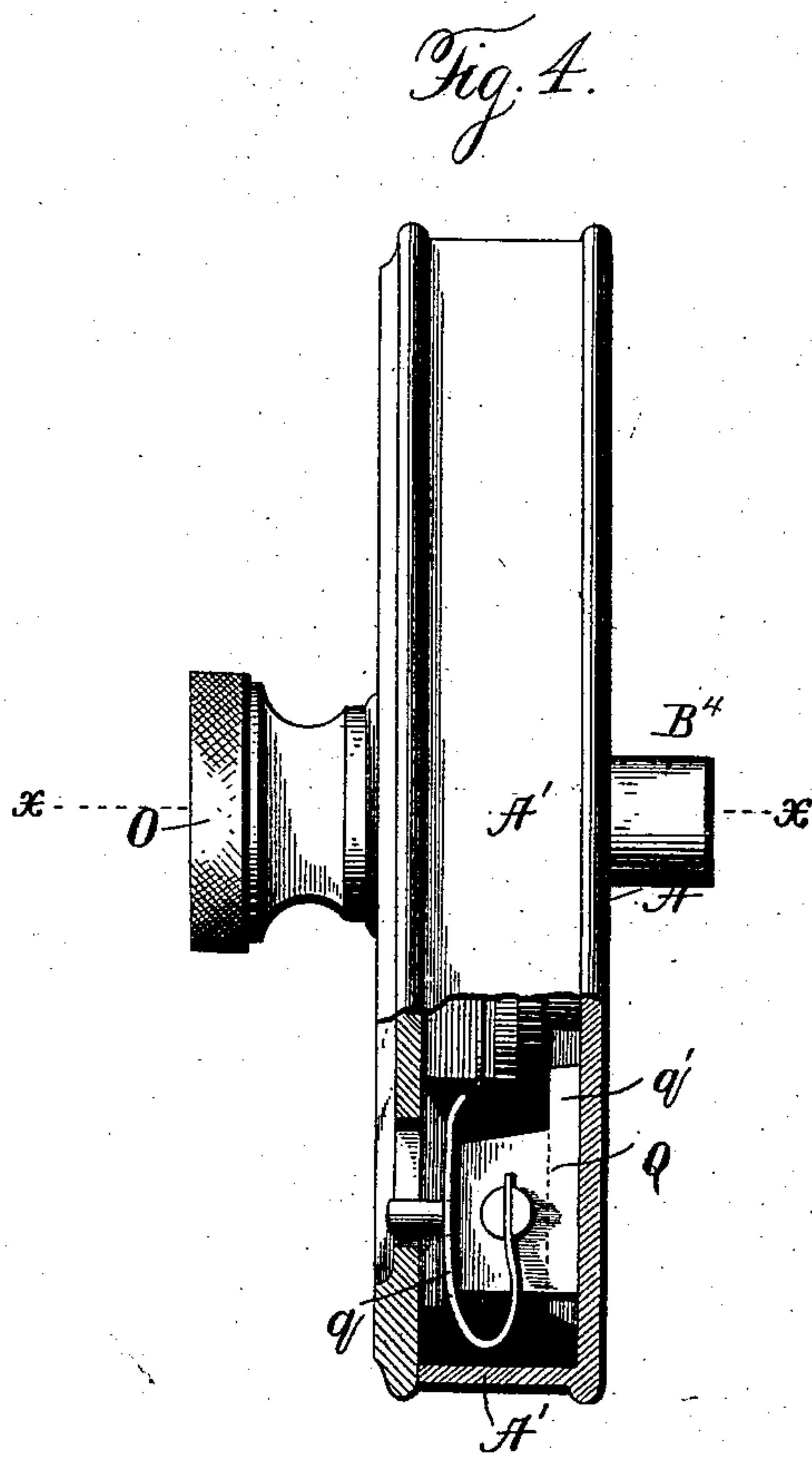
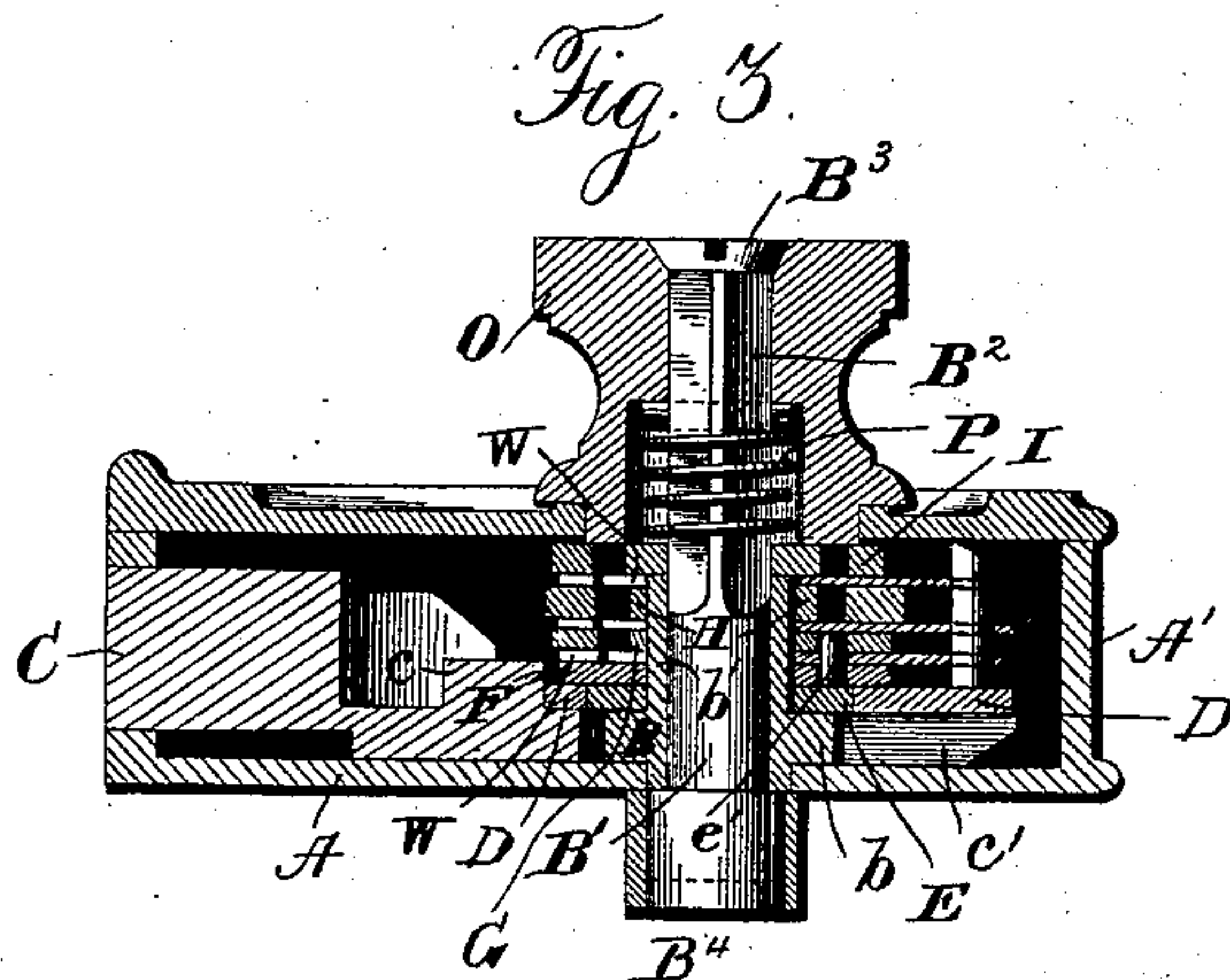
(No Model.)

3 Sheets—Sheet 2.

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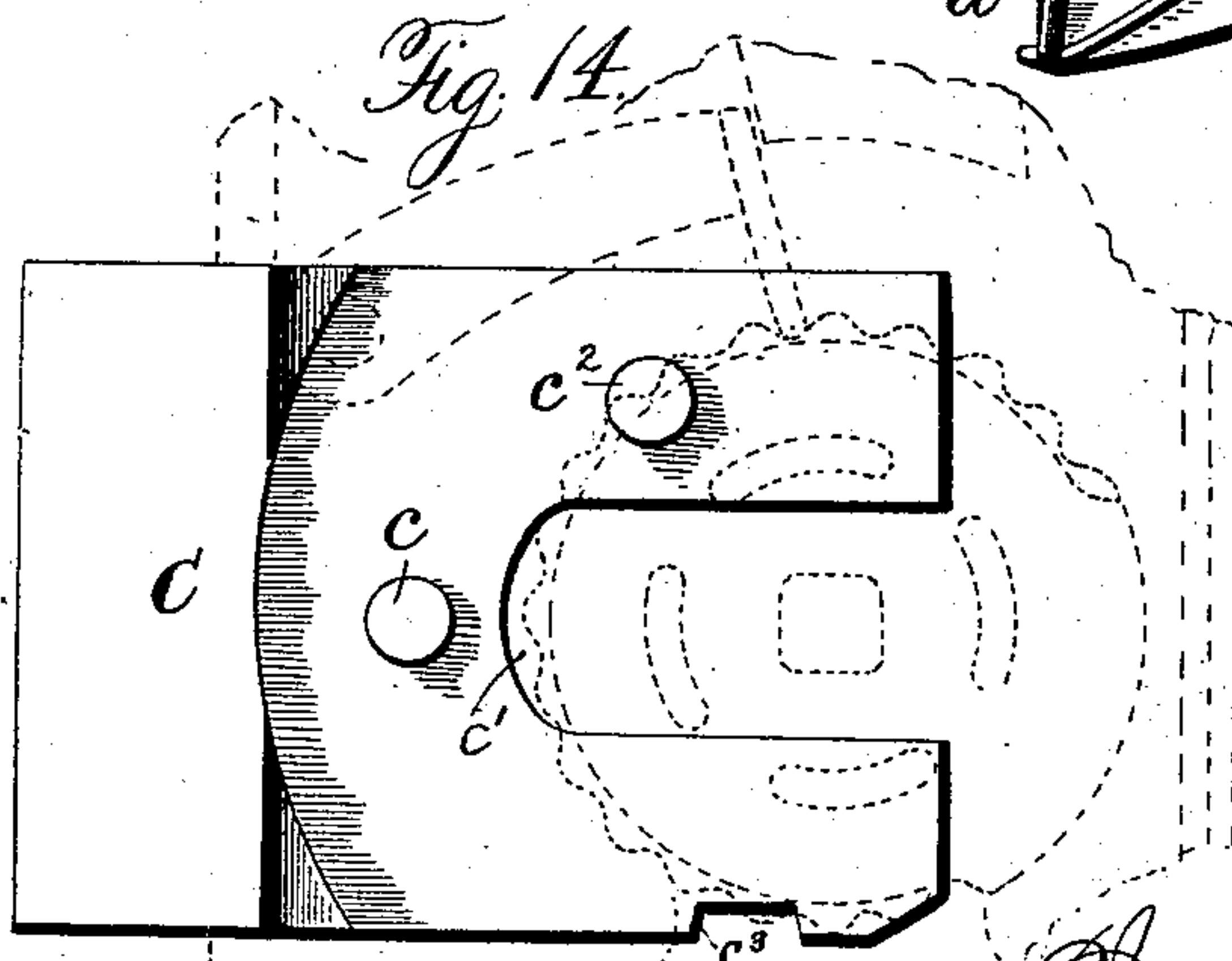
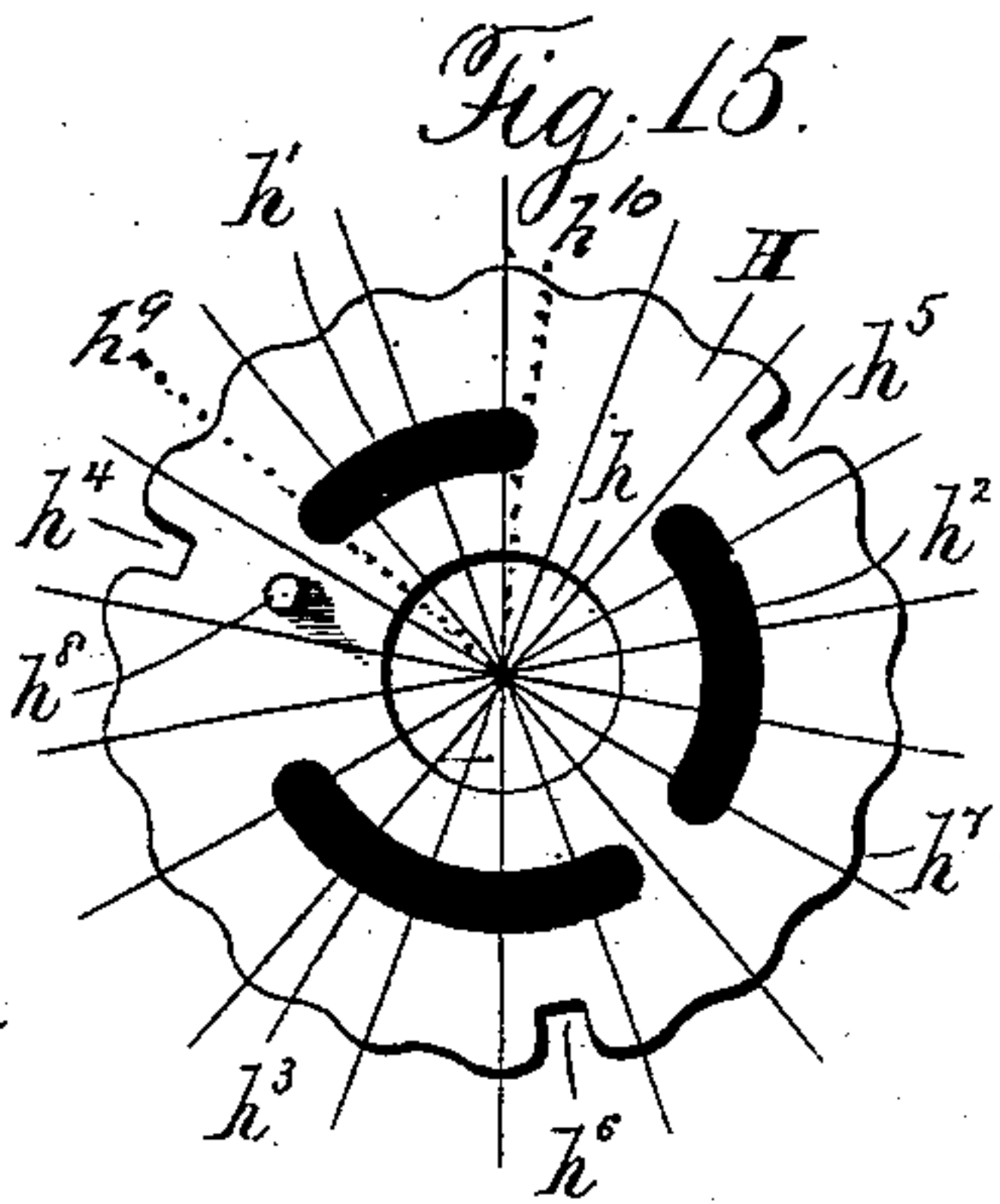
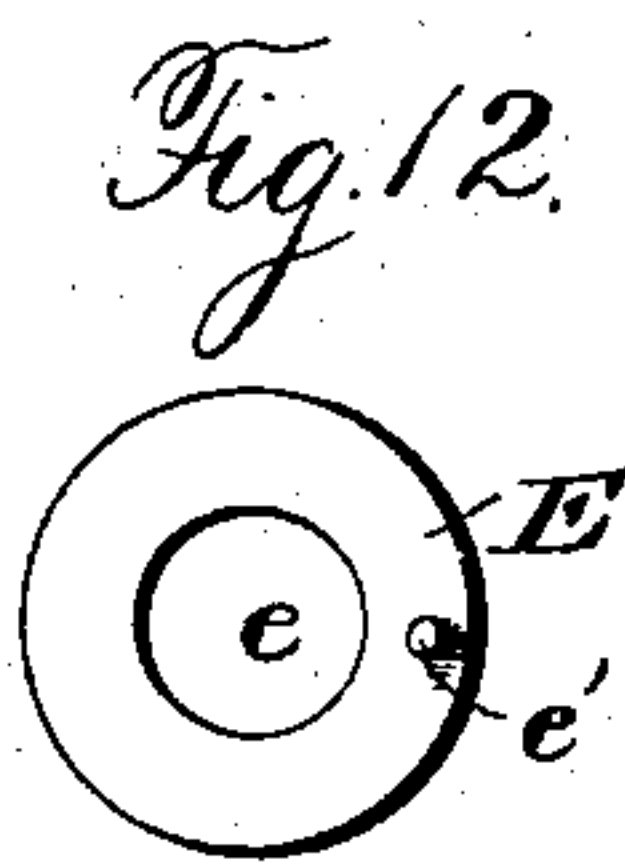
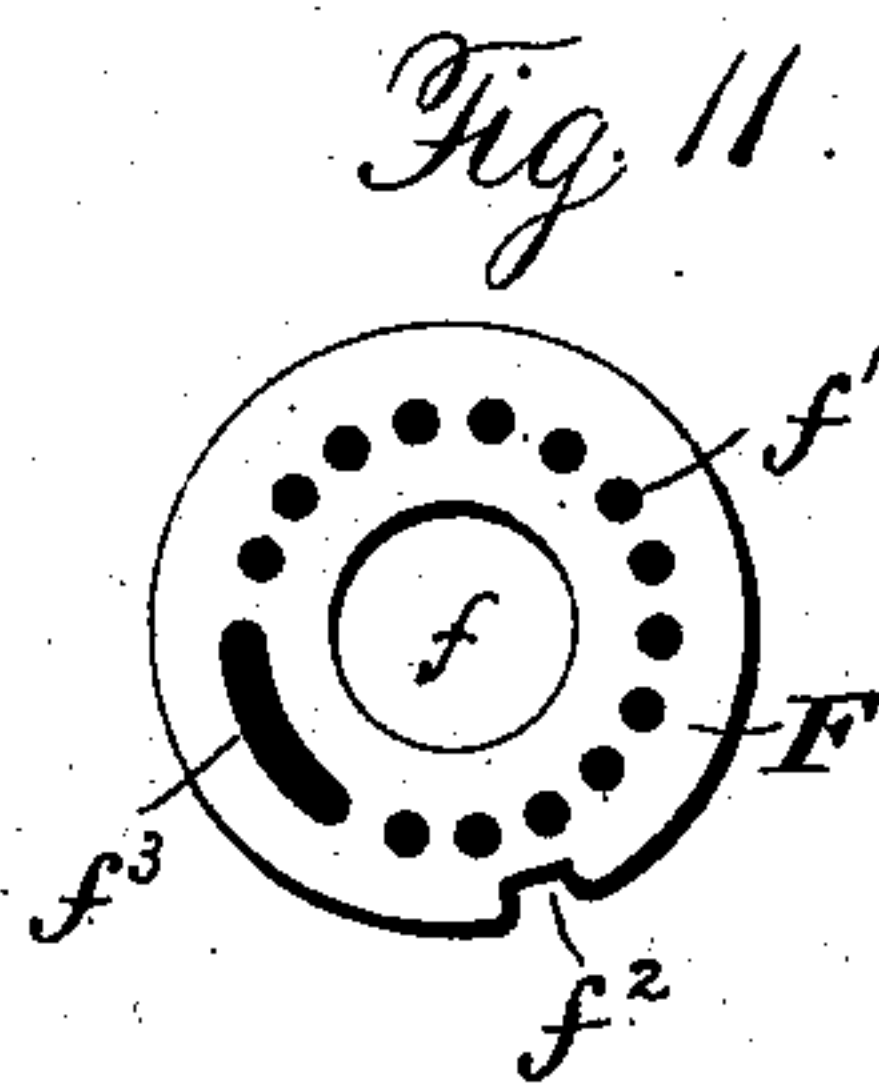
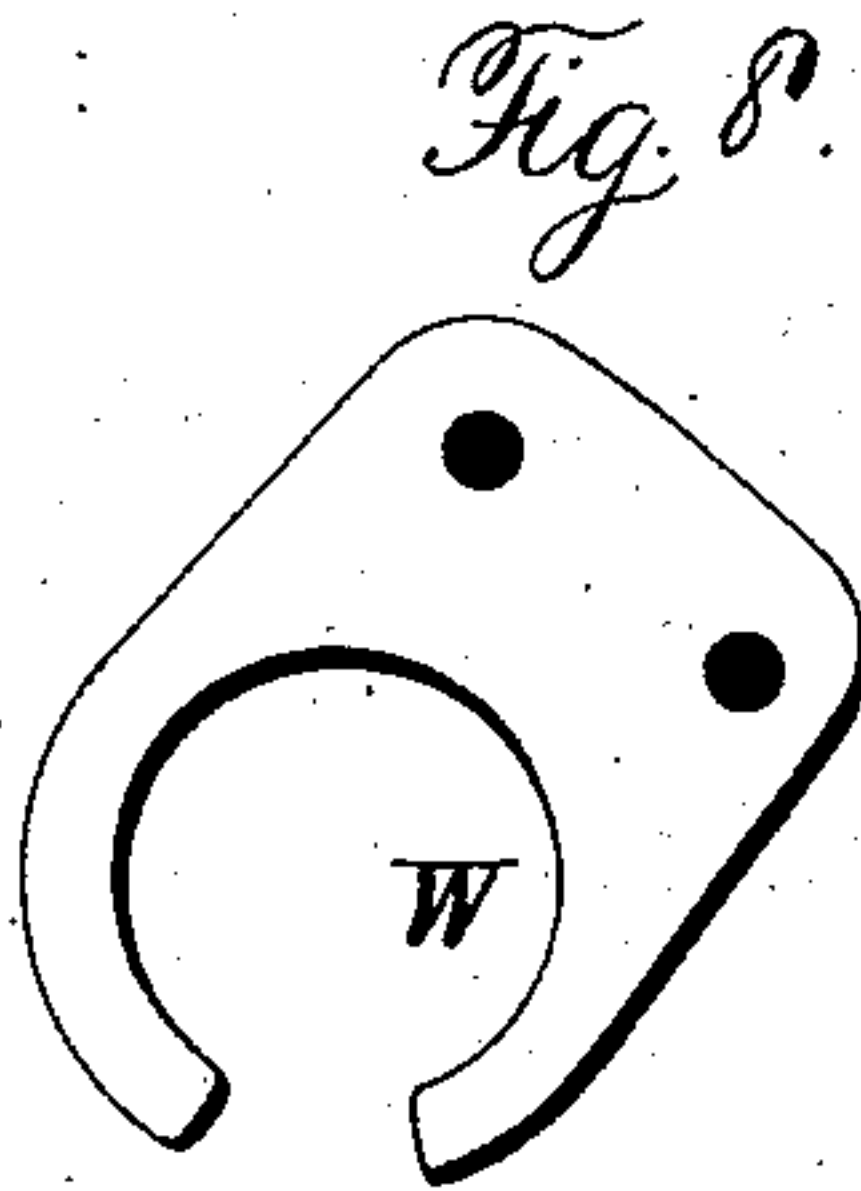
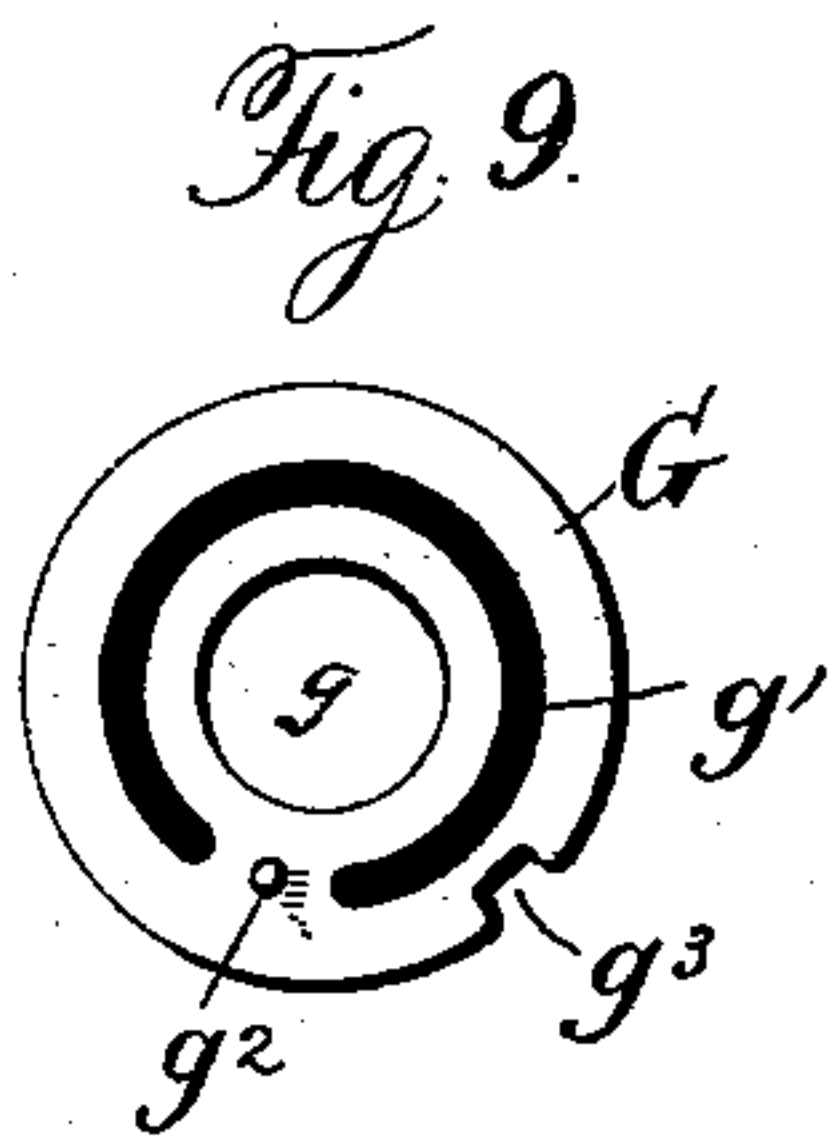
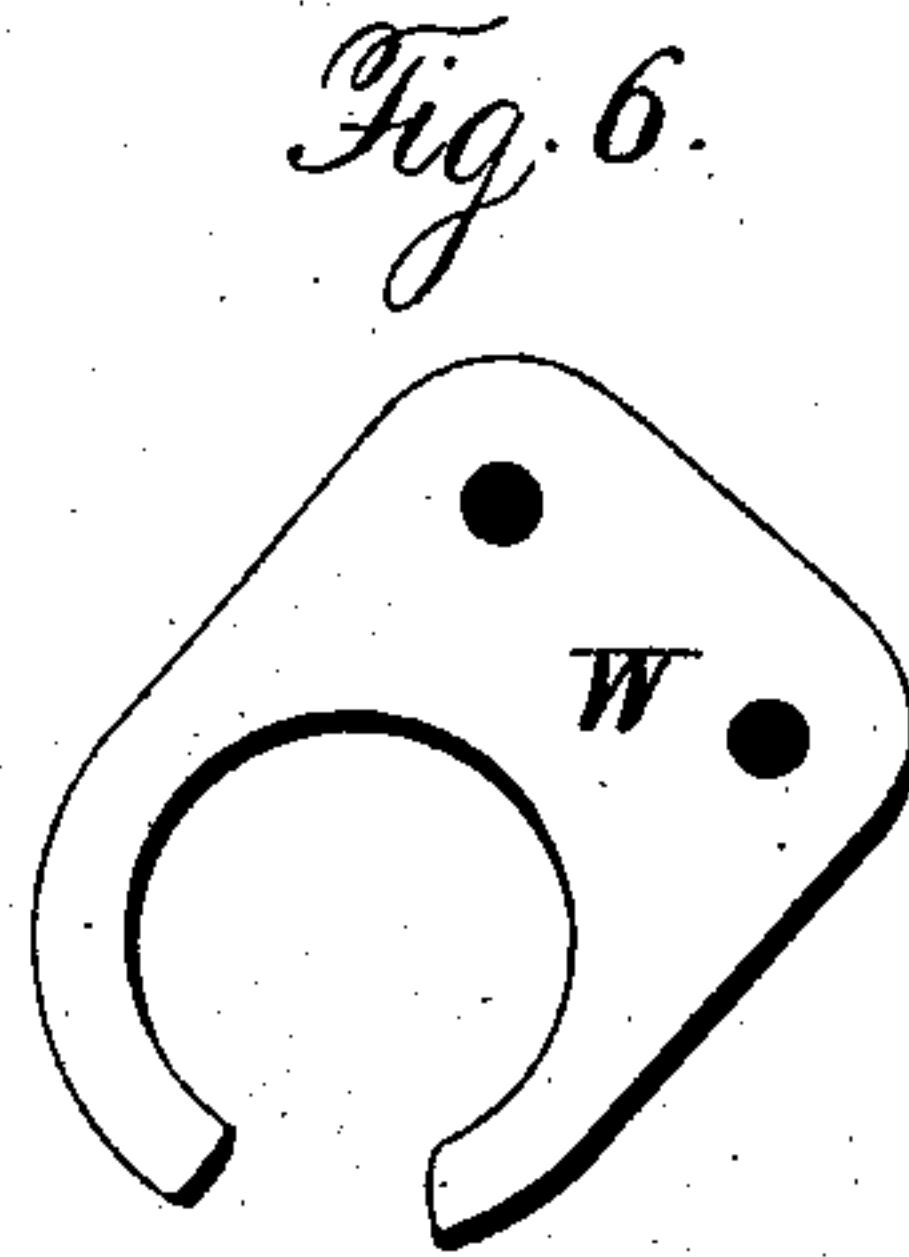
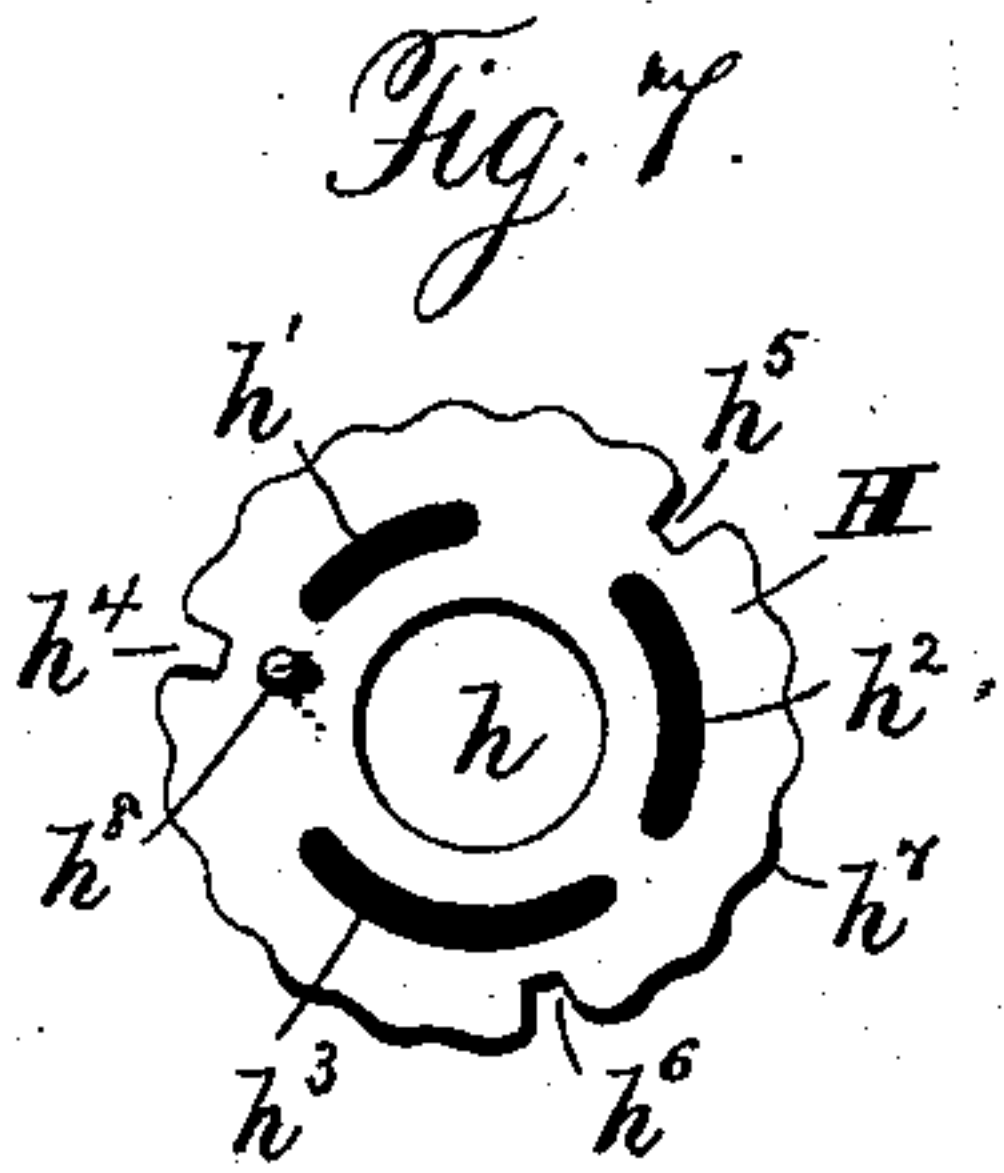
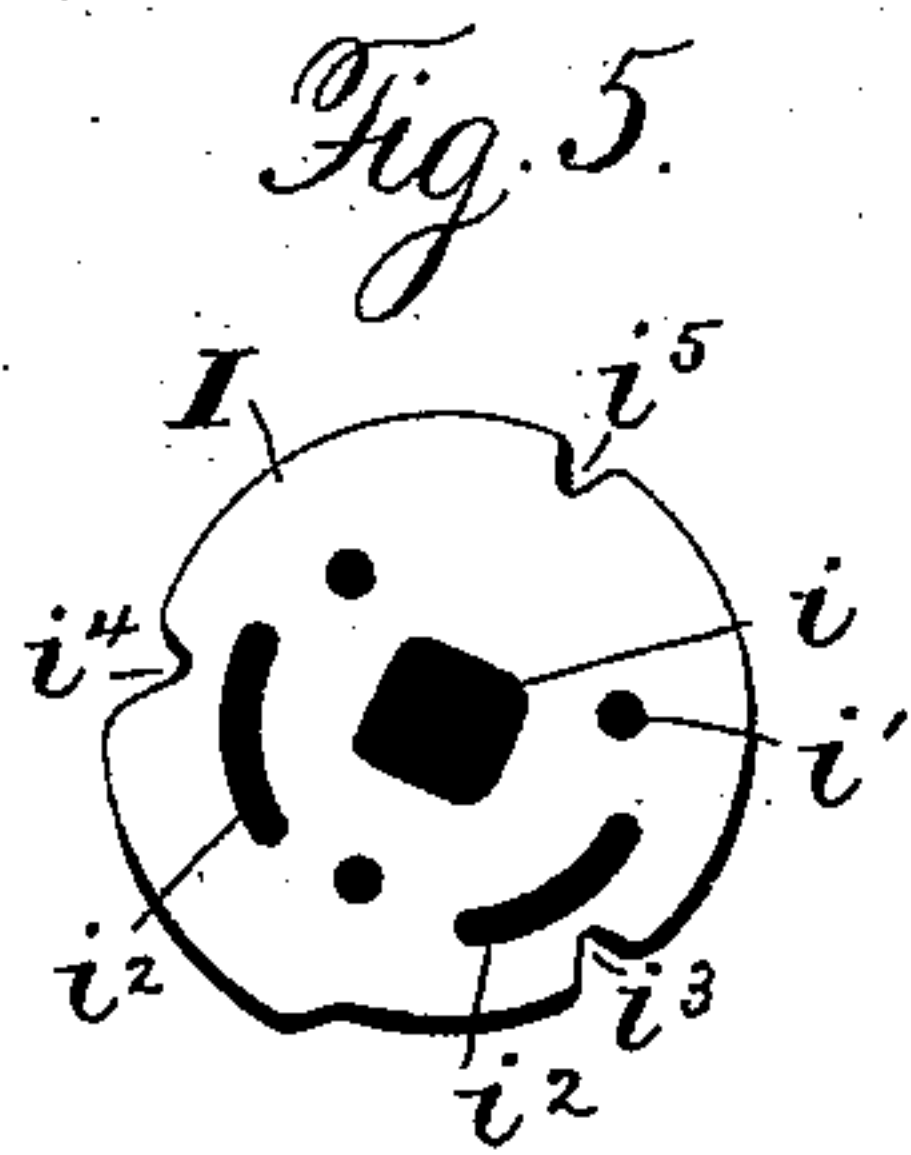
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J. D. CRAIG.  
COMBINATION LOCK.

No. 491,158.

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# UNITED STATES PATENT OFFICE

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## COMBINATION-LOCK.

SPECIFICATION forming part of Letters Patent No. 491,158, dated February 7, 1893.

Application filed May 28, 1891. Serial No. 394,354. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES D. CRAIG, a citizen of the United States, residing at Rogers Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Combination or Permutation Locks, of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a plan view of the lock, the cap plate of the casing being removed, showing the operative mechanism of the interior of the lock, the bolt being projected and the tumbler key about to be thrown out of engagement from within the radial registering notches in the peripheries of the tumblers. Fig. 2 is a similar view excepting that the bolt is drawn within the casing, and the tumbler key is held in engagement within the aforesaid radial notches under the changed condition resulting from the opposite rotation of the cam plate, the engagement of the key being maintained by an adjacent flange until a reverse movement of the cam plate again projects the bolt and relocks it in its most outwardly thrust position. Fig. 3 is a sectional view taken on the line  $x-x$  of Fig. 4. Fig. 4 is a rear elevation view of the lock casing with the operating hand knob attached, showing the position the lock would occupy (when constructed as a rim lock) on a door,—the lower part of the case being broken away to show the construction of a “dead” lock slide catch. Figs. 5 to 14 inclusive, are plan views in detail of the various operative parts of mechanism to be assembled in the lock case about the standard, which latter is considered as projecting upwardly in Figs. 1 and 2, the said parts being designed to be put together in the reverse order of their being numbered. Fig. 15 is an enlarged plan view of the index tumbler.

Heretofore the aim of inventors of combination locks, appears to have been chiefly devoted to devising constructions designed to baffle the efforts of the lock picking expert and the burglar without a pronounced aim at economic modes of construction. In my invention I have kept the primary object of difficulty of picking steadily in view, while also directing due attention to the produc-

tion of a combination or permutation lock embodying structural simplicity and economy.

My invention relates to that class of locks known as combination or permutation locks, it being, more especially, an improvement on the lock for which Patent No. 408,795 was granted me, August 13, 1889.

It has for its objects to provide a construction wherein a tumbler is possessed of a slot or slots in its body of such peculiarity of termination as to render it a matter essential to finding a combination that a certain direction of commencing the rotation of the driver tumbler be practiced, according to which side of said tumbler is upper most in assembling the parts on the standard. Also, to provide a driver tumbler of such construction as to throw the tumbler key out of engagement therewith and out of the other tumblers at the termination of the locking movement. Also, to provide a driver tumbler having an elevated peripheral part for the tumbler key to have a slight frictional bearing upon and to count from, which tumbler shall be entirely independent in character from the index tumbler, and is additional thereto; also to provide a construction whereby the locks may readily be made, as it were, “rights” and “lefts” by having the cam plate carrying the dog of such peculiarity of form as to render the same practically reversible. Also, to provide the cam plate with two entirely different cam faces for operating on different parts of the sliding bolt, in the economizing of space around the standard and between circumscribing flanges or parts.

The invention consists of the various constructions and combinations of parts as expressed in the claims.

A is the base-plate of the lock case provided with a right-angled flange or rim  $A'$ , extending entirely around its edges excepting where an opening  $A^2$  is left for the end of the bolt C to lie within and be projected through. The base-plate has two curved flanges  $a$ ,  $a'$  arising from its interior, they preferably being cast integral therewith, the front portions  $a^2$  of the flanges being just sufficiently near each other to afford a passage way between them for the bolt C. The curved flange  $a'$  is provided with a top plate  $a^3$  having an inner



curved face  $a^4$ , to occupy a position immediately in the rear of the back of the key  $d^4$  when it is rotated in the act of locking and unlocking, in order to securely hold the key in engagement with the tumbler notches until such time as it is desired to throw it out of engagement in throwing off the combination.

B is a hollow standard rigidly affixed to the base-plate A, or formed integrally therewith, having a shouldered base portion  $b$ , and a smaller super-base portion  $b'$ . The lower enlarged or base portion  $b$  of the hollow standard is designed to occupy a position in the slot  $c'$  of the bolt C and afford a guiding bearing for the inner forked end of said bolt, while the super-base portion  $b'$  is designed to receive all the tumblers (it being of circular form in cross-section), and afford a bearing for them to rotate about, excepting the top or driver tumbler which is provided with a central opening of rectangular shape for positive engagement of an interior rotary bolt  $B'$  that is squared in its upper part  $B^2$ , to correspond, and rigidly secured by a screw  $B^3$ , to the knob O that operates the locking and unlocking mechanism on turning the same by hand. The bolt C is provided with a pin  $c$  for the outer cam face of the cam-plate D to bear against in projecting the bolt, and with a pin  $c^2$ , for the curved bearing face that is, the concaved part  $d^8$  bordering the slot  $d^7$  in the cam plate to bear against in retracting the bolt. The cam-plate D has a circular aperture  $d$  which is of a size suitable for receiving therein the annular disk E, which latter rests on the top of the shoulder of the base portion  $b$  of the standard B and laps slightly over the interior edges of the forked end of the bolt C. The annular disk E has a central circular aperture  $e$  to fit around the super-base portion  $b'$  and turn thereupon, and also has a pin  $e'$ , projecting at right angles to its top surface, to engage in any one of a series of holes  $f'$  (or a slot  $f^3$  in the line of said series) of the annular disk F.

It will be observed that in assembling the parts as far as described, the bolt C is first placed in the lock case with its pin  $c$ ,  $c^2$ , up and its forked end inclosing the enlarged base  $b$  of the hollow standard B; then the cam-plate is placed thereupon, the slot  $d^7$  inclosing the pin  $c^2$  and with the tumbler key  $d^4$  immediately in the rear of the top plate  $a^3$ , and then the annular disk E is placed upon the top or shouldered portion of the base  $b$  of the standard B, the central opening  $e$  allowing its fitting around the super-base  $b'$ , the outer portion of the annular disk E fitting snugly within the central circular aperture  $d$  of the cam plate D. Then the annular disk F is placed on the standard B, its central aperture  $f$  allowing it to inclose the super-base  $b'$ , the pin  $e'$  being passed up through either one of the holes  $f'$  or through the slot  $f^3$  in the said annular disk F which latter is placed directly upon the top surface of the

annular disk E. After this comes the first washer W.

The parts E and F make up, when put together, the first tumbler, as in the patented lock above referred to, the only difference in the construction of the said parts being that the annular disk F is provided with a slot  $f^3$ , in the line of its series of holes  $f'$ , instead of there being only a series of holes. The pin  $e'$  of the first tumbler E F (the two-part tumbler) may be placed in any one of the series of holes  $f'$  or in the slot  $f^3$  of the part F of said first tumbler, and the pin  $e'$  is made of such length that notwithstanding the first washer W is placed immediately on top of the first tumbler E F, and between that and the second tumbler G, that its upper end will take operative bearing in the arc-shaped slot  $g'$  of said second tumbler, the said slot being of sufficient width to allow the pin  $e'$  to freely travel therein to an operative position,—at one end or the other of said slot. The annular disk F is provided with a radial notch  $f^2$  in its periphery for the tumbler key  $d^4$  to engage in. The tumbler G is provided with an arc-shaped slot  $g'$ , a pin  $g^2$ , and a radial notch  $g^3$  substantially as in the patented construction, having a central opening  $g$  allowing it to fit around the super-base  $b'$ , and serves as a second tumbler in the same manner. Upon the second tumbler is placed the second washer W. Then comes the third tumbler H, which is serrated and notched throughout its entire periphery—this being an index tumbler without any smooth peripheral surface portion,—either elevated or otherwise. It is shown as provided with three arc-shaped slots  $h'$ ,  $h^2$ ,  $h^3$ , in its body, and three radial notches  $h^4$ ,  $h^5$ ,  $h^6$ , in its periphery, and five serrations  $h^7$  between each two radial notches,—passing from one to the other around the tumbler. Its central opening  $h$  allows it to fit around the super-base  $b'$  of the hollow standard. It is not intended to limit the arc-shaped slots, the radial notches or the serrations to the precise numbers shown.

It will be observed that the arc-shaped slots  $h'$ ,  $h^2$ ,  $h^3$ , have the one corresponding end of each so placed that the pin  $g^2$  of the tumbler G will come either below the hollow portion of a serration (the depressed part or hollow between each two contiguous teeth) or below a radial notch when placed operatively in that particular end of each of said arc-shaped slots. In other words, when the pin  $g'$  is in that end of either of said slots it will be on the same radial line either with the hollow of a serration or with a radial notch. In the illustration given in Fig. 7, it would only come beneath a single radial slot in said particular end,—as would be the case when the pin  $g^2$  is in the arc-shaped slot  $h^2$  at the end thereof nearest the arc-shaped slot  $h'$ . The other end of each of said arc-shaped slots will not allow the pin  $g^2$  engaging operatively therein to come directly beneath either the hollow of a



serration or the apex of a tooth, but half way between.

It will be further observed, that the radial notches  $h^4, h^5, h^6$ , come directly in what otherwise would be the hollows of regular serrations. The result of this construction is that when the lock is set on a combination, the tumbler key will drop and hit between the top and the bottom of a serration when the knob is turned in one direction, providing it would no so hit if turned in the other, in an attempt to get or find the combination; and as no one, without previous knowledge as to which direction to commence turning to get the combination,—can obviate the liability of being frustrated, it adds an embarrassing obstacle to one attempting to pick the lock. This index tumbler is reversible, it only being necessary to have the pin  $h^8$ , put in to project on the other side, and hence its adaptability for furnishing combinations is thereby doubled.

In the enlarged view Fig. 15, of the index tumbler H, the latter is considered as divided into eighteen measurement sectors whereby to measure to the eye at a glance the lengths of the slots  $h', h^2, h^3$ , this number representing the sum of the serrations and the radial notches. It will be observed that the pin  $g'$ , placed in one end of the radial slot  $h'$  would be beneath the hollow of a serration, while at the other end it would neither be directly beneath the apex of a tooth nor the hollow between the teeth in the series of serrations. The peculiarity of one particular end of each arc-shaped slot falling beneath the hollow of a serration or a radial notch, and the other end presenting the confusing features above described, will be apparent, also, on inspection of the arc-shaped slots  $h^2$  and  $h^3$  in said enlarged view. While one corresponding end of each of the slots  $h', h^2, h^3$ , is thus shown as being directly beneath the hollow of a serration or the central point of a radial tumbler key notch, it is not intended to limit the use of those slots to commencing at such points,—nor to ending precisely as shown and described. Corresponding ends should preferably have similar relations to depressions in the periphery (of the tumbler) in the immediate vicinity, or nearest the radial lines passing through said ends and continuing to the periphery. Furthermore, it is not intended to limit the said slots  $h', h^2, h^3$ , to precise arc-shaped slots, as they might be rectangular, or oblong and still answer to allow the travel of a tumbler pin therein and to work effectively.

In geometry, a segment of a circle is defined as "a portion of a circle bounded by an arc and its chord;" and a sector of a circle as "a portion bounded by two radii and the arc they intercept." The part of the index tumbler that I denominate as segmental part of a sector, is not the part of a circle, known as a segment of a circle, bounded by an arc and its subtending chord, but the outer or larger

part or end of a sector severed from the rest by an intervening slot said to subtend said outer part, and cutting the sector into two parts at some point interior to its chord and, preferably, at a point about midway between the sector's arc-bound end and its inner or smaller end.

In general terms, I define a certain part of the index tumbler as being a segmental part of a sector thereof subtended by a slot in the body of the index tumbler,—meaning thereby that it is that part (or segmental part) of a sector included between the two radial lines that pass through the ends of said slot (either of the arc-shaped slots  $h', h^2, h^3$ ) and located exteriorly to said slot; in other words, that part of the sector between the slot and the peripheral arc of said sector;—and said "ends of the slot" through which the radii pass are to be regarded not as the extreme terminal points of the slot, but as the points at which the axis line of the pin  $g^2$  is located when the said pin is placed in its operative position at either end of said slot. The slot is therefore not spoken of as subtending a segment,—because the slot does not terminate in the arc of the circle forming the circumference of the index tumbler, and is not consequently a chord,—but as subtending (cutting below) a segmental part of a sector of the index tumbler; and the arc of said sector is to be regarded as being one passing through the bases of the teeth or projections resulting from the production of the serrations and the radial notch or notches in the index tumbler, or, in other words, as being the arc of a sector coincident with a part of the arc of a circle passing through the innermost points of the peripheral depressions.

On further inspection of the enlarged view of the index tumbler H, as represented in Fig. 15, wherein a diagrammatic illustration of said tumbler (as divided into eighteen measurement sectors of equal size by means of radial full lines) is presented, it will be observed that the smallest segmental part of a sector subtended by a slot is the part above the slot  $h'$ , and further bounded by the radial dotted lines  $h^9$  and  $h^{10}$ , and the arc which said radial dotted lines intercept. And it will be further observed, that the slot  $h'$  cuts entirely through two of said measurement sectors and partly through two more measurement sectors, the left hand end of the slot  $h'$  extending so far into the partly cut measurement sector at that end as to allow the pin  $g^2$ , when engaging operatively therein, to come directly beneath the hollow of the nearest serration above. The other end of the slot  $h'$  extends so far into the partly cut measurement sector at that end, as to allow the pin  $g^2$ , when engaging operatively therein, to come directly beneath an intermediate portion of the periphery of the index tumbler between a hollow of a serration and an apex of a tooth of a serration, that is, half way between. Accordingly, the part above the slot  $h'$ , and included between the two ra-



dial dotted lines  $h^9$  and  $h^{10}$  (said radial dotted lines extending through the ends of the slot  $h'$  at those precise points wherein the axis line of pin  $g^2$  would be when said pin comes into operative engagement at either end of said slot) is a segmental part of a sector, and the slot  $h'$  is one subtending (between the dotted lines  $h^9$  and  $h^{10}$ ) the said "segmental part of a sector." The peripheral arc of the said segmental part of a sector, it is apparent on inspection, does not correspond in length to the distance between any two serrations,—or to the distance between the hollow of a serration and a radial notch anywhere in the tumbler's circumference. The same peculiarity exists in each of the other segmental parts of sectors of the index tumbler H, subtended by the slots  $h^2$  and  $h^3$ . The driver tumbler I has a rectangular central opening  $i$  allowing it to fit upon the squared portion  $B^2$ , of the spindle bolt  $B'$  connected to the knob O. It has two arc-shaped slots  $i^2$ , in either of which the pin  $h^8$  of the index tumbler H may be placed, and it has three V-shaped notches  $i^3$ ,  $i^4$ ,  $i^5$ , in its periphery in either of which the tumbler key may engage at the time of locking and unlocking. Being the last tumbler it is not provided with a pin as a part thereof, and is reversible, thus doubling its capability of producing combinations. The tumblers G and H are reversible, it being, however, necessary in each case to change the pin of each to the other side. The part F is reversible, the pin  $e'$  of part E entering a hole or the slot from either side. By this feature of the reversibility of tumblers,—and of one part F of the two-part tumbler E F,—the capability of setting up the tumblers on a vast number of combinations is greatly increased over an arrangement not admitting of like reversibility of parts.

As indicated by dotted lines in Fig. 14, I may adopt a modification by which I can dispense with the cam-plate in certain instances, by pivoting the lever or dog carrying the tumbler key directly to the bolt, with the provision of a guard flange to hold its key in the notches of the tumblers until at the time of complete locking of the bolt. In this case I would depend on gravity, or a spring, to cause the tumbler key to drop into the registering tumbler notches.

I purpose constructing the operative parts of such form as to render them readily applicable for use in locks in making them "rights" or "lefts." The cam-plate is so made that by putting the pins, for holding the washers, to project from the opposite side shown in Fig. 13, and placing a pivoted spring lever, having a tumbler key, on the opposite side also,—a manufacturer may readily make use of said cam-plate in either a "right" or "left" lock case, while all the tumblers and washers would be as applicable in the one case as in the other.

Within the lower hollow portion of the knob O is a coiled spring P surrounding the squared

end  $B^2$  of the bolt  $B'$ , a pin passing through said bolt above the spring to keep it from slipping up thereon, the lower end of the spring resting on the top of the driver tumbler, I, and holding all the tumblers together under slight spring pressure. The bolt  $B'$  is passed up through the hollow standard B, the enlarged bolt head  $B^4$ , by its shoulder in taking a bearing against the outside of the case, affording a means of preventing the bolt from passing too far through and presenting also a bearing surface for rotation on the case.

The person using the lock depends principally on the sense of touch,—though he may, in some cases, use the sense of hearing as well, in order to find the combination, in counting the tremors of the tumbler key as the serrations of the index plate are rotated beneath said key, the mode of operation being similar to that employed in the patented lock above referred to. The tumbler key, in throwing off the combination in this case, does not need to be lifted out of the slots in the tumblers, but,—owing to the stand still or dead stop of the cam-plate at the moment of completion of locking, and the circumstance that the tumbler key has at that time just passed beyond the guarding action of the curved face  $a^4$  of the top plate  $a^3$ , (on the flange  $a'$ ),—the strain on the driver tumbler I causes the impinging bordering portion of whichever wedge-shaped or V-shaped notch thereof the tumbler key happens to be engaged in, to wedge or slide out said tumbler key,—lifting it thereby out of all the other registering tumbler notches, as well,—thus throwing off the combination.

A catch slide Q is provided with a friction spring  $q$  to keep it in place, and has a point  $q'$  to engage in the notch  $c^3$  in the underside of the bolt C. The said catch slide is not intended to dead lock the bolt when the door is locked, but is used when the door is unlocked, and it serves, in a measure, to prevent persons meddling with the lock when not in use.

Having thus fully described my invention and its mode of operation, what I claim is,—

1. A index tumbler having serrations and a radial notch or notches in its periphery, and provided with a slot in its body subtending a segmental part of a sector thereof whose peripheral arc does not correspond in length to the distance between any two serrations,—or the distance between the hollow of a serration and a radial notch, in combination with a bolt and with means for operating the tumbler.

2. An index tumbler having depressions in the form of serrations and a radial notch or notches in its periphery, and provided with two or more slots in its body, each of said slots subtending a segmental part of a sector thereof whose peripheral arc surface differs in length from the distance between the hollows of any two serrations,—or the distance



between the hollow of a serration and a radial notch,—the corresponding end of each of said slots sustaining a similar relation to the peripheral depressions, in combination with a bolt and with means for operating the tumbler.

3. A reversible index tumbler provided with serrations and one or more radial notches in its periphery, and having slots in its body to receive the pin of another tumbler, the corresponding end of each of said slots affording room for the pin to take operative position therein and have a similar relation to a serration depression or a radial notch depression in the periphery immediately above, the different ends of each slot being of different relation to immediately adjacent depressions in the periphery of the tumbler, in combination with a bolt and with means for operating the tumbler.

4. A driver tumbler connected with a knob, and provided with one or more tumbler key notches, and an index tumbler provided with serrations and a radial notch or notches in its periphery, and having slots in its body to receive a pin of another tumbler, the corresponding end of each of the slots having the same relation to adjacent depressions in the periphery while the other end of each of the slots has a distinctive relation of its own to adjacent peripheral depressions, in combination with a bolt and means for operating the tumbler.

5. A driver tumbler provided with one or more slots in its body, and having one or more tumbler key notches in its peripheral portion, and having a portion of the peripheral surface elevated above the rest, and means for positively engaging and turning said driver tumbler, in combination with an index tumbler, provided with serrations in its periphery and one or more radial notches therein.

6. A driver tumbler connected positively with a knob spindle, and provided with one or more tumbler key notches, and an index tumbler provided with serrations in its periphery and one or more radial notches, and having slots in its body to receive a pin of another tumbler, one corresponding end of each of said slots affording room for the pin to take operative position therein and be, at the same time, either beneath the hollow of a serration or beneath a radial notch while the other corresponding end of each slot will not allow the pin to take operative position therein, and be, at the same time, either beneath the hollow of a serration or beneath a radial notch.

7. A driver tumbler connected to a knob and provided with a tumbler key receiving notch or notches and with slots in its body, a reversible index tumbler provided with serrations and radial notches in its periphery, and slots in its body, in combination with one or more tumblers, a sliding bolt, a tumbler

key, and mechanism connecting the latter with the sliding bolt.

8. A driver tumbler provided with an elevated smooth arc surface and having a V-shaped notch in its periphery in combination with a bolt and with means for operating the tumbler.

9. A driver tumbler having a V-shaped notch or notches in its periphery, a tumbler having a notch or notches in its periphery, a sliding bolt, a tumbler key carried by a dog or lever, and a flange having a circular face bearing against the tumbler key.

10. A two-part tumbler, one part being an annular disk provided with a pin, and the other part an annular disk provided with a series of holes with a slot intervening, each of said apertures being adapted to receive the pin in combination with a bolt and with means for operating the tumbler.

11. A reversible cam-plate having an exterior bearing face and an interior bearing face, and provided with a central opening to fit around the base of the standard, in combination with a sliding bolt.

12. A reversible sliding lock bolt, and a reversible cam-plate in combination with a driver tumbler and one or more tumblers, each tumbler being provided with a tumbler key notch, in combination with a tumbler key and mechanism connecting the latter with the bolt.

13. A lock mechanism, in which all the single tumblers are reversible, in combination with a two-part tumbler one part of which is reversible, a sliding reversible bolt, a tumbler key and a reversible cam plate, and mechanism connecting the key and the cam-plate.

14. A driver tumbler having a tumbler key notch or notches, and a slot or slots to receive the pin of another tumbler, an index tumbler, a tumbler key, a dog or lever and mechanism connecting the tumbler key and a sliding bolt, and a catch piece for engaging the bolt.

15. A reversible index tumbler having serrations and one or more radial notches in its periphery, and a driver tumbler having a smooth arc-shaped elevated surface and a notch in the periphery and an arc-shaped slot in its body, in combination with a tumbler having a radial notch in its periphery, and a tumbler key carried on the end of a lever provided with mechanism connecting it with the sliding bolt.

16. A tumbler having a V-shaped notch in its periphery provided with inclined sides for throwing out a tumbler key, in combination with a bolt and a tumbler key and means for keeping the latter in the said notch while moving the bolt into locking position.

17. A tumbler having a V-shaped notch in its periphery provided with inclined sides for throwing out a tumbler key in combination with a tumbler key and means for holding the



latter in the notch during a part of the rotary movement of the tumbler.

18. A tumbler having a V-shaped notch in its periphery provided with inclined sides for  
5 throwing out a tumbler key, in combination with a tumbler having a notch in its periphery, and a tumbler key for engaging in the notch of each, and means for operating the tumbler key.

10 19. A cam-plate having an exterior bearing or cam face and an interior bearing or cam face, in combination with a sliding bolt provided with pins or projections for said cam faces to engage.

15 20. A base plate having interior flanges and

a standard between the flanges combined with tumblers mounted on said standard, the tumbler key, and means for operating the tumblers.

21. A base plate having interior curved  
20 flanges and a standard between the flanges combined with tumblers mounted on said standard, the tumbler key, and means for operating the tumblers.

In testimony whereof I affix my signature in  
25 presence of two witnesses.

JAMES D. CRAIG.

Witnesses:

CHAS. F. RENNE,  
GEO. C. LOWELL.