2 Sheets.
Sheet. 1.

E. R. Hopkins.

Lock.

No 57,508. Patented Aug 28, 1866.

Fig. 1

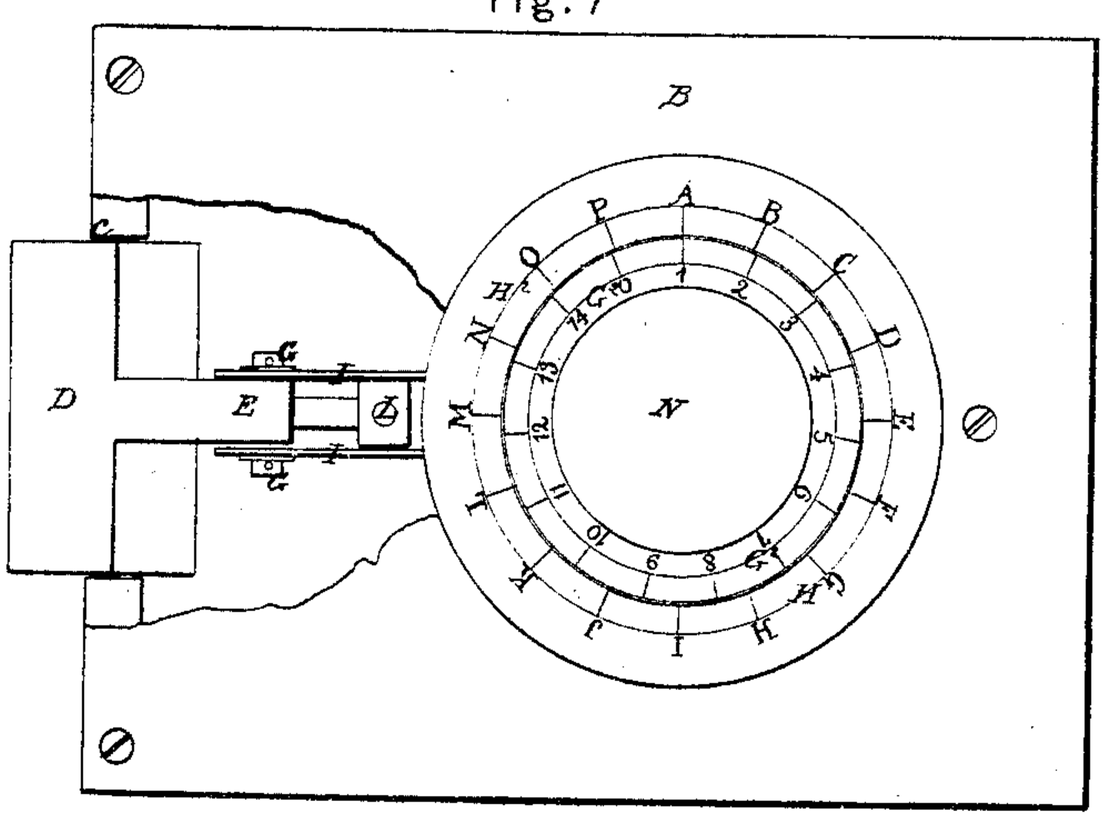
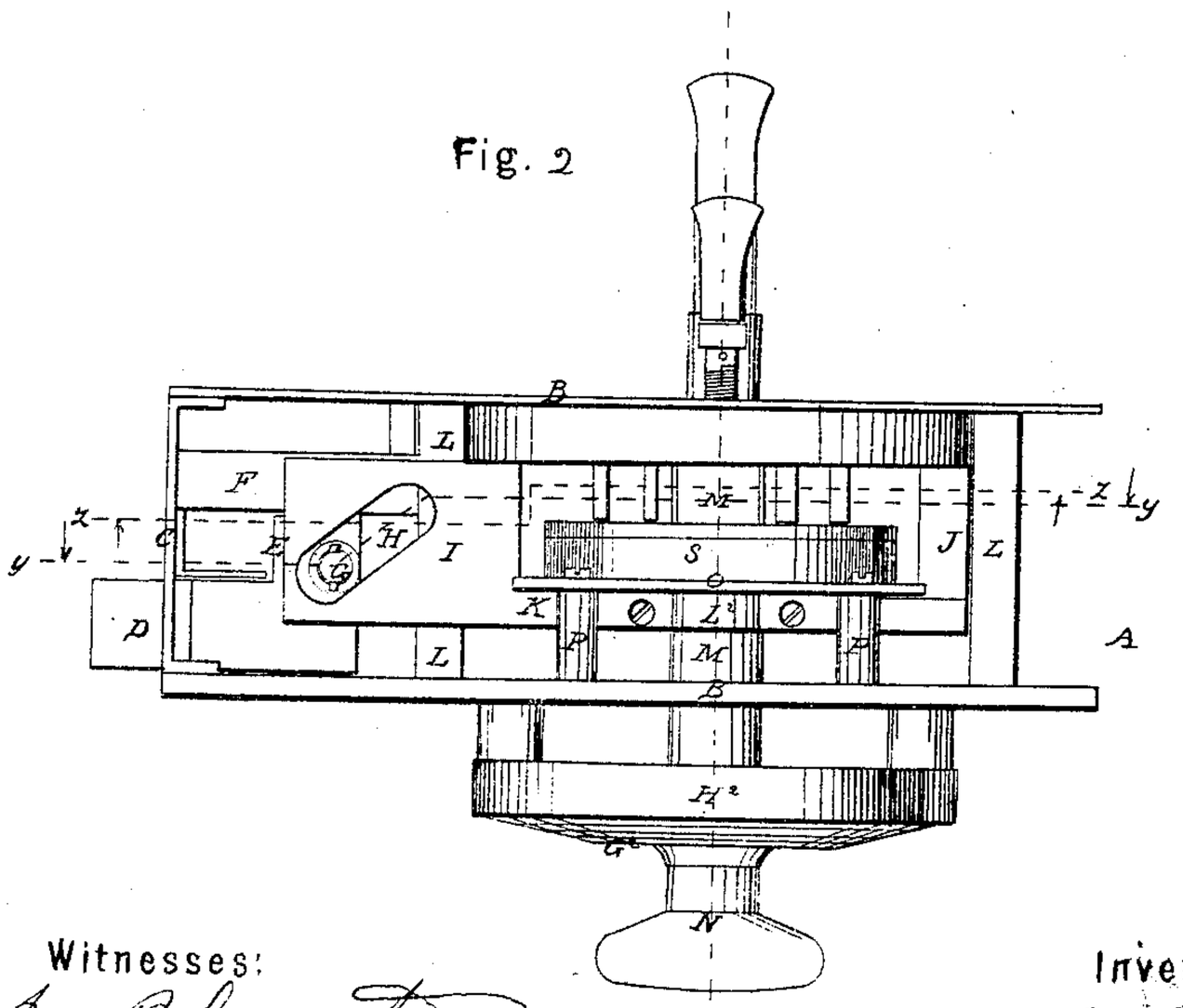


Fig. 2



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2 Sheets.
Sheet. 2.

E. R. Hopkins.
Lock.

No 57,508. Patented Aug 28. 1866.

Fig. 3

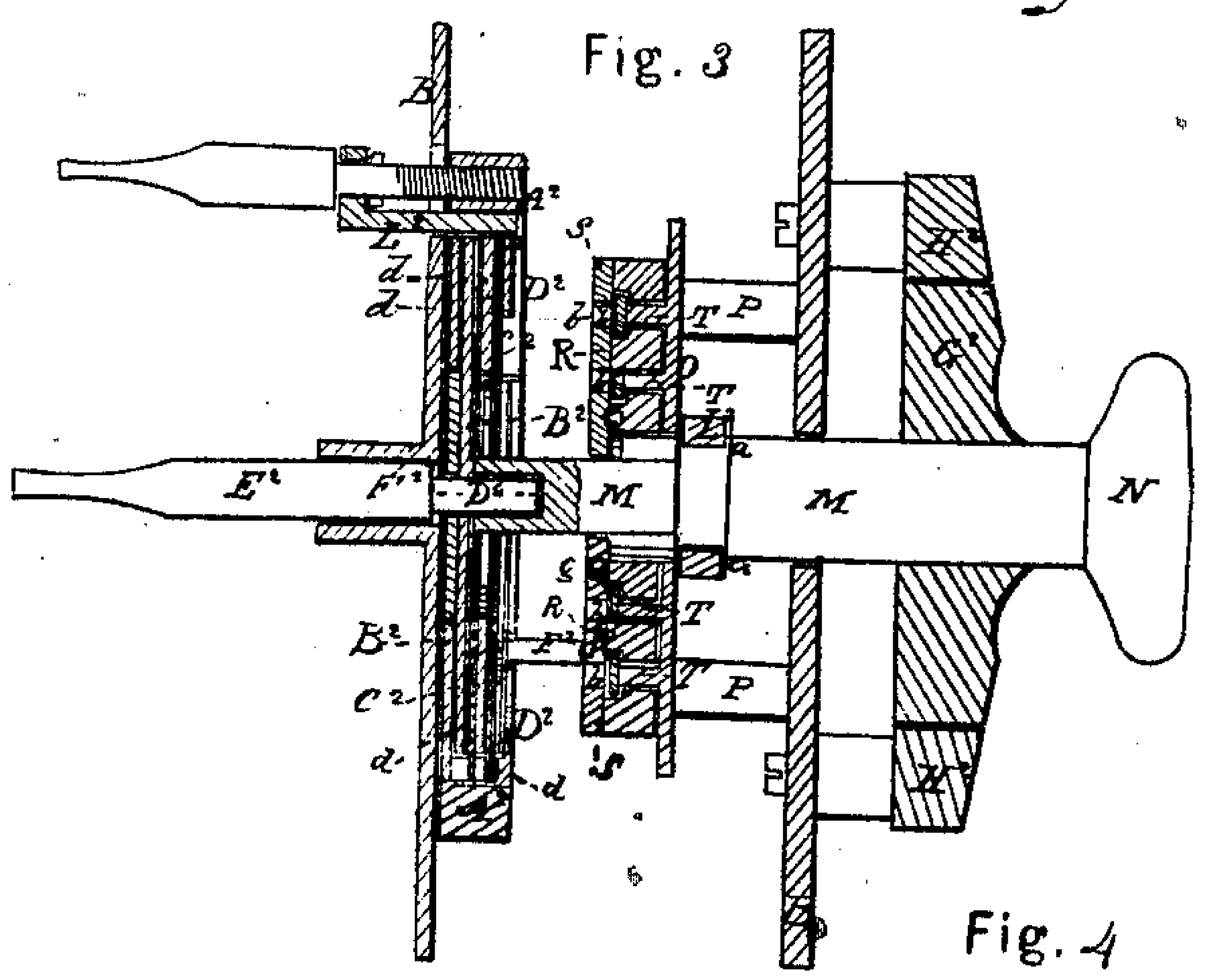


Fig. 3*

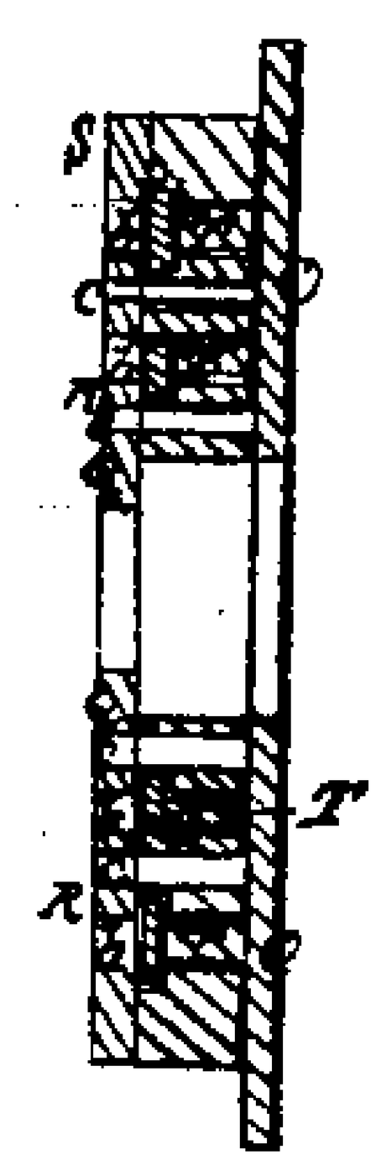
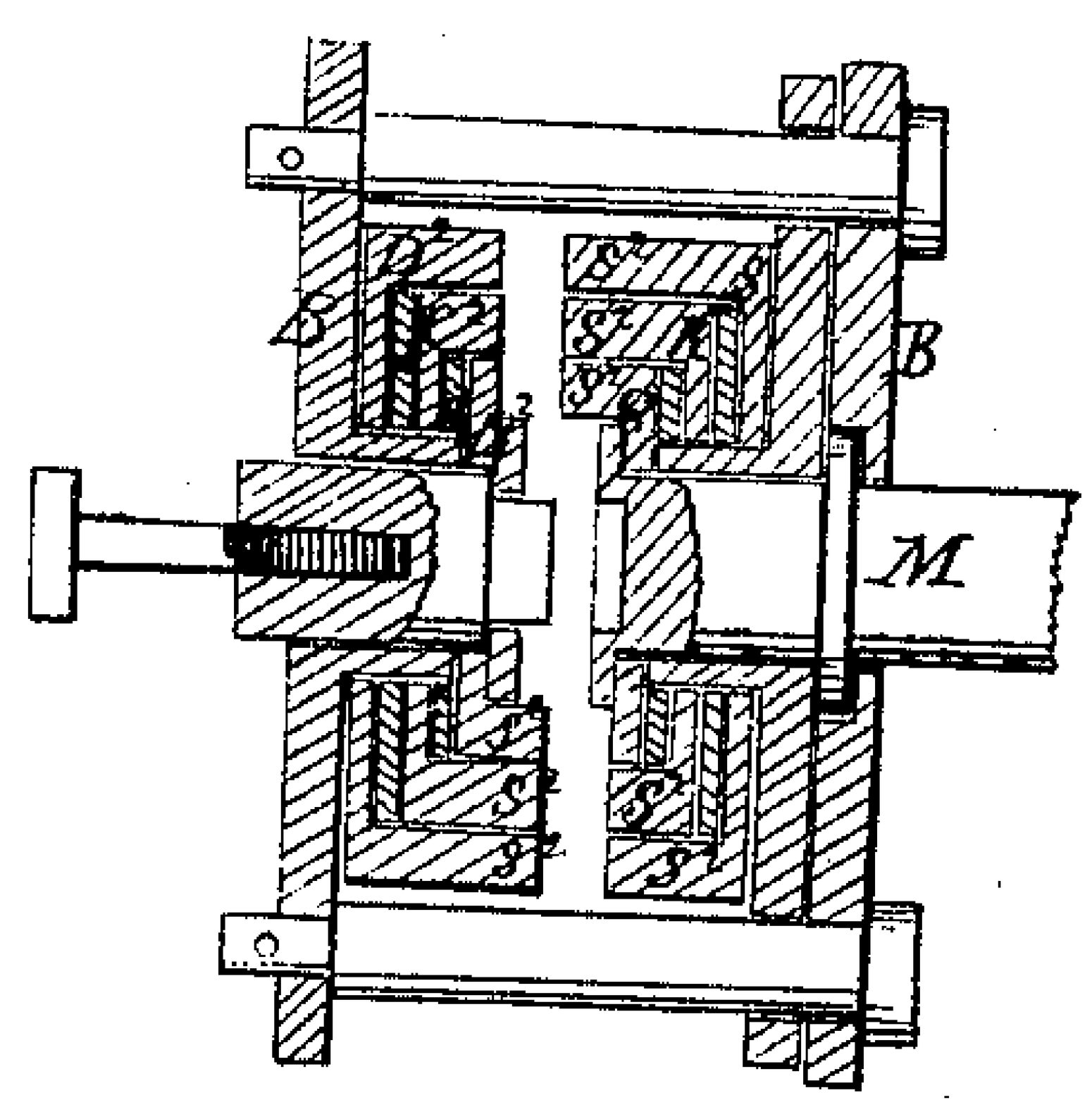


Fig. 4

Fig. 7



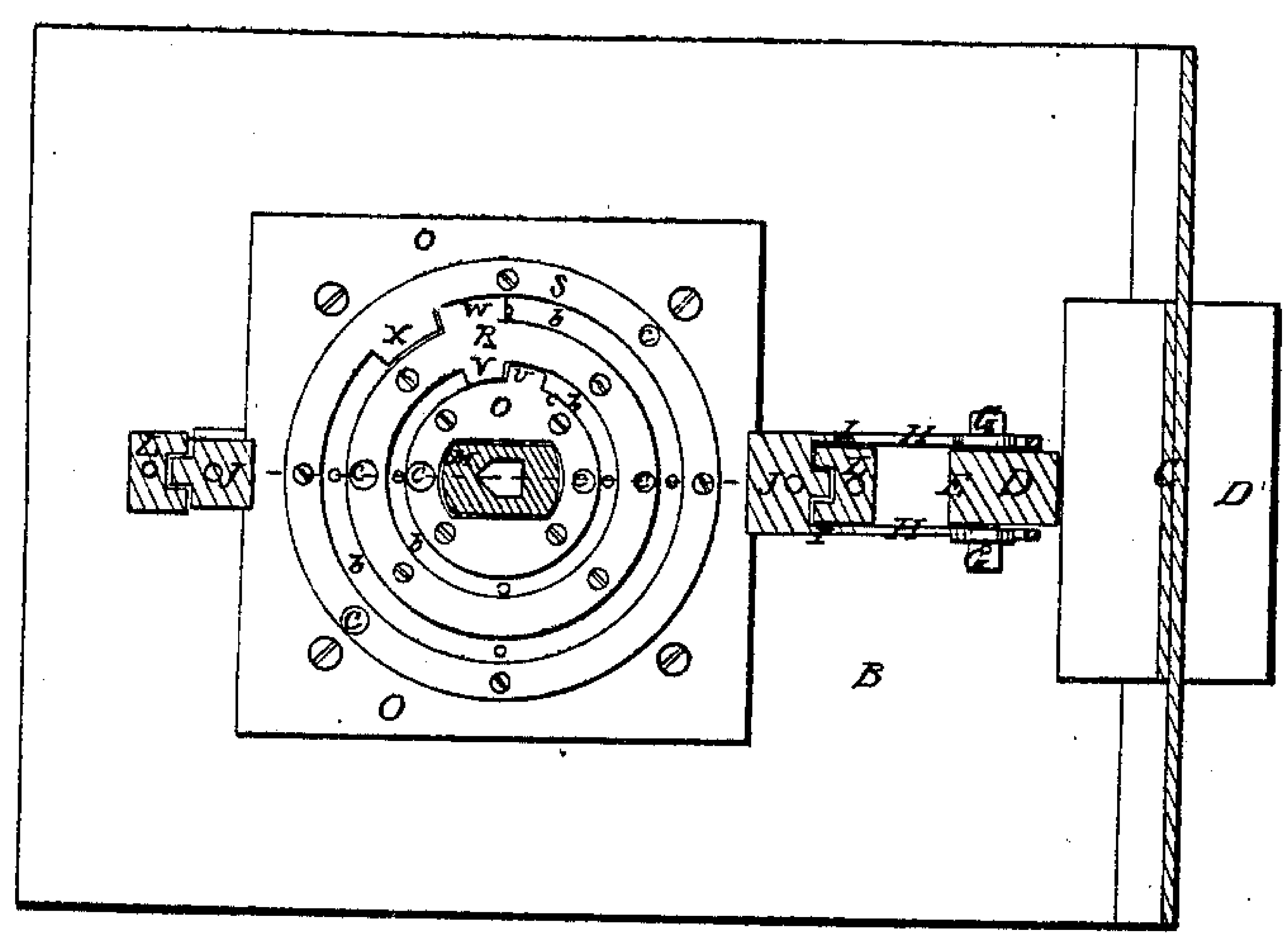


Fig. 5

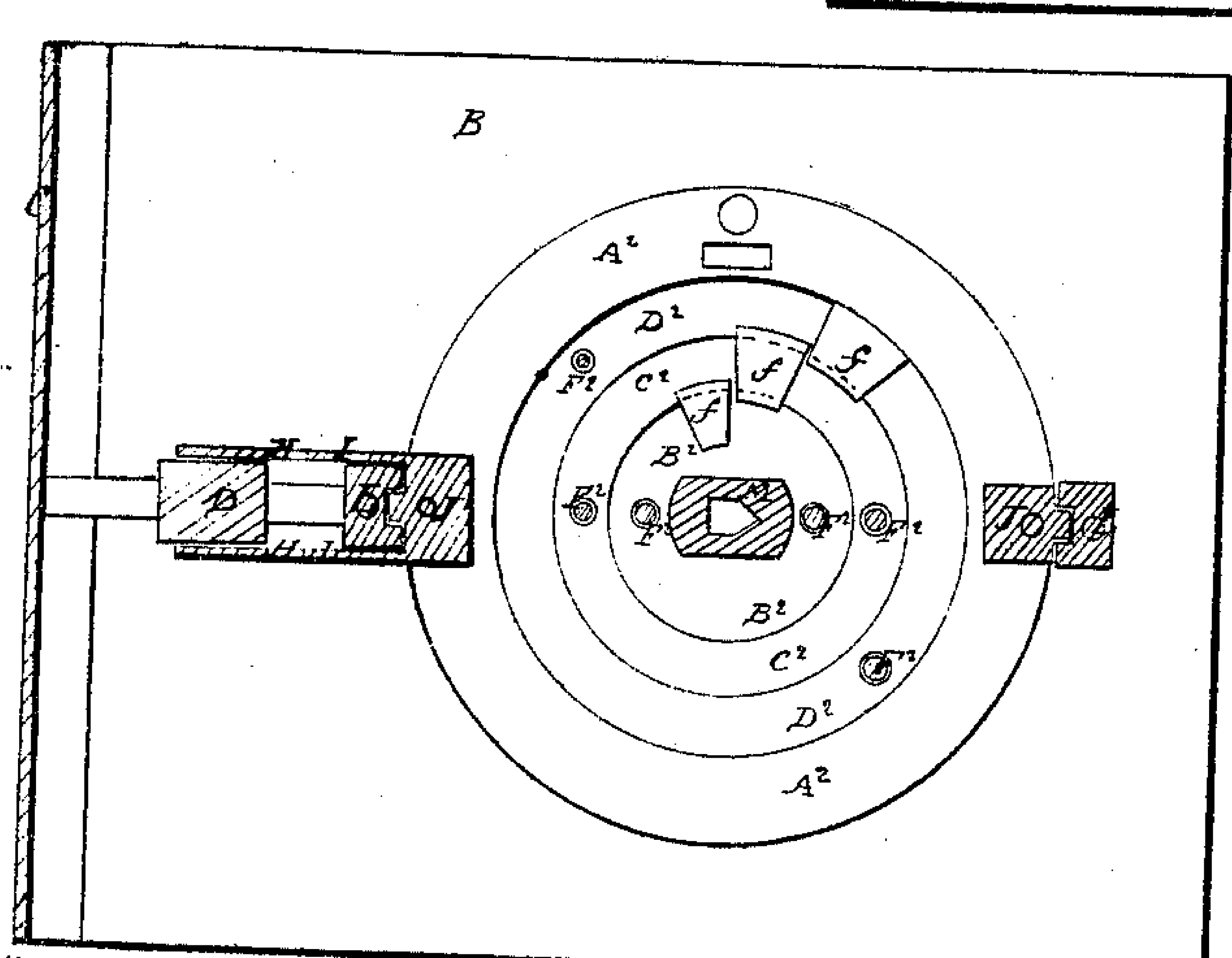
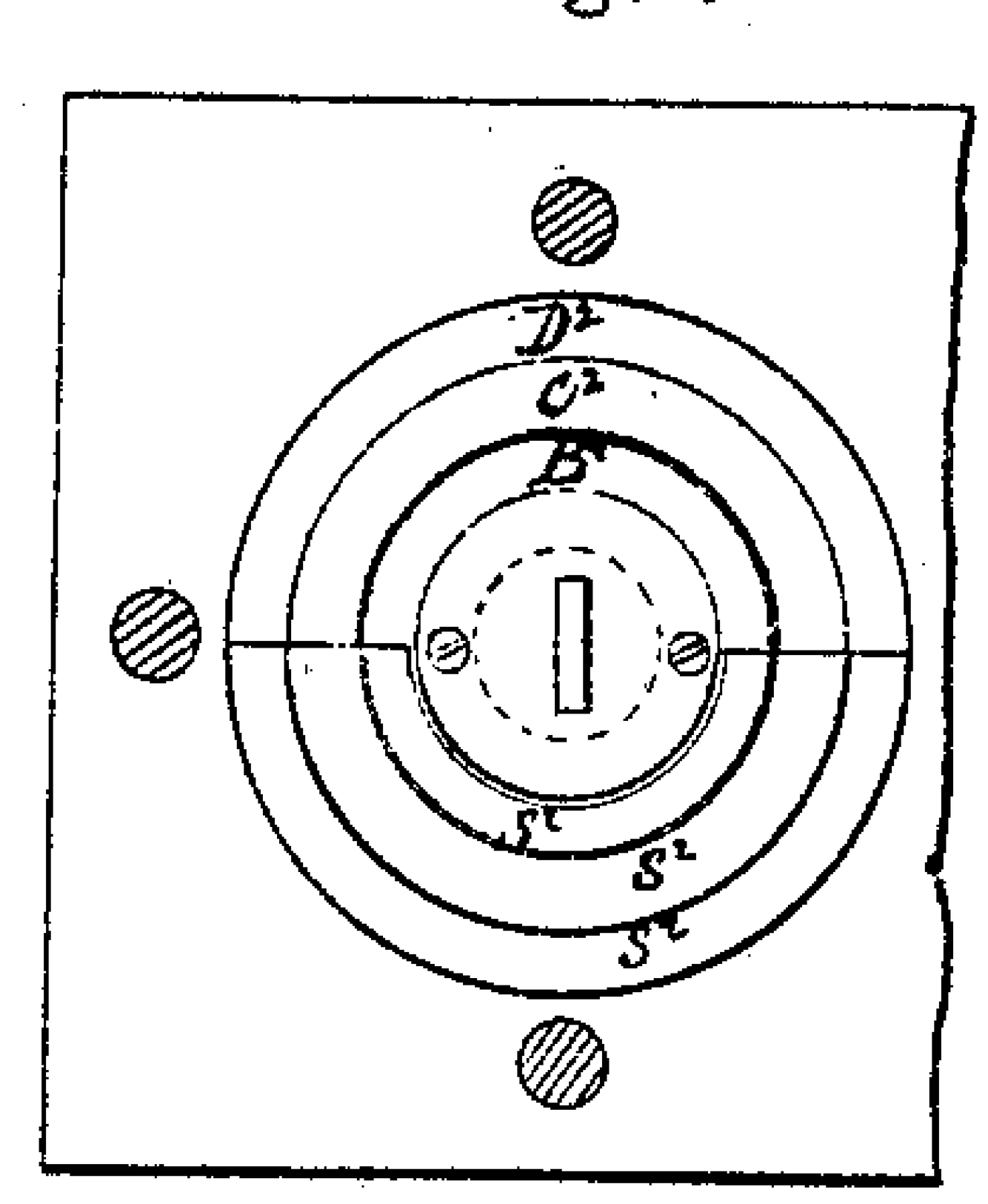


Fig. 6



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UNITED STATES PATENT OFFICE.

E. R. HOPKINS, OF NEW YORK, N. Y.

IMPROVEMENT IN LOCKS.

Specification forming part of Letters Patent No. **57,508**, dated August 28, 1866.

To all whom it may concern:

Be it known that I, E. R. HOPKINS, of the city, county, and State of New York, have invented new and useful Improvements in Locks; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming a part of this specification.

The present invention relates particularly to that class of locks familiarly and commonly known as "combination-locks," or, in other words, such locks as are susceptible of having the operating parts for throwing the bolt so set and adjusted with regard to each other that to unlock the lock it is necessary to perform a combination of movements corresponding to that performed in the setting of the locking devices.

In the lock embraced by this invention its bolt is thrown out or drawn in, as the case may be, by either pulling out or pushing in the handle or knob upon the outside of the lock-casing or the door in which the lock is fitted, said handle being suitably connected with said bolt to so operate it. With the shaft of this handle is so connected a series of vertically-arranged concentric rings (the inner one of which is attached to the said shaft in such a manner as to revolve with it but yet allow the handle-shaft to play through it) that by turning the handle in either direction the inner or shaft ring will become interlocked through a lug of its outer edge with a lug upon the inner edge of the next ring, and this ring, by then turning with such inner ring, will, if the turning of the handle is continued in the same direction, in its turn become interlocked with the next, and so on through the whole series, when they will all thus turn in conjunction with each other or together as if they were one, moving around and within suitable annular ways or guides of a frame fixed to the inside of the lock-casing. The handle-shaft projects beyond this series of concentric annular rings, arranged with regard to it as above explained, and comes to a bearing, or nearly so, by its inner end against the inner one of a series of vertically-arranged flat annular disk-shaped plates, corresponding in number to that of the rings, which disks are concentric with each other, and are laid loosely one upon another (decreasing in width from the inner to the outer plate) within a common frame embracing the outer edges of the series, which frame is connected with the operating devices for throwing out and drawing in the bolt, and moves forward and backward within the lock-casing as the handle is pulled outward from the lock-plate or pushed or shoved toward the same. With this series of concentric disks, arranged as above explained, the handle-shaft of the lock is connected or disconnected by inserting a suitable-shaped key in an aperture made in the center of the inner disk and passing into the said shaft, or removing it therefrom, so that when the inner disk is thus connected therewith it will turn with the same as it is turned through its handle, and thus, by means of a series of lugs attached to the several disks and arranged with regard thereto in substantially a similar manner to that described for the concentric rings, the whole series of disks will finally turn together and as one, and consequently in conjunction with the rings arranged upon such shaft, as before explained.

From these several disks a series of pins project, extending toward the annular rings, corresponding to which in number and size are a series of apertures formed in the said rings, the pins of the inner disk corresponding to the apertures of the inner ring both in their distance from the center of the common handle-shaft and in their distance apart, and with regard to their respective lugs, and so on for the succeeding disks and rings, so that, as is obvious, after having once interlocked all the rings with each other, and also the disks, by the turning of the handle of the shaft, to which they are both secured, as described, (in which position the pins of the one must correspond exactly to the apertures of the other, and are respectively each and all exactly opposite to each other,) by then pulling the handle outward the pins can enter the apertures, and thus allow the frame in which the disks are arranged to move forward, consequently causing the bolt to be drawn in or moved; whereas, if such a relative position of the pins and apertures were not produced, no movement of the bolt could possibly take place, as then the pins would abut against the faces of the rings in

lieu of entering the same, thus preventing the forward movement of the frame in which the disks are hung, and consequently any movement of the bolt; but as the inner ring and disk both turn with the handle-shaft when the latter or disk is keyed to it, as before stated, it is plain that after the several disks and rings have all been respectively interlocked with each other by properly turning the handle-shaft therefor, whatever combination of movements may be then performed with the two sets of rings and disks while connected with the common shaft, the respective pins and apertures of the two series will always be opposite to each other, and thus in proper position to allow the bolt to be thrown out or drawn in, although relatively in a different position from that when the two sets were respectively interlocked, as before stated, so that if then the disks be disconnected from the handle-shaft by removing the key therefrom, and the handle-shaft turned sufficiently to completely destroy the relative positions of the apertures, it is obvious that before the bolt can be drawn in—or, in other words, the lock unlocked—the apertures of the rings must necessarily be brought back to the same position with regard to each other that they were in when the disks were detached from the handle-shaft, or otherwise they will not correspond in position to the disk-pins, to accomplish which the same combination of movements must be made as that by which they were brought to such a relative position when in connection with the disks through the common shaft, whereby, without such combination of movements is known and can be and is accurately performed with the handle of the lock, it is utterly impossible to draw in the bolt, and thus unlock the lock.

In combination with such arrangement of the disks and rings with regard to each other, whereby the results above stated can be produced, I have arranged a device by means of which an accurate register and record of the movements of the rings and disks when in common connection with the handle-shaft can be made, and with which, after the disks have been disconnected from the handle-shaft, the same movements can be accurately and exactly performed with the rings alone to bring their apertures to the relative position with regard to each other to correspond with the relative position of the several pins of the disks, no matter how much the relative position of such apertures, or that in which they were set by the handle in connection with the disks, has been disturbed, the importance of which will be manifest from the following detail description of the arrangement of the parts constituting my improved lock, and their mode of operation, &c.

In the accompanying plates of drawings my improvements are illustrated, of which Figure 1, Plate 1, is a view of the front plate of the lock, and Fig. 2 a view of the top edge of the lock; Fig. 3, Plate 2, a transverse vertical section taken in the plane of the line *x x*, Fig. 2; Fig. 3², a central transverse vertical section through the annular concentric rings of the knob or handle-shaft with them in a different position to that shown in Fig. 3; Fig. 4, a vertical section taken in the plane of the crooked line *y y*, Fig. 2, Plate 1, and in the direction of the length of the lock-casing; Fig. 5, a vertical section taken in the plane of the crooked line *z z*, Fig. 2, Plate 1, and in the direction of the length of the lock-casing. Figs. 6 and 7 are detail views of portions of my improved lock, but modifications of those shown in preceding figures.

Similar letters of reference indicate like parts.

A in the drawings represents the outer casing or box of the lock, which box consists of two parallel plates, B B, of suitable length and width, placed a short distance apart, and joined together at one end by an end plate, C, through which plays the lock-bolt D, made of a square shape.

The inner portion, E, of the bolt D slides upon a short fixed bar, F, of the inside of the lock-box A, and by trunnion pins or studs G upon its upper and lower sides, plays in two inclined or angular slots, H, of parallel horizontal extension-plates I I, attached to or forming a part of one of the two parallel end cross-bars, J J, of the frame K, which end bars, J, move upon and between parallel horizontal fixed guide strips or bars L, extending from one plate B to the other, to each of which they are secured in any proper manner, the width of this frame K being less than the space between the two plates B.

In the center collar portion, L², of the frame K the round spindle or shaft M of the knob or handle N upon the outside of the lock-casing is hung and turns by its groove *a*, formed around its periphery. This shaft M passes loosely through the front lock-plate B, and also through the center of the vertical plate or frame O upon the inside of the lock-casing, to the front plate of which it is fixed by four horizontal corner-posts, P P.

From the above description of the manner in which the lock-bolt is connected with the shaft of the knob or handle N it is obvious that if the handle be pulled outward or away from the lock-plate B the bolt will be drawn in, and if pushed toward the plate B the bolt will be thrown out, and vice versa, the distance to which the bolt is thrown out, and consequently drawn in, being limited by the length of play allowed to the frame, to which its inner end is connected, as explained, within the lock-casing, and also to the inclination of the slots H of such frame, as is manifest without further explanation and by an inspection of the drawings.

The inner end of the knob-spindle M, or that projecting from the vertical plate O, is made of a square shape, and upon it is loosely

placed the inner ring, Q, of a series of three rings, Q, R, and S, placed concentric with each other upon the rear side of the vertical plate O, upon suitable fixed projecting flanged guide-rings T of which they turn around. These guide-rings T are interposed between the edges of the rings and separate one ring from another, leaving a narrow annular space, *b*, between each ring. From the outside edge *c* of the inner ring, Q, of the series projects a lug or radial arm, U, which, as the ring is moved round by turning the knob spindle or shaft N, comes to a bearing against and interlocks with the radial projecting arm or lug V upon the inside edge of the next ring, R, thereto, carrying such ring R then around with it, when the radial lug or arm W upon the outside edge of such ring R, and in the same radial line from its center as the arm upon its inside edge, coming to a bearing against the radial arm, X, upon the inside of the next and outer ring, S, of the series, it in turn is then carried or moved around with it, the lugs of the three rings then occupying the relative positions with regard to each other shown in Fig. 4 of the drawings, so that by continuing to turn the handle of the lock in the same direction to that by which their respective lugs were brought together or interlocked, as above explained, the several rings will move around upon the plate O as if they were one and the same; but by turning the handle in the opposite direction the inner one only will be moved until it again comes to a bearing against the inside projecting lug upon the next or middle ring of the series, which then, moving around with it, comes to a bearing in its turn by its outside lug against the inside lug of the outer ring of the series, when all three rings then move together the same as before, but with the lugs of each ring acting upon the opposite sides of each other to that shown in Fig. 4.

In each of the concentric rings Q, R, and S are two apertures, *c*, which extend through their entire thickness, the two apertures in each ring being at points diametrically opposite to each other, and those in the two inner rings, when the several ring are in the position shown in Fig. 4, being in the same radial line with each other, with the radial line through the apertures in the outer ring at an angle thereto, as plainly shown in Fig. 4, these apertures *c c* being made all of one size or of varying sizes, as may be deemed best or desirable.

To the back ends of the end bars, J, of the sliding frame K of the lock is fastened an annular ring casing or frame, A^2, in an upright or vertical position, and parallel with the frame or plate O, upon which the concentric rings Q, R, and S are arranged and turn, in which annular ring-casing A^2 are arranged a series of three annular rings or disks, B^2 C^2 D^2, placed one upon another, with a thin washer ring or plate, *d*, between each ring, these rings being all of the same external diameter, but of different internal diameters, the upper or outer ring, D^2, being a little greater than the ring C^2 between it and the inner ring or disk, B^2, of the series, so that portions of each of the said rings are left exposed, as plainly seen both in Figs. 3 and 5 of the drawings. Each of these rings turn independent of the others, and have a radial lug, *f*, attached to each of them, the operation of which with regard to each other as the rings are turned is substantially the same to that hereinbefore described for the series of rings Q, R, and S, so that by turning the center or inner ring of the series in the proper direction the whole series, when the several lugs are in the relative position shown in Fig. 5, will be turned together and as one, whereas by then reversing the direction in which the inner disk is turned the other two will remain stationary until the lug of the inner one comes to a bearing against the lug of the next one, and then it, in its turn, by continuing the rotation of these two in the same direction, against the lug of the outer ring, when the three will be turned in conjunction with each other, as before.

To each of these rings B^2 C^2 D^2 are secured horizontal projecting pins F^2, two to each ring, and at points thereof diametrically opposite to each other, the pins of the two inner rings, when the rings are in the position shown in Fig. 5, being in the same radial line with each other, and the pins upon the outer ring and radial line at an angle to the line drawn through the other pins, as seen in Fig. 5, the pins of the respective rings B^2 C^2 D^2 being at the same distance from their common center as the apertures in the respective rings Q, R, and S—that is, the pins of the inner ring, B^2, corresponding in distance from its center to the distance of the apertures of the inner ring, Q, of the series R S from its center, and so on for the pins of the next disk C^2 and apertures in ring R, and pins of disk D^2 and apertures in ring S, the pins also corresponding in size thereto, so that when the disks are in the position shown in Fig. 5 and the rings in the position shown in Fig. 4, by then drawing or pulling the handle outward or away from the plate B of the lock-casing, the pins of the several disks can enter the corresponding apertures of the concentric rings Q, R, and S, the rings remaining stationary while the frame in which the disks are arranged moves forward and backward with the handle N, to the frame K of which handle it is fastened, as before explained.

The square portion of the handle-shaft M terminates against the inner or center disk, B^2, of the series in the frame A^2, and by means of the square or triangular shaped portion D^2 of a key, E^2, inserted in the aperture F^2 of the back plate B of the lock-casing and passing through the disk B^2 and into the center of the shaft M, it is connected with such shaft, so that, if the handle N is then turned, the series

of disks B^2 C^2 and D^2 will be turned in conjunction with the ring series, Q, R, and S, thus enabling both series to be brought into the respective relative positions shown in Figs. 4 and 5, in which position the pins of the disks, as before stated, can enter the apertures of the rings when the handle is pulled outward, as they are then exactly opposite to each other, thus allowing the bolt to be drawn in and thrown out at pleasure, the several pins being shorter (either more or less) thau the width of the space between the outer surfaces or faces of the rings and the respective disks from which they project.

From the above description it is obvious that, without the pins of the disks and the apertures of the rings are all directly opposite to each other, the handle cannot be pulled outward, and consequently no movement of the lock-bolt can possibly take place, so that if a certain combination of movements be made with the rings and disks, when the latter are connected with the handle-shaft through the key E^2, as explained, by turning the handle either to the right or left, so as to destroy the relative position of the pins shown in Fig. 5, (the position of the ring-apertures being correspondingly changed, as they then move in conjunction with each other,) by then removing the key E^2, and thus destroying the connection between the disks and the ring-shaft M, so that if the shaft is then turned no movement of the disks can possibly take place, it is plain to be seen that if then a few turns are given to the handle N the position of the ring-apertures, which previous to such movement of the handle exactly corresponded to and were directly opposite to the disk-pins, then becomes so destroyed that, without they are again brought back to such position, it is impossible to produce the least effect upon the handle N, the pins, if the handle is then pulled outward to draw in the lock-bolt, abutting or coming to a bearing against the surfaces or faces of the several rings opposite to them, it being thus absolutely necessary for the drawing in of the bolt that the disk-pins and ring-apertures should exactly correspond in position with each other.

Thus it will be seen that if some system or means are provided by which a record of the movements imparted to the disks and rings when the former are in connection with the shaft M of the latter can be made with accuracy, and susceptible of being repeated with the rings alone after the disks have been disconnected by removing the key E^2 to the shaft M, it is plainly apparent that the drawing in of the bolt can then be accomplished with the utmost readiness and facility by a person and persons acquainted with such record or register of movements by simply performing the same movements with the rings alone as were performed by the rings and disks when together, or, rather, the latter connected with the ring-shaft M, thus bringing the holes or apertures of the rings directly opposite to their respective pins of the disk series, when the forward and backward play of the handle N is freely permitted, and the lock bolted or unbolted at pleasure.

To enable the above-stated record or register to be made, I have attached to the handle-shaft M and upon the outside of the front plate B of the lock-casing a circular disk, G^2, divided into fifteen equal parts or graduations, numbered from 0 to 14, inclusive, which disk, by the turning of the handle, moves around and upon the inside of a stationary annular ring, H^2, fixed to the front plate B of the lock, having its surface divided into sixteen equal parts or graduations, lettered in regular order and succession from A to P, inclusive, so that, as is obvious, if one graduation of the disk is made to correspond and exactly coincide with one of the graduations of the fixed ring—as, for instance, the graduation of the disk marked 1 with the graduation of the ring marked A, as shown in Fig. 1 of the drawings—no other graduations or marks of the disk and ring will coincide, the importance of which arrangement of the graduations of the ring and disk with regard to each other will be manifest from the explanation of the setting of the lock thereby, which is soon to be given.

To illustrate the operation of the lock having the construction and arrangement of parts above explained, I will now proceed to describe one combination of movements.

First, key the set of disks to the handle-shaft, when turn the handle in the proper direction to cause both sets of disks and rings to turn in unison with it, and the lock is ready for being set to any one of the number of combinations of which the graduations of the handle-disk and annular ring H^2 will admit; but, for illustration, we will suppose that graduation No. 1 of the handle-disk be selected, and the three graduations, respectively marked G, D, and M, of the fixed graduated ring H^2, it being only necessary to use three graduations, as only three disks and rings are used to produce a change in the position of all the disks or rings, as is obvious. Now turn the handle in the proper direction—say to the left—to bring its division 1 exactly in line with the graduation G of the ring, in which direction all the disks and ring move together, when turn the handle in the opposite direction, thus leaving the two outer disks and rings stationary at such point, the inner disk and ring only moving until the lugs of such disk and ring respectively abut against the lugs of the next or middle disk and ring, when, carrying such disk and ring with it by continuing the turning of the handle in the same direction, bring handle-graduation 1 opposite to D of the fixed graduated plate; then turn the handle in the opposite direction and bring the same graduation, 1, opposite to M, the last movement of the handle carrying only with it the inner ring and disk of the two series, leaving the center

or intermediate ring and disk at the time when the turning was reversed in direction. By turning the handle in the various directions and bringing its division 1 to the several graduations of the graduated ring H^2, as above explained, it is plainly apparent that the several pins and apertures of the disks and rings are both set or brought to certain relative positions, (the pins of each disk corresponding exactly, however, in position to the apertures of the ring corresponding thereto,) when, pulling the handle outward, the bolt can be drawn in. Now remove or draw out the key from the back plate of the lock and close the door in which the lock is placed; then push the handle back toward the front plate of the lock, thus throwing out its bolt, and consequently locking the door.

The handle is now turned round sufficiently to break up or destroy the positions of its ring-apertures with regard to the disk-pins as previously set by the combination of movements above explained, (the disks, as they have been detached from the handle-shaft by the removal of the key, not being affected by such turning of the handle,) when, as is obvious, the door is locked beyond all possibility of being unlocked, except the same combination of movements be performed with its handle as was performed by it when both the rings and disks were in connection with its shaft, as is manifest without further explanation; to do which, it is of course necessary that a knowledge should be had of the same.

From the above description it is plain to be seen that with my improved lock, by setting it to a particular combination, one illustration of which has been given, it is rendered impossible to unlock it except such combination is known to the person, the importance and advantages of which in its use for safes, bank-vaults, and other depositaries or receptacles for valuables and papers of importance are self-evident to all.

In order to avoid all possibility, after the door is locked, of the previous adjustment of the disks being disturbed, I make use of a frictional slide, L^2, in the ring-holder A^2, for the disks, which slide is passed through the back plate of the lock and into the said holder A^2 in such a manner as to come to a bearing upon the edge of the several disks therein, and thereby tightly and firmly hold them from moving, this slide, of course, being so inserted before the door is closed and bolted, as explained.

By using the two graduated faces or surfaces G^2 and H^2 for performing the movements by which the lock is set, the number of which graduations upon one is greater or less than upon the other either by one or more, it is plain to be seen that without the precise combination of movements is performed, and with as great accuracy for each graduation used as was performed in the setting of the lock, the withdrawing of the bolt cannot be effected; for an illustration of which, suppose a person ignorant of the entire combination used should, however, be aware that No. 1 was used with letters G, D, and N in lieu of M, as was the case. Now, it is plain that with the two first letters the movements so far can be properly made; but by placing the 1 opposite to N in lieu of M, the lock, by such system of graduations, is still beyond the possibility of being unbolted, as is obvious without further explanation.

In Figs. 6 and 7 a modification in the construction of the rings and disks for being interlocked with each other is shown, it consisting simply and principally in dispensing with the apertures of one and the pins of the other, and forming a similar raised flange or lip, S^2, upon the edge of each disk and of each ring, extending one-half of the distance around their respective peripheries, which flanges interlock with each other when the handle is drawn out or pushed in, first, however, having brought them into the proper relative positions therefor, as before explained, for the pins and apertures, the other modifications consisting in the manner of keying the disks to the handle-shaft, which is plainly shown in Fig. 7, and therefore needs no particular description herein.

In lieu of having the disk-holder move with the frame by which the bolt of the lock is thrown out or drawn in, and the rings arranged upon a stationary frame of the lock-casing, the reverse may be the case, it being evident that the operation of the lock will be as perfect in one as the other way, and that no material alterations or modifications are necessary therefor.

Although I have particularly in the preceding detail description spoken of but three-rings and three disks, it is obvious that the number of either may be increased or decreased at pleasure, but must both be the same, or, in other words, of an equal number in each case, whether large or small.

I claim as new and desire to secure by Letters Patent—

1. The combination, with the handle-shaft and the bolt of a lock, of two separate series or sets of concentric rings or disks, one of which series, by its holder or frame, is so connected with the handle-shaft as to always turn with it, while the other series is susceptible of being brought in connection with or disconnected from the said first series, when the two series of rings or disks are so constructed and arranged with regard to each other and with the handle-shaft and lock-casing as to allow the bolt of the lock to be thrown out or drawn in only by properly moving the handle therefor after said disks have been brought to certain positions with regard to each other, substantially as herein described, and for the purposes specified.

2. Adjusting the operating parts of the lock herein described for throwing its bolt in ac-

cordance with a graduated disk attached to the handle-shaft and turning in connection with it and the annular fixed graduated ring of the lock-casing, when such graduations of the said disk and ring are so arranged with regard to each other that only one of the said graduations of both the ring and disk can coincide with each other at one and the same time, substantially as herein described, and for the purpose set forth.

The above specification of my invention signed by me this 7th day of February, 1866.

E. R. HOPKINS.

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