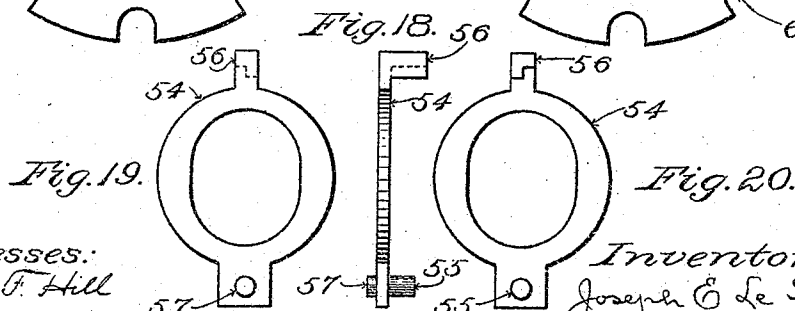
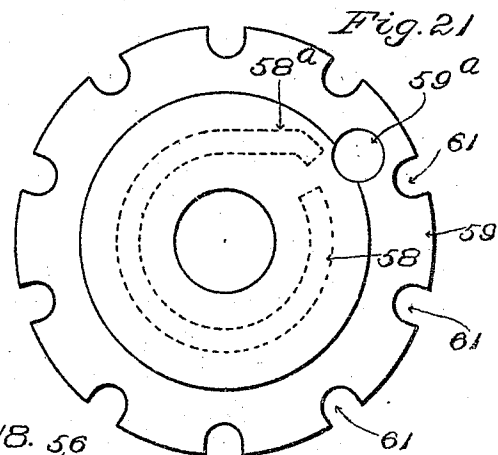
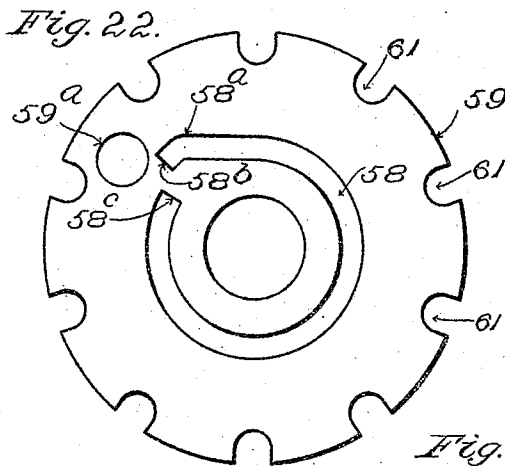
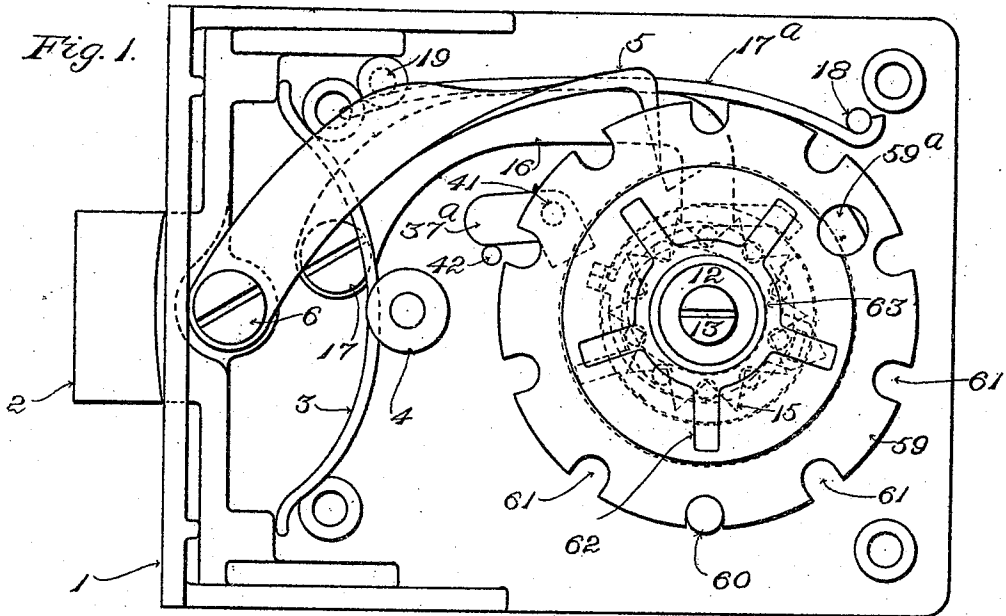


940,936.

J. E. LE MYRE.
PERMUTATION LOCK.
APPLICATION FILED JAN. 11, 1909.

Patented Nov. 23, 1909.
6 SHEETS—SHEET 1.



Witnesses:
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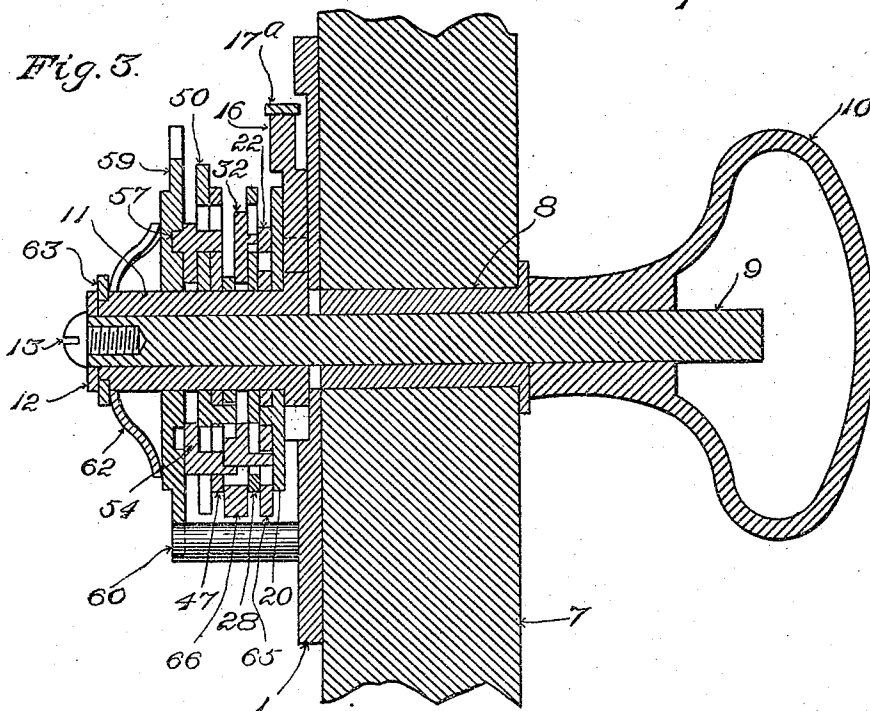
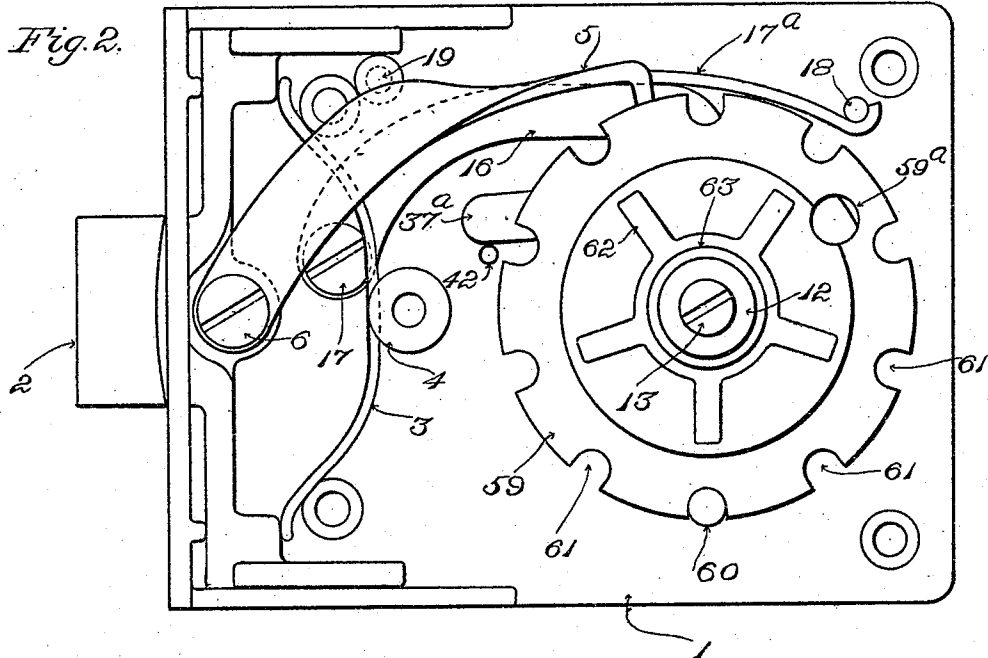
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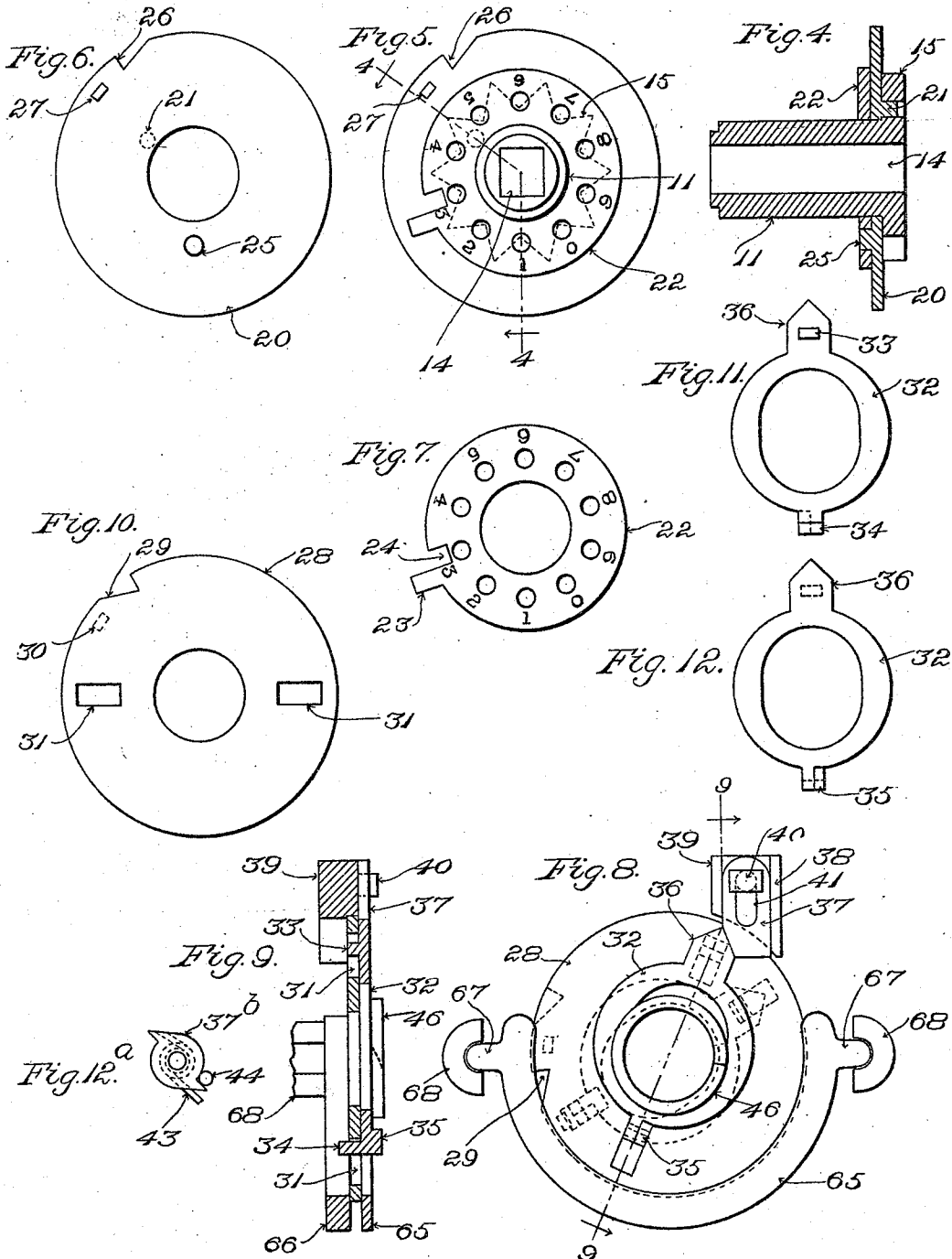
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6 SHEETS—SHEET 3.

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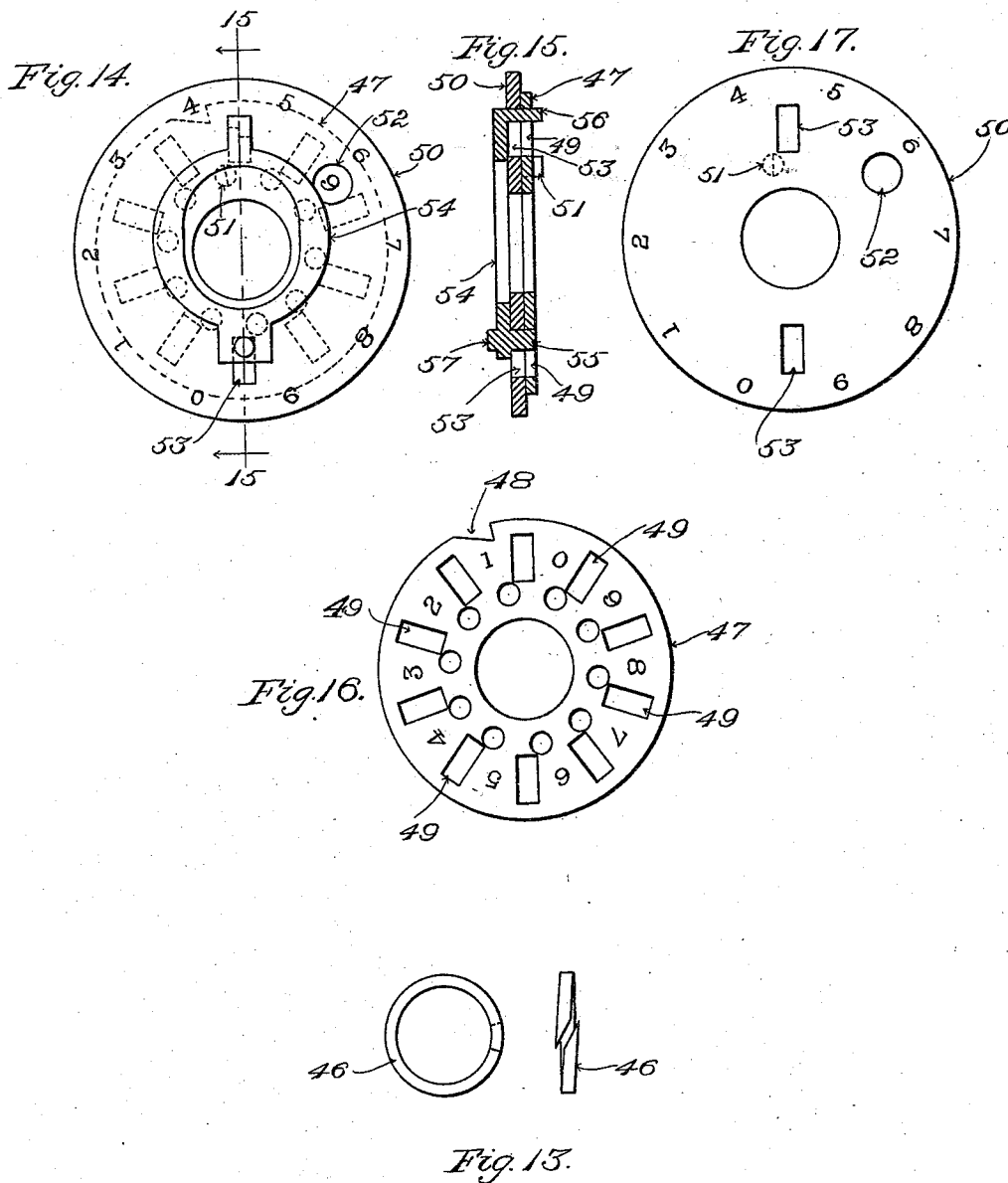
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6 SHEETS—SHEET 4.



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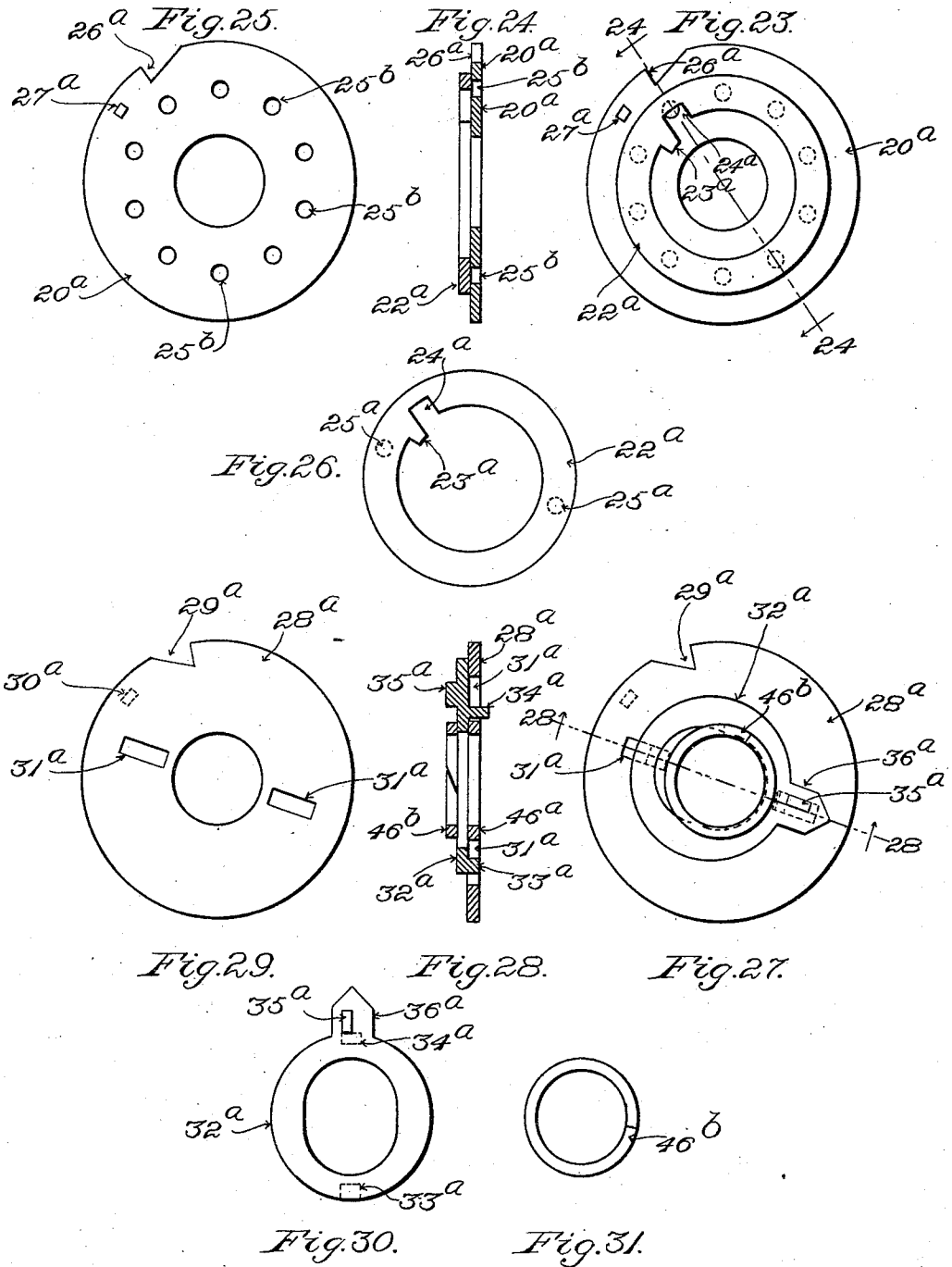
J. E. LE MYRE.
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Patented Nov. 23, 1909.

6 SHEETS—SHEET 5.

940,936.



Witnesses:
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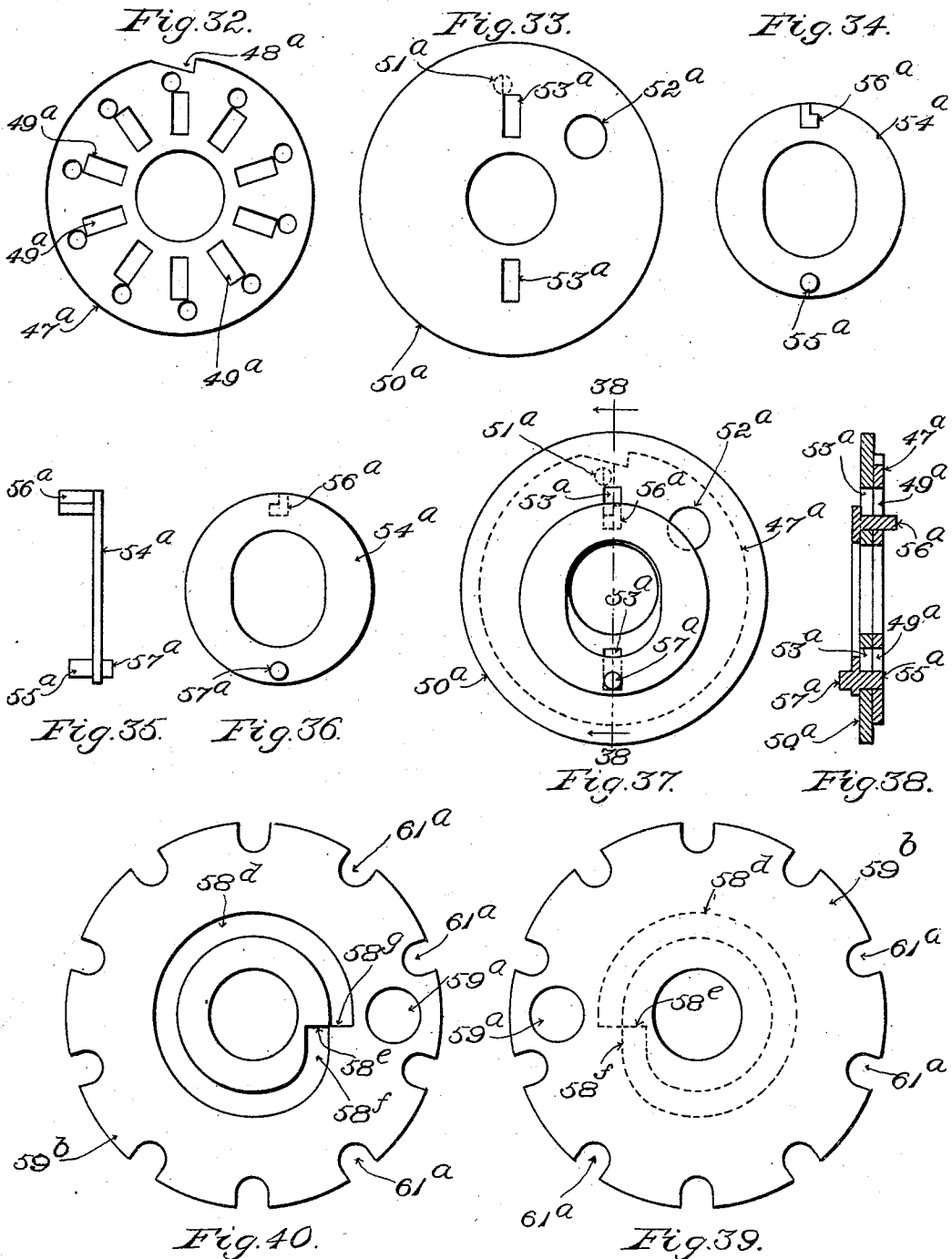
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6 SHEETS—SHEET 6.



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UNITED STATES PATENT OFFICE.

JOSEPH E. LE MYRE, OF NASHUA, NEW HAMPSHIRE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO PATENT SALES COMPANY, OF KITTERY, MAINE, A CORPORATION OF MAINE.

PERMUTATION-LOCK.

940,936.

Specification of Letters Patent.

Patented Nov. 23, 1909.

Application filed January 11, 1909. Serial No. 471,821.

To all whom it may concern:

Be it known that I, JOSEPH E. LE MYRE, a citizen of the United States, residing at Nashua, in the county of Hillsboro, State of New Hampshire, have invented a certain new and useful Improvement in Permutation-Locks, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to permutation locks, and primarily to those of the class containing rotary tumblers, although not in all cases restricted in application to permutation locks of that particular class.

It resides in tumbler-mechanism having a fixed or dead starting-point, and so constructed that during the setting operation the tumblers to be set are moved in unison forward and backward without play or lost movement until they successively have been left at rest, the mechanism also being contrived to automatically release or unlatch a tumbler at or near the start of the movement by which it is to be set, so that during the remainder of such movement there shall be no release or other change perceptible to feeling or hearing to indicate arrival at the point at which the tumbler should be left. The tumblers of a lock embodying the invention are set without it being necessary to turn the operating knob or handle of the lock two or more times around, first in one direction and then in the other, as usually required heretofore, and thereby quick opening is facilitated.

The invention includes among its features clutch-devices combined with the tumblers and arranged to lock them together for the setting operations, and trip-devices and a stationary cam for controlling the action of the said clutch-devices, the said cam operating to arrest the parts in the starting-position aforesaid.

The drawings show two embodiments of the features of the invention, one thereof characterized by the employment of a stationary cam having an outwardly directed grade at and adjoining the starting point, and the other having the grade directed inwardly.

Figure 1 of the drawings is a front elevation of a lock containing the first-mentioned embodiment of the invention, with the cover removed, and showing in dotted lines the position and relations of certain parts which

are hidden from view. Fig. 2 is a similar front elevation, but with dotted lines almost entirely omitted. Fig. 3 is a sectional view of the parts of Figs. 1 and 2, showing also a knob on the lock-spindle, and a portion of a door to which the lock is applied. Fig. 4 is a view of the tumbler-carrying sleeve, its detent- or click-wheel, the terminal tumbler 20 engaged therewith, and the clutch-driver, in section on line 4, 4, of Fig. 5. Fig. 5 is a view of the parts shown in Fig. 4, looking from the left in said figure. Fig. 6 shows the tumbler 20 separately in side elevation. Fig. 7 is a side elevation of the clutch-driver, detached. Fig. 8 is a side elevation of the intermediate tumbler 28, the clutch-slide 32, a trip cooperating with the said clutch-slide, and the friction-devices which are employed to prevent undesired turning movement of the said tumbler. Fig. 9 is a view in section on line 9, 9, of Fig. 8. Fig. 10 shows tumbler 28 alone. Figs. 11 and 12 are opposite face-views of clutch-slide 32. Fig. 12^a shows a modified form of trip. Fig. 13 shows a split washer that is employed between the clutch-slide 32 and the next succeeding tumbler. Fig. 14 shows in side-elevation the opposite terminal tumbler 47 (in dotted lines), the clutch-disk 50, and the clutch-slide 54. Fig. 15 is a view in section on line 15, 15, of Fig. 14. Fig. 16 shows tumbler 47 alone. Fig. 17 shows clutch-disk 50 alone. Fig. 18 is an edge-view of clutch-slide 54. Figs. 19 and 20 are opposite side-elevations of clutch-slide 54. Figs. 21 and 22 are opposite side-elevations of the stationary cam. Fig. 23 shows in elevation the first terminal tumbler, 20^a, and clutch-driver, 22^a, of a modified embodiment. Fig. 24 is a view in section on line 24, 24, of Fig. 23. Fig. 25 shows tumbler 20^a in elevation, alone. Fig. 26 shows clutch-driver 22^a in elevation, alone. Fig. 27 shows in elevation the intermediate tumbler 28^a, clutch-slide 32^a, and spacing and friction washers in connection with said clutch-slide. Fig. 28 is a view in section on line 28, 28, of Fig. 27. Fig. 29 shows the intermediate tumbler 28^a alone. Fig. 30 shows the clutch-slide 32^a alone. Fig. 31 is a side elevation of the friction washers 46^b. Fig. 32 is a side elevation of terminal tumbler 47^a alone. Fig. 33 shows the clutch-disk 50^a alone. Fig. 34 shows one face of clutch-slide 54^a. Fig. 35 in an edge-view of

the same. Fig. 36 shows the opposite face thereof. Fig. 37 is an elevation of the parts of Figs. 32 to 36, assembled. Fig. 38 is a view in section on line 38, 38, of Fig. 37.

5 Figs. 39 and 40 are views of the opposite faces of cam-disk 59^b.

Having reference to the drawings,—A portion of a convenient lock-case is shown at 1, Figs. 1, 2 and 3, and a sliding lock-bolt at 2, Figs. 1 and 2, a bolt-projecting spring being shown at 3, bearing by its ends against surfaces on the bolt and backed up at its middle by a fixed abutment-post 4 on the back-plate of the case, and at 5 is a dog 15 hinged to the bolt by means of a screw-pivot 6, and arranged to coöperate with the tumblers in known manner. The said back-plate is represented in Fig. 3 as applied to a portion of a door 7, the latter having a hole 20 therethrough which is occupied by a bushing or sleeve 8, the said bushing or sleeve having a square hole therethrough occupied by the spindle 9 employed in connection with the lock, and the said spindle carrying the knob 25 10 upon one end-portion thereof, at the side of the door opposite that at which the lock is located. At the latter side, the other end-portion of the spindle 9 projects into the lock-case 1, and occupies the central hole 14 30 (Figs. 4 and 5) of the tumbler-carrying sleeve 11, the said sleeve being shown in place in Fig. 3 and in detail in Figs. 4 and 5. The spindle is held in place in the said sleeve by a washer 12 and screw 13, Figs. 1, 35 2 and 3, the said washer surrounding the extreme end of the spindle at the outer end of the said sleeve, and the said screw having its threaded stem entered into a screw-threaded hole that is tapped into such end, lengthwise 40 of the spindle, and the projecting rim or flange of its head being in engagement with the outer face of the washer. The said central hole 14 of the sleeve 11 is square in cross-section to fit the cross-section of the 45 spindle, so that the sleeve shall turn in unison with the spindle when the latter is turned.

At 15 is a detent- and click-wheel having radiating V-shaped teeth and formed integral with the inner end of sleeve 11, and at 50 16, Figs. 1, 2 and 3, is a detent- or click-arm, the V-shaped acting portion of which engages with the said detent- and click-wheel. The said arm 16 is supported in the lock-case upon a screw-pivot 17, and held in engagement with the wheel 15 by means of a spring 17^a which is engaged by its ends with studs or pins 18, 19, projecting from the back-plate of the lock-case, and bears by its middle portion upon the top of the said arm 60 16. This detent-and click-arrangement is of well-known character, its main functions being to restrain the tumblers and associated parts from accidental turning movement, define the extent of each of the successive steps 65 of the turning movements, and indicate by a

slight jar perceptible to the hand grasping the knob the completion of each step so that count may be kept of the number of steps through which the knob has been turned.

The tumblers and the devices which more 70 immediately co-act therewith are mounted upon the sleeve 11 at the outer side of the toothed wheel 15. In the illustrated embodiments of the invention the tumblers are three in number, and are shown at 20, 28, 75 and 47, respectively, although in practice two or more intermediate tumblers may be employed between the terminal tumblers 20 and 47, if desired. The tumblers, respectively, have in their peripheries notches 26 80 (Figs. 5 and 6), 29 (Figs. 8 and 10) and 48 (Fig. 16), to receive the coacting element of the lock. The said coacting element may vary in construction, character, and function in different applications of the invention, 85 according to the manner in which it is preferred the tumbler-mechanism should act in controlling or effectuating the release and movement of the bolt. In the present instance I have shown a convenient arrange- 90 ment of well-known type through which the tumbler-mechanism serves to directly effectuate the withdrawal of the bolt, and in which, accordingly, the acting portion of the dog 5 already mentioned is adapted to enter 95 the notches of the tumblers when such notches are in alinement, so that when the knob is turned over from left to right the said acting portion shall be engaged by the shoulder of notch 26 of tumbler 20 and 100 pulled toward the right, taking the bolt with it, and thereby effecting the withdrawal.

Before describing the general construction in detail, reference will be made briefly to the clutch-devices, trip-devices, and stationary cam aforesaid. In conjunction with the tumblers 20 and 28 are shown the clutch-driver 22 (Figs. 3, 4, 5 and 7) and the clutch-slide 32, (Figs. 3, 8, 9 11 and 12) 105 which are employed to clutch the tumbler 28 to tumbler 20, so that the former shall turn forward and backward in unison with the latter. In conjunction with tumbler 47 is shown another clutch-slide, 54, (Figs. 3, 14, 15, and 18 to 20) and a clutch-disk 50, 115 (Figs. 3, 14, 15 and 17) which coöperate at times with clutch-slide 32 in clutching tumbler 47 to tumbler 28 to cause the former to turn in unison with the latter and tumbler 20. The stationary cam is shown at 59 (Figs. 1, 120 2, 3, 21 and 22). It controls the action of clutch-slide 54, and when the parts are turned backward to the proper extent it, by its engagement with the said clutch-slide, operates the clutch-devices to lock all the 125 tumblers together, and then arrests the tumblers in a fixed dead starting position. The said cam is adjustable, to enable the starting position to be varied. When the tumblers are turned forward from such position in 130

setting them, the cam operates the clutch-slide 54 to unclutch tumbler 47 to permit the latter to be left in the required position. The trip-devices 37, (Fig. 8) and 37^a (Figs. 1 and 2) are arranged to operate the clutch-slide 32 to effect the unclutching of tumbler 28 from tumbler 20 at the proper time so as to permit tumbler 28 to be left in the desired position, as well as to render tumbler 20 free to be set in its own required position. When the number of intermediate tumblers is increased, additional clutch-slides and trip-devices will be employed to coöperate therewith. All of these parts and their relations and mode of operation are more fully and specifically explained in the general description which follows.

The terminal tumbler 20, shown in detail in Figs. 4, 5, and 6, is shown in Figs. 3 and 4 mounted upon the inner portion of the sleeve 11, next to the toothed wheel 15. It is engaged with such wheel and the sleeve, so as to cause it to turn in unison therewith, by means of a pin 21 projecting laterally from it and occupying a hole in the wheel. Upon it, near the notch 26 in its periphery which receives the acting portion of the dog 5, is a lateral projection 27 to coact with a similar projection upon the adjoining tumbler, 28, as will be explained hereinafter. Next to the tumbler 20 is placed the clutch-driver 22, which is shown in place in Fig. 3 and in detail in Figs. 5 and 7. The said clutch-driver is furnished with a driver-finger 23 extending radially outward from its periphery, and immediately adjacent the said finger is a notch 24 in the said periphery. It also is formed with a circular series of holes which are numbered from 0 to 9, Figs. 5 and 7, and the tumbler 20 is provided with a pin or projection 25 which, when it occupies one of the said holes, serves to cause the clutch-driver to turn in unison with the said tumbler. The said circular series of holes, in any one of which the pin or projection 25 of the tumbler 20 may be placed, enables the clutch-driver to be adjusted angularly around the sleeve 11 so as to vary the position of its finger 23 and notch 24 with reference to the notch 26 of the said tumbler in fixing the combination. The numerals upon the clutch-driver 22 are so arranged that when the clutch-driver is applied to the said tumbler the numeral in connection with the hole occupied by the pin 25 of the tumbler corresponds with the last numeral of the combination. It will be perceived that when knob 10 and its spindle 9 are turned, the tumbler 20 and clutch-driver 22 will be caused to turn positively and in unison with the sleeve 11 and detent-wheel 15. Next to the clutch-driver 22, at the outer side thereof, is the intermediate tumbler 28, shown in place in Fig. 3, and in detail in Figs. 8, 9 and 10, having adjacent to its peripheral

notch 29 the lateral projection 30, shown by dotted lines in Fig. 10. The said lateral projection co-acts with lateral projection 27 of tumbler 20, as will be explained later. The tumbler 28 is formed with radial slots 31, 31, located at opposite sides of the center of the tumbler.

The clutch-slide 32, Figs. 8, 9, and 11, is located at the outer side of the tumbler 28. It is furnished at the outer side of one arm thereof with a practically radial flat-sided projection 35, the function of which will presently be explained. The said clutch-slide also has at its inner side two diametrically opposite lateral projections 33, 34, respectively occupying the radial slots 31, 31, of the said tumbler 28. The said projections 33, 34, connect the clutch-slide 32 and the tumbler 28 together, through engagement with the walls of the said slots, so that such parts must turn together. The length of the slots permits the clutch-slide to move diametrically with reference to the tumbler 28. The projection 33 is short so that it does not project at the inner side of the tumbler, but the projection 34 is long and projects far enough to engage the acting radial face of the finger 23 of the clutch-driver 22, and also is adapted to enter the notch 24 of the said clutch-driver when the clutch-slide 32 is moved in the right direction to carry the projection 34 inward toward the center. In the position of the clutch-slide which is represented in full lines in Fig. 8, the projection 34 occupies the said notch 24, so that when the tumbler 20 and clutch-driver 22 are turned in either direction the clutch-slide 32 and the tumbler 28 will be caused to accompany the same around positively and without lost motion or play. Diametrical movement of the clutch-slide, shifting the projection 34 away from the center, will withdraw the projection 34 outward from the notch 24. However, it will not thereby be carried out beyond finger 23 of the clutch-driver, and if next the clutch-driver is turned over from left to right the action of said finger against the projection 34 will turn the clutch-slide and the tumbler 28 around positively and without lost motion or play so long as turning movement of the clutch-driver in that direction continues. After the termination thereof, turning movement of the clutch-driver in the reverse direction will merely separate the clutch-driver finger 23 from the clutch-slide projection 34, and the clutch-slide 32 and tumbler 28 will remain in the position which was given to them by the first turning movement. This is the manner in which the setting of tumbler 28 is effected. If, later, the clutch-driver is turned so as to cause its finger to bear against one side of the projection 34 of the clutch-slide, the latter projection and the

notch 24 will again occupy the same radial line. If, then, movement of the clutch-slide occurs in the direction which carries projection 34 toward the center, such projection 5 will reënter the said notch and thereby lock the tumbler 28 with the clutch-driver again.

The movement of the clutch-slide 32 in the direction which carries the projection 34 away from the center is effected automatically 10 through the action of devices with which the arm 36 of the clutch-slide engages during the conjoint turning movement of the tumbler and clutch-slide. One or a plurality of trips is employed, preferably a plurality, suitably distributed in the path of 15 movement of the said arm. The use of a plurality is preferred, inasmuch as the clutch-slide will in such case be moved diametrically by the first trip with which it 20 engages in its turning movement, and consequently usually sooner than if the outward movement took place at only one point in the circle. The outer end of the arm 36 is formed with opposite bevels, converging 25 as shown, so as to enable the said end to act in cam-fashion in connection with the trip or trips. Different forms of trips are shown in the drawings. That illustrated at 37 in Figs. 8, and 9 is arranged to move 30 vertically. In this movement, the trip 37 is guided by the flange 38 of a fixed guide 39, and by the stem of a pin or screw 40 occupying a longitudinal slot 41 in the trip. By engagement of the end-walls of the said slot 35 with the stem of the said pin or screw, the extent of the longitudinal movement of the trip 37 is limited, and the head of the screw or pin overlaps the outer lateral surface of the trip so as to keep the latter in place laterally. The trip gravitates into its normal 40 or inner position. It will be apparent that if the upper bevel of the arm 36 is carried against the lower end of trip 37 by movement of the arm in upward direction, the 45 trip simply will be pushed upward out of the way, and the arm will be permitted to pass freely without displacement of the clutch-slide 34 diametrically of the tumbler 28, and the trip will drop back into place as 50 soon as released by the passage of the arm, but when the arm 36 is moved around from left to right against trip 37, the flange 38 will support the trip against the pressure of the leading bevel of the arm upon the left-hand side of the trip, and the cam-action 55 will cause the clutch-slide to move diametrically across the tumbler 28, from the position with reference to the center in which it is shown in full lines in Fig. 8, to a position 60 with reference thereto corresponding with that which is shown in dotted lines in the said figure. By this diametrical movement the clutch-projection 34 of the clutch-slide is moved radially out of the clutching-notch 65 24 of the clutch-driver 22. Thus, in the full-

line position of the clutch-slide of Fig. 8, the clutch-projection 34 will occupy the clutching-notch 24; in the dotted-line position in such figure, the said clutch-projection will be radially outside the clutching- 70 notch.

Fig. 1 shows at the left a trip 37^a which is hung by a pivot 41 to the back-plate of the lock-case, its normal position being determined by the fixed stop 42 on the said 75 plate, upon which the outwardly-extending gravity-arm of the trip rests. It will be perceived that this form of trip will yield freely to permit the arm 36 of the clutch-slide 32 to pass, without shifting the clutch- 80 slide with reference to the center, when the said arm 36 is caused to travel over from right to left in Fig. 1, but when the said arm is carried around in the reverse direction, and thereby caused to engage with the act- 85 ing portion of the trip from beneath, the trip will remain immovable, and the slide will be moved diametrically across the tumbler 28 with the result already explained in treating of the trip 37. Fig. 12^a shows 90 a pivoted trip, 37^b, held by means of a spring 43 in its normal position with a shoulder thereof in contact with a fixed stop 44, the action being essentially the same as in the case of the pivoted gravitating 95 trip 37^a.

The spacing washer 46, shown in place in Figs. 3, 8, and 9, and separately in Fig. 13, intervenes between the clutch-slide 32 and the next succeeding tumbler 47, the latter 100 being shown in place in Fig. 3 and in detail in Figs. 14, 15 and 16. This tumbler has a series of holes around the center thereof marked with the numerals from 0 to 9, and a corresponding series of radial slots 105 49, 49, etc.

At the outer side of the tumbler 47 is a clutch-disk 50, shown in place in Fig. 3 and in detail in Figs. 14, 15 and 17, having a 110 clutch-pin 51 which projects laterally from the side thereof at which the said tumbler is located, and is adapted to be entered into any one of the holes of the said tumbler at will in assembling or adjusting the parts. A portion of the said clutch-pin extends lat- 115 erally inward beyond the tumbler 47. Such portion is of reduced width and formed with a radial driving-surface for engagement with one radial side of the projection 35 of the clutch-slide 32. The said clutch-disk 120 50 has a view-hole 52 that is located at the same distance from the center as the series of numerals of the tumbler 47, and through which, when the pin 51 occupies one of the holes of tumbler 47, the appropriate numeral 125 of the said tumbler may be seen. The clutch-disk is also formed with two oppositely-located radial slots 53, 53. In connection with the disk 50 and tumbler 47 I employ the diametrically-movable slide 54, shown in 130

place in Fig. 3 and in detail in Figs. 14, 15, 18, 19 and 20. From one side of the slide 54 projections 55 and 56 extend laterally. As shown in Figs. 3, 14 and 15, these projections occupy the radial slots 53, 53, of the disk 50 and also those two of the radial slots 49, 49, etc., of the tumbler 47 which register with the said slots 53, 53. By forming the circular series of slots 49, 49, etc., in the tumbler 47, a pair of such slots is provided to receive the projections 55 and 56 in every position of relative angular adjustment of the disk 50 and tumbler 47. The numeral which is visible on tumbler 47 through the view-hole 52 of disk 50 corresponds with the second numeral of the combination.

The projection 56 of clutch-slide 54, and the clutch-pin 51 of disk 50, extend laterally inward through and beyond tumbler 47, (see Fig. 15), far enough to engage with the radial projection 35 of the clutch-slide 32. They are so spaced apart, angularly, that the said radial projection will fit between them when all three projections are at the same distance from the center. Projection 56, in addition, is formed with an angular notch, thus providing a radial shoulder for engagement with the adjacent radial side of projection 35, and an overhang to overlap the outer end of the latter projection when the said radial side is against the said radial shoulder.

The clutch-slide 54 is provided with a projection 57 extending oppositely with relation to projection 55. This projection 57 works in the cam-groove 58 of the stationary cam 59, the latter being shown in place in Figs. 1, 2, and 3, and in detail in Figs. 21 and 22. Cam 59 is capable of being turned around for the purpose of adjusting its angular relations with the other parts of the tumbler-mechanism. It normally is locked from turning by means of a fixed pin or stud 60 projecting from the back-plate. When the cam occupies its working position with its face against the outer side of clutch-slide 54, the said fixed pin or stud occupies one of a series of notches 61, 61, etc., formed in the periphery of the cam. A spring spider 62 surrounds the sleeve 11 with the ends of its legs in contact with the outer face of the cam-disk. The said spider is confined by a washer 63 occupying a rabbet in the extreme outer end of the sleeve and in turn held in place by the washer 12 and screw 13. The pressure of the said spider keeps the cam in its normal working position and in engagement with the pin or stud 60. The cam-groove 58 has a portion of its length concentric with sleeve 11, and while the projection 57 occupies this portion such projection remains at a uniform distance from the center, and no diametrical movement of clutch-slide 54 takes

place. Another portion, 58^a, of the said cam-groove is eccentrically disposed, and when projection 57 is carried into this eccentric portion by the turning movement of the tumblers, etc., the said clutch-slide is moved diametrically.

In the embodiment thus far explained the eccentric portion 58^a is at a greater distance from the center than the concentric portion. Consequently, when the projection 57 advances into this portion the clutch-slide 54 is moved in the direction which shifts the projection 56 on the other end of such clutch-slide inward toward the center, and vice-versa when the parts are turned to move the projection 57 from the eccentric portion of the cam-groove into the concentric portion. The end-wall 58^b at the extreme end of the eccentric portion, and that, 58^c, at the extreme end of the concentric portion, constitute stops for the projection 57 by which the limits of the turning movements of the tumbler-mechanism are determined. The position of the end-wall 58^b defines the fixed dead starting point. By shifting the cam-disk into different angular positions, the angular position of the said starting-point may be adjusted. This shifting is effected by forcing the cam-disk outward upon sleeve 11 against the pressure of the spring spider 62 until the cam-disk is disengaged from the pin or stud, then turning the cam-disk around to the required extent, and then permitting the spider to press the cam-disk inward. The pin or stud will enter the notch 61 which in the new angular position of the cam-disk is presented in line with the pin or stud. By this adjustment the count in setting the tumbler 47 may be varied. The cam-disk is formed with a view-hole 59^a at the same distance from the center as a series of numerals from 0 to 9 on the outer face of clutch-disk 50. The numeral which is visible through the said view-hole is the first numeral of the combination, and indicates the count by which tumbler 47 is set.

Let it be assumed that the tumbler-mechanism occupies some position in which the combination is broken, and that the parts are in various positions away from starting position, with projection 57 of clutch-slide 54 in the concentric portion of the cam-groove 58, and consequently with the notched projection 56 in an outward position radially. If the knob be turned over from left to right, the tumbler 20 and clutch-driver 22 will turn therewith. Finger 23 of the clutch-driver will encounter projection 34 of clutch-slide 32, whatever the radial distance of such projection from the center may be, and carry around with it the tumbler 28 and said clutch-slide. Sooner or later the arm 36 of clutch-slide 32 will encounter one of the trips, which will cause

the said clutch-slide to move diametrically so as to carry projection 35 out radially far enough to clear the pin 51 of disk 50. Should the projection encounter the said pin prior to being moved outward it will carry disk 50 and tumbler 47 around until it is forced outward clear of the pin by the action of a trip, after which the disk and tumbler will remain at rest until the onward movement of projection 35 carries it into engagement with the radial shoulder of projection 56 of clutch-slide 54. This engagement will cause the latter clutch-slide, and the tumbler 47 and disk 50 to turn around, thereby causing projection 57 of clutch-slide 54 to travel in cam-groove 58. When projection 57 passes into the eccentric portion 58^a of the cam-groove, the clutch-slide 54 will be moved thereby diametrically in the right direction to carry projection 56 radially inward, and such projection, by hooking over the outer end of projection 35, will carry clutch-slide 32 with it, thus causing the projection 34 on the latter clutch-slide to slip inward along finger 23 of clutch-driver 22 into clutching-notch 24. The parts will now have become locked together, and will be arrested by contact of projection 57 with end-wall 58^b of the cam-groove 58. The radial projection 35 of clutch-slide 32 will be confined between the reduced end of pin 51 of disk 50 and the radial shoulder of projection 56 of clutch-slide 54. The tumbler-mechanism being now in starting position, the knob may be turned over from right to left to set the first tumbler. This turning movement will carry the parts around positively, and without play or lost-motion, in consequence of the fact that the notch 24 of clutch-driver 22 contains projection 34 of clutch-slide 32, and the further fact that projection 35 of the said clutch-slide is in engagement with clutch-pin 51. The first part of this turning movement will cause the projection 57 to travel from the eccentric portion of the cam-groove 58 into the concentric portion thereof, with the result that clutch-slide 54 will be moved diametrically in the direction to carry projection 56 outward clear of projection 35 of clutch-slide 32. The point at which this outward withdrawal of projection 56 takes place bears no particular relation to the point at which the tumbler 47 should be set. By discontinuing the turning movement over from right to left when the predetermined number of steps have been taken, the tumbler 47 will be given the required position. The knob will now be turned over from left to right. At the very beginning of this movement projection 34 of clutch-slide 32 will still occupy clutching-notch 24, alongside the finger 23. More or less promptly after such beginning, however, the encounter of the arm 36 of clutch-slide 32

with a trip will move such clutch-slide diametrically so as to take projection 34 out of notch 24, thereby unlocking the tumbler 28 from the clutch-driver preparatory to the return-movement of tumbler 20 and the clutch-driver, but the finger 23 at the rear side of the projection 34 will continue to carry around with it the clutch-slide 32 and intermediate tumbler 28. The knob having been turned the required number of steps in this direction, the tumbler 28 will be thereby set. Turning movement of the knob over from right to left will carry the finger 23 from projection 34, leaving tumbler 28 at rest, and such movement continued the proper number of steps will set the tumbler 20. The acting end of the dog will now be free to enter the notches of all the tumblers, which are now in alinement, and turning movement of the knob over from left to right in Figs. 1 and 2 will cause the shoulder of notch 26 of tumbler 20 to engage the said acting end and draw the bolt 2 inward so as to effect the unlocking.

Tumbler 28 having been set so as to place the notch 29 thereof in proper position with relation to the acting end of the dog, the setting of tumbler 20 by a movement over from right to left placing its notch 26 in alinement with notch 29 will also cause the lateral projection 27 (Figs. 5 and 6) of tumbler 20 to approach closely or just touch the lateral projection 30 (Fig. 10) of tumbler 28. Should the tumbler 20 be turned one or more steps too far in the said setting movement the engagement of its projection 27 with the said projection of tumbler 28 will cause the latter tumbler to be turned so as to carry its notch 29 out of position. Inasmuch as projection 27 acts against projection 30 only in the one direction of movement, tumbler 28 cannot be reset by turning back tumbler 20, and consequently the entire operation must be begun over again from the starting point.

After the tumblers have all been set correctly and the knob turned to draw the bolt, turning movement of the knob in the other direction will cause the inclined side of notch 26 to raise the acting end of the dog out of the notches of the tumblers, whereupon the latch and dog will be thrown by the action of the spring 3. To again unlock, the entire combination will have to be set from the starting point.

It will be perceived that the action of the eccentric portion of the groove of the cam-disk in producing diametrical movement of clutch-slide 54 is in effect the same as the action of one of the trips. Also, that the end-wall of such portion acts essentially as a fixed stop in connection with the said clutch-slide in arresting the rotation of the tumblers, etc., in the starting position.

In practice, suitable provision will be

made for holding the tumblers from turning except when motion is transmitted to them through the clutch-devices, so as to prevent accidental movement of the disks, and so that after a tumbler has been set it will remain at rest in the position which has been given to it, without being disturbed from such position by the turning movements of adjoining parts in setting the remaining tumblers. The preferred arrangement for the purpose consists of segmental pieces 65, 66, which are arranged to make contact with the side-faces of the tumblers at the peripheral margins of the latter. The segment 65 is interposed between the tumblers 20 and 28, and makes contact with the proximate faces thereof. The segment 66 intervenes between tumblers 28 and 47, and makes contact with the proximate faces thereof. The segments are supported, and held from turning with the tumblers, by lugs 67, 67, Fig. 8, projecting from opposite portions of the segments and entering the concavities of projections 68, 68, extending outward from the back-plate of the lock-case. The said lugs are capable of movement within the said concavities, toward and from the back-plate. The pressure of the spring spider 62 keeps the adjacent surfaces of the tumblers and segments firmly pressed against one another, and the frictional engagement of one such surface with another tends to hold the tumblers from turning movement, so that the tumblers turn only upon the application of force sufficient to overcome the frictional resistance.

To obviate tendency of clutch-slide 32 to move lengthwise, the spacing washer 46 is a friction-washer, it being cut across at one point, as shown in Fig. 13, and its ends being bent apart transversely. This washer will exert spring pressure against the clutch-slide sufficient to resist tendency of the same to move accidentally.

The invention is not in all cases restricted to the precise construction and arrangement of tumblers, clutch-devices, and cam, which have been described. Various modifications and changes therein are possible without necessarily involving a departure from the spirit of the invention. Figs. 23 to 40 illustrate, for instance, a modification embodying certain changes and adaptations providing for movement of the clutch-slides inward toward the center to effect unlocking, and outward therefrom to effect unlocking. In this modification, the eccentric portion 58^f, Figs. 39 and 40, of the cam 59^b inclines inwardly toward the center, the fixed stop, 58^e, being located at the inner end of such portion, the opposite stop being marked 58^g. The tumbler corresponding with tumbler 20 of the first described embodiment is shown at 20^a in Figs. 23, 24 and 25, it being formed with a circular series of holes 25^b, 25^b, etc.,

and the clutch-driver is shown at 22^a in Figs. 24 and 26, it being furnished with oppositely located pins 25^a, 25^a, to enter the predetermined holes of the series 25^b, 25^b, of the said tumbler 20^a. The clutch-driver 22^a is made with a large central hole, and its finger 23^a projects inwardly into the said hole, the clutching notch 24^a opening into the hole. The intermediate tumbler 28^a is shown in Figs. 27, 28 and 29, the corresponding clutch-slide being represented at 32^a in Figs. 27, 28 and 30. The outermost tumbler is shown at 47^a in Fig. 32, the difference between the same and the tumbler 47 of the first described embodiment being that the series of radial slots 49^a, 49^a, located between the center and the series of holes to receive the clutch-pin of the clutch-disk, the latter holes being next the periphery. In the case of the clutch-disk 50^a shown in Figs. 33, 37, and 38, the clutch-pin 51^a is nearer the outer rim than in the case of the clutch-pin 51 of the clutch-disk 50 of the first described embodiment. The notched projection 56^a of the clutch-slide 54^a is reversed so that the notch thereof is turned toward the periphery as shown in Figs. 33 to 37, instead of toward the center as in Figs. 14, 18, 19 and 20. In the case of this modification, the action is essentially the same as in the case of the first described embodiment, but some of the movements are reversed in obvious respects.

I claim as my invention:—

1. In a permutation lock, in combination, a plurality of tumblers, means for locking them together to move in unison forward and backward without lost-motion or play relative to each other in either direction until the tumblers have been respectively set and left at rest, and means for unlocking a tumbler at the start of the movement by which it is set so that there shall be no perceptible release to indicate the point where such tumbler should be set.

2. In a permutation lock, in combination, a plurality of tumblers, means for locking them together to move in unison forward and backward without lost-motion or play relative to each other in either direction until the tumblers have been respectively set and left at rest, a fixed stop defining a dead starting point, and means for unlocking a tumbler at the start of the movement by which it is set so that there shall be no perceptible release to indicate the point where such tumbler should be set.

3. In a permutation lock, in combination, a plurality of tumblers, movable clutch-members for connecting said tumblers to move together backward and forward until the tumblers respectively have been set, and means for successively unclutching the tumblers to enable them to be left at rest in set position.

4. In a permutation lock, in combination, a plurality of tumblers, movable clutch-members connecting said tumblers to move together until the tumblers respectively have
5 been set, a fixed stop defining a dead starting point, and means for successively unclutching the tumblers to enable them to be left at rest in set position.

5. In a permutation lock, in combination,
10 a plurality of tumblers, movable clutch-members combining the tumblers in a series moving together in unison forward and backward without lost-motion or play relative to each other until the tumblers respectively
15 have been set, and means for successively unclutching the tumblers to enable them to be left at rest in set position.

6. In a permutation lock, in combination, a plurality of tumblers, movable clutch-
20 members combining the tumblers in a series moving together in unison forward and backward without lost-motion or play relative to each other until the tumblers respectively have been set, a fixed stop defin-
25 ing a dead starting point, and means for successively unclutching the tumblers to enable them to be left at rest in set position.

7. In a permutation lock, in combination, a plurality of tumblers, movable clutch-
30 members connecting said tumblers to move together until they respectively have been set, and means for releasing a tumbler at the start of the movement by which it is set so that there shall be no perceptible release to
35 indicate the position in which the tumbler should be set.

8. In a permutation lock, in combination, a plurality of tumblers, movable clutch-
40 members connecting said tumblers to move together until they respectively have been set, a fixed stop defining a dead starting point, and means for releasing a tumbler at the start of the movement by which it is set so that there shall be no perceptible release
45 to indicate the position in which the tumbler should be set.

9. In a permutation lock, in combination, a tumbler, a second tumbler, a movable clutch-member, and means for operating
50 such clutch-member for engaging the tumblers together to move in unison in both directions, and subsequently changing the engagement so that one tumbler shall drive the other in one direction but leave the latter
55 tumbler at rest when the former is moved in the opposite direction.

10. In a permutation lock, in combination, a tumbler, a clutch-member connected there-
60 with, a second tumbler, a movable clutch-member connected therewith, and adapted in one position thereof to cause the two tumblers to move together in unison in both directions and in another position to cause one tumbler to move the other positively
65 when itself is moved in one direction but

leave it at rest when itself is moved in the other direction.

11. In a permutation lock, in combination, a tumbler, a second tumbler, means to en-
70 gage such tumblers with each other to transmit turning movement from one to the other thereof in each direction, and means to unlock the driven tumbler from the actuator tumbler at the start of the movement by
75 which the driven tumbler is to be set.

12. In a permutation lock, in combination, a tumbler, a second tumbler, clutch-devices for connecting such tumblers with each other, and devices for operating the said
80 clutch-devices to connect the tumblers so that they shall turn in unison in both directions, and also for partially disengaging the tumblers so that movement shall be commu-
85 nicated to the driven tumbler in one direction but it shall be left at rest with the first tumbler is turned in the other direction.

13. In a permutation lock, the combina-
90 tion with a series of tumblers, and movable clutch-devices, of a cam for locking all the tumblers together preliminary to the setting operation.

14. In a permutation lock, the combina-
95 tion with a series of tumblers, and movable clutch-devices, of a cam for locking all the tumblers together preliminary to the setting operation and arresting them in a fixed or dead starting position.

15. In a permutation lock, the combina-
100 tion with a series of tumblers, movable clutch-devices, and a cam for locking all the tumblers together preliminary to the setting operation, said cam unlocking the first tumbler at the start of the movement by which such tumbler is set, and means for
105 unlocking an intermediate tumbler at the start of the movement by which it is set.

16. In a permutation lock, in combination, a tumbler, a clutch-driver turning there-
110 with and having a finger and a clutching notch, a second tumbler, a movable clutch-member in connection therewith having a projection which engages with said finger and also is adapted to enter the said notch, and means to move said clutch-member to
115 shift the projection out of said notch and thereby unlock the said second tumbler from the clutch-driver.

17. In a permutation lock, in combination, a tumbler, a clutch-driver turning therewith
120 and having a finger and a clutching notch, a second tumbler, a movable clutch-member in connection therewith having a projection to engage with said finger and also adapted to enter the said notch, and a trip acting in
125 the turning movement of the parts to move the clutch-member to shift the projection out of the notch and thereby unlock the said second tumbler from the clutch-driver.

18. In a permutation lock, in combination, a tumbler, a clutch-driver turning therewith
130

and having a finger and a clutching notch, a second tumbler, a movable clutch-member turning therewith and having a projection to engage with the said finger and enter the
 5 said notch, a third tumbler, clutch-devices movable therewith, a cam which actuates said clutch-devices to clutch all the tumblers together, and also unclutches the third tumbler for being set, and means acting in the
 10 turning movement of the parts to move said clutch-member to shift its projection out of the clutching-notch to unlock the second tumbler for being set.

19. In a permutation lock, in combination,
 15 a tumbler, a clutch-device turning therewith and having a finger and a clutching notch, a second tumbler, a movable clutch-member turning therewith and having a projection to engage the said finger and enter the said
 20 notch, a third tumbler, a clutch-pin in connection therewith, a movable clutch-member turning with the said third tumbler, a cam which operates the last-mentioned
 25 clutch-member to lock all the tumblers together and also operates it to unlock the third tumbler for being set, and means acting in the turning movement of the parts to move the first-mentioned clutch-member to shift its projection out of the clutching-
 30 notch to unlock the second tumbler for being set.

20. In a permutation lock, in combination, a tumbler, a clutch-driver turning therewith, a second tumbler, a movable clutch-member

turning therewith and adapted to cooperate 35 with the said clutch-driver, and a plurality of trips arranged in the path of said movable clutch-member.

21. In a permutation lock, in combination, a plurality of tumblers, friction-pieces con- 40 forming to the rims of said tumblers, and engaging with the side-faces of the said rims, and means for pressing said friction-pieces and rims together transversely to prevent undesired turning movement of a tum- 45 bler.

22. In a permutation lock, in combination, two tumblers, means for turning them in unison in one direction for setting the first thereof, and engaging members in connec- 50 tion with the respective tumblers acting to displace said first tumbler in case the second tumbler in being set is carried past the point at which it should stop.

23. In a permutation lock, in combination, 55 two tumblers, means for turning them in unison in one direction for setting the first thereof, and projections on such tumblers acting in the return movement of the second tumblers to displace the first if the second 60 is carried past the point at which it should stop.

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

JOSEPH E. LE MYRE.

Witnesses:

CHAS. F. RANDALL,
 HENRI T. LEDOUX.