Feb. 5, 1935. A. H. WOODWARD 1,989,780

COMBINATION LOCK

Filed July 2, 1932 3 Sheets-Sheet 1

Fig. 1

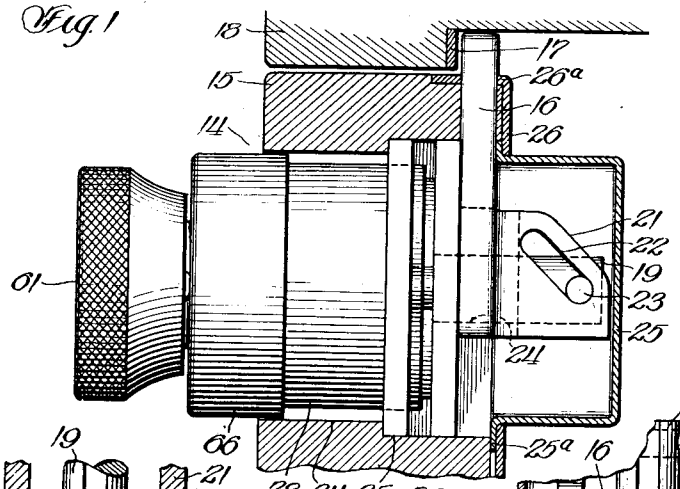


Fig. 2

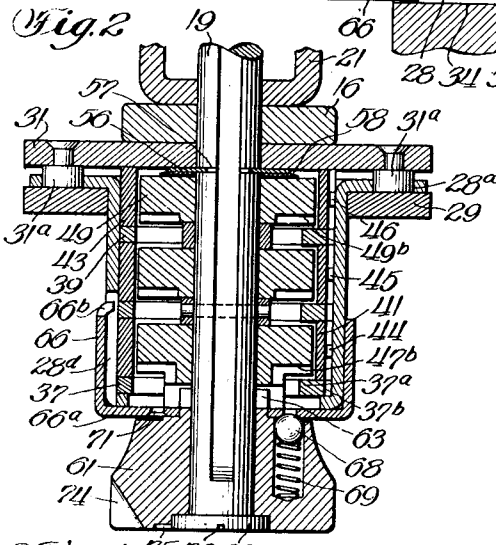


Fig. 3

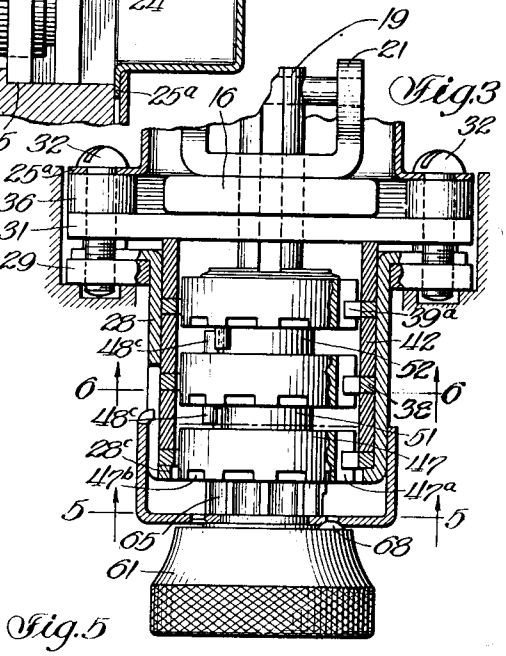


Fig. 4

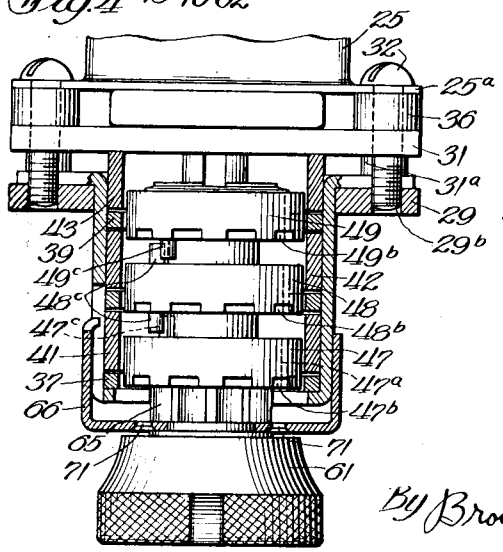
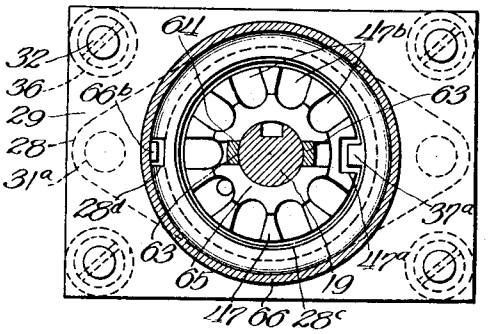


Fig. 5



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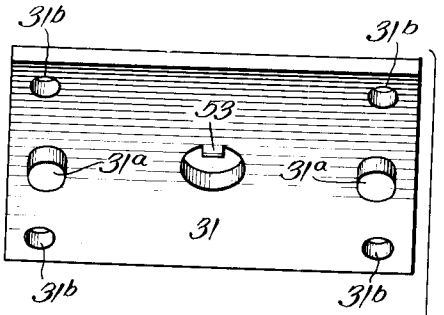
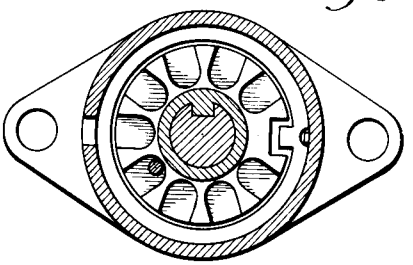


Fig. 6



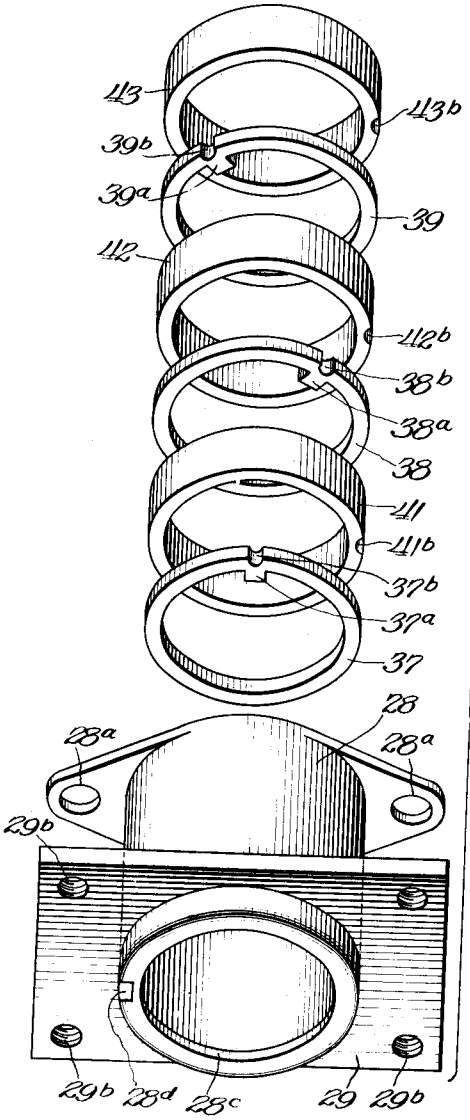


Fig. 7

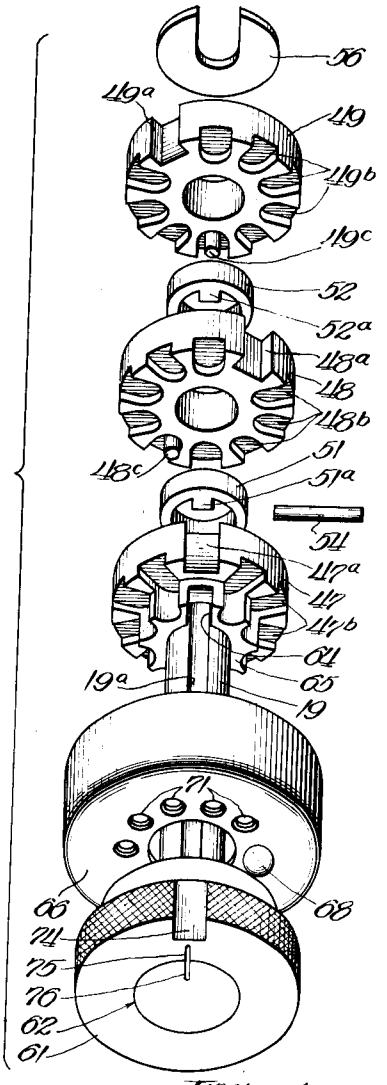


Fig. 8

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COMBINATION LOCK

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Fig. 15

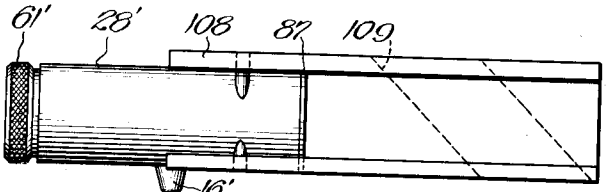


Fig. 9

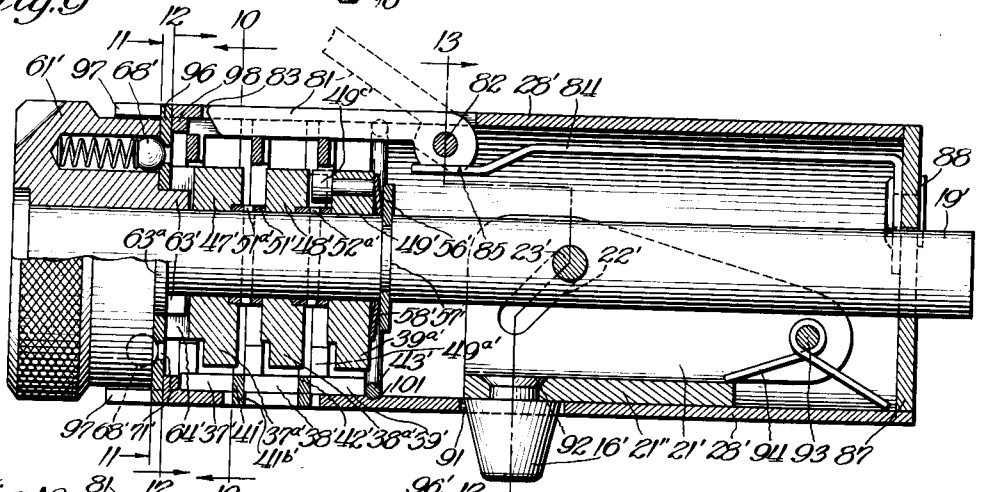


Fig. 10

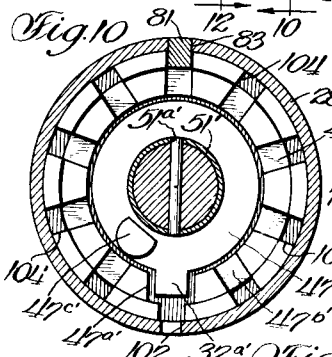


Fig. 11

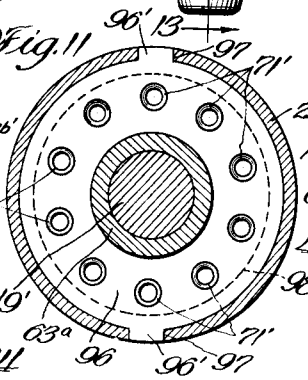


Fig. 12

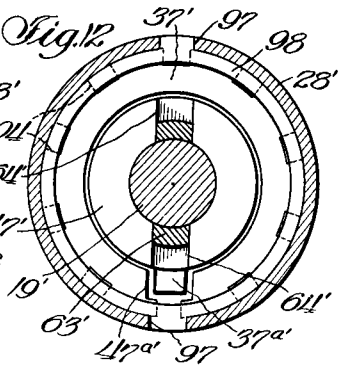


Fig. 111

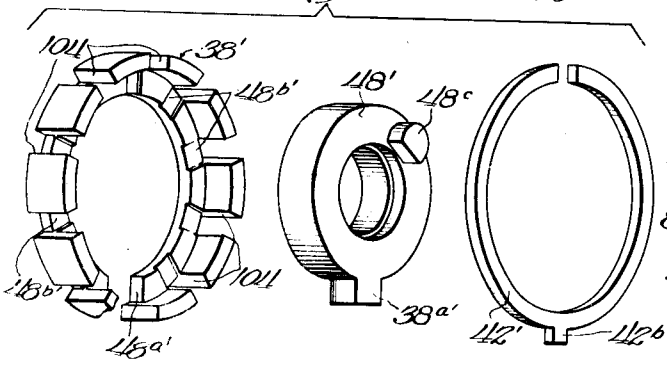
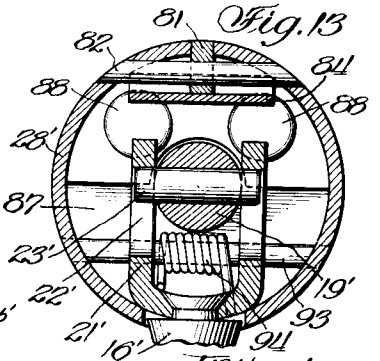


Fig. 13



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UNITED STATES PATENT OFFICE

1,989,780

COMBINATION LOCK

Arthur H. Woodward, Winnetka, Ill.

Application July 2, 1932, Serial No. 620,622

13 Claims. (Cl. 70—53)

The present invention relates to combination locks.

The fundamental object of the invention is to provide a combination lock in which the combination can be changed from the exterior of the lock, i. e. the combination can be changed without the necessity of taking the lock apart.

A further object of the invention is to provide a combination lock in which the combination can be changed by direct manipulation of the same knob or dial which is ordinarily operated in releasing the lock.

A further object of the invention is to provide a combination lock in which the combination can be changed from the exterior of the lock only when the lock is in released condition.

Numerous advantages accrue to the ability to change the combination of the lock from the exterior thereof. For example, in the case of safety deposit boxes having the conventional types of combination locks, whenever the box is rented to a new depositor, the combination lock must be taken apart and an explanation made to the depositor of the method of setting the pins or tumblers for a new combination, in order that he can set his own combination in secrecy, without the assistance of the bank employees. Much difficulty is frequently experienced by the new depositor in properly setting the pins or tumblers, and in reassembling the lock after the new combination has been established. All of this is avoided by the use of my improved lock, since the establishment of a new combination does not necessitate taking the lock apart, and since the method of setting the new combination by appropriately rotating the knob of the lock can be easily explained. There are innumerable other instances where a combination lock of this characteristic is desirable, as, for example, in situations where employees are frequently changed, necessitating frequent changes of the combination, or in the case of strong boxes, trunks, tire locks, etc. where the purchaser may desire to change the combination himself after purchasing the article.

A further object of the invention is to provide such a combination lock which is of small, compact dimensions and which is of inexpensive construction, thereby adapting it to widespread utility for filing cabinets, desk drawers, etc., where large, expensive locks would not be feasible.

Further objects of the invention are: To provide an improved combination lock which can be operated in the dark; to provide a combination lock of the aforesaid general description which is tamper proof and cannot be picked or deciphered by sense of feel; and to improve upon locks of this type generally.

In the accompanying drawings illustrating a typical, preferred embodiment of my invention on an enlarged scale:

Figure 1 represents a typical installation, being a vertical sectional view through the drawer of a filing cabinet or desk, showing my improved lock mounted therein;

Figure 2 is an axial sectional view through the lock, illustrating the position of the parts when the mechanism is locked;

Figure 3 is a similar view, but illustrating portions of the tumblers, etc. in elevation, and showing the general relation of the parts when the actuating knob is pulled forwardly for releasing the lock;

Figure 4 is a view similar to Figure 3, but illustrating the clamping pressure removed from the locking rings and illustrating in exaggerated proportions the resulting spaces between the locking rings and spacing rings which enable the locking rings to be rotated by the outer actuating knob for changing the combination;

Figure 5 is a transverse sectional view taken approximately on the plane of the line 5—5 of Figure 3;

Figure 6 is a transverse sectional view taken approximately on the plane of the line 6—6 of Figure 3;

Figure 7 is a perspective view, showing in exploded relation, the normally stationary parts of the lock assembly, comprising the cylindrical casing, the locking and spacing rings which are assembled therein, and the clamping plates which rigidly lock the aforesaid locking rings in place after a new combination has been set up in the lock;

Figure 8 is a similar perspective, exploded view illustrating the normally movable parts of the assembly comprising the tumblers, shaft, actuating knob, etc.

Figure 9 is a longitudinal sectional view, on an enlarged scale, of a modified form of my invention;

Figures 10, 11, 12 and 13 are transverse sectional views taken on the planes of the lines 10—10, 11—11, 12—12 and 13—13, respectively, in Figure 9;

Figure 14 is a perspective view in exploded relation showing one of the tumblers, one of the locking rings and one of the spacing rings of the modified construction, and

Figure 15 is a side elevational view of this modi-

fied construction showing a master-bolt actuating attachment.

In Figure 1 my improved combination lock, indicated in its entirety at 14, is shown in a typical installation in the front panel 15 of a drawer in a filing cabinet or desk. Any suitable locking bolt arrangement may be provided for actuation by the combination lock; in the illustrated arrangement a locking bolt 16 being projected upwardly from the edge of the drawer into position behind a keeper 17 secured to a stationary part 18 of the cabinet or desk. The combination lock 14 comprises an axial shaft 19 which is moved longitudinally in effecting the throwing of the bolt 16. Any suitable motion transmitting mechanism may be provided for translating the endwise motion of the shaft 19 into proper actuation of the bolt 16; in the illustrated arrangement the lower end of the bolt has a U-shaped bracket 21 secured thereto and the side arms of this bracket are provided with inclined cam slots 22, in which engage the ends of a transverse pin 23 anchored in the end portion of the shaft 19. The shaft passes through an elongated slot 24 in the bolt 16. It will be evident that endwise motion of said shaft operates through the pin 23 and cam slots 22 to project the bolt either upwardly or downwardly. A suitable housing 25 encloses these bolt actuating parts, said housing having an outwardly extending flange 25*a* by which it is secured to other parts of the lock assembly. The mounting of the bolt may be reenforced by an inner plate 26 which is secured to the inner side of the front wall 15 of the drawer and which has a forwardly extending upper flange 26*a* provided with a suitable guide slot through which the bolt passes.

Referring to Figure 7, the combination lock comprises a cylindrical casing 28 having apertured ears 28*a* projecting outwardly thereform at its rear end. A front clamping plate 29 has a cylindrical opening therein slipping freely over the barrel or casing 28. A rear clamping plate 31 is disposed in rear of the casing 28 and has forwardly extending studs 31*a* anchored therein, which studs are adapted to enter the holes in the ears 28*a* for holding the casing 28 against rotation. Holes 31*b* in the corners of the rear clamping plate 31 are adapted to pass screws 32 which thread into tapped holes 29*b* in the front clamping plate 29. Referring to Figures 1 and 3, the cylindrical casing 28 is extended forwardly through a cylindrical hole 34 in the drawer panel and the front and rear clamping plates 29—31 are disposed in a rectangular recess 35 formed in said panel. Preferably, the clamping screws 32 also pass through holes in the flange 25*a* of the rear casing 25, and spacing sleeves 36 are mounted on the clamping screws between said flange and the rear clamping plate 31 whereby clamping pressure exerted through these screws will not bind and prevent reciprocation of the bolt 16.

Assembled within the cylindrical casing 28 is a series of locking rings 37, 38 and 39, together with a series of spacing rings 41, 42 and 43. One of these spacing rings is interposed between each pair of locking rings, and a final spacing ring is interposed between the rearmost locking ring and the rear clamping plate 31. The front end of the cylindrical casing 28 is provided with a small inturned flange 28*c* forming an inner rim or shoulder against which the front locking ring 37 bears, as illustrated in Figures 2–4. With the several rings assembled within the casing 28, the rear spacing ring 43 projects slightly beyond the rear end of the casing. It will hence be seen that by drawing up on the clamping screws 32 the tendency is to draw the front and rear clamping plates 29 and 31 together thereby firmly clamping all of the rings together against rotation within the casing 28. The locking rings have inwardly extending lugs 37*a*, 38*a* and 39*a* and, as hereinafter described, changing the combination of the lock is effected by rotating these rings to dispose said lugs in different angular positions relatively to each other. Such rotation of the locking rings is permitted upon releasing the clamping pressure exerted by the screws 32, this only being possible when the lock is unlocked and the drawer is open to afford access to the heads of the screws from the inside of the drawer. Each of the aforesaid rings has a peripheral notch 37*b*, 38*b*, etc. which enable the rings to pass three spaced studs or spline members 44, 45 and 46 which are rigidly secured in the casing 28 and project inwardly therefrom. The location of these studs longitudinally of the casing is such that at all times one of the studs is engaging in each one of the notches or keyways 41*b*, 42*b* and 43*b* of the three spacing rings, whereby at all times the spacing rings are held against rotation in the operation of changing the combination of the lock. Since the notches or keyways 37*b*, 38*b* and 39*b* of the locking rings are not in register with these studs, these rings can be rotated in the casing when the clamping pressure is released from the rings as previously described.

The inwardly projecting lugs 37*a*, 38*a* and 39*a* of these locking rings constitute the register or keying elements, with which the notches in the tumbler discs must be brought into registry before the lock can be released.

Referring to Figure 8, the tumbler discs are indicated at 47, 48 and 49. These tumbler discs are each provided with a single peripheral notch or keyway 47*a*, 48*a* and 49*a* which extends from one face to the other of each disc and which is caused to register respectively with the register or keying elements 37*a*, 38*a* and 39*a* of the locking rings when the tumbler discs have been rotated into the proper combination. The front face of each disc is also provided with a series of false or teaser notches 47*b*, 48*b*, 49*b* which are relatively shallow pockets which are also capable of receiving the register elements 37*a*, 38*a* and 39*a*, and thereby serving to confuse any one attempting to pick or circumvent the lock. The front tumbler 47 has a pin 47*c* projecting from its rear face; the rear tumbler 49 has a like pin 49*c* projecting from its front face; and the intermediate tumbler 48 has a pin 48*c* passing entirely therethrough and projecting from both faces thereof for coaction with the pins 47*c* and 49*c*.

The three tumbler discs are all mounted for free, independent rotation on the shaft 19. This shaft has a longitudinal keyway 19*a* extending substantially the entire length of the shaft. Interposed between the three tumbler discs are spacing collars 51 and 52, having inwardly extending keys 51*a* and 52*a* which fit in the keyway 19*a*. This shaft is capable of reciprocation, but is held against rotation by the transverse pin 23 at its rear end; the aperture in the rear clamping plate 31 through which this shaft passes may also be provided with an inwardly extending lug 53 for engaging in the keyway 19*a*, in order to assist in holding the shaft against rotation. The front spacing collar 51 is preferably fastened to the shaft by a pin 54 passing through the collar and through the shaft. The tumblers 47, 48 and

49 are assembled within the group of rings 37—43, within which rings the tumblers are capable of rotation, and are held in assembled relation on the shaft 19 by a U-shaped key washer 56 which engages in an annular groove 57 formed in the shaft 19 at a point just beyond the rear tumbler 49. A flexible spring washer 58 may be interposed between the key washer 56 and the rear tumbler 49.

Mounted on the front end of the shaft 19 for free rotation thereon is the operating knob or dial 61 by which the lock is operated. Rigid with the front end of the shaft is a flange or end disc 62 which is set in an annular recess in the knob 61 and prevents the knob from being pulled outwardly off the end of the shaft. Projecting from the rear side of the knob 61 are two lugs 63 which engage in sockets 64 formed in a hub portion 65 projecting forwardly from the first tumbler 47. This coupled relation compels said first tumbler 47 to turn with the knob 61 at all times. The pinned relation of the first spacing collar 51 to the shaft 19 directly back of the first tumbler, and the engagement of the key washer 56 in the annular groove 57 in back of the last tumbler, compels the three tumblers, the shaft 19 and the knob 61 to reciprocate as a unit when the knob is pushed inwardly or pulled outwardly.

Closing the open front end of the barrel 28 is a cup-shaped end cap 66 which preferably reciprocates directly with the operating knob 61 but which is held against rotation relatively to the barrel 28. The transverse web portion 66*a* of this cap is confined between the inner side of the knob 61 and the front side of the boss 65 projecting from the tumbler 47 (Figure 2) whereby the knob and tumbler can rotate relatively to said cap but the cap is compelled to move longitudinally with the knob. An inwardly bent spur 66*b* at the inner end of the cap fits slidably in a longitudinal slot 28*d* formed in the outer portion of the barrel 28, this arrangement holding the cap against rotation relatively to the barrel but permitting endwise motion of the cap with the knob.

In the preferred construction, the rotative movements of the knob 61 to the right and to the left are calculated by counting the impulses of a spring click comprising a ball 68 mounted in a hole in the knob 61 and having a compression spring 69 pressing against the ball. The web portion 66*a* of the end cap 66 is provided with a circularly grouped series of holes or depressions 71 therein into which the ball is successively snapped in the rotation of the knob 61. A starting or index point, from which the spring click impulses are counted, is established by providing a notch 74 at one point in the outer periphery of the knob 61. The index point from which the first number of the combination is counted may be based on having this notch at the very top or at the bottom of the knob, as a starting point. By sense of touch afforded by this notch such index point can be readily ascertained in the dark, by first appropriately disposing this notch in the aforesaid position, and thereafter the combination can be gone through by counting the impulses of the spring click 68. If desired, additional index indicia may be provided by forming a small slot or other mark 75 in the front face of the knob, which mark is adapted to register with a like mark 76 in the front face of the shaft or end disc 62 when the knob is at the starting point. While the spring click method of reckoning the rotative movement of the knob in each direction is preferable because of the ability to operate the lock in the dark, and because of the greater secrecy resulting from the inability of any bystander to observe the degree of each rotative movement, it will of course be understood that a numerical dial arrangement can be provided by placing a circular group of dial numbers or marks, like the mark 75, around the front face of the knob 61, or by placing a circular group of dial numbers or marks, like the mark 76, around the front face of the end head 62. With such dialing arrangement the spring click might be dispensed with.

In describing the operation of the lock it will be assumed that there are ten click depressions 71 which, counting from the zero or index position with the notch 74 at the very top of the knob 61, will count in successive steps from 0 to 9 inclusive. It shall be assumed that the combination is: right 7—left 17—right 8. For this combination, all of the tumblers are collected by successive revolutions of the knob 61 to the right (clockwise), the tumblers being collected by two or more such revolutions to the right, which brings all three tumbler pins 47*c*, 48*c* and 49*c* in series contact, substantially as illustrated in Figures 3 and 4. The knob is then rotated to bring the notch 74 up to the index or starting position at the top of the knob, and starting from this index point the first number of the combination is counted off by continuing such right hand or clockwise rotation of the knob through seven steps or clicks from the index position. This leaves the notch 49*a* of the last tumbler 49 in registry with the register lug 39*a* of the last locking ring 39. The direction of rotation of the knob 61 is now reversed, so as to leave this last tumbler 49 in its position of registry, and in this reverse rotation of the knob to the left seventeen clicks or steps are counted off from the point where said last tumbler was left. These seventeen steps carry the front tumbler pin 47*c* around to engage on the reverse side of the intermediate tumbler pin 48*c*, whereupon the intermediate tumbler is picked up to rotate with the first tumbler 47 in this left hand or counterclockwise direction. At the end of the seventeenth step in this direction the notch 48*a* of the intermediate tumbler 48 will be in registry with the register lug 38*a* of the intermediate locking ring 38. From this position the direction of rotation of the knob 61 is now reversed, so as to leave the intermediate tumbler 48 in its position of registry, and eight steps are now counted off in such rotation of the knob to the right, counting from the point where the intermediate tumbler was left. The completion of this eighth step to the right places the notch 47*a* of the first tumbler 47 in registry with the register lug 37*a* of the first locking ring 37. Thereupon the lock can be unlocked. This is accomplished by pulling the knob 61 outwardly, which operates through the shaft 19 to draw the three tumblers forwardly, at which time the notches therein move forward over their respective register elements 37*a*, 38*a* and 39*a*. The forward motion of the shaft 19 operates through the pin 23 and cam slots 22 to retract the bolt 16 to its released position, enabling the drawer to be opened. Relocking the device merely involves thrusting the knob 61 inwardly to restore the tumblers to their normal positions, as illustrated in Figure 2, and then rotating the knob in one di-

rection or the other to destroy the set-up of the tumblers. (Figures 3 and 4 illustrate the knob and tumblers drawn forward in the lock releasing operation and in these figures the three notches 47*a*, 48*a* and 49*a* and the three register elements 37*a*, 38*a* and 39*a* are shown in longitudinal alignment, this showing being made solely for the purpose of illustrating the construction and operation to better advantage, but such aligned condition of the register elements on the tumblers and on the locking rings would probably never be assumed in the normal operation of the lock).

It will of course be understood that the right and left sequence of the combination may be reversed if desired in the setting of the combination; for example, the combination might be—left 7—right 17—left 8. Also, the operating method may be modified, if desired, by following the practice of going back to the index point before starting to count off the steps for the intermediate tumbler 48, whereby in a ten-step construction such as illustrated, the combination number for the intermediate tumbler 48 would be a number not exceeding 10. This same result—having a combination number for the intermediate tumbler not exceeding 10—might be obtained by having two spaced pins projecting forwardly from the front face of the intermediate tumbler 48 or projecting rearwardly from the rear face of the front tumbler 47, so as to reduce the amount of rotation necessary to position the intermediate tumbler in its registry position for unlocking. In lieu of two spaced pins on either of the tumblers 47 or 48, the same result can be secured by providing a segment on one of these tumblers of predetermined angular length for cooperating with the pin on the other tumbler.

To change the combination of the lock, the lock is first placed in released condition with the tumblers drawn forwardly to have their notches embracing the register lugs 37*a*, 38*a* and 39*a*. The four clamping screws 32 are then actuated from the inside of the drawer, to back these screws away sufficiently to remove all clamping pressure from the rings 37—43. Figure 4 illustrates the clamping pressure released from these rings by illustrating spaces in exaggerated form between successive rings, but it will be understood that in practice the clamping pressure need only be released to the point where the locking rings 37, 38 and 39 can be freely rotated. These three locking rings are now under the control of their companion tumblers 47, 48 and 49, since the register portions (the lugs) of said rings are engaging in the register portions (the notches) of the companion tumblers, and hence by rotating the tumblers the said rings can be rotated to position their respective register lugs in different angular settings. The tumblers are first all collected, as by rotating the knob 61 to the right through successive revolutions, and this brings all three tumbler pins 47*c*, 48*c* and 49*c* into series contact, as illustrated in Figures 3 and 4. The new combination is now established by rotating the knob 61 in the appropriate direction and through the same distances that will be subsequently used in unlocking the lock in its new combination. For example, for a new combination of—right 6—left 12—right 3, starting from 0 position the knob is turned to the right through six steps, then to the left through twelve steps and then to the right through three steps. Thereupon, the clamping screws 32 are tightened to rigidly clamp all of the rings 37 to 43 inclusive in stationary relation. The above described rotative movements of the knob resulted in the register lug 39*a* being left in position corresponding to—right 6; in the register lug 38*a* being left in position corresponding to—left 12; and in the register lug 37*a* being left in position corresponding to—right 3. In the rotation of these locking rings 37, 38 and 39 the spacing rings 41, 42 and 43 were maintained in stationary relation by the engagement of their notches 41*b*, etc. over the studs 44, 45 and 46, and these stationary spacing rings prevented the rotation of any later actuated locking ring from transmitting any rotative force tending to disturb the setting of a previously located locking ring. After the tightening of the screws 32 the lock is then ready to operate in its new combination.

As previously remarked, it will be understood that the right and left sequence may be reversed if desired; for example, the new combination might be made—left 6—right 12—left 3. It will also be understood that more than three tumblers might be employed and, furthermore, the tumblers in large embodiments might be made of much larger size (the accompanying drawings of Figures 1–8 being approximately twice the scale of a typical small embodiment) which would permit of a much finer subdivision of each tumbler movement than ten steps per revolution. The false or teaser notches 47*b*, etc. in the tumblers greatly increase the difficulty of circumventing the lock, even in the small three tumbler type that I have shown, because one attempting to feel out the combination cannot detect the difference between the teaser notches and the genuine notches 47*a*, and only the latter permit the necessary amount of longitudinal movement required to release the lock.

In Figures 9, 10, 11, 12, etc. I have illustrated a modified construction differing principally from the preceding construction in that the rotatable locking rings are not held in their new positions by clamping pressure, but by a releasable detent or keying member, generally indicated at 81. This keying member is pivotally mounted at its inner end on a cross pin 82 which is carried by the cylindrical casing 28′ of the lock. In its normal position said member is swung inwardly to repose in a longitudinal slot 83 provided in the casing 28′ directly above the locking rings 37′, 38′ and 39′, and in this normal position said keying member 81 engages in peripheral notches in said locking rings for holding the latter against rotation. When said keying element is swung up to released position, substantially as indicated in dotted lines in Figure 9, the locking rings are free to be turned. A leaf spring 84 has its free end bearing against a flat surface 85 formed on the inner side of the hub portion of said keying element 81 for normally holding the latter in its ring locking position.

This modified construction also incorporates other alternative features, such as the reversal of the register elements as by providing the register lugs on the tumblers and the register notches in the locking rings; the mounting of the bolt actuating parts within the lock casings 28′, etc. which will now be described. The casing 28′ is made sufficiently long to enclose the bolt actuating parts, and has its rear end closed by an end head 87 which is suitably secured to the casing. The shaft 19′ has reciprocable bearing support in this end head, and the rear end of

the leaf spring 84 has a widened portion which is fixedly secured to said end head by rivets 88. The locking bolt 16' is in this instance in the form of a button or tapered head which is adapted to be projected downwardly through a hole 91 in the bottom of the casing 28'. Said bolt is riveted at 92 in the transverse bottom portion 21'' of a U-shaped bolt actuating member 21'. The side wings of this bolt actuating member extend up on opposite sides of the shaft 19' and have inclined cam slots 22' therein in which engage the ends of the transverse pin 23' which is anchored in the shaft. The rear end of said actuating member 21' is pivotally mounted on a cross pin 93 having its ends supported in the side walls of the casing, and a coil spring 94 is wound around said pin and has its ends bearing respectively against the casing and against the bottom portion 21'' of the actuating member and normally tending to swing the locking projection 16' outwardly into locking position.

The rear portion of the operating knob 61' extends into the open front end of the casing sleeve 28'. The knob carries two diametrically opposite ball clicks 68' which are adapted to snap into a circular series of holes 71' which are formed in a disc 96 mounted in the casing at the inner end of the knob. Diametrically opposite slots 97 extend inwardly from the front end of the casing for receiving lugs 96' projecting outwardly from the disc (Figure 11), whereby the disc 96 is held against rotation. The casing sleeve is provided with an inwardly extending annular flange 98 against which the disc can bear. The provision of two spring clicks 68' at diametrically opposite points in the knob 61' avoids side twist on the knob from the spring pressure of the clicks, and this provision of two spring clicks can also be incorporated in the previously described embodiment.

The three locking rings 37', 38' and 39' each has a rotatable fit in the casing 28'. The front locking ring 37' bears against the inwardly projecting casing flange 98. A spacing ring 41' is interposed between the locking rings 37' and 38', and a second spacing ring 42' is interposed between the locking rings 38' and 39'. A snap ring 43' having separated ends is sprung into an annular groove 101 formed in the inside of the casing 28', this snap ring holding the assembly of locking and spacing rings 37'—42' in place in the casing. The two spacing rings 41' and 42' are held against rotation by providing each with a downwardly extending lug 41*b*' and 42*b*' which project into a longitudinal slot 102 in the bottom of the casing 28'. The spring grip of the snap ring 43' in the groove 101 holds the latter against rotation.

As shown in Figures 9 and 14, each of the three locking rings 37', 38' and 39' is of cup shape comprising an inwardly extending radial flange and a longitudinally extending peripheral flange. Equally spaced around the periphery of each locking ring are ten notches or slots 104 in which the pivoted keying arm 81 is adapted to engage. The radially extending flange of each ring is provided with a single register notch or keyway 47*a*', 48*a*' and 49' which extends from one side to the other of the ring flange and which are caused to register respectively with the register or keying elements 37*a*', 38*a*' and 39*a*' of the tumblers 47', 48' and 49'. As best shown in Figure 14, the inner face of the radially extending flange portion of each locking ring is also provided with a series of false or teaser notches 47*b*', 48*b*' and 49*b*' which are relatively shallow pockets also capable of receiving the register elements 37*a*', 38*a*' and 39*a*', and thereby serving to confuse anyone attempting to pick or circumvent the lock.

The three tumblers 47', 48' and 49' are all mounted for independent rotation on the shaft 19' in substantially the same manner previously described, i. e., spacing collars 51' and 52' are interposed between these three tumbler discs, being held against rotation by transverse pins 51*a*' and 52*a*', however, instead of by keys and keyways, and the end tumbler being held in assembled relation on the shaft by a U-shaped key washer 56' which engages in an annular groove 57' formed in the shaft and which confines a flexible spring washer 58' against the rear tumbler 49'. The operating knob 61' is operatively coupled to the first tumbler 47' by two lugs 63' which engage in sockets 64' formed in the front face of the tumbler. The lugs 63' project from the reduced hub portion 63*a* which extends from the rear face of the knob and has rotatable bearing support in the central aperture of the disc 96, whereby said disc and hub portion 63*a* establish bearing support for the front end of the shaft 19'.

The front and rear tumblers 47' and 49' have tumbler pins 47*c*' and 49*c*' projecting therefrom, substantially as previously described, these pin or lug projections either being integral portions of the tumblers or being headed pins anchored in the tumblers. The intermediate tumbler 48' may have a single pin extending entirely therethrough or it may have the pin which projects from one face of the tumbler in diametrically opposite or other angular relationship to the pin which projects from the other face of the tumbler.

When a combination has been properly established in the lock one of the peripheral slots 104 in each of the three locking rings will be presented in register with the longitudinal slot 83 in the casing, whereby the keying finger 81 can engage in these aligned slots of all three locking rings and hold them against rotation. The spacing rings 41' and 42' also have slots cut therethrough which register with the casing slot 83 for permitting the finger 81 to occupy this locking position. The running of the combination, in the operation of unlocking the lock, is performed in the same manner previously described so as to bring the lugs 37*a*', 38*a*' and 39*a*' in proper angular positions for registry with the registered notches 47*a*', 48*a*' and 49*a*' of the locking rings. Thereupon, the knob 61' is drawn forwardly, the ability of the register lugs to move forwardly into the register notches permitting such movement, and such forward motion of the shaft 19' operating through the pin 23' and cam slots 22' to swing the bolt element 16' up into retracted position in the casing 28'.

In the installation of the lock, whether installed in a desk drawer, filing cabinet or any other type of closure element, the arrangement is always such that when the closure element is closed and locked the keying finger 81 is inaccessible. When it is desired to change the combination of the lock, the lock is unlocked to release the closure element whereby access can be gained to the finger 81. By inserting a pin or any other instrument under the front end of said finger it can be swung up out of the slot 83 into a released position, substantially as indicated in dotted lines. This frees all of the locking rings 37', 38' and 39'. Thereupon, a new combination can be set by rotating the knob 61' through successive revolutions to

collect all of the tumblers and locking rings, and then proceeding to set up a new combination by appropriate rotation of the knob in the proper directions and through the proper distances to set up the desired new combination. The locking rings are compelled to rotate with their respective tumblers during this operation because of the engagement of the register lugs on the tumblers with the register notches in the rings. After the new combination has been established the keying finger 81 is swung down into its normal locking position, whereby it is caused to engage in the aligned peripheral slots 104 of the three locking rings, thereby fixedly holding said rings against rotation as long as the lock remains with this combination.

It will be evident that this latter embodiment affords a quick, convenient method of releasing the locking rings for the setting of different combinations. Such embodiment also illustrates a reversed relation of the register portions, with the register lugs 37*a'*, etc. provided on the tumblers and the register notches 47*a'* formed in the rings, which reversed relation can be incorporated in the embodiment of Figures 1 to 8, inclusive, or the arrangement of the lugs and notches illustrated in the embodiment of Figures 1 to 8, inclusive, can also be embodied in the construction of Figures 9 to 15, inclusive.

The locking bolt 16' is arranged to cooperate with a suitable keeper opening in a stationary part of the device to be locked and may constitute the sole locking part; or, as illustrated in Figure 15, an extension portion 108 may be secured to the casing 28' and carry a suitable cam guide 109 for actuating a main locking bar. For example, in the case of a filing cabinet or other device having a multiple arrangement of drawers or the like closure elements the locking bar responsive to the cam slot 109 would serve to lock or unlock all of the drawers. In such event the bolt 16' would serve solely to release the lock casing 28', whereby it could be drawn forwardly through a longer range of motion than is afforded by the motion of the shaft 19' within said casing, in order to obtain the desired range of movement for unlocking all of the drawers.

While I have illustrated what I regard to be the preferred embodiment of my invention, nevertheless it will be understood that numerous modifications and rearrangements may be made therein without departing from the essence of the invention. For example, in a multiple tumbler lock, not all the locking rings 37, 38, 39, etc. need be capable of adjustment to a different position, but one or even more of the registration lugs might be fixed in a permanent, unchangeable position.

I claim:

1. A lock comprising a first register element adapted to occupy a position defining a registry point, a second register element rotatable and reciprocable relatively thereto and permitting unlocking of the lock when said second element is in position to permit predetermined registry between said two elements at said registry point, means supporting said first register element enabling the latter to be moved in order to differently locate said registry point, and an external operating knob operatively connected to rotate and reciprocate said second register element.

2. A combination lock comprising a first group of register elements adapted to occupy positions whereby each element defines a registry point individual to that element, a second group of register elements in companion relation to said first elements and movable relatively thereto and permitting unlocking of the lock only when said second elements are in position to permit predetermined registry between the companion elements at the respective registry points defined by said first elements, means supporting said first elements enabling the latter to be moved in order to differently locate the registry points defined by said first elements, and an external lock operating knob operatively connected for selectively rotating said second group of register elements in the normal operation of the lock, and operative to rotate said first group of register elements when the combination of the lock is to be changed.

3. A combination lock comprising register means adapted to define registry points, a plurality of rotatable tumblers permitting unlocking of the lock only when said tumblers are in position to permit predetermined registry between said register means and said tumblers at the registry points defined by said register means, means holding said register means enabling the latter to be moved in order to differently locate said registry points, and an operating knob common to all of said tumblers for rotating the latter.

4. A combination lock comprising a plurality of rotatable tumblers, means for transmitting rotation from one of said tumblers to the next, register means normally held against rotation with said tumblers when the latter are rotated in the normal lock releasing operation, means supporting said register means enabling the latter to be rotated with said tumblers, and a single operating member for rotating said tumblers.

5. A combination lock comprising a plurality of relatively rotatable tumblers, a plurality of register elements coacting with said tumblers whereby the lock can only be released when said tumblers have predetermined registry with said register elements, said register elements remaining substantially stationary in the normal operation of the lock, but being rotatable for the purpose of changing the combination of the lock, means supporting said register elements, normally holding the latter against rotation with said tumblers but permitting the release of said register elements to enable said elements to rotate with said tumblers, and an external operating member for operating all of said tumblers.

6. A combination lock comprising a plurality of tumblers, a plurality of rings each comprising a register portion defining a registry point individual to one of said tumblers, and a common operating member for rotating all of said tumblers, said rings being rotatable to shift their register portions for changing the registry points of said tumblers.

7. A combination lock comprising a plurality of rotatable tumblers each having a register notch therein, a plurality of register members mounted concentrically of said tumblers, each of said latter members comprising a register lug defining a registry point individual to one of said tumblers, at which point the registry of the lug with the notch in its companion tumbler permits opening of the lock, an operating member for selectively rotating said tumblers, and means for normally holding said register members stationary, but enabling the latter to be released for rotative movement to change the combination of the lock.

8. A combination lock comprising a plurality of relatively rotatable tumblers each having a register projection thereon, a plurality of register members mounted concentrically of said tumblers,

each of said latter members comprising a register opening defining a registry point individual to one of said tumblers, at which point the registry of the opening with the projection on its companion tumbler permits opening of the lock, an operating member for selectively rotating said tumblers, and means for normally holding said register members stationary, but enabling the latter to be released for rotative movement to change the combination of the lock.

9. A combination lock comprising a plurality of relatively rotatable tumblers, a plurality of register elements coacting with said tumblers whereby the lock can only be released when said tumblers have predetermined registry with said register elements, said register elements being held against rotation in the normal operation of the lock but being rotatable to shift their register portions for changing the registry points of said tumblers, releasable holding means adapted to engage with said register elements for holding the latter against rotation, and an external operating knob operatively connected to rotate said tumblers and to rotate said register elements when said elements are released.

10. A combination lock comprising a plurality of relatively rotatable tumblers each comprising a register portion, a plurality of rings each comprising a register portion defining a registry point individual to one of said tumblers, said rings being held against rotation in the normal operation of the lock, but being rotatable to shift their register portions for changing the registry points of said tumblers, shoulders on said rings, releasable holding means adapted to engage with said shoulders for holding said rings against rotation, and an external lock operating knob operatively connected to rotate said tumblers, and also operative to rotate said rings when the latter are released.

11. A combination lock comprising a casing, a shaft extending longitudinally of said casing, said shaft being held against rotation but being capable of longitudinal movement in said casing, a plurality of locking rings in said casing mounted concentrically relatively to said shaft, said rings remaining substantially stationary in the normal operation of the lock but being capable of relative rotation to permit changing the combination of the lock, each of said locking rings having a lock releasing registration portion, non-rotatable spacing means interposed between said locking rings in said casing, a plurality of relatively rotatable tumblers mounted on said shaft, each of said tumblers having a registration portion therein adapted to coact with the registration portion of a companion locking ring, said tumblers normally lying in planes offset from the planes of said locking rings but being movable longitudinally into the planes of said rings when the register portions of said tumblers are in registry with the register portions of said rings, a knob mounted on said shaft and operatively connected to transmit rotative movement to said tumblers and to transmit longitudinal movement to said shaft and tumblers, a non-rotative member co-acting between said knob and the end of said casing, a spring click effective between said knob and said non-rotative member for indicating the advancing steps imparted to the successive tumblers, said casing having a longitudinal slot therein, each of said locking rings having a series of notches around its periphery adapted to align with said slot, and a pivoted finger adapted to swing down into said slot for engaging in the aligned notches of the several locking rings after the combination of the lock has been changed.

12. A combination lock comprising a plurality of relatively rotatable tumblers each having an irregularity or aligning point therein, a plurality of register members mounted concentrically with relation to said tumblers, each of said register members having an irregularity or aligning point individual to one of said tumblers at which point the alignment of the irregularity with the corresponding irregularity of the companion tumbler permits opening of the lock, an operating member for selectively rotating said tumblers, and means for normally holding said register members stationary, but enabling the latter to be released for rotative movement to change the combination of the lock.

13. A lock comprising a register element remaining fixed in the normal operation of the lock, a tumbler capable of being so positioned with relation to said register element as to permit unlocking the lock, and means whereby the tumbler may be used to move the register element so that the unlocking position of the lock may be changed.

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