

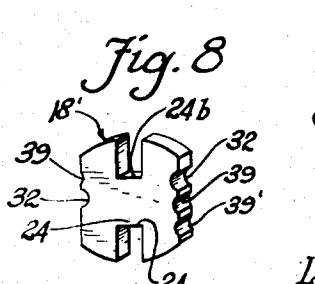
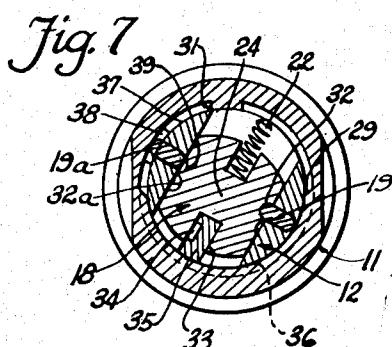
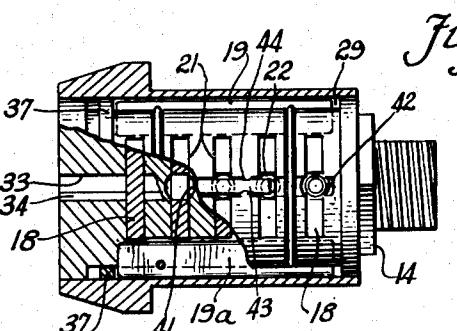
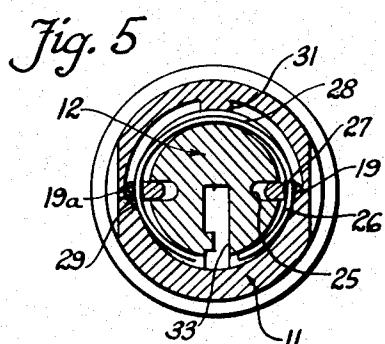
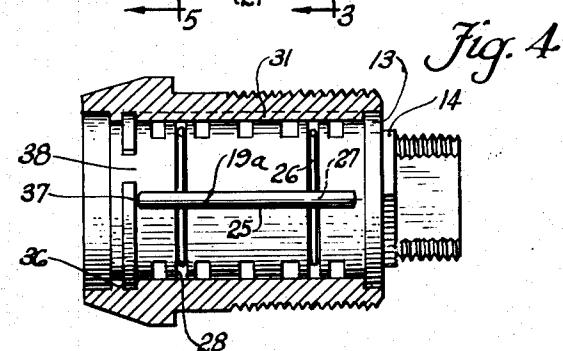
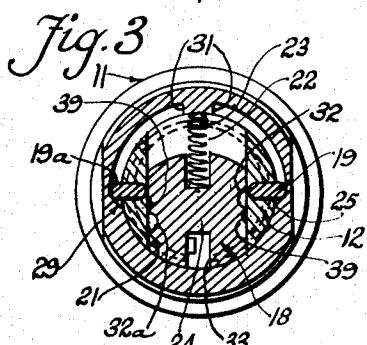
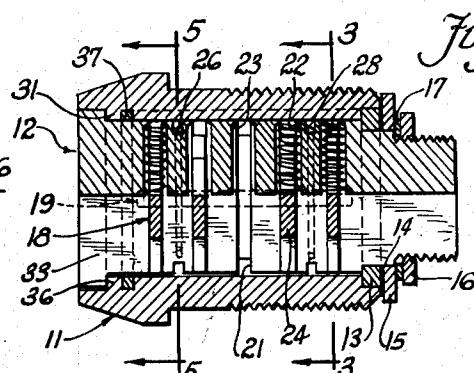
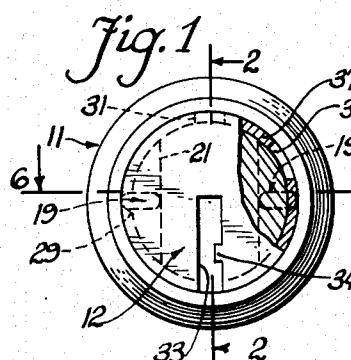
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CYLINDER LOCK

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CYLINDER LOCK

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10 Claims. (Cl. 70—340)

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This invention relates in general to locks, and more particularly to permutation type of locks in which a plurality of blocking elements are provided for individual movement to an inoperative or releasing position by the act of inserting a proper key therein.

A principal object of the invention is to provide a lock mechanism comprising a locking member normally blocked against unlocking movement by a plurality of elements which may be moved individually to releasing positions to permit unlocking movement of the locking member, but wherein insufficient or excessive movement of any one of the blocking elements from its normal position will prevent unlocking of the locking member.

Another object of the invention is the provision of such locking mechanism in a rotatable cylinder which is housed in a casing with which the locking member cooperates.

A further important object of the invention is to enable selective repositioning of the blocking elements in different positions in such a locking mechanism, to permit setting of different combinations in this permutation type of lock, by so constructing the blocking elements as to enable removal of any of them and replacement thereof in a reversed position by an authorized person.

Another object is to so construct such a lock that the act of inserting a key of proper conformation therein will position all of the blocking elements in inoperative relationship relative to the locking member so as to enable the latter to be moved out of its normal locking relationship with the casing.

A further object of the invention is to so mount the locking member in the barrel of such a lock as to cause it to be moved relative thereto into inactive position by the co-action therewith of a cam surface in the casing when the key is turned, after insertion of a proper key has moved the blocking elements to their release positions.

Another object is the provision of means normally cooperating with the locking member to prevent withdrawal of the barrel from the casing and so arranged that authorized unlocking rotation of the barrel will move the locking member relative to such removal preventing means and out of cooperative relationship therewith to enable withdrawal of the barrel from the casing.

Another important object is to enable the use of master keys in such locks by providing two such locking members, each cooperating with all of the blocking elements, so that insertion of an ordinary key with the proper conformation will move all of the blocking elements to release one of the locking members only to permit turning of

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the key in one direction to unlock the lock, and insertion of a master key of different conformation will move all of the blocking elements to different releasing positions to release the other locking member to permit turning of the key in the opposite direction to unlock the lock.

A further object of the invention is to limit the unlocking rotation of the barrel in either direction in such a lock, which is accomplished by providing means formed integrally with the casing which cooperates with either of the locking members when they are in normal, operative position.

Another object is to provide a simplified locking mechanism comprising locking members and H-shaped blocking elements normally so positioned that their outer edges block inward movement of the locking members to inoperative position, with notches formed in such outer edges at different distances from the ends thereof, so that different degrees of vertical movement imparted thereto by a key, upon insertion of the latter into the lock, will be required to align an associated notch horizontally with a locking member to permit such inward releasing movement of the latter into the notches.

Another object of the invention is to enable the use of duplicate or identical blocking elements in such a locking mechanism, which may be accomplished by giving these slideable elements the H-shape above described and forming the locking member receiving notch in one edge at a different distance from the end thereof than that in the other edge, whereby end-for-end and/or front-to-rear reversal of any blocking element enables it to be disposed in any one of four different positions relative to the locking members.

A further important object of the invention is to render such a locking mechanism substantially pick-proof by providing additional notches in the outer edge of the blocking elements which function as "foolers" to anyone attempting to pick the lock by relieving the pressure of the associated locking member against the blocking element when the latter is moved to align such "fooler" notch with the locking member, and which are more shallow than the regular notches so as not to release the locking member when aligned therewith.

Another object is to provide a cleanly designed and completely contained locking mechanism of the above description in which a spring is associated with each of the blocking elements for maintaining the same normally in a lower, operative position and for resiliently resisting upward key-actuated movements of these elements, and wherein such springs are confined by, and disposed entirely within, the rotatable barrel.

A further important object of the instant invention is the provision of a locking mechanism having all of the above-noted features and advantages while, at the same time, having an extremely small number of parts and being simple and inexpensive to manufacture.

Numerous other objects and advantages of the invention will be apparent from a consideration of the following specification and accompanying drawings, wherein:

Figure 1 is an elevational front end view of a lock embodying the features of the instant invention;

Fig. 2 is a longitudinal, vertical section taken substantially on the line 2—2 of Fig. 1, with one of the blocking elements and two of the springs therefor removed;

Fig. 3 is a transverse vertical section taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a longitudinal section similar to, and taken on the same line as, Fig. 2, with the barrel shown therein in side elevation;

Fig. 5 is a lateral section taken substantially on the line 5—5 of Fig. 2;

Fig. 6 is a horizontal section taken substantially on the line 6—6 of Fig. 1 and showing the barrel partially in top plan and a modified means for retaining the blocking element springs in the barrel;

Fig. 7 is a transverse section similar to Fig. 3, showing the barrel rotated by a master key to release position for removal from the casing;

Fig. 8 is a perspective view of one of the blocking elements; and

Fig. 9 is a perspective view of one of the locking members.

Referring now more particularly to the drawings, a lock embodying the features of the instant invention is illustrated therein which comprises a cylindrical casing, designated generally by reference numeral 11, and a barrel, indicated generally by reference numeral 12, rotatably mounted therein. The casing 11 may be given the standard, or any other desired configuration, so long as the bore thereof is properly dimensioned to receive and enclose the barrel 12. At its rear end, the casing is counterbored to receive a ring 13 (Fig. 2) which may be press-fitted therein and functions as a rear bearing for the barrel 12 as well as to close the otherwise open spaces between the periphery of the barrel 12 and the casing 11 against entry of foreign matter (Figs. 3, 5 and 7). In the form herein illustrated, the rear end of the barrel 12 is provided with suitable external threads terminating at a squared shoulder 14 upon which any suitable cam 15, or other desired type of bolt-throwing member, may be mounted. A standard lock nut 16 may be screwed onto this rear threaded end of the barrel 12 for retaining the bolt-actuating cam 15 thereon, and a suitable spring lock-washer 17 may be interposed between this lock nut 16 and the cam 15 to insure proper retention of the latter on the barrel 12. If desired, these members 15, 16 and 17 also may function to retain the barrel 12 in the casing 11, although means preferably are provided in the instant lock for preventing unauthorized removal of the barrel from the casing, even though the members 15, 16 and 17 be removed from the barrel. This means will be described in detail hereinafter.

The barrel 12 is so formed as to receive the instant locking mechanism and maintain the several parts thereof as a unitary assemblage, and

this locking mechanism comprises a plurality of vertically movable blocking elements 18 and a pair of diametrically opposed locking bars or members 19, 19a. Each of the blocking elements 18 is slidably mounted in a vertical or transverse slot 21, five of the latter being illustrated in the present embodiment of the invention, which are spaced equidistantly from each other in the manner best illustrated in Figs. 2 and 6. These slots 21 may be formed in the barrel 12 by a suitable broaching operation, or the barrel may be formed by die casting to include the slots 21. A drill is passed upwardly through the central portion of each of the slots 21 to provide a suitable guide aperture for a coil spring 22. This drilling operation is terminated just after the point of the drill extends beyond the outer surface of the barrel 12, so as to leave an upper shoulder 23 (Fig. 2) as a means for retaining the upper end of the associated spring 22. The lower end of each coil spring 22 engages a transverse central portion 24 of the associated blocking element 18 to resist upward movement of the latter from its normal position of Fig. 3. Each of the blocking elements 18 is H-shaped, as best seen in Figs. 3, 7 and 8, to provide such transverse central portion 24, and the ends of the leg portions thereof are rounded off to conform to the shape of the outer surface of the barrel 12.

As best seen in Figs. 4, 5 and 6, the barrel 12 also is provided with a pair of diametrically opposed and longitudinally extending slots 25 in its outer surface for receiving the two locking members 19, 19a. These slots 25 prevent end-wise or longitudinal movement of their associated locking members 19, 19a but permit inward and outward sliding of the locking members relative to the barrel. In order to retain the locking members 19, 19a on the barrel 12 when the latter is removed from the casing 11, and also to urge these locking members to their normal outermost positions of Figs. 3 and 5, a pair of split rings 26 are provided, each of which passes through a suitable vertically disposed aperture 27 in the locking members 19, 19a and embraces the barrel 12 in the manner illustrated in Fig. 5. The barrel is provided with a pair of circumferential grooves 28 for receiving these rings 26, and the latter are so formed as to urge the locking members 19, 19a to their outermost positions of Fig. 5.

The bore of the casing 11, as best illustrated in Figs. 3 and 5, is provided with a pair of longitudinally extending recesses or slots, each of which terminates at its lower end in a horizontally disposed, inwardly and downwardly sloping cam surface 29, and at its upper end in a vertical shoulder 31. These recesses permit limited movement of the associated locking member 19, the outer edge of which normally is disposed therein, upon rotation of the barrel 12 relative to the casing 11 in a given direction, when the locking member 19 is maintained in its normal outermost position. In addition to being resiliently retained in such outermost position by the split rings 26, the locking members 19 also normally are positively maintained therein and restrained against inward sliding movement to an operative position in their slots 25 by the several blocking elements 18. As best seen in Fig. 3, the outer edge surfaces of these blocking elements 18 normally are disposed in substantial contact with the inner edge surfaces of the locking members 19, 19a to perform this blocking function.

Each of the blocking elements 18, however, is provided with one or more locking member relief slots 32, 32a formed in the outer edge surfaces thereof. Upon vertical movement of all of the blocking elements 18 to position these slots 32, 32a opposite or in horizontal registry with their associated locking members 19, 19a, the latter may be moved inwardly in their slots 25 a sufficient distance to bring the outer edges thereof into the plane of the outer surface of the barrel 12. Such released or inoperative position of a locking member 19 is illustrated at the right side of Fig. 7. The necessary movements of the several blocking elements 18 to so dispose them in such inoperative positions, is accomplished by the insertion of a key having the proper conformation into the barrel 12. The body of the latter is provided with a transversely extending key slot 33 which preferably has a key-guiding rib 34 (Fig. 1) extending along one side thereof. As a key of the proper conformation is inserted into this slot 33, the upper edge thereof will come in contact with the lower surface of the transverse central portions 24 of the several blocking elements 18 to lift the latter against the action of their associated springs 22. Thus, the act of inserting a key into the lock, if the upper edge of the key has the proper conformation, will result in the several blocking elements 18 being moved to, and maintained thereby in, their respective released or inoperative positions. As shown in Fig. 3, the locking member relieving slots in the two lateral edges of this blocking element 18 are designated, respectively, by the numerals 32 and 32a, and are disposed at different distances from the lower edge of the blocking element. Consequently, in order to align these slots 32 or 32a horizontally with their associated locking members 19 or 19a, it is necessary that insertion of a key move the blocking element upwardly different distances. It also will be apparent from Fig. 3 that raising of the blocking element 18 a sufficient distance to align the slot 32 with the locking member 19, will permit inward movement of the latter, so far as this blocking element 18 is concerned, but the latter will still be in such position as to block inward movement of the other locking member 19a, since such vertical movement of the blocking element is insufficient to align the other slot 32a with the locking member 19a.

It is contemplated that all of the blocking elements 18 may be formed identically with that shown in Fig. 3, in order to facilitate the manufacture of the instant lock. As therein shown, slot 32 is disclosed as being disposed the same distance from the upper edge of element 18 as slot 32a is disposed from the lower edge thereof. Consequently, a double reversal of this blocking element 18 from its position of Fig. 3, comprising an end-for-end and a front-to-rear turning thereof, would result in slot 32 assuming an identical position to that shown in Fig. 3 for slot 32a, and vice versa. Likewise, a plain end-for-end reversal of this blocking element 18 from its position of Fig. 3 would result in the same relationship between these slots and their then associated locking members as exists in this figure, since the slots are disposed at the same distance from the opposite ends of the blocking element. It will be readily understood that these slots are so disclosed in the drawing merely as a matter of convenience to this description, and that in actual practice the dis-

tance between the upper end of the blocking element and slot 32 will be different from that between the lower end of the blocking element and slot 32a, whereby end-for-end reversal of the blocking element will require different degrees of vertical movement to be imparted to the blocking element by keys of different conformation to align the relief slots with their respective locking members. Plain front-to-rear reversal of the blocking element 18 from its position in Fig. 3 will require the same amount of vertical movement of the blocking element to align the slot 32 with the locking member 19a, as is required to align it with the locking member 19 in its position of Fig. 3. Thus, it will be seen that each of the several blocking elements 18 may be disposed within its retaining slot 21 in any desired one of four different positions. With the slots 32 and 32a disposed at different distances from their closest adjacent ends of the blocking element, this will result in an authorized person being enabled to pre-set each of these blocking elements 18 in such manner as to require any one of four different increments of vertical movement to be applied thereto by a key in order to align the associated relief slots horizontally with each of the locking members 19, 19a.

In order to employ a master keying arrangement with a plurality of the instant locks and to increase the possible permutations therein, it is preferred to use several different blocking elements 18, each having their relief notches 32 and 32a disposed at different distances from a given transverse reference line. For practical purposes, such theoretical reference line is taken as a transverse line through the upper surface of the central portion 24 of each H-shaped element 18. The plurality of different blocking elements 18 are formed with the horizontal center lines of their relief notches 32 and 32a, one in each lateral edge of the central portion 24, at different distances spaced downwardly from this theoretical reference line. For example, the lateral edges of the blocking elements between this reference line and a lower parallel line thru the lower surface of the central portion 24 may be divided into six equal increments which, together with such upper and lower reference lines, locate seven stations on each lateral edge. These stations locate the centers of the differently placed relief notches, one in each edge, of the different blocking elements 18. Of course, any other desired spacing method may be employed to locate the centers of the differently placed relief notches, depending upon the number of combinations the manufacturer wishes to make available. And with such different blocking elements 18 available, it will be readily understood by those skilled in the art that substitution of one or more other blocking elements for those in a given lock, having their notches 32 located similarly to the notches 32 in the elements in the lock but with their notches 32a differently located from the notches 32a of those in the lock, will not effect release of locking member 19 by a key, such as a master key, formed to effect release thereof with the original blocking elements, but will prevent release of locking member 19a by the same key which would have been effective to release it with the original elements.

The two locking members 19 and 19a are provided for the purpose of enabling the use of more than one key with the instant lock. In

other words, the locking mechanism herein illustrated is adapted to be unlocked by rotation of the barrel 12 relative to the casing 11 in one direction by a first key of the proper conformation, and to be unlocked by the rotation of the barrel in the opposite direction by a second key of different conformation. More specifically, a first or standard key of proper conformation to correspond, in the formation of the active or upper edge thereof, to the various settings of the several blocking elements 18 will move each of the latter vertically, upon insertion into the lock, to dispose all of the relief slots 32a in horizontal alignment with their associated locking member 19a. Subsequent rotation of the barrel 12 in a clockwise direction relative to the casing 11 (as viewed in Fig. 1) by turning of the inserted key, will result in this released locking member 19a being moved inwardly against the spring action of the split rings 26 by contact with the associated cam surface 29 of the casing 11. As viewed in Figs. 3 and 5, such unlocking rotation of the barrel by a first or standard key will be in a counter-clockwise direction. While the insertion of such a key in the keyway 33 will not result in release of the other locking member 19, such rotation of the barrel is permitted because of the relief or clearance provided in the casing for the resulting opposite rotational movement of this other locking member 19. However, such unlocking rotation of the barrel will be limited by contact of this other locking member 19 with its associated shoulder 31.

Likewise, insertion of a second or master key of different but proper conformation into the slot 33 of the lock will result in vertical movement being imparted thereby to the several blocking elements 18, against the action of their springs 22, to align their slots 32 with the other locking member 19. Rotation of the barrel 12 in a counter-clockwise direction, viewing Fig. 1, or a clockwise direction viewing Figs. 3, 5 and 7, will thereby be permitted. In Fig. 7, such partial rotation of the barrel 12 relative to the casing 11 is illustrated, wherein a portion of a second or master key 35 is shown in operative position in the key slot 33. This figure also clearly illustrates how the locking member 19 has been cammed inwardly by such rotation of the key and barrel by the camming action of the surface 29 against the outer edge of the locking member 19.

From the above description, it will be appreciated that the different blocking elements 18 in the locking mechanism each may be formed with their notches 32 and 32a horizontally aligned with each other, so that either locking member 19 or 19a may be released by the same key. This is of particular utility where it is desired to incorporate the instant locking mechanism in a lock of generally different characteristics from that herein specifically illustrated, wherein master-keying is not desired.

Means are provided for enabling authorized removal of the barrel 12 from the casing 11 to facilitate the setting of a different combination in the lock by repositioning or replacing one or more of the several blocking elements 18. As previously described herein, but for such means, removal from the rear end of the barrel of the members 15, 16 and 17 (Fig. 2) would enable such removal of the barrel from the casing, since the latter is formed interiorly with the longitudinal recesses, defined by the rib 31 and the cam surfaces 29,

in which the locking members 19 and 19a normally are disposed. However, adjacent the forward end of the bore of the casing an annular groove which passes through the rib 31 and, together with the counter-bore provided in the forward end of the casing for accommodating the outer end flange on the barrel 12, defines a semi-annular rib 36 (Figs. 2 and 4) which extends below and between the two cam surfaces 29 (Fig. 7). Mounted within this annular groove is a split ring 37, which is press fitted therein to prevent rotation of the ring relative to the casing. The ends of this ring 37 are spaced a short distance from each other, as shown at 38 in Figs. 1, 4 and 7. Normally, the locking members 19 and 19a are disposed rearwardly of, and in substantially abutting relationship relative to, this ring 37, as best seen in Fig. 6, so that the ring 37 alone is sufficient to normally prevent outward or withdrawal movement of the barrel 12 relative to the casing. Inward movement of the locking member 19a, resulting from insertion and rotation of a first or standard key, while clearing this locking member from the blocking action of the ring 37, will not enable withdrawal of the barrel from the casing, because the other locking member 19 remains blocked against outward longitudinal movement by the ring 37. If a second, or the master key 35 is inserted into the lock and the barrel turned thereby to the position of Fig. 7, however, such unlocking action will result in the inward movement of the locking member 19 beyond the inner periphery of the retaining ring 37, and the other locking member 19a will be aligned with the space 38 between the ends of the split retaining ring 37. Consequently, longitudinal withdrawal of the barrel 12 from the casing 11 is permitted in this partially unlocked position of Fig. 7.

Upon withdrawal of the barrel 12 from the casing 11 after rotation thereof to the position illustrated in Fig. 7, the several blocking elements 18 will be retained in the barrel by the key 35, since radial expulsion of the latter from the key slot 33 of the barrel, by the springs 22, will be prevented by the guide rib 34. After the barrel has been removed from the casing, however, it may be turned to an inverted position and the key 35 withdrawn longitudinally from the slot 33. Any one or more of the blocking elements 18 then may be withdrawn from their associated slots 21 and reversed and repositioned therein or replaced by other and different elements as desired, to change the combination of the lock. Insertion of a new key having the proper upper edge conformation into the barrel then will enable re-insertion of the barrel into the casing 11. Such withdrawal of the barrel from the casing is greatly facilitated by the action of the split rings 26 in their additional function of maintaining the locking members 19 and 19a in their associated slots 25. Of course, the barrel cannot be re-inserted in the casing except by manual movement of the locking member 19 inwardly to its inoperative position of Fig. 7, and this cannot be accomplished with any degree of facility unless a key having the proper conformation first is inserted into the key slot 33 to move the several blocking elements 18 to their proper inoperative positions. This means for preventing unauthorized removal of the barrel 12 and the locking mechanism carried thereby from the casing 11 is of particular importance in some types of locks different from that herein illustrated, such as padlocks, wherein no other means are provided for retaining the locking mechanism in the housing which are comparable

to the instant members 15, 16 and 17. If the lock housing or casing 11 is made as a die casting, the ring 37 may be formed integrally therewith, rather than as a separate member as shown herein. The reason for making this ring 37 as illustrated is because the instant casing 11 is broached endwise to provide the longitudinal recesses between ribs 31 and 36.

The instant locking mechanism also incorporates novel means for rendering the same substantially pick-proof. As is well understood in the art, anyone attempting to unlock such a mechanism relies upon his sense of touch to indicate when each of the blocking elements 18 has been moved individually to an inoperative position. This is accomplished by insertion of a thin tool into the keyway and thereby maintaining a rotative pressure against the barrel. With such pressure being maintained, another tool or pick is inserted into the key slot, and each of the blocking elements 18, in order, is moved individually thereby against the action of its spring 22. During such movement of a blocking element 18, the above-mentioned rotative pressure is maintained so that an abnormal lateral pressure of the active locking member 19 against the blocking elements 18 results. Consequently, an individual with the requisite skill might be enabled to ascertain the inoperative position of each of the blocking elements 18 by virtue of the hardly perceptible lessening in resistance against upward movement thereof when the relief slot 32 is moved into alignment with the active locking member 19. In order to obviate such deciphering of the combination of the lock, the blocking elements 18 are provided in their lateral edges with additional slots 39 (Figs. 3, 7 and 8) which comprise "foolers," since they are more shallow than the regular relief slots 32, but still will relieve the blocking element 18 from the pressure applied thereto by the active locking member 19, if aligned with the latter during an attempted lock-picking operation. These auxiliary slots 39, however, are not sufficiently deep to permit inward movement of the locking members 19 to their inoperative position. While it is substantially impossible to pick the instant locking mechanism even in the absence of these auxiliary slots 39, the latter inject an additional hazard in the path of anyone attempting to pick the lock sufficient to guarantee against a successful lock-picking operation.

In Fig. 8 a blocking element 18' is illustrated which is a modification of those shown elsewhere, and indicated by reference numeral 18, the two regular relief notches 32 being shown as located at different stations or distances from the upper and lower reference lines in the planes, respectively, of the upper and lower surfaces 24a and 24b of the central portion 24. This modified blocking element 18' incorporates a "fooler" notch 39 in each lateral edge and a second such shallow notch 39' in one of its edges to illustrate the possibility of employing a plurality of these "fooler" notches.

Fig. 6 illustrates a modified arrangement for housing the springs 22 and retaining them inescapably in the barrel 12. In this modified form, the barrel 12 is drilled from above centrally of each of the transverse slots 21 to provide spring-receiving apertures terminating in horizontal shelves or shoulder 41 just below the center of the barrel. A longitudinal groove 42 also is milled in the upper surface of the barrel. It will be apparent that these spring-receiving

recesses and the groove 42 may be formed directly in the barrel, if the latter is die cast. After the springs 22 have been inserted in these recesses during assembly of the locking mechanism, a strip or bar 43 is placed in the groove 42 and rigidly secured in any desired manner to the barrel 12, as by a crimping over of portions of the edges of the groove 42, as indicated in Fig. 6 at 44, by swaging or stamping. The springs 22 thus are inescapably retained within the barrel 12.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. In a permutation lock having a stationary casing, a barrel rotatably mounted in said casing, and a locking member carried by said barrel for rotation therewith and normally extending beyond the outer surface of said barrel for co-operation with said casing to prevent rotation of the barrel relative to the casing; a plurality of blocking elements mounted in said barrel with their lateral edges substantially in engagement with said locking member to normally prevent inward movement of said locking member relative to the barrel and having relief notches in said lateral edges, whereby longitudinal movement of said blocking elements from normal to inoperative positions by a key of proper conformation to align said relief notches with said locking member will permit inward movement of said locking member to enable rotation of said barrel relative to said casing, each of said plurality of blocking elements being of symmetrical configuration and having at least one relief notch in each of its lateral edges spaced longitudinally from its ends at different distances, whereby said blocking elements are individually reversible end-for-end and front-to-rear to any desired one of four possible normal positions.

2. In a permutation lock having a casing, and a barrel rotatably mounted therein; locking mechanism for preventing unauthorized unlocking rotation of said barrel, comprising a locking member mounted on said barrel and having an outer edge portion normally extending beyond the outer surface thereof, means mounted on said barrel and engaging with said locking member to resiliently maintain the latter in its normal outermost position, a cam surface formed interiorly of said casing for engaging the outer edge of said locking member to move the latter inwardly to an inoperative position against the action of said resilient means upon rotation of said barrel relative to said casing, and a plurality of elements mounted in said barrel for normally blocking such inward movement of said locking member by a side edge of each of said elements being disposed in the path of movement of the inner edge of said locking member, whereby said cam surface normally prevents unlocking rotation of the barrel relative to the casing, said blocking elements having relief notches differently located in each of their side edges alignable to receive the inner edge of said locking member by individual movement of the blocking elements to inoperative position by a key of proper conformation to permit unlocking rotation

of the barrel and to enable removal of the latter from the casing to effect a change of combination in the lock, said locking member having apertures therethrough and said resilient means passing through said apertures for retaining said locking member in normal position on the barrel upon removal thereof from the casing, and said blocking elements being mounted for ready removal from the barrel upon removal thereof from the casing and of symmetrical conformation to enable individual reversal to any selected one of a plurality of possible normal positions to effect selected changes in combination.

3. A lock, comprising a stationary casing having a bore with a pair of recesses each of which extends longitudinally and circumferentially over approximately a quadrant of a circle and terminates at one side in a cam surface substantially diametrically disposed from the other and at the other side in a shoulder, a barrel rotatably mounted in said casing, locking mechanism carried by said barrel and including a pair of locking members each normally extending outwardly beyond the outer surface of said barrel into a said recess, and a plurality of blocking elements normally disposed in operative position with their said edges engaging the inner edges of said locking members for preventing inward movement of either of said locking members from their operative positions, said locking members cooperating respectively with said cam surfaces in their operative positions each to prevent rotation of the barrel relative to the casing in one direction only, and relief means in the form of notches in each side edge of each said blocking element spaced at different distances from one end of each of said blocking elements, whereby when the notches in one edge of said blocking elements are aligned, said barrel may be rotated in one direction by virtue of the associated locking member being retracted by one of said cam surfaces, and when the notches in the other edge of said blocking elements are aligned, the barrel may be rotated in the opposite direction by virtue of the associated locking member being retracted by the other said cam surface.

4. A lock according to claim 3, in which said casing is provided with retaining means cooperating with said locking members in their operative positions to prevent longitudinal withdrawal of the barrel from the casing and having a passage therein to provide clearance for one of said locking members in its operative position when in its associated said recess of the bore of the casing and aligned therewith by partial rotation of the barrel following retraction of the other said locking member by its associated said cam surface out of cooperative relationship with said retaining means to enable authorized removal of the barrel from the casing.

5. In a lock having a stationary casing and a barrel rotatably mounted therein, locking mechanism for preventing removal of the barrel from the casing, comprising a pair of locking members mounted on said barrel for sliding movement inwardly and outwardly only relative thereto, spring means mounted on said barrel and engaging said locking members to normally resiliently maintain the same in an outermost operative position with the outer edges thereof extending beyond the outer surface of said barrel, an annular ridge formed in said casing for cooperation with the forward ends of said locking members, when the latter are in operative position, to prevent forward withdrawal of the barrel from

the casing and having a longitudinal slot peripherally spaced from said locking members when the latter are in normal operative position, and said casing having a bore having a pair of recesses each of which extends longitudinally and circumferentially over nearly a quadrant of a circle and terminates at one side in a longitudinally disposed cam surface substantially diametrically disposed from the other and at the other side in a shoulder, with the outer edges of said locking members extending into said recesses when in operative position, whereby rotation of the barrel relative to the casing in one direction from its normal position will cause inward movement against the action of said spring means of one of said locking members only by its associated said cam surface to an inoperative position out of cooperative relation with said annular ridge, and rotation of said barrel relative to said casing in the opposite direction similarly will move the other said locking member only to an inoperative position out of cooperative relation with said annular ridge and will move said first locking member into alignment with said longitudinal slot to enable withdrawal of the barrel from the casing.

6. In a permutation lock having a casing and a barrel mounted for rotation therein, locking mechanism carried by said barrel to normally prevent rotation of the barrel relative to the casing and adapted to be rendered inoperative by a key of proper conformation to enable withdrawal of the barrel from the casing to permit selective changing of the combination therein, comprising a plurality of blocking elements, said barrel having a plurality of transverse slots extending completely therethrough for their full cross sectional areas for slidably housing said elements and permitting their free removal from one end thereof and a longitudinal key-receiving slot passing therethrough, and a plurality of coil springs having an outer diameter greater than the thickness of said slots and abutting respectively at their inner ends against a said blocking element to hold the same against said casing when said barrel is mounted therein, each of said transverse slots being enlarged centrally to receive a said coil spring and to provide inwardly extending shoulders adjacent the outer end thereof to limit outward movement of the associated spring.

7. In a permutation lock having a casing with a bore and a barrel disposed in said bore and supported thereby, locking mechanism carried by the barrel and cooperating with said casing to prevent unlocking movement of the barrel relative to the casing, comprising locking means slidably mounted on said barrel, means for resiliently urging said locking means to operative position, a plurality of blocking members carried by said barrel for normally preventing movement of said locking means to inoperative position and movable to release said locking means for movement to inoperative position to enable removal of said barrel from said casing to permit substitution of other blocking members therefor to change the combination of said locking mechanism, said barrel having a plurality of transverse slots extending completely therethrough for their full cross sectional areas for slidably housing said blocking members and permitting free removal thereof from their lower ends upon removal of the barrel from the casing, each of said transverse slots being enlarged centrally from its upper end to a point short of its lower end to provide inwardly extending shoulders, a plurality of coil

springs having an outer diameter greater than the thickness of said slots disposed respectively in the enlarged central portions thereof and each abutting at its lower end against a said blocking member to resiliently maintain said blocking members in normal position against the bore of said casing when the barrel is mounted in the casing, and means mounted on said barrel for engaging the upper ends of said springs to cooperate with said inwardly extending shoulders to inescapably retain said springs in said barrel upon removal thereof from the casing.

8. In a permutation lock having a casing with a bore and a barrel disposed in said bore and supported thereby, locking mechanism carried by the barrel and cooperating with the casing to prevent unlocking rotational movement and longitudinal withdrawal of the barrel relative to the casing, comprising locking means slidably mounted on said barrel for movement radially thereof only, means for resiliently urging said locking means to operative position and engaging the locking means to retain the same on said barrel when the latter is withdrawn from said casing, a plurality of blocking members carried by said barrel for normally preventing movement of said locking means to inoperative position and movable to release said locking means for movement to inoperative position to enable removal of said barrel from said casing to permit substitution of other blocking members therefor to change the combination of said locking mechanism, said barrel having a transverse slot extending therethrough for its full cross sectional area for slidably receiving each of said blocking members, springs mounted in said barrel to resiliently maintain said blocking members in normal position against the bore of said casing, said blocking members being free to be removed from said barrel when the latter is withdrawn from said casing, the bore of said casing having an outwardly extending groove adjacent the forward end thereof, and a split ring seated in said groove for cooperation with an end of said locking means to normally prevent said longitudinal withdrawal of the barrel from the casing.

9. In a lock having a casing with a bore having a pair of longitudinally extending recesses each having cam and shoulder surfaces spaced peripherally from each other over approximately a quadrant of a circle, and a barrel rotatably mounted therein; locking mechanism for preventing unlocking rotation of the barrel in either direction relative to the casing and adapted to be unlocked selectively by either of two different keys of different conformation, comprising two locking members carried by the barrel and each normally extending beyond the outer surface thereof into a said longitudinally extending recess for cooperation with a said cam surface of the casing to prevent unlocking rotation of the barrel in one direction relative to the casing, and a plurality of blocking elements normally disposed in operative position to prevent inward movement of either of said locking members by abutment of the outer side edges thereof with the inner edges of said locking members and having relief notches formed in said outer side edges at different distances from one end thereof adapted to be aligned with said locking members upon longitudinal movement of the blocking elements to relief position to permit inward movement of the locking members to enable unlocking rotation of the barrel relative to the casing, whereby inser-

tion of a first key of proper conformation into the barrel will move all of said blocking elements into relief position with relation to one of said locking members to permit unlocking rotation of the barrel in one direction, and insertion of a second and different key of proper conformation will move all of said blocking elements to different relief positions relative to the other said locking member to permit unlocking rotation of the barrel in the other direction.

10. In a permutation lock having a casing with a bore having a pair of longitudinally extending recesses each having cam and shoulder surfaces spaced peripherally from each other over approximately a quadrant of a circle, and a barrel rotatably mounted therein; locking mechanism for preventing unlocking rotation of the barrel in either direction relative to the casing and adapted to be unlocked selectively by either a regular or a master key of proper conformation, comprising two locking members carried by the barrel and each normally extending beyond the outer surface thereof into a said longitudinally extending recess for cooperation with a said cam surface of the casing to prevent unlocking rotation of the barrel in one direction relative to the casing, and a plurality of blocking elements normally disposed in operative position to prevent inward movement of either of said locking members by abutment of the outer side edges thereof with the inner edges of said locking members and having relief notches formed in said outer side edges at different distances from one end thereof adapted to be aligned with said locking members upon longitudinal movement of the blocking elements to relief position to permit inward movement of the locking members to enable unlocking rotation of the barrel relative to the casing, whereby insertion of a regular key of proper conformation into the barrel will move all of said blocking elements into relief position with relation to one of said locking members to permit unlocking rotation of the barrel in one direction, and insertion of a master key of proper conformation will move all of said blocking elements to different relief positions relative to the other said locking member to permit unlocking rotation of the barrel in the other direction, said barrel having a plurality of transverse recesses open at one end for their full cross sectional areas and each of said blocking elements being mounted respectively in one of said latter recesses for ready removal through the open end thereof when the barrel is removed from the casing to enable individual reversal of said blocking elements to any selected one of a plurality of possible normal positions to reposition said relief notches relative to said locking members to effect selectable changes in the combination in the lock.

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