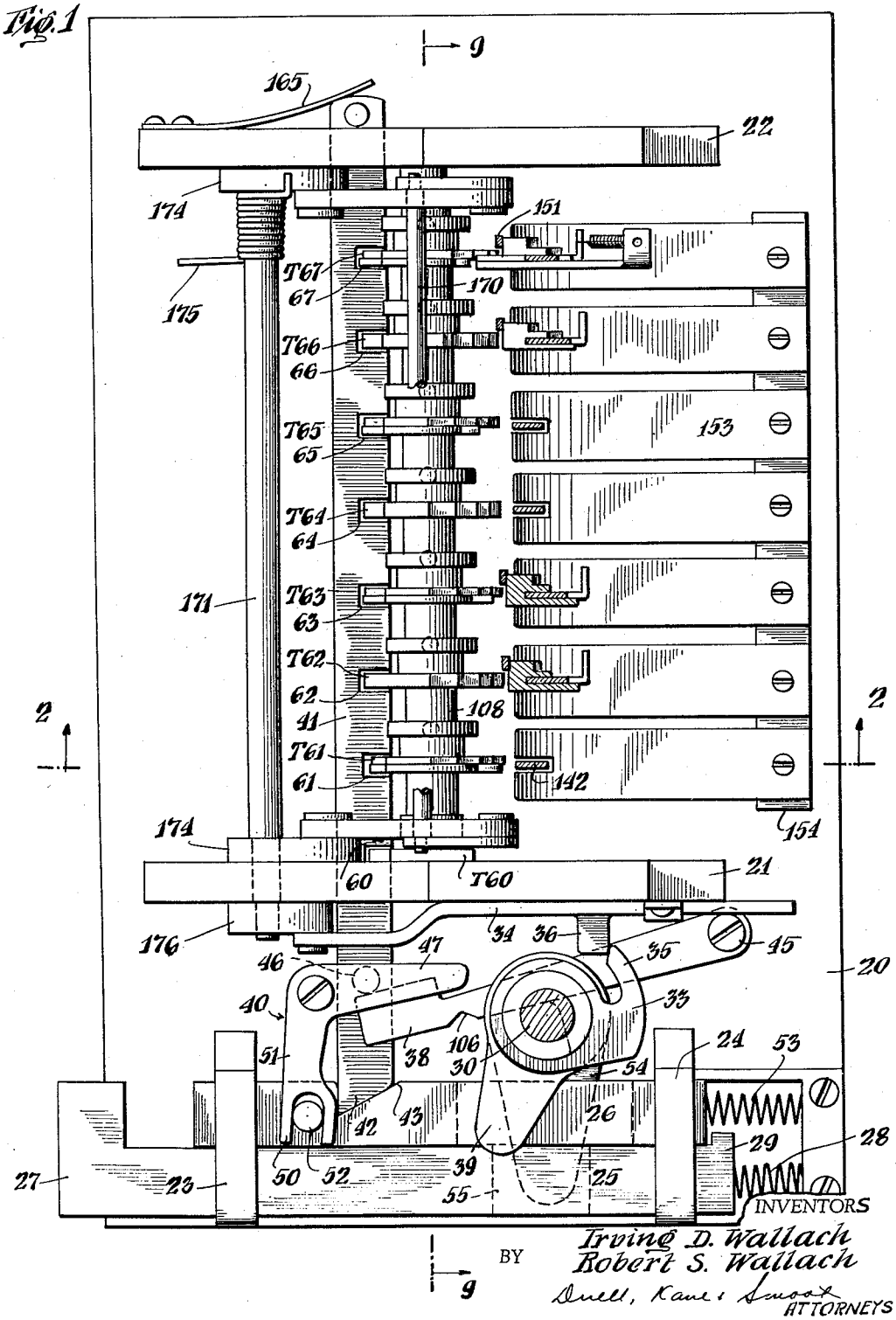
Nov. 7, 1950 R. S. WALLACH ET AL 2,529,119

COMBINATION LOCK

Filed May 16, 1946 5 Sheets-Sheet 1

Fig. 1



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Fig. 2

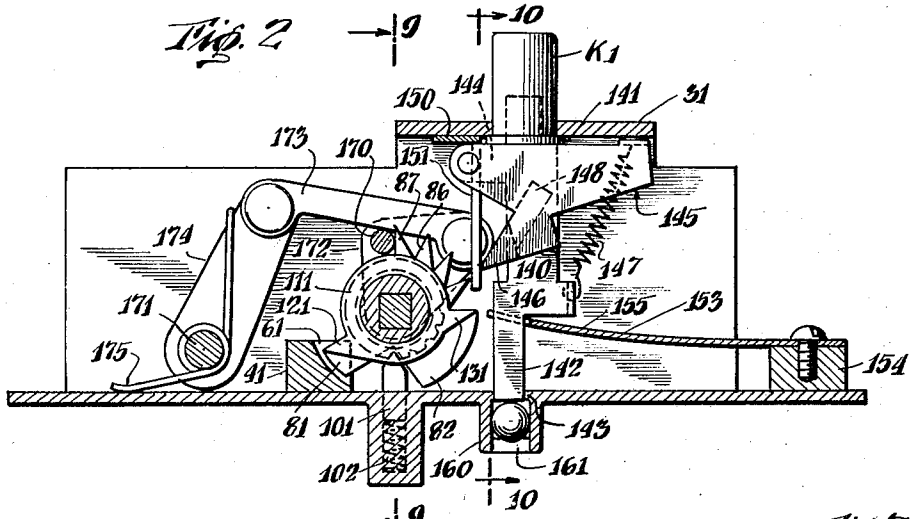


Fig. 3

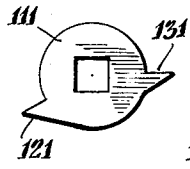


Fig. 4

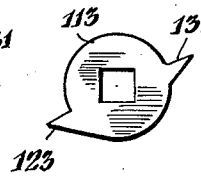


Fig. 5

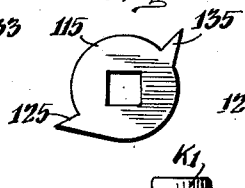
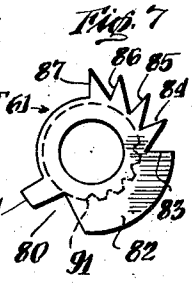


Fig. 6



Fig. 7



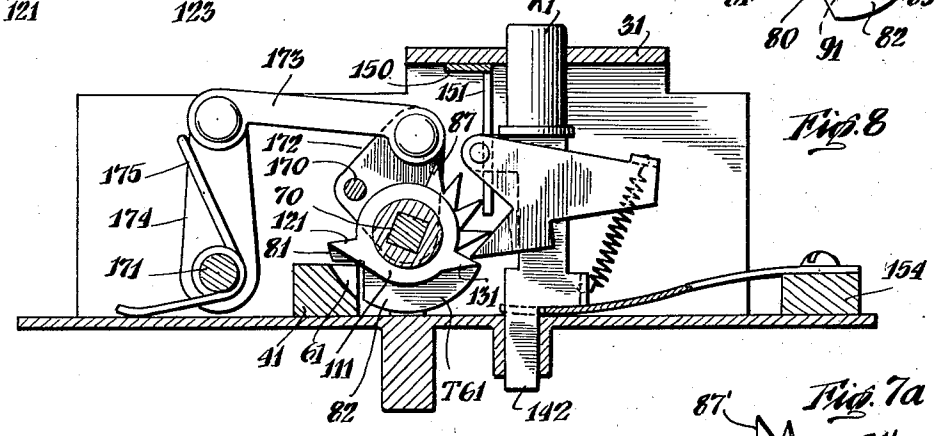


Fig. 8

Fig. 11

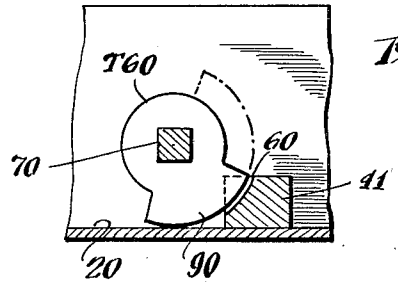
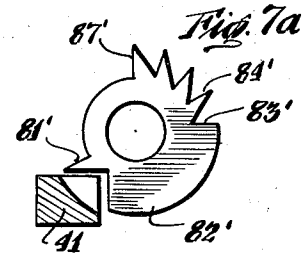


Fig. 7a



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COMBINATION LOCK

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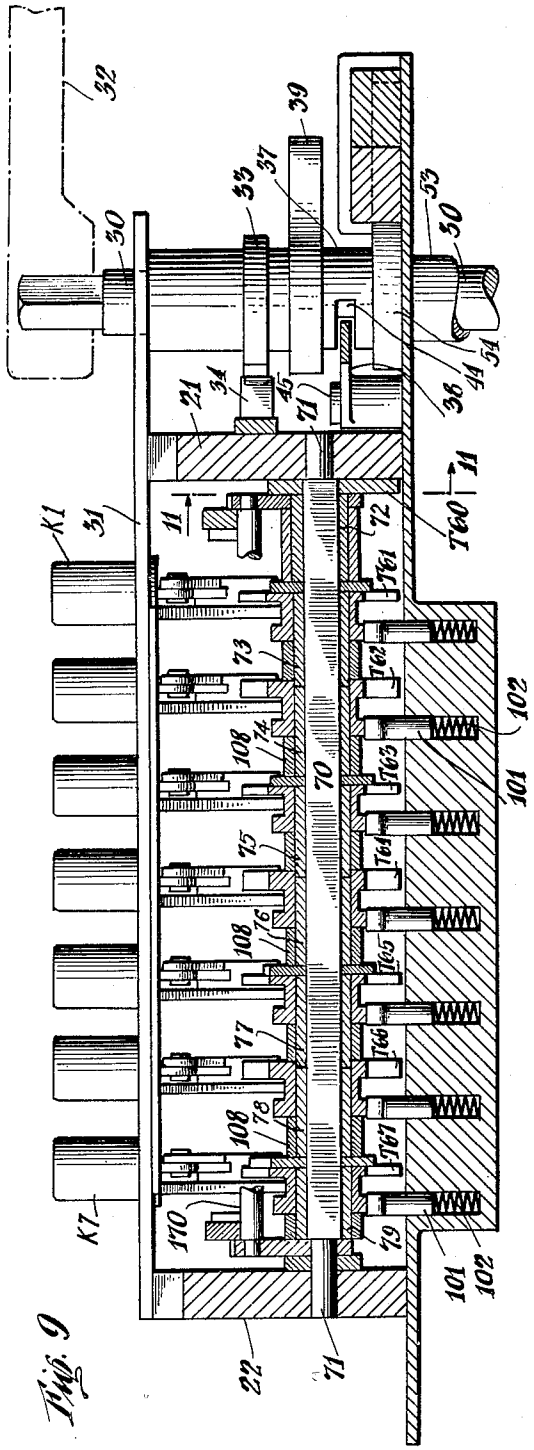


Fig. 9

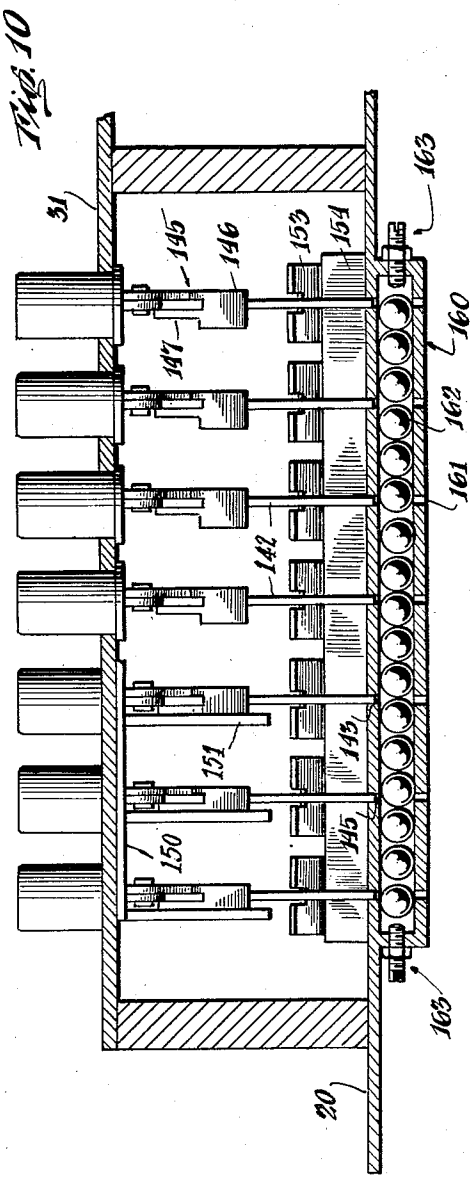


Fig. 10

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COMBINATION LOCK

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Fig. 12

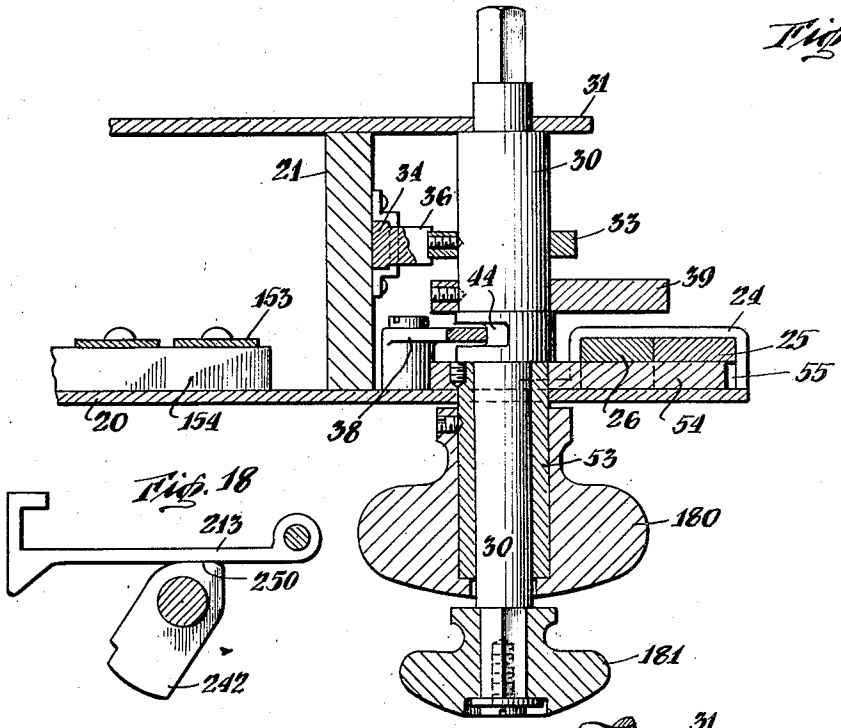


Fig. 18

Fig. 13

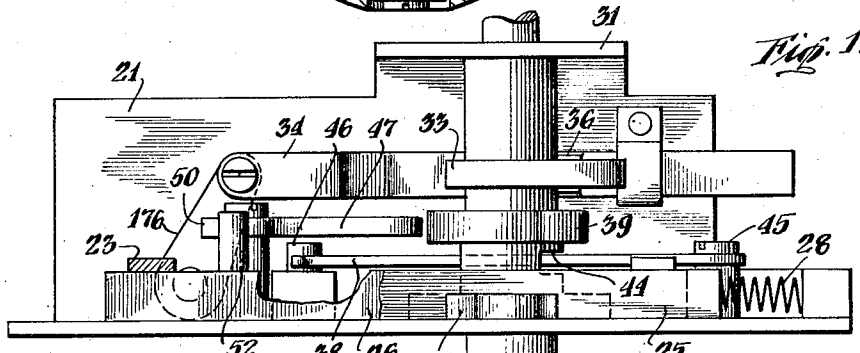


Fig. 19

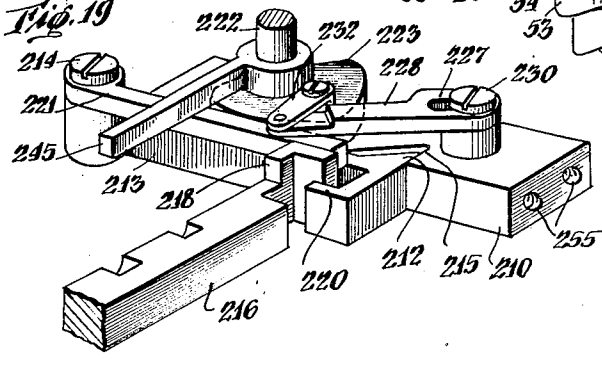
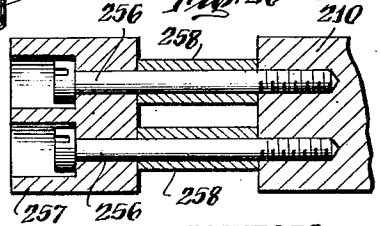


Fig. 20



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COMBINATION LOCK

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Fig. 15

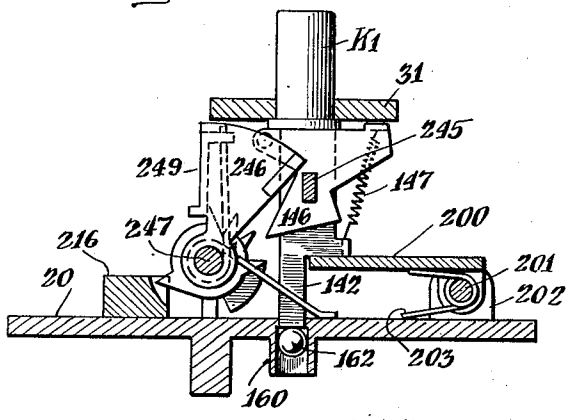


Fig. 14

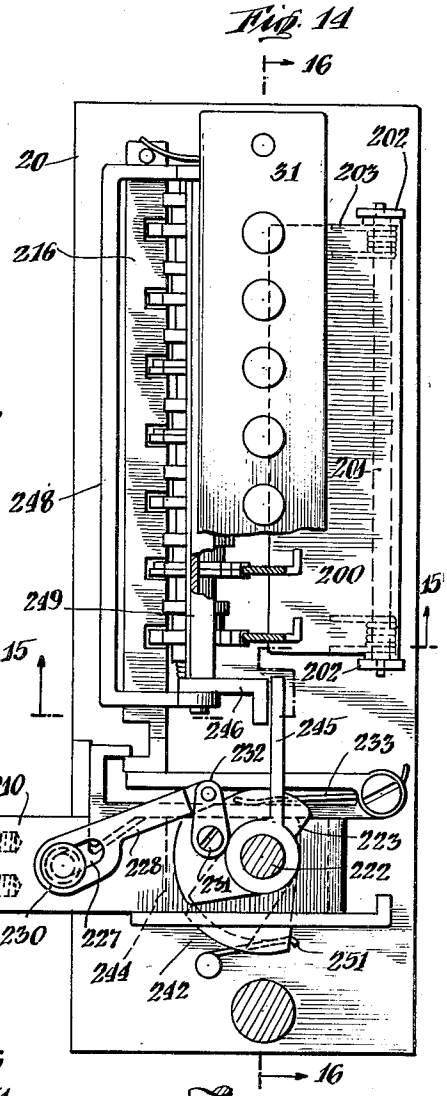


Fig. 17

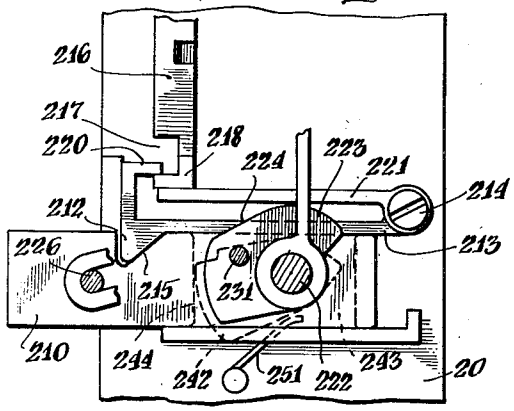
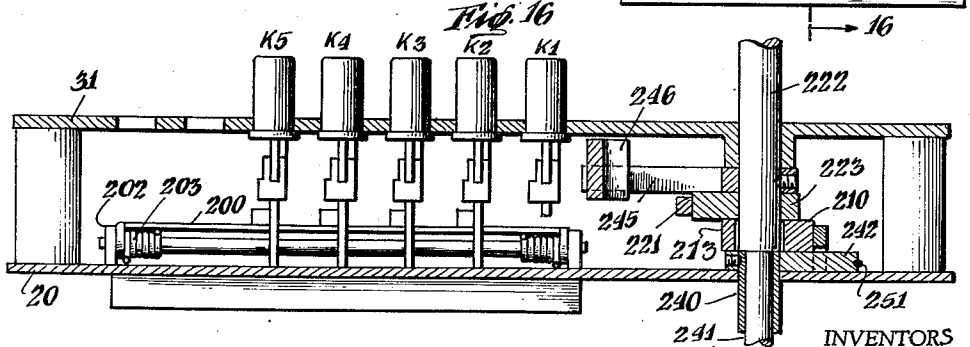


Fig. 16



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UNITED STATES PATENT OFFICE

2,529,119

COMBINATION LOCK

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Application May 16, 1946, Serial No. 670,092

37 Claims. (Cl. 70—306)

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This invention relates to an improved lock, and particularly to a keyless, or "combination" lock.

It is a principal object of the invention to provide a combination lock which is more rugged and durable than conventional locks of this type.

It is an object of the invention to provide a combination lock which may be operated in the dark.

It is an object of the invention to provide a combination lock which does not require the usual careful manipulation of a dial—which many people find difficult—but instead requires merely the actuation of push buttons according to the particular combination of the lock.

It is still another object of the invention to provide a lock of the combination type in which the combination is reset to locked position upon turning the doorknob or handle in one direction, but in which turning the handle in the other direction permits the door or other closure utilizing the lock to be opened and closed freely without having to reoperate the combination for each successive opening.

It is yet another object of the invention to provide a combination lock of the button-press type in which it is impossible to distinguish, even by the most sensitive touch, between the actuation of the proper, or "combination" keys and the other, or "trap" keys.

It is a further object of the invention to provide a button-press type of combination lock having means to prevent the depression or actuation of more than one button at one time, thus introducing an additional deterrent to solving the combination by trial and error.

It is another object of the invention to provide a combination lock which may not be forced, even if all but one of the tumblers has been moved to "clear" condition.

It is an object of the invention to provide a combination lock in which the combination may easily be changed.

It is an object of the invention to provide a combination lock in which all moving parts are of relatively heavy construction and which do not require delicate balance or precision workmanship, whereby the lock is operable over long periods of time without mechanical difficulties.

It is an object of the invention to provide a permutation lock which may be "night latched" so that the lock bolt may not thereafter be withdrawn even by one in possession of the combination.

It is an object of the invention to provide a permutation lock of the "dead latch" type, in

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which the bolt, having been withdrawn to permit the opening of a door for example, must be manually returned to locking position.

It is an object of the invention to provide a lock having a pair of concentrically disposed knobs, one of which sets the night latch mechanism.

It is an object of the invention to provide a permutation lock, the keys or push buttons of which have a common spring means to restore them to initial position, so that the "feel" of every push button is the same, regardless of the fact that the combination keys will be actuated more frequently than the non-combination keys of the lock.

It is an object of the invention to provide a lock in which the operating head of the latching bolt may be extended to meet specific installation conditions.

One presently preferred form of the invention includes a slidable bolt and bolt actuator, with a keeper bar preventing operation of the bolt actuator until the combination has been accurately followed. A plurality of keys control tumblers which engage with the keeper bar to prevent operation thereof. Certain of the keys—which must be operated in the required combination sequence—move tumblers out of engagement with the keeper bar to clear it for operation. Other key-controlled tumblers are normally out of engagement with the keeper bar, but are moved into engagement therewith upon depression of the associated key, thereby comprising "trap" means which prevent opening of the lock even if prior to or after the actuation of such a trap key the correct keys are operated in proper sequence. The tumblers of the "combination" keys are so set up that the improper operation of such a key will operate the tumbler in such fashion that the lock may not be opened.

The number of keys may be as desired. In banks or offices, in which it is usual to record the combination, there may be a total of ten, twelve, or more keys, with a correspondingly more complex combination. For household use, seven keys, of which four, for example, may be involved in the combination, appears to be desirable. In such a combination, and even when repetitive action of the same key is avoided, such as a combination 1—1—1—1, there are thousands of practical combinations available.

A number of inherent safeguards make it an impossibility to detect the combination by sensing the difference in the response of the several keys to finger pressure. For example, every tumbler

has substantially the same resistance to rotation. The key springs are balanced, or in one embodiment, a single spring system acts on all of the keys. Thus there is no weakening or sensible difference in response of a spring associated with a combination key as against a lesser-actuated non-combination key. Only one key at a time may be actuated, thereby causing one seeking to discover the combination by trial and error to painstakingly actuate the keys independently. The lock may not be forced even if all but one tumbler has cleared.

Other features and advantages will hereinafter be described.

In the accompanying drawings:

Fig. 1 is a plan view, partly in section, of one embodiment of a lock comprising the present invention;

Fig. 2 is a vertical section, taken on lines 2—2 of Fig. 1, showing a tumbler and tumbler actuator in locking position;

Figs. 3, 4, 5 and 6 are elevational views of tumbler shaft actuators which are associated with the respective keys of the combination;

Fig. 7 is an elevational view of a tumbler which is typical of those individual to each of the keys of the combination group;

Fig. 7*a* is an elevational view of a tumbler which is typical of those individual to the non-combination or "trap" keys;

Fig. 8 is a sectional view similar to Fig. 2, but showing how key pressure moves the associated tumbler into clear position; Fig. 8 is also used to show a partial actuation of the reset mechanism, it being understood that the reset mechanism is not actuated at the same time as a key is depressed;

Fig. 9 is a front elevation in section on lines 9—9 of Fig. 2;

Fig. 10 is a front elevation in section on lines 10—10 of Fig. 2;

Fig. 11 is a fragmentary sectional view showing the main tumbler in normal, i. e., locked, association with the keeper bar;

Fig. 12 is an elevation, partly in section, showing in detail the arrangement of the bolt actuating and reset knob mechanisms disposed at the inside face of the lock;

Fig. 13 is a side elevation of the bolt actuator and reset mechanism;

Fig. 14 is a top plan view, partly in section, of a lock embodying a second form of the invention;

Fig. 15 is a vertical section taken on lines 14—14 of Fig. 14;

Fig. 16 is a vertical section taken on lines 16—16 of Fig. 14;

Fig. 17 is a plan view showing the night latch means in operative position;

Fig. 18 is a detail of the night latch cam;

Fig. 19 is a perspective view of the keeper bar and restoring mechanism of the second embodiment of the invention; and

Fig. 20 is a side elevation in section showing the manner in which the lock bolt may be extended to accommodate unusual installation conditions.

Referring to the drawings, Fig. 1 is a front elevation, partly in section, looking toward the lock from the outside of the door. A bed plate 20 supports two main standards or walls 21, 22 and by means of yokes or straps 23, 24 independently, and slidably, carries the bolt 25 and a bolt actuator 26. When the lock is to be of the self-latching, rather than the dead-latch type, the slope of the nose 27 of the bolt is such that when the opened door is slammed shut, the engagement of said nose with the conventional latch plate (not shown) will slide the bolt to the right against the tension of its spring 28, whereupon the spring will drive the bolt into the latch plate aperture, as is common in the art.

The bolt has no connection with an outside knob, and may be actuated from the outside only through the agency of the bolt actuator 26, which must be moved to the right of Fig. 1. The end of the actuator will engage the shoulder 29 of the bolt, and will withdraw the bolt from the latch plate.

The bolt actuator is driven by rotation of the knob shaft 30, which is suitably supported between the bed plate 20 and a cover plate 31. The outside knob or handle 32, indicated in broken line in Fig. 9, is non-rotatably secured to said shaft. Fixed to the shaft 30 for rotation therewith is a lock reset cam 33 for cooperation with slidably mounted reset bail actuator 34, as by engagement of nose 35 of said cam with a stud 36 on actuator 34. Shaft 30 also carries a cam 37, Fig. 9, which operates a keeper bar throw lever 38. A lever 39, rotatable with cam 37 is in the plane of a bolt-actuator crank 40 and throws the same as later described.

The keeper bar 41, slidably supported for guided movement on the surface of bed plate 20, and of heavy bar stock, is the main locking means. So long as its angular nose 42 is within the notch 43 of the bolt actuator, the actuator cannot be moved to the right of Fig. 1. Assuming that the keeper bar is free to be moved upwardly of Fig. 1, the clockwise rotation of shaft 30 will rotate the cam 37 so that its operating face 44, with which the throw lever 38 is in engagement (see Fig. 9) will rotate said lever clockwise about its pivot 45. The head of the lever 38 will engage with a stud 46 projecting from keeper bar 41 and will start to lift the nose of the bar out of the notch 43. The angular relationship of cam face 44 and lever 39 is such that after the keeper bar has been cleared with respect to bar 26, the lever 39 engages the arm 47 to rotate crank 40. The forked end 50 of crank arm 51 engages a stud 52 on bolt actuator 26 to move the same to the right, whereupon it engages shoulder 29 and carries bolt 25 to open position. Bolt actuator spring 53 is compressed upon such movement. The bolt having been withdrawn from the latch plate, the door may be opened.

The permutation mechanism

The keeper bar may be cleared for movement only after the operation of certain keys or buttons in a predetermined sequence. In the illustrated embodiment of the invention there are seven keys, K1 to K7, which slidably project through the outside cover plate 31. A typical combination will be presumed to call for K1, K3, K5, K7 to be depressed in sequence. These keys will be hereinafter referred to as the "combination keys." The intermediate keys K2, K4, and K6 will be known as "trap" keys, because depression of any one will trap the keeper bar and prevent movement thereof even though the combination keys may also have been pressed in proper order. For example, if one seeking to open the lock depressed K1, K2, K3, K5 and K7, the keeper bar will be trapped by the action

of K2 as later described, and the bolt cannot be withdrawn.

The keeper bar 41 is provided with a series of arcuate kerfs, designated 60 to 67, there being one more kerf than there are keys, for a purpose later described. The shape of the kerfs is apparent from Fig. 11. Cooperating with each kerf is a tumbler, T60 to T67. A shaft 70 having a polygonal—illustratively square—center portion is rotatably supported by its circular ends 71 in the end plates 21, 22. Tumbler T60 is mounted directly on the squared portion of the shaft, as shown in Fig. 9, and will rotate with the shaft. Circular sleeves 72 to 79, inclusive, having square axial openings, are carried on shaft 70.

Fig. 7 shows tumbler T61, which is typical of the T61, T63, T65, T67 group. It has a right angled notch 80 (assuming the keeper bar to be rectangular in cross section), a lug 81 which normally is disposed within the associated keeper bar kerf, a solid locking web 82 which enters the kerf if the tumbler is rotated more than is consistent with the combination, and a plurality of actuating teeth 83, to 87, there being preferably one more actuating tooth than the required number of key depressions required by the combination. Tumbler T60, Fig. 11, has no reset lug and no actuating teeth; its locking web 90 comprehends a ninety degree arc. As later explained it is necessary to rotate shaft 70 through ninety degrees before the locking web 90, normally within the kerf 60 of the bar 41 will disengage from said kerf.

Fig. 7*a* shows a tumbler which is typical of the T62, T64, T66 group. This group differs from the T61 group in that its lug 81' has a lower face which is parallel with and slightly above the surface of the keeper bar 41, and the forward edge of its locking web 82' is vertical and parallel with the facing side of the bar at all times when the lock is in its normal closed position. In such position, it is noticed that the surface 83' is horizontal with respect to the top surface of bar 41. The remaining actuator teeth 84', etc., are exactly similar in positioning and size and shape with teeth 84, 85, 86 and 87 of the Fig. 7 tumbler.

Tumblers T61 and T67, inclusive, have collars which are provided with the detent provided flanges 91 to 97; said flanges have the same number of notches as there are actuating teeth. Cooperating with each detent flange is a spring-pressed detent 101 mounted in the bed plate 20, see Fig. 9, and having a rounded nose which engages in the respective detent notches. The spring 102 of each detent should be relatively stiff to hold the detents firmly within the notches.

Suitable spacing sleeves, such as 108, Fig. 1, maintain the spacing of the tumblers, so that the respective locking webs thereof are in registry with the keeper bar kerfs.

Tumblers T62, T64 and T66 are associated with the respective trap keys K2, K4 and K6, and as shown in Figs. 1 and 9, said tumblers are approximately twice the thickness of tumblers T61, T63 and T65 and T67, which are associated with the combination keys K1, K3, K5 and K7.

Associated with each tumbler T61, T63, T65, and T67 is a tumbler shaft actuator, respectively 111, 113, 115 and 117, essentially comprising a circular plate having a square opening through which passes shaft 70, a reset lug 121, 123, 125, 127, and a single actuator tooth, respectively 131, 133, 135, 137. The upper edge of the reset lugs of all shaft actuation are initially in the same plane, and all are initially parallel with the respective lugs of the tumblers. The actuator teeth of the respective shaft actuators are placed at variant relative angles with respect to a common surface of shaft 70. The relative angular displacement of the actuator teeth is equal to ninety degrees divided by the total number of key actuations required to disengage all tumblers from the associated keeper bar kerfs. In the illustrated embodiment, four key actuations are required, and hence the actuator tooth of each shaft actuator is at an angle of 22½ degrees with respect to the tooth of its adjacent actuator.

As previously described the actuators for shaft 70 are paired with the tumblers of the T61, T63, T65 and T67 group. These actuators and tumblers are so mounted that, for example, the upper surface of each of the reset lugs 121, etc., is in exact registry with the upper surface of the lug 81 of the tumblers. The upper surface of tooth 131 is in registry with tooth 83 of the tumbler T61; tooth 133 of 113 registers with 84 of the tumbler T63, tooth 135 of actuator 115 registers with tooth 85 of the tumbler T65 and tooth 137 of the 117 registers with tooth 86 of tumbler T67. Each of the tumblers is so positioned that its tooth surface 83 is parallel with the top surface of bar 41.

The key assembly

The keys have identical shapes and associated structures. As shown in Figs. 2 and 9, the key button K1 surmounts a flat sheet metal post 140 at the upper end of which is a stop plate 141 which abuts against the underside of the cover plate 31. A lower leg 142 of the key bar rests within a slot 143 provided in the bed plate 20 as shown in Fig. 10. To a forwardly extending ear 144 of the key bar there is pivotally supported a pawl 145. A spring 147 which may be hooked to lugs or extensions respectively on the key bar and the pawl 145 continually urges the pawl into clockwise rotation as respects Fig. 2. The pawl is preferably of sheet metal and has a forwardly extending sharply angular nose 146 which is relatively wide, see Fig. 10, and is provided with a rearwardly directed arm 148, whereby the pawl has a substantial surface contact with both sides of the key post, thereby eliminating any skewing or canting of the pawl with respect thereto.

Secured to the underside of the cover plate 31 is a comb plate 150 having narrow, rigid, teeth 151 which are disposed in front of the nose portions 146 of the respective pawls. As clearly appears in Fig. 2, the respective teeth 151 are tangent to the circle of rotation of the tumbler teeth and the respective actuator teeth 131, etc., of each shaft rotator, and said comb teeth extend downwardly to a point which prevents the engagement of the pawl nose with any tooth the upper surface of which is not in a substantially horizontal plane.

A key return spring 153 is mounted on a longitudinally extending support post 154. Said spring has a cantilever leaf 155 which in the present embodiment may be individual to each key bar, and the ends of the respective leaves are slotted to accommodate the passage of the key post leg 142 therethrough. As clearly appears in Fig. 2, the configuration of the key bars is such as to provide a shoulder or offset which the respective spring leaf engages to urge the key

assembly upwardly to a position in which the stop 141 abuts with the top plate 31.

Means are provided to make it impossible to depress two keys at the same time, thereby introducing an additional deterrent to solving the lock combination by depressing keys haphazardly. As shown in Figs. 2 and 10, there is provided a ball cage 160 beneath and in alignment with the respective openings 143 in the bed plate. The inner wall to wall width of the cage is but slightly larger than the width of the key leg 142. Immediately beneath the respective openings 143, the lower wall of the ball cage has openings 161 to permit the lower end of the key leg 142 to pass downwardly therebetween, as shown in Fig. 8.

The ball cage confines a plurality of balls 162, the size of the balls and the cage being such that two adjacent balls can separate to an extent which permits a key leg to be driven downwardly therebetween. However, with one key leg positioned between two adjacent balls, there is insufficient room to permit other pairs of balls to separate sufficiently to permit a second key leg to be pushed downwardly into the ball cage. Hence, the plurality of balls provides a positive yet flexible locking means to prevent the simultaneous downward movement of any two keys. To facilitate the proper positioning of the series of balls, each end wall of the ball cage has an adjustment screw and lock nut assembly 163. The screws can be projected inwardly of the ball cage to a sufficient amount permitting the desired freedom of movement of the balls, and then locked in position to retain the adjustment.

Keeper bar release operation

Assuming that the lock is closed and none of the buttons or keys has been actuated, tumbler T60 will have its locking web 90 projecting into the kerf 60 as shown in Fig. 11, and each of the tumblers T61, T63, T65, T67 and their respective shaft actuators will have their lugs also within a kerf in bar 41 as shown in Fig. 2. The tumblers of the trap keys will be positioned as in Fig. 7*a* wherein no part of the locking webs or lugs thereof projects into an associated slot or kerf.

The combination has been assumed to be the operation of keys K1, K3, K5, and K7 in the order named, there being but a single operation of each key. Looking now at Fig. 2, which represents key K1 in its normal position, the downward movement of the key bar 140 carries with it the pawl 145. The comb plate tooth 151 holds the pawl nose 146 out of operative position with respect to any tooth of the tumbler T61 or the associated shaft actuator 111 until the depression of the key has reached a point where the nose 146 is considerably beneath the lower edge of the tooth 151, at which time the spring 147 will rotate the pawl 145 clockwise and bring its nose 146 into operative relationship with respect to the upper surface of tooth 131 and the upper surface of tooth 83 of the tumbler, which, as previously stated, are in alignment. Continued downward pressure on the key causes a 22½ degree rotation of the element 111 and the tumbler T61, and moves the respective reset lugs 121 and 81 out of the kerf in bar 41. Shaft 70 has been rotated 22½ degrees. The device is now in the position shown in Fig. 8; the balls 162 have shifted to open a space therebetween to permit the end 142 of the key bar to pass downwardly through the slot 161 into the ball cage. The detent 101 has yielded to permit the rotation of the tumbler T61 and has been spring driven into the succeeding detent nose. Release of the key K1 will bring it back to original position; the detent 101 will hold the tumbler T61 against rotation.

All of the other actuators 113, 115, 117, rotating with the shaft 70 have advanced 22½ degrees, but their respective tumblers have been held against rotation by their respective detents. Therefore although the reset lug 123 of actuator 113 will have been moved out of the kerf, the lug 81 of its associated tumbler will still be within the kerf in bar 41. The 22½ degree rotation of shaft 70 will have rotated tumbler T60 without disengaging its locking web 90 from the kerf 60.

The rotation of shaft 70 has brought the actuator tooth 133 into the plane of the tooth 83 of tumbler T63, it being recalled that said tooth 133 was initially in alignment with tooth 84 of said tumbler. When key K1 is released to permit it to return to the Fig. 2 position, the balls 162 are again freed for movement within the cage 160. K3 is now depressed, and after its pawl nose disengages from its associated comb tooth 161, said nose 146 will come to rest on the collective surfaces 133 of member 113 and 83 of tumbler T63 to rotate the tumbler and shaft a second 22½ degrees. Such rotation will bring the reset lug 81 of tumbler T63 out of engagement with the kerf and the said tumbler will come to rest in a position wherein the converging edges which form the opening 80 thereof will have a position relatively above and in front of the top and side walls of the bar 41, as also typified in Fig. 8. The keeper bar is now freed as respects tumblers T61 and T63 and their respective shaft actuators.

The tumbler T60 has now rotated through 45 degrees, but its lock web 90 is still within the kerf 60. Actuator 115 has rotated to a point where its tooth 135 is in alignment with tooth 83 of its tumbler T65, inasmuch as the said tumbler has been held against rotation by its associated detent. Release of key K3 and subsequent depression of K5 will cause a similar combined rotation of actuator 115 and tumbler T65 to free the kerf in bar 41. Tumbler T60 has not yet been rotated sufficiently to bring its lock web 90 out of the kerf 60.

Actuator 117 has rotated three 22½ degree steps and its tooth 137 is now in line with tooth 83 of its associated tumbler T67. Upon the actuation of key K7, member 117 and its associated tumbler are rotated the final 22½ degrees, as is the tumbler T60, and upon the completion of such rotation all of the kerfs of the keeper bar 41 have been cleared.

Referring now to Fig. 1, a clockwise rotation of the shaft 30 will cause the bar 38 to slide the keeper bar 41 against the pressure of its associated spring 165 and the bell crank 40 will be free to slide bolt actuator 26 to the right and, upon engagement with the shoulder 29, it carries with it the bolt 25. The unlocking operation is completed.

So long as the outside door handle 32 is returned only to its initial vertical position, the bolt may be closed and opened successively without having to reoperate the keys because there is no direct connection between the tumbler shaft and the handle shaft.

It is apparent from Figs. 2 and 8 that each of the tumblers T61, T63, T65, and T67 has its notch

80 so disposed with respect to bar 41 that a 22½ degree rotation of the tumbler will bring the said notch into clearance position with respect to the keeper bar, and that more than one 22½ degree rotation will bring the locking web 82 into the kerf of the keeper bar. Thus, if the combination calls for a single actuation of key K1, more than one actuation will hold the keeper bar locked against movement. For example, four successive actuations of any key will not rotate the shaft 70 through ninety degrees as needed to bring the lock web 90 of tumbler T60 clear of kerf 60 in the keeper bar; also the locking web of at least one other tumbler will be within a kerf of the keeper bar and the lock cannot be opened.

Similarly, the actuation of any of the trap keys will bring the lock webs thereof into the associated keeper bar kerf. Two successive actuations of a combination key will bring the web 82 of the associated tumbler into a keeper bar kerf and will prevent the opening of the lock.

It is to be understood, of course, that certain combinations may call for the actuation of a particular combination key more than once, either repetitively or after operation of some other combination key. In that case, the design of the tumbler of such plural-actuated key will be appropriate to the combination. The combination of any lock may be changed by the replacement of any or all combination key tumblers with others appropriate to the new combination. The four-key combination discussed above is intended to be merely illustrative; with a seven key lock, mathematics proves that there are more than fifteen thousand practical combinations which are possible. By "practical" combinations is meant combinations which will not unduly tax the memory of those authorized to have it. If, as in the case of a bank or office wherein combinations are sometimes written down on a private memorandum, unusual or otherwise difficult to remember combinations are used, the number of effective combinations on a seven key lock reach into the hundreds of thousands.

It is contemplated that each cantilever spring 155 and each detent spring 102 will be substantially equal tension, so that the "feel" of each key and its associated tumbler will be indistinguishable from any other key. There is enough inherent friction in the various rotating and sliding members to compensate in this regard for any inequalities of spring tension or wearing or weakening of the spring structures, etc., of the frequently-used combination keys.

It may be thought that with all but one of the kerfs cleared, for example, the keeper bar may be forced back by applying a substantial leverage to the handle 32. To forestall this, the structure can be suitably weakened at one or more points so that it will break or become deranged upon the application of such excessive leverage. As shown in Fig. 1, keeper bar actuating lever 33 is weakened, as by a notch 106 therein, so that the application of extra leverage sufficient to break a tumbler lock web will bend the lever before such breakage could occur, thus making it impossible in any event to force the lock.

The reset mechanism

The reset mechanism comprises a bail 170 so disposed as to be in the path of rotation of the lugs of all tumblers and the reset lugs of all shaft actuators. In its normal position the reset bail is so placed that it will permit five successive depressions of any key before the reset lugs of the unit associated with said key strike against the bail. The bail therefore prevents six successive depressions of any one key, in the structure illustrated. The bail 170 in normal position is as shown in Fig. 2. At each end of the lock structure, adjacent the end plates, the bail is articulated to a rock shaft 171 by linkage which includes a bail supporting plate 172 freely pivotal upon the circular collars disposed about shaft 70, and pivot links 173, 174. A suitable spring 175 which may be disposed at one or both ends of the rock shaft 171 rotates the bail structure clockwise of Fig. 2 until the bail normally engages with the topmost vertical tooth 87 of the respective tumblers.

Rotation of the shaft 171 and the thereto affixed reset links 174 is accomplished by the movement of the bail actuator 34 when the handle 32 is rotated counterclockwise of Fig. 1, in which event the cam nose 35 drives the stud 36 to the left. The actuator 34 is pivoted to a bail crank member 176 fixed to the rock shaft 171.

When the keys of the lock have been pressed, and even if not in proper combination to unlock the device, the reset lugs of the tumbler and shaft rotators will be out of their original aligned position. The reset lugs of the tumbler group T62, T64 and T66 have not been shifted in position because said tumblers, being held by their respective detents, have not rotated. Rotation of the door handle counterclockwise over its permitted arc will cause the bail to be rotated counterclockwise and it will successively pick up the misaligned reset lugs until when the bail has rotated through its full permitted arc, all of the reset lugs will be returned to where they occupy their original position with respect to the keeper bar 41. The lock is again in its original condition wherein the keeper bar is held by the collective tumblers against any movement.

If during the stage of attempting to open the lock a mistake is made in the combination, the lock mechanism can be at any time restored to original position to permit unlocking operation to commence anew.

Fig. 12 shows the bolt actuator and reset knob on the inner side of the lock. The bolt actuator knob 180 is fixed to the sleeve 53 which is rotatable on shaft 30. As has previously been stated the arm 54 is pinned or otherwise secured to the sleeve 53 for rotation therewith. Hence, after the room has been entered and the door again closed the combination may be left in its unlocked position and the door again opened by rotation of the knob 180 which causes the lever 54 to operate against the independently slidable bolt 25 as previously stated.

To reset the combination so that it will be necessary for one seeking later to enter the room to go through the operation of depressing the keys to release the keeper bar 41, there is provided a second knob 181 affixed to the polygonal end of the shaft 30. Rotation of said knob 181 causes the shaft 30 to rotate and to actuate the bail operator cam 33 to restore the alignment of the respective lugs to original position.

The second embodiment

The structure shown in Figs. 14 to 19 represents a second embodiment of the lock which is rather more compact than the previously illustrated type and which embodies additional structural features making it more appropriate for use as a conventional household or room lock. For example, where the lock of the Fig. 1 type is

well suited for vaults or store rooms, the second embodiment incorporates an effective night latch by means of which a door may be locked from the inside against the entry even of one who may be in possession of the combination. The present embodiment is illustrative of the dead latch type in which the bolt does not return to effective position by spring tension; it is to be understood, of course, that the previously described embodiment may also be of the dead latch type.

In the Fig. 14 embodiment the tumbler mechanism and the key mechanism is the same as that previously described and need not be repeated; identical reference characters have been used to represent the parts which are in common with respect to the Figs. 1 and 14 devices. Instead of utilizing the individual spring leaves 153, however, the latter embodiment utilizes a key restoration plate 200 pivotally supported by the shaft 201 on suitable standards 202. At each end of the shaft there is provided a mouse trap spring 203 which tends always to rotate the plate clockwise of Fig. 15. The upper surface of the plate bears against the anchor shoulder of spring 147 of each key post and therefore all keys are held in their projected position. The use of spring means which is common to all of the keys of the lock has a definite advantage in that every key necessarily has the same spring tension. Therefore although the keys in the combination will, of course, be actuated much more than the trap keys there will be no difference in the spring tension as respects a combination and trap key.

The bolt 210 is suitably guided for movement on the bed plate 20 by any suitable combination or assembly of guide rails, and is normally held against movement to the right in Figs. 14 and 17 by the nose 212 of a lever 213, pivotally mounted upon a stud 214. The nose fits within a pocket 215 formed in the bolt 210 and normally the front edge of the nose bears against the front portion of the pocket. There is a relatively small clearance to the rear of the nose, as shown in Fig. 14. It will be seen therefore that before the bolt may be withdrawn, the nose 212 must be completely clear of the pocket. The keeper bar 216 is formed at one end with a socket 217 and terminates in an upstanding shoulder 218 which is considerably higher than the inwardly projecting hook 220 on the lever 213. As clearly appears in Figs. 14 and 17 the end 220 extends into the socket 217 at the end of the keeper bar and engages the shoulder 218. Disposed above the lever 213 and independently rotatable on the stud 214 is a keeper bar actuator lever 221, the free end of which engages the outermost face of the shoulder 218.

Assuming the combination to have been properly actuated to clear, in the manner previously set forth, the respective tumblers form the detent notches of the keeper bar, the outside knob is rotated in clockwise direction to rotate the shaft 222 to which it is affixed. Secured to said shaft for rotation therewith is a cam 223. The cam is disposed above the lever 213 as appears in Fig. 17 and the face 224 of said cam cooperates with the lever 221. Upon rotation of shaft 222 the face 224 comes into position against lever 221 and continued rotation of the shaft causes the said lever to rotate about pivot 214 to raise the keeper bar 216 upwardly in Figs. 14 and 17, the movement of said keeper bar causing the lever 213 to rotate about its pivot by virtue of the engagement of the end 220 of lever 213 with the shoulders 218 of the keeper bar. In this fashion the lever 213 is rotated until its nose 212 has cleared the pocket 215 provided in the bolt.

At this instant there has been no motion of the bolt 210. The bolt is provided with a stud 226 which passes into the bolt through an elongate slot 227 formed in the end of a bolt-throw link 228. The stud has a head 230 which prevents disengagement of the link and the stud. Freely pivoted upon a screw or stud 231 which is secured to the cam 223 is a relatively short link 232 pivoted to the end of link 228. As the door handle and shaft 222 are rotated, the respective links 228, 232 assume a wider angle with respect to each other, and at the time when the nose 212 has been cleased from the pocket 215, the respective links are substantially in a straight line, whereupon continued rotation of the cam 223 causes the linkage 228, 232 to draw the bolt 210 to the right of Fig. 14, thereby opening the lock.

After entry of the room the bolt may be restored to latching position without restoring the combination to its original status by means of a knob or equivalent mounted upon sleeve 240 freely rotatable upon the reduced diameter end 241 of the shaft 222. Affixed to the sleeve 240 for rotation therewith is a cam member 242 which rides within a slot 243 formed in the underside of the bolt 210. when the bolt has initially been moved to the right, or unlocked position, the left hand wall 244 of the slot 243. will have engaged the lower corner of the cam 242 and rotated said cam and its associated sleeve 240 counterclockwise of Fig. 14. It is understood of course that there is no restraint on the rotation of sleeve 240. Therefore when the occupant of the room wishes to throw the bolt into locking position, he merely rotates the knob affixed to sleeve 240 so that the edge of the cam 242 engages with the adjacent end wall 244 of the slot and propels the bolt to the left of Fig. 14.

Reverse rotation of the inside knob causes cam 242 to engage with the opposite edge of slot 243 to shoot the bolt to the right. the cam face 250 lifting the lever 213 to permit such bolt movement.

With the lock in that position the combination has not been disturbed or restored to keeper bar restraining position and the door may be opened from the outside without having to go through the sequence of key actuation. So long as the combination settings have not been restored, the bolt may be thrown open or closed any number of times, and by either the inside or the outside knob.

If after having entered the room the occupant wishes to restore the combination or tumblers to a status wherein the person seeking to enter the room must operate the combination, the room occupant first restores the bolt to locking position by rotating the knob affixed to sleeve 240 as aforesaid, then rotates a second knob, not shown, fixed to the end 241 of the shaft 222. Fixed to shaft 222 for rotation therewith is a lever 245 which is in operative relationship to a bail plate 246 pivotally mounted on a shaft 241 rotatably supported in a bracket 248 fixed to the plate 20. A second bail plate is mounted on the opposite end of said shaft, and the plates collectively support a bail structure 249, see Figs, 14 and 15. Said bail is rotatable downwardly of Fig. 15 to successively engage the lugs or actuating noses on the tumblers and shaft actuators to

mutually align them and restore the lock to original condition.

In Figs. 14 and 17, the rotation of the shaft 222 has caused the cam 223 to rotate similarly and the said cam has been restored to the Fig. 14 position. The links 228, 232 have restored the bolt to home position. The spring 233 operates on the lever 213 and as the notch 215 comes into position with respect to nose 212 which had been resting upon the upper left hand edge of the bolt 210 when the bolt was moved to the right, the lever 213 snaps home and restores the keeper bar to original position.

The instant embodiment provides a night latch by means of which the bolt 210 may be held against operation despite the proper operation of the combination. The night latch comprises a cam 242 which is capable of being rotated additionally clockwise of Fig. 14 into the Fig. 17 position wherein it is so aligned with respect to the path of movement of the bolt that it abolutely prevents movement of the bolt.

Obviously, as the cam 242 is rotated to night latch position there must be a slight additional leftward movement of the bolt 210. This is permitted by the slot 227 of link 228 and the clearance provided in the notch 215.

As shown in Fig. 18, the configuration of the cam 242 is such that there is a very pronounced face 250 which is normally in engagement with the lever 213 when the bolt is in its home position. A spring 251 restrains the free movement of the cam. When the bolt is moved to the right when opening the door, the cam 242 is rotated counterclockwise of Fig. 14, whereupon the cam face 250 is no longer in flat engagement with lever 213. To throw cam 242 to night latch position, it first goes to its initial position wherein the face 250 is flat against the lever 213, and a "snap" or definite interruption of smooth movement is experienced. The cam 242 rotates to night latch position. Because of the sensible "break" or "stop" which is felt before the night latch position is reached, it is highly improbable that one meaning merely to send the bolt home to permit another person freely to enter the room would accidentally put on the night latch. However, to insure against accidental night latching, the inner escutcheon plate of the lock may be marked or indexed to show the knob position at which night latching is accomplished.

Either the bolt 25 or 210 may be provided with an extensible nose which permits the lock mechanism to be placed more to the left of the edge of the door than is conventional, if conditions so require. As shown in Figs. 19 and 20, the outer end of the bolt 210 may be provided with tapped holes 255 to receive long screws 256. An extension bolt head 257 has passages which freely receive the screws in countersunk relation. Spacer sleeves 258 are disposed about the screws to establish the proper position of head 257 with respect to the bolt structure. Selecting the desired length of screws 256 and sleeves 258 thus makes it possible to accomplish any desired extension of the effective length of the bolt 210 or 25.

Although the invention has been described by making a fully detailed reference to the certain presently preferred embodiments, such detail of description is to be understood in an instructive rather than a limiting sense, many changes being possible within the scope of the claims hereto appended.

We claim:

1. A lock comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement; said keeper bar having a plurality of kerfs cut transversely of the length thereof; a plurality of tumblers having rigid webs normally within certain of said kerfs to lock said keeper bar against movement, a second plurality of tumblers having rigid webs in alignment with other of said kerfs but normally not disposed within said kerfs; pawl means for actuating said first-named tumblers to remove the webs thereof from the said kerfs, other pawl means for actuating said second-named tumblers to introduce the webs thereof into the therewith associated kerfs, whereby said keeper bar may be unlocked for movement only by the actuation of the proper pawl means; external handle means for moving said unlocked keeper bar out of bolt securing position; and lever means operatively associated with said handle means and said bolt for subsequently withdrawing said bolt from said latch plate socket.

2. A lock comprising, a bolt for movement into or out of a latch plate socket, a slidably mounted keeper bar normally securing said bolt against movement, said keeper bar having a plurality of kerfs cut transversely of the length thereof; a plurality of rotatable tumblers having web members normally within certain therewith associated kerfs of said keeper bar to lock said bar against movement, said web members being interrupted to provide an opening which will cause said webs to free said keeper bar upon a predetermined extent of rotation of said tumblers; a second plurality of rotatable tumblers having web members normally not disposed within other of said kerfs but rotatable into said kerfs; pawl means associated with each of said tumblers to rotate the same; push-button means for actuating said pawl means, whereby the proper pawl means may be actuated to unlock the keeper bar for movement; external handle means for moving said unlocked keeper bar out of bolt securing position; and lever means operatively associated with said handle means and said bolt for subsequently withdrawing said bolt from said latch plate socket.

3. A lock, comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement, said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotatably mounted whereby the first group may be individually rotated to remove the rigid elements thereof from said keeper bar openings to unlock said bar for movement and the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; pawl and ratchet means individual to each of said tumblers to rotate the same; spring means for restoring said pawls to initial position after actuation thereof; means operable externally of said lock structure to move the unlocked keeper bar out of bolt-securing position and means articulated with said last-named means to move

said bolt out of said socket after said keeper bar has released said bolt.

4. A lock comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement; said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotatably mounted whereby the first group may be individually rotated to remove the rigid elements thereof from said keeper bar openings to unlock said bar for movement and the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; pawl and ratchet means individual to each of said tumblers to rotate the same; spring means for restoring said pawls to initial position after actuation thereof; means operable externally of said lock structure to move the unlocked keeper bar out of bolt securing position; means articulated with said last-named means to move said bolt out of said socket after said keeper bar has released said bolt; and means operable externally of said lock structure to restore all of said tumblers to initial status.

5. A lock, comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against withdrawal from said latch plate; said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotatably mounted whereby the first group may be individually rotated to remove the rigid elements thereof from said keeper bar openings to unlock said bar for movement and the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; pawl and ratchet means individual to each of said tumblers to rotate the same; spring means for restoring said pawls to initial position after actuation thereof; cam and lever means operable from the outside of said lock structure to move the unlocked keeper bar out of bolt-securing position; means articulated with said last-named means to move said bolt out of said socket after said keeper bar has released said bolt; and means operable from the other side of said lock to withdraw said bolt from said socket independently of the status of said keeper bar with respect to said bolt.

6. A lock, comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement in a direction effecting the withdrawal of said bolt from said latch plate, said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotatably mounted whereby the first group may be individually rotated to remove the rigid elements thereof from said keeper bar openings to unlock said bar for movement and the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; pawl and ratchet means individual to each of said tumblers to rotate the same; spring means for restoring said pawls to initial position after actuation thereof; cam and lever means operable from the outside of said lock structure to move the unlocked keeper bar out of bolt securing position; means articulated with said last-named means to move said bolt out of said socket after said keeper bar has released said bolt, means operable from the other side of said lock to withdraw said bolt from said socket even though said keeper bar may be locked against movement with respect to said bolt; and means operable from either side of said lock to restore all of said tumblers to initial position.

7. A lock, comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement in a direction effecting the withdrawal of said bolt from said latch plate, said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotatably mounted whereby the first group may be individually rotated to remove the rigid elements thereof from said keeper bar openings to unlock said bar for movement and the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; each of said tumblers having reset lug means; pawl and ratchet means individual to each of said tumblers to rotate the same; said pawl means being operatively associated with key means individual thereto whereby depression of such key means actuates said pawl means; spring means individual to each said key means to return the same to initial status after release thereof; means operable externally of said lock structure to move the unlocked keeper bar out of bolt-securing position; means articulated with said last-named means to subsequently move the bolt out of said latch plate socket; and bail means operable externally of said lock structure and engageable with the reset lugs of said tumblers to restore all of said tumblers to initial status.

8. A lock, comprising a bolt for movement into or out of a latch plate socket, a movable keeper bar normally securing said bolt against movement, said keeper bar having a plurality of spaced openings provided along its length, a group of tumblers aligned with certain of said openings and having rigid elements normally disposed within said openings to lock said keeper bar against movement; a second group of tumblers aligned with other of said openings and having rigid elements normally not disposed therein but movable thereinto; all of said tumblers being individually rotably mounted whereby those of the first group may be rotated to remove the rigid elements thereof from said keeper bar openings

to unlock said bar for movement and those of the second group may be individually rotated to move the rigid elements thereof into said keeper bar apertures; each of said tumblers having reset lug means; pawl and ratchet means individual to each of said tumblers to rotate the same; said pawl means being operatively associated with key means individual thereto whereby depression of such key means actuates said pawl means; a single spring means common to all of the said key means to return a depressed key to original position after release thereof; means operable externally of said lock structure to move the unlocked keeper bar out of bolt-securing position; means articulated with said last-named means to subsequently move the bolt out of said latch plate socket; and bail means operable externally of said lock structure and engageable with the reset lugs of said tumblers to restore all of said tumblers to initial status.

9. A lock of the combination type, comprising a slidable bolt, a keeper bar engaging therewith to lock said bolt against manipulation to unlocked condition from the outside of said lock, a plurality of tumblers movable with respect to said keeper bar and having rigid means engaging with said keeper bar to restrain the same against disengagement with said bolt; other tumblers having rigid means engageable with said keeper bar to restrain said movement thereof; means for actuating said first-named tumblers to disengage from said keeper bar the rigid means thereof; means for actuating said other tumblers to bring the rigid means thereof into engagement with said keeper bar, each said tumbler-actuating means being identical in appearance and operation, whereby only an informed person may know which tumbler actuators to employ for unlocking the lock; handle means extending from one face of the lock for moving the unlocked keeper bar out of bolt-restraining position and for withdrawing the bolt; and handle means extending from the opposite face of the lock, said handle means including cam means engageable with the bolt to move the same to withdrawn position independently of the status of the keeper bar; said cam means being movable to an extreme position to engage with said bolt to prevent withdrawal thereof under any circumstances.

10. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar having a plurality of openings along its length, and a member interfitting with said bolt; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to prevent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said shaft-rotation key means disengages the web means of said other tumblers from said bar; a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; and key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings.

11. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar and a member interfitting with said bolt, said bar having a plurality of openings along its length; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to prevent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said shaft-rotation key means disengage the web means of said other tumblers from said bar; a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; and key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings, said last-named key means being ineffective to rotate said shaft.

12. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar and a member interfitting with said bolt, said bar having a plurality of openings along its length; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to prevent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said key means conjointly rotates said shaft and rotates said other tumblers to a position disengaging the webs thereof from said bar, a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; and key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings.

13. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar and a member interfitting with said bolt, said bar having a plurality of openings along its length; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to pre-

vent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said shaft-rotation key means disengage the web means of said other tumblers from said bar; a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings; and means preventing the concurrent operation of any two key means.

14. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar and a member interfitting with said bolt, said bar having a plurality of openings along its length; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to prevent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said shaft-rotation key means disengage the web means of said other tumblers from said bar; a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; and key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings, and means whereby upon actuation of any one of said key means a second key means may not be actuated until the first key means has been released.

15. In a lock of the combination type, a bolt for movement into or out of a latch plate socket; a keeper assembly normally restraining said bolt against withdrawal from said socket, said keeper assembly including a slidably mounted keeper bar, a plurality of tumbler means engaging with said keeper bar to prevent movement thereof; depressible key means individual to each tumbler means for actuating the same to disengage from said keeper bar, each said key means including a relatively flat leg portion; a ball cage in the path of movement of the leg portions of said key means; and a plurality of balls disposed within said cage, the leg portion of any key being movable into a position between adjacent balls upon depression of said key, the spacing of said balls relative to each other being such that when the leg of a key is positioned between adjacent balls the remaining balls are crowded together to offer a physical barrier against the depression of any other key.

16. A lock according to claim 15, in which the ball cage has means for adjusting the mutual spacing of the balls therein.

17. In a lock of the combination type, a bolt for movement into or out of a latch plate socket, a keeper assembly normally restraining said bolt to maintain the same in locked position, said keeper assembly including a slidably mounted elongate bar and a member interfitting with said bolt said bar having a plurality of openings along its length; a shaft rotatably mounted with respect to said bar and extending parallel thereto; a tumbler mounted on said shaft for rotation therewith, said tumbler having a rigid web normally engaging with one of said openings to prevent movement of said bar; means whereby a predetermined angular rotation of said shaft will disengage said tumbler from said bar; key means for effecting a step by step rotation of said shaft; other tumblers independently rotatable on said shaft and having web means normally engaging with other openings of said bar; means whereby actuation of said shaft-rotation key means disengage the web means of said other tumblers from said bar; a third group of tumblers independently rotatable on said shaft and having web means in alignment with the openings of said bar but normally out of engagement therewith; and key means operatively associated with said last group of tumblers whereby actuation of said last key means will introduce said tumbler webs into said bar openings, and means whereby upon the disengagement of all of said webs with the respective keeper bar openings the bolt-interfitting member of said keeper assembly may be disengaged from said bolt to permit the same to be withdrawn from said latch plate socket.

18. In a lock of the combination type, a bolt mounted for movement into and out of a latch plate socket, and a permutation mechanism for opening said lock according to a preestablished combination, including a slidably mounted keeper bar normally engaging with said bolt to hold the same against movement, said keeper bar having a plurality of kerfs along its length, said kerfs being at right angles to the direction of movement of said bar; a shaft mounted adjacent said bar and in parallelism therewith; a plurality of tumblers carried by said shaft in alignment with the respective kerfs, said tumblers being individually rotatable upon said shaft and each said tumbler having an arcuate web insertable into an adjacent kerf to lock said keeper bar against disengagement with said bolt; each said tumbler having a plurality of pawl-engaging teeth so disposed with respect to the web of said tumbler that when the same tooth of the respective tumblers is in a common plane the webs of some tumblers are disposed within the adjacent kerfs and the webs of other tumblers are not within their respectively adjacent kerfs; pawl means individual to each tumbler for engaging a tooth thereof to rotate said tumbler; means for causing said pawl means to engage a tooth of the respective tumblers only when said tooth occupies a preestablished position within the arc of rotation of said tumbler, whereby each said pawl means rotates its associated tumbler through a predetermined arc of rotation in which the webs of some tumblers are disengaged from the associated kerfs and the webs of others are introduced into said kerfs; and key means individual to said pawl means whereby each pawl means may be individually actuated and only certain keys will clear the kerfs of said bar to permit said bar to be moved into bolt-disengaging position.

19. In a lock of the combination type, a bolt mounted for movement into and out of a latch plate socket, and a permutation mechanism for opening said lock according to a preestablished combination, including a slidably mounted keeper bar normally engaging with said bolt to hold the same against movement, said keeper bar having a plurality of kerfs along its length, said kerfs being at right angles to the direction of movement of said bar; a shaft mounted for rotation adjacent said bar and in parallelism therewith; a plurality of tumblers carried by said shaft in alignment with the respective kerfs, said tumblers being individually rotatable upon said shaft and each said tumbler having an arcuate web insertable into an adjacent kerf to lock said keeper bar against disengagement with said bolt; each said tumbler having a plurality of pawl-engaging teeth so disposed that when the same tooth of the respective tumblers is in a common plane the webs of some tumblers are disposed within the adjacent kerfs and will clear the kerfs upon tumbler rotation, and the webs of other tumblers are not within their respectively adjacent kerfs but will enter an adjacent kerf upon rotation of such tumblers; shaft rotation means disposed adjacent those tumblers whose webs are normally within the kerfs; pawl means individual to each tumbler and engageable with a tooth thereof to rotate the tumbler when said tooth occupies a predetermined position the pawl means of certain tumblers simultaneously rotating the shaft rotation means associated therewith, whereby said shaft may be rotated in step by step manner; another tumbler carried by said shaft for rotation therewith, said tumbler having an arcuate web normally within a kerf of said keeper bar and of such arcuate extent that rotation of said shaft over a predetermined arc is necessary to disengage said web from said kerf; means whereby rotation of those of the first-named tumblers associated with the shaft rotation means will disengage the webs of said tumblers from the associated kerfs and whereby the total of said tumbler actuations will cause said shaft to rotate sufficiently to disengage the web of the last-named tumbler from the associated kerf; and key means individual to each pawl for actuating the same for tumbler rotation.

20. A lock mechanism according to claim 18, in which all of the respective tumblers are held against accidental rotation during the rotation of any other tumbler.

21. A lock mechanism according to claim 18, in which each tumbler has a detent collar formed with notches equal in number and angular spacing to the pawl teeth thereof, and each detent collar has a spring pressed detent engageable with the notches thereof.

22. A lock mechanism according to claim 18, in which the webs of the respective tumblers have an angular notch corresponding to the angle formed by the top and adjacent front wall of the keeper bar, whereby rotation of a tumbler more than required by the combination will introduce a solid portion of said web into a keeper bar kerf to hold said keeper bar against movement.

23. A lock mechanism according to claim 18, in which the webs of the respective tumblers are such that rotation of any tumbler out of the sequence required by the combination will introduce its said web into the associated keeper bar kerf.

24. A lock mechanism according to claim 19, in which each shaft rotation means has a pawl-engaging tooth so disposed that after a predetermined extent of shaft rotation said tooth will come into adjacency with the tumbler tooth engageable by its associated pawl, whereby the pawl may then simultaneously engage both of said teeth upon the next actuation of said pawl.

25. In a combination lock, a slidable bolt, a slidable keeper bar normally engaging with said bolt to hold the same against movement, tumblers engageable with said keeper bar to hold the same against movement, means for disengaging said tumblers and said keeper bar to clear the same for movement; a knob shaft extending through the lock and having knobs at each end thereof, lever means on said shaft and engageable with said keeper bar move the same out of bolt-engaging position upon rotation of said shaft after clearance of said keeper bar, and lever means on said shaft and engageable with said bolt to move the bolt, said last-named lever means being so disposed with respect to said first named lever means that bolt movement occurs only after said keeper bar has disengaged from said bolt.

26. In a combination lock, a slidable bolt, a slidable keeper bar normally engaging with said bolt to hold the same against movement in an unlocking direction, tumblers engageable with said keeper bar to hold the same against disengagement from said bolt; means for clearing said keeper bar for movement by moving said tumblers; a knob shaft extending through the lock and having knobs at each end of said shaft to rotate the shaft; lever means on said shaft and engageable with said keeper bar to move the same out of bolt-engaging position upon rotation of the shaft in one direction after clearance of said keeper bar; bail means operable on said tumblers to restore the same to initial position before keeper bar actuation; lever means operated by rotation of said shaft in an opposite direction to actuate said bail means; and lever means on said shaft and engageable with said bolt to move the bolt, said last-named lever means being so disposed with respect to said first-named lever means that bolt movement occurs only after said keeper bar has disengaged from said bolt.

27. In a combination lock, a slidable bolt, a keeper bar movable relative to said bolt; tumbler means engaging with said keeper bar to hold the same against movement; means operating on said tumbler means to disengage the same from said keeper bar to permit movement; a lever pivotally mounted relative to said bolt, said lever having a nose engageable within an aperture formed in said bolt; means operating on said lever to normally hold the nose thereof within said notch to prevent movement of said bolt; a knob shaft mounted for rotation; a cam on said knob shaft; means associated with said cam and said keeper bar whereby rotation of said shaft after disengagement of said tumblers from said shaft will move the keeper bar relative to said bolt; a mechanical connection between said keeper bar and said bolt-engaging lever to move the latter out of bolt engaging position; and a lost-motion link mechanism between said shaft and said bolt to move said bolt into unlocked position after the said lever has disengaged therefrom.

28. In a combination lock, a slidable bolt, a keeper bar movable relative to said bolt, a detent controlled by said keeper bar and normally engaging with said bolt to prevent movement thereof to unlocked position; a plurality of tumbler

means engaging with said keeper bar to hold the same against movement; means for moving said tumbler means clear of said keeper bar to free the same; and lever means operating on said keeper bar to move the same, said lever means being of less strength than the resistance to movement of said keeper bar by engagement of a single tumbler therewith, whereby such single tumbler engagement will hold said keeper bar against forcible movement.

29. In a combination lock, a slidable bolt, a keeper bar movable relative to said bolt, a detent controlled by said keeper bar and engaging with said bolt when the latter is in locking position to prevent movement of the bolt to unlocked status; a plurality of tumblers rotatably mounted adjacent said keeper bar and engageable therewith to prevent movement thereof; means for moving said tumblers out of engagement with said keeper bar to free the same for movement; shaft means for moving the keeper bar and its therewith associated detent to free the bolt for movement; handle means on one side of said lock fixed to said shaft means for conjointly moving said keeper bar and said bolt; handle means on the other side of said lock and fixed to said shaft means for moving said bolt independently of keeper bar position; means controlled by said first-named handle means for resetting said tumblers in keeper bar engagement position; and means operable independently of said second-named handle means for resetting said tumblers in keeper bar engagement position.

30. A lock according to claim 29, in which said second-named tumbler resetting means includes a sleeve rotatably carried by said shaft means.

31. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means and means functioning to arrest the movements of any tumbler which is moved to a point at which its notch has aligned with the adjacent edge portion of said shiftable member and has moved beyond such point.

32. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means and an element engageable with said tumblers to move all of the latter to predetermined initial positions.

33. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means, a movably mounted bail shiftable with respect to said tumblers and means for moving said bail to engage all of said tumblers and return the latter to predetermined initial positions.

34. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means, a movably mounted bail shiftable with respect to said tumblers, means for moving said bail to engage all of said tumblers and return the latter to pre-determined initial positions and said bail functioning to arrest the movement of any tumbler which is moved to a point at which its notch has aligned with the adjacent edge portion of said shiftable member and has moved beyond such point.

35. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means, additional notched tumblers—the notches of which are normally aligned with said member to allow of a shifting of the same, and means for moving said additional tumblers to bring the notches thereof out of alignment with the adjacent edges of said member.

36. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means and means functioning under certain conditions for arresting tumbler movements.

37. In a lock in combination a movable bolt, actuating means connected to said bolt whereby the latter may be retracted, a shiftable member operatively connected to said actuating means for preventing bolt retraction by the latter, said member being formed with kerfs, movably mounted tumblers extending into said kerfs to prevent a shifting of said member, said tumblers being formed with notches, means for moving said tumblers to positions at which their notches accommodate said member to permit of a shifting of the same by said actuating means and means for returning said tumblers to positions

at which they again prevent shifting of said member.

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