March 1, 1966 S. F. JACKES ETAL 3,237,434

PERMUTATION LOCK WITH CHANGEABLE COMBINATION

Filed April 29, 1963 6 Sheets-Sheet 1

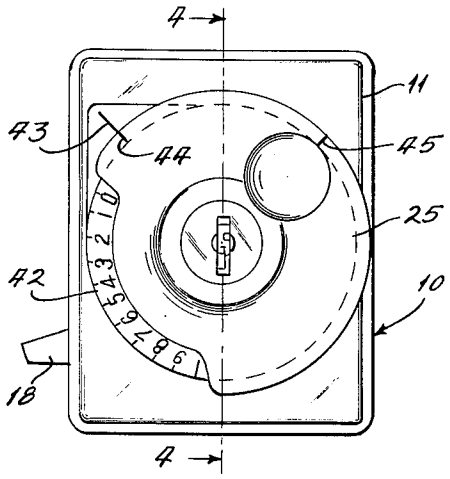


FIG.1

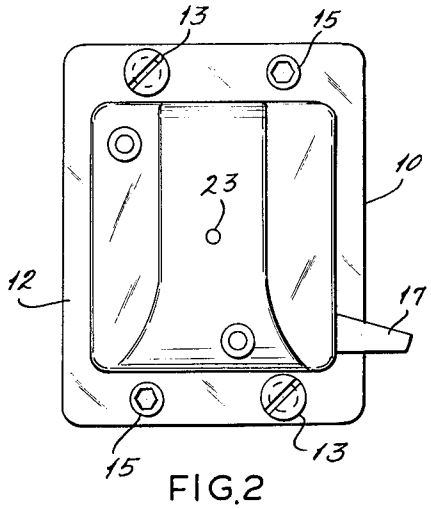


FIG.2

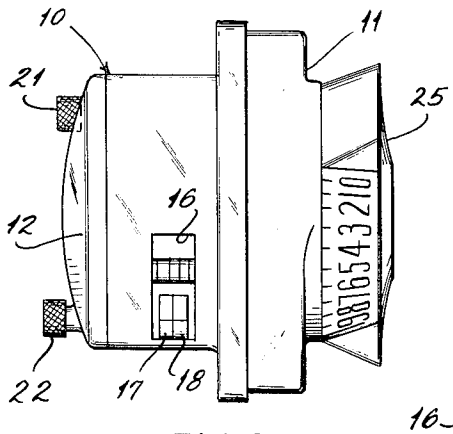


FIG.3

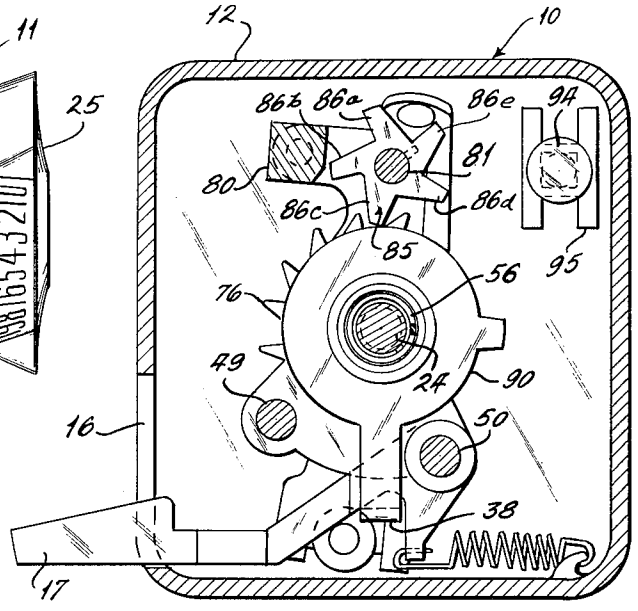


FIG.8

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PERMUTATION LOCK WITH CHANGEABLE COMBINATION

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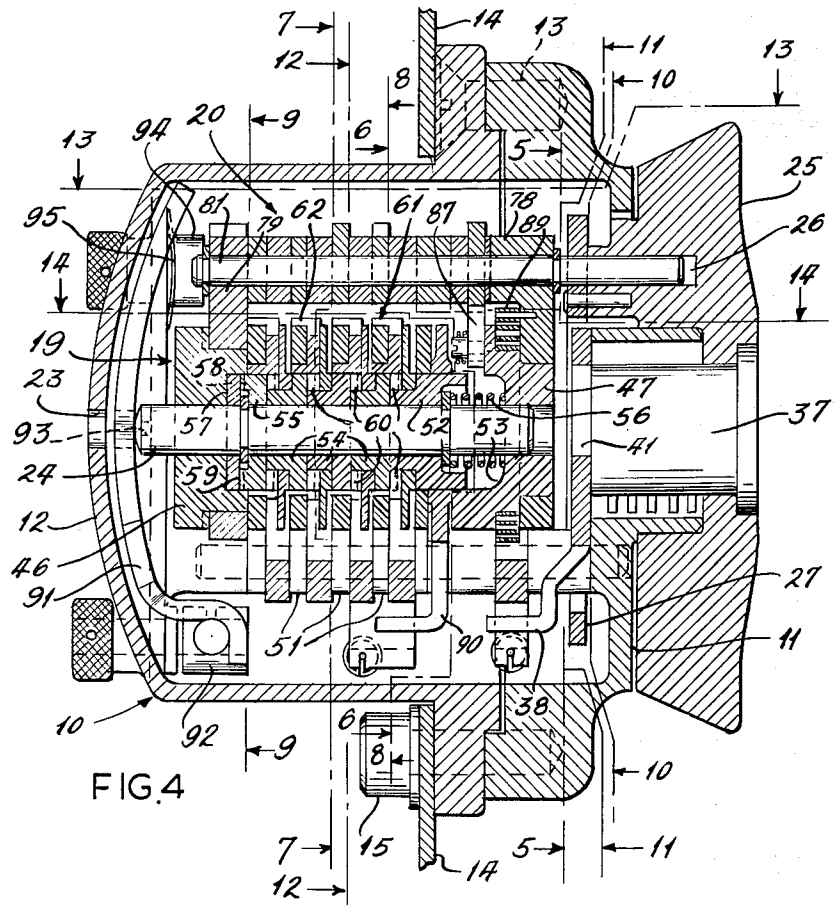


FIG.4

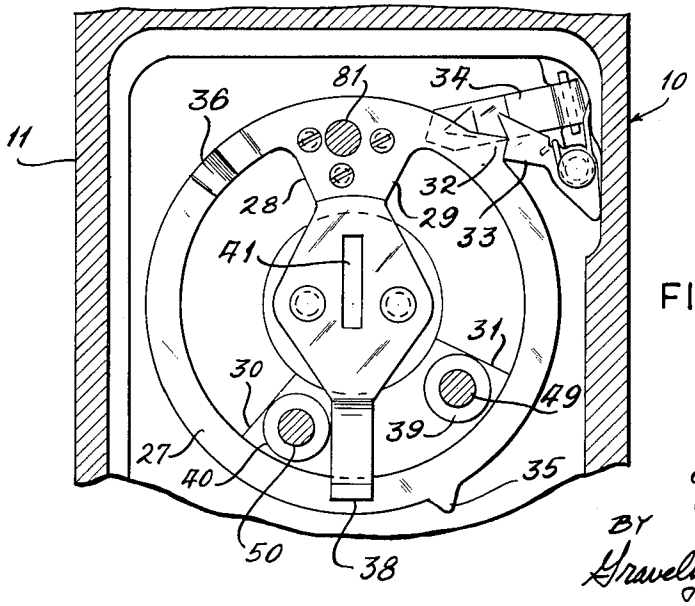


FIG.5

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PERMUTATION LOCK WITH CHANGEABLE COMBINATION

Filed April 29, 1963 6 Sheets-Sheet 3

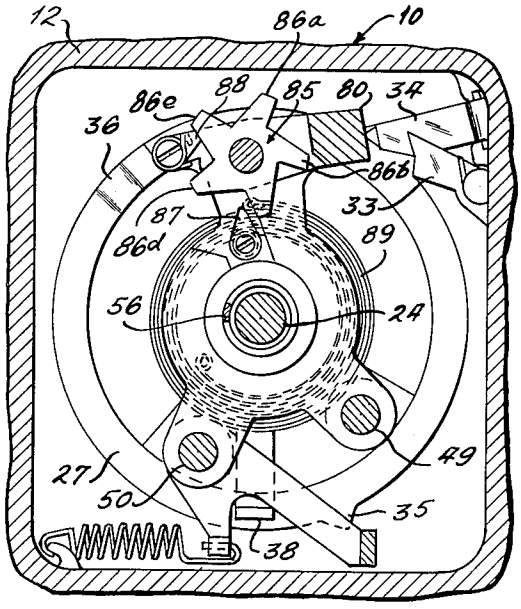


FIG.6

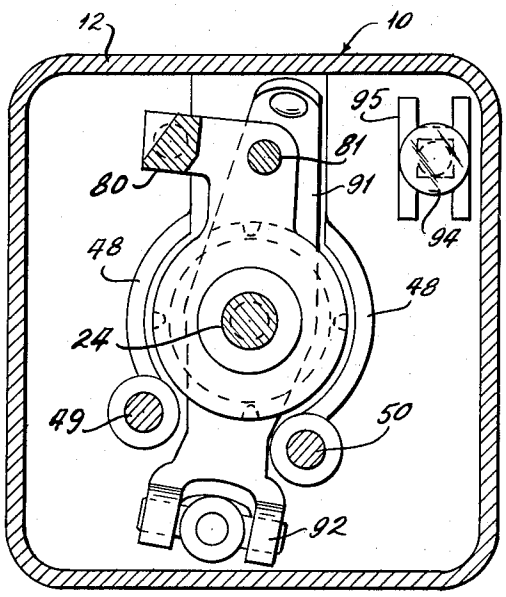


FIG.9

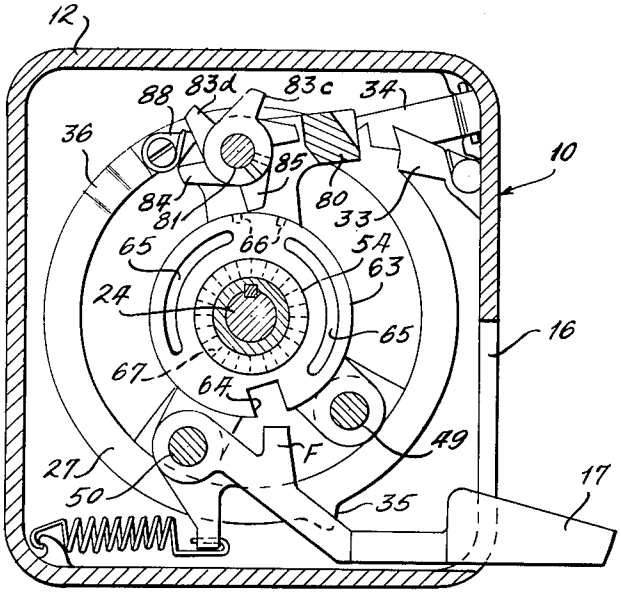


FIG.7

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PERMUTATION LOCK WITH CHANGEABLE COMBINATION

Filed April 29, 1963 6 Sheets-Sheet 4

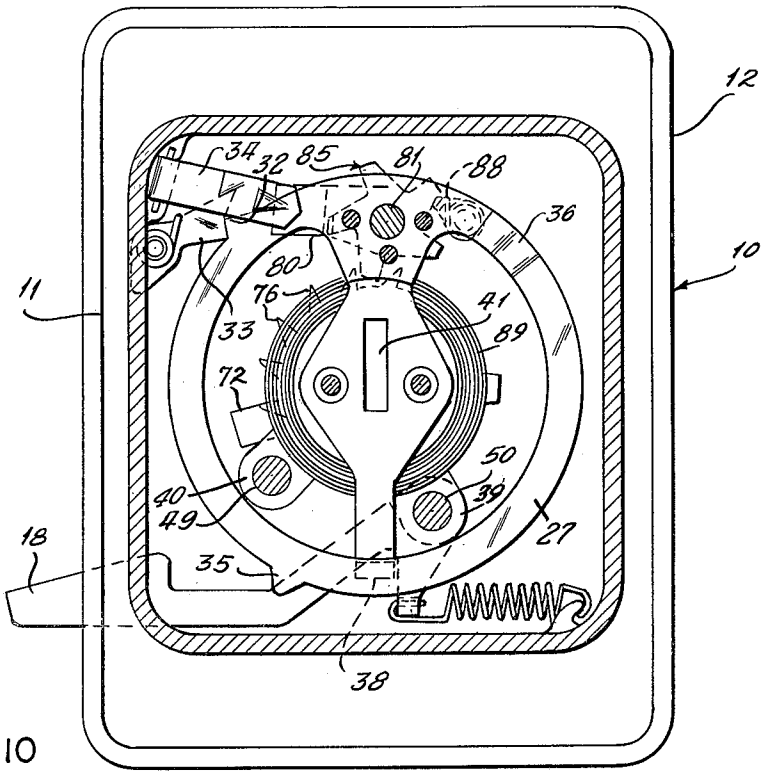


FIG.10

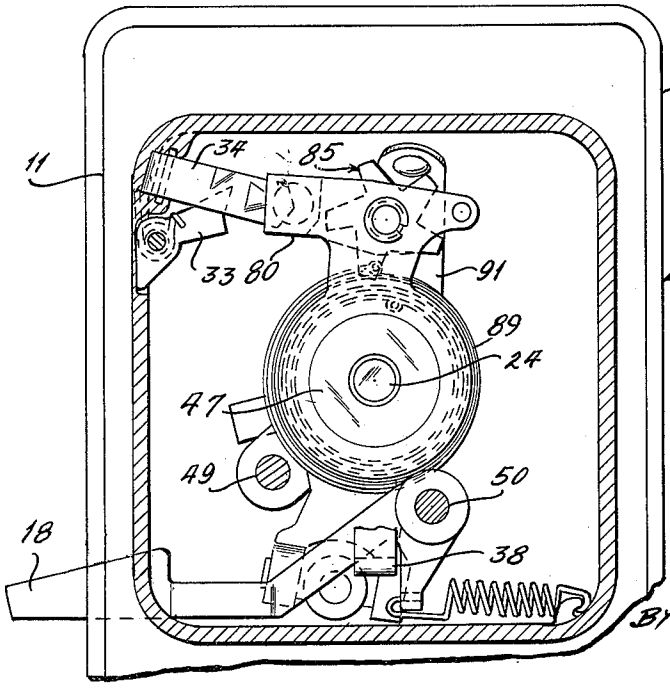


FIG.11

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PERMUTATION LOCK WITH CHANGEABLE COMBINATION

Filed April 29, 1963 6 Sheets-Sheet 5

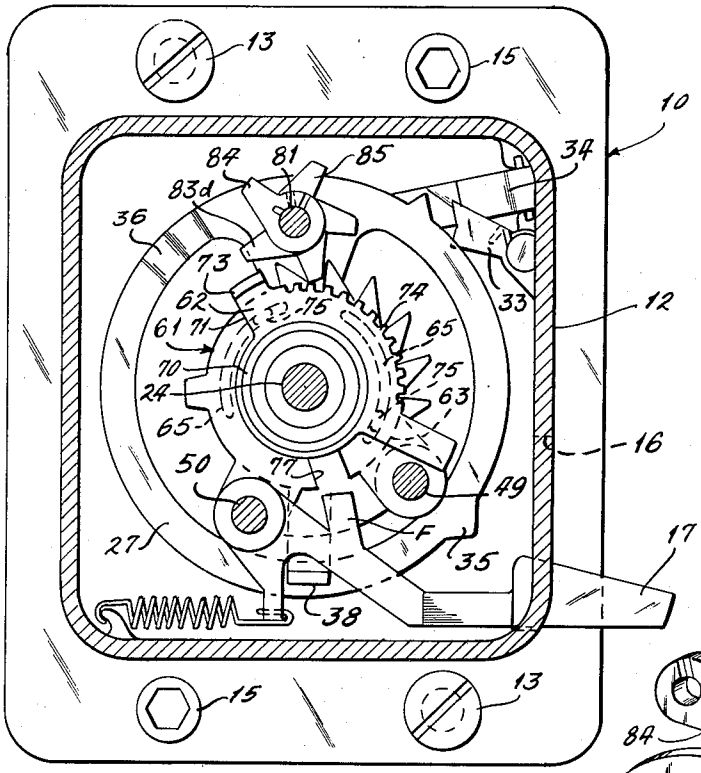


FIG.12

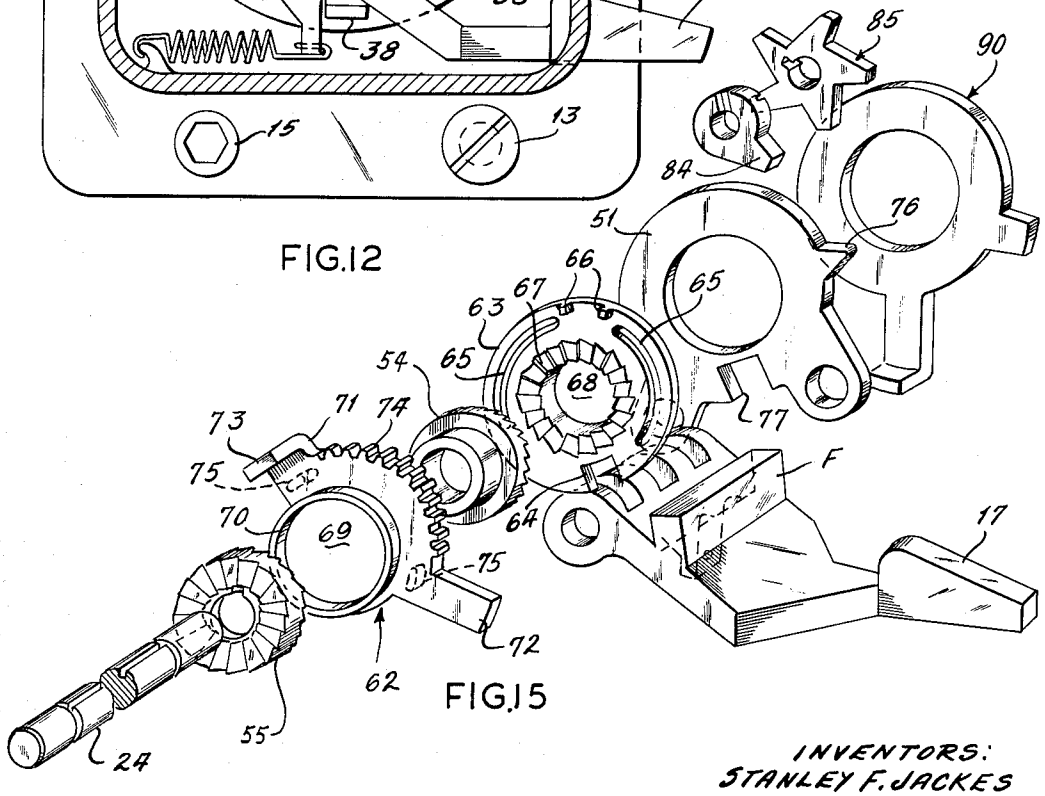


FIG.15

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PERMUTATION LOCK WITH CHANGEABLE COMBINATION

Filed April 29, 1963 6 Sheets-Sheet 6

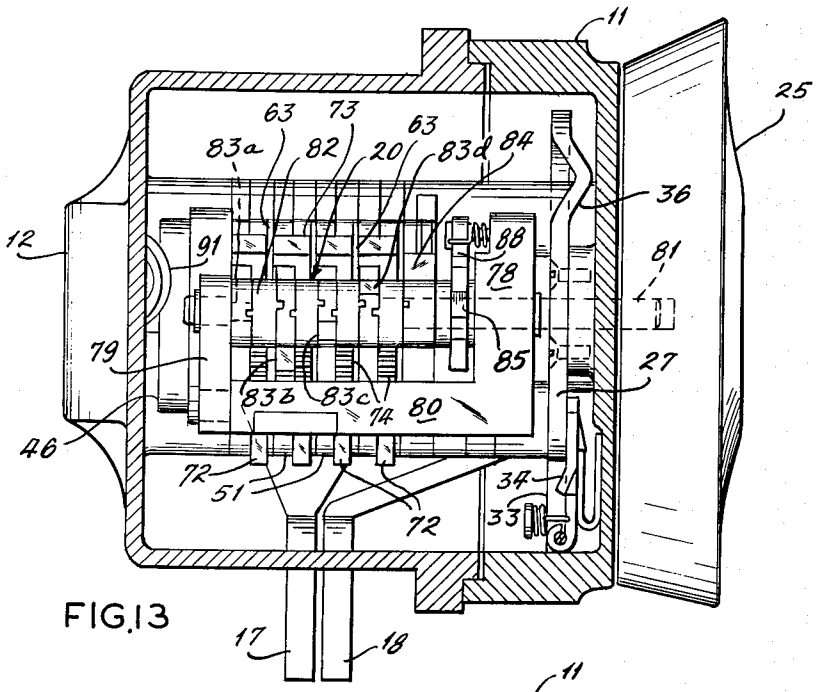


FIG.13

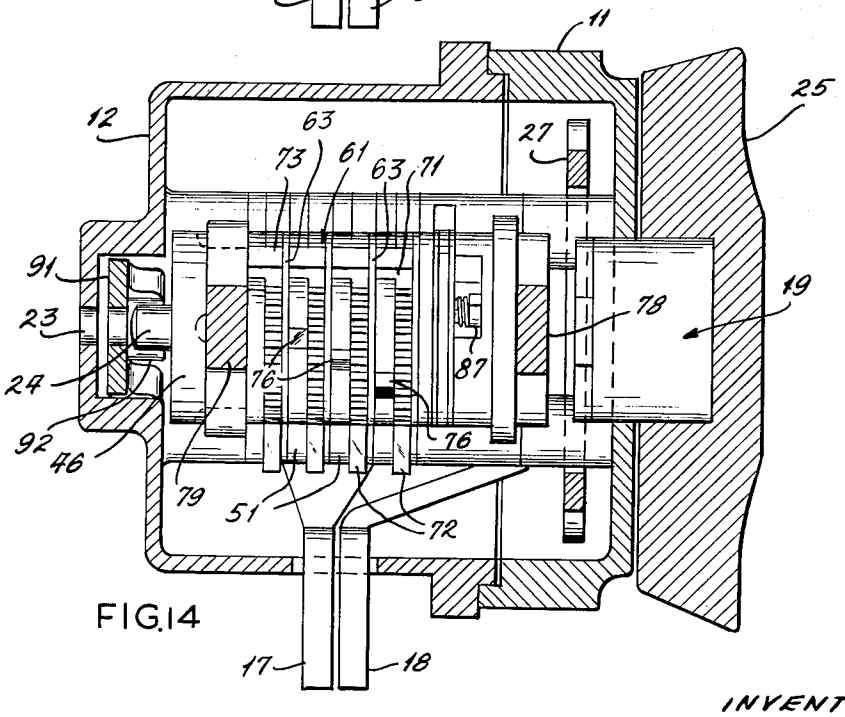


FIG.14

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United States Patent Office

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Patented Mar. 1, 1966

3,237,434

PERMUTATION LOCK WITH CHANGEABLE COMBINATION

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Filed Apr. 29, 1963, Ser. No. 276,556
14 Claims. (Cl. 70—317)

The present invention relates to permutation locks and particularly relates to a permutation lock having a shiftable main shaft by means of which a new random combination may be simply dialed into the lock.

One of the principal objects of the present invention is to provide a permutation lock having a multiplicity of random combination possibilities any of which may be readily placed into the lock mechanism.

Another object of the present invention is to provide a permutation lock whereby the tumbler mechanism may be locked out of the action and the lock may be used as a simple latching device.

Still another object of the present invention is to provide a permutation lock having an axially shiftable main shaft to facilitate changing the combination of the lock.

A further object of the present invention is to provide a permutation lock having a master key operated latch mechanism for bypassing the tumbler arrangement.

Still another object of the present invention is to provide a lock having a plurality of tumbler assemblies composed of parts which are rotatable together when the combination is being dialed, and which are rotatable independently when a new combination is set into the mechanism.

A further object of the present invention is to provide a permutation lock having a plurality of tumblers operated by a pinion assembly.

Yet another object of the present invention is to provide a lock wherein the combination may be randomly varied by several methods.

Still another object of the present invention is to provide a lock which can be entered by a master key and the current combination of which can be erased and a new common digit combination set in by using a key to shift the main shaft and rotate the tumbler parts independently and in concert to set a common angle between a set projection and a latch lever notch on each of the tumblers.

A further object of the present invention is to provide a lock having a two part assembly with hidden means for fastening the parts together and incorporating mounting means accessible only from inside the locker on which the lock is mounted.

Another object is to provide a lock having a spring loaded dial which returns to a stop position after dialing a number of the combination.

These and other objects and advantages will become apparent hereinafter.

In the drawings, wherein like numbers refer to like parts wherever they occur,

FIG. 1 is a front elevational view of the lock mechanism,

FIG. 2 is a back elevational view of the lock casing,

FIG. 3 is a side elevational view of the lock casing,

FIG. 4 is an enlarged vertical sectional view taken along line 4—4 of FIG. 1,

FIG. 5 is a fragmentary sectional view taken along line 5—5 of FIG. 4,

FIG. 6 is a vertical sectional view taken along line 6—6 of FIG. 4,

FIG. 7 is a vertical sectional view taken along line 7—7 of FIG. 4,

FIG. 8 is a sectional view taken along line 8—8 of FIG. 4,

FIG. 9 is a sectional view taken along line 9—9 of FIG. 4,

FIG. 10 is a vertical sectional view taken along line 10—10 of FIG. 4,

FIG. 11 is a vertical sectional view taken along line 11—11 of FIG. 4,

FIG. 12 is a vertical sectional view taken along line 12—12 of FIG. 4,

FIG. 13 is a horizontal sectional view taken along line 13—13 of FIG. 4,

FIG. 14 is a horizontal sectional view taken along line 14—14 of FIG. 4, and

FIG. 15 is an exploded view showing a portion of the center shaft and showing the tumbler assembly in greater detail.

Lock casing

The lock construction 10 includes a two-piece outer casing formed by a front dial section 11 and a rear lock assembly section 12. The sections are joined by fastening means, such as screws 13, and the entire assembly is secured to a locker door 14 or the like by set screws 15, with the lock assembly screws 13 hidden (FIG. 4).

The lock casing section 12 is provided with an opening 16 in one side wall through which extend a combination latch lever 17 and a key latch lever 18. Mounted inside the casing 12 are the main shaft or tumbler assembly 19 and the pinion assembly 20. Projecting through the back wall of the casing 12 are a lock out button 21 and a main shaft shifting button 22. An opening 23 in the casing rear wall also is aligned with a main shaft 24 and provides access to the rear end thereof. The operation of all of these parts and structures will be explained more fully hereinafter.

The front or dial section 11 includes a rotatable operating dial 25 provided on the interior thereof with a pinion pin bracket 26 and carrying a cam ring 27. The rotation of the cam ring 27 is limited by engagement of surfaces 28 and 29 with a pair of stop members 30 and 31. The ring also is provided with a positive stop 32 which is engaged by a spring loaded stop pawl 33. A pawl lock 34 holds the stop pawl 33 in inactive position. The cam ring 27 includes a stop pawl cocking node 35, and a stop pawl actuating detent 36. When the dial 25 is rotated fully counterclockwise, the detent 36 engages the pawl lock 34 and releases the stop pawl 33. During subsequent clockwise rotation of the dial 25, the pawl 33 rides over the positive stop 32, and prevents rotation of the dial and cam ring 27 past the stop 32 in a counterclockwise direction until the dial 25 has been rotated in a fully clockwise direction past the cocking node 35 to re-engage the stop pawl 33 with the pawl lock 34.

The dial 25 is provided with a standard tumbler barrel 37 which rotates a key lock lever actuating arm 38 between a pair of stud brackets 39 and 40 when a key is inserted in a keyway 41. The tumbler barrel 37 is a master key bypass of the combination and allows a custodian rapid access to the locker and to the rear of the lock 10 for purposes hereinafter described.

The dial face is provided with numbered indicia 42 which correspond to the number of settings on each of the tumblers and which are aligned with a stationary marker 43 on the front of the casing. The stationary marker 43 corresponds to the stop pawl 33, and a return line 44 is engraved on the dial 25 to correspond to the cam ring positive stop 32. A second engraved line 45 on the dial 25 corresponds to the cam ring pawl actuating detent 36. When the dial 25 is rotated counterclockwise until the line 45 is aligned with the marker 43, the pawl 33 is actuated; and upon subsequent clockwise movement

of the dial 25, the positive stop line 44 passes the marker 43, and the pawl 33 drops into place and prevents subsequent counterclockwise movement of the dial 25 past the stop line 44.

Main shaft construction

The main shaft 24 is mounted in a rear bearing 46 and a front cradle bearing 47. The shaft 24 is axially and rotatably mounted with respect to the bearings 46 and 47. The rear bearing 46 is fixed to arcuate brackets 48 on the casing rear wall. Stationary studs 49 and 50 extend forwardly from fixed mounting brackets in the casing rear wall and support the front cradle bearing 47.

The front cradle bearing 47 is fixed longitudinally on the studs 49 and 50 by the engagement of the front stud brackets 39 and 40 thereagainst. The space along the right hand stud 50 between the stud brackets is filled (from front to rear) by the key operated latch lever 18, the front cradle bearing 47, and a plurality of spaced stationary index plates 51, with portions of the lock latch lever 17 positioned therebetween. The levers 17 and 18 are rotatably journaled on the stud 50. The left hand stud 49 is filled by similar parts, except that spacers are substituted for the lock latch lever parts, and the cradle bearing portion is elongated to compensate for the key latch lever portion.

Positioned from front to rear on the main shaft 24 are a front spacer 52 which is pinned to the main shaft 24 and projects into a cavity 53 in the front bearing 47; intermediate spacers 54; and a rear spacer 55, which also is pinned to the shaft 24. All of the spacers 52, 54 and 55 are keyed to the shaft 24 and are rotatable therewith. A return spring 56 is compressed between the front spacer 52 and the front bearing cavity 53 urging the main shaft 24 rearwardly. A lock plate spacer 57 is press-fit to the rear bearing 46 and has teeth 58 on the front face adapted to be engaged with similar teeth 59 on the rear face of the rear spacer 55. Engagement of the teeth 58 and 59 occurs when the main shaft 24 is in its rearmost position and rotation of the main shaft 24 then is restrained.

The rear spacer 55 and the middle spacers 54 all have radial teeth 60 on their front faces for use in combination with the tumbler assemblies 61 in changing the combination as will be explained more fully hereinafter.

Each of the tumbler assemblies 61 includes a combination index lever 62 and a combination index spacer 63. A stationary index plate 51 and either the rear spacer 55 (in the case of the rearmost tumbler assembly) or an intermediate spacer 54 (in the case of the rest of the tumbler assemblies) are associated with each tumbler assembly 61.

Each of the index spacers 63 is circular in shape and is provided with a notch 64 in its peripheral edge, opposed arcuate slots 65 spaced inwardly from its peripheral edge, and spaced nodes 66 on its rear surface adjacent to the peripheral edge. Radial teeth 67 are positioned on the rear surface surrounding a center opening 68.

Each of the index levers 62 is provided with a center opening 69 surrounded by a rear flange 70; two angularly positioned arms or levers 71 and 72 one of which 71 is bent backwardly at the tip 73 forming a combination set projection which overlies the flange 70 and the other of which 72 is designated a combination reset lever; and a plurality of notches 74 on the peripheral edge adapted to receive the index spacer nodes 66 to establish a particular one of a series of possible angular relationships between the set projection 71 and the index spacer notch 64. A pair of pins 75 project from the front face of the index lever 62 and are adapted to ride in the combination index spacer slots 65 and then to engage the rear face of the next adjacent stationary index plate 51.

The engagement of the nodes 66 in the notches 74 couples the index spacer 63 and the index lever 62 to rotate as a unit. The inner surfaces 68 of the index spacers 63 rotate on the bearing surfaces provided by the small

diameter portions of the middle spacers 54 and the front spacer 52, and the inner surfaces 69 of the index levers 62 rotate on the bearing surfaces provided by the larger diameter portions of the middle spacers 54 and the rear spacer 55. The tumbler assemblies 61 are held in engagement by the action of the return spring 56 and are rotated to unlocking position by the action of the pinion assembly 20 (hereinafter described in detail) on the combination set projections 71.

The tumbler assemblies 61 are separated from one another by the non-rotating stationary index plates 51, and the middle spacers 54 and the front spacer 52. Thus the tumbler assemblies 61 are rotatable independently. The index levers 62 bear against the front faces of the stationary index plates 51, and the index spacers 63 bear against the rear faces of the middle spacers 54 and the rear face of the front spacer 52.

Each of the stationary index spacers 51 carries a pinion reset tooth 76 on its outer edge and is provided with a notch 77 on its outer edge. The teeth 76 cooperate with the pinion assembly 20 during the dialing of the combination (hereinafter described). The notches 77 permit movement of the lock latch lever 17 to an unlocking position when the index spacer notches 64 are aligned therewith. There is a different angular relationship between the reset tooth 76 and the notch 77 on each of the stationary index plates 51, so that the pinion assembly 20 is engaged by at least one tooth 76 regardless of the position of the pinion assembly 20, except during the dialing and unlocking phase.

Pinion assembly

The pinion assembly 20 actually performs the unlocking of the lock mechanism by rotating the tumbler assemblies 61 to a predetermined position, so that the index spacer notches 64 are aligned with each other and with the notches 77 in the stationary index plates 51. The rotary motion of the dial 25 is transmitted to the tumbler assemblies 61 by the pinion assembly 20.

The pinion assembly 20 includes a front pinion cradle 78 rotatably mounted on the front cradle bearing 47; a rear pinion cradle 97 rotatably mounted on the rear cradle bearing 46 and joined to the front pinion cradle 78 by a pinion cradle arm 80; and a pinion pin 81, which is drivingly engaged in the bracket 26 in the dial 25, and which is mounted in both the front pinion cradle 78 and the rear pinion cradle 79. Rotatably mounted between the front pinion cradle 78 and the rear pinion cradle 79 on the pinion pin 81 is a pinion 82, having pinion teeth 83*a–d* angularly arranged over the surface thereof, with each tooth 83 being aligned with a combination set projection 71 on a tumbler assembly 61 and with a reset tooth 76 on a stationary index plate 51. A wide drive pinion tooth 84 is positioned adjacent to a five-tooth pinion 85 which is positioned on the pinion pin 81 adjacent to the front pinion cradle 78. The angular position of the teeth 86*a–e* on the five-tooth pinion 85 is the same as the angular position of the pinion teeth 83*a–d* and the drive tooth 84 on the pinion 82. For ease of construction, the pinion 82 is composed of separate pinion teeth and spacers keyed together, but could be of one-piece construction.

A spring loaded bearing pawl 87 is mounted in the front bearing 47 and is depressed by the teeth 86*a–e* on the five-tooth wheel 85 during dialing of the combination (clockwise rotation of the dial 25 and the pinion cradle 78). The pinion 82 is restrained from rotation by a spring loaded stabilizer pawl 88 mounted on the front pinion cradle 78. The stabilizer pawl 88 engages the five-tooth pinion 85 to prevent rotation of the pinion 82 during clockwise movement of the dial 25. On counterclockwise movement of the dial 25 and the pinion cradle 78, the bearing pawl 87 rotates the five-tooth pinion 85 to lift the stabilizer pawl 88 and to rotate the pinion 82. The stabilizer pawl 88 drops between the next adjacent teeth

86*a–e* on the five-tooth pinion 85 to lock the pinion assembly 20 in position for another clockwise movement.

Operation during dialing of a combination

In the lock mechanism 10 shown in the accompanying drawings, a four digit permutation must be dialed to effect the opening of a locker door or the like. Prior to dialing a permutation, the internal parts of the lock must be set to a starting position. This is accomplished by rotating the dial 25 in a counterclockwise direction as far as it will go. As mentioned, this actuates the stop pawl 33, so that after subsequent rotation of the dial 25 in a clockwise direction, the stop pawl 33 drops behind the positive stop 32 to limit rotation of the dial 25 in a counterclockwise direction.

The combination then is dialed by rotating the dial 25 in a clockwise direction until the selected number on the dial indicia 42 lines up with the stationary marker 43 and returning the dial 25 in a counterclockwise direction to the positive stop 32 (as indicated when the stop line 44 aligns with the marker 43). Each number is dialed in this fashion. The fifth movement of the dial 25 in a clockwise direction raises the combination latch lever 17 to effect opening of the door. This movement also causes the cam ring cocking node 35 to raise the stop pawl 33 into its inactive position.

A torsion return spring 89 mounted on the front pinion cradle 78 rotates the dial 25 in a counterclockwise direction to disrupt the combination, and to move the stop pawl 33 into active position.

The operation of the pinion assembly 20 and the main shaft assembly 19 will now be described in detail. The setting motions of the dial 25 are transmitted to the tumblers 61 by the pinion cradle 78. The teeth on the pinion 82 engage the combination set levers 71 on the combination index lever 62 and the effect is of a finger which moves the tumblers 61 during the clockwise movement of the dial 25 to a combination number. During the following counterclockwise movement of the dial 25 to the stop position (indicated by the return line 44), the adjusting finger shifts along the axis of the lock to be in position to adjust the next adjacent tumbler 61 during the next clockwise motion of the dial 25. After all of the tumblers 61 have been adjusted, the last movement of the finger is to operate the combination lock lever 90 (which rotates the combination latch lever 17) on the final clockwise motion of the dial 25.

The lock lever 90 can operate a spring bolt or a dead bolt having a linear motion rather than the latch lever 17 which has a rotary motion. The latch lever 17 also can be shortened to operate a linear motion bolt which projects from the main housing.

To condition the lock for dialing a combination, the dial 25 initially is rotated to its most counterclockwise position. This moves the pinion cradle 78 in a counterclockwise direction and the leading edge of the cradle 78 engages the reset projections 72 on the combination index levers 62 to drive the four tumbler assemblies 61 to their start position with the index levers 62 adjacent to the left stud 49. The pinion 82 is carried by the pinion cradle 78 and the pinion teeth 83*a–d* engage one or more of the reset teeth 76 on the stationary index plates 51 to rotate the pinion 82 in a counterclockwise direction (with respect to the pinion cradle 78), so that the rearmost pinion tooth 83*a* comes to rest pointing toward the central axis of the lock.

The lock now is in condition to start dialing the current combination. From the full counterclockwise position, the dial 25 is rotated past the return line 44 to the first number of the combination. The dial 25 rotates the pinion cradle 78 in a clockwise direction. As the pinion 82 passes the detent position 44, a tooth 86*a* of the five-tooth pinion 85 depresses the bearing pawl 87 in passing. The pinion 82 is restrained from rotation by the stabilizer pawl 88.

In addition to this action, as the dial 25 is rotated clockwise to the first number of the combination, the rearmost tooth 83*a* on the pinion 82 (which has an angular position identical to that of the tooth 86*a* on the five-tooth pinion 85) engages the right angle combination set projection 73 on the combination index lever 62 of the rearmost tumbler assembly 61*a* carrying the tumbler 61*a* to a position corresponding to the first number of the combination. This action aligns the index disc notch 64 of tumbler 61*a* with a projection or fence F on the combination lock latch lever 17.

The dial 25 is then turned counterclockwise to the return line 44 carrying the pinion cradle 78 with it. This motion carries the tooth 86*a* of the five-tooth pinion 85 into engagement with the bearing pawl 87. Since the pawl 87 can be depressed only when the pinion cradle 78 is moved in a clockwise direction, rotation of the cradle 78 in a counterclockwise direction rotates the pinion 82 to bring the tooth 83*b* on the left end of the pinion 82 into active position, that is, pointing toward the center axis of the lock.

As the pinion 82 is rotated by the bearing pawl 87, the stabilizer pawl 88 is lifted, and drops into the space between the tooth 86*a* and the next adjacent tooth 86*b* on the five-tooth pinion 85 to continue its detenting action.

The next number of the combination is then dialed and the foregoing action of the mechanism is repeated. The third and fourth numbers of the combination are dialed in a similar fashion. When the dial 25 is returned to the return position 44 after selecting the fourth number of the combination, the bearing pawl 87 rotates the pinion 82 so that the wide pinion drive tooth 84 (on the right end of the pinion 82) points toward the aixs of the lock. A final clockwise rotation of the dial 25 engages the tooth 84 with a projection on the combination lock lever 90, which, in turn, engages the combination latch lever 17, lifting the same to an upward or unlocking position. The projection F on the latch lever 17 engages the notches 64 on the tumblers 61 and the notches 77 on the stationary index plates 51 as it is rotated to its unlocking position. In a school locker or other type of steel locker application, the latch lever 17 will have raised a vertical latch on the locker door. Pulling on the dial 25 will now open the door. The dial 25 is then returned to the detent position 44 by the spring 89. In moving to the detent position 44, the pinion 82 is rotated, moving the pinion tooth 83*a* into active position and moving the drive tooth 84 (the latch lever actuating tooth) away from its active position. Thus, a subsequent motion of the dial 25 cannot lift the latch lever 17 and the combination is effectively disrupted. The door may now be slammed shut for automatic locking.

Operation during changing of a combination

The feature of the lock that permits instant use of any one of 10,000 or more permutations is provided by the structure of the tumbler assemblies 61 whereby the angular relationships between the right angle combination set lever projections 71 of the combination index levers 62 and the notches 64 in the combination index discs 63 are changeable. As herein shown, the slots 74 in the periphery of the index lever 62 engage the nodes 66 on the index spacer 63 to positively couple the index lever 62 and the spacer 63 together and establish the angular relationship between the spacer notch 64 and the lever setting projection 71. The illustrated structure corresponds to a set of 10 combination digits for each of the four tumbler assemblies 61 and therefore 10,000 different combinations are possible.

There are two ways in which the angular relationship between the spacer notch 64 and the lever set projection 71 can be varied. We shall first describe how the locker occupant without the use of keys can reset his combination.

After the current combination has been dialed and the door opened, the dial 25 is moved clockwise as far as it will go, and held in that position while the door is opened and the reset knob or shaft shifting button 22 is rotated to move a reset lever 91 toward the front of the lock into engagement with the main shaft 24. Continued movement of the knob 22 shifts the main shaft 24 toward the front of the lock to condition the tumbler assemblies 61 for receiving a new combination. A reset bracket 92 also is moved by the knob 22 and engages the lock lever 17 unless the lock lever 17 is raised to unlocking position so that the bracket 92 can move under the lock lever 17. This prevents unauthorized persons from changing the combination any time the locker door is opened. The lock lever 17 must be raised to effect the shifting of the center shaft 24 by the reset knob 22 and the reset lever 91.

The projection F on the lock lever 17 is engaged in the index spacer notches 64 when the lever 17 is raised, and this holds the notches 64 in alignment and prevents rotary motion of the index spacers 63. Forward motion of the main shaft 24 disengages the index spacers 63 from the index levers 62 and causes the teeth 60 on the front faces of the middle spacers 54 to engage the teeth 67 on the rear faces of the index spacers 63. As the index spacers 63 are locked against rotation by their engagement with the latch lever projection F, the main shaft 24 also is locked against rotation, since the middle spacers 54 are keyed to the shaft 24.

With the reset lever 91 depressed and the main shaft 24 forward, the dial 25 is turned full counterclockwise and the pinion cradle 78 carries the reset projections 72 of the four tumbler assemblies 61 to the start position. With the reset lever 91 depressed, a new combination is dialed as hereinbefore described for dialing a current combination, moving the dial appropriately between the detent or return line 44 and the desired numbers. Since the index spacers 63 are fixed in their unlocked position by the latch lever projection F, this dialing action sets up new angular relationships between the index spacers 63 and the index levers 62 corresponding to the desired new combination. After the fourth number has been selected, the dial 25 is returned to the detent position 44 and the reset lever 91 is released. The return spring 56 moves the shaft 24 rearwardly and the index spacers 63 are engaged with the index levers 62 in the new combination relationships. The center shaft 24 is decoupled from the index spacers 63 and recoupled to the spacer lock plate 57 through the center opening in the rear spacer 51, and the lock is ready for dialing a new combination.

The second method for setting a new combination involves the use of a master key positioned in a keyway or socket 93 in the rear end of the center shaft 24. This method allows the combination to be reset to 0000 by the custodian at the end of a semester or when the locker is assigned to a new occupant. The door may be opened using the bypass key and tumbler barrel 37 or by dialing the current combination. After the door has been opened, a key, such as an Allen wrench, is inserted through the opening 23 in the rear of the lock casing and into the key slot 93 in the rear end of the main shaft 24. The key is used to push the shaft 24 forward which disengages the index spacers 63 from the index levers 62, and couples the index spacers 63 to the shaft 24 through engagement of the teeth 67 on their rear faces with the teeth 60 on the front faces of the rear spacer 55 and the middle spacers 54. The shaft 24 and the index spacers 63 are free to turn, however, since the latch lever 17 is not engaged in the spacer notches 64. The index levers 62 also are free to turn. The key is turned in a manner to rotate the index spacers 63 in a clockwise direction, when the lock is viewed from the front. This causes the ends of the cam slots 65 on the spacers 63 to contact the pins 75 on the index levers 62 and rotate the index lever 62 so that the angular relationship between the index spacer notches 64 and the index lever combination set projections 71 for all of the tumbler assemblies 61 is that of the combination 0000. When axial pressure on the key is released, the shaft 24 is returned to its rearward position and the index spacers 63 are locked to the index levers 62.

The occupant may also set his combination to 0000 if he so desires, by opening the lock after dialing the current combination, and moving the dial 25 to hold the lock lever projection F in the spacer notches 64. The reset lever 91 is depressed, and the dial 25 is turned counterclockwise as far as it will go. When the reset lever 91 is released and the shaft 24 moves rearwardly again, the combination is set at 0000.

Lock out construction and operation

The lock-out button 21 positioned on the rear of the casing includes a lock-out stop 94 urged toward the interior of the casing by a leaf spring 95. The function of the lock-out structure is to prevent counterclockwise motion of the pinion cradle 78 when the button 21 is rotated to move the stop 94 into the return path of the pinion cradle 78.

In operation, after dialing the combination and moving the dial 25 full clockwise to open the door, the lock-out mechanism is operated to move the lock-out stop 94 inwardly. The stop 94 prevents the dial 25 from returning to the detent position 44, which in turn prevents the bearing pawl 87 from turning the fifth pinion tooth 86e out of its active position pointing toward the axis of the lock. Limiting the counterclockwise motion of the pinion cradle 78 also maintains alignment of the tumbler notches 64 in their unlocked position. Under these conditions, the latch lever 17 is raised to its unlocked position each time the dial 25 is turned full clockwise. When the dial 25 is returned to the counterclockwise position permitted by the lock-out mechanism, the latch lever 17 is dropped to its latching position. When the lock is used on a country club locker, the owner often does not wish to have to redial the combination each time the locker is opened. Under these conditions the lock-out feature is extremely desirable.

This invention is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A permutation lock comprising a lock casing, a lock element reciprocally mounted in the casing, a main shaft reciprocally and rotatably mounted in the casing, a plurality of tumbler assemblies rotatably mounted on the shaft, each tumbler assembly comprising, an index spacer having a notch in its edge for receiving a flange on the lock element when in unlocking position, an index lever having a combination set lever and a reset lever on its peripheral edge, and means for adjustably coupling the index spacer and the index lever so that the angular relation between the spacer notch and the combination set lever is varied, means for uncoupling the index spacer and the index lever when the main shaft is moved inwardly away from its normal position toward the tumbler assemblies, means for fixing against rotation one of the index spacer and the index lever in uncoupled position, means for rotating the other of the index spacer and the index lever to adjust the angular relation between the combination set lever and the notch, and means for reciprocating the main shaft.

2. The structure of claim 1 including a rotatable dial, a rotatable pinion having teeth aligned with the combination set levers, a stationary index plate between each tumbler assembly, said stationary index plates having teeth aligned with the pinion teeth and adapted to rotate the pinion upon engagement thereof, means for locking the pinion against rotation during combination setting movement thereof to drive the tumblers to their unlock-

ing position, means drivingly connecting the pinion and the dial so that motion of the dial is transmitted by the pinion to the tumblers during unlocking.

3. The structure of claim 2 including a lock-out mechanism for deactivating the tumbler assembly after the combination has been dialed comprising a lock-out button accessible from the rear of the lock and a lock-out stop movable by the button into the return path of the pinion to restrain disruption of the setting after the combination has been dialed.

4. A permutation lock comprising a lock casing, a locking element reciprocally mounted in the casing and having a fence, an axially movable and rotatable main shaft mounted in the casing, a plurality of stationary index plates positioned along the main shaft, said stationary spacers having pinion setting teeth on their outer edges and having aligned notches for receiving the locking element fence when the combination is properly dialed, tumbler assemblies positioned between the stationary index plates, the tumbler assemblies each having a set projection and the angularly positioned notch for receiving the locking element fence when set to the proper combination, means for varying the angular relation between the set projection and the notch and a reset lever for adapting to position the tumblers in an initial common starting position prior to dialing the combination, a rotatable dial for setting the tumblers to the combination numbers and for actuating the lock element on an additional movement of the dial, a rotatable pinion having teeth aligned with the pinion setting teeth on the stationary index plates and with the set projections on the tumbler assemblies, an initial movement of the pinion past a start position driving the tumblers through the reset levers to a common starting position and said initial movement also rotating the pinion into a starting position through engagement of the teeth with the pinion reset teeth of the stationary index plates, said inital movement aligning the first pinion tooth with the set projection of the first tumbler, means for locking the pinion teeth against rotation during combination setting movement of the dial and pinion past the start position in the opposite direction of the inital movement, means for rotating the pinion to set the next pinion tooth into active position aligned with the next tumbler set projection on subsequent return of the pinion to a start position, and means for actuating the locking element on a final movement of the dial and pinion after the combination has been dialed in the opposite direction of the initial movement of the pinion.

5. A permutation lock comprising a lock casing, a latch lever rotatably mounted in the casing and projecting through one wall thereof, said latch lever having a projection, an axially movable and rotatable main shaft mounted in the casing, a plurality of stationary index plates positioned along the main shaft, said stationary spacers having pinion setting teeth on their outer edges and having aligned notches for receiving the latch lever projection when the combination is properly dialed, tumbler assemblies positioned between the stationary index plates, the tumbler assemblies each comprising an index lever having a combination set projection and a reset projection and provided with a plurality of notches in one edge, and an index spacer provided with a notch in one edge for receiving the latch lever projection when the combination is dialed, the index spacer having nodes on one surface adapted to engage the notches in the index lever edge to set the angular relation between the lever set projection and the spacer notch, means for locking the index spacer to the main shaft when the main shaft is moved axially toward the front of the lock, means for shifting the main shaft toward the front of the lock, said means being operable only when the latch lever projection is received in the spacer plate and index spacer projections, said means being actuated from the rear of the lock, a rotatable dial for dialing the combination and for setting a new combination on the lock, pinion means for moving the tumblers through sequential engagement of pinion teeth with the tumbler set projections, said pinion means also setting a new combination on the tumblers by rotating the index levers when the main shaft is moved toward the front of the lock and the index spacers are held in fixed position to vary the angular relation between the index spacer notches and the index lever set projections, and means connecting the dial and the pinion means in operable relation.

6. The structure of claim 5 wherein the rear wall of the lock casing is provided with an opening aligned with the rear end of the main shaft, the main shaft is provided with a socket in its rear end, the index spacer has arcuate slots, and the index lever has pins riding in the spacer slots, the shaft socket receiving an actuating member for shifting the shaft forwardly, thus locking the index spacer to the main shaft, and for rotating the forwardly shifted shaft, the pin and slot connections between the lever and the spacer carrying all of the tumblers into a common relationship between the index lever set projections and the index spacer notches so that all of the tumblers have a common predetermined combination number.

7. The structure of claim 5 including a lock-out mechanism for deactivating the tumblers after the combination has been dialed, comprising a lock-out button accessible from outside the lock casing, and a lock-out stop movable by the button into the path of the pinion to restrain rotation of the pinion after the combination has been dialed while permitting movement of the latch lever into the index spacer and spacer plate notches.

8. A tumbler assembly comprising an index lever having a center opening and a plurality of locking notches along a portion of its peripheral edge, a combination set projection extending from the edge of the lever in the same plane, an index spacer having a center opening coaxial with the lever center opening, and provided with a notch in its outer edge, and nodes on one surface of the spacer adapted to engage the lever locking notches to establish a plurality of angular relations between the lever set projection and the spacer notch.

9. The structure of claim 8 wherein the spacer is provided with radial teeth adjacent to the center opening and arcuate slots adjacent to its outer edge, and the lever has pins projecting into the slots and being movable therein.

10. The structure of claim 9 including a spacer element having a center opening and adjacent bearing surfaces, the index lever rotating on one of the bearing surfaces and the index spacer rotating on the other.

11. The structure of claim 10 including teeth on the spacer element for engaging the teeth on an adjacent index spacer and locking the same against relative rotation.

12. A permutation lock comprising a lock casing, a lock element reciprocally mounted in the casing, a main shaft mounted in the casing, a plurality of tumbler assemblies rotatably mounted on the shaft, each tumbler assembly comprising an index spacer having a notch in its edge for receiving a flange on the lock element when in unlocking position, an index lever having a combination set lever on its peripheral edge, and means for adjustably coupling the index spacer and the index lever so that the angular relation between the spacer notch and the combination set lever is varied, means for uncoupling the index spacer and the index lever, means for fixing against rotation one of the index spacers and the index lever in uncoupled position, and means for rotating the other of the index spacers and the index lever to adjust the angular relation between the combination set lever and the notch; the main shaft being reciprocally mounted in the casing and the index spacer and the index lever being uncoupled when the main shaft is moved inwardly toward the tumbler assemblies and away from its normal position.

13. The structure of claim 12 including means for moving the main shaft inwardly in the casing, said means being accessible only from the rear of the casing.

14. A permutation lock comprising a lock casing, a lock element reciprocally mounted in the casing, a main shaft rotatably and axially movably mounted in the casing, an assembly of tumblers rotatably mounted on the shaft, each tumbler comprising an index spacer, an index lever, and means for coupling the index spacer and the index lever in a plurality of angular relationships, the index spacers and the index levers being uncoupled when the main shaft is axially moved in one direction, means for rotating the tumblers into unlocking position, and means for clearing the existing combination from the lock and simultaneously coupling all of the index spacers and the index levers in all of the tumblers in a common angular relationship when the main shaft has been axially moved in said one direction.

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