

Dec. 30, 1969

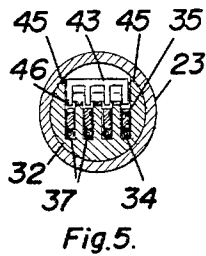
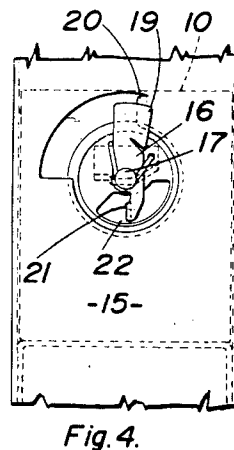
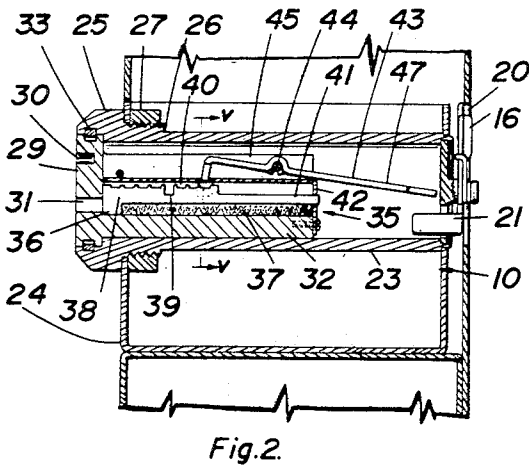
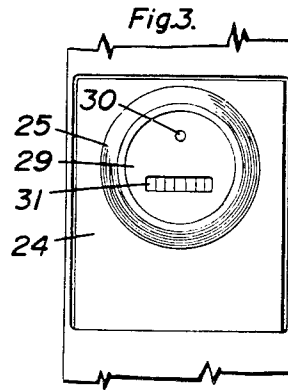
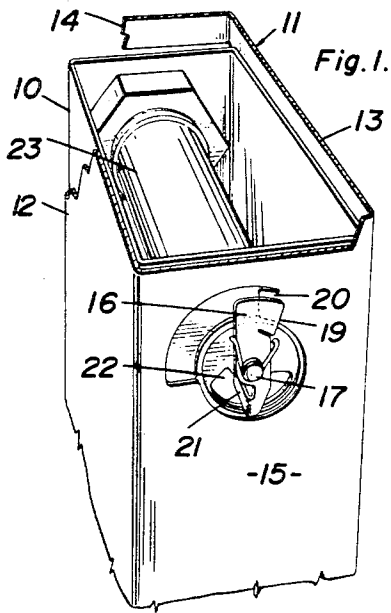
A. PILVET

3,486,353

LOCK MECHANISMS AND KEYS THEREFOR

Filed Oct. 13, 1967

3 Sheets-Sheet 1



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LOCK MECHANISMS AND KEYS THEREFOR

Filed Oct. 13, 1967

3 Sheets-Sheet 2

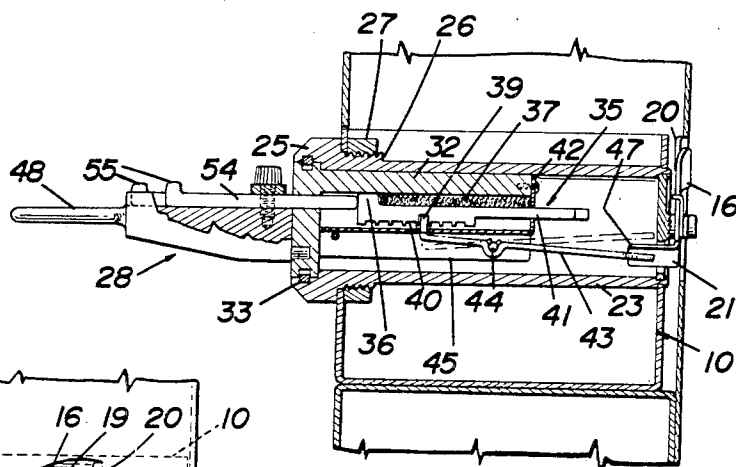


Fig. 6.

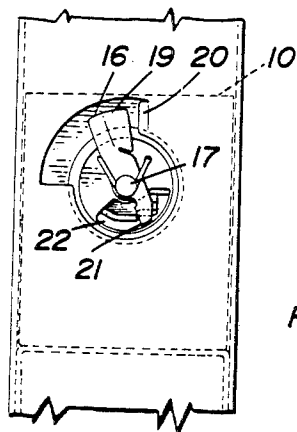


Fig. 7.

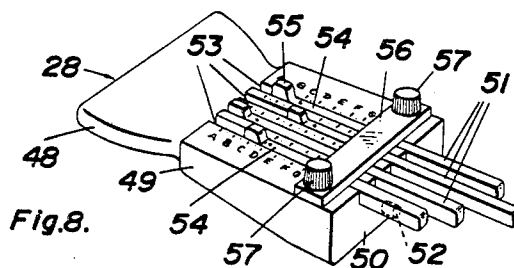


Fig. 8.

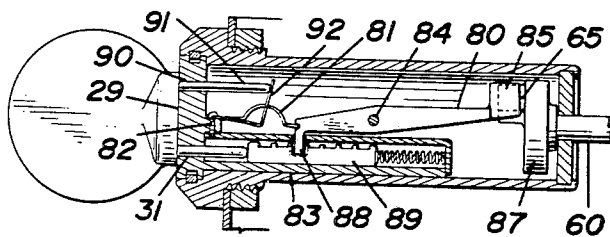


Fig. 14.

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LOCK MECHANISMS AND KEYS THEREFOR

Filed Oct. 13, 1967

3 Sheets-Sheet 3

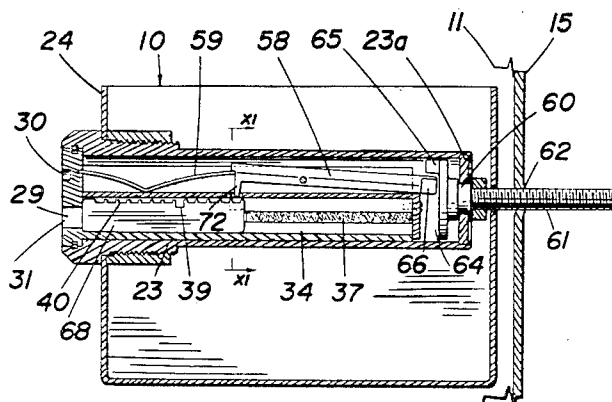


Fig. 9.

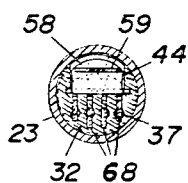


Fig. 11.

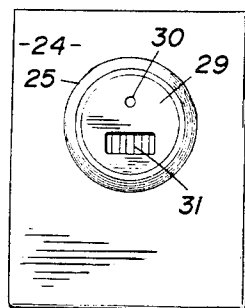


Fig. 10.

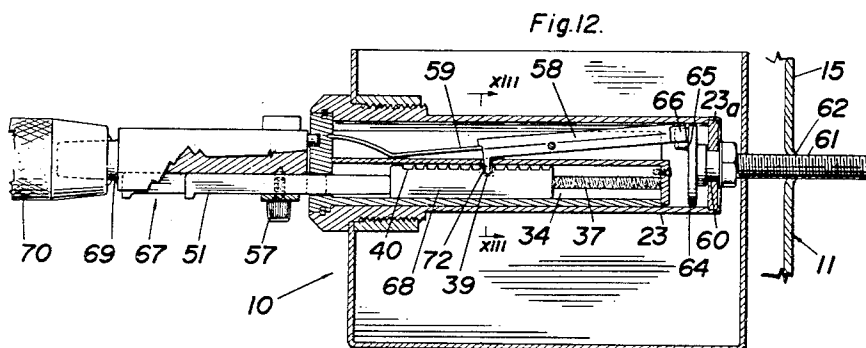


Fig. 12.

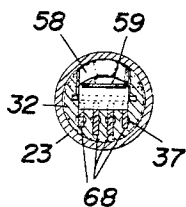


Fig. 13.

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LOCK MECHANISMS AND KEYS THEREFOR

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Int. Cl. E05b 29/08, 19/18

U.S. Cl. 70—363

13 Claims

ABSTRACT OF THE DISCLOSURE

In a key-operated tumbler lock in which the locking element is actuated by a rotatable plug, the plug is normally disengaged from the locking element and is freely rotatable. A movable coupling member is provided for engaging the plug with the locking element, when rotation of the locking element is required, and movement of the member to its operative, engaging position is permitted only when the lock tumblers are appropriately set by a key. The lock is especially suitable for use in a coin-freed vending machine.

BACKGROUND OF THE INVENTION

This invention relates to lock mechanisms and to keys therefor. The invention is particularly concerned with lock mechanisms of the kind comprising a rotatable plug, which is usually adapted to receive a key, a locking element which may be rotated by the plug between locking and unlocking positions, a series of slotted tumbler elements or pins carried by the plug and individually movable within the plug so that their slots are normally misaligned but become aligned upon proper displacement by a key, for example, and a lock bar or abutment means which is engageable with the slots, when the slots are aligned, so as to permit rotation of the locking element by rotation of the plug. Such lock mechanisms are herein referred to as "lock mechanisms of the kind specified."

In known lock mechanisms of this kind the locking element is usually coupled to the rotatable plug so that it can be actuated whenever the plug is rotated. Rotation of the plug is normally prevented by the lock bar, which engages with a recess or other stop in the wall of the plug housing or cylinder when the slots are misaligned. In order to permit rotation of the plug for actuating the locking element, it is necessary to align the slots in the tumbler elements or pins so that the lock bar can become disengaged from the fixed recess or stop as it moves into the aligned slots. Since the tumbler elements or pins must be displaced at the same time to respective predetermined positions, in order to release the mechanism, a large number of different locking configurations are available. In the case of a key-operated lock the lock can only be opened readily with the proper key.

A key for such a lock has a plurality of fingers or projections of different lengths, corresponding to the number of tumbler elements or pins and the positions of their slots, and a lug which engages with a cooperating formation on the lock face, so that when the key is inserted into the lock the pins are displaced to their appropriate positions and the plug can be rotated by turning the key.

A disadvantage of known locks of the kind specified is that they can be picked by a skilled lock picker, who may probe each pin individually while trying to rotate the plug; when a pin is moved to its release position, this condition can be felt by the lock picker and so the complete combination can be determined.

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It is one object of the present invention to provide a lock mechanism in which this disadvantage is overcome.

SUMMARY OF THE INVENTION

According to the present invention, in a lock mechanism of the kind specified the plug is freely rotatable within the cylinder and the locking element is normally disengaged therefrom; instead of a lock bar, a movable member (herein referred to as a rocker element) is mounted on the plug and movable from a first position, at which it permits free rotation of the plug independently of the locking element, to a second position at which it engages the slots in the tumbler elements, when the slots are aligned, and at the same time permits rotation of the locking element with the plug. The rocker element may conveniently take the form of a pivoted lever having an abutment at one end which is adapted to enter the aligned slots of the tumbler elements, and an abutment at its other end which is adapted to engage a cooperating formation on the rotatable locking element, or lock-actuating member, when the rocker element is moved to its second position.

The rocker element may be weighted so as to be biased by gravity towards its first or second position according to the angular position of the plug. In such a case the lock must be mounted so that the cylinder in which the plug is rotatably mounted, as well as the pivotal axis of the rocker element, are horizontal. Alternatively, the rocker element may be spring-biased towards its first position and moved towards its second position centrifugally by rotating the plug at a certain speed. In such a case the plug would be rotated mechanically rather than manually.

Since the plug is freely rotatable within the cylinder, it is impossible to "feel" the appropriate positions of the tumbler elements or pins, because the plug encounters no sideways pressure as it is turned. A further advantage of a freely rotatable plug is that it is almost impossible to drill through it axially using a rotary drill.

In a preferred embodiment of the invention, each of the tumbler elements is provided with a series of notches, one of which is of such a depth as to constitute said slot, the remaining notches being shallow. The shallow or "false" notches can engage the rocker element but do not permit movement of the rocker element to its second or release position.

This feature of providing false notches on the tumbler elements or pins may be applied with advantage to known lock mechanisms, in which the plug is normally prevented from rotating, since picking would become very difficult because of the false indication that would be received by a lock picker whenever a tumbler element is moved to any position.

According to another aspect of the present invention, therefore, in a lock mechanism of the kind specified, each tumbler element is formed with a series of shallow notches and a notch of substantial depth constituting a said slot, all the notches being engageable by the rocker element but only the slot permitting movement of the lock bar to a position at which the lock may be released.

According to another feature of the present invention there is provided a key for a lock mechanism of the kind specified, having a plurality of projecting fingers corresponding to the number of tumbler elements in the lock and adapted to engage the tumbler elements for the displacement thereof when the key is inserted, wherein the fingers are individually adjustable relative to a graduated scale on the key and means are provided for releasably holding the fingers at any position to which they are adjusted. In this way a large number of combinations are made available on a single key.

BRIEF DESCRIPTION OF THE DRAWINGS

Two embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary perspective view of a coin drawer of a coin-free vending machine incorporating a lock mechanism according to the invention;

FIGURE 2 is a sectional elevation of the lock mechanism shown in FIGURE 1;

FIGURE 3 is a front elevation of the lock mechanism and coin drawer;

FIGURE 4 is a rear elevation of the lock mechanism and coin drawer, the figure showing the locking element in its locked position;

FIGURE 5 is a section on line V—V in FIGURE 2;

FIGURE 6 is a view similar to that of FIGURE 2 of a lock mechanism which has been rotated to its release position by the insertion of a key;

FIGURE 7 is a rear elevation, similar to FIGURE 4, showing the locking element in its release position;

FIGURE 8 is a general perspective view of the key for the lock mechanism;

FIGURE 9 is a sectional elevation of a modified lock mechanism mounted in the coin drawer of a coin-free vending machine;

FIGURE 10 is a front elevation of the lock mechanism and coin drawer of FIGURE 9;

FIGURE 11 is a section on line XI—XI in FIGURE 9;

FIGURE 12 is a view similar to that of FIGURE 9 showing the lock rotated to its release position by the insertion of a key;

FIGURE 13 is a section of line XIII—XIII in FIGURE 12, and

FIGURE 14 is a sectional elevation of another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, the coin-drawer 10 of a coin-free vending machine is slidably mounted in a compartment 11 provided in the machine. The compartment 11 has side walls 12 and 13 and front and rear walls 14 and 15. Means not shown are provided for supporting the drawer horizontally within the compartment. The drawer is locked by means of a locking element 16 rotatably mounted on a stud 17 projecting from the rear wall 18 of the drawer 10. The locking element 16 comprises a latch member 19 which engages behind a keeper 20 formed by a portion of the wall 15, and a finger 21, constituting a lock-actuating member, which projects through an arcuate slot 22 in the rear wall 18 of the drawer to engage an actuating mechanism, as herein-after described, for rotating the locking element to and from its locking position. The latch member 19 and keeper 20 are preferably formed as cam surfaces, as shown, which engage one another frictionally so as to minimise the risk of accidental unlocking by vibration or shock.

Referring now also to FIGURES 2 to 7, the lock-actuating mechanism is housed in a horizontal cylinder 23 or mounting member which is rigidly mounted on the front wall 24 of the drawer 10 so as to extend rearwardly therefrom. The cylinder 23 has a flanged head 25, which bears against the front of the wall 24, and a screw-threaded neck 26 which extends through a circular opening in the front wall of the drawer and carries a threaded clamping collar 27 to clamp the cylinder rigidly in position. The rear end of the cylinder is located in a circular opening in the rear wall of the drawer.

Rotatably mounted within a longitudinal bore of the cylinder 23 is a plug assembly comprising a rotatable plug body and movable parts carried thereby. The plug body consists of a circular key-receiving face 29 having a recess 30 and a horizontal slot 31 to receive parts of a key 28 as described below, and a part-cylindrical hol-

lowed out shank 32. Bearings 33 between the plug body and the cylinder 23 permit rotation of the plug while preventing axial displacement of the latter. Slidably arranged within a number of parallel, longitudinal grooves 34 in the shank 32 of the plug body are slotted pins 35 which constitute tumbler elements. In the present example there are four such grooves and four pins. The grooves 34 are of rectangular cross section and the pins are correspondingly shaped. Each pin 35 comprises a front head portion 36 against which a spring 37 bears to bias the pin towards the front end of the groove, a body portion 38 having at its upper edge a deep slot 39 and a series of equally spaced shallow slots or notches 40, and a tail portion 41 which extends through a guide slot in the rear wall 42 of the plug body. The position of the slot 39 is a characteristic of the pin and in general the slots of the four pins are at different predetermined positions. Also mounted in the plug body is a rocker element 43. The rocker element 43 takes the form of a lever pivotally mounted on a pivot pin 44 extending horizontally between side walls 45 of the shank 32. One end of the rocker element has four downwardly turned abutments 46 which are adapted to enter the slots 39, or the notches 40, depending upon the longitudinal positions of the pins 35, when the rocker element is pivoted about the pivot pin 44. The abutments 46 are preferably bevelled at their ends to provide inclined faces which ride easily over the shallow notches. The other end of the rocker bar, which in the present example is weighted by suitably choosing the position of the pivot, is formed with a lock-actuating abutment 47 which is adapted to engage the lock-actuating member 21 of the locking element 16 when the plug is rotated, provided that the rocker element is first moved to an operative position.

In the position shown in FIGURE 2 the position of the rocker element is such that its end abutment 47 is radially displaced from the member 21 and cannot possibly engage it when the plug is rotated. The plug is therefore free to rotate independently of the locking element 16. It is necessary to engage the abutment 47 with the member 21 in order to rotate the locking element, and this is accomplished by inserting the appropriate key, which may be of the construction shown in FIGURE 8, and turning the key.

The key shown in FIGURE 8 comprises essentially a handle portion 48, a body portion 49 having a face 50, a horizontal row of four fingers 51 of different lengths projecting forwardly from the face 50, and a lug 52 which is adapted to engage in the recess 30 of the plug body. When the key is inserted into the lock, the lug 52 enters the recess 30 and the fingers 51 enter the slot 31 of the plug body. The fingers 51 slidably engage in the grooves 34 to displace the pins 35 longitudinally, and their respective lengths are such that each pin 35 is displaced to a position at which its slot 39 is aligned with the projections 46 of the rocker element 43, the slots then being aligned with each other. The pins are thus moved from a first configuration, corresponding to a closed lock, to a second configuration corresponding to opening of the lock.

FIGURE 6 shows the manner in which the key cooperates with the lock mechanism. In this view the pins 35 have been displaced to their appropriate positions to bring the slots 39 into alignment with each other and the abutments 46 of the rocker element, and the plug has been turned clockwise through 180° so that the rocker element turns about its pivot, under gravity, bringing the abutments 46 into the aligned slots. Since the rocker element 43 has pivotally moved into engagement with the slots 39, its end abutment 47 can engage with the lock-actuating member 21 of the locking element 16 and further rotation of the key through one quarter turn releases the locking element from the keeper 20. In order to re-lock the drawer, the key must be inserted and turned in the opposite direction, the key being with-

drawn when the plug is in the position shown in FIGURE 2 so that the rocker element 43 automatically returns to its inoperative or disengaging position. The pins 35 are spring-biased to their end positions, or first configuration, thus putting the slots 39 out of alignment and preventing the rocker element from returning to its operative or engaging position if the plug is merely turned without inserting the appropriate key.

Referring again to FIGURE 8, the key illustrated is specially designed for use with a large number of locks having different locking configurations. For this purpose the fingers 51 are adjustable in length. The body portion 49 of the key is milled to provide four grooves 53 in which four bars 54 are slidably located, the parts of the bars which project beyond the ends of the grooves constituting the fingers 51. The ends of the bars 54 remote from the fingers are provided with upstanding lugs or ears 55 which can be grasped between thumb and forefinger to facilitate the positioning of the bars. A cross member 56, which is secured by releasable screws 57, is clamped onto the exposed edges of the bars to hold them in any position to which they are adjusted. Alongside each groove 53 is a graduated scale defining a number of discrete positions, denoted by the letters A, B, . . . G, in the drawing, to which a mark on the associated bar may be set. Obviously, in the case of the key having four adjustable bars each with seven possible settings, as shown, a total of 47 different locking combinations is possible. This feature is very advantageous for two reasons. In the first place it is unnecessary for an attendant who has to operate a number of such locks to have more than one key for the purpose, irrespective of the fact that the locks would normally have different locking configurations. In the second place, the key may be reset to an inoperative configuration after use so that it cannot be used subsequently by an unauthorized person without knowledge of a required combination.

In the modified lock mechanism illustrated in FIGURES 9 to 13, wherein parts which are identical with corresponding parts of the mechanism described above are denoted by the same reference numerals, the pivoted rocker element 58 is permanently biased towards its inoperative position irrespective of the angular position of the plug, by means of a blade spring 59. The locking element in this embodiment comprises a rotatable shaft 60 mounted in the rear wall 23a of the cylinder 23, the shaft 60 having a rearwardly and axially extending screw-threaded rod 61 which engages in a threaded opening 62 in the rear wall 15 of the compartment 11. On the front end of the shaft 60 is a disc 64 which carries an inwardly extending projection 65 corresponding to the lock-actuating member 21 of FIGURES 1 and 2, and this may be engaged by a lock-actuating abutment 66 at the rear end of the rocker element 58. As in the preceding example the lock-actuating member can only be engaged by the lock-actuating abutment 66 when the rocker element 58 moves to its operative or engaging position. This is effected by inserting an appropriately set key 67 into the lock so as to displace the pins 68 longitudinally, and rotating the key.

Since the locking element comprises a screw-threaded rod 61 engaging the threaded opening 62, it must be turned many times in order to unlock the drawer 10. Moreover, since the rocker element 58 is permanently biased towards its inoperative position it is necessary to rotate the plug assembly rapidly in order to overcome the bias of the spring 59 by centrifugal force. Both these requirements can easily be met by providing the key 67 with a tapered shank 69, instead of a handle portion as shown in FIGURE 8, and engaging the shank 69 with a rotary chuck, 70, such as a drill chuck. The key is in other respects similar to the key shown in FIGURE 8.

In order to release or lock the lock mechanism, the key 67, which is mounted in the chuck 70 and rotatable mechanically, is inserted into the lock so that the pins 68

are displaced longitudinally by the key fingers 51. When the key is fully inserted, the slots 39 of the pins 68 are aligned, but the rocker element remains in its inoperative position under the bias of spring 59. The key is now rotated rapidly in the appropriate direction, whereby the weighted end of the lock bar carrying the abutment 66 is moved outwardly by centrifugal force, a downwardly extending abutment 72 at the other end of the lock bar entering the slots 39 and the abutment 66 engaging the projection 65. Continued rotation of the plug assembly by the key causes the locking element to rotate so that the rod 61 is screwed into or out of the threaded opening 62.

It will be noted that the pins 68 are of a slightly different form from the pins 35 of the previous embodiment. Each pin 68 comprises simply a body portion which is longitudinally slidable in a groove 34, the upper edge of the body portion being formed with a slot 39 and a series of false notches 40. The fingers 51 of the key, and the biasing springs 37 bear against opposite ends of the body portion. However, either type of pin is quite suitable for both of the described embodiments.

In each of the embodiments described above, the tumbler elements are described as pins which are slidable longitudinally in parallel grooves formed in the plug body. The tumbler elements may take different forms, however. For example, each tumbler element may be a disc or disc sector having a slotted edge which cooperates with the rocker element. When a key is inserted into the lock, the key will thus rotate the discs or disc sectors by different amounts according to the different lengths of the key fingers.

The invention is not limited in its application to key-operated locks. It will be readily appreciated that the tumbler elements, whether they take the form of pins, discs or disc sectors, may be moved individually to their respective unlocking positions in accordance with a known combination.

This it will be seen that the invention has broader applications than those particularly described herein, and in particular is not limited to any particular form of tumbler elements and means for positioning the tumbler elements. Essentially the invention resides in a tumbler lock in which the tumbler-carrying assembly is freely rotatable, and in which the locking element or latching element may be coupled to, and rotated by, the tumbler-carrying assembly when the tumblers are correctly positioned.

In the modified lock mechanism illustrated in FIGURE 14, the rocker element 80 is biased towards its inoperative position by means of a blade spring 81 mounted in cantilever fashion on a step 82 adjacent to the outer end of the plug body 83. The rocker element 80 is pivoted about a pin 84, and has an abutment 85 at its outer end, which is engageable with a projection 86 on the lock-actuating member 87, and an abutment 88 at its inner end, which is engageable with the tumbler pins 89. The rocker element is shown in its operative or engaging position. The form and disposition of the tumbler pins and the lock-actuating member are substantially as shown in FIGURE 12.

The key-receiving face 29 of the plug has a horizontal key slot 31 and an opening 90 through which an activating pin or trigger 91 extends. The inner end of the activating pin is adapted to engage, when the activating pin is moved to the position shown, one end of a lever 92. The other end of the lever acts the blade spring 81, forming a toggle mechanism, so that when the lever is moved to the position shown the toggle mechanism passes a dead-centre position and urges the rocker element to its engaging position. Thus the spring toggle mechanism urges the rocker element positively into one or other of its operative positions.

What I claim is:

1. A lock mechanism comprising:
 - a mounting member;

a plug body having an axis of rotation, the plug body being mounted within the mounting member for rotation about said axis;

a rotatable lock-actuating member;

means mounted on the plug body and rotatable therewith for rotating the lock-actuating member, said means being movable from a first position in which it is disengaged from the lock-actuating member to a second position in which it engages the lock-actuating member;

a series of slotted tumbler elements carried by the plug body and spaced in a direction transverse to said axis, the tumbler elements having a first configuration corresponding to a closed lock, in which the slots therein are misaligned, and a second configuration corresponding to opening of the lock, in which the slots therein are aligned in said direction;

means biasing the tumbler elements towards their first configuration, the tumbler elements being mounted for individual movement to a second configuration;

a rocker element having a first position at which engagement between said means and the lock-actuating member is prevented, and a second position at which engagement between said means and the lock-actuating member is permitted, the rocker element being mounted for movement between said first and second positions, and

the rocker element having a tumbler-engaging abutment positioned to enter the aligned slots of the tumbler elements in the second configuration of the tumbler elements, said abutment being engageable with the tumbler elements to prevent movement of the rocker element to its second position except when the tumbler elements are moved to their second configuration.

2. A lock mechanism according to claim 1, wherein the tumbler elements are formed each with a series of shallow notches and a notch of substantial depth, constituting said slot, all the notches being engageable by the rocker element but movement of the rocker element to its second position being permitted only when the slots of the tumbler elements are aligned in the second configuration of the tumbler elements.

3. A lock mechanism according to claim 1, wherein the tumbler elements comprise pins located in axially extending parallel grooves in the plug body and individually slidable along the grooves.

4. A lock mechanism comprising:

a mounting member having a bore therein;

a plug body having an axis of rotation, the plug body being mounted within the bore for rotation about said axis;

a rotatable lock-actuating member;

a series of slotted tumbler elements carried by the plug body and spaced in a direction transverse to said axis, the tumbler elements having a first configuration corresponding to a closed lock, in which the slots therein are misaligned, and a second configuration corresponding to opening of the lock, in which the slots therein are aligned in said transverse direction;

means biasing the tumbler elements towards the first configuration, the tumbler elements being mounted for individual movement to the second configuration;

a rocker element pivotally mounted on the plug body, the rocker element having first abutment means engageable with the lock-actuating member and second abutment means engageable with the tumbler elements,

the rocker element being pivotally movable between a first position at which said first abutment means is disengaged from the lock-actuating member, and a second position at which the first abutment means engages the lock-actuating member, the rocker element being normally biased to said first position, the tumbler elements being normally engageable with the rocker element to prevent movement of the rocker element to its second position, and

the tumbler elements being individually movable to the second configuration for permitting movement of the rocker element to its second position.

5. A lock mechanism according to claim 4, wherein the tumbler elements are formed each with a series of shallow notches and a notch of substantial depth, constituting said slot, all the notches being engageable by the rocker element but movement of the rocker element to its second position being permitted only when the slots of the tumbler elements are aligned in the second configuration of the tumbler elements.

6. A lock mechanism comprising:

a mounting member having a bore therein;

a key-receiving plug having an axis of rotation, the plug being mounted within the bore for rotation about said axis;

a rotatable lock-actuating member;

a series of slotted tumbler pins carried by the plug, the tumbler pins being located in axially extending parallel grooves in the plug, the tumbler pins having a first configuration corresponding to a closed lock in which the slots therein are misaligned, and a second configuration corresponding to opening of the lock, in which the slots therein are aligned in a direction transverse to said axis;

spring means biasing the tumbler pins towards the first configuration;

the tumbler pins being mounted for individual movement by a key along said grooves to the second configuration;

a rocker element pivotally mounted on the plug body, the rocker element having first abutment means engageable with the lock-actuating member and second abutment means engageable with the tumbler elements;

the rocker element being movable between a first position at which the first abutment means is disengaged from the lock-actuating member and a second position at which the first abutment means engages the lock-actuating member, the rocker element being normally biased to said first position, movement of the rocker element to its second position being normally prevented by engagement of the said second abutment means with the tumbler elements, and movement of the rocker element to its second position being permitted when the tumbler elements are in the second configuration.

7. A lock mechanism according to claim 6, wherein the tumbler elements are formed each with a series of shallow notches and a notch of substantial depth, constituting said slot, all the notches being engageable by the rocker element but movement of the rocker element to its second position being permitted only when the slots of the tumbler elements are aligned in the second configuration of the tumbler elements.

8. A lock mechanism according to claim 6, including spring means for biasing the rocker element towards its second position, and a trigger operable by insertion of a key for actuating the spring means.

9. A lock mechanism according to claim 6, wherein the rocker element is weighted at one end for biasing the rocker element towards its second position when the plug body is rotated to an inverted position.

10. A lock mechanism according to claim 6, wherein the rocker element is pivotally mounted on the plug body and spring-biased towards its first position, and wherein the rocker element is weighted at one end for biasing the rocker element towards its second position centrifugally when the plug body is rapidly rotated.

11. In combination with a coin drawer of a coin-freed machine, a locking mechanism in accordance with claim 6.

12. A lock mechanism comprising a mounting member having a cylindrical bore therein, a key receiving plug having an axis of rotation, the plug being mounted in the bore for rotation about said axis, a locking element mounted for rotation between locking and unlocking positions, a series of slotted tumbler pins carried by the plug and spaced in a direction transverse to said axis, the pins being mounted for individual movement in the axial direction between a first configuration at which the slots therein are misaligned and a second configuration at which the slots therein are aligned in said transverse direction, a rocker element pivotally mounted on the plug, the rocker element being movable into the slots when the slots are aligned, characterized in this that the plug is mounted for free rotation within the bore of the mounting member and the locking element is normally disengaged therefrom, the rocker element being pivotally mounted on the plug and movable from a first position, at which it permits free rotation of the plug independently of the locking element, to a second position at which it engages the slots in the pins, when the slots are aligned, and at the same time engages the locking element for actuating the latter.

13. In combination with a lock mechanism according to claim 6, a key having a plurality of projecting fingers corresponding to the number of said tumbler pins, said fingers being engageable with the pins for displacing the pins when the key is inserted into the plug, the fingers being individually adjustable relative to a graduated scale on the key, and means being provided for releasably holding the fingers at any position to which they are adjusted.

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U.S. Cl. X.R.

70—379, 398, 411, 419