

United States Patent

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 [33] **Canada**
 [31] **057834**

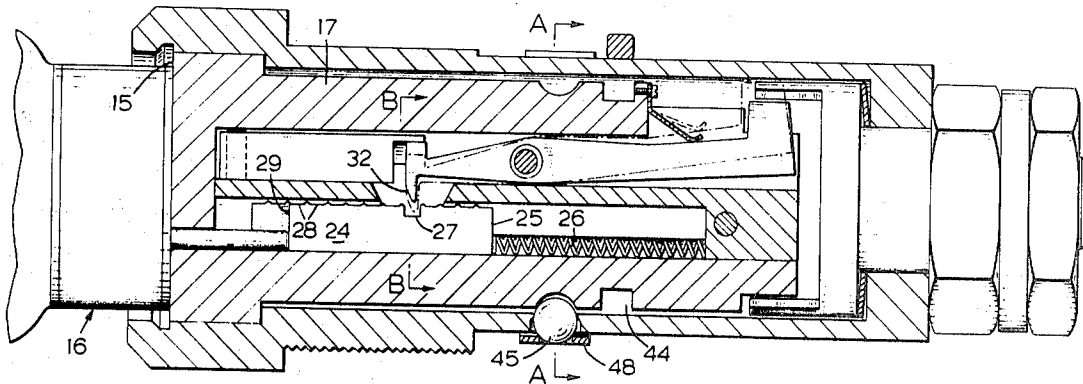
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 378-380, 394-395, 399, 403-404, 419-421,
 DIG. 9, DIG. 13

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Primary Examiner—Robert L. Wolfe
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[54] **TUMBLER LOCK**
7 Claims, 14 Drawing Figs.
 [52] U.S. Cl..... **70/363,**
70/379, 70/395, 70/403, 70/419
 [51] Int. Cl..... **E05b 17/04,**
E05b 19/12, E05b 29/08

ABSTRACT: In a tumbler lock including a freely rotatable plug and a clutch element which is permitted to move into an operative lock-engaging position only when the tumblers have been set by a proper key, the clutch element is normally biased to an inoperative position and an inertial cam member is provided for moving the clutch element towards its operative position in response to rapid rotation of the plug.



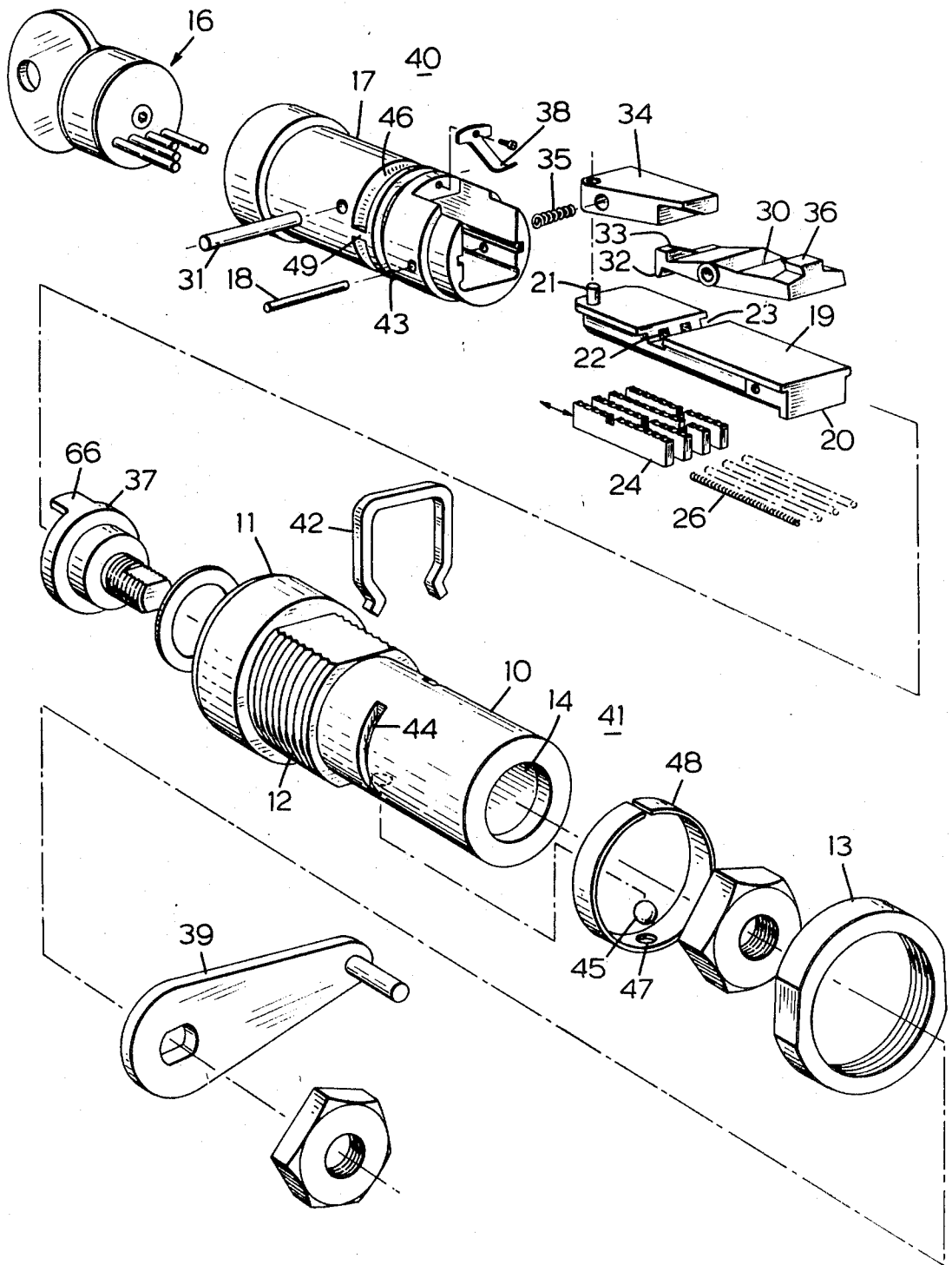


FIG. 1

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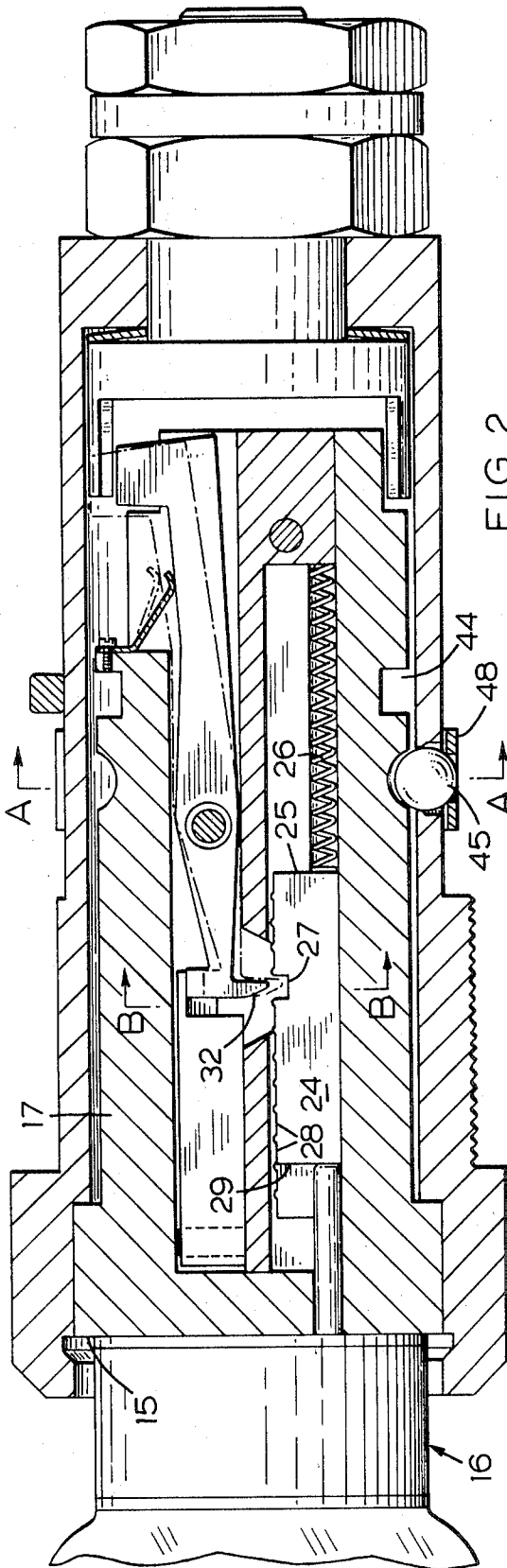


FIG. 2

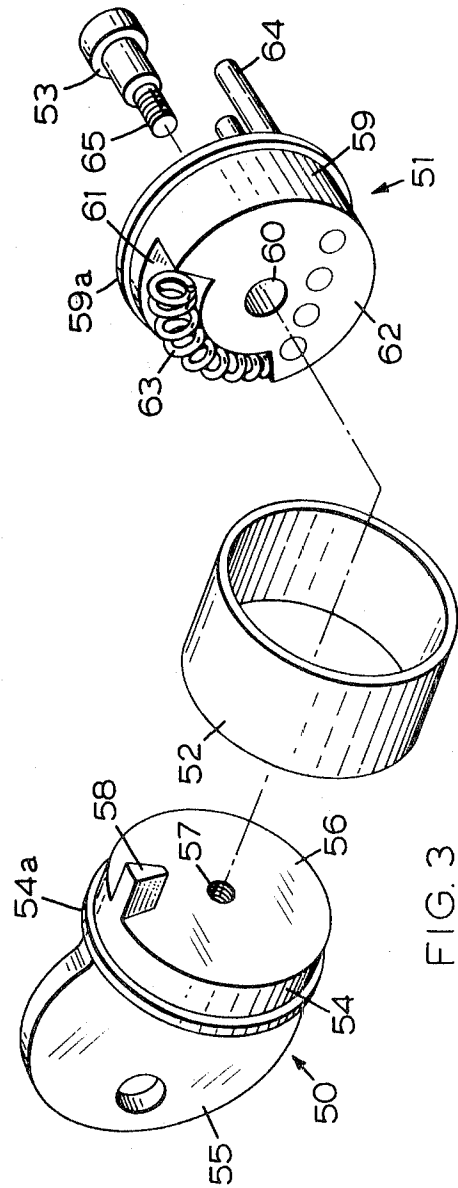
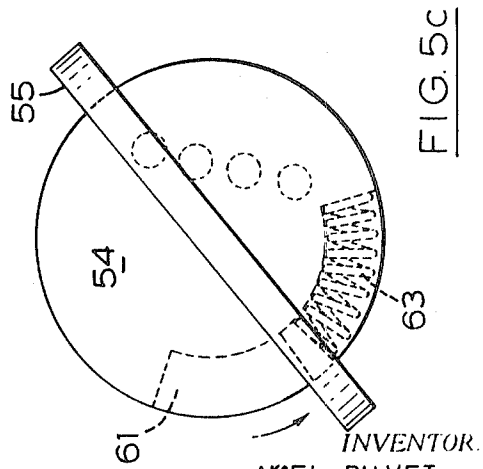
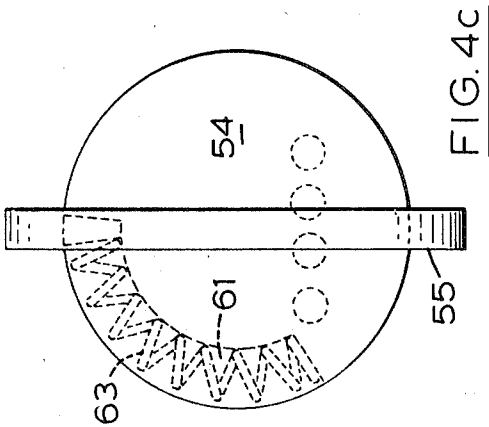
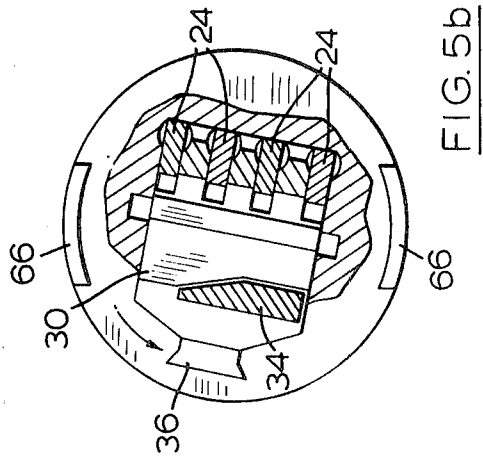
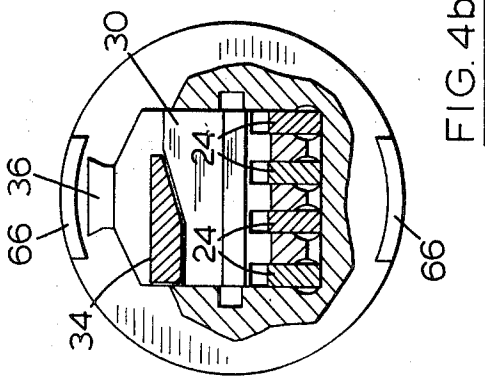
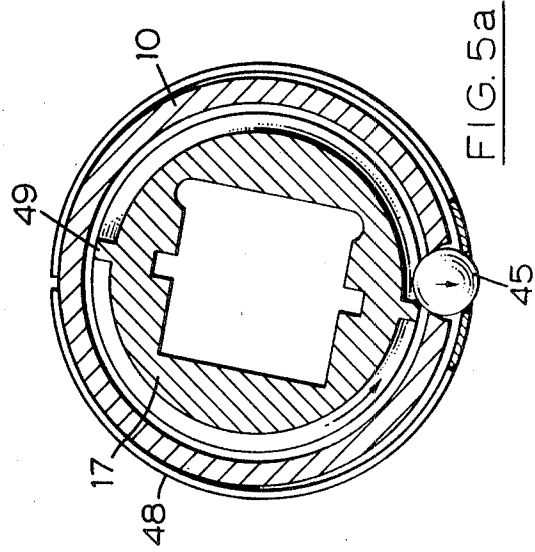
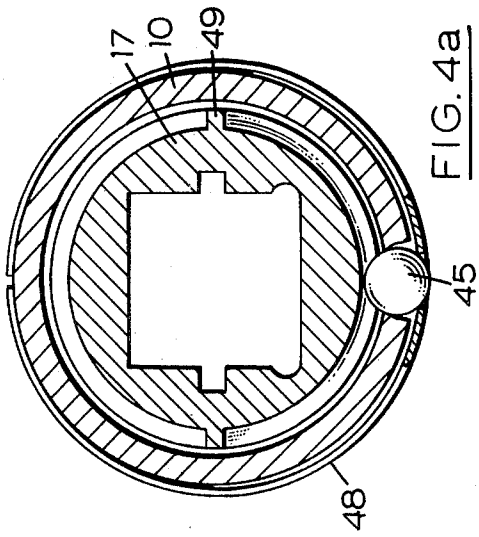


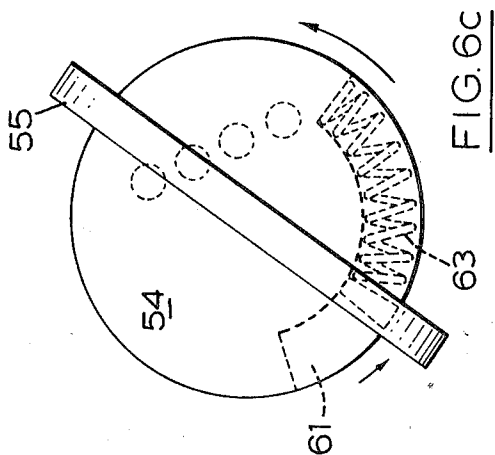
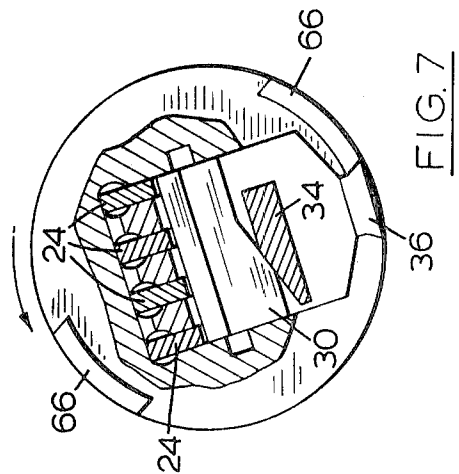
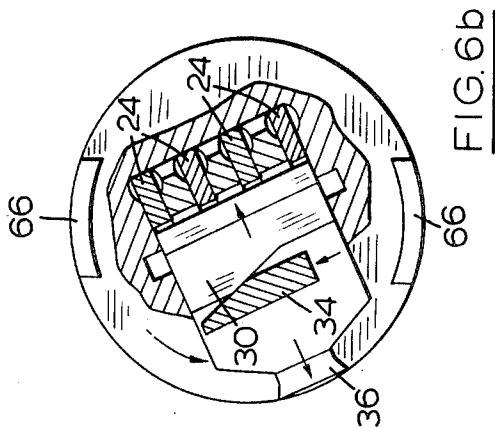
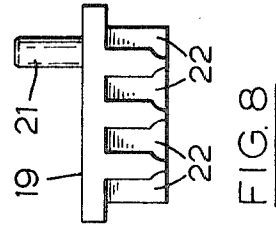
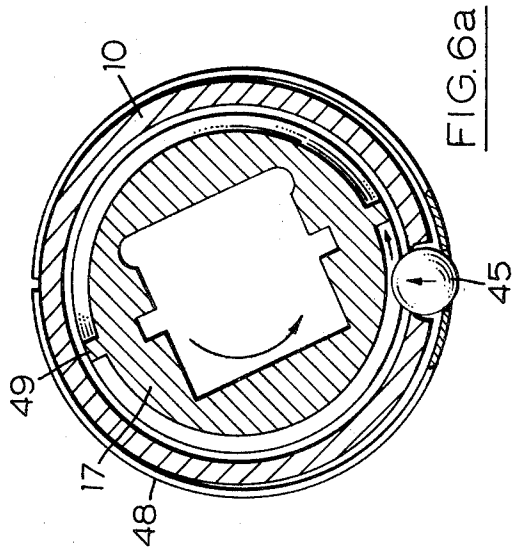
FIG. 3

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TUMBLER LOCK

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 carried by the plug and individually movable 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.

In locking 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 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 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 is engageable with the face of the lock, 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 referred to above 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, this condition can be felt by the lock picker and so the complete combination can be determined.

In my U.S. Pat. application Ser. No. 675,132 filed on Oct. 13, 1967, now U.S. Pat. No. 3,486,353 issued Dec. 30, 1969, and entitled "Lock Mechanisms and Keys Therefor," there is described a lock mechanism of this general kind, wherein the plug is freely rotatable within the cylinder and the locking element is normally disengaged from the plug; instead of a lock bar, a rocker element or clutch 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. Since the plug is freely rotatable within the cylinder, it is impossible to "feel" the appropriate positions of the tumbler elements, because the plug encounters no sideways pressure as it is turned. This characteristic makes the mechanism particularly suitable for high security locks.

The present invention is concerned with a lock of this general kind, that is to say a tumbler lock including a plug which is freely rotatable about an axis, the plug carrying a set of tumbler elements which are displaceable to an operative configuration by a key, and a lock-actuating clutch which is permitted to move to an operative lock-engaging position in accordance with the displacement of the tumbler elements. It is an object of the invention to provide a lock which is intrinsically even more secure than the locks described in my application referred to above.

A tumbler lock in accordance with the present invention is characterized by spring means biasing the clutch to an inoperative position, and inertial means carried by the plug, the inertial means being responsive to rotational acceleration of the plug to engage the clutch for moving the clutch towards its operative position against the bias of said spring means.

A preferred lock mechanism according to the invention comprises:

- 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 lock-actuating member;
- a series of slotted tumbler pins carried by 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;
- spring means biasing the tumbler pins towards the first configuration;
- the tumbler pins being mounted for individual movement by a key to the second configuration;
- a rocker element pivotally mounted on the plug, 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 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;
- a first catch member on said mounting member;
- a second catch member on said plug;
- said catch members being positioned to engage one another for preventing rotation of the plug; and
- spring means biasing the catch members into releasable engagement.

The key preferably comprises an actuating member, a plug-engaging member, said members being connected together for relative rotation about a common axis, tumbler-engaging means carried by the plug-engaging member, and a spring intercoupling the actuating and plug-engaging members for exerting a torque on the plug-engaging member to overcome the bias of said spring means.

One preferred embodiment of the invention is illustrated by way of example in the accompanying drawings, in which:

FIG. 1 is an exploded perspective view of the lock mechanism and key;

FIG. 2 is a longitudinal sectional view of the lock mechanism;

FIG. 3 is an exploded perspective view of the key;

FIG. 4a, 4b, and 4c are, respectively, a section on line A-A in FIG. 2, the central portion of the mechanism being omitted for clarity, a diagrammatic section on line B-B in FIG. 2, and an end elevation of the key after its insertion into the lock, all three figures corresponding to a lock position immediately prior to turning of the key;

FIGS. 5a, 5b and 5c are views corresponding to FIG. 4a, 4b and 4c after the key has been rotated by a certain amount;

FIGS. 6b and 6c correspond to FIGS. 4a, 4b and 4c at an instant at which the lock plug is being rotationally accelerated;

FIG. 7 is a view corresponding to FIG. 6b at an instant when the plug has been further rotated; and

FIG. 8 is an end elevation of a component shown in FIG. 2.

Referring to FIGS. 1, 2 and 8, particularly, the locking mechanism is housed in a horizontal cylinder 10, or mounting member which is arranged to be rigidly mounted on the front wall of a door or like member to be secured so as to extend rearwardly therefrom. The cylinder 10 has a flanged head 11, which bears against said front wall, and a screw-threaded neck 12 which extends through a circular opening in the front wall and carries a threaded clamping collar 13 to clamp the cylinder rigidly in position. Rotatably mounted within a longitudinal bore 14 of the cylinder 10 is a plug assembly com-

prising a rotatable plug body and movable parts carried thereby. The plug body consists of a circular key-receiving face 15 having openings to receive parts of a key 16 as described below, and a part-cylindrical hollowed out shank 17. The plug body is mounted so as to permit rotation about its axis within the cylinder 10, but so as to prevent its axial displacement. Axially located within the shank 17 by a crosspin 18 is a plate member 19 having a downward abutment 20 at its rear end, an upstanding spigot 21 towards its front end, and a number of axially extending parallel grooves 22. An opening 23 extending across the plate member exposes the grooves at one position. Slidably arranged within the longitudinal grooves 22 are a number of slotted pins 24 which constitute tumbler elements. In the present example there are four such grooves and four pins. The grooves 22 are of rectangular cross section and the pins are correspondingly shaped. Each pin has an end 25 against which a spring 26 bears to bias the pin towards the front end of the groove 22, a body portion having at its upper edge a deep slot 27 and a series of equally spaced shallow slots or notches 28, and an end 29 which is engaged by the key 16. The springs 26 also bear against the downward abutment 20. The position of the slot 27 is a characteristic of the pin and in general the slots of the four pins are at different predetermined positions. Also mounted on the plug body is a rocker element 30.

The rocker element 30 takes the form of a lever pivotally mounted on a pivot pin 31 extending horizontally between sidewalls of the shank 17. One end of the rocker element has a downwardly turned abutment 32 which is adapted to enter the slots 27, or the notches 28, depending upon the longitudinal positions of the pins 24, when the rocker element is pivoted about the pivot pin 31. The abutment 32 is preferably bevelled at its end to provide an inclined face which rides easily over the shallow notches. A wedge-shaped cam surface 33 is provided on the upper side of the rocker element, and the surface is adapted to be engaged by a correspondingly shaped cam member 34. The member 34 is radially offset from the axis of rotation of the plug assembly, and is pivotally mounted on the spigot 21, the latter providing a pivotal axis which is transverse to said rotational axis. The cam member is normally biased to a nonengaging position by a small coil spring 35. The other end of the rocker element is formed with a lock-actuating abutment 36 which is adapted to engage a rotatable lock-actuating member 37 of the locking mechanism when the plug is rotated, provided that the rocker element is first moved to an operative position.

The rocker element 30 is normally biased to its inoperative position, shown in FIG. 2, by a leaf spring 38 mounted at the rear end of the shank 17. The rocker element can be displaced to the operative position to actuate the lock, however, when the tumbler slots 27 are properly aligned, by movement of the cam member 34 across the cam surface 33 so as to depress the abutment 32 into the aligned slots. The plug assembly can then be rotated so as to rotate the lock-actuating member 37, which is coupled to a lock bolt or the like, 39.

The plug assembly (indicated at 40 in FIG. 1) is rotatably mounted within the cylinder assembly (indicated at 41 in FIG. 1) and is located axially therein by means of a U-clip 42 whose arms engage an annular slot 43 of the plug shank 17 through side slots 44 in the cylinder. Rotation of the plug assembly is restricted, however, by means of a ball catch member 45 which registers with a channel 46 in the plug shank 17. This ball is held captive in a hole 47 of the cylinder by means of a spring 48, which biases the ball into firm running engagement with the channel 46. The latter, however, includes a pair of diametrically opposed walls or barriers 49, which act as stops to prevent further rotation of the plug within the cylinder until sufficient torque is applied to the plug to enable the ball 45 to pass over the wall 49, the radial bias exerted by spring 48 being overcome.

Referring now to FIG. 3, also, the key 16 comprises an actuating member 50, a plug-engaging member 51, and means 52, 53 for connecting these members together for relative rota-

tion about a common axis. The actuating member 50 consists of cylindrical plug 54 having a front face from which a handle member 55 projects, and a rear face 56 with a threaded central hole 57 and an axially projecting abutment 58 at the edge of the rear face. The plug-engaging member 51 consists of a cylindrical plug 59 having a bore 60 on its axis, an arcuate recess 61 on one face 62 in which a coil spring 63 is located, and four tumbler engaging PROJECTIONS 64 on its other face. The cylindrical plugs are formed with respective annular flanges 54a and 59a, between which a sleeve 52 is located, and are secured together by a bolt 53 threaded at one end 65 to engage the hole 57.

The operation of the lock mechanism will now be described. Initially, prior to insertion of the key 16, the tumbler pins 24 are biased by springs 26 to their normal configuration in which the slots 27 are misaligned. Thus the rocker element is prevented from moving from its normal position and so the abutment 36 cannot engage the lock-actuating member 37. Moreover, the rocker element is spring-biased to its normal position by the leaf spring 38, thus ensuring that the abutment 32 of the rocker element remains disengaged from the tumbler pins 24. The Cam member 34 is biased by coil spring 35 away from the cam surface 33 of the rocker element.

When the key is inserted into the lock, the tumbler pins 24 are removed to their operative configuration in which the slots 27 are aligned in a direction transverse to the plug axis, the abutment 32 being positioned directly above the aligned slots. The key has not been rotated. This condition is illustrated in FIG. 2, and in FIGS. 4a, 4b and 4c.

As the key 16 is turned, the plug assembly is rotated until the ball 45 meets the wall 49, the coil spring 63 of the key 16 being compressed since the plugs 54 and 59 of the key can rotate relatively to one another. This condition is illustrated in FIGS. 5a, 5b and 5c. A restraint is now placed on the further rotation of the plug assembly, but as the key is turned the compression of the coil spring 63 becomes great enough to overcome the radial bias exerted by the spring 48 on the ball 45, whereupon the latter moves radially outwardly and passes over the wall 49; the restraint having been removed, the coil spring 63 expands to rotate the plug assembly rapidly, the spring applying a torque which accelerates the plug assembly. As the plug assembly is accelerated, the cam member 34 swings about the axis of the spigot 21 due to its own inertia and in so swinging it engages the cam surface 33 to depress the latter. This condition is illustrated in FIGS. 6a, 6b and 6c. It will be seen that the rocker element is thus displaced to a position in which the abutment 32 engages in the aligned slots 27, and in which the abutment 36 is able to engage the lock-actuating member 37. Further rotation of the plug assembly brings the abutment 36 into engagement with the member 37, as illustrated in FIG. 7, and the lock can then be operated.

It will be noted that the edges of the abutment 36 and the edges of the cooperating projections 66 of the lock-actuating member 37 are of an interfitting dovetail formation, which prevents accidental disengagement of the two parts before completion of the lock turning operation.

The embodiments of the invention in which I claim an exclusive property or privilege are defined as follows:

1. In a tumbler lock including a plug which is freely rotatable about an axis. The plug carrying a set of tumbler elements which are displaceable to an operative configuration by a key and a lock-actuating clutch which is permitted to move to an operative lock-engaging position in accordance with the displacement of the tumbler elements:

- i. spring means biasing the clutch to an inoperative position;
- ii. inertial means carried by the plug, said inertial means being responsive to rotational acceleration of the plug to engage the clutch for moving the clutch towards its operative position against the bias of said spring means.

2. In 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 lock-actuating member;
 means mounted on the plug body and rotatable therewith for actuating 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, 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;
 means biasing the tumbler elements towards their first configuration, the tumbler elements being mounted for individual movement to the 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 removed their second configuration, the improvement comprising
 i. means biasing the rocker element to its first position;
 ii. inertial means carried by the plug, said inertial means being radially offset from said axis of rotation and engageable with the rocker element;
 iii. said inertial means being responsive to rotational acceleration of the plug to engage the rocker element for displacing the rocker element towards its second position against the action of said biasing means.

3. A lock mechanism as claimed in claim 2, wherein said inertial means comprises a cam member which is pivoted about an axis extending transversely to said rotational axis, said member having a cam surface which is engageable with a cooperating surface of the rocker element for effecting said displacement of the rocker element.

4. In 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 lock-actuating member;
 a series of slotted tumbler pins carried by 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;
 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, the improvement comprising
 i. spring means biasing the rocker element to its first position;
 ii. inertial means carried by the plug, said inertial means being radially offset from said axis of rotation and engageable with the rocker element;
 iii. said inertial means being responsive to rotational acceleration of the plug to engage the rocker element for displacing the rocker element towards its second position against the action of said biasing means.

5. A lock mechanism as claimed in claim 4, and including
 i. a first catch member on said mounting member;
 ii. a second catch member on said plug;
 iii. said catch members being positioned to engage one another for preventing rotation of the plug; and
 iv. spring means biasing the catch members into releasable engagement.

6. In combination with a lock mechanism according to claim 5, a key comprising:
 i. an actuating member;
 ii. a plug-engaging member;
 iii. means connecting the actuating and plug-engaging members for relative rotation about a common axis;
 iv. tumbler-engaging means carried by the plug-engaging member; and
 v. a spring intercoupling the actuating and plug-engaging members for exerting a torque on the plug-engaging member to overcome the bias of said spring means.

7. A tumbler lock mechanism comprising
 i. a mounting member,
 ii. a first rotary member,
 iii. a second rotary member,
 iv. spring means interconnecting the first and second rotary members to cause the first member to follow movement of the second member with a degree of lost motion,
 v. a set of tumbler elements which are individually displaceable to a predetermined operative configuration,
 vi. a lock-actuating clutch which is permitted to move to an operative lock-engaging position in accordance with the displacement of the tumbler elements to said operative configuration,
 vii. spring means biasing the clutch to an inoperative position,
 viii. a spring-loaded releasable catch carried by the mounting member and engaging the second rotary member to resist rotation thereof, and
 ix. inertial means responsive to rotational acceleration of said second rotary member for moving the clutch towards its operative position against the bias of said spring means.