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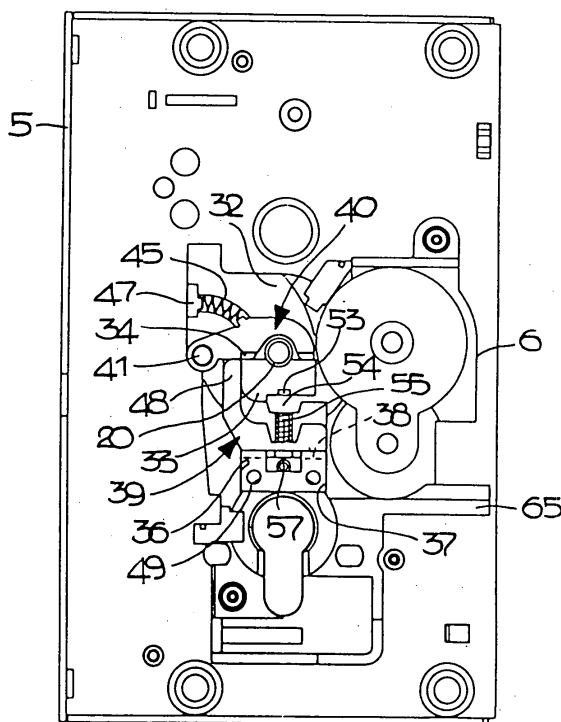
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(54) **Lock with deadbolt actuatable by an electric motor by way of a reduction gearset or a cylinder**

(57) A lock provided with a deadbolt (8) that can be actuated electrically by an electric motor (10) through a reduction gearset (12-16) and manually by a cylinder (82), the gearset comprising a gear (16) that is provided with elements (26, 27) for driving the deadbolt by successive turns of the lock and is adapted to actuate an

element for blocking the deadbolt (75), at right angles to the direction of the sliding of the deadbolt, characterized in that the driving elements (26, 27) are actuated between a position in which they drive the deadbolt and a position in which they do not drive it by actuation means (39, 40) controlled by the cylinder (82).



**FIG 5**

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## Description

**[0001]** The present invention relates to a lock with a deadbolt that can be actuated by an electric motor by way of a reduction gearset or a cylinder.

**[0002]** Locks of the cited type are already known for example from US patents no. 4,833,465 and 5,083,448, from German publications no. 34.07.073 and 36 20 799, and from European patent no. 281,137. In known locks there are drawbacks due to the fact that the movement of the deadbolt has critical points, which cause malfunctions and even jamming if the electrical actuation elements, for any reason, jam in the position in which the deadbolt has not yet completed its stroke. These jamming of the electrical operation do not allow to open the lock with the key but require interventions on the part of specialized personnel.

**[0003]** The technical aim of the present invention is therefore to provide a lock in which these drawbacks are substantially eliminated.

**[0004]** Within the scope of this aim, an object of the present invention is to provide a lock that is structurally strong and constructively reliable, so as to ensure the necessary requirements of mechanical strength in use and against break-in attempts.

**[0005]** This aim and this object are achieved with a lock whose features are defined in the claims.

**[0006]** Further features will become better apparent from the description that follows of a preferred embodiment, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a side view of the lock;

Figure 2 is a view, similar to Figure 1, but with a cutout line to show the detent of the deadbolt;

Figure 3 is a view in which the elements that cover the deadbolt on one side are not shown;

Figure 4 is a view of the elements that lie under the deadbolt;

Figure 5 is a view, similar to Figure 4, in which the electric motor and the elements for transmitting motion to the deadbolt have been removed;

Figure 6 is a perspective view of a mechanical detail that is shown in front view in Figure 5;

Figure 7 is a sectional plane view, taken along the line VII-VII of Figure 4;

Figure 8 is a sectional plane view, taken along the line VIII-VIII of Figure 3;

Figure 9 is a view in which a halted condition of the electrical actuation elements is considered;

Figure 10 is a sectional plane view, taken along the line X-X of Figure 9;

Figure 11 is a view of the lock after a first movement of the deadbolt performed by actuating the cylinder;

Figure 12 is a sectional plane view, taken along the line XII-XII of Figure 11;

Figure 13 is a view of the lock after an additional movement of the deadbolt performed by actuating

the cylinder;

Figure 14 is a sectional plane view, taken along the line XIV-XIV of Figure 13.

**[0007]** With reference to Figures 1 to 8, the lock comprises a casing, generally designated by the reference numeral 1, which is composed of a rectangular back 2 from the upper, lower and front sides of which three walls rise, said walls being designated by the reference numerals 3, 4 and 5 respectively.

**[0008]** On the back 2 there is a lower plate 6 (hereinafter termed base and shown more clearly in Figure 5), which together with an upper complementary plate 7 (hereinafter termed cover and shown by Figure 1), associated therewith by way of screw means, forms an enclosure for a deadbolt, which is generally designated by the reference numeral 8.

**[0009]** The base 6 has a protrusion 9 (Figure 4), to which a reversible electric motor 10 is coupled by means of a flange, said motor resting on the back. A worm gear 11 is keyed to the output shaft of the electric motor 10 and drives a helical gear 12, which can rotate about a pivot 13 that rises from the base 6.

**[0010]** A pinion 14 is coaxially rigidly coupled to the helical gear 12 and, by means of a reduction gearset 15, transmits motion to a gear 16, hereinafter termed driving gear owing to the fact that it has driving elements (specified hereafter) which, under the actuation of the electric motor 10, drive the deadbolt 8 in and out of the casing 1. The gearset 15 also can rotate about a pivot 17 that rises from the casing 1.

**[0011]** The driving gear 16, as shown more clearly in Figure 7, has two pivots, a lower one 18 and an upper one 19, which are coaxial to each other; the first pivot 18 rotatably engages in a bush 20 of the base 6, while the second pivot 19 protrudes from the upper face of the gear 16 and has two diametrically opposite cams 21 and 22 that are spaced from the gear 16 by a groove 23.

**[0012]** In the gear 16, in alignment with the cams 21 and 22, there are two holes 24 and 25, in which two respective driving pins 26 and 27 with hemispherical heads 28 and 29 can slide. Said heads form annular shoulders on which springs 30 and 31 act; said springs are accommodated in enlarged portions of the holes 24 and 25 and actuate the pins 26 and 27 toward the back of the casing.

**[0013]** As shown more clearly by Figure 5, the base 6 has a recess 32 that runs around the upper half of the bush 20 and forms, under said bush, a flattened raised portion 33 that is delimited by a step 34 that is diametrical with respect to the bush 20. The recess 32 also runs around the raised portion 33 and is connected, under said raised portion, to a seat 35, which is delimited by two parallel walls 36 and 37; the bottom of said seat is raised so as to form a step 38 that is parallel to the step 34 (see Figure 8).

**[0014]** A slider 39 (shown in a perspective view in Figure 6) is arranged in the seat 35, is guided between the

walls 36 and 37, and is intended to cooperate with a lever 40, which is pivoted to a pivot 41 that rises from the recess 32 and has the same thickness as the raised portion 33.

**[0015]** The lever 40 (see Figures 5 and 6) comprises a semicircular portion 42, which surrounds the bush 20 and has two bevels 43 and 44 that are aligned so as to abut against the step 34 of the raised portion 33. The lever 40, by way of a spring 45 whose opposite ends are rigidly coupled to a tooth 46 of said lever and to a protrusion 47 of the base 6, is actuated against the step 34 so that in the abutment position its upper face and the face of the raised portion 33 form a single surface on which the hemispherical heads 28 and 29 of the pins 26 and 27 rest.

**[0016]** The slider 39 is constituted by a plate that is contoured and folded so as to be provided laterally with a finger 48 that lies on the bottom of the recess 32 and is therefore co-planar to the lever 40, with a rectangular lip 49 that is guided between the walls 36 and 37 and lies on the region that is raised with respect to the region on which the finger 48 rests, and with a rib 50 that connects the finger 48 to the lip 49. An opening 51 is formed in the lip 49 and leaves a tooth 52 of the rib 50, which has an end that rises above the upper face of the lip 49 (see Figure 8) and is provided with a bevel 52a.

**[0017]** To the side of the finger 48, in alignment with the tooth 52, there is a rod 53, which is slidingly inserted in a hole of a ridge 54 of the base 6.

**[0018]** A spring 55 is arranged on the rod 53, abuts against the ridge 54 and actuates the slider 39 into a position in which the rib 50 abuts against the step 38.

**[0019]** As shown by Figure 8, a hole 56 is provided in the raised bottom of the seat 35 and proximate to the step 38, and a pin 57 is inserted therein; said pin 57 has a conical tip 58 at one end and, at the other end, an enlarged head 59, on which a spring 60 acts which rests on the back wall 2 of the casing and keeps the head 59 in abutment against an annular shoulder of the hole 56, so that the conical tip 58 of the pin 57 can act on the rim of the opening 51 in order to retain the slider 39 and, at the same time, retract into the hole 56 when the slider 19 is raised toward the lever 40. The deadbolt 8 (see Figure 3) is composed of a substantially rectangular plate 61, which has, on the side of the front wall 5, a rib 62 to which multiple cylindrical pins 63, guided in slots of the wall 5, are rigidly coupled.

**[0020]** The plate 61 covers the gears 12-16 and the slider 39 at the level of the groove 23 of the pivot 19, and is guided on the base 6 between two parallel ridges 64 and 65, which are perpendicular to the front wall 5 in the direction A, and by a pin 66 that slides in a slot 67 of the cover 7. Conveniently, as shown by Figure 8, the thickness of the lip 49 is smaller than the distance between the bottom of the seat 35 and the plate 61 so that the slider oscillates slightly and allows the tooth 52 to move downward under the plate 61.

**[0021]** In the plate 61 (see Figure 3) there are two

openings 68 and 69 that are elongated in the direction A. In the upper rim of the opening 68 there is a rack-like set of teeth, which is constituted by a plurality of suitably shaped teeth 70 that are spaced by gaps 71 for actuating by successive turns the deadbolt 8 by means of the pins 26 and 27 during the rotation of the gear 16.

**[0022]** Each turn of the lock corresponds to a 180° rotation of the gear 16.

**[0023]** A similar rack-like set of teeth, which comprises a series of teeth 72 spaced by gaps 73, is formed in the lower rim of the lower opening 69. A square locking pin 74, suitable to block the deadbolt 8 at the end of each turn of the lock, is meant to engage in the gaps 73.

**[0024]** The square pin 74 is rigidly coupled to a detent 75 (see Figures 1 and 2) that is substantially rectangular and is guided in a seat formed in the face of the cover 7 that is directed toward the plate 61.

**[0025]** The detent 75 is guided in the direction B, which is perpendicular to A, by a pin 76, which can slide in a slot 77 of the cover 7, and by a rod 78, which passes through a bridge 78a from the cover 7 in which it is guided. The pin 76 protrudes from a face of the detent 75, while the square pin 74 is rigidly coupled thereto but protrudes from the opposite face, as shown more clearly by Figure 8. The bridge 78a acts not only as a guide for the rod 78 but also as an abutment for a spring 79, which acts on the detent 75 so as to push the square pin 74 between the teeth 72 in order to retain it in the provided gap that corresponds to the turn of the deadbolt.

**[0026]** The detent 75 is co-planar to the cams 21 and 22, which engage an opening 80 thereof that is substantially semicircular, is elongated in the direction B and is wider than the diametrical extension of the cams 21 and 22.

**[0027]** The opening 80 is delimited in an upward region by an inner rim 81, whose contour is slightly convex; said rim is kept centrally in contact with the pivot 19 by way of the spring 79.

**[0028]** The lock can be actuated not only electrically but also manually by way of a conventional cylinder with pins 82 (shown only in Figure 2), for which there is a receptacle 83 formed through the base 6 and the cover 7 and, of course, through the back 2 and the cover of the casing 1.

**[0029]** The cylinder acts, through its cam 84, in a known manner on the lower end 85 of the detent 75 so as to raise it, in order to disengage the square pin 74 from the blocking position between the teeth 73 during a first rotation angle and then move the deadbolt 8 during a subsequent rotation angle following to the action of the cam 84 on the teeth 86 of a third set of teeth, which are formed along the lower rim of the plate 61.

**[0030]** The operation of the described lock is as follows.

**[0031]** In the opening or closure condition or at the end of each turn of the lock, said lock is in the position shown in Figures 1 to 5, in which the cams 21 and 22 are arranged horizontally, so that the detent 75 keeps

the square pin 74 engaged in a gap 73 of the plate 61, so as to prevent the sliding of the deadbolt 8.

**[0032]** In this situation, by actuating electrically the movement of the deadbolt 8 for opening or closure, the actuation of the electric motor 10, by way of the gear train 12-15, turns the driving gear 16 and therefore the cams 21 and 22 and the pins 26 and 27; since the heads 28 and 29 of said pins rest on the semicircular portion 42 of the lever 40, said pins protrude from the upper face of the gear 16. In this manner, through the cyclic action of the cams 21 and 22, depending on the direction of the rotation imparted to the gear 16, first the detent 75 rises and the square pin 74 is disengaged from the gaps 73, and then the cyclic engagement of the pins 26 and 27 between the teeth 70 drives the deadbolt in or out.

**[0033]** The same occurs if the actuation is performed manually by way of the cylinder 82, as specified above. Since at the end of each turn of the lock the pins 26 and 27 are in the position for disengagement from the teeth 70 and do not block the sliding of the deadbolt, the cam 84 of the cylinder 82 can move said deadbolt as soon as the square pin 74 has been raised from its blocking position between the teeth 86.

**[0034]** It should be noted that with manual action, the cam 84 of the cylinder 82 also acts on the slider 39, which in turn, by means of the finger 48, acts on the lever 40. However, the rotation of the lever 40 has no effect, since the heads of the pins 26 and 27 remain substantially in contact against the raised portion 33 at the step 38.

**[0035]** However, the deadbolt, due to any malfunction of the electric motor, for example due to lack of electric power, might stop in the position in which one of the pins 26 and 27 is still engaged between the teeth 70. In this situation (shown in Figures 9 and 10), although the square pin 74 is disengaged from the teeth 73 through the action of the cams 21 and 22 that keep the detent 75 raised, driving of the deadbolt 8 is still prevented by the worm gear 11, which in the condition in which the electric motor 10 is stopped does not allow the rotation of the gearset 12-16 when one acts on the gear 16. The position of the slider 39 is likewise irrelevant in this step; said slider, by way of the spring 55, abuts with its rib 50 against the step 38 of the seat 35, while the tooth 52, under the thrust of the pin 57 that lies below the lip 49, is kept in contact with the plate 61 in the region between the teeth 72 of the opening 69 and the teeth 86, as shown more clearly in Figures 8 and 10.

**[0036]** If one now acts on the cylinder 82 with the key, the cam 84 of said cylinder, by penetrating between the teeth 86, first moves the slider 39 upward, so that the finger 48, by acting on the lever 40, causes its rotation and the spacing of the bevels 43 and 44 from the step 34 of the raised portion 33. Accordingly, the pin 26 that was located on the semicircular portion 42 of the lever 40, pushed by its own spring 30, can descend until it abuts against the bottom of the recess 32, accordingly disengaging from the teeth 70 of the slot 68 (see Figures

11 and 12) and clearing the groove 23 of the pivot 19 for the passage of the teeth 70.

**[0037]** It should be noted that in the situation considered, the square pin 74 is in the position for disengagement from the teeth 72, and that the tooth 52, under the thrust of the underlying elastic pin 57, rests against the lower face of the plate 61, proximate to the teeth 72.

**[0038]** As the rotation of the cam 84 continues, the tooth 52 of the slider 39 reaches the level of the gaps 73, so that when the cam 84 starts to act on the teeth 86 in order to drive the deadbolt 8, the tooth 52 engages at each turn of the lock in the gaps 73, blocking the deadbolt 8 (see Figures 13 and 14).

**[0039]** In practice, therefore, the tooth 52 compensates for the blocking function of the square pin 74, which is rendered ineffective by the cams 21 and 22, which since the gear 16 is blocked continue to keep the detent 75 raised in the raised position in which the square pin 74 is disengaged from the teeth 72.

**[0040]** It should be noted that at each turn performed by the cylinder, under the thrust applied by the spring 45, the lever 40, by way of the bevels 43 and 44, arranges itself in abutment against the step 34, so that when the electric motor 10 restarts the pins 26 and 27 and the detent 75 can resume their function of driving and blocking the deadbolt. In particular, the square pin 74, by resuming the position for blocking the deadbolt in the gap 73 already partially occupied by the tooth 52, acts on the bevel 52a, pushing the tooth 52 under the plate 61 and producing the abutment of the slider 39 against the step 38 through the thrust applied by the spring 55.

**[0041]** The described lock is susceptible of numerous modifications and variations, all of which are within the scope of the same inventive concept.

**[0042]** In the practical execution of the invention, a recess 87 is formed in the cover 7 at the slot in order to flush-mount a plate 88 made of hard metal, which is suitable to provide protection against attempts at break-ins of the square pin 74. The plate 88 has a slot that faces the slot 77 of the cover 7 in order to allow the sliding of the pin 76 of the detent 75.

**[0043]** The disclosures in Italian Patent Application no. BO2002A000130, from which this application claims priority, are incorporated herein by reference.

**[0044]** Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

## Claims

1. A lock provided with a deadbolt (8) that can be actuated electrically by an electric motor (10) by way of a reduction gearset (12-16) and manually by a

cylinder (82), said gearset comprising a gear (16) that is provided with elements (26, 27) for driving said deadbolt by successive turns of the lock and is adapted to actuate an element for blocking said deadbolt (75), at right angles to the direction of the sliding of said deadbolt, **characterized in that** said driving elements (26, 27) are actuated between a position in which they drive said deadbolt and a position in which they do not drive it by actuation means (39, 40) controlled by said cylinder (82).

2. A lock with a deadbolt (8) that can be actuated electrically by an electric motor (10) by way of a reduction gearset (12-16) and manually by a cylinder (82), said gearset comprising a gear (16) that is provided with elements (26, 27) for driving said deadbolt, said deadbolt comprising a plate (61) in which there is a first set of teeth (70) that can be engaged by successive turns of the lock by said driving elements, a second set of teeth (72) that can be engaged by a square pin (74) for stopping said deadbolt, which is rigidly coupled to a detent (75) that is actuated by cam means (21, 22) that are rigidly coupled to said driving gear (16) at right angles to the sliding direction of said deadbolt, and a third set of teeth (86) that can be engaged by successive turns of the lock by the cam (84) of said cylinder (82), **characterized in that** said driving elements are constituted by pins (26, 27) that are guided transversely to said gear (16) and are actuated from a driving position for driving said deadbolt and a non-driving position, by actuation means (39, 40) controlled by said cylinder.
3. The lock according to claim 1, **characterized in that** said driving elements are constituted by two pins (26, 27) that can slide in holes (24, 25) that pass through said gear (16) in diametrically opposite positions and can be actuated, in contrast with elastic return means (30, 31), from a position for not driving the deadbolt to a position for driving said deadbolt, by way of a lever (40) that is actuated by said actuation means (39) in contrast with elastic return means (45).
4. The lock according to claim 2, **characterized in that** said lever (40) comprises a portion (42) that runs around the rotation axis (19) of said driving gear (16) and abuts against a step (34) that is diametrical with respect to said axis formed by a raised portion (33), said lever in abutment position on said step forming, with said raised portion, a surface that runs around said axis for the resting of said pins (26, 27) so as to retain them in the driving position.
5. The lock according to claim 3, **characterized in that** said actuation means are constituted by a slider (39) that is guided at right angles to the direction

(A) of the sliding of said deadbolt and can be actuated by said cylinder (82) in contrast with elastic return means (55), said slider being shaped so as to act on said lever (40) in order to disengage it from said step (34) and allow one of said pins (26, 27) to disengage from said first set of teeth (70).

6. The lock according to claim 5, **characterized in that** said slider is constituted by a plate that comprises a lip (49) on which said cylinder (82) is adapted to act, a finger (48) that is adapted to act on said lever (40), and an abutment (50) for stopping said plate in a position in which said finger is disengaged from said lever.
7. The lock according to claim 6, **characterized in that** said plate oscillates and has a tooth (52) that is adapted to engage between the teeth (72) of said third set of teeth, a pin (57) being provided which is actuated by elastic means (60) against said lip (49) so as to move said tooth into the position for blocking the deadbolt when said lever is in the position for disengagement from said driving pins (26, 27).

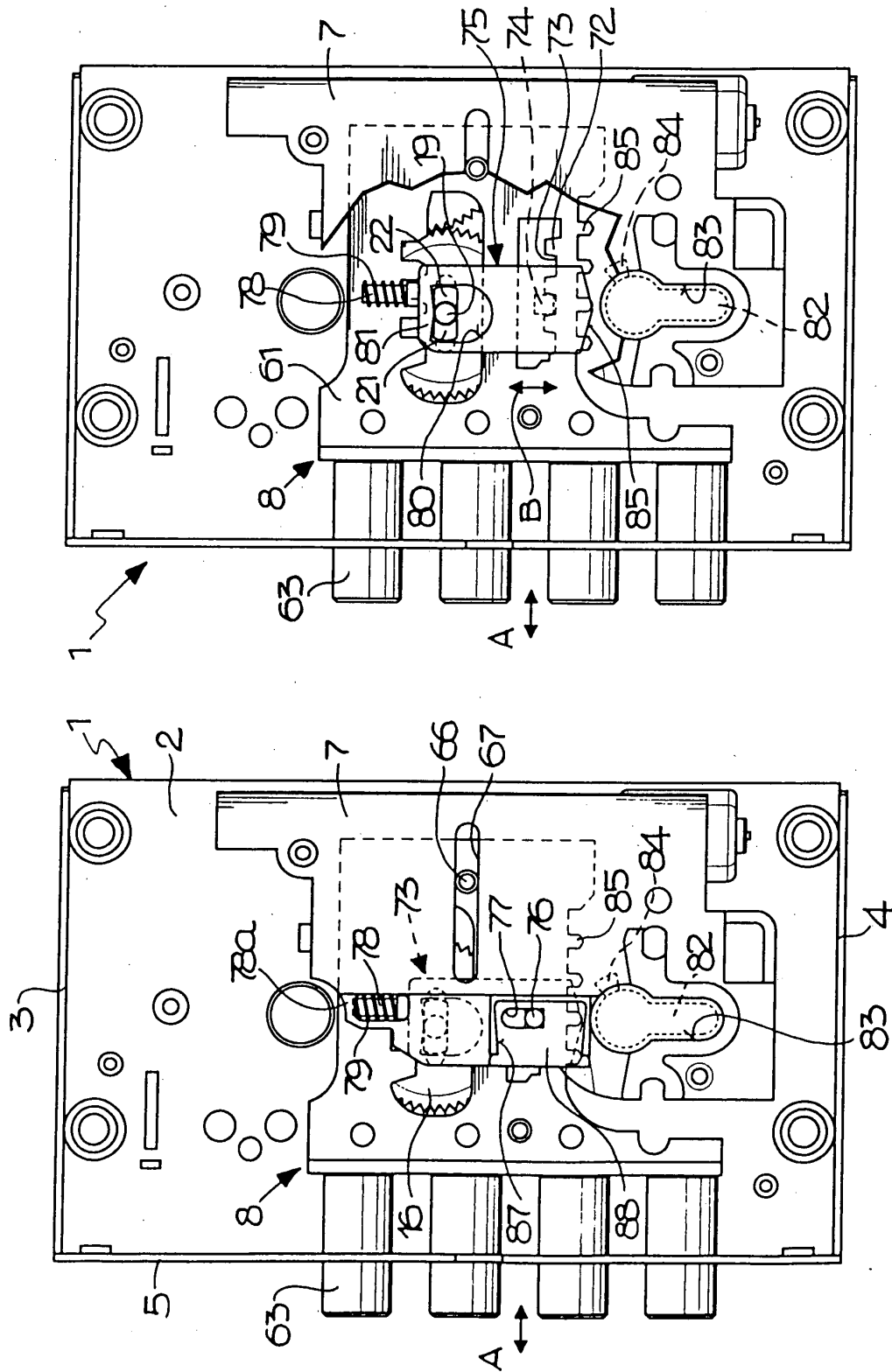
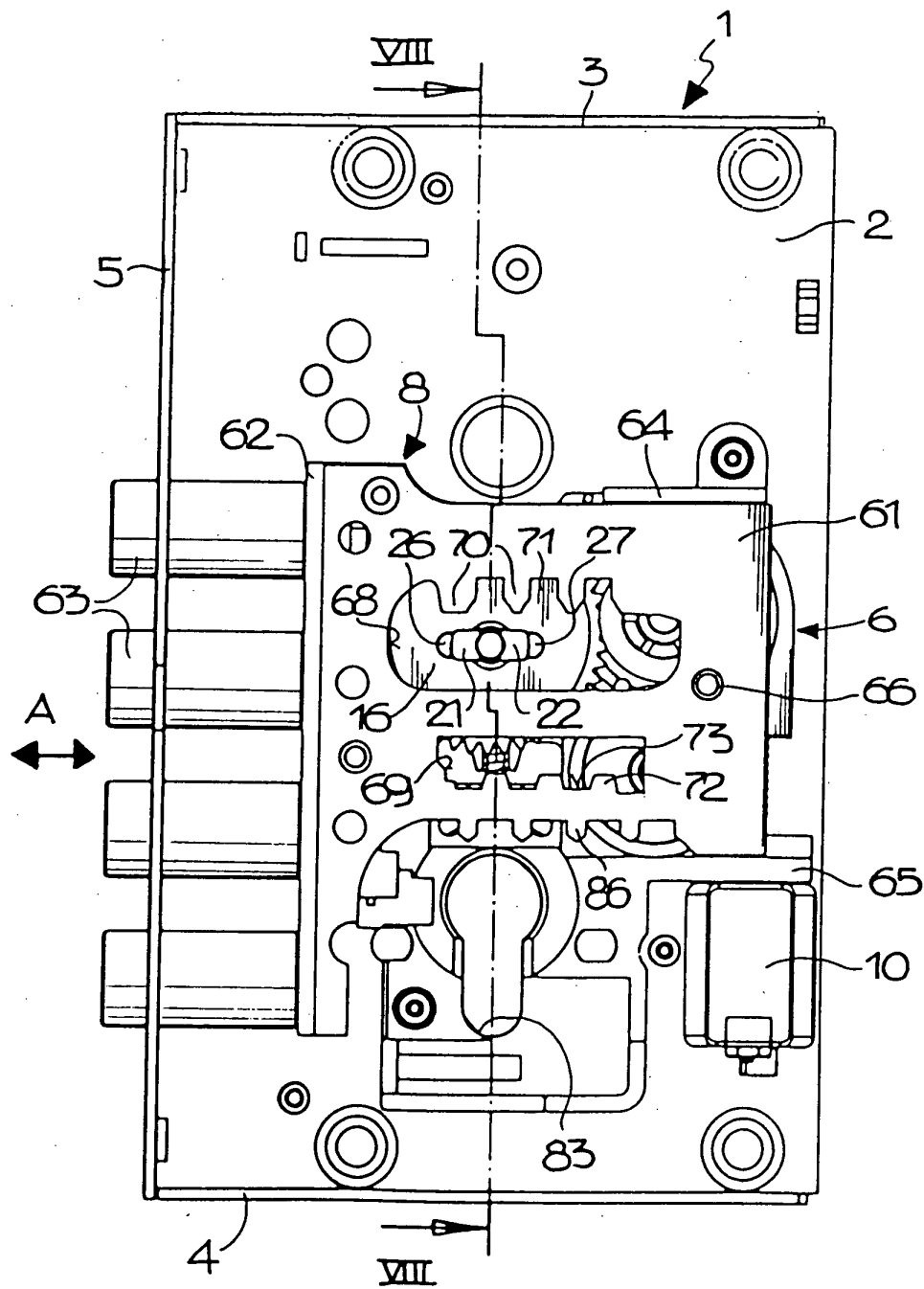


FIG 2

FIG 1



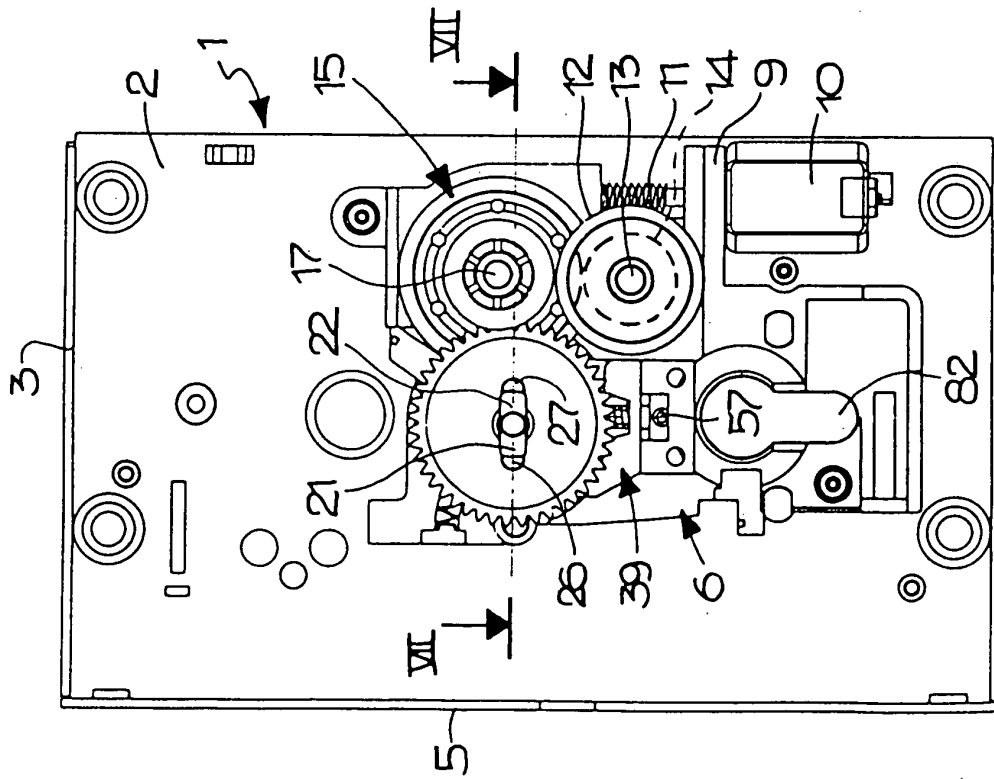


FIG 4

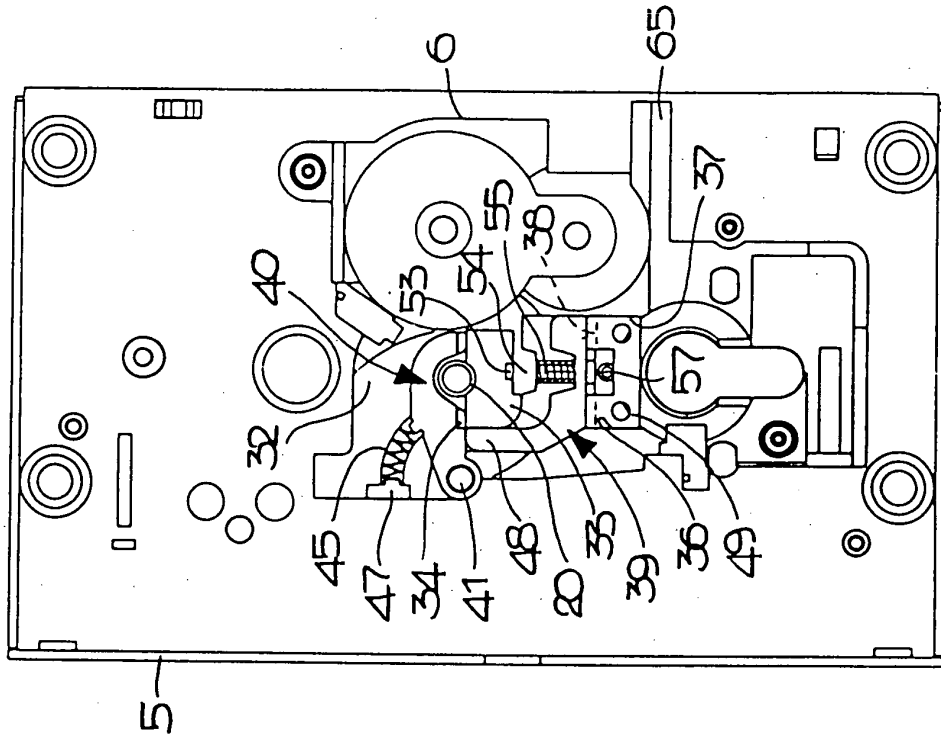


FIG 5



FIG 6

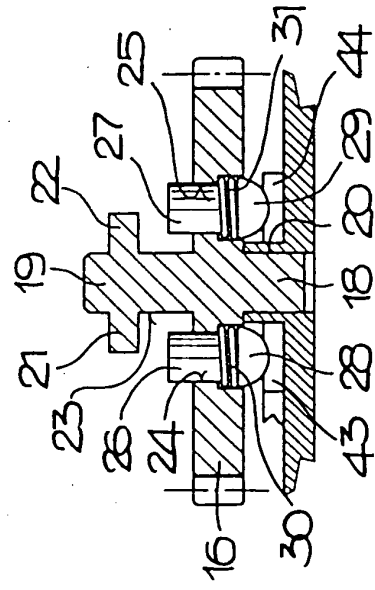
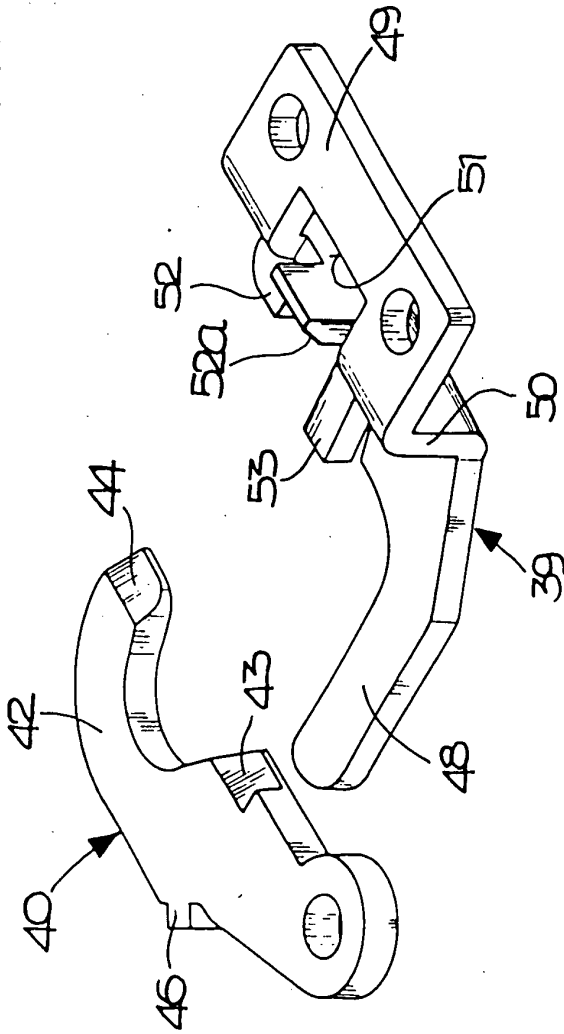
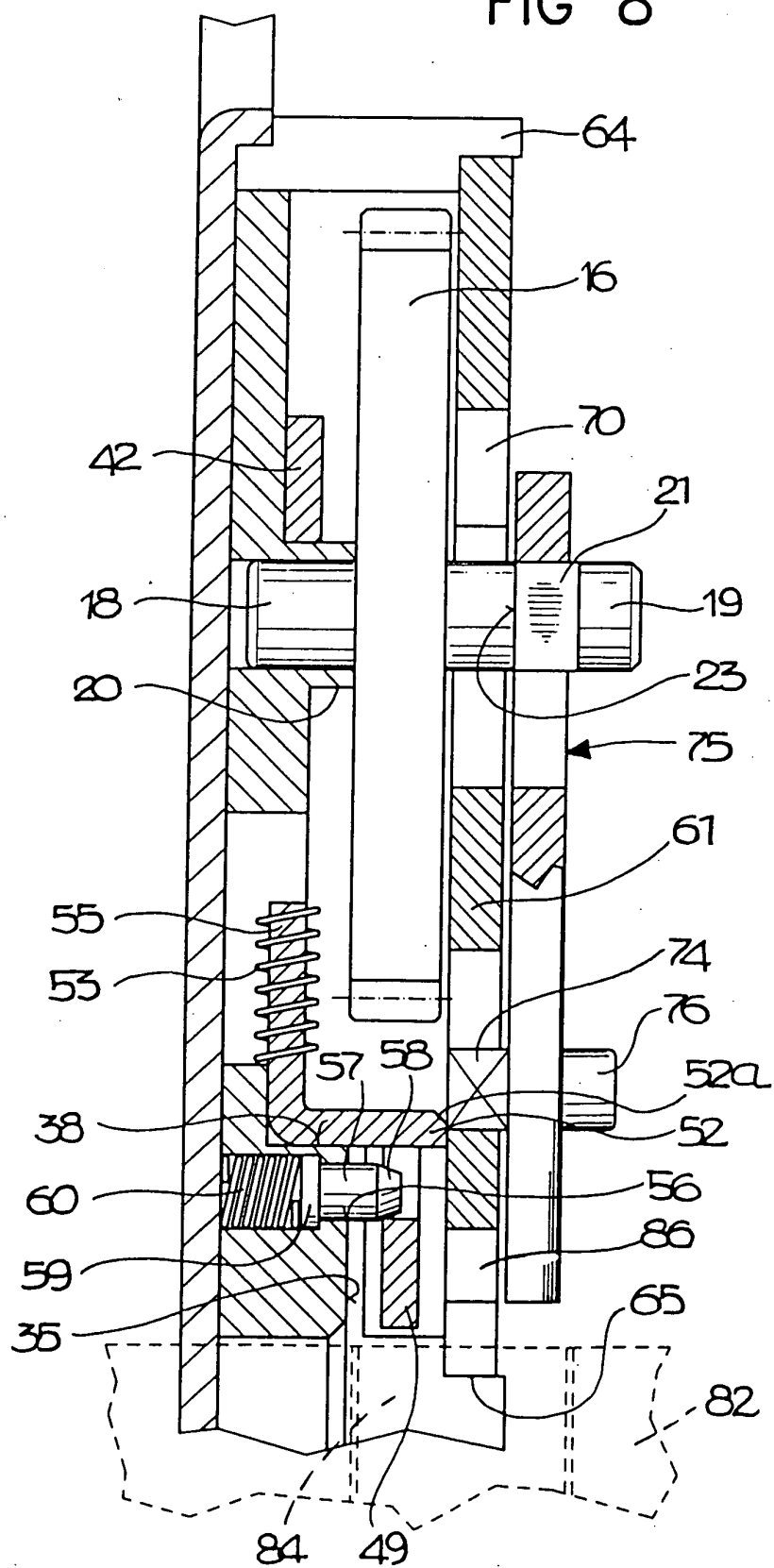


FIG 7

FIG 8



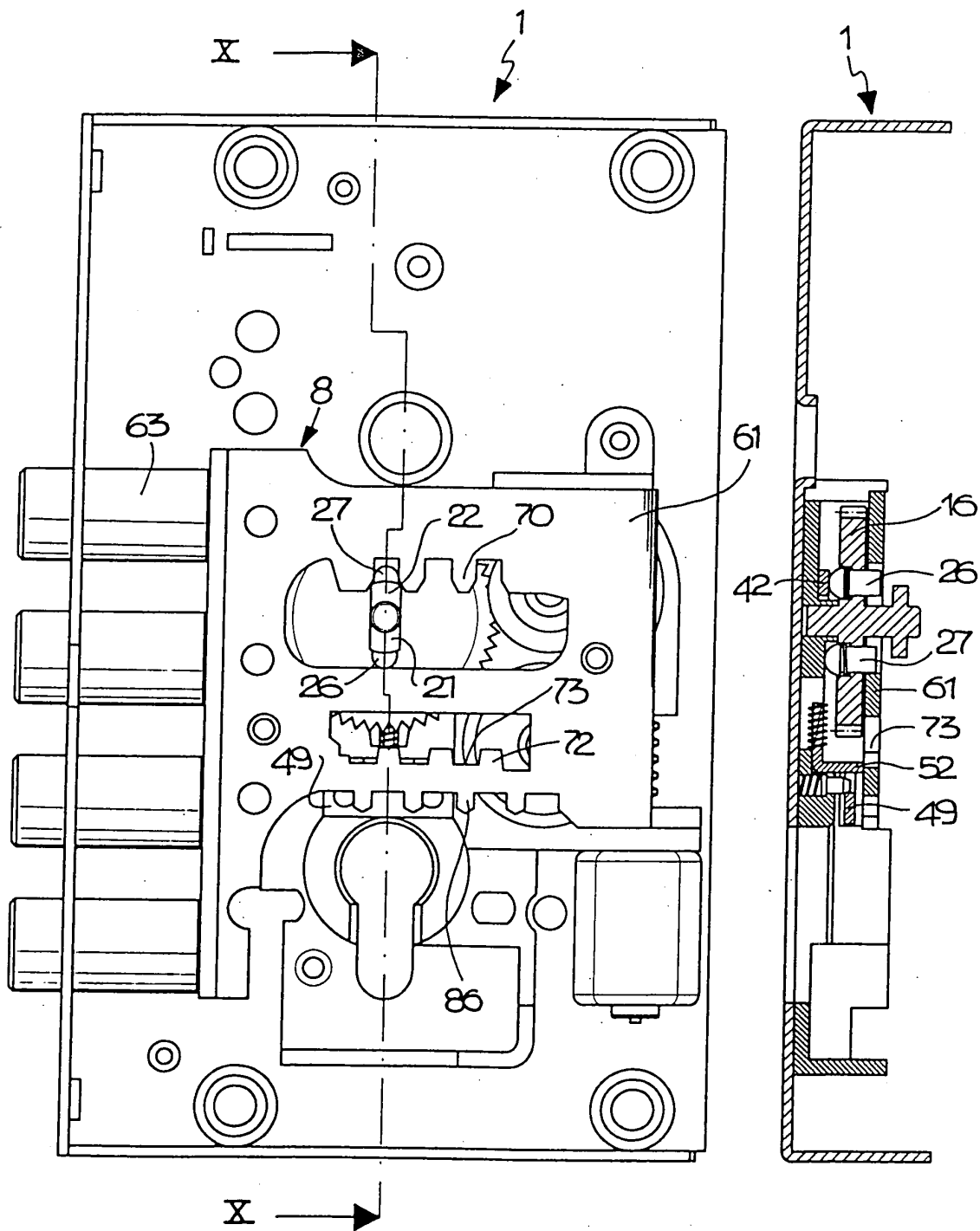


FIG 9

FIG 10

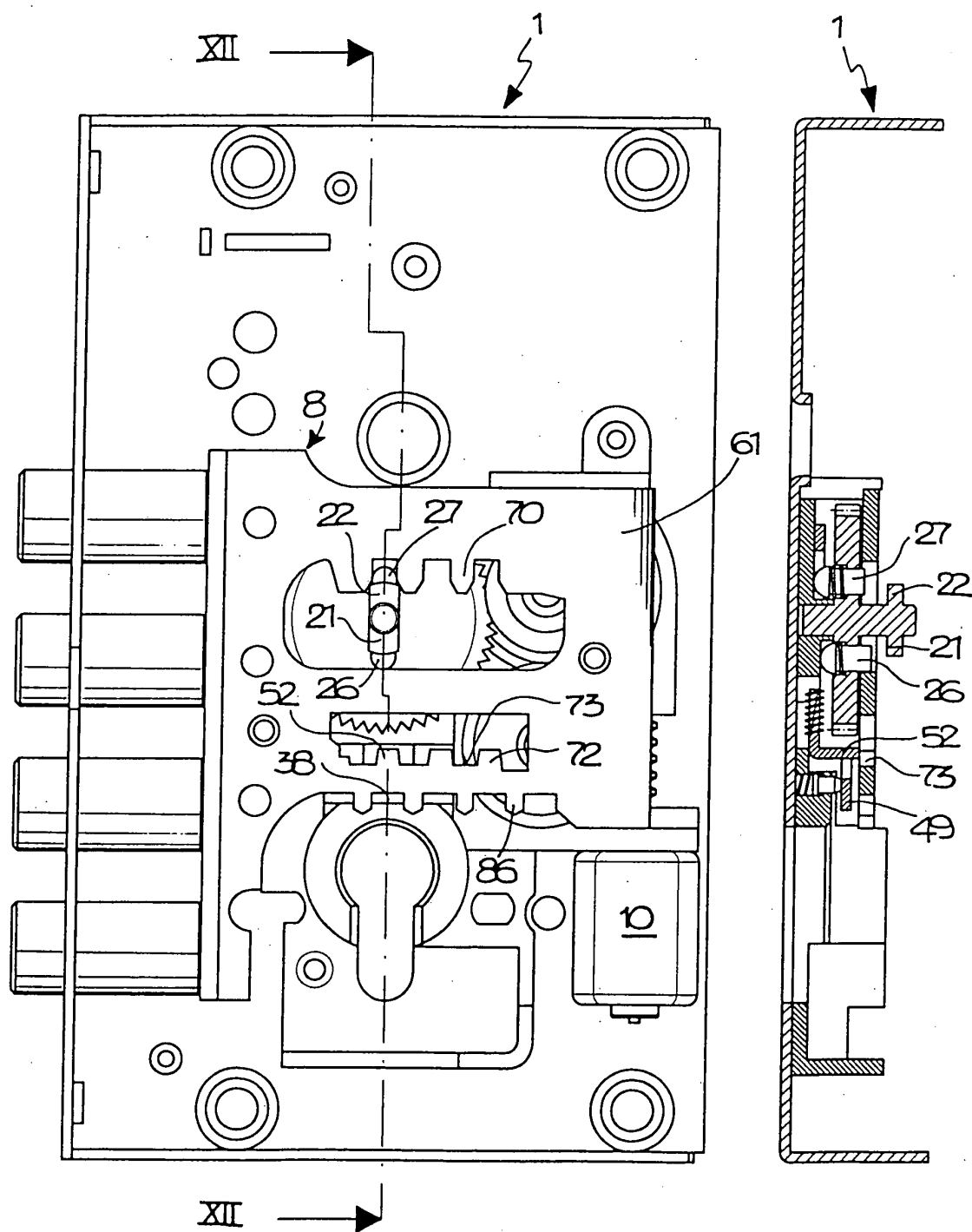


FIG 11

FIG 12

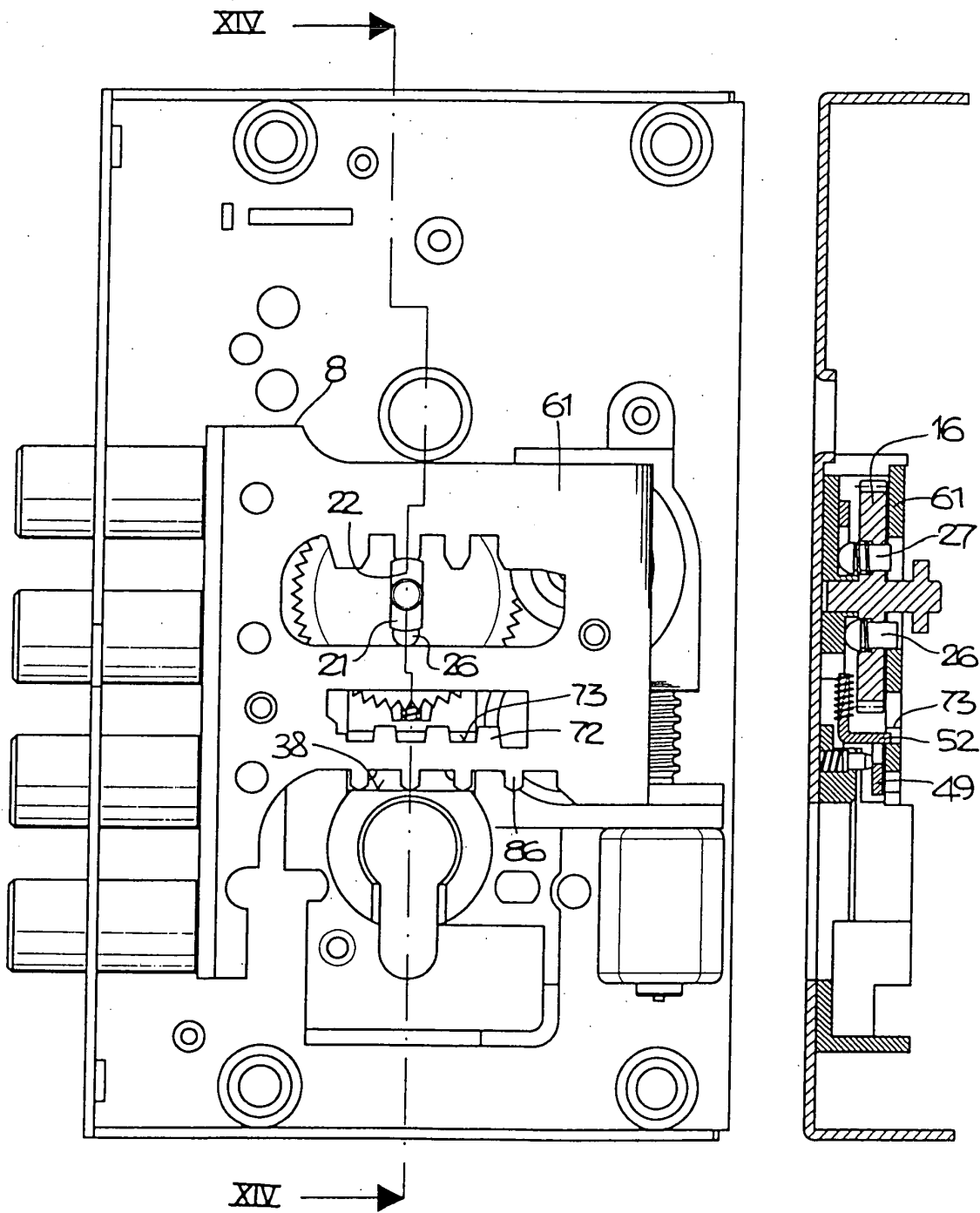


FIG 13

FIG 14