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(71) Applicant: Costruzioni Italiane Serrature
Affini C.I.S.A. S.p.A.
I-48018 Faenza (Province of Ravenna) (IT)

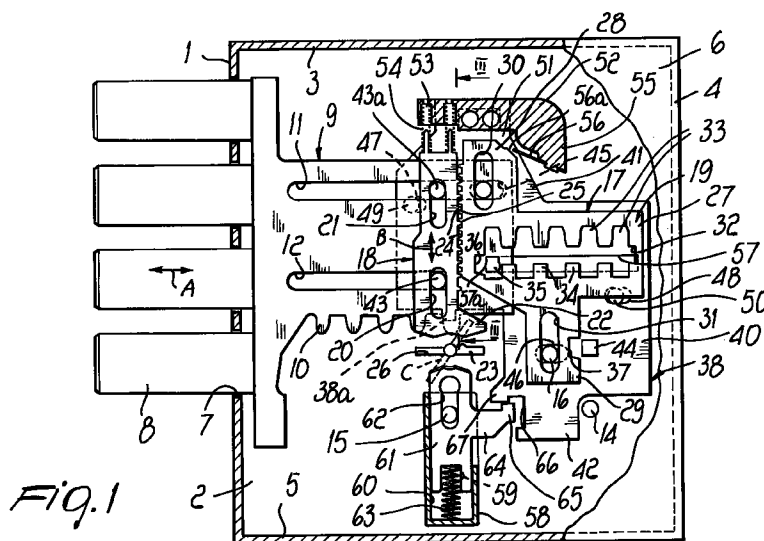
(72) Inventor: Errani, Deo
48018 Faenza, Ravenna (IT)

(74) Representative: Modiano, Guido, Dr.-Ing. et al
Modiano & Associati S.r.l.
Via Meravigli, 16
20123 Milano (IT)

(54) Improved lock with flat tumblers and changeable combination

(57) The lock comprises tumblers (17), each composed of two parts (18,19) that are provided with mutually opposite sets of teeth (24,25) that can be coupled to each other frontally. By means of a change key (C,C1),

the sets of teeth (24,25) are arranged according to a new combination that matches the combination of the new actuation key.



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Description

The present invention relates to an improved lock with flat tumblers and changeable combination, of the type disclosed in EPA 94118920.1 filed December 1, 1994 in the name of the same Applicant.

Although this known type of lock with flat tumblers and changeable combination has proved to be satisfactory from many points of view, it has nevertheless been found to be susceptible to improvement. In particular, the need was felt to make such a lock constructively simpler. There was also a need to provide a lock with flat tumblers and changeable combination that could be manufactured in a more economically advantageous manner. It was also desired to even further improve the reliability of the lock in operation and during combination-changing operations.

Accordingly, a principal aim of the present invention is to provide an improved lock with flat tumblers and changeable combination, so as to make it constructively simpler and therefore cheaper and more reliable in operation and in combination-changing operations.

With this aim in view, the invention provides an improved lock with flat tumblers and changeable combination, as defined in the appended claims.

Further characteristics and advantages of the invention will become apparent from the following detailed description of an embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a view of the improved lock at the beginning of the combination-changing operations;
figure 2 is a view of the same lock during combination changing;
figure 3 is a sectional view, taken along the plane III-III of figure 1.

With reference to the above figures, the reference numeral 1 designates the faceplate of the case of the lock; said case furthermore comprises the bottom 2, which is surrounded by a peripheral wall composed of the walls 3, 4, and 5, which are referenced respectively as upper, rear, and lower walls for the sake of convenience in description. The reference numeral 6 designates the cover of the case.

A plurality of openings 7 are formed in the faceplate 1, and the pins 8 that form the bolt of the lock protrude outside through said openings, said pins being slideable in the direction A. A tang 9 protrudes from the pins 8 inside the case and is constituted by a flat bar which, along the lower edge, has a plurality of teeth 10 that form a rack on which the key for moving the bolt acts. Two slots 11 and 12 are formed in the tang 9 and are elongated in the direction A; a threaded bush 13 engages the first slot and rises from the bottom 2 of the case, to which it is fixed. The bush 13 allows to guide the bolt during its sliding, and together with other bushes 14, 15, and 16 it acts as an engagement means

for the screws which fix the cover 6 so as to close the case of the lock. An equal number of flat tumblers is arranged on either side of the tang 9; one of said tumblers, generally designated by the reference numeral 17, is shown in the drawings.

For the sake of illustration, it is assumed that the total number of tumblers is six, divided into two sets of three adjacent tumblers, in which one set is on one side and the other set is on the opposite side of the tang 9. Each tumbler 17 is composed of a substantially rectangular part 18 and of a composite-shaped part 19. The part 18 is hereinafter referred to as the "changing strip", in view of its combination-changing function as specified hereinafter, whereas the part 19 will be referred to as the "blocking lamina", in view of its ability to block the sliding of the bolt 8. The strip 18 is provided with two slots 20 and 21 that are elongated in the direction B, at right angles to the direction A, and with a lower end 22 that is shaped so that it can be engaged by the profile of a conventional key 23 inserted through an opening 26 of the bottom 4 or of the cover 6 of the case. The key 23 has a double web and lifts the strip in the direction B at every half-turn. One edge of the strip 18 is straight and parallel to the slots 20 and 21 and has a set of teeth 24 adapted to mesh with a set of teeth 25 formed on a contiguous edge of the lamina 19. The lamina 19 comprises a rectangular central portion 27 lying along the direction A; two rectangular wings 28 and 29 extend upwards and downwards therefrom, and slots 30 and 31, elongated in a direction that is parallel to the slots 20 and 21, are formed in said wings.

The slots 30 and 31 are engaged by the bushes 13 and 16, so that the laminae 19 can move only in the direction B.

An opening 32 is formed in the central portion 27 of each lamina and is elongated in the direction A; a set of teeth 33 protrudes from the upper longitudinal edge of said opening and, together with a second set of opposite teeth 34 that protrude from the lower edge of the opening 32, determines the combination of the lock.

The teeth 33 form tooth spaces having a square shape and such as to allow the engagement, between them, of a pin 35 having a square cross-section and protruding from both sides of the tang 9 to which it is rigidly coupled. The teeth 33 of each tumbler have alternately identical heights, but said height is different from that of the teeth of the adjacent tumbler. Furthermore, the opposite ends of the upper teeth 33 and of the lower teeth 34 delimit a passage that allows the pin 35 to pass between the opposite teeth when the tumblers are actuated by the key 23.

The lamina 19 is completed by two notches 37 and 36 formed respectively in the rear edge of the wing 29 that is directed towards the wall 4 and at the end of the opening 32, towards which the pin 35 moves when the bolt 8 is pushed out of the lock. The tumblers 17 (three on one side of the tang 9 and three on the other side thereof) are arranged between a lower plate 38 and an upper plate 39; the lower plate 38 is adjacent to the bot-

tom 2 of the case. Since the plates 38 and 39 are substantially identical, their details are described hereinafter with reference only to the lower plate 38 which, as shown by figures 1 and 2, substantially duplicates the profile of the tumblers 17.

The plates 38 and 39 in fact each comprise a central portion 40 from which an expansion 41 protrudes upwards and an expansion 42 protrudes downwards.

The plates 38 and 39 are fixed to each other (at a distance corresponding to the thickness of the tumblers 17 and of the tang 9) by means of screws that engage spacer bushes 43 and 43a that are guided through the slots 20 and 21 of the strips 18 of the tumblers. The mutual fixing of the plates 38 and 39 also locks a square pin 44 that is arranged between the expansions 41 adjacent to the wings 29 of the blocking laminae 19 in front of the notch 37.

The plates 38 and 39 can perform small horizontal movements in the direction A during lock combination changing. For this purpose, in the portion 40, in the expansions 41 and 42 of the plates 38 and 39, and at the opposite ends of the central portion 40, slots 45, 46 and 47, 48 are provided which are elongated in the direction A and are adapted to be engaged respectively by the bushes 13 and 16 used for the vertical guiding of the laminae 19 and by the pins 49 and 50 that protrude inwards from the bottom 2 and from the cover 6. The pins 49 and 50 are not higher than the thickness of the plates 38 and 39, so as to avoid interfering with the strips 18 and the laminae 19 of the tumblers. A tab 51 protrudes from each one of the expansions 41 towards the upper wall 3 and extends above the strips 18. A bridge 52 is fixed between the tabs 51, and recesses 53 are formed therein to accommodate respective springs 54 for pushing on the strips 18. The bridge 52 furthermore has a coupling step 55 for the elastic tabs 56, which are adapted to act on the tops of the wings 28 of the blocking laminae 19. Each tab 56 acts on a respective lamina, making contact with a chamfered region 56 of the wings 28.

The springs 54, by acting so that one affects each corresponding strip 18, are capable of pushing downwards the tumblers 17 to move and keep the pin 35 at each turn (i.e., at each half-rotation of the key) in the engagement position between the upper teeth 33 and thus block the movement of the bolt 8.

Respective longitudinal notches 57 are formed in the lower plate 38 and in the upper plate 39, at the pin 35. The notches allow the sliding of the pin 35, and have a length that corresponds to the length of the openings 32 of the tumblers. When the bolt 8 is fully extracted from the box-like body, as shown in figure 1, the pin 35 is in abutment against the end 57a of the notches 57.

A tooth 38a is formed in the plate 38, at the lower edge of the central portion 40 that lies below the expansion 41 and above the keyhole 26; a key can act on said tooth 38a during combination-setting operations, as will become apparent hereinafter.

The described lock is completed by a block 58 located below the keyhole 26 for the key 23 and fixed by the bush 15, which passes therethrough, and by a stud 59 which protrudes from the bottom 2 of the case. The block 58 is locked in position by the cover 6 that closes the case.

A flat channel 60 is formed in the block 58, and its axis intersects the rotation axis of the key; the bush 15 passes through said channel. A slider 61 is guided in the channel 60 and is constituted by a plate that has a slot 62 at the bush 25. A spring 63 is accommodated in a wider recess of the channel 60 and keeps the slider 61 in abutment against the bush 15 in a position in which its top protrudes out of the channel 60 up to the region where the key 23 acts.

A tab 64 protrudes from the slider 61 and forms, at the top, a tooth 65 that is directed upwards. The tab 64 is folded so that the tooth 65 is co-planar with respect to the lower plate 38, so as to engage a hollow 66 of the expansion 42.

The hollow 66 is shaped so as to form a lug 67 that protrudes downwards to cooperate with the tooth 65.

The operation of the described lock is as follows, bearing in mind that:

- a) the laminae 19 can move only in the direction B with respect to the box-like body by virtue of the bushes 13 and 16;
- b) the plates 38 and 39 can move only in the direction A with respect to the box-like body due to the bushes 13, 16 and of the pins 49, 50;
- c) the strips 18 can move only in the direction B with respect to the plates 38 and 39 by virtue of the bushes 43 and 43a, but can move together with the plates 38 and 39 in the direction A. Each user will be provided with a key for normal opening and closing actuation and with an auxiliary key, or change key, which is used to change the combination.

Of course, the first user will have a change key that he will not require for combination setting, since the combination of the lock will have been factory-preset. However, said change key (hereinafter referred to as the old change key) will have to be kept to allow subsequent combination changing. This combination changing can be performed for example when a new user of the lock wishes to prevent the previous user from opening the lock.

Setting the new combination therefore entails using the old normal key, the old change key, a new change key, and a new normal key. The old change key will allow only to preset the tumblers for combination changing, which will be performed with the new change key as follows.

By operating the lock with the old key, the bolt is moved to the full protrusion position, shown in figure 1, which in the illustrated example occurs at the end of four turns. In this position, the opposite ends of the pin 35

abut against the ends 57a of the notches 57 of the plates 38 and 39.

It should be noted that during the sliding of the bolt 8 the sets of teeth 24 of the strips 18 remain coupled to the respective sets of teeth 25 of the laminae 19, because the plates 38 and 39 supporting the strips 18 are prevented from sliding in the direction A, i.e., they are prevented from spacing from the laminae 19, by the abutment of the pin 44 against the expansions 29 of the laminae 19. At least one of the laminae 19 will in fact have a notch 37 that is offset with respect to the pin 44, so as to prevent said pin from engaging the notches 37.

At this point, by inserting the old change key C and turning it counterclockwise in figure 1, one acts on the tumblers 17 so as to raise them to the level at which the notches 36 and 37 face the pins 35 and 44.

By virtue of the further rotation of the old change key C, an additional movement of the bolt 8 occurs, since the pins 35 and 44 can now engage in the notches 36 and 37.

However, the pin 35, by acting on the end 57a of the notch 57, moves the plates 38 and 39 by an extent corresponding to the depth of the notches 36 and 37. Since the laminae 19 cannot follow the movement of the plates 38 and 39 because they are retained by the bushes 13 and 16, the strips 18 move away from the laminae 19. As a consequence of the separation of the strips 18 from the laminae 19, the teeth 24 disengage from the teeth 25. At the same time, as a consequence of the movement of the plates 38 and 39, the tooth 65, by means of the spring 63, engages the hollow 66 and, by abutting against the lug 67, prevents the plates 38 and 39 from performing further movements in the direction A, particularly from retracting in case of inward movements of the bolt caused by accidental impacts.

The lock is now in the configuration shown in figure 2, ready for combination changing.

At this point, the old change key C is removed and the new change key C1 is inserted; said new change key is actuated so as to return the bolt 8 inside the case, i.e., clockwise in the figures. With a first rotation angle of the new change key C1, the strips 18 are raised according to the new combination set by the new change key. At the same time, the tooth 65 disengages from the lug 67, thus releasing the plates 38 and 39. Once the new position of the strips 18 has been reached, the further rotation of the new change key C1 causes the engagement of the key on the tooth 38a of the plate 38 and the movement of the entire pack composed of the plates 38, 39 and of the strips 18, which is returned to a position in which it is adjacent to the laminae 19, causing the engagement of the teeth 24 between the teeth 25 before the pins 35 and 44 leave the notches 36 and 37.

As soon as the pins 35 and 44 have left their respective notches 36 and 37, by removing the new change key C1 the pin 35 engages between the upper teeth 33 by means of the springs 54 which, by actuating the strips 18 downwards, also move downwards the

laminae 19 by virtue of the coupling between the teeth 24 and 25.

It is evident that the offset between the strips 18 and the laminae 19 changes the tumblers 17 according to a new combination that corresponds to the combination of the new change key C1, which can provide for a new positioning of one or more strips 18 with respect to the respective laminae.

The lock is now ready to be actuated with the new normal key, which has such a profile that when the tumblers 17 are raised, the passage formed between the mutually opposite teeth 33 and 34 is aligned with the pin 35 to allow the bolt-turning strokes. In summary, the change key allows the bolt to perform the stroke for separating the strips 18 from the laminae 19 at a level that is set by the notches 36 and 37. This level thus becomes a combination-setting variable together with the profile of the change key.

It is evident that the invention fully achieves the intended aim and objects. In particular, the action of the elastic laminae 56 on the laminae 19 in the combination-changing position, i.e., when the pin 35 engages the notches 36, keeps the laminae 19 rested on the pin 35. In this manner, machining tolerances and plays between the various elements are recovered, and possible jammings when the sets of teeth 24 and 25 are moved to mesh together are avoided.

Another considerable advantage resides in the fact that regardless of the combination that is set, when the key is not inserted in the lock, the strips 18 abut against the bushes 43 and 43a, so that the lower edges of the ends 22, on which the profile of the key acts, all remain at the same level, making it impossible to decipher the combination by reading the tumblers through the key-hole 26.

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 interpretation of each element identified by way of example by such reference signs.

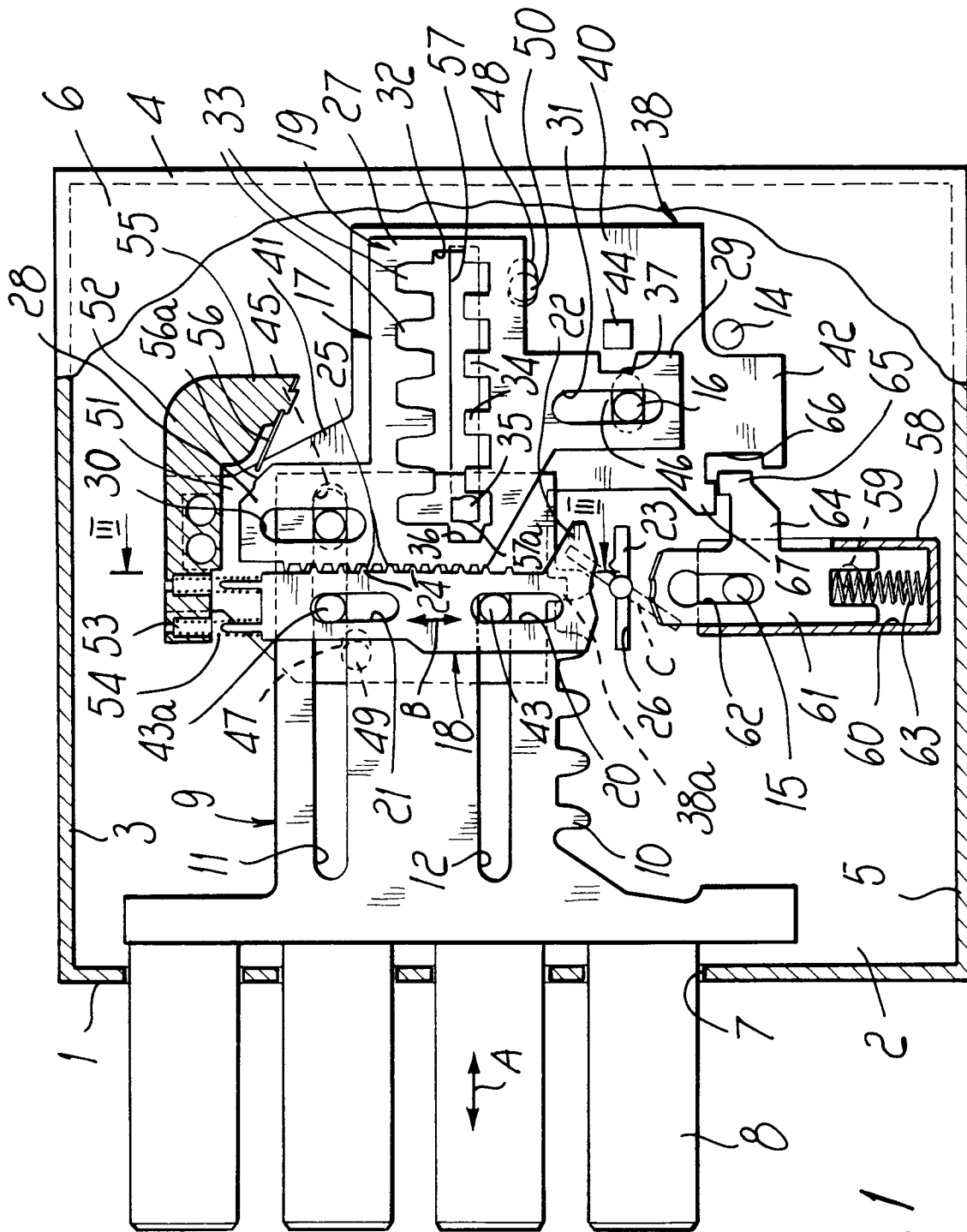
Claims

1. Improvements to a lock with flat tumblers and changeable combination, comprising a box-like body (2-6) that slidably accommodates a bolt (8) having a tang (9) provided with teeth (10) for moving the bolt by means of a double-web actuation key and with a transverse pin (35) that engages openings (32) of the tumblers (17) that lie in the sliding direction (A) of the bolt (8) and have, along the longitudinal edges, opposite teeth (33) which form passages through which said pin (35) advances by successive turns; characterized in that each tumbler (17) is composed of a first part or blocking lamina (19), that has said openings (32) and is guided at right angles to said tang (9) between a position

for affecting said bolt (8), in which said pin (35) engages between the teeth (33) of said opening (32), and a position for the sliding of the bolt (8), in which said pin (35) can slide through said passages; and of a second part or strip (18) that is mounted between two plates (38, 39) that are mutually rigidly coupled and are guided parallel to the sliding direction (A) of said bolt (8), said strips (18) being guided between said plates (38, 39) parallel to said blocking laminae (19) and being actuatable by virtue of double-web key means, said strips (18) and said blocking laminae (19) having mutually opposite sets of teeth (24, 25) adapted to mesh together to keep said strips (18) coupled to said laminae (19) in a direction (B) at right angles to the bolt (8); at least one (38) of said plates (38, 39) being provided with an opening (57) adapted to allow the free sliding of the pin (35) of the bolt (8) and forming an abutment for said pin (35) when the bolt (8) fully protrudes from said box-like body (2-6); said key means comprising: a first change key (C) which, when the bolt is fully extracted from the box-like body, is adapted to move the tumblers (17) into a position in which said pin (35) is in front of a notch (36) of said openings (32) that is located at a different level than said passages between the teeth (33, 34), said first change key being thus adapted to act on the tang (9) of the bolt (8) to move said pin (35) so that it engages said notches (36) and acts on said plates (38, 39) to move them into a position in which the sets of teeth (24, 25) of said strips (18) and laminae (19) are mutually disengaged; a second change key (C1) which, by acting on said strips (18) of the tumblers (17), lifts them according to a new combination; at least one (38) of said plates being provided with a tooth (38a) that can be engaged by said second change key (C1) after it has completed the lifting of the strips (18) according to the new combination, so as to produce the movement of the plates (38, 39) and of the strips (18) towards said blocking laminae (19) and the meshing of the sets of teeth (24, 25) according to the new combination.

2. Improvements to a lock according to claim 1, characterized in that said plates (38, 39) are connected by a bridge-like element (52), to which elastic tabs (56) are fixed, said tabs keeping said blocking laminae (19) rested on said pin (35) when the sets of teeth (24, 25) are mutually disengaged and the pin (35) of the bolt (8) engages the notches (36) of said blocking laminae (19).
3. Improvements to a lock according to claim 1 or 2, characterized in that they comprise: a block (58) that is fixed in the box-like body (2-6); a channel (60) that is formed in said block and intersects the keyhole (26); a slider (61) that is guided in said channel; elastic means (63) to keep said slider in an

abutment position, in which one of its ends protrudes out of the channel up to the key action region, said slider being provided with a tab (64) that is provided with a tooth (65) orientated in the slider sliding direction; a hollow (66) being formed in one (38) of said plates, said hollow being shaped so as to form a lug (67) that is adapted to cooperate with said tooth (65) so that said tooth (65) assumes a position for engagement with said tooth lug (67) to retain the plates (38, 39) when the sets of teeth (24, 25) of the strips (18) and of the laminae (19) of the tumblers (17) have been spaced to change the combination by said first change key (C) and a release position when one acts on said slider (61) with the second change key (C1), said tooth (65) being adapted to assume a position for abutment against said lug (67) when the sets of teeth (24, 25) mesh together.



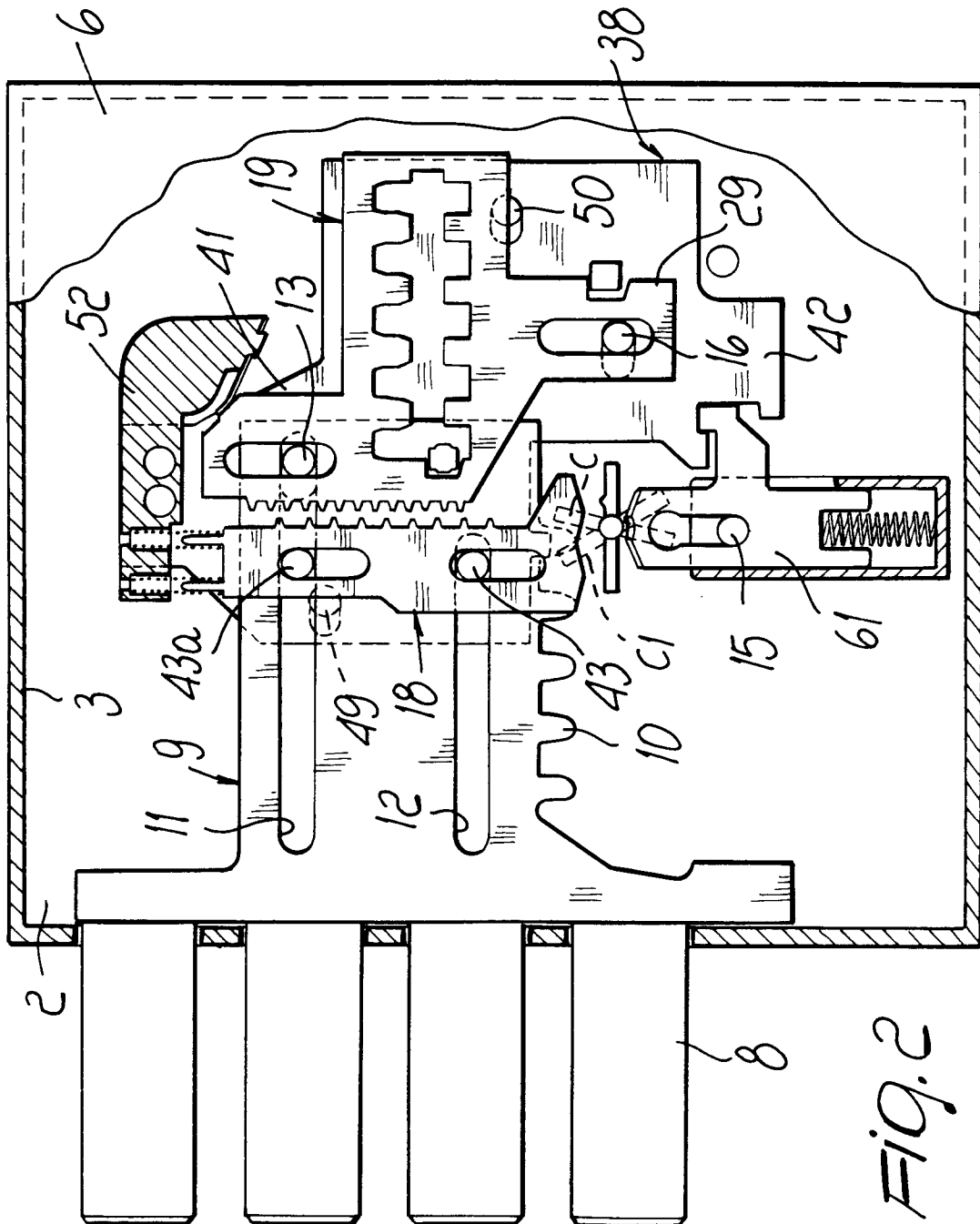


Fig. 2

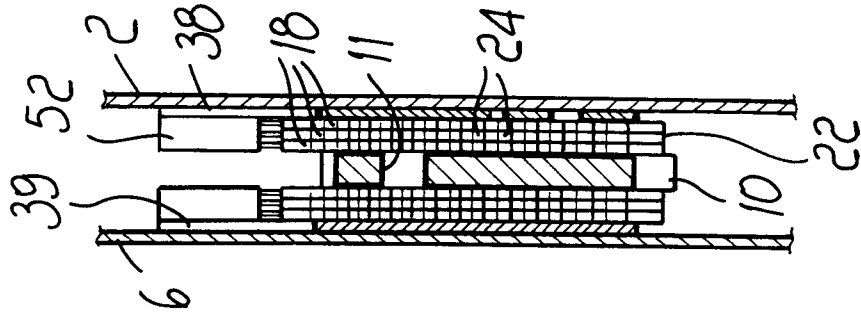


Fig. 3