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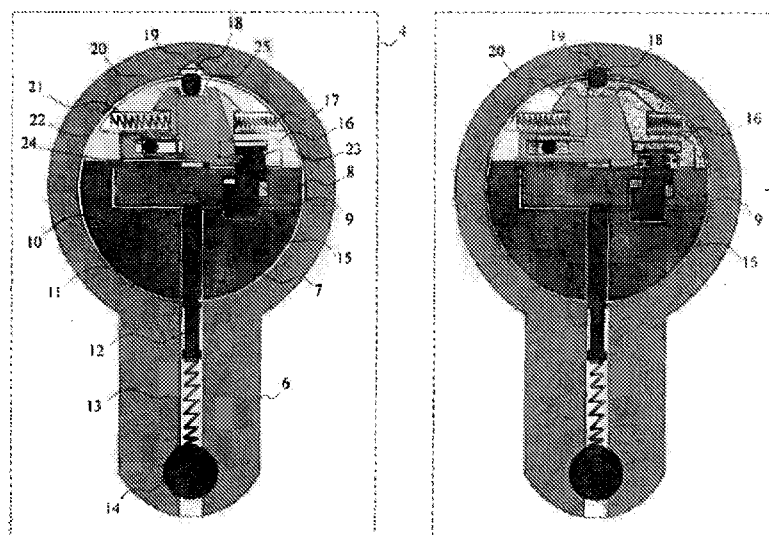


Figure 1

(57) Abstract: Apparatus comprising a lock and the key for the said lock in which the key offers an improved security against the unauthorized duplication because it comprises a moveable element that on its own surface carries bi-dimensional shape-type ciphers that are strongly interdependent with a further mono-dimensional cipher that is represented by the relative position between the moveable element and the part of the key that is coupled to the same element; and in which the lock comprises a mechanism for verifying the ciphers on the moveable element by checking the proper matching between the bi-dimensional shape-type ciphers and their own conjugate shapes through a powertrain configuration that is intrinsically resistant to the possibility of being manipulated using "bumping" (impulse) style techniques, and in which the said mechanism is implemented according to a technical solution can be industrially manufactured easily and with reduced production costs.

HIGH SECURITY CYLINDER LOCK AND KEY FOR THE SAME

TECHNICAL FIELD OF THE INVENTION

- The present invention concerns a cylinder type lock and a key for the same that comprises a moveable element on the key having two shape-type bi-dimensional ciphers strongly interdependent from a dimension-type cipher constituted by the position of the moveable element, and a cipher verification mechanism immune to "bumping" type picking techniques..

BACKGROUND ART

- 10 Are well known locks in which the cipher is obtained through a specific dimensional characteristic detectable in points univocally defined on a key, and in which the said cipher is verified through a leverage-type, disc-type, lamella-type or piston-counterpiston-type cipher in which the opening of the lock is subordinated to the proper alignment of the elements of the cipher that is produced when all the ciphers of the key are verified.
- Are also well known locks with shape-type cipher in which the cipher is obtained through a whole shape-type
- 15 characteristic of one part of the key that is verified through coupling to a part of the lock having a shape conjugated to it.
- Are also known high security locks in which the key is characterized by a movable element on which it is located one cipher of the same key in terms of one specific dimensional characteristic of the same movable element.
- 20 Through locating one cipher on one movable element of the key it is in fact possible, in the lock, verify the cipher related to it in a point out of the fixed shape of the key, with the aims of:
- increasing the resistance to picking by means of adding one additional cipher whose verification point is more difficult to reach; and
 - protect the key from the unauthorized duplication thanks to the addition of the movable element of difficult
- 25 replication.
- Figure 2 summarizes some principles of operation of locks with key characterized by at least one moveable element, that can be referable to known documents.
- In this respect it is known the document EP0029498A1 in which the principle of operation is described in the frame (1) of the Figure 2, characterized by a key that comprises ball-type movable elements capable to displace
- 30 themselves partially outside the section of the key seconding changes of the profile of the keyhole of the cylinder along the insertion stroke of the same key, and piston-counterpiston-type ciphers in the cylinder capable to verify the presence of the movable elements in the proper displaced condition, solution in which the movable element is characterized by a single dimension-type cipher that is constituted by the diameter of the ball.
- It is also known the document DE3542008A1 in which it is described a key that comprises one disc shaped
- 35 movable element with operation similar to what described in the previous document and in which the movable element is characterized by a single dimension-type cipher that is constituted by the diameter of the disc.
- It is also known the document EP1767731A1 in which it is described a key that comprises one piston-shaped moveable sliding member with operation similar to as already known and in which the movable element is characterized by a single dimension-type cipher that is constituted by the height of the sliding member.
- 40 It is also known the document ES294528U in which it is described a key that comprises one cylindrical movable element with operation similar to as already known and in which the movable element is characterized by a single dimension-type cipher that is constituted by the diameter of the cylinder member protruding outside the shape of the key.
- It is also known the document WO03064795A1 in which it is described a key that comprises one movable ring
- 45 characterized by a single dimension-type cipher that is constituted by the external diameter of the ring that indirectly acts on the mechanism for the verification of the cipher enabling the possibility of moving of members that are forming part of the proper cipher verification mechanism, according to a principle similar to that described in the document DE4035934A.
- It is also known the document EP0890694A1 the principle of operation of which is described in the frame (2) of
- 50 the Figure 2, in which it is described a key that comprises one movable element that constitutes one lever of first type in which one arm second changes in the profile of the keyhole of the cylinder during the insertion stroke of the same key and forces the other arm to dislocate partially outside the shape of the section of the key up to act on one couple piston-counterpiston of the lock, and in which movable element is characterized by a single dimension-type cipher that is represented by the sum of the thicknesses of the same lever between each point of
- 55 contact, the plane identified of the lever and by its rotation axis.
- It is also known the document FR2647841A1 in which it is described a principle of operation analogous to what already known for the previous documents and in which the key is characterized by a flexible appendix part of which is shaped so that to exercise similar functions to that of the movable element and is characterized by a single dimension-type cipher represented by the thickness of the appendix in the area that from one side is

pushed from the change in the profile of the keyhole and in the other is verified by the mechanism piston-counterpiston.

Are also known the documents FR2871497A1 and US1735868A where are described devices characterized by a crescent-shaped movable element hinged to the key and characterized by a single dimension-type cipher substantially represented by the portion of angle of circumference that constitutes the crescent element.

It is also known the document US1567979A in which it is described one key that comprises one movable element comprising a semicircular part and a protruding part that in the lock dislocates partially outside the shape of the section of the key to couple on one side with a couple piston-counterpiston acting normally to the direction of insertion of the key, and at a different end with a slide acting in the direction parallel to the direction of insertion of the key, in a configuration characterized by two dimension-type ciphers only respectively constituted by the diameter of the circular part and by the length of the protruding part that constitutes the movable element.

It is at last known the document EP0416500A1 the principle of operation of which is described in the frame (3) of the Figure 2 in which it is described a key that comprises one movable element that embodies one lever of third type that, under the pushing action of a first couple piston-counterpiston moved by a spring with predominating force, is dislocated partially outside the shape of the section of the key up to act on a second couple piston-counterpiston counter-acting in the opposite direction and on an axis parallel to that of the first couple, so that to embody a mechanism where the movable element is characterized by two dimension-type ciphers only, one defined by the thickness of the lever between the point of pushing of the predominating couple and the point of stop of the rotation, and one defined by the thickness of the same lever between the point of pushing of the counter-acting couple and the plane identified by the lever and by its rotation axis.

From what is exposed in the above it is clear that:

- are not known technical solutions comprising a key with movable elements characterized by a shape-type cipher;
- are not known technical solutions comprising a key with movable elements each of which can be characterized by an high number of separate dimension-type ciphers without that is required a not tolerable increment of the complication of manufacturing of the apparatus;
- the known technical solutions comprising a key with movable elements are characterized by the use of mechanisms of verification of the cipher of the movable elements based on the piston-counterpiston type mechanism that are necessarily located in positions that, in the conventional organization of the mechanisms of a cylinder lock, especially with European-type profile, require machining difficult to obtain especially on the cylinder body and where the thickness of the stator body is reduced, and require in addition a degree of miniaturization of the mechanism piston-counterpiston that make its industrial manufacturing difficult and costly.

DISCLOSURE OF THE INVENTION

In a first broad independent aspect the present invention provides a lock system and key for the same that is characterized by an increased level of resistance to picking with levers and that is characterized by a type of key more easily protected against the possibility of unauthorized duplication thanks to the presence of a mechanism difficult to replicate.

In a first subsidiary aspect the present invention provides a security lock that comprises a key having one movable element characterized by two distinct ciphers strongly inter-dependent from a third cipher that is related to the position of the same movable element.

In a second subsidiary aspect the present invention provides a security lock that can be embodied in the dimensions of an European-type cylinder lock.

In a third subsidiary aspect the present invention provides a security lock that, when embodied in the dimensions of an European-type cylinder lock, does not required mechanical manufacturing procedures difficult and costly to execute on parts of the stator body having reduced thicknesses and where the verification of the cipher of the movable element of the key does not require an additional piston-counterpiston mechanism that for the degree of miniaturization and for the direction of housing would be of difficult and expensive industrial reproducibility.

In a fourth subsidiary aspect the present invention is that of making a security lock characterized by an increased level of resistance to picking with "bumping" methods, that is with methods that use the inertia characteristics of the elements that constitutes the mechanisms of verification of the cipher with the scope of obtaining a momentary displacement only of the element that realizes the lockout of the lock by means of applying pulses through one key with deepened cipher hit by a blowback.

The previous scopes are fulfilled by the present invention since it discloses one security lock characterized by:

- a key having a movable element that accommodates two distinct shape-type ciphers strongly interdependent from a third position-type cipher represented by the relative position between the moveable element and the rest of the key, and

- a type of reading system of the abovementioned ciphers comprising a type of shape-type cipher mechanism, and
 - a mechanism of the verification system of the ciphers that is intrinsically immune from the possibility of picking with the methods of "bumping" already described, and
- 5 - the possibility of being industrially reproduced with a level of easiness to be found cheaper.

BRIEF DESCRIPTION OF DRAWINGS

A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specifications, which makes reference to the appended figures, in
10 which:

Figure 1 illustrates a sectional view of one preferred embodiment, even if not binding, of the lock of the present invention that in the frame (4) is shown in a first configuration where the cipher verification mechanisms match to the authorized key and in the frame (5) is shown in a second configuration where the cipher verification mechanisms match to one unauthorized key; and

15 Figure 2 illustrates different types of mechanisms related to the prior art; and

Figure 3 illustrates an axonometric view of one first preferred embodiment, even if not binding, of part of the key of the present invention; and

Figure 4 illustrates an axonometric view of one second preferred embodiment, even if not binding, of part of the key of the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Selected combinations of aspects of the disclosed technology correspond to a plurality of different embodiments of the present invention. It should be noted that each of the exemplary embodiments presented and discussed herein should not insinuate limitations of the present subject matter. Features or steps described as part of one
25 embodiment may be used in combination with aspects of another embodiment to yield yet further embodiments. Additionally, certain features may be interchanged with similar devices or features not expressly mentioned which perform the same or similar function.

The invention will now be illustrated referring to the attached figures that represent preferred embodiments of the same not binding with respect to the protection purposes of the present document.

30 Figure 1 illustrates a non-limiting representation of one section of a device according to the present invention positioned so that to show also the operation of the mechanism related to the verification of the ciphers on the moveable element of the key.

The frame (4) encloses the sectional representation in a configuration in which the lock couples with one key characterized by the right opening cipher.

35 The lock comprises at least one stator body (6) of suitable shape, having one cavity in which it is housed at least one rotor body (7) capable to rotate with respect to the stator (6) when the lock is in the unlocked state.

The rotor (7) is characterized by at least one keyhole capable to accept the insertion of the protruding part of the key (8), that houses one sliding movable element (9) partially trapped inside one through hole with offset section that is obtained on the frame of the same key (8), so that the sliding element (9) can translate up to partially
40 protrude outside the section of the key (8) from both sides, but without ever been totally extracted from the cavity that houses it.

In the insertion stroke of the key, from one of the sides of the same key (8) the sliding element (9) slithers against one indentation (15) (or bump) of the keyhole whose height is shaped so hat to bring the relative position between the movable part (9) and the frame (8) of the key at a suitably predetermined value that
45 constitutes one first dimension-type cipher of the movable element and that is suitable to drive the sliding element (9) to protrude out from the other side of the key (8) of a quantity big enough to uncover at least one pre-determined portion of the two at least bi-dimensional shape-type ciphers of the moveable element (23 and 24) that characterize the sides of the part of the said sliding element.

One first bi-dimensional shape-type cipher (23) present on one of the sides of the sliding element (9) is verified
50 by the shape-comparison mechanism comprising one lamella (16) that is housed in a cut of the rotor (7) and that under the action of one spring (17) pushes against the moveable element stopping in a position that is defined by the comparison between the cipher (23) and the shape of the edge of the lamella (16) that hosts the cipher profile conjugated to it.

Similarly, also a second bi-dimensional shape-type cipher (24), present on the side of the sliding element (9)
55 opposite to that of the cipher (23), is verified by the shape-comparison mechanism comprising the lamella (20), that moves above or under the other lamella (16), and that under the action of one spring (21), not necessarily distinguished from the spring (17), pushes against the moveable element (9) stopping in a position that is defined by the comparison between the cipher (24) and the shape of the edge of the lamella (20) that hosts the cipher profile conjugated to it.

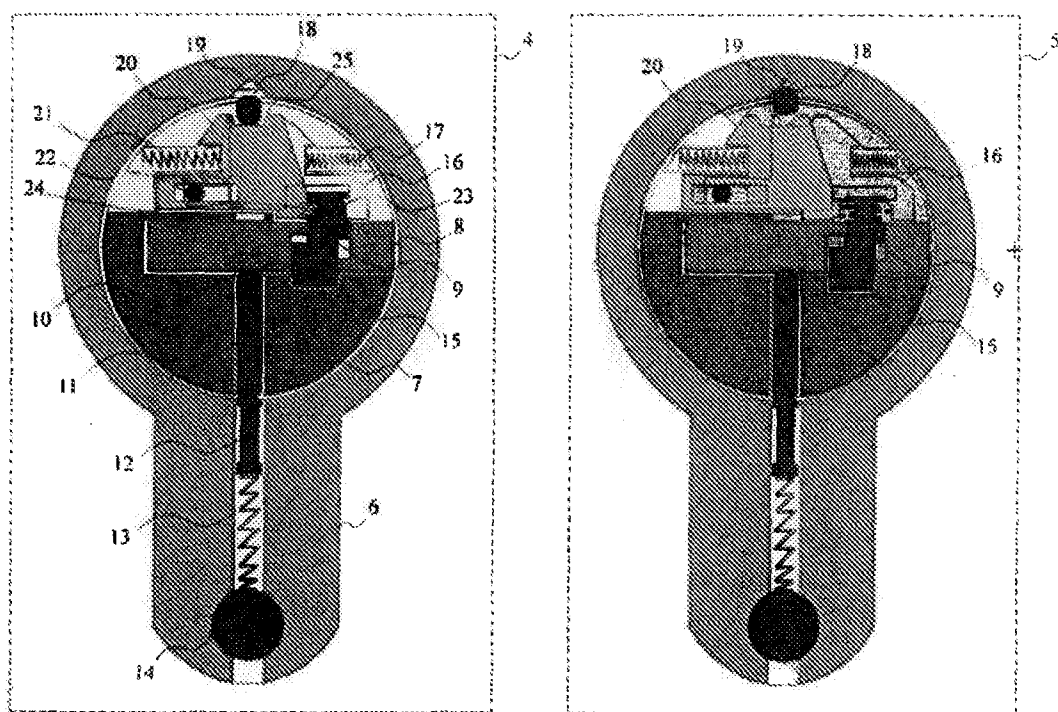
- When the ciphers respectively (23) and (24) are properly found, the lamellae respectively (16) and (20) are each one displaced in a position in which one indentation (25) of the lamella is aligned with a shutter body (18) that consequently, when both lamellae (16) and (20) assume at the same time the said position, can leave the seat (19) of the stator (6) configuration where differently it is partially (18) forced and in which it realizes a lockout of the possibility of rotation of the rotor (7) with respect to the stator (6).
- The mechanism of verification of the ciphers (23) and (24) is characterized by one verification element, represented respectively by the lamellae (16) and (20) that moves in a direction normal to the direction of motion of the locking element, represented by the shutter body (18), condition that realizes a mechanism substantially immune from the possibility of picking with "bumping" methods.
- 10 Suitably, even if not necessarily with respect to the protection scopes of the present document, the seat (19) could be obtained on the axis of the holes of the stator (6) intended to house other mechanisms, realizing a solution of easy and cheap industrial reproducibility.
- Suitably, even if not necessarily with respect to the protection scopes of the present document, it will be present at least one arrest element (22) capable to limit the stroke of at least one of the lamellae (16, 20) and/or limit
- 15 their possibility of motion to that necessary to the operation of the mechanism.
- Suitably, even if not necessarily with respect to the protection scopes of the present document, it will be present on the key (8) at least one further dimension-type cipher system realized by means of the depth of cavities (10) obtained on the same key, and will be also present one mechanism of verification of the said further cipher (10) constituted by a piston (11) of height big so that, when coupled at one end to the key (8) with the right cipher
- 20 (10), displaces totally inside the housing arranged in the rotor (7) and aligns the point of contact between the piston (11) and the counterpiston (12) with the surface that separates the rotor (7) and the stator (6), and in which one spring (13) pushes the group piston (11) and counterpiston (12) to couple to the cipher (10) of the key (8).
- Suitably, even if not necessarily with respect to the protection scopes of the present document, it could be furthermore present at least one mean suitable to contrast the motion of the sliding element (9) imposed by the
- 25 indentation (15) with a suitable force, with the scope to avoid that the sliding element could dislocate improperly due to the effect of its proper weight when the lock is installed in a configuration so that to allow it.
- Suitably, even if not necessarily with respect to the protection scopes of the present document, it could be furthermore present a plug (14) with the function of avoiding the spillage of the said elements (11), (12) and (13). Differently, the frame (5) encloses the sectional representation in a configuration in which the lock couples
- 30 with one key characterized by one possible wrong opening cipher on the moveable element.
- In the case illustrated it is possible to see how the sliding element (9) is coupled with one indentation (15) having height different with respect to the section of the frame (4) and consequently the relative position between the moveable element (9) and the frame of the key (8) reaches a different value of the first dimension-type cipher of the moveable element not matching that necessary for the unlocking of the lock.
- 35 Consequently to this condition, the portion of the shape-type ciphers (23) and (24) that can be accessed are different with respect to what is necessary to unlock the mechanism of verification of the shape comparison, and the lamellae (16) and (20) keep displaced in a position that forces the shutter element (19) to engage between the rotor (7) and the stator (6) locking out the relative rotation, independently from the eventual correct verification of the cipher (10) on the frame of the key (8).
- 40 Figure 3 illustrates one axonometric representation, not limiting, of one particular of the portion of the key (8) intended to being inserted into the lock. In the figure is illustrated how part of the moveable sliding element (9) facing towards the end of insertion of the key into the lock is characterized by tapered surfaces, and furthermore the portion of sliding element (9) capable to lean out of the frame of the key (8) is aligned with one rib (30) that, at least in the portion that precedes the insertion of the same sliding element (9) into the lock, has a section inside
- 45 which is inscribed the protruding section of the sliding member (9) and is characterized by tapering (31, 32) of its own section at the leading and trailing edges.
- Figure 4 illustrates one axonometric representation of one different possible embodiment, not limiting, of one particular of the portion of the key (8) intended to being inserted into the lock. In the figure it is illustrated how part of the moveable sliding element (9) facing towards the end of insertion of the key into the lock is
- 50 characterized by tapered surfaces (40) both laterally and on the top.
- It is therefore clear that what is described above can realize one security lock characterized by a key having one moveable element that accommodates two separate shape-type ciphers strongly interdependent from one third dimension-type cipher in which the lamella-type verification elements (16) and (20) displaces themselves orthogonally to the direction of displacement of the shutter (18) realizing one mechanism intrinsically immune
- 55 from the possibility of picking by means of the methods of "bumping" already described.
- It is also clear that what described in the above has devices that make the lock easy to be industrially reproduced with a cheap process.
- Finally it is clear that modifications and variations can be made to the described device without leaving the scope of protection of the present invention.

CLAIMS

What is claimed is:

- 5 1. An apparatus that constitutes a lock system having:
 - an improved degree of protection against the unauthorized duplication of the key, and
 - an improved degree of resistance against the burglary by manipulation in general and in particular using "bumping" techniques, and
 - 10 - the possibility of being industrially manufactured by means of processes more simple and cost-effective;
 that is characterized by the fact that:
 - the apparatus comprises at least one key system that in turn comprises:
 - 15 a) at least one key frame having a prolonged portion (8) designed to be inserted in a keyhole of the lock, and
 - b) at least one movable element (9) that is coupled to the key frame in a way that allows it to be moved with respect to the frame at least within proper limits, and the said movable element (9) is characterized by at least one bi-dimensional shape-type cipher (23, 24) engraved on the profile of at least part of its exposed surface, and configured so that the fraction of exposed
 - 20 part of the said cipher strongly depends on the relative position between the movable element (9) and the key frame (8);
 - the apparatus comprises at least one lock system that in turn comprises:
 - a) at least a stator body (6) having at least one cavity,
 - 25 b) at least one rotor body (7) that is at least partially housed inside a cavity of the stator body (6), and is potentially capable to rotate with respect to the stator, and has at least one keyhole opening capable to accept the insertion of at least part of the key (8), and the said keyhole has a shape of its section characterized by at least an indentation and/or protrusion (15) that, during the insertion of the key (8), couples with the movable element (9) imposing a specific relative position between the movable element (9) and the key frame (8), and
 - 30 c) at least one verification element (16, 20) for a bi-dimensional shape-type cipher that capable to compare at least one of the exposed portions of the shape ciphers (23, 24) of the movable element (9) with the proper conjugated bi-dimensional shape, and
 - d) at least a biasing element (17, 21) that forces at least one verification element to couple with an exposed portion of the shape-type ciphers of the movable element (9), and
 - 35 e) at least one locking pin (18) that can prevent the rotation between the rotor (7) and the stator (6) when it engages a seat cavity (19) in the stator (6) and can move to disengage the said seat cavity (19) aligning itself with at least one indentation (25) of at least one verification element (16, 20) only when at least one verification element assumes the position that is consequent to the positive verification of the shape-type cipher (16, 20) of the movable element (9), and in
 - 40 which the direction of the motion of the locking pin (18) is normal to the direction of the movement of the verification element (16, 20).
2. An apparatus according to claim 1 that is characterized by the fact of comprising at least one group of more verification elements (16, 20) arranged the one with respect to the others so that the locking pin (18) can
- 45 disengage the seat cavity (19) when all the indentations (25) of the verification elements (16, 20) of the group are aligned between them and with the locking pin in the configuration that is consequent to the positive verification of more shape-type ciphers (16, 20), and/or parts of shape type cipher, of the movable element (9) by all the verification elements (16, 20) of the same group.
- 50 3. An apparatus according to any of the previous claims that is characterized by the fact of comprising at least one additional dimension-type cipher system represented by the depth of cavities (10) cut in the frame of the key (8), and comprising at least one verification mechanism for the said dimension-type cipher comprising at least one piston (11) and one counter-piston (12), with the piston (11) having a length that, when it couples with the cavity (10) of the correct cipher on the key (8) on one side, it is completely contained in the
- 55 rotor body (7) and aligns its opposite edge, that touches the counter-piston (12) on the surface that separates the rotor (7) and the stator (6), and comprising at least one spring element (13) that biases the mechanism to couple with the cipher cavity (10).

4. An apparatus according to any of the previous claims that is characterized by the fact of comprising at least one mean capable to bias the movement of the movable element (9) with a proper force, in order to prevent the movable element (9) to misplace due to the effect to the proper weight when the lock system is installed with an orientation that could allow this to happen.
5. An apparatus according to any of the previous claims that is characterized by the fact that the position of at least one verification element (16, 20) that allows the disengagement of the locking pin (18) from the seat cavity (19) is consequent to a partially positive verification of the shape-type cipher on the movable element (9).
10. An apparatus according to any of the previous claims that is characterized by the fact that the seat cavity (19) is aligned with one hole in the stator (6) that houses at least one other different component of the lock system.
- 15 7. An apparatus according to any of the previous claims that is characterized by the fact of comprising at least one mean to limit (22) con the stroke and/or the possibility of at least one verification element (16, 20) for shape-type cipher.
8. An apparatus according to any of the previous claims that is characterized by the fact that at least one of the verification elements for shape-type cipher is a properly shaped lamina and is housed in a cavity of the rotor (7) obtained by partially cutting the rotor on a plane normal to its rotation axis.
20. An apparatus according to any of the previous claims in which the key frame (8) is characterized by the fact that the movable element (9) is preceded in the direction of the key insertion by a rib (30) of the key frame (8) and the said rib has at least one tapered edge (31) and it has a section big enough to prevent the peaking between the movable element (9) and the verification elements (16, 20) during the insertion and/or extraction of the key in/from the keyhole.
25. An apparatus according to any of the previous claims in which the key frame (8) is characterized by the fact that the movable element (9) is preceded in the direction of the key insertion by a rib (30) of the key frame (8) and the said rib has at least one tapered edge (31) and it has a section big enough to prevent the peaking between the movable element (9) and the verification elements (16, 20) during the insertion and/or extraction of the key in/from the keyhole.
30. An apparatus according to any of the previous claims in which the key frame (8) is characterized by the fact that the movable element (9) is tapered at at least one of its edges to prevent the peaking between the movable element (9) and the verification elements (16, 20) during the insertion and/or extraction of the key in/from the keyhole.

**Figure 1**

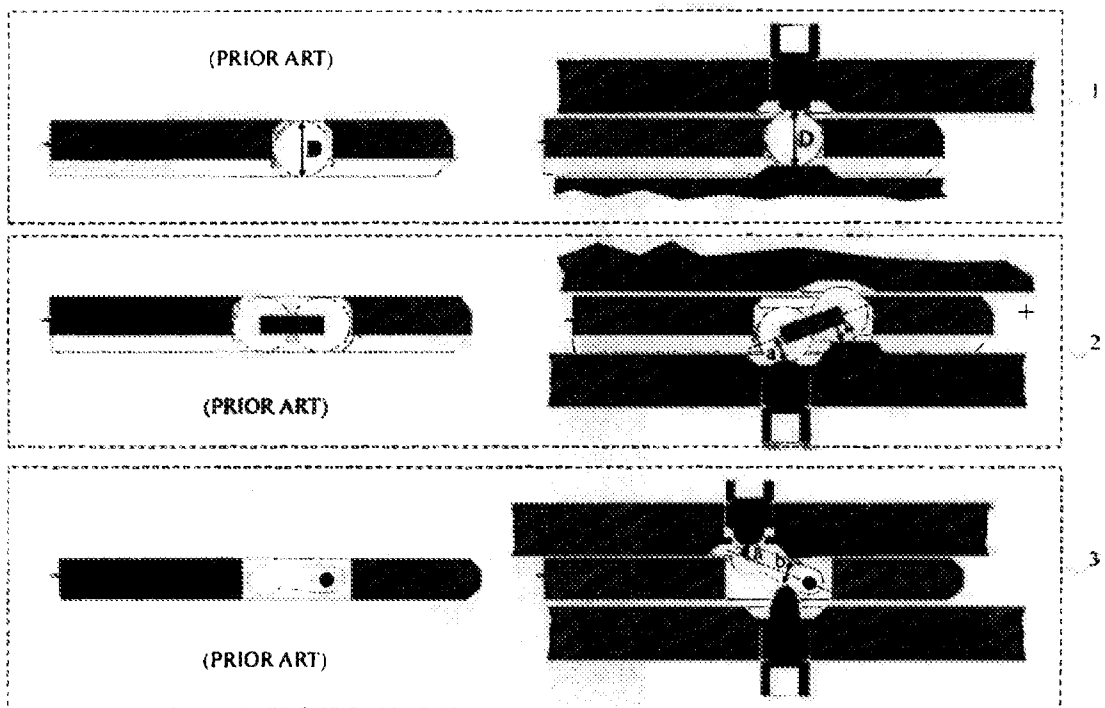


Figure 2

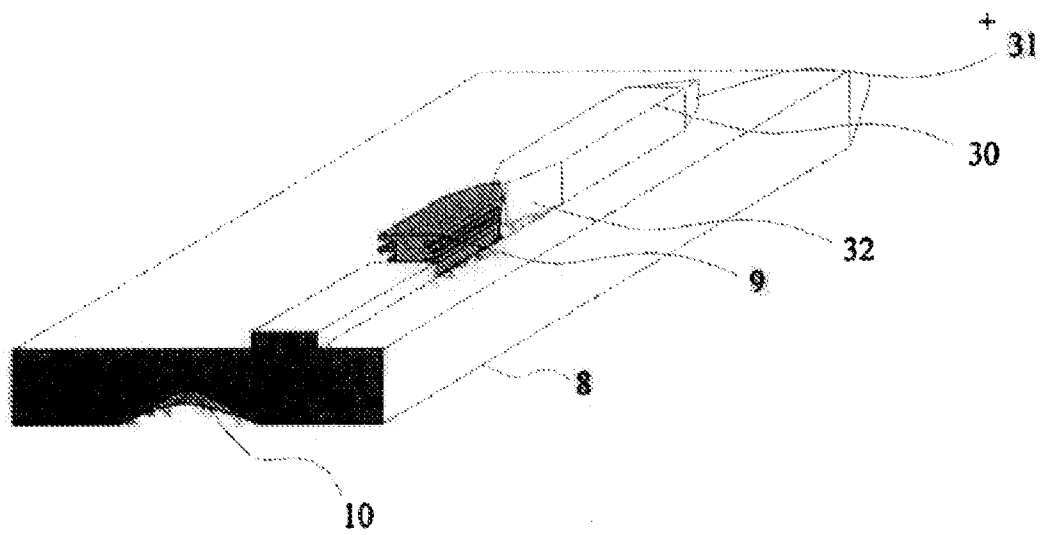


Figure 3

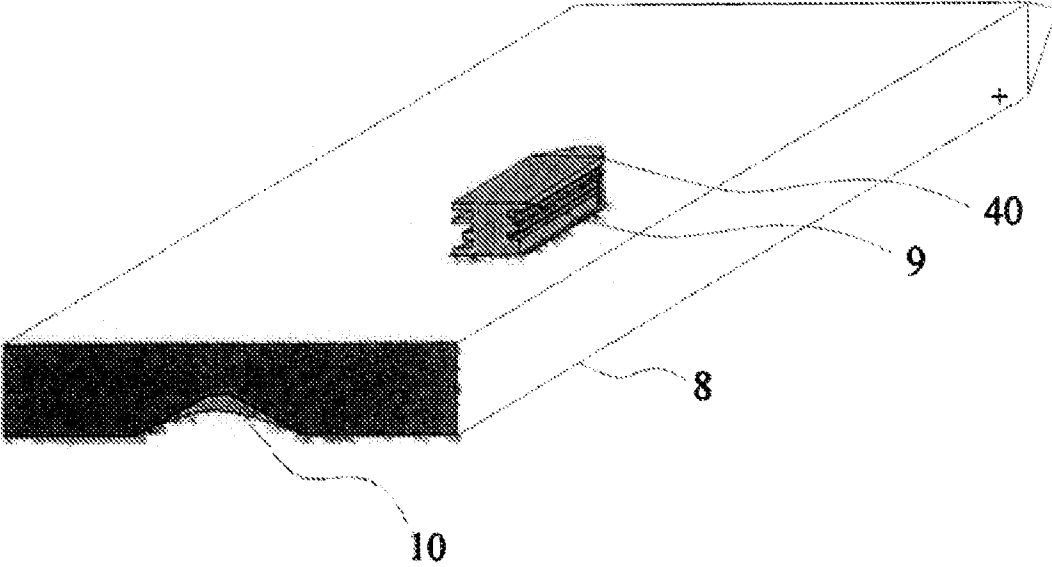


Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2014/000072

A. CLASSIFICATION OF SUBJECT MATTER
INV. E05B27/00 E05B35/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/247163 A1 (DAMIKOLAS GERRY [US]) 4 October 2012 (2012-10-04) the whole document -----	1
A	US 2008/236224 A1 (CHONG GERALD B [US]) 2 October 2008 (2008-10-02) the whole document -----	1
A	US 2011/265530 A1 (NICOARA PETRISOR [IL]) 3 November 2011 (2011-11-03) the whole document -----	1
A	WO 2008/111089 A2 (MUL T LOCK TECHNOLOGIES LTD [IL]; MARKBREIT DANI [IL]; BEN-AHARON EFFI) 18 September 2008 (2008-09-18) the whole document ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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