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Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) Cylinder lock and associated key

(57) A cylinder lock with associated key, comprising a body (1), a cylindrical seat (4) formed in the body, a plug (5) that can rotate in the seat, an actuation cam that is rotationally rigidly coupled to the plug, a keyway (6) for the key (7) that is formed axially in the plug, a plurality of actuation tumblers which, when the key is extracted, prevent the rotation of the plug and, when the key is inserted in the keyway, are actuated into the position that allows the rotation of the plug, at least one auxiliary tumbler (23, 29), which is accommodated in a seat (11, 18) of the plug (5) that is connected to the keyway (6) and is actuated by a spring (22) so as to prevent the rotation of the plug when the key is extracted; the auxiliary tumbler (23, 29), when the key is extracted, does not protrude into the keyway and the key (7) has at least one transverse hollow (34) that accommodates a movable element (36) that is pushed by a spring (35) into a position that protrudes from one side of the key so as to assume, when the key is inserted, a position that is opposite to a respective auxiliary tumbler (23, 29), the spring (35), which acts on the movable element in the opposite position, being suitable to push the auxiliary tumbler (23, 29) into the position that allows the rotation of the plug (5).

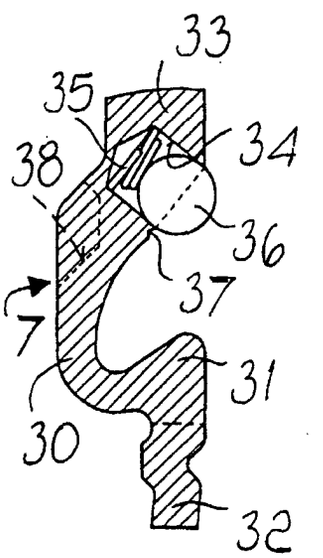

Fig. 2

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Description

[0001] The present invention relates to a cylinder lock and to the associated key.

[0002] As is known, cylinder locks are formed by a body, commonly known as cylinder, which rotatably contains a plug. A cam for actuating a bolt or spring latch is rotationally rigidly coupled to one end of the plug. In the cylinder there is at least one row of blind holes, and the plug has at least one row of through holes that are radial with respect to the rotation axis of the plug and a keyway that intersects such row of holes.

[0003] The through holes accommodate pins that have a conical end that protrudes into the keyway and the blind holes accommodate complementary pins actuated by springs. The pins and the complementary pins constitute the so-called tumblers for actuating the lock. The respective key is provided with a row of teeth that are formed according to a preset code along an edge of the portion that is inserted in the lock. The conical ends of the row of pins of the plug engage between the teeth of the key when the key is fully inserted in the keyway, aligning the plane of contact between the pins and the complementary pins in the plane of contact of the plug with the cylinder. The plug can thus rotate in the cylinder, causing the rotation of the cam and opening the door.

[0004] The drawback of this type of lock and of its key is that it is exposed to fraudulent tampering by means of tools such as picks, which are inserted in the keyway to act on the accessible ends of the pins and successively place them on the plane of contact of the plug with the cylinder.

[0005] In order to prevent effractions of cylinder locks as much as possible, appropriately staggered ridges are provided in the keyway and hinder actions on the pins.

[0006] However, the keyway, due to reasons related to manufacturing and to the mechanical strength of the key, is still too wide to constitute an effective barrier to forcing attempts.

[0007] In order to increase the effraction resistance of known locks, refinements have been proposed which consist in adding auxiliary pins in the cylinder which cooperate with the sides of the key (see Austrian patent no. 371,883 and German patents 1,260,340 and 2,003,059), or auxiliary pins that cooperate with an element that is movably accommodated in a seat of the key (see European patent no. 416,500, US patents 4,377,082, 4,667,495, 5,520,035 and 6,125,674, and international publication WO99/49161).

[0008] In known solutions with auxiliary pins that cooperate with a movable element in the key there is the problem that the auxiliary pins, in order to be engaged by the moving element, protrude significantly into the keyway and can be easily located and neutralized with picks or by removing the part that protrudes into the keyway.

[0009] The aim of the present invention is to provide a cylinder lock with a corresponding key that allows to obviate the above drawbacks.

[0010] Within this aim, an object of the invention is to provide a lock that is capable of offering greater resistance to effraction attempts without substantially compromising the requirements of low cost.

[0011] Another object of the present invention is to provide a lock in which the provided improvements can be used to increase the coding possibilities.

[0012] This aim and these and other objects that will become better apparent hereinafter are achieved with a cylinder lock with associated key, comprising a body, a cylindrical seat formed in said body, a plug that can rotate in said seat, an actuation cam that is rotationally rigidly coupled to said plug, a keyway for said key that is formed axially in said plug, a plurality of actuation tumblers which, when the key is extracted, prevent the rotation of the plug and, when the key is inserted in said keyway, are actuated into the position that allows the rotation of the plug, at least one auxiliary tumbler, which is accommodated in a seat of the plug that is connected to the keyway and is actuated by elastic means so as to prevent the rotation of the plug when the key is extracted, characterized in that said auxiliary tumbler, when the key is extracted, does not protrude into the keyway and in that said key has at least one transverse hollow that accommodates a movable element that is pushed by elastic means into a position that protrudes from one side of said key so as to assume, when the key is inserted, a position that is opposite to a respective auxiliary tumbler, said elastic means, which act on said movable element in said opposite position, being suitable to push said auxiliary tumbler into the position that allows the rotation of said plug.

[0013] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of some embodiments thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a sectional view of the lock;
Figure 2 is a sectional view of the key for actuating the lock of Figure 1;
Figures 3, 4 and 5 are views of the lock in three successive operating positions;
Figure 6 is a view of the lock of Figure 1, in which an incorrect key has been inserted;
Figure 7 is a view of the lock of Figure 1, in which an incorrect key, different from the one of Figure 6, has been inserted;
Figure 8 is a sectional view of the key according to a second embodiment; and finally
Figure 9 is a view of the key according to another embodiment.

[0014] With reference to Figures 1 and 2, the lock comprises a body 1 that is composed of a cylindrical portion 2, which is mirror-symmetrical along the central plane A and from which a portion 3 protrudes.

[0015] A cylindrical seat 4 is formed in the portion 2 and rotatably accommodates a plug 5, with which a cam (not shown in the drawings) of the lock is rotationally rigidly coupled.

[0016] The plug 5 has a longitudinal keyway 6 whose profile is contoured so as to receive an actuation key 7, which has a complementary cross-section, and a plurality of holes 8. When the key is extracted, the holes 8 lie on a central plane A of the lock and are aligned with a corresponding number of holes 9 having the same diameter, which are formed in the portion 3 of the body 1.

[0017] The holes 8 and 9 accommodate main tumblers for actuating the rotation of the plug; each tumbler comprises a pin, which is provided with a conical end, and a complementary pin; said pins are kept in mutual contact by a spring. The tumblers are not shown in the drawings because they are fully conventional (see German patents no. 1,260,340 and 2,003,059). They operate so that when the key is not inserted the springs push the pins and complementary pins into a position in which the conical ends of the pins abut against longitudinal protrusions of the walls of the keyway 6 and the complementary pins intersect a coupling plane B between the surfaces of the seat 4 and of the plug 5, preventing the rotation of the plug. Vice versa, when the key 7 is inserted in the keyway 6, the contact plane between the pins and the complementary pins shifts until it lies on the coupling plane B, allowing the rotation of the plug 5 in the seat 4.

[0018] Additional holes 10, 11 are formed in the plug 5, are arranged on the sides of the keyway 6, and are orientated along axes C and D, which are radial with respect to the rotation axis of the plug.

[0019] When the lock is in the position shown in Figure 1, which corresponds to the position in which the key is not inserted, the holes 10, 11 are aligned with recesses 12 and 13 constituted by longitudinal grooves with a very wide V-shape formed by two ramps 14 and 15 that are connected by a circular arc-like region 16.

[0020] The hole 10 is connected to the keyway 6 and accommodates a ball 17 whose diameter is such that when it is accommodated in the hole 10 it protrudes with a dome into the keyway 6 and is substantially tangent to the coupling plane B without however invading the recess 12. The ball 17 acts as an auxiliary tumbler of a known kind, which prevents the rotation of the plug if an incorrect key is inserted in the keyway 6.

[0021] In the plug 5 there is also a hole 18 that intersects the hole 11 at right angles and enters the keyway 6 proximate to the region meant to be occupied by the spine of the key.

[0022] A wing 19 protrudes into the hole 18, on the opposite side with respect to the keyway 6, and is rigidly coupled to a pin 20 that is inserted in a blind hole 21 of the plug 5 that is perpendicular to the hole 18. The wing 19 acts as an abutment for a spring 22 that acts on a pin 23 that can slide in the hole 18.

[0023] The pin 23 comprises a cylindrical collar 24 and a tang 25 that protrudes toward the keyway 6 and has a narrower region that forms an annular cavity 26 that has a circular arc-like cross-section and an edge 27 by means of which the pin 23, due to the spring 22, abuts against a shoulder 28 of the hole 18.

[0024] The hole 11 intersects the hole 18 at the shoulder 28. Furthermore, the shoulder 28 is closer than the axis D to the inlet of the hole 18 in the keyway 6, so that when the edge 27 abuts against the shoulder 28 the collar 24 closes more than half of the opening of the hole 11.

[0025] The length of the tang 25 is such that it does not protrude into the keyway 6 when the edge 27 abuts against the shoulder 28.

[0026] The hole 11 accommodates a ball 29 which forms, together with the pin 23, an additional auxiliary tumbler that is suitable to prevent the rotation of the plug 5 if an incorrect key, different from the one neutralized by the ball 17, is used.

[0027] The ball 29 has the same radius as the annular cavity 26 and can assume two positions inside the hole 18. In a first position, which corresponds to the position in which the key is not inserted, shown in Figure 1, it surmounts the collar 24 so as to engage in the recess 13 and prevent the rotation of the plug. In the second position, which corresponds to the position in which the key is inserted in the keyway 6, the pin 23, by means of the key described below, is displaced until the cavity 26 lies opposite the ball 29, which accordingly can engage therein and allow the rotation of the plug.

[0028] The key 7 according to the invention for the actuation of the lock of Figure 1 is shown in cross-section in Figure 2 and comprises a profiled stem 30, which has an edge 31 provided with coded teeth 32 that are suitable to cooperate with the main tumblers accommodated in the holes 8 and 9 and a spine 33 in which there is a cylindrical hollow 34 which is substantially axially aligned with the hole 18 when the key is inserted.

[0029] The cylindrical hollow 34 accommodates a spring 35, which acts on a movable element constituted by a ball 6 and keeps it in abutment against an annular lip 37 formed by beveling the edge of the hollow 34. The lip 37 is such that the ball 36 protrudes from the hollow 34 with a hemispherical dome. The spring 35 is stronger and more preloaded than the spring 22, so as to prevail over it.

[0030] The key 7 is completed by a notch 38 that is formed in the stem 30 in such a position that it lies opposite the ball 17 when the key is inserted.

[0031] It should be noted that, for the sake of clarity, in the provided description reference has been made to a single auxiliary tumbler 23, 29 on one side of the keyway 6 and to a single auxiliary tumbler 17 on the other side of the key. Actually, it is possible to use one or more series of auxiliary tumblers along each side of the keyway. In this case, the key 7 has an equivalent number of notches 38 and balls 36.

[0032] As shown in Figure 1, when the key is extracted the plug 5 is prevented from rotating by the action of

the pin 23, which by being pushed by the spring 22 against the shoulder 28 blocks the movement of the ball 29, preventing the rotation of the plug 5.

[0033] By inserting a key 7 in the keyway 6, the ball 36 retracts into the hollow 34 until, in the fully inserted position, it reaches the respective auxiliary tumbler 23, 29. In this position, shown in Figure 3, since the spring 35 prevails over the spring 22, the ball 36 enters the hole 18, pushing the pin 23 into the position in which the edge 27 lies beyond the axis D with respect to the ball 36.

[0034] At this point, by turning the plug 5, the ball 29 engages the ramp 15 of the notch 13, so that by retracting into the hole 11 it forces the pin 23 to move toward the wing 19 (see Figure 4).

[0035] Once the ball 29 has moved up the ramp 15 and has reached the surface of the seat 4, the pin 23 has performed a movement that allows the ball 29 to engage in the cavity 26 of the tang 25, so as to allow the free rotation of the plug (see Figure 5).

[0036] At the same time, the notch 38 of the key 7, after assuming a position so as to face the ball 17, allows the ball to move freely in a radial direction and to retract fully into the hole 10 so as to not affect the rotation of the plug.

[0037] As is evident from the above description, the lock according to the invention perfectly achieves the intended aim and objects.

[0038] In particular, the auxiliary tumbler 23 has no parts that protrude into the keyway 6 of the key and is therefore difficult to locate and neutralize to anyone viewing the keyway axially.

[0039] Figure 6 shows that by inserting a key that is not splined, i.e., not provided with longitudinal slots capable of rendering ineffective traditional auxiliary tumblers of the type constituted by a simple ball 17, both the ball 17 and the tumbler 23, 29 remain in the engagement position.

[0040] Figure 7 shows that if the key is splined with longitudinal slots 39 and 40, while traditional tumblers 17 are neutralized, the tumblers 23 and 29 remain fully effective.

[0041] A particular advantage of the invention is the fact that the ball 36 of the key 7, due to the spring 35, protrudes from the side of said key and is able to act on tumblers that are not visible to anyone viewing the keyway 6 longitudinally.

[0042] Numerous modifications and variations are possible in the practical embodiment of the invention and all are within the scope of the same inventive concept. For example, advantageously, the keyway of the lock and the corresponding key have a profile of the type disclosed in US-4,683,740 by this same Applicant.

[0043] Figure 8 illustrates a different embodiment of the key 7, in which the ball 36 is retained by a lip 37 of a bush 41 that is inserted in a wider portion of the hollow 34.

[0044] Figure 9 illustrates a further embodiment, in which the moving element comprises a hemispherical dome 42 and a cylindrical portion 43 that is guided in the hollow 34. Also in this embodiment, the moving element can slide in a bush inserted in the hollow 34.

[0045] The disclosures in Italian Patent Application No. BO2002A000913 from which this application claims priority are incorporated herein by reference.

[0046] 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 cylinder lock with associated key, comprising a body (1), a cylindrical seat (4) formed in said body, a plug (5) that can rotate in said seat, an actuation cam that is rotationally rigidly coupled to said plug, a keyway (6) for said key (7) that is formed axially in said plug, a plurality of actuation tumblers which, when the key is extracted, prevent the rotation of the plug and, when the key is inserted in said keyway, are actuated into the position that allows the rotation of the plug, at least one auxiliary tumbler (23, 29), which is accommodated in a seat (11, 18) of the plug (5) that is connected to the keyway (6) and is actuated by elastic means (22) so as to prevent the rotation of the plug when the key is extracted, **characterized in that** said auxiliary tumbler (23, 29), when the key is extracted, does not protrude into the keyway and **in that** said key (7) has at least one transverse hollow (34) that accommodates a movable element (36) that is pushed by elastic means (35) into a position that protrudes from one side of said key so as to assume, when the key is inserted, a position that is opposite to a respective auxiliary tumbler (23, 29), said elastic means (35), which act on said movable element in said opposite position, being suitable to push said auxiliary tumbler (23, 29) into the position that allows the rotation of said plug (5).

2. The lock according to claim 1, **characterized in that** said moving element is constituted by a ball (36) that is movably accommodated in a hollow (34) of said key (7) and is kept, by means of a spring (35) accommodated in said hollow, in abutment with an annular lip (37) of said hollow (34) so as to protrude substantially with a dome from the side of said key (7) in order to act on said auxiliary tumbler (23, 29) and push it into the position that allows the rotation of the plug (5) when the key (7) is fully inserted in said keyway (6).

3. The lock according to claim 1, **characterized in**

that said moving element comprises a hemispherical portion (42) and a cylindrical portion (43) guided in said hollow (34), said moving element being kept, by means of a spring (35) accommodated in said hollow, in abutment with an annular lip (37) of said hollow (34), so as to protrude substantially with a said hemispherical portion (42) from the side of said key (7) in order to act on said auxiliary tumbler (23, 29) and push it into the position that allows the rotation of the plug (5) when the key (7) is fully inserted in said keyway (6).

4. The lock according to one of claims 2 and 3, **characterized in that** said moving element is guided in a bush (41) that is inserted in said hollow (34) and has said annular lip (37) for the abutment of said moving element (36; 42, 43).

5. The lock according to one of claims 1 to 3, **characterized in that** in said plug (5), for each auxiliary tumbler (23, 29), there is a first radial hole (11) which, in the position in which the key is inserted, is aligned with a respective recess (13) of said seat (4), and there is a second hole (18) that intersects at right angles said first hole (11) and enters the keyway (6) of the key (7), a ball (29) being movably arranged in said first hole (11) and being suitable to engage in said recess (13), said second hole (18) accommodating a pin (23) that comprises a collar (24) and a tang (25) that protrudes toward the keyway (6) of the key (7) and forms an edge (27) with which said pin (23), due to a spring (22) accommodated in said second hole (18), abuts against a shoulder (28) that is formed in said second hole in the region of intersection with said first hole and is arranged so that said collar (24), in the position in which the key is extracted, closes more than half of the opening of said first hole (11), while in the position in which the key is inserted said edge (27) is displaced by the movable element (36) of said key (7), so that by turning the plug (5) the ball (29) acts on said edge (27) and completes the movement of the pin into the position in which the ball (29) can disengage from the recess (13) and allow the rotation of the plug.

6. The lock according to claim 5, **characterized in that** said tang (25) has an annular cavity (26) that has a circular cross-section, with a radius that is equal to the radius of said ball (29).

7. The lock according to one of claims 2 to 6, **characterized in that** said spring (22) rests on a wing (19) that is rigidly coupled to a pin (20) that is inserted in an additional hole (21) of said plug (5) that is perpendicular to said second hole (18).

8. The lock according to claim 2, **characterized in that** said annular lip (37) for the abutment of said moving element is obtained by beveling the edge of the hollow (34).

9. The lock according to claim 8, **characterized in that** said lip (37) is formed in a bush (41) that is inserted in said hollow (34).

Amended claims in accordance withRule 86(2) EPC.

1. A cylinder lock with associated key (7), comprising
a body (1),
a cylindrical seat (4) formed in said body,
a plug (5) rotatably arranged in said seat,
an actuation cam rotatably rigidly coupled to said plug,
a keyway (6) for said key (7) axially formed in said plug (5),
a plurality of main tumblers which, when the key is extracted from said keyway, prevent rotation of said plug and, when the key is inserted in said keyway, permit rotation of said plug,
said key (7) having at least one transverse hollow (34) in which a movable element (36) having a hemispherical portion and an elastic means (35) are accommodated, said elastic means urging said movable element so that said hemispherical portion protrudes from one side of said key,
at least one seat (11,18) formed in said plug and open into said keyway,
at least one auxiliary tumbler (23,29) accommodated in said seat,
an elastic means (22) being provided acting on said auxiliary tumbler (23,29) so as to prevent rotation of the plug when the key is extracted and to permit rotation of the plug when the key is inserted,
characterized in that each auxiliary tumbler is of the type comprising a ball (29) movably arranged in a first hole (11) radially formed in said plug (5) and aligned with a respective recess (13) formed in said seat (4) when the key (7) is extracted, a pin (23) movably arranged in a second hole (18) which intersects at right angle said first hole (11) and enters said keyway (6), said second hole (18) being suitable to receive said hemispherical portion of said movable element (36) when the key (7) is inserted, a spring (22) arranged in said second hole (18) so as to urge said pin (23) toward said keyway, said pin (23) comprising a collar (24) and a tang (25) extending toward said keyway (6) and forming an edge (27) with which said pin (23), due to said spring (22), abuts against a shoulder (28) formed in said second hole (18) in the region of intersection with said first hole (11) and arranged so that said collar (24), in the position in which said key (7) is extracted, closes more than one half of the opening

of said first hole (11) so as to retain said ball (29) in engagement into said recess (13) and to prevent rotation of the plug, while in the position, in which the key (7) is inserted, said hemispherical portion of said movable element (36) causes displacement of said pin (23) to assume a position inside said second hole (18) such that, by subsequent turning the plug (5), the ball (29) is urged out of said recess (13) and acts on said edge thus causing said pin (23) to complete a supplementary displacement which permits complete introduction of said ball (29) into said first hole (11) and free rotation of the plug.

2. The lock according to claim 1, **characterized in that** said movable element is constituted by a ball (36) that is movably accommodated in a hollow (34) of said key (7) and is kept, by means of a spring (35) accommodated in said hollow, in abutment with an annular lip (37) of said hollow (34) so as to protrude substantially with a hemispherical portion from the side of said key (7) in order to act on said pin (23) and push it into the position that allows the rotation of the plug (5) when the key (7) is fully inserted in said keyway (6).

3. The lock according to claim 1, **characterized in that** said movable element comprises a hemispherical portion (42) and a cylindrical portion (43) guided in said hollow (34), said movable element being kept, by means of a spring (35) accommodated in said hollow, in abutment with an annular lip (37) of said hollow (34), so as to protrude substantially with said hemispherical portion (42) from the side of said key (7) in order to act on said pin (23).

4. The lock according to one of claims 2 and 3, **characterized in that** said movable element is guided in a bush (41) that is inserted in said hollow (34) and has said annular lip (37) for the abutment of said moving element (36; 42, 43).

5. The lock according to claim 5, **characterized in that** said tang (25) has an annular cavity (26) that has a circular cross-section, with a radius that is equal to the radius of said ball (29).

6. The lock according to one of claims 2 to 5, **characterized in that** said spring (22) rests on a wing (19) that is rigidly coupled to a pin (20) that is inserted in an additional hole (21) of said plug (5) that is perpendicular to said second hole (18).

7. The lock according to claim 2, **characterized in that** said annular lip (37) for the abutment of said moving element is obtained by caulking the edge of the hollow (34).

8. The lock according to claim 7, **characterized in that** said lip (37) is formed in a bush (41) that is inserted in said hollow (34).

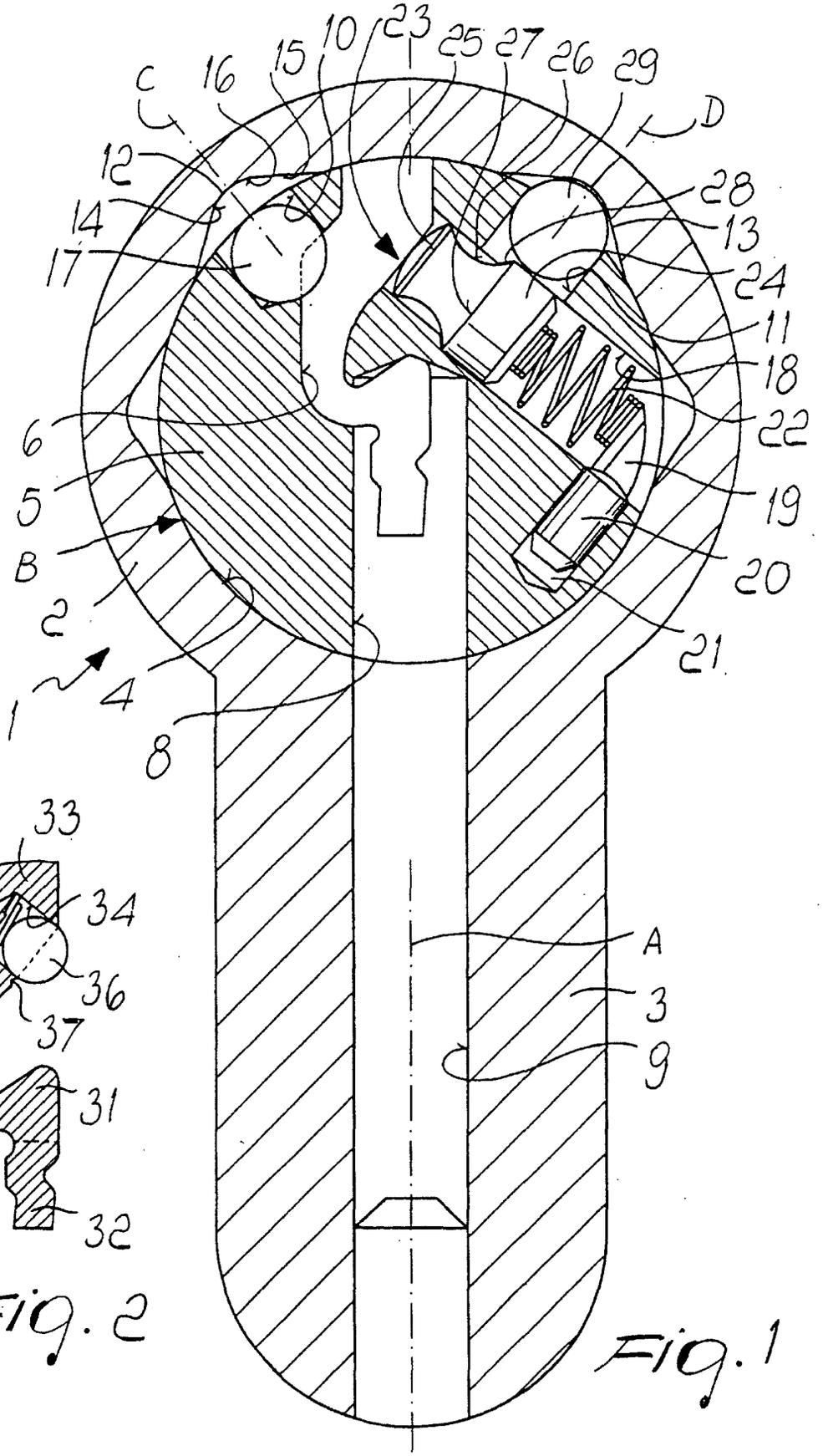
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Fig. 1

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Fig. 2

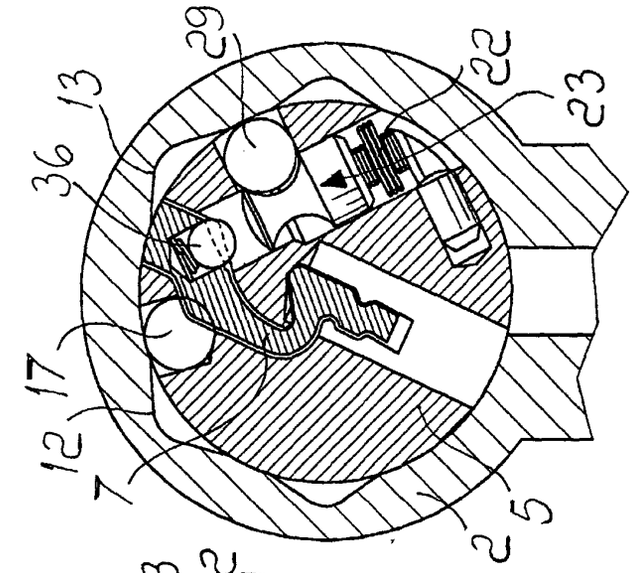

Fig. 5

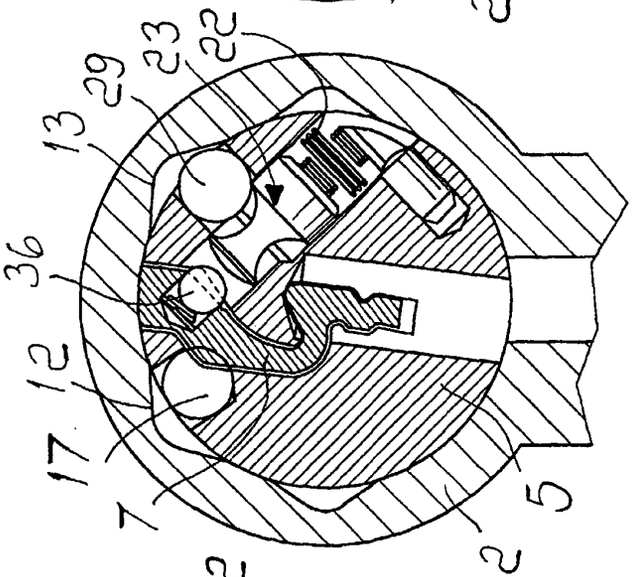

Fig. 4

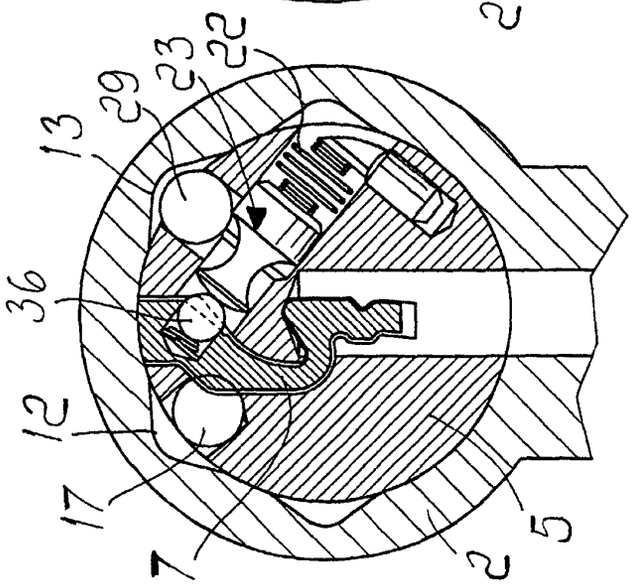

Fig. 3

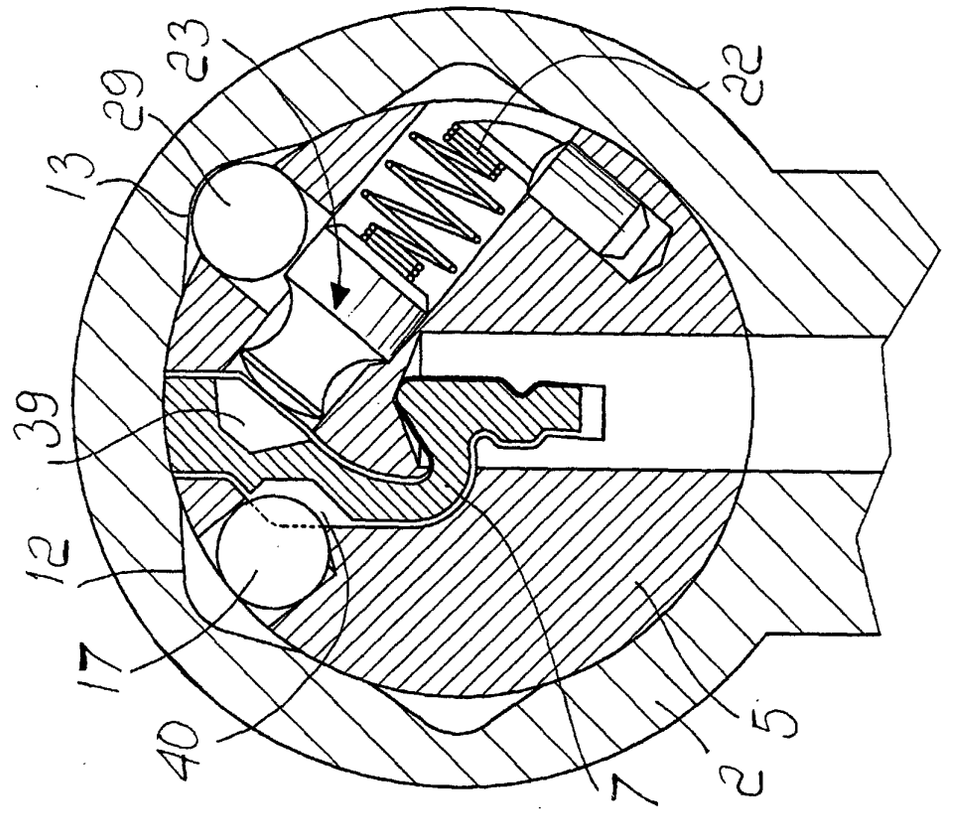

Fig. 7

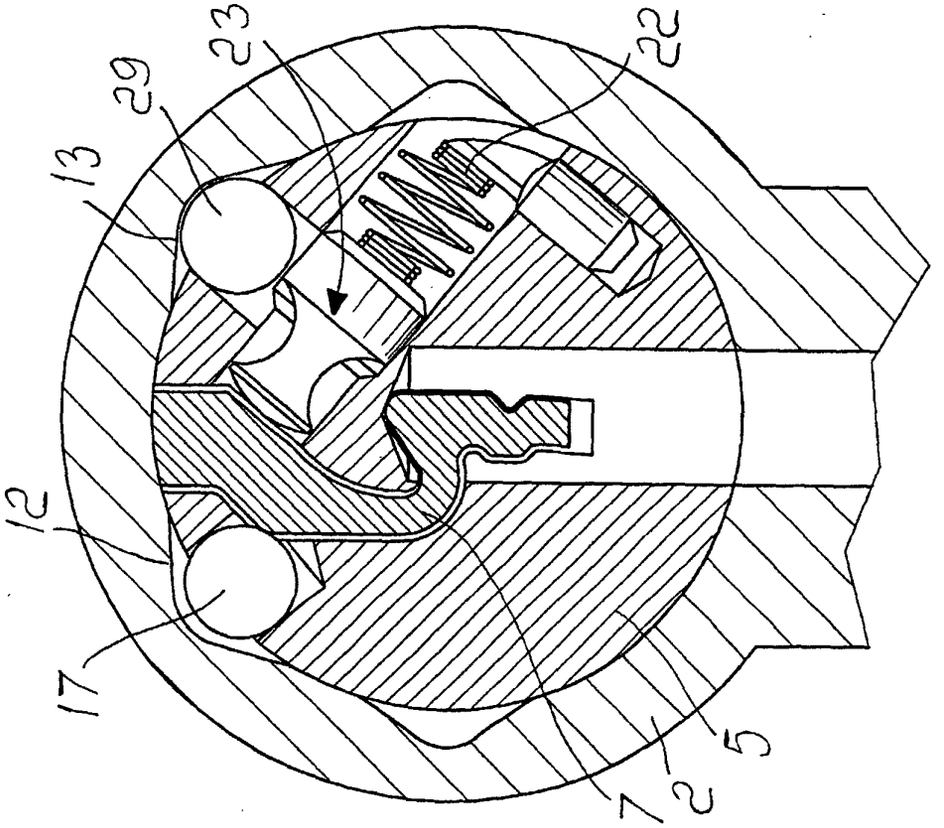

Fig. 6

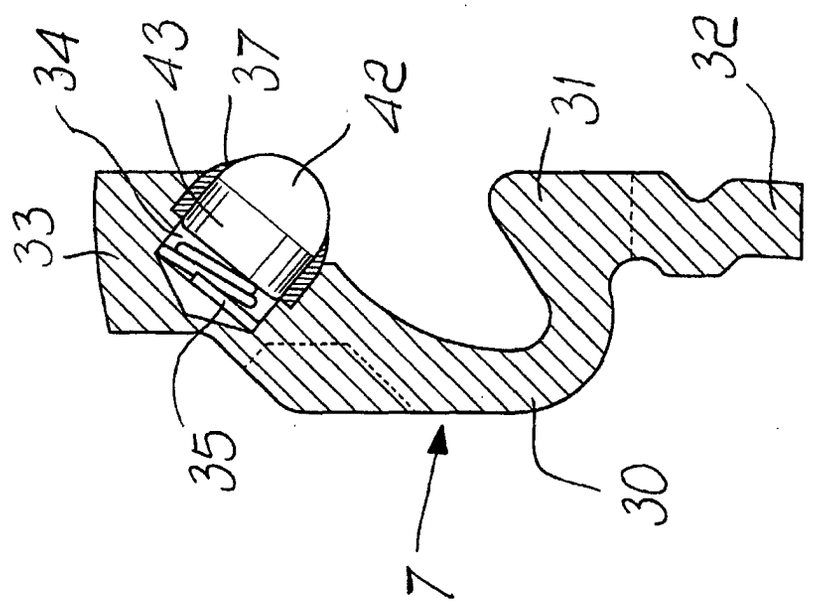

Fig. 9

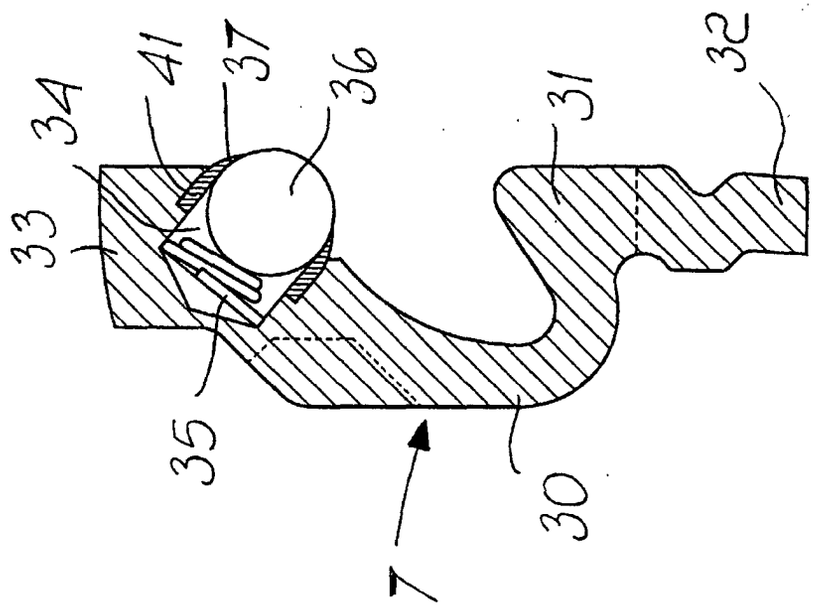

Fig. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 3495

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Place of search	Date of completion of the search	Examiner
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