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Mertanen

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[54] **BI-DIRECTIONAL CYLINDER LOCK**

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[52] **U.S. Cl.** **70/366,** 70/372

[51] **Int. Cl.** **E05b 29/02**

[58] **Field of Search** ..... 70/362, 365, 366, 372, 70/379 R, 379 A, 380

[56] **References Cited**

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Attorney, Agent, or Firm—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A cylinder lock mechanism is disclosed comprising a cylinder housing with a cylindrical opening and a cylinder turnable in this opening. At the turning axis of the cylinder there are a plurality of locking discs each provided with a central opening forming the keyway of the lock mechanism. The locking discs are turnable by means of a key of the lock mechanism relative to the cylinder both in clockwise and in counter clockwise direction from a key insertion position into a cylinder-releasing position. The lock mechanism also includes a turnable reset member connected through a slip clutch to the key of the lock when the key is in operating position in the keyway. Turning of the key from its cylinder-releasing position back to its insertion and removal position causes a corresponding turning movement of the reset member which is provided with contact surfaces arranged to engage the locking discs and to return them due to the movement of the reset member to their initial position, allowing removal of the key from the lock mechanism.

9 Claims, 7 Drawing Figures

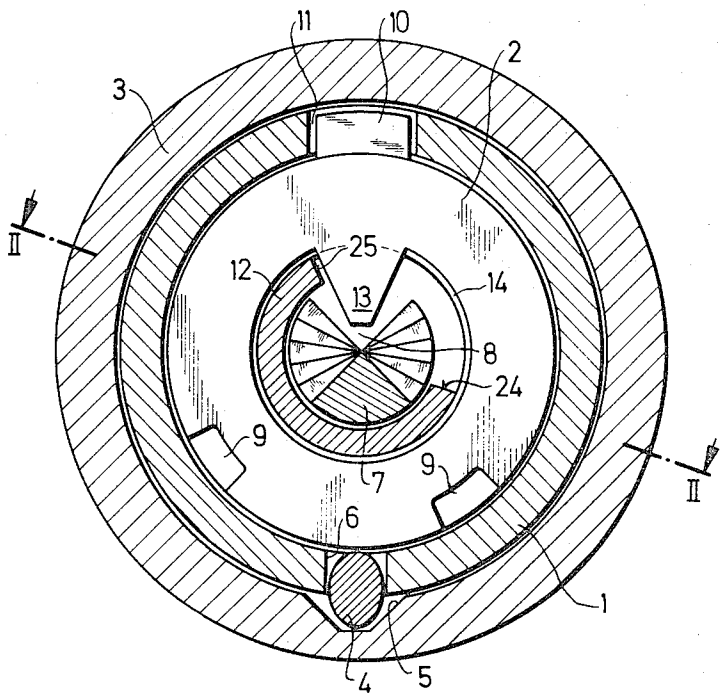


Fig. 1

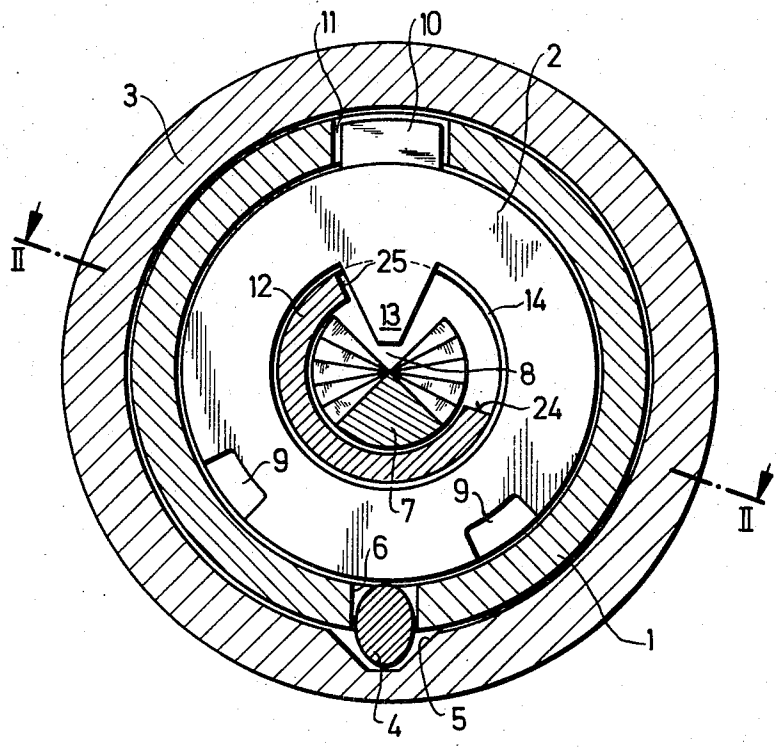


Fig. 2

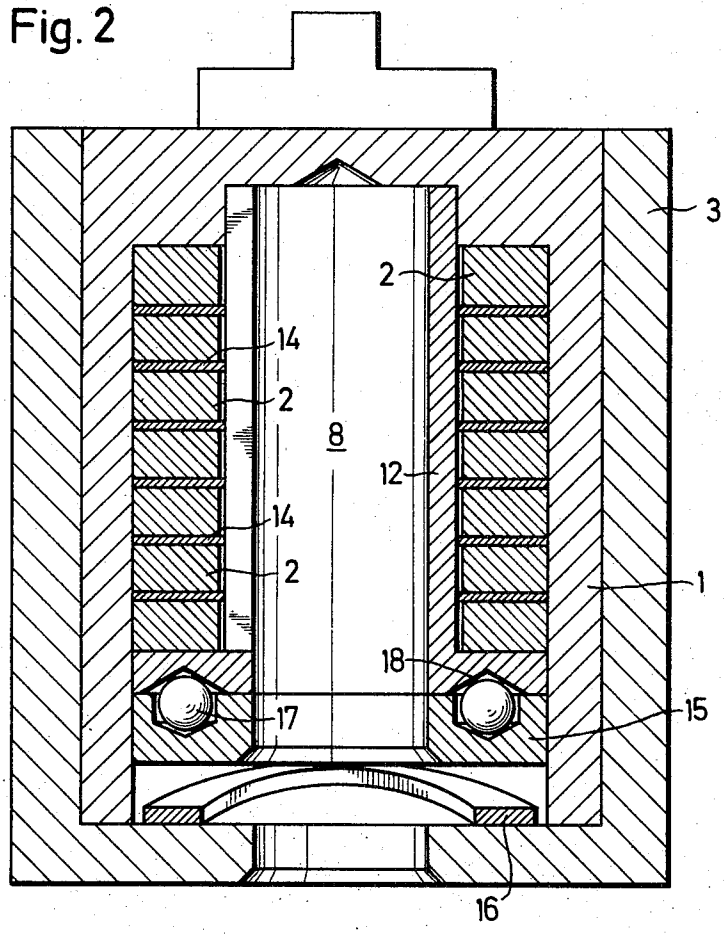

3
2
14
2
8
12
14
2
1
18
17
15
16

Fig. 3

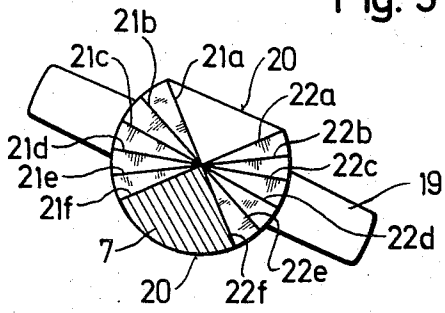

21b
21c
21a
20
22a
22b
21d
22c
21e
19
21f
22d
7
22e
20
22f

Fig. 4

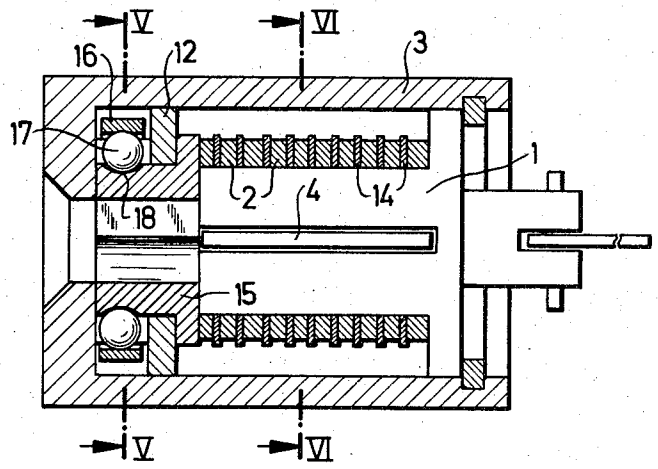


Fig. 5

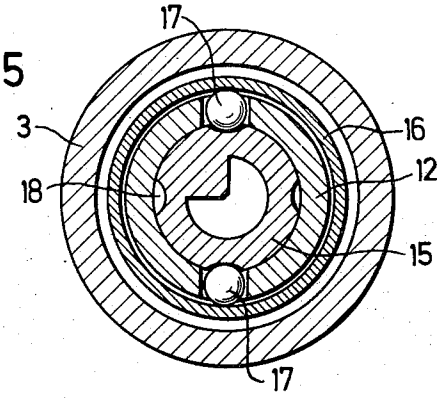


Fig. 6

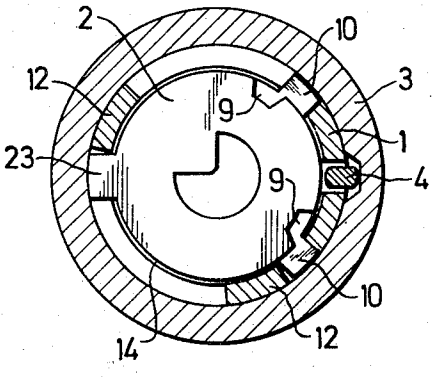
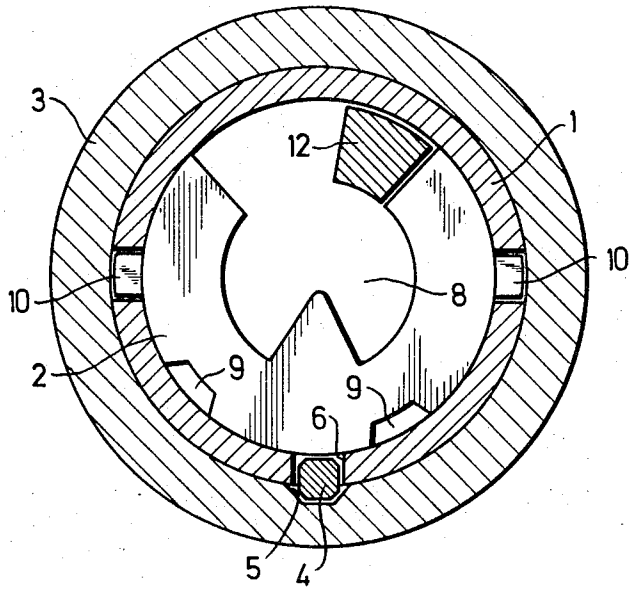


Fig. 7



BI-DIRECTIONAL CYLINDER LOCK

Many attempts have been made to obtain bi-directional function in a disc cylinder lock having a lockable and releasable lock cylinder which is released by rotating the locking discs of the lock with a key into a cylinder releasing position and wherein the discs must be rotated to their initial cylinder locking position to allow removal of the key. Due to the special characteristics of this type of locks, bi-directional function has not been able to obtain unless additional actions have been introduced into the operation cycle of the lock, as for instance an additional axial moment, different key insertion positions, etc. Locks with a complicated operation are not suitable as standard locks in doors or the like. That is why earlier solutions for obtaining bi-directional function in cylinder locks of this kind referred to must be considered unsatisfactory.

The object of the invention is to provide a lock of the kind referred to, with bi-directional function and with the same simple mode of operation as in normal uni-directional disc cylinder locks. By providing the lock with a reset member and a slip clutch two operating directions can be obtained without deviating from the simple operation cycle known from uni-directional locks of basically the same kind.

The words "slip - clutch", whenever used in this specification and in the claims, mean a clutch providing a slipping action when a certain torque load is exceeded but functioning otherwise as a fixed coupling member.

The reset member may be located in the keyway of the lock, or at the periphery of the locking discs, or between the keyway and the periphery of the locking discs, in a free space provided for this purpose. The first mentioned embodiment provides good guidance of the locking discs. The reset member also prevents access to the interior of the lock mechanism and thus gives extra protection against picking attempts. The second embodiment makes it possible to reduce the outer diameter of the lock, but it also makes it difficult to obtain proper guidance of the locking discs. The third embodiment allows the most compact design to be achieved. On the other hand it weakens the locking discs, which may have to be made open so that the space provided for the reset member extands all the way from the keyway opening to the periphery of the locking discs.

The slip clutch is most suitably located at one end of the lock, preferably at the outer end of the lock, so that the torque needed to free the clutch is transmitted from the strongest part of the key blade, that is the part close to the key bow. The slip clutch can be provided with balls, protrusions or corresponding parts, which in certain positions are pressed by a spring member into matching recesses in the opposite clutch member. The clutch may work in axial or in radial direction or in any intermediate direction. A radial clutch has the advantage, that the spring member can be of annular configuration and so that it does not transmit any reaction forces to other parts of the lock mechanism. The clutch may be designed to have no particular coupling positions, or there may be a great number of coupling positions close to each other. However, three coupling positions are quite sufficient, two of which correspond to the end positions of the turning movement of the key relatively to the turnable cylinder of the lock, and one

corresponding to the insertion and removal position of the key. A clutch with only a few coupling positions is naturally easier to manufacture and is also more reliable in service.

In a lock mechanism according to the invention, the locking discs are preferably, in a way known per se, provided with a radial inwardly extending protrusion in the control opening that receives the key. This protrusion is influenced by the combination surface of the key provided at the position of each single disc. The combination surfaces for each of the two operating directions engage opposite sides of said protrusion.

In locks according to the invention, the reset member may transmit not-desired turning movements to the locking discs through frictional contact with them. In order to avoid this the lock can be provided in a way known per se, with intermediate discs between the locking discs, non-rotatably fixed to the movable cylinder. By giving the intermediate discs somewhat greater radial dimensions than the locking discs in a direction towards the reset member, undesired contact between the reset member and the locking discs is avoided.

The invention will now be described by way of example, with reference to the accompanying drawings showing schematically different embodiments of the invention. In the drawings,

FIG. 1 is a cross-sectional view of a lock according to a first embodiment of the invention,

FIG. 2 is an axial section view of the lock of FIG. 1,

FIG. 3 is a cross-sectional view of a key of the lock,

FIG. 4 is an axial section view of a lock according to a second embodiment of the invention,

FIG. 5 shows section V—V of FIG. 4,

FIG. 6 shows section VI—VI of FIG. 4 and

FIG. 7 is a cross-sectional view of a lock according to a third embodiment of the invention.

In the drawings, 1 indicates the turnable cylinder of the lock and 2 locking discs enclosed within the cylinder. The cylinder 1 and the locking discs 2 are enclosed within the immovable cylinder housing 3. When the key of the lock is not inserted, the cylinder 1 is non-rotatably fixed to the cylinder housing 3 by means of a locking bar 4 partially located in an axial groove 5 in the cylinder housing 3 and partially in an axial slot 6 in the cylinder 1. The locking of the cylinder is not released merely by insertion of the key 7 into the keyway 8 of the lock mechanism. Only when the key after insertion is turned to the right or the left through a certain angle, the cylinder 1 is released as the recesses 9 in the locking discs 2 are brought in a position, in line with the locking bar 4. The recesses 9 form in this position a groove which receives the locking bar 4, when a torque is transmitted to the cylinder 1 by turning the key further in the same direction. After this operation the cylinder 1 can be freely rotated in the initially chosen turning direction of the key.

Most of the locking discs 2 are rotatable between a zero-position, shown in FIG. 1, in which the insertion and removal of the key of the lock is possible, and two other positions, called releasing positions, in which either one of the recesses 9 of the locking discs lined-up at the position of the locking bar 4. The location of the recesses 9 in the locking discs determines the combination value of each locking disc, that is the angle the disc has to be turned from its zero-position to its releasing

position. As later on will be explained, the key of the lock is provided for each locking disc with two combination surfaces, each of them acting in its own turning direction. When the key is turned, its different combination surfaces rotates each of the locking discs through the right angle (in the embodiment shown, 0°, 18°, 36°, 54°, 72° or 90°) so that all the locking discs are brought into releasing position allowing the cylinder to be rotated. One or some of the locking discs having a turning angle of 0° may be non-rotatably fixed to the inner cylinder **1**. These so called fixed locking discs are used to transmit the torque from the key **7** to the cylinder **1**. A fixed locking disc (and any 0° turning disc) has only one recess **9**, which is constantly in releasing position, that is, at the position of the locking bar **4**. The fixed locking discs are non-rotatably secured to the inner cylinder **1** by means of a protrusion **10** which is received by an axial groove **11** in the cylinder **1**. This groove receives also corresponding protrusions of a member of intermediate discs, located between the locking discs **2** to keep the locking discs out of direct contact with each other. The intermediate discs, are also non-rotatably fixed to the cylinder **1**.

In the embodiment shown in FIG. **1**, the reset member of the lock is located in the keyway **8** of the lock. When turned, the key engages the radial inward protrusions **13** in the central opening of the locking discs. In order to allow removal of the key from the lock mechanism, every locking disc must be brought back to the zero-position. This is obtained by transmitting torque from the key through a clutch to the reset member **12**, the radial contact surfaces **24** and **25** of which engages, each in its own rotation direction, the protrusions **13** of the locking discs, thus bringing the locking discs back to their zero position, when the key is turned back to its zero position.

FIG. **1** shows the position of the parts of the lock mechanism after a lock operation including releasing of the locking action by turning the key **7** counter clockwise and relocking by turning the key back into zero position. If after such an operation the opposite operation direction of the lock is to be used, the slip clutch, which will be described in detail below, occupies another coupling position. This is because the key **7** and the reset member **12**, coupled together by the clutch so that the reset member seeks to follow the clockwise turning movement of the key but is prevented from doing so by the protrusions **13** of the fixed locking discs, which as already explained are non rotatably fixed to the cylinder **1**. As the reset member **12** cannot be rotated clockwise, the clutch between the key and the reset member slips and occupies a new coupling position upon turning the key clockwise through its full turning angle relatively to the cylinder **1**. This rotation of the key brings simultaneously the locking discs to their releasing position. When the key is turned back, the radial face **24** of the reset member, now recoupled to the key, engages the protrusion **13** of each of the rotated locking disc and brings them back to the zero position. A repeated opening of the lock in clockwise direction does not cause any slip in clutch between the key and the reset member, but a change back to counter clockwise operation causes the clutch to slip back into the position illustrated in FIG. **1**.

FIG. **2** shows in principle the sectional view II—II of FIG. **1**, yet with the exception of the key **7** which is not shown in FIG. **2**. FIG. **2** is also more schematical than FIG. **1** in that the clearances between the parts of the lock mechanism are not shown.

FIG. **2** shows how the slip clutch **15** is arranged at the outer end of the cylinder housing **3**. The clutch **15** connects the key of the lock and the reset member **12**. The clutch slips when a certain torque is exceeded, but functions otherwise as a fixed coupling. The torque is transmitted through the clutch by a number of balls **17**, which in certain positions are urged by a clutch spring **16** into corresponding recesses **18** in the clutch part of the reset member **12**. The function of the lock requires only a few fixed clutch positions, while the clutch otherwise can be slipping. If the clutch comprises four balls **17** and corresponding recesses **18** arranged with a regular pitch on the clutch faces, there will be four fixed clutch positions at right angles to each other. One of these clutch positions should then correspond to the zero position of the key of the lock and two other positions should correspond to the maximum turning angle of the key relatively to the cylinder **1**. The clutch part **15** is provided with a protrusion, connecting this part non-rotatably to the key when the key is in the lock mechanism. This protrusion is not shown in FIG. **2** because it is located outside the sectional view plane.

FIG. **3** is a schematical cross-sectional view of a key-type, which can be used in a lock according to the invention. The key bow is indicated by **19** and the key blade by **7** in FIG. **1**. The contour line **20** is the unmachined profile of the key blade. By cutting straight across the key blade a number of combination surfaces **21***a*, **21***b*, **21***c*, **21***d*, **21***e* and **21***f* can be produced. These combination surfaces act on the locking discs **2** when the key is turned counter clockwise as seen from the key bow (clockwise according to FIG. **3**). The corresponding combination surfaces **22***a*, **22***b*, **22***c*, **22***d*, **22***e* and **22***f* on the other side of the key act on the locking discs **2**, as the key is turned clockwise, seen from the direction of the key bow (counter clockwise according to FIG. **3**).

FIG. **3** shows only one of many possible key profiles and key cutting patterns. The key can be modified in several different ways. Essential is only that the key has a number of combination surfaces which when the key is turned rotate the different locking discs to their releasing position. As the lock has two operating directions, also the key must have two sets of combination surfaces, one for each operating direction.

FIG. **4** shows a second embodiment of the invention. The clutch acts in this embodiment in radial direction and comprises as in the embodiment shown in FIG. **2**, clutch balls **17** and a clutch spring **16**. The clutch spring **16** is annular which gives the advantage that no reaction forces are transmitted to the cylinder housing **3** or to the cylinder **1**. The reset member **12** is located on the periphery of the locking discs **2**.

FIG. **5** shows the clutch **15** with its balls **17** and spring **16**, and the coupling recesses **18** in the reset member **12** as seen in a section perpendicular to the longitudinal axis of the cylinder housing.

FIG. **6** shows that the turnable cylinder **1** in this embodiment of the invention, has been reduced to two narrow axial wings each on its own side of the locking bar **4**. This is necessary in order to provide sufficient space at the periphery of the locking discs **2** for the two axial wings of the reset member **12** and the protrusions **10** locking the intermediate discs **14** and the fixed locking discs of the lock relatively to the cylinder **1**. The

locking discs **2** are provided with a protrusion **23** to which the reset member **12** transmits torque when the locking discs are to be returned into zero position. In order to avoid undesired contact between the reset member **12** and the locking discs **2**, the intermediate discs **14** are somewhat larger in the radial direction than the locking discs **2** within the sectors where the reset member moves. The same method has been used in the embodiment shown in FIGS. **1** and **2** where the intermediate discs **14** have a somewhat smaller central opening than the locking discs **2**.

In the embodiment shown in FIG. **7**, the reset member **12** is located between the keyway **8** of the lock and the periphery of the locking discs **2**. In order to simplify the manufacturing of the parts of the lock, the locking discs **2** have been made open, that is, their central opening has no limit in the sector where the reset member **12** moves. The fixed locking discs and the intermediate discs are non-rotatably fixed to the cylinder **1** by means of protrusion **10**, Two such protrusions are shown, but in principle one is sufficient. The lock of FIG. **7** functions in the same manner as the locks illustrated by FIGS. **1** to **2** and **4** to **6**, respectively. The clutch of the lock of FIG. **7** can be of the axial type as in FIG. **2** or of the radial type as in FIG. **4**.

The invention is not limited to the embodiments shown, but several variations and modifications are feasible within the scope of the following claims.

I claim:

1. A cylinder lock mechanism comprising a cylinder housing with a cylindrical opening, a cylinder turnable in said opening and providing at its turning axis a free space for a plurality of locking discs provided with a central opening forming the keyway of the lock mechanism and being turnable by means of a key of the lock mechanism relative to said cylinder both in clockwise and in counter clockwise direction from a key insertion position into a cylinder-releasing position, said lock mechanism including a turnable reset member, connected through a slip clutch to said key of the lock when the key is in operating position in said keyway, so that turning of said key from its cylinder-releasing position back to its insertion position, causes a corresponding turning movement of said reset member which is provided with contact surfaces engaging said locking disc and returning them during said movement to their initial position allowing removal of said key from said lock mechanism.

2. A lock mechanism according to claim **1**, in which said reset member is located in said keyway of the lock mechanism.

3. A lock mechanism according to claim **1**, in which said reset member is located at the periphery of said locking discs.

4. A lock mechanism according to claim **1**, in which said reset member operates in an opening provided in said locking discs between said keyway of the lock mechanism and the periphery of said locking discs.

5. A lock mechanism according to claim **1**, in which said clutch is located at an end portion of said lock cylinder.

6. A lock mechanism according to claim **1**, in which said clutch comprises a first part having a number of recesses and a second part having protruding members fitting into said recesses, and a spring member arranged to press said parts of the clutch towards each other.

7. A lock mechanism according to claim **1**, in which said clutch has several coupling positions, two of which correspond the extreme positions of said key relative to said cylinder and one corresponds to said insertion position of said key.

8. A lock mechanism according to claim **1**, in which each locking disc, in the keyway of the lock mechanism, has a radially inwards extending protrusion having contact surfaces to be engaged by corresponding combination surfaces on said key for turning said discs into cylinder-releasing position.

9. A lock mechanism according to claim **1**, having intermediate discs between said locking discs, which intermediate discs are non-rotatably fixed relative to said cylinder, the radial dimension of said intermediate discs in a direction towards said reset member exceeding the corresponding dimension of said locking discs, thus preventing radial contact between said reset member and said locking discs.

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