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ABSTRACT

Electromechanical Cylinder Lock

An electromechanical cylinder lock including a lock body (1) and, inside thereof, a turnable lock cylinder (2) and a locking mechanism comprising locking means which normally prevent turning of the lock cylinder (2) with regard to the lock body (1) and which can be moved by means of a key (7) of the lock into a releasing position allowing turning of the lock cylinder (2), whereby a key (7) for the lock includes means (11) for transmitting an electronic code and the lock correspondingly includes means (13,14) for receiving and identifying the code of the key so that, on identifying a correct code, the receiving and identifying means (13,14) are arranged to enable mechanical opening of the lock by means of the key (7). The lock includes at least one locking disc (9,9',9") with a key opening (9b,9',9b") which is so designed that turning of the key does not directly act mechanically on the locking disc (9,9',9"). The lock also includes coupling means for coupling the at least one locking disc (9,9',9") to the turning movement of the key. In addition the lock is provided with electric operating means (17,17',17") activated by means of the electronic code from the key and which in its active state controls the coupling means so that the at least one locking disc (9,9',9") turns with the key into a position required for the opening of the locking mechanism.

(With Figure 1)

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The following statement is a full description of this invention, including the best method of performing it known to me:-

This invention relates to an electromechanical cylinder lock arrangement.

As is well known, the operation of a cylinder lock mechanism can be controlled by means of an electronic code supplied from a key. For this purpose the lock is provided with a blocking member or the like which prevents normal use of the key. When the code supplied from the key is identified as being correct, control logic associated with the lock causes the blocking member to move into a position allowing turning of the locking mechanism and, thus, opening of the lock. However, arranging a blocking member in the lock body and guiding its movements requires space and often also a modification in the construction of the lock mechanism. A solenoid of sufficient power and a power supply therefor are required to provide the necessary movement of the blocking member which makes the construction more complicated and increases its cost.

An aim of the present invention is to provide a novel electromechanical cylinder lock arrangement in which the control of members of the lock mechanism, as a consequence of an identification of an electronic code supplied from the key of the lock, is provided by an arrangement which is advantageous as to its requirement of space and costs and entails as little change to the actual locking mechanism as possible. A further aim of the invention is to create a cylinder lock in which the members of a selected locking mechanism can be utilized as blocking members.

According to one aspect of the present invention there is provided an electromechanical cylinder lock arrangement a cylinder lock arrangement including an electromechanical. cylinder lock and a key therefor, the lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which is adapted to be moved by means of said key into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby said key includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc; coupling means for coupling said at least one locking disc to the turning movement of the key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

According to a further aspect of the present invention there is provided an electromechanical cylinder lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which an adapted to be moved by means of a key of the lock into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby a key for the lock includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc, coupling means for coupling said at least one locking disc to the turning movement of the key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

Thus with a lock arrangement according to the invention, turning of the at least one locking disc takes

place only when a correct key code is identified and makes use of a coupling arrangement controlled separately by electric operating means. If an erroneous code is detected, the at least one "special" locking disc is not turned at all but this does not prevent turning of the key. In this case, for example with a cylinder lock provided with a locking mechanism having turnable locking discs, the conventional locking bar of the lock, together with the special locking disc(s), prevent the lock mechanism from opening even if operated by a key having the correct mechanical opening configuration or combination.

Advantageously the lock body is provided with a control unit which turns with the key on turning of the latter and on which said electric operating means are arranged. Suitably the control unit is provided with a key channel the cross-section of which corresponds to the cross-sectional profile of a shank part of the key of the lock. In addition the control unit may, with advantage, include said means for receiving and identifying the key code.

In order to provide a relatively simple construction, the key of the lock is provided with a power source and first electric contact means. In this case the control unit includes second electric contact means which are arranged, in cooperation with the first electric contact means and after identification of a correct electronic key code, to connect current from the power source in the key to said electric operating means. The second electric contact means of the control unit are conveniently located inside the key channel.

In order to secure undisturbed operation for the said at least one special locking disc the range of angular turning of the control unit and said at least one locking disc is limited with regard to the lock cylinder, preferably so that it corresponds at most to the selecting movement for the lock mechanism. In addition the control unit may be provided with a protrusion or like member which acts on said

locking disc and which is arranged to return the locking disc together with the control unit and the key to their initial positions. Since the return of the locking disc is, in this case, carried out under positive guidance, the power supply can be disconnected immediately after opening of the lock mechanism to save on battery power.

In an advantageous embodiment of the invention the electric operating means comprise electromagnetic means serving as said coupling means and the at least one locking disc is of ferromagnetic material and is located in the immediate vicinity of the control unit. Thus in this case, the turning of the at least one locking disc is achieved by a magnetic force created by the electromagnetic means so that a separate blocking member is not required, which is of advantage from the viewpoints of simplicity of construction and utilization of space. The electric current required for this kind of electric control is also relatively small in comparison with conventional solutions.

In an alternative embodiment of the invention the electric operating means may include coupling means operated by an electromagnet or the like. The coupling means is movable from a free, non-coupling position into a coupling position in which it is arranged to mechanically engage the at least one locking disc so that, when the control unit is turned by means of the key, the at least one locking disc turns together with the control unit.

In a further embodiment of the invention the at least one locking disc may be provided with a spring-loaded coupling member which is movable transversally with regard to the turning movement of the locking disc between two end positions in which it protrudes from said locking disc. In this case the electric operating means can with advantage be arranged to control the movement of the coupling member for controlling the turning of the said locking disc(s). In order to provide the necessary control, the electric operating means comprises an actuating member which is

operated by an electromagnet or the like and which is turnable between two turning positions so that in one of its turning positions the actuating member is movable in its axial direction, whereby the actuating member is arranged, in cooperating with the coupling member, to control turning of the locking disc(s). In this case the control unit, which turns continuously with the key, conveniently includes a coupling recess or the like for the coupling member. The coupling member tries to enter the coupling recess, urged by a spring, and is arranged at the position of the actuating member.

At an initial position corresponding to the insertion position of the key, the coupling member is located at a distance of a certain turning angle, for instance about 45°, from the coupling recess so that the coupling member and the coupling recess are opposite to each other when the key is turned in the lock from its initial position through said turning angle. In addition the lock may include a guiding disc which is located beside the at least one locking disc on the side opposite to the control unit. The guiding disc is non-turnably connected to the lock cylinder and comprises a coupling recess into which the coupling member is pressed against the force of an associated spring in the initial position of the key thereby preventing turning of the locking disc(s). In this embodiment the at least one locking disc is not turned at all unless a correct electronic code is supplied to the lock to control the coupling means so that it connects with the locking disc(s) and turns into a position required for opening of the locking mechanism. Since in this case coupling cannot be accomplished in the initial position of the locking members, possible manipulation of the coupling member can be prevented when the key is not inserted in the lock.

The invention can with advantage be applied to a cylinder lock with so-called turnable or rotatable locking discs. In this case the lock is provided with a set of locking discs mechanically turnable by means of the key of

the lock. The locking discs are located inside the lock cylinder and are each provided with a peripheral notch determining the opening combination of the lock. The locking means comprise additionally a locking bar which, in its locking position, together with the locking discs prevent turning of the lock cylinder relative to the lock body and which is movable into a releasing position allowing said turning when the locking discs are first turned by means of the key into positions required by the opening combination. In this case the control unit is with advantage located inside the lock cylinder and includes a groove corresponding to the peripheral notches of the locking discs for the locking bar of the lock. With such a construction the basic functions and components of a conventional mechanical cylinder lock construction with locking discs can be utilized.

The invention can also be utilized in the case where the locking means determining the turning of the lock cylinder with regard to the lock body comprises a pin tumbler mechanism known as such. In this case separate means for blocking the turning of the lock cylinder may be arranged for the special locking disc or alternatively side bar arrangements utilized in many pin tumbler mechanisms for providing additional security may be availed of.

Embodiments of the invention will now be described, by way of example only, with particular reference to the accompanying drawings, in which:

Figure 1 is an exploded view of one embodiment of an electromechanical cylinder lock arrangement according to the invention;

Figure 2 is a block diagram illustrating schematically operational principles of an electric part of the arrangement shown in Figure 1;

Figure 3 is an enlarged view of an alternative embodiment of electric operating means for inclusion in the cylinder lock arrangement of Figure 1;

Figure 4 is an axial sectional view of another embodiment of a cylinder lock arrangement according to the invention, the locking members being shown in initial positions corresponding to the insertion position of the key;

Figure 5 is a sectional view taken on the line V-V of Figure 4;

Figure 6 is a sectional view taken on the line VI-VI of Figure 4;

Figure 7 is an enlarged sectional view taken on the line VII-VII of Figure 4;

Figure 8 is an axial sectional view of the embodiment of Figure 4, taken at the position of the locking bar of the lock, after the key of the lock has been turned about 45° but without the correct electric code having been supplied;

Figure 9 is a sectional view taken on the line IX-IX of Figure 8;

Figure 10 is an enlarged sectional view taken on the line X-X of Figure 9;

Figure 11 is an axial sectional view of the embodiment of Figure 4, taken at the position of the locking bar of the lock, after the key of the lock has been turned about 45° but with the correct electric code having been supplied; and

Figure 12 is an enlarged sectional view taken on the line XII-XII of Figure 9 with the lock parts in an

operating position corresponding to the situation of Figure 11.

In the drawings 1 indicates a lock body of a cylinder lock. A turnable lock cylinder 2 is arranged inside the lock body 1 and encloses a set of locking discs 3, each provided with a peripheral notch 3a, and intermediate discs 4 separating the locking discs from each other. The lock mechanism also includes a locking bar 5 which, in a locking position, is located partly in a groove 1a in the inner surface of the lock body 1 and partly in a slot 6 in the lock cylinder 2 (cf. Figure 6) and, together with the locking discs, prevents turning of the lock cylinder 2 relative to the lock body 1.

Installation of the lock cylinder 2 into the lock body 1 and installation of the whole cylinder lock at its place of application is achieved with the use of members 30 in a manner known as such.

As shown in Figure 1, the set of locking discs includes a "special" locking disc 9. In the embodiment of Figure 1, the locking disc 9 is of ferromagnetic material. The lock also includes inside the lock cylinder 2 a control unit 10 including electric operating means 17 (not shown in detail in Figure 1). On insertion and turning of a key 7 in the lock, the control unit turns together with the key.

The locking disc 9 has a peripheral notch 9a and an opening 9b for the key which is so designed that the disc 9 is not contacted by the key when the latter is inserted and turned whereby the locking disc 9 cannot be directly turned by means of the key. The control unit 10 is provided with a peripheral groove 10a corresponding to a normal peripheral notch of a locking disc and with a key channel 10b. The cross-section of the channel 10b corresponds to the cross-sectional profile of a shank 7a of the key exclusive of any combination surfaces determining the opening of the lock. The control unit 10 and locking disc 9 also include counter

surfaces 10c and 9c, respectively, which cooperate with guiding surfaces 2a of the lock cylinder 2 so that the angular turning range of the parts 9 and 10 relative to the lock cylinder 2 corresponds to the turning angle required for opening of the lock mechanism, typically about 90°. A protrusion 10d extending in an axial direction from the control unit acts on one of the counter surfaces 9c of the locking disc 9 and ensures that the locking disc 9 always returns to its initial position at the same time as the control unit 10 is turned with the key back to its initial position.

In the embodiment of Figure 1, the electric operating means 17 in the control unit 10 comprise electromagnetic means. When current is connected to the electromagnetic means a magnetic field is created simultaneously affecting the locking disc 9 and also causing, when the control unit 10 is turned, turning of the locking disc 9 together with the control unit 10 and the key 7. Thus with current connected and when the locking discs 3, the control unit 10 and, with it, the locking disc 9 of the lock are turned by means of the key of the lock into a position in which the peripheral notches 3a and 9a and the peripheral groove 10a form a uniform channel at the position of the slot 6, the locking bar 5 can enter this channel and the lock mechanism can be opened. On further turning of the key the turning movement can be transmitted through the lock cylinder as is required by a particular application. In order to lock the lock mechanism, the key is turned in the opposite direction, whereby the locking bar 5 moves back to its locking position preventing turning of the lock cylinder. In the application shown in the drawings, return of the locking discs 3 takes place by means of a separate returning bar 8. The operation of this basic mechanism is explained in detail in, for instance, US-A-5490405.

In practice a coil (not shown) may with advantage serve as the electromagnetic means of the control unit 10. When current passes through the windings of the coil, the

magnetic force so created ensures that the locking disc 9 is magnetically attached to the control unit 10 and turns together with the latter when the key is turned in the lock. On the other hand when there is no current in the coil, the locking disc 9 is not magnetically attached to the control unit 10 and does not turn together with the control unit 10 when the key is turned. The locking disc 9 is held stationary primarily due to frictional forces. However even if the locking disc 9 were able to turn slightly with the control unit 10, it would not result in opening of the lock mechanism since this requires the locking disc 9 to be turned through a full range of selection in order for the locking bar 5 to be released. Correspondingly when the key and, thus, also the control unit 10, are turned back to their initial positions, the protrusion 10d of the control unit ensures return of also the locking disc 9 to its initial position.

The lock and key include electronic parts of their own and, on the basis of their cooperation, determine when current is to be connected to the coil of the control unit 10 so that the cylinder lock mechanism can be opened by a key provided with the correct mechanical opening combination. This is illustrated schematically in Figure 2.

The key 7 is provided with an electronic part 11 comprising means for saving and transmitting an electronic code and a battery or some other suitable power source (not shown). In the embodiment shown the electronic code and electric current are fed from the key to the control unit 10 through first contact means 12 located in the key and corresponding second contact means 13 located in the key channel 10b. From the second contact means 13 the code is supplied to an electronic unit 14 in the lock where the received code is identified at 15 by comparison with a presaved code or codes. The second contact means 13 are not shown in Figure 1 and are schematically shown in Figure 2 but are conveniently located in a similar position to the contact means 13" shown in the embodiment of Figure 4.

On the occurrence of a correct code, connection of electric current to the electromagnetic means included in the electric operating means 17 is provided by means 16 whereby, at the same time, there is created a magnetic field affecting the locking disc 9. In this case the locking disc 9 will be turned with the control unit 10 until the current is disconnected, which would normally take place after the lock mechanism is relocked and the key is turned into its initial position and removed from the lock. Since, however, return of the locking disc 9 occurs under positive guidance under the influence of the protrusion 10d of the control unit 10, the supply of current can be disconnected immediately after opening of the lock mechanism in order to preserve battery power.

If the code supplied from the key is not correct, current is not connected to the electromagnetic means and, thus, no magnetic field is created to act on the locking disc 9, whereby turning of the key in the lock does not provide opening of the lock mechanism as described above. In addition to the second contact means 13 the above described electronic part 14 with its components can with advantage and in order to save space be located in the control unit 10.

The electronic code of the key can be transmitted or fed from the key to the lock by many different ways and techniques and, when necessary, independently of the current supply. This is true especially when the lock is provided with a power supply of its own. However, with the solution according to the embodiment shown in Figure 1, it is possible to accomplish a less complicated and a space saving construction for the cylinder lock.

By arranging for the control unit 10 and the locking disc 9 to be positioned, as shown, at one end of the set of discs, the supply of current and code may be arranged in a simple manner from the base part of the key shank 7a. However, in principle there is nothing to prevent the

location being at other parts along the key channel. Also more than one "special" locking disc 9 may be utilized, for instance located on either side of the control unit 10 or side by side.

In practice the control unit 10, which may take about 5 - 6 mm of the length of the key channel, and the locking disc 9 are a substitute for part of the conventional assembled set of locking discs, so that the total length of the set of discs is not increased. As a consequence the number of mechanical opening combinations is correspondingly decreased. However, when the mechanical opening combinations available are combined with the numerous electronic codes, a multiple number of new key combinations can be obtained. This, together with the magnetic control arrangement, increases essentially both the security of the lock mechanism and the key security.

In the embodiment of Figure 3, the control unit 10' and the locking disc 9' with their mechanical members correspond analogously to the control unit 10 and the locking disc 9 and their members shown in Figure 1. The embodiment of Figure 3 differs, however, from the embodiment of Figure 1 in that there is provided an electromagnet 18' controlling a coupling member 19 movable in axial directions depending on whether or not there is current in the electromagnet. This, for its part, depends on the code fed or transmitted from the key. If the code is correct, the coupling member 19 moves, under the influence of the electromagnet 18', from the control unit 10' into a protruding position which engages in an opening 20 arranged in the locking disc 9'. Thus when the control unit 10' is turned by the key of the lock the locking disc 9' is turned with it through the coupling member 19. Return of the coupling member 19 can be arranged in many alternative ways, for example by changing the polarity of the electromagnet, by additionally utilizing a permanent magnet or by using fully mechanical arrangements. In other respects the operation of this embodiment corresponds substantially to

that of the embodiment of Figure 1. For example return of the locking disc 9' occurs under positive guidance under the influence of a protrusion 10d' of the control unit 10'.

Since the coupling of the embodiment of Figure 3 is mechanical, the locking disc 9' need not be made of ferromagnetic material. The actual coupling member 19 may in practice be the anchor member of the electromagnet 18', which is relatively small in size and mass. Hence, no great power is required for its movement, whereby the solenoid to be used can be small which is advantageous as to its costs and economy of use of electric power.

The embodiment of Figures 4 to 12 differs from the embodiments described above in that movable coupling means, controlled by electric operating means 17" and by means of which the special locking disc 9" can be turned into an opening position of the lock mechanism, are located both in the control unit 10" and in the locking disc 9". Another difference is that coupling is accomplished only when the key has already been turned through a certain angle, for instance about 45°, provided, of course, that the correct electronic code is fed into the lock.

In the arrangement shown in Figures 4 to 12, the lock body 1 includes, at the key insertion end of the key channel, an element 21 which turns continuously with the key. The element 21 defines the profile of keys compatible with the lock and also serves as a deterrent to drilling of the lock. Located radially outside the element 21 there is a guiding disc 22, which is non-turnably supported against the lock cylinder 2 and which supports and guides the locking disc 9" which, thus, remains between the control unit 10" and the guiding disc 22.

In order to connect the locking disc 9" to the turning movement of the key, the control unit 10" includes an actuating member 25 which is controlled by an electromagnet 18" included in electric operating means 17".

At the position of the actuating member 25 there is a coupling recess 24 in the control unit 10" which is provided with a bevelled guiding surface 24a. The actuating member 25 can be turned between two end positions by changing the polarity of the electromagnet 18" so that in one end position the actuating member 25 can be pressed against the force of a spring 26 entirely inside the control unit 10" as is apparent from Figure 10. For this purpose an inner end 25a of the actuating member 25 is suitably designed to be narrower. In addition the body unit of the electromagnet 18" is provided with limiting members 27 (cf. Figure 7) which determine the angular turning range of the actuating member 25, which is preferably 90° or less. Furthermore, the arrangement advantageously includes a permanent magnet 28, which keeps the actuating member 25 in one of its end positions corresponding to the initial position and thereby ensures that the actuating member cannot be affected by means of external magnetic fields or other disturbances, for instance shakes or vibrations.

The locking disc 9" for its part includes a through-going hole 9d" which encloses a coupling member 23 which can be pressed, against the force of a spring 29, so that it extends into a recess 22a in the guiding disc 22. In this position of the coupling member 23 the locking disc 9" cannot be turned (cf. Figures 8 and 10). As is apparent from Figure 5, in the initial position the coupling member 23 and the recess 22a are located at a turning angle of about 45° from the coupling recess 24 and the actuating member 25.

The operation of the embodiment of Figures 4 to 12 is as follows. In the initial position of the mechanism according to Figures 4 to 7, in which the key is inserted into the key channel of the lock (for clarity the key is not shown in these figures), the actuating member 25, urged by the spring 26, extends beyond the coupling recess 24 against the locking disc 9". Initially when the key is turned in the lock, the locking disc 9" remains at its initial

position, in which the coupling member 23 extends into the recess 22a in the guiding disc 22 pressed by the control unit 10" (this position is shown in Figure 10). After turning of the key about 45°, the coupling member 23 is located at the position of the coupling recess 24 and the actuating member 25. In the absence of a correct electric code the turning position of the actuating member 25 is not changed. Hence, the actuating member 25 prevents movement of the coupling member 23 into the coupling recess 24 and the locking disc 9" remains together with the guiding disc 22 in its position (cf. Figures 8 - 10) and the lock mechanism cannot be opened.

Figures 11 and 12 for their part show the operation when a correct electric code is fed into the lock. As a result of identifying the code a control command is provided which changes the polarity of the electromagnet 18". This results in the actuating member 25 being turned through 90° so that its inner end 25a is pressed by the coupling member 23, urged by the spring 29, against the force of the spring 26 into a position allowing the coupling member 23 to enter the coupling recess 24. At the same time the coupling member 23 is released from the recess 22a in the guiding disc 22. As a consequence, when the key is turned further, the locking disk 9" turns with it so that its peripheral notch 9a" (see Figures 6 and 9) is located at the position of the locking bar 5 (not shown) thereby allowing for its part opening of the lock mechanism.

In contrast to the embodiments of Figures 1 and 3, in this embodiment the return of the locking disc 9" does not require a separate protrusion 10d or 10d' to be arranged on the control unit 10", but the locking disc 9" turns under the influence of the coupling recess 24 and the coupling member 23 back to a position determined by the guiding surface 2a in the lock cylinder in which the coupling recess and coupling member are at the position of the recess 22a in the guiding disc 22. In this case, when the key is turned further, the coupling member 23 moves into the recess 22a

against the force of its spring 29 urged by the guiding surface 24a in the coupling recess 24 (cf. Figures 12 and 10) and prevents again turning of the locking disc 9" when the key is turned in the opening direction of the locking mechanism. At the same time the spring 26 urges the actuating member 25 out against the locking disc 9" and the actuating member 25 is turned back into the initial position according to Figure 4 due to the changed polarity of the electromagnet 18".

The operation of the actuating member 25 does not necessarily need a separate spring 26 since a corresponding operation can be accomplished through suitable design of the end 25a and of the counter surfaces in the body part cooperating therewith.

There are many alternative ways of providing a coupling for the special locking disc. One further way could be based on the embodiment of Figure 3 but modified according to the embodiment of Figures 4 to 12 so as to make use of an angular turning range of the special locking disc for releasing the lock mechanism to be less than the whole turning range of the key for selecting the opening combination. Then, at the initial position, the special locking disc would always be coupled to the control unit by means of a coupling member located in the control unit and, for example, a permanent magnet located in the lock body or in a guiding disc or the like so as to be turnable together with it by means of the key. In the absence of a correct code, the special locking disc would be turned continuously beyond the correct turn for "releasing". On the other hand, on the occurrence of a correct code, the electric operating means would be activated so as to disengage the coupling after a certain turning angle when the special locking disc is moved out of the effective magnetic field of the permanent magnet. Thereafter the locking disc could be further moved a correct turning angle, i.e. less than the full range of turning, by means of an additional protrusion

arranged in the control unit so as to place it at the correct position for releasing the locking mechanism.

In addition to the lock mechanism shown in Figure 1, the invention may of course also be applied to a number of other types of cylinder lock mechanisms based on rotatable locking discs, for instance the conventional cylinder lock mechanism, which does not include a return bar 8, and in which return of the locking discs to their initial positions is accomplished directly by the key of the lock, as well as bi-directionally operable locking disc mechanisms.

In addition the invention may be applied to entirely different cylinder lock mechanisms such as so-called pin tumbler mechanisms. Since in this case the lock cylinder is not hollow in the same way, the control unit and the special locking disc should be located at the end of the cylinder barrel outside thereof. In addition a separate locking member arrangement is required for the special locking disc, for instance a member corresponding to the locking bar, which acts on both the control unit and on the special locking disc so that it does not allow turning of the lock cylinder and the control unit to the final end position as required by the application in each case without turning the special locking disc correspondingly a selected turning angle so as to make releasing of the locking bar possible. Hence also in this case the lock cannot be opened by a key provided merely with a correct mechanical opening combination, even if the lock cylinder could be turned somewhat. The lock can only be opened if a correct electronic key code is fed and, as a consequence thereof, power supply to the electromagnetic means in the control unit is connected, whereby the special locking disc turns with the key and the control unit into a position in which the locking bar or the like is released so as to allow further turning of the members.

Thus, the invention is not restricted to the embodiments shown, but several modifications are feasible within the scope of the attached claims.

Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

The claims defining the invention are as follows:

1. A cylinder lock arrangement including an electromechanical cylinder lock and a key therefor, the lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which is adapted to be moved by means of said key into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby said key includes means for transmitting an electronic code and the lock correspondingly includes means for receiving and identifying the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key; wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc; coupling means for coupling said at least one locking disc to the turning movement of the key, and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

2. The cylinder lock arrangement according to claim 1, wherein the lock body is provided with a control unit turnable continuously with the key and on which said electric operating means are arranged.

3. The cylinder lock arrangement according to claim 2, wherein the control unit is provided with a key channel having a cross-section which corresponds to the cross-sectional profile of a shank part of said key, and wherein the control unit further includes said means for receiving and identifying the key code.

4. The cylinder lock arrangement according to claim 2 or claim 3, wherein said key for the lock is provided with a power source and first electric contact means and wherein said control unit includes second electric contact means which are arranged to cooperate with said first electric contact means and, after identification of a correct electronic key code, to connect current from said power source to said electric operating means.

5. The cylinder lock arrangement according to claim 4, wherein the second electric contact means are located inside the key channel.

6. The cylinder lock arrangement according to any one of claims 2 to 5, wherein the turning range of the control unit and said at least one locking disc is limited with regard

to the lock cylinder.

7. The cylinder lock arrangement according to any one of claims 2 to 6, wherein the control unit is provided with protrusion means which acts on said locking disc and which is arranged to return said locking disc together with the control unit and the key to the initial position of the locking mechanism.

8. The cylinder lock arrangement according to any one of claims 2 to 7, wherein said electric operating means includes electromagnetic means and wherein said at least one locking disc includes ferromagnetic material and is located in the immediate vicinity of the control unit.

9. The cylinder lock arrangement according to any one of claims 2 to 7, wherein said electric operating means include coupling means operated by electromagnet means and which is movable from a free, non-coupling position into a coupling position in which it is arranged to mechanically engage said locking disc so that, when the control unit is turned by means of the key, said locking disc turns together with the control unit.

10. The cylinder lock arrangement according to any one of claims 2 to 6, wherein said at least one locking disc is provided with a spring-loaded coupling member which is movable transversely with regard to the turning movement of the locking disc between two end positions in which it protrudes from said locking disc, and wherein said electric operating means is arranged to control movement of said coupling member for controlling turning of said locking disc.

11. The cylinder lock arrangement according to claim 10, wherein said electric operating means include an actuating member which is operated by electromagnet means and is turnable between two angular positions so that in one of its angular positions the actuating member is movable in an axial direction, and wherein the actuating member is arranged in cooperation with said coupling member for controlling turning of said locking disc.

12. The cylinder lock arrangement according to claim 11, wherein said control unit includes a coupling recess towards which said coupling member is urged by a spring for entry into the coupling recess, and wherein said coupling recess is arranged at the position of said actuating member.

13. The cylinder lock arrangement according to claim 12, wherein at an initial position corresponding to the insertion position of the key, the coupling member is located at a distance of a certain turning angle from said coupling recess so that the coupling member and the coupling recess are opposite to each other when the key is turned in the lock from its initial position through said turning angle.

14. The cylinder lock arrangement according to claim 13, wherein said angle is about 45°.

15. The cylinder lock arrangement according to any one of claims 10 to 14, wherein the lock includes a guiding disc which is located beside said at least one locking disc on the opposite side with regard to the control unit, and wherein the guiding disc is non-turnably connected to the lock cylinder and includes a coupling recess into which the coupling member is pressed against the force of its spring in the initial position of the key thereby preventing turning of the locking disc.

16. The cylinder lock arrangement according to any one of claims 2 to 14, in which the lock cylinder of the lock includes an axial slot and a set of locking discs mechanically turnable by means of said key, said locking discs being located inside the lock cylinder and each being provided with a peripheral notch determining the opening combination of the lock, whereby the locking means further includes a locking bar which, in its locking position, together with the locking discs prevents turning of the lock cylinder with regard to the lock body and which is movable into a releasing position allowing said turning when the locking discs are first turned by means of the key into positions in which the peripheral notches thereof form a uniform channel at the position of the locking bar and said slot in the lock cylinder, wherein said control unit is located inside the lock cylinder and includes a groove corresponding to the peripheral notches of the locking discs for receiving the locking bar of the lock.

17. The cylinder lock arrangement according to any one of claims 1 to 9, wherein the locking means determining the turning of the lock cylinder with regard to the lock body include a pin tumbler mechanism known as such.

18. An electromechanical cylinder lock including a lock body and, inside the lock body, a turnable lock cylinder and a locking mechanism including locking means which normally prevent turning of the lock cylinder relative to the lock body and which an adapted to be moved by means of a key of the lock into a releasing position allowing turning of the lock cylinder relative to the lock body, whereby a key for the lock includes means for transmitting an electronic code and the lock correspondingly includes means for

receiving and identifying the code of the key so that, on identifying a correct code, said code receiving and identifying means allow mechanical opening of the lock by means of the key, wherein the lock further includes at least one locking disc with a key opening which is so designed that turning of the key does not directly act mechanically on the locking disc, coupling means for coupling said at least one locking disc to the turning movement of the key; and electric operating means activated by means of the electronic code from the key and which, in the active state, control said coupling means so that said at least one locking disc turns with the key into a position required for the opening of the locking mechanism.

19. A cylinder lock arrangement as claimed in claim 1, substantially as described herein with reference to the accompanying drawings.

20. An electromechanical cylinder lock as claimed in claim 18, substantially as described herein with reference to the accompanying drawings.

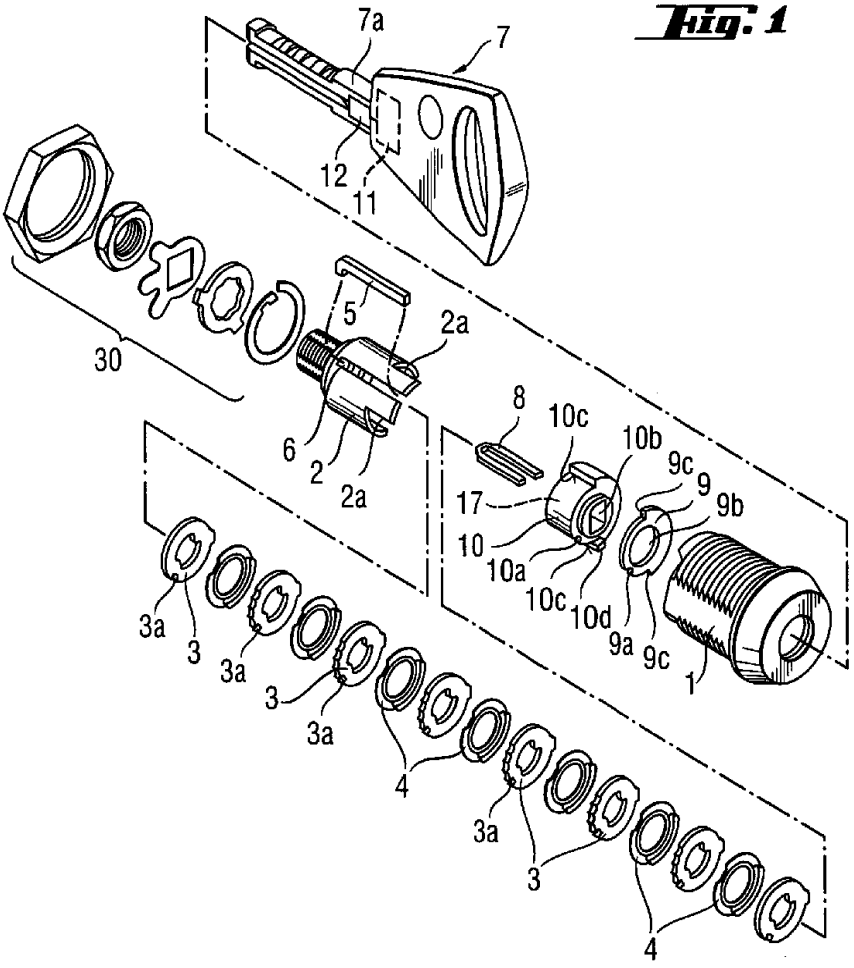
DATED this 30th day of August , 2002

ABLOY OY

By their Patent Attorneys:

CALLINAN LAWRIE

Fig. 1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7
12
11
30
5
2a
6
2
2a
8
10c
10b
9c
9
9b
17
10
10a
10c
10d
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9c
1
3a
3
3a
3
3a
4
3a
3
4

Fig. 2

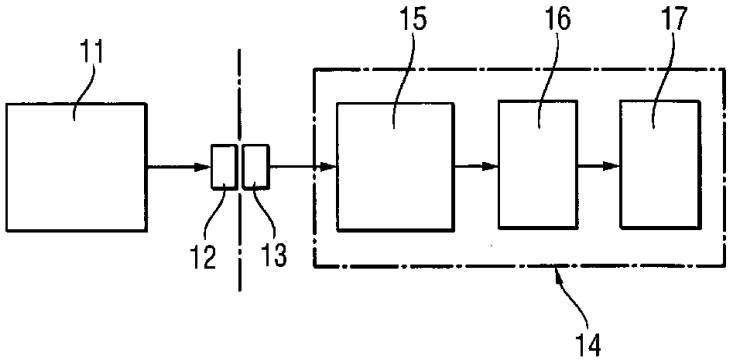


Fig. 3

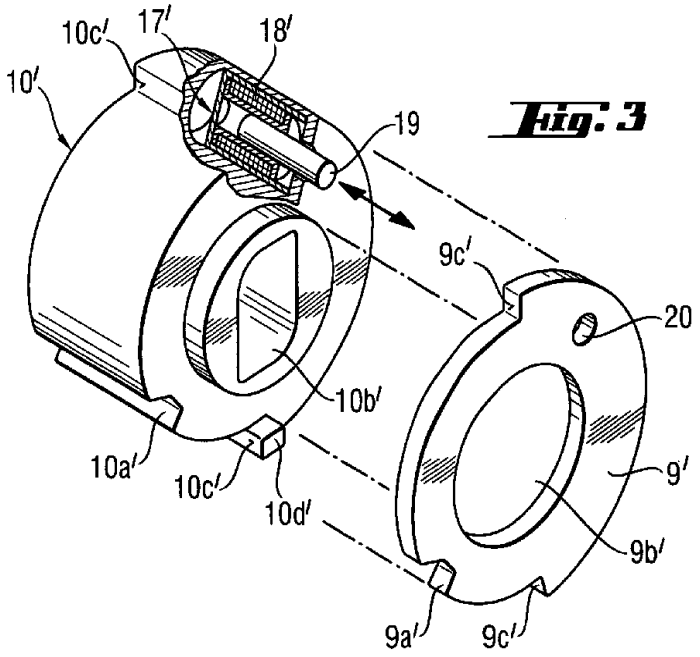
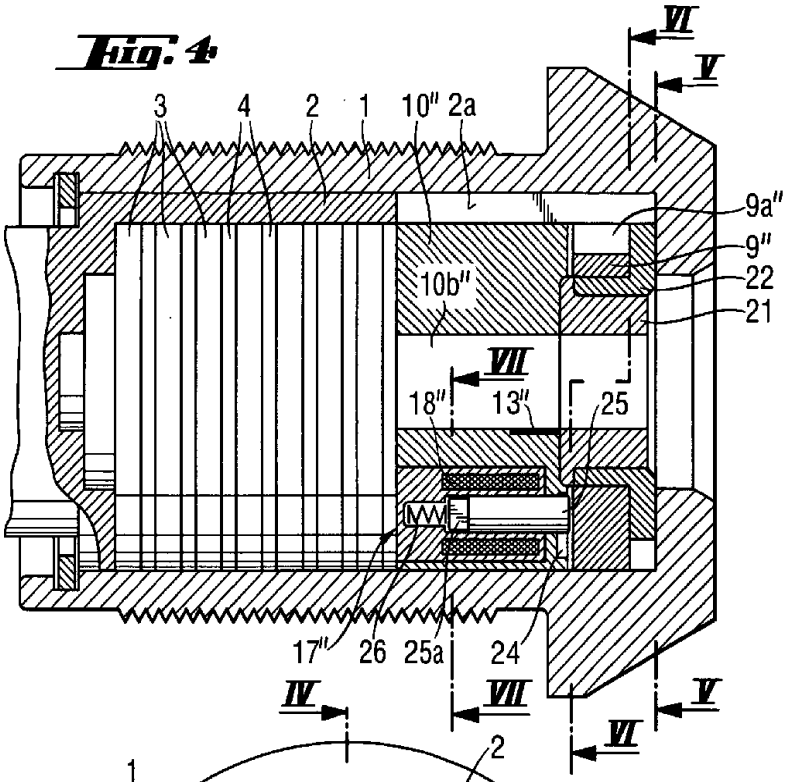
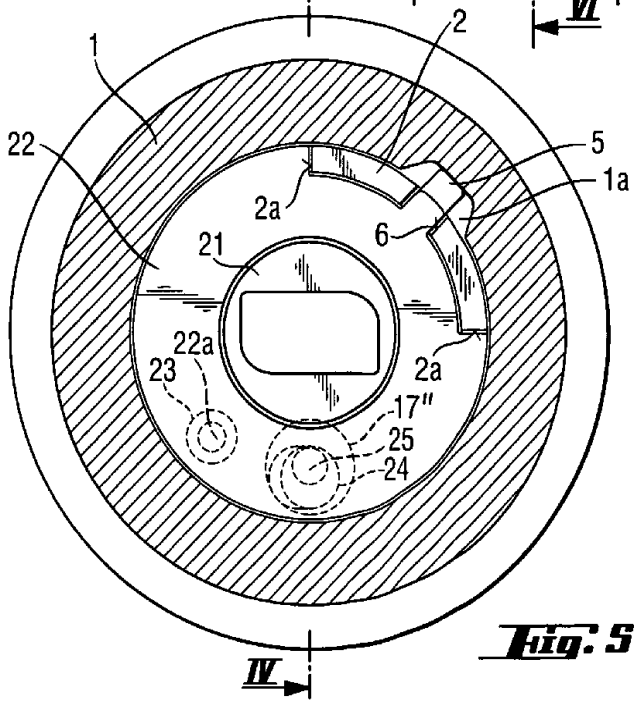


Fig. 4


VI
V
3
4
2
1
10"
2a
9a"
9"
22
21
10b"
VII
18"
13"
25
17"
26
25a
24
IV
VII
V
VI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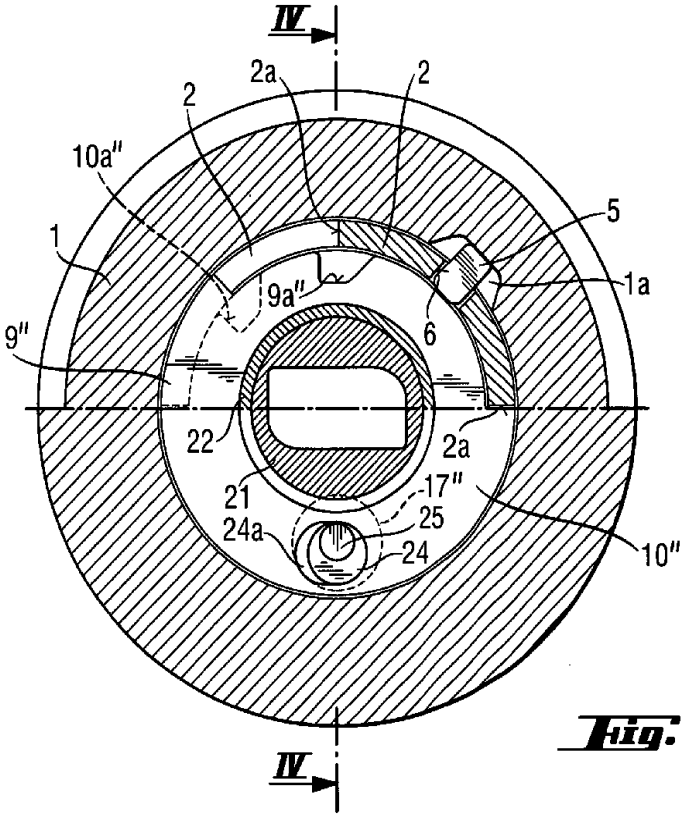
1
22
5
1a
2a
6
21
22a
23
2a
17"
25
24
IV

Fig. 5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2a
2
2
10a"
1
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5
1a
9"
6
22
2a
21
17"
25
24a
24
10"
IV

Fig. 6

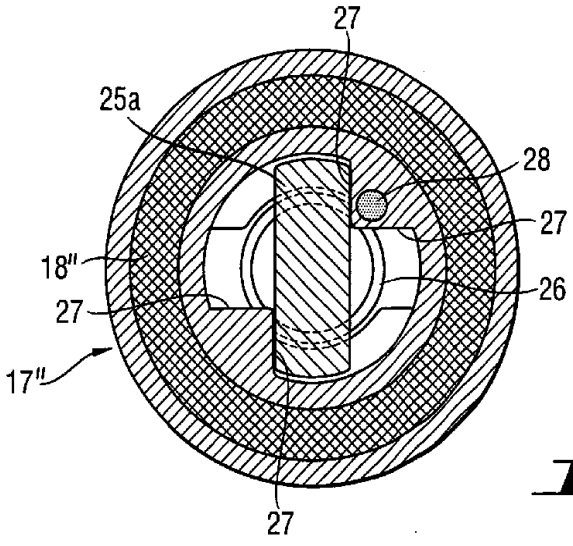
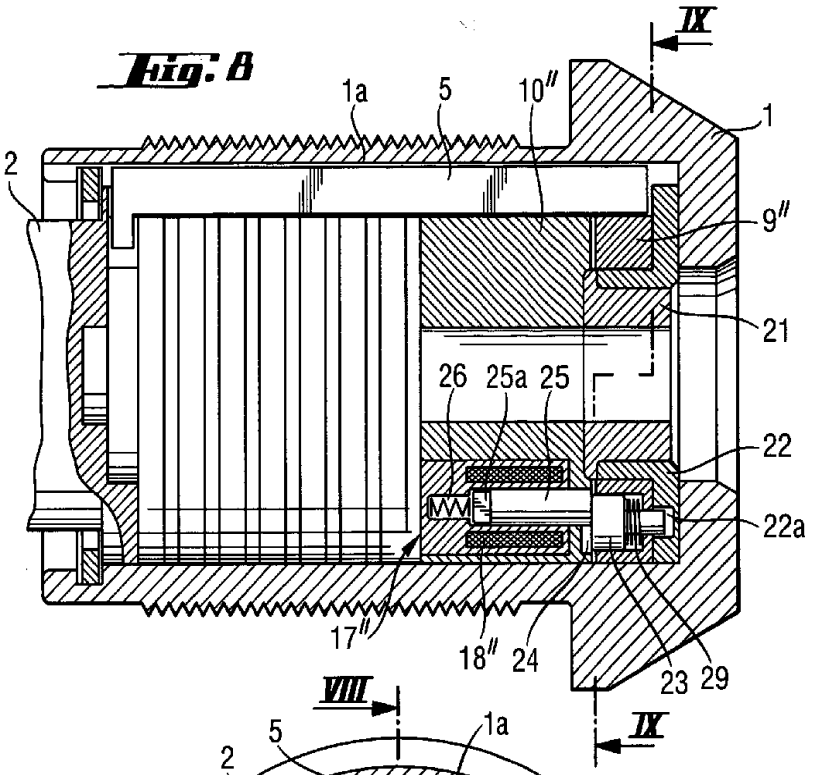

27
25a
28
27
18"
26
27
17"
27

Fig. 7

Fig. 8


IX
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1
2
9″
21
26
25a
25
22
22a
17″
18″
24
23
29
IX

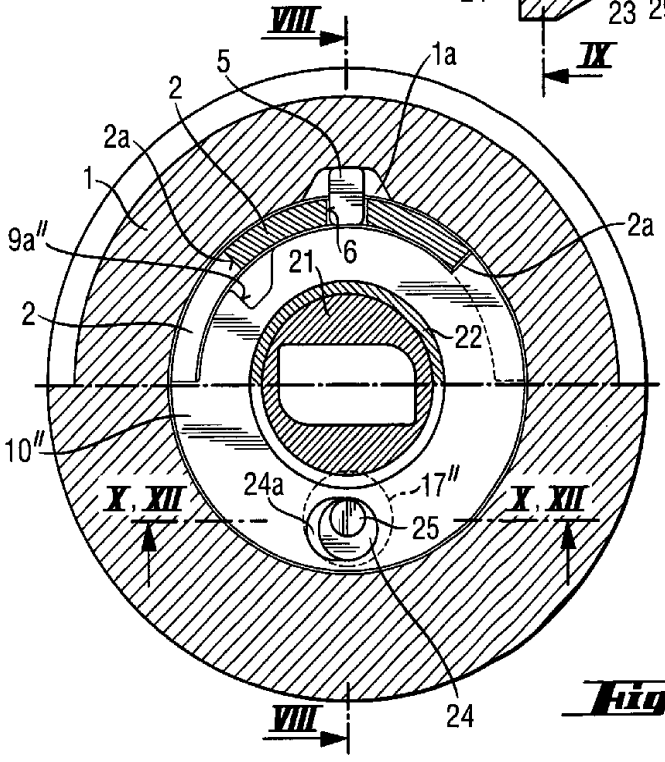
VIII
5
1a
2
2a
1
9a″
6
21
2a
2
22
10″
X, XII
24a
17″
25
X, XII
24
VIII

Fig. 9

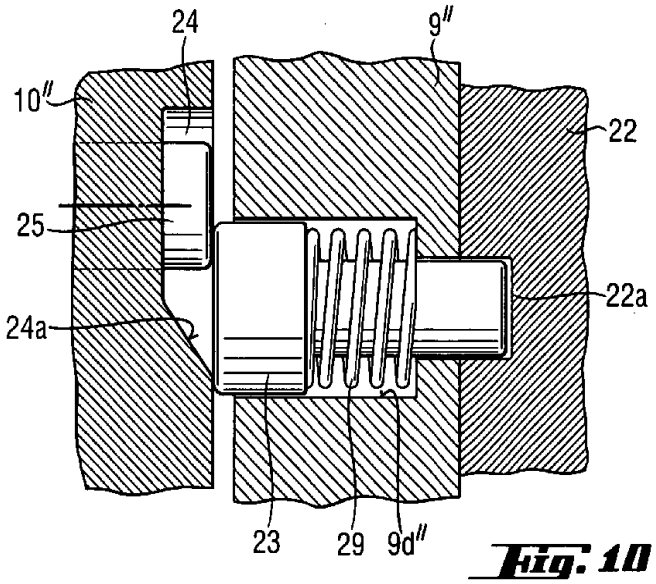
24
9''
10''
22
25
22a
24a
23
29
9d''

Fig: 10

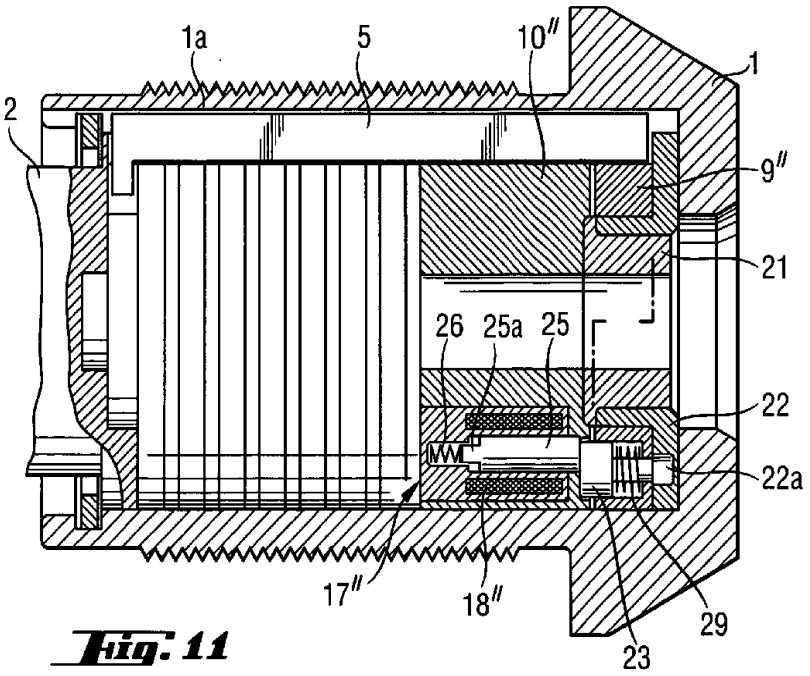
1a
5
10''
1
2
9''
21
26
25a
25
22
22a
17''
18''
29
23

Fig: 11

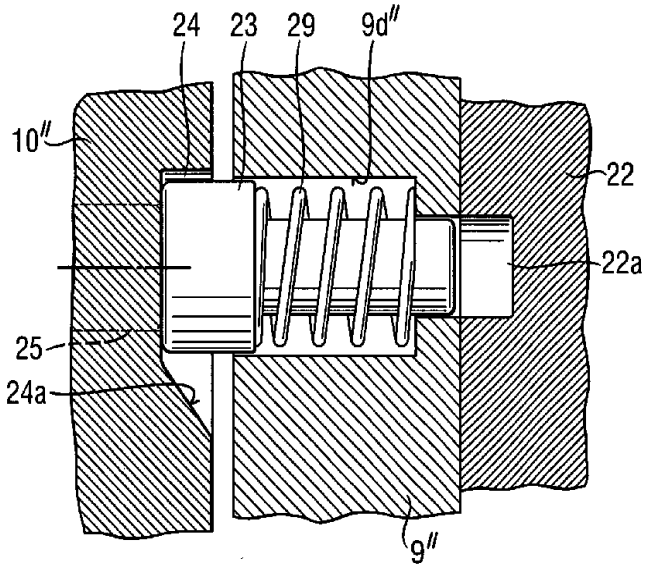

Fig. 12