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(54) **Lock cylinder for driving a lock latch**

Schließzylinder zum Antrieb eines Riegels

Cylindre de serrure pour commander un loquet de verrouillage

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(56) References cited:
**EP-A1- 1 707 712 EP-A2- 1 323 880
WO-A1-00/28179 WO-A2-2005/033446
DE-A1- 2 807 080 DE-A1- 19 609 400
GB-A- 2 166 484 GB-A- 2 264 976
US-A- 3 889 501 US-A- 4 090 175**

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Description

Field of the invention

[0001] The present invention concerns an electronic lock cylinder suitable for replacing mechanical cylinders of known Yale type locks.

State of the art

[0002] Current mechanical cylinder locks, i.e. so-called Yale type locks, although they are able to reproduce a large number of combinations - indicatively at least equal to a few thousand - over the years have proven to be highly vulnerable to break-in, performed with various kinds of techniques like for example key bumping, duplication through remote photography, opening through mechanical passe-partout key.

Therefore, electronic locks have later been developed that are increasingly reliable, with better performance from various points of view, for example with increasingly difficult-to-discover combinations, greater flexibility of programming and reprogramming, greater freedom in managing the opening of the same lock with different keys and opening combinations. However, in order for known electronic locks to obtain the above performance they are much more expensive than standard mechanical locks, and are often not interchangeable with the latter ones. Therefore, known electronic locks are currently used in specific niche markets such as hotels or workplaces, in which the doors are specially made to mount them.

Therefore, it would be desirable to be able to make more secure the locks already installed on the outer doors of apartments, single houses, condominiums, gardens and any place in general in which it is necessary to limit and flexibly control access, by simply replacing the very common cylinders for mechanical keys of the Yale type with cylinders for electronic keys.

[0003] Such replacement is, however, hindered by various problems, including the fact that most of the cylinder locks currently installed are mounted on doors without electrical power supply; housing an electromechanical system that does not need external power supply in the small overall bulks of a current lock cylinder is currently very difficult or it involves extensive and expensive modifications to the door. In particular, it is extremely difficult to make an electromechanical system with a high degree of safety and reliability with energy consumption that is low enough to not require too frequent replacement of the batteries or of other standard storage cells normally on the market, indicatively no more than once per year, having such small sizes to be contained also in a complete standard mechanical construction -that is provided with a double-cylinder- and having also low cost.

As an example, the state of the art includes a solution (EP 1 707 712 A1, "Cylinder lock assembly with mechanical and electronic mechanism") that combines the clas-

sic mechanical code with an electronic code. The unlocking code is stored in an electronic circuit on the key that is powered by the cylinder through mobile and sliding electrical contacts, which are not very reliable because they suffer from wear and from the influence of environmental factors. The manufacturing cost of such key is higher than a simple passive key. This solution also allows the key to be inserted just at one end of the cylinder due to the presence of the battery, the motor and the decoding circuit at the other end.

In another example of the state of the art (WO 00/28179A1, "Improvements in or relating to key operated switches") an activation switch comprises a sensor for exclusively detecting the absence or the presence of the key and controlling the power supply of the locking/unlocking circuit in on/off mode. This means that the higher is the absorption of electrical energy, the longer is the time the key stays inserted in the cylinder. This solution is therefore unsuitable for replacing a classic mechanical cylinder when a battery-power is used; on the other hand, this solution is more suitable for the use with electrified and motorised locks, also by virtue of the circular section of the key and its housing that do not allow manual actuation of the bolt.

A last example of the state of the art (DE 28 07 080 A1, "Electromagnetisch betätigbares Sicherheitsschloß mit Schlüssel") describes a key that reproduces the unlocking combination through a plurality of windows all read at the same moment, when the key is completely inserted. This solution involves a high cost of the reading sensor and a high peak power absorption during the reading phase, unsuitable for being powered for a long time with a low-capacity battery, i.e. a small battery, capable of supplying only low peak currents. Moreover, with this solution it is extremely complex to manually actuate the bolt by rotating the key, since it would involve the rotation of the entire reading sensor.

[0004] GB 2166484 discloses a lock having a rotatable member (15) defining a key-slot (25). In the member, there are diodes for transmitting radiation across the key-slot and detectors (26,27) for receiving the radiation and thereby reading from the key (10) information represented in the key by alternating areas which are transparent to and which are opaque to the radiation emitted by the diodes. Rotation of the member (15) is normally prevented by engagement of a plunger (21) in a recess (20) in the member. The plunger can be withdrawn by a solenoid controlled by a controller (24). Circuits connecting the controller electrically with the diodes and with the sensors (26,27) include sliding contacts (28) on the member (15) and (29) on a stationary housing (14) so that the circuits are opened when the member 15 is turned.

[0005] A purpose of the present invention is to avoid the aforementioned drawbacks of the state of the art, and in particular to provide a cylinder for electronic key locks that can easily replace the lock cylinders for mechanical keys, for example so-called Yale locks, of locks that have already been installed.

Summary of the invention

[0006] In a first aspect of the invention such a purpose is achieved with a lock cylinder having the features according to claim 1.

None of the documents EP 1 707 712 A1, WO 00/28179A1 and DE 28 07 080 A1 teach how to make a lock provided for example with one or more reading sensors arranged to progressively detect, through exchange of electrical and/or magnetic and/or optical signals, the predetermined unlocking combination reproduced on a proper key when the latter is moving and is being inserted into the cylinder of the lock.

In a second aspect of the present invention, a lock cylinder having the features according to claim 14 is provided.

Further characteristics of the device are the object of the dependent claims.

The advantages that can be obtained with the present invention will become clearer, to the man skilled in the art, from the following detailed description of some particular non-limiting embodiments, illustrated with reference to the following schematic figures.

List of Figures

[0007]

Figure 1 shows a perspective view of the inside of a lock and corresponding electronic key according to a first embodiment of the invention;

Figure 2 shows a perspective view of the outside of the lock cylinder of the lock represented in Figure 1; Figure 3 shows an exploded view of the lock cylinder of Figure 2;

Figure 4 shows a diagram of the electrical circuit of the lock cylinder of Figure 2;

Figure 5 shows a perspective view of the lock cylinder of Figure 2, in partial cross-section along a longitudinal plane;

Figure 6 shows a perspective view of a first embodiment of an electronic key suitable for actuating the lock of Figure 1;

Figure 7 shows the front view of the outer housing of the lock cylinder of Figure 2;

Figure 8 shows an electrical diagram of a second embodiment of an electronic key suitable for actuating the lock of Figure 1.

Detailed description

[0008] Though the first and second embodiments are described in respect of a lock and a key, it is to be noted that the invention as claimed is directed to the lock cylinder only.

[0009] Figures 1-7 relate to a lock and related electronic key according to a first embodiment of the invention. In the present description, by cylinder lock, unless spec-

ified otherwise, a lock is meant of the type commonly indicated in the jargon as "Yale lock" or rotary drum lock. This kind of lock generally comprises an outer housing, a rotary drum inside the drum and one or more mechanical locking/unlocking elements that, when the correct key is inserted in the drum, move transversally to the axis of the latter, allowing it to rotate.

Yale or cylinder locks can be divided into different varieties, including the pin tumbler lock, wafer tumbler lock, disc tumbler lock. By cylinder of a Yale or cylinder lock type in the common technical jargon an assembly is meant comprising the mechanism that recognises whether a correct key is inserted in it and authorises the rotation of the inner drum with respect to the outer housing of the cylinder; in the embodiment of Figure 1 the cylinder is indicated with the overall reference numeral 1 (Figure 2). The lock cylinder 1 comprises a cylinder housing 3 and a driving pin 5A, 5B housed in the cylinder housing 3. The cylinder housing 3 and the driving pins 5A, 5B are called, in the technical jargon, "fixed cylinder"/"cilindro fisso" and "sprocket"/"rocchetto", respectively. In the driving pin 5A, 5B a key seat 7 is provided that is suitable for receiving a key 9, on which the reproduction of a predetermined unlocking combination is formed (Figure 3). On the cylinder housing 3 a key opening 2 is formed so to act as a keyhole of the lock, and through which the key 9 can be introduced into the key seat 7 (Figure 2).

[0010] According to an aspect of the invention the lock cylinder 1 is provided with a logic circuit which in turn comprises:

- a reading sensor suitable for detecting, through exchange of electrical and/or magnetic and/or optical signals, the predetermined unlocking combination reproduced on the key 9 when the latter moves and is inserted into the lock cylinder 1, thus starting to detect it when the key has not yet completed its insertion stroke;
- a logic unit 11 programmed or anyway suitable for receiving the output signals of the reading sensor, checking, based on these signals, whether the predetermined unlocking combination corresponds to a predetermined opening combination stored in the logic unit and, in the affirmative case, allowing the driving pin 5A or 5B to actuate the lock bolt 13, in which the cylinder 1 is mounted, by rotating on itself (Figures 1-3); in order to do this, preferably the driving pin 5A, 5B rotates on itself around its longitudinal axis. The insertion stroke is the one the key must carry out in order to unlock the lock, for example to allow the logic unit or more generally the lock to completely read the predetermined unlocking combination.

The reading sensor can be arranged to detect the predetermined unlocking combination reproduced on the key 9 when the latter is at least partially inserted in the

key seat 7.

[0011] The logic unit 11 can consist of, or in any case comprise, a suitable programmable microprocessor. The reading sensor preferably comprises:

- one or more emitters 170A arranged for emitting suitable detection radiations;
- one or more receivers 170B arranged for receiving the detection radiations filtered by the key 9 at least partially inserted in the key seat 7 or anyway in the keyhole 2, where the key 9 is arranged to filter the detection radiations so as to reproduce the predetermined unlocking combination.

Preferably, the emitters 170A and the receivers 170B are respectively arranged to emit and receive an electromagnetic radiation in the band of wavelengths comprised between infrared and ultraviolet inclusive, i.e. indicatively between 1mm and 0.1 μ m. More preferably, the emitters 170A and the receivers 170B are respectively arranged to emit and receive infrared radiation, i.e. with wavelength indicatively comprised between 0.7 μ m-1 mm, and even more preferably comprised between 0.7 μ m - 1.6 μ m, moreover making the emitters 170A and the receivers 170B less sensitive to environmental disturbances. Further advantages of this choice will be outlined hereafter.

[0012] Each emitter 170A can be or comprise for example an LED, whereas each receiver 170B can be or comprise for example a photo cell, a photo diode, a phototransistor or CCD or CMOS photodetectors.

Advantageously, one or more of the following elements is housed in the cylinder housing and is integral with it, and is also arranged outside of the driving pin, not mounted on it but integral with the outer housing 3: the logic unit 11, the reading sensor 170A, 170B, the one or more emitters 170A, the one or more receivers 170B. By doing so, all of the logic circuit of the lock cylinder 1 can be fixed and integral with respect to the outer housing 3, so to significantly simplify the power supply and signal wiring that connect the various electronic components of the logic circuit thus allowing a circuit arrangement much more compact, simpler and less bulky; the driving pin 5, which rotates with respect to the housing 3, can completely avoid the use of electrical or electronic circuits and components, it is extremely simple to be manufactured and does not pose any problem for power supply and electrical connection.

Advantageously, the reading sensor comprises a plurality of emitters 170A and a plurality of receivers 170B, and both the emitters 170A and the receivers 170B are arranged on at least one row that extends transversally, and more preferably perpendicular, to the insertion direction D1 of the key 9 in the key seat 7 or in any case in the keyhole 2 (Figures 2, 3), allowing the emitters 170A and the receivers 170B to be made less bulky.

[0013] Advantageously, as we will explain better hereafter, the emitters 170A are arranged in front of the receivers 170B so as to be able to irradiate them directly

with a rectilinear trajectory, allowing the circuitry of the reading sensor to be sensibly simplified, increasing its reliability and also allowing the construction of the key 9 to be simplified.

- 5 Advantageously, the one or more emitters 170A, the one or more receivers 170B - or more generally the reading sensor - and the logic unit 11 are arranged to read the combination of the key 9 when the latter is in movement - at least with respect to the one or more emitters 170A, to the one or more receivers 170B, or more generally, to the reading sensor - and it is inserted in the key seat 7 or in any case in the keyhole 2; this allows a smaller number of emitters 170A and receivers 170B to be used with respect to the number of encoding windows present on the key, since with a few sensors it is possible to read many windows in sequence; by doing so, the peak absorption is reduced and the space available inside the housing of the cylinder 3 and the autonomy of the cylinder is increased. Indeed, the emitters 170A and the receivers 170B can be arranged on just two rows (arrays), one for the emitters and one for the receivers, limiting the needed number of emitters and receivers for example with respect to a matrix of emitters/receivers the rows and columns of which extend over the entire side of the key 9 to read it only when it is completely inserted. Moreover, starting to read - for example progressively - the combination of the key when the latter is still moving while it is inserted makes it possible to execute in advance the validation procedure of the combination, reducing the waiting time before being able to rotate the key.

[0014] For this purpose, the emitters 170A and the receivers 170B are preferably arranged close to the opening 2 that forms the keyhole of the lock, so as to be able to start reading as early as possible the combination of the key 9 as soon as it begins to be inserted in the keyhole 2. Moreover, even the arrangement of the emitters 170A and the receivers 170B close to the opening 2 allows the layout of the logic circuit to be optimised and made less bulky.

[0015] In order to improve the reliability of reading the combination of the key when the latter is in movement, advantageously the one or more emitters 170A, the one or more receivers 170B and the logic unit 11 are arranged to read the combination of the key 9 with a so-called majority vote algorithm, i.e. the emitters 170A emit impulses of detection radiations with sufficiently high frequency so to allow the receivers 170B to carry out many readings, preferably at least three, and even more preferably at least ten, of each window 96 of the key 9 that passes in front of them when the key is being inserted in the keyhole 2. The reading with majority vote algorithm reduces the probability of incorrect readings of the combination reproduced by the key, it can be implemented with few instructions of a software program residing inside the cylinder and it can involve very low energy consumption.

[0016] In order not to need an external power supply, in the cylinder housing 3 an electrical power supply 19

is housed, arranged for powering one or more of the logic unit 11, the one or more emitters 170A and the one or more receivers 170B; advantageously, the electrical power supply 19, which can for example be a battery or another storage cell of electrochemical energy, is fixed to the housing 3 or in any case it is integral with it, contributing to make the electronic circuit that implements the logic circuit of the cylinder 1 more compact, less bulky and simple.

The logic circuit is provided with an activation switch 15 arranged to activate the logic unit 11 when the key 9 is close to the lock cylinder or partially inserted in the key seat 7 or in the key opening 2, making the logic unit 11 pass from a first stand-by operating mode, i.e. with zero or reduced energy consumption, to one or more higher energy consumption operating modes. There can for example be two higher energy consumption operating modes: a so-called wake-up operating mode and a fully operating mode. In the fully operating mode the logic unit 11 performs all the functions needed to control the motor while engaging or disengaging - or in general actuating - the driving pin 5A and/or 5B, the power consumption of the logic unit 11 can be very high but preferably for a very short time interval, for example not longer than 3 seconds. In the wake-up operating mode the logic unit 11 performs the functions needed to switch from the stand-by operating mode to the fully operating mode and the power consumption of the logic unit 11 is preferably kept at a medium level, lower than power consumption at fully operational mode and for very short time periods, for example not longer than 3 seconds. In the stand-by operating mode, wherein the possible one or more clutch motors 27A, 27B are inactive and not supplied with power, the activity of the logic unit 11 is reduced to the bare minimum for detecting the insertion of the key 9 in the lock cylinder 1; preferably in stand-by the clock frequency of the logic unit 11 is also reduced. In stand-by, the state in which generally and advantageously most of the operating life of the lock cylinder 1 is spent, the power consumption of the logic unit 11 is preferably reduced to the minimum, for example to not more than 1% of the power consumption during wake-up or fully operational mode. The power consumption of the logic unit 11 in stand-by can for example be equal to or less than 50 μ W, or in any case not more than a few tens of μ W.

[0017] Advantageously, the activation switch 15 is a normally-open type. For this purpose the switch 15 can comprise or consist of one or more reed contacts capable of opening or closing in the presence of a magnetic field or in any case of a variation of the magnetic field in which the contacts are immersed. Preferably, when the key 9 is not inserted in the lock cylinder 1, the reed contacts are open, so as not carrying current and reduce power consumption of the logic unit 11 in stand-by.

[0018] Advantageously, the logic circuit comprises two boards or plates for electronic circuits 21A, 21B arranged facing one another; the one or more emitters 170A are fixed on one of the two boards or plates, for example 21a,

whereas the one or more receivers 170B are fixed on the other of the two boards or plates, for example 21B (Figure 5): such an arrangement sensibly simplifies the practical embodiment of the logic circuit, for example making it much easier to face the emitters 170A and the receivers 170B opposite one another. In general, the contraposition of the plates 21A, 21B makes it possible to greatly simplify the paths and the connections of the tracks that supply the various components of the logic circuit or transmit the related signals, and in order to allow the interconnection of electrical power supply or signals between the two plates it may be sufficient to use dedicated pins or a suitable connector.

[0019] Advantageously, each pair of boards or plates for electrical circuit 21A, 21B is separated, in the direction perpendicular to the insertion and extraction direction of the key, by an empty space in which the electrical power supply 19 is housed (Figure 5): this arrangement also greatly contributes to simplify the logic circuit, and in particular its power supply or signal tracks, as well as reducing the overall size of the circuit itself, allowing larger and higher capacity batteries 19 to be housed in the cylinder housing 3. Advantageously, the electrical contacts that touch the power supply 19 supplying its energy to the rest of the logic circuit of the cylinder 1 are arranged one on a power supply plate 21A or 21B, the other contact on the other facing power supply plate, 21B or 21A respectively, further simplifying the circuit.

[0020] Advantageously, an opening 35 is formed on the cylinder housing 3 arranged on the front or rear face of the lock cylinder 1, so as to face onto the empty space between the two boards or plates for electrical circuits 21A, 21B, allowing access and allowing the storage cell 19 to be easily replaced, with a very basic and compact electro-mechanical construction.

In order to be able to open and close a door with a key from both sides, it may be useful to have a lock cylinder like that of Figure 5, provided with two driving pins 5A, 5B able to be actuated one by inserting a key for example from outside a home, and the other from inside.

[0021] Advantageously, the lock cylinder 1 comprises an actuating clutch arranged for:

- mechanically engaging with at least one of the driving pins 5A, 5B allowing the latter to actuate, e.g. by rotating on itself, the bolt 102 of the lock 100 in which the lock cylinder 1 is mounted, when the logic unit 11 detects that key 9 that reproduces an unlocking combination equal to one of the predetermined opening combinations stored in the logic unit 11 is at least partially inserted in the key seat 7 or in any case in the keyhole 2; and
- mechanically disengaging from at least one of the driving pins 5A, 5B preventing it from actuating, e.g. by rotating on itself, the bolt 102 when the logic unit 11 does not detect that a key 9 that reproduces an unlocking combination equal to the opening combination stored in the logic unit 11 is at least partially

inserted in the key seat 7 or in any case in the keyhole 2.

[0022] As shown in Figure 5, the actuating clutch can comprise one or more sliding shafts 23A, 23B, each of which is arranged to engage and disengage reversibly with a corresponding driving pin 5A, 5B translating along its axis (arrow D2). Each sliding shaft 23A, 23B can be permanently engaged with the bolt actuation tooth 25, so as to be able to actuate it.

The lock cylinder 1 is advantageously provided with one or more clutch motors 27A, 27B each of which is arranged to move a corresponding sliding shaft 23 under the control of the logic unit 11.

As shown in Figures 4, 5, each clutch motor 27 can actuate the corresponding sliding shaft 23A, 23B through a speed reducer comprising the gear wheels 29A, 29B; 31A, 31B and the screw/nut screw mechanism 33A, 33B.

[0023] Figure 6 shows an embodiment of a key 9 that is particularly advantageous and suitable for being used to actuate a lock cylinder 1 according to the invention.

The key 9 comprises a control head 90, a shank 92 narrower than the control head 90 and preferably a gripping end 94, wider than the shank and arranged to be gripped.

The control head 90 is preferably shaped substantially like a plate or parallelepiped, and more preferably like a more or less squashed parallelepiped. On the control head 90 a plurality of windows 96 is preferably formed, some of which can be crossed by detection radiations - i.e. they are transparent to radiation -, whereas the material that surrounds them is more opaque to such radiations. The transparent windows 96 are arranged so that the detection radiations emitted by one of the emitters 170A after having crossed a corresponding window 96 strike one of the receivers 170B. Preferably, the windows 96 are aligned according to a plurality of rows 90R and columns 90C.

[0024] Preferably, the number of rows 90R and/or columns 90C is equal to or greater than three. For example, the number of rows 90R can be comprised between 4 and 5, and the number of columns 90C between 4 and 10. Such numbers of rows and columns allow a key to compose a sufficiently large number of opening combinations; indeed, with three rows and three columns it is possible to compose more than 500 possible nominal opening combinations, with four rows and four columns it is possible to compose more than 65000 and with five rows and six columns it is possible to compose more than one billion, i.e. much more than the number of combinations (100,000) above which the standard EN 1303 classifies a lock at the maximum degree of safety.

[0025] Preferably, the unlocking combination reproduced by the key 9 is obtained by ensuring that part of the windows 96 are also opaque to the detection radiations. The number and position of the transparent windows 96 and of the opaque windows is preferably different in the various columns 90C, so as to greatly increase the number of possible combinations potentially able to

be reproduced by the key 9.

[0026] Advantageously, the transparent windows 96 are made from a material substantially opaque to visible light but transparent to non visible detection radiation, i.e. ultraviolet or infrared, emitted by the emitters 170A. Advantageously, each window 96 fills the corresponding cavity formed in the remaining part of the head 90 flush with the surface of the head itself. These last two solutions make windows 96 practically invisible to the naked eye, greatly reducing the possibility of copying the opening combination for example by taking a picture or casts of the key, or probing with tools inside the keyhole 2.

[0027] Advantageously, on the free end of the control head there is an activation element 98 arranged to activate the activation switch 15 when the control head 90 starts to enter into the keyhole of the lock 2 or into the key seat 7. The activation element 98 can be or can comprise for example a permanent magnet, an electromagnet or another generator of magnetic field or even just a piece of electrically and/or magnetically conductive material, depending on the type of activation switch 15 used. The choice of a permanent magnet has the advantage of not requiring a key 9 with batteries or other sources of internal energy and allows a switch to be used that does not have mechanical contacts with the key (contactless), providing advantages in terms of reliability of activation and much longer lifetime, thanks to the lower exposure to wear and to foreign agents; in this case preferably the activation switch 15 comprises or consists of reed contacts that are open in the absence of magnetic fields.

[0028] As an alternative the activation switch 15, besides reed contacts can comprise a permanent magnet that, when the key 9 is not inserted in the lock cylinder 1, keeps the reed contacts open - which in this case would be normally-closed type - whereas the activation element 98 preferably comprises a material capable of deviating the flux lines of the field of the permanent magnet enough to open the reed contacts when the key 9 is inserted into the cylinder 1. Mounting the permanent magnet on board of the lock instead of the key allows the costs of the system to be reduced, whilst still allowing a switch without mechanical contacts with the key (contactless) to be made.

[0029] Advantageously, the two smaller sides of the cross sections of the control head 90 are substantially shaped like an arrowhead or peaked (Figure 6), just as the smaller sides of the keyhole 2 of the cylinder correspondingly have such a shape (Figures 2, 7), so as to ensure the correct orientation of the key in the lock without occupying the useful surfaces of the key reserved for the encoding windows. In other embodiments that have not been shown however, the cross sections of the control head 90 of the key advantageously have a shape without axial, rotary, star-like or circular symmetries, so as to ensure that the key is inserted in the keyhole with a single and very precise orientation with respect to the insertion direction.

Preferably, the key 9 is purely passive and not powered

by any internal electrical or chemical energy source.

[0030] In order to be able to open and close a door with a key from both sides, as shown in Figure 5 a lock cylinder according to the invention can also be provided with two keyholes 2 and with some or all of the following items: two or more emitters 170A, two or more receivers 170B, two clutch motors 27A, 27B, two groups of gear wheels and of screws 29A, 31A, 33A; 29B, 31B, 33B. Advantageously, in order to reduce the energy consumption of the cylinder 1, both the emitters 170A, the receivers 170B and the clutch motors 27A, 27B are controlled by a single logic unit 11 and are powered by a single storage cell 19. For this purpose the logic circuit advantageously comprises a fifth board or plate for electronic circuits or flexible plate or flat cable 21C that mechanically fixes and electrically connects the two boards 21A and/or the two boards 21B together, according to the insertion and extraction direction of the key (Figure 5). Advantageously one or more electric conductors that electrically connect together the electrical and electronic components arranged on the two boards or plates 21A or 21B are arranged on the fifth board or plate, for example connecting the single storage cell 19 and/or the single logic unit 11 to both of the emitters 170A, both of the receivers 170B and/or both of the clutch motors 27A, 27B. Preferably, the fifth board 21C is already fixed to and integral with the two boards 21A and/or the two boards 21B before being inserted in the rest of the lock cylinder 1: this solution allows the assembly of the cylinder itself to be simplified.

[0031] A possible example of use and of operation of the lock cylinder 1 and of a lock on which it is mounted will now be described.

When the key 9 is not inserted in the keyhole 2 or in the key seat 7 of the lock, the contacts of the activation switch 15 are for example open, the logic circuit of the cylinder 1 is in the first stand-by operating mode with minimum energy consumption and the sliding shaft 23A is disengaged from the corresponding driving pin 5A.

[0032] If a key 9 is inserted in the keyhole 2 or in the key seat 7, the permanent magnet of the activation element 98 closes the contacts of the reed that acts as activation switch 15; the closure of the contacts is detected by the logic unit 11, which passes from the stand-by state to the wake-up state, and from this to the fully operational state. The logic unit 11 then activates the emitters 170A and the receivers 170B, starting to supply them with power, which start to progressively read the unlocking combination reproduced by the windows 96. More specifically, the emitters 170A and the receivers 170B detect the sequence of ones and zeros reproduced by the various columns 90C of the key as the columns slide in front of the emitters 170A and the receivers 170B, i.e. while the key 9 is moving to enter into the keyhole of the lock. If the logic unit 11 detects that the unlocking combination read by the receivers 170B is equal to one of the opening combinations stored in the unit 11 itself, it commands the unlocking of the cylinder 1 by actuating the clutch motor

27, which through the gear wheels 29A, 31A and the screw mechanism 23A makes the sliding shaft 23A translate, engaging it with the driving pin 5A and keeping it simultaneously engaged with the bolt actuation tooth 25.

Therefore, by rotating the driving pin 5A by turning the key 9 inserted in the key seat 7 it is now possible to rotate - or in any case actuate - the tooth 25 and open or close the bolt of the lock 102. If the key 9 is extracted from the lock, or in any case from the keyhole 2 or from the key seat 7, preferably the logic unit 11 is programmed or in any case arranged to disengage again the driving pin 5A from the sliding shaft 23A, once again preventing the actuation of the tooth 25 rotating the driving pin 5A.

[0033] If a key 9 that reproduces an unlocking combination different from the opening combination, or from one of the opening combinations, stored in the logic unit 11 is inserted into the keyhole 2 or into the key seat 7, or a tool is inserted that does not reproduce any combination that can be read by the receivers 170B, even if the activation switch 15 closes - or in any case activates - the logic unit 11 is arranged, or in any case programmed, to keep the driving pin 5A disengaged from the sliding shaft 23A, making it rotate idly and preventing actuation of the tooth 25 acting on the driving pin 5A. Similarly, the driving pin 5A stays disengaged from the sliding shaft 23A even when a key, or other tool, not able to close, or in any case activate, the activation switch 15 is inserted into the keyhole 2 or into the key seat 7. Advantageously, the logic circuit is arranged to go back to the first zero or reduced consumption mode (stand-by) for example in one or more of the following situations:

- after it has correctly detected the unlocking combination of the key, and the driving pin 5A and/or 5B is enabled to actuate the bolt;
- after a predetermined time period has passed since the key 9 was completely inserted into the lock cylinder 1 without the logic unit having read the correct unlocking combination on the key (time out procedure);
- after a predetermined time period has passed since the cylinder 1 left the null or reduced consumption condition.

These last solutions also contribute to substantially reduce the energy consumption of a lock according to the invention, for example avoiding running down the batteries 19 by simply leaving the key 9 inserted in the cylinder 1, even in unlocked condition, for an indefinite time. This behaviour allows the use of the key 9 and the behaviour of the cylinder 1 to be made very similar to that of a classical mechanical key and cylinder.

[0034] It is clear how the previous teachings allow to make an electronic lock cylinder with an external Yale profile without external power supply, having very low power consumption, great energy autonomy even without external power supply - indicatively, such as to require replacement of the batteries even only once every 1-2

years - and great safety and resistance to unauthorised attempts to break in or to duplicate the key.

[0035] Indeed, the choice to activate the lock cylinder 1 by making it pass to the higher consumption mode only when the key 9 is inserted greatly reduces the energy consumption of the cylinder, since the latter stays in the first minimum energy consumption operating mode, i.e. stand-by, on average for at least 90% or in any case for the majority of its operating life. The particular choice of reed contacts to make the activation switch 15 allows the energy consumption of the lock cylinder 1 to be kept quite low in the stand-by state, as well as allowing a simple, cost-effective switch to be made without mechanical contact with the key 9. The different solutions that allow the electrical/electronic circuit housed in the lock cylinder 1 to be made more compact and simplified also contribute to reduce its energy consumption in general. Since the driving pin 5 is turned manually by the end user through the key 9, the movement of the bolt 102 and the opening of the lock do not involve absorption of energy from the storage cell 19 and make using the new lock totally equivalent - i.e. manual - to that of old mechanical locks; this does not prevent making cylinders for motorised locks of the latest generation according to the invention. Since they are only used to move the sliding shafts 23A, 23B, the clutch motors 27A, 27B absorb very little energy and can have for example approximately maximum powers of about 40 mW or even less.

[0036] The shape substantially like a plate, like a parallelepiped - or in any case different from that of a rotation solid - of the control head 90, in particular like a squashed parallelepiped, is particularly effective and handy for manually rotating the driving pin 5, as well as reducing the wear of the head 90 itself and of the inside of the lock. The narrower shank 92 of the control head 90 advantageously allows a narrower keyhole 2 to be adopted that better protects the components inside the cylinder 1. If advantageously, when the key 9 is completely inserted into the seat 7 of the cylinder, the reading sensor 170A, 170B is at the shank 92, all of the circuits and the electrical components of the lock can be placed outside of the driving pin 5A, 5B and stay fixed with respect to the cylinder housing 3 while the pin 5A or 5B rotates; this allows the electromechanical implementation and circuitry of the cylinder 1 to be made substantially simpler, avoiding for example sliding electrical contacts or transmission of electromagnetic signals.

[0037] Thanks to the previous solutions it is possible to make a cylinder for an electronic key lock that has the shape and the size of current standardised cylinders, and in particular lock cylinders with a so-called European, English, Scandinavian or Australian profile, all in the oval or semi-oval versions, and yet other unified profiles like for example so-called loose inside/outside cylinder, rim cylinder, mortise cylinder or cylinder for deadbolt. Figure 7 provides an indicative example of the external dimensions of the cross sections of a common European profile cylinder, in which the electrical-electronic circuits and the

mechanisms according to the invention can be housed: the height H1 can be about 33 mm, the width L1 about 17 mm and the width L2 about 10 mm.

[0038] Based on the previous description it is clear how, unlike for example known mechanical cylinder locks, it is not possible to discover the opening combination of the lock according to the invention by probing with mechanical tools inside the keyhole 2. The fact that, like in the embodiment of Figures 1-7, the sliding shafts 23A, 23B, the clutch motors 27A, 27B and their gears are arranged in the most inner part of the lock cylinder 1, protected by big and strong driving pins 5A, 5B, as well as the absence of exposed rotating parts, greatly increases the safety and resistance to break-in of the lock.

[0039] Since they do not need external power supply, the lock cylinders according to the invention can replace, very easily and at low cost, the mechanical cylinders - for example with pistons - currently mounted on the overwhelming majority of external doors of homes, gardens, enclosures, wine cellars, garages, offices, workplaces and places with limited access in general. Since the combination or combinations for opening it can be simply stored in the logic unit 11, it is clear how a cylinder for locks 1 according to the invention is particularly suitable for being used with different keys that can open and close it with different opening combinations, and allows the modification of the opening combination - or combinations - to be managed with great flexibility and ease through a simple reprogramming of the logic unit 11, the replacement of keys and the management of various situations like for example losing a key, changing tenants, enabling opening with one new key and only one, opening a lock with different keys and opening some locks, but not others, with a single key.

[0040] The example embodiments described above can undergo various modifications and variations without departing from the scope of protection of the present invention. As an alternative to the reed contacts the activation switch 15 can for example comprise:

- a purely mechanical switch, normally open and that is temporarily closed following the pushing, or other mechanical action, imparted by the key 9 when the latter is at least partially inserted in the keyhole 2; or
- two electrical contacts 160A, 160B that are short-circuited by a conducting portion 162 of the key 9, where the conducting portion 162 acts as an activation element (Figure 8);
- a switch capable of making the logic circuit pass from the first null or reduced energetic consumption operating mode to the second higher energetic consumption operating mode when the key 9 is close to the lock cylinder - for example a few millimetres or centimetres, for example 0-30 mm and more preferably between 0-10 mm-, without having to necessarily be inserted in it.

[0041] Instead of an emitter 170A and a receiver 170B

of infrared light, visible light or ultraviolet radiation, the reading sensor can comprise a microcircuit reader, said microcircuits being able to be housed on the key 9. A lock cylinder according to the invention can also be powered from the outside, for example if mounted on security doors with external power supply also - but not only - in order to motorise opening, still ensuring the operation of the door when there is no current. A lock cylinder according to the invention can also be arranged to be opened with a key on just one side of a door, and in this case a single emitter 170A, a single receiver 170B, a single driving pin 5A, a single sliding shaft 23A and a single clutch motor 27A can be provided. A key 9 can also be provided with several activation elements 98, arranged so to be read in sequence while the key is inserted or extracted from the keyhole 2 and allow the logic unit to recognise whether the key is inserted or extracted from the lock cylinder; for this purpose, an activation element 98 can be placed on the free end of the key and a second activation element 98 closer to the end to be gripped. The control head 90 can more generally have a different shape from that of a solid of revolution, and for example have a radiated symmetry or completely asymmetrical shape with respect to the rotation axis of the key 9.

[0042] In general, all of the details can be replaced by technically equivalent elements. For example, the materials used, as well as the sizes, can be whatever according to the technical requirements. It should be understood that an expression of the type "A comprises B, C, D" also comprises and describes the particular case in which "A consists of B, C, D". The examples and lists of possible variants of the present application should be considered to be non-exhaustive lists.

Claims

1. Lock cylinder (1) suitable for actuating a lock bolt (102) and comprising:

- a cylinder housing (3);
- a driving pin (5A, 5B) rotatably housed in the cylinder housing (3) and wherein a key seat (7) is obtained, which is suitable for receiving a key (9) when said key (9) is introduced along an insertion direction (D1), a predetermined unlocking combination being reproduced on said key (9);

and wherein:

a) the lock cylinder (1) is provided with a logic circuit which in turn comprises:

- a reading sensor (170A, 170B) suitable for detecting progressively, through exchange of electrical and/or magnetic and/or optical signals, the predetermined unlocking com-

bination reproduced on the key (9) when the latter is being inserted in the lock cylinder (1);

- a logic unit (11) programmed or anyway arranged for stimulating and receiving the signals from the reading sensor (170A, 170B), for verifying, on their basis, whether the predetermined unlocking combination corresponds to a predetermined opening combination stored in the logic unit (11) and, in the affirmative case, for allowing the driving pin (5A, 5B) to actuate the bolt (102) by the driving pin (5A, 5B) rotating on itself with respect to the cylinder housing (3);
- an activation switch (15);

characterized in that:

the cylinder housing (3) comprises a keyhole (2), through which said key (9) can be introduced into said key seat (7) and

b) the activation switch (15) is arranged for:

- activating the logic unit (11) and the logic unit activating the reading sensor (170A, 170B) when the key (9) is 0-30 mm from the lock cylinder (1), or starts to enter into the keyhole (2) by making the logic unit (11) pass from a first null or reduced energetic consumption operating mode to a second higher energetic consumption operating mode, wherein

the reading sensor (170A, 170B) is housed in the cylinder housing (3) and is integral with the latter, and the reading sensor (170A, 170B) is located between said keyhole (2) and said driving pin (5A, 5B) along said insertion direction (D1).

2. Lock cylinder (1) according to claim 1 wherein the activation switch (15) is open, at least when the key (9) reproducing the predetermined opening combination is not inserted in the cylinder (1) or in one or more of the following conditions:

- i) after the unlocking combination of the key has been correctly detected, and the driving pin (5A, 5B) is in a condition to actuate the bolt;
- ii) after a predetermined time period has passed since the key (9) has been completely inserted into the lock cylinder (1) without the logic unit having read the correct unlocking combination on the key (time out procedure);
- iii) after a predetermined time period has passed since the cylinder (1) has come out from the null or reduced consumption condition.

3. Lock cylinder (1) according to claim 1 wherein the activation switch (15) comprises or consists of one

or more reed contacts.

4. Lock cylinder (1) according to claim 1, wherein the reading sensor comprises:

- one or more emitters (170A) arranged for emitting detection radiations;
- one or more receivers (170B) arranged for receiving the detection radiations filtered or anyway processed by the key (9) when it moves and is at least partially inserted in the lock cylinder (1), where the key (9) is suitable for filtering or anyway acting on the detection radiations so as to reproduce the predetermined unlocking combination,

wherein the one or more emitters (170A) and the one or more receivers (170B) are housed in the cylinder housing (3) and are integral with the latter.

5. Lock cylinder (1) according to one of the previous claims, wherein the logic unit (11) is housed in the cylinder housing (3) and is integral with the latter.

6. Lock cylinder according to claim 1, comprising a plurality of emitters (170A) and a plurality of receivers (170B), wherein both the emitters and the receivers are arranged on at least one row which extends transversally to the insertion direction of the key in the lock cylinder (1).

7. Lock cylinder according to one or more of the previous claims, wherein the cylinder housing (3) is conformed so as to reproduce one of the following standardized profiles: oval or semi-oval European profile, oval or semi-oval English profile, oval or semi-oval Scandinavian profile, oval or semi-oval Australian profile, rim cylinder, loose inside/outside cylinder, mortise cylinder, deadbolt cylinder.

8. Lock cylinder according to claim 1, comprising an electrical power supply (19) arranged for powering one or more of the logic unit (11), the one or more emitters (170A) and the one or more receivers (170B), and the electrical power supply (19) is housed in the cylinder housing (3) and is integral with it.

9. Lock cylinder according to claim 1, wherein the logic circuit comprises two boards or plates for electronic circuits (21A, 21B) facing towards each other, wherein:

- the one or more emitters (170A) are fixed on one of the two boards or plates for electronic circuits (21A);
- the one or more receivers (170B) are fixed on the other of the two boards or plates for elec-

tronic circuits (21B) .

10. Lock cylinder according to claim 1, wherein electrical power supply (19) is housed between the two boards or plates for electronic circuits (21A, 21B).

11. Lock cylinder according to claim 1, comprising:

- two driving pins (5A, 5B), each of which is located close to an end of the cylinder housing (3) opposite to the end close to which the other driving pin is located, so as to allow opening a door or other shutter, whereon the lock cylinder is mounted, by inserting the key (9) from both sides of the door or other shutter and at least partially rotating it; and
- two reading sensors (170A, 170B), each of which is arranged for detecting the predetermined unlocking combination reproduced on the key (9) when the latter is at least partially inserted in an end of the cylinder housing (3);
- a logic unit (11) programmed or anyway arranged for receiving the output signals of both reading sensors (170A, 170B) and for allowing at least one of the driving pins (5A, 5B) to activate the bolt (102) if the unlocking combination detected by at least one of the two reading sensors corresponds to the predetermined opening combination.

12. Lock cylinder according to claim 1, wherein the logic circuit comprises:

- a) two first boards or plates for electronic circuits (21A), each of which is located close to one end of the cylinder housing (3) opposite to the end close to which the other first board or plate (21A) is located;
- b) two second boards or plates for electronic circuits (21B), each of which is located close to one end of the cylinder housing (3) opposite to the end close to which the other second board or plate (21B) is located;
- c) a fifth board or plate for electronic circuits or flexible plate or flat cable (21C) fixed or anyway integral with the two first (21A) and/or second boards or plates for electronic circuits (21B) and interposed between them;
- d) a logic unit (11) and/or a storage cell (19), each of which is fixed on just one of the first (21A) or second boards or plates for electronic circuits (21B); and wherein:

- on each of the first boards or plates for electronic circuits (21A) one or more emitters (170A) are fixed;
- on each of the second boards or plates for electronic circuits (21B) one or more receivers

- ers (170B) are fixed;
 - on the fifth board or plate for electronic circuits (21C) one or more electric conductors are present, arranged for allowing the logic unit (11) to exchange signals and/or power supply with the one or more emitters (170A) and/or the one or more receivers (170B) fixed on both the first (21A) or the second boards or plates for electronic circuits (21B) and/or the possible clutch motors (27A, 27B) located close to both ends of the cylinder housing (3).
13. Lock cylinder according to claim 1, comprising an actuating clutch arranged for:
- mechanically engaging with at least one of the driving pins (5A, 5B) allowing the latter to actuate the lock bolt (102) wherein the lock cylinder (1) is mounted, when the logic unit (11) detects that a key (9) is at least partially inserted in the lock cylinder (1), key which reproduces an unlocking combination equal to the predetermined opening combination; and
 - mechanically disengaging from at least one of the driving pins (5A, 5B) preventing the latter from actuating the lock bolt (102) wherein the lock cylinder (1) is mounted, when the logic unit (11) does not detect that a key (9) is at least partially inserted in the lock cylinder (1), key which reproduces an unlocking combination equal to the predetermined opening combination.
14. Lock cylinder (1) suitable for actuating a lock bolt (102) and comprising:
- a cylinder housing (3);
 - a driving pin (5A, 5B) rotatably housed in the cylinder housing (3) and wherein a key seat (7) is obtained, which is suitable for receiving a key (9) when said key (9) is introduced along an insertion direction (D1), a predetermined unlocking combination being reproduced on said key (9), and said key having a control head provided with an activation element (98) comprising a permanent magnet;
- and wherein:
- a) the lock cylinder (1) is provided with a logic circuit which in turn comprises:
 - a reading sensor (170A, 170B) suitable for detecting progressively, through exchange of electrical and/or magnetic and/or optical signals, the predetermined unlocking combination reproduced on the key (9) when the

latter is being inserted in the lock cylinder (1);

- a logic unit (11) programmed or anyway arranged for stimulating and receiving the signals from the reading sensor (170A, 170B), for verifying, on their basis, whether the predetermined unlocking combination corresponds to a predetermined opening combination stored in the logic unit (11) and, in the affirmative case, for allowing the driving pin (5A, 5B) to actuate the bolt (102) by the driving pin (5A, 5B) rotating on itself with respect to the cylinder housing (3);

an activation switch (15) comprising a reed contact arranged to be activated by the activation element (98) of the key,

characterized in that:

the cylinder housing (3) comprises a keyhole (2), through which said key (9) can be introduced into said key seat (7) and

b) the activation switch being arranged for activating the logic unit (11) and the logic unit activating the reading sensor (170A, 170B) by making the logic unit (11) pass from a first null or reduced energetic consumption operating mode to a second higher energetic consumption operating mode, wherein

the reading sensor (170A, 170B) is housed in the cylinder housing (3) and is integral with the latter, and the reading sensor (170A, 170B) is located between said keyhole (2) and said driving pin (5A, 5B) along said insertion direction (D1).

Patentansprüche

1. Schließzylinder (1), der zum Betätigen eines Schließbolzens (102) geeignet ist und Folgendes aufweist:

- ein Zylindergehäuse (3);
- einen in dem Zylindergehäuse (3) drehbar untergebrachten Mitnehmerstift (5A, 5B), in dem ein Schlüsselsitz (7) gebildet ist, der zur Aufnahme eines Schlüssels (9) geeignet ist, wenn der Schlüssel (9) entlang einer Einführrichtung (D1) eingeführt wird, wobei eine vorbestimmte Entriegelungskombination an dem Schlüssel (9) reproduziert ist;

und wobei:

- a) der Schließzylinder (1) mit einer Logikschaltung versehen ist, die wiederum aufweist:

- einen Lesesensor (170A, 170B), der durch

Austausch elektrischer und/oder magnetischer und/oder optischer Signale zum progressiven Erfassen der an dem Schlüssel (9) reproduzierten, vorgegebenen Entriegelungskombination geeignet ist, wenn dieser in den Schließzylinder (1) eingeführt wird;

- eine Logikeinheit (11), die zum Stimulieren und Empfangen der Signale von dem Lesesensor (170A, 170B) programmiert oder anderweitig ausgebildet ist, um auf ihrer Basis zu überprüfen, ob die vorbestimmte Entriegelungskombination einer vorbestimmten Öffnungskombination entspricht, die in der Logikeinheit (11) gespeichert ist, und um im positiven Fall zu ermöglichen, dass der Mitnehmerstift (5A, 5B) den Bolzen (102) betätigt, indem sich der Mitnehmerstift (5A, 5B) in Bezug auf das Zylindergehäuse (3) um sich selbst dreht;
- einen Aktivierungsschalter (15);

dadurch gekennzeichnet, dass das Zylindergehäuse (3) ein Schlüsselloch (2) aufweist, durch das der Schlüssel (9) in den Schlüsselsitz (7) eingeführt werden kann, und
b) dass der Aktivierungsschalter (15) dazu ausgebildet ist:

- die Logikeinheit (11) zu aktivieren, und die Logikeinheit den Lesesensor (170A, 170B) aktiviert, wenn der Schlüssel (9) 0-30 mm von dem Schließzylinder (1) entfernt ist oder in das Schlüsselloch (2) einzutreten beginnt, indem die Logikeinheit (11) dazu veranlasst wird, von einem ersten Nullbetriebsmodus oder Betriebsmodus mit verringertem Energieverbrauch in einen zweiten Betriebsmodus mit höherem Energieverbrauch zu wechseln,

wobei der Lesesensor (170A, 170B) in dem Zylindergehäuse (3) untergebracht ist und mit diesem in integraler Weise ausgebildet ist, und
wobei der Lesesensor (170A, 170B) entlang der Einführrichtung (D1) zwischen dem Schlüsselloch (2) und dem Mitnehmerstift (5A, 5B) angeordnet ist.

2. Schließzylinder (1) nach Anspruch 1, wobei der Aktivierungsschalter (15) geöffnet ist, zumindest wenn der Schlüssel (9), der die vorbestimmte Öffnungskombination wiedergibt, nicht in den Zylinder (1) eingeführt ist, oder wenn eine oder mehrere der folgenden Bedingungen vorliegen:

- i) nachdem die Entriegelungskombination des Schlüssels korrekt festgestellt wurde und sich der Mitnehmerstift (5A, 5B) in einem Zustand

zum Betätigen des Bolzens befindet;

ii) nach Ablauf einer vorbestimmten Zeitspanne seit dem vollständigen Einstecken des Schlüssels (9) in den Schließzylinder (1), ohne dass die Logikeinheit die korrekte Entriegelungskombination an dem Schlüssel gelesen hat (Timeout-Vorgang);

iii) nach Ablauf einer vorbestimmten Zeitspanne, seit der Zylinder (1) den Null-Zustand oder den Zustand mit reduziertem Verbrauch verlassen hat.

3. Schließzylinder (1) nach Anspruch 1, wobei der Aktivierungsschalter (15) einen oder mehrere Reedkontakte aufweist oder daraus besteht.

4. Schließzylinder (1) nach Anspruch 1, wobei der Lesesensor aufweist:

- einen oder mehrere Sender (170A), die zum Senden von Erfassungsstrahlen angeordnet sind;

- einen oder mehrere Empfänger (170B), die zum Empfangen der vom Schlüssel (9) gefilterten oder anderweitig verarbeiteten Erfassungsstrahlen ausgebildet sind, wenn sich dieser bewegt und zumindest teilweise in den Schließzylinder (1) eingeführt ist, wobei der Schlüssel (9) zum Filtern oder anderweitigen Einwirken auf die Erfassungsstrahlen geeignet ist, um die vorbestimmte Entriegelungskombination zu reproduzieren,

wobei der eine oder die mehreren Sender (170A) und der eine oder die mehreren Empfänger (170B) in dem Zylindergehäuse (3) untergebracht sowie in integraler Weise mit diesem ausgebildet sind.

5. Schließzylinder (1) nach einem der vorhergehenden Ansprüche, wobei die Logikeinheit (11) in dem Zylindergehäuse (3) untergebracht und in integraler Weise mit diesem ausgebildet ist.

6. Schließzylinder nach Anspruch 1, der eine Mehrzahl von Sendern (170A) und eine Mehrzahl von Empfängern (170B) aufweist, wobei sowohl die Sender als auch die Empfänger in mindestens einer Reihe angeordnet sind, die sich quer zu der Einführrichtung des Schlüssels in den Schließzylinder (1) erstreckt.

7. Schließzylinder nach einem oder mehreren der vorhergehenden Ansprüche, wobei das Zylindergehäuse (3) derart ausgebildet ist, dass es eines der folgenden standardisierten Profile wiedergibt: ovales oder halbovales europäisches Profil, ovales oder halbovales englisches Pro-

fil, ovaless oder halbovaless skandinavissches Profil, ovaless oder halbovaless australissches Profil, Randzylinder, loser Innen-/Außenzylinder, Einsteckzylinder, Riegelzylinder.

8. Schließzylinder nach Anspruch 1, mit einer elektrisschen Stromversorgung (19), die dazu ausgebildet ist, einen oder mehrere von der Logikeinheit (11), dem einen oder den mehreren Sendern (170A) und dem einen oder den mehreren Empfängern (170B) mit Strom zu versorgen, und wobei die elektrissche Stromversorgung (19) in dem Zylindergehäuse (3) untergebracht und mit diesem in integraler Weise ausgebildet ist.

9. Schließzylinder nach Anspruch 1, wobei die Logikschtaltung zwei einander zugewandte Platinen oder Platten für elektronissche Schaltungen (21A, 21B) aufweist, wobei:

- der eine oder die mehreren Sender (170A) auf einer der beiden Platinen oder Platten für elektronissche Schaltungen (21A) befestigt sind;
- der eine oder die mehreren Empfänger (170B) auf der anderen der beiden Platinen oder Platten für elektronissche Schaltungen (21B) befestigt sind.

10. Schließzylinder nach Anspruch 1, wobei die elektrissche Stromversorgung (19) zwischen den beiden Platinen oder Platten für elektronissche Schaltungen (21A, 21B) untergebracht ist.

11. Schließzylinder nach Anspruch 1, aufweisend:

- zwei Mitnehmerstifte (5A, 5B), die sich jeweils nahe bei einem Ende des Zylindergehäuses (3) gegenüber von dem Ende befinden, in dessen Nähe sich der andere Mitnehmerstift befindet, um dadurch ein Öffnen einer Tür oder eines anderen Verschlusses, an der bzw. dem der Schließzylinder montiert ist, durch Einstecken des Schlüssels (9) von beiden Seiten der Tür oder des anderen Verschlusses und durch zumindest teilweises Drehen desselben zu ermöglichen; und
- zwei Lesesensoren (170A, 170B), die jeweils zum Erfassen der an dem Schlüssel (9) wiedergegebenen, vorbestimmten Entriegelungskombination ausgebildet sind, wenn dieser zumindest teilweise in ein Ende des Zylindergehäuses (3) eingeführt ist;
- eine Logikeinheit (11), die dazu programmiert oder anderweitig ausgebildet ist, die Ausgangssignale der beiden Lesesensoren (170A, 170B) zu empfangen sowie es mindestens einem der Mitnehmerstifte (5A, 5B) zu ermöglichen, den Bolzen (102) zu aktivieren, wenn die von min-

destens einem der beiden Lesesensoren erfasste Entriegelungskombination der vorbestimmten Öffnungskombination entspricht.

12. Schließzylinder nach Anspruch 1, wobei die Logikschtaltung aufweist:

- a) zwei erste Platinen oder Platten für elektronissche Schaltungen (21A), die sich jeweils nahe bei einem Ende des Zylindergehäuses (3) gegenüber von dem Ende befinden, in dessen Nähe andere erste Platine oder Platte (21A) angeordnet ist;
- b) zwei zweite Platinen oder Platten für elektronissche Schaltungen (21B), die sich jeweils nahe bei einem Ende des Zylindergehäuses (3) gegenüber von dem Ende befinden, in dessen Nähe die andere zweite Platine oder Platte (21B) angeordnet ist;
- c) eine fünfte Platine oder Platte für elektronissche Schaltungen oder eine flexible Platte oder ein Flachkabel (21C), die bzw. das an den beiden ersten (21A) und/oder zweiten Platinen oder Platten für elektronissche Schaltungen (21B) festgelegt oder anderweitig in integraler Weise damit ausgebildet ist und zwischen diesen angeordnet ist;
- d) eine Logikeinheit (11) und/oder eine Speicherzelle (19), die jeweils nur an einer von den ersten (21A) oder zweiten Platinen oder Platten für elektronissche Schaltungen (21B) festgelegt sind; und wobei:

- auf jeder der ersten Platinen oder Platten für elektronissche Schaltungen (21A) ein oder mehrere Sender (170A) befestigt sind;
- auf jeder der zweiten Platinen oder Platten für elektronissche Schaltungen (21B) ein oder mehrere Empfänger (170B) befestigt sind;
- auf der fünften Platine oder Platte für elektronissche Schaltungen (21C) ein oder mehrere elektrissche Leiter vorhanden sind, die dazu ausgelegt sind, der Logikeinheit (11) den Austausch von Signalen mit und/oder die Stromzufuhr zu dem einen oder den mehreren Sendern (170A) und/oder dem einen oder den mehreren Empfängern (170B) zu ermöglichen, die sowohl auf den ersten (21A) oder zweiten Platinen oder Platten für elektronissche Schaltungen (21B) und/oder an den möglichen Kupplungsmotoren (27A, 27B) befestigt sind, die sich in der Nähe der beiden Enden des Zylindergehäuses (3) befinden.

13. Schließzylinder nach Anspruch 1, mit einer Betätigungskupplung, die ausgebildet ist

zum:

- mechanischen Zusammenwirken mit mindestens einem der Mitnehmerstifte (5A, 5B), so dass dieser den Schließbolzen (102) betätigen kann, in dem der Schließzylinder (1) montiert ist, wenn die Logikeinheit (11) feststellt, dass ein Schlüssel (9) zumindest teilweise in den Schließzylinder (1) eingeführt ist, der eine Entriegelungskombination gleich der vorbestimmten Öffnungskombination wiedergibt; und
- mechanisches Lösen von mindestens einem der Mitnehmerstifte (5A, 5B), um zu verhindern, dass dieser den Schließbolzen (102) betätigt, in dem der Schließzylinder (1) montiert ist, wenn die Logikeinheit (11) nicht feststellt, dass ein Schlüssel (9) zumindest teilweise in den Schließzylinder (1) eingeführt ist, der eine Entriegelungskombination gleich der vorgegebenen Öffnungskombination wiedergibt.

14. Schließzylinder (1), der zum Betätigen eines Schließbolzens (102) geeignet ist und Folgendes aufweist:

- ein Zylindergehäuse (3);
- einen in dem Zylindergehäuse (3) drehbar untergebrachten Mitnehmerstift (5A, 5B), in dem ein Schlüsselsitz (7) gebildet ist, der zur Aufnahme eines Schlüssels (9) geeignet ist, wenn der Schlüssel (9) entlang einer Einführrichtung (D1) eingeführt wird, wobei eine vorbestimmte Entriegelungskombination an dem Schlüssel (9) reproduziert ist, und wobei der Schlüssel einen Steuerkopf aufweist, der mit einem Aktivierungselement (98) versehen ist, das einen Permanentmagneten aufweist;

und wobei:

- a) der Schließzylinder (1) mit einer Logikschaltung versehen ist, die wiederum aufweist:
 - einen Lesesensor (170A, 170B), der durch Austausch elektrischer und/oder magnetischer und/oder optischer Signale zum progressiven Erfassen der an dem Schlüssel (9) reproduzierten, vorgegebenen Entriegelungskombination geeignet ist, wenn dieser in den Schließzylinder (1) eingeführt wird;
 - eine Logikeinheit (11), die zum Stimulieren und Empfangen der Signale von dem Lesesensor (170A, 170B) programmiert oder anderweitig ausgebildet ist, um auf ihrer Basis zu überprüfen, ob die vorbestimmte Entriegelungskombination einer vorbestimmten Öffnungskombination entspricht, die in der

- Logikeinheit (11) gespeichert ist, und um im positiven Fall zu ermöglichen, dass der Mitnehmerstift (5A, 5B) den Bolzen (102) betätigt, indem sich der Mitnehmerstift (5A, 5B) in Bezug auf das Zylindergehäuse (3) um sich selbst dreht;
- einen Aktivierungsschalter (15), der einen Reedkontakt aufweist, der zur Aktivierung durch das Aktivierungselement (98) des Schlüssels ausgebildet ist,

dadurch gekennzeichnet, dass das Zylindergehäuse (3) ein Schlüsselloch (2) aufweist, durch das der Schlüssel (9) in den Schlüsselsitz (7) eingeführt werden kann, und
b) dass der Aktivierungsschalter (15) zum Aktivieren der Logikeinheit (11) ausgebildet ist und die Logikeinheit den Lesesensor (170A, 170B) aktiviert, indem die Logikeinheit (11) dazu veranlasst wird, von einem ersten Nullbetriebsmodus oder Betriebsmodus mit verringertem Energieverbrauch in einen zweiten Betriebsmodus mit höherem Energieverbrauch zu wechseln,

- wobei der Lesesensor (170A, 170B) in dem Zylindergehäuse (3) untergebracht ist und mit diesem in integraler Weise ausgebildet ist, und
wobei der Lesesensor (170A, 170B) entlang der Einführrichtung (D1) zwischen dem Schlüsselloch (2) und dem Mitnehmerstift (5A, 5B) angeordnet ist.

Revendications

1. Cylindre de serrure (1) adapté à actionner un pêne de serrure (102) et comprenant :

- un logement de cylindre (3) ;
- une broche d'entraînement (5A, 5B) logée en rotation dans le logement de cylindre (3) et dans laquelle un siège de clef (7) est obtenu, qui est adapté à recevoir une clef (9) quand ladite clef (9) est introduite le long d'une direction d'insertion (D1), une combinaison de déverrouillage prédéterminée étant reproduite sur ladite clef (9) ;

et dans lequel :

- a) le cylindre de serrure (1) est muni d'un circuit logique qui lui-même comprend :

- un capteur de lecture (170A, 170B) adapté à détecter progressivement, au moyen d'un échange de signaux électriques et/ou magnétiques et/ou optiques, la combinaison de déverrouillage prédéterminée reproduite sur la clef (9) quand cette dernière est insé-

rée dans le cylindre de serrure (1) ;
 - une unité logique (11) programmée ou configurée d'une quelconque manière pour stimuler et recevoir les signaux provenant du capteur de lecture (170A, 170B), pour vérifier, sur leur base, si la combinaison de déverrouillage prédéterminée correspond à une combinaison d'ouverture prédéterminée stockée dans l'unité logique (11) et, dans l'affirmative, pour permettre à la broche d'entraînement (5A, 5B) d'actionner le pêne (102) au moyen de la broche d'entraînement (5A, 5B) en tournant sur lui-même par rapport au logement de cylindre (3) ;
 - un commutateur d'activation (15) ;

caractérisé en ce que :

le logement de cylindre (3) comprend un trou de serrure (2) dans lequel ladite clef (9) peut être introduite dans ledit siège de clef (7) et b) le commutateur d'activation (15) est configuré pour :

- activer l'unité logique (11) et l'unité logique active le capteur de lecture (170A, 170B) quand la clef (9) est à 0-30 mm du cylindre de serrure (1), ou commence à entrer dans le trou de serrure (2) en faisant passer l'unité logique (11) d'un premier mode de fonctionnement à consommation énergétique nulle ou réduite à un deuxième mode de fonctionnement à consommation d'énergie supérieure, dans lequel

le capteur de lecture (170A, 170B) est logé dans le logement de cylindre (3) et est intégré avec ce dernier, et

le capteur de lecture (170A, 170B) est placé entre ledit trou de serrure (2) et ladite broche d'entraînement (5A, 5B) le long de ladite direction d'insertion (D1).

2. Cylindre de serrure (1) selon la revendication 1, dans lequel le commutateur d'activation (15) est ouvert, au moins quand la clef (9) reproduisant la combinaison d'ouverture prédéterminée n'est pas insérée dans le cylindre (1) ou dans une ou plusieurs des situations suivantes :

i) après que la combinaison de déverrouillage de la clef a été correctement détectée, et que la broche d'entraînement (5A, 5B) est en situation d'actionner le pêne ;

ii) après qu'une période de temps prédéterminée s'est écoulée depuis que la clef (9) a été complètement insérée dans le cylindre de serrure (1) sans que l'unité logique ait lu la combinaison de déverrouillage correcte sur la clef

(procédure de temporisation) ;

iii) après qu'une période de temps prédéterminée s'est écoulée depuis que le cylindre (1) est sorti de l'état de consommation nulle ou réduite.

3. Cylindre de serrure (1) selon la revendication 1, dans lequel le commutateur d'activation (15) comprend ou consiste en un ou plusieurs contacts à lames souples.

4. Cylindre de serrure (1) selon la revendication 1, dans lequel le capteur de lecture comprend :

- un ou plusieurs émetteurs (170A) configurés pour émettre des radiations de détection ;
 - un ou plusieurs récepteurs (170B) configurés pour recevoir les radiations de détection filtrées ou traitées d'une quelconque manière par la clef (9) quand elle se déplace et est au moins partiellement insérée dans le cylindre de serrure (1), dans lequel la clef (9) est adapté à filtrer ou agir d'une quelconque manière sur les radiations de détection de façon à reproduire la combinaison de déverrouillage prédéterminée,

dans lequel lesdits un ou plusieurs émetteurs (170A) et lesdits un ou plusieurs récepteurs (170B) sont logés dans le logement de cylindre (3) et sont intégrés dans ce dernier.

5. Cylindre de serrure (1) selon l'une quelconque des revendications précédentes, dans lequel l'unité logique (11) est logée dans le logement de cylindre (3) et est intégrée dans ce dernier.

6. Cylindre de serrure selon la revendication 1, comprenant une pluralité d'émetteurs (170A) et une pluralité de récepteurs (170B), dans lequel tant les émetteurs que les récepteurs sont disposés sur au moins une rangée qui s'étend transversalement par rapport à la direction d'insertion de la clef dans le cylindre de serrure (1).

7. Cylindre de serrure selon une ou plusieurs des revendications précédentes, dans lequel le logement du cylindre (3) est conformé de manière à reproduire un des profils normalisés suivants : profil européen ovale ou semi-ovale, profil anglais ovale ou semi-ovale, profil scandinave ovale ou semi-ovale, profil australien ovale ou semi-ovale, cylindre en applique, cylindre lâche intérieur/extérieur, cylindre à mortaiser, cylindre de pêne dormant.

8. Cylindre de serrure selon la revendication 1, comprenant une alimentation électrique (19) configurée pour alimenter une ou plusieurs unités logiques (11), lesdits un ou plusieurs émetteurs (170A) et lesdits un ou plusieurs récepteurs (170B), et l'alimentation

électrique (19) est logée dans le logement du cylindre (3) et est intégrée dans celui-ci.

9. Cylindre de serrure selon la revendication 1, dans lequel le circuit logique comprend deux cartes ou plaques pour circuits électroniques (21A, 21B) se faisant face l'une à l'autre, dans lequel :
- lesdits un ou plusieurs émetteurs (170A) sont fixés sur une des deux cartes ou plaques pour circuits électroniques (21A) ;
 - lesdits un ou plusieurs récepteurs (170B) sont fixés sur l'autre des deux cartes ou plaques pour circuits électroniques (21B) .
10. Cylindre de serrure selon la revendication 1, dans lequel une alimentation électrique (19) est logée entre les deux cartes ou plaques pour circuits électroniques (21A, 21B).
11. Cylindre de serrure selon la revendication 1, comprenant :
- deux broches d'entraînement (5A, 5B), chacune d'elles étant à proximité d'une extrémité du logement de cylindre (3) opposée à l'extrémité proche de laquelle l'autre broche d'entraînement est située, de manière à permettre l'ouverture d'une porte ou d'une autre fermeture sur laquelle le cylindre de serrure est monté, en insérant la clef (9) des deux côtés de la porte ou de l'autre fermeture et en la tournant au moins partiellement ; et
 - deux capteurs de lecture (170A, 170B), chacun d'eux étant configuré pour détecter la combinaison de déverrouillage prédéterminée reproduite sur la clef (9) quand cette dernière est au moins partiellement insérée dans une extrémité du logement de cylindre (3) ;
 - une unité logique (11) programmée ou configurée d'une quelconque manière pour recevoir les signaux de sortie des deux capteurs de lecture (170A, 170B) et pour permettre à au moins une des broches d'entraînement (5A, 5B) d'activer le pêne (102) si la combinaison de déverrouillage détectée par au moins un des deux capteurs de lecture correspond à la combinaison d'ouverture prédéterminée.
12. Cylindre de serrure selon la revendication 1, dans lequel le circuit logique comprend :
- a) deux premières cartes ou plaques pour des circuits électroniques (21A), chacune d'elles se trouvant près d'une extrémité du logement de cylindre (3) opposé à l'extrémité proche de laquelle l'autre première carte ou plaque (21A) se trouve ;

b) deux deuxième cartes ou plaques pour circuits électroniques (21B), chacune d'elles se trouvant près d'une extrémité du logement de cylindre (3) opposée à l'extrémité proche de l'autre deuxième carte ou plaque (21B) ;

c) une cinquième carte ou plaque pour circuits électroniques ou une plaque flexible ou un câble plat (21C) fixée ou intégrée d'une quelconque manière aux deux premières (21A) et/ou deuxièmes (21B) cartes ou plaques pour circuits électroniques et interposée entre elles ;

d) une unité logique (11) et/ou une cellule de stockage (19), chacune d'elles étant fixée à une seule des premières (21A) ou deuxièmes (21B) cartes ou plaques pour circuits électroniques ; et dans lequel :

- sur chacune des premières cartes ou plaques pour circuits électroniques (21A), un ou plusieurs émetteurs (170A) sont fixés ;

- sur chacune des deuxièmes cartes ou plaques pour circuits électroniques (21B), un ou plusieurs récepteurs (170B) sont fixés ;

- sur la cinquième carte ou plaque pour circuits électroniques (21C), un ou plusieurs conducteurs électriques sont présents, configurés pour permettre à l'unité logique (11) d'échanger des signaux et/ou une alimentation avec lesdits un ou plusieurs émetteurs (170A) et/ou lesdits un ou plusieurs récepteurs (170B) fixés à la fois sur les premières (21A) ou sur les deuxièmes (21B) cartes ou plaques pour circuits électroniques et/ou les éventuels moteurs d'accouplement (27A, 27B) situés à proximité des deux extrémités à la fois du logement de cylindre (3) .

13. Cylindre de serrure selon la revendication 1, comprenant un accouplement d'actionnement configuré pour :

- coopérer mécaniquement avec au moins une des broches d'entraînement (5A, 5B) permettant à ces dernières d'actionner le pêne de serrure (102) dans lequel le cylindre de serrure (1) est monté, quand l'unité logique (11) détecte qu'une clef (9) est au moins partiellement insérée dans le cylindre de serrure (1), clef qui reproduit une combinaison de déverrouillage égale à la combinaison d'ouverture prédéterminée ; et pour

- se désengager mécaniquement d'au moins une des broches d'entraînement (5A, 5B) empêchant cette dernière d'actionner le pêne de serrure (102) dans lequel le cylindre de serrure (1) est monté, quand l'unité logique (11) ne détecte pas la clef (9) est insérée au moins partiel-

lement dans le cylindre de serrure (1), clef qui reproduit une combinaison de déverrouillage égale à la combinaison d'ouverture prédéterminée.

14. Cylindre de serrure (1) adapté à actionner un pêne de serrure (102) et comprenant :

- un logement de cylindre (3) ;
- une broche d'entraînement (5A, 5B) logée en rotation dans le logement de cylindre (3) et dans lequel un siège de clef (7) est obtenu, qui est adapté à recevoir une clef (9) quand ladite clef (9) est introduite le long d'une direction d'insertion (D1), une combinaison de déverrouillage prédéterminée étant reproduite sur ladite clef (9), et ladite clef ayant une tête de commande munie d'un élément d'activation (98) comprenant un aimant permanent ;

et dans lequel :

a) le cylindre de serrure (1) est muni d'un circuit logique qui lui-même comprend :

- un capteur de lecture (170A, 170B) adapté à détecter progressivement, au moyen d'un échange de signaux électriques et/ou magnétiques et/ou optiques, la combinaison de déverrouillage prédéterminée reproduite sur la clef (9) quand cette dernière est insérée dans le cylindre de serrure (1) ;
- une unité logique (11) programmée ou configurée d'une quelconque manière pour stimuler et recevoir les signaux du capteur de lecture (170A, 170B), pour vérifier, sur leur base, si la combinaison de déverrouillage prédéterminée correspond à une combinaison d'ouverture prédéterminée stockée dans l'unité logique (11) et, dans l'affirmative, pour permettre à la broche d'entraînement (5A, 5B) d'actionner le pêne (102) par la rotation de la broche d'entraînement (5A, 5B) sur elle-même par rapport au logement de cylindre (3) ;

un commutateur d'activation (15) comprenant un contact à lames souples configuré pour être activé par l'élément d'activation (98) de la clef, **caractérisé en ce que :**

le logement de cylindre (3) comprend un trou de serrure (2), dans lequel ladite clef (9) peut être introduite dans ledit siège de clef (7) et

b) le commutateur d'activation est configuré pour activer l'unité logique (11) et l'unité logique active le capteur de lecture (170A, 170B) en faisant passer l'unité logique (11) d'un premier mode de fonctionnement à consommation énergé-

tique nulle ou réduite à un deuxième mode de fonctionnement à consommation d'énergie supérieure, dans lequel

le capteur de lecture (170A, 170B) est logé dans le logement de cylindre (3) et est intégré avec ce dernier, et

le capteur de lecture (170A, 170B) est placé entre ledit trou de serrure (2) et ladite broche d'entraînement (5A, 5B) le long de ladite direction d'insertion (D1).

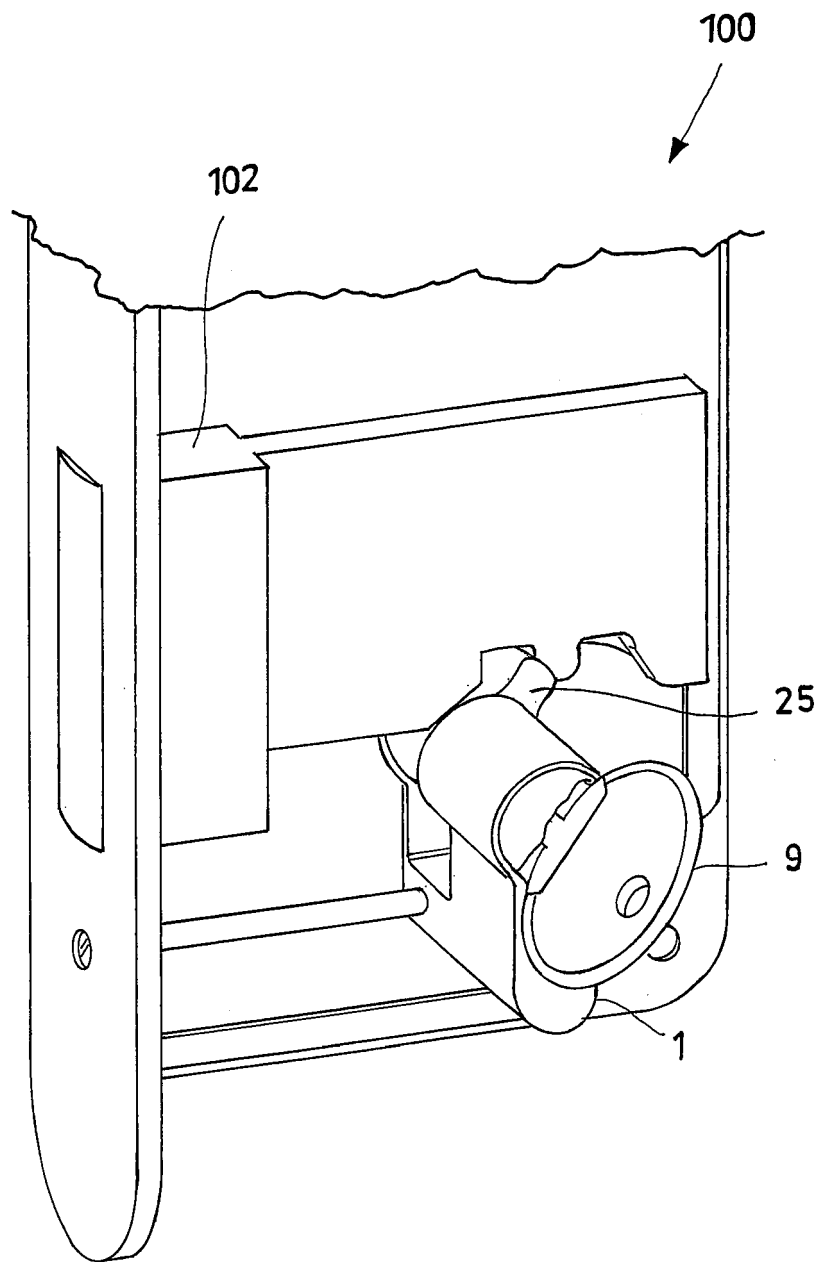


Fig.1

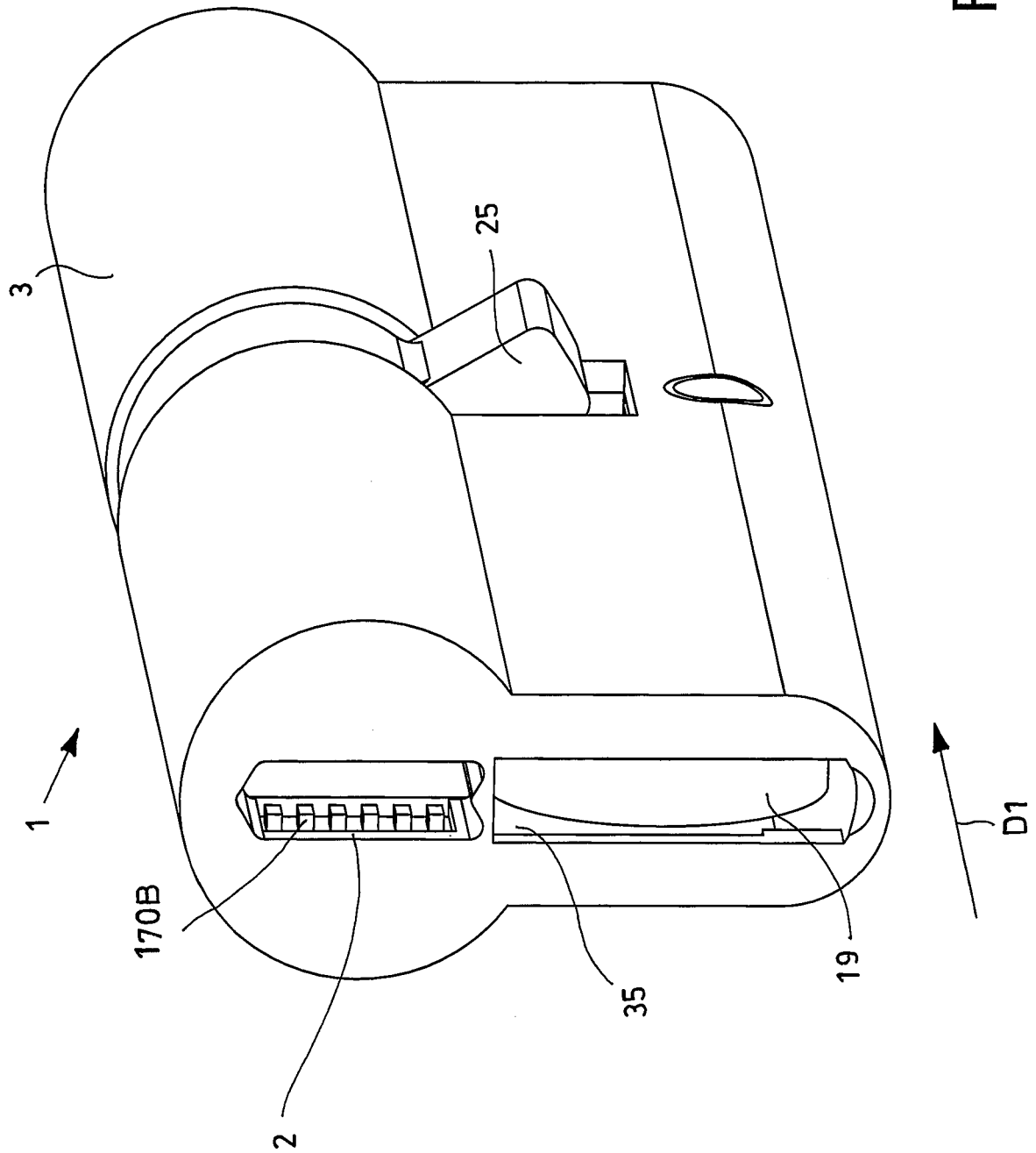


Fig. 2

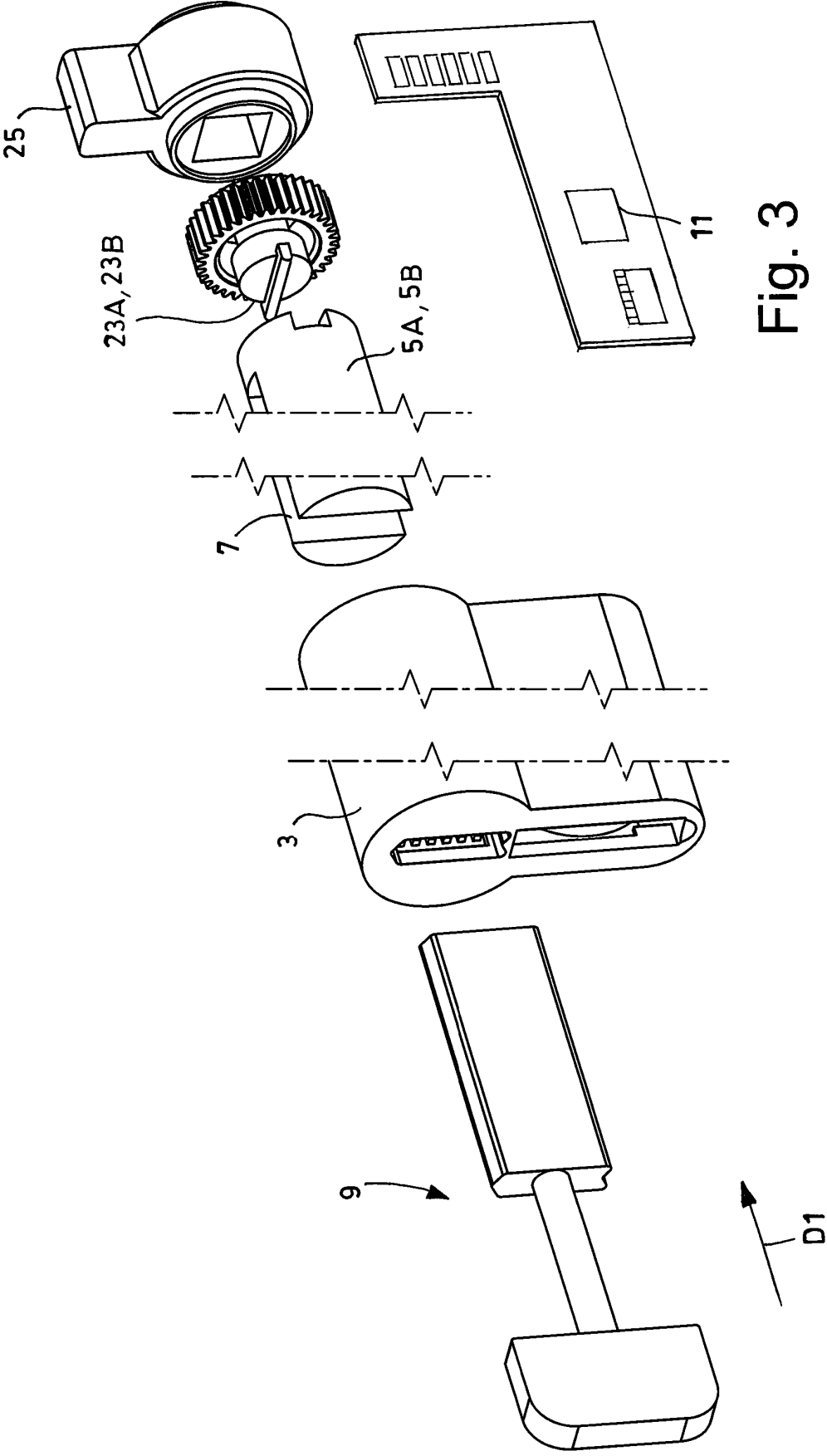
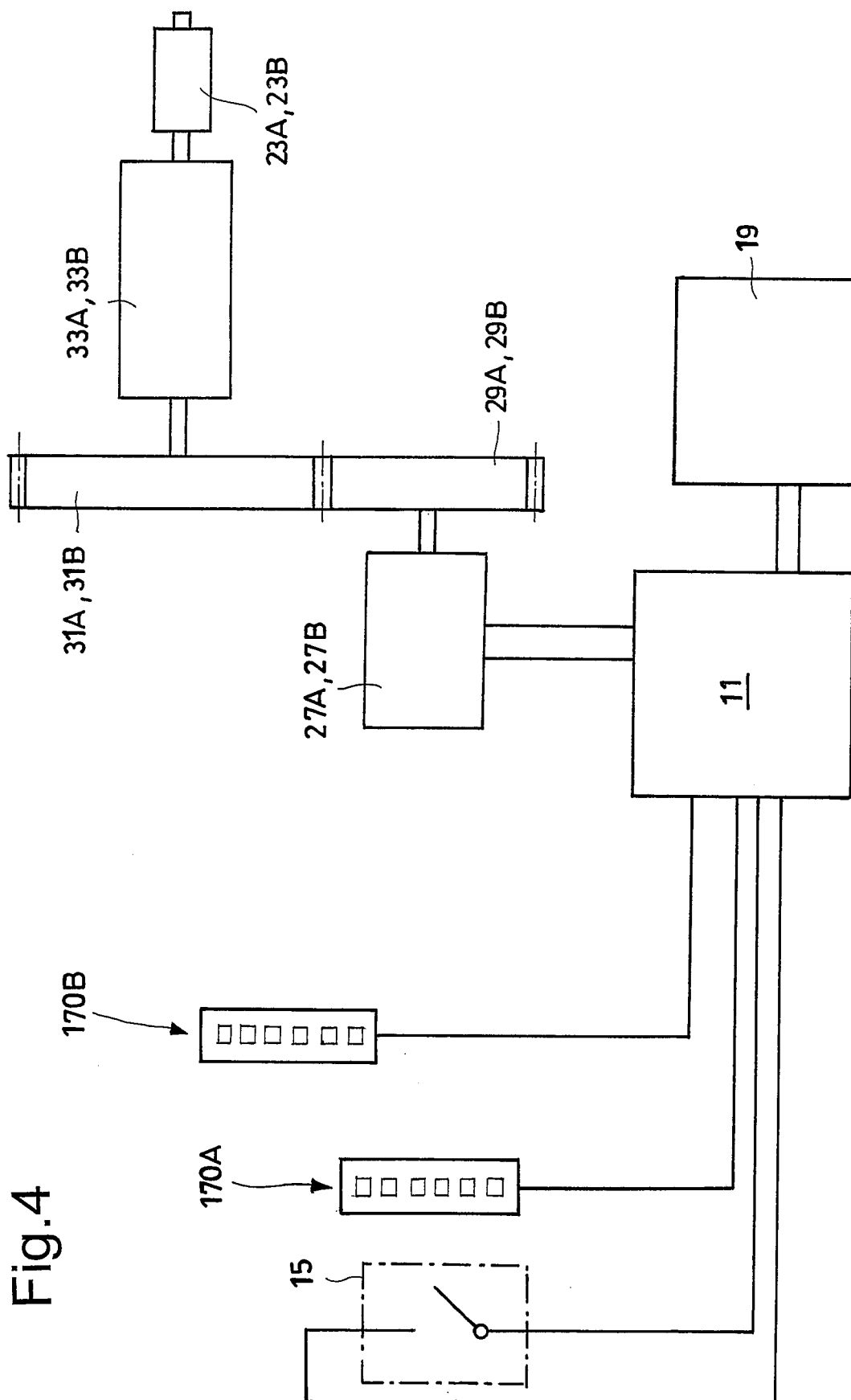


Fig. 3



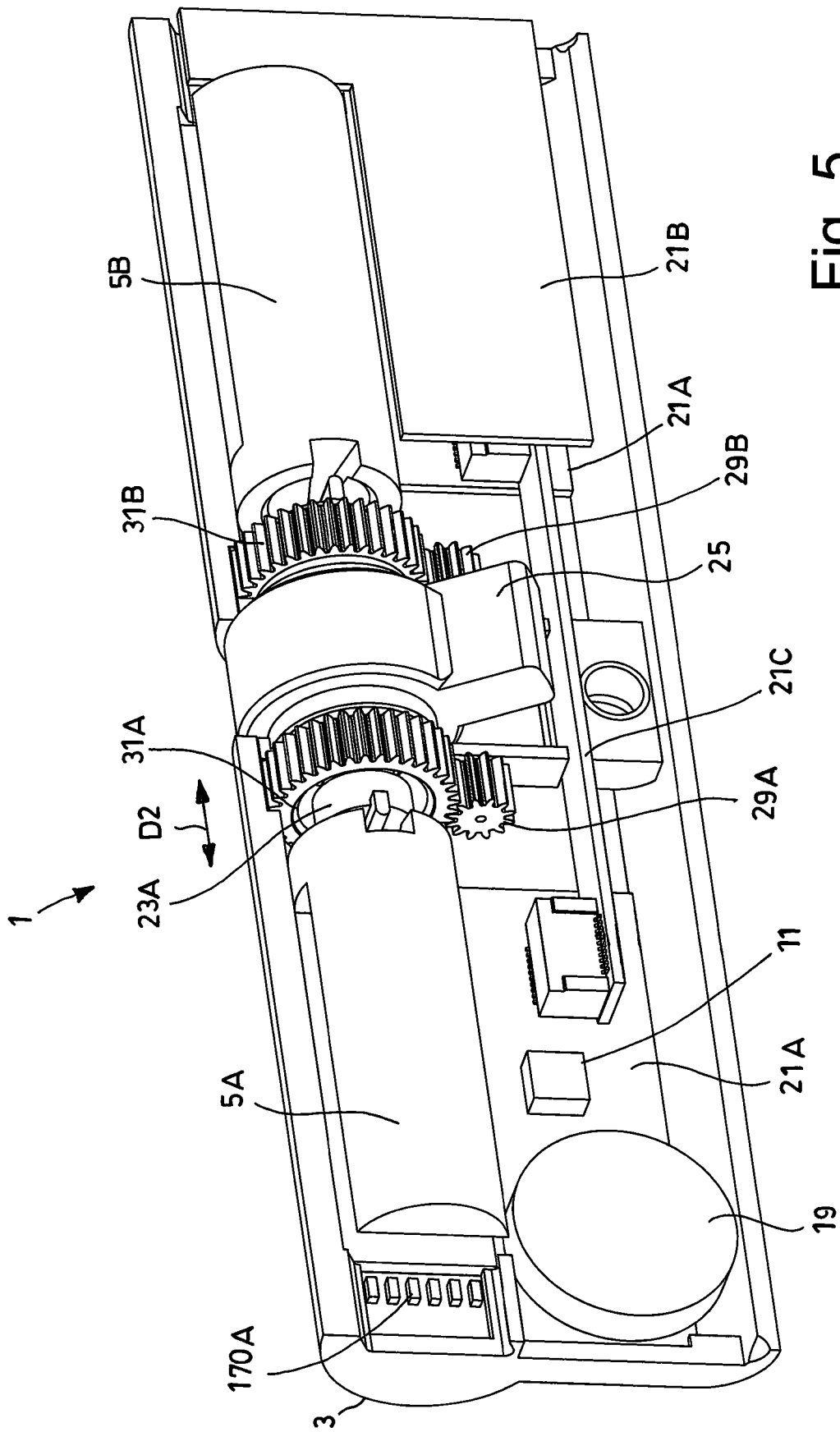


Fig. 5

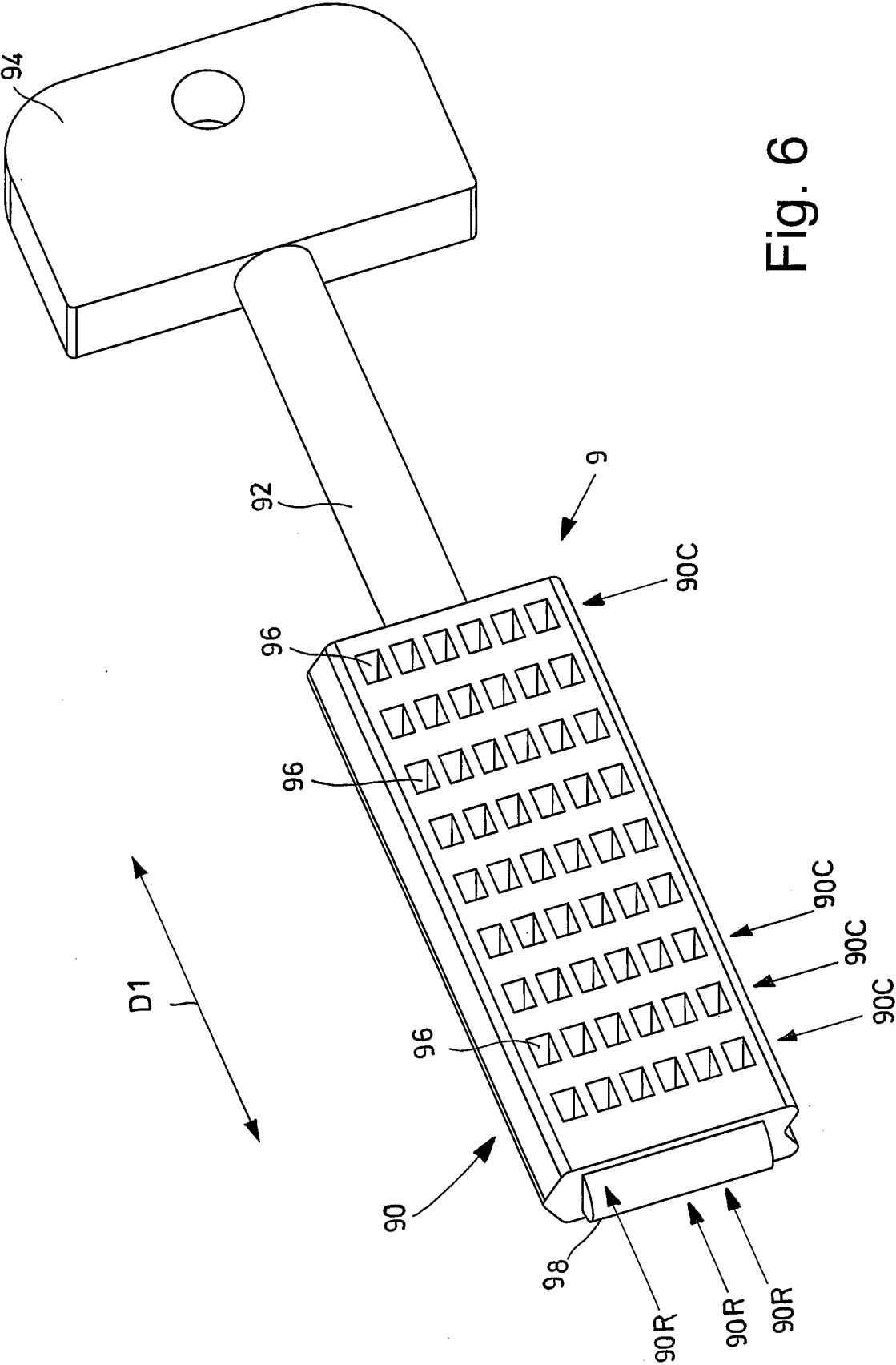


Fig. 6

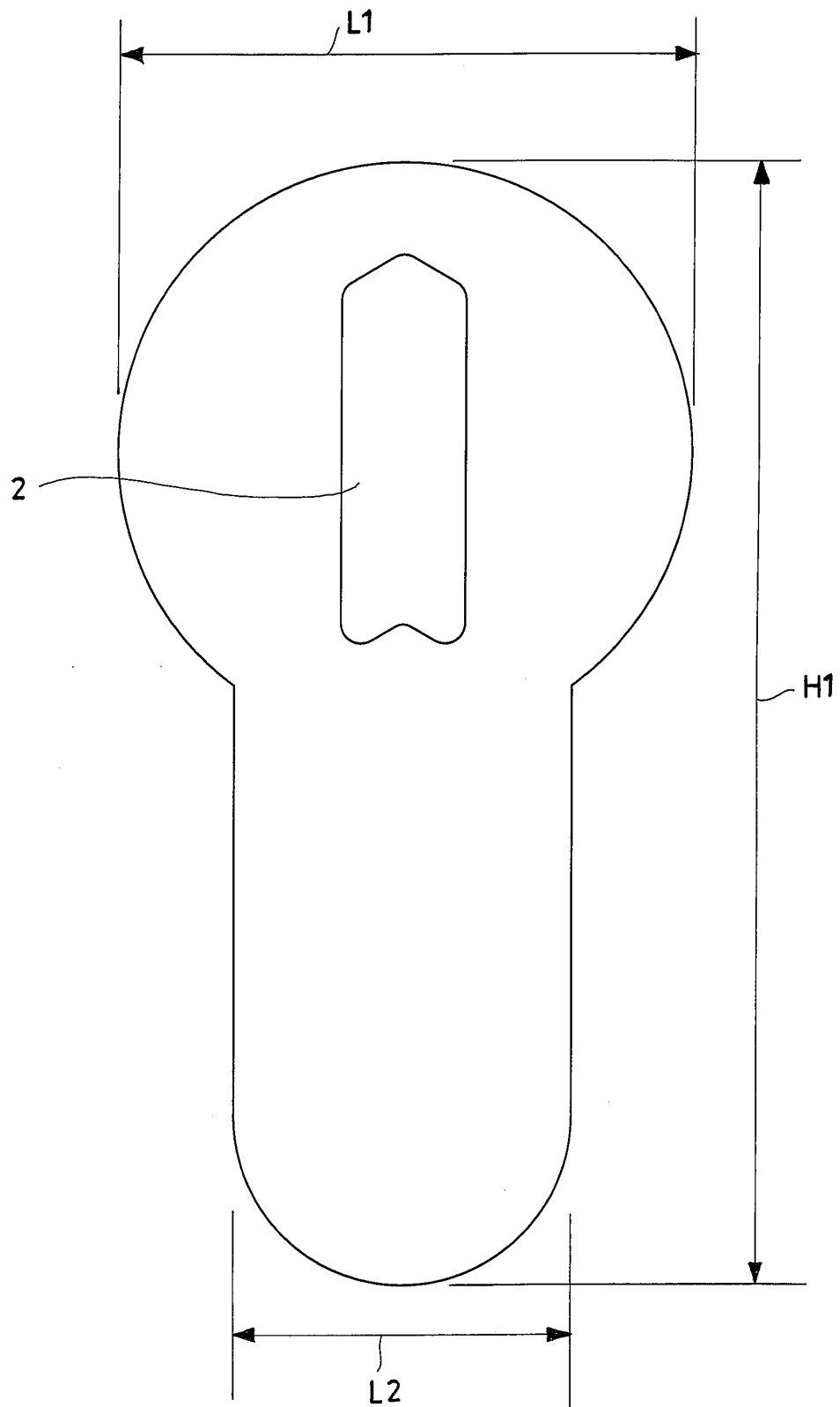
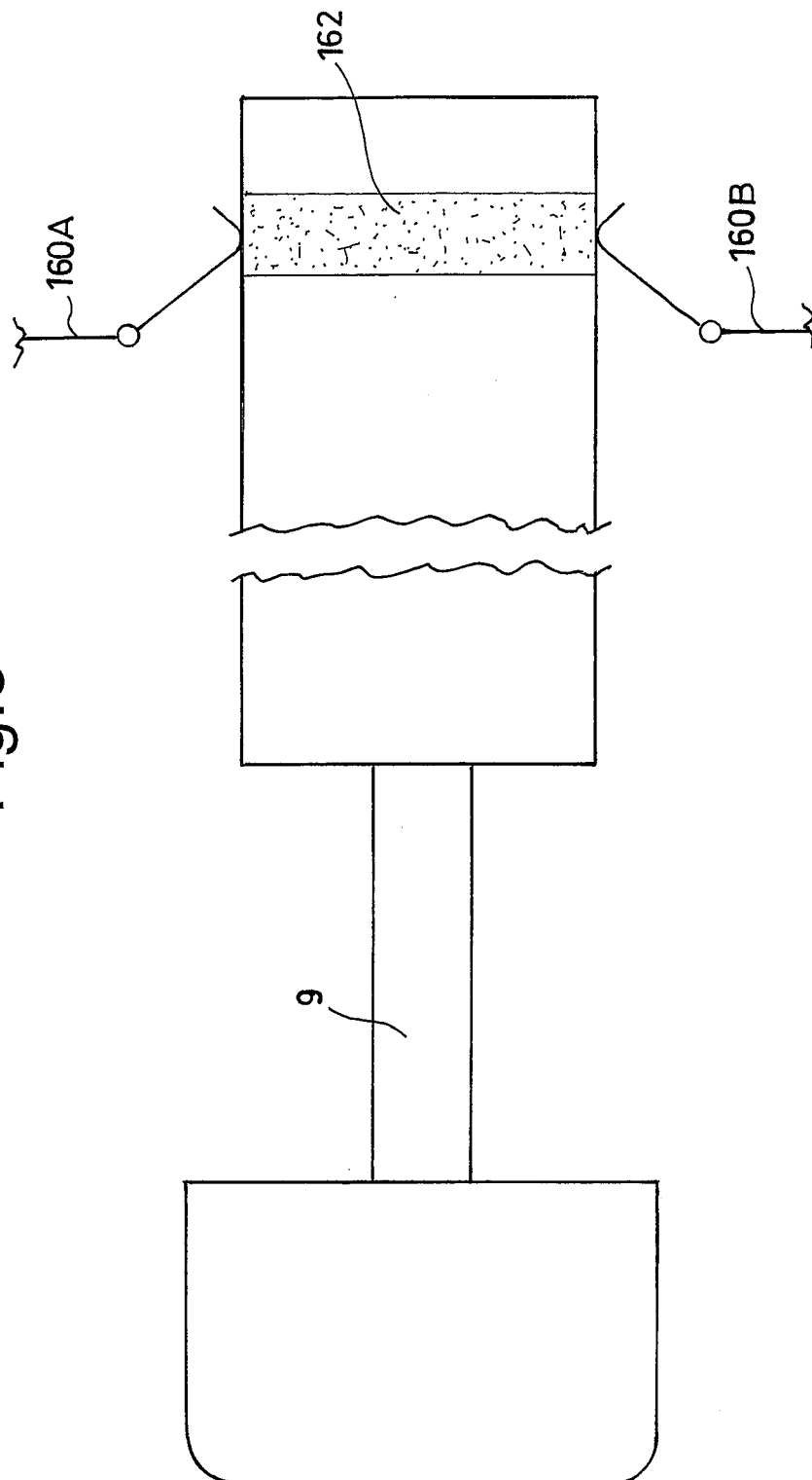


Fig. 7

Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1707712 A1 [0003] [0006]
- WO 0028179 A1 [0003] [0006]
- DE 2807080 A1 [0003] [0006]
- GB 2166484 A [0004]