

Lock cylinder

The present invention relates to a lock cylinder and, in particular, to an electronic lock cylinder for insertion into mortise dead locks or mortise locks for doors.

Mortise locks for doors according to DIN 18251 are in a great number provided with mechanical lock cylinders according to DIN 18252. Such lock cylinders comprise a cylinder housing and a cylinder core arranged therein that can be rotated in the housing by a suitable key and then moves a lock bit or catch protruding out of the cylinder housing approximately at the center of the cylinder housing within the mortise lock to lock and unlock the lock.

Known mechanical lock cylinders leave much to be desired in terms of safety, lock scheme design and flexibility, because mechanical keys can easily be copied, lock schemes defining access authorizations must substantially be structured hierarchical, and for loss of the key and lock scheme modification the lock cylinder must be replaced completely.

For preventing these problems electronic lock systems have been suggested. Examples of these types of lock systems are described in DE-A-4438832 and DE-A-19502288. According to these publications a mortise lock for doors is modified so that the lock cylinder is replaced by a rod system comprising a rotary knob on the inner and outer side of the door, respectively. The rod system comprises a catch actuating the lock in the same way as is the case for a mechanical lock cylinder. The catch is connected in a rotationally fixed manner with the knob at the inner side of

the door and through an electromagnetically actuatable coupling with the knob at the outer side of the door. Electronics controls the coupling so, that it establishes a rotationally fixed connection only, when a radio frequency transponder is positioned at the outer side of the door within the range of an antenna, for example, that has received an access authorization in a preceeding programming process. The electronics, the antenna and an electromagnetic actuator for actuating the coupling are distributed on the door fittings at the inner and outer side of the door. However, it is very cost intensive to protect this arrangement against manipulation and corresponding safety provisions result in expensive and unattractive door fittings.

US-A-4901545 and US-A-5447047 describe door locks comprising in addition to a mechanical lock electronic access control components arranged in the knob or handle at the outer side of the door. Even these arrangements are susceptible to manipulations. A special lock with integrated electronics partially arranged at the outer door fitting is described in US-A-4820320.

From DE-U-29703559 there is known a door lock having at least one handle on a rotation axis protruding from the door leaf for actuating the fall and/or the bar. In a locked position of the door lock the handle is arranged rotatably on the rotation axis. A coupling actuatable by an electric drive connects the handle and the rotation axis for opening the door. The electric drive is actuatable by a code evaluating means comprising a means for contactless code input. The electric drive, the coupling, the evaluating means comprising the contactless code input means and a power supply for the electric drive and the code evaluating means are arranged in the handle of the door lock. However,

even this door lock leaves much to be desired in terms of its reliability and safety. For example, the coupling mechanism provided in this door lock is substantially unprotected against mechanical and magnetical attacks from the outside so that manipulations or bursting is possible relative easily.

It is object of the present invention to provide an improved lock cylinder which is in particular safer and more reliable than conventional lock cylinders and simultaneously provides an easy and safe as well as flexibly employable lock system. This object is achieved with the features of the claims.

To solve this problem, particularly in terms of the replacement of already existing lock cylinders, one has to consider the aspect, that these types of lock cylinders usually comprise an autonomous power supply. Thus, to assure a high lifetime it is desirable to design the electronic lock cylinder with low power consumption.

The invention is based on the fundamental idea to use the lock cylinder comprising a coupling mechanism for rotatably connecting an outer actuator such, that the coupling means is axial moveable and/or tiltable provided on a drive member of a drive means. According to a preferred embodiment the guide portion of the coupling means is axial moveably borne between stops of the drive member, wherein the first stop acts for engaging and the second for disengaging the coupling means. In this way the coupling means can be decoupled in a substantial more reliable way than hitherto, which results in a substantial improvement of the safety of this type of electronic lock cylinders. According to another preferred embodiment of the invention a spring member is provided between the coupling means and the drive means, effecting a safe engagement of the coupling

means. The spring member is preferably a pressure spring which is tensioned during an engaging movement of the drive means when the coupling means is in a non-engageable position and which forces the coupling means into the engaged state by the pressure force due to its bias as soon as an engageable position is present.

By providing at least one so-called "counter magnet" within the housing of the lock cylinder according to the invention the safety can be further improved because the coupling means will not be engaged when an exterior magnetic field is superimposed, but will continue to remain in the disengaged state.

As drive means for the coupling means preferably a temporary monostable material is used. This material has the characteristic that it can be magnetized by a current pulse by an exterior coil, and this magnetization can be cancelled after a predetermined duration by an appropriate electric control or drive. By applying a hold current to the coil the magnetization can preferably be further supported. With reduction or loss of the magnetic characteristics the coupling means will be disengaged automatically.

In the following a preferred embodiment of a lock cylinder according to the invention will be described by example with reference to the drawings; in which:

Figure 1 shows a schematic longitudinal cross section of a lock cylinder according to the invention;

Figure 2 shows a schematic transverse cross section of a coupling means provided in the lock cylinder according to a first embodiment of the invention;

Figure 3 shows a sectional view along line III-III of the coupling means of Figure 2;

Figure 4 shows a schematic representation of an asymmetric embodiment of a coupling member;

Figur 5 shows a sequence of an disengaging process of the coupling means of a lock cylinder according to an embodiment of the invention;

Figure 6 shows an enlarged schematic longitudinal cross section of the coupling means of a lock cylinder according to another embodiment of the invention; and

Figure 7 shows a schematic longitudinal cross section of the lock cylinder according to a further preferred embodiment.

Figur 1 shows a lock cylinder 2 according to a preferred embodiment of the invention in a schematic longitudinal cross section. The electronic lock cylinder 2 according to the invention can be inserted into a conventional door lock, however, it can comprise any exterior shape. The lock cylinder 2 according to the invention substantially comprises a housing 4, a lock bit 6 arranged rotatably relative to the housing 4, an actuator 8 taking the form of a first door knob at the inner side of the door and opposite to the potential attack side, respectively, and an actuator 10 taking the form of a second door knob at the outer side of the door and facing the potential attack side, respectively. An electronic access control circuit 12 for verifying an access authorization is arranged in the cylinder lock 2 according to the invention preferably within the actuator 8 at the inner side of the door. The power supply for the electronic lock cylinder 2 taking the form of a battery 14 is preferably provided in the actuator 10 at the outer side of the door. The actuator 8 at the inner side of the door is connected rotationally fixed with the lock bit 6 of the cylinder lock 2 according to the invention by a connecting sleeve or bush 16 so that the lock bit 6 can be permanently actuated from the inside or from the side opposite to the potential attack side.

The schematic representation in Figure 1 shows the lock cylinder 2 of the present invention in a disengaged or decoupled state, i.e. a rotationally fixed effective connection is established between the actuator 10 at the outer side and the lock bit 6. In the decoupled state the actuator 10 at the outer side can preferably rotate freely without actuating the lock bit 6. For coupling the lock cylinder 2 according to the invention it is preferred that the outer actuator 10 after termination of a verification protocol temporarily couples with the lock bit 6. To this end there are provided a coupling means 18 and a drive means 20 for the coupling means 18 within the housing 4 of the lock cylinder 2 according to the invention.

The drive means 20 for the coupling means 18 preferably takes the form of an electromagnet comprising a coil 22 and a armature 24 axial moveable in relation thereto. The armature or drive member 24 is borne axial movably in a guide member 26 mounted in the connecting sleeve or bush 16. The maximum hub of the armature or stamp is indicated by "s" in Figure 1. The armature 24 is preferably made from a monostable material, which, for example, can temporary be magnetized by applying a magnetic field. This magnetization is preferably further supported by a hold current at a coil. To terminate the coupling the magnetization of this material can be cancelled by an appropriate electric signal, for example.

The coupling means 18 is preferably shaped as a coupler cross. In the embodiment shown in Figur 1 the coupling means 18 comprises a guide portion 28 guiding the coupling means 18 axial moveably and/or tiltably in the area of a guide member 30 of the armature 24. The guide member 30 of the armature 24 is defined in the axial direction by two stops 32 and 34, respectively. By activating the coupling means,

i.e. when an access authorization is imparted and the drive means 20 has been activated by circuit 12 the armature 24 shifts the coupling means 18 by means of the stop 34 into the position shown in Figure 1. In this position the coupling means 18 connects the actuator 10 at the outer side of the door with the lock bit 6, so that the door can be opened from the outside, too. The rotationally fixed connection between the actuator 10 at the outer side of the door and the lock bit 6 is preferably established through a connection bush 36 and an engaging member 38; both of which are connected in a rotationally fixed manner with the actuator 10. The engaging member 38 comprises for example cutouts 40 which can be formed corresponding to the shape of engagement portions 42 of the coupling means 18. However, a bush is preferably provided as engaging member 38 comprising a pinnacle type engaging portion at an end portion facing to the coupling means and which is engageable with the coupler cross as a preferred coupling means 18. The coupling means 18 is preferably axial moveably guided in the housing 4 or in an outer guide bush.

According to a preferred embodiment shown in Figures 2 and 3 the cutouts 40 are formed at an angle α opening in the direction of disengagement. The angle α is preferably in the range between 1° and 5° and preferably has a value of approximately 3° . In case of the preferred bush like engaging member 38 the inclinations at the longitudinal faces of the pinnacles are provided such that the spaces between the pinnacles increase in the direction of disengagement. By providing the inclinations at the angle α at the cutouts 40 or the pinnacles of the connecting member 38 and/or by providing inclinations at the engagement portion 42 of the coupling means 18 or the coupler cross a more reliable decoupling of the coupling means 18 can be

achieved. This is particularly due to the fact that the contact face between the engagement portions 42 of the coupling means 18 and the cutouts 40 of the engaging member 38 is relative small, so that after an initial release of the coupled parts due to the increasing spaces in the direction of disengagement further disengagement is achieved with substantial reduced friction or even without further contact. Therefore the release force or break off force of the engagement portions 42 from the cutouts 40 can be reduced markedly, so that the reliability of the lock cylinder according to the invention can be enhanced substantially.

The actual connection between the coupling means 18 and the lock bit 6 is realized by a connection bush 44 provided at the coupling means 18. This is shown merely schematically in Figur 1. As already described previously the coupling means 18 is axial movably and/or tiltably guided on the guide portion 30 of the armature 24. This is particularly advantageous for the disengagement of the coupling means 18. In the decoupled state the coupling means 18 is disengaged from the engaging member 38, so that the actuator 10 at the outer side of the door is free to rotate. The lock cylinder 2 according to the invention is set in this position whenever the drive means 20 is current-free. To this end a pressure spring 46 is preferably provided acting as a return spring and forcing the armature 24 into its decoupled position. By recognizing an access authorization circuit 12 energizes the coil 22 of the drive means 20 so that the armature 24 retracts from the coil and catches the coupling means 18 by means of the stop 34 to connect the engaging portions 42 of the coupling means 18 in a form fitting manner with the cutouts 40 of the engaging members 38.

Locking or latching the lock cylinder 2 according to the invention or disengaging the coupling means 18 is achieved by de-energizing the current of the drive means 20. Immediately after switching off the power supply the return spring 46 shifts the armature 24 towards its initial position, and the coupling means 18 at first remains in the engaged state until the armature 24 has covered the distance Δs (shown in Figure 1) and comes into contact with the stop 32. The distance Δs is preferably approximately 0.5 mm. Thus it is assured that the relative large mass of the armature 24 is already moving when it hits the coupling means 18 and thus releases it from the engagement state by a corresponding break off momentum. This effect can be advantageously combined in particular with the inclinations described previously because by means of the break off momentum the coupling means is particularly reliably released from the initial couple position. Stop 32 of the armature 24 shifts the coupling means 18 due to the force of the return spring 46 further until the rest position is reached, i.e. the complete decoupled state.

In the housing 4 of the cylinder 2 according to the invention additionally a drilling protection 48 is provided, which is preferably made of hard metal and prevents that the lock cylinder 2 according to the invention can be forcibly unlocked from the outer side of the door. For example, the return spring 46 can be guided in the housing 4 of the lock cylinder by a centering element 50.

A further preferred embodiment and the function of the lock cylinder 2 according to the invention, respectively, is shown in Figures 4 and 5. According to Figure 4 it can be preferred to form the coupling means 18 as an asymmetric coupler cross to achieve a particularly advantageous disengagement action during decoupling of the coupling means

18 from the actuator 10 at the outer side of the door. By use of an asymmetric coupling means 18 preferably only a part (e.g. only one) of the engagement portions 42 engage with the engaging member 38 so that during disengagement of the coupling means 18 first of all those portions that are not engaged (or are engaged with a small force) and therefore the easily releasable portions are released first before the stronger engaged engagement portions 42 become released. The resulting tilting movement of the coupling means 18 will result in a more reliable decoupling.

However, the disengaging process of the coupling means 18 shown schematically in Figur 5 can also be achieved independently from the shape of the coupling means 18. The disengaging process shown in Figur 5 can be applied in combination with the break off momentum and/or the inclinations according to Figur 3 as well as independently therefrom. According to Figur 5 the stop 32 of the armature 24 initially contacts the coupling means 18. During demagnetization or de-energization of the power supply for the drive means 20 the return spring 46 pushes the armature 24 towards the direction of disengagement whereby the coupling means 18 will be tilted at first according to the center illustration of Figur 5 to release the engagement portions 42 from the cutouts 40. Then the coupling means 18 will be moved into the disengaged or decoupled rest position by the stop 32 und the return spring 46.

Figur 6 shows a further preferred embodiment of the lock cylinder 2 according to the invention and, in particular, the coupling means used therein. According to this embodiment the engaging stop 34 of the embodiment described in the foregoing is formed as a support for an engaging spring 52. Spring 52 can be provided as a pressure spring, for example, so that it can force the coupling means

18 away from the support member 24. This coupling arrangement is particularly advantageous in that an even more reliable engagement of the coupling means 18 can be assured.

For the engaging process the armature 24 of the drive means 20 is at first shifted in the direction of engagement. If the parts to be coupled are not arranged relatively in a defined couple position at this time, the momentum energy transmitted from drive means 20 to the armature 52 will be intermediately stored by compressing the spring 52 until a decoupling process is possible. Then the spring 52 shifts the coupling means 18 into the coupled position without applying any further electric energy. Decoupling is established by the stop 32 as described in the foregoing with reference to the other embodiments and the spring 52 due to its pressure force can further assist to bring the disengaging stop 32 and the coupling means 18 into contact, if necessary.

According to the embodiment of the lock cylinder 20 according to the invention shown in Figur 7 the armature 24 of the drive means 20 is disconnected by a magnetic decoupling means 54, from which extends an extension portion 56 of the armature 24 comprising preferably a reduced cross section. The extension portion 56 preferably extends to the disengaging stop 32. A ferromagnetic material 60 is preferably provided between the decoupling means 54 and the extension portion 56. In this embodiment the spring 46 is formed as a tension spring. According to this embodiment at least one so called "counter magnet" 58 is provided in an area of the extension portion 56 having a tapering diameter. Otherwise this lock cylinder 2 corresponds to the efficiency principle described previously, however, the direction of engagement and disengagement are reversed. The embodiment

described with reference to Figure 7 can be combined with the embodiments explained above and with the aspects of the invention described therein.

Counter magnet 58 is provided as safety means as protection against manipulations from the outside. It is isolated from the remaining magnetic circuit (of the drive means) by means of the magnetic decoupling means 54 and is preferably magnetizable by an external magnetic field. This means that with an attempt to manipulate the lock cylinder 2 according to the invention from the outside by a strong magnetic field the lock cylinder 2 will be "overflowed" by the magnetic field, so that it becomes magnetized and the counter magnet 58 applies a stronger force to the armature 24 than the drive means 20 so that the armature 24 together with the member 60 will be forced towards the counter magnet 58 into the decoupled position. In contrast, during an intentional coupling a magnetic field for driving the armature 24 can be applied punctually.

In case of such an overflow of the magnetic field the armature 24 and therefore the coupling means 18 are forced into the rest position, which is equivalent to a decoupling of the lock cylinder 2 according to the invention.

The lock cylinder according to the invention can be provided according to another embodiment (not shown) such that when an external magnetic field is applied for manipulation purposes a locking means is activated by a counter magnet. The locking means is preferably formed so, that it prevents engagement of the coupling means 18.

C l a i m s

1. Lock cylinder (2) comprising:
 - a housing (4) insertable into a door lock;
 - a lock bit (6) arranged rotatably with respect to the housing (4);
 - an actuator (8) at an inner side of the door for the lock bit (6);
 - an access control circuit (12) for verifying an access authorization;
 - an actuator (10) at an outer side of the door; and
 - a coupling means (18) for rotatably connecting the outer actuator (10) with the lock bit (6);
 - wherein the coupling means (18) is provided with at least one engagement portion (42) axial movable relative to an engaging member (40) establishing an effective connection with the actuator (10) at the outer side of the door; and
 - the coupling means (18) is axial movably and/or tiltably provided on a drive member (24) of a drive means (20).
2. Lock cylinder (2) comprising:
 - a housing (4) insertable into a door lock;
 - a lock bit (6) arranged rotatably with respect to the housing (4);
 - an actuator (8) at an inner side of the door for the lock bit (6);
 - an access control circuit (12) for verifying an access authorization;
 - an actuator (10) at an outer side of the door; and



a coupling means (18) which can be activated electromagnetically for rotatably connecting the outer actuator (10) with the lock bit (6); wherein

at least one counter magnet (50) is provided within the housing (4) and which forces the coupling means (18) stronger into a decoupled position when an external magnetic field is superimposed than an electromagnetic actuating means (20) of the coupling means (18).

3. Lock cylinder (2) comprising:

a housing (4) insertable into a door lock;

a lock bit (6) arranged rotatably with respect to the housing (4);

an actuator (8) at an inner side of the door for the lock bit (6);

an access control circuit (12) for verifying an access authorization;

an actuator (10) at an outer side of the door; and

a coupling means (18) which can be activated electromagnetically for rotatably connecting the outer actuator (10) with the lock bit (6); wherein

at least one counter magnet (50) is provided within the housing (4) which activates a locking means when an external magnetic field is superimposed preventing coupling of the coupling means (18).

4. Lock cylinder (2) comprising:

a housing (4) insertable into a door lock;

a lock bit (6) arranged rotatably with respect to the housing (4);

an actuator (8) at an inner side of the door for the lock bit (6);



an access control circuit (12) for verifying an access authorization;

an actuator (10) at an outer side of the door; and

a coupling means (18) for rotatably connecting the outer actuator (10) with the lock bit (6); wherein

a temporary monostable drive member (24) actuates the coupling means (18).

5. Combination of the lock cylinder according to at least two of claims 1 to 4.
6. Lock cylinder (2) according to any one of claims 1 to 5, wherein the coupling means (18) is guided at the inside.
7. Lock cylinder (2) according to any one of claims 1 to 5, wherein the coupling means (18) is guided at the outside.
8. Lock cylinder (2) according to any one of claims 1 to 5, wherein the coupling means (18) is guided at the inside and at the outside.
9. Lock cylinder (2) according to any one of claims 1 to 5, wherein the guide portion (30) is borne axially movably between two stops (32, 34) of the drive means (24), wherein the first stop (32) acts for disengaging and the second stop (34) acts for engaging the coupling means (18).
10. Lock cylinder (2) according to claim 9, wherein a spring member (52) is provided between the disengaging stop (34) and the coupling means (18).



11. Lock cylinder (2) according to claim 9 or 10, wherein the first stop (32) can be guided with a momentum against the coupling means (18) by means of a return spring (46) for disengagement.
12. Lock cylinder (2) according to any one of claims 1 to 11, wherein the engagement portion (42) of the coupling means (18) and/or the engaging member (40) of the actuator (8, 10) at the outer and/or inner side of the door is inclined in the direction of disengagement.
13. Lock cylinder (2) according to any one of claims 1 to 12, wherein the access authorization can only be imparted temporarily.
14. Lock cylinder (2) according to any one of claims 1 to 13, wherein the coupling means (18) and/or the coupable parts are formed asymmetrically such that during disengagement a tilting movement is assisted.
15. Lock cylinder (2) according to any one of claims 1 to 14, wherein the actuator (8) at the inner side of the door comprises the access control circuit (12) and the actuator (10) at the outer side of the door comprises a power supply (14).
16. Lock cylinder (2) according to any one of claims 1 to 15, wherein the access control circuit (12) is designed such that it executes data exchange with an identification medium of a person requesting for access according to a predetermined access control protocol to verify access authorization.



17. Lock cylinder (2) according to claim 16, wherein the identification medium comprises a transponder and data exchange with the access controll circuit is executed wireless.
18. Lock cylinder (2) according to any one of claims 1 to 17, wherein a drilling protection (48) is provided between the actuator (10) at the outer side of the door and the lock bit (6).
19. Lock cylinder (2) according to any one of claims 4 to 18, wherein the temporary monostable drive member (24) will additionally be magnetized by a continuous magnetic field during a potential actuation of the coupling means (18) and then be demagnetized.

