

CYLINDER LOCK WITH REPLACEABLE PLUGFIELD OF INVENTION

The present invention relates generally to cylinder
5 lock-key combinations and concerns more specifically
cylinder locks with a plug that is easy to replace,
wherein the plug comprises the complete combination for
coded pins or the like.

BACKGROUND

10 It is previously known to provide a lock device with a
removable and therewith replaceable plug. The advantage
of locks with a replaceable or interchangeable plug is
that relatively unskilled personnel can quickly give
the lock a new code. Such new codes can be required if
15 e.g. someone fails to return a key and thereby this key
can come into wrong hands.

The coding of locks wherein the plug comprises the com-
plete combination can easily be accomplished by replac-
ing the entire plug with another plug provided with a
20 new code. A known way of providing a removable plug is
to use a pin going through the housing or the like,
which pin is actuated by a key inserted into the plug.
A specially designed key, a so-called service key, has
been used for releasing the plug.

25 A lock with a replaceable plug of the kind initially
mentioned is disclosed in the PCT publication
WO 97/36072 in the name Australian Lock Company. This
lock comprises a concentric groove in a cavity in a
housing for receiving a plug. The plug comprises pro-
30 trusions in the form of balls which, when running in
the concentric groove, retain the plug in the cavity

and thus prevent mutual longitudinal movement between plug and housing. When using a service key, the sides of which are provided with recesses, the balls can sink down into the recesses and thereby they do not block
5 the longitudinal movement of the plug.

The disclosed solution gives a fragile construction because the contact surface taking up longitudinal forces is small. This can lead to yielding or breaking of the mounting device when the lock is manipulated, e.g. when
10 someone tries to open a heavy or stiff door by solely pulling the key handle.

OBJECT OF THE INVENTION

An object of the present invention is to provide a cylinder lock-key combination wherein the lock plug is
15 easier to replace than in known locks. Another object is to provide a cylinder lock-key combination wherein the lock plug is better mounted against longitudinal forces than in known locks. Another object is to provide a key for said combination.

20 SUMMARY OF THE INVENTION

The invention is based on the insight that a key with a back profile can be used in order to retain the plug against longitudinal movement in certain positions. This is combined with protrusions on the plug that co-
25 operate with grooves in a cavity in the housing. The plug is thereby easily replaceable and also the mounting of the plug is stronger than in previously known locks.

According to the invention there is provided a cylinder
30 lock-key combination, wherein the cylinder lock com-

prises a lock cylinder with a cylinder housing and a cavity in the cylinder housing adapted for receiving a cylinder plug with a key slot for a key bit part of a key, and wherein the wall of the cavity comprises at least one concentric groove running concentrically with the center axis of the cavity, said combination being characterized in that said at least one concentric groove cooperates with a profile provided on the back of the key bit of an operator or user key when the key is inserted to an operative position in the cylinder lock to prevent turning of a key with an incorrect profile; and further in that the combination comprises a first longitudinal groove provided in the wall of the cavity and adapted to permit, in a first rotary position of the plug in which the key slot is aligned with the first longitudinal groove, insertion of an operator key provided with a back profile; a cam part provided on the envelope surface of the cylinder plug which, when interacting with said at least one concentric groove, prevents mutual longitudinal movement between the housing and the plug; and a second longitudinal groove provided in the wall of the cavity and adapted to permit, in a second rotary position of the plug in which the cam part is aligned with the second longitudinal groove, mutual longitudinal movement between the housing and the plug; wherein, in a rotary position of the plug different from said first rotary position, when an operator key with a back profile is inserted in the key slot, the back profile interacts with said at least one concentric groove to prevent mutual longitudinal movement between the key and the housing and thereby between the plug and the housing; and when a service key lacking a back profile is inserted in the

plug, mutual longitudinal movement between the plug and the housing is permitted in said second rotary position, whereby the plug can be withdrawn from or inserted into the housing.

- 5 Further the invention includes an operator key and a service key for use with the above-mentioned combination.

Other preferred embodiments are given by the dependent claims.

10 BRIEF DESCRIPTION OF DRAWINGS

The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1a,b show a cylinder lock housing according to the invention;

- 15 Figs. 2a,b show a cylinder lock plug;

Figs. 3a,b show an operator key according to the invention for use with the cylinder lock housing shown in Figs. 1a,b;

- 20 Figs. 4a,b show the operator key inserted into the cylinder;

Figs. 5a,b show the operator key inserted and turned approx. 45° from the position of insertion;

Figs. 6a,b show a service key; and

- 25 Figs. 7a,b show the service key in Figs. 6a,b inserted into a lock and turned to a replacement position for the lock plug.

DETAILED DESCRIPTION OF THE INVENTIONConstruction

In the following a preferred embodiment of a cylinder lock will be described together with an associated key
5 according to the invention.

Fig. 1 shows a cylinder lock housing 10 intended for mounting in a door or the like and with a conventional, generally cylindrical outer shape. Thus, it is completely interchangeable with today's known cylinder
10 lock housings.

A cavity 12 is bored out in the housing 10 for receiving a cylinder lock plug 20 shown in Fig. 2. The shown housing is intended for a lock of the type marketed under the trade mark ASSADESMO® and the function of this
15 type of locks is described in e.g. the Swedish patents with publication numbers SE-B-469 565 and SE-B-469 566 in the name of ASSA AB to which reference is made for further information. Two grooves 14a, 14b known per se are running longitudinally in the walls of the cavity
20 and which are engaged by a respective side bar when the lock is in a locked position. A further groove 15 is running in parallel with the two grooves 14a, 14b. This latter groove 15, which has a preferred width of 2 mm, is adapted to receive a part of the back part of an inserted key 30. This key will be described in more detail under reference to Fig. 3.
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The cavity is also provided with a longitudinal groove 17 which is wider than the other grooves and is adapted to cooperate with protrusions or cam parts 27 on the
30 plug 20 shown in Fig. 2 when this is inserted or with-

drawn. In a preferred embodiment these cam parts have a width of approx. 5 mm. The function of these cam parts will be further described in the following.

Besides the longitudinal grooves already mentioned
5 there are a number of concentric grooves 16a-e which are displayed in Fig. 1b. The shape, depth or width of these grooves can vary but they have in common that they run around the inner wall of the cavity 12 in a plane perpendicular to the longitudinal direction of
10 the housing, i.e., perpendicular to the direction of insertion of the key.

The inner diameter of the cavity 12 is adapted for insertion of the cylinder lock plug 20 shown in Fig. 2. Except for the cam part 27, this plug has a conven-
15 tional shape for the kind of lock in question and comprises a shoulder or collar 22 for correct positioning in the housing 10. The plug also comprises two slits for side bars 24, of which only one is displayed in the figures. The plug also comprises a key slot 26 for in-
20 sersion of the key, the position of which appears from Fig. 2b. In the preferred embodiment the width of the key slot is larger than the width of the groove 15 in the housing 10. The meaning of this will be explained below.

25 The plug 20 also comprises the cam parts 27a-e already mentioned. These have a shape that in the longitudinal direction harmonizes with the circumferential grooves 16a-e in the wall of the cavity 12, see Fig. 1b. This means that when the plug 20 has been inserted into the
30 housing 10 and is in a position in which the cam parts 27a-e are not aligned with the groove 17, see Fig. 4b,

the cam parts will prevent mutual longitudinal movement between the housing 10 and the plug 20, whereby the plug is established firmly in the housing. However, if the plug has been turned to a position in which the groove 17 is aligned with the cam parts 27a-e, see Fig. 5b, the groove 17 will permit this mutual longitudinal movement, whereby the plug can be inserted into or withdrawn from the housing. In this position the plug will follow the key because the key and the plug are interlocked by the code grooves on the key and the driving pins in the plug.

In Fig. 3a a key 30 is shown, the main parts of which are made up of a grip 31 and a key bit 32. The sides of the key bit 32 are provided with code slots, which, during insertion of the key, cooperate with lock pins known per se in the cylinder lock plug 20, see e.g. the above mentioned patent publications in the name of ASSA AB. The cross section of the key bit is shown in Fig. 3b and from this figure is seen that the back surface 33 of the key bit is rounded to be adapted to the radius of the cavity 12 in the housing. The largest height of the key bit 32 essentially corresponds to the length of the key slot 26 in the plug 20 and the depth of the groove 15 in the housing 10 added together, whereby the key can be inserted into the key slot when the plug is in such a position in the housing 10 that the key slot is aligned with the key groove 15.

The back surface 33 has a toothed profile when viewed from the side and comprises protrusions 34a-e and straight parts 35 located therebetween. The shape and the position of the protrusions 34a-e correspond to a respective groove 16a-e in the housing and a respective

cam part 27a-e of the plug, which is best seen in Fig. 3a. Because this kind of lock lacks top and bottom tumblers etc., there is no need for a straight dividing line between the plug and the housing. Therefore the positions of the protrusions can be varied freely along essentially the entire back surface 33 which allows a large variation of back profiles.

Again with reference to Fig. 3b is seen, that the profile in the transverse direction of the key is limited to a part of the back surface and that a guiding part 37 is provided on a limited part of the width of the back surface, which in the shown embodiment is approx. 1/3 of the total width of the back surface. The purpose of this guiding part is to allow insertion of the key into the longitudinal groove 15 in the housing 10 because the width of the groove 15 is less than the width of the key blank.

Fig. 4 shows an insertion position for the key. From this figure is seen that the guiding surface 37 rests against the wall in the cavity 12 in the housing 10. If there were no guiding surface, the protrusions 34 of the key profile would bump against the bottom of the groove 15 causing abrasion damage on the key as well as on the housing. This is avoided with the shown shape of the key 30 provided with the guiding surface 37 in combination with the groove 15.

One realizes that the total height of the key bit 32 is larger than the height of a key for conventional locks and therefore a key blank with a higher bit part has to be used. The back part is milled off so that the parts between the protrusions are created. Due to heating

created with cutting methods and rotary tools and in order to get a smoother shape, inclined transition surfaces between the protrusions 34 and the parts 35 therebetween, such as at the protrusion 34d, are preferred. However, also right angles can be used. The key blank can be cut with a back profile if that is preferred. The material of the guide 37 is then milled away. Alternatively, the key blank can be provided with the guide surface 37 before milling and thereby the final machining is simplified.

In order to achieve correct insertion position for the key 30 in the lock the key is also provided with a stop lug 36 that blocks further insertion of the key when the lug abuts the front surface of the plug.

15 Operation

In the following, the operation of the lock and the key according to the invention will be explained with reference to Figs. 4 and 5. In Fig. 4 the key 30 is shown inserted into the plug 20 but not turned from the insertion position. In the insertion position, the key is tilted approx. 45°, which can be seen from Fig. 4b. The reason for that is the preferred location of the slits 14a,b for the side bars which can be seen in Fig. 1a. By this location of these slits the possible width of the housing 10 is minimized and thereby a more compact construction is achieved.

Fig. 5a shows how the back profile of the key corresponds with the circumferential grooves in the housing when the key has been inserted to a position in which the lug 36 abuts the front surface of the plug. Because the protrusions 34 can run in the grooves 16 when the

key is turned, this turning is not blocked and the key operates as in a conventional lock.

However, if the key presents an incorrect back profile, i.e., one that does not harmonize with the grooves 16, 5 the turning of the key is blocked from the position shown in Fig. 4 and the lock cannot be unlocked, even when the key presents correct code slots or surfaces.

In the position shown in Fig. 5b with the key turned approx. 45° from the insertion position shown in Fig. 10 4b, i.e., with the key 30 in a vertical position, the protrusions 34a-e engage in the corresponding groove 16a-e. This means that the axial movement of the key is blocked and that the key can take up relatively large axial forces without damage to the key or lock. This is 15 an advantage when the key functions as a doorknob for opening of the door in which the lock is mounted.

However, in this position the cam parts 27 of the key are aligned with the longitudinal groove 17 provided therefor in the housing, and thus in this position it 20 is solely the back profile of the key that prevents mutual axial movement between the plug and the housing. The shape of the back profile makes it possible to take up large axial forces because the interaction area between the back profile and the grooves in the housing 25 amounts to several square millimeters, in the shown embodiment approx. 9 square millimeters, even though the grooves are relatively shallow.

When the plug is to be replaced, a service key without back profile, see Fig. 6, is inserted as a usual key 30 tilted 45° as in Fig. 4. The material in the housing

- adjacent to the groove 15 then prevents the service key from "slipping down" even though it lacks the back profile. The service key is then turned to the position shown in Fig. 7. It is in this position that the plug
5 can be replaced. Because a service key is used which lacks a back profile preventing withdrawal of the key, the plug can be withdrawn from the housing by means of the key and be replaced with another plug, also by means of a service key.
- 10 The man skilled in the art realizes that the shown embodiment can be varied and modified within the scope of the appended claims without departing from the inventive idea. Thus, the invention is not limited to locks of the type ASSADESMO®.
- 15 In a preferred embodiment the entire lock system is integrated in the plug. The side bars are retained in the recesses provided therefor, e.g. by means of circumferential rings or protrusions on the edges of the recesses. In that way the side bars will not fall off
20 when the plug is removed from the housing and thus facilitates easy replacement of the plug.

In the shown embodiment the grooves 16a-e are circumferential, i.e., they enable 360° turning of the key. It is also possible to provide a lock in which the
25 grooves run through only a part of the cavity for the cylinder plug.

In the preferred embodiment the longitudinal groove 15 has a width less than the width of the key blank. A construction in which the width of the groove essentially corresponds to that of the key blank is also
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possible. The drawback then is that the service key tends to "slip down" into the groove during insertion.

A housing with two grooves 14a, 14b for the side bars is shown in the drawings. The inventive idea can of course be used with a lock provided with only one side bar or one entirely lacking side bars. The number of grooves 16 can of course also vary depending on the number of profile shapes used.

Keys for use with the inventive lock are preferably made of a conventional key material, such as nickel-brass.

The position of insertion as well as the angle through which the key is turned when locking or unlocking can of course vary.

The grooves shown can be given a different shape or position. If the turning angle for unlocking is larger than 90°, e.g. 180°, the longitudinal groove 17 can be made broader than what has been shown.

CLAIMS



1. A cylinder lock-key combination, wherein the
5 cylinder lock comprises a lock cylinder with a cylinder
housing (10) and a cavity (12) in the cylinder housing
(10) adapted for receiving a cylinder plug (20) with a
key slot (26) for a key bit part (32) of a key (30),
and wherein the wall of the cavity (12) comprises at
10 least one concentric groove (16a-e) running concentri-
cally with the center axis of the cavity (12),

characterized in that

said at least one concentric groove (16a-e)
cooperates with a profile (34a-e, 35) provided on the
15 back (33) of the key bit (32) of an operator key when
the key is inserted to an operative position in the
cylinder lock to prevent turning of a key with an in-
correct profile (34a-e, 35); and further in that the
combination comprises

20 a first longitudinal groove (15) provided in
the wall of the cavity (12) and adapted to permit, in a
first rotary position (Fig. 4b) of the plug in which
the key slot is aligned with the first longitudinal
groove, insertion of an operator key (30) provided with
25 a back profile;

a cam part (27a-e) provided on the envelope
surface of the cylinder plug which, when interacting
with said at least one concentric groove (16a-e), pre-
vents mutual longitudinal movement between the housing
30 and the plug; and

a second longitudinal groove (17) provided in the wall of the cavity (12) and adapted to permit, in a second rotary position (Fig. 5b) of the plug in which the cam part (27) is aligned with the second longitudinal groove (17), mutual longitudinal movement between the housing and the plug;

wherein, in a rotary position of the plug different from said first rotary position, when an operator key with a back profile is inserted in the key slot, the back profile interacts with said at least one concentric groove to prevent mutual longitudinal movement between the key and the housing and thereby between the plug and the housing; and

when a service key lacking a back profile is inserted in the plug, mutual longitudinal movement between the plug and the housing is permitted in said second rotary position, whereby the plug can be withdrawn from or inserted into the housing.



2. A combination according to claim 1, characterized in that the profile (34a-e, 35) runs through a limited part of the width of the key bit (32), preferably through 2/3 of the width of the key bit, and in that the width of the first longitudinal groove (15) essentially corresponds to the width of the profile (34a-e, 35).

3. A combination according to claim 1 or 2, characterized in that the width of the second longitudinal groove (17) is larger than the width of the first longitudinal groove (15), preferably 5 mm.



4. An operator key for use with a combination according to any of the preceding claims, **characterized in** that a part of the section of the back surface (33) on the key bit (32) is
- 5 provided with a profile (34a-e, 35) in the longitudinal direction of the key, said profile interacting with at least one groove (16a-e) in a cavity (12) in the cylinder housing (10).
5. A service key for use with a combination
- 10 according to any of claims 1-3, **characterized in** that the section of the back surface (33) on the key bit (32) is profileless in the longitudinal direction of the key.