

16-12-2010

PROFILED KEY FOR CYLINDER LOCKSField and background of the invention

- 5 The present invention relates to a key for use in a cylinder lock with a rotatable key plug having a profiled key hole or keyway, said key comprising:
- an elongated, substantially flat key blade having a longitudinal profile groove extending along at least a portion of
 - 10 the length of the key blade, with an inner wall of said groove being substantially parallel to a side surface of said flat key blade,
 - said longitudinal profile groove having an undercut portion adjacent to and inside a ridge portion of the key blade, the
 - 15 outside of said ridge portion forming a side surface of the key blade.

Such a key with an undercut groove is previously known, e.g. from US patent 5,715,717 (Widén) or US patent 5,640,865

20 (Widén). Such keys have proven to be very useful in that they provide an improved security. The key profile is quite distinguished from conventional keys, and it is rather difficult to copy such keys. Moreover, they permit a great variation of the cross-sectional profile, which is a great advantage.

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Object of the invention

However, over time, there is a constant need for further distinguishing profiles and many more possible variations

30 thereof.

A further object of the invention is to make it even more difficult to copy such profiled keys with ordinary lock smith tools.

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Summary of the invention

In accordance with one aspect, there is provided a key for use in a cylinder lock with a rotatable key plug having a profiled key way, said key comprising:

- an elongated, substantially flat key blade having a longitudinal profile groove extending along at least a portion of the length of the key blade, with an inner wall of said groove being substantially parallel to a side surface of said flat key blade,

- said longitudinal profile groove having an undercut portion adjacent to and inside a ridge portion of the key blade, the outside of said ridge portion forming a part of said side surface of the key blade,

characterized in that

- said undercut portion of said longitudinal profile groove, at its innermost part inside said ridge portion, is extended, substantially in a direction in parallel to said side surface of the key blade, into a longitudinal pocket having opposite lateral wall portions and a lowermost transverse end wall, which is substantially flat or slightly curved, and which is substantially parallel to a lower edge portion of the key blade and faces upwardly in a direction in a central plane of the key blade and the vertical dimension of said ridge portion, measured in a plane of said side surface of the key blade, is more than half of the smallest width of said longitudinal profile groove adjacent to said side surface, said smallest width being measured as a perpendicular projection onto said inner wall of said longitudinal profile groove.

A key according to one embodiment is provided with an undercut groove, a portion of which is extended, at its innermost part inside said ridge portion, substantially in a direction in parallel to said side surface of the key blade, into a longitudinal pocket having opposite lateral wall portions and a lowermost transverse end wall, which is substantially flat or slightly curved, and which is substantially parallel to a lower edge portion of the key blade and faces upwardly in a direction in a central plane (A) of the key blade. The inside wall of the ridge portion may be substantially parallel to a side surface of the key blade, so that the ridge portion forms a massive and strong material portion extending in parallel to the side surface of the key blade. The pocket inside the ridge portion may have a substantially rectangular cross-section, a substantially circular cross-section, with a relatively large curvature, or some other configuration.

In this way, the material of the key blade is used in an optimum way, and a new kind of profile is obtained, and it will be very difficult to copy such keys, especially if they are produced by stamping and milling. A cutting disc is normally not enough. Rather, it will be necessary to use broaching tools and a well-controlled use of such tools in order to secure exact dimensions of the pocket-like extension of the groove. This is of great importance for key control and high security to the end user of the key.

With such a configuration of the undercut groove, many advantages are obtained at the same time, as will be explained further below.

Other preferable features are stated in the dependent claims and will appear from the detailed description below.

Brief description of the drawings

The invention will be described more fully below with reference to the appended drawings.

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Figure 1 and Figure 2 illustrates a prior art lock and key combination;

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Figure 3 shows a side view of the key illustrated in Figure 2;

Figure 4 is a cross-section through the prior art lock with an inserted key;

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Figure 5 is a cross-sectional view of the prior art key blade;

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Figure 6 shows a side view of a profiled key according to the present invention for an embodiment with a wave-like code pattern;

Figure 7 is a cross-section through the key of Figure 6;

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Figure 8 is a cross-section through an associated lock with a key plug and a side tumbler;

Figure 9 is a similar view of a lock and an inventive key inserted into the lock;

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Figures 10 - 20 are cross-sectional views of some additional embodiments of the profiled key according to the invention, and

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Figures 21 - 31 are similar cross-sectional views of some further modified embodiments of the profiled key according to the invention.

Brief description of some preferred embodiments

Figures 1 through 5 show a prior art lock and key system with a key blade having an undercut profile groove in a side surface thereof, such as the system disclosed in US patent 5,715,717 (Widén). The lock 10 is of the kind having a housing 11 with a rotatable key plug 12 accommodated in a cylindrical bore of the housing. In the key plug 12, there is a central longitudinal keyway or key hole 13 having a sectional profile corresponding to an associated key 20 provided with conventional recesses 21 at the upper edge thereof and a profile groove 22 at a side surface 23 of the key blade. As appears from Figure 3, the key also has a grip portion 24.

The operation of the lock is more readily understood from the cross-sectional view in Figure 4. The key plug 12 is rotatable within the housing 11 and can be locked against rotation by means of a longitudinal row of upper and lower locking pins 14a, 14b. Each pair of such locking pins can be positioned with their abutting end surfaces at the shear line between the key plug 12 and the housing 11. In this position, as shown in Figure 4, the key plug 12 is rotatable. Here, as is well-known in the art, the locking pins are positioned so as to release the lock by means of a properly cut key 20.

The full profile of the key 20 (of prior art design) is illustrated in Figure 5, as disclosed e.g. in the above-mentioned US patent 5,715,717 (Widén). Accordingly, this prior art key has a longitudinal profile groove 22 extending longitudinally along the key blade at a depth which is slightly greater than half the thickness of the key blade. In Figure 5, the central plane of the key blade is denoted "A". The longitudinal groove 22 has an inner wall 24 and opposite walls 25 and 26. One of these opposite walls, in particular the wall or surface 26 located closest to the base edge 27 of the key blade is undercut and extends in a plane being inclined so as to face inwardly towards the bottom wall or surface 24. This

lower side wall 26 of the undercut groove 22 forms an inside wall of a ridge portion 28, the outside of which forms part of the above mentioned side surface 23 of the key blade.

- 5 The prior art key blade shown in Figures 2, 3, 4 and 5 also has two further longitudinal grooves 30 and 31 on the other side of the key (to the left in Figure 5).

10 The undercut portion 29 of the longitudinal groove 22 has many advantages, as explained in the above-mentioned US patent specification 5,715,717 (Widén), especially with regard to increasing the number of possible profile variations, improved resistance against picking the lock and high security against unauthorized key copying.

15 According to the present invention and as illustrated in Figure 6 through 9, a further improvement resides in a modification of the undercut groove. This modification comprises an expansion or extension of the innermost part of the undercut portion of the groove 122 (Figure 7) so as to form a
20 longitudinal pocket-like configuration 135. In these Figures, all reference numerals relating to the key correspond to those shown in Figure 5, although they have been supplemented with the digit "1" before the number given in Figure 5.

25 The downwardly extended pocket-like configuration 135 of the modified undercut groove 122, is (in this particular embodiment) substantially rectangular in cross-section, with opposite lateral walls 132 and 133 being parallel to each other,
30 and a lowermost transverse end wall 134, being parallel to the lower edge surface 127 of the key blade and facing upwardly in the direction of the central plane A of the key blade.

- 35 The innermost lateral wall 132 of the pocket-like extension 135 adjoins with the inner wall 124 of the undercut groove, but is slightly displaced inwardly (away from the groove

16-12-2010

opening) so as to form a step 136, whereas the opposite lateral wall 133 forms the inside wall of the ridge portion 128, in parallel to the external side surface 123 of the key blade.

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Thus, the surfaces 123, 133 and 132 are substantially parallel to each other.

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The ridge portion 128 is somewhat longer, measured in parallel to the central plane A of the key blade, than the prior art structure (Figure 5). More particularly, the ridge portion 128 has a vertical dimension h, which is more than half of the smallest width w of the undercut groove 122, this smallest width w being measured as a perpendicular projection onto the bottom wall 124 of the longitudinal groove 122.

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Also, the vertical dimension h of the ridge portion 128 is greater than the distance d between the lowermost transverse end wall 134 and the lower edge surface 127 of the key blade. This structure is advantageous for several reasons:

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- by varying the width, depth (in the plane A) and longitudinal extension of the pocket-like configuration, the profile shape can be varied considerably;
- because of the opposite lateral wall portions 132, 133 the total width of the undercut portion of the profile groove 122 can be accommodated in a limited region laterally, so that the total width of the key blade can be kept rather small. It appears from Figures 5 and 7 that the total width of the new key blade is about the same;
- 30 - the corresponding tongue portion, which may form a part of a longitudinal rib 150 at a side wall of the key way (see Figures 8 and 9), will be stronger and does not have to have a pointed or sharp end portion, as in the prior art structure (compare Figure 4);
- 35 - the pocket-like extension 135 of the undercut portion of the groove 122 will make it much more difficult to make copies of such keys, since it is not sufficient to use only a

cutter disk. Normally, other tools also have to be used. Accordingly it will be difficult for others than specialized manufacturers to produce such key blanks;

- the relatively long vertical extension of the ridge portion 128, in parallel to the central plane A of the key blade, will make it possible to cut rather deep recesses in the ridge portion. Accordingly, just like in the prior art embodiment of Figure 1 - 5, it is possible to provide many vertical levels of code recesses in this material region, see Figure 6. Of course, this will also facilitate lock and key systems having a very high number of code combinations.

In Figures 8 and 9 there is shown an embodiment with a side locking tumbler 105, which is guided in a cylindrical cavity 106 in the rotatable key plug 112. In principle, the arrangement is similar to those disclosed in the US patents 4,756,177 (Widén) and 5,715,717 (Widén).

The parts that correspond to the previous, prior art embodiment (Figure 5) have been given the same reference numerals, with the digit "1" added before the numbers shown in Figure 5.

Accordingly, the side tumbler 105 is rotatable around its cylindrical axis, so that a transversally projecting finger 105a will pivot back and forth when the projecting finger 105a follows a wave-like coded surface on the side of the key blade (see Figure 6), in this case in the ridge portion 128 (see Figure 7). When the side tumbler 105 is correctly positioned, a recess 105b in its cylindrical surface will register with corresponding projections 108a on a side bar 108 (Figure 9). In this way, the side bar may move radially inwards so as to permit rotation of the key plug 112.

The projecting finger 105a on the side tumbler 105 will contact the wave-like code pattern on the side of the key blade 120, as shown in Figure 6, while pivoting back and forth and

16-12-2010

also moving vertically up and down. When the key blade is fully inserted, the various side tumbler projections 105a will be located in the concavities 102a, 102b, 102c, 102d, 102e and possibly also (or alternatively) onto an upper code surface portion 102f at an uppermost extra code level. Such an upper, extra code level is disclosed in the published international patent application WO2005/028789 (Winloc et al).

It would be possible to provide an even deeper pocket-like extension 135 of the undercut portion of the profile groove, in parallel to the central vertical plane A of the key blade. Then, the number of possible code levels in the ridge portion 133 (see Figures 6 and 7) would be larger than in prior art structures.

It should be noted that the new configuration of the undercut groove 122, with the pocket-like extension 135, is useful even without having a side tumbler 105. Then, the ridge portion is basically continuous and does not have any cuts or codes.

Also, if at least one side tumbler is used, it does not have to be rotatable, but can be guided for elevational movement only. Furthermore, the side tumbler does not have to operate as a locking means for locking the key plug against rotation. Alternatively, it may serve only as a blocking element, which prevents incorrectly cut keys from being fully inserted into the key way 13 of the lock 10. Such a blocking element is disclosed in a patent application being filed by the same applicant on the same day as the earliest priority date of this application.

The exact configuration or shape of the longitudinally extending pocket may be modified in various ways within the scope of the present invention. In Figure 10, there is shown an embodiment where the inner wall 124 of the longitudinal

profile groove 122 merges smoothly with the adjoining lateral wall 132 of the pocket-like configuration 135, without any step (136 in Figure 7).

- 5 In Figure 11, the pocket-like configuration 135 is similar to the one in Figure 7, but the lowermost transverse end wall 134' is rounded or curved.

The embodiment shown in Figure 12 is similar to the one in
10 Figure 11, but the lowermost transverse end wall 134'' is shorter (but still curved), and the inner wall 124 of the groove merges smoothly with the adjoining lateral wall 132 (as in Fig. 10).

- 15 In Figure 13, the pocket-like configuration 135' is modified into a circular cross-section. Accordingly, in this embodiment, the lateral walls 132, 133 and the lowermost end wall 134 are all formed as circular arcs merging with each other.

20 The embodiment shown in Figure 14 is like the one shown in Figure 10, but the lateral wall 132 adjoining the inner wall 124 is provided with a longitudinal recess 132a, which is rectangular in cross-section.

- 25 The embodiment of Figure 15 is similar to the one of Figure 14, but there is also a longitudinal recess 133a in the lateral wall 133 opposite to the longitudinal recess 132a.

The embodiment in Figure 16 is similar to the one in Figure
30 15, but there is a longitudinal rib 133b (instead of a recess 133a) opposite to the longitudinal recess 132a.

The modified embodiment shown in Figure 17 comprises relatively small longitudinal recesses 132c, 133c, 134c with part
35 cylindrical cross-sections in the lateral walls 133 and 132 and the lowermost end wall 134, respectively. Except for

16-12-2010

these part-circular recesses, this embodiment corresponds to the one shown in Figure 7.

5 The embodiments of Figures 14 through 17 are included to illustrate that the opposite lateral wall portions and the lowermost transverse end wall of the longitudinal pocket may be provided with irregular surface portions.

10 In the embodiments shown in Figures 18 and 19, the key blade 120' has a relatively wide lower portion 140' and a relatively narrow upper portion 141', there being a shelf or step surface 142' in the transition region between the wider lower portion 140' and the narrow upper portion 141'. In both embodiments, the longitudinal profile groove 122' is located
15 adjacent to this shelf surface 142'. Like in the other embodiments shown in Figures 10 - 17, the longitudinal undercut groove 122' is extended, adjacent to its side wall portion 126', into a pocket-like configuration 135'. In the shown embodiments, these pocket-like configurations are substantially rectangular, but they may preferably be formed with
20 irregularities or any desired shape, e.g. as illustrated in the previous embodiments. In Figure 18, the lateral wall 132' merges smoothly with the inner wall 124' of the undercut groove 122', and the latter adjoins the associated side wall 143' of the upper, relatively narrow portion 141' of the key
25 blade via a step 144'. In Figure 19, on the other hand, there is no such step 144', and the lateral wall 132', the inner wall 124' and the side wall 143' all merge smoothly into a common side surface.

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The key blade 120" shown in Figure 20 is composed of a lower part 150", which is identical or similar to the lower parts 140, 140' of the key blades shown in Figures 10 - 19, and an upper part 151", which is identical to the lower part 150",
35 but turned upside down. In this way the key blade 150", 151" can be inserted either way into an associated key hole, either as shown in Figure 20 or turned upside down (the profile

16-12-2010

is then exactly the same because of the symmetry of the lower and upper parts).

Finally, Figs. 21 through 29 show modified embodiments similar to those shown in Figs. 10 through 18. Thus, the keys 321 through 329 each have a cross-sectional profile corresponding to those shown in Figs. 10 through 18, respectively, except that the upper part of the ridge portion 228 is uniformly thick, and the inside 226 thereof is parallel to the central plane of the key blade.

Fig. 30 corresponds to Fig. 20, and Fig. 31 corresponds to Figs. 11 and 22, except that the lowermost transverse end wall 234 is flat.

In all embodiments described above, and in the appended claims, it is assumed that the inner wall 124 of the longitudinal undercut groove 122, 122', 122" is substantially parallel to the central plane A of the key blade and a side surface 123, 123', 123" thereof. Within this definition, the inner wall may be oriented at a small angle to said central plane A, this angle being normally no more than 15°.

The longitudinally extending pocket may be shorter than the length of key blade and extend along only a portion thereof.

Also, the longitudinal profile rib at the key plug may be interrupted or formed as one or more separate elements mounted in the key plug.

CLAIMS

1. A key for use in a cylinder lock with a rotatable key plug having a profiled key way, said key comprising:
- 5 - an elongated, substantially flat key blade having a longitudinal profile groove extending along at least a portion of the length of the key blade, with an inner wall of said groove being substantially parallel to a side surface of said flat key blade,
 - 10 - said longitudinal profile groove having an undercut portion adjacent to and inside a ridge portion of the key blade, the outside of said ridge portion forming a part of said side surface of the key blade,
characterized in that
 - 15 - said undercut portion of said longitudinal profile groove, at its innermost part inside said ridge portion, is extended, substantially in a direction in parallel to said side surface of the key blade, into a longitudinal pocket having opposite lateral wall portions and a lowermost transverse end wall,
 - 20 which is substantially flat or slightly curved, and which is substantially parallel to a lower edge portion of the key blade and faces upwardly in a direction in a central plane of the key blade and the vertical dimension of said ridge portion, measured in a plane of said side surface of the key
 - 25 blade, is more than half of the smallest width of said longitudinal profile groove adjacent to said side surface, said smallest width being measured as a perpendicular projection onto said inner wall of said longitudinal profile groove.
- 30 2. A key as defined in claim 1, wherein the vertical dimension of said ridge portion is greater than the distance between said end wall and said lower edge surface.
3. A key as defined in claim 1, wherein said pocket has a
- 35 substantially rectangular cross-section.
4. A key as defined in claim 1, wherein at least one of said opposite lateral wall portions is curved.

5. A key as defined in claim 1, wherein said opposite lateral wall portions of said pocket are substantially parallel to said side surface of the flat key blade.

5 6. A key as defined in claim 1, wherein said lowermost transverse end wall of said pocket is curved with a radius being more than half of the width of said pocket, said width being measured transversely to said side surface of said key blade.

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7. A key as defined in claim 1, wherein at least one of said opposite lateral wall portions and said lowermost transverse end wall is provided with an irregular surface portion.

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8. A key as defined in claim 1, wherein said inner wall of said longitudinal profile groove merges with one of said opposite lateral walls portions of said pocket.

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9. A key as defined in claim 1, wherein said vertical dimension of said ridge portion is equal to or greater than said smallest width.

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10. A key as defined in claim 1, constituting a key blank with a continuous upper edge portion configured so as to permit coded recesses to be cut therein.

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11. A key as defined in claim 1, having coded recesses cut into said ridge portion, so as to form a side code on the key blade, said side code recesses being configured to cooperate with at least one side tumbler in an associated lock.

12. A key as defined in claim 11, wherein said side code recesses forming a side code constitute a wave-like, longitudinal code pattern.

5 13. A key as defined in claim 11, wherein said side code recesses are cut into the whole material thickness of said ridge portion, so that the side code recesses reach all the way from the outside surface of said ridge portion into said longitudinal pocket of the undercut profile groove.

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14. A key as defined in claim 11, wherein said side code recesses are cut from an upper edge of the ridge portion down to various levels between said upper edge and the lowermost part of said longitudinally extending pocket.

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15. A key as defined in claim 11, wherein said side code recesses form concavities with lower bottom portions located at a number of different levels, each representing a code.

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16. A key as defined in claim 15, wherein said different levels also include an uppermost level at the upper edge of said ridge portion.

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17. A key as defined in claim 15, wherein the number of different levels is at least three.

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18. A key as defined in claim 1, wherein the inner wall of said longitudinal profile groove and the adjoining longitudinal pocket are located at a depth from said side surface of the key blade which is greater than half the thickness of said key blade.

19. A key as defined in claim 1, wherein said substantially flat key blade has a relatively wide lower portion, in which said longitudinal profile groove is located, and a relatively narrow upper portion.

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20. A key as defined in claim 1, wherein said substantially flat key blade has upper and lower portions, each having an undercut groove with said innermost longitudinal pocket, such that the key is symmetrical and can be inserted either way
10 into an associated keyway of said cylinder lock.