

DESCRIPTIONA Cylinder Lock Unit and an Associated Key

FIELD OF THE INVENTION

[0001] The present invention relates to a cylinder lock unit of the kind indicated in the preamble of claim 1. Thus, the cylinder lock unit comprises a housing with an upper part and lower part,

[0002] said lower part of the housing having a cylindrical bore accommodating a rotatable key plug,

[0003] said rotatable key plug being formed in one piece and being adapted, via a torque transferring connection, to transfer a torque to a locking mechanism when the key plug is rotated,

[0004] said upper part of the housing being provided with a central row of upper and lower locking pins in associated cavities,

[0005] said key plug having a central row of corresponding cavities for accommodating said lower locking pins in said central row,

[0006] said key plug having at least one side locking mechanism being operative independently of said central row of upper and lower locking pins,

[0007] a keyway extending axially backwards from a front end of said key plug and being configured to accommodate an associated key,

[0008] said central row of upper and lower locking pins and said side locking mechanism being arranged to engage with and lock the key plug against rotation in said lower part the housing unless said associated key is inserted into the keyway.

[0009] The invention also relates to a cylinder lock unit of the above-defined kind, in combination of a key for unlocking the cylinder lock unit, said key comprising a grip portion and a key blade.

[0010] Moreover, the invention relates to a key for unlocking such a cylinder lock unit having a rotatable cylindrical key plug with a keyway and at least one side locking mechanism confined to a front region thereof.

BACKGROUND OF THE INVENTION

[0011] Such lock and key systems, cylinder lock units, and keys are frequently used in locking systems with a large number of lock units serving e.g. as door locks.

5 [0012] However, in general, there are no really high security cylinder lock units on the market, with a compact structure and with sufficient room for possibly accommodating an extra lock component in the back region of the key plug. Indeed, there is a desire to make room for such extra lock components, e.g. a part of a torque transferring connection, a blocking mechanism for preventing a non-authorized key blade to be fully inserted into the keyway, or some electronic component which facilitates the utility of the cylinder lock unit.

10 [0013] Because of the extra lock component possibly being located in the back region of the key plug, there is no room for a conventional side bar or other kinds of side tumbler mechanisms which normally require a longitudinal extension along the full length of the key plug.

[0014] In a prior art lock construction of similar design, disclosed in the US patent 6,981,396 (Kim) and also disclosed in a service manual "CX5 HIGH SECURITY CYLINDERS – small format interchangeable core service manual", there is a key plug with a side locking mechanism including a side bar which interacts with a number of side locking tumblers. The side bar also interacts with a retainer sleeve (a "tubular operation body") which extends along the full length of the key plug. Accordingly, on the side provided with the side bar, the key plug will be solid virtually all the way to its rear end, and the associated prong in the associated lock unit will have to be sheared in order to accommodate the key plug and its security full length sidebar. With this construction, the torque to be transferred to the lock unit, by rotating the key plug by means of an inserted key, will be effected by means of a single prong, situated on the opposite side of the key plug.

20 [0015] Another similar prior art document is the published US patent application US 2002/0056301 A1 (Theriault), where the cylinder lock core includes two side bars, one on each lateral side of the keyway, and also a locking segment which is movable relative to the side bar and the lock shell in response to the insertion of a key blade having a uniquely configured camming projection. In this prior art embodiment, the side bars extend along substantially the whole length of the key plug.

OBJECT OF THE INVENTION

30 [0016] There is always a need for further improvement, and the main object of the present invention is to further increase the security and provide a cylinder lock unit with a high security side locking mechanism which is very difficult to manipulate so as to open the lock without using a properly cut key and which will also permit the key plug to possibly accommodate an extra

lock component in the back region of the key plug, e.g. a part of a torque transferring connection, a blocking mechanism for blocking full insertion of a key blade which is not correctly cut, or an electronic component which facilitates the functioning of the lock unit.

5 **[0017]** SUMMARY OF THE INVENTION

[0018] Actually, the present invention is a further development of an invention for which a US application and an international patent application (PCT/EP2018/062713), have already been filed, but these pending patent applications have not yet been published as of the filing date of the present application. The present invention is different from the one disclosed in the earlier
10 applications, the novelty being that the "shell" of the lock unit (with the terminology used in the earlier applications) is integrated with or is permanently retained in the housing of the lock unit, and there is no division into an external housing and an internal, exchangeable lock "core". Rather, the housing and the overall structure is more like a lock unit as disclosed in the US patent specification 8,720,241 (Widén), the housing being divided into an upper part with locking pins and a lower part
15 with a bore accommodating a rotatable key plug.

[0019] The object stated above is achieved by providing a cylinder lock unit of the kind defined in the opening paragraph, and having the following new features (in relation to the publicly available prior art):

20 **[0020]** a back region of the key plug has a minimum length of at least 50% of a total length of the key plug,

[0021] whereas an adjoining front region of the key plug has a maximum length of 50% of said total length,

[0022] said back region of the key plug accommodates a rear part of the central row of
25 corresponding cavities, which cooperate with said lower locking pins, as well as two side portions, at each lateral side of the keyway, being reserved for possibly accommodating at least one additional lock component,

[0023] said front region of the key plug accommodates, on at least one lateral side of said keyway, said at least one side locking mechanism,

30 **[0024]** said at least one side locking mechanism is confined entirely within said front region of the key plug,

[0025] said at least one side locking mechanism comprises a longitudinal row of at least two side locking tumblers, each interacting with the lower part of the housing, either directly or indirectly via a side bar, and

[0026] said at least two coded side locking tumblers in each side locking mechanism are movable independently of each other, there being at least three different code positions for each coded side locking tumbler and a plurality of different code combinations for the at least two side locking tumblers in each said longitudinal row in said front region of the key plug.

5 [0027] In contrast to some prior art structures, there is a direct contact between the side locking tumblers and an associated key, without the intermediary of any other moving part. In this way, the structure will be relatively simple and reliable. Because of the different code positions for each side locking tumbler in the row, the number of possible combinations will be very large, so the security will be high. Even so, there is room for possibly accommodating an extra lock compo-
10 nent, separate from the coded locking pins and tumblers, on each lateral side of the keyway in the relatively long back region of the key plug.

[0028] On the other hand, the relatively short front region of key plug is rather compact and preferably substantially solid, except for the keyway, the cavities for the locking pins and any recesses and holes for accommodating the side locking mechanism or mechanisms.

15 [0029] Thanks to the above-defined structure of the cylinder lock core, with a relatively short front region of the rotatable key plug, having a maximum length of 50% of the total length of the key plug, there will be a secure and distinct interaction between the key plug and the surrounding housing, by way of the side locking mechanism which is located in its entirety within the front region of the key plug, and yet leaving room for possibly accommodating an extra lock component
20 in the back region of the rotatable key plug.

[0030] Preferably, there is one relatively short (in the axial direction) side locking mechanism on each side of the keyway in the front region of the key plug. Then, it is possible to accommodate at least four (two or more on each side) independently movable locking tumblers being separate and independent from the conventional central locking pins. However, it is also possible
25 to arrange only one side locking mechanism arranged on one lateral side of the keyway.

[0031] The length of the front region of the key plug, where the at least one side locking mechanism is located in its entirety, is thus rather short, e.g. 50%, about 40% or about 30% of the total length of the key plug. Nevertheless, thanks to the compact structure of the side locking mechanism, it can still provide a very large number of code combinations and a high security for the cyl-
30 inder lock core.

[0032] It has turned out that each longitudinal row of side locking tumblers, on one or both lateral sides of the key plug, may comprise at least two and preferably at least three (or even more) side locking tumblers.

[0033] Preferably, the additional lock component possibly accommodated in the back region of the key plug, on each lateral side of the keyway, may form a part of the torque transferring connection, e.g. a threaded hole for engaging with a fastening screw being connected to a door locking mechanism in the associated lock unit, or a blocking device for preventing the full insertion of an incorrectly cut key blade, or an electronic device for assisting in the proper functioning of the cylinder lock unit.

[0034] Also, according to the present invention, the cylinder lock unit as defined above may be provided in combination with a key for unlocking the cylinder lock unit, the key comprising a grip portion and a key blade, wherein

10 [0035] said key blade, on at least one side thereof, has a wave-like side code pattern consisting of a row of at least two side code portions being substantially confined to the longitudinal half of the key blade located closest to said grip portion, said wave-like code pattern adjoining to a straight profile groove extending towards the free end of the key blade.

[0036] Moreover, the present invention relates to a key, as such, for unlocking a cylinder lock unit of the kind referred to above, the key blade, on at least one side thereof, having a wave-like side code pattern consisting of a row of at least two side code portions being substantially confined to the longitudinal half of the key blade located closest to the grip portion, said wave-like side code pattern adjoining to a straight profile groove extending to the free end of the key blade, and the wave-like side code pattern being located at a ridge portion of an undercut profile groove in at least one side surface of the key blade.

[0037] Further advantageous features of the present invention are stated in the appended claims and will also appear from the detailed description of some preferred embodiments, reference being made to the attached drawings.

[0038]

25 BRIEF DESCRIPTION OF THE DRAWINGS

[0039] Fig. 1 shows, in a perspective view, a lock unit according to the present invention, and a key which is insertable into a key plug forming part of the lock unit;

[0040] Fig. 2a shows an exploded view of the various parts of the lock unit of fig. 1;

[0041] Fig. 2b shows the key of fig. 1, in a perspective view from the other side;

30 [0042] Fig. 3 shows a longitudinal section through the lock unit of fig. 1 with the key being inserted into the key plug;

[0043] Fig. 4 shows a cross-section through the lock unit of fig. 1 and 2a, at the location of a side locking tumbler;

[0044] Figs. 5a, 5b, 5c and 5d show the key plug of fig. 2a, in views from below, from the front end, from above and in a longitudinal section, respectively;

[0045] Fig. 6 shows a key plug of a similar embodiment as in Fig. 5d, but with four side locking tumbler holes in a row;

5 [0046] Figs. 7a, 7b, 7c and 7d show a key plug of a second embodiment which is similar to the one of Figs. 5a to 5d, but with a shorter side locking mechanism on each side of the key plug, with two locking tumblers in each side locking mechanism;

[0047] Figs. 8a, 8b, 8c and 8d show a key plug of a modified embodiment which is similar to the one of Figs. 5a to 5d, but with only six locking pins (instead of seven locking pins in the
10 previous embodiments) and two side locking tumblers on each side of the key plug;

[0048] Figs. 9a, 9b, 9c, 9d, 9e, 9f, 9g and 9h show, in various views, a third embodiment having a side locking mechanism provided with a side bar which cooperates with two side locking tumblers on one lateral side of the keyway;

[0049] Fig. 10 shows a modified embodiment of the side locking mechanism having a
15 side bar interacting with side locking tumblers which are movable up and down and also rotatable around their own axes;

[0050] Fig. 11 shows another modified embodiment where the side locking tumblers are each provided with a longitudinally displaced finger;

[0051] Figs. 12a, 12b, 12c and 12d show, in views corresponding to Figs. 5a, 5b, 5c and
20 5d, respectively, an embodiment having three side locking tumblers interacting with a side bar, on one lateral side of the keyway;

[0052] Figs. 13a and 13b show, in sectional and perspective views, a fourth embodiment with two side bars, one on each lateral side of the keyway of the key plug;

[0053] Fig. 13c shows a modified embodiment with a massive back region of the key
25 plug, and two short side bars in the front region of the key plug; and

[0054] Figs. 14a and 14b show a modified embodiment of the key with two different side code patterns on each side of the key blade.

[0055] DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0056] A first embodiment of the lock unit 100 of the invention is shown in Figs. 1, 2a,
30 2b, 3, 4, 5a, 5b, 5c and 5d, including a cylindrical housing 200 with a rotatable key plug 300, and an associated key 40.

[0057] The cylindrical housing 200 has a threaded rear end portion and a slightly conical front end flange.

[0058] The lock unit 100 is normally permanently mounted in a door or the like in order to cooperate with a door locking mechanism, as is well known *per se*. The cylindrical housing 200 includes an upper, solid part 220 and a lower part 240 forming a cylindrical bore accommodating a rotatable key plug 300.

5 [0059] The rotatable key plug 300 is formed in one piece and is adapted to transfer a torque to a locking mechanism when the plug is rotated. In this embodiment, as will be seen in fig. 2a, this is achieved by a torque transferring connection including a cam member 151 which is secured to the key plug 300 by means of two fastening screws 152a, 152b, which engage with threaded holes in a back region L1 of the key plug, on each side of a keyway 320.

10 [0060] It should be pointed out that the torque transferring connection may be formed by other mechanical means, e.g. with a recess in the rear end of the key plug being coupled to a mating member forming a part of a locking mechanism in a door or some other object to be locked in a closed position. If so, the back region L1 of the key plug may be used for some other lock component, as indicated above. It is also possible to leave the back region of the key plug as a massive
15 material portion, on each lateral side of the key way, as indicated in fig. 13c.

[0061] The upper, solid part 220 of the housing 200 (see Fig. 2a), has a central row of parallel cavities or holes 221a, 221b, 221c, 221d, 221e, 221f and 221g, the number of cavities being seven in this particular embodiment. As will be shown below, other normal embodiments are provided with six such cavities in a central row. At the upper side, a longitudinal cover plate 222 will
20 normally cover the holes 221a, etc. from above and keep a corresponding number of upper and lower locking pins 231a, etc., 232a, etc. and associated springs 235a, etc. in place.

[0062] The key plug can also be seen in Figs. 3, 4, 5a, 5b, 5c and 5d. The outer diameter of the cylindrical key plug is slightly smaller than the inside diameter of the bore in the lower part 240 of the housing, so that the key plug can rotate in relation to the housing 200. However, the
25 possible rotary motion of the key plug is dependent on the positions of lower locking pins 231a, 231b, 231c, 231d, 231e, 231f, 231g shown in Fig. 2a and being movable in corresponding vertical cavities or holes 331a, 331b, 331c, 331d, 331e, 331f, 331g arranged in a central longitudinal row in the upper part of the key plug 300. These vertical holes 331a, etc. are located above the central keyway 320. The lower locking pins 231a etc. are held in place by associated top or upper pins 232a, 232b, 232c, 232d, 232e, 232f, 232g (collectively denoted 232a – 232g in Fig. 2a) and corresponding
30 helical springs 235a, 235b, 235c, 235d, 235e, 235f, 235g (collectively denoted 235a-235g in Fig. 2a).

[0063] Accordingly, In the key plug 300, the central row of corresponding cavities 331a, 331b, 331c, 331d, 331e, 331f, 331g will accommodate the lower locking pins 231a, 231b, 231c, 231d, 231e, 231f, 231g.

[0064] In the normal operation of the cylinder lock, a correctly cut key 40 will operate the cylinder lock unit so as to rotate the key plug 300 and turn the rear cam 151.

[0065] In accordance with the present invention, the back region (L1 in fig. 5d) of the key plug 300 is relatively long, viz. at least 50% of the total length (L1 + FR1) of the key plug, measured from the back end up to a front end flange 310, whereas the front region (FR1 in fig. 5 d) of the key plug is relatively short, viz. at most 50 % of the full length thereof. Yet, the front region FR1 should be long enough to accommodate a side locking mechanism including a longitudinal row of at least two side locking tumblers.

[0066] As indicated above, the back region (L1) of the key plug serves to accommodate the rear part of the central row of holes 331a – 331g above the keyway 320, possibly also an additional lock component, which may be a part of the torque transferring connection, such as the fastening screws 152b on either side of the keyway, or a blocking mechanism which will prevent the full insertion of an incorrectly cut key blade, or an electronic component which will facilitate or assist in the proper functioning of the lock unit.

[0067] Importantly, the key plug 300 is provided with a side locking mechanism which is located on at least one lateral side of the keyway 320 and which is confined entirely within the front region FR1 located longitudinally in front of the back region L1. Preferably, this front region FR1 is substantially solid, except for the keyway, the cavities for the lower locking pins and any recesses and holes for accommodating the side locking mechanism itself. According to the invention, the side locking mechanism comprises at least two independently movable side locking tumblers providing a high security mechanism with at least three different code positions for each locking tumbler and a plurality of different code combinations for the side locking tumblers.

[0068] In the embodiment described above, see Fig. 3, 4, 5a, 5b, 5c, and 5d, the side locking mechanism includes three coded side locking tumblers 351a, 351b, 351c (figs. 2a and 5a) which are arranged in a row at one side of the keyway 320 of the key plug 300, in the solid front region thereof. The three locking tumblers are located entirely within this front region and also radially inside the lower part 240 of the housing. This location of the side locking mechanism 351a, 351b, 351c has the advantage that it will interact mainly with the lower part 240 of the housing in associated recesses or holes 242 (fig. 2a and fig. 4), next to the front end flange 310 of the key plug 300. Other embodiments are possible, as will be described below.

[0069] The three side locking tumblers 351a, 351b, 351c are biased by springs 361a, 361b, 361c (collectively denoted 361a – 361c in Fig. 2a) in associated vertical cavities or holes 371a, 371b, 371c (collectively denoted 371a-371c in Fig. 4a) at some lateral distance from the keyway 320 so as to project into the keyway with a projecting finger which will cooperate with a wave-like side

code pattern 41 on the key blade of the associated key 40 (fig. 2b). When the key 40 is inserted into the keyway 320, the locking tumblers 351a, etc. will move up and down in response to their contact with the side code pattern 41. The lower ends of the coded side locking tumblers 351a, etc. will then interact with the associated recesses or holes 242 in the lower part 240 of the housing 200. At the same time, a number of V-shaped bittings at the upper edge portion 42 of the key 40 will interact with the central row of locking pins 231a, etc. Only when all of the lower and upper locking pins 231a, etc. and 232a, etc. and the three side locking tumblers 351a, etc. are correctly positioned within the circumference of the key plug 300, will it be possible to turn the key 40 so as to rotate the key plug 300 and unlock the cylinder lock unit.

[0070] It is important that the side tumblers 351a, etc. are movable independently of the central locking pins 231a, etc. Thus, if the cylinder lock is manipulated with a so called "bumping" technique, it may be possible to position all the locking pins 231a, but it will be much more difficult to simultaneously manipulate also the coded side locking tumblers 351a, etc. into their respective coded positions. Thus, the side locking mechanism 351 will provide a high security for the cylinder lock core.

[0071] The interaction between the side locking tumbler 351b of the key plug 300 and the surrounding lower part 240 of the housing is illustrated further in Figure 4 showing the embodiment of Fig. 2a in cross-section.

[0072] In Fig. 4, the side locking tumbler 351b is located in its totally retracted position within the key plug, where both of its ends are located at the shear line between the key plug 300 and the surrounding lower part 240 of the housing, and the central pin 231f is also located with its upper end being located flush with the shear line. In this position, the key plug can be rotated or turned, provided that all other central pins and coded side locking tumblers are also confined within the key plug.

[0073] In Figs. 5a, 5b, 5c, 5d, the basic (first) embodiment is shown, with the three side locking tumblers 351a, 351b, 351c in a longitudinal row in associated holes 371a, 371b, 371c on one lateral side of the keyway 320, as described above. Since each side locking tumbler 351a, 351b, 351c has three possible codes, in this example, the total number of codes for the side locking mechanism will be $3 \times 3 \times 3 = 27$ in this case.

[0074] In a modified version of the first embodiment, as shown in Fig. 6, there are four side locking tumblers in a longitudinal row, in associated holes 371a, 371b, 371c, 371d. The back region L1 and the front region FR1 of the key plug are just as long as in the previous embodiment.

[0075] In a second embodiment, illustrated in Figs. 7a, 7b, 7c and 7d, the structure is similar to the first embodiment (all the reference numerals starting with the digit 4 instead of 3),

but here there is a row of coded side locking tumblers on each side of the keyway 420, each such row consisting of two independently movable side locking tumblers 451a, 451b and 461a, 461b, respectively. Each side locking tumbler will interact with the surrounding lower part of the housing in the same way as shown in Fig. 4. Thus, there are four side locking tumblers which are movable
5 independently of each other, each in at least three elevational positions. So, the number of possible code combinations will be even higher in this embodiment (at least $3 \times 3 \times 3 \times 3 = 81$).

[0076] The back region L2 of the key plug 400 is somewhat longer in this second embodiment, and the front region FR2 is shorter, the total length L2 + FR2 being the same as in Fig. 5d.

[0077] In a modified version of the second embodiment, shown in Figs. 8a, 8b, 8c and
10 8d, the structure is exactly the same as in the one shown in Figs. 7a, etc., except that the number of central locking pins 231a', ...231f' (Fig. 8c) in the key plug 400' is six rather than seven and the total length of the key plug is a little shorter. Still, the length of the back region L2' is slightly more than half of the length of the key plug.

[0078] In a third embodiment, shown in Figs. 9a, 9b, 9c, 9d, 9e, 9f, 9g, 9h and Fig. 10,
15 the number of central locking pins is again seven, like in most of the previous embodiments, but the side locking mechanism is different, with only two side locking tumblers on one side of the key plug 500 only, these two side locking tumblers 551a, 551b cooperating with a relatively short side bar 580 (Fig. 9d). Such a side locking mechanism with a side bar is known *per se*, but not in the context of cylinder lock unit having a key plug with a back region being reserved for a possible extra lock
20 component, e.g. two relatively long fastening screws for securing a cam member or the like in the back region of the key plug. The side bar 580 is normally held in a longitudinal recess or groove 243 (see Fig. 9a) by a spring 581 (see Fig. 9d), located between the two side locking tumblers to save longitudinal space, in a position where it projects sideways outside the contour of the key plug 500. In this position, the side bar will register with the corresponding groove 243 in the lower part 240
25 of the housing 200 and thereby effectively lock the key plug against rotation. However, when the side locking tumblers 551a and 551b are positioned in certain vertical positions, by means of the properly cut key 40, the side bar 580 can be moved sideways, against the action of the spring 581, into a retracted position where it is no longer seated in the groove 243. Thus, by turning the key 40, the side bar 580 will be retracted and permit rotation of the key plug 500. Then, a projecting lug
30 580a of the sidebar will find its way into a coded recess 555 in the cylindrical surface of the side locking tumbler 551b. This interaction will be seen clearly in the enlarged view in Fig. 9c, which also shows how the transverse finger 554 of the side locking tumbler 551b will be lifted to the right position by the side code pattern on the key 40. By way of the side bar, the side locking mechanism will provide a high degree of security, since it is difficult to manipulate the side locking tumblers

551a, 551b so as to release the lock. In this embodiment, with only two side locking tumblers in a row, the back region of the key plug 500 may have a greater length L3, as shown in Fig. 9h, leaving only a relatively short front region FR3.

[0079] As shown in Figs. 10 and 11, each side locking tumbler can interact in different ways with the side bar, either by way of rotating along its axis or being non-rotatable and having a longitudinally displaced finger. In Fig. 10, the side locking tumbler 651b can rotate between two rotary end positions, as indicated by the arrow R. A material portion 655, between two adjacent recesses 656, 657 in the cylindrical surface of the side locking tumbler can fit into a corresponding slot 680a in the side bar 680. With two or three rotary positions and three or more levels of the coded recesses 656, 657, the code combinations for each locking tumbler 651b will be 6 or higher. In this case, the code pattern at the side of the key must be configured to accommodate for two or three different pivotal positions of the transverse finger 654.

[0080] Similarly, in Fig. 11, the transverse finger 754 of the side locking tumbler 751b, is longitudinally displaced (along the longitudinal axis of the keyway of the key plug) into one of three coded positions. Accordingly, with several possible levels of the recesses 755 at the cylindrical surface of the tumbler, there will also be a large number of code combinations for each side locking tumbler, e.g. 9 or higher.

[0081] In a modified version of the third embodiment, shown in Figs. 12a, 12b, 12c, 12d, there are three side locking tumblers 951a, 951b, 951c (on one side of the keyway 920 of the key plug 900) which interact with a somewhat longer side bar 980, biased by springs 981.

[0082] In a fourth embodiment, shown in Figs. 13c, there are two relatively short side locking mechanisms, one on each side of the keyway and each having a side bar 880, adjacent to the front end flange of the key plug 800. This is a favorable embodiment with a very high number of code combinations and yet a very compact structure confined within a rather small part (less than 20%) of the total length of the key plug. The back region has a relatively long length L2, being massive except for the rear part of the central row of holes or cavities, and the front region FR2 is relatively short, but if necessary, the front region of the key plug may be just as short as in the embodiment shown in Fig. 9h (FR3).

[0083] Finally, a fifth embodiment is shown in Figs. 13a and 13b where the key plug 800', in its solid front end region FR1, is provided, on each lateral side of the keyway, with a row of four side locking tumblers 851a', 851b', 851c', 851d' cooperating with an associated side bar 880'. Here, since the side locking mechanisms are arranged on both lateral sides of the keyway, each with four side locking tumblers in a row, the result will be a very large number of code combinations.

[0084] Figs. 13b shows also the housing for the fifth embodiment. It is similar to the one shown in Fig. 2a, although it is adapted to the arrangement with two side bars 880'. Here, each side bar 880' is seated, in its locking position, in a respective groove 243" in the lower part of the housing.

5 [0085] The side bars shown in Figs. 9a to 9h, 10, 11, 12d, 13a, 13b, 13c are very favorable in that the springs (e.g. 581 in Fig. 9d), which push the side bar radially outwardly, are each located between a pair of side locking tumblers, so that the end of the side bar can be positioned very close to the front end of the key plug, thereby saving space. Preferably, one of the springs should be positioned between the two neighboring side locking tumblers being located closest to
10 the front end flange of the key plug and cooperate with the side bar. When there are only two side locking tumblers cooperating with the side bar, as shown in figs. 9h and 13c, there is only a single spring, making the side locking mechanism very compact.

[0086] Also, in all embodiments, the hole (e.g. 371c) for the side locking tumbler (e.g. 351c) being located closest to the front end of the key plug is located closer to the front end flange
15 than all the central holes (e.g. 331a – 331g), whereby the space for the side locking mechanism is utilized efficiently, and there is consequently room for at least two and possibly three or four side locking tumblers in a row in the front region FR1, FR2, FR3 which is at the most half of the total length of the key plug and possibly much shorter.

[0087] The associated key 40, having a wave-like side code pattern 41 (see Fig. 2b) with
20 code portions interacting with the side locking tumblers, will have the entire side code pattern 41 located substantially within the half of the key blade being located closest to the grip portion of the key. Furthermore, the side code portion of this pattern 41 located closest to the grip portion will be located closer to the grip portion than all the V-shaped bittings 42 on the edge of the key, the latter bittings interacting with the central row of locking pins of the cylinder lock. In this way, these keys
25 40 will be distinguished from all prior art keys.

[0100] The key, see fig. 2b, may alternatively have a wave-like side code pattern 41 on only one side of the key blade. The other side may be just flat or provided with some other code pattern or configuration.

[0101] An example of different code patterns 141 and 141' on the two sides of the key
30 blade is shown in figs. 14a and fig. 14b.

[0102] In fig. 14a, the side code pattern 141' on one side of the key blade is formed by two parallel upper and lower wall surfaces of a profile groove having a first part with two side code portions confined to the longitudinal half of the key blade, located closest to the grip portion of the key, and a second part forming a straight profile groove without any side code portions.

[0103] The other side of the key, shown in fig. 14b, also has a first part with side code portions confined to the longitudinal half of the key blade located closest to the grip portion, and a second part forming a straight profile groove without any side code portions. On this side of the key blade, however, the profile groove is undercut and provided with a ridge portion where the side code portions are located. The upper wall surface of the profile groove is straight all the way, so the side code tumblers of the lock unit interacting with the lower wave-like guiding surface of the profile groove must be biased downwardly, e.g. by springs, in order to follow the wave-like guiding surface.

[0104] As is known *per se* in this kind of technology, the side code portions may be formed by concavities in the wave-like guiding surface of the undercut profile groove.

[0105] In principle, it is possible to use a key which is only provided with a side code pattern, on one or both sides of the key blade, and no bittings at the upper edge of the key blade. If so, a local lock smith can form an edge code on such a key at a later stage, if desired.

[0106] As is also known in this kind of technology, the V-shaped bittings of the upper edge code pattern, if any, may be skew cut at different angles.

[0107] Also, it is of course possible to provide a key where the wave-like side code pattern is selected from a group of possible code positions, the possible code position including, at different vertical levels:

[0108] – a central position, corresponding to the position of an axis of a side locking tumbler of the associated cylinder lock unit, when the key is fully inserted in the keyway,

[0109] – a forwardly displaced position being displaced longitudinally at an incremental distance from the central position towards the free end of the key blade,

[0110] – a rearwardly displaced position being displaced longitudinally at an incremental distance from the central position towards the grip portion of the key,

[0111] – said central position, said forwardly displaced position and said rearwardly displaced position each corresponding to a particular position of a transverse finger, such as the finger 654 or the finger 754 described above, on said side locking tumbler of the associated lock unit when the key is fully inserted into the keyway of the rotatable key plug.

CLAIMS

1. A cylinder lock unit (100), comprising

- a housing (200) with an upper part (220) and a lower part (240),

5 - said lower part (240) of the housing having a cylindrical bore accommodating a rotatable key plug,

- said rotatable key plug (300) being formed in one piece and being adapted, via a torque transferring connection, to transfer a torque to a locking mechanism when the key plug is rotated,

10 - said upper part (220) of the housing being provided with a central row of upper and lower locking pins in associated cavities (232a-232g, 231a-231g)

- said key plug (300) having a central row of corresponding cavities (331a-331g) for accommodating said lower locking pins in said central row,

15 - said key plug having at least one side locking mechanism (351a-351c) being operative independently of said central row of upper and lower locking pins (231a-231g, 232a-232g);

- a keyway (320) extending axially backwards from a front end (310) of said key plug and being configured to accommodate an associated key (40),

20 - said central row of upper and lower locking pins and said side locking mechanism being arranged to engage with and lock the key plug against rotation in said lower part of said housing unless said associated key is inserted into said keyway,

characterized in that

- a back region (L1) of the key plug has a minimum length of 50% of a total length of the key plug,

25 - whereas an adjoining front region (FR1) of the key plug has a maximum length of 50% of said total length,

- said back region (L1) of the key plug accommodates a rear part of said central row of corresponding cavities (331a-331g), which cooperate with said lower locking pins,

- as well as two side portions, at each lateral side of said keyway, being reserved for possibly accommodating at least one additional lock component (152b),
- said front region (FR1) of the key plug accommodates, on at least one lateral side of said keyway, said at least one side locking mechanism,
 - 5 - said at least one side locking mechanism is confined entirely within said front region (FR1) of the key plug,
 - said at least one side locking mechanism comprises a longitudinal row of at least two side locking tumblers (351a-351c), each interacting with the lower part of the housing, either directly or indirectly via a side bar, and
 - 10 - said at least two coded side locking tumblers (351a-351c) in each side locking mechanism are movable independently of each other, there being at least three different code positions for each coded side locking tumbler and a plurality of different code combinations for the at least two side locking tumblers in each said longitudinal row in said front region of the key plug.
- 15 2. A cylinder lock unit as defined in claim 1, wherein
- said longitudinal row of side locking tumblers in said side locking mechanism comprises at least three side locking tumblers (351a-351c).
3. A cylinder lock unit as defined in claim 1 or 2, wherein
- said at least one additional lock component comprises a part of said torque transferring connection.
- 20 4. A cylinder lock unit as defined in claim 3, wherein
- said part of said torque transferring connection comprises at least one fastening screw (152b).
5. A cylinder lock unit as defined in any one of the preceding claims, wherein
- said key plug is provided with two side locking mechanisms (451a, 451b; 461a, 461b), one on each side of said keyway.
- 25 6. A cylinder lock unit as defined in any one of the preceding claims, wherein

- each of said coded side locking tumblers in said front region of the key plug is provided with a transverse finger (554) being held in direct contact with a side code pattern (41) on said associated key when the key is being inserted into said keyway.

7. A cylinder lock unit as defined in any one of the preceding claims, wherein

5 - at least two of said coded side locking tumblers (351a, 352b) are movable between a coded releasing position where they are totally confined within the key plug, and at least one locking position where they project radially outside the key plug and engage with at least one recess (242) in said housing, whereby they will prevent rotation of the key plug.

10 8. A cylinder lock unit as defined in any one of claims 1 to 6, wherein

- said longitudinal row of coded side locking tumblers in each side locking mechanism cooperate with an associated side bar (580), forming a part of said side locking mechanism and being located at the cylindrical outer circumference of the key plug and being adapted to engage with an associated groove (243) at the inside of said
15 housing, so as to prevent rotation of the key plug unless a correctly cut key is inserted into said keyway, the side bar being then seated inside the circumferential contour of the key plug.

9. A cylinder lock core as defined in claim 8, wherein

- each of said coded side locking tumblers is provided with a transverse finger (554)
20 cooperating with a side code pattern on an associated key, and with at least one coded recess (555) in an outside portion thereof at a vertical distance from said transverse finger, adapted to cooperate with said side bar (580), so as to enable the latter to disengage from said groove at the inside of said housing.

10. A cylinder lock unit as defined in claim 9, wherein

25 - said transverse finger (754) is longitudinally displaced, along said keyway, to form a coded location, in relation to a central axis of the associated coded side locking tumbler, each locking tumbler being coded both in respect of the longitudinal displacement of the transverse finger, and the location of said at least one coded recess cooperating with said side bar.

11. A cylinder lock unit as defined in claim 9, wherein

- each of said coded side locking tumblers (651b) is movable up and down as well as rotationally in an associated cavity, the rotational position also forming a code.

12. A cylinder lock unit as defined in any one of claims 8 to 11, wherein

5 - at least one of said side tumblers (351c) is positioned in front of a first cavity (331g) being located closest to said front end (310) in said central row of corresponding cavities.

13. A cylinder lock unit as defined in claim 12, wherein

10 - said at least one coded side locking mechanism extends backwards from an area adjacent to said first cavity.

14. A cylinder lock unit as defined in any one of claims 8 to 13, wherein

- at least one spring (581) is disposed between two side locking tumblers (551a, 551b) cooperating with said side bar (580), there being no spring located between a side locking tumbler (551b) and an end of the side bar.

15 15. A cylinder lock unit as defined in claim 14, wherein

- a single spring (581) is disposed between the two neighboring side locking tumblers (551a, 551b) being located closest to said front end of the key plug and cooperating with said side bar (580).

16. A cylinder lock unit as defined in any one of claims 8 to 15, wherein

20 - said back region (L2) of the key plug is massive except for said rear part of said central row of corresponding cavities.

17. A cylinder lock unit as defined in any one the preceding claim, wherein

- the side locking tumblers (351a - 351c) are movable in a plane which is displaced laterally in relation to the keyway (320).

25 18. A cylinder lock unit defined in any one of the preceding claims, wherein

- said row of locking pins in said upper part of said shell comprises six or seven locking pins adapted to cooperate with bittings (42) on an edge portion of said associated key (40) being inserted into said keyway.

5 19. A cylinder lock unit as defined in any one of the preceding claims, in combination with a key (40) for unlocking the cylinder lock unit (200), said key comprising a grip portion and a key blade, wherein

- said key blade has an edge code pattern (42) comprising a longitudinal continuous row of code portions defined by V-shaped bittings configured to interact with said central row of locking pins in said housing of the cylinder lock unit,

10 - said key blade also has a wave-like side code pattern (41) configured to interact with said at least one side locking mechanism being located in the front region of the key plug on at least one lateral side of said key plug, and

- said wave-like side code pattern (41) is confined substantially to the longitudinal half of the key blade located closest to said grip portion and comprises at least two
15 coded portions configured to interact with said at least two side locking tumblers of said at least one side locking mechanism.

20. A combination of a lock unit and a key as defined in claim 19, wherein

- at least one of said side code portions of the wave-like side code pattern (41) of said key is located closer to the grip portion of the key than all the code portions of
20 the edge code pattern (42).

21. A combination of a lock unit and a key as defined in claim 19 or 20, wherein

- the side code portions of said wave-like side code pattern (41) are arranged in a continuous row in said longitudinal half of the key blade.

22. A key for unlocking an associated cylinder lock unit having a rotatable cylindrical
25 key plug having a keyway and at least one side locking mechanism confined to a front region thereof, the key comprising a grip portion and a key blade, wherein

- said key blade, on at least one side thereof, has a wave-like side code pattern consisting of a row of at least two side code portions being substantially confined to the longitudinal half of the key blade located closest to said grip

portion, said wave-like side code pattern adjoining to a straight profile groove extending towards the free end of the key blade, and

- said wave-like side code pattern is located at a ridge portion of an undercut profile groove in at least one side surface of the key blade.

5 23. A key as defined in claim 22, wherein

- said key blade also has an edge code pattern (42;142) comprising a longitudinal continuous row of code portions defined by V-shaped bittings.

24. A key as defined in claim 23, wherein

- said V-shaped bittings are skew cut with different angles.

10 25. A key as defined in claim 23 or 24, wherein at least one of said side code portions of the wave-like code pattern is located closer to the grip portion of the key than all the code portions of said edge code pattern.

26. A key as defined in any one of claim 22 to 25, wherein

- said key blade has a wave-like side code pattern on both sides thereof.

15 27. A key as defined in any one of claims 22 to 26, wherein

- said key blade has different kinds of wave-like side code patterns (141, 141') on the two sides of the key blade.

28. A key as defined in any one of claims 22 to 26, wherein

20 - each of said code portions is formed by a concavity in said wave-like side code pattern.

29. A key as defined in any one of claims 22 to 28, wherein

- each of said at least two side code portions of the wave-like side code pattern is selected from a group of possible code positions, said possible code positions including, at different vertical levels:

25 - a central position, corresponding to the position of an axis of a side locking tumbler of the associated cylinder lock unit, when the key is fully inserted into said keyway ,

- a forwardly displaced position being displaced longitudinally at an incremental distance from said central position towards said free end of the key blade,
and

- a rearwardly displaced position being displaced longitudinally at an incremental distance from said central position towards said grip portion of the key,

- said central position, said forwardly displaced position and said rearwardly displaced position each corresponding to a particular position of a transverse finger (654; 754) on said side locking tumbler of the associated cylinder lock unit when the key is fully inserted into said keyway of the rotatable key plug.