locations of the recesses or "gates" that cooperate with the projections on the side bar.

Further objects are to ensure that the side bar slides back and forth without overdue resistance when the key is turned either way to operate the lock, and to provide a large variety of tumbler pins so as to increase the number of possible codes.

Another object is to increase the security of the lock even more as compared to prior art locks of this kind.

A still further object is to provide improved key profiles and key bittings cooperating with the lowermost end portions of the tumbler pins.

SUMMARY OF THE INVENTION

Disclosed herein is a key for a lock, comprising:

- a key blade having a single upper edge with V-cut bittings, each V-cut bitting standing at a respective one of a first number of angles relative to a transverse vertical plane, each being perpendicular to a longitudinal direction of the key blade, and each being located at a respective one of a second number of vertical levels in relation to an opposite lower edge of the key blade,

  wherein the V-cut bittings at the upper edge of the key blade are irregularly arranged in two ways:

  - a linear bottom portion of at least some V-cut bittings is displaced in the longitudinal direction of the key blade in relation to a vertical plane extending transversely and centrally through a position corresponding to the central axis of an

associated one of tumbler pins of the lock when the key is fully inserted into the lock, and

- the linear bottom portion of the at least some V-cut bittings is inclined in relation to a horizontal plane extending along the key blade, so that the at least some V-cut bittings are deeper at one side of the key blade than at another side of the key blade, said horizontal plane extending along the key blade being normal to central axes of the associated tumbler pins of the lock when the key is fully inserted into the lock, and the at least some V-cut bittings of the key blade are configured to cooperate with the associated tumbler pins, and

wherein each of the tumbler pins includes:

a projecting V-formed end portion having a shape that is substantially complementary to the associated V-cut bittings, and a lowermost edge portion that is generally offset in the longitudinal direction of a keyway in relation to a central, longitudinal axis of the tumbler pins, so that the lowermost edge portion is also inclined in relation to a plane that is perpendicular to the central, longitudinal axes of the tumbler pins.

These objects are achieved by a combination of features of the tumbler pins, the side bar and the key blade, as follows:

- each of the lugs in said row of inner projecting lugs of said side bar is located at a relatively high level, above a rotary axis of the key plug, when being moved sideways with the side bar into the respective tumbler pin recesses, whereas the outer longitudinal ridge portion of the side bar is located at a substantially lower vertical level than the inner projecting lugs, namely at substantially a same

vertical level as the rotary axis of the key plug, seen in a central vertical plane in the keyway, when the outer longitudinal ridge portion engages with the associated groove in the housing, and

- said tumbler pins are configured so that each of said pin recesses is located entirely above the rotary axis of the key plug and also entirely above a lowermost end portion of

CLAIMS

1. A cylinder lock and key combination, including a cylinder lock ~~(100)~~, comprising:

- a housing ~~(104)~~ having a cylindrical bore ~~(103)~~ accommodating a rotatable key plug ~~(102)~~,
- said key plug ~~(102)~~ having a longitudinally extending keyway ~~(101)~~ for receiving a key blade ~~(202)~~,
- a row of tumbler pins ~~(111,…, 116)~~ arranged for elevational and rotational movement in corresponding cylindrical chambers ~~(111a,…, 116a)~~ in said key plug ~~(102)~~ for engagement with coded V-cut bittings ~~(211,…, 216)~~ on an upper edge of an associated key upon insertion thereof into said keyway ~~(101)~~, and
- a longitudinal side bar ~~(150)~~ which is slidingly journalled for transversal movement in said key plug ~~(102)~~,
- said side bar having an outer, longitudinal ridge portion ~~(160)~~ fitting into an associated groove ~~(105)~~ in said housing, so as to normally prevent rotation of said key plug ~~(102)~~ in said cylindrical bore of the housing,
- said side bar ~~(150)~~ also having a row of inner projecting lugs ~~(151,…, 156)~~ each selectively registering with one or more recesses ~~(111h,…, 116h)~~ in said tumbler pins when said key has been inserted into the keyway ~~(101)~~,
- said side bar ~~(150)~~ being movable sideways by turning of a correctly cut key, while said projecting lugs enter into an one of associated tumbler pin recesses so that said longitudinal ridge portion ~~(160)~~ is released from said groove and the key plug ~~(102)~~ is permitted to rotate relative to said housing ~~(104)~~, and
- a key ~~(200)~~, comprising said key blade ~~(202)~~ having:

- an upper edge provided with said coded V-cut bittings ~~(211,…, 216)~~,

wherein:

- each of the lugs in said row of inner projecting lugs ~~(151,…, 156)~~ of said side bar ~~(150)~~ is located at a relatively high level, above a rotary axis (A) of the key plug ~~(102)~~, when being moved sideways with the side bar ~~(150)~~ into the respective tumbler pin recesses ~~(111h,…, 116h)~~, whereas the outer longitudinal ridge portion ~~(160)~~ of the side bar ~~(150)~~ is located at a substantially lower vertical level than the inner projecting lugs ~~(151,…, 156)~~, namely at substantially a same vertical level as the rotary axis ~~(A)~~ of the key plug ~~(102)~~, seen in a central vertical plane ~~(P)~~ in the keyway ~~(101)~~, when the outer longitudinal ridge portion ~~(160)~~ engages with the associated groove ~~(105)~~ in the housing ~~(104)~~, and
- said tumbler pins ~~(111,…, 116)~~ are configured so that each of said pin recesses ~~(111h,…, 116h)~~ is located entirely above the rotary axis ~~(A)~~ of the key plug ~~(102)~~ and also entirely above a lowermost end portion of the tumbler pin ~~(111, …, 116)~~ in a cylindrical outer surface of the tumbler pin and is covered by a cylindrical wall part of an associated one of said cylindrical chambers ~~(111a,…, 116a)~~, without communicating downwardly with the keyway ~~(101)~~,
- whereby each pin recess is concealed and invisible from an inside of said keyway, even when the keyway ~~(101)~~ is empty.

2. The cylinder lock and key combination as defined in claim 1, wherein each of inner projecting lugs ~~(151,…, 156)~~ in the row is located above the keyway ~~(101)~~.

3. The cylinder lock and key combination as defined in claim 1, wherein when the key blade ~~(200)~~ is inserted into the keyway ~~(101)~~, the key blade ~~(200)~~ has a top bitting level (B) located above the rotary axis ~~(A)~~ of the key blade ~~(200)~~, and each of the inner projecting lugs ~~(151,…, 156)~~ in the row of the inner projecting lugs ~~(151,…, 156)~~ is located above the top bitting level ~~(B)~~ of the key blade ~~(200)~~.

4. The cylinder lock and key combination as defined in claim 1, wherein said side bar ~~(150)~~, at each longitudinal end portion ~~(170, 180)~~ thereof, has transversally extending guiding surfaces ~~(171, 172, 181, 182)~~ which secure a precise lateral guiding of the side bar ~~(150)~~ in said key plug.

5. The cylinder lock and key combination as defined in claim 4, wherein said transversally extending guiding surfaces ~~(171, 172, 181, 182)~~ are located opposite to each other at a mutual distance which is smaller than an overall thickness ~~(t)~~ of the side bar ~~(150)~~.

6. The cylinder lock and key combination as defined in claim 1, wherein said side bar ~~(150')~~ has transversally extending upper guiding surfaces ~~(172', etc.)~~ between at least some of said inner projecting lugs ~~(151', etc.)~~, and a mutual distance between the upper guiding surfaces ~~(172', etc.)~~ and opposite lower guiding surfaces ~~(172, 182)~~ being smaller than an overall thickness ~~(t)~~ of the side bar ~~(150)~~.

7. The cylinder lock and key combination as defined in claim 1, wherein at least some of the tumbler pins ~~(11)~~ have pin recesses ~~(11h, 11h')~~ located at at least two different locations, so as to enable forming of a master key system, said different locations being at least one of different vertical levels and different circumferential locations.

8. The cylinder lock and key combination as defined in claim 1, wherein all of said cylindrical chambers ~~(111a, …, 116a)~~ reach down to a same vertical level ~~(E)~~, below which said keyway ~~(101)~~, is wider than an upper part of said keyway ~~(101)~~, corresponding to a lower, relatively wide part ~~(W)~~ of the key blade ~~(202)~~ of said key ~~(200)~~, and
wherein the V-cut code bittings ~~(211,…, 216)~~ are all located in an upper, relatively narrow part (N) of said key blade ~~(202)~~.

9. The cylinder lock and key combination as defined in claim 8, wherein said narrow part ~~(N)~~ of said key blade ~~(202')~~ is offset in relation to a central vertical plane ~~(P)~~ through said keyway and said key blade ~~(202')~~ upon insertion of the key blade into the keyway.

10. The cylinder lock and key combination as defined in claim 1, wherein each of said tumbler pins ~~(11)~~ has a lower portion with two oppositely located inclined planar surface portions ~~(11c, 11d)~~ forming between them a linear, relatively narrow guiding portion ~~(11e)~~ fitting into a corresponding one of the coded V-cut bittings ~~(B)~~, and
wherein each pin recess ~~(11h)~~ is located at a cylindrical outer surface portion at a distance from any of said inclined surface portions.

11. The cylinder lock and key combination as defined in claim 10, wherein said two oppositely located inclined planar surfaces portions ~~(11c, 11d)~~ have a same inclinational angle, and

wherein said relatively narrow guiding portion ~~(11e)~~ is offset from a central axis ~~(L)~~ of the tumbler pin ~~(11)~~.

12. The cylinder lock and key combination as defined in claim 10, wherein said two oppositely located inclined planar surface portions occupy only a part of a circumference of the tumbler pin ~~(41)~~, leaving a massive, part-cylindrical skirt portion ~~(41f)~~ at a lower end of the pin, said skirt portion ending at substantially a same vertical level as said relatively narrow guiding portion ~~(41e')~~.

13. The cylinder lock and key combination as defined in claim 12, wherein said pin recess ~~(41h, 81h)~~ on at least one of the tumbler pins is located at an outer cylindrical surface of said skirt portion, without communicating with a lowermost end surface or any of the two oppositely located inclined planar surface portions,

whereby said pin recess ~~(81h)~~ may be located relatively close ~~(81h')~~ to the lowermost end of the tumbler pin, without being visible from an inside of a key slot, and enabling a shortest one of the tumbler pins to have a relatively short length which is only slightly longer than a vertical bitting range ~~(R)~~ of the key blade ~~(202)~~.

14. The cylinder lock and key combination as defined in claim 10, wherein said relatively narrow guiding portion ~~(21e)~~ is inclined at an angle relative to a horizontal plane which is perpendicular to a longitudinal axis of the tumbler pin ~~(21)~~.

15. The cylinder lock and key combination as defined in claim 14, wherein said V-cut bittings ~~(211',..., 216')~~ on the key blade are also inclined at said angle relative to said horizontal plane, so as to provide a linear contact with said guiding portions ~~(21c)~~ of the associated pins ~~(21)~~.

16. The cylinder lock and key combination as defined in claim 1, wherein each of said tumbler pins ~~(111,..., 116)~~ is provided with a guiding fin ~~(113b)~~ projecting radially outwardly and being accommodated in a cavity ~~(190)~~, which forms a radial extension of an associated chamber ~~(113a)~~ within a limited angular region, whereby the tumbler pins ~~(111,..., 116)~~ are always adapted to be oriented within a limited rotational range in said associated chamber.

17. The cylinder lock and key combination as defined in claim 16, wherein said radial fins ~~(113b)~~ have different vertical lengths, in parallel to a vertical axis of the associated pin ~~(113)~~, so that the tumbler pins ~~(111,..., 116)~~ are adapted to be urged downwards with lower ends thereof, and are adapted to be located at different vertical levels when the key blade ~~(202)~~ is retracted from the keyway ~~(101)~~.

18. The cylinder lock and key combination as defined in claim 1, wherein the outer cylindrical surface of at least one of said tumbler pins ~~(41')~~ is provided with an extra recess ~~(41'h')~~ which is deliberately configured or located so as to retain the pin ~~(41')~~ and/or the side bar ~~(150')~~, when the associated projecting lug ~~(151,..., 156)~~ is seated in said extra recess, in a position which does not permit rotation of the key plug ~~(102)~~ relative to the housing ~~(104)~~ of the lock ~~(100)~~.

19. The cylinder lock and key combination as defined in claim 1, wherein the side bar ~~(150)~~ has an overall thickness ~~(t)~~, measured in a vertical direction in parallel to the central vertical plane ~~(P)~~, which is at least half of a radius of the cylindrical bore ~~(103)~~.

20. The cylinder lock and key combination as defined in claim 1, wherein each V-cut bitting ~~(211, …, 216)~~ in the upper edge of the key blade ~~(202)~~ of the key ~~(200)~~ stands at respective one of a first number of angles relative to a transverse direction, and is located at a respective one of a second number of vertical levels in relation to an opposite lower edge of the key blade ~~(202)~~.

21. A side bar for a cylinder lock having a key plug ~~(102)~~ which is rotatable in a housing ~~(104)~~, the side bar ~~(150)~~ being slidable sideways in the key plug ~~(102)~~ and having an outer ridge portion ~~(160)~~ which is normally seated in a groove ~~(105)~~ in the housing, and inner projecting lugs ~~(151,…, 156)~~ dimensioned to be seated in associated recesses ~~(111h,…, 116h)~~ in tumbler pins, which are movable in said key plug, wherein:

- said projecting lugs ~~(151,…, 156)~~ are located at a substantially higher level than said outer ridge portion ~~(160)~~ of the side bar ~~(150)~~ and said axis ~~(A)~~ of said key plug ~~(102)~~, and
- the side bar ~~(150)~~ is guided by means of opposite guiding surfaces ~~(171, 172, 181, 182, 172', … 176')~~ located at a mutual distance being substantially smaller than an overall thickness ~~(t)~~ of the side bar ~~(150)~~.

22. The side bar as defined in claim 21, wherein the overall thickness ~~(t)~~ of the side bar ~~(150)~~ is at least as large as half of a radius ~~(D/2)~~ of said key plug ~~(102)~~.

23. A key ~~(200)~~ for a lock ~~(100)~~, comprising:

- a key blade ~~(202)~~ having a single upper edge with V-cut bittings ~~(213, …)~~, each V-cut bitting ~~(213, …)~~ standing at a respective one of a first number of angles relative to a transverse vertical plane, each being perpendicular to a longitudinal direction of the key blade ~~(202)~~, and each being located at a respective one of a second number of vertical levels in relation to an opposite lower edge of the key blade ~~(202)~~,

wherein the V-cut bittings ~~(213, …)~~ at the upper edge of the key blade ~~(202)~~ are irregularly arranged in two ways:

- a linear bottom portion of at least some V-cut bittings ~~(213, … , 216,~~ is displaced in the longitudinal direction of the key blade ~~(202)~~ in relation to a vertical plane extending transversely and centrally through a position corresponding to the central axis of an associated one ~~(21)~~ of tumbler pins ~~(111 …)~~ of the lock when the key ~~(200)~~ is fully inserted into the lock ~~(100)~~, and
- the linear bottom portion of the at least some V-cut bittings ~~(213, …)~~ is inclined in relation to a horizontal plane extending along the key blade ~~(202)~~, so that the at least some V-cut bittings ~~(213, … , 216)~~ are deeper at one side of the key blade ~~(202)~~ than at another side of the key blade ~~(202)~~, said horizontal plane extending along the key blade ~~(202)~~ being normal to central axes of the associated tumbler pins of the lock ~~(100)~~ when the key is fully inserted into the lock, and the at least some V-cut bittings ~~(213, …)~~ of the key blade ~~(202)~~ are configured to cooperate with the associated tumbler pins ~~(111 …)~~, and

wherein each of the tumbler pins ~~(111 ...)~~ includes:
a projecting V-formed end portion having a shape that is substantially complementary to the associated V-cut bittings, and a lowermost edge portion ~~(21e)~~ that is generally offset in the longitudinal direction of a keyway in relation to a central, longitudinal axis of the tumbler pins ~~(111 ...)~~, so that the lowermost edge portion ~~(21e)~~ is also inclined in relation to a plane that is perpendicular to the central, longitudinal axes of the tumbler pins ~~(111 ...)~~.

24. A key as defined in claim 23, wherein the linear bottom portion of at least one of the V-cut bittings ~~(213, ...)~~ is inclined upwardly from one side of the key blade ~~(202)~~ to an opposite side at a first part of a thickness of the key blade ~~(202)~~, and is inclined downwardly at a second part of the thickness of the key blade ~~(202)~~, so that the at least one of the V-cut bittings ~~(213, ...)~~ is deeper at the one side of the key blade ~~(202)~~ than at the opposite side of the key blade ~~(202)~~.

25. A key as defined in claim ~~21~~23, wherein the linear bottom portion of the at least one of the V-cut bittings ~~(213, ...)~~ includes:

- a first portion that is inclined in relation to the horizontal plane, and
- a second portion that is parallel to said horizontal plane,

so that the at least one of the V-cut bittings ~~(213, ...)~~ is deeper at the one side of the key blade than at the second side of the key blade ~~(202)~~.

26. A key as defined in claim ~~21~~23, wherein at least one of the tumbler pins ~~(111, ...)~~ having the V-formed end portion

includes a lowermost edge portion that is at least partially inclined in relation to the plane that is perpendicular to the central, longitudinal axis of the tumbler pin ~~(21)~~, and

- the key ~~(200)~~ has an upper single edge portion on each of the V-cut bittings ~~(213, ...)~~ having two opposite sloping surfaces which merge at the linear bottom portion, and
- each of the V-cut bittings ~~(213, ...)~~ stands at a respective one of the first number of angles relative to the transverse vertical plane, that is perpendicular to the longitudinal direction of the key blade, and
- each of the V-cut bittings ~~(213, ...)~~ is located at a respective one of the second number of vertical levels in relation to an opposite lower edge of the key blade ~~(202)~~,

wherein the linear bottom portion of the at least one of the V-cut bittings ~~(213, ...)~~ is inclined in relation to the horizontal plane extending along the key blade ~~(202)~~, so that the at least one of the V-cut bittings ~~(213, ...)~~ is deeper at the one side of the key blade ~~(202)~~ than at the opposite side of the key blade ~~(202)~~, and

- the V-formed end portion of the at least one of the tumbler pins ~~(111, ...)~~ and the associated one of the V-cut bittings ~~(213, ...)~~ of the key blade ~~(202)~~ have substantially complementary geometrical configurations,

whereby the at least one of the tumbler pins ~~(111, ...)~~ is elevated and rotated into a predetermined position upon fully inserting the key ~~(200)~~ into the lock ~~(100)~~.

27. A key as defined in claim 23, comprising an elongated key blade having a lower, relatively wide part ~~(W)~~ and an upper, relatively narrow part ~~(N)~~ provided with a number of bittings, wherein said relatively narrow part ~~(N)~~ of said key blade

~~(202)~~ is offset in relation to a central vertical plane ~~(P)~~ through said lower, relatively wide part ~~(W)~~, and

wherein there is an inclined transition region of the key, extending obliquely upwards from one side of said relatively wide part ~~(W)~~ to a position above the other side of said relatively wide part ~~(W)~~.