

(19)



(11)

**EP 3 303 735 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:  
**07.05.2025 Bulletin 2025/19**

(51) International Patent Classification (IPC):  
**E05B 19/00<sup>(2006.01)</sup> E05B 21/06<sup>(2006.01)</sup>**

(21) Application number: **16799409.4**

(52) Cooperative Patent Classification (CPC):  
**E05B 19/0047; E05B 19/0029; E05B 21/066**

(22) Date of filing: **18.05.2016**

(86) International application number:  
**PCT/FI2016/050334**

(87) International publication number:  
**WO 2016/189193 (01.12.2016 Gazette 2016/48)**

(54) **COMBINATION OF A DISC TUMBLER CYLINDER LOCK AND A KEY, SERIES KEY, KEY BLANK AND METHOD FOR MAKING A KEY**

KOMBINATION AUS SCHEIBEN-ZUHALTUNGSSCHLOSS UND SCHLÜSSEL, SERIENSCHLÜSSEL, SCHLÜSSELROHLING UND VERFAHREN ZUR HERSTELLUNG EINES SCHLÜSSELS

COMBINATION D'UNE SERRURE À CYLINDRE À PAILLETES ET CLÉ, CLÉ DE SÉRIE, CLÉ BRUTE ET PROCÉDÉ DE FABRICATION D'UNE CLÉ

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(30) Priority: **26.05.2015 FI 20155388**

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(43) Date of publication of application:  
**11.04.2018 Bulletin 2018/15**

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**Description****FIELD OF THE INVENTION**

[0001] The invention relates to a combination of a disc tumbler cylinder lock and a key, a method for making a key of a disc tumbler cylinder lock, as well as to a key blank and a series key for a disc tumbler cylinder lock.

**BACKGROUND OF THE INVENTION**

[0002] A disc tumbler cylinder lock is a widely used lock structure which comprises a fixed outer cylinder, inside which there is an inner cylinder. Inside the inner cylinder there are a number of tumbler discs arranged as a pack of discs to be rotated with a key of the lock from their locking positions to opening positions. Each tumbler disc comprises a circumferential notch, a key opening corresponding to the cross-sectional profile of the key so as to form a key passageway, and a circumferential limiter which, in cooperation with a rotation opening of the inner cylinder, is arranged to limit the path of movement of the disc tumbler to a specific circular sector. In addition, the lock comprises a tumbler bar which in a locked position locks the inner cylinder to the outer cylinder. When the circumferential notches of all tumbler discs are rotated to the position of the tumbler bar, the tumbler bar is arranged to free the inner cylinder to rotate relative to the outer cylinder for opening the lock in a way that the tumbler bar is received in the groove formed by the circumferential notches.

[0003] The opening combinations of the disc tumbler cylinder lock amount to millions, but they still are limited. A number of additional combinations have therefore been developed by using keys of a different cross-sectional profile, whereby only a specific key profile fits in the key opening extending through the tumbler discs.

[0004] The keys of different lock models use a different number of evenly spaced notches having a standard angle which are made by key cutters manufactured for this purpose. Thus, for example in the ASSA Abloy company's key series Classic<sup>®</sup>, Exec<sup>®</sup> and Sento<sup>®</sup>, only notches corresponding to tumbler disc angles 0°, 18°, 36°, 54°, 72° and 90° are cut on the keys. As to the key series Protec<sup>®</sup>, the notches to be cut on the keys correspond to tumbler disc angles 0°, 15°, 30°, 45°, 60°, 75° and 90°.

[0005] As the variations increase, misopenings in the lock sets increase as well, and locks will open by keys that do not belong to the lock set. For example, residents of an apartment building will have access with their own keys to the apartments of a neighbouring building. The misopenings of lock sets are attempted to be controlled for example with software based on automatic data processing whereby, after the computed variations are complete, it is no more possible to rekey the series in the lock sets. Thus, the only option is to renew the lock set as a whole. Renewing a lock set is a very expensive and difficultly

predictable operation.

[0006] Examples of a disc tumbler cylinder lock and a key for said lock are presented in documents EP 1279788 A1 and DE 44 04 137 A1.

5 [0007] To remedy the problems with current technology, the number of code tumblers should be raised and all machines and devices on the market for making keys should be replaced with machines and devices that would allow the making of cuts on the keys corresponding to the new tumblers. The invention is also related to a lock assembly device used for making tumbler discs which is disclosed in international patent application WO 2014/184425 A1. The compact lock assembly device enables quick making of tumbler discs regardless of place with accurate and exact notch machining.

**OBJECTIVE OF THE INVENTION**

20 [0008] The objective of the invention is to remedy the defects of the prior art mentioned above. Specifically, the objective of the invention is to disclose a novel technique for extending the size of lock sets and continuing their lifespan in a safe way without increasing the misopening possibilities.

**SUMMARY OF THE INVENTION**

25 [0009] In the method according to the invention for making a key of a disc tumbler cylinder lock, the key is cut to have lock-model-specific standard angle notches corresponding to tumbler discs of the lock for rotating, when the key is turned in the lock, the tumbler discs of the lock to certain lock-model-specific standard rotation angles. According to the invention, the key is provided with a shape for rotating, when the key is turned in the lock, at least one tumbler disc of the lock to a position that differs from its lock-model-specific standard rotation angles for multiplying the variations of the lock.

30 [0010] The differing shape according to the invention is made in one embodiment of the invention before cutting the lock-model-specific standard angle notches. Thus, the key blank already has the differing shape when it is cut to have the lock-specific notches.

35 [0011] In a second embodiment of the invention, the shape is made at the same time with cutting the lock-model-specific standard angle notches. However, this requires that the existing cutter machines are modified in ways that such shape that differs from the standard notches can be made.

40 [0012] In a third embodiment, the shape is made after cutting the lock-model-specific standard angle notches. When the above-mentioned inventive shape is made at a different time than the lock-model-specific standard angle notches, they can be made with other cutters or corresponding machines so as to avoid modifications of the standard cutter machines.

45 [0013] Depending on the embodiment, the shape according to the invention can be made by cutting a notch on

the shank of the key or by shaping the shank of the key or by adding the shape to the shank of the key. The essential feature is that the shape forms a notch having an angle that differs from the lock-model-specific standard angle notches, i.e. the shape rotates one or more tumbler discs to an angle to which they cannot be rotated by any of the standard angle notches.

**[0014]** The invention further relates to a key blank comprising a bow and a shank. According to the invention, the shank comprises a shape arranged to rotate at least one tumbler disc of a disc tumbler cylinder lock corresponding to the key blank to a position that differs from lock-model-specific standard rotation angles.

**[0015]** The shape according to the invention may be in a series lock set area, i.e. in the area for cutting a series lock set notch. The shape may also be immediately after an area of a raising zero at the tip of the shank of the key blank.

**[0016]** The shape according to the invention preferably has an angle approximately halfway between standard cutter angles. Depending on the lock sets, the standard cutter angles are the angles 0°, 18°, 36°, 54°, 72° and 90° or the angles 0°, 15°, 30°, 45°, 60°, 75° and 90°. It is not obligatory that the angle of the notch with the inventive shape is halfway between standard angles, but it is sufficient that this shape differs to a notable degree from the standard angles, i.e. that malfunctions in the lock are not able to occur. In general, in precision-made disc tumbler cylinder locks it is sufficient to have even a difference of one degree from the standard angles to differentiate between operations of the locks.

**[0017]** The invention further relates to a series key comprising a bow and a shank as well as lock-model-specific standard cutter angle notches cut on the shank and corresponding to tumbler discs of a lock that corresponds to the profile of the shank. According to the invention, the series key comprises a shape that differs from said notches, arranged to rotate at least one tumbler disc of the lock to a position that differs from the lock-model-specific standard rotation angles. The inventive shape mentioned above may be a notch or a projection.

**[0018]** Preferably, the shape has an angle which is approximately halfway between standard cutter angles. The lock-model-specific standard cutter angles may be the angles 0°, 18°, 36°, 54°, 72° and 90° or the angles 0°, 15°, 30°, 45°, 60°, 75° and 90°.

**[0019]** The invention further relates to a combination of a disc tumbler cylinder lock and a key. According to the invention, the series key comprises a shape that differs from said notches, arranged to rotate at least one tumbler disc of the lock to a position that differs from the lock-model-specific standard rotation angles.

### ADVANTAGES PROVIDED BY THE INVENTION

**[0020]** The method, key blank and series key according to the invention have notable advantages over the prior art. The size of lock sets can be extended and their

lifespan continued in a safe way by means of the invention without increasing misopenings. When the combinations of a specific lock set have been used up, it is possible to bring into use a completely new lock set, i.e. a new lock set in the old lock set, by using a single shape that differs from the standard angles in the keys. This is done in the simplest way by making such differing notch already in the key blanks. Then, the normal standard angle notches can be made with the existing standard cutter machines on the blank provided with such a notch so that they do not fit in any existing locks already in use. A new lock cylinder with new tumbler discs is then made by filling uncut tumbler discs in the inner cylinder of the lock, by rotating, with the new key, the tumbler discs to the opening position determined by the key, and by cutting the rotated tumbler discs to have a notch for a tumbler bar as described in more detail in the above-mentioned international patent application WO 2014/184425 A1 Even a single new notch or other shape that differs from the standard angles doubles the number of different combinations for use in the lock set. When the angle of this notch is changed and it is maintained different from the standard angles, yet another new combination series is obtained. For example, with factory-made key blanks it is thus possible, by changing the angle of a single notch, to multiply the number of different locking combinations of the same lock series in a safe and secure way. The safety of widely used and old lock series is even increased by the invention, because the keys are provided with notch angles which, with the normal key cutters as such, are not even possible to be made.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]** The invention will now be described in detail with reference to the accompanying drawings, in which

Fig. 1 illustrates a conventional key blank,

Fig. 2 illustrates the key blank according to the invention and

Fig. 3 illustrates the key according to the invention.

### DETAILED DESCRIPTION OF THE INVENTION

**[0022]** Fig. 1 illustrates a conventional key blank which comprises a bow 1 and a shank 2. Such uncut key blanks with a smooth shank are used by locksmithing stores when they make keys for locks with their cutter machines.

**[0023]** Fig. 2 illustrates the key blank according to the invention, which also comprises a plate-shaped bow 1 and a cross-sectionally semicircular shank 2. However, the shank 2 is already beforehand in factory conditions or otherwise before making the actual tumbler notches machined to have a shape 3, i.e. a notch in this embodiment. The angle 4 of the notch, shown at the tip of the key blank in a dotted line, differs from all angles which are used in a lock model corresponding to this key as tumbler notches.

**[0024]** In Fig. 3, tumbler notches have been made on the key blank of Fig. 2, i.e. the key is ready. The angles of the tumbler notches vary along the shank as follows: the angle of a first notch 5 is 54°,

the angle of a second notch 6 is 0°,  
 the angle of a third notch 7 is 18°,  
 the angle of a fourth notch 8 is 36°,  
 the angle of a fifth notch 9 is 90°,  
 the angle of a sixth notch 10 is 36°,  
 the angle of a seventh notch 11 is 18°,  
 the angle of an eighth notch 12 is 0°,  
 the angle of a ninth notch 13 is 54°,  
 the angle of a tenth notch 14 is 0°.

**[0025]** The last one before an area 15 of a raising zero is the new and inventive shape 3 already provided on the blank as shown in Fig. 2, i.e. a notch with an angle of approximately 82° in this embodiment. Thus, the angle of this notch 3 is such that it does not appear in any standard tumbler notches of this lock model, which are 0°, 18°, 36°, 54°, 72° and 90°. 82° is just about in the middle of the last two angles, i.e. 72° and 90°.

**[0026]** Thus, by making a key having a tumbler notch with a differing angle which rotates a corresponding tumbler disc of the lock in a differing way, a completely new lock series for use in an existing lock set is obtained. It is completely safe to bring all key combinations used previously in this lock set into use again, because the keys are made new and unique due to the new notch 3 that differs from the other notches. In this embodiment, this new and inventive notch 3 is made immediately after the area 15 of the raising zero before the actual tumbler notch area of the key. However, there is no objection to making this new and differing notch in the actual tumbler notch area, i.e. as one of these ten tumbler notches.

**[0027]** Because the angle of the notch 3 differs from the conventional angles, it cannot be made with the existing key cutter machines. It is therefore made already beforehand on the key blank according to the invention. Locksmiths are thus provided with key blanks having one notch with a differing angle for making the keys. When the tumbler notches of the key are cut, the tumbler discs of the lock can be made with the device and method according to the above-mentioned international patent application WO 2014/184425 A1. The locksmith will therefore only need basic tumbler discs free of the notches for a tumbler bar and key blanks according to the invention provided with the differing notch 3, and thereby new lock series can be created and even large lock sets safely rekeyed without the risk that the keys would fit in inappropriate locks.

**[0028]** The invention has been described above by way of example with reference to the accompanying drawings, different embodiments of the invention being possible within the scope defined by the claims.

## Claims

1. A combination of a disc tumbler cylinder lock and a key, wherein

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the disc tumbler cylinder lock comprises tumbler discs having lock-model-specific standard rotation angles,

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the key comprises a bow (1) and a shank (2) as well as lock-model specific standard cutter angle notches (5-14) cut on the shank and corresponding to tumbler discs of the lock that corresponds to the profile of the shank, wherein standard cutter angles are 0°, 18°, 36°, 54°, 72° and 90°, or 0°, 15°, 30°, 45°, 60°, 75° and 90°,

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**characterized in that** the key comprises a shape (3) that differs from said notches, arranged to rotate at least one tumbler disc of the lock to a position that differs from the lock-model-specific standard rotation angles.

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2. A series key for the combination of claim 1, wherein the series key comprises a bow (1) and a shank (2) as well as lock-model-specific standard cutter angle notches (5-14) cut on the shank and corresponding to tumbler discs of a lock that corresponds to the profile of the shank, **characterized in that** the series key comprises a shape (3) that differs from said notches, arranged to rotate at least one tumbler disc of the lock to a position that differs from the lock-model-specific standard rotation angles.

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3. The series key according to claim 2, **characterized in that** the shape (3) is a notch.

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4. The series key according to claim 2, **characterized in that** the shape is a projection.

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5. The series key according to claim 2, **characterized in that** the shape (3) has an angle approximately halfway between standard cutter angles.

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6. A key blank for making a series key according to any one of claims 2 to 5, comprising a bow (1) and a shank (2), **characterized in that** the shank (2) comprises a shape (3) arranged to rotate at least one tumbler disc of a disc tumbler cylinder lock corresponding to the key blank to a position that differs from lock-model-specific standard rotation angles.

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7. The key blank according to claim 6, **characterized in that** the shape is in a series lock set area, i.e. in the area for cutting a series lock set notch.

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8. The key blank according to claim 6, **characterized in that** the shape (3) is immediately after an area (15) of a raising zero at the tip of the shank (2) of the key

blank.

9. A method for making a series key, according to any one of claims 2 to 5, of a disc tumbler cylinder lock, in which method the key is cut to have lock-model-specific standard angle notches corresponding to tumbler discs of the lock, **characterized in that** the key is provided with a shape (3) which, when the key is turned in the lock, rotates a tumbler disc of the lock to a position that differs from its lock-model-specific standard rotation angles for multiplying the variations of the lock.
10. The method according to claim 9, **characterized in that** the shape (3) is made before cutting the lock-model-specific standard angle notches.
11. The method according to claim 9, **characterized in that** the shape is made at the same time with cutting the lock-model-specific standard angle notches.
12. The method according to claim 9, **characterized in that** the shape is made after cutting the lock-model-specific standard angle notches.
13. The method according to any one of claims 9-12, **characterized in that** the shape (3) is made by cutting the shank (2) of the key to have a notch.
14. The method according to any one of claims 9-12, **characterized in that** the shape is made by shaping the shank of the key or by adding the shape to the shank of the key.
15. The method according to any one of claims 9-14, **characterized in that** the shape (3) forms a notch with an angle that differs from the lock-model-specific standard angle notches.

#### Patentansprüche

1. Kombination aus Scheibenzuhaltungszylinderschloss und Schlüssel, wobei das Scheibenzuhaltungszylinderschloss Zuhaltungsscheiben umfasst, die schlossmodell-spezifische Standardrotationswinkel aufweisen, wobei der Schlüssel einen Bügel (1) und einen Schaft (2) sowie schlossmodell-spezifische Standardfräswinkelkerben (5-14) umfasst, die auf dem Schaft gefräst sind und Zuhaltungsscheiben des Schlosses entsprechen, das dem Profil des Schaftes entspricht, wobei Standardfräswinkel 0°, 18°, 36°, 54°, 72° und 90° oder 0°, 15°, 30°, 45°, 60°, 75° und 90° betragen, **dadurch gekennzeichnet, dass** der Schlüssel eine Form (3) umfasst, die sich von den Kerben unterscheidet und so ausgelegt ist, dass sie mindestens eine Zuhaltungsscheibe des Schlosses in eine Position rotiert, die sich von den

schlossmodell-spezifischen Standardrotationswinkeln unterscheidet.

2. Serienschlüssel für die Kombination nach Anspruch 1, wobei der Serienschlüssel einen Bügel (1) und einen Schaft (2) sowie schlossmodell-spezifische Standardfräswinkelkerben (5-14) umfasst, die auf dem Schaft gefräst sind und Zuhaltungsscheiben eines Schlosses entsprechen, das dem Profil des Schaftes entspricht, **dadurch gekennzeichnet, dass** der Serienschlüssel eine Form (3) umfasst, die sich von den Kerben unterscheidet und so ausgelegt ist, dass sie mindestens eine Zuhaltungsscheibe des Schlosses in eine Position rotiert, die sich von den schlossmodell-spezifischen Standardrotationswinkeln unterscheidet.
3. Serienschlüssel gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Form (3) eine Kerbe ist.
4. Serienschlüssel gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Form ein Vorsprung ist.
5. Serienschlüssel gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Form (3) einen Winkel aufweist, der ungefähr in der Mitte zwischen den Standardfräs winkeln liegt.
6. Schlüsselrohling zur Herstellung eines Serienschlüssels gemäß einem der Ansprüche 2 bis 5, umfassend einen Bügel (1) und einen Schaft (2), **dadurch gekennzeichnet, dass** der Schaft (2) eine Form (3) umfasst, die so ausgelegt ist, dass sie mindestens eine Zuhaltungsscheibe eines Scheibenzuhaltungszylinderschlosses, die dem Schlüsselrohling entspricht, in eine Position rotiert, die sich von schlossmodell-spezifischen Standardrotationswinkeln unterscheidet.
7. Schlüsselrohling gemäß Anspruch 6, **dadurch gekennzeichnet, dass** sich die Form in einem Serienschlosseinstellungsgebiet, d.h. in dem Gebiet zum Fräsen einer Serienschlosseinstellungskerbe, befindet.
8. Schlüsselrohling gemäß Anspruch 6, **dadurch gekennzeichnet, dass** sich die Form (3) unmittelbar nach einem Gebiet (15) eines erhöhten Nullpunkts an der Spitze des Schafts (2) des Schlüsselrohlings befindet.
9. Verfahren zur Herstellung eines Serienschlüssels gemäß einem der Ansprüche 2 bis 5 von einem Scheibenzuhaltungszylinderschloss, wobei bei dem Verfahren der Schlüssel so gefräst wird, dass er schlossmodell-spezifische Standardwinkelkerben aufweist, die Zuhaltungsscheiben des Schlosses entsprechen, **dadurch gekennzeichnet, dass** der

Schlüssel mit einer Form (3) bereitgestellt ist, die, wenn der Schlüssel im Schloss gedreht wird, eine Zuhaltungsscheibe des Schlosses in eine Position rotiert, die sich von ihrem schlossmodell-spezifischen Standardrotationswinkel zur Vervielfältigung der Schlossvariationen unterscheidet.

10. Verfahren gemäß Anspruch 9, **dadurch gekennzeichnet, dass** die Form (3) vor dem Fräsen der schlossmodell-spezifischen Standardwinkelkerben hergestellt wird.
11. Verfahren gemäß Anspruch 9, **dadurch gekennzeichnet, dass** die Form gleichzeitig zu dem Fräsen der schlossmodell-spezifischen Standardwinkelkerben hergestellt wird.
12. Verfahren gemäß Anspruch 9, **dadurch gekennzeichnet, dass** die Form nach dem Fräsen der schlossmodell-spezifischen Standardwinkelkerben hergestellt wird.
13. Verfahren gemäß einem der Ansprüche 9-12, **dadurch gekennzeichnet, dass** die Form (3) durch Fräsen des Schaftes (2) des Schlüssels hergestellt wird, so dass er eine Kerbe aufweist.
14. Verfahren gemäß einem der Ansprüche 9 bis 12, **dadurch gekennzeichnet, dass** die Form durch Verformung des Schaftes des Schlüssels oder durch Hinzufügen der Form zum Schaft des Schlüssels hergestellt wird.
15. Verfahren gemäß einem der Ansprüche 9-14, **dadurch gekennzeichnet, dass** die Form (3) eine Kerbe mit einem Winkel bildet, der sich von den schlossmodell-spezifischen Standardwinkelkerben unterscheidet.

## Revendications

1. Combinaison d'une serrure à cylindre à paillettes et clé, dans laquelle
 

la serrure à cylindre à paillettes comprend des paillettes présentant des angles de rotation standards spécifiques au modèle de serrure, la clé comprend un coude (1) et une tige (2) ainsi que des encoches d'angles de coupes standards spécifiques au modèle de serrure (5-14) découpées sur la tige et correspondant aux paillettes de la serrure qui correspond au profil de la tige, dans laquelle les angles de coupes standards sont 0°, 18°, 36°, 54°, 72° et 90°, ou 0°, 15°, 30°, 45°, 60°, 75° et 90°, **caractérisée en ce que** la clé comprend une forme (3) qui diffère desdites encoches, agen-

cée pour tourner au moins une paillette de la serrure vers une position qui diffère des angles de rotation standards spécifiques au modèle de serrure.

2. Clé de série pour la combinaison selon la revendication 1, dans laquelle la clé de série comprend un coude (1) et une tige (2) ainsi que des encoches d'angles de coupes standards spécifiques au modèle de serrure (5-14) découpées sur la tige et correspondant aux paillettes d'une serrure qui correspond au profil de la tige, **caractérisée en ce que** la clé de série comprend une forme (3) qui diffère desdites encoches, agencée pour tourner au moins une paillette de la serrure vers une position qui diffère des angles de rotation standards spécifiques au modèle de serrure.
3. Clé de série selon la revendication 2, **caractérisée en ce que** la forme (3) est une encoche.
4. Clé de série selon la revendication 2, **caractérisée en ce que** la forme est une saillie.
5. Clé de série selon la revendication 2, **caractérisée en ce que** la forme (3) présente un angle approximativement à mi-chemin entre les angles de coupes standards.
6. Clé brute destinée à fabriquer une clé de série selon l'une quelconque des revendications 2 à 5, comprenant un coude (1) et une tige (2), **caractérisée en ce que** la tige (2) comprend une forme (3) agencée pour tourner au moins une paillette d'une serrure à cylindre à paillettes correspondant à la clé brute vers une position qui diffère des angles de rotation standards spécifiques au modèle de serrure.
7. Clé brute selon la revendication 6, **caractérisée en ce que** la forme est une zone de jeu de serrure en série, à savoir dans la zone pour découper une encoche de jeu de serrure en série.
8. Clé brute selon la revendication 6, **caractérisée en ce que** la forme (3) est immédiatement après une zone (15) d'un zéro en relief au bout de la tige (2) de la clé brute.
9. Procédé de fabrication d'une clé de série, selon l'une quelconque des revendications 2 à 5, d'une serrure à cylindre à paillettes, dans lequel procédé la clé est découpée de façon à présenter des encoches d'angles standards spécifiques au modèle de serrure correspondant aux paillettes de la serrure, **caractérisé en ce que** la clé est pourvue d'une forme (3) qui, lorsque la clé est tournée dans la serrure, tourne une paillette de la serrure vers une position qui diffère de ses angles de rotation standards spécifiques au

modèle de serrure pour multiplier les variantes de la serrure.

10. Procédé selon la revendication 9, **caractérisé en ce que** la forme (3) est fabriquée avant la découpe des encoches d'angles standards spécifiques au modèle de serrure. 5
11. Procédé selon la revendication 9, **caractérisé en ce que** la forme est fabriquée en même temps que la découpe des encoches d'angles standards spécifiques au modèle de serrure. 10
12. Procédé selon la revendication 9, **caractérisé en ce que** la forme est fabriquée après la découpe des encoches d'angles standards spécifiques au modèle de serrure. 15
13. Procédé selon l'une quelconque des revendications 9 à 12, **caractérisé en ce que** la forme (3) est fabriquée par découpe de la tige (2) de la clé pour présenter une encoche. 20
14. Procédé selon l'une quelconque des revendications 9 à 12, **caractérisé en ce que** la forme est fabriquée en formant la tige de la clé ou en ajoutant la forme à la tige de la clé. 25
15. Procédé selon l'une quelconque des revendications 9 à 14, **caractérisé en ce que** la forme (3) forme une encoche avec un angle qui diffère des encoches d'angles standards spécifiques au modèle de serrure. 30

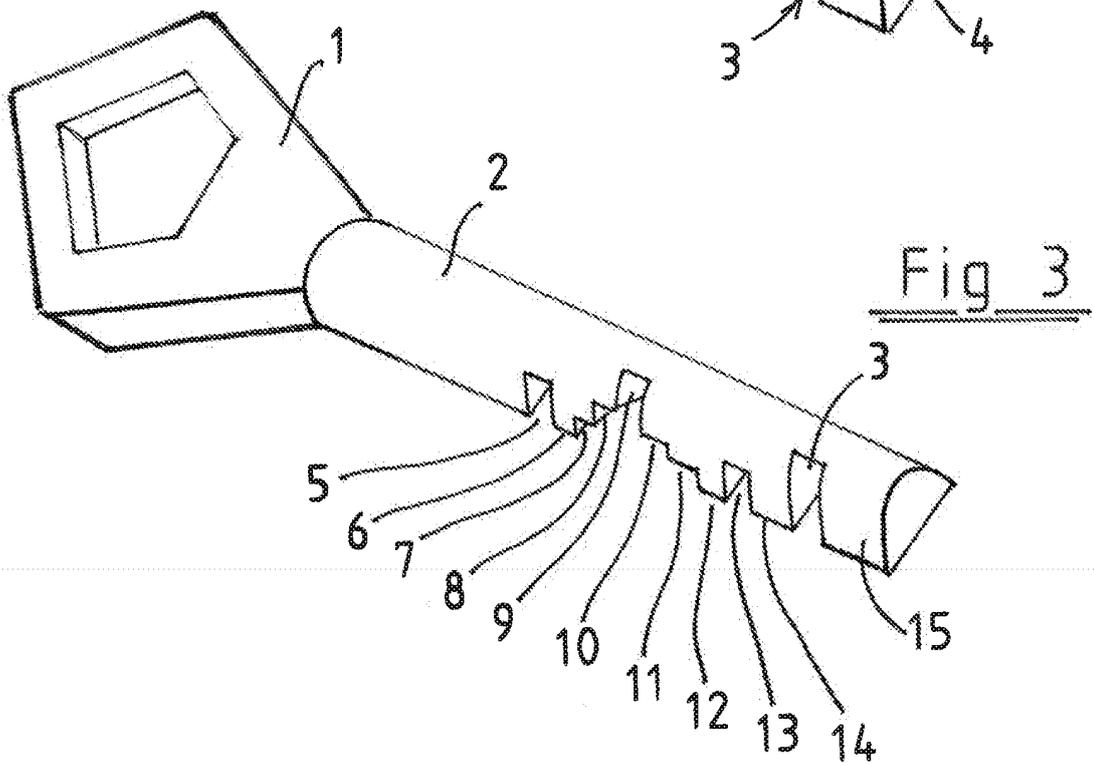
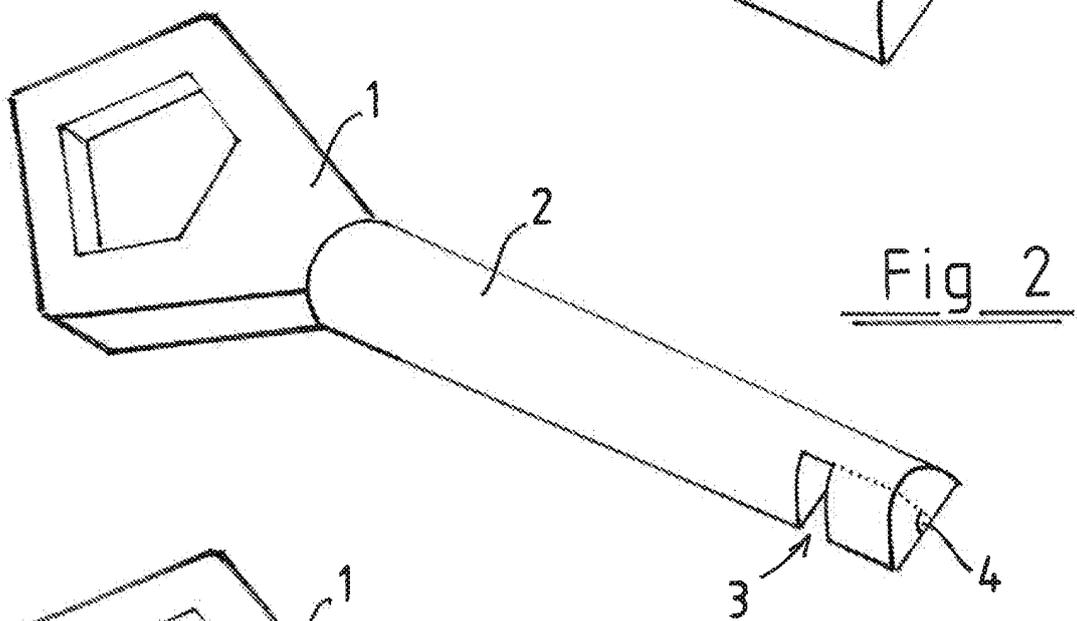
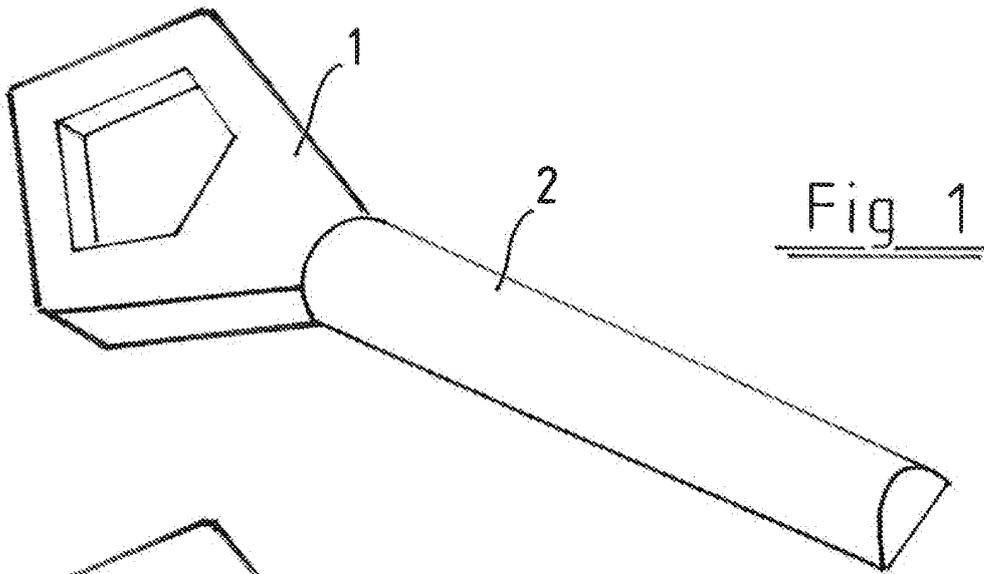
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**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- WO 2014184425 A1 [0007] [0020] [0027]