

Safety key and locking cylinder, and locking system
with such safety keys and locking cylinders

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The invention relates to a safety key and locking cylinder, the locking cylinder having a stator and a rotor, with a front end and a rear end, and a keyway, and the safety key having a shank which is provided with a plurality of control surfaces for properly positioning tumblers and has a front end and a rear end. The invention also relates to a locking system with such safety keys and locking cylinders.

15 Safety keys and locking cylinders of the abovementioned type are known in numerous configurations. The essential factor for safety keys for high-grade systems is for there to be no possibility of straightforward copying on comparatively simple drilling and milling machines. A safety key which is difficult to copy may be achieved in accordance with the applicant's EP 0 621 384 B1 by the shank of the safety key being provided with a control element which is designed as a pin and is mounted in a displaceable manner in the shank. This control element can be properly positioned by an additional tumbler in the locking cylinder. Such a key cannot be copied with justifiable outlay. A so-called toothed key with a similar control element has been disclosed in EP 0 802 289. It is also ensured that this key is comparatively difficult to copy.

The abovementioned safety key is rendered disadvantageous by the costs which arise from the formation of the abovementioned control elements and from the additional tumblers in the locking cylinder. These control elements, in addition, may have an adverse effect on the combinatorics.

The object of the invention is to provide a safety key which is difficult to copy and, nevertheless, can be produced comparatively cost-effectively.

5 The object is achieved, in the case of a safety key of the generic type, in that, at its front end, the rotor is extended and has at least one further control surface, which interacts with a further control surface arranged at the rear end of the shank. In the case of
10 the key according to the invention, the front extended end of the rotor and the rear end of the key shank are used for providing further control surfaces. These control surfaces may be produced particularly cost-effectively by depressions and in particular by
15 slots in the extended front end of the rotor. On the safety key, the control surfaces may be created particularly cost-effectively by recesses and in particular milled cut-outs on shoulders of the key shank. The safety key may be a turning key with bores
20 in the key shank or also some other safety key, for example a toothed key or cam key.

A significant advantage of the safety key according to the invention is that it is backward compatible. The
25 safety key and the locking cylinder according to the invention can readily be integrated in an existing system. In the case of a system which is supplemented in this way, it is possible to have a general key which operates both the existing locking cylinders and the
30 locking cylinders according to the invention. The existing safety keys, however, cannot open the corresponding new locking cylinders. It is thus possible for any existing locking system to be extended and enhanced. The additional control surface of the
35 rear end of the shank results in comparatively high outlay being required for copying purposes, since additional and usually unavailable tools and special blanks are necessary.

A further advantage of the invention is also to be seen in the fact that the system design is simplified. In addition, the flexibility of such systems is increased and it is easily possible to form groups which do not effect the permutation. The invention benefits the combinatorics to a considerable extent and simplifies the subdivision of groups.

A particularly high level of security is achieved when, at the rear end of the shank, the safety key has at least one laterally projecting part which interacts with a control surface at the front end of the rotor. Such a projecting part is, for example, a lug which is difficult to copy but can be produced without significant further costs. The lug may be produced in different shapes and dimensions in a locking system in order to increase the number of locking arrangements.

Further advantageous features can be gathered from the dependent patent claims, the following description and the drawing.

Exemplary embodiments of the invention are explained in more detail hereinbelow with reference to the drawing, in which:

Figures 1a to 1c show, schematically, three-dimensional illustrations of safety keys according to the invention,

Figures 2a to 2c show, schematically, three-dimensional views of rotors of locking cylinders according to the invention,

Figures 3a to 3f show, schematically, front views of locking cylinders according to the invention, the stator having been left out in Figures 3b to 3f,

- Figures 4a to 4d show schematic views of safety keys according to a variant,
- 5 Figures 5a and 5b show, schematically, further views of a safety key according to the invention,
- Figure 6 shows, schematically, a view of a master key,
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- Figures 7a to 7f show, schematically, front views of locking cylinders according to a variant,
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- Figures 8a to 8f show, schematically, front views of locking cylinders according to a further variant,
- 20 Figures 9a to 9h show, schematically, front views of locking cylinders according to a further variant.
- Figur 10 shows, schematically, a side view of a locking cylinder and a key partly introduced into the keyway and
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- Figur 11 shows a front view of the locking cylinder, whereas the key is not shown.
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Figure 1a shows a safety key 1 which has a shank 6 and a grip 14. The key 1 is a so-called flat key or turning key. It is also possible, however, for the key to be a toothed key or cam key. The shank 6, in a manner known per se, has control bores 7, which are usually made in the broad sides and in the narrow sides of the shank 6. These control bores 7 serve for properly positioning

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tumblers (not shown here) which are known per se and belong to an associated locking cylinder 2, which, according to Figure 3a, has a stator 3 and a rotor 4.

5 The shank 6 of the key 1 has a front end 6a and a rear end 6b. By means of the front end 6a, the key 1 is introduced in the customary manner into a keyway 5 of the rotor 4. The abovementioned tumblers are properly positioned by virtue of the shank 6 being introduced
10 into the keyway 5. As a result, the rotor 4 is unlocked and can be rotated by way of the grip 14 of the key for the purpose of actuating the lock.

At its rear end 6b, the key 1 has additional control
15 surfaces 9, which are formed by laterally projecting shoulders 15 and recesses 13 in these shoulders 15. These control surfaces 9 interact with a corresponding control surface 8 of the rotor 4, which is depicted in Figure 2. The control surface 8 is formed by a recess
20 10 which is made in an extended front end 4a of the rotor 4. The control bores 7 are positioned such that the corresponding tumblers are at locking level if the control surfaces 9 butt against the control surface 8. The recess 10 may be produced, for example, by a
25 milling cutter. The recess 10 is offset laterally in relation to the keyway 5, as can be seen in Figure 2a. Correspondingly, the control surfaces 9 of the key 1a are likewise offset laterally. In the case of a turning key, the control surfaces 9 are rotationally
30 symmetrical in relation to one another. If the shank 6 is inserted into the keyway 5, then one shoulder or the other engages into the slot 10 until a control surface 9 butts against the control surface 8. The control surface 8 here forms a stop for the safety key 1.

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The key 1' according to Figure 1b has control surfaces 9' which are formed in each case by two lateral recesses 13'. The control surfaces 9' are arranged centrally in relation to the plane of the key 1'. The

associated rotor 4' is shown in Figure 2b. The recess 10', as can be seen, is arranged in the center of the keyway 5 and forms a control surface 8'. The recess 10' here is a slot which is open laterally and at the front.

Control surfaces 9'' of the key 1'' according to Figure 1c are formed by recesses 13''. The corresponding rotor 4'' is shown in Figure 2c. The recess 10'' is likewise offset laterally, but in the opposite direction to Figure 2a. The control surface 8'' is formed by the slot 10''. The slots 10, 10' and 10'' and the corresponding recesses 13, 13' and 13'' may also be designed differently. Intermediate stages are also possible. In addition, the slots 10, 10' and 10'' need not necessarily be continuous and linear.

Figure 4a shows a key 20 with a projecting lug 12 arranged laterally on a shoulder 15 of the shank 6. The keys 20', 20'' and 20''' according to Figures 4b to 4d are provided with the abovementioned respective control surfaces 9, 9'' and 9', with the abovementioned functions. The lug 12 forms a further group-forming means. The corresponding locking cylinders 2 are shown in Figures 3a to 3c. The locking cylinder 2 according to Figure 3a has a rotor 24 which is mounted in a housing 3. A slot 17 is made in the extended front end of the rotor 24, the slot running at right angles to the keyway 5, as Figure 3a shows. This slot 17 is formed such that it can accommodate the lug 12. The key according to Figure 4c is provided for the rotor 4' according to Figure 3b. The recess 10' here is offset to the right in relation to the keyway 5. The slot 17 corresponds to that according to Figure 3a and, in this case, likewise serves for accommodating the lug 12. The key according to Figure 4d is provided for the rotor 24'' according to Figure 3c. The key 20''' shown in Figure 4d cannot operate the rotors 24 and 24' since the control surface 9' is central and not offset

laterally. The key 20'' according to Figure 4c, in turn, can only operate the rotor 24' according to Figure 3b. The same applies to the key 20'. All three safety keys described, however, also open cylinders
5 with rotors according to Figure 3d.

Figures 5a and 5b show a key 21 which has a lateral lug 12 but no shoulder 15. The shank 6' of the key 21 nevertheless corresponds to the length of the shank 6.
10 The key 21 can operate all the rotors 24, 24' and 24'' since, in this case, the slots 10, 10' and 10'' do not have any excluding function. The key 21 is thus a passe-partout for the lock cylinders 2 according to Figures 3a to 3e.

15 Figure 3d shows a central rotary locking cylinder 2' which can be operated by all the keys 20 to 20''' and by the passe-partout 21 and by a master key 22. This is ensured by the wide slot 10''', which is the same width
20 as the keyway 5. The control surface 18 on the base of the slot 10''' is of a corresponding width.

Figure 3e shows a blocking cylinder 24''' which can be operated by the key 21 but not by the keys according to
25 Figures 4a to 4d. The rotor extends in solid form over the keyway 5 and, correspondingly, the shoulders 15 prevent the control surfaces 7 from being positioned in a manner which is necessary for releasing the rotor. The rotary locking cylinder 24''' can nevertheless be
30 operated by the key 21 and key 22, since these have no shoulders 15.

Figure 6 shows the master key 22, which has a shank 6'' with a laterally arranged narrow lug 12'. This key 22
35 has no shoulders 15. This master key 22 operates all the rotors of Figures 3a to 3e and the rotor 24^{IV} of Figure 3f. This rotor 24^{IV} has a slot 17' which is considerably narrower than the recess 17 and has a width of, for example, 1.5 mm.

Figures 7a to 7f, 8a to 8f and 9a to 9h illustrate the large number of locking arrangements which can be formed by different recesses 27, 27', 27'', 27''', 27^{IV}; 28, 28', 28''; 29, 29', 29''; 30, 30', 30'', 30''' and 31, 31', 31'', 31''' in the front end of the rotor 4 or 4'. The associated safety keys 1 and 1' have corresponding control surfaces 9 and 12, which interact with the control surfaces of these recesses. Figure 7c also shows, in section, a shank of a key 1'. As can be seen, the lug 12 engages in the recess 27 here. A turning key has two recesses 27 in each case, as is shown in Figures 7a and 7c.

As can be seen, the invention allows the construction of locking systems with group and individual locking arrangements. Existing systems may be supplemented with corresponding rotors and keys. The production of extended-head rotors and keys with the abovementioned control surfaces and lugs 12 can be carried out comparatively cost-effectively. The slots and/or recesses in the extended head of the rotor can be varied in many different ways. Numerous variations of the control surfaces 9 and shoulders 15 and of the lug 12 are likewise possible.

Figures 10 and 11 show a locking cylinder 32, provided with a stator 3 and a rotor 4. As can be seen, the front end 4a of the rotor 4 protrudes the stator 3, but this is not mandatory. The front end 4a could be flushed with the front end of the stator 3. The key 1 is a Yale type key for properly positioning tumblers 33.

WHAT IS CLAIMED IS:-

1. A safety key and locking cylinder, the locking cylinder having a stator and a rotor, with a front end and a rear end, and a keyway, and the safety key having an upper and a lower surface each of which is flat and has no projection extending out from either said surface, the safety key having a shank which is provided with a plurality of control surfaces for properly positioning tumblers and a front end and a rear end, wherein at the front end, the rotor is extended and has at least one control surface, which interacts with a control surface, arranged at the rear end of the shank, wherein the control surface arranged at the rear end of the shank is formed by at least one recess on at least one shoulder of the key;

wherein the control surface of the rotor is formed by a recess which is located in the rotor and is open at the front; and

wherein the recess extends radially in relation to the axis of the rotor and is open at the front and also to the side of the rotor.

2. The key and locking cylinder as claimed in claim 1, wherein the extended front end of the rotor projects at the front of the stator.

3. The key and locking cylinder as claimed in claim 1, wherein the control surface of the rotor is formed by a recess in the extended front end of the rotor.

4. The key and locking cylinder as claimed in claim 1, wherein the recess is open in the direction of the keyway.

5. The key and locking cylinder as claimed in claim 4, wherein the recess is narrower than the keyway.
6. The key and locking cylinder as claimed in claim 5, wherein the recess passes centrally or in a laterally offset manner through the keyway.
7. The key and locking cylinder as claimed in claim 3, wherein the recess of the rotor has a depth of not more than 0.5 to 3 mm.
8. The key and locking cylinder as claimed in claim 7, wherein the recess has a depth of approximately 1 to 2 mm.
9. The key and locking cylinder as claimed in claim 1, wherein the control surface arranged at the rear end of the shank is formed by at least one shoulder at the rear end of the shank.
10. The key and locking cylinder as claimed in claim 1, wherein at least two shoulders each have a control surface arranged at the rear end of the shank.
11. The key and locking cylinder as claimed in claim 10, is a turning key and the shank has a plurality of control bores for properly positioning tumblers.
12. The key and locking cylinder as claimed in claim 3, wherein the recess in the extended front end of the rotor is closed in the direction of the outside of the rotor.
13. A locking system with a plurality of safety keys and locking cylinders as claimed in claim 1, wherein the control surfaces of the safety keys differ in shape and/or position.

14. The locking system as claimed in claim 13, wherein the locking cylinders have different control surfaces.

15. The locking system as claimed in claim 14, wherein the control surfaces of the locking cylinders are formed by recesses of different extents and/or in different positions.