

Lock cylinder

The invention relates to a lock cylinder that comprises a cylinder housing having a core
5 receiving section and a cylinder core that is rotatably supported in the core receiving
section about a cylinder axis of rotation between a closed position and an open
position and that has a keyway which extends along the cylinder axis of rotation and
into which an associated key may be introduced along a key introduction direction
through a key introduction opening. The keyway has an elongate cross-section having
10 two mutually opposite keyway broad sides and two mutually opposite keyway narrow
sides. Furthermore, the lock cylinder comprises at least one tumbler that is configured
to secure the cylinder core that is in the closed position against a rotation into the open
position when the key is not introduced into the keyway, wherein, by introducing the
associated key, the at least one tumbler may be sorted into a release configuration in
15 which the at least one tumbler releases the cylinder core for a rotation relative to the
cylinder housing.

Such lock cylinders may be used in a variety of applications and may, for example, be
used in door locks to selectively be able to selectively release a door for an opening or
20 to be able to lock the door against an opening. For this purpose, the rotatable cylinder
core may in particular be directly or indirectly connectable to a latch element so that
the latch element may be driven by rotating the cylinder core. In the closed position of
the cylinder core, such a latch element may, for example, engage into a receiver
provided for this purpose at a door frame and may thereby lock the door against a
25 movement relative to the door frame, whereas the latch element may be movable out
of the receiver by rotating the cylinder core into the open position to be able to release
the door for an opening. In a similar way, lock cylinders may, for instance, also be used
in locks for locking windows or window handles as well as, for example, in hoop locks
in that, by rotating the cylinder core between the closed position and the open position,
30 a hoop may, for example, be lockable relative to a lock body of a hoop lock or may be
releasable for a movement relative to the lock body.

In order to secure the lock cylinder against an unauthorized actuation, one or more
tumblers may be provided that, when the key is not introduced into the keyway, may

block the cylinder core against a rotation relative to the cylinder housing in the closed position and/or against a rotation into the open position. For example, the at least one tumbler may for this purpose be configured as a pin holder that may have a housing pin, which is preloaded by a tumbler spring towards the cylinder core and which is

5 arranged in the cylinder housing, and a core pin arranged in the cylinder core, wherein the housing pin may project into the cylinder core when the associated key is not introduced into the keyway in order, as a result, to prevent a rotation of the cylinder core relative to the cylinder housing. By introducing the associated key, which is configured to sort the at least one tumbler into the release configuration, the core pin

10 and, via it, the housing pin may be displaced against the preload of the spring, wherein the core pin may in particular be moved straight up to an outer side of the cylinder core by the correct key. Therefore, after a full introduction of the associated key into the keyway, the housing pin may be arranged outside the cylinder core so that the cylinder core is released for a rotation relative to the cylinder housing. In particular, lock

15 cylinders may have a plurality of such tumblers and the associated key may be configured to sort all the tumblers into the release configuration in order to release the cylinder core for a rotation into the open position.

In principle, such lock cylinders may be configured as robust and reliable so that a high

20 level of security of the respective locks with respect to break-open attempts may be achieved by using lock cylinders. However, the coding possibilities of conventional lock cylinders are often predefined by the number and configuration of the tumblers so that the cylinder cores of such lock cylinders may be movable into the open position by any key that is suitable for sorting the tumbler or the tumblers into the release

25 configuration. In order therefore to be able to increase the security of lock cylinders against unauthorized actuation attempts and the protection against forgery of the associated key even further, there is a need for lock cylinders that offer coding possibilities that go beyond the respective tumblers so that further properties of the associated key may be queried and a forging of the associated key may thereby be

30 made more difficult.

It is therefore an object of the invention to provide a lock cylinder of the explained kind with extended coding possibilities in order, as a result, to be able to achieve increased protection against forgery of the associated key.

This object is satisfied by a lock cylinder having the features of claim 1.

This lock cylinder has a blocking device that has a querying pin and a blocking pin.

- 5 The querying pin is preloaded towards the keyway and engages into the keyway (at least when the key is not fully introduced into the keyway). The blocking pin is arranged in alignment with the querying pin. The blocking pin is outwardly preloaded into a blocking position with respect to the cylinder axis of rotation and is configured to prevent and/or to block a rotation of the cylinder core into the open position in the
10 blocking position.

- The querying pin may further be urged into a querying position, in particular against its preload, by fully introducing the associated key into the keyway. Furthermore, the querying pin has a permanent magnet at an end section facing the blocking pin and/or
15 the blocking pin has a permanent magnet at an end section facing the querying pin, wherein the permanent magnet is configured to hold the blocking pin in a release position – in which the blocking pin releases the cylinder core for a rotation into the open position – against the preload of the blocking pin when the querying pin is urged into the querying position.

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- Since the lock cylinder has such a blocking device having a blocking pin, which prevents a rotation of the cylinder core into the open position in the blocking position, an additional security level and coding of the lock cylinder may be achieved compared to an exclusive coding of the cylinder core by the at least one tumbler. In particular a
25 key, by means of which the cylinder core may be actuated and may be moved from the closed position into the open position, must not only sort the at least one tumbler into the release configuration, but must also cooperate with the querying pin such that the querying pin may be moved into the querying position by the key in order, as a result, to enable a holding of the blocking pin in the release position and to be able to release
30 the cylinder core. This may in particular take place in that, at the key, a coding elevation is formed by which the querying pin may be urged against its preload back into the querying position when the key is fully introduced into the keyway. This will be explained in more detail below.

Since, in some embodiments, the querying position may be precisely defined and must be reached to be able to hold the blocking pin in the release position, different coding possibilities that go beyond the tumblers may be provided for coding the lock cylinder, for instance, via an engagement depth of the querying pin into the keyway, a
5 positioning of the querying pin and thus a location of the engagement into the keyway, respective lengths of the querying pin and the blocking pin, strengths of the respective preloads of the querying pin and the blocking pin and/or a strength of the permanent magnet(s). In particular, due to such coding of the lock cylinder, a coding elevation must be formed at the key in the correct position and at the correct height to be able to
10 move the querying pin into the querying position so that a forging of the associated key may ultimately be made more difficult by providing a blocking device.

Nevertheless, these codings may be realized with comparatively little effort with respect to the production of the lock cylinder and the associated key since only two
15 additional pins – the querying pin and the blocking pin – have to be inserted into the cylinder core and preloaded accordingly, whereas only the additional coding elevation has to be attached to the key. Furthermore, the permanent magnet may, for example, be easily pressed onto the respective end section. In this respect, the arrangement of the permanent magnet at the querying pin and/or the blocking pin enables a greater
20 durability and fail-safeness compared to an arrangement of a magnet at a key since the blocking pin and the querying pin are only moved on an actuation of the lock cylinder and – unlike a magnet arranged at a key – are, for example, not exposed to a friction during a transport of the key that could cause a release of the permanent magnet.

25 To be able to hold the blocking pin in the release position, the permanent magnet may in particular be configured to exert an attractive force on the respective other one of the querying pin or blocking pin at which the permanent magnet is not arranged. Therefore, at least that one of the blocking pin and the querying pin which does not
30 have the permanent magnet may have a magnetic material and/or be made of a magnetic material at an end section facing the permanent magnet. In particular, the respective pin may be made entirely of a magnetic material. Furthermore, in embodiments in which both the querying pin and the blocking pin have a respective permanent magnet, the permanent magnets may be polarized in opposite directions to

be able to achieve an attraction between the blocking pin and the querying pin and, as a result, a holding of the blocking pin in the release position.

In particular, provision may be made that the querying pin and the blocking pin
5 mechanically contact one another in the release position when the querying pin is positioned in the querying position and the blocking pin is positioned in the release position. Therefore, in the release position, the blocking pin may, for example, directly contact the querying pin if the querying pin is positioned in the querying position. Alternatively thereto, provision may, however, generally also be made that the
10 permanent magnet is configured to hold the blocking pin in the release position against the preload of the blocking pin when the querying pin is positioned in the querying position without the querying pin and the blocking pin directly contacting one another.

Furthermore, a strength of the permanent magnet may be selected such that the
15 permanent magnet may pull the blocking pin out of the blocking position into the release position immediately on a positioning of the querying pin in the querying position and may then hold said blocking pin in the release position. However, provision may also be made that the blocking pin must first be moved in another way towards the querying pin positioned in the querying position and, for example, up to
20 and into the release position to be able to enter into active contact with the permanent magnet and to be able to be held in the release position by the permanent magnet. In such embodiments, a strength of the permanent magnet must therefore only be sufficient to compensate for a force in the direction of the blocking position that acts on the blocking pin in the release position, but without having to overcome the preload of
25 the blocking pin and to pull the blocking pin into the release position. Such embodiments and possibilities for moving the blocking pin towards the querying pin are in particular explained in more detail below.

The blocking pin may further generally be arranged in the cylinder core, but may be
30 configured to project out of the cylinder core up to and into the cylinder housing in the blocking position in order, as a result, to be able to block the cylinder core against a rotation relative to the cylinder housing into the open position. However, provision may be made that the cylinder core is also rotatable about a predefined angle of rotation when the querying pin is not positioned in the querying position and/or when the

blocking pin is not positioned in the release position, before the blocking pin blocks a further rotation towards the open position. This is also explained in more detail below.

5 In some embodiments, the lock cylinder may have a plurality of tumblers, wherein these tumblers may in particular be configured as pin tumblers. Such pin tumblers may, for example, have tumbler springs and housing pins that are arranged in the cylinder housing and that are preloaded by the tumbler springs towards the cylinder core. Furthermore, the pin tumblers may comprise core pins arranged in the cylinder core. When the key is not introduced into the keyway, the housing pins may further
10 project out of the cylinder housing and into the cylinder core in order, as a result, to block the cylinder core against a rotation relative to the cylinder housing. However, the associated key may have sorting structures, in particular sorting elevations and/or sorting recesses, so that the core pins may be outwardly displaced upon an introduction of the associated key into the keyway and the housing pins may thereby
15 be moved out of the cylinder core to release the cylinder core for a rotation. Such pin tumblers are generally known to the skilled person.

Furthermore, in some embodiments, provision may in particular be made that the tumblers and/or the querying pin projects/project into the keyway at a keyway broad
20 side so that, accordingly, in particular also the mentioned sorting structures and/or a coding elevation cooperating with the querying pin may be formed at a key broad side of the associated key.

The lock cylinder may in particular be configured as a profile cylinder in accordance
25 with DIN 18252. In such a profile cylinder, the cylinder housing may have a core receiving section for receiving the cylinder core and a flange section which projects radially away from the cylinder core with respect to an axis of rotation of said cylinder core and in which the mentioned housing pins and tumbler springs may be arranged. However, as an alternative to a profile cylinder, provision may, for example, also be
30 made that the lock cylinder is configured as a round cylinder or oval cylinder and has a correspondingly shaped cylinder housing.

In principle, a radial and an axial direction within the scope of the present disclosure may refer to the cylinder axis of rotation and a longitudinal axis of the associated key,

unless another reference axis is explicitly mentioned. Furthermore, the longitudinal axis of the associated key may correspond to the cylinder axis of rotation when the key is introduced. In addition, the key may generally be introducible into the keyway along or parallel to the cylinder axis of rotation so that the cylinder axis of rotation may define the key introduction direction. The key may furthermore be introducible along its longitudinal axis into the keyway.

Further embodiments are explained in the dependent claims, in the description, and in the Figures.

In some embodiments, the permanent magnet may be arranged at an end section of the querying pin.

In some embodiments, the blocking pin may, in the closed position of the cylinder core, engage into a blocking recess formed at the cylinder housing. In particular, in such embodiments, the blocking pin may block a rotation of the cylinder core out of the closed position through the engagement into the blocking recess if the querying pin is not arranged in the querying position. However, in some embodiments, provision may also be made that, on a rotation of the cylinder core, the blocking pin may be guided out of the blocking recess by a querying slope adjoining the blocking recess in order to block a rotation of the cylinder core towards the open position only after a rotation about a predefined angle of rotation if the querying pin is not arranged in the querying position. This is also explained in more detail below.

In some embodiments, the querying pin may engage into the keyway at one of the keyway broad sides.

Furthermore, in some embodiments, the querying pin may be more strongly preloaded than the blocking pin. In particular, due to such a more pronounced preload of the querying pin compared to the preload of the blocking pin, it may be achieved that the querying pin may hold the blocking pin in the release position and may not, for instance, be pulled outwards beyond the querying position by the blocking pin due to its preload. In particular, a force acting on the querying pin towards the keyway due to the preload when the querying pin is positioned in the querying position may therefore

be greater than a force acting outwardly on the blocking pin due to the preload of the blocking pin when the blocking pin is positioned in the release position.

Alternatively or additionally, in some embodiments, the querying pin may furthermore
 5 contact a holding edge of the cylinder core in the querying position, said holding edge blocking an outwardly directed movement of the querying pin. It may hereby also be prevented that the querying pin may be pulled outwards by the blocking pin and that the blocking pin may engage into the cylinder housing despite the positioning of the querying pin in the querying position.

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In addition, in some embodiments, the strength of the permanent magnet may be greater than a force acting outwardly on the blocking pin in the release position, but less than a sum of the force acting outwardly on the blocking pin in the release position and a force that acts inwardly in the direction of the keyway on the querying pin in the
 15 querying position. In particular, the force acting inwardly on the querying pin in the querying position due to its preload may be compensated for by a coding elevation that is formed at the associated key and that may block a movement of the querying pin towards the keyway. Since a strength of the permanent magnet may exceed the force acting outwardly on the blocking pin, the blocking pin may therefore be held in the
 20 release position when the associated key is introduced. If, however, the key is removed again, the force acting on the querying pin is no longer compensated and the added force of the opposing preloads exceeds the force of the permanent magnet so that the blocking pin may move back into the blocking position to be able to secure the cylinder core against an unauthorized movement into the open position.

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In some embodiments, the cylinder housing may have a querying contour. By rotating the cylinder core starting from the closed position into a querying rotational position, the blocking pin may be guided along the querying contour and may hereby be moved towards the querying pin and may in particular be urged into the release position.

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Furthermore, the blocking pin and/or the querying pin may, upon reaching the querying rotational position, be able to be brought into active contact with the permanent magnet when the querying pin is in the querying position. In other words, a magnetic force-fitting connection may thus be produced between the blocking pin and the querying pin if the key is fully introduced into the keyway at the same time.

In particular, the blocking pin may be movable towards the querying pin by rotating the cylinder core into the querying rotational position, for which purpose the querying contour may, for example, have a querying slope which rises towards the keyway in the direction of rotation of the cylinder core and along which the blocking pin may be guided during the rotation. If the querying pin is in the querying position, the permanent magnet may further exert a sufficient attractive force on the blocking pin and the querying pin to be able to hold the blocking pin in the release position upon reaching the querying rotational position. In particular, the blocking pin may for this purpose, by rotating the cylinder core, be movable into the release position and/or be able to be brought into mechanical contact with the querying pin that is in the querying position in order, as a result, to be able to be held at the querying pin and in the release position.

In principle, however, such a rotation may in particular also be possible if the querying pin is not in the querying position and thus no key configured to cooperate with the querying pin has been introduced into the keyway. In particular, a rotation of the cylinder core into the querying rotational position may thus be performed by a key that may indeed sort the at least one tumbler into the release configuration, but does not have the additional coding for moving the querying pin into the querying position. In this case, no active contact may thus be established with the permanent magnet so that the blocking pin may block a further rotation of the cylinder core and in particular block a rotation up to and into the open position.

In general, bringing the blocking pin and/or the querying pin into active contact with the permanent magnet may mean producing such a small distance between the blocking pin and the querying pin that the permanent magnet may exert a sufficient attractive force to be able to hold the blocking pin in the release position and in particular to be able to keep the blocking pin in mechanical contact with the querying pin.

In some embodiments, the querying contour may have a querying slope along which the blocking pin may be guided from the closed position into the querying position during the rotation of the cylinder core. In particular, such a querying slope may form a deflection of the rotational movement of the cylinder core to convert the rotational movement into a movement of the blocking pin against the preload on the querying

pin. Therefore, the querying slope may rise towards the keyway, and thus towards the querying pin, in particular viewed along the direction of rotation of the cylinder core during the rotation from the closed position into the open position.

- 5 In some embodiments, the querying contour may have a querying section that extends at least up to an outer side of the cylinder core, wherein the blocking pin may contact the querying section in the querying rotational position.

10 In particular, by rotating the cylinder core into the querying rotational position, the blocking pin may thus be movable into a position in which the blocking pin no longer engages into the cylinder housing. If the blocking pin is thus held in the position reached in the querying rotational position, in particular the release position, the blocking pin no longer engages into the cylinder housing so that a further rotation of the cylinder core, in particular up to and into the open position, is possible. Due to such
15 a querying section, it may thus be achieved that, after the rotation into the querying rotational position, the blocking pin only has to be held in the assumed position and so-to-say has to be taken over by the querying pin without having to be moved against the preload by a magnetic force exerted by the permanent magnet.

20 In some embodiments, the cylinder core may be rotatable from the querying rotational position towards the open position up to and into a blocking rotational position when the querying pin is not in the querying position. Furthermore, the blocking pin may be configured, when the querying pin is not in the querying position, to enter into engagement with a blocking receiver of the querying contour due to the preload of said
25 blocking pin by rotating the cylinder core from the querying rotational position into the blocking rotational position, wherein the blocking receiver may have a blocking abutment for the blocking pin, with the blocking pin, which engages into the blocking receiver, abutting said blocking abutment upon reaching the blocking rotational position.

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In particular, the blocking pin may again assume the blocking position in the blocking rotational position if the querying pin is not positioned in the querying position and the blocking pin was therefore not taken over during the passing through of the querying rotational position in order to be held in the release position. Such a querying contour

thus makes it possible to first move the blocking pin towards the querying pin by rotating the cylinder core into the querying rotational position in order – if the querying pin is positioned in the querying position – to be able to hold the blocking pin in the release position and to be able to release the cylinder core for a rotation into the open position. However, if the querying pin is not in the querying position because no key configured for a corresponding cooperation with the querying pin has been introduced into the keyway, the blocking pin is moved outwards again due to its preload on a rotation from the querying rotational position towards the open position and ultimately engages into the blocking receiver in order, as a result, to block the cylinder core against a rotation going beyond the blocking rotational position in the direction of the open position.

In some embodiments, provision may therefore also be made in general – and independently of the configuration of the lock cylinder with a querying contour and/or a querying section – that the cylinder core, when the querying pin is not in the querying position, may be rotated starting from the closed position up to and into a blocking rotational position in which the blocking pin preloaded into the blocking position engages into a blocking receiver formed at the cylinder housing and thereby blocks a further rotation of the cylinder core towards the open position.

In some embodiments, the cylinder core may be rotatable from the blocking rotational position into the closed position when the querying pin is not in the querying position. In particular, in some embodiments, the cylinder core may thus be rotatable between the closed position and the blocking rotational position when the querying pin is not in the querying position. This may in particular be provided in embodiments in which the key may only be released from the keyway in the closed position of the cylinder core so that an incorrect key that may have been accidentally introduced may be removed again after the cylinder core has been rotated back into the closed position, whereas a movement of the cylinder core into the open position may be prevented by an abutting of the blocking pin at the blocking abutment.

In some embodiments, the querying contour may have a return slope along which the blocking pin may be guided out of the blocking receiver on a rotation of the cylinder core from the blocking rotational position towards the closed position. In this regard,

the blocking receiver may in particular not have a blocking abutment in the direction of the closed position, but rather a return slope that enables an urging back of the blocking pin against its preload. The return slope may further in particular adjoin the already mentioned querying section so that, on a rotation from the blocking rotational position into the closed position, the blocking pin may be guidable via the querying rotational position and the querying section in order, starting from the querying section, in particular to be able to be guided via the already mentioned querying slope back into the already mentioned blocking recess into which the blocking pin may engage into the closed position.

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In some embodiments, the cylinder core may be rotatable from the closed position via the querying rotational position into the open position. In other embodiments, provision may, however, be made that the cylinder core may be rotated from the closed position along a first direction of rotation into the querying rotational position and from the querying rotational position along a second direction of rotation, which is opposite the first direction of rotation, into the open position.

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In this regard, in some embodiments, provision may be made that the cylinder core may be rotated by a continuous rotation from the closed position into the open position, wherein, during this rotation, the cylinder core may pass through the querying rotational position in which the blocking pin may so-to-say be taken over and may be held in the release position during the further rotation into the open position. In particular, the cylinder core may in this respect also pass through the blocking rotational position, wherein a rotation going beyond this may only be possible if the querying pin is arranged in the querying position and the blocking pin is therefore held in the release position.

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In other embodiments, provision may, however, be made that the cylinder core must first be rotated along a first direction of rotation into the querying rotational position in order, as a result, to be able to transfer the blocking pin into the release position and then to be able to hold said blocking pin at the querying pin. After this rotation along the first direction of rotation, the cylinder core in such embodiments may be moved along a second direction of rotation, which is opposite the first direction of rotation, into the open position, provided that the associated key has been introduced into the

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keyway and the blocking pin is therefore held in the release position. During this rotation along the second direction of rotation, the cylinder core may thus pass through the closed position, which in such embodiments may in particular also correspond to the blocking rotational position, so that the blocking pin may abut a blocking receiver upon reaching the closed position if the querying pin has not been brought into the querying position. In this regard, in such embodiments, the already mentioned blocking recess may also form the blocking receiver so that the blocking pin may, for example in the closed position, directly contact a blocking abutment that prevents a rotation along the second direction of rotation, starting from the closed position, unless the rotation along the first direction of rotation into the querying rotational position has previously taken place.

In some embodiments, the permanent magnet may be configured to pull the blocking pin into the release position against the preload of the blocking pin when the querying pin is in the querying position. Such embodiments may in particular be provided as an alternative to embodiments with the above-explained querying contour in that a key merely has to be introduced into the keyway, by means of which key the querying pin may be transferred into the querying position, whereupon the blocking pin may be pulled into the release position against its preload and may then be held at the querying pin. In such embodiments, it may furthermore in particular be provided that the respective preloads exerted on the querying pin and the blocking pin in addition exceed an attractive force exerted by the permanent magnet when the querying pin is in the querying position and the blocking pin is in the release position so that the blocking pin may enter the blocking position again after a return of the cylinder core into the closed position and a removal of the key from the keyway.

In some embodiments, the associated key may be introducible into the keyway and removable from the keyway in the closed position. In particular, the associated key may be removable from the keyway solely in the closed position.

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In some embodiments, the querying pin and the blocking pin as well as the respective preloading elements for generating the respective preload, in particular respective springs, may be able to be preassembled in an assembly sleeve, wherein the cylinder core may have an assembly receiver into which the assembly sleeve may be inserted.

In particular, such a preassembly of the blocking device may simplify the assembly of the lock cylinder overall since the small components of the blocking device – the respective preloading elements, the querying pin and the blocking pin – do not have to be inserted directly and, for example, successively into the cylinder core, but may first be preassembled in the assembly sleeve in order to subsequently be able to insert the entire blocking device as an assembled unit into the assembly receiver in a single assembly step. In particular, the blocking device may therefore comprise the assembly sleeve and/or the blocking device may be able to be preassembled as a whole outside the cylinder core to be able to be insertable into the cylinder core as a preassembled unit.

In particular, the assembly sleeve may further have respective support edges for the preloading elements. Furthermore, the preloading elements may be insertable into the assembly sleeve from two opposite sides. Accordingly, the querying pin and the blocking pin may also be insertable into the assembly sleeve from opposite sides. The assembly sleeve may therefore be designed as open at both sides.

In some embodiments, the querying pin may be able to be urged into the querying position by a coding elevation that is arranged in an axial groove extending from a key tip of the associated key.

Due to the above-explained cooperation between the querying pin and the blocking pin, a height of such a coding elevation may in particular be probeable. If a key is introduced into the keyway that may indeed sort the tumblers into the release position, but, for instance, has a coding elevation with a height that is too low, the querying pin cannot be brought into the querying position and the querying pin and the blocking pin cannot be moved sufficiently close to one another that the querying pin may hold the blocking pin in the release position. As a result, the cylinder core may thus not be moved into the open position. If, on the other hand, a key is introduced into the keyway that has a coding elevation with too great a height, the querying pin is urged beyond the querying position so that a blocking pin contacting the querying pin and held at the querying pin by the permanent magnet may still project into the cylinder housing and may thereby block a rotation of the cylinder core. In embodiments in which the

querying pin contacts a holding edge of the cylinder core in the querying position, a configuration of a key with a coding elevation of too great a height may furthermore have the result that the key may not be fully introduced into the keyway since the querying pin is already pressed against the holding edge by the coding elevation
5 before a full introduction of the key into the keyway and a further introduction of the key is therefore blocked. In this regard, a precise design of the coding elevation is required to be able to achieve a rotation of the cylinder core into the open position.

Furthermore, the formation of a coding elevation in an axial groove may require a more
10 precise configuration of the key since the coding elevation must be formed with a correct height and positioning at the key, in particular in the groove. As will be explained in more detail below, the lock cylinder may also have further elements that cooperate with the groove and/or the coding elevation so that an arrangement of the coding elevation in the groove may be necessary to be able to cooperate with the
15 querying pin, whereas the mere formation of a large-area elevation at the key may not be sufficient. In such embodiments, a precise positioning of the coding elevation and a formation of the coding elevation with a precisely provided height at the associated key may therefore be necessary to be able to move the querying pin into the querying position and, as a result, to be able to hold the blocking pin in the release position.

20 In some embodiments, the lock cylinder may further have a coding device that has a first axial abutment and a second axial abutment for the key, wherein the first axial abutment and the second axial abutment engage into the keyway and wherein the second axial abutment is offset along the key introduction direction with respect to the
25 first axial abutment towards an axial end of the cylinder core, said axial end facing away from the key introduction opening. Furthermore, the first axial abutment may have a passage for allowing a coding elevation formed at the associated key to pass through, wherein the second axial abutment may form an abutment for the coding elevation.

30 In particular, the coding elevation may be the coding elevation already mentioned above that is also configured to cooperate with the querying pin to be able to urge the querying pin into the querying position and, as a result, to be able to hold the blocking pin in the release position. Furthermore, provision may be made that the associated

key is configured as a reversible key and has a respective coding elevation at opposite key broad sides, wherein one of the coding elevations may cooperate with the querying pin and the other of the coding elevations may cooperate with the coding device in dependence on an orientation of the key during the introduction into the keyway, as is likewise explained in more detail below.

By providing two mutually offset axial abutments for the key, the coding device may in particular offer further possibilities for coding the key in that, for example, an axial position of the coding elevation at the key may be queried by the second axial abutment. If, for example, the coding elevation is arranged offset too far towards the key tip, the key already abuts the second axial abutment before a full introduction into the keyway so that the lock cylinder cannot be actuated and the coding elevation or a further coding elevation in particular cannot reach the querying pin. In addition, by providing the first axial abutment with the passage for the coding elevation, a width and a positioning of the coding elevation transverse to the key introduction direction may also be queried in that coding elevations that are too wide and/or that are not precisely positioned in the transverse direction may abut boundaries of the first axial abutment or of the passage so that the respective key may not be fully introduced into the keyway. Furthermore, in some embodiments, the passage may be closed at a side facing away from the keyway so that a height of the coding elevation may also be queried by the first axial abutment.

In addition, the first axial abutment may also form an abutment for the associated key so that a correct distance along the key introduction direction between the coding elevation and an element of the key that abuts the first axial abutment may further be queried. If this distance is too small, the key already abuts the first axial abutment before the coding elevation reaches the second axial abutment so that the key cannot be fully introduced into the keyway and the cylinder core therefore cannot be actuated. The coding device thus also enables further codings of the associated key in order to increase its protection against forgery.

Thus, in some embodiments, the associated key fully introduced into the keyway may abut both the first axial abutment and the second axial abutment.

In some embodiments, the coding device and the querying pin may engage into the keyway at mutually opposite keyway broad sides.

5 In particular, provision may also be made that the cylinder core has two cylinder core halves that may be assembled during an assembly of the cylinder core and/or the lock cylinder, wherein the coding device and the querying pin may be arranged at different cylinder core halves in some embodiments.

10 In some embodiments, the coding device and the querying pin may be configured to cooperate with respective coding elevations that are formed at mutually opposite key broad sides of the associated key.

As already explained, the associated key may in particular be a reversible key that may be designed symmetrically with respect to rotations about the cylinder axis of rotation by 180°. Therefore, the key may be introducible into the keyway in any desired
15 orientation with respect to such rotations by 180°, wherein a respective coding elevation may furthermore cooperate with the querying pin and the coding device regardless of the orientation of the key. This may make it possible to probe a positioning of the coding elevation, a width of the coding elevation and/or a height of
20 the coding elevation by means of the coding device, wherein the positioning and height of the coding elevation may likewise be probed by the querying pin. Furthermore, by probing the height of the coding elevation twice, any tolerances may, for example, be minimized in order to increase the protection against forgery of the key.

25 In some embodiments, the passage may have two lateral boundaries which are offset from one another transversely to the cylinder axis of rotation and through which the coding elevation may be guided upon an introduction of the key into the keyway. In particular, the passage may thus be bounded at both sides in order, for example, to be able to query the width of the coding elevation and/or its positioning transverse to the
30 cylinder axis of rotation.

In some embodiments, end faces of the boundaries that face the key introduction opening may form the first axial abutment. In this regard, it may in particular be provided that the associated key abuts the end faces of the boundaries that bound the

passage for the coding elevation if the associated key is fully introduced into the keyway.

- 5 In some embodiments, the outer surfaces of the boundaries may form an inner guide for a groove which is formed at the associated key and in which the coding elevation is formed.

- 10 The boundaries of the passage may thus form elements that cooperate directly with the groove in order to facilitate the guidance of the key into the keyway, on the one hand, but also to be able to query a width of the groove, on the other hand. Due to the configuration of the coding device with a passage for the coding elevation, the coding elevation must inevitably be formed in a groove of the associated key since a key configured with a broad elevation already directly abuts the first axial abutment. If the groove is furthermore too narrow, the key likewise directly abuts the first axial
- 15 abutment and cannot be fully introduced into the keyway. In this regard, the coding device may serve to probe a shape of the key in the region of a key tip overall in that a position of the coding elevation, its width and height as well as the width and/or length of the groove may be queried.

- 20 In some embodiments, the passage may be formed in the shape of an archway and the first abutment may have a connection section by which the lateral boundaries are connected to one another at a side of the first axial abutment that faces away from the keyway.

- 25 Based on an observation in which the coding elevation extends upwards from a key shank, the passage may thus be closed above the coding elevation in some embodiments in order, as a result, to be able to probe a height of the coding elevation.

- 30 A passage in the shape of an archway may in particular act as a gate for the leading through of the coding elevation, wherein, however, the connection section of such an archway-shaped passage may, for example, also be straight and may, for instance, be oriented approximately perpendicular to the lateral boundaries. However, it is also possible for the connection section to have a curved shape in order, for example, to be able to probe a frustoconical coding elevation and/or a coding elevation with a rounded

or curved upper side as precisely as possible. In this regard, in some embodiments, a shape of the coding elevation at an end facing away from the key shank may also be probeable by the passage.

- 5 In some embodiments, the keyway may extend laterally beyond the first abutment element and the second abutment element transversely to the key introduction direction. In this regard, in some embodiments, the keyway broad sides may extend transversely to the key introduction direction beyond the axial abutments. Due to such a configuration, the key may, for example, be guidable laterally past the axial
10 abutments for the key at the key tip in order, as a result, to be able to achieve a guidance of the key, for example.

In some embodiments, the coding device may be arranged at an end section of the cylinder core, said end section being opposite the key introduction opening.

- 15 Alternatively or additionally, the lock cylinder may have a plurality of tumblers, wherein all of the plurality of tumblers may be arranged between the key introduction opening and the coding device. However, with a coding device arranged at an end section of the cylinder core that is opposite the key introduction opening, provision may also be made that the coding device is arranged between the key introduction opening and a
20 groove, which is formed at the cylinder core, for attaching a circlip for axially fixing the cylinder core in the cylinder housing. On the other hand, the installation space required for the tumblers may in principle be kept free by the coding device so that the coding device may enable an additional coding compared to the tumblers without a tumbler having to be saved.

- 25 In some embodiments, the coding device may be arranged off-center with respect to the keyway, in particular transversely to the key introduction direction. Accordingly, the two axial abutments may also be arranged off-center in such embodiments and/or none of the axial abutments may engage centrally into the keyway with respect to a
30 transverse direction oriented transversely to the key introduction direction.

In some embodiments, the first axial abutment and the second axial abutment may be formed at respective coding elements inserted into the cylinder core, in particular at respective small plates.

In particular, in some embodiments, the first axial abutment and the second axial abutment may therefore be formed at separate coding elements that may be insertable into the cylinder core during an assembly of the lock cylinder. For example, the coding elements may furthermore directly contact one another in the inserted state.

In some embodiments, the cylinder core may have a receiver for inserting the coding elements. In particular, in such embodiments, the coding elements may therefore be insertable into a receiver of the cylinder core during an assembly of the lock cylinder so that the first axial abutment and the second axial abutment may engage into the keyway. For this purpose, the receiver may, for example, have respective edges to be able to determine a radial positioning of the coding elements and a depth of an engagement of the axial abutments into the keyway. Furthermore, in some embodiments, the cylinder core may have a respective receiver for inserting the coding elements or the cylinder core may have a common receiver for inserting both coding elements, wherein the coding elements inserted into the common receiver may in particular contact one another.

In some embodiments, the receiver may have, at an outer side of the cylinder core, a receiving opening through which the coding elements may be inserted into the receiver. The inserted coding elements may in particular extend radially up to the outer side of the cylinder core and may have, at the outer side, a curvature corresponding to the cylinder core. In this regard, the receiving opening may so-to-say be closed by inserting the coding elements such that the cylinder core is completed at the outer side to be able to be inserted precisely into the core receiving section of the cylinder housing.

In some embodiments, the coding device may further comprise a single-piece coding element at which the first axial abutment and the second axial abutment are formed. In particular, in such embodiments, the coding device may have a single coding element which is configured as a single materially bonded part and at which both the first axial abutment and the second axial abutment are formed. In addition, in some embodiments, the single coding element may be selectively insertable into the cylinder

core and in particular into a receiver formed at the cylinder core or the coding element may be formed directly at the cylinder core and may, for example, be molded thereto.

5 In some embodiments, the single-piece coding element may be arranged in the keyway at an end of the keyway that is opposite the key introduction opening.

10 In some embodiments, the coding element may be molded to the cylinder core. In particular, in some embodiments, the cylinder core may comprise two cylinder core halves, wherein the coding element may be molded in one of the two cylinder core halves. For example, the cylinder core or its cylinder core halves may be formed by a zinc die-casting process, wherein a relief of the coding element may be provided in a mold for producing the one cylinder core half to be able to form and/or mold the coding element directly at the respective cylinder core half.

15 In some embodiments, the coding element may be configured in the manner of a fork and may have two prolongations which bound the passage, which face towards the key introduction opening and between which the coding elevation may be introduced into the fork. The prolongations may further form the first axial abutment and a receiving section that connects the two prolongations at a side of the fork that faces
20 away from the key introduction opening may form the second axial abutment. Furthermore, in such embodiments, the prolongations may in particular extend axially towards the key introduction opening to be able to receive the coding elevation. However, a base formed by the cylinder core may bound the passage at a side facing away from the keyway so that, even in such embodiments, a height of the coding
25 elevation may be probeable by the fork-like coding element.

The invention further relates to a locking system that comprises a lock cylinder according to any one of the embodiments explained above and the associated key.

30 In particular, the associated key may have a coding elevation that cooperates with the querying pin and that is configured to urge the querying pin into the querying position when the key is fully introduced into the keyway. A height of the coding elevation may in particular be selected precisely such that the querying pin just reaches the querying position when the associated key is fully introduced into the keyway.

Furthermore, the associated key may in particular be configured to sort the tumblers into the release configuration upon a full introduction into the keyway to be able to release the cylinder core for a rotation relative to the cylinder housing. For this purpose, the associated key may in particular have respective sorting structures that cooperate with a respective tumbler. These sorting structures may in particular be formed at a key broad side of the associated key.

In some embodiments, the associated key may have an axial groove which starts from a key tip and in which a coding elevation is arranged. The coding elevation may be configured to urge the querying pin into the querying position when the key is fully introduced into the keyway.

In particular, the coding elevation may be formed at a key broad side of the associated key so that the axial groove may also be formed at the key broad side. As already explained, by forming such a coding elevation and by arranging it in an axial groove, a further coding of the associated key may be achieved, in particular to increase its protection against forgery.

An axial groove may in general extend substantially along a longitudinal axis of the associated key, but without necessarily having to have rectilinear shape. For example, respective outer sides or lateral boundaries of an axial groove may therefore be straight or curved.

In some embodiments, the coding elevation may be formed free-standing in the groove. In particular, in such embodiments, the groove may therefore have a depth between the coding elevation and a rear boundary of the groove, said rear boundary facing away from the key tip, that corresponds to a depth of the groove between the coding elevation and the key tip. A free-standing coding elevation may, for example, have a frustoconical shape, a conical shape, a truncated pyramid shape, a pyramid shape, a pin shape and/or a hemispherical shape.

Alternatively thereto, it is, however, generally also possible that the coding elevation extends in the groove as an axial web that leads to a rear boundary of the groove, said rear boundary facing away from the key tip.

- 5 In some embodiments, the coding elevation may have a recess for an engagement of the querying pin at a querying surface that faces towards the querying pin when the key is introduced into the keyway.

Such a recess may also enable a further coding of the associated key in that an
10 absolute or maximum height of the coding elevation is not decisive for the displacement of the querying pin, but rather this height minus a depth of the recess into which the querying pin engages when the associated key is fully introduced into the keyway. As a result, in the case of coding elevations that basically have the same maximum height, further codings may be realized at the key in that coding elevations
15 that indeed have the correct maximum height but no recess may urge the querying pin beyond the querying position so that the querying pin cannot be positioned exactly in the querying position and the blocking pin cannot be held in the release position.

Furthermore, in particular in embodiments that have the aforementioned coding
20 device, a maximum height of the coding elevation may nevertheless also be probed by a height of the passage provided by a first axial abutment of such a coding device.

In some embodiments, the associated key may be configured as a reversible key that has an elongate key shank and that has two mutually opposite key broad sides and
25 two mutually opposite key narrow sides, wherein the key has a respective groove with a coding elevation arranged therein at each key broad side. Such a reversible key may in particular be designed symmetrically with respect to rotations by 180° about the longitudinal axis of the key so that the associated key may be introducible into the keyway in any desired orientation with respect to such rotations by 180° . Irrespective
30 of this orientation of the key, a respective one of the coding elevations may furthermore always cooperate with the querying pin.

In some embodiments, the lock cylinder may have a coding device that has a first axial abutment and a second axial abutment for the key, wherein the first axial abutment

and the second axial abutment engage into the keyway. Furthermore, the second axial abutment may be offset along the key introduction direction with respect to the first axial abutment towards an axial end of the cylinder core, said axial end facing away from the key introduction opening. The first axial abutment may have a passage for
5 allowing the one coding elevation of the two coding elevations to pass through and the second axial abutment may form an abutment for the one coding elevation, wherein the other of the two coding elevations of the associated key may be configured to urge the querying pin into the querying position when the one coding elevation contacts the second axial abutment.

10

In such embodiments, each of the two coding elevations may thus always cooperate with a respective element, the second axial abutment or the querying pin, irrespective of an orientation of the associated key in order, as a result, to be able to realize the explained additional codings of the key.

15

The lock cylinder and/or the key of the locking system may further have one or more features of the features already mentioned above in connection with embodiments of a lock cylinder.

20 The invention further relates to a key for use in a locking system of the kind explained above, wherein the key is configured to sort the at least one tumbler into the release configuration upon a full introduction into the keyway, and wherein the key has a coding elevation that is configured to urge the querying pin into the querying position upon full introduction of the key into the keyway.

25

In some embodiments, the coding elevation may further be arranged, in particular in a free-standing manner, in an axial groove starting from a key tip. Furthermore, the coding elevation may in particular be arranged at a key broad side of the key.

30 In some embodiments, the coding elevation may have a recess for an engagement of the querying pin at a querying surface that faces towards the querying pin when the key is introduced into the keyway. As already explained, an additional coding of the associated key may be achieved via a depth of the recess.

In some embodiments, the key may be configured as a reversible key that has an elongate key shank and that has two mutually opposite key broad sides and two mutually opposite key narrow sides, wherein the key may have a respective groove with a coding elevation arranged therein at each of the key broad sides. In this regard, 5 the key may in particular be designed symmetrically with respect to rotations by 180° about the cylinder axis of rotation that may correspond to a longitudinal axis of the key.

The key may further have one or more features of the features already mentioned above in connection with a lock cylinder to be actuated or the explained locking 10 system.

Furthermore, the invention relates to the use of a key of the kind explained above for actuating a lock cylinder of the kind explained above, wherein the key in particular has a coding elevation that is configured to urge the querying pin into the querying position 15 upon a full introduction of the key into the keyway.

The invention will be explained in the following purely by way of example with reference to the drawings and to embodiment examples.

20 There are shown:

Fig. 1 an exploded representation of a first embodiment of a locking system comprising a lock cylinder and an associated key, wherein, however, a cylinder housing of the lock cylinder is masked; 25

Fig. 2 a plan view of the associated key;

Figs. 3A to 3C two perspective representations of the key together with coding elements of a coding device of the lock cylinder and a longitudinal sectional representation of the lock cylinder with the key introduced for illustrating the cooperation of the key with the coding device of the lock cylinder; 30

- Fig. 4 an exploded representation of a further embodiment of the locking system with the cylinder housing again masked;
- 5 Figs. 5A and 5B respective cross-sectional representations through the lock cylinder for illustrating the cooperation of a coding elevation of the associated key with a blocking device of the lock cylinder;
- 10 Figs. 6A and 6B a respective longitudinal sectional representation of a cylinder core of a respective embodiment of a lock cylinder with the key introduced for a further illustration of the cooperation of the coding elevation with the blocking device, wherein, in the embodiment in accordance with Fig. 6B, an assembly sleeve for preassembling components of the blocking device is furthermore provided;
- 15 Figs. 7A and 7B a respective longitudinal sectional representation for illustrating a further embodiment of the lock cylinder and its blocking device, wherein the cooperation of the associated key with the blocking device requires a recess in the coding elevation formed at the key; and
- 20 Figs. 8A and 8B respective perspective exploded representations of a cylinder core of a lock cylinder according to a further embodiment.
- 25 Fig. 1 shows an exploded representation of a locking system 123 that has a lock cylinder 11 and an associated key 23 provided for actuating the lock cylinder 11. However, with regard to the lock cylinder 11, only a cylinder core 19 of the lock cylinder 11 comprising two cylinder core halves 65 and 67 is shown in Fig. 1, wherein, when the lock cylinder 11 is assembled, this cylinder core 19 is rotatably received in a core receiving section 15 of a cylinder housing 13, not shown in Fig. 1, about a cylinder axis of rotation D between a closed position G and an open position O (cf. Figs. 5A and 5B). Such a cylinder housing 13 is generally known to the skilled person and is, for example, illustrated in Figs. 5A and 5B, wherein the cylinder housing 13 illustrated there has the core receiving section 15 for receiving the cylinder core 19 and a flange
- 30

section 17 projecting radially away from the core receiving section 15 so that the respective lock cylinder 11 is configured as a profile cylinder. Furthermore, the lock cylinder 11 may have tumblers, not shown in the Figures, to prevent a rotation of the cylinder core 19 relative to the core receiving section 15 of the cylinder housing 13, unless the associated key 23 has been fully introduced through a key introduction opening 25 into a keyway 21, which is formed at the cylinder core 19, along a key introduction direction E that corresponds to a longitudinal axis L of the associated key 23.

For example, tumblers of such a lock cylinder 11 may be configured as pin tumblers that have housing pins, which are arranged in the flange section 17 and which are preloaded by tumbler springs towards the cylinder core 19, in order, for example, to engage into bores 37 of the cylinder core 19 when the key 23 is not introduced into the keyway 21. Core pins of the pin tumblers may furthermore be arranged in the cylinder core 19, wherein the core pins may be outwardly displaced by corresponding sorting structures of the key 23 upon a full introduction of the associated key 23 into the keyway 21 in order, as a result, to transfer the tumblers into a release configuration and to urge the housing pins against their preload back into the flange section 17 so that the tumblers release the cylinder core 19 for a rotation into the open position O. However, the design of such tumblers and in particular of such pin tumblers is generally known to the skilled person so that it is not necessary to go into detail here.

Furthermore, it can in particular be seen from Figs. 5A and 5B that the keyway 21 has an elongate cross-section having two mutually opposite keyway broad sides 27 and 29 and two mutually opposite keyway narrow sides 31 and 33. Accordingly, a key shank 127 of the associated key 23 is also elongate and has two mutually opposite key broad sides 115 and 117 and two mutually opposite key narrow sides 119 and 129 so that the key 23 may be suitably introduced into the keyway 21. In particular, the keyway narrow sides 31 and 33 are further oriented perpendicular to the keyway broad sides 27 and 29, and the key narrow sides 119 and 121 are oriented perpendicular to the key broad sides 115 and 117.

Although Figs. 5A and 5B illustrate only one possible embodiment of a lock cylinder 11 according to the present disclosure, each of the disclosed lock cylinders 11 may in

principle have a cylinder housing 13 having a core receiving section 15 for rotatably supporting the cylinder core 19 and the cylinder core 19 may in general have an elongate keyway 21. However, embodiments in which the lock cylinder 11 is not configured as a profile cylinder, but, for example, as a round or oval cylinder, are also possible, for example.

To be able to achieve further coding possibilities in addition to the tumblers in such a lock cylinder 11, a coding device 39 is arranged at an end section 55 of the cylinder core 19 in the lock cylinder 11 of the locking system 123 illustrated by means of Fig. 1. The coding device 39 comprises, by way of example, two coding elements 56 that are configured as respective small plates 57 and that may be inserted at an outer side of the cylinder core 19 through a receiving opening 61 into a receiver 59 of the cylinder core 19. In this respect, one of the coding elements 56 forms a first axial abutment 41 and the other of the two coding elements 56 forms a second axial abutment 43 for the associated key 23, wherein the two axial abutments 41 and 43 – as is in particular also illustrated by the longitudinal sectional representation of Fig. 3C – engage into the keyway 21 when the coding elements 56 are inserted into the receiver 59. Furthermore, the second axial abutment 43 is offset along the key introduction direction E with respect to the first axial abutment 41 towards an axial end of the cylinder core 19, said axial end being opposite the key introduction opening 25.

Fig. 1 further shows that the first axial abutment 41 has a passage 45 which is bounded by two lateral boundaries 47 and through which a coding elevation 125 formed at the associated key 23 may be guided during an introduction of the key 23 into the keyway 21. On the other hand, the second axial abutment 43 forms an axial abutment for the coding elevation 125 so that the coding elevation 125 contacts the second axial abutment 43 when the associated key 23 has been fully introduced into the keyway 21 (cf. in particular also Fig. 3C).

As can in particular be seen from Fig. 2, the coding elevation 125 at the associated key 23 is formed in a groove 51 that extends axially, starting from a key tip 91, with respect to a longitudinal axis A of the associated key 23. Furthermore, the coding elevation 125 is formed free-standing in the axial groove 51 so that the coding elevation 125 forms a somewhat local and, by way of example, frustoconical elevation in the groove

51, wherein a depth of the groove 51 between the coding elevation 125 and a rear boundary 93 of the groove 51 corresponds to a depth of the groove 51 between the coding elevation 125 and the key tip 91. Furthermore, the key 23 is in particular configured as a reversible key and is designed symmetrically with respect to rotations
 5 by 180° about the longitudinal axis A of the key 23 so that a groove 51 with a correspondingly designed coding elevation 125 is likewise provided at the key broad side 117 that is opposite the key broad side 115 visible in Fig. 2. This may in particular make it possible to be able to introduce the key 23 into the keyway 21 in any desired orientation with respect to such rotations by 180° and to be able to actuate the lock
 10 cylinder 11.

Figs. 3A and 3B illustrate that the outer boundaries 47 of the passage 45 form an inner guide for the groove 51 so that the key 23 may be centered and guided by the cooperation of the inner sides of the groove 51 with the outer boundaries 47 of the
 15 passage 45 of the first axial abutment 41 during the introduction into the keyway 21. In particular, end faces 49 of the outer boundaries 47 of the first axial abutment 41 that face the key introduction opening 25, however, form an abutment for the rear boundary 93 of the groove 51, said rear boundary facing away from the key tip 91, so that, when the key 23 is fully introduced into the keyway 21, the coding elevation 125 may contact
 20 the second axial abutment 43 and the rear boundary 93 of the groove 51 may contact the first axial abutment (cf. in particular Figs. 3B and 3C).

This configuration of the lock cylinder 11 and its cylinder core 19 with the coding device 39 in particular enables a coding of the lock cylinder 11 that goes beyond the
 25 tumblers. For example, due to the positioning of the second axial abutment 43, an axial position of the coding elevation 125 at the associated key 23 or in the groove 51 may be queried in that, for example, a coding elevation 125 that is axially offset too far in the direction of the key tip 91 may already abut the second axial abutment 43 before a full introduction of the key 23 into the keyway 21 so that the cylinder core 19 cannot be
 30 actuated by means of the respective key even if the key is generally suitable for a sorting of the tumblers.

Furthermore, due to the passage 45 formed by the first axial abutment 41, a width of the coding elevation 125 and a positioning of the coding elevation 125 transverse to

the key introduction direction E may be probed since, for example, a coding elevation 125 that is too wide or that is incorrectly positioned in the transverse direction cannot be guided through the passage 45 and already abuts the first axial abutment 41 so that the respective key again cannot be fully introduced into the keyway 21.

5

Furthermore, Figs. 1, 3A and 3B show that, according to this embodiment, the passage 45 is formed in the shape of an archway and the two lateral boundaries 47 are connected to one another at a side facing away from the keyway 21 by a connection section 53. Therefore, a height of the coding elevation 125 may also be probed by the
 10 passage 45 in the sense of an extent of the coding elevation 125, starting from a base of the groove 51, perpendicular to a plane of extent of the key shank 127. Coding elevations 125 that are too high likewise already abut the first axial abutment 41 so that the cylinder core 19 cannot be actuated by means of the respective key, even if this key is suitable for sorting the tumblers. Furthermore, due to the engagement of the
 15 first axial abutment 41 into the keyway 21, it is also necessary that the coding elevation 125 is formed in a correctly designed groove 51 since a mere raised design of the key tip 91 as a whole or a groove that is too narrow would result in the key 23 already abutting the first axial abutment 41 with the key tip 91.

20 In addition, due to the configuration of the coding device 39 with two offset axial abutments, a distance between the coding elevation 125 and the rear boundary 93 of the groove 51 may be checked in that the rear boundary 93 of the groove 51 may, for example as a result of a distance between the coding elevation 125 and the rear boundary 93 being too small, already abut the first axial abutment 41 before the coding
 25 elevation 125 reaches the second axial abutment 43. Thus, in this case, the respective key 43 cannot be fully introduced into the keyway 21 either.

In this regard, the coding device 39, in summary, in particular makes it possible, by varying an axial extent of the coding element 56 or of the small plate 57 that forms the
 30 first axial abutment 41 (querying the distance between the coding elevation 125 and the rear boundary 93 of the groove 51), by varying a positioning of the passage 45 in the transverse direction (querying the position of the coding elevation 125 in the transverse direction), by varying a width of the passage (querying the width of the coding elevation 125), by varying an axial positioning of the second axial abutment 43

(querying the axial position of the coding elevation 125), by varying a height of the passage (querying the height of the coding elevation 125) and/or by varying a width of the first axial abutment 41 and/or of the second axial abutment (querying the width of the groove 51), to realize numerous further codings of the lock cylinder 11, in particular
 5 to be able to increase the protection against forgery of the associated key 23.

Fig. 3C further shows that the coding elements 56 adjoin an outer side of the cylinder core 19 in a flush manner after the insertion into the receiver 59, wherein, as can, for instance, be seen from Fig. 1, the coding elements 56 furthermore have, at the outer
 10 side, a curvature corresponding to the cylinder core 19 so that the cylinder core 19 may so-to-say be completed by the insertion of the coding elements 56 to be able to be suitably rotatably received in the core receiving section 15 of the cylinder housing 13.

Fig. 4 shows a further embodiment of a locking system 123 comprising a lock cylinder 11, wherein the cylinder housing 13, which is basically illustrated by means of Figs. 5A and 5B, is again masked. In this embodiment, a coding device 39 is also arranged at an end section 55 of a cylinder core 19 of the lock cylinder 11 and has a first axial
 15 abutment 41 and a second axial abutment 43. As is already the case in the embodiment explained with reference to Figs. 1 to 3C, the first axial abutment 41 has a passage 45 for the explained coding elevation 125 of the associated key 23 so that the fully introduced key 23 may abut the second axial abutment 43 with the coding
 20 elevation 125 and may abut the first axial abutment 41 with a rear boundary 93 of a groove 51 in which the coding elevation 125 is formed.

25 While the coding device 39 and its coding elements 56 may be inserted into a receiver 59 of a first cylinder core half 65 of the cylinder core 19, a blocking device 75 is furthermore provided at a second cylinder core half 67 of the cylinder core 19 in the embodiment illustrated by means of Fig. 4. The blocking device 75 has a querying pin
 30 77 that is preloaded towards the keyway 21 by means of a spring 79 and that engages into the keyway 21. Furthermore, a blocking pin 83 that is preloaded outwardly and towards the cylinder housing 13 by a spring 85 is provided that may be urged due to the preload into a blocking position S in which the blocking pin 83 prevents a rotation

of the cylinder core 19 into the open position O. The mode of operation of the blocking device 75 will be explained in the following with reference to Figs. 5A and 5B.

Fig. 5A illustrates the cylinder core 19 in the closed position G in which the associated
5 key 23 may be introduced into the keyway 21 and may be removed from the keyway 21. In accordance with the representation of Fig. 5A, no key 23 is, however, introduced into the keyway 21 and the querying pin 77 engages into the keyway 21 due to its preload that is developed by the spring 79 supported at an edge 81 of the cylinder core 19. Furthermore, the blocking pin 83 is supported by the spring 85 at an edge 87 of the
10 cylinder core 19 and, due to the developed preload, assumes the aforementioned blocking position S in which the blocking pin 83 engages into a blocking recess 97 that is formed in the core receiving section 15 of the cylinder housing 13.

In order, for example, to open a lock, as part of which the lock cylinder 11 may be
15 used, the cylinder core 19 may be movable by 90° , starting from the closed position G illustrated in Fig. 5A, into the open position O in that the cylinder core 19 may be rotated along a direction of rotation D1 up to and into the open position O after the introduction of the associated key 23 and the transfer of the tumblers into the release configuration. However, an additional coding may be provided by the blocking device
20 75, wherein the cylinder core 19 may be rotated into the open position O solely by a key 23 that may sort the tumblers, on the one hand, and that has a coding elevation 125 configured to cooperate with the blocking device 75, on the other hand.

As Fig. 5B illustrates, by introducing the associated key 23 into the keyway 21, the
25 querying pin 77 may be outwardly displaced by the coding elevation 125 into a querying position A against the preload developed by the spring 79. A permanent magnet 95 is furthermore arranged at an end section 107 of the querying pin 77, said end section facing the blocking pin 83, but, as can be seen from the combination with Fig. 5A, does not already enter into direct mechanical contact with the blocking pin 83
30 simply by introducing the associated key 23. Therefore, in this embodiment, provision is made that the blocking pin 83 first remains in the blocking position S when the associated key 23 has been introduced into the keyway 21.

However, a querying contour 99 is formed at the cylinder housing 13 so that the cylinder core 19 may be moved, starting from the closed position G, along the direction of rotation D1 into a querying rotational position C despite the blocking pin 83 being in the blocking position S. During this rotation of the cylinder core 19, the blocking pin 83 is guided along a querying slope 103 up to a querying section 101 of the querying contour 99, wherein the blocking pin 83 contacting the querying section 101 no longer projects into the cylinder housing 13. Rather, during the rotation from the closed position G into the querying rotational position C, the blocking pin 83 is urged back against the preload of the spring 85 up to and into a release position F and, as Fig. 5B shows, in the querying rotational position C, enters into mechanical contact with the querying pin 77 located in the querying position A and with the permanent magnet 95 arranged at the end section 107 of said querying pin.

According to this embodiment, the strength of the permanent magnet 95 is selected such that the permanent magnet 95 may hold the blocking pin 83 against its preload in the release position F when the querying pin 77 is in the querying position A.

Therefore, the cylinder core 19 may be rotated, starting from the querying rotational position C shown in Fig. 5B, into the open position O, provided that the querying pin 77 has previously been moved into the querying position A by the correctly formed coding elevation 125 of the key 23 and the blocking pin 83 is held in the release position F by the magnetic force-fitting connection formed.

To be able to reliably hold the blocking pin 83 in the release position F, the querying pin 77 according to this embodiment is further designed wider than the blocking pin 83 and contacts a holding edge facing the blocking pin 83 in the cylinder core 19 so that the blocking pin 83 cannot pull the querying pin 77 further outwards against its preload in order to engage into the cylinder housing 13 despite the querying pin 77 being positioned in the querying position A. Furthermore, the strength of the attractive force exerted by the permanent magnet 95 on the blocking pin 83 may indeed exceed the preload developed by the spring 85 on the blocking pin 83 to be able to hold the blocking pin 83 in the release position F, but may be lower than a sum of the preload developed by the spring 85 on the blocking pin 83 and the preload developed by the spring 79 on the querying pin 77 so that the querying pin 77 and the blocking pin 83

may be released from one another again after a rotation of the cylinder core 19 back into the closed position G and a removal of the associated key 23 from the keyway 21.

In particular, the blocking device 75 comprising the querying pin 77 and the blocking pin 83 thus also enables a further coding of the lock cylinder 11. For instance, it can be seen from Fig. 5B that the blocking pin 83 assumes the release position F in the querying rotational position C, and indeed irrespective of whether the querying pin 77 is in the querying position A and a coding elevation 125 of the correct height is correspondingly formed at the introduced key 23. However, the blocking pin 83 that is not held in the release position F, due to its preload as a result of a further rotation of the cylinder core 19 towards the open position O, enters into engagement with a blocking receiver 109 upon reaching a blocking rotational position B, said blocking receiver 109 being formed at the cylinder housing 13 and having a blocking abutment 111 which the blocking pin 83 abuts upon reaching the blocking rotational position B. As a result of this abutment, the blocking pin 83 thus blocks a further rotation of the cylinder core 19 towards the open position O, unless the querying pin 77 has previously been arranged in the querying position A and the blocking pin 83 has thus so-to-say been taken over in the release position F when passing the querying rotational position C.

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To be able to transfer the cylinder core 19 into the open position O, it is therefore necessary to introduce an associated key 23 with a correctly formed coding elevation 125 into the keyway 21. However, a return slope 105 adjoins the blocking receiver 109 in a direction of rotation D2 opposite the direction of rotation D1 so that, even when the querying pin 77 is not positioned in the querying position A, the cylinder core 19 may be moved back into the closed position G, starting from the blocking rotational position B, in order to enable a removal of a possibly unintentionally introduced incorrect key. Furthermore, provision may generally also be made that the cylinder core 19 must first be rotated along the direction of rotation D2 opposite the direction of rotation D1 in order to transfer the blocking pin 83 into the release position F and to take it over by means of the querying pin 77 in order to subsequently rotate the cylinder core 19 along the direction of rotation D1 into the open position O. In particular, in such embodiments, provision may also be made that the blocking recess 97 already has a blocking abutment for the blocking pin 83 so that, in such

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embodiments, the cylinder core 19, starting from the closed position G, must first be rotated along the second direction of rotation D2 into the querying rotational position C in order to subsequently be able to be rotated along the direction of rotation D1 via the closed position G into the open position O when the blocking pin 83 is held in the
 5 release position F.

Due to the cooperation of the querying pin 77 with the coding elevation 125, in particular a height and a positioning of the coding elevation 125 may be probed and the cylinder core 19 may only be actuated when a coding elevation 125 of the correct
 10 height is positioned at the key shank 127 such that the coding elevation 125 comes into contact with the querying pin 77. Furthermore, the configuration of the associated key 23 as a reversible key makes it possible that, irrespective of an orientation of the key 23 with respect to a rotation by 180° about its longitudinal axis A, a respective one of the coding elevations 125 may always cooperate with the blocking device 75 and its
 15 querying pin 77, whereas the respective other of the two coding elevations 125 may in particular cooperate with the coding device 39 that is, for example, illustrated in Fig. 4.

Fig. 6A again illustrates, in a longitudinal sectional representation, the cooperation of the coding elevation 125 with the querying pin 77 in order to urge the latter into the
 20 querying position A and, as a result, to be able to hold the blocking pin 83 in the release position F.

In the embodiment illustrated by means of Fig. 6B, an assembly sleeve 89 is furthermore provided, in which the blocking device 75 may be preassembled. In
 25 particular, the querying pin 77, the spring 79, the blocking pin 83 and the spring 85 may thus be inserted into the assembly sleeve 89 outside the cylinder core 19, whereupon the blocking device 75 may be inserted as a preassembled unit into an assembly receiver 113 of the cylinder core 19 in a single assembly step. In particular, the assembly sleeve 89 may for this purpose also provide the respective edges 81 and
 30 87 for supporting the springs 79 and 85.

Figs. 7A and 7B further illustrate an embodiment in which the coding device 75 requires an additional coding in the form of a recess 129 formed at the coding elevation 125 of the associated key 23 to be able to hold the blocking pin 83 in the

release position F. In Fig. 7A, a key 23 has been introduced into the keyway 21 that indeed has a coding elevation 125 of the correct maximum height, but with no recess 129 being formed at the coding elevation 125. As a result, the querying pin 77, which is formed with a tip, is urged beyond the querying position A by the coding elevation 125 and the blocking pin 83 extends beyond the cylinder core 19 up to and into the cylinder housing 13, which is not shown in Fig. 7A, so that the blocking pin 83 blocks a rotation of the cylinder core 19 into the closed position G. While the coding elevation 125 of the key 23 shown in Fig. 7A could thus indeed be suitable for correctly urging the querying pin 77 of an embodiment in accordance with one of Fig. 6A or 6B into the querying position A, the respective key 23 cannot be used to actuate the lock cylinder 11 in accordance with Fig. 7A.

Fig. 7B, on the other hand, illustrates the configuration of the key 23 which is associated with this cylinder core 19 or the lock cylinder 11 and in which the coding elevation 125 has the aforementioned recess 129 so that the querying pin 77 may engage into the recess 129 and may be correctly arranged in the querying position A to be able to hold the blocking pin 83 in the release position F. In particular, in this embodiment, provision may be made that a strength of the permanent magnet 95 is selected such that the permanent magnet 95 may pull the blocking pin 83 at least a little inwards against its preload up to and into the release position F. Here, too, provision may, however, be made that the blocking pin 83 is first moved towards the querying pin 77 by a querying contour 99 in order to facilitate a takeover by the querying pin 77 and its permanent magnet 95. Furthermore, in such embodiments, provision may generally also be made that the blocking pin 83 may be urged into a direct mechanical contact with the querying pin 77 positioned in the querying position A by a querying contour 99.

In addition, in embodiments in accordance with Fig. 7B, provision may be made that a preload of the querying pin 77 exceeds a preload of the blocking pin 83 so that the querying pin 77 cannot be pulled out of the querying position A by the blocking pin 83 against the preload acting on the querying pin 77. On the other hand, the strength of the permanent magnet 95 or the attractive force exerted by the permanent magnet 95 on the blocking pin 83 may again be less than a sum of the preloads of the blocking

pin 83 and the querying pin 77 in order to enable a separation of the blocking pin 83 and the querying pin 77 after a removal of the key 23.

Figs. 8A and 8B illustrate a further embodiment of a lock cylinder 11 that has a blocking device 75 and a coding device 39. In contrast to the coding devices 39 explained above with reference to Figs. 1 to 4, the coding device 39 according to the embodiment of Figs. 8A and 8B only has a single coding element 63 that is directly molded to the cylinder core half 67 and that may, for example, be formed in the course of a zinc die-casting process for producing the cylinder core halves 65 and 67.

The coding element 63 is configured in the manner of a fork 69 and has two prolongations 71 that face axially in the direction of the key introduction opening 25 of the keyway 21, that form a first axial abutment 41 and that bound a passage 45 for the coding elevation 125 of the associated key 23. The two prolongations 71 are connected by a receiving section 73 so that the receiving section 73 may form an abutment for the coding elevation 125. Furthermore, the coding element 63 is arranged directly at a base 131 of the cylinder core half 67 and the keyway 21 so that a height of the coding elevation 125 may also be probed by a height of the coding element 63 and in particular of the prolongations 71. Once again, in a configuration of the associated key 23 as a reversible key, one of the coding elevations 125 may cooperate with the coding device 39 and the coding element 63, whereas the other coding elevation 125 may urge the querying pin 77 of the blocking device 75 into the querying position A in order, as a result, to be able to hold the blocking pin 83 in the release position F.

Reference numeral list

	11	lock cylinder
	13	cylinder housing
5	15	core receiving section
	17	flange section
	19	cylinder core
	21	keyway
	23	key
10	25	key introduction opening
	27	keyway broad side
	29	keyway broad side
	31	keyway narrow side
	33	keyway narrow side
15	37	bore
	39	coding device
	41	first axial abutment
	43	second axial abutment
	45	passage
20	47	lateral boundary
	49	end face
	51	groove
	53	connection section
	55	end section
25	56	coding element
	57	small plate
	59	receiver
	61	receiving opening
	63	coding element
30	65	cylinder core half
	67	cylinder core half
	69	fork
	71	prolongation
	73	receiving section

	75	blocking device
	77	querying pin
	79	spring
	81	edge
5	83	blocking pin
	85	spring
	87	edge
	89	assembly sleeve
	91	key tip
10	93	rear boundary of the groove
	95	permanent magnet
	97	blocking recess
	99	querying contour
	101	querying section
15	103	querying slope
	105	return slope
	107	end section of the querying pin
	109	blocking receiver
	111	blocking abutment
20	113	assembly receiver
	115	key broad side
	117	key broad side
	119	key narrow side
	121	key narrow side
25	123	locking system
	125	coding elevation
	127	key shank
	129	recess
	131	base
30	A	querying position
	B	blocking rotational position
	C	querying rotational position
	D	cylinder axis of rotation
	D1	direction of rotation

	D2	direction of rotation
	E	key introduction direction
	F	release position
	G	closed position
5	L	longitudinal axis
	O	open position
	S	blocking position

Claims

1. A lock cylinder (11) comprising
 - 5 - a cylinder housing (13) having a core receiving section (15);
 - a cylinder core (19) that is rotatably supported in the core receiving section (15) about a cylinder axis of rotation (D) between a closed position (G) and an open position (O) and that has a keyway (21) which extends along the cylinder axis of rotation (D) and into which an
 - 10 associated key (23) can be introduced along a key introduction direction (E) through a key introduction opening (25), wherein the keyway (21) has an elongate cross-section having two mutually opposite keyway broad sides (27, 29) and two mutually opposite keyway (21) narrow sides;
 - at least one tumbler (35) that is configured to secure the cylinder core (19) that is in the closed position (G) against a rotation into the open position (O) when the key (23) is not introduced into the keyway (21),
 - 15 wherein, by introducing the associated key (23), the at least one tumbler (35) can be sorted into a release configuration in which the at least one tumbler (35) releases the cylinder core (19) for a rotation relative to the cylinder housing (13); and
 - 20 - a blocking device (75) that has a querying pin (77), which is preloaded towards the keyway (21) and which engages into the keyway (21), and a blocking pin (83) arranged in alignment with the querying pin (77), wherein the blocking pin (83) is outwardly preloaded into a blocking position (S) with respect to the cylinder axis of rotation (D) and is configured to prevent a
 - 25 rotation of the cylinder core (19) into the open position (O) in the blocking position (S), and wherein the querying pin (77) can be urged into a querying position (A) by fully introducing the associated key (23) into the keyway (21),
 - 30 wherein the querying pin (77) has a permanent magnet (95) at an end section (107) facing the blocking pin (83) and/or wherein the blocking pin (83) has a permanent magnet (95) at an end section facing the querying pin (77), and wherein the permanent magnet (95) is configured to hold the blocking pin (83) in a release position (F) – in which the blocking pin (83) releases the cylinder core

(19) for a rotation into the open position (O) – against the preload of the blocking pin (83) when the querying pin (77) is urged into the querying position (A).

2. A lock cylinder (11) according to claim 1,
5 wherein, in the closed position (G) of the cylinder core (19), the blocking pin (83) engages into a blocking recess (97) formed at the cylinder housing (13).
3. A lock cylinder (11) according to claim 1 or 2,
10 wherein the querying pin (77) engages into the keyway (21) at one of the keyway broad sides (27, 29).
4. A lock cylinder (11) according to any one of the preceding claims,
wherein the querying pin (77) is more strongly preloaded than the blocking pin (83).
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5. A lock cylinder (11) according to any one of the preceding claims,
wherein the cylinder housing (13) has a querying contour (99), wherein, by
rotating the cylinder core (19) starting from the closed position (G) into a
querying rotational position (C), the blocking pin (83) can be moved along the
20 querying contour (99) towards the querying pin (77), in particular can be urged into the release position (F), and wherein the querying pin (77) and/or the blocking pin (83), upon reaching the querying rotational position (C), can be brought into active contact with the permanent magnet (95) when the querying pin (77) is in the querying position (A).
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6. A lock cylinder (11) according to claim 5,
wherein the querying contour (99) has a querying slope (103) along which the
blocking pin (83) can be guided from the closed position (G) into the querying
position (A) during the rotation of the cylinder core (19).
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7. A lock cylinder (11) according to claim 5 or 6,
wherein the querying contour (99) has a querying section (101) that extends at
least up to an outer side of the cylinder core (19), wherein the blocking pin (83)
contacts the querying section (101) in the querying rotational position (C).

8. A lock cylinder according to any one of the claims 5 to 7,
 wherein the cylinder core (19) can be rotated from the querying rotational
 position (C) towards the open position (O) up to and into a blocking rotational
 position (B) when the querying pin (77) is not in the querying position (A),
 wherein the blocking pin (83) is configured, when the querying pin (77) is not in
 the querying position (A), to enter into engagement with a blocking receiver
 (109) of the querying contour (99) due to the preload of said blocking pin (83) by
 rotating the cylinder core (19) from the querying rotational position (C) into the
 blocking rotational position (B), wherein the blocking receiver (109) has a
 blocking abutment (111) for the blocking pin (83), with the blocking pin (83),
 which engages into the blocking receiver (109), abutting said blocking abutment
 (111) upon reaching the blocking rotational position (B).
9. A lock cylinder (11) according to claim 8,
 wherein the cylinder core (19) can be rotated from the blocking rotational
 position (B) into the closed position (G) when the querying pin (77) is not in the
 querying position (A).
10. A lock cylinder (11) according to claim 8 or 9,
 wherein the querying contour (99) has a return slope (105) along which the
 blocking pin (83) can be guided out of the blocking receiver (109) on a rotation
 of the cylinder core (19) from the blocking rotational position (B) towards the
 closed position (G).
11. A lock cylinder according to any one of the claims 5 to 10,
 wherein the cylinder core (19) can be rotated from the closed position (G) via
 the querying rotational position (C) into the open position (O), or wherein the
 cylinder core (19) can be rotated from the closed position (G) along a first
 direction of rotation (D2) into the querying rotational position (C) and from the
 querying rotational position (C) along a second direction of rotation (D1), which
 is opposite the first direction of rotation (D2), into the open position (O).
12. A lock cylinder (11) according to any one of the preceding claims,

wherein the permanent magnet (95) is configured to pull the blocking pin (83) into the release position (F) against the preload of the blocking pin (83) when the querying pin (77) is in the querying position (A).

- 5 13. A lock cylinder (11) according to any one of the preceding claims,
 wherein the associated key (23) can be introduced into the keyway (21) and can
 be removed from the keyway (21) in the closed position (G).

- 10 14. A lock cylinder (11) according to any one of the preceding claims,
 wherein the querying pin (77) and the blocking pin (83) as well as respective
 preloading elements for generating the respective preload, in particular
 respective springs (79, 85), can be preassembled in an assembly sleeve (89) ,
 wherein the cylinder core (19) has an assembly receiver (113) into which the
 assembly sleeve (89) can be inserted.

- 15 15. A lock cylinder (11) according to any one of the preceding claims,
 wherein the querying pin (77) can be urged into the querying position (A) by a
 coding elevation (125) that is arranged in an axial groove (51) extending from a
 key tip (91).

- 20 16. A lock cylinder (11) according to any one of the preceding claims,
 wherein the lock cylinder (11) further has a coding device (39) that has a first
 axial abutment (41) and a second axial abutment (43) for the key (23), wherein
 the first axial abutment (41) and the second axial abutment (43) engage into the
 keyway (21) and wherein the second axial abutment (43) is offset along the key
 introduction direction (E) with respect to the first axial abutment (41) towards an
 axial end of the cylinder core (19), said axial end facing away from the key
 introduction opening (25),
 wherein the first axial abutment (41) has a passage (45) for allowing a coding
 elevation (125) formed at the associated key (23) to pass through, and wherein
 the second axial abutment (43) forms an abutment for the coding
 elevation (125).

- 30 17. A lock cylinder (11) according to claim 16,

wherein the coding device (39) and the querying pin (77) engage into the keyway (21) at mutually opposite keyway broad sides (27, 29).

18. A lock cylinder (11) according to claim 16 or 17,
5 wherein the coding device (39) and the querying pin (77) are configured to cooperate with respective coding elevations (125) that are formed at mutually opposite key broad sides (115, 117) of the associated key (23).
19. A lock cylinder according to any one of the claims 16 to 18,
10 wherein the passage (45) has two lateral boundaries (47) which are offset from one another transversely to the cylinder axis of rotation (D) and through which the coding elevation (125) can be guided upon an introduction of the key (23) into the keyway (21).
- 15 20. A lock cylinder (11) according to claim 19,
wherein end faces (49) of the boundaries (47) that face the key introduction opening (25) form the first axial abutment (41).
21. A lock cylinder (11) according to claim 19 or 20,
20 wherein outer surfaces of the boundaries (47) that face away from the passage (45) form an inner guide for a groove (51) which is formed at the associated key (23) and in which the coding elevation (125) is formed.
22. A lock cylinder according to any one of the claims 19 to 21,
25 wherein the passage (45) is formed in the shape of an archway and wherein the first abutment has a connection section (53) by which the lateral boundaries (47) are connected to one another at a side of the first axial abutment (41) that faces away from the keyway (21).
- 30 23. A lock cylinder according to any one of the claims 16 to 22,
wherein the first axial abutment (41) and the second axial abutment (43) are formed at respective coding elements (56) inserted into the cylinder core (19), in particular at respective small plates (57).

24. A lock cylinder (11) according to claim 23,
wherein the cylinder core (19) has a receiver (59) for inserting the coding
elements (56).
- 5 25. A lock cylinder (11) according to claim 24,
wherein the receiver (59) has, at an outer side of the cylinder core (19), a
receiving opening (61) through which the coding elements (56) can be inserted
into the receiver, wherein the inserted coding elements (56) extend radially up to
the outer side of the cylinder core (19) and have, at the outer side, a curvature
10 corresponding to the cylinder core (19).
26. A lock cylinder according to any one of the claims 16 to 22,
wherein the coding device (39) has a single-piece coding element (63) at which
the first axial abutment (41) and the second axial abutment (43) are formed.
- 15 27. A lock cylinder (11) according to claim 26,
wherein the coding element (63) is molded to the cylinder core (19), in particular
wherein the cylinder core (19) comprises two cylinder core halves (65, 67) (19),
wherein the coding element (63) is molded to one of the two cylinder core
20 halves (65, 67) (19).
28. A lock cylinder (11) according to claim 26 or 27,
wherein the coding element (63) is configured in the manner of a fork (69) and
has two prolongations (71) which bound the passage (45), which face towards
25 the key introduction opening (25) and between which the coding elevation (125)
can be introduced into the fork (69), wherein the prolongations (71) form the first
axial abutment (41) and wherein a receiving section (73) that connects the two
prolongations (71) at a side of the fork (69) that faces away from the key
introduction opening (25) forms the second axial abutment (43).
- 30 29. A locking system (123) comprising a lock cylinder (11) according to any one of
the preceding claims and the associated key.
30. A locking system (123) according to claim 29,

wherein the associated key (23) has an axial groove (51) which starts from a key tip (91) and in which a coding elevation (125) is arranged, wherein the coding elevation (125) is configured to urge the querying pin (77) into the querying position (A) when the key (23) is fully introduced into the keyway (21).

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31. A locking system (123) according to claim 30,
wherein the coding elevation (125) is formed free-standing in the groove (51).

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32. A locking system (123) according to claim 30 or 31,
wherein the coding elevation (125) has a recess (129) for an engagement of the querying pin (77) at a querying surface that faces towards the querying pin (77) when the key (23) is introduced into the keyway (21).

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33. A locking system (123) according to any one of the claims 30 to 32,
wherein the associated key (23) is configured as a reversible key that has an elongate key shank (127) and that has two mutually opposite key broad sides (115, 117) and two mutually opposite key narrow sides (119, 121), wherein the key (23) has a respective groove (51) with a coding elevation (125) arranged therein at each of the key broad sides (115, 117).

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34. A locking system (123) according to claim 33,
wherein the lock cylinder (11) further has a coding device (39) that has a first axial abutment (41) and a second axial abutment (43) for the key (23), wherein the first axial abutment (41) and the second axial abutment (43) engage into the keyway (21) and wherein the second axial abutment (43) is offset along the key introduction direction (E) with respect to the first axial abutment (41) towards an axial end of the cylinder core (19), said axial end facing away from the key introduction opening (25),

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wherein the first axial abutment (41) has a passage (45) for allowing the one coding elevation (125) of the two coding elevations (125) to pass through, and wherein the second axial abutment (43) forms an abutment for the one coding elevation (125),

wherein the other of the two coding elevations (125) of the associated key (23) is configured to urge the querying pin (77) into the querying position (A) when the one coding elevation (125) contacts the second axial abutment (43).

5 35. A key for use in a locking system (123) according to any one of the claims 29 to 34,

 wherein the key (23) is configured to sort the at least one tumbler (35) into the release configuration upon a full introduction into the keyway (21), and wherein the key (23) has a coding elevation (125) that is configured to urge the querying
10 pin (77) into the querying position (A) upon full introduction of the key (23) into the keyway (21).

 36. A key according to claim 35,
 wherein the coding elevation (125) is arranged, in particular in a free-standing
15 manner, in an axial groove (51) starting from a key tip (91).

 37. A key (33) according to claim 35 or 36,
 wherein the coding elevation (125) has a recess (129) for an engagement of the querying pin (77) at a querying surface that faces towards the querying pin (77)
20 when the key (23) is introduced into the keyway (21).

 38. A method according to one of the claims 36 or 37,
 wherein the key (23) is configured as a reversible key that has an elongate key shank (127) and that has two mutually opposite key broad sides (115, 117) and
25 two mutually opposite key narrow sides (119, 121), wherein the key (23) has a respective groove (51) with a coding elevation (125) arranged therein at each of the key broad sides (115, 117).