

Cylinder lock mechanism

This invention relates to a key operated cylinder lock mechanism of the kind comprising a hollow stationary cylinder housing, a power transmission element turnable within said housing, a locking bar having a position locking the turning movement of said power transmission element relative to said housing, and a set of discs including a number of locking discs turnable by means of combination surfaces on a key of the lock mechanism, the locking discs being turnable, by the turning movement of said key, from an initial key insertion position to a releasing position, in which the power transmission element is released from its locked connection to the housing.

A general drawback of known cylinder lock mechanisms of the kind referred to is the fact that the lock mechanism is operable only in one turning direction. This is due to the fact that the locking discs have to be turned back to their initial positions by turning back of the key. Consequently, the form of the key has to be such that it serves as a member which operates the lock mechanism only in one turning direction. There have been numerous proposals for special arrangements according to which a lock mechanism operable in opposite turning directions can be obtained by additional movements of the key or by means of additional members in the lock mechanism. However, none of these known arrangements has proved to be satisfactory, as a rule due to the fact that the construction is too complicated or that the construction includes elements that wear out too soon or

the operational security of which is insufficient.

The present invention aims to provide a cylinder lock mechanism of the kind referred to which is operable in either turning direction by means of the same key of the lock mechanism, but which, if required, easily can be arranged to be operable only in one turning direction, and the construction of which is uncomplicated and secure.

According to the invention, a lock mechanism of the kind referred to is characterised in that the key of the lock mechanism is arranged to transmit a turning force directly to a number of locking discs only in a direction from said initial position to said releasing position, whereas the return of these locking discs to their initial position is arranged to be carried out by means of a separate return bar, receiving turning power from said key through one or more members turning with the key, and in that the lock mechanism comprises means for guiding said return bar, said guiding means including means for allowing said return bar to move in the circumferential as well as in the radial direction of said lock mechanism.

In a lock mechanism according to the invention, return of the locking discs to their initial position is arranged in a new way. The result is that only a few axially short portions are needed in the key for the returning surfaces. These portions can advantageously be located, for instance, at both ends of that portion of the key which is inserted into the lock mechanism. The key can then be provided with adjacent series of combination surfaces acting on the locking

discs and turning them in either direction into a releasing position.

The releasing combination of the lock mechanism can be the same in both turning directions, but this is not an
5 essential feature of a lock mechanism according to the inven-

tion. On the contrary, it is preferred to have a different turning angle for a number of locking discs in the opposite turning directions, or for the key to have a different combination when operated in the clockwise direction than when
5 operated in the counter-clockwise direction.

It may be found that a cylinder lock mechanism according to the invention has a slightly indefinite zero-position, i.e. the key insertion and removal position, so that it is difficult for the user of the lock mechanism to detect
10 said position. For eliminating this problem the lock mechanism can with advantage be provided with a guiding surface arranged to allow the insertion as well as the removal of the key only in a position corresponding to the initial position of the locking discs.

15 A lock mechanism according to the invention may with advantage have a turnable inner cylinder, like a conventional cylinder lock mechanism. This means that a hollow cylindrical member is formed integrally with or connected to the power transmission element of the lock mechanism, the locking
20 discs being arranged inside said cylindrical member. In an embodiment of this kind the return bar can be arranged to move in a space between the peripheral edge of the locking discs and the inner surface of the hollow cylindrical member.

It is of advantage to have two return bars which are
25 arranged positively to guide the return movements of the locking discs, each return bar in its own returning direction. As the return bars can easily be arranged to guide the locking discs, the radial guidance of the locking discs advan-

tageously is improved when using two return bars. In practice this is preferably carried out by arranging the return bars in their basic position together with the locking bar in such a way as to divide the periphery of the lock mechanism into three portions of at least substantially equal size. By this means a most favourable guidance is obtained for the locking discs.

To obtain a lighter lock mechanism operation as well as to make it easier to detect the zero-position of the lock mechanism, the return bars can advantageously be urged by spring means, preferably in a direction radially outwards. Said spring means can be a U-shaped or arcuate spring element, which, at the same time, can be arranged also to urge the locking bar in a direction radially outwards. By this means a useful spring load of suitable magnitude is obtained. A most favourable load distribution is obtained when the return bars are urged by spring means at both ends thereof. On the other hand, the return bars can with advantage be positively guided all the way so that no spring means for this purpose is required. In this case the lock mechanism includes a separate spring for the locking bar. It is also possible to have only one return bar, which is urged by spring means in a direction radially inwards. Also in this case the return bar can be arranged to be positively guided without said spring means.

In another embodiment of the lock mechanism according to the invention there is no inner cylinder, and, in a manner known per se, the locking discs are directly guided by the

cylinder housing and the return bar is guided by means of the locking discs and intermediate discs located between the locking discs. By providing the locking discs and the intermediate discs with suitable guiding edges, a construction can be obtained in which said edges jointly form a closed channel in which the return bar can move. This embodiment can also be provided with two return bars which are urged by spring means preferably in a direction radially outwards, said return bars further being arranged positively to guide the returning movements of the locking discs, each return bar in its own returning direction. In this case, too, the operation of the return bars can be arranged to be positively guided without any spring means. Alternatively only one return bar may be provided, which is then urged by spring means preferably in a direction radially outwards, or the operation of the return bar is arranged to be positively guided all the way without any spring means.

A most favourable operation is generally obtained when the cross-section of the return bar is substantially circular.

The lock mechanism according to the invention can easily be converted so as to be operable, if required, in only one turning direction. This can be arranged by blocking the turning of the return bar relative to the set of discs in one turning direction of the lock mechanism, so as to prevent operation of the lock mechanism in said one turning direction. Such blocking of the return bar may be effected by means of a separate locking member or by suitably formed guiding edges of the power transmission element.

A key for a cylinder lock mechanism according to the invention can with advantage be made so that the basic form of that portion of the key which is to be inserted into the lock mechanism is a hollow cylinder having an axial groove, from both edges of which portions of different size are removed for obtaining the combination surfaces of the key. Such a key can easily be manufactured and in particular the combination surfaces for the opposite turning directions can be formed without difficulty. Another possible embodiment is a key in which that portion which is to be inserted into the lock mechanism has a basic form corresponding to a cylinder, from which is cut a cylindrical segment, or preferably two cylindrical segments of different size. This embodiment is advantageous for the reason that the key cannot be inserted into the lock mechanism in a wrong position. A third embodiment is a key in which that portion which is to be inserted into the lock mechanism again has a basic form corresponding to a cylinder, but from both sides of which portions, e.g. cylindrical segments, of equal size are cut away. The blade of the key thus obtained can with advantage be provided with four series of combination surfaces, which are located symmetrically relative to the longitudinal axis of the key. If those series of combination surfaces which are located diametrically opposite one another relative to the blade of the key are the same, the key can be inserted into the lock mechanism in two separate positions which can be obtained relative to each other by turning the key through 180° around its longitudinal axis. As a consequence of this arrangement

there are, however, some restrictions for the combination surface pairs turning the same locking discs in opposite directions, which restrictions are described in greater detail hereinafter.

5 The invention will now be described, by way of example, with reference to the accompanying drawings, in which

Figure 1 is a transverse sectional view of a first embodiment of a cylinder lock mechanism according to the invention,

10 Figures 2 to 4 are views of three different disc of the lock mechanism of Figure 1,

Figure 5 is an exploded perspective view of an arrangement for spring loading the return bars of the locking discs in the embodiment according to Figures 1 to 4,

15 Figure 6 is a transverse sectional view of a second embodiment of a cylinder lock mechanism according to the invention,

Figure 7 is a sectional view taken on the line 7-7 of Figure 6,

20 Figures 8 to 10 are views of three different discs of the lock mechanism of Figures 6 and 7.

Figure 11 is an axial sectional view of a third embodiment of a cylinder lock mechanism according to the invention,

25 Figures 12 and 13 are sectional views taken on the lines 12-12 and 13-13, respectively, of Figure 11,

Figures 14 to 16 are views of three different discs of the lock mechanism according to Figures 11 to 13,

Figure 17 is an axial sectional view of a fourth embodi-

ment of a cylinder lock mechanism according to the invention,

Figure 18 is a sectional view taken on the line 18-18 of Figure 17,

Figures 19 to 21 are views of three different discs of the lock mechanism according to Figures 17 and 18,

Figure 22 is a side view of part of a first embodiment of a key for a cylinder lock mechanism according to the invention,

Figures 23 and 24 are sectional views taken on the lines 23-23 and 24-24, respectively, of Figure 22,

Figure 25 is a front view of the cylinder housing of a lock mechanism having a key insertion opening for the key according to Figures 22 to 24,

Figure 26 is a side view of part of a second embodiment of a key for a cylinder lock mechanism according to the invention,

Figures 27 and 28 are sectional views taken on the lines 27-27 and 28-28, respectively, of Figure 26,

Figure 29 is a front view of the cylinder housing of a lock mechanism having a key insertion opening for the key according to Figures 26 to 28,

Figure 30 is a sectional end view of a third embodiment of a key for a cylinder lock mechanism according to the invention,

Figure 31 is a perspective view of the key of Figure 30,

Figures 32, 33 and 35 are transverse sectional views of three modified forms of the cylinder lock mechanism of Figures 11 to 16,

Figure 34 is a view of a disc of the lock mechanism of Figure 33, and

Figure 36 is a view of a disc of the lock mechanism of Figure 35.

5 The lock mechanism shown in Figures 1 to 4 comprises a cylinder housing 1 enclosing a turnable inner cylinder 2. The cylinder 2 is formed integrally with, or connected to, a power transmission element (not shown) for operating a mechanism, e.g. a door locking mechanism, which is operated
10 by the lock mechanism. For example, the cylinder 2 may be formed in the same way as in the embodiment of the lock mechanism shown in Figure 7, from which it will be seen that the cylinder 2 is formed integrally with a power transmission member 49 which projects axially from the housing 1, the
15 cylinder 2 being located axially in the housing 1 by a locking ring 31.

Referring again to Figures 1 to 4, within the cylinder 2 are a number of locking discs 7 (see Figure 4) which are turnable with a key (not shown) of the lock mechanism, these
20 discs being disposed perpendicular to the axis of the cylinder 2. The periphery of each locking disc 7 includes a respective notch 9 for each of the turning directions of the lock mechanism, the location of these notches determining the opening combination of the lock mechanism. The locking
25 discs 7 include a central opening 11 for the key, the edge surfaces of which opening serve as stop faces 12 for the combination surfaces of the key when turning the locking discs into a position for releasing the inner cylinder 2.

The turning of the cylinder 2 relative to the housing 1 is prevented, when the lock mechanism is in the locking position, in a manner known per se, i.e. with a locking bar 4 located partly in an axial groove 3 in the inner surface of the housing 1 and partly in a slot 10 through the periphery of the cylinder 2. When turning the locking discs 7, with the key of the lock mechanism, into the releasing position, the peripheral notches 9 of separate discs 7 jointly form a groove into which the locking bar 4 is allowed to move, so that the cylinder 2 is released and the lock mechanism can be operated.

The set of discs located inside the cylinder 2 also includes, in a manner known per se, an intermediate disc 6 (see Figure 3) between each pair of adjacent locking discs 7. All the intermediate discs 6 are identical and have a central opening 15 for the key and a peripheral notch 13 for the locking bar 4 as well as protrusions 14 which are received in the slot 10 of the cylinder 2 in order to prevent turning of the discs 6 relative to the cylinder 2. Furthermore, the set of discs within the cylinder 2 includes at least one locking bar operating locking disc 5 (see Figure 2), preferably located at an end of the set of discs. Preferably, two of these discs 5 are provided, one at each end of the set of discs, and in the ensuing description it will be assumed that two such discs 5 are provided. Each disc 5 has a central opening 8 and, on each side of the latter, a peripheral notch 16 for the locking bar 4. Stop faces 17 in the central opening 8 of each disc 5 cooperate with the

combination surfaces of the key in such a way that the disc 5 always turns with the key. The way in which the discs 5, 6 and 7 are stacked together in the cylinder 2 is the same as in the embodiment of the lock mechanism 5 described hereinafter with reference to Figures 6 to 10 (see Figure 7 in particular).

In the case of an ordinary disc cylinder lock mechanism which is operable only in one turning direction, after opening of the lock mechanism, the locking discs are returned 10 directly to their initial locking position with the key of the lock mechanism, the key blade including a so-called returning surface for this purpose. However, in a cylinder lock mechanism which is operable in both turning directions, such an arrangement cannot be used. The reason for this is that 15 the combination surfaces of the key are located at both sides of the key blade (as will be explained hereinafter with reference to Figures 22 to 24 and Figures 26 to 28) so that there is no place left for a conventional returning surface which directly turns the locking discs back to their initial 20 positions. Consequently, in the embodiment of Figures 1 to 4, return of the locking discs 7 is effected by means of return bars 18a, 18b acting on the locking discs and receiving turning power from the key through the discs 5. For this purpose, as will be described hereinafter, the key blade 25 includes returning surfaces 63 (see Figures 22, 26 and 31) which act on the stop faces 17 of the discs 5 located at the ends of the set of discs. The returning surfaces 63 force the discs 5 to turn with the key as previously mentioned.

Thus, when bringing the lock mechanism into the locking position the key acts, through the discs 5, on the return bars 18a, 18b, which return the locking discs 7 to the locking position.

5 In the embodiment shown in Figures 1 to 4, the inner cylinder 2 includes grooves 19a and 19b for the return bars 18a, 18b, respectively. The intermediate discs 6 include a long peripheral notch 20, the locking discs 7 include a long peripheral notch 22 provided with stop edges 21a and
10 21b and the discs 5 include short peripheral notches 25a and 25b provided with guiding edges 23a and 23b and stop edges 24a and 24b, respectively.

The operation of the lock mechanism of Figures 1 to 4 is analogous in both turning directions, and the operation in
15 one turning direction will now be described.

When turning the key of the lock mechanism, the intermediate discs 6 do not turn at all at the beginning of the turning movement. The locking discs 7 begin to turn independently of each other when the combination surfaces of the
20 key contact the respective stop faces 12 of the locking discs. On the other hand, the discs 5 turn immediately with the key when the latter is turned. Accordingly, when turning the key in, for instance, the clockwise direction, the guiding edge 23b of each disc 5 acts on the return bar 18b pushing
25 it from the groove 19b into a groove formed jointly by the peripheral notches 25b of the discs 5, the peripheral notches 20 of the intermediate discs 6 and the peripheral notches 22 of the locking discs 7, so allowing it to turn along with

(46)

the discs 5 between the set of discs and the inner surface of the cylinder 2. Urged by separate spring elements 27 in the lock mechanism, located preferably at both ends of the set of discs and urging the return bars 18a and 18b as well as the locking bar 4 radially outwards, the return bar 18a is already located in the groove 19a of the inner cylinder 2. If the lock mechanism did not include spring elements 27 urging the return bars, the stop edges 24a of the discs 5 would act on the return bar 18a, which would be guided into the groove 19a of the inner cylinder, because of the stop edges 26a of the intermediate discs 6 which are still in their initial position at this phase. Thus, if required, the operation of the return bars 18a, 18b could be positively guided all the way by only designing the peripheral notches of the discs in a suitable manner so as to minimise the friction due to the movements of the return bars relative to the set of discs.

Continued turning of the key brings the return bar 18b up to the return bar 18a. Simultaneously, however, one of the peripheral notches 16 of each of the discs 5, one of the peripheral notches 9 of each of the locking discs 7 and the peripheral notches 13 of the intermediate discs jointly form a groove for the locking bar 4 to move into, thus releasing the inner cylinder 2 relative to the cylinder housing 1. Consequently, both the inner cylinder 2, the locking bar 4 and the set of discs are free to be turned and this turning movement is transmitted by the aforementioned power transmission element to the mechanism which is operated

by means of the cylinder lock mechanism.

When the key is turned back, it acts on the discs 5, which, through the locking bar 4, turn the other members of the set of discs as well as the cylinder 2 relative to the cylinder housing 1. When the required power transmitting operation has been carried out by means of the inner cylinder 2 and the key is turned back in the opposite direction, the locking bar 4 moves around with the discs 5 and the inner cylinder 2 to the position of the groove 3 of the cylinder housing 1. The locking bar 4 is then urged back into the groove 3 of the cylinder housing, preferably by means of the spring elements 27 located at both ends of the set of discs or possibly by means of a separate spring element for the locking bar, and, at the same time, by making use of a suitably formed edge 28 of the peripheral notches 16 of the discs 5. As a result, the locking bar 4 prevents turning of the inner cylinder 2 relative to the cylinder housing 1. By further turning of the key in the same direction, the stop edges 24b of the discs 5 begin to push the return bar 18b back towards the groove 19b of the inner cylinder 2. As the return bar 18b moves, it acts simultaneously on the stop edges 21b of the locking discs 7, thus forcing them to turn into their initial locking positions. The spring elements 27 and, on the other hand, a projection 29 on each of the discs 5 prevent the other return bar 18a from moving away from the groove 19a during said turning movement.

Viewed from the point of the operational security of the lock mechanism, it is of advantage that, as described above, both ends of the set of discs are provided with a

disc 5 and a spring element 27. Figure 5 shows one way of attaching the spring elements 27 to the return bars 18a and 18b in which ends of the spring elements are received in holes 66 at the ends of the return bars. As shown in Figure 4, the peripheral notches 9 of the locking discs 7 need not be symmetrically located with respect to the opening 11 of the locking disc. As a result, the opening combinations of the lock mechanism are different in the opposite turning directions of the mechanism. Furthermore, the periphery of the locking discs may be provided, in a manner known per se, with shallow, so-called false peripheral notches 30 to improve the security of the lock mechanism against picking.

Figures 6 to 10 show a second embodiment of a cylinder lock mechanism according to the invention, which is operable in both turning directions. In these Figures, the same reference numerals are used as in Figures 1 to 4 to designate similar items in the two embodiments.

The lock mechanism of Figures 6 to 10 has only one return bar 18 for the locking discs 7, this return bar 18 being provided at each end with a spring element 27, consisting of two parts and serving to urge the return bar radially inwards. This embodiment requires a separate spring 45 which urges the locking bar 4 radially outwards. As can be seen from Figure 7, the inner cylinder 2 which is located axially in the housing 1 by a locking ring 31, includes a space 33, at one end of the set of discs, for the reception of one of the spring elements 27. A support 32, at the other end of the set of discs, receives the other spring element 27. Circular

shoulders 34 and 35 provide the necessary support for stressing the spring elements 27. These constructional arrangements can also be applied to the embodiment of Figures 1 to 4, for guiding the spring elements when they turn with the set of discs.

The basic operating principle of the lock mechanism of Figures 6 to 10 corresponds to that of the embodiment of Figures 1 to 4. In the initial position, the return bar 18 is enclosed, urged by the spring elements 27, in either of the grooves formed jointly by one of the peripheral notches 25a, 25b of the discs 5, the long peripheral notches 20 of the intermediate discs 6 and the long peripheral notches 22 of the locking discs 7. With reference to the position shown in Figure 6, when the key of the lock mechanism is turned in the counter-clockwise direction, the return bar 18 moves with the discs 5, being pushed by the guiding edge 23a thereof. The spring elements 27 prevent the return bar 18 from moving into the groove 19b. In other respects the operation of the lock mechanism corresponds to that of the embodiment of Figures 1 to 4. When the key is turned back, after the movement of the locking bar 4 to prevent turning of the inner cylinder 2 relative to the cylinder housing 1, the stop edges 24a of the discs 5 begin to push the return bar 18 back to its initial position at the position of groove 19a. Simultaneously, the return bar 18 acts on the stop edges 21a of the locking discs 7 to force the locking discs into their initial positions.

Referring again to the position of the lock mechanism

shown in Figure 6, if the key is turned in the clockwise direction the stop edges 24a of the discs 5 act on the return bar 18. In this position, on the other hand, the intermediate discs 6 cannot be turned, and their stop edges 26a prevent the return bar 18 from turning. As a result, the stop edges 24a of the discs 5 press the return bar 18 into the groove 19a of the inner cylinder 2. As the discs 5 turn, the return bar 18 is held in the groove 19a by the projections 29 of the discs 5, until the latter reach a position in which the return bar 18 is urged out of the groove 19a, by the spring elements 27, into the peripheral notches 25b of the discs 5. Thereafter the operation of the lock mechanism is analogous to that of the embodiment of Figures 1 to 4, with the exception that the return bar 18 finally moves, when the key is turned back, at the position of the groove 19b of the inner cylinder 2, i.e. the return bar 18 is moved into another position relative to the set of discs.

Figures 11 to 21 show two embodiments of lock mechanism according to the invention in which the discs of the set of discs are directly guided by the cylinder housing 1, i.e. there is no inner cylinder 2 as in the embodiments of Figures 1 to 10. In Figures 11 to 21 the same reference numerals are employed as in the embodiments of Figures 1 to 10 to designate similar items. In the locking position of the lock mechanism shown in Figures 11 to 21 the locking bar 4 engages the intermediate discs 6 and prevents turning of the set of discs relative to the cylinder housing 1, as can be seen from Figures 11, 12, 17 and 18. In other respects the

actual operation of the lock mechanisms of Figures 11 to 21 takes place in a similar manner to the previously described embodiments. In the embodiment shown in Figures 11 to 16 the return bars 18a and 18b are guided by means of guiding grooves 50 in the discs 5 and guiding grooves 52 in the intermediate discs 6. The guiding grooves 50 and 52 are provided with end portions 51a, 51b and 55a, 55b, respectively. Furthermore, the guiding groove 52 in each of the intermediate discs 6 includes lifting edges 54a and 54b and a guiding edge 53. Each of the locking discs 7 has a slot 56 for the return bars with stop edges 57a and 57b. The operation of the return bars 18a, 18b of the lock mechanism of Figures 11 to 16 will now be described.

When the lock mechanism is in the locking position, the return bars 18a and 18b are located in the end portions 55a and 55b, respectively, of the guiding grooves 52 of the intermediate discs 6, these end portions forming channels in the axial direction of the set of discs. When the key of the lock mechanism is turned, for instance in the clockwise direction, the discs 5 turn with the key, whereas the intermediate discs 6, the peripheral notches 13 of which are locked by the locking bar 4, remain at this phase in their initial position. The lifting edges 54b of the guiding grooves 52 of the intermediate discs 6 then press the return bar 18b into the end portions 51b of the guiding grooves 50 of the discs 5, in which it remains because of the guiding edges 53 of the discs 6. The other return bar 18a remains all the time in the end portions 55a of the guiding grooves

52 of the intermediate discs 6. Thereafter the operation of the lock mechanism is largely analogous to that of the lock mechanism of Figures 1 to 4. When the key is turned back, the return bar 18b engages the stop edges 57b of the locking discs 7 and turns the latter back into their initial locking positions, the return bar 18b, at the same time, being guided back into the channel formed jointly by the end portions 55b of the guiding grooves 52 of the intermediate discs 6.

10 The locking bar 4 can be loaded with a spring (like the spring 45 in Figure 7) for urging it radially outwards relative to the set of discs. The locking bar is pushed back into the groove 3 of the cylinder housing by means of this spring and, at the same time, by the edges 28 of the peripheral notches 16 of the discs 5. The return bars 18a and 18b can be provided with a separate spring for urging them radially outwards. As shown in Figures 11 and 13, spring elements 27, corresponding to the spring elements 27 shown in Figures 1 and 5, can act on both the locking bar 4 and the return bars 18a and 18b, in which case no separate spring means corresponding to the spring 45 shown in Figure 7 is needed for the locking bar 4. However, in the embodiment according to Figures 11 to 16 it is advantageous to have the operation of the return bars positively guided without any spring elements 27. In this case the locking bar 4 has to be provided with a separate spring as described above.

As can be seen from Figure 11, the lock mechanism includes a turnable power transmission element 48, from which

torque is transmitted via a member 49 to a mechanism (not shown) that it is required to operate. Naturally, this is carried out only after the lock mechanism is opened with the key, so that the whole set of discs is released for turning relative to the cylinder housing 1. In this embodiment, a locking ring 41, similar to the ring 31 of Figure 7, is used for locating the power transmission element 48 axially inside the cylinder housing 1. The lock mechanism is provided with attachment means 46 having holes 47 for fastening elements, e.g. screws, for securing the lock mechanism in its place of use. Naturally, other kinds of fastening means and elements, known per se, could be used instead.

In the embodiment according to Figures 17 to 21, there is only one return bar 18. Figures 17 and 18 show spring elements 27 which urge both the locking bar 4 and the return bar 18 radially outwards. The return bar 18 could be urged radially inwards instead, the set of discs then including discs according to Figures 14 to 16. In this case, however, separate spring means, e.g. corresponding to the spring 45 in Figure 7, is required for the locking bar 4.

The operation of the cylinder lock mechanism shown in Figures 17 to 21 corresponds, for part of the operation of the return bar, to the operation of the embodiment according to Figures 6 to 10, with the exception that the spring element 27 acts in opposite directions in the two embodiments. In the initial position the return bar 18 is located in the end portions 55b of the guiding grooves 52 of the intermediate

discs 6 and locked by guiding edges 39 of the discs 5. When the key is turned in the clockwise direction, from the position shown in Figure 18, the return bar 18 is brought into the end portions 51b of the guiding grooves 50 of the discs 5 and is moved along the guiding grooves 52 of the intermediate discs 6. The spring element 27, however, prevents the return bar 18 from moving into the end portions 55a of the grooves 52. The actual locking operation is analogous to that of the embodiment of Figures 6 to 10. When the key is turned back, stop edges 40b in the discs 5 push the return bar 18 back into its initial position, in which it is located in the end portions 55b of the intermediate discs 6, simultaneously turning the locking discs 7 by means of the stop edges 57b thereof into their initial locking positions. If the key is turned in the counter-clockwise direction, from the position shown in Figure 18, the return bar 18 at first remains in its position while the guiding grooves 50 in the discs 5 move relative to the return bar 18. When the end portions 51a of the guiding grooves 50 reach the position of the return bar 18, the spring element 27 urges the return bar into the end portions 51a. At the same time, obviously, the return bar moves away from the bottom portions 55b of the guiding grooves 52 of the intermediate discs 6. When the key is turned back, the stop edges 40a of the discs 5 push the return bar 18 along the guiding grooves 52 of the intermediate discs finally into the other end portions 55a of the guiding grooves 52. In other respects the operation is analogous to that described above.

54

In Figure 21 different alternatives for locating the peripheral notches 9 of the locking discs 7 are indicated by chain lines 36. By varying the location of the peripheral notches 9 a very large number of lock mechanisms with different opening combinations is obtained.

Figures 22 to 24 and 26 to 28 show two advantageous embodiments of a key for the lock mechanisms described above. In each case, the blade 61 of the key 60 includes two series of combination surfaces 62 so arranged that the lock mechanism can be opened by turning the key in either direction. As already mentioned above, the series of combination surfaces of a key need not be the same but they can be independent of each other, whereby the lock mechanism has different opening combinations in the opposite turning directions. The key also includes returning surfaces 63, which return the locking discs 7 into their initial position by means of the discs 5 and the return bars 18 as described above.

Figures 25 and 29 show the form of the key insertion opening in the cylinder housing 1 for the embodiments of the key described above. In each case, the key hole 37 in the cylinder housing is provided with guiding surfaces 64 allowing the insertion and the removal of the key only in a position corresponding to the initial position of the locking discs 7. The surfaces 64 enable the key insertion and removal position to be detected with ease.

Figures 30 and 31 show a third embodiment of a key for a cylinder lock mechanism according to the invention including

four series of combination surfaces in all, so arranged that those located diametrically opposite one another in relation to the longitudinal axis of the key correspond to each other. Such a key can be inserted into the lock mechanism in two separate positions, which are obtained by turning the key through 180° around its longitudinal axis. However, for the combination surfaces located adjacent each other and turning the same locking disc 7 in opposite turning directions, the restriction applies that the sum of the combination steps must not exceed the maximum value of a combination step of the combination system. In Figure 30 the combination steps are exemplified with numerals 0....5. The restriction in question implies in this case that the sum of the combination steps must not exceed the value 5.

15 If, for instance, the value of a combination step is selected to be 1, the value of the combination step for turning the same locking disc 7 in the opposite direction can be chosen at most to be 4. The corresponding other combination value pairs or mutually complementing combination steps according to said restriction are (0;5), (2;3), (3;2), (4;1) and (5;0).

20 In Figure 31 grooves 69 can be seen, located at the end 65 of the key which is to be inserted into the lock mechanism and determining the insertion and removal position of the key relative to the lock mechanism. By changing the location of the grooves 69 a large number of new series of combination surfaces can be obtained.

If required, the lock mechanism according to the invention can easily be converted so as to be operable in only one turning direction. Figures 32 to 36 show by way of example

some alternative ways of doing this based on the embodiment of Figures 11 to 16. The other embodiments described above can be converted for operation in only one turning direction as well in an analogous way. A practical requirement is that turning of the set of discs from the initial position in the other direction is totally blocked so that the locking discs cannot be turned into an uncontrollable position, in which the lock mechanism may not be opened even with a correct key of the lock mechanism.

10 In the embodiment shown in Figure 32, a locking member 67 is placed into the end portion 51a of the guiding groove 50 of the disc 5 so as to prevent the return bar 18a from moving into the end portion 51a when it is attempted to turn the disc 5 with the key of the lock mechanism in the counter-
15 clockwise direction. As a result, the return bar 18a and the edges 54a (see Figure 15) of the intermediate discs 6 block the locking discs 7 so that they cannot be turned in the counter-clockwise direction. Correspondingly, by placing the locking member 67 in the end portion 51b of the guiding
20 groove 50 of the disc 5 the operation of the lock mechanism in the clockwise direction can be prevented. The locking member 67 may be, for instance, a ball-shaped or a plate-like body.

In the embodiment shown in Figures 33 and 34 the guiding
25 groove 50 of the disc 5 is redesigned, as more clearly shown in Figure 34, by omitting the end portion 51a. This has the same effect as the construction shown in Figure 32. The operational direction of the lock mechanism can be changed

for instance by turning the disc 5 around so that the front face seen in Figure 34 becomes the rear face. The end portion 51b of the guiding groove 50 will then be located at the position of the return bar 18a.

5 The disc 5 can also be redesigned as shown in Figures 35 and 36 so that it has holes 68 for the return bars 18 instead of the groove 50 of the earlier embodiments. The holes 68 are located in the radial direction of the disc 5 at the position of the guiding groove 52 of the intermediate disc
10 6 (see Figure 15). The lock mechanism can be made to be operable in only one turning direction by removing one of the return bars 18. In this case the operational direction of the lock mechanism can easily be changed by removing the return bar 18 from one of the holes 68 of the disc 5 and
15 inserting it into the other. No spring element 27 such as shown in Figure 13 is needed in this embodiment. This form of the disc 5, in which the disc is arranged continuously to guide the return bar substantially without interrelated movements of said members, can with advantage be employed
20 in the embodiments of the lock mechanism according to the invention which include only one return bar.

CLAIMS

1. A key operated cylinder lock mechanism comprising a hollow stationary cylinder housing, a power transmission element turnable within said housing, a locking bar having a position locking the turning movement of said power transmission element relative to said housing, and a set of discs including a number of locking discs turnable by means of combination surfaces on a key of the lock mechanism, the locking discs being turnable, by the turning movement of said key, from an initial key insertion position to a releasing position, in which the power transmission element is released from its locked connection to the housing, characterised in that the key of the lock mechanism is arranged to transmit a turning force directly to a number of locking discs only in a direction from said initial position to said releasing position, whereas the return of these locking discs to their initial position is arranged to be carried out by means of a separate return bar, receiving turning power from said key through one or more members turning with the key, and in that the lock mechanism comprises means for guiding said return bar, said guiding means including means for allowing said return bar to move in the circumferential as well as the radial direction of said lock mechanism.
2. A lock mechanism as claimed in claim 1, in which the correct turning angle, that is, the combination value of a number of locking discs is different in opposite turning directions.

3. A lock mechanism as claimed in claim 1 or 2, in which the cylinder housing includes a guiding surface which is arranged to allow insertion and removal of the key only in a position corresponding to the initial position of the 5 locking discs.





4. A lock mechanism as claimed in any of the preceding claims, comprising a hollow cylindrical member connected to the power transmission element, the locking discs being arranged inside said cylindrical member, and the return bar being arranged to move in a space between the peripheral edge of the locking discs and the inner surface of the hollow cylindrical member.

5. A lock mechanism as claimed in claim 4, comprising two return bars arranged positively to guide the returning movements of the locking discs, each return bar in its own returning direction.

6. A lock mechanism as claimed in claim 5, in which the return bars are arranged to guide the locking discs in the radial direction, the return bars in their basic position and the locking bar dividing the periphery of the lock mechanism into three portions of at least substantially equal size.

7. A lock mechanism as claimed in claim 5 or 6, in which the return bars are urged by spring means.

8. A lock mechanism as claimed in claim 7, in which the spring means urges the return bars radially outwardly.

9. A lock mechanism as claimed in claim 7 or 8, in which the spring means is a flexible, U-shaped or arcuate spring element.

10. A lock mechanism as claimed in claim 9, in which said spring element is arranged to urge the locking bar radially outwardly.

11. A lock mechanism as claimed in any of claims 7 to



10, in which the return bars are urged by spring means at both ends thereof.

12. A lock mechanism as claimed in claim 4, comprising only one return bar, which is urged radially inwardly by spring means.

13. A lock mechanism as claimed in any of claims 1 to 3, in which the locking discs are directly guided by the cylinder housing, the return bar being guided by means of the locking discs and intermediate discs located between the locking discs.

14. A lock mechanism as claimed in claim 13, in which the locking discs and the intermediate discs include guiding edges jointly forming a closed channel and serving as guiding surfaces for the return bar.

15. A lock mechanism as claimed in claim 13 or 14, comprising two return bars arranged positively to guide the returning movement of the locking discs, each return bar in its own returning direction.

16. A lock mechanism as claimed in claim 15, in which the return bars are urged by spring means.

17. A lock mechanism as claimed in claim 16, in which the spring means urges the return bars radially outwardly.

18. A lock mechanism as claimed in claim 13 or 14, comprising only one return bar, which is urged by spring means.

19. A lock mechanism as claimed in claim 18, in which the return bar is urged radially outwardly by said spring means.



20. A lock mechanism as claimed in any of the preceding claims, in which the cross-section of the return bar is substantially circular.

21. A lock mechanism as claimed in any of the preceding claims, in which turning of the return bar relative to the set of discs is blocked in one turning direction of the lock mechanism in order to prevent the operation of the lock mechanism in said one turning direction.

22. A lock mechanism as claimed in claim 21, in which said blocking of the return bar is arranged by means of a separate locking member, which together with the return bar blocks turning of the set of discs to prevent operation of the lock mechanism in said one turning direction.

23. A lock mechanism as claimed in claim 21, in which the power transmitting member turnable with the key includes guiding edges for the return bar, said guiding edges being suitably formed so as to block turning of the return bar in said one turning direction, said return bar thereby blocking turning of the set of discs and preventing operation of the lock mechanism in said one turning direction.

24. The combination of a lock mechanism as claimed in any of the preceding claims and a key therefor, in which the basic form of that portion of the key which is to be inserted into the lock mechanism is a hollow cylinder having an axial groove, from both edges of which portions of different size are removed for obtaining the combination surfaces of the key.



25. The combination of a lock mechanism as claimed in any of claims 1 to 23 and a key therefor, in which the basic form of that portion of the key which is to be inserted into the lock mechanism corresponds to a cylinder, from which a cylindrical segment is cut.

26. The combination claimed in claim 25, in which two cylindrical segments of different size are cut away from said portion of the key.

27. The combination of a lock mechanism as claimed in any of claims 1 to 23 and a key therefor, in which the basic form of that portion of the key which is to be inserted into the lock mechanism corresponds to a cylinder, from both sides of which portions of equal size are cut away, the blade of the key thus obtained being provided with four series of combination surfaces, which are located symmetrically relative to the longitudinal axis of the key and of which the ones located diametrically opposite to one another relative to the blade of the key are the same.

28. A cylinder lock mechanism as claimed in claim 1, constructed and arranged substantially as herein described with reference to, and as illustrated in, Figures 1 to 5, Figures 6 to 10, Figures 11 to 16, Figures 17 to 21, Figures 6 to 10 as modified by Figure 32, Figures 6 to 10 as modified by Figures 33 and 34, or Figures 6 to 10 as modified by Figures 35 and 36, of the accompanying drawings.