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(54) **CYLINDER LOCK AND KEY LOCKING SYSTEM, A CYLINDER LOCK AND A KEY**

(57) The invention relates to a locking system of a cylinder lock and a shank of a key with at least one disc tumbler (3) with a central opening (20a) to receive the shank (5) of the key. The tumbler (3) is rotatable about the longitudinal axis (O) and is provided with at least one coding projection (2000) and with at least one coding cut-out (30) for a latch (40). The shank (5) is formed by a longitudinal plate-shaped body with at least one coding surface (50) to interact with a coding projection (2000) for rotation of the tumbler (3). At least one coding surface

(50) is formed by a coding surface (50a) displaced in the direction (T) of the width of the shank (5) at a distance (ΔT_5) from the edge surface (523) of the shank (5) and the at least one coding cut-out (30) is formed by a coding cut-out (30a) shifted by an angle ($\Delta \alpha_3$) relative to the position for cooperation with the coding surface (50) on the edge surface (523) of the shank (5).

The invention also relates to a cylinder lock with this locking system and a key for this locking system and this cylinder lock.

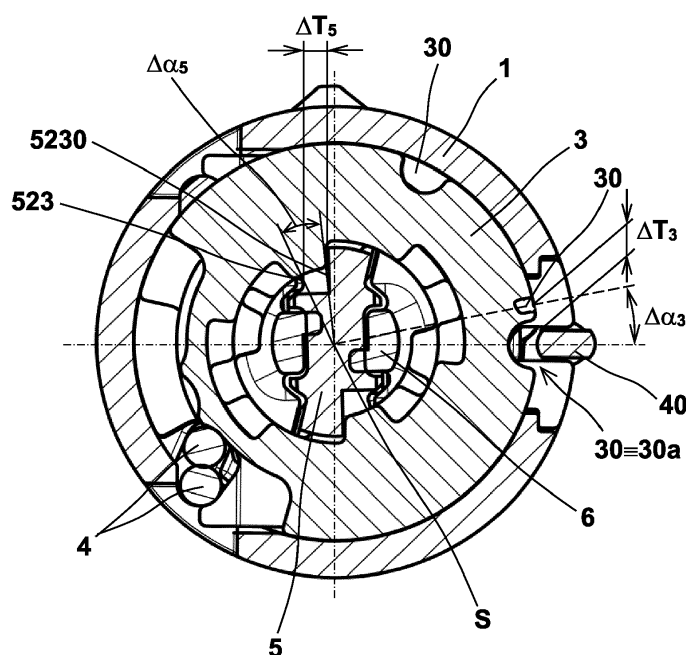


Fig. 5a

Description

Technical field

[0001] The invention relates to a locking system of a cylinder lock and shank of a key, which comprises at least one disc tumbler with a central opening for insertion and rotation of the shank of the key, wherein the disc tumbler is arranged rotatably about the longitudinal axis of the lock and the disc tumbler is provided with at least one coding projection on the circumference of its central opening and is provided with at least one coding cut-out for a latch on its outer circumference, wherein the shank of the key is formed by a longitudinal plate-shaped body which is defined by a pair of opposite side surfaces defining the shank width and by a pair of opposite upper surfaces defining the shank height, and the shank is provided with at least one coding surface which is adapted to interact with the at least one coding projection on the disc tumbler about the longitudinal axis of the lock by the at least one coding cut-out on the disc tumbler to a position opposite the latch.

[0002] The invention further relates to a cylinder lock with a locking system, which comprises at least one disc tumbler with a central opening for insertion and rotation of a shank of a key, whereby the disc tumbler is arranged rotatably about the longitudinal axis of the lock and the disc tumbler is on the circumference of its central opening provided with at least one coding projection and on its outer circumference it is provided with at least one coding cut-out for a latch, whereby the coding projections is adapted to rotate the coding disc in a defined manner by the action of the coding surface on the shank of the key about the longitudinal axis of the lock with the at least one coding cut-out on the disc tumbler to a position opposite the latch.

[0003] The invention also relates to a key for the locking system and the lock, wherein the key comprises a longitudinal plate-shaped body which is defined by a pair of opposite side surfaces defining the shank width and by a pair of opposite upper surfaces defining the height of the shank and the shank is provided with at least one coding surface which is adapted to interact with the at least one coding projection on the disc tumbler for defined rotation of the coding tumbler about the longitudinal axis of the lock and with the at least one coding cut-out on the at least one disc tumbler to a position opposite the latch.

Background art

[0004] EP 989 262 discloses a combination of a cylinder lock and a key, a key blank and a respective key. The cylinder lock comprises a lock body, in which a rotary cylinder of the lock is rotatably mounted. The lock cylinder is provided with a slot. A set of locking discs is located inside the lock cylinder, and each is provided with at least

one circumferential notch determining the opening combination of the lock and each of the discs is further provided with a central opening for receiving the key. The lock further comprises a locking bar which, in a locking position, prevents turning of lock cylinder relative to the lock body. At least one of the coding locking discs is provided with a key opening in its central part, in which the disc is provided with at least two separate oblique counter-acting surfaces, which are arranged on pitch diameters and are adapted to cooperate with combination surfaces on the key on the same pitch diameter. The key is substantially of rectangular cross-section with at least one obliquely bevelled corner on which the key is provided with oblique combination surfaces for an oblique counter-acting surface on the respective locking disc. These oblique combination surfaces on the key are arranged so that, on insertion of the key into the lock and turning of the key, they abut the oblique counter-acting surfaces on the inner circumference of the respective locking disc and cause, when the key is turned again, the respective locking disc to turn into a position in which the circumferential notches of all locking discs are aligned and form a uniform channel to allow the locking bar to enter to release the lock cylinder for turning relative to the lock body, i.e. for unlocking the lock. The cooperating surfaces of each locking disc, the oblique coding surfaces of the key and the circumferential notches are so arranged that combination values of the lock can be created.

[0005] A certain drawback of this solution is the arrangement of the oblique coding surfaces on the key and the arrangement of the oblique counter-acting surfaces on the inner circumference of the coding discs, which in practice limits the achievable number of combination possibilities of the lock, because in the need to increase the combination possibilities of such a lock and key, it is very demanding and difficult, especially in terms of labour intensity and accuracy of key production, to increase the number and inclination of differently oblique individual cooperating surfaces on the key and on the inner diameter of the discs in relation to the position of individual coding discs in the direction of the length of the lock and to the position of the circumferential notches on the outer circumference of these coding discs. Furthermore, any simple increase in the number of coding discs is disadvantageous due to the increase in the length of the lock, since the length of the lock should not exceed an acceptable limit.

[0006] CZ 2010-0879, CZ 2010-0843, CZ 2010-0880 and CZ 2010-0882 disclose a cylinder lock with a rotatable key, wherein the lock comprises a base body with a cylindrical bore in which a set of locking discs is arranged axially one behind the other and secured against spontaneous rotation. The locking discs are arranged either in a rotatable housing mounted in the cylindrical bore of the base body of the lock. The locking discs are provided with a central opening and in it they are provided on pitch diameters with counter-acting surfaces for coded contact with coding surfaces which are formed on the

sides of the key on corresponding pitch diameters of the side edges of the radial notches in the rotatable key. The locking discs are on their outer circumference provided with notches for at least one latch and at least one guiding element which is adapted to align the tumblers to the required rotation for removal of the rotatable key. The position of the grooves for the latch depends on the respective coding function of the lock in relation to the position of the counter-acting surface on the respective pitch diameter in the central opening of the respective coding disc and on the corresponding coding surface of the key on the side surface of the key body. A guiding element of the key further passes through the central opening in the tumblers. The guiding element of the key is adapted to guide the central part of the key shank inside the lock. The key itself has a flat shape whose transverse profile is in the shape of the letter "X", or, in other words, it is in the form of a pair of letters "V" attached to each other with their lower parts, wherein the width of the key body increases from the centre of the key body to the circumference of the key body. The side surfaces of the key body, after being defined by radial notches in the key body, are intended to cooperate with counter-acting surfaces arranged on the inner circumference of the locking discs on a pitch diameter which corresponds to the depth of the radial notches in the key body. As shown in Figs. 1a and 1, which show this background art, the counter-acting surfaces P1, P2, ..., PX on the locking discs KUK, together with the side coding surfaces K1, K2, ..., KX on the key KL and the circumferential cut-outs V1 and V2 on the locking discs KUK are mutually arranged to form combination values of the lock, whereby the combination surfaces K1, K2, ..., KX on the key KL are always on the side wall BS of the body D of the key KL and the position angles α of the cut-outs V on the outer circumference of the locking discs KUK depend not only on the position angles β of the counter-acting surfaces on the inner circumference of the locking discs KUK, but they also depend on the corresponding pitch diameters R_x of the side edges of the respective combination surfaces K_x on the key KL (formed by radial notches in the key) and on the corresponding pitch diameters R_U on the locking discs KUK.

[0007] The main disadvantage of this solution is a limited number of coding combinations in relation to the limited possible length of the lock, where the counter-acting surfaces P are arranged on the inner circumference of the locking discs, the coding surfaces K are always on the side surface on the key KL, or, more specifically, on the side wall BS of the body D of the key KL and the angular positions α of the circumferential notches V on the locking discs KUK are adapted to them, which in practice limits the number of combination possibilities of the lock. When the combination of this lock and key needs to be increased, it is very demanding and difficult, especially in terms of labour intensity and production accuracy and also in terms of sufficient product durability, to increase the number of surfaces P and K on the available

angular range of about $\frac{1}{4}$ of the entire circumference of the locking discs, increase the number of pitch circles R_x and R_U and adequately create circumferential cut-outs V in the corresponding angular positions on the locking discs, etc. To achieve the required number of locking combinations, it is then necessary to produce a relatively large number of different locking discs with different projections and circumferential cut-outs, which need to be mounted in locks with corresponding coding combinations and to adapt the key and radial notches therein. These disadvantages are reflected to a lesser extent in the individual locking systems, but they are mainly manifested in the locking systems of the so-called master and general key.

[0008] The objective of the invention is to eliminate or at least minimize the disadvantages of the background art and, in particular, to allow the number of coding combinations between the key and the locking discs to be extended, if possible while reducing the production complexity of the lock or some of its components, both for individual locking systems and especially for master and general key locking systems.

Principle of the invention

[0009] The objective of the invention is achieved by a locking system of a cylinder lock and shank of the key, whose principle consists in that at least one coding surface on the shank of the key is formed by a shifted coding surface, which is situated on the shank of the key in the direction of the width of the shank at a distance ΔT_5 from the edge surface of the shank of the key to the depth of the key shank material, wherein at least one coding cut-out of at least one disc tumbler is formed by a shifted coding cut-out which is displaced on the outer circumference of the disc tumbler by an angle $\Delta\alpha_3$ relative to the position of the coding cut-out for cooperation with the coding surface situated on the edge surface of the shank of the key.

[0010] The principle of the cylinder lock with this locking system consists in that the coding cut-out of the at least one disc tumbler is formed by a shifted coding cut-out which is shifted on the outer circumference of the disc tumbler by the angle $\Delta\alpha_3$ relative to the position of the coding cut-out for cooperation with the coding surface on the edge surface of the shank of the key.

[0011] The principle of the key for this locking system and for this cylinder lock consists in that at least one coding surface on the shank of the key is formed by a shifted coding surface which is situated on the shank of the key in the direction of the shank width at a distance ΔT_5 from the edge surface of the shank of the key to the depth of the material of the shank of the key, whereby this distance ΔT_5 corresponds to the shifted position of the shifted coding cut-out on the respective disc tumbler.

[0012] The advantage of this solution is a substantial increase in the number of locking, i.e., coding combinations, both for individual locking systems and for master

and general key locking systems (SGHK). The invention allows to use the dimension of the shank of the key in the direction of the shank thickness for further, space-dependent, layout of the coding elements on the key and on the disc tumblers, which extends the possibilities of mutual positions of the coding elements on the key and on the disc tumblers and the lock in the direction of the circumference of the lock and the key and it makes it possible to extend the circumferential angle of the disc tumblers and keys usable for the geometry of the locking system, for combining the relative positions of the coding elements on the disc tumblers and on the key, etc. In essence, the invention adds another dimension to existing disc tumbler systems in which locking combinations of the disc tumblers and the key can be formed. At the same time, this places higher demands on key production, but on the other hand it provides a higher degree of security of the lock and especially the key against unauthorized production and counterfeiting, it provides increased security of the lock and key while maintaining simplicity of the design of the disc tumbler system and of the lock as such. The potential increase in key production requirements can be counterbalanced by using the present invention, namely by using pairs of identical disc tumblers in a single lock to generate a key lock code, which are only mirror-inverted relative to each other in the lock assembly, which allows two different locking codes to be implemented by using a pair of factory-identical disc tumblers, which are only mirror-inverted in the lock assembly, so that it is possible to produce only half the number of disc tumblers that are shaped differently from each other for the lock and the lock system according to the invention, while maintaining the number of different locking codes.

Description of the drawings

[0013] The invention is schematically represented in a drawing, wherein Fig. 1 shows a cross-section of a key according to the background art, Fig. 1a shows an arrangement of a key and a disc tumbler according to the background art of Fig. 1, Fig. 1b shows an arrangement of a disc tumbler according to the background art of Fig. 2, Fig. 2 shows schematically an arrangement of a locking system according to the invention comprising a lock and a key, Fig. 2a shows an arrangement of one disc tumbler according to the invention, Fig. 2b shows an arrangement of a base body with inserted disc tumblers and spring discs, Fig. 2c shows an arrangement of a disassembled assembly of the base body with the disc tumblers and spring discs, Fig. 2d shows a slightly bottom view of the arrangement of Fig. 2c, Fig. 2e shows an exemplary embodiment of a spring disc, Fig. 3 shows a detail of an embodiment of a coding system on the key according to the invention, Fig. 4 shows a cross-section of the key shank along the plane A-A of Fig. 3, Fig. 5 shows a longitudinal section along the plane in the direction of the key height through an arrangement of a lock with an in-

serted key, Fig. 5a represents a cross-section along the plane A - A of Fig. 5, Fig. 6 shows a cross-section of an alternative embodiment of a key with an oblique shifted coding surface and with coding surfaces also in the area of the grooves for a longitudinal guiding element of the key in the lock, Figs. 7 to 7d show exemplary embodiments of the disc tumblers with a shifted coding cut-out and finally, Figs. 7e and 7f show the use of the disc tumblers with the shifted coding cut-out according to Figs. 7 and 7a with the key according to the present invention.

Examples of embodiment

[0014] The invention will be described with reference to exemplary embodiments of a locking system of a cylinder lock and a key, wherein the lock comprises a system of disc tumblers 3 arranged behind each other, and also with reference to an exemplary embodiment of a cylinder lock with this locking system and with reference to exemplary embodiments of a key K and disc tumblers 3 for this locking system and for this cylinder lock.

[0015] The lock comprises a base body 1 which is at one end provided with a coupling S for connection to an unillustrated unlocking tooth. The base body 1 is at its other end provided with a longitudinal cylindrical opening 10 in which a set of coding discs 3 is arranged rotatably about a longitudinal axis O of the lock.

[0016] In an illustrated exemplary embodiment, the coding discs 3 are separated from each other by spring discs 2 which are adapted to separate adjacent disc tumblers 3 and to resiliently define axial clearances in the direction of the longitudinal axis O of the lock within the system of the disc tumblers 3. To improve the definition of these axial clearances, a system of axial stops is formed on the base body 1 for a defined group of disc tumblers 3 and spring discs 2 associated with them, where, for example, each triplet of spring discs 2 and the disc tumblers 3 arranged between them is positionally defined in the base body 1 by the position of these axial stops so that the end spring discs 2 of this trio are defined by axial stops and the middle spring disc 2 is arranged as a so-called floating spring disc between a pair of so-called floating disc tumblers 3.

[0017] In the illustrated exemplary embodiment, the axial stops on the base body 1 are represented by side walls 110 of through windows 11 in the base body 1.

[0018] In the unillustrated exemplary embodiment, the disc tumblers 3 are axially separated from each other by flat disc inserts without spring capabilities, or the disc tumblers 3 are axially separated from each other by separating cups, or the disc tumblers 3 are axially separated from each other by some other suitable axially separating means, including a suitable system of axial stops arranged on the inner wall of the base body 1 either separately for each disc tumbler 3, or arranged on the inner wall of the base body 1 always for a defined group of disc tumblers 3.

[0019] In an unillustrated exemplary embodiment, the

disc tumblers 3 are arranged in such a manner that they axially abut on each other, i.e., in the direction of the longitudinal axis $\underline{O}$ of the lock, i.e., there is no axially separating means between them.

[0020] The disc tumblers 3 and possible axial separating means, these axial separating means in the illustrated embodiment, being represented by spring discs 2, are provided with a central through opening 20a which, in the direction of the longitudinal axis $\underline{O}$ of the lock, i.e., in the direction of the length of the lock, form a key cavity 21 of the lock in which, in an illustrated exemplary embodiment of the lock, a guiding element 6 is arranged longitudinally to guide the central part of the shank 5 of the key in the lock. The guiding element 6 is rotatable about its longitudinal axis, which is identical to the longitudinal axis $\underline{O}$ of the lock. The guiding element 6 is adapted both to guide longitudinally the shank 5 of the key and to support the shank 5 of the key during the rotation of the shank 5 of the key about the longitudinal axis $\underline{O}$ of the lock and about the longitudinal axis 51 of the shank 5. The front entrance to the key cavity 21 is covered by a front shield 7 with a key opening 70, the shape of which follows the shape of the basic envelope of the cross-section of the shank 5 of the key.

[0021] Figs. 2e and 2f show an exemplary embodiment of an axially separating means in the form of a spring disc 2. In this exemplary embodiment, the spring disc 2 is configured as a flat disc with a central through opening 20a, whereby this flat disc is bent in its central part into an arc having a radius $\underline{R_0}$, the depth $\underline{h_p}$ of this bend is greater than or equal to the minimum required axial distance of two adjacent disc tumblers 3 of the lock assembly. In the illustrated embodiment, the spring disc 2 is provided with an upper end 2a with a pair of flat projections 2a1 for axial locking by abutment on the side walls 110 of the through windows 11 in the base body 1. At its opposite end, the flat disc is provided with a guiding projection 2b1 with a groove 2b2 for a latch 40 of the lock, whereby the guiding projection 2b1 passes through the longitudinal cut-out 12 in the base body 1, for example. At the base, the shank 5 of the key has a flat shape with a cross-section in the shape of the letter "X" or, in other words, in the shape of a pair of letters "V" attached to each other with their lower parts, wherein the width $\underline{T}$ of the shank 5 of the key increases in the direction away from the centre $\underline{S}$ of the shank 5 of the key towards the circumference of the shank of the key.

[0022] The disc tumbler 3 is on the circumference 200 of its central opening 20a provided with a set of coding projections 2000 for contact with the coding surfaces 50 on the key K. The coding projections 2000 in the central opening 20a of the disc tumbler 3 are formed on corresponding pitch radii $\underline{R_0}$, $\underline{R_1}$, $\underline{R_2}$, etc. from the centre $\underline{S}$ of symmetry of the respective disc tumbler 3 and are provided with radially disposed coding surfaces 2001 or 2002. The longitudinal axis $\underline{O}$ of the lock passes through the centre $\underline{S}$ of symmetry of the respective disc tumbler 3.

[0023] The pitch radii $\underline{R_0}$, $\underline{R_1}$, $\underline{R_2}$ to $\underline{R_x}$ of the disc tum-

bler 3 correspond to the pitch radii $\underline{P_0}$, $\underline{P_1}$, $\underline{P_2}$ to $\underline{P_x}$, or, in other words, to the depth of the radial notches, to create the radially disposed coding surfaces 50 on the rotatable key K which will be described in greater detail further on.

[0024] In the illustrated exemplary embodiment, the disc tumblers 3 in the central opening 20a are provided with coding projections 2000 on three pitch radii $\underline{R_0}$, $\underline{R_1}$, $\underline{R_2}$, which are intended to cooperate with the coding surfaces 50 on the shank 5 of the rotatable key on three corresponding radii $\underline{P_0}$, $\underline{P_1}$, $\underline{P_2}$. In an unillustrated exemplary embodiment, the number of mutually corresponding radii $\underline{R_x}$ and $\underline{P_x}$ is another suitable, e.g., 4 or 2, etc.

[0025] The disc tumblers 3 are provided on their outer circumference with at least one coding cut-out 30 for at least one latch 40 of the lock coupled to an unillustrated locking latch of the lock. The disc tumblers 3 are further provided on their outer circumference with at least one guiding notch 31 for at least one control bar 4 of the lock, which is adapted in a well-known manner to align the disc tumblers 3 to a required rotation for the removal of the shank 5 of the rotatable key from the lock. The control bar 4 and the latch 40 are arranged parallel to the longitudinal axis $\underline{O}$ of the lock.

[0026] Each coding cut-out 30 is arranged on the circumference of the disc tumbler 3 at an angular position corresponding to the angular coding function specified by the relative angular position of the respective coding surface 2002 on the respective pitch radius $\underline{R_0}$, $\underline{R_1}$, $\underline{R_2}$ to $\underline{R_x}$ on the circumference of the central opening 20a in the disc tumbler 3 and the respective coding surface 50 on a corresponding pitch radius $\underline{P_0}$, $\underline{P_1}$, $\underline{P_2}$ to $\underline{P_x}$ on the shank 5 of the key. The coding cut-outs 30 on the outer circumference of each of the disc tumblers 3 then determine the locking code of the respective disc tumbler 3 by their angular positions and in cooperation with the angular positions and sizes of the coding surfaces 2001 or 2002 on the inner circumference of this disc tumbler 3, and in cooperation with the other disc tumblers 3 and the coding surfaces 50 on the corresponding pitch radii $\underline{P_0}$, $\underline{P_1}$, $\underline{P_2}$ to $\underline{P_x}$ on the shank 5 of the key they determine the locking code of the entire lock.

[0027] In order to achieve the required or desired complexity of the locking code of the entire lock, a certain number of disc tumblers 3 is required in the direction of the longitudinal axis $\underline{O}$, i.e., in the direction of the length of the lock.

[0028] The key cavity 21 is arranged longitudinally about the longitudinal axis $\underline{O}$ of the lock and is adapted for the shank 5 of the key to be longitudinally inserted and for the shank 5 of the key to be rotated about its longitudinal axis 51, which, in this arrangement, with the shank 5 being inserted in the lock, coincides with the longitudinal axis $\underline{O}$ of the lock. When the shank 5 of the key is rotated in the key cavity 21, the shank 5 of the key, or its coding surfaces 50 described below, interact with the coding surfaces 2002 on the projections 2000 on the central opening 20a of the disc tumblers 3.

[0029] The shank 5 of the key comprises a longitudinal

plate-shaped body, which is defined in the direction of its length d by a front end 53, through which the shank 5 is inserted into the lock, and a rear end 54, on which an unillustrated holder of the shank 5 is usually located. At its front end 53, the longitudinal plate-shaped body of the shank 5 is provided with an oblique tapered portion to facilitate the insertion of the shank 5 into the lock.

[0030] In the direction T of the thickness of the shank 5 the plate-shaped body is defined by a pair of opposite side surfaces 52 of the shank 5, which are provided with edge surfaces 523 situated in a part of the side surfaces 52 adjacent to the upper surfaces 55 of the shank 5. In the illustrated exemplary embodiment, the side surfaces 52 of the shank 5 of the key in the central part of the width of the shank 5 are further provided with longitudinal grooves 520 and/or longitudinal recesses 521 and/or longitudinal projections 522, which are generally intended to guide longitudinally the shank 5 of the key, to ensure the required dimensional strength of the shank 5 of the key and optionally are adapted to extend the coding functions of the lock by coding between the sides 52 of the shank 5 of the key and the front face 7 and/or between the sides 52 of the shank 5 of the key and the inner walls of the guiding element 6.

[0031] In the direction V of the height of the shank 5, the longitudinal plate-shaped body of the shank 5 is defined by the upper surfaces 55, which adjoin the side surfaces 52 of the shank 5 at their side ends and at their front and rear ends adjoin the front end 53 of the shank 5 and the rear end 54 of the shank 5.

[0032] In the illustrated exemplary embodiment, from the direction against the upper surfaces 55, i.e., in the direction against the height V of the shank 5, the shank 5 is provided with a set of radial notches 550 running perpendicularly to the length of the shank 5, which also pass through the edge surfaces 523 in the side surfaces 52 of the shank 5. The radial notches 550 thus remove part of the material of the shank 5, whereby the parts of the edge surfaces 523 of the shank 5 left on the shank 5 comprise at least one coding surface 50 to cooperate with the coding surfaces 2002 or 2001 on the projections 2000 on the inner circumference of the central opening 20a of the disc tumbler 3. The position of the radial notches 550 on the shank 5 in the direction d of the length of the shank 5 and the depth H of the radial notches 550 (or the pitch radii P_0, P_1, P_2 to P_x of the edges on the shank 5 of the key) determine the position and size of the coding surfaces 50 on the edge surfaces 523 of the shank 5, which are adapted to cooperate with the corresponding coding projections 2000, or their coding surfaces 2001 or 2002, on the inner circumference of the opening 20a of the respective disc tumbler 3. In this case, the position and size of the coding surfaces 50 on the edge surfaces 523 of the shank 5 correspond to the position of the respective disc tumbler 3 in the direction of the longitudinal axis O , i.e., in the direction of the length of the lock, and also to the position of the coding projection 2000, or the position of its coding surface 2001 or

2002, in the through opening 20a of the disc tumbler 3, to the pitch radius R_0, R_1, R_2 to R_x of the respective coding projection 2000 or of its contact edge 2001, to the size of the coding projection 2000, or its coding surface 2001 or 2002 and to the angular position of the coding cut-outs 30 on the outer circumference of the disc tumbler 3, etc., to co-create the locking code of the lock between the shank 5 of the key and all the disc tumblers 3 of the lock, i.e., the locking system of the lock.

[0033] At least one coding surface 50 on the shank 5 is formed on the shifted surface 5230 and constitutes a shifted coding surface 50a, which is situated on the shank 5 of the key at a distance ΔT_5 from the edge surface 523 on the shank 5 in the direction T of the width of the shank 5.

[0034] This shifted surface 5230 is thus situated in the direction T of the width of the shank 5 from the edge surface 523 on the shank 5 in the direction T of the width of the shank 5 to the depth of the material of the shank 5 in the direction T of the width off the shank 5. In angular expression, the shifted surface 5230 relative to the edge surface 523 on the shank 5 is angularly rotated about the centre S of the shank 5 of the key by an angle $\Delta\alpha_5$, as shown in Figs. 3, 4 and 5a. The shifted surface 5230 is in this case formed, e.g., by milling, etc., in the form of a recess, from the side wall (edge surface 523) in the direction of the thickness T of the shank 5 to the required material depth ΔT_5 corresponding to the angular rotation $\Delta\alpha_5$.

[0035] This shifted coding surface 50a on the shifted surface 5230 corresponds to at least one coding surface 2001 or 2002 on the coding projection 2000 in the central opening 20a of the disc tumbler 3, and at the same time to at least one coding cut-out 30 on the outer circumference of the respective disc tumbler 3 shifted on the outer circumference of the disc tumbler 3 by the angle $\Delta\alpha_3$ relative to the position in which this coding cut-out 30 would be, if it corresponded to the coding surface 50 located on the edge surface 523 of the shank 5 of the key. The thus shifted coding cut-out is shifted on the outer circumference of the disc tumbler by the angle $\Delta\alpha_3$ relative to the position of the coding cut-out for cooperation with the coding surface situated on the edge surface of the shank of the key. Thus, at least one shifted coding cut-out 30a is formed on the locking disc 3. The angular displacement $\Delta\alpha_3$ of the shifted coding cut-out 30a can also be expressed as a tangential displacement ΔT_3 of the shifted coding cut-out 30a in the tangential direction to the circumference of the disc tumbler 3, wherein the magnitude of this tangential displacement ΔT_3 of the shifted coding cut-out 30a corresponds to the distance ΔT_5 of the shifted coding surface 50a on the shank 5 of the key from the edge surface 523 of the shank 5 in the direction T of the width of the shank 5.

[0036] Fig. 6 shows an alternative embodiment according to Fig. 4, wherein the shank 5 of the key in the longitudinal grooves 520 for the longitudinal guide 6 of the key is provided with at least one additional recess

520a for extended coding also between the shank 5 of the key and the longitudinal guide 6 of the key. In this alternative embodiment, at least one coding surface 50 on the shank 5 is formed on the shifted surface 5230, thereby creating the shifted coding surface 50a, which is situated on the shank 5 of the key at a distance from the edge surface 523 on the shank 5 in the direction T of the width of the shank 5, here at a distance ΔT_5 . This shifted surface 5230 is thus situated in the direction T of the width of the shank 5 from the edge surface 523 on the shank 5 in the direction T of the width of the shank 5 to the depth of the material of the shank 5 in the direction T of the width of the shank 5. In angular terms, the shifted surface 5230 is angularly rotated about the centre S of the shank 5 of the key relative to the edge surface 523 on the shank 5 by the angle $\Delta\alpha_5$. The shifted surface 5230 is formed, e.g., by milling, etc., in the form of a recess from the side wall (the edge surface 523) in the direction of the thickness T of the shank 5 to the required depth of the material ΔT_5 corresponding to the angular rotation $\Delta\alpha_5$.

[0037] According to an exemplary embodiment in Figs. 2 and 3, the shank 5 is provided with at least two differently shifted surfaces 5230, 5231, wherein on at least one of them is formed at least one displaced coding surface 50a with a functional connection to the shifted coding cut-out 30a on the outer circumference of the respective disc tumbler 3. The magnitude of the displacement ΔT of each shifted coding surface 50a relative to the side surface 523 of the shank 5 of the key is either the same or different or it is the same for a part of the shifted surfaces 5230, 5231 and different for a part of the shifted surfaces 5230, 5231.

[0038] For the practical use of the solution according to the invention in the form of a dimensionally standardized locking insert, the distances ΔT_5 and ΔT_3 preferably have a value from 0.01 mm to 3 mm and angles $\Delta\alpha_5$ and $\Delta\alpha_3$ preferably have a value from 0.01° to 15° .

[0039] Figs. 7 to 7d show a set of three different disc tumblers 3 for the locking system and the lock according to the invention. The disc tumbler 3 comprises a central opening 20a, which is axially symmetrical about two mutually perpendicular axes, which are, for example, the horizontal X-axis and the vertical Y-axis which is perpendicular to the horizontal X-axis. On the circumference of the central opening 20a, coding projections 2000 are formed on pitch radii R_0 , R_1 , R_2 , the front faces 2001 or 2002 of which are intended to cooperate with the coding surfaces 50 on the shank 5 of the rotatable key on the corresponding radii P_0 , P_1 , P_2 . This state of the art of Figs. 1 to 1b is transferred to the exemplary embodiment of the present invention in Figs. 7 to 7c by means of a first coding cut-out shown by a solid line, and by means of a virtual cut-out 30b on their outer circumference provided with a pair of coding cut-outs 30 for the latch 40 of the lock. According to known prior art in Figs. 1 to 1b, these coding cut-outs 30 are also arranged axially symmetrically along to one of the mutually perpendicular axes

on the outer circumference of the disc tumbler 3. This background art of Figs. 1 to 1b is transferred to the exemplary embodiment of the present invention in Figs. 7 to 7c and represented by means of a first coding cut-out 30 indicated in solid line and by means a virtual cut-out 30b symmetrically arranged axially to the first coding cut-out 30 about the vertical Y-axis, the virtual cut-out 30b being indicated by a dashed line. At the same time, the disc tumbler 3 is provided with a shifted coding cut-out 30a, which is shifted on the outer circumference of the disc tumbler 3 by the angle $\Delta\alpha_3$, or shifted by the tangential displacement ΔT_3 , relative to the position of the virtual cut-out 30b, i.e., relative to the position known from the background art and indicated in Figs. 7 to 7c by a pair of angles α_3 . The magnitude of the displacement angle $\Delta\alpha_3$ of the shifted coding cut-out 30a corresponds to the magnitude of the displacement angle $\Delta\alpha_5$ of the shifted coding surface 50a on the shank 5 of the key from the edge surface 523 of the shank 5 in the direction T of the width (of the thickness) of the shank 5, i.e., the magnitude of the tangential displacement ΔT_3 of the shifted coding cut-out 30a corresponds to the distance ΔT_5 of the shifted coding surface 50a on the shank 5 of the key from the edge surface 523 of the shank 5 in the direction T of the width of the shank 5.

[0040] Figs. 7 and 7a show one and the same disc tumbler 3 which is configured to fulfil the function of two locking codes, simply by mirror rotating this disc tumbler 3 about the vertical Y-axis and inserting the disc tumbler 3 thus rotated into the set of disc tumblers 3 of the locking system and the lock according to the present invention. Thus, to meet two different locking codes in the system and the lock according to the invention, it is therefore sufficient to produce one disc tumbler 3, whereby a pair of shifted coding surfaces 50a is correspondingly formed on the shank 5 of the key.

[0041] An equivalent embodiment of one and the same disc tumbler 3 with a first coding cut-out 30, a virtual cut-out 30b and a shifted coding cut-out 30a according to Fig. 7 and 7a is shown in Figs. 7b and 7c with different positioning of the cut-outs 30, 30a and 30b. Also this embodiment of the disc tumbler 3 allows two locking codes to be implemented in the system and in the lock according to the invention by means of one disc tumbler 3 by simply rotating the disc tumbler 3 about the vertical Y-axis and inserting the disc tumbler 3 thus rotated into the set of the disc tumblers 3 of the locking system and the lock according to the invention, whereby a pair of shifted coding surfaces 50a is correspondingly formed on the shank 5 of the key.

[0042] Fig. 7d shows a completely symmetrical disc tumbler 3 with the coding cut-out 30 and without the shifted coding cut-out 30a.

[0043] Figs. 7e and 7f show the cooperation of the disc tumbler 3 of Figs. 7 and 7a with the shank 5 of the key, where in the direction of view W, i.e., in the direction away from the inner end of the lock to the entrance opening of the lock, is first arranged the disc tumbler 3 of Figure 7

in the position as shown in Fig. 7 and behind it is arranged the disc tumbler 3 of Fig. 7a in the position as shown in Fig. 7a. It can be seen in Figs. 7e and 7f that the disc tumbler 3 located here on the left interacts by its coding surface 2001 with the coding surface 50 on the side 523 of the shank 5 of the key and by this interaction the coding cut-out 30 is rotated to a position suitable for the entry of the latch 40. In contrast, the disc tumbler 3 which is shown in Fig. 7e on the right interacts by its opposite coding surface 2002 with the shifted coding surface 50a in the recess in the side 523 of the shank 5 of the key, and by this interaction the shifted coding cut-out 30a is rotated to a position suitable for the entry of the latch 40, in which the shifted coding cut-out 30a of the "right" disc tumbler 3 is in alignment with the coding cut-out 30 of the "left" disc tumbler 3. The disc tumbler 3 on the right consists of an identical and only mirror-inverted disc tumbler 3 on the left.

[0044] The invention is not limited to the embodiments explicitly described or illustrated herein but is applicable to any disc tumbler lock.

Industrial applicability

[0045] The invention is utilized in locking systems of cylinder locks with disc tumblers, cylinder locks with disc tumblers, as well as in keys for these locks. The invention is applicable to safe locks, lock inserts and other types of disc tumbler locks.

List of references

[0046]

1	base body
10	cylindrical opening
2	spring disc
200	circumference of the central opening
2000	coding projection
2001	radially positioned coding surface
2002	radially positioned coding surface
20a	central through opening
21	key cavity
3	disc tumbler
30	coding cut-out for the latch
30a	shifted coding cut-out for the latch
30b	virtual cut-out
31	guiding notch
4	control bar
40	latch
5	shank of the key
50	coding surface
50a	shifted coding surface
51	longitudinal axis of the shank of the key
52	side surface of the shank
520	longitudinal groove of the shank
520a	additional recess

521	longitudinal recess of the shank
522	longitudinal projection of the shank
523	edge surface of the side surface of the shank
5	5230 shifted surface
5231	shifted surface
53	front end of the shank
54	rear end of the shank
55	upper surface of the shank
10	550 radial notch of the shank
6	guiding element of the key
7	front face of the lock
70	key opening
D	length of the shank of the key
15	H depth of the radial notch in the shank key
	K
	O longitudinal axis of the lock
	P ₀ , P ₁ , P ₂ to P _x pitch radius on the key
	R ₀ , R ₁ , R ₂ to R _x pitch radius of the coding projections in the central opening of the disc tumblers
20	
	S centre of the shank of the key
	T thickness (width) of the shank
	V height of the shank
25	$\Delta\alpha_3$ angle of displacement of the coding cut-out on the disc tumbler
	$\Delta\alpha_5$ angle of displacement of the coding surface on the shank of the key
	ΔT displacement of the shifted coding surface
30	
	ΔT_3 displacement of the shifted coding cut-out for the latch on the disc tumbler relative to the coding cut-out for the latch on the disc tumbler
35	ΔT_5 displacement of the shifted surface on the shank of the key from the edge surface of the key shank to the depth of the material of the shank of the key

Claims

1. A locking system of a cylinder lock and a shank of a key, which comprises at least one disc tumbler (3) with a central opening (20a) for insertion and rotation of the shank of the key (5), whereby the disc tumbler (3) is arranged rotatably about the longitudinal axis (O) of the lock and the disc tumbler (3) is on the circumference of its central opening (20a) provided with at least one coding projection (2000) and on its outer circumference is provided with at least one coding cut-out (30) for a latch (40), whereby the shank (5) of the key is formed by a longitudinal plate-shaped body which is defined by a pair of opposite side surfaces (52) defining the width (T) of the shank (5) and by a pair of opposite upper surfaces (55) defining the height (V) of the shank (5) and the shank (5) is provided with at least one coding surface (50),

- which is adapted to interact with at least one coding projection (2000) on the disc tumbler for defined rotation of the disc tumbler (3) about the longitudinal axis (O) of the lock by at least one coding cut-out (30) on the disc tumbler (3) to a position opposite the latch (40), **characterized in that** at least one coding surface (50) on the shank (5) of the key is formed by a shifted coding surface (50a) which is situated on the shank (5) of the key in the direction (T) of the width of the shank (5) at a distance (ΔT_5) from the edge surface (523) of the shank (5) of the key to the depth of the material of the shank (5) of the key, whereby at least one coding cut-out (30) of at least one disc tumbler (3) is formed by a shifted coding cut-out (30a) which is shifted on the outer circumference of the disc tumbler (3) by an angle ($\Delta\alpha_3$) relative to the position of the coding cut-out (30) for cooperation with the coding surface (50) situated on the edge surface (523) of the shank (5) of the key.
2. The locking system according to claim 1, **characterized in that** the shank (5) is provided with at least two shifted surfaces (5230, 5231), whereby at least one shifted coding surface (50a) is formed on each of them.
 3. The locking system according to any of claims 1 or 2, **characterized in that** the distance (ΔT_5) has a value from 0.01 mm to 3 mm and the angle ($\Delta\alpha_3$) has a value of 0.01° to 15°.
 4. The locking system according to any of claims 1 to 3, **characterized in that** at least two disc tumblers (3) in the set of disc tumblers (3) are identical and are arranged mirror-inverted relative to one another.
 5. The locking system according to any of claims 1 to 4, **characterized in that** between each adjacent disc tumblers (3) is arranged an axially springing disc (2) which is adapted to define the axial clearance of the disc tumblers (3).
 6. A cylinder lock with a locking system, which comprises at least one disc tumbler (3) with a central opening (20a) for insertion and rotation of a shank (5) of a key, whereby the disc tumbler (3) is arranged rotatably about the longitudinal axis (O) of the lock and the disc tumbler (3) is on the circumference of its central opening (20a) provided with at least one coding projection (2000) and on its outer circumference it is provided with at least one coding cut-out (30) for a latch (40), whereby the coding projection (2000) is adapted for defined rotation of the coding disc (3) by the action of the coding surface (50) on the shank (5) of the key about the longitudinal axis (O) of the lock with the at least one coding cut-out (30) on the disc tumbler (3) to a position opposite the latch (40), **characterized in that** the coding cut-out (30) of the at least one disc tumbler (3) is formed by a shifted coding cut-out (30a), which is on the outer circumference of the disc tumbler (3) displaced by an angle ($\Delta\alpha_3$) relative to the coding cut-out (30) for the cooperation with the coding surface (50) on the edge surface (523) of the shank (5) of the key.
 7. The cylinder lock according to claim 6, **characterized in that** at least two disc tumblers (3) in the set of disc tumblers (3) are identical and are arranged mirror-inverted relative to one another.
 8. The cylinder lock according to any of claims 6 or 7, **characterized in that** between each adjacent disc tumblers (3) is arranged one axially springing disc (2) adapted to define the axial clearance of the disc tumblers (3).
 9. A key for a locking system and for a lock, wherein the key comprises a shank (5) which is formed by a longitudinal plate-shaped body which is defined by a pair of opposite side surfaces (52) defining the width (T) of the shank (5) and by a pair of opposite upper surfaces (55) defining the height (V) of the shank (5) and the shank (5) is provided with at least one coding surface (50) which is adapted to interact with at least one coding projection (2000) on the disc tumbler (3) for defined rotation of the coding tumbler (3) about the longitudinal axis (O) of the lock and with at least one coding cut-out (30) on at least one disc tumbler (3) to a position opposite the latch (40), **characterized in that** the at least one coding surface (50) on the shank (5) of the key is formed by a shifted coding surface (50a), which is on the shank (5) of the key situated in the direction (T) of the width of the shank (5) at a distance (ΔT_5) from the edge surface (523) of the shank (5) of the key to the depth of the material of the shank (5) of the key, whereby this distance (ΔT_5) corresponds to the displaced position of the shifted coding cut-out (30a) on the respective disc tumbler (3).
 10. The key according to claim 9, **characterized in that** the shank (5) is provided with at least two shifted surfaces (5230, 5231), whereby at least one shifted coding surface (50a) is formed on each of them.
 11. The key according to claim 9 or 10, **characterized in that** the magnitude of the displacement (ΔT_5) of each shifted surface (5230, 5231) and each shifted coding surface (50a) relative to the side surface (523) on the shank (5) is the same or different, or it is the same for a part of the shifted surfaces (5230, 5231) and part of the shifted coding surfaces (50a) and simultaneously it is different for a part of the shifted surfaces (5230, 5231) and part of the shifted coding surfaces (50a).

12. The key according to any of claims 9 to 11, **characterized in that** the magnitude of the displacement (ΔT_5) has a value from 0.01 mm to 3 mm.

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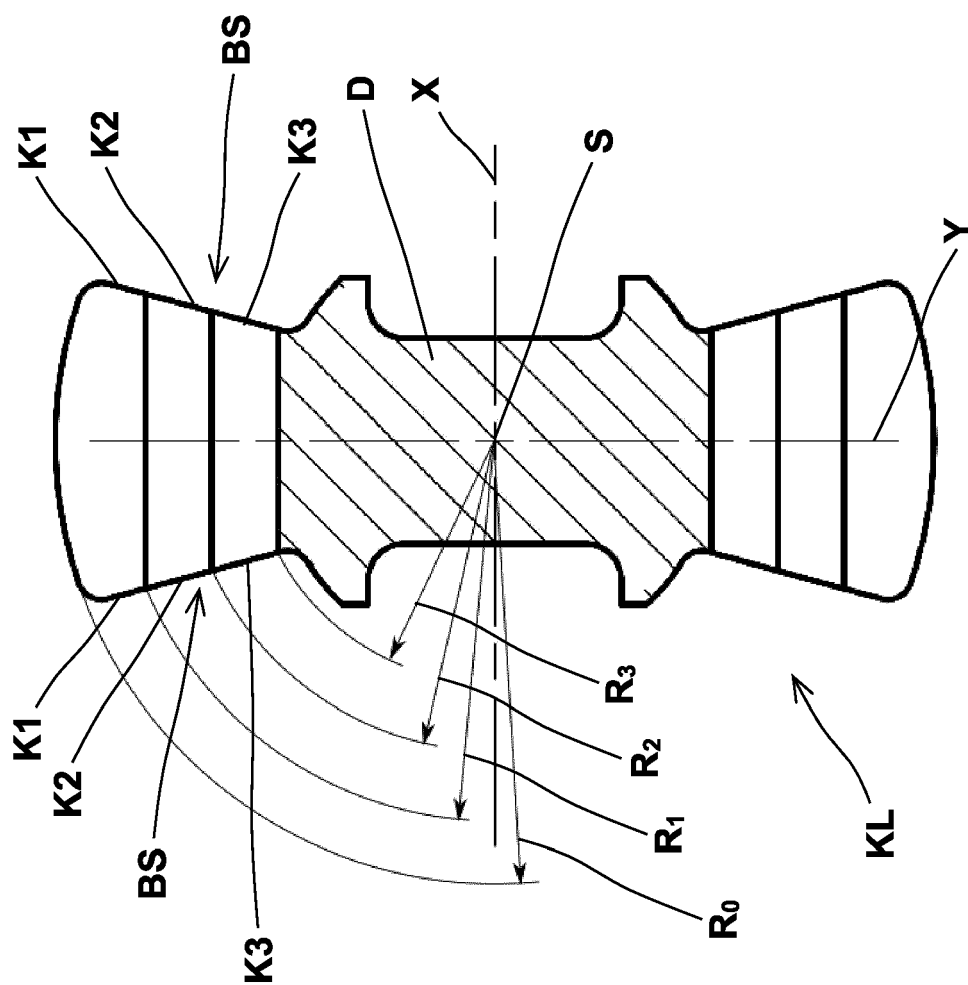
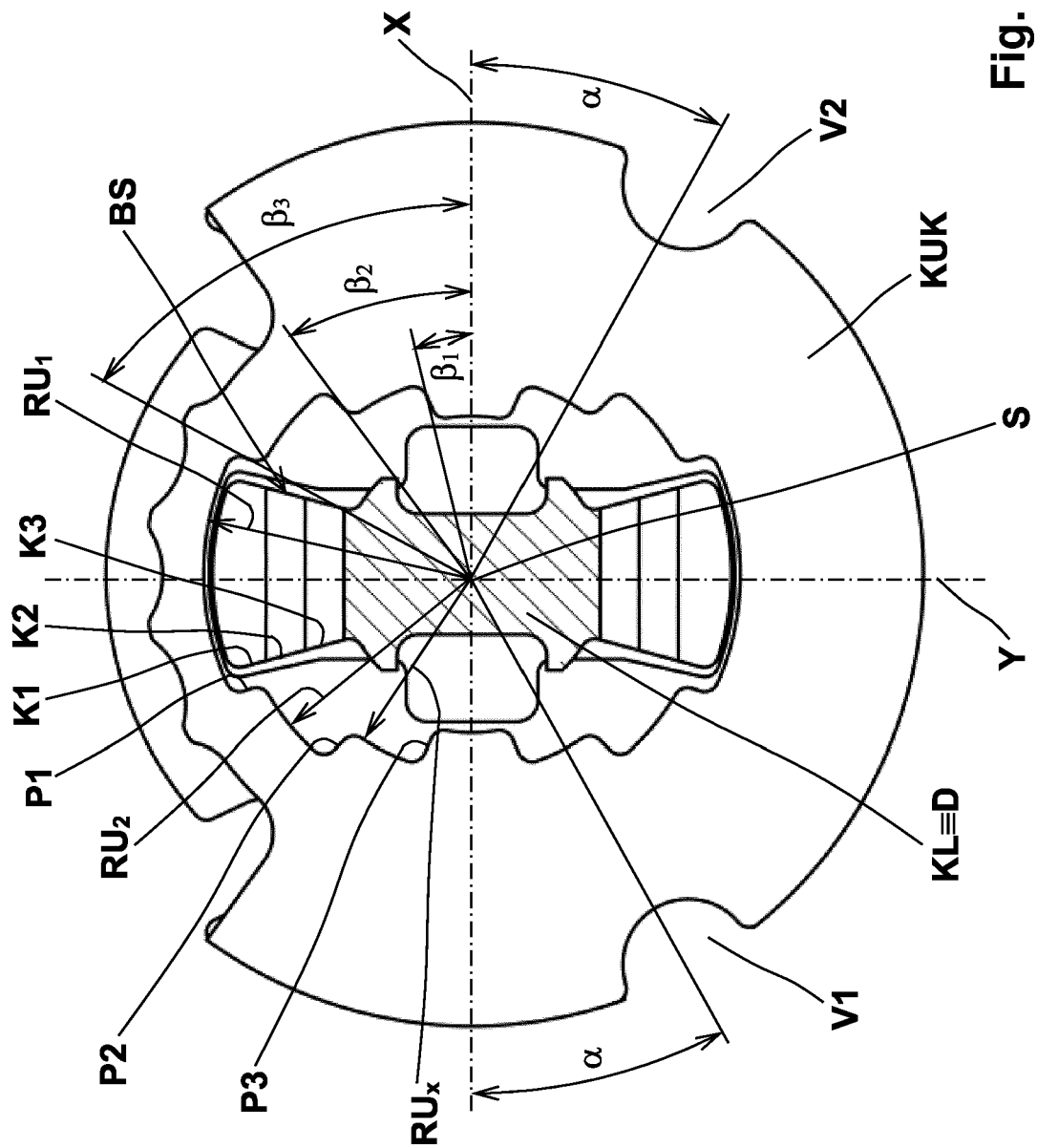


Fig. 1



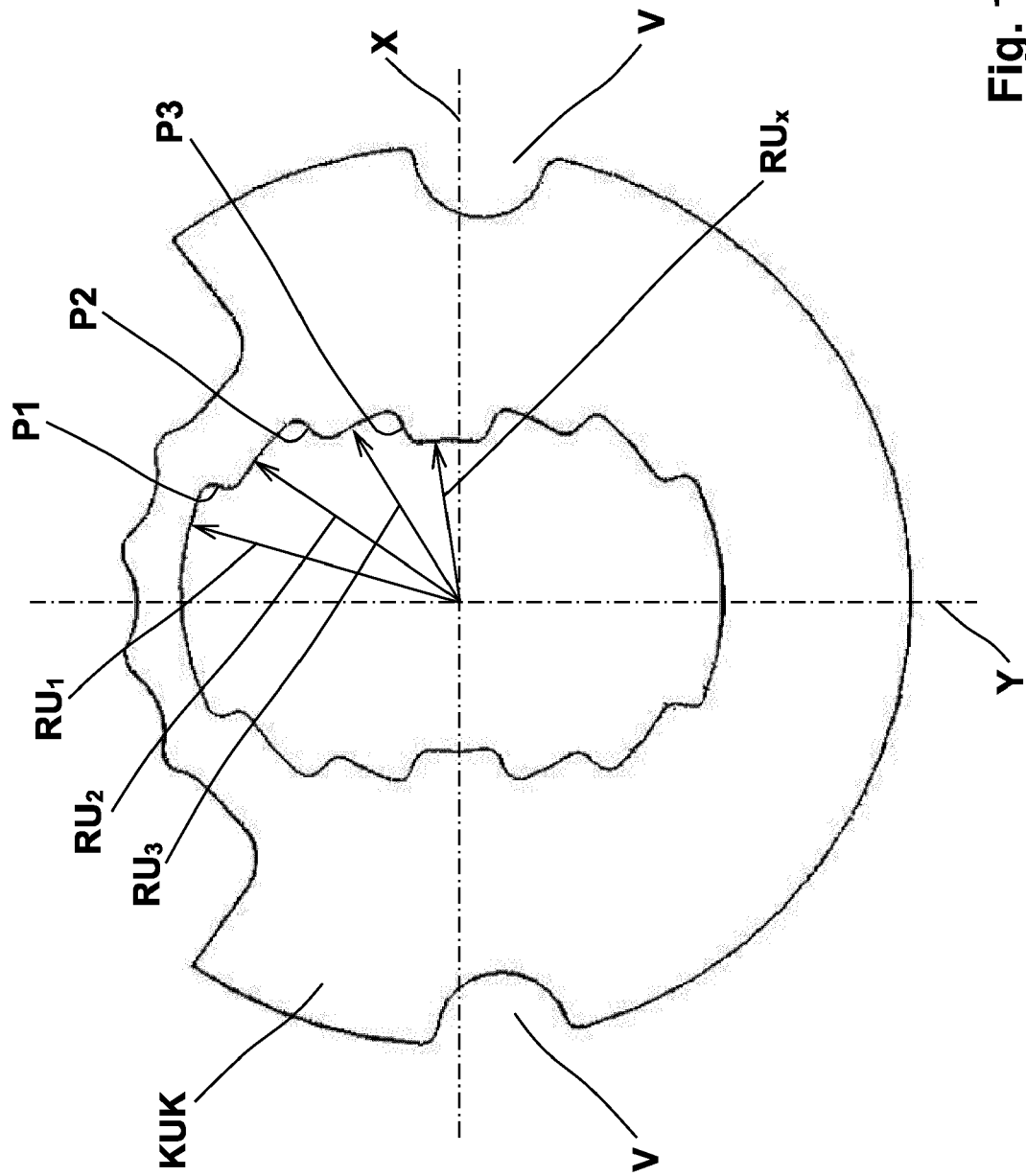


Fig. 1b

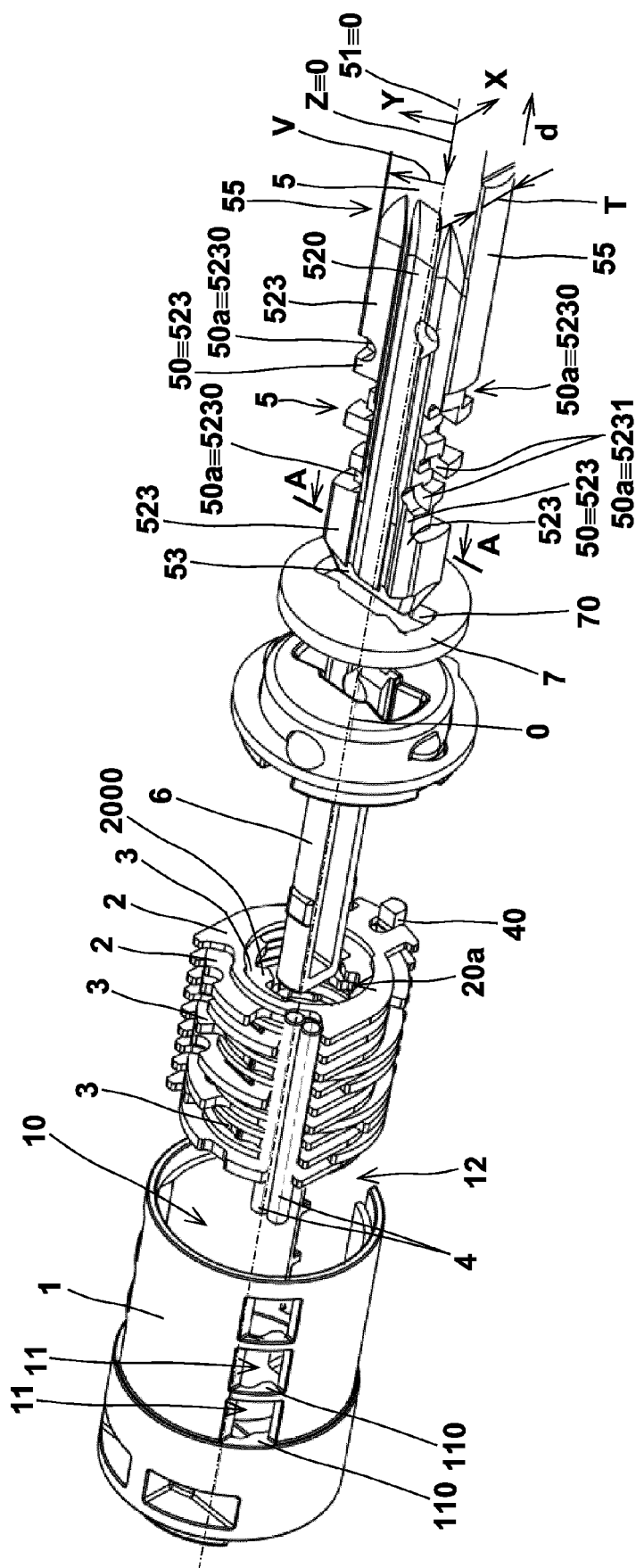


Fig. 2

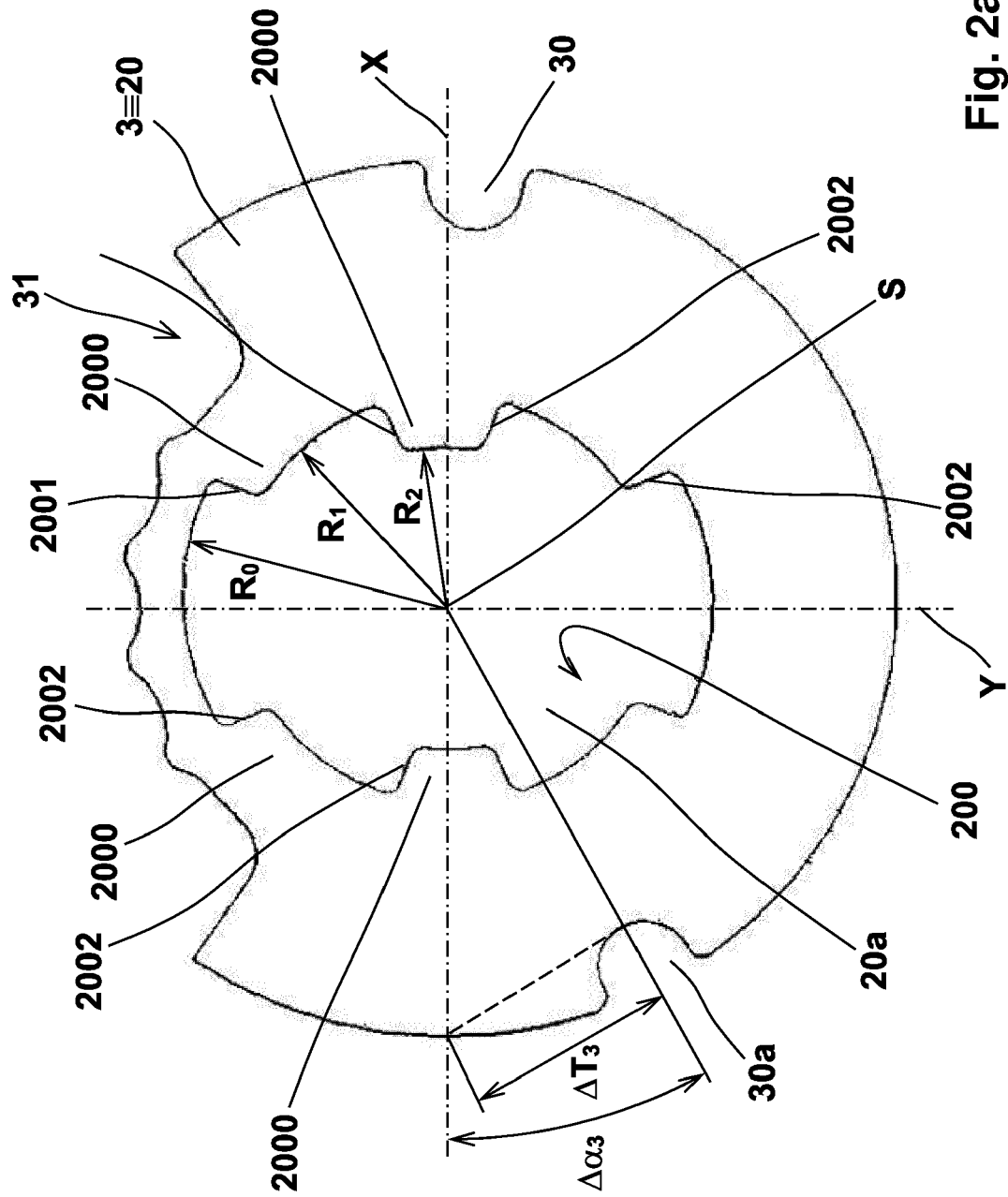


Fig. 2a

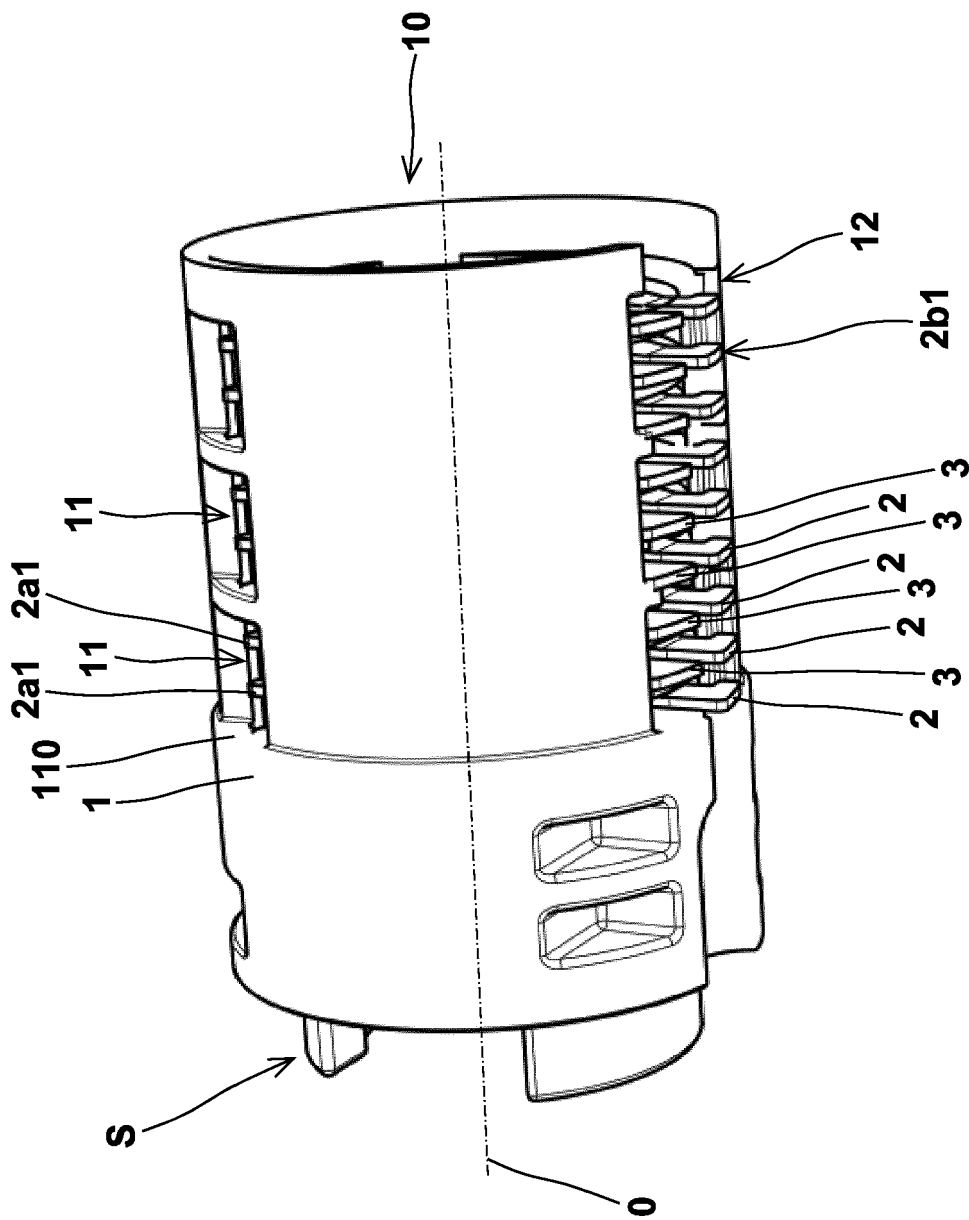


Fig. 2b

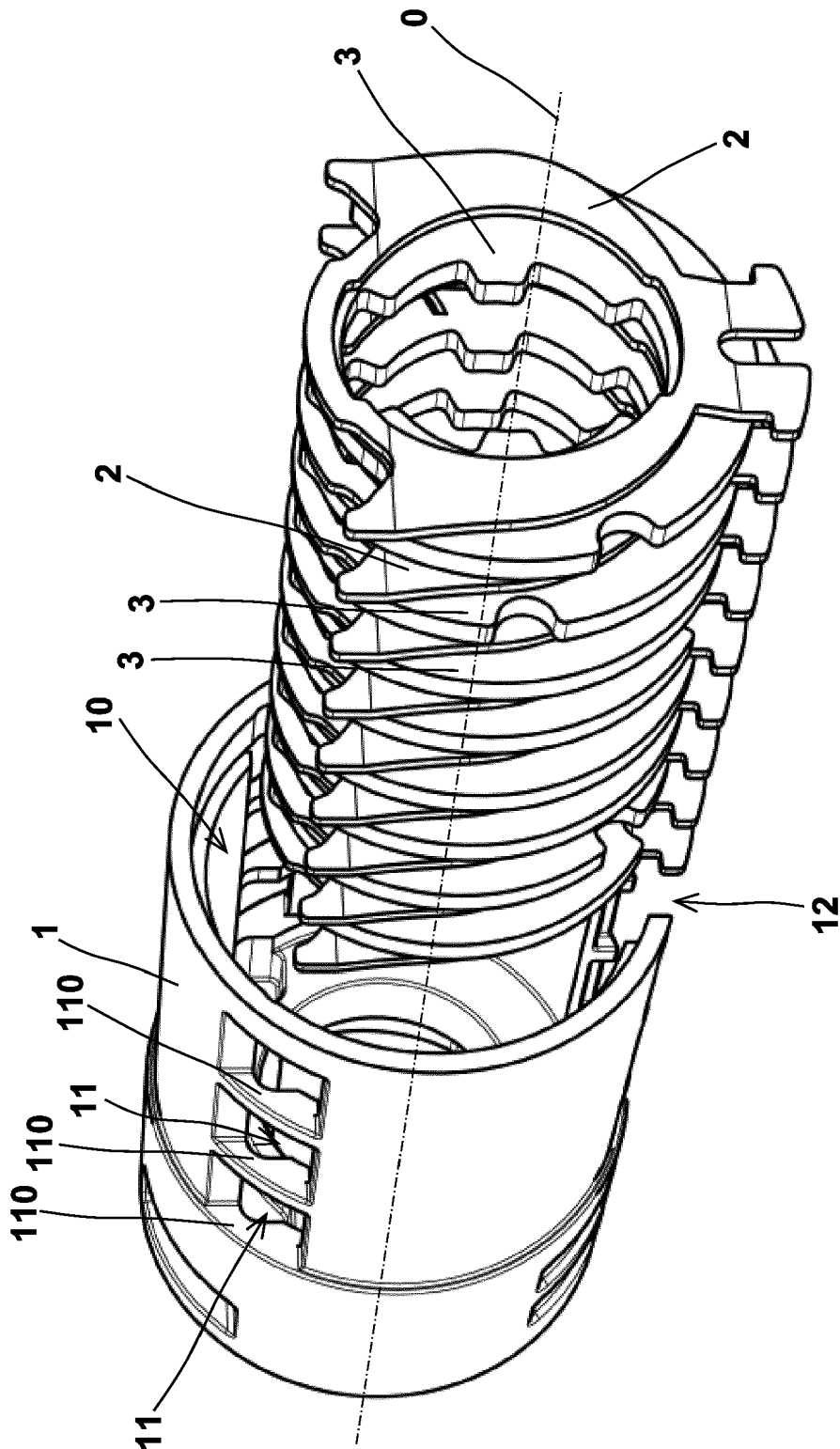


Fig. 2c

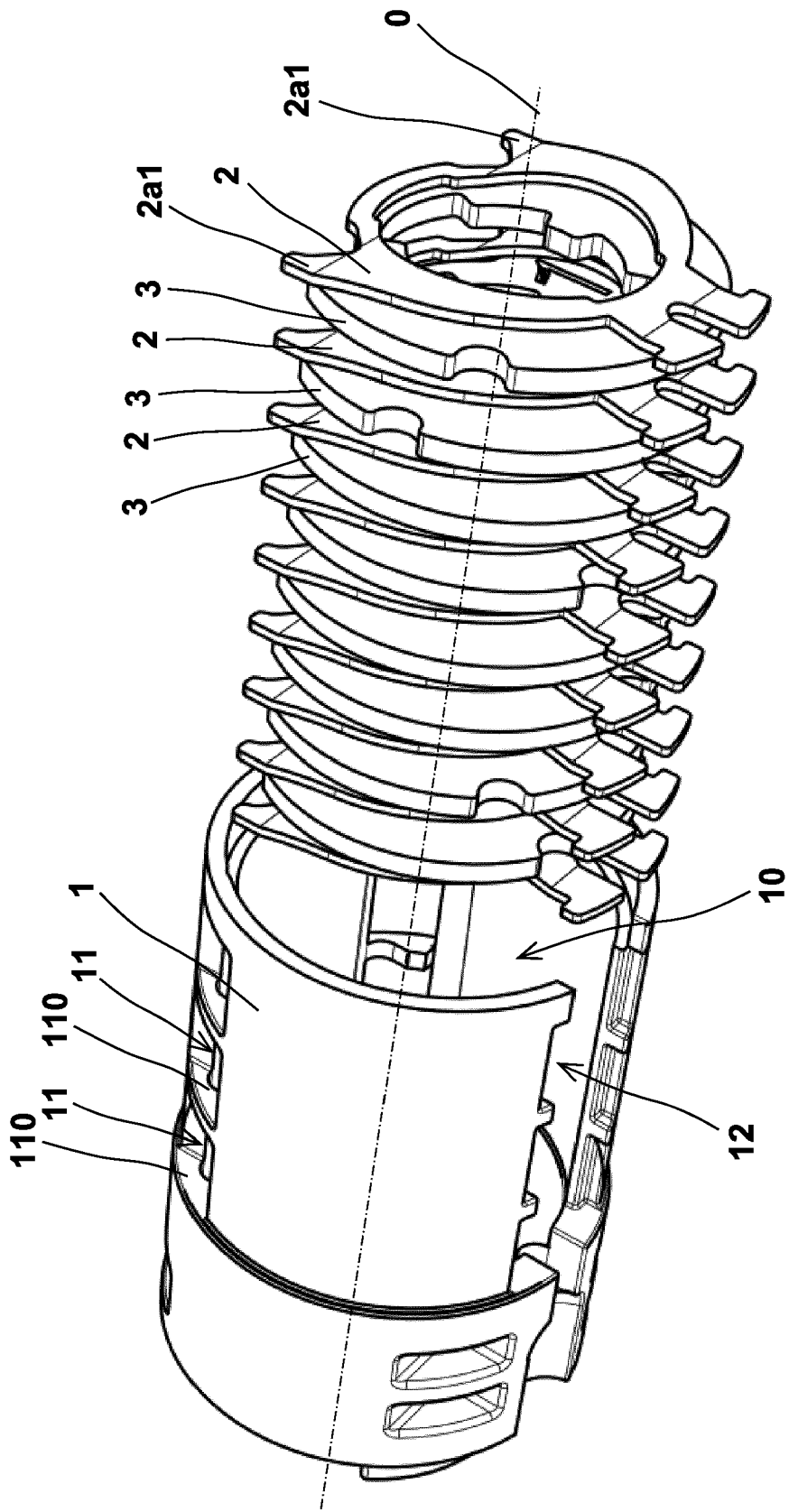


Fig. 2d

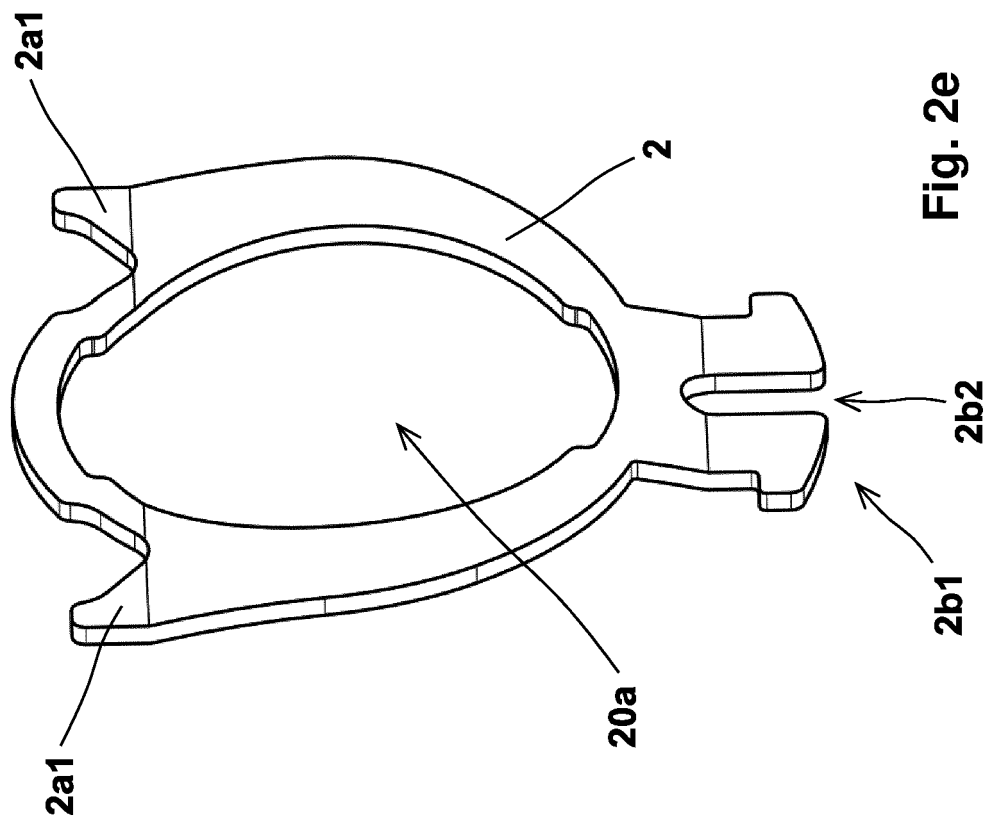


Fig. 2e

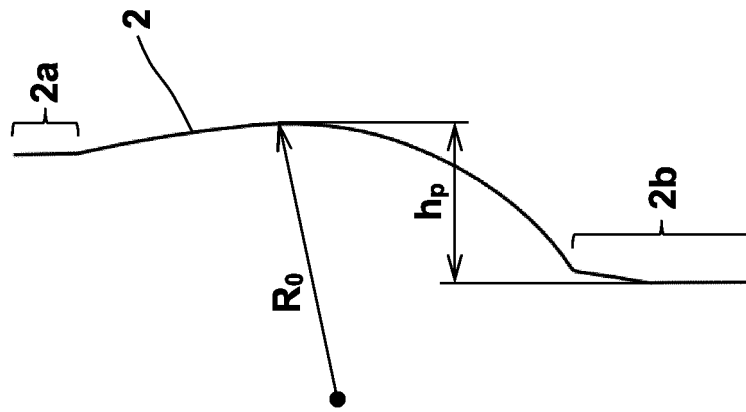


Fig. 2f

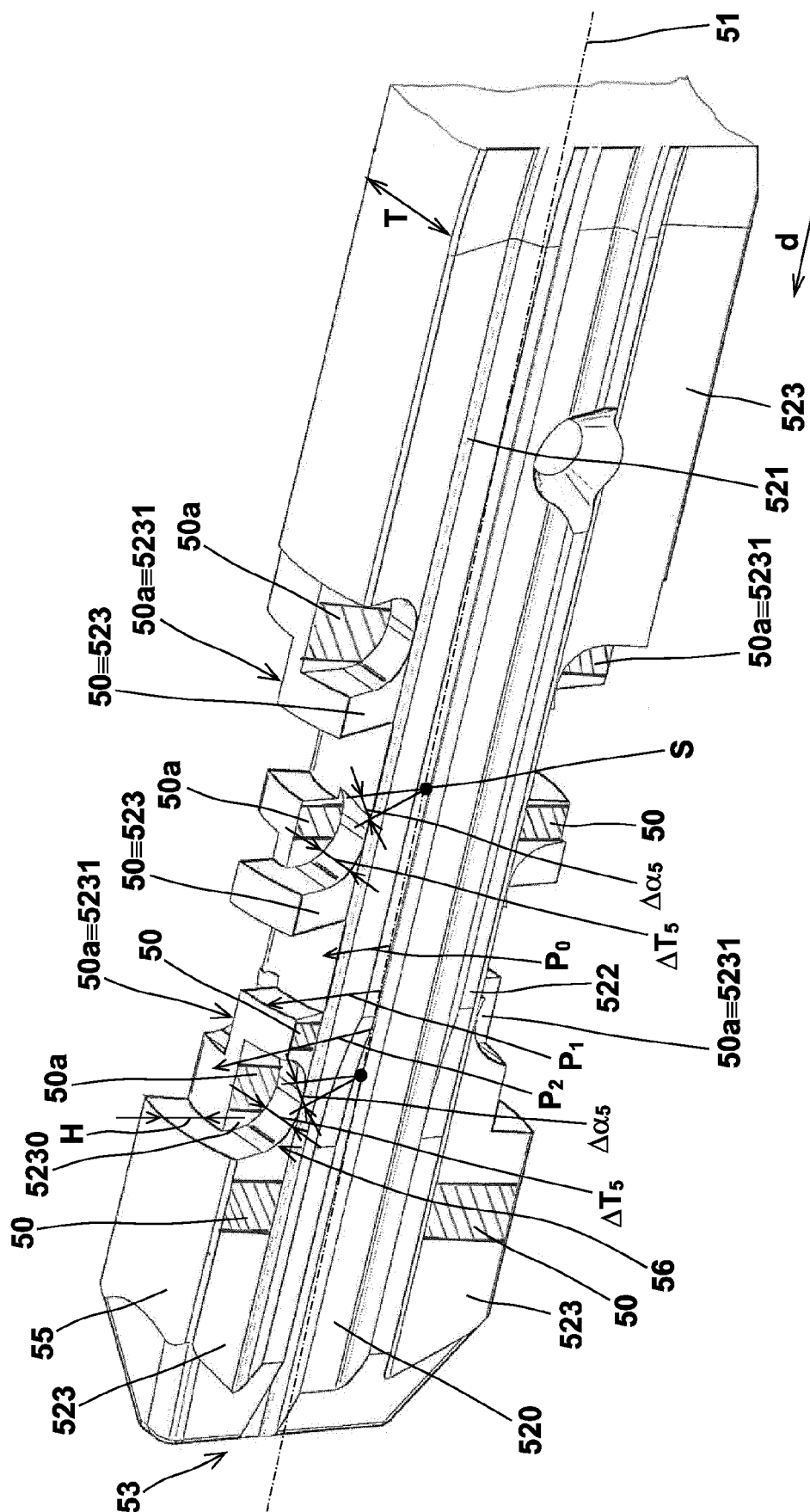


Fig. 3

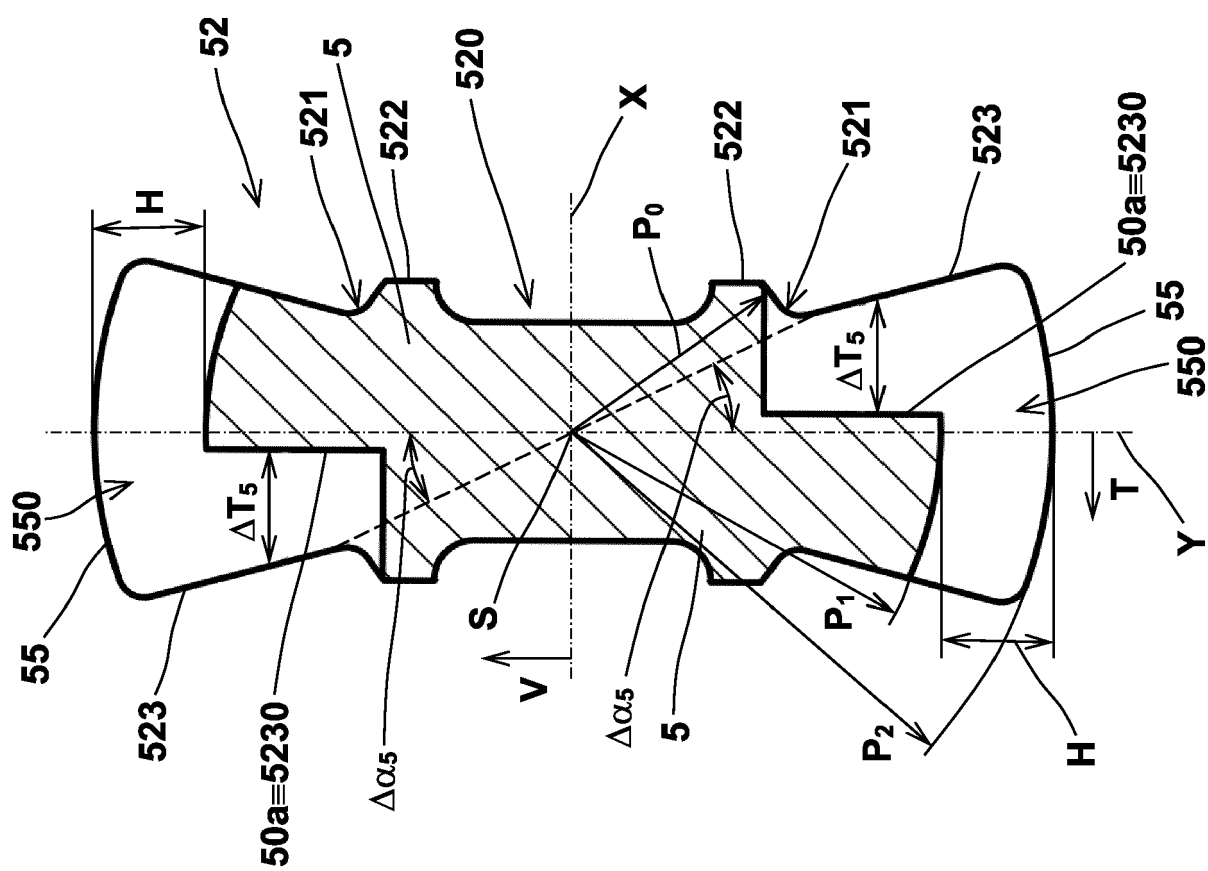


Fig. 4

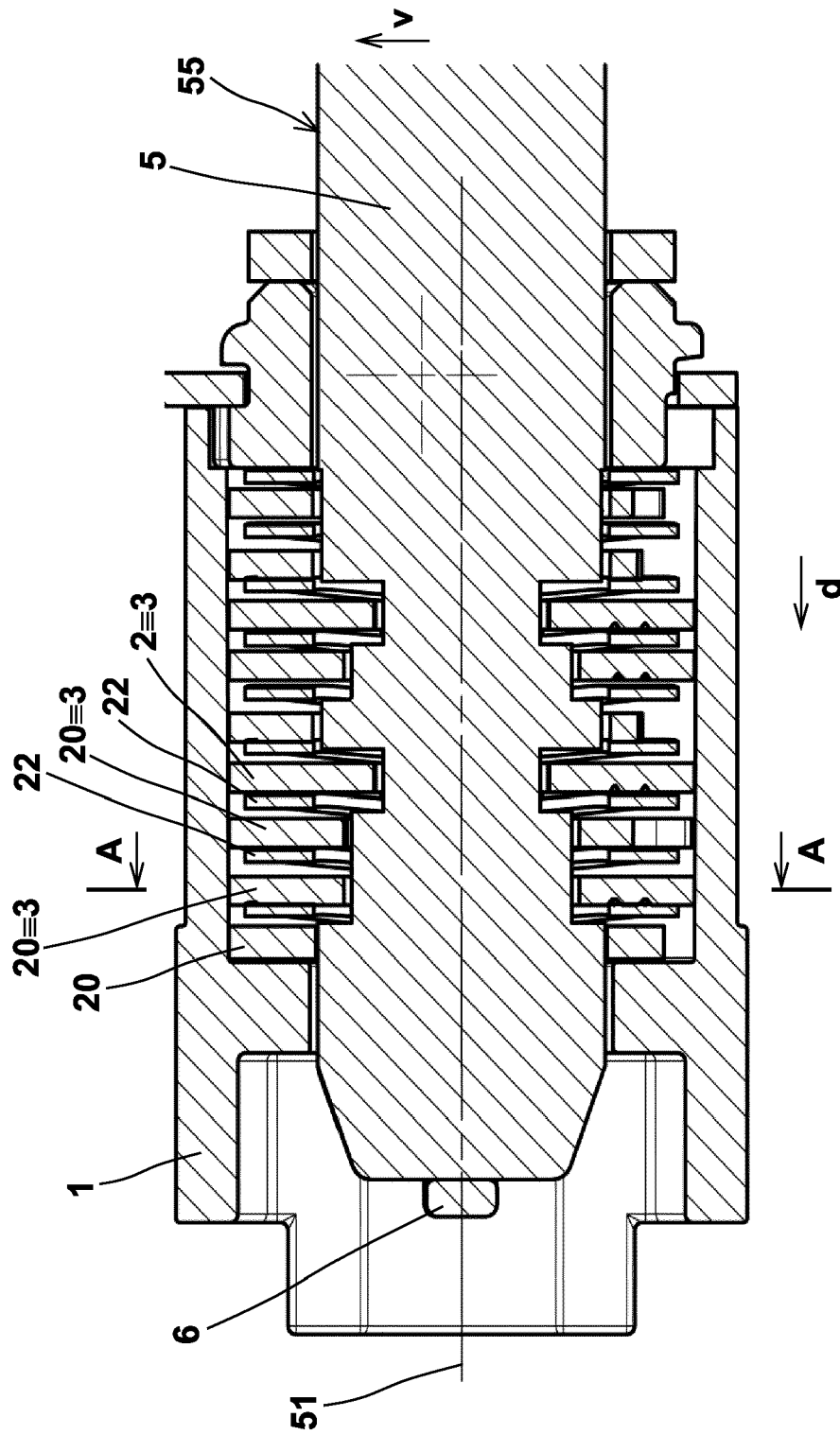


Fig. 5

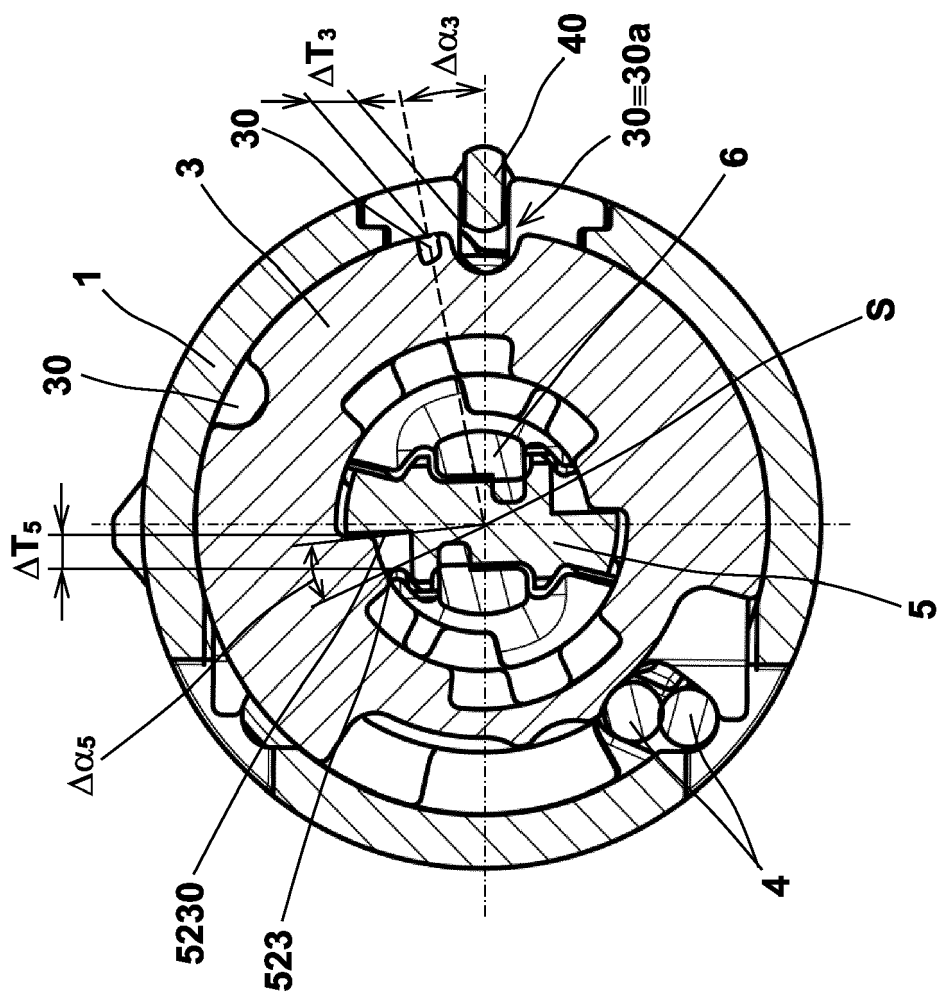


Fig. 5a

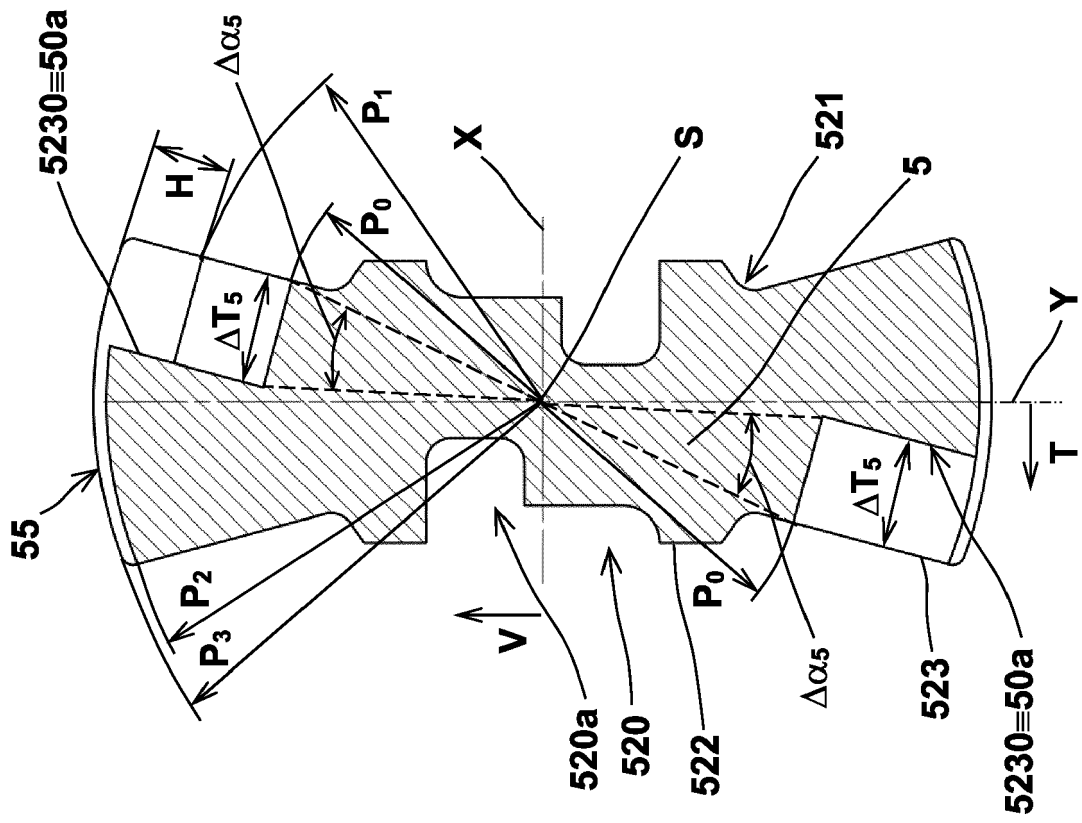


Fig. 6

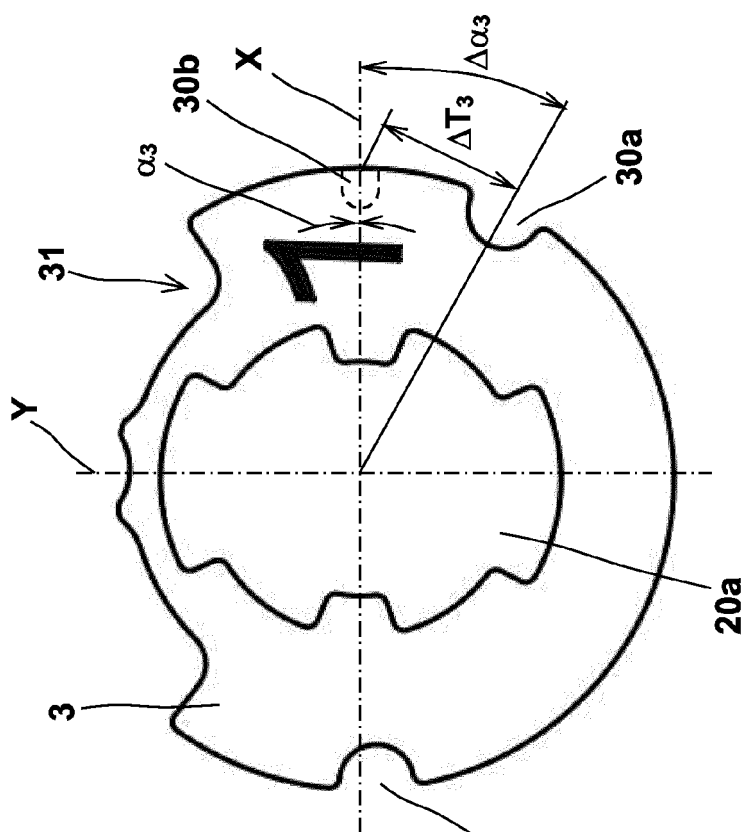


Fig. 7a

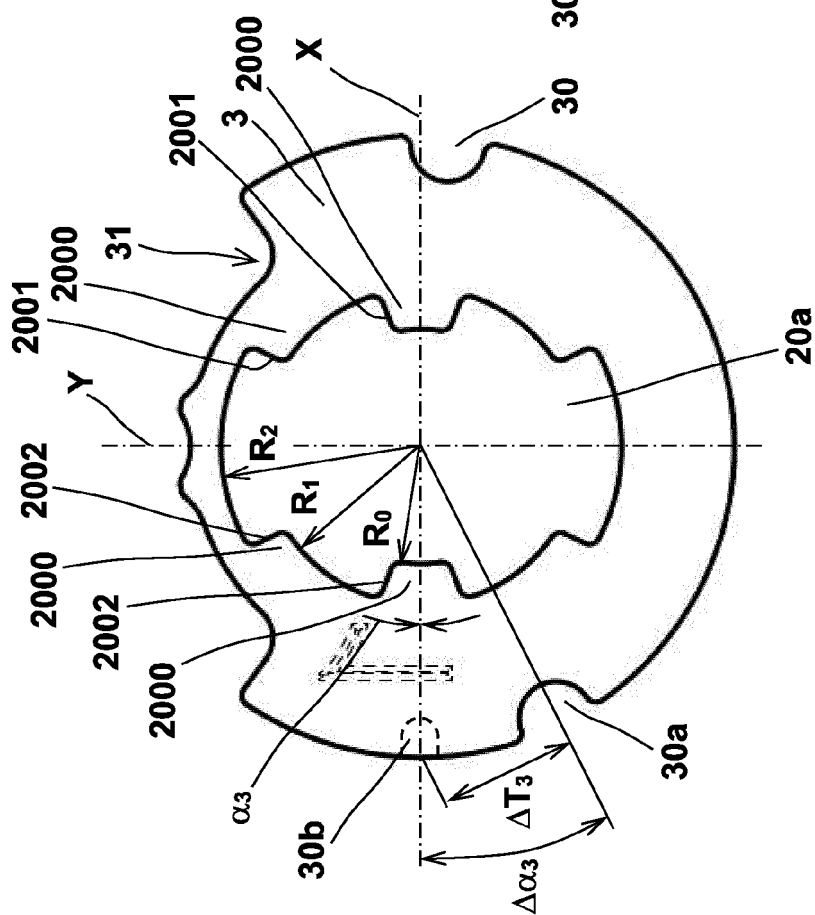


Fig. 7

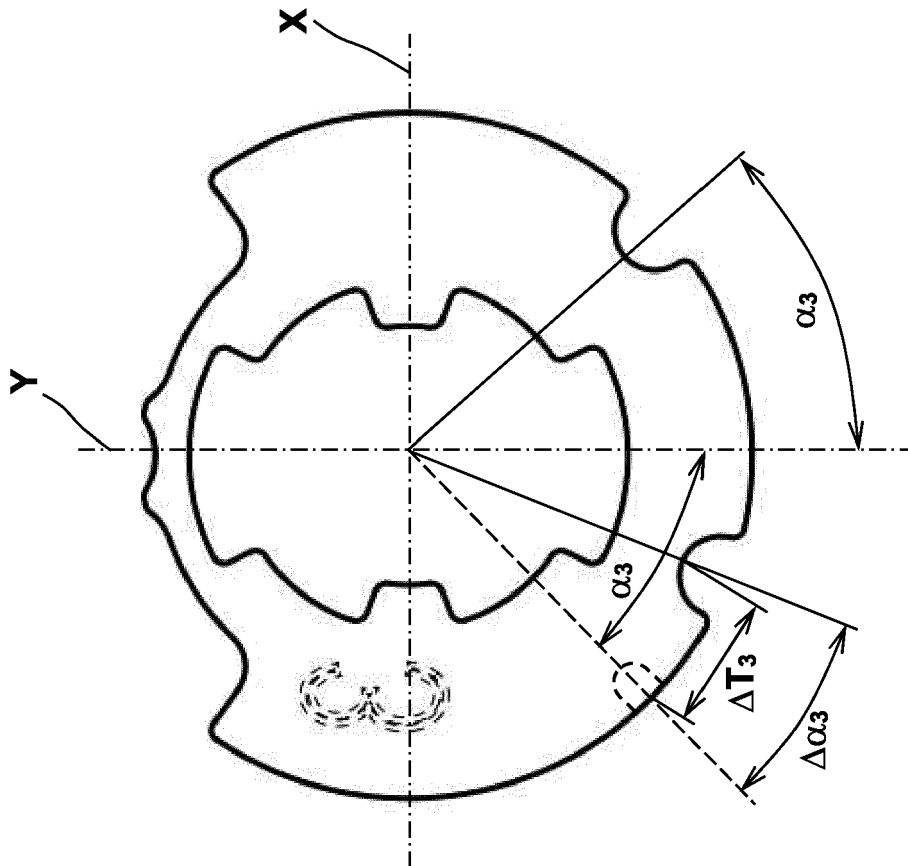


Fig. 7b

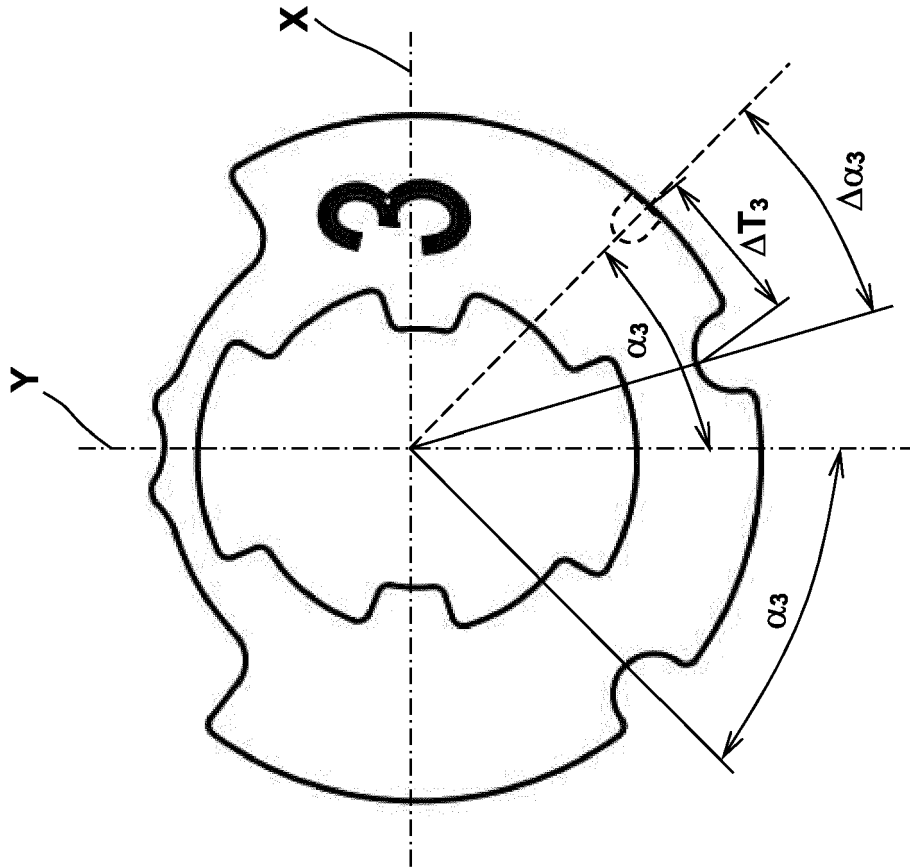


Fig. 7c

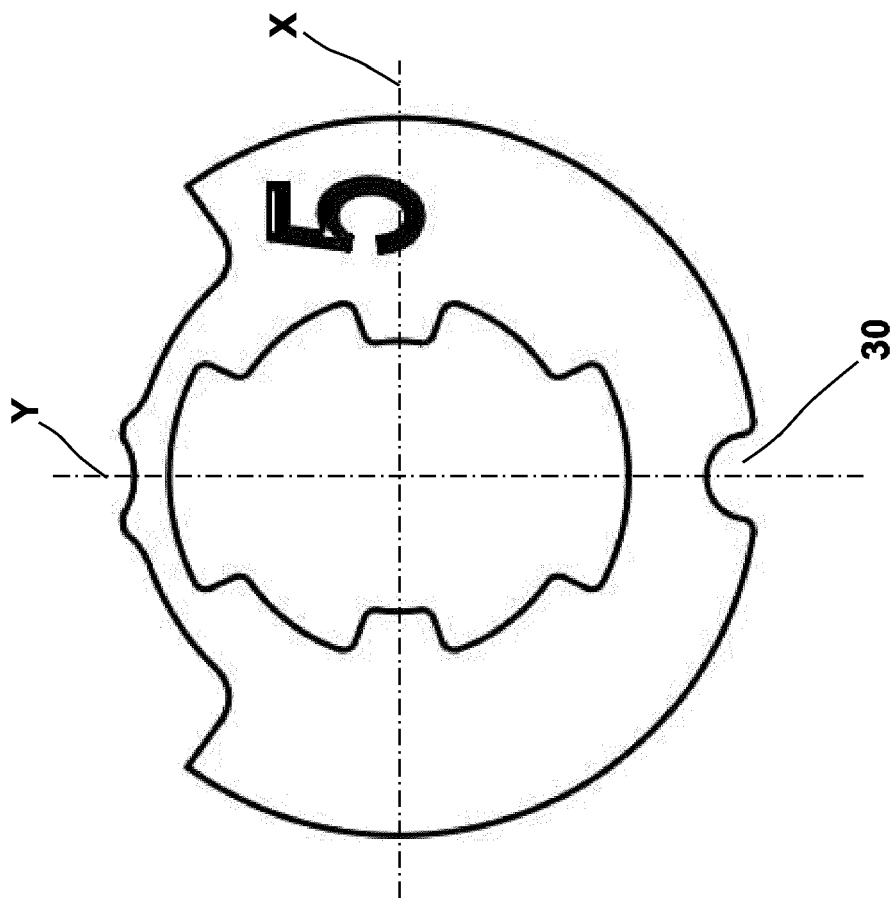


Fig. 7d

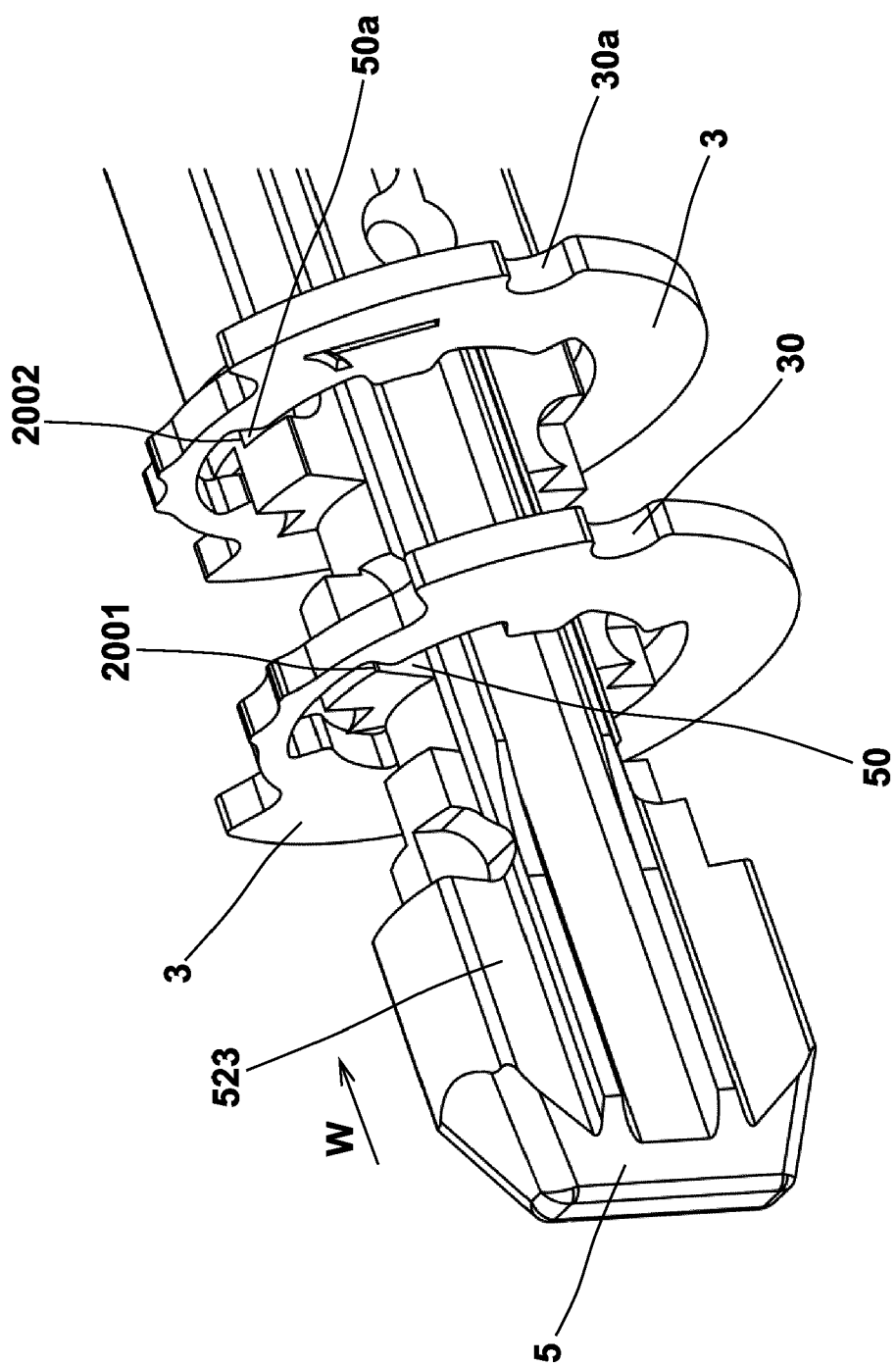
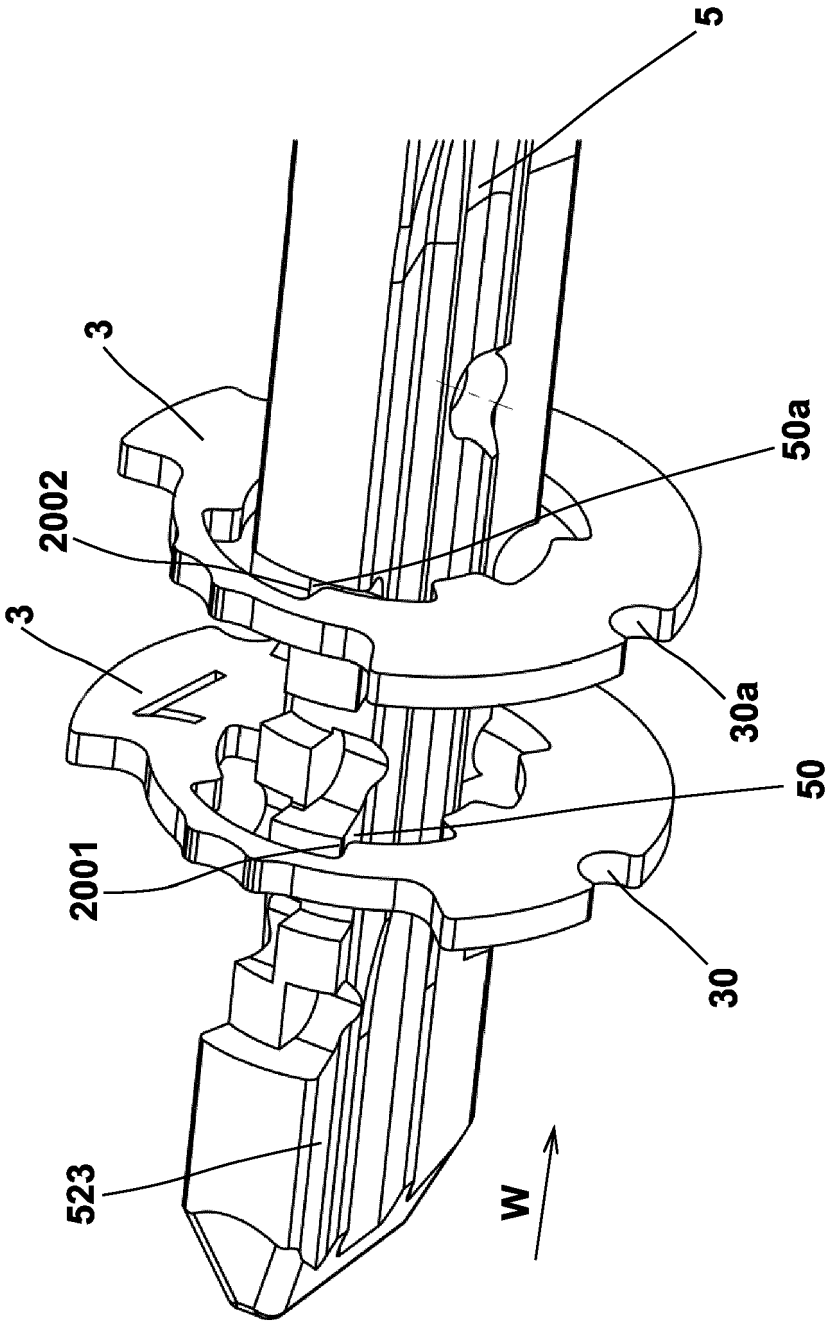


Fig. 7e



(Fig. 7f



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 375 159 A (BECHTIGER CHARLES G [CH] ET AL) 1 March 1983 (1983-03-01)	1-3, 5, 6, 8-12	INV. E05B21/06
A	* the whole document *	4, 7	E05B19/00

A	EP 0 488 619 A1 (ABLOY SECURITY LTD OY [FI]) 3 June 1992 (1992-06-03)	1, 6, 9	
	* the whole document *		

A	US 5 131 248 A (HO IHUI [TW]) 21 July 1992 (1992-07-21)	1, 6, 9	
	* the whole document *		

A	EP 3 045 620 A1 (ABUS AUGUST BREMICKER SÖHNE KG [DE]) 20 July 2016 (2016-07-20)	9	
	* figure 2a *		

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E05B
Place of search		Date of completion of the search	Examiner
The Hague		17 August 2022	Ansel, Yannick
CATEGORY OF CITED DOCUMENTS			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 22 16 6743

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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45

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55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4375159 A	01-03-1983	CH 650055 A5	28-06-1985
		US 4375159 A	01-03-1983
EP 0488619 A1	03-06-1992	AU 640539 B2	26-08-1993
		CA 2055969 A1	31-05-1992
		EP 0488619 A1	03-06-1992
		FI 905909 A	31-05-1992
		JP H04269279 A	25-09-1992
		US 5205143 A	27-04-1993
US 5131248 A	21-07-1992	NONE	
EP 3045620 A1	20-07-2016	CN 105735765 A	06-07-2016
		DE 102014119676 A1	30-06-2016
		DK 3045620 T3	18-11-2019
		EP 3045620 A1	20-07-2016
		ES 2765705 T3	10-06-2020
		TW 201632704 A	16-09-2016
		US 2016186461 A1	30-06-2016

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 989262 A [0004]
- CZ 20100879 [0006]
- CZ 20100843 [0006]
- CZ 20100880 [0006]
- CZ 20100882 [0006]