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Canadian Intellectual Property Office

CA 2739799 C 2018/02/27

(11)(21) 2 739 799

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2011/05/10

(41) Mise à la disp. pub./Open to Public Insp.: 2011/11/30

(45) Date de délivrance/Issue Date: 2018/02/27

(30) Priorité/Priority: 2010/05/31 (DE102010017166.2-14)

(51) Cl.Int./Int.Cl. *B23C 3/35* (2006.01)

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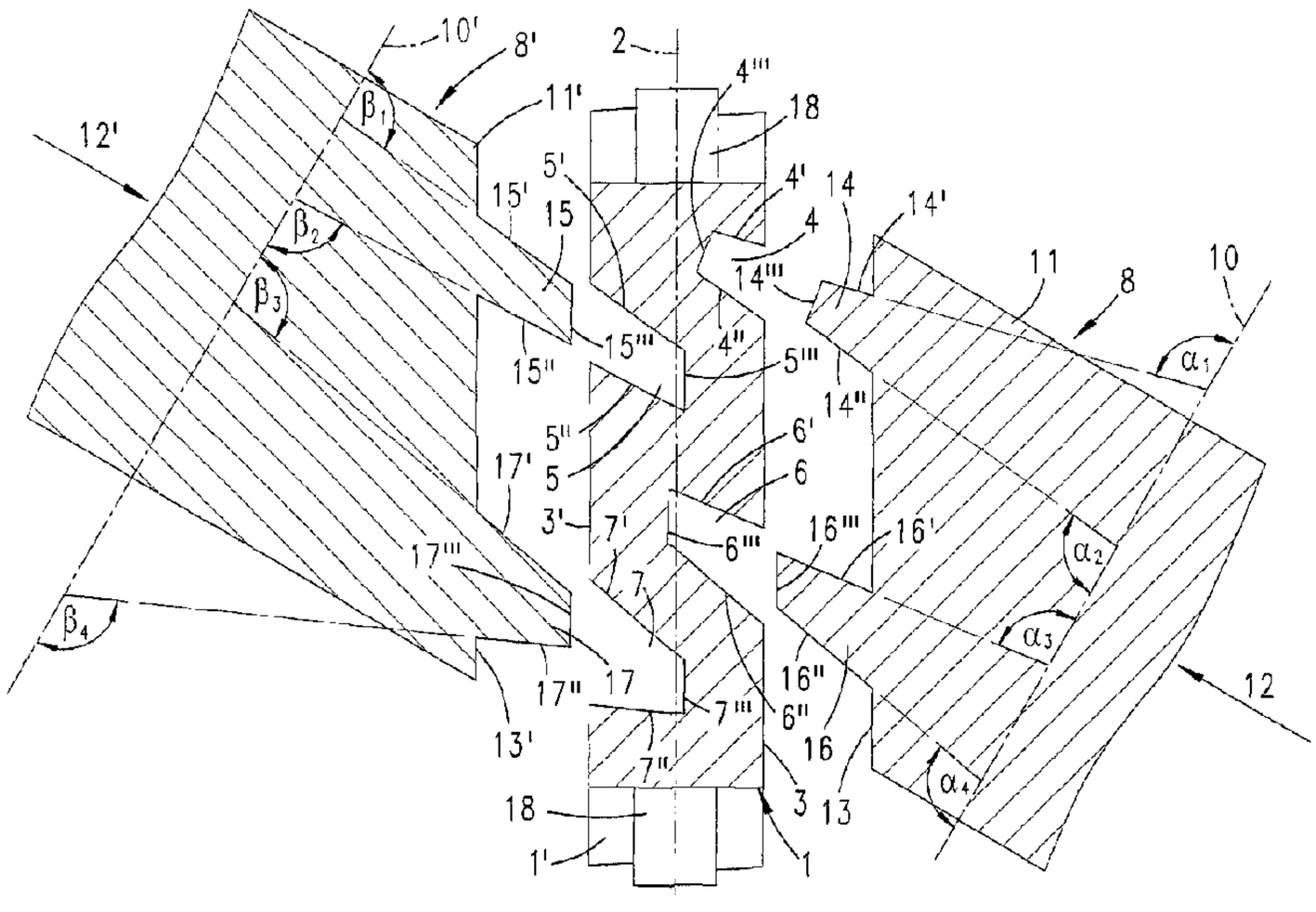
(54) Titre : METHODE DE PROFILAGE D'UNE CLE PLATE ET CLE PLATE PRODUITE SELON CETTE METHODE
(54) Title: METHOD FOR PROFILING A FLAT KEY, AND FLAT KEY PRODUCED ACCORDING TO THE METHOD



(57) Abrégé/Abstract:
The invention relates to a method for profiling the broad sides (3, 3') of a flat key, a key blank (1) being clamped in a clamping device (18) in such a way that the broad side (3, 3') of the key blank is exposed, guide grooves (4, 5) and variation grooves (6, 7) which are complementary to the longitudinal sectional profile of the cutter teeth (11, 11') being milled into the broad side (3, 3') by advance in the longitudinal direction of the key, in one work operation, using a milling cutter (8, 8') that has cutter teeth (11, 11') on its peripheral surface and rotates about a cutter shaft. To produce undercut grooves, it is proposed that the axis of the cutter shaft is inclined at an angle of inclination (φ) relative to the longitudinal center plane (2) of the key (1), ribs (14, 15, 16, 17) of the cutter teeth (11) producing an undercut guide wall (4', 5'') using at least one rib (14, 15). The invention further relates to a flat key, and a lock cylinder having a supplemental tumbler formed by a wear protection pin.

Abstract

The invention relates to a method for profiling the broad sides (3, 3') of a flat key, a key blank (1) being clamped in a clamping device (18) in such a way that the broad side (3, 3') of the key blank is exposed, guide grooves (4, 5) and variation grooves (6, 7) which are complementary to the longitudinal sectional profile of the cutter teeth (11, 11') being milled into the broad side (3, 3') by advance in the longitudinal direction of the key, in one work operation, using a milling cutter (8, 8') that has cutter teeth (11, 11') on its peripheral surface and rotates about a cutter shaft. To produce undercut grooves, it is proposed that the axis of the cutter shaft is inclined at an angle of inclination (φ) relative to the longitudinal center plane (2) of the key (1), ribs (14, 15, 16, 17) of the cutter teeth (11) producing an undercut guide wall (4', 5") using at least one rib (14, 15). The invention further relates to a flat key, and a lock cylinder having a supplemental tumbler formed by a wear protection pin.

Method for profiling a flat key, and flat key produced according to the method

The invention relates to a method for profiling the broad side of a flat key, a key blank being clamped in a clamping device in such a way that the broad side of the key blank is exposed, guide grooves and variation grooves which are complementary to the longitudinal sectional profile of the cutter teeth being milled into the broad side in one work operation, using a milling cutter that has cutter teeth on its peripheral surface and rotates about a cutter shaft.

Flat keys produced according to a method of this kind have an elongate key shank whose broad sides are profiled with alternating grooves and ribs. The ribs and grooves extend in the direction of the longitudinal extent of the key shank. At one end, the key shank has a key tip via which the key may be inserted into a profiled key channel, which is substantially complementary to the key profile, of a lock cylinder. The key shank originates from a key bow at the end opposite from the key tip. Such flat keys have a back, which is formed by a narrow side of the key shank, and a key front face situated opposite from the back and having notched indentations of varying depths which represent the lock code. The grooves and ribs directly adjacent to the back perform a guide function in order to guide the key in the key channel of the lock cylinder. The key channel forms complementary grooves and ribs, so that in this region grooves and ribs of the key, i.e., of the walls of the key channel, interengage in a guiding manner. The portion of the key shank having the indentations is likewise provided with ribs and grooves which may have different rib heights and groove depths in order to individualize keys or locking systems. Locking hierarchies are usually developed

by these variation grooves. However, locking hierarchies may also be developed by means of different profilings, i.e., rib heights and groove depths, of the guide grooves. Essentially the only difference between guide grooves and variation grooves is that the variation grooves are situated in the region of the indentations on the front side, i.e., are interrupted in places by cut edges in the longitudinal direction of the key shank.

A generic method for producing such a key is disclosed in DE 10 2007 057 407 A1. As described therein, the key blank is clamped between two clamping jaws so that one of the two broad sides is exposed. The broad sides are profiled using a milling cutter having cutter teeth on its peripheral surface which have a profile that is complementary to the profiled grooves and profiled ribs of the key shank being produced. The key is advanced in the direction of extent of the shank. The axes of the milling cutters, which are rotationally driven by an electric motor, extend parallel to the plane of the broad side of the key. This means that these axes extend perpendicularly to the surface normal of the plane of the broad side.

A similar device which may be used to carry out the generic method is disclosed in DE 100 49 662 C2. Here as well, grooves and ribs are milled parallel to the direction of extent of the key, using a milling cutter which is rotationally driven about a rotational axis that extends parallel to the plane of the broad side of the key. This method may be used to mill only grooves or ribs whose groove walls or rib walls, respectively, define a positive angle relative to the key normals. The flank angles of the cutter tooth ribs are greater than 90°. Therefore, the flank angles of the grooves are also greater than 90°. The magnitude of the clearance angle relative to the vertical is usually 3° in order to avoid harmful friction of the

cutter teeth against the groove walls.

DE 694 21 093 T2 describes the production of undercut profiled grooves on a key blank, using cutting discs which are driven about rotational axes that are inclined with respect to the plane of the broad side of the key.

It is known from DE 35 42 008 to produce undercut grooves by applying a disc to the broad side of a key.

DE 33 14 511 A1 describes a flat key, wherein grooves having an undercut groove wall are cut on each of two oppositely situated broad sides.

A key profile is likewise known from DE 10 2005 036 113 A1, wherein groove walls of the profiled grooves are undercut. Here as well, the undercut grooves must be milled in a separate work operation, using inclined cutting discs.

It is an object of the invention to provide a method for producing key profiles having at least one undercut groove wall, wherein each broad side may be profiled in a single work operation.

The object is achieved by the invention specified in the claims.

It is first and primarily provided that the axis of the cutter shaft is inclined at an angle of inclination relative to the longitudinal center plane of the key. This angle of inclination defines the maximum possible undercut angle of the at least one undercut groove. The ribs or grooves of the cutter teeth originate from an at least virtual frustoconical lateral surface having a cone angle which corresponds to the

angle of inclination. This frustoconical lateral surface is situated in the region of the cutter tooth engagement, parallel to the longitudinal center plane, i.e., the plane of the broad side of the key blank. At least one groove flank of one of the cutter teeth has a flank angle relative to the rotational axis of the milling cutter which is small enough for this cutter tooth flank to produce an undercut groove wall. In the method according to the invention, the unprofiled key is first clamped between two clamping jaws, so that one of the two mutually parallel broad sides of the key blank is exposed. The other broad side of the key blank is supported on a support surface situated between the two clamping jaws. The clamping jaws preferably engage at the two oppositely situated longitudinal narrow sides of the key shank, i.e., at the front and the back of the blank. The rotational axis of the milling cutter with which the first broad side of the key blank is profiled extends at an angle relative to the broad side of the key. The cutter ribs of the cutter teeth project from the peripheral surface of the cutter head which extends substantially on a conical lateral surface. The cutter teeth are brought into engagement with the broad side of the key blank to be machined by advancing the cutter head transverse to the milling cutter axis. Either the cutter head or the key blank is then advanced in the direction of the longitudinal axis of the key, so that a broad side surface of the key blank is machined in one work operation. After this first machining step, the key is removed from the clamping device with the aid of a gripper arm, for example, and is placed in a second clamping device, in which the already profiled broad side surface of the key shank now faces the support surface of the clamping device, so that the second broad side of the key which has not yet been profiled is exposed. This second broad side of the key is then similarly milled using a second cutter head, it being possible here as well to provide undercut groove walls in the key shank. The cutter shaft of this second milling cutter is preferably inclined by the same angle relative to the plane of the broad

side of the blank. Coding notches which represent the lock code of the key are then cut into the front face of the key, these notches extending only over the region of the key shank having variation grooves or variation ribs. At least one of the guide grooves preferably has an undercut groove wall. The variation grooves preferably have no undercuts, thus avoiding sharp edges in the region of the indentation flanks of the coding notches. The key shank preferably has at least two paracentric groove pairs. There is a longitudinal plane through the key shank which in each case extends through a groove in the two broad sides. As a result, corresponding ribs which project from the walls of the key channel of the lock cylinder overlap. The angle of inclination of the cutter shaft relative to a plane of the broad side is preferably between 5° and 50°. This angle is particularly preferably between 10° and 40°. Both broad sides are preferably machined with milling cutters whose axes extend at an angle relative to the center plane of the key. These angles of inclination are preferably the same. The profiles of the key may be dry-machined when the flank angles of the cutter tooth ribs are greater than 90°, preferably greater than 92°.

The flat key produced according to the above-described method has at least one undercut groove. A groove having an undercut groove wall preferably extends in each of the two broad sides. These undercut grooves are preferably guide grooves. The coding indentations, which are introduced into the profiled key on the front side, are preferably situated only in a region of variation grooves having groove walls without undercuts. The two groove flanks of each profiled groove of the key converge in the direction of the groove base. The two flanks of each profiled rib of the key diverge in the direction of the groove base. In a refinement of the invention, it is provided that the milling cutters are profiled in such a way that they machine broad side portions of the key shank so that the surface thereof is

situated on a portion of a cylindrical lateral surface. This may be an outer cylindrical lateral surface or an inner cylindrical lateral surface. These curved portions of the key shank are associated with the region of the key shank in which the coding indentations are also situated. A negatively curved portion may be situated opposite from a positively curved portion. The associated outer cylindrical lateral surface wall is part of a cylinder which is coaxial with the cylinder on the opposite side that generates the portion of an inner cylindrical lateral surface.

The invention further relates to a flat key, wherein grooves which in each case are associated with a broad side have first groove walls which are associated with a first narrow side of the key, and which have a first flank angle relative to the center plane of the key, i.e., the plane of the broad side of the key, and have second groove walls which are associated with a second narrow side of the key and which have a second flank angle. For such a key profile, it is provided that at least one first flank angle of one, preferably of each, broad side is less than 90°. However, at least one further first flank angle should be greater than 90°. The sum of the two flank angles is greater than 90°, and in particular may be at least 93°. The first flank angles are limited to a range between an angle of inclination of φ and $\varphi + 90°$. The angle of inclination φ is less than 90°. The undercut flank angles, which are less than 90°, are limited to the region of the guide grooves. All flank angles in the region of the profiled grooves are greater than 90°.

The invention further relates to a lock cylinder having a supplemental tumbler formed by a wear protection pin, this tumbler being displaced from a blocking position to a release position when the key is inserted. The wear protection pin is preferably acted on by the rib of the key. A stop bevel may be provided for this

purpose. An undercut wall of a guide rib or an undercut wall of a guide groove is particularly suited for controlling movement of the wear protection pin from its blocking position to its release position. The wear protection pin is made of a fairly hard material, and is preferably composed of a hard metal plate. This plate is inserted into a receiving opening in the cylinder core. A further wear protection pin is preferably situated opposite the cylinder core. The wear protection pin is movable in a plane parallel to the center plane of the key, and is moved into the locked position when acted on by a spring. The wear protection pin has a recess in which the laterally projecting actuating rib of the key shank is able to engage. When the key tip is inserted into the key channel, the tip portion of this actuating rib strikes against a stop bevel in order to move the wear protection pin, which is designed as a locking pin, into its release position. The lock cylinder may also have further supplemental tumbler elements which may also be moved by swiveling from a blocking position to a release position.

An exemplary embodiment of the invention is explained below with reference to accompanying drawings, which show the following:

Figure 1 shows in a rough schematic manner the spatial arrangement of a clamped key blank in relation to a milling cutter 8 which machines a broad side 3,

Figure 2 shows an enlarged illustration which schematically shows the key blank 1 which is machined on both sides, and the two cutter teeth 11, 11' which machine the broad side profile,

Figure 3 shows an illustration corresponding to Figure 2, but with the cutter

teeth illustrated in engagement,

Figure 4a shows the cutter engagement during milling of the first broad side of the key,

Figure 4b shows the cutter engagement during milling of the second broad side of the key,

Figure 5 shows the finished key profile,

Figure 6 shows a lock cylinder with a key inserted therein,

Figure 7 shows a cross-section corresponding to line VII–VII in Figure 6, with the key not inserted,

Figure 8 shows a cross-section corresponding to line VIII–VIII in Figure 7,

Figure 9 shows an illustration corresponding to Figure 7, with the key inserted,

Figure 10 shows an illustration corresponding to Figure 8, with the key inserted,

Figure 11 shows a cross-section corresponding to line XI–XI in Figure 6,

Figure 12 shows a cross-section corresponding to line XII–XII in Figure 11,

Figure 13 shows the view of a broad side of a flat key, and

Figure 14 shows a cross-section corresponding to line XIV–XIV in Figure 13 for illustrating the flank angles.

Figure 1 shows the spatial relationship between the key blank 1 and the milling cutter 8. The key blank, which has a key shank having parallel broad sides 3, 3' and a key bow 1', is held in a clamping device by clamping means, not illustrated, for example by the two clamping jaws 18 indicated in Figure 2. The two planes of the broad side 3, 3' of the key, which extend parallel to the longitudinal center plane 2 of the key blank, define a reference plane. The shaft axis 9 about which a profile cutter 8 is rotated is inclined by an angle φ relative to the longitudinal center plane 2 of the key blank 1. In the exemplary embodiment, the angle of inclination φ is approximately 30°.

The milling cutter 8 has a peripheral surface which extends substantially on a conical lateral surface 13, the cone opening angle corresponding to the angle of inclination φ. As a result, a line drawn through the conical lateral surface 13 in the region of the teeth engagement in the plane of the broad side of the key blank 1 extends parallel to the plane of the broad side of the key blank. The milling cutter 8 has a multiplicity of cutter teeth 11 on its peripheral surface which have cutter tooth ribs and cutter tooth grooves having a profile complementary to that of the guide grooves 4, 5 or variation grooves 6, 7 of the key to be produced.

For profiling one of the two broad sides 3, 3' of the key blank that face away from one another, the milling cutter 8 which is rotationally driven about the shaft axis 9 is advanced. In the illustration corresponding to Figure 1, the direction of advancement corresponds to a displacement of the milling cutter 8, perpendicular to the shaft axis 9, to the left. Either the milling cutter 8 or the key blank 1, i.e.,

the clamping device gripping the key blank 1, is then displaced in the direction of extent of the key shank. In the illustration corresponding to Figure 1, this displacement occurs perpendicular to the plane of the drawing.

Figure 2 schematically shows, in a direct comparison, the cross-section of a milling cutter 8, which profiles the broad side 3 of the key, and the cross-section of a milling cutter 8', which profiles the opposite broad side 3' of the key face. Also indicated in Figure 2 are two clamping jaws 18 which clamp the key front face and the key back face therebetween.

The milling cutter 8 has a multiplicity of cutter teeth 11, only one of which is illustrated in cross-section. For simplicity, the cutter tooth 11 is illustrated with only one cutter tooth rib 14 for producing a guide groove 4, and only one cutter tooth rib 16 for producing a variation groove 6. In this case, both ribs 14, 16 originate from a conical lateral surface 13. The conical lateral surface 13 may be an imaginary plane. For producing more complex key profiles, such as that shown in Figure 5, for example, milling cutters 8 are used in which the conical lateral surface 13 is not physically provided.

Milling cutter 8' is likewise illustrated with only two ribs 15, 17, one rib 15 milling a guide groove 5 and one rib 17 milling a variation groove 7. Here as well, both cutter tooth ribs 15, 17 originate from a physically provided conical lateral surface 13'.

Auxiliary lines 10, 10' extend parallel to the shaft axes 9, which are not illustrated in Figure 2 but are illustrated in Figure 3. The auxiliary lines 10, 10' are used to show the flank angles α_1 through α_4 and β_1 through β_4 of flank angles 14', 14", 15',

15", 17', 17", 16', 16" of the cutter tooth ribs 14, 15, 16, 17, respectively.

The cutter tooth rib 14 has two cutting flanks 14', 14" which converge at an acute angle, and an inclined cutter tooth head line 14"'. Angles α_1, α_2, by which the cutter tooth flanks 14', 14" are respectively inclined with respect to the shaft axis 9, i.e., auxiliary line 10, are greater than 90°. However, it is apparent from Figure 2 that the groove wall 4' of the guide groove 4 produced by the cutter tooth flank 14' is an undercut groove. The cutter tooth 8 is advanced in the direction of advancement denoted by reference numeral 12. A flatly extending groove flank 4" is produced by the cutter tooth flank 14".

A similar, likewise undercut guide groove 5 is milled using the cutter tooth rib 15 of the milling cutter 8'. Here as well, the flank angles β_1, β_2 respectively defined by the cutter tooth flanks 15', 15" relative to the rotational axis, i.e., auxiliary line 10, are greater than 90°. In this case, the head line 15"' extends parallel to the longitudinal center plane 2, resulting in a groove base 5"' which extends parallel to the longitudinal center plane 2.

A variation groove 6 is milled using the cutter tooth rib 16 of the milling cutter 8. In this case, the head line 16"' of the cutter tooth rib 16 extends at an angle relative to the rotational axis 9 such that a groove base 6"' is produced which extends parallel to the longitudinal center plane 2. The two grooves 6, 5 are paracentric with respect to one another, since the longitudinal center plane 2 extends through groove 5 as well as through groove 6 on the oppositely situated broad side.

Groove 6 is likewise paracentric with respect to variation groove 7, which is

associated with the oppositely situated broad side 3' and which likewise has a groove base 7"' extending parallel to the longitudinal center plane 2. The groove walls 6' and 6" of the variation groove 6, the same as the groove walls 7', 7" of the variation groove 7, may have no undercuts. The flank angles α_3, α_4 of flanks 16', 16", respectively, relative to the auxiliary line 10, i.e., the shaft axis 9, have corresponding values. The values of flank angles β_3 and β_4 of flanks 17', 17", respectively, may also be such that the groove walls 7', 7" produced by the flanks 17', 17" have no undercuts.

Whereas the method has been explained in a strictly schematic manner with reference to previously described Figures 1 through 3, a first exemplary embodiment for producing a key profile is explained below with reference to Figures 4a through 5. The key shank of the key blank 1 is once again clamped in a clamping device. The milling cutter 8 is used to introduce a corresponding broad side profile into the broad side 3 of the key blank. It is apparent that a guide groove 5 having only a single groove wall 5" is undercut, since the single groove wall 5" of this guide groove 5 has a negative angle relative to the surface normal of the broad side of the key.

In the region of the variation groove 7, the finished milled broad side of the key shank extends along an inner cylindrical lateral surface, the cylinder generating this inner cylindrical lateral surface having a radius R_1. A likewise curved broad side portion 19 is situated opposite from this curved broad side portion 20. The broad side portion 19 extends on a portion of an outer cylindrical lateral surface wall having a radius R_2. R_1 and R_2 originate from the same center point. Two variation grooves 6 are situated in the curved broad side portion 19.

The milling cutter 8' which machines the plane of the broad side 3' has a cross-sectional contour line of the cutter tooth 11' with an appropriate curvature for milling the cylindrical surface portion 19. Cutter ribs for producing the guide groove 4 and the two variation grooves 6 project from a base area which extends on an imaginary conical lateral surface. The portion of the cutter tooth which produces the guide groove 4 is designed in such a way that the guide groove 4 has an undercut groove flank 4'.

Figure 6 shows a lock cylinder 21 designed as a double locking cylinder. When the appropriate key 1 is inserted into the key channel 23 in question, a lock member 22 may be turned by one of the two cylinder cores which are each rotatably situated in a cavity in the housing of the lock cylinder 21. Supported in the profile portion of the cylinder housing on the base of a pin hole is a pin spring 36 which acts on a housing pin 35 to move same into a locked position. A core pin 34 is also inserted in the pin hole. Overall, a multiplicity of such pin tumblers 34, 35 are provided which in each case may be sorted by the coding indentations of the key 1 into their release position (Figure 9) in which the cylinder core 37 may be turned.

A hard metal plate 28 which forms a wear protection pin is inserted into a cutout provided near the opening of the key channel 23. Situated on the opposite side of the key channel 23 is a bearing opening 33, having the same configuration, which extends parallel to the broad side of the key that is inserted into the key channel 23. A further wear protection pin 29 is displaceably supported in this bearing opening 33. Such wear protection pins are known from DE 10 2007 007 688 A1. Therefore, reference is made to this published document with regard to the mode of operation of these wear protection pins 28, 29.

The movable wear protection pin 29 has a recess 39 in which a profiled rib of the key is able to engage. This is a profiled rib whose rib wall is formed by the undercut wall 5" of the guide groove 5.

As shown in Figure 8, the recess 39 enlarges toward the opening in the key channel 23, forming a stop bevel 40. With the key 1 not inserted, a locking extension 31 of the wear protection pin 29 having a reduced cross-section projects into a locking receptacle 32 in the cylinder housing. The spring 30 acts on the wear protection pin 29 in this direction (see Figure 7).

When a key 1 is inserted into the key channel 23, a front portion of the groove wall 5" slides against the stop bevel 40 and moves the wear protection pin 29 into the position illustrated in Figure 9. This causes the wear protection pin 29 to be moved against the restoring force of the spring 30, so that the locking extension 31 of the wear protection pin leaves the locking receptacle 32. When the key is completely inserted, the wear protection pin 29 is held in the release position illustrated in Figure 10 by the actuating rib which forms the flank 5".

Figures 11 and 12 show further tumbler elements, which prevent the cylinder core 37 situated in a core hole 38 from twisting when the key is not inserted. The supplemental tumbler pins 41 may be swiveled back and forth about a pivot axis which is parallel to the rotational axis of the cylinder core 37, between a blocking position and a release position. The supplemental tumblers 41 have sampling heads which are used to sample a profile of the key shank.

Pivot pins 42 are also provided, which likewise have sampling heads that sample

the broad side profilings of the key shank in order to move a blocking end from a blocking position to a release position.

Figure 13 shows the view of a broad side of a flat key in a preferred exemplary embodiment of the invention. Figure 14 shows a cross section of the key shank, and in particular shows the flank angles of the grooves 4, 5, 6, 7 cut into the broad sides 3, 3' of the key. With regard to the broad side 3 of the key, the narrow side 43 of the key forms a first narrow side with which the first groove flanks 4', 6' are associated. Flank angle γ_4 of groove flank 4' is less than 90°. Flank angle γ_6 of groove flank 6' is greater than 90°. Both flank angles γ_4, γ_6 are greater than an angle of inclination φ, and may have a maximum value which is maximum 90°, greater than the angle of inclination φ.

The oppositely situated broad side 3' of the key also has such first groove flanks 5", 7". In this case the narrow side 44 of the key opposite from the narrow side 43 of the key forms a first narrow side with which at least one undercut groove flank 5" is associated. The groove flank 7" of groove 7 has a flank angle γ_7 which is greater than 90°.

The groove flanks 4", 6", 5', 7' opposite from the respective first groove flanks 4', 6', 5", 7" have a larger flank angle δ_4, δ_5, δ_6, δ_7. The sum of each second flank angle and the respective first flank angle γ_4, γ_5, γ_6, γ_7 is greater than 180°.

It is shown in Figure 13 that grooves 6, 7, whose flank angles γ_6, δ_6 and γ_7, δ_7, respectively, are each greater than 90°, form variation grooves. These grooves 6, 7 are situated in a region in which coding recesses 45 are milled on the front side. In this case, the key front face is formed by the narrow side 44 of the key. The

narrow side 43 of the key opposite from the key front face 44 forms a key back face which is adjacent to guide grooves 4, 5. The two guide grooves 4, 5 each have just one groove flank 4', 5" that has a flank angle γ_4, γ_5 which is less than 90°. Both guide grooves 4, 5 are undercut on one side. On the other hand, none of the variation grooves 6, 7 have undercuts, and instead have groove flank angles γ_6, δ_6, and γ_7, δ_7, respectively, which are greater than 90°, preferably greater than 93°.

List of reference numerals

1 Key blank

1' Key bow

2 Longitudinal center plane

3 Broad side surface

3' Broad side surface

4 Guide groove

4' Groove flank

4" Groove flank

5 Guide groove

5' Groove flank

5" Groove wall, groove flank

5"' Groove base

6 Variation groove

6' Groove wall, groove flank

6" Groove wall, groove flank

6"' Groove base

7 Variation groove

7' Groove wall, groove flank

7" Groove wall, groove flank

7"' Groove base

8 Milling cutter

8' Milling cutter

9 Shaft axis

10 Auxiliary line parallel to shaft axis

11 Cutter tooth

12 Direction of advancement

13 Conical lateral surface

13' Conical lateral surface

14 Cutter tooth rib

14' Cutter tooth flank

14" Cutter tooth flank

14"' Cutter tooth head line

15 Cutter tooth rib

15' Cutter tooth flank

15" Cutter tooth flank

15"' Cutter tooth head line

16 Cutter tooth rib

16' Cutter tooth flank

16" Cutter tooth flank

16"' Cutter tooth head line

17 Cutter tooth rib

17' Cutter tooth flank

17" Cutter tooth flank

18 Clamping jaw

19 Cylindrical surface portion

20 Cylindrical surface portion

21 Lock cylinder

22 Lock member

23 Key channel

24 Profiled rib

25 Profiled rib

26 Profiled rib

27 Profiled rib

28 Wear protection pin

29 Wear protection pin

30 Spring

31 Locking extension

32 Locking receptacle

33 Bearing opening

34 Core pin

35 Housing pin

36 Pin spring

37 Cylinder core

38 Core hole

39 Recess

40 Stop bevel

41 Supplemental tumbler

42 Pivot pins

43 Narrow side of key

44 Narrow side of key

R_1 Radius

R_2 Radius

α_1 Flank angle

α_2 Flank angle

α_3 Flank angle

α_4 Flank angle

β_1 Flank angle

β_2 Flank angle

β_3 Flank angle

β_4 Flank angle

δ_4 Flank angle

δ_5 Flank angle

δ_6 Flank angle

δ_7 Flank angle

γ_4 Flank angle

γ_5 Flank angle

γ_6 Flank angle

γ_7 Flank angle

φ Angle of inclination

Claims

1. A method for profiling at least one broad side of a flat key, a key blank being clamped in a clamping device in such a way that the broad side of the key blank is exposed, guide grooves and variation grooves, which are complementary to the longitudinal sectional profile of cutter teeth of a milling cutter that has cutter teeth on its peripheral surface and rotates about a cutter shaft, being milled into the broad side by advance in the longitudinal direction of the key, in one work operation, characterized in that the axis of the cutter shaft is inclined at an angle of inclination relative to the longitudinal centre plane of the key , ribs of the cutter teeth producing an undercut guide groove wall using at least one rib.

2. The method according to Claim 1, characterized in that all variation grooves have groove walls, which have no undercuts.

3. The method according to any one of Claims 1 to 2, characterized by at least two paracentric groove pairs.

4. The method according to any one of Claims 1 to 3, characterized in that the angle of inclination is between 5° and 50°.

5. The method according to Claim 4, wherein the angle of inclination is between 10° and 40°.

6. The method according to any one of Claims 1 to 5, characterized in that the two broad sides are each machined using a milling cutter whose cutter shaft axes are inclined with respect to the longitudinal centre plane of the key by an angle of inclination.

7. The method according to Claims 6, wherein the angle of inclination is the same for the cutter shaft axes.

8. The method according to any one of Claims 1 to 7, characterized in that the flanks have flank angles, respectively, relative to the cutter axis, which are > 90°.

9. The method according to Claim 8, wherein the flank angles are >92°.

10. A flat key having profile grooves, of which at least one is a guide groove having an undercut groove wall, and of which all variation grooves situated in the region of coding indentations on the front edge have walls, which have no undercuts, characterized in that the flat key is produced according any one of Claims 1 to 9, so that the groove flanks of each profile groove converge in the direction of the groove base.

11. The flat key according to Claim 10, characterized by a broad side portion, extending on a cylindrical lateral surface, which has the variation grooves.

12. The flat key according to Claim 10 or Claim 11, characterized in that a broad side portion extends on an outer cylindrical lateral surface, and the broad side portion situated opposite from this broad side portion extends on an inner cylindrical lateral surface, the two cylindrical lateral surfaces being concentric.

13. The flat key according to any one of Claims 10 to 12, wherein all grooves associated with a broad side of the key, have respective first groove walls, which are each associated with a first narrow side of the key, the first groove walls having a first flank angle relative to the centre plane of the key, and have second groove walls, which are associated with a second narrow side of the key, the second groove walls having a second flank angle relative to the centre plane of the key, at least one first flank angle of one broad side being less than 90°, the first flank angle being in the range of a specified angle of inclination of φ and φ + 90°, and the second flank angle being in a range of the angle of inclination of φ + 90° and 180°, the angle of inclination being between 0° and 90°, all groove walls extending in the region of the coding indentations on the front edge of the key having flank angles which are greater than 90°.

14. The flat key according to Claim 13 wherein at least one first flank angle of each broad side is less than 90°.

15. A lock cylinder for a flat key according to any one of Claims 10 to 12, characterized by a wear protection pin which may be displaced by a wall, of a guide groove or a guide rib, from a locked position to a release position, when the key is inserted into a key channel of the lock cylinder.

16. The lock cylinder according to claim 15, wherein the wall is an undercut wall.

Fig. 1

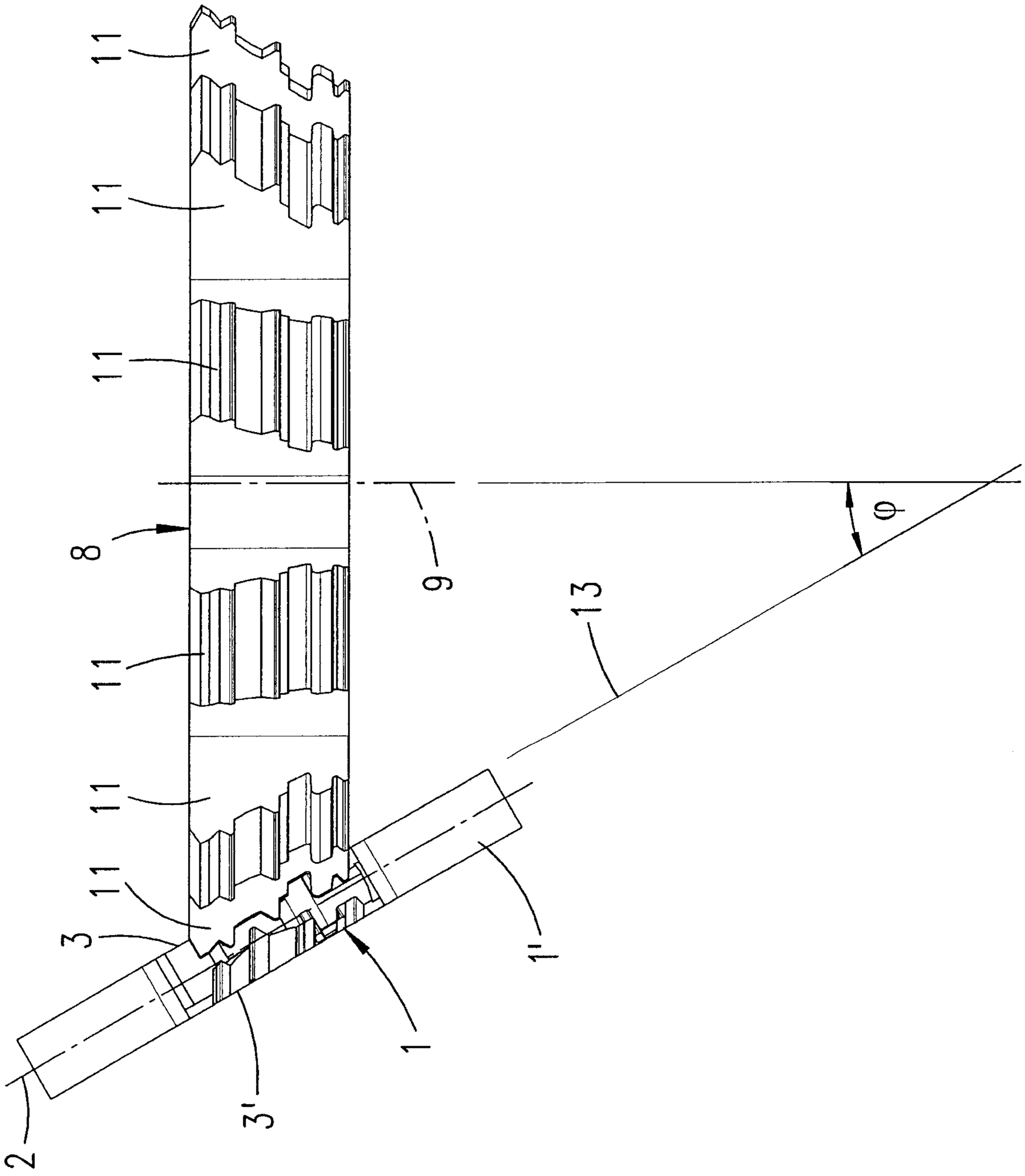


Fig.2

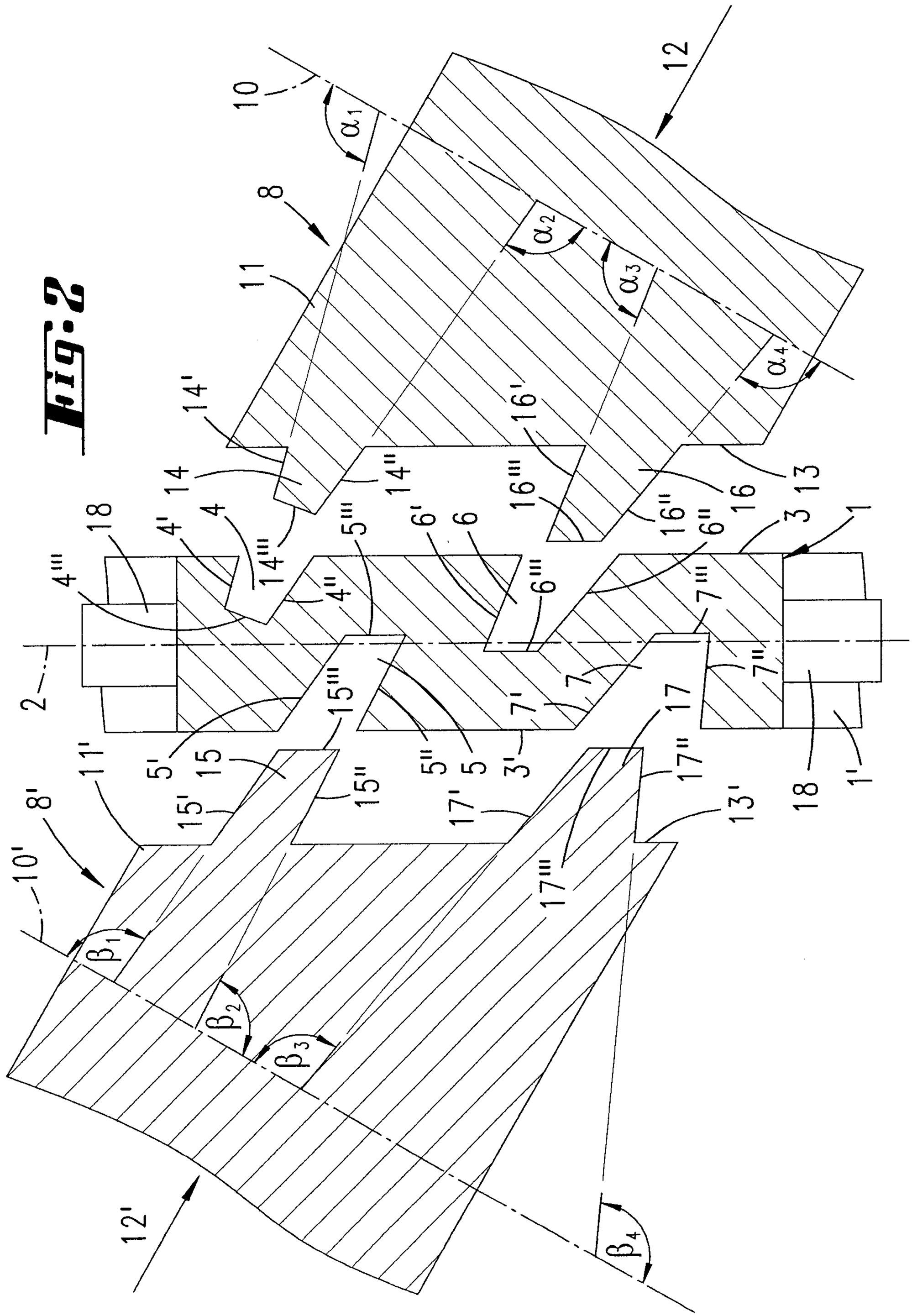
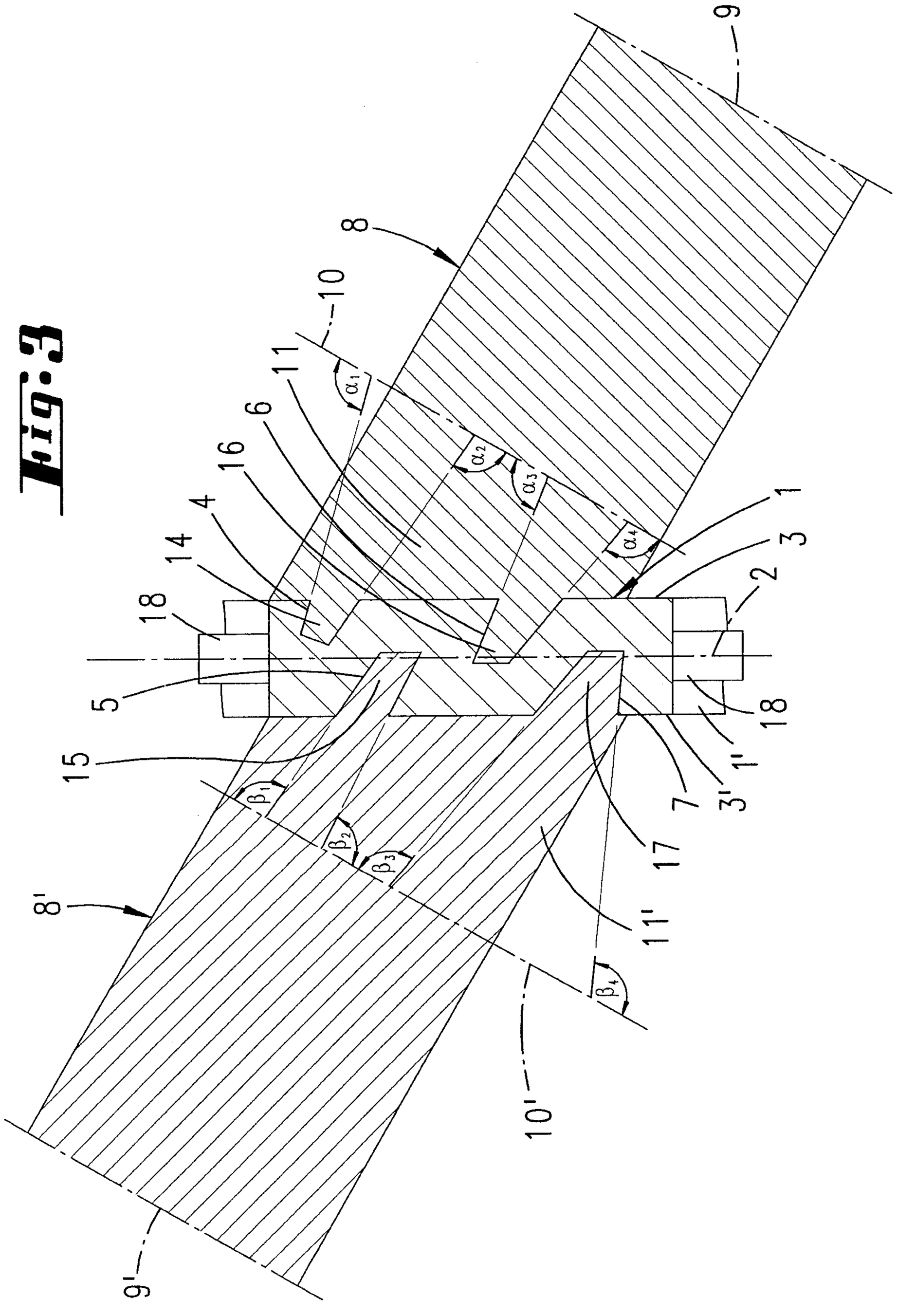

10
12
α_1
8
11
α_2
α_3
α_4
14'
14
14''
14'''
16'
16'''
16''
16
13
4'
4
4'''
4''
5'''
6'
6
6'''
6''
3
1
7'''
7''
7
7'
2
5'
15'''
15
15''
5''
5
3'
17
17''
17'''
17'
11'
8'
18
1'
13'
10'
β_1
β_2
β_3
β_4
12'

Fig.3


9
8
10
11
α_1
6
16
α_2
α_3
4
14
α_4
1
3
2
18
5
15
β_1
β_2
β_3
8'
11'
17
7
3'
1'
18
β_4
10'
9'

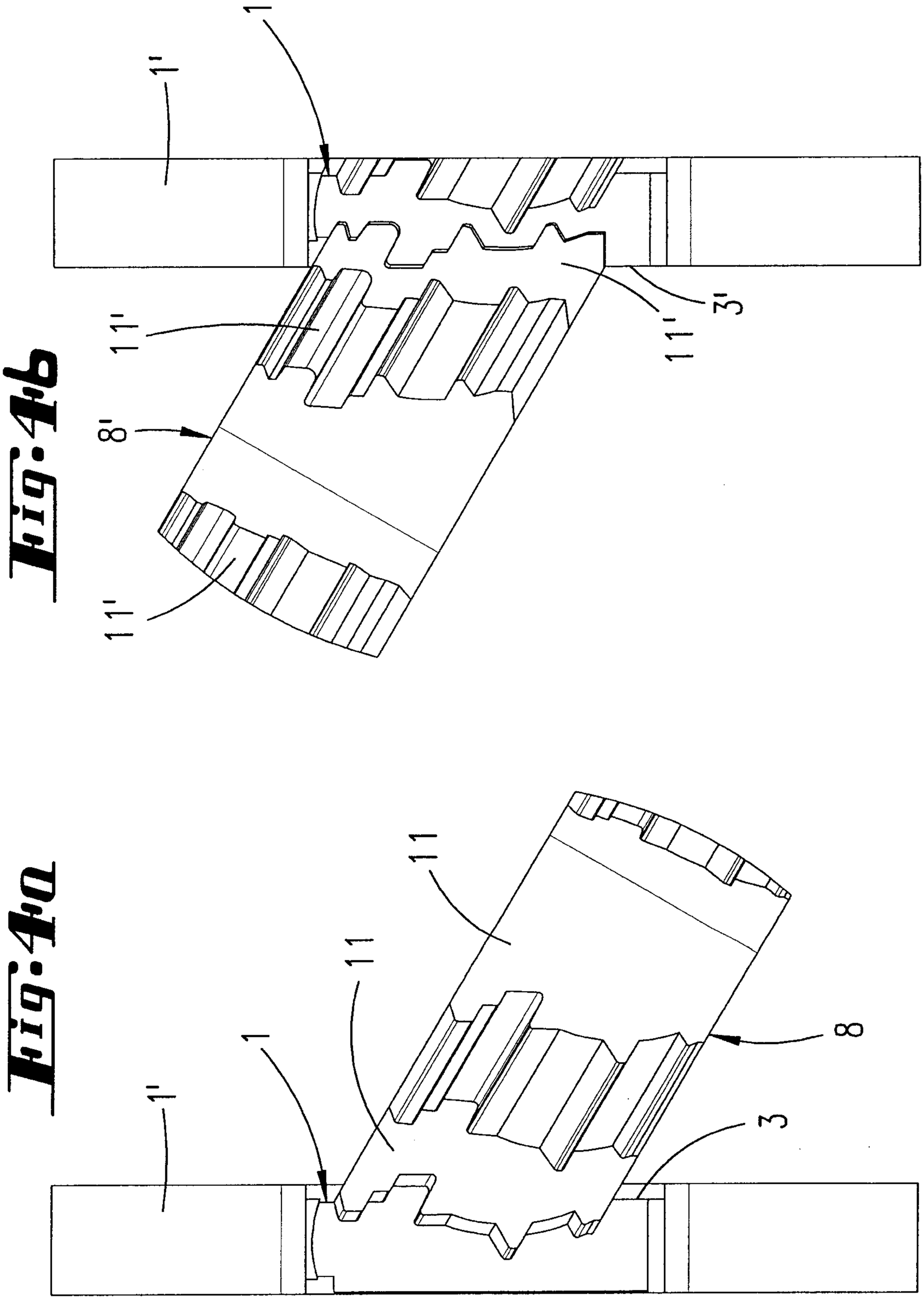
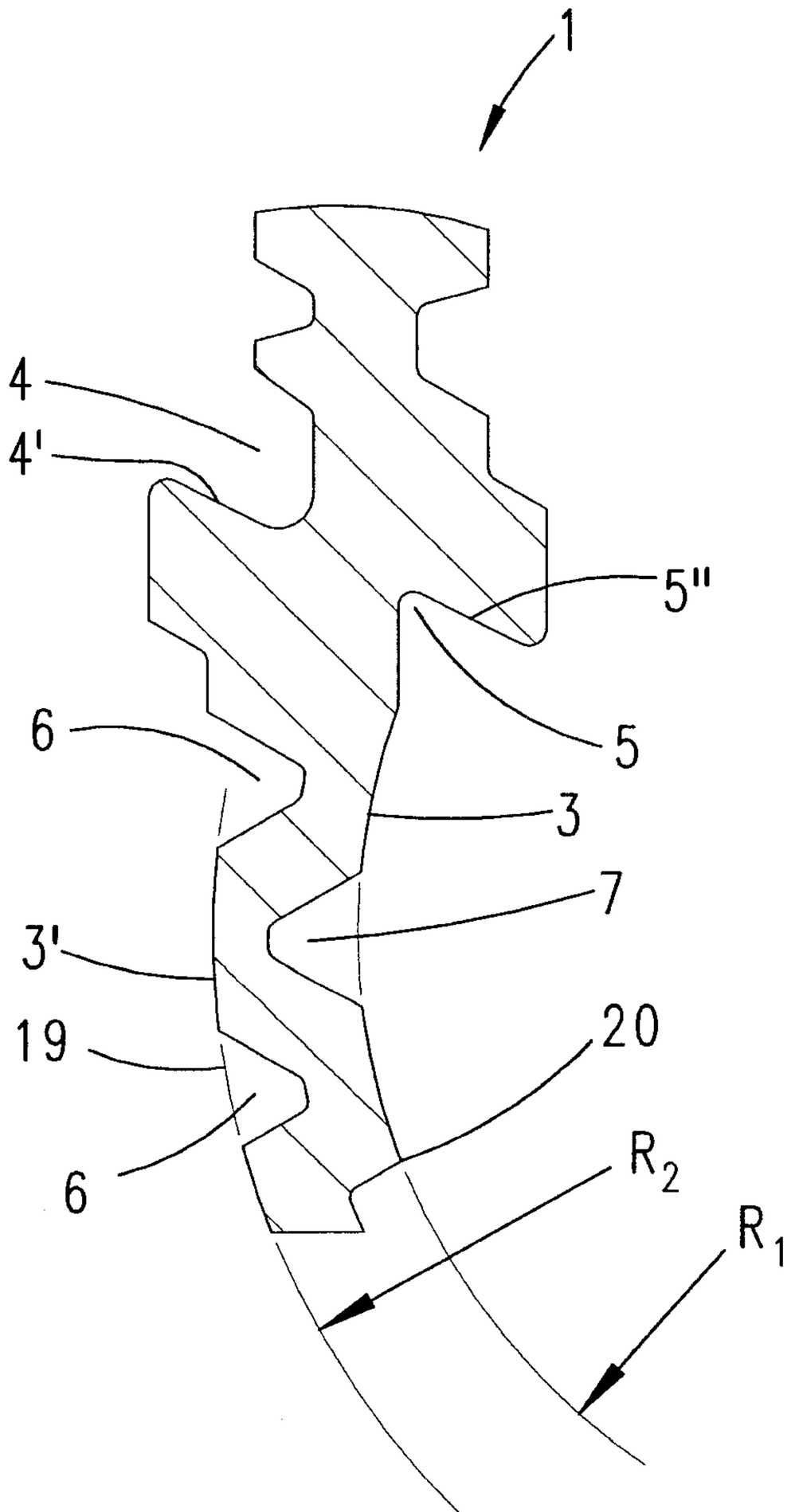


Fig.4b

Fig.4a

Fig:5



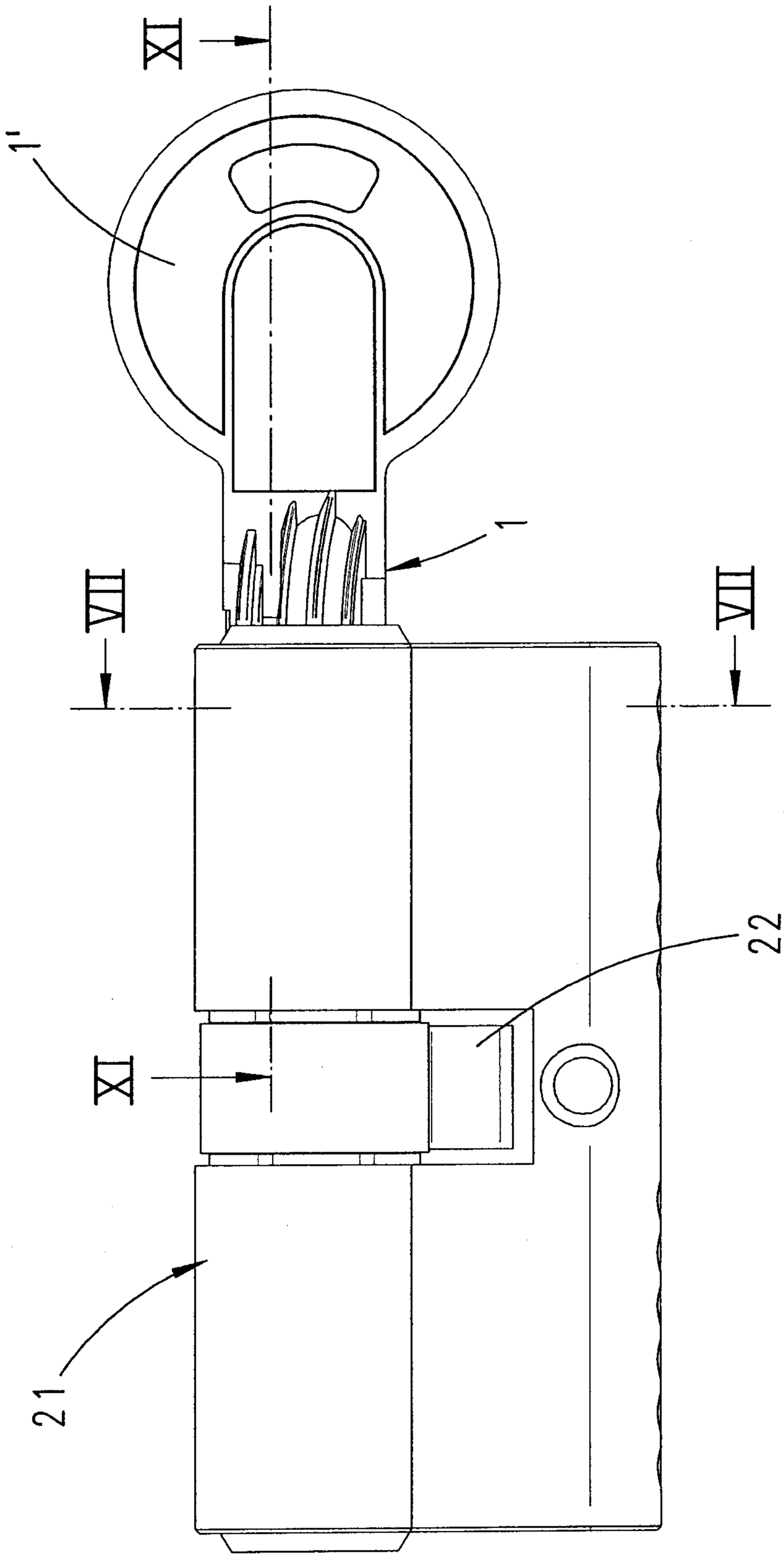


Fig.6

Fig:7

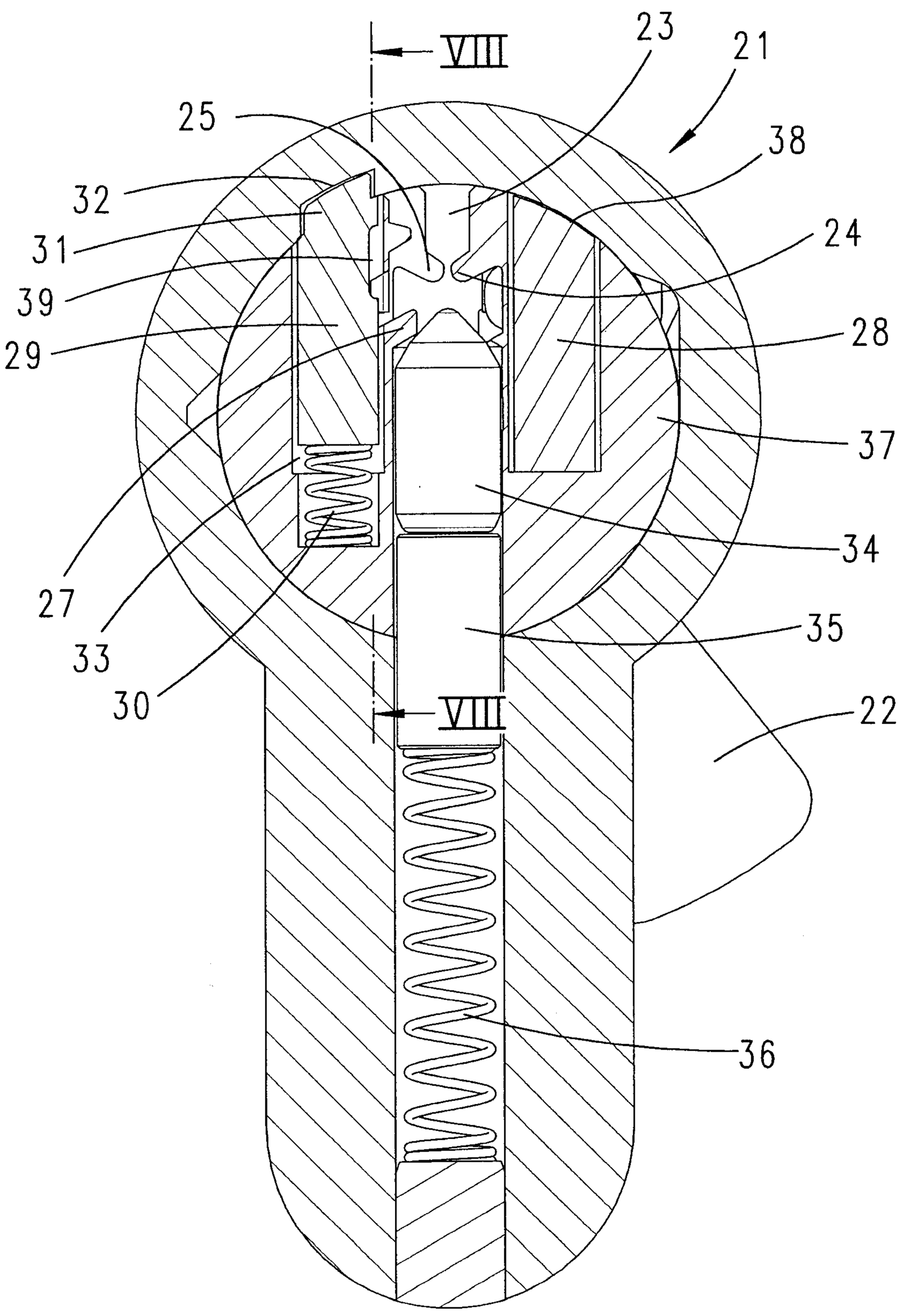


Fig. 8

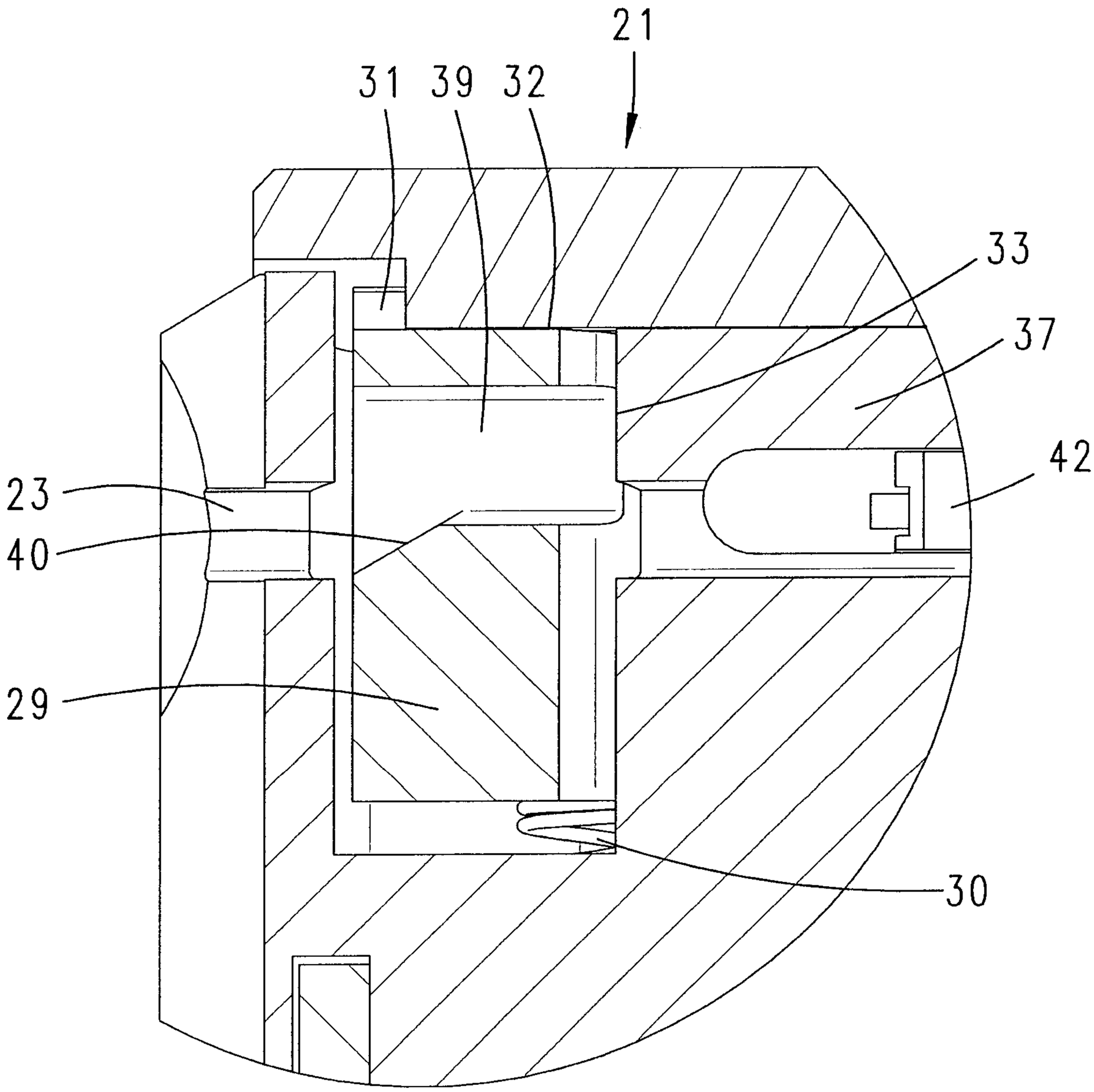


Fig: 9

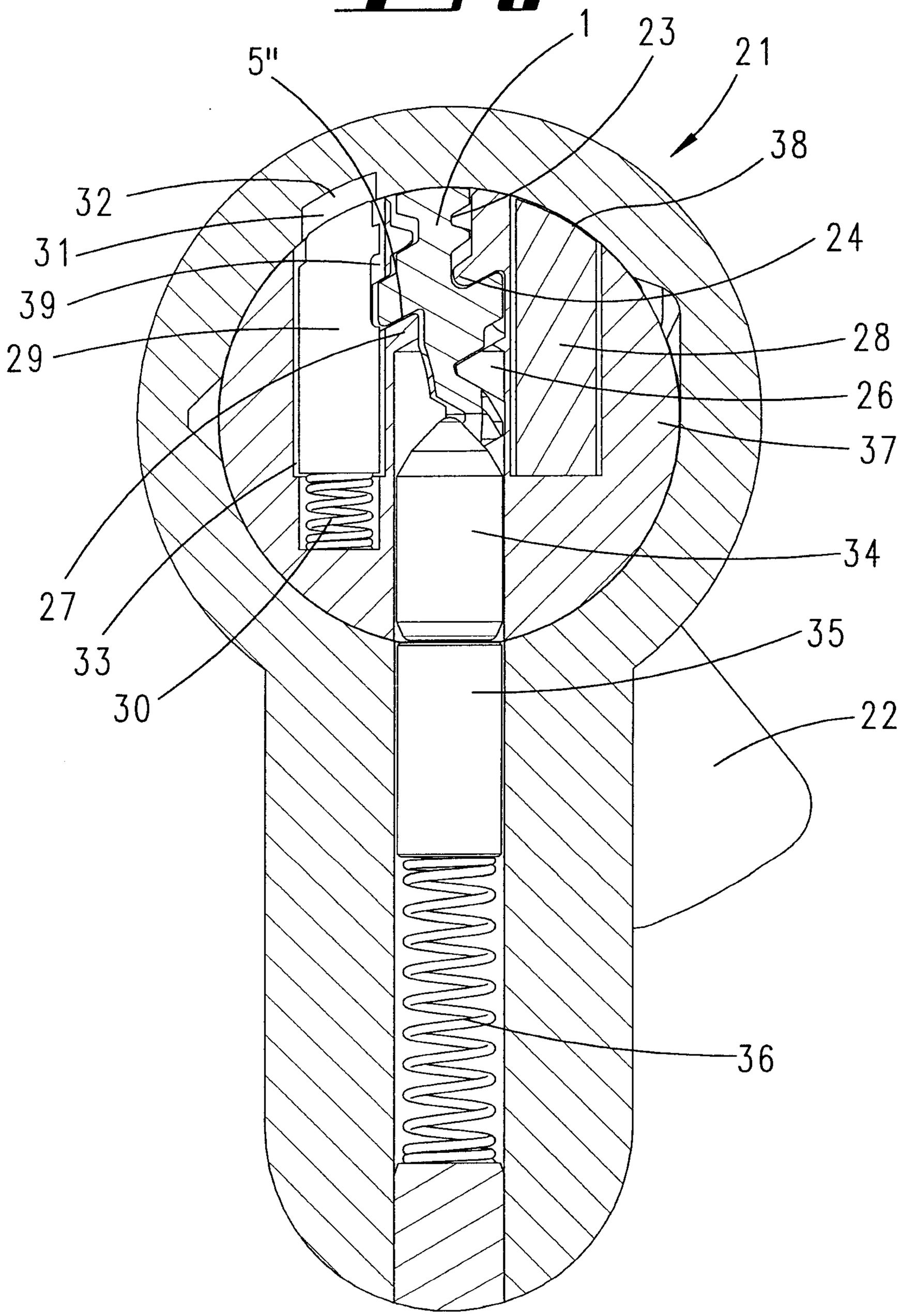


Fig. 10

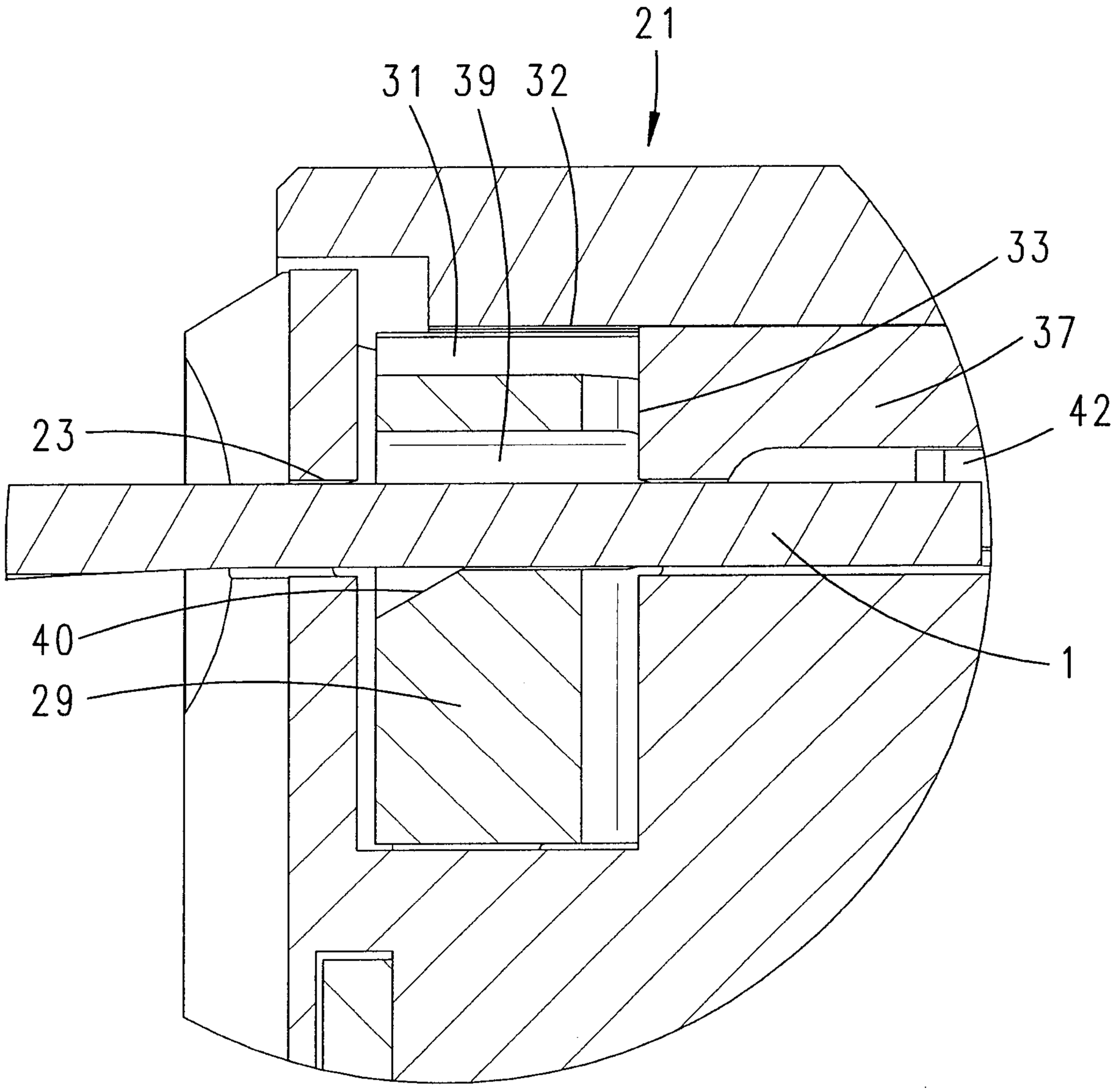


Fig. 11

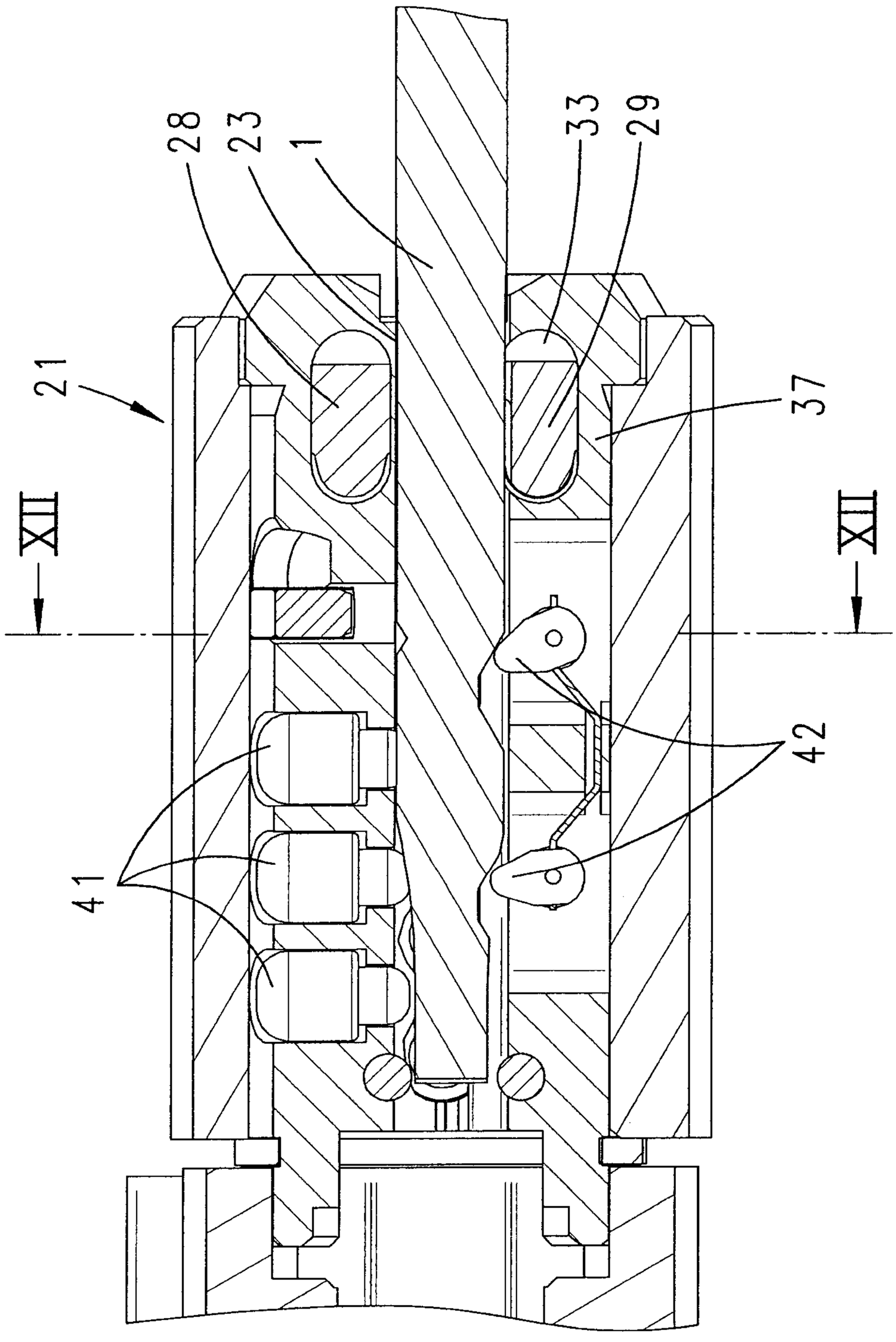


Fig. 12

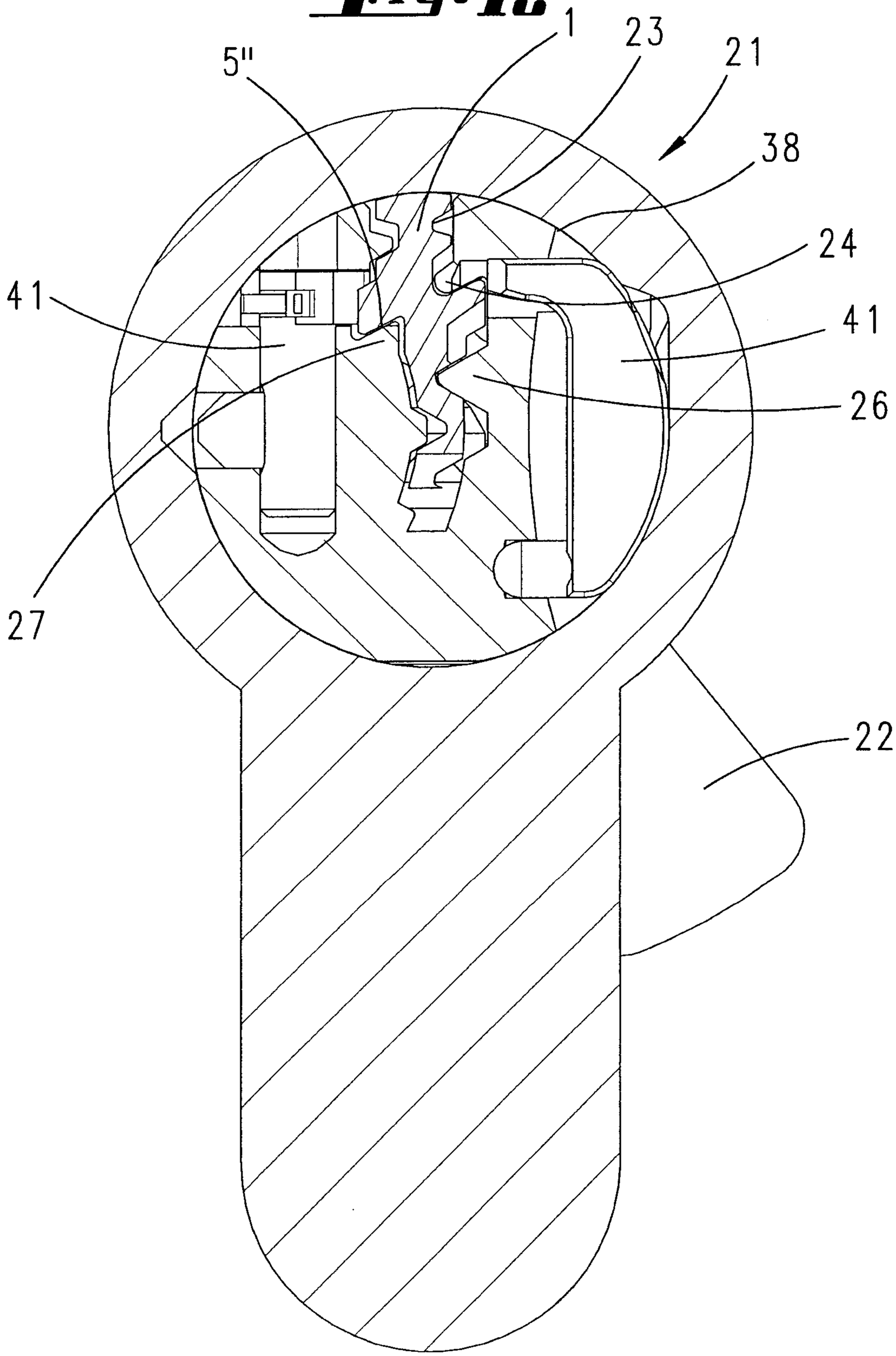


Fig.14

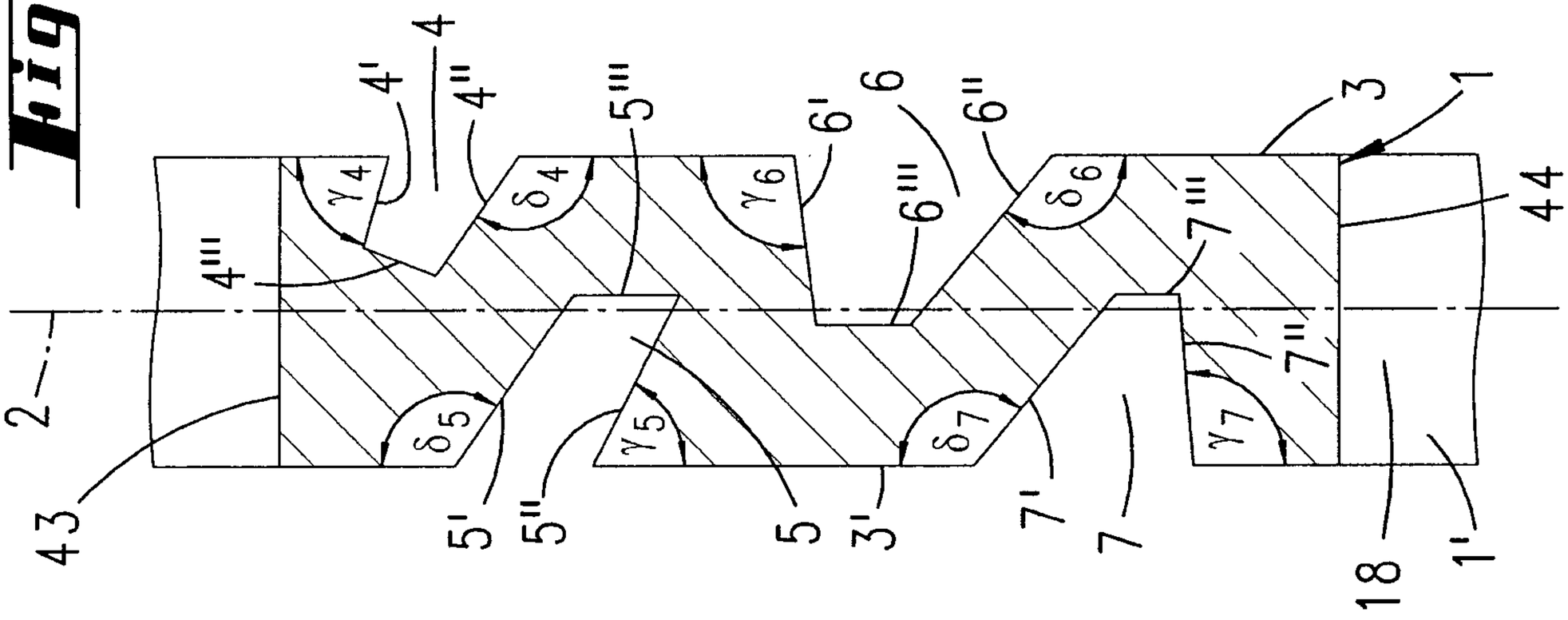
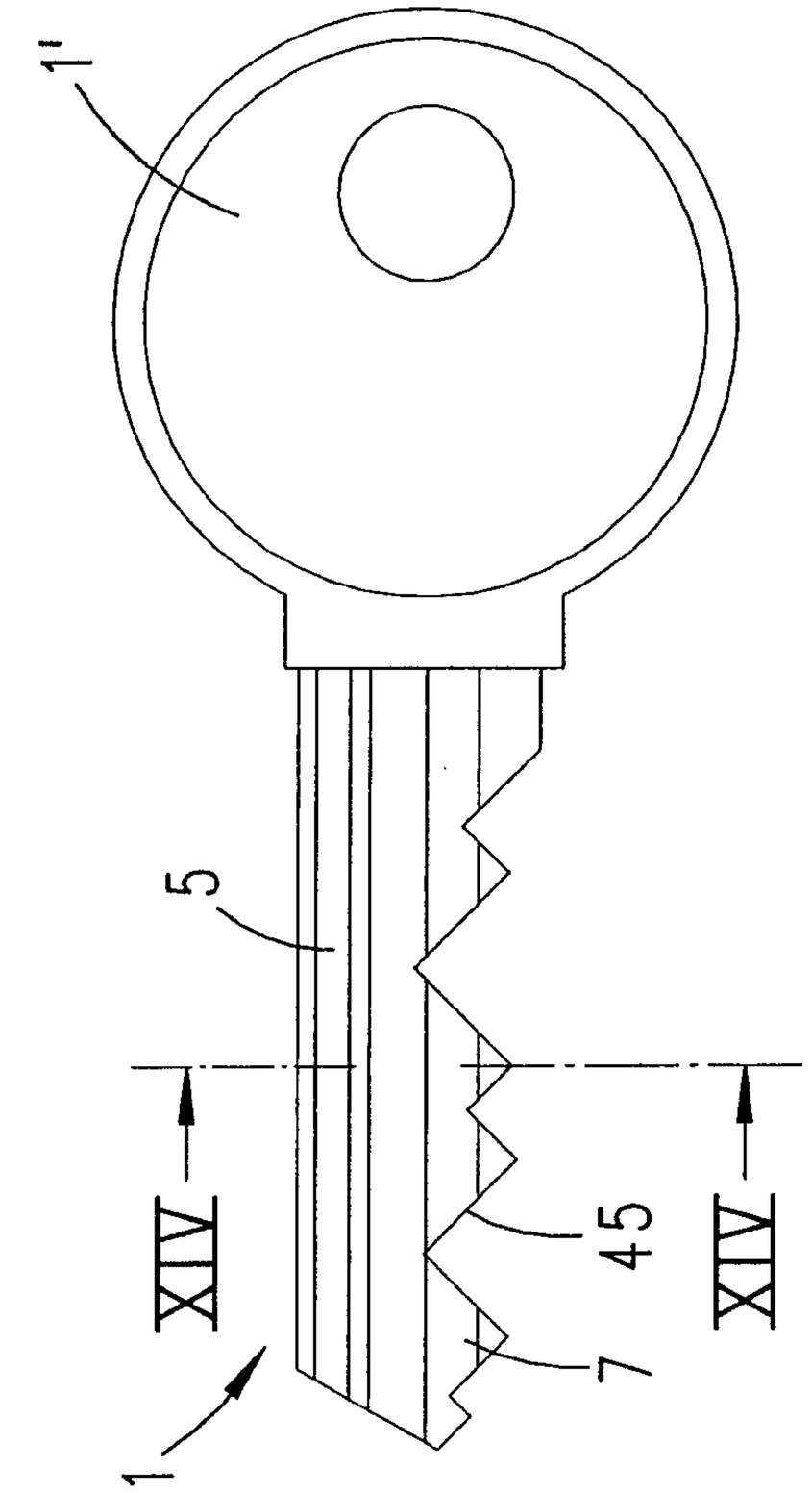
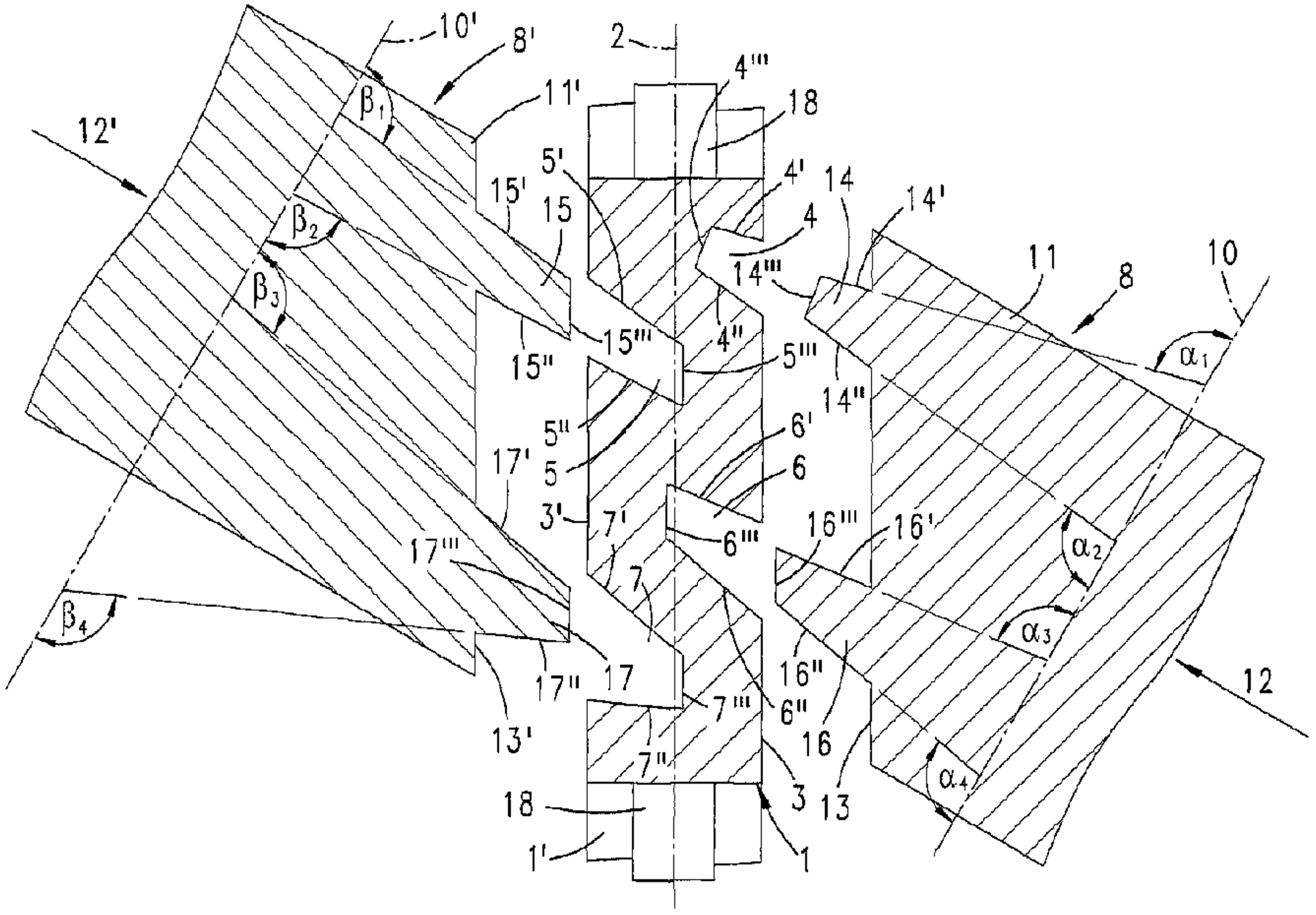

4
4'
4''
4'''
5'''
6'
6
6''
6'''
3
1
44
γ4
δ4
γ6
δ6
7'''
2
δ5
γ5
δ7
γ7
7''
43
5'
5''
5
3'
7'
7
18
1'

Fig.13


1''
5
XIV
45
7
XIV
1


10'
8'
2
4'''
11'
18
12'
β_1
5'
4'
14
14'
15'
15
4
β_2
β_3
14'''
11
8
10
15'''
4''
5'''
α_1
15''
14''
5''
6'
17'
5
6
3'
7'
6'''
16'''
16'
α_2
17'''
7
α_3
β_4
16''
12
17''
17
7'''
6''
13'
16
7''
α_4
3
18
13
1'
1