

12

EUROPEAN PATENT APPLICATION

21 Application number: 89310516.3

51 Int. Cl.⁵ E05B 35/00

22 Date of filing: 13.10.89

30 Priority: 29.10.88 DE 3836872

43 Date of publication of application:
09.05.90 Bulletin 90/19

34 Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

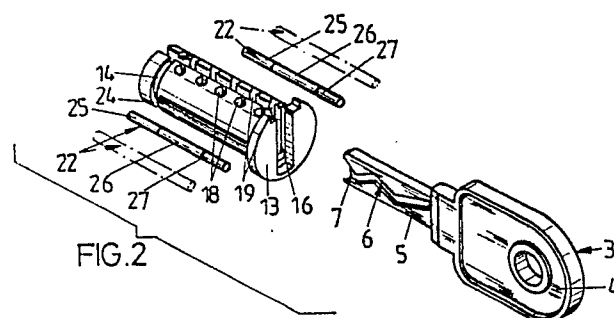
71 Applicant: DOM-Sicherheitstechnik GmbH & Co. KG
Wesseling Strasse 10-16
D-5040 Brühl(DE)

72 Inventor: Braun, Peter Bernhard
Koenigstrasse 147
D-5303 Bornheim(DE)
Inventor: Hauser, Herbert Philipp
Josef-Feuser-Strasse 11
D-5013 Elsdorf Heppendorf(DE)
Inventor: Wedekind, Robert
Kranichstrasse 50
D-5042 Erftstadt-Erp(DE)

74 Representative: Stagg, Diana Christine et al
Emhart Patents Department Lyn House 39
The Parade
Oadby Leicester LE2 5BB(GB)

54 Locking device consisting of flat key and lock cylinder.

57 A locking device (1) comprises a lock cylinder (2) and a flat key (3), which has tumblers (17) controlled by at least one groove (6) provided in the broad side of the key (3). Each tumbler (17) is provided with recesses (21) for the partial entry of at least one locking element (22) extending parallel to the lock cylinder axis which can be displaced in a generally radial direction and which acts together with at least one cutout (23) of the cylinder housing (8) lying in the shear line of the cylinder plug (12). The locking element (22) is a cylinder of circular cross-section and the recess (21) and cutout (23) are each of a depth which is smaller than the radius of the cylinder (22).



EP 0 367 433 A1

LOCKING DEVICE CONSISTING OF FLAT KEY AND LOCK CYLINDER

This invention relates to a locking device comprising a flat key and a lock cylinder, having tumblers controlled by at least one groove located on the broad side of the key, each tumbler being provided with recesses for the partial entry of at least one locking element which extends parallel to the lock cylinder and can be displaced in a generally radial direction, which acts together with at least one cutout of the cylinder housing lying in the shear line of the cylinder plug.

A locking device of the kind referred to above is known from US Patent Specification No. 3,035,433, in which the locking element is designed as a body of rectangular cross-section, the thickness of which is approximately half its height in the radial direction. Projections depart from the inner flank of the locking element, which act together with the recesses of the tumblers. The locking element is acted on by compression springs at each end in the outward direction, so that when the key is withdrawn, the outer section of the locking element engages the cutout of the cylinder housing.

It is an object of the invention to provide a locking device of the kind referred to above which is simple to manufacture, such that while a maximum locking effect is attained the component parts are reduced to a minimum.

The invention provides a locking device comprising a flat key and a lock cylinder, having tumblers controlled by at least one groove provided in the broad side of the key, each tumbler being provided with recesses for the partial entry of at least one locking element extending parallel to the lock cylinder axis which can be displaced in a generally radial direction which acts together with at least one cutout of the cylinder housing lying in the shear line of the cylinder plug, characterised in that the locking element is a cylinder of a circular cross-section and that the recess and the cutout are each of a depth, which is smaller than the radius of the cylinder.

As a result of this design a locking device of the type referred to is produced, which has a particularly simple construction and is consequently economical to produce. The number of the component parts is reduced to a minimum, having regard to the high locking effect. The manufacture of the locking element, in the form of a cylinder of circular cross-section, can be carried out using calibrated, commercially-obtainable round bar material. To produce the locking elements, it is only required to cut the round bar material into pieces of appropriate length. There is a further advantage that no special extending bevels or inclined planes

are required, since after insertion of the correct flat key into the keyway of the lock cylinder the locking element is extended by its cross-sectional shape. Depending on the cross-sectional shape of the locking element and the ratio of the radius of the cylinder to the depth of the recess and to the cutout, it is possible to locate the locking element without any springs thus saving the respective compression springs. In addition to this saving there is a further advantage that friction is reduced during locking, so that locking can be carried out with less force. When the lock cylinder is appropriately aligned, the spring loading of the tumblers can also be dispensed with. They, or at least some of them, are moved into their end position by the driving force of the groove on the broad side of the key and push with it the cylindrical locking element into the cutout of the cylinder housing lying at the shear line of the plug. According to the position of the locking element it is also possible, that the tumblers move into the end position under gravity. The tumblers are then displaced by the inserted key so that their recesses lie opposite to the locking element. The locking element can thus engage into the recesses as the key is turned for locking. The locking element which eventually rolls along the plug bore of the cylinder housing thereby additionally results in a bearing effect, so that locking is easy to perform.

There is a further advantage that the tumblers are in the form of pins which are resistant to twisting and that the recess has a profile in the shape of the segment of a circle. This ensures that after the tumblers are appropriately arranged by the key the recesses lie exactly opposite to the locking element. The tumbler may be a pin of circular-cylindrical cross-section, from which a radial projection departs. The latter projects into the keyway and moves along the groove in the broad side of the key. A square pin could alternatively be used.

Accurate arrangement of the tumblers is achieved by the curvature of the wall of the recess and of the circumference of the cylinder matching one another.

In order to absorb great forces without risk of damage, the stop ends of the cutout are shaped to match the shape of the circumferential wall of the cylinder. Provision of the locking element is made simpler since the depth of the recess and cutout are equal to approximately half of the radius of the cylinder.

Additional locking function results where at least one of the tumblers has a number of recesses arranged one after the other.

In a preferred embodiment of the invention, the cylinder can be sub-divided into a number of longitudinal sections. If cutouts are then assigned to the longitudinal sections, which cutouts are then assigned to the longitudinal sections, which cutouts extend over tangential angles of differing size, then keys can be used, so that rotary angles which vary in size can be used in the locking operation. It is therefore suitable for this embodiment of the locking device according to the invention to be used for cashier systems. With even a small construction, sixteen different angular positions can be obtained.

For improved security, it is possible to arrange the tumblers which are in the form of pins in two rows, and to control these by grooves provided on both broad sides of the key, and further to provide two cylinders diametrically opposed to one another. The effectiveness of locking is increased. Additionally two diametrically-opposed cylinders also provide improved support, in particular with respect to bearing efficiency.

There is a further advantageous feature in that the tumblers have transverse bosses for engagement in the appropriate groove on the broad side of the key. To accommodate the transverse bosses, angular slots of an appropriate width are provided between the keyway and the bore for the tumblers, so that the transverse bosses have a dual function. On the one hand they prevent the tumblers from twisting and on the other hand they follow the groove in the broad side of the flat key.

An exemplary embodiment of the invention will now be described in conjunction with the accompanying drawings, in which:

Figure 1 is an enlarged representation of a view of the locking device comprising a flat key and a lock cylinder;

Figure 2 is a perspective representation of the cylinder plug of the lock cylinder and the flat key;

Figure 3 is a further enlarged representation of a longitudinal cross-section through the lock cylinder showing the flat key inserted therein, and in which the cylindrical locking element is subdivided into three longitudinal sections;

Figure 4 is the sectional view on line IV-IV of Figure 3;

Figure 5 is the sectional view on line V-V of Figure 3;

Figure 6 is the sectional view on line VI-VI of Figure 3;

Figure 7 to Figure 9 are cross-sectional views equivalent to Figures 4 to 6, but showing the cylinder plug in a rotated position;

Figure 10 is a longitudinal cross-section equivalent to Figure 3 but with a modified key inserted which permits a locking rotation of 90° only;

Figure 11 is the sectional view on line XI-XI of Figure 10;

Figure 12 is the sectional view on line XII-XII of Figure 10;

Figure 13 is the sectional view on line XIII-XIII of Figure 10;

Figure 14 to Figure 16 are cross-sectional views equivalent to Figures 11 to 13, but showing the cylinder plug rotated through 90° into the defined stop position;

Figure 17 is a longitudinal cross-section also equivalent to Figure 3, in which a modified key is inserted, which permits a locking rotation of the cylinder plug through 120°;

Figure 18 is the sectional view on line XVIII-XVIII of Figure 17;

Figure 19 is the sectional view on line XIX-XIX of Figure 17;

Figure 20 is the sectional view on line XX-XX of Figure 17; and

Figure 21 to Figure 23 are the cross-sectional views equivalent to Figures 18 to 20, wherein the cylinder plug is rotated through 120°.

The locking device 1 is a unit comprising a lock cylinder 2 and a flat key 3. The latter has a key handle 4, onto which is joined in stepped-down arrangement a key shank 5. A groove 6 is machined into each of the two broad sides of the key shank 5. The grooves 6 are arranged so that the flat key can also be inserted in a position rotated through 180°. The groove 6 of the flat key 3 as shown in Figure 3 comprises control sections a, b, c, d and e, which are joined over intermediate sections. In front of the control section a, located at the front end of the key a capture slot 7 which widens into a V-shape is arranged.

The lock cylinder 2 has a cylinder housing 8 having a radially projecting collar 9 at the key insertion end. The cylinder housing 8 is circular in cross-section and is provided with an external thread 10. A core bore 11 for locating a cylinder plug 12 extends centrally within the cylinder housing 8. A flange 13 is provided at the key insertion end, projecting above the cylinder plug 12, which flange locates in a bore section 11' of the core bore 11 of matching profile and determines the axial position of the plug 12. The other end of the cylinder plug 12 is provided with an annular groove 14 for the insertion of a retaining ring 15. The retaining ring 15 abuts the rear end of the cylinder housing 8 as shown in Figure 3.

A keyway 16 is provided centrally in the cylinder plug 12, penetrating the plug 12 in the longitudinal direction. One narrow edge of the keyway 16 terminates within the area of the cylinder plug 12. The centre of the keyway 16 consequently lies offset to the centre axis of the cylinder plug 12.

A row of tumblers 17 is adjacent to each broad

side of the keyway 16. In the embodiment according to the drawings each row comprises five tumblers 17 so that two tumblers of each of the two rows lie on a common cross-sectional plane. The tumblers 17 are in the form of pins of circular-cylindrical cross-section and are guided in blind holes 18 of matched cross-section of the cylinder plug 12, which blind holes 18 depart from the same side of the plug 12 as the keyway 16. The blind holes 18, which run parallel to the keyway 16 touch the adjacent keyway wall. The tangential region of each blind hole 18 is open towards the keyway 16 because of a transverse slit 19. The transverse slit 19 ending in the blind hole 18 accommodates a transverse boss 20 of the tumbler 17. The transverse bosses 20 are of circular cross-section and are matched in their diameter with the width of the transverse slits 19. In this way, the tumblers 17 are protected from twisting. Further, the transverse bosses 20 are of such a length, that the end projecting into the keyway 16 is equal to approximately one third of the width of the keyway.

Opposite to the transverse boss 20, each tumbler 17 is provided with a recess 21 for the partial entry of a locking element 22 which extends parallel to the axis of the lock cylinder and can be displaced in a generally radial direction which locking element 22 acts together with a cutout 23 of the cylinder housing 8 provided in the shear line of the cylinder plug. The locking element 22 is a cylinder of circular cross-section, so that the recess 21 and also the cutout 23 are of a depth which is smaller than the radius of the cylinder. In the embodiment shown in the drawings the depth of the recess 21 and the cutout 23 are approximately equal to half of the radius of the cylinder 22. Additionally the curvature of the wall of the recess 21 and of the circumference of the cylinder 22 match each other. That means, that the cylinder 22 enters into the recess 21 with a matching profile. Appropriate matching was made for the cutout 23, the stop ends 23' and 23'' of which are shaped to match the contour of the circumferential wall of the cylinder 22. The stop ends start at the level of the cylinder plug join and extend up to the lowest point of the cutout.

The dimensions are also matched so that as the tumblers 17 are moved under gravity into their lower position, the locking element 22 is completely pressed by the tumblers into the cutout 23 and is arranged with practically no radial play.

Corresponding to the two rows of tumblers 17, two locking elements 22 are provided. To accommodate each locking element 22, the cylinder plug 12 has two radially aligned, diametrically opposed longitudinal slots 24, which form the connection between the circumference of the cylinder plug and the blind holes 18. The width of the slots 24

thereby matches the diameter of the locking element 22.

In the embodiment shown in the drawings each locking element 22 is subdivided into three longitudinal sections 25, 26, 27 arranged one behind the other. The two longitudinal sections 25, 26 lying towards the inside of the cylinder are of such a length, that each longitudinal section 25, 26 acts with two tumblers 17. The longitudinal section 27 at the key insertion end acts with a single tumbler 17.

Cutouts 23 are assigned to the aforementioned longitudinal sections 25, 26, 27, which cutouts 23, extend over tangential angles which differ in size. The cutouts 23 which accommodate the longitudinal sections 25 therefore have stop ends 23', 23'', which are directly adjacent to each other. On the other hand the stop ends 23', 23'' of the cutouts 23, to which the longitudinal sections 26 are assigned are joined together over an arc section B, which extends over approximately 90°. The stop ends 23', 23'' of the cutouts working together with the shorter longitudinal sections 27 have an angular distance of approximately 120°, bridged by an arc B'.

The locking elements 22 and the tumblers 17 operate without springs. If the flat key 3 is not inserted, then all or at least some of the tumblers 17, according to the ratio of friction, take up due to gravity their lower end position defined by the bottom of the blind holes 18. The longitudinal sections 25, which enter into the corresponding cutouts 23, the stop ends of which are not joined over the arc, prevent any rotation of the cylinders plug 12.

If the key 3 is now inserted into the keyway 16, then the tumblers 17 are arranged by the control sections a to e over the transverse bosses 20, so that the longitudinal sections 25 to 27 of the locking elements 22 are in alignment with the recesses 21 of the tumblers 17. The cylinder plug 12 can then be rotated in any direction. Respective angular positions are shown in the Figures 7 to 9. At the start of the locking rotation in the clockwise direction of the locking elements 22, because of their cross-sectional profile and the appropriate stop ends of the cutouts 23, are moved inwardly in the radial direction and become embedded in the recesses 21 of the tumblers 17.

In Figures 10 to 16, the lock cylinder 2 is shown locked with an alternative design of flat key 3'. The key 3' is basically similar in design to the flat key 3. Only the control section b' on the broad side of the key groove 6 is in a different place. If the reversible flat key 3' is inserted into the keyway 16, then all tumblers 17 are properly arranged except for the two tumblers lying in a cross-sectional plane, which are associated with the control sections b'. The control sections b' are arranged,

so that they displace the corresponding tumblers, as shown in Figures 10 and 12, so that the recesses 21 lie offset relative to the cylinders 22. The longitudinal sections 26 of the locking elements 22 are thus not able to deflect radially. Rotary displacement of the cylinder plug 12 in one direction is still possible, that is over the arc B extending through 90° , which joins together the stop ends $23'$ and $23''$. This partial rotation is terminated as soon as the longitudinal sections 26 locate against the stop ends $23'$ of the appropriate cutouts 23, as can be seen in the rotated position of the cylinder plug in Figures 14 to 16, in which the backstop position is shown in Figure 15.

If locking rotation of the cylinder plug 12 through 120° is to be made possible, then the flat key $3''$ as shown in the Figures 17 to 23 is to be used. This key is of similar design to the flat key $3'$ and differs from it in that the control stage e' takes up a different vertical position. As a consequence of this the tumblers associated with the longitudinal sections 25, 26 are properly arranged by the inserted flat key $3''$ so that the recesses of the tumblers 21 are in alignment with the longitudinal sections 25, 26, as shown in Figures 18 and 19. The appropriate tumblers 17 are however displaced by the control sections e' so that the recesses 21 of the tumblers cannot align with the longitudinal sections 27. The arcs B' joining the stop ends $23'$ and $23''$ allow a rotary displacement of the cylinder plug through 120° , until the longitudinal sections 27 locate against the stop ends $23''$, as shown particularly in Figure 23. The other longitudinal sections 25, 26 do not however provide any obstruction during rotation, as shown in Figures 21 and 22.

It can be seen from this, that the lock cylinder 2 can be operated by three keys 3 , $3'$ and $3''$. A type of construction is also possible, in which the locking elements 22 are undivided, as shown in dash-dotted depiction in Figure 2. Two diametrically opposed cutouts 23 departing from the core bore 11 are then provided. A flat key similar to flat key 3 would then have to be used. The remaining flat keys $3'$, $3''$ would not be able to produce rotation.

To obtain additional key functions, it is possible that, as is shown in Figure 4 in dash-dotted lines, appropriate tumblers 17 are provided with additional recesses $21'$, which will be engaged by an appropriate key. It would for example be possible to provide three appropriate recesses spaced out over a tumbler.

Claims

1. Locking device (1) comprising a flat key (3)

and lock cylinder (2), having tumblers (17) controlled by at least one groove (6) provided in the broad side of the key (3) each tumbler (17) being provided with recesses (21) for the partial entry of at least one locking element (22) extending parallel to the lock cylinder axis which can be displaced in a generally radial direction, which acts together with at least one cutout (23) of the cylinder housing (8) lying in the shear line of the cylinder plug (12), characterised in that the locking element (22) is a cylinder of circular cross-section and that the recess (21) and the cutout (23) are each of a depth, which is smaller than the radius of the cylinder (22).

2. A locking device according to claim 1, further characterised in that the tumblers (17) are twist-resistant pins and the recess (21) has a profile in the shape of a segment of a circle.

3. A locking device according to claim 2, further characterised in that the curvatures of the wall of the recess (21) and of the circumference of the cylinder (22) match each other.

4. A locking device according to one or more of the preceding claims, further characterised in that stop ends ($23'$, $23''$) of the cutout (23) are shaped to match the shape of the circumferential wall of the cylinder (22).

5. A locking device according to one or more of the preceding claims, further characterised in that the depth of recess (21) and cutout (23) represents approximately half the radius of the cylinder (22).

6. A locking device according to one or more of the preceding claims, further characterised in that at least one of the tumblers (17) has a number of recesses (21 , $21'$) arranged one after the other.

7. A locking device according to one or more of the preceding claims, further characterised in that the cylinder (22) is subdivided into a number of longitudinal sections (25, 26, 27).

8. A locking device according to claim 7, further characterised in that to the longitudinal sections (25, 26, 27) are associated with cutouts (23), which extend over tangential angles which differ in size.

9. A locking device according to one or more of the preceding claims, further characterised in that the tumblers (17) in the form of pins are arranged in two rows and are controlled by grooves (6) provided on both broad sides of the key (3 , $3'$, $3''$), and that the cylinder plug (12) supports two cylinders (22) lying diametrically opposed to each other.

10. A locking device according to one or more of the preceding claims, further characterised in that the tumblers (17) have transverse bosses (20) for engagement with the appropriate broad side groove (6) of the key (3).

FIG.1

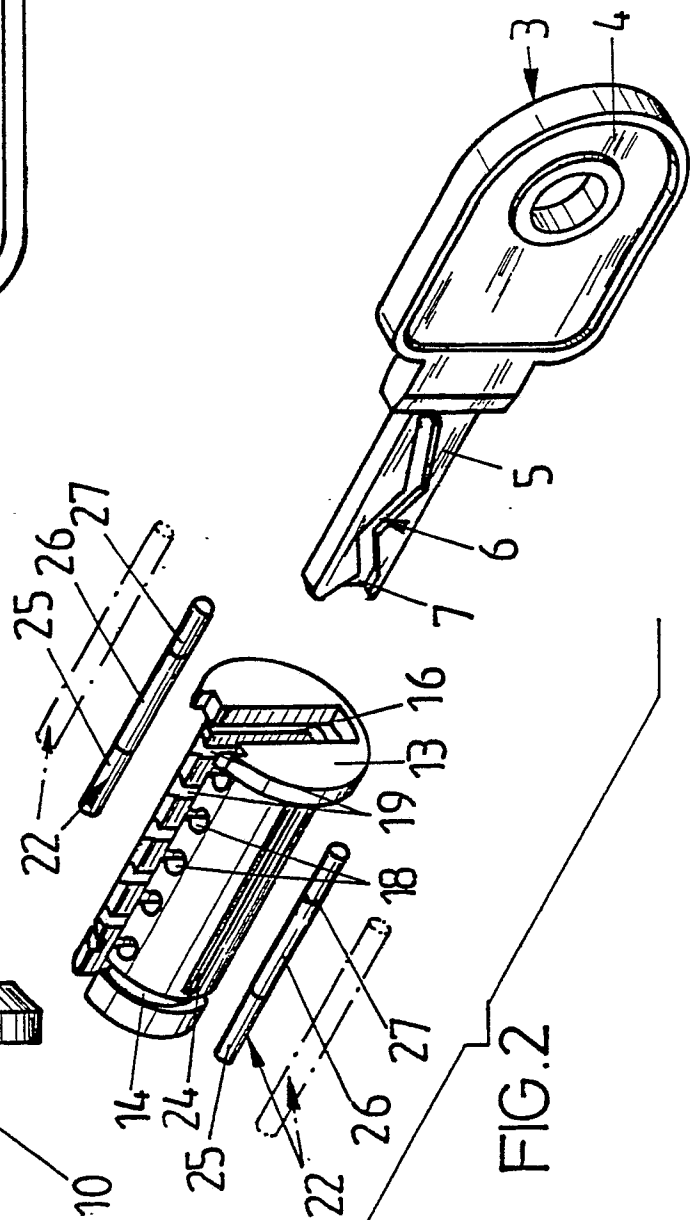
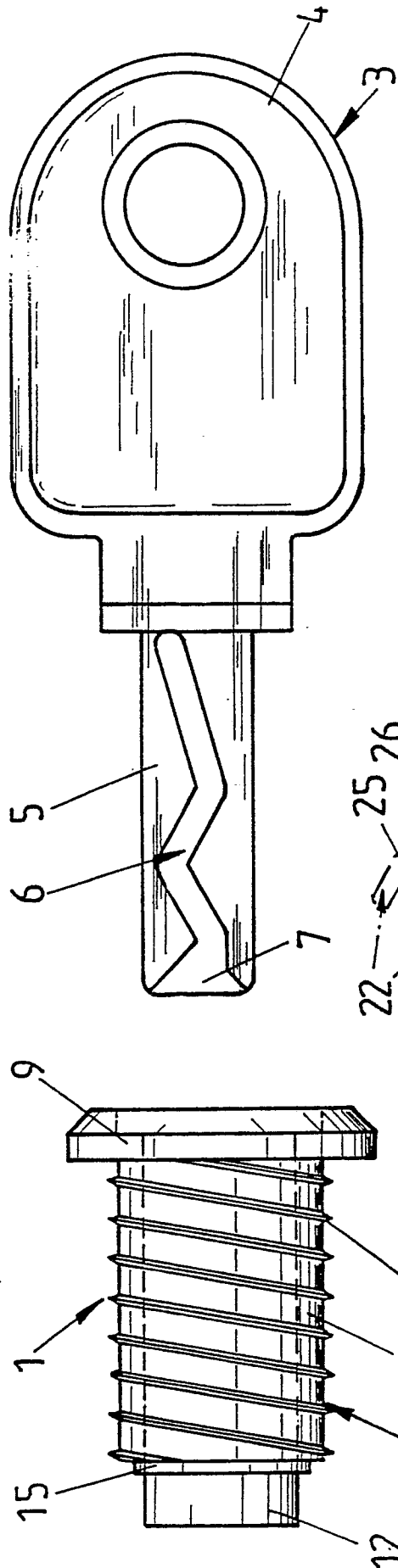


FIG.3

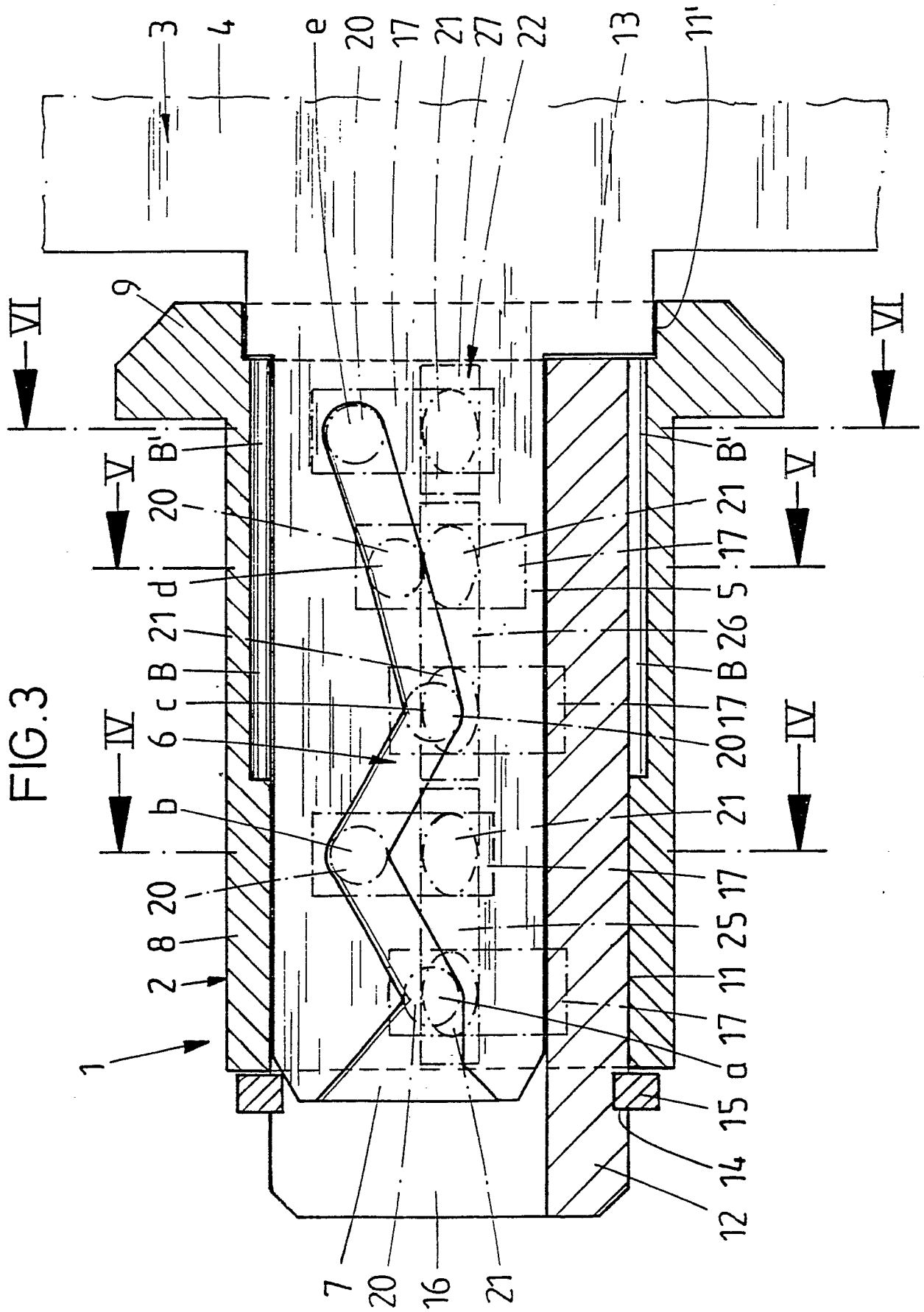


FIG.4

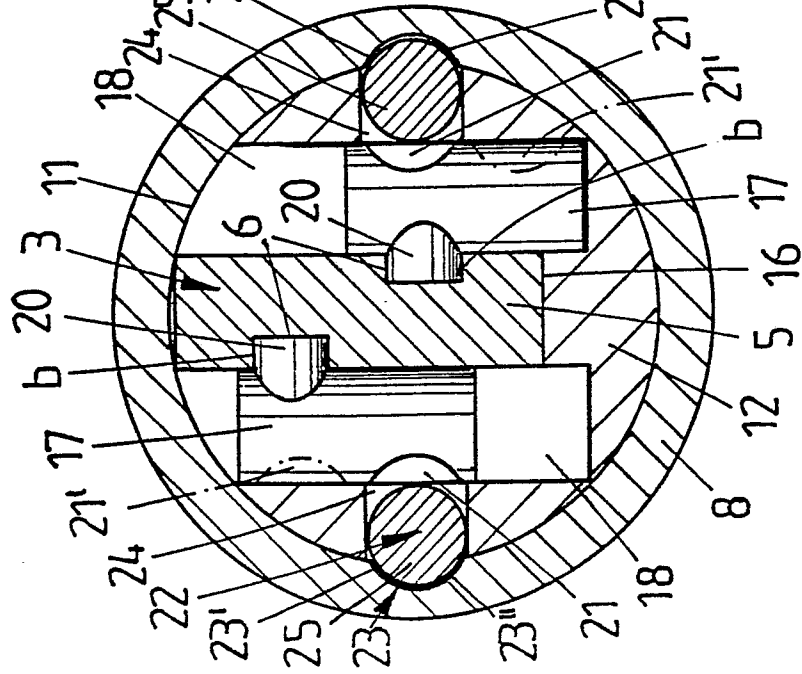


FIG.5

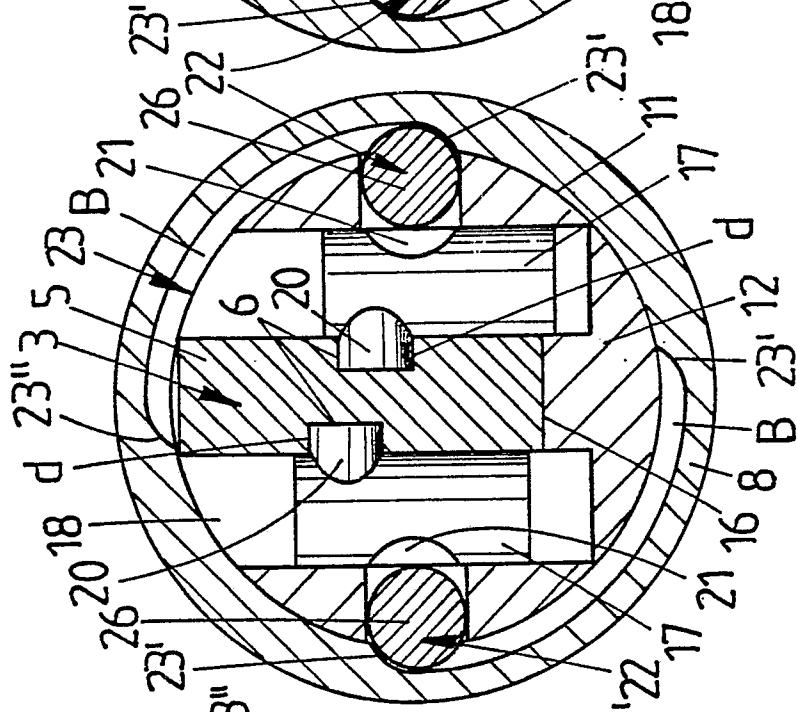


FIG.6

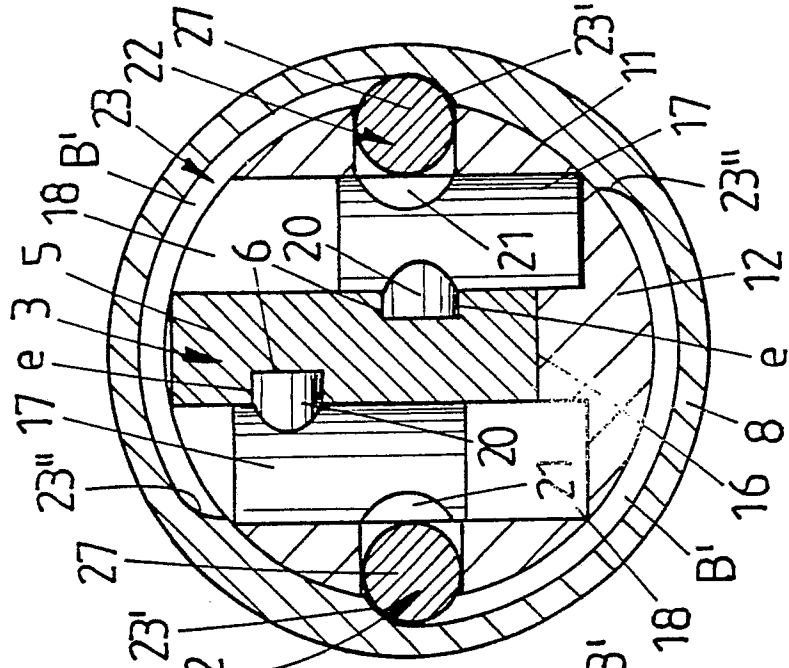


FIG. 7

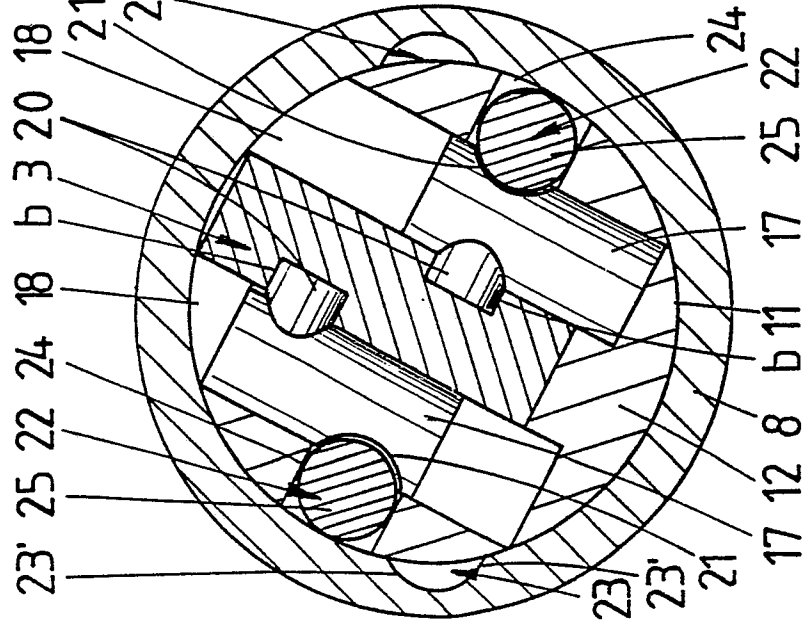


FIG. 8

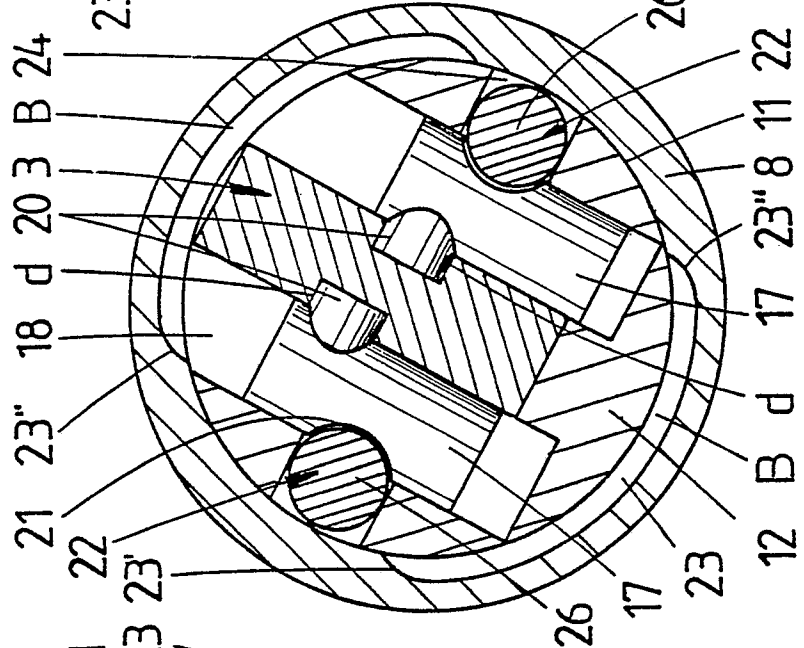


FIG. 9

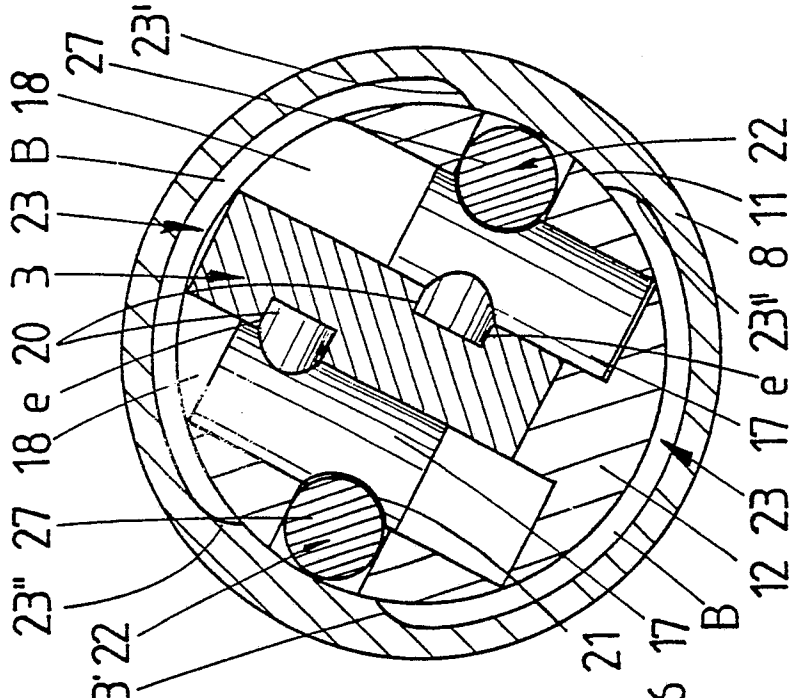


FIG. 10

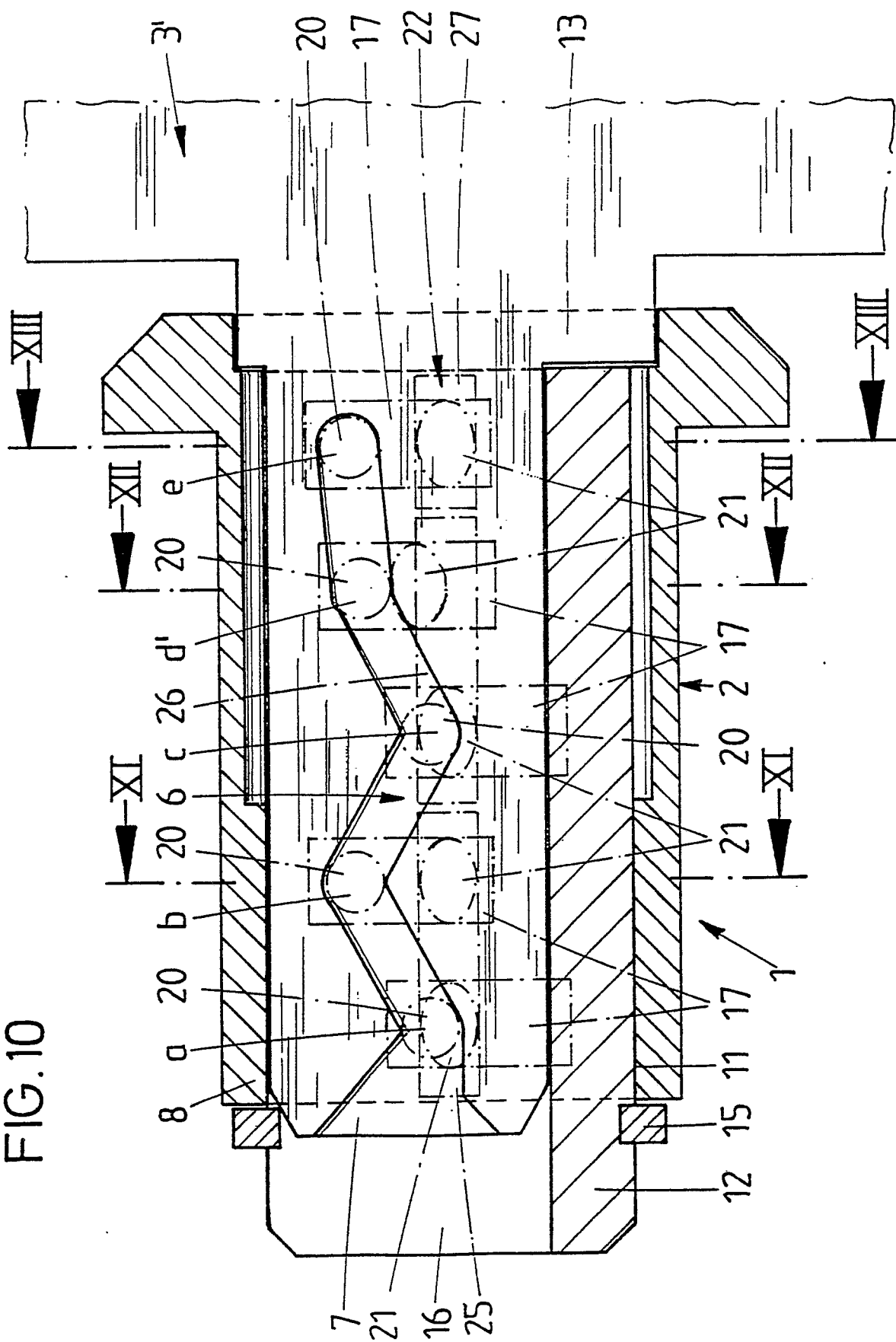


FIG.11

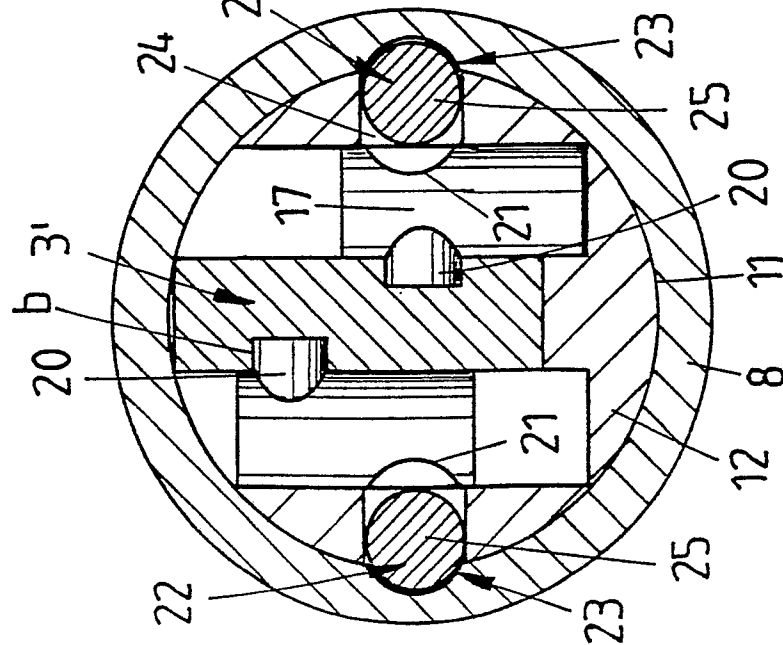


FIG.12

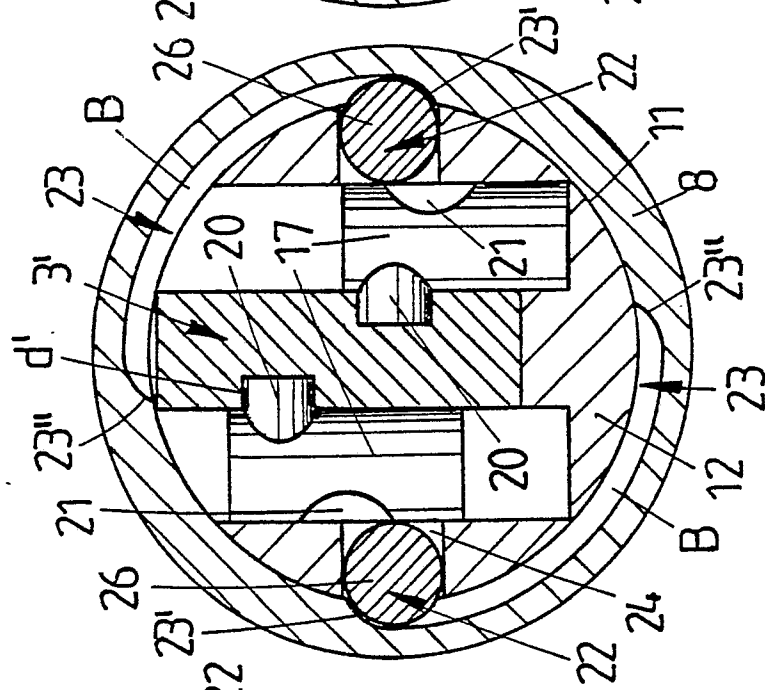


FIG.13

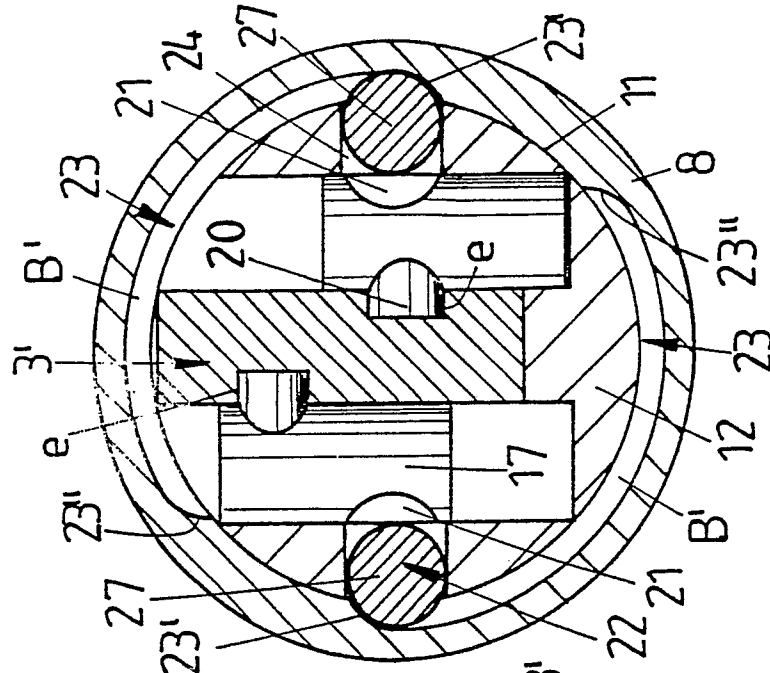


FIG. 14

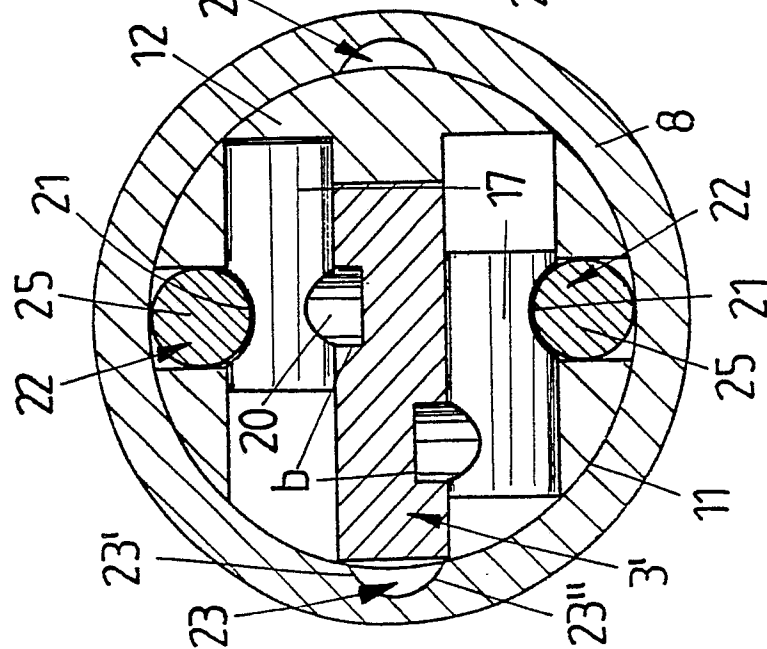


FIG.15

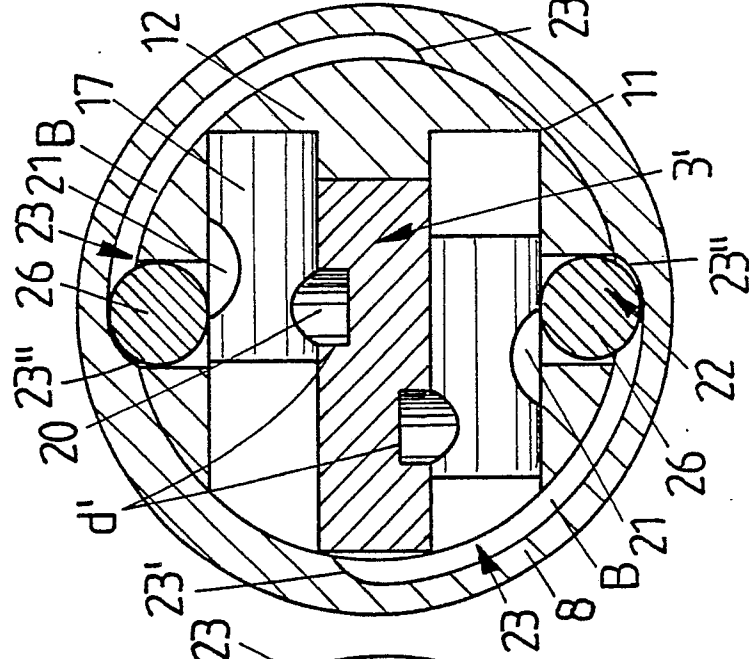


FIG. 16

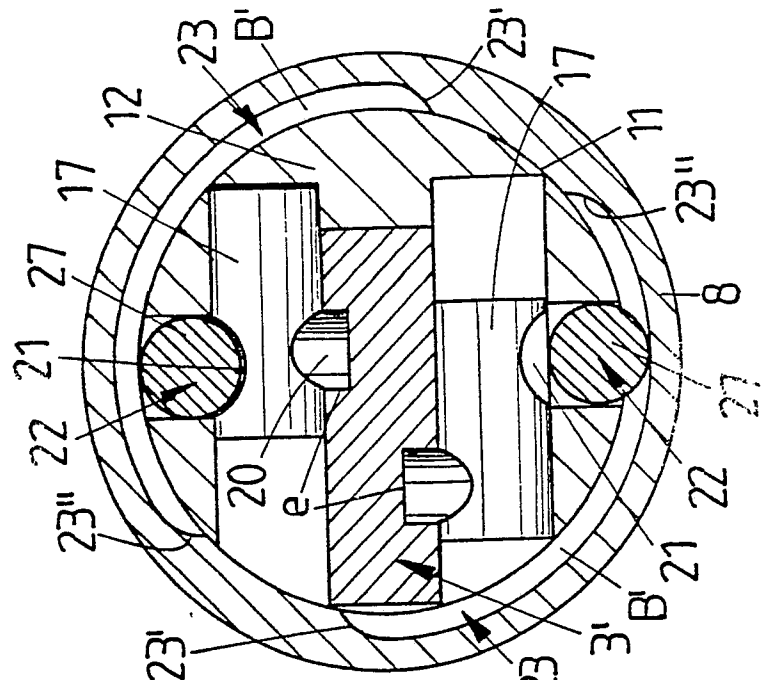


FIG.17

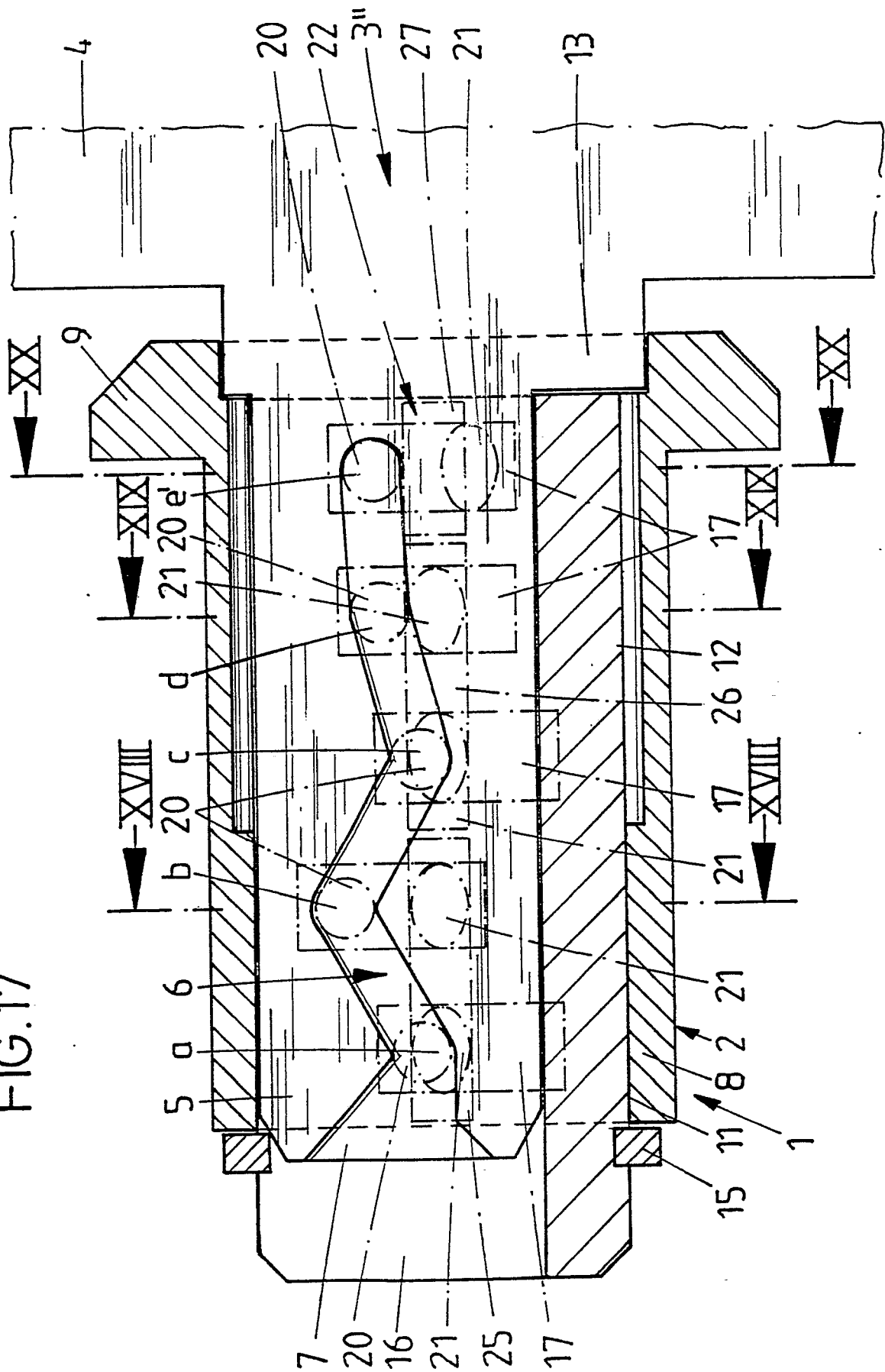


FIG. 18

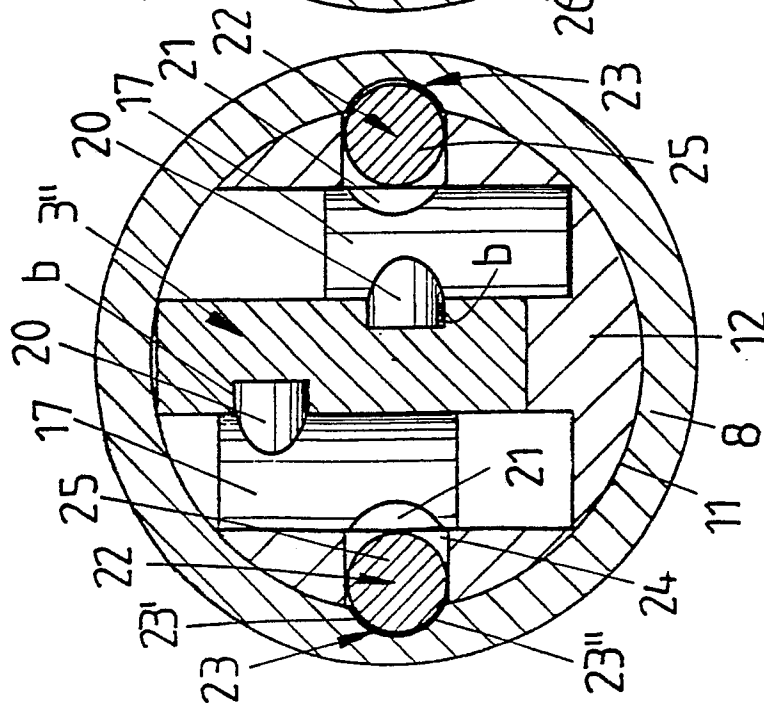


FIG. 19

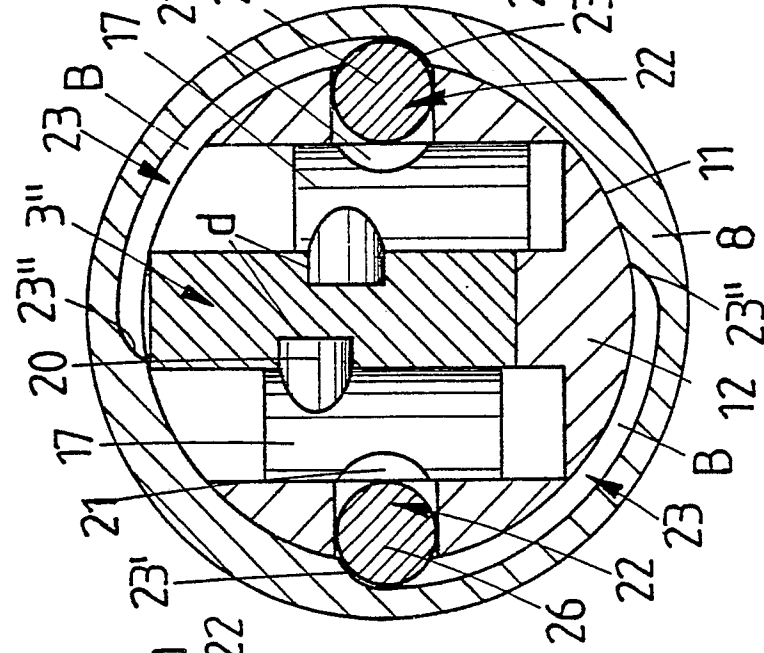


FIG. 20

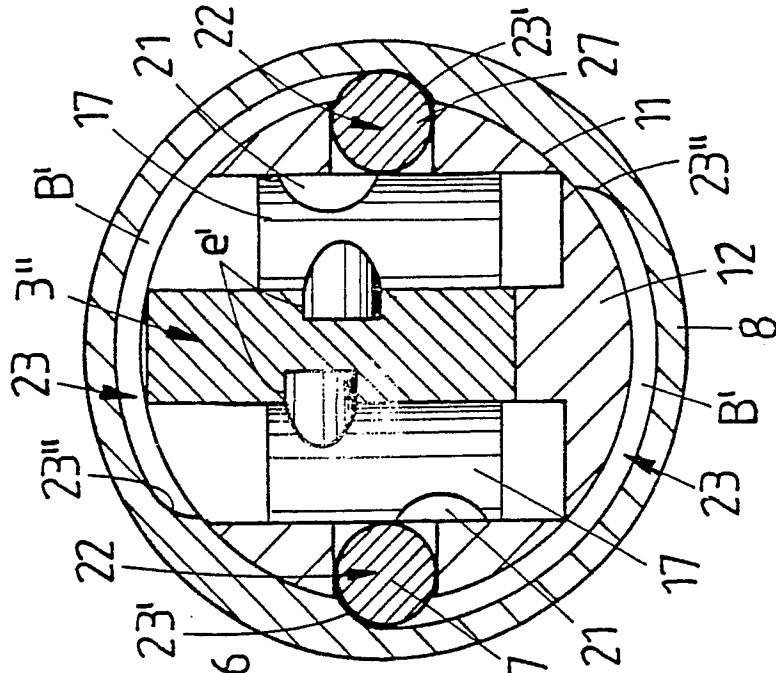


FIG. 21

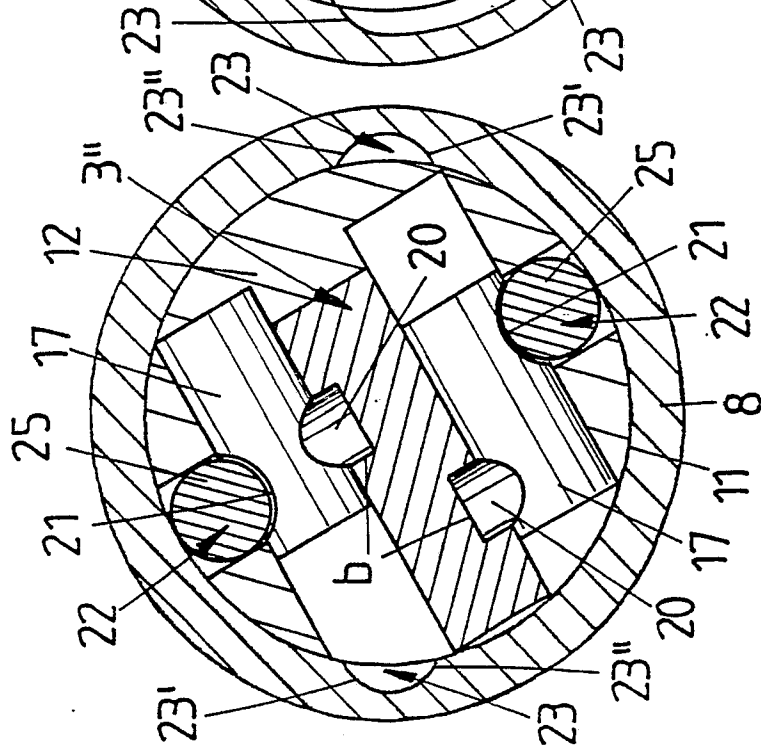


FIG. 22

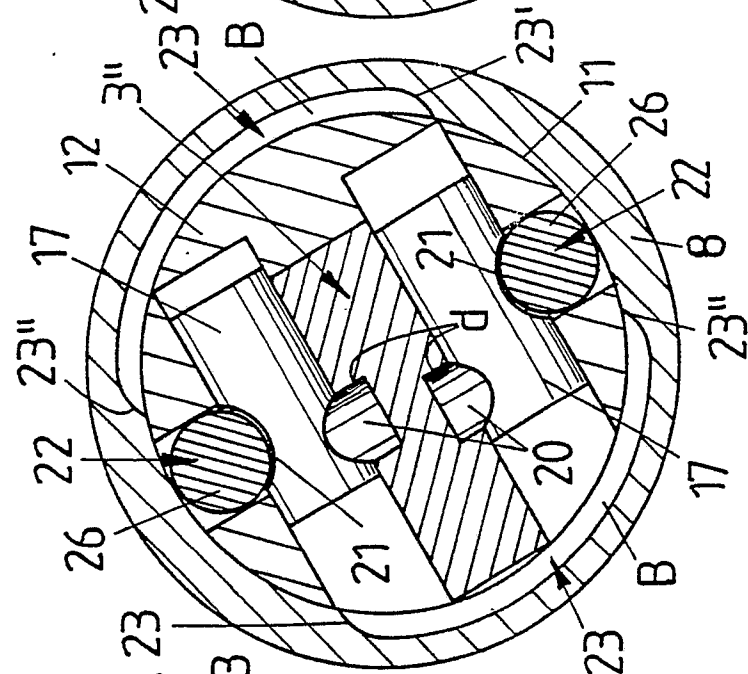
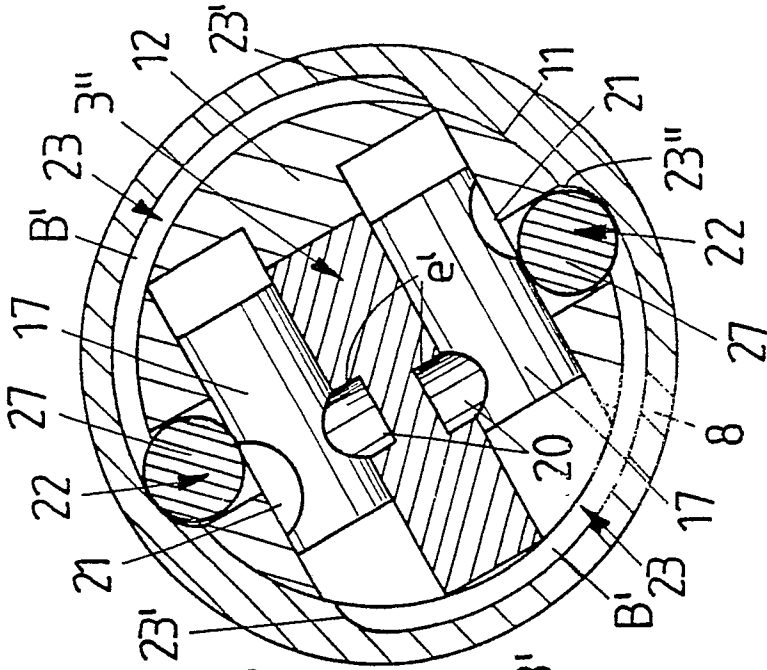


FIG. 23





EP 89310516.3

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.) <u>5</u>
A	<u>AT - A - 341 903</u> (BAUER KABA) * Fig. 1-14; claims 1-13 * --	1,3-8	E 05 B 35/00
A	<u>AT - A - 319 084</u> (R. PARLIER UND S. PFISTER) * Fig. 1-7; claim 1 * --	1-10	
A	<u>FR - A - 475 121</u> (M.C. RENAUX) * Fig. 1-23 * --	1	
D,A	<u>US - A - 3 035 433</u> (F.J. TESTA) * Fig. 1-6; claims 1-3 * ----	1-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.) <u>5</u>
			E 05 B
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 01-02-1990	Examiner CZASTKA
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	