(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 728 448 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.12.2006 Bulletin 2006/49

(51) Int Cl.:
A43C 15/16 *(2006.01)*

(21) Application number: **05425395.0**

(22) Date of filing: **31.05.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

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(54) An interchangeable stud structure for sports shoes

(57) An interchangeable stud structure for sports shoes comprises a supporting element (2) which can be fixed to a sole (22) of a sports shoe, having a connecting seat (9), and a stud body (3) with a pin (10) that has at least one engagement tooth (11). The stud body (3) can be rotated relative to the supporting element (2) about an axis of rotation between a first position in which it can be removed and a second position in which the tooth (11) is coupled with the connecting seat (9) and secures the stud body (3) to the supporting element (2). The connecting seat (9) extends along a spiral trajectory coaxial with the axis of rotation and has an engagement zone (12) and a locking zone (13). Each point of the locking zone (13) is at a distance from the external side (7) not less than any other point of the connecting seat (9) between the engagement zone (12) and the locking zone (13).

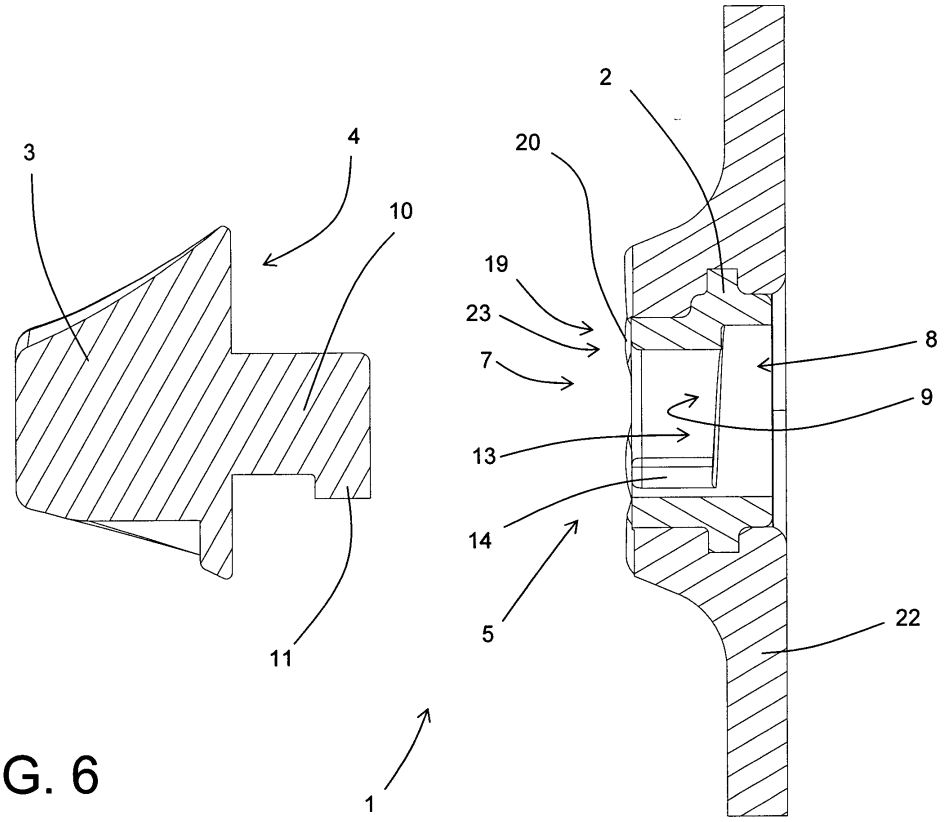

FIG. 6

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Description

[0001] The present invention relates to an interchangeable stud structure for sports shoes.

[0002] At present there are many known types of interchangeable stud structures, in which the connection between the stud body and a supporting element integral with the sole 22 of the shoe can be made in many different ways (by screwing, snapping into place by pressing, with bayonet connectors, etc.).

[0003] In particular, the present invention is intended for stud structures in which there is a rapid connection between the stud body and the supporting element, such as the known snap-in and bayonet connections.

[0004] Examples of interchangeable stud structures of this type are described in patents: EP 360202, EP 346624, DE 3423363, US 4445288, GB 475623, US 3267593, US 5628129, DE 3134817, US 5768809, US 4648187, US 2223794, US 2784503, US 4633600, EP 501853, US 4644672, EP 183860, US 4492047 and US 3911600.

[0005] As regards the bayonet connection systems, to connect the stud body to the supporting element, the body must first be pressed against the supporting element, creating a temporary deformation of both, rotated into the locking position then released.

[0006] An alternative is described in patent US 5628129, which illustrates a structure with a bayonet connector in which the stud body has a pin with three radial teeth, two of which, diametrically opposed, are designed to slide along a connecting seat for each made in the supporting element. In turn, each connecting seat has first an angled sliding section, then a depression (for the bayonet connector) designed to hold the stud body connected to the supporting element.

[0007] In this way, thanks to the angle of the sliding seats, it is the rotation of the stud body which "pulls" the body towards the supporting element, producing a temporary deformation of at least one of the two, a deformation which disappears when the teeth reach the relative depression.

[0008] However, all of the solutions known today have disadvantages.

[0009] The main problems with the stud structures with screw connections are the relatively long time needed to substitute the stud bodies and the fact that the threads of both the stud body and the supporting element tend to be easily ruined in the event of over-tightening.

[0010] The structures with a press in (snap-in) connection have the significant disadvantage of a relatively complex composition and mechanical strength which is not optimum.

[0011] Finally, bayonet connectors have the disadvantage of requiring high level production precision for their correct operation. Since the connection is made by means of elastic deformation of the components, any tolerances that are too high would compromise the strength of the connection.

[0012] In this situation the technical need which forms the basis of the present invention is to provide an interchangeable stud structure for sports shoes which overcomes the above-mentioned disadvantages.

[0013] In particular, the technical need of the present invention is to provide an interchangeable stud structure for sports shoes which has a simple structure, can be fitted rapidly and does not require excessive precision during production.

[0014] Another technical need of the present invention is to provide an interchangeable stud structure for sports shoes which guarantees optimum locking of the stud body to the supporting element (which may consist of the sole itself).

[0015] The technical need specified and the aims indicated are substantially achieved by an interchangeable stud structure for sports shoes as described in the claims herein.

[0016] Further features and the advantages of the present invention are more clearly illustrated in the detailed description which follows, with reference to the accompanying drawings, which illustrate a preferred embodiment of an interchangeable stud structure for sports shoes, without limiting the scope of the inventive concept, in which:

- Figure 1 is an exploded axonometric bottom view of an interchangeable stud structure made in accordance with the present invention;
- Figure 2 is a side view of the structure illustrated in Figure 1;
- Figure 3 is a front view of the stud body belonging to the structure illustrated in Figure 2;
- Figure 4 is a top view of the structure illustrated in Figure 1;
- Figure 5 is a view of a possible extension of a part of the structure illustrated in Figure 4;
- Figure 6 is a cross-section of the structure illustrated in Figure 1 according to the line VI - VI indicated in Figure 4;
- Figure 7 is a bottom view of the structure illustrated in Figure 1 with the stud body in a first operating position;
- Figure 8 is a cross-section of the structure illustrated in Figure 7 according to the line VIII
- VIII;
- Figure 9 is a cross-section of the structure illustrated in Figure 7 according to the line IX - IX;
- Figure 10 is a side view of the structure illustrated in Figure 7 with the stud body in a second operating position;
- Figure 11 is an enlarged view of a detail of the structure illustrated in Figure 10; and
- Figure 12 is a top view of the structure illustrated in Figure 10.

[0017] With reference to the accompanying drawings, the numeral 1 denotes as a whole an interchangeable

stud structure for sports shoes in accordance with the present invention.

[0018] The structure 1 comprises a supporting element 2 which can be fixed to a sole 22 of a sports shoe, and a stud body 3 which can be removably connected to the supporting element 2.

[0019] However, in general, although in the embodiment illustrated there is a supporting element 2 connected to the sole 22, the supporting element 2 may also consist directly of a portion of the sole 22. Therefore, hereinafter, references to the supporting element 2 will refer to both a special element to be fixed to a sole 22, and to a sole 22 specially shaped to form the supporting element 2.

[0020] The stud body 3 and the supporting element 2 have, respectively, a first and a second connecting surface 4, 5 for connection to one another which, when the structure 1 has been assembled, are facing and connected to one another.

[0021] The supporting element 2 has a through-hole 6 extending from its external side 7 to its internal zone 8. In addition, at the internal zone 8, the supporting element 2 has a connecting seat 9 designed to be engaged by the stud body 3.

[0022] The latter, in turn, has a pin 10 which extends perpendicular to the connecting surface 4 and has at least one engagement tooth 11 which extends in a radial direction (only one in the accompanying drawings - Figure 2).

[0023] The pin 10 can be inserted in the supporting element 2 through the through-hole 6 which, advantageously, is shaped to match the pin 10 and the tooth 11 (Figure 1).

[0024] When the pin 10 is inserted in the through-hole 6, the tooth 11 enters the internal zone 8 of the supporting element 2. Once the pin 10 has been inserted in the through-hole 6, the stud body 3 may be rotated about an axis of rotation, which in the accompanying drawings coincides with the axis of extension of the pin 10. In particular, the stud body 3 may be rotated relative to the supporting element 2, between a first position (Figures 8 - 9) in which the pin 10 can be removed from the through-hole 6 because it is aligned with it, and a second position in which the tooth 11 is coupled with the connecting seat 9 and secures the stud body 3 to the supporting element 2 (Figures 10 - 12).

[0025] In accordance with the present invention, the connecting seat 9 extends along a spiral trajectory coaxial with the stud body 3 axis of rotation. In particular, the connecting seat 9 extends between an engagement zone 12 at a minimum distance from the external side 7 of the supporting element 2 and a locking zone 13 which is further from the external side 7 than the engagement zone 12.

[0026] Moreover, according to the present invention, each point of the locking zone 13 is at a distance from the external side 7 not less than any other point of the connecting seat 9 between the engagement zone 12 and the locking zone 13. In other words, the connecting seat 9 extends in an ever increasing fashion (or, at most, is flat), but never has inverted slopes (which in contrast are present in a bayonet connector).

[0027] As a result, rotation of the stud body 3 from the first position to the second position causes the tooth 11 to slide along the connecting seat 9 respectively from the engagement zone 12 (Figure 9) to the locking zone 13 (Figure 12). Therefore, when it is in the locking zone, the tooth 11 is further from the external side 7 of the supporting element 2 than when it is in the engagement zone 12.

[0028] Moreover, in the preferred embodiment of the present invention, the slope of the connecting seat 9 is determined on the basis of specific technical evaluations.

[0029] Based on the materials used to make the tooth 11 and the connecting seat 9, it is possible to identify a sliding friction coefficient between them. In particular, both a static friction coefficient and a dynamic friction coefficient may be identified.

[0030] Moreover, each friction coefficient between a first and a second material corresponds, in the known way, to a so-called angle of sliding friction, understood to be the angle of inclination to the horizontal of an angled surface created with the first (second) material on which an object made with the second (first) material is placed, an angle of inclination corresponding to an equilibrium between the tangential component of the weight force of the object and the resistant force caused by the friction.

[0031] In the case of the present invention, for each pair of materials used, the minimum angle of sliding friction φ is identified, understood to be the angle corresponding to the lowest friction coefficient of the two materials (typically the dynamic friction coefficient).

[0032] Therefore, advantageously, according to the present invention, the connecting seat 9 has, at least at the locking zone 13, but preferably over its entire extension, a slope less than or equal to the minimum angle of sliding friction φ identifiable for that configuration. The connecting seat 9 also preferably has a slope which is less than half of the minimum angle of sliding friction φ (Figure 5). A second important aspect of the set up of the present invention is the difference in level that the connecting seat 9 must guarantee for the tooth 11.

[0033] Said difference in level must be greater than all of the plays and tolerances which may be present in the stud structure 1 once fitted in a shoe.

[0034] In general, in the preferred embodiments, the connecting seat 9 has an overall difference in level of between 0.5 and 2 mm, which advantageously is between 0.8 and 1.5 mm.

[0035] It may be seen how, in order to achieve the differences in level indicated, using a seat with the above-mentioned slopes, seats 9 with a relatively long extension may be required.

[0036] In light of this, the connecting seat 9 preferably extends circumferentially through an angle greater than 180°, which, in the embodiments illustrated is a little more than 270°. Therefore, it may be seen how, in the embod-

iment illustrated (Figure 3), in plan view, the connecting seat 9 occupies almost the entire circular arc available to it, the remainder being occupied by a stop 14, designed to prevent rotations of the stud body 3 beyond the second position, and by the projection 15 of the through-hole 6 designed to allow the passage of the tooth 11. The through-hole 6 comprises a central zone 16 shaped to match the pin 10 and the side projection 15 shaped to match the tooth 11.

[0037] In the preferred embodiments the pin 10 has a diameter of between 4 and 8 mm. Consequently, in an embodiment in which the pin 10 has a diameter of 6 mm, the length of the connecting seat 9 is approximately 13 - 15 mm.

[0038] In any event, the connecting seat 9 may have a section 17 with a greater slope at the engagement zone 12 (but preferably less than the minimum angle of sliding friction φ), so that overall it can provide a greater difference in level, the slope in the locking zone 13 being equal. An example of this concept is schematically illustrated in Figure 5, showing a possible flat extension of the connecting seat 9.

[0039] In the embodiment illustrated in the accompanying drawings (Figure 3), the tooth 11 has an active surface 18 for contact with the connecting seat 9 (facing the stud body 3 connecting surface) which is shaped to match the connecting seat 9. The active surface 18 has a slope corresponding to the slope of the connecting seat 9, in particular in the locking zone 13. In this way, the tooth 11 rests on the connecting seat 9 with all of its active surface 18, and is therefore less subject to deformations caused by the stresses created when the stud body 3 is fixed in place.

[0040] In addition, the first and/or second connecting surface 4, 5 preferably has one or more grip elements 19.

[0041] However, in the preferred embodiment (Figures 1, 2 and 11) instead of being on the supporting element 2, the grip elements 19 are on an extension 23 of the second surface 5, formed directly by the sole 22 of the shoe to which the supporting elements 2 are fixed (in the accompanying drawings they are embedded in it). Said grip elements 19 consist of a continuous circumferential undulation 20 of the extension of the second surface 5, whilst the first connecting surface 4 has one or more grip elements 19 consisting of a protrusion 21 in the shape of a localised undulation.

[0042] In this way (Figure 11), when the stud body 3 is fixed to the supporting element 2, the grip elements 19 interfere with one another, preventing any accidental rotation of the stud body 3.

[0043] Any materials may be used to make the stud body 3 and the supporting element 2, according to requirements. For example, they may be made of aluminium, steel, ceramic, plastic, etc. and they may or may not be the same for both the stud body 3 and the supporting element 2. As indicated, each pair of materials has a corresponding predetermined minimum friction coefficient and therefore a minimum angle of sliding friction φ based on which the slope of the connecting seat 9 must be designed.

[0044] For example, reference may be made to a steel - steel connection. For such a connection a dynamic friction coefficient of 0.54 is normally defined, corresponding to a minimum angle of sliding friction φ of 28° (tan φ = friction coefficient). Consequently, the connecting seat will preferably have a slope less than 14°, for example 10°.

[0045] Therefore, if it is assumed that the seat is approximately 13 mm long (see above) there is approximately a 2.3 mm adjusted maximum difference in level.

[0046] The present invention also refers to both a sole 22 for shoes and to a shoe, fitted with a stud structure 1 made as indicated above.

[0047] Operation of the stud structure 1 disclosed derives directly from the description of the structure 1 above.

[0048] To connect the stud body 3 to the supporting element 2, it is sufficient to insert the pin 10 in the through-hole 6, so that the tooth 11 is brought close to the engagement zone 12, and turn the stud body 3 from the first position to the second position, applying sufficient torque.

[0049] It should be noticed that the second position is not limited to one position. In fact, this is the position in which the stud body 3 stops, and it therefore depends on the torque applied to the stud body 3 during rotation and on the tolerances of the individual components.

[0050] Moreover, if correctly fitted (that is to say, by applying suitable torque), at least the final section of the rotation corresponds to an elastic deformation of any grip elements 19 present, so that when the stud body 3 is in the second position the grip elements 19 on the stud body 3 and on the supporting element 2 are inserted between one another (Figure 11).

[0051] The present invention brings important advantages.

[0052] Firstly, the stud structure 1 disclosed allows simple and rapid stud body 3 fitting.

[0053] Secondly, the structure disclosed can automatically adjust the construction tolerances of the elements of which it is composed (the stud locking position can be varied according to the tolerances involved; therefore, both during production and during stud fixing to the sole 22 of a shoe, the normal tolerances of such operations may be accepted).

[0054] It should also be noticed that the present invention is relatively easy to produce and that even the cost linked to implementation of the invention is not very high.

[0055] The invention described may be subject to many modifications and variations, without thereby departing from the scope of the inventive concept.

[0056] All details may be substituted by other technically equivalent elements and in practice all materials used, as well as the shapes and dimensions of the various components, may be any according to requirements.

Claims

1. An interchangeable stud structure for sports shoes, comprising:

   a supporting element (2) with a through-hole (6) extending from an external side (7) to an internal zone (8) of the supporting element (2), and having a connecting seat (9) at the internal zone (8);
   a stud body (3) removably connectable to said supporting element (2), the stud body (3) having a pin (10) with at least one engagement tooth (11), it being possible to insert the pin (10) in the supporting element (2) through the through-hole (6) so that the tooth (11) is brought to the internal zone (8);
   once the pin (10) is inserted in the through-hole (6), the stud body (3) being able to rotate relative to the supporting element (2) about an axis of rotation between a first position in which the pin (10) can be removed from the through-hole (6), and a second position in which the tooth (11) is coupled to the connecting seat (9) and secures the stud body (3) to the supporting element (2);
   the stud structure being **characterised in that** the connecting seat (9) extends along a spiral trajectory coaxial with the axis of rotation, the rotation of the stud body (3) from the first position to the second position causing the tooth (11) to slide along the connecting seat (9) from an engagement zone (12) to a locking zone (13) where the tooth (11) is further from the external side (7) than when it is in the engagement zone (12), and also being **characterised in that** each point of the locking zone (13) is at a distance from the external side (7) not less than any other point of the connecting seat (9) between the engagement zone (12) and the locking zone (13).

2. The stud structure according to claim 1, **characterised in that** the connecting seat (9) and the tooth (11) are made respectively of a first and a second material, and also **characterised in that** the connecting seat (9) has a slope which is less than or equal to the minimum angle of sliding friction (φ) identifiable for the tooth (11) and the connecting seat (9).

3. The stud structure according to claim 2, **characterised in that** the connecting seat (9) has a slope which is less than half of the minimum angle of sliding friction (φ) identifiable for the tooth (11) and the connecting seat (9).

4. The stud structure according to any of the foregoing claims, **characterised in that** the pin (10) has only one tooth (11), and **in that** the connecting seat (9) extends circumferentially through an angle greater than 180°.

5. The stud structure according to claim 4, **characterised in that** the connecting seat (9) extends circumferentially through an angle greater than 270°.

6. The stud structure according to any of the foregoing claims, **characterised in that** the seat also has a stop (14) to prevent stud body (3) rotations beyond the second position.

7. The stud structure according to any of the foregoing claims, **characterised in that** the tooth (11) has an active surface (18) for contact with the connecting seat (9) and shaped to match the latter.

8. The stud structure according to claim 7, **characterised in that** the active surface (18) has a slope corresponding to the slope of the connecting seat (9).

9. The stud structure according to any of the foregoing claims, **characterised in that** the seat has a section (17) with a greater slope at the engagement zone (12).

10. The stud structure according to any of the foregoing claims, **characterised in that** the through-hole (6) is shaped to match the pin (10) and the tooth (11).

11. The stud structure according to any of the foregoing claims, **characterised in that** the stud body (3) and the external side (7) of the supporting element (2) have, respectively, a first connecting surface (4) and a second connecting surface (5) for connection to one another, at least one of said surfaces having one or more grip elements (19).

12. The stud structure according to claim 11, **characterised in that** at least some of the grip elements (19) consist of undulations (20), (21) in the relative connecting surface (4), (5).

13. The stud structure according to any of the foregoing claims, **characterised in that** the pin (10) has a diameter of between 4 and 8 mm.

14. The stud structure according to claim 13, **characterised in that** the pin (10) has a diameter of 6 mm.

15. The stud structure according to any of the foregoing claims, **characterised in that** the length of the connecting seat (9) is between 13 and 15 mm.

16. The stud structure according to any of the foregoing claims, **characterised in that** the connecting seat (9) has an overall difference in level of between 0.5 and 2 mm.

17. The stud structure according to claim 16, **characterised in that** the connecting seat (9) has an overall

difference in level of between 0.8 and 1.5 mm.

18. The stud structure according to any of the foregoing claims, **characterised in that** the supporting element can be fixed to a sole (22) of a sports shoe.

19. The stud structure according to any of the claims from 1 to 17, **characterised in that** the supporting element consists of a portion of a sole (22) of a sports shoe.

20. The sole of a sports shoe, **characterised in that** it comprises one or more interchangeable stud structures made in accordance with any of the foregoing claims.

21. The sole of a sports shoe according to claim 20, also comprising grip elements (19) designed to couple with grip elements (19) integral with the stud body (3).

22. A sports shoe **characterised in that** it comprises a sole (22) made according to claim 20 or 21.

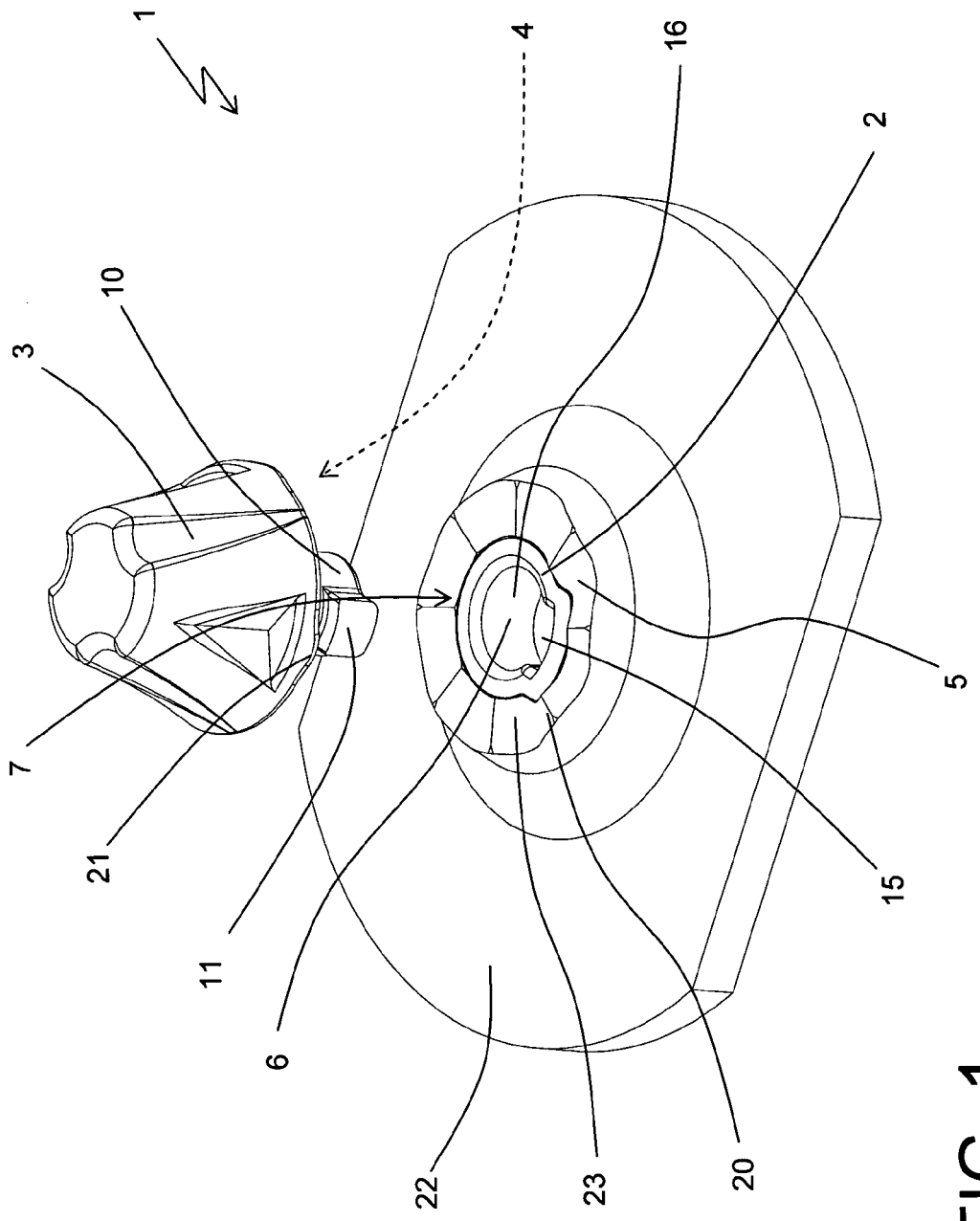

FIG. 1

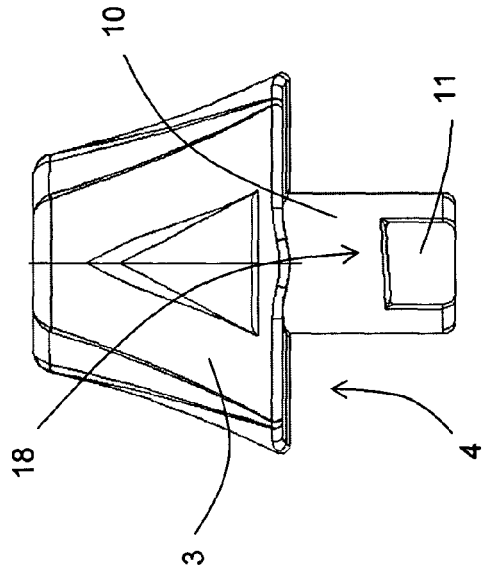

FIG. 3

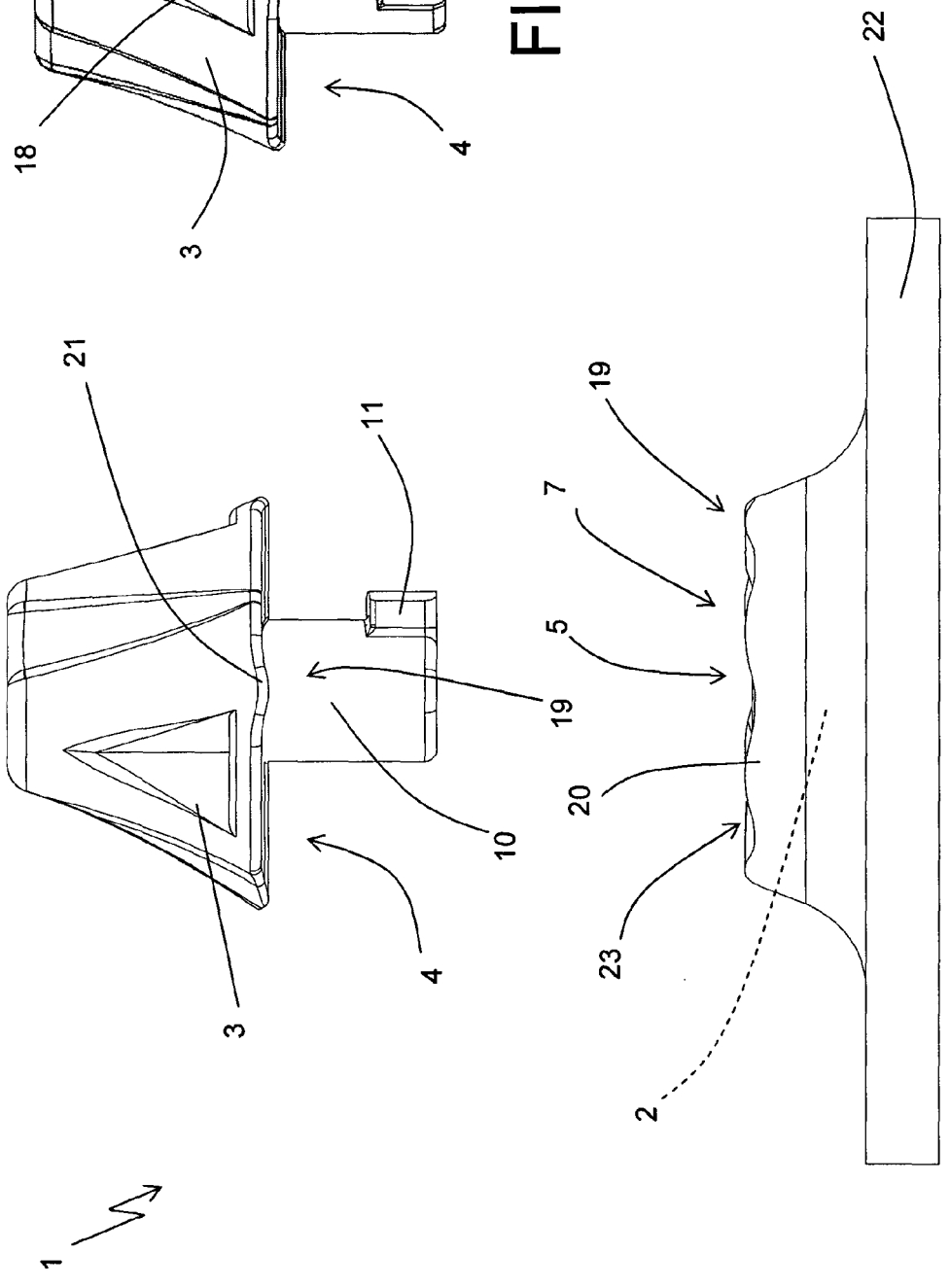

FIG. 2

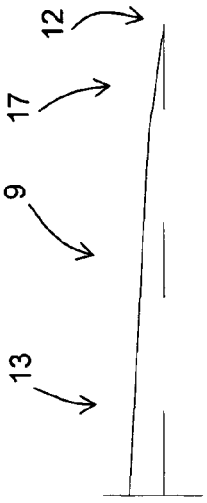

FIG. 5

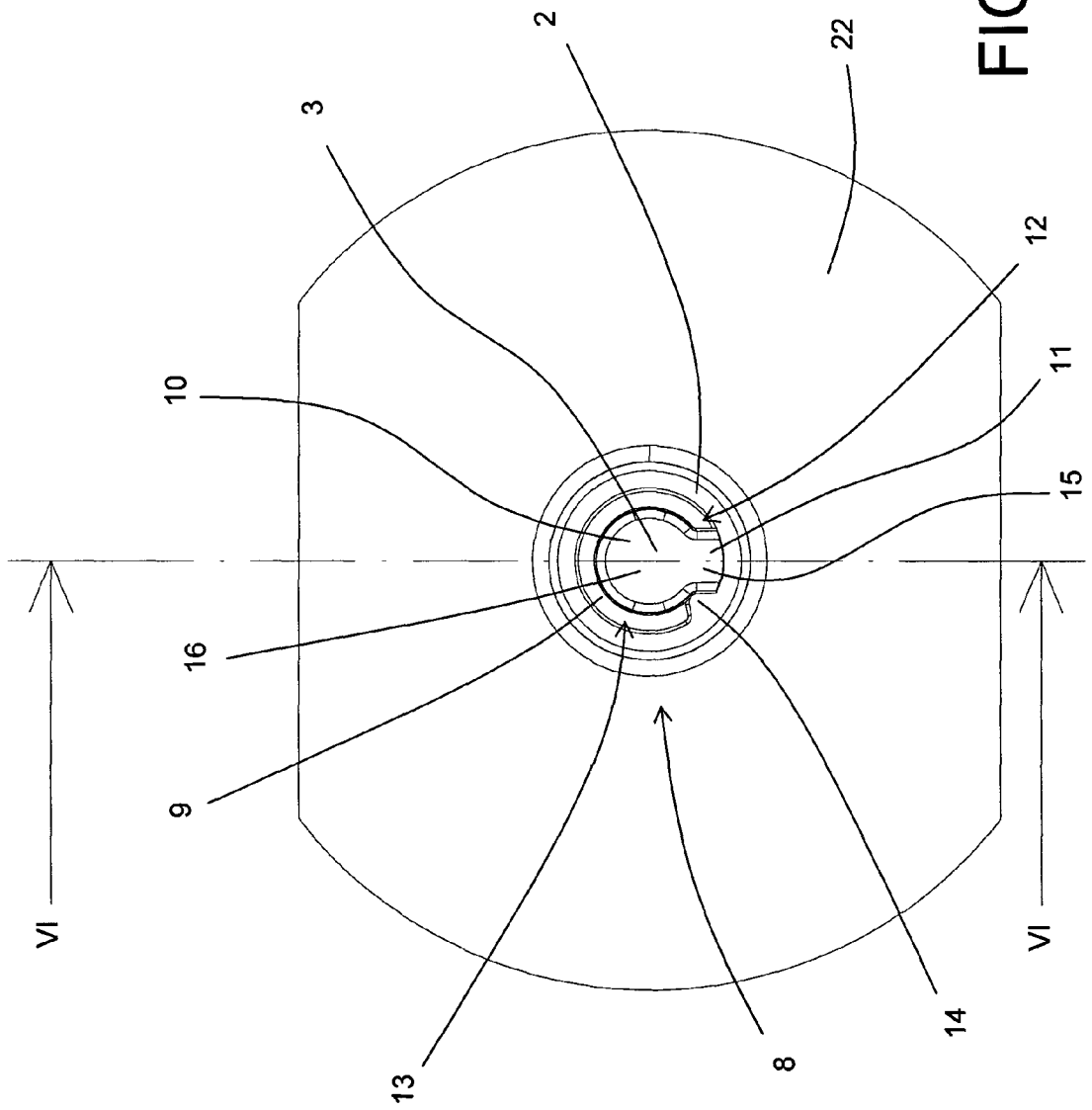

FIG. 4

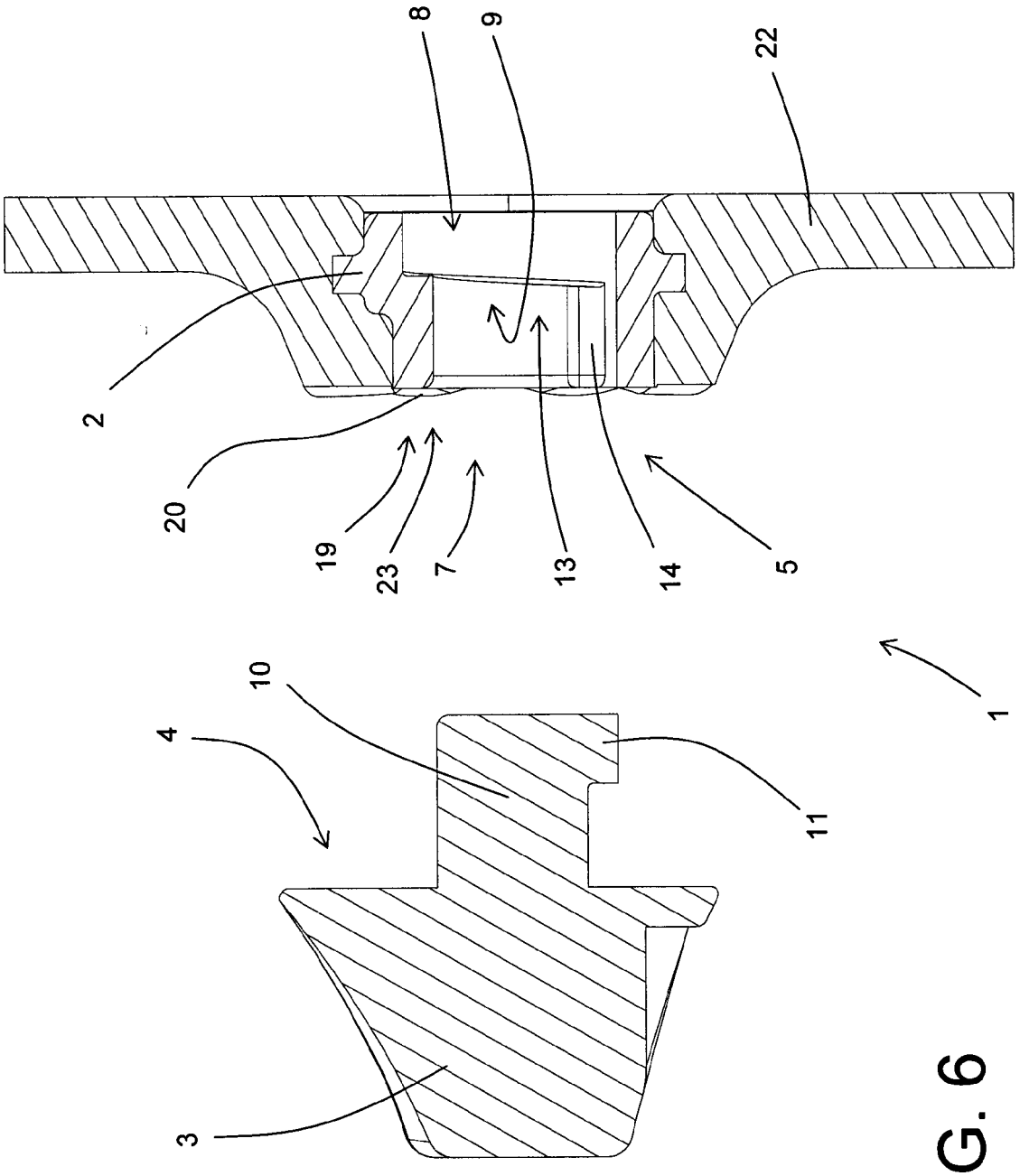

FIG. 6

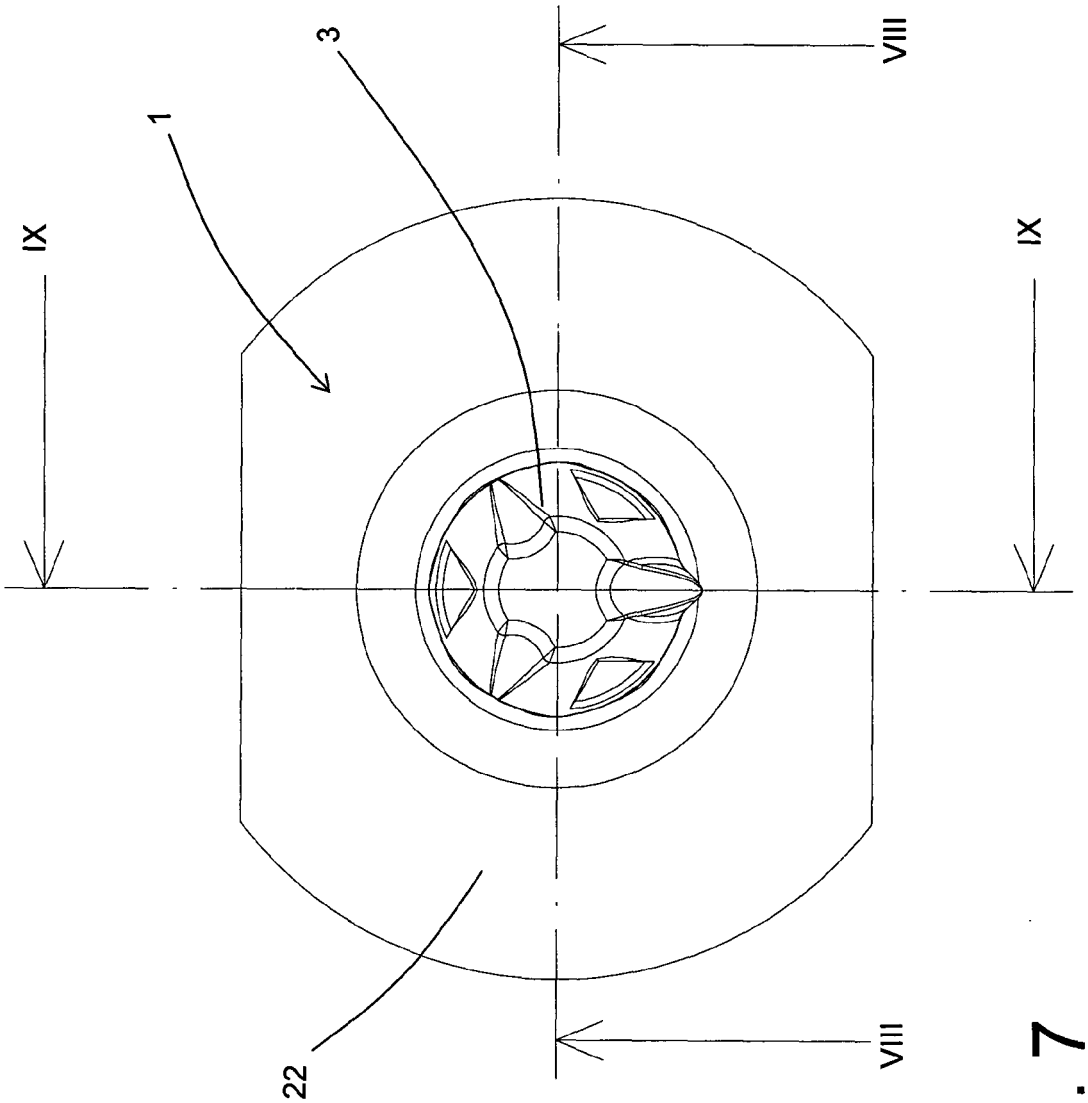

FIG. 7

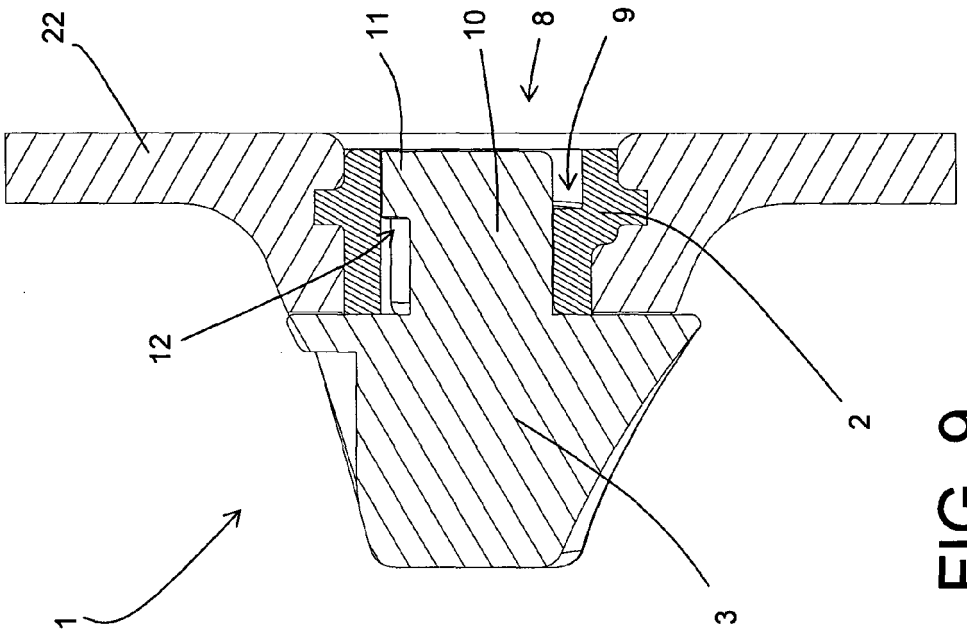

FIG. 9

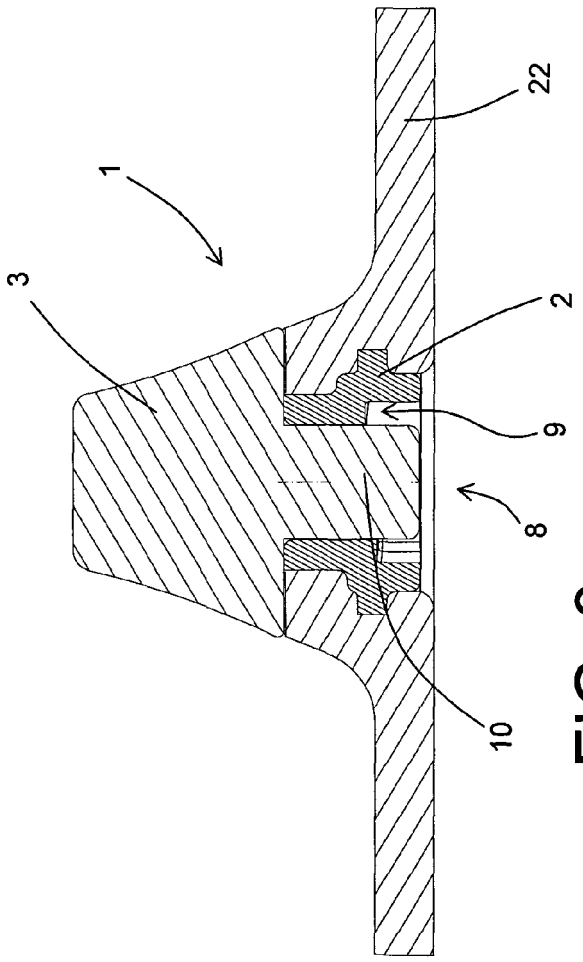

FIG. 8

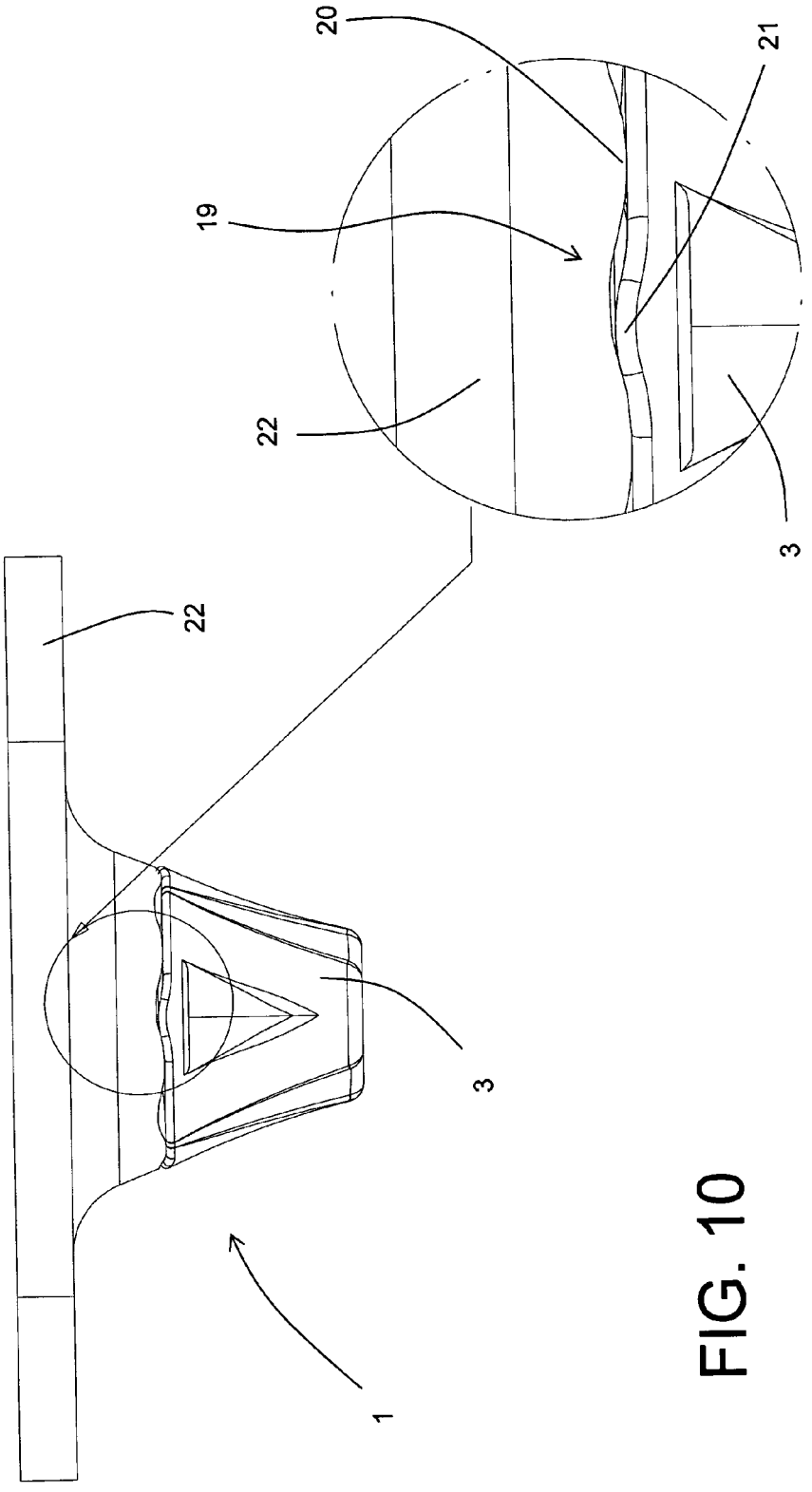

FIG. 10

FIG. 11

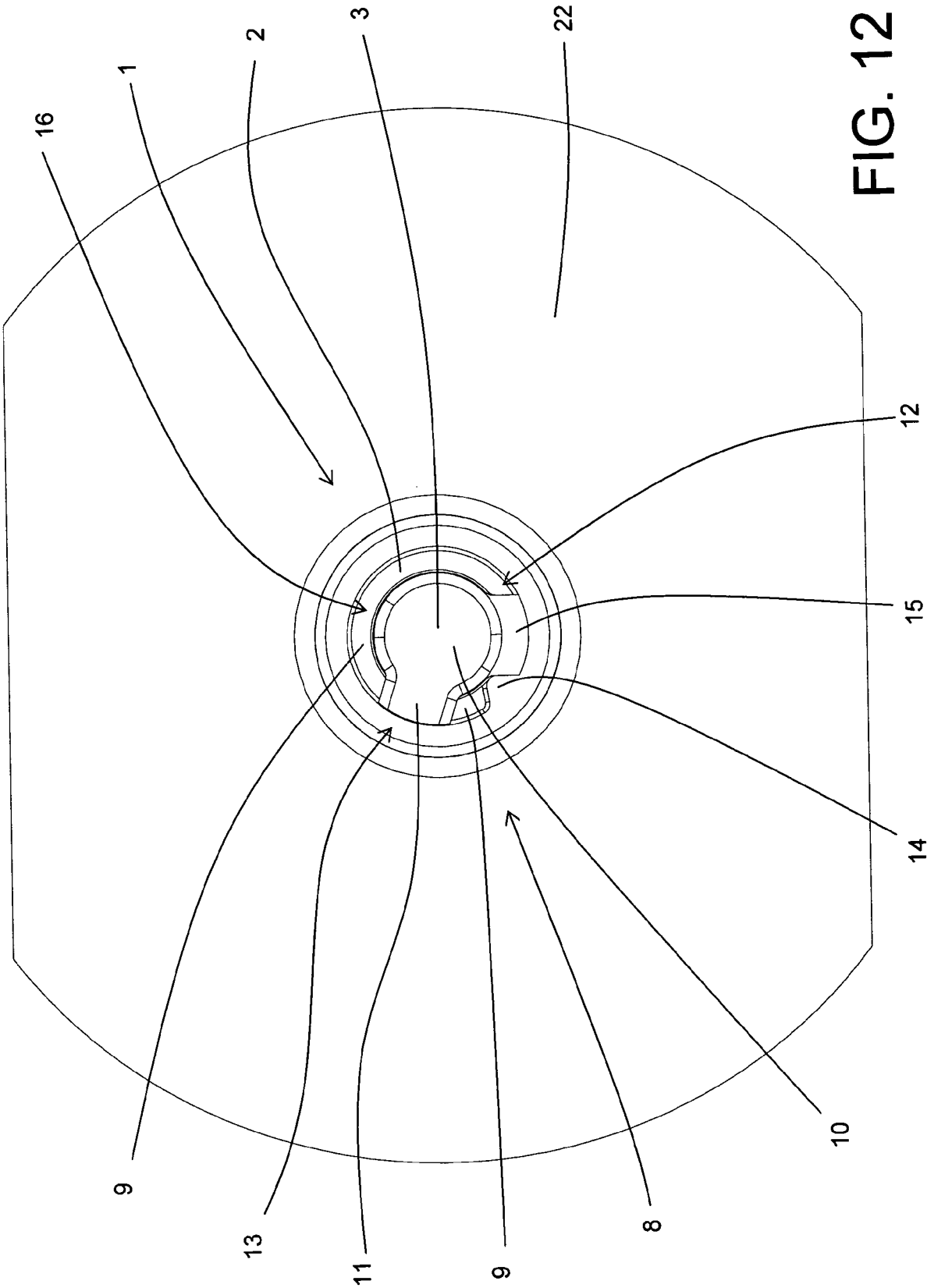

FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5395

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.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 October 2005	Vesin, S

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 42 5395

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