



(51) International Patent Classification:
F16D 65/12 (2006.01)

(21) International Application Number:
PCT/IB2018/056632

(22) International Filing Date:
30 August 2018 (30.08.2018)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
102017000097892 31 August 2017 (31.08.2017) IT

(71) Applicant: **FRENI BREMBO S.P.A.** [IT/IT]; Via Brembo, 25, I-24035 Curno, Bergamo (IT).

(72) Inventors: **MATTI, Andrea**; c/o Freni Brembo S.P.A., Via Brembo, 25, I-24035 Curno, Bergamo (IT). **ROSSI, Hy-**

dra; c/o Freni Brembo S.P.A., Via Brembo, 25, I-24035 Curno, Bergamo (IT).

(74) Agent: **CRIPPA, Paolo Ernesto** et al.; c/o Jacobacci & Partners S.P.A., Via Senato, 8, I-20121 Milano (IT).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: BRAKE DISC ASSEMBLY

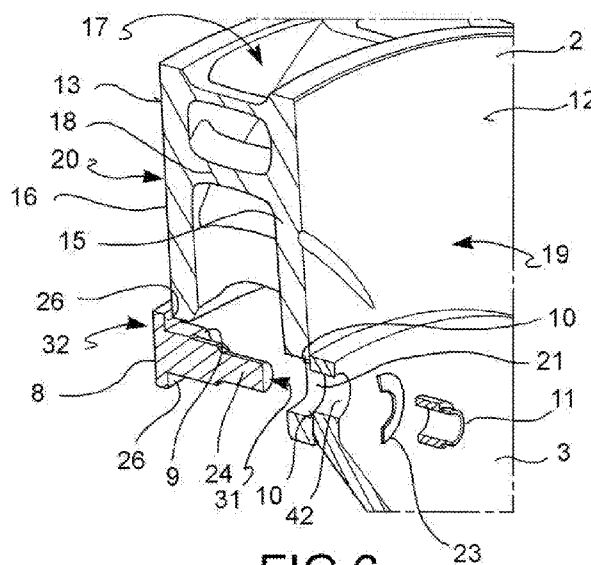


FIG. 6

(57) Abstract: A brake disc assembly (1) comprising: a brake band (2), a bell (3), adapted to be operatively connected to a vehicle wheel associable with the brake disc assembly (1), and at least one connecting device (4), which forms a connection between said brake band (2) and said bell (3); said connecting device (4) and said bell (3) cooperate by delimiting at least one axial band seat (5) where the brake band (2) may slide in an axial direction (X-X) of a predetermined axial stroke; said bell (3) comprises at least a first end-of-stroke surface (6) which forms a first abutment surface in the axial direction (X-X) for said brake band (2); said connecting device (4) comprises a second end-of-stroke surface (7), opposite to said first end-of-stroke surface (6), which forms a second opposite abutment surface in the axial direction (X-X) for said brake band (2); said connecting device (4) comprises at least one male element (8), which is accommodated in at least one male element bell seat (14) obtained in said bell (3); said male element (8) comprises at least one bell

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

abutment surface (9); said bell (3) comprises at least one male element abutment surface (10); said bell abutment surface (9) of the male element (8) forming an abutment surface in the axial direction (X-X) for said male element abutment surface (10) of the bell (3) so as to avoid said connecting device (4) and said bell (3) from tightening said brake band (2) therebetween.

BRAKE DISC ASSEMBLY

[0001]. Field of the invention

[0002]. The present invention relates to a brake disc assembly.

5 [0003]. In particular, the present invention relates to a brake disc assembly comprising a brake band and a bell made in separate pieces and assembled by using at least one connecting device.

[0004]. The present invention further relates to a male element of said connecting device.

10 [0005]. Prior art

[0006]. In a disc brake, the brake caliper is generally arranged straddling the outer peripheral margin of a brake disc, adapted to rotate about a rotational axis defining an axial direction (X-X). In a disc brake, a radial direction (R-R), which is substantially
15 orthogonal to said axial direction (X-X), and a tangential (T-T) or circumferential direction (T-T), orthogonal to both said axial direction (X-X) and said radial direction (R-R), is further defined.

[0007]. Many brake disc embodiments currently provide making a
20 brake band on which the disc brake caliper acts to generate the braking torque, separate from the bell which is intended to be fixed to the wheel hub. In this manner, the brake band can be made of a material different from that used for manufacturing the bell. Typically, the brake band is made of a material highly resistant
25 to friction wear, such as spheroidal carbon cast iron or composite material, e.g. as shown in document WO-03-001076 by the Applicant.

At the same time, the bell may be made of a lighter material than that of the brake band, e.g. aluminum, particularly to respond to the need of reducing the weight of the unsprung vehicle weights.

[0008]. The connection between brake band and bell is very
5 important because it ensures the transfer of braking torque from band to bell. The tangential constraint between brake band and bell can be made with systems which provide protuberances of the brake band which couple in respective seats of the bell in order to achieve a tangential constraint system between band and bell
10 having a particularly simple structure and therefore low production costs. Otherwise, the tangential constraint between brake band and bell may be achieved by using bushes or fixing pins designed to form a secure connection between axially overlapped portions of the brake band and the bell, e.g. as shown in document
15 **WO-03-089802** by the Applicant.

[0009]. As known, a brake caliper body comprises two opposite elongated portions facing the opposite braking surfaces of the brake band of the disc brake, and at least one caliper bridge to connect said opposite elongated portions to each other by placing
20 the caliper body straddling the brake disc. During the braking action, thrust means, usually hydraulically or electro-mechanically actuated cylinder-piston assemblies, determine that at least one pair of opposite brake pads with which the brake caliper is provided abut against the opposite surfaces of the
25 brake band of the disc brake, producing friction for the braking action when operated.

[0010]. In conditions of prolonged use and particularly on high-performance vehicles in which high friction is generated between brake pads and disc as a result of fast decelerations, a different wear of the friction material of the opposite brake pads is typically found, which necessarily implies an imbalance of forces acting on the opposite braking surfaces of the brake disc and consequently of the reactions on the caliper body. This problem is further exacerbated by the manufacturing and assembly tolerances of the disc brake components, such as, for example, the manufacturing tolerances of the bell and the operating tolerances of the elements of the brake caliper, e.g. of the thrust means and of the associated actuating system.

[0011]. For these reasons, in a disc brake it is usually known to provide an axial elastic preload on the brake band, preload which, however minimal, allows the brake band to slide, or float axially, in order to settle substantially halfway between the opposite pads of the brake caliper.

[0012]. Such axial float prevents the disc from being rigidly constrained in axial direction and consequently prevents portions of the disc from being plastically deformed due to the imbalance of the stresses caused by asymmetric clamping applied by the pads on the disc, as well as due to the thermal stresses which induce deformations of different extent on the material of the bell and on the material of the brake band.

[0013]. Typically, the axial float occurs by sliding of the brake band, biased by elastic preload means, on the outer surface

of the connecting pin or a bush fitted thereon. An example of solution of this type is shown in document **WO-01-36836** which provides a preload spring interposed between a brake band wall and the underhead of the pin connection to elastically bias the brake
5 band away from the underhead of the pin, forcing it into axial abutment against the bell, so that such pin cooperates with the spring to tightly clamp brake band and bell.

[0014]. Solutions of this type, in which the connecting pin tightly clamps brake band and bell, force the bell to slide
10 axially on the connecting pin together with the brake band, resulting in premature damage due by wear of the material of the bell which slides on the pin surface. Indeed, as is known, the material of which the bell is made is usually softer than the material of the brake band, because a component which is as light
15 as possible is desirable, and is therefore intended to wear rapidly by friction. In some cases, this may require a frequent replacement of the bell only or of the entire disc brake.

[0015]. Document **US-6604613** shows a solution in which a bush comprising an annular protrusion is fitted on the connecting pin
20 whereby forming with such protrusion a first abutment for the axial sliding of the brake band and forming a second abutment with a further protrusion, in the latter case for the bell. This solution, although advantageous because it avoids tightly clamping the brake band and the bell, however requires high manufacturing
25 and assembly tolerances, particularly of the bushing and pin components and of their mutual threads, which by cooperating

delimit the axial stroke or axial float of the brake band and constrain the bell.

[0016]. Providing such axial float or end float requires maintaining the accesses to the bell and the brake band seats adapted to receive the connecting pins as isolated from the surrounding environment as possible, in order to limit the introduction of dust and debris, e.g. debris of the pad friction material and dust raised from the road surface, the latter particularly for applications on rally or off-road vehicles. Indeed, the accumulation of such dust and debris can prevent the axial mobility of the brake disc components with respect to the axial position of the caliper body.

[0017]. For example, document **EP-1466106** by the Applicant illustrates a pin solution which connects the brake band and the bell having an underhead portion having tangentially facing walls shaped so as to be inserted with minimal tangential clearance in a seat provided in the bell, so as to be able to abut against the facing walls of the bell seat to transfer the tangential braking action. Such pin is at the same time adapted to provide the necessary axial clearance, or axial float, which allows it to slide in relative axial direction between the brake band of the disc and the gripper body.

[0018]. This solution, although advantageous from many points of view, does not fully solve the problem, because the relative axial motion between the underhead portion of the connecting pin and the bell seat walls implies a mutual rubbing which necessarily

deteriorates the bell seat walls, obliging to make the bell itself of friction wear-resistant material in order to cope with the deterioration due to the prolonged rubbing action, or on the contrary by imposing a frequent replacement of the disc bell when
5 this is made of aluminum or other soft material and therefore is light in weight.

[0019]. The need is thus felt to provide a solution for the drawbacks mentioned with reference to the state of the art.

[0020]. The need is strongly felt to provide a disc brake
10 solution, in which the brake band is made in one piece separate from the bell, of increased resistance to wear compared to known solutions, without for this reason increasing the weight of the brake disc or increasing the number of components to be assembled.

[0021]. The need is strongly felt to reduce the number of brake
15 disc components, while allowing the brake band and the bell to be formed in separate pieces, without because of this determining a reduction of working life caused by the accumulation of dust and debris in the connection between brake band and bell and at the same time capable of ensuring a predetermined axial float between
20 the brake band and the caliper body associable with the disc brake.

[0022]. The need is felt to provide a brake disc solution which is light yet strong and which is simpler to assemble than known solutions and at the same time which is adapted for off-road
25 vehicles, particularly high-performance vehicles, such as for example rally vehicles, without because of this causing an

accumulation of debris and dust in the connection between brake band and bell.

[0023]. Solution

[0024]. It is an object of the present invention to solve the drawbacks of the prior art and to provide a solution to the needs described hereto with reference to the prior art.

[0025]. These and other objects are achieved by a brake disc assembly according to claim 1 and by a male element according to claim 7.

10 [0026]. Some advantageous embodiments are the object of the dependent claims.

[0027]. Figures

[0028]. Further features and advantages of the brake disc assembly and of the male element of the connecting device will be apparent from the following description of its preferred embodiments, given by way of non-limiting examples, with reference to the accompanying figures, in which:

[0029]. - figure 1 is a plan view of a brake disc, according to an embodiment;

20 [0030]. - figure 2 is an axonometric view showing a brake band and bell portion with a dashed line for the sake of clarity together with a connecting device with a solid line, according with an embodiment, shown on the vehicle-wheel-oriented side of the brake band;

25 [0031]. - figure 3 is an axonometric view which shows the brake band and bell portion shown in figure 2 from the vehicle-oriented

brake band side;

[0032]. - figure 4 is an axonometric view of parts separated for the sake of clarity which shows a portion of a brake disc assembly, according to an embodiment;

5 [0033]. - figure 5 is an axonometric view with some parts in section along a cutting plane directly along the axial and radial directions for the sake of clarity which shows a portion of a brake disc assembly, according to an embodiment;

[0034]. - figure 6 is an axonometric and section view taken
10 along a cutting plane directed along the axial and radial directions which shows a portion of a brake disc assembly with parts separated, according to an embodiment;

[0035]. - figure 7 is a section view taken along a cutting plane directed along the axial and radial directions, as indicated by
15 arrows VII-VII in figure 1, which shows a portion of a brake disc assembly comprising a connecting device, according to an embodiment;

[0036]. - figure 8 is an axonometric section view of a portion of male element of a connecting device, according to an
20 embodiment;

[0037]. - figure 9 is a section view taken along a cutting plane directed along the axial and tangential directions, as indicated by arrows IX-IX in figure 7, which shows a portion of a brake disc assembly comprising a connecting device, according to an
25 embodiment;

[0038]. - figure 10 is an axonometric view of a male element of

a connecting device, according to an embodiment;

[0039]. - figure 11 is an axonometric view of parts separated for the sake of clarity which shows a portion of a brake disc assembly, according to an embodiment;

5 [0040]. - figure 12 is a section view taken along a cutting plane directed along the axial and radial directions, which shows a portion of a brake disc assembly comprising a connecting device, according to an embodiment;

[0041]. - figure 13 is a section view of a portion of a bell,
10 according to an embodiment;

[0042]. - figure 14 is a section view taken along a cutting plane directed along the axial and tangential directions, which shows a portion of a brake disc assembly comprising a connecting device, according to an embodiment;

15 [0043]. - figure 15 is an axonometric and section view taken along a cutting plane directed along the axial and tangential directions of a portion of said brake disc assembly, according to an embodiment;

[0044]. - figure 16 is an axonometric and section view taken
20 along a cutting plane directed along the axial and tangential directions of a portion of said brake disc assembly, according to an embodiment.

[0045]. Description of some preferred embodiments

[0046]. A brake disc 1 is provided according to a general
25 embodiment.

[0047]. Said brake disc assembly 1 is adapted to rotate about a

rotation axis. Said disc brake assembly 1 defines an axial direction X-X either coinciding with or parallel to the rotation axis, a radial direction R-R orthogonal to the axial direction X-X, and a tangential T-T or circumferential direction T-T, orthogonal to both the axial direction X-X and to the radial direction R-R.

[0048]. Said brake disc assembly 1 comprises a brake band 2, comprising at least two opposite braking surfaces 12, 13, adapted to cooperate with at least one brake caliper associable with the brake disc assembly 1 to apply a braking action.

[0049]. According to an embodiment, said brake band 2 is a ventilated brake band comprising two flares 15, 16 arranged mutually side-by-side, coaxial to the same axial direction X-X and spaced apart in the axial direction X-X with respect to one another so as to define at least one gap 17. Preferably, each of said two flares 15, 16 comprises one of said braking surfaces 12, 13. Preferably, said two flares 15, 16 are connected to each other by flare connecting pins 18.

[0050]. Said brake disc assembly 1 comprises a bell 3, adapted to be operatively connected to a vehicle wheel associable with the brake disc assembly 1.

[0051]. According to an embodiment, said brake band 2 comprises a vehicle-oriented band side 20, adapted to face the vehicle, and an opposite vehicle side band 19 or wheel-oriented band side 19, axially opposite to said vehicle-oriented band side 20 and adapted

to face a vehicle wheel. Preferably, said bell 3 is associated with said wheel-oriented band side 19 of at least one portion of the brake band 2.

[0052]. According to an embodiment, said brake band 2 comprises at least one connecting protrusion 22, which extends in radial direction R-R from said brake band 2 towards the rotation axis of the brake disc assembly 1 and adapted to be associated with said bell 3.

[0053]. Said brake disc assembly 1 comprises at least one connecting device 4, which forms a connection between said brake band 2 and said bell 3. Preferably, said at least one connecting device 4 is made as a piece which is separate from both the brake band 2 and said bell 3.

[0054]. Said connecting device 4 and said bell 3 cooperate by delimiting at least one axial band seat 5 where the brake band 2 may slide in an axial direction X-X by a predetermined axial stroke. According to a preferred embodiment, said brake band 2 may slide in said axial band seat 5 of said predetermined axial stroke without being biased.

[0055]. Said bell 3 comprises at least one first end-of-stroke surface 6 which forms a first abutment surface in the axial direction X-X for said brake band 2.

[0056]. According to a preferred embodiment, said connecting device 4 comprises a second opposite end-of-stroke surface 7, which forms a second opposite abutment surface in the axial

direction X-X for said brake band 2.

[0057]. According to an embodiment, said first end-of-stroke surface 6 of the bell 3 and said second opposite end-of-stroke surface 7 of the connecting device 4 delimit said axial band seat 5 5.

[0058]. Said connecting device 4 comprises at least one male element 8, which is accommodated in at least one female element bell seat 14 obtained in said bell 3. According to a preferred embodiment, said male element bell seat 14 of the bell 3 defines, 10 on said bell 3, an opening which is substantially circular in shape for accessing the seat.

[0059]. Said male element 8 of the connecting device 4 comprises at least one bell abutment surface 9.

[0060]. Said bell 3 comprises at least one male element abutment 15 surface 10.

[0061]. Advantageously, said bell abutment surface 9 of the male element 8 forms an abutment surface in axial direction X-X for said male element abutment surface 10 of the bell 3, whereby preventing said connecting device 4 and said bell 3 from 20 tightening said brake band 2 therebetween.

[0062]. In this manner, a brake disc assembly 1 can be provided in which the brake band 2 can slide axially with a predetermined axial stroke, avoiding jamming of the disc as well as stresses on the disc during the braking action, when the disc is clamped 25 between the opposite brake pads of an associated brake caliper

adapted to straddle the brake band 2.

[0063]. Said male element 8 has a male element body 30.

[0064]. According to a preferred embodiment, said bell abutment surface 9 of the male element 8 which receives the direct support of the bell 3 is made in one piece with said male element body 30. In other words, said bell abutment surface 9 of the male element 8 which receives the direct support of the bell 3 is made in one piece with said male element body 30. In this manner, said male element body 30 is made in one piece and comprises said bell abutment surface 9.

[0065]. Providing said male element 8 of the connecting device 4 in a single piece prevents said connecting element 4 from comprising one or more bushes fitted, e.g. screwed, onto said male element 8 in order to form abutments for the bell or for the brake band 2.

[0066]. By providing such connecting device 4 said bell 3 and said connecting device 8 can cooperate to form said first end-of-stroke surface 6 and said second opposite end-of-stroke surface 7, whereby delimiting said axial band seat 5 in which the brake band 2 can slide axially free and unbiased, and at the same time said male element 8 can form an axial abutment for said bell 3. In this manner, tightly clamping said brake band 2 is avoided and at the same time the sliding of said bell 3 with respect to said male element 4 is prevented, whereby making it possible to make the bell 3 of material which is soft and therefore light or at least

softer and lighter than the material with which the brake band 2 is made.

[0067]. According to a preferred embodiment, said bell 3 is made of aluminum or aluminum alloy.

5 [0068]. According to a preferred embodiment, said male element body 30 has a predominant extension along a longitudinal direction Z-Z and comprises a vehicle-oriented male element side 32, adapted to face the vehicle, when under operating conditions, and an opposite vehicle male element opposite side 31 or wheel-oriented
10 male element side 31 opposite to said vehicle-oriented male element side 32 and adapted to face a vehicle wheel, when under operating conditions. Preferably, said male element body 30 comprises said axial bell abutment surface 9 and a brake band abutment surface, forming a direct or indirect axial abutment
15 surface, through the interposition of at least one of a connecting ring 28 and an elastic element 23, for said brake band 2, wherein said axial bell abutment surface 9 and said brake band abutment surface are oriented towards the same side. Preferably, said wheel-oriented male element side 31 comprises both said axial bell
20 abutment surface 9 and said brake band abutment surface. In other words, said bell axial abutment surface 9 and said brake band abutment surface are both adapted to face a same vehicle wheel, in operating conditions.

[0069]. Preferably, when under operating conditions, said
25 longitudinal direction Z-Z of said male element 8 is either

parallel to or coincident with the axial direction X-X.

[0070]. According to an embodiment, said male element body 30 of said male element 8 comprises a head 25 comprising an underhead portion 26 and a stem 24 which extends from said underhead portion 26. According to an embodiment, said stem 24 overhangs from said underhead portion 26 forming a stem free end 27.

[0071]. According to a preferred embodiment, said male element 8 is inserted in at least said bell male element seat 14 from said vehicle-oriented axial side 20 of the brake band 2.

[0072]. According to an embodiment, said brake band 2, preferably said connecting protuberance 22 of the brake band 2, comprises at least one band male element seat 21 which receives at least one portion of said male element 8. According to an embodiment, said band male element seat 21 defines, on said brake band 2, an access opening which is substantially quadrilateral in shape.

[0073]. According to an embodiment, during the insertion of said male element 8 in the bell male element seat 14, said free end 27 of the stem 24 of the male element 8 is inserted firstly into said band male element seat 21 and then into said bell male element seat 14.

[0074]. According to an embodiment, during the assembly of said male element 8, said free end 27 of the stem 24 of the male element 8 is inserted firstly into said male ring element seat 29 and then into said bell male element seat 14.

[0075]. According to an embodiment, said stem 24 of the male element body 8 comprises a first stem portion 34 or stem proximal portion 34 which forms a step with said head 25, so that at least one surface of said underhead portion 26 is adapted to face said wheel-oriented male element side 31. According to an embodiment, said proximal stem portion 34 is directly connected to said head 25. According to an embodiment, said proximal stem portion 34 extends from said underhead portion 26.

[0076]. According to an embodiment, said stem 24 of the male element body 8 comprises a second stem portion 35 or stem intermediate portion 35, which forms a step with said stem proximal portion 34, so that at least one surface of said stem proximal portion 34 is adapted to face said wheel-oriented male element side 31. According to an embodiment, said stem proximal portion 34 has a surface forming said bell abutment surface 9 facing said stem intermediate portion 35. According to an embodiment, said stem proximal portion 34 comprises said bell abutment surface 9. According to an embodiment, said stem intermediate portion 35 comprises said bell abutment surface 9.

[0077]. According to an embodiment, said stem 24 of the male element body 8 comprises a third stem portion 36 or stem distal portion 36, which forms a step with said stem intermediate portion 35, so that at least one surface of said stem intermediate portion is adapted to face said wheel-oriented male element side 31.

[0078]. According to an embodiment, said connecting device 4

comprises at least one elastic element 23 which applies a direct elastic biasing action to axially tightly clamp said bell 3 and said connecting device 4 to one another, thereby avoiding elastically biasing the brake band 2.

5 [0079]. According to a preferred embodiment, said elastic element 23 has a substantially annular shape which embraces a portion of the stem 24 of said male element 8. According to a preferred embodiment, said elastic element 23 is a Belleville washer.

10 [0080]. According to an embodiment, said elastic element 23 forms a barrier, preferably around the body of said male element 8, to limit the introduction and accumulation of dust and/or debris in the male element seat 21 of band 21. According to an embodiment, said elastic element 23 forms a barrier, preferably
15 about the body of said male element 8, to prevent dust and/or debris from entering and accumulating at least in the bell male element seat 14.

[0081]. According to an embodiment, said elastic element 23 comprises a dustproof wall 49 of elastic element embracing at
20 least one portion of said stem 24 of the male element 8 to limit the entry and accumulation of dust and/or debris in the male element seat 21 of the band and to prevent dust and/or debris from entering and accumulating at least in the male element seat 14 of the bell.

25 [0082]. By providing such elastic element 23 the accumulation

and stratification of dust and debris is prevented and in the band male element seat 21 which can prevent the axial float of the brake band in the band seat. At the same time, the stratification of dust and debris covering the portions of the disc brake employed to transmit the braking action by feeding in tangential direction T-T is avoided. At the same time, said elastic element 23 applies an elastic biasing action aimed at ensuring the axial float of the brake band 2, tightly clamping the bell 3 and avoiding to tightly clamp the brake band 3. It also prevents dust or debris from deteriorating the walls of the bell 3 which form the bell male element seat 14.

[0083]. Providing such an elastic element 23 makes it possible to keep the accesses to the bell and brake band seats adapted to receive the male connecting elements as isolated from the surrounding environment as possible, whereby minimizing the introduction of dust and debris, e.g. debris of friction material of the brake pads and, particularly for applications on rally or off-road vehicles, the dust raised from the rough road surface, accumulation of such dust and debris which may form layers of additional material which imply a significant deterioration of the axial mobility of the components of the brake disc with respect to the axial position of the caliper body, with the risk of causing plastic deformations of the brake disc when tightly clamped by the brake pads during the braking action.

[0084]. According to a preferred embodiment, said male element 8 is a pin 8.

[0085]. According to an embodiment, said elastic element 23 biases the male element abutment surface 10 of the bell 3 abutting against the bell abutment surface 9 of the male element 8. In this manner, said elastic element 23 elastically biases said first end-of-stroke surface 6 of the bell 3 towards said second end-of-stroke surface 7, whereby avoiding elastically biasing the brake band 2.

[0086]. According to an embodiment, said elastic element 23 biases at least one of said first end-of-stroke surface 6 of the bell 3 and said second end-of-stroke surface 7 of the connecting device 4 abutting against an abutment surface of the male element body 30 or of the bell 3, respectively, so as to provide at least one of said first end-of-stroke surface 6 and said second end-of-stroke surface 7 with a minimum yield. In this manner, it is possible to limit the damage to the brake band in the case of axial shock pulses against the walls of said band axial seat 5.

[0087]. According to an embodiment, said connecting device 4 comprises at least one connecting ring 28. According to an embodiment, said connecting ring 28 comprises said second opposite end-of-stroke surface 7. According to an embodiment, said connecting ring 28 delimits at least one male ring element seat 29 which receives at least one portion of said male element 8.

[0088]. According to an embodiment, said at least one connecting protuberance 22 of the brake band 2 comprises two tangentially opposite feeding walls 40, adapted to transmit the feeding action

in tangential direction T-T between the brake band 2 and the bell 3. In this manner, a brake disc assembly 1 with teeth feeding is provided. Preferably, said at least one connecting protuberance 22 of the brake band 2 is interposed between two connecting protrusions 41 of the bell 3. Preferably, said connecting protrusions 41 of the bell 3 comprise counter-feeding walls 42, at least one of said counter-feeding walls 42 of the bell 3 cooperates with at least one of said feeding walls 40 of the brake band 2 to transmit the braking action of the brake band to the bell 3. According to an embodiment, said connecting protrusions 41 of the bell 3 extend in axial direction X-X from said first end-of-stroke wall 6 of the bell. According to an embodiment, at least one of said connecting protrusions 41 of the bell 3 comprises said axially facing ring abutment surface 38.

[0089]. According to an embodiment, said underhead portion 26 of the male element 8 comprises said opposite end-of-stroke surface 7. In this manner, said axial band seat 5 is delimited by said first end-of-stroke surface 6 of the bell 3 and from said second opposite end-of-stroke surface 7 of the underhead portion 26 of the male element 8.

[0090]. According to an embodiment, said first end-of-stroke surface 6 of the bell 3 is axially flush with said male element abutment surface 10 of the bell 3. According to an embodiment, said first end-of-stroke surface 6 of the bell 3 and said male element abutment surface 10 of the bell 3 are two portions of the

same surface. According to an embodiment, said first end-of-stroke surface 6 of the bell 3 and said male element abutment surface 10 of the bell 3 are two substantially annular portions of the same surface, wherein said first end-of-stroke surface 6 substantially surrounds said male element abutment surface 10.

[0091]. According to an embodiment, said connecting device 4 comprises at least one connecting ring 28 which is fixed by means of said male element 8 to at least said bell 3, said connecting ring 28 forming said second end-of-stroke surface 7 of the axial band seat 5. Preferably, said elastic element 23 elastically biases said connecting ring 28 abutting against a ring abutment surface 38 of said bell 3. For example, said connecting ring 28 is made of steel.

[0092]. According to an embodiment, said bell 3 comprises at least one seat edge portion 39 which surrounds the inlet of said at least one male bell element seat 14 forming an axial protrusion which has a male element abutment surface 10 abutting against said underhead portion 26 of the male element body 30, in other words against said bell abutment surface 9 of the body of the male element 30 which is comprised in said underhead portion 26. In this manner, the male element 8 abuts against the bell 3 and this prevents the male element 8 from tightly clamping said brake band 2.

[0093]. According to an embodiment, said bell male element seat 14 is substantially cup-shaped and comprises a seat bottom wall

43. In this manner, said bell male element seat 14 is a blind hole accessible exclusively by said male element 8 from the side of the bell 3 facing said brake band 2, in other words from the vehicle-oriented bell side 44. According to an embodiment, said bell 3 further comprises a side opposite bell vehicle 45 or side of the bell facing wheel 45, axially opposite to said vehicle-oriented bell side 44 and adapted to face a vehicle wheel.

[0094]. According to an embodiment, said male element seat 14 of the bell is a through hole, preferably putting into communication one vehicle-oriented bell side 44 with a wheel-oriented bell side 45.

[0095]. According to an embodiment, said connecting device 4 comprises at least one nut 11 fitted, e.g. screwed, onto a portion of said stem 24, wherein said nut 11 forms an axial reference abutment for said elastic element 23. In this manner, said elastic element 23 applies an elastic biasing action between said nut 11 and said bell 3, to make said male element abutment surface 10 of the bell 3 to abut against said bell abutment surface 9 of the male element body 8.

[0096]. According to an embodiment, said nut 11 cooperates with said elastic element 23 to limit the entry and accumulation of dusts and/or debris in the male element seat 21 of the band. According to an embodiment, said nut 11 cooperates with said elastic element 23 to prevent the entry of dust and/or debris at least into the bell male element seat 14.

[0097]. According to an embodiment, said stem 24 of the male element 8 comprises at least one threaded portion.

[0098]. According to an embodiment, said intermediate stem portion 35 comprises an abutment surface for nut 37, which forms a
5 reference abutment for said nut 11. In this manner, said nut 11 avoids being tightened against said bell 3, e.g. by being screwed against said bell. According to an embodiment, said distal stem portion 36 is externally threaded.

[0099]. According to an embodiment, said male element body 30
10 comprises said abutment surface for nut 37 in a single piece.

[00100]. According to an embodiment, said nut abutment surface 37 faces towards the same side of said bell abutment surface 9 and said second end-of-stroke surface 7.

[00101]. According to an embodiment, said at least one connecting
15 protrusion 22 comprises said band male element seat 21 which receives said male element 8 so as to transmit the tangential braking action from the brake band 2 to said male element body 30. Preferably, said male element body 30 comprises at least two tangentially opposite tangential walls 48 which cooperate with the
20 walls of said seat of the band male element 21 to transfer the tangential braking action from the brake band 2 to said male element 8. According to an embodiment, said proximal stem portion 34 of said male element body 30 comprises said opposite tangential walls 48.

25 [00102]. According to an embodiment, said male element body 30,

preferably said intermediate stem portion 35, comprises said two opposite feeding walls 40 and said bell 3 comprises said counter-feeding walls 42 to delimit said bell male element seat 14 to transmit the tangential braking action from the brake band 2 to the bell 3, by means of said male element 8. In this manner, a brake disc assembly 1 is provided with feeding by means of a third element, e.g. a male element 8.

[00103]. According to an embodiment, the extension in longitudinal direction Z-Z of said stem proximal portion 34 of said male element body 30 is smaller than the extension in axial direction X-X of the band axial seat 5. This ensures said predetermined axial stroke of the brake band 2.

[00104]. According to an embodiment, said connecting device 4 comprises a plurality of said male elements 8, mutually and tangentially spaced by a predetermined circumferential distance.

[00105]. According to an embodiment, said male element body 30 is integrally made in one piece, whereby avoiding to delimit through holes longitudinally directed in said male element body 30.

[00106]. According to a variant embodiment, said body of the male element 30 is longitudinally hollow for at least one portion of the longitudinal extension of the stem 24.

[00107]. According to a variant embodiment, said male element 8 is a bushing.

[00108]. According to an embodiment, said male element body 30 is symmetrical with respect to at least one definable longitudinal

plane parallel to said longitudinal direction Z-Z.

[00109]. According to an embodiment, said predetermined axial stroke of the brake band 2 is less than 1 millimeter, preferably less than 0.5 millimeters. According to a preferred embodiment, 5 said predetermined axial stroke of the brake band 2 is substantially equal to 0.3 millimeters.

[00110]. According to a general embodiment, a male element 8 of a connecting device 4 is provided, adapted to form a connection between a brake band 2 and a bell 3 of a brake disc assembly 1, 10 said connecting device 4 and said bell 3 being adapted to cooperate to delimit at least one axial band seat 5 in which the brake band 2 may slide in an axial direction X-X of a predetermined axial stroke.

[00111]. According to a preferred embodiment, said male element 8 15 comprises a male element body 30. Preferably, said male element body 30 has a predominant extension along a longitudinal direction Z-Z and comprises a vehicle-oriented male element side 32, adapted to face the vehicle, when under operating conditions, and an opposite vehicle male element opposite side 31 or a wheel-oriented 20 male element side 31 opposite to said vehicle-oriented male element side 32 and adapted to face a vehicle wheel, when under operating conditions.

[00112]. According to a preferred embodiment, said male element body 30 comprises at least one bell abutment surface 9, adapted to 25 form an abutment surface for a portion of said bell 3.

[00113]. Preferably, said male element body 30 comprises said axial bell abutment surface 9 and a brake band abutment surface, forming a direct or indirect axial abutment surface, through the interposition of at least one of a connecting ring 28 and an elastic element 23, for said brake band 2, wherein said axial bell abutment surface 9 and said brake band abutment surface are oriented on the same side.

[00114]. According to an embodiment, said male element body 30 comprises at least one second end-of-stroke surface 7, opposite to a first end-of-stroke surface 6 of the bell 3 and adapted to form an abutment surface for said brake band 2.

[00115]. Preferably, said second end-of-stroke surface 7 and said bell abutment surface 9 are made in one piece with said male element body 30.

[00116]. According to an embodiment, said male element body 30 comprises a head 25 comprising an underhead portion 26 and a stem 24 which extends from said underhead portion 26, said stem 24 comprises a first stem portion 34 which forms a step with said head 25, so that at least one surface of said underhead portion is adapted to face said wheel-oriented male element side 31. Preferably, said underhead portion, adapted to face said wheel-oriented male element side 31, comprises said second end-of-stroke surface 7.

[00117]. According to an embodiment, said stem 24 comprises a second stem portion 35 which forms a step with said proximal stem

portion 34, so that a surface of said proximal stem portion 34 is adapted to face said wheel-oriented male element side 31. Preferably, said surface of said proximal stem portion 34 adapted to face said wheel-oriented male element side 31 comprises said bell abutment surface 9.

[00118]. Preferably, said bell abutment surface 9 and said second end-of-stroke surface 7 are oriented towards the same side of the male element body 30, preferably said wheel-oriented male element side 31.

[00119]. By virtue of the features described above, either separately or mutually in combination with particular embodiments, it is possible to obtain a brake disc assembly and a male element capable of responding to the aforesaid, sometimes contrasting needs, and in particular:

[00120]. - it makes it possible to provide a disc brake solution in which the brake band is free to slide or float axially by a predetermined axial stroke with respect to the bell, so as to be arranged in the desired axial position between the brake pads of an associable caliper body during the braking action;

[00121]. - at the same time, it forms a barrier which prevents, or at least minimizes with respect to known solutions, the introduction of dust and debris into the coupling between brake band and bell, thereby avoiding their accumulation and stratification, thus improving the performance of the disc brake in this manner, particularly for applications on high-performance

or racing vehicles, without reducing the working life of the brake disc;

[00122]. - the suggested solution makes it possible to close the coupling between bell and connecting device, whereby preventing the introduction of dust and debris into the coupling between the bell and the male element of the connecting device, so as to avoid deteriorating the surfaces of the bell, which can therefore be advantageously made of softer, and thus lighter, material with respect to the brake band, without risking premature wear;

[00123]. - the suggested solution makes it possible to isolate the coupling between bell and connection device from dust and debris and at the same time applies an axial elastic bias aimed at axially tightly clamping the bell, while leaving a predetermined axial float to the brake band;

[00124]. - the suggested solution makes it possible to tightly clamp the bell defining at the same time an axial band seat in order to allow the axial float of the brake band, and at the same time it makes it possible to avoid, or at least minimize, the introduction of dust and debris in the connection between bell and connection device;

[00125]. - at the same time, it prevents tightly clamping the brake band and it avoids applying an elastic bias on the brake band;

[00126]. - at the same time, it avoids the sliding of the bell on the male connecting element with the brake band, making it

possible to make the bell in soft, and therefore light, material;
[00127]. - a connecting male element is obtained between brake
band and bell having surfaces adapted to form reference abutments
for the bell and either directly or indirectly for the brake band
5 made in one piece with the body of said male connecting element;

[00128]. - a connecting male element is obtained between brake
band and bell having surfaces adapted to form reference abutments
for the bell and either directly or indirectly for the brake band
either facing or oriented towards the same side;

10 [00129]. - it makes it possible to obtain a male connecting
element between brake band and bell adapted to transfer the
tangential feeding action between brake band and bell and at the
same time is adapted to ensure said axial stroke of the brake
band.

15 [00130]. A person skilled in the art may make many changes,
adaptations and replacements to the embodiments described above or
may replace elements with others which are functionally equivalent
in order to satisfy contingent needs without however departing
from the scope of protection of the appended claims.

LIST OF REFERENCES

- 1 Brake disc assembly
- 2 Brake band
- 3 Bell
- 5 4 Connecting device
- 5 Axial band seat
- 6 First end-of-stroke surface of the bell
- 7 Second end-of-stroke surface of the connecting device
- 8 Male element of the connecting device
- 10 9 Axial abutment surface for bell of the male element
- 10 Axial abutment surface for male element of the bell
- 11 Nut of the connecting device
- 12 First braking surface of the brake band
- 13 Second opposite braking surface of the brake band
- 15 14 Male element seat of the bell
- 15 First flare of the brake band
- 16 Second flare of the brake band
- 17 Brake band gap
- 18 Brake band flare connecting pin
- 20 19 Wheel-oriented axial side of the brake band or brake band opposite vehicle side
- 20 Vehicle-oriented axial side of the brake band
- 21 Brake band male element seat or band male element seat
- 22 Brake band connecting protuberance
- 25 23 Connecting device elastic means
- 24 Male element stem
- 25 Male element head
- 26 Underhead portion of the male element
- 27 Stem free end
- 30 28 Connection device connecting ring
- 29 Connecting ring male element seat or ring male element seat
- 30 Male element body
- 31 Wheel-oriented male element side, or male element opposite vehicle side
- 35 32 Vehicle-oriented male element side

- 34 First stem portion or proximal stem portion
- 35 Second stem portion or intermediate stem portion
- 36 Third stem portion or distal stem portion
- 37 Male element nut axial abutment surface
- 5 38 Bell ring abutment surface
- 39 Bell seat edge
- 40 Feeding wall
- 41 Bell feeding protrusion
- 42 Counter-feeding wall
- 10 43 Seat bottom wall of bell male element seat
- 44 Vehicle-oriented bell side
- 45 Bell opposite vehicle side or bell wheel-oriented side
- 48 Male element tangential walls
- 49 Dust-proof wall of elastic element
- 15 X-X Axial direction
- R-R Radial direction
- T-T Tangential or circumferential direction
- Z-Z Longitudinal direction of the male element

CLAIMS

1. A brake disc assembly (1) comprising:

- a brake band (2),
- a bell (3), adapted to be operatively connected to a vehicle wheel associable with the brake disc assembly (1);
- at least one connecting device (4), which forms a connection between said brake band (2) and said bell (3);
- said connecting device (4) and said bell (3) cooperate by delimiting at least one axial band seat (5) where the brake band (2) may slide in an axial direction (X-X) of a predetermined axial stroke;

wherein:

- said bell (3) comprises at least a first end-of-stroke surface (6) which forms a first abutment surface in the axial direction (X-X) for said brake band (2);
- said connecting device (4) comprises a second end-of-stroke surface (7), opposite to said first end-of-stroke surface (6), which forms a second opposite abutment surface in the axial direction (X-X) for said brake band (2);

and wherein:

- said connecting device (4) comprises at least one male element (8), which is accommodated in at least one male element bell seat (14) obtained in said bell (3);
- said male element (8) comprises at least one bell abutment surface (9);
- said bell (3) comprises at least one male element abutment

surface (10);

- said bell abutment surface (9) of the male element (8) forming an abutment surface in the axial direction (X-X) for said male element abutment surface (10) of the bell (3) so as to avoid said connecting device (4) and said bell (3) from tightening said brake band (2) therebetween;

characterized in that

said male element (8) has a male element body (30), wherein said bell abutment surface (9) of the male element (8) receiving the direct support of the bell (3) is made in one piece with said male element body (30).

2. A brake disc assembly (1) according to claim 1, wherein said brake band (2) may slide in said axial band seat (5) of said predetermined axial stroke without being biased; and/or wherein said predetermined axial stroke of the brake band (2) is less than 1 millimeter, preferably less than 0.5 millimeters; and/or wherein said predetermined axial stroke of the brake band (2) is substantially equal to 0.3 millimeters; and/or wherein and/or wherein

said male element body (30) is integrally made in one piece, avoiding to delimit through holes longitudinally directed in said male element body (30); and/or wherein said bell (3) is made of aluminum or aluminum alloy.

3. A brake disc assembly (1) according to claim 1 or 2, wherein

said stem (24) of the male element body (8) comprises a proximal stem portion (34) which forms a step with said head (25), so that at least one surface of said underhead portion (26) is adapted to face said wheel-oriented male element side (31); and/or wherein

5 said stem (24) of the male element body (8) comprises an intermediate stem portion (35) which forms a step with said proximal stem portion (34), so that a surface of said proximal stem portion (34) is adapted to face said wheel-oriented male element side (31); and/or wherein

10 said proximal stem portion (34) has a surface forming said bell abutment surface (9) facing said intermediate stem portion (35); and/or wherein

said proximal stem portion (34) comprises said bell abutment surface (9); and/or wherein

15 said stem (24) of the male element body (8) comprises a distal stem portion (36) which forms a step with said intermediate stem portion (35) so that at least one surface of said intermediate stem portion is adapted to face said wheel-oriented male element side (31).

20

4. A brake disc assembly (1) according to any one of the claims from **1** to **3**, wherein said connecting device (4) comprises at least one elastic element (23) which exerts an elastic bias aimed at axially tightening said bell (3) and said connecting device (4)
25 together, avoiding to elastically bias the brake band (2); and/or

wherein

said elastic element (23) is substantially annular in shape to embrace a portion of the stem (24) of said male element (8); and/or wherein

5 said elastic element (23) biases the male element abutment surface (10) of the bell (3) abutting against the bell abutment surface (9) of the male element (8), so that said elastic element (23) elastically biases said first end-of-stroke surface (6) of the bell (3) when approaching said second end-of-stroke surface (7),
10 avoiding to elastically bias said brake band (2); and/or wherein said elastic element (23) biases at least one of said first end-of-stroke surface (6) of the bell (3) and said second end-of-stroke surface (7) of the connecting device (4) abutting against an abutment surface of the male element body (30) or of the bell
15 (3), respectively, so as to provide at least one of said first end-of-stroke surface (6) and said second end-of-stroke surface (7) with a minimum compliance; and/or wherein said elastic element (23) forms a barrier, preferably around the body of said male element, to limit the entry and accumulation of
20 dusts and/or debris in the male element seat (21) of the band; and/or wherein said elastic element (23) forms a barrier, preferably around the body of said male element, to prevent dusts and/or debris from entering and accumulating at least in the male element seat (14)
25 of the bell; and/or wherein

said elastic element (23) comprises a dustproof wall (49) of elastic element embracing at least one portion of said stem (24) of the male element (8) to limit the entry and accumulation of dusts and/or debris in the male element seat (21) of the band and to prevent dusts and/or debris from entering and accumulating at least in the male element seat (14) of the bell; and/or wherein said male element seat (14) of the bell is a through hole, preferably putting into communication one vehicle-oriented bell side (44) with a wheel-oriented bell side (45).

5. A brake disc assembly (1) according to any one of the preceding claims, wherein said connecting device (4) comprises at least one connecting ring (28) which is fixed by means of said male element (8) to at least said bell (3), said connecting ring (28) forming said second end-of-stroke surface (7) of the axial band seat (5); and/or wherein said elastic element (23) elastically biases said connecting ring (28) abutting against a ring abutment surface (38) of said bell (3).

6. A brake disc assembly (1) according to any one of the claims from 1 to 4, wherein said underhead portion (26) of the male element (8) comprises said second opposite end-of-stroke surface (7) so that said axial band seat (5) is delimited by said first end-of-stroke surface (6) of the bell (3) and by said second opposite end-of-stroke surface (7) of the underhead portion (26)

of the male element (8); and/or wherein
said first end-of-stroke surface (6) of the bell (3) is axially
flush with said male element abutment surface (10) of the bell
(3); and/or wherein

5 said first end-of-stroke surface (6) of the bell (3) and said male
element abutment surface (10) of the bell (3) are two
substantially annular portions of the same surface, wherein said
first end-of-stroke surface (6) substantially surrounds said male
element abutment surface (10); and/or wherein

10 said connecting device (4) comprises at least one nut (11) fitted
onto a portion of said stem (24), wherein said nut (11) forms an
axial abutment surface for said elastic element (23) so that said
elastic element (23) exerts an elastic bias between said nut (11)
and said bell (3), in order to abut said male element abutment
15 surface (10) of the bell (3) against said bell abutment surface
(9) of the male element body (8); and/or wherein

said brake band (2) comprises at least one male element seat (21)
of the band which accommodates at least one portion of said male
element (8); and/or wherein

20 said male element seat (21) of the band defines, on said brake
band (2), an opening which is substantially quadrilateral in shape
for accessing the seat; and/or wherein

said male element bell seat (14) of the bell (3) defines, on said
bell (3), an opening which is substantially circular in shape for

25 accessing the seat; and/or wherein

said nut (11) cooperates with said elastic element (23) to limit

the entry and accumulation of dusts and/or debris in the male element seat (21) of the band.

7. A male element (8) of a connecting device (4) adapted to form a connection between a brake band (2) and a bell (3) of a brake disc assembly (1), said connecting device (4) and said bell (3) being adapted to cooperate to delimit at least one axial band seat (5) where the brake band (2) may slide in an axial direction (X-X) of a predetermined axial stroke;

wherein said male element (8) comprises a male element body (30) having a predominant extension along a longitudinal direction (Z-Z); said male element body (30) comprising a vehicle-oriented male element side (32), adapted to face the vehicle, when under operating conditions, and a wheel-oriented male element side (31) opposite to said vehicle-oriented male element side (32) and adapted to face a vehicle wheel, when under operating conditions; and wherein

- said male element body (30) comprises at least a second end-of-stroke surface (7), opposite to a first end-of-stroke surface (6) of the bell (3) and adapted to form an abutment surface for said brake band (2);

- said male element body (30) comprises at least one bell abutment surface (9), adapted to form an abutment surface for a portion of said bell (3);

and wherein said second end-of-stroke surface (7) and said bell

abutment surface (9) are made in one piece with said male element body (30).

8. A male element (8) according to claim 7, wherein said male element body (30) comprises a head (25) comprising an underhead portion (26) and a stem (24) which extends from said underhead portion (26); and/or wherein

said stem (24) comprises a first stem portion (34) which forms a step with said head (25), so that at least one surface of said underhead portion is adapted to face said wheel-oriented male element side (31); and/or wherein

said underhead portion, adapted to face said wheel-oriented male element side (31), comprises said second end-of-stroke surface (7); and/or wherein

said stem (24) comprises a second stem portion (35) which forms a step with said proximal stem portion (34), so that a surface of said proximal stem portion (34) is adapted to face said wheel-oriented male element side (31); and/or wherein

said surface of said proximal stem portion (34) adapted to face said wheel-oriented male element side (31) comprises said bell abutment surface (9); and/or wherein

said bell abutment surface (9) and said second end-of-stroke surface (7) are oriented towards the same side of the male element body (30), preferably said wheel-oriented male element side (31).

9. A brake disc assembly (1) comprising:

- a brake band (2);
- a bell (3), adapted to be operatively connected to a vehicle wheel associable with the brake disc assembly (1);
- at least one connecting device (4), which forms a connection
5 between said brake band (2) and said bell (3);
- said connecting device (4) and said bell (3) cooperate by delimiting at least one axial band seat (5) where the brake band (2) may slide in an axial direction (X-X) of a predetermined axial stroke;

10 wherein:

- said bell (3) comprises at least a first end-of-stroke surface (6) which forms a first abutment surface in the axial direction (X-X) for said brake band (2);

and wherein:

- 15 - said connecting device (4) comprises at least one male element (8), which is accommodated in at least one male element bell seat (14) obtained in said bell (3);

- said male element (8) comprises at least one bell abutment surface (9);

- 20 - said bell (3) comprises at least one male element abutment surface (10);

- said bell abutment surface (9) of the male element (8) forming an abutment surface in the axial direction (X-X) for said male element abutment surface (10) of the bell (3) so as to avoid said
25 connecting device (4) and said bell (3) from tightening said brake band (2) therebetween;

said male element body (30) has a predominant extension along a longitudinal direction (Z-Z) and comprises a vehicle-oriented male element side (32), adapted to face the vehicle, when under operating conditions, and a wheel-oriented male element side (31) opposite to said vehicle-oriented male element side (32) and adapted to face a vehicle wheel, when under operating conditions;

characterized in that

said male element body (30) comprises said axial bell abutment surface (9) and a brake band abutment surface, forming a direct or indirect axial abutment surface, through the interposition of at least one of a connecting ring (28) and an elastic element (23), for said brake band (2);

and wherein said axial bell abutment surface (9) and said brake band abutment surface are oriented towards the same side.

10.A brake disc assembly (1) according to claim 9, wherein said wheel-oriented male element side (31) comprises both said axial bell abutment surface (9) and said brake band abutment surface; and/or wherein

when under operating conditions, said longitudinal direction (Z-Z) of said male element (8) is parallel to or coincident with the axial direction (X-X).

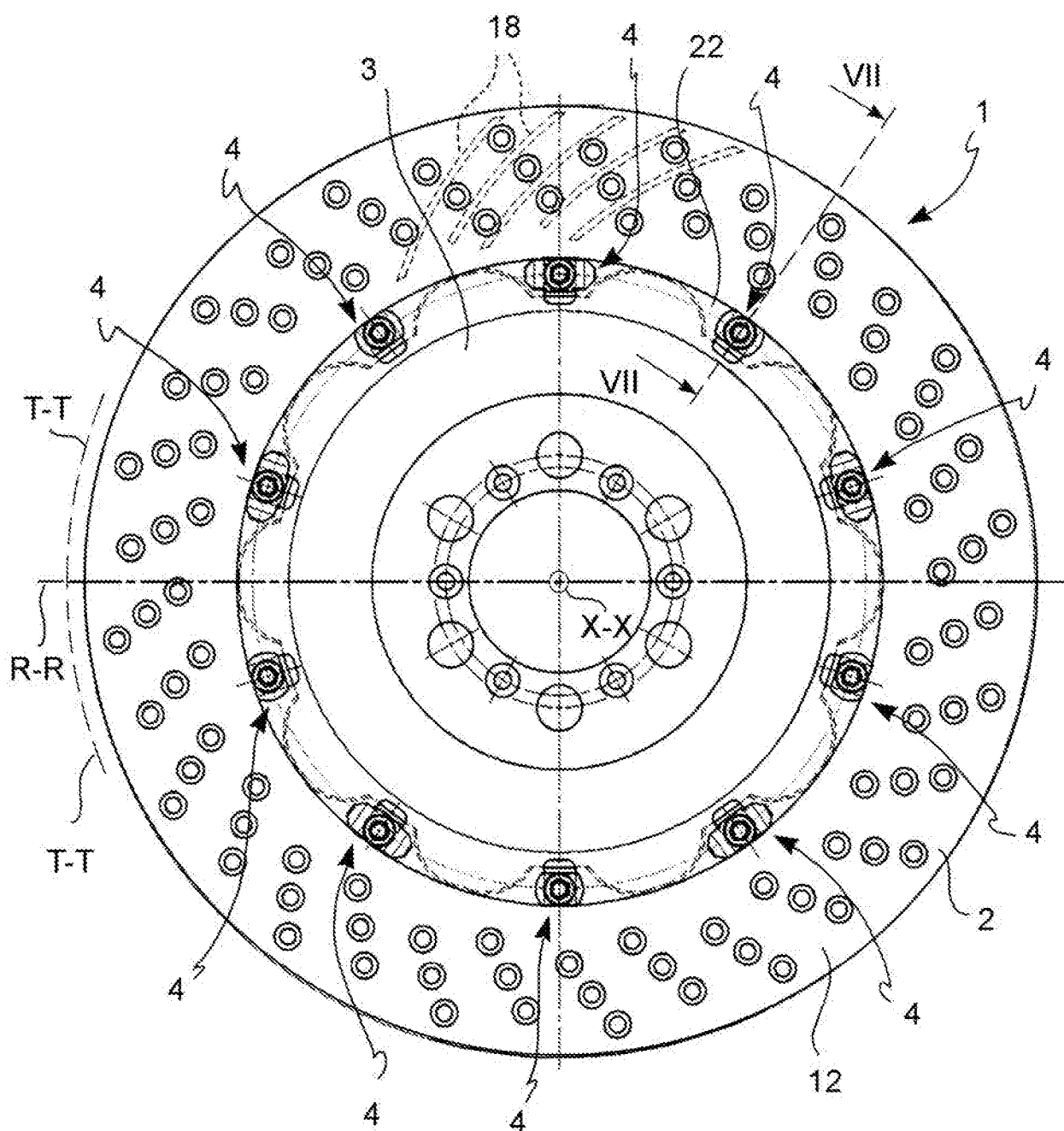


FIG. 1

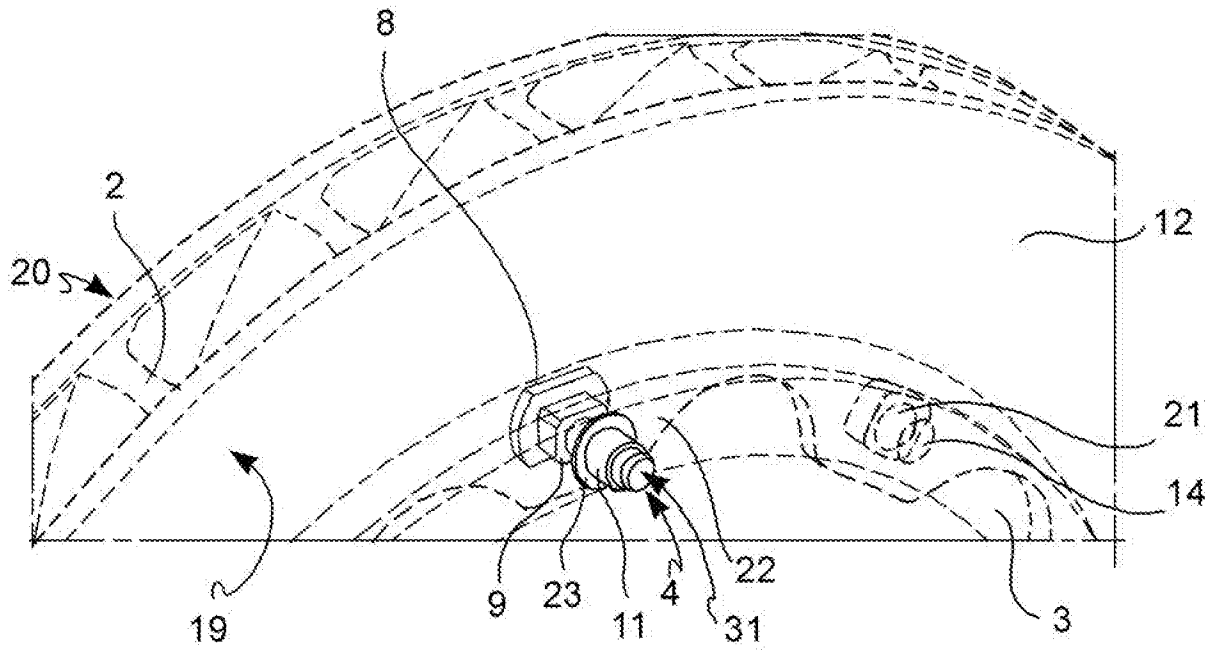


FIG. 2

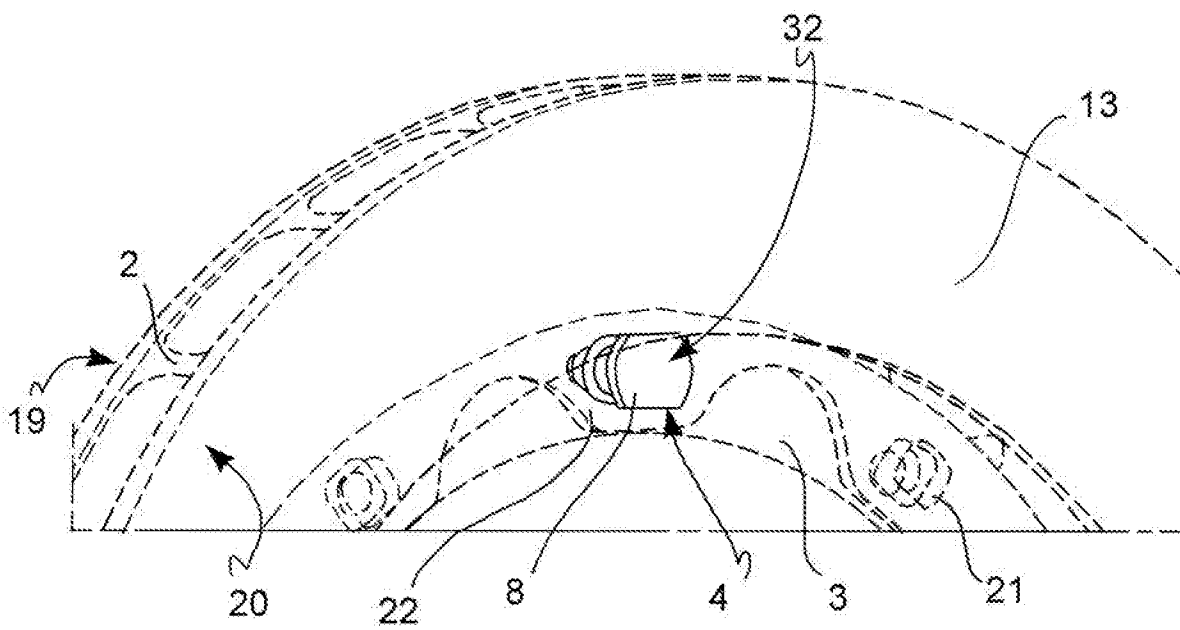
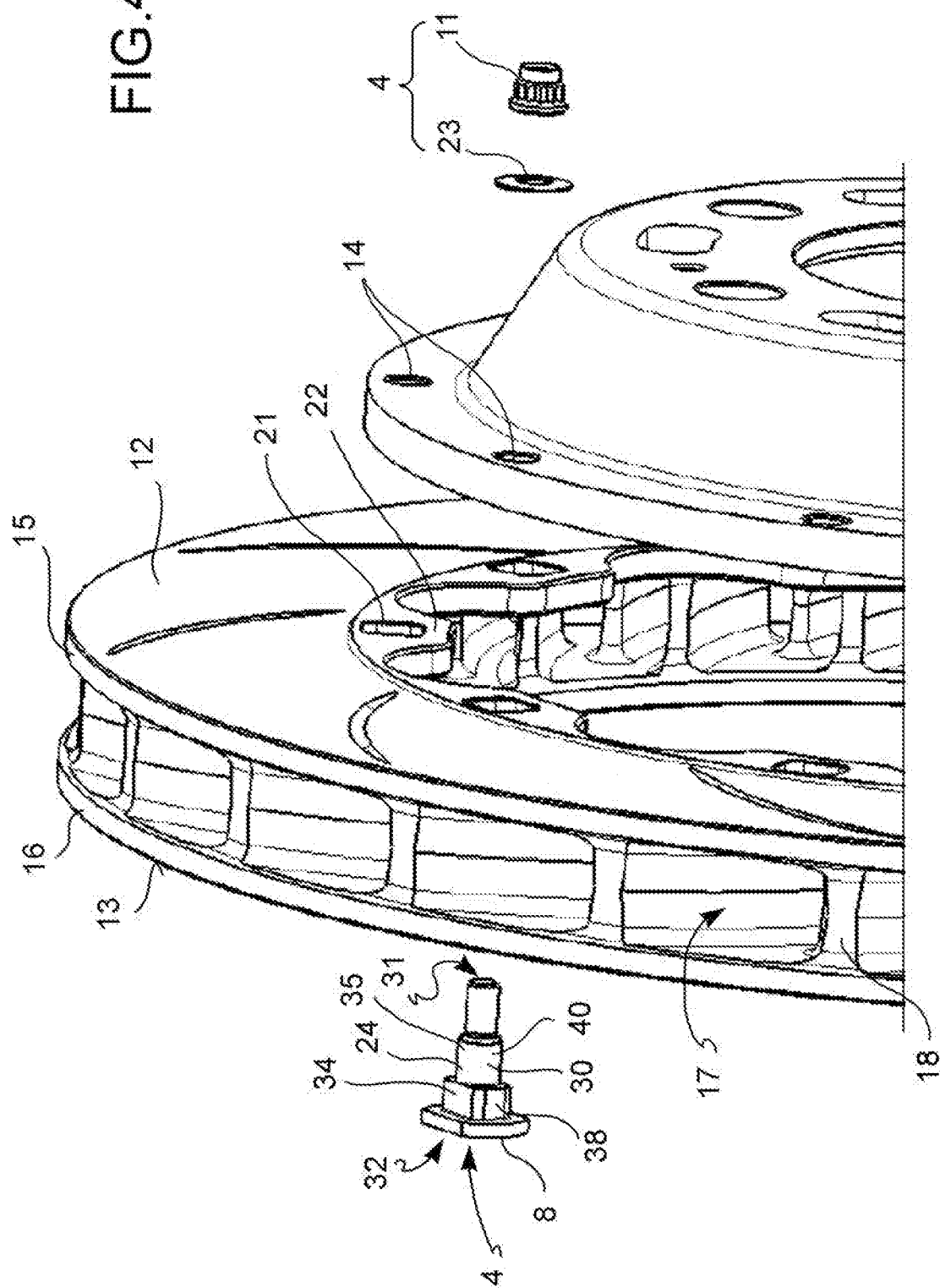


FIG. 3

FIG. 4.



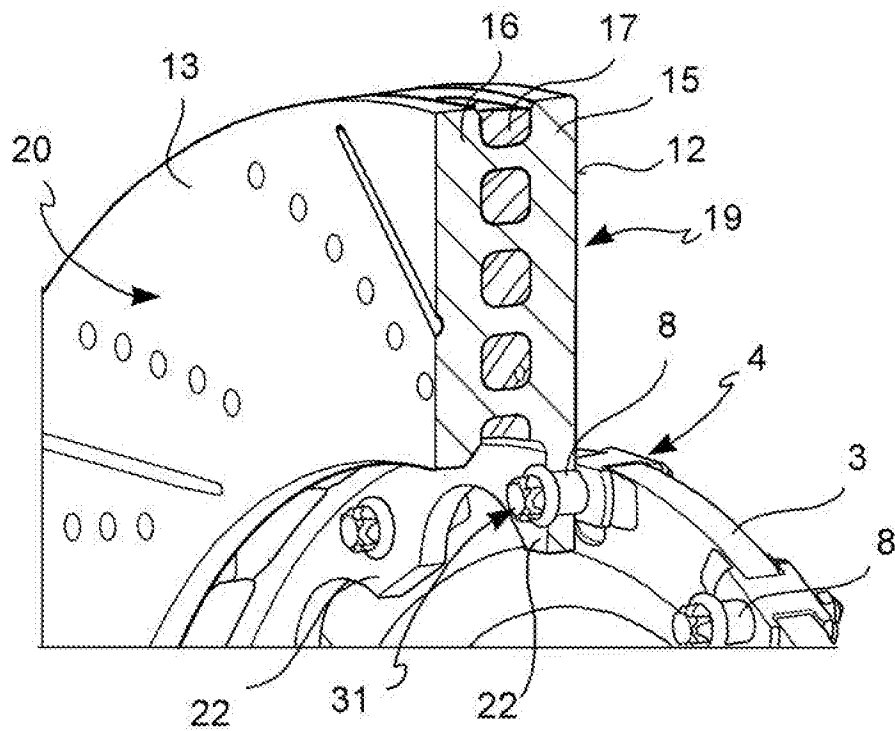


FIG. 5

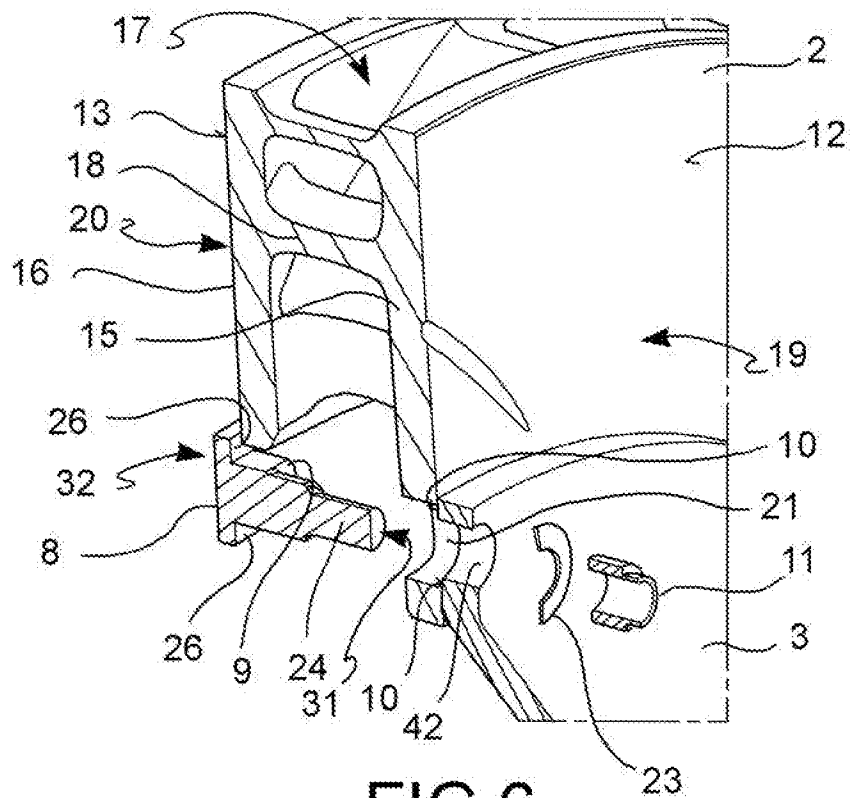


FIG. 6

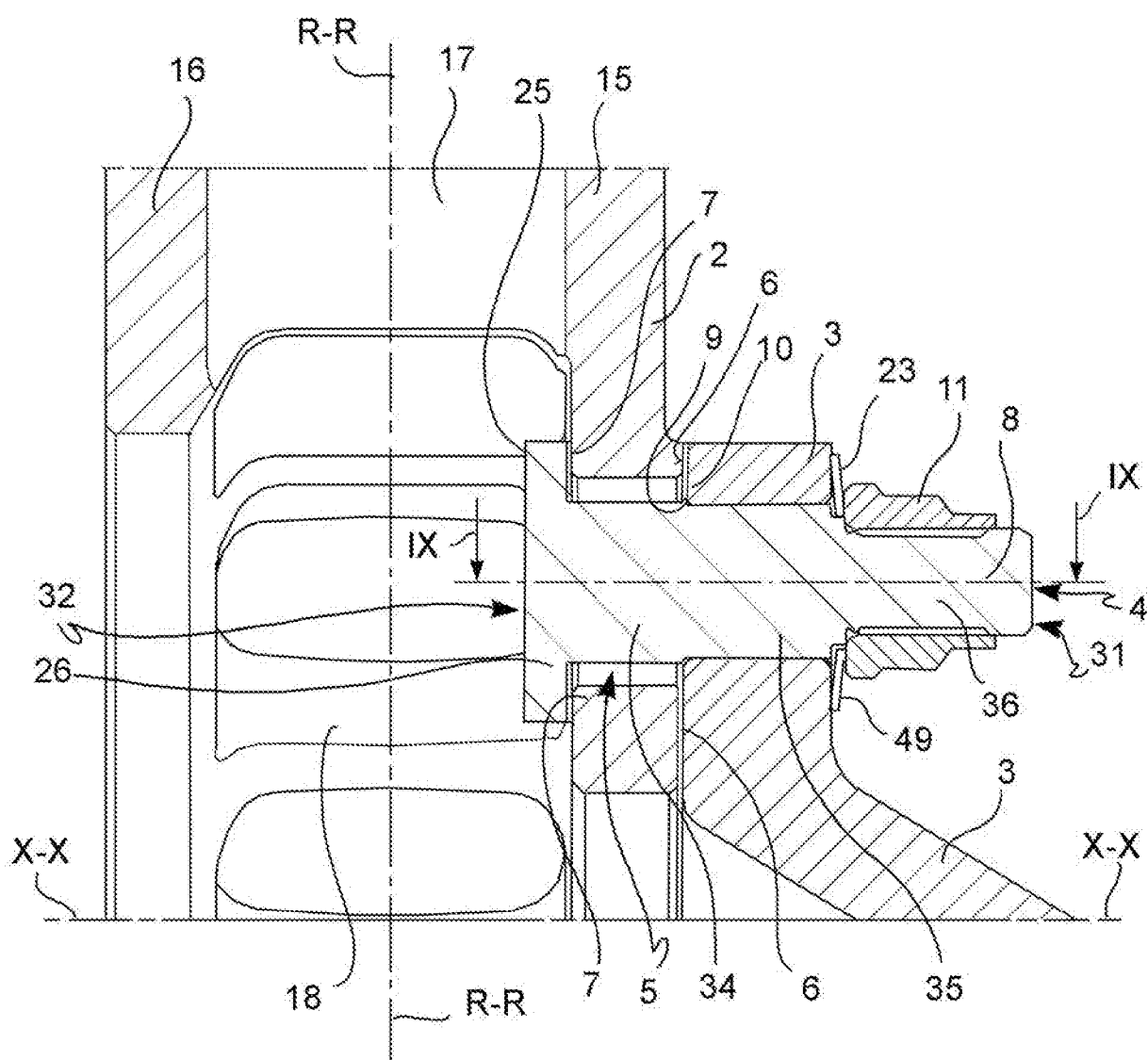
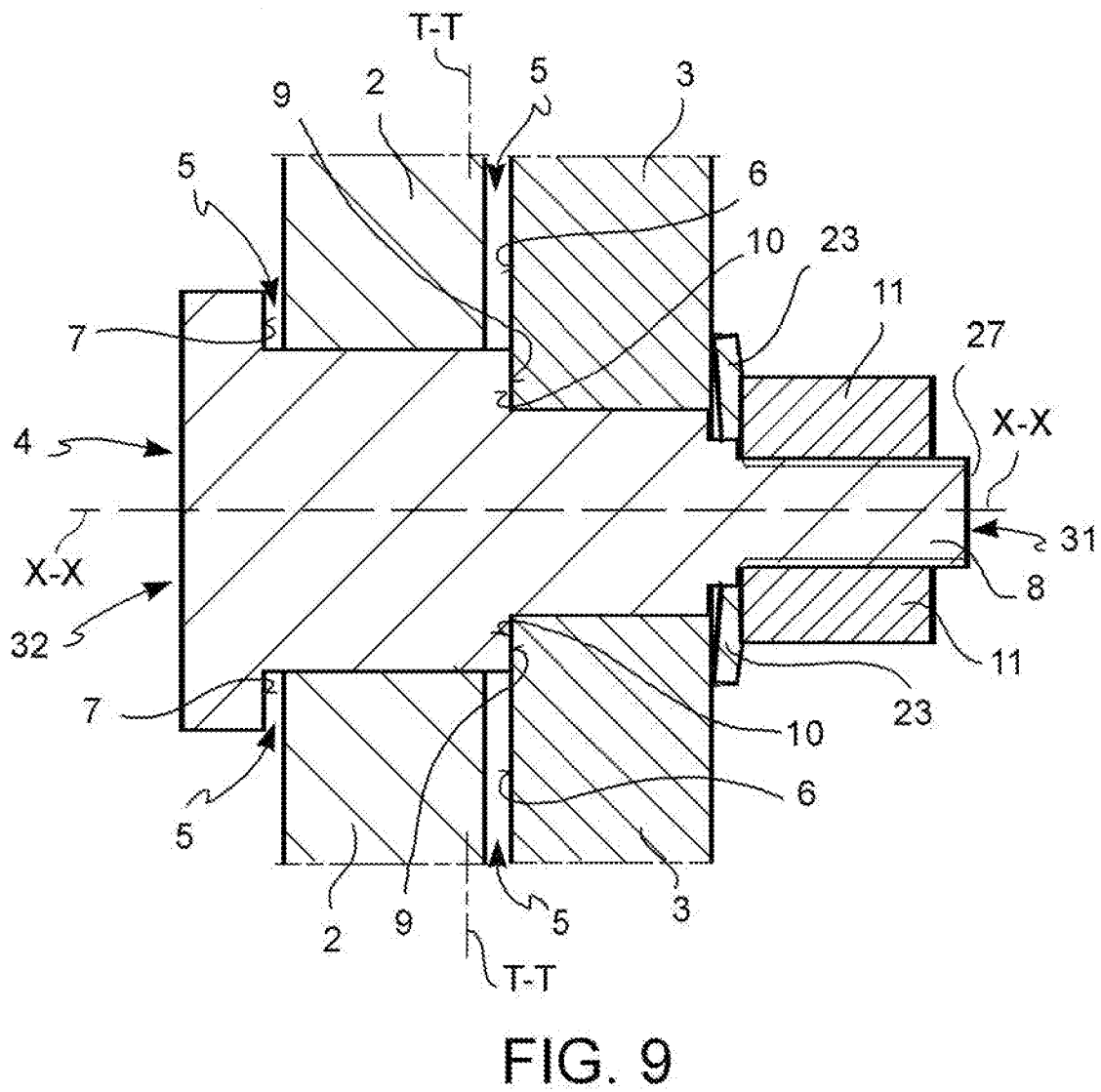
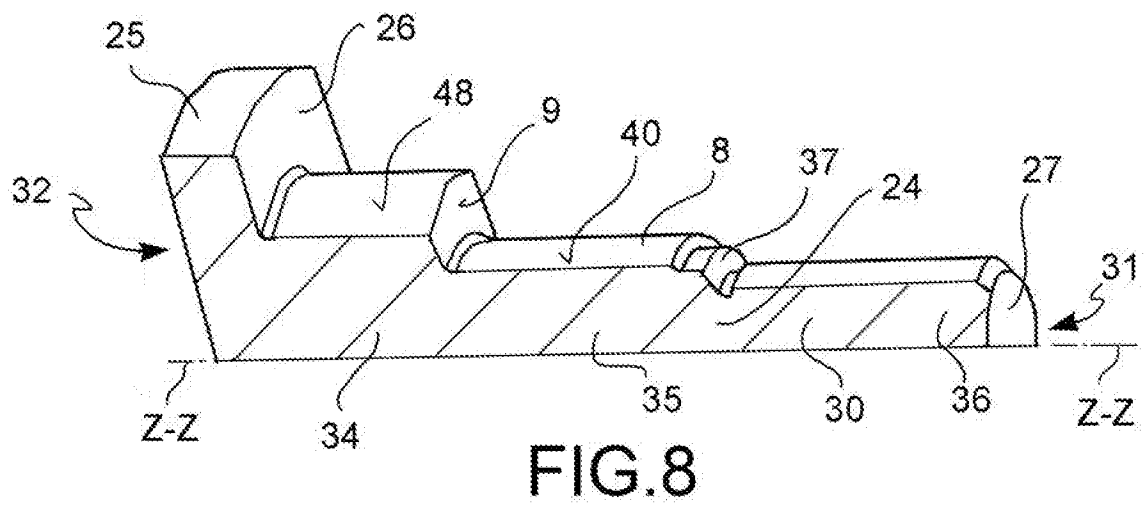


FIG.7



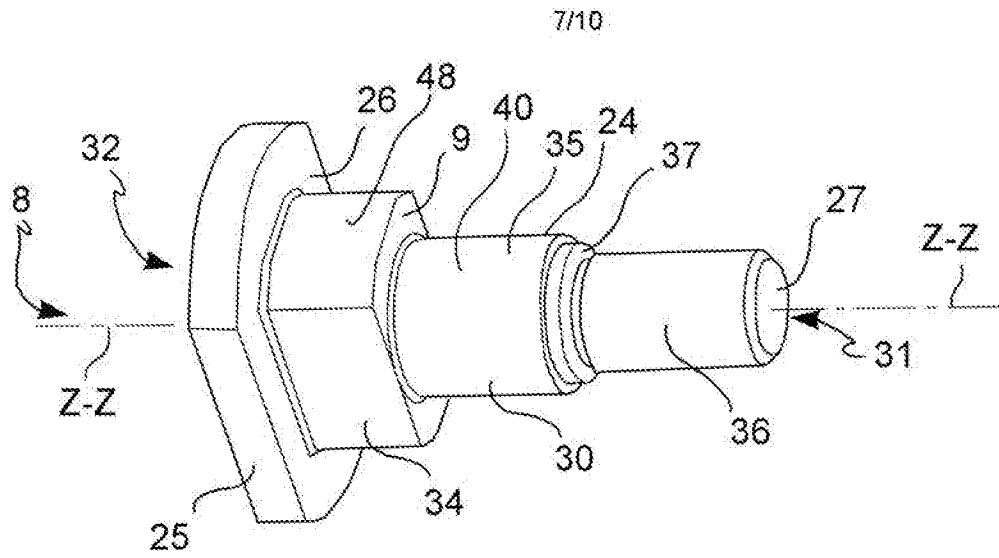


FIG. 10

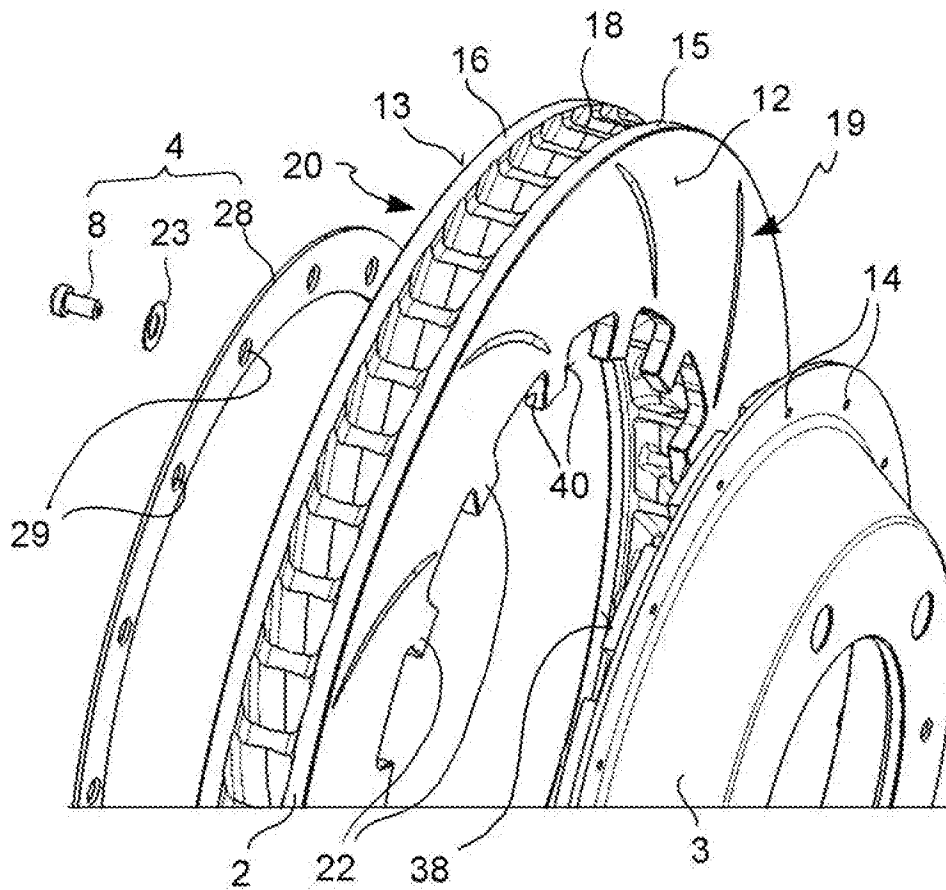


FIG. 11

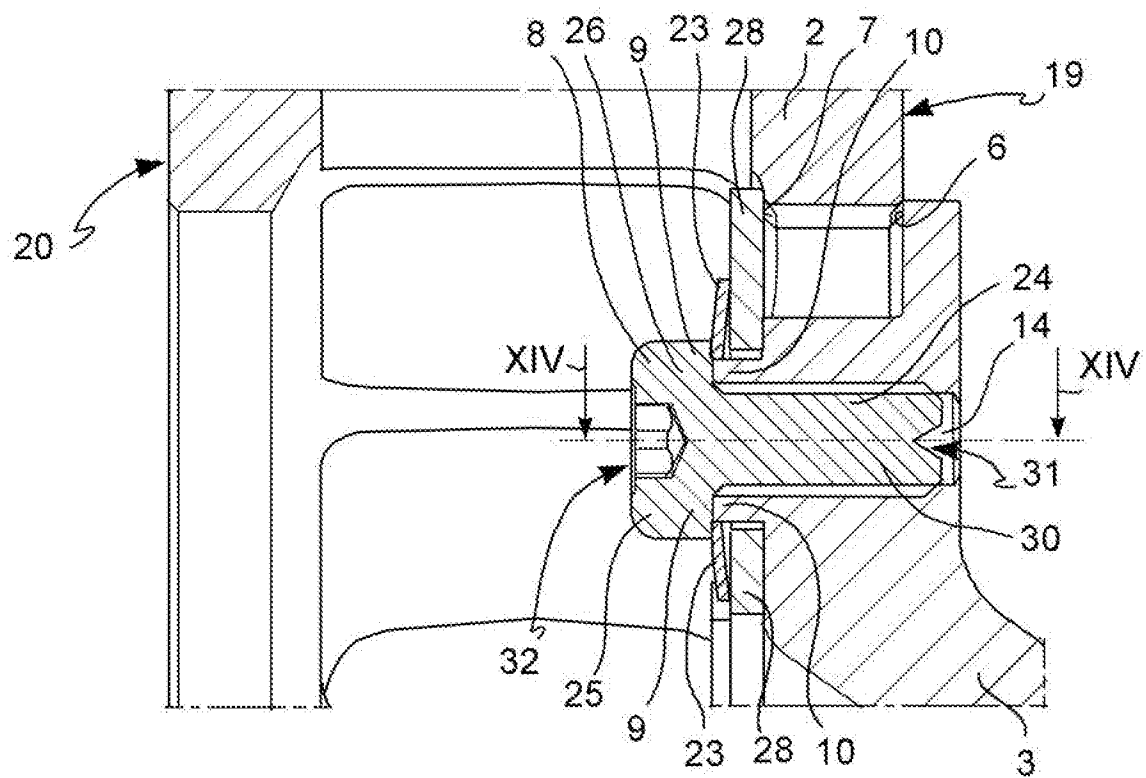


FIG. 12

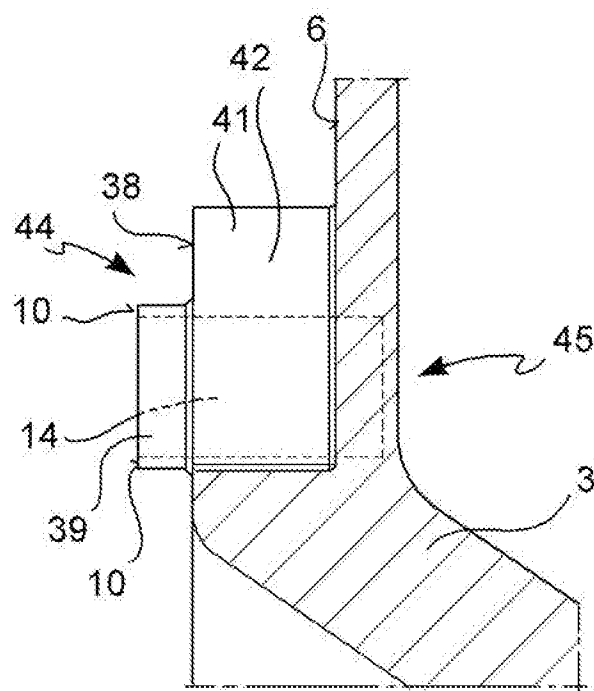


FIG. 13

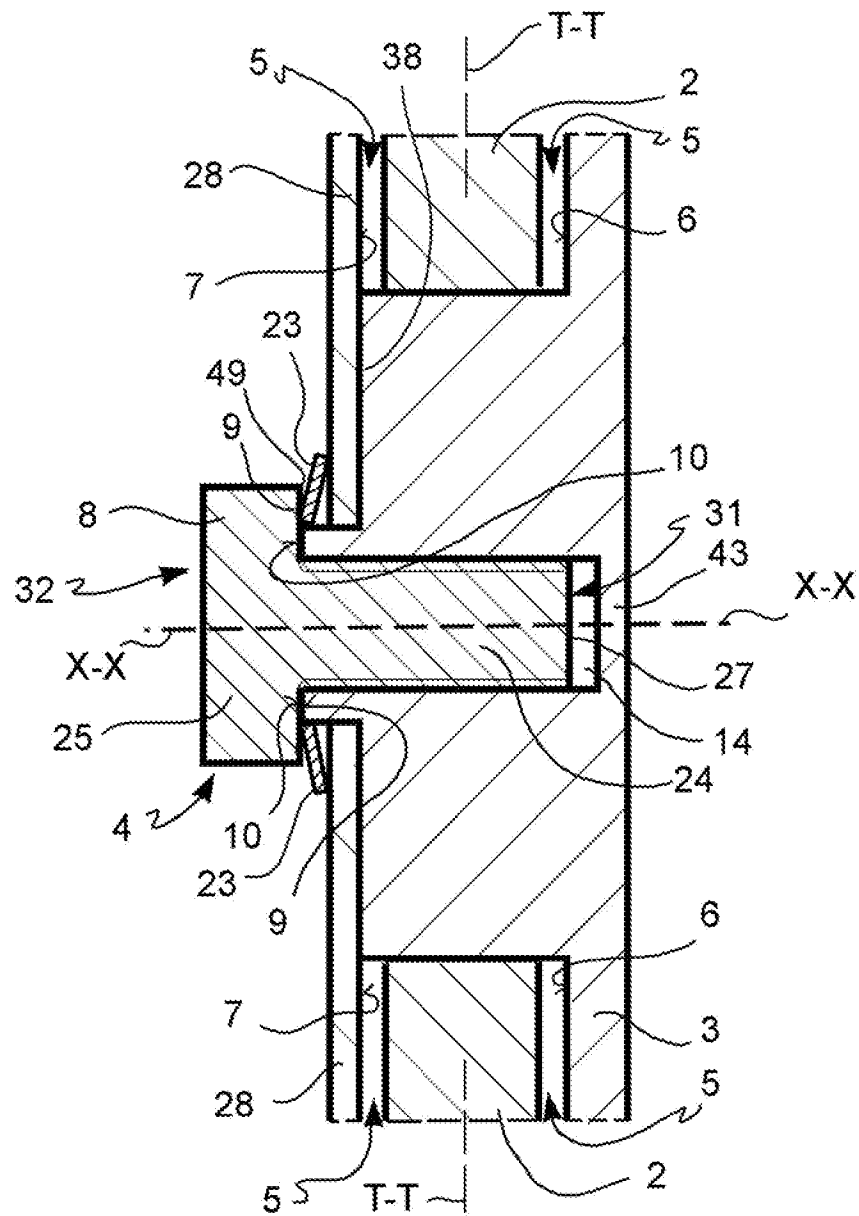


FIG.14

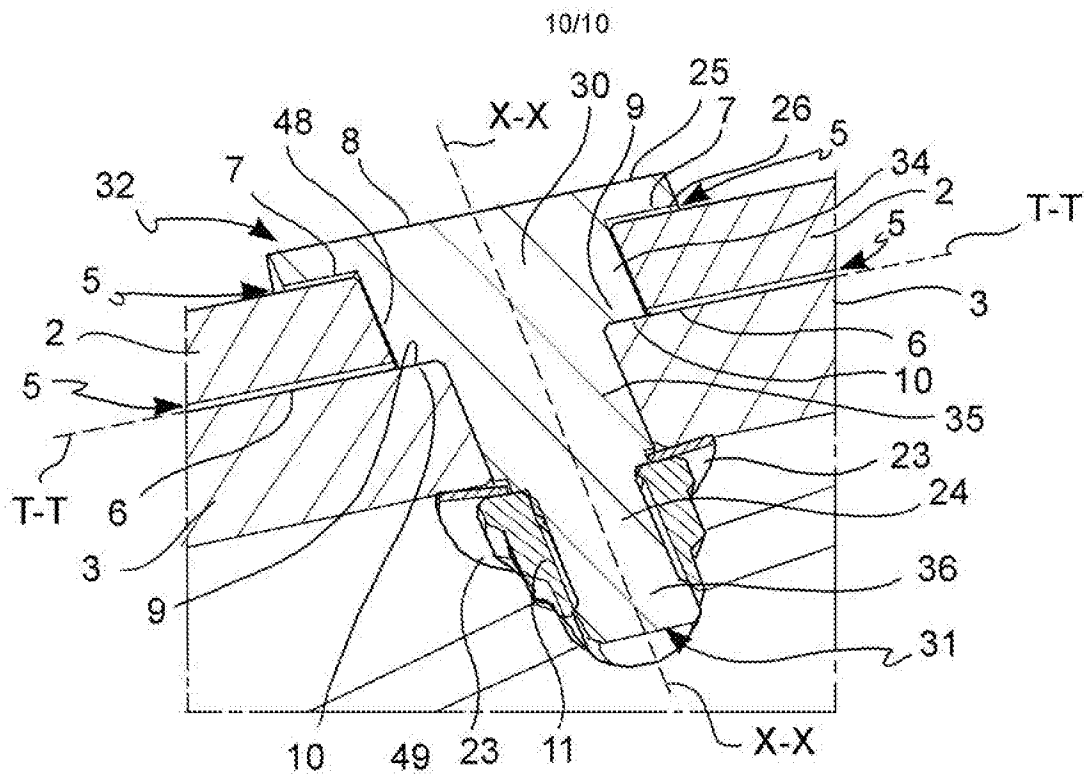


FIG. 15

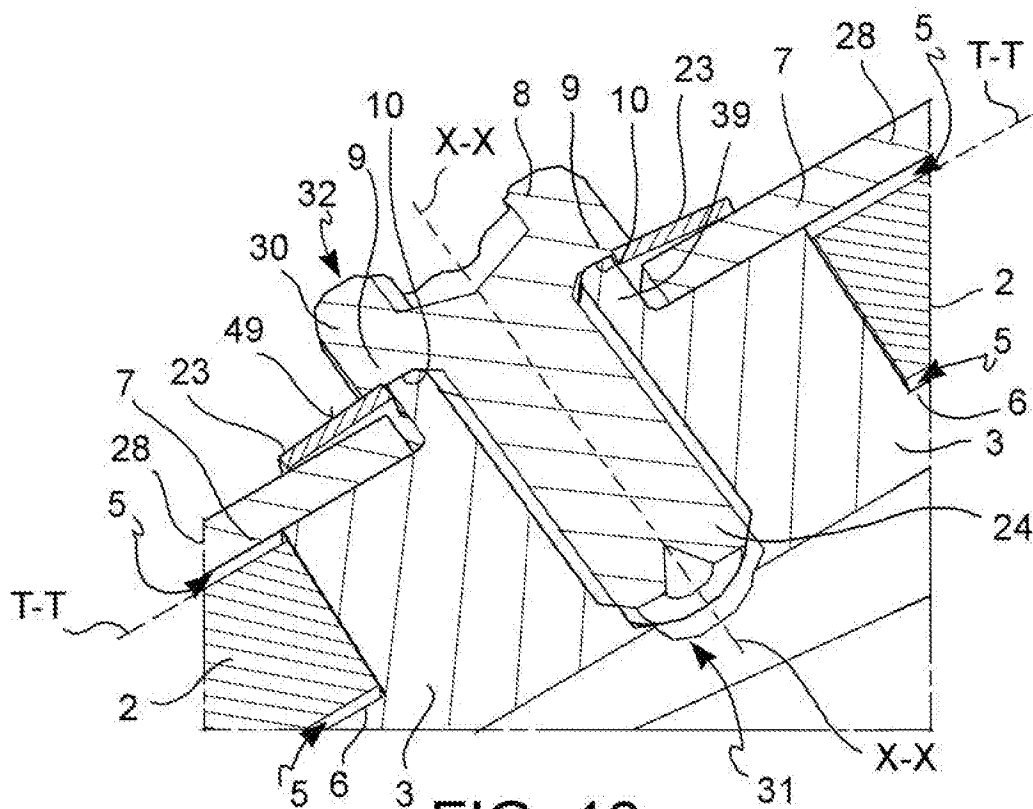


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2018/056632

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16D65/12

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 6 267 210 B1 (BURGOON DONALD L [US] ET AL) 31 July 2001 (2001-07-31) column 3, line 8 - column 5, line 13; figures	1,5 7,9,10
X A	----- EP 1 466 106 A1 (FRENI BREMBO SPA [IT]) 13 October 2004 (2004-10-13) cited in the application paragraph [0007] - paragraph [0013]; figure 2	7 1,5,9,10
X A	----- JP H09 166168 A (YUTAKA GIKEN CO LTD) 24 June 1997 (1997-06-24) abstract; figures	1,5,9,10 7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 November 2018

Date of mailing of the international search report

05/12/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Sangiorgi, Massimo

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2018/056632

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6267210	B1	31-07-2001	NONE

EP 1466106	A1	13-10-2004	AT 401513 T 15-08-2008
			AU 2002232123 A1 24-07-2003
			EP 1466106 A1 13-10-2004
			US 2005284712 A1 29-12-2005
			WO 03058087 A1 17-07-2003

JP H09166168	A	24-06-1997	JP 2916888 B2 05-07-1999
			JP H09166168 A 24-06-1997
