

(57) Abrégé(suite)/Abstract(continued):

located in the tire stud body (2, 2') and an end portion (3a) of which protrudes from the tire stud body (2, 2'), wherein: the insert (5, 5') has a base part (5a, 5'a) partly forming the base flange (4, 4') and has a pin holder (5b, 5'b) that holds the tire stud pin (3); and the tire stud body (2, 2'), optionally except for the insert (5, 5'), consists of a non-metal material, which surrounds the base part (5a, 5'a) at the base flange (4, 4'). At least the lower part of the base flange (4, 4') is surrounded by a vibration-damping rubber material into the region of lateral surfaces of the base flange (4, 4'), and at least that part (7, 7'b) of the tire stud body (2, 2') that directly adjoins the end portion (3a) of the tire stud pin (3) that protrudes from the tire stud body (2, 2') consists of an abrasion- and cutting-resistant material.

Abstract**Tire stud**

A tire stud (1, 1') for anchoring in a tire stud hole of a tread of a pneumatic vehicle tire, comprising a tire stud body (2, 2'), which has a base flange (4, 4'), and comprising a tire stud pin (3) of hard metal, which is anchored in an insert (5, 5') located in the tire stud body (2, 2') and an end section (3a) of which projects beyond the tire stud body (2, 2'), wherein the insert (5, 5') has a base part (5a, 5'a) partly forming the base flange (4, 4') and has a pin holder (5b, 5'b) that holds the tire stud pin (3), and wherein the tire stud body (2, 2'), optionally except for the insert (5, 5'), consists of a nonmetallic material, which encases the base part (5a, 5'a) at the base flange (4, 4').

At least the lower part of the base flange (4, 4') is encased by a vibration-damping rubber material into the region of side faces of the base flange (4, 4'), wherein at least that part (7, 7'b) of the tire stud body (2, 2') that directly adjoins the end section (3a) of the tire stud pin (3) that projects beyond the tire stud body (2, 2') consists of an abrasion- and cutting-resistant material.

Figure 4

1 **Description**

2 **Tire stud**

3 The invention relates to a tire stud for anchoring in a
4 tire stud hole of a tread of a pneumatic vehicle tire,
5 comprising a tire stud body, which has a base flange, and
6 comprising a tire stud pin of hard metal, which is anchored
7 in an insert located in the tire stud body and an end
8 section of which projects beyond the tire stud body,
9 wherein the insert has a base part partly forming the base
10 flange and has a pin holder that holds the tire stud pin,
11 and wherein the tire stud body, optionally except for the
12 insert, consists of a nonmetallic material, which encases
13 the base part at the base flange.

14 Tire studs are generally held in the tire stud holes of the
15 tread of pneumatic vehicle tires by a combination of
16 positive engagement and clamping. Conventional tire studs
17 comprise a tire stud body composed of aluminum or steel, in
18 which is held the tire stud pin, which projects beyond the
19 tread surface and is composed of hard metal.

20 It is customary to use gritting material on winter roads to
21 increase traffic safety. In recent years, the use of sand
22 has been reduced in favor of grit since sand tends to be
23 ground up by tires into dust or fine dust, which should be
24 reduced or avoided to protect the health of the population.
25 However, the use of grit leads to increased wear on the
26 conventional tire studs used in pneumatic vehicle tires,
27 especially if the tire stud body thereof is composed of
28 aluminum.

29 There has therefore already been a proposal to use tire
30 studs with tire stud bodies made of rubber or of plastic.

1 DE 2 202 373 A1 discloses a plastic tire stud which is
2 composed of a hard metal pin and a plastic casing, wherein
3 the hard metal pin is embedded in the plastic stem by means
4 of ultrasonic vibrations. In the case of other known
5 production methods for plastic tire studs, the hard metal
6 pin is overmolded with a thermoplastic.

7 WO 2017/0888995 A1 discloses tire studs in which the tire
8 stud pin and/or the plastic or aluminum base flange is or
9 are embedded at least partially into a rubber jacket or
10 into rubber material. The particular advantages of these
11 embodiments consist in the fundamental material properties
12 of the rubber body. Its low density of about 1 g/cm³ makes
13 rubber particularly light in comparison with aluminum and
14 steel. Replacing aluminum and steel with rubber as a body
15 material therefore leads to a reduction in the tire stud
16 weight, which has a particularly positive effect on road
17 wear and the formation of fine dust. Road wear is
18 determined principally by the impact energy of the tire
19 stud. The flexible material properties of rubber have even
20 more advantages. On the one hand, the flexible body
21 material damps impacts, with the result that smaller forces
22 act on stones in the road surface or on particles of
23 gritting material. Thus, road wear and the formation of
24 fine dust are also reduced thereby. Moreover, tire stud
25 bodies composed of rubber are superior to those composed of
26 aluminum or steel in terms of abrasion behavior since they
27 have completely different wear behavior. If the tire rolls
28 over stones in the road surface and, in particular, grit
29 from gritting material in the vicinity of a conventional
30 tire stud, the profile in the tread is deformed to a great
31 extent and gives way to the side. The fixed, rigid tire
32 stud cannot follow these movements of giving way. As a
33 result, a gap is formed between the tire stud and the

1 rubber, exposing the upper and the side face of the tire
2 stud body to the abrasive action of stones. Since stones in
3 the road surface and grit are generally harder than
4 aluminum and even steel, a tire stud body made of aluminum
5 or steel is severely abraded, resulting in a reduction in
6 the tire stud body height and the diameter of the tire stud
7 body. This leads to the tire stud hole edge regions being
8 subject to abrasion with a cutting effect. They erode, as a
9 result of which the gap between the tire stud and the
10 surrounding rubber matrix is enlarged. This favors the
11 penetration of sand and smaller stones, further
12 accelerating tire stud body abrasion. As a consequence, the
13 lateral retaining forces on the tire stud are reduced,
14 leading to a reduction in the winter properties due to
15 severe tilting and, in the worst case, to loss of the tire
16 stud.

17 It is the object of the invention to design a tire stud of
18 the type mentioned in the introduction such that road wear
19 and the formation of fine dust can be yet further reduced,
20 wherein it is sought to ensure the grip characteristics of
21 the tire stud on icy surfaces, the ice performance, and
22 optimum retention of the tire stud in the tread.

23 According to the invention, the stated object is achieved
24 by virtue of the fact that at least the lower part of the
25 base flange is encased by a vibration-damping rubber
26 material into the region of side faces of the base flange,
27 wherein at least that part of the tire stud body that
28 directly adjoins the end section of the tire stud pin that
29 projects beyond the tire stud body consists of an abrasion-
30 and cutting-resistant material.

1 In the case of tire studs embodied in accordance with the
2 invention, therefore, the part which is primarily
3 responsible for anchoring the tire stud in the rubber
4 material of the tread, namely the base flange, has a casing
5 composed of a vibration-damping rubber material. Tire studs
6 according to the invention are therefore embedded in the
7 rubber material of the tread in such a way that they can
8 absorb and damp forces acting on them from outside
9 particularly well. In the region which directly adjoins the
10 tread periphery when the tire stud is inserted in a tread,
11 the tire stud body is furthermore preferably and
12 advantageously produced from an abrasion-resistant and
13 cutting-resistant material, preferably from an appropriate
14 rubber material or a thermoplastic vulcanizate. The
15 abrasion of the tire stud body is therefore substantially a
16 good match for that of the surrounding rubber matrix of the
17 tread. As a result, no gaps are formed between the tire
18 stud body and the tread material, thereby ensuring that the
19 tire stud retains its winter properties or its ice
20 performance over the life of the tire. Tire studs embodied
21 in accordance with the invention furthermore have a low
22 weight, which is advantageous for low road wear and low
23 fine dust formation.

24 In a preferred embodiment, the tire stud body is composed
25 of the vibration-damping rubber material, which at least
26 partially encases the base flange, and of the abrasion- and
27 cutting-resistant material, which can likewise be a rubber
28 material or, alternatively, a thermoplastic vulcanizate.

29 An embodiment in which the vibration-damping rubber
30 material encases the base flange and the pin holder of the
31 insert, the latter at least partially, is particularly
32 preferred. It is advantageous especially for the base

1 flange to have a casing composed of a vibration-damping
2 material.

3 A variant embodiment in which the tire stud body has at
4 least one further tire stud body part composed of a further
5 rubber material between the casing of the base flange
6 composed of the vibration-damping rubber material and the
7 tire stud body part composed of the abrasion- and cutting-
8 resistant material is furthermore particularly preferred.
9 This measure enables tire studs with special bedding and
10 damping properties to be made available.

11 In one possible variant embodiment, the respective parting
12 plane(s) between the different materials can extend
13 transversely to the vertical axis of the tire stud and, in
14 an alternative embodiment, obliquely to the vertical axis
15 of the tire stud, preferably at an acute angle of 60° to
16 85° to said axis. This measure makes it possible to match
17 the bedding and damping properties of the tire stud body
18 particularly well to the respective position of the tire
19 stud in the tread.

20 The invention furthermore relates to a pneumatic vehicle
21 tire having a tread with tire studs that are embodied in
22 accordance with the invention.

23 Further features, advantages and details of the invention
24 will now be discussed in more detail on the basis of the
25 drawing, which illustrates exemplary embodiments. In the
26 drawing,

27 Figure 1 and figure 2 show side views of a first embodiment
28 of a tire stud,

1 Figure 3 shows a plan view of the tire stud according to
2 the first embodiment,

3 Figure 4 and figure 5 show sectional illustrations along
4 the lines IV-IV and V-V of figure 3,

5 Figure 6 and figure 7 show side views of a second
6 embodiment of a tire stud according to the invention,

7 Figure 8 shows a plan view of the tire stud according to
8 the second embodiment, and

9 Figure 9 and figure 10 show sectional illustrations along
10 the lines IX-IX and X-X of figure 8.

11 In the description, designations such as top, bottom,
12 perpendicularly and the like refer to the position of the
13 respective tire stud in the figures.

14 The tire studs 1 (figure 1 to figure 5) and 1' (figure 6 to
15 figure 10) shown in the figures have a central vertical
16 axis a and consist fundamentally of a tire stud body 2, 2'
17 and an insert 5, 5' with a tire stud pin 3.

18 In the embodiment shown in figures 1 to 5, the tire stud
19 body 2 has a circular-cylindrical or approximately
20 circular-cylindrical part which rests centrally on a base
21 flange 4, which, in plan view, has an approximately oval
22 shape with two side faces extending along the longer extent
23 of the oval and parallel to one another. The circular-
24 cylindrical part has a diameter which, in the embodiment
25 shown, corresponds to the width of the base flange 4,
26 wherein the diameter can also be slightly smaller or
27 slightly larger than the width of the base flange 4. In the
28 embodiment shown in figures 6 to 10, the tire stud body 2'

1 has a part which has an oval form in plan view, wherein the
2 oval remains constant or largely constant over the vertical
3 extent of the tire stud body 2. The part of oval
4 configuration is arranged approximately centrally on a base
5 flange 4', which has an approximately oval shape in plan
6 view with two side faces extending along the longer extent
7 of the oval, which extend obliquely in opposite directions
8 and at a small acute angle with respect to a single plane
9 of symmetry S_1 of the base flange 4', said plane extending
10 along the longitudinal extent of the base flange 4'. In the
11 embodiment shown, the extent of the oval part of the tire
12 stud body 2' coincides with that of the oval of the base
13 flange 4' when considered in plan view.

14 In both embodiments, the insert 5, 5' is situated within
15 the tire stud body 2, 2', said insert having a base part
16 5a, 5'a, which partly forms the base flange 4, 4' and is
17 configured in a manner substantially similar to said
18 flange, and a pin holder 5b, 5'b. In the embodiments shown,
19 the pin holder 5b, 5'b is of cylindrical or approximately
20 cylindrical configuration, and the tire stud pin 3 is
21 anchored in the middle thereof. The height h of the insert
22 5, 5' is preferably 40% to 60% of the tire stud height H.
23 An end section 3a of the tire stud pin 3 projects beyond
24 the tire stud body 2, 2' in a known manner.

25 The insert 5, 5' is preferably composed of a metal,
26 especially aluminum, but can also be composed of a plastic,
27 either a thermoset or a thermoplastic.

28 The tire stud body 2, 2' is composed of different,
29 nonmetallic materials, as explained below.

1 In the embodiment shown in figures 1 to 5, the base flange
2 4 is encased by a first rubber material, and the casing 6
3 also covers the upper side of the base flange 4. The pin
4 holder 5b and that section of the tire stud pin 3 which
5 extends within the tire stud body 2 are embedded in a
6 second material, which forms a tire stud body part 7. In
7 this case, the end section 3a of the tire stud pin 3 which
8 projects beyond the tire stud body 2 can also be covered
9 with a thin layer of this material.

10 The rubber material of the casing 6 of the base flange 4
11 has particularly good vibration-damping properties. Rubber
12 compound compositions which are suitable for the production
13 of such a rubber material are sufficiently well known to
14 tire specialists. The parting plane between the casing 6
15 and the tire stud body part 7 extends horizontally and
16 therefore at a right angle to the vertical axis a of the
17 tire stud 1. In the region of the base flange 4, the casing
18 6 largely has a layer thickness of 0.5 to 1.5 mm. However,
19 the layer thickness can also be greater at some points,
20 e.g. in the region of a recess which is formed on the lower
21 side of the base part 5a of the insert 5 and is filled with
22 the rubber material of the casing 6.

23 In an alternative embodiment, which is not illustrated
24 separately, the casing extends out of the first rubber
25 material on the base flange 4 only as far as the region of
26 the lateral boundary surfaces thereof and, here, is
27 directly adjoined by the second material.

28 The tire stud body part 7 is composed of a cutting-
29 resistant and abrasion-resistant material, either of
30 another rubber material or of a thermoplastic vulcanizate.
31 Rubber compound compositions for the production of a

1 cutting-resistant and abrasion-resistant rubber material
2 are sufficiently well known to tire specialists. As is
3 known, a thermoplastic vulcanizate is composed of at least
4 one thermoplastic and one elastomer, wherein the
5 thermoplastic forms a continuous phase and the elastomer
6 forms a disperse phase finely distributed in said
7 thermoplastic. In a thermoplastic vulcanizate, elastomer
8 particles are therefore surrounded by thermoplastic. The
9 thermoplastic is or contains, in particular, at least one
10 thermoplastic from the group comprising polyurethane (PU),
11 polypropylene (PP), polystyrene (PS), polyamide (PA) or
12 acrylonitrile butadiene styrene copolymer (ABS). As the
13 rubber, the rubber compound of the elastomer contains at
14 least one of the rubbers from the group comprising natural
15 rubbers (NR), synthetic polyisoprene (IR), polybutadiene
16 (BR), styrene butadiene rubber (SBR) and nitrile butadiene
17 rubber (NBR).

18 In the embodiment shown in figures 6 to 10, the base part
19 5'a is likewise encased by a first rubber material, which,
20 similarly to the first embodiment, has a particularly good
21 vibration-damping effect. The casing 6' extends into the
22 lower region of the pin holder 5'b and here forms a parting
23 plane with respect to a tire stud body part 7'a of strip-
24 shaped cross section composed of another rubber material,
25 said parting plane extending obliquely at an acute angle
26 of, for example, 5° to 30° to the horizontal, wherein the
27 part 7'a extends around the pin holder 5'b and wherein the
28 part 7'a is adjoined by a tire stud body part 7'b composed
29 of a cutting-resistant and abrasion-resistant material,
30 either of a rubber material or of a thermoplastic
31 vulcanizate. The tire stud body part 7'b encases the upper
32 section of the pin holder 5'b and that section of the tire
33 stud pin 3 which extends within the tire stud body 2', as

1 well as possibly the end section 3a of the tire stud pin 3,
2 the latter with a thin layer. The parting plane between the
3 two tire stud body parts 7'a and 7'b preferably similarly
4 extends obliquely to the parting plane between the casing
5 6' and the tire stud body part 7'a.

6 Particularly in the case of tire studs which are used in
7 directional treads of pneumatic vehicle tires, particularly
8 advantageous bedding and damping properties of the tire
9 stud can be achieved by means of the oblique parting planes
10 between the compounds.

11 In an alternative embodiment, which is not illustrated
12 separately, the parting planes between the casing 6' and
13 the tire stud body part 7'a and between the tire stud body
14 parts 7'a and 7'b extend horizontally and therefore at a
15 right angle to the central vertical axis a of the tire stud
16 1'.

17 The tire stud body part 7'a is preferably composed of a
18 rubber material, which ensures a particularly good
19 connection between the two materials of the casing 6' and
20 of the tire stud body part 7'b.

21 In other alternative embodiments, which are not illustrated
22 separately, the casing 6, 6' can extend further up in the
23 vertical direction than shown, and, in particular, can also
24 at least partly encase the pin holder 5b, 5'b and, in the
25 case of the embodiment shown in figures 1 to 5, can also
26 preferably encase it completely.

List of reference numerals

1, 1'..... Tire stud
2, 2'..... Tire stud body
3..... Tire stud pin
3a..... End section
4, 4'..... Base flange
5, 5'..... Insert
5a, 5'a... Base part
5b, 5'b... Pin holder
6, 6'..... Casing
7..... Tire stud body part
7'a, 7'b.. Tire stud body part
h..... Height of the insert
a..... Vertical axis
H..... Tire stud height
S₁..... Plane of symmetry

Patent claims

1. A tire stud (1, 1') for anchoring in a tire stud hole of a tread of a pneumatic vehicle tire, comprising a tire stud body (2, 2'), which has a base flange (4, 4'), and comprising a tire stud pin (3) of hard metal, which is anchored in an insert (5, 5') located in the tire stud body (2, 2') and an end section (3a) of which projects beyond the tire stud body (2, 2'), wherein the insert (5, 5') has a base part (5a, 5'a) partly forming the base flange (4, 4') and has a pin holder (5b, 5'b) that holds the tire stud pin (3), and wherein the tire stud body (2, 2'), optionally except for the insert (5, 5'), consists of a nonmetallic material, which encases the base part (5a, 5'a) at the base flange (4, 4'),

c h a r a c t e r i z e d

in that at least the lower part of the base flange (4, 4') is encased by a vibration-damping rubber material into the region of side faces of the base flange (4, 4'), wherein at least that part (7, 7'b) of the tire stud body (2, 2') that directly adjoins the end section (3a) of the tire stud pin (3) that projects beyond the tire stud body (2, 2') consists of an abrasion- and cutting-resistant material.

2. The tire stud (1, 1') as claimed in claim 1, characterized in that the abrasion- and cutting-resistant material is a second rubber material or a thermoplastic vulcanizate.

3. The tire stud (1) as claimed in claim 1 or 2, characterized in that the tire stud body (2) is composed of the vibration-damping rubber material, which at least partially encases the base flange (4), and of the abrasion- and cutting-resistant material.

4. The tire stud (1, 1') as claimed in any of claims 1 to 3, characterized in that the vibration-damping rubber material (6, 6') encases the base flange (4, 4') and the pin holder (5b, 5'b) of the insert (5, 5'), the latter at least partially.

5. The tire stud (1') as claimed in any of claims 1 to 4, characterized in that the tire stud body (2') has at least one further tire stud body part (7'a) composed of a further rubber material between the casing (6') of the base flange (4') composed of the vibration-damping rubber material and the tire stud body part (7'b) composed of the abrasion- and cutting-resistant material.

6. The tire stud (1, 1') as claimed in any of claims 1 to 5, characterized in that the parting plane(s) between the different materials extends or extend transversely to the vertical axis (a) of the tire stud (1, 1').

7. The tire stud (1, 1') as claimed in any of claims 1 to 5, characterized in that the parting plane(s) between the different materials extends or extend obliquely to the vertical axis (a) of the tire stud (1, 1').

8. A pneumatic vehicle tire having a tread with tire studs (1, 1') which are embodied as claimed in one or more of claims 1 to 7.

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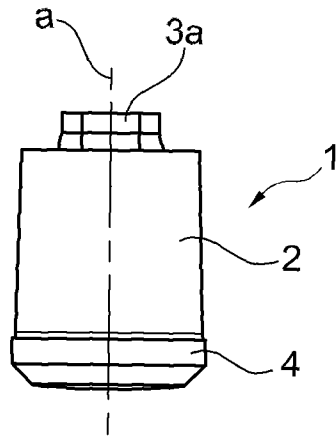


Fig. 1

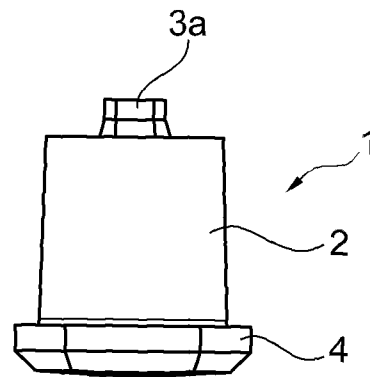


Fig. 2

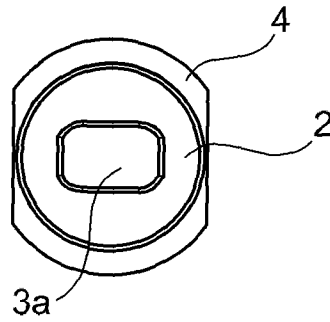


Fig. 3

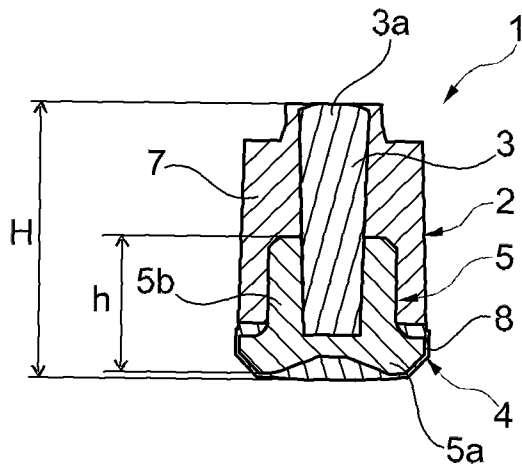


Fig. 4

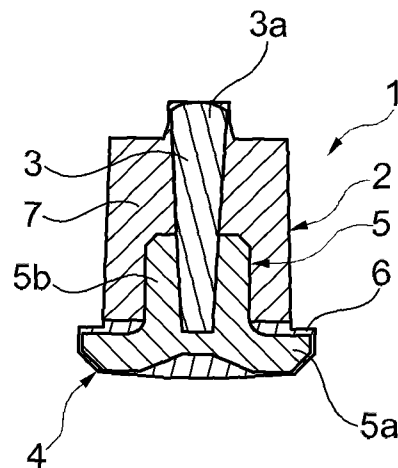


Fig. 5

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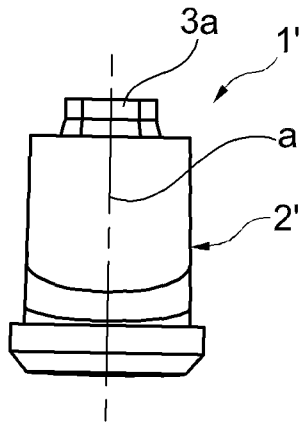


Fig. 6

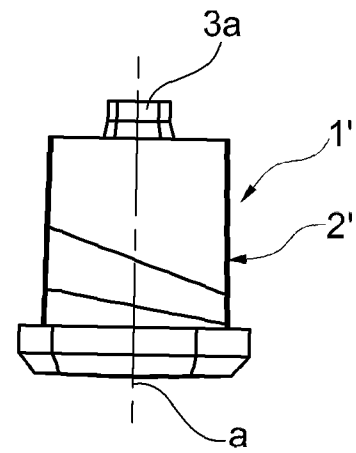


Fig. 7

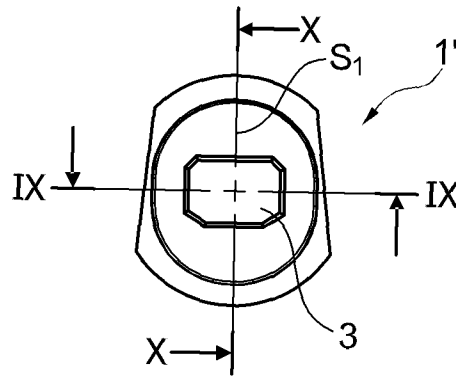


Fig. 8

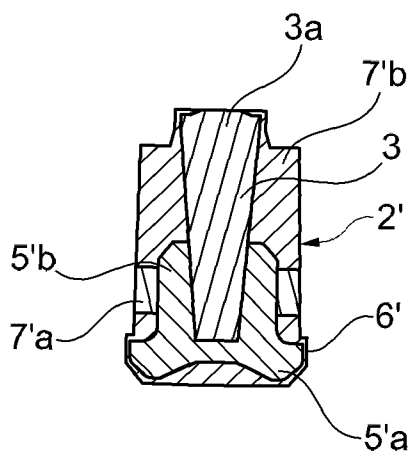


Fig. 9

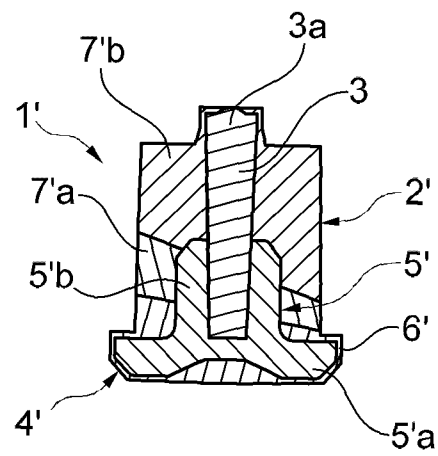


Fig. 10

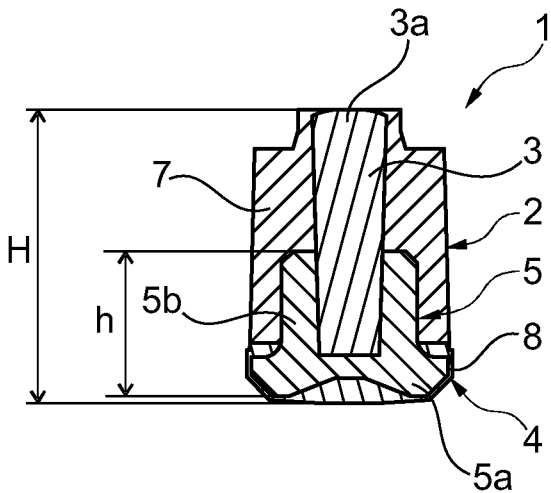


Fig. 4