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(54) Mine support assembly for anchoring in a bore hole in the form of an improved rock bolt

(57) The present invention relates to a mine support assembly for anchoring in an axial bore hole (4) in the form of an improved rock bolt (2). The present invention particularly relates to a rock anchoring system (1) to reinforce a rock face (3) with a rock bolt (2) drilled into rock formations to stabilize said rock formations, said rock bolt (2) being securable into a region defined by an axial bore hole (4) and having a longitudinally extending linear shank body (5) with a bore hole end (6) and a rock face end (7), said bore hole end (6) being fixable furthest within the rock formation, said rock bolt (2) further comprising a planar bearing plate (8) bearing against the rock face (3) with a circular outline being placed flush with the opening of the axial bore hole (4).

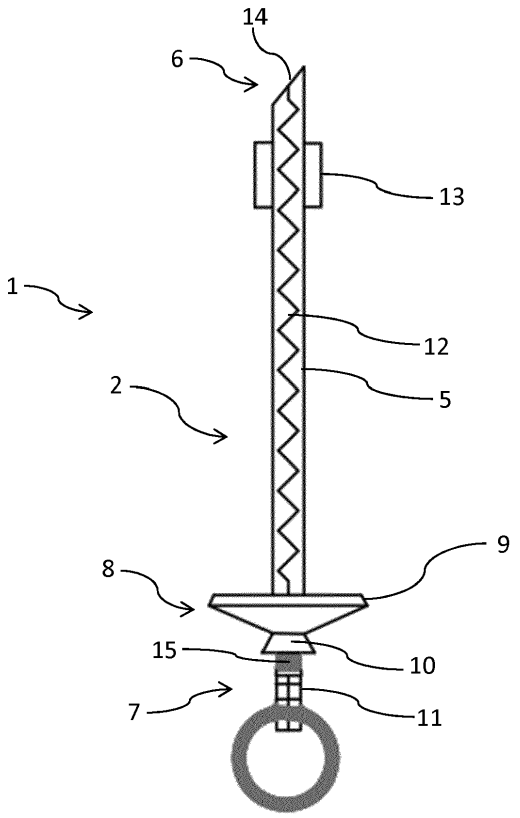

Fig. 1

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Description

Technical Field of the Present Invention

[0001] The present invention relates to a mine support assembly for anchoring in a bore hole in the form of an improved rock bolt.

Background of the Present Invention

[0002] As is known, a rock bolt is typically inserted into a drilled bore hole and tightened up against a bearing plate in a rock surface so as to serve to the purpose of securing wall surfaces of tunnels in shafts or inclines of a mining area. Such elements are typically used as stabilizing supporting elements fastened inside a rock by mechanical means having contact relationship with the rock.

[0003] A rock bolt is expected to maintain a load when the wall surfaces and the rock with the rock bolt fastened inside deforms. The rock bolts are usually anchored into the rock by a mechanical anchor or additionally or alternatively by being bonded to the rock with a resinous/cementitious material being injected.

[0004] A typical problem in relation with rock bolts originate from the fact that underground tunnel walls may dynamically displace and converge in response to altering ground conditions and such change can break rock bolts. Therefore, in order for holding a fractured rock formation in place, rock bolts having certain physical characteristics are necessary.

[0005] A prior art publication in the technical field of the present invention may be referred to as US4678374 among others, the document disclosing an elongated rod with an expansion shell assembly positioned on the upper end portion thereof is advanced behind a resin cartridge system into a bore hole drilled in a rock formation. A bearing plate and a stop nut are positioned on the end of the rod emerging from the bore hole. Unitary rotation of the nut and rod in a preselected direction while maintaining the shell assembly in an unexpanded condition effects mixing of the resin components. Continued rotation of the nut and rod after the resin components are mixed effects expansion of the shell into engagement with the wall of the bore hole to anchor the rod in the bore hole. The rotation applied to the nut after setting of the shell permits the nut to advance on the lower end of the rod to urge the bearing plate into compressive relation with the rock formation to put the rod under tension without interrupting rotation to allow the mixed resin to cure.

[0006] The present invention, on the other hand, provides a rock anchoring system that is mechanically improved to maintain a load when the rock formations into which the rock bolt is drilled deforms such that an improved stabilizing effect can be obtained. This is achieved by means of a special design involving no expansion mechanism whereby engagement of the rock bolt with the wall of the bore hole to anchor the bolt in therein is not effectuated by an expansion mechanism. Although no such mechanism is proposed, the rock bolt of the invention engages with the surrounding bore hole walls in efficient manner thanks to a plurality of pre-conditioned retaining means.

[0007] Further, the present invention is devised under the recognition that an observation means for monitoring tensions in the rock bed based on the surface formation of the rock wall surface remains a need.

[0008] The present invention provides a rock anchoring system as defined by the characterizing features given in Claim 1 and subsequent Claims.

Objects of the Present Invention

[0009] Primary object of the present invention is hence to provide a mechanically improved rock anchoring system serving for reinforcing a rock face in underground mining areas.

Brief Description of the Figures of the Present Invention

[0010] Accompanying drawings are given solely for the purpose of exemplifying a, whose advantages over prior art were outlined above and will be explained in brief hereinafter.

[0011] The drawings are not meant to delimit the scope of protection as identified in the claims nor should they be referred to alone in an effort to interpret the scope identified in said claims without recourse to the technical disclosure in the description of the present invention.

Fig. 1 demonstrates a general front view of a rock anchoring system according to the present invention.

Fig. 2 demonstrates a general front view of the rock anchoring system with extended outward-biased retaining means according to the present invention.

Fig. 3 demonstrates a general front view of the rock anchoring system with extended outward-biased retaining means drilled into a rock formation according to the present invention.

Fig. 4a demonstrates another general front view of the rock anchoring system according to the present invention.

Fig. 4b demonstrates a general perspective view of the rock anchoring system according to the present invention.

Fig. 5 demonstrates a longitudinal cross-sectional view of the rock anchoring system according to the present invention.

Detailed Description of the Present Invention

[0012] The following numerals are assigned to different parts demonstrated in the drawings:

1)	Rock anchoring system
2)	Rock bolt
3)	Rock face
4)	Axial bore hole
5)	Shank body
6)	Bore hold end
7)	Rock face end
8)	Bearing plate
9)	Lateral surface
10)	Spherical washer
11)	Fastening means
12)	Ribbed shaft wall
13)	Retaining means
14)	Inclined bore hole end-surface
15)	Threaded portion
16)	Welded region
17)	Bearing plate dome

[0013] The present invention relates to a rock anchoring system (1) serving for reinforcing a rock face (3) with at least one rock bolt (2).

[0014] A plurality of anchor bolts or rock bolts (2) may be drilled into rock formations in an underground mining area for stabilizing rock excavations. A rock bolt (2) is secured into a region defined by the confined inner part of the rock mass in the form of an axial bore hole (4). The rock bolt (2) has a longitudinally extending linear shank body (5) with a bore hole end (6) and a rock face end (7), said bore hole end (6) being fixed furthest within the rock formation. The rock bolt (2) is manufactured from mild steel or a metal alloy with the shaft being in tubular form and having ribs to provide a better engagement relationship between the ribbed shaft wall (12) and a cementitious material being conventionally injected in the axial bore hole (4).

[0015] In accordance with the present invention, the rock bolt (2) comprises a planar bearing plate (8) bearing against the rock face (3) with a circular outline being placed flush with the opening of the axial bore hole (4). The bearing plate (8) has a lateral surface (9) along the circular periphery thereof, configured to be inclined with regard to the axial direction of the rock bolt (2) so as to form a right circular truncated cone where the smaller circular surface of the truncated cone bears against the rock face (3) and the larger circular surface of the truncated cone is closer to the rock face end (7) of the rock bolt (2).

[0016] This arrangement produces the effect that tensions in the rock based on the progression of surface formations of the rock wall surface are dynamically observable. In other words, it is easier to monitor changes on the rock face (3) by analyzing the lateral surface (9) of the bearing plate (8) and determine on which parts the inwardly extending peripheral groove around the annular lateral surface (9) is filled by rock face (3) formations. This provides critical information for workmen on site.

[0017] In accordance with the present invention, a plurality of pre-conditioned retaining means (13) are provided so as to ensure better anchoring of the rock bolt (2) in the axial bore hole (4). This is achieved by means of the outward-biased structure of said retaining means (13), which are designed as elongate strips of metal plate welded onto the shank body (5) of the rock bolt (2) with a predetermined orientation so that they tend to preserve the plane on which they are attached to the shank body (5) in the axial bore hole (4). In other words, where the inner walls of the axial bore hole (4) apply a closing force to the outward-biased retaining means (13), they apply a counter force to effectuate thorough anchoring of the rock bolt (2). The arrow-shaped structure of the rock bolt (2) obtained by the welded metal plate strips have proven to bring about a more secure hold of the shank body (5).

[0018] Further the present invention provides that a fastening means (11) is connectable with the rock bolt (2) at the rock face end (7) of the rock bolt (2).The rock bolt (2) has a threaded portion (15) with which the fastening means (11) can be threaded into firm engagement with a mating threaded part, therefore matingly screwing into said threaded portion (15) in the form of screw threaded male and female parts.

[0019] According to the present invention, the rock bolt (2) is fitted to the axial bore hole (4) while a spherical washer (10) abuts the bearing plate (8). Considering the fact that the spherical washer (10) is not threaded onto the rock bolt (2) but welded at a welded region (16), it features a less vulnerable part in terms of mechanical durability. The welding process is carried out using MG-211 gas welding rods. The rock bolt (2) has an inclined bore hole end-surface (14) conventionally suitable for providing a puncturing effect, for instance for puncturing a cementitious material pack.

[0020] In a nutshell, the present invention proposes a rock anchoring system (1) to reinforce a rock face (3) with a rock bolt (2) drilled into rock formations to stabilize said rock formations, said rock bolt (2) being securable into a region defined by an axial bore hole (4) and having a longitudinally extending linear shank body (5) with a bore hole end (6) and a rock face end (7), said bore hole end (6) being fixable furthest within the rock formation, said rock bolt (2) further comprising a planar surface bearing plate (8) bearing against the rock face (3) with a circular outline being placed flush with the opening of the axial bore hole (4).

[0021] In one embodiment of the present invention, said bearing plate (8) comprises a lateral surface (9) along the circular periphery thereof, configured to be inclined with regard to the axial direction of the rock bolt (2) so as to form a right circular truncated cone. This

arrangement advantageously produces an annular groove between the lateral surface (9) and the rock face (3) such that it is possible to observe in which portions of the annular line the rock face (3) move and crash into each other to fill the groove.

[0022] In a further embodiment of the present invention, a first circular surface of the truncated cone bears against the rock face (3) and a second circular surface of the truncated cone is closer to the rock face end (7) of the rock bolt (2), said first circular surface being smaller than said second larger circular surface. Therefore formation of the annular groove between the lateral surface (9) and the rock face (3) is ensured.

[0023] In a still further embodiment of the present invention, angle of the lateral surface (9) between said small and large circular surfaces of the truncated cone is about 30 degrees. It is established that the amount of inclination as determined is critical to provide both a satisfactory observation effect and a large enough groove to adjacent to rock formations.

[0024] In a yet still further embodiment of the present invention, a spherical washer (10) abuts a bearing plate dome (17) adjacent to said large circular surface of the truncated cone. This ensures a more durable and sturdy structure by which the bearing plate dome (17) and the truncated cone are fixedly secured against the rock face (3).

[0025] In a yet still further embodiment of the present invention, said spherical washer (10) is welded to the rock bolt (2) at a welded region (16) to be in abutment with said bearing plate dome (17) adjacent to or proximate said large circular surface of the truncated cone.

[0026] In a yet still further embodiment of the present invention, said rock bolt (2) comprises a threaded portion (15) spaced apart from said welded region (16). The fact that the threaded portion (15) is spaced apart from the welded region (16) improves mechanical durability as no threaded parts are employed for effecting connection of the spherical washer (10).

[0027] In a yet still further embodiment of the present invention, a fastening means (11) is connectable with the rock bolt (2) to be matingly threaded into firm engagement with the threaded portion (15).

[0028] In a yet still further embodiment of the present invention, said rock bolt (2) is made from mild steel or a metal alloy.

[0029] In a yet still further embodiment of the present invention, said rock bolt (2) has a tubular-form shaft with a ribbed shaft wall (12) to have an engagement relationship between ribs and a resinous and/or cementitious material being injectable in the axial bore hole (4).

[0030] In a yet still further embodiment of the present invention, the rock bolt (2) comprises a plurality of retaining means (13), each welded onto the shank body (5) with an outward-biased structure, whereby anchoring of the rock bolt (2) in the axial bore hole (4) is provided.

[0031] In a yet still further embodiment of the present invention, the retaining means (13) are configured as elongate strips of metal plate welded onto the shank body (5) at one transverse edge thereof with a predetermined orientation with respect to the longitudinal axis of the rock bolt (2).

[0032] In a yet still further embodiment of the present invention, the rock bolt (2) comprises at least a pair of annularly equally-spaced retaining means (13) forming an arrow-shaped rock bolt (2) structure, each retaining means (13) with the same predetermined orientation. The annularly equally-spaced structure and the resulting specific arrow shape improve balance and retention effect of the rock bolt (2) in the axial bore hole (4).

[0033] In a yet still further embodiment of the present invention, the rock bolt (2) comprises a plurality of retainer means (13) pairs being spaced apart longitudinally along the axial direction of the rock bolt (2). This improves retention effect even further.

[0034] In a yet still further embodiment of the present invention, separate pairs of retainer means (13) being longitudinally spaced apart have different predetermined orientations. This feature advantageously provides that a rock bolt (2) with specific engagement characteristics peculiar to the structural nature of the axial bore hole (4) can be manufactured. In other words, the rock bolt (2) will better fit in to the axial bore hole's (4) longitudinally changing inner diameter.

[0035] In a yet still further embodiment of the present invention, said rock bolt (2) has an inclined bore hole end-surface (14).

Claims

1. A rock anchoring system (1) to reinforce a rock face (3) with a rock bolt (2) drilled into rock formations to stabilize said rock formations, said rock bolt (2) being securable into a region defined by an axial bore hole (4) and having a longitudinally extending linear shank body (5) with a bore hole end (6) and a rock face end (7), said bore hole end (6) being fixable furthest within the rock formation, said rock bolt (2) further comprising a planar surface bearing plate (8) bearing against the rock face (3) with a circular outline being placed flush with the opening of the axial bore hole (4) **characterized in that**;
said bearing plate (8) comprises a lateral surface (9) along the circular periphery thereof, configured to be inclined with regard to the axial direction of the rock bolt (2) so as to form a right circular truncated cone.

2. A rock anchoring system (1) as set forth in Claim 1, **characterized in that** a first circular surface of the truncated cone bears against the rock face (3) and a second circular surface of the truncated cone is closer to the rock face end (7) of the rock bolt (2), said first circular surface being smaller than said second larger circular surface.

3. A rock anchoring system (1) as set forth in Claim 2, **characterized in that** angle of the lateral surface (9) between said small and large circular surfaces of the truncated cone is about 30 degrees.

4. A rock anchoring system (1) as set forth in Claim 2 or 3, **characterized in that** a spherical washer (10) abuts a bearing plate dome (17) adjacent to said large circular surface of the truncated cone.

5. A rock anchoring system (1) as set forth in Claim 4, **characterized in that** said spherical washer (10) is welded to the rock bolt (2) at a welded region (16) to be in abutment with said bearing plate dome (17) adjacent to said large circular surface of the truncated cone.

6. A rock anchoring system (1) as set forth in Claim 5, **characterized in that** said rock bolt (2) comprises a threaded portion (15) spaced apart from said welded region (16).

7. A rock anchoring system (1) as set forth in Claim 6, **characterized in that** a fastening means (11) is connectable with the rock bolt (2) to be matingly threaded into firm engagement with the threaded portion (15).

8. A rock anchoring system (1) as set forth in any preceding Claims, **characterized in that** said rock bolt (2) is made from mild steel or a metal alloy.

9. A rock anchoring system (1) as set forth in Claim 1, 2, 4 or 6, **characterized in that** said rock bolt (2) has a tubular-form shaft with a ribbed shaft wall (12) to have an engagement relationship between ribs and a resinous/cementitious material being injectable in the axial bore hole (4).

10. A rock anchoring system (1) as set forth in Claim 1, 2, 4 or 6, **characterized in that** the rock bolt (2) comprises a plurality of retaining means (13), each welded onto the shank body (5) with an outward-biased structure, whereby anchoring of the rock bolt (2) in the axial bore hole (4) is provided.

11. A rock anchoring system (1) as set forth in Claim 10, **characterized in that** the retaining means (13) are configured as elongate strips of metal plate welded onto the shank body (5) at one transverse edge thereof with a predetermined orientation with respect to the longitudinal axis of the rock bolt (2).

12. A rock anchoring system (1) as set forth in Claim 11, **characterized in that** the rock bolt (2) comprises at least a pair of annularly equally-spaced retaining means (13) forming an arrow-shaped rock bolt (2) structure, each retaining means (13) with the same predetermined orientation.

13. A rock anchoring system (1) as set forth in Claim 12, **characterized in that** the rock bolt (2) comprises a plurality of retainer means (13) pairs being spaced apart longitudinally along the axial direction of the rock bolt (2).

14. A rock anchoring system (1) as set forth in Claim 13, **characterized in that** separate pairs of retainer means (13) being longitudinally spaced apart have different predetermined orientations.

15. A rock anchoring system (1) as set forth in in any preceding Claims, **characterized in that** said rock bolt (2) has an inclined bore hole end-surface (14).

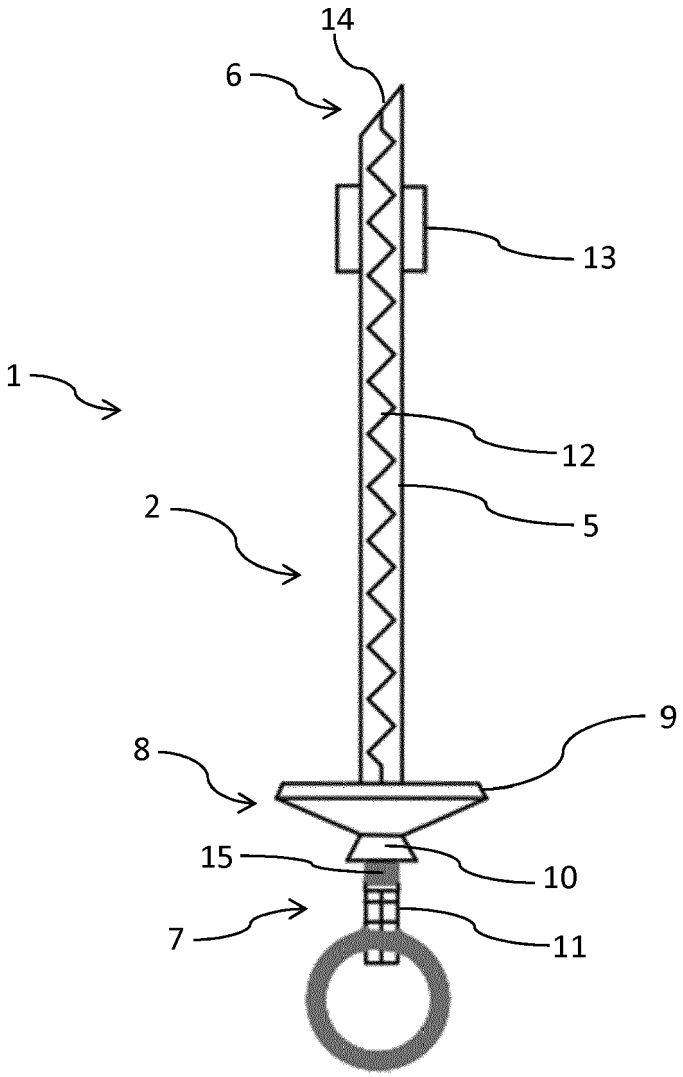

Fig. 1

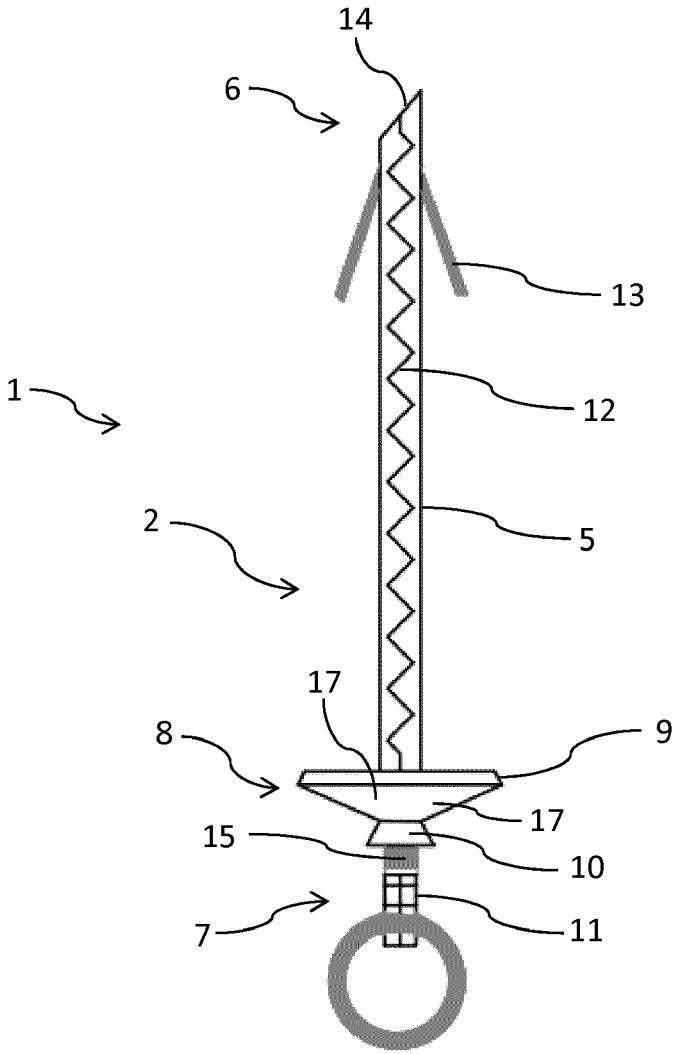

Fig. 2

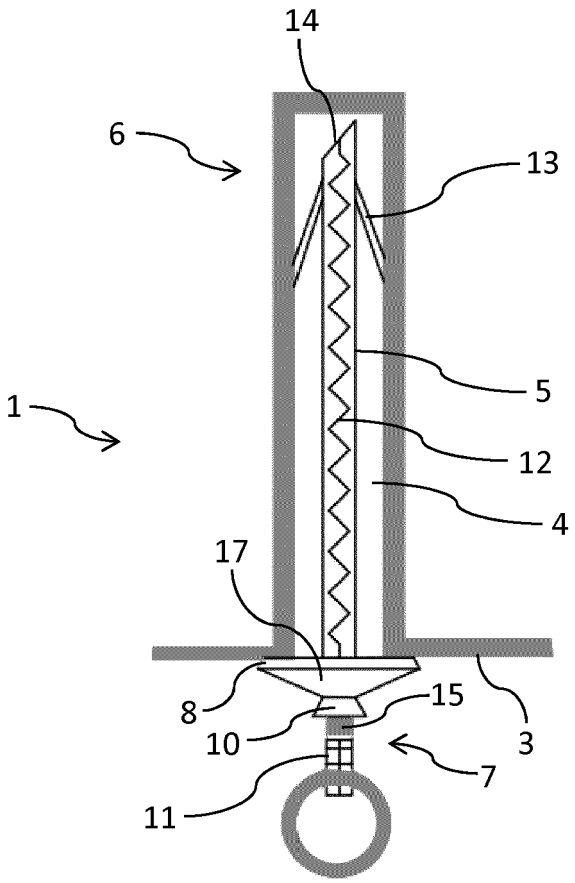

Fig. 3

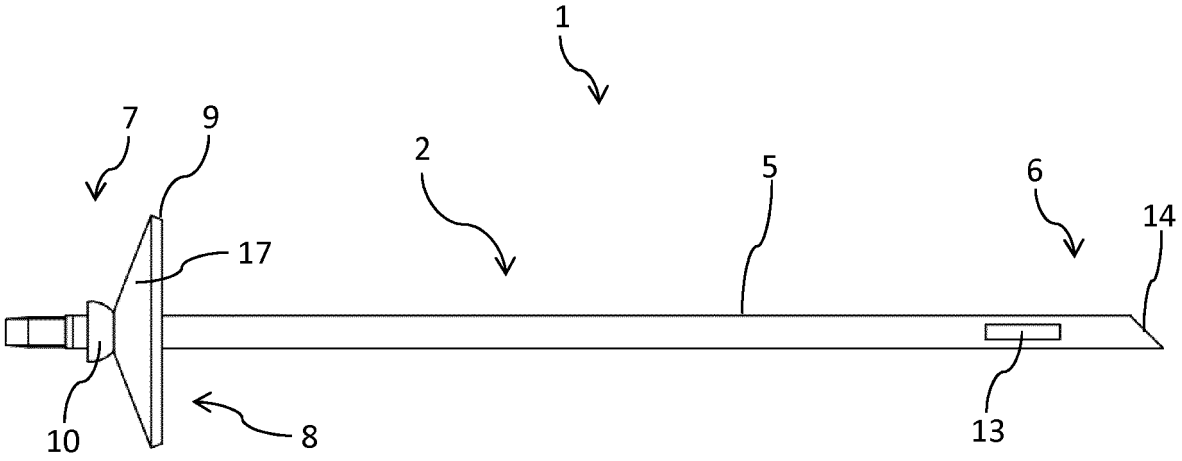

Fig. 4a

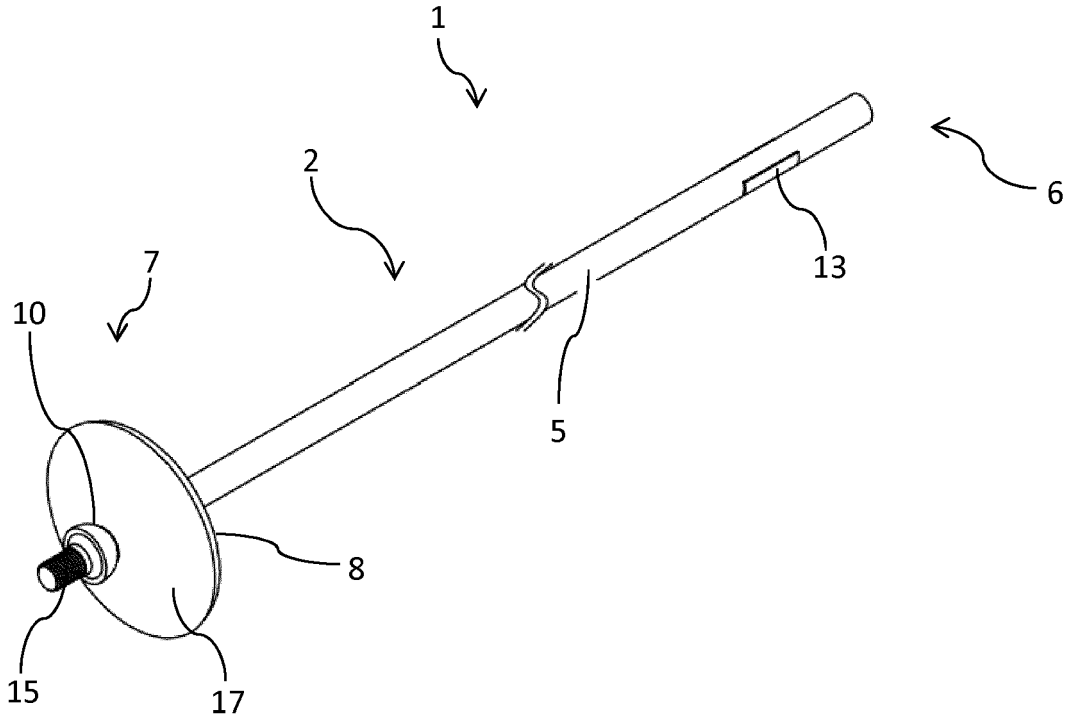

Fig. 4b

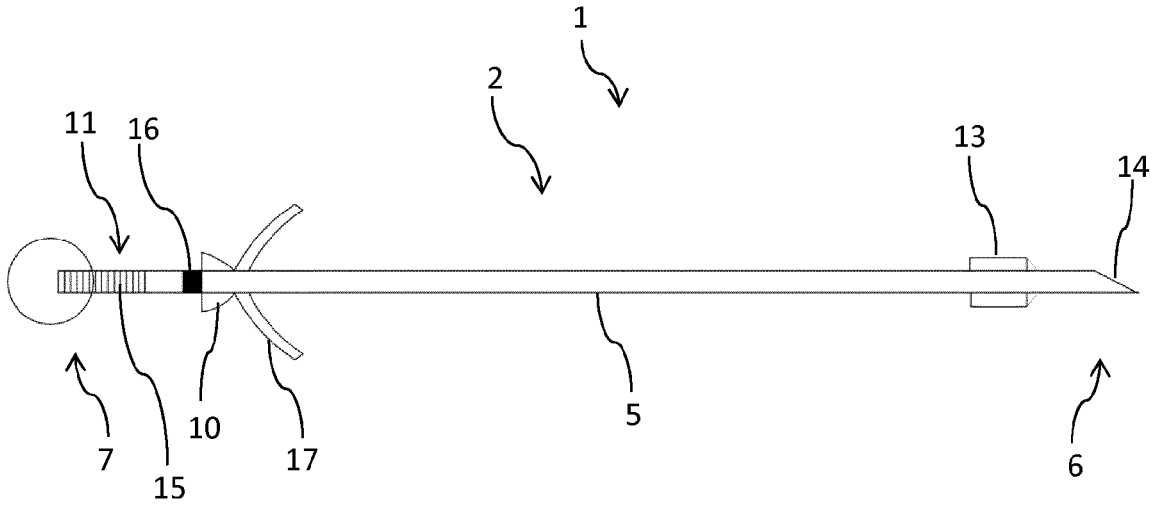

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 6350

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 00/00718 A1 (SIKA AG [CH]; BLEIBLER ALEXANDER [CH]; SCHUEMPERLI ERNESTO [CH]) 6 January 2000 (2000-01-06) * figure 1 *	1-4,6-9, 15 5,10-12	INV. E21D21/00 E21D21/02
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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
The Hague	12 March 2015	Dantinne, Patrick

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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