

(19)



(11)

EP 3 966 429 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

03.07.2024 Bulletin 2024/27

(21) Application number: **20801528.9**

(22) Date of filing: **06.05.2020**

(51) International Patent Classification (IPC):
E21D 21/00^(2006.01)

(52) Cooperative Patent Classification (CPC):
E21D 21/00; E21D 21/004; E21D 21/0073

(86) International application number:
PCT/IB2020/054269

(87) International publication number:
WO 2020/225735 (12.11.2020 Gazette 2020/46)

(54) **AN INFLATABLE ROCK BOLT**

AUFBLASBARER GEBIRGSANKER

BOULON D'ANCRAGE GONFLABLE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **06.05.2019 ZA 201902816**

(43) Date of publication of application:
16.03.2022 Bulletin 2022/11

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WO-A1-90/04085 WO-A1-2017/025933

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Description**FIELD OF THE INVENTION**

[0001] The invention relates to an inflatable rock bolt of the kind that includes a sealed tubular (metal pipe) body formed with at least one longitudinal fold to provide a reduced and substantially circular cross-sectional profile for insertion into a drill hole and to, in use, be expanded into frictional engagement with a wall of the drill hole by introducing a pressurised fluid into an interior of the body.

BACKGROUND TO THE INVENTION

[0002] These inflatable rock bolts generally have a sealed tube with a longitudinal channel formed by a fold, which reduces the cross-sectional dimension of the tube (sufficiently for the required purpose). A check valve at one end remains outside a drill hole into which the rock bolt is inserted and allows the tube to be inflated or expanded. The pressurised fluid is usually water. On expansion of the body through outward deformation of the fold, the surface of the tube engages in the hole.

[0003] An improved version of such a rock bolt is disclosed in PCT/2016/053817 and PCT/2016/054864. The first of these two International applications teaches a beneficial construction of what is preferably an inner end of the rock bolt.

[0004] WO2017025933 A1 discloses an inflatable rock bolt according to the preamble of claim 1 and a method of making an inflatable rock bolt according to the preamble of claim 7.

OBJECT OF THE INVENTION

[0005] It is an object of the present invention to provide an inflatable rock bolt with a sealed inner end having a configuration that provides improved durability to the stress placed on the folded regions of material during the expansion operation in use.

SUMMARY OF THE INVENTION

[0006] In accordance with a first aspect of the invention, there is provided an inflatable rock bolt comprising:

- a pipe with a cap welded in sealing engagement onto an end of the pipe in a pre-formed condition;
- the cap having a sidewall that extends from a rim of the cap to a closed end provided by an end wall of the cap;
- the rock bolt provided with a fold formed from a first side of the rock bolt and extending along a length of the pipe;
- a bottom of the fold located adjacent an opposite, second side of the rock bolt where it extends along the length of the pipe;

characterised in that

the bottom of the fold extending from the pipe into the sidewall of the cap and outwardly towards the first side of the rock bolt to a position separated by a ridge from a first portion of the end wall that remains outside the fold, with a second portion of the end wall drawn into the fold; and

the ridge extends from a front of the rock bolt as a substantially U-shaped ridge formed around the fold at the cap of the rock bolt, with an edge of the ridge located on the first side relative to an axis of the pipe as it exists in a pre-formed condition of the pipe.

[0007] The invention provides for the second portion of the end wall to be arranged at a forward region of the fold with the first portion of the end wall in an oppositely disposed position at a front of the rock bolt.

[0008] The invention further provides for a rock bolt as defined, in which:

a greater portion of the end wall of the cap to be maintained substantially in a pre-formed condition as the first portion with an adjacent lesser portion curved rearwardly and pressed toward the fold as the second portion.

[0009] The invention still further provides for a rock bolt as defined, in which:

the closed end of the cap is pressed outwardly in line with the fold where it is formed into a forward most section of the U-shaped ridge;

the end wall of the cap transitions from the sidewall uniformly through a curve to the closed end of the cap which is substantially flat [relative to the transition curve]; and

the sidewall of the cap includes a substantially cylindrical region at the rim that locates with a press-fit into the pre-formed pipe.

[0010] In accordance with a second aspect of the invention, there is provided a method of making an inflatable rock bolt which includes the steps of:

providing a length of pre-formed pipe with at least one open end, welding a cap to the open end, and thereafter deforming the pipe and the cap into a folded form to provide a fold that extends along the pipe, characterised in that the fold is formed by a tool that is sized with a working edge that stops sufficiently short of an end wall at a closed end of the cap to:

- maintain a first portion of the end wall that is in line with the fold on an outside of the fold; and
- draw a second portion of the end wall in a curve rearwardly toward and into the fold.
- provide a substantially U-shaped ridge that extends from a front of the rock bolt around the fold at the cap with an edge of the ridge located to one side of an axis of the pipe as it exists in a pre-formed condition of the pipe.

[0011] The invention still further provides for a method as defined, in which:

the fold is formed with the first portion as a greater portion of the end wall and the second portion as a lesser portion of the end wall; and
the rock bolt is pressed closed around the fold in a second forming operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] These and other features of the invention will become more apparent from the following description of a preferred embodiment, made by way of example only, with reference to the accompanying illustrations, in which:

- Figure 1 shows three inner ends of pre-formed, intermediate and final formed rock bolts from a position facing the fold;
Figure 2 shows a perspective view of the intermediate and final formed rock bolts;
Figure 3 shows a side view of the rock bolt ends in Figure 2 from a position lateral to the fold; and
Figure 4 shows the pre-formed and final formed rock bolt ends marked with an axis of the pre-formed rock bolt.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] Referring to the accompanying drawings, a rock bolt (1) having a cap (2) at an inner end manufactured in accordance with the invention is shown. The rock bolt (1) is illustrated in progressive forming conditions labelled as follows in the Figures:

- "A" pre-formed condition;
"B" intermediate condition; and
"C" formed condition.

[0014] The rock bolt (1) is made from a length of pipe (3) initially having a circular cross-section in the pre-formed condition. The pipe (3) is made from a suitable metal. The cap (2) is used to seal an open end of the pipe (3) that will be located inside a drilled rock bolt hole (not shown). It is only this inner end of the rock bolt (1) that is shown in the Figures.

[0015] The construction and components used at the opposite, outer end of the rock bolt (1) may be varied and will be within the understanding of a person skilled in the art. Examples are set out in the second of the two PCT applications referred to in the "Background" above.

[0016] The cap (2) is fabricated from a suitably ductile metal and has a sidewall or skirt (5) that extends from a rim (not shown) of the cap (2) to a closed end (6). The sidewall (5) extends forwardly from the pipe (3) with a slight inward taper. The closed end of the cap (2) in this

embodiment is substantially flat and provides an end wall (7) to the front of the sidewall (5). The end wall (7) transitions substantially uniformly through a curve at an annular outer region from the sidewall (5) and into a central region of the closed end (6) which is, in this embodiment, substantially flattened (relative to the transition curve).

[0017] The sidewall (5) of the cap (2) has an outer diameter on a substantially cylindrical region at the rim (not shown). This short region (not shown) of the sidewall (5) adjacent the rim is provided with a substantially parallel wall for press-fitting with a friction or interference fit into the pre-formed pipe (3). The pipe (3) with the cap (2) so fitted is shown as "A" in Figure 1. It will then be welded (8) at a junction along an edge at the end of the pipe (3). By securing the cap (2) to the pipe (3) in this manner the open and operatively inner end of the rock bolt (1) is sealed.

[0018] Once the cap (2) is welded in place, the pre-formed rock bolt is subjected to a subsequent metalworking process, in which the pipe (3) and the cap (2) are formed into an intermediate condition of the rock bolt (1) with convoluted or folded shape as shown as "B" in Figures 1, 2, and 3. The configuration referred to involves an initial, first step of press-forming the longitudinal fold or channel (9) to reduce the cross-sectional dimension of a post-formed rock bolt (1) shown as "C" in Figures 1, 2 and 3.

[0019] In accordance with the invention, the fold (9) is formed from a first side "x" of the rock bolt (1) and extending along a length of the pipe (3). A bottom (10) of the fold (9) located adjacent an opposite, second side "y" of the rock bolt (1) where it extends along the length of the pipe (3).

[0020] The fold (9) is formed so that the bottom (10) extends from the pipe (3) into the sidewall (5) and with a concave curve into a forward region (11) outwardly towards the first side "x" of the rock bolt (1) to a position separated by a front region of a U-shaped ridge (12) from a first portion (13) of the end wall (7) that remains outside the fold (9), with a second portion (14) of the end wall (7) drawn toward and/or into the forward region (11) of the fold (9).

[0021] In the current embodiment, a greater portion of the end wall (7) is maintained substantially in a pre-formed condition [apart from being pressed slightly forwardly in the forming of a front of the U-shaped ridge (12)] as the first portion (13) with an adjacent lesser portion of the end wall (7) curved rearwardly and pressed toward and/or into the fold (9) as the second portion (14).

[0022] After the welding has been completed the pipe (3) and cap (2) still have a circular outline or profile in cross-section. In the first forming step, the pipe (3) and cap (2) assembly is placed in a trough-shaped cavity of a first die. A pressing tool in a hydraulic press is then used to deform the pipe (3) and cap (2) assembly into the intermediate condition, which is accompanied by some lateral bulging or outward distortion to either side of the fold as well as the forward displacement of the end

wall (7) where the U-shaped ridge (12) takes form.

[0023] The tool is in the shape of an elongate blade with a straight working edge (parallel to the pipe) that is curved between two planar sides. In use, the working edge directly contacts the outer surface of the pipe (3) and cap (2) assembly. The first die is supported in a hydraulic press that is used to bias the tool into engagement with the outer surface of the pipe. The tool deforms the pipe (3) and cap (2) assembly radially inwardly to form the relatively deep fold or channel (9) as shown.

[0024] In accordance with previous versions of the rock bolt, a fold was formed to extend through the cap and past its closed end to reduce the profile of the cap in line with the forming process to which the length of pipe was subjected.

[0025] The modification which brings about the current invention involves, in the first forming operation, the use of a tool that is sized with a folding or working edge that stops sufficiently short of the closed end (6) of the cap (2). At the relevant end which locates over the cap (2), the tool will be radiused from the working edge (which is provided parallel to the pipe) to an end of the tool that is perpendicular to or inclined away from the working edge. It is this radiused portion of the tool that is pressed down in the required position to form the fold in the cap (2).

[0026] It follows that the pre-formed rock bolt needs to be placed in a predetermined position in the hydraulic press so that the fold is formed by the pressing tool with the upwardly curved or radiused end of the working edge located to stop short of the closed end (6) of the cap (2). The arrangement avoids providing a lateral compression force that would act in line with the material across the cap end wall (7) and particularly in the central flat region thereof. Instead, the tool engages the cap of pre-formed rock bolt where a lateral bending force can be applied to the sidewall (5).

[0027] The forming process of the invention provides for the following features:

- A substantially U-shaped ridge (12) is formed around the fold (9) at the cap (2) of the rock bolt (1) - see "B" and "C" in Figure 1;
- A greater, first portion (13) of the end wall (7) that is in line with the fold (9) is maintained substantially in a pre-formed condition and outside of the fold (9) with an adjacent lesser, second portion (14) formed rearwardly and pressed toward and/or into the fold (9) - see "B" and "C" Figure 3; and
- An edge "e" of the ridge (12) is located to the first side "x" of an axis "a" of the pipe (3) as it exists in a pre-formed condition of the pipe (3). This is shown as "A" and "C" in the comparison of Figure 4.

[0028] In the result, the second portion (14) of the end wall is arranged at the forward region (11) of the fold (9) with the first portion (13) of the end wall in an oppositely disposed position at the front of the rock bolt (1) on an outside of the fold (9). The section at the bottom of the

"U" of the U-shaped ridge (12) separates the first portion (13) from the second portion (14) of the end wall.

[0029] The forces exerted by the tool in the first forming step are such that when the fold (9) is formed, the outer surface of the pipe (3) and cap (2) assembly is no longer generally of circular form. The rock bolt (1) in intermediate form is then subjected to a second step of the forming process. This operation involves placing the rock bolt (1) into a second die set which includes upper and lower dies that together define an elongate die cavity of circular cross-section and which locates over the pipe (3) and the cap (2). The second die set is closed using hydraulic pressure with the intermediate condition rock bolt in the die cavity. In the result, a rock bolt is formed with a body that, except for the fold (9), has a substantially circular axial profile. This configuration of the finished product (post-formed rock bolt) is suited for insertion into a round drill hole and presents further capacity for expansion over the intermediate form.

[0030] The cap (2) remains connected with leak-proof seal provided by the weld to the pipe (3). The pipe (3) then has an elongate longitudinally extending channel (9) which extends into a region occupied by the sidewall (5) of the cap (2).

[0031] In the second forming operation, the rock bolt (1) is pressed closed around the fold (9). The post-formed rock bolt shown "C" in Figures 1, 2, 3 and 4 is thus formed with the fold (9) having a substantially closed or abutting configuration where it extends along the majority of the pipe length. This is not the case in the region of the cap (2) as illustrated in the drawings of the current embodiment. The outer diameter of the cap (2) is smaller than that of the pipe (3) into which it fits and is welded in place. In the first forming step, the material in the region of the cap (2) inside of the fold (9) is pressed close to an outside of portion of the cap (2) around the fold (9) at and around the second side "y" of the rock bolt (1). When the two dies of the set are closed onto the rock bolt (1) in the second forming step, the cap is not closed over the fold to the same extent as the larger diameter pipe wall.

[0032] In use, the rock bolt is inserted into a drill hole and expanded from a formed, folded condition towards a pre-formed condition, wherein the fully pre-formed condition represents a (substantially) maximal expansion which is in excess of that required for the rock bolt to engage in the drill hole. In practice, the wall of the drill hole is usually engaged with the rock bolt resembling the intermediate condition shown as "B" in Figures 1, 2 and 3. In situ conditions and the particular embodiment of the rock bolt used will determine the form that the expanded rock bolt takes.

[0033] The configuration of the cap formed in the manner illustrated and described serves to provide a configuration that involves folded regions of material that afford improved durability to the stress placed on the material in those regions during expansion of the rock bolt.

[0034] The forming process involves a smaller component of lateral compression in the region of the end wall

of the cap. The majority of the deformation involves bending of the sidewall of the cap (similar to the sidewall of the pipe). The sidewall of the cap is more suitably arranged to accommodate bending than the end wall which has a large component of material provided substantially at a right angle to the pressing tool. The bending at the end wall of the cap involves having the material pressed or drawn by the pressing tool, rearwardly towards and/or into the fold to form the substantially U-shaped ridge around the front of the rock bolt.

[0035] This folded configuration has been found to mitigate weakening of the material in the cap around the fold or folded regions and deter against any leaks forming when the rock bolt is expanded.

[0036] The terms used to describe the forming of the components and the cap sidewall and end wall are indicative and/or instructive of the process and components. These terms and description will be understood by a person suitably skilled in the art and will allow the invention to be implemented as a modification or improvement over the teaching of PCT/IB2016/053817.

[0037] While the invention is described and illustrated with respect to a configuration having a single fold providing the longitudinal channel for the reduced dimension of the rock bolt, it may also be employed where more than one such channel is formed along the pipe.

[0038] The capped and folded configuration of a rock bolt end in accordance with the invention is particularly suited for the inner or leading end of a rock bolt that is, in use, located into and towards the bottom of a drilled hole. This is not however a limitation and the invention may well be employed at both ends of a rock bolt. A pressurised fluid inlet may be provided through the wall of the pipe adjacent the outer end that protrudes from the drill hole.

[0039] A person skilled in the art will appreciate that a number of variations may be made to the features of the embodiments described without departing from the scope of the invention, as set out in the appended claims.

Claims

1. An inflatable rock bolt (1) comprising:

a pipe (3) with a cap (2) welded in sealing engagement onto an end of the pipe in a pre-formed condition;

the cap (2) having a sidewall (5) that extends from a rim of the cap to a closed end (6) provided by an end wall (7) of the cap;

the rock bolt provided with a fold (9) formed from a first side of the rock bolt and extending along a length of the pipe; and

a bottom (10) of the fold located adjacent an opposite, second side of the rock bolt where it extends along the length of the pipe;

characterised in that

the bottom of the fold extends from the pipe into the sidewall of the cap and outwardly towards the first side of the rock bolt to a position separated by a ridge (12) from a first portion (13) of the end wall that remains outside the fold, with a second portion (14) of the end wall drawn into the fold and

the ridge extends from a front of the rock bolt as a substantially U-shaped ridge formed around the fold at the cap of the rock bolt, with an edge of the ridge located on the first side relative to an axis of the pipe as it exists in a pre-formed condition of the pipe.

2. A rock bolt (1) as claimed in claim 1, in which the second portion (14) of the end wall is arranged at a forward region (11) of the fold with the first portion (13) of the end wall in an oppositely disposed position at a front of the rock bolt.

3. A rock bolt (1) as claimed in claim 1, in which the closed end (6) of the cap is pressed outwardly in line with the fold where it is formed into a forward most section of the U-shaped ridge.

4. A rock bolt (1) as claimed in claim 1, in which the end wall (7) of the cap transitions from the sidewall uniformly through a curve to the closed end of the cap which is substantially flat.

5. A rock bolt (1) as claimed in claim 1, in which the sidewall (5) of the cap includes a substantially cylindrical region at the rim that locates with a press-fit into the pre-formed pipe.

6. A rock bolt (1) as claimed in claim 1, in which a greater portion of the end wall (7) of the cap to be maintained substantially in a pre-formed condition as the first portion (13) with an adjacent lesser portion curved rearwardly and pressed toward the fold as the second portion (14).

7. A method of making an inflatable rock bolt (1) which includes the steps of

providing a length of pre-formed pipe (3) with at least one open end welding a cap (2) to the open end, and

thereafter deforming the pipe and the cap into a folded form to provide a fold (9) that extends along the pipe,

characterised in that the fold is formed by a tool that is sized with a working edge that stops sufficiently short of an end wall (7) at a closed end of the cap to:

- maintain a first portion (13) of the end wall that is in line with the fold on an outside of the fold; and
 - draw a second portion (14) of the end wall in a curve rearwardly toward and into the fold
 - wherein the fold is formed to provide a substantially U-shaped ridge (12) that extends from a front of the rock bolt around the fold at the cap with an edge of the ridge located to one side of an axis of the pipe as it exists in a pre-formed condition of the pipe.
8. A method as claimed in claim 7, in which the fold (9) is formed with the first portion as a greater portion of the end wall and the second portion as a lesser portion of the end wall.
9. A method as claimed in claim 7, in which the rock bolt is pressed closed around the fold (9) in a second forming operation.

Patentansprüche

1. Aufblasbarer Felsanker, umfassend:

ein Rohr mit einer Kappe, die in einem vorgeformten Zustand dichtend an einem Ende des Rohrs angeschweißt ist;
 wobei die Kappe eine Seitenwand aufweist, die sich von einem Rand der Kappe bis zu einem geschlossenen Ende erstreckt, das durch eine Endwand der Kappe bereitgestellt wird;
 wobei der Felsanker mit einer Falte bereitgestellt ist, die von einer ersten Seite des Felsankers gebildet ist und sich entlang einer Länge des Rohrs erstreckt; und
 einen Boden der Falte, der neben einer gegenüberliegenden zweiten Seite des Felsankers angeordnet ist, wo er sich entlang der Rohrlänge erstreckt;

dadurch gekennzeichnet, dass

der Boden der Falte sich vom Rohr in die Seitenwand der Kappe und nach außen zur ersten Seite des Felsankers bis zu einer Position erstreckt, die durch einen Steg von einem ersten Abschnitt der Endwand getrennt ist, die außerhalb der Falte bleibt, wobei ein zweiter Abschnitt der Endwand in die Falte hineingezogen wird; und
 der Steg sich von einer Vorderseite des Felsankers als ein im Wesentlichen U-förmiger Steg erstreckt, der um die Falte an der Kappe des Felsankers geformt ist, wobei eine Kante des Stegs auf der ersten Seite relativ zu einer Achse des Rohrs ange-

ordnet ist, wie sie in einem vorgeformten Zustand des Rohrs vorliegt.

2. Felsanker nach Anspruch 1, bei dem der zweite Abschnitt der Endwand an einem vorderen Bereich der Falte angeordnet ist, wobei der erste Abschnitt der Endwand in einer gegenüberliegenden Position an einer Vorderseite des Felsankers angeordnet ist.
3. Felsanker nach Anspruch 1, bei dem das geschlossene Ende der Kappe entlang der Falte nach außen gedrückt wird, wo es in einen vordersten Abschnitt des U-förmigen Stegs geformt wird.
4. Felsanker nach Anspruch 1, bei dem die Endwand der Kappe von der Seitenwand gleichmäßig durch eine Kurve zum geschlossenen Ende der Kappe übergeht, die im Wesentlichen flach ist.
5. Felsanker nach Anspruch 1, bei dem die Seitenwand der Kappe einen im Wesentlichen zylindrischen Bereich am Rand umfasst, der mit einer Presspassung in das vorgeformte Rohr eingreift.
6. Felsanker nach Anspruch 1, bei dem ein größerer Abschnitt der Endwand der Kappe im Wesentlichen in einem vorgeformten Zustand als der erste Abschnitt gehalten werden soll, wobei ein benachbarter kleinerer Abschnitt als der zweite Abschnitt nach hinten gebogen und in Richtung der Falte gedrückt wird.
7. Verfahren zur Herstellung eines aufblasbaren Felsankers, das die folgenden Schritte umfasst:
- Bereitstellen einer vorgeformten Rohrlänge mit mindestens einem offenen Ende,
 Anschweißen einer Kappe an das offene Ende, und
 anschließendes Verformen des Rohrs und der Kappe in eine gefaltete Form, um eine Falte bereitzustellen, die sich entlang des Rohrs erstreckt,
dadurch gekennzeichnet, dass die Falte durch ein Werkzeug gebildet wird, dessen Arbeitskante ausreichend kurz vor einer Endwand an einem geschlossenen Ende der Kappe endet, um:
- einen ersten Abschnitt der Endwand, der mit der Falte auf einer Außenseite der Falte ausgerichtet ist, aufrechtzuerhalten; und
 - einen zweiten Abschnitt der Endwand in einer Kurve nach hinten in Richtung und in die Falte zu ziehen
 - wobei die Falte geformt ist, um einen im Wesentlichen U-förmigen Steg bereitzustellen, der sich von einer Vorderseite des Felsankers um die Falte an der Kappe he-

rum erstreckt, wobei eine Kante des Stegs auf einer Seite einer Achse des Rohrs angeordnet ist, wie sie in einem vorgeformten Zustand des Rohrs vorliegt.

8. Verfahren nach Anspruch 7, bei dem die Falte mit dem ersten Abschnitt als größeren Abschnitt der Endwand und dem zweiten Teil als kleineren Teil der Endwand geformt wird.
9. Verfahren nach Anspruch 7, bei dem der Felsanker in einem zweiten Umformprozess um die Falte herum zugedrückt wird.

Revendications

1. Un boulon d'ancrage gonflable (1) comprenant :

un tuyau (3) avec un capuchon (2) soudé en prise étanche sur une extrémité du tuyau dans un état préformé,

le capuchon (2) possédant une paroi latérale (5) qui s'étend à partir d'un rebord du capuchon vers une extrémité fermée (6) fournie par une paroi d'extrémité (7) du capuchon,

le boulon d'ancrage étant muni d'un pli (9) formé à partir d'un premier côté du boulon d'ancrage et s'étendant le long d'une longueur du tuyau, et une partie inférieure (10) du pli étant située adjacente à un deuxième côté opposé du boulon d'ancrage lorsqu'il s'étend le long de la longueur du tuyau,

caractérisé en ce que

la partie inférieure du pli s'étend du tuyau vers la paroi latérale du capuchon et vers l'extérieur vers le premier côté du boulon d'ancrage vers une position séparée par une crête (12) d'une première partie (13) de la paroi d'extrémité qui demeure à l'extérieur du pli, avec une deuxième partie (14) de la paroi d'extrémité tirée dans le pli, et la crête s'étend à partir d'une partie avant du boulon d'ancrage sous la forme d'une crête sensiblement en forme de U formée autour du pli au niveau du capuchon du boulon d'ancrage, avec un bord de la crête situé sur le premier côté par rapport à un axe du tuyau tel qu'il existe dans un état préformé du tuyau.

2. Un boulon d'ancrage (1) selon la Revendication 1, dans lequel la deuxième partie (14) de la paroi d'extrémité est agencée au niveau d'une zone avant (11) du pli avec la première partie (13) de la paroi d'extrémité dans une position disposée de manière opposée au niveau d'une partie avant du boulon d'an-

crage.

3. Un boulon d'ancrage (1) selon la Revendication 1, dans lequel l'extrémité fermée (6) du capuchon est pressée vers l'extérieur en ligne avec le pli lorsqu'il est formé dans une section la plus en avant de la crête en forme de U.

4. Un boulon d'ancrage (1) selon la Revendication 1, dans lequel la paroi d'extrémité (7) du capuchon effectue une transition à partir de la paroi latérale uniformément au travers d'une courbe vers l'extrémité fermée du capuchon qui est sensiblement plate.

5. Un boulon d'ancrage (1) selon la Revendication 1, dans lequel la paroi latérale (5) du capuchon comprend une zone sensiblement cylindrique au niveau du rebord qui comporte un ajustement serré vers le tuyau préformé.

6. Un boulon d'ancrage (1) selon la Revendication 1, dans lequel une plus grande partie de la paroi d'extrémité (7) du capuchon est à maintenir sensiblement dans un état préformé en tant que première partie (13) avec une plus petite partie adjacente incurvée vers l'arrière et pressée vers le pli en tant que deuxième partie (14).

7. Un procédé de fabrication d'un boulon d'ancrage gonflable (1) qui comprend les opérations suivantes :

la fourniture d'un longueur de tuyau préformé (3) avec au moins une extrémité ouverte, la soudure d'un capuchon (2) à l'extrémité ouverte, et

ensuite la déformation du tuyau et du capuchon en une forme pliée de façon à fournir un pli (9) qui s'étend le long du tuyau,

caractérisé en ce que le pli est formé par un outil qui est dimensionné avec un bord de travail qui s'arrête suffisamment proche d'une paroi d'extrémité (7) au niveau d'une extrémité fermée du capuchon de façon à :

- maintenir une première partie (13) de la paroi d'extrémité qui est en ligne avec le pli sur une partie extérieure de du pli, et

- tirer une deuxième partie (14) de la paroi d'extrémité dans une courbe vers l'arrière vers et dans le pli,

- où le pli est formé de façon à fournir une crête sensiblement en forme de U (12) qui s'étend à partir d'une partie avant du boulon d'ancrage autour du pli au niveau du capuchon avec un bord de la crête situé sur un côté d'un axe du tuyau tel qu'il existe dans un état préformé du tuyau.

8. Un procédé selon la Revendication 7, dans lequel le pli (9) est formé avec la première partie en tant que plus grande partie de la paroi d'extrémité et la deuxième partie en tant que plus petite partie de la paroi d'extrémité. 5
9. Un procédé selon la Revendication 7, dans lequel le boulon d'ancrage est pressé fermé autour du pli dans une deuxième opération de formation. 10

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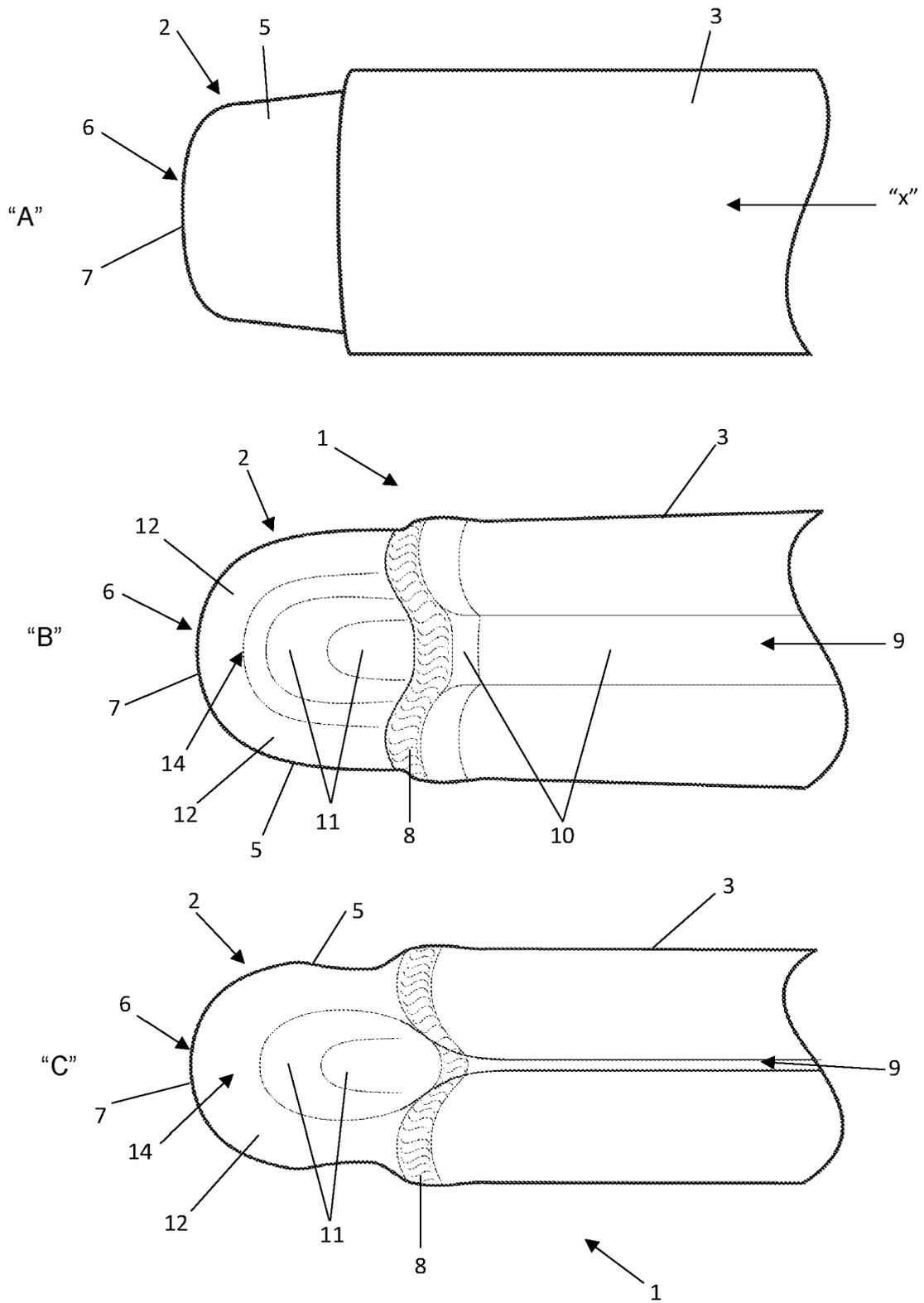


FIGURE 1

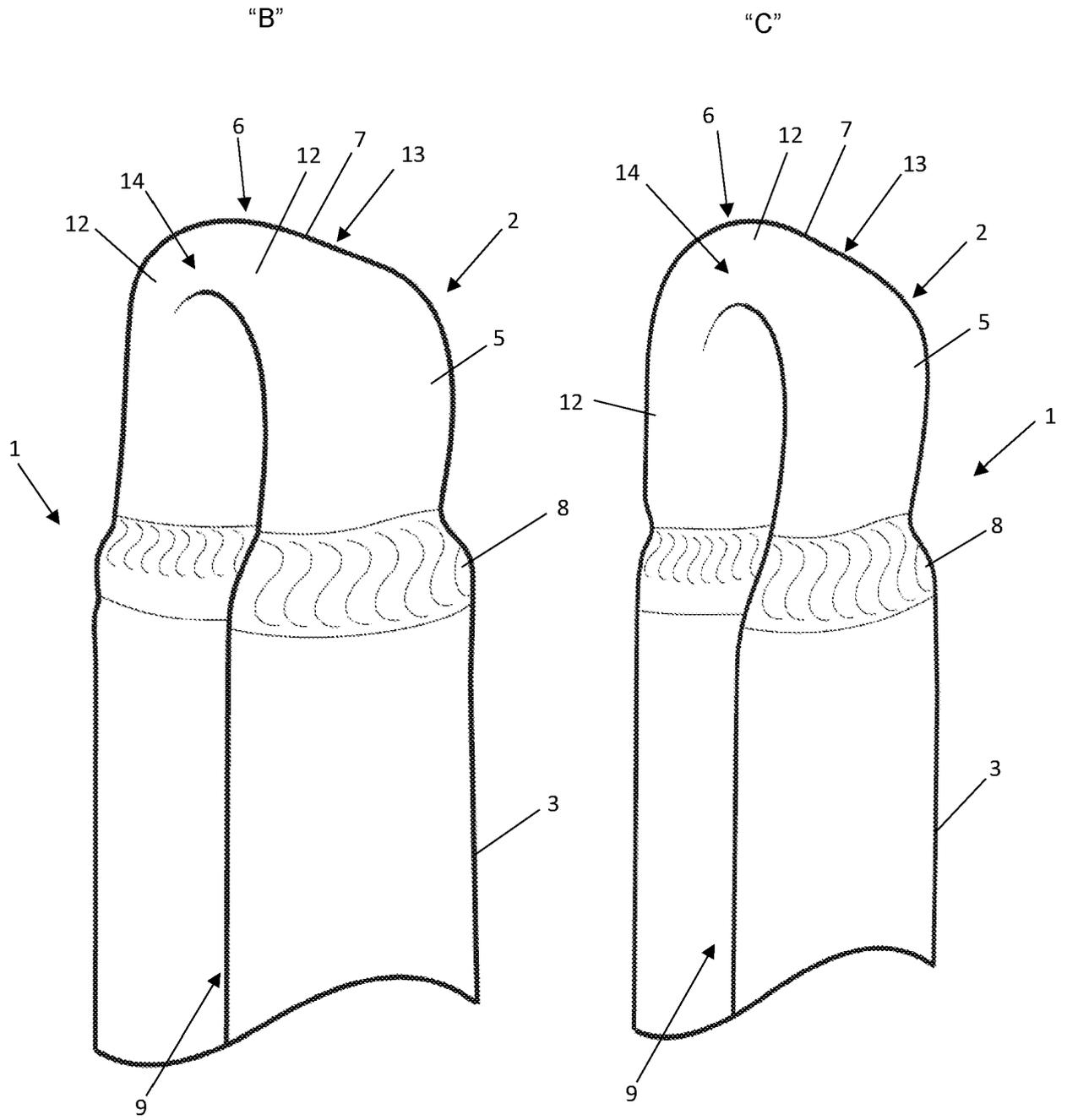


FIGURE 2

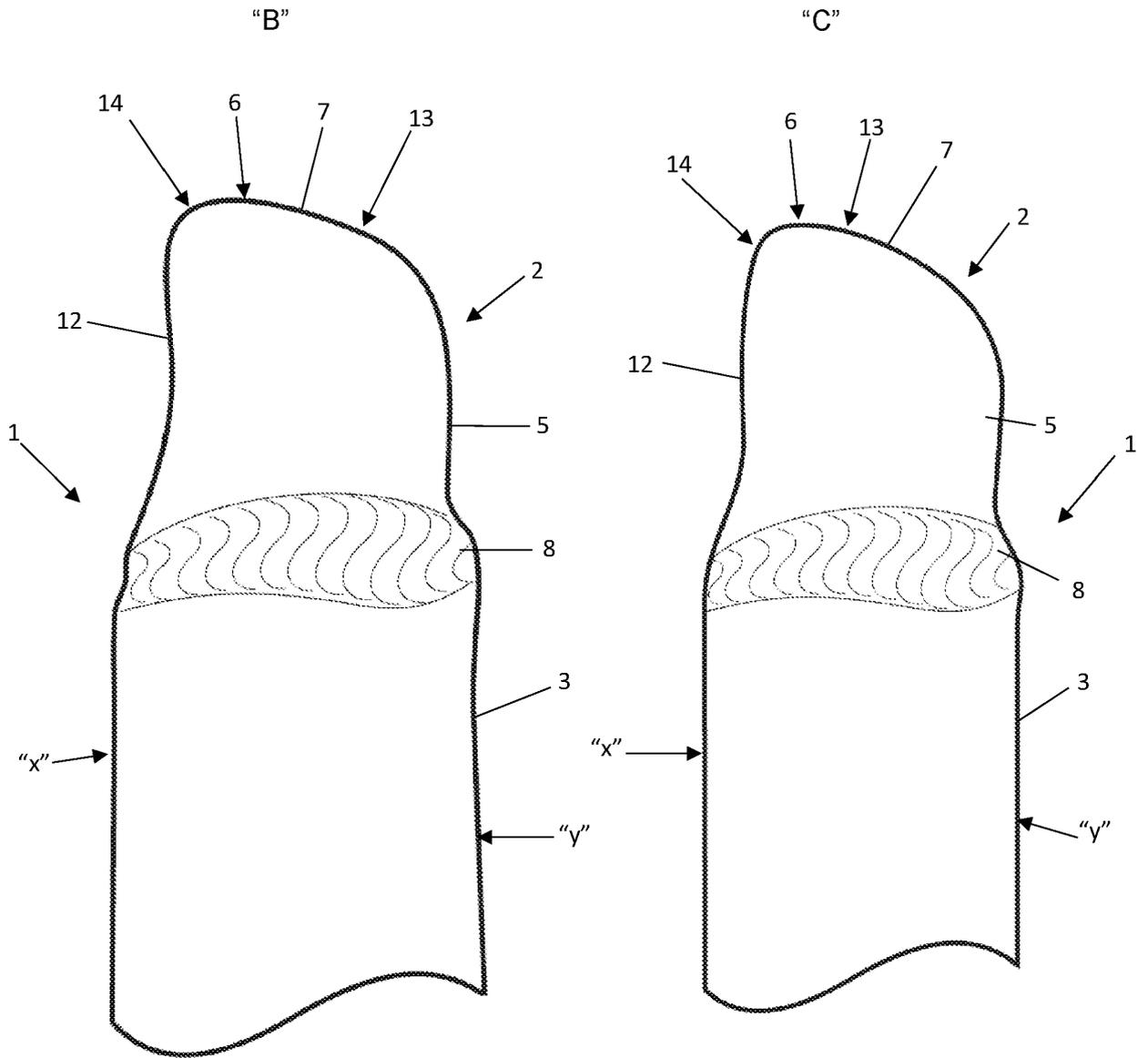


FIGURE 3

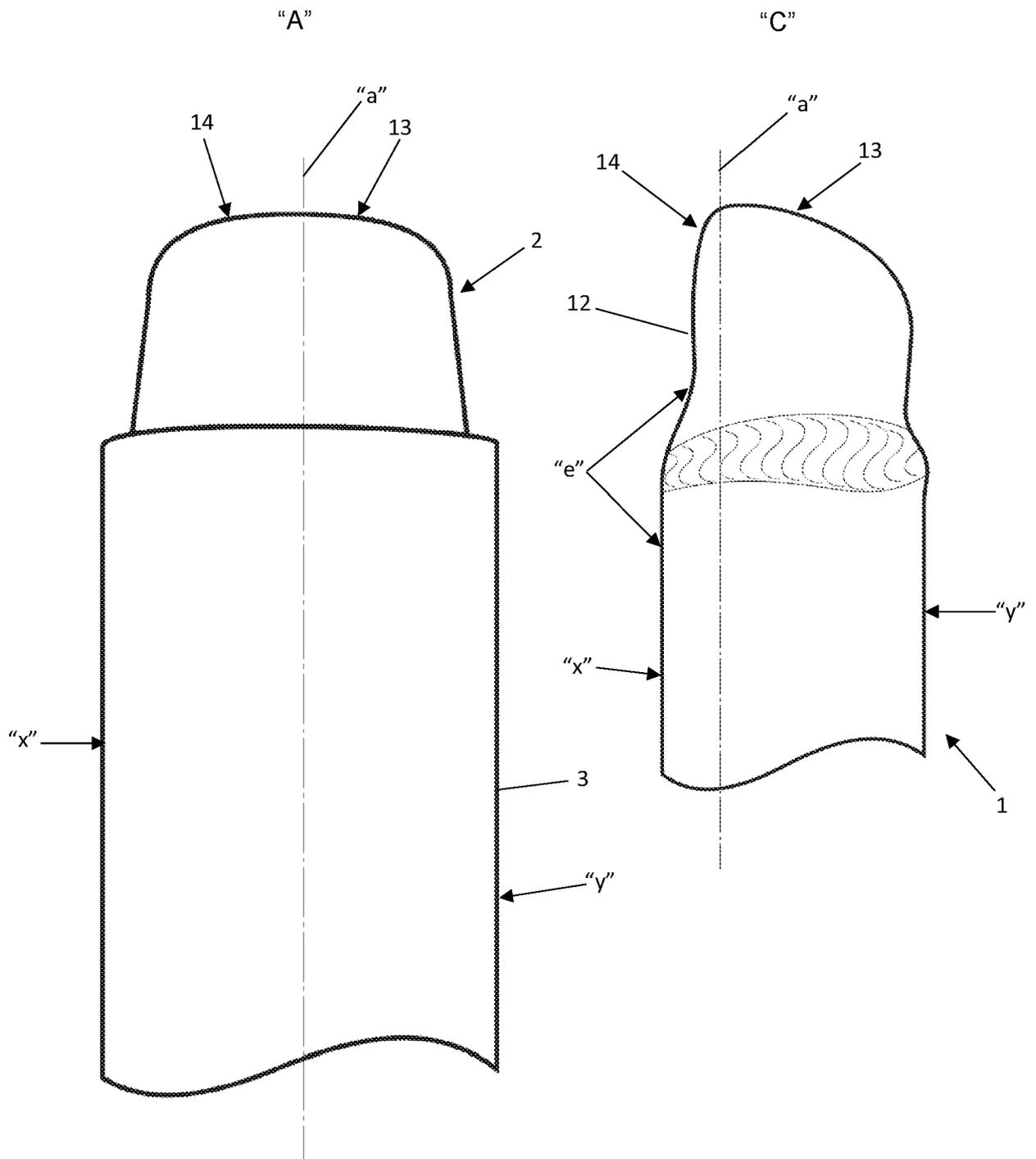


FIGURE 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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