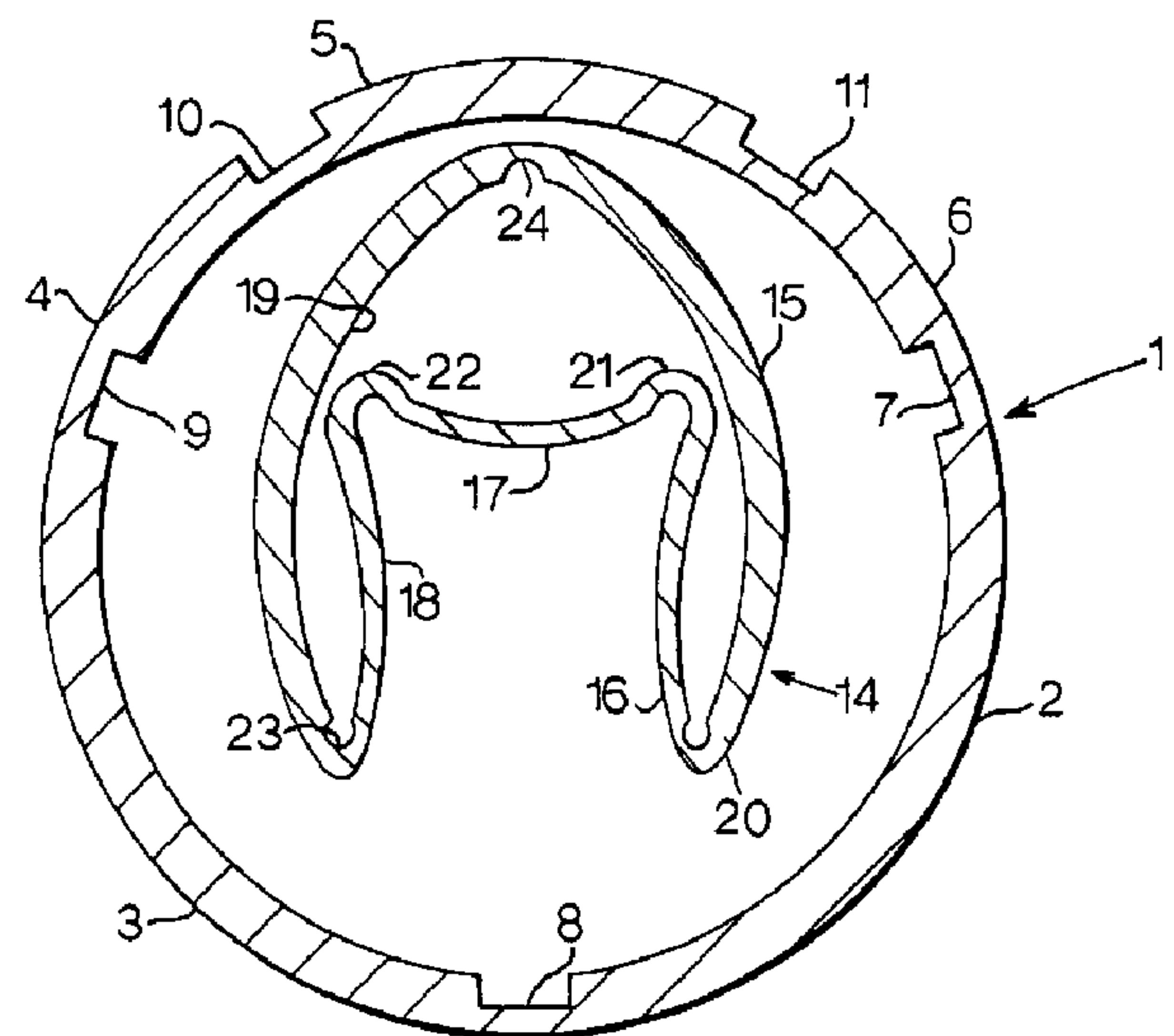
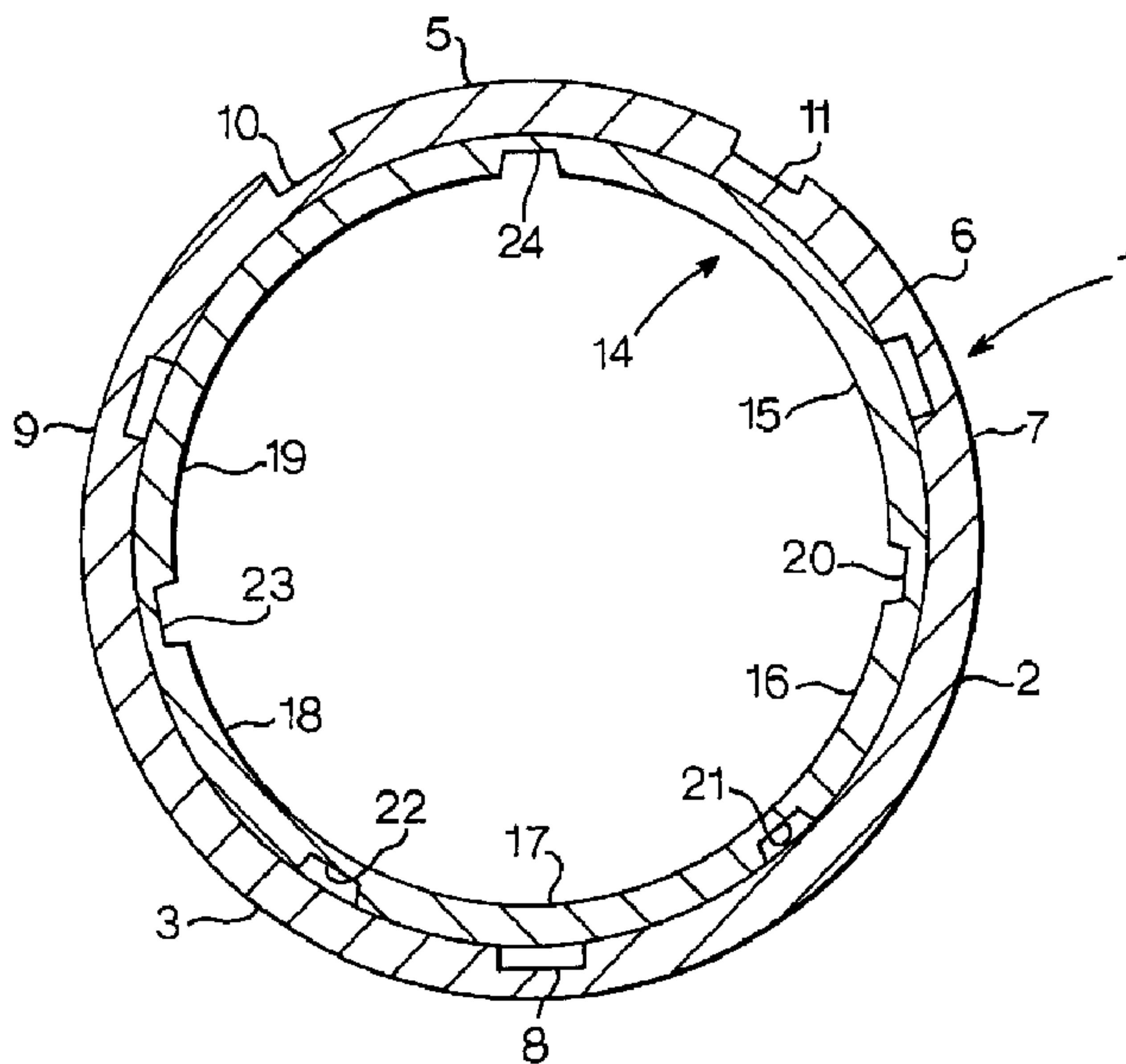




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(54) Title: CONTRACTABLE AND EXPANDABLE TUBULAR WELLBORE SYSTEM



(57) **Abrégé/Abstract:**

A tubular system arranged in a wellbore, comprising an outer tube extending into the wellbore and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the outer tube to move between a collapsed mode in which the outer tube has a relatively small cross-sectional size and an expanded mode in which the outer tube has a relatively large cross-sectional size. An inner tube extends into the outer tube and has a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the inner tube to move between a collapsed mode in which the inner tube has a relatively small cross-sectional size and an expanded mode in which the inner tube has a relatively large cross-sectional size. With the tubes in their respective expanded modes, the inner tube supports the outer tube and is oriented in the outer tube such that each hinge of the inner tube is circumferentially displaced from each hinge of the outer tube.

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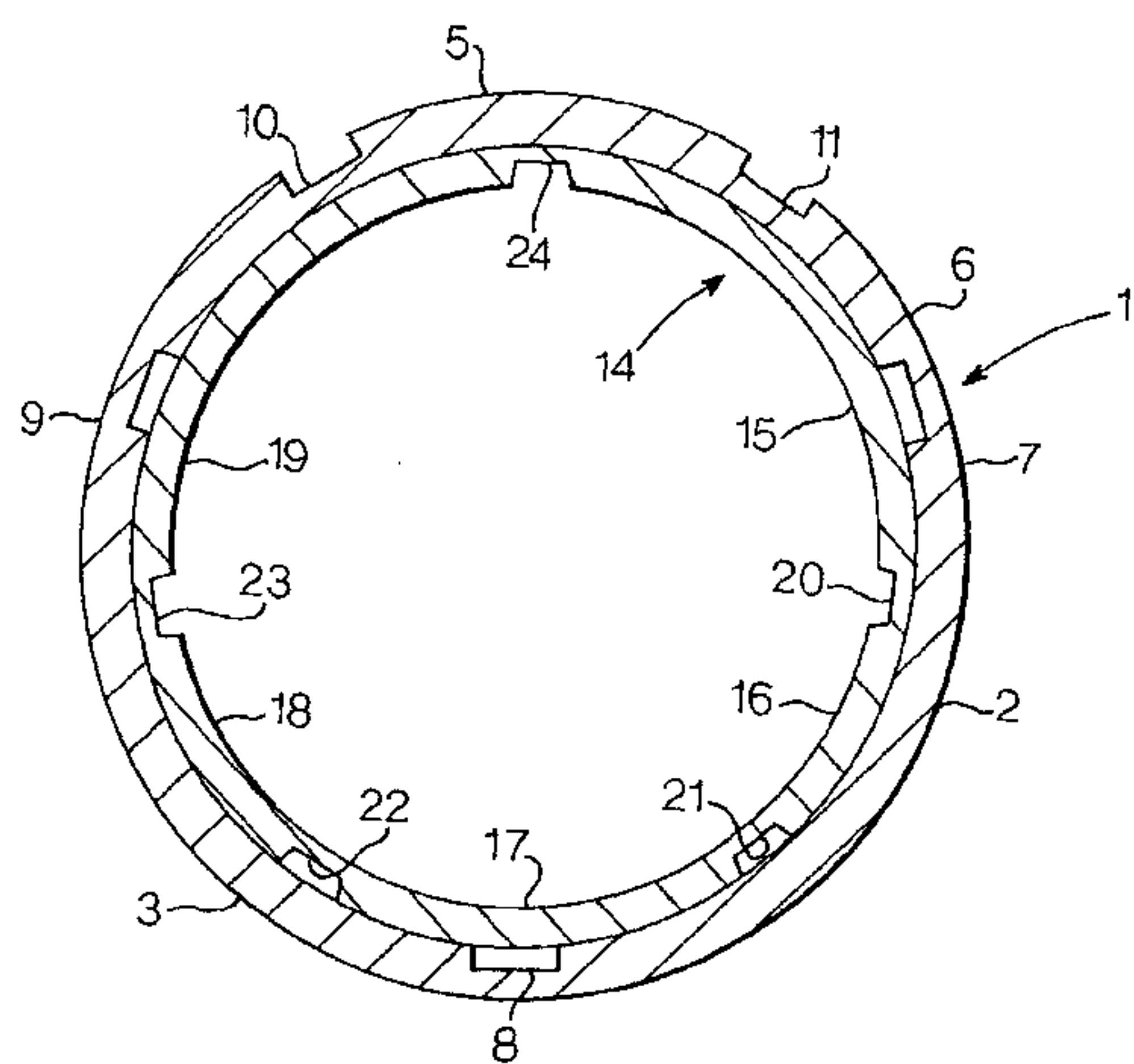
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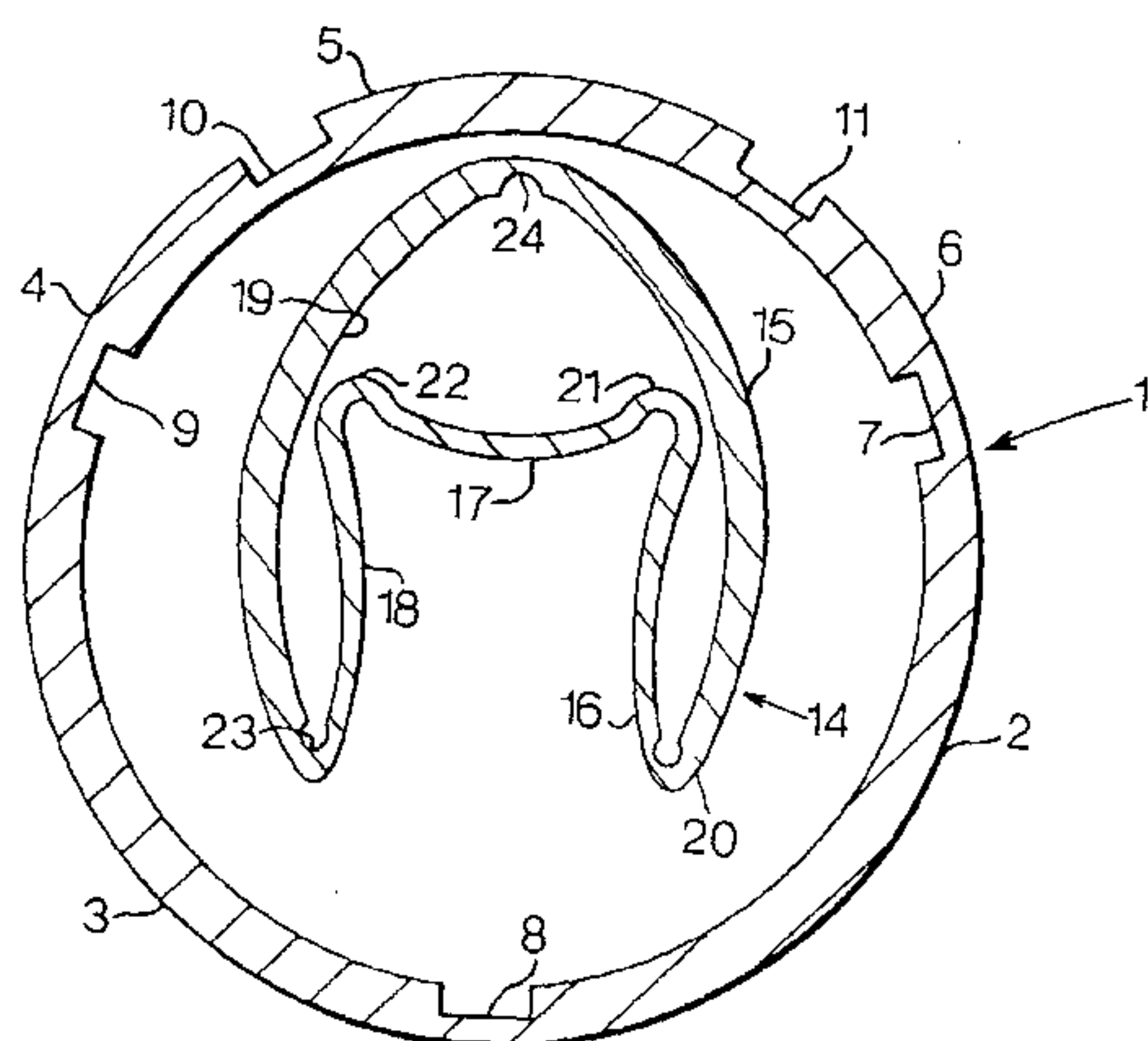
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(54) Title: CONTRACTABLE AND EXPANDABLE TUBULAR WELLBORE SYSTEM



(57) Abstract: A tubular system arranged in a wellbore, comprising an outer tube extending into the wellbore and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the outer tube to move between a collapsed mode in which the outer tube has a relatively small cross-sectional size and an expanded mode in which the outer tube has a relatively large cross-sectional size. An inner tube extends into the outer tube and has a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the inner tube to move between a collapsed mode in which the inner tube has a relatively small cross-sectional size and an expanded mode in which the inner tube has a relatively large cross-sectional size. With the tubes in their respective expanded modes, the inner tube supports the outer tube and is oriented in the outer tube such that each hinge of the inner tube is circumferentially displaced from each hinge of the outer tube.



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CONTRACTABLE AND EXPANDABLE TUBULAR WELLBORE SYSTEM

The present invention relates to a tubular system arranged in a wellbore, comprising a tube extending into the wellbore and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the tube to move between a collapsed mode in which the tube has a relatively small cross-sectional size and an expanded mode in which the tube has a relatively large cross-sectional size.

WO 99/55999 discloses such system wherein the tube forms a wellbore casing which stabilizes the borehole wall and prevents collapse of the borehole.

A drawback of the known system is that the collapse resistance of the tube, when in the expanded mode, is lower than conventional tubular elements without hinges.

It is an object of embodiments of the invention to provide an improved tubular system which overcomes the aforementioned drawback.

In accordance with the invention there is provided a tubular system arranged in a wellbore, comprising: an outer tube extending into the wellbore and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the outer tube to move between a collapsed mode in which the outer tube has a relatively small cross-sectional size and an expanded mode in which the outer tube has a relatively large cross-sectional size; an inner tube extending into the outer tube and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the inner tube to move between a collapsed mode in which the inner tube has a relatively small cross-sectional size and an expanded mode in which the inner tube has a relatively large cross-sectional size; wherein, when said tubes are in their respective expanded modes, the inner tube supports the outer tube and is oriented in the outer tube such that each hinge of the inner tube is circumferentially displaced from each hinge of the outer tube.

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By virtue of the staggered arrangement of the respective sets of hinges it is achieved that each hinge of the outer tube is arranged opposite a section of the inner tube of full wall thickness, so that inadvertent/unintentional bending of the hinges of the outer tube (when in the expanded mode) is
5 prevented.

The invention will be described hereinafter in more detail and by way of example with reference to the accompanying drawings in which:

Fig. 1 schematically shows a cross-sectional view of an outer tube in an expanded mode thereof;

10 Fig. 2 schematically shows the outer tube in a collapsed mode thereof;

Fig. 3 schematically shows the outer tube and the inner tube, both in their respective expanded modes;

15 Fig. 4 schematically shows the outer tube in its expanded mode and an inner tube in a collapsed mode.

Referring to Fig. 1 there is shown a wellbore casing in the form of tubular member 1 which is to be installed in a wellbore (not shown) which has been drilled in an earth formation, whereby the tubular member 1 in the

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final position thereof is either directly surrounded by the rock formation (not shown) optionally with a cement bonding agent or rubber sleeve inbetween, or is surrounded by another wellbore tubular member. The tubular member 1 will be referred hereinafter as an "outer tube 1" in order to distinguish from an "inner tube" referred to hereinafter.

The outer tube 1 has five arcuate sections 2, 3, 4, 5, 6 having a relatively thick wall, and five short sections 7, 8, 9, 10, 11 interconnecting the arcuate sections and having a relatively thin wall. The short sections 7, 8, 9, 10, 11 extend in longitudinal or near longitudinal direction of the outer tube 1. By virtue of their reduced wall thickness, the short sections 7, 8, 9, 10, 11 have a reduced bending stiffness and therefore form plastically deformable hinges. Hereinafter the outer tube 1 when in the rounded cross-sectional shape as shown in Fig. 1, will be referred to as the expanded mode of the outer tube 1.

In Fig. 2 is shown the outer tube 1 when in a collapsed mode whereby the outer tube 1 has been bent at the plastic hinges 7, 8, 9, 10, 11 so that arcuate section 5 has moved radially inwards. In the collapsed mode, the outer tube 1 has a smaller cross-sectional size than in the expanded mode, which smaller cross-sectional size allows the outer tube 1 to be transported through the wellbore to the desired location.

In Fig. 3 is shown an inner tube 14 concentrically arranged within the outer tube 1, whereby the inner tube 14 is biased against the outer tube 1 so as to support the outer tube 1. The inner tube 14 has five arcuate sections 15, 16, 17, 18, 19 having a relatively thick wall, and five short sections 20, 21, 22, 23, 24

interconnecting the arcuate sections 15, 16, 17, 18, 19 and having a relatively thin wall. The short sections 20, 21, 22, 23, 24 extend in longitudinal direction of the outer tube 1. By virtue of their reduced wall thickness, the short sections 20, 21, 22, 23, 24 have a reduced bending stiffness and therefore form plastic hinges. Hereinafter the inner tube 1 when in the rounded cross-sectional shape as shown in Fig. 3, will be referred to as the expanded mode of the inner tube 14.

As shown in Fig. 3 the arrangement of the tubes 1, 14 is such that each hinge 20, 21, 22, 23, 24 of the inner tube 14 is circumferentially displaced from each hinge 7, 8, 9, 10, 11 of the outer tube 1. In other words, the hinges 20, 21, 22, 23, 24 of the inner tube 14 are staggeredly arranged relative to the hinges 7, 8, 9, 10, 11 of the outer tube 1.

In Fig. 4 is shown the inner tube 14 when in a collapsed mode thereof whereby the inner tube 14 has been bent at the plastic hinges 20, 21, 22, 23, 24 so that arcuate section 17 has moved radially inwards. In the collapsed mode, the inner tube 14 has a smaller cross-sectional size than in the expanded mode, which smaller cross-sectional size allows the inner tube 14 to be transported through the outer tube 1.

During normal operation an upper part of the wellbore is drilled and provided with an upper casing (not shown) to support the wellbore wall and thereby to prevent collapse of the wellbore. A lower part of the wellbore is then drilled using a drill string (not shown) extending through the upper casing, and subsequently under-reamed to a larger diameter. The diameter of the under-reamed wellbore is equal to, or slightly larger than, the outer diameter of the outer tube 1 when in its expanded mode.

The outer tube 1 is then brought to its collapsed mode by plastically deforming the outer tube 1 at the hinges 7, 8, 9, 10, 11 to the shape shown in Fig. 2. The outer tube 1 is then lowered through the upper casing to the lower part of the wellbore where the outer tube 1 is suspended by any suitable means. Subsequently the outer tube 1 is brought to its expanded mode by means of, for example, an expander or an inflatable device.

Thereafter the inner tube 14 is brought to its collapsed mode by plastically deforming the inner tube 14 at the hinges 20, 21, 22, 23, 24 to the shape shown in Fig. 4. The inner tube 14 is then lowered through the upper casing into the outer tube 1.

In a next step the inner tube 14 is oriented in the outer tube 1 such that, after expansion of the inner tube 14, the hinges 20, 21, 22, 23, 24 of the inner tube 14 are staggeredly arranged relative to the hinges 7, 8, 9, 10, 11 of the outer tube 1 (as shown in Fig. 3). Subsequently the inner tube 14 is expanded to its expanded mode by means of, for example, a suitable expander (which may be the same expander as used to expand the outer tube 1) or an inflatable device.

With the inner tube 14 expanded against the outer tube 1 whereby the respective sets of hinges are staggeredly arranged, each hinge 7, 8, 9, 10, 11 of the outer tube 1 is arranged opposite a respective arcuate section 15, 16, 17, 18, 19 of the inner tube 14. In this manner it is achieved that the hinges 7, 8, 9, 10, 11 are "locked" so that inadvertent collapse of the outer tube 1 due to external pressure from the rock formation or wellbore fluid (e.g. water, gas or oil) is prevented.

If desired, real hinges can be applied instead of, or in addition to, the plastic hinges for the inner and outer tubes.

5 To allow for some diameter variation between the tubes, a compressible layer can be applied between the tubes. Also, one or more of the hinges can be formed by a small tubular element (named "cell tube") which has reduced bending stiffness and which accommodates for the diameter variation by virtue of its flattening upon
10 bending.

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CLAIMS:

1. A tubular system arranged in a wellbore, comprising:

- an outer tube extending into the wellbore and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the outer tube to move between a collapsed mode in which the outer tube has a relatively small cross-sectional size and an expanded mode in which the outer tube has a relatively large cross-sectional size;

- an inner tube extending into the outer tube and having a wall with at least one section of reduced bending stiffness, each section of reduced bending stiffness defining a hinge allowing the inner tube to move between a collapsed mode in which the inner tube has a relatively small cross-sectional size and an expanded mode in which the inner tube has a relatively large cross-sectional size;

wherein, when said tubes are in their respective expanded modes, the inner tube supports the outer tube and is oriented in the outer tube such that each hinge of the inner tube is circumferentially displaced from each hinge of the outer tube.

2. The tubular system of claim 1, wherein the tubular system forms a wellbore casing arranged to support the wellbore wall.

3. The tubular system of claim 1 or 2, wherein each tube has at least three said hinges.

4. The tubular system of claim 3, wherein each tube has at least four said hinges.

5. The tubular system of any one of claims 1-4, wherein each hinge extends in substantially longitudinal direction of the respective tube.

6. The tubular system of any one of claims 1-5, wherein, when said tubes are in their respective expanded modes, the inner tube is expanded against the outer tube.

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7. The tubular system of any one of claims 1-6, wherein, when said tubes are in their respective expanded modes, the outer tube is expanded against the wellbore wall.

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Fig.1.

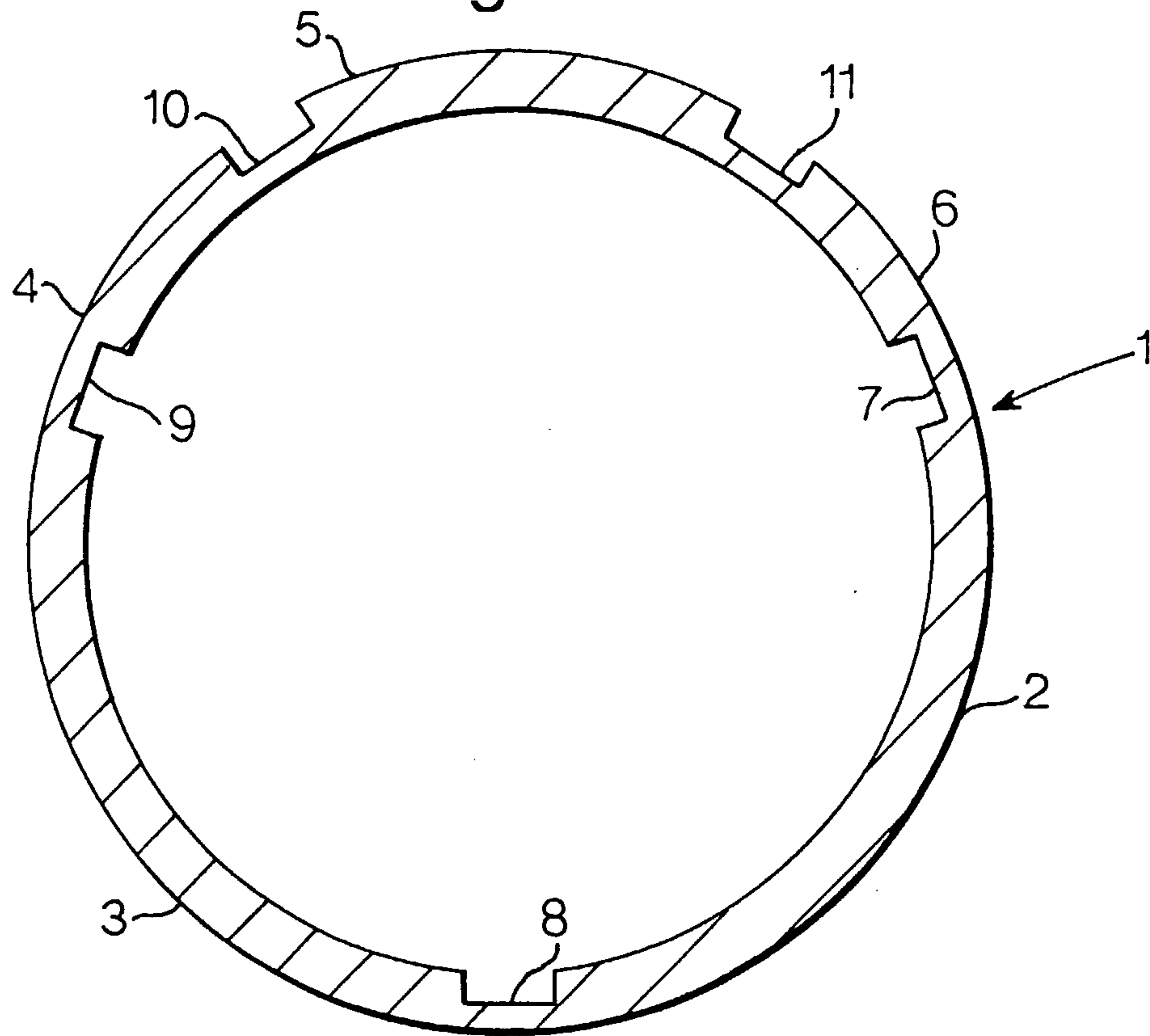
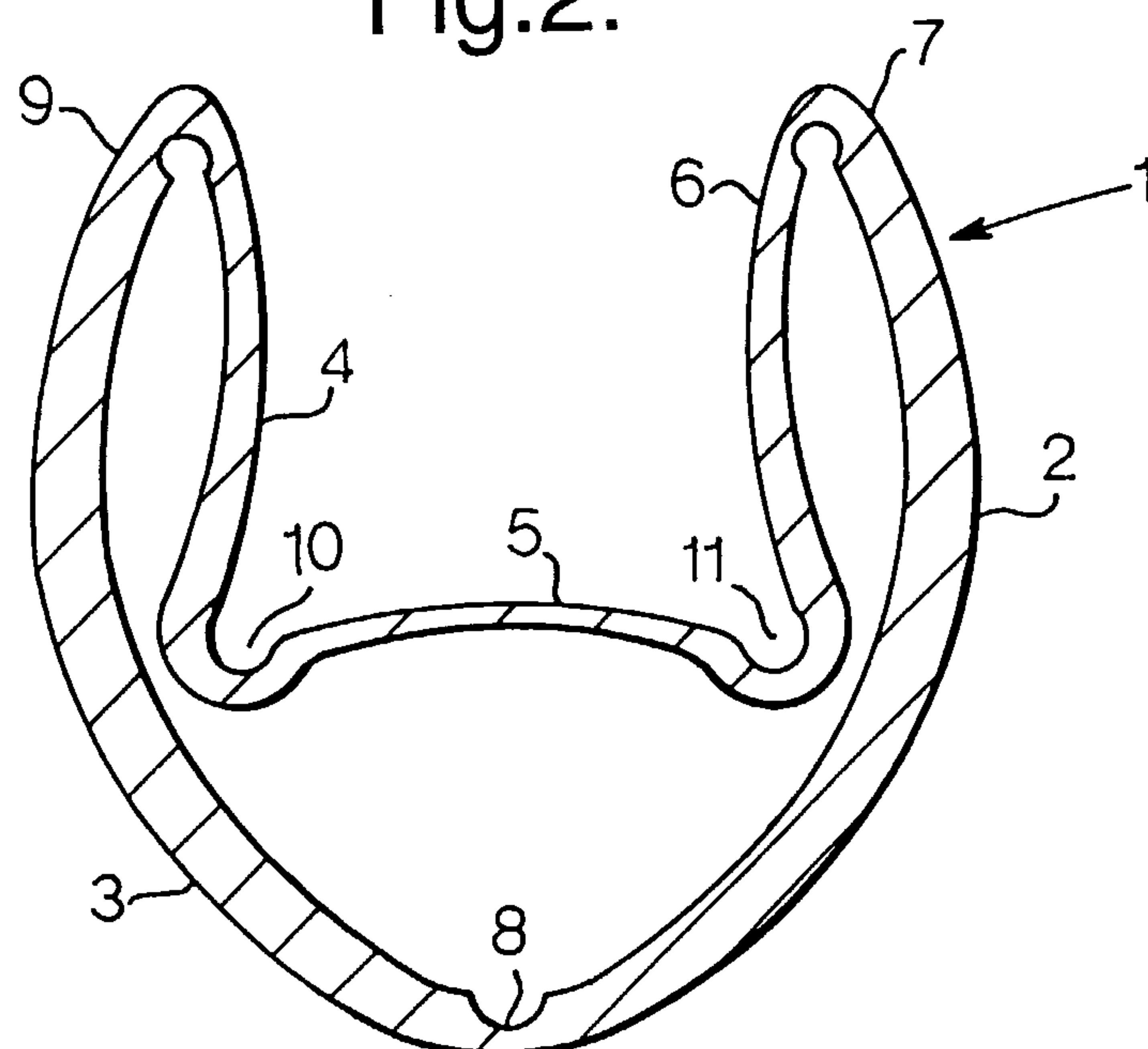


Fig.2.



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Fig.3.

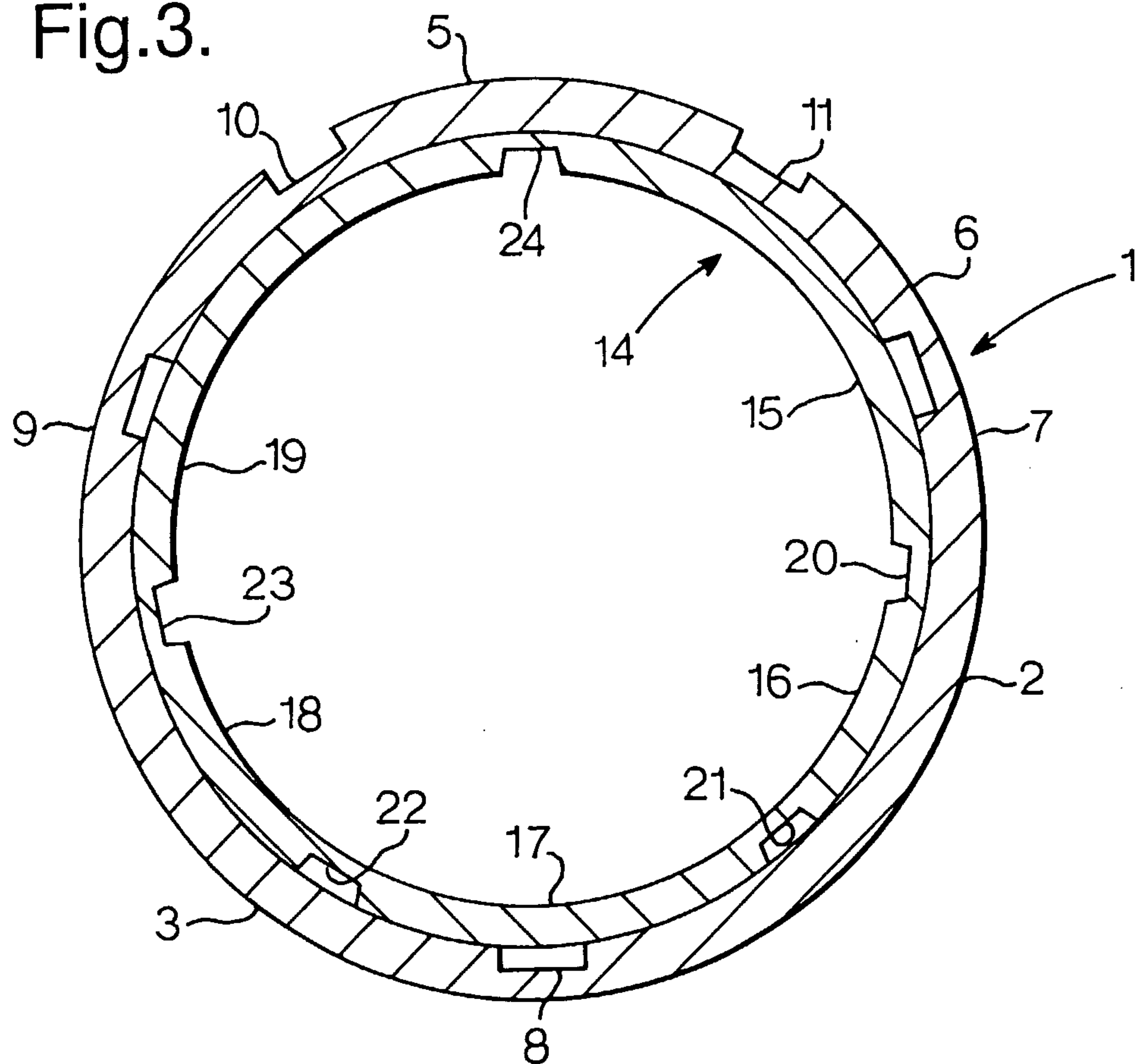


Fig.4.

