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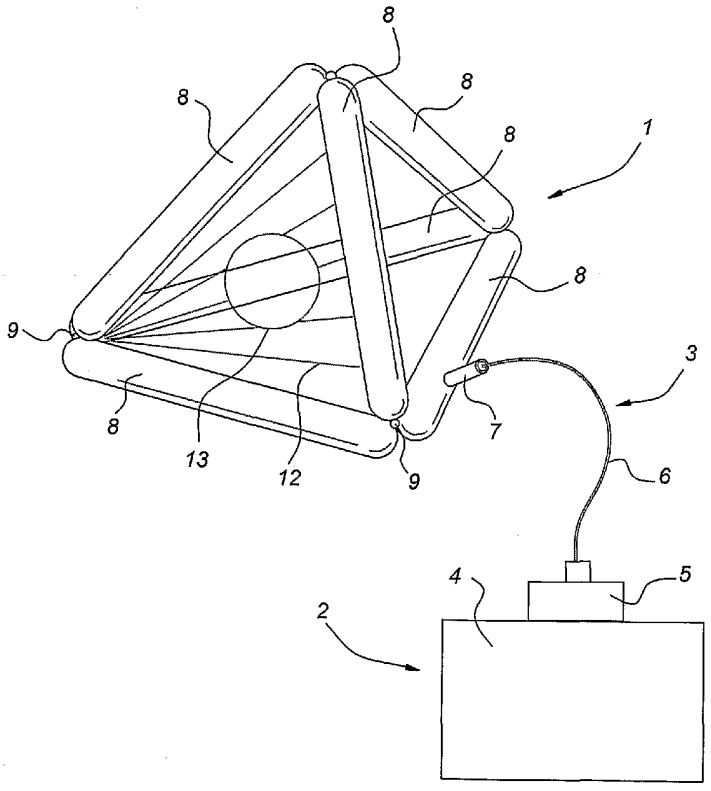
(54) Title: SURGICAL EXPANSION DEVICE



(57) Abstract: A surgical device for application in a treatment performed on the human or animal body with the aim of providing access to a surgical site in said body comprises expansion means (1) suitable for exerting a force on the organs and/or tissues at said surgical site, e.g. for mobilising and/or supporting said organs and/or tissues, upon expansion of said device at the location of the surgical site, at least one fluid reservoir (2) as well as means (3) for conveying fluid from said reservoir (2) to the expansion means (1) with the aim of expanding said expansion means (1). The expansion means comprises a sheet type material (11) having a relatively low bending stiffness and a relatively high in-plane stiffness.

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Surgical expansion device

The invention is related to a surgical device for application in a treatment performed on the human or animal body with the aim of providing access to a surgical site in said body, comprising expansion means suitable for exerting a force on the organs and/or tissues at said surgical site, e.g. for mobilising and/or supporting said organs and/or tissues, upon expansion of said device at the location of the surgical site, at least one fluid reservoir as well as means for conveying fluid from said reservoir to the expansion means with the aim of expanding said expansion means.

Such a surgical device is disclosed in US-A-5218586. It consists of i.a. an expandable tip mounted at the end of a manipulation tube. The tip can be brought into puncture type opening in e.g. the abdominal, pelvic or chest cavities. In particular, said prior art device is suitable for application in laparoscopic or thorascopic procedures. The expandable tip itself consists of a generally hollow inflatable device member similar to a balloon. It is fabricated from a non-toxic, relatively strong, flexible and resilient material such as polypropylene or a similar type of impervious material which is flaccid and deformable in the unexpanded state. The internal space of said balloon type member can be inflated by either introducing a liquid or a gas therein.

Said prior art surgical device has several disadvantages. Due to the elastic character of the balloon type member, an energy build up occurs during expanding the balloon. The wall thereof is stretched during the process of filling the balloon, and in the case of filling the balloon with a gas energy build-up also occurs due to compression of the gas. In case in that state an inadvertent rupture of the balloon occurs, said energies are suddenly released. This results in a disastrous shock effect, which may cause severe trauma to the organs or tissues in the vicinity.

A further disadvantage of the prior art surgical device is related to the balloon shape thereof. Although a somewhat better access to the surgical site can be obtained thereby upon expansion, it nevertheless also has a shielding effect with respect to the directly adjoining tissues or organs. In those cases, the expansion member has to be moved out of the way, which complicates the surgical operation.

The object of the invention is to provide a surgical device of the type described before which does not pose the risk of causing trauma, even in the case of an inadvertent failure of the expansion means. A further object is to provide a surgical

device which allows a better access to the surgical site in question. This object is achieved in that the expansion means comprises a sheet type material having a relatively low bending stiffness and a relatively high in-plane stiffness.

The expansion means according to the invention can be stowed into a small package, as a result of the bendable character of the material thereof. Upon expansion however, it will not stretch as a result of the high in-plane stiffness thereof. Thus, the expansion means itself will not store energy itself, as it does not, or hardly not, stretch. In case an inadvertent rupture occurs, no stored energy is therefore freed. The rupture can occur in an orderly fashion, without causing trauma to the surrounding tissues or organs. In this connection, preferably, a liquid is used as expansion medium. As is known a liquid is hardly compressible, in any case in comparison to a gas. Thus, upon expanding the device according to the invention, hardly energy will be stored in the expansion liquid either. In case of a rupture of the expansion means, the liquid will spill over at the surgical site, but the release of liquid will not occur with a large impulse thereby mitigating the effects of the spill-over.

Preferably, the expansion means comprises at least one elongate expansion member which has a longitudinal shape in the expanded state. Such elongate expansion member offers the possibility to form a cavity at the surgical site which has an improved accessibility. In this connection, more preferably the expansion means has at least two elongate expansion members which are angled with respect tot each other's longitudinal direction in the expanded state. In case the expansion means comprises at least one tension member the length of which is smaller than the sum of the lengths of the elongate expansion members, the expanded device will obtain a predetermined, desired shape which is prescribed by the dimensions of the various members. It will be clear that the expansion members will then delimit a specific open area, which allows a better accessibility of the enclosed area.

Furthermore, according to a specific embodiment at least three elongate expansion members can be provided which together constitute a triangle. The frame thus obtained may further be used to form expansion means having specific height, length and width dimensions. As a result, the multiple elongate expansion members thus applied may constitute a spatial structure. As an example, a tetrahedron is given, but other structures such as a cube and the like are possible as well. All these structures have in common that they offer a frame after expansion of the several expansion

members, which to that end preferably have interconnected fluid chambers allowing a simultaneous expansion. The frames thus obtained are able to create a free space within the body at the surgical site. The surgeon is thus able to reach through the open sides of the expanded frame, and is therefore able to perform intricate operations at the site without being hampered by the expansion means itself.

Preferably, the surgical device comprises at least one restrictor for restricting the expansion of the expansion means. By means of such restrictor, the expansion means in question can be urged into a specific, prescribed shape, for instance a curved shape. In the latter case, the restrictor comprises a tension member, in particular a pull member.

The invention will now be described further with reference to an embodiment of the surgical device as shown in the figures.

Figure 1 shows a surgical device according to the invention.

Figure 2 shows a component of the surgical device according to figure 1.

Figure 1 shows a surgical device according to the invention, comprising the expansion means 1 which is in figure 1 is shown in the expanded state. Furthermore, there is at least one fluid reservoir as well as a means 3 for conveying fluid from said reservoir 2 to the expansion means.

The fluid reservoir comprises a container 4 which holds an amount of preferably liquid, which by means of pump 5 is pumped into the line 6. The line 6 in turn is connected to a connection port 7, which gives access to the internal space of the expansion means 1.

Said expansion means comprises six elongate members 8, which together constitute a tetrahedron. The elongate expansion members 8 are connected to each other at the notes 9. Also, the expansion members contain a fluid chamber 10, which fluid chambers 10 at the location of the notes 9 are interconnected.

In a rest state, the elongate members 10 are deflated, which means that they can be reduced to relatively small dimensions for introduction at a surgical site. After positioning the deflated expansion means 1, liquid is fed to the internal space, in particular the fluid chambers 10 thereof, thus inflating the expansion means 1 to the shape of the tetrahedron as shown in figure 1.

The advantage of such form of the expanded expansion means 1 is clear: first of all a hollow space is formed within the tetrahedron, giving the surgeon access to sites which are otherwise difficult to reach. The open phases between the elongate members

8 enable the surgeon to reach through, enabling him a further improved access to the surgical site.

Additionally, a flexible web 12 is mounted between three of the expansion members. Said flexible web 12 is stretched upon expansion of said members 8, whereby the formation of an open surgical site is further enhanced. A fenestration hole 13 is provided in said flexible web 12 so or to enable the surgeon to reach the surgical target site. Further webs 12 may be mounted to the other expansion member 8 as well.

Figure 2 shows a possible embodiment of a tension member 8 provided with a pull member 14. The pull member 14, e.g. wire, is connected to the opposite ends of the tension member 8. The length of the pull member 14 is somewhat smaller than the length of the tension member 8 between the mutual connection points. Thereby, upon expansion of the tension member 8, it is brought into a slightly curved shape due to the fact that it is restricted in its full expansion by the restrictor 14. In this way, the surgical device according to the invention can be brought in a specific, desired shape upon expansion thereof.

Claims

1. Surgical device for application in a treatment performed on the human or animal body with the aim of providing access to a surgical site in said body, comprising expansion means (1) suitable for exerting a force on the organs and/or tissues at said surgical site, e.g. for mobilising and/or supporting said organs and/or tissues, upon expansion of said device at the location of the surgical site, at least one fluid reservoir (2) as well as means (3) for conveying fluid from said reservoir (2) to the expansion means (1) with the aim of expanding said expansion means (1), characterised in that the expansion means comprises a sheet type material (11) having a relatively low bending stiffness and a relatively high in-plane stiffness.

2. Surgical device according to claim 1, wherein the expansion means (1) comprises at least one connection port (7) for feeding the fluid into the internal space of said expansion means (1).

3. Surgical device according to claim 1 or 2, wherein the expansion means (1) comprises at least one elongate expansion member (8) which has a longitudinal shape in the expanded state.

4. Surgical device according to claim 3, wherein the expansion means (1) has at least two elongate expansion members (8) which are angled with respect to each other's longitudinal direction in the expanded state.

5. Surgical device according to claim 4, wherein the expansion means (1) comprises at least one tension member (8) the length of which is smaller than the sum of the lengths of the elongate expansion members (8).

6. Surgical device according to claim 5, wherein at least three elongate expansion members (8) are provided which together constitute a triangle.

7. Surgical device according to any of claims 4-6, wherein multiple elongate expansion members (8) are provided which constitute a spatial structure.

8. Surgical device according to claim 7, wherein the spatial structure constitutes a tetrahedron.

9. Surgical device according to one of claims 4-8, wherein a flexible web (12) is provided which extends between at least two elongate expansion members (8).

10. Surgical device according to claim 9, wherein the flexible web (12) has a fenestration (13).

11. Surgical device according to any of claims 3-10, wherein each expansion member (8) comprises a fluid chamber (10).

12. Surgical device according to claim 11, wherein at least two expansion members (18) are provided and the fluid chambers (10) of said expansion members are in fluid communication with each other.

13. Surgical device according to any of the preceding claims, wherein the fluid is a liquid.

14. Surgical device according to any of the preceding claims, comprising at least one restrictor (14) for restricting the expansion of the expansion means.

15. Surgical device according to claim 14, wherein the restrictor comprises a pull member (14).

Fig 1

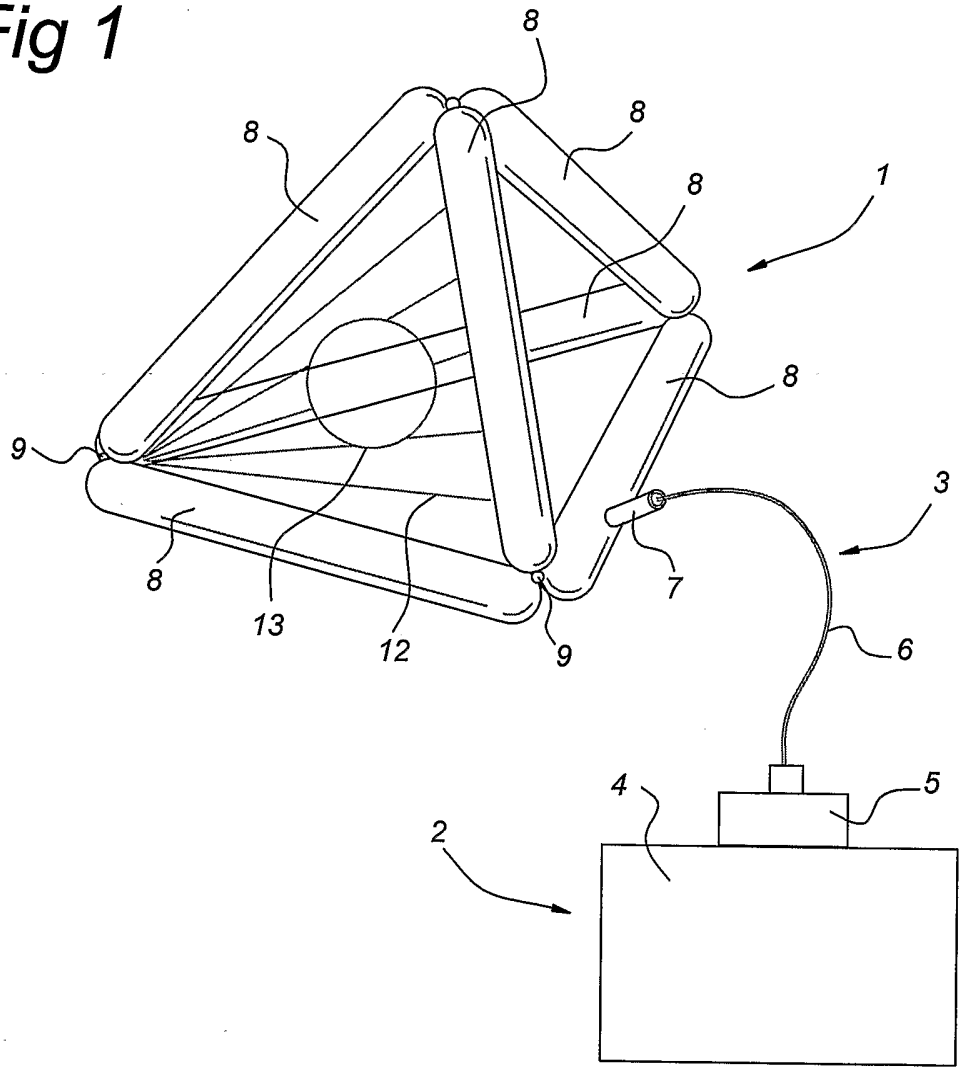
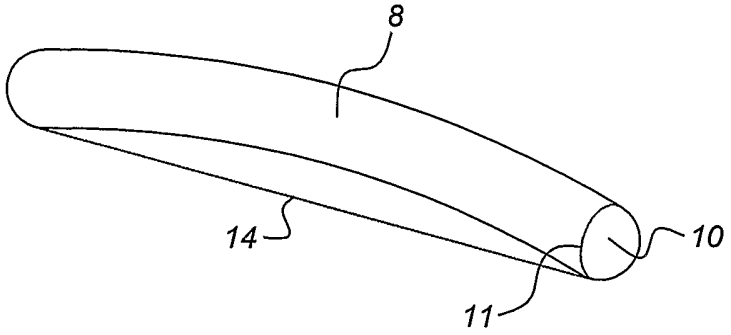


Fig 2



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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 270 505 B1 (YOSHIDA OSAMU ET AL) 7 August 2001 (2001-08-07) column 9, line 38 - column 15, line 20 figures 1-9b	1-4,7-13
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X	US 6 371 910 B1 (ZWART HANS J ET AL) 16 April 2002 (2002-04-16) column 13, line 32 - column 14, line 41 figures 6,8,9	1-4,7, 11-13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2005	26/09/2005

Name and mailing address of the ISA	Authorized officer
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