

(19)



(11)

EP 3 061 901 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.08.2016 Bulletin 2016/35

(51) Int Cl.:
E21B 33/12 ^(2006.01) **E21B 33/127** ^(2006.01)
E21B 43/10 ^(2006.01)

(21) Application number: **15305303.8**

(22) Date of filing: **27.02.2015**

(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**
Designated Extension States:
BA ME

- **Neveu, Romain**
35000 Rennes (FR)
- **Uguen, Yannick**
56380 Beignon (FR)

(71) Applicant: **Saltel Industries**
35170 Bruz (FR)

(74) Representative: **Vidon Brevets & Stratégie**
16B, rue de Jouanet
B.P. 90333
Technopole Atalante
35703 Rennes Cedex 7 (FR)

(72) Inventors:

- **Saltel, Jean-Louis**
35650 Le Rheu (FR)
- **Roselier, Samuel**
35650 Le Rheu (FR)

Remarks:

Amended claims in accordance with Rule 137(2) EPC.

(54) **DEVICE FOR FRACTURING OR RE-FRACTURING A WELL AND CORRESPONDING MANUFACTURING METHOD**

(57) The present invention relates to a device (11) of a part of a completion string arranged in a well (A), said well being lined with a casing or open hole, comprising a tubular conduit (12) designed to be placed within said well and comprising at least one expandable part (20) along its length, said part being radially expandable under the action of fluid pressure so as to be applied tightly

against the inner wall of the well or casing.

The wall (124) of said tubular conduit is of reduced thickness along the length of the expandable part, and the expandable part (20) has an inner diameter smaller than the tubular conduit outer diameter when unexpanded.

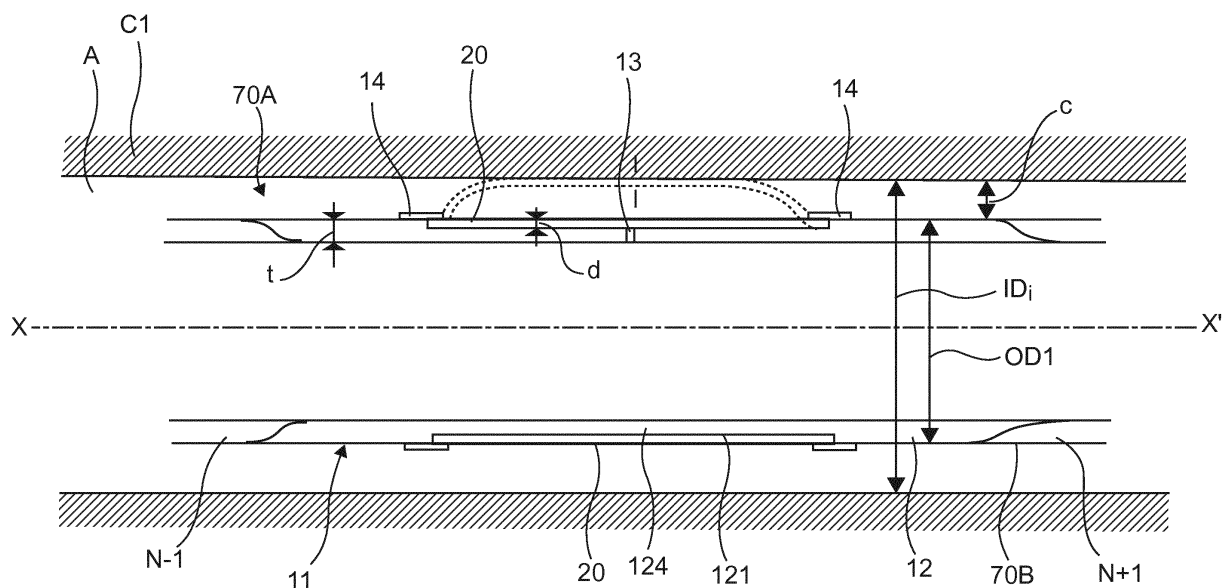


Fig. 2

EP 3 061 901 A1

Description

1. TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of well drilling and completing.

[0002] The present invention relates more particularly to a device that can be employed, but not exclusively, for fracturing wells or re-fracturing wells originally fractured, the device comprising a tubular conduit having comprising at least one radially expandable part along its length.

[0003] The present invention may be used in oil and gas wells and the like.

2. BACKGROUND OF THE INVENTION

[0004] The exploitation of wells by an hydraulic fracturing process is well-known.

[0005] Hydraulic fracturing (also called "*fracking*") is a technique for cracking of the rock by injection of a liquid comprising sand and chemicals under pressure. This technique enables extraction of oil or gas contained in highly compact and impermeable rocks.

[0006] Hydraulic fracturing of horizontal wellbores is usually conducted in multiple stages so as to perform multiple fractures in specific places along and perpendicularly to the wellbore.

[0007] It is common to use one of the following two hydraulic fracturing methods, depending on whether the well has a cemented casing, or a non-cemented casing respectively :

- "*plug and perf*" fracturing in which the fracturing process is executed sequentially in several sections of a horizontal well having a cemented casing. Starting from the bottom of the well, each section is perforated, fractured and isolated using a plug that is pumped into the well and set inside the casing. The process is repeated until all the sections have been fractured. The plugs are then drilled and the production stage can be initiated. A drawback of this method is that the cementing operation of the horizontal well is lengthy and difficult;
- "*open hole multistage* (OHMS)" fracturing in which a casing string is installed into a well, the casing being provided with sliding sleeves (or frac sleeves) and packers to provide annular isolation and divide the well into sections (a sliding sleeve is placed between two packers). The sleeves are sequentially shifted to their opened position, from the bottom to the top of the well, by specifically sized balls that are pumped into the well. When a sleeve is moved under the action of a ball, frac ports are opened and the isolated zone is fractured and stimulated by fluid diverted through the opened frac ports. A drawback of this method is that the number of sized balls that can be used limits the number of sections of the well that can be fractured. Also, the totality of the isolated sec-

tion located between two packers is exposed to pressure. It is thus difficult to control the area in which the fracture is initiated and then spreads.

5 [0008] Others methods combining sliding sleeves and cemented casings are also used.

[0009] The gas or oil production level of a well decreases after a few years. It is common to re-stimulate a well after an initial period of production. Such a re-fracturing (or re-frac) operation restores well productivity to near original or even higher rates of production and extends the productive life of a well. Re-fracturing aims in particular at increasing the depth of the original fracture or to develop a new network of fractures in order to extract gas or oil still trapped inside the rock.

[0010] Re-fracturing is also advantageous in that it does not require the drilling and completion steps of the well to be carried out again. This limits the costs involved. In other words, re-fracturing a well is sometimes more economical than to drill a new well.

[0011] There are currently several re-fracturing methods. For wells having been fractured by the plug and perf method described previously, it is possible to install and cement a new casing having a smaller diameter than the original casing. The plug and perf method is then conducted again. It is critical that the cemented layer located between the two casings ensures high-quality sealing between those casings. Also, the perforating steps conducted during the re-fracturing process must go through two casing walls.

[0012] As illustrated in Figure 1, it is also possible to install a new casing, or tubular conduit, 1 provided with expandable metallic tubular sleeves (designated by the term "packers" or "isolation devices"), such sleeves being designed to be expanded within the original casing of well A, and to conduct the plug and perf method described previously.

[0013] Here only one sleeve, labelled 2, is shown, solely for the sake of simplicity. In known fashion, as illustrated in figure 1, the opposite ends of each tubular metal sleeve 2 are firmly bonded, directly or indirectly, to the outer face of the casing 1 by reinforcing rings or skirts 6. The sleeve 2 is represented in its unexpanded position, the new casing 1 being located inside the well A that is cased (the casing being labelled C1) and cemented (the cementing layer being labelled C2 and the rock formation being labelled R). The metallic sleeve 2 is expanded radially by supplying the inside of the sleeve 2 with fluid under pressure through the casing 1 and the expansion port (or hole, or valve) 3. It is to be noted that, in the unexpanded position of the sleeve 2, the outer diameter OD2 of the sleeve 2 is higher than the outer diameter OD1 of the casing 1. It is also to be noted that the inner diameter of the sleeve 2 is superior to the outer diameter OD1 of the casing 1.

[0014] The problem that arises with those re-fracturing techniques is that the new casing has a reduced internal diameter compared to the initial internal diameter of the

well casing, thus limiting the re-fracturing fluid flow. Indeed, when considering the technique described in relation to Figure 1, the clearance between the inner wall of the well casing C1 and the outer wall of the casing 1 needs to be large enough to install the casing 1 (carrying several sleeves 2 on its periphery) within the well casing C1.

[0015] Consequently, the internal diameter of the casing 1 needs to be of reduced diameter.

3. BRIEF SUMMARY OF THE INVENTION

[0016] The aim of the present invention is to solve the weaknesses in these prior techniques, especially, but not exclusively, for hydraulic re-fracturing applications.

[0017] The present invention provides a device of a part of a completion string arranged in a well, said well being lined with a casing or open hole, comprising a tubular conduit designed to be placed within said well and comprising at least one expandable part along its length, said part being radially expandable under the action of fluid pressure so as to be applied tightly against the inner wall of the well or casing.

[0018] According to the invention, the wall of said tubular conduit is of reduced thickness along the length of the expandable part, and the expandable part has an inner diameter smaller than the tubular conduit outer diameter when unexpanded.

[0019] The device of the present invention proposes a tubular conduit provided with one or more expandable parts, and whose internal diameter is maximized in order to maximize the fluid flow inside the conduit during re-fracturing.

[0020] This is achieved by reducing the thickness of the wall of the conduit at the level of the expandable parts, the latter having an inner diameter smaller than the tubular conduit outer diameter when unexpanded.

[0021] In one embodiment of the present invention, the expandable parts are radially expandable sleeves, which are mounted flush with the outer surface of the conduit on which they are arranged. The conduit can thus be run in a well casing with minimum clearance. Also, this flush mounting of the sleeves does not require the internal diameter of the conduit to be reduced. The re-fracturing fluid flow within the conduit is thus maximized.

[0022] In a preferred embodiment of the present invention, the wall of reduced thickness is configured so that it forms an annular groove in the external face of said tubular conduit.

[0023] In one embodiment of the present invention, the wall of reduced thickness forms the expandable part.

[0024] In another embodiment of the present invention, the expandable part is formed by an expandable sleeve connected fixedly and hermetically at its opposite ends in said groove, the wall of said conduit comprising at least one inflation opening which allows the internal space of the conduit to communicate with the internal space of said sleeve, the groove being configured so that the outer

face of said sleeve when unexpanded is substantially flush with the external face of said tubular conduit.

[0025] In one embodiment of the present invention, the expandable part has an internal diameter equal to or higher than the tubular conduit internal diameter.

[0026] Alternatively or additionally, the expandable part has an external diameter equal to or smaller than the tubular conduit external diameter.

[0027] In one embodiment of the present invention, when the sleeve is unexpanded, the inner face of said sleeve facing the conduit is in contact with the bottom surface of said groove.

[0028] In a preferred embodiment of the present invention, each opposite end of said sleeve abuts against an edge of said groove.

[0029] In one embodiment of the present invention, said device comprises a reinforcing ring connected to an end of said sleeve and to the external face of said tubular conduit.

[0030] In a preferred embodiment of the present invention, the depth of said groove is comprised between 2 and 3 mm.

[0031] In a preferred embodiment of the present invention, both ends of said tubular conduit are provided with first flush connecting means configured to join said tubular conduit to other tubular conduits of said completion string.

[0032] In one embodiment of the present invention, the tubular conduit is formed from at least two sections joined end to end using second flush connecting means.

[0033] Preferably, said first and second flush connecting means are threading means.

[0034] In a preferred embodiment of the present invention, the expandable part is made of metal.

[0035] In one embodiment of the present invention, the expandable part is surrounded along at least part of its length by sealing material.

[0036] Preferably, the sealing material is made of elastomer.

[0037] The present invention further provides a method of manufacturing a device according to one embodiment of the invention, the method comprising the steps of:

- machining at least one annular groove on the external face of a tubular conduit;
- fitting a sleeve around the tubular conduit so that it faces the annular groove ;
- crimping said sleeve in said groove, and
- fastening the opposite ends of said sleeve within said groove.

[0038] Preferably, the opposite ends of said sleeve are fastened to said groove by welding.

[0039] The present invention further provides a method of manufacturing a device according to another embodiment of the invention, the method comprising the steps of:

- obtaining at least two sections configured to be joined end to end by flush connecting means so as to form a tubular conduit, a first section having an annular groove on its external face ;
- fitting a sleeve around said first section of the tubular conduit within said annular groove;
- connecting the two sections using flush connecting means, and
- fastening the opposite ends of said sleeve within said groove.

4. BRIEF DESCRIPTION OF THE DRAWINGS

[0040] Other characteristics and advantages of the present invention will emerge from the following detailed description of some preferred embodiments. This description will be given in reference to the attached drawings, in which:

- FIG. 1 is, as indicated hereinabove, a schematic representation, in cross-section, of a portion of a device of the prior art located inside a well lined with a casing and used for re-fracturing of the well by the plug and perf method;
- FIG. 2 is a schematic representation, in cross-section, of a device according to a first embodiment of the invention;
- FIG. 3A to 3D illustrate a first method of manufacturing a device according to the first embodiment of the invention;
- FIG. 4A to 4C illustrate a second method of manufacturing a device according to the first embodiment of the invention;
- FIG. 5 is a schematic representation, in cross-section, of a device according to a second embodiment of the invention;
- FIG. 6A and 6B are a schematic representation, in cross-section, of the device according to the first embodiment of the invention when installed inside a well lined with a casing;
- FIG. 7 is a schematic representation, in cross-section, of a device according to the invention when used for re-fracturing a well ;
- FIG. 8A and 8B are a schematic representation, in cross-section, of the device according to the second embodiment of the invention when installed inside a well lined with a casing.

5. DETAILED DESCRIPTION OF THE INVENTION

[0041] In the attached figures 2, 6A and 6B, and for the sake of clarity, only one fraction of the horizontal part of a well A to be re-fractured is shown.

[0042] It is of course possible for this horizontal portion to extend over a considerable length. It is attached to a vertical portion terminating in open air via an intermediate portion substantially in an arc of a circle (not shown).

[0043] This well A is lined with a casing C1 cemented

in place (the cementing layer is labelled C2).

[0044] For all the figures, it is considered that the well-head of well A (terminating in open air) is located to the left of the figures and its base to the right.

5 [0045] The figures illustrate a metallic tubular conduit 12, which is part of the device 11 according to the invention. The tubular conduit 12 is placed inside the well A and, more particularly, in the horizontal part of the latter. In practice, this conduit 12 is a part of a completion string, 10 which comprises a vertical upstream end, which terminates in the surface of the well, as well as a curved intermediate portion for joining the vertical part to the horizontal part. The conduit 12 is kept in place according to the axis X-X' of the well by well-known means which rest 15 against the walls of the well.

[0046] Figure 2 shows the conduit 12 placed end to end with a right conduit N+1 and a left conduit N-1.

[0047] As will be evident hereinbelow in the description, fracturing fluid is circulated in the conduit 12 from 20 the apex to the base, from upstream to downstream.

[0048] The tubular conduit 12 has a series of radially expandable metallic tubular sleeves (or packers, or isolation devices), spaced out in predetermined fashion. For the sake of clarity, only one sleeve 20 is shown in Figures 2, 6A and 6B. The opposite ends of the sleeve 20 are 25 connected fixedly and hermetically to the conduit 12 at its periphery.

[0049] The wall of the tubular conduit 12 comprises for each sleeve 20 at least one opening 13 enabling communication between the inner space of the conduit 12 30 and the interior of the corresponding sleeve 20.

[0050] The metallic sleeve 20 is expanded radially by supplying the inside of each sleeve 20 with fluid under pressure through the conduit 12 and the opening 13 until 35 the sleeve 20 makes contact with the interior surface of the casing C1, thus creating an annular barrier (Figure 6B). When the pressure decreases, the metal sleeve 20 retains its shape definitively. The outer wall of the sleeve 20 may be provided with sealing material, such as an 40 annular joint or membrane.

[0051] The wall of the tubular conduit 12 comprises a cylindrical groove 121 (figure 2), which is obtained by machining. The wall of the conduit 12 is thus of reduced thickness in the zone of the groove 121 (the reduced 45 thickness part of the wall is labelled 124). The groove 121 and the sleeve 20 are designed so that the sleeve 20 can be flush mounted inside the groove 121. The opposite ends of the sleeve 20 are connected fixedly and hermetically to the wall of the conduit 12 inside the groove 50 121. The length of the groove 121 is slightly larger than the length of the sleeve 20. The depth of the groove 121 is equal to the width of the wall of the sleeve 20.

[0052] Figure 2 illustrates the sleeve 20 in its unexpanded position extending parallel to the axis X-X' of the conduit 12. In dotted lines, part of the sleeve 20 is shown 55 in its expanded position.

[0053] Optionally, a reinforcing ring 14 of reduced thickness may connect each end of the sleeve 20 and

the external face of the tubular conduit 12.

[0054] The conduit 12 comprises at both ends flush connecting means 70A, 70B, preferably formed by hermetic/sealed screw threads.

[0055] The device 11 of the invention is thus of compact design. At rest, the diameter of the device 11 is equal to the outer diameter of the conduit 12 (the sleeve being in a contracted state) and is less than the diameter of the casing C1 in which it is installed. Once the device 11 has been put into position in the desired zone, the sleeve 20 is inflated by pumping in a liquid, suitable for causing the sleeve 20 to expand and to seal against the wall of the casing C1 and provide a fluid barrier.

[0056] In figure 6A, the sleeve 20 is shown when unexpanded inside the initial casing C1. The outer diameter OD1 of the new casing (i.e. of the conduit 12) is inferior to the inner diameter IDi of the initial casing C1.

[0057] The outer diameter OD1 of the sleeve 20 when unexpanded is equal to the outer diameter OD1 of the new casing (i.e. of the conduit 12).

[0058] Due to the specific mounting of the sleeve 20 on the conduit 12, the clearance between the conduit 12 and the casing C1 is minimized compared to the technique described in relation to Figure 1. The diameter of the conduit 12 is thus maximized, which in turn leads to higher refracturing fluid flow within the conduit 12 (in other words, no restriction on the inner diameter of the conduit 12 is required).

[0059] In the example of Figure 2, the external diameter OD1 of the conduit 12 is equal to 88,9 mm (3,5 inch). The internal diameter IDi of the casing C1 in which the conduit 12 is installed is equal to 98,43 mm in this example. The wall thickness "t" of the conduit 12 is equal to 9,53 mm. The clearance "c" between the outer face of the conduit 12 and inner face of the casing C1 is equal to 8,64 mm.

[0060] The depth "d" of the groove 121 is for instance comprised between 2 and 3 mm (the value "d" corresponds to the width of the wall of the sleeve 20).

[0061] A first method of manufacturing the device 11 of the invention is described in relation to Figures 3A to 3D.

[0062] The sleeve 20 has initially a larger inner diameter than the outer diameter of the conduit 12 (1 mm larger for instance). Once the sleeve 20 is fitted around the conduit 12 and faces the groove 121, the sleeve 20 is crimped along its entire length onto the conduit 12 (i.e. onto the wall of the groove 121). The extremities of the expandable sleeve 20 are then fixedly connected to the conduit 12 (i.e. to the wall of the groove 121), by welding for instance.

[0063] A second method of manufacturing the device 11 is represented in figures 4A to 4C. The conduit 12 is made of two parts 12A, 12B (Figure 4A), the first part 12A comprising a threaded bore 122 at one end and connecting means 70A at the other end. The second part 12B comprises connecting means 70B at one end and a threaded portion 123 at the other end, the threaded por-

tion 123 being located inside the groove 121.

[0064] Referring to Figure 4B, the expandable sleeve 20 is slid around the groove 121 of the second part 12B. The two parts 12A, 12B are then screwed together (the threaded portion 123 being fitted inside the threaded bore 122) and the extremities of the expandable sleeve 20 are fixedly connected to the two parts 12A, 12B, inside the groove 121 (Figure 4C).

[0065] The particular re-fracturing method disclosed in French Patent Application FR1461268 may implement the device 11 of the invention. As shown in Figure 7, the method involves the use of a tubular conduit 12 carrying a series of sleeves 20 as previously described. The sleeves 20 are first inflated (they are represented in their expanded state in Figure 7) and radially expanded under a first pressure. The conduit 12 is then closed at its downstream end using a ball 5 cooperating with a seat 4. Multi-stage re-fracturing is conducted between the sleeves 20 from the downstream end to the upper end of the conduit 12 under a second pressure. Before each re-fracturing step, a plug 8 is set in the conduit 12 downstream of the pair of sleeves 20 between which re-fracturing is required. It can be seen in Figure 7 that re-fracturing has been carried out in zones Z1 and Z2 and that re-fracturing is being carried out in zone Z3

[0066] (previously fractured) via perforations 9 in the wall of the conduit 12. The zones Z4 and Z5 previously fractured are then re-fractured according to the same approach.

[0067] Figure 5 is a schematic representation, in cross-section, of a device 11 according to a second embodiment of the invention.

[0068] In this specific embodiment, the wall of the conduit 12 has reduced thickness along a part of its length (the reduced thickness part of the wall is labelled 124). The device 11 does not comprise any expandable sleeve fitted around the conduit 12. It is this part 124 of reduced thickness that is expandable. In other words, the part 124 of reduced thickness forms an expandable sleeve. The thickness of the part 124 is chosen so that the part 124 is expanded radially by supplying fluid under predetermined pressure through the conduit 12.

[0069] The inner diameter of the part 124 is inferior to the outer diameter of the conduit 12. The outer diameter of the part 124 is inferior to the outer diameter of the conduit 12, thus forming a groove 121 (but it could be equal in an alternative embodiment).

[0070] The outer wall of the part 124, which is shown when unexpanded, may be provided with sealing material, such as an annular joint or membrane.

[0071] Both extremities of the conduit 12 are provided with connections 70A, 70B.

[0072] Figures 8A and 8B are a schematic representation, in cross-section, of the device 11 according to the second embodiment of the invention when installed inside a well A lined with a casing C1. The part 124 of reduced thickness is shown unexpanded in Figure 8A. The outer diameter OD1 of the new casing (i.e. of the

conduit 12) is inferior to the inner diameter IDi of the initial casing C1. The expanded part 124 of reduced thickness is shown expanded in Figure 8B.

[0073] The device of the invention may be used for re-fracturing wells lined with a cemented casing, which were previously fractured by the plug and perf method, but not only. It could also be used for fracturing or re-fracturing any type of wells, in particular open hole wells.

[0074] It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments.

[0075] Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. A device of a part of a completion string arranged in a well, said well being lined with a casing or open hole, comprising a tubular conduit designed to be placed within said well and comprising at least one expandable part along its length, said part being radially expandable under the action of fluid pressure so as to be applied tightly against the inner wall of the well or casing,
characterized in that the wall of said tubular conduit is of reduced thickness along the length of the expandable part,
and **in that** the expandable part has an inner diameter smaller than the tubular conduit outer diameter when unexpanded.
2. A device according to claim 1, the wall of reduced thickness is configured so that it forms an annular groove in the external face of said tubular conduit.
3. A device according to claim 1 or 2, **characterized in that** the expandable part is formed by the wall of reduced thickness.
4. A device according to claim 2, **characterized in that** the expandable part is formed by an expandable sleeve connected fixedly and hermetically at its opposite ends in said groove, the wall of said conduit comprising at least one inflation opening which allows the internal space of the conduit to communicate with the internal space of said sleeve, the groove being configured so that the outer face of said sleeve when unexpanded is substantially flush with the external face of said tubular conduit.
5. A device according to claim 3 or 4, **characterized in that** the expandable part has an internal diameter equal to or higher than the tubular conduit internal diameter.
6. A device according to any one of claims 3 to 5, **characterized in that** the expandable part has an external diameter equal to or smaller than the tubular conduit external diameter.
7. A device according to any one of claims 4 to 6, **characterized in that**, when the sleeve is unexpanded, the inner face of said sleeve facing the conduit is in contact with the bottom surface of said groove.
8. A device according to any one of claims 4 to 7, **characterized in that** each opposite end of said sleeve abuts against an edge of said groove.
9. A device according to any one of claims 2 to 8, **characterized in that** the depth of said groove is comprised between 2 and 3 mm.
10. A device according to any one of claims 1 to 9, **characterized in that** both ends of said tubular conduit are provided with first flush connecting means configured to join said tubular conduit to other tubular conduits of said completion string.
11. A device according to any one of claims 1 to 10, **characterized in that** said tubular conduit is formed from at least two sections joined end to end using second flush connecting means.
12. A device according to claim 10 or 11, **characterized in that** said first and second flush connecting means are threading means.
13. Method for manufacturing a device according to any one of claims 1, 2, 4 to 10 and 12, **characterized in that** it comprises the steps of:
 - machining at least one annular groove on the external face of a tubular conduit;
 - fitting a sleeve around the tubular conduit so that it faces the annular groove ;
 - crimping said sleeve in said groove, and
 - fastening the opposite ends of said sleeve within said groove.
14. Method according to claim 13, **characterized in that** the opposite ends of said sleeve are fastened to said groove by welding.
15. Method for manufacturing a device according to claim 11, **characterized in that** it comprises the steps of:
 - obtaining at least two sections configured to be joined end to end by flush connecting means

so as to form a tubular conduit, a first section having an annular groove on its external face ;
 - fitting a sleeve around said first section of the tubular conduit within said annular groove ;
 - connecting the two sections using flush connecting means, and
 - fastening the opposite ends of said sleeve within said groove.

Amended claims in accordance with Rule 137(2) EPC.

1. A device (11) of a part of a completion string arranged in a well (A), said well (A) being lined with a casing or openhole, comprising a tubular conduit (12) designed to be placed within said well (A) and comprising at least one expandable part along its length, said part being radially expandable under the action of fluid pressure so as to be applied tightly against the inner wall of the well (A) or casing, the wall of said tubular conduit (12) being of reduced thickness along the length of the expandable part, and the expandable part having an inner diameter smaller than the tubular conduit (12) outer diameter when unexpanded.
characterized in that the wall (124) of reduced thickness is configured so that it forms an annular groove (121) in the external face of said tubular conduit (12),
 and **in that** the expandable part is formed by an expandable sleeve (20) connected fixedly and hermetically at its opposite ends in said groove (121), the wall of said tubular conduit (12) comprising at least one inflation opening (13) which allows the internal space of the tubular conduit (12) to communicate with the internal space of said sleeve (20), the groove (121) being configured so that the outer face of said sleeve (20) when unexpanded is substantially flush with the external face of said tubular conduit (12).
2. A device (11) according to claim 1, **characterized in that** the expandable part (20) has an internal diameter equal to or higher than the tubular conduit (12) internal diameter.
3. A device (11) according to claim 1 or 2, **characterized in that** the expandable part (20) has an external diameter equal to or smaller than the tubular conduit (12) external diameter.
4. A device (11) according to any one of claims 1 to 3, **characterized in that**, when the sleeve (20) is unexpanded, the inner face of said sleeve (20) facing the tubular conduit (12) is in contact with the bottom surface of said groove (121).
5. A device (11) according to any one of claims 1 to 4,

characterized in that each opposite end of said sleeve (20) abuts against an edge of said groove (121).

6. A device (11) according to any one of claims 1 to 5, **characterized in that** the depth of said groove (121) is comprised between 2 and 3 mm.
7. A device (11) according to any one of claims 1 to 6, **characterized in that** both ends of said tubular conduit (12) are provided with first flush connecting means (70A, 70B) configured to join said tubular conduit (12) to other tubular conduits of said completion string.
8. A device (11) according to any one of claims 1 to 7, **characterized in that** said tubular conduit (12) is formed from at least two sections (12A, 12B) joined end to end using second flush connecting means (122, 123).
9. A device (11) according to claim 8, **characterized in that** said first and second flush connecting means (70A, 70B; 122, 123) are threading means.
10. Method for manufacturing a device (11) according to any one of claims 1 to 7, **characterized in that** it comprises the steps of:
 - machining at least one annular groove (121) on the external face of a tubular conduit (12);
 - fitting a sleeve (20) around the tubular conduit (12) so that it faces the annular groove (121) ;
 - crimping said sleeve (20) in said groove 121, and
 - fastening the opposite ends of said sleeve (20) within said groove (121).
11. Method according to claim 10, **characterized in that** the opposite ends of said sleeve (20) are fastened to said groove (121) by welding.
12. Method for manufacturing a device according to claim 8, **characterized in that** it comprises the steps of:
 - obtaining at least two sections (12A, 12B) configured to be joined end to end by flush connecting means (122, 123) so as to form a tubular conduit (12), a first section (12B) having an annular groove (121) on its external face ;
 - fitting a sleeve (20) around said first section (12B) of the tubular conduit (12) within said annular groove (121) ;
 - connecting the two sections (12A, 12B) using flush connecting means (122, 123), and
 - fastening the opposite ends of said sleeve (20) within said groove (121).

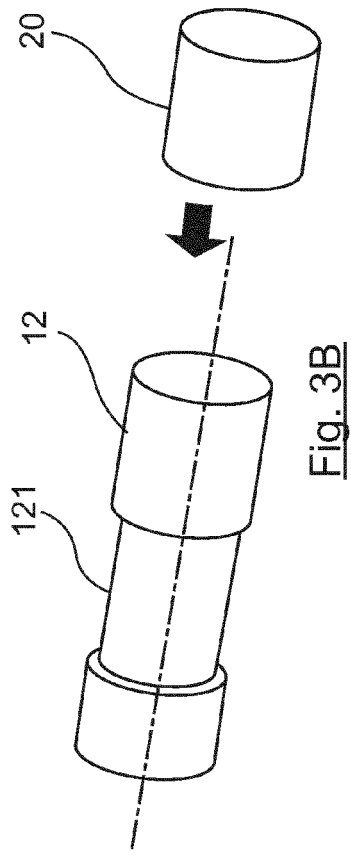


Fig. 3B

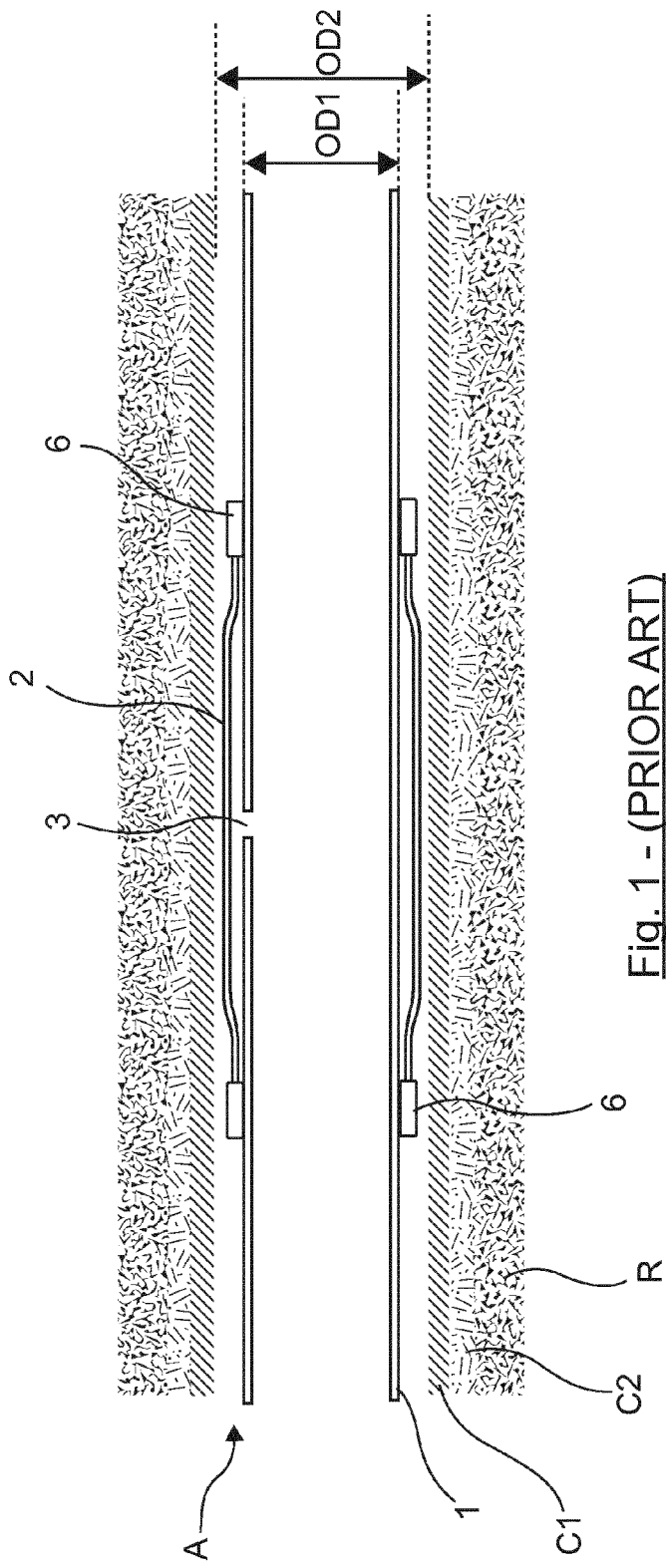


Fig. 1 - (PRIOR ART)

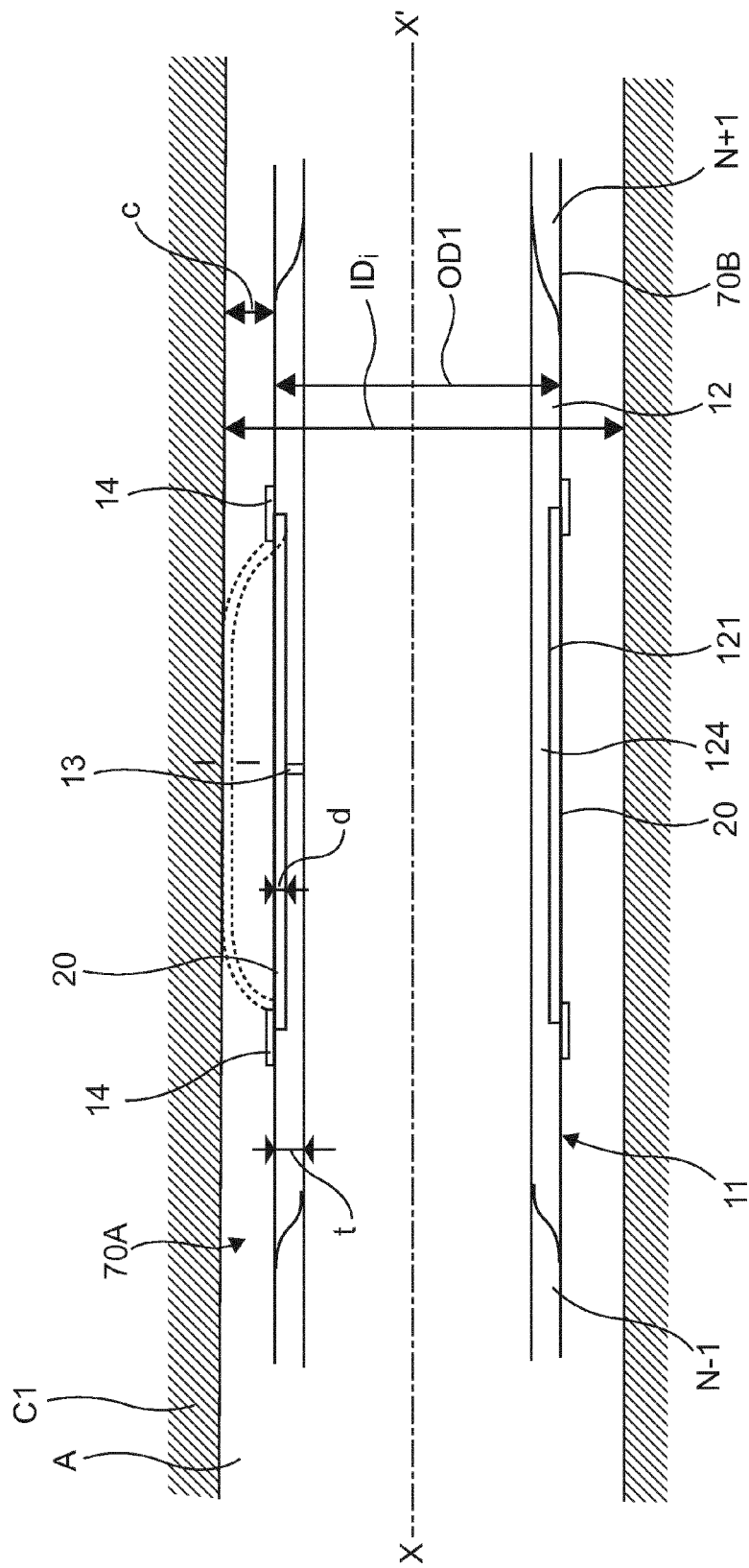


Fig. 2

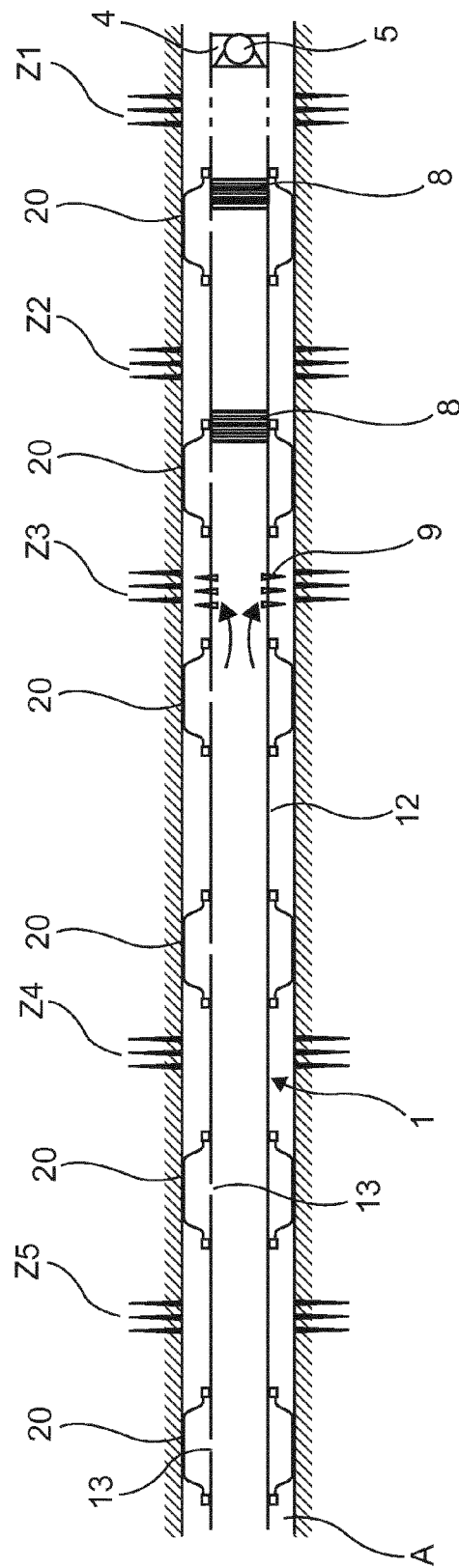


Fig. 7

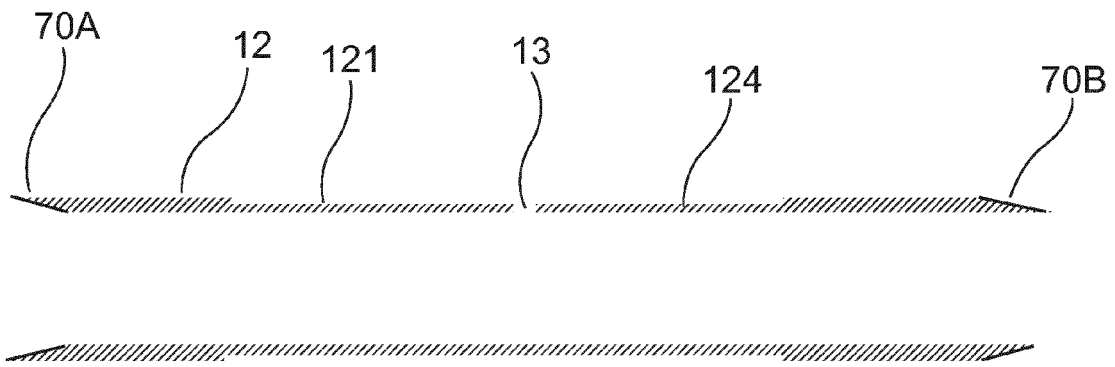


Fig. 3A

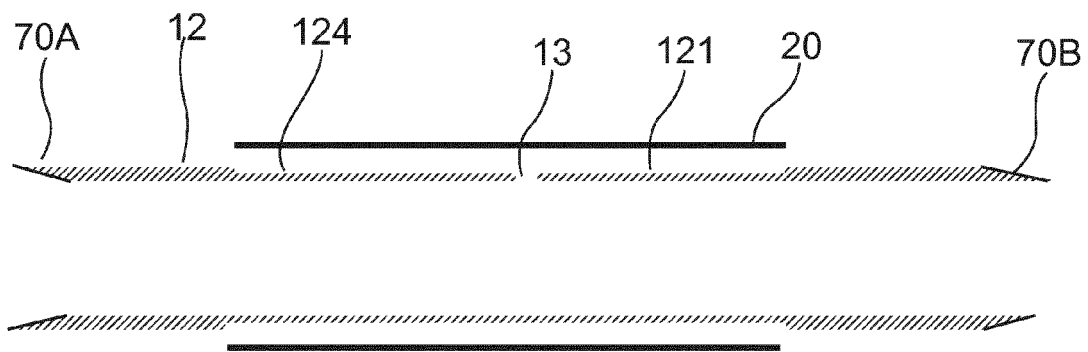


Fig. 3C

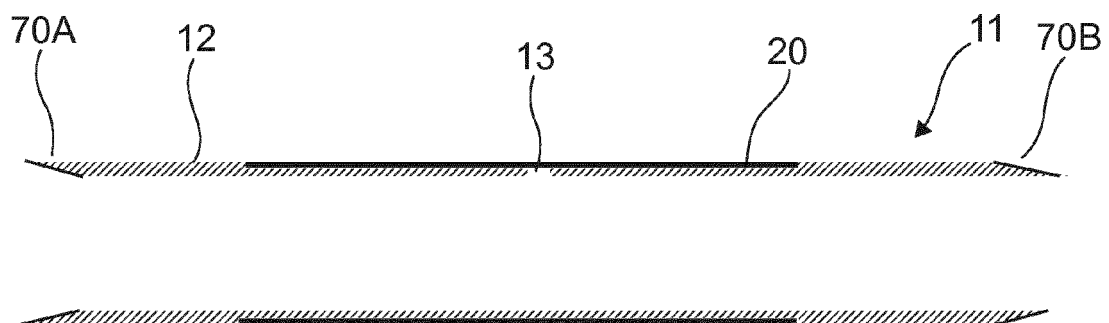
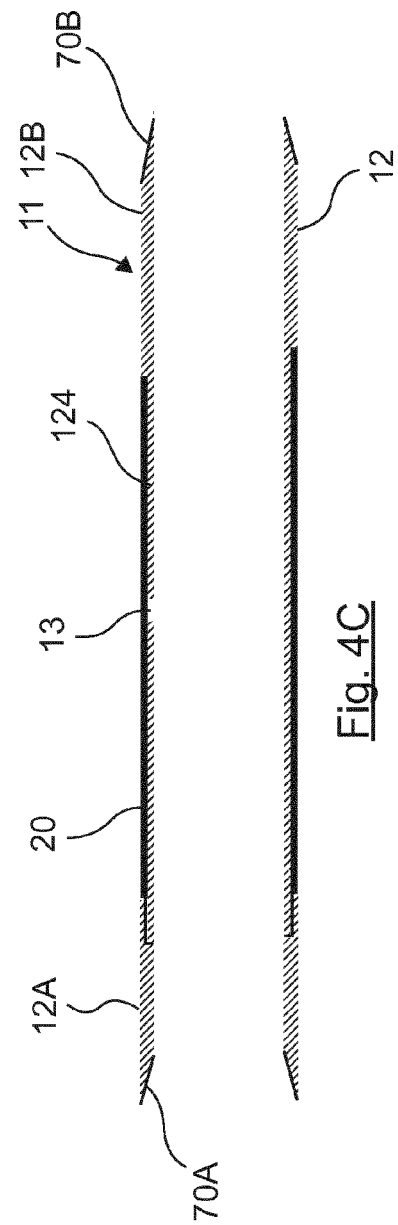
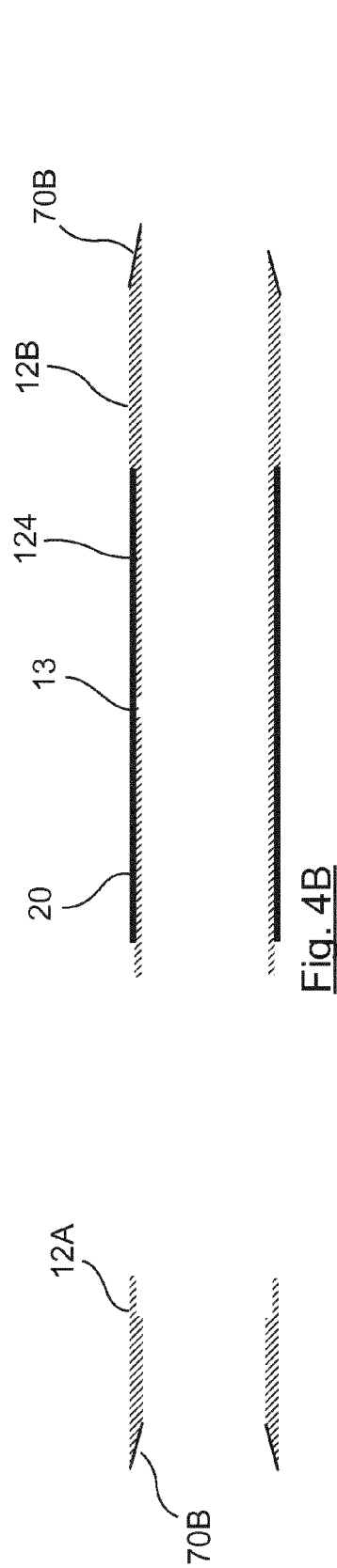
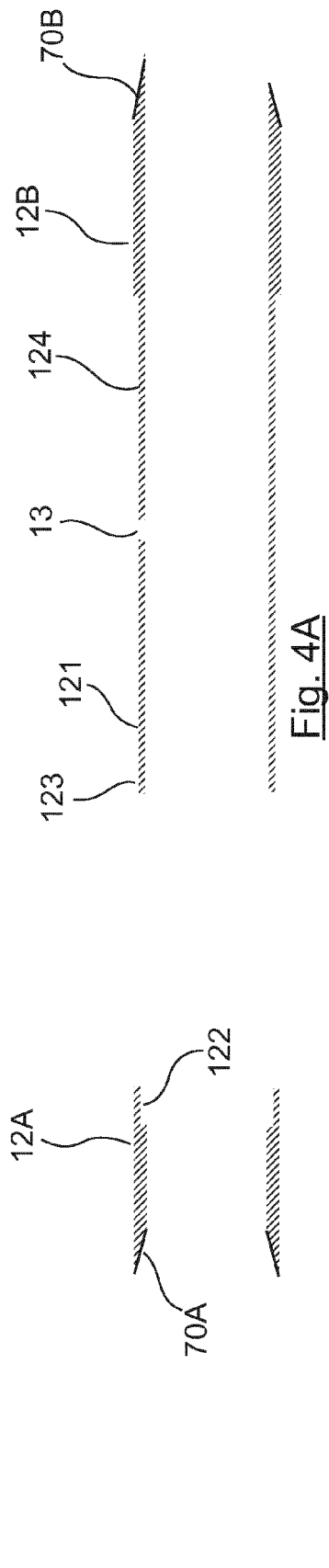


Fig. 3D



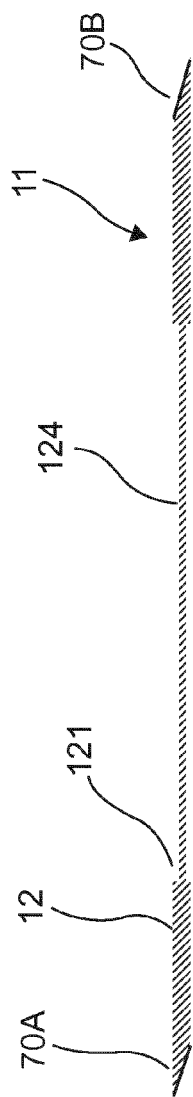


Fig. 5

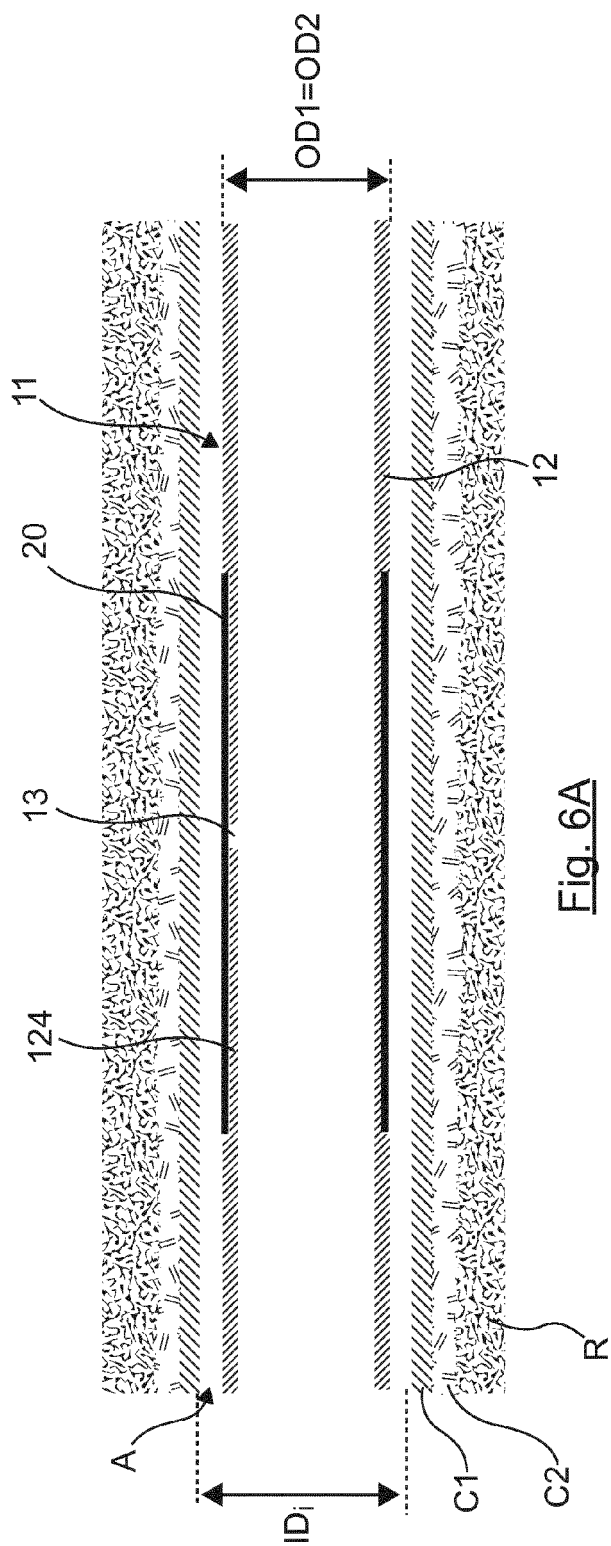


Fig. 6A

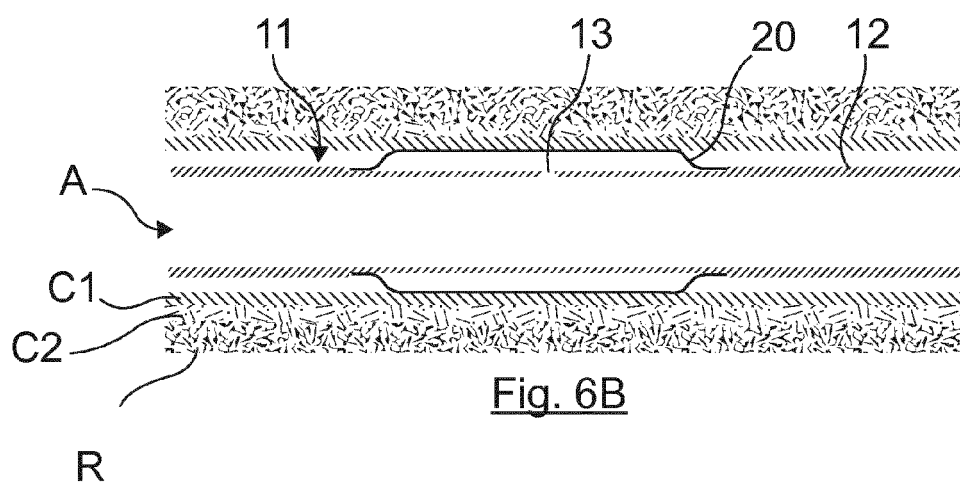


Fig. 6B

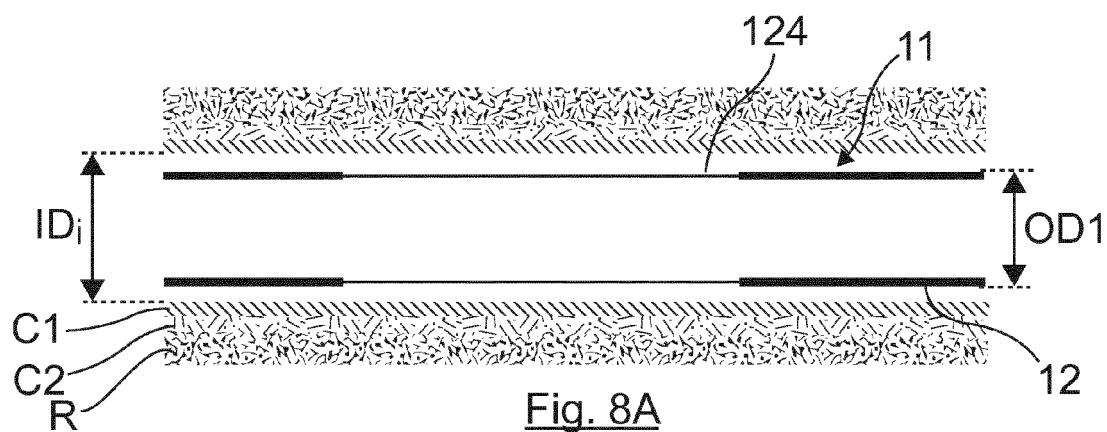


Fig. 8A

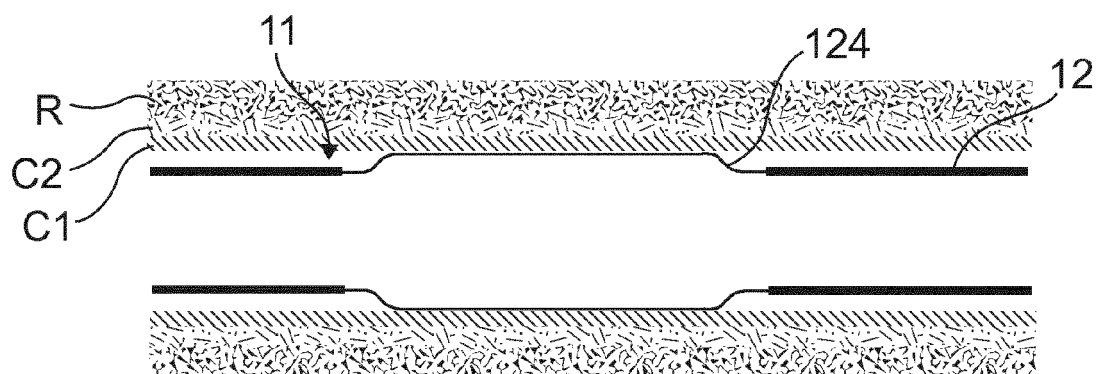


Fig. 8B



EUROPEAN SEARCH REPORT

Application Number
EP 15 30 5303

5

10

15

20

25

30

35

40

45

50

55

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	US 6 640 893 B1 (RUMMEL FRITZ [DE] ET AL) 4 November 2003 (2003-11-04) * column 2, line 8 - line 16; figure 1 * * column 2, line 62 - column 3, line 40 * -----	1,2,4-8, 10-12,15	INV. E21B33/12 E21B33/127 E21B43/10
X	US 2014/196914 A1 (RING LEV [US] ET AL) 17 July 2014 (2014-07-17) * paragraph [0045] * * paragraph [0055] * * figures 18,19 * * figure 15 * * paragraph [0009] * * paragraph [0011] * * paragraph [0073] - paragraph [0075] * -----	1-3,5,6, 9-12 13,14	
Y	US 2002/014339 A1 (ROSS RICHARD [US]) 7 February 2002 (2002-02-07) * paragraph [0034] - paragraph [0035]; figures 2,3 * -----	1-3,5-7, 10-12	
Y	EP 2 789 791 A1 (WELLTEC AS [DK]) 15 October 2014 (2014-10-15) * paragraph [0022]; figures 1,4 * -----	13,14	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2012/045813 A1 (WELLTEC AS [DK]; HALLUNDBAEK JOERGEN [DK]; HAZEL PAUL [GB]; ANDERSEN T) 12 April 2012 (2012-04-12) * abstract; figures 1,3,6-9 * -----	1-15	E21B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		20 August 2015	Dantinne, Patrick
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 30 5303

5

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-08-2015

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6640893 B1	04-11-2003	AT 268429 T	15-06-2004
		DE 60011254 D1	08-07-2004
		DE 60011254 T2	08-09-2005
		DK 1165933 T3	11-10-2004
		EP 1165933 A1	02-01-2002
		ES 2223487 T3	01-03-2005
		FR 2791732 A1	06-10-2000
		JP 2002540330 A	26-11-2002
		PT 1165933 E	29-10-2004
		US 6640893 B1	04-11-2003
		WO 0058601 A1	05-10-2000

US 2014196914 A1	17-07-2014	NONE	

US 2002014339 A1	07-02-2002	CA 2329388 A1	22-06-2001
		GB 2357536 A	27-06-2001
		NO 20006607 A	25-06-2001
		US 2002014339 A1	07-02-2002

EP 2789791 A1	15-10-2014	EP 2789791 A1	15-10-2014
		WO 2014167092 A1	16-10-2014

WO 2012045813 A1	12-04-2012	AU 2011311540 A1	02-05-2013
		CA 2813896 A1	12-04-2012
		CN 103154425 A	12-06-2013
		RU 2013120131 A	20-11-2014
		US 2013186615 A1	25-07-2013
		WO 2012045355 A1	12-04-2012
		WO 2012045813 A1	12-04-2012

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- FR 1461268 [0065]