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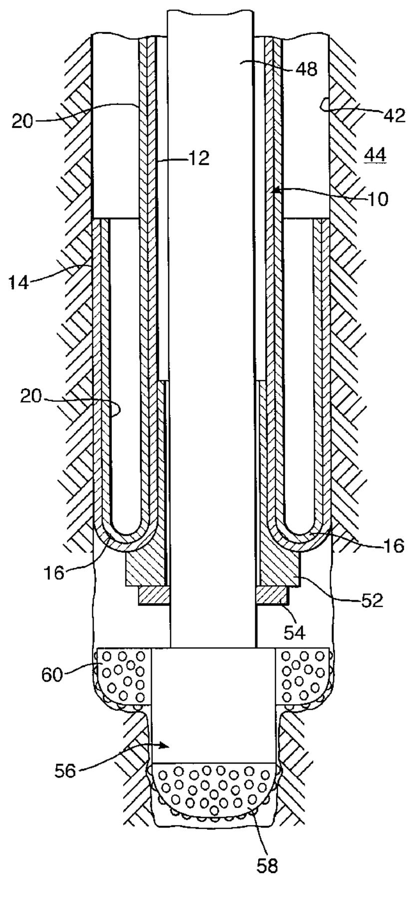
(54) Title: RADIALLY EXPANDING A TUBULAR ELEMENT



(57) Abstract: The invention relates to a method of radially expanding a tubular element. The method comprises inducing the wall of the tubular element to bend radially outward and in axially reverse direction so as to form an expanded tubular section extending around an unexpanded section of the tubular element, said wall having a resistance to radially outward bending and a resistance to stretching in circumferential direction. Said wall is provided with at least one of primary means for increasing the resistance to radially outward bending of the wall, and secondary means for reducing the resistance to stretching in circumferential direction of the wall.

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RADIALLY EXPANDING A TUBULAR ELEMENT

The present invention relates to a method of radially expanding a tubular element.

Expansion of tubular elements finds application in various fields of technology such as, for example, the production of hydrocarbon fluid from a wellbore formed in an earth formation. Wellbores are generally provided with one or more casings or liners to provide stability to the wellbore wall, and / or to provide zonal isolation between different earth formation layers. The terms "casing" and "liner" normally refer to wellbore tubulars for supporting and stabilising the wellbore wall, whereby it is generally understood that a casing extends from a downhole location to surface, whereas a liner does not fully extend to surface. However, in this specification the terms "casing" and "liner" are used interchangeably and without intended distinction.

In conventional wellbore construction, several casings are set at different depth intervals in a nested arrangement whereby each subsequent casing is lowered through the previous casing and therefore must have a smaller diameter than the previous casing. As a result, the cross-sectional wellbore size available for oil and gas production decreases with depth. To alleviate this drawback, it has been practiced to radially expand tubular elements in the wellbore after lowering thereof to the required depth. Such expanded tubular element forms, for example, an expanded casing section or an expanded clad against a previously installed existing casing. Also, it has been proposed to radially expand

subsequent casing sections to about the same diameter so that the available diameter in the wellbore remains substantially constant along (a portion of) its depth, as opposed to the conventional nested arrangement whereby the available diameter decreases with depth.
EP-044706-A2 discloses a method of radially expanding a tubular element by eversion of an inner tube to form an outer tube around a portion of the inner tube, the tubes being interconnected at their respective forward ends to present a rollover area capable of being moved forwardly.

The rollover area is induced to move forward by pumping driving fluid into the annular space between the inner and outer tubes.

It is a drawback of the known system and method that there is a risk that damage occurs to the tubular element as a result of the eversion process in the rollover area where the inner tube deforms into the outer tube, particularly for applications wherein the inner and outer tubes have a relatively large wall thickness.

Thus there is a need for an improved method of radially expanding a tubular element, which overcomes the drawbacks of the prior art.

In accordance with the invention there is provided a method of radially expanding a tubular element, the method comprising inducing the wall of the tubular element to bend radially outward and in axially reverse direction so as to form an expanded tubular section extending around an unexpanded section of the tubular element, said wall having a bending stiffness and a resistance to stretching in circumferential direction, wherein said wall is provided with at least one of primary means for increasing the bending stiffness of the wall, and secondary means for reducing the resistance to stretching in circumferential direction of the wall.

It is to be understood that the expression "bending the wall radially outward and in axially reverse direction" refers to eversion of the tubular element whereby a U-shaped wall portion is formed of which one leg forms the unexpanded section and the other leg forms the expanded section.

The resulting bending radius of the wall, and thus the degree of radially outward movement of the wall, depends on the bending stiffness of the wall and the resistance to stretching in circumferential direction of the wall. More specifically, the bending radius tends to increase with increasing bending stiffness and to decrease with increased resistance to stretching in circumferential direction. Therefore the actual bending radius follows from a balance between the effect of the bending stiffness tending to increase the bending radius, and the effect of the resistance to stretching in circumferential direction tending to decrease the bending radius. By providing the wall with means for increasing the bending stiffness and / or means for reducing the resistance to stretching in circumferential direction, it is achieved that the balance is shifted in favour of a larger bending radius. By virtue of such larger bending radius, the (equivalent) strains in the wall become less severe and consequently the risk of damage to the wall is reduced.

Suitably said primary means comprises at least one stiffening member connected to said wall, each stiffening member extending in longitudinal direction of the tubular element. The stiffening member can be connected, for example, to the outer surface and / or the inner surface of the wall by suitable connecting means, or it can be integrally formed with the wall. Furthermore, the stiffening member can be arranged parallel to the central longitudinal axis of the tubular element, or at an angle relative to the central longitudinal axis. In the latter case, the stiffening member suitably extends in a spiral-shape along the tubular element.

In a preferred embodiment, the primary means comprises a plurality of said stiffening members regularly spaced along the circumference of the tubular element.

Said secondary means suitable comprises at least one groove formed in said wall, each groove extending in longitudinal direction of the tubular element. The groove can be formed, for example, in at least one of the outer surface and the inner surface of said wall.

Preferably the secondary means comprises a plurality of said grooves regularly spaced along the circumference of the tubular element.

To progressively form the expanded tubular section, said bending of the wall occurs in a bending zone of the tubular element, and the method further comprises progressively increasing the length of said expanded tubular section by inducing the bending zone to move in axial direction along the tubular element.

The bending zone defines the location where the instantaneous bending process takes place. By inducing the bending zone to move in axial direction along the tubular element it is achieved that the tubular element is progressively expanded without the need for an expander that has to be pushed, pulled or pumped through the tubular element. Moreover, if the tubular element extends in vertical direction, for example into a wellbore, the weight of the unexpanded tubular section can be utilised to contribute to the force needed to induce downward movement of the bending zone.

Suitably said wall is induced to bend by moving the unexpanded tubular section in axial direction relative to the expanded tubular section. For example, the expanded tubular section can be held stationary while the unexpanded tubular section is moved in axial direction through the expanded section.

In a preferred embodiment the tubular element extends into a wellbore formed in an earth formation whereby, for example, the expanded tubular section extends between the wellbore wall and the unexpanded section of the tubular element. The expansion process is carried out in an effective manner if the expanded tubular section is kept substantially stationary in the wellbore and the unexpanded tubular section is moved in downward direction of the wellbore to induce said bending of the wall.

Further, the expansion process suitably can be initiated by bending the wall of the tubular element at a lower end portion thereof.

If the weight of the unexpanded tubular section is insufficient to induce movement of the bending zone, suitably a downward force is exerted to the unexpanded tubular section to move the unexpanded tubular section in downward direction of the wellbore.

Advantageously the wellbore is being drilled with a drill string extending through the unexpanded tubular section. In such application the unexpanded tubular section and the drill string preferably are lowered simultaneously through the wellbore during drilling with the drill string.

Optionally the bending zone can be heated to promote bending of the tubular wall.

To reduce any buckling tendency of the unexpanded section during the expansion process, the unexpanded section advantageously is centralised in the expanded section using any suitable centralising means.

Bending of the tubular wall can be promoted by providing longitudinal grooves at the outer surface of the tubular element before expansion.

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 an example of a tubular element during expansion thereof, not in accordance with the invention;

Fig. 2 schematically shows an embodiment of a tubular element during expansion in accordance with the invention;

Fig. 3 schematically shows cross-section 3-3 of Fig. 2;

Fig. 4 schematically shows a cross-section of an alternative embodiment of a tubular element during expansion in accordance with the invention;

Figs. 5a-5f schematically show various examples of stiffening members for use in the embodiments of Figs. 2-4;

Fig. 6 schematically shows the tubular element of Fig. 2 during expansion in a wellbore; and

Fig. 7 schematically shows the tubular element of Fig. 2 during expansion in a wellbore while the wellbore is being drilled.

In the Figures and the description like reference numerals relate to like components.

Referring to Fig. 1 there is shown a radially expandable tubular element 1 comprising an unexpanded section 2 and a radially expanded section 4 extending around the unexpanded section 2. The unexpanded and expanded sections 2, 4 are interconnected at their respective lower ends by a U-shaped wall portion 6 having a bending radius R1. The expanded section 4 is formed by bending the lower end of the wall of the tubular element 1 radially outward and in axially reverse direction. Subsequently the unexpanded section 2 is moved downward relative to the expanded section 4 so that, as a result, the unexpanded section 2 gradually becomes everted to form the expanded section 4. The resulting bending radius R_1 at the U-shaped wall portion 6 results from an equilibrium between the tendency of the wall to assume a relatively large bending radius due to the inherent bending stiffness of the wall, and the tendency of the wall to assume a relatively small bending radius due to the inherent resistance to stretching of the wall.

Referring to Fig. 2 there is shown a radially expandable tubular element 10 comprising an unexpanded section 12 and a radially expanded section 14 extending around the unexpanded section 12, the unexpanded and expanded tubular sections 12, 14 being interconnected at their lower ends by a U-shaped wall portion 16 having a bending radius R_2. The tubular element 10 is substantially similar to the tubular element 1 of Fig. 1 with regard to material properties, wall thickness and unexpanded diameter. However the tubular element 10 is additionally provided with a plurality of longitudinal stiffening members 20 extending along the outer surface of the unexpanded section 12 and the inner surface of the expanded section 14. The expanded section 14 is formed by bending the wall of the tubular element 10, at the lower end thereof, radially outward and in axially reverse direction, and subsequently moving the unexpanded section 12 downward relative to the expanded section 14 so that, as a result, the unexpanded section 12 is gradually everted to form the expanded section 14. The resulting bending radius R2 at the U-shaped wall portion 16 results from an equilibrium between the tendency of the wall to assume a relatively large bending radius due to the inherent bending stiffness of the wall, and the tendency of the wall to assume a relatively small bending radius due to the inherent resistance to stretching of the wall. By virtue of the stiffening members 20, the bending stiffness of the tubular element 10 is larger than the bending stiffness of the tubular element 1 of Fig. 1 so that, as a result, the equilibrium between said tendency of the wall to assume a relatively large bending radius and said tendency of the wall to assume a relatively small bending radius shifts towards a larger bending radius for the tubular element 10. In other words: $R_2 > R_1$.

In Fig. 3 is shown a cross-sectional view of the unexpanded section 12 of tubular element 10 whereby a layer 22 of metal, or other suitable material, is arranged around the outer surface of the tubular element 10. The layer 22 is provided with a plurality of longitudinal grooves 24 regularly spaced in circumferential direction of the tubular element 10. Each stiffening member 20 is defined in-between a respective pair of adjacent grooves 24. The layer 22 can be connected to the outer surface of the tubular element 10 in any suitable manner, or it can be integrally formed with the tubular element 10. In the latter case, the tubular element 10 and the layer 22 can be machined from one piece.

In Fig. 4 is shown a cross-sectional view of an alternative embodiment of a tubular element 26 to be expanded with the method of the invention. The tubular element 26 is at its inner surface provided with a layer 28 provided with a plurality of longitudinal grooves 30 regularly spaced in circumferential direction of the tubular element 10. The grooves 30 define a plurality of longitudinal stiffening members 32, whereby each stiffening member 32 is defined in between a respective pair of adjacent grooves 30. The metal layer 28 can be connected to the inner surface of the tubular element 26 in any suitable manner, or it can be integrally formed with the tubular element 26.

Figs. 5a-5f show various embodiments, in cross-sectional view, of stiffening members for a tubular element to be expanded with the method of the invention.

In each of Figs. 5a-5f, reference sign 34 indicates the wall of the tubular element, and the respective stiffening members are indicated by reference signs 35, 36, 37, 38, 39, 40.

Similarly to the embodiments shown in Figs. 3 and 4, the stiffening members 35, 36, 37, 38, 39, 40 can be arranged at the outer surface or the inner surface of the unexpanded tubular element.

In Fig. 6 is shown the tubular element 10 of Fig. 2 in a wellbore 42 formed in an earth formation 44.

During normal operation the lower end portion of the wall of the (yet unexpanded) tubular element 10 is bent radially outward and in axially reverse direction by any suitable means so as to initially form the U-shaped lower section 16. Subsequently, a downward force is applied to the unexpanded section 12 to move the unexpanded section 12 gradually downward. The unexpanded section 12 thereby becomes progressively everted to form into the expanded section 14. During the eversion process, the U-shaped lower section 16 moves downward at approximately half the speed of the unexpanded section 12. By virtue of the enhanced bending stiffness of the wall of the tubular element 10 due to the stiffening members 20, the bending radius R2 of the U-shaped lower section is relatively large so that the tubular element 10 is expanded to a relatively large diameter. If desired, the tubular element 10 and / or the stiffening members 20 can be selected such that the expanded tubular section 14 becomes firmly expanded against the wellbore wall so that a seal is formed between the expanded tubular section 14 and the wellbore wall.

Referring to Fig. 7 there is shown the tubular element 10 of Fig. 2 in combination with a drill string 48 extending from surface through the unexpanded section 12, and further to the bottom of the wellbore 42. The drill string 48 is provided with a tubular guide member 52 for guiding and supporting the U-shaped lower section 16 of the tubular element 10, the guide member 52 being supported by a support ring 54 connected to the drill string 48. The support ring 54 is made radially retractable so as to allow it to pass in retracted mode through the guide member 52 and the unexpanded section 12.

Furthermore, the drill string 48 is provided with a drill bit 56 that is driven in rotation either by a downhole motor (not shown) or by rotation of the drill string 48 itself. The drill bit 56 comprises a pilot bit 58 and a collapsible reamer 60 for drilling the wellbore

48 to its nominal diameter. The pilot bit 58 and the reamer 60, when in collapsed mode, have a maximum diameter slightly smaller than the internal diameter of the guide member 52 so as to allow the pilot bit 58 and the reamer 60 to be retrieved to surface through the guide member 52 and through the unexpanded tubular section 12.

During normal operation the drill bit 56 is driven in rotation to deepen the wellbore 42 whereby the drill string 48 and the unexpanded tubular section 12 move simultaneously deeper into the wellbore 42. The unexpanded tubular section 12 can be assembled from individual pipe sections at surface, as is normal practice for tubular strings such as drill strings, casings or liners. Alternatively the unexpanded tubular section can be supplied as a continuous tubular element, such as a coiled tubing.

The U-shaped lower portion 16 of the tubular element 10 is supported and guided by the guide member 52. Initially a downward force needs to be applied to the unexpanded section 12 to induce lowering thereof simultaneously with the drill string 48. As the length of the unexpanded section 12 in the wellbore 42 increases, the weight of the unexpanded section 12 gradually replaces the applied downward force. Eventually, after the weight of the unexpanded section has fully replaced the applied downward force, an upward force may need to be applied to the unexpanded section 12 to prevent overloading of the U-shaped lower portion 16.

The weight of the unexpanded tubular section 12 also can be used to thrust the drill bit 56 forward during drilling of the wellbore 42. In the embodiment of Fig. 7 such thrust force is transmitted to the drill bit 56 via the guide member 52 and the support ring 54. In an alternative embodiment, the guide member is dispensed with and the thrust force is directly transmitted from the unexpanded tubular section to the drill string, for example via a suitable thrust bearing (not shown) between the unexpanded section and the drill string.

Thus, by gradually lowering the unexpanded tubular section 12 into the wellbore 42, the U-shaped lower wall portion 16 progressively bends in radially outward and axially reverse direction, thereby progressively forming the expanded tubular section 14. During the expansion process, the U-shaped lower portion 16 is supported and guided by the guide member 52 so as to promote bending of the wall of the unexpanded section 12.

When it is required to retrieve the drill string 48 to surface, for example when the drill bit is to be replaced or after drilling has completed, the support ring 54 is radially retracted and the reamer bit 60 collapsed. Thereafter the drill string 48 is retrieved through the unexpanded tubular section 12 to surface. The guide member 52 can remain downhole. Alternatively the guide member can be made collapsible so as to allow it to be retrieved to surface in collapsed mode through the unexpanded tubular section.

With the method described above it is achieved that there is only a very short open-hole section in the wellbore 42 during drilling since the expanded tubular section 14 extends to near the lower end of the drill string 48 at any time. The method therefore finds many advantageous applications. For example, if the expanded tubular section is a casing, longer intervals can be drilled without the need to interrupt drilling to set new casing sections, thereby leading to fewer casing sections of stepwise decreasing diameter. Also, if the wellbore is drilled through a shale layer the substantial absence of an open-hole section eliminates problems due to shale heaving.

After drilling of the wellbore 42 has been finalised and the drill string 48 has been removed from the wellbore, the length of unexpanded tubular section 12 still present in the wellbore 42 can be cut-off from the expanded section 14 and subsequently retrieved to surface, or it can be left in the wellbore. In the latter case there are several options for completion of the wellbore, including for example:

i) A fluid, for example brine, is pumped into the annular space between the unexpanded and expanded sections 12, 14 so as to increase the collapse resistance of the expanded section 14. Optionally, an opening can be made in the wall of the tubular element 10, near its lower end, to allow the pumped fluid to be circulated therethrough;

ii) A heavy fluid is pumped into the annular space between the unexpanded and expanded sections 12, 14 to support the expanded tubular section 14 and increase its collapse resistance;

iii) Cement is pumped into the annular space between the unexpanded and expanded sections 12, 14 to create a solid body in the annular space after hardening of the cement. Suitably, the cement expands upon hardening;

iv) The unexpanded section 12 is radially expanded against the expanded section 14, for example by pumping, pushing or pulling an expander (not shown) through the unexpanded section 12.

Optionally a weighted fluid can be pumped into the annular space between the unexpanded and expanded sections, or the annular space can pressurized, during or after the expansion process, to reduce the collapse loading on the expanded section 14 and/or to reduce the burst loading on the unexpanded liner section 12.

Furthermore, electric wires or optical fibres can be arranged in the annular space between the unexpanded and expanded sections for downhole data communication or for downhole electric power transmission. Such wires or fibres can be attached to the outer surface of the tubular element 10 before expansion thereof. Also, the unexpanded and expanded sections 12, 14 can be used as electric conductors for transferring data and/or power downhole.

Since the length of unexpanded tubular section that is left in the wellbore does not need to be expanded, less stringent requirements regarding material properties etc. may apply to it. For example, said length may have a lower or higher yield strength, or a smaller or larger wall thickness than the expanded tubular section.

Instead of leaving a length of unexpanded tubular section in the wellbore after the expansion process, the entire tubular element can be expanded with the method of the invention so that no unexpanded tubular section remains in the wellbore. In such case, an elongate member, for example a pipe string, can be used to exert the necessary downward force to the unexpanded tubular section during the last phase of the expansion process.

Suitably a friction-reducing layer, such as a Teflon layer, is applied between the unexpanded and expanded tubular sections during the expansion process to reduce friction forces. For example, a friction reducing coating can be applied to the outer surface of the tubular element before expansion. Such layer of friction reducing material has the additional advantage of reducing the annular clearance between the unexpanded and expanded sections, thus resulting in a reduced buckling tendency of the unexpanded section. Instead of, or in addition to, a friction-reducing layer, centralizing pads and/or rollers can be applied between the unexpanded and expanded sections to reduce friction forces.

With the method of the invention, the expanded tubular section can extend from surface into the wellbore, or it can extend from a downhole location deeper into the wellbore.

Instead of expanding the tubular element against the wellbore wall (as described above), the tubular element can be expanded against the inner surface of a tubular element previously installed in the wellbore. Furthermore, instead of expanding the tubular element in downward direction in the wellbore, the tubular element can be expanded in upward direction whereby the U-shaped section is located at the upper end of the tubular element.

Although the examples described above refer to applications of the invention in a wellbore, it is to be understood that the method of the invention also can be applied at the earth surface. For example, the expanded tubular section can be expanded against the inner surface of a pipe, for example an existing flowline for the transportation of oil or gas located at the earth surface or at some depth below the surface. Thereby the flowline is provided with a new lining, thus obviating the need to replace the entire flowline in case of damage or corrosion of the flowline.

CLAIMS

1. A method of radially expanding a tubular element, the method comprising inducing the wall of the tubular element to bend radially outward and in axially reverse direction so as to form an expanded tubular section extending around an unexpanded section of the tubular element, said wall having a bending stiffness and a resistance to stretching in circumferential direction, wherein said wall is provided with at least one of primary means for increasing the bending stiffness of the wall, and secondary means for reducing the resistance to stretching in circumferential direction of the wall.

2. The method of claim 1, wherein said primary means comprises at least one stiffening member extending in longitudinal direction along said wall.

3. The method of claim 2, wherein the stiffening member is connected to at least one of the outer surface and the inner surface of said wall.

4. The method of claim 2 or 3, wherein the stiffening member and the wall are integrally formed.

5. The method of any one of claims 2-4, wherein said primary means comprises a plurality of said stiffening members regularly spaced along the circumference of the tubular element.

6. The method of any one of claims 1-5, wherein said secondary means comprises at least one groove formed in said wall, each groove extending in longitudinal direction of the tubular element.

7. The method of claim 6, wherein the groove is formed in at least one of the outer surface and the inner surface of said wall.

8. The method of claim 6 or 7, wherein said secondary means comprises a plurality of said grooves regularly spaced along the circumference of the tubular element.

9. The method of any one of claims 1-8, wherein said bending of the wall occurs in a bending zone of the tubular element, and wherein the method further comprises progressively increasing the length of said expanded tubular section by inducing the bending zone to move in axial direction along the tubular element.

10. The method of any one of claims 1-9, wherein the wall is induced to bend by moving the unexpanded tubular section in axial direction relative to the expanded tubular section.

11. The method of any one of claims 1-10, wherein the tubular element extends into a wellbore formed in an earth formation.

12. The method of claim 11, wherein the expanded tubular section extends between the wellbore wall and the unexpanded section of the tubular element.

13. The method of claim 11 or 12, wherein said bending of the wall is started at a lower end portion of the tubular element.

14. The method of any one of claims 11-13, wherein the expanded tubular section is kept substantially stationary in the wellbore and the unexpanded tubular section is moved in downward direction of the wellbore to induce said bending of the wall.

15. The method of claim 14, wherein a downward force is exerted to the unexpanded tubular section to move the

unexpanded tubular section in downward direction of the wellbore.

16. The method of any one of claims 11-15, wherein the wellbore is being drilled with a drill string extending through the unexpanded tubular section.

17. The method of claim 16, wherein the unexpanded tubular section and the drill string are simultaneously lowered through the wellbore during drilling with the drill string.

18. The method of any one of claims 11-17, wherein the expanded tubular section is compressed against the wellbore wall or against another tubular element arranged in the wellbore as a result of the expansion process.

19. A radially expanded tubular element obtained with the method of any one of claims 1-18.

20. The method substantially as described hereinbefore with reference to the drawings.

21. The radially expanded tubular element substantially as described hereinbefore with reference to the drawings.

Fig.2.

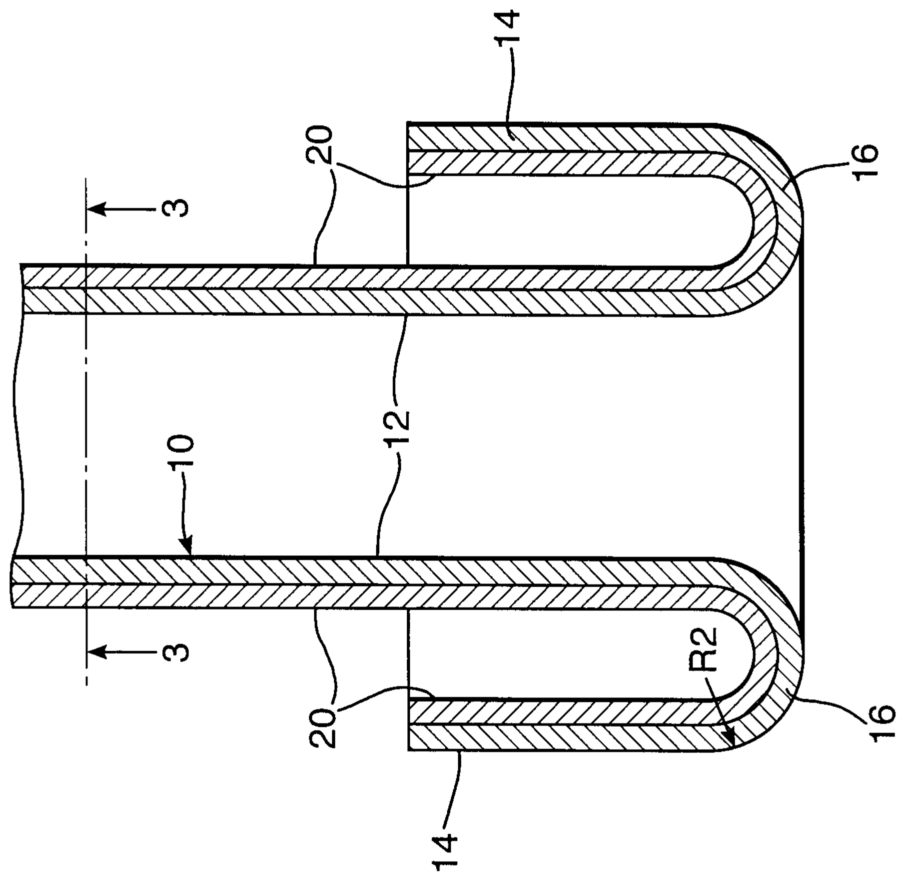


Fig.1.

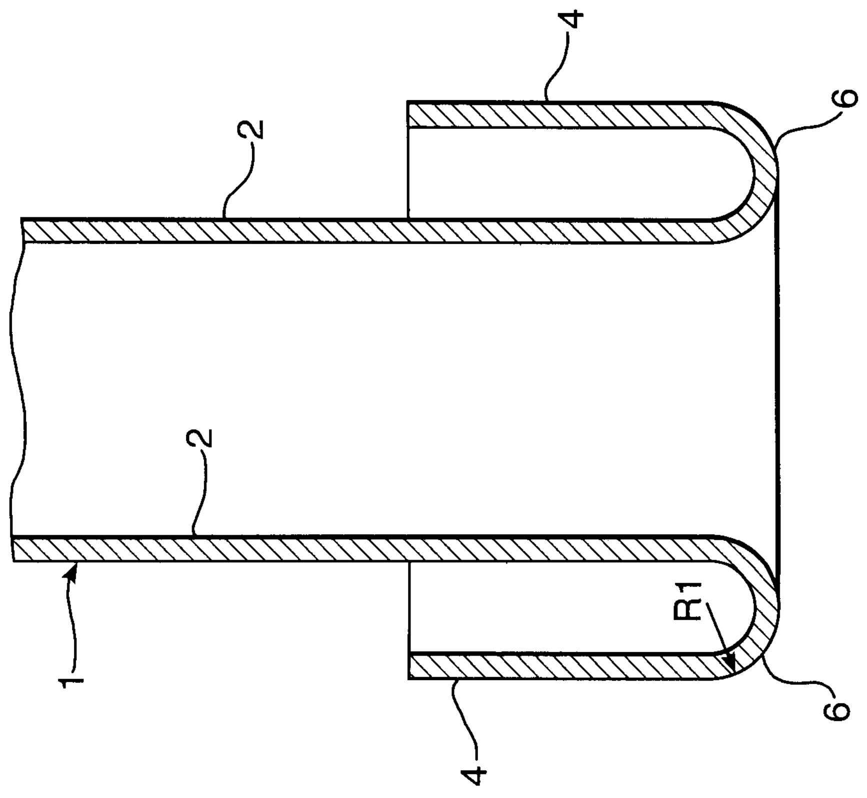


Fig.3.

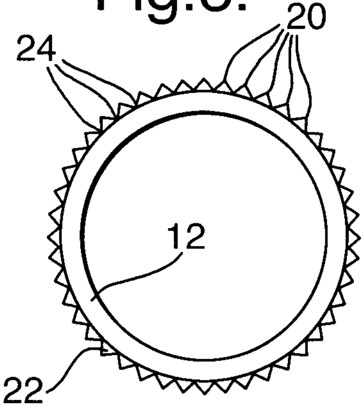


Fig.4.

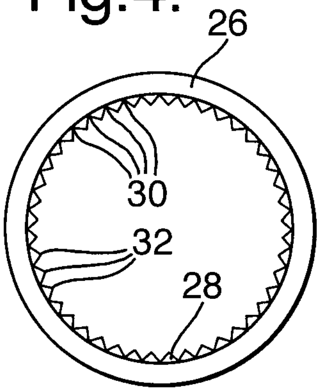


Fig.5a.

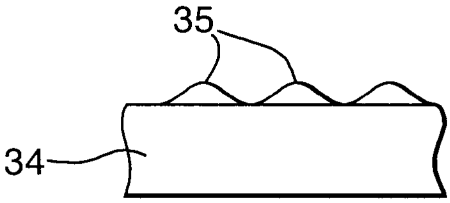


Fig.5b.

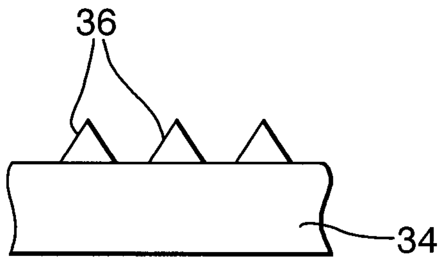


Fig.5c.

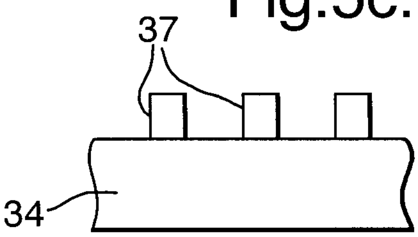


Fig.5d.

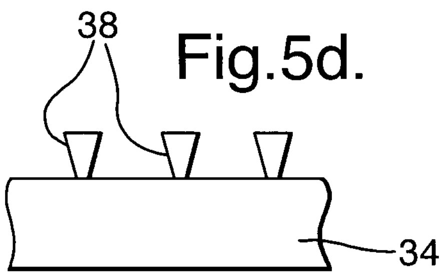


Fig.5e.

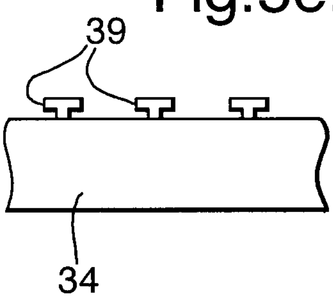


Fig.5f.

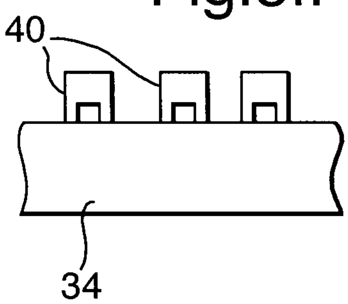


Fig.6.

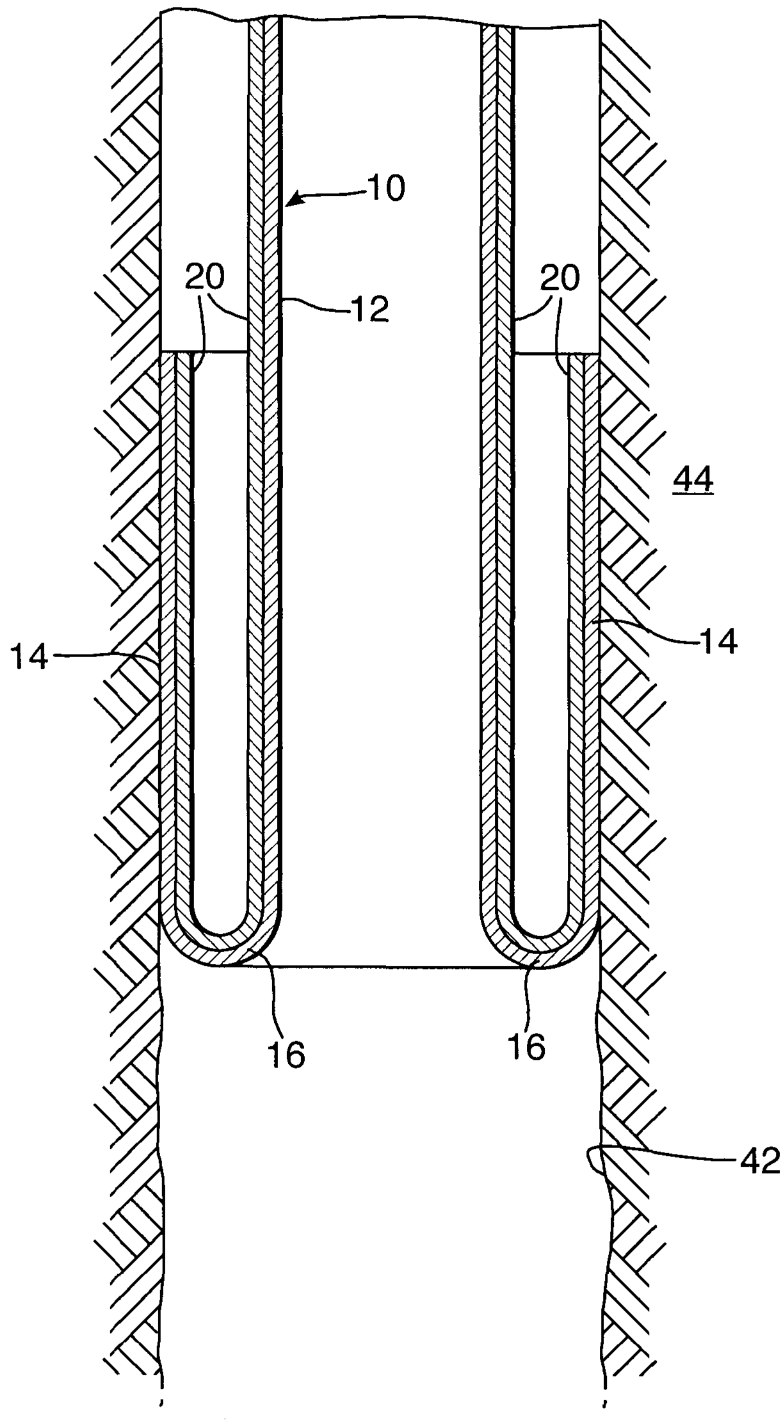
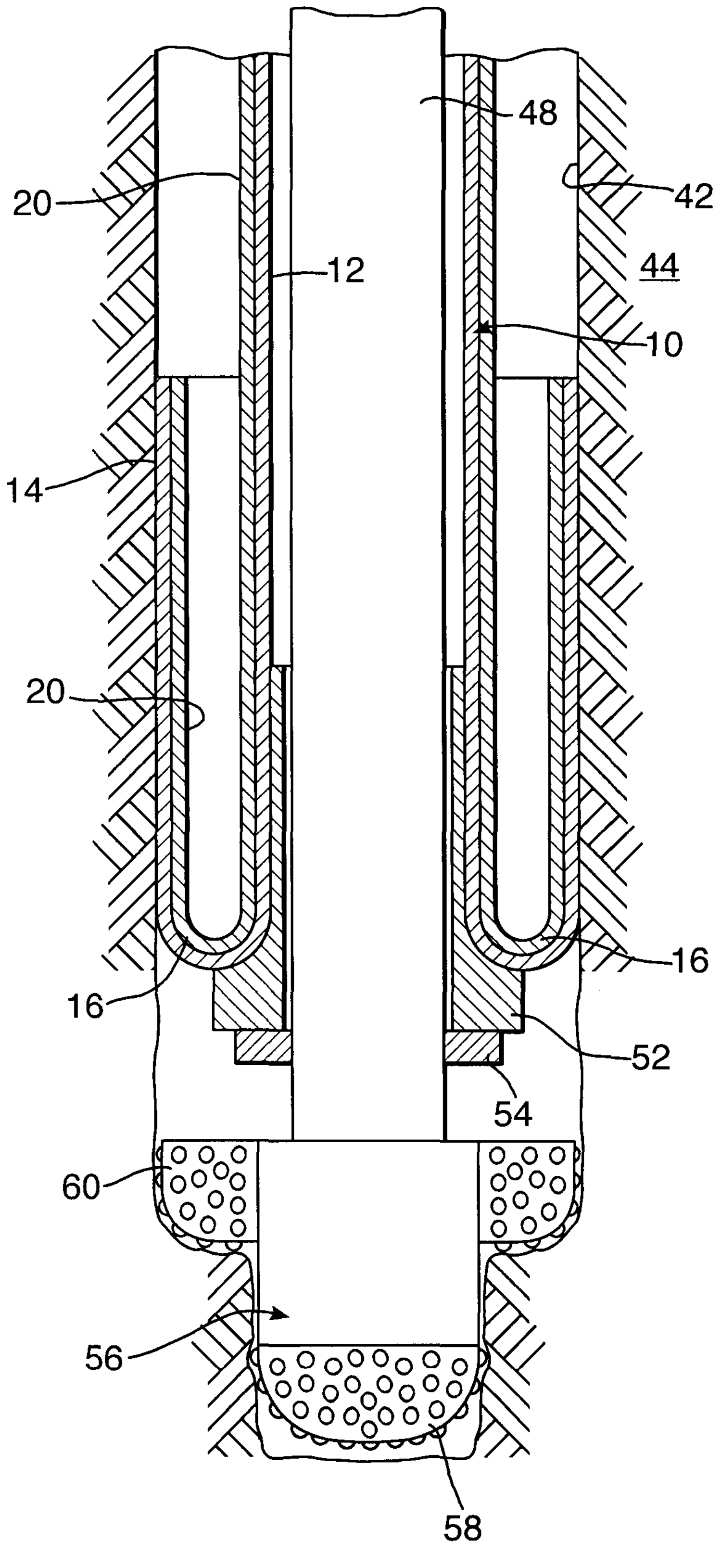


Fig.7.



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/061324

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B43/10 F16L55/165

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)
E21B B29C F16L

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	EP 0 611 914 A (LIONEL RICHARD [FR]) 24 August 1994 (1994-08-24) column 2, line 34 - line 56; figures 1-8	1-21
X	US 6 708 729 B1 (SMITH E PETER [US]) 23 March 2004 (2004-03-23) column 3, line 29 - column 4, line 9; figures 1,10,12 column 6, line 43 - line 54	1-3,5, 9-15, 18-21
X	WO 03/038331 A (OWENS CORNING COMPOSITES S P R [BE]; OWENS CORNING FIBERGLAS ESPANA [E) 8 May 2003 (2003-05-08) page 2, line 18 - line 21; figure 1a page 3, line 24 - line 27 page 6, line 1 - line 28 page 15, line 12 - line 26	1-3,5, 9-15, 18-21

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

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 February 2008	14/02/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dantinne, Patrick

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2007/061324

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