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(71) Applicant (for all designated States except US): **BAKER HUGHES INCORPORATED** [US/US]; 3900 Essex Lane, Suite 1200, Houston, Texas 77027 (US).

(72) Inventors: **CORONDADO, Martin, P.**; 19826 Red Cedar Canyon Lane, Cypress, Texas 77429 (US). **CROW, Steve, L.**; 5019 Fox Grass Trail, Kingwood, Texas 77345 (US). **PETERSON, Elmer, R.**; 19606 Riverview Drive, Porter, Texas 77367 (US). **ZACHMANN, James, R.**; 14 Amber Fire Place, The Woodlands, Texas 77381 (US). **MENEDEZ, Luis, E.**; 15805 Elwood, Houston, Texas 77040 (US).

(74) Agents: **RIDDLE, Albert, J.** et al.; Baker Hughes Incorporated, 3900 Essex Lane, Suite 1200, Houston, TX 77027 (US).

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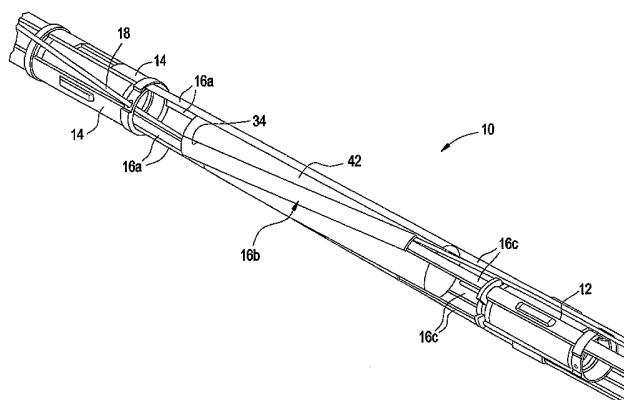
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(54) Title: GRAVEL PACK SHUT TUBE WITH CONTROL LINE RETENTION AND METHOD FOR RETAINING CONTROL



(57) Abstract: A gravel pack multi-pathway tube includes a body and a flow passage at the body. Further, the tube includes a projection at the body, the projection receptive to a control line. A gravel packing device component wherein the component includes a shroud, a multi-pathway tube at the shroud, and a projection appurtenant the multi-pathway tube, the projection being receptive to a control line. A method for running and protecting a control line at a gravel pack component, which includes running a component into a wellbore wherein the component includes a shroud, a multi-pathway tube at the shroud, and a projection appurtenant the multi-pathway tube, the projection being receptive to a control line and inserting a control line at the projection.

GRAVEL PACK MULTI-PATHWAY TUBE WITH CONTROL LINE
RETENTION AND METHOD FOR RETAINING CONTROL LINE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of an earlier filing date from U.S. Provisional Application Serial No. 60/643,819 filed January 14, 2005, the entire disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] In oil and gas wells, multi-pathway tubes around screen shrouds are known to convey gravel pack slurry beyond annular obstructions of any kind. In general, such multi-pathway tubes (also termed alternate path technology) begin “operating” automatically when an obstruction such as an annular bridge arises. Multi-pathway tubes are open to the annulus just downstream of a gravel pack packer and provide an alternate path for the flow of the slurry if indeed gravel slurry pressure rises due to an annular obstruction. Where no annular obstruction exists, the multi-pathway tube is naturally bypassed for the easier flowing annulus.

[0003] Where the multi-pathway tube does become a slurry conduit, that slurry is reintroduced to the annulus downstream of the obstruction by exiting ports in the multi-pathway tube where pressure in the annulus allows. Because of the high pressure in the multi-pathway tube, the slurry tends to exit at a high velocity. Slurry being by nature erosive, a property exacerbated by high velocity, it is a very effective cutting implement. Any type of control line utilized must be protected from this discharge.

[0004] In order to run control lines downhole, the art has clamped the lines to outside of the screen shroud, and run an additional screen shroud outside of the multi-pathway tubes. This may be effective but does increase the overall outside dimension of the assembly. As one of skill in the art is all too aware, increasing an outside dimension or reducing an inside dimension are to be avoided.

SUMMARY

[0005] Disclosed herein is a gravel pack multi-pathway tube that includes a body and a flow passage at the body. Further, the tube includes a projection at the body, the projection receptive to a control line.

[0006] Further disclosed herein is a gravel packing device component wherein the component includes a shroud, a multi-pathway tube at the shroud, and a projection appurtenant the multi-pathway tube, the projection being receptive to a control line.

[0007] Yet further disclosed herein is a method for running and protecting a control line at a gravel pack component, which includes running a component into a wellbore wherein the component includes a shroud, a multi-pathway tube at the shroud, and a projection appurtenant the multi-pathway tube, the projection being receptive to a control line and inserting a control line at the projection.

[0008] Yet further disclosed herein is a multi-pathway tube including an elongated body cross-sectionally defining a flow passage, the body having a radially larger boundary and a radially smaller boundary, the boundaries joined laterally by semicircular boundaries. A projection extends from the radially larger boundary and has a substantially equivalent radius of curvature, the projection being receptive to a control line to provide retention for the control line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Referring now to the drawings wherein like elements are numbered alike in the several Figures:

[0010] Figure 1 is a perspective schematic view of a gravel pack component illustrating multi-pathway tubes and a control line;

[0011] Figure 2 is a cross-sectional view of the multi-pathway tube with a screen shroud shown in phantom;

[0012] Figure 3 is a schematic elevation view of the component illustrated in Figure 1 entering a rotary and the control line being inserted;

[0013] Figure 4 is a view similar to Figure 2 but with one of the projections bent;

[0014] Figure 5 is a schematic representation of an alternative multi-pathway tube; and

[0015] Figure 6 is a schematic representation of the alternative multi-pathway tube of Figure 5 in a completed condition.

DETAILED DESCRIPTION

[0016] Referring to Figure 1, some of the components of a gravel packing apparatus 10 are illustrated to provide environment for the arrangement disclosed herein. In Figure 1, a cross coupling connector 12 is illustrated twice with a space interval. The space interval is occupied primarily by a gravel pack screen. Such screens are known to the art and do not require explanation here. The screen itself is not shown in the figures hereof but will be understood by one of ordinary skill in the art to be beneath the screen shroud (identified as 42 hereunder), which is represented in the figures. Although the view includes only two connectors 12, it is to be understood that more (or only one) may be utilized in the gravel pack apparatus 10. Each connector 12 is illustrated with pass-through 14 for four multi-pathway tubes 16a. The tubes 16a proceed longitudinally and meet in a fluid conveyable manner with multi-pathway tubes 16b. Multi-pathway tubes 16b proceed helically along apparatus 10 until meeting in a fluid conveyable manner with multi-pathway tubes 16c. Multi-pathway tubes 16c proceed longitudinally into the next connector 12. It will be understood that tubes 16a-c are each considered a multi-pathway tube and are broken into parts merely to aid discussion. As noted, four multi-pathway tubes 16a-c are illustrated; it is to be understood that more or fewer can be utilized as desired.

[0017] At each connector 12, at least one of the multi-pathway tubes 16a-c will have ports (not shown but known to one of skill in the art and present in the commercially available "direct pak" screen from Baker Oil Tools, Houston, Texas). Multi-pathway tubes adjacent those with ports will not have ports. A particular tube will have ports for about one-quarter of the total length of the screen component (see screen shroud 42) of the gravel pack apparatus 10. For example, a 1000-foot screen will have the ports change four times, once at each 250-foot increment of the 1000-foot screen. Each change will occur at a cross coupling connector 12. The fact that one of the tubes 16a-c will not have ports at each increment means that such tube may safely retain a control line 18 in an appurtenant projection (specifically identified hereunder). To maintain the control line in safety along the entirety of the screen

section, the line may be moved back and forth between adjacent appurtenant projections at the end of each increment, with the change taking place at a connector 12. As is apparent from the foregoing, a desired location for the control line is along one of the tubes 16b that does not have ports. Utilizing this arrangement, a control line may be secured in a position that is not particularly exposed to the high velocity gravel slurry while also avoiding the need for any external clamps or extra shroud. Further, because of the ability of the control line to be shifted back and forth between adjacent tubes 16a-c, the control line may be kept away from the high velocity slurry over the entire extent of the screen section (see screen shroud 42) of apparatus 10.

[0018] Because of the arrangement noted, the inventors hereof determined that securement of the control line near a multi-pathway tube that did not include ports for each of the segments of the apparatus would be advantageous. Unfortunately, there was no known way to achieve this without resorting to external clamps, which suffer from the drawbacks noted above. Referring to Figure 2, a cross-section view of a multi-pathway tube 16b according to the teaching herein is illustrated. Tube 16b includes a body 30 defining a flow passage 32, the body having a radially larger boundary 60 and a radially smaller boundary 62, the boundaries joined laterally by semicircular boundaries 64. Further, appurtenant the body 30 is at least one, and as illustrated two, wing-shaped projections 34. Each projection 34 extends from body 30, at a substantially equivalent radius of curvature to the radially larger boundary 60, at a lateral edge thereof and extends for a length sufficient to receive a control line (not shown). Each projection forms a pocket 36 between a concave surface 38 thereof and an outer surface 40 (shown in phantom) of screen shroud 42 (see Figure 1). Advantageously, projection 34 includes a lip 44 at an end thereof remote from body 30. Lip 44 is useful for enhancing retention of control line 18 once inserted at projection 34. Further, lip 44 causes an outside surface 46 of projection 34 to present a convex configuration, which is helpful with respect to avoiding hang-ups during the running of the apparatus 10.

[0019] As noted above, tube 16b is helically arranged about shroud 42, which additionally assists in maintaining the control line 18 against the shroud 42.

[0020] Referring to Figure 3, a schematic representation depicting shroud 42, tube 16b, control line 18 and an insertion device is provided. A rotary table 50 is

known to the art and requires no explanation. Extending from a portion of the tube 50 is a support 52 upon which is mounted a cable snap machine 54. The cable snap machine 54 is here illustrated to comprise a body 56 and four rolling or non-rolling bushings 58. It is to be understood that more or fewer bushings could be utilized and that bearings could be substituted without departing from the scope of the disclosure hereof. The bushings 58 that are horizontally (in the figure) spaced from each other are a fixed distance apart, that distance calculated to support the tube 16b at one side and urge the control line 18 under the projection 34 on the other side of the same tube 16b. Movement of the shroud (and the rest of the apparatus 10) in a downward direction (relative to the figure) automatically causes the control line to engage the projection 34. The second pair of bushings illustrated lower in the figure either further engage the control line with the projection or merely ensure that it engaged appropriately when passing through the first set of bushings. Additionally, in one embodiment, if one of the wing-shaped projections 34 at the multi-pathway tube does not contain a control line, the snap machine may be configured to deform the unsupported projection inwards toward the screen shroud 42 to reduce the possibility of the unsupported projection 34 coming in contact with any restrictions in the wellbore, which may potentially damage the flow area section of the tube. Such a condition is illustrated in figure 4. The deforming of the projection can be accomplished simultaneously while the control line is being snapped into the other side of the tube or can be accomplished without regard for whether or not a control line is present on the other side of the tube 16b.

[0021] In yet another embodiment, referring to figures 5 and 6, the projection 34 (here illustrated to be welded at weld bead 70 onto the multi-pathway tube 16b) is deformed over an inserted control line by bending lip 44 toward the shroud 42 to more permanently and encapsulatively engage the control line. The lip is illustrated in the undeformed condition in figure 5 and in the deformed condition in figure 6. The snap in machine is easily modifiable to accomplish the deforming of the projection to encapsulate the control lines against the shroud 42 by substituting a differently shaped bushing or bearing having a concave shape to form the lip 44.

[0022] Earlier in this disclosure, it was stated that the control line is maintained in a protected position relative to ports in the multi-pathway tubes 16b.

When inserting the control line into the tube 16b, and after a one-quarter length of the total gravel screen is reached the control line is manually moved over to position it to be engaged by an adjacent tube 16b. The process of inserting the control line 18 then continues as described hereinabove. One of skill in the art should appreciate that when the line 18 is moved over to an adjacent tube 16b, the line will be on a physically opposite side of the machine 54. In an embodiment where each side of machine 54 is a mirror image, no adjustment will be necessary but only a reengagement with the control line need be performed. Alternatively, and where one of the described embodiments that causes deformation is utilized, the machine 54 will be adjusted to reverse the action of the machine such as by reversing the bushings 58.

[0023] In accordance with the concepts and apparatus disclosed herein, control lines hereby can be added to the apparatus 10 right on the rig floor and while the apparatus is being run in the hole. Resultantly, the control line is protected and maintained in position. It is to be understood that "control line" as used herein is intended to include single or multiple hydraulic, electrical, fiber optic lines, etc. and that the lines may be individual in form, nested, flat packed, etc.

[0024] While preferred embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

What is claimed is:

- Claim 1. A gravel pack multi-pathway tube comprising:
a body;
a flow passage at the body; and
a projection at the body, the projection receptive to a control line.
- Claim 2. A gravel pack multi-pathway tube as claimed in claim 1 wherein the projection is wing shaped.
- Claim 3. A gravel pack multi-pathway tube as claimed in claim 1 wherein the projection has a first surface and a second surface that are convex and concave respectively.
- Claim 4. A gravel pack multi-pathway tube as claimed in claim 3 wherein the concave surface receives the control line.
- Claim 5. A gravel packing device component comprising:
a shroud;
a multi-pathway tube at the shroud; and
a projection appurtenant the multi-pathway tube, the projection being receptive to a control line.
- Claim 6. A gravel packing device component as claimed in claim 5 wherein the projection holds the control line between a surface of the projection and a surface of the shroud.
- Claim 7. A gravel packing device component as claimed in claim 5 wherein the multi-pathway tube and projection extend helically along a longitudinal extent of the component.
- Claim 8. A method for running and protecting a control line at a gravel pack component comprising:
running a component as claimed in claim 5 into a wellbore; and

inserting a control line.

Claim 9. A method for running and protecting a control line at a gravel pack component as claimed in claim 8 wherein the inserting is by urging a rolling or sliding implement against a source of control line in a direction calculated to engage the projection.

Claim 10. A method for running and protecting a control line at a gravel pack component as claimed in claim 8 wherein the inserting includes:

diverting the control line to an adjacent multi-pathway tube projection to avoid control line contact with multi-pathway tube ports.

Claim 11. A method for running and protecting a control line at a gravel pack component as claimed in claim 8 wherein the component includes two or more multi-pathway tubes having ports, the ports being staggered with respect to a longitudinal extent of the component such that ports of one multi-pathway tube do not overlap ports from another multi-pathway tube and the method includes inserting the control line in the projection of one of the multi-pathway tubes alternates to maintain the control line away from the ports.

Claim 12. A method for running and protecting a control line at a gravel pack component as claimed in claim 5 wherein the method further includes deforming the projection toward the shroud.

Claim 13. A method for running and protecting a control line at a gravel pack component as claimed in claim 12 wherein deforming is around a control line.

Claim 14. A method for running and protecting a control line at a gravel pack component as claimed in claim 12 wherein deforming is without a control line.

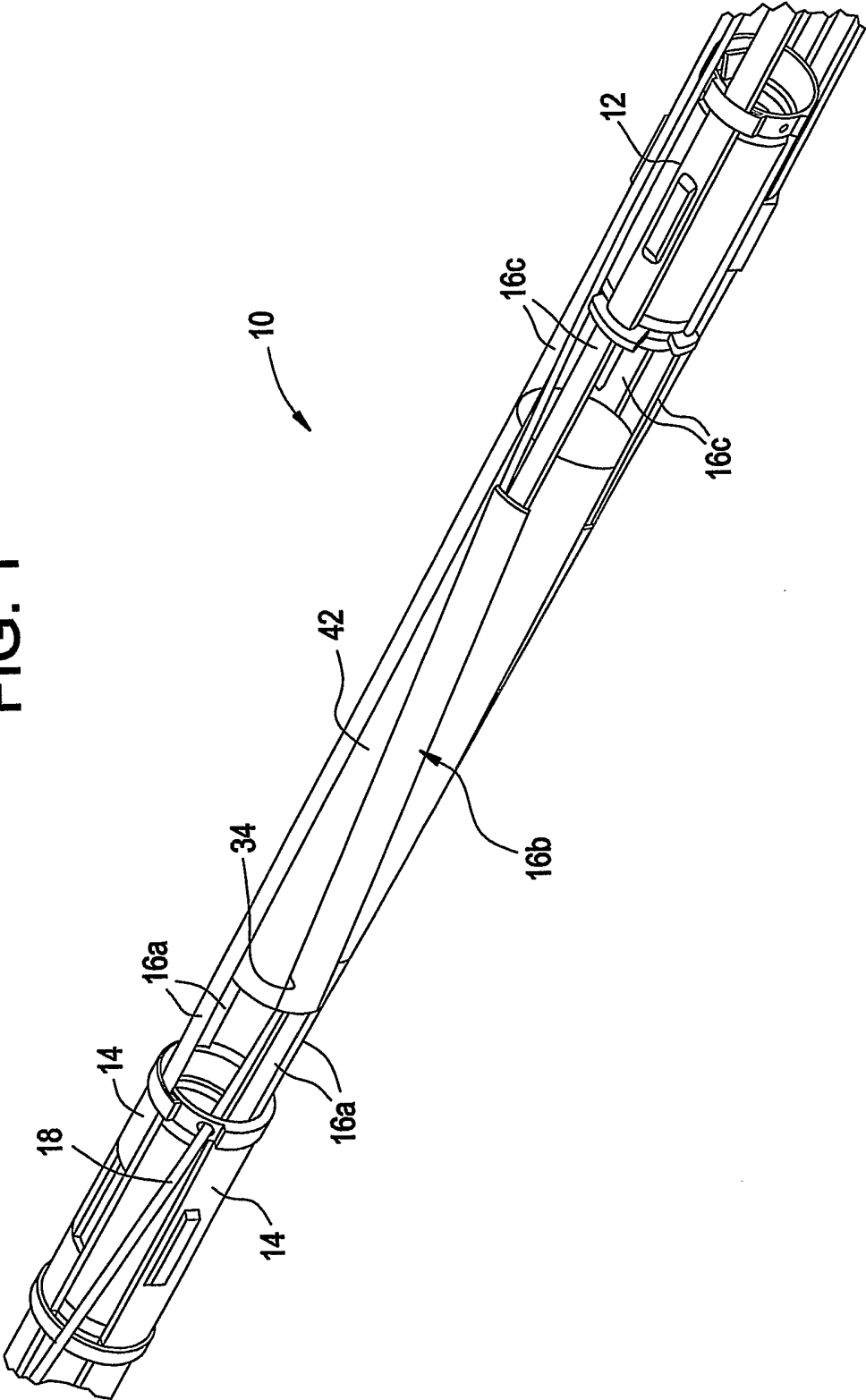
Claim 15. A method for running and protecting a control line at a gravel pack component as claimed in claim 12 wherein deforming is on a projection opposite a projection in which a control line is inserted.

Claim 16. A multi-pathway tube comprising:
an elongated body cross-sectionally defining a flow passage, the body having a radially larger boundary and a radially smaller boundary, the boundaries joined laterally by semicircular boundaries;
a projection extending from the radially larger boundary and having a substantially equivalent radius of curvature, the projection being receptive to a control line to provide retention for the control line.

Claim 17. The multi-pathway as claimed in claim 16 wherein the projection further comprises a lip at the projection remote from the body.

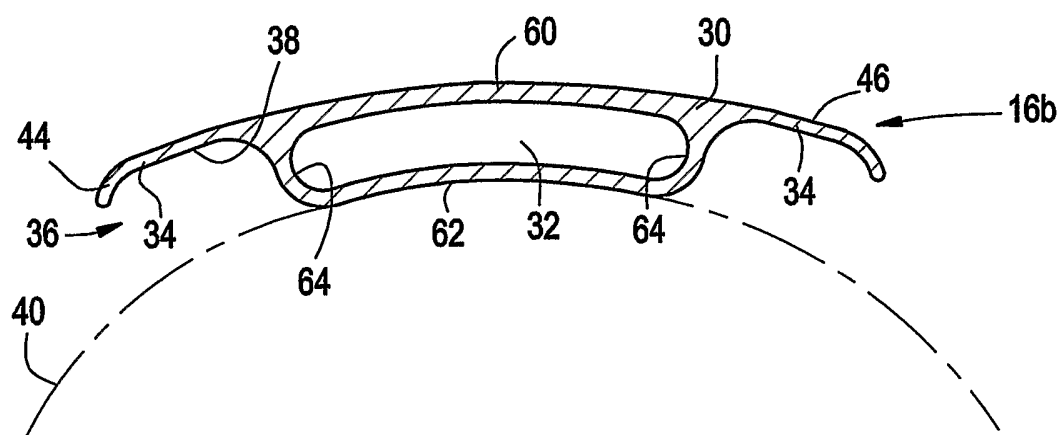
Claim 18. The multi-pathway as claimed in claim 17 wherein the lip extends from the projection toward a radius of curvature equivalent to the radially smaller boundary.

FIG. 1



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FIG. 2



3/5

FIG. 3

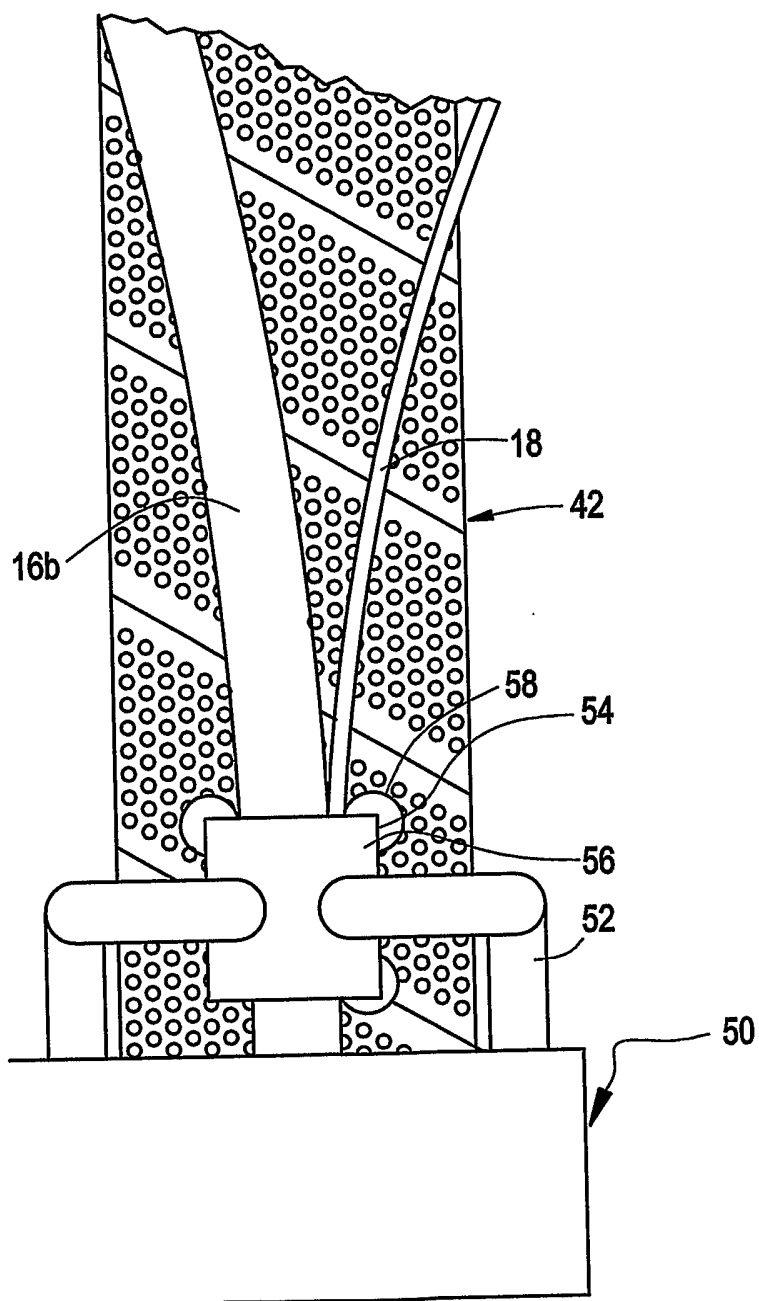


FIG. 4

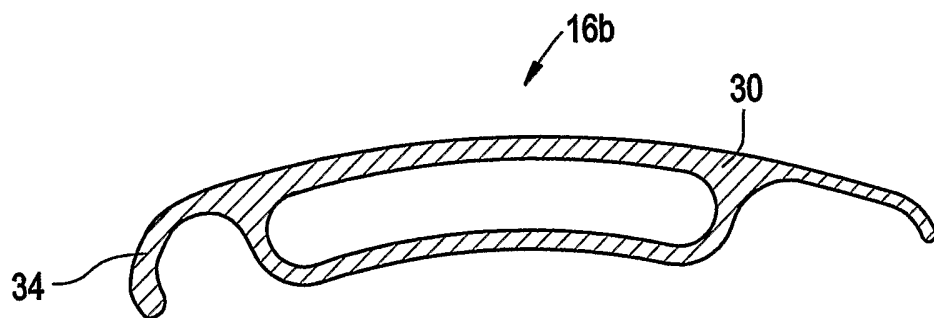


FIG. 5

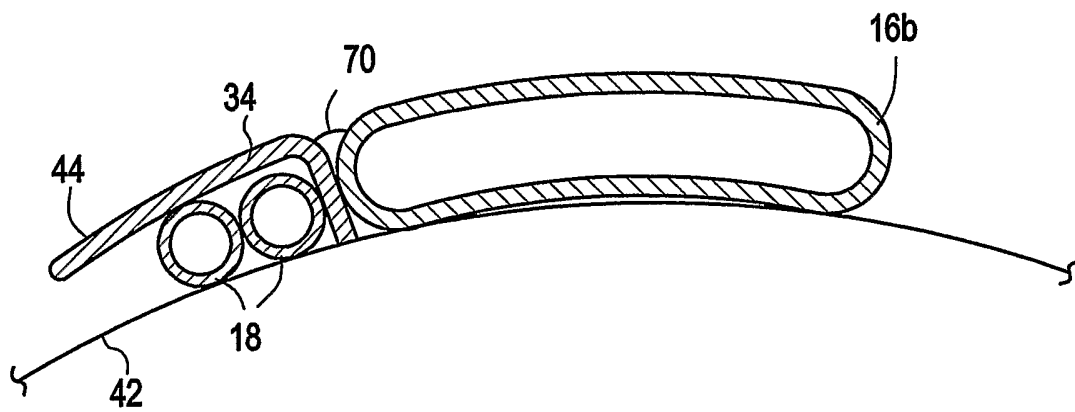
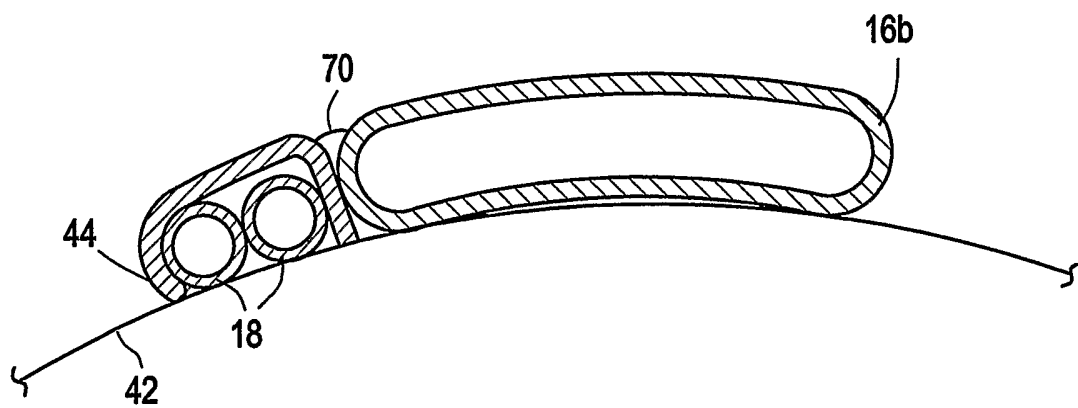


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/001144

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B17/10 E21B43/04 E21B23/14

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

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 2002/092649 A1 (BIXENMAN PATRICK W ET AL) 18 July 2002 (2002-07-18)	1-6, 8
Y	paragraph [0019]; figures 18-22 paragraph [0031] paragraph [0042] - paragraph [0043]	7
Y	WO 2004/044376 A (BAKER HUGHES INCORPORATED) 27 May 2004 (2004-05-27) figure 2	7
A	GB 2 392 461 A (* SCHLUMBERGER HOLDINGS LIMITED) 3 March 2004 (2004-03-03) page 6, line 13 - page 8, line 12; figures 4,5	1,5,8,16
A	US 5 343 942 A (DEL SERRA ET AL) 6 September 1994 (1994-09-06) column 1, line 49 - line 68; figures 2-4	1,5,8,16

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

☒ See patent family annex.

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Name and mailing address of the ISA/

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

Authorized officer

Dantinne, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/001144

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