



## (51) International Patent Classification:

*E21B 17/042* (2006.01) *F16L 15/06* (2006.01)  
*B23P 19/00* (2006.01) *E21B 19/16* (2006.01)  
*F16L 15/00* (2006.01)

## (21) International Application Number:

PCT/EP2013/053502

## (22) International Filing Date:

21 February 2013 (21.02.2013)

## (25) Filing Language:

English

## (26) Publication Language:

English

## (30) Priority Data:

12156680.6 23 February 2012 (23.02.2012) EP

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

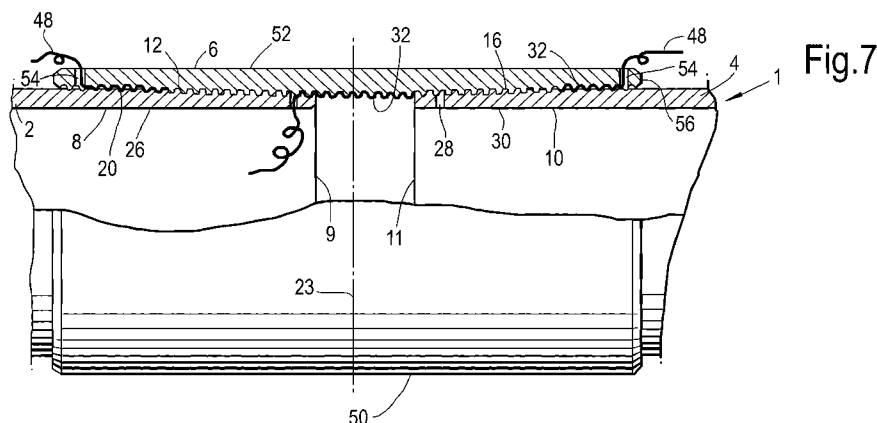
## Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

## Published:

— with international search report (Art. 21(3))  
 — before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

## (54) Title: CONNECTOR ASSEMBLY



(57) Abstract: The invention provides a connector assembly for interconnecting tubular elements. The connector assembly comprises at least one pin member, at least one box member, and for each box member a respective coating layer. Each pin member has a threaded outer surface and each box member has a threaded inner surface allowing the pin member and the box member to be screwed together. Herein the respective coating layer is positioned between the threaded surfaces of the pin member and the box member. Each coating layer is of a softer material than said threaded surfaces. The connector assembly further comprises means for removing excess coating material during make up of the pin member and the box member.

## CONNECTOR ASSEMBLY

The present invention relates to a connector assembly for interconnecting tubular elements. The connector assembly includes a pin member and a box member, the pin member having a threaded outer surface and the box member having a corresponding threaded inner surface allowing the pin member and box member to be screwed together.

Connectors of this type are generally used in oilfield applications, for instance to connect sections of wellbore casing or production tubing. Often, connectors for oilfield applications are required to provide liquid-tight and/or gas-tight sealing and to have a strength at least approximately equal to the body strength of the pipe sections joined by the connectors.

An API (American Petroleum Institute) threaded connector is a commonly used type of connector which performs relatively well at relatively low cost. The API however may not always provide reliable gas-tight sealing. In view thereof the API threaded connectors are generally primarily used for liquid service applications, while more expensive premium connections are used for applications where gas-tight sealing is required, for instance in production tubing of gas wells.

There is a need to adapt API threaded connectors for applications whereby gas-tight sealing is required. In order to improve the gas sealability of API threaded connectors it has been proposed to apply a soft metal plating to the threaded surfaces. Examples of such plating material include zinc phosphate, zinc and tin.

US patent no. 5,212,885 discloses a threaded connector wherein the threaded section of each pin member is marked with a band, and wherein the threaded surface

of the box member is plated with tin. A thread lubricant is applied to the threads of the box member, and the pin and box members are screwed together until the face of the box member overlaps the band. The connection is considered acceptable if the face of the box member is properly positioned over the band on the pin member, and if the make-up torque is within predetermined limits.

However, proper make-up of the connector of US-5,212,885 may be difficult or impossible if the coating layer is too thick. In particular, unallowable deformation of the pin member and/or the box member can occur. Also, the make-up torque can become excessive, and poor thread engagement can occur which negatively impacts performance of the connector.

It is an object of the present invention to provide an improved connector which overcomes the problems of the prior art.

In accordance with the invention there is provided a connector assembly for interconnecting tubular elements, comprising at least one pin member, at least one box member, and for each box member a respective coating layer, each pin member having a threaded outer surface and each box member having a threaded inner surface allowing the pin member and the box member to be screwed together whereby the respective coating layer is positioned between the threaded surfaces of the pin member and the box member, each coating layer being of a softer material than said threaded surfaces, the connector assembly further comprising means for removing excess coating material from the coating layer during screwing of the pin member and the box member together.

By removing excess coating material of the coating layer during make-up of the connector, it is achieved

that the thickness of the coating layer becomes accurately adjusted to the dimensions of the engaged threaded surfaces of the pin member and the box member, even if the initial coating layer is too thick to fit properly between the threaded surfaces.

Suitably the coating layer is susceptible of plastic deformation due to screwing of the pin member and the box member together, and wherein said means for removing excess coating material from the coating layer comprises at least one passage arranged to allow said excess coating material to be pressed into the passage as a result of said plastic deformation, each passage being provided in one of the pin member and the box member. In this manner the excess coating material is extruded into the passage from where it can be adequately discharged. An additional advantage of plastic deformation of the coating material is that any undesired clearance between the engaged threaded surfaces is filled with coating material so that gas-tight sealing of the engaged threaded surfaces is achieved.

In case the passage is provided in the pin member, and the threaded outer surface of the pin member tapers to a smaller diameter at an end surface of the pin member, the passage is preferably formed near said end surface of the pin member. Preferably, the passage formed in the pin member extends from an outer surface to an inner surface of the pin member.

Similarly, in case the passage is provided in the box member, and the threaded inner surface of the box member tapers to a larger diameter at an end surface of the box member, the passage is preferably formed near said end surface of the box member. To adequately discharge the excess coating material, the passage formed in the box

member preferably extends from an inner surface to an outer surface of the box member.

In a modified embodiment, said means for removing excess material from the coating layer comprises a cutting edge provided at one of the pin member and the box member, the cutting edge being arranged to cut away the excess coating material upon screwing of the pin member and the box member together. Suitably, the cutting edge is provided at the threaded outer surface of the pin member. For example, the cutting edge is formed by a sharp end of the thread of the threaded outer surface.

Suitably the coating layer includes a soldering or brazing material, and wherein a soldering or brazing flux is applied to a surface selected from the threaded outer surface of the pin member and the threaded inner surface of the box member so as to promote bonding of the coating layer to the selected surface upon a temperature increase of the selected surface.

In a preferred embodiment, at least part of the temperature increase is due to friction between the pin member and the box member during screwing of the pin member and the box member together. In an embodiment, the coating layer includes a soldering material and the entire temperature increase required to spread said coating layer over the selected surface is due to friction between the pin member and the box member during make-up of the pin member and the box member. Herein, said required temperature may be relatively low, for instance below 400 degree C or even below 150 degree C. Said temperature is for instance in the order of 100 to 125 degree C.

The threaded outer surface of the pin member and the threaded inner surface of the box member overlap each

other along an overlapping length when the pin member and the box member are screwed together. In case bonding of the coating layer to the bonding surface appears to be too strong, which may lead to relatively high friction forces between the engaged threaded surfaces during make-up of the connector, it is preferred that the coating layer is absent along an uncoated portion of said overlapping length. Preferably, the coating layer is present along opposite end portions of the overlapping length, wherein the uncoated portion extends between said opposite end portions.

In a preferred embodiment, the connector assembly comprises a first said box member, a second said box member, a first said coating layer and a second said coating layer, wherein during a first stage of use the pin member is screwed to the first box member whereby the first coating layer is positioned between the threaded surfaces of the pin member and the first box member, and wherein during a second stage of use the pin member is screwed to the second box member whereby the second coating layer is positioned between the threaded surfaces of the pin member and the second box member.

Sometimes it may be required to break the connection between the pin member and the first box member for operational reasons. By replacing the first box member and the first coating layer with the second box member and the second coating layer after the connection between the pin member and the first box member has been broken, it is achieved that the connector fulfils the general requirement for qualification in the oilfield industry that the connector must be able to be made-up and broken at least three times without performance deterioration below the specified operating envelope. In order to

ensure that the thread of the pin member remains undamaged after repeatedly screwing and unscrewing the connection, it is preferred that the first coating layer is bonded to the threaded inner surface of the first box member, and that the second coating layer is bonded to the threaded inner surface of the second box member.

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 embodiment of a connector assembly according to the invention, partly in longitudinal section;

Fig. 2 schematically shows a detail of the embodiment of Fig. 1;

Fig. 3 schematically shows an embodiment of a modified pin member for use in the connector assembly of the invention;

Fig. 4 schematically shows an end view of the modified pin member of Fig. 3.

Fig. 5 schematically shows another embodiment of a modified pin member for use in the connector assembly of the invention;

Fig. 6 schematically shows an end view of the modified pin member of Fig. 5;

Fig. 7 shows another embodiment of a connector according to the invention, partly in longitudinal section;

Fig. 8 shows yet another embodiment of a modified pin member for use in the connector assembly of the invention; and

Fig. 9 shows another embodiment of a sharp cutting edge for the connector assembly of the invention.

In the Figures, like reference signs relate to like components.

Referring to Figs. 1 and 2 there is shown a connector 1 for interconnecting two tubular elements 2, 4. The connector 1 comprises a steel box member 6, a first steel pin member 8 having tip 9 and being integrally formed with tubular element 2, and a second steel pin member 10 having tip 11 and being integrally formed with tubular element 4. The box member 6 and the pin members 8, 10 are of tubular shape. The first pin member 8 has a threaded outer surface 12 tapering slightly radially inward towards the tip 9 of the first pin member 8. Similarly, the second pin member 10 has a threaded outer surface 16 tapering slightly radially inward towards the tip 11 of the second pin member 10. The box member 6 has a first threaded inner surface 20 corresponding to the threaded outer surface 12 of the first pin member 8 so as to allow the first pin member 8 to be screwed to the box member 6, and a second threaded inner surface 22 arranged opposite the first threaded inner surface 20 and corresponding to the threaded outer surface 16 of the second pin member 10 so as to allow the second pin member 10 to be screwed to the box member 6. In the configuration of Fig. 1, the first pin member 8 is fully screwed to the box member 6, while the second pin member 10 is only partially screwed to the box member 6. Reference sign 23 indicates an axis of symmetry of the box member 6.

The first pin member 8 is provided with a through-bore 24 located near tip 9, whereby the through-bore 24 extends from the threaded outer surface 12 to an inner surface 26 of the first pin member 8. The through-bore 24 is shown in Fig. 2 in more detail. In similar manner, the second pin member 10 is provided with a through-bore 28



located near tip 11, whereby the through-bore 28 extends from the threaded outer surface 16 to an inner surface 30 of the second pin member 10. Furthermore, the box member 6 is internally provided with a coating layer 32 of a relatively soft metal. Relatively soft metal herein implies that the metal of the coating layer is softer than the steel of the respective threaded surfaces 12, 16, 20, 22. Suitable metals for the coating layer 32 include for instance Babbitt, pure metals such as copper and tin or alloys of such metals.

Deposition of such soft metal on the threaded inner surfaces 20, 22 of the box member 6 is suitably done by for example flame spraying or electro deposition. Herein the coating the coating layer 32 is for instance bonded to the threaded inner surfaces 20, 22.

In an embodiment, the coating layer 32 may extend along less than the full length of each inner threaded inner surface 20, 22. Rather, the coating layer 32 extends from the symmetry axis 23 in axial direction along portions of the threaded inner surfaces 20, 22.

Reference is further made to Figs. 3 and 4 showing a modified pin member 40 for use in the connector 1. The modified pin member 40 has a threaded outer surface 42 with thread 44 ending in a sharp cutting edge 46 near end surface 14. In the present example, the modified pin member 40 is not provided with a through-bore. However, if desired the modified pin member may be provided with a through-bore like in the embodiment of Figs. 1, 2.

Figures 5 and 6 show another embodiment of the pin member 40 for use in the connector assembly 1. The pin member 40 has the threaded outer surface 42 with thread 44 ending in the sharp cutting edge 46 near end surface 14. The pin member 40 is provided with through-bore 24.

In top view (Fig. 5), the through-bore or opening 24 may be (slightly) elliptical, to improve the discharge of excess material. Also, the opening 24 may be arranged at an angle  $\alpha$  with respect to the radius  $r$  (Fig. 6).

5        Besides or in addition to the first pin member 8, also the box member may be provided with a through-bore 54, preferably located near box end 50, near end surface 56. Herein, the through-bore 54 may extend from the threaded inner surface 16 to an outer surface 52 of the  
10       box member 6 (Fig. 7). Furthermore, the box member 6 or respective pin member 8 may be provided with a coating layer 32 near the openings 54 in the box member.

Figure 8 shows another yet embodiment of the pin member 40 for use in the connector assembly 1. The pin  
15       member 40 has the threaded outer surface 42 with thread 44 ending in the sharp cutting edge 46 near end surface 14. The pin member 40 is provided with through-bore 24, which is elliptical. The sharp edge 46 has a first side 60 which is aligned with the threads 44. A second side 64  
20       is arranged at an angle  $\delta$  with respect to the first side, and extends towards the opposite side 62 of said thread 44.

Figure 9 shows an embodiment of the cutting edge 46 of the thread 44. The cutting edge comprises a top  
25       surface 80 which inclines from the surface 42 to the top of the thread 44. In a side elevation, the top surface 80 will resemble the cutting edge as shown in Figure 6, i.e. arranged at an angle  $\gamma$  with respect to the surface 42. The cutting edge 46 is also provided with left and right  
30       side surfaces 82, 84 respectively. The side surfaces 82, 84 have sides 86, 88 which are aligned with the sides of the thread 44. The side surfaces 82, 84 are inclined, starting at the sides 86, 88 respectively towards the top

surface 80. The side surfaces 82, 84 improve the discharge of excess material as indicated by arrows 90, 92 respectively.

At the front end, the left side surface 82, top surface 80 and right side surface 84 have a width L1, L2, L3 respectively. The height and width of the thread is indicated by L4 and L5 respectively. Herein, the sum of L1+L2+L3 equals L5. In a preferred embodiment, the ratio of L1:L2:L3 is about 1:1:1.

In a practical embodiment, the ratio of largest diameter to smallest diameter of the opening 24 is for instance in the range of 1:1 to 3:1 or more, for instance about 1:2. The angle  $\alpha$  may be in the range of 0 to 30 degrees.

The sharp cutting edge 46 may have a leading edge which is V-shaped, having an angle  $\beta$  (in top view, see Fig. 5). The angle  $\beta$  may be in the range of about 20 to 180 degrees. Preferably the angle  $\beta$  is in the range of about 20 to 40 degrees. In side view (Fig. 6), the leading edge of the sharp cutting edge 46 may be arranged at an angle  $\gamma$  with respect to the tangent of the outer surface of the pin 40. Herein, the angle  $\gamma$  may be in the range of about 1 to 60 degrees, for instance in the range of about 25 to 45 degrees. When the angle  $\beta$  is about 180 degrees, the angle  $\gamma$  will preferably be in the range of 1 to 60 degrees. In the embodiment of Fig. 8, the angle  $\delta$  may be in the range of about 10 to 45 degrees, and preferably in the range of about 20 to 30 degrees.

The opening 24 may be arranged at a distance D1 from said leading edge of the edge 46. Herein, D1 may be less than a single rotation around the tip 40. Optimally,

distance D1 is in the range of about 20% to 60% of a single rotation around the pin 40.

The opening or through-bore 24 may have a diameter which is in the order of the distance D2 between the threads (Fig. 5) or less. For instance, the diameter of the opening 24 is in the range of about 70 to 90% of D2.

Although not shown, the end of the box member 6 may be provided with an opening 24 and/or a sharp cutting edge, similar to the end of the pin member shown in Figures 3 to 6. Such opening and/or cutting edge may be provided in addition to, or as an alternative for, the cutting edge or the opening in the pin member.

During normal use of the embodiment of Figs. 1, 2 the pin members 8, 10 are initially screwed hand-tight to the box member 6, and then fully screwed to the box member 6 using a suitable wrench until the desired make-up torque is reached or until a mark (not shown) on each pin member arrives at an end face of the box member. At the stage shown in Fig. 1, the second pin member 10 has been screwed hand-tight to the box member 6 until the tip 11 of second pin member 10 touches the coating layer 32. The first pin member 8 has been fully screwed to the box member 6 using a wrench whereby the coating layer 32 is squeezed between the threaded outer surface 12 of the first pin member 8 and the threaded inner surface 20 of the box member 6. Due to the softness of the coating material and the squeezing action of the engaged threaded surfaces 12, 20, the coating layer 32 deforms plastically and becomes pressed into the through-bore 24 of pin member 8. As a result excess coating material 48 that is present between the engaged threaded surfaces 12, 20 is extruded through the through-bore 24. Similarly, when the second pin member 10 is screwed further into the box

member 6 using a wrench, the coating layer 32 becomes squeezed between the threaded outer surface 16 of the second pin member 10 and the threaded inner surface 22 of the box member 6. Any excess coating material of the coating layer 32 that is present between the engaged threaded surfaces 16, 22 is thereby extruded through the through-bore 28. The remaining coating layer 32 fits accurately between the engaged threaded surfaces 12, 20 and the engaged threaded surfaces 16, 22. A gas-tight seal is thereby provided to the connector 1, without causing excessive make-up torque or intolerable deformation of the pin and box members.

During normal use of the modified embodiment of Figs. 3 and 4, the pin member 40 is screwed to the box member 6. Any excess coating material of the coating layer 32 is cut away by the sharp cutting edge 46 of thread 44 during screwing of the pin member 40 and the box member 6 together.

Thus, the connector of the invention prevents problems caused by the coating layer being too thick and enables proper distribution of the coating across the selected surface. Also, the connector enables gas-tight sealing of the connector. Herein, the invention enables to improve a relatively cost-effective API connector to provide these advantages, thus providing a relatively inexpensive gas-tight connector.

The invention is not limited to the above-described embodiments thereof, wherein various modifications are conceivable within the scope of the appended claims. Features of respective embodiments may for instance be combined.

C L A I M S

1. A connector assembly for interconnecting tubular elements, comprising:

at least one pin member having a threaded outer surface;

5 at least one box member having a threaded inner surface corresponding to the threaded outer surface of the pin member allowing the pin member and the box member to be screwed together;

10 at least one coating layer which is positioned between the threaded outer surface and the threaded inner surface, each coating layer being of a softer material than said threaded surfaces; and

15 removal means for removing excess coating material from the coating layer during screwing of the pin member and the box member together.

2. The connector assembly of claim 1, the removal means comprising a cutting edge provided at one of the pin member and the box member, the cutting edge being arranged to cut away at least part of the excess coating material upon screwing of the pin member and the box member together.

3. The connector assembly of claim 2, wherein the cutting edge is provided at the threaded outer surface of the pin member.

25 4. The connector assembly of claim 2 or 3, wherein the cutting edge is formed by a sharp end of the thread of the threaded outer surface of the pin member.

30 5. The connector assembly of any of claims 2 to 4, wherein the cutting edge is formed by a sharp end of the thread of the threaded inner surface of the box member.

6. The connector assembly of claim 4 or 5, wherein the sharp cutting edge comprises:

a top surface which is inclined from the threaded outer surface to a top of the thread;

5 a left side surface arranged on the left side of the top surface; and

a right side surface arranged on the right side of the top surface.

10 7. The connector assembly of claim 6, wherein a left width of the left side surface (L1), a middle width of the top surface (L2) and a right width of the right side surface (L3) are substantially equal at a front end of the cutting edge.

15 8. The connector assembly of claim 4 or 5, the sharp end having:

a first side which is aligned with the thread; and

a second side being arranged at an angle  $\delta$  with respect to the first side and extending towards the opposite side of said thread.

20 9. The connector assembly of claim 8, wherein the angle  $\delta$  is in the range of about 10 to 45 degrees.

10. The connector assembly of claim 4 or 5, the sharp end having a top surface which inclines from an outer surface of the connector to a top of the thread, wherein said top surface is arranged at an angle  $\gamma$  with respect to the outer surface.

25 11. The connector assembly of claim 10, wherein the angle  $\gamma$  is in the range of about 1 to 60 degrees.

12. The connector assembly of any one of the previous claims, the removal means comprising at least one passage, each passage being provided in one of the pin member and the box member,

30

wherein said passage formed in the pin member extends from an outer surface to an inner surface of the pin member and wherein said passage formed in the box member extends from an inner surface to an outer surface of the box member.

13. The connector assembly of claim 11, wherein the coating layer is susceptible of plastic deformation due to screwing of the pin member and the box member together, and

wherein said at least one passage allows said excess coating material to be pressed into the passage as a result of said plastic deformation.

14. The connector assembly of claim 12 or 13, said at least one passage comprising a pin passage which is provided near an end surface of the pin member.

15. The connector assembly of any one of claims 12 to 14, said at least one passage comprising a box passage which is provided near an end surface of the box member.

16. The connector assembly of any one of claims 1-15, wherein the coating layer includes a brazing or soldering material, and wherein a brazing or soldering flux is applied to a surface selected from the threaded outer surface of the pin member and the threaded inner surface of the box member to promote bonding of the coating layer to the selected surface upon a temperature increase of the selected surface.

17. The connector assembly of claim 16, wherein at least part of the temperature increase is due to friction between the pin member and the box member during screwing of the pin member and the box member together.

18. The connector assembly of claim 16, wherein the coating layer includes a soldering material, and wherein the entire temperature increase required to spread said



coating layer over the selected surface is due to friction between the pin member and the box member during make-up of the pin member and the box member.

5 19. The connector assembly of claim 16, wherein said required temperature is below 400 degree C.

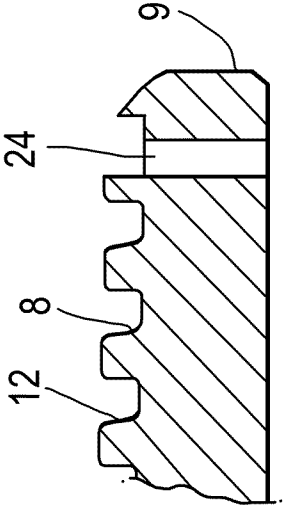
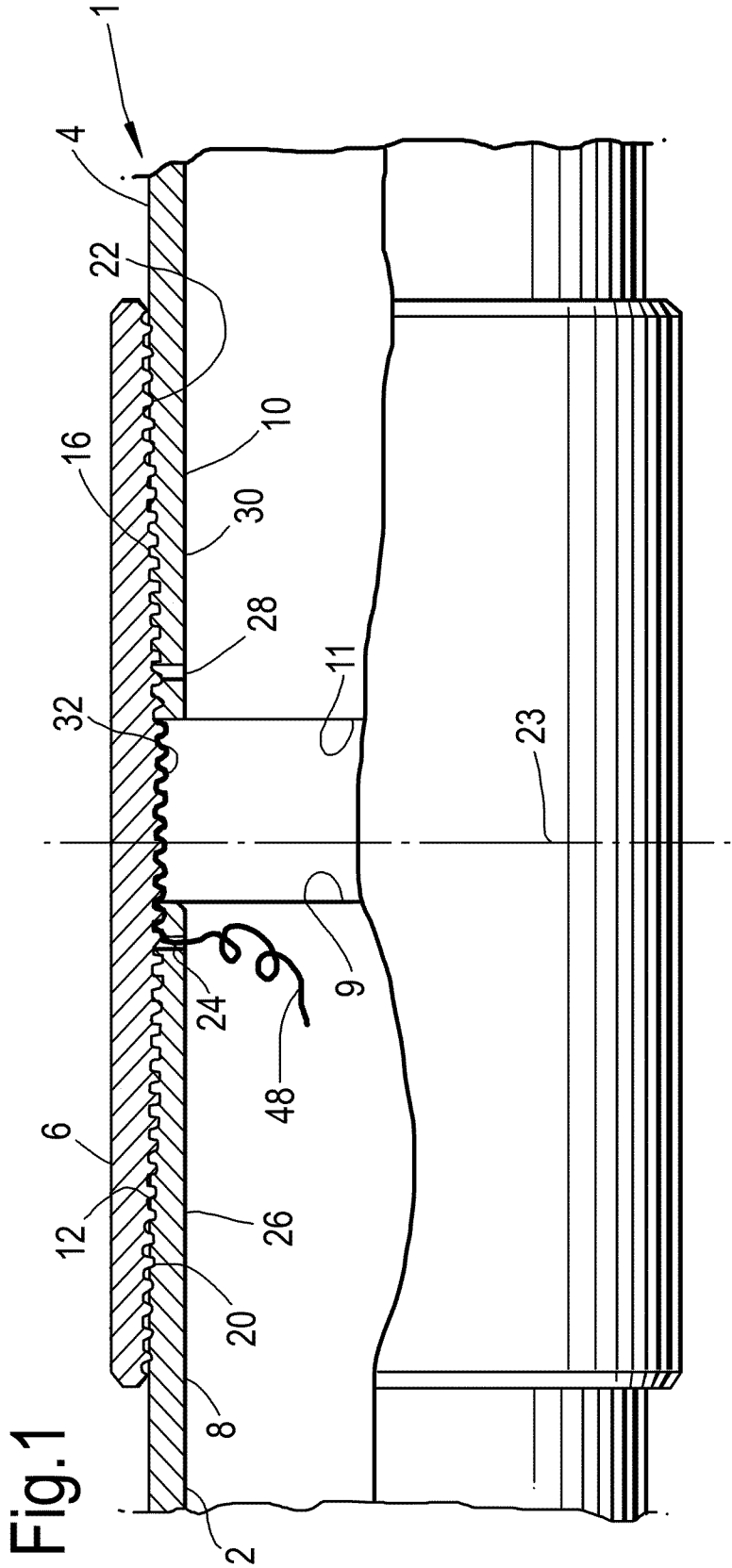


Fig.2

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Fig.4

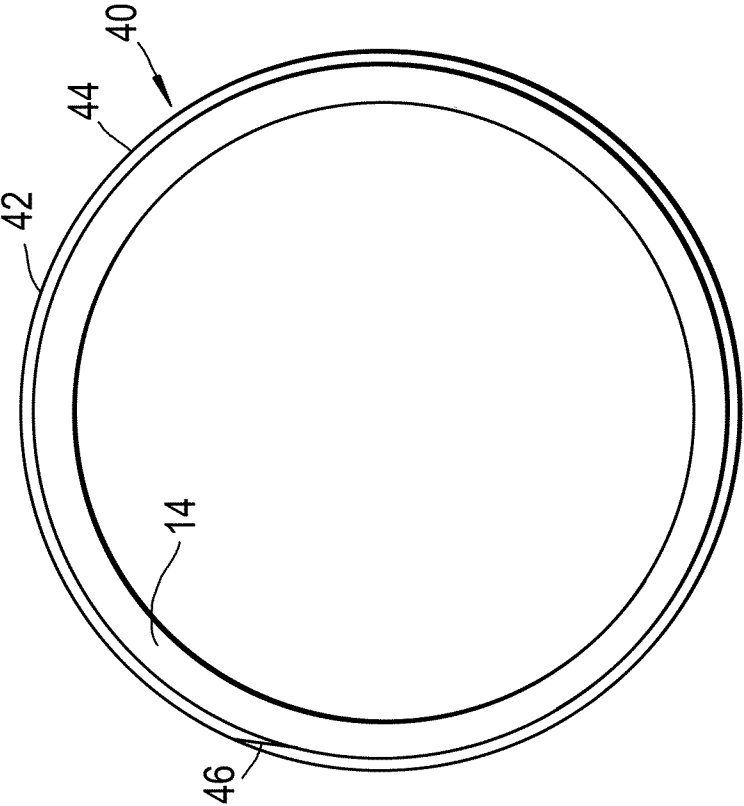


Fig.3

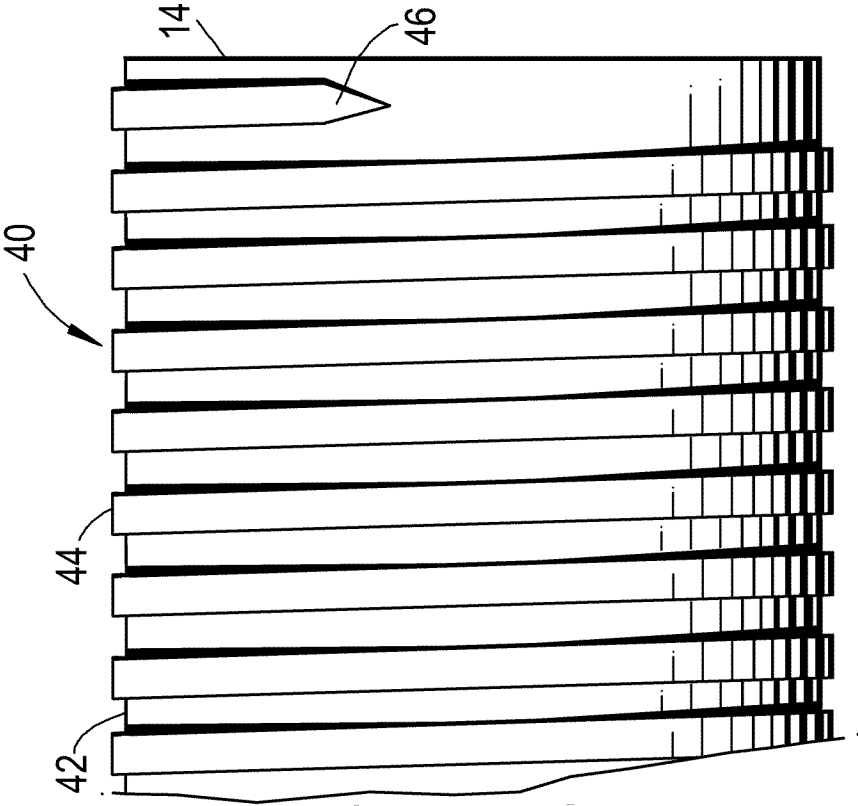


Fig.5

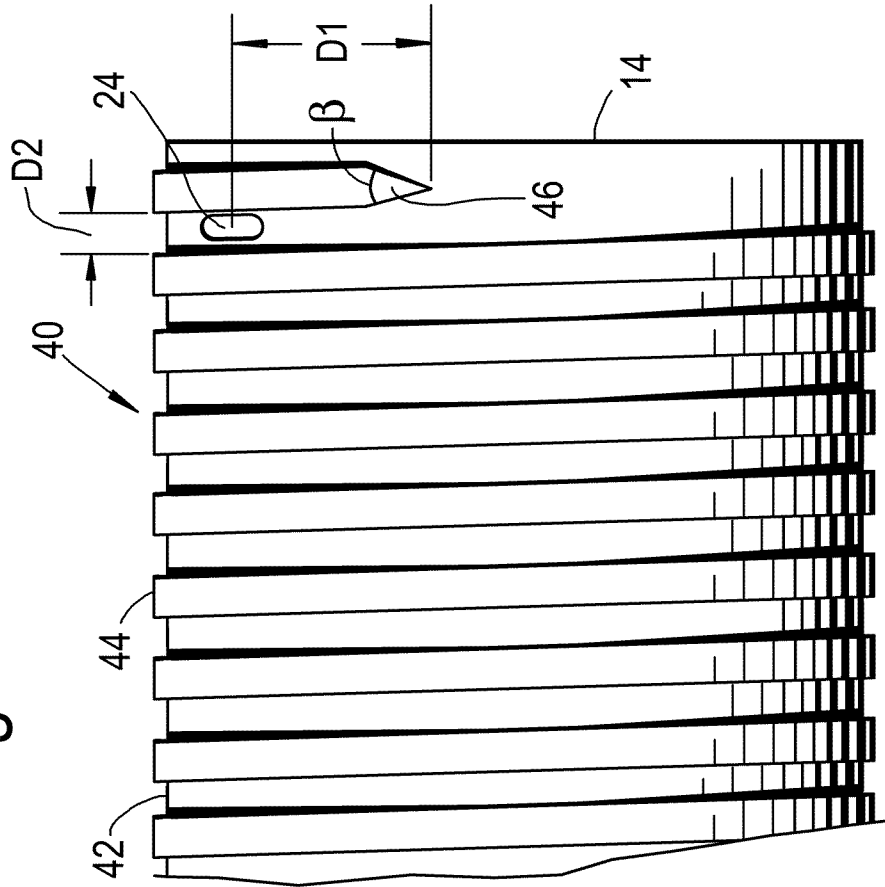
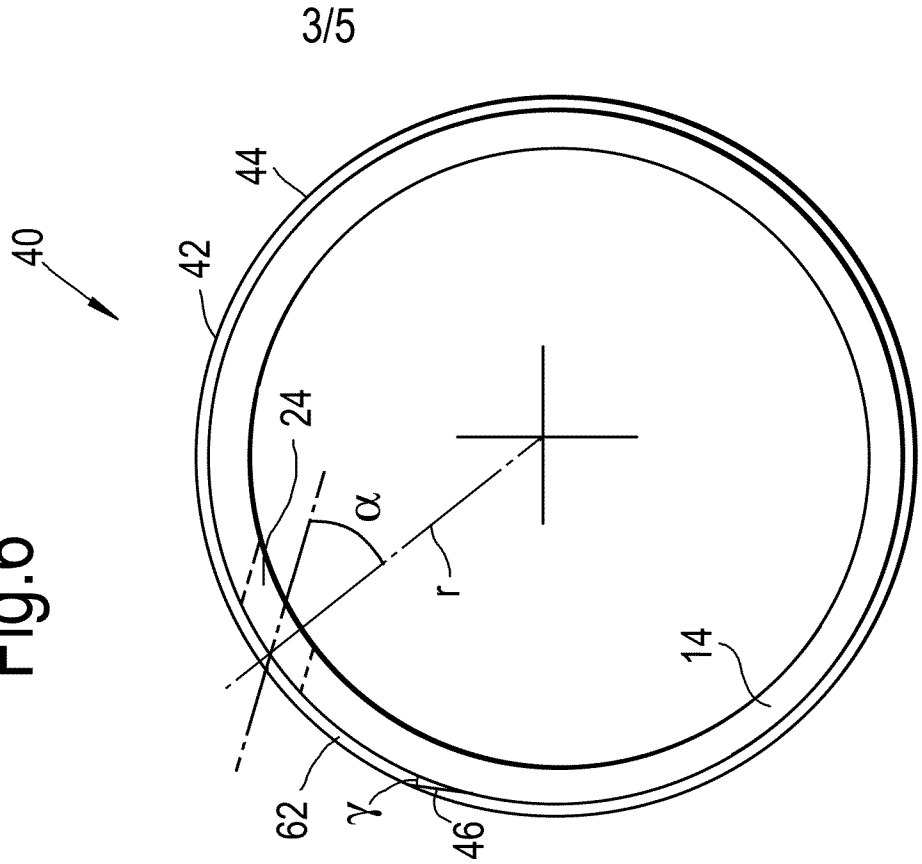


Fig.6



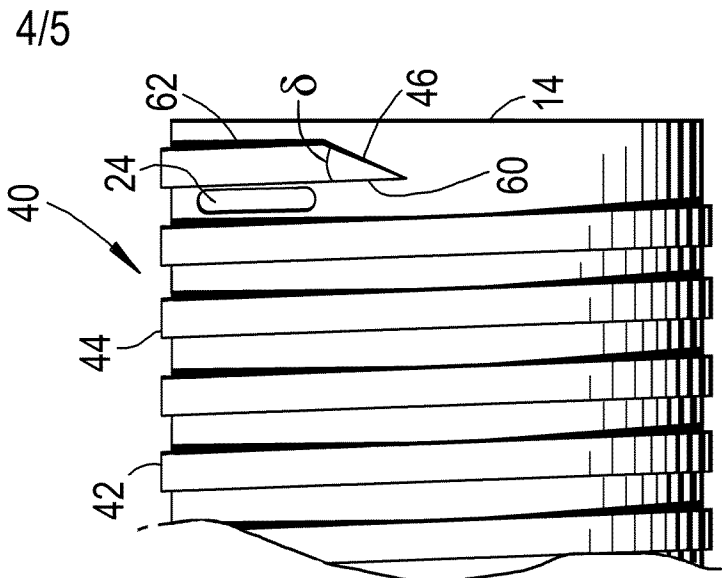
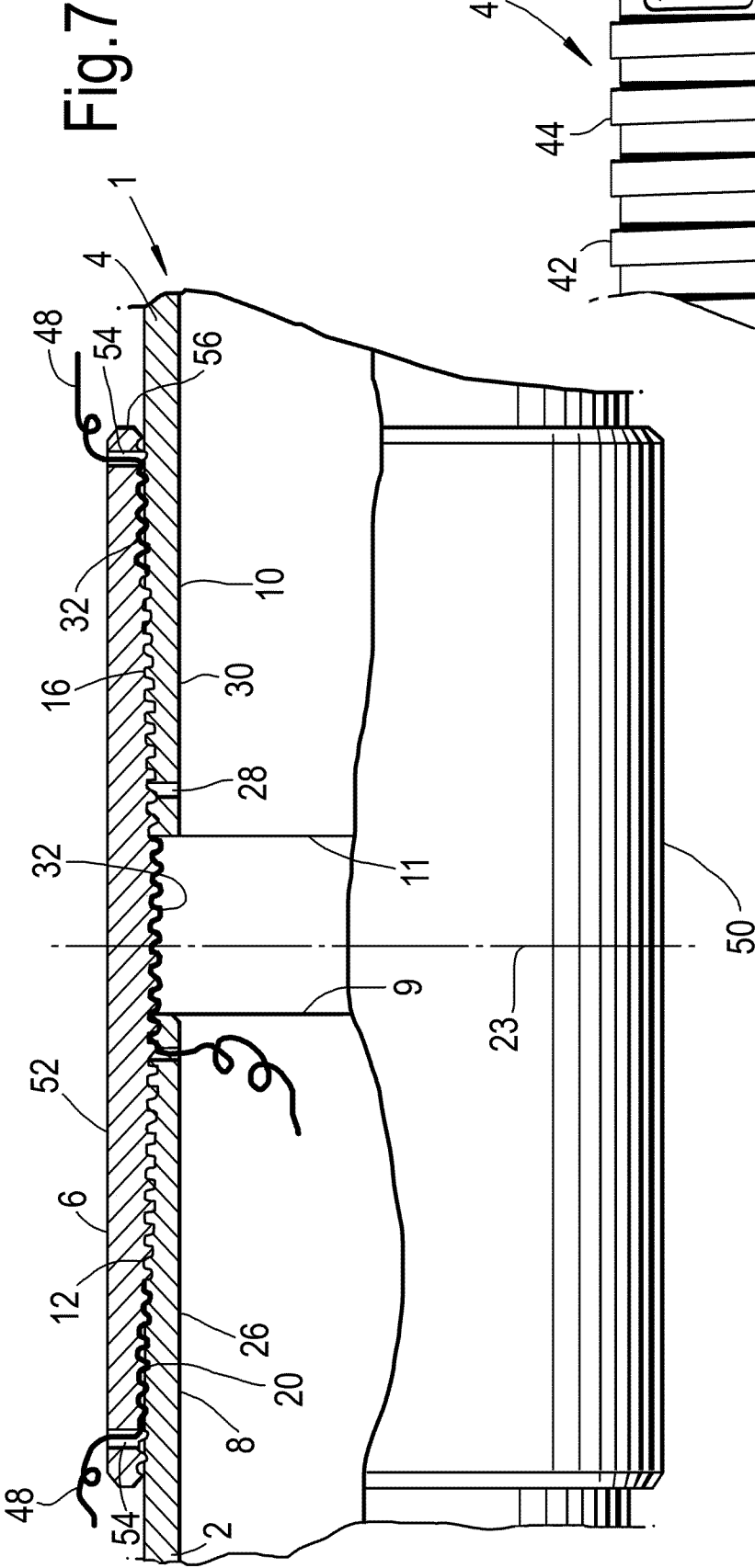
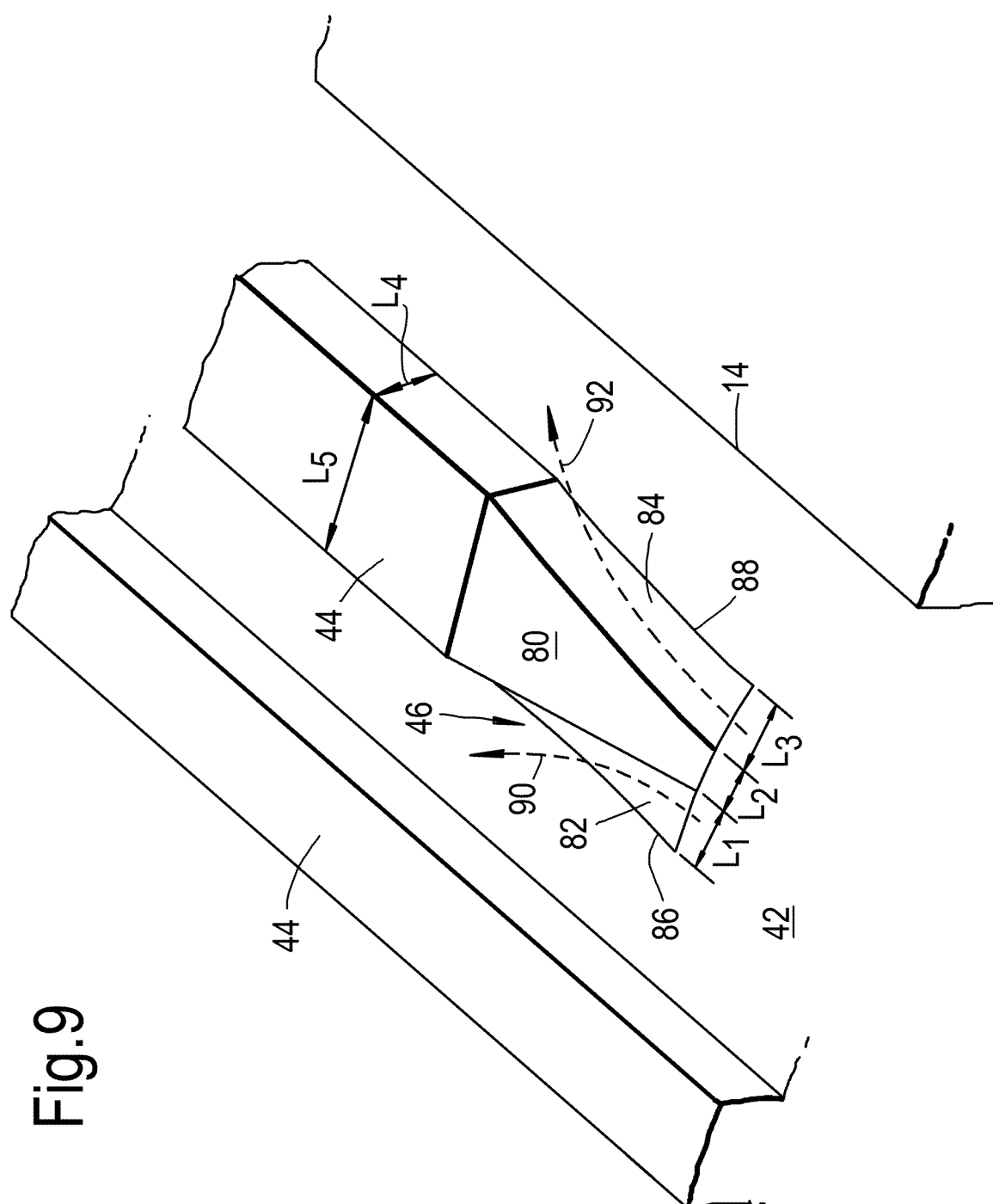


Fig.8



**Fig. 9**

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

|                                                                  |                                                                                                              |                                                                  |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Applicant's or agent's file reference<br>TS4062WOPCT2            | <b>FOR FURTHER ACTION</b><br><small>see Form PCT/ISA/220 as well as, where applicable, item 5 below.</small> |                                                                  |
| International application No.<br>PCT/EP2013/053502               | International filing date ( <i>day/month/year</i> )<br>21/02/2013                                            | (Earliest) Priority Date ( <i>day/month/year</i> )<br>23/02/2012 |
| Applicant<br><br>SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V. |                                                                                                              |                                                                  |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 6 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6**bis**(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☒ **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant
- ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant
- ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 7
- ☒ as suggested by the applicant
- ☐ as selected by this Authority, because the applicant failed to suggest a figure
- ☐ as selected by this Authority, because this figure better characterizes the invention
- b. ☐ none of the figures is to be published with the abstract

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP2013/053502

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-15

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.



## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2013/053502

A. CLASSIFICATION OF SUBJECT MATTER  
INV. E21B17/042 B23P19/00 F16L15/00 F16L15/06 E21B19/16  
ADD.

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 B23P 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 practicable, 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 2004/130152 A1 (DELANGE RICHARD W [US]<br>ET AL) 8 July 2004 (2004-07-08)                                            | 1                     |
| Y         | paragraph [0077]; figures 1-9<br>figures 10-12<br>the whole document                                                    | 12-15                 |
| Y         | -----<br>US 2 140 467 A (CLIFTON CARGILE)<br>13 December 1938 (1938-12-13)<br>page 2, column 1, lines 5-56; figures 2-6 | 12-15                 |
| A         | -----<br>CH 557 499 A (PAVEG ANSTALT)<br>31 December 1974 (1974-12-31)<br>figures 1,3<br>the whole document             | 1                     |
|           | -----<br>-/-                                                                                                            |                       |



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 April 2013

Date of mailing of the international search report

16/08/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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Fax: (+31-70) 340-3016

Authorized officer

van Berlo, André

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2013/053502

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                        |                       |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                     | Relevant to claim No. |
| A                                                    | US 2007/170722 A1 (REYNOLDS HARRIS A JR<br>[US] ET AL REYNOLDS JR HARRIS A [US] ET<br>AL) 26 July 2007 (2007-07-26)<br>paragraph [0034]<br>the whole document<br>----- | 1                     |
| A                                                    | GB 465 538 A (SPANG CHALFANT AND CO INC)<br>10 May 1937 (1937-05-10)<br>figure 4<br>-----                                                                              | 1                     |
| A                                                    | JP 11 062939 A (SUGIURA SEISAKUSHO KK)<br>5 March 1999 (1999-03-05)<br>the whole document<br>-----                                                                     | 1                     |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/053502

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2004130152                             | A1                  | 08-07-2004                 |                     |
|                                           |                     | AU 2003297946 A1           | 29-07-2004          |
|                                           |                     | BR 0317933 A               | 29-11-2005          |
|                                           |                     | CA 2512069 A1              | 22-07-2004          |
|                                           |                     | EP 1592910 A2              | 09-11-2005          |
|                                           |                     | MX PA05007252 A            | 30-09-2005          |
|                                           |                     | US 7350830 B1              | 01-04-2008          |
|                                           |                     | US 2004130152 A1           | 08-07-2004          |
|                                           |                     | WO 2004060590 A2           | 22-07-2004          |
| -----                                     |                     |                            |                     |
| US 2140467                                | A                   | 13-12-1938                 | NONE                |
| -----                                     |                     |                            |                     |
| CH 557499                                 | A                   | 31-12-1974                 | NONE                |
| -----                                     |                     |                            |                     |
| US 2007170722                             | A1                  | 26-07-2007                 | NONE                |
| -----                                     |                     |                            |                     |
| GB 465538                                 | A                   | 10-05-1937                 | NONE                |
| -----                                     |                     |                            |                     |
| JP 11062939                               | A                   | 05-03-1999                 | -----               |

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-15

Connector comprising cutting edge

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2. claims: 16-19

Coating containing brazing/soldering material

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