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(54) **Title:** METHOD AND APPARATUS FOR FORMING A PROTECTIVE COAT ABOUT A CUTBACK BETWEEN PIPES FORMING PART OF AN UNDERWATER PIPELINE, AND UNDERWATER-PIPELINE-LAYING VESSEL COMPRISING SUCH AN APPARATUS

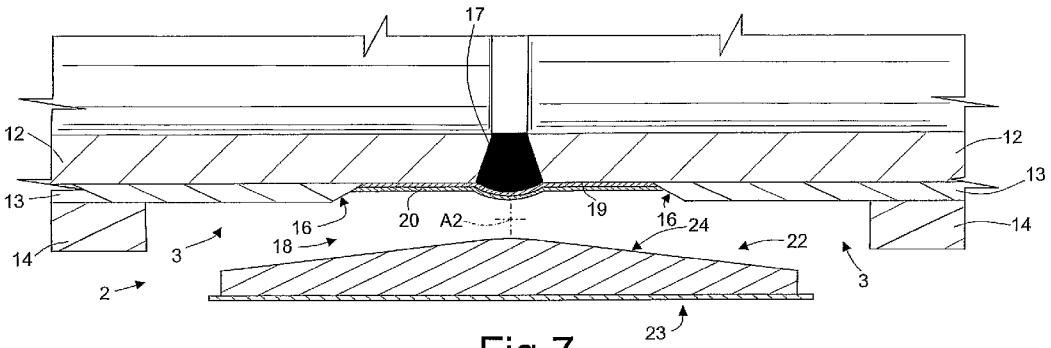

Fig.7

(57) **Abstract:** A method of forming a protective coat (21) about a cutback (18) between pipes (3) forming part of an underwater pipeline (2) provides for laying a thermoplastic sheet (22; 42) on a supporting sheet (23; 27; 40); and winding the thermoplastic sheet (22; 42) and the supporting sheet (23; 27; 40) about the cutback (18) to join the thermoplastic sheet (22; 42) to the cutback (18). A method of forming a protective coat (21) about a cutback (18) between pipes (3) forming part of an underwater pipeline (2) provides for laying a thermoplastic sheet (22; 42) on a supporting sheet (23; 27; 40); and winding the thermoplastic sheet (22; 42) and the supporting sheet (23; 27; 40) about the cutback (18) to join the thermoplastic sheet (22; 42) to the cutback (18).

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METHOD AND APPARATUS FOR FORMING A PROTECTIVE COAT ABOUT A CUTBACK BETWEEN PIPES FORMING PART OF AN UNDERWATER PIPELINE, AND UNDERWATER-PIPELINE-LAYING VESSEL COMPRISING SUCH AN APPARATUS

TECHNICAL FIELD

The present invention relates to a method of forming a protective coat about a cutback between pipes joined end to end to form underwater pipelines.

The method according to the present invention forms part of a general method of producing underwater pipelines, and which comprises, among other things, joining the facing free ends of two adjacent pipes, aligned along an axis, to form an annular joint portion known as a cutback; and winding a protective sheet about the cutback.

BACKGROUND ART

Underwater pipelines comprise a number of pipes joined to total lengths of hundreds of kilometers. The pipes are of normally 12-metre standard length, and relatively large diameters ranging between 0.2 and 1.5 metres, and each comprise a steel cylinder; a first coating of polymer material to protect the steel pipe; and possibly a second coating of Gunite or cement to weigh down the pipeline. In some applications, the pipes and underwater pipelines do not need and therefore have no second coating.

To weld the steel cylinders to one another, the

opposite free ends of each pipe have no first or second coating. The pipes are joined at on-land installations into multiple-standard-length pipes, as well as on pipeline-laying vessels, on which standard-length or multiple-standard-length pipes are joined to others, in turn already joined to other pipes, to form part of the underwater pipeline.

The actual joining operation comprises welding the steel cylinders, normally in a number of weld passes, and bridging the first and, possibly, second coating. Once an annular weld is formed between two steel cylinders, the cutback, with no first or second coating, extends astride the weld. In other words, the cutback is defined substantially by the free ends of the pipes, extends axially between two end portions of the first coating, and must be protective coated to prevent corrosion.

Cutback protective coating is known as "field joint coating", and comprises coating the cutback with three coats to ensure protection and adhesion of the coats to the steel cylinders. More specifically, cutback protective coating comprises heating, e.g. induction heating, the cutback to 250°C; spraying the cutback with powdered epoxy (FBE - Fusion Bonded Epoxy) resin, which, in contact with the cutback, forms a relatively thin first coat or "primer"; spraying the cutback, on top of the first coat, with a modified copolymer, which acts as adhesive and, in contact with the first coat, forms a

relatively thin second coat; applying a third so-called "top coat", which also extends partly over the first coating; and then bridging the second coating if necessary.

Welding, non-destructive weld testing, and bridging the first and second coating, are performed at joining stations equally spaced along the path of the pipes (or of the pipeline being formed, when the pipes are joined to this). The pipes are therefore advanced in steps, and are stopped at each joining station for a length of time determined by the longest operation, which, at present, is that of applying the third or top coat.

Known methods currently employed to apply the third coat include:

- "cigarette wrapping", which comprises heating, winding, and compressing a number of thin sheets of polymer material about the cutback, on top of the adhesive second coat;

- "spiral wrapping", which comprises heating, double-winding, and compressing a strip about the cutback, on top of the second coat;

- "flame spraying" using a hot spray gun to melt and spray on polymer;

- fitting a mold about the cutback, and injecting liquid polymer about the cutback, on top of the second coat;

- preparing a polymer strip having a heat-shrink outer protective layer (third coat) and an adhesive

inner layer (second coat); heat-shrinking the strip; and melting the adhesive inner layer so the strip adheres firmly to the first coat. This last method differs from the previous methods by simultaneously applying the second and third coat.

All the above methods of applying the third coat are extremely time-consuming. More specifically, coating large cutbacks, such as those of a 48-inch (roughly 1.2-metre) diameter steel cylinder, calls for applying a relatively long third coat, which, in addition, may be as much as 5 mm thick and 400 mm wide. In other words, since, in most cases, the mass of polymer material to be applied to form the third coat is relatively considerable, and the third coat must be plastic enough, when applied, to achieve effective chemical/mechanical adhesion to the second coat, known methods of applying the third coat do not allow a satisfactory reduction in coating time.

Moreover, when applying the third coat using known methods, small amounts of air may become trapped between the third coat and underlying coats, and are particularly harmful by preventing firm grip of the third coat to the underlying coats, and possibly impairing the field joint coating as a whole.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide a method of forming a protective coat about a cutback between two pipes, designed to eliminate the drawbacks

of the known art.

According to the present invention, there is provided a method of forming a protective coat about a cutback between pipes forming part of an underwater pipeline; the method comprising laying a thermoplastic sheet on a supporting sheet; and winding the thermoplastic sheet and the supporting sheet about the cutback to join the thermoplastic sheet to the cutback.

The method according to the present invention has the advantage of applying the thermoplastic sheet at very high temperature, and therefore in such a plastic condition as to fill any gaps; while the supporting sheet prevents in-handling deformation of the thermoplastic sheet, even when highly plastic.

The present invention also relates to an apparatus for forming a protective coat about a cutback between pipes forming part of an underwater pipeline.

According to the present invention, there is provided an apparatus for forming a protective coat about a cutback between pipes forming part of an underwater pipeline; the apparatus comprising a winding device for winding a thermoplastic sheet and a supporting sheet, supporting the thermoplastic sheet, about the cutback.

The present invention also relates to an underwater-pipeline-laying vessel.

According to the present invention, there is provided an underwater-pipeline-laying vessel comprising

an apparatus as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a side view, with parts removed for clarity, of an underwater-pipeline-laying vessel implementing the method according to the present invention;

Figures 2 and 3 show sections, with parts removed for clarity, of pipes at various joining stages;

Figures 4 and 5 show larger-scale sections, with parts removed for clarity, of pipes at various stages in formation of the protective coat;

Figure 6 shows a view in perspective, with parts removed for clarity, of one step in the method according to the present invention;

Figures 7 to 10 show longitudinal sections, with parts removed for clarity, of steps in the method according to the present invention;

Figures 11 and 12 show cross sections, with parts removed for clarity, of further steps in the method according to the present invention;

Figure 13 shows a larger-scale cross section, with parts removed for clarity, of a step in the method according to the present invention;

Figure 14 shows a side view, with parts removed for clarity, of a variation of the Figure 6 step;

Figure 15 shows a larger-scale cross section, with parts removed for clarity, of a variation of the Figure 13 step;

Figure 16 shows a schematic front view, with parts removed for clarity, of an apparatus for forming a protective coat in accordance with the present invention;

Figures 17 and 18 show longitudinal sections, with parts removed for clarity, of steps in a variation of the method according to the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figure 1 indicates a pipeline-laying vessel in the process of producing and laying in the sea (SL indicates sea level) an underwater pipeline 2 comprising pipes 3 joined to one another. Vessel 1 comprises buoyancy hulls 4; an above-water tunnel 5; a partly above-water, inside ramp 6; an underwater outside ramp 7; and a work line 10 extending along tunnel 5 and the above-water portion of inside ramp 6.

The partly formed underwater pipeline 2 and pipes 3 ready for joining to it extend along an axis A1 of work line 10, which comprises a number of joining stations 11 equally spaced along axis A1, and each for performing a given operation, such as welding, non-destructive testing, or bridging a coating.

The distance between adjacent joining stations 11 equals the standard length, about 12 metres, of each pipe 3, or a multiple of the standard length, when

joining, along line 10, multiple-standard-length pipes 3 joined beforehand at on-land installations or off-line on the vessel.

With reference to Figure 2, each pipe 3 comprises a steel cylinder 12; a first polymer coating 13, normally of polyethylene or polypropylene, contacting and for corrosionproofing steel cylinder 12; and a second coating 14 of Gunite or cement for weighing down underwater pipeline 2.

In an alternative embodiment not shown, the pipes have no second coating.

Each pipe 3 has two opposite free ends 15 (only one shown in Figures 2 and 3) with no first coating 13 and no second coating 14; and first coating 13 has a bevel 16 at each free end 15.

Two consecutive pipes 3, aligned along axis A1 (Figure 2), are positioned with free ends 15 parallel, facing, and close together, and are welded - possibly in a number of weld passes at successive joining stations 11 - to form an annular weld bead 17 between pipes 3 (Figure 3). With reference to Figure 3, two welded pipes 3 form a cutback 18 extending along axis A1, between two successive bevels 16 of first coating 13, and along annular weld bead 17.

In addition to welding cylinders 12, joining pipes 3 also comprises bridging first coating 13 and second coating 14. Bridging first coating 13 comprises surface treating (shot peening) cutback 18; induction heating

cutback 18 to 250°C; and applying a first coat 19, second coat 20, and third coat 21 of polymer material to cutback 18 in rapid succession (Figure 9).

With reference to Figure 4, first coat 19 is 100 to 500 microns thick, and is made of epoxy (FBE : Fusion Bonded Epoxy) resin applied to cutback 18 in powdered form using a spray gun not shown in the drawings.

With reference to Figure 5, second coat 20 is 100 to 500 microns thick, and is made of a modified copolymer, normally CMPE or CMPP, applied in powdered form about cutback 18, on top of first coat 19, using a spray gun not shown in the drawings.

With reference to Figure 9, third coat 21 is 2 to 5 mm thick, and is made of a modified copolymer, normally CMPE or CMPP, applied by winding a single thermoplastic sheet 22 about cutback 18 at a joining station 11, as shown in Figure 11. In the example shown, sheet 22 is made of a modified copolymer, is wound about cutback 18 at a joining station 11 (Figure 1), is wider than cutback 18 (measured along axis A1) so as to overlap first coatings 13 of both joined pipes 3, and is long enough to wind completely about the circumference of cutback 18 and overlap the end portions of sheet 22.

With reference to Figure 6, the method of applying sheet 22 comprises laying sheet 22 on a flexible supporting sheet 23, which can be done in substantially two ways : by extruding sheet 22 directly onto sheet 23 at station 11, or withdrawing sheet 22 from a store at

station 11 and simply laying it on sheet 23.

Sheet 23 is rectangular, is slightly larger than sheet 22, and is made of very thin metal material for flexibility, or of high-temperature-resistant silicone.

Sheet 22 is rectangular, extends lengthwise parallel to an axis A2, and has a contoured face 24. That is, sheet 22 varies in thickness crosswise to axis A2, is thickest in the centre and thinnest at the edges parallel to axis A2, and is of substantially constant thickness in the directions parallel to axis A2. In the Figure 6 example, the contoured face 24 of sheet 22 is a convex face parallel to axis A2, and which eventually defines the surface contacting second coat 20 and the overlapped first coatings 13.

To ensure a high degree of plasticity of the thermoplastic material of sheet 22, the method provides for winding sheet 22, at a temperature of over 130°C, about cutback 18. The necessary temperature can be achieved in two ways: one, by extruding sheet 22 at station 11, simultaneously depositing sheet 22 on sheet 23, and applying sheet 22 immediately, before it cools, about cutback 18; and, two, by heating sheet 22, laid on sheet 23, before sheet 22 is wound on.

Once sheet 22 is at the right temperature, sheet 23 and sheet 22 are positioned at cutback 18 in the flat configuration shown in Figure 7, in which, axis A2 is substantially perpendicular to axis A1, and sheet 22 is substantially centred with respect to cutback 18.

Next, sheet 22 and sheet 23, both in the flat configuration, are moved up closer to lay a portion of contoured face 24 of sheet 22 on second coat 20, as shown in Figure 8, and are pressed onto cutback 18 to locally deform sheet 22 and gradually adapt face 24 outwards from the centre of cutback 18. Pressure is applied to sheet 22 through sheet 23 by means of a roller or two rollers 25 and 26, as shown in Figures 11 and 12. Roller 26 is rolled about axis A1 to press on the whole of sheet 22, whereas roller 25 holds the end of sheet 22 on cutback 18, as shown in Figure 12.

With reference to Figure 13, when sheet 22 is more or less completely wound about cutback 18, roller 25 is moved to partly detach the end portion of sheet 23. Sheet 23 springs back off when made of metal material, or is detached when made of silicone. Roller 26 thus continues its winding movement, and secures the free end of sheet 22 to the end of sheet 22 on cutback 18. Once the ends are joined, the third coat 21 is completed, and sheet 23 is removed and may be used in applying another sheet 22 to another cutback 18.

Third coat 21 may be covered with a layer C of cement or Gunite, as shown in Figure 10.

In the Figure 14 variation, sheet 22 is slightly shorter than the circumference of cutback 18, and is laid on a sheet 27, which is slightly shorter than sheet 22 and has bevelled edges 28 along its short sides. Sheet 22 is laid on sheet 27 so that the opposite ends

of sheet 22 project slightly from the bevelled edges of sheet 27, and bevelled edges 28 converge with the ends of sheet 22.

As sheet 22 is wound and pressed, the free ends of sheet 22 therefore swell, due to creep of the material, as shown in Figure 15, and rollers 25 and 26 press and seal the swollen free ends firmly to one another.

Next, a layer C of cement (or Gunite) is formed to bridge the outer coating 14 in known manner.

Number 29 in Figure 16 indicates an apparatus for applying sheet 22 to cutback 18 at a joining station 11 (Figure 1).

Apparatus 29 is located at joining station 11, and comprises a trolley 30 movable along a path P1 crosswise to axis A1; a winding device 31 fixed to pipeline 2 being produced; an oven 32 located along path P1; and possibly an extruder (not shown) or a store (not shown) of sheets 22.

Trolley 30 runs along rails 33 defining path P1, and has a supporting surface 34 defined by parallel, side by side rollers 35 and for supporting sheet 23 or 27.

Oven 32 is a tunnel type to allow the whole of trolley 30 to travel through it, and comprises heating elements 36.

Apparatus 29 comprises two annular structures 37 (only one shown in Figure 16); and two satellites 38 guided by annular structures 37 and supporting rollers

25 and 26 respectively.

Annular structures 37 are located on opposite sides of cutback 18, in accordance with a widely used pipe-joining technique described, for example, in WO 00/45986, as regards pipe welding, and in US 6,440,245, as regards cutback coating.

Each satellite 38 is supported and guided along an annular path defined by annular structures 37, and comprises a first motor (not shown) for moving the satellite along the annular path, and a second motor for moving respective roller 25, 26 to and from cutback 18 when applying sheet 22 as described above.

The operations performed by apparatus 29 are clearly inferable from the above description of the method of applying sheet 22.

Number 40 in Figure 17 indicates a curved, rectangular supporting sheet having a convex face 41, the convexity of which is parallel to axis A2 parallel to the longer dimension of sheet 40. And the method provides for laying on convex face 41 of sheet 40 a thermoplastic sheet 42 which, unlike sheet 22, has a substantially rectangular cross section, and is of constant thickness in all directions. When laid on sheet 40, sheet 42 assumes a curved configuration, in which the face 43 of sheet 42 assumes substantially the same convex configuration as face 41 of sheet 40.

Sheet 42 is applied in the same way as sheet 22, except that, in this case, sheet 40 and sheet 42 assume

a substantially flat configuration when pressed by rollers 25 and 26 and wound about cutback 18.

In a further variation, not shown, the supporting sheet is rectangular and defined by rigid sectors hinged to one another about axes perpendicular to an axis parallel to the longer dimension of the sheet.

The supporting sheets have knurled faces to improve adhesion of the thermoplastic sheets, and holes or cavities at the ends to assist detachment of the supporting sheets from the thermoplastic sheets.

Applying the thermoplastic sheet using a supporting sheet substantially has the advantages of enabling application of a highly plastic thermoplastic sheet, without compromising the structure of the thermoplastic sheet, and of configuring the face of the thermoplastic sheet laid on the cutback. The face laid on the cutback is advantageously of varying thickness, so that adhesion occurs gradually in wavelike manner, thus preventing air from becoming trapped between the thermoplastic sheet and the cutback.

CLAIMS

1) A method of forming a protective coat (21) about a cutback (18) between pipes (3) forming part of an underwater pipeline (2); the method comprising laying a thermoplastic sheet (22; 42) on a supporting sheet (23; 27; 40); and winding the thermoplastic sheet (22; 42) and the supporting sheet (23; 27; 40) about the cutback (18) to join the thermoplastic sheet (22; 42) to the cutback (18).

2) A method as claimed in Claim 1, characterized by pressing the thermoplastic sheet (22; 42) and the supporting sheet (23; 27; 40) onto the cutback (18) by means of at least one roller (25, 26) movable about the cutback (18).

3) A method as claimed in Claim 1 or 2, characterized in that the thermoplastic sheet (22; 42) is made of polypropylene; the method providing for winding the thermoplastic sheet (22; 42) about the cutback (18) when the thermoplastic sheet (22; 42) is at a temperature of over 130°C.

4) A method as claimed in Claim 3, characterized by heating the thermoplastic sheet (22; 42) to a temperature of over 130°C, when the thermoplastic sheet (22; 42) is laid on the supporting sheet (23; 27; 40).

5) A method as claimed in Claim 3, characterized by extruding the thermoplastic sheet (22; 42) at a temperature of over 130°C, and simultaneously laying the

thermoplastic sheet (22; 42) on the supporting sheet (23; 27; 40).

6) A method as claimed in any one of the foregoing Claims, characterized in that the cutback (18) extends about a first axis (A1); and the thermoplastic sheet (22; 42), when laid on the supporting sheet (23; 27; 40), is of a length substantially equal to the circumference of the cutback (18), and has a contoured face (24; 43) parallel to a second axis (A2) and sloping downwards to the lateral edges of the thermoplastic sheet (22; 42).

7) A method as claimed in Claim 6, characterized in that the thermoplastic sheet (22) varies in thickness crosswise to the second axis (A2), and is thickest at the centre.

8) A method as claimed in Claim 6 or 7, characterized in that the contoured face (24) is convex.

9) A method as claimed in Claim 6 or 8, characterized by laying the thermoplastic sheet (22) on a supporting sheet (23; 27) in substantially flat configuration.

10) A method as claimed in Claim 6 or 7, characterized by laying the thermoplastic sheet (42) on a supporting sheet (40) in substantially curved configuration having a convex face (41) contacting the thermoplastic sheet (42) and parallel to the second axis (A2).

11) A method as claimed in Claim 10, characterized

in that the thermoplastic sheet (42) is of constant thickness.

12) A method as claimed in any one of Claims 6 to 11, characterized by positioning the thermoplastic sheet (22; 42) close to the cutback, with the contoured face (24; 43) facing the cutback (18), and with the second axis (A2) substantially perpendicular to the first axis (A1).

13) A method as claimed in any one of Claims 1 to 12, characterized in that the thermoplastic sheet (22; 42) is shorter in length than the supporting sheet (23; 40).

14) A method as claimed in any one of Claims 1 to 12, characterized in that the thermoplastic sheet (22) is longer than the supporting sheet (27); the opposite ends of the thermoplastic sheet (22) projecting with respect to the supporting sheet (27).

15) A method as claimed in any one of the foregoing Claims, characterized in that the supporting sheet (23; 27; 40) is flexible.

16) A method as claimed in any one of the foregoing Claims, characterized in that the supporting sheet (23; 27; 40) is elastic.

17) An apparatus for forming a protective coat (21) about a cutback (18) between pipes (3) forming part of an underwater pipeline (2); the apparatus (29) comprising a winding device (31) for winding a thermoplastic sheet (22; 42) and a supporting sheet (23;

27; 40), supporting the thermoplastic sheet (22; 42), about the cutback (18).

18) An apparatus as claimed in Claim 17, characterized in that the winding device (31) comprises at least one roller (25, 26) movable about the cutback (18) to press the thermoplastic sheet (22; 42), together with the supporting sheet (23; 27; 40), onto the cutback (18).

19) An apparatus as claimed in Claim 17, characterized in that the winding device (31) comprises two rollers (25, 26) movable about the cutback (18) to press the thermoplastic sheet (22; 42), together with the supporting sheet (23; 27; 40), onto the cutback (18).

20) An apparatus as claimed in any one of Claims 17 to 19, characterized by comprising heating elements (36) to heat the thermoplastic sheet (22; 42) to a temperature of over 130°C, when the thermoplastic sheet (22; 42) is laid on the supporting sheet (23; 27; 40), and just before winding the thermoplastic sheet (22; 42) and the supporting sheet (23; 27; 40) about the cutback (18).

21) An apparatus as claimed in Claim 20, characterized by comprising a tunnel oven (32); the heating elements (36) being located inside the oven (32).

22) An apparatus as claimed in Claim 21, characterized by comprising transportation means (30)

for transferring the supporting sheet (23; 27; 40) and the thermoplastic sheet (22; 42) along a path (P1) through the oven (32) and beneath the cutback (18).

23) An underwater-pipeline-laying vessel comprising an apparatus as claimed in any one of Claims 17 to 22.

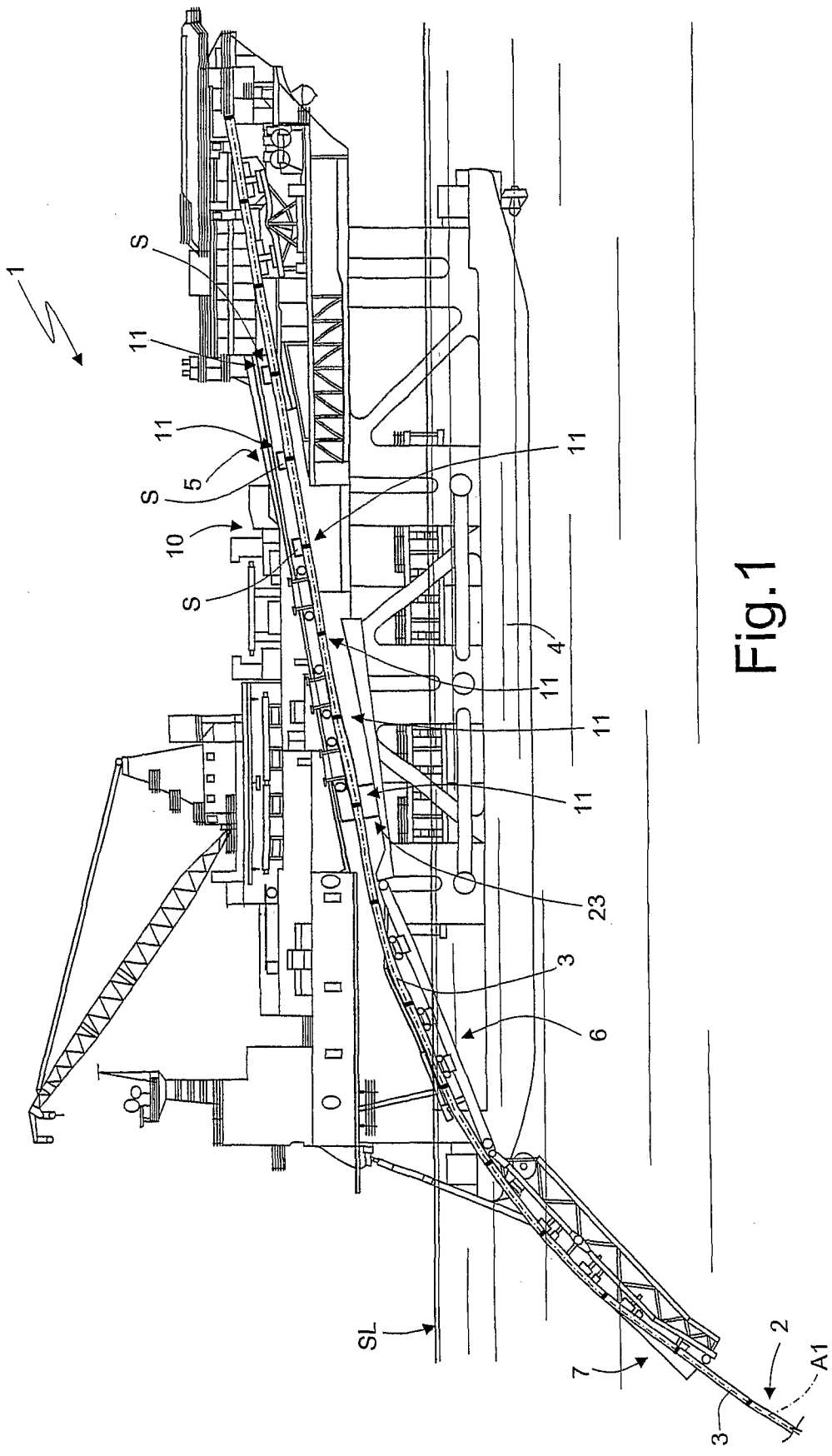

Fig.1

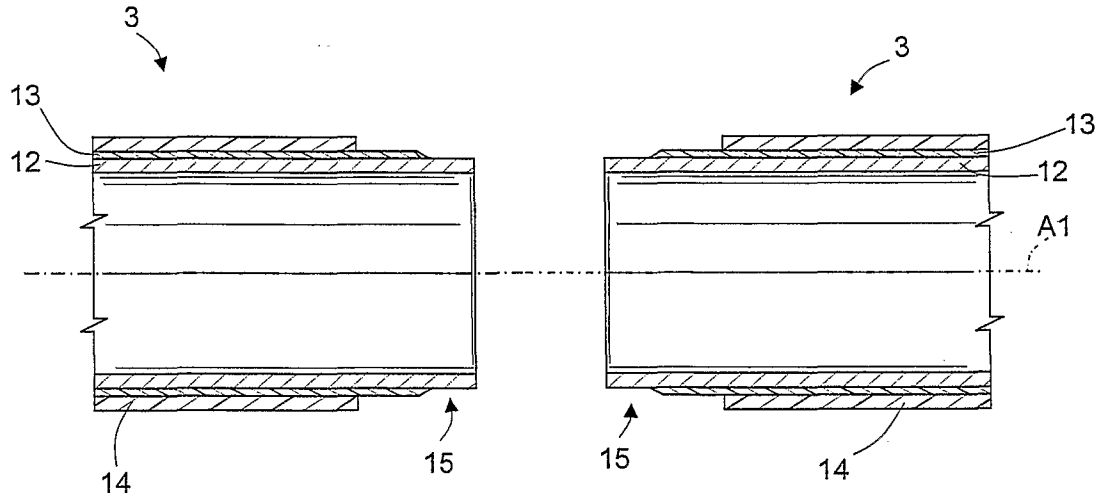

Fig.2

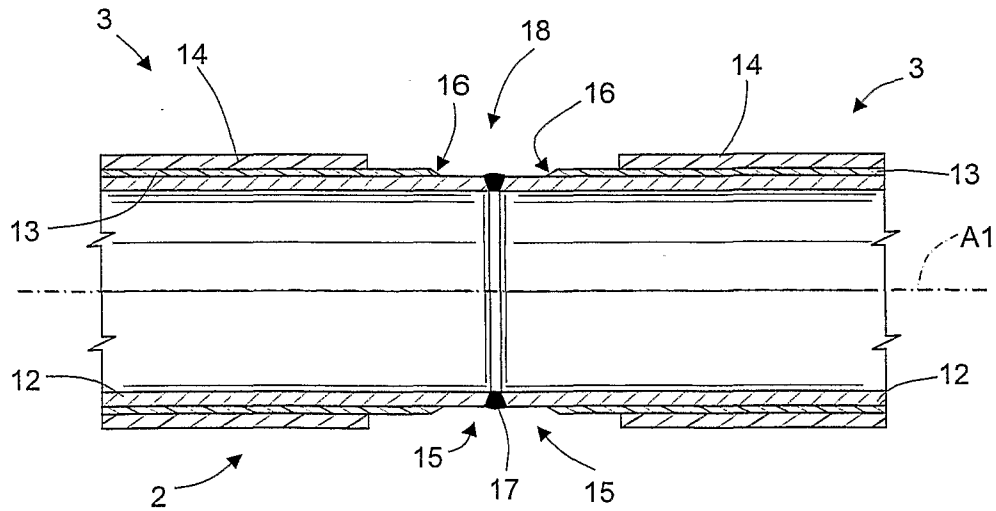

Fig.3

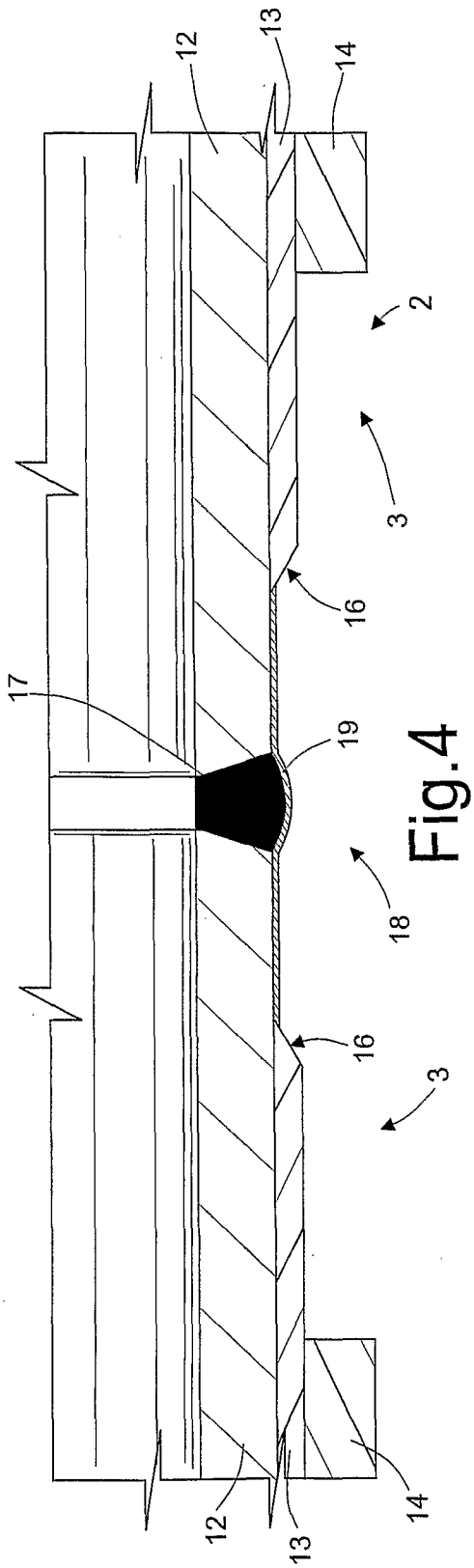
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Fig.4

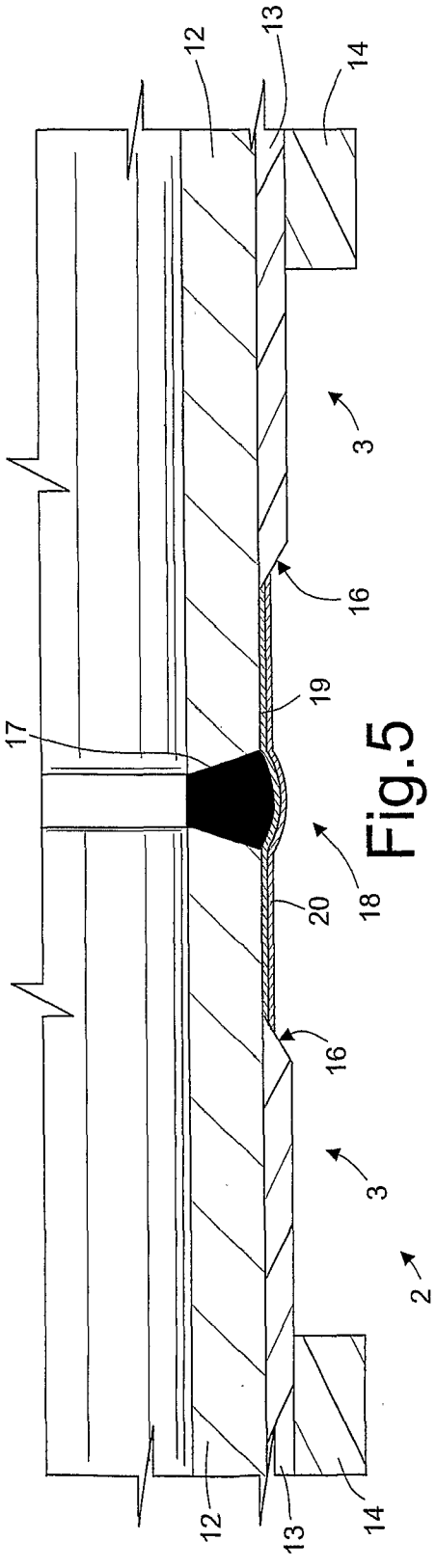
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Fig.5

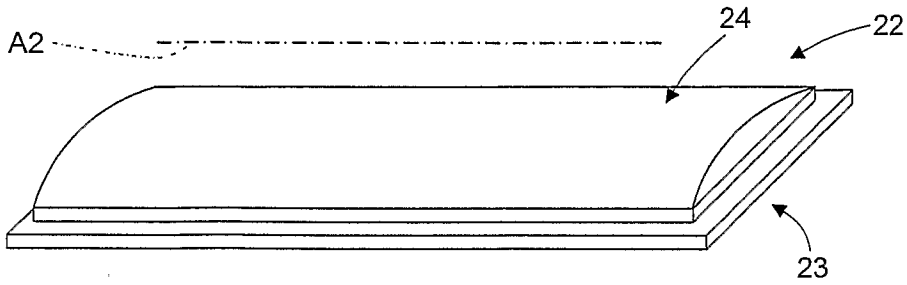

Fig.6

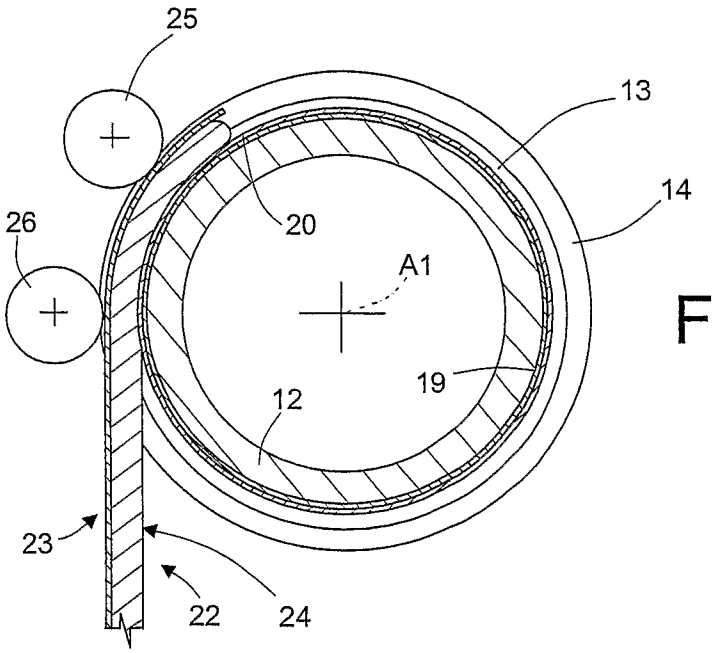

Fig.11

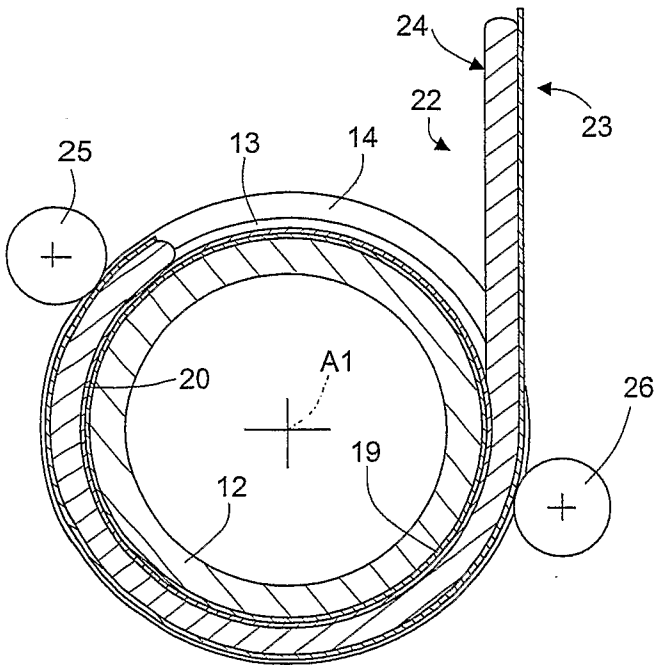

Fig.12

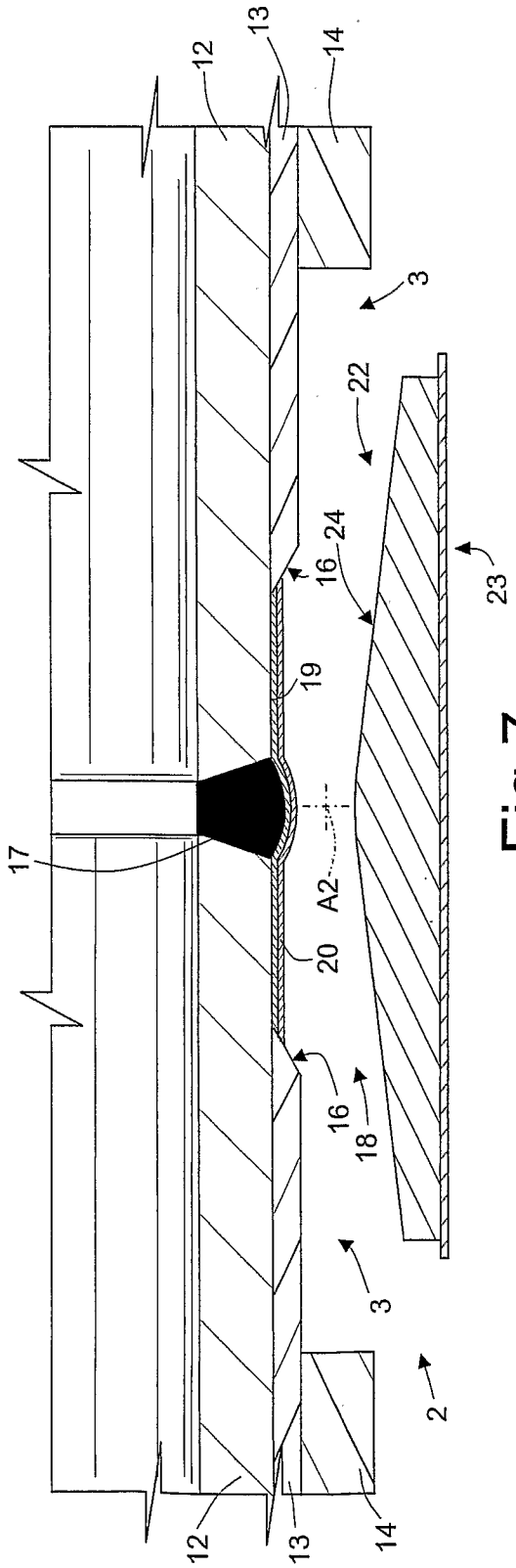
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Fig.7

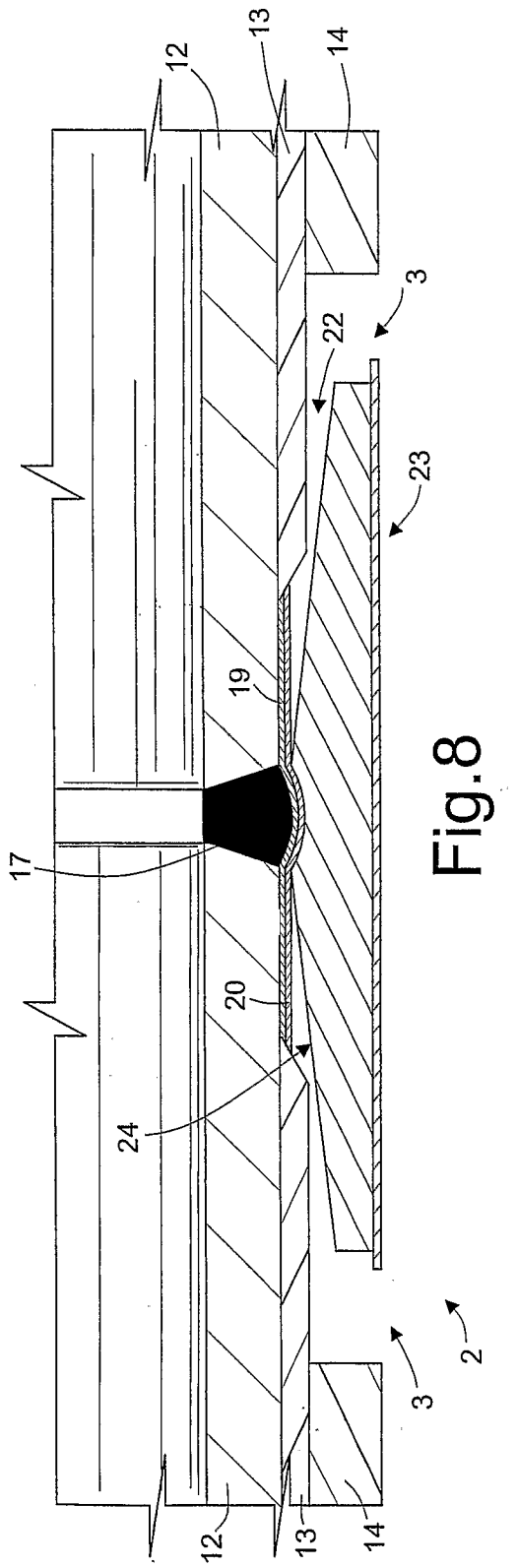
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Fig.8

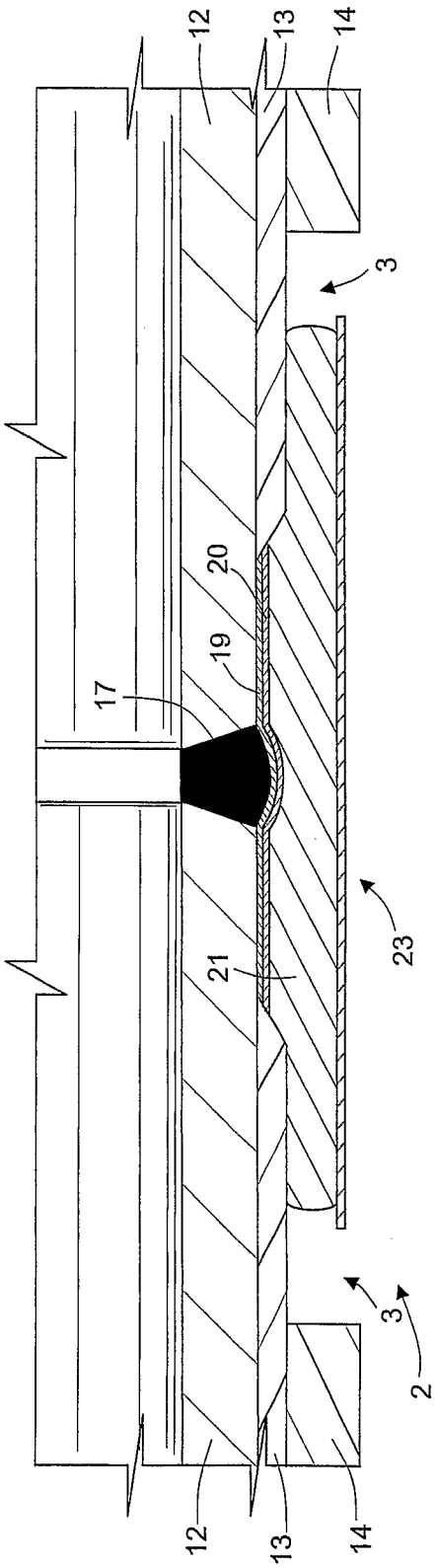

Fig.9

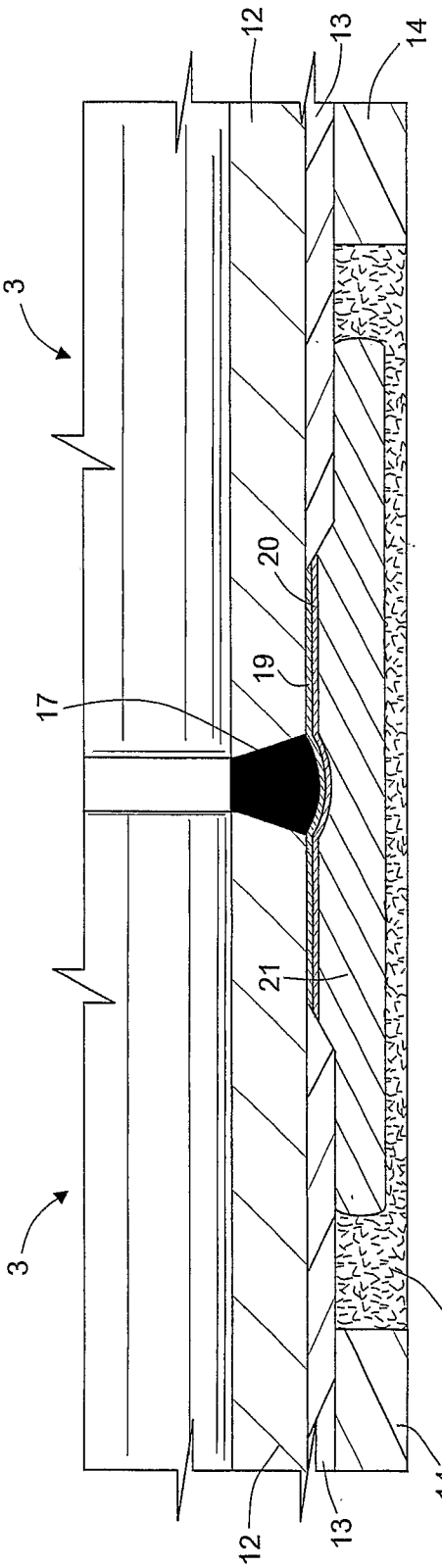

Fig.10

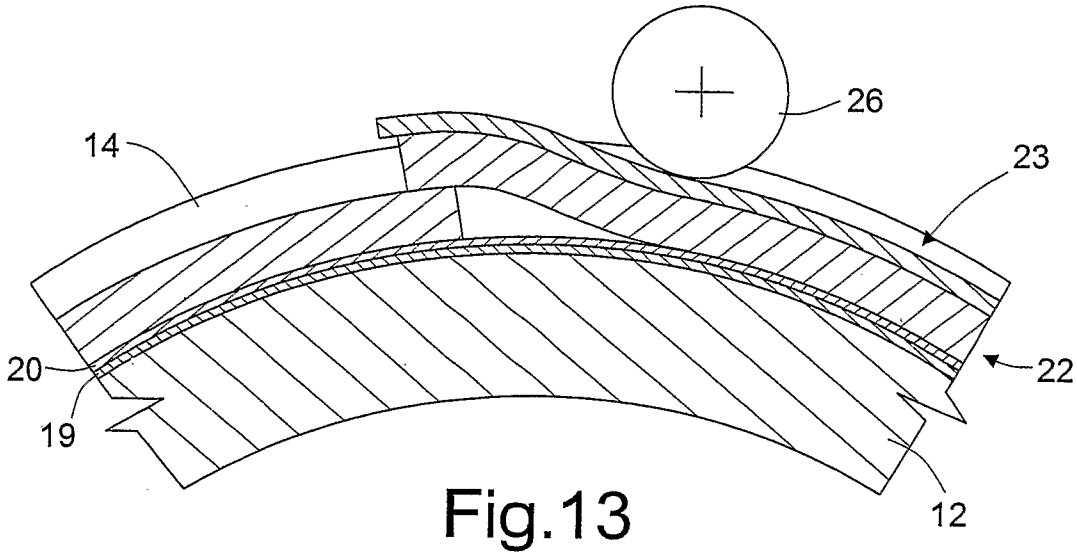

Fig.13

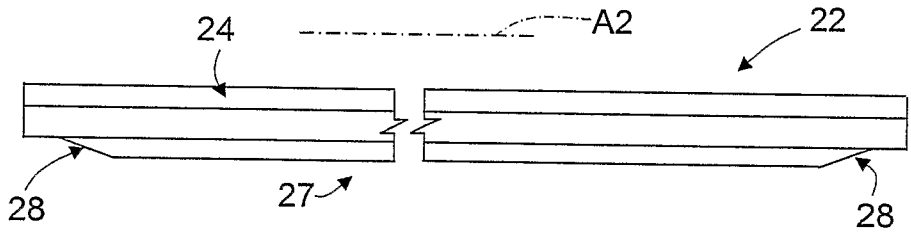

Fig.14

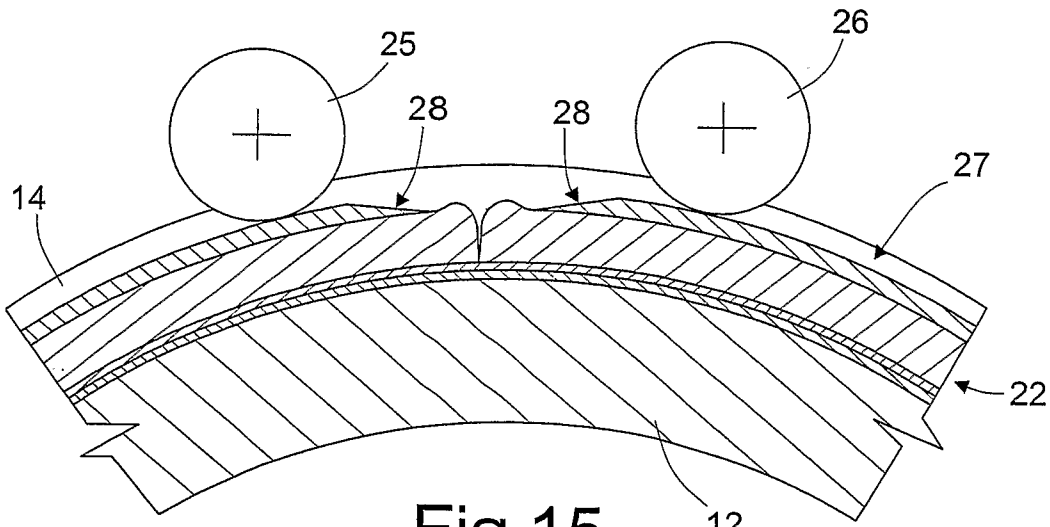

Fig.15

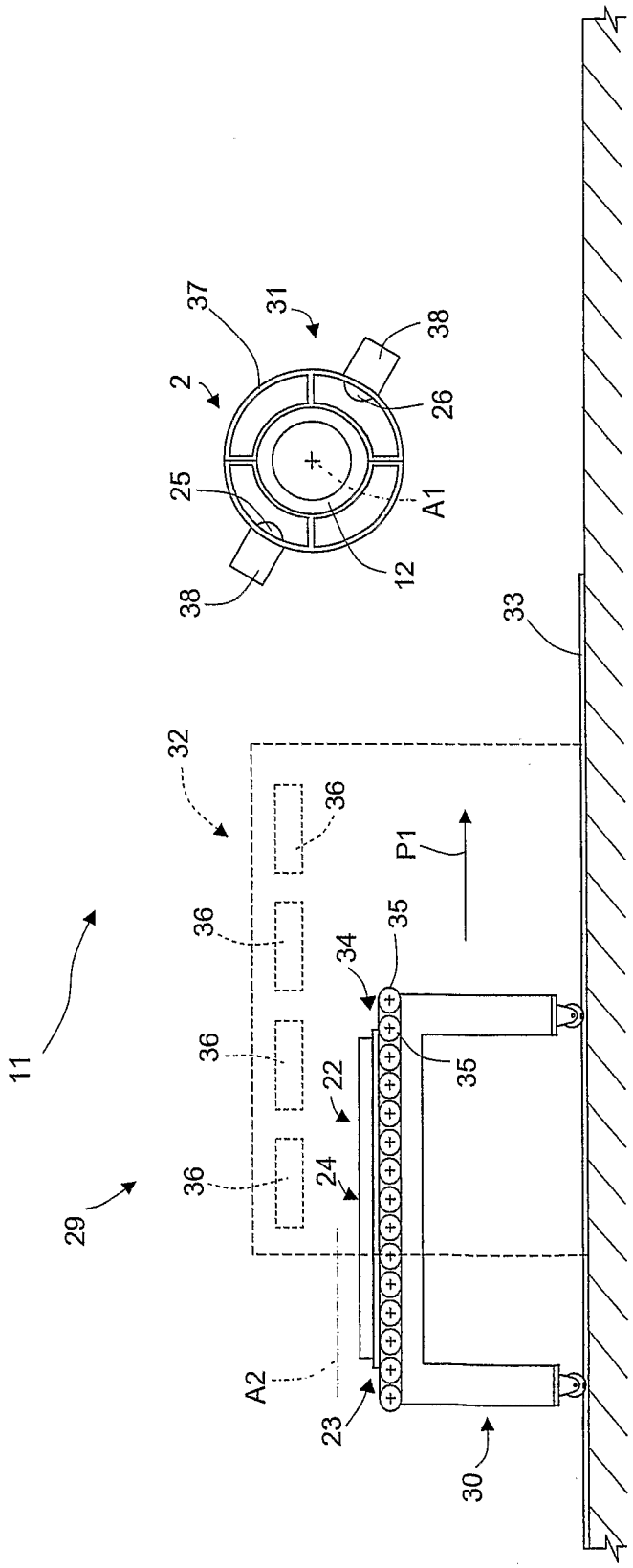
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Fig.16

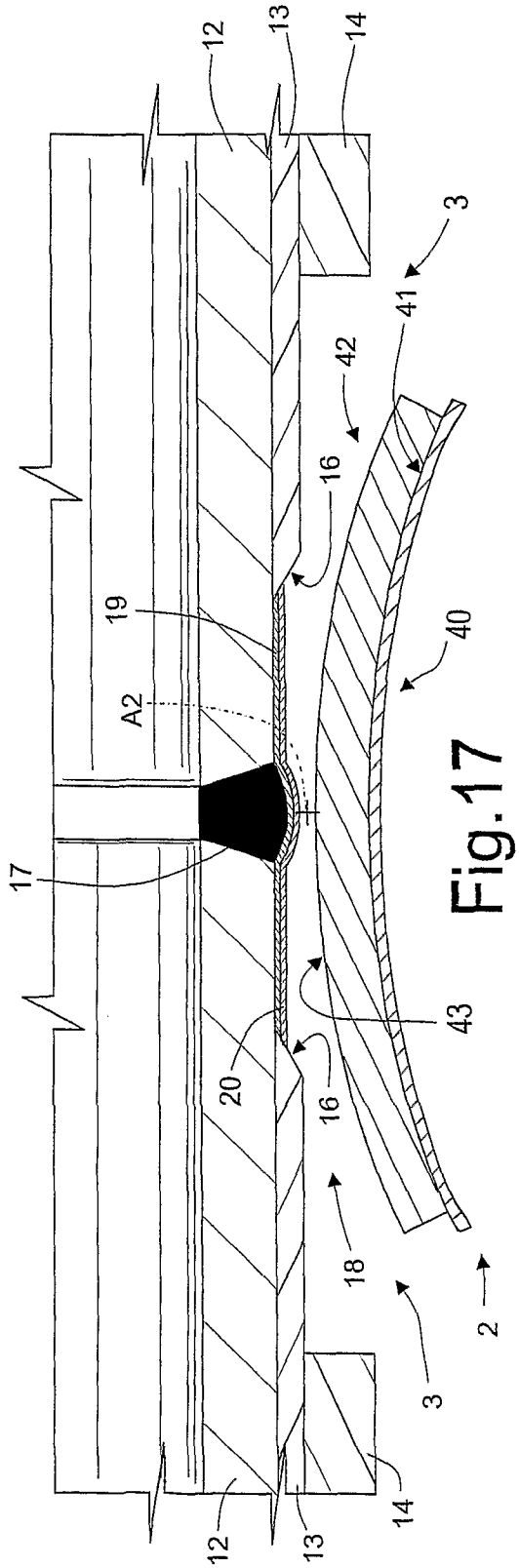
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Fig.17

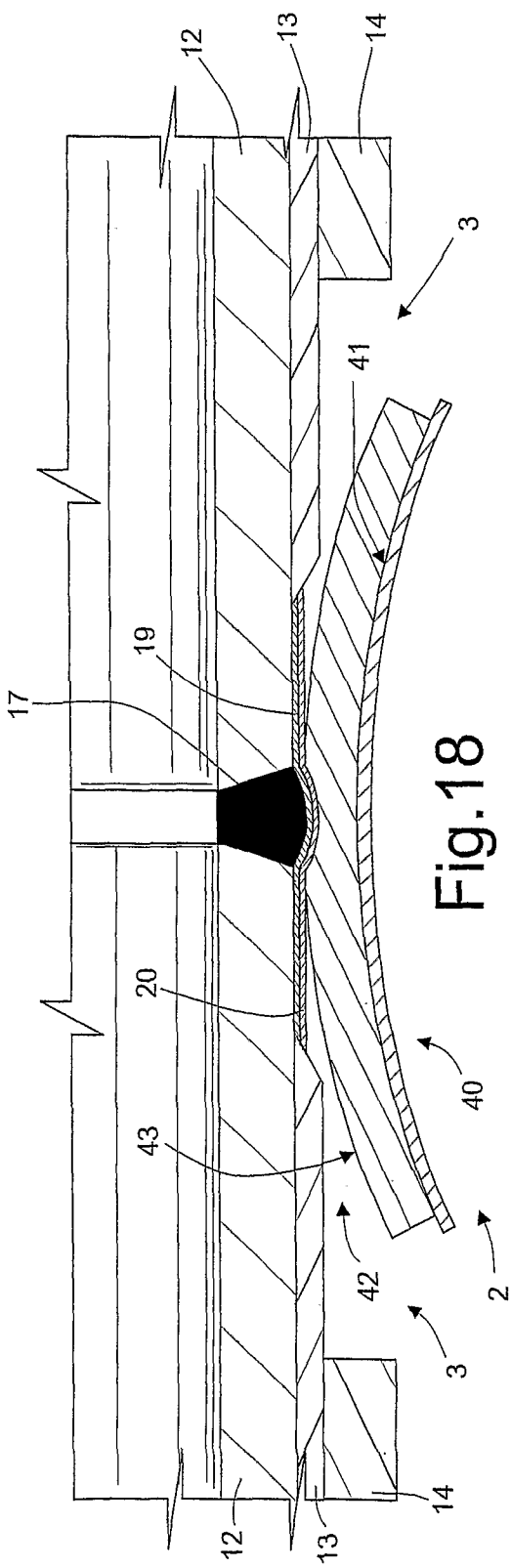
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Fig.18

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/000441

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C63/06 F16L13/02 F16L58/18 F16L59/20

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)
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 A	US 3 470 057 A (STUART LINDEN JR ET AL) 30 September 1969 (1969-09-30) column 1, line 20 - column 2, line 10 column 4, line 18 - line 54 figures 1,9-11	1,2, 15-23 3
X A	US 6 440 245 B1 (CULZONI FERNANDO [IT] ET AL) 27 August 2002 (2002-08-27) cited in the application column 2, line 56 - column 4, line 17 column 5, line 25 - column 8, line 55; figures 1-5	1-5, 15-20 13,14, 21-23

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"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

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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
15 July 2008	25/07/2008

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	Vecchio, Giovanni

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/000441

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 574 023 A (EDWARDS NEIL A [US] ET AL) 4 March 1986 (1986-03-04)	17-19
A	column 2, line 10 - line 68 column 4, line 45 - line 60 figures 2,4	1-3,15, 16,20,23

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2008/000441

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