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(72) Inventors:
• **RONALDO ANDRADE DOS REIS, Carlos**
22750-320 RIO DE JANEIRO (BR)
• **LEITÃO GONÇALVES TOSTE, Fernando**
20540-140 RIO DE JANEIRO (BR)
• **LARANJEIRA MOURA FARIAS, Livia**
22790-705 RIO DE JANEIRO (BR)
• **BOTTINO DI GIOIA ALMEIDA, Hugo**
22630-012 RIO DE JANEIRO (BR)

(71) Applicant: **Technip France**
92400 Courbevoie (FR)

(74) Representative: **Lavoix**
2, place d'Estienne d'Orves
75441 Paris Cedex 09 (FR)

(54) **APPARATUS FOR MOUNTING A FLEXIBLE LINE ONTO A SURFACE FACILITY AND RELATED METHOD**

(57) The invention comprises an apparatus (20) for mounting a flexible line (18) onto a surface facility (16), comprising:

- a tube (40) intended to be secured to said surface facility (16) to receive the flexible line,
- a curvature limiter (42) intended to be mounted around the flexible line (18), said curvature limiter (42) being intended to be connected to the bottom of the tube (40), said curvature limiter (42) defining a retaining stop, and
- a stopper collar (48) able to co-operate with the retaining stop to retain the curvature limiter (42) against the detachment of the curvature limiter from the tube (40), characterised in that the stopper collar (48) is mounted rotatable around the curvature limiter (42).

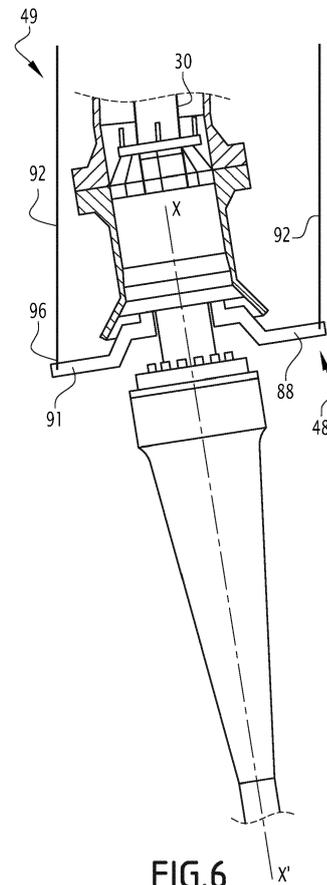


FIG.6

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Description

[0001] The present invention concerns an apparatus for mounting a flexible line onto a surface facility, comprising:

- a tube intended to be secured to said surface facility to receive the flexible line,
- a curvature limiter intended to be mounted around the flexible line, said curvature limiter being intended to be connected to the bottom of the tube, said curvature limiter defining a retaining stop, and
- a stopper collar able to co-operate with the retaining stop to retain the curvature limiter against the detachment of the curvature limiter from the tube.

[0002] Such a mounting apparatus is used in particular in a hydrocarbon production installation on a body of water, for instance, a fixed rigid structure on the seabed, an oscillating structure secured to the seabed, or a floating structure, such as a surface naval base, a semisubmersible platform, a floating vertical column, or a vessel.

[0003] The flexible line to be mounted on the structure is for instance a rising flexible pipe, also referred to as riser. Herein 'flexible pipes' are understood to mean those described in the standards published by the American Petroleum Institute (API), API 17J (4th Edition, May 2014) and API RP 17 B (5th Edition, May 2014), and well known to the person skilled in the art. More generally, the flexible line can be an integrated production bundle, an umbilical or an electrical cable.

[0004] A mounting apparatus of the aforementioned type is used in particular when installing and connecting the flexible line to the surface structure.

[0005] For this purpose, in order to reduce the risks of damaging the structure and the flexible line, it is known to immerse the flexible line into the body of water below the surface structure and to lift it up to the connecting area located on the surface structure by means of a hoist. Such a connection is referred to by the term 'pull-in'.

[0006] The flexible line is guided over the structure by introducing the same through a hollow rigid tube integral with the structure and oriented vertically, which is a protective sleeve. The hollow tube is for instance of the 'I tube' or 'J tube' type, depending on its conformation.

[0007] At the upper outlet of the tube, the flexible line is connected to the surface installation via a manifold.

[0008] In order to avoid any deterioration of the flexible line, for example under the effect of water agitation likely to bring it into contact with the structure, it is known to engagedly mount around the flexible line a curvature limiter adapted to locally impose a radius of curvature greater than the minimum radius of curvature which may be adopted by the flexible line.

[0009] Hereafter, curvature limiters are understood to both curvature limiters, composed e.g. of articulated rigid elements called 'vertebrae', and stiffeners, composed e.g. of plastic molded blocks, as well as combinations

thereof.

[0010] A stiffener is for instance arranged around the flexible line close to the upper end thereof, so as to co-operate with the hollow tube when the flexible line is inserted into the tube.

[0011] For this purpose, at first, the stiffener and the flexible line are moved together to the lower end of the hollow tube until the stiffener has been partially inserted into the hollow tube. Next, in a second stage, the flexible line is moved upwards in relation to the stiffener for lifting the same up through the hollow tube in view of connecting it to the surface structure.

[0012] During this second phase, the stiffener is maintained to be translationally immobile within the bottom extremity of the hollow tube through embedding and/or fastening by means of clamps.

[0013] During this process the bend stiffener and portion of flexible pipe body are typically orientated in a vertical direction. If the bend stiffener is unsupported partially or wholly, due to an error during assembly the bend stiffener can plummet down the length of the pipe by virtue of gravitational force. This can be highly disruptive, as the bend stiffener is very heavy (typically more than 5000 kg, and even more than 10000 kg in some instances). This could also damage the flexible pipe, and/or the bend stiffener.

[0014] In order to overcome such problems, an apparatus of the above-mentioned type is known from US 8 955 593 B2. In this apparatus, safety ropes are connected to the bell mouth at the lower end of the hollow tube and to a stopper collar secured on the bend stiffener. The ropes are able to prevent the fall of the bend stiffener in case the clamps fail.

[0015] Despite offering a solution to avoid the bend stiffener to drop unexpectedly by supporting it with safety ropes, this solution is however not entirely satisfactory. Indeed during the installation, the bell mouth and the bend stiffener need to be perfectly aligned so as to allow the safety ropes to remain vertical and approximately parallel to the tube. In reality, achieving this alignment necessitates adjustments of the bell mouth and the bend stiffener, often not straightforward given the movements of the structure resulting for example from waves and currents.

[0016] One aim of the invention is to provide an apparatus which allows the easy and safe installation of a bend stiffener around a flexible line, with limited risk of damage to the stiffener and/or the line.

[0017] For this purposes, the subject matter of the invention is an apparatus for mounting a flexible pipe onto a surface facility, in which the stopper collar is mounted rotatable around the curvature limiter.

[0018] The apparatus according to the invention may comprise any or several of the following features, taken individually or according to any technically possible combination:

- the stopper collar is made of several parts assem-

- bled together;
- a retaining line to connect the stopper collar to the tube and/or to the surface facility;
 - the stopper collar comprises a central ring mounted around the curvature limiter and at least one protruding arm, a first end of the retaining line being connected to said protruding arm;
 - a plurality of retaining lines angularly distributed around a rotation axis of the stopper collar, each first end of a retaining line being connected to the protruding arm;
 - the curvature limiter comprises a cap, said cap capable of being at least partially inserted into the tube, a bend stiffener, and a connection between the cap and the bend stiffener, the connection defining an annular groove located between said cap and said bend stiffener.
 - the cap defines the retaining stop, the stopper collar being received in the annular groove;
 - the curvature limiter is moveable between a disengaged position where the retaining stop is not in direct contact with the stopper collar, and a safety-engaged position where the retaining stop is in direct contact with the stopper collar.

[0019] The present invention also concerns a method for mounting a flexible line onto a surface facility by means of an apparatus as defined above, characterised by the following steps:

- providing a tube secured to said surface facility,
- providing a curvature limiter mounted around the flexible line, connecting the curvature limiter to the bottom of the tube, said curvature limiter defining a retaining stop,
- mounting a stopper collar able to co-operate with the retaining stop to retain the curvature limiter against the detachment of the curvature limiter from the tube.

[0020] The stopper collar is mounted rotatable around the curvature limiter.

[0021] The method according to the invention may comprise one or several of the following features, taken individually or in any technically possible combination:

- connecting the stopper collar to the tube and/or to the surface facility by at least one retaining line;
- connecting the stopper collar to the surface facility comprises, in succession: hanging the retaining line from the surface facility without connecting it to the stopper collar, rotating the stopper collar around the curvature limiter to align the stopper collar with the retaining line, then connecting the retaining line to the stopper collar;
- the mounting of the stopper collar comprises mounting a central ring of the stopper collar around the curvature limiter, mounting at least one protruding arm protruding from the central ring, then connecting

- the retaining line to the protruding arm;
- the stopper collar is made of several parts, the mounting of the stopper collar including assembling the parts of the stopper collar around the curvature limiter before connecting the curvature limiter to the bottom of the tube;
- the curvature limiter comprises a cap, said cap capable of being at least partially inserted into the tube, a bend stiffener, and an annular groove located between said cap and said bend stiffener, the method comprising mounting of the stopper collar in the annular groove;
- after mounting the stopper collar onto the curvature limiter, putting the curvature limiter in a disengaged position where the retaining stop is not in direct contact with the stopper collar, and when the curvature limiter detaches from the tube, letting the stopper collar pass into a safety-engaged position where the retaining stop is in direct contact with the stopper collar.

[0022] The invention will be better understood by reading the following description, provided only as way of example, and given with reference being made to the enclosed drawings, where:

- Fig. 1 is a schematic view of an installation for extracting fluid according to the invention;
- Fig. 2 illustrates the curvature limiter represented in Fig. 1 before its attachment to the tube;
- Fig. 3 is a view similar to Fig. 2 illustrating the moment when the curvature limiter is attached to the tube;
- Fig. 4 is a view similar to Fig. 3 illustrating the continued rising of the flexible pipe after the breaking of the frangible rods;
- Fig. 5 is a view similar to Fig. 4 with the stopper collar being in the disengaged position;
- Fig. 6 is a view similar to Fig. 5 with the stopper collar being in the safety-engaged position;
- Fig. 7 is a detailed view of the stopper collar; and
- Fig. 8 is a variant of the stopper collar according to the invention.

[0023] Fig. 1 illustrates an installation 10 for producing fluids according to the invention. This installation 10 is for instance intended to collect a fluid, namely a hydrocarbon tapped at the bottom 12 of a body of water 14, and/or transfer said hydrocarbon to a transport vessel.

[0024] The installation 10 comprises a surface facility 16 located at the surface of the body of water 14, at least a flexible line 18 to be connected to the surface facility 16, and an apparatus 20 for mounting the flexible line 18 to the surface facility 16.

[0025] The body of water 14 is for instance a lake, a sea, or an ocean. The depth of the body of water 14 perpendicular to the surface facility 16 is typically between 15 m and 3000 m.

[0026] The surface facility 16 is for example a surface

naval base, a semisubmersible platform, a floating vertical column, an offloading buoy or a vessel such as an FPSO (« Floating Production, Storage and Offloading), or a FLNG (« Floating Liquefied Natural Gas).

[0027] Alternatively, surface facility 16 is a jacket-like fixed rigid structure or an oscillating structure secured downward of the sea, e.g. a TLP (« Tension Leg Platform »).

[0028] The surface facility 16 has an upper surface 22, on which is mounted a hoist 24 for handling the flexible line 18 and a manifold 26 adapted for connecting one end of the flexible line 18.

[0029] The hoist 24 comprises a cable 28, which can be deployed for pulling up the flexible line 18.

[0030] In the example represented in Fig. 1, the flexible line 18 is a fluid-carrying flexible tubular pipe 30 internally defining a fluid flow path. This pipe is also referred to as a rising pipe, or riser, and is to connect a wellhead (not shown) located at the bottom 12 of the body of water 14 to the manifold 26 located at the upper surface 22 of the floating surface facility 16.

[0031] Alternatively, the flexible line 18 is for example an umbilical-like composite harness or 'integrated service umbilical' (ISU), well known by the person skilled in the art and described in the standards published by the American Petroleum Institute (API) API RP 17 B paragraph 4.3.4. Alternatively, the flexible line may be a harness of electrical cables.

[0032] The pipe 30 has at the upper end 32 thereof a head 33 for connecting the working line to the cable 28.

[0033] As illustrated in Figs. 2 to 4, the head 33 comprises a connecting sleeve 34 fastened to the upper end 32 of the pipe 30, and an eyelet 35 for inserting the lower end of the working line to the cable 28, rotatably mounted on an upper part of the sleeve 34 around a travel axis X-X' of line 18.

[0034] The pipe 30 is typically unwound and immersed into the body of water 14 from a surface laying vessel and is stored at the bottom 12 of the body of water 14. Next, the end of pipe 30 (section not laid on the seabed) is abandoned at the bottom 12 via a drop cable.

[0035] The mounting apparatus 20 comprises a hollow rigid tube 40 for guiding and protecting the flexible line 18, which is integral with surface facility 16, a local curvature limiter 42 of line 18, engaged around the line 18, remote from the upper end 32, and an assembly 44 for fastening the curvature limiter 42 to the lower end of the hollow rigid tube 40.

[0036] The mounting apparatus 20 further comprises an axial immobilisation mechanism 46 for axially immobilising the flexible line 18 in the curvature limiter 42.

[0037] According to the invention, as shown in Fig. 5, the mounting apparatus 20 further comprises a stopper collar 48 able to retain the curvature limiter 42 against the detachment of said curvature limiter 42 from the tube 40, and a retaining apparatus 49 connecting the stopper collar 48 to the surface facility 16.

[0038] In the example represented in Fig. 1, the hollow

rigid tube 40 is a J-tube having a vertical straight upper part and a bent lower end. Alternatively, the hollow rigid tube 40 is a straight tube of the I-tube type.

[0039] The tube 40 comprises a hollow vertical sleeve 50, integral with the floating surface facility 16, and a lower end collar 52 located at the lower end 54 of sleeve 50.

[0040] Sleeve 50 defines a lower passageway opening into the body of water 14 at lower end 54 and opening at the upper end 56 thereof close to the upper surface 22 of the surface facility 16, above the body of water 14.

[0041] Lower end collar 52 is immersed into the body of water 14. It has a truncated shape converging upward. Lower end collar 52 flares out downwards to co-operate with the curvature limiter 42 via the fastening assembly 44.

[0042] The curvature limiter 42 comprises, from bottom to top in Figs. 2, 3, and 4, a bend stiffener 62 and a cap 64. The curvature limiter 42 further comprises a connection 66 between the bend stiffener 62 and the cap 64, joining said bend stiffener 62 to said cap 64.

[0043] The bend stiffener 62 is for instance moulded from plastic material, such as polyurethane. It has here a truncated shape converging downward.

[0044] Bend stiffener 62 and cap 64 internally define a central lumen for the travel of the flexible line 18 defining the travel axis X-X' of line 18 inside the curvature limiter 42, coinciding with the longitudinal axis of line 18.

[0045] As shown in Figs. 2 to 4, in the bend stiffener 62 and in the cap 64, the lumen has a cross-section substantially conjugate with the external cross-section of line 18.

[0046] The bend stiffener 62 and cap 64 thus locally enforce upon the flexible line 18 a radius of curvature which is greater than the minimum radius of curvature that the flexible line 18 allows.

[0047] As will be apparent below, the curvature limiter 42 is moveable between a dismantled position represented in Figs. 1 and 2, in which it is placed remote from the hollow rigid tube 40, and a position mounted on the hollow rigid tube 40, represented in Figs. 3 et 4, in which the cap 64 is fastened to the lower end collar 52 by means of the fastening assembly 44.

[0048] The cap 64 is here bell-shaped. It comprises an upper surface 76 and a lower surface 78. The cap further comprises a frustum 80 converging upwards from the lower surface 78.

[0049] The upper surface 76 is connected to the head 33 by the axial immobilisation mechanism 46. In the example represented in Figs. 2 to 4, the axial immobilisation mechanism 46 comprises a plurality of frangible rods 81.

[0050] The lower surface 78 defines a retaining stop.

[0051] The frustum 80 is able to co-operate with lower end collar 52 to abut the cap 64 to the lower end collar 52.

[0052] The bend stiffener 62 and the cap 64 are located at a vertical distance from each other. The connection 66 connects the bend stiffener 62 and the cap 64. It has a transverse extent smaller than the transverse extent of

the bend stiffener 62 and of the cap 64. The connection 66 hence defines an annular groove 82 between the bend stiffener 62 and the cap 64.

[0053] In the example shown in Fig. 2 to 4, the connection 66 is tubular.

[0054] The fastening assembly 44 connects the curvature limiter 42 to the tube 40. The fastening assembly 44 is configured to engage on the lower surface 78 of the cap 64 to retain the cap 64 in displacement. This is the case in particular when the frangible rods 81 are broken. This allows the flexible line 18 and the head 33 to move axially relative to the curvature limiter 42, the curvature limiter 42 remaining fastened to the lower end of tube 40.

[0055] The fastening assembly 44 for example comprises supports 83, a locking apparatus (in this case locking pawls 84) and elastic elements 85. The supports 83, the locking pawls 84 and the elastic elements 85 are mounted on the tube 40.

[0056] The supports 83 are fastened securely to the tube 40. The locking pawls 84 are pivotally connected to the supports 83 by means of spindles which are securely fastened to the supports 83. The lower part of each locking pawl 84 can pass inside slots in the lower end collar 52.

[0057] The elastic elements 85 are disposed inside the supports 83. Their function is to hold the respective locking pawl 84 in the locking position.

[0058] The locking pawls 84 are able to co-operate with the lower surface 78 to prevent the curvature limiter 42 from falling downwards.

[0059] In reference to figure 7, the stopper collar 48 comprises a central ring 87 mounted around the curvature limiter 42 and at least one protruding arm 88, radially protruding from the central ring 87.

[0060] As illustrated in Fig. 5 to 6, the stopper collar 48 is mounted freely rotatable around a rotation axis X-X' around the curvature limiter 42. In a preferred embodiment, the stopper collar 48 is received in the annular groove 82. It is able to abut against the lower surface 78 of the cap.

[0061] Coming back to Fig. 7, the stopper collar 48 comprises several circumferential segments assembled together by connecting parts 90.

[0062] The connecting parts 90 comprise for example bolts and nuts.

[0063] The protruding arms 88 radially protrude from the central ring 87. The protruding arms 88 protrude generally radially to the axis X-X' from the central ring 87.

[0064] Each protruding arm 88 comprises a hole 91 intended to receive the retaining lines 92. The hole 91 preferably locates at the free end of the protruding arm 88, away from the central ring 87.

[0065] In the example shown in Fig. 7, the stopper collar 48 comprises four protruding arms 88. The number of protruding arms 88 is more generally comprised between 1 and 6.

[0066] As illustrated in Figs. 5 to 6, after being mounted on the tube 40, the curvature limiter 42 is moveable be-

tween a disengaged position, in which the retaining stop is not in direct contact with the stopper collar 48, and a safety-engaged position, in which the retaining stop is in direct contact with the stopper collar 48.

[0067] The retaining apparatus 49 comprises at least a retaining line 92. It generally comprises at least a retaining line 92 for each protruding arm 88.

[0068] The retaining lines 92 are angularly distributed around the rotation axis X-X' of the stopper collar 48. The number of the retaining lines 92 preferably equals the number of the protruding arms 88.

[0069] Each of the retaining lines 92 comprises two ends. A first lower end 96 is connected to the corresponding protruding arm 88 of each retaining line 92. A second upper end 98 is connected to the tube 40 and/or to the surface facility 16, preferably to a retaining structure located above the lower end of the tube 40.

[0070] A method for mounting the flexible line 18 to the surface facility 16 will now be described with reference to Figs. 2 to 6.

[0071] Initially, when the flexible line 18 is stored in a vessel or ashore, a curvature limiter 42 is engaged around the line 18, remote from the upper end 32 of pipe 30.

[0072] For this purpose, the line 18 is inserted into the lumen successively through bend stiffener 62, connection 66, and the cap 64. Next, the connecting head 33 is axially and angularly fastened to line 18, at the upper end 32 of pipe 30.

[0073] With reference to Fig. 2, the frangible rods 81 enable axial immobilisation of the flexible line 18 in the axial direction inside the curvature limiter 42, namely when an upward pulling force is applied to line 18. Thereby, the axial immobilisation mechanism 46 is activated.

[0074] As a next step, the stopper collar 48 is installed around the annular groove 82 of the curvature limiter 42. The central ring 87 forming the stopper collar 48 are assembled together around the annular groove 82 and connected together to form an integral component by the connecting parts 90, for example with bolts and nuts.

[0075] The stopper collar 48 is not shown on the figures 2, 3 and 4. The line 18 is then immersed into the body of water 14. When line 18 is to be connected to the manifold 26 of the surface facility 16, the hoist 24 is activated for lowering the cable 28 through the hollow rigid tube 40, next connecting the lower end of the cable 28 to the connecting head 33 located at the upper end 32 of line 18. Line 18 and the curvature limiter 42 are placed under the lower end collar 52 of the hollow rigid tube 40, away from the tube 40.

[0076] The hoist 24 is then activated for lifting the cable 28 up to the upper end 56 of the hollow rigid tube 40. Lifting the cable 28 causes the line 18 to be moved together with the curvature limiter 42 towards the lower end collar 52 up to the intermediate position represented in Fig. 2.

[0077] Next, in the vicinity of the rigid tube 40 or when the curvature limiter 42 is partially introduced into the

rigid tube 40, the hoist 24 is stopped.

[0078] The stopper collar 48 is connected to the retaining structure of tube 40 which is located above the lower end of the tube 40.

[0079] Firstly, the second ends of retaining lines 92 are connected to the retaining structure of tube 40. The first ends 96 of retaining lines 92 are disposed at approximately the same height, and are preferably angularly evenly distributed around the rigid tube 40. The retaining lines 92 are then hung from the tube 40 with their first free ends located in the vicinity of the lower end of the tube 40 below the lower end collar 52.

[0080] Then, the first ends 96 of the retaining lines 92 are attached to the protruding arms 88 of the stopper collar 48, advantageously by a diver. Because the stopper collar 48 is freely rotatable around its rotation axis X-X', if the retaining lines 92 are not aligned to the holes 91, the stopper collar 48 is simply rotated around its rotation axis X-X' to achieve the alignment without additional measures.

[0081] Once the holes 91 on each protruding arms 88 are aligned with respective retaining lines 92, the first ends 96 of the retaining lines 92 can be fixed to the holes 91 without distorting the retaining lines 92.

[0082] The retaining apparatus is now connected to the stopper collar 48 placed around the connection 66 of the curvature limiter 42.

[0083] The diver leaves the vicinity of the curvature limiter 42 for safety.

[0084] The hoist 24 is then activated for lifting the cable 28, and the introduction of the cap 64 into the lower end collar 52 continues, until the lower surface 78 comes into contact with the locking pawls 84, as represented in Fig. 3.

[0085] With the raising operation continuing, the locking claws 84 are first pushed away from the rotation axis X-X', which causes the locking pawls 84 to pivot about the spindles.

[0086] As soon as the lower surface 78 projects beyond the claws 84, the claws 84 are forced by the elastic elements 85 to rotate towards the rotation axis X-X'. When this movement has been completed, the curvature limiter 42 is locked. The co-operation between the frustum 80 and the lower end collar 52 prevents the curvature limiter 42 from rising and, moreover, the locking claws 84 prevent the curvature limiter 42 from descending.

[0087] The fastening assembly 44 thus immobilises the curvature limiter 42 axially in relation to the hollow tube 40.

[0088] In this position, the stopper collar 48 is in a disengaged position with respect to the curvature limiter 42. The stopper collar 48 locates at a distance from the retaining stop at the lower surface 78 of the cap 64.

[0089] Then, the axial immobilisation mechanism 46 is released to allow the line 18 to be lifted up through the curvature limiter 42 and tube 40. In the example illustrated in Fig. 4, the frangible rods 81 are broken, which enables the line 18 to be lifted through the curvature limiter

42 and tube 40, the curvature limiter 42 remaining immobilised inside the tube 40.

[0090] For this purpose, the hoist 24 is activated to move the connecting head 33 in the axial direction.

[0091] The pulling force necessary to break the frangible rods 81 for axially releasing the line 18 in relation to curvature limiter 42 is much lower than the axial strength of the pipe 30 so that there is no risk of over stressing and damaging the line 18 during this step.

[0092] With reference to Fig. 3, the line 18 is then lifted up through the central lumen of the curvature limiter 42 and through the interior of the tube 40, up to the manifold 26, the curvature limiter 42 remaining immobile in relation to tube 40. Line 18 is then connected to the manifold 26.

[0093] As shown in Fig. 5, during the lifting of line 18, the curvature limiter 42 is in most cases immobilised in relation to the tube 40 through the fastening assembly 44. In the unlikely event of an incomplete engagement into the fastening assembly or/and of the failure of the fastening assembly 44, represented in Fig. 6, the curvature limiter 42 detaches from the tube 40 and falls under the effect of gravity.

[0094] In this case, the stopper collar 48 comes into direct contact with the retaining stop, reaching a safety-engaged position. The retaining lines 92, being active to retain the stopper collar 48 through the protruding arms 88, the stopper collar 48 co-operates with the retaining stop to retain the curvature limiter 42. This prevents the further drop of the curvature limiter 42.

[0095] In the event of the failure of fastening assembly 44 between the curvature limiter 42 and the tube 40, the stopper collar 48 is particularly efficient to retain the curvature limiter 42 in place, which prevents damages to both the external sheath of the flexible line 18 and to the bend stiffener 62.

[0096] The stopper collar 48 being able to rotate freely around the tube, the retaining lines 92 are able to run approximately in parallel to tube 40 without twisting. This is especially beneficial during the installation where no additional alignment of the stopper collar and the tube is required. The apparatus according to the invention is therefore particularly simple to assemble.

[0097] In addition, the stopper collar is relatively light and cheap to produce, incurring less cost.

[0098] In a variant as shown in Fig. 8, the lower surface 78 of the cap further comprises a secondary ring 99 fixed to the lower surface 78. The secondary ring 99 is adapted to co-operate with the central ring 87 of the stopper collar 48 as an upper mechanical stop. Preferably, the secondary ring 99 possesses the same width as the stopper collar 48.

[0099] In a variant, a monitoring system is coupled to the apparatus 20 to oversee its change. The monitoring system can comprise a sensor measuring the relative displacement between the curvature limiter 42 and the stopper collar 48 after the former is connected to the tube 40. The sensor could emit signals when the curvature limiter 42 starts slipping out of the tube 40.

Claims

1. Apparatus (20) for mounting a flexible line (18) onto a surface facility (16), comprising:

- a tube (40) intended to be secured to said surface facility (16) to receive the flexible line (18),
 - a curvature limiter (42) intended to be mounted around the flexible line (18), said curvature limiter (42) being intended to be connected to the bottom of the tube (40), said curvature limiter (42) defining a retaining stop, and
 - a stopper collar (48) able to co-operate with the retaining stop to retain the curvature limiter (42) against the detachment of the curvature limiter (42) from the tube (40),

characterised in that the stopper collar (48) is mounted rotatable around the curvature limiter (42).

2. Apparatus (20) according to claim 1, wherein the stopper collar (48) is made of several parts assembled together.

3. Apparatus (20) according to claim 1 or 2, comprising at least a retaining line (92) to connect the stopper collar (48) to the tube (40) and/or to the surface facility (16).

4. Apparatus (20) according to claim 3, wherein the stopper collar (48) comprises a central ring (87) mounted around the curvature limiter (42) and at least one protruding arm (88), a first end (96) of the retaining line (92) being connected to said protruding arm (88).

5. Apparatus (20) according to claim 4, comprising a plurality of retaining lines (92) angularly distributed around a rotation axis of the stopper collar (48), each first end (96) of a retaining line being connected to the protruding arm (88).

6. Apparatus (20) according to any one of the preceding claims, wherein the curvature limiter (42) comprises:

- a cap (64), said cap (64) capable of being at least partially inserted into the tube (40),
 - a bend stiffener (62), and
 - a connection (66) between the cap (64) and the bend stiffener (62), the connection (66) defining an annular groove (82) located between said cap (64) and said bend stiffener (62).

7. Apparatus (20) according to claim 6, wherein the cap (64) defines the retaining stop, the stopper collar (48) being received in the annular groove (82).

8. Apparatus (20) according to any one of the preceding

claims, wherein the curvature limiter (42) is moveable between:

- a disengaged position where the retaining stop is not in direct contact with the stopper collar (48), and
 - a safety-engaged position where the retaining stop is in direct contact with the stopper collar (48).

9. A method for mounting a flexible line (18) onto a surface facility (16), comprising the steps of

- providing a tube (40) secured to said surface facility (16),
 - providing a curvature limiter (42) mounted around the flexible line (18), connecting the curvature limiter (42) to the bottom of the tube (40), said curvature limiter (42) defining a retaining stop, and
 - mounting a stopper collar (48) able to co-operate with the retaining stop to retain the curvature limiter (42) against the detachment of the curvature limiter (42) from the tube (40),

characterised in that the stopper collar (48) is mounted rotatable around the curvature limiter (42).

10. The method according to claim 9, comprising connecting the stopper collar (48) to the tube (40) and/or to the surface facility (16) by at least one retaining line (92).

11. The method according to claim 10, wherein connecting the stopper collar (48) to the surface facility (16) comprises, in succession:

- hanging the retaining line (92) from the surface facility (16) without connecting it to the stopper collar (48),
 - rotating the stopper collar (48) around the curvature limiter (42) to align the stopper collar (48) with the retaining line (92), then
 - connecting the retaining line (92) to the stopper collar (48).

12. The method according to claim 11, wherein the mounting of the stopper collar (48) comprises mounting a central ring (87) of the stopper collar (48) around the curvature limiter (42), mounting at least one protruding arm (88) protruding from the central ring (87), then connecting the retaining line (92) to the protruding arm (88).

13. The method according to any one of claims 9 to 12, wherein the stopper collar (48) is made of several parts, the mounting of the stopper collar (48) including assembling the parts of the stopper collar (48)

around the curvature limiter (42) before connecting the curvature limiter (42) to the bottom of the tube (40).

14. The method according to any one of claims 9 to 13, wherein the curvature limiter (42) comprises: 5

- a cap (64), said cap (64) capable of being at least partially inserted into the tube (40),
- a bend stiffener (62), and 10
- an annular groove (82) located between said cap (64) and said bend stiffener (62),

the method comprising mounting of the stopper collar (48) in the annular groove (82). 15

15. A method according to any one of the claims 9 to 14 comprising, after mounting the stopper collar (48) onto the curvature limiter (42), putting the curvature limiter (42) in a disengaged position where the retaining stop is not in direct contact with the stopper collar (48), and when the curvature limiter (42) detaches from the tube (40), letting the stopper collar (48) pass into a safety-engaged position where the retaining stop is in direct contact with the stopper collar (48). 20 25

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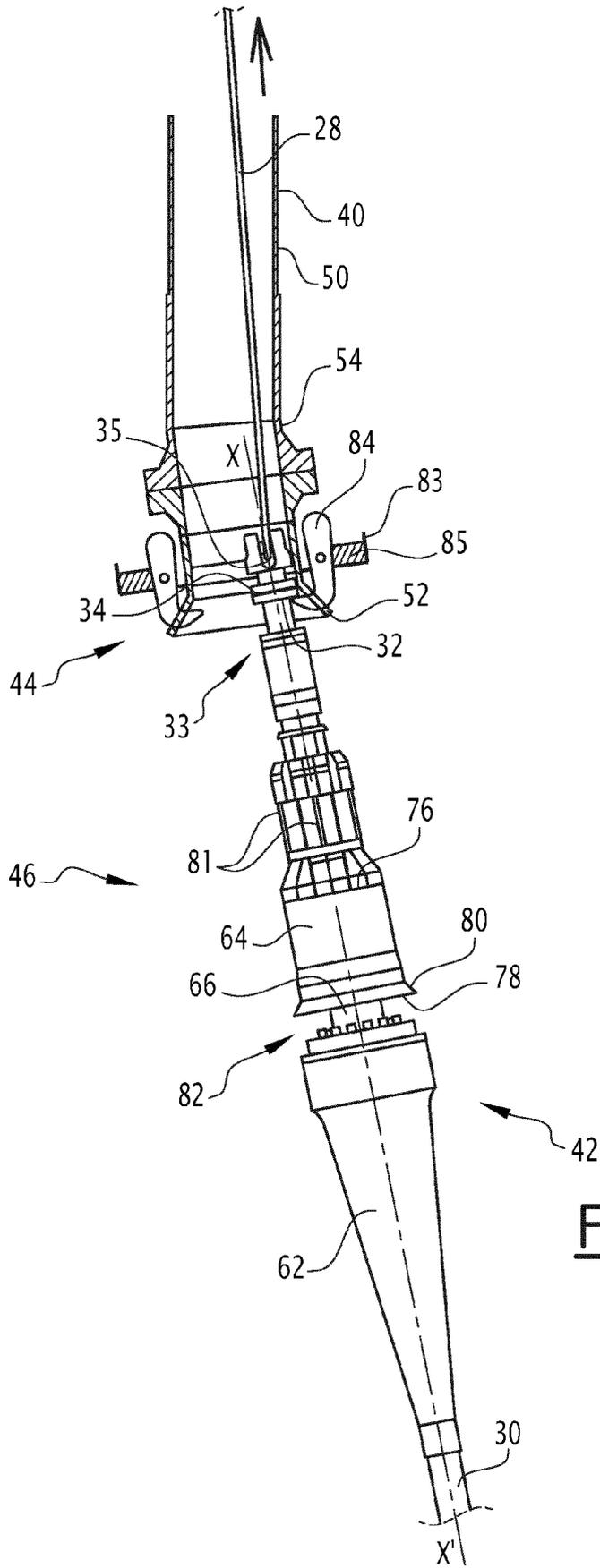


FIG.2

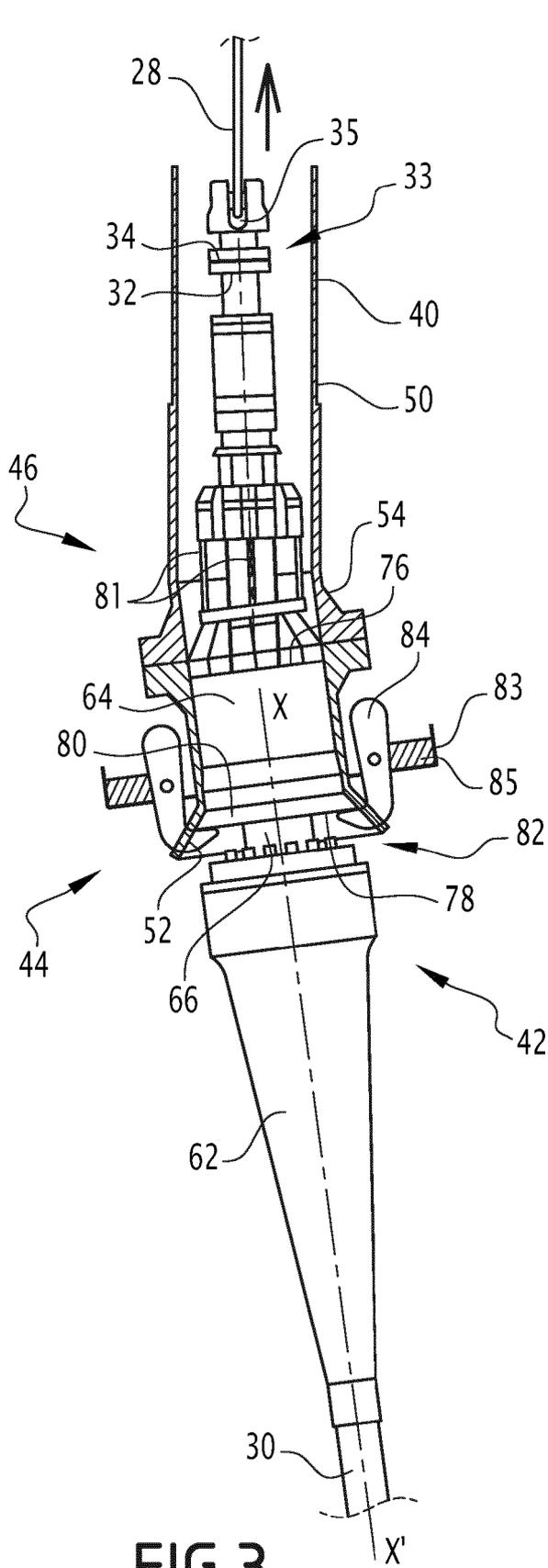


FIG. 3

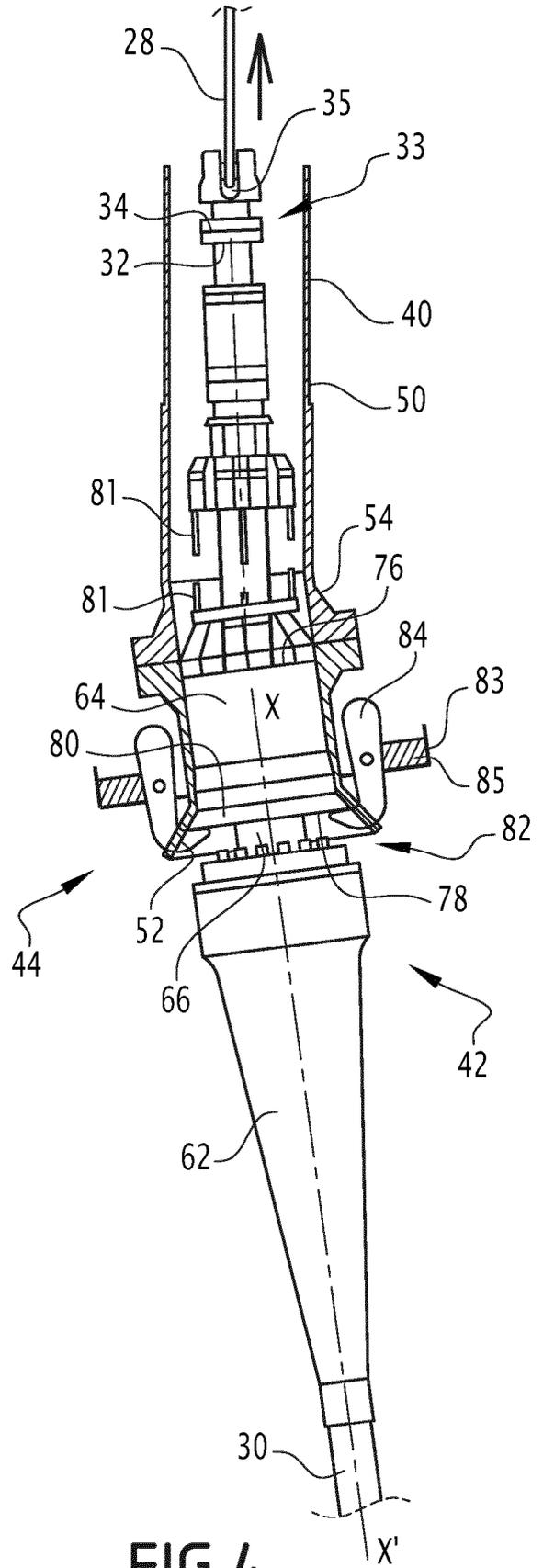
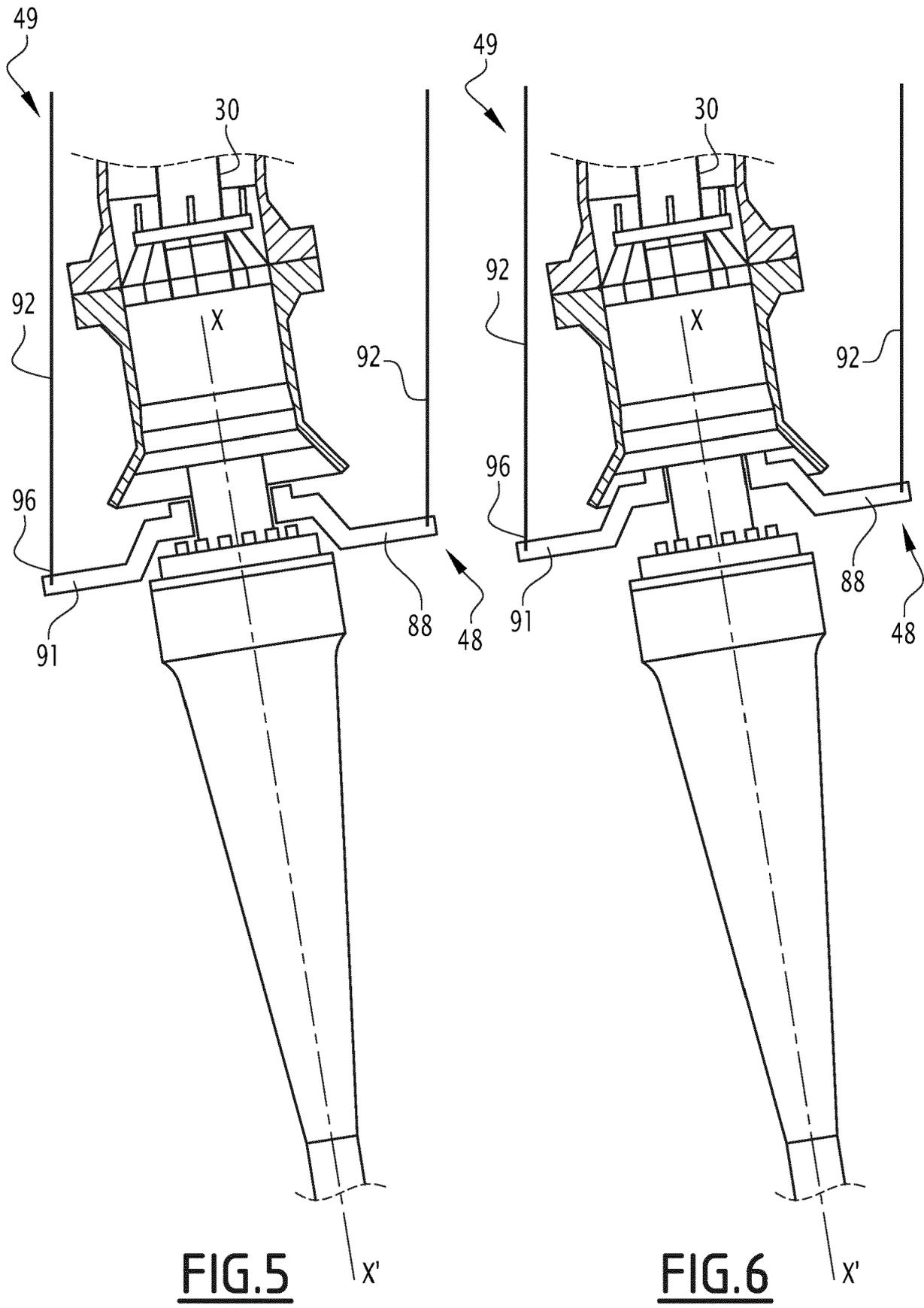
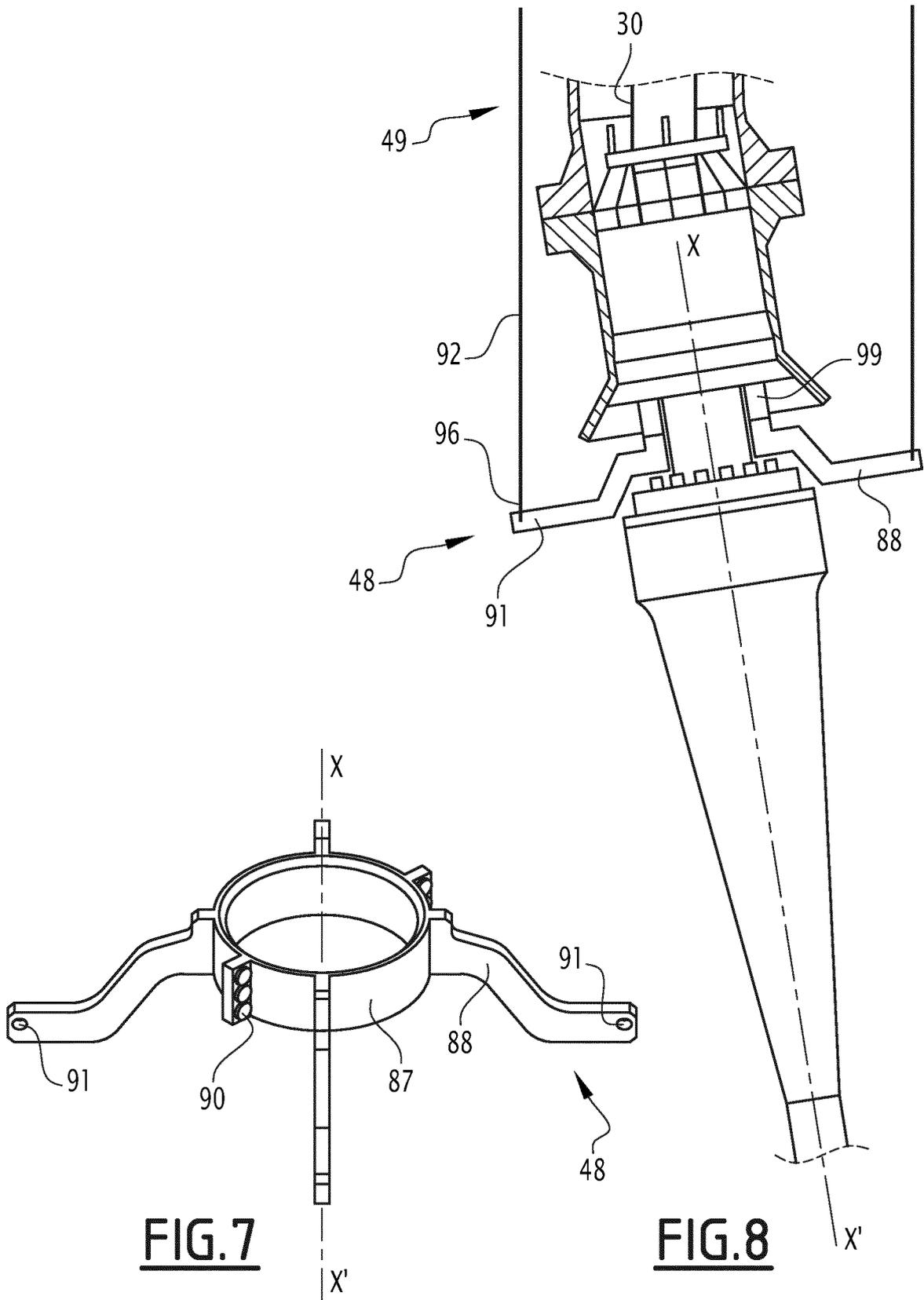


FIG. 4







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Place of search Munich		Date of completion of the search 23 March 2018	Examiner Patrascu, Bogdan
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