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(54) **Method for wrapping a cable around a pipe construction and pipe construction assembly**

Verfahren um ein Kabel um einen Rohraufbau zu wickeln und Rohraufbaueinrichtung

Procédé pour enrouler un câble autour d'une construction de tuyau et arrangement de construction de tuyau

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(56) References cited:
WO-A-97/29944
FR-A- 2 376 989
GB-A- 2 063 968
GB-A- 2 117 822
US-A- 3 424 242
US-A- 3 718 183
US-A- 4 979 296
US-A- 5 547 314

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Description

[0001] The invention relates to a method for wrapping a cable around a pipe construction, in particular a method for making a flow line bundle in which an umbilical is wrapped around a flow line, and to a flow line-umbicical assembly.

[0002] Such a method is for instance described in U. S. patent nrs. 4,979,296 and 4,843,713 in which a flow line bundle is formed of two pipe sections, an umbilical cable and other risers, which are twisted or braided into a permanent rope-like helical configuration prior to laying the flow line bundle offshore by a reel method. By wrapping the umbicical around the pipe sections in a helical manner, it is prevented that the umbilical becomes overstressed or buckles upon bending of the flow line, which would occur in a parallel configuration of the pipe sections and umbilical. The known helical winding and assemblage of the pipe sections and umbilical requires one free end of the umbilical, which is unwound from a reel and helically wrapped around each pipe section prior to attachment of said pipe sections to the partially assembled flow line. For very large flow lines and umbilicals, which may have a length of 2,000 metres or more, said method is unpractical. Furthermore, if after installation a part of the flow line is leaking, the complete flow line-umbilical arrangement must be dismantled to change the non-functional part of the flow line because of the very tight helical wrapping of the umbilical. The same applies when a defect in the umbilical occurs or when after installation one or more umbilicals must be replaced by a new one.

[0003] It is therefore an object of the present invention to provide a method for wrapping a cable around a pipe construction and to provide a flow line-umbilical assembly which allows for easy installation at limited costs, which allows for replacement of a section of the flow line in case of a defect and which allows for easy replacement of the umbilical in case of exchange.

[0004] Thereto the method according to the present invention is characterized by the steps of:

- providing along the pipe construction spaced apart first and second connection points and a third connection point located between said first and second connection points,
- connecting the cable at said first and second connection points or at said third connection point such that a cable length that is larger than the distance between said first and second connection points extends between said first and second connection points,
- wrapping the cable length between the first and second connection points at least one time around the pipe construction by rotating the cable part at the position of the thrid connection point around the pipe construction, while maintaining a fixed position of the cable parts of the first and second connection points or by rotating the cable part at the position of the first and second connection points around the pipe construction while maintaining a fixed position of the cable part of the third connection point and
- fixing the rotated cable parts to the pipe construction.

[0005] With the method according to the present invention a part of the cable is locally wrapped around the pipe construction between two spaced apart connection points. Hereby it is possible, in case of a defect of the flow line, to locally unwrap the umbilical and to exchange the defective flow line part. The method of the present invention also allows to first install the flow line, and after testing thereof place the umbilical cables around the flow line. In case the umbilical cable has to be exchanged, the flow line needs not be dismantled and can in certain circumstances remain operative during change-out of the umbilical.

[0006] The firmness of the wrapping pattern of the cable can be easily adapted to the water depth and flow line characteristics (flexible versus rigid) by adjusting the distance between first and second connection points, and by adjusting the cable length extending between those points.

[0007] With the term "pipe construction" as is used therein, it is meant to include flexible and rigid pipe segments. The connection points can be separate clamps placed around the pipe construction having a guide opening for receiving the cable or can be formed as a part of integral coupling members of the pipe sections, such as flanges having separate attachment means for the cable.

[0008] According to the method of the present invention the cable may be attached to the pipe in the first and second connection points by means of clamps. Thereafter the cable may be connected to a further clamp which is connected to the pipe at the third connection point and which is thereafter rotated to wrap the cable around the pipe segment while the first and second clamps are stationary. It is also possible to connect the cable to the pipe at the first and second connection points, then wrap the middle section around the pipe and thereafter connect the middle section fixedly to the pipe at the third connection point. Finally it is also possible to first fix the cable at the third connection point, to connect the cable at the first and second connection point which are then rotated and finally fixed to the pipe to wrap the cable locally around the pipe.

[0009] A further embodiment of the method according to the present invention comprises the steps of:

- connecting two or more pipe sections via their coupling members on shore to form a pre-assembled element,
- placing a number of pre-assembled elements on an installation vessel,
- connecting the cable to a respective pre-assembled

element at the three connection points at an installation site, and

- adding the pre-assembled element to a second pre-assembled element to which the cable has been connected at the three connection points in a previous step.

[0010] The method according to the present invention allows a cheap and fast wrapping of an umbilical cable around the flow line, especially on the limited deck space of an installation vessel.

[0011] By pre-assembling two or more pipe sections, for instance three or four pipe sections (depending on the size of the installation vessel), beforehand on shore and wrapping the umbilical around the pre-assembled elements on the installation vessel at the installation site, the offshore time and cost of installation of the flow line is reduced, offshore time being much more expensive than onshore time.

[0012] In a further embodiment the cable can be slidably connected to the first and second connection points such that upon wrapping of the cable around the pipe construction an extra tension is placed on the cable of the adjacent segments. By executing the holding device at the third connection point as a rotatable holding device, cable tensioning can be carried out by adjusting the angular position of said holding device.

[0013] The principles of the method according to the present invention will be explained in detail with reference to the accompanying drawings. In the drawings:

Figure 1a to 1c show the principle of the method according to the present invention on a single pipe segment,

Figures 2a and 2b show wrapping an umbilical cable around a preinstalled flow line, and

Figures 3 and 4 show a plan view and a cross-sectional view, respectively, of a connection member for use in the present invention.

[0014] Figures 1a to 1c show a flow line 1 made of flexible or rigid piping for the transportation of hydrocarbons from a subsea structure to a surface structure such as a floating production, storage and offloading vessel (FPSO), a tension leg platform, a shuttle tanker or other vessel. Around the flow line 1, two spaced apart connection members 2, 3 are provided through which a cable, such as an umbilical 4, is guided. Cable length 5 extending between the connection members 1, 2, is longer than the distance between the connection members i, 2 measured along the flow line 1. As shown in figure 1b, the umbilical 5 is wrapped around the flow line section that extends between the connection members 1, 2 such that the helical configuration shown in figure 1c is obtained. Thereafter the cable length 5 is fixed to the flow line 1 by means of a third connection member 6. In one embodiment, the connection member 6 is rotatably connected to the flow line 4, such that by turning said element the umbilical 5 can be tightened around the flow line 1. For applying a further pretention, it is possible that the umbilical 5 is slidably connected to the first connection members 1, 2. Engaging means (not shown in the drawing) may be provided on the connecting members 1, 2 for blocking any further movement of the umbilical 5 upon engagement thereof.

[0015] Figures 2a and 2b show another method of wrapping an umbilical 10 around segments 7, 8 of flow line 9. Each segment is near its end provided with flanges 12, 13 for mutually attaching to a neighbouring segment. Near the flanges 12, 13 the first and second connection members 15, 16 are attached to the flow line. It is, however, also possible that the connection members 15, 16 are integrated with the flanges 12, 13. After installation of the complete flow line 9 and testing thereof, the umbilical 10 may be wrapped around each flow line segment 7, 8 several times as shown in figure 2b. After being placed in the configuration shown in figure 2b, a third connection member may be applied at positions 18 and 19, shown in figure 2b for maintaining the umbilical 10 in its wrapped around configuration.

[0016] Figures 3 and 4 show a connection member 20 with a central opening 21 which can be fixed around a pipe segment. The connection member 20 consists of two halves 22, 23 which are attached by bolts 24, 25. The connection member 20 comprises a clamping part 26 in which a cable 27 can clampingly engaged, as is clearly shown in figure 4.

[0017] Although the invention is illustrated by an umbilical being wrapped around a flow line, it can also be applied to other cables such as a bundle of umbilicals, a bundle of electrical cables or a combination of umbilicals, electrical cables and/or flowlines.

Claims

1. Method for wrapping a cable (4,10) around a pipe construction (1,9) **characterised by** the steps of:

   - providing along the pipe construction spaced apart first and second connection points (2,3; 15,16) and a third connection point (6; 18,19) located between said first and second connection points,
   - connecting the cable (4,10) at said first and second connection points (2,3;15,16) or at said third connection point (6;18,19) such that a cable length that is larger than the distance between said first and second connection points extends between said first and second connection points (2,3;15,16),
   - wrapping the cable length between the first and second connection points (2,3;15,16) at least one time around the pipe construction by rotating the cable part at the position of the thrid connection point (6;18,19) around the pipe con-

struction, while maintaining a fixed position of the cable parts at the first and second connection points (2,3;15,16) or by rotating the cable part at the position of the first and second connection points (2,3;15,16) around the pipe construction while maintaining a fixed position of the cable part at the third connection point (6; 18,19), and
- fixing the rotated cable parts to the pipe construction.

2. Method according to claim 1, wherein the pipe construction comprises a number of segments (7,8) having coupling members (12,13), the first and second connection points (15,16) being provided at or near each respective coupling member (12,13).

3. Method according to claim 2, **characterised by** the steps of:

- connecting two or more pipe segments (7,8) via their coupling members (12,13) on shore to form a pre-assembled element,
- placing a number of pre-assembled elements on an installation vessel,
- connecting the cable (10) to a respective pre-assembled element at the three connection points (15,16;18,19) at an installation site, and
- adding the pre-assembled element to a second pre-assembled element to which the cable has been connected at three connection points in a previous step.

4. Method according to any of the previous claims, **characterised in that** the cable (14,10) is slidably connected to the first and second connection points (2,3;15,16).

5. Method according to according to any of the previous claims, **characterised in that** connection means are provided at the first and second connection points and/or at the third connection point (6; 18,19) which comprise a cable holding device which is rotatably attached to the pipe construction.

6. Assembly of a pipe construction comprising spaced apart first and second cable connection elements (2,3;15,16), and a third cable connection element (6;18,19) located between said first and second connection elements, and a cable comprising outer cable parts connected to the first and second connection elements (2,3;15;16) and a middle cable part being wrapped at least once around the pipe construction and being attached at the third connection element (6;18,19).

7. Assembly according to claim 6, **characterised in that** at least one of the connection elements (2;3;6; 15;16;18;19) is rotatably connected to the pipe construction and comprises a fixing member for fixing the angular position of the connection element with respect to the pipe construction.

Patentansprüche

1. Verfahren, um ein Kabel (4, 10) um einen Rohraufbau (1, 9) zu wickeln, **gekennzeichnet durch** die Schritte des:

- Vorsehens von entlang des Rohraufbaus räumlich getrenntem ersten und zweiten Verbindungspunkts (2, 3; 15, 16) und eines dritten Verbindungspunkts (6; 18, 19), der zwischen dem ersten und zweiten Verbindungspunkt angeordnet ist,

- Verbindens des Kabels (4, 10) am ersten und zweiten Verbindungspunkt (2, 3; 15, 16) oder am dritten Verbindungspunkt (6; 18, 19), so dass eine Kabelstrecke, die länger als der Abstand zwischen dem ersten und zweiten Verbindungspunkt ist, zwischen dem ersten und zweiten Verbindungspunkt (2, 3; 15, 16) verläuft,

- Wickelns der Kabelstrecke zwischen dem ersten und zweiten Verbindungspunkt (2, 3; 15, 16) zumindest einmal um den Rohraufbau, **durch** Drehen des Kabelteils an der Position des dritten Verbindungspunkts (6; 18, 19) um den Rohraufbau während des Beibehaltens einer starren Position der Kabelteile am ersten und zweiten Verbindungspunkt (2, 3; 15, 16), oder **durch** Drehen des Kabelteils an der Position des ersten und zweiten Verbindungspunkts (2, 3; 15, 16) um den Rohraufbau während des Beibehaltens einer starren Position des Kabelteils am dritten Verbindungspunkt (6; 18, 19), und

- Befestigens der gedrehten Kabelteile am Rohraufbau.

2. Verfahren nach Anspruch 1, wobei der Rohraufbau eine Anzahl von Segmenten (7, 8) mit Kupplungsgliedern (12, 13) umfasst, wobei der erste und zweite Verbindungspunkt (15, 16) an den oder in der Nähe der jeweiligen Kupplungsglieder (12, 13) vorgesehen sind.

3. Verfahren nach Anspruch 2, **gekennzeichnet durch** die Schritte des;

- Verbindens zweier oder mehrerer Rohrsegmente (7, 8) über ihre Kupplungsglieder (12,

13) an Land, um ein vorgefertigtes Element auszubilden,

- Anordnens einer Anzahl von vorgefertigten Elementen auf einem Installationsschiff,

- Verbindens des Kabels (10) mit einem jeweiligen vorgefertigten Element an den drei Verbindungspunkten (15, 16; 18, 19) an einem Einrichtungsort, und

- Anfügens des vorgefertigten Elements an ein zweites vorgefertigtes Element, mit dem das Kabel an drei Verbindungspunkten in einem vorhergehenden Schritt verbunden wurde.

4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Kabel (14, 10) gleitbar mit dem ersten und zweiten Verbindungspunkt (2, 3; 15, 16) verbunden ist.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** Verbindungsmittel am ersten und zweiten Verbindungspunkt und/oder am dritten Verbindungspunkt (6; 18, 19) vorgesehen sind, die eine Kabelhaltevorrichtung umfassen, die drehbar an dem Rohraufbau befestigt ist.

6. Einrichtung eines Rohraufbaus, umfassend räumlich getrennte erste und zweite Kabelverbindungs-Elemente (2, 3; 15, 16) und ein drittes Kabelverbindungselement (6; 18, 19), das zwischen dem ersten und zweiten Kabelverbindungselement liegt, und eines Kabels, umfassend äußere Kabelteile, die mit dem ersten und zweiten Verbindungselement (2, 3; 15, 16) verbunden sind, und ein mittleres Kabelteil, das zumindest einmal um den Rohraufbau gewikkelt und am dritten Verbindungselement (6; 18, 19) befestigt ist.

7. Einrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** zumindest eines der Verbindungselemente (2; 3; 6; 15; 16; 18; 19) drehbar mit dem Rohraufbau verbunden ist und ein Befestigungsglied zum Fixieren der winkligen Position des Verbindungselements bezüglich des Rohraufbaus umfasst.

Revendications

1. Procédé pour enrouler un câble (4, 10) autour d'une construction de tuyau (1, 9) **caractérisé par** les étapes de :

- fourniture le long de la construction de tuyau espacés à part un premier et un deuxième point d'attachement (2, 3; 15, 16) et un troisième point d'attachement (6; 18, 19) positionné entre lesdits premier et deuxième points d'attachement,

- attachement du câble (4, 10) auxdits premier et deuxième points d'attachement (2, 3; 15, 16) ou audit troisième point d'attachement (6; 18, 19) de telle façon qu'une longueur de câble qui est plus grande que la distance entre lesdits premier et deuxième points de connexion s'étende entre lesdits premier et deuxième points d'attachement (2, 3; 15, 16),

- enroulement de la longueur du câble entre le premier et le deuxième point d'attachement (2, 3; 15, 16) au moins une fois autour de la construction de tuyau en faisant tourner la partie de câble à la position du point de troisième attachement (6; 18, 19) autour de la construction de tuyau, tout en maintenant les parties du câble dans une position fixe au premier et au deuxième points d'attachement (2, 3; 15, 16) autour de la construction de tuyau tout en maintenant une position fixe de la partie du câble au troisième point d'attachement (6; 18, 19), et

- fixation des parties du câble entouré à la construction de tuyau.

2. Procédé selon la revendication 1, dans lequel la construction de tuyau comprend un nombre de segments (7, 8) ayant des éléments de couplage (12, 13), la premier et le deuxième points d'attachement (15, 16) étant fournis à ou près de chaque élément respectif de couplage (12, 13).

3. Procédé selon la revendication 2, **caractérisé par** les étapes de :

- attachement de deux ou plusieurs segments de tuyau (7, 8) via leurs éléments de couplage (12, 13) à terre pour former un élément pré assemblé,

- placement d'un nombre d'éléments pré assemblés sur un bâteau d'installation,

- attachement du câble (10) à un élément respectif pré assemblé aux trois points d'attachement (15, 16; 18, 19) à un site d'installation, et

- ajouter l'élément pré assemblé à un deuxième élément pré assemblé auquel le câble a été relié à trois points d'attachement dans une étape précédente.

4. Procédé selon l'une quelconque des revendications

précédentes, **caractérisé en ce que** le câble (14, 10) est relié de façon coulissante au premier et au deuxième point d'attachement (2, 3; 15, 16).

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'on fournit les moyens d'attachement au premier et au deuxième point d'attachement et/ou au troisième point d'attachement (6; 18, 19) qui comprend un dispositif de support de câble qui est attaché de façon tournante à la construction de tuyau.

6. Arrangement d'une construction de tuyau comprenant espacés à part un premier et un deuxième élément d'attachementde câble (2, 3; 15, 16), et un troisième élément d'attachement de câble (6; 18, 19) positionné entre lesdits premier et deuxième éléments d'attachement, et un câble comprenant des parties de câble externes reliées aux premier et deuxième élément d'attachement (2, 3; 15; 16) et un partie de câble intermédiaire étant enroulée au moins une fois autour de la construction de tuyau et étant attachée au troisième élément d'attachement (6; 18, 19).

7. Arrangement selon la revendication 6, **caractérisé en ce que** au moins un des éléments d'attachement (2; 3; 6; 15; 16; 18; 19) est reliée de façon tournante à la construction de tuyau et comprend un élément d'attachement pour attacher la position angulaire de l'élément d'attachement en fonction de la construction de tuyau.

fig-1a

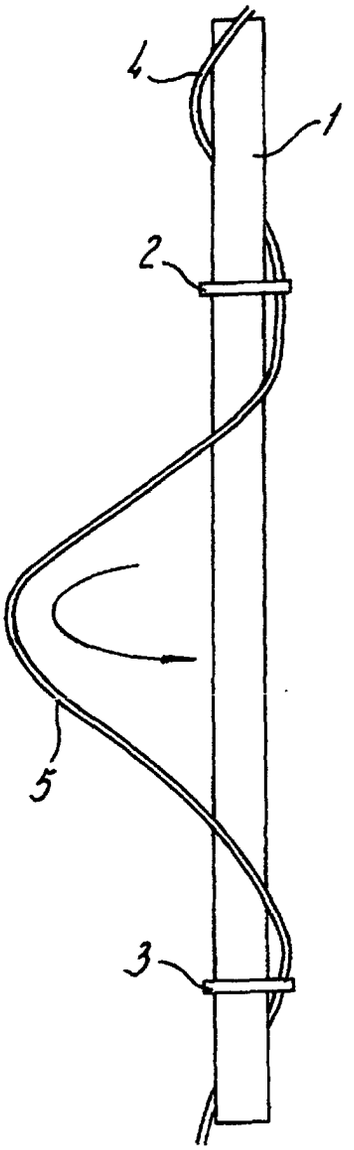


fig-1b

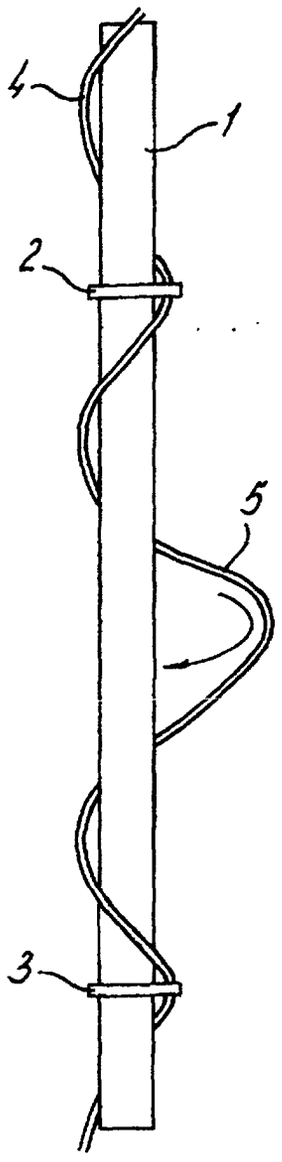


fig-1c

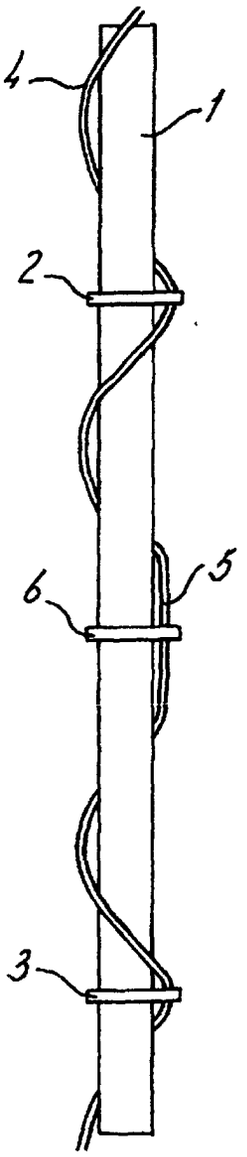


Fig-2a

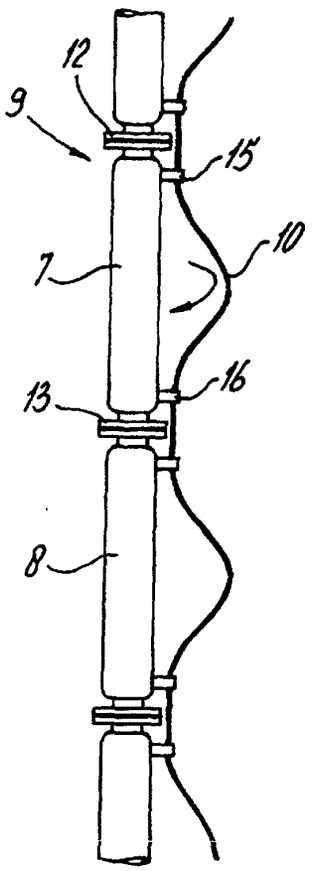


Fig-2b

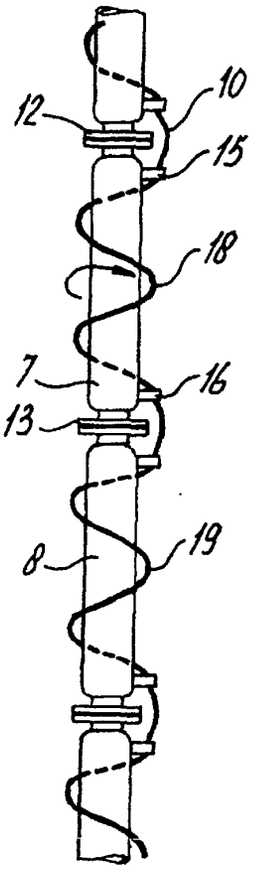


Fig-3

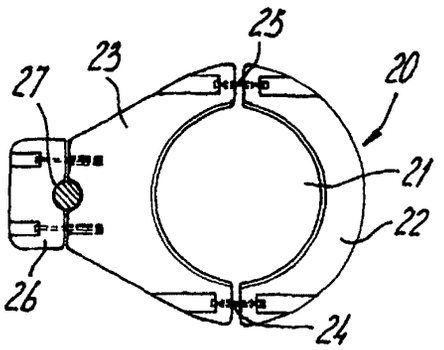


Fig-4

