

SPECIFICATION

Improvements in the suspension of an immersed flow line or bundle of flow lines

- 5 The invention relates to apparatus for maintaining the direction of a flow line or bundle of flow lines, hereinafter called "flow line means", which has been or is being immersed in a body of water, the top end of the flow line means being held by a retaining means at the surface of the body of water.
- 10 Operations for laying submerged flow line means for collecting oil products are examples of work in which the flow line means have to be held in a constant direction irrespective of the direction of the surface retaining means from which the upper end of the flow line means is suspended. The flow line means are
- 20 preferably laid by giving them a J cross-section, one end of the flow line means being suspended from the surface retaining means, as soon as the flow line means has come to rest at a certain depth. In this method the
- 25 surface retaining means has to be kept in a clearly-defined direction, which is impossible in practice without applying excessive force, owing to variations in wind, currents and swell, even if use can be made of a ship with
- 30 dynamic positioning, i.e. a ship capable of staying at a given place in a given direction.
- According to the invention, there is provided apparatus for holding flow line means immersed in water in a constant direction, the
- 35 flow line means being supported by a surface retaining means at the surface of the water and comprising a central well and extending through the central well, the apparatus comprising suspension means for engaging the upper
- 40 end of the flow line means and from which the flow line means is suspended, the suspension means being rotatable relative to the surface retaining means, and guide means for guiding the flow line means in the well, said guide
- 45 means being secured to said suspension means for angular movement therewith relative to the surface retaining means.

- Advantageously the guide means are connected to drive means for rotating the guide
- 50 means and the suspension means relative to the surface retaining means about the axis of the suspension means.

- It can thus be easy to guide the surface retaining means in a given direction while
- 55 holding the flow line means in a constant vertical plane, its suspension means rotating relative to the surface retaining device.

- The guide means may allow some degree of transverse motion of the flow line means in its
- 60 vertical plane, while allowing the flow line means to move longitudinally. The flow line means can thus bend somewhat with the swell of the water without being excessively stressed by the connections between the sus-
- 65 pension means and the flow line means.

The guide means may include means for guiding floats attached to the flow line means and which gave bouyancy to the flow line means. This latter feature has the advantage

70 that the floats can then be attached to the flow line means on board the surface retaining means, i.e. without using divers.

- Preferably the flow line means has a partly vertical and partly inclined shape so that the
- 75 suspension means for securing and suspending the upper end of the flow line means can be horizontal with the flow line means inclined at any desired angle inside the well. It is thus easy to join sections of the flow line means
- 80 end to end in the vertical position, thus facilitating any change in the direction of the surface retaining means.

- Of course, the apparatus can be adapted to any kind of flow line means, inter alia when
- 85 the flow line means is suspended from a surface retaining means and has to be kept in a given direction, as in the case of a tube having a lower end connected to an ore-extracting device and an upper end connected
- 90 to a tipping means at the surface.

The invention will be more fully understood from the following description of embodiments thereof, given by way of example only, with reference to the accompanying drawings.

- 95 In the drawings:

Figure 1 is a diagrammatic view of the surface retaining means during the laying of flow line means;

- Figure 2* is a diagrammatic elevation, partly
- 100 in section, of an embodiment of apparatus in accordance with the invention on the surface retaining means of *Fig. 1*;

- Figure 3* is an enlarged partial view of part of the apparatus of *Fig. 2* for rotating the
- 105 apparatus;

Figure 4 is a view in elevation of suspension means for suspending the end of the flow line means in the apparatus of *Fig. 2*;

- Figure 5* is a plan view of the suspension
- 110 means of *Fig. 4*;

Figure 6 is a diagrammatic partial plan view of part of the apparatus of *Fig. 2* for guiding flow line means equipped with floats;

- Figure 7* is an enlarged view of means for
- 115 securing floats to the flow line means; and

Figure 8 is a view in elevation of the means for securing floats to the flow line means.

- The apparatus for keeping the direction of a surface retaining means, e.g. a ship, independent of the direction of flow line means suspended therefrom is adapted to ships with dynamic positioning but is equally suitable for any surface retaining means comprising a central well, as shown in *Fig. 1*. By way of
- 120 example an embodiment of the apparatus will now be described for laying an under water flowline means for an oil or gas well.

- Fig. 1* shows a flow line means 8 which is provided with floats 23 and is in the form of a
- 130 J in the part between the bottom 3 of the

water and a drilling platform 7 on a surface retaining means 4 at the surface of the water. The part of the flow line means near its upper end 9 is vertical and the flow line means 8 slopes progressively inside well 40 of the surface retaining means. It is thus easy to join the end of a new section of the flow line means to the end 9, by vertically joining the end of the new section, using a derrick 41 and a surface of rotation diagrammatically indicated at 42.

A slide 1, enabling the direction of means 4 to be independent of the direction of flow line means 8, is shown in general view in Fig. 2.

At its upper end, it comprises means 13 for securing the top end 9 of flow line means 8, the securing means 13 and slide 1 being secured to a trolley 12 having fittings 50 for receiving the securing means 13. The securing means 13 may be ordinary wedges as shown in Figs. 4 and 5.

The slide trolley 12 is borne by rollers 6 moving on circular rails 2 on the drilling platform 7. The assembly can be supplemented by two further circular rails 18, 19 secured to and below platform 7. Arms 54 and 55 of the upper part of slide 1 bear rollers 20 and 21 with horizontal axes and which move on rails 18 and 19 respectively. Rail 19 has vertical flanges acting as circular guides for rollers 22 which have vertical axes.

The central part of slide 1 is inclined and a partially similar assembly is associated with the central inclined part of slide 1 above the central platform 43 giving access to well 40. This assembly, like the preceding assembly, comprises rails 18 and 19 (Figs. 2 and 3) on which rollers 20, 21 and 22 run, but the support 36 of rollers 20 is also driven by a crown gear 11 engaging a gear wheel 10 driven by a set of bevel gears 14 actuated by a motor 5 secured to platform 43.

The low part of the slide 1 is held and guided in part 44 of well 40 by an assembly similar to the assembly below platform 7, like components being given like reference numerals.

Thus, the top and bottom parts of slide 1 are held and guided by sets of rollers 20, 21, 22 which are freely movable on corresponding rails 18 and 19. The central part of the slide, which is also held and guided by similar means, also has the crown gear 11 which can be driven by motor 5 and the gear train 14-10.

The motor 5 can be actuated either manually or automatically in accordance with any change in the direction or course of the surface retaining means 4. Consequently, slide 1 cannot be arbitrarily rotated simply by friction of its rollers on means 4, but is positively driven around the axis of derrick 41 in the opposite direction to the rotation of means 4 and through an angle equal to the angle through which means 4 rotates, so that slide

1 retains its original direction.

During the aforementioned maintenance of direction, horizontal axis guide rollers 15, 16 and 17 (see more particularly Fig. 6) remain in the same direction and remain adjacent the flow line means 8 on the same side thereof, so that, if means 8 comes away from the surface of the rollers as a result of a bending motion produced for example by the rapid lowering of the surface retaining means, the flow line means 8 is brought back to the apex of the angle formed by the angular arrangement of the lateral guide rollers 15 and 16. Rollers 17 are also arranged so as to give the desired cross-section to the part of the flow line means 8 inside the well, whereas rollers 15 and 16 are positioned so as to hold the flow line means 8 in a constant vertical plane.

Rollers 25 are mounted on slide 1 to guide the floats 23, which are preferably mounted in pairs as shown in Figs. 6-8. The rollers 25 are mounted on slide 1 (as clearly shown in Fig. 6) so as not to interfere with the guidance of the flow line means 8 or with the free bending thereof, and are arranged with their axes parallel to the axes of rollers 15 and 16.

Each pair of floats 23 is interconnected by a pin 26 and each float is connected by an arm 34 to a shaft 29 bearing rollers 28 and moving in a movable annular collar 31 comprising two circular U-section members 27 mounted on the flow line means 8. The collar 31 is made up of two half annular parts jointed at 32, the ends remote from joint 32 being connected by an explosive bolt 33.

Consequently when, during the motion of the surface retaining means 4 after a new section of flow line means 8 has been joined, a pair of floats 23 moves entirely out of the lower end of the well 40, they escape from the guide system and, after pin 26 has been released by any known means, automatically return to an equilibrium position above means 8, as shown in Fig 2 owing to rollers 28 running on collar 31. After the flow line means has been laid on the seabed 3, the floats 23 can be recovered by actuating the explosive bolt 33 by any known means.

The upper part of the apparatus may also be provided with a suitable device for compensating for the action of the swell, the device supporting the trolley 12, roller 6 and rail 2. Numerous suitable swell compensating devices are known.

It can be seen that, without departing from the scope of the invention, the various aforementioned means can be replaced by their equivalents. The shape of the slide can be varied in dependence on the floats associated with the flow line means and in dependence on devices on the surface retaining means, e.g. a swell compensation device, of which there are numerous varieties.

There is thus provided an apparatus whereby the direction of the surface retaining

means can be independent of the direction of the flow line means lowered through its well, and which enables the surface retaining means to change direction through 360° without moving the suspension means which hold the upper end of the flow line means at the surface.

CLAIMS

- 10 1. Apparatus for holding flow line means immersed in water in a constant direction, the flow line means being supported by surface retaining means at the surface of the water and comprising a central well and extending through the central well, the apparatus comprising suspension means for engaging the upper end of the flow line means and from which the flow line means is suspended, the suspension means being rotatable relative to the surface retaining means, and guide means for guiding the flow line means in the well, said guide means being secured to said suspension means for angular movement therewith relative to the surface retaining means.
- 15 2. Apparatus as claimed in claim 1, wherein said suspension means and said guide means are adapted to maintain the upper end of the flow line means vertical and the part thereof extending through the well inclined to the vertical.
- 20 3. Apparatus as claimed in either claim 1 or claim 2, wherein said suspension means is mounted on a trolley, said trolley being rotatable about the axis of said suspension means relative to the surface retaining means.
- 25 4. Apparatus as claimed in claim 3, wherein said trolley is mounted on rollers movable on a circular rail coaxial with said suspension means.
- 30 5. Apparatus as claimed in either claim 3 or claim 4, comprising a slide on which said guide means are mounted and which is held and guided by rollers moving on circular rails, said slide being secured to said trolley.
- 35 6. Apparatus as claimed in any one of claims 1 to 4, wherein said guide means are associated with means for rotating said guide means and said suspension means relative to said surface retaining means.
- 40 7. Apparatus as claimed in any one of claims 1 to 4 and 6, wherein said guide means is supported by a slide which is rotatable about the axis of said suspension means, said slide being connected to drive means to be driven in the opposite direction to the change in direction of the surface retaining means, and through the same angle as the surface retaining means.
- 45 8. Apparatus as claimed in either claim 5 or claim 7, wherein said slide is connected to be driven by a motor connected to a gear assembly engaging a crown gear secured to the central part of said slide.
- 50 9. Apparatus as claimed in any one of the preceding claims, wherein said suspension

means is coaxial with a derrick on the surface retaining means.

10. Apparatus as claimed in any one of the preceding claims, wherein said guide means comprise a plurality of sets of rollers disposed in vertically spaced horizontal planes, each set of rollers comprising rollers for determining the slope of the flow line means and rollers constituting lateral guides therefor.

11. Apparatus as claimed in claim 10, comprising float guide means for guiding floats secured to the flow line means.

12. Apparatus as claimed in claim 11, wherein said float guide means comprise horizontal rollers extending in the same direction as said lateral guide rollers of said flow line means guide means.

13. Apparatus as claimed in either claim 11 or claim 12, wherein the floats are attached in pairs to the flow line means by connection means which is freely rotatable in a collar around the flow line means.

14. Apparatus for holding flow line means immersed in water in a constant direction, the flow line means being supported by a surface retaining device at the surface of the water and comprising a central well and extending through the central well, substantially as herein described with reference to the accompanying drawings.

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CLAIMS

1. Apparatus for holding flow line means immersed in water in a constant direction, the flow line means being supported by surface retaining means at the surface of the water and comprising a central well and extending through the central well, the apparatus comprising suspension means for engaging the upper end of the flow line means and from which the flow line means is suspended, the suspension means being rotatable relative to the surface retaining means, and guide means for guiding the flow line means in the well, said guide means being secured to said suspension means for angular movement therewith relative to the surface retaining means.
2. Apparatus as claimed in claim 1, wherein said suspension means and said guide means are adapted to maintain the upper end of the flow line means vertical and the part thereof extending through the well inclined to the vertical.
3. Apparatus as claimed in either claim 1 or claim 2, wherein said suspension means is mounted on a trolley, said trolley being rotatable about the axis of said suspension means relative to the surface retaining means.
4. Apparatus as claimed in claim 3, wherein said trolley is mounted on rollers movable on a circular rail coaxial with said suspension means.
5. Apparatus as claimed in either claim 3 or claim 4, comprising a slide on which said guide means are mounted and which is held and guided by rollers moving on circular rails, said slide being secured to said trolley.
6. Apparatus as claimed in any one of claims 1 to 4, wherein said guide means are associated with means for rotating said guide means and said suspension means relative to said surface retaining means.
7. Apparatus as claimed in any one of claims 1 to 4 and 6, wherein said guide means is supported by a slide which is rotatable about the axis of said suspension means, said slide being connected to drive means to be driven in the opposite direction to the change in direction of the surface retaining means, and through the same angle as the surface retaining means.
8. Apparatus as claimed in either claim 5 or claim 7, wherein said slide is connected to be driven by a motor connected to a gear assembly engaging a crown gear secured to the central part of said slide.
9. Apparatus as claimed in any one of the preceding claims, wherein said suspension

means is coaxial with a derrick on the surface retaining means.

10. Apparatus as claimed in any one of the preceding claims, wherein said guide means comprise a plurality of sets of rollers disposed in vertically spaced horizontal planes, each set of rollers comprising rollers for determining the slope of the flow line means and rollers constituting lateral guides therefor.

11. Apparatus as claimed in claim 10, comprising float guide means for guiding floats secured to the flow line means.

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13. Apparatus as claimed in either claim 11 or claim 12, wherein the floats are attached in pairs to the flow line means by connection means which is freely rotatable in a collar around the flow line means.

14. Apparatus for holding flow line means immersed in water in a constant direction, the flow line means being supported by a surface retaining device at the surface of the water and comprising a central well and extending through the central well, substantially as herein described with reference to the accompanying drawings.

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