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(58) Field of Search:
INT CL **B61B, F03D, H02G**
Other: **SEARCH-PATENT**

(54) Title of the Invention: **Offshore structure**
Abstract Title: **Offshore structure and vessel comprising a zipwire for transferring cables**

(57) Transferring a first end 12 of a power cable 10 from a floating vessel 520 to an offshore structure 100 (Figure 1) such that the first end remains above sea level 40 (Figure 1), comprising a transfer apparatus 500 comprising a zip line arrangement comprising a zip line 540 suspended between a first connection 501 positioned on the offshore structure, to a second connection 502 positioned on the floating vessel; a cable mounting device 550 is positioned on the zip line and receives a first end of a power cable. A driving arrangement may move the first connection along the vertical length of the offshore structure. A cable drive unit may transfer the cable mounting device along the suspended zipwire. The offshore structure may comprise a routing unit 102 (Figure 3) connectable to the power cable and an actuator 300 (Figure 3) which moves the routing unit from a first position where the routing unit is above sea level and a second position where the routing unit is in an installed position.

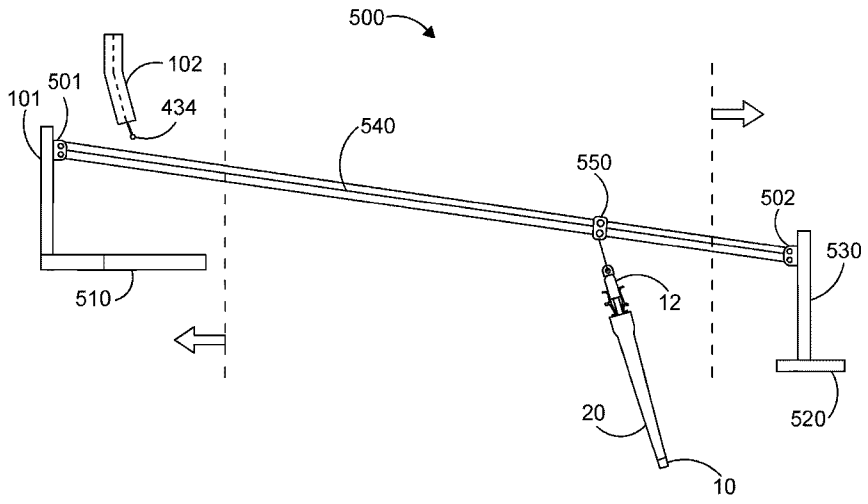


FIG. 4

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

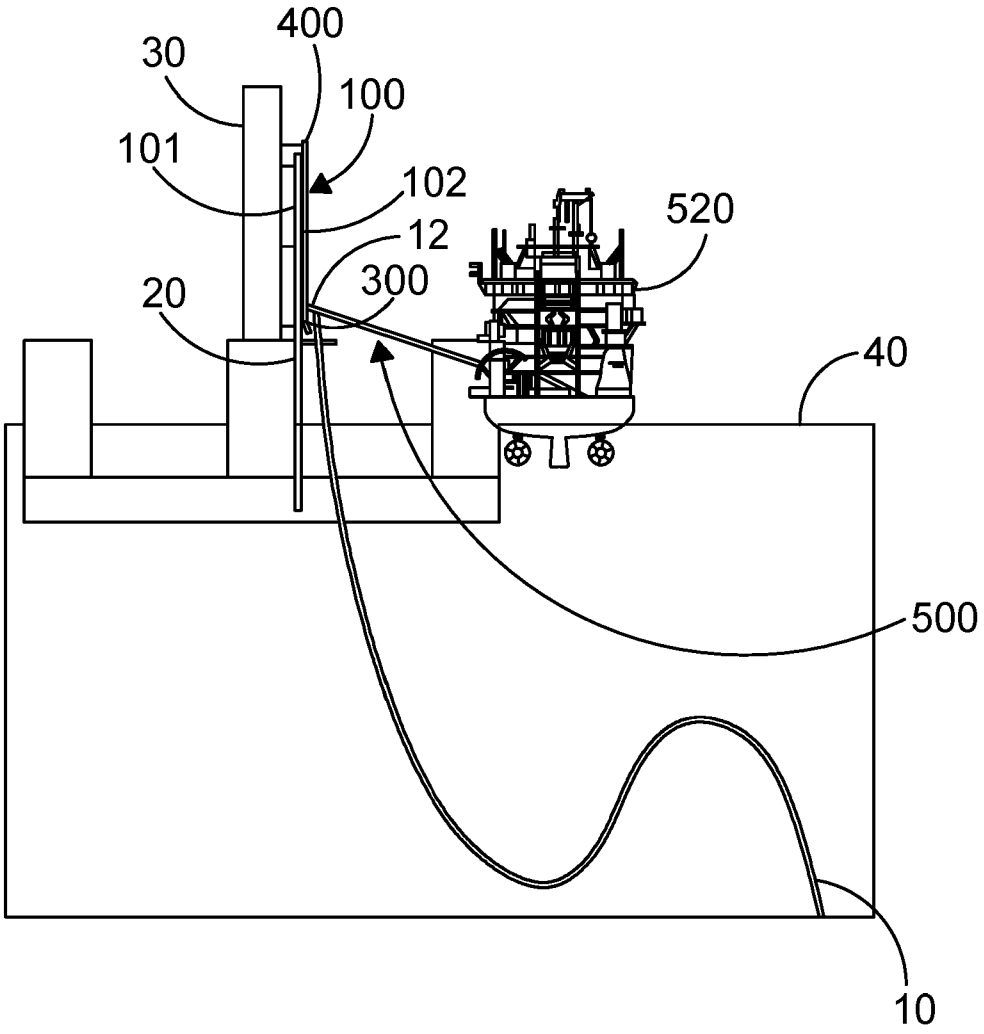


FIG. 1

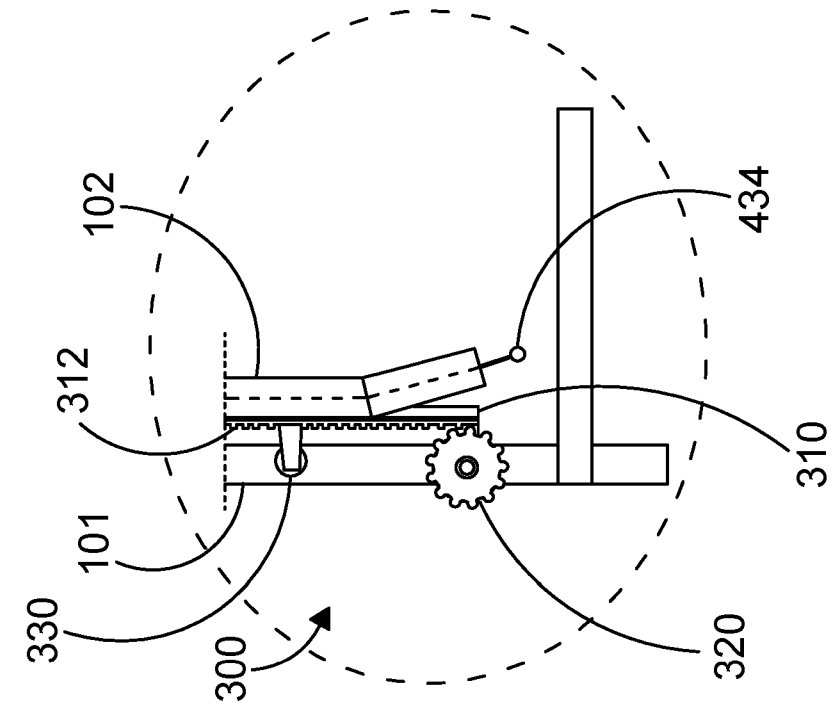


FIG. 3

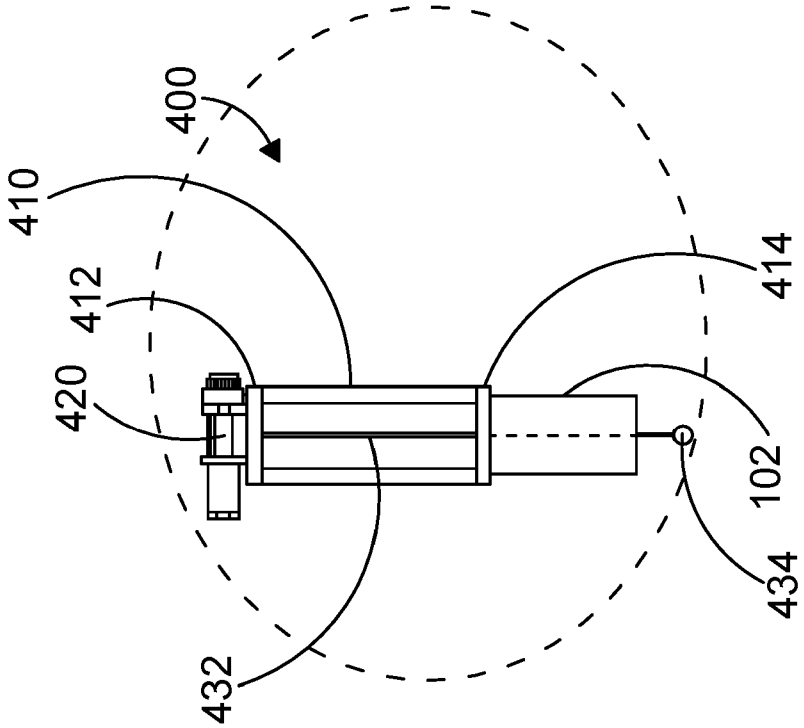


FIG. 2

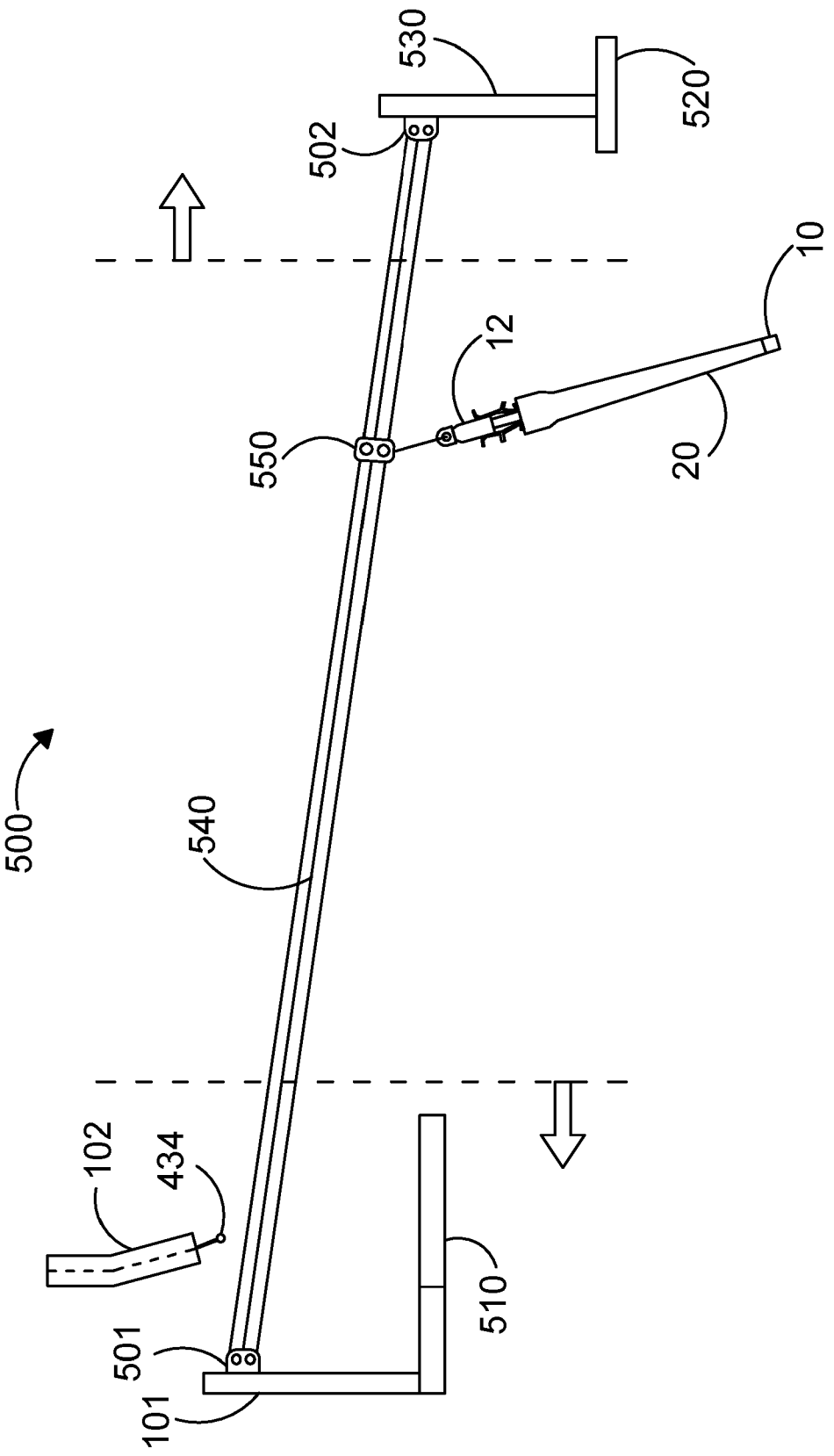


FIG. 4

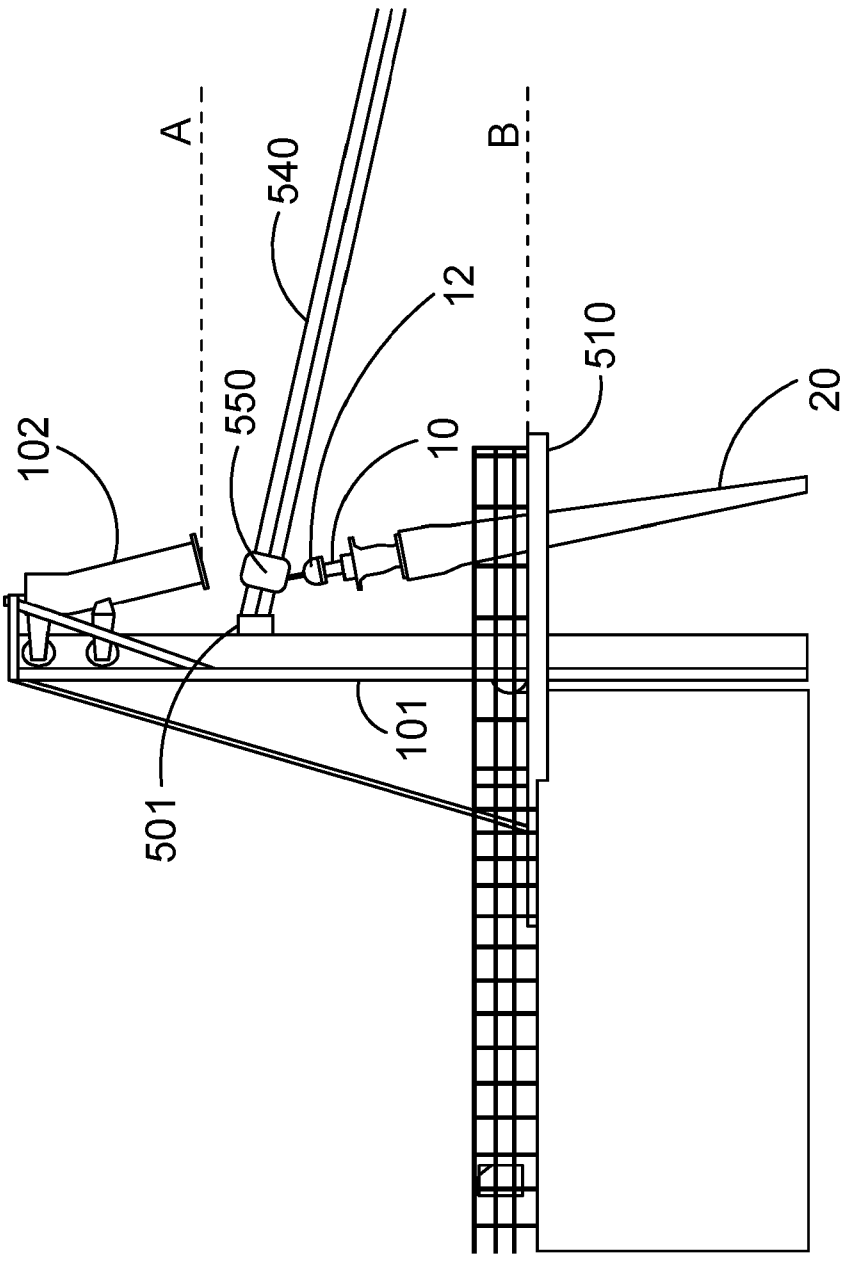


FIG. 5

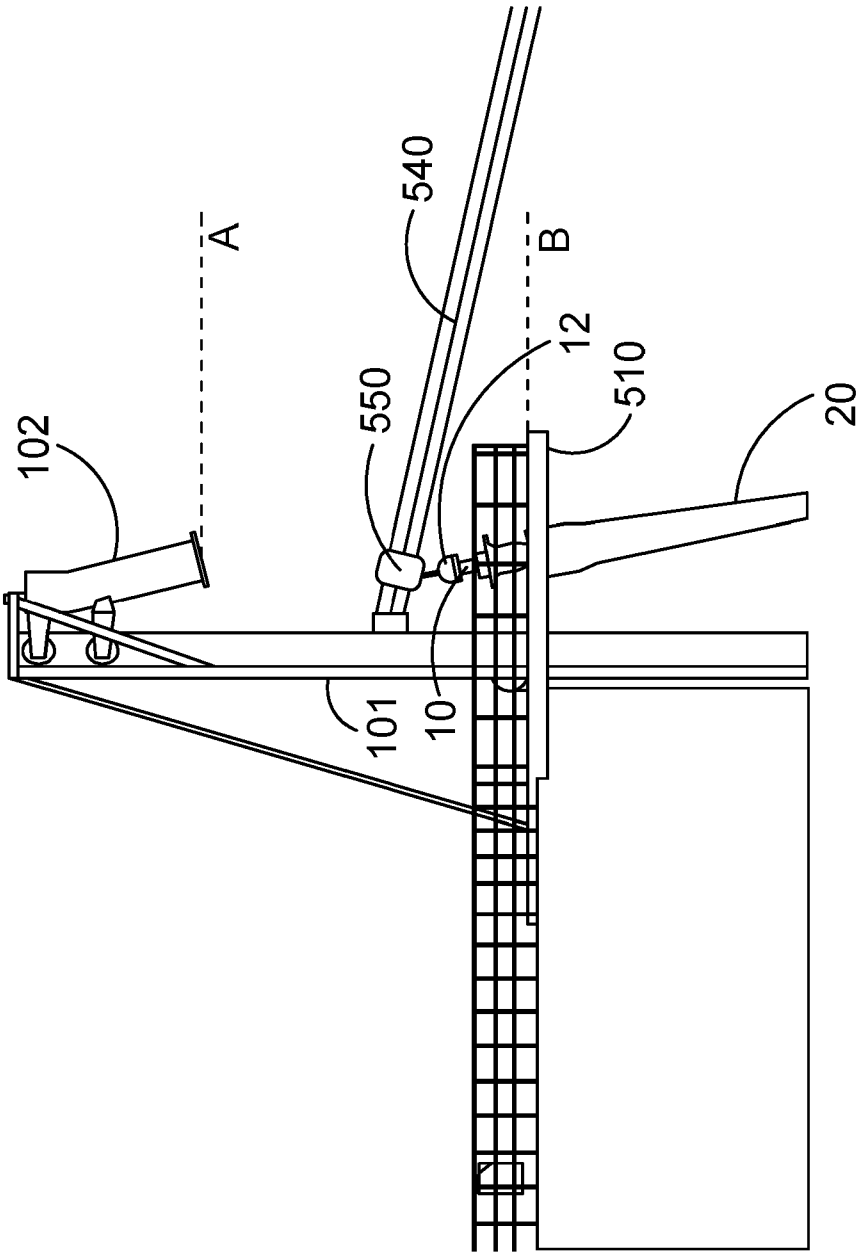


FIG. 6

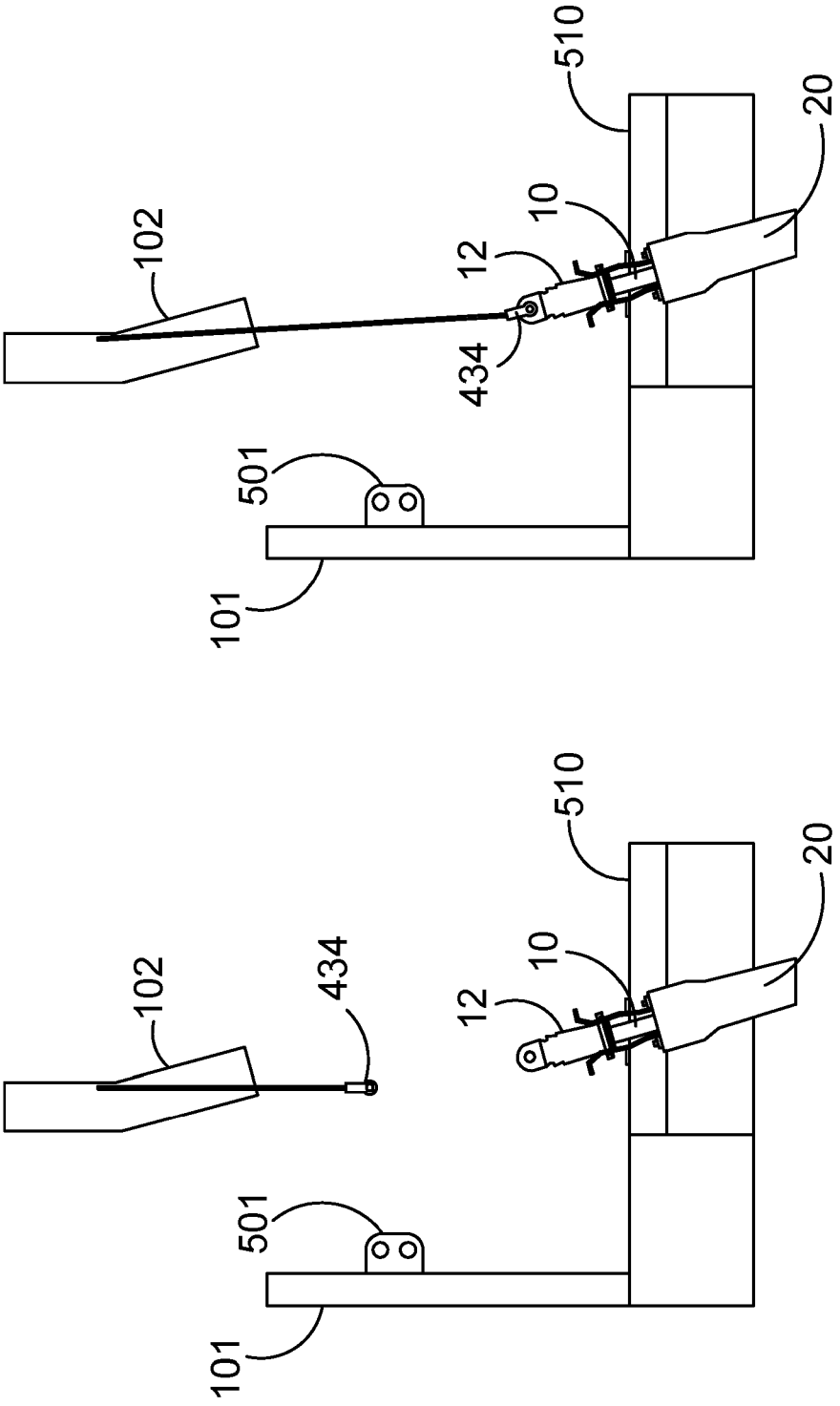


FIG. 7A




FIG. 7B

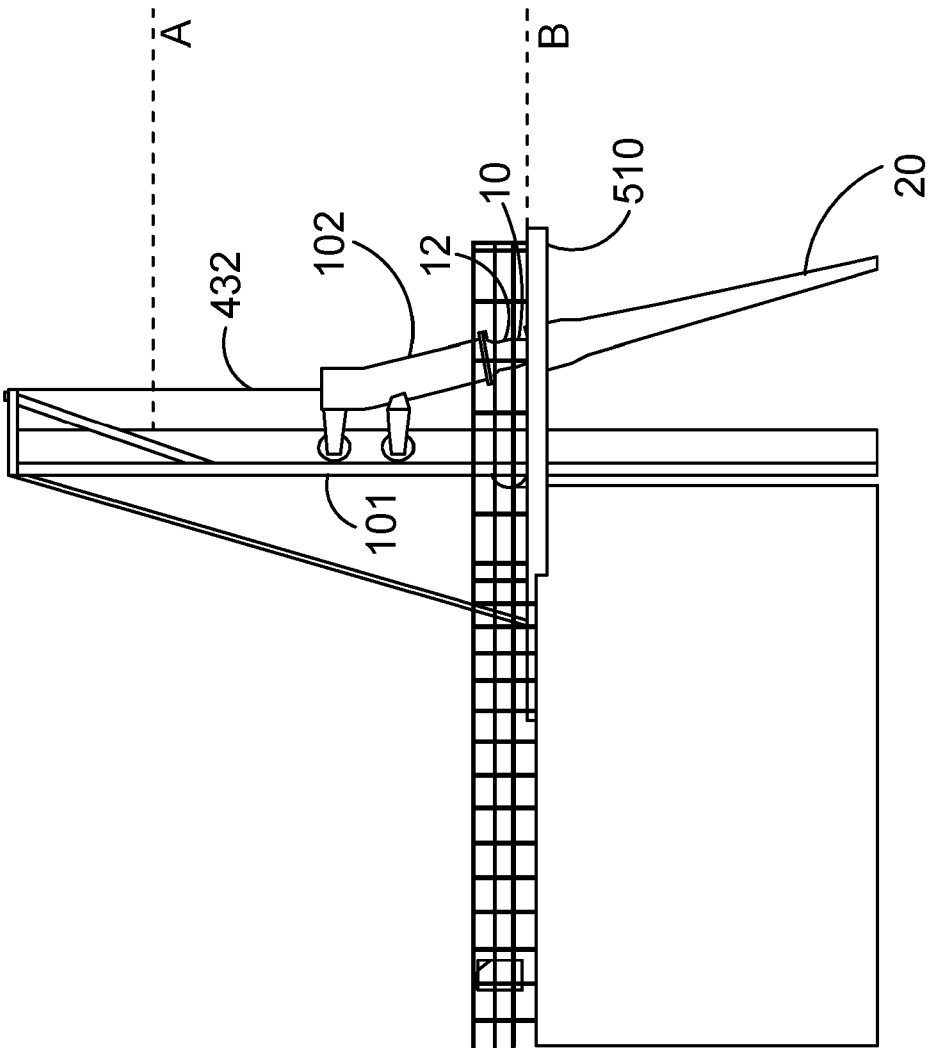


FIG. 8

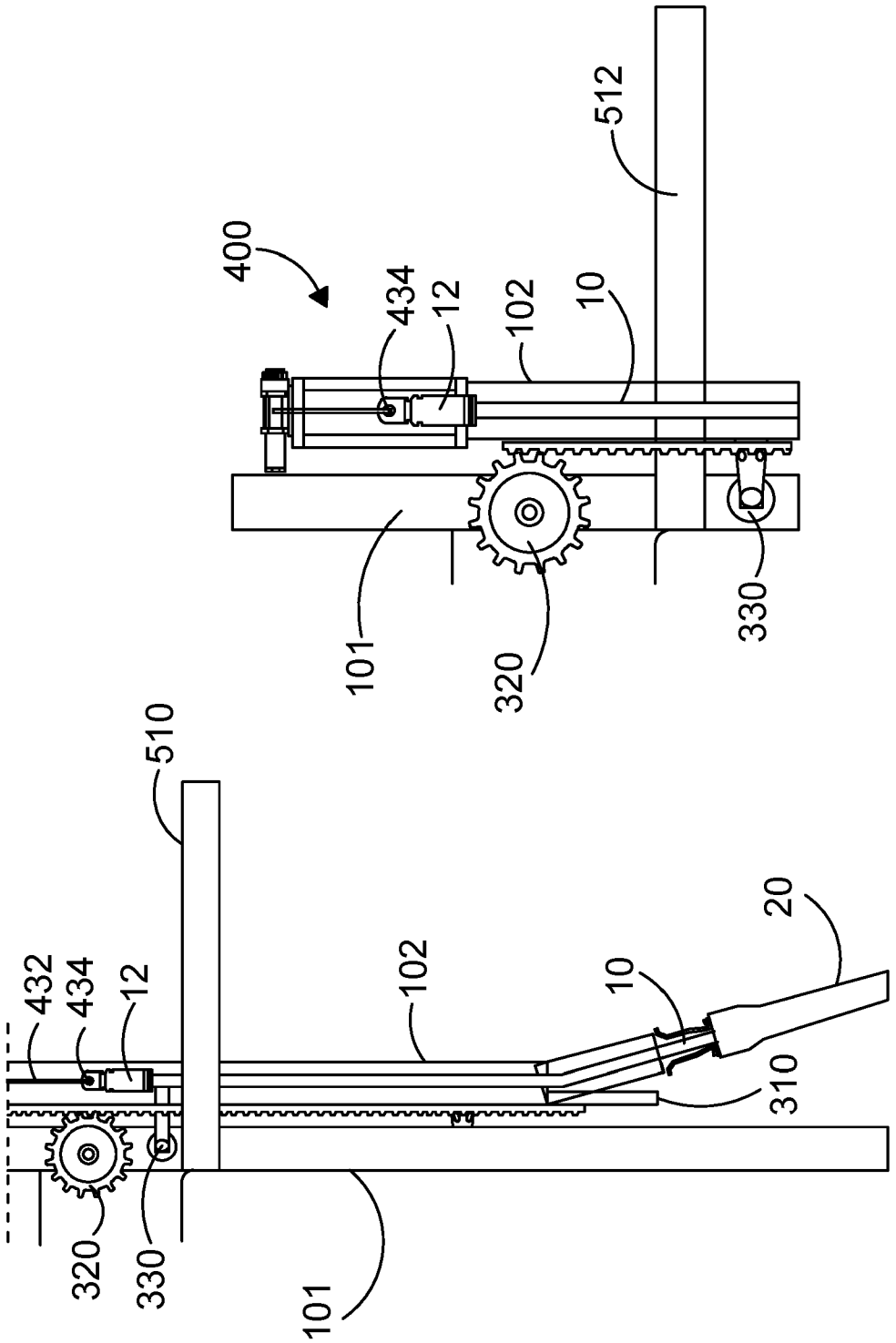


FIG. 9B

FIG. 9A

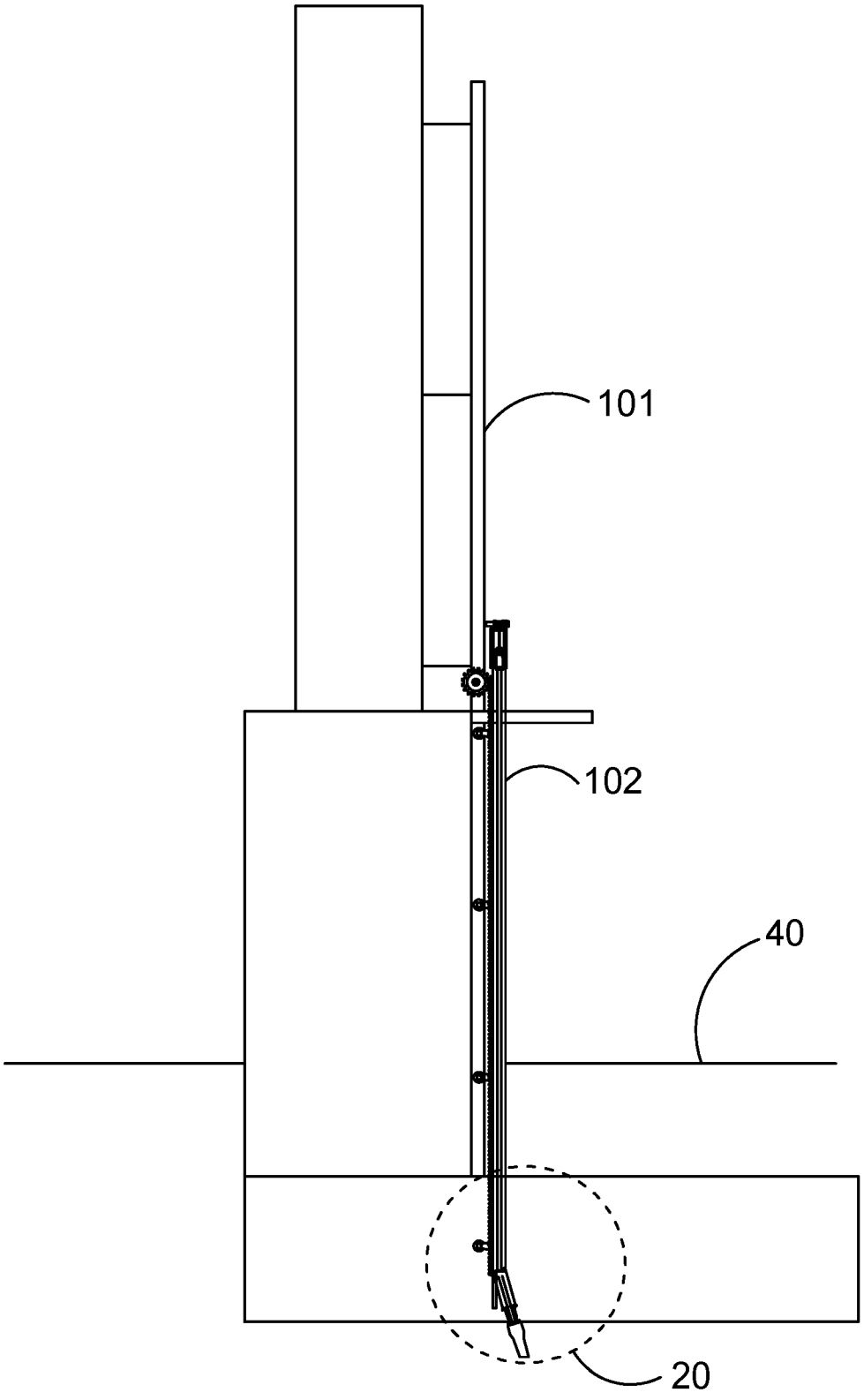


FIG. 10

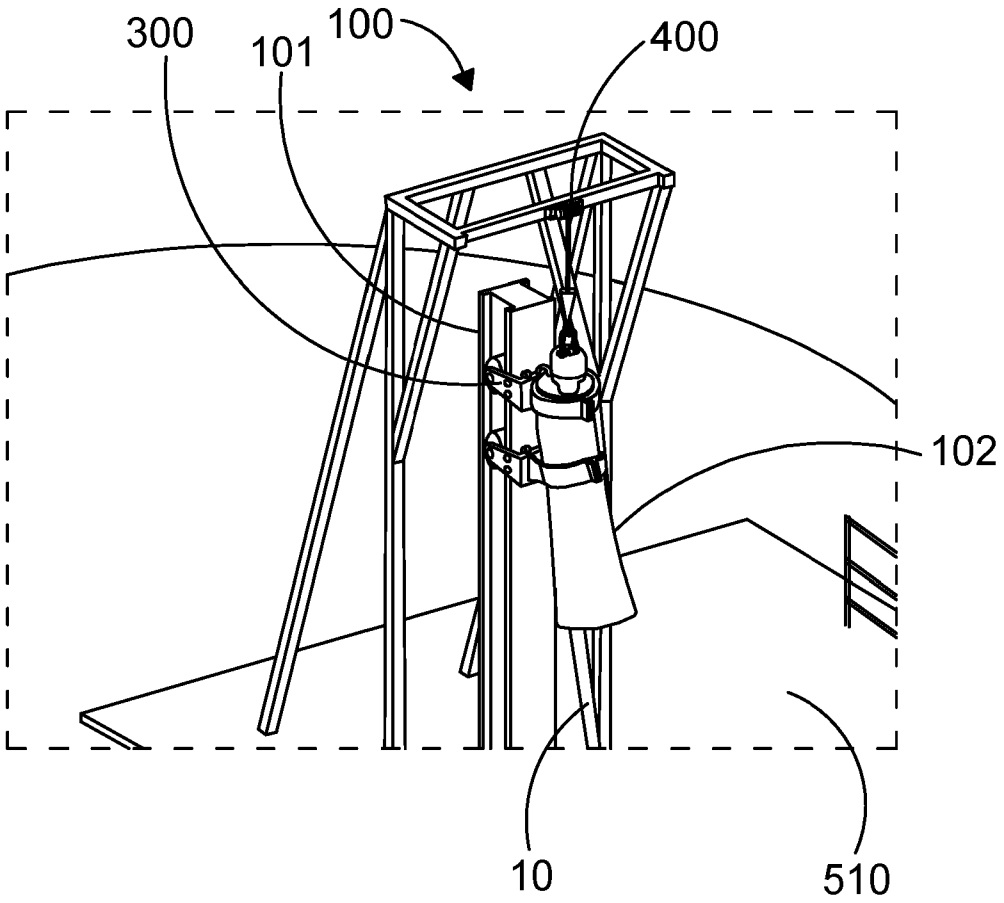


FIG. 11

# OFFSHORE STRUCTURE

## Technical Field

The present disclosure relates generally to the field of offshore power generating structures and power cables. More specifically, the present invention relates to a system and method for transferring a first end of a power cable from a floating vessel to an offshore structure.

## Background

In wind farms positioned offshore, power cables or inter array power cables are used to transport the energy generated at the different wind mills positioned around at the offshore location to an export cable for transfer of the power to shore. Electric energy generated by offshore wind and wave power is transported via one or more of the power cables to a consumer offshore or on land. Power cables are also used for other renewable energy productions sites or for oil and gas structures offshore. Due to the offshore location the power cables extend in normal operation from a position at top off an offshore structure and down into the water and are extending in the water or at the seabed to another location.

I-tubes or J-tubes are normally used for guiding and protecting the power cables as they extend from the body of water and up to a deck on an offshore structure. These tubes are fixed to the offshore structure and would normally extend from the deck of the offshore structure and down into the body of water. However, installing the power cable so that it runs through these tubes is considered to be a technical challenge.

A problem with conventional installation procedures is that since the lower end of the tubes are provided at sea level, wet mate connectors must be utilized. Such connections are a more complicated and relatively expensive in comparison to dry mate connectors. Furthermore, installing the power cables 10 to the offshore structure when in shallow waters becomes impractical due to the tubes extending down into a body of water.

Aspects of the present disclosure seek to provide a system and method for overcoming these problems. In particular, the present invention aims to provide an arrangement to transport a cable end from a vessel to an offshore structure, and positioning the cable end such that it can be connected to the offshore structure in a dry state.

**Summary**

It is an objective of the present invention to provide a system and a method for transferring a first end of a power cable from a floating vessel to an offshore structure such that the first end remains above sea level. This objective can be achieved by the features as defined by the independent claims. Further enhancements are characterized by the dependent claims. The invention is defined by the claims. A system for positioning a power cable for connecting to an offshore structure, and a method for the same is disclosed.

According to a first aspect of the present invention, there is provided a system having a floating vessel, an offshore structure positioned in the vicinity of the vessel, and a transfer apparatus. The transfer apparatus comprises a zip line arrangement comprising a zip line extending between a first connection positioned on the offshore structure, to a second connection positioned on the floating vessel. A cable mounting device is positioned on the zip line and configured to receive a first end of a power cable. The cable mounting device is moveable along the zip line for the transfer, above sea level, of a first end of a power cable between the floating vessel and the offshore structure.

The first connection may comprise a driving arrangement configured to move the first connection along a vertical length of the offshore structure. The cable mounting device may further comprise an adjustable connecting portion configured to be raised or lowered relative to the cable mounting the device, and further configured to receive the first end of the power cable.

The zip line arrangement may further comprise a cable drive unit arranged on the cable mounting device and configured to move the cable mounting device along the zip line. Optionally, the zip line arrangement may further comprise a zip line drive unit arranged on the zip line and configured to pull the zip line relative to the offshore structure.

The zip line arrangement may further comprise a secondary line extending between the first connection and second connection, wherein cable mounting device is attached to the zip line and secondary line, and wherein either the zip line or secondary line, or the system, comprises a winch configured to pull the cable mounting device along the zip line and secondary line.

The offshore structure may further comprise a hang off balcony extending from the offshore structure to a free end spaced from the offshore structure. The

hang off balcony may be substantially parallel to the sea level. The hang off balcony may be arranged in the vicinity of the first connection. The first end of the power cable may be attachable to the hang off balcony, such that the hang off balcony is structured to transfer load of the power cable from the cable mounting device to the offshore structure.

The offshore structure may comprise a routing unit for the power cable such that the power cable is protected and in a position to be electrically coupled to the offshore structure, or to components on the offshore structure. The routing unit is movably attached to the offshore structure between at least two positions relative to the offshore structure. The system further comprises an actuator adapted to selectively move the routing unit between a first position in which the routing unit is completely above sea level, where a relative lower end of the routing unit is accessible from the offshore structure; and a second position, relatively lower than the first position, in which the lower end of the routing unit is in a normal installed position or normally operated position relative the offshore structure. The routing unit may be movably relative to the offshore structure between a plurality of predetermined positions, wherein the predetermined positions comprises the first position and the second position.

The first position may be further defined such that the lower end of the routing unit is accessible to a worker on the offshore structure, for example a worker on a ground level of the offshore structure, or on a hang off balcony on the offshore structure. This may be the position at which the worker connects the cable to the offshore structure, before arranging the cable and the routing unit in their final position that they have during normal subsequent operation of the offshore structure. That the relative lower end is accessible from the offshore structure should be understood such that it is possible to perform work close to or on the lower end of the routing unit from a deck positioned at the offshore structure. This meaning that the work with possibly connecting a bend restrictor to the routing unit can be done above sea level in dry conditions, i.e not seawater influenced conditions. The first position may be substantially spaced from the second position. Preferably, a lower end of the routing unit is proximate to the sea level in the second position. Optionally, the lower end of the routing unit is at least partially below sea level in the second position. Such a position would normally not be accessible from the floating structure as such. The hang off balcony may further operate as an elevated working platform

to allow a tradesperson to access and service the offshore structure and/or power cable when the routing unit is held in a first or third position.

The system may further comprise a hoisting device. The hoisting device may be arranged on the offshore structure. The hoisting device may comprise a pulling element attachable to the first end of the power cable, and configured to pull the power cable through the routing unit. The routing unit may be selected from a group consisting of: an I-Tube, a J-Tube, a telescopic tube, a short tube element, a bell mouth, and a connector unit.

The offshore structure may be a floating offshore structure but it could alternatively be a bottom fix structure. Preferably, the floating offshore structure comprises a wind turbine, in an alternative it comprises a wave an/or tidal energy power plant, or a renewable energy power plant solution as such where the cable is an energy export cable from the offshore structure.

The offshore structure may comprise a supporting post, such that the routing unit is movably attached to the supporting post. The supporting post and the routing unit each extend parallel to each other in a substantially perpendicular direction to the sea level.

According to a second aspect of the claimed invention, there is provided a method for transferring a first end of a power cable from a floating vessel to an offshore structure such that the first end remains above sea level. The method comprises:

providing a system according to the first aspect of the claimed invention, or any other embodiments disclosed herein;

providing the first end of the power cable at the vessel;

attaching the first end of the power cable to the cable mounting device; and

moving the first end of the power cable from the vessel to the offshore structure.

The method may further comprise the step of moving the first connection along the vertical length of the offshore structure prior to releasing the first end from the cable mounting device. The method may further comprise the step of attaching the first end to the hang off balcony, and releasing the first end from the cable mounting device. Attaching the power cable to the hang off balcony may be assisted by extending/retracting the adjustable connecting portion of the cable mounting device to lower/raise the power cable.

The power cables described herein may also be used for other renewable energy productions sites or even for oil and gas structure offshore. Due to the offshore location the power cables extends in normal operation from a position at top off an offshore structure and down into the water and are extending in the water or at the seabed to another location. The offshore structure may be a fix structure, but can also be a floating structure. That the relative lower end is accessible from the offshore structure should be understood such that it is possible to perform work close to or on the lower end of the routing unit from a deck positioned at the offshore structure. This meaning that the work with possibly connecting a bend restrictor to the routing unit can be done above sea level in dry conditions, i.e not seawater influenced conditions.

At least one of the above embodiments provides one or more solutions to the problems and disadvantages with the background art. Other technical advantages of the present disclosure will be readily apparent to one skilled in the art from the following description and claims. Various embodiments of the present application obtain only a subset of the advantages set forth. No one advantage is critical to the embodiments. Any claimed embodiment may be technically combined with any other claimed embodiment or embodiments.

**Brief Description of the Drawings**

The accompanying drawings illustrate presently exemplary embodiments of the disclosure and serve to explain, by way of example, the principles of the disclosure.

FIG. 1 is a schematic of an offshore structure according to one embodiment of the disclosure in a first position completely above sea level, and a transfer apparatus.

FIG. 2 is a detailed view according to one embodiment of the disclosure of a hoisting device arranged on the offshore structure;

FIG. 3 is a detailed view according to one embodiment of the disclosure of an actuator arranged on the offshore structure;

FIG. 4 is a schematic according to one embodiment of the disclosure of a transfer apparatus;

FIG. 5 is a detailed view according to one embodiment of the disclosure of the offshore structure in the first position;

FIG. 6 is a detailed view according to one embodiment of the disclosure of a load transfer between the transfer apparatus and offshore structure;

FIGs. 7A and 7B are detailed views according to embodiments of the disclosure of a power cable connecting to a hoisting device;

FIG. 8 is a detailed view according to one embodiment of the disclosure of the offshore structure in a third position;

FIGs. 9A- 9B are detailed views according to embodiments of the disclosure of the power cable being pulled through the routing unit;

FIG. 10 is a schematic according to one embodiment of the disclosure of the offshore structure with the routing unit in a second position; and

FIG. 11 is a schematic view according to one embodiment of the disclosure with the routing unit being a bell mouth.

**Detailed Description**

As illustrated by the figures, embodiments of the present disclosure a method for transferring a first end 12 of a power cable 10 from a floating vessel 520 to an offshore structure 100 such that the first end 12 remains above sea level 40, and a system therefore. There is provided a method for transporting a power cable to an offshore structure and positioning the power cable such that it may be connected to the offshore structure, and a system therefore.

The system as shown in FIG. 1 comprises an offshore structure 100 having a moveably attached routing unit 102, the routing unit 102 may be a guide unit 102. The offshore structure 100 is provided with a power cable 10 having a first portion of length arranged vertically along the offshore structure 100, and a second portion of length deviating out of the offshore structure 100 into a body of water and eventually laying on a sea bed. The power cable 10 may have a first portion of length extending between an upper end of the routing unit 102 to a lower end of the routing unit 102, and a second portion of length extending between a lower end of the routing unit 102 to below a sea level 40. A first end 12 of the power cable 10 may be connected to the offshore structure 100.

The routing unit 102 serves to guide the power cable 10 from the body of water to the offshore structure 100, such that the power cable 10 is in position to be electrically connected to the offshore structure 100. Electrically connecting to the offshore structure 100 may also include connections to one or more electrical components on the offshore structure. The offshore structure 100 may further

comprise a windmill 30, such that the offshore structure 100 forms part of a power distribution system that facilitates the transmission of electricity from the windmill 30 to various components. The offshore structure 100 may comprise other types of energy generators, such as for example a wave, tidal, and/or wind generator. The offshore structure 100 may comprise any suitable structure for generating electricity to which the first end 12 of the power cable 10 may be connected.

As illustrated, the routing unit 102 may be moveably attached to a supporting post 101, with the routing unit 102 and supporting post 101 each extending parallel to one another in a direction substantially perpendicular to a sea level 40. Initially, the routing unit 102 may be held in a first position defined as where the routing unit 102 is completely above the sea level 40, and preferably substantially spaced from the sea level 40. The first position may be accessible to a worker from an elevated platform 510, such as for example a hang off balcony 510, on the offshore structure 100. In the first position, the lower end of the routing unit 102 may be accessible to a worker from an elevated platform 510, such as for example a hang off balcony 510, on the offshore structure 100.

The routing unit 102 may be a generally hollow body structured to protect the power cable 10 and route the power cable 10 inside the routing unit 102 to the offshore structure 100. To further protect the power cable, a bend stiffener 20 may be provided towards the first end 12 of the power cable 10. The bend stiffener 20 may be formed with an elongate sleeve defining a substantially cylindrical passage which can receive at least a portion of the power cable 10. The bend stiffener 20 may be provided with a bend stiffener connector removably connectable to the routing unit 102. As illustrated, the routing unit 102 comprises an I-Tube having a flange attachable with the bend stiffener connector. However, other types of tubes with an appropriate connecting means to the power cable directly, or via a bend stiffener connector 20, such as a J-Tube, a telescopic tube, a short tube element, a bell mouth, and a connector unit.

As illustrated in the figures, the offshore structure 100 is provided with an actuator 300 adapted to selectively move the routing unit 102 relative to the offshore structure 100 between a plurality of predetermined positions. The plurality of positions may comprise at least a first position, wherein the routing unit 102 is completely above sea level, see for example FIG. 1; and a second position, lower than the first position. The second position may be, for example, proximate to the lower end of the offshore structure 100. The second position may be, for example,

proximate to the sea level. For example, the second position may be proximate yet above the sea level 40. For example, the second position may be proximate yet below the sea level 40. For example, the lower end of the routing unit 102 may be at an elevation at least partially below the sea level, see for example FIG. 10. The second position may be the position that the routing unit 102 have after the power cable 10 has been fully installed and the offshore structure is operating and generating electric power and transporting the electric power via the power cable 10. The first position may be defined by that the lower end of the routing unit 102 being accessible to a worker from a level of the offshore structure 100. The level may be a hang off balcony or other a platform on which a worker electrically connects the power cable 10 to the offshore structure 100. The first position may be substantially spaced from the second position. Attaching the power cable 10 to the offshore structure 100 when the routing unit is held in the first position provides the technical benefit of being able to deploy a dry-mate connection, rather than a wet mate connection. By having the routing unit 102 in the first position the power cable 10 may be protected from damages by being dragged on the sea bed when the offshore structure 100 is in relatively shallow water.

FIG 2. illustrates a detailed view of the offshore structure 100 provided with a hoisting device 400. The hoisting device may be winch, such as for example a pull-in winch and gantry. Sections of the routing unit 102 have been removed from the illustration for clarity purposes. The hoisting device may be arranged on the offshore structure 100, or on the routing unit 102, and may comprise a frame 410 removably mounted to the offshore structure 100, or to the routing unit 102. A rotatable drum 420 having a wire 432 wound thereon may be positioned on an upper end 412 of the frame 410. The wire 432 hangs downwardly due to gravity, and can extend into and along the entire length of the routing unit 102, such that a wire end 434 terminates below an opening at the lower end of the routing unit 102. The wire end 434 is attachable to the first end 12 of the power cable 10. The hoisting device 400 may reel in the wire 432, such an attached power cable 10 is pulled towards the frame 410. The hoisting device 400 may be coupled to a controller, such that the hoisting device 400 is remotely operable. The rotatable drum 420 may further comprise a motor configured to reel the wire end 434 towards, or away from the upper end of the routing unit 102. The hoisting device 400 may be operable to pull a first end 12 of the power cable 10 into and through the opening in the routing unit 102, thereby making the power cable 10 at least partially protected by the routing unit 102. The hoisting

device 400 is further operable to lower the power cable 10 back through the routing unit 102 until the wire 432 emerges at an opening at the lower end of the routing unit 102.

FIG. 3 illustrates a detailed view of the routing unit's 102 lower end, and details an example of the actuator 300 arranged on the offshore structure 100. FIG. 3 may illustrate the first position proximate to the hang off balcony 510. A side of the routing unit 102 adjacent to the supporting post 101 may be provided with a bracket 310 having a rack profile 312 extending along the length of the routing unit 102. A motor-driven toothed wheel 320 may be rotatably mounted on the routing unit 102 and forms an interlocking mesh with the corresponding teeth of the rack profile 312. The bracket 310 is further provided with a guide roller 330 extending from the bracket 310 and contacting the supporting post 101. The toothed wheel 320 is designed to rotate, via power supplied by the motor, to move the routing unit 102 relative to the supporting post 101. Alternatively, the bracket 310 can be provided on the supporting post 101, with the wheel 320 provided on the routing unit 102.

The actuator 300 and hoisting device 400 discussed herein are examples of a means structured to provide a relative movement between the routing unit 102 and the power cable 10. The means may be further configured to rotate the routing unit 102 around an axis parallel to the sea level 40. This may facilitate the routing of the power cable 10 into the routing unit 102 because the lower end of the routing unit 102 can be swung around an axis parallel to the sea level 40. The offshore structure may be further provided with a locking means for locking a relative movement between the routing unit 102 and the power cable 10. The locking means may comprise any known apparatus suitable to selectively restrict movement between the two components, such as a retractable tab and a receiving slot arranged on the first end 12 of the power cable 10 and the routing unit 102 respectively. The locking means may be for example a wedge, or a clamp, or a holder.

The relative movement provided by means 300, 400, structured to provide the relative movement, and prevented by the locking means is in reference to a substantially vertical relative movement between the guide unit 102 and power cable 10. Alternatively, the relative movement may be in a direction along the longitudinal length of the guide unit 102. There may, however, be an additional horizontal relative movement between the power cable 10 and the guide unit 102 due to wind and/or tidal forces. While the present invention can provide/prevent a relative movement vertically or in a direction of the guide unit 102, the power cable 10 may still be

capable of being displaced horizontally inside the guide unit 102 such that a part of the power cable 10 is engageable with the guide unit 102.

FIG. 4 illustrates an arrangement designed to allow the power cable 10 to be positioned and readily attachable to the offshore structure 100. This is done without the first end 12 of the power cable 10 coming in contact with the seawater. A hang off balcony 510 may be provided at a third position. The third position may be the same as, or proximate to, the first position. The third position may be proximate and vertically below the first position. The third position is completely above the sea level 40. The hang off balcony 510 may extend towards free-end remote from the offshore structure 100 in an orientation that is substantially parallel to the sea level 40. In the vicinity of the offshore structure 100 there may be a vessel 520, such as a ship, having a vessel post 530. The vessel 520 may carry at least a part of the power cable 10 to be connected to the offshore structure 100.

A transfer apparatus 500 may be provided between the vessel 520 and the offshore structure. In FIG. 4 the transfer apparatus 500 comprises a zip line arrangement having a zip line cable 540 extending between two removably attachable connections 501, 502. The first connection 501 is located on the offshore structure 100 and may be positioned proximate and above the hang off balcony 510. The second connection 502 may be positioned directly on the vessel 520, or an appropriate vessel post 530.

As illustrated, arranged on the zip line cable 540 is a cable mounting device 550 having a connecting portion removably attachable to the first end 12 of the power cable 12. A cable drive unit may be arranged on the cable mounting device 550, and configured to move the cable mounting device 550 along the zip line 540. The cable drive unit may comprise a motor and a chassis or framework having a modular subassembly of wheels driven by the motor. Furthermore, a zip line drive unit may be arranged on the zip line 540 and configured to pull the zip line 540, such that the cable mounting device 550 mounted thereon can move towards or away from the offshore structure. The transfer apparatus 500 may be structured to move the first end 12 of the power cable 10 from the vessel 520 to the third position, or directly to the first position. Alternatively, rather than positioning the power cable 10 via the transfer apparatus 500, the power cable 10 may be lifted into place, for example by a crane arm/winch.

Both the first and second connections 501, 502 may include a driving arrangement structured to move the connections vertically along their corresponding

post. Furthermore, the connecting portion of the cable mounting device 550 may be adjustable, such that the connecting portion can extend/retract to raise/lower the power cable 10 relative to the cable mounting device 550. These functionalities allow more precise positioning of the power cable 10 once it is proximate to the offshore structure 100. Any of the cable mounting device 550, first connection 501, second connection 502, zip line drive unit, and cable drive unit may be coupled to a controller such that they are remotely operable.

An example operation of the system will now be described in reference to the figures, especially FIGs. 4 to 10. Beginning with FIG. 4, a transfer apparatus 500 having the zip line arrangement is provided, and the power cable 10 is provided on the vessel 520. The first end 12 of the power cable 10 is fixed onto the connecting portion of the cable mounting device 550. The cable mounting device 550 transports the power cable 10 from the vessel 520 to the offshore structure in the first position, denoted by label 'A'. As depicted in FIGs 5-6, the power cable 10 may then be lowered, via the driving arrangement on the first connection 501 and/or the adjustable connecting portion of the cable mounting device 550, until the power cable 10 is coupled with the hang off balcony 510 via appropriate means, in the third position. This allows the load of the power cable 10 to be transferred from the zip line arrangement to the hang off balcony 510. The first end 12 of the power cable 10 is hereby held in the third position, denoted by label 'B'. Alternatively, the power cable 10 can be directly provided at the third position by the zip line arrangement. To complete the load transfer, the cable mounting device 550 is detached from the power cable 10. As shown in FIGs. 7A and 7B, the pulling element of the hoisting device 400 is then lowered through the routing unit 102 unit, and secured to the power cable 10.

Moving on to FIG. 8, the lower end of the routing unit 102 is secured with a connecting means provided on the power cable 10, such as a bend stiffener connector 20. If the optional hang off balcony 510 is present with the power cable 10 attached thereto, there are alternative steps of activating the actuator 300, moving the routing unit 102 from the first position to the third position, securing the routing unit 102 to the connecting means, and detaching the power cable 10 from the hang off balcony 510.

Next, the actuator 300 is (re)activated. As shown in FIG. 9A and 9B, the routing unit 102 is thereby moved downwards relative to the supporting post 101 towards the second position. Simultaneously, or as separate steps, the hoisting

device 400 pulls the first end 12 of the power cable 10 through the routing unit 102, until the first end 12 emerges from an opening at the upper end of the routing unit 102. The locking means is activated to prevent further movement of the power cable 10 relative to the routing unit, and the hoisting device 400 is detached from routing unit 100. Finally, the routing unit is held in the second position, see for example FIG. 10, and the power cable 10 is electrically coupled to the offshore structure 100.

FIG. 11 is an example system wherein the routing unit 102, shown to be in the first position, is in the form of a bell mouth. The hang off balcony 510 may further operate as a working platform to allow a worker to conveniently access the routing unit 102 and the power cable 10. Since the routing unit 102 is movably attached to the offshore structure 100, the bell mouth can be raised for installation and connection of the power cable 10 and then subsequent lowered into the normal installed position when the offshore structure is normally operating or ready for operation.

The power cable 10 may be an electric power cable. However, this disclosure is not limited to only electric power cables. The power cable 10 may be any flexible connecting member used in subsea applications, for example a flexible pipeline, a tension cable, an attachment cable, a communication cable, and/or a chain.

The arrangement of the present invention provides numerous advantages over known prior art. A problem with past arrangements is that they require the use of wet mate connectors because the power cables engage with the lower end of the routing units proximate to sea level, thus there is a need for connectors that can operate in underwater conditions. However, wet-mate connectors are relatively expensive in comparison to dry-mate connectors. The present invention provides a means to perform a dry mate connection at a position substantially spaced and vertically above sea level. This is particularly advantageous because dry mating is relatively inexpensive compared to wet mate connections. Furthermore, there is a greater selection of dry mate connectors to choose from, whereas the options when selecting wet mate connectors are more limited. The system and method for transferring the first end 12 of the power cable 10 described herein, as well as the system and method for connecting the power cable 10 to the offshore structure 100 described herein, allow for the transfer and connection to be done completely above the sea level, and in addition allow for the transfer and connection to be done in shallow waters without damaging the power cable on the sea bed.

It will be apparent to those skilled in the art that various modifications and variations can be made to the system and method described herein. Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the disclosed system and method. It is intended that the specification and examples be considered as exemplary only, with a true scope being indicated by the following claims and their equivalents.

Claims

1. A system comprising:

a floating vessel (520);

an offshore structure (100) positioned in the vicinity of the vessel (520);

a transfer apparatus (500) comprising a zip line arrangement comprising a zip line (540) extending between a first connection (501) positioned on the offshore structure (100), to a second connection (502) positioned on the floating vessel (520);

wherein a cable mounting device (550) is positioned on the zip line (540) and configured to receive a first end (12) of a power cable (10); and

wherein the cable mounting device (550) is moveable along the zip line (540) for the transfer, above sea level (40), of the first end (12) of the power cable (10) between the floating vessel (520) and the offshore structure (100).

2. The system according to claim 1, wherein the first connection (501) comprises a driving arrangement (115) configured to move the first connection (501) along a vertical length of the offshore structure (100).

3. The system according to any one of the preceding claims, wherein the cable mounting device (550) further comprises an adjustable connecting portion (555) configured to be raised or lowered relative to the cable mounting the device (550), and further configured to receive the first end (12) of the power cable (10).

4. The system according to any one of the preceding claims, wherein the zipline arrangement comprises a cable drive unit (515) arranged on the cable mounting device (550) and configured to move the cable mounting device (550) along the zip line (540); and/or wherein the zip line arrangement further comprises a zip line drive unit arranged on the zip line (540) and configured to pull the zip line (540) relative to the offshore structure (100).

5. The system according to any one of the preceding claims, wherein the zip line arrangement further comprises a secondary line extending between the first connection (501) and second connection (502), wherein the cable mounting device (550) is attached to the zip line (540) and the secondary line, and wherein either the

zip line (540) or the secondary line comprises a winch configured to pull the cable mounting device (550) along the zip line (540) and the secondary line.

6. The system according to any one of the preceding claims, wherein the offshore structure (100) comprises a hang off balcony (510) arranged in the vicinity of the first connection (501); and wherein the first end (12) of the power cable (10) is attachable to the hang off balcony (510) such that the hang off balcony (510) is structured to transfer load of the power cable (10) from the cable mounting device (550) to the offshore structure (100).

7. The system according to any one of the preceding claims, wherein the offshore structure (100) comprises:

a routing unit (102) connectable to the power cable (10) such that the power cable (10) is in a position to be electrically connected to the offshore structure (100); and

an actuator (300) adapted to selectively move the routing unit (102) relative to the offshore structure (100) between: a first position in which the routing unit (102) is completely above sea level (40), where a relative lower end of the routing unit (102) is accessible from the offshore structure (100); and a second position, relatively lower than the first position, in which the lower end of the routing unit (102) is in a normal installed position relative the offshore structure (100).

8. The system according to claim 7, wherein the system further comprises a hoisting device (400) arranged on the offshore structure (100), the hoisting device (400) having a pulling element attachable to the first end (12) of the power cable (10) and configured to pull the power cable (10) through the routing unit (102).

9. The system according to any one of the proceeding claims 7 or 8, wherein the routing unit (102) is selected from a group consisting of: an I-Tube, a J-Tube, a telescopic tube, a short tube element, a bell mouth, and a connector unit.

10. The system according to any one of the preceding claims, wherein a bend stiffener (20) is attachable to the first end (12) of the power cable (10); and/or wherein the bend stiffener (20) is attachable to the routing unit (102).

11. The system according to any one of the preceding claims, wherein the offshore structure (100) is a floating offshore structure (100), and wherein the floating offshore structure comprises a wind turbine (30).

12. The system according to any one of claims 7 - 11, wherein the offshore structure (100) further comprises a supporting post (101);

wherein the routing unit (102) is movably attached to the supporting post (101); and

wherein the supporting post (101) and the routing unit 102 each extend parallel to one another in a direction substantially perpendicular to the sea level (40).

13. A method for transferring a first end (12) of a power cable (10) from a floating vessel (520) to an offshore structure (100) such that the first end (12) remains above sea level (40), the method comprising:

providing a system according to any one of the preceding claims;

providing the first end (12) of the power cable (10) at the vessel (520);

attaching the first end (12) of the power cable (10) to the cable mounting device (550); and

moving the first end (12) of the power cable (10) from the vessel (520) to the offshore structure (100).

14. The method according to claim 13, when providing a system according to claim 2, wherein the method further comprises the step of:

moving the first connection (501) along the vertical length of the offshore structure (100) prior to releasing the first end (12) from the cable mounting device (550).

15. The method according to claim any one of claims 13 - 14 when providing a system according to claim 6, further comprising the steps of:

attaching the first end (12) to the hang off balcony (510); and

releasing the first end (12) from the cable mounting device (550).

Intellectual Property Office

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| **Application No:** | GB2312045.4 | **Examiner:** | Mr Jorge Quintero |
| **Claims searched:** | 1-15 | **Date of search:** | 1 February 2024 |

## Patents Act 1977: Search Report under Section 17

**Documents considered to be relevant:**

| Category | Relevant to claims | Identity of document and passage or figure of particular relevance |
|---|---|---|
| A | - | WO 2021/104598 A1 (VESTAS OFFSHORE WIND AS) - See whole document. See also EP4065838. |
| A | - | US 2017/0327129 A1 (CYLVICK) - See Figure 20 and abstract |

Categories:

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC$^{X}$ :

Worldwide search of patent documents classified in the following areas of the IPC

B61B; F03D; H02G

The following online and other databases have been used in the preparation of this search report

SEARCH-PATENT

**International Classification:**

| Subclass | Subgroup | Valid From |
|---|---|---|
| H02G | 0001/00 | 01/01/2006 |
| B61B | 0007/00 | 01/01/2006 |
| F03D | 0080/80 | 01/01/2016 |
| H02G | 0007/00 | 01/01/2006 |
| H02G | 0011/00 | 01/01/2006 |