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The present invention relates to a capstan for handling cables, comprising a central hub provided with means of rotation about an axis D.

5 The invention is applied in the general field of cable handling, and more particularly, in the field of handling fragile cables like those used in marine seismology.

10 Marine seismology uses cables, called streamers, of great length which, in operational configuration, are submerged and towed by a ship. At rest, the streamers are stored on drums installed on the after deck of the ship. Technological development is presently tending to increase the length of the streamers and also their quantity, which raises a certain number of problems.

15 On the one hand, the increase in length of the streamers requires drums provided with larger cheeks, resulting in an increase of the volume occupied for the storage of each streamer, this volume having to be multiplied by the increasing quantity of streamers used simultaneously. This results in such congestion of the area of deck allocated to the putting of the streamers in the water that today it would be necessary to consider using larger ships, with the disadvantage of a higher cost of prospecting programmes.

25 On the other hand, in the storage position the first layers of wound cables are subject to large permanent stresses which are due to the winding tension of the cable, to the pressure applied by the succession of layers of turns, to the high curvature related to the diameter of the body of the drum and, finally, to the elements for joining lengths of streamer. These joining elements, of larger diameter, generate additional localised stresses which are harmful to the components of the streamer cables, and this effect becomes greater as technology in the marine seismology field develops in the direction of better performance, but also in the direction of greater fragility of the internal elements of the streamers.

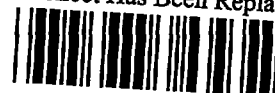
An ideal solution would consist in storing the

cables inside the ship, on drums, in wells or loose, in optimum conditions, that is to say with neither stresses nor excessive curvatures. A means of handling still has to be designed allowing the cable to be brought from its operational configuration into its storage configuration and vice versa.

Thus, the technical problem to be solved by the subject of the present invention is to produce a capstan for handling cables, according to the preamble, which, with a reduced overall size, would be adapted to the handling of new technology cables, without introducing stresses or curvatures which are incompatible with the fragility of the components used.

A solution to the technical problem presented, consists, according to the present invention, in that the said capstan comprises, at the periphery of the said central hub, a plurality of centring modules each comprising a conveyor belt disposed between two parallel cylinders, the assembly of conveyor belts forming a drum for the said capstan and the said drum having a winding zone intended to receive the turns of cables, and in that one of the cylinders of each centring module, called the drive cylinder, is coupled to a drive motor provided for displacing the said conveyor belt in each direction parallel to the axis D of rotation of the central hub, and in that a device for checking the position of the cables during the winding controls, in a synchronous manner, the said drive motors in order to displace the conveyor belts of the centring modules in order to maintain, by the centring effect, the said turns in the winding zone of the said capstan drum.

Thus, the function of this capstan being solely to draw cables for storage at the end of operation, or on the contrary to bring the cables from storage into operational configuration, the winding zone, limited to a small number of turns, typically 3 or 4, can be of very small size, resulting in a drum width and therefore a capstan width much smaller than that of the currently used drums, which allows the envisaging of the



installation on the ship's deck of a plurality of capstans according to the invention for multicable marine seismology applications for example.

Furthermore, since the capstan of the invention comprises no cheeks, it is possible to increase the diameter of the drum in order to limit the stress on the constituent elements of the cables. Similarly, the stress on the cables is low as it is applied only during the passage over the drum in the course of winding, the storage phase being carried out subsequently with a stress reduced to that of keeping the strand taught.

It will also be noted that the presence of elements for joining lengths of cable has no effect on the functioning on the capstan of the invention. Similarly, no adjustment is necessary in order to use cables of different diameters.

The control of the drive motors by the device for checking the position of the cable in the course of winding allows the turns to be kept on the drum in the winding zone, generally the central section of the conveyor belts, despite the screw pitch phenomenon generated by the winding. This position correction being carried out synchronously, no particular stress is applied to the cables during the centring.

The following description with reference to the appended drawings given by way of non-limitative examples will give a good understanding of what the invention comprises and of how it can be embodied.

Figure 1 is a perspective view of a capstan according to the invention.

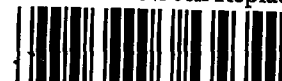
Figure 2 is a side view of a centring module of the capstan of Figure 1.

Figure 3 is a cross-section of the conveyor belt of the centring module of Figure 2.

Figure 4 is a side view of a cylinder of the centring module of Figure 2.

Figure 5 is a side view of a capstan according to the invention provided with a pivoting means.

Figure 6 is a plan view of the after deck of a



ship on which the capstan of Figure 5 is installed.

Figure 7 is a similar view to that of Figure 6 in which the capstan is coupled to a storage winch.

5 Figure 8 is a side view of a capstan according to the invention provided with a pressure wheel.

10 Figure 1 shows a perspective view of a capstan 10 for handling a cable 100, comprising a central hub 200 provided with means of rotation about an axis D constituted by a hydraulic motor 210, for example a cam motor,
15 mounted directly without reduction gear on the shaft 220 of the said central hub 200. This technique allows the application to the cable 100 of the minimum force necessary for its handling in the winding configuration. Furthermore, the hydraulic motor 210 is provided with
20 safety valves adjusted to the maximum torque permissible for the cable 100. In the case of a snagging of the cable, the capstan 10 is immobilised at the set torque and can even unwind in order to avoid any abnormal force on the cable. The speed of the capstan is independent of
the load, even in the course of unwinding at reduced torque.

As shown in Figure 1, the capstan 10 comprises, at the periphery of the central hub 200, a plurality of centring modules 300 and a side view of one of these
25 centring modules is given in Figure 2. Each centring module comprises a conveyor belt 310 disposed between two parallel cylinders 321 and 322. As can be seen in Figure 1, the assembly of conveyor belts 310 forms a drum for the capstan 10. This drum is intended to receive in a
30 winding zone Z a limited number of turns 110 of the cable 100, 4 in the case of Figure 1, this number not being imperative. The said winding zone Z will generally, but not exclusively, be located about the median plane of the drum, that is to say in a central zone of the conveyor
35 belts 310.

In order to counteract the spiral effect generated by the winding or the unwinding of the cable 100 on the drum of the capstan 10, and therefore in order to keep the turns 110 of the cable in the winding zone Z,



one 321 of the cylinders of each centring module 300, called the drive cylinder, is coupled to a drive motor 330 shown in Figure 1. This drive motor 330 can be a hydraulic motor capable of displacing the conveyor belts parallel to the axis D of rotation of the central hub in both directions as required.

Furthermore, a device 410, 420 for checking the position of the cable 100 in the course of winding controls, in a synchronous manner, the said drive motors 330 in order to displace the conveyor belts 310 of the centring modules 300 in order to maintain, by the centring effect, the turns 110 in the winding zone Z of the drum of the capstan 10. This centring is carried out in a way which is independent of the direction of rotation of the capstan (winding or unwinding).

As shown in Figure 1, the said position checking device comprises a feeler 410 which controls a unit 420 for the synchronous supply of the drive motors 330 when the cable 100 laterally overshoots a predetermined mean position. The direction of supply of the motors 330 depends on the winding or unwinding function with respect to the theoretical winding zone (central zone) of the drum of the capstan.

It is obvious that the sought centring effect will only be obtained if the speed of the drive motors of the belts 310 is sufficient with respect to the speed of rotation of the central hub 200.

The speed of displacement of the conveyor belts is independent of the speed of rotation of the capstan. It is a function of the angular position of the checking device 410-420. The control, proportional to the angle, allows the obtaining of a very flexible variation of correction with a speed which tends to zero towards the ideal winding position. This technique allows a fast correction of the position in the case of a transient off-centring phenomenon.

It is also necessary to emphasise that the position checking device described with reference to Figure 1 makes the functioning independent of the



diameter of the cable 100 to be wound and of localized variations of shape along its length due, for example, to connecting elements. Finally, the large diameter of the drum of the capstan 10 has the advantage of resulting in a very reduced speed of displacement of the belts 310.

As can be seen in Figures 2 and 3, each conveyor belt 310, comprises, for example, 4 notched belts 311 separated by trapezoidal guidance cross pieces 312. The belts 311 and the cross pieces 312, made in particular from polyurethane, are covered with a flexible elastomer 313 having a high coefficient of adhesion in order to allow winding without risk of damage to the fragile elements of the cable and to prevent the sliding of the cable during the winding.

According to Figure 3, the elastomer coating 313 has a profile which is slightly curved in the convex direction in order to reconstitute the diameter of the drum of the capstan to be formed.

Figures 2 and 4 show that the notched belts 311 work in conjunction with the longitudinal teeth 330 formed on the said cylinders 321, 322, to ensure the longitudinal driving of the belt 310 according to the conventional belt principle. Furthermore, the guidance cross pieces 312 work in conjunction with annular grooves 340 formed in the cylinders in order to allow the longitudinal guidance of the conveyor belt 310 and to resist the transverse sliding of the belt caused by the starting acceleration due to the formation of the first turn.

For the purpose of withstanding the load applied by the cable on the conveyor belts, each centring module 300 comprises a fixed reinforcing plate 350 over which the conveyor belt 310 slides, as shown in Figures 2 and 3. This reinforcing plate 350 can be a polished metal plate.

The hydraulic motor 210 for rotating the capstan comprises, preferably, a counterpressure valve in the motor circuit in order to allow, in the winding or unwinding configuration, control of the inertia of the drum and to maintain, by forced unwinding on the motor,



the tension of the cable during stocking or unstocking.

Furthermore, the hydraulic motor 210 is equipped with a cylinder selection unit which allows a double function of the motor:

- 5 - maximum speed at reduced torque
- reduced speed at high torque.

This feature allows, for example, a reduction of the time for putting seismic streamers in the water depending on the sea conditions by increasing the speed of the ship.
10 For this function, the hydraulic motor 210 for rotating the capstan is coupled in small cylinder mode and therefore with maximum speed and reduced torque.

When the ship on which the capstan according to the invention is installed is subjected to a side wind and/or to a surface current, the direction of the winding or unwinding of the cable makes a non-zero and essentially variable angle with the axis of the said ship. That is why provision is made, as shown in Figures 5 and 6, for the capstan 10 to furthermore comprise a means 500 of pivoting about a direction Δ orthogonal to the axis D of rotation. In the embodiment shown in Figure 5, the means 500 of pivoting is formed by a stirrup fixed to the capstan 10 and connected at its ends to fixed points by pivoting bearings 510, 520. In Figure 5 it can also be
20 seen that the axis Δ of pivoting passes through the point T of tangency, during winding, of the outgoing strand of the cable 100.
25

The capstan of the invention thus rendered steerable can follow angular variations in the order of
30 10 to 20°, which has the advantageous effect of limiting the transverse forces on the centring modules resulting from a difference between the actual direction of the cable and the nominal direction of unwinding/winding of the capstan.

35 It is obvious that during the winding or unwinding operation, the tension of the cable 100 on the capstan 10 can be sufficient to prevent the capstan from pivoting about the axis Δ due to the effect of roll for example. On the other hand, at the end of winding or at



the start of unwinding, the length of submerged cable being short, the tension on the capstan is less such that the latter becomes more sensitive to roll and can therefore pivot freely with the danger that this represents for the crew responsible for handling the capstan. Thus, the invention provides that the said means 500 of pivoting should be fitted with means of limitation of the amplitude of pivoting, provided for example by a hydraulic feedback brake. Integral with the means 500 of pivoting, a mechanical assembly incorporating the checking device 410-420 is provided at one end with a guiding means 800 of the cable when drawn on board. Said guiding means 800 is further provided with sensors included in a correction loop of the angular position of the assembly relative to the position of the cable in water.

As shown in Figure 7, the capstan according to Figures 5 and 6 can be coupled to a winch 600 for storing the cable 100 on which the said cable is wound with a fixed and constant tension. For this purpose the capstan 10 comprises means of lateral displacement of the means 500 of pivoting parallel to the storage winch 600. These means are constituted by guidance paths 530 in which the pivoting bearings 510, 520 can slide due to the action of a synchronous hydraulic motor.

Finally, Figure 8 shows an embodiment of the capstan of the invention which is particularly advantageous in that it comprises a pressure wheel 700 pressing on the said capstan 10 substantially at the point T of tangency, during winding, of the outgoing strand of the cable 100, the linear speed of the said pressure wheel being at least equal to the linear speed of the capstan. This arrangement allows the cable to be held against the centring modules particularly at the end of winding and at the start of unwinding.





Claims

1. Capstan (10) for handling cables (100), comprising a central hub (200) provided with means of rotation about an axis D, characterised in that the said capstan (10) comprises, at the periphery of the said central hub (200), a plurality of centring modules (300) each comprising a conveyor belt (310) disposed between two parallel cylinders (321, 322), the assembly of conveyor belts (310) forming a drum for the said capstan and the said drum having a winding zone (Z) intended to receive the turns (110) of cables, and in that one (321) of the cylinders of each centring module (300), called the drive cylinder, is coupled to a drive motor (330) provided for displacing the said conveyor belt (310) in each direction parallel to the axis D of rotation of the central hub (200), and in that a device (410, 420) for checking the position of the cables during the winding controls, in a synchronous manner, the said drive motors (330) in order to displace the conveyor belts (310) of the centring modules (300) in order to maintain, by the centring effect, the said turns (110) in the winding zone (Z) of the said capstan (10) drum.

2. Capstan according to Claim 1, characterised in that each conveyor belt (310) comprises a plurality of notched belts (311) working in conjunction with longitudinal notches (330) produced on the said cylinders (321, 322), the said notched belts being separated by longitudinal guidance cross pieces (312) working in conjunction with annular grooves (340) produced in the cylinders (321, 322).

3. Capstan according to Claim 2, characterised in that the said notched belts (311) and the said cross pieces (312) are covered with an elastomer coating (313) with a high coefficient of adhesion.

4. Capstan according to Claim 3, characterised in that the said elastomer coating (313) has a convex profile.

5. Capstan according to any one of Claims 2 to 4, characterised in that each centring module (300)





comprises a fixed reinforcing plate (350) over which the conveyor belt (310) slides.

5 6. Capstan according to any one of Claims 1 to 5, characterised in that the said means of rotation comprise a hydraulic cam motor (210) mounted without reduction gear on the shaft (220) of the said central hub (200).

10 7. Capstan according to Claim 6, characterised in that the circuit of the said hydraulic motor (210) comprises a counterpressure valve intended to control the inertia of the capstan (10).

15 8. Capstan according to one of Claims 6 or 7, characterised in that the said hydraulic motor (210) is fitted with a cylinder selection unit allowing a double function: maximum speed at reduced torque and reduced speed at high torque.

9. Capstan according to any one of Claims 1 to 8, characterised in that it furthermore comprises a means (500) of pivoting about a direction A orthogonal to the axis D.

20 10. Capstan according to Claim 9, characterised in that the said direction A of pivoting passes substantially through the point T of tangency, during winding, of the outgoing strand of the cable (100).

25 11. Capstan according to one of Claims 9 or 10, characterised in that the said means (500) of pivoting is fitted with means of limitation of the amplitude of pivoting.

30 12. Capstan according to Claim 11, characterised in that the said means of limitation are constituted by a hydraulic feedback brake.

13. Capstan according to any one of Claims 9 to 12, characterised in that it comprises means (530) of lateral displacement of the means (500) of pivoting parallel to a storage winch (600).

35 14. Capstan according to any one of Claims 1 to 13, characterised in that it furthermore comprises a pressure wheel (700) pressing on the said capstan (10), the linear speed of the said pressure wheel (700) being at least equal to the linear speed of the capstan (10).





15. Capstan according to Claim 14, characterised in that the said pressure wheel (700) presses on the capstan (10) substantially at the point (T) of tangency, during winding, of the outgoing strand of the cable (100).

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