ABSTRACT OF THE DISCLOSURE

Extensible and retractable boom means comprising a trough-shaped steel strip.

The present invention relates to an extensible jib, mast or the like comprising a fixed member and a member which may be retracted and run out axially inside said member.

Known devices of this kind have consisted of telescopic tubes or the like which could be displaced relative each other by means of hydraulic cylinders. These devices are of course quite heavy and their extension length is limited to the piston rod stroke. The telescopic tubes furthermore require machining to close tolerances and, consequently, said devices entail high production costs. Said hydraulic devices also require a great amount of maintenance which is time consuming as well as expensive.

The present invention has for its purpose to overcome all above mentioned drawbacks. The invention is characterized in that the fixed member is constituted by a housing in which one or more strips, for instance of steel, constituting the retractable and extensible member of the device are displaceably arranged, which strip or strips can be reeled on or unreeled from a winch drum or drums, one for each strip, arranged in the housing. Said housing suitably comprises means for trough-shaping i.e. putting up the sides of each strip to form a trough so as to increase the rigidity of the strip or strips.

It is known in prior art that a trough-shaped steel strip has a certain rigidity against bending in the direction towards the ridge of the trough while it can easily be coiled by being bent in the opposite direction. The present invention is based upon said property of trough-shaped steel strips.

The present invention provides an entirely new working member in the field of machine engineering. A device, the extensible member of which is constituted by such a trough-shaped steel strip—which in retracted position is reeled on a drum and thus requires very little space and which in extended position forms a rigid, protected member—provides the solution to many engineering problems.

The device of the invention can for instance be used as a combined pulling device and hoisting crane and may, as such, be used for loading timber in the forest for instance. Hilberto used hoisting devices are limited to a radius of action of about 4 m. For greater distances two operators at least are required, one of them pulling out a wire rope which is fastened by hand to the log while the other one operates the hoisting machinery. A log hoist or timber crane provided with a device of the invention in which a single or a pair of levers or the like is secured to the free end of the strip makes it possible to wind and load timber stocks in one operation up to a distance from about 20 m. from the crane. This can be carried out by a single operator which does not have to leave the controls of the crane.

The device of the invention may in its various embodiments be used when a rope is to be carried over an obstacle, as for instance when mooring a ship to a pier or in rescue operations, for bridging over a natural obstacle, as auxiliary appliance in bridge building etc.

Another possible field of application is provided by the iron and steel industry where a device of the invention may be used for opening and closing the tap hole of blast furnaces and in general for operating a member at a certain distance in order to avoid bodily injuries due to heat radiation or any other kind of radiations, as in nuclear plants for instance.

A further embodiment of the device of the present invention may be used as an extensible mast in various fields of applications, i.e. in military operations as radio antenna or for carrying radar antennas, emergency air fields lights and the like which have to be quickly lowered in order to escape discovery.

The invention will be described more in detail in connection with two preferred embodiments, references being made to the accompanying drawings, in which:

FIG. 1 is a perspective, partly cut-away view of a timber crane mounted on the platform of a truck and provided with the device of the invention.

FIG. 2 is a cross-section through the trough-shaped steel strip in FIG. 1, the section a being taken along the line I—I, b along the line II—II and c along the line III—III in FIG. 1.

FIG. 3 is a detailed view, partly in section, of the device in FIG. 1 and shows the set-up of the trough-shaping rolls on both sides of the strip.

FIG. 4 is a detailed view, partly in section, of the FIG. 1 and shows a transverse brace arranged on the trough-shaped steel strip.

FIG. 5 is a schematic top plan view of the timber crane in FIG. 1 set up for timber loading.

FIG. 6 is a perspective view of a slightly modified embodiment of the device in FIG. 1 used for rescue operations.

FIG. 7 is a schematic, partly cut-away view in perspective of the device according to the invention set up as an extensible mast.

FIG. 8 is a side view of the mast shown in FIG. 7 partly extended and FIG. 9 is a detailed view, partly in section, of the mast in FIG. 7 showing a transverse brace arranged on two opposite trough-shaped steel strips.

In FIG. 1, reference 1 designates a tubular post arranged on a truck platform 2 behind the driving cab so that it can be swung around the centre axis. On top of the post a bearing bracket 4 is arranged, carrying a bearing arrangement, known per se, with a horizontal swinging axle on which a jib 5 is-journalled. Inside the post 1 is arranged a hydraulic ram (not shown) the piston rod 7 of which can slide in a bushing 8 on top of the post 1. The upper end of the piston rod 7 is-journalled in a manner known per se (not shown) in the jib 5, the swinging axle being horizontal. The jib 5 swings upwards when the piston rod 7 is run out of the hydraulic cylinder (not shown) and swung downwards when the piston rod 7 again is retracted into the cylinder, so that the position of the piston rod 7 relative the post top bushing 8 determines the angle formed between the longitudinal axis of the jib 5 and the horizontal plane.

The jib 5 essentially consists of two rigid side members 9, 10, spaced from each other and connected by means of cross pieces 11, 12 so as to form a housing-like box structure. The cross piece 12 is shaped so as to constitute a hollow nose piece of the jib 5. A drum 13 provided with flanges 14, 15 is journalled in the jib 5 between the side members 9, 10. The drum 13 can be rotated both clockwise and counter-clockwise by driving means 16 known per se. A steel strip 17 of self-troughing type is fastened to the drum barrel, the width of
said strip in flat condition being equal to the distance between the side flanges 14, 15. The steel strip 17 is partly reeled around the drum barrel 13 and extends partly axially inside the jib 5 in its longitudinal direction so that the free end of the steel strip 17 runs out through the nose piece 12 of the jib 5. Several pairs of rolls are provided inside the jib 5, each pair comprising an upper roll 18, 20, 22 and a lower roll 19, 21, 23. All roll axes are journaled in the side members 9, 10 of the jib 5 and parallel relative the axle of the drum 13. The rolls are further arranged so that the upper rolls 18, 20, 22 lie against the upper side of the strip 17 while the lower rolls 19, 21, 23 lie against the underside of the strip. The upper rolls 18, 20, 22 have a convex axial profile and the respective lower rolls 19, 21, 23 have a corresponding concave profile. As can be seen in FIG. 3 the trough radius of the strip 17 is determined at each pair of rolls by the profile of the rolls. The rolls are further arranged in such a way that the trough radius of the steel strip 17 determined by the respective pairs of rolls decreases gradually in the direction from the drum 13 to the nose piece 12 of the jib 5. FIG. 2 shows three different sections through the strip 17, namely a at the roll pair 18, 19, b at the roll pair 20, 21 and c at the roll pair 22, 23.

The free end of the strip 17 is provided with a nose piece 24 carrying a pair of lifting tongs 25 known per se. Said nose piece 24 is shaped in such a way that it can be partly engaged into the nose piece 12 of the jib 5 when the strip 17 is being retracted into the jib 5.

As already mentioned, the steel strip derives its rigidity from its trough shape. It is also important that the strip 18 remains trough-shaped all the way from the last pair of rolls 22, 23 to the nose piece 24. This is achieved by prestressing the strip 17 during manufacture so that it becomes self-toughening. Said self-toughening property can furthermore be sustained by transverse braces 26a slidingly arranged on the strip 17 and fixed in spaced relationship to each other by a rope 27 which is fastened to the nose piece 24. FIG. 4 shows how a transverse brace 26 surrounds the strip 17, whereby the strip is kept trough-shaped. Each end of the transverse brace 26 is fastened to the rope 27 by means of a screw 28 but other fastening devices can of course be provided.

The strip 17 is axially guided inside the jib 5 by means of guiding rolls (not shown) provided in pairs on both sides of the strip 17 so that their axes are parallel with the plane of symmetry of the strip 17 and perpendicular to the longitudinal axis of the strip 17.

Loading operations with a device of the invention is carried out as follows. Since the steel strip 17 is fastened to the drum barrel 13 and partly reeled around said barrel, said steel strip 17 will be unreeled when the drum 13 is rotated in one direction and reeled when the drum is rotated in the opposite direction. Inside the jib 5 the strip 17 is axially guided by the pairs of rolls 18, 19, 20, 21 and 22, 23, the strip being trough-shaped so that its trough radius decreases gradually towards the last pair of rolls 22, 23. Due to this trough shape the strip will have a certain rigidity which is sufficient to prevent the strip from being bent downwards under the action of its own weight and the weight of the lifting tongs 25. When the strip 17 is retracted in the jib 5 so that the nose piece 24 engages the nose piece 12 of the jib 5, the transverse braces 26a will be stacked against each other (not shown) inside the nose piece 12 of the jib 5. When the strip 17 is reeled out, the rope fastened to the nose piece 24 will be successively taut between adjacent transverse braces 26 so that said braces will follow the strip 17 in a spaced relationship determined by the length of the pair 18, 19 and 20, 21. The pair of lifting tongs 25 is raised or lowered by vertically actuating the jib 5 with the trough-shaped steel strip by means of the hydraulic piston rod 7. The lateral movements of the lifting tongs 25 are obtained by rotating the post 1 around its axis while the movement of the tongs 25 and from the truck platform is obtained by rotating the drum 13 in one or the other direction by means of the driving mechanism 16 so that the trough-shaped steel strip is run out of the jib 5 or retracted into it.

The loading and unloading operations are illustrated in FIG. 5. The crane jib 5 is directed towards the timber log to be loaded. The pair of lifting tongs 25 is run out to said log and lowered until the tongs are gripping the log. The pair of tongs 25 and the log are thereafter hauled in towards the jib 5 by reeling in the steel strip 17 until the nose piece 24 of the strip 17 engages the nose piece 12 of the jib. The steel strip 17 is thus relieved from vertical downward forces, the weight of the timber log being transmitted over the tongs 25 and the nose piece 24 to the nose piece 12 of the jib 5. The log is thereafter hoisted on the trailer 19, the jib 5 with the nose piece 24 partly engaged in the jib nose piece 12 and carrying the pair of tongs 25 being used for the loading in a conventional manner. In the embodiment shown on the drawing the crane post may swing 360° and when the vehicle is stationary the loading of the logs can be carried out in a circular zone indicated by a chain-dotted line in FIG. 5.

From the above description it is apparent that a timber crane provided with the device of the invention can be used in places where it hitherto was necessary to use both a prior art hoisting crane and a winch required for hauling the logs within the radius of action of a conventional crane jib. With the device of the invention the loading operation can furthermore be carried by a single operator.

According to another one of its embodiments, the device of the invention can be efficiently used for rescue operations or the like. The embodiment shown in FIG. 6 is similar to the one shown in FIG. 1 with the difference that the strip nose piece 24 is provided with a hook 30 and a sheave block 31. Another sheave block 32 is arranged on the crane post 1. The wire 33 is co-operating in a manner known per se with a sheave block 31 and 32 for hoisting and lowering a rescue harness 34. In the embodiment shown in FIG. 6 the hook 30 is hooked on a window ledge or the like so as to permit rescuing from the subjacent floors.

FIG. 7 shows a further embodiment of the device of the invention in form of an extensible mast. A housing 35 which constitutes the lower part of the mast is provided with two drums 13a, 13b, shown schematically in the drawing, arranged in parallel relationship to each other at the bottom of the housing 25. Two trough-shaped steel strips 17a, 17b are partly reeled around the drums 13a, 13b, respectively, in the same way as described for the strip 17 on the drum 13 in connection with FIG. 1. The housing is furthermore provided with several pairs of rolls for each strip, namely 18a, 19a, 20a, 21a and 22a, 23a for the strip 17a and similar (not shown) pairs of rolls for the strip 17b which roll pairs correspond to the roll pairs 18, 19, 20, 21 and 22, 23 in FIG. 1. The steel strips 17a, 17b are at their free end connected by means of a nose piece 24a. Both trough-shaped strips 17a, 17b are furthermore connected by means of transverse braces 26a slidably arranged on said strips which braces are spaced from each other on a wire 27a fastened to the nose piece 24a. The transverse braces 26a are arranged so as to determine the trough-shape of the strips 17a and 17b in the same way as described for the strip 17 and the transverse braces 26 in connection with FIGURES 1 and 4. The housing 35 rests on a base plate 36b and is articulated at joint 37. The housing 35 can be locked in relation to the base plate 36 by means of prior art locking devices 38, 39. The drums 13a, 13b are driven in opposite direction relative each other by means of a driving mechanism (not shown). To run out the mast the drums are rotated in the direction indicated by arrows in FIG. 7. The
strips 17a, 17b are thereby unreeled from the drums 13a, 13b at the same time as they are trough-shaped by the pairs of rolls 18a . . . 22a for the strip 17a and the corresponding (not shown) roll pairs for the strip 17b. For retracting the mast the drums 13a, 13b are rotated in the direction opposite to the one indicated by the arrows in FIG. 7.

Although the invention has been described in connection with embodiments shown on the drawing it is obvious that many alterations or modifications may be made within the scope of the appending claims.

What I claim is:

1. An extensible and retractable boom device comprising support means including a housing, powered drum means rotatably journaled in said housing for rotation in opposite directions, boom forming strip means secured to and reeled on said drum means, said strip means being inherently tensioned when free to curl transversely into a trough-shaped member having greater length than width, a plurality of pairs of trough-shaping rolls journaled in said housing along the path of said strip means during unreeeling, one roll of each of said pairs of rolls having a convex profile corresponding to a trough radius of the strip permitting the same in extended position to carry at least its own weight within the gravity field of the earth without deformation, the other roll of each of said pairs of rolls having a corresponding complementary concave profile, the trough radius determined by each of said pairs of rolls in the direction progressing away from said drum means along said path being smaller than the trough radius determined by the preceding pair of rolls, so as to progressively cause said strip means to assume a trough-shape when paid out and to assume a generally flat shape when found on said drum means.

2. An extensible and retractable boom device as set forth in claim 1 further comprising a rigid nose piece secured to the trough-shaped outermost end of said strip means.

3. An extensible and retractable boom device as set forth in claim 2 wherein said rigid nose piece is provided with gripping means.

4. An extensible and retractable boom device as set forth in claim 1 wherein said housing is pivotally mounted for vertical and rotary movement relative to said support means.

5. An extensible and retractable boom device as set forth in claim 1 further comprising transverse braces slidably mounted on said strip means for movement relative thereto, each of said transverse braces having aperture means for determining and maintaining the trough radius of the strip means after passage through said pairs of rolls and means connecting said transverse braces to each other to keep the braces spaced at predetermined distances from each other as said strip means is extended.

6. An extensible and retractable boom device as set forth in claim 1 wherein said boom device is comprised of two boom forming trough-shaped strips, powered drum means for each of said strips mounted in said housing and means for guiding and maintaining said strips parallel to each other with the concave surfaces of said strips being opposed to each other.

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