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(54) **Reinforced console column and the method of its production**

(57) The reinforced column (1) consists of a column section (2) with a hole bored through the column section (2), into which an anchor element (6) is mounted, and the ends of at least two prestressed guys (8) are anchored to the anchor elements (6) on each side of the column section, the guy (8) goes through the respective holes in the anchor element (6) and the other end of the prestressed guy (8) is firmly anchored in the anchor (10) in the foundation (5) and further at least one duct (12) is made in the console (3) vertically to the column axis (1) going through the console (3) and the adjacent part of the column strut, the prestressed clamping cable (13) or bar is arranged in the duct, both ends of which are provided with anchor sockets (15) mounted to the anchor plates (14). By the process of manufacture the guy (8) is anchored on both sides of the column section with one end in the foundation and with the other one in the anchor element (6) which is to be created in the upper part of the column section, subsequently the guy (8) is prestressed either parallel with the axis of the column section or angle-wise, and a duct will be made in the console, vertical to the column axis, going through the console and the adjacent part of the column strut, afterwards a clamping cable (s) (13) or bar is arranged in the duct (12) and subsequently prestressed and anchored on both ends.

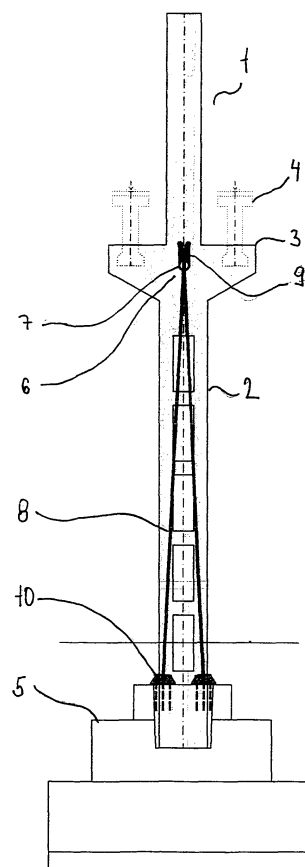


Fig.3

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DescriptionBackground of the Invention

[0001] The invention relates to the reinforcement of an existing armoured concrete console column with consoles by pre-stressing, which will enable manipulation with heavier products in old production halls than those for which the hall was originally designed, and the process of its reinforcement.

State of the Art

[0002] There are numerous production halls dating back to the sixties up to the nineties that were built as armoured concrete structures. A part of the structure was a crane runway made on armoured concrete beams with short armoured concrete consoles. The original crane runways were usually designed for 5-ton bridge cranes. However, recently the style of the production has notably changed. Demands for engineering production in particular require manufacturing ever bigger and more complete units that are shipped to customers as ready-to-use products. Thus the manufacturer has to deal with challenging requirements for manipulation, usually followed by a requirement for the installation of a bigger bridge crane with a higher load carrying capacity into the existing production hall. Current engineering plants thus call for cranes with a higher load carrying capacity, often requiring a load carrying capacity of 25 tons.

[0003] The problem may be dealt with by installing a new carrying system for a new crane runway into the existing hall structure. The new structure, which is usually made of steel, requires, besides heavy expenses, an intervention into the layout of the hall space itself. A new system of posts and separate footings will be added that must be embedded beside the existing modular system. The utility value of the hall space is thus reduced.

[0004] The stress analysis of the structural hall system usually demonstrates, in particular with terminal, less load carrying columns, where the strain is taken off the roof structure e.g. due to skylights, or if there is little transversal span between the columns, the insufficiency of the columns from the viewpoint of the strength limit state No. 1 (I.LS).

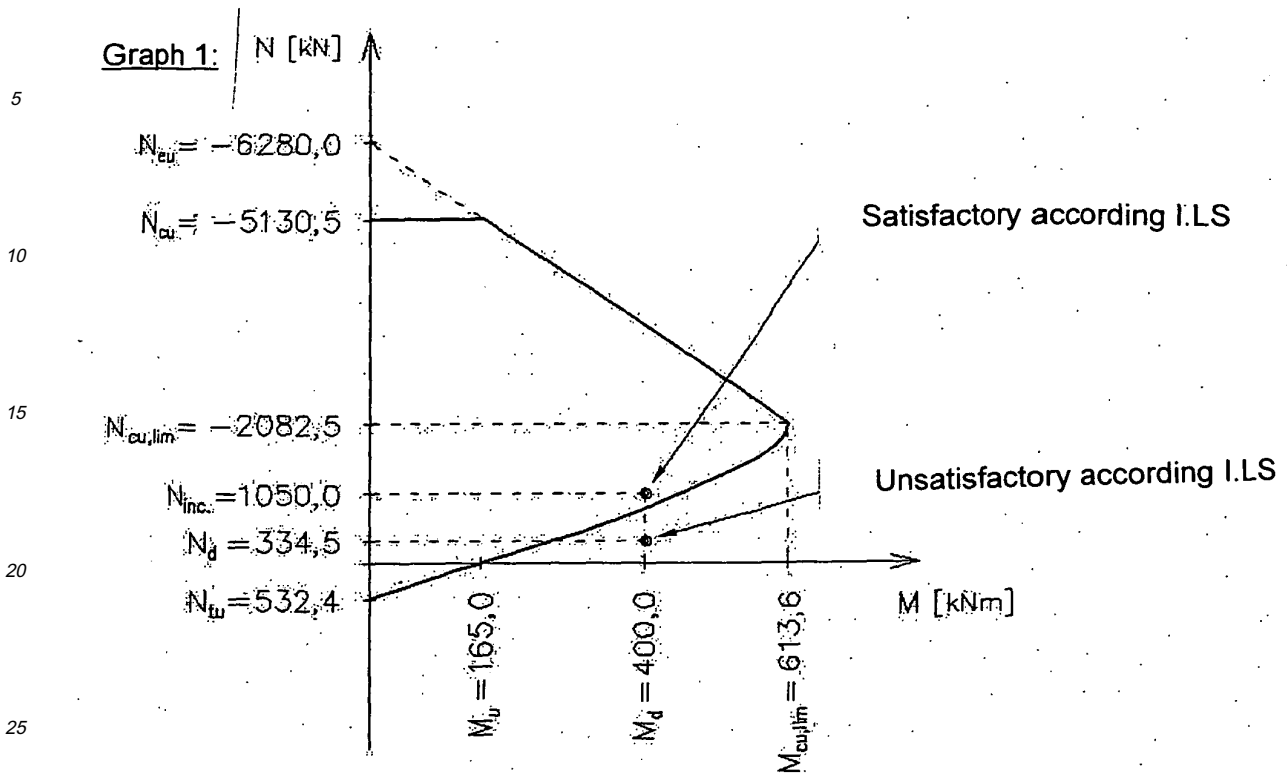
[0005] One commonly used possibility is to reinforce the armoured concrete column by bandaging it with steel mending plates forming a new external steel carrying system anchored into the existing columns. A problem arises concerning the divergent behaviour of steel and concrete, as well as concerning the high labour requirements. This option may also be complicated by spout pipes and media distribution systems for manufacturing and heating usually going along the columns.

[0006] These solutions are indeed very costly and require the stoppage of production and operations in the hall being reconstructed.

[0007] The aim of this invention is to present a solution ensuring enhanced load carrying capacity of the columns that would allow bridge cranes to be used with high load carrying capacity, while the manufacture of the invention will not limit operations in the production hall.

Feature of the Invention

[0008] The above-mentioned disadvantages are considerably eliminated by the use of a reinforced console column according to the invention, where a hole is bored through the column section, into which an anchor element is mounted, and the ends of at least two prestressed guys are anchored to the anchor elements on each side of the column section, the guy goes through the respective holes in the anchor element and the other end of the prestressed guy is firmly anchored in the anchor in the foundation and further at least one duct is made in the console vertically to the column axis going through the console and the adjacent part of the column strut, the prestressed clamping cable or bar is arranged in the duct, both ends of which are provided with anchor sockets mounted to the anchor plates. The fundamentals of the invention can be seen in the attached Graph 1 of the column load carrying capacity depending on the axial force (kN) and the bending moment (kN/m). The figures shown are just illustrative, but they in general correspond to normal conditions.



[0009] By introducing compression into the existing, low loaded but bent column, its load carrying capacity will be significantly enhanced. In such a case the foundation structure will not be exposed to an additional load.

[0010] In an advantageous embodiment, the anchor elements are created as anchor tubes and the prestressed guys are anchored in anchor sockets that fit to the outer surface of the tube from above and the guys go through them.

[0011] In another advantageous embodiment, the prestressed guy goes angle-wise.

[0012] In still another advantageous embodiment, the hole and the anchor section are arranged in the upper part of the column section in the area from where the consoles are projecting.

[0013] In another advantageous embodiment, the column is provided with four prestressed guys with two cables going along each side of the column element whose ends are anchored in the anchor tube from where the guys go crossways alongside the axis to the anchors in the foundation.

[0014] Another feature of the invention is the process of manufacture of the reinforced column where the guy is anchored on both sides of the column section with one end in the foundation and with the other one in the anchor element which is to be created in the upper part of the column section, subsequently the guy is prestressed either parallel with the axis of the column section or angle-wise, and a duct will be made in the console, vertical to the column axis, going through the console and the adjacent part of the column strut, afterwards a clamping cable (s) or bar is arranged in the duct and subsequently prestressed and anchored on both ends.

Description of the Drawings

[0015] The invention will be further explained using drawings, in which Fig. 1 is a side view of the reinforced column subject to the invention according to design no. 1 with two stay cables, Fig. 2 shows a front view of the same reinforced column, Fig. 3 shows a side view of the reinforced column subject to the invention according to design no. 2 with four stay cables, Fig. 4 shows a front view of the same reinforced column, Fig. 5 shows a schematic cross section of the reinforced console of the armoured concrete column subject to the invention with console on both sides for the crane runway, Fig. 6 shows a schematic cross section of the reinforced console of the armoured concrete column subject to the invention with a console for the crane runway on one side only, and Fig. 7 shows a partial cross section of an alternative design of the reinforced console.

Preferred Embodiments of the Invention

[0016] Figs. 1 and 2 show that the reinforced column 1 consists of an armoured concrete column section 2 equipped with a console 3, on which beams 4 of the crane runway are mounted. The column section 2 is embedded in the foundation 5. A hole is bored through the column section 2, into which an anchor element 6 is embedded. In an advantageous embodiment, it is made as an anchor tube 7. The ends of the prestressed guys 8 are anchored into the anchor elements 6 by pulling the guy through the respective holes in the anchoring tube 7, and in the downward direction the ends of the guys 8 are firmly fixed in the anchor sockets 9 that fit to the anchor tube 7. In this case the bearing surface of the anchor sockets 9 has such a shape to allow it to fit to the tube 7 perimeter shape-wise.

[0017] The other end of the prestressed guy 8 is firmly anchored in the anchor 10 in the foundation 5. In the embodiment shown, the prestressed guy 8 is arranged angle-wise, but this is not conditional. It may also be arranged vertically. The reason of the arrangement of the guys 8 on the column element 2 is the reinforcement of column 1 in the direction of its axis.

[0018] The hole with the anchor tube 7 is made in the upper part of the column section 2 taking advantage of the spot where the consoles 3 project from the section.

[0019] Figs. 3 and 4 show the embodiment of the reinforced column 1 provided with four prestressed guys 8. Afterwards the ends of both guys 8 are arranged in the anchor tube 7 on each side of the column section 2; from there the guys 8 go crossways to the anchors 10 in the foundation 5.

[0020] As it is evident in Figs. 1 and 3, two guys are used for columns with one console, while four guys 8 are used for columns with consoles on both sides. These columns are subject to greater stress and it is thus necessary to reinforce column 1 more.

[0021] Fig. 5 shows that consoles 3 for crane runways are projecting from the armoured concrete column 1 on both sides, on which beams 4 for bridge crane tracks will be mounted. Both consoles 3 are interconnected by pre-bored ducts 12, vertical to the column 1 axis. The prestressed clamping cables 13, or rather bars, go through these pre-bored ducts 12. They are anchored on each side in the anchor sockets 15 with nuts. There is an anchor plate 14 under the anchor sockets.

[0022] The upper prestressed clamping cable(s) 13 is led in the upper part of the consoles 3 where the lateral surface is vertical to the pre-bored duct 12. Thus the anchor plate 14 will easily fit to the side of the console 4. The lower prestressed clamping cable 13 is led in the bottom part where the bottom wall of the console 3 joins the strut angle-wise: A recess 11 is made around the duct 12 with its front parallel to the axis of the column 1. The anchor plate 14 will then easily lean against this front.

[0023] Fig. 6 shows the reinforced (e.g. terminal) console column 1 also consisting of a strut from which, however, a console 3 for beam 4 projects, on which the tracks for the bridge crane are mounted on one side only. The console 3 and the adjacent part of the strut are interconnected by pre-bored ducts 12, vertically to the axis of the column 1. Prestressed clamping cables 13 or rather bars are led through these pre-bored ducts 12. They are anchored on each side in the anchor sockets 15 with nuts. Under the anchor sockets there is the anchor plate 14. In the area of the lower prestressed clamping cable 13, a recess 11 is made in the oblique wall of the console 3.

[0024] Fig. 7 shows details of a solution in which the recess 11 referred to in the previous designs is not used for the lower post-tensioning cable, but a spacer 16 is inserted in between the anchor plate 14, which is oblique and lies on the unmodified oblique lateral wall of the console 3, and the socket 15 with a nut. The spacer corresponds on one side to the inclination of the oblique lateral wall of the console 3 and has a bearing surface for the anchor socket 14 on the other side parallel to the column axis. The concept of a reinforced console of a column is based on a surprising discovery that, in contrast to the theories acknowledged so far, it is not necessary to apply counter pressure in the same direction against the direction of the stress. The point is that the console 3 is subject to downward stress and that the anticipated deforming fracture would go from the lower footing of the console crossways to the upper surface where the beam for crane tracks is mounted. So far theory would induce to anchor the cable on the oblique side of the console and to anchor its other end somewhere higher to the column so that the cable goes vertically to the fracture, i.e. against the direction of stress. It is obvious that such anchorage would be very demanding as far as the anchoring element on the column is concerned; it would require double boring of the column for ducts 12 in the bilateral console.

[0025] There is lateral force applied against the direction of stress in the reinforced console column subject to the invention.

The Process of Reinforcement of Short consoles of Armoured Concrete Columns by Prestressing

[0026] The use of a non-typical steel device mounted to the armoured concrete column allows for boring with a standard drill, even in the oblique part of the column console. The minimum diameter of the borehole for one cable is 24 mm, being 40 mm for a cluster of cables. For a cluster of cables the borehole is widened to a minimum diameter of 80 mm at its end with a depth of 170 mm. The recess will allow for distributing the cables into the anchoring elements with permissible curvature. The directioning itself of the prestressed clamping cables 13 is achieved by beveling the bearing

surface for the anchors on the anchor bearing plate and directioning the cable entry.

[0027] Prestressing of each separate cable is carried out in 6 steps, starting at 0 kN and reaching the final value of 220 kN. The prestressing procedure is checked during each step in accordance with the stress-strain diagram of the prestressing jack where the value of the operating pressure of the jack corresponds to the prestress force introduced. The pressure is monitored with a pressure gauge. Individual steps of the whole prestressing procedure are entered into a control record where the value of elongation in mm is entered with the particular value of the operating pressure of the prestressing jack in MPa. After achieving the maximum value of the jacking force of 220 kN, the cable is re-tensioned twice with a 15-minute delay as a minimum. This shall eliminate the losses of prestress force due to relaxation of the prestressed reinforcement. The overall elongation of the cable, the anchorage of the opposite anchor and cable rectification may vary from 35 to 55 mm with commonly used consoles. Subsequently the cable is carefully anchored at the side where tensioning takes place.

[0028] Concrete compression from 50 $\mu\text{m/m}$ to 90 $\mu\text{m/m}$ is achieved by the above-mentioned method for standard types of consoles using three cables prestressed at 220 kN, depending on the particular value of the stress modulus of the column console concrete.

[0029] When using a cluster of cables, the widened area of the borehole is injected with a constant-volume sealing compound. A grout hole is made in the anchor plate for this purpose.

[0030] An analogical procedure will be used with other types of prestressing reinforcement taking into account its particular stress-strain diagram, the maximum value of prestress and the manner of anchorage.

Claims

1. Reinforced console column consisting of a column section and a console, **characterized in that** a hole is bored through the column section (2), into which an anchor element (6) is mounted, and the ends of at least two prestressed guys (8) are anchored to the anchor elements (6) on each side of the column section, the guy (8) goes through the respective holes in the anchor element (6) and the other end of the prestressed guy (8) is firmly anchored in the anchor (10) in the foundation (5) and further at least one duct (12) is made in the console (3) vertically to the column axis (1) going through the console (3) and the adjacent part of the column strut, the prestressed clamping cable (13) or bar is arranged in the duct, both ends of which are provided with anchor sockets (15) mounted to the anchor plates (14).
2. Reinforced console column according to claim 1 **characterized in that** the anchor elements (6) are created as anchor tubes (7) and the prestressed guys (8) are anchored in anchor sockets (9) that fit to the outer surface of the tube (7) from above and the guys (8) go through them.
3. Reinforced console column according to claim 1 **characterized in that** at least one cable (13) is arranged under the upper surface of the console (3) in the manner that the anchorage is made on the flat part of the lateral wall parallel to the column axis, and the other cable is arranged in the lower part of the console (3) and the anchorage is made on the oblique part of the lateral wall.
4. Reinforced console column according to claim 7 **characterized in that** the anchor plates (14) of the lower prestressed clamping cable (13) are placed on the oblique part of the lateral wall of the console (3), and a spacer (16) is inserted between the anchor plate (14) and the anchor socket, whose bearing surface towards the anchor plate (14) has an inclination corresponding to the inclination of the oblique part of the lateral wall of the console (3).
5. Reinforced console column according to claim 1 **characterized in that** a recess (17) is made in the console (3) under the anchor plate (14) for the distribution of the cluster of cables and subsequent constant-volume mortar injection.
6. The process of manufacture of the reinforced console column according to claims 1 to 9 **characterized in that** the guy is anchored on both sides of the column section with one end in the foundation and with the other one in the anchor element which is to be created in the upper part of the column section, subsequently the guy is prestressed either parallel with the axis of the column section or angle-wise, and a duct will be made in the console, vertical to the column axis, going through the console and the adjacent part of the column strut, afterwards a clamping cable (s) or bar is arranged in the duct and subsequently prestressed and anchored on both ends.
7. The process according to claim 6 **characterized in that** two guys are anchored on each side of the column section and both of them are anchored in the anchor element and are led to the anchors in the base angle-wise.

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8. The process of manufacture of the console column according to claim 7 **characterized in that** one the prestressed clamping cable is arranged under the upper surface of the console and the other cable in the lower part of the console on the oblique part of its lateral wall.

5 9. The process of manufacture of the console column according to claim 8 **characterized in that** a recess is made in the oblique part of the lateral wall of the console.

10 10. The process of manufacture of the console column according to claim 6 **characterized in that** the duct is widened at its periphery into a recess which, is filled with grout after prestressing of the clamping cable.

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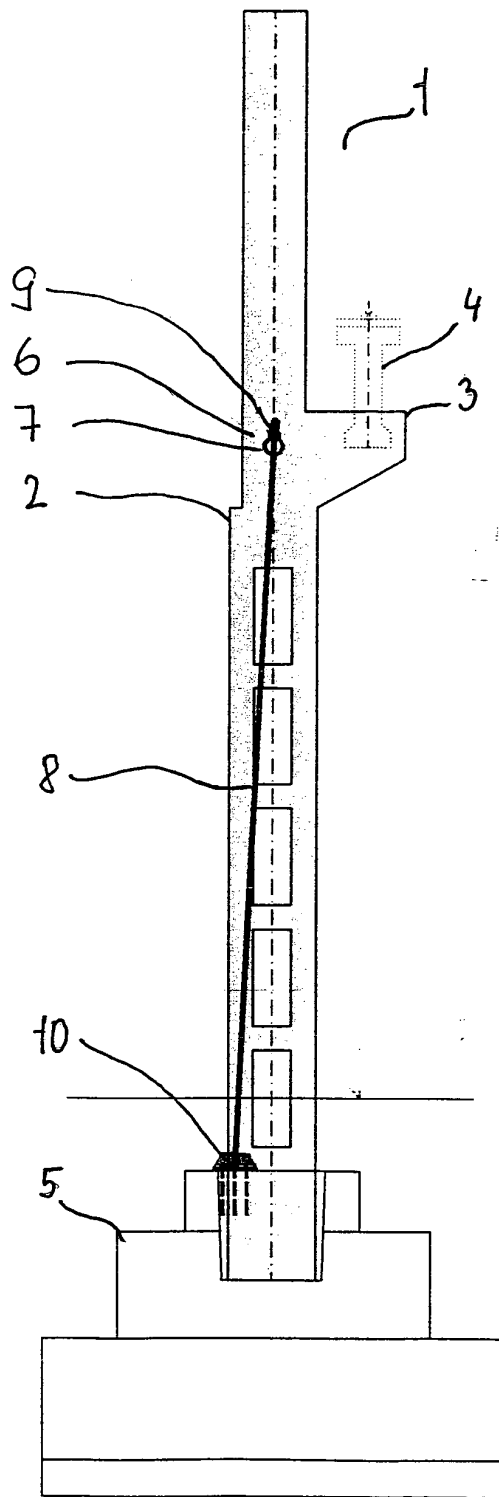


Fig.1

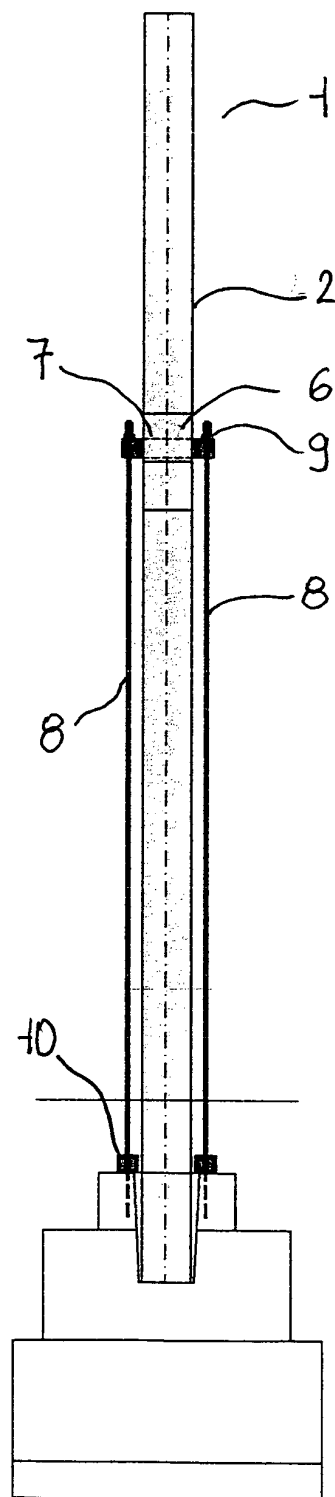


Fig.2

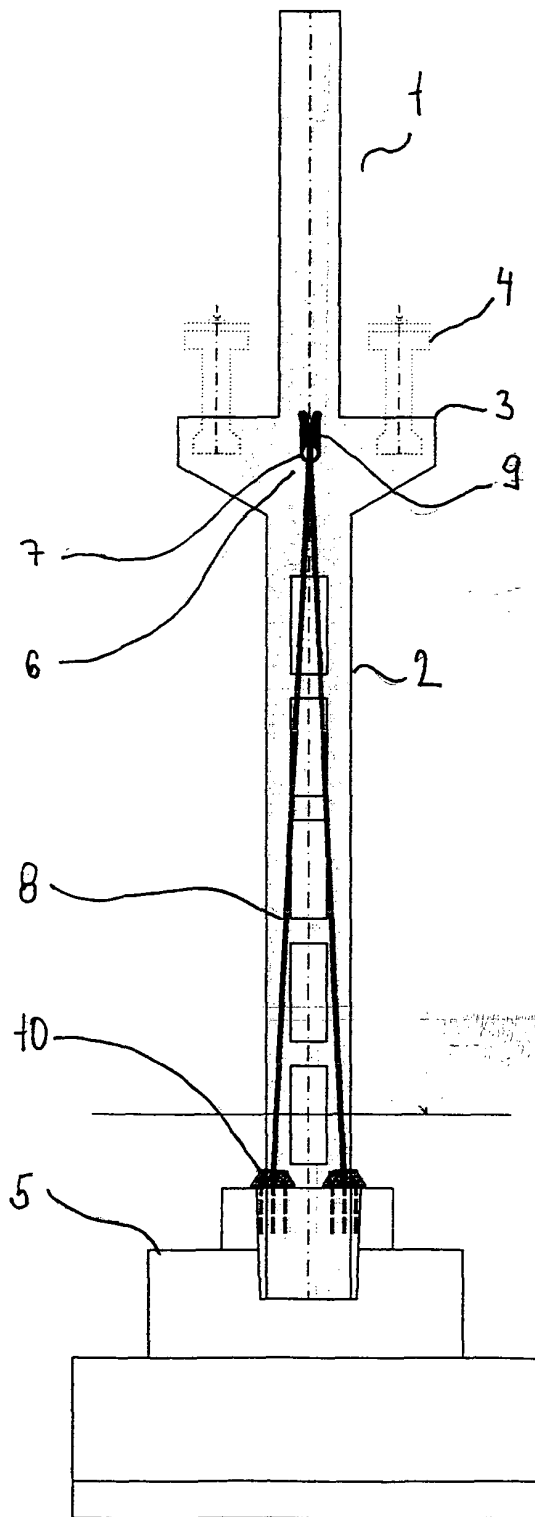


Fig. 3

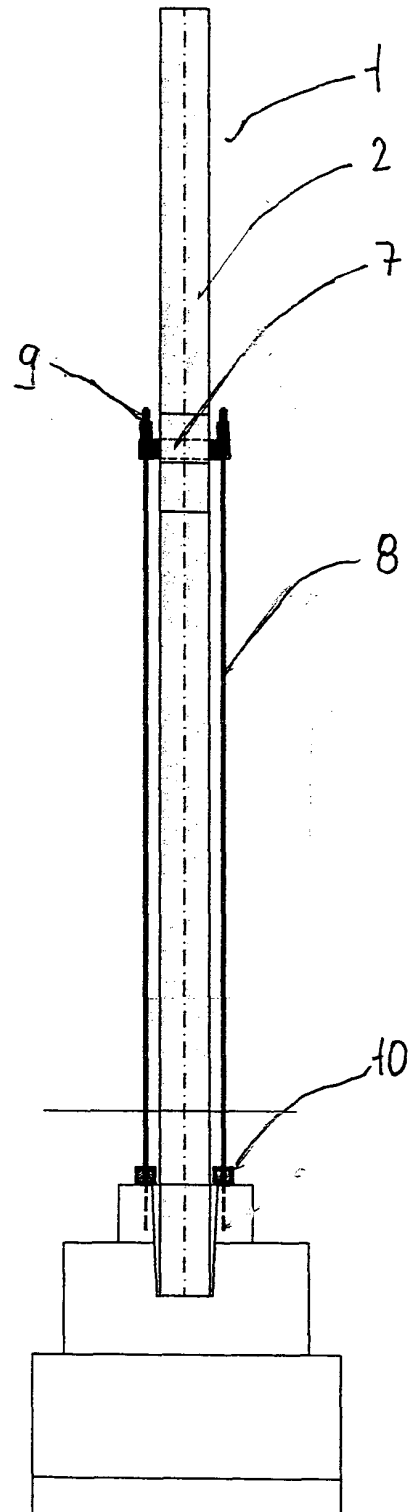


Fig. 4

