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(54) Rotary unit for bridges

(57) A rotary unit 10 is described for use with a rotatable horizontal construction such as e.g. swing bridge, whereby, in order to operate the horizontal construction, e.g. in order to open the bridge, a horizontal construction section is first lifted and then rotated. The rotary unit 10 comprises a plurality of lifting means 1 for lifting a means for rotating 14 to which the horizontal construction section is connected. The means for rotating 14 preferably also is driven by a number of driving means. The rotary unit 10 is especially useful in swing bridges used for railway applications, as it allows to provide a smooth transition between tracks on the shore side and tracks on the bridge section. Swing bridges based on such a rotary unit 10 furthermore provide a high degree of reliability of operation. A method for operating such a horizontal construction, e.g. a bridge, also is described.

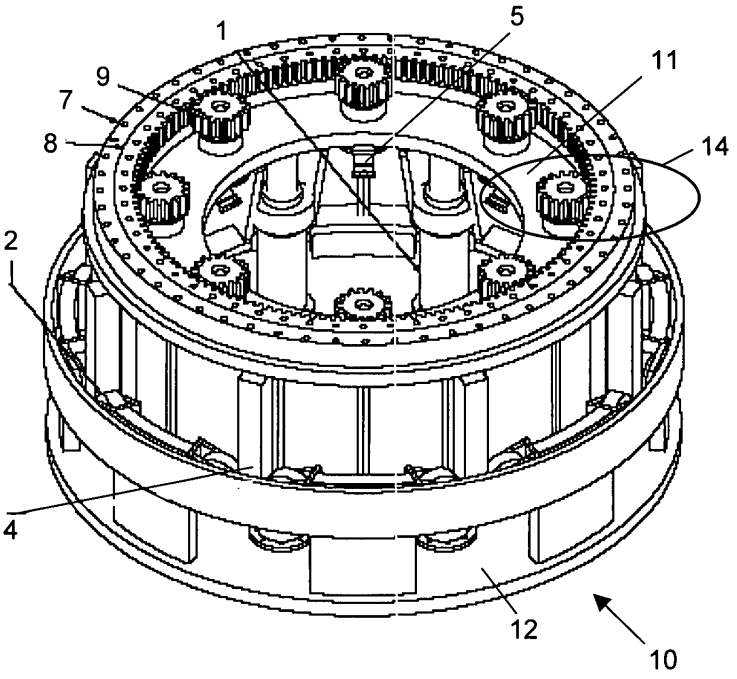

Fig. 7

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Description

Technical field of the invention

[0001] The present invention relates to moveable horizontal constructions. More particularly, the present invention relates to a rotary unit for a moveable horizontal construction such as e.g. a bridge like a swing bridge, to a construction, e.g. bridge, using such a rotary unit and to a method for operating such a moveable horizontal construction, such as e.g. a swing bridge.

Background of the invention

[0002] The use of bridges to span a gorge, valley, road, railroad track, river or other body of water or any other physical obstacle is known already for a very long time. Moveable bridges typically are used for spanning rivers or waterways such that if ships need to pass which cannot pass under the bridge, the bridge can be moved, typically either upwards or sideways, thereby providing clear passage for water traffic. Several construction types of moveable bridges are known. Bascule bridges have sections that rotate upward and away from the centerline of the river. Vertical lift bridges have a center part that is lifted completely, whereby the part remains in horizontal orientation, allowing the water traffic to pass under the bridge. Swing bridges typically rotate at least one section in a horizontal plane. The bridge section in this case thus typically stays substantially in horizontal orientation. The present invention is related to swing type bridges.

[0003] In a swing type bridge, typically one bridge section is turned in a horizontal plane around a vertical pivot and when closed, its ends are supported at the proper level. The pivot can be positioned either in the centre of the rotatable bridge section, thus making typically two openings for water traffic, or it may be positioned rather at one side of the centre, thus making one larger opening for water traffic and one smaller opening for water traffic. In the latter case, typically a counterweight is used to balance the bridge about its pivot. Alternatively, two pivots are used and two bridge sections are rotated, typically such that, in closed position the sections meet in the centre of the waterway to be spanned. Typically a locking arrangement then is needed to lock the bridge sections together in the centre and to lock the other ends of the bridge sections to the shores.

[0004] For closing, swing type bridges typically need a lifting arrangement to lift the end of the bridge section or bridge sections near the shore so that the bridge sections make a continuous span with the surface on the shore, i.e. typically the road or railway. The end parts typically are lifted and Supporting means such as e.g. pins are introduced between the shore and the end parts of the bridge section(s). The lifting typically is done based on rollers, screws, cams, eccentrics, toggle joints, etc. Lifting the bridge from the centre typically is less preferred as it requires a larger power consumption. Known swing type bridges with a lifting arrangement in the centre furthermore have the disadvantage that a part of the truss, that carries the stress while swinging, is taken by the lifting means, thereby limiting the available top side of the carrying surface. For opening the swing type bridges, i.e. to allow water traffic to pass, the supporting means are pulled back or shifted away, whereby the end points of the bridge-sections are typically slightly lower in vertical position, due to the weight of the bridge sections.

[0005] If swing bridges are used as railway bridges or bridges to at least partly transfer vehicles running on tracks, which is often the case as swing bridges are best adapted for long and heavy spans, the issue of obtaining good connection between the tracks on the shore and the tracks on the bridge is very important. Typically, with the swing bridges described above, a small spacing between the tracks on the shore and the tracks on the bridge-section(s) is present, in this way reducing the comfort and safety of the track-based vehicles. In other words, the tracks typically are interrupted between the bridge sections and the shore making a gap oriented transverse the direction of the tracks, which increases the lack of comfort and safety.

[0006] Another important issue for bridge construction is reliability of operation of the system. If a bridge fails, either the water traffic or the road traffic, e.g. railroad traffic, is blocked, which can lead to a significant economical cost, both in time and in money.

[0007] None of the known systems provides an optimal solution such that both reliability for operation and comfort can be guaranteed.

Summary of the invention

[0008] It is an object of the present invention to provide a rotary unit for use in a horizontal moveable construction such as e.g. a swing bridge which allows a high degree of reliability of operation and a high comfort especially in the case of track-based vehicle traffic.

[0009] The above objective is accomplished by a method and device according to the present invention.

[0010] The invention relates to a rotary unit for rotating a substantially horizontal construction, the rotary unit comprising a plurality of lifting means coupled to a means for rotating, whereby said plurality of lifting means are adapted for vertically moving said horizontal construction and said means for rotating is adapted for horizontally rotating said horizontal construction. The horizontal construction may be a bridge such as e.g. a swing bridge. The plurality of lifting means may be a plurality of hydraulic cylinders. The coupling of the plurality of lifting means to the means for rotating may be obtained by swivel joints. The means for rotating may have at least a bottom portion. The plurality of lifting means may be adapted for supporting said means for rotating substantially homogeneous over said bottom portion. Substantially homogeneous may mean that the lifting means may be positioned in a circular arrangement under the ring bearings

or close to the ring bearings. The rotary unit may furthermore comprise a base, wherein said plurality of lifting means may be coupled to the base using swivel joints. The means for rotating may comprise an outer ring bearing, an inner ring bearing and at least one gear unit, whereby one of said inner ring bearing or outer ring bearing is connected to the substantially horizontal construction and is adapted to be driven by the at least one gear unit. The at least one gear unit may be a planar gear unit. The at least one gear unit may be a plurality of gear units. The plurality of lifting means may comprise preferably at least 2, more preferably at least 4, even more preferably at least 6, still more preferably at least 8 hydraulic cylinders. The rotary unit may furthermore comprise an additional guiding system for guiding said vertically movement. The additional guiding system may be based on vertical steel bars and wheels running on said vertical steel bars.

[0011] The invention also relates to a rotatable bridge construction, the bridge construction comprising a substantially horizontal bridge-section and a rotary unit, the rotary unit comprising a plurality of lifting means and a means for rotating, wherein said plurality of lifting means are adapted for vertically moving said substantially horizontal bridge-section and said means for rotating is adapted for rotating said substantially horizontal bridge-section horizontally.

[0012] The invention also relates to a rotatable horizontal construction, the horizontal construction comprising a horizontal section and a rotary unit, the rotary unit comprising a plurality of lifting means and a means for rotating, wherein said plurality of lifting means are adapted for vertically moving said substantially horizontal section and said means for rotating is adapted for rotating said substantially horizontal section horizontally, i.e. in a horizontal plane.

[0013] The invention furthermore relates to a method for rotating a horizontal construction-section of a rotatable horizontal construction, the method comprising moving said horizontal construction-section in a vertical direction using at least two of a plurality of lifting means and rotating said horizontal construction-section horizontally using a means for rotating. The moving may be lifting or may be lowering the horizontal construction-section.

[0014] It is an advantage of the present invention that the rotary unit comprises a plurality of lifting means, whereby upon failure of one or more lifting means the system's operation still may be guaranteed.

[0015] It is an advantage of the present invention that the track interruption between the bridge-section and the shore side can be made different from transverse to the track direction, which diminishes the shock or impact on the track-based vehicle when crossing the interruption.

[0016] Although there has been constant improvement, change and evolution of devices in this field, the present concepts are believed to represent substantial new and novel improvements, including departures from prior practices, resulting in the provision of more efficient, stable and reliable devices of this nature.

[0017] The teachings of the present invention permit the design of improved methods and apparatus for units for swing bridges and the swing bridges using these units, especially - but not limited to - swing bridges used at least partly as railway bridge.

[0018] These and other characteristics, features and advantages of the present invention Will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

Brief description of the drawings

[0019]

Fig. 1 is a top view of the rotary unit for horizontal moveable constructions, according to a first embodiment of the present invention, the system being in a non-lifting state.

Fig. 2 is an elevated top view of the rotary unit for horizontal moveable constructions, according to the first embodiment of the present invention, the system being in a non-lifting state.

Fig. 3 is a side view along an A-A cross-section of the rotary unit for horizontal moveable constructions as shown in Fig. 1.

Fig. 4 is an enlarged view of a planar unit for driving a ring bearing as to rotate a horizontal moveable construction-section as part of a rotary unit for horizontal moveable constructions as shown in Fig. 3

Fig. 5 is an enlarged view of a hydraulic cylinder with swivel joints connected to a base and a means for rotating according to a rotary unit for horizontal moveable constructions as shown in Fig. 3

Fig. 6 is a top view of the rotation system for horizontal moveable constructions, according to the first embodiment of the present invention, the system being in a lifting state.

Fig. 7 is an elevated top view of the rotation system for horizontal moveable constructions, according to the first embodiment of the present invention, the system being in a lifting state.

Fig. 8 is a side view along a A-A cross-section of the rotation system for horizontal moveable constructions as shown in Fig. 6.

Fig. 9 is an enlarged view of a planar unit for driving a ring bearing as to rotate a horizontal moveable construction-section as part of a rotary unit for horizontal moveabie constructions as shown in Fig. 8.

Fig. 10 is an enlarged view of a hydraulic cylinder with swivel joints connected to a base and a means for rotating according to a rotary unit for horizontal moveable constructions as shown in Fig. 9.

Fig. 11 is a side view of an example of a swing bridge

according to a second embodiment of the present invention.

Fig. 12, Fig. 13 and Fig. 14 show the cross-section of the swing bridge as shown in Fig. 11, the cross-sections taken along AA', BB' and CC' respectively.

Fig. 15 is a top view of the swing bridge as shown in Fig. 11.

Fig. 16 is an illustration of a rotary unit as can be used in the exemplary swing bridge as shown in Fig. 11 to Fig. 15.

Fig. 17 to Fig. 19 are illustrations of different states of one lifting means as can be used in the embodiments of the present invention.

Fig. 20 is a cross-sectional view of an exemplary gear unit for driving the rotary unit according to embodiments of the present invention.

Fig. 21a to Fig. 23b are top and side cross-sectional views of examples of ring bearings as can be used in the embodiments of the present invention.

Fig. 24a and Fig. 24b show a top and side cross-sectional view of ring bearing combined with a bottom portion of the rotational part of a rotary unit according to embodiments of the present invention.

Fig. 24c is an illustration of a gear unit for driving the rotational part of a rotary unit according to embodiments of the present invention.

[0020] In the different figures, the same reference signs refer to the same or analogous elements.

Description of illustrative embodiments

[0021] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes.

[0022] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0023] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0024] Similarly, it is to be noticed that the term "coupled", also used in the claims, should not be interpreted as being restricted to direct connections only. Thus, the scope of the expression "a device A coupled to a device B" should not be limited to devices or systems wherein an output of device A is directly connected to an input of device B. It means that there exists a path between an output of A and an input of B which may be a path including other devices or means.

[0025] In a first embodiment, the present invention relates to a system for use in a rotatable horizontal construction, such as a bridge, e.g. a swing bridge. The rotary unit 10 or parts thereof is shown in Fig. 1 to Fig. 5 for the situation whereby the rotatable horizontal construction, such as e.g. a bridge, is closed and in Fig. 6 to Fig. 10 for a rotatable bridge construction that is lifted, i.e. for example if a bridge moved by the rotary unit 10 is open such that water traffic can pass.

[0026] The system consists of a rotary unit 10 comprising a plurality of lifting means 1 and a means for rotating 14 a section of a horizontal construction, e.g. a bridge section. The plurality of lifting means 1 typically are hydraulic lifting means such as e.g. hydraulic cylinders, although other lifting means which are suitable for lifting a horizontal construction, such as e.g. a bridge section also can be used. The number of lifting means 1 and the size thereof typically depends on the horizontal construction that is to be lifted, the length of the section, the width of the section and the used materials for the construction. In a preferred embodiment, the number of lifting means 1 is significantly high such that if one or possibly more of the lifting means 1 is not-operational anymore, sufficiently other operational lifting means 1 are available such that the horizontal construction, e.g. bridge, still can be operated. Redundancy may thus be provided. The system preferably has 2 or more lifting means, more preferably 4 or more lifting means, even more preferably 8 or more lifting means. Therefore, preferably the lifting means 1 are distributed over the means for rotating 14, e.g. over the bottom side thereof, which is in the present example supported by the lifting means 1. In this way, even upon failure and/or removal of a lifting means 1 the other lifting means 1 still can keep the horizontal construction such as e.g. the bridge-section in balance. The plurality of lifting means 1 are connected to the means for rotating 14 by means of a joint construction 3, as illustrated e.g. in Fig. 5 and Fig. 10. Fig. 17 to Fig. 19 further illustrate by way of example a possible implementation of a lifting means 1 of the rotary unit 10. Fig. 17 shows a hydraulic cylinder as one of the lifting means 1, both in non-lifted position (S) and in lifted position (S') in side view, and in top view (T). Fig. 18 and Fig. 19 show one of the lifting means embedded in the rotary unit 10 in lifted position and in non-lifted position, respectively. The joint constructions 3 are also shown. In a preferred embodiment, these joint constructions 3 are swivel joint constructions such that they allow a certain misalignment for the horizontal construction such as e.g. the

bridge-section, thereby preventing too large side forces acting on the plurality of lifting means 1, such as e.g. the hydraulic cylinders.

[0027] The means for rotating 14 can be any means for rotating a horizontal construction such as e.g. a bridge-section, such as e.g. - but not limited to - a stack of discs, conical rollers or balls on a track and ring bearing, etc. In a preferred embodiment, as shown in Fig. 1 to Fig. 4 and Fig. 6 to Fig. 9, the means for rotating 14 comprises a bottom portion 11, which is connected to the plurality of lifting means 1, a large inner ring bearing 8 and an outer ring bearing 7. One of these ring bearings 7, 8 is connected to the horizontal construction, e.g. the bridge section that is to be rotated horizontally, whereas the other one is fixed to the bottom portion 11 of the means for rotating 14. The ring bearing 8 connected to the horizontal construction, such as e.g. the bridge section, is geared. Gear units 9, for gearing the ring bearing 8, can be driven in any suitable way, such as by e.g. hydraulical or electrical motors 5. Examples of ring bearings are shown in more detail in Fig. 21 a to Fig. 24b. Fig. 21 a and Fig. 21 b illustrate the combination of an outer ring bearing 7 and an inner ring bearing 8. Fig. 21 a shows a top view, whereas Fig. 21 b shows a cross section along line D-D'. Fig. 22a and Fig. 23a illustrate the inner ring bearing 8 respectively the outer ring bearing 7, whereas Fig. 22b and Fig. 23b illustrate cross sections along lines E-E' and F-F'. Fig. 24a and Fig. 24b illustrate the ring bearings 7, 8 and their relative position with respect to each other and to the surrounding components. Fig. 20 and Fig. 24c are illustrations of a driving gear 9 for creating rotation of the horizontal construction and the position and coupling of such a driving gear 9 to the surrounding parts of the rotary unit 10.

[0028] By way of example, the inner ring bearing 8 is shown to be driven by gear planar units 9, although other types of reduction gear units 9 also can be used. Transfer of the power generated by the motor 5 to the gear planar units 9 is in this example done indirectly via an intermediate planar unit 6 whereon the gear planar units 9 are mounted and which are driven by the motor 5. By way of example, for a horizontal construction of about 55m length and 8.5m width, a number of Brevini EC4250 gear units may be used. In this example, the inner ring bearing 8 is fixedly connected to the horizontal construction, e.g. bridge section, as can be appreciated from Fig. 18 to 20, such that rotation of the inner ring bearing 8 will lead to rotation of the horizontal construction, e.g. the bridge section. The outer ring bearing 7 is connected to the remaining portion of the means for rotating 14, it is e.g. the bottom portion 11 of the means for rotating 14.

[0029] Similar to the plurality of lifting means 1, the number of gear units 9 and the number of motors 5 preferably is larger than one, thus providing redundancy, such that upon failure of one of the elements, the system can further be operated.

[0030] The lifting means 1, which are in the present embodiment supporting the means for rotating 14, typically are connected to a base 12 of the rotary unit 10. This connection preferably also is performed using joint constructions 13, e.g. swivel joint constructions 13, again to allow a certain misalignment and thus preventing side forces acting on the lifting means 1, e.g. hydraulic cylinders. The base 12 typically will be connected to a pile, which is positioned under the horizontal construction, e.g. bridge section, such that the pile supports the rotary unit 10 and thus indirectly the horizontal construction, e.g. bridge section. Alternatively, the lifting means 1 could be immediately connected to the environment, i.e. for example to the pile supporting the structure. An advantage of the use of a base 12 is that support for the vertical movement can be provided by e.g. wheels 2 that are supported by the base 12 and run on vertical steel bars 4 mounted on the vertically moveable assembly of the construction, i.e. on the means for rotating 14, or vice versa.

[0031] The preferred materials from which the rotary unit is built can be any material that has the strength to support a horizontal construction. The material choice may also be influenced from environmental circumstances. A typical material, although the invention is not limited thereto, that can be used is steel. The size of the components of the rotary unit 10 depends on the size and weight of the horizontal construction and can be easily calculated by a person skilled in the art.

[0032] In this way a moveable horizontal construction such as e.g. a bridge construction, having a precise rotation is obtained. Due to the combination of a lifting means 1 and a rotational means 14 in one rotary unit 10, the system is substantially compact. Furthermore, upon failure of one of the components, the bridge can in a lot of occasions be further operated.

[0033] In a further embodiment, the invention also relates to a horizontal construction such as e.g. a swing bridge using the rotary unit 10 as described in the first embodiment. The swing bridge using the rotary unit 10 can be any type of swing bridge, e.g. in a centrally supported swing bridge-section whereby a double pathway is cleared for the water traffic or in an asymmetrically supported swing bridge whereby the rotary unit is positioned at one side of the centre of the bridge-section. In the latter case the shortest arm of the bridge-section typically is provided with a counter weight to allow the bridge-section to be balanced around the rotary unit 10, as well known by a person skilled in the art. The invention is especially useful for railway bridges, i.e. any bridge that at least partly provides a throughway to track-based vehicle traffic, as it allows to provide an improved transition between the tracks on the shore and the tracks on the bridge section. It is to be noted that the bridge may have non-moveable sections, which in the present application will play the same role as the shore edges. Furthermore, the bridges are also especially useful on places where there is a lot of bridge operation, as it has a high degree of reliability for operation. By way of example, a swing bridge 50 with a centrally supported swing bridge

section 52 is illustrated in Fig. 11 to Fig. 15, the invention not being limited thereto. In Fig. 11 a side view is shown of the swing bridge 50 in a position allowing traffic from one shore to the other. Fig. 12, Fig. 13 and Fig. 14 are cross-sectional views of the bridge 50 and its environment along lines AA', BB' and CC'. In Fig. 12 the bridge section 52 is shown, in combination with part of the first shore 54. In Fig. 13 the bridge section 52 is shown in combination with the rotary unit 10 and the pile 56 supporting the rotary unit 10 and thus indirectly the bridge section 52. In Fig. 14, the bridge section 52 is shown in combination with part of the second shore 58. In Fig. 15, a top view of the swing bridge 50 is shown, furthermore indicating a means for centering 60 the bridge 50 in an open position, i.e. for allowing traffic along the waterway or obstacle bridged by the swing bridge section 52, and buffering means 62 for buffering the swing bridge section 52 during rotating. Furthermore positioning means 64, 66 may be provided allowing to obtain accurate position of the bridge 50. Fig. 16 shows a cross-sectional top view of a rotary unit 10 according to the previous embodiment, as can be used in the horizontal swing construction according to the present embodiment. Besides the parts as shown in drawings Fig. 1 to Fig.10 and Fig. 17 to Fig. 24c, Fig. 16 also illustrates the possibility for using a base portion 20 which is rotatable and which is connected to the horizontal construction on the one hand and, in the present example, to the rotatable inner bearing 8 on the other hand.

[0034] According to another aspect, the present invention relates to a method for operating a horizontal construction such as e.g. a swing bridge using any of a rotary unit 10 as described above. By way of illustration, the method will be described with reference to a bridge.

[0035] The bridge 50 is first unlocked so that it is given free for mechanical movement. Typically locking is done by a set of pins or a system of locks. After unlocking is done, the plurality of lifting means 1, i.e. e.g. the hydraulic cylinders, push the bridge-section 52 up to a certain position which is needed for turning the bridge 50. The distance over which the horizontally oriented bridge 50 is pushed up or down in the vertical direction typically is of the order of a few tens of centimetres, such as e.g. over 50cm. Supporting wheels 2 running in vertically steel bars 4 may provide additional support for this vertical movement. After this vertical movement, the rotary unit 10 is in a state as shown by way of example in Fig. 6 to Fig. 10.

[0036] Now the bridge 50 is ready for turning. The rotational movement in the horizontal plane defined by the horizontal orientation of the bridge-section 52 or in other words the swing is done by driving the gear units 9 such that the geared ring bearing 8 rotates and the bridge-section, connected to this section also rotates. In order to close the bridge 50, the inversion action is performed, i.e. the bridge 50 is rotated back in between the two shores and after this rotational movement, the bridge-section 52 is lowered.

[0037] It is an advantage of the present invention that, for opening the bridge, the bridge-section is first brought to another vertical height, preferably above the vertical height of the edge of the shore. This allows that to a certain extent, parts can be mounted on the bridge section that extend over the edge of the bridge section. If e.g. railway tracks are placed on the bridge section, these can at least extend partly over the bridge section such that they allow to make a smooth transition to railway tracks on the shore. This furthermore allows to reduce the interruption in the railway tracks and to change the direction of the interruption from transverse to the railway track direction to diagonal, i.e. slightly in the length direction of the railway track. This results in a more smooth transition between the railway track parts. The latter is impossible for a bridge which is only based on rotating or swinging and which does not have a lift during opening of the bridge or a drop during closing of the bridge, as the extending parts would not be able to follow the rotation movement without being obstructed by parts connected to the shore.

[0038] Other arrangements for accomplishing the objectives of the rotation system for bridges embodying the invention will be obvious for those skilled in the art.

[0039] It is to be understood that although preferred embodiments, specific constructions and configurations, as well as materials, have been discussed herein for devices according to the present invention, various changes or modifications in form and detail may be made without departing from the scope and spirit of this invention. For example, although the invention has been illustrated using an embodiment wherein the means for rotating are directly coupled to the bridge-section and the plurality of hydraulic cylinders are connected to a base which is fixed with respect to the environment, alternative systems also may be used. The means for rotating may e.g. be coupled to a base which is fixed with respect to the environment and the hydraulic cylinders may be coupled directly to the bridge-section on the one hand and to the rotating means on the other hand. The connection between the hydraulic cylinders and the means for rotating then also preferably are swivel joint connections such that a certain misalignment is allowed.

[0040] It furthermore is clear to a person skilled in the art that, although a method for opening a swing bridge is described, the invention also relates to a method for closing the swing bridge. The method then comprises first rotating the horizontal construction-section of the swing bridge substantially in a horizontal plane and then lowering or raising the horizontal construction-section substantially vertically. Whereas the method for rotating a horizontal construction-section of a rotatable horizontal construction comprises the steps of lifting the horizontal construction-section and rotating the lifted horizontal construction-section, the method also could comprise lowering a horizontal construction-section and then rotating it. The system according to the present invention then should have lifting means, which in this case also could be referred to as lowering means, that are in a lifted

state when the bridge can be used for allowing traffic from one shore to the other. Furthermore the shore needs to be adapted such that it provides sufficient space for iowering the horizontal construction-section and for rotating the horizontal construction-section. Furthermore, if the horizontal construction is a bridge comprising tracks, the interruption between the tracks still may be slightly along the length direction of the tracks if the interruption is provided on the horizontal construction-section instead of at the shores.

Claims

1. A rotary unit (10) for rotating a substantially horizontal construction (52), the rotary unit (10) comprising a plurality of lifting means (1) coupled to a means for rotating (14), whereby said plurality of lifting means (1) are adapted for vertically moving said horizontal construction (52) and said means for rotating (14) is adapted for horizontally rotating said horizontal construction (52).

2. A rotary unit (10) according to claim 1, wherein said horizontal construction (52) is a bridge-section.

3. A rotary unit (10) according to any of the previous claims, wherein said plurality of lifting means (1) is a plurality of hydraulic cylinders.

4. A rotary unit (10) according to any of the previous claims, wherein said coupling of said plurality of lifting means (1) to said means for rotating (14) is obtained by swivel joints (3).

5. A rotary unit (10) according to any of the previous claims, said means for rotating having at least a bottom portion (11), wherein said plurality of lifting means (1) are adapted for supporting said means for rotating (14) substantially homogeneously over said bottom portion (11).

6. A rotary unit (10) according to any of the previous claims, said rotary unit (10) furthermore comprising a base (12), wherein said plurality of lifting means (1) is coupled to said base (12) using swivel joints (3).

7. A rotary unit (10) according to any of the previous claims, said means for rotating comprising an outer ring bearing (7), an inner ring bearing (8) and at least one gear unit (9), whereby one of said inner ring bearing (8) or outer ring bearing (7) is connected to said substantially horizontal construction (52) and is adapted to be driven by said at least one gear unit (9).

8. A rotary unit (10) according to the previous claim, wherein said at least one gear unit (9) is a planar gear unit.

9. A rotary unit (10) according to any of claims 7 to 8, wherein said at least one gear unit (9) is a plurality of gear units.

10. A rotary unit (10) according to any of the previous claims, wherein said plurality of lifting means (1) comprises at least 4, preferably at least 6, more preferably at least 8 hydraulic cylinders.

11. A rotary unit (10) according to any of the previous claims, the rotary unit (10) furthermore comprising an additional guiding system (2, 4) for guiding said vertical movement.

12. A rotary unit (10) according to the previous claim, wherein said additional guiding system is based on vertical steel bars (4) and wheels (2) running on said vertical steel bars (4).

13. A rotatable bridge construction (50), the bridge construction comprising a substantially horizontal bridge-section (52) and a rotary unit (10), the rotary unit (10) comprising a plurality of lifting means (1) and a means for rotating (14), wherein said plurality of lifting means (1) are adapted for vertically moving said substantially horizontal bridge-section (52) and said means for rotating (14) is adapted for rotating said substantially horizontal bridge-section horizontally (52).

14. A method for rotating a horizontal construction-section of a rotatable horizontal construction (52), the method comprising

    - moving said horizontal construction-section (52) in a vertical direction using at least two of a plurality of lifting means (1)
    - rotating said horizontal construction-section (52) horizontally using a means for rotating.

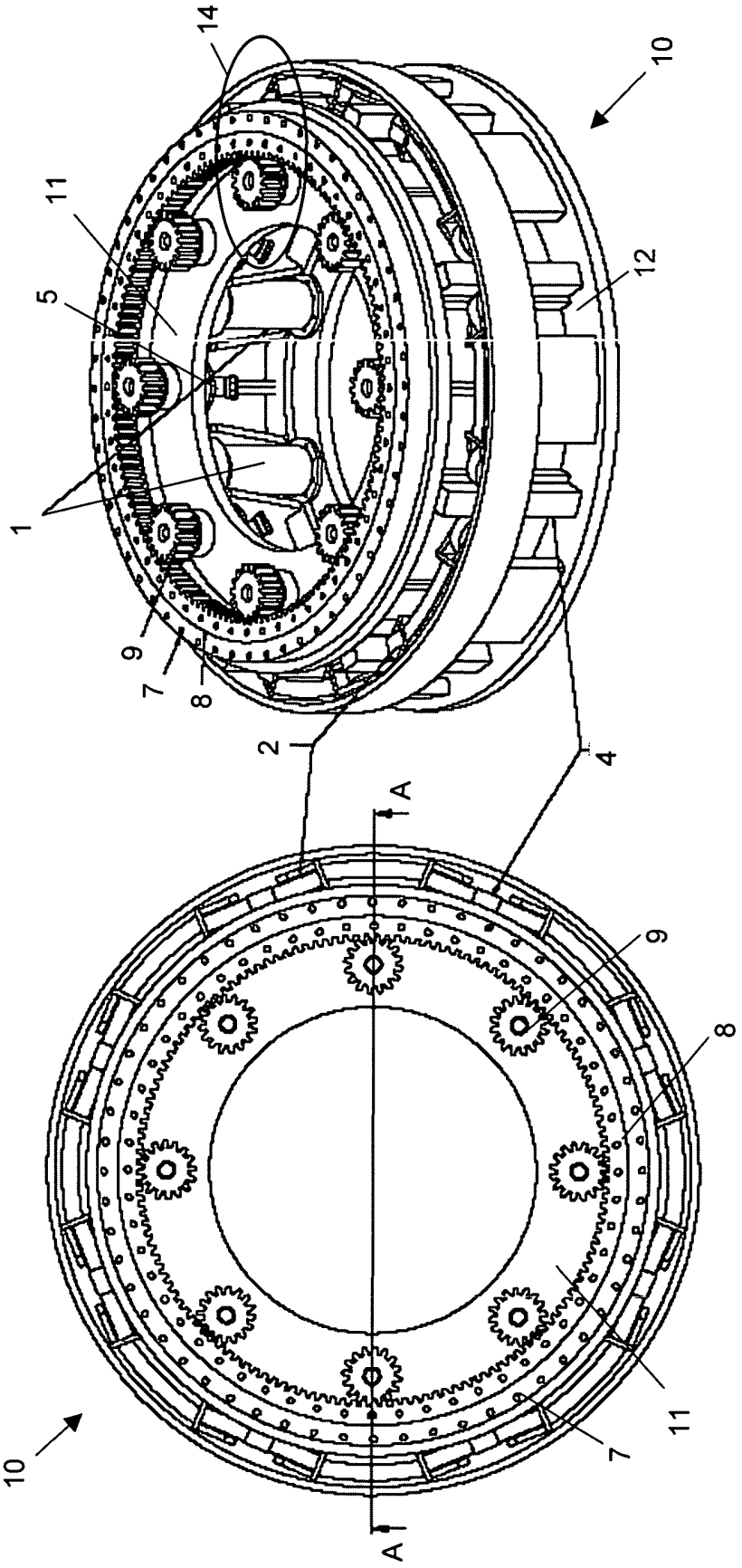


Fig. 1

Fig.2

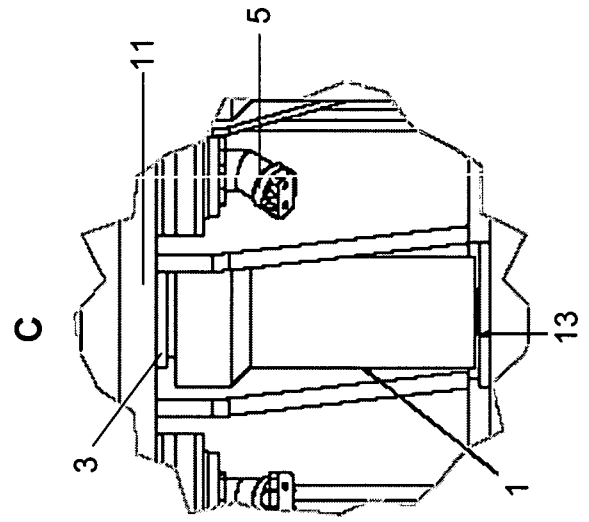


Fig. 5

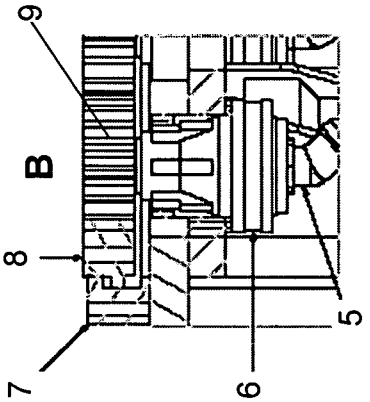
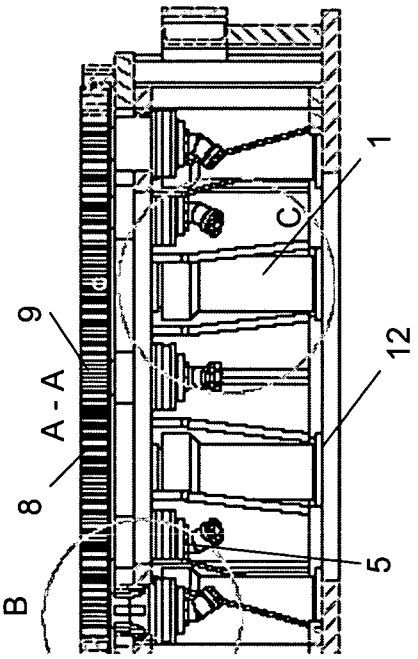


Fig. 4



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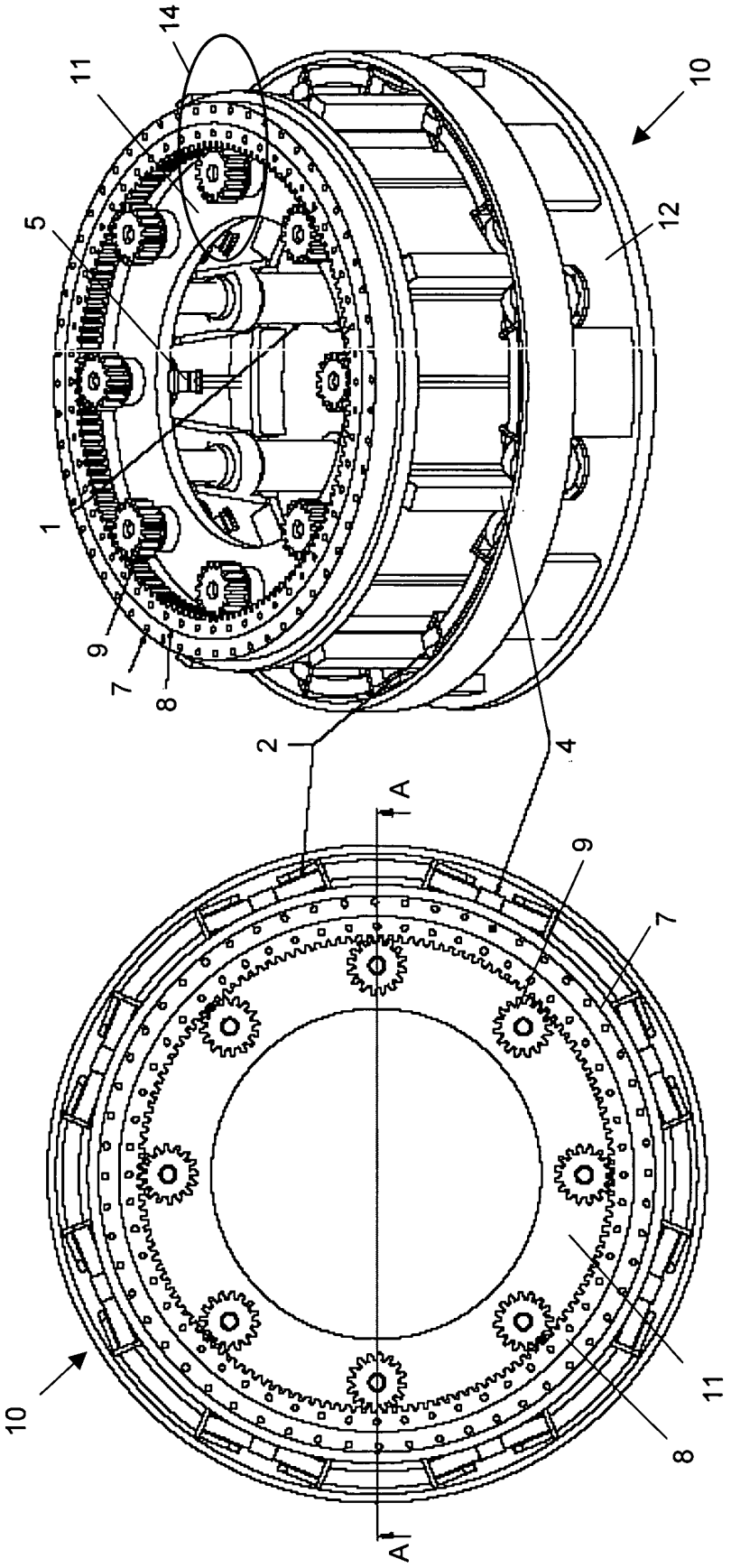
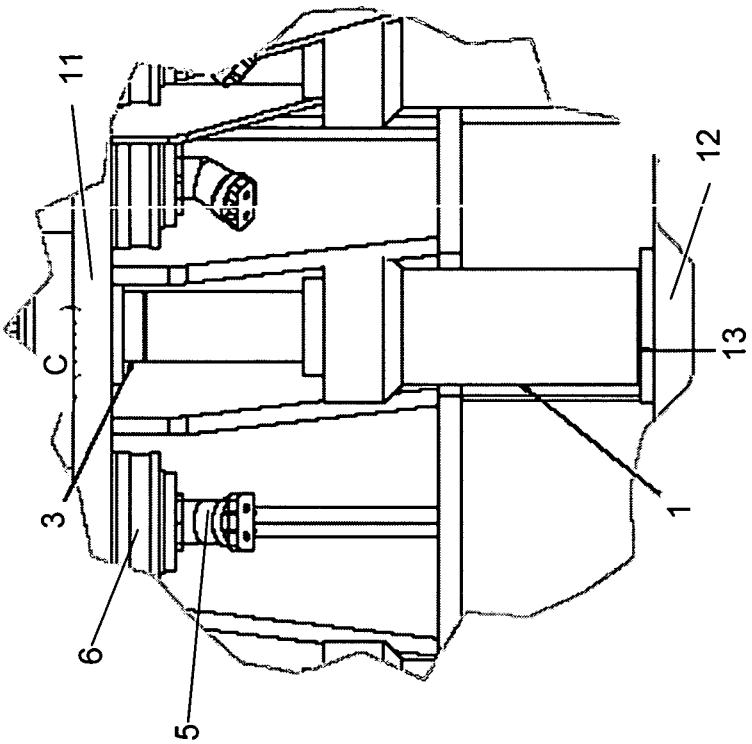


Fig. 7

Fig. 6



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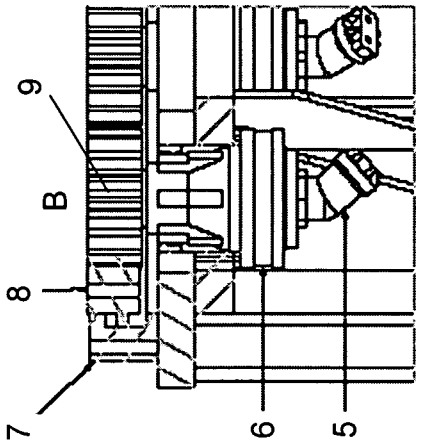

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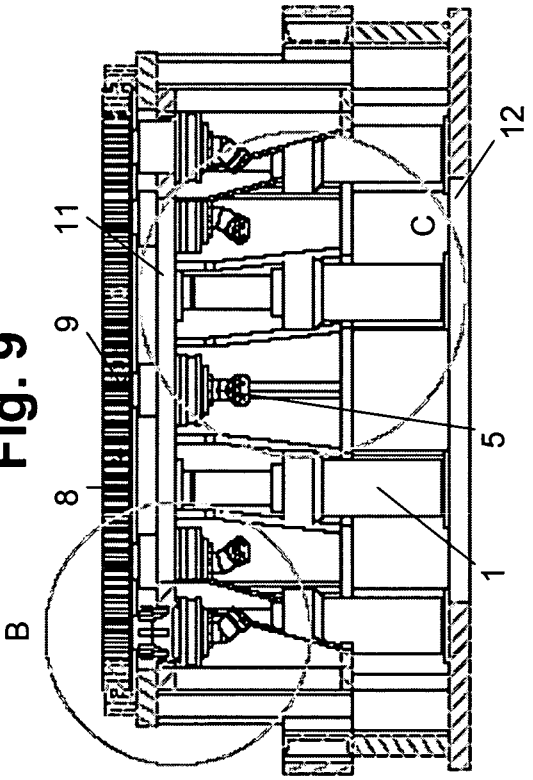

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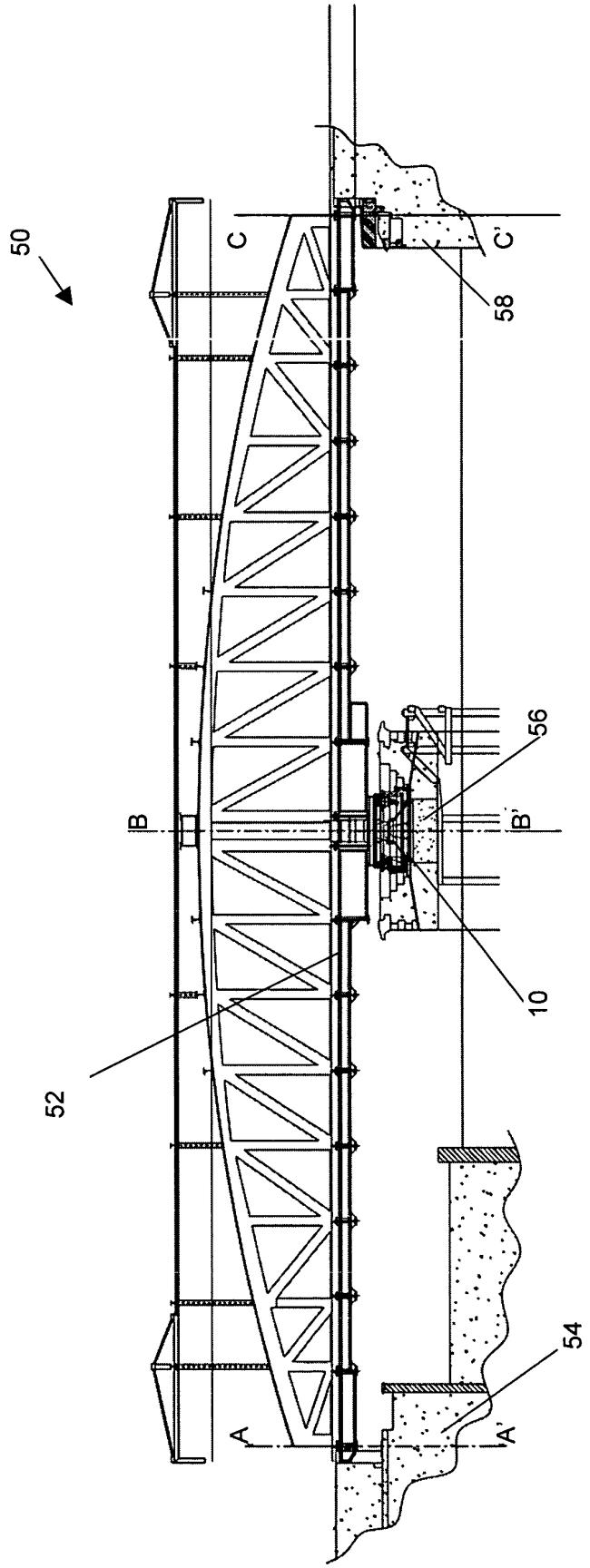
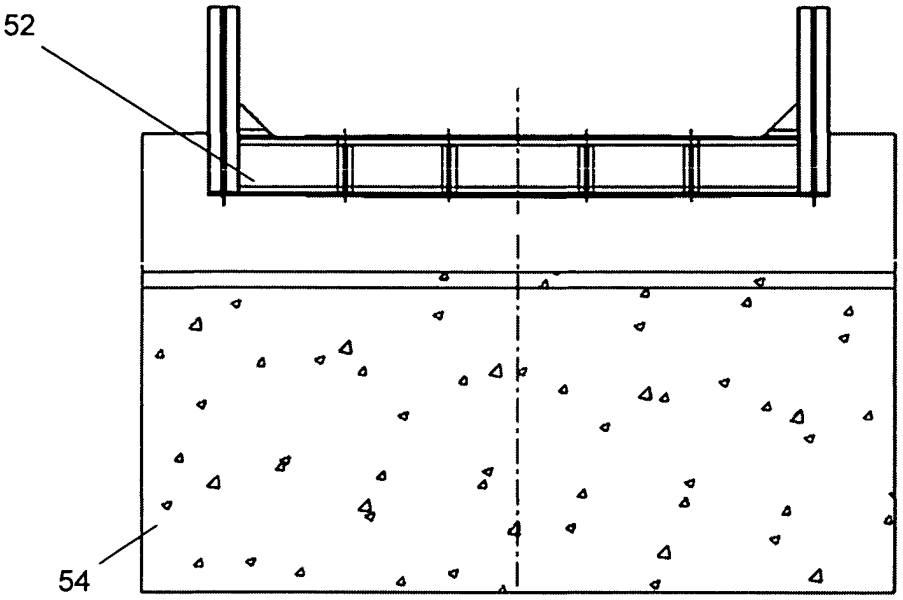


Fig. 11



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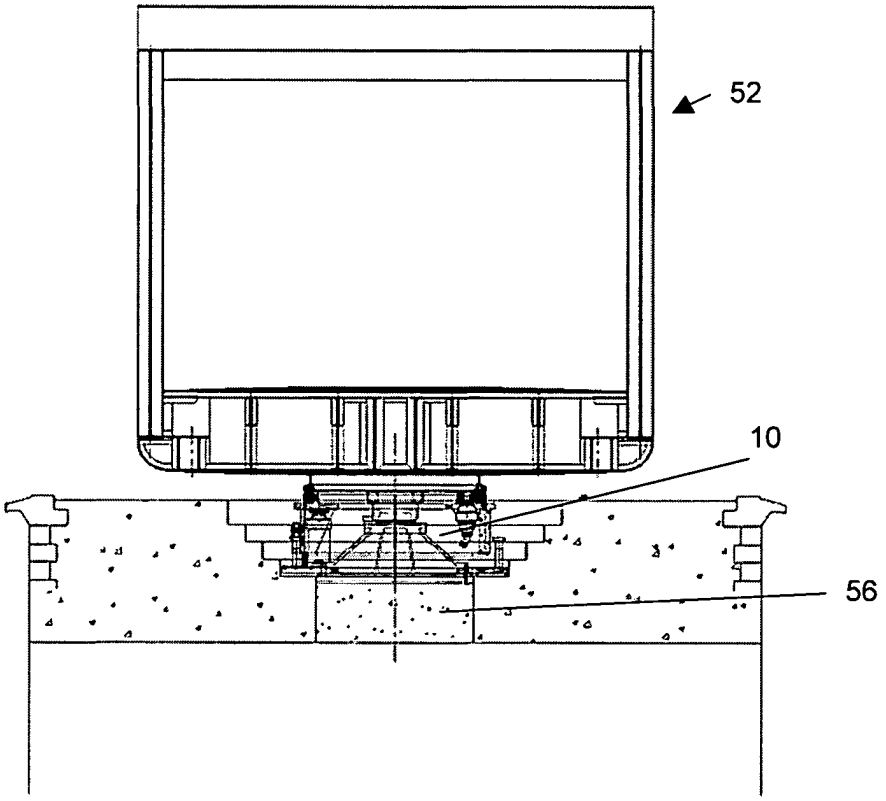

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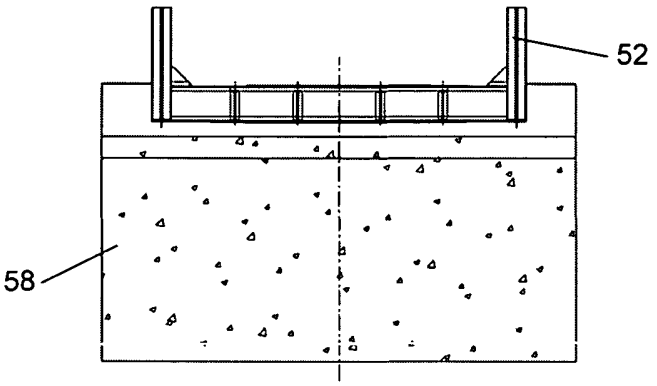

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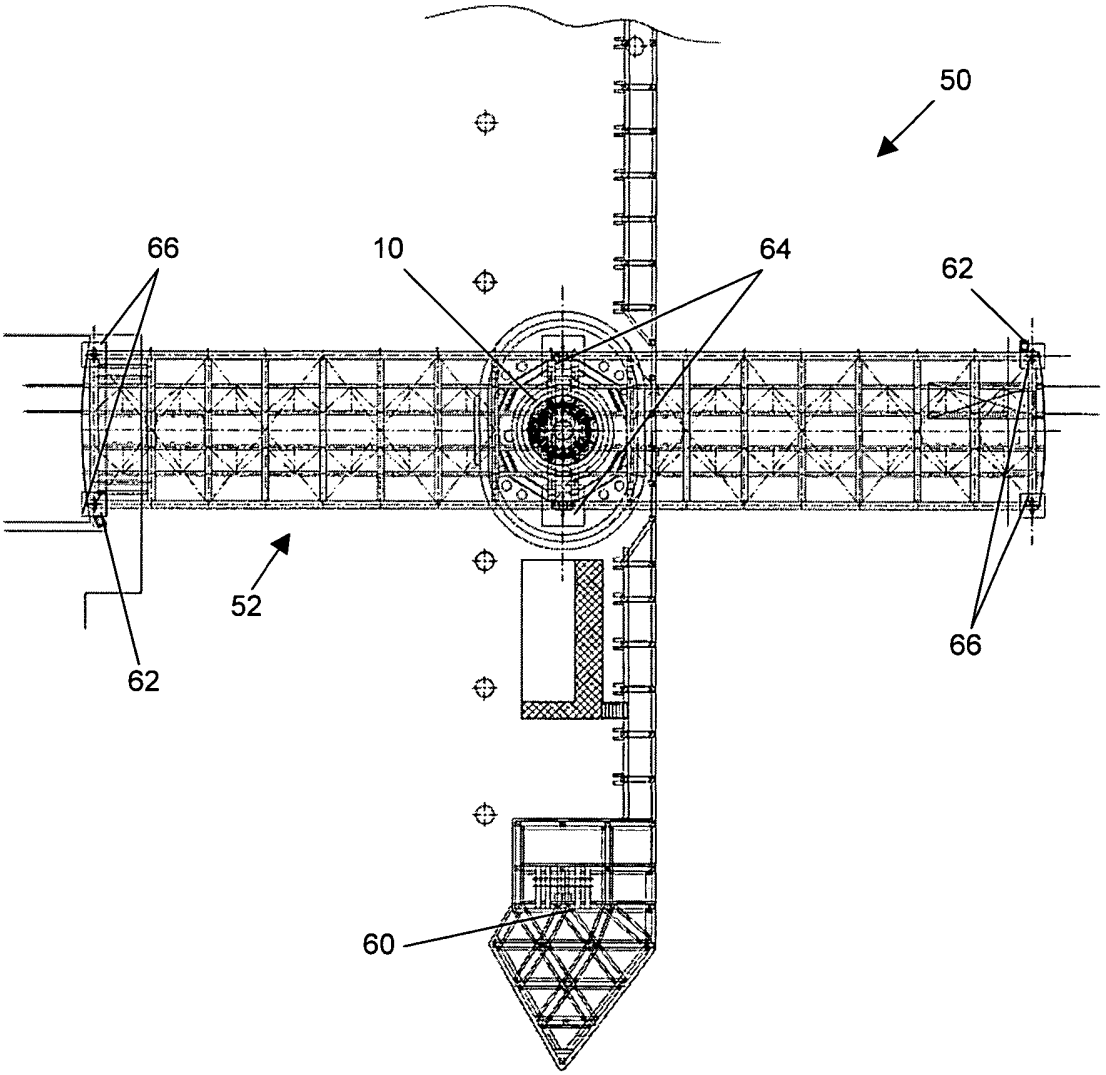


Fig. 15

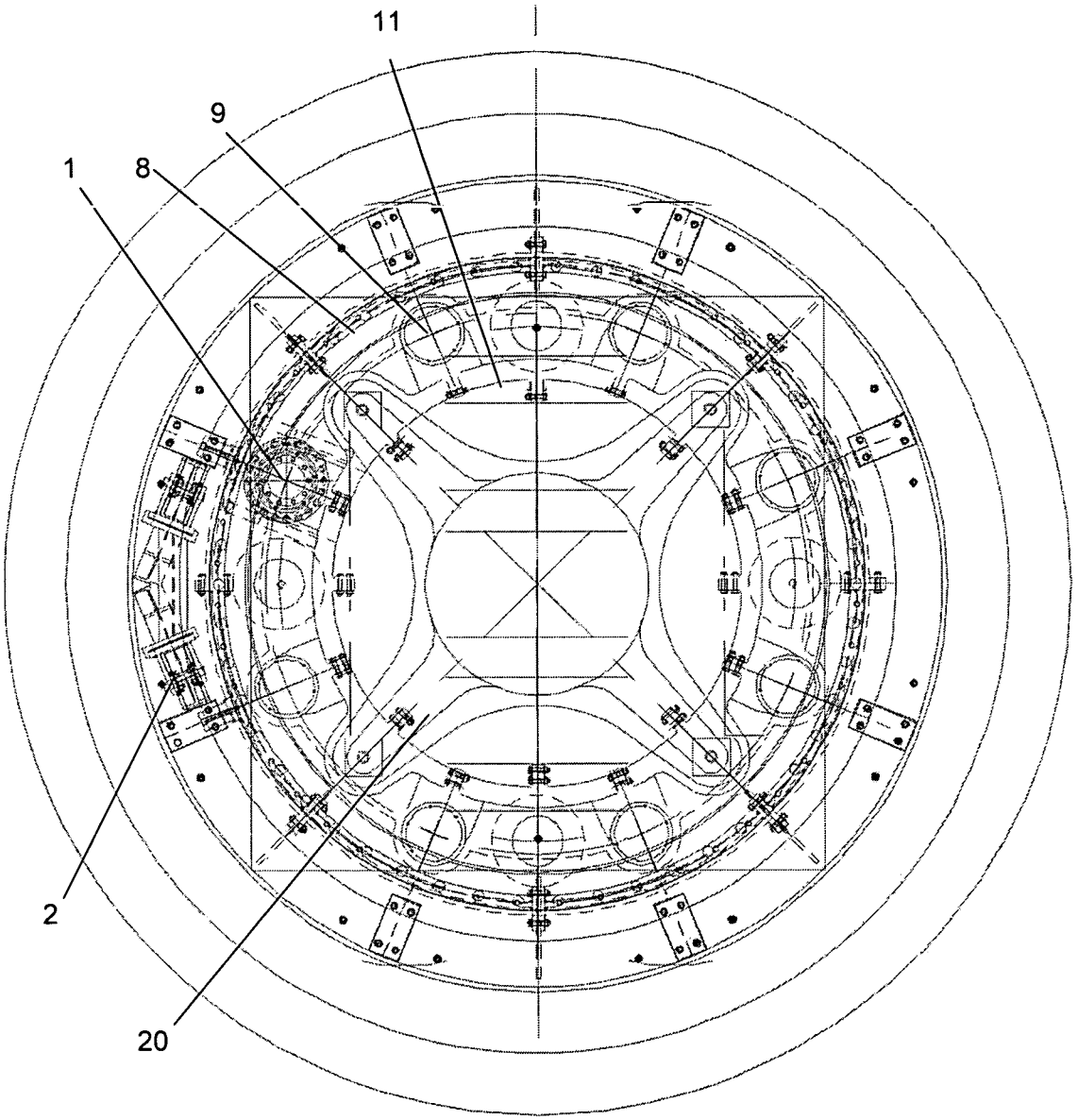


Fig. 16

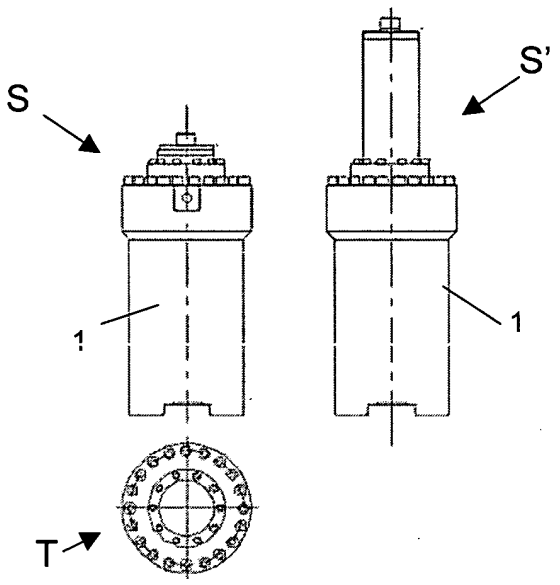
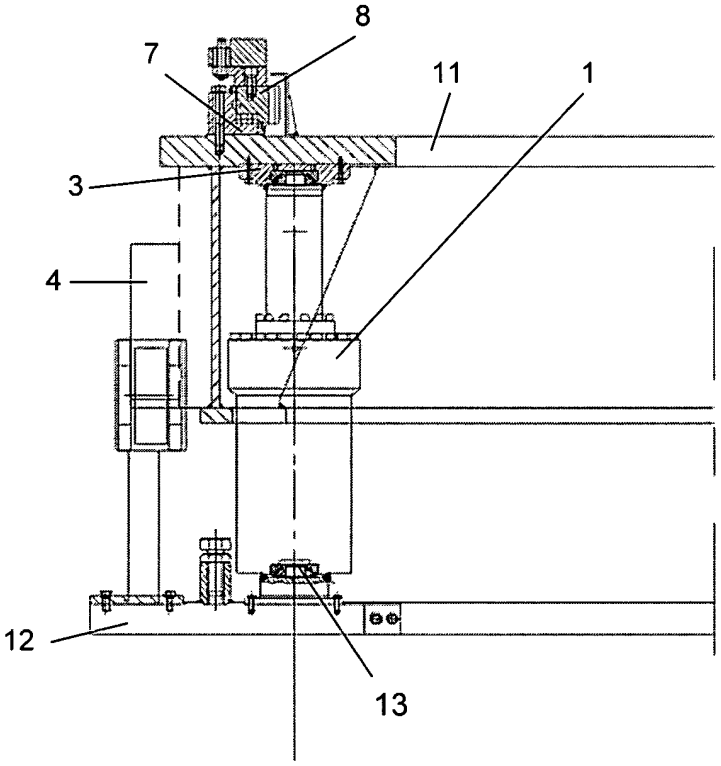


Fig. 17



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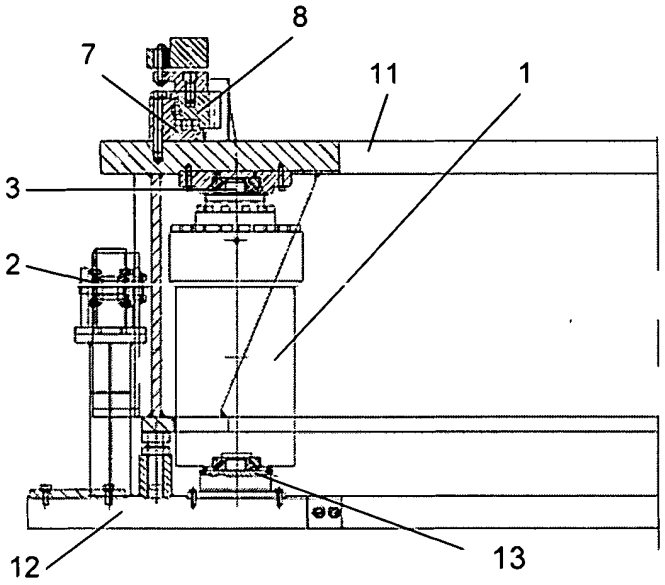

Fig. 19

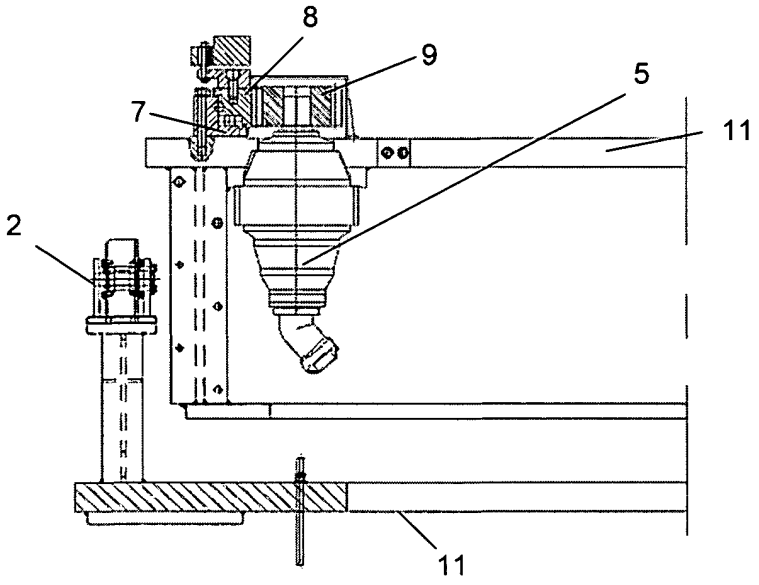

Fig. 20

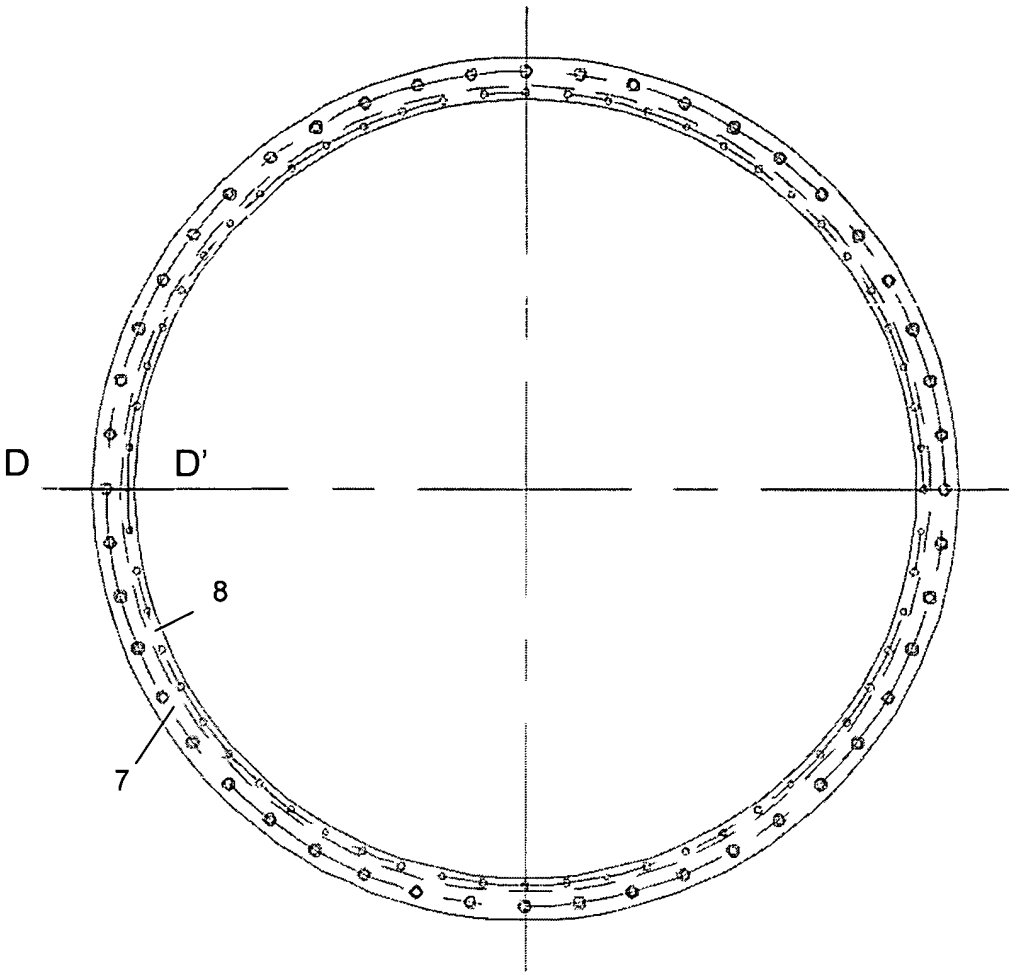

Fig. 21a

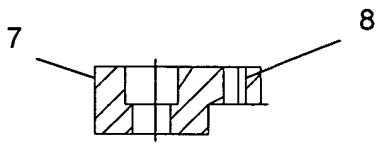

Fig. 21b

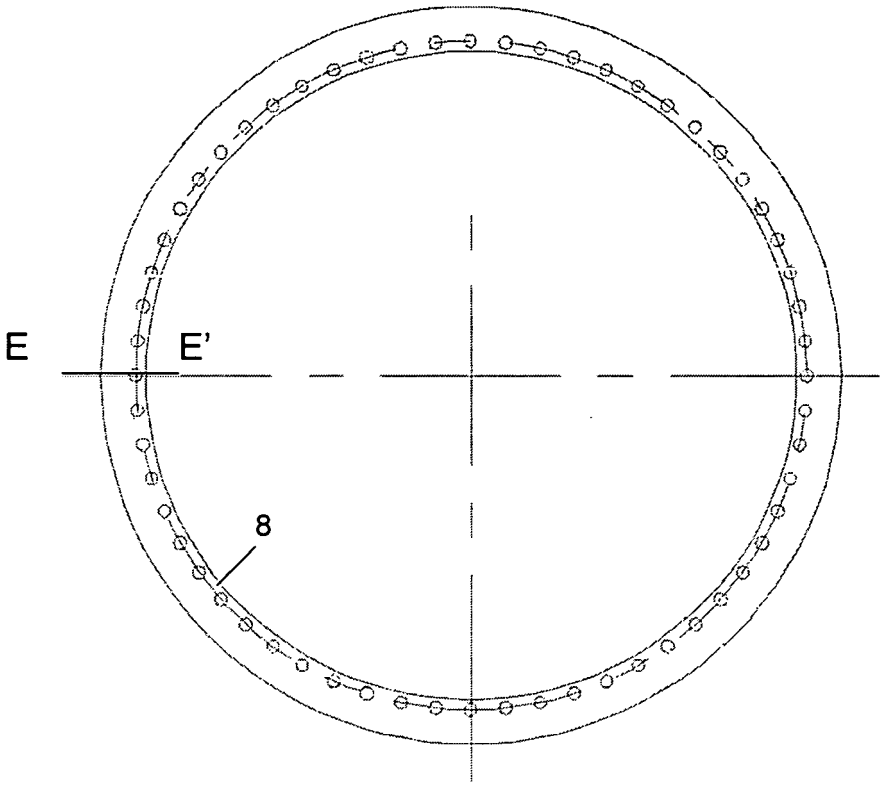

Fig. 22a

Fig. 22b

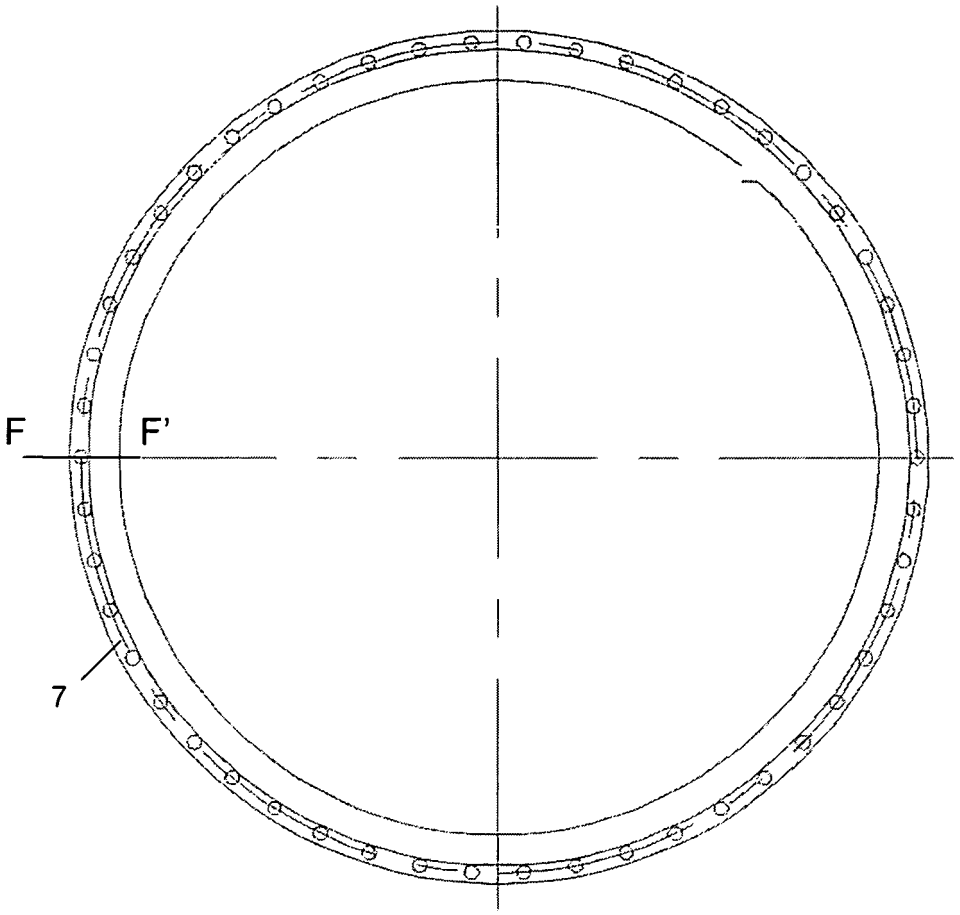

Fig. 23a

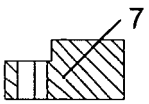

Fig. 23b

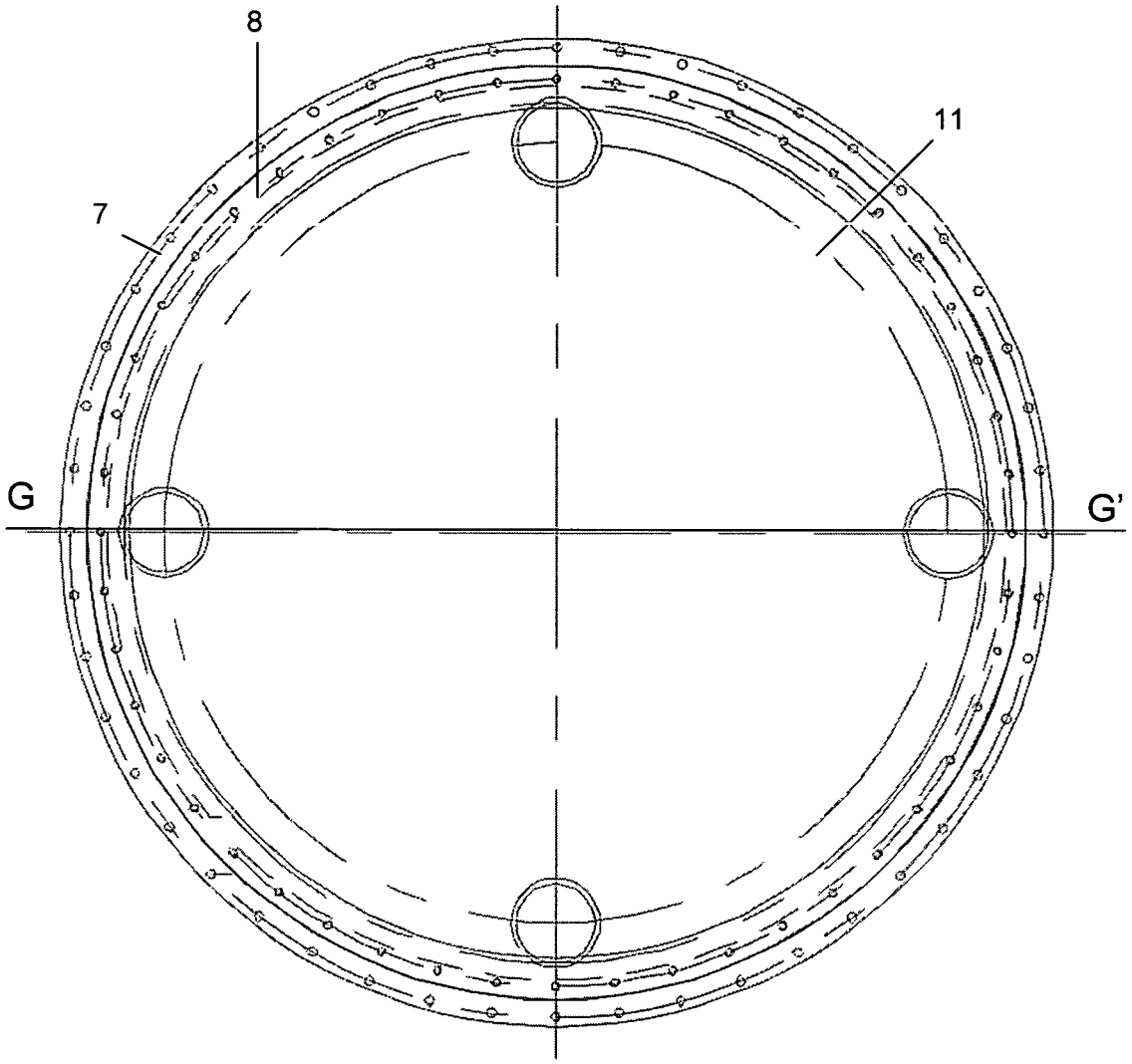

Fig. 24a

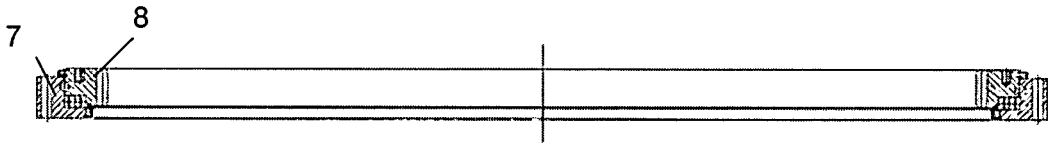

Fig. 24b

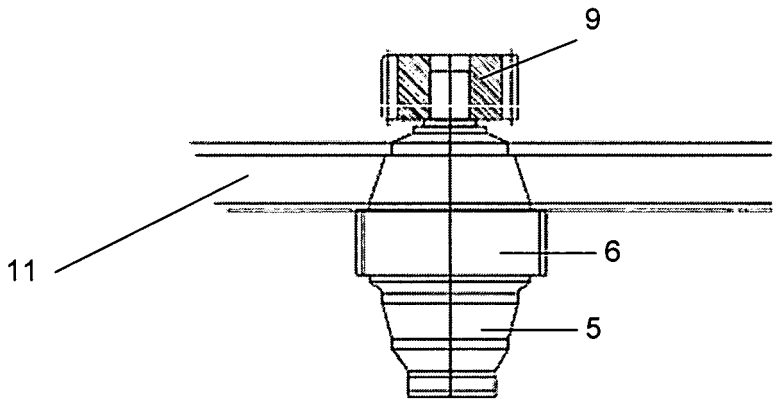

Fig. 24c

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 44 7191

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 11 63 882 B (GUTEHOFFNUNGSHUETTE STERKRADE AKTIENGESELLSCHAFT) 27 February 1964 (1964-02-27) * the whole document *	1,2,13, 14	E01D15/04
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TECHNICAL FIELDS SEARCHED (IPC)

E01D
B66F
B61J
E01F
B60P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 December 2005	Flores Hokkanen, P

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