

ROTARY TABLE DEVICE FOR A PIPE STRING

There is described a device for a rotary table provided with means arranged for suspension of a pipe string, the rotary table comprising a rotary ring arranged rotatably about the central axis of the rotary table, the rotary ring more particularly being formed by two or more ring sections, each connected to a system comprising a bearing housing section being rotatable relative to a base section, a bearing housing groove being formed in a base contact surface on the bearing housing section and a corresponding base groove being formed in an opposing bearing contact surface in the base section, said groove having a curve centre coinciding with the central axis of the rotary table, and the rolling diameter of the roller body exceeding the collective depth of said groove, and a channel connecting the end portions of the bearing housing groove being formed in the bearing housing section.

While using a rotary table for suspension and rotation of a pipe string, such as a drill string, where the rotary table typically constitutes the driving element in a drilling machine arranged displaceably in a rig derrick or the like in such a manner that the drilling machine is displaced vertically as the drill string works its way downward in the borehole, there is a need to be able to open the rotary table so that the drilling machine may be pulled away from the pipe string and be displaced vertically to be made ready for an-

other operation. This is particularly relevant in a continuous drilling operation where several drilling machines cooperate in building and rotating the pipe string. In such divisibility it is complicated to provide a sufficiently
5 powerful and functional supporting of the divisible rotary table in a divisible base when the rotary table shall be able to carry a pipe string weight of several hundred tonnes.

From NO 323330 is known a power tong comprising two mutually revolving housing halves, as the housing halves are arranged
10 to be able to be rotated between a closed, active position and an open inactive position, and where a radially split drive ring provided with hydraulically activated clamping jaws directed toward the power tong central axis, is positioned in the housing halves, the drive ring being supported
15 in and connected to a drive motor for rotation of the drive ring about said axis, and the drive ring being provided with at least one locking organ arranged for being able to tie the drive ring parts lockably together.

The object of the invention is to remedy or reduce at least
20 one of the disadvantages of the prior art, or at least to provide a useful alternative to the prior art.

The object is achieved by the features disclosed in the below description and in the subsequent claims.

There is provided a rotary table constituted by two essentially equal rotary table sections each attached in a frame
25 pivotally supported about a pivotal axis parallel to a central axis through a central opening in the turning table.
When the rotary table is closed, the rotary table sections are brought together forming a ring shaped body, and when the
30 rotary table is open, there is formed an opening from the rotary table centre to its periphery, as the opening is suited

for radial displacement of a pipe relative to the rotary table central opening into or out of the rotary table.

Each rotary table section comprises a base section, a ring section and also a bearing housing section. The bearing housing section is, in an end surface facing the base section, provided with one or more horizontal, countersunk, continuous grooves that are arc-shaped having their curve centre coincident with the rotary table's central opening and stretching through an essential part of the sector formed by the ring section. Equivalently, corresponding rolling track(s) are arranged in an opposing surface in the base section. Together two opposing grooves form a rolling track for a rotary body, typically a ball, and exhibits a profile corresponding to the shape of the rotary body. Equivalently the corresponding return channel(s) are arranged enclosed in the bearing housing section and is in each end connected to said grooves by means of a first and a second, vertical, arc-shaped transition channel in such a manner that said grooves, transition channels and return channel form a continuous rolling track loop arranged for receiving a series of rotary bodies, as these in turning of the bearing housing section relative to the base section roll in the opposing grooves of the base section and the bearing housing section until they reach the end of the groove and move into the first transition channel, into the return channel and back to the groove through the second transition channel, as the roller bodies during the return travel are pushed forward as needed by succeeding roller bodies on their way from the groove into the return channel. The number of roller tracks depends on the size of rotary bodies employed and the size of the load the rotary table shall be able to carry.

The invention relates more particularly to a device for a rotary table provided with means arranged for suspension of a pipe string, where the rotary table comprises a rotary ring arranged revolving about the rotary table central axis, characterised in that the rotary ring is formed from two or more ring sections, each connected to a system comprising a bearing housing section being rotatable relative to a base section, a bearing housing groove being formed in a base contact surface on the bearing housing section and a corresponding base groove being formed in the opposing bearing contact surface in the base section, said groove forming an arc-shaped track for a roller body and said track having a centre of curvature coincident with the rotary table's central axis, and the roller body rolling diameter exceeding the collective depth of said groove, and a channel connecting the end portions of the bearing housing groove being formed in the bearing housing section.

The channel may be provided with a lead portion protruding downward into the base groove. Thereby the roller bodies are more easily guided into the return channel.

The roller body may have the shape of a ball. The same dimension of the roller body may thereby be used independently of the distance of the grooves from the rotary table central axis.

At least one ring section and the appurtenant base section may form a rotary table section being displaceable between a first position where the rotary table is radially closed and a second position where there in the rotary table is provided a radial pipe string opening.

Each ring section may have a drive unit connected to it. The ring sections are thereby exposed to a more even loading during rotation.

5 The rotary table may comprise two rotary table sections rotatably supported in a frame. The radial pipe string opening is thereby provided in an uncomplicated manner.

The rotary table sections may be supported on a contact face arranged in the frame perpendicularly to the rotary table central axis. The supporting function is thereby essentially
10 provided by a static element, and elements providing the rotary table sections opening and closing functions, may thereby be made having smaller dimensions.

The element contacting the frame contact surface, and/or the frame is provided with a series of resilient sliding shoes
15 which, when the rotary table is unloaded, is arranged to be able to maintain a clearance between the contact surface and an opposing end surface on the base section, each sliding shoe being resiliently supported in a recess in said element, or possibly in the frame, and protruding from the end surface
20 of the element, respectively from the contact surface.

The bearing housing section may be arranged above the base section. Alternatively the bearing housing section may be arranged below the base section. This gives greater flexibility, particularly when the rotary table is provided with multiple bearing systems, for example to make override running
25 of a pipe string possible during rotation.

In the following is described an example of a preferred embodiment illustrated in the accompanying drawings, wherein:

Fig. 1 shows a top view of a rotary table according to the
30 invention in an open position;

Fig. 2 shows a top view the rotary table in a closed position;

Fig. 3 shows a side view of the rotary table in a closed position;

5 Fig. 4 shows in a larger scale a vertical section IV-IV in Figure 1 through a portion of the bearing housing section and the base section; and

Fig. 5 shows a side view of a rotary table in the closed position with the bearing housing arranged below
10 the base.

In the figures the reference numeral 1 indicates a rotary table attached to and supported by a frame 2. The frame 2 is attached to a vertical derrick 3 typically projecting up from a drill floor (not shown) in a drilling rig (not shown). The
15 frame 2 is connected to the derrick 3 by means of multiple connectors 22 and may be displaced in the vertical direction along sliding surfaces 31 arranged on the derrick. The rotary table 1 is provided with an axial pipe string opening 18 arranged for receiving a pipe string 4 of *per se* known type.

20 The rotary table 1 comprises, in the first embodiment example (see particularly Figures 1 and 2) two rotary table sections 1a, 1b each provided with a base section 11 attached in the frame by means of a swivel 114, as the rotary table sections 1a, 1b are pivotal about a pivot axis each 114a by means of a
25 pivot actuator 115. The base section may be displaced in the direction of the pivot axis 114a.

The base section 11 is supported on a contact surface 21 arranged perpendicularly to the rotation axis 114a. Multiple sliding shoes 116 are arranged in recesses 118 in the base
30 section 11 as they are arranged to be pushed out from an end

surface 112 toward the contact surface 21 by means of a spring 117. In the unloaded position the rotary table sections 1a, 1b will rest against the frame 2 on the sliding shoes 116 only, the base section 11 end surface 112 being
5 lifted clear of the contact surface 21 by means of the sliding shoes 116 and their springs 117. When the rotary table sections 1a, 1b are loaded, the base section 11 end surface 112 will abut the base contact surface 21, as the sliding shoes 116 are pushed into their respective recesses 118.

10 The contact surface 21 is provided with a recess 211 (see Figure 1) extending from an outer edge and inward toward the rotary table centre and forming together with the rotary table sections 1a, 1b a radial pipe string opening 17 when the rotary table sections 1a, 1b are moved away from each other.

15 A bearing contact surface 111 is arranged recessed in the upper portion of the base section 11 and is defined by a side wall 119 and a central opening (not shown) that constitutes a portion of the axial pipe string opening 18. The bearing surfaces 111 of the base sections 11 of the two rotary table
20 sections 1a, 1b and adjacent side wall 119 form, in the condition where they are pushed together, a cylindrical recess housing two semi-cylindrical bearing housing sections 13 being radially supported by multiple support bearings 136 arranged in connection with the side walls 119.

25 The bearing housing sections 13 are ring-shaped; forming, in the condition where they are pushed together, a portion of the axial pipe string opening 18 in the rotary table 1.

The bearing housing sections 13 are attached to each ring section 12a and 12b respectively, which, in the state where
30 they are pushed together, form a cylindrical rotation ring 12 constituting a portion of the axial pipe string opening 18 in

the rotary table 1. The ring sections 12a, 12b are each provided with a recess 122 arranged for receiving a wedge abutment 15 and a wedge belt section 16.

In a base contact surface 131 on the bearing housing sections 13 is arranged multiple parallel, arc-shaped grooves 132 concentrically with the central axis of the bearing housing sections 13. The end portions 132a of the grooves 132 are spaced apart from the radially arranged side edges of the base contact surfaces 131. Parallel to the grooves 132 is extending a return channel 133 through the bearing housing section 13, the return channel 133 having a cross-section larger than the cross-section of a roller body 14 and which in each end is connected with said groove 132 by means of an arc-shaped transition portion 134 leading into the ends of the respective grooves 132.

In the bearing contact surfaces 111 of the base sections 11 are arranged grooves 113 that are complementary to the grooves 132 in the opposing base contact surfaces 131 on the bearing housing section 13. The grooves extend to the radially arranged side edges of the bearing contact surfaces 111.

A guide portion 135 protrudes downward into the base section 11 groove 113 forming an extension of the outer periphery of the transition portion 134.

The grooves 113, 132 form a rolling track for a series of roller bodies 14, as the collective depth of the grooves is less than the roller body 14 diameters. When several roller bodies 14 are placed in their grooves 113, 132 the bearing housing section 13 will have a clearance to the base section 11 and roll on the roller bodies 14 which, when they have moved to the end of the groove 113 in the base section 11,

are directed into the return channel 133 via the transition portion 134. The roller bodies 14 form a continuous line in the grooves 113, 132 and the return channel 133 as they are driven forward in the grooves 113, 132 at the rotation of the bearing housing section 13 relative to the base section 11
5 until they meet with the guide portion 135 and are directed into the transition portion 134 and the return channel 133 as the roller bodies here are pushed forward by continuous feeding of new roller bodies 14.

10 Each rotary table section 1a, 1b is provided with a rotary drive unit 19 engaged with a sectioned gear rim 121 arranged on the ring sections 12a, 12b.

In the closed state (see Figure 2) the bearing housing sections 13 forming a cylindrical body, may rotate continuously,
15 as the base sections 11 form continuous, ring-shaped grooves 113, while the roller bodies 14 are directed into the return channel 133 via the transition portion 134 when the roller bodies 14 meet the guide portion 135 protruding into the base groove 113.

20 When the rotary table 1 is to be opened to be able to be drawn away from the pipe string 4, the ring sections 12a, 12b are rotated to an initial position wherein they are flush with their respective base section 11, so that the rotary table sections 1a, 1b form an essentially plane interface
25 against each other, as is shown in Figure 1. It is obvious to provide the rotary table 1 according to the invention with means safeguarding that the rotary table sections 1a, 1b are not shifted away from each other unless the ring sections 12a, 12b are in their initial positions.

30 Even if in the preceding is described and shown roller bodies 14 being ball-shaped, this does not exclude the use of other

forms of rotary bodies, such as conical rollers having a cone angle corresponding to the radius of the rolling track 113, 132.

5 The sliding shoes 116 are shown here inlaid in the base sections 11, but it is clear that being inlaid in the frame 2 where the glide shoes 116 extend upward toward the base sections 11 will provide the same resilient support as described above.

10 It is obvious to provide the surface 21, 112 whereon the sliding shoes slide, with replaceable sliding tracks (not shown).

Even if in the preceding is shown two half cylindrical ring sections 12a, 12b with corresponding base sections 11 rotatable about vertical rotary axes 114a, a radial pipe string opening 17 may be provided in other ways, for example by 15 opening and closing a C-shaped ring section (not shown) by a completing ring section (not shown) is displaced in a radial direction in and out of the C-shaped ring section opening, to thereafter being displaced away from the opening sector outside the periphery of the C-shaped ring section. 20

In the embodiment example described above and with reference to the Figures 1-4 the bearing housing sections 13 are arranged above the base sections 11. That does not preclude that these elements change place so that the base sections 11 25 are supported by the bearing housing sections 13, as is indicated in Figure 5. In such an embodiment said sliding shoes 116 are arranged in recesses 118 in a support surface 137 arranged in the bearing housing sections 13 and facing the frame 2 contact surface 21.

30 For a person skilled in the art it is also obvious to arrange the rotary table 1 according to the invention having a second

bearing system (not shown) mirrored relative to and connected to that being described above for the rotary table 1 thereby to be able to apply to the pipe string 4 an axially downward force when the pipe string must be driven by force down into
5 a bore hole in so-called "snubbing".

C l a i m s

1. A rotary table device (1) provided with means (15, 16, 122) arranged for suspension of a pipe string (4), the rotary table (1) comprising a rotary ring (12) arranged rotatable about the central axis of the rotary table (1), characterised in that the rotary ring (12) is formed by two or more ring sections (12a, 12b), each connected to a system comprising a bearing housing section (13) rotatable relative to a base section (11), a bearing housing groove (132) being formed in a base contact surface (131) on the bearing housing section (13) and a corresponding base groove (113) being formed in an opposing bearing housing surface (111) in the base section (11), said grooves (113, 132) forming an curve-shaped track for a roller body (14) and said groove (113, 132) having an curvature centre coinciding with the central axis of the rotary table (1), and the rolling diameter of the roller body (14) exceeding the collective depth of said grooves (113, 132), and a channel (133) connecting the end portions (132a) of the bearing housing groove (132) being formed in the bearing housing section (13), the channels (133) comprising transition portions (134) each provided with a guide portion (135) protruding into the base groove (113).
2. A device according to claim 1, characterised in that the roller body is ball-shaped.
3. A device according to claim 1, characterised in that at least one ring section (12a, 12b) and the appurtenant base section (11) form a rotary table section (1a, 1b) displaceable between a first position where the rotary table (1) is radially

closed and a second position where there in the rotary table (1) is provided a radial pipe string opening (17).

5 4. A device according to claim 1, characterised in that there to each ring section (12a, 12b) is connected a drive unit (19) in engagement with a sectioned gear rim (121) arranged on the ring sections (12a, 12b).

10 5. A device according to claim 1, characterised in that the rotary table (1) comprises two rotary table sections (1a, 1b) rotatably supported in a frame (2).

15 6. A device according to claim 5, characterised in that the rotary table sections (1a, 1b) are supported on a contact surface (21) arranged in the frame (2) perpendicularly to the central axis of the rotary table (1).

20 7. A device according to claim 6, characterised in that the one of the base section (11) and the bearing housing section (13) abutting the frame (2) contact surface (21), and/or the frame (2) is provided with a series of resilient sliding shoes (116) which, when the rotary table (1) is unloaded, are arranged to be able to maintain a clearance between the contact surface (21) and an opposing end surface (112, 137) on the base section (11), each sliding shoe (116) being resiliently supported in a recess (118) in said element (11, 13), or possibly in the frame (2), and protruding from the element (11, 25 13) end surface (112, 137) or the contact surface (21) respectively.

30

8. A device according to claim 1, c h a r a c t e r -
i s e d i n that the bearing housing section (13) is
arranged above the base section (11).
9. A device according to claim 1, c h a r a c t e r -
5 i s e d i n that the bearing housing section (13) is
arranged below the base section (11).