

ARRANGEMENT FOR FASTENING A PISTON-CYLINDER ARRANGEMENT
AND METHOD FOR REPLACING SEALINGS THEREIN.

- The present invention relates to an apparatus for mounting a piston-cylinder arrangement in a derrick, comprising two or more hydraulic piston-cylinder arrangements for raising and lowering a yoke which travels on guide rails in the derrick itself, in accordance with the preamble of claim 1, and a method of changing gaskets in this type of piston-cylinder arrangement according to the preamble of claim 5.
- 10 A derrick structure which was developed in 1987 by the present inventor and which has shown great promise embodies the RamRig™ concept. Two hydraulic piston-cylinder arrangements are used in the derrick for raising and lowering the drill string. The cylinders operate between the drill floor and a yoke which travels on guide rails in the derrick itself. The advantages of this concept are numerous. Among the most
- 15 important are that it is possible to place the drill floor at a higher level than the platform floor, that a derrick may be constructed having a significantly lower air resistance, and that a higher level of safety and longer lifetime are attained for the most expensive components of the derrick.
- 20 Since it is possible to position the drill floor higher than the platform floor, pipe handling is significantly simplified. There is no longer any need to arrange the pipe handling equipment at a high level in the derrick. All pipe handling equipment may be placed on the platform floor and the drill floor.
- 25 US 4,341,373 shows a similar derrick structure, where a yoke is slidably mounted on guide rails and is raised with the aid of a plurality of piston-cylinder arrangements. A travelling block is suspended from the yoke by a plurality of wire lines. In the travelling block is mounted the top drive.
- 30 The object of the present invention is to solve an important practical problem in the realization of the RamRig™ concept. This problem consists of the need to periodically change gaskets on the piston and/or cylinder in the piston-cylinder arrangement. This is very important with respect to safety. By means of the features disclosed in the characterizing clause of the subsequent claim 1, and the method in
- 35 accordance with the characterizing clause of claim 5, we have succeeded in providing a simple mounting apparatus for the cylinder which permits rapid and uncomplicated changing of the gaskets.

The invention will now be explained in greater detail with reference to the enclosed drawings, where

5 Figure 1 shows a RamRigTM derrick in every essential detail;

Figure 2 shows the derrick schematically, viewed from the side;

Figure 3 shows the derrick schematically, viewed from the front, with the top drive in its
10 lowermost position;

Figure 4 shows the derrick schematically, viewed from the front, with the top drive in its uppermost position;

15 Figures 5 - 7 show a section of the derrick and the drill floor and illustrate the lowering of one of the cylinders in sequence; and

Figures 8 - 13 show in detail the apparatus for mounting the cylinder and illustrate in detail the solution for this mounting process.

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Figure 1 shows a derrick 1 positioned on a drill floor. Drill floor 2 is arranged at a higher level than the platform floor 3, enabling the pipe handling equipment 4 to be placed mainly between the platform floor 3 and drill floor 2. Derrick 1 is generally gantry-shaped, having gantry legs 5, 6. Guide rails 7 for a yoke 8 and a top drive 9 run
25 along each gantry leg 5, 6. Hydraulic piston-cylinder arrangements 10 and 11 are positioned so as to extend along each gantry leg 5, 6, and operate between drill floor 2 and yoke 8, for moving yoke 8 vertically along guide rails 7.

The yoke 8 is provided with a plurality of sheaves 12, preferably four, for running the
30 wire lines 13. Wire lines 13 extend from drill floor 2 along each gantry leg 5, 6, over sheaves 12 and down to top drive 9. By retracting and extending the piston-cylinder arrangement 10, 11, it is thereby possible to raise and lower top drive 9.

In Figures 2, 3 and 4 the function of the hoisting system is seen most clearly. In
35 Figures 2 and 3 the piston-cylinder arrangement 10, 11 is shown in a completely retracted state. Top drive 9 is then at its lowermost position, quite close to the drill floor. Yoke 8 is at the upper end of the piston-cylinder arrangement.

When the pistons in the piston-cylinder arrangement are extended, yoke 8 is lifted along guide rails 7 and up to the top of derrick 1. The top drive is then lifted, as a result of the transmission generated as wire lines 13 are run over sheaves 12, from its position adjacent drill floor 2 to a position directly below yoke 8. The height to which top drive 9 is lifted is thus the double of that to which yoke 8 is lifted.

There may, for example, be as many as eight wire lines 13 arranged in the hoisting apparatus described above, with the wire lines being strung two by two in their respective tracks over the same sheave 12. On yoke 8 four sheaves are arranged in pairs at each end of yoke 8. Wire lines 13 are thus arranged in two sets 13a and 13b, extending from attachment points 14a and 14b at drill floor 2, over sheaves 12 and down to top drive 9. Attachment points 14a and 14b are spaced apart horizontally by a distance corresponding approximately to the length of yoke 8.

Figures 5 - 7 provide a schematic illustration of the lower portion of derrick 1 and drill floor 2. Here are also shown the piston-cylinder arrangements 10, 11, yoke 8 with sheaves 12 and top drive 9. Wire lines 13 run from drill floor 2 over their respective sheaves 12 and down to top drive 9.

Each piston-cylinder arrangement 10, 11 consists of a cylinder 20 and a piston 21 having piston rod 22. Cylinder 20 is secured at one end thereof to drill floor 2, while piston rod 22 is attached to yoke 8. Piston 21 divides the cylinder into two chambers, a lower chamber and an upper chamber. The lower chamber is circular-cylindrical and delimited only by the walls of cylinder 20 and the lower end surface 25 of the piston. The upper chamber is also delimited by the walls of cylinder 20, but in addition is bounded by piston rod 22 and the upper annular surface 26 of piston 21. the piston is further provided with one or more gaskets 27, and the cylinder comprises an end cover (not shown) with a gasket (not shown) for sealing off cylinder 20.

Cylinder 20 is suspended in a support pipe 28 in a suspension device 29 at the upper end of support column 28. Feed lines 30 for supplying hydraulic fluid to cylinder 20 are inserted through an opening in the lower end of the support column. Support column 28 is, on its part, fixed in place with the aid of a mounting apparatus 31 (not shown in Figures 5 - 7) at drill floor 2. This mounting apparatus 31 is illustrated in detail in Figures 8 -13, which figures show a detailed section at drill floor 2.

Figure 8 shows cylinder 20 with support column 28 mounted in drill floor 2. The upper portion of Figures 8 - 10 show the section in elevation and cross-section, while the lower portion of the same figures shows the mounting apparatus viewed from above. Mounting apparatus 31 is also shown in an enlarged section in Figure 8, and consists of a flange 32 fixedly joined to support column 28, in which flange 32 is formed a groove 33 which extends around the periphery of support column 28. When the mounting apparatus 31 is in assembled state, a locking ring 34 is engaged with groove 33. Locking ring 34 also rests against drill floor 2, either directly or via a structure firmly connected with drill floor 2. To permit the attachment and removal of locking ring 34, the ring 34 is separated into two or more segments.

Radially exterior to locking ring 34 is provided a safety ring 35 which is also separated into two or more segments. Safety ring 35 is adapted to hold locking ring 34 in engagement with groove 33 in flange 32, and thus fills out a gap 36 between locking ring 34 and a fixing device 37, which is firmly connected with drill floor 2. To prevent safety ring 35 from moving upwards and thus out of gap 36, a locking means 38, also divided into two or more sections, is arranged over said ring.

Locking means 38 may be secured to fixing device 37 with the aid of, for example, a plurality of bolts 39.

With the aid of Figures 5 - 13, the method of changing piston gaskets 27 and the gasket for cylinder 20 at the upper end thereof will now be explained. First, yoke 8 is locked securely to its guide rails 7 in derrick 1 so as to relieve the downward-directed force of the piston-cylinder arrangement 10, 11. Then the mounting apparatus 31 is loosened, first by unscrewing bolts 39 to enable the removal of locking means 38. This results in the situation depicted in Figure 9. Lowermost in Figure 9 is shown the locking means 38, now removed. Above this is the remainder of the mounting apparatus 31 shown in plan view, where fixing device 37 is now visible. At the top of Figure 9, this is illustrated in elevation and in cross-section.

Now it is possible to lift safety ring 35 out of gap 36. This is illustrated in Figure 10, where safety ring 35 is shown at the bottom and the remainder of the mounting apparatus is shown thereabove in plan view and in elevation, respectively.

Now the locking ring 34 is exposed. However, it is now clamped between the upper wall of groove 33 and drill floor 2. Cylinder 20 and support column 28 must thus be

raised slightly in order to nullify this clamping effect. This may be done in a variety of ways. For example, one may apply a pressure in cylinder 20 on the rod side 26 of piston 21 and, with the aid thereof, raise cylinder 20 and support column 28. Another way to do this is to position a jack 40 (see Figure 6 and Figure 7), or the like, between
5 drill floor 2 and a projection 41 on support column 28, or between platform floor 3 and support column 28. If desired, another type of lifting device may be used.

In Figure 12 is shown the situation after locking ring 34 has been removed, where locking ring 34 is shown lowermost in Figure 12 and the remaining part of the mounting
10 apparatus is shown thereabove in plan view and in elevation, respectively. An enlarged section of the remaining part of mounting apparatus 31 is also shown at top, right, in Figure 12.

When the mounting apparatus for support column 28 has now been loosened, the
15 support column 28 with cylinder 20 may be lowered downward in relation to drill floor 2. This lowering may be done, for example, by controlled release of the pressure on the top side 26 of piston 21. Said lowering may be carried out until piston 21 rests against the end cover of cylinder 20. Now the end cover must be removed in order for cylinder 20 to be drawn off piston 21. To hold cylinder 20 during the removal of the end cover,
20 some form of hoisting or lifting apparatus, for example, a jack 40, must be provided.

After cylinder 20 has been drawn completely off piston 21, the gaskets 27 on piston 21 may be changed in a conventional manner. Gaskets in the end cover of cylinder 20 and any gaskets at the upper end of the cylinder may also be changed in a conventional
25 manner.

In remounting of cylinder 20, it is lifted up and drawn down over piston 21 with the aid, for example, of jacks 40. Then the end cover may be mounted and pressure may again be applied in cylinder 20 on the upper side 26 of piston 21, whereby with the aid
30 of this hydraulic pressure the cylinder may be raised upward in relation to drill floor 2 until groove 33 in flange 32 aligns with fixing device 37. Locking ring 34 is then put into place, cylinder 20 with support column 28 is lowered downward until locking ring 34 rests on drill floor 2, and safety ring 35 is positioned in gap 36, thereafter to be securely locked with the aid of locking means 38 and bolts 39. The changing of the
35 gaskets is now completed, and the only task remaining is to release the yoke 8 from its locked position on the guide rails.

Although a specific embodiment of the mounting apparatus is described in the above, the present invention is not restricted to the use of this specific embodiment. Locking ring 34 may also be held in engagement with groove 34 in other ways and with the aid of devices other than those shown and described herein. During the process, certain steps in the method may be carried out in a different sequence; for example, one may remove the cylinder's end cover before commencing the lowering of the cylinder in relation to the drill floor, but then it will not be possible to utilize hydraulic pressure on the rod side of the piston to execute a controlled lowering, and one would thus have to use other types of hoisting or lifting devices in order to accomplish this.

P a t e n t C l a i m s

1.

An apparatus for mounting a piston-cylinder arrangement in a derrick (1) placed on a drill floor (2), which hydraulic piston-cylinder arrangement (10, 11) is adapted to raise and lower a yoke (8) which travels on guide rails (7) in the derrick (1) itself, and comprises a cylinder (20), a piston (21), and a piston rod (22), which piston rod (22) is joined at one end thereof to the piston (21), which piston (21) is adapted to be inserted into the cylinder (20), the end of said piston rod (22) opposite the piston (21) being connected to the yoke (8), and the cylinder (20) being held securely with the aid of a mounting apparatus (31) in relation to the drill floor (2), characterized in that the cylinder (20), for the changing of gaskets (27) on the piston (21) and the cylinder (20), is arranged so as to be lowerable in relation to the mounting thereof, and that the mounting apparatus (31) therefor is designed to be releasable and comprises a flange (32) permanently mounted on the cylinder (20), a fixing device 37 in fixed position in relation to the drill floor (2), a dividable locking ring (34), and a locking means (38), said locking ring (34) being adapted for engagement between the flange (32) and the fixing device (37) and being firmly held in said engagement with the aid of the locking means (38).

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2.

An apparatus in accordance with claim 1, characterized in that the locking ring (34) is adapted for placement in engagement with a groove (33) in the flange (32), which groove (33) extends continuously or with interruption around a substantial portion of the periphery of the cylinder (20), and that the locking ring (34) is maintained in said engagement with the aid of a dividable safety ring (35) which is placed between the locking ring (34) and the fixing device (37).

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3.

An apparatus in accordance with claim 2, characterized in that the locking means (38) constitutes a dividable flange which in mounted state is secured to the fixing device (37) and bears against the safety ring (35) and optionally also the locking ring (34).

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An apparatus in accordance with any one of the preceding claims,



characterized in that the cylinder (20) is suspended in a support column (28) which encloses the cylinder (20) and that the flange (32) is attached to this support column (28).

5 5.

A method of changing gaskets in a piston-cylinder arrangement (10, 11) in a derrick (1) which is placed on a drill floor (2), which hydraulic piston-cylinder arrangement (10, 11) is adapted to raise and lower a yoke (8) which travels on guide rails (7) in the derrick (1) itself, and comprises a cylinder (20), a piston (21), and a piston rod (22),
10 which piston is joined at one end thereof to the piston (21), which piston (21) is adapted to be inserted into the cylinder (20), the end of said piston rod (22) opposite the piston (21) being connected to the yoke (8), and the cylinder (20) being held securely with the aid of a mounting apparatus (31) in relation to the drill floor (2), which mounting apparatus (31) is in accordance with any one of the claims 1 - 4, characterized
15 in that:

- the yoke 8 is locked securely to the derrick (1), by means of a locking apparatus,
- the hydraulic pressure in the cylinder (20) is relieved,
- the locking device (38) is exposed,
- the locking ring (34) is removed from its engagement with the flange (32) mounted
20 on the cylinder (20),
- the end cover for the cylinder (20) is removed,
- the cylinder (20) is lowered in relation to the drill floor (2) and the piston rod (22) until the rod is drawn completely out of the piston (21),
- the gaskets (27) on the piston, and optionally at the upper end and/or the end cover
25 of the cylinder, are removed and replaced with new ones,
- the cylinder (20) is raised and slid back onto the piston (21) until the flange (32) aligns with the fixing device (37),
- the end cover for the cylinder is mounted,
- the locking ring (34) is put into place in engagement between the flange (32) and the
30 fixing device (37),
- the locking device (38) is secured in place,
- the hydraulic pressure in the cylinder (20) is restored, and
- the yoke (8) is released from its locked position in the derrick (2).

35 6.

A method in accordance with claim 5, characterized in that, prior to removal of the end cover for the cylinder (20), pressure is applied in the chamber of the cylinder



(20), on the piston rod side (26) of the piston (21), to effect controlled lowering of the cylinder (20) in relation to the drill floor (2), that the end cover is then removed, and that the further lowering and withdrawal of the cylinder (20) from the piston (21) is carried out with the aid of a separate hoisting/lifting apparatus, e.g., a jack (40).

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7.

A method in accordance with claim 5 or 6, characterized in that the cylinder (20) is raised slightly after the locking device (38) is released to nullify any possible clamping effect between the locking ring (34), the groove (33) in the flange (32) and the
10 drill floor (2).

