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(54) **Drill string stabiliser**

(57) A drilling string stabiliser tool comprising a cylindrical stabiliser body and a plurality of stabiliser blade assemblies mounted on the outer surface of said cylindrical body, wherein said stabiliser assembly comprises a stabiliser blade having an upper surface and side walls,

wherein the stabiliser blade has an elongated shape with a front half having a front end and a back half having a back end, and wherein the average width of the back half of the stabiliser blade is substantially smaller than the average width of the front half.

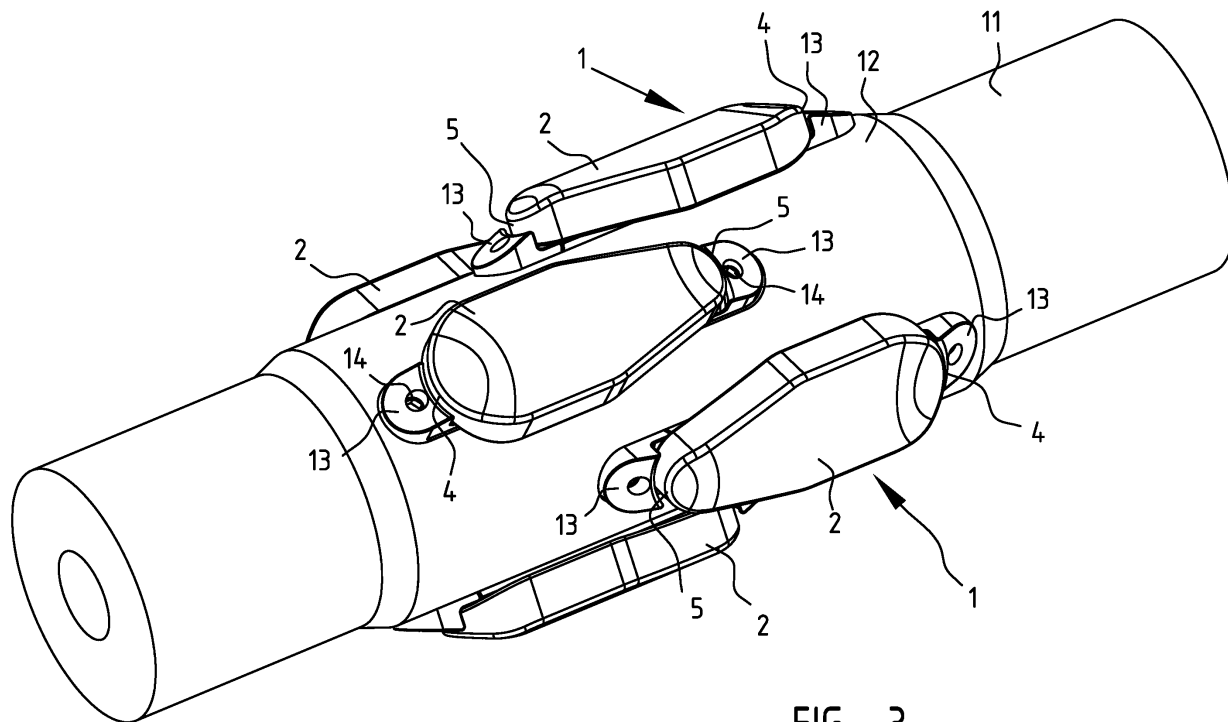


FIG. 3

Description

[0001] The invention relates to a drilling string stabiliser tool comprising a cylindrical stabiliser body and a plurality of stabiliser blade assemblies mounted on the outer surface of said cylindrical body, wherein said stabiliser blade assembly comprises a stabiliser blade having an upper surface and side walls, wherein the stabiliser blade has an elongated shape with a front half having a front end and a back half having a back end.

[0002] Such a stabiliser tool, which for instance are used when drilling oil wells, is described in WO 00/58596. The primary function of the stabiliser in the drilling string is to support and stabilise the bottom hole assembly in the borehole through the earth surface. The design of the stabiliser blades should be such that they reduce both friction and drag in the borehole during all phases of the drilling operations. In addition the stabiliser should not inhibit the drilled cuttings being carried out of the hole by the drilling fluid. The contact area of the stabiliser blades should be large enough to adequately support the drill string in the borehole while minimising or eliminating penetration of the borehole wall. The stabiliser should also provide stability when weight is applied or buffeting occurs caused by vibration and shock loads being transmitted through the drill string.

[0003] The invention aims at a stabiliser with improved properties, in particular with respect to friction, hydrodynamic properties, use, maintenance and/or costs.

[0004] Therefore, preferably the average width of the back half of the stabiliser blade is substantially smaller than the average width of the front half. Hereby the shape more or less resembles that of the cross section of the wing of an aircraft, and the drilling fluids and drilling cuttings are efficiently displaced around the stabiliser blades, and balling-up and packing off of the stabiliser with drilled cuttings is greatly reduced.

[0005] Preferably the stabiliser blades are axially aligned with the stabiliser body, i.e. orientated along the axes of the stabiliser body, to minimise the increased frictional drag experienced while sliding the drill string in the oriented mode, while making trajectory changes to the borehole. The orientations of the stabiliser blades will enhance performance and increase the rate of penetration in an otherwise problematic and time-consuming operation.

[0006] Preferably the centres of the stabiliser blade assemblies are located on at least two coaxial spaced apart circles on the surface of the stabiliser body. Preferably three stabiliser blade assemblies are located on each circle. Preferably the back halves of the stabiliser blades on one circle extend towards the other circle. Thereby the front halves of the blades on the front circle are always actually in front, whether the drilling string is in boring mode or being retracted. Preferably the back ends of the back halves of the stabiliser blades on one circle extend between the back halves of the stabiliser blades on the other circle and beyond the back ends thereof. More pref-

erably the back ends of the back halves of the stabiliser blades on one circle extend between the back halves of the stabiliser blades on the other circle and at least up to the central part thereof. The positioning of the stabiliser blades - three upper and three lower - are suitably positioned to optimise the hydrodynamic efficiency of the tool. This arrangement also assists in streamlining the mud flow around the stabiliser blades, minimising the restriction of cuttings being carried out of the hole and enhancing hole cleaning, while maintaining all round centralisation of the bottom hole assembly in the borehole.

[0007] Preferably the stabiliser blade assemblies are detachably connected with the stabiliser body. Replaceable blades can be easily and quickly replaced on the rig site. This feature enables the stabiliser to be redressed at the rig site, enabling worn and damaged stabiliser blades to be quickly replaced, eliminating the necessity to transport worn or damaged stabilisers to specialised workshop for repair. Blades of different sizes can be fitted to the stabiliser body, eliminating the necessity to have additional

under-gauge stabilisers on the rig site. The ability to replace damaged or worn stabiliser blades on location, and dress the stabiliser body with blades of different sizes will greatly reduce the inventory of stabilisers required on location. The cost saving on daily rental charges, transportation costs, and the reduction in storage space, adds to the technical advantage of the replaceable blade stabiliser concept.

[0008] Preferably the surface of the stabiliser body comprises recessed slots wherein the stabiliser blade assemblies are mounted, such that at least a substantial part of the stabiliser blades extend outside the stabiliser body. In this manner the mounting features of the blade assembly could be designed independently from the stabilising features.

[0009] Preferably the front end of the stabiliser blade is substantially semicircular, seen from above. Preferably the back end of the stabiliser blade is substantially semicircular, seen from above. Preferably the back half of the stabiliser blade is tapered towards the back end, seen from above. Preferably the upper surface of the stabiliser blade slopes downwards near and towards the front end. Preferably the upper surface of the stabiliser blade slopes downwards near and towards the back end. Preferably the bottom surface of the stabiliser blade slopes upwards near and towards the front end. Preferably the bottom surface of the stabiliser blade slopes upwards near and towards the back end. Preferably the edges between the side walls and the upper surface are unsharp.

[0010] The shape of the stabiliser blades is such that they efficiently displace the drilling fluids and drilling cuttings around the stabiliser blades, and greatly reduce balling-up and packing off of the stabiliser with drilled cuttings. The stabiliser blade has a large surface contact area. The tapered shapes of the blade reduce friction, and enhance the stabilisers performance while sliding in the oriented mode. The function of the cross sectional

taper of the blade is to reduce rotary torque and minimise undercutting when drilling in the rotary mode. The toe and heel angle of the stabilised blades are preferably machined at approximately 20 degrees to minimise hanging-up and reduce up and down drag in the borehole.

[0011] Preferably the stabiliser blade assembly further comprises two mounting blocks, having holes for mounting the blocks on a stabiliser body with bolts, which mounting blocks have engaging walls that are shaped such that they secure the front end and the back end of the stabiliser blade to the stabiliser body when they are mounted. Preferably the stabiliser blade comprises a downwards projecting mounting part having a sloping front end engaging wall and a sloping back end engaging wall, and wherein the engaging walls of the mounting blocks are complementary sloping, such that the mounting part of the stabiliser blade is in a clamping manner pressed against the stabiliser body by the mounting blocks when they are mounted. Preferably the dimensions of the mounting blocks, the mounting part of the stabiliser blade and the stabiliser body are such that the bottom sides of the mounting blocks cannot touch the stabiliser body when they are mounted. Preferably the mounting blocks comprise a bolt head slot extending from the engaging wall towards the interior of the block, and a narrower bolt shank slot extending along said bolt head slot towards the bottom surface of the block, such that a head of the bolt can be inserted in the bolt head slot and the bolt shank can slide in the bolt shank slot before the blocks are mounted. Preferably the mounting blocks comprise a tooling bore extending between the top surface and the interior side of the bolt head bore for inserting the end of a mounting tool, such as a screwdriver or a wrench, when the blocks are mounted.

[0012] The stabiliser blades are according to this preferred embodiment mounted in the recess, milled in the body of the stabiliser and secured to the body by two tapered blocks both mounted in the recess, one in front of the blade and one after. The tapered part of the blocks mates with the tapered lower part (anchor) of the stabiliser blade. The tapered blocks are secured to the stabiliser body by a bolt. The bolt is slotted into a recess in the tapered block so the head of the bolt is not exposed to the wall of the well bore. When the two tapered blocks are tightened into position, the pressure exerted between the tapered blocks and the tapered anchor of the stabiliser blade in the recess locks the entire assembly in place. The head of the bolt that slots into the tapered block is greater than the hole in the top of the tapered block, through which the bolt is tightened. When undoing the bolt to redress the blades, the bolt extracts the tapered blocks from the recess in the stabiliser body ensuring that the tapered surfaces of the blocks are disengaged from the tapered surface of the stabiliser blade.

[0013] Preferably the outer ends of the mounting blocks are substantially semicircular, seen from above. Preferably the upper surfaces of the mounting blocks slope downwards towards the outer ends. The upper sur-

face of the mounting blocks which locks the blades to the stabiliser body, thus preferably have wedge shaped taper extending from the stabiliser body to the toe and heel angle of the blade respectively to protect the blade and streamline the shape to minimise hanging-up when tripping in and out of the hole.

[0014] The invention also relates to a stabiliser blade assembly for use with a drilling string stabiliser, comprising a stabiliser blade having an upper surface and side walls, wherein the stabiliser blade has an elongated shape with a front half having a front end and a back half having a back end.

[0015] Each of the above preferred features, whether separate or in combination, can be considered as separate inventions.

[0016] The invention will be illustrated by way of a preferred embodiment and with reference to the drawings, wherein like elements are assigned like reference numerals, and in which:

Figure 1 is a perspective view of a stabiliser blade;

Figure 2 is a cross-section of a stabiliser tool;

Figure 3 is a perspective view of the stabiliser tool of Figure 2; and

Figure 4 is a partial longitudinal cross-section of a mounted stabiliser blade assembly.

[0017] According Figure 1 a stabiliser blade 1 is made from mild steel and comprises an upper stabilising part 2 and a lower mounting part 3. The stabilising part 2 has an elongated shape with front end 4 and a back end 5, an upper surface 6 and substantially upright side walls 7. The average width of the back half of the stabilising part 2 is tapered towards the back end 5, seen from above, and thereby the average width of the back half is substantially smaller than the average width of the front half.

[0018] Both ends 4, 5 of the stabilising part 2 are semicircular, seen from above. The end part of upper surface 6 slopes downwards near and towards both ends 4, 5. Likewise, the end part of the bottom surface 8 slopes upwards near and towards both ends 4, 5. The edges between the side walls 7 and the upper surface 6, as well as between the side walls 7 and the bottom surface 8, are provided with a small radius. The angle between the sloping surfaces and the horizontal plane is approximately 20 degrees.

[0019] The mounting part 3 projects downwards from the stabilising part 2, and has a sloping front end engaging wall 9 and a sloping back end engaging wall 10. The angle between the engaging walls 9, 10 and the horizontal plane is approximately 75 degrees. The side walls of the mounting part 3 are upright. The width and the length of the mounting part 3 are smaller than the width and length of the stabilising part 2, whereas the height of both

parts 2, 3 is approximately equal.

[0020] According to Figures 2 and 3 a stabiliser body 11 comprises a central portion 12 having a slightly larger diameter than the end portions of the stabiliser tool, which can be connected to a drilling string having the same diameter. Six stabiliser blades 1 are mounted in an axially aligned manner on the cylindrical surface of the central portion 12. A first group of three stabiliser blades 1 is arranged and equally distributed on a first circle on said cylindrical surface and a second group of three stabiliser blades 1 is arranged and equally distributed on a second circle, which second circle is spaced apart from the first circle. The front ends 4 on both circles extend in opposite directions, away from both circles, such that the front area of the forward moving stabiliser tool is provided with the wider front ends 4 of the stabiliser blades 1, irrespective of the direction in which the drilling string is being moved. The back halves of the two groups of stabiliser blades 1 are arranged in between each other, where the back ends 5 reach, in axial direction, approximately towards the centres of the neighbouring stabiliser blades 1. Thereby oblique channels are formed between the back halves of each neighbouring pair of stabiliser blades 1.

[0021] Each stabiliser blade 1 is mounted on the stabiliser body 11 by means of two mounting blocks 13 and recessed head bolts 14, which will be explained in more detail with reference to Figure 4.

[0022] According to Figure 4 the cylindrical surface of central portion 12 of stabiliser body 11 is provided with axially aligned mounting slots 15, having the same width and height as the mounting part 3 of the stabiliser blades 1. The length of the mounting slot 15 is such that a mounting block 13 having the same width fits between the engaging wall 9, 10 of the mounting part 3 and the semicircular end wall of the mounting slot 15 at both ends. The mounting blocks 13 are also provided with sloping engaging walls 18 which mate with the engaging walls 9, 10 of the mounting part 3. The length of the bottom of the mounting blocks 3 is slightly longer than the remaining length of the bottom of the mounting slot 15 when the mounting part 3 is present on the bottom. Thereby the mounting blocks cannot reach said bottom when the bolts 14 are mounted, and the stabiliser blade 1 is pressed onto the stabiliser body 11 in a clamping manner.

[0023] The upper surface 16 of the mounting blocks 13 is sloping at approximately the same angle, that is approximately 20 degrees, as the ends of the upper surface 6 of the stabiliser part 2. Further the outer ends of the mounting blocks 13 are semicircular, so that they fit in the mounting slot 15.

[0024] The mounting blocks 13 are provided with a bolt head slot 19, which extend from the engaging wall 18 towards the interior of the block 13, and a narrower bolt shank slot 20 extending along said bolt head slot 19 towards the bottom surface of the block, such that the head of the bolt 14 can be inserted in the bolt head slot 19 and the bolt shank can slide in the slot before the blocks 13

are mounted. The mounting blocks 13 further comprise a tooling bore 21 extending between the top surface 16 and the interior side of the bolt head slot 19 for inserting the end of a mounting tool, such as a screwdriver or a wrench, when the blocks 13 are mounted.

[0025] Whereas the invention is described by way of a preferred embodiment, the man skilled in the art will appreciate that many modifications can be made within the scope of the invention as defined by the claims.

Claims

1. A drilling string stabiliser tool comprising a cylindrical stabiliser body (11) and a plurality of stabiliser blade assemblies (1, 13) mounted on the outer surface of said cylindrical body (11), wherein said stabiliser blade assembly (1, 13) comprises a stabiliser blade (1) having an upper surface (6) and side walls (7), wherein the stabiliser blade (1) has an elongated shape with a front half having a front end (4) and a back half having a back end (5), **characterized in that** the average width of the back half of the stabiliser blade (1) is substantially smaller than the average width of the front half.
2. The drilling string stabiliser tool according to claim 1, wherein the stabiliser blades (1) are axially aligned with the stabiliser body (11).
3. The drilling string stabiliser tool according to claim 1 or 2, wherein the centres of the stabiliser blade assemblies (1, 13) are located on at least two coaxial spaced apart circles on the surface of the stabiliser body (11).
4. The drilling string stabiliser tool according to claim 3, wherein three stabiliser blade assemblies (1, 13) are located on each circle.
5. The drilling string stabiliser tool according to claim 3 or 4, wherein the back halves of the stabiliser blades (1) on one circle extend towards the other circle.
6. The drilling string stabiliser tool according to claim 3, 4 or 5, wherein the back ends (5) of the back halves of the stabiliser blades (1) on one circle extend between the back halves of the stabiliser blades (1) on the other circle and beyond the back ends (5) thereof, preferably at least up to the central part thereof.
7. The drilling string stabiliser tool according to any of the previous claims 1 - 6, wherein the stabiliser blade assemblies (1, 13) are detachably connected with the stabiliser body (11).
8. The drilling string stabiliser tool according to any of the previous claims 1 - 7, wherein the surface of the

stabiliser body (11) comprises recessed slots (15) wherein the stabiliser blade assemblies (1, 13) are mounted, such that at least a substantial part of the stabiliser blades (1) extend outside the stabiliser body (11).

9. A stabiliser blade assembly (1, 13) for use with a drilling string stabiliser, comprising a stabiliser blade (1) having an upper surface (6) and side walls (7), wherein the stabiliser blade (1) has an elongated shape with a front half having a front end (4) and a back half having a back end (5), **characterized in that** the average width of the back half is substantially smaller than the average width of the front half.
10. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1-9, wherein the front end (4) of the stabiliser blade (1) is substantially semicircular, seen from above.
11. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 10, wherein the back end (5) of the stabiliser blade (1) is substantially semicircular, seen from above.
12. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 11, wherein the back half of the stabiliser blade (1) is tapered towards the back end (5), seen from above.
13. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 12, wherein the upper surface (6) of the stabiliser blade (1) slopes downwards near and towards the front end (4).
14. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 13, wherein the upper surface (6) of the stabiliser blade (1) slopes downwards near and towards the back end (5).
15. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 14, wherein the bottom surface (8) of the stabiliser blade (1) slopes upwards near and towards the front end (4).
16. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 15, wherein the bottom surface (8) of the stabiliser blade (1) slopes upwards near and towards the back end (5).
17. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 16, wherein the edges between the side walls (7) and the upper surface (6) and/or the bottom surface (8)

are unsharp.

18. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 1 - 17, wherein the stabiliser blade assembly (1, 13) further comprises two mounting blocks (13), having holes (19, 20, 21) for mounting the blocks (13) on a stabiliser body (11) with bolts (14), which mounting blocks (13) have engaging walls (18) that are shaped such that they secure the front end (4) and the back end (5) of the stabiliser blade (1) to the stabiliser body (11) when they are mounted.
19. The stabiliser tool or stabiliser blade assembly (1, 13) according to claim 18, wherein the stabiliser blade (1) comprises a downwards projecting mounting part (3) having a sloping front end (9) engaging wall and a sloping back end engaging wall (10), and wherein the engaging walls (18) of the mounting blocks (13) are complementary sloping, such that the mounting part (3) of the stabiliser blade (1) is in a clamping manner pressed against the stabiliser body (11) by the mounting blocks (13) when they are mounted.
20. The stabiliser tool or stabiliser blade assembly (1, 13) according to claim 19, wherein the dimensions of the mounting blocks (13), the mounting part (3) of the stabiliser blade (1) and the stabiliser body (11) are such that the bottom sides of the mounting blocks (13) cannot touch the stabiliser body (11) when they are mounted.
21. The stabiliser tool or stabiliser blade assembly (1, 13) according to claim 18, 19 or 20, wherein the mounting blocks (13) comprise a bolt head slot (19) extending from the engaging wall (18) towards the interior of the block (13), and a narrower bolt shank slot (20) extending along said bolt head slot (19) towards the bottom surface of the block, such that a head of the bolt (14) can be inserted in the bolt head slot (19) and the bolt shank can slide in the bolt shank slot (20) before the blocks (13) are mounted.
22. The stabiliser tool or stabiliser blade assembly (1, 13) according to claim 21, wherein the mounting blocks (13) comprise a tooling bore (21) extending between the top surface (16) and the interior side of the bolt head slot (19) for inserting the end of a mounting tool, such as a screwdriver or a wrench, when the blocks (13) are mounted.
23. The stabiliser tool or stabiliser blade assembly (1, 13) according to any of the previous claims 18 - 22, wherein the outer ends of the mounting blocks (13) are substantially semicircular, seen from above.
24. The stabiliser tool or stabiliser blade assembly (1,

13) according to any of the previous claims 18 - 23,
wherein the upper surfaces (16) of the mounting
blocks slope downwards towards the outer ends.

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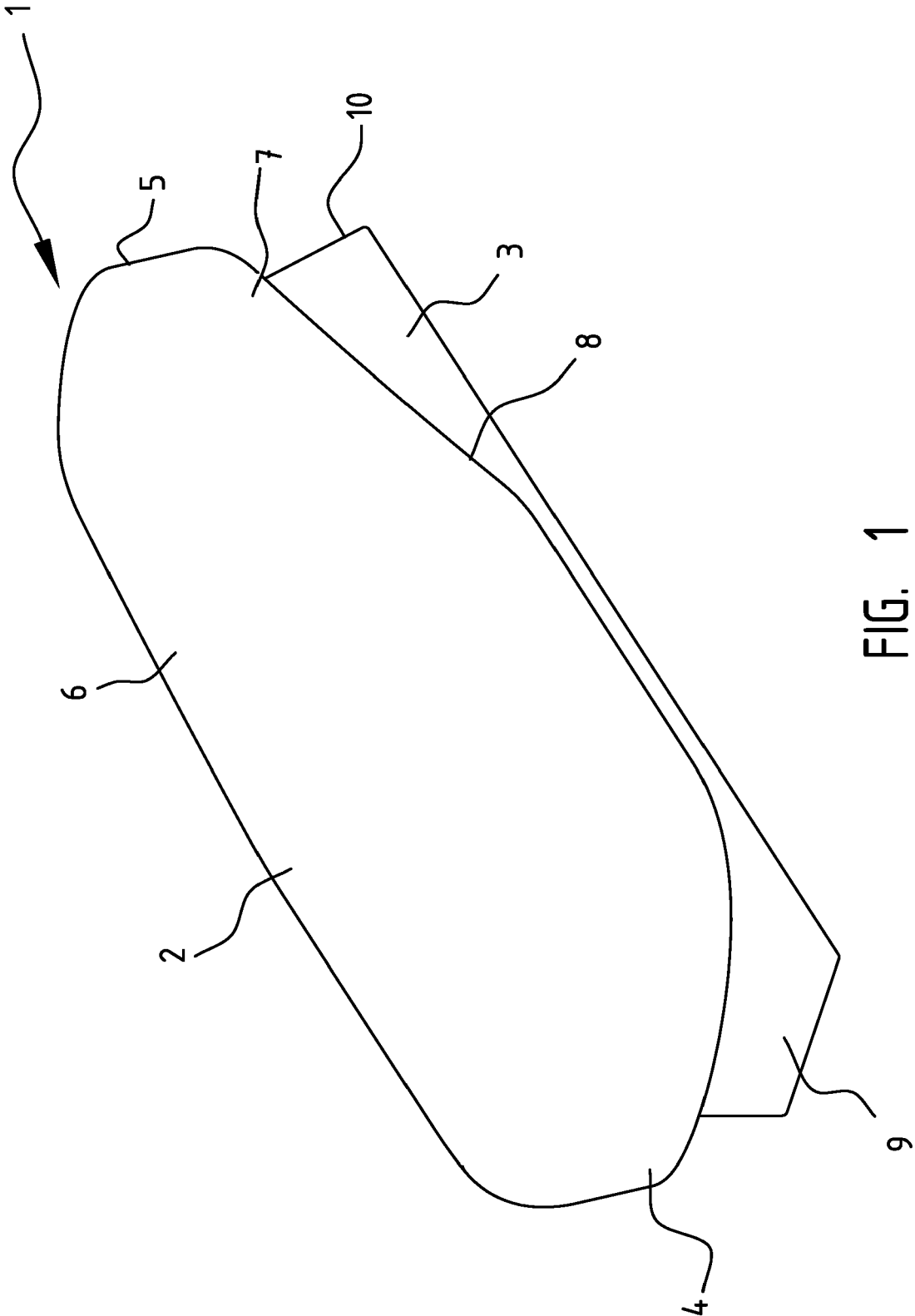


FIG. 1

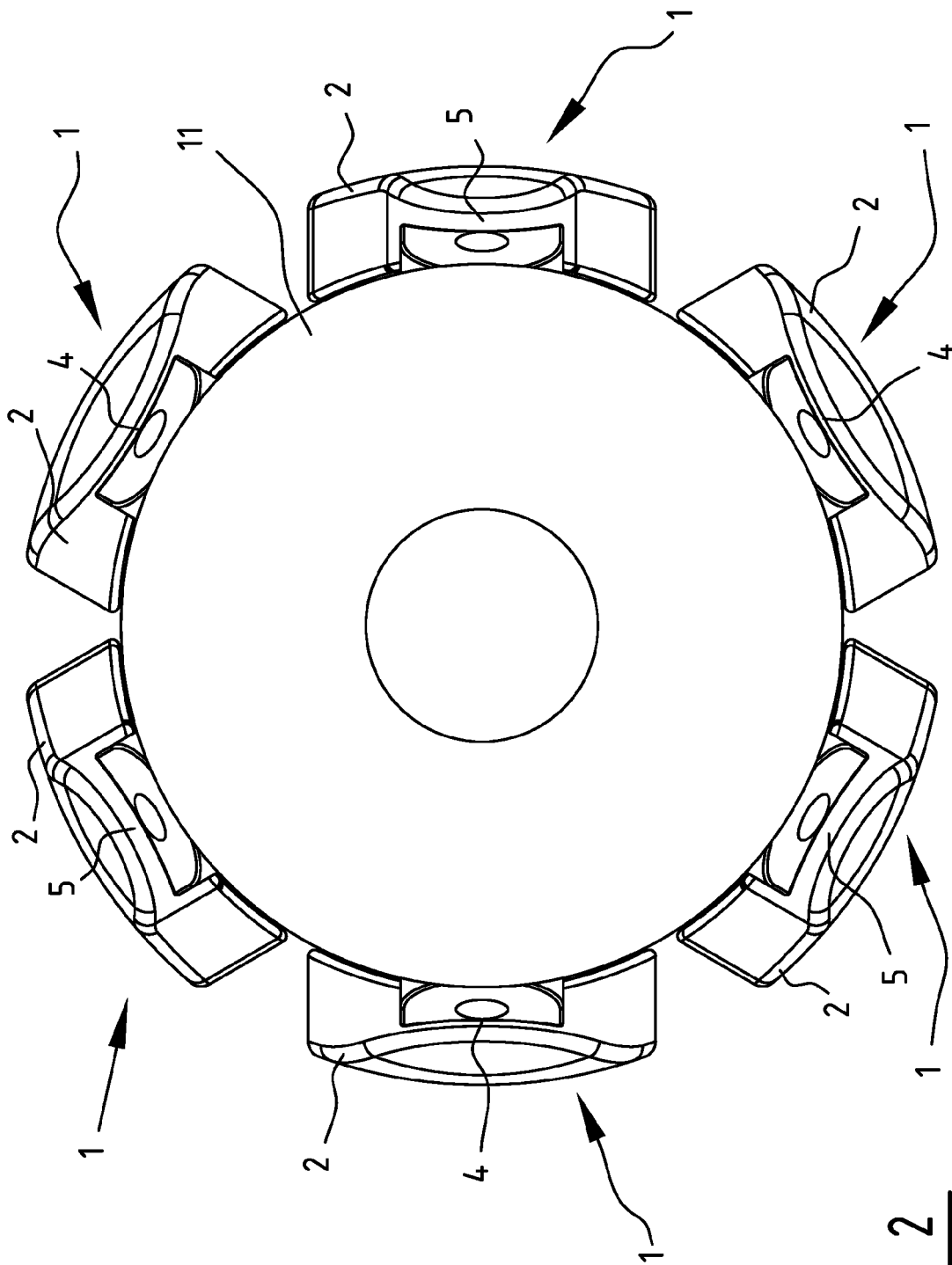


FIG. 2

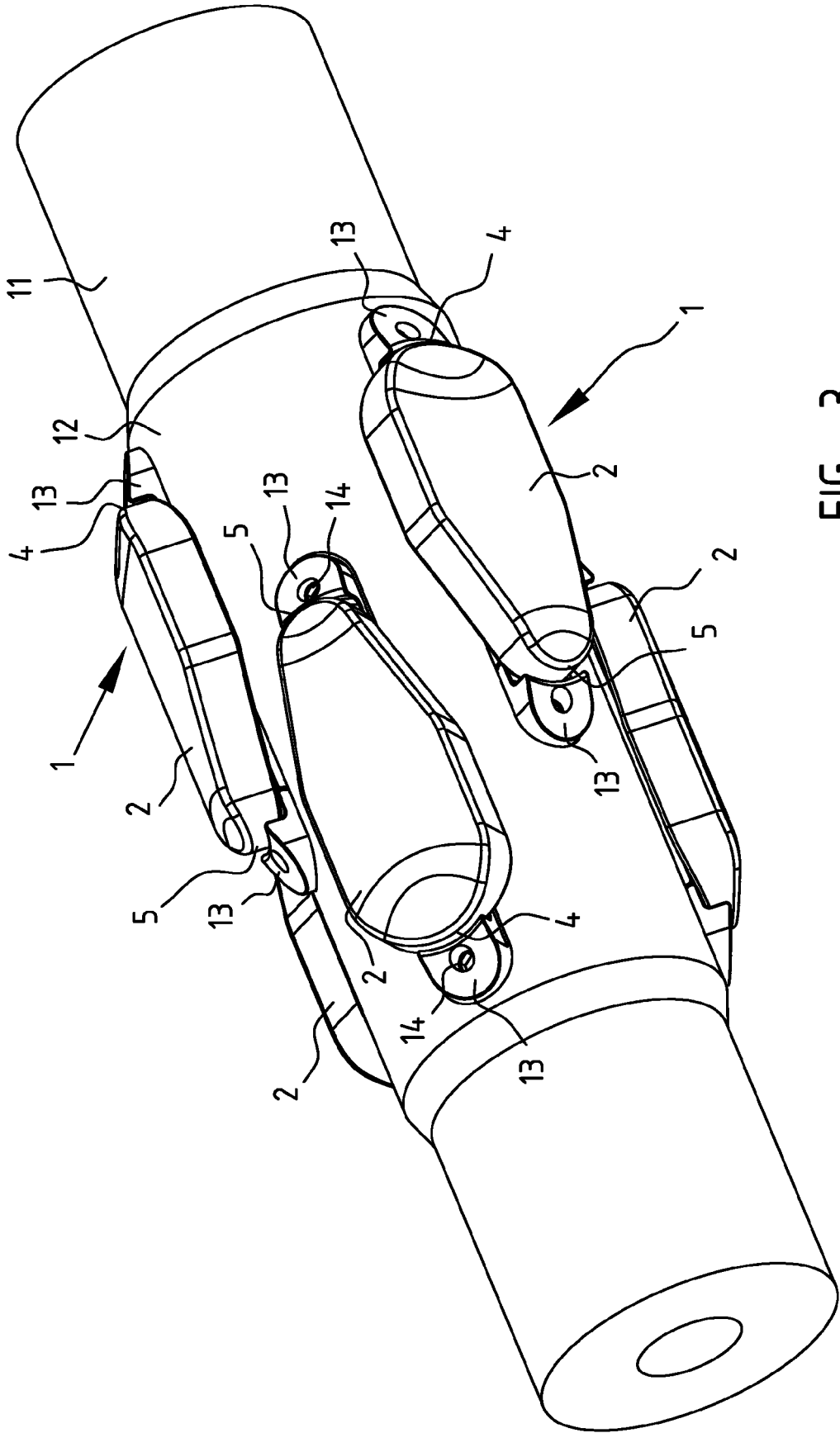


FIG. 3

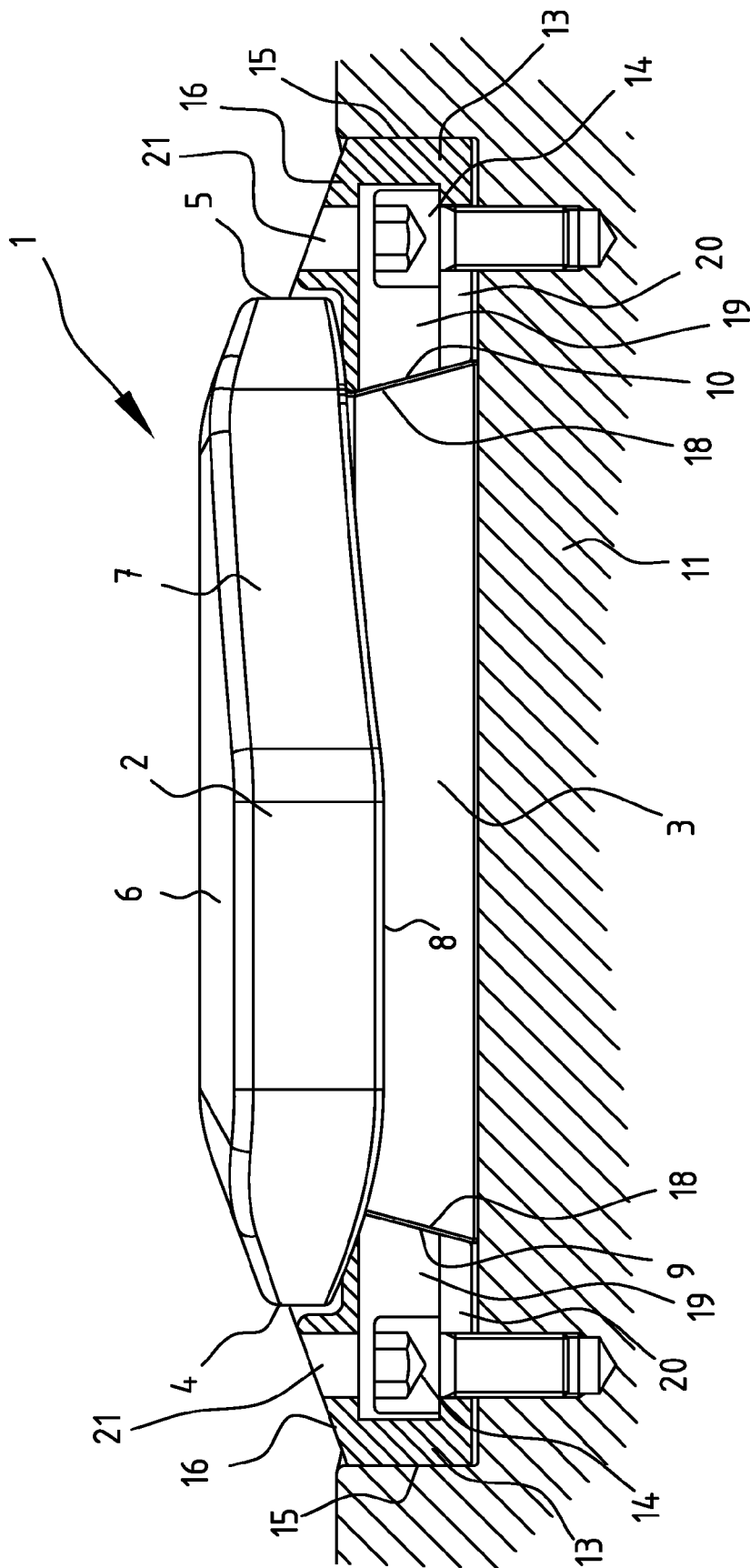


FIG. 4



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Place of search The Hague		Date of completion of the search 10 January 2005	Examiner Schouten, A
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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