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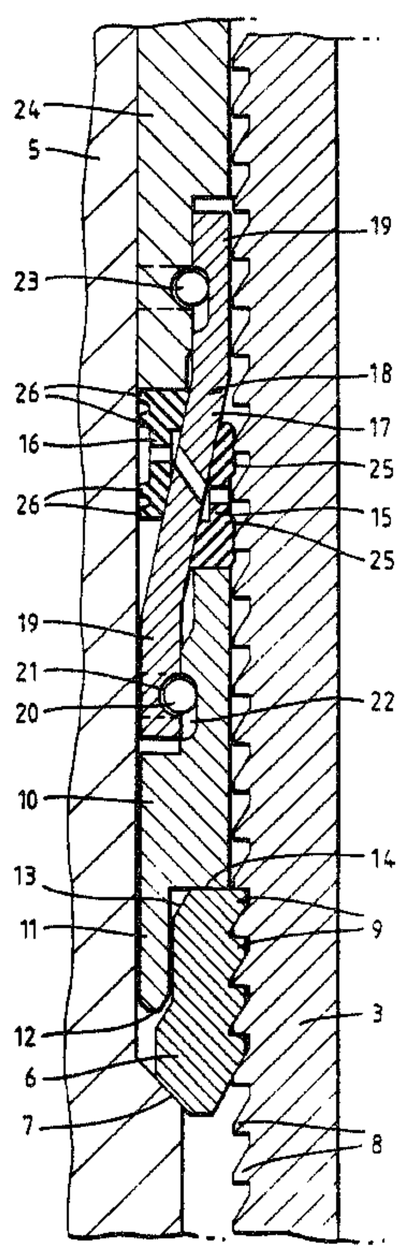


(57) Abrégé/Abstract:
A hanger (3) is suspended and sealed within a wellhead housing (5) by means of a landing ring which engages teeth (8) on the hanger, and a sealing device consisting of wedge rings (15 and 16) which seal respectively against the teeth (8) and the wall of the housing (5).

ABSTRACT

A hanger (3) is suspended and sealed within a wellhead housing (5) by means of a landing ring which engages teeth (8) on the hanger, and a sealing device consisting of wedge rings (15 and 16) which seal respectively against the teeth (8) and the wall of the housing (5).

HANGER ASSEMBLY

In the formation or operation of a well in an oil or gas field, it is sometimes desirable to be able to tie a hanger for a working or production string back at a wellhead at an adjustable height. For example this may be desirable in a subsea tie-back system for a production string casing hanger when the height from the mudline to a platform is uncertain or variable.

To meet this contingency, it is known to provide complementary annular ratchet teeth on a hanger and on a surrounding spool or other housing but in order to allow appreciable variation in the height at which the hanger is to be suspended, the teeth on the hanger must extend over a significant axial length of the hanger. In addition it is usually necessary to provide a high pressure proof seal between the hanger and surrounding housing in which the hanger is suspended and provision must be made beyond the end of the toothed portion of the hanger for engagement of the hanger by an appropriate sealing device. This requires the sealing device to be spaced from the toothed portion of the housing by at least the length of the toothed portion of the hanger.

The object of the invention is to reduce the completion height which has previously been necessary to accommodate such a hanger.

In accordance with the present invention, a hanger assembly for a wellhead comprises a tubular metal hanger having a portion with a series of axially spaced, external, annular teeth, a supporting device, which is arranged to be landed in a surrounding tubular housing and which is engageable with selected ones of the hanger teeth to suspend the hanger at a selected height within the housing; and a sealing device including a wedge and a metal sealing ring surrounding the toothed portion of the hanger and deformable radially inwardly into sealing contact with at

least one of the hanger teeth by relative axial movement between the sealing ring and the wedge.

With this arrangement, since both the supporting and sealing devices engage the same toothed profile of the hanger, they may be spaced closely together, thereby leading to a shorter completion height in the wellhead than would otherwise be possible.

In order to complete a seal between the hanger and housing, the sealing device may include a second deformable metal sealing ring and the action of the wedge, which may itself be formed by the second sealing ring, is also arranged to deform the second sealing ring radially outwardly into sealing contact with the surrounding housing.

Although the supporting device could, in theory, consist of a ring of circumferentially spaced dogs, it is preferably provided by a split landing ring, particularly of C-shape, having a series of axially spaced internal annular teeth complementary to the hanger teeth. The landing ring is then radially expandable so that the landing ring may ride over the hanger teeth relatively down the hanger during suspension of the hanger. There will then be a packoff which is arranged to be inserted axially between the landing ring and surrounding housing to hold the landing ring radially contracted and hence hold the teeth on the hanger and those on the landing ring in engagement with one another when the hanger is at its selected height with the landing ring landed in the housing.

Since the sealing device is energized by relative axial movement of the wedge, an axial counter-reaction must be provided so that the movement of the wedge can be converted by wedging action into radial deformation of at least the first sealing ring. This axial counter-reaction may be provided by the packoff which acts as an abutment for the sealing device.

When the sealing device includes both the first and second sealing rings, the second ring forming the wedge, there may be a carrier tool for the sealing device, the tool being arranged to be forced downwards to provide the relative axial movement and hence to energize the sealing device by deforming the two sealing rings; the packoff being a ring captively, but relatively axially movably, supported from the carrier tool by a sleeve passing down between wedge surfaces of the two sealing rings, whereby the carrier tool, sealing device and packoff ring form a unitary assembly. With this arrangement, the packoff ring and sealing assembly can be inserted into the annulus between the hanger and casing as one preassembly, both to contract and lock the landing ring to the hanger, and thereafter to energize the sealing device.

An example of a hanger assembly constructed in accordance with the present invention is illustrated in the accompanying drawing, in which:

Figure 1 is a part axial section of the assembly and associated parts; and,

Figure 2 is an enlargement of part of Figure 1.

As shown, a tubular hanger 3 has at its lower end a conventional screw threaded coupling 4 for connection to the upper end of a production casing string. The hanger is shown suspended within a housing 5, situated, for example at a tie-back wellhead on a platform and fixed, directly or indirectly, to a riser extending down to a mudline suspension system of a subsea oil well. The hanger 3 is carried in the housing 5 by means of a C-shaped radially expandable and contractible locking ring 6 which seats in a landing bowl 7 formed on the inner surface of the housing 5. The outer surface of the hanger 3 is provided with an axially spaced array of annular teeth 8, each with a downwardly inclined upper flank, a substantially horizontal lower flank, and a blunt tip conforming to a substantially cylindrical envelope. The landing ring 6 has a similar,

but axially inverted, set of four axially spaced annular teeth 9, which complement the teeth 8.

Above the landing ring 6 is a packoff ring 10 having a depending annular skirt 11 with a chamfered end 12, which can ride down over a chamfer 13 on the landing ring 6, to a position surrounding the landing ring, whereby the landing ring is held radially contracted and in secure engagement with the hanger. In this position a shoulder 14 on the packoff ring seats rigidly on the upper surface of the landing ring 6.

Above the packoff ring is a so called "Canh" sealing device consisting of two wedge sealing rings 15 and 16 which are located one on each side of a frustoconical portion 17 of a sleeve 18 having cylindrical end portions 19. The lower end portion 19 is captively but axially movably coupled with the packoff ring 10 by means of a plurality of balls 20, which are located partly within an annular groove 21 of semi-circular cross-section in the sleeve 18, and partly within an annular groove 22 in the packoff ring 10, the groove 22 having a cross-section which is elongate in the axial direction. The upper end portion 19 of the sleeve 18 is similarly captively, but axially movably, coupled by balls 23 to the lower end of a carrier tool 24. As shown, the wedge sealing ring 15 seats on the top of the packoff ring 10, and the lower end of the tool 24 abuts the upper end of the sealing ring 16. When the sealing device is energized, two cylindrical sealing surfaces 25 on the ring 15 seal against a respective pair of the teeth 8 on the hanger, while four annular sealing rings 26 on the ring 16 are in sealing engagement with the inner surface of the housing 5.

Assembly is carried out by suspending the hanger 3 and tubing string stretched, with the hanger within the housing 5, and then forcing the landing ring 6 down around the hanger 3 by means of an hydraulic setting tool. The ring 6 can ride down the hanger because of the ratchet effect of the inclined faces of the teeth 8 and 9, and this continues

until the ring 6 lands in the bowl 7. At that time some of the teeth 8 may not be exactly aligned with the teeth 9, and the tension in the tubing spring is relaxed so that the hanger moves slightly down through a distance less than the pitch of the teeth 8, to the fully engaged position shown in Figures 1 and 2. The hanger and tubing string are then secured against downward movement within the housing 5.

After withdrawal of the setting tool, the sub assembly consisting of packoff ring 10, sealing device and carrier tool 24 are lowered down into the annulus between the hanger 3 and housing 5 until the skirt 11 rides around the landing ring 6, to hold the landing ring radially contracted and hence resist any relative movement between the landing ring and hanger in the event of upward compressive loads through the tubing spring. The tool 24 is thereafter forced downwards to energize the sealing device, against a counteraction provided by the packoff ring 10 from the landing bowl 7. The energization naturally occurs owing to the wedge shape of the rings 15 and 16, the ring 15 being deformed radially inwardly into secure metal to metal contact with respective ones of the teeth 8, and the ring 16 being deformed radially outwardly so that the ribs 26 are forced into secure metal to metal sealing engagement with the inner surface of the housing 5. The relative movement between the tool 24 and packoff ring 10, to accommodate the wedging is accommodated by the coupling balls 20 and 23 moving in the elongate slots.

The sealing device is held locked down by a mechanism comprising a split locking ring 27, which is held expanded in engagement with an annular seating in the wall of the casing by a packoff ring 28, and by an abutment ring 29, which abuts the underside of the ring 27 and is coupled to the tool 24 by a screw threaded connection 30. The mechanism may be set by a second hydraulic setting tool which provides the necessary downward face on the tool 24 and then sets the seal device lockdown mechanism to maintain the axial compression in the sealing device,

before removal of the second setting tool. The operation of the second setting tool and lockdown mechanism is generally as disclosed in our EP-A-0421037.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A hanger assembly for a wellhead, the assembly comprising a tubular metal hanger (3) having a portion with a series of axially spaced, external, annular teeth (8), a supporting device (6), which is arranged to be landed in a surrounding tubular housing (5) and which is engageable with selected ones of the hanger teeth to suspend the hanger at a selected height within the housing; and a sealing device including a wedge (16) and a metal sealing ring (15) surrounding the toothed portion of the hanger, and deformable radially inwardly into sealing contact with at least one of the hanger teeth by relative axial movement between the sealing ring and the wedge.

2. The assembly according to claim 1, in which the sealing device includes a second deformable metal sealing ring (16) and the wedge action is also arranged to deform the second sealing ring radially outwardly into sealing contact with the surrounding housing (5) to complete a seal between the hanger and housing.

3. The assembly according to claim 2, in which the second sealing ring (16) forms the wedge.

4. The assembly according to any one of claims 1 to 3, in which the supporting device is a split landing ring (6) having a series of axially spaced internal annular teeth (9) complementary to the hanger teeth (8), the landing ring being radially expandable so that the landing ring may ride over the hanger teeth relatively down the hanger during suspension of the hanger; and there being a packoff (10) which is arranged to be inserted axially between the landing ring and surrounding housing to hold the landing ring radially contracted and the teeth on the landing ring in engagement with those on the hanger when the hanger is at its selected height with the landing ring landed in the housing.

5. The assembly according to claim 4, in which the packoff

(10) acts as an abutment for the sealing device (15,16) to provide an axial counter-reaction to the relative axial movement.

6. The assembly according to any one of claims 3, 4, and 5, further comprising a carrier tool (24) for the sealing device, the tool being arranged to be forced downwards to provide the relative axial movement and hence to energize the sealing device by deforming the two sealing rings (15,16), the packoff being a ring (10) captively, but relatively axially movably, supported from the carrier tool, by a sleeve (17) passing down between wedge surfaces of the two sealing rings, whereby the carrier tool, sealing device, and packoff ring form a unitary assembly.

Fig.1.

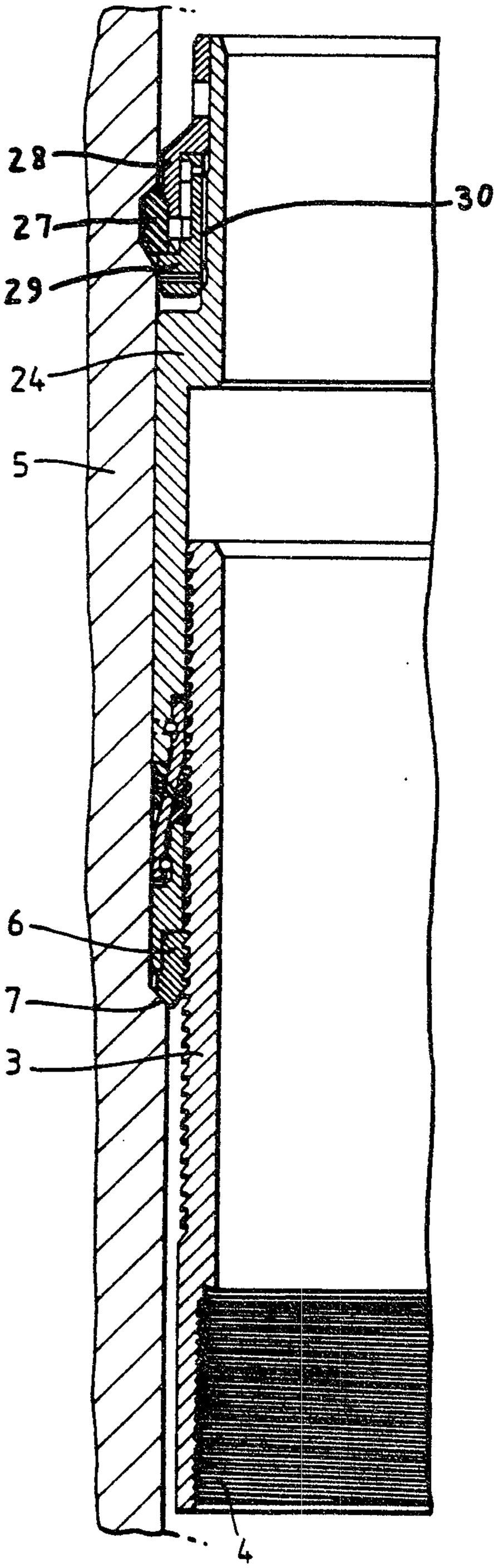
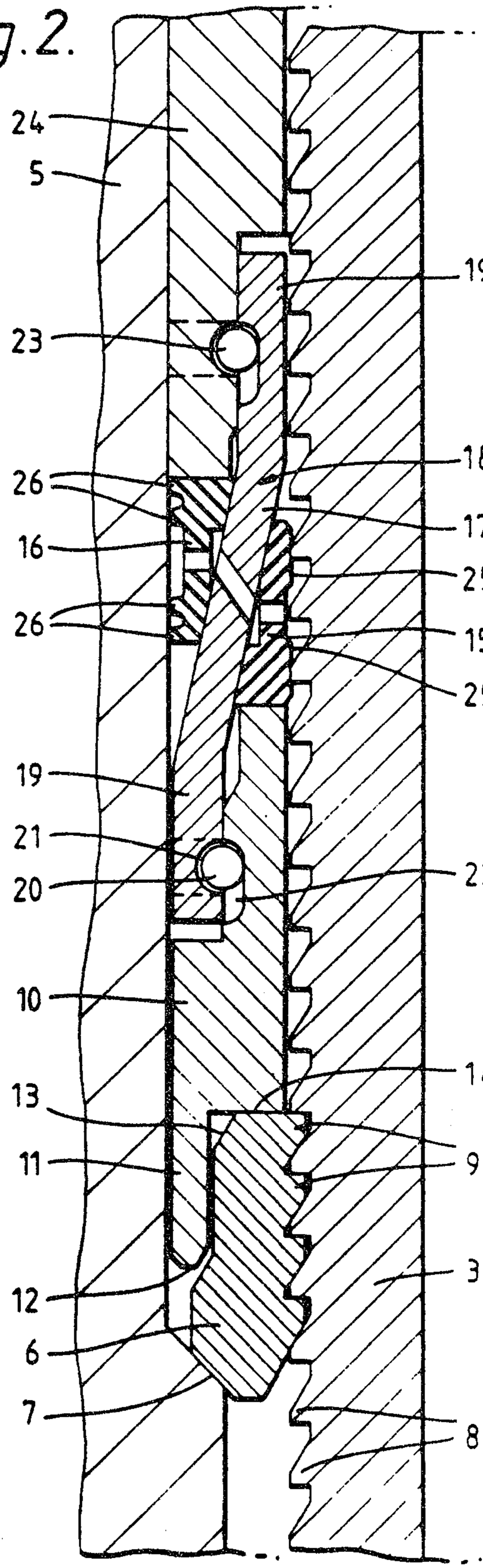


Fig.2.



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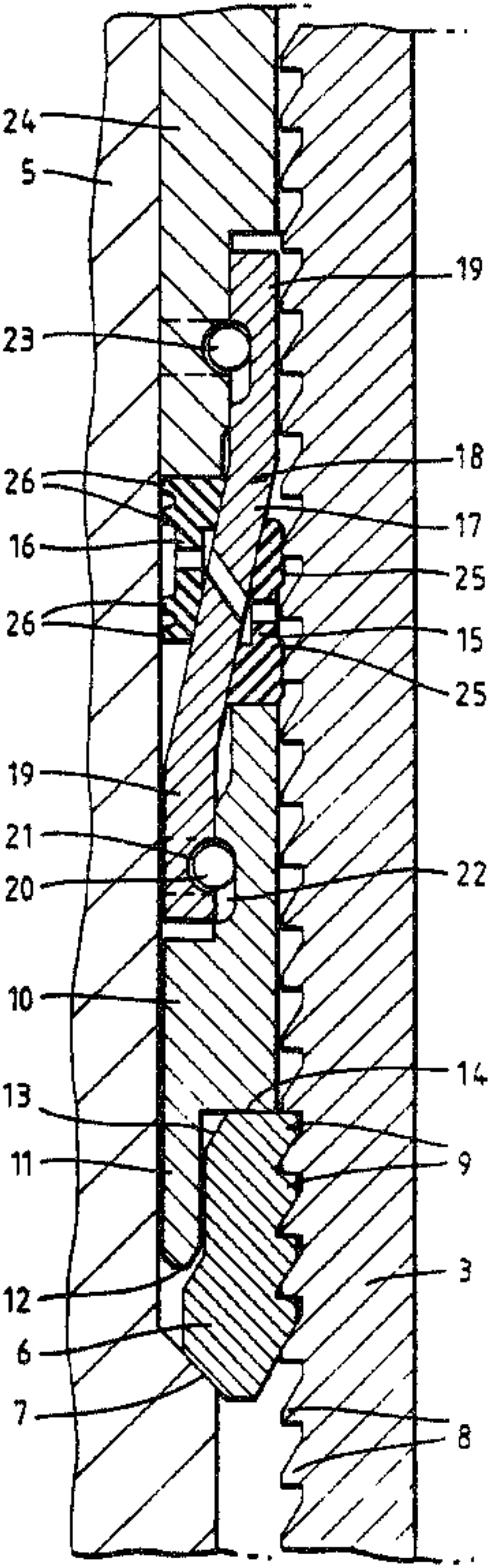
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