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Wellhead Annulus Monitoring

Field of the invention

5 This invention relates to subsea well heads and particularly to the monitoring of pressure in the region between a production casing string and a relatively outer casing.

Background to the invention

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Subsea wellheads support a multiplicity of casing strings which extend down into a well. These casing strings include a production casing string and a relatively outer casing string. These strings are usually within a larger casing known as the outer conductor. The annular region between the production string and the relatively outer string is usually called the B annulus. It is desirable to monitor the pressure in the B annulus and preferable for the monitoring to be performed by means of an associated production tree, i.e. a Xmas tree.

20 There exists a variety of designs such as those described in the documents GB-2376485-A and GB-2395736-A for this general purpose. These and other existing designs are however quite complex. In particular they include penetrations of the wellhead housing and conduits either through this housing or external thereto to a region above any casing hanger. There exists a need for a simpler yet reliable design.

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It is known (for example from US-5366017) to provide communication from the B annulus to the tree by way of a passage through a production casing hanger. However, the passage needs blocking during the stages of drilling and the installation of the casing hanger and it is the object of the present invention to provide an assembly which allows the selective closure and opening of the passage by means of an easily operated sealing adaptor.

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Summary of the invention

In a preferred form of the invention a subsea wellhead assembly comprises a production casing hanger defining a series of passageways from an annulus between a production casing string and a relatively outer casing to a region communicable with a production tree, the passageways extending to the interior of the casing hanger. A positionally adjustable sleeve fits within the casing hanger and carries exterior seals which are disposed so that for a first position of the sleeve within the casing hanger fluid passage through the series of passageways is blocked and for a second position of the sleeve within the casing hanger said fluid passage is allowed.

The positionally adjustable sleeve may make a screw threaded engagement with the casing hanger such that movement of the sleeve between the two positions can be effected by rotation of the sleeve.

The passageways through the casing hanger may include two passageways which communicate with the interior of the casing hanger in spaced apart locations. One of these passageway may extend radially through the casing hanger from the outside to the inside thereof and the other may extend radially from the inside of the casing hanger partly through the casing hanger and may lead to a vertical passageway extending upwardly through the body of the casing hanger to the region which can communicate with the production tree.

The said seals may comprise two spaced apart seals which in the first position of said sleeve are disposed one above and one below one of said two passageways. The seals may include a third seal, the third seal and at least one of said two seals sealing a space embracing said locations from above and below.

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The assembly may include an isolation sleeve which provides communication between said region and the production tree, and in particular by way of an upward passageway from said region.

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The invention also provides a production casing hanger for a subsea well and comprising an upper cylindrical part and a lower cylindrical part of lesser internal diameter than the upper cylindrical part, in which a first passageway extends radially through said lower part of the casing hanger from the outside to the inside thereof and a second passageway extends radially from the inside of the casing hanger partly through the casing hanger, and in which a passageway extends upwardly from said second passageway through the lower part of the casing hanger to a region within the upper part of the casing hanger, said casing hanger being adapted to receive an internal sleeve which is positionally adjustable to allow and prevent fluid flow through the said upward passage to said region.

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One embodiment of the invention is now described by way of example with reference to the drawing.

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Brief description of the drawing

The single Figure 1 illustrates the relevant parts of a wellhead assembly including a casing hanger and an adaptor according to the invention.

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Detailed description

The assembly 1 shown in Figure 1 includes a production casing hanger 2 which has an upper larger diameter part 2a and a lower lesser diameter cylindrical part 2b which extends downwardly. 'Upwardly' and 'downwardly' herein refer to the normal disposition of the assembly in use. Outside the casing

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hanger part 2a is an upper pack-off seal 3 disposed between the casing hanger 2 and the wellhead casing (not shown). Below the casing hanger part 2a and outside the part 2b are the various parts of a locking assembly 4, 5 and 7 associated with a lower pack-off seal 6 which is disposed between the casing
5 hanger 2 and the wellhead casing (not shown).

Below the lower pack-off seal 6, overlapping the lower part thereof and disposed outside the lower part 2b of the casing hanger 2, is a (relatively) outer casing 8, sometimes called the 13 $\frac{3}{8}$ " or 14" (356mm) casing. The lower pack-off
10 seal 6 engages the exterior of this casing.

The design of the locking assembly is not directly relevant to the invention but in this example it comprises an upper activator ring 4, an outer ring 5 making a threaded engagement with the lower pack-off seal 6; and a lower activator ring
15 7. The lower activator ring 7 is secured to the upper activator ring 4 by screws (not shown). The lower activator ring has a slot 71 which is opposite a groove 72 in the outer ring 5. Within the slot 71 in the ring 7 is a holder 73 which supports a shear pin 74 biased outwardly by a spring 75. The holder 73 is held in place by a screwed retainer ring 76. During the setting of the lower pack-off seal
20 6 the activator rings 4 and 7 move downwards; the spring loaded shear pin 74 engages the groove 72. There would normally be a plurality of such assemblies but only a single one is shown.

Between the outer casing 8 and the lower part of a production casing string, sometimes called the 9 $\frac{5}{8}$ " or 10" (254mm) casing, which is not shown in
25 the Figure but will be supported by and within the casing hanger 2, is an annular space, which is usually called the B annulus and is denoted by the letter B.

Within the upper part 2a of the casing hanger 2 is shown the lower part of
30 a secondary isolation sleeve 9a for a production tree. The lowermost part of the isolation sleeve 9a fits within the part 2b of the casing hanger 2 and can be

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sealed relative thereto by a seal 10, which is held in place by a threaded ring 11 at the lower margin of the sleeve 9a, and a seal 12 which is disposed in an annular groove in the outer surface of the sleeve 9a just above the seal 10.

5 A primary isolation sleeve 9b fits within the upper part 2a of the casing hanger 2 and is sealed thereto by annular seals 13 and 14 each disposed in annular grooves in the periphery of the isolation sleeve 9b.

10 The secondary isolation sleeve 9a provides a vertical passageway 15 which leads upwards from a space 16 which is defined by the isolation sleeves 9a and 9b and the casing hanger 2 and in particular is below the primary isolation sleeve 9b and between the secondary isolation sleeve 9a and the casing hanger 2. This passageway 15 leads upwards to pressure monitoring devices which may be disposed in any convenient manner in the production tree and which can monitor the pressure in the annular space B. However, other arrangements may be used to provide communication between the space 16 and the production tree.

20 Within the lower part 2b of the casing hanger 2 is shown a generally cylindrical adaptor sleeve 17 which on its lower part has a screw threading 18 engageable with a screw-threading 19 on the inside of the lower part 2b of the casing hanger 2. There is a gap A between the top of the adaptor sleeve 17 and the bottom of the secondary isolation sleeve 9a to allow for the vertical movement of the adaptor sleeve 17 when it is rotated in screw-threaded engagement with the casing hanger.

25 The arrows in the Figure show the flow of fluid under pressure from the B annulus through a series of passageways provided by the casing hanger 2 to the passageway 15 which is between the primary isolation sleeve 9b and the secondary isolation sleeve 9a and which in this example leads to the production tree. This series of passageways comprises a passageway 20 between the

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casing 8 and the casing hanger 2, a radial passageway 21 through the part 2b of the casing hanger to the interior, a space 22 between the exterior of the adaptor 17 and the inside of the casing hanger 2, another radial passageway 23 partly through the casing hanger from the space 22, and a vertical passageway 24 which extends upwardly within the body of the casing hanger 2 to the space 16 between the casing hanger 2 and the isolation sleeves 9a and 9b. Thereby there is communication with the passageway 15.

The radial passageways 21 and 23 are spaced apart where they communicate with the interior of the casing hanger 2. The adaptor sleeve 17 carries exterior annular seals 25, 26 and 27, of which seal 25 is normally always above the passageway 21. The seals 26 and 27 may be disposed, according to the vertical position of the adaptor 17, either one above and one below the passageway 23 or both below the passageway 23.

For a position of the adaptor when the seals 26 and 27 straddle the passage 23, the passage of fluid from the B annulus to the passageway 15 is blocked, because fluid will not enter the passageway 23 from the space 22. For a position of the adaptor 17 as is shown in the Figure, the series of passageways between the annulus B and the passageway 15 is open. The space 22 embracing the locations where passageways 21 and 23 communicate with the interior of the casing hanger is however sealed from above and below by at least the seals 25 and 27 to prevent leakage upwards or downwards from or into the space 22.

It may be noted that the adaptor 17 may be operated by a simple mechanical spring-loaded key tool (not shown), which is required only to rotate the adaptor. Such a tool may readily be configured to operate through the Xmas tree after the tree has been landed and tested, so as to permit the testing of the adaptor and the communication interface before the installation of the blow-out preventer (BOP) and the completion string.

Claims

1. A subsea wellhead assembly comprising a production casing hanger (2) defining a series of passageways (20-22) from an annulus (B) between a production casing string and a relatively outer casing (8) through the casing hanger to the interior of the hanger; **characterised in that** the series of passageways (23, 24) further extends from the interior of the casing hanger upwardly within the body of the casing hanger to a region (16) communicable with a production tree; and a positionally adjustable sleeve (17) fits within the casing hanger and carries exterior seals (25-27) which are disposed so that for a first position of the sleeve within the casing hanger fluid passage through the series of passageways is blocked and for a second position of the sleeve within the casing hanger said fluid passage is allowed.
2. An assembly according to claim 1 in which the sleeve (17) makes screw-threaded engagement with the casing hanger (18) such that movement of the sleeve between said positions can be effected by rotation of the sleeve.
3. An assembly according to claim 1 or claim 2 in which said passageways include two passageways (21, 23) which communicate with the interior of the casing hanger in spaced apart locations and said seals comprise two spaced apart seals (26, 27) which in said first position of said sleeve (17) are disposed one above and one below one of said two locations.
4. An assembly according to claim 3 in which said seals include a third seal (25), the third seal and at least one of said two seals (26, 27) sealing a space (22) embracing said locations from above and below.
5. An assembly according to any foregoing claim and further comprising an isolation sleeve (9a) which provides communication between said region (16) and a production tree.

6. An assembly according to claim 5 in which said isolation sleeve (9a) defines an upward passageway (15) from said region.

5 7. A production casing hanger (2) for a subsea well and comprising an upper cylindrical part (2a) and a lower cylindrical part (2b) of lesser internal diameter than the upper cylindrical part, ***characterised in that*** a first passageway (21) extends radially through said lower part (2b) of the casing hanger from the outside to the inside thereof and a second passageway (23) extends radially from the inside of the casing hanger partly through the casing
10 hanger, and a passageway (24) extends upwardly from said second passageway through the lower part (2b) of the casing hanger to a region within the upper part (2a) of the casing hanger, said casing hanger being adapted to receive an internal sleeve (17) which is positionally adjustable to allow and prevent fluid flow through the second passageway (23).

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8. A production casing hanger according to claim 7 in which the casing hanger (2) has an internal screw-threading (19) for engagement by the sleeve (17) and allowing positional adjustment thereof.

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