CLAIMS

What is claimed is.

1. A subsea wellhead assembly (20) comprising:

a wellhead housing (24);

a spool on an upper end of the wellhead housing (24);

an annular member landed in the spool; and

characterized by,

a ring (34) rotatably disposed on the annular member and having a contoured upper surface;

a production tree (40) landed on an upper end of the spool having a lower end engaged with an upper surface of the ring (34), the lower end having a contour corresponding to the contoured upper surface of the ring (34), so that when the production tree (40) is lowered onto the ring (34), the ring (34) rotates into a designated azimuth.

2. The assembly of claim 1, further characterized by a passage (46) vertically provided through the ring (34) having flexible tubing that extends into a bore (30) vertically formed through the annular member.

3. The assembly of claim 2, characterized in that the contoured upper surface comprises a series of pockets (44) along the circumference of the ring (34), and wherein an upper end of the passage (46) terminates in a pocket (44).

4. The assembly of claim 1, characterized in that the contoured upper surface of the ring (34) and contour of the lower end of the production tree (40) each comprise a series of pockets (44) with angled lateral sides that form an interference when the production tree (40) is positioned at an azimuth offset from the designated azimuth.

5. The assembly of claim 4, further characterized by vertical bores (30) in the annular member, axial passages (46) in the ring (34), flexible tubing extending between the vertical bores (30) and axial passages (46) in the ring (34), and axial passages (46) in the production tree (40), wherein when the production tree (40) is landed while positioned at an azimuth offset from the designated azimuth, the axial passages (46) in the ring (34) azimuthally move with respect to the vertical bores (30) and the flexible tubing bends in response to the movement of the axial passages (46) in the ring (34).

6. The assembly of claim 5, characterized in that the vertical bores (30) and axial passages (46) in the production tree (40) come into communication when the production tree (40) lands onto the spool and remain in communication when the ring (34) is rotated.

7. The assembly of any of claims 1-6, further characterized by a channel 36 extending circumferentially along the upper surface of the annular member, wherein the ring (34) is rotationally disposed in the channel 36.

8. The assembly of any of claims 1-7, characterized in that the azimuth of the production tree (40) remains substantially the same while being landed.

9. The assembly any of claims 1-8, characterized in that the annular member comprises a tubing hanger (26).

10. The assembly of any of claims 1-9, characterized in that the spool comprises a tubing hanger spool (22).

11. A method of forming a wellhead assembly (20) subsea comprising:

a. providing a ring (34) having an axial passage (46) that is mountable onto an annular member having a vertical bore (30) and has flexible tubing extendable between the axial passage (46) and the vertical bore (30);

characterized by,

b. providing an upper member with a vertical passage (46) and a lower surface having a profile configured to mate with a profile on an upper surface of the ring (34) and positioning the ring (34) and upper member into a designated orientation;

c. lowering (34) the upper member onto the ring (34) when the ring (34) is mounted on the annular member; and

d. communicating the vertical passage (46) in the upper member with the vertical bore (30) by engaging the respective profiles on the upper member and the ring (34) to azimuthally rotate the ring (34) into the designated orientation that aligns the vertical passages in the ring (34) and the upper member.

12. The method of claim 11, characterized in that the upper member comprise tree (40).

13. The method of claim 11, characterized in that the annular member comprises a tubing hanger (26).

14. The method of any of claims 11-13, further characterized by landing the annular member in a wellhead housing (24).

15. The method of any of claims 11-14, characterized in that the annular member comprises a tubing hanger (26) and the wellhead housing (24) comprises a tubing hanger spool (22).

16. The method of any of claims 11-15, further characterized by orienting the upper member before being landed onto the ring (34) at an angular range of around (20)º from a designated azimuth.

17. The method of any of claims 11-16, further characterized by flowing fluid through the axial passages (46) of the upper member and ring (34), the flexible tubing, and the vertical bore (30).

18. A wellhead assembly (20) comprising:

a production tree (40A) having passages (46) formed therein;

an annular production stab (86) mounted in the production tree (40A);

characterized by,

a disk (88) coaxially mounted on the production stab 86 with an alignment slot (90) formed on an outer periphery, couplings (94) provided on a side facing away from the production tree (40A) and tubing 98 having an end attached to the production tree (40A) that is in communication with the couplings (94) on the disk (88);

a wellhead housing (24); and

a tubing hanger (26A) landable in the wellhead housing (24A) having couplings (96) on an upper surface that communicate with passages (30A) that extend axially through the tubing hanger (26A), and an alignment pin (92) on the upper surface, so that when the tubing hanger

(26A) is landed in the wellhead housing (24A) and the alignment pin (92) engages the alignment slot (90), the disk (88) is oriented to align the couplings (96) on the upper surface of the tubing hanger (26A) with the couplings (94) on the side of the disk (88).

19. The wellhead assembly (20) of claim 18, characterized in that a width of the alignment slot (90) decreases with distance away from the alignment pin (92).

20. The wellhead assembly (20) of claim 19, characterized in that the tubing 98 is in communication with the passages (46A) in the production tree (40A).

CLAIMS

1. A method of forming a subsea wellhead assembly comprising:

a. providing a ring, said ring being mountable onto a hanger having a sidewall with a vertical bore and having an axial passage that is located through a sidewall of the ring and spaced radially outward from a main bore in the ring, and providing flexible tubing extendable between the axial passage and the vertical bore;

b. providing a production tree with a vertical passage and a lower surface having an undulating profile configured to mate with an undulating profile that circumscribes an upper surface of the ring;

c. lowering the production tree onto the ring when the ring is mounted on the hanger; and

d. communicating the vertical passage in the production tree with the vertical bore by engaging the respective profiles on the production tree and the ring to azimuthally rotate the ring into a designated azimuthal orientation that aligns the axial passages in the ring with the vertical passage in the production tree.

2. The method of claim 1, wherein when the ring is offset from the designated azimuthal orientation when the production tree is lowered onto the ring, interference between the respective profiles on the production tree and the ring rotates the ring into the designated azimuthal orientation.

3. The method of claim 2, wherein when the ring is rotated into the designated azimuthal orientation, flexible tubing that extends through the vertical passages bends to accommodate rotation of the ring.

4. The method of claim 1, wherein the hanger is a tubing hanger that has a string of tubing depending into a wellbore below the wellhead assembly.

5. The method of claim 4, further comprising producing wellbore fluid through the tubing hanger.

6. The method of claim 1, further comprising orienting the production tree before being landed onto the ring at an angular range of around 20° from the designated azimuthal orientation.

7. The method of claim 1, further comprising flowing fluid through the passages of the production tree and ring, the flexible tubing, and the vertical bore.