Claims:

1. A subsea wellhead assembly, characterized by:

a housing (12) having a bore (14), a longitudinal axis, and containing at least one housing upward facing conical load shoulder (16);

a hanger (10) that is lowered into the housing (12), the hanger (10) having at least one hanger downward facing conical load shoulder (40);

a load ring (42) having a load ring downward facing conical shoulder (44), wherein the load ring (42) is carried by the hanger (10) for movement between a retracted position, wherein the hanger (10) downward facing load conical shoulder (44) is spaced radially overlapping and in contact with a portion of the housing upward facing load conical shoulder (16), and a radially expanded position wherein the hanger downward facing load conical shoulder (40) has a greater surface area in engagement with the housing upward facing conical load shoulder (16) than while in the retracted position that expands within elastic limits of the load ring (42),

wherein the load ring (42) is a solid steel member.

2. The assembly according to claim 1, further characterized by a retaining member (26) located within the bore (14) of the housing (12) above the housing upward facing load shoulder (16) and having an inward facing surface (32) that is contacted by an housing outer diameter surface (48) of the load ring (42) when the hanger (10) is expanded.

3. The assembly according to claim 1, wherein an annular clearance exists between the retaining member (26) and the load ring (42) while the load ring (42) is in the retracted position.

4. The assembly according to claim 2, wherein the inward facing surface (32) of the retaining member (26) has an inner diameter selected to prevent inelastic expansion of the load ring (42) while moving to the expanded position.

5. The assembly according to claim 1, wherein the housing (12) upward facing conical load shoulder (16) has a larger radial width than the hanger downward facing conical load shoulder (40).

6. The assembly according to claim 1, wherein the hanger (10) downward facing conical shoulder (40) is inclined at a first angle relative to the axis;

the load ring downward facing conical shoulder (44) is inclined at a second angle relative to the axis that is greater than the first angle.

7. The assembly according to claim 1, further characterized by:

a housing load ring (18) mounted in a recess in the housing upward facing conical load shoulder (16), the housing load ring (18) defining the load shoulder (16).

8. The assembly according to claim 1, wherein the load ring (42) is moved from the retracted to the expanded position in response to a downward force applied to the hanger (10).

9. The assembly according to claim 1, wherein:

the load ring (42) has a load ring upward facing conical shoulder (43) that slides on the hanger downward facing conical load shoulder (40) and the loading downward facing conical load shoulder (44) slides on the housing upward facing conical load shoulder (20) while moving from the retracted to the expanded position.

10. A method for installing a hanger (10) in a subsea wellhead housing assembly, characterized by:

providing the hanger (10) with a load shoulder (40) and mounting a load ring (42) to the hanger (10) in engagement with the load shoulder (40);

lowering the hanger (10) into the housing (12), and landing the load ring (42) on a housing load shoulder (16);

securing a string of casing to the hanger (10);

applying a casing weight of the string of casing to the hanger (10), causing the load ring (42) to expand radially outward on the housing load shoulder (16); and

limiting the expansion of the load ring (42) such that the expansion is elastic.

11. The method of claim 10, further characterized by increasing a contact area between the load ring (42) and the housing load shoulder (16) as the casing weight increases.

12. The method of claim 10, wherein, the load ring (42) slides on the housing load shoulder (16) while moving to the expanded position.

13. The method of claim 10, further characterized by lifting the hanger (10) to retrieve the casing, which removes the casing weight on the load ring (42) and allows the load ring (42) to return to the retracted position.

14. The method of claim 10, wherein the load ring (42) slidingly engages the hanger load shoulder (40) and slidingly engages the housing load shoulder (16) while moving to the expanded position.

15. The method of claim 10, wherein mounting the load ring (42) to the hanger (10) comprises mounting a solid annular steel member (26) to the housing (12).

CLAIMS

1. A subsea wellhead assembly, comprising:

a housing having a bore, a longitudinal axis, and containing at least one housing upward facing conical load shoulder;

a hanger that is lowered into the housing, the hanger having at least one hanger downward facing conical load shoulder; and

a load ring having a load ring downward facing conical shoulder, wherein the load ring is carried by the hanger for movement between a retracted position, wherein the load ring extends a full 360 degrees around an axis of the hanger and the load ring downward facing load conical shoulder is spaced radially overlapping and in contact with a portion of the housing upward facing load conical shoulder, and a radially expanded position wherein the load ring extends a full 360 degrees around the axis of the hanger, and the load ring downward facing lead conical shoulder has a greater surface area in engagement with the housing upward facing conical load shoulder than while in the retracted position that expands within elastic limits of the load ring.

2. The assembly according to claim 1, further comprising a retaining member located within the bore of the housing above the housing upward facing load shoulder and having an inward facing surface that is contacted by an outer diameter surface of the load ring when the load ring is expanded.

3. The assembly according to claim 2, wherein an annular clearance exists between the retaining member and the load ring while the load ring is in the retracted position.

4. The assembly according to claim 2, wherein the inward facing surface the retaining member has an inner diameter selected to prevent inelastic expansion of the load ring while moving to the expanded position.

5. The assembly according to claim 1, wherein the housing upward facing conical load shoulder has a larger radial width than the hanger downward facing conical load shoulder.

6. The assembly according to claim 1, wherein the hanger downward facing conical load shoulder is inclined at a first angle relative to the axis;

the load ring downward facing conical shoulder is inclined at a second angle relative to the axis that is greater than the first angle.

7. The assembly according to claim 1, further comprising:

a housing load ring mounted in a recess in the housing upward facing conical load shoulder, the housing load ring defining the load shoulder.

8. The assembly according to claim 1, wherein the load ring is moved from the retracted to the expanded position in response to a downward force applied to the hanger.

9. The assembly according to claim 1, wherein:

the load ring has a load ring upward facing conical shoulder that slides on the hanger downward facing conical load shoulder and the load ring downward facing conical load shoulder slides on the housing upward facing conical load shoulder while moving from the retracted to the expanded position.

10. A subsea wellhead assembly, comprising:

a housing having a bore, a longitudinal axis, and containing at least one housing upward facing conical load shoulder;

a hanger that is lowered into the housing, the hanger having at least one hanger downward facing conical load shoulder;

a load ring having a load ring downward facing conical shoulder, wherein the load ring is carried by the hanger for movement between a retracted position, wherein the load ring downward facing load conical shoulder is spaced radially overlapping and in contact with a portion of the housing upward facing load conical shoulder, and a radially expanded position wherein the load ring downward facing conical shoulder has a greater surface area in engagement with the housing upward facing conical load shoulder then while in the retracted position that expands within elastic limits of the load ring,

wherein,

the load ring is a solid metailic member that extends a full 360 degrees around the hanger when in the retracted position and when in the radially expanded position;

the housing upward facing conical load shoulder has a larger radial width than the hanger downward facing conical load shoulder

the load ring has a load ring upward facing conical shoulder that slides on the hanger downward facing conical load shoulder and the load ring downward facing conical load shoulder slides on the housing upward facing conical load shoulder while moving from the retracted to the expanded position; and

a retaining member located within the bore of the housing above the housing upward facing load shoulder and having an inward facing surface that is contacted by an outer diameter surface of the load ring when the hanger is expanded.

11. The assembly according to claim 10, wherein an annular clearance exists between the retaining member and the load ring while the load ring is in the retracted position.

12. The assembly according to claim 10, wherein the inward facing surface of the retaining member has an inner diameter selected to prevent inelastic expansion of the load ring while moving to the expanded position.

13. The assembly according to claim 10, further comprising:

housing load ring mounted in a recess in the housing upward facing conical load shoulder, the housing load ring defining the load shoulder.

14. The assembly according to claim 10, wherein the load ring is moved from the retracted to the expanded position in response to a downward weight of casing.

15. A method for installing a hanger in a subsea wellhead housing assembly, comprising:

providing the hanger with a load shoulder and mounting a load ring to the hanger in engagement with the load shoulder and that extends a full 360 degrees around the hanger;

lowering the hanger into the housing, and landing the load ring on a housing load shoulder;

securing a string of casing to the hanger;

applying a casing weight of the string of casing to the hanger, causing the load ring to expand radially outward on the housing load shoulder to a radially expanded position so that the load ring extends a full 360 degrees around the axis of the hanger; and

limiting the expansion of the load ring such that the expansion is elastic.

16. The method of claim 15, further comprising increasing a contact area between the load ring and the housing load shoulder as the casing weight increases.

17. The method of claim 15, wherein, the load ring slides on the housing load shoulder while moving to the expanded position.

18. The method of claim 15, further comprising lifting the hanger to retrieve the casing, which removes the casing weight on the load ring and allows the load ring to return to the retracted position.

19. The method of claim 15, wherein the load ring slidingly engages the hanger load shoulder and slidingly engages the housing load shoulder while moving to the expanded position.

20. The method or claim 15, wherein mounting the load ring to the hanger comprises mounting a solid annular steel member to the hanger.