

Claims:

1. A subsea wellhead assembly, comprising:
 - a housing having a bore containing at least one generally upward facing load shoulder;
 - a hanger that is lowered into the housing, the hanger having at least one downward facing load shoulder;
 - a load ring having an upward facing shoulder that slidably engages the downward facing load shoulder of the hanger and a downward facing shoulder that transfers load to the upward facing load shoulder of the housing, wherein the load ring is carried by the hanger for movement between a retracted position, wherein the downward facing load shoulder is spaced radially inward from the upward facing load shoulder of the housing, and an expanded position wherein the downward facing load shoulder is in load transfer engagement with the upward facing load shoulder;
 - a centralizing ring fastened to the hanger below the load ring and having an outward facing portion that contacts the bore of the wellhead housing; and
 - a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the load ring from moving into the expanded position until the the centralizing ring is compressed by a desired portion of the housing.
2. The assembly according to claim 1, wherein the centralizing ring comprises a plurality of fingers having a lower end fastened to the hanger and the hook is formed on a top end of the finger, the finger having an inward facing protrusion that contacts an outer surface of the hanger to create an outward force on the top end of the finger when the hook is restrained.
3. The assembly according to claim 1, wherein the upward facing load shoulder of the

housing has a larger radial width than the downward facing load shoulder of the hanger.

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

an upward facing tag shoulder formed in the bore of the housing; and

an activation ring mounted to the hanger below the load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder while the hanger is being lowered into the well, stopping downward movement of the activation ring and the load ring, the continued downward movement of the hanger relative to the activation ring causing the load ring to move to the expanded position; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

5. The assembly according to claim 4, further comprising:

a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulders engage each other.

6. The assembly according to claim 5, wherein:

disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.

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

a load ring supported by the upward facing load shoulder on the bore having a generally upward facing shoulder for sliding engagement with the downward facing shoulder of the load ring for transferring a load from the hanger to the housing;

an upward facing tag shoulder formed on an interior surface of the load ring of the housing; and

an activation ring mounted to the hanger below the load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder on the load ring while the hanger is being lowered into the well, stopping downward movement of the activation ring and the load ring, the continued downward movement of the hanger relative to the activation ring causing the load ring on the hanger to move to the expanded position and in contact with the load ring on the housing; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

8. The assembly according to claim 6, further comprising:

a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulders engage each other.

9. The assembly according to claim 8, wherein:

disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.

10. The assembly according to claim 1, wherein:

at least one of upward facing load shoulder comprises a plurality of upward facing load shoulders; and

at least one of downward facing load shoulder comprises a plurality of downward facing load shoulders.

11. A subsea wellhead assembly, comprising:

a housing having a bore containing at least one conical generally upward facing load shoulder that inclines relative to an axis of the bore;

a hanger that is lowered into the housing, the hanger having at least one conical downward facing load shoulder that inclines relative to the axis of the bore;

a load ring supported by the upward facing load shoulder on the bore having a generally upward facing shoulder for transferring a load from the hanger to the housing;

a split load ring having an upward facing shoulder that slidably engages the downward facing load shoulder of the hanger and a downward facing shoulder that slidably engages the upward facing shoulder of the load ring on the housing, wherein the split load ring is carried by the hanger for movement between a retracted position, wherein the downward facing load shoulder is spaced radially inward from the upward facing load shoulder of the housing, and an expanded position wherein the downward facing load shoulder is in engagement with the upward

facing shoulder of the load ring on the housing;

a centralizing ring fastened to the hanger below the split load ring and having an outward facing protrusion that contacts the bore of the wellhead housing;

a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the split load ring from moving into the expanded position until the protrusion on the centralizing ring encounters a reduction in a diameter of the bore of the housing;

an upward facing tag shoulder formed on an interior surface of the load ring of the housing; and

an activation ring mounted to the hanger below the load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder on the load ring while the hanger is being lowered into the well, stopping downward movement of the activation ring and the load ring, the continued downward movement of the hanger relative to the activation ring causing the load ring on the hanger to move to the expanded position and in contact with the load ring on the housing; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

12. The assembly according to claim 11, wherein the centralizing ring comprises a plurality of fingers having a lower end fastened to the hanger and the hook is formed on a top end of the finger, the finger having an inward facing protrusion that contacts an outer surface of the hanger to create an outward force on the top end of the finger when the hook is restrained.

13. The assembly according to claim 11, wherein the upward facing load shoulder of the housing has a larger radial width than the downward facing load shoulder of the hanger.
14. The assembly according to claim 11, further comprising:
a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulders engage each other.
15. The assembly according to claim 14, wherein:
disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.
16. The assembly according to claim 11, wherein:
at least one of upward facing load shoulder comprises a plurality of upward facing load shoulders; and
at least one of downward facing load shoulder comprises a plurality of downward facing load shoulders.
17. A method for installing a subsea wellhead assembly, comprising:
providing a housing having a bore containing at least one conical generally upward facing load shoulder that inclines relative to an axis of the bore;

lowering a hanger into the housing, the hanger having at least one conical downward facing load shoulder that inclines relative to the axis of the bore;

delaying radial outward movement of a split load ring carried on the hanger until the hanger is lowered to the desired position within the housing, wherein the split load ring moves between a retracted and expanded position; and

urging the split load ring outward to the expanded position to allow load from casing hanger to be transferred to the housing.

18. The method of claim 17, further comprising moving the hanger downward relative to an activation ring, wherein the activation ring has a tag shoulder that contacts an upward facing tag shoulder in the bore of the housing to prevent downward movement of the activation ring and the split load ring.

19. The method of claim 18, wherein,

the split load ring has an upward facing shoulder that slidably engages the downward facing load shoulder of the hanger and a downward facing shoulder that slidably engages the upward facing load shoulder of the housing, wherein the load ring is carried by the hanger for movement between the retracted position, wherein the downward facing load shoulder is spaced radially inward from the upward facing load shoulder of the housing, and the expanded position wherein the downward facing load shoulder is in load transfer engagement with the upward facing load shoulder;

a centralizing ring fastened to the hanger below the split load ring and having an outward

facing protrusion contacts the bore of the wellhead housing; and

a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the split load ring from moving into the expanded position until the protrusion on the centralizing ring encounters a reduction in a diameter of the bore of the housing.

20. The method of claim 17, wherein an upward force is applied to the hanger when set, to overcome the load on the hanger, unset the hanger, and retrieve the hanger.

CLAIMS

What is claimed is:

1. A subsea wellhead assembly, comprising:

a housing having a bore containing at least one generally upward facing load shoulder;

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

a first load ring that slidingly engages the downward facing load shoulder of the hanger and having a downward facing shoulder that transfers load to the upward facing load shoulder of the housing, wherein the load ring is carried by the hanger for movement between a retracted position, wherein the downward facing shoulder is spaced radially inward from the upward facing load shoulder of the housing, and an expanded position wherein the downward facing shoulder is in load transfer engagement with the upward facing load shoulder;

a centralizing ring fastened to the hanger below the load ring and having an outward facing portion that contacts the bore of the housing; and

a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the load ring from moving into the expanded position until the centralizing ring is compressed by a desired portion of the housing.

2. The assembly according to claim 1, wherein the centralizing ring comprises a plurality of fingers having a lower end fastened to the hanger and the hook is formed on a top end of the finger, the finger having an inward facing protrusion that contacts an outer surface of the hanger to create an outward force on the top end of the finger when the hook is restrained.

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

4. The assembly according to claim 1, further comprising:
an upward facing tag shoulder formed in the bore or the housing; and

an activation ring mounted to the hanger below the load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder while the hanger is being lowered into the well, stopping downward movement of the activation ring and the load ring, the continued downward movement of the hanger relative to the activation ring causing the load ring to move to the expanded position; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

5. The assembly according to claim 4, further comprising:
a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulder engage each other.

6. The assembly according to claim 5, wherein:
disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.

7. The assembly according to claim 1, further comprising:
a second load ring supported by the upward facing load shoulder on the bore having a generally upward fixing shoulder sliding engagement with the downward facing shoulder of the first load ring for transferring a load from the hanger to the housing;

an upward facing tag shoulder formed on an interior surface of the second load ring; and

an activation ring mounted to the hanger below the second load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder on the first load ring while the hanger is being lowered into the

well, stopping downward movement of the activation ring and the second load ring, the continued downward movement of the hanger relative to the activation ring causing the first load ring on the hanger to move to the expanded position and in contact with the second load ring on the housing; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

8. The assembly according to claim 6, further comprising:
a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulders engage each other.

9. The assembly according to claim 8, wherein:
disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.

10. The assembly according to claim 1, wherein:
at least one of upward facing load shoulder comprises a plurality of upward facing load shoulders; and

at least one of downward facing load shoulder comprises a plurality of downward facing load shoulders.

11. A subsea wellhead assembly, comprising:
a housing having a bore containing at least one conical generally upward facing load shoulder that inclines relative to an axis of the bore;

a hanger that is lowered into the housing, the hanger having at least one conical downward facing load shoulder that inclines relative to the axis of the bore;

a load ring supported by the upward facing load shoulder on the bore having a generally upward facing shoulder for transferring a load from the hanger to the housing;

a split load ring having an upward facing shoulder that slidingly engages the downward facing load shoulder of the hanger and a downward facing shoulder that slidingly engages the upward facing shoulder of the load ring on the housing, wherein the split load ring is carried by the hanger for movement between a retracted position, wherein the downward facing shoulder is spaced radially inward from the upward facing load shoulder of the housing, and an expanded position wherein the downward facing shoulder is in engagement with the upward facing shoulder of the load ring on the housing;

a centralizing ring fastened to the hanger below the split load ring and having an outward facing protrusion that contacts the bore of the housing;

a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the split load rings from moving into the expanded position until the protrusion on the centralizing ring encounters a reduction in a diameter of the bore of the housing;

an upward facing tag shoulder formed on an interior surface of the load ring of the housing; and

an activation ring mounted to the hanger below the split load ring, the activation ring having a downward facing tag shoulder that engages the upward facing tag shoulder on the load ring while the hanger is being lowered into the well, stopping downward movement of the activation ring and the split load ring, the continued downward movement of the hanger relative to the activation ring causing the split load ring on the hanger to move to the expanded position and in contact with the load ring on the housing; wherein,

the activation ring has a hook formed on a lower end that engages the hook formed on the upper end of the centralizing ring, the hook from the centralizing ring disengaging from the hook on the activation ring when the outward facing protrusion on the centralizing ring encounters the reduction in a diameter of the bore below the upward facing tag shoulder.

12. The assembly according to claim 11, wherein the centralizing ring comprises a plurality of fingers having a lower end fastened to the hanger and the hook is formed on a top end of the finger, the finger having an inward

facing protrusion that contacts an outer surface of the hanger to create an outward force on the top end of the finger when the hook is restrained.

13. The assembly according to claim 11, wherein the upward facing load shoulder of the housing has a larger radial width than the downward facing load shoulder of the hanger.

14. The assembly according to claim further comprising:
a retaining member that secures the activation ring to the hanger for movement therewith until the tag shoulder engage each other.

15. The assembly according to claim 14, wherein:
disengagement of the hooks allows further downward movement of the hanger to shear the retaining member and allow hanger to move downward relative to the activation ring.

16. The assembly according to claim 11, wherein:
at least one of upward facing load shoulder comprise a plurality of upward facing load shoulders; and

at least one of downward facing load shoulder comprises a plurality of downward facing load shoulders.

17. A method for installing a subsea wellhead assembly, comprising:
providing a housing having a bore containing at least one conical generally upward facing load shoulders that inclines relative to an axis of the bore;

lowering a hanger into the housing, the hanger having at least one conical downward facing load shoulder that inclines relative to the axis of the bore;

delaying radial outward movement of a split load ring carried on the hanger until the hanger is lowered to the desired position within the housing, wherein the split load ring moves between a retracted and expanded position;

urging the split load ring outward to the expanded position to allow load from the hanger to be transferred to the housing; and

moving the hanger downward relative to an activation ring, wherein the activation ring has a tag shoulder that contacts an upward facing tag shoulder in the

bore of the housing to prevent downward movement of the activation ring and the split load ring;

wherein the split load ring has an upward facing shoulder that slidably engages the downward facing load shoulder of the hanger and a downward facing shoulder that slidably engages the upward facing load shoulder of the housing, wherein the split load ring is carried by the hanger for movement between the retracted position, wherein the downward facing shoulder is spaced radially inward from the upward facing load shoulder of the housing, and the expanded position wherein the downward facing shoulder is in load transfer engagement with the upward facing load shoulder;

a centralizing ring fastened to the hanger below the split load ring and having an outward facing protrusion that contacts the bore of the housing; and

a hook formed at an upper end of the centralizing ring that exerts an outward force that delays the split load ring from moving into the expanded position until the protrusion on the centralizing ring encounters a reduction in a diameter of the bore of the housing.

18. The method of claim 17, wherein an upward force is applied to the hanger when set, to overcome the load on the hanger, unset the hanger, and retrieve the hanger.