

CLAIMS

What is claimed is:

1. A system (200, 250, 270; 300, 350; 400) for locking components (202-208) in a wellhead assembly, characterized by:

a first wellhead component (208; 304; 404) defining at least one recess (208A; 314) in an outer surface thereof;

a second wellhead component (206; 316; 402) positioned adjacent the first wellhead component;

a first annular member (204; 306; 406B) positioned adjacent the first wellhead component and having at least one protrusion (204B; 320) configured to correspond to the at least one recess of the first wellhead component, the first annular member having a first annular member stepped surface (204A; 306A); and

a second annular member (202; 308; 406A) positioned adjacent the first wellhead component and having a second annular member stepped surface (202A; 308B) adapted to interact with the first annular member stepped surface to limit relative movement between the first annular member and the second annular member upon contact between the first annular member stepped surface and the second annular member stepped surface.

2. The system of claim 1, wherein the first wellhead component is a wellhead housing, the second wellhead component is a hanger, the first annular member is a lockdown ring, and the second annular member is an actuator member.

3. The system of claim 1, wherein the first wellhead component is a mandrel, the second wellhead component is a wellhead connector, the first annular member is a lockdown ring, and the second annular member is a cam ring.

4. The system of claim 1, wherein the first wellhead component is a low pressure wellhead housing, the second wellhead component is a high pressure wellhead housing, the first annular member is a lockdown ring, and the second annular member is an actuating member.

5. The system of claim 1, wherein the first annular member stepped surface is configured to mate with the second annular member stepped surface to create a rigid interface between the first annular member and the second annular member.

6. The system of claim 1, wherein the first annular member is compressible so that the at least one protrusion enters the at least one recess of the first wellhead component as the first annular member engages the second annular member.

7. A system (200, 250, 270; 300, 350; 400) for rigid locking of components (202-208) in a wellhead assembly, characterized by:

a wellhead housing (208; 304; 404);

a hanger (206; 316; 402);

a lockdown ring (204; 306; 406B) having a first lockdown ring surface defining lockdown ring stepped tapers (204A; 306A); and

an actuating member (202; 308; 406A) having a first actuating member surface defining actuating member stepped tapers (202A; 308B) that correspond to the lockdown ring stepped tapers, the lockdown ring stepped tapers and the actuator ring stepped tapers configured to mate when positioned between the wellhead housing and the hanger.

8. The system of claim 7, wherein the lockdown ring has a second lockdown ring surface having at least one protrusion (204B; 320) for engaging the wellhead housing.

9. The system of claim 8, wherein the wellhead housing defines at least one recess (208A; 314) configured to receive the at least one protrusion of the second lockdown ring surface.

10. The system of claim 7, wherein the lockdown ring has a third lockdown ring surface (204D) positioned to engage a surface (206A) of the hanger.

11. The system of claim 7, wherein the interface between the lockdown ring stepped tapers and the actuator member stepped tapers is a ratcheting interface.

12. A method (500) for rigidly locking two components in a wellhead assembly, characterized by:

placing (502) a first mechanical connector, having a first mechanical connector surface with mechanical connector stepped tapers, in an area between rigid members of the wellhead assembly;

inserting (504) an actuating member having a first actuator member surface with actuator member stepped tapers into the area; and

mating (510) the mechanical connector stepped tapers with the actuator member stepped tapers so that the mechanical connector and the actuating member are rigidly locked together.

13. The method according to claim 12, further characterized by:

inserting, concurrently, the mechanical connector and the actuating member in a loose engagement within the area.

14. The method according to claim 12, further characterized by:

adjusting (506, 508) the relative position of the first mechanical connector surface and the first actuator member surface so that the mechanical connector stepped tapers ratchet against the actuator member stepped taper until a predetermined position or a predetermined value for a mechanically loaded connection is achieved.

15. The method according to claim 14, wherein the step of adjusting the relative position of the first mechanical connector surface and the first actuator member surface is further characterized by causing one or more of:

a) a lateral extension of the mechanical connector towards a portion of the wellhead assembly,

b) a rotation of the mechanical connector towards a portion of the wellhead assembly,

c) a pivoting of the mechanical connector towards a portion of the wellhead assembly, and

d) a tilting of the mechanical connector towards a portion of the wellhead assembly.