CLAIMS

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) which is a single-piece component and which is 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 tapered surface comprising thereon a plurality of first annular stepped tapers (204A; 306A);

a second annular member (202; 308; 406A) positioned adjacent the first wellhead component and having a second tapered surface comprising thereon a plurality of second annular stepped tapers (202A; 308B) adapted to be fully engaged with the plurality of first annular stepped tapers in a locked phase for the first annular member and the second annular member to limit relative upward movement between the first annular member and the second annular member upon contact between the first annular member tapered surface and the second annular member tapered surface; and

a shoulder surface of the second wellhead component to support loading of the first annular member thereon in the locked phase.

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 tapered surface is configured to mate with the second annular member tapered 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) which is a single-piece component;

a lockdown ring (204; 306; 406B) having a first lockdown ring tapered surface with a plurality of lockdown ring stepped tapers (204A; 306A) and having a bottom surface to load against a shoulder surface of the hanger in a locked phase of the lockdown ring; and

an actuating member (202; 308; 406A) having a first actuating member tapered surface that has defined thereon a plurality of actuating member stepped tapers (202A; 308B) that correspond to the lockdown ring stepped tapers, the plurality of lockdown ring stepped tapers and the plurality of actuating member stepped tapers configured to be fully engaged with each other when positioned between the wellhead housing and the hanger in a locked phase to prevent relative upward movement between the lockdown ring and the actuating member.

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 plurality of lockdown

ring stepped tapers and the plurality of actuating 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 mechanical connector, having a first mechanical connector tapered surface comprising thereon a plurality of mechanical connector stepped tapers, in an area between rigid members of the wellhead assembly;

inserting (504) into the area an actuating member having a first actuator member tapered surface comprising thereon a plurality of actuating member stepped tapers; and

enabling a bottom surface of the mechanical connector to load against a shoulder surface associated with one of the rigid members of the wellhead assembly in a locked phase of the mechanical connector and the actuating member, wherein the one of the rigid members is a single-piece component and wherein (510) the plurality of mechanical connector stepped tapers fully engage with the plurality of actuating member stepped tapers so that the mechanical connector and the actuating member are rigidly locked together in a locked phase to prevent relative upward movement between the mechanical connector and the actuating member.

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.