CLAIMS

~~What is claimed is:~~

1. An annular seal system ~~(200, 240, 280; 300, 340, 380; 400, 440, 480; 500, 540, 580, 590; 600)~~ for sealing between a casing hanger ~~(202; 302; 402; 502; 602)~~ and a wellhead housing ~~(204; 304; 404; 504; 604)~~, ~~characterized by~~the system comprising:

an actuator ring ~~(210; 310; 410; 510; 612) characterized by~~comprising a rigid portion ~~(210A; 310A; 410A; 510A; 612)~~ and a flexible portion ~~(218; 318; 418A, 418B; 518; 614)~~;

a lockdown ring ~~(214; 314; 414; 514; 614)~~ positioned adjacent the actuator ring; and

a seal assembly ~~(206, 208; 306, 308; 406, 408; 506, 508; 606, 608)~~ capable of moving from a de-energized position to an energized position, wherein when the seal assembly is in the de-energized position there is defined a space ~~(220; 320; 420; 520)~~ between the seal assembly and the rigid portion of the actuator ring, and when the seal assembly is in the energized position the space is closed, the rigid portion of the actuator ring contacts a surface of the casing hanger, and the flexible portion of the actuator ring pushes the lockdown ring into engagement with the wellhead, the flexible portion of the actuator ring adapted to axially compress to allow positional variation between the lockdown ring and the wellhead housing.

2. The system of claim 1, wherein the seal assembly ~~is characterized by~~comprises:

a U-shaped seal ~~(208; 308; 408; 508; 608)~~; and

an energizing ring ~~(206; 306; 406; 506; 606)~~ configured to push the U-shaped seal into sealing contact with the casing hanger and the wellhead housing.

3. The system of claim 1, wherein at least a part of the flexible portion of the actuator ring extends between the seal assembly and the rigid portion of the actuator ring while the space between the seal assembly and the rigid portion of the actuator ring is maintained.

4. The system of claim 1, wherein the flexible portion of the actuator ring includes a flexible element selected from the group consisting of a bladder, one or more collapsible or compressible members, and a combination of a collet and bump.

5. An annular seal and lockdown assembly (200, 240, 280; 300, 340, 380; 400, 440, 480; 500, 540, 580, 590; 600) between a hanger (202; 302; 402; 502; 602) and a wellhead housing (204; 304; 404; 504; 604), characterized by:

a seal assembly (206, 208; 306, 308; 406, 408; 506, 508; 606, 608) between the hanger and the wellhead housing, the seal assembly having an energized position;

a supporting structure characterized by a rigid portion of an actuator ring (210A; 310A; 410A; 510A; 612), a flexible portion of the actuator ring (218; 318; 418A, 418B; 518; 614), and a lockdown ring (214; 314; 414; 514; 614);

a first load path directed, when the seal assembly is in the energized position, from the hanger through the rigid portion of the actuator ring to the seal assembly such that the position of the hanger relative to the seal assembly remains fixed; and

a second load path from the wellhead housing through the lockdown ring and the flexible portion of the actuator ring to the seal assembly such that the relative position of the lockdown ring and the wellhead housing can vary as the seal assembly is energized.

6. The annular seal assembly of claim 5, wherein the flexible portion of the actuator ring is capable of compression when a load is applied to the seal assembly.

7. The annular seal assembly of claim 5, wherein the flexible portion of the actuator ring is selected from the group consisting of a bladder, one or more collapsible or compressible members, and a combination of a collet and bump.

8. The annular seal assembly of claim 5, wherein the actuator ring is further characterized by a first tapered surface (210B; 310B; 410B; 510B), and the lockdown ring is characterized by a second tapered surface (214A; 314A; 414A; 514A), the first tapered surface and the second tapered surface interacting to form a tapered interface of the supporting structure, relative axial movement between the actuator ring and the lockdown ring at the tapered interface acting to drive the lockdown ring toward the wellhead housing.

9. The annular seal assembly of claim 5, wherein the rigid portion of the actuator ring includes a pin (212A; 312A; 412A), and the flexible portion of the actuator ring defines a notch (210C; 310C; 410C) adapted to receive the pin to maintain relative positions of the rigid portion and the flexible portion of the actuator ring while inserting or removing the support structure into or away from between the hanger and the wellhead housing.

10. The annular seal assembly of claim 5, further characterized by:
protrusions (214B; 314B; 414B; 514B) on the lockdown ring to engage the wellhead housing when the seal assembly is in the energized position.

11. A method (750) for decoupling a seal assembly from reactive forces in a supporting structure, the supporting structure including an actuator ring having a rigid portion and a flexible portion, and a lockdown ring, the method characterized by the steps of:

a) enabling a first load path (752) directed from a hanger through the rigid portion of the actuator ring to the seal assembly such that the position of the hanger relative to the seal assembly remains fixed; and

b) enabling a second load path (756) directed from a wellhead housing through the lockdown ring and the flexible portion of the actuator ring to the seal assembly such that the relative position of the lockdown ring and the wellhead housing can vary as the seal assembly is energized.

12. The method of claim 11, further characterized by the step of:
compressing (758) the flexible portion of the actuator ring to allow for positional variation between the wellhead housing and the lockdown ring.

13. The method of claim 12, further characterized by the step of:

dissipating (762) the reactive forces in the flexible portion of the actuator ring to prevent the reactive forces from reaching the seal assembly.

14. The method of claim 13, wherein the flexible support member is one of a spring (218), a bladder (318), a collet (418A) and a bump (418B), or a dual bias washer (518), and wherein the

~~step of dissipating the reactive forces in the flexible support member includes of one: compressing the spring, collapsing the bladder, driving the collet past the bump, or flexing the dual bias washer inside out.~~