CLAIMS

1. An apparatus for reducing pressure in a radial seal on a RCD at a wellbore, comprising:
   an inner member housed in the RCD, wherein the inner member has an outer surface;
   a wear sleeve adjacent to the outer surface of the inner member;
   a top seal adjacent to the wear sleeve;
   a bottom seal adjacent to the wear sleeve;
   wherein the wear sleeve is configured to be sealed by the top seal and the bottom seal as the inner member rotates in the RCD; and
   a pressure reduction system mounted with the RCD configured to apply a pressure via a wellbore pressure between the top seal and the bottom seal, which is higher relative to a pressure above the top seal, and which is lower relative to a pressure below the bottom seal.
2. The apparatus of claim 1, wherein the pressure reduction system is a closed hydraulic system.
3. The apparatus of claim 1, wherein the pressure reduction system further comprises a reduction piston having a first piston surface exposed to a first volume of fluid and a second piston surface configured to motivate a second volume of fluid within a reduction piston chamber.
4. The apparatus of claim 3, wherein the first piston surface has a first piston surface area and the second piston surface has a second piston surface area, and wherein the first piston surface area is less than the second piston surface area.
5. The apparatus of claim 4, wherein the ratio between the first piston surface area and the second piston surface area is less than or equal to 0.7 of the wellbore pressure.
6. The apparatus of claim 5, further comprising an accumulator within the reduction piston chamber, wherein the accumulator includes a receptacle.
7. The apparatus of claim 6, wherein the receptacle further includes an amount of compressible gas therein.

8. The apparatus of claim 6, wherein the receptacle further includes a compressible spring therein.
9. The apparatus of claim 1, further comprising a fluid communication port configured to allow fluid communication between the pressure reduction system and the RCD.
10. The apparatus of claim 3, wherein the second volume of fluid is an incompressible fluid.
11. A system for increasing the longevity of an RCD at a wellbore, comprising:

a bearing assembly configured for operating in the RCD; wherein the bearing assembly is configured for reducing pressure around the bearing assembly.

12. The system of claim 11, wherein the bearing assembly configured for reducing pressure comprises a system for reducing pressure and friction in a radial seal on the RCD at the wellbore comprising:

an inner member mounted in the bearing assembly, and having an outer surface and wherein the inner member is configured to engage a piece of oilfield equipment as the piece of oilfield equipment passes through the RCD, and further wherein the inner member has an outer surface; a piston coupled to the bearing assembly, wherein the piston is configured to compress a first volume of fluid in a piston chamber; and

a pressure reduction system mounted with the RCD comprising:

a wear sleeve adjacent to the outer surface of the inner member;

a top seal adjacent to the wear sleeve;

a bottom seal adjacent to the wear sleeve;

wherein the wear sleeve is configured to be sealed by the top seal and the bottom seal as the inner member rotates in the RCD;

a fluid communication port configured to allow fluid communication between the pressure reduction system and the wear sleeve; and

wherein the pressure reduction system is configured to apply a pressure via a wellbore pressure between the top seal and the bottom seal, which is higher relative to a pressure above the top seal, and which is lower relative to a pressure below the bottom seal.

13. The system of claim 12, wherein the pressure reduction system is a closed hydraulic system.

14. The system of claim 12, wherein the pressure reduction system further comprises a reduction piston having a first piston surface exposed to a pressure in the piston chamber and a second piston surface configured to motivate a second volume of fluid within a reduction piston chamber.

15. The system of claim 14, wherein the first piston surface has a first piston surface area and the second piston surface has a second piston surface area, and wherein the first piston surface area is less than the second piston surface area.

16. The system of claim 15, wherein the ratio between the first piston surface area and the second piston surface area is less than or equal to 0.7 of the pressure in the piston chamber.

17. The system of claim 16, further comprising an accumulator within the reduction piston chamber, wherein the accumulator includes a receptacle.

18. The system of claim 17, wherein the receptacle further includes an amount of compressible gas therein.

19. The system of claim 17, wherein the receptacle further includes a compressible spring therein.

20. The system of claim 14, wherein the second volume of fluid is an incompressible fluid.

21. A method for reducing pressure in a radial seal on a RCD at a wellbore, comprising the steps of:

transferring a pressure from the wellbore to a first volume of fluid in a piston chamber;

applying a force from the first volume of fluid to a first piston surface of a reduction piston, wherein the first piston surface has a first piston surface area, and wherein the reduction piston further has a second piston surface having a second piston surface area, and further wherein the first piston surface area is less than the second piston surface area;

compressing a second volume of fluid in a reduction piston chamber;

decreasing a pressure in the reduction piston chamber to a reduced pressure by a ratio between the first piston surface area and the second piston surface area; and

conveying the reduced pressure to the radial seal on the RCD.

22. The method according to claim 21, wherein the step of transferring a pressure from the wellbore to a first volume of fluid in a piston chamber comprises the steps of:

applying the pressure from the wellbore to a piston located within the RCD;

moving the piston towards the piston chamber; and

compressing the first volume of fluid within the piston chamber.

23. The method according to claim 21, wherein the step of conveying the reduced pressure to the radial seal on the RCD comprises the step of transferring the reduced pressure through a fluid communication port to a wear sleeve, a top seal, and a bottom seal.

24. The method according to claim 21, further comprising the step of:

regulating the pressure in the reduction piston chamber with an accumulator piston and an accumulator, wherein the accumulator is filled with an amount of compressible gas.

25. The method according to claim 24, wherein the step of regulating the pressure in the reduction piston chamber comprises the steps of:

allowing the second volume of fluid to fluctuate due to pressure change; and

compensating for fluctuation of the second volume of fluid with the amount of compressible gas in the accumulator.

26. The method according to claim 25, further comprising the step of adjusting the temperature of the amount of compressible gas.

27. The method according to claim 21, further comprising the steps of:

regulating the pressure in the reduction piston chamber with an accumulator piston and an accumulator, wherein the accumulator includes a compressible spring;

allowing the second volume of fluid to fluctuate due to pressure change; and

compensating for fluctuation of the second volume of fluid with the compressible spring.

28. A method for reducing pressure in a radial seal on a RCD at a wellbore, comprising the steps of:

transferring a pressure via a wellbore pressure between a top seal and a bottom seal and between a fixed component and a rotating component, and reducing the transferred pressure wherein the reduced pressure is higher relative to a pressure above the top seal, and which is lower relative to a pressure below the bottom seal.

CLAIMS

1. An apparatus for reducing pressure in a radial seal on a rotating control device (RCD) at a wellbore, comprising:

an inner member housed in the RCD, wherein the inner member has an outer surface;

a wear sleeve adjacent to the outer surface of the inner member;

a top seal in contact with the wear sleeve;

a bottom seal in contact with the wear sleeve;

wherein the wear sleeve is sealed by the top seal and the bottom seal as the inner member rotates in the RCD; and

a pressure reduction system mounted with the RCD and configured for pressure communication with wellbore pressure, whereby pressure is applied between the top seal and the bottom seal, the pressure between the seals being higher relative to a pressure above the top seal, and the pressure between the seals being lower relative to a pressure below the bottom seal.

2. The apparatus of claim 1, wherein the pressure reduction system is a closed hydraulic system.

3. The apparatus of claim 1, wherein the pressure reduction system further comprises a reduction piston having a first piston surface exposed to a first volume of fluid and a second piston surface configured to motivate a second volume of fluid within a reduction piston chamber.

4. The apparatus of claim 3, wherein the first piston surface has a first piston surface area and the second piston surface has a second piston surface

area, and wherein the first piston surface area is less than the second piston surface area.

5. The apparatus of claim 4, wherein the ratio between the first piston surface area and the second piston surface area is less than or equal to 0.7 of the wellbore pressure.

6. The apparatus of claim 5, further comprising an accumulator within the reduction piston chamber, wherein the accumulator includes a receptacle.

7. The apparatus of claim 6, wherein the receptacle further includes an amount of compressible gas therein.

8. The apparatus of claim 6, wherein the receptacle further includes a compressible spring therein.

9. The apparatus of claim 1, further comprising a fluid communication port configured to allow fluid communication between the pressure reduction system and the RCD.

10. The apparatus of claim 3, wherein the second volume of fluid is an incompressible fluid.

11. A system for increasing the longevity of a rotating control device (RCD) at a wellbore, comprising:

a bearing assembly configured for operating in the RCD;

wherein the bearing assembly is configured for reducing pressure around the bearing assembly,

wherein the bearing assembly configured for reducing pressure comprises a system for reducing pressure and friction in a radial seal on the RCD at the wellbore comprising:

an inner member mounted in the bearing assembly, wherein the inner member is configured to engage a piece of oilfield equipment as the piece of oilfield equipment passes through the RCD, and further wherein the inner member has an outer surface;

a piston coupled to the bearing assembly, wherein the piston is configured to compress a first volume of fluid in a piston chamber; and

a pressure reduction system mounted with the RCD comprising:

a wear sleeve adjacent to the outer surface of the inner member;

a top seal adjacent to the wear sleeve;

a bottom seal adjacent to the wear sleeve;

wherein the wear sleeve is configured to be sealed by the top seal and the bottom seal as the inner member rotates in the RCD;

a fluid communication port configured to allow fluid communication between the pressure reduction system and the wear sleeve; and

wherein the pressure reduction system is configured to apply a pressure via a wellbore pressure between the top seal and the bottom seal, wherein the pressure between the seals is higher relative to a pressure above the top seal, and wherein the pressure between the seals is lower relative to a pressure below the bottom seal.

12. The system of claim 11, wherein the pressure reduction system is a closed hydraulic system.

13. The system of claim 11, wherein the pressure reduction system further comprises a reduction piston having a first piston surface exposed to a pressure in the piston chamber and a second piston surface configured to motivate a second volume of fluid within a reduction piston chamber.

14. The system of claim 13, wherein the first piston surface has a first piston surface area and the second piston surface has a second piston surface area, and wherein the first piston surface area is less than the second piston surface area.

15. The system of claim 14, wherein the ratio between the first piston surface area and the second piston surface area is less than or equal to 0.7 of the pressure in the piston chamber.

16. The system of claim 15, further comprising an accumulator within the reduction piston chamber, wherein the accumulator includes a receptacle.

17. The system of claim 16, wherein the receptacle further includes an amount of compressible gas therein.

18. The system of claim 16, wherein the receptacle further includes a compressible spring therein.

19. The system of claim 13, wherein the second volume of fluid is an incompressible fluid.

20. A method for reducing pressure in a radial seal on a rotating control device (RCD) at a wellbore, comprising the steps of:

transferring a pressure from the wellbore to a first volume of fluid in a piston chamber;

applying a force from the first volume of fluid to a first piston surface of a reduction piston, wherein the first piston surface has a first piston surface area, and wherein the reduction piston further has a second piston surface having a second piston surface area, and further wherein the first piston surface area is less than the second piston surface area;

compressing a second volume of fluid in a reduction piston chamber;

decreasing a pressure in the reduction piston chamber to a reduced pressure by a ratio between the first piston surface area and the second piston surface area; and

conveying the reduced pressure to the radial seal on the RCD.

21. The method according to claim 20, wherein the step of transferring a pressure from the wellbore to a first volume of fluid in a piston chamber comprises the steps of:

applying the pressure from the wellbore to a piston located within the RCD;

moving the piston towards the piston chamber; and

compressing the first volume of fluid within the piston chamber.

22. The method according to claim 20, wherein the step of conveying the reduced pressure to the radial seal on the RCD comprises the step of transferring the reduced pressure through a fluid communication port to a wear sleeve, a top seal, and a bottom seal.

23. The method according to claim 20, further comprising the step of:

regulating the pressure in the reduction piston chamber with an accumulator piston and an accumulator, wherein the accumulator is filled with an amount of compressible gas.

24. The method according to claim 23, wherein the step of regulating the pressure in the reduction piston chamber comprises the steps of:

allowing the second volume of fluid to fluctuate due to pressure change; and

compensating for fluctuation of the second volume of fluid with the amount of compressible gas in the accumulator.

25. The method according to claim 24, further comprising the step of adjusting the temperature of the amount of compressible gas.

26. The method according to claim 20, further comprising the steps of:

regulating the pressure in the reduction piston chamber with an accumulator piston and an accumulator, wherein the accumulator includes a compressible spring;

allowing the second volume of fluid to fluctuate due to pressure change; and

compensating for fluctuation of the second volume of fluid with the compressible spring.

27. A method for reducing pressure in a radial seal on a rotating control device (RCD) at a wellbore, comprising the steps of:

transferring wellbore pressure to a pressure reduction system of the RCD;

reducing the pressure in the pressure reduction system; and

applying the reduced pressure between a top seal and a bottom seal and between a fixed component and a rotating component of the RCD,

wherein the reduced pressure is higher relative to a pressure above the top seal, and wherein the reduced pressure is lower relative to a pressure below the bottom seal.