CLAIMS

1. A separation seal for preventing fluid from entering a dry gas seal surrounding a shaft of a rotating machine, the separation seal comprising:

a stator configured to be mounted around the shaft and configured to be fixedly attached to the rotating machine, the stator including primary ring control chamber formed therein;

a porous primary ring formed of a porous material and having a back;

a first thrust ring at least partially within the primary ring control chamber and coupled to the porous primary ring;

a mating ring coupled to the shaft that rotates with the shaft and relative to the porous primary ring; and

one or more biasing members that urge the porous primary ring toward the mating ring to form a seal interface between porous primary ring and the mating ring;

wherein the stator includes a passageway constructed and arranged to convey pressurized buffer gas at a gas pressure in normal operation to the primary ring control chamber such that the pressurized buffer gas passes from the back of the porous primary ring, through the porous primary ring and to the seal interface;

wherein buffer gas that reaches the seal interface passes, in normal operation, both radially inward and radially outward along the seal interface;

wherein the mating ring includes grooves formed on a face thereof, wherein in the event of a buffer gas delivery pressure reduction, the grooves pump gas from an inner diameter of the seal interface to an outer diameter of the seal interface.

2. The separation seal of claim 1, wherein the porous primary ring is formed of porous carbon.

3. The separation seal of claim 1, further comprising:

one or more sealing elements disposed between the first thrust ring and the back of the porous primary ring and within the primary ring control chamber, wherein the sealing elements are spaced apart from the back of the porous carbon seal by a separating member.

4. The separation seal of claim 3, wherein the separating member is a ring.

5. The separation seal of claim 4, wherein the separating member is a second thrust ring.

6. The separation seal of claim 5, further comprising:

one or more secondary sealing elements disposed between the second thrust ring and the back of the porous carbon ring, wherein the one or more secondary sealing elements are not in the primary ring control chamber and do not contact a side of the primary ring control chamber.

7. The separation seal of claim 3, wherein the back of the porous carbon ring includes one or move grooves formed therein to receive the one or more sealing elements.

8. The separation seal of claim 3, wherein the one or more sealing elements include a first sealing element and a second sealing element and wherein the first and second sealing elements are 0-rings having different cross-sectional diameters.

9. An assembly for sealing a fluid in a rotating machine, the assembly comprising:

a primary dry gas seal adapted and configured to surround a shaft of the rotating machine and prevent the fluid from exiting the rotating machine; and

a secondary seal connected to the primary dry gas seal adapted and configured to prevent a liquid from entering the dry gas seal, the secondary seal comprising:

a stator configured to be mounted around the shaft and configured to be fixedly attached to the rotating machine, the stator including primary ring control chamber formed therein;

a porous primary ring formed of a porous material and having a back;

a split thrust ring at least partially within the primary ring control chamber and coupled to the porous primary ring, the split thrust ring including an inner ring and outer ring, wherein the inner ring is configured to move axially inboard relative to the outer ring in the event of an increase in the flow of the fluid through the primary dry gas seal;

a mating ring coupled to the shaft that rotates with the shaft and relative to the porous primary ring;

an outer ring biasing members that urges the outer ring and the porous primary ring toward the mating ring to form a seal interface between porous primary ring and the mating ring;

an inner ring biasing members that urges the inner ring and the porous primary ring toward the mating ring; and

one or more sealing elements disposed between the split thrust ring and the back of the porous primary ring and within the primary ring control chamber;

wherein the stator includes a passageway constructed and arranged to convey pressurized buffer gas a buffer gas pressure during normal operation to the primary ring control chamber such that gas passes from the back of the porous primary ring, through the porous primary ring and to the seal interface.

10. The assembly seal of claim 9, wherein buffer gas that reaches the seal interface passes, in normal operation, both radially inward and radially outward along the seal interface.

11. The assembly of claim 10, wherein a vent is provided that receives gas that passes through the primary dry gas seal and the buffer gas that travels radially inward along the seal interface.

12. The assembly of claim 11, wherein the stator defines a dry gas seal side passage way that allows buffer gas that passes radially inward to reach the vent during normal operation.

13. The assembly of claim 12, wherein the fluid is process gas and, in the event that the flow process gas through primary gas seal increases pressure in the vent above a threshold, the process gas that passes through the primary gas seal travels along the dry gas seal side passage to an inner diameter of the seal interface.

14. The assembly of claim 13, wherein the process gas at the inner diameter causes the inner ring to move axially with respect to the outer ring when the gas in the vent exceeds the threshold.

15. The assembly of claim 14, wherein the axial movement of the inner ring allows the process gas to enter the primary ring control chamber.

16. The assembly of claim 15, wherein the mating ring includes grooves formed on a face therein, wherein the grooves pump process gas from the inner diameter of the seal interface to an outer diameter of the seal interface.

17. The assembly of claim 9, wherein the porous primary ring is formed of porous carbon.

18. The assembly of claim 17, wherein the sealing elements are spaced apart from the back of the porous carbon seal by a separating member.

19. The assembly of claim 18, wherein the separating member is a ring.

20. The assembly of claim 9, wherein the back of the porous carbon ring includes one or move grooves formed therein to receive the one or more sealing elements.

21. A separation seal for preventing fluid from entering a dry gas seal surrounding a shaft of a rotating machine, the separation seal comprising:

a stator configured to be mounted around the shaft and configured to be fixedly attached to the rotating machine, the stator including a primary ring control chamber formed therein;

a primary ring having a back;

a first thrust ring at least partially within the primary ring control chamber and coupled to the porous primary ring;

a mating ring coupled to the shaft that rotates with the shaft and relative to the primary ring; and

one or more biasing members that urge the primary ring toward the mating ring to form a seal interface between primary ring and the mating ring;

wherein the stator includes a passageway constructed and arranged to convey pressurized buffer gas at a gas pressure in normal operation to the primary ring control chamber;

wherein the primary ring is configured such that the pressurized buffer gas in the primary ring control chamber passes from the back of the primary ring, through the primary ring and to the seal interface;

wherein buffer gas that reaches the seal interface passes, in normal operation, both radially inward and radially outward along the seal interface;

wherein the mating ring includes grooves formed on a face thereof, wherein in the event of a buffer gas delivery pressure reduction, the grooves pump gas from an inner diameter of the seal interface to an outer diameter of the seal interface.

22. The separation seal of claim 21, further comprising:

one or more sealing elements disposed between the first thrust ring and the back of the primary ring and within the primary ring control chamber, wherein the sealing elements are spaced apart from the back of the carbon seal by a separating member.

23. The separation seal of claim 22, wherein the separating member is a ring.

24. The separation seal of claim 23, wherein the separating member is a second thrust ring.

25. The separation seal of claim 24, further comprising:

one or more secondary sealing elements disposed between the second thrust ring and the back of the primary ring, wherein the one or more secondary sealing elements are not in the primary ring control chamber and do not contact a side of the primary ring control chamber.

26. The separation seal of claim 22, wherein the back of the primary ring includes one or move grooves formed therein to receive the one or more sealing elements.

27. The separation seal of claim 22, wherein the one or more sealing elements include a first sealing element and a second sealing element and wherein the first and second sealing elements are 0-rings having different cross-sectional diameters.

28. An assembly for sealing a fluid in a rotating machine, the assembly comprising:

a primary dry gas seal adapted and configured to surround a shaft of the rotating machine and prevent the fluid from exiting the rotating machine; and

a secondary seal connected to the primary dry gas seal adapted and configured to prevent a liquid from entering the dry gas seal, the secondary seal comprising:

a stator configured to be mounted around the shaft and configured to be fixedly attached to the rotating machine, the stator including primary ring control chamber formed therein;

a primary ring having a back;

a split thrust ring at least partially within the primary ring control chamber and coupled to the primary ring, the split thrust ring including an inner ring and outer ring, wherein the inner ring is configured to move axially inboard relative to the outer ring in the event of an increase in the flow of the fluid through the primary dry gas seal;

a mating ring coupled to the shaft that rotates with the shaft and relative to the primary ring;

an outer ring biasing members that urges the outer ring and the primary ring toward the mating ring to form a seal interface between porous primary ring and the mating ring;

an inner ring biasing members that urges the inner ring and the primary ring toward the mating ring; and

one or more sealing elements disposed between the split thrust ring and the back of the primary ring and within the primary ring control chamber;

wherein the stator includes a passageway constructed and arranged to convey pressurized buffer gas a buffer gas pressure during normal operation to the primary ring control chamber;

wherein the primary ring is configured such that gas in the primary ring control chamber passes from the back of the primary ring, through the primary ring and to the seal interface.

29. The assembly seal of claim 28, wherein buffer gas that reaches the seal interface passes, in normal operation, both radially inward and radially outward along the seal interface.

30. The assembly of claim 29, wherein a vent is provided that receives gas that passes through the primary dry gas seal and the buffer gas that travels radially inward along the seal interface.

31. The assembly of claim 30, wherein the stator defines a dry gas seal side passage way that allows buffer gas that passes radially inward to reach the vent during normal operation.

32. The assembly of claim 31, wherein the fluid is process gas and, in the event that the flow process gas through primary gas seal increases pressure in the vent above a threshold, the process gas that passes through the primary gas seal travels along the dry gas seal side passage to an inner diameter of the seal interface.

33. The assembly of claim 32, wherein the process gas at the inner diameter causes the inner ring to move axially with respect to the outer ring when the gas in the vent exceeds the threshold.

34. The assembly of claim 33, wherein the axial movement of the inner ring allows the process gas to enter the primary ring control chamber.

35. The assembly of claim 34, wherein the mating ring includes grooves formed on a face therein, wherein the grooves pump process gas from the inner diameter of the seal interface to an outer diameter of the seal interface.

36. The assembly of claim 28, wherein the porous primary ring is formed of porous carbon.

37. The assembly of claim 36, wherein the sealing elements are spaced apart from the back of the porous carbon seal by a separating member.

38. The assembly of claim 37, wherein the separating member is a ring.

39. The assembly of claim 28, wherein the back of the mating ring includes one or move grooves formed therein to receive the one or more sealing elements.