

## CLAIMS

What is claimed is:

1. A fluid to fluid pressurizer comprising:

an elongated stationary portion comprising a plurality of flow channels, said  
5 stationary portion comprising a first face at a first end and a second face at a second  
end;

a first rotor housing disposed adjacent to the first end of the elongated  
stationary portion;

a second rotor housing disposed adjacent the second end of the stationary  
10 portion, said first rotor housing and the second rotor housing being stationary;

each of the first rotor housing and the second rotor housing comprising a fluid  
inlet fluidically coupled to a first annular channel and a fluid outlet fluidically coupled to  
a second annular channel;

each of the first rotor housing and the second rotor housing comprising a first  
15 rotary valve plate and a second rotary valve plate respectively, each rotary valve plate  
comprising an inlet valve port fluidically coupling the fluid inlet to at least a first flow  
channel of the plurality of flow channels, each rotary valve plate comprising an outlet  
valve port fluidically coupling a second flow channel to the plurality of flow channels to  
the second annular channel; the first rotary valve plate comprising a first sealing  
20 surface adjacent the first face and the second rotary valve plate comprising a second  
sealing surface adjacent the second face;

a first annular seal disposed between the first rotor housing and the rotary valve  
plate between the first annular channel and the second annular channel; and

a first motor coupled to the first rotary valve plate.

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2. The fluid to fluid pressurizer as recited in claim 1 wherein the first rotary  
valve plate simultaneously couples a first plurality of plurality of flow channels to the  
fluid inlet and the second rotary valve plate simultaneously couples a second plurality  
of flow channels to the fluid outlet.

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3. The fluid to fluid pressurizer as recited in claim 1 wherein the first  
plurality of flow channels and the second plurality of flow channels are symmetrically  
opposite about a longitudinal axis of the rotary plate.

4. The fluid to fluid pressurizer as recited in claim 1 further comprising a motor shaft wherein the first motor is coupled to the first rotary valve plate and the second rotary valve plate with the motor shaft.

5 5. The fluid to fluid pressurizer as recited in claim 1 further comprising a first motor shaft coupling the first motor and the first rotary valve plate and a second motor shaft coupling a second motor to the second rotary valve plate.

10 6. The fluid to fluid pressurizer as recited in claim 5 wherein the first motor shaft comprises a first encoder generating a first encoder signal and the second motor shaft comprises a second encoder generating a second encoder signal and a motor controller synchronously controlling the first motor and the second motor based on the first encoder signal and the second encoder signal.

15 7. The fluid to fluid pressurizer as recited in claim 1 wherein the plurality of flow channels are defined by a plurality of radial walls, an inner annular wall and an outer annular wall, said radial walls defining a first width for each of the plurality of flow channels.

20 8. The fluid to fluid pressurizer as recited in claim 7 wherein the rotary valve comprises a sealing area comprising a first radial sealing edge, a second radial sealing edge having a second width therebetween, said second width equal to or greater than the first width.

25 9. The fluid to fluid pressurizer as recited in claim 8 wherein the first radial sealing edge comprises a first taper extending therefrom, the sealing edge comprising an insert formed of a wear resistant material different than a port plate material.

30 10. The fluid to fluid pressurizer as recited in claim 9 wherein the first taper is linear.

11. The fluid to fluid pressurizer as recited in claim 9 wherein the first taper is curved.

12. The fluid to fluid pressurizer as recited in claim 9 wherein the insert is removable.

13. The fluid to fluid pressurizer as recited in claim 8 wherein the first radial sealing edge comprises a trailing edge and the second radial sealing edge comprises a leading edge, wherein the second radial sealing edge comprises a second taper.

14. The fluid to fluid pressurizer as recited in claim 8 wherein the rotary valve comprises a pair of oppositely disposed sealing areas comprising a first area.

15. The fluid to fluid pressurizer as recited in claim 8 wherein the sealing area comprises four diametrically opposite and evenly spaced apart sealing areas.

16. The fluid to fluid pressurizer as recited in claim 8 wherein the sealing area comprises a plurality of groups of four diametrically opposite and evenly spaced apart sealing areas.

17. The fluid to fluid pressurizer as recited in claim 8 wherein the first rotary valve plate comprises a first annular sealing portion, a second annular sealing portion spaced apart from the first annular sealing portion, said first radial sealing edge and said second radial sealing edge extending between the first annular sealing portion and the second annular sealing portion.

18. The fluid to fluid pressurizer as recited in claim 17 wherein the first annular sealing portion comprises a plurality of radially overlapping grooves.

19. The fluid to fluid pressurizer as recited in claim 18 wherein the plurality of radially overlapping grooves are radially extending.

20. The fluid to fluid pressurizer as recited in claim 18 wherein the plurality of radially overlapping grooves are disposed at angles relative to a radius.

21. The fluid to fluid pressurizer as recited in claim 18 wherein the plurality of radially overlapping grooves are one millimeter deep or less.

22. The fluid to fluid pressurizer as recited in claim 8 wherein the sealing area  
5 comprises a plurality of grooves disposed thereon.

23. The fluid to fluid pressurizer as recited in claim 22 wherein the sealing area comprises a first set of grooves extending from the first sealing edge toward the second sealing edge and a second set of grooves extending from second sealing edge  
10 toward the first sealing edge.

24. The fluid to fluid pressurizer as recited in claim 1 wherein the first rotor housing further comprising a chamber disposed adjacent to the rotary valve plate, the chamber fluidically coupled to the inlet through a first control valve and wherein the  
15 chamber is fluidically coupled to the fluid outlet through a second control valve, a controller coupled to the first control valve and the second control valve controlling a fluid pressure within the chamber.

25. The fluid to fluid pressurizer as recited in claim 24 wherein the fluid  
20 pressure within the chamber provides an axial force of on the rotor toward the stationary portion.

26. The fluid to fluid pressurizer as recited in claim 1 wherein the plurality of flow channels comprises a first flow channel end portion having a first cross sectional area a second flow channel end portion having a second cross sectional area and a  
25 middle flow channel portion having a third cross sectional area, said middle cross sectional area less than the first cross sectional area and the second cross sectional area.

27. The fluid to fluid pressurizer as recited in claim 26 wherein the middle  
30 flow channel portion comprises a movable partition disposed therein.

28. The fluid to fluid pressurizer as recited in claim 27 wherein the first flow channel end portion comprises a partition stop spaced apart from the middle flow channel portion allowing the movable partition to partially extend therefrom.

5           29. The fluid to fluid pressurizer as recited in claim 26 wherein the first flow channel end portion comprises a first partition stop disposed in the first flow channel end portion and a second partition stop disposed in the second flow channel end portion.

10           30. The fluid to fluid pressurizer as recited in claim 29 wherein the first partition stop is disposed closer to the middle portion than the second partition stop.

            31. The fluid to fluid pressurizer as recited in claim 27 wherein the movable partition has a first end position adjacent the first partition stop and a second end position adjacent the second partition stop, in the first end position fluid flow the flow channel is blocked and, in the second end position, fluid flow through the flow channel is partially block.

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            32. The fluid to fluid pressurizer as recited in claim 26 wherein the stationary portion comprises a first removable faceplate and a second removable faceplate.

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            33. The fluid to fluid pressurizer as recited in claim 26 wherein the first flow channel end portion is disposed in a first removable faceplate and the second flow channel end portion is disposed in a second removable faceplate.

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            34. The fluid to fluid pressurizer as recited in claim 26 wherein the partition comprises a guide fin.

            35. The fluid to fluid pressurizer as recited in claim 1 wherein the plurality of flow channels comprises a plurality of pipes coupled to a first pipe manifold and a second pipe manifold.

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36. The fluid to fluid pressurizer as recited in claim 35 wherein the plurality of pipes are coupled to the first pipe manifold at a plurality of pipe joints.

37. The fluid to fluid pressurizer as recited in claim 35 wherein the rotary valve plate housing is coupled to the first pipe manifold.

38. A reverse osmosis system comprising:  
a membrane chamber having a feed fluid inlet, a permeate outlet and brine outlet;  
a fluid to fluid pressurizer as recited to claim 1 wherein the first rotor housing is fluidically coupled to the feed fluid inlet of the membrane chamber and the second rotor housing is coupled to the brine outlet;  
a first flow rate sensor generating a brine flow rate signal; and  
a controller coupled to the first flow rate sensor and controlling a speed of the motor in response to the brine flow rate.

39. The reverse osmosis system as recited in claim 38 further comprising a salinity sensor coupled to a fluid outlet of the first rotor housing generating a salinity signal corresponding to a salinity of the fluid from the fluid outlet;  
the controller coupled to the motor and the salinity sensor, said controller controlling a motor speed of the motor in response to the salinity signal.

40. A method of operating a fluid to fluid pressurizer having an elongated stationary portion comprising a plurality of flow channels, a first face at a first end and a second face at a second end,  
a first stationary rotor housing disposed adjacent to the first end of the elongated stationary portion and comprising a first rotary valve plate therein,  
a second stationary rotor housing disposed adjacent the second end of the stationary portion comprising a second rotary valve plate therein, said method comprising:  
communicating low pressure feed fluid to the fluid to fluid pressurizer,  
communicating high pressure process fluid to the fluid to fluid pressurizer,

rotating the first rotary valve plate and the second rotary vale plate within the first stationary rotor housing and the second stationary rotor housing synchronously so that low pressure feed fluid is pressurized by the high pressure process fluid within the plurality of flow channels to form high pressure feed fluid; and

- 5           controlling a speed of rotating in response to a sensed condition in the high pressure feed fluid or a high pressure process fluid.

41. The method of claim 40 wherein controlling the speed of rotating comprises controlling the speed of rotating in response to a salinity of the high pressure feed  
10   fluid.

42. The method of claim 40 wherein controlling the speed of rotating comprises controlling the speed of rotating in response to a flow rate of the high pressure process fluid.

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43. The method of claim 40 wherein rotating the first rotary valve plate and the second rotary vale plate within the first stationary rotor housing and the second stationary rotor housing synchronously comprising rotating the first rotary valve plate and the second rotary vale plate within the first stationary rotor housing and the  
20   second stationary rotor housing synchronously based on a signal from a first encoder and a second encoder.