CLAIMS

WHAT IS CLAIMED IS:

1. A fluid delivery system comprising:

a substrate block comprising:

an upper surface;

a substrate port in the upper surface;

a substrate fluid passageway extending from the substrate port;

a substrate ring defining the substrate port;

a substrate seal channel formed in the upper surface and surrounding the substrate ring, an outer surface of the substrate ring forming an inner surface of the substrate seal channel; and

a conical portion extending from the substrate ring to the substrate fluid passageway;

an active component comprising:

a lower surface;

a component port in the lower surface;

a component fluid passageway extending from the component port;

a component ring defining the component port;

a component seal channel formed in the lower surface and surrounding the component ring, an outer surface of the component ring forming an inner surface of the component seal channel; and

a conical portion extending from the component ring to the component fluid passageway;

a seal ring comprising:

an interior sleeve comprising an upper conical portion, a lower conical portion, and a central portion, the interior sleeve defining a sleeve fluid passageway, the sleeve fluid passageway having a diameter that is substantially constant along a longitudinal axis; and

an outer ring connected to the central portion of the interior sleeve and surrounding the interior sleeve so that: (1) an annular upper sleeve groove is formed between an upper portion of the outer ring and an upper portion of the interior sleeve;

and (2) an annular lower sleeve groove is formed between a lower portion of the outer ring and a lower portion of the interior sleeve;

the active component mounted to the substrate block so that: (1) the substrate port and the component port are aligned; and (2) the seal ring nests in each of the substrate seal channel and the component seal channel and the seal ring fluidly seals the substrate fluid passageway and the component fluid passageway.

2. The fluid delivery system of claim 1 wherein the seal ring is symmetrical about the longitudinal axis.

3. The fluid delivery system of claim 1 wherein the substrate fluid passageway has a diameter, the diameter of the substrate fluid passageway being less than the diameter of the sleeve fluid passageway.

4. The fluid delivery system of claim 1 wherein the interior sleeve of the seal ring has a first height and the outer ring of the seal ring has a second height, the first height being greater than the second height.

5. The fluid delivery system of claim 1 wherein the conical portion of the substrate port joins the substrate fluid passageway at an oblique angle; and wherein the lower conical portion of the seal ring extends a first distance from a central plane and the conical portion of the substrate port extends a second distance from the central plane, the second distance being greater than the first distance.

6. The fluid delivery system of any one of claims 1 to 5 wherein a transition portion of the conical portion of the substrate port remains exposed.

7. The fluid delivery system of claim 1 wherein the interior sleeve of the seal ring has a first height and the outer ring of the seal ring has a second height, the first and second heights being equal.

8. The fluid delivery system of claim 1 wherein the conical portion of the substrate port joins the substrate fluid passageway at a perpendicular angle.

9. The fluid delivery system of any one of claims 1, 2, 7, or 8 wherein the conical portion of the substrate port terminates in an end surface that is perpendicular to the longitudinal axis.

10. The fluid delivery system of claim 9 wherein the lower conical portion of the seal ring extends a first distance from a central plane and the conical portion of the substrate port extends a second distance from the central plane, the second distance being equal to the first distance.

11. The fluid delivery system of any one of claims 1 to 5 wherein the outer ring comprises castellations formed into upper and lower terminal surfaces of the outer ring.

12. A seal ring, the seal ring comprising:

an interior sleeve comprising an upper conical portion, a lower conical portion, and a central portion, the interior sleeve defining a sleeve fluid passageway, the sleeve fluid passageway having a diameter that is substantially constant along a longitudinal axis; and

an outer ring connected to the central portion of the interior sleeve and surrounding the interior sleeve so that: (1) an annular upper sleeve groove is formed between an upper portion of the outer ring and an upper portion of the interior sleeve; and (2) an annular lower sleeve groove is formed between a lower portion of the outer ring and a lower portion of the interior sleeve.

13. The seal ring of claim 12 wherein the upper conical portion joins the sleeve fluid passageway at an acute angle.

14. The seal ring of claim 12 or claim 13 wherein outer surfaces of the upper conical portion and the lower conical portion have a constant slope.

15. The seal ring of claim 12 wherein the upper and lower conical portions terminate in an end surface that is perpendicular to the longitudinal axis.

16. A fluid delivery system comprising:

a substrate block comprising:

an upper surface;

a substrate port in the upper surface;

a substrate fluid passageway extending from the substrate port;

a substrate ring defining the substrate port;

a substrate seal channel formed in the upper surface and surrounding the substrate ring, an outer surface of the substrate ring forming an inner surface of the substrate seal channel; and

a conical portion extending from the substrate ring to the substrate fluid passageway;

an active component comprising:

a lower surface;

a component port in the lower surface;

a component fluid passageway extending from the component port;

a component ring defining the component port;

a component seal channel formed in the lower surface and surrounding the component ring, an outer surface of the component ring forming an inner surface of the component seal channel; and

a conical portion extending from the component ring to the component fluid passageway;

a seal ring comprising:

an interior sleeve comprising an upper conical portion, a lower conical portion, and a central portion, the interior sleeve defining a sleeve fluid passageway; and

an outer ring connected to the central portion of the interior sleeve and surrounding the interior sleeve so that: (1) an annular upper sleeve groove is formed between an upper portion of the outer ring and an upper portion of the interior sleeve; and (2) an annular lower sleeve groove is formed between a lower portion of the outer ring and a lower portion of the interior sleeve;

the active component mounted to the substrate block so that: (1) the substrate port and the component port are aligned; and (2) the seal ring nests in each of the substrate seal channel and the component seal channel and the seal ring fluidly seals the substrate fluid passageway and the component fluid passageway; and

wherein the outer ring comprises castellations.

17. The fluid delivery system of claim 16 wherein the castellations comprise a plurality of grooves extending from an outer surface of the outer ring to the inner surface of the outer ring.

18. The fluid delivery system of claim 16 wherein the castellations comprise a plurality of floor surfaces, the floor surfaces having a height from a central plane which is less than a height of the upper and lower conical portions as measured from the central plane.

19. The fluid delivery system of claim 16 wherein the outer ring has a height which is greater than a height of the interior sleeve.

20. The fluid delivery system of any one of claims 16 to 19 wherein the castellations are formed into upper and lower terminal surfaces of the outer ring.