CLAIMS

1. A gate valve, comprising:

a valve body having a flow passageway extending therethrough;

a gate having an opening, the gate located in the flow passageway and having an open position, in which the opening is aligned with the flow passageway, and a closed position, in which the opening is not aligned with the flow passageway and the gate blocks the flow passageway;

a stem attached to the gate and extending substantially perpendicularly away from the flow passageway, the stem arranged to move the gate between the open and the closed position;

a bonnet attached to the valve body and substantially surrounding the stem;

a seat ring positioned between the valve body and the gate, and circumscribing the flow passageway, the seat ring configured to guide the gate as it moves between an open and a closed position;

a stem seal assembly between the bonnet and the stem, the stem seal assembly comprising:

a primary pressure-energized metal stem seal having a sealing portion configured to seal against surfaces of the stem and the bonnet to prevent fluid from passing between the stem and the bonnet;

a secondary pressure-energized stem seal positioned adjacent the stem and further from the gate than the primary pressure-energized stem seal, the secondary pressure-energized stem seal configured to seal against the stem if the primary stem seal leaks; and

a seat seal assembly between the valve body and the seat ring, the seat seal assembly comprising:

a thermoplastic pressure-energized seat position between the seat ring and the valve body, the thermoplastic pressure-energized seat seal configured to seal against surfaces of the seat ring and the valve body;

a face metal seat seal having a flat sealing face configured for sealing engagement with a flat surface of the valve body; and

a sand excluder comprising a biased mechanism in retained engagement with the seat ring, for substantially constant contact with the valve body to recue passage of solids between the valve body and the seat ring, the sand excluder defining apertures that permit the passage of fluid while preventing the passage of solid particles, the sand

excluder positioned between the seat ring and the valve body, and between the flow passageway and the face metal seat seal.

2. The gate valve of claim 1, wherein the primary pressure-energized stem seal has an extended portion that extends away from the flow passageway substantially parallel to the stem, and the secondary pressure-energized stem seal is positioned between the stem and the extended portion of the primary pressure-energized stem seal.

3. The gate valve of claim 1, wherein the stem seal assembly further comprises a tertiary stem seal having a leg configured for sealing engagement with the stem and located farther from the gate than the primary pressure-energized stem seal and the secondary pressure-energized stem seal.

4. The gate valve of claim 1, wherein the stem seal assembly further comprises a cartridge body between the bonnet and the stem, and wherein the primary pressure-energized stem seal and the secondary pressure-energized stem seal are mounted to the cartridge body.

5. The gate of valve 4, wherein the stem seal assembly is fluidly connected to an environment outside the bonnet by a check line, the stem seal assembly further comprising a check line seal between the cartridge body and the bonnet to prevent backflow of fluid from the environment into the stem seal assembly.

6. The gate valve of claim 4, wherein the cartridge body includes a secondary metal bonnet seal configured to seal against a surface of the bonnet to prevent fluid from passing between the cartridge body and the bonnet.

7. The gate valve of claim 4, further comprising an annular spacer between the secondary pressure-energized stem seal and the cartridge body to prevent axial movement of the secondary pressure-energized stem seal away from the flow passageway.

8. The gate valve of claim 1, wherein the sand excluder comprises:

an excluding arm having an aperture sized to allow passage of fluids through the aperture, and to block solid particles from passing through the aperture; and

a spring positioned between the seat ring and the excluding arm, the spring biased to push the excluding arm against a surface of the valve body.

9. A gate valve, comprising:

a valve body having a flow passageway extending therethrough;

a gate having an opening, the gate located in the flow passageway and having an open position, in which the opening is aligned with the flow passageway, and a closed position, in

which the opening is not aligned with the flow passageway and the gate blocks the flow passageway;

a stem attached to the gate and extending substantially perpendicularly away from the flow passageway, the stem arranged to move the gate between the open and the closed position;

a bonnet attached to the valve body and substantially surrounding the stem;

a seat ring positioned between the valve body and the gate, and circumscribing the flow passageway, the seat ring configured to guide the gate as it moves between an open and a closed position;

a stem seal assembly between the bonnet and the stem, the stem seal assembly comprising:

a primary stem seal having a sealing portion configured to seal against surfaces of the stem and the bonnet to prevent fluid from passing between the stem and the bonnet;

a secondary stem seal positioned between the stem and the primary stem seal, and configured to seal against surfaces of the stem and the primary stem seal, the secondary stem seal positioned farther from the flow passageway than the primary stem seal;

a seat seal assembly between the valve body and the seat ring, the seat seal assembly comprising:

a thermoplastic seat seal positioned between the seat ring and the valve body, and configured to seal against surfaces of the seat ring and the valve body;

a face metal seat seal having a flat sealing face configured for sealing engagement with a flat surface of the valve body, and positioned farther from the flow passageway than the thermoplastic seat seal; and

a sand excluder comprising a biased mechanism in retained engagement with the seat ring, for substantially constant contact with the valve body to reduce passage of solids between the valve body and the seat ring, the sand excluder defining apertures that permit the passage of fluid while preventing the passage of solid particles, the sand excluder positioned between the seat ring and the valve body, and between the flow passageway and the face metal seat seal.

10. The gate valve of claim 9, wherein the stem seal assembly further comprises a cartridge body between the bonnet and the stem, and wherein the primary stem seal, and the secondary

stem seal are mounted to the cartridge body and insertable as a unit into an annular space between the bonnet and the stem.

11. The gate of valve 10, wherein the stem seal assembly is fluidly connected to an environment outside the bonnet by a check line, the stem seal assembly further comprising a check line seal between the cartridge body and the bonnet to prevent backflow of fluid from the environment into the stem seal assembly.

12. The gate valve of claim 9, further comprising:

a tertiary stem seal having a leg configured for sealing engagement with the stem, and positioned farther from the flow passageway than the primary stem seal and the secondary stem seal, wherein the tertiary stem seal is integral to a cartridge body.

13. The gate valve of claim 10, wherein the cartridge body includes a secondary bonnet seal configured to seal against a surface of the bonnet to prevent fluid from passing between the cartridge body and the bonnet.

14. A gate valve, comprising:

a valve body having a flow passageway extending therethrough;

a gate having an opening, the gate located in the flow passageway and having an open position, in which the opening is aligned with the flow passageway, and a closed position, in which the opening is not aligned with the flow passageway and the gate blocks the flow passageway;

a stem attached to the gate and extending substantially perpendicularly away from the flow passageway, the stem arranged to move the gate between the open and the closed position;

a bonnet attached to the valve body and substantially surrounding the stem, and enclosing an annular space between the bonnet and the stem;

a seat ring positioned between the valve body and the gate, and circumscribing the flow passageway, the seat ring configured to guide the gate as it moves between an open and a closed position;

a stem seal assembly including a cartridge body that fits into the annular space between the bonnet and the stem, the stem seal assembly comprising:

a primary stem seal mounted to the cartridge body and having a sealing portion and an extended portion, the sealing portion configured to seal against surfaces of the stem and the bonnet to prevent fluid from passing between the stem and the bonnet, and

the extended portion extending away from the flow passageway substantially parallel to the stem;

a secondary stem seal positioned between the stem and the extended portion of the primary stem seal, and configured to seal against surfaces of the stem and the extended portion of the primary stem seal; and

a seat seal assembly between the valve body and the seat ring, the seat seal assembly comprising:

a thermoplastic seat seal positioned between the seat ring and the valve body, and configured to seal against surfaces of the seat ring and the valve body; and

a sand excluder comprising a biased mechanism in retained engagement with the seat ring, for substantially constant contact with the valve body to reduce passage of solids between the valve body and the seat ring, the sand excluder defining apertures that permit the passage of fluid while preventing the passage of solid particles, the sand excluder positioned between the seat ring and the valve body, and between the flow passageway and the thermoplastic seat seal.

15. The gate valve of claim 14, wherein the stem seal assembly further comprises a tertiary metal stem seal that is integral with the cartridge body, and that has a leg configured for sealing engagement with the stem.

16. The gate valve of claim 14, wherein the seat seal assembly further comprises a face metal seat seal having a flat sealing face configured for sealing engagement with a flat surface of the valve body.

17. The gate valve of claim 14, wherein the primary stem seal is threadedly engaged with the cartridge body.

18. The gate valve of claim 14, wherein the cartridge body includes a secondary bonnet seal configured to seal against a surface of the bonnet to prevent fluid from passing between the cartridge body and the bonnet.

19. The gate valve of claim 14, wherein the seat seal assembly further comprises a primary seat seal attached to the seat ring and configured to seat against a surface of the valve body to prevent fluid from passing between the seat ring and the valve body.