ELONGATED TRUNNION FOR HIGH PRESSURE BALL VALVES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] None.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not applicable.

BACKGROUND

[0004] Wellbores are sometimes drilled into subterranean formations containing hydrocarbons to allow recovery of the hydrocarbons. During the drilling and production of a hydrocarbon bearing formation, various procedures may be performed that involve temporarily isolating fluid flowing between the surface of a wellbore and the formation through a wellbore tubular. Such procedures can include flow control operations, completion operations, and/or interventions. Various valves, including ball valves, may be used during these procedures to control the flow of fluid through the wellbore tubular. When the ball valves are in the closed position, they can be used to isolate the flow of fluid through the valve. When the ball valves are in the open position, the valves may provide a fluid communication pathway through the valve as well as allowing tools and/or wellbore tubulars to be passed through the ball valve for use below the valve.

SUMMARY

[0004a] According to a first aspect of the present invention, there is provided a ball valve comprising: a ball rotatably disposed within a housing; and a trunnion plate supporting the ball, wherein the trunnion plate comprises: a trunnion plate hole, and a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, wherein the trunnion plate shoulder comprises an inward protrusion from an inner surface of the trunnion plate, wherein the inward protrusion extends towards a central longitudinal axis of the ball valve, wherein the inward protrusion protrudes from a flat innermost surface of the trunnion plate, and wherein the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve.

[0005] In an embodiment, a ball valve comprises a ball rotatably disposed within a housing, and a trunnion plate supporting the ball. The trunnion plate comprises a trunnion plate hole, and a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, where the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve. The ball valve may also include an actuation member configured to actuate the ball between an open and closed position, and the actuation member may be configured to actuate the ball using a linear movement along the axial direction. The actuation member may comprise a plurality of arms, and a plurality of windows. Each of the plurality of windows may be disposed in a corresponding one of the plurality of arms, and the trunnion plate shoulder may extend into at least one of the windows. The ball may comprise a spigot, and the spigot may extend through the at least one of the windows and engages the trunnion plate shoulder. A ratio of an inner diameter of an interior flow passage of the ball to an outer diameter of the ball valve may be greater than about 0.35. The length in the axial direction may be at least about 10% greater than the width in the radial direction of the ball valve. The length in the axial direction of the ball valve may be at least about 10% of a diameter of the trunnion plate hole. A ratio of the length in the axial direction to the width in the radial direction may be between about 1.05: 1 and 20: 1. The trunnion plate shoulder may have an elongated shape comprising two sides in the axial direction having semi-circular cross-sections and two sides in the radial direction having parallel sides that are aligned with the axial direction. The trunnion plate shoulder may have a rectangular shape comprising two sides in the axial direction having sides that are parallel and perpendicular to the axial direction and two sides in the radial direction having parallel sides that are aligned with the axial direction. The trunnion plate shoulder may have a diamond-like shape comprising two triangular sides in the axial direction. The trunnion plate shoulder may have an elliptical shape comprising rounded sides in the axial directions that intersect at the radial edge of the trunnion plate hole.

[0006] In an embodiment, a ball valve comprises a ball comprising a plurality of spigots, and a plurality of trunnion plates. Each trunnion plate supports one of the plurality of spigots, and the trunnion plates are each configured to resist a greater load applied through the spigots in an axial direction than a radial direction. The plurality of trunnion plates may each comprise a trunnion plate hole configured to receive the one of the plurality of spigots. The ball valve may also include a bearing disposed within the trunnion plate hole and configured to receive the one of the plurality of spigots.

[0006a] According to a second aspect of the present invention, there is provided a method comprising: applying a load to a ball within a ball valve, wherein the ball valve is in a closed position, and wherein the ball valve comprises a trunnion plate supporting the ball, wherein the trunnion plate comprises: a trunnion plate hole, and a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, wherein the trunnion plate shoulder comprises an inward protrusion from an inner surface of the trunnion plate, wherein the inward protrusion extends towards a central longitudinal axis of the ball valve, wherein the inward protrusion protrudes from a flat innermost surface of the trunnion plate, and wherein the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve; and retaining the ball in the closed position against the load using the trunnion plate.

[0007] In an embodiment, a method comprises applying a load to a ball within a ball valve, where the ball valve is in a closed position, and where the ball valve comprises a trunnion plate supporting the ball, and retaining the ball in the closed position against the load using the trunnion plate. The trunnion plate comprises: a trunnion plate hole, and a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, where the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve. Applying the load to the ball may comprise establishing a pressure differential greater than about 1,000 psi across the ball when the ball valve is in the closed position. The ball valve may be a subsea safety valve, a subsurface safety valve, a lubricator valve, a retainer valve, a control valve, a fluid loss valve, or a barrier valve. The trunnion plate shoulder may be configured to resist a greater load without deforming than a comparative trunnion plate shoulder having a length in the axial direction of the ball valve that is about the same as or less than a width in the radial direction of the ball valve.

[0008] These and other features will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings and claims.

CLAIMS

1. A ball valve comprising:

a ball rotatably disposed within a housing; and

a trunnion plate supporting the ball, wherein the trunnion plate comprises:

a trunnion plate hole, and

a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, wherein the trunnion plate shoulder comprises an inward protrusion from an inner surface of the trunnion plate, wherein the inward protrusion extends towards a central longitudinal axis of the ball valve, wherein the inward protrusion protrudes from a flat innermost surface of the trunnion plate, and wherein the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve.

2. The ball valve of claim 1, further comprising an actuation member configured to actuate the ball between an open and closed position.

3. The ball valve of claim 2, wherein the actuation member is configured to actuate the ball using a linear movement along the axial direction.

4. The ball valve of claim 3, wherein the actuation member comprises:

a plurality of arms, and

a plurality of windows, wherein each of the plurality of windows is disposed in a corresponding one of the plurality of arms, wherein the trunnion plate shoulder extends into at least one of the windows.

5. The ball valve of claim 4, wherein the ball comprises a spigot, and wherein the spigot extends through the at least one of the windows and engages the trunnion plate shoulder.

6. The ball valve of claim 1, wherein a ratio of an inner diameter of an interior flow passage of the ball to an outer diameter of the ball valve is greater than ~~about~~ 0.35.

7. The ball valve of claim 1, wherein the length in the axial direction is at least ~~about~~ 10% greater than the width in the radial direction of the ball valve.

8. The ball valve of claim 1, wherein the length in the axial direction of the ball valve is at least ~~about~~ 10% of a diameter of the trunnion plate hole.

9. The ball valve of claim 1, wherein a ratio of the length in the axial direction to the width in the radial direction is between ~~about~~ 1.05:1 and 20:1.

10. The ball valve of claim 1, wherein the trunnion plate shoulder has an elongated shape comprising two sides in the axial direction having semi-circular cross-sections and two sides in the radial direction having parallel sides that are aligned with the axial direction.

11. The ball valve of claim 1, wherein the trunnion plate shoulder has a rectangular shape comprising two sides in the axial direction having sides that are parallel and perpendicular to the axial direction and two sides in the radial direction having parallel sides that are aligned with the axial direction.

12. The ball valve of claim 1, wherein the trunnion plate shoulder has a diamond-like shape comprising two triangular sides in the axial direction.

13. The ball valve of claim 1, wherein the trunnion plate shoulder has an elliptical shape comprising rounded sides in the axial directions that intersect at the radial edge of the trunnion plate hole.

14. ~~A ball valve comprising:~~

~~a ball comprising~~ The ball valve of claim 1, wherein the ball comprises a plurality of spigots; and

a plurality of trunnion plates, wherein each trunnion plate supports one of the plurality of spigots, wherein the trunnion plates are each configured to resist a greater load applied through the spigots in an axial direction than a radial direction.

15. The ball valve of claim 14, wherein the plurality of trunnion plates each comprise a trunnion plate hole configured to receive the one of the plurality of spigots.

16. The ball valve of claim 15, further comprising a bearing disposed within the trunnion plate hole and configured to receive the one of the plurality of spigots.

17. A method comprising:

applying a load to a ball within a ball valve, wherein the ball valve is in a closed position, and wherein the ball valve comprises a trunnion plate supporting the ball, wherein the trunnion plate comprises:

a trunnion plate hole, and

a trunnion plate shoulder disposed on a surface of the trunnion plate about the trunnion plate hole, wherein the trunnion plate shoulder comprises an inward protrusion from an inner surface of the trunnion plate, wherein the inward protrusion extends towards a central longitudinal axis of the ball valve, wherein the inward protrusion protrudes from a flat innermost surface of the trunnion plate, and wherein the trunnion plate shoulder has a length in the axial direction of the ball valve that is greater than a width in the radial direction of the ball valve; and

retaining the ball in the closed position against the load using the trunnion plate.

18. The method of claim 17, wherein applying the load to the ball comprises establishing a pressure differential greater than ~~about~~ 1,000 psi across the ball when the ball valve is in the closed position.

19. The method of claim 17, wherein the ball valve is a subsea safety valve, a subsurface safety valve, a lubricator valve, a retainer valve, a control valve, a fluid loss valve, or a barrier valve.

20. The method of claim 17, wherein the trunnion plate shoulder is configured to resist a greater load without deforming than a comparative trunnion plate comprising a comparative trunnion plate hole and a comparative trunnion plate shoulder having a length in the axial direction of the ball valve that is about the same as or less than a width in the radial direction of the ball valve.