CLAIMS

What is claimed is.

1. A valve assembly 30 for use in a subterranean hydraulic fracturing system 10 comprising:

a body 32 having a passage 34;

a gate 36 disposable in the body 32;

a bore 38 in the gate 36 that selectively registers with the passage 34;

characterized by,

a valve lock assembly 44 comprising:

a valve lock assembly 44;

a balance stem 46 connected between the valve lock assembly 44 and the gate 36;

a retention element 70 urged into a path of the valve lock assembly 44 by a resilient member 72, so that when a force is applied to the gate 36 to urge the valve lock assembly 44 against the retention element 70 that is less than a designated amount, the retention element 70 is retained in the path of the valve lock assembly 44 by the resilient member 72.

2. The valve assembly 30 system of claim 1, characterized in that when a force is applied to the gate 36 to urge the valve lock assembly 44 against the retention element 70 that exceeds the designated amount, a force is exerted by the valve lock assembly 44 onto the retention element

70 to overcome a force applied by the resilient member 72 and the retention element 70 is moved out of the path of the valve lock assembly 44.

3. The valve assembly 30 of claims 1 or 2, characterized in that the valve lock assembly 44 comprises a beveled outer edge that contacts the retention element 70.

4. The valve assembly 30 of claim 3, characterized in that the force applied to the gate 36 to urge the valve lock assembly 44 against the retention element 70 defines a thrust force, and wherein upper and lower portions of the outer edge are beveled at angles with respect to an axis of the valve lock assembly 44 so that the thrust force necessary to urge the valve lock assembly 44 past the retention element 70 is greater in one axial direction than in an opposite axial direction.

5. The valve assembly 30 of any of claims 1 -4, characterized in that the retention element 70 comprises a ball bearing and the resilient member 72 comprises a spring.

6. The valve assembly 30 of claim 5, further characterized by a plurality of ball bearings and springs, a housing 52 that circumscribes the balance stem 46 having bores radially formed through a sidewall of the housing 52 for retaining the ball bearings and springs.

7. The valve assembly 30 of any of claims 1-6, further characterized by a valve actuator 40 coupled to the gate 36.

8. A balancing system 44 for use with a hydraulic fracturing valve 30 comprising:

a generally planar cam member 48 in selective coupling engagement with a valve gate 36 and subject to a thrust force from the valve gate 36 in response to a force applied to the valve gate 36; and

characterized by,

a latching assembly 64 comprising a latching element 70 that is maintained in interfering contact with the cam member 48 by a resilient member 72 when the thrust force produces a resultant force against the latching element 70 that is less than a designated amount.

9. The balancing system of claim 8, characterized in that the latching element 70 is urged out of interfering contact and out of a path of the cam member 48 when the thrust force produces a resultant force against the latching element 70 that exceeds the designated amount.

10. The balancing system of claims 8 or 9, characterized in that the cam member 48 comprises an outer periphery having an upper section 60 profiled at an angle with respect to an upper surface 54 of the cam member 48 and a lower section 62 profiled at an angle with respect to a lower surface 56 of the cam member 48.

11. The balancing system of claim 10, characterized in that the upper and lower surfaces 54, 56 are substantially parallel, and wherein the upper and lower sections 60, 62 are profiled at different angles, so that an amount of the thrust force that produces a resultant force against the latching element 70 that exceeds the designated amount is greater when the cam member 48 is axially urged in one direction than when the cam member 48 is axially urged in an opposite direction.

12. The balancing system of claim 10, characterized in that the gate 36 is subjected to forces from vibrations that produce resultant forces that are less than the designated amount.

13. A valve assembly 30 for use in a hydraulic fracing system 10 comprising:

a valve body 32 having a passage 34;

a gate 36 having a bore 38 that is in selective registration with the passage 34;

an actuator 40 coupled with the gate 36; and

characterized by,

a means for retaining the gate 36 in a designated position within the valve body 32 that is unlockable from the designated position with a force applied to the gate 36 that is greater than a force applied to lock the gate 36.

14. The valve assembly 30 of claim 13, characterized in that the means for retaining the gate 36 comprises a valve lock assembly 44 coupled to the gate 36 and a latch that retains the valve lock assembly 44 in place when the lock force is applied to the gate 36 and releases the gate 36 when an unlock force is applied to the gate 36.

CLAIMS

1. A valve assembly for use in a subterranean hydraulic fracturing system comprising:

a body having a passage;

a gate disposable in the body;

a bore in the gate that selectively registers with the passage;

a valve lock assembly comprising:

a cam disk having an upper surface, a lower surface, and an outer periphery extending between the upper and lower surfaces having a mid-portion with an outer circumference greater than outer circumferences of the upper and lower surfaces, and which defines an upper beveled surface and a lower beveled surface that is at an angle with respect to an axis of the cam disk different from an angle between the upper beveled surface and the axis of the cam disk;

a balance stem connected between the cam disk and the gate;

a retention element urged into a path of the cam disk by a resilient member, so that when a force is applied to the gate to urge the cam disk against the retention element that is less than a designated amount, the retention element is retained in the path of the cam disk by the resilient member.

2. The valve assembly system of claim 1, wherein when a force is applied to the gate to urge the cam disk against the retention element that exceeds the designated amount, a force is exerted by the cam disk onto the retention element to overcome a force applied by the resilient member and the retention element is moved out of the path of the cam disk.

3. The valve assembly of claim 1, wherein the force applied to the gate to urge the cam disk against the retention element defines a thrust force, and wherein upper and lower beveled surfaces are beveled at angles with respect to the axis of the cam disk so that the thrust force necessary to urge the cam disk past the retention element is greater in one axial direction than in an opposite axial direction.

4. The valve assembly of claim 1, wherein the retention element comprises a ball bearing and the resilient member comprises a spring.

5. The valve assembly of claim 1, wherein a distance between the mid-portion and upper surface is different from a distance between the lower surface and mid-portion; and further comprising a plurality of ball bearings and springs, and a housing that circumscribes the balance stem having bores radially formed through a sidewall of the housing for retaining the ball bearings and springs.

6. The valve assembly of claim 1, further comprising a valve actuator coupled to the gate.

7. A balancing system for use with a hydraulic fracturing valve comprising:

a generally planar cam member having upper and lower surfaces, and a beveled edge on an outer radial periphery of the cam member that depends radially inward with distance towards the upper and lower surfaces to define upper and lower beveled surfaces that are disposed at differing angles with respect to an axis of the cam member;

a coupling for engaging the cam member with a valve gate, and which is subject to a thrust force from the valve gate in response to a force applied to the valve gate; and

a latching assembly comprising a latching element that is maintained in interfering contact with the cam member by a resilient member when the thrust force produces a resultant force against the latching element that is less than a designated amount.

8. The balancing system of claim 7, wherein the latching element is urged out of interfering contact and out of a path of the cam member when the thrust force produces a resultant force against the latching element that exceeds the designated amount.

9. The balancing system of claim 7, wherein the upper beveled surface comprises an upper section profiled at an angle with respect to the upper surface of the cam member and the lower beveled surfaces comprises a lower section profiled at an angle with respect to the lower surface of the cam member.

10. The balancing system of claim 9, wherein the upper and lower surfaces are substantially parallel, and wherein the upper and lower sections are profiled at different angles, so that an amount of the thrust force that produces a resultant force against the latching element that exceeds the designated amount is greater when the cam member is axially urged in one direction than when the cam member is axially urged in an opposite direction.

11. The balancing system of claim 9, wherein the gate is subjected to forces from vibrations that produce resultant forces that are less than the designated amount.

12. A valve assembly for use in a hydraulic fracing system comprising:

a valve body having a passage;

a gate having a bore that is in selective registration with the passage;

an actuator coupled with the gate; and

a retention system for retaining the gate in a designated position within the valve body that is unlockable from the designated position with a force applied to the gate that is greater than a force applied to lock the gate and that comprises:

a cam disk having an upper surface, a lower surface, and an outer periphery extending between the upper and lower surfaces having a mid-portion with an outer circumference greater than outer circumferences of the upper and lower surfaces, and which defines upper and lower beveled surfaces that are at differing angles with respect to an axis of the cam disk;

a balance stem connected between the cam disk and the gate;

a retention element urged into a path of the cam disk by a resilient member, so that when a force is applied to the gate to urge the cam disk against the retention element that is less than a designated amount, the retention element is retained in the path of the cam disk by the resilient member.

13. The valve assembly of claim 12, wherein the retention element and resilient member define a latch that retains the cam disk in place when the lock force is applied to the gate and releases the gate when an unlock force is applied to the gate.