of additional pumps at an oilfield. Thus, the damage may see its effects at neighboring pumps, for example, by placing added strain on these pumps or by translation of the damaging water hammering effects to these pumps. Indeed, cascading pump failure, from pump to pump to pump, is not an uncommon event where a significant amount of cavitation and/or water hammering is found.

SUMMARY

[0009] A positive displacement pump is provided with a housing for a pressurizable chamber. The chamber may be defined in part by a valve thereof which may be employed for controlling fluid access to the chamber. The positive displacement pump may also include a valve actuation guide that is positioned at least partially external to the chamber and coupled to the valve so as to assist the controlling of the fluid access to the chamber.

[0009a] In view of the above, according to a first aspect of the present application, there is provided a positive displacement pump comprising: a housing for a pressurizable chamber; a plunger configured to reciprocate inside the pressurizable chamber; a valve of said housing for controlling fluid communication with the pressurizable chamber; a valve actuation guide external to the pressurizable chamber connected to said valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and, a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

[0009b] According to a second aspect of the present application, there is provided a positive displacement pump assembly for positioning at an oilfield to deliver a fluid to a well thereat during an operation, the positive displacement pump assembly comprising: a housing for a pressurizable chamber; a plunger configured to reciprocate inside the pressurizable chamber; a supply of the fluid adjacent the pressurizable chamber; a valve of said housing for controlling access by the fluid to the pressurizable chamber; a valve actuation guide external to the pressurizable chamber connected to the valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and, a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

[0009c] According to a third aspect pf the present application, there is provided a valve actuation guide assembly for positioning adjacent a housing for a pressurizable chamber of a positive displacement pump, the valve actuation guide assembly comprising an actuation guide connected to a valve of the housing by a coupling to control fluid communication with the pressurizable chamber, wherein said actuation guide assists opening or closing the valve to control fluid communication with the pressurizable chamber, and a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a side view of an embodiment of a positive displacement pump employing a valve actuation guide assembly.

[0011] Fig. 2 is a cross-sectional view of the pump of Fig. 1 revealing an embodiment of a valve actuation guide of the assembly.

[0012] Fig. 3 is a cross-sectional view of the pump of Fig. 1 revealing an alternate embodiment of a valve actuation guide of the assembly.

[0013] Fig. 4 is a cross-sectional view of the pump of Fig. 1 revealing another alternate embodiment of a valve actuation guide of the assembly.

[0014] Fig. 5 is a partially sectional overview of an oilfield employing the pump of Fig. 1 as part of a multi-pump operation.

CLAIMS:

1. A positive displacement pump comprising:

a housing for a pressurizable chamber;

a plunger configured to reciprocate inside the pressurizable chamber;

a valve of said housing for controlling fluid communication with the pressurizable chamber, wherein the valve is configured to move in a direction that is substantially perpendicular to a reciprocating movement of the plunger;

a valve actuation guide external to the pressurizable chamber connected to said valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and,

a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

2. The positive displacement pump of claim 1 wherein the coupling is of an electromagnetic nature.

3. The positive displacement pump of claim 2 wherein said valve actuation guide is an electromagnetic power source coupled to at least one electromagnetic inductor and said valve is of a magneto-responsive material.

4. The positive displacement pump of claim 3 wherein the at least one electromagnetic inductor is of reversible polarity.

5. The positive displacement pump of claim 3 wherein the at least one electromagnetic inductor is accommodated at a valve seat for contacting said valve.

6. The positive displacement pump of any one of the preceding claims further comprising a mechanical arm disposed between said valve and said valve actuation guide for the coupling.

7. The positive displacement pump of claim 6 wherein said mechanical arm is of a contractible configuration.

8. The positive displacement pump of claim 6 or 7 wherein said valve actuation guide is configured to drive said mechanical arm and assist the valve to control fluid communication with the pressurizable chamber by one of a cam mechanism, a crank mechanism, a hydraulic mechanism, an electromagnetic mechanism, a servo motor, and a stepper motor.

9. The positive displacement pump of claim 8 wherein said valve actuation guide is configured to drive said mechanical arm by the hydraulic mechanism, said mechanical arm further comprises a plate, the hydraulic mechanism having a hydraulic mechanism housing disposed about said plate to form a pressurizable compartment on at least one side of the plate, said mechanical arm configured to reciprocate in accordance with a

10. The positive displacement pump of claim 8 wherein said valve actuation guide is configured to drive said mechanical arm by the electromagnetic mechanism, said valve actuation guide is an electromagnetic power source and the electromagnetic mechanism includes at least one electromagnetic inductor.

11. The positive displacement pump of claim 10 wherein said mechanical arm is of a magneto-responsive material.

12. The positive displacement pump of claim 10 or 11 wherein the at least one electromagnetic inductor is of reversible polarity.

13. The positive displacement pump of any one of the preceding claims further comprising:

a power supply;

the plunger coupled to said power supply and in communication with the pressurizable chamber to direct a pressurization of the pressurizable chamber; and

where the timing mechanism is a timing belt, the timing mechanism disposed between said power supply and said valve actuation guide.

14. The positive displacement pump of any one of the preceding claims wherein control of the timing for when the valve actuation guide assists opening or closing the valve to control fluid communication with the pressurizable chamber is tunable in real-time.

15. The positive displacement pump of any one of the preceding claims wherein said valve is a first valve and said valve actuation guide is a first valve actuation guide for connecting to said first valve, the positive displacement pump further comprising:

a second valve of said housing for controlling fluid communication with the pressurizable chamber; and

a second valve actuation guide coupled to said second valve to assist opening or closing the second valve to control fluid communication with the pressurizable chamber.

16. A positive displacement pump assembly for positioning at an oilfield to deliver a fluid to a well thereat during an operation, the positive displacement pump assembly comprising:

a housing for a pressurizable chamber;

a plunger configured to reciprocate inside the pressurizable chamber;

a supply of the fluid adjacent the pressurizable chamber;

a valve of said housing for controlling access by the fluid to the pressurizable chamber, wherein the valve is configured to move in a direction that is substantially perpendicular to a reciprocating movement of the plunger;

a valve actuation guide external to the pressurizable chamber connected to the valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and,

a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

17. The positive displacement pump assembly of claim 16 wherein the coupling is one of a mechanical coupling and an electromagnetic coupling.

18. The positive displacement pump assembly of claim 16 or 17 wherein the operation is one of fracturing and cementing.

19. A valve actuation guide assembly for positioning adjacent a housing for a pressurizable chamber of a positive displacement pump, the valve actuation guide assembly comprising an actuation guide connected to a valve of the housing by a coupling to control fluid communication with the pressurizable chamber, wherein said actuation guide assists opening or closing the valve to control fluid communication with the pressurizable chamber, wherein the valve is configured to move in a direction that is substantially perpendicular to a plunger reciprocating inside the pressurizable chamber, and a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

20. The valve actuation guide assembly of claim 19 wherein the coupling is one of electromagnetic and mechanical.

CLAIMS:

1. A positive displacement pump comprising:

a housing for a pressurizable chamber;

a plunger configured to reciprocate inside the pressurizable chamber;

a valve of said housing for controlling fluid communication with the pressurizable chamber;

a valve actuation guide external to the pressurizable chamber connected to said valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and,

a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

2. The positive displacement pump of claim 1 wherein the coupling is of an electromagnetic nature.

3. The positive displacement pump of claim 2 wherein said valve actuation guide is an electromagnetic power source coupled to at least one electromagnetic inductor and said valve is of a magneto-responsive material.

4. The positive displacement pump of claim 3 wherein the at least one electromagnetic inductor is of reversible polarity.

5. The positive displacement pump of claim 3 wherein the at least one electromagnetic inductor is accommodated at a valve seat for contacting said valve.

6. The positive displacement pump of claim 1 further comprising a mechanical arm disposed between said valve and said valve actuation guide for the coupling.

7. The positive displacement pump of claim 6 wherein said mechanical arm is of a contractible configuration.

8. The positive displacement pump of claim 6 wherein said valve actuation guide is configured to drive said mechanical arm and assist the valve to control fluid communication with the pressurizable chamber by one of a cam mechanism, a crank mechanism, a hydraulic mechanism, an electromagnetic mechanism, a servo motor, and a stepper motor.

9. The positive displacement pump of claim 8 wherein said valve actuation guide is configured to drive said mechanical arm by the hydraulic mechanism, said mechanical arm further comprises a plate, the hydraulic mechanism having a hydraulic mechanism housing disposed about said plate to form a pressurizable compartment on at least one side of the plate, said mechanical arm configured to reciprocate in accordance with a pressure of the pressurizable compartment when the mechanical arm is driven by the valve actuation guide.

10. The positive displacement pump of claim 8 wherein said valve actuation guide is configured to drive said mechanical arm by the electromagnetic mechanism, said valve actuation

guide is an electromagnetic power source and the electromagnetic mechanism includes at least one electromagnetic inductor.

11. The positive displacement pump of claim 10 wherein said mechanical arm is of a magneto-responsive material.

12. The positive displacement pump of claim 10 wherein the at least one electromagnetic inductor is of reversible polarity.

13. The positive displacement pump of claim 1 further comprising:

a power supply;

the plunger coupled to said power supply and in communication with the pressurizable chamber to direct a pressurization of the pressurizable chamber; and

where the timing mechanism is a timing belt, the timing mechanism disposed between said power supply and said valve actuation guide.

14. The positive displacement pump of claim 1 wherein control of the timing for when the valve actuation guide assists opening or closing the valve to control fluid communication with the pressurizable chamber is tunable in real-time.

15. The positive displacement pump of claim 1 wherein said valve is a first valve and said valve actuation guide is a first valve actuation guide for connecting to said first valve, the positive displacement pump further comprising:

a second valve of said housing for controlling fluid communication with the pressurizable chamber; and

a second valve actuation guide coupled to said second valve to assist opening or closing the second valve to control fluid communication with the pressurizable chamber.

16. The positive displacement pump of claim 1 wherein the valve is configured to move in a direction that is substantially perpendicular to a reciprocating movement of the plunger.

17. A positive displacement pump assembly for positioning at an oilfield to deliver a fluid to a well thereat during an operation, the positive displacement pump assembly comprising:

a housing for a pressurizable chamber;

a plunger configured to reciprocate inside the pressurizable chamber;

a supply of the fluid adjacent the pressurizable chamber;

a valve of said housing for controlling access by the fluid to the pressurizable chamber;

a valve actuation guide external to the pressurizable chamber connected to the valve by a coupling to assist opening or closing the valve to control fluid communication with the pressurizable chamber; and,

a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

18. The positive displacement pump assembly of claim 17 wherein the coupling is one of a mechanical coupling and an electromagnetic coupling.

19. The positive displacement pump assembly of claim 17 wherein the operation is one of fracturing and cementing.

20. A valve actuation guide assembly for positioning adjacent a housing for a pressurizable chamber of a positive displacement pump, the valve actuation guide assembly comprising an actuation guide connected to a valve of the housing by a coupling to control fluid communication with the pressurizable chamber, wherein said actuation guide assists opening or closing the valve to control fluid communication with the pressurizable chamber, and a timing mechanism for controlling a timing of when the valve actuation guide assists opening or closing the valve relative to a position of the plunger inside the pressurizable chamber, and wherein the timing mechanism is selected from the group consisting of (i) a timing belt, and (ii) a sensor to monitor said position of said plunger and a processor to analyze data from said sensor.

21. The valve actuation guide assembly of claim 20 wherein the coupling is one of electromagnetic and mechanical.

22. The valve actuation guide assembly of claim 20 wherein the valve is configured to move in a direction that is substantially perpendicular to a reciprocating movement of the plunger.