Variable Flow Resistance System for Use with a Subterranean Well

Background

[0001] This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the presently described embodiments. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present embodiments. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

[0002] This disclosure relates generally to equipment utilized and operations performed in conjunction with a subterranean well and, in an example described below, more particularly provides a selectively variable flow restrictor.

[0003] In a hydrocarbon production well, it is many times beneficial to be able to regulate flow of fluids from an earth formation into a wellbore, from the wellbore into the formation, and within the wellbore. A variety of purposes may be served by such regulation, including prevention of water or gas coning, minimizing sand production, minimizing water and/or gas production, maximizing oil production, balancing production among zones, transmitting signals, etc.

[0004] Therefore, it will be appreciated that advancements in the art of variably restricting fluid flow in a well would be desirable in the circumstances mentioned above, and such advancements would also be beneficial in a wide variety of other circumstances.

Summary

[0004a] According to a first aspect of the present disclosure, there is provided a variable flow resistance system for use with a subterranean well, the system including: a first flow path configured to receive a fluid; a sensor configured to measure a property of the fluid received into the first flow path; an actuator configured to control an inflow rate of the fluid received into the first flow path based upon the property of the fluid measured by the sensor; and a communications unit configured to receive a communications signal, wherein the actuator configured to control an inflow rate of the fluid received into the first flow path based upon the communications signal received by the communications unit, and wherein the communication signal indicates a well phase of a plurality of well phases, wherein different control parameters for the inflow rate of fluid are used for different well phases.

[0004b] According to a second aspect of the present disclosure, there is provided a method of variably controlling flow resistance in a well, the method including: receiving a fluid into a first flow path; measuring a property of the fluid received into the first flow path; adjusting an inflow rate of the fluid received into the first flow path based upon the measured property of the fluid; receiving a communication signal from a remote location; and adjusting the inflow rate of the fluid received into the first flow path based upon the received communication signal, wherein the communication signal indicates a well phase of a plurality of well phases; wherein different control parameters for the inflow rate of fluid are used for different well phases.

Brief Description of the Drawings

[0005] Illustrative embodiments of the present disclosure are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein and wherein:

CLAIMS

1. A variable flow resistance system for use with a subterranean well, the system comprising:

a first flow path configured to receive a fluid;

a sensor configured to measure a property of the fluid received into the first flow path;

an actuator configured to control an inflow rate of the fluid received into the first flow path based upon the property of the fluid measured by the sensor; and

a communications unit configured to receive a communications signal, wherein the actuator configured to control an inflow rate of the fluid received into the first flow path based upon the communications signal received by the communications unit, and wherein the communication signal indicates a well phase of a plurality of well phases, wherein different control parameters for the inflow rate of fluid are used for different well phases.

2. The variable flow resistance system of claim 1, wherein the property of the fluid to be measured by the sensor comprises at least one of a resistivity of the fluid, a flow rate of the fluid, a pressure of the fluid, a density of the fluid, and a viscosity of the fluid.

3. The variable flow resistance system of claim 1, wherein the sensor comprises at least one of a resistivity sensor, a conductivity sensor, a capacitive sensor, an inductive sensor, a nuclear sensor, a temperature sensor, a flow sensor, and an acoustic sensor.

4. The variable flow resistance system of claim 1, further comprising a controller configured to control the actuator based upon the property of the fluid measured by the sensor.

5. The variable flow resistance system of claim 1, further comprising a power generator configured to generate power for the variable flow resistance system.

6. The variable flow resistance system of claim 5, wherein the power generator comprises a turbine configured to generate power solely from fluid received into the first flow path.

7. The variable flow resistance system of claim 5, further comprising a power storage device configured to store power generated by the power generator.

8. The variable flow resistance system of claim 1, wherein the communications unit is further configured to send a communications signal.

9. The variable flow resistance system of claim 1, further comprising a tool body and a second flow path configured to send the fluid into an interior of the tool body.

10. The variable flow resistance system of claim 1, further comprising a production tubing string, wherein the first flow path comprises a production orifice for the production tubing string.

11. The variable flow resistance system of claim 1, wherein the actuator comprises at least one of a screw assembly, a piezoelectric actuator, a hydraulic cylinder, an electric motor, and a hydraulic pump.

12. A method of variably controlling flow resistance in a well, the method comprising:

receiving a fluid into a first flow path;

measuring a property of the fluid received into the first flow path;

adjusting an inflow rate of the fluid received into the first flow path based upon the measured property of the fluid;

receiving a communication signal from a remote location; and

adjusting the inflow rate of the fluid received into the first flow path based upon the received communication signal, wherein the communication signal indicates a well phase of a plurality of well phases; wherein different control parameters for the inflow rate of fluid are used for different well phases.

13. The method of claim 12, wherein the adjusting the inflow rate comprises:

comparing the measured property of the fluid with a predetermined value; and

adjusting the inflow rate of the fluid received into the first flow path based upon the comparison of the measured property of the fluid with the predetermined value.

14. The method of claim 12, wherein the measuring the property of the fluid comprises measuring at least one of resistivity, flow rate, pressure, density, and viscosity of the fluid.

15. The method of claim 12, wherein the measuring the property of the fluid comprises measuring a resistivity of the fluid, and wherein the adjusting the inflow rate comprises:

comparing the measured resistivity of the fluid with a predetermined value for the resistivity of the fluid;

increasing the inflow rate of the fluid received into the first flow path if the measured resistivity of the fluid is above the predetermined value for the resistivity of the fluid; and

decreasing the inflow rate of the fluid received into the first flow path if the measured resistivity of the fluid is below the predetermined value for the resistivity of the fluid.

16. The method of claim 12, further comprising generating power from the fluid received into the first flow path.

17. The method of claim 12, wherein the first flow path comprises a production orifice for a production tubing string.