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 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; a communications unit configured to receive a

communications signal from the surface; and an actuator configured to control an inflow rate of the fluid received into the first flow path based upon a comparison of the property of the fluid measured by the sensor and a selected predetermined value of a plurality of predetermined values of the property, wherein the actuator is further configured to select the selected predetermined value from the plurality of predetermined values based on the communication signal.

[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; receiving a communication signal from the surface; selecting a predetermined value from a plurality of predetermined values of the property based on the communication signal; and adjusting an inflow rate of the fluid received into the first flow path based upon a comparison of the measured property of the fluid and the selected predetermined value.

[0004c] According to a third aspect of the present disclosure, there is provided a method of variably controlling flow resistance in a well, the method including: method of variably controlling flow resistance in a well, the method including: receiving a fluid into a first flow path; receiving a communication signal from the surface; and adjusting an inflow rate of the fluid received into the first flow path from a first inflow rate to a second inflow rate based upon the received communication signal.

Brief Description of the Drawings

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;

a communications unit configured to receive a communications signal from the surface; and

an actuator configured to control an inflow rate of the fluid received into the first flow path based upon a comparison of the property of the fluid measured by the sensor and a selected predetermined value of a plurality of predetermined values of the property, wherein the actuator is further configured to select the selected predetermined value from the plurality of predetermined values based on the communication signal.

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. 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;

receiving a communication signal from the surface;

selecting a predetermined value from a plurality of predetermined values of the property based on the communication signal; and

adjusting an inflow rate of the fluid received into the first flow path based upon a comparison of the measured property of the fluid and the selected predetermined value.

12. The method of claim 11, wherein the measuring the property of the fluid comprises measuring at least one of resistivity, flow rate, pressure, density, and viscosity of the fluid.

13. The method of claim 11, wherein the measuring the property of the fluid comprises measuring a resistivity of the fluid, and wherein the adjusting the inflow rate comprises:

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.

14. The method of claim 11, further comprising generating power from the fluid received into the first flow path.

15. The method of claim 11, wherein the first flow path comprises a production orifice for a production tubing string.

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

receiving a fluid into a first flow path;

receiving a communication signal from the surface; and

adjusting an inflow rate of the fluid received into the first flow path from a first inflow rate to a second inflow rate based upon the received communication signal.