DOWNHOLE PRESSURE MAINTENANCE SYSTEM USING REFERENCE PRESSURE

TECHNICAL FIELD

The present disclosure relates generally to a downhole pressure maintenance system, and specifically a pressure maintenance system that maintains a pressure within an isolated annulus of a wellbore within a predetermined pressure range.

BACKGROUND

After a well is drilled and a target reservoir has been encountered, completion and production operations are performed, which may include gravel packing operations. Generally, gravel packing operations include placing a lower completion assembly, which forms part of a working string, downhole within a target reservoir in a formation. In a multi-zone completion, a number of packers are located within the lower completion assembly and are activated to isolate a portion of a wellbore annulus formed between the working string and the casing (if a cased hole) or the formation (if an open hole). Each of these portions may be production zones that are subsequently packed with gravel or coarse sand. Often, after one of the packers is set but prior to the gravel packing of the production zones, each production zone is isolated from the wellbore hydrostatic pressure. As the formation absorbs drilling fluids from each production zone, the wellbore annulus pressure within each of the production zones may drop, which may cause collapse of an open hole or influx of sand in an unconsolidated cased hole installation.

The present disclosure is directed to a downhole pressure maintenance system that overcomes one or more of the shortcomings in the prior art.

SUMMARY

According to a first aspect of the present invention, there is provided a completion assembly comprising: an elongated base pipe having an external surface at least partially defining an external region and an internal surface at least partially defining an internal region; and a pressure maintenance device disposed in the base pipe and comprising: a first flow path that extends between an opening in the external surface and an opening in the internal surface; a first valve that controls the flow of a first fluid from the internal region to the external region through the first flow path; a first pressure differential sensor that controls the actuation of the first valve and is in fluid communication with the external region; and a pressurized fluid source in fluid communication with the first pressure differential sensor; wherein a first pressure differential threshold associated with the first pressure differential sensor is the difference between a pressure within the external region and the pressurized fluid source.

According to a second aspect of the present invention, there is provided a method of maintaining an isolated portion of an external region of a completion string within a predetermined pressure range, the method comprising: positioning a completion string that has an internal surface that at least partially defines an internal region and an external surface that at least partially defines an external region within a wellbore; pressurizing a pressurized fluid source located within a pressure maintenance device that is located within a wall of the completion string to a reference pressure that is associated with a wellbore hydrostatic pressure within the external region; isolating a portion of the external region from the wellbore hydrostatic pressure to form the isolated portion of the external region; and allowing a first fluid within the internal region to flow through a first flow path within the pressure maintenance device to the isolated portion of the external region when a pressure differential between the external region and the reference pressure is less than a first pressure differential threshold that is associated with the predetermined pressure range.

Disclosed herein is a method of providing pressure maintenance comprising: positioning a completion string within a wellbore, the completion string having an internal surface that at least partially defines an internal region and an external surface that at least partially defines an external region; isolating a portion of the external region from a wellbore hydrostatic pressure; fluidically connecting the internal region to the isolated portion of the external region via a first flow path; providing a first valve that controls the flow of a first fluid through the first flow path, the first valve comprising a first pressure differential sensor; opening the first valve when the first pressure differential sensor measures a pressure differential between an external pressure within the isolated portion of the external region and a reference pressure that is less than a first pressure threshold; and closing the first valve when the pressure differential between the external pressure and the reference pressure is greater than or equal to the first pressure threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the present disclosure will be understood more fully from the detailed description given below and from the accompanying drawings of various embodiments of the disclosure. In the drawings, like reference numbers may indicate identical or functionally similar elements.

FIG. 1 is a schematic illustration of an oil and gas rig operably coupled to a lower completion system, the lower completion system including a pressure maintenance device, according to an exemplary embodiment of the present disclosure;

FIG. 2 is a schematic illustration of the lower completion system of FIG. 1, according to an exemplary embodiment of the present disclosure;

FIG. 2A is an enlarged view of a portion of the lower completion system of FIG. 2, according to an exemplary embodiment of the present disclosure;

wherein the pressure maintenance device comprises a rupture disk that is in fluid communication with the pressurized fluid source and with the external region; and

wherein the method further comprises depressurizing the pressurized fluid source when a second relief pressure differential threshold associated with the rupture disk is met or exceeded.

13. The method of claim 8, wherein allowing the first fluid within the internal region to flow through the first flow path when a pressure differential between the external region and the reference pressure is less than a first pressure differential threshold that is associated with the predetermined pressure range comprises opening a first valve that controls the flow of the first fluid through the first flow path.

14. The method of claim 9, wherein preventing the first fluid within the internal region from flowing through the first flow path when a pressure differential between the internal region and the external region exceeds a second pressure differential threshold comprises closing a second valve that controls the flow of the first fluid through the first flow path.

15. The method of claim 14, further comprising allowing the first fluid to flow through the first flow path when a third pressure differential across a third valve exceeds a third pressure differential threshold associated with the third valve.

16. The method of claim 9, wherein isolating a portion of the external region to form the isolated portion of the external region comprises setting a packer that is disposed on the completion string.