

ADJUSTABLE FLOW CONTROL DEVICE

BACKGROUND

[0001] Wellbores are sometimes drilled into subterranean formations to produce one or more fluids from the subterranean formation. For example, a wellbore may be used to produce one or more hydrocarbons. Additional components such as water may also be produced with the hydrocarbons, though attempts are usually made to limit water production from a wellbore or a specific interval within the wellbore. Other components such as hydrocarbon gases may also be limited for various reasons over the life of a wellbore.

[0002] Where fluids are produced from a long interval of a formation penetrated by a wellbore, it is known that balancing the production of fluid along the interval can lead to reduced water and gas coning, and more controlled conformance, thereby increasing the proportion and overall quantity of oil or other desired fluid produced from the interval. Various devices and completion assemblies have been used to help balance the production of fluid from an interval in the wellbore. For example, inflow control devices (ICD's) have been used in conjunction with well screens to restrict the flow of produced fluid through the screens for the purpose of balancing production along an interval. For example, in a long horizontal wellbore, fluid flow near a heel of the wellbore may be more restricted as compared to fluid flow near a toe of the wellbore, to thereby balance production along the wellbore.

SUMMARY

[0002a] ~~According to a first aspect of the present invention, there is provided a flow control device comprising: a fluid pathway configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular; a flow restriction disposed in the fluid pathway, wherein the flow restriction is disposed in a radial alignment with respect to the wellbore tubular; a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway; and a second flow restriction disposed in the fluid pathway in series with the flow restriction, wherein the flow blockage is disposed between the flow restriction and the second flow restriction.~~

According to a first aspect of the present invention, there is provided a flow control device comprising: a housing comprising a shape to fit around a wellbore tubular; a fluid pathway disposed through the housing in a generally longitudinal direction with respect to the wellbore tubular and configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular; a flow restriction disposed along the fluid pathway, wherein the flow restriction is disposed within the housing such that an opening of the flow restriction is oriented in a direction substantially perpendicular to the longitudinal direction the wellbore tubular; and a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway.

~~[0002b] According to a second aspect of the present invention, there is provided a flow control device comprising: a fluid pathway configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular; a plurality of flow restrictions disposed in series in the fluid pathway; a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway; and a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway, wherein the flow blockage is disposed between at least two of the plurality of flow restrictions.~~

According to a second aspect of the present invention, there is provided a flow control device comprising: a housing comprising a shape to fit around a wellbore tubular; a fluid pathway disposed through the housing in a generally longitudinal direction with respect to the wellbore tubular and configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular; a plurality of flow restrictions disposed in series in the fluid pathway; a flow blockage comprising a rod that is removably disposed in the fluid pathway, wherein the rod is elongated to substantially fill the fluid pathway in the generally longitudinal direction to substantially prevent a fluid flow through the fluid pathway; and a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

[0002c] ~~According to a third aspect of the present invention, there is provided a method comprising: providing a flow control device comprising: a fluid pathway between an exterior of a wellbore tubular and an interior of the wellbore tubular, and a plurality of flow restrictions disposed in series in the fluid pathway, wherein at least one of the plurality of flow restrictions is disposed in a radial alignment with respect to the wellbore tubular; and selectively installing or removing one or more flow blockages from the plurality of fluid pathways, wherein each of the flow blockage is disposed between at least two of the plurality of flow restrictions.~~

According to a third aspect of the present invention, there is provided a method comprising: a housing comprising a shape to fit around a wellbore tubular; a fluid pathway disposed through the housing in a generally longitudinal direction with respect to the wellbore tubular and configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular; a plurality of flow restrictions disposed in series in the fluid pathway; a flow blockage comprising a rod that is removably disposed in the fluid pathway, wherein wherein the rod is elongated to substantially fill the fluid pathway in the generally longitudinal direction to substantially prevent a fluid flow through the fluid pathway; and a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

[0003] In an embodiment, a flow control device comprises a fluid pathway configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular, a flow restriction disposed in the fluid pathway, wherein the flow restriction is disposed in a radial alignment with respect to the wellbore tubular, and a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway.

[0004] In an embodiment, a flow control device comprises a fluid pathway configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular, a plurality of flow restrictions disposed in series in the fluid pathway, a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway, and a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

CLAIMS

1. A flow control device comprising:
 - a housing comprising a shape to fit around a wellbore tubular;
 - a fluid pathway disposed through the housing in a generally longitudinal direction with respect to the wellbore tubular and configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular;
 - a flow restriction disposed ~~in~~ along the fluid pathway, wherein the flow restriction is disposed ~~in a radial alignment with respect to~~ within the housing such that an opening of the flow restriction is oriented in a direction substantially perpendicular to the longitudinal direction the wellbore tubular; and
 - a flow blockage disposed in the fluid pathway, wherein the flow blockage substantially prevents a fluid flow through the fluid pathway; and
 - ~~a second flow restriction disposed in the fluid pathway in series with the flow restriction, wherein the flow blockage is disposed between the flow restriction and the second flow restriction.~~
2. The flow control device of claim 1, wherein the flow restriction comprises a nozzle.
3. The flow control device of claim 1 or 2, wherein the flow blockage is disposed between the exterior of the wellbore tubular and the flow restriction.
4. The flow control device of claim 1, ~~where the~~ further comprising a second flow restriction comprises a nozzle disposed in the fluid pathway in series with the flow restriction.
5. The flow control device of any of claims 1 to 4, further comprising a retaining member removably engaged with an end of the housing in the longitudinal direction and configured to ~~maintain~~ retain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

6. The flow control device of any of claims 1 to 5, further comprising an access port in radial alignment with the flow restriction.

87. The flow control device of any of claims 1 to 6, wherein the fluid pathway comprises a narrowed portion configured to retain the flow blockage within the fluid pathway.

98. The flow control device of any of claims 1 to 87, wherein the flow blockage comprises at least one of a rod configured to be removably disposed within the fluid pathway, a rod comprising a tapered end section that is configured to sealingly engage a narrowed portion within the fluid pathway, a ball configured to engage one or more openings within the fluid pathway to substantially prevent the fluid flow through the fluid pathway, a plug configured to be removably disposed within the fluid pathway, a plug comprising a thinned section that is configured to be punctured to establish fluid communication through the plug, or a deformable plug configured to be disposed within the fluid pathway.

9. The flow control device of claim 1, wherein the flow blockage comprises a rod removably disposed in the fluid pathway, wherein the rod is elongated to substantially fill the fluid pathway in the generally longitudinal direction to substantially prevent a fluid flow through the fluid pathway.

10. A flow control device comprising:

a housing comprising a shape to fit around a wellbore tubular;

a fluid pathway disposed through the housing in a generally longitudinal direction with respect to the wellbore tubular and configured to provide fluid communication between an exterior of a wellbore tubular and an interior of the wellbore tubular;

a plurality of flow restrictions disposed in series in the fluid pathway;

a flow blockage comprising a rod that is removably disposed in the fluid pathway, wherein the rod is elongated to substantially fill the fluid pathway in the generally longitudinal direction to ~~the flow blockage~~ substantially prevents a fluid flow through the fluid pathway; and

a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway;

~~wherein the flow blockage is disposed between at least two of the plurality of flow restrictions.~~

11. The flow control device of claim 10, wherein at least one of the plurality of flow restrictions is disposed ~~on a radial alignment with respect to~~ within the housing such that an opening of the flow restriction is oriented in a direction substantially perpendicular to the longitudinal direction of the wellbore tubular.

12. The flow control device of claim 10 or 11, wherein the plurality of flow restrictions comprises at least one square edged restriction.

13. The flow control device of any of claims 10 to 12, wherein the plurality of flow restrictions comprise at least one restriction type selected from the group consisting of a nozzle, a restrictor tube, a narrow flow tube, an annular passage, a bent tube flow restrictor, and a helical tube.

14. The flow control device of any of claims 10 to 13, wherein the plurality of flow restrictions are configured to provide a different resistance to the flow of water than the flow of a hydrocarbon.

15. The flow control device of claim 10, wherein the flow blockage is disposed between at least two of the plurality of flow restrictions.

16. The flow control device of claim 10, wherein the retaining member is removably engaged with an end of the housing in the longitudinal direction and configured to retain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

~~15~~17. A method comprising:

providing a flow control device comprising:

a housing comprising a shape to fit around a wellbore tubular;

a plurality of fluid pathways disposed through the housing, each of the plurality of fluid pathways being disposed in a generally longitudinal direction with respect to the wellbore tubular and fluidly connecting between an exterior of a wellbore tubular and an interior of the wellbore tubular, and

a plurality of flow restrictions disposed in series in along the plurality of fluid pathways, wherein at least one of the plurality of flow restrictions is disposed in a radial alignment with respect to within the housing such that an opening of the flow restriction is oriented in a direction substantially perpendicular to the longitudinal direction of the wellbore tubular; and

selectively installing or removing one or more flow blockages from the plurality of fluid pathways, wherein each of the flow blockage is disposed between at least two of the plurality of flow restrictions.

18. The method of claim 17, wherein one or more of the plurality of fluid pathways comprise two or more of the plurality of flow restrictions disposed in series.

~~16~~19. The method of claim ~~15~~17, wherein the plurality of flow restrictions are configured to provide a different resistance to the flow of water than the flow of a hydrocarbon.

~~17. The method of claim 16, wherein the plurality of flow restrictions are configured to provide a higher resistance to the flow of water than the flow of a hydrocarbon.~~

20. The method of claim 17, further comprising selectively removing one or more of a plurality of retaining members from the housing to allow access to a corresponding one or more of the plurality of fluid pathways for installing or removing one or more of the plurality of flow blockages.