

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.

[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.

[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.

[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

What is claimed is:

1. 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; 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 any of claims 1 to 3, further comprising a second flow restriction disposed in the fluid pathway in series with the flow restriction.~~
- ~~5. The flow control device of claim 4, wherein the flow blockage is disposed between the flow restriction and the second flow restriction.~~
- ~~64. The flow control device of claim 4 or 5 1, where the second flow restriction comprises a nozzle.~~

~~75~~. The flow control device of any of claims 1 to ~~64~~, further comprising a retaining member configured to maintain the flow blockage within the fluid pathway and allow access to the flow blockage within the fluid pathway.

~~86~~. The flow control device of any of claims 1 to ~~75~~, further comprising an access port in radial alignment with the flow restriction.

~~98~~. The flow control device of any of claims 1 to ~~86~~, wherein the fluid pathway comprises a narrowed portion configured to retain the flow blockage within the fluid pathway.

~~409~~. The flow control device of any of claims 1 to ~~98~~, 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.

~~44~~~~10~~. 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.

~~4211.~~ The flow control device of claim ~~4410~~, wherein at least one of the plurality of flow restrictions is disposed on a radial alignment with respect to the wellbore tubular.

~~4312.~~ The flow control device of claim ~~4410~~ or ~~4211~~, wherein the plurality of flow restrictions comprises at least one square edged restriction.

~~4413.~~ The flow control device of any of claims ~~4410~~ to ~~4312~~, 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.

~~4514.~~ The flow control device of any of claims ~~4410~~ to ~~4413~~, wherein the plurality of flow restrictions are configured to provide a different resistance to the flow of water than the flow of a hydrocarbon.

~~46.~~ ~~The flow control device of any of claims 11 to 15, wherein the flow blockage is disposed between at least two of the plurality of flow restrictions.~~

~~4715.~~ A method comprising:

providing a flow control device comprising:

a ~~plurality of fluid pathways~~ 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 ~~plurality of fluid pathways~~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.

~~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.~~

~~19~~16. The method of claim ~~17~~15 or ~~18~~, wherein the plurality of flow restrictions are configured to provide a different resistance to the flow of water than the flow of a hydrocarbon.

~~20~~17. The method of claim ~~19~~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.