

CLAIMS

What is claimed is:

1. A sand control device for restricting the flow of particles within a wellbore, the sand control device comprising:
at least a first compartment, wherein each compartment comprises:
a base pipe having a permeable section and an impermeable section,
a first filtering conduit circumscribing the base pipe and forming a first annular region between the base pipe and the first filtering conduit, the first filtering conduit having a filtering medium adjacent the impermeable section of the base pipe,
a second filtering conduit also circumscribing the base pipe and forming a second annular region between the base pipe and the second filtering conduit, the second filtering conduit having a filtering medium adjacent the permeable section of the base pipe,
a blank tubular housing circumscribing the second filtering conduit and forming a third annular region between the second filtering conduit and the surrounding housing, and
an under-flow ring disposed along the base pipe between the first filtering conduit and the second filtering conduit, the under-flow ring placing the first annular region in fluid communication with the third annular region, and the under-flow ring having an outer diameter that sealingly receives the blank tubular housing at an end.
2. The sand control device of claim 1, wherein the first filtering conduit and the second filtering conduit are each substantially concentrically placed around the base pipe.
3. The sand control device of claim 1, wherein the filtering medium of the first filtering conduit and the filtering medium of the second filtering conduit each comprises a wound wire screen or a wire mesh.
4. The sand control device of claim 1, further comprising:
at least a second compartment.
5. The sand control device of claim 4, further comprising:
at least one shunt tube adjacent to the first filtering conduit and the second filtering conduit, the at least one shunt tube running longitudinally substantially along the first

compartment and the second compartment and providing an alternate flow path for gravel slurry during a gravel-packing operation.

6. The sand control device of claim 1, wherein the under-flow ring comprises:
a tubular body having an inner diameter and an outer diameter;
at least two inner ridges radially and equi-distantly spaced about the inner diameter;
and
flow channels between the at least two inner ridges for directing formation fluids.
7. The sand control device of claim 6, wherein:
the flow channels are oriented to direct the flow of production fluids from the first annular region into the third annular region during a production operation.
8. The sand control device of claim 7, further comprising:
a baffle ring disposed between the under-flow ring and the second filtering conduit for circumferentially dispersing fluids as the fluids move from the first annular region to the third annular region; and
wherein the baffle ring comprises a tubular body having an inner diameter and an outer diameter.
9. The sand control device of claim 8, wherein the baffle ring further comprises:
at least two outer baffles radially and equi-distantly spaced about the outer diameter;
and
flow channels between the at least two outer baffles for dispersing formation fluids.
10. The sand control device of claim 8, wherein the baffle ring further comprises:
an inner shoulder; and
a plurality of fluid distribution ports placed radially and equi-distantly around the inner shoulder, with the fluid distribution ports being configured to receive formation fluids from the under-flow ring and deliver the formation fluids into the third annular region.
11. The sand control device of claim 7, further comprising:
a section of blank pipe disposed between the under-flow ring and the second filtering conduit for permitting a circumferential dispersion of fluids as the fluids move from the first annular region to the third annular region; and
wherein the housing also circumscribes the section of blank pipe.

12. The sand control device of claim 6, wherein:
the flow channels are oriented to direct the flow of injection fluids from the third annular region into the first annular region during an injection operation.
13. The sand control device of claim 1, wherein the sand control device is between about 10 feet (3.05 meters) and 40 feet (12.19 meters) in length.
14. The sand control device of claim 4, wherein each compartment is between about 5 feet (1.52 meters) and 40 feet (12.19 meters) in length.
15. The sand control device of claim 8, wherein the at least one permeable section of the base pipe comprises (i) circular holes, (ii) slots, (iii) a wound screen, or (iv) combinations thereof for receiving formation fluids from the second filtering conduit.
16. The sand control device of claim 8, wherein:
the first filtering conduit comprises a first end and a second end;
the first annular region in the first compartment is sealed at the first end; and
an under-flow ring is placed along the first filtering conduit at the second end.
17. The sand control device of claim 8, wherein:
the second filtering conduit comprises a first end proximal to the first filtering conduit, and a second end distal to the first filtering conduit; and
an under-flow ring is placed proximate the first end of the second filtering conduit.
18. The sand control device of claim 17, wherein:
the second and third annular regions in the first compartment are sealed at the second end of the second filtering conduit; and
the blank tubular housing circumscribing the second filtering conduit is also sealed at the second end of the second filtering conduit.
19. The sand control device of claim 1, further comprising:
at least one wall disposed inside (i) the first annular region, (ii) the third annular region, or (iii) both, to form at least one chamber in (i) the first annular region, (ii) the third annular region, or (iii) both;
wherein the chamber has at least one inlet and at least one outlet; and wherein the at least one chamber is adapted to accumulate particles in the chamber to progressively

increase resistance to fluid flow through the chamber in the event the at least one inlet is impaired and allows particles larger than a predetermined size to pass into the chamber.

20. A method for completing a wellbore in a subsurface formation, the method comprising:

providing a sand control device, the sand control device comprising:

at least a first compartment, wherein each compartment comprises:

a base pipe having a permeable section and an impermeable section, the base pipe being in fluid communication with a string of tubing within the wellbore,

a first filtering conduit circumscribing the base pipe and forming a first annular region between the base pipe and the first filtering conduit, the first filtering conduit having a filtering medium adjacent the impermeable section of the base pipe,

a second filtering conduit also circumscribing the base pipe and forming a second annular region between the base pipe and the second filtering conduit, the second filtering conduit having a filtering medium adjacent the permeable section of the base pipe,

a blank tubular housing sealingly circumscribing at least the second filtering conduit and forming a third annular region between the second filtering conduit and the surrounding housing, and

an under-flow ring disposed between the first filtering conduit and the second filtering conduit and placing the first annular region in fluid communication with the third annular region, and the under-flow ring having an outer diameter that sealingly receives the blank tubular housing at an end; and

running the sand control device into a wellbore to a selected subsurface location, and thereby forming an annulus in the wellbore between the sand control device and the surrounding wellbore.

21. The method of claim 20, further comprising:

running the at least a first compartment into an inner diameter of a completion tool of a previously-completed wellbore.

22. The method of claim 21, wherein the completion tool is a perforated pipe or a sand control device.

23. The method of claim 20, further comprising:
injecting a gravel slurry into the wellbore in order to form a gravel pack around the sand control device and within the annulus.
24. The method of claim 20, wherein the filtering medium of the first filtering conduit and the filtering medium of the second filtering conduit each comprises a wound wire screen or a wire mesh.
25. The method of claim 20, wherein the at least a first compartment comprises at least a first compartment and a second compartment.
26. The method of claim 20, wherein:
the sand control device further comprises at least one shunt tube adjacent to the first filtering conduit, the second filtering conduit, and the housing, the at least one shunt tube running longitudinally substantially along the first compartment and providing an alternate flow path for gravel slurry during the gravel-packing operation; and
the method further comprises:
injecting the gravel slurry at least partially through the at least one shunt tube to allow the gravel slurry to bypass any premature sand bridges or packers around the sand control device so that the wellbore is more uniformly gravel-packed within the annulus around the sand control device.
27. The method of claim 20, wherein the under-flow ring comprises:
a tubular body having an inner diameter and an outer diameter;
at least two inner ridges radially and equi-distantly spaced about the inner diameter;
and
flow channels between the at least two inner ridges for directing formation fluids.
28. The method of claim 20, wherein:
the tubing is a string of production tubing such that the base pipe is in fluid communication with a string of production tubing; and
the flow channels of the under-flow ring are oriented to direct the flow of production fluids from the first annular region into the third annular region during a production operation.
29. The method of claim 28, wherein:
the formation fluids comprise hydrocarbon fluids; and
the method further comprises:

producing hydrocarbon fluids from the subsurface formation, through the filtering medium of the first filtering conduit, along the first annular region, through the under-flow ring, into the third annular region, through the filtering media of the second filtering conduit, into the second annular region, through the permeable section of the base pipe, and up the production tubing.

30. The method of claim 29, wherein the sand control device further comprises:
a baffle ring disposed between the under-flow ring and the second filtering conduit for dispersing fluids as the fluids move from the first annular region to the third annular region.
31. The method of claim 30, wherein the baffle ring comprises:
a tubular body having an inner diameter and an outer diameter;
at least two outer baffles radially and equi-distantly spaced about the outer diameter;
and
flow channels between the at least two outer baffles for dispersing formation fluids.
32. The method of claim 29, wherein the sand control device further comprises:
a section of blank pipe disposed between the under-flow ring and the second filtering conduit for permitting a circumferential dispersion of fluids as the fluids move from the first annular region to the third annular region; and
wherein the housing also circumscribes the section of blank pipe.
33. The method of claim 20, wherein the sand control device is between about 10 feet (3.05 meters) and 40 feet (12.19 meters) in length.
34. The method of claim 25, wherein each compartment is between about 5 feet (1.52 meters) and 40 feet (12.19 meters) in length.
35. The method of claim 20, wherein the at least one permeable section of the base pipe comprises (i) circular holes, (ii) slots, (iii) a wound screen, (iv) a wire mesh, or (v) combinations thereof for receiving formation fluids from the second filtering conduit.
36. The method of claim 35, wherein:
the first filtering conduit comprises a first end and a second end;
the first annular region in the first compartment is sealed at the first end; and
an under-flow ring is placed along the first filtering conduit at the second end.

37. The method of claim 35, wherein:
the second filtering conduit comprises a first end proximal to the first filtering conduit,
and a second end distal to the first filtering conduit; and
an under-flow ring is placed proximate the first end of the second filtering conduit.
38. The method of claim 37, wherein:
the second and third annular regions in the first compartment are sealed at the
second end of the second filtering conduit; and
the blank tubular housing circumscribing the second filtering conduit is also sealed at
the second end of the second filtering conduit.
39. The method of claim 20, wherein:
the tubing is a string of injection tubing such that the base pipe is in fluid
communication with a string of injection tubing; and
the flow channels of the under-flow ring are oriented to direct the flow of injection
fluids from the third annular region into the first annular region during a fluid injection
operation.
40. A system for producing fluid from a wellbore, the system comprising:
providing a wellbore to a subsurface formation comprising a producible fluid;
preparing the wellbore to control sand production, by running a sand control device
into a wellbore to a selected subsurface location, and thereby forming an annulus in the
wellbore between the sand control device and the surrounding wellbore, the sand control
device comprising:
at least a first compartment, wherein each compartment comprises:
a base pipe having a permeable section and an impermeable section,
the base pipe being in fluid communication with a string of tubing within the
wellbore,
a first filtering conduit circumscribing the base pipe and forming a first
annular region between the base pipe and the first filtering conduit, the first
filtering conduit having a filtering medium adjacent the impermeable section of
the base pipe,
a second filtering conduit also circumscribing the base pipe and
forming a second annular region between the base pipe and the second
filtering conduit, the second filtering conduit having a filtering medium
adjacent the permeable section of the base pipe,

a blank tubular housing sealingly circumscribing at least the second filtering conduit and forming a third annular region between the second filtering conduit and the surrounding housing, and

an under-flow ring disposed between the first filtering conduit and the second filtering conduit and placing the first annular region in fluid communication with the third annular region, and the under-flow ring having an outer diameter that sealingly receives the blank tubular housing at an end; and

producing fluid from the wellbore by passing the fluid through at least a portion of the sand control device.

CLAIMS

1. A sand control device for restricting the flow of particles within a wellbore, the sand control device comprising:

at least a first compartment, wherein each compartment comprises:

a base pipe having a permeable section and an impermeable section,

a first filtering conduit circumscribing the base pipe and forming a first annular region between the base pipe and the first filtering conduit, the first filtering conduit having a filtering medium adjacent the impermeable section of the base pipe,

a second filtering conduit also circumscribing the base pipe and forming a second annular region between the base pipe and the second filtering conduit, the second filtering conduit having a filtering medium adjacent the permeable section of the base pipe,

a blank tubular housing circumscribing the second filtering conduit and forming a third annular region between the second filtering conduit and the surrounding housing, and

an under-flow ring disposed along the base pipe between the first filtering conduit and the second filtering conduit, the under-flow ring placing the first annular region in fluid communication with the third annular region, and the under-flow ring having an outer diameter that sealingly receives the blank tubular housing at an end.

2. The sand control device of claim 1, wherein the first filtering conduit and the second filtering conduit are each substantially concentrically placed around the base pipe.

3. The sand control device of claim 1, wherein the filtering medium of the first filtering conduit and the filtering medium of the second filtering conduit each comprises a wound wire screen or a wire mesh.

4. The sand control device of claim 1, further comprising:
at least a second compartment.

5. The sand control device of claim 4, further comprising:

at least one shunt tube adjacent to the first filtering conduit and the second filtering conduit, the at least one shunt tube running longitudinally substantially along the first compartment and the second compartment and providing an alternate flow path for gravel slurry during a gravel-packing operation.

6. The sand control device of claim 1, wherein the under-flow ring comprises:
a tubular body having an inner diameter and an outer diameter;
at least two inner ridges radially and equi-distantly spaced about the inner diameter; and
flow channels between the at least two inner ridges for directing formation fluids.
7. The sand control device of claim 6, wherein:
the flow channels are oriented to direct the flow of production fluids from the first annular region into the third annular region during a production operation.
8. The sand control device of claim 7, further comprising:
a baffle ring disposed between the under-flow ring and the second filtering conduit for circumferentially dispersing fluids as the fluids move from the first annular region to the third annular region; and
wherein the baffle ring comprises a tubular body having an inner diameter and an outer diameter.
9. The sand control device of claim 8, wherein the baffle ring further comprises:
at least two outer baffles radially and equi-distantly spaced about the outer diameter; and
flow channels between the at least two outer baffles for dispersing formation fluids.
10. The sand control device of claim 8, wherein the baffle ring further comprises:
an inner shoulder; and
a plurality of fluid distribution ports placed radially and equi-distantly around the inner shoulder, with the fluid distribution ports being configured to receive formation fluids from the under-flow ring and deliver the formation fluids into the third annular region.
11. The sand control device of claim 7, further comprising:

a section of blank pipe disposed between the under-flow ring and the second filtering conduit for permitting a circumferential dispersion of fluids as the fluids move from the first annular region to the third annular region; and
wherein the housing also circumscribes the section of blank pipe.

12. The sand control device of claim 6, wherein:
the flow channels are oriented to direct the flow of injection fluids from the third annular region into the first annular region during an injection operation.

13. The sand control device of claim 8, wherein:
the second filtering conduit comprises a first end proximal to the first filtering conduit, and a second end distal to the first filtering conduit; and
an under-flow ring is placed proximate the first end of the second filtering conduit.

14. The sand control device of claim 13, wherein:
the second and third annular regions in the first compartment are sealed at the second end of the second filtering conduit; and
the blank tubular housing circumscribing the second filtering conduit is also sealed at the second end of the second filtering conduit.

15. The sand control device of claim 1, further comprising:
at least one wall disposed inside (i) the first annular region, (ii) the third annular region, or (iii) both, to form at least one chamber in (i) the first annular region, (ii) the third annular region, or (iii) both;

wherein the chamber has at least one inlet and at least one outlet; and wherein the at least one chamber is adapted to accumulate particles in the chamber to progressively increase resistance to fluid flow through the chamber in the event the at least one inlet is impaired and allows particles larger than a predetermined size to pass into the chamber.

16. The sand control device according to any of the preceding claims, using in a method for completing a wellbore in a subsurface formation, the method comprising:

providing a sand control device, the sand control device comprising:

at least a first compartment, wherein each compartment comprises:

a base pipe having a permeable section and an impermeable section, the base pipe being in fluid communication with a string of tubing within the wellbore,

a first filtering conduit circumscribing the base pipe and forming a first annular region between the base pipe and the first filtering conduit, the first filtering conduit having a filtering medium adjacent the impermeable section of the base pipe,

a second filtering conduit also circumscribing the base pipe and forming a second annular region between the base pipe and the second filtering conduit, the second filtering conduit having a filtering medium adjacent the permeable section of the base pipe,

a blank tubular housing sealingly circumscribing at least the second filtering conduit and forming a third annular region between the second filtering conduit and the surrounding housing, and

an under-flow ring disposed between the first filtering conduit and the second filtering conduit and placing the first annular region in fluid communication with the third annular region, and the under-flow ring having an outer diameter that sealingly receives the blank tubular housing at an end; and

running the sand control device into a wellbore to a selected subsurface location, and thereby forming an annulus in the wellbore between the sand control device and the surrounding wellbore.

17. The method of claim 16, further comprising:

running the at least a first compartment into an inner diameter of a completion tool of a previously-completed wellbore.

18. The method of claim 17, wherein the completion tool is a perforated pipe or a sand control device.

19. The method of claim 16, further comprising:

injecting a gravel slurry into the wellbore in order to form a gravel pack around the sand control device and within the annulus.

20. The method of claim 16, wherein the filtering medium of the first filtering conduit and the filtering medium of the second filtering conduit each comprises a wound wire screen or a wire mesh.

21. The method of claim 16, wherein the at least a first compartment comprises at least a first compartment and a second compartment.

22. The method of claim 16, wherein:

the sand control device further comprises at least one shunt tube adjacent to the first filtering conduit, the second filtering conduit, and the housing, the at least one shunt tube running longitudinally substantially along the first compartment and providing an alternate flow path for gravel slurry during the gravel-packing operation; and

the method further comprises:

injecting the gravel slurry at least partially through the at least one shunt tube to allow the gravel slurry to bypass any premature sand bridges or packers around the sand control device so that the wellbore is more uniformly gravel-packed within the annulus around the sand control device.

23. The method of claim 16, wherein:

the tubing is a string of injection tubing such that the base pipe is in fluid communication with a string of injection tubing; and

the flow channels of the under-flow ring are oriented to direct the flow of injection fluids from the third annular region into the first annular region during a fluid injection operation.

24. The method of claim 23, further comprising:

injecting a fluid into the tubing; and

further injecting the fluid into the base pipe, into the second annular region, through the filtering media of the second filtering conduit, into the third annular region, through the under-flow ring, into the first annular region, through the filtering media of the first filtering conduit, and into the surrounding subsurface formation.