

WHAT IS CLAIMED IS:

1. A flowcontrol apparatus for a borehole, comprising:
a basepipe having a bore for conveying fluid and defining at least one opening for communicating fluid into the bore; and
at least one flow device disposed on the basepipe and communicating with fluid from outside the basepipe to the at least one opening defined in the basepipe,
at least a portion of the at least one flow device being accessible on an exterior of the apparatus, the at least one flow device being externally configurable and selectively controlling flow of the fluid from outside the basepipe to the at least one opening defined in the basepipe.
2. The apparatus of claim 1, further comprising a screen disposed on the basepipe, the screen screening the fluid from outside the basepipe and communicating the fluid with the at least one flow device.
3. The apparatus of claim 1, wherein the at least one flow device is externally configurable between first and second states, the at least one flow device in the first state permitting fluid communication to the at least one opening, the at least one flow device in the second state preventing fluid communication to the at least one opening.
4. The apparatus of claim 1, wherein the at least one flow device defines at least one flow port restricting the flow of the fluid.
5. The apparatus of claim 1, wherein the at least one flow device comprises a nozzle disposed in at least one flow port, the nozzle restricting the flow of the fluid.
6. The apparatus of claim 1, wherein the at least one flow device comprises means for producing a pressure drop in the flow of the fluid.

7. The apparatus of claim 1, wherein the at least one flow device comprises:
a first end in fluid communication with the fluid from outside the basepipe; and
a second end in fluid communication with the at least one opening.
8. The apparatus of claim 7, wherein the first end comprises a first end-ring defining a fluid passage in fluid communication with the fluid from outside the basepipe, and wherein the second end comprises a second end-ring.
9. The apparatus of claim 8, wherein the second end-ring defines at least one flow port communicating with the at least one opening.
10. The apparatus of claim 8, wherein the at least one flow port comprises a nozzle restricting the flow of the fluid.
11. The apparatus of claim 8, wherein the at least one flow device comprises a sleeve affixed to the first and second end-rings and defining a chamber with the first and second end-rings.
12. The apparatus of claim 1, wherein the at least one flow device comprises:
a flow port in fluid communication with the at least one opening; and
a valve being externally accessible on the exterior of the apparatus and being selectively configurable between an open state and a closed state relative to the flow port.
13. The apparatus of claim 12, wherein the valve comprises a ball valve having an orifice defined therein and being rotatable relative to the flow port, the rotation of the ball valve being externally accessible on the exterior of the apparatus and changing fluid communication through the flow port.

14. The apparatus of claim 12, wherein the valve comprises a gate valve having a gate movable relative to the flow port, the movement of the gate being externally accessible on the exterior of the apparatus and changing fluid communication through the flow port.

15. The apparatus of claim 12, wherein the valve comprises a butterfly valve having a flapper rotatable relative to the flow port, the rotation of the flapper being externally accessible on the exterior of the apparatus and changing fluid communication through the flow port.

16. The apparatus of claim 1, wherein the at least one flow device comprises:
a flow port in fluid communication with the at least one opening; and
a stopper externally insertable into the apparatus from the exterior relative to the flow port, the stopper inserted into the apparatus closing off fluid communication through the flow port.

17. The apparatus of claim 16, wherein the stopper comprises a pin threading into an external opening in the apparatus, a portion of the pin inserting in the internal flow port and closing off fluid communication therethrough.

18. The apparatus of claim 17, comprising an internal seat disposed in the flow port and engaging the portion of the pin inserted therein.

19. The apparatus of claim 16, wherein the at least one flow device comprises a cap attachable to an external opening in the apparatus relative to the internal flow port, the cap attached to the external opening closing off fluid communication of the internal flow port out of the external opening and permitting fluid communication through the internal flow port.

20. The apparatus of claim 1, wherein the at least one flow device comprises:
a pin usable to close the at least one flow device;
a cap useable to open the at least one flow device; and
a flow port in fluid communication with the at least one opening,
each of the pin and cap being selectively attachable to an external opening in the
exterior of the apparatus relative to the flow port,
the pin attached to the external opening closing off fluid communication through
the flow port,
the cap attached to the external opening closing off fluid communication of the
flow port out of the external opening.
21. A flow control apparatus for a borehole, comprising:
a base pipe having a bore for conveying fluid and defining at least one opening for
communicating fluid into the bore;
means for receiving fluid from outside the base pipe;
means for selectively configuring flow of the received fluid from the receiving means
to the at least one opening in the base pipe; and
means for externally accessing, on an exterior of the apparatus, the configuring
means.
22. The apparatus of claim 21, wherein the means for receiving the fluid from outside
the base pipe comprises means for screening the fluid from outside the base pipe.
23. The apparatus of claim 21, wherein the means for selectively configuring the flow
of the received fluid comprises means for restricting the flow of the received fluid.
24. The apparatus of claim 21, wherein the means for selectively configuring the flow
of the received fluid comprises means for producing a pressure drop in the flow of the
received fluid.

25. The apparatus of claim 21, wherein the means for selectively configuring comprises means for selectively permitting or preventing fluid communication of the received fluid to the at least one opening.
26. The apparatus of claim 21, wherein the means for externally accessing, on the exterior of the apparatus, the configuring means comprises means for inserting in an exterior opening of the apparatus.
27. The apparatus of claim 21, wherein the means for externally accessing, on the exterior of the apparatus, the configuring means comprises means for adjusting an internal valve of the apparatus through an external opening on the apparatus.
28. A flow control method for a borehole, comprising:
selectively configuring one or more flow devices disposed in a housing on a basepipe by externally accessing the one or more flow devices on an exterior of the housing;
deploying the basepipe in the borehole;
receiving fluid in the housing from outside the basepipe; and
controlling flow of the received fluid to one or more internal openings in the basepipe using the one or more flow devices.
29. The method of claim 28, wherein controlling the flow of the received fluid to the one or more internal openings comprises restricting the flow of the received fluid through the one or more flow devices.
30. The method of claim 29, wherein restricting the flow of the received fluid through the one or more flow devices comprises producing a pressure drop in the flow of the received fluid.

31. The method of claim 28, wherein selectively configuring the one or more flow devices disposed in the housing on the basepipe comprises selectively permitting or preventing fluid communication to the one or more internal openings through the one or more flow devices.

32. The method of claim 28, wherein selectively configuring the flow devices disposed in the housing on the basepipe comprises selectively opening or closing fluid communication through the one or more flow devices by externally opening or closing an internal valve of the one or more flow devices.

33. The method of claim 28, wherein selectively configuring the one or more flow devices disposed in the housing on the basepipe comprises selectively opening or closing fluid communication through the one or more flow devices by inserting or removing a stopper in an external opening of the housing on the basepipe.

34. The method of claim 28, wherein selectively configuring the one or more flow devices disposed in the housing on the basepipe comprises selectively opening or closing fluid communication through the one or more flow devices by attaching or removing a cap on an external opening of the housing disposed on the basepipe.

CLAIMS

1. A flow control apparatus for a borehole, comprising:
 - a basepipe having a bore for conveying fluid and defining at least one opening for communicating fluid into the bore;
 - a flow device disposed on the basepipe and defining at least one flow port, the at least one flow port communicating fluid from outside the basepipe to the at least one opening defined in the basepipe; and
 - at least one internal valve disposed inside the flow device at the at least one flow port, at least a portion of the at least one internal valve being externally accessible on an exterior of the flow device, the at least one internal valve being externally configurable between an open state and a closed state relative to the at least one flow port and selectively controlling flow of the fluid from outside the basepipe to the at least one opening defined in the basepipe.
2. The apparatus of claim 1, further comprising a screen disposed on the basepipe, the screen screening the fluid from outside the basepipe and communicating the fluid with the flow device.
3. The apparatus of claim 1, wherein the at least one internal valve in the open state permits fluid communication through the at least one flow port to the at least one opening, and wherein the at least one internal valve in the closed state prevents fluid communication through the at least one flow port to the at least one opening.
4. The apparatus of claim 1, wherein the flow device comprises a nozzle disposed in the at least one flow port, the nozzle restricting the flow of the fluid.
5. The apparatus of claim 1, wherein the at least one internal valve comprises means for producing a pressure drop in the flow of the fluid through the internal valve in the opened state.
6. The apparatus of claim 1, wherein the flow device comprises:

a first end in fluid communication with the fluid from outside the basepipe; and
a second end in fluid communication with the at least one opening.

7. The apparatus of claim 6, wherein the first end comprises a first end-ring defining a fluid passage in fluid communication with the fluid from outside the basepipe, and wherein the second end comprises a second end-ring.

8. The apparatus of claim 7, wherein the second end-ring defines the at least one flow port communicating with the at least one opening, and wherein the second end-ring has the at least one valve disposed internally therein.

9. The apparatus of claim 7, wherein the at least one flow port comprises a nozzle restricting the flow of the fluid.

10. The apparatus of claim 7, wherein the flow device comprises a sleeve affixed to the first and second end-rings and defining a chamber with the first and second end-rings.

11. The apparatus of claim 1, wherein the at least one internal valve comprises a ball valve having an orifice defined therein, the ball valve disposed inside the flow device and being rotatable therein relative to the at least one flow port, the rotation of the ball valve being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

12. The apparatus of claim 11, wherein the ball valve comprises a rotatable body disposed in an external opening in the flow device, the rotatable body having the orifice therethrough and being rotatable relative to the at least one flow port, the rotatable body having a spindle extending therefrom, the spindle being accessible externally in the external opening in the flow device for rotating the rotatable body.

13. The apparatus of claim 12, wherein the ball valve comprise seal elements disposed inside the external opening against the rotatable body.

14. The apparatus of claim 12, wherein the orifice of the ball valve in the opened state produces a pressure drop in the flow of the fluid therethrough.

15. The apparatus of claim 1, wherein the at least one internal valve comprises a gate valve disposed inside the flow device and having a gate, the gate being movable relative to the at least one flow port, the movement of the gate being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

16. The apparatus of claim 15, wherein the gate valve comprises a body disposed in an external opening in the flow device, the body having an orifice therethrough in communication with the at least one flow port, the gate disposed in the body and being movable relative to the orifice, the gate having a screw extending therefrom, the screw being accessible externally in the external opening in the flow device for moving the gate.

17. The apparatus of claim 1, wherein the at least one internal valve comprises a butterfly valve disposed inside the flow device and having a flapper, the flapper being rotatable relative to the at least one flow port, the rotation of the flapper being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

18. The apparatus of claim 17, wherein the butterfly valve comprises a body disposed in an external opening in the flow device, the body having an orifice therethrough in communication with the at least one flow port, the flapper disposed in the body and being rotatable relative to the orifice, the flapper having a spindle extending therefrom, the spindle being accessible externally in the external opening in the flow device for rotating the flapper.

19. The apparatus of claim 1, wherein the flow device comprises a plurality of the at least one internal valves disposed inside the flow device.

20. The apparatus of claim 1, wherein the flow device defines a tortuous path for the flow of fluid therethrough to the opening in the basepipe.

21. A flow control apparatus for a borehole, comprising:
a basepipe having a bore for conveying fluid and defining at least one opening for communicating fluid into the bore;
a flow device having means for receiving fluid from outside the basepipe;
at least one internal valve disposed inside the flow device and selectively configurable between opened and closed conditions to control flow of the received fluid from the receiving means to the at least one opening in the basepipe; and
means for externally accessing, on an exterior of the flow device, the internal valve.
22. The apparatus of claim 21, wherein the means for receiving the fluid from outside the basepipe comprises means for screening the fluid from outside the basepipe.
23. The apparatus of claim 21, comprising means for restricting the flow of the received fluid.
24. The apparatus of claim 21, wherein the internal valve comprises means for producing a pressure drop in the flow of the received fluid.
25. The apparatus of claim 21, wherein the internal valve comprises means for selectively permitting or preventing fluid communication of the received fluid to the at least one opening.
26. The apparatus of claim 21, wherein the means for externally accessing, on the exterior of the flow device, the internal valve comprises means for adjusting the internal valve through an external opening on the flow device.
27. The apparatus of claim 21, wherein the at least one internal valve comprises a ball valve having an orifice defined therein, the ball valve disposed inside the flow device and being rotatable therein relative to the at least one flow port, the rotation of the ball valve being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

28. The apparatus of claim 27, wherein the ball valve comprises a rotatable body disposed in an external opening in the flow device, the rotatable body having the orifice therethrough and being rotatable relative to the at least one flow port, the rotatable body having a spindle extending therefrom, the spindle being accessible externally in the external opening in the flow device for rotating the rotatable body.

29. The apparatus of claim 28, wherein the ball valve comprises seal elements disposed inside the external opening against the rotatable body.

30. The apparatus of claim 28, wherein the orifice of the ball valve in the opened state produces a pressure drop in the flow of the fluid therethrough.

31. The apparatus of claim 21, wherein the at least one internal valve comprises a gate valve disposed inside the flow device and having a gate, the gate being movable relative to the at least one flow port, the movement of the gate being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

32. The apparatus of claim 31, wherein the gate valve comprises a body disposed in an external opening in the flow device, the body having an orifice therethrough in communication with the at least one flow port, the gate disposed in the body and being movable relative to the orifice, the gate having a screw extending therefrom, the screw being accessible externally in the external opening in the flow device for moving the gate.

33. The apparatus of claim 21, wherein the at least one internal valve comprises a butterfly valve disposed inside the flow device and having a flapper, the flapper being rotatable relative to the at least one flow port, the rotation of the flapper being externally accessible on the exterior of the flow device and changing fluid communication through the at least one flow port.

34. The apparatus of claim 33, wherein the butterfly valve comprises a body disposed in an external opening in the flow device, the body having an orifice therethrough in communication with the at least one flow port, the flapper disposed in

the body and being rotatable relative to the orifice, the flapper having a spindle extending therefrom, the spindle being accessible externally in the external opening in the flow device for rotating the flapper.

35. A flow control method for a borehole, comprising:
selectively configuring one or more internal valves disposed in a housing on a basepipe by externally accessing the one or more internal valves from an exterior of the housing and selectively opening or closing fluid communication through the one or more internal valves;
deploying the basepipe in the borehole;
receiving fluid in the housing from outside the basepipe; and
controlling flow of the received fluid to one or more internal openings in the basepipe using the one or more internal valves.

36. The method of claim 35, wherein controlling the flow of the received fluid to the one or more internal openings comprises restricting the flow of the received fluid through the one or more internal valves in an open condition.

37. The method of claim 36, wherein restricting the flow of the received fluid through the one or more internal valves in the opened condition comprises producing a pressure drop in the flow of the received fluid through the one or more internal valves in the open condition.

38. The method of claim 35, wherein selectively opening or closing fluid communication through the one or more internal valves comprises selectively permitting or preventing fluid communication to the one or more internal openings through the one or more internal valves.

39. The method of claim 35, wherein selectively opening or closing fluid communication through the one or more internal valves comprises rotating a ball valve having an orifice defined therein, the ball valve disposed inside the housing and being rotatable therein relative to at least one flow port, the rotation of the ball valve being externally accessible on the exterior of the housing and changing fluid communication through the at least one flow port.

40. The method of claim 35, wherein the ball valve comprises a rotatable body disposed in an external opening in the housing, the rotatable body having the orifice therethrough and being rotatable relative to the at least one flow port, the rotatable body having a spindle extending therefrom, the spindle being accessible externally in the external opening in the housing for rotating the rotatable body.

41. The method of claim 40, wherein the ball valve comprises seal elements disposed inside the external opening against the rotatable body.

42. The method of claim 40, comprising producing a pressure drop in the flow of the fluid through the orifice of the ball valve in the opened state.

43. The method of claim 35, wherein selectively opening or closing fluid communication through the one or more internal valves comprises moving a gate valve disposed inside the housing relative to at least one flow port, the movement of the gate being externally accessible on the exterior of the housing and changing fluid communication through the at least one flow port.

44. The method of claim 43, wherein the gate valve comprises a body disposed in an external opening in the housing, the body having an orifice therethrough in communication with the at least one flow port, the gate valve having a gate disposed in the body and being movable relative to the orifice, the gate having a screw extending therefrom, the screw being accessible externally in the external opening in the housing for moving the gate.

45. The method of claim 35, wherein selectively opening or closing fluid communication through the one or more internal valves comprises rotating a butterfly valve disposed inside the housing relative to at least one flow port, the rotation of the butterfly valve being externally accessible on the exterior of the housing and changing fluid communication through the at least one flow port.

46. The method of claim 45, wherein the butterfly valve comprises a body disposed in an external opening in the housing, the body having an orifice

therethrough in communication with the at least one flow port, the butterfly valve having a flapper disposed in the body and being rotatable relative to the orifice, the flapper having a spindle extending therefrom, the spindle being accessible externally in the external opening in the housing for rotating the flapper.