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(54) **A PROCESS FOR PRODUCING HYDROCARBON MATERIAL FROM A SUBTERRANEAN FORMATION WHILE EMPLOYING SOLIDS CONTROL**

VERFAHREN ZUR HERSTELLUNG VON KOHLENWASSERSTOFFMATERIAL AUS EINER  
UNTERIRDISCHEN FORMATION BEI FESTSTOFFKONTROLLE

PROCÉDÉ DE PRODUCTION DE MATÉRIAU HYDROCARBONÉ À PARTIR D'UNE FORMATION  
SOUTERRAINE EN METTANT EN UVRE UNE RÉGULATION DES MATIÈRES SOLIDES

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## Description

### FIELD

**[0001]** The present disclosure relates to production of hydrocarbon material from a subterranean formation and controlling entrainment of solids within the produced hydrocarbon material.

### BACKGROUND

**[0002]** Production of hydrocarbon reservoirs is complicated by the presence of solid particulate matter that is entrained within the produced fluid. Such solid particulate matter includes naturally-occurring solids debris, such as sand. It also includes solids, such as proppant, which have been intentionally injected into the reservoir, in conjunction with treatment fluid, for improving the rate of hydrocarbon production from the reservoir. The entrained solids can complicate operations by causing erosion and interfering with fluid flow.

**[0003]** US 2014/345876 discloses a selectively openable inflow control sub. The sub includes a tubular body and an inflow port that extends through a wall of the body. The sub further includes a sliding sleeve valve that is slidable within an inner bore of the tubular body between a closed-port position, closing the inflow port, and an open-port position, opening the inflow port to fluid flow therethrough. The sliding sleeve valve is axially moveable from the closed-port position and the open-port position by pushing the sleeve with a mill string.

**[0004]** US 2013/168099 discloses an apparatus for fluid treatment of a borehole. The apparatus effects initial outflow injection of fluids into a wellbore in which it is installed, and then is actuable to allow fluid inflow control. The apparatus includes a tubular body, a first port and a second port opened through the wall of the tubular body, wherein the second port has a fluid inflow controller positioned to control the flow of fluid into the tubular body through the port. The apparatus further includes a sliding sleeve valve in the tubular body that is moveable from (i) a first position, wherein the first and second ports are closed by the sleeve valve, to (ii) a second position, wherein the second port is closed by the sleeve valve, while fluid flow through the first port is permitted by the sleeve valve, to (iii) a third position, wherein the first port is closed by the sleeve valve, while fluid flow through the second port is permitted by the sleeve valve. The apparatus further includes a sleeve actuator for actuating the sliding sleeve valve to move from the first position to the second position in response to a force applied thereto. The apparatus further includes a releasable lock for locking the sliding sleeve valve in the first position and selected to maintain the sliding sleeve valve in the first position after the force is removed, and a lock release mechanism configured to actuate the releasable lock to release the sliding sleeve valve to move into the third position.

**[0005]** US 2014/224471 discloses an apparatus for fluid treatment of a borehole. The apparatus includes a tubular body, a first port extending through the wall of the tubular body, and a second port extending through the wall of the tubular body. The second port has a fluid inflow control mechanism positioned to control the flow of fluid into the tubular body through the port. The first port is configurable from an open position to a closed position. The apparatus further includes a controller to actuate the first port into the closed position, a set time after the first port is placed into the open position.

### SUMMARY

**[0006]** There is provided a hydrocarbon production process, implemented via a system including a wellbore string disposed within a wellbore extending into a subterranean formation, wherein the wellbore string includes a flow communication station including a material injection station and a material production station, wherein the material production station is disposed downhole relative to the material injection station, wherein the material injection station includes a material injection flow control member for opening and closing a material injection flow communicator that is disposed in flow communication with the subterranean formation via a wellbore space, and the material production station includes a material production flow control member for opening and closing a material production flow communicator that is disposed in flow communication with the subterranean formation via a wellbore space, wherein the material production flow communicator includes a filter medium for preventing oversize particulate material from entering the wellbore string, comprising:

opening the material injection flow communicator by displacing the material injection flow control member, relative to the material injection flow communicator, from the closed position to the open position with a shifting tool;

while: (i) the material injection flow communicator is disposed in the open condition, and (ii) a sealed interface is disposed within the wellbore string, downhole relative to the material injection flow communicator, and uphole relative to the material production flow communicator, with effect that bypassing of the material injection flow communicator, by stimulation material injected from the surface, is prevented or substantially prevented, injecting stimulation material, including proppant, from the surface and into the subterranean formation, via the wellbore string, the material injection flow communicator, and the wellbore space, such that hydraulic fracturing of a hydrocarbon material-containing reservoir of the subterranean formation is effected;

continuing to inject the stimulation material with ef-

fect that a screen out is obtained, with effect that the frac pack is obtained within the wellbore space, between the subterranean formation and the material production flow communicator; and

after the frac pack has been obtained:

opening the material production flow communicator by displacing the material production flow control member, relative to the material production flow communicator, from the closed position to the open position, with a shifting tool; and

after the opening of the material production flow communicator, producing hydrocarbon material from the subterranean formation via the frac pack, the material production station and the wellbore string.

**[0007]** In another aspect, there is provided a hydrocarbon production process, implemented via a system including a wellbore string disposed within a wellbore extending into a subterranean formation, wherein the wellbore string includes a material injection station and a material production station, wherein the material production station is disposed downhole relative to the material injection station, wherein the material injection station includes a material injection flow controller for modulating a flow communication condition of a material injection flow communicator that is disposed in flow communication with the subterranean formation via a wellbore space, and the material production station includes a material production flow controller for modulating a flow communication condition of a material production flow communicator that is disposed in flow communication with the subterranean formation via a wellbore space, wherein the material production flow communicator includes a filter medium for preventing oversize particulate material from entering the wellbore string, comprising:

opening the material injection flow communicator by displacing the material injection flow controller relative to the material injection flow communicator;

while the material injection flow communicator is disposed in the open condition, injecting stimulation material, including proppant entrained within a fluid, from the surface and into the subterranean formation, via the wellbore string, the material injection flow communicator, and the wellbore space, such that hydraulic fracturing of a hydrocarbon material-containing reservoir of the subterranean formation is effected;

suspending the injection of the stimulation material;

after the suspending of the injection of the stimulation material, partially opening the material production

flow communicator by displacing the material production flow controller relative to the material production flow communicator, such that:

(i) an uphole-disposed portion of the material production flow communicator is occluded by the material production flow controller; and

(ii) flow communication is effected between the subterranean formation and the wellbore string via a downhole-disposed portion of the material production flow communicator, such that reservoir material is conducted from the subterranean formation and into the wellbore string via the downhole-disposed portion of the material production flow communicator in response to a pressure differential between the subterranean formation and the wellbore string, and such that solid particulate material, entrained within the conducted reservoir material, separates from the conducted reservoir material and accumulates within the wellbore space, that is disposed between the subterranean formation and the material production flow communicator, and at least contributes to formation of a solid particulate material-containing filtering medium;

wherein the downhole-disposed portion of the material production flow communicator is disposed downhole relative to the uphole-disposed portion of the material production flow communicator; and

after the formation of a solid particulate material-containing filtering medium, increasing the percentage opening of the material production flow communicator by displacing the material production flow controller relative to the material production flow communicator such that a production mode material production flow communicator is established, with effect that reservoir material is conducted from the subterranean formation and into the wellbore string via the solid particulate material-containing filtering medium and the production mode material production flow communicator.

## **BRIEF DESCRIPTION OF DRAWINGS**

**[0008]** The preferred embodiments will now be described with the following accompanying drawings, in which:

Figure 1 is a schematic illustration of a system of the present disclosure;

Figure 1A is a schematic illustration of an embodiment of an apparatus of the material injection station of the system illustrated in Figure 1, showing the flow control member disposed in the closed position;

Figure 1B is a schematic illustration of the apparatus of the material injection station illustrated in Figure 1A, showing the flow control member disposed in the open position;

Figure 2 is a sectional view of an embodiment of an apparatus of the material production station of the system illustrated in Figure 1, showing the flow control member disposed in the closed position;

Figure 2A is a detailed view of Detail A in Figure 2;

Figure 2B is a detailed view of Detail B in Figure 2

Figure 2C is a detailed view of Detail C in Figure 2;

Figure 3 is a sectional view of the apparatus illustrated in Figure 2, showing the flow control member disposed in the intermediate position;

Figure 3A is a detailed view of Detail A in Figure 3;

Figure 3B is a detailed view of Detail B in Figure 3;

Figure 3C is a detailed view of Detail C in Figure 3;

Figure 4 is a sectional view of the apparatus illustrated in Figure 2, showing the flow control member disposed in the open position;

Figure 4A is a detailed view of Detail A in Figure 4;

Figure 4B is a detailed view of Detail B in Figure 4;

Figure 4C is a detailed view of Detail C in Figure 4;

Figure 5 is a schematic illustration of a partially completed embodiment of the screened port of the apparatus illustrated in Figure 2, showing screen having been wrapped around a portion of a perforated base pipe;

Figure 6 is a schematic illustration of an exemplary flow communication station of a system of the present disclosure;

Figure 7 is a schematic illustration of the system illustrated in Figure 6, showing injection of stimulation material into subterranean formation via the material injection station for formation of a frac pack;

Figure 8 is a schematic illustration of an exemplary flow communication station of the system illustrated

in Figure 6, after a frac pack has been obtained, and while a clean out is on-going;

Figure 9 is a schematic illustration of the system illustrated in Figure 6 during production;

Figure 10 is a schematic illustration of another exemplary flow communication station of a system of the present disclosure;

Figure 11 is a schematic illustration of the system illustrated in Figure 10, showing injection of stimulation material into subterranean formation, via the material injection station, for effecting hydraulic fracturing of the subterranean formation;

Figure 12 is a schematic illustration of the system in Figure 10, after the injection of stimulation material has been suspended and the material production flow communicator has been partially opened; and

Figure 13 is a schematic illustration of the system in Figure 10, after the the material production flow communicator has been fully opened.

## DETAILED DESCRIPTION

**[0009]** Referring to Figure 1, there is provided a system 2 for producing hydrocarbon material from a subterranean formation 100 including a plurality of flow communication stations (in the illustrated embodiment, five, 200A-E, are illustrated) disposed within a wellbore 102. Successive flow communication stations 200A-E are spaced from each other within the wellbore 102, along a longitudinal axis of the wellbore 102, such that each one of the flow communication stations 200A-E, independently, is positioned adjacent a zone of the subterranean formation for effecting flow communication between the wellbore 102 and the zone. In this respect, each one of the flow communication stations 200A-E, independently, is configured for effecting flow communication between the surface and a respective zone within the subterranean formation 100.

**[0010]** The wellbore 102 can be straight, curved, or branched. The wellbore 102 can have various wellbore sections. A wellbore section is an axial length of a wellbore 102. A wellbore section can be characterized as "vertical" or "horizontal" even though the actual axial orientation can vary from true vertical or true horizontal, and even though the axial path can tend to "corkscrew" or otherwise vary. The term "horizontal", when used to describe a wellbore section, refers to a horizontal or highly deviated wellbore section as understood in the art, such as, for example, a wellbore section having a longitudinal axis that is between 70 and 110 degrees from vertical.

**[0011]** In some embodiments, for example, for each one of the flow communication stations 200A-E, the flow communication, between the flow communication station

and the respective zone of the subterranean formation, is effected by integrating the flow communication station 200, in succession, into a production string 202 that is disposed within the wellbore 102. In some of these embodiments, for example, the disposition of the production string 202 within the wellbore 102 is such that a wellbore space 104, such as an annular space, is established within the wellbore 102, between the production string 202 and the subterranean formation 100.

**[0012]** The wellbore space includes a plurality of wellbore space sections 104A-E. Each one of the wellbore space sections 104A-E, independently, is respective to a one of the flow communication stations 200A-E, such that, for each one of the flow communication stations 200A-E, flow communication, between the flow communication station and the subterranean formation, is effected via a respective one of the wellbore space sections 104A-E.

**[0013]** Each one of the flow communication stations 200A-E, independently, includes a material injection station 204 and a material production station 206.

**[0014]** For each one of the flow communication stations 200A-E, independently, the material injection station 204 includes an apparatus 2042. Referring to Figures 1A and 1B, the apparatus 2042 includes a housing 2044. The housing 2044 includes a passage 2046. A material injection flow communicator 2048 extends through the housing 2044. In some embodiments, for example, the material injection flow communicator 2048 includes one or more ports. The material injection flow communicator 2048 is configured for effecting flow communication between the housing passage 2046 and the subterranean formation.

**[0015]** The apparatus 2042 further includes a material injection flow controller 2050 configured for controlling flow communication between the housing passage 2046 and the material injection flow communicator 2048. In some embodiments, for example, the material injection flow controller 250 is a flow control member 250. In some embodiments, for example, the material injection flow controller 250 is in the form of a sleeve that is slidable, relative to the flow communicator 2048, within the housing passage 2046. In some embodiments, for example, the flow control member 2050 is configured for opening and closing the material injection flow communicator 2048.

**[0016]** In some embodiments, for example, while the flow control member 2050 is disposed in the closed position (see Figure 1A), the material injection flow communicator 2048 is disposed in a closed condition. In some embodiments, for example, in the closed condition, the flow communicator 2048 is occluded by the flow control member 2050. In some embodiments, for example, while the flow communicator 2048 is disposed in the closed condition, there is an absence, or substantial absence of fluid communication between the passage 2046 and the subterranean formation 100 via the material production flow communicator 2048. In other words, fluid communi-

cation between the passage 2046 and the subterranean formation 100 via the flow communicator 2048 is prevented or substantially prevented. In some embodiments, for example, while the flow control member 2050 is disposed in the closed position, a sealed interface is established, preventing, or substantially preventing, flow communication, via the material injection flow communicator 2048, between the surface 4 and the subterranean formation 100. In some embodiments, for example, the closed position of the material injection flow control member 2050 is established by abutting engagement of the flow control member 2050 with the hard stop 2060 that is disposed uphole of the material injection flow communicator 2048.

**[0017]** In some embodiments, for example, while the flow control member 2050 is disposed in the open position (see Figure 1B), flow communication, between the surface and the respective zone of the subterranean formation 100, is effected via the material injection flow communicator 2048. In some embodiments, for example, while the flow control member 250 is disposed in the open position, the flow communicator 2048 is disposed in an open condition. In some embodiments, for example, while the flow communicator is disposed in the open condition, there is an absence of occlusion of any portion, or substantially any portion, of the flow communicator 2048 by the flow control member 250. In some embodiments, for example, the disposition of the flow control member 250 in the open position is such that the entirety, or substantially the entirety, of the flow communicator 2048 is non-occluded by the flow control member 250. In some embodiments, for example, the open position of the material injection flow control member 2050 is established by abutting engagement of the flow control member 2050 with the hard stop 2062 that is disposed downhole of the material injection flow communicator 2048.

**[0018]** In some embodiments, for example, while the flow control member 250 is disposed in the closed position, the flow control member 250 is releasably retained relative to the housing 2044. Similarly, in some embodiments, for example, while the flow control member 250 is disposed in the open position, the flow control member 250 is releasably retained relative to the housing 2044. The releasable retention of the flow control member 250, relative to the housing 2044, can be effected by a collet retainer 2070, similar to the manner by which the flow control member 14, of the material production station 206, is releasably retained by a collet retainer 22, as described below.

**[0019]** While the material injection flow communicator 2048 is disposed in the open condition, treatment material is injectable from the surface and into the subterranean formation via the flow communicator 2048 for stimulating production of a hydrocarbon material-containing reservoir within the subterranean formation.

**[0020]** In some embodiments, for example, the treatment material includes a liquid, such as a liquid including water. In some embodiments, for example, the liquid in-

cludes water and chemical additives. In other embodiments, for example, the stimulation material is a slurry including water and solid particulate matter, such as proppant. In some embodiments, for example the treatment material includes chemical additives. Exemplary chemical additives include acids, sodium chloride, polyacrylamide, ethylene glycol, borate salts, sodium and potassium carbonates, glutaraldehyde, guar gum and other water soluble gels, citric acid, and isopropanol. In some embodiments, for example, the treatment material is injected into the subterranean formation for effecting hydraulic fracturing of the reservoir.

**[0021]** In some embodiments, for example, while the apparatus 10 is being deployed downhole, the flow control member 250 is maintained in the closed position, by one or more frangible interlocking members 2501 (such as, for example, shear pins), such that the material injection flow communicator 2048 remains disposed in the closed condition while the deployment is occurring. The one or more frangible interlocking members are provided to releasably secure the flow control member 250 to the housing 2044 so that the passage 2046 is maintained fluidically isolated from the subterranean formation 100 until it is desired to effect hydrocarbon production from the subterranean formation 100.

**[0022]** For each one of the flow communication stations 200A-E, independently, the material production station 206 includes an apparatus 10. Referring to Figures 2 to 5, the apparatus 10 includes a housing 12. The housing 12 includes a passage 16. A material production flow communicator 15 extends through the housing 12. In some embodiments, for example, the material production flow communicator 15 includes one or more ports. The material injection flow communicator 15 is configured for effecting flow communication between the housing passage 16 and the subterranean formation, such as for effecting the receiving of hydrocarbon material, from the subterranean formation, by the production string 202. The material production flow communicator 15 includes a filter medium 15AA configured for preventing, or substantially preventing, oversize solid particulate matter from being conducted from the subterranean formation 100 and into the production string 202. In some embodiments, for example, the filter medium is in the form of a screen, such as a wire screen. In some embodiments, for example, the filter medium 15AA is defined by a sand screen that is wrapped around a perforated section (defined by ports 15CC) of a base pipe 15BB, the perforated section defining a plurality of apertures. In some embodiments, for example, the filter medium is in the form of a porous material that is integrated within an aperture of a base pipe. In some embodiments, for example, the filter medium is configured for preventing, or substantially preventing, passage of + 100 mesh proppant from the subterranean formation 100, via the material production flow communicator 15, and into the production string 202.

**[0023]** The apparatus 10 further includes a material production flow controller 14 configured for controlling

flow communication between the housing passage 16 and the material production flow communicator 15. In some embodiments, for example, the material production flow controller 14 is a flow control member 14. In some embodiments, for example, the flow control member 14 is in the form of a sleeve that is slidable, relative to the flow communicator 15, within the housing passage 16. In some embodiments, for example, the flow control member 14 is configured for opening and closing the material injection flow communicator 15.

**[0024]** For each one of the flow communication stations 200A-E, the integration of the flow communication station into the production string 202 is with effect that the material production station 206 is disposed downhole relative to the material injection station 204.

**[0025]** Referring to Figures 2, 2A, 2B, and 2C, while the flow control member 14 is disposed in the closed position, the material production flow communicator is disposed in the closed condition. In some embodiments, for example, in the closed condition, the entirety, or the substantial entirety, of the material production flow communicator 15 is occluded by the flow control member 14. In some embodiments, for example, while the flow communicator 15 is disposed in a closed condition, there is an absence, or substantial absence of fluid communication between the passage 16 and the subterranean formation 100 via the material production flow communicator 15. In other words, fluid communication between the passage 16 and the subterranean formation 100 via the material production flow communicator 15 is prevented or substantially prevented. In some embodiments, for example, while the flow control member 14 is disposed in the closed position, a sealed interface is established, preventing, or substantially preventing, flow communication, via the material production flow communicator 15, between the surface 4 and the subterranean formation 100.

**[0026]** Referring to Figures 4, 4A, 4B, and 4C, while the flow control member 14 is disposed in the open position, flow communication, between the surface and the respective zone of the subterranean formation 100, is effected via the material production flow communicator 15. In some embodiments, for example, while the flow control member is disposed in the open position, the material production flow communicator 15 is disposed in an open condition. In some embodiments, for example, while the material production flow communicator 15 is disposed in the open condition, there is an absence of occlusion of any portion, or substantially any portion, of the material production flow communicator 15 by the flow control member 14; In some embodiments, for example, the disposition of the flow control member 14 in the open position is such that the entirety, or substantially the entirety, of the material production flow communicator 15 is non-occluded by the flow control member 14.

**[0027]** In some embodiments, for example, the flow control member 14 is displaceable from the closed position to the open position for effecting flow communication between the subterranean formation 100 and the pas-

sage 16 such that reservoir fluids are producible via the wellbore 102.

**[0028]** In some embodiments, for example, the flow control member 14 is displaceable from the open position to the closed position while fluids are being produced from the subterranean formation 100 through the material production flow communicator 15, and in response to sensing of a sufficiently high rate of water production from the subterranean formation 100 through the material production flow communicator 15. In such case, moving the flow control member 14 blocks further production through the material production flow communicator 15.

**[0029]** In some embodiments, for example, the flow control member 14 is displaceable along an axis that is parallel to the central longitudinal axis of the passage 16.

**[0030]** In some embodiments, for example, the housing 12 includes sealing surfaces 11A, 11B configured for sealing engagement with the flow control member 14 for effecting the sealed interface coincident with the flow communicator 15 being disposed in the closed condition. In this respect, in some embodiments, for example, the flow control member 14 includes sealing members 11AA, 11BB. The material production flow communicator 15 is disposed between the sealing surfaces 11A, 11B. In some embodiments, for example, when the flow control member 14 is disposed in a position corresponding to the closed position of the flow communicator 15, each one of the sealing members 11AA, 11BB, is, independently, disposed in sealing engagement with both of the housing 12 and the flow control member 14.

**[0031]** In some embodiments, for example, each one of the sealing members 11AA, 11BB, independently, includes an o-ring. In some embodiments, for example, the o-ring is housed within a recess formed within the flow control member 14. In some embodiments, for example, each one of the sealing members 11AA, 11BB, independently, includes a molded sealing member (i.e. a sealing member that is fitted within, and/or bonded to, a groove formed within the sub that receives the sealing member).

**[0032]** In some embodiments, for example, the flow control member 14 cooperates with the sealing surfaces 11A, 11B to effect opening and closing of the material production flow communicator 15. While the material production flow communicator 15 is disposed in the closed position, the flow control member 14 is sealingly engaged to both of the sealing surfaces 11A, 11B. While the material production flow communicator 15 is disposed in the open condition, the flow control member 14 is spaced apart or retracted from at least one of the sealing surfaces (referring to Figure 4, in the illustrated embodiment, this would be the sealing surface 11B), thereby providing a passage for reservoir material to be conducted to the passage 16 via the material production flow communicator 15.

**[0033]** In some embodiments, while disposed in the closed position, the flow control member 14 is releasably retained relative to the housing 12. In this respect, in some embodiments, for example, a retaining collet 22

extends from the housing 12, and is configured to engage the flow control member 14 for resisting a displacement of the flow control member. In some embodiments, for example, the retaining collet 22 includes at least one resilient flow control member-engaging collet finger 22A, and each one of the at least one flow control member-engaging collet finger includes a tab 22B that engages the flow control member. The flow control member 14 and the retaining collet 22 are co-operatively configured such that engagement of the flow control member 14 by the flow control member-engaging collet 22 is effected while the material production flow communicator 15 is disposed in the closed condition.

**[0034]** Referring to Figure 2, 2A, 2B, and 2C, while the flow control member 14 is disposed in the closed position (i.e. the material production flow communicator 15 is disposed in the closed condition) the retaining collet 22 is engaging the flow control member 14 such that interference or resistance is being effected to displacement of the flow control member 14, such that the flow control member 14 is releasably retained relative to the housing 12. The flow control member 14 includes a closed condition-defining recess 24. The at least one flow control member-engaging collet finger 22A and the recess 24 are co-operatively configured such that, while the flow control member-engaging collet finger tab 22B is disposed within the closed condition-defining recess 24, the flow control member 14 is disposed in the closed position. In order to effect a displacement of the flow control member 14, while the flow control member-engaging collet finger tab 22B is disposed within the closed condition-defining recess 24, a first displacement force is applied to the flow control member 14 to effect displacement of the tab 22B from (or out of) the recess 24. Such displacement is enabled due to the resiliency of the collet finger 22A. Once the flow control member-engaging collet finger tab 22B has become displaced out of the recess 24, continued application of force to the flow control member 14 (such as, in the embodiments illustrated in Figures 2, 2A, 2B, and 2C, in a downhole direction) effects displacement of the flow control member 14, relative to the material production flow communicator 15.

**[0035]** Similarly, in some embodiments, for example, while disposed in the open position, the flow control member 14 is releasably retained relative to the housing 12, such as, for example, by the retaining collet 22. In this respect, and referring to Figures 4, 4A, 4B, and 4C, while the flow control member 14 is disposed in the open position (i.e. the material production flow communicator 15 is disposed in the open condition), the retaining collet 22 is engaging the flow control member 14 such that interference or resistance is being effected to displacement of the flow control member 14, such that the flow control member 14 is releasably retained relative to the housing 12. The flow control member 14 includes an open condition-defining recess 26. The at least one flow control member-engaging collet finger 22A and the recess 26 are co-operatively configured such that, while the flow

control member-engaging collet finger tab 22B is disposed within the open condition-defining recess 26, the flow communicator 15 is disposed in the open condition. In order to effect a displacement of the flow control member 14, while the flow control member-engaging collet finger tab 22B is disposed within the open condition-defining recess 26, a second displacement force is applied to the flow control member 14 to effect displacement of the tab from (or out of) the recess 26. Such displacement is enabled due to the resiliency of the collet finger 22A. Once the flow control member-engaging collet finger tab 22B has become displaced out of the recess 26, continued application of the second displacement force to the flow control member 14 (such as, in the embodiment illustrated in Figure 2, in a downhole direction) effects displacement of the flow control member 14, relative to the material production flow communicator 15.

**[0036]** Referring to Figure 2, in some embodiments, for example, while the apparatus 10 is being deployed downhole, the flow control member 14 is maintained in the closed position, by one or more frangible interlocking members 30 (such as, for example, shear pins), such that the material production flow communicator 15 remains disposed in the closed condition while the deployment is occurring. The one or more frangible interlocking members 30 are provided to releasably retain the flow control member 14 to the housing 12 so that the passage 16 is maintained fluidically isolated from the subterranean formation 100 until it is desired to effect hydrocarbon production from the subterranean formation 100. In some embodiments, for example, the one or more frangible interlocking members 30 extends through apertures 14B provided in a centralizer portion 14A of the flow control member 14.

**[0037]** While the flow control member 14 is releasably retained to the housing by the one or more frangible interlocking members 30, the flow control member 14 is disposed in a retained position. To effect the fracturing of the frangible interlocking members 30 such that the flow control member 14 is displaceable relative to the material production flow communicator 15, sufficient force must be applied to the flow control member 14 such that the one or more frangible interlocking members 30 become fractured, resulting in the flow control member 14 becoming displaceable relative to the material production flow communicator 15.

**[0038]** In some embodiments, for example, while the flow control member 14 is retained relative to the housing 12 by the one or more frangible interlocking members 30, the flow control member 14 is positioned downhole relative to the space occupied by the flow control member 14 while disposed in the open position. In such embodiments, for example, the one or more frangible interlocking members 30 are configured for fracturing (such that the flow control member 14 is displaceable relative to the material production flow communicator 15) by application of a sufficient downhole force. Upon the fracturing of the one or more frangible interlocking members 30, contin-

ued application of the downhole force effects displacement of the flow control member 14 in a downhole direction. If the downhole force were permitted to continue to effect the displacement of the flow control member 14 in a downhole direction (such as, for example to effect opening of the material production flow communicator 15), the flow control member 14 would continue to accelerate, and attain a sufficiently high speed, such that, upon rapid deceleration of the flow control member 14 caused by an obstruction to its downhole displacement (such as by a hard stop), associated components become vulnerable to damage. In this respect, the displacement of the flow control member 14, relative to the flow communicator 15, in a downhole direction, that is effected after the fracturing of the one or more frangible interlocking members 30, is limited by a hard stop 32 that extends from the housing 12 and into the passage 16. The flow control member 14 and the hard stop 32 are co-operatively configured such that, while the flow control member 14 is disposed in abutting engagement with the hard stop 32 (i.e. the flow control member 14 is disposed in the downhole displacement-limited position), displacement of the flow control member 14 relative to the flow communicator 15, in the downhole direction, is prevented or substantially prevented by the hard stop 32. The flow control member, 14, while disposed in the releasably retained position by the one or more frangible interlocking members 30, and the hard stop 32 are co-operatively disposed such that the distance by which the flow control member 14 is displaced by the applied force, after its release from retention relative to the housing 12 by the one or more frangible interlocking members 30, is sufficiently short such that the speed attained by the flow control member 14, during the displacement of the flow control member 14 relative to the flow communicator 15, is sufficiently slow such that there is an absence of undesirable mechanical damage to associated components upon impact (i.e. the abutting engagement) of the hard stop 32 by the flow control member 14 (see Figures 3, 3A, 3B, and 3C). In this respect, In some embodiments, for example, the distance by which the flow control member 14 is displaced, relative to the flow communicator 15, between the retained position and the downhole-displacement limited position, as measured along the central longitudinal axis of the passage 16, is less than six (6) inches, such as less than three (3) inches, such as less than two (2) inches.

**[0039]** Relatedly, in those embodiments where the material production flow communicator 15 has a dimension, measured along an axis that is parallel to the central longitudinal axis of the passage 16, that is greater than the distance by which the flow control member 14 is displaced, relative to the flow communicator 15, from the secured position and the downhole displacement-limited position, as measured along the central longitudinal axis of the passage, in order to effect opening of the flow communicator 15 such that the flow communicator becomes disposed in the non-occluded condition (i.e. there is an absence, or substantial absence, of occlusion of any por-

tion of the flow communicator 15 by the flow control member 14), the displacement of the flow control member 14, relative to the flow communicator 15, from the retained position to the open position, is a displacement in the uphole direction. Otherwise, if such displacement of the flow control member 14, relative to the flow communicator 15, for effecting opening of the flow communicator 15 such that the flow communicator 15 becomes disposed in the non-occluded condition, were a displacement in the downhole direction, the hard stop 32 would need to, correspondingly, be positioned further downhole so as to permit sufficient downhole displacement of the flow control member 14 to effect the opening of the material production flow communicator 15. In such case, as a consequence, the speed attainable by the flow control member 14, while the downhole force continues to be applied (after the fracturing of the one or more frangible interlocking members 30) for effecting such displacement, is sufficiently high such that associated components are vulnerable to damage upon the flow control member 14 impacting (i.e. becoming disposed in abutting engagement with) the hard stop 32. Similar concerns about component damage are not present while displacing the flow control member 14, relative to the flow communicator 15, in an uphole direction, after having initially fractured the one or more frangible interlocking members 30 with an applied force in the downhole direction. This is because it is easier to maintain a lower applied force (such as, for example, a pulling up force applied to the workstring to which the shifting tool is coupled) to effect such uphole displacement, relative to the material production flow communicator 15, in these circumstances, relative to the above-described circumstances where the displacement of the flow control member 14, to effect opening of the material production flow communicator 15, is effected by a force that continues to be applied after having effected the fracturing of the one or more frangible interlocking members 30.

**[0040]** In some embodiments, for example, a dimension of the material production flow communicator 15, measured along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, is at least one (1) foot, such as, for example, at least three (3) feet, such as, for example, at least five (5) feet, or such as, for example, at least eight (8) feet. In some embodiments, for example, a dimension of the material production flow communicator 15, measured along an axis that is parallel to the central longitudinal axis of the passage 16, is ten (10) feet. Relatedly, the minimum distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the retained position, wherein the displacement is with effect that the flow communicator 15 becomes disposed in the non-occluded condition, is at least one (1) foot, such as, for example, at least three (3) feet, such as, for example, at least five (5) feet, or such as, for ex-

ample, at least eight (8) feet, and, in some embodiments, for example, is ten (10) feet. Also relatedly, the minimum distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the retained position, wherein the displacement is with effect that the entirety, or the substantial entirety, of the flow communicator 15 is non-occluded by the flow control member 14, is at least one (1) foot, such as, for example, at least three (3) feet, such as, for example, at least five (5) feet, or such as, for example, at least eight (8) feet, and, in some embodiments, for example, is ten (10) feet. Also relatedly, the distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the closed position, wherein the displacement is with effect that the flow communicator 15 becomes disposed in the non-occluded condition, is at least one (1) foot, such as, for example, at least three (3) feet, such as, for example, at least five (5) feet, or such as, for example, at least eight (8) feet, and, in some embodiments, for example, is ten (10) feet. Also relatedly, the distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the closed position, wherein the displacement is with effect that the entirety, or the substantial entirety, of the flow communicator 15 is non-occluded by the flow control member 14, is at least one (1) foot, such as, for example, at least three (3) feet, such as, for example, at least five (5) feet, or such as, for example, at least eight (8) feet, and, in some embodiments, for example, is ten (10) feet. Also relatedly, the distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the position at which the flow control member 14 is disposed while in abutting engagement with the hard stop 32, wherein the displacement is with effect that the flow communicator 15 becomes disposed in the non-occluded condition, is at least 14 inches, such as, for example, at least 38 inches, such as, for example, at least 62 inches, or such as, for example, at least 98 inches, and, in some embodiments, for example, is 122 inches. Also relatedly, the distance, by which the flow control member 14 is displaced (in the uphole direction), relative to the flow communicator 15, along an axis that is parallel, or substantially parallel, to the central longitudinal axis of the passage 16, from the position at which the flow control member 14 is disposed while in abutting engagement with the hard stop 32, wherein the displacement is with effect that the entirety, or the substantial entirety, of the flow communicator 15 is non-occluded by the flow control member 14, is at least 14 inches, such as, for

example, at least three (3) feet, such as, for example, at least 62 inches, or such as, for example, at least 98 inches, and, in some embodiments, for example, is 122 inches.

**[0041]** Referring to Figures 4, 4A, 4B, and 4C, in some embodiments, for example, the apparatus 10 includes a hard stop 34 for limiting displacement of the flow control member 14, in an uphole direction, relative to the material production flow communicator 15. In this respect, when disposed in abutting engagement with the hard stop 34, the flow control member 14 is disposed in the open position. In this respect, the hard stop 34 determines the open position of the flow control member 14.

**[0042]** In some embodiments, for example, all of the displacement forces are imparted by a shifting tool, and the shifting tool is integrated within a bottom hole assembly 208 that includes other functionalities. The bottom-hole assembly may be deployed within the wellbore on a workstring. Suitable workstrings include tubing string, wireline, cable, or other suitable suspension or carriage systems. Suitable tubing strings include jointed pipe, concentric tubing, or coiled tubing. The workstring includes a passage, extending from the surface, and disposed in, or disposable to assume, fluid communication with the fluid conducting structure of the tool. The workstring is coupled to the bottomhole assembly such that forces applied to the workstring are translated to the bottomhole assembly to actuate movement of the flow control member 14. All of the displacement forces are impartable in such embodiments by a shifting tool that is actuable by a workstring because, for amongst other reasons, each one of the first, second, and third positions are determined by a respective hard stop, and which, therefore, facilitates the positioning of the flow control member 14 such that positioning of flow control member is not entirely dependent on the manipulation of the shifting tool.

**[0043]** The flow communication stations 200A-E and the wellbore space sections 104A-E are co-operatively configured such that, for each one of the flow communication stations 200A-E, independently,:

(i) the flow communication station is disposed in flow communication with a respective zone of the subterranean formation 100 via the respective wellbore space section, and

(ii) flow communication between the respective wellbore space section and the other ones of the wellbore space sections 104A-E is sealed or substantially sealed such that:

(a) stimulation material, that is being injected from the material injection station 204 of a flow communication station and into the wellbore space section, is prevented, or substantially prevented, from bypassing the respective zone of the subterranean formation 100; and

(b) hydrocarbon material, that is being received

within the respective wellbore space section from the respective zone of the subterranean formation 100, is prevented, or substantially prevented, from bypassing the material production station 206.

**[0044]** In some embodiments, for example, the wellbore is a cased-hole completion.

**[0045]** In some embodiments, for example, the wellbore 102 includes a cased-hole completion. A cased-hole completion involves running casing down into the wellbore 102 through the production zone. The casing 106 at least contributes to the stabilization of the subterranean formation 100 after the wellbore 102 has been completed, by at least contributing to the prevention of the collapse of the subterranean formation 100 that is defining the wellbore 102. In some embodiments, for example, the casing 106 includes one or more successively deployed concentric casing strings, each one of which is positioned within the wellbore 102, having one end extending from the well head 50. In this respect, the casing strings are typically run back up to the surface. In some embodiments, for example, each casing string includes a plurality of jointed segments of pipe. The jointed segments of pipe typically have threaded connections.

**[0046]** The annular region between the deployed casing 106 and the subterranean formation 100 may be filled with zonal isolation material for effecting zonal isolation. The zonal isolation material is disposed between the casing 106 and the subterranean formation 100 for the purpose of effecting isolation, or substantial isolation, of one or more zones of the subterranean formation 100 from fluids disposed in another zone of the subterranean formation 100. Such fluids include formation fluid being produced from another zone of the subterranean formation 100 (in some embodiments, for example, such formation fluid being flowed through a production string 202 disposed within and extending through the casing 106 to the surface), or injected stimulation material. In this respect, in some embodiments, for example, the zonal isolation material is provided for effecting sealing, or substantial sealing, of flow communication between one or more zones of the subterranean formation 100 and one or more others zones of the subterranean formation 100 via space between the casing 106 and the subterranean formation 100. By effecting the sealing, or substantial sealing, of such flow communication, isolation, or substantial isolation, of one or more zones of the subterranean formation 100, from another subterranean zone (such as a producing formation) via the is achieved. Such isolation or substantial isolation is desirable, for example, for mitigating contamination of a water table within the subterranean formation 100 by the formation fluids (e.g. oil, gas, salt water, or combinations thereof) being produced, or the above-described injected fluids.

**[0047]** In some embodiments, for example, the zonal isolation material is disposed as a sheath within an annular region between the casing 106 and the subterra-

nean formation 100. In some embodiments, for example, the zonal isolation material is bonded to both of the casing 106 and the subterranean formation 100. In some embodiments, for example, the zonal isolation material also provides one or more of the following functions: (a) strengthens and reinforces the structural integrity of the wellbore, (b) prevents, or substantially prevents, produced formation fluids of one zone from being diluted by water from other zones. (c) mitigates corrosion of the casing 106, and (d) at least contributes to the support of the casing 106. The zonal isolation material is introduced to an annular region between the casing 106 and the subterranean formation 100 after the subject casing 106 has been run into the wellbore 102. In some embodiments, for example, the zonal isolation material includes cement.

**[0048]** In those embodiments where the wellbore is a cased-hole completion and the production string 202 is spaced apart from the casing 106 such that the wellbore space is established, the casing 106 is perforated for effecting flow communication between the flow communication stations 200A-E and the subterranean formation 100. In this respect, a plurality of perforations 110 extend from the wellbore space, through the casing 106, and into the subterranean formation 100, and flow communication between the flow communication stations 200A-E and the subterranean formation 100 is effected via the wellbore space 104 and the perforations 100.

**[0049]** In this respect, the flow communication stations 200A-E, the wellbore space sections 104A-E, and the perforations are co-operatively configured such that, for each one of the flow communication stations 200A-E, independently,:

(i) the flow communication station is disposed in flow communication with the respective zone of the subterranean formation 100 via the respective wellbore space section and a respective one or more perforations 100, and

(ii) flow communication between the respective wellbore space section and the other ones of the wellbore space sections 104A-E is sealed or substantially sealed such that:

(a) stimulation material, that is being injected from the material injection station 204 of a flow communication station and into the wellbore space section, is prevented, or substantially prevented, from bypassing the respective zone of the subterranean formation 100; and

(b) hydrocarbon material, that is being received within the respective wellbore space section from the respective zone of the subterranean formation 100, is prevented, or substantially prevented, from bypassing the material production station 206.

**[0050]** In some embodiments, for example, the sealing, or substantial sealing, of the flow communication is effected by disposing sealing members, such as packers 108A-F, between adjacent ones of the wellbore space sections 104A-E.

**[0051]** In some embodiments, for example, for each one of the flow communication stations 200A-E, independently, the material production station 206 is disposed in alignment, or substantial alignment, with the respective one or more perforations 110.

**[0052]** In one aspect, a hydrocarbon material production process is implemented via the system 100.

**[0053]** Referring to Figures 6 to 9, the process includes, for each one of the flow communication stations 200A-E, in succession in the uphole direction from the furthest downhole-disposed flow communication station, forming a frac pack between the one or more perforations and the material production flow communication 15. The frac pack, amongst other things, mitigates production of fine particulate matter. The forming of a frac pack includes:

opening the material injection flow communicator 2048 by displacing the material injection flow controller 2050, relative to the material injection flow communicator 2048, from the closed position to the open position with a shifting tool;

while the material injection flow communicator 2048 is disposed in the open condition, injecting stimulation material, including proppant, from the surface 4 and into the subterranean formation 100, via the production string 202, the material injection flow communicator 2048, the wellbore space, and the one or more perforations 110 (see Figure 7), with effect that hydraulic fracturing of a hydrocarbon material-containing reservoir within the subterranean formation 100;

continuing to inject the stimulation material with effect that a screen out is obtained, with effect that the frac pack 212 is obtained within the wellbore space section, between the one or more perforations and the material production flow communicator (see Figure 7);

**[0054]** In some embodiments, for example, after the frac pack has been obtained, the stimulation material that has accumulated within the production string 202 is cleaned out, such as, for example, by circulating fluid within the wellbore between the surface and the flow communication station (see Figure 8).

**[0055]** In some embodiments, for example, a sealed interface 210 is disposed within the production string 202, downhole relative to the material injection flow communicator 2048. In some embodiments, for example, the sealed interface 210 is provided for preventing, or substantially preventing, bypassing of the material injection

flow communicator 2048, by stimulation material injected from the surface 4.

**[0056]** In some embodiments, for example, the sealed interface 210 is disposed uphole relative to the material production flow communicator 15. In this respect, in some of these embodiments, for example, prior to the producing (see below), the sealed interface 210 is defeated.

**[0057]** In some embodiments, for example, the sealed interface 210 is established, at least in part, with a packer, such as, for example, a packer that is deployed with a bottomhole assembly.

**[0058]** In some embodiments, for example, for each one of the flow communication stations 200A-E, independently, the injection of the stimulation material is effected while the material production flow communicator 15 is disposed in the closed condition.

**[0059]** In some embodiments, for example, after the frac pack has been obtained, and prior to forming a frac pack for the next uphole one of the flow communication stations 200A-E, the material injection flow communicator 2048 is closed by displacement of the material injection flow controller 2050 relative to the flow communicator 2048 with effect that the flow communicator 2048 becomes occluded by the flow controller 2050. In some embodiments, for example, such closing of the flow communicator 2048 enables the cleaning out of the injected stimulation material, as above-described.

**[0060]** After the frac pack 212 has been obtained for each one of the flow communication stations 200A-E, as above-described, for each one of the flow communication stations 200A-E, independently, and in succession, and while: (i) the material injection flow communicator 2048 is disposed in a closed condition, and (ii) the sealed interface 210 has been removed/defeated, the flow control member 14 is displaced for effecting opening of the material production flow communicator 15, to thereby effect production, via the production string 202, of hydrocarbon material from the subterranean formation 100 (see Figure 9). In such case, the hydrocarbon material, prior to entering the production string 202, is conducted through the obtained frac pack, thereby effecting removal of some solid particulate matter from the hydrocarbon material before its entry into the production string 202.

**[0061]** Referring to Figures 10 to 13, in another aspect, another hydrocarbon material production process is provided for implementation with the system 100. In this respect, the process includes:

opening the material injection flow communicator 2048 by displacing the material injection flow controller 2050 relative to the material injection flow communicator 2048;

while the material injection flow communicator 2048 is disposed in the open condition, injecting stimulation material 300, including proppant entrained within a fluid, from the surface and into the subterranean formation 100, via the wellbore string 202, the ma-

terial injection flow communicator 2048, and the wellbore space, such that hydraulic fracturing of a hydrocarbon material-containing reservoir of the subterranean formation 100 is effected (see Figure 11);

suspending the injection of the stimulation material;

after the suspending of the injection of the stimulation material, partially opening the material production flow communicator 15 by displacing the material production flow controller 14 relative to the material production flow communicator 15, such that:

(i) an uphole-disposed portion 15A of the material production flow communicator is occluded by the material production flow controller 14; and

(ii) flow communication is effected between the subterranean formation 100 and the wellbore string 202 via a downhole-disposed portion 15B of the material production flow communicator 15, such that reservoir material is conducted from the subterranean formation 100 and into the wellbore string 202 via the downhole-disposed portion 15B of the material production flow communicator 15 in response to a pressure differential between the subterranean formation 100 and the wellbore string 202, and such that solid particulate material, entrained within the conducted reservoir material, separates from the conducted reservoir material and accumulates within the wellbore space 200, that is disposed between the subterranean formation and the material production flow communicator, and at least contributes to formation of a solid particulate material-containing filtering medium 120 (see Figure 12); wherein the downhole-disposed portion 15B of the material production flow communicator 15 is disposed downhole relative to the uphole-disposed portion 15A of the material production flow communicator 15; and

after the formation of a solid particulate material-containing filtering medium 120, increasing the percentage opening of the material production flow communicator 15 by displacing the material production flow controller 14 relative to the material production flow communicator 15 such that a production mode material production flow communicator 15C is established, with effect that reservoir material is conducted from the subterranean formation to the wellbore string 202 via the solid particulate material-containing filtering medium 120 and the production mode material production flow communicator 15C (see Figure 13).

**[0062]** The reservoir material 400, including hydrocarbon material, that is received within the wellbore string 202 is produced to the surface.

**[0063]** In some embodiments, for example, the partial opening of the flow communicator 15 is such that the fluid velocity and pressure differential between the reservoir and the wellbore string 202 will transport material from the reservoir to the filter through natural flowback. In some embodiments, for example, the flowback velocity is controlled through open flow area of the material production flow communicator 15 so as to not exceed the erosional fluid velocity limits on the flow communicator 15 while exceeding the transport velocity required to deposit materials around the material production flow communicator 15. Both cases are governed by the magnitude of reservoir pressure present.

**[0064]** In some embodiments, for example, the solid particulate material-containing filtering medium 120 includes solid particulate material that has accumulated during the injection of stimulation material.

**[0065]** In some embodiments, for example, the partial opening of the material production flow communicator 15 is with effect that the uphole-disposed portion 15A, of the material production flow communicator 15 that is being occluded by the flow controller 14, defines at least 50% of the total cross-sectional flow area of the material production flow communicator 15, such as, for example, at least 75% of the total cross-sectional flow area of the material production flow communicator 15. In some embodiments, for example, the increasing of the percentage opening of the material production flow communicator 15 is with effect that the material production flow communicator 15 is disposed in the non-occluded condition.

**[0066]** In some embodiments, for example, the injection of the stimulation material is effected while the material production flow communicator 15 is disposed in the closed condition. In some embodiments, for example, the injection of the stimulation material is effected while a sealed interface 204 is disposed within the wellbore string 202, downhole relative to the material injection flow communicator 2048.

**[0067]** In some embodiments, for example, where there is a sealed interface 204 disposed uphole relative to the material production flow communicator 15, after the formation of a solid particulate material-containing filtering medium 120, and prior to the increasing of the percentage opening of the material production flow communicator 15, the sealed interface is defeated 204 (for example, a packer is unset).

**[0068]** In some embodiments, for example, prior to the partial opening of the material production flow communicator 15, the material injection flow communicator 2048 is closed by displacing the flow controller 2050 relative to the material injection flow communicator and thereby occluding the material injection flow communicator 2048.

**[0069]** In some embodiments, for example, displacement of one, or both, of the flow control members 250, 14, in the downhole direction, is effectible with a shifting

tool, by actuating a bottomhole assembly including a shifting tool and a suitable sealing member (e.g. packer), such that the shifting tool becomes disposed in gripping engagement with the second flow control member 216 and a suitable sealed interface is established, and applying a fluid pressure differential across the sealed interface with effect that the resulting force, being applied in a downhole direction, is translated by the shifting tool to the flow control member 216. In those embodiments where the flow control member is being maintained in the closed position, by one or more frangible interlocking members, in some of these embodiments, for example, the translated force is sufficient to effect fracturing of the frangible interlocking members, and thereby effect release of the flow control member from the housing such that the flow control member is displaceable relative to the flow communicator, such as by continued application of the translated force. In those embodiments where the flow control member is releasably retained relative to the housing (such as, for example, in the closed position) by a collet retainer, the translated force is sufficient to effect displacement of the collet retainer such that the flow control member becomes released relative to the housing.

**[0070]** In some embodiments, for example, displacement of one, or both, of the flow control members 250, 14, in the uphole direction, is effectible with a shifting tool, by actuating a bottomhole assembly including a shifting tool, such that the shifting tool becomes disposed in gripping engagement with the second flow control member 216 is established, and applying a tensile force (a force applied in the uphole direction) to a workstring, with effect that the applied tensile force (e.g. pulling up force) is translated by the shifting tool to the flow control member 216. In those embodiments where the flow control member is releasably retained relative to the housing (such as, for example, in the open position) by a collet retainer, the translated force is sufficient to effect displacement of the collet retainer such that the flow control member becomes released relative to the housing.

**[0071]** In some embodiments, for example, the above-described displacements are effected by the same shifting tool. In some embodiments, for example, an exemplary shifting tool, for effecting the above-described displacements, is the SHIFT FRAC CLOSE™ tool available from NCS Multistage Inc. In some embodiments, for example, the bottomhole assembly 208 is any one of the embodiments of a bottomhole assembly described in U.S. Patent Publication No. 2016/0251939 A1.

**[0072]** In the above description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the present disclosure. Although certain dimensions and materials are described for implementing the disclosed example embodiments, other suitable dimensions and/or materials may be used within the scope of this disclosure. All such modifications and variations, including all suitable

ble current and future changes in technology, are believed to be within the sphere and scope of the present disclosure.

## Claims

1. A hydrocarbon production process, implemented via a system (2) including a wellbore string (202) disposed within a wellbore (102) extending into a subterranean formation (100), wherein the wellbore string includes a material injection station (204) and a material production station (206), wherein the material production station is disposed downhole relative to the material injection station, wherein the material injection station includes a material injection flow controller (2050) for modulating a flow communication condition of a material injection flow communicator (2048) that is disposed in flow communication with the subterranean formation via a wellbore space (104), and the material production station includes a material production flow controller (14) for modulating a flow communication condition of a material production flow communicator (15) that is disposed in flow communication with the subterranean formation via the wellbore space (104), wherein the material production flow communicator (15) includes a filter medium (15AA) for preventing oversize particulate material from entering the wellbore string, comprising:

opening the material injection flow communicator (2048) by displacing the material injection flow controller (2050) relative to the material injection flow communicator (2048);

while the material injection flow communicator (2048) is disposed in the open condition, injecting stimulation material, including proppant entrained within a fluid, from the surface and into the subterranean formation, via the wellbore string, the material injection flow communicator (2048), and the wellbore space, such that hydraulic fracturing of a hydrocarbon material-containing reservoir of the subterranean formation is effected;

suspending the injection of the stimulation material;

after the suspending of the injection of the stimulation material, partially opening the material production flow communicator (15) by displacing the material production flow controller (14) relative to the material production flow communicator (15), such that:

- (i) an uphole-disposed portion (15A) of the material production flow communicator (15) is occluded by the material production flow controller (14); and

(ii) flow communication is effected between the subterranean formation and the wellbore string via a downhole-disposed portion (15B) of the material production flow communicator (15), such that reservoir material is conducted from the subterranean formation and into the wellbore string via the downhole-disposed portion (15B) of the material production flow communicator (15) in response to a pressure differential between the subterranean formation and the wellbore string, and such that solid particulate material, entrained within the conducted reservoir material, separates from the conducted reservoir material and accumulates within the wellbore space (104), that is disposed between the subterranean formation and the material production flow communicator (15), and at least contributes to formation of a solid particulate material-containing filtering medium (120);

wherein the downhole-disposed portion (15B) of the material production flow communicator (15) is disposed downhole relative to the uphole-disposed portion (15A) of the material production flow communicator (15);

and

after the formation of a solid particulate material-containing filtering medium (120), increasing the percentage opening of the material production flow communicator (15) by displacing the material production flow controller (14) relative to the material production flow communicator (15) such that a production mode material production flow communicator (15C) is established, with effect that reservoir material is conducted from the subterranean formation and into the wellbore string via the solid particulate material-containing filtering medium (120) and the production mode material production flow communicator (15C).

2. The process as claimed in claim 1; wherein the partial opening of the material production flow communicator (15) is with effect that the uphole-disposed portion (15A), of the material production flow communicator (15) that is being occluded by the flow controller (14), defines at least 50% of the total cross-sectional flow area of the material production flow communicator (15).
3. The process as claimed in claim 1; wherein the partial opening of the material production flow communicator (15) is with effect that the uphole-disposed portion (15A), of the material production flow communicator (15) that is being occluded

ed by the flow controller (14), defines at least 75% of the total cross-sectional flow area of the material production flow communicator (15).

4. The process as claimed in any one of claims 1 to 3; wherein the increasing of the percentage opening of the material production flow communicator (15) is with effect that the material production flow communicator (15) is disposed in the non-occluded condition.

5. The process as claimed in any one of claims 1 to 3; wherein solid particulate material-containing filtering medium (120) includes solid particulate material that has accumulated during the injection of stimulation material.

6. The process as claimed in any one of claims 1 to 5; wherein the injection of the stimulation material is effected while the material production flow communicator (15) is disposed in the closed condition.

7. The process as claimed in any one of claims 1 to 6; wherein the injection of the stimulation material is effected while a sealed interface (210) is disposed within the wellbore string, downhole relative to the material injection flow communicator (2048).

8. The process as claimed in claim 7;

wherein the sealed interface (210) is disposed uphole relative to the material production flow communicator (15);  
and further comprising:  
after the formation of a solid particulate material-containing filtering medium (120), and prior to the increasing of the percentage opening of the material production flow communicator (15), defeating the sealed interface (210).

9. The process as claimed in any one of claims 1 to 8, further comprising:  
prior to the partial opening of the material production flow communicator (15), closing the material injection flow communicator (2048).

10. The process as claimed in any one of claims 1 to 9; wherein:

the displacing of the material injection flow controller (2050), relative to the material injection flow communicator (2048), is effected by a shifting tool; and  
the displacing of the material production flow controller (14), relative to the material production flow communicator (15), is effected by a shifting tool.

11. The process as claimed in any one of claims 1 to 9; wherein both of:

- (i) the displacing of the material injection flow controller (2050) relative to the material injection flow communicator (2048); and  
(ii) the displacing of the material production flow controller (14) relative to the material production flow communicator (15);  
is effected by the same shifting tool.

12. The process as claimed in any one of claims 1 to 10; wherein:

the material injection flow controller (2050) includes a sleeve; and  
the material production flow controller (14) includes a sleeve

13. The process as claimed in any one of claims 1 to 12; wherein:

the partial opening of the flow communicator (15) is such that the fluid velocity and pressure differential between the subterranean formation and the wellbore string will transport material from the subterranean formation via natural flowback.

14. The process as claimed in any one of claims 1 to 13; wherein the filter medium (15AA) is configured for preventing, or substantially preventing, passage of +100 mesh proppant from the subterranean formation, via the material production flow communicator (15), and into the wellbore string.

15. The process as claimed in any one of claims 1 to 14; wherein the filter medium (15AA) includes a wire screen.

#### Patentansprüche

1. Kohlenwasserstoffförderverfahren, das über ein System (2) umgesetzt ist, das einen Bohrlochstrang (202) beinhaltet, der innerhalb eines Bohrlochs (102) angeordnet ist, das sich in eine unterirdische Formation (100) erstreckt, wobei der Bohrlochstrang eine Materialeinspritzstation (204) und eine Materialherstellungstation (206) beinhaltet, wobei die Materialförderstation im Bohrloch relativ zu der Materialeinspritzstation angeordnet ist, wobei die Materialeinspritzstation eine Materialeinspritzströmungssteuerung (2050) zum Modulieren eines Strömungskommunikationszustands einer Materialeinspritzströmungskommunikationseinrichtung (2048) beinhaltet, die über einen Bohrlochraum (104) in Strömungskommunikation mit der unterirdischen Formation angeordnet ist, und die Materialförderstation eine Materialförderströmungssteuerung

rung (14) zum Modulieren eines Strömungskommunikationszustands einer Materialförderströmungskommunikationseinrichtung (15) umfasst, die über den Bohrlochraum (104) in Strömungskommunikation mit der unterirdischen Formation angeordnet ist, wobei die Materialförderströmungskommunikationseinrichtung (15) ein Filtermedium (15AA) zum Verhindern beinhaltet, dass übergroßes partikelförmiges Material in den Bohrlochstrang eintritt, umfassend:

Öffnen der Materialeinspritzströmungskommunikationseinrichtung (2048) durch Verschieben der Materialeinspritzströmungssteuerung (2050) relativ zu der Materialeinspritzströmungskommunikationseinrichtung (2048); während die Materialeinspritzströmungskommunikationseinrichtung (2048) im offenen Zustand angeordnet ist, derartiges Einspritzen von Stimulationsmaterial, das Stützmittel beinhaltet, das in einem Fluid mitgeführt wird, von der Oberfläche und in die unterirdische Formation über den Bohrlochstrang, die Materialeinspritzströmungskommunikationseinrichtung (2048) und den Bohrlochraum, dass ein hydraulisches Brechen einer Kohlenwasserstoffmaterial enthaltenden Lagerstätte der unterirdischen Formation bewirkt wird; Unterbrechen der Einspritzung des Stimulationsmaterials; nach dem Unterbrechen der Einspritzung des Stimulationsmaterials, teilweises Öffnen der Materialförderströmungskommunikationseinrichtung (15) durch derartiges Verschieben der Materialförderströmungssteuerung (14) relativ zur Materialförderströmungskommunikationseinrichtung (15), dass:

- (i) ein übertägig angeordneter Abschnitt (15A) der Materialförderströmungskommunikationseinrichtung (15) durch die Materialförderströmungssteuerung (14) verstopft ist; und
- (ii) eine Strömungskommunikation zwischen der unterirdischen Formation und dem Bohrlochstrang über einen im Bohrloch angeordneten Abschnitt (15B) der Materialförderströmungskommunikationseinrichtung (15) derartig bewirkt wird, dass Lagerstättenmaterial von der unterirdischen Formation und in den Bohrlochstrang über den im Bohrloch angeordneten Abschnitt (15B) der Materialförderströmungskommunikationseinrichtung (15) als Reaktion auf eine Druckdifferenz zwischen der unterirdischen Formation und dem Bohrlochstrang geleitet wird, und derartig, dass sich festes partikelförmiges Material,

das in dem geleiteten Lagerstättenmaterial mitgeführt wird, von dem geleiteten Lagerstättenmaterial trennt und sich innerhalb des Bohrlochraums (104) sammelt, der zwischen der unterirdischen Formation und der Materialförderströmungskommunikationseinrichtung (15) angeordnet ist, und mindestens zur Bildung eines festes partikelförmiges Material enthaltenden Filtermediums (120) beiträgt;

wobei der im Bohrloch angeordnete Abschnitt (15B) der Materialförderströmungskommunikationseinrichtung (15) im Bohrloch relativ zu dem übertägig angeordneten Abschnitt (15A) der Materialförderströmungskommunikationseinrichtung (15) angeordnet ist; und nach der Bildung eines festes partikelförmiges Material enthaltenden Filtermediums (120), Erhöhen der prozentualen Öffnung der Materialförderströmungskommunikationseinrichtung (15) durch derartiges Verschieben der Materialförderströmungssteuerung (14) relativ zu der Materialförderströmungskommunikationseinrichtung (15), dass eine Fördermodusmaterialförderströmungskommunikationseinrichtung (15C) eingerichtet wird, mit der Wirkung, dass Lagerstättenmaterial von der unterirdischen Formation und in den Bohrlochstrang über das festes partikelförmiges Material enthaltende Filtermedium (120) und die Fördermodusmaterialförderströmungskommunikationseinrichtung (15C) geleitet wird.

2. Verfahren nach Anspruch 1; wobei das teilweise Öffnen der Materialförderströmungskommunikationseinrichtung (15) bewirkt, dass der übertägig angeordnete Abschnitt (15A) der Materialförderströmungskommunikationseinrichtung (15), die durch die Strömungssteuerung (14) verstopft wird, mindestens 50 % der gesamten Strömungsquerschnittsfläche der Materialförderströmungskommunikationseinrichtung (15) definiert.
3. Verfahren nach Anspruch 1; wobei das teilweise Öffnen der Materialförderströmungskommunikationseinrichtung (15) bewirkt, dass der übertägig angeordnete Abschnitt (15A) der Materialförderströmungskommunikationseinrichtung (15), die durch die Strömungssteuerung (14) verstopft wird, mindestens 75 % der gesamten Strömungsquerschnittsfläche der Materialförderströmungskommunikationseinrichtung (15) definiert.

mungskommunikationseinrichtung (15) definiert.

4. Verfahren nach einem der Ansprüche 1 bis 3;  
wobei das Erhöhen der prozentualen Öffnung der  
Materialförderströmungskommunikationseinrich-  
tung (15) bewirkt, dass die Materialförderströ-  
mungskommunikationseinrichtung (15) in dem nichtver-  
schlossenen Zustand angeordnet ist.

5. Verfahren nach einem der Ansprüche 1 bis 3;  
wobei das festes partikelförmiges Material enthal-  
tende Filtermedium (120) festes partikelförmiges  
Material beinhaltet, das sich während der Einsprit-  
zung von Stimulationsmaterial angesammelt hat.

6. Verfahren nach einem der Ansprüche 1 bis 5;  
wobei die Einspritzung des Stimulationsmaterials er-  
folgt, während die Materialförderströmungskommuni-  
kationseinrichtung (15) in dem geschlossenen Zu-  
stand angeordnet ist.

7. Verfahren nach einem der Ansprüche 1 bis 6;  
wobei die Einspritzung des Stimulationsmaterials er-  
folgt, während eine abgedichtete Schnittstelle (210)  
innerhalb des Bohrlochstrangs im Bohrloch relativ  
zu der Materialeinspritzströmungskommunikati-  
onseinrichtung (2048) angeordnet ist.

8. Verfahren nach Anspruch 7;

wobei die abgedichtete Schnittstelle (210) über-  
tägig relativ zu der Materialförderströmungs-  
kommunikationseinrichtung (15) angeordnet ist;  
und ferner umfassend:  
nach der Bildung eines festes partikelförmiges  
Material enthaltenden Filtermediums (120) und  
vor dem Erhöhen der prozentualen Öffnung der  
Materialförderströmungskommunikationsein-  
richtung (15), Überwinden der abgedichteten  
Schnittstelle (210).

9. Verfahren nach einem der Ansprüche 1 bis 8, ferner  
umfassend:  
vor dem teilweisen Öffnen der Materialförderströ-  
mungskommunikationseinrichtung (15), Schließen  
der Materialeinspritzströmungskommunikationsein-  
richtung (2048).

10. Verfahren nach einem der Ansprüche 1 bis 9;  
wobei:

das Verschieben der Materialeinspritzströ-  
mungssteuerung (2050) relativ zu der  
Materialeinspritzströmungskommunikati-  
onseinrichtung (2048) durch ein Verschiebe-  
werkzeug erfolgt; und  
das Verschieben der Materialförderströ-  
mungssteuerung (14) relativ zu der Materialförderströ-

mungskommunikationseinrichtung (15) durch  
ein Verschiebewerkzeug erfolgt.

11. Verfahren nach einem der Ansprüche 1 bis 9;  
wobei sowohl:

(i) das Verschieben der Materialeinspritzströ-  
mungssteuerung (2050) relativ zu der  
Materialeinspritzströmungskommunikati-  
onseinrichtung (2048); als auch  
(ii) das Verschieben der Materialförderströ-  
mungssteuerung (14) relativ zu der  
Materialförderströmungskommunikationsein-  
richtung (15);  
durch dasselbe Verschiebewerkzeug erfolgt.

12. Verfahren nach einem der Ansprüche 1 bis 10;  
wobei:

die Materialeinspritzströmungssteuerung  
(2050) eine Hülse beinhaltet; und  
die Materialförderströmungssteuerung (14) ei-  
ne Hülse beinhaltet.

13. Verfahren nach einem der Ansprüche 1 bis 12;  
wobei:

das teilweise Öffnen der Strömungskommuni-  
kationseinrichtung (15) derartig abläuft, dass die Fluid-  
geschwindigkeit und der Druckunterschied zwi-  
schen der unterirdischen Formation und dem Bohr-  
lochstrang Material aus der unterirdischen Formati-  
on über eine natürliche Rückströmung transportie-  
ren.

14. Verfahren nach einem der Ansprüche 1 bis 13;  
wobei das Filtermedium (15AA) zum Verhindern  
oder im Wesentlichen Verhindern des Durchgangs  
von +100 Maschenstützmittel aus der unterirdischen  
Formation über die Materialförderströmungskom-  
munikationseinrichtung (15) und in den Bohrloch-  
strang konfiguriert ist.

15. Verfahren nach einem der Ansprüche 1 bis 14;  
wobei das Filtermedium (15AA) ein Drahtgitter be-  
inhaltet.

## Revendications

1. Procédé de production d'hydrocarbures, mis en œu-  
vre par l'intermédiaire d'un système (2) comportant  
une colonne de puits de forage (202) disposée dans  
un puits de forage (102) s'étendant dans une forma-  
tion souterraine (100), dans lequel la colonne de  
puits de forage comporte une station d'injection de  
matériau (204) et une station de production de ma-  
tériau (206), dans lequel la station de production de  
matériau est disposée en fond de trou par rapport à

la station d'injection de matériau, dans lequel la station d'injection de matériau comporte un dispositif de commande de flux d'injection de matériau (2050) pour moduler une condition de communication fluide d'un communicateur de flux d'injection de matériau (2048) qui est disposé en communication fluide avec la formation souterraine par l'intermédiaire d'un espace de puits de forage (104), et la station de production de matériau comporte un dispositif de commande de flux de production de matériau (14) pour moduler une condition de communication fluide d'un communicateur de flux de production de matériau (15) qui est disposé en communication fluide avec la formation souterraine par l'intermédiaire de l'espace de puits de forage (104), dans lequel le communicateur de flux de production de matériau (15) comporte un milieu filtrant (15AA) pour empêcher le matériau particulaire surdimensionné d'entrer dans la colonne de puits de forage, comprenant :

l'ouverture du communicateur de flux d'injection de matériau (2048) en déplaçant le dispositif de commande de flux d'injection de matériau (2050) par rapport au communicateur de flux d'injection de matériau (2048) ;

pendant que le communicateur de flux d'injection de matériau (2048) est disposé en position ouverte, l'injection d'un matériau de stimulation, comportant un agent de soutènement entraîné dans un fluide, depuis la surface et dans la formation souterraine, par l'intermédiaire de la colonne de puits de forage, le communicateur de flux d'injection de matériau (2048), et l'espace du puits de forage, de sorte que la fracturation hydraulique d'un réservoir du matériau hydrocarboné de la formation souterraine soit effectuée ;

la suspension de l'injection du matériel de stimulation ;

après la suspension de l'injection du matériau de stimulation, l'ouverture partielle du communicateur de flux de production de matériau (15) en déplaçant le dispositif de commande de flux de production de matériau (14) par rapport au communicateur de flux de production de matériau (15), de sorte que :

(i) une partie disposée vers le haut du trou (15A) du communicateur de flux de production de matériau (15) est obstruée par le dispositif de commande de flux de production de matériau (14) ; et

(ii) une communication fluide est effectuée entre la formation souterraine et la colonne de puits de forage par l'intermédiaire d'une partie disposée en fond de trou (15B) du communicateur de flux de production de matériau (15), de sorte que le matériau du

réservoir est conduit depuis la formation souterraine et dans la colonne de puits de forage par l'intermédiaire de la partie disposée en fond de trou (15B) du communicateur de flux de production de matériau (15) en réponse à un différentiel de pression entre la formation souterraine et la colonne de puits de forage, et de sorte que le matériau particulaire solide, entraîné dans le matériau de réservoir conduit, se sépare du matériau de réservoir conduit et s'accumule dans l'espace de puits de forage (104), qui est disposé entre la formation souterraine et le communicateur de flux de production de matériau (15), et contribue au moins à la formation d'un milieu filtrant contenant un matériau particulaire solide (120) ;

dans lequel la partie disposée en fond de trou (15B) du communicateur de flux de production de matériau (15) est disposée en fond de trou par rapport à la partie disposée vers le haut du trou (15A) du communicateur de flux de production de matériau (15) ; et

après la formation d'un milieu filtrant contenant un matériau particulaire solide (120), l'augmentation du pourcentage d'ouverture du communicateur de flux de production de matériau (15) en déplaçant le dispositif de commande de flux de production de matériau (14) par rapport au communicateur de flux de production de matériau (15) de sorte qu'un communicateur de flux de production de matériau en mode production (15C) est établi, avec pour effet que le matériau du réservoir est conduit depuis la formation souterraine et dans la colonne de puits de forage par l'intermédiaire du milieu filtrant contenant un matériau particulaire solide (120) et du communicateur de flux de production de matériau en mode production (15C).

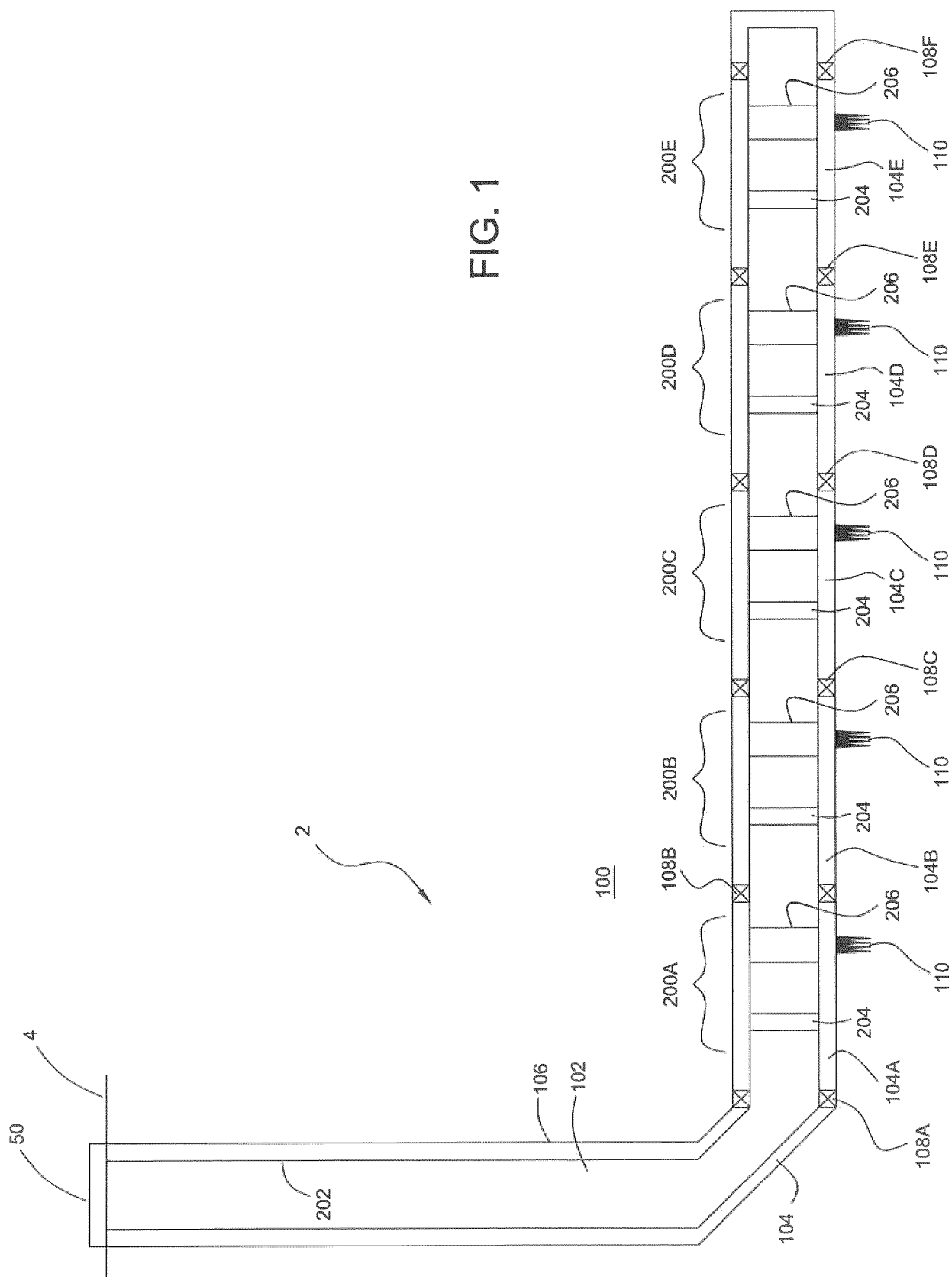
## 2. Procédé selon la revendication 1 ;

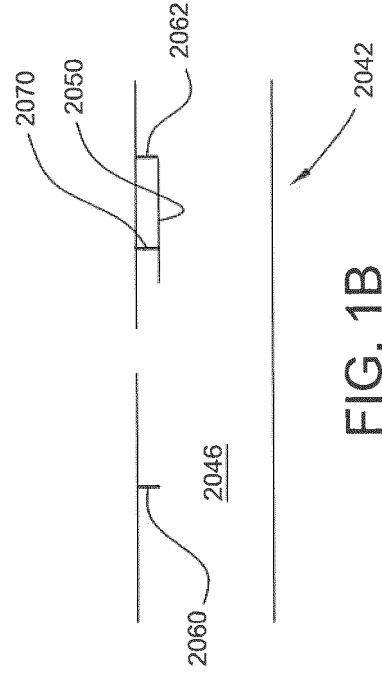
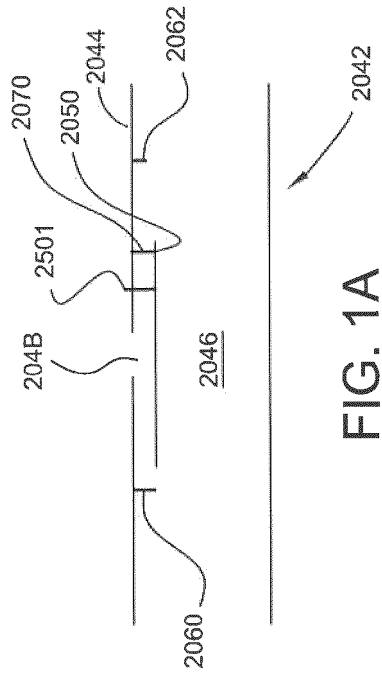
dans lequel l'ouverture partielle du communicateur de flux de production de matériau (15) a pour effet que la partie disposée vers le haut du trou (15A), du communicateur de flux de production de matériau (15) qui est obstruée par le dispositif de commande de flux (14), définit au moins 50 % de la surface d'écoulement en coupe transversale totale du communicateur de flux de production de matériau (15).

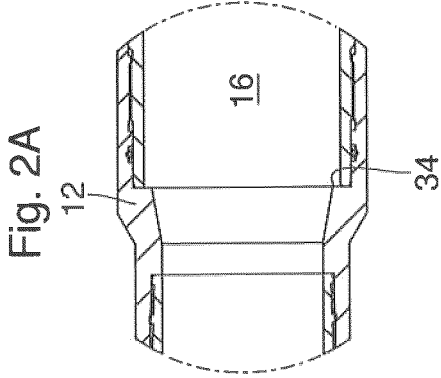
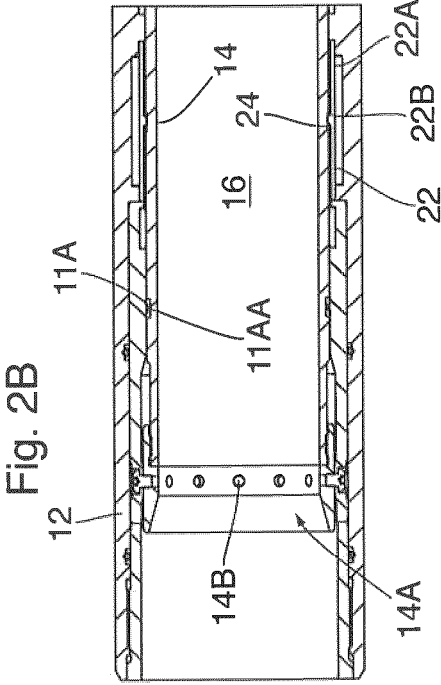
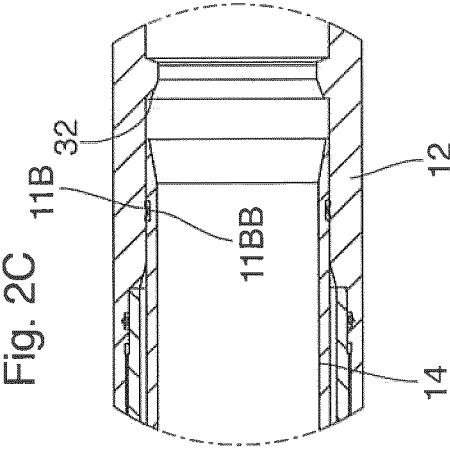
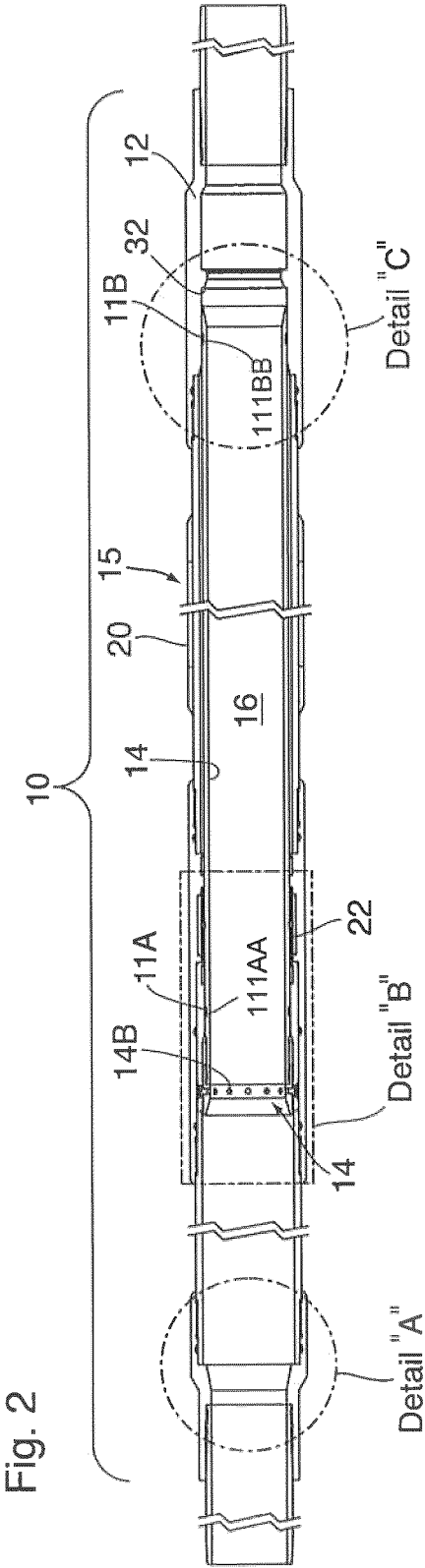
## 3. Procédé selon la revendication 1 ;

dans lequel l'ouverture partielle du communicateur de flux de production de matériau (15) a pour effet

- que la partie disposée vers le haut du trou(15A), du communicateur de flux de production de matériau (15) qui est obstruée par le dispositif de commande de flux (14), définit au moins 75 % de la surface d'écoulement en coupe transversale totale du communicateur de flux de production de matériaux (15). 5
4. Procédé selon l'une quelconque des revendications 1 à 3 ; 10  
dans lequel l'augmentation du pourcentage d'ouverture du communicateur de flux de production de matériau (15) a pour effet que le communicateur de flux de production de matériau (15) est disposé dans la condition non obstruée.
5. Procédé selon l'une quelconque des revendications 1 à 3 ; 15  
dans lequel le milieu filtrant contenant un matériau particulaire solide (120) comporte un matériau particulaire solide qui s'est accumulé pendant l'injection du matériau de stimulation. 20
6. Procédé selon l'une quelconque des revendications 1 à 5 ; 25  
dans lequel l'injection du matériau de stimulation est effectuée pendant que le communicateur de flux de production de matériau (15) est disposé en position fermée.
7. Procédé selon l'une quelconque des revendications 1 à 6 ; 30  
dans lequel l'injection du matériau de stimulation est effectuée pendant qu'une interface étanche (210) est disposée dans la colonne de puits de forage, en fond de trou par rapport au communicateur de flux d'injection de matériau (2048). 35
8. Procédé selon la revendication 7 ; 40  
dans lequel l'interface étanche (210) est disposée vers le haut du trou par rapport au communicateur de flux de production de matériau (15) ; et comprenant en outre : 45  
après la formation d'un milieu filtrant contenant un matériau particulaire solide (120), et avant l'augmentation du pourcentage d'ouverture du communicateur de flux de production de matériau (15), la victoire sur l'interface étanche (210).
9. Procédé selon l'une quelconque des revendications 1 à 8, comprenant en outre : 50  
avant l'ouverture partielle du communicateur de flux de production de matériau (15), la fermeture du communicateur de flux d'injection de matériau (2048). 55
10. Procédé selon l'une quelconque des revendications 1 à 9 ;  
dans lequel :
- le déplacement du dispositif de commande de flux d'injection de matériau (2050), par rapport au communicateur de flux d'injection de matériau (2048), est effectué par un outil de déplacement ; et  
le déplacement du dispositif de commande de flux de production de matériau (14), par rapport au communicateur de flux de production de matériau (15), est effectué par un outil de déplacement.
11. Procédé selon l'une quelconque des revendications 1 à 9 ;  
dans lequel les deux parmi :  
(i) le déplacement du dispositif de commande de flux d'injection de matériau (2050) par rapport au communicateur de flux d'injection de matériau (2048) ; et  
(ii) le déplacement du dispositif de commande de flux de production de matériau (14) par rapport au communicateur de flux de production de matériau (15) ;  
est effectué par le même outil de déplacement.
12. Procédé selon l'une quelconque des revendications 1 à 10 ;  
dans lequel :  
le dispositif de commande de flux d'injection de matériau (2050) comporte un manchon ; et  
le dispositif de commande de flux de production de matériau (14) comporte un manchon
13. Procédé selon l'une quelconque des revendications 1 à 12 ;  
dans lequel :  
l'ouverture partielle du communicateur de flux (15) est telle que la vitesse du fluide et le différentiel de pression entre la formation souterraine et la colonne de puits de forage transporteront le matériau depuis la formation souterraine par l'intermédiaire d'un reflux naturel.
14. Procédé selon l'une quelconque des revendications 1 à 13 ;  
dans lequel le milieu filtrant (15AA) est configuré pour empêcher, ou sensiblement empêcher, le passage de +100 d'agent de soutènement à maille depuis la formation souterraine, par l'intermédiaire du communicateur de flux de production de matériau (15), et dans la colonne de puits de forage.
15. Procédé selon l'une quelconque des revendications 1 à 14 ;  
dans lequel le milieu filtrant (15AA) comporte un tamis métallique.







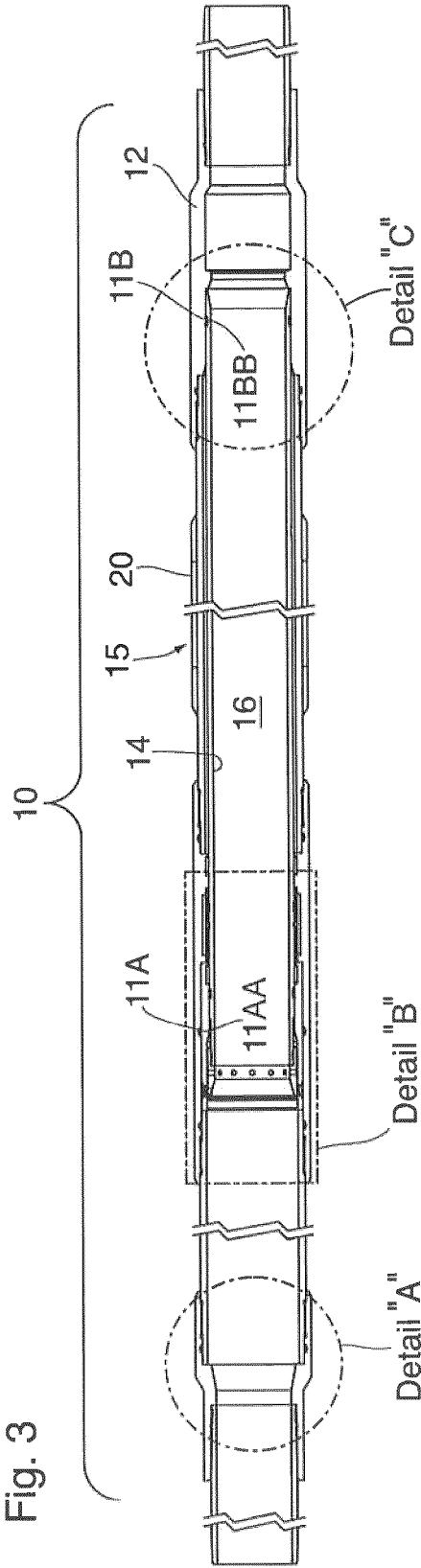


Fig. 3A

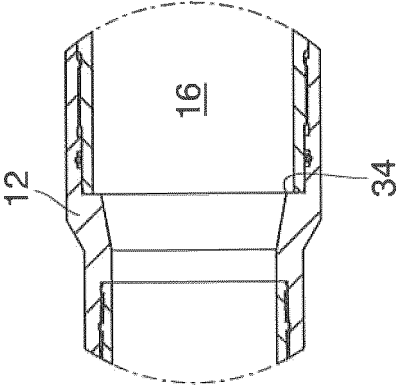


Fig. 3B

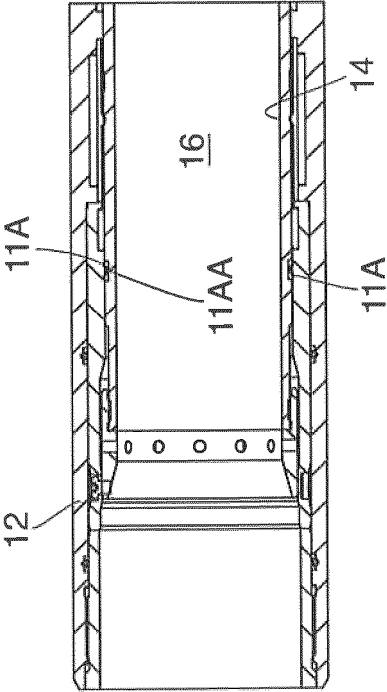
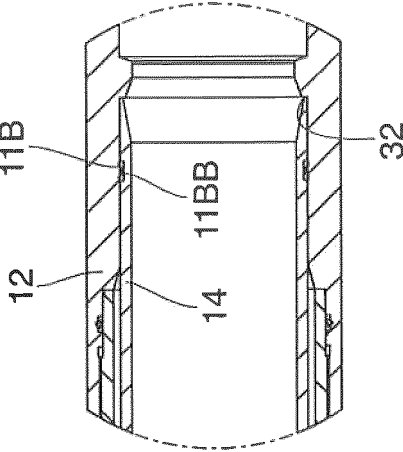
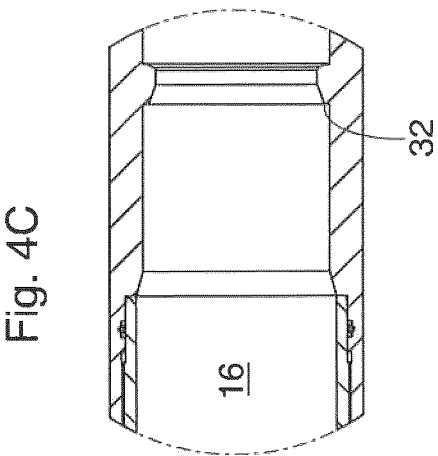
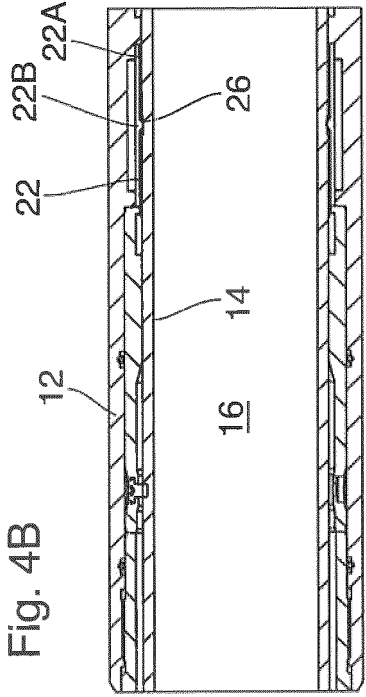
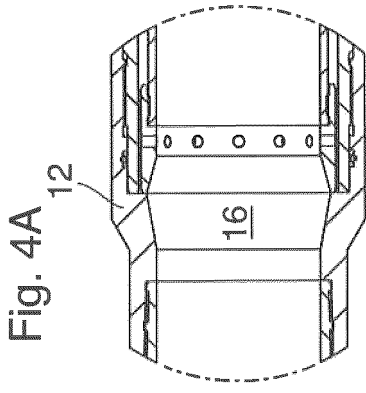
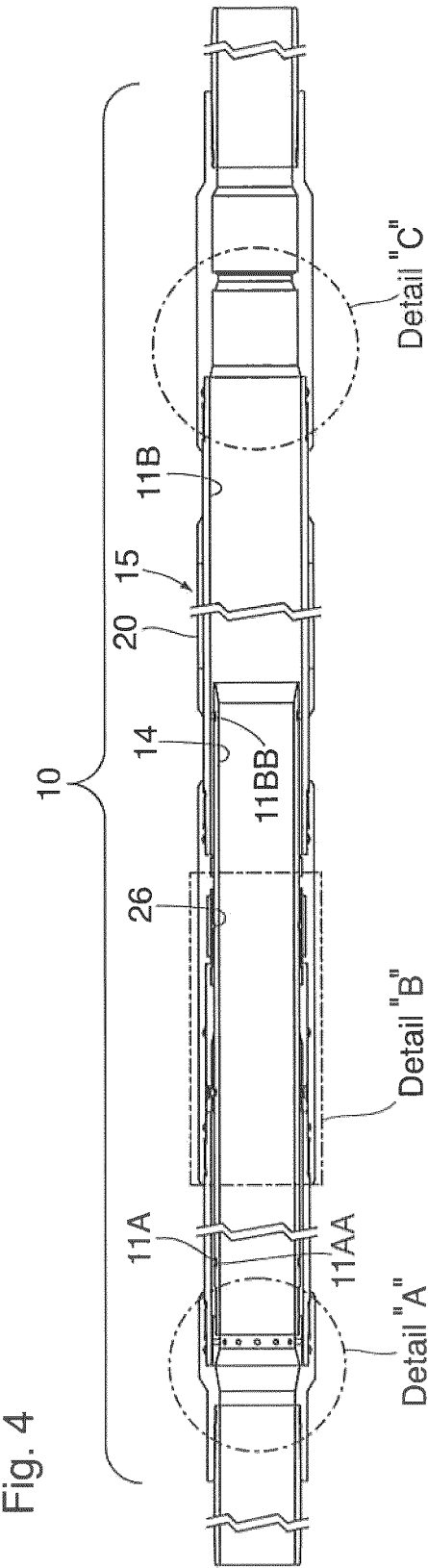
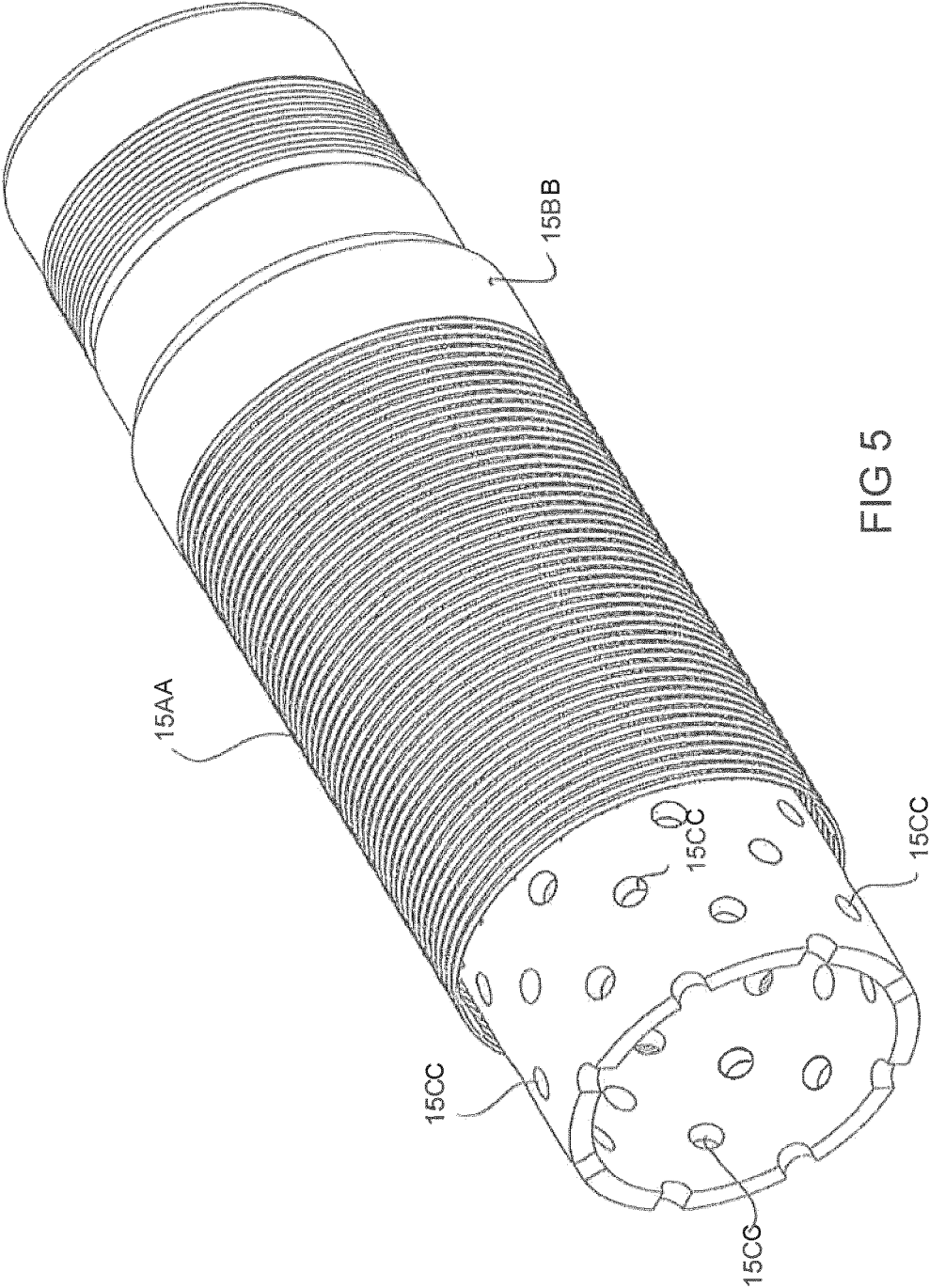


Fig. 3C







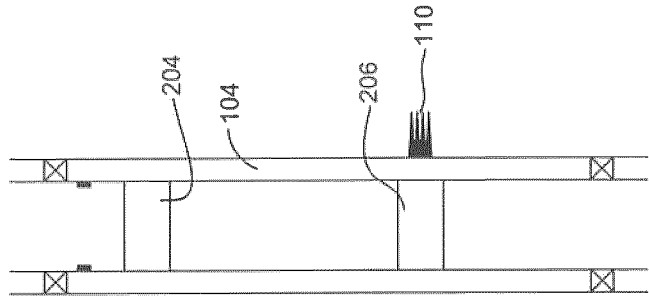


FIG. 6

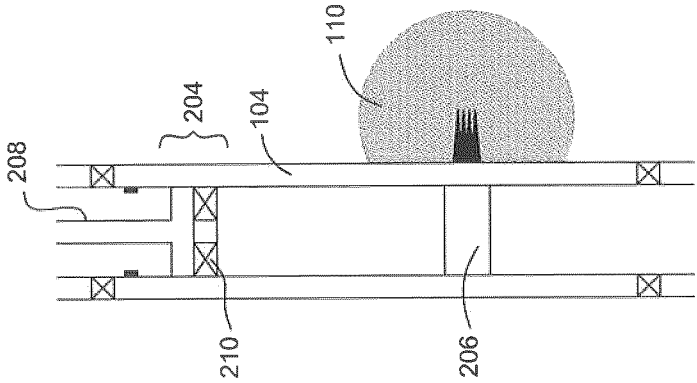


FIG. 7

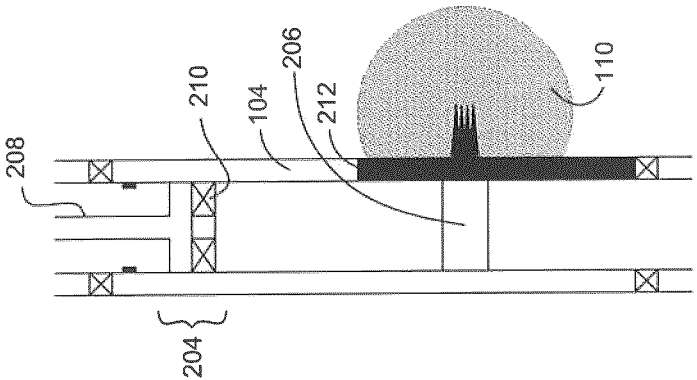


FIG. 8

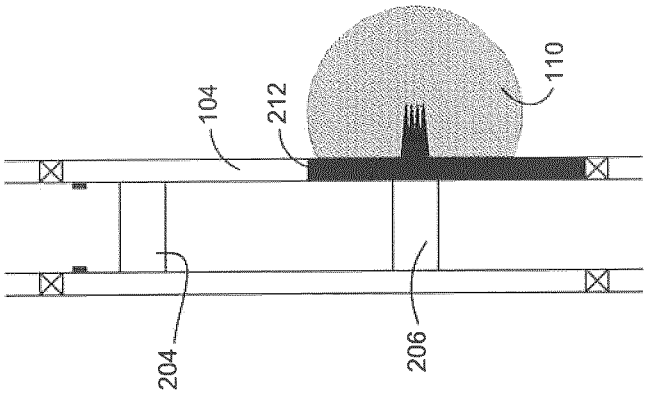


FIG. 9

FIGURE 10

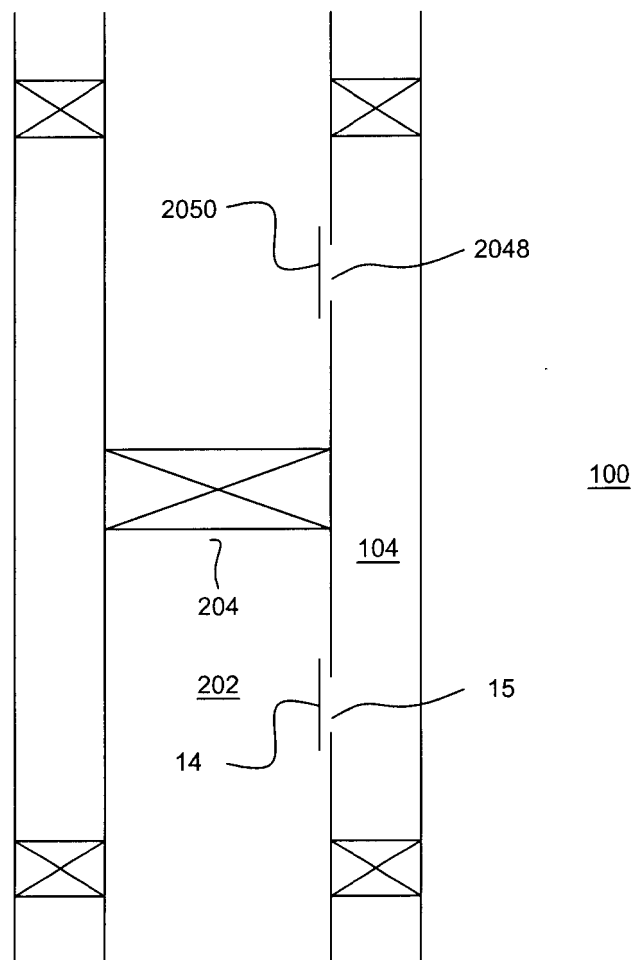


FIGURE 11

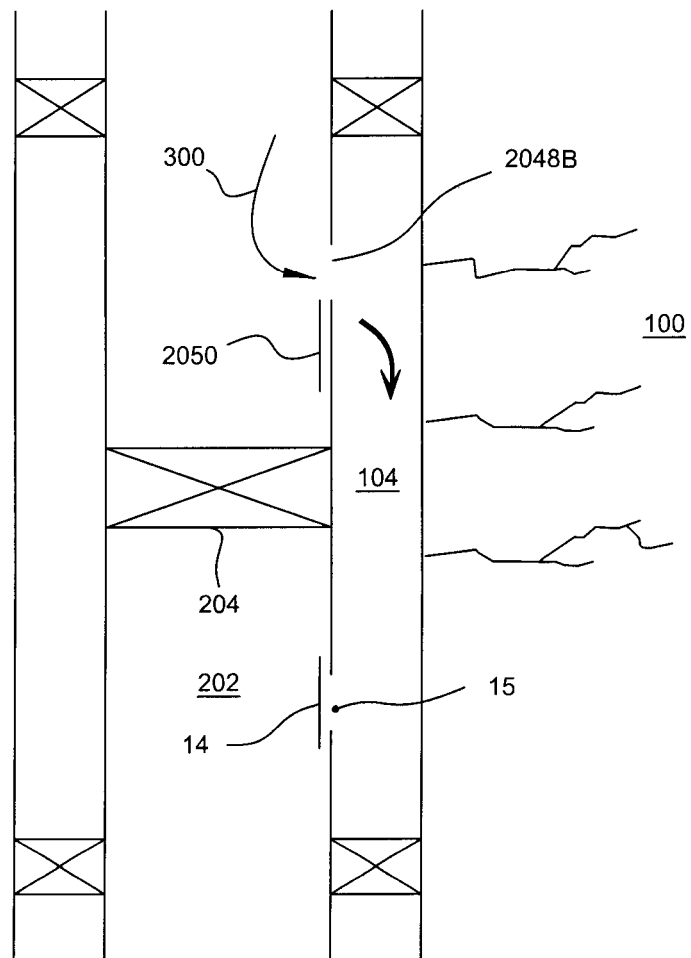


FIGURE 12

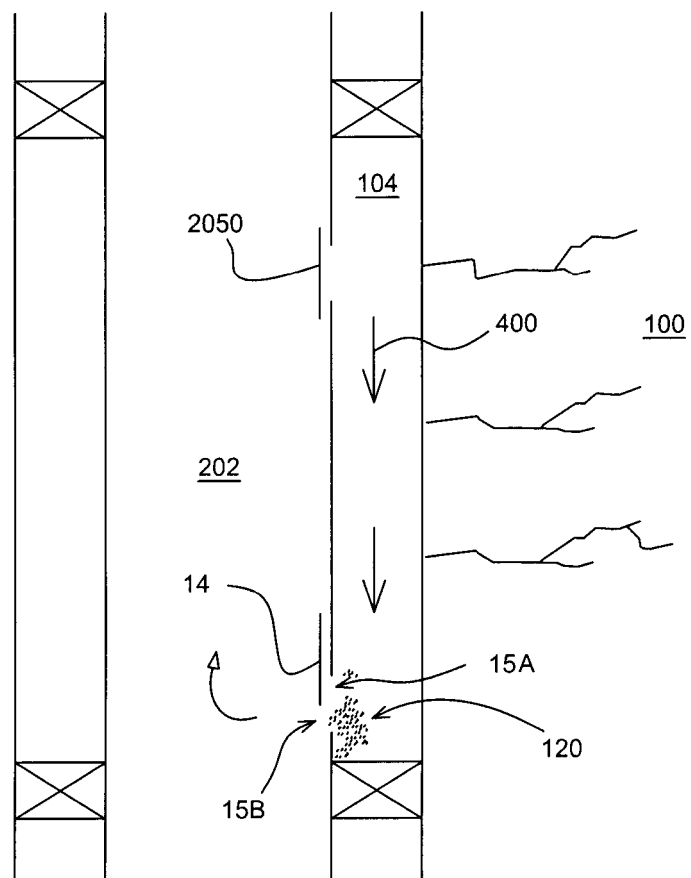
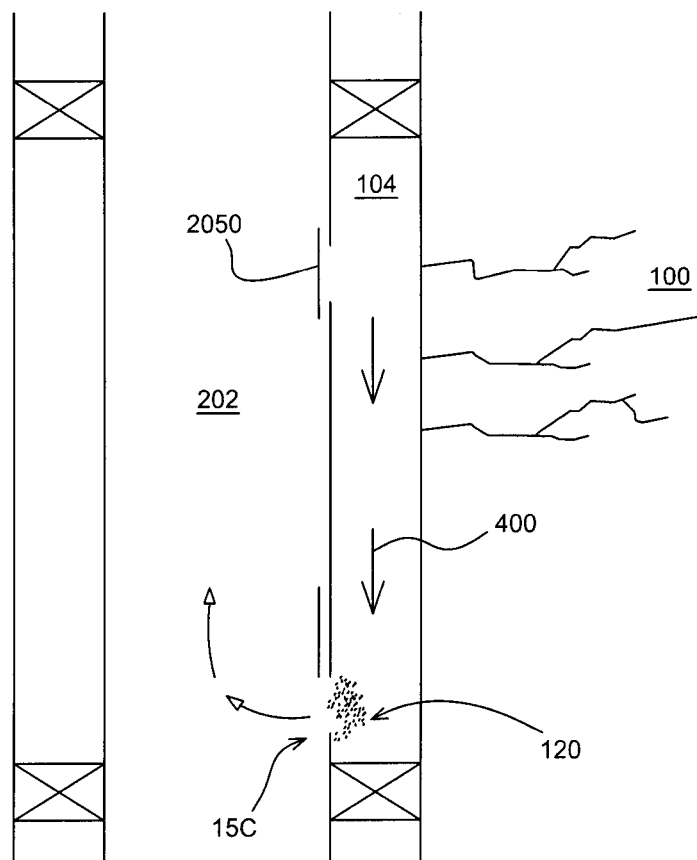


FIGURE 13



**REFERENCES CITED IN THE DESCRIPTION**

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