Fluid flow reduction or cessation in a wellbore or pipe may be provided. A body member may be longitudinally translated through a wellbore or pipe. The body member may have an external wall facing an internal wall of the wellbore or pipe. The body member may have an internal flow path configured to facilitate communication of fluid within the wellbore or pipe through the body member. A braking force may be applied to the body member to slow and stop translation of the body member through the wellbore or pipe. A first fluidic seal may be provided between the external wall of the body member and the internal wall of the wellbore or pipe. The first fluidic seal may restrict fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore or pipe. A second fluidic seal may be provided restricting fluid within the wellbore or pipe from being communicated through the internal flow path of the body member.
**FIG. 10**

1000

START

1002

LONGITUDINALLY TRANSLATE BODY MEMBER THROUGH WELLBORE

1004

APPLY BREAKING FORCE TO BODY MEMBER TO SLOW AND STOP TRANSLATION OF BODY MEMBER THROUGH WELLBORE

1006

PROVIDE FIRST FLUIDIC SEAL BETWEEN EXTERNAL WALL OF BODY MEMBER AND INTERNAL WALL OF WELLBORE

1008

PROVIDE SECOND FLUIDIC SEAL RESTRICTING FLUID WITHIN WELLBORE FROM BEING COMMUNICATED THROUGH INTERNAL FLOW PATH OF BODY MEMBER

FINISH

**FIG. 11**

1100

START

1102

DEPLOY RETRIEVING TOOL AND ENGAGE BODY MEMBER

1104

REMOVE FLUIDIC SEAL THAT IS RESTRICTING FLUID WITHIN WELLBORE FROM BEING COMMUNICATED THROUGH INTERNAL FLOW PATH OF BODY MEMBER

1106

REMOVE FLUIDIC SEAL BETWEEN EXTERNAL WALL OF BODY MEMBER AND INTERNAL WALL OF WELLBORE

1108

REMOVE BREAKING FORCE BEING APPLIED TO BODY MEMBER

1110

RETRIEVE BODY MEMBER USING RETRIEVING TOOL

FINISH
SYSTEMS AND METHODS FOR FLOW REDUCTION OR ISOLATION IN A WELLBORE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Application No. 61/677,900, entitled “Wellbore Isolation and Flow Cessation,” filed on Jul. 31, 2012. The complete disclosure of the above-identified application is hereby fully incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates generally to a method and apparatus configured to provide isolation and/or flow reduction or cessation in a wellbore or pipe.

BACKGROUND

[0003] Hydrocarbon-producing wells generally are fitted with a blowout preventer (BOP) or similar mechanical device to cope with unanticipated wellbore pressures and undesired flow (formation kick) emanating from a well reservoir during drilling and maintain control of the well. Kicks can lead to a potentially catastrophic event known as a blowout.

[0004] In the circumstance when a blowout preventer is unable to stop the flow from the well, the wellbore must be isolated and/or controlled using other means. Some techniques for wellbore isolation exist. Conventional approaches typically involve using a capping device, plugging element, and/or valves. However, the use of these devices may not be effective as the fluid flow forces resulting from the blowout may prevent the plugging element from being deployed downward. Other means for controlling the blowout can include drilling a secondary hole to the well (relief well) to relieve the pressure on the well with the blowout. However, this method is costly, very timely, and must be precise to be effective.

[0005] Accordingly, there exists a need for an easily deployable apparatus for isolating and/or controlling a wellbore experiencing uncontrolled flow in a relatively short amount of time.

SUMMARY

[0006] The present application is directed to systems and apparatus for flow reduction or cessation within a wellbore or pipe. The present application is also directed to methods of implementing such systems.

[0007] One aspect of the invention relates to an apparatus configured to provide wellbore isolation. The apparatus includes one or more of a body member, a braking element, an external sealing element, an internal sealing element, and/or other components. The body member is configured to translate longitudinally through a wellbore. The body member has an external wall facing an internal wall of the wellbore when the body member is within the wellbore. The body member has an internal flow path configured to facilitate communication of fluid within the wellbore through the body member. The braking element is disposed proximate to the external wall of the body member. The braking element is configured to slow and stop translation of the body member through the wellbore by providing a braking force to the body member. The external sealing element is disposed proximate to the external wall of the body member. The external sealing element is configured to provide a first fluidic seal between the external wall of the body member and the internal wall of the wellbore. The first fluidic seal restricts fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore. The internal sealing element is disposed proximate to the internal flow path of the body member. The internal sealing element is configured to actuate between an opened position and a closed position. While in the open position, the internal sealing element is configured to allow communication of fluid within the wellbore through the internal flow path of the body member. While in the closed position, the internal sealing element is configured to provide a second fluidic seal restricting fluid within the wellbore from being communicated through the internal flow path of the body member.

[0008] Another aspect of the invention relates to a method for providing wellbore isolation. A body member is longitudinally translated through a wellbore. The body member has an external wall facing an internal wall of the wellbore when the body member is within the wellbore. The body member has an internal flow path configured to facilitate communication of fluid within the wellbore through the body member. A braking force is applied to the body member to slow and stop translation of the body member through the wellbore. A first fluidic seal is provided between the external wall of the body member and the internal wall of the wellbore. The first fluidic seal restricts fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore. A second fluidic seal is provided restricting fluid within the wellbore from being communicated through the internal flow path of the body member.

[0009] Yet another aspect of the invention relates to an apparatus configured to fluid flow within a pipe. The apparatus includes one or more of a body member, a braking element, an external sealing element, an internal sealing element, and/or other components. The body member is configured to translate longitudinally through a pipe. The body member has an external wall facing an internal wall of the pipe when the body member is within the pipe. The body member has an internal flow path configured to facilitate communication of fluid within the pipe through the body member. The braking element is disposed proximate to the external wall of the body member. The braking element is configured to slow and stop translation of the body member through the pipe by providing a braking force to the body member. The external sealing element is disposed proximate to the external wall of the body member. The external sealing element is configured to provide a first fluidic seal between the external wall of the body member and the internal wall of the pipe. The first fluidic seal restricts fluid within the pipe from being communicated between the external wall of the body member and the internal wall of the pipe. The internal sealing element is disposed proximate to the internal flow path of the body member. The internal sealing element is configured to actuate between an opened position and a closed position. While in the open position, the internal sealing element is configured to allow communication of fluid within the pipe through the internal flow path of the body member. While in the closed position, the internal sealing element is configured to provide a second fluidic seal restricting fluid within the pipe from being communicated through the internal flow path of the body member.

[0010] These and other objects, features, and characteristics of the present invention, as well as the methods of opera-
tion and functions of the related elements of structure and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the exemplary embodiments of the present invention and the advantages thereof, reference is now made to the following description in conjunction with the accompanying drawings, which are briefly described as follows.

FIG. 1 is a side cross-sectional view of a system including an apparatus configured to provide wellbore isolation, according to an exemplary embodiment.

FIG. 2A is a side cross-sectional view of a system including an apparatus configured to provide wellbore isolation, according to another exemplary embodiment.

FIG. 2B is a side cross-sectional view of the system of FIG. 2A, after actuation of a braking element, according to an exemplary embodiment.

FIG. 2C is a side cross-sectional view of the system of FIGS. 2A-2B, after actuation of an external sealing element, according to an exemplary embodiment.

FIG. 2D is a side cross-sectional view of the system of FIGS. 2A-2C, upon actuation of an internal sealing element, according to an exemplary embodiment.

FIG. 2E is a side cross-sectional view of the system of FIGS. 2A-2D, showing the internal sealing element in a closed position, according to an exemplary embodiment.

FIG. 2F is a side cross-sectional view of the system of FIGS. 2A-2E, after deployment of a secondary internal sealing element, according to an exemplary embodiment.

FIG. 3 is a top view of an internal sealing element in a closed position, according to an exemplary embodiment.

FIG. 4 is a top view of an internal sealing element in a closed position, according to another exemplary embodiment.

FIG. 5 is a top view of an internal flow reducing element in a closed position, according to yet another exemplary embodiment.

FIG. 6A is a side cross-sectional view of a system including an apparatus configured to provide wellbore isolation, showing an internal sealing element in an open position, according to yet another exemplary embodiment.

FIG. 6B is a side cross-sectional view of the system of FIG. 6A, upon actuation of the internal sealing element, according to an exemplary embodiment.

FIG. 6C is a side cross-sectional view of the system of FIGS. 6A-6B, showing the internal sealing element in a closed position, according to an exemplary embodiment.

FIG. 7 is a perspective view of the internal sealing element of FIGS. 6A-6C, according to an exemplary embodiment.

FIG. 8A is a side cross-sectional view of a system including an apparatus configured to provide wellbore isolation, according to yet another exemplary embodiment.

FIG. 8B is a side cross-sectional view of the system of FIG. 8A, after actuation of a braking element, according to an exemplary embodiment.

FIG. 8C is a side cross-sectional view of the system of FIGS. 8A-8B, after actuation of a hold-down element, according to an exemplary embodiment.

FIG. 8E is a side cross-sectional view of the system of FIGS. 8A-8C, after actuation of an external sealing element, according to an exemplary embodiment.

FIG. 8F is a side cross-sectional view of the system of FIGS. 8A-8E, upon actuation of internal sealing elements, according to an exemplary embodiment.

FIG. 9 is a side cross-sectional view of a system including an apparatus configured to provide wellbore isolation, according to yet another exemplary embodiment.

FIG. 10 illustrates a method for providing wellbore isolation, according to an exemplary embodiment.

FIG. 11 illustrates a method for retrieving an apparatus for flow control from a wellbore, according to an exemplary embodiment.

ILLUSTRATIVE DESCRIPTION

Illustrative embodiments of the invention are described below. In the interest of clarity, not all features of an actual implementation are described in this specification. One of ordinary skill in the art will appreciate that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

The present invention may be better understood by reading the following description of non-limitative embodiments with reference to the attached drawings wherein like parts of each of the figures are identified by the same reference characters. The words and phrases used herein should be understood and interpreted to have a meaning consistent with the understanding of those words and phrases by those skilled in the relevant art. No special definition of a term or phrase, for example, a definition that is different from the ordinary and customary meaning as understood by those skilled in the art, is intended to be implied by consistent usage of the term or phrase herein. To the extent that a term or phrase is intended to have a special meaning, for instance, a meaning other than that understood by skilled artisans, such a special definition will be expressly set forth in the specification in a definitional manner that directly and unequivocally provides the special definition for the term or phrase.

FIG. 1 illustrates a system including an apparatus configured to provide wellbore isolation, in accordance with one or more embodiments. In exemplary embodiments, apparatus 102 is used to slow or stop fluid flow within a wellbore 104 such as, for example, during a well blowout. In certain exemplary embodiments, the apparatus 102 is retrievable. The apparatus 102 has a generally annular shape and is configured to move within wellbore 104 such that a longitudinal axis of wellbore 104 is parallel to that of apparatus 102. The apparatus 102 is configured to fall under the force of gravity and against fluid flow down wellbore 104, in some embodiments. The apparatus 102 is tamped or pushed into place, in some embodiments. Once apparatus 102 is halted in wellbore 104, either by a braking force or other positioning approach, a fluidic seal is formed between an outer surface of the apparatus 102 and an inner surface of the wellbore 104. At
this point, fluid continues to flow through the center of apparatus 102. A second fluidic seal is formed to prevent fluid flow through wellbore 104.

[0038] The wellbore 104 may be a part of a production well. In such instances, wellbore 104 is configured to transport a fluid to and/or from the Earth’s surface. The fluid transported by wellbore 104 may include a fluid being extracted (e.g., oil or gas) or a fluid being injected (e.g., water). The fluid may be under negative pressure created by a pump (e.g., up-hole) and/or may flow through the pipe by virtue of pressure within the underlying reservoir of fluid. The wellbore 104 may be cased or uncased. The wellbore 104 may include production tubing and/or other tubulars disposed within the production well. Production tubing for a given well is generally selected to be compatible with the wellbore geometry, reservoir production characteristics, the reservoir fluids, and/or other production factors. While embodiments are described in the context of production wells, this is not intended to be limiting as other applications are contemplated. For example, some embodiments may be configured to slow or stop fluid flow in other types of pipes and/or tubulars, such as in pipelines and flowlines.

[0039] As depicted in FIG. 1, apparatus 102 includes one or more of a body member 106, an external sealing element 110, and an internal sealing element 112. A controller 114, a sensor 116, a weight element 118, and/or other components. The depiction of apparatus 102 in FIG. 1 is not intended to be limiting as apparatus 102 may include more or less components than those shown. Additionally, two or more components may be combined as singular components.

[0040] The body member 106 is configured to translate longitudinally through a wellbore. The body member 106 has an external wall 120 facing an internal wall 122 of wellbore 104 when body member 106 is within wellbore 104. The body member 106 has an internal flow path 124 configured to facilitate communication of fluid within wellbore 104 through body member 106. The body member 106 may be shaped so as to minimize its cross-sectional area in order to allow fluid to flow around and/or through body member 106. In some embodiments, body member 106 is hydro-dynamically shaped to decrease drag forces caused by fluid flowing around and/or through body member 106. The body member 106 may be formed of metal and/or other suitable materials.

[0041] The braking element 108 is disposed proximate to external wall 120 of body member 106. The braking element 108 is configured to slow and stop translation of body member 106 through wellbore 104 by providing a braking force to body member 106. The braking force is provided by applying friction to internal wall 122 of wellbore 104, in some embodiments. The braking element 108 may include one or more of a slip with teeth configured to provide the braking force responsive to contacting internal wall 122 of wellbore 104, a band configured to provide the braking force by expanding to contact internal wall 122 of wellbore 104, a rough surface configured to provide the braking force responsive to contacting internal wall 122 of wellbore 104, and/or other components configured to provide a braking force.

[0042] The braking element 108 may be configured to activate (i.e., provide) the braking force and/or deactivate (i.e., remove) the braking force. Activating the braking force may include inflating, squeezing, expanding, actuating, and/or otherwise manipulating braking element 108 such that at least a portion of braking element 108 contacts internal wall 122 of wellbore 104. Providing the braking force may include using one or more of a pyrotechnic explosion, a chemical reaction, a mechanical linkage, and/or other approach suitable for providing the braking force. In some embodiments, braking element 108 includes one or more hydraulic or mechanical actuators configured to activate and/or deactivate the braking force.

[0043] The braking force may be provided responsive to one or more triggers. For example, the braking force may be provided responsive to braking element 108 receiving an instruction from controller 114, as described further herein. In some embodiments, the braking force is provided responsive to body member 106 reaching a specific depth within wellbore 104. In some embodiments, the braking force is provided responsive to body member 106 experiencing a specific fluid pressure within wellbore 104. Depth and/or fluid pressure may be determined in conjunction with sensor 116, as described further herein.

[0044] The external sealing element 110 is disposed proximate to external wall 120 of body member 106. The external sealing element 110 is configured to provide a first fluidic seal between external wall 120 of body member 106 and internal wall 122 of wellbore 104. The first fluidic seal restricts fluid within wellbore 104 from being communicated between external wall 120 of body member 106 and internal wall 122 of wellbore 104. When the first fluidic seal is provided, fluid may be communicated through body member 106 via internal flow path 124. In some embodiments, external sealing element 110 includes one or more of an elastomer packer, a sintered metal sleeve, metal-to-metal seal, and/or other components configured to provide the first fluidic seal. The braking element 108 and external sealing element 110 form a singular element configured to provide both the braking force and the first fluidic seal, according to some embodiments.

[0045] The external sealing element 110 may be configured to activate (i.e., provide) the first fluidic seal and/or deactivate (i.e., remove) the first fluidic seal. Activating the first fluidic seal may include inflating, squeezing, expanding, actuating, and/or otherwise manipulating external sealing element 110 such that at least a portion of external sealing element 110 contacts internal wall 122 of wellbore 104. Providing the first fluidic seal may include using one or more of a pyrotechnic explosion, a chemical reaction, a mechanical linkage, and/or other approach suitable for providing the first fluidic seal. In some embodiments, external sealing element 110 includes one or more hydraulic or mechanical actuators configured to activate and/or deactivate the first fluidic seal.

[0046] The first fluidic seal may be provided responsive to one or more triggers. For example, the first fluidic seal may be provided responsive to external sealing element 110 receiving an instruction from controller 114, as described further herein. In some embodiments, the first fluidic seal is provided responsive to body member 106 ceasing to translate within wellbore 104.

[0047] The internal sealing element 112 is disposed proximate to internal flow path 124 of body member 106. According to various embodiments, internal sealing element 112 is disposed within internal flow path 124 or adjacent to internal flow path 124. The internal sealing element 112 is configured to actuate between an opened position and a closed position. While in the open position, internal sealing element 112 is configured to allow communication of fluid within wellbore 104 through internal flow path 124 of body member 106. While in the closed position, internal sealing element 112 is configured to provide a second fluidic seal restricting fluid
within wellbore 104 from being communicated through internal flow path 124 of body member 106. In some embodiments, internal sealing element 112 may include one or more of a linear shutter, a radial shutter, an axial shutter, a telescoping closure, a flapper, and/or other structure suitable for actuating between the open and closed positions. A linear shutter may resemble louvered window shutters. A radial shutter may resemble louvers that extend radially from a central axis. An axial shutter may resemble a camera shutter. A telescoping closure may resemble a series of coaxial cone segments of varying size, which, when collapsed, allow fluid to flow between the segments and, when extended, seal together much like a telescoping antenna. A flapper may include a rigid hinged flap that can cover the internal flow path 124. In some embodiments, internal sealing element 112 may close internal flow path 124 using flow pressure provided by fluid flowing within wellbore 104.

[0048] The internal sealing element 112 may be configured to activate (i.e., provide) the second fluidic seal and/or deactivate (i.e., remove) the second fluidic seal. Activating the second fluidic seal may include inflating, squeezing, expanding, actuating, and/or otherwise manipulating internal sealing element 112 such that at least a portion of internal sealing element 112 contacts internal wall 126 of body member 106. Providing the second fluidic seal may include using one or more of a pyrotechnic explosion, a chemical reaction, a mechanical linkage, and/or other approach suitable for providing the second fluidic seal. In some embodiments, internal sealing element 112 includes one or more hydraulic or mechanical actuators configured to activate and/or deactivate the second fluidic seal.

[0049] The second fluidic seal may be provided responsive to one or more triggers. For example, the second fluidic seal may be provided responsive to internal sealing element 112 receiving an instruction from controller 114, as described further herein. In some embodiments, the second fluidic seal is provided responsive to the first fluidic seal being provided.

[0050] The controller 114 is configured to control one or more components of apparatus 102. For example, in some embodiments, controller 114 is configured to control braking element 108 to cause braking element 108 to slow and/or stop transfer of body member 106 through wellbore 104. In some embodiments, controller 114 is configured to control external sealing element 110 to cause external sealing element 110 to provide the first fluidic seal. In some embodiments, controller 114 is configured to control internal sealing element 112 to cause internal sealing element 112 to provide the second fluidic seal.

[0051] In some embodiments, controller 114 may include one or more processors (not depicted) configured to execute computer software modules, electronic storage (not depicted) configured to store information received from or used by the one or more processors, and/or other components facilitating functionalities of controller 114 described herein. In embodiments where controller 114 includes more than one processors, those processors may be collocated or may be disparately located operating in concert. The controller 114 may be disposed proximate to body member 106 and/or remotely from body member 106. For example, controller 114 may be located outside of wellbore 104 and communicate with apparatus 102 via a wire filament spool. In some embodiments, controller 114 communicates wirelessly with one or more components of apparatus 102.

[0052] The sensor 116 may include one or more sensors disposed proximate to body member 106. The sensor 116 is configured to provide one or more signals conveying information associated with apparatus 102 and/or wellbore 104. For example, in some embodiments, sensor 116 is configured to provide a depth signal conveying information associated with a depth of body member 106 within wellbore 104. In some embodiments, sensor 116 is configured to provide a pressure signal conveying information associated with a pressure of fluid within wellbore 104 proximate to body member 106. The sensor 116 is configured to provide a temperature signal associated with a temperature of fluid within wellbore 104 proximate to body member 106, according to some embodiments.

[0053] The weight element 118 may include one or more weight elements disposed proximate to body member 106. The weight element 118 is configured to decrease a buoyancy of body member 106 such that body member 106 falls with gravity within wellbore 104 and against a flow of fluid within wellbore 104. In some embodiments, weight element 118 is incorporated in body member 106. In some embodiments, weight element 118 is suspended below body member 106 and centrally within wellbore 104. The weight element 118 may be hydro-dynamically shaped to decrease drag forces caused by fluid flowing around and/or through body member 106. The weight element 118 may be formed of metal and/or other suitable materials.

[0054] FIGS. 2A-2F illustrate an exemplary system 200 including an apparatus 202 configured to provide wellbore isolation, in accordance with another embodiment. The system 200 is the same as that described above with regard to system 100, except as specifically stated below. For the sake of brevity, the similarities will not be repeated hereinbelow. Referring now to FIGS. 2A-2F, the apparatus 202 includes a braking element 208 disposed within a channel 240 proximate to external wall 120 of body member 106. In certain exemplary embodiments, the channel 240 is configured to include a vertical surface 240a and an angled surface 240b. In certain embodiments, the body 106 includes a single channel 240 extending along a circumference of the external wall 120, with a cylindrical braking element 208 disposed therein. In other embodiments, the body 106 includes multiple channels 240 spaced around the external wall 120, with separate braking elements 208 disposed within each channel 240. The braking element 208 can be actuated by an actuation mechanism 246 that responds to instructions from a wire filament spool 214. In certain exemplary embodiments, the actuation mechanism 246 may include using one or more of a pyrotechnic explosion, a chemical reaction, a mechanical linkage, and/or one or more hydraulic or mechanical actuators. The braking element 208 is positioned along the vertical surface 240a prior to actuation of the braking element 208 (FIG. 2A) and shifts along the angled surface 240b upon actuation (FIG. 2B) to engage internal wall 122 of wellbore 104. In certain exemplary embodiments, the braking element 208 includes teeth 244 configured to provide the braking force responsive to contacting internal wall 122 of wellbore 104, as shown in FIG. 2B.

[0055] Referring to FIG. 2C, once the braking element 208 engages the wellbore 104, the actuation mechanism 246 activates the external sealing element 110 to provide a fluidic seal between external wall 120 of body member 106 and internal wall 122 of wellbore 104 such that fluid may be communicated through body member 106 via internal flow path 124.
Referring to FIGS. 2A-2F, the apparatus 202 includes an internal sealing element 212 configured to actuate between an open position (FIG. 2C) and a closed position (FIG. 2E) by actuation mechanism 246. In certain exemplary embodiments, the internal sealing element 212 includes one or more shutters positioned within a channel 250 (FIGS. 213-2F) along the internal wall 126 of the body member 106. The shutters can be coupled to the body 106 such that the shutters are movable about a pivot point 254 from the opened position to the closed position. In exemplary embodiments, a portion of each shutter overlaps with a portion of its adjacent shutter such that when one shutter is actuated by actuation mechanism 246 and begins shifting towards the closed position, the adjacent shutter also shifts towards the closed position (FIG. 2D). In certain exemplary embodiments, once the internal sealing element 212 has been actuated, the force from the fluid flow F through the internal flow path 124 aids in shifting the shutters towards the closed position. In some embodiments, internal sealing element 212 may significantly reduce or close internal flow path 124.

Referring to FIG. 2F, in certain exemplary embodiments, once the internal sealing element 212 is in the closed position, thereby reducing or stopping the fluid flow F from the wellbore 104 through the apparatus 202, a secondary sealing element 260 may be deployed to provide additional sealing force to stop the flow from the wellbore 104. In certain exemplary embodiments, the secondary sealing element 260 can be a solid weighted element, an inflatable packer or packer element, a mineral weight element (such as barite or hematite), a pack-off element, and the like. In certain exemplary embodiments, the secondary sealing element 260 can be locked or anchored in place by a mechanical means, such as an expandable locking ring 262 or slips (not shown). In addition, once the fluid flow F from the wellbore 104 is reduced or eliminated, a capping stock (not shown) can be coupled to a wellhead of wellbore 104 to provide a second method of isolation and facilitate future additional well control and well intervention activities and operations.

FIGS. 3-5 illustrate top down views of variations of the internal sealing element 212 in the closed position (FIG. 2E). Referring to FIG. 3, an internal sealing element 300 includes two circular shutters 312a, 312b. In certain exemplary embodiments, the shutters 312a, 312b are actuated independently of each other and fully close the internal flow path 124 when in the closed position. In certain embodiments, shutter 312a has a radius R1 that is greater than a radius R2 of the shutter 312b such that the shutter 312b overlaps shutter 312a.

Referring to FIG. 4, an internal sealing element 400 includes multiple shutters 412 that each overlap an adjacent shutter such that when one shutter is actuated and begins to move upward, the overlapping region forces the adjacent shutter to also move upward to finally close off the internal flow path 124. In certain exemplary embodiments, each shutter 412 has three curved edges. In other embodiments, each shutter 412 can have a curved edge proximate to the internal wall 126 and straight edges proximate to each adjacent shutter 412.

Referring to FIG. 5, an internal flow reducing element 500 includes multiple shutters 512 that each overlap an adjacent shutter such that when one shutter is actuated and begins to move upward, the overlapping region forces the adjacent shutter to also move upward to finally reduce the internal flow path 124. The internal flow reducing element 500 is generally similar to the internal sealing element 400 (FIG. 4), except that the flow reducing element 500 partially closes the internal flow path 124 while the internal sealing element 400 fully closes the internal flow path 124.

FIGS. 6A-6C illustrate an exemplary system 600 including an apparatus 602 configured to provide wellbore isolation, in accordance with another embodiment. The system 600 is the same as that described above with regard to system 200, except as specifically stated below. For the sake of brevity, the similarities will not be repeated hereinbelow. Referring now to FIGS. 6A-6C, the apparatus 602 includes an internal sealing element 612 configured to actuate between an open position (FIG. 6A) and a closed position (FIG. 6C) by actuation mechanism 246. In certain exemplary embodiments, the internal sealing element 612 is a curved circular shutter (FIG. 7) designed to fit within a channel 650 (FIGS. 63-6C) along the internal wall 126 of the body member 106. The internal sealing element 612 has a pivot end 612a coupled to the body member 106 and a distal end 612b. In certain exemplary embodiments, the curved circular shutter has a diameter D1 greater than an internal diameter D2 of the body member 106. In certain other embodiments, the internal sealing element 612 is a curved oval shutter (not shown) having a length greater than the internal diameter D2 of the body member 106. Referring to FIG. 6A, prior to actuation of the internal sealing element 612, the internal sealing element 612 is seated within channel 650 (FIGS. 63-6C). Referring to FIG. 6B, once the apparatus 602 engages the wellbore 104, the internal sealing element 612 is actuated and moves out of the channel 650. The fluid flow F from the wellbore 104 facilitates moving the internal sealing element 612 upwards until shutter contacts the internal wall 126 of body member 106 and cannot continue moving upwards due to the larger diameter D1 than the internal diameter D2 of the body member 106. In certain exemplary embodiments, the internal wall 126 can include a channel 660 configured to receive the distal end 612b of the internal sealing member 612. In certain embodiments, the distal end 612b of the shutter includes a retractable feature 662 that retracts upon contacting the internal wall 126 and then extends into the channel 660, thus locking the shutter in place. In certain embodiments, the retractable feature 662 is a spring-loaded system whereby a spring (not shown) is compressed when the shutter contacts the internal wall 126 to allow the shutter to shift into the channel 660, and then the spring returns to its original state to lock the shutter in place, and thus closing the internal flow path 124. In certain exemplary embodiments, the retractable feature 662 resembles a door latching mechanism.

FIG. 7 is a perspective view of the internal sealing element 612 of FIGS. 6A-6C. The internal sealing element 612 has diameter D1 greater than an internal diameter of the body member 106, and a radius of curvature R1 to the curved ends 768 similar to a radius of curvature of the internal wall 126 of the apparatus 602.

FIGS. 8A-8F illustrate an exemplary system 800 including an apparatus 802 configured to provide wellbore isolation, in accordance with yet another embodiment. The system 800 is the same as that described above with regard to system 600, except as specifically stated below. For the sake of brevity, the similarities will not be repeated hereinbelow. Referring now to FIGS. 8A-8F, the apparatus 802 includes hold-down elements 870 to help hold the apparatus 802 in place and prevent it from being moving upwards in the hole in the direction of fluid flow F. The hold-down elements 870 are...
disposed within channels 872 proximate to external wall 120 of body member 106. In certain exemplary embodiments, the channels 872 are configured to each include a vertical surface 872a and an angled surface 872b. The hold-down elements 870 can be actuated by actuation mechanisms 846. The hold-down elements 870 are positioned along the vertical surface 872a prior to actuation of the hold-down elements 870 (FIGS. 8A-8B) and shift along the angled surface 872b upon actuation (FIG. 8C) to engage internal wall 122 of wellbore 104. In certain exemplary embodiments, the hold-down elements 870 include teeth 844 configured to provide the braking force responsive to contacting internal wall 122 of wellbore 104, as shown in FIG. 8C.

[0064] Referring to FIG. 8D, once the braking elements 208 and hold-down elements 870 engage the wellbore 104, the actuation mechanisms 246, 846 activate the external sealing elements 110, 810 to provide a fluidic seal between external wall 120 of body member 106 and internal wall 122 of wellbore 104 such that fluid may be communicated through body member 106 via internal flow path 124. In certain alternative embodiments, the external sealing elements 110, 810 are activated prior to actuating the hold-down elements 870.

[0065] Referring to FIGS. 8A-8F, the apparatus 802 includes multiple internal sealing elements 612 configured to actuate between an open position (FIG. 8D) and a closed position (FIG. 8F) by actuation mechanisms 246, 846. Each of the internal sealing elements 612 has a pivot end 612a coupled to the body member 106 and a distal end 612b. Each of the internal sealing elements 612 has a diameter D1 greater than an internal diameter D2 of the body member 106. Referring to FIGS. 8A-8D, prior to actuation of the internal sealing elements 612, the internal sealing elements 612 are seated within channels 650 (FIGS. 8E-8F). Referring to FIG. 8E, once the apparatus 802 engages the wellbore 104, the internal sealing elements 612 are actuated and move out of the channels 650. The fluid flow F from the wellbore 104 facilitates moving the internal sealing elements 612 upwards until the distal ends 612b contact the internal wall 126 of body member 106 and cannot continue moving upwards due to the larger diameter D1 than the internal diameter D2 (FIG. 8F). In certain exemplary embodiments, the internal sealing elements 612 can be replaced with baffles (not shown) to help reduce the forces from the fluid flowing from the wellbore 104. The baffles (not shown) can be actuated from an open position to a closed position similar to actuation of the internal sealing elements 612. In certain exemplary embodiments, the internal sealing elements 612 act as baffles to significantly reduce the forces from the fluid flowing from the wellbore 104.

[0066] FIG. 9 illustrates an exemplary system 900 including an apparatus 902 configured to provide wellbore isolation, in accordance with another embodiment. The system 900 is the same as that described above with regard to system 200, except as specifically stated below. For the sake of brevity, the similarities will not be repeated hereinbelow. Referring now to FIG. 9, the apparatus 902 includes one or more weight elements 918 disposed proximate to body member 106. The weight element 918 is configured to decrease a buoyancy of body member 106 such that body member 106 falls with gravity within wellbore 104 and against a flow F of fluid within wellbore 104. In some embodiments, weight element 918 is incorporated in body member 106. The weight element 918 is hydro-dynamically shaped to decrease drag forces caused by fluid flowing around and/or through body member 106. The weight element 918 may be formed of metal and/or other suitable materials. The weight element 918 may have any length suitable for use within the wellbore 104.

[0067] FIG. 10 illustrates a method 1000 for providing wellbore isolation, in accordance with one or more embodiments. The operations of method 1000 presented below are intended to be illustrative. In some embodiments, method 1000 may be accomplished with one or more additional operations not described, and/or without one or more of the operations discussed. Additionally, the order in which, and/or the operations of method 1000 are illustrated in FIG. 10 and described below is not intended to be limiting.

[0068] In some embodiments, method 1000 may be partially or wholly implemented by one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices may include one or more devices executing some or all of the operations of method 1000 in response to instructions stored electronically on an electronic storage medium. The electronic storage medium may include one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. The one or more processing devices may include one or more devices configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the operations of method 1000.

[0069] At an operation 1002, a body member (e.g., body member 106) is longitudinally translated through a wellbore (e.g., wellbore 104). The body member has an external wall (e.g., external wall 120) facing an internal wall (e.g., internal wall 122) of the wellbore when the body member is within the wellbore. The body member has an internal flow path (e.g., internal flow path 124) configured to facilitate communication of fluid within the wellbore through the body member. Operation 1002 may be performed by allowing the body member to fall within the wellbore under the force of gravity, by pushing the body member through the wellbore, and/or other methods for causing the body member to translate through the wellbore, in accordance with one or more embodiments.

[0070] At an operation 1004, a braking force is applied to the body member to slow and stop translation of the body member through the wellbore. Operation 1004 may be performed using a braking element that is the same as or similar to braking element 108, in accordance with some embodiments.

[0071] At an operation 1006, a first fluidic seal is provided between the external wall of the body member and the internal wall of the wellbore. The first fluidic seal restricts fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore. Operation 1006 may be performed using a sealing element that is the same as or similar to external sealing element 110, in accordance with some embodiments.

[0072] At an operation 1008, a second fluidic seal is provided restricting fluid within the wellbore from being communicated through the internal flow path of the body member.
Operation 1008 may be performed using a sealing element that is the same as or similar to internal sealing element 112, in accordance with some embodiments.

[0073] FIG. 11 illustrates a method 1100 for retrieving a sealing system of the present invention that has been deployed in a wellbore, in accordance with one or more embodiments. The operations of method 1100 presented below are intended to be illustrative. In some embodiments, method 1100 may be accomplished with one or more additional operations not described, and/or without one or more of the operations discussed. Additionally, the order in which the operations of method 1100 are illustrated in FIG. 11 and described below is not intended to be limiting.

[0074] In some embodiments, method 1100 may be partially or wholly implemented by one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices may include one or more devices executing some or all of the operations of method 1100 in response to instructions stored electronically on an electronic storage medium. The electronic storage medium may include one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. The one or more processing devices may include one or more devices configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the operations of method 1100.

[0075] At an operation 1102, a retrieving tool may be deployed to engage a body member (e.g., body member 106) of a sealing system (e.g., apparatus 102) that is positioned within a wellbore (e.g., wellbore 104). Operation 1102 may be performed by allowing the retrieving tool to hook or clasp on the body member, and/or other methods for physically engaging the body member, in accordance with one or more embodiments.

[0076] At an operation 1104, the fluidic seal restricting fluid within a wellbore (from being communicated through the internal flow path of a body member of the sealing system is removed. Operation 1104 may be performed by opening a sealing element that is the same as or similar to internal sealing element 112, in accordance with some embodiments.

[0077] At an operation 1106, the fluidic seal between the external wall of the body member and the internal wall of the wellbore is removed. Operation 1106 may be performed by breaking the seal provided by sealing element that is the same as or similar to external sealing element 110, in accordance with some embodiments.

[0078] At an operation 1108, the braking force applied to the body member to slow and stop translation of the body member through the wellbore is removed. Operation 1108 may be performed by disengaging braking element that is the same as or similar to braking element 108, in accordance with some embodiments, from the wellbore.

[0079] At an operation 1110, the retrieving tool engaging the body member of the sealing system retrieves the sealing system, thereby allowing the wellbore to be utilized again.

[0080] The present application is generally directed to systems and methods for controlling undesired flow of fluid from a wellbore. The exemplary systems may include an apparatus having a body member, a controller/actuation mechanism, a braking element, an external sealing element, and an internal sealing element. The present invention is advantageous over conventional systems and methods as the apparatus is quickly and easily deployable and retrievable.

[0081] Therefore, the present invention is well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment. While numerous changes may be made by those skilled in the art, such changes are encompassed within the spirit of this invention as defined by the appended claims. For instance, it is to be understood that the present invention can address fluid flow reduction or cessation in any tubular member with high fluid flow, but could also be used for controlling low fluid flow, such as a pipe leak at a chemical plant or nuclear reactor, or in any hazardous, inaccessible location, such as on a submarine. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present invention. The terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee.

What is claimed is:

1. An apparatus configured to provide wellbore isolation, the apparatus comprising:
   a body member configured to translate longitudinally through a wellbore, the body member having an external wall facing an internal wall of the wellbore when the body member is within the wellbore, the body member having an internal flow path configured to facilitate communication of fluid within the wellbore through the body member;
   an external sealing element disposed proximate to the external wall of the body member, the external sealing element being configured to provide a first fluidic seal between the external wall of the body member and the internal wall of the wellbore, the first fluidic seal restricting fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore; and
   an internal sealing element disposed proximate to the internal flow path of the body member, the internal sealing element being configured to actuate between an opened position and a closed position, while in the open position the internal sealing element being configured to allow communication of fluid within the wellbore through the
internal flow path of the body member, while in the closed position the internal sealing element being configured to provide a second fluidic seal restricting fluid within the wellbore from being communicated through the internal flow path of the body member.

2. The apparatus of claim 1, further comprising a braking element disposed proximate to the external wall of the body member, the braking element being configured to slow and stop translation of the body member through the wellbore by providing a braking force to the body member.

3. The apparatus of claim 2, wherein the braking force is provided by applying friction to the internal wall of the wellbore.

4. The apparatus of claim 2, wherein the braking element includes one or more of a slip with teeth configured to provide the braking force responsive to contacting the internal wall of the wellbore, a band configured to provide the braking force by expanding to contact the internal wall of the wellbore, or a rough surface configured to provide the braking force responsive to contacting the internal wall of the wellbore.

5. The apparatus of claim 2, wherein the braking force is provided to the body member responsive to the body member reaching a first depth within the wellbore.

6. The apparatus of claim 2, wherein the braking force is provided to the body member responsive to the body member experiencing a first fluid pressure within the wellbore.

7. The apparatus of claim 2, wherein the external sealing element includes one or both of an elastomer packer or a sintered metal sleeve.

8. The apparatus of claim 2, wherein the braking element and the external sealing element form a singular element.

9. The apparatus of claim 1, further comprising a hold-down element disposed proximate to the external wall of the body member, the hold-down element being configured to hold the body member in place within the wellbore by providing a holding force to the body member.

10. The apparatus of claim 1, wherein the external sealing element is configured to provide the first fluidic seal responsive to the body member ceasing to translate within the wellbore.

11. The apparatus of claim 1, wherein the internal sealing element includes one or more of a linear shutter, a radial shutter, an axial shutter, a telescoping closure, or a flapper.

12. The apparatus of claim 1, wherein the internal sealing element is configured to provide the second fluidic seal responsive to the first fluidic seal being provided.

13. The apparatus of claim 1, wherein the internal sealing element is configured to reduce a size of the internal flow path.

14. The apparatus of claim 1, wherein the internal sealing element includes a curved circular disc having a diameter greater than an internal diameter of the body member.

15. The apparatus of claim 1, wherein the internal sealing element includes a curved oval disc having a length greater than an internal diameter of the body member.

16. The apparatus of claim 1, wherein the internal sealing element includes a plurality of baffles.

17. The apparatus of claim 1, further comprising a controller configured to control one or more components of the apparatus.

18. The apparatus of claim 17, wherein the controller is configured to control the internal sealing element to cause the external sealing element to provide the first fluidic seal.

19. The apparatus of claim 17, wherein the controller is configured to control the internal sealing element to cause the internal sealing element to provide the second fluidic seal.

20. The apparatus of claim 17, wherein the controller is configured to control the braking element to cause the braking element to slow and/or stop translation of the body member through the wellbore.

21. The apparatus of claim 1, further comprising one or more sensors disposed proximate to the body member, individual ones of the one or more sensors being configured to provide one or more of (1) a depth signal conveying information associated with a depth of the body member within the wellbore, (2) a pressure signal conveying information associated with a pressure of fluid within the wellbore proximate to the body member, or (3) a temperature signal associated with a temperature of fluid within the wellbore proximate to the body member.

22. The apparatus of claim 1, further comprising one or more weight elements disposed proximate to the body member, a given weight element being configured to decrease a buoyancy of the body member such that the body member falls with gravity within the wellbore and against a flow of fluid within the wellbore.

23. A method for providing wellbore isolation, the method comprising:
   longitudinally translating a body member through a wellbore, the body member having an external wall facing an internal wall of the wellbore when the body member is within the wellbore, the body member having an internal flow path configured to facilitate communication of fluid within the wellbore through the body member; applying a braking force to the body member to slow and stop translation of the body member through the wellbore;
   providing a first fluidic seal between the external wall of the body member and the internal wall of the wellbore, the first fluidic seal restricting fluid within the wellbore from being communicated between the external wall of the body member and the internal wall of the wellbore; and
   providing a second fluidic seal restricting fluid within the wellbore from being communicated through the internal flow path of the body member.

24. An apparatus configured to control fluid flow within a pipe, the apparatus comprising:
   a body member configured to translate longitudinally through the pipe, the body member having an external wall facing an internal wall of the pipe when the body member is within the pipe, the body member having an internal flow path configured to facilitate communication of fluid within the pipe through the body member;
   an external sealing element disposed proximate to the external wall of the body member, the external sealing element being configured to provide a first fluidic seal between the external wall of the body member and the internal wall of the pipe, the first fluidic seal restricting fluid within the pipe from being communicated between the external wall of the body member and the internal wall of the pipe; and
   an internal sealing element disposed proximate to the internal flow path of the body member, the internal sealing element being configured to actuate between an opened position and a closed position, while in the open position the internal sealing element being configured to allow
communication of fluid within the pipe through the internal flow path of the body member, while in the closed position the internal sealing element being configured to provide a second fluidic seal restricting fluid within the pipe from being communicated through the internal flow path of the body member.

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