SYSTEM AND METHOD FOR REMOVING DEBRIS FROM A DOWNHOLE WELLBORE

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ABSTRACT
A method for removing fines and debris from a downhole wellbore in a formation, including introducing a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into the downhole wellbore; positioning the downhole debris removal tool substantially proximal to the fines and debris; circulating fluid through the downhole debris removal tool for disintegrating the fines and debris; and collecting the fines and debris in the downhole debris removal tool for removal out of the downhole wellbore.
FIG. 4

START

ATTACH TOOL TO END OF TUBULAR MEMBERS

RUN TUBULAR MEMBERS AND TOOL INTO FORMATION

CIRCULATE FLUID THROUGH TOOL

DISINTEGRATE RESTRICTION OR BLOCKAGE

RESUME ADVANCEMENT OF TUBULAR MEMBERS AND TOOL

STOP
Fig. 5

START

1. Extract water from downhole wellbore (502)

2. Extract hydrocarbons from downhole wellbore (504)

3. Run tool into downhole wellbore (506)

4. Circulate fluid through tool (508)

5. Disintegrate restriction or blockage (510)

6. Advance tool into downhole wellbore (512)

7. Remove tool from downhole wellbore (514)

8. Resume hydrocarbon extraction (516)

STOP
FIG. 6

START

RUN SUBMERSIBLE PUMPS INTO DOWNHOLE WELLBORE 600

RUN TOOL INTO DOWNHOLE WELLBORE 602

CIRCULATE FLUID THROUGH TOOL 604

DISINTEGRATE COAL FINE MASSES 606

ADVANCE TOOL INTO DOWNHOLE WELLBORE 608

REMOVE TOOL FROM DOWNHOLE WELLBORE 610

START HYDROCARBON EXTRACTION/RECOVERY 612

STOP 614
SYSTEM AND METHOD FOR REMOVING DEBRIS FROM A DOWNHOLE WELLBORE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/804,789, filed 25 Mar. 2013. The entirety of this aforementioned application is incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

[0002] This invention relates, in general, to a system and method for removing debris from a downhole wellbore.

BACKGROUND OF THE INVENTION

[0003] Without limiting the scope of the present invention, its background will be described in relation to a system and method for removing debris from a downhole wellbore, as an example.

[0004] Recovering hydrocarbon gas from downhole environments can be problematic. For example, in coal seam gas recovery operations, water in the wellbores oftentimes impedes the gas recovery process in a particular hydrocarbon bearing formation. In some gas recovery or production processes, one or more horizontally drilled wellbores are intersected or connected with one or more vertical wellbores that contain pumps for removing the water that collects in the wellbore system. After the water is removed through the vertical wellbores, then hydrocarbon gas can be recovered through the same vertical wellbores, for example.

[0005] One problem associated with the de-watering process is that it creates a low bottom hole pressure in the downhole wellbore that causes fines and debris, drawn with the hydrocarbon gas, to accumulate in the horizontal wellbore. Eventually, the horizontal wellbore accumulate enough fines or debris to reduce or block the flow of the hydrocarbon gas into the vertical wellbores causing a reduction in gas production. At this point, the fines or debris must be removed from the wellbore to restore the flow of hydrocarbon gas. Similarly, fines and/or debris may restrict or block the flow of hydrocarbon gas through the vertical wellbores, which then may also need to be removed to restore production gas flows.

SUMMARY OF THE INVENTION

[0006] The present invention disclosed herein is directed to a system and method for removing debris from a downhole wellbore ("downhole debris removal system"). In one embodiment, the present invention is directed to a downhole debris removal tool, including a mandrel having an upper end and a lower end and a central passageway extending therebetween; a screen basket having an upper end and a lower end, the screen basket slidably disposed about the mandrel and operable between an open position and a closed position; and a nose member having an upper end and a lower end and located substantially proximal to and in fluid communication with the lower end of the mandrel, the lower end of the nose member having one or more outlets for providing a stream of fluid therethrough.

[0007] In one aspect, the lower end of the screen basket may include a flared end for sealing with the upper end of the nose member when in the closed position. Additionally, the upper end of the screen basket may be in a sealed arrangement with the mandrel for creating an annular space between the inner surface of the screen basket and the outer surface of the mandrel for retaining fines and debris. Further, the upper end of the nose member may terminate in an angular shoulder for sealing with the flared end of the lower end of the screen basket.

[0008] In another aspect, the screen basket may include a plurality of screen openings sized to allow fluid to pass through while retaining fines and debris. Also, the flared end may be a gage ring. The downhole debris removal tool may also include an upper sub connected to the upper end of the mandrel, the upper sub having a larger diameter than the mandrel for engaging with the upper end of the screen basket when in the open position.

[0009] In another embodiment, the present invention may be directed to a method for removing fines and debris from a downhole wellbore in a formation, including introducing a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into the downhole wellbore; positioning the downhole debris removal tool substantially proximal to the fines and debris; circulating fluid through the downhole debris removal tool for disintegrating the fines and debris; and collecting the fines and debris in the downhole debris removal tool for removal out of the downhole wellbore.

[0010] In one aspect, the disintegrating the fines and debris may include flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool. Also, the collecting the fines and debris may include filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool. Further, the method may include advancing distally the tubing string into the downhole wellbore.

[0011] In another aspect, the introducing a tubing string having a downhole debris removal tool may further include flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool. Additionally, the positioning the downhole debris removal tool may include reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris. In yet another aspect, the collecting the fines and debris in the downhole debris removal tool may further include slidingly closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.

[0012] In yet another embodiment, the present invention may be directed to a method for recovering hydrocarbon gas from a downhole wellbore in a formation, including providing one or more substantially lateral wellbores and one or more substantially vertical wellbores in fluid communication with one another in the formation; introducing a subsurface pump into one or more of the one or more vertical wellbores; extracting water from the downhole wellbore through one or more of the substantially vertical wellbores; extracting the hydrocarbon gas from the downhole wellbore through one or more of the one or more substantially lateral wellbores and the one or more substantially vertical wellbores; introducing a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into the downhole wellbore; positioning the downhole debris removal tool substantially proximal to a blockage of fines and debris; circulating fluid through the downhole debris removal tool for disintegrating the blockage of fines and debris; and
collecting the fines and debris in the downhole debris removal tool for removal out of the downhole wellbore.

[0013] In one aspect, the method may further include removing the downhole debris removal tool from the downhole wellbore. Also, the method may further include resuming the extraction of the hydrocarbon gas from the downhole wellbore through one or more of the one or more substantially lateral wellbores and the one or more substantially vertical wellbores. In another aspect, the disintegrating the blockage may include flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool.

[0014] In yet another aspect, the collecting the fines and debris may include filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool. Further, the positioning the downhole debris removal tool may include reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris. Additionally, the collecting the fines and debris in the downhole debris removal tool may include slidably closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.

[0015] In still yet another embodiment, the present invention may be directed to a method for recovering hydrocarbon gas from a coal seam gas well, including providing one or more substantially lateral wellbores and one or more substantially vertical wellbores; circulating fluid through the downhole debris removal tool disposed substantially near the lower end of the tubing string into one or more of the one or more substantially lateral wellbores; circulating fluid through the downhole debris removal tool disposed substantially near the lower end of the tubing string into one or more of the one or more substantially vertical wellbores. Also, the method may further include moving distally the downhole debris removal tool further into the coal seam gas well. In another aspect, the disintegrating a mass of coal fines may include flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool. Additionally, the collecting the fines and debris may include filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool.

[0016] In yet another aspect, the positioning the downhole debris removal tool may further include reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris. Further, the collecting the fines and debris in the downhole debris removal tool may further include slidably closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.

[0017] For a more complete understanding of the features and advantages of the present invention, reference is now made to the detailed description of the invention along with the accompanying figures in which corresponding numerals in the different figures refer to corresponding parts and in which:

[0018] FIG. 1 is a schematic illustration of a downhole debris removal system according to an embodiment;
[0019] FIG. 2 is a schematic illustration of a downhole debris removal system according to another embodiment;
[0020] FIG. 3A is a cross-section view of a downhole debris removal tool in a first operating position of the downhole debris removal system according to an embodiment;
[0021] FIG. 3B is a cross-section view of a downhole debris removal tool in a second operating position of the downhole debris removal system according to an embodiment;
[0022] FIG. 3C is a side view of a downhole debris removal tool of the downhole debris removal system according to an embodiment;
[0023] FIG. 4 is a flowchart of a process for removing fines and debris from a downhole wellbore of the downhole debris removal system according to an embodiment;
[0024] FIG. 5 is a flowchart of a process for removing fines and debris from a downhole wellbore of the downhole debris removal system according to another embodiment; and
[0025] FIG. 6 is a flowchart of a process for removing coal fines from a downhole wellbore in a coal seam of the downhole debris removal system according to another embodiment.

[0026] For a more complete understanding of the features and advantages of the present invention, reference is now made to the detailed description of the invention along with the accompanying figures in which corresponding numerals in the different figures refer to corresponding parts and in which:

[0027] While the making and using of various embodiments of the present invention are discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts which can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative of specific ways to make and use the invention, and do not limit the scope of the present invention.

[0028] In the following description of the representative embodiments of the invention, directional terms, such as “above,” “below,” “upper,” “lower,” etc., are used for convenience in referring to the accompanying drawings. In general, “above,” “upper,” “upward,” and similar terms refer to a direction toward the earth’s surface along a wellbore, and “below,” “lower,” “downward,” and similar terms refer to a direction away from the earth’s surface along the wellbore. Additionally, the term “proximal” refers to a linear, non-linear, or curvilinear distance or point nearer to a point of reference or direction that is closer to a relative term or object, and the term “distal” refers to a linear, non-linear, or curvilinear distance or point farther to a point of reference or direction that is farther to a relative term or object.

[0029] Referring to FIG. 1, a downhole debris removal system in use with an oil and gas production unit is schematically illustrated and generally designated 50. One or more water onshore extraction control units 52-52n (collectively water extraction control units 52) are located over an oil and gas formation 54. Although downhole debris removal system 50 is discussed herein with reference to onshore production, downhole debris removal system 50 may be used with any type of onshore or offshore oil and/or gas rig and/or operation.
as are commonly known to those skilled in the art. A wellhead installation 56 may include a blowout preventer 58, which may be located on ground 60 for providing fluid communication and control between formation 54 and oil and gas operations, such as a coiled tubing unit (not shown), for example. As is known to those skilled in the art, wellhead installation 56 and blowout preventer 58 are part of many different configurations of oil and gas rigs, platforms, operations, and the like, and that other components that may be commonly associated with processing and recovering hydrocarbon gases and fluids for consumer use are not shown or described herein. Further, downhole debris removal system 50 may be used with other types of hydrocarbon recovery operations that are commonly known to those skilled in the art.

[0030] In another embodiment, other types of surface control units other than wellhead installation 56 and blowout preventers 58 may be used with downhole debris removal system 50. For example, a coiled tubing unit may be in place of wellhead installation 56 and blowout preventers 58.

[0031] A wellbore 62 extends through the various earth strata including formation 54. A casing 64 may be cemented within a vertical and/or horizontal section of wellbore 62 by cement 66. Even though FIG. 1 depicts one lateral wellbore 62, it should be understood by those skilled in the art that downhole debris removal system 50 may be used in conjunction with any number of vertical and/or lateral wellbores. Additionally, wellbore 62 may be a cased or open hole wellbore in fluid communication with one or more vertical wellbores, as described further below.

[0032] Downhole debris removal system 50 may include a conduit 68, such as coiled tubing or tubular members, which provide fluid communication to the downhole end of wellbore 62. Some examples of conduit 68 may include casing liners, and the like. Additionally, downhole debris removal system 50 may include one or more vertical wellbores 70a-70n (collectively vertical wellbores 70) that are in fluid communication with wellbore 62.

[0033] FIG. 1 shows a substantially cased wellbore 62 where conduit 68 extends substantially towards the end of wellbore 62. In this embodiment, conduit 68 may include perforations, screens, and the like for allowing gas and liquids to pass from formation 54 into conduit 68. Additionally in this embodiment, wellbore 62 may be partially or fully cemented. As shown in FIG. 1, cement 66 is not in place throughout the entire length of wellbore 62.

[0034] In another embodiment, wellbore 62 may be an open hole wellbore 62 where conduit 68 is not in place throughout the entire length of wellbore 62. In this embodiment, conduit 68 may extend a partial length through wellbore 62, but may end prior to vertical wellbores 70. In yet another embodiment, conduit 68 may extend any length through wellbore 62.

[0035] In addition, even though FIG. 1 depicts downhole debris removal system 50 in a substantially horizontal wellbore, it should be understood by those skilled in the art that downhole debris removal system 50 is equally well suited for use in wells having other directional configurations including horizontal wells, vertical wells, deviated wellbores, slanted wells, multilateral wells, and the like.

[0036] Although three substantially vertical wellbores 70 are shown in FIG. 1, any number of vertical wellbores 70 may be included with the present downhole debris removal system. Vertical wellbores 70 and wellbore 62 may all be in fluid communication with each other and may constitute a well system, in one embodiment.

[0037] Downhole debris removal system 50 may further include one or more conduits 72a-72n (collectively conduits 72) in fluid communication with one or more pumps 74a-74n (collectively pumps 74) for extracting water and other fluids from any portions, including vertical, horizontal, lateral, and the like, of wellbore 62 as described further below. As shown in FIG. 1, conduit 72a is located in vertical wellbore 70a, conduit 72b is located in vertical wellbore 70b, and conduit 72c is located in vertical wellbore 70c. As discussed above, any number of vertical wellbores 70 may be used with downhole debris removal system 50. Additionally, in some instances, downhole debris removal system 50 may be used in a wellbore system that includes wellbore 62 but does not include vertical wellbores 70. In yet another embodiment, downhole debris removal system 50 may be used in a wellbore system that includes vertical wellbores 70 but does not include wellbore 62. Conduits 72 may be any type of tubular members, pipes, etc. that provide a pathway/flowpath between pumps 74 and water extraction control units 52 for gases, liquids, and fluids as are commonly known to those skilled in the art.

[0038] Further, downhole debris removal system 50 may include a downhole debris removal tool 76 for removing fines and debris from any portions of wellbore 62, in one embodiment. As shown in FIG. 1, downhole debris removal tool 76 is located substantially between vertical wellbores 70a and vertical wellbore 70n for clearing fines and debris in this section of wellbore 62, in one example. Further, downhole debris removal tool 76 may be moved along and through any section of wellbore 62, such as from any vertical wellbores 70 to any other vertical wellbores 70 as desired for selectively removing fines and debris disposed or accumulated in any portions of wellbore 62, in one embodiment.

[0039] As shown in FIG. 1, downhole debris removal system 50 may include one or more wellbores 62 for extracting hydrocarbon gas, water, and other gases and fluids. In addition, this wellbore may be used to extract or remove fines and debris with downhole debris removal tool 76 when parts of the well system become blocked or restricted by accumulated fines and debris in the well system. Additionally, wellbores 70a-70n may be used for extracting or removing water for de-watering the well system and they may also be used for recovering hydrocarbon gas from formation 54 once a desirable amount of water has been removed from the well system. In another embodiment, other components may be used in vertical wellbores 70 for de-watering the well system and recovering/controlling the recovery of hydrocarbons, such as hydrocarbon liquid and/or gas, that are commonly known to those skilled in the art.

[0040] Turning now to FIG. 2, a downhole debris removal system in use with two oil and gas production units are schematically illustrated and generally designated 100. In describing downhole debris removal system 100 many of the corresponding numerals shown refer to corresponding elements, parts, and the like described relative to downhole debris removal system 50, thus they may not be repeated in detail below. As shown in FIG. 2, downhole debris removal system 100 further includes another oil and gas production unit including blowout preventer 102 and wellhead installation 104 for recovering oil and gas from a substantially vertical wellbore, such as vertical wellbore 70a.
Wellhead installation 56, including blowout preventer 58, are located on ground 60 for providing fluid communication and control between formation 54 and oil and gas operations, such as a coiled tubing unit (not shown), for example. As is known to those skilled in the art, wellhead installation 56 and blowout preventer 58 may be part of many different configurations of oil and gas rigs, platforms, operations, and the like, and that other components that may be commonly associated with processing hydrocarbon gases and fluids are not shown or described herein.

Wellbore 70a extends through the various earth strata including formation 54. Even though FIG. 2 depicts one substantially lateral wellbore 62 and one substantially vertical wellbore 70a for recovering hydrocarbon gases and fluids, it should be understood by those skilled in the art that downhole debris removal system 100 may be used in conjunction with any number of wellbores, such as lateral wellbore 62. Further, downhole debris removal system 100 may be used with any number of substantially horizontal wellbores and vertical wellbores of a wellbore system. Additionally, wellbores 62 and 70a may be cased or open hole wellbores in fluid communication with one or more vertical wellbores, as described further herein.

In addition, even though FIG. 2 depicts downhole debris removal system 100 with a substantially vertical wellbore, it should be understood by those skilled in the art that the downhole debris removal system is equally well suited for use in wells or well systems having other directional configurations including horizontal wells, vertical wells, deviated wellbores, slanted wells, multilateral wells and the like.

Downhole debris removal system 100 may include a conduit 106, such as coiled tubing, tubular members, pipe, and the like which provides fluid communication to the downhole end of wellbore 70a. Additionally, downhole debris removal system 100 may include one or more vertical wellbores 70b-70n (collectively vertical wellbores 70) that are in fluid communication with wellbores 62 and 70a. Although three vertical wellbores 70a-70n are shown in FIG. 2, any number of vertical wellbores 70 may be included with the present downhole debris removal system. Vertical wellbores 70 and wellbore 62 may all be in fluid communication with each other and may constitute a well system, in one embodiment.

Conduit 106 is in fluid communication with formation 54 for extracting hydrocarbon gas and other fluids from any portions, including vertical, horizontal, lateral, and the like, of formation 54 as described further below. Further, downhole debris removal system 100 may include a downhole debris removal tool 76 located within vertical wellbore 70a for removing fines and debris from any portions of wellbore 70a, in one embodiment. As can be seen in FIG. 2, downhole debris removal tool 76 is also located with wellbore 62.

As shown in FIG. 2, downhole debris removal system 100 may include one or more wellbores 62 and 70a for extracting hydrocarbon gas, water, and other gases and fluids. In addition, these wellbores may be used to extract or remove fines and debris with downhole debris removal tool 76 when parts of the well system become blocked or restricted by accumulated fines and debris in the well system. Additionally, wellbores 70b-70m may be used for extracting or removing water for de-watering the well system and they may also be used for recovering hydrocarbon gas from formation 54 once a desirable amount of water has been removed from the well system.

Downhole debris removal systems 50, 100 may include any number of downhole debris removal tools 76 for removing accumulated fines and debris within any of the wellbores of the well or well system. In addition, several downhole debris removal tool 76 may be used in series or in a stacked configuration in each of one or more wellbore 62 and vertical wellbores 70. For example, a series of downhole debris removal tools 76 may be located one above another along a work string and the like for utilizing in a downhole well environment.

Referring now to FIGS. 3A-3C, one embodiment of downhole debris removal tool 76 is shown. Downhole debris removal tool 76 includes a substantially tubular upper end 302 and upper sub 304 having a substantially tubular axially threaded end or connector 306 for coupling to a lower end of a tubular member or conduits 68 and 106 located above upper sub 304. Downhole debris removal tool further includes a lower end 308. Lower end 308 preferably is adapted to engage a collection of sand or other mass of fines and debris within formation 54 and/or the well system. In one embodiment, lower end 308 may be beveled or conical in shape for improved removal or engagement with fines and debris in formation 54 and/or well system. Lower end 308 also should be adapted or configured to provide a stream of fluid therethrough and thus, like upper end 302, may also be substantially tubular.

Most preferably, lower end 308 forms a nose cone or member 310 with one or more fluid nozzles, outlets, or jets sized and positioned to provide multiple jets of fluid at the leading end of nose member 310. For example, nose member 310 may have a first outlet 312 along the longitudinal axis (L.A) of downhole debris removal tool 76. Additionally, nose member 310 also may have one or more angled nozzles, outlets, or jets 314 that are angled relative to L.A, for example.

Extending between upper end 302 and the lower end 308 of downhole debris removal tool 76 is a substantially tubular member, such as mandrel 316. In one embodiment, the upper end of nose member 310 may be threadedly connected to the lower end of mandrel 316 via threaded ends or connectors 317, while the lower end of upper sub 304 may be threadedly connected to the upper end of mandrel 316 via threaded ends or connectors 305. These thread connections may be provided with or include seals, such as O-rings (not shown). Still further, mandrel 316 may be integrally formed with the upper sub 304, nose member 310, or both. Additionally, mandrel 316 may consist of one member or may be one or more members that provide a flow path between upper sub 304 and nose member 310. Thus, the lumens, passageways, or flowpaths of the upper sub 304, mandrel 316, and nose member 310 are continuous and form a flow passageway extending end-to-end through the downhole debris removal tool 76.

A strainer or screen basket 320 is slantly supported on mandrel 316 substantially between upper sub 304 and nose member 310. In one embodiment, an annular flowpath or space 325 is provided between the inner surface of screen basket 320 and the outer surface of mandrel 316 for providing a flowpath for the recovered fluids and fines from wellbore 62 and vertical wellbores 70. While the structure and shape of screen basket 320 may vary, in a preferred form, screen basket 320 includes a tubular body 322 having multiple screen open-
ings 324, which are disposed through and about tubular body 322. In one embodiment, screen basket 320 may be made from screen type materials that provide fluid flow through while retaining fines and debris.

Additionally, the diameter or size of screen openings 324 may be determined based on the size of fines and debris that are to be recovered from wellbore 62 and vertical wellbores 70. The size of screen openings 324 should be such that the fines and debris recovered by downhole debris removal tool 76 in wellbore 62 and vertical wellbores 70 are trapped in space 325 of downhole debris removal tool 76 while providing for the flow of fluid through screen openings 324 of downhole debris removal tool 76 as discussed further below.

The upper end of tubular body 322 may include an upper end member 326 that is slidably disposed about mandrel 316. Upper end member 326 preferably may have a sloped exterior wall 328 on its upper or uphole end. The lower or downhole end of tubular body 322 is open for providing an opening or entrance to space 325 for enabling the flow of fines, debris, and fluid to flow into space 325 as discussed further below. In this particular embodiment, the lower or downhole end of tubular body 322 may include a gage ring 330 with a flared inlet 332. Gage ring 330 may be connected to the end of tubular body 322 by a threaded coupler 334.

Another embodiment, in place of gage ring 330, a belted or flared end may be formed to the lower end of tubular body 322. The upper end of member 310 preferably has a flanged annular shoulder 336 to facilitate a sealing engagement with inlet 332 of gage ring 330 of screen basket 320 when downhole debris removal tool 76 is in a substantially closed position as best shown in FIG. 3B.

Now it will be understood that as the tubing string, such as conduit 68, is advanced into any of wellbores 62 and 70, screen basket 320 will be urged upwardly on mandrel 316 allowing fines and debris carried in the well fluids to enter inlet 332 as shown by flowpath 327. Screen openings 324 of screen basket 320 trap the fines and debris substantially within space 325 while allowing well fluid to flow through screen openings 324 by flowpath 329. When the tubing string is withdrawn from the well system, screen basket 320 will be urged downwardly on the mandrel 316 until the flared inlet 332 abuts shoulder 336 and closes screen basket 320 thus trapping the fines and debris within space 325 of downhole debris removal tool 76. This allows the collected fines and debris to be removed from the well system and pulled up to the surface.

Downhole debris removal system 50 and downhole debris removal system 100 may also include methods of extracting fines and debris from one or more well systems in formation 54, for example. With reference to FIG. 4, an embodiment of a method for removing fines and debris from a well and/or well system in formation 54 is schematically and generally designated 400. In step 402, downhole debris removal tool 76 may be attached to the end of one or more conduits and/or tubing strings, such as conduit 68 and conduits 72, to be run into formation 54. In step 404, the conduit and/or tubing string including downhole debris removal tool 76 may then be introduced into formation 54 and advanced in a conventional manner.

In step 406, while the tubing string is advanced into one or more of wellbores 62 and/or vertical wellbores 70, fluid may be circulated down through the tubing string through passageway 318 in downhole debris removal tool 76 and out the end of one or more outlets 312, 314. This flow will agitate the well fluids and assist in the flow of fluid, fines, and debris into inlet 332 of gage ring 330. This is shown via flowpath 327 entering inlet 332, where fines, debris, and fluid enter space 325. Fines and debris are then screened or trapped within space 325 while fluid is allowed to pass through screen openings 324 shown via flowpath 329. Fluid flow through downhole debris removal tool 76 may be continuous or intermittent.

In step 408, if a mass of fines, coal fines, sand, or other debris restricts or blocks the downhole wellbore, advancement of the tubing string may be halted while the fluid flow through downhole debris removal tool 76 is continued. Additionally, the tubing string may even be withdrawn slightly during this step to further facilitate the breaking up and removal of such a blockage. This step will allow one or more of outlets 312 and outlets 314 to force jet streams of fluid on the obstruction until it is broken and dislodged. This step may also include allowing fluid flow to be increased to facilitate the disintegration of the plug or obstruction, if necessary. In step 410, advancement of the tool string may be resumed until the operation is completed.

Now it will be appreciated that this method provides removal of fines and debris from a downhole wellbore in a formation, such as formation 54. Downhole debris removal tool 76 enables continuous fluid flow while the drill string is advanced to agitate well fluids and debris, enhancing the operation of the tool and reducing the likelihood that operation will be interrupted by blockages of sand and debris in the well.

With reference now to FIG. 5, another embodiment of a method for removing fines and debris from a well and/or well system in formation 54 is schematically and generally designated 500. In this embodiment, one or more substantially lateral wellbores, such as wellbore 62 may be intersected with one or more substantially vertical wellbores 70. In this embodiment, wellbore 62 and vertical wellbores 70 may be cased or open hole wellbores as commonly known to those skilled in the art.

In step 502, water may be first extracted from vertical wellbores 70 via conduits 72, pumps 74, and water extraction control units 52. This dewatering step may occur through any or all of vertical wellbores 70, for example. This step may include operating one or more water extraction control units 52 for controlling the flow of water through pumps 74 and conduits 72 to dewater the downhole wellbore or well system formed by the intersection of the substantially lateral section of wellbore 62 and vertical wellbores 70. In step 504, hydrocarbon gas may be recovered or extracted from one or more of wellbore 62 and vertical wellbores 70. This step may include additional processing of the hydrocarbon gas subsequent to recovering it above ground 60, for example.

Once fines and debris begin to accumulate in the downhole wellbore in formation 54, the flow of hydrocarbon gas may become restricted or blocked fully thereby reducing or stopping production of the hydrocarbon gas above ground 60. In step 506, downhole debris removal tool 76 may be run into the downhole well or well system and positioned substantially adjacent or proximal to the restriction or blockage. In step 508, fluid may be circulated down through the tubing string through passageway 318 in downhole debris removal tool 76 and out the end of outlets 312 and 314. This flow will agitate the well fluids and assist in the flow of fines, debris, and fluid through into inlet 332 as shown in flowpath 327 and
into space 325. Fines and debris will be screened or trapped within space 325 while fluid flow will occur through screen openings 324 as shown in flowpath 329. Fluid flow through downhole debris removal tool 76 may be continuous or intermittent.

[0063] In step 510, if a mass of fines, coal fines, sand, or other debris restricts or blocks the downhole wellbore, advancement of the tubing string may be halted while the fluid flow through downhole debris removal tool 76 is continued. Additionally, the tubing string may even be withdrawn slightly during this step to further facilitate the breaking up and removal of such a blockage. This step will allow one or more of outlet 312 and outlets 314 to force jet streams of fluid on the obstruction until it is broken and dislodged. This step may also include allowing fluid flow to be increased to facilitate the disintegration of the plug or obstruction, if necessary. In step 512, advancement of the tool string may be resumed until the operation is completed.

[0064] In step 514, downhole debris removal tool 76 may be removed from the downhole wellbore or well system. In step 516, recovery or extraction of the hydrocarbon gas may be resumed through one or more of wellbore 62 and vertical wellbores 70 as described herein. This step may include recovering and further processing the hydrocarbon gas above ground 60 via one or more of wellbore 62 and vertical wellbores 70, in one example.

[0065] Now it will be appreciated that that this method provides removal of fines and debris from a downhole wellbore in a formation, such as formation 54. Downhole debris removal tool 76 enables continuous fluid flow while the drill string is advanced to agitate well fluids and debris, enhancing the operation of the tool and reducing the likelihood that operation will be interrupted by blockages of fines, sand, and debris in the well.

[0066] With reference now to FIG. 6, an embodiment of a method for removing coal fines from a well and/or well system in formation 54 is schematically and generally designated 600. This particular embodiment may be applicable for coal seam gas wells, in one example. In this embodiment, one or more substantially lateral wellbores, such as wellbore 62 is intersected with one or more substantially vertical wellbores 70. In this embodiment, wellbore 62 and vertical wellbores 70 may be cased or open hole wellbores as commonly known to those skilled in the art. In this embodiment, formation 54 may be a coal seam as is commonly known to those skilled in the art.

[0067] In step 602, submersible pumps 74 are run into or positioned in one or more vertical wellbores 70 and operated to extract water from the downhole wellbore or well system via conduits 72 and water extraction control units 52, for example. As the water is pulled into the substantially lateral section of wellbore 62, coal fines begin to accumulate and restrict one or more of wellbore 62 and vertical wellbores 70. Due to the low bottom hole pressure, the coal fines are difficult to circulate out of the substantially lateral section of wellbore 62 and/or lower sections of vertical wellbores 70 and they accumulate creating blockages within one or more of wellbore 62 and vertical wellbores 70, for example.

[0068] In step 604, downhole debris removal tool 76 may be run into the downhole well or well system and positioned substantially adjacent or proximal to the restriction or blockage caused by the accumulation of the coal fines. In steps 606 and 608, fluid may be circulated down through the tubing string to passageway 318 in downhole debris removal tool 76 and out the end of one or more outlets outlet 312, 314. This flow will agitate the well fluids and assist in the flow of fluid, fines, and debris into inlet 332 of gage ring 330. This is shown in flowpath 327 entering inlet 332, where fines, debris, and fluid enter space 325. Fines and debris are then screened or trapped within space 325 while fluid is allowed to pass through screen openings 324 shown in flowpath 329. Fluid flow through downhole debris removal tool 76 may be continuous or intermittent.

[0069] Additionally regarding step 608, if a mass of coal fines restricts or blocks the downhole wellbore, advancement of the tubing string may be halted in any of the wellbores while the fluid flow is continued, and the tubing string may even be withdrawn slightly. This step provides for a forceful stream of fluid to exit one or more outlet 312 and outlets 314 to work on the obstruction of coal fines until it is broken and dislodged. This step may also include allowing fluid flow to be increased to facilitate the disintegration of the plug or obstruction, if necessary. This step may further include capturing the coal fines in one or more downhole debris removal tool 76. This step further includes having a pore size or screen mesh size of screen basket 320 to retain or collect the coal fines while simultaneously allowing fluid to pass through screen openings 324 of screen basket 320. In step 610, advancement of the tool string may be resumed until the operation is completed.

[0070] In step 612, downhole debris removal tool 76 may be removed from the downhole wellbore or well system. In step 614, recovery or extraction of the hydrocarbon gas may begin through one or more of wellbore 62 and vertical wellbores 70 as described herein. This step may include recovering and further processing the hydrocarbon gas above ground 60 via one or more of wellbore 62 and vertical wellbores 70, in one example.

[0071] Now it will be appreciated that that this method provides removal of fines and debris from a downhole wellbore in a formation, such as formation 54. Downhole debris removal tool 76 enables continuous fluid flow while the drill string is advanced to agitate well fluids and debris, enhancing the operation of the tool and reducing the likelihood that operation will be interrupted by blockages of fines, sand, and debris in the well.

[0072] While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications and combinations of the illustrative embodiments as well as other embodiments of the invention will be apparent to persons skilled in the art upon reference to the description. It is, therefore, intended that the appended claims encompass any such modifications or embodiments.

What is claimed is:

1. A downhole debris removal tool, comprising:
   a mandrel having an upper end and a lower end and a central passageway extending therebetween;
   a screen basket having an upper end and a lower end, the screen basket slidably disposed about the mandrel and operable between an open position and a closed position; and
   a nose member having an upper end and a lower end and located substantially proximal to and in fluid communication with the lower end of the mandrel, the lower end of the nose member having one or more outlets for providing a stream of fluid therethrough.
2. The downhole debris removal tool as recited in claim 1, wherein the lower end of the screen basket includes a flared end for sealing with the upper end of the nose member when in the closed position.

3. The downhole debris removal tool as recited in claim 1, wherein upper end of the screen basket is in a sealed arrangement with the mandrel for creating an annular space between the inner surface of the screen basket and the outer surface of the mandrel for retaining fines and debris.

4. The downhole debris removal tool as recited in claim 2, wherein the upper end of the nose member terminates in an angular shoulder for sealing with the flared end of the lower end of the screen basket.

5. The downhole debris removal tool as recited in claim 1, wherein the screen basket includes a plurality of screen openings sized to allow fluid to pass through while retaining fines and debris.

6. The downhole debris removal tool as recited in claim 2, wherein the flared end is a gage ring.

7. The downhole debris removal tool as recited in claim 1, further comprising:
   an upper sub connected to the upper end of the mandrel, the upper sub having a larger diameter than the mandrel for engaging with the upper end of the screen basket when in the open position.

8. A method for removing fines and debris from a downhole wellbore in a formation, comprising:
   introducing a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into the downhole wellbore;
   positioning the downhole debris removal tool substantially proximal to the fines and debris;
   circulating fluid through the downhole debris removal tool for disintegrating the fines and debris; and
   collecting the fines and debris in the downhole debris removal tool for removal out of the downhole wellbore.

9. The method as recited in claim 8, wherein the disintegrating the fines and debris comprises:
   flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool.

10. The method as recited in claim 8, wherein the collecting the fines and debris comprises:
    filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool.

11. The method as recited in claim 8, further comprising:
    advancing distally the tubing string into the downhole wellbore.

12. The method as recited in claim 8, wherein the introducing a tubing string having a downhole debris removal tool further comprises:
    flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool.

13. The method as recited in claim 8, wherein the positioning the downhole debris removal tool further comprises:
    reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris.

14. The method as recited in claim 8, wherein the collecting the fines and debris in the downhole debris removal tool further comprises:
    slidably closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.

15. A method for recovering hydrocarbon gas from a downhole wellbore in a formation, comprising:
    providing one or more substantially lateral wellbores and one or more substantially vertical wellbores in fluid communication with one another in the formation;
    introducing a submersible pump into one or more of the one or more vertical wellbores;
    extracting water from the downhole wellbore through one or more of the substantially vertical wellbores;
    extracting the hydrocarbon gas from the downhole wellbore through one or more of the one or more substantially lateral wellbores and the one or more substantially vertical wellbores;
    introducing a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into the downhole wellbore;
    positioning the downhole debris removal tool substantially proximal to a blockage of fines and debris;
    circulating fluid through the downhole debris removal tool for disintegrating the blockage of fines and debris; and
    collecting the fines and debris in the downhole debris removal tool for removal out of the downhole wellbore.

16. The method as recited in claim 15, further comprising:
    removing the downhole debris removal tool from the downhole wellbore.

17. The method as recited in claim 15, further comprising:
    removing the extraction of the hydrocarbon gas from the downhole wellbore through one or more of the one or more substantially lateral wellbores and the one or more substantially vertical wellbores.

18. The method as recited in claim 15, wherein the disintegrating the blockage comprises:
    flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool.

19. The method as recited in claim 15, wherein the collecting the fines and debris comprises:
    filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool.

20. The method as recited in claim 15, wherein the positioning the downhole debris removal tool further comprises:
    reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris.

21. The method as recited in claim 15, wherein the collecting the fines and debris in the downhole debris removal tool further comprises:
    slidably closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.

22. A method for recovering hydrocarbon gas from a coal seam gas well, comprising:
    providing one or more substantially lateral wellbores and one or more substantially vertical wellbores in fluid communication with one another in a coal seam;
    introducing a submersible pump into one or more of the one or more vertical wellbores;
    extracting water from the downhole wellbore through one or more of the substantially vertical wellbores;
running a tubing string having a downhole debris removal tool disposed substantially near the lower end of the tubing string into one or more of the one or more substantially lateral wellbores; circulating fluid through the downhole debris removal tool for disintegrating a mass of coal fines; collecting the coal fines in the downhole debris removal tool for removal out of the coal seam gas well; removing the downhole debris removal tool from the coal seam gas well; and extracting the hydrocarbon gas from the coal seam gas well through one or more of the one or more substantially lateral wellbores and the one or more substantially vertical wellbores.

23. The method as recited in claim 22, wherein the running a tubing string may further comprise:
running a second tubing string having a downhole debris removal tool disposed substantially near the lower end of the second tubing string into one or more of the one or more substantially vertical wellbores.

24. The method as recited in claim 22, further comprising: moving distally the downhole debris removal tool further into the coal seam gas well.

25. The method as recited in claim 22, wherein the disintegrating a mass of coal fines comprises: flowing a fluid under pressure through one or more outlets disposed through the end of the downhole debris removal tool.

26. The method as recited in claim 22, wherein the collecting the fines and debris comprises:
filtering the fines and debris from the fluid through screens disposed about the downhole debris removal tool.

27. The method as recited in claim 22, wherein the positioning the downhole debris removal tool further comprises:
reversing direction of travel of the tubing string to create a larger distance between the downhole debris removal tool and the fines and debris.

28. The method as recited in claim 22, wherein the collecting the fines and debris in the downhole debris removal tool further comprises:
sidably closing the downhole debris removal tool to contain the fines and debris within the downhole debris removal tool.