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(54) **SAND CONTROL SYSTEM AND METHODOLOGY EMPLOYING A TRACER**

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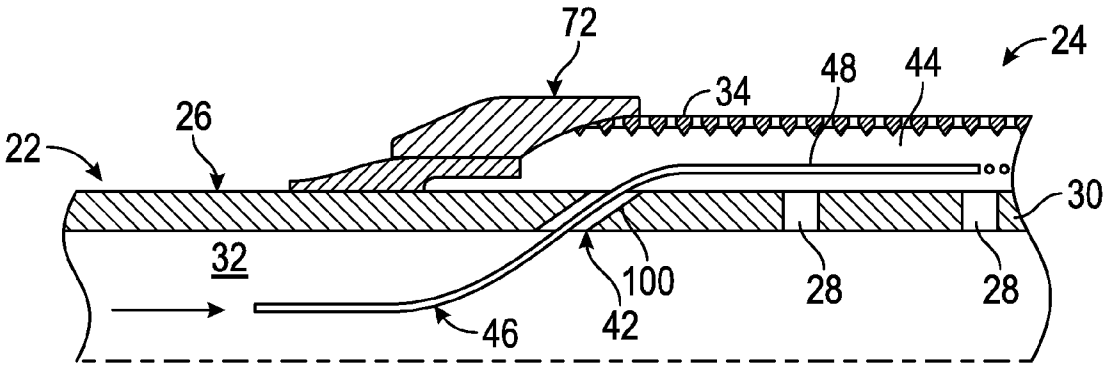
USPC **166/250.12**; 166/227

(57) **ABSTRACT**

A technique facilitates detection of specific constituents in a well fluid as it is produced from a reservoir. The technique employs a screen assembly having a base pipe and a filter media coupled with the base pipe. An access opening is provided in the screen assembly for insertion of a tracer into a region between the base pipe and the filter media. The tracer is then secured in the region between the base pipe and the filter media. The technique enables selection and application of specific, interchangeable tracers while in the field, e.g. at a well site.



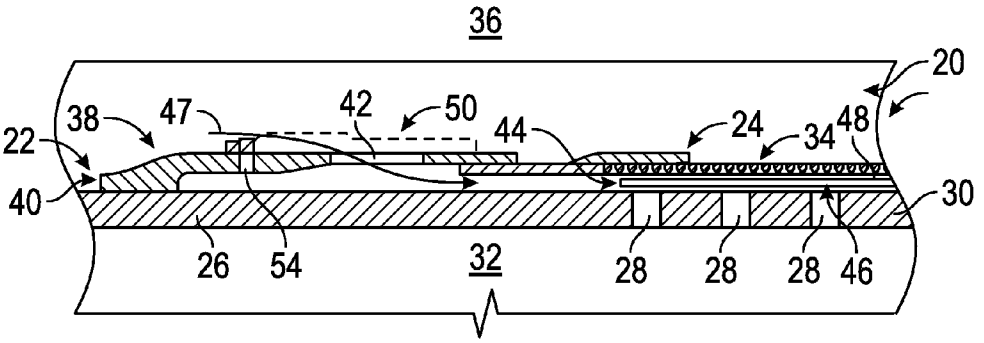

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FIG. 1

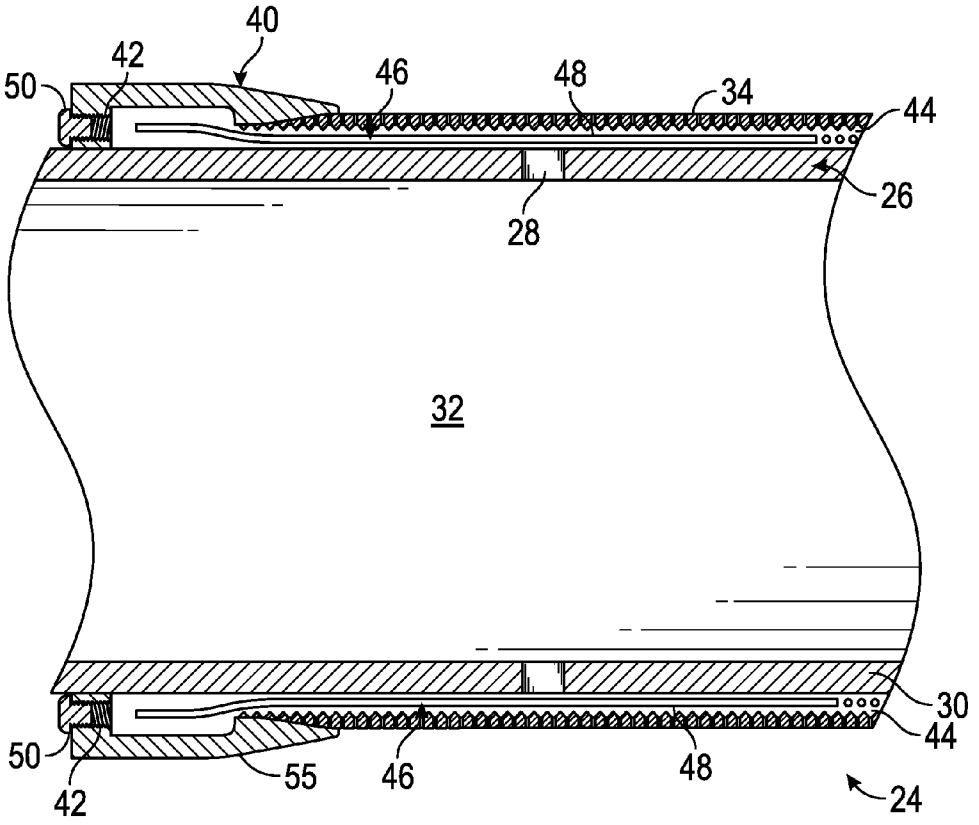
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FIG. 2

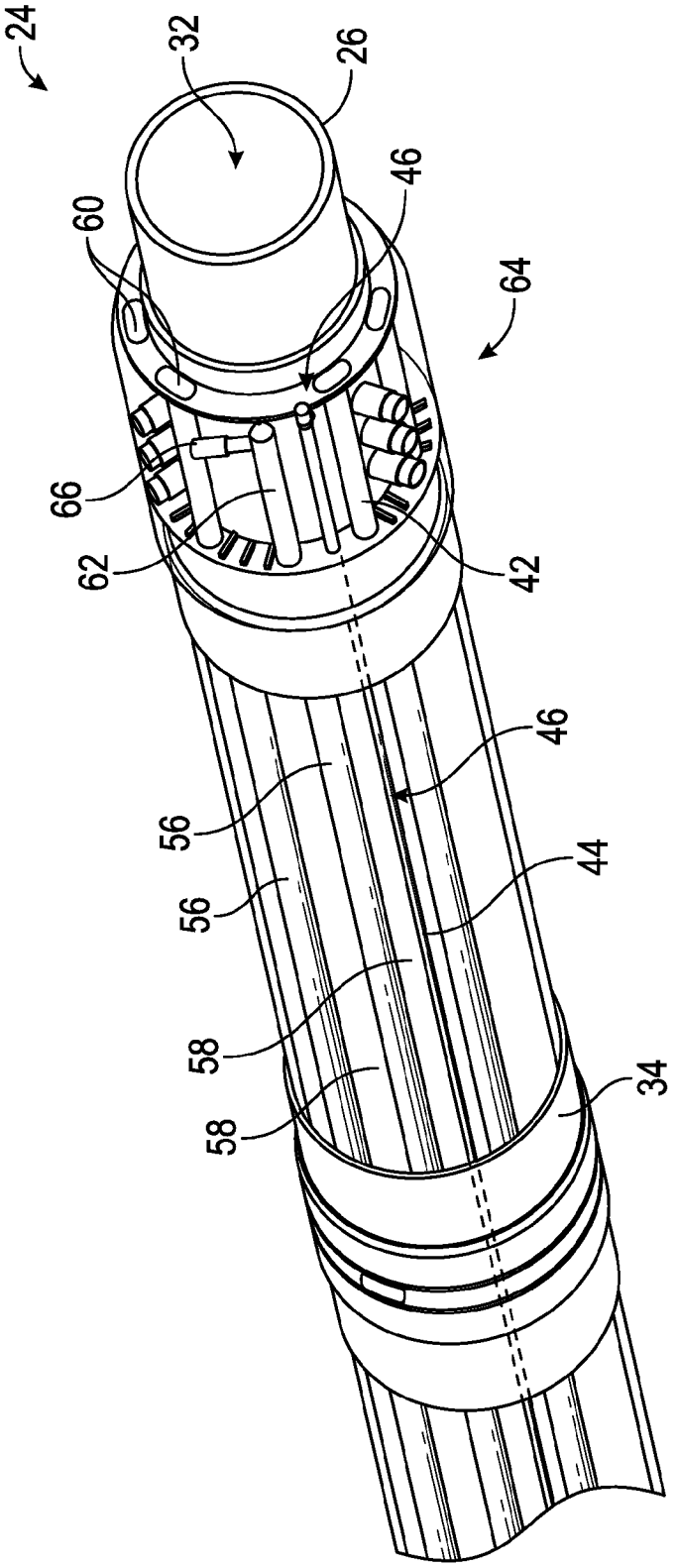

FIG. 3

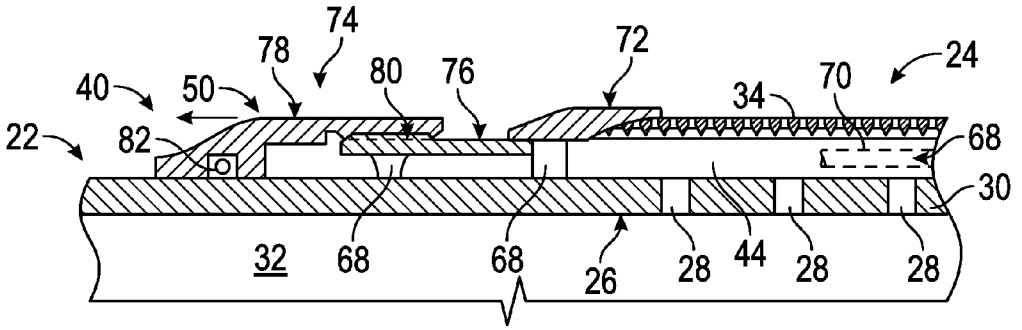

FIG. 4

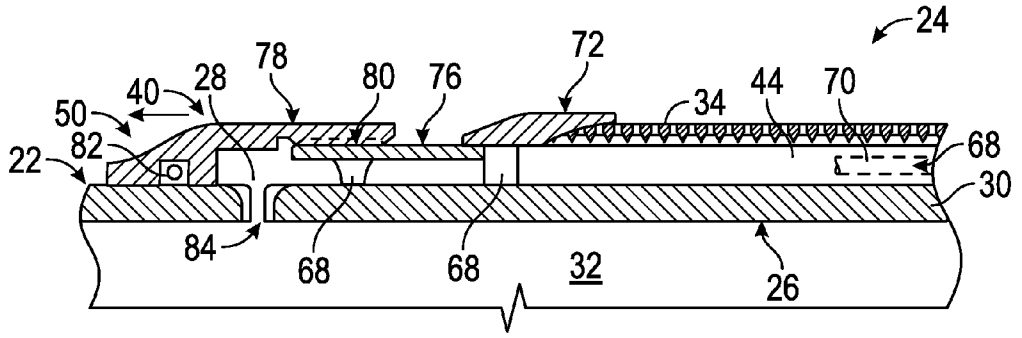

FIG. 5

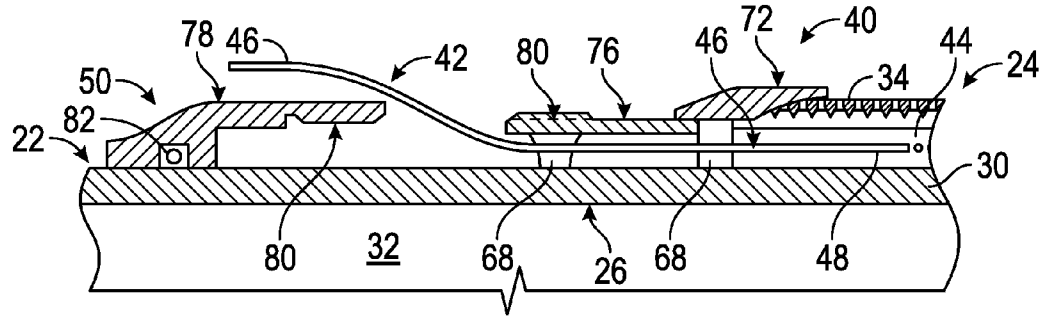

FIG. 6

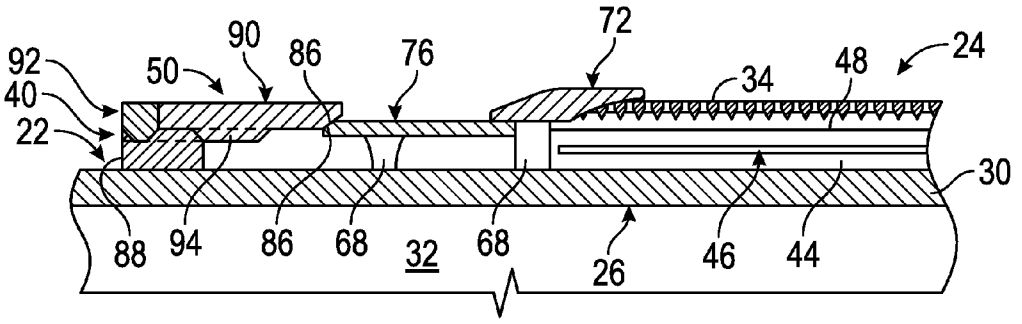

FIG. 7

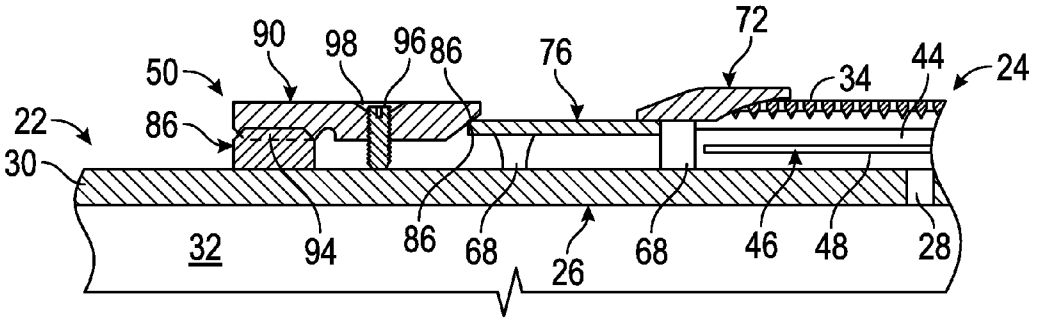

FIG. 8

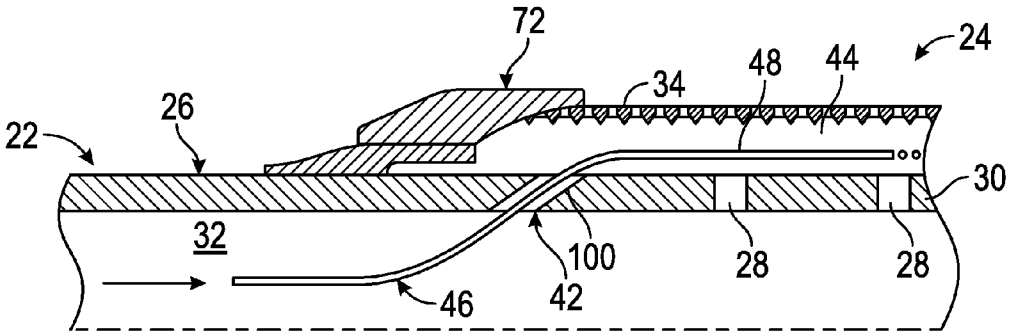

FIG. 9

SAND CONTROL SYSTEM AND METHODOLOGY EMPLOYING A TRACER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present document is based on and claims priority to U.S. Provisional Application Ser. No. 61/872,311 filed Aug. 30, 2013, and to U.S. Provisional Application Ser. No. 61/878,169 filed Sep. 16, 2013, both of which are incorporated herein by reference.

BACKGROUND

[0002] Hydrocarbon fluids such as oil and natural gas are obtained from a subterranean geologic formation, referred to as a reservoir, by drilling a well that penetrates the hydrocarbon-bearing formation. Once a wellbore is drilled, various forms of well completion components, including sand control systems, may be installed in the well. In certain applications, detection systems are employed to help operators analyze the types of well fluids, e.g. oil, water, and/or gas, being produced from specific well zones. In many applications, the detection systems are installed during manufacture of the completion system components and lack adaptability with respect to making adjustments to the detection systems in the field.

SUMMARY

[0003] In general, a system and methodology are provided for facilitating detection of constituents, e.g. oil, water, and gas, in a well fluid as it is produced from a reservoir. The technique employs a screen assembly having a base pipe and a filter media coupled with the base pipe. An access opening is provided in the screen assembly for insertion of a tracer into a region between the base pipe and the filter media. The tracer is then secured in the region between the base pipe and the filter media. The technique enables selection and application of specific, interchangeable tracers while in the field, e.g. at a well site.

[0004] However, many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Certain embodiments of the disclosure will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements. It should be understood, however, that the accompanying figures illustrate the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

[0006] FIG. **1** is a schematic illustration of an example of a well system comprising a screen assembly deployed in a wellbore and having an insertable tracer, according to an embodiment of the disclosure;

[0007] FIG. **2** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure;

[0008] FIG. **3** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure;

[0009] FIG. **4** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure;

[0010] FIG. **5** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure;

[0011] FIG. **6** is an illustration of an example of a screen assembly having an access opening in an open position for insertion of a tracer, according to an embodiment of the disclosure;

[0012] FIG. **7** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure;

[0013] FIG. **8** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure; and

[0014] FIG. **9** is an illustration of another example of a screen assembly having an insertable tracer, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0015] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

[0016] The disclosure herein generally involves a tracer which may be combined with a screen assembly of a downhole well completion system. The tracer may comprise chemical elements or other elements which are released upon sufficient exposure to a specific constituent. In well applications, for example, the tracer may release elements indicative of a specific well fluid constituent, such as oil, water, gas, or another constituent, that may be found in the well fluid produced from a subterranean reservoir.

[0017] In an embodiment, a well system comprises a tracer which may be selected and readily inserted into a completion component while in the field, e.g. at a well site. In this example, the technique facilitates detection of specific well fluid constituents, e.g. water, in a well fluid as it is produced from a reservoir. The technique employs a screen assembly having a base pipe and a filter media coupled with the base pipe. An access opening is provided in the screen assembly for insertion of a tracer into a region between the base pipe and the filter media. The tracer is then secured in the region between the base pipe and the filter media. In some examples, the tracer is secured by attaching a cover over the access opening. This type of system enables the selection and application of specific tracers for specific screen assemblies while in the field, e.g. at a well site. Accordingly, an operator has great flexibility in customizing well fluid monitoring with respect to the parameters of a specific well fluid, well application, and/or subterranean environment.

[0018] Referring generally to FIG. **1**, an example of a well system **20** is illustrated in the form of a well string comprising a sand control completion **22** having at least one screen assembly **24**. The screen assembly **24** comprises a base pipe **26** with a port or a plurality of ports **28** extending radially through a base pipe wall **30** between an exterior and an interior passage **32** of the base pipe **26**. The screen assembly **24** further comprises a filter media **34** disposed about the base pipe **26** in a position so as to filter a flow of well fluid during, for example, a production operation. During production, the well fluid may flow from a reservoir/formation **36** and into a wellbore **38** in which the sand control completion **22** is

deployed. From an annulus of the wellbore **38**, the well fluid flows inwardly through filter media **34** and through base pipe wall **30**, via ports **28**, to interior passage **32**. The interior passage **32** directs the well fluid to a surface location or other suitable location.

[0019] In the example illustrated, the filter media **34** is secured to the base pipe **26** by a friction fitted direct wrap filter media **34** and/or by a housing **40**, e.g. an end ring, which may be positioned at an axial end or ends of the filter media **34**. The filter media **34** may comprise wire wrap, mesh, and/or other filter material for filtering sand from the fluid flowing inwardly from the surrounding formation **36**. The screen assembly **24** further comprises an access opening **42** extending to a region **44** between the base pipe **26** and the filter media **34**. By way of example, the access opening **42** may be formed through housing **40** although the access opening **42** may be positioned at other locations. In some applications, the housing **40** may comprise a standard end ring at one longitudinal end of the filter media **34** and an end ring constructed with the access opening **42** at the other longitudinal end of the filter media **34**.

[0020] A tracer **46** is sized for insertion through the access opening **42**, as represented by arrow **47**. The tracer **46** is inserted into the region **44** between base pipe **26** and filter media **34** after assembly of the base pipe **26** and the filter media **34**. In this example, the tracer **46** is elongated and may be in the form of an elongated rod or strip **48**. The tracer **46** comprises chemical elements or other elements which are released when sufficiently exposed to a specific fluid or fluids, e.g. oil, water, or gas.

[0021] During a production operation, for example, well fluid flows from reservoir **36**, into wellbore **38**, through filter media **34**, and into contact with tracer **46** in region **44**. The tracer **46** is formulated and selected so that if a specific constituent is present in the well fluid, e.g. water, chemical elements or other elements are released from the tracer **46**. The tracer elements flow with the inflowing fluid through ports **28** and into interior **32** of base pipe **26**. The well fluid then flows along the interior passage **32** to a surface location or other location with appropriate sensors to detect the presence of the tracer elements. Detection of the tracer elements provides a control system/operator with an indication that the specific constituent is present at a specific well zone along the wellbore **38**.

[0022] Additionally, a cover **50** may be removably positioned over the access opening **42** so as to ensure sand control is maintained and to secure the tracer **46** in region **44** after insertion of the tracer **46** through access opening **42**. The removable cover **50** may be removably attached to housing **40** or to another suitable component by a variety of techniques. In the illustrated embodiment, removable cover **50** is removably attached by a securing device **54**, such as a threaded fastener, latch, pin or other suitable securing device. In some embodiments, removable cover **50** may be a ring or sleeve having threads along its interior for removable attachment to housing **40** by mating with corresponding threads on housing **40**.

[0023] Referring generally to FIG. **2**, another embodiment of screen assembly **24** is illustrated. In this embodiment, housing **40** is in the form of an end ring or end rings **55**, and access opening **42** extends through at least one of the end rings **55**. In the example illustrated, the access opening **42** extends through end ring **55** in a longitudinal/axial direction to facilitate longitudinal insertion of tracer **46** into the region **44** between base pipe **26** and filter media **34**. In this example, cover **50** is in the form of a plug, such as a sand controlling fit plug, threaded cap, bolt, or other suitable type plug. In some applications, a plurality of the access openings **42** may be provided through the housing **40** to enable insertion of a plurality of tracers **46** into region **44**. Access opening(s) **42** also may be a radial opening in housing **40** or a slanted opening oriented at a selected angle between radial and longitudinal orientations.

[0024] In some applications, longitudinal elements **56** may be arranged in region **44** to create longitudinal channels **58** into which the tracer(s) **46** may be inserted, as illustrated in FIG. **3**. By way of example, the longitudinal elements **56** may comprise axial rods sized to provide a desired distance between base pipe **26** and filter media **34**. However, in some embodiments the longitudinal elements **56** may comprise transport tubes, **60**, packing tubes **62**, and/or other types of tubes or solid members disposed between base pipe **26** and filter media **34**. In the example illustrated in FIG. **3**, the housing **40** comprises a torque sleeve **64** which may comprise packing tube nozzles **66** in communication with the corresponding packing tubes **62**. The tracer **46** may be inserted through access opening **42** and positioned between the longitudinal elements **56**. It should be noted that portions of the filter media **34** and outer surface of the torque sleeve **64** have been illustrated as see-through surfaces to better illustrate the longitudinal elements **56** and other internal features.

[0025] Referring generally to FIG. **4**, another embodiment of screen assembly **24** is illustrated. In this embodiment, a plurality of standoffs **68** may be positioned between the base pipe **26** and the filter media **34** to maintain separation between the filter media **34** and the base pipe **26**, thus maintaining region **44**. By way of example, the standoffs **68** between base pipe **26** and filter media **34** may comprise longitudinal rods **70** or other suitable standoffs which facilitate movement of fluid along region **44**. The longitudinal rods **70** may be circumferentially spaced around the base pipe **26** to create channels for fluid flow, such as the longitudinal channels **58** described above. Additionally, standoffs **68** may be located between base pipe **26** and housing **40**.

[0026] In the embodiment illustrated, housing **40** comprises an end ring **72** which engages the filter media **34** and the base pipe **26** to provide structural support and a connection between the filter media **34** and the base pipe **26**. The housing **40** further comprises an access assembly **74** which may comprise a bypass ring **76** and a removable ring assembly **78**. In this example, the removable ring assembly **78** serves as cover **50**. The bypass ring **76** may be connected to end ring **72** by welding or by another suitable fastening mechanism. Additionally, the removable ring assembly **78** may be secured to the bypass ring **76** via a threaded engagement region **80** or by another suitable fastener. The removable ring assembly **78** also may be sealed against an external surface of the base pipe **26** by a suitable seal **82**, such as an O-ring seal. The seal **82** may be formed from, for example, a plastic material or a Teflon material to provide a sand seal for the removable ring assembly **78**.

[0027] In some embodiments, an inflow control device (ICD) **84** may be disposed in the base pipe **26**, as illustrated in FIG. **5**. By way of example, the ICD **84** may comprise an orifice, nozzle, and/or tortuous flow path which establishes port **28** for communication with interior **32**. A single ICD **84** or a plurality of ICDs **84** may be used to regulate flow into the interior **32** of base pipe **26**. For example, fluid from reservoir

36 flows through filter media 34, into region 44, along the channels between standoffs 68, into access assembly 74, through the ICD 84, and into interior 32 of base pipe 26. However, the ICD 84 can be positioned at other suitable locations.

[0028] Referring again to the embodiments of FIGS. 4 and 5, the access assembly 74 and removable ring assembly 78/cover 50 are illustrated in a closed position. However, the removable ring assembly 78 may be disconnected from bypass ring 76 via unthreading removable ring assembly 78 from bypass ring 76 at threaded engagement region 80. The removable ring assembly 78 is then slid away from the bypass ring 76 to provide the access opening 42, as illustrated in FIG. 6. The tracer 46 may then be inserted through access opening 42 and into region 44 between the standoffs 68. In some embodiments, the tracer 46 is in the form of elongate strip or rod 48 and constructed with limited flexibility so it may be inserted along region 44 with limited bending.

[0029] As described above, the tracer 46 may comprise chemical elements or other elements which are released as a specific fluid flows past the tracer 46 and into interior 32 of base pipe 26. The released elements may be monitored at a surface location of the well or at other suitable locations within the well to provide information related to constituents of the well fluid produced from certain well zones into interior 32. The easy removability of cover 50/removable ring assembly 78 enables a variety of tracers 46 to be selected at the well site and positioned between the base pipe 26 and filter media 34. In other words, the desired tracer 46 may be selected in the field rather than being mounted during a manufacturing process at a manufacturing facility.

[0030] Referring generally to FIG. 7, another embodiment of screen assembly 24 is illustrated. In this embodiment, the removable ring assembly 78 and the bypass ring 76 are provided with tapered ends 86 which meet each other to provide a taper fit. The tapered ends 86 effectively provide a sand control seal between the bypass ring 76 and the removable ring assembly 78 when the removable ring assembly 78 is in the closed position. In this example, the removable ring assembly 78 comprises a stationary ring component 88 and an adjustable ring element 90. The removable ring assembly 78 may further comprise a locking member 92, such as a lock nut.

[0031] The adjustable ring element 90 is removably secured to the stationary ring component 88 by, for example, a threaded region 94 or other suitable fastener. This allows the ring element 90 to be unthreaded with respect to stationary ring component 88 so as to separate the tapered ends 86 and to create access opening 42. The removable ring assembly 78/cover 50 may again be closed by threading the adjustable ring element 90 with respect to the stationary ring element 88 so as to move tapered ends 86 together and to close the access opening 42. The tracer 46 may be inserted through the open access opening 42, as described above.

[0032] Referring generally to FIG. 8, another embodiment of screen assembly 24 is illustrated. This embodiment is similar to the embodiment illustrated in FIG. 7, but the locking member 92 comprises a set screw 96 which is threadably engaged with an opening 98 through adjustable ring element 90. When the adjustable ring element 90 is moved into engagement with bypass ring 76 via engagement of tapered ends 86, the set screw 96 may be threaded into engagement with base pipe 26, as illustrated. The set screw 96 is thus able to securely hold the adjustable ring element 90 in the closed position once tracer 46 is inserted into region 44.

[0033] In FIG. 9, another embodiment is illustrated in which access opening 42 is in the form of a base pipe opening 100. The base pipe opening 100 provides an opening through which the tracer 46 may be inserted into region 44 from interior 32 of base pipe 26. The base pipe opening 100 is sized to accommodate tracer 46 and may be angled through the wall 30 of base pipe 26. For example, the base pipe opening 100 may be angled from 15° to 60° with respect to a perpendicular opening extending radially through wall 30 of base pipe 26. In some applications the base pipe opening 100 may be sized 2 to 10 times larger in diameter than base pipe ports 28. The base pipe opening 100 also may comprise a slot aligned with the base pipe axis to guide the tracer 46 into opening 100. By way of example, the slot may have a length of 2 to 10 times longer than the diameter of base pipe ports 28 and a width at least as wide as the corresponding tracer 46.

[0034] In an operational example, the screen assembly 24 is assembled at a manufacturing facility. However, tracers 46 may be selected and inserted into the corresponding screen assembly 24 at a well site. In some applications, the screen assembly 24 is shipped to a staging area at the well site with the access opening 42 in a closed position. At the staging area and prior to running the screen assembly 26 into the well, an operator can choose to insert a selected tracer 46 into region 44 of screen assembly 26 by opening the access opening 42. This allows the user to select a specific tracer 46 at the time tracer 46 is to be used in the wellbore 38. The user simply exposes the access opening 42 by removing cover 50, e.g removing the removable ring assembly 78, inserting the desired tracer 46, and closing the access opening 42. The screen assembly 24 is then delivered downhole into wellbore 38 via well string system 20.

[0035] Depending on the application, many types of sand control completions 22 may be employed in the overall well system 20. Additionally, the sand control completions 22 may comprise single or multiple screen assemblies 24 having many types of base pipes 26, filter media 34, housings 40, and/or tracers 46. Additionally, the housings 40 may comprise end rings having a variety of components, connections, and/or features depending on the parameters of a given application. Additionally, many types of standoffs, flow tubing, and/or other components may be positioned in the region 44 between the base pipe 26 and the filter media 44.

[0036] Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

What is claimed is:

1. A system for use in a wellbore, comprising:

a screen assembly having:

a base pipe with at least one port extending between an exterior and an interior of the base pipe to enable a flow of fluid through the at least one port to the interior;

a filter media disposed about the base pipe in a position to filter the flow of fluid as it flows to the at least one port for entry into the interior;

an access opening extending to a region between the base pipe and the filter media; and

a tracer sized for insertion through the access opening to the region between the base pipe and the filter media after assembly of the filter media to the base pipe.

2. The system as recited in claim **1**, wherein the screen assembly further comprises a removable cover which is securable over the access opening.

3. The system as recited in claim **2**, wherein the removable cover comprises openings sized to provide sand control.

4. The system as recited in claim **2**, wherein the screen assembly comprises a housing coupling the filter media to the base pipe, the removable cover being selectively securable to the end housing.

5. The system as recited in claim **2**, wherein the removable cover comprises a plug which is selectively insertable into the access opening.

6. The system as recited in claim **2**, wherein the removable cover comprises a removable ring assembly.

7. The system as recited in claim **2**, wherein the removable cover comprises a removable ring assembly working in cooperation with an end ring coupled between the filter media and the base pipe.

8. The system as recited in claim **2**, wherein the removable cover comprises a removable ring assembly held in position by a lock member.

9. The system as recited in claim **1**, wherein the tracer comprises an elongate member having a chemical released in the presence of a specific fluid.

10. A method, comprising:

providing a screen assembly with a base pipe and a filter media;

inserting a tracer through an access opening and into a region between the base pipe and the filter media while the filter media is coupled to the base pipe; and

securing the tracer in the region between the base pipe and the filter media.

11. The method as recited in claim **10**, wherein securing comprises attaching a cover over the access opening.

12. The method as recited in claim **10**, further comprising coupling the screen assembly into a well string and delivering the screen assembly downhole into a wellbore.

13. The method as recited in claim **12**, further comprising producing a well fluid which flows through the filter media, into contact with the tracer, and through the base pipe to an interior of the base pipe.

14. The method as recited in claim **13**, further comprising monitoring the well fluid after the well fluid flows along the interior of the base pipe for the presence of elements from the tracer indicative of a specific constituent in the well fluid.

15. The method as recited in claim **14**, wherein monitoring comprises monitoring for elements from the tracer indicative of water in the well fluid.

16. The method as recited in claim **11**, wherein attaching comprises attaching a removable end ring which engages the base pipe and the filter media.

17. The method as recited in claim **10**, wherein inserting comprises inserting the tracer longitudinally along the region and between standoffs separating the filter media from the base pipe.

18. The method as recited in claim **10**, wherein inserting comprises inserting the tracer through the base pipe from an interior of the base pipe.

19. A system, comprising:

a screen assembly having:

a base pipe with an interior passage and a flow port in communication with the interior passage;

a filter media coupled to the base pipe to form a region between the filter media and the base pipe; and

a housing coupled between the base pipe and the filter media, the housing being configured to provide an access opening to the region to enable insertion of a tracer element.

20. The system as recited in claim **19**, further comprising the tracer element inserted into the region through the access opening, the tracer element being an elongate element positioned between standoffs maintaining the region between the filter media and the base pipe.

* * * * *