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**Atkinson et al.**(10) **Pub. No.: US 2012/0175112 A1**(43) **Pub. Date: Jul. 12, 2012**(54) **GRAVEL PACKING IN LATERAL  
WELLBORE****Publication Classification**(51) **Int. Cl.**  
**E21B 43/04** (2006.01)(52) **U.S. Cl.** ..... **166/278; 166/51**(57) **ABSTRACT**

A technique facilitates performance of a treatment application in a lateral wellbore. The technique may be employed in an open lateral wellbore and comprises deploying a completion within the open wellbore wall of the lateral wellbore. A service tool is used in cooperation with the completion to perform a gravel packing or other well treatment operation while maintaining hydrostatic pressure on the open lateral wellbore to prevent collapse of the open lateral wellbore. A variety of features may be incorporated into the completion or used in cooperation with the completion to facilitate the well treatment operation while maintaining the hydrostatic pressure until completion of the desired gravel pack.

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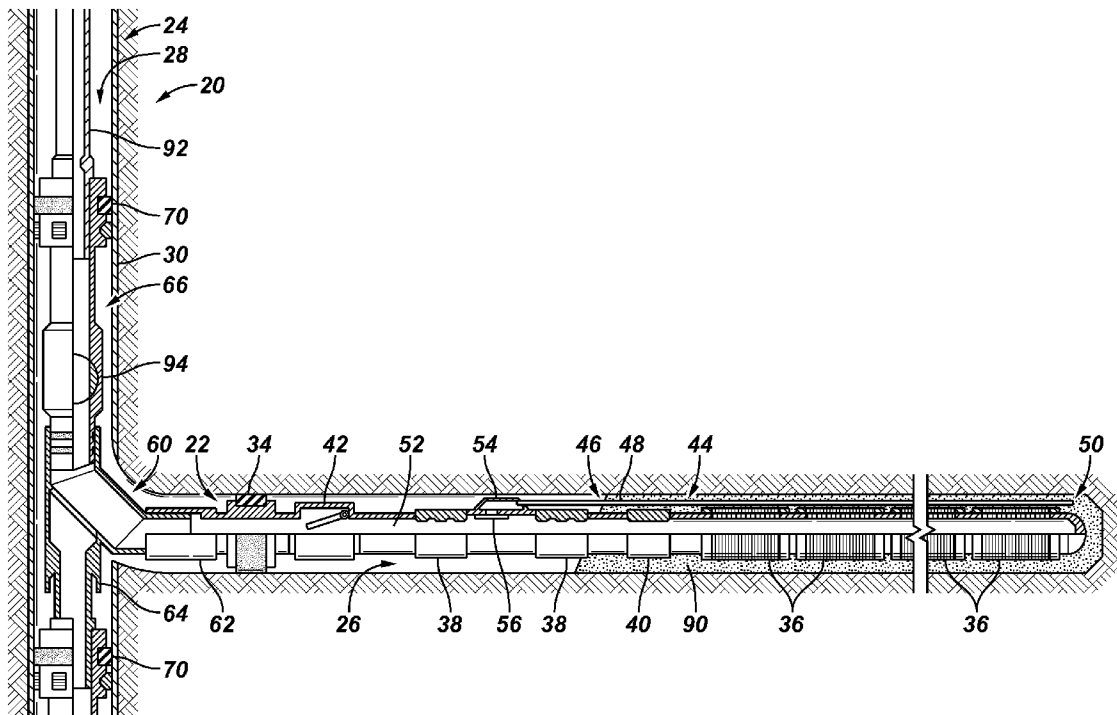


FIG. 1

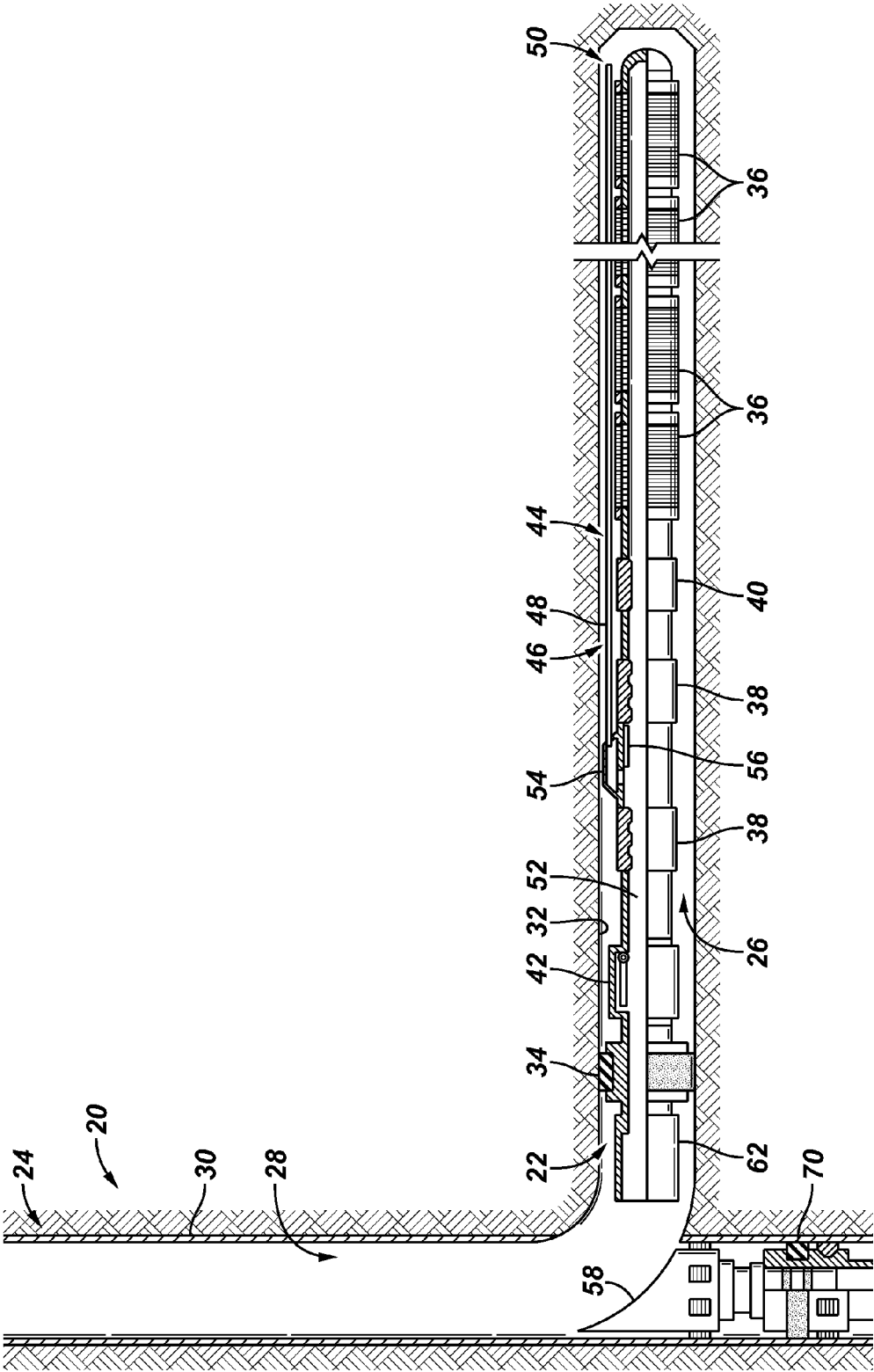


FIG. 2

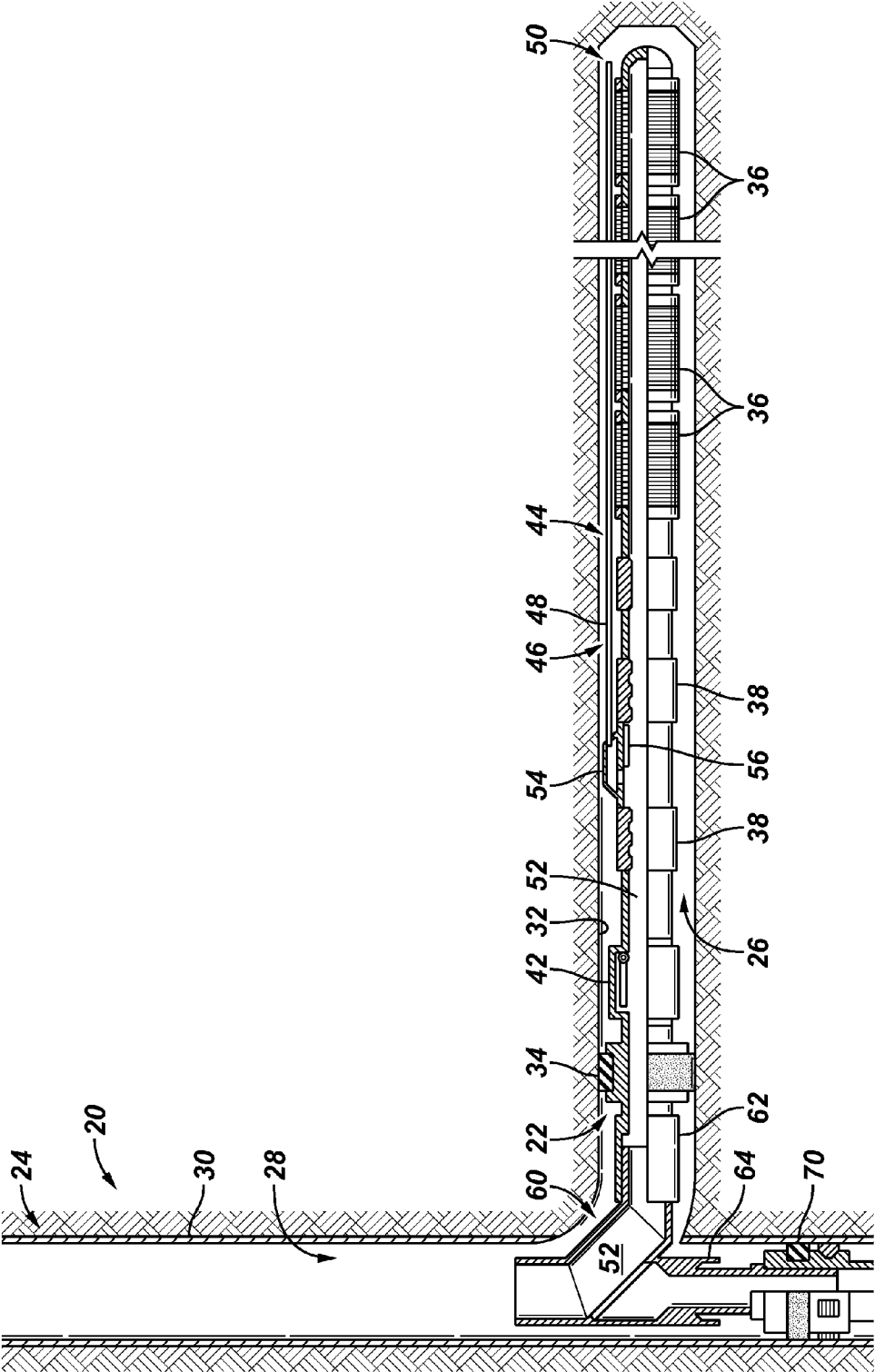


FIG. 3

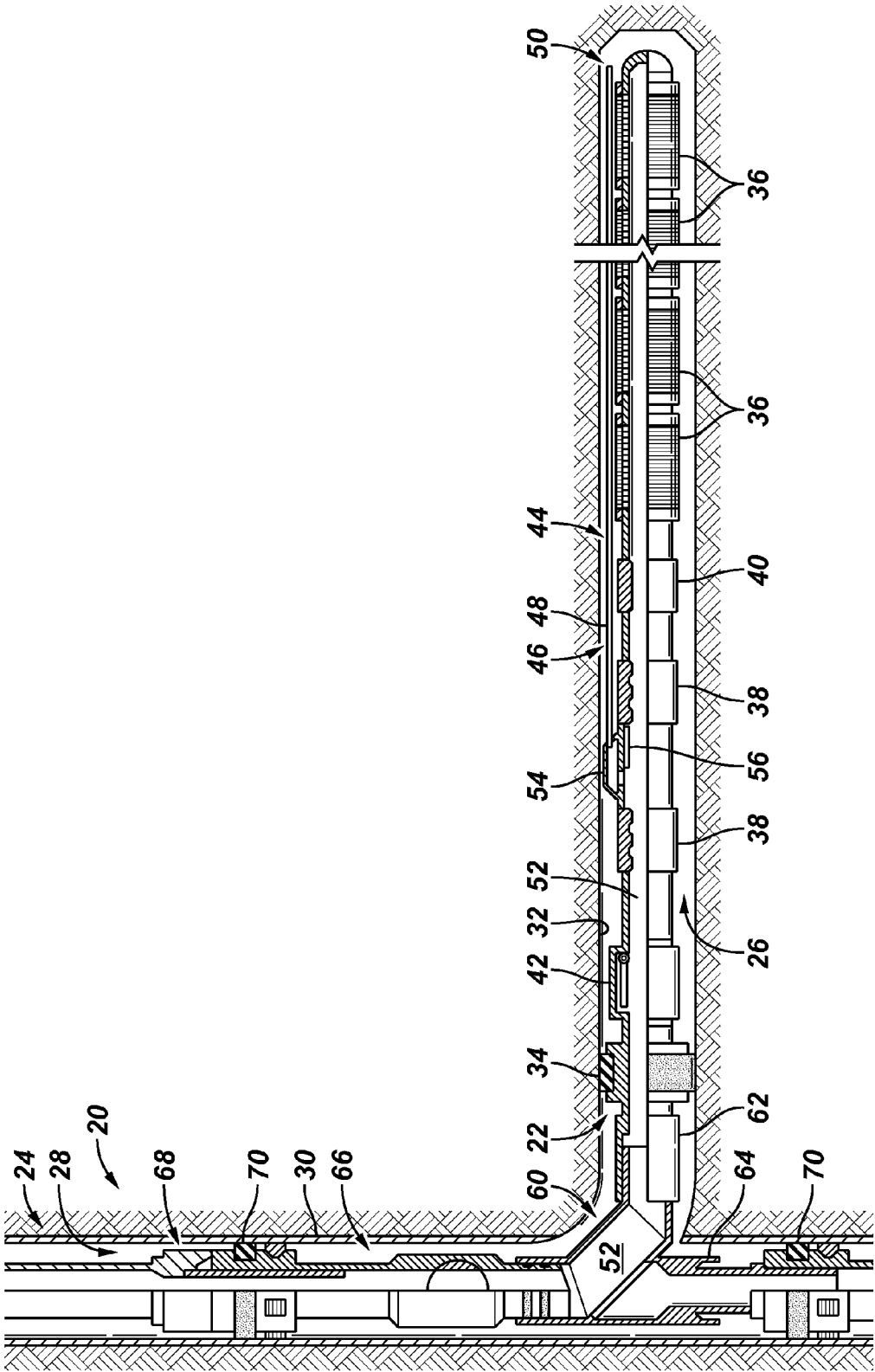


FIG. 4

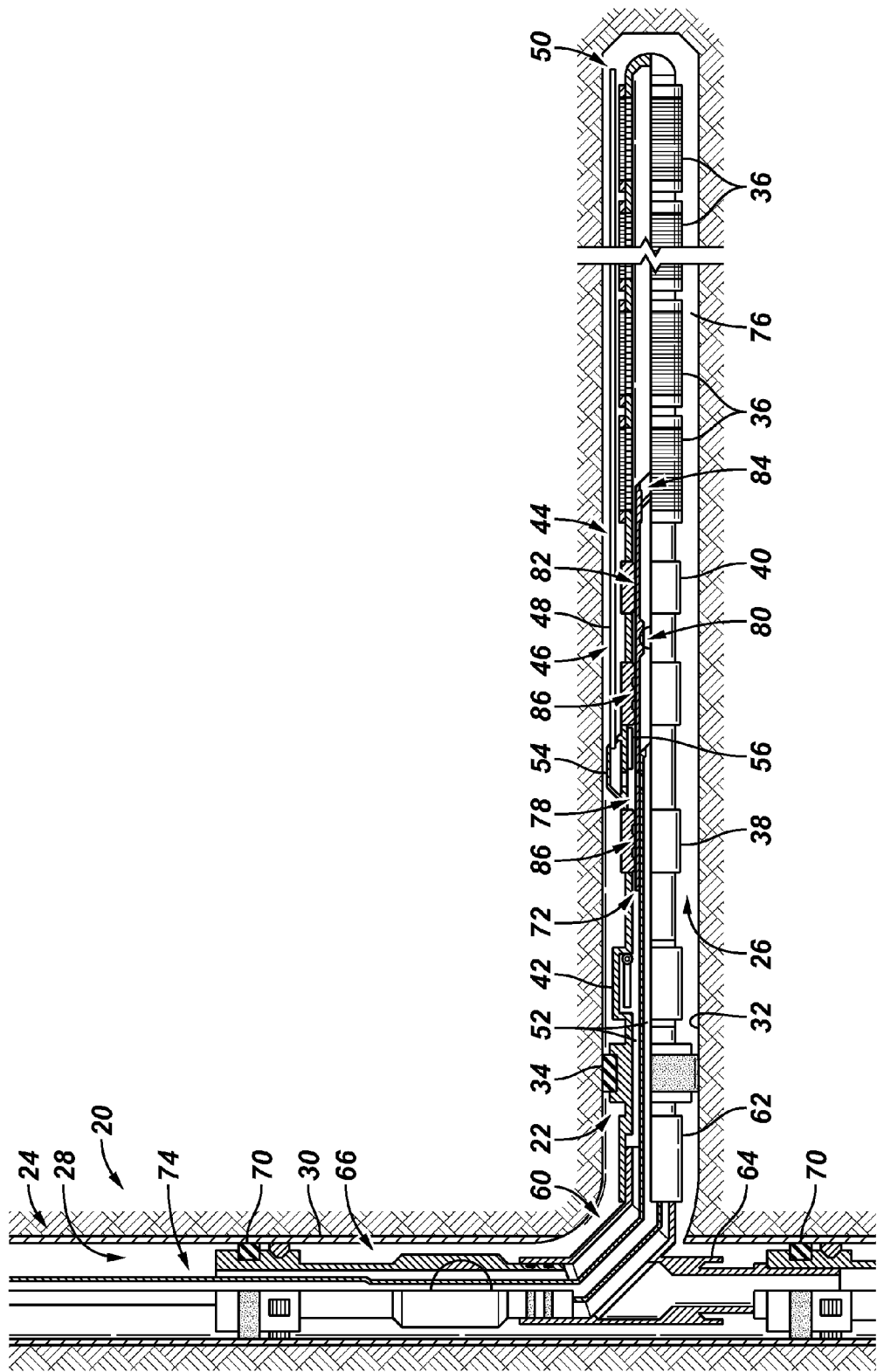


FIG. 5

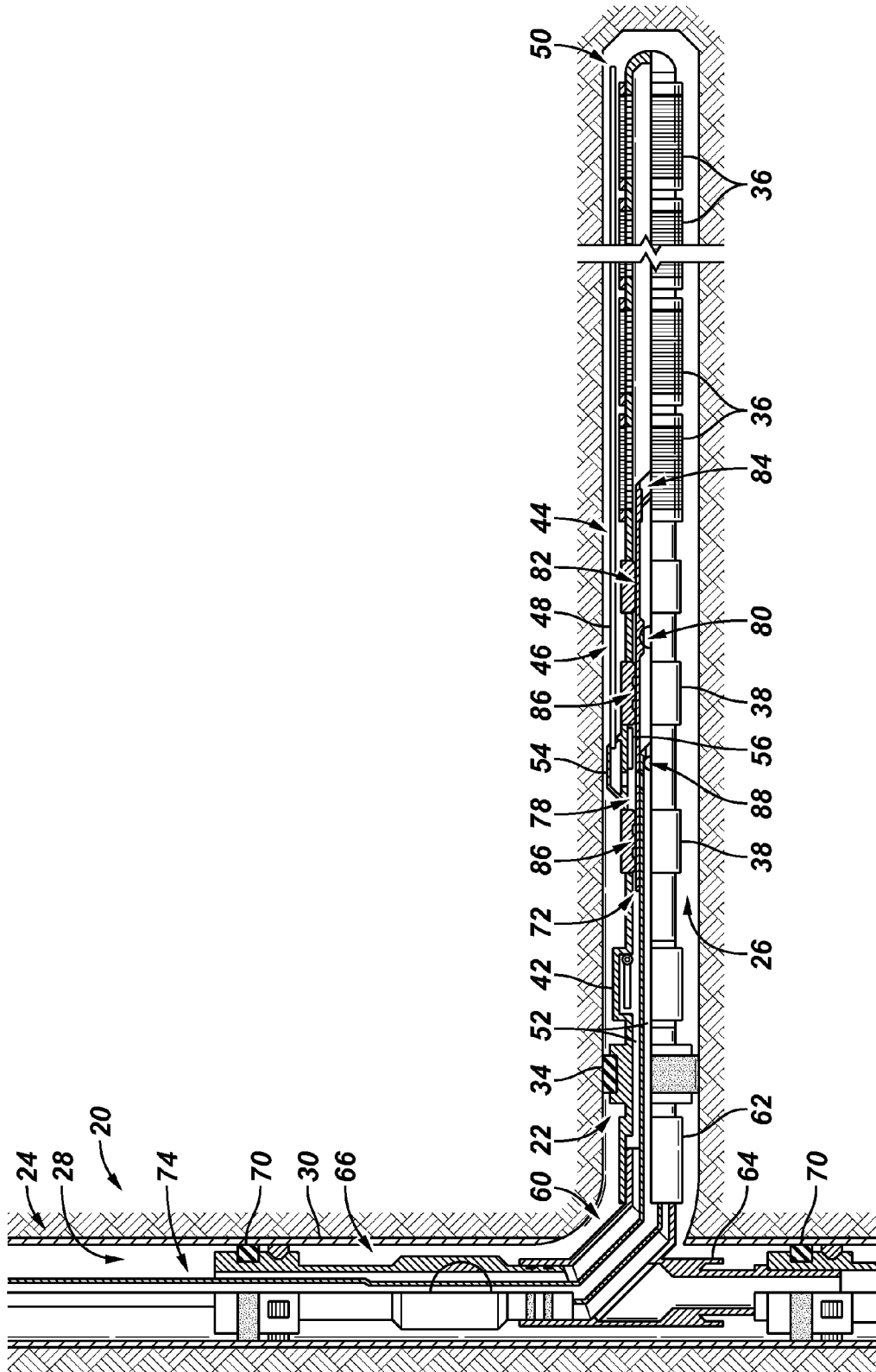


FIG. 6

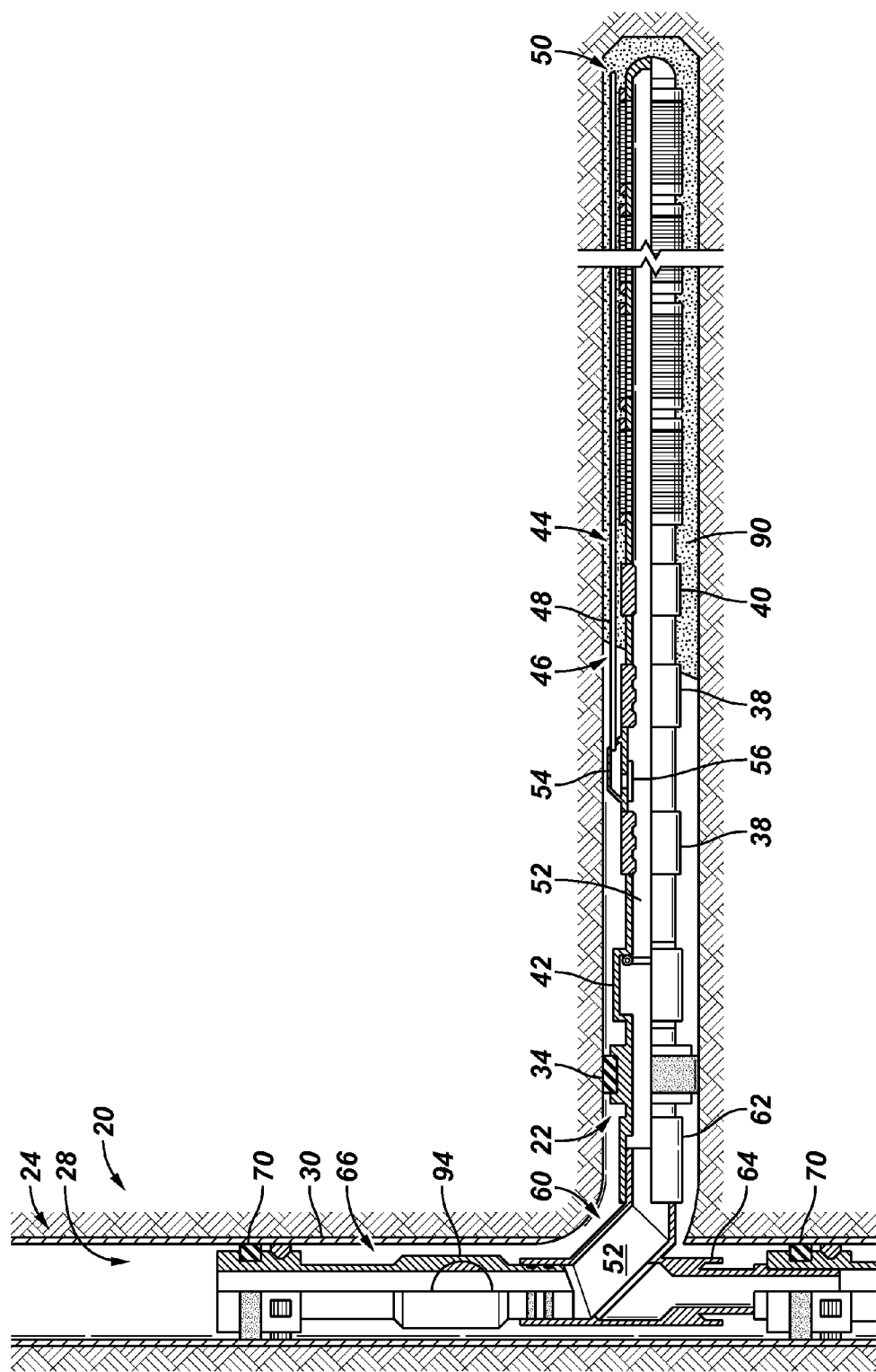
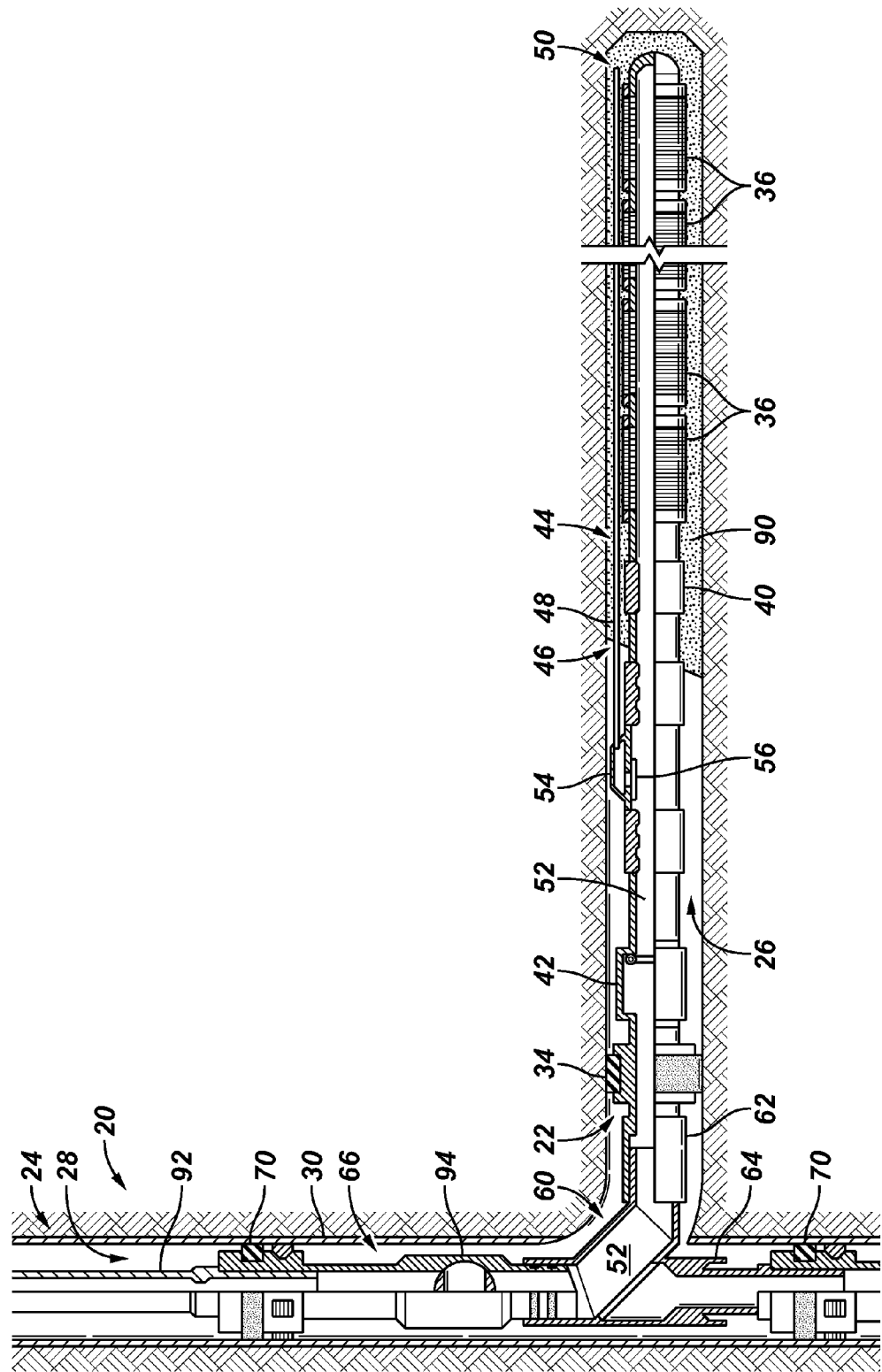
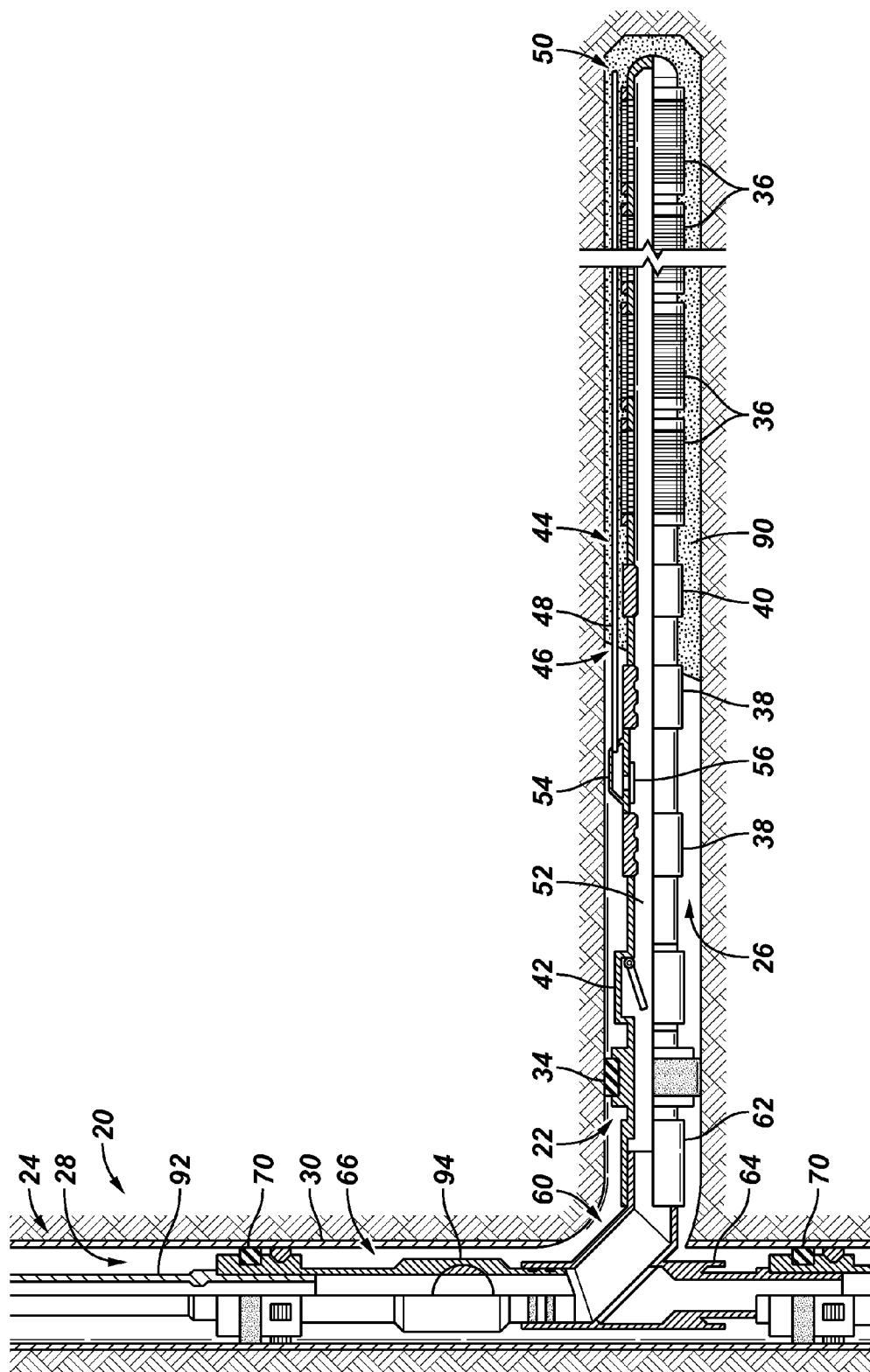


FIG. 7





**FIG. 8**



## GRAVEL PACKING IN LATERAL WELLBORE

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present document is based on and claims priority to U.S. Provisional Application Ser. No. 61/431,715, filed Jan. 11, 2011, incorporated herein by reference.

### BACKGROUND

[0002] Hydrocarbon fluids, e.g. oil and natural gas, are obtained from a subterranean geologic formation by drilling a well that penetrates the hydrocarbon-bearing formation. Once a wellbore is drilled, various forms of well completion components may be installed to control and enhance the efficiency of producing fluids from the subterranean geologic formation. In certain applications, the production of hydrocarbon fluids is enhanced by drilling and completing lateral wellbores extending from a primary wellbore, e.g. a generally vertical wellbore. Various gravel packing operations are employed to create gravel packs around the completions in the lateral wellbores.

### SUMMARY

[0003] In general, the present disclosure provides a methodology and system for treating, e.g. gravel packing, a lateral wellbore. The methodology and system may be employed in an open hole lateral wellbore and comprise a completion conveyed into the lateral wellbore. A service tool is used in cooperation with the completion to perform the gravel packing or other well treatment operation while maintaining hydrostatic pressure on the open lateral wellbore to prevent collapse of the wellbore. A variety of features may be incorporated into the completion or used in cooperation with the completion to facilitate the well treatment operation while maintaining the hydrostatic pressure until completion of the desired gravel pack.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Certain embodiments 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 only the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

[0005] FIG. 1 is an illustration of a well system having an example of a completion deployed in an open hole lateral wellbore, according to an embodiment of the disclosure;

[0006] FIG. 2 is an illustration similar to that of FIG. 1 but showing completion of a junction which is coupled with the completion disposed in the open hole lateral wellbore, according to an embodiment of the disclosure;

[0007] FIG. 3 is an illustration similar to that of FIG. 2 but showing the addition of an intermediate completion deployed in the primary wellbore, according to an alternate embodiment of the disclosure;

[0008] FIG. 4 is an illustration similar to that of FIG. 3 but showing deployment a work string and service tool down to the completion disposed in the open hole lateral wellbore, according to an embodiment of the disclosure;

[0009] FIG. 5 is an illustration similar to that of FIG. 4 in which a ball has been dropped to divert gravel slurry to an

alternate path tubing separate from the main flow path of the completion, according to an embodiment of the disclosure;

[0010] FIG. 6 is an illustration of a completed gravel pack disposed around the completion in the open hole lateral wellbore, according to an embodiment of the disclosure;

[0011] FIG. 7 is an illustration similar to that of FIG. 6 with the addition of an upper completion coupled to the intermediate completion, according to an embodiment of the disclosure; and

[0012] FIG. 8 is an illustration of an example of the well system in a producing configuration, according to an embodiment of the disclosure.

### DETAILED DESCRIPTION

[0013] In the following description, numerous details are set forth to provide an understanding of some illustrative 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.

[0014] The disclosure herein generally relates to a system and methodology that facilitate performance of a treatment operation in a lateral wellbore. For example, the system and methodology facilitate gravel packing operations in open hole lateral wellbores. According to an embodiment of the well system, a completion is deployed in a lateral wellbore. Subsequently, a junction is completed and coupled to the completion in the lateral wellbore to form an enclosed flow path from a primary wellbore, e.g. a generally vertical wellbore, to the lateral wellbore. After completing the junction, a service tool may be used to facilitate formation of a gravel pack in the lateral wellbore while maintaining hydrostatic pressure. The hydrostatic pressure is applied through the completion in the lateral wellbore and into contact with the open wellbore wall of the lateral wellbore to maintain the integrity of the lateral wellbore by, for example, preventing collapse. The hydrostatic pressure may be released once the gravel pack is completed.

[0015] The completion deployed in the lateral wellbore may comprise an alternate path system which directs gravel slurry, for performing the gravel packing operation, along an alternate flow path outside of the primary flow path extending through the completion. The alternate path system may comprise an alternate path tubing, such as a shunt tube, extending along the completion to a desired discharge location. For example, the gravel slurry may be directed along the alternate path tubing to an annular region surrounding one or more sand screens. In some applications, the entire gravel slurry used to form the gravel pack is directed down through an interior of the junction within the primary internal flow path until directed outwardly to the alternate path tubing via, for example, a shrouded port closure sleeve. Thus, the gravel slurry is completely contained, routed along the alternate path tubing, and discharged at the desired location with respect to the gravel pack.

[0016] The alternate path system may be employed when performing the gravel packing operation through the completed junction. However, the alternate path system also may be utilized in other types of applications. For example, the alternate path system may be used to facilitate formation of the desired gravel pack prior to completion of the junction between the primary wellbore and the lateral wellbore.

[0017] Depending on the specific parameters of a given well environment and well treatment operation, the components of the well system and the specific methodology may be adjusted. For example, the completion deployed in the lateral wellbore may be run with a variety of suitable packers, such as a packer/disconnect, an external casing packer, a swell packer, or a completion packer. The service tool may be designed to both maintain hydrostatic pressure when performing the gravel pack and to allow for a post job cleaning operation. Many other types of components and tools may be incorporated into the system to facilitate well treatment operations, e.g. gravel packing operations, in single or multiple lateral wellbores.

[0018] Referring generally to FIG. 1, an example of one type of system and methodology for performing the treatment operation in a lateral wellbore is illustrated. The example is provided to facilitate explanation, and it should be understood that a variety of components and operational techniques may be utilized with the well system described herein. The various completions described may utilize a variety of packers, valves, sliding sleeves, screens, tubing, engagement devices, crossover ports, and other components selected for use in many types of environments and applications.

[0019] In FIG. 1, an embodiment of a well system 20 is illustrated as comprising a completion 22 deployed in a well 24. In this example, completion 22 is deployed in a lateral wellbore 26 which extends from a primary wellbore 28, e.g. a generally vertical wellbore. In the example illustrated, the primary wellbore 28 is cased with a casing 30 and the lateral wellbore 26 is an open hole lateral wellbore defined by an open wellbore wall 32. Depending on the specific application, various well completions may be used in the well 24 and well 24 may comprise many types of wellbores, including deviated, e.g. horizontal, single bore, multilateral, single zone, multi-zone, cased, uncased (open bore), or other types of wellbores.

[0020] In the example illustrated, completion 22 comprises a packer 34 which may be an open hole packer designed to seal off the lateral wellbore section extending from the packer 34 to the toe of the lateral wellbore 26. By way of example, packer 34 may comprise an external casing packer, a swell packer, a completion packer or another packer suitable for the desired application, e.g. an open hole application. Completion 22 also may comprise a variety of other components, such as a sand screen 36 or a plurality of sand screens 36. The completion 22 also may comprise a polished bore receptacle 38 or other suitable device for receiving the service tool as described in greater detail below. A set down collar 40 also may be used in cooperation with the polished bore receptacle 38. Various other components, such as a flapper valve or other type of fluid loss device 42, may be further incorporated into the completion 22.

[0021] In the specific example illustrated, completion 22 is designed to route gravel slurry through an alternate path system 44. By way of example, the alternate path system 44 may comprise an alternate path tubing 46, e.g. at least one shunt tube 48, positioned to deliver gravel slurry to a discharge location 50. The alternate path tubing 46 discharges the gravel slurry at the discharge location 50 to create the desired gravel pack in the annulus around, for example, sand screens 36. According to an example of the present technique, the gravel slurry is directed downhole along a main flow path 52 which extends into the interior of completion 22. As explained in greater detail below, the gravel slurry may be directed through

a work string and service tool deployed within the main flow path 52 and coupled with the completion 22. In such an application, the work string and the service tool contain the gravel slurry within main flow path 52 until discharged to the exterior of the main flow path 52, e.g. to the alternate path system 44. In this embodiment, a director device 54 works in cooperation with the service tool to direct gravel slurry into the alternate path tubing 46. During the gravel packing or other servicing operation, the gravel slurry may be directed along the main flow path 52 while remaining fully enclosed within the work string and service tool until the gravel slurry is directed into the alternate path tubing 46 for delivery to the discharge location 50. This enables control and containment of 100% of the gravel slurry used in forming the desired gravel pack around completion 22. By way of example, the director device 54 may comprise a shrouded port closure sleeve 56.

[0022] In the example illustrated, a whipstock 58 or other suitable device may be used to facilitate formation of the lateral wellbore 26. The whipstock 58 also may be used to facilitate other completion activities, such as completion of a junction used to couple the completion 22 with an intermediate completion in the region of transition between the primary wellbore 28 and the lateral wellbore 26. The whipstock 58 may be designed as a retrievable component to enable access to possible additional lateral wellbores disposed beneath the illustrated lateral wellbore 26.

[0023] Referring generally to FIG. 2, an illustration of well system 20 is provided in which a junction 60 has been completed and coupled with completion 22 via, for example, a connector 62, such as a disconnect sub. In this embodiment, the junction 60 is positioned above a template 64. Once the junction 60 is completed, an intermediate completion 66 may be run downhole via a suitable running tool 68 and coupled with junction 60 in primary wellbore 28, as illustrated in FIG. 3. Depending on the application, the intermediate completion 66 may comprise a variety of components, such as a packer 70. In the embodiment illustrated, packer 70 is designed to form a seal with a casing 30 within primary wellbore 28. Additional packers 70 and other components may be deployed in primary wellbore 28 beneath junction 60.

[0024] Following placement of the intermediate completion 66, a service tool 72 is run downhole on a work string 74, as illustrated in FIG. 4. The service tool 72 is deployed down through intermediate completion 66 and junction 60 before being received within completion 22 via polished bore receptacle 38. The service tool 72 is designed to engage and seal within polished bore receptacle 38 to enable maintenance of hydrostatic pressure on the open hole lateral wellbore 26 during a gravel packing operation. The hydrostatic pressure is maintained within completion 22 and within an annulus 76 between completion 22 and the surrounding open wellbore wall 32 to preserve the integrity of the open hole lateral wellbore 26, e.g. to prevent collapse of the lateral wellbore. The design of service tool 72, completion 22, and junction 60 also serves to maintain sand exclusion within the junction 60 during the gravel packing operation.

[0025] Service tool 72 may be designed with a variety of components and features to facilitate performance of a desired well treatment operation. In the example illustrated, the service tool 72 is designed to facilitate a gravel packing operation and comprises a crossover port body 78 located to direct the gravel slurry out of the service tool 72, into the shrouded port closure sleeve 56, and then into the alternate

path tubing 46 for delivery to the discharge location 50. By way of further example, the service tool 72 may comprise one or more flow control valves 80, a service tool collet 82, a fluid loss device 84, and suitable seals 86 for forming a seal with the surrounding polished bore receptacle 38. However, these components are described and illustrated to provide examples of components that may be included in the service tool 72, and other embodiments of the service tool may comprise additional, alternate, and/or modified components to facilitate the desired well treatment operation. The service tool 72 and completion 22 also may be used to perform a post gravel pack cleaning operation.

[0026] In FIG. 5, a drop member, such as a ball 88, is moved down through work string 74 and service tool 72 until seated proximate crossover port body 78. When gravel slurry is delivered down through work string 74 and service tool 72 within main flow path 52, the ball 88 directs the flow of gravel slurry out through crossover port body 78. The gravel slurry then flows into the director device 54, e.g. into shrouded port closure sleeve 56, and along alternate path tubing 46 until discharged at discharge location 50. During the flow of gravel slurry, hydrostatic pressure is maintained in the lateral wellbore 26.

[0027] In this example, all of the gravel slurry is discharged through the alternate path tubing 46 to create a gravel pack 90, as illustrated in FIG. 6. The gravel pack 90 is located in the annulus 76 between completion 22 and the surrounding open wellbore wall 32. As well fluid flows from a surrounding formation, the gravel pack 90 serves to filter the inflowing well fluid before entering completion 22 through sand screens 36. Following formation of gravel pack 90, the hydrostatic pressure may be released in lateral wellbore 26. After the gravel pack 90 is formed, the service tool 72 may be withdrawn and fluid loss device 42 may be allowed to close, thus preventing any further down flow of fluid along main flow path 52.

[0028] Once the service tool 72 is withdrawn, an upper completion 92 may be delivered down through primary wellbore 28 for engagement with intermediate completion 66, as illustrated in FIG. 7. During deployment of the upper completion 92, a valve 94 in intermediate completion 66 may be used to prevent flow along the main flow path 52. However, once the well 24 is fully completed, valve 94 may be opened to a producing configuration which allows production fluids to flow upwardly through well 24, as illustrated in FIG. 8.

[0029] In some applications, the ability to complete junction 60 and then to perform the gravel packing operation while maintaining hydrostatic pressure greatly facilitates formation of the desired gravel pack 90. In these applications, the alternate path system 44 may be employed to deliver the gravel slurry, however other gravel slurry delivery systems also may be employed to direct the gravel slurry to a desired location along completion 22. The alternate path system 44 also may be used in a variety of applications to facilitate the gravel packing operation. In some of these applications, the alternate path system 44 is used to contain and deliver 100% of the gravel slurry for a controlled discharge of all of the gravel slurry when forming gravel pack 90. The alternate path system 44 may be used in applications which perform the gravel packing operation after completing junction 60 or prior to completing junction 60.

[0030] The specific configuration of well system 20 and completion 22 may vary depending on the parameters of a given application. Additionally, the junction 60, director

device 54, alternate path system 44, and other components of the system may be formed in a variety of configurations and from a variety of materials suitable for a selected operation and environment. Also, various types of service tools 72 and work strings 74 may be used to deliver gravel slurry or other treatment fluids down to completion 22 through main flow path 52.

[0031] Furthermore, several types of intermediate completions and upper completions may be employed depending on the specifics of a given treatment application and/or production application. Additional completions also may be employed in additional lateral wellbores. Each of the additional lateral wellbores may be gravel packed or otherwise treated as described above. For example, the gravel packing of each additional lateral wellbore can be conducted by completing the corresponding junction and then forming the gravel pack while maintaining hydrostatic pressure. The alternate flow path system also can be employed with each corresponding completion located in the additional lateral wellbores.

[0032] Although only a few embodiments of the system and methodology 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 method of treating a well, comprising:
  - completing a junction and connecting the junction with a completion located in an open hole lateral wellbore;
  - deploying a service tool into the completion; and
  - after completing the junction, using the service tool to perform a gravel packing operation in the open hole lateral wellbore while maintaining hydrostatic pressure in the open hole lateral wellbore to prevent collapse of the open hole lateral wellbore.
2. The method as recited in claim 1, further comprising performing the gravel packing operation through an alternate path tubing separate from a main flow path of the completion.
3. The method as recited in claim 2, wherein performing comprises directing a gravel slurry along an enclosed path within an interior of the junction and out into the alternate path tubing for delivery to a desired discharge location.
4. The method as recited in claim 2, wherein performing comprises directing a gravel slurry along an enclosed path within an interior of the junction and out into the alternate path tubing in the form of at least one shunt tube.
5. The method as recited in claim 1, further comprising releasing the hydrostatic pressure after completing the gravel pack operation.
6. The method as recited in claim 1, further comprising maintaining sand exclusion within the junction.
7. The method as recited in claim 3, wherein directing comprises using a shrouded port closure sleeve to direct the gravel slurry into the alternate path tubing.
8. The method as recited in claim 1, further comprising using the service tool to perform a post gravel pack cleaning operation in the open hole lateral wellbore.
9. A well system, comprising:
  - a completion with a sand screen, a shrouded port closure sleeve, an alternate path tubing extending from the shrouded port closure sleeve to the sand screen, and a packer, the completion enabling hydrostatic pressure to

- be maintained on the formation when the completion is placed in a lateral wellbore;
- a junction which may be completed and joined with the completion to enclose a primary flow path between an intermediate completion in a generally vertical wellbore and the completion in the lateral wellbore; and
- a service tool selectively engaged with the completion in a manner able to maintain the hydrostatic pressure while a gravel slurry is delivered along the primary flow path within the junction and the completion to form a gravel pack.
- 10.** The well system as recited in claim **9**, wherein the alternate path tubing comprises at least one shunt tube.
- 11.** The well system as recited in claim **9**, wherein the packer comprises an external casing packer.
- 12.** The well system as recited in claim **9**, wherein the packer comprises a swell packer.
- 13.** The well system is recited in claim **9**, wherein the packer comprises a completion packer.
- 14.** The system as recited in claim **9**, further comprising a disconnect sub coupling the completion to the junction.
- 15.** A method, comprising:
- providing a completion with a sand screen and a packer which seals against open wellbore wall of a lateral wellbore;

- running the completion downhole into the lateral wellbore; engaging a service tool with the completion;
- performing a gravel packing operation to create a gravel pack around the completion via the service tool by routing a gravel slurry from the service tool and out to an alternate path tubing separate from a main flow path of the completion; and
- maintaining hydrostatic pressure via the completion and the service tool during the gravel packing operation.
- 16.** The method as recited in claim **15**, further comprising maintaining open hole stability in the lateral wellbore.
- 17.** The method as recited in claim **15**, further comprising performing a post gravel pack cleaning operation.
- 18.** The method as recited in claim **15**, further comprising completing a junction prior to performing the gravel packing operation.
- 19.** The method as recited in claim **15**, further comprising completing a junction after performing the gravel packing operation.
- 20.** The method as recited in claim **15**, wherein performing the gravel packing operation comprises delivering gravel through the alternate path tubing in the form of at least one shunt tube.

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