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(54) JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION

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(60) Provisional application No. 60/599,937, filed on Aug. 9, 2004.

(30) **Foreign Application Priority Data**

Feb. 10, 2003 (CA) 2,418,565

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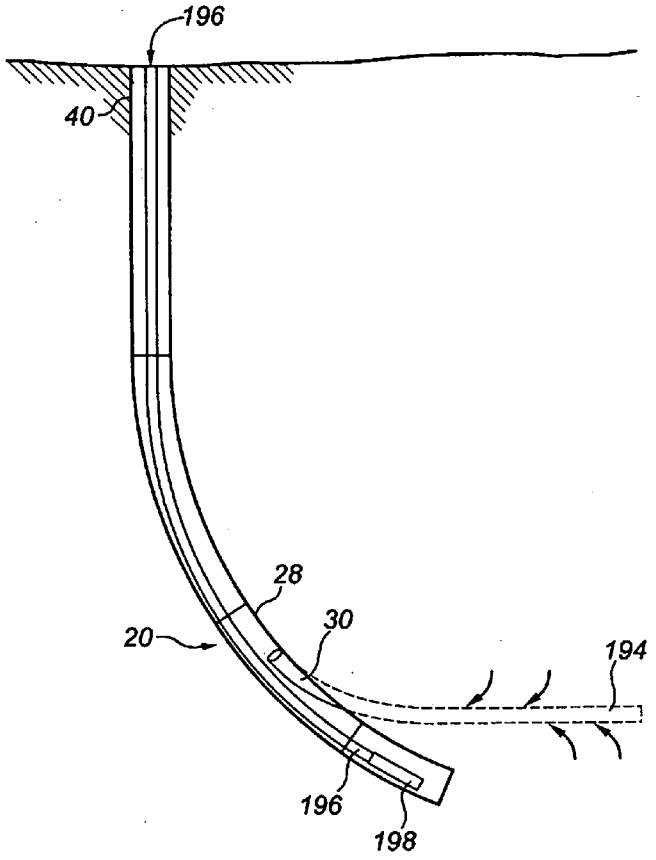
(52) **U.S. Cl.** **166/255.3**; 166/50; 166/117.6; 166/313; 166/242.1

(57) **ABSTRACT**

The invention is directed at a junction assembly adapted for insertion in a borehole and a system and a method for providing a junction in a borehole. The junction assembly is comprised of a primary conduit and a lateral conduit. The primary conduit has an upper end, a lower end, and defines a primary conduit bore extending through the primary conduit from the upper end to the lower end. The lateral conduit is connected with the primary conduit at a conduit junction located between the upper end of the primary conduit and the lower end of the primary conduit, wherein the lateral conduit extends within the primary conduit bore from the conduit junction towards the upper end of the primary conduit.



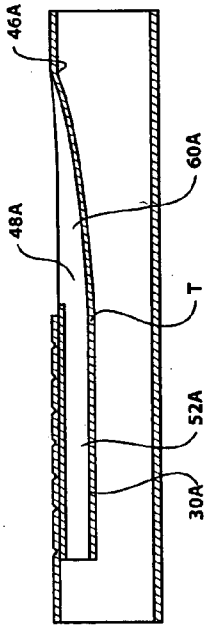


FIG. 1A

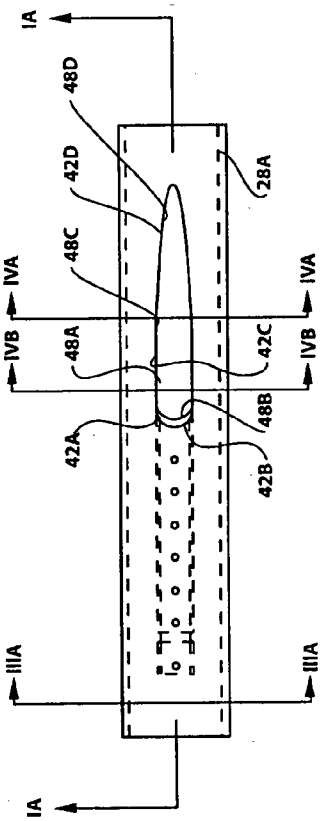


FIG. 2A

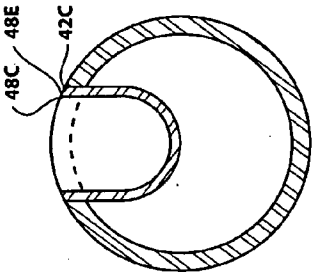


FIG. 4B

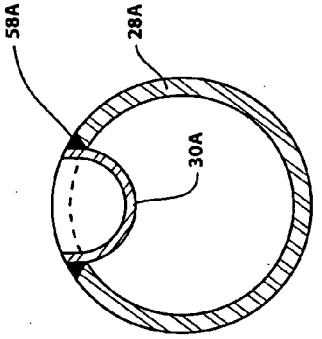


FIG. 4A

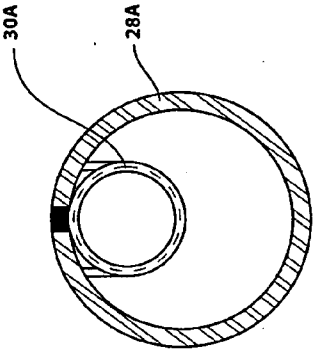


FIG. 3A

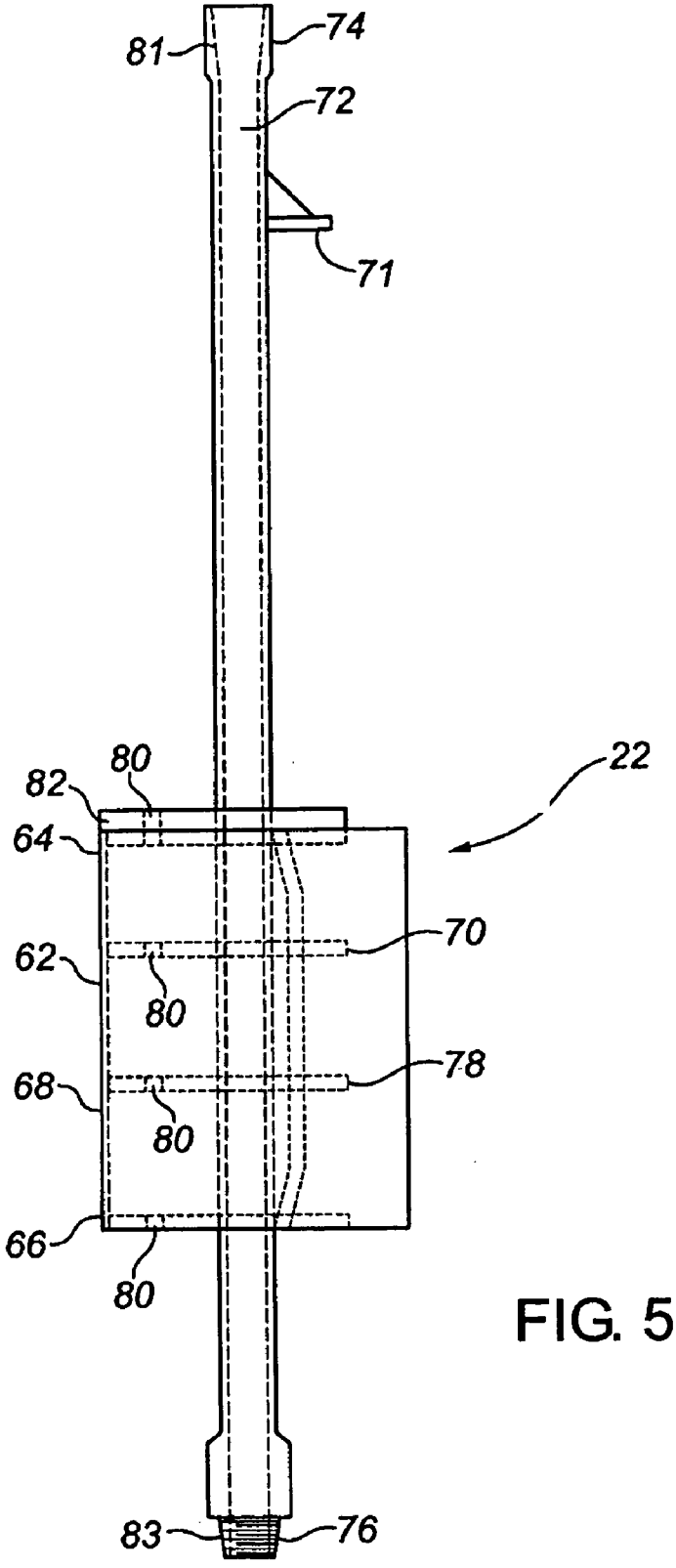


FIG. 5

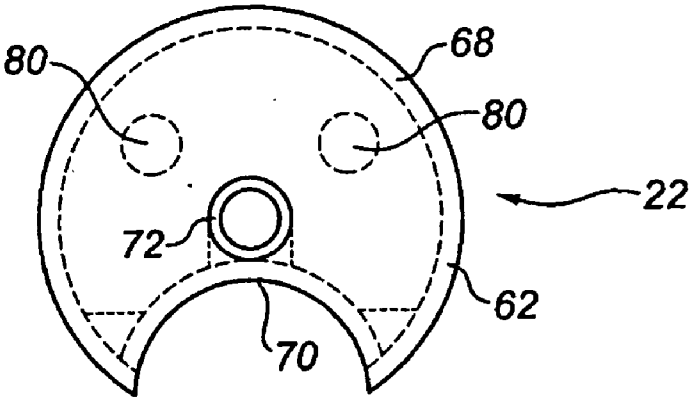


FIG. 6

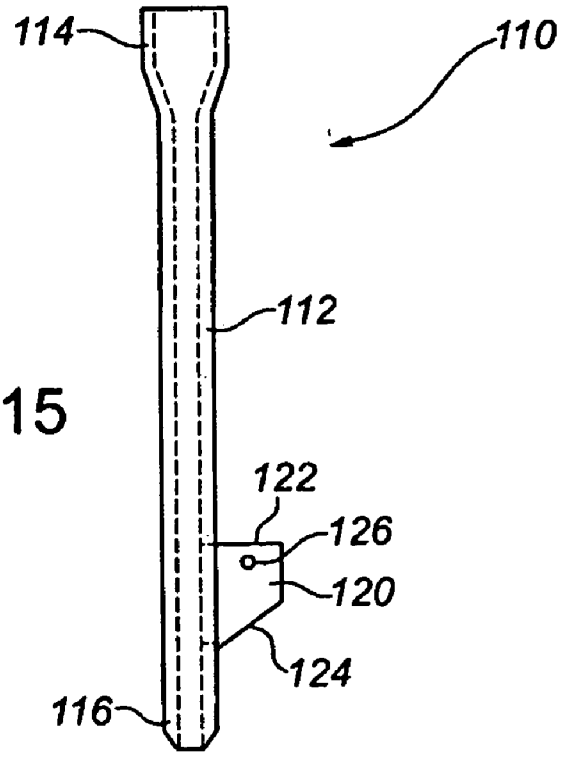


FIG. 15

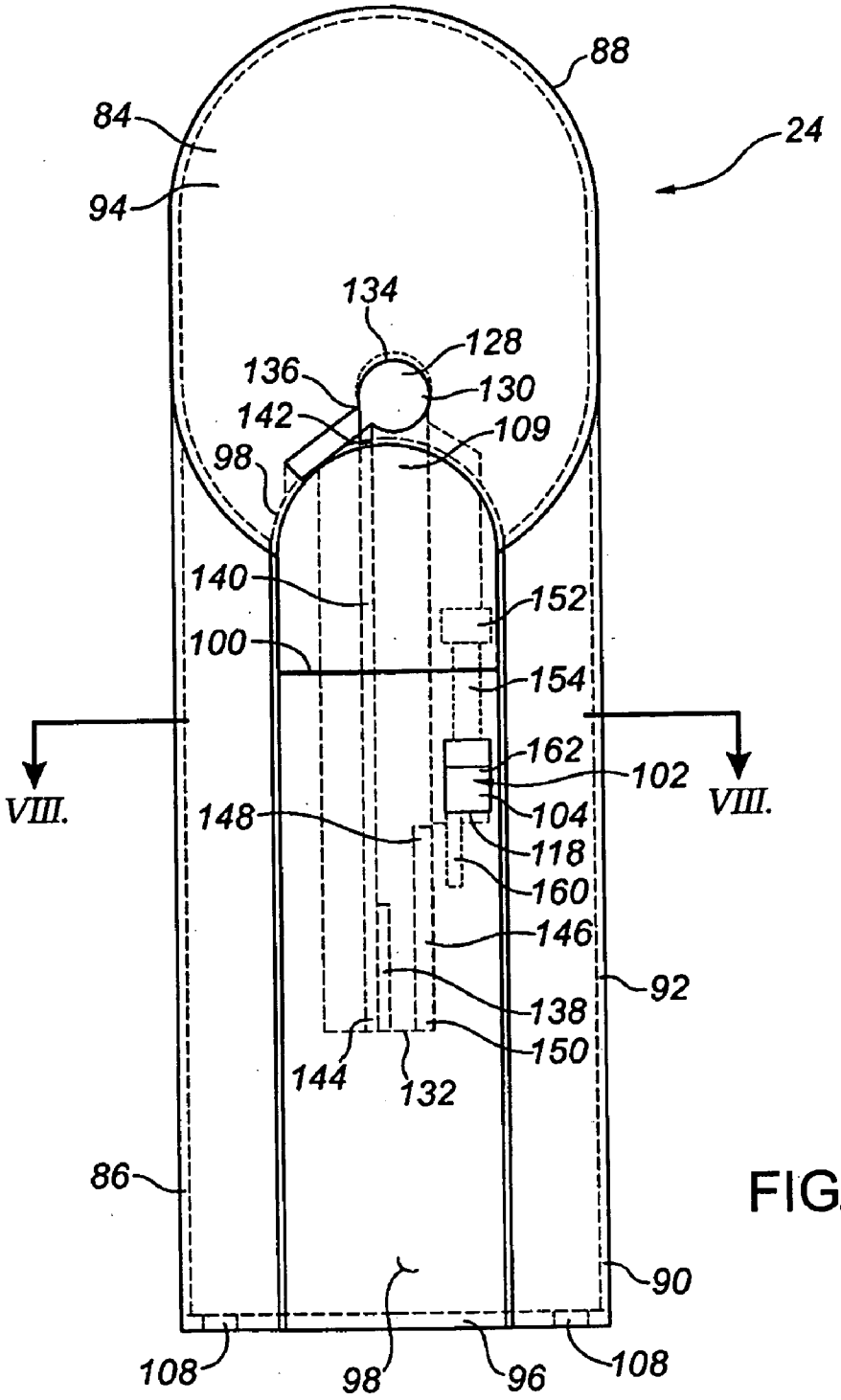

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FIG. 7

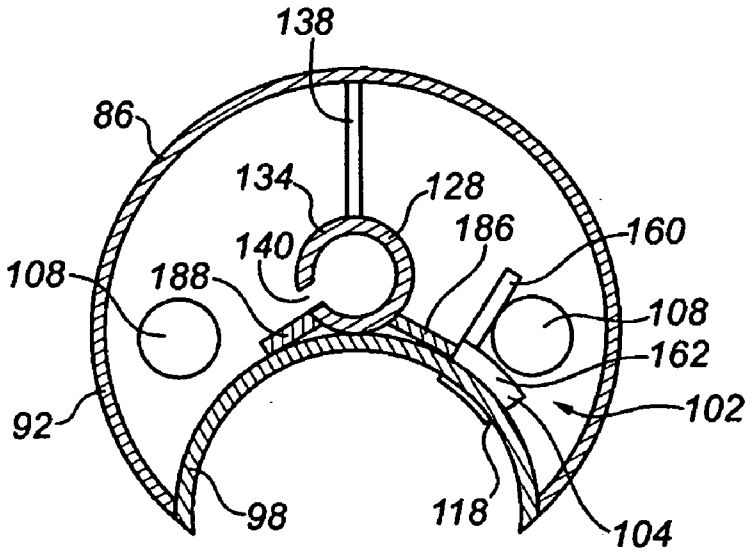
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FIG. 8

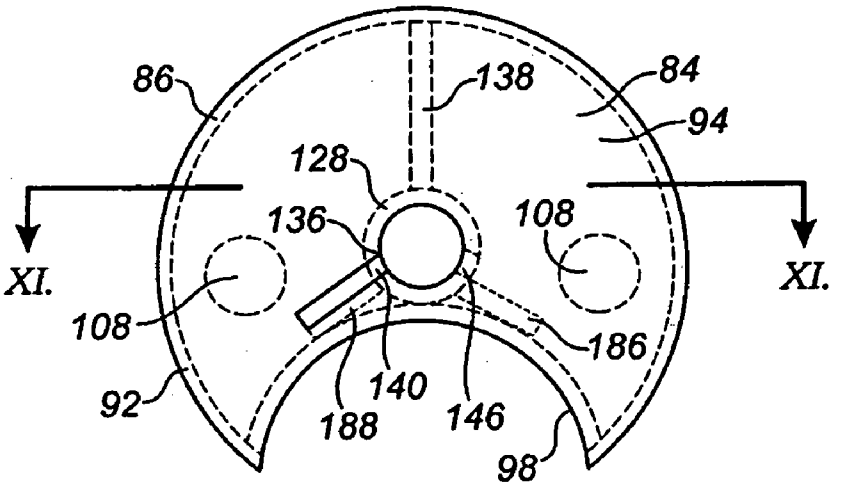
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FIG. 10

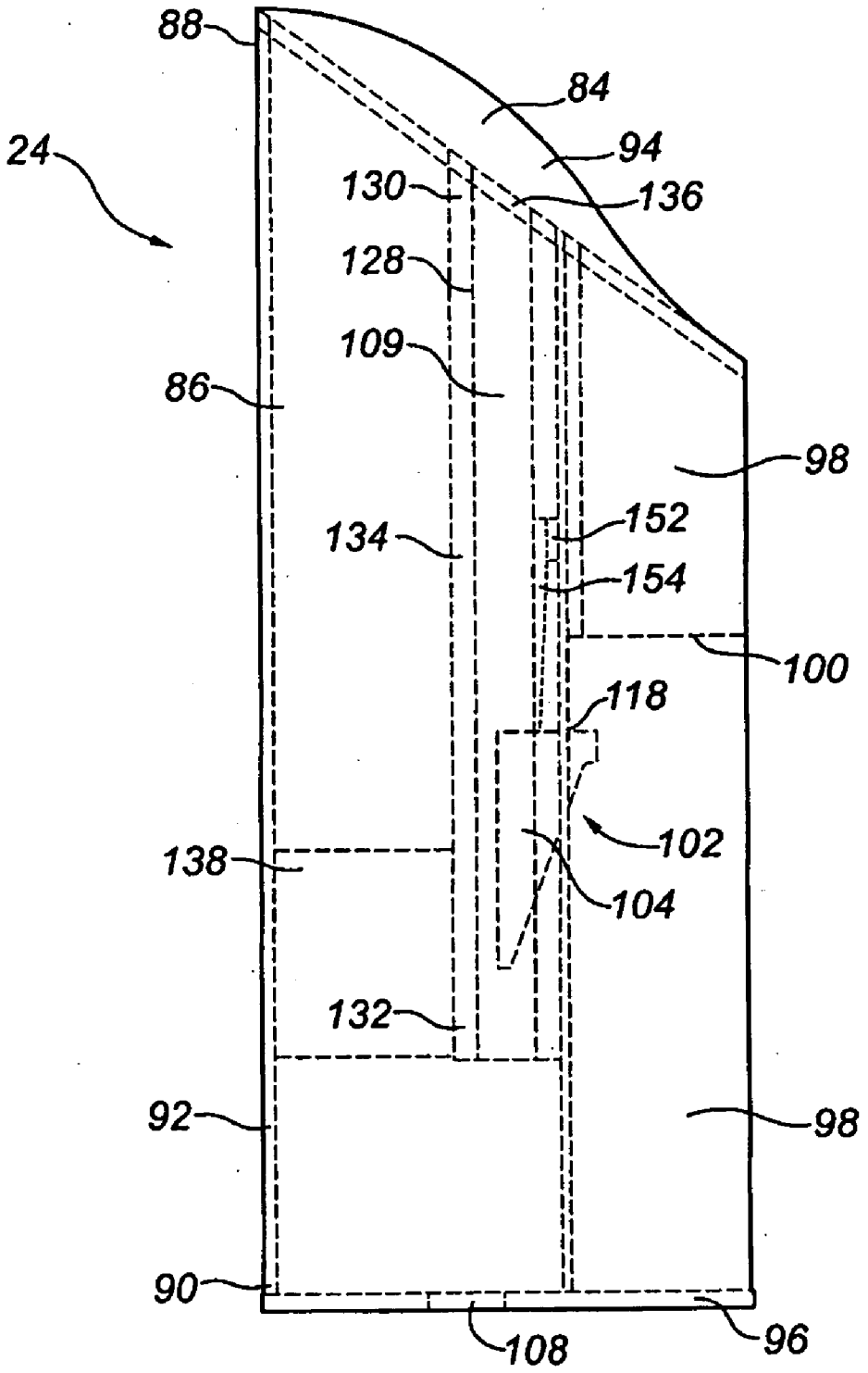
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FIG. 9

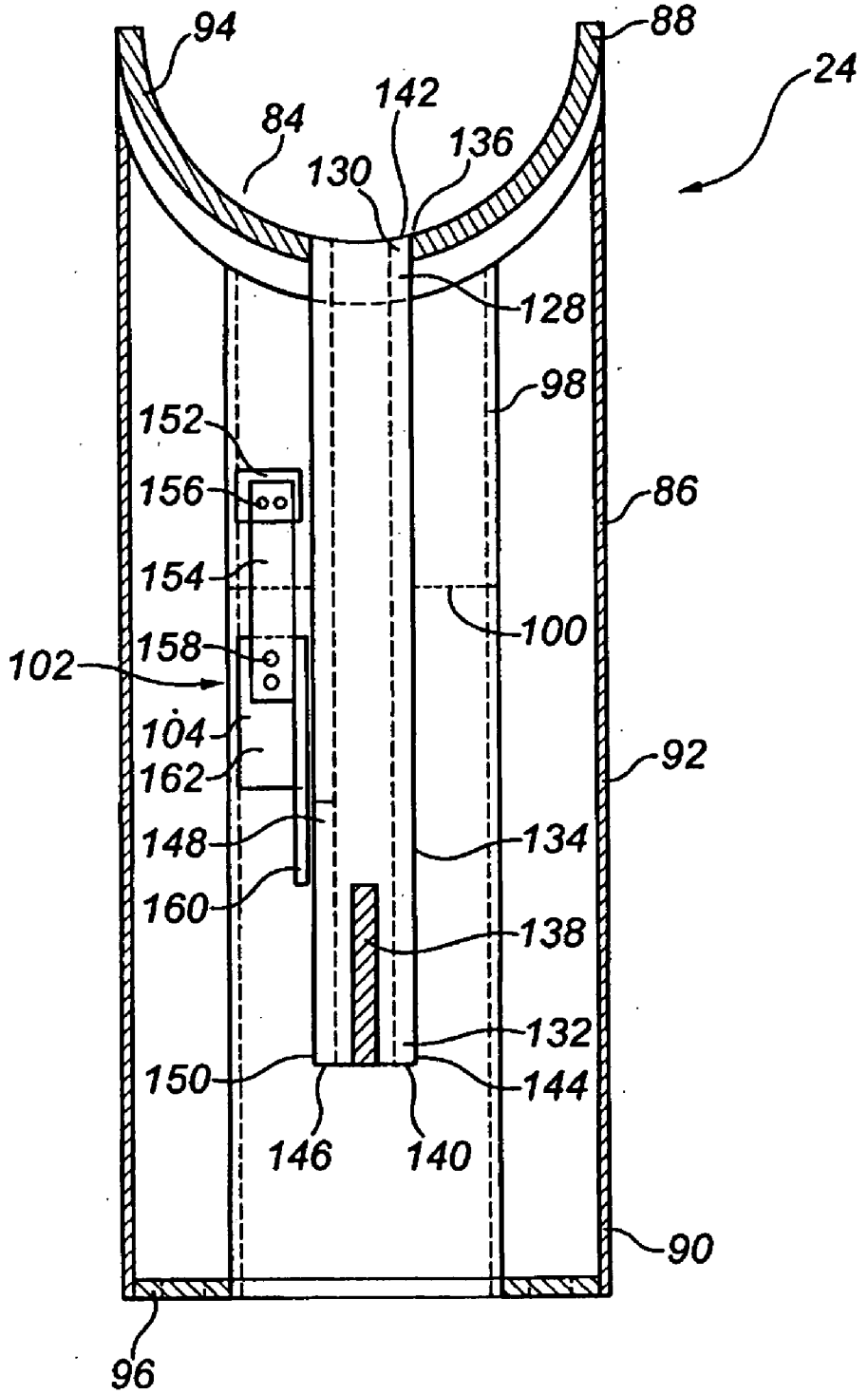
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FIG. 11

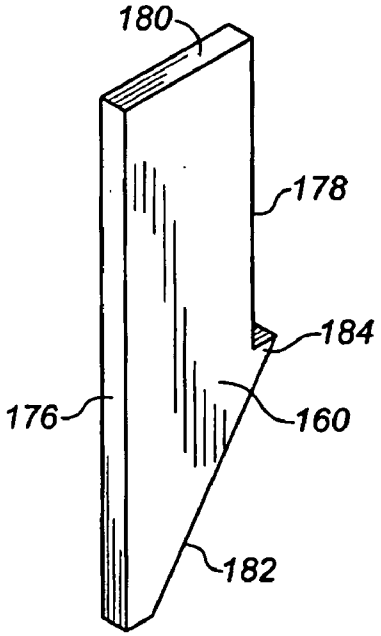

FIG. 12

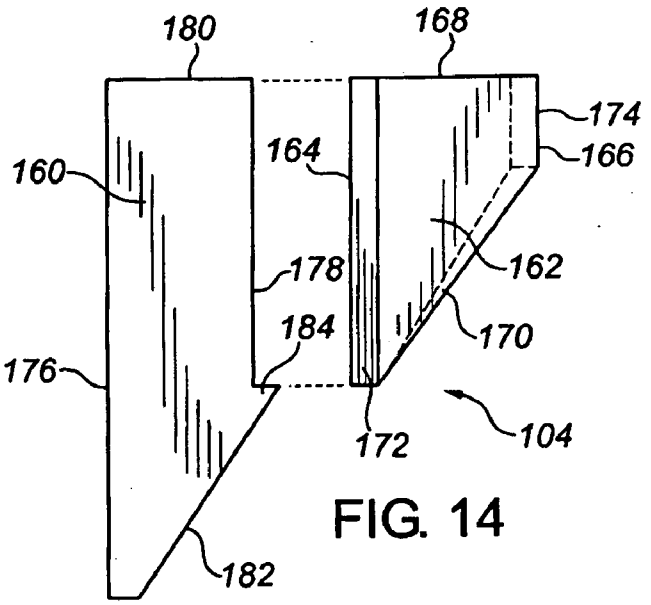

FIG. 14

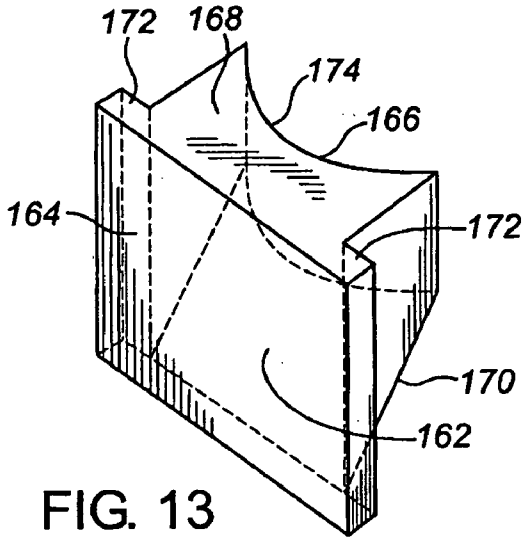

FIG. 13

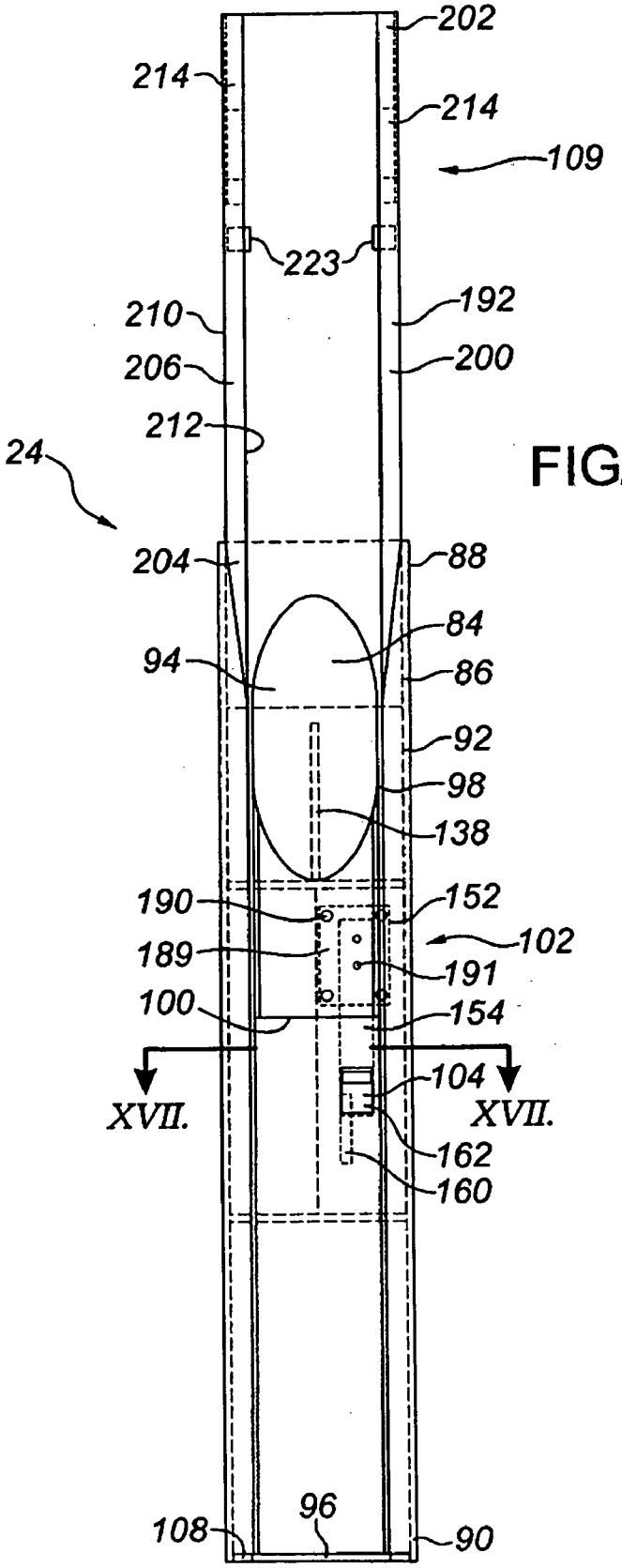
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FIG. 16

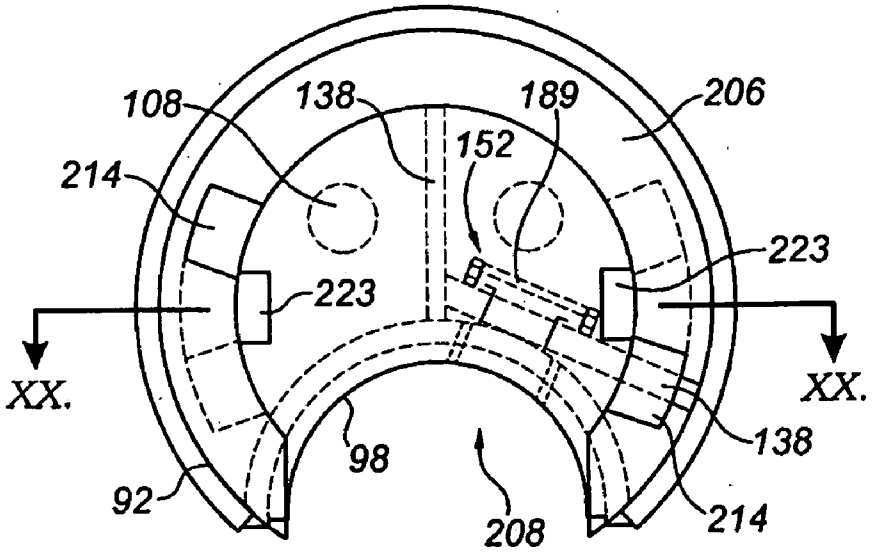
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FIG. 19

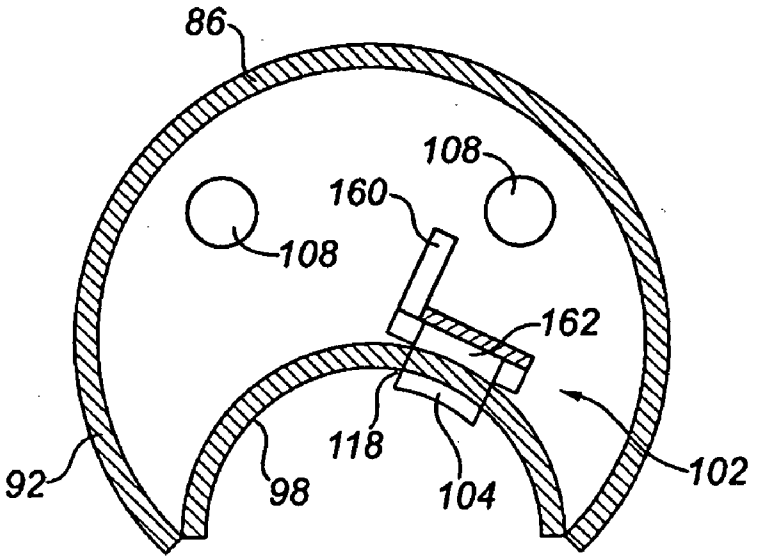
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FIG. 17

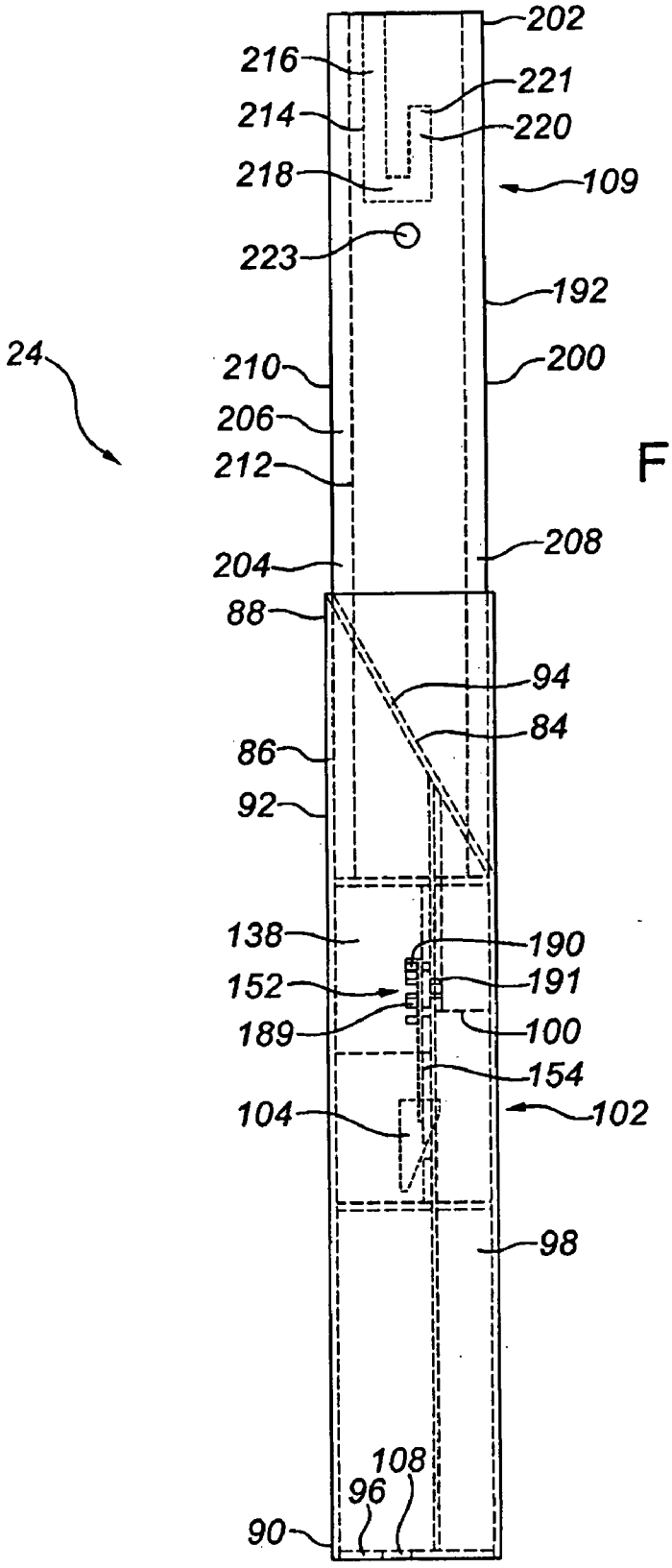
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FIG. 18

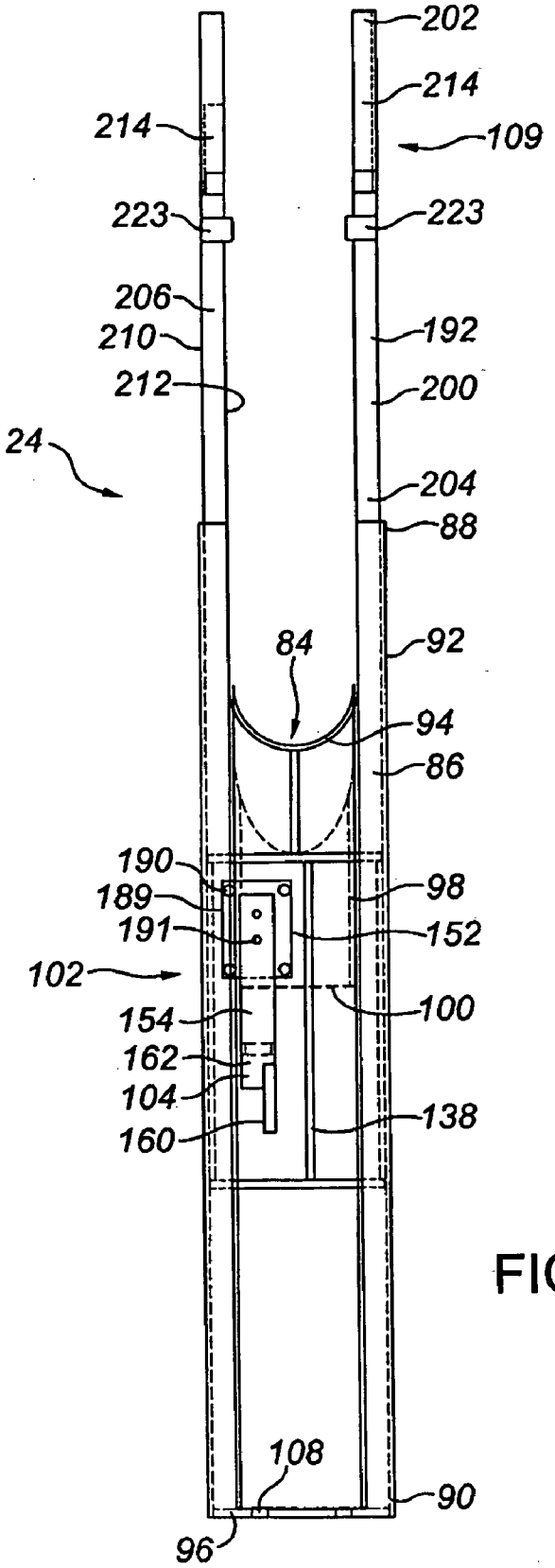
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FIG. 20

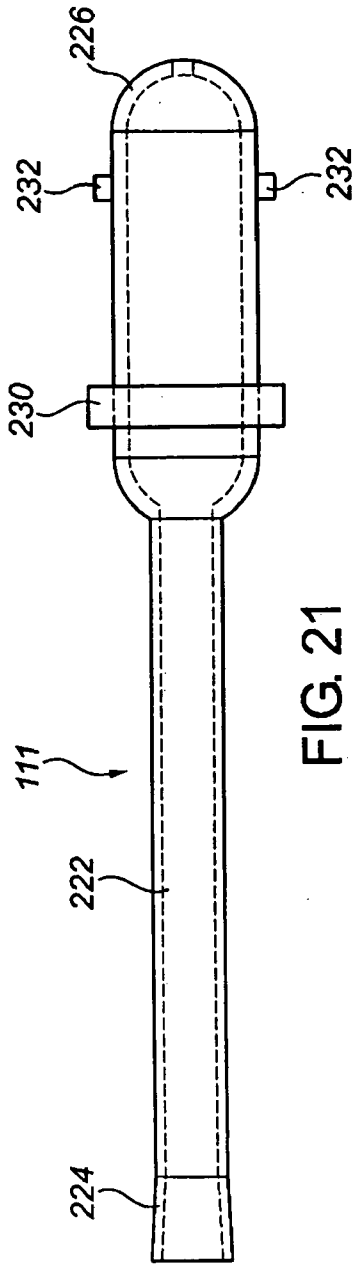

FIG. 21

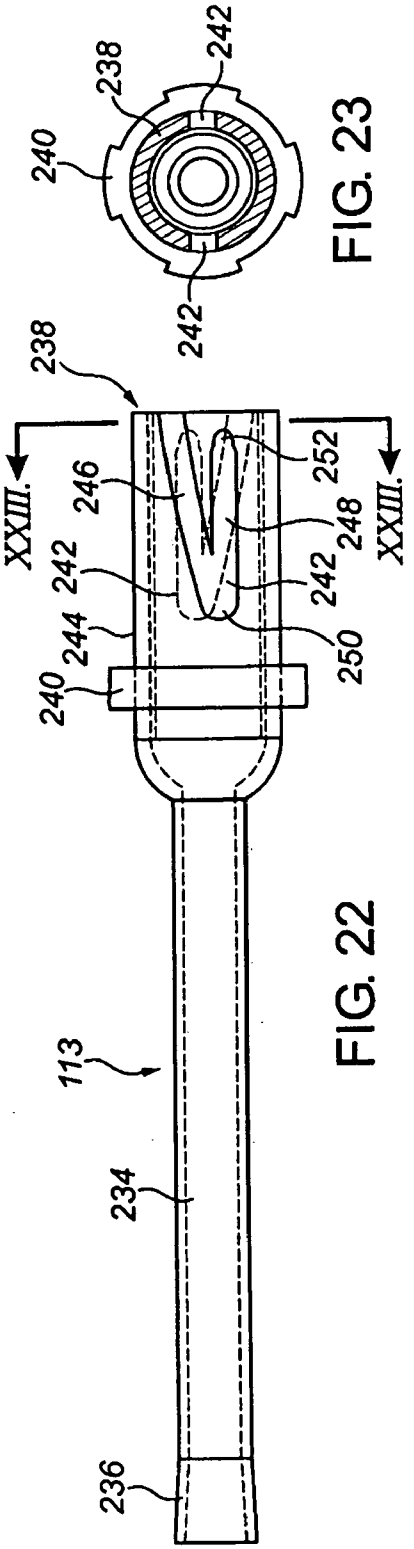

FIG. 22

FIG. 23

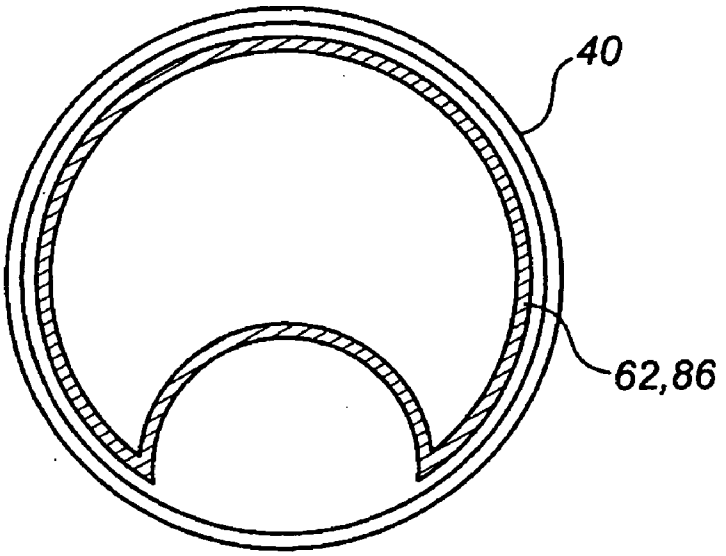

FIG. 24

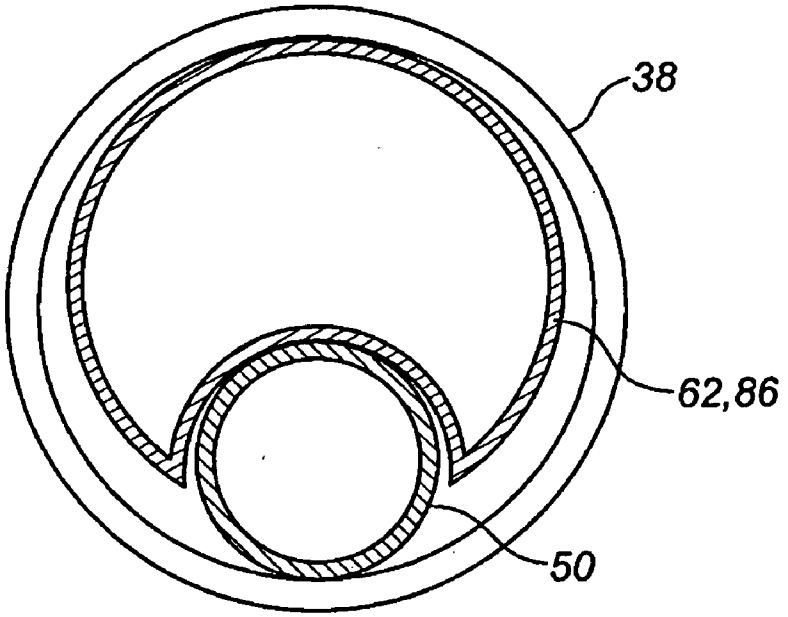

FIG. 25

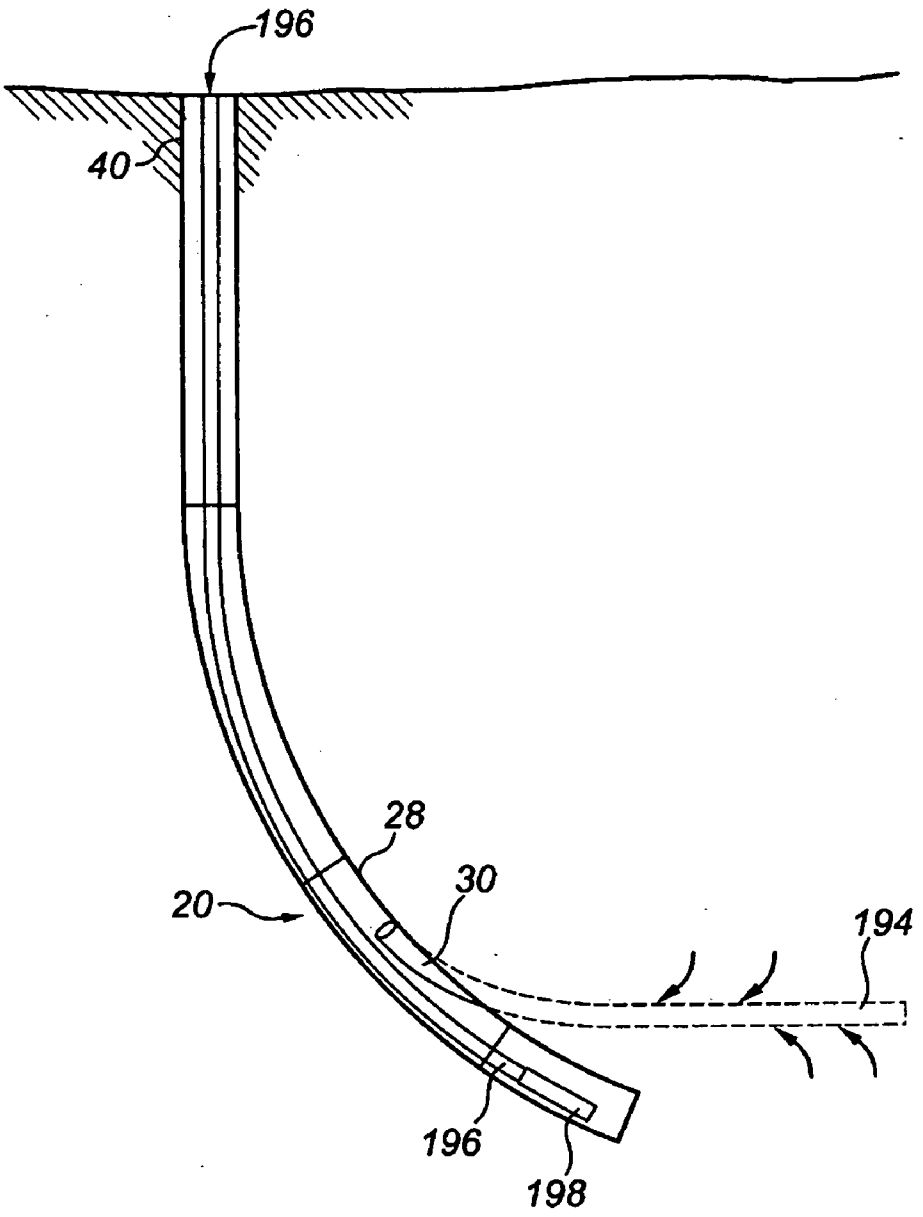

FIG. 26

JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION

REFERENCE TO CO-PENDING APPLICATIONS

[0001] The entire subject matter of U.S. Provisional application Ser. No. 60/599,937 filed Aug. 9, 2004 and entitled JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION is incorporated herein by reference. Applicant claims priority benefit under Title 35, United States Code of U.S. of U.S. application Ser. No. 60/599,937 filed Aug. 9, 2004 and entitled JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION.

[0002] The entire subject matter of the Applicant's co-pending PCT application number PCT/CA03/01052 filed Jul. 10, 2003 and entitled JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION is incorporated by reference. Applicant claims priority benefit under Title 35, United States Code of United States of PCT application number PCT/CA03/01052 filed Jul. 10, 2003 and entitled JUNCTION ASSEMBLY, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION.

[0003] The entire subject matter of the Applicant's co-pending Canadian patent application serial number 2,418,565 filed Feb. 10, 2003 and entitled APPARATUS, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION is also incorporated by reference. Applicant claims priority benefit under Title 35, United States Code of United States of Canadian patent application serial number 2,418,565 filed Feb. 10, 2003 and entitled APPARATUS, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION.

FIELD OF INVENTION

[0004] The present invention relates to a junction assembly adapted for insertion in a borehole, as well as a system and a method for providing a junction in a borehole.

BACKGROUND OF INVENTION

[0005] Directional drilling technology permits the drilling of a lateral, branch or secondary borehole from a primary, main or mother borehole. Further, greater than one lateral borehole may be drilled from the primary borehole resulting in a well referred to as a multilateral well.

[0006] Typically, the lateral borehole is drilled, and subsequently produced, through a gap or window cut or milled through a section of the existing casing string in the primary borehole. The resulting junction between the primary and lateral boreholes may be completed in any desired manner depending upon the intended use and production of either or both of the primary and lateral boreholes. For instance, the Forum on Technical Advancement—Multi-Laterals ("TAML") provides a Multi Lateral Well Classification Matrix which assigns a "Level" number to a well indicative of its complexity, and particularly, the complexity of the junction. In determining the complexity of the junction, the type of support provided at the junction including the casing and/or cementing of the junction are considered. For instance, a Level 6 junction delivers pressure integrity at the junction using the casing.

[0007] U.S. Pat. No. 5,388,648 issued Feb. 14, 1995 to Jordan, Jr. provides a number of methods and devices for completing multilateral wells and for sealing the junction between the primary and lateral boreholes. For instance, to complete and seal the junctions, Jordan, Jr. utilizes "deformable means." A deformed or fully collapsed mold or device is run into the primary borehole adjacent to the pre-drilled junction with the lateral borehole. Once the device is in position, heat and/or pressure are applied to cause the device to expand or regain its original shape. As a result, a laterally extending portion of the device or mold extends from the primary borehole into the lateral borehole.

[0008] However, previous approaches to the provision, including the drilling and completion, of the junction between the primary and lateral boreholes have not been found to be fully satisfactory.

[0009] Thus, there remains a need for an improved junction assembly for insertion in a borehole, and an improved system and a method for providing a junction in a borehole

SUMMARY OF INVENTION

[0010] The present invention relates to a junction assembly adapted for insertion in a borehole and a system and method for providing a junction in a borehole, preferably between a primary borehole and a lateral borehole extending or to extend therefrom. Further, the present invention preferably provides for a Level 6 junction as defined by the TAML Multi Lateral Well Classification Matrix.

[0011] Preferably, the junction provides the ability to control the pressure within the lateral borehole at the junction rather than controlling the pressure through a production liner extending to the surface. In addition, the junction preferably permits an amount of downhole separation of gases from the formation fluids in order to enhance the performance of the downhole pumps and to minimize the amount of gas separation required at the surface. Further, the junction preferably permits a relatively high kick off and build angle of the lateral borehole.

[0012] In a first aspect of the invention, the invention is comprised of a junction assembly adapted for insertion in a borehole. The junction assembly preferably provides a junction between a primary borehole and a lateral borehole to be drilled and/or produced therefrom. The junction assembly is comprised of a primary conduit and a lateral conduit having a conduit junction therebetween. To utilize the junction assembly, the junction assembly is positioned within the borehole, such as a primary borehole, at a desired depth or location and is oriented at a desired orientation such that the conduit junction is positioned adjacent a desired location or in a desired direction such as in the direction of a desired lateral borehole.

[0013] Upon extending or passing an object, such as a downhole tool or other equipment through the borehole, the junction assembly permits or provides for the passage of the object from the borehole and through the junction assembly to extend from the conduit junction in order to access the lateral borehole or to access the desired location or direction of the lateral borehole to be drilled therefrom. For instance, a drilling tool or equipment may be passed through the conduit junction in the junction assembly in order to drill the lateral borehole in the direction of the conduit junction. As

well, once the lateral borehole is drilled, other downhole tools or equipment, including liners and production equipment, may be passed through the conduit junction of the junction assembly for access to the lateral borehole. Thus, the junction assembly assists in forming the junction between a primary borehole and a lateral borehole, as well as maintaining the integrity and stability of the junction, while permitting access to either or both the primary and lateral boreholes, as desired. Preferably, the conduit junction is oriented on the high side of the junction assembly to facilitate passage of an object through the junction assembly to the bottom of the primary borehole along the low side of the junction assembly.

[0014] In a preferred embodiment of the first aspect, the invention is comprised of a junction assembly adapted for insertion in a borehole, the junction assembly comprising:

[0015] (a) a primary conduit, the primary conduit having an upper end, a lower end, and defining a primary conduit bore extending through the primary conduit from the upper end to the lower end; and

[0016] (b) a lateral conduit, wherein the lateral conduit is connected with the primary conduit at a conduit junction located between the upper end of the primary conduit and the lower end of the primar conduit and wherein the lateral conduit extends within the primary conduit bore from the conduit junction towards the upper end of the primary conduit.

[0017] The conduit junction is formed or comprised of the interaction, intersection or communication between the primary conduit and the lateral conduit. The intersection may be provided between any of the elements or components of the primary and lateral conduits and may be defined in several manners. First, the primary conduit is preferably comprised of a primary conduit wall, the lateral conduit preferably defines a lateral conduit bore, and the conduit junction may be comprised of an intersection of the primary conduit wall and the lateral conduit bore. Second, the lateral conduit preferably has a lower end and the conduit junction may be comprised of an intersection of the primary conduit wall and the lower end of the lateral conduit. Third, the lateral conduit is preferably comprised of a lateral conduit wall and the conduit junction may be comprised of an intersection of the primary conduit wall and the lateral conduit wall.

[0018] In each instance, the conduit junction is preferably comprised of a junction opening. More preferably, the lateral conduit defines a lateral conduit bore and the lateral conduit bore communicates with the junction opening. In addition, the lateral conduit is preferably connected with the primary conduit at the conduit junction such that the junction opening is sealed from the primary conduit bore. This seal or sealed connection between the lateral and primary conduits may be provided by any sealing mechanism or means for sealing the connected conduits. However, in the preferred embodiment, the lateral conduit is connected with the primary conduit at the conduit junction by welding such that the junction opening is sealed from the primary conduit bore by welding.

[0019] The primary and lateral conduits may have any relative dimensions and configurations permitting a connection therebetween to provide the conduit junction and permitting the lateral conduit to extend within the primary conduit bore from the conduit junction towards the upper end of the primary conduit. For instance, an upper end of the lateral conduit may be positioned within the primary conduit or extend from the upper end of the primary conduit. However, preferably, the upper end of the lateral conduit is located within the primary conduit bore. Further, the entire lateral conduit is preferably contained within the primary conduit. In the preferred embodiment, the primary conduit is comprised of a primary conduit wall, the primary conduit wall has an external dimension, and the lateral conduit is contained entirely within the external dimension of the primary conduit wall.

[0020] However, although the lateral conduit is preferably completely contained within the primary conduit, the dimensions of the lateral conduit are preferably further selected such that the lateral conduit does not substantially obstruct the primary conduit bore. Thus, in the preferred embodiment, the lateral conduit extends within the primary conduit bore such that passage is permitted through the primary conduit bore from the upper end of the primary conduit to the lower end of the primary conduit. As a result, an object may be passed through the primary conduit bore between the upper and lower ends of the primary conduit. Alternately, an object may be passed from the upper end of the primary conduit through the primary conduit bore to an upper end of the lateral conduit and into the lateral conduit bore. From the lateral conduit bore, the object may pass through the conduit junction, preferably comprised of the junction opening.

[0021] Thus, the lateral conduit is preferably further configured to facilitate the passage of an object therethrough and to facilitate the passage of the object through the conduit junction in a desired direction. For instance, preferably, the lateral conduit has an upper end and the lateral conduit is comprised of a build angle section having a length extending from the conduit junction to a location between the conduit junction and the upper end of the lateral conduit. In addition, preferably, the primary conduit bore defines a longitudinal axis, the lateral conduit defines a lateral conduit bore, the lateral conduit bore defines a longitudinal axis, and the longitudinal axis of the lateral conduit bore along the build angle section forms an angle relative to the longitudinal axis of the primary conduit bore. In the preferred embodiment, the conduit junction is comprised of a junction opening and the junction opening extends along the length of the build angle section of the lateral conduit. Thus, the lateral conduit provides a "kick-off" angle for objects passing out of the conduit junction.

[0022] As well, the junction assembly may be utilized with a guide to facilitate the passage of an object from the primary conduit into the lateral conduit. Thus, at least one of the primary conduit and the lateral conduit is preferably comprised of a latching mechanism for engaging with a complementary latching mechanism located on a guide for guiding an object into the lateral conduit. Although the latching mechanism may be associated with either the primary or lateral conduits, in the preferred embodiment, the lateral conduit is comprised of the latching mechanism.

[0023] Finally, the primary conduit is preferably connectable with a pipe string, such as a casing string, for placement in the borehole. Thus, the junction assembly comprises a

portion of the casing string extending from the surface downhole. More particularly, an upper end of the primary conduit is preferably connectable with an upper pipe string, while a lower end of the primary conduit is preferably connectable with a lower pipe string. The connection may be provided by any means or mechanism for connecting the end of the primary conduit with the pipe string. In the preferred embodiment, the primary conduit is comprised of an upper connector for connecting the upper end of the primary conduit with an upper pipe string. In addition, in the preferred embodiment, the primary conduit is further comprised of a lower connector for connecting the lower end of the primary conduit with a lower pipe string.

[0024] In a second aspect of the invention, the invention is comprised of a system or a kit for providing a junction in a borehole. Preferably, the system is comprised of a pipe string adapted for insertion in the borehole and the junction assembly, as described above, connected with the pipe string. Further, the system is preferably comprised of at least one of an orienting device and a removable guide, and preferably both the orienting device and the removable guide.

[0025] The orienting device is adapted for insertion in the pipe string for indicating an orientation of the orienting device, wherein the orienting device is further adapted to selectively engage the junction assembly such that the orientation of the orienting device provides an indication of an orientation of the junction assembly.

[0026] The orienting device may be comprised of any device or apparatus capable of insertion in the junction assembly and which is preferably removable and which is capable of indicating or providing to a user or operator the orientation of the orienting device such that the orientation of the junction assembly may be determined. Preferably, the orienting device is particularly adapted to be inserted in the primary conduit and to engage the lateral conduit in order to selectively engage the orienting device with the junction assembly. In the preferred embodiment, the orienting device is comprised of a device housing and the device housing is adapted to be inserted in the primary conduit and to engage the lateral conduit in order to selectively engage the orienting device with the junction assembly.

[0027] Further, the orienting device preferably defines a passage therethrough for conducting a fluid through the orienting device. Thus, a fluid, such as a bonding agent or a slurry of a hardenable or settable liquid, including a cementitious slurry, may be passed through the junction assembly following the orientation of the junction assembly utilizing the orienting device in order to maintain the position of the junction assembly in the borehole.

[0028] In the preferred embodiment, the orienting device is comprised of: (a) a device housing adapted for insertion in the primary conduit, wherein the device housing comprises a recess for receiving the lateral conduit such that the device housing engages the lateral conduit; and (b) a tubular member extending through the device housing, wherein the tubular member defines a passage for conducting a fluid through the orienting device.

[0029] In addition, the orienting device is preferably comprised of an orientation indicator for providing an indication of the orienting device. The orienting device may be comprised of one or more apparatuses or sensors capable of sensing and communicating the orientation of the orienting device. The selective engagement of the junction assembly by the orienting device is such that the orientation of the orienting device provides an indication of an orientation of the junction assembly. Preferably, the information concerning the orientation, as provided or indicated by the orienting device, is communicated to the surface for use by an operator of the system.

[0030] The orientation indicator may be mounted, affixed, fastened or otherwise associated with the orienting device, preferably the device housing, in any manner permitting the orientation indicator to perform its function. If desired, the orientation indicator may be contained within a separate tubular member, pipe joint or sub, such as within an orienting sub, which is fastened, connected or mounted with the device housing in a manner permitting the orientation indicator to operate and to sense and communicate the orientation of the orienting device.

[0031] Further, the orienting device is preferably comprised of a stop mechanism for limiting the extent to which the orienting device may be inserted in the primary conduit. In addition, in order to insert and remove the orienting device from the junction assembly, the orienting device is preferably connectable with a pipe string in any manner and by any connecting means or mechanism. In the preferred embodiment, the tubular member is comprised of an upper connector for connecting the orienting device with an upper pipe string. The tubular member is further preferably comprised of a lower connector for connecting the orienting device with a lower pipe string.

[0032] Similarly, the removable guide is preferably adapted for insertion in the pipe string for guiding an object into the lateral conduit, wherein the guide is adapted to selectively engage the junction assembly such that the guide is oriented to guide the object into the lateral conduit. The guide is provided to guide or direct objects such as downhole tools or equipment, including a drilling tool or production tool or equipment, through the junction assembly from the primary borehole to the lateral borehole. Thus, the guide preferably guides or directs the object into the lateral conduit towards the conduit junction, and particularly the junction opening, so that the object may extend from or pass through the junction opening to the lateral borehole.

[0033] The removable guide may be comprised of any removable device or apparatus capable of insertion in the pipe string or casing string, adapted to selectively engage the junction assembly and able to guide an object into the lateral conduit. Preferably, the guide is comprised of a guide housing and the guide housing is adapted to be inserted in the primary conduit and to engage the lateral conduit in order to selectively engage the guide with the junction assembly. Further, the guide is preferably comprised of an upper surface which is sloped towards the lateral conduit when the guide is engaged with the junction assembly.

[0034] In the preferred embodiment, the guide is comprised of a guide housing adapted for insertion in the primary conduit, wherein the guide housing comprises a recess for receiving the lateral conduit such that the guide housing engages the lateral conduit, wherein the guide housing has an upper surface and wherein the upper surface is sloped towards the recess in order to guide the object into the lateral conduit.

[0035] The guide is also further preferably comprised of a latching mechanism for engagement with a complementary latching mechanism associated with the junction assembly. The complementary latching mechanisms inhibit or prevent the movement of the guide within the junction assembly following the proper placement of the guide within the junction assembly. In order to remove the guide from the junction assembly, the latching mechanisms must be released in some manner. Preferably, the guide is released by shearing of the latching mechanism or complementary latching mechanism. In the preferred embodiment, the latching mechanism of the guide is comprised of a shear mechanism for releasing the latching mechanism. In addition, the guide is further preferably comprised of a stop mechanism for limiting the extent to which the guide may be inserted in the primary conduit.

[0036] The removable guide may be placed within and retrieved from the junction assembly by any apparatus including a pipe string or other device or means for running and retrieving the guide. However, preferably, the guide is further comprised of a running and retrieval mechanism for engagement with a running and retrieval tool for placement and retrieval of the guide. Specifically, the running and retrieval tool is adapted to selectively engage and disengage the running and retrieval mechanism of the guide. Although the running and retrieval mechanism and the running and retrieval tool may have any compatible or complementary structures capable of engaging each other, the running and retrieval mechanism is preferably comprised of a slot or a pin for engagement with a complementary slot or a complementary pin associated with the running and retrieval tool.

[0037] In a third aspect of the invention, the invention is comprised of a method for providing a junction in a borehole. Preferably, the method is performed utilizing the junction assembly and system of the within invention as described herein, and particularly, the preferred embodiments of the junction assembly and system. However, the method may be performed using any junction assembly, system or device suitable for, and capable of, performing the within method.

[0038] Preferably, the method is comprised of the following steps:

[0039] (a) positioning a pipe string and a junction assembly connected with the pipe string at a desired depth in the borehole;

[0040] (b) inserting an orienting device in the pipe string such that the orienting device selectively engages the junction assembly;

[0041] (c) obtaining an indication of an orientation of the orienting device;

[0042] (d) rotating the pipe string and the junction assembly in order to obtain a desired orientation of the junction assembly;

[0043] (e) maintaining the desired orientation of the junction assembly in the borehole while introducing a bonding agent into the borehole through the orienting device; and

[0044] (f) removing the orienting device from the pipe string.

[0045] Any bonding agent may be used such as a slurry of a hardenable or settable liquid, such as a cementitious slurry. The bonding agent is conducted through the orienting device and passes into the borehole, particularly the primary borehole, and subsequently into a space or annulus between the junction assembly and the wall of the primary borehole. Once the bonding agent sets or hardens, the junction assembly is fixed in the desired orientation and the hardened bonding agent forms or provides a portion of the casing string of the borehole. Subsequently, to exit the junction assembly through the junction opening, a drilling tool may be required to drill through the portion of the hardened bonding agent adjacent the junction opening.

[0046] In addition, the method is preferably further comprised of the following steps:

[0047] (g) inserting a guide in the pipe string with a running and retrieval tool such that the guide selectively engages the junction assembly; and

[0048] (h) inserting an object in the pipe string such that the object is guided into the lateral conduit by the guide.

[0049] Any object may be guided into the lateral conduit including any drilling, completion or production equipment or tools. For instance, the object may be comprised of a drilling tool for drilling a lateral borehole. The object may also be comprised of a liner for lining a lateral borehole.

[0050] Finally, the method may be further comprised of the step of removing the guide from the pipe string with the running and retrieval tool. In the preferred embodiment, the step of removing the guide from the pipe string is comprised of shearing a shear mechanism associated with the junction assembly.

[0051] In another of its aspects, the present invention provides a junction device for providing a lateral junction in a borehole, comprising a primary conduit having an upper end portion and a lower end portion, each of which is arranged for attachment with one or more casing members to form a borehole casing string, the primary conduit forming a primary conduit bore, a lateral conduit having a lateral conduit bore, the lateral conduit being anchored to the primary conduit so as to be immovable relative thereto, the primary conduit having a first peripheral region encircling a junction opening formed therein, the lateral conduit having a second peripheral region encircling the lateral conduit bore, the second peripheral region being sealably welded to the first peripheral region so as to form a lateral conduit path which is isolated from the primary bore.

[0052] Preferably, the first peripheral region includes a first peripheral surface and the second peripheral region includes an upstanding flange which extends at least partway along the junction opening, the upstanding flange including a second peripheral surface, the second peripheral surface lying immediately adjacent the first peripheral surface.

[0053] In an embodiment, a continuous weld seam joins the first and second peripheral regions adjacent the first and second peripheral surfaces, though other attachment means may be provided as required.

[0054] In an embodiment, attachment means is provided for attaching the lateral conduit to the primary conduit in advance of the junction opening. In an embodiment, the

attachment means includes one or more weld joints between the adjacent lateral and primary conduits.

[0055] In one example, the lateral conduit has an outer surface exposed to the primary conduit bore, the primary conduit having an inner surface exposed to the primary conduit bore and attachment means is provided for attaching the lateral conduit to the primary conduit with the outer and inner faces immediately adjacent one another.

[0056] In an embodiment, the primary conduit has an outer surface to communicate with the borehole and the second peripheral region terminates at or is substantially flush with the outer surface within the first peripheral region.

[0057] In a further desirable aspect, the primary conduit is operable to maintain a first fluid pressure ranging from about 0 to about 10 MPA while the lateral conduit is operable to maintain a second fluid pressure ranging from about 30 to 60 MPA, though other pressures and/or pressure ranges may be used as needed depending on the specifications of the pipes, for instance.

[0058] Preferably, the primary conduit includes a primary longitudinal axis and the first section of the lateral conduit includes a first longitudinal axis which is substantially parallel with but offset from the primary longitudinal axis. The second section of the lateral conduit has a second longitudinal axis which is at an angle of less than ninety degrees relative to the primary longitudinal axis.

[0059] In another of its aspects, the present invention provides a junction device for providing a lateral junction in a borehole, comprising primary conduit means having an upper end portion and a lower end portion, first attachment means for attaching the upper and lower end portions to one or more casing members to form a borehole casing string, the primary conduit means forming a primary conduit bore, the lateral conduit means having a lateral conduit bore, the lateral conduit means being anchored to the primary conduit means so as to be immovable relative thereto, the primary conduit means having a first peripheral region circumscribing a junction opening formed therein, the lateral conduit means having a second peripheral region circumscribing the lateral conduit bore, second attachment means for sealingly attaching the second peripheral region to the first peripheral region so as to form a lateral conduit path which is isolated from the primary bore.

SUMMARY OF DRAWINGS

[0060] Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

[0061] **FIG. 1** is a side view of a preferred embodiment of a junction assembly of the within invention;

[0062] **FIG. 1A** is a side view of an alternative junction assembly;

[0063] **FIG. 2** is a top view of the junction assembly shown in **FIG. 1**;

[0064] **FIG. 2A** is a top view of the alternative junction assembly shown in **FIG. 1A**;

[0065] **FIG. 3** is a cross-sectional view of the junction assembly taken along lines **3-3** of **FIG. 2**;

[0066] **FIG. 3A** is a cross-sectional view of the alternative junction assembly taken along lines **3A-3A** of **FIG. 2A**;

[0067] **FIG. 4** is a cross-sectional view of the junction assembly taken along lines **4-4** of **FIG. 2**;

[0068] **FIG. 4A** is a cross-sectional view of the alternative junction assembly taken along lines **4A-4A** of **FIG. 2A**;

[0069] **FIG. 4B** is a cross-sectional view of the alternative junction assembly taken along lines **4B-4B** of **FIG. 2A**;

[0070] **FIG. 5** is a side view of a preferred embodiment of a removable orienting device of the within invention;

[0071] **FIG. 6** is a top view of the orienting device as shown in **FIG. 5**;

[0072] **FIG. 7** is a front view of a first embodiment of a removable guide of the within invention;

[0073] **FIG. 8** is a cross-sectional view of the guide taken along lines **8-8** of **FIG. 7**;

[0074] **FIG. 9** is a side view of the guide as shown in **FIG. 7**;

[0075] **FIG. 10** is a top view of the guide as shown in **FIG. 7**;

[0076] **FIG. 11** is a longitudinal sectional view of the guide taken along lines **111-11** of **FIG. 10** showing a latch;

[0077] **FIG. 12** is a perspective view of a preferred embodiment of an inner latch member comprising the latch shown in **FIG. 11**;

[0078] **FIG. 13** is a perspective view of a preferred embodiment of an outer latch member comprising the latch shown in **FIG. 11**;

[0079] **FIG. 14** is a side view of the inner and outer latch members shown in **FIGS. 12 and 13**;

[0080] **FIG. 15** is a side view of a first removable guide running and retrieving tool for use with the first embodiment of the removable guide as shown in **FIG. 7**;

[0081] **FIG. 16** is a front view of a second preferred embodiment of a removable guide of the within invention;

[0082] **FIG. 17** is a cross-sectional view of the guide taken along lines **17-17** of **FIG. 16**;

[0083] **FIG. 18** is a side view of the guide as shown in **FIG. 16**;

[0084] **FIG. 19** is a top view of the guide as shown in **FIG. 16**;

[0085] **FIG. 20** is a longitudinal sectional view of the guide taken along lines **20-20** of **FIG. 19**;

[0086] **FIG. 21** is a side view of a second removable guide running and retrieving tool for use with the second embodiment of the removable guide as shown in **FIG. 16**;

[0087] **FIG. 22** is a side view of a third removable guide running and retrieving tool for alternate use with the second embodiment of the removable guide as shown in **FIG. 16**;

[0088] **FIG. 23** is a cross-sectional view of the third running and retrieval tool taken along lines **23-23** of **FIG. 22**;

[0089] **FIG. 24** is a schematic cross-sectional view of a casing string showing the configuration schematically of the orienting device and the guide as shown in **FIGS. 5 and 7** or **16** respectively within the casing string;

[0090] **FIG. 25** is a schematic cross-sectional view of the junction assembly shown in **FIG. 1**, showing the configuration schematically of the orienting device and the guide as shown in **FIGS. 5 and 7** or **16** respectively within the conduit;

[0091] **FIG. 26** is a pictorial view of the junction assembly shown in **FIG. 1** positioned within a primary borehole.

DETAILED DESCRIPTION

[0092] Referring to **FIG. 1**, the within invention is comprised of a junction assembly **(20)** for insertion in a borehole for providing a downhole junction, preferably between a primary borehole and an existing or intended lateral borehole. More particularly, the junction assembly **(20)** provides a pre-formed junction for placement at a desired location in the primary borehole. Once positioned, and preferably cemented, at the desired location in the borehole, the junction assembly **(20)** may be utilized to direct any object such as a drilling tool or drilling equipment from the primary borehole in the direction that the lateral borehole is to be drilled for the drilling of the lateral borehole. Further, the junction assembly **(20)** may be utilized to direct other objects such as downhole tools or equipment, including production equipment and tubing strings, into the lateral borehole in order to produce fluids from the lateral borehole or conduct fluids downhole into the lateral borehole.

[0093] Further, referring to **FIGS. 1, 5, 7** and **16**, the within invention is also directed at a system for providing a junction in a borehole, preferably between the primary borehole and the lateral borehole. In the preferred embodiment, the system is comprised of the junction assembly **(20)** and at least one, and preferably both, of a removable orienting device **(22)** and a removable guide **(24)**.

[0094] Referring to **FIGS. 1-4**, the junction assembly **(20)** is adapted for insertion in the borehole, referred to herein as the primary borehole. In other words, the outer dimensions of the junction assembly **(20)** are selected such that the junction assembly **(20)** may be readily inserted within and passed through the primary borehole to the desired depth. The junction assembly **(20)** is preferably comprised of a primary conduit **(28)** and a lateral conduit **(30)** connected at a conduit junction **(31)**.

[0095] The primary conduit **(28)** may be comprised of any suitable tubular member or pipe joint and has an upper end **(32)**, a lower end **(34)** and a primary conduit bore **(36)** extending therethrough between the upper and lower ends **(32, 34)**. Further, the primary conduit **(28)** is comprised of a primary conduit wall **(38)** which defines the primary conduit **(28)** between the upper and lower ends **(32, 34)** and defines the bore **(36)** therein. Preferably, the primary conduit **(28)** is comprised of a single tubular member extending between the upper and lower ends **(32, 34)**. However, alternately, the primary conduit **(28)** may be comprised of two or more tubular members connected, affixed, mounted or otherwise attached together, either permanently or removably, to form an integral unit between the upper and lower ends **(32, 34)**.

[0096] The upper end **(32)** of the primary conduit **(28)** is adapted for connection with an upper pipe string, preferably an upper portion of a casing string, such that the primary conduit **(28)** may be connected with the casing string for lowering and rotating the primary conduit **(28)** within the primary borehole. Further, the upper portion of the casing string preferably extends to the surface to permit communication between the surface and the junction assembly **(20)**. In other words, objects such as downhole tools and equipment, including drilling and production tools, may be passed through the casing string from the surface for insertion into the primary conduit **(28)** through its upper end **(32)**. Conversely, fluids may be pumped from the primary conduit **(28)** out of its upper end **(32)** and to the surface either within the casing string itself or within production tubing or a production string extending therethrough.

[0097] The upper pipe string may be comprised of one or more joints, subs or lengths of pipe or casing. In the preferred embodiment, the upper pipe string is comprised of the upper portion of a casing string **(40)** as shown in **FIG. 26**. Further, preferably, the upper portion of the casing string **(40)** is comprised of a plurality of joints of casing connected together and extending from the upper end **(32)** of the primary conduit **(28)** to the surface. The upper end **(32)** may be permanently or removably connected with the upper pipe string in any manner and by any connector or connection mechanism. However, preferably, the primary conduit **(28)** is comprised of an upper connector **(33)** for connecting the upper end **(32)** with the upper pipe string, In the preferred embodiment, the upper connector **(33)** is comprised of a threaded connection provided between the upper end **(32)** of the primary conduit **(28)** and the adjacent end of the upper pipe string, being the upper portion of the casing string **(40)**. In the preferred embodiment, the upper end **(32)** of the primary conduit **(28)** is comprised of a threaded box connector for engagement with a compatible threaded pin connector of the casing string **(40)**.

[0098] Similarly, the lower end **(34)** of the primary conduit **(28)** is preferably adapted for connection with a lower pipe string, preferably a lower portion of a casing string, such that the primary conduit **(28)** may be connected with further portions of a pipe string which extend downhole from the primary conduit **(28)** within the primary borehole. The lower pipe string may be comprised of one or more further joints, subs or lengths of pipe or casing, which may be connected with further downhole equipment such as a cementing shoe or cement float for facilitating the casing of the primary borehole or a downhole pump for producing fluids from the primary borehole. Thus, communication is preferably permitted between the lower portion of the pipe string and the lower end **(34)** of the primary conduit **(28)**. For instance, drilling tools and equipment may be passed through the primary conduit **(28)** and the lower pipe string from the surface for further drilling of the primary borehole. As well, fluids may be pumped from the primary borehole through the lower pipe string, into the primary conduit **(28)** and subsequently to the surface either within the lower pipe string itself or within production tubing or a production string extending therethrough.

[0099] The lower end **(34)** may be permanently or removably connected with the lower pipe string in any manner and by any connector or connection mechanism. However, preferably, the primary conduit **(28)** is comprised of a lower

connector (35) for connecting the lower end (34) with the lower pipe string, In the preferred embodiment, the lower connector (35) is comprised of a threaded connection provided between the lower end (34) of the primary conduit (28) and the adjacent end of the lower pipe string. In the preferred embodiment, the lower end (34) of the primary conduit (28) is comprised of a threaded box connector for engagement with a compatible threaded pin connector of the lower pipe string.

[0100] Thus, preferably, the primary conduit (28) forms a portion or section of a pipe string or bottomhole assembly extending downhole from the surface. More particularly in the preferred embodiment, the primary conduit (28) forms or comprises a portion of the casing string (40) bottomhole assembly, being connected between an upper portion and a lower portion of the casing string (40). The outside diameter of the primary conduit (28), as defined by the primary conduit wall (38), may be selected to match or be the same as the outside diameter of the adjacent upper and lower pipe string or casing string portions. However, as described further below, in the preferred embodiment of the junction assembly (20), the outside diameter of the primary conduit (28) is typically greater than the outside diameters of the adjacent upper and lower pipe string portions to accommodate the further structural members or components of the primary conduit (28) therein. For instance, in the preferred embodiment, the typical outside diameter of the upper pipe or casing string portion is about 9⅝ inches (about 24.45 cm). However, the outside diameter of the primary conduit (28) is preferably about 10¾ inches (about 27.31 cm). Thus, where necessary, a connector member or connector joint, often referred to as an "upset" or a connector sub, may be connected between the primary conduit (28) and the adjacent pipe string to accommodate or provide for the change in the outside diameters.

[0101] In addition, where a multilateral well is desired, greater than one junction assembly (20) may be connected together in series either directly or indirectly and connected with the casing string (40) for insertion in the primary borehole. For instance, the upper end (32) of one primary conduit (28) may be directly connected with the lower end (34) of a further primary conduit (28). In this case, a threaded box connector may be provided by one of the upper end (32) of the first primary conduit (28) and the lower end (34) of the further primary conduit (28) and a threaded pin connector may be provided by the other of the upper end (32) of the first primary conduit (28) and the lower end (34) of the further primary conduit (28). Alternately, a connector sub or joint, or one or more further sections or joints of pipe or tubular members, may be connected between the adjacent ends of the primary conduits (28).

[0102] The junction assembly (20) is further comprised of the lateral conduit (30) which is connected with the primary conduit (28) at the conduit junction (31). Preferably, the conduit junction (31) is located between the upper and lower ends (32, 34) of the primary conduit (28). Further, the lateral conduit (30) preferably extends within the primary conduit bore (36) from the conduit junction (31) towards the upper end (32) of the primary conduit (28). The conduit junction (31) is preferably comprised or formed from the intersection of the structure of the primary conduit (28) and the structure of the lateral conduit (30). This intersection may be described in various manners as discussed further below.

[0103] The lateral conduit (30) is preferably rigidly or securely mounted or connected within the primary conduit (28) in any manner and by any connecting means or mechanism. However, in the preferred embodiment, the lateral conduit (30) is connected with the primary conduit (28) at the conduit junction (31) by welding such that a sealed connection is provided.

[0104] The lateral conduit (30) has an upper end (44), a lower end (46) and a lateral conduit bore (48) extending therethrough between the upper and lower ends (44, 46). Further, the lateral conduit (30) is comprised of a lateral conduit wall (50) which defines the lateral conduit (30) between the upper and lower ends (44, 46) and defines the bore (48) therein. Preferably, the lateral conduit (30) is comprised of a single tubular member or joint of pipe extending between the upper and lower ends (44, 46). However, alternately, the lateral conduit (30) may be comprised of two or more tubular members or joints of pipe connected, affixed, mounted or otherwise attached together, either permanently or removably, to form an integral unit between the upper and lower ends (44, 46).

[0105] Preferably, the upper end (44) of the lateral conduit (30) is located within the primary conduit bore (36). Further, in the preferred embodiment, the primary conduit wall (38) has an external dimension and the lateral conduit (30) is contained entirely within the external dimension of the primary conduit wall (38). However, the lateral conduit (30) further preferably extends within the primary conduit bore (36) such that passage is permitted through the primary conduit bore (36) from the upper end (32) to the lower end (34) of the primary conduit (28). In other words, the primary conduit bore (36) is not substantially obstructed by the lateral conduit (30).

[0106] The conduit junction (31) may be comprised of an intersection of the primary conduit wall (38) and the lateral conduit bore (48). Alternately, the conduit junction (31) may be described as being comprised of an intersection of the primary conduit wall (38) and the lower end (46) of the lateral conduit (30). Finally, the conduit junction (31) may be also alternately be described as being comprised of an intersection of the primary conduit wall (38) and the lateral conduit wall (50).

[0107] In any event, the conduit junction (31) is preferably comprised of a junction opening (42). In the preferred embodiment, the primary conduit wall (38) defines the junction opening (42) therein. The junction opening (42) may have any shape or configuration compatible with its intended function as described herein, however, in the preferred embodiment, the junction opening (42) is elongate and is oriented longitudinally between the upper and lower ends (32, 34) of the primary conduit (28). Further, in the preferred embodiment, the lateral conduit bore (48) communicates with the junction opening (42).

[0108] The upper end (44) of the lateral conduit (30) is preferably positioned within the primary conduit (28) for communication with the bore (36) of the primary conduit (28). Thus, any object including tools and equipment and any fluids may communicate and pass between the bore (36) of the primary conduit (28) and the bore (48) of the lateral conduit (30) through the upper end (44) of the lateral conduit (30). The lower end (46) of the lateral conduit (30) is adapted to be compatible with the junction opening (42) for

engagement therewith such that the bore (**48**) of the lateral conduit (**30**) communicates with the junction opening (**42**). Thus, tools, equipment and fluids may communicate and pass between the bore (**48**) of the lateral conduit (**30**) and outside the primary conduit wall (**38**) through the lower end (**46**) of the lateral conduit (**30**) and the junction opening (**42**).

[**0109**] In other words, tools, equipment and fluid may communicate and pass between the primary borehole and the lateral borehole by passing through the upper end (**32**) of the primary conduit (**28**) into the bore (**36**) of the primary conduit (**28**), the upper end (**44**) of the lateral conduit (**30**) into the bore (**48**) of the lateral conduit (**30**) and through the lower end (**46**) of the lateral conduit (**30**) and the junction opening (**42**) engaged with the lower end (**46**).

[**0110**] Further, the connection at the conduit junction (**31**) preferably provides for the sealing of the junction opening (**42**) from the primary conduit bore (**36**). The sealing may be accomplished in any manner. However, in the preferred embodiment, the lower end (**46**) of the lateral conduit (**30**) is shaped or configured to engage, and preferably sealingly engage, the primary conduit wall (**38**) within the bore (**36**) of the primary conduit (**28**) about the entire junction opening (**42**). Although the lateral conduit (**30**) may be mounted in the bore (**36**) of the primary conduit (**28**) in any manner, in the preferred embodiment, an upper portion (**52**) of the lateral conduit wall (**50**) adjacent the upper end (**44**) of the lateral conduit (**30**) is securely affixed within the bore (**36**) of the primary conduit (**28**) to the primary conduit wall (**38**) in a position uphole of the junction opening (**42**) such that the lower end (**46**) of the lateral conduit (**30**) may engage the junction opening (**42**).

[**0111**] Specifically, the junction opening (**42**) is sealed from the primary conduit bore (**36**) by welding. In particular, the upper portion (**52**) of the lateral conduit wall (**50**) is preferably welded to the primary conduit wall (**38**). Referring to **FIGS. 2 and 3**, a weld hole or slot (**54**) is preferably drilled or otherwise formed within the primary conduit wall (**38**) along the portion or section of the primary conduit wall (**38**) intended to be affixed or mounted with the upper portion (**52**) of the lateral conduit (**30**). Each weld slot (**54**) may have any configuration, but preferably, each weld slot (**54**) is about 1 inch (2.54 cm) long and ¾ inch (1.905 cm) wide and is oriented longitudinally along the primary conduit wall (**38**). Further, the weld slots (**54**) are preferably spaced apart along the portion of the primary conduit wall (**38**) to engage the upper portion (**52**) of the lateral conduit wall (**50**). In the preferred embodiment, the weld slots (**54**) are preferably spaced apart by about 8 inches (20.32 cm). Once the lateral conduit wall (**50**) is positioned adjacent the weld slots (**54**), a plug weld (**54**) is created in the weld slot (**54**) to secure the lateral conduit (**30**) within the primary conduit (**28**) as shown in **FIG. 3**.

[**0112**] Referring to **FIGS. 2 and 4**, the lower end (**46**) of the lateral conduit (**38**) is shaped to be compatible with the junction opening (**42**). Thus, the lower end (**46**) is preferably elongated or shaped in a manner similar to that of the junction opening (**42**). However, the edge of the elongated lower end (**46**) of the lateral conduit (**30**) need not engage the entire edge defining the junction opening (**42**). In other words, the lower end (**46**) of the lateral conduit (**30**) only needs to be compatible with the junction opening (**42**) in that the bore (**48**) of the lateral conduit (**30**) must communicate with the junction opening (**42**) when the lateral conduit (**30**) is mounted within the primary conduit (**28**).

[**0113**] For instance, as shown in **FIG. 2** in the preferred embodiment, the width of the junction opening (**42**) and the width of the lower end (**46**) of the lateral conduit (**30**) are similar. However, the length of the junction opening (**42**) is greater than that of the lower end (**46**). Alternately, however, the lengths may also be similar. In any event, in order to provide a sealed junction, the complete or entire edge defining the junction opening (**42**) is preferably sealing engaged with the adjacent lateral conduit (**30**), either the lower end (**46**) or a portion of the lateral conduit wall (**50**), as shown in **FIGS. 2 and 4**. In the preferred embodiment, a weld (**58**) is provided between the adjacent surfaces of the junction opening (**42**) and the lateral conduit (**30**).

[**0114**] The lateral conduit (**30**) is preferably comprised of two portions. First, the upper portion (**52**) adjacent the upper end (**44**) of the lateral conduit (**30**) is also referred to as the "no build section" of the lateral conduit (**30**). The upper portion (**52**) or no build section of the lateral conduit (**30**) preferably has a longitudinal axis which extends parallel with a longitudinal axis of the primary conduit bore (**36**). In use, as described further below, an uphole end of a production liner for the lateral borehole may be anchored or hung from the lateral conduit (**30**), particularly the upper portion (**52**) of the lateral conduit (**30**).

[**0115**] Second, the lateral conduit (**30**) is comprised of a lower portion (**60**), also referred to as the "build angle section" of the lateral conduit (**30**), located downhole of the upper portion (**52**) adjacent the lower end (**46**) of the lateral conduit (**30**). The build angle section (**60**) thus has a length extending from the conduit junction (**31**) to a location between the conduit junction (**31**) and the upper end (**44**) of the lateral conduit (**30**). The lower portion (**60**) or build angle section is bent or deflected to provide a desired angle offset from the longitudinal axis of the lateral conduit (**30**) in the upper portion (**52**) or no build section. In other words, the lateral conduit bore (**48**) defines a longitudinal axis and the longitudinal axis of the lateral conduit bore (**48**) along the build angle section (**60**) forms an angle relative to the longitudinal axis of the primary conduit bore (**36**). As a result of the bend or deflection, the lower portion (**60**) or build angle section engages or intersects with the junction opening (**42**) in the primary conduit wall (**38**). Preferably, the junction opening (**31**) extends along the length of the build angle section (**60**) of the lateral conduit (**30**).

[**0116**] Another embodiment is shown in **FIGS. 1A, 2A, 3A, 4A** and **4B**. In this case, both the lateral junction opening (**42A**) in the primary conduit (**28A**) and the lateral conduit bore (**48A**) in the lateral conduit (**30A**) are provided with generally semicircular upper end sections as shown at (**42B, 48B**). In this case, the lateral conduit bore opening (**48A**) is relatively closer to the lateral junction opening (**42A**), compared with the embodiment shown in **FIGS. 1 and 2**. In one example, the lateral conduit bore (**48A**) may be within about 0.1 m of the lateral junction opening (**42A**), as opposed to a distance of about 1 m in one example of the embodiment of **FIGS. 1 and 2**.

[**0117**] The position of the lateral junction opening (**42A**) has not, in this particular example, changed relative to the primary conduit (**28A**), while the lower end (**46A**) of the

lateral conduit (**30**A) remains unchanged relative to the primary conduit (**28**A), compared with the embodiment shown in **FIGS. 1 and 2**.

[**0118**] Downstream of the generally semicircular upper end sections (**42**B, **48**B), the lateral junction opening (**42**A) and the lateral conduit bore **48**A are bordered by generally parallel intermediate sections (**42**C, **48**C) and further downstream by generally converging sections (**42**D, **48**D) which then generally converge downwardly toward the lower end (**46**A) of the lateral conduit (**30**A). In addition, the transition point shown at (T) between the upper portion (**52**A) and the lower portion (**60**A) is, in this case, adjacent the upper boundary of the lateral junction opening (**42**A).

[**0119**] The lower portion (**60**A) also provides upstanding flange portions (**48**E) which are formed by shaping the lower portion (**60**A) on opposite sides of the lateral conduit bore (**48**A). This provides a location for a weld seam or other attachment means between the flange portions (**48**E) and the adjacent intermediate sections (**42**C) and the converging sections (**42**D).

[**0120**] Referring to **FIG. 26**, the desired angle of the offset in the lower portion (**60**) or build angle section is selected depending upon the desired kick off angle of the lateral borehole when utilizing the junction assembly (**20**) to drill the lateral borehole. Thus, the kick off angle of the lateral borehole is preset and incorporated into the design or configuration of the lateral conduit (**30**). Although the lateral conduit (**30**) may be configured to provide any desired kick off angle, preferably a kick off angle of less than or equal to about 15 degrees is provided for. Specifically, it has been found that the junction assembly (**20**) may be configured to safely achieve about a 15 degree angle over a distance of about 20 feet (6.096 m).

[**0121**] The junction assembly (**20**A) may, in one example, be operable to provide, in the primary conduit (**20**A) a first fluid pressure ranging from about 0 to about 10 MPA while the lateral conduit (**30**A) may be operable to maintain a second fluid pressure ranging from about 30 to 60 MPA, though other pressures and/or pressure ranges may be used as needed depending on the specifications of the pipes, for instance. In one example, the welded connection between the primary and lateral conduits (**28**A, **30**A) is sufficient to enable the junction opening **42**A to withstand pressure limits defined by the pressure ratings of the primary and lateral conduits (**30**A, **28**A). This means that the operating pressures, in this example, need not be reduced below the normal operating pressure ratings of the primary and lateral conduits because of a reduced pressure rating at the junction opening.

[**0122**] In manufacturing the junction assembly (**20**), the junction opening (**42**) and the weld slots (**54**) are cut or otherwise formed in the primary conduit wall (**38**). The lower portion (**60**) of the lateral conduit (**30**) is bent to achieve a preselected angle and then the lateral conduit (**30**) is installed or positioned within the bore (**36**) of the primary conduit (**28**) such that the lower end (**46**) of the lateral conduit (**30**) extends through and beyond the junction opening (**42**). The upper portion (**52**) of the lateral conduit (**30**) is then welded to the primary conduit wall (**38**) to maintain the lateral conduit (**30**) in position. Further, the edge of the junction opening (**42**) is welded to the adjacent surface of the lateral conduit wall (**50**). Subsequently, the lower end (**46**) of the lateral conduit (**30**) is cut at a slant or angle to provide an elongated lower end (**46**) which corresponds with the junction opening (**42**) in the primary conduit wall (**38**). In other words, the portion of the lower end (**46**) which extends out of or beyond the junction opening (**42**) is removed so that the lower end (**46**) no longer extends from the primary conduit (**28**).

[**0123**] The junction assembly (**20**) may have any desired dimensions compatible with insertion in the primary borehole and compatible with the downhole tools or equipment intended to be passed through to the lateral borehole. However, in the preferred embodiment, the primary conduit (**28**) has an outer diameter of about 10.75 inches (27.305 cm) and an inner diameter of about 9.76 inches (24.79 cm). Further, the lateral conduit (**30**) has an outer diameter of about 5 inches (12.7 cm). With respect to length, in the preferred embodiment, the primary conduit (**28**) has a length of about 13 meters, while the lateral conduit (**30**) has a length of about 9 meters. The lateral conduit (**30**) is preferably substantially centrally mounted within the primary conduit (**28**) between the upper and lower ends (**32**, **34**) of the primary conduit (**28**). Thus, preferably, about 2 meters is provided between the upper end (**32**) of the primary conduit (**28**) and the upper end (**44**) of the lateral conduit (**30**). Similarly, about 2 meters is provided between the lower end (**34**) of the primary conduit (**28**) and the lower end (**46**) of the lateral conduit (**30**). Finally, with respect to the lateral conduit (**30**), the upper portion (**52**) or no build section is preferably about 3 meters in length, while the lower portion (**60**) or build angle section is preferably about 6 meters in length depending upon the desired kick off angle.

[**0124**] As described further below, once the junction assembly (**20**) is positioned and oriented within the primary borehole, it is preferable that the position of the junction assembly (**20**) in the primary borehole be maintained in some manner during subsequent downhole operations. In the preferred embodiment, the junction assembly (**20**) is cemented in position within the primary borehole by conducting an unset cementitious slurry into the annulus between the primary conduit wall (**38**) and the wall of the primary borehole. During this operation, it is desirable that the cementitious slurry not be permitted to flow into the primary conduit (**28**) through the junction opening (**42**) and the bore (**48**) of the lateral conduit (**30**). Thus, any mechanism, device or method may be used to inhibit or prevent this undesirable flow of the cementitious slurry.

[**0125**] For instance, the outside or outer surface of the primary conduit wall (**38**) may be wrapped with a material, such as a shrink wrapping, about the area of the junction opening (**42**) in order to prevent the passage of any fluid therethrough. Once in position, a drilling tool may be used to drill through the shrink wrapping to permit communication between the bore (**36**) of the primary conduit (**28**) and the bore (**48**) of the lateral conduit (**30**).

[**0126**] However, preferably, prior to placing the junction assembly (**20**) within the primary borehole, the bore (**48**) of the lateral conduit (**30**) is filled with a material capable of plugging the bore (**48**) to inhibit the passage of fluid therethrough. Once in position, once again, the plug would either be removed or a drilling tool would be used to drill through the material to permit communication between the bore (**36**) of the primary conduit (**28**) and the bore (**48**) of the lateral conduit (**30**). For example, the plugging material may be

comprised of a cementitious material. In the preferred embodiment, the bore (**48**) is plugged or blocked by an aluminum and rubber inflatable packer having a layer of hardened cement on either side.

[**0127**] Referring to **FIGS. 5, 6, 24** and **25**, the orienting device (**22**) is adapted for insertion in the primary conduit (**28**) to engage the lateral conduit (**30**) for facilitating the orienting of the junction assembly (**20**) in the borehole. Further, the orienting device (**22**) preferably facilitates the completion of the primary borehole, particularly the cementing of the junction assembly (**20**) in the primary borehole at a desired orientation. The orienting device (**22**) is configured or adapted for insertion in the pipe string, particularly the casing string (**40**), and for selectively engaging the junction assembly (**20**) such that the orientation of the orienting device (**22**) provides an indication of an orientation of the junction assembly (**20**). Further, the orienting device (**22**) is preferably removable such that the orienting device (**22**) may be removed from the junction assembly (**20**) following its use.

[**0128**] The orienting device (**22**) is particularly adapted to engage the lateral conduit (**30**) when inserted within the bore (**36**) of the primary conduit (**28**) in order to selectively engage the orienting device (**22**) with the junction assembly (**20**). The orienting device (**22**) is specifically adapted to engage the lateral conduit (**30**) in a manner such that rotation of the junction assembly (**20**) within the primary borehole correspondingly rotates the orienting device (**22**) contained therein. More particularly, the junction assembly (**20**), and particularly the primary conduit (**28**), may be rotated within the primary borehole by rotation of the upper pipe string connected with the upper end (**32**) of the primary conduit (**28**). Throughout this operation, the orienting device (**22**) provides an indication of the orientation of the orienting device, which necessarily provides an indication of the orientation of the junction assembly (**20**) as a result of the engagement of the orienting device (**22**) with the junction assembly (**20**). As a result, the junction assembly (**20**) may be rotated such that the conduit junction (**31**), and particularly the junction opening (**42**), are oriented in a desired direction.

[**0129**] The orienting device (**22**) may be inserted within the primary conduit (**28**) in any manner and by any mechanism or apparatus. However, preferably, a pipe string or any suitable tubular string is connected with an end of the orienting device (**22**) for inserting the orienting device (**22**) through the primary borehole for insertion in the primary conduit (**28**). Once the orienting device (**22**) is positioned in the primary conduit (**28**), the upper portion of the casing string (**40**) connected with the upper end (**32**) of the primary conduit (**28**), as described above, may be rotated from the surface in order to rotate the primary conduit (**28**), and the orienting device (**22**) inserted therein, downhole. In the preferred embodiment, the upper portion of the casing string (**40**) is rotated at the surface using a standard or conventional rotary table or rig table.

[**0130**] Further, where desired to complete the primary borehole, a hardenable or settable slurry, such as a cementitious slurry, or a bending agent may be conducted through the pipe or tubular string connected with the end of the orienting device (**22**). In order to permit the cementitious slurry to access the annulus between the casing string (**40**) and the junction assembly (**20**) and the wall of the primary borehole, the orienting device (**22**) preferably defines a passage therethrough for conducting the slurry. Thus, the slurry may be conducted through the orienting device (**22**) while the orienting device (**22**) remains in the primary conduit (**28**) in order to maintain the desired orientation of the junction assembly (**20**) in the primary borehole during the completion operation. Specifically, the slurry is preferably conducted through the orienting device (**22**) and out of the lower end (**34**) of the primary conduit (**28**) for subsequent passage into the annulus.

[**0131**] The orienting device (**22**) may be comprised of any apparatus or device capable of engaging the lateral conduit (**30**) in the described manner while permitting the flow of a fluid therethrough. However, preferably, the orienting device (**22**) is comprised of a device housing (**62**) having an upper end (**64**), a lower end (**66**) and a device housing wall (**68**) extending therebetween. The device housing (**62**), and particularly the device housing wall (**68**), is shaped or configured for receipt in the primary conduit (**28**) adjacent the upper portion (**52**) or no build section of the lateral conduit (**30**).

[**0132**] Thus, to permit the lateral conduit (**30**) to be closely or securely received by the orienting device (**22**), the device housing (**62**) has a recess (**70**) as shown in **FIG. 6**. In the preferred embodiment, the device housing wall (**68**) defines a longitudinally oriented C-shaped recess (**70**) which extends the complete length of the device housing (**62**) between the upper and lower ends (**44, 46**). The recess (**64**) is particularly configured to be compatible with the outer dimensions of the lateral conduit wall (**50**). As a result, rotation of the primary conduit (**28**) causes the lateral conduit (**30**) to act upon and engage the recess (**70**) of the device housing (**62**) to cause a corresponding rotation of the device housing (**62**).

[**0133**] The device housing (**62**) may have any dimensions compatible with insertion of the device housing (**62**) within the primary conduit (**28**) and receipt of the lateral conduit (**30**) within the C-shaped recess (**70**). However, in the preferred embodiment, the outside diameter of the device housing (**62**) is preferably about 8.625 inches (21.91 cm) such that the orienting device (**22**) may readily pass through the inside diameter of the casing string (**40**) as shown in **FIG. 24**, wherein the casing string (**40**) has an outside diameter of about 9.625 inches (24.45 cm) and an inside diameter of about 8.835 inches (22.44 cm). Further, the outside diameter of the device housing (**62**) is preferably about 8.625 inches (21.91 cm) such that the orienting device (**22**) may readily seat within the primary conduit (**28**) as shown in **FIG. 25**, wherein the primary conduit wall (**38**) has an outside diameter of about 10.75 inches (27.31 cm). As well, the C-shaped recess (**70**) preferably defines a portion of a circle having an inside diameter of about 5.012 inches (12.73 cm) for ready receipt of the lateral conduit (**30**) as shown in **FIG. 25**, wherein the lateral conduit (**30**) has an outside diameter of about 5 inches (12.7 cm).

[**0134**] The device housing (**62**) may have any length compatible with the junction assembly (**20**). However, in the preferred embodiment, the device housing (**62**) is preferably about 24 inches (about 60.96 cm) in length. In the preferred embodiment, the device housing (**62**) is inserted within the primary conduit (**28**) adjacent the lateral conduit (**30**) such

that the device housing (62) is adjacent the upper portion (52) of the lateral conduit (30). If required or desired to ensure proper placement of the orienting device (22) in the primary conduit (28), the orienting device (22) may be further comprised of a stop mechanism (71) for limiting the extent to which the device housing (62) may be inserted in the primary conduit (28). Preferably, the stop mechanism is comprised of a stop block or stop plate (71) or other structure which is associated with the orienting device (22) in order to inhibit or prevent the insertion of the device housing (62) within the primary conduit (28) beyond or past the desired position adjacent the upper portion (52) of the lateral conduit (30). However, preferably an amount of movement of the orienting device (22) relative to the lateral conduit (30) is permissible while still maintaining the orientation of the primary conduit (28).

[0135] The stop block or stop plate (71) may be positioned within or associated with the C-shaped recess (70) of the device housing (62). However, in the preferred embodiment, the orienting device (22) is further comprised of a tubular member (72) which extends through the device housing (62) and the stop block (71) is associated with the tubular member (72) and particularly an upper end (74) of the tubular member (72) as described further below. The stop block or stop plate (71) is positioned along the upper end (74) of the tubular member (72) such that the stop block (71) abuts or engages the upper end (44) of the lateral conduit (30) when the device housing (62) is in the desired position within the primary conduit (28). In the preferred embodiment, the stop block is positioned along the tubular member (72) at a distance of about 4 feet (about 1.22 m) above or uphole of the upper end (64) of the device housing (62). Thus, the stop block or plate (71) preferably prevents further downhole movement of the orienting device (22) within the primary conduit (28) and defines a "maximum downhole position."

[0136] As stated, preferably an amount of movement of the orienting device (22) relative to the lateral conduit (30) is permissible while still maintaining the orientation of the primary conduit (28). In the preferred embodiment, a maximum upward or uphole movement of the orienting device (22) of about 1.5 to 2 meters is permitted from the maximum downhole position before the orienting device (22) fully disengages the lateral conduit (30). Thus, in the event that the pipe string connected with the orienting device (22) is reciprocated for any reason during use, caution must be exercised to ensure that a maximum upward movement of about 1.5 meters is not exceeded. Otherwise, the orienting device (22) may become disengaged from the lateral conduit (30). Where reciprocation of the casing string is required, the pipe string with the attached orienting device (22) and the casing string are preferably moved simultaneously or concurrently.

[0137] Preferably, the orienting device (22) is further comprised of a tubular member (72) which extends through the device housing (62). The tubular member (72) preferably defines the passage for conducting the fluid through the orienting device (22). The tubular member (72) may be comprised of two or more members or units connected together to provide an integral tubular member (72). However, preferably, the tubular member (72) is comprised of a single member having an upper end (74) and a lower end (76). The tubular member (72) is oriented longitudinally within the device housing (62) such that the upper end (74) of the tubular member (72) extends from the upper end (64) of the device housing (62) and such that the lower end (76) of the tubular member (72) extends from the lower end (66) of the device housing (62).

[0138] As indicated above, a pipe string or tubular string, and particularly an upper portion of the pipe string or upper pipe string, is preferably engagable with the upper end (74) of the tubular member (72) in a manner permitting fluid communication therebetween. Thus, in the preferred embodiment, the upper end (74) of the tubular member (72) is comprised of an upper connector (81) for connecting the orienting device (22) with the upper pipe string. In the preferred embodiment, the upper connector (81) is comprised of a threaded connection provided between the upper end (74) of the tubular member (72) and the adjacent upper portion of the pipe string. As shown in **FIG. 5**, the upper end (74) preferably provides a threaded box connector. Similarly, the lower end (76) of the tubular member (72) is preferably configured to be threadably connectable with a pipe string or tubular string, and preferably a lower portion of a pipe string or a lower pipe string. Thus, in the preferred embodiment, the lower end (76) of the tubular member (72) is comprised of a lower connector (83) for connecting the orienting device (22) with the lower pipe string. In the preferred embodiment, the lower connector (83) is comprised of a threaded connection provided between the lower end (76) of the tubular member (72) and the adjacent lower portion of the pipe string. As shown in **FIG. 5**, the lower end (76) preferably provides a threaded pin connector.

[0139] Further, in the preferred embodiment, each of the upper and lower portions of the pipe string is comprised of one or more lengths or joints of a 2⅞ inches (7.3025 cm) tubular pipe. The length of the upper portion of the pipe string is selected such that the pipe string preferably extends from the surface to the upper end (74) of the orienting device (22) when the stop block or stop plate (71) is engaged or abutted with the upper end (44) of the lateral conduit (30). The lower portion of the pipe string extends from the lower end (76) of the orienting device (22) to a lowermost or downhole end. In the preferred embodiment, the length of the lower portion of the drill string is selected such that when the stop block or stop plate (71) is engaged or abutted with the upper end (44) of the lateral conduit (30), the lowermost or downhole end of the lower portion of the pipe string is a spaced distance above or uphole of the cement floats at the downhole end of the casing string. Preferably, a minimum distance of about 1 meter is provided between the downhole end of the pipe string and the cement floats.

[0140] Further, the tubular member (72) is preferably securely mounted or affixed within the device housing (62). In the preferred embodiment, the device housing (62) is comprised of a plurality of longitudinally spaced apart reinforcement members (78) which extend axially between the inner surface of the housing wall (68) and the adjacent surface of the tubular member (72) and which are rigidly or securely affixed thereto in order to securely mount the tubular member (72) within the device housing (62). Further, in order to facilitate the passing of the orienting device (22) through the primary borehole, the device housing (62) may define one or more circulation holes (80) which extend through the device housing (62) between the upper and lower ends (64, 66).

[0141] Accordingly, in use or operation, a lower portion of a pipe string is threadably connected with the lower end (76) of the tubular member (72). Similarly, an upper portion of a pipe string is threadably connected with the upper end (74) of the tubular member (72). The orienting device (22) is then lowered through the primary borehole from the surface by the upper portion of the pipe string until the device housing (62) is seated within the primary conduit (28) adjacent the lateral conduit (30), preferably by abutment of the upper end (44) of the lateral conduit (30) with the stop block (71). In this position, the lowermost or downhole end of the lower portion of the pipe string is configured to extend to a desired distance downhole within the primary borehole. Specifically, as discussed above, the lowermost end preferably terminates above a cement float associated with the casing string. However, alternately, the downhole end may include a stinger for engaging a downhole cementing shoe.

[0142] More particularly, in the preferred embodiment, the distance from the upper end (44) of the lateral conduit (30) to the surface or the depth of the upper end (44) beneath the surface is known. This distance is referred to herein as the "lateral conduit depth." Preferably, the depth of the lowermost or downhole end of the lower portion of the pipe string connected with the orienting device (22) is monitored relative to the lateral conduit depth as the orienting device (22) is lowered within the primary borehole by the pipe string. Once the lowermost or downhole end of the lower portion of the pipe string achieves the lateral conduit depth, the operator may need to determine if the lowermost end has entered the lateral conduit (30) or has passed by the lateral conduit (30) through the primary conduit (28).

[0143] In the preferred embodiment, a preset plug or packer (not shown) is present inside the lateral conduit (30) about 1 meter from the upper end (44) of the lateral conduit (30). Therefore, to determine the location of the lowermost end of the lower portion of the pipe string, the pipe string is further lowered within the primary borehole. If further downward movement of the pipe string is prevented when the lowermost end achieves a depth about 1 meter greater than the lateral conduit depth, then the lowermost end has entered the lateral conduit (30). Otherwise, the lowermost end is passing through the primary conduit (28).

[0144] Where the lowermost end of the lower portion of the pipe string has undesirably entered the lateral conduit (30), it may be assumed that the lateral conduit (30) is located on the low side of the casing string. Therefore, to re-position the lowermost end, the pipe string is raised upwardly about 1 meter and the casing string is rotated from the surface, preferably 180 degrees, to attempt to move the lateral conduit (30) to the high side of the casing string. Upon subsequent lowering of the pipe string, if the lowermost end again enters the lateral conduit (30), this process should be repeated at 90 degree rotations of the casing string until the lowermost end passes through the primary conduit (28).

[0145] The orienting device (22) is then further lowered through the primary borehole until the lower end (66) of the device housing (62) contacts or abuts the upper end (44) of the lateral conduit (30). The orienting device (22) is then permitted to rest upon the lateral conduit (30) so that the pipe string weight decreases. The pipe string is then rotated from the surface, preferably to the right or clockwise, in order to rotate the orienting device (22) downhole. Rotation continues until the rotation torque increases, further rotation is prevented and/or the drill string weight increases, indicating that the lateral conduit (30) has been aligned with the C-shaped recess (70) of the device housing (62). The orienting device (22) is then further lowered by the pipe string and the lateral conduit (30) is inserted within the C-shaped recess (70) of the device housing (62). In this position, in the preferred embodiment, the lowermost or downhole end of the lower portion of the pipe string terminates about 1 meter above a cement float associated with the casing string.

[0146] Once the orienting device (22) is in position within the primary conduit (28), the orienting device (22) provides an indication of the orientation of the orienting device (22) downhole within the primary borehole. To achieve a desired orientation of the junction assembly (20) within the primary borehole, the upper portion of the casing string (40) connected with the upper end (32) of the primary conduit (28) is rotated from the surface to rotate the primary conduit (28) downhole. During this operation, the orienting device (22) indicates the variations in the orientation of the orienting device (22) which provides an indication of the orientation of the junction assembly (20). When the desired orientation of the junction assembly (20) downhole is achieved, rotation of the casing string (40) from the surface ceases. Typically, the junction assembly (20) will be preferably oriented such that the junction opening (42), and thus the lateral conduit (30), are located on the high side of the primary borehole or the casing string, as shown in **FIG. 26**, or is otherwise adjacent the desired direction of the existing or intended lateral borehole. Positioning of the lateral conduit (30) on the high side facilitates passage of subsequent objects, tools or equipment through the primary conduit (28), past the lateral conduit (30), as the objects, tools and equipment will tend to travel along the low side.

[0147] In order to provide an indication of the orientation of the orienting device (22), and thus the junction assembly (20) downhole, the orienting device (22) is preferably further comprised of an orientation indicator or device (82) which is capable of sensing and communicating the orientation of the orienting device (22), preferably to a user or operator at the surface. Specifically, the orientation indicator (82) may be comprised of any type or configuration of sensor, sensors or sensing apparatus capable of sensing or determining the orientation of the orienting device (22) downhole and communicating the sensed information or data concerning the orientation of the orienting device (22) to the surface. Thus, the orientation indicator (82) is selected to be compatible for use with or within the particular orientation of the primary borehole. In the preferred embodiment, the orientation indicator (82) is comprised of a gyroscope or other surveying sensors and equipment.

[0148] Further, the orientation indicator (82) may be associated with any member or component of the orienting device (22). In the preferred embodiment, the orientation indicator (82) is associated with the device housing (62) in order to sense and communicate the orientation of the device housing (62) and particularly the orientation of the C-shaped recess (70) having the lateral conduit (30) engaged therein. The orientation indicator (82) may be associated with the device housing (62) at any location and in any manner permitting the functioning of the orientation indicator (82). For instance, the orientation indicator (82) may be contained

within a separate tubular member, pipe joint or sub, such as within an orienting sub (not shown), which is fastened, connected or mounted with the device housing (**62**) in a manner permitting the orientation indicator (**82**) to sense and communicate the orientation of the device housing (**62**). In this case, the orienting sub including the orientation indicator (**82**) is preferably mounted with the upper end (**64**) of the device housing (**62**) in a manner permitting fluid communication between the tubular member (**72**) and the adjacent upper portion of the pipe string.

[**0149**] Once the junction assembly (**20**) is rotated to achieve the desired orientation in the primary borehole, a casing material or bonding agent, preferably a cementitious slurry, is conducted from the surface through the upper portion of the pipe string connected with the tubular member (**72**) of the orienting device (**22**), through the tubular member (**72**) and out of the tubular member (**72**) into the lower portion of the pipe string for passage to the bottom of the primary borehole. As indicated above, a cementing shoe or cement float may be located downhole of the junction assembly (**20**) to facilitate the completion, and particularly the casing, of the primary borehole. For instance, a spring loaded ball cement float may be provided to permit one-way communication of the cementitious slurry through the cement float in order to conduct the slurry into the annulus between the casing string and the junction assembly (**20**) and the wall of the primary borehole. Thus, the cementitious slurry is permitted to harden or set to provide a portion of the casing of the primary borehole. Once the primary borehole is cemented, the orienting device (**22**) is removed from the primary conduit (**28**) by removal or withdrawal of the upper portion of the pipe string from the surface.

[**0150**] When greater than one junction assembly (**20**) is connected together for insertion in the primary borehole to provide a multilateral well, the orientation of each of the junction assemblies (**20**) relative to each other is predetermined and fixed upon connection of the junction assemblies (**20**) in series prior to insertion. Once at the desired distance downhole in the primary borehole, the orienting device (**22**) is inserted in the uppermost or uphole junction assembly (**20**). Use of the orienting device (**22**) to orient the uppermost conduit (**22**) will therefore result in the proper orientation of any junction assemblies (**20**) downhole of the uppermost junction assembly (**20**). Further, the lower portion of the pipe string is connected with the uppermost orienting device (**22**). The lower portion of the pipe string extends through each of the lower junction assemblies (**20**) to the desired location downhole. Thus, again, cementing may be completed through the upper portion of the pipe string connected with the tubular member (**72**) of the uppermost orienting device (**22**) and through the tubular member (**72**) and the lower portion of the pipe string. Following cementing, the orienting device (**22**) is removed by removal of the pipe string from the surface.

[**0151**] Where necessary to maintain the desired hydrostatic pressure in the primary borehole during the completion or cementing operation, the primary borehole may need to be sealed at the surface. For this purpose, a packer, such as a hydro-cement bag, may be positioned at the surface at the top of the casing string within the primary borehole. Thus, the hydrostatic pressure assists or facilitates the expulsion of the cementitious slurry through the downhole cement float and into the annulus.

[**0152**] Referring to **FIGS. 7-11** of the first embodiment of the removable guide (**24**) and to **FIGS. 16-20** of the second preferred embodiment of the removable guide (**24**), the removable guide (**24**) is adapted for insertion in the primary conduit (**28**) adjacent the lateral conduit (**30**) for directing or guiding downhole tools and equipment, such as a drilling tool, from the primary conduit (**28**) into the lateral conduit (**30**). Therefore, the guide (**24**) is configured to be receivable within the primary conduit (**28**). Further, the guide (**24**) is removable such that the guide (**24**) may be removed from the primary conduit (**28**) following the desired downhole operation.

[**0153**] The guide (**24**) is adapted to direct a downhole tool inserted through the upper end (**32**) of the primary conduit (**28**) towards or in the direction of the upper end (**44**) of the lateral conduit (**30**) when the guide (**24**) is positioned within the primary conduit (**28**) adjacent the lateral conduit (**30**). Although the guide (**24**) may be comprised of any structure capable of guiding the downhole tool in the described manner, in the preferred embodiment, the guide (**24**) is comprised of an upper surface (**84**) sloped in a direction towards the upper end (**32**) of the lateral conduit (**30**).

[**0154**] More particularly, as indicated, the guide (**24**) may be comprised of any apparatus or device receivable in the primary conduit (**28**) and capable of directing a downhole tool from the primary conduit (**28**) into the lateral conduit (**30**). However, preferably, the guide (**24**) is comprised of a guide housing (**86**) having an upper end (**88**), a lower end (**90**) and a guide housing wall (**92**) extending therebetween. The upper end (**88**) is comprised of a guide plate (**94**) which defines the upper surface (**84**). The lower end (**90**) is comprised of a base plate (**96**). Further, the guide housing (**86**), and particularly the guide housing wall (**92**), is shaped or configured for receipt in the primary conduit (**28**) adjacent the upper portion (**52**) or no build section of the lateral conduit (**30**).

[**0155**] Thus, to permit the lateral conduit (**30**) to be closely received by the guide (**24**), the guide housing (**86**) preferably has a recess (**98**) as shown in **FIGS. 8 and 10** and **FIGS. 17 and 19** of the first and second embodiments respectively. Although the recess (**98**) may have any shape compatible with the lateral conduit (**30**) and capable of receiving the lateral conduit (**30**) therein, the guide housing wall (**92**) preferably defines a longitudinally oriented C-shaped recess (**98**) which extends the complete length of the guide housing (**86**) between the guide plate (**94**) and the base plate (**96**). The C-shaped recess (**98**) is configured to be compatible with the outer dimensions of the lateral conduit wall (**50**). As a result, the directing of the downhole tool from the primary conduit (**28**) into the lateral conduit (**30**) is facilitated.

[**0156**] Further, as shown in **FIGS. 7 and 9** and **FIGS. 16 and 18** of the first and second embodiments respectively, the guide plate (**94**) defines the upper surface (**84**) of the guide (**24**) which is shaped or configured to guide or direct an object coming into contact with the upper surface (**84**) into the upper end (**44**) of the lateral conduit (**30**) positioned within the C-shaped recess (**94**). More particularly, the upper surface (**84**) is sloped in a direction towards the C-shaped recess (**98**). Thus, the upper surface (**84**) is angled downwards towards the C-shaped recess (**98**). In addition, the upper surface (**84**) is preferably both angled and ovaled to

provide a bowl-like surface in order to guide or direct the object in the desired direction regardless of the specific portion or area of the upper surface (**84**) that it contacts.

[**0157**] Further, the guide (**24**) is preferably comprised of a stop mechanism for limiting the extent to which the guide (**24**) may be inserted in the primary conduit (**28**). Although any mechanism or means for limiting the movement may be used, the stop mechanism is preferably comprised of a stop collar (**100**) which ensures or assists with the proper placement of the upper end (**44**) of the lateral conduit (**30**) within the C-shaped recess (**98**) of the guide housing (**86**). In particular, the C-shaped recess (**98**) includes the stop collar (**100**) or other stop mechanism for inhibiting, and preferably preventing, the insertion of the upper end (**44**) within the C-shaped recess (**98**) past a desired position.

[**0158**] In the preferred embodiment, the stop collar (**100**) provides a lip or ridge extending about the C-shaped recess (**98**) at a desired position between the upper and lower ends (**88**, **90**) of the guide housing (**86**). The stop collar (**100**) is configured to engage the upper end (**44**) of the lateral conduit (**30**) when the lateral conduit (**30**) is received within the C-shaped recess (**98**). The engagement of the stop collar (**100**) with the upper end (**44**) of the lateral conduit (**30**) prevents further travel or movement of the lateral conduit (**30**) towards the upper end (**88**) of the guide housing (**86**) past the stop collar (**100**). Conversely, the engagement of the stop collar (**100**) with the upper end (**44**) of the lateral conduit (**30**) inhibits or prevents any further downward movement of the guide (**24**) within the primary conduit (**28**). Thus, the stop collar (**100**) assists with maintaining the proper positioning of the guide (**24**) within the primary conduit (**28**).

[**0159**] It is also preferable that any upward movement of the guide (**24**) relative to the lateral conduit (**30**) be inhibited and preferably prevented. Thus, the guide (**24**) is preferably further comprised of a guide latching mechanism (**102**) associated with the guide housing (**86**). Preferably, the latching mechanism (**102**) is associated with the C-shaped recess (**98**) of the guide housing (**86**). Any latch mechanism (**102**) may be used which is capable of engaging the lateral conduit (**30**) within the C-shaped recess (**98**) to inhibit the movement of the lateral conduit (**30**) therein.

[**0160**] Although the latching mechanism (**102**) may be used to inhibit or prevent movement of the lateral conduit (**30**) relative to the guide housing (**86**) in either or both an upwards and downwards direction, in the preferred embodiment, the latching mechanism prevents further upward movement of the guide (**24**) relative to the lateral conduit (**30**) while the stop collar (**100**) prevents further downward movement of the guide (**24**) relative to the lateral conduit (**30**). Thus, the latching mechanism (**102**) and the stop collar (**100**) together maintain the desired position of the lateral conduit (**30**) within the C-shaped recess (**98**) of the guide housing (**86**).

[**0161**] As will be described in further detail below in relation to each of the first and second embodiments of the guide (**24**), the latch mechanism (**102**) is preferably comprised of a latch (**104**) which extends through the guide housing wall (**92**) into the C-shaped recess (**98**) for engagement with the upper end (**44**) of the lateral conduit (**30**).

[**0162**] In order to provide a more secure engagement, the lateral conduit (**30**), and particularly its upper end (**44**), is also preferably comprised of a latching mechanism (**106**) which is complementary to the latching mechanism (**102**) of the guide (**24**). Thus, the lateral conduit latching mechanism (**106**) and the guide latching mechanism (**102**) are selected to be compatible or complementary with each other to secure the guide (**24**) with the lateral conduit (**30**). In the preferred embodiment, the lateral conduit latching mechanism (**106**) is comprised of the upper end (**44**) of the lateral conduit (**30**) defining an indentation (**106**) oriented axially about the lateral conduit wall (**50**) for receipt of the latch (**104**) therein. The stop collar (**100**) and the latching mechanism (**102**) are configured so that the latch (**104**) extends from the guide housing wall (**92**) for receipt in the indentation (**106**) at the upper end (**44**) of the lateral conduit (**30**) when the upper end (**44**) engages or abuts against the stop collar (**100**).

[**0163**] The guide housing (**86**) may have any dimensions compatible with insertion of the guide housing (**86**) within the primary conduit (**28**) and receipt of the lateral conduit (**30**) within the C-shaped recess (**98**). However, in the preferred embodiment, the outside diameter of the guide housing (**62**) is preferably about 8.625 inches (21.91 cm) such that the guide (**24**) may readily pass through the inside diameter of the casing string (**40**) as shown in **FIG. 24**, wherein the casing string (**40**) has an outside diameter of about 9.625 inches (24.45 cm) and an inside diameter of about 8.835 inches (22.44 cm). Further, the outside diameter of the guide housing (**86**) is preferably about 8.625 inches (21.91 cm) such that the guide (**24**) may readily pass within the primary conduit (**28**) as shown in **FIG. 25**, wherein the primary conduit wall (**38**) has an outside diameter of about 10.75 inches (27.31 cm).

[**0164**] As well, the C-shaped recess (**98**) preferably defines a portion of a circle having an inside diameter of about 5.012 inches (12.73 cm) for ready receipt of the lateral conduit (**30**) as shown in **FIG. 25**, wherein the lateral conduit (**30**) has an outside diameter of about 5 inches (12.7 cm).

[**0165**] In use or operation, when the lateral conduit (**30**) is positioned within the C-shaped recess (**98**) as described, the object may pass from the primary borehole through the upper end (**32**) of the primary conduit (**28**) for contact with the upper surface (**84**) of the guide (**24**), which directs the object towards the C-shaped recess (**98**). The object then passes into the C-shaped recess (**98**) and subsequently the upper end (**44**) of the lateral conduit (**30**) which is received therein. The object is then permitted to pass through the bore (**48**) of the lateral conduit (**30**) and out of its lower end (**46**) and through the junction opening (**42**) in the primary conduit wall (**38**).

[**0166**] In order to facilitate the passing of the guide (**24**) through the primary borehole, the guide housing (**86**) may define one or more circulation holes (**108**), particularly in either or both of the guide and base plates (**94**, **96**), which permit circulation of fluids through the guide housing (**86**) between the upper and lower ends (**88**, **90**).

[**0167**] The guide (**24**) may be conducted through the primary borehole and positioned and removed from the primary conduit (**28**) using any mechanism or method compatible with this function. Preferably, the guide (**24**) is connected with a pipe string or a tubular string which extends from the surface into the primary borehole.

Although the guide (**24**) may be connected with the pipe string in any manner permitting the placement and subsequent retrieval of the guide (**24**), the guide (**24**) is preferably comprised of a running and retrieval mechanism (**109**) for engagement with a running and retrieval tool. Any compatible or complementary running and retrieval mechanisms and running and retrieval tools may be used. However, three complementary running and retrieval mechanisms and tools are described herein.

[**0168**] Specifically, a first running and retrieval tool (**110**), as shown in **FIG. 15**, is provided for use with the first embodiment of the removable guide (**24**) as shown in **FIGS. 7-11**. A second running and retrieval tool (**111**), as shown in **FIG. 21**, and a third running and retrieval tool (**113**), as shown in **FIGS. 22-23**, are provided for use with the second preferred embodiment of the removable guide (**24**). Each removable running and retrieval tool (**110**, **111**, **113**) is adapted for engagement with the running and retrieval mechanism (**109**) comprised of the particular structure of the guide housing (**86**) such that the guide (**24**) may be placed within and retrieved from the primary conduit (**28**). Further, the first running and retrieval tool (**110**) is also used to operate the latching mechanism (**102**) of the first embodiment of the removable guide (**24**).

[**0169**] Except where indicated to the contrary, the structure and operation of the first running and retrieval tool (**110**) with respect to the first embodiment of the guide (**24**) will primarily be described first, followed by the second and third running and retrieval tools (**111**, **113**) with respect to the second embodiment of the guide (**24**).

[**0170**] Referring to **FIG. 15**, for use with the first embodiment of the guide (**24**), the first running and retrieval tool (**110**) is comprised of an elongated member (**112**) having an upper end (**114**) and a lower end (**116**). The upper end (**114**) is adapted for engagement with a pipe string or other tubular string for lowering the first running and retrieval tool (**110**) through the primary borehole. Although the upper end (**114**) may be engaged or connected with the pipe string by any fastening or connection mechanism, preferably a threaded connection is provided therebetween. Preferably, the upper end (**114**) of the elongated member (**112**) of the first running and retrieval tool (**110**) is comprised of a threaded box connector for connection with a threaded pin connector on the adjacent end of the pipe string. The lower end (**116**) of the elongated member (**112**) of the first running and retrieval tool (**110**) is adapted for engagement with the guide housing (**86**).

[**0171**] More particularly, the lower end (**116**) of the elongated member (**112**) of the first running and retrieval tool (**110**) is preferably adapted and configured for insertion within the guide housing (**86**) through the upper surface (**84**) in a manner such that the lower end (**116**) engages the guide housing (**86**) to permit the placement of the guide (**24**) within, and the subsequent removal of the guide (**24**) from, the primary conduit (**28**). In addition, the lower end (**116**) releasably engages the guide housing (**86**) so that the first running and retrieval tool (**110**) may be removed or disengaged from the guide housing (**86**) when the guide (**24**) is in position within the primary conduit (**28**) to permit the use of the guide (**24**) as described above.

[**0172**] Further, the lower end (**116**) of the elongated member (**112**) of the first running and retrieval tool (**110**) is also preferably adapted to operate or act upon the latching mechanism (**102**) of the guide (**24**). Specifically, in both the first and second embodiments of the guide (**24**), the latch (**104**) of the latching mechanism (**102**) extends through the guide housing (**86**) within the C-shaped recess (**98**) through a compatible opening (**118**) in the guide housing (**86**). The latch (**104**) is preferably biased outwardly, being in a direction to extend from the opening (**118**) into the C-shaped recess (**98**) for engagement with the lateral conduit (**30**). In the first embodiment of the guide (**24**), the lower end (**116**) of the first running and retrieval tool (**110**) is adapted to disengage the latching mechanism (**102**) by withdrawing the latch (**104**) within the guide housing (**86**) through the opening (**118**) in the C-shaped recess (**98**).

[**0173**] More particularly, referring to **FIG. 15**, the lower end (**116**) of the elongated member (**112**) of the first running and retrieval tool (**110**) is comprised of a key (**120**) for insertion within the guide housing (**86**) of the first embodiment of the guide (**24**) as described further below. The key (**120**) extends axially or radially from the elongated member (**112**) at, adjacent or in proximity to the lower end (**116**). Although the key (**120**) may have any shape or configuration compatible with the latching mechanism (**102**) and capable of insertion in the guide housing (**86**), the key (**120**) is preferably comprised of an upwardly facing shoulder (**122**) and a downwardly facing shoulder (**124**).

[**0174**] The upwardly facing shoulder (**122**) faces or extends towards the upper end (**114**) of the elongated member (**112**) and is preferably a square shoulder such that the shoulder (**122**) is substantially perpendicular to the elongated member (**122**). This configuration is preferred to prevent or inhibit further movement of the elongated member (**112**) in an upward or uphole direction when the upwardly facing shoulder (**122**) contacts or engages a portion of the guide housing (**86**) as described in further detail below. Further, the upwardly facing shoulder (**122**) is provided for engaging the latch (**104**) to withdraw the latch (**104**) from the C-shaped recess (**98**) into the guide housing (**86**).

[**0175**] The downwardly facing shoulder (**124**) faces or extends towards the lower end (**116**) of the elongated member (**112**) and is preferably a sloped or angled shoulder such that the shoulder (**124**) is sloped or angled inwardly towards the lower end (**116**) as shown in **FIG. 15**. This configuration is preferred to permit further movement of the elongated member (**112**) in an downward or downhole direction when necessary upon engagement or contact of the downwardly facing shoulder (**124**) with a portion of the guide housing (**86**).

[**0176**] Finally, for the purpose outlined below, the key (**120**) further defines a pin hole (**126**) for receipt of a shear pin (not shown) therein. The shear pin is received in the pin hole (**126**) when the key (**120**) is in a desired position within the guide housing (**86**), wherein the latch (**104**) is withdrawn, to prevent movement of the elongated member (**112**) relative to the guide housing (**86**) and engagement of the latching mechanism (**102**) when running or positioning the first embodiment of the guide (**24**) within the primary conduit (**28**). Once the guide (**24**) is properly positioned, the shear pin is sheared or broken to permit the removal of the first running and retrieval tool (**110**) and to permit the latch

(104) to extend into the C-shaped recess (98) to engage the indentation (106) in the upper end (44) of the lateral conduit (30).

[0177] Referring to the first embodiment of the guide (24) in FIGS. 7-11, the guide housing (86) is preferably hollow and comprises the running and retrieval mechanism (109). Specifically, the running and retrieval mechanism (109) of the first embodiment of the guide (24) is comprised of a tubular guide member (128) mounted within the guide housing (86) adjacent the C-shaped recess (98). The tubular guide member (128) may be mounted within the guide housing (86) by any mechanism or method, however, preferably the tubular guide member (128) is welded within the guide housing wall (92) adjacent the C-shaped recess (98). The tubular guide member (128) has an upper end (130), a lower end (132) and a guide member wall (134). Further, the tubular guide member (128) is sized and configured for ready receipt of the elongated member (112) of the first running and retrieval tool (110) therein. In other words, the elongated member (112) is insertable within the tubular guide member (128). The length of the tubular guide member (128) is preferably selected such that the lower end (116) of the elongated member (112) of the first running retrieval tool (110) may extend from the lower end (132) of the tubular guide member (128) while the upper end (114) of the elongated member (112) extends from the upper end (130) of the tubular guide member (128).

[0178] In addition, the tubular guide member (128) is preferably mounted within the guide housing wall (92) such that the upper end (130) of the guide member (128) is adjacent and extends to the upper end (88) of the guide housing (86). In order to permit access to the upper end (130) of the tubular guide member (128) by the first running and retrieval tool (110), the upper surface (84) of the guide (24) defines an upper surface opening (136). The upper surface opening (136) communicates with the upper end (130) of the tubular guide member (128).

[0179] Preferably, in the first embodiment of the guide (24), the guide member wall (134) is mounted with the inside or inner surface of the guide housing wall (92), preferably by welding. Preferably, the welding or mounting extends along the guide member wall (134) between the upper and lower ends (130, 132) of the guide member (128). Where additional stabilization of the tubular guide member (128) within the guide housing (86) is desired or required, one or more reinforcement plates (138) or members may be mounted about the circumference of the guide member wall (134) between the guide member wall (134) and the inner surface of the guide housing wall (92). Each reinforcement plate (138) is placed or positioned such that the reinforcement plate (138) does not interfere with the movement of the elongated member (112) and key (120) of the first running and retrieval tool (110) through the tubular guide member (128) as described herein.

[0180] To permit the insertion of the lower end (116) of the elongated member (112) of the first running and retrieval tool (110) with the key (120) attached thereto into the tubular guide member (128), the tubular guide member (128) defines two slots therein. A first long slot (140) provides a channel extending longitudinally through the guide member wall (134) for the entire length of the guide member (128) between its upper and lower ends (130, 132). Thus, the long slot (140) has an upper end (142) co-terminous with the upper end (130) of the guide member (128). To permit access of the key (120) to the upper end (142) of the long slot (140), the upper surface opening (136) is configured to accommodate or permit the passage of the key (120) therethrough, as shown in FIGS. 7 and 10. Further, the long slot (140) has a lower end (144) co-terminous with the lower end (132) of the guide member (128). Thus, the key (120) may pass from the upper end (142) of the long slot (140), through the long slot (140) and out the lower end (144).

[0181] A second short slot (146) provides a channel extending longitudinally parallel to the long slot (140) through the guide member wall (134) from the lower end (132) of the guide member (128) for a portion of the length of the guide member (128). The short slot (146) does not extend to the upper end (130) of the guide member (128). Thus, the short slot (146) has an upper end (148) which terminates within the guide member wall (134) and a lower end (150) which is co-terminous with the lower end (132) of the guide member (128). Thus, after passing out of the lower end (144) of the long slot (140), the key (120) may pass within the lower end (150) of the short slot (146).

[0182] Each of the long and short slots (140, 146) may be located about the circumference of the tubular guide member (128) at any spaced apart locations. However, preferably, for ease of use of the first running and retrieval tool (110), the long and short slots (140, 146) are positioned at opposed locations on either side of the guide member (128) adjacent the C-shaped recess (80) in the guide housing (86) as shown in FIGS. 7 and 10. The latching mechanism (102) is preferably associated with the short slot (146) such that the key (120) acts upon the latch (104) as it travels within the short slot (146). In particular, referring to FIGS. 9 and 11, the latching mechanism (102) is mounted within the guide housing (86) adjacent the tubular guide member (128), and more particularly, adjacent the short slot (146).

[0183] In each of the first and second embodiments of the guide (24), the latching mechanism (102) is comprised of the latch (104), a latch mount (152) and a spring (154) for biasing the latch (102) in the desired manner. However, in the first embodiment of the guide (24), the latch mount (152) is mounted with the inner surface of the guide housing wall (92) adjacent the tubular guide member (128). The latch mount (152) may be affixed or mounted with the guide housing wall (92) in any manner, however, preferably the latch mount (152) is welded to the guide housing wall (92). The spring (154) is preferably a leaf spring comprised of spring steel having two opposed ends. One end is mounted with the latch mount (152) by any fastener or fastening mechanism, preferably one or more screws or bolts (156). As a fail-safe or safety feature, the end of the spring steel (154) may be mounted with the latch mount (152) by one or more shearing screws or bolts (156) to permit shearing of the latch (102) from within the guide housing (86) when necessary to remove the guide (24). The other opposed end of the spring steel (154) is attached or mounted with the innermost surface of the latch (104) in any manner, but preferably as described below by a fastener or fastening mechanism such as one or more screws or bolts (158).

[0184] The latch mount (152) is positioned, and the components of the latching mechanism (102) are configured, so that the latch (104) is positioned adjacent the short slot (146)

such that it may be acted upon by the key (**120**) and so that the latch (**104**) is biased outwardly through the opening (**118**) in the guide housing wall (**92**) within the C-shaped recess (**98**) by the spring steel (**154**).

[**0185**] Referring to **FIGS. 12-14**, the latch (**140**) preferably has the same configuration in both the first and second embodiments of the guide (**24**). However, as described below, the shapes or configurations of various components or surfaces of the latch (**104**) are provided to interact with the key (**120**) of the first running and retrieval tool (**110**). Accordingly, these particular components or surfaces may be modified where the latch is not intended for use with the first running and retrieval tool (**110**).

[**0186**] The latch (**104**) is preferably comprised of an inner portion (**160**) and an outer portion (**162**) which are affixed or mounted together, preferably by welding, to form the latch (**104**). Alternately, the latch (**104**) may be comprised of a single member or component or greater than two members or portions affixed together to provide an integral unit. In the first embodiment of the guide (**24**), the inner portion (**160**) comprises the portion of the latch (**104**) acted upon by the key (**120**). Further, the outer portion (**162**) is affixed or mounted with the spring steel (**154**) and may also comprise a portion of the latch (**104**) acted upon by the key (**120**). The outer portion (**162**) comprises the portion of the latch (**104**) which extends from the opening (**118**) in the guide housing wall (**92**) for engagement with the indentation (**106**) in the upper end (**44**) of the lateral conduit (**30**).

[**0187**] The outer portion (**162**) has an inner surface (**164**) for mounting or attaching with the spring (**154**) and an opposed outer surface (**166**). Further, the outer portion (**162**) has an upper surface (**168**) and an opposed lower surface (**170**). As indicated, the inner surface (**164**) is mounted or otherwise attached with the spring (**154**) for biasing the latch (**104**). The outer surface (**166**) is sized and configured to extend through the compatible opening (**118**) in the guide housing wall (**92**). The inner surface (**164**) is comprised of opposed side flanges (**172**) which are configured to prevent the outer portion (**162**) of the latch (**102**) from completely passing through the opening (**118**) in the guide housing wall (**92**). In other words, the side flanges (**172**) on the inner surface (**164**) engage the guide housing wall (**92**) and prevent the passage of the inner surface (**164**) through the opening (**118**).

[**0188**] The outer surface (**166**) is adapted to engage the indentation (**106**) in the lateral conduit (**30**). Therefore, the outer surface (**166**) is sized and shaped to be compatible with the lateral conduit (**30**). Accordingly, the outer surface (**166**) preferably provides a C-shaped recess (**174**) for securely engaging the indentation (**106**) in the upper end (**44**) of the lateral conduit (**30**).

[**0189**] Finally, the upper surface (**168**) of the outer portion (**162**) is preferably substantially perpendicular to the inner and outer surfaces (**164, 166**). The lower surface (**170**) of the outer portion (**162**) is sloped or angled inwardly from the outer surface (**166**) to the inner surface (**164**). In the first embodiment of the guide (**24**), the lower surface (**170**) is sloped or angled to provide a portion of a sloped or angled shoulder which engages the upwardly facing shoulder (**122**) of the key (**120**) as the key (**120**) travels upwardly or in an uphole direction through the short slot (**146**).

[**0190**] The inner portion (**160**) also has an inner surface (**176**) and an opposed outer surface (**178**) for engaging the inner surface (**164**) of the outer portion (**164**) of the latch (**104**). Specifically, the outer surface (**178**) defines a lip or ridge (**184**) for seating of the outer portion (**162**) thereon. Preferably, the outer surface (**178**) of the inner portion (**160**) is welded with the inner surface (**164**) of the outer portion (**162**) such that the inner portion (**160**) is adjacent the location or position of the mounting of the end of the spring steel (**154**) with the outer portion (**162**).

[**0191**] Further, the inner portion (**160**) has an upper surface (**180**) and an opposed lower surface (**182**). The upper surface (**180**) of the inner portion (**160**) is preferably substantially perpendicular to the inner and outer surfaces (**176, 178**). When the inner and outer portions (**160, 162**) are mounted together, the upper surfaces (**180, 168**) of the inner and outer portions (**160, 162**) terminate adjacent to each other. The lower surface (**182**) of the inner portion (**160**) is preferably sloped or angled inwardly from the outer surface (**178**) to the inner surface (**176**). In the first embodiment of the guide (**24**), the lower surface (**182**) is preferably sloped or angled to provide a portion of a sloped or angled shoulder which engages the upwardly facing shoulder (**122**) of the key (**120**) as the key (**120**) travels upwardly or in an uphole direction through the short slot (**146**). When the inner and outer portions (**160, 162**) are mounted together, the sloped or angled lower surface (**182**) of the inner portion (**160**) is continuous with the sloped or angled lower surface (**170**) of the outer portion (**162**) to provide an integral abutment or engagement surface for the key (**120**).

[**0192**] In the first embodiment of the guide (**24**), to actuate the latching mechanism (**102**) and to utilize the first running and retrieval tool (**110**), the lower end (**116**) of the elongated member (**112**) of the first running and retrieval tool (**110**) with the key (**120**) attached thereto is inserted within the upper end (**142**) of the long slot (**140**) of the tubular guide member (**128**) through the upper surface opening (**136**) in the guide housing (**86**). The key (**120**) is passed through the length of the long slot (**140**) and out of the lower end (**144**) of the long slot (**140**). Upon passing out of the lower end (**144**) of the long slot (**140**), the lower end (**116**) of the elongated member (**112**) preferably engages or abuts against the base plate (**96**) of the guide housing (**86**) to signal to the operator that the key (**120**) has passed from the long slot (**140**).

[**0193**] The elongated member (**112**) of the first running and retrieval tool (**110**) is then turned or rotated, preferably to the right or in a clockwise direction relative to the guide housing (**86**), until the key (**120**) is adjacent the lower end (**150**) of the short slot (**146**). In the preferred embodiment, the key (**120**) rotates about 270 degrees. To aid with the proper positioning of the key (**120**) below the short slot (**146**), a stop plate (**186**) may be mounted within the guide housing wall (**92**) adjacent the lower end (**150**) of the short slot (**146**) to inhibit or prevent further rotation of the key (**120**) to the right or in the clockwise direction.

[**0194**] Once positioned below the short slot (**146**), the elongated member (**112**) of the running and retrieval tool (**110**) is moved up or in an uphole direction to move the key (**120**) into the short slot (**146**) through its lower end (**150**). As the key (**120**) travels through the short slot (**146**) from the lower end (**150**) to the upper end (**148**), the upwardly facing shoulder (**122**) on the key (**120**) engages or contacts one or both of the angled or sloped lower surface (**182**) of the inner

portion (**160**) and the angled or sloped lower surface (**170**) of the outer portion (**162**) which causes the latch (**104**) to be moved inwardly against the biasing of the spring steel (**154**) to withdraw the outer surface (**166**) of the outer portion (**162**) from the C-shaped recess (**98**) in the guide housing (**86**) through the opening (**118**) therein. Thus, the latching mechanism (**102**) is disengaged.

[**0195**] Once the locking mechanism (**102**) is disengaged, preferably a shear pin (not shown) is passed through the guide housing (**86**) for insertion through the pin hole (**126**) in the key (**120**). Thus, the key (**120**) and the latching mechanism (**102**) are held or maintained in the disengaged condition. Thus, the shear pin is preferably provided to minimize the possible disconnection of the key (**120**) from the latching mechanism (**102**) or movement of the key (**120**) out of the disengaged condition while placing the guide (**24**) in the primary borehole. The guide (**24**) is then inserted through the primary borehole and within the primary conduit (**28**) using a pipe string connected with the upper end (**114**) of the elongated member (**112**) of the first running and retrieval tool (**110**). The upper end (**44**) of the lateral conduit (**30**) is inserted within the C-shaped recess (**98**) of the guide housing (**86**) until the upper end (**44**) contacts the stop collar (**100**).

[**0196**] More particularly, the guide (**24**) is passed through the primary borehole until the lower end (**90**) of the guide housing (**86**), defined by the base plate (**96**), contacts or abuts the upper end (**44**) of the lateral conduit (**30**). Upon contact, the shear pin as described above may shear. The guide (**24**) is then permitted to rest upon the lateral conduit (**30**) so that the pipe string weight decreases. The pipe string is then rotated, preferably to the right or clockwise, in order to rotate the guide (**24**) downhole. Rotation continues until the rotation torque increases and/or the pipe string weight increases, indicating that the lateral conduit (**30**) has been aligned with the C-shaped recess (**98**) of the guide housing (**86**). The guide (**24**) is then further lowered by the pipe string and the lateral conduit (**30**) is inserted within the C-shaped recess (**98**) of the guide housing (**86**) until the upper end (**44**) of the lateral conduit (**30**) contacts the stop collar (**100**).

[**0197**] Once the upper end (**44**) of the lateral conduit (**30**) contacts the stop collar (**100**), a further downward force, or force in a downhole direction, is applied through the elongated member (**112**) of the first running and retrieval tool (**110**). This further downward force causes the shearing of the shear pin within the pin hole (**126**) of the key (**120**), thus permitting movement of the key (**120**) within the short slot (**146**).

[**0198**] As the downward force is applied, the key (**120**) is moved within the short slot (**146**) from its upper end (**148**) towards its lower end (**150**) and subsequently passes out of the lower end (**150**) of the short slot (**146**). When the key (**120**) no longer engages the lower surfaces (**182**, **170**) of the inner and outer portions (**160**, **162**) of the latch (**104**), the biasing of the spring steel (**154**) causes the latch (**104**) to move outwardly such that the outer surface (**166**) of the outer portion (**162**) of the latch (**104**) engages the upper end (**44**) of the lateral conduit (**30**) within the indentation (**106**). Thus, the latching mechanism (**102**) is engaged.

[**0199**] To remove the first running and retrieval tool (**110**) while leaving the guide (**24**) within the primary conduit (**28**), once the key (**120**) exits the lower end (**150**) of the short slot (**146**), the elongated member (**112**) of the first running and retrieval tool (**110**) is turned or rotated, preferably to the left or in a counterclockwise direction relative to the guide housing (**86**), until the key (**120**) is adjacent the lower end (**144**) of the long slot (**140**). As indicated above, in the preferred embodiment, the key (**120**) rotates about 270 degrees. Upon passing out of the lower end (**150**) of the short slot (**146**), the lower end (**116**) of the elongated member (**112**) preferably engages or abuts against the base plate (**96**) of the guide housing (**86**) to signal to the operator that the key (**120**) has passed from the short slot (**146**). Following rotation, to aid with the proper positioning of the key (**120**) below the long slot (**140**), a further stop plate (**188**) may be mounted within the guide housing wall (**92**) adjacent the lower end (**144**) of the long slot (**140**) to inhibit or prevent further rotation of the key (**120**) to the left or in the counterclockwise direction.

[**0200**] Once positioned below the long slot (**140**), the elongated member (**112**) of the first running and retrieval tool (**110**) is moved up or in an uphole direction to move the key (**120**) into the long slot (**140**) through its lower end (**144**). The key (**120**) travels through the long slot (**140**) from its lower end (**144**) to its upper end (**142**) and out the upper end (**142**) through the upper surface opening (**136**) in the guide housing (**86**). The first running and retrieval tool (**110**) may then be removed to the surface to permit the insertion of downhole tools or equipment through the primary borehole.

[**0201**] When it is desired to remove the guide (**24**) from the junction assembly (**20**), the operation as described above is repeated. The first running and retrieval tool (**110**) is connected with the pipe string and passed through the primary borehole to the guide (**24**) until the lower end (**116**) of the elongated member (**112**) contacts the guide plate (**94**) of the upper end (**88**) of the guide housing (**86**). The first running and retrieval tool (**110**) is then rotated, preferably to the right or clockwise, until the key (**120**) is aligned with the upper surface opening (**136**) in the guide (**24**). The key (**120**) of the first running and retrieval tool (**110**) is then passed through the long slot (**140**), rotated to the right and then moved within the short slot (**146**) to act upon the latch (**102**) and actuate the latching mechanism (**102**) to the disengaged position or condition. Once in the disengaged condition, a further upward force, or force in an uphole direction, is applied through the elongated member (**112**) of the first running and retrieval tool (**110**). This causes the key (**120**) to engage or abut against the upper end (**148**) of the short slot (**146**), which moves the guide housing (**86**) in an upwards or uphole direction to disengage the lateral conduit (**30**) from within the C-shaped recess (**98**). The guide (**24**) may then be removed to the surface.

[**0202**] Rotation of the pipe or tubular string and the attached first running and retrieval tool (**110**) within the casing string during placement and removal of the guide (**24**) are not desirable. Further, it is preferable that the casing string be held at the surface in an unlocked position permitting rotation of the casing string within the borehole during placement and removal of the guide (**24**). Finally, if necessary, fluids may be pumped through the guide (**24**) during the removal process in order to flush any debris, such as

drilling cuttings, from the long and short slots (**140**, **146**) and thereby facilitate entry of the key (**120**) into and passage through the slots (**140**, **146**).

[**0203**] Referring to **FIGS. 16-20** of the second preferred embodiment of the guide (**24**), the guide housing (**86**) does not include the tubular guide member (**128**) and the associated structure for use with the first running and retrieval tool (**110**). An alternate running and retrieval mechanism (**109**) is provided for use with the second and third running and retrieval tools (**111**, **113**).

[**0204**] In the second embodiment of the guide (**24**), the guide housing (**86**) is also preferably hollow and includes one or more reinforcement plates (**138**) or members as required to brace or support the structure of the guide housing (**86**). Preferably, the guide housing (**86**) includes at least one central reinforcement plate (**138**) extending across the guide housing (**86**) between the inner surface of the C-shaped recess (**98**) and the inner surface of the opposed guide housing wall (**92**). Further, the central reinforcement plate (**138**) is positioned within the guide housing (**86**) such that it does not interfere with the guide latching mechanism (**102**) and the associated opening (**118**) in the C-shaped recess (**98**).

[**0205**] As described above, the latching mechanism (**102**) of the guide (**24**) is comprised of the latch (**104**), the latch mount (**152**) and the spring (**154**) for biasing the latch (**104**) in the desired manner. However, the latching mechanism (**102**) in the second embodiment of the guide (**24**) does differ in some respects from that of the first embodiment of the guide (**24**) described above. In particular, referring to **FIGS. 16-20**, the latch mount (**152**) is mounted either directly or indirectly with the inner surface of the guide housing wall (**92**). More particularly, the latch mount (**152**) is preferably mounted with or adjacent the C-shaped recess (**98**) at a location or position permitting the latch (**104**) to extend through the opening (**118**) therein.

[**0206**] In the preferred embodiment, as shown in **FIG. 19**, a reinforcement plate (**138**) is mounted with the inner surface of the guide housing wall (**92**) across a portion of the C-shaped recess (**98**). Further, the latch mount (**152**) is comprised of a latch plate (**189**) affixed or mounted with the reinforcement plate (**138**) by at least one, and preferably four, bolts or screws (**190**). The latch plate (**189**) is mounted with the reinforcement plate (**138**) a spaced distance therefrom to provide a space or pocket between the adjacent surfaces of the latch plate (**189**) and the reinforcement plate (**138**). The space or pocket is of a sufficient size to permit one end of the leaf spring (**154**) to be received therebetween. Once the end of the leaf spring (**154**) is received therebetween, one or more shearing pins (**191**) or screws or other shearing members are mounted between the latch plate (**189**) and the reinforcement plate (**138**) by passing or extending through the end of the spring (**154**) in order to secure the spring (**154**) in position.

[**0207**] As described further below, the latching mechanism (**102**) is preferably comprised of a shear mechanism for releasing the latching mechanism (**102**) when it is desired to remove the guide (**24**) from the conduit junction (**20**). Although any shear mechanism may be used, the shear mechanism is preferably comprised of the shear pins (**191**) mounted between the latch plate (**189**) and the reinforcement plate (**138**) to permit shearing of the latch (**104**) from within the latch mount (**152**) when necessary to remove the guide (**24**).

[**0208**] The other opposed end of the spring (**154**) may be attached or mounted with the innermost surface of the latch (**104**) in any manner. However, preferably, the spring (**154**) is mounted by welding the end of the spring (**154**) with the latch (**104**). As stated, the latch mount (**152**) is positioned, and the components of the latching mechanism (**102**) are configured, so that the latch (**104**) is biased outwardly through the opening (**118**) in the guide housing wall (**92**) within the C-shaped recess (**98**) by the spring (**154**).

[**0209**] In addition, referring to **FIGS. 16, 18** and **20** of the second preferred embodiment of the guide (**24**), the upper end (**88**) of the guide housing (**86**) is comprised of a fishing neck portion (**192**) or fishneck portion which is configured for use with the second and third running and retrieval tools (**111**, **113**). Although any conventional or known fishing neck may be used so long as it is compatible with the desired fishing tool, the preferred fishing neck portion (**192**) is described below.

[**0210**] In the second preferred embodiment of the guide (**24**), the running and retrieval mechanism (**109**) is comprised of the fishing neck portion (**192**). As described further below, the fishing neck portion (**192**) is comprised of at least one of a slot or pin for engagement with a complementary slot or a complementary pin associated with the running and retrieval tools (**111**, **113**) in order to install and remove the guide (**24**). A fishing neck portion (**192**) may also be mounted with the first embodiment of the guide (**24**) where desired to permit placement and removal of the first embodiment of the guide (**24**) by any of the first, second and third running and retrieval tools (**110**, **111**, **113**). In this case, the guide (**24**) is preferably installed using either the second or third running and retrieval tools (**111**, **113**), while the first running and retrieval tool (**110**) is preferably used to remove the guide (**24**).

[**0211**] Specifically, if a fishing neck portion (**192**) is mounted with the first embodiment of the guide (**24**), the guide (**24**), including the long and short slots (**140**, **146**), is preferably packed with grease prior to placement or positioning within the primary conduit (**28**). The grease packing is provided to minimize or prevent any debris, such as drilling cuttings, from settling inside the guide (**24**) which may affect the removal of the guide (**24**) once drilling is complete. Use of the first running and retrieval tool (**110**) would disturb the grease packing and permit debris to enter the slots (**140**, **146**). Thus, the second or third running and retrieval tool (**111**, **113**) is preferably used in order to minimize any disturbance to the grease packing in the guide (**24**) during placement.

[**0212**] However, in the first embodiment of the guide (**24**), the latching mechanism (**102**) is engaged upon placement of the guide (**24**) in the primary conduit (**28**). The key (**120**) of the first running and retrieval tool (**110**) is required to actuate the latching mechanism (**102**) to the disengaged condition or position to permit removal of the guide (**24**). Accordingly, the first running and retrieval tool (**110**) is preferably used to remove the guide (**24**). However, the second and third running and retrieval tools (**111**, **113**) may be used as back-ups to remove the guide (**24**) upon failure of the first

running and retrieval tool (**110**) or following unsuccessful attempts to use the first running and retrieval tool (**110**) for any reason.

[**0213**] Referring to **FIGS. 16, 18** and **20**, the upper end (**88**) of the guide housing (**86**) is comprised of the fishing neck portion (**192**). The fishing neck portion (**192**) of the guide (**24**) is comprised of a tubular extension which is integrally formed with the upper end (**88**) of the guide housing (**86**) or which is connected, attached or otherwise mounted, permanently or removably, in any manner with the upper end (**88**) of the guide housing (**86**). In the second embodiment, the fishing neck portion (**192**) is preferably welded to the upper end (**88**) of the guide housing (**86**) such that the upper end (**88**) is comprised of the fishing neck portion (**192**). More particularly, the fishing neck (**190**) is comprised of a tubular member (**200**) having an upper end (**202**) defining an upper end of the fishing neck portion (**192**), a lower end (**204**) defining a lower end of the fishing neck portion (**192**) and a wall (**206**) extending therebetween. The lower end (**204**) of the fishing neck portion (**192**) is fitted within the upper end (**88**) of the guide housing (**86**) and welded in position.

[**0214**] Further, the wall (**206**) of the tubular member (**200**) defines a cut-away portion (**208**) such that the tubular member (**200**) is substantially C-shaped on cross-section as shown in **FIG. 19**. Further, the cut-away portion (**208**) is preferably sized and configured to be compatible with the size and configuration of the C-shaped recess (**98**) of the guide housing (**86**). In addition, the lower end (**204**) of the tubular member (**200**) is welded with the upper end (**88**) of the guide housing (**86**) such that the cut-away portion (**208**) is aligned with the C-shaped recess (**98**).

[**0215**] The outer diameter of the fishing neck portion (**192**), and particularly the outer diameter of the wall (**206**), is preferably compatible with the outer diameter of the guide housing wall (**92**). In the preferred embodiment, the wall (**206**) of the tubular member (**200**) has an outer surface (**210**) defining an outer diameter of about 8 inches (about 20.32 cm) and an inner surface (**212**) defining an inner diameter of about 6 inches (about 15.24 cm), which provides a wall thickness or width of about 2 inches (about 5.08 cm). At least two J-shaped slots (**214**) are defined by the inner surface (**212**) of the wall (**206**) and extend from the upper end (**202**) towards the lower end (**204**) of the wall (**206**). In the preferred embodiment, two J-shaped slots (**214**) are preferably arranged on either side of the cut-away portion (**208**) a spaced distance apart. More preferably, the J-shaped slots (**214**) are spaced about 180 degrees apart such that the J-shaped slots (**214**) are positioned within opposed sides of the wall (**206**). The J-shaped slots (**214**) are configured for use with the second running and retrieval tool (**111**).

[**0216**] Preferably, each J-shaped slot (**214**) has a first longitudinal leg (**216**) extending from the upper end (**202**) of the wall (**206**) towards the lower end (**204**), an axial leg (**218**) extending perpendicularly from the lowermost or downhole end of the first longitudinal leg (**206**) and a second longitudinal leg (**220**) opposed to the first longitudinal leg (**216**) extending in an upwards or uphole direction from the axial leg (**218**) to form a J-shape. The second longitudinal leg (**220**) does not extend to the upper end (**202**) but terminates at a slot shoulder (**221**) providing an engagement surface for the second running and retrieval tool (**111**) as described below. The axial leg (**218**) of each J-shaped slot (**214**) extends from the first longitudinal leg (**216**) in the same direction. In the preferred embodiment, the axial leg (**218**) of each J-shaped slot (**214**) extends from the first longitudinal leg (**216**) to the right or in a clockwise direction when viewed from the upper end (**202**) of the fishing neck portion (**192**).

[**0217**] Each leg (**216, 218, 220**) of the J-shaped slot (**214**) may have any length. However, in the preferred embodiment, the first longitudinal leg (**216**) has a length of about 6 inches (about 15.24 cm), the axial leg (**218**) has a length of about 2 inches (about 5.08 cm) and the second longitudinal leg (**220**) has a length of about 4 inches (about 10.16 cm).

[**0218**] In addition, the fishing neck portion (**192**) is preferably comprised of at least two pins (**223**) extending inwardly from the inner surface (**212**) of the wall (**206**) of the tubular member (**200**). The pins (**223**) are configured for use with the third running and retrieval tool (**113**). Preferably, two pins (**223**) are preferably arranged on either side of the cut-away portion (**208**) a spaced distance apart. More preferably, as shown in **FIG. 19**, the pins (**223**) are spaced about 180 degrees apart such that the pins (**223**) are positioned on and extend inwardly from opposed sides of the inner surface (**212**) of the wall (**206**). The pins (**223**) are provided to engage the third running and retrieval tool (**113**).

[**0219**] Referring to **FIG. 21**, the second running and retrieval tool (**111**) is configured for engagement with the J-shaped slots (**214**) of the fishing neck portion (**192**). The second running and retrieval tool (**111**) is comprised of an elongated member (**222**) having an upper end (**224**) and a lower end (**226**). The upper end (**224**) is adapted for engagement with a pipe string or tubular string, for lowering the second running and retrieval tool (**111**) through the primary borehole. Although the upper end (**224**) may be engaged or connected with the pipe string by any fastening or connection mechanism, preferably a threaded connection is provided therebetween. In the preferred embodiment, the upper end (**224**) of the elongated member (**222**) of the second running and retrieval tool (**111**) is comprised of a threaded box connector for connection with a threaded pin connector on the adjacent end of the pipe string.

[**0220**] The lower end (**226**) may have any shape or configuration compatible with its passage within the fishing neck portion (**192**). Where desired, the upper end (**202**) of the fishing neck portion (**192**) may have an inwardly sloped surface to guide or direct the lower end (**226**) of the elongated member (**222**) within the tubular member (**200**). Further, the outer diameter of the elongated member (**222**) is selected to fit within the inner diameter of the wall (**206**) of the fishing neck portion (**192**). If desired, to assist in centralizing the elongated member (**222**) within the tubular member (**200**) of the fishing neck portion (**192**), the elongated member (**222**) may be comprised of one or more centralizing members (**230**) mounted about the circumference of the elongated member (**222**) and extending axially from the elongated member (**222**) to contact the inner surface (**212**) of the wall (**206**) of the fishing neck portion (**192**).

[**0221**] Finally, the elongated member (**222**) is comprised of one or more pins (**232**) or members shaped or configured for receipt within the J-shaped slots (**214**) of the fishing neck portion (**192**). The number of pins (**232**) is selected to be

compatible with the number of J-shaped slots (**214**) such that a single pin (**232**) is provided for receipt in each J-shaped slot (**214**). Thus, in the preferred embodiment, the elongated member (**222**) is comprised of two pins (**232**). The pins (**232**) are adapted and configured for insertion within and passage through the J-shaped slots (**214**) for abutment or engagement with the slot shoulder (**221**). Each pin (**232**) extends axially outwardly from the elongated member (**222**) for receipt in its respective J-shaped slot (**214**). Further, the two-pins (**232**) are arranged on either side of the elongated member (**222**) a spaced distance apart. In the preferred embodiment, the pins (**232**) are spaced about 180 degrees apart such that the pins (**232**) are positioned on opposed sides of the elongated member (**222**) and compatible with the positioning of the J-shaped slots (**214**) within the fishing neck portion (**192**).

[**0222**] Finally, for the purpose outlined below, the elongated member (**222**) may define a pin hole (not shown) for receipt of a shear pin (not shown) therein. The shear pin is received in the pin hole when the pins (**232**) are in a desired position within the J-shaped slots (**214**), and particularly when the pins (**232**) engage or abut against the slot shoulders (**221**), to prevent movement of the elongated member (**222**) relative to the fishing neck portion (**192**) when running or positioning the guide (**24**) within the primary conduit (**28**). Once the guide (**24**) is properly positioned, the shear pin is sheared or broken to permit the removal of the second running and retrieval tool (**111**).

[**0223**] To utilize the second running and retrieval tool (**111**), the lower end (**226**) of the elongated member (**222**) of the second running and retrieval tool (**111**) is inserted within the upper end (**202**) of the fishing neck portion (**192**) such that the pins (**232**) are aligned with and pass into the first longitudinal leg (**216**) of the J-shaped slots (**214**) at the upper end (**202**) of the wall (**206**). Each pin (**232**) is passed downwards through the length of the first longitudinal leg (**216**) of its respective J-shaped slot (**214**) until the pin (**232**) abuts against its lowermost end, intersecting with the axial leg (**218**).

[**0224**] The elongated member (**222**) of the second running and retrieval tool (**111**) is then turned or rotated, preferably to the right or in a clockwise direction relative to the wall (**206**). This rotation moves the pin (**232**) from one end of the axial leg (**218**) of the J-shaped slot (**214**) to the other opposed end until the pin (**232**) abuts against the opposed end of the axial leg (**218**), intersecting with the second longitudinal leg of the J-shaped slot (**214**).

[**0225**] Finally, the elongated member (**222**) of the second running and retrieval tool (**111**) is moved up or in an uphole direction to move the pin (**232**) through the second longitudinal leg (**220**) of the J-shaped slot (**214**) from its lowermost end to abut or engage against the slot shoulder (**221**). In this position, preferably a shear pin (not shown) is passed through the wall (**206**) of the tubular member (**200**) of the fishing neck portion (**192**) for insertion through a pin hole (not shown) in the elongated member (**222**). Thus, the shear pin is preferably provided to minimize the possible disconnection of the elongated member (**222**) from the fishing neck portion (**192**) or movement of the pin (**232**) out of engagement with the slot shoulder (**221**) while placing the guide (**24**) in the primary borehole. The guide (**24**) is then inserted through the primary borehole and within the primary conduit (**28**) using a pipe string or tubular string connected with the upper end (**224**) of the elongated member (**222**) of the second running and retrieval tool (**111**).

[**0226**] More particularly, the guide (**24**) is passed through the primary borehole until the lower end (**90**) of the guide housing (**86**), defined by the base plate (**96**), contacts or abuts the upper end (**44**) of the lateral conduit (**30**). Upon contact, the shear pin as described above may shear. The guide (**24**) is then permitted to rest upon the lateral conduit (**30**) so that the pipe string weight decreases. The pipe string is then rotated, preferably to the right or clockwise, in order to rotate the guide (**24**) downhole. Rotation continues until the rotation torque increases and/or the pipe string weight increases, indicating that the lateral conduit (**30**) has been aligned with the C-shaped recess (**98**) of the guide housing (**86**). The guide (**24**) is then further lowered by the pipe string and the lateral conduit (**30**) is inserted within the C-shaped recess (**98**) of the guide housing (**86**) until the upper end (**44**) of the lateral conduit (**30**) contacts the stop collar (**100**).

[**0227**] Once the upper end (**44**) of the lateral conduit (**30**) contacts the stop collar (**100**), a further downward force, or force in a downhole direction, may be applied through the elongated member (**222**) of the second running and retrieval tool (**111**). This further downward force causes the shearing of the shear pin within the pin hole of the elongated member (**222**), thus permitting movement of the pins (**232**) within the J-shaped slot (**214**).

[**0228**] To remove the second running and retrieval tool (**111**) while leaving the guide (**24**) within the primary conduit (**28**), a further downward or downhole force is applied through the elongated member (**222**) to cause each of the pins (**232**) to move in a downwards or downhole direction within the second longitudinal leg (**220**) of its respective J-shaped slot (**214**) away from the slot shoulder (**221**) towards the axial leg (**218**). Once the pin (**232**) abuts the end of the second longitudinal leg (**222**) intersecting the axial leg (**218**), the elongated member (**222**) of the second running and retrieval tool (**111**) is turned or rotated, preferably to the left or in a counterclockwise direction relative to the wall (**206**) of the fishing neck (**190**), so that the pin (**232**) travels through the axial leg (**218**) towards the first longitudinal leg (**216**). Once the pin (**232**) abuts the end of the axial leg (**218**) intersecting the first longitudinal leg (**216**), an upward or uphole force is applied through the elongated member (**222**) to cause each of the pins (**232**) to move in a upwards or uphole direction within the first longitudinal leg (**216**) away from axial leg (**218**) towards the upper end (**202**) of the tubular member (**200**) of the fishing neck portion (**192**) in order to disengage and remove the pins (**232**) from the J-shaped slots (**214**). The second running and retrieval tool (**111**) may then be removed to the surface to permit the insertion of downhole tools or equipment through the primary borehole.

[**0229**] If required or desired to use the second running and retrieval tool (**111**) to remove the guide (**24**) from the junction assembly (**20**), the operation as described above is repeated. The second running and retrieval tool (**111**) is connected with the pipe string and passed through the primary borehole to the guide (**24**) until lower end (**226**) of the elongated member (**222**) enters the upper end (**202**) of the fishing neck portion (**192**). Upon further downward

movement, the pins (232) of the elongated member (222) contact or abut the upper end (202) of the fishing neck portion (190). The second running and retrieval tool (111) is then rotated, preferably to the right or clockwise, until the pins (232) are aligned with the J-shaped slots (214). When the pins (232) and slots (214) are aligned, further rotation may be inhibited or the pipe string weight may increase, signaling the alignment to the operator. The pins (232) of the second running and retrieval tool (111) are then passed through the first longitudinal legs (216) of the J-shaped slots (214) by moving the elongated member (222) in a downward or downhole direction. The elongated member (222) is then rotated to the right to pass the pins (232) through the axial legs (218). Finally, the elongated member (222) is moved upward or in an uphole direction to pass or move the pins (232) through the second longitudinal legs (220) for abutment against the slot shoulders (221). The guide (24) may then be removed to the surface by further upward or uphole movement of the second running and retrieval tool (111), which will result in shearing of the shear pins (191) to permit shearing of the latch (104) from within the guide housing (86).

[0230] Referring to **FIG. 22**, the third running and retrieval tool (113) is configured for engagement with the pins (223) of the fishing neck portion (192). The third running and retrieval tool (113) is also comprised of an elongated member (234) having an upper end (236) and a lower end (238). The upper end (236) is adapted for engagement with a pipe string or tubular string, for lowering the third running and retrieval tool (113) through the primary borehole. Although the upper end (236) may be engaged or connected with the pipe string by any fastening or connection mechanism, preferably a threaded connection is provided therebetween. In the preferred embodiment, the upper end (236) of the elongated member (234) of the third running and retrieval tool (113) is comprised of a threaded box connector for connection with a threaded pin connector on the adjacent end of the pipe string.

[0231] The lower end (238) may have any shape or configuration compatible with its passage within the fishing neck portion (192). Further, the outer diameter of the elongated member (234) is selected to fit within the inner diameter of the wall (206) of the fishing neck portion (192). To assist in centralizing the elongated member (234) within the tubular member (200) of the fishing neck portion (192), the elongated member (234) may be comprised of one or more centralizing members (240) mounted about the circumference of the elongated member (234) and extending axially from the elongated member (234) to contact the inner surface (212) of the wall (206) of the fishing neck portion (192).

[0232] Finally, the elongated member (234) is comprised of one or more slots (242) configured for receiving the pins (223) of the fishing neck portion (192). The slots (242) are defined by or within an outer surface (244) of the elongated member (234) in a manner such that each slot (242) extends to the lower end (238) of the elongated member (234) to permit entry of a pin (223) therein. The number of slots (242) is selected to be compatible with the number of pins (223) such that a single slot (242) is provided for receiving each pin (223). Thus, the elongated member (234) preferably defines two slots (242). The pins (223) are adapted and configured for insertion within and passage through the slots (242) as described below. Further, the two-slots (242) are arranged on either side of the elongated member (234) a spaced distance apart. In the preferred embodiment, the slots (242) are spaced about 180 degrees apart such that the slots (242) are positioned on opposed sides of the elongated member (234) and compatible with the positioning of the pins (223) on the fishing neck portion (192).

[0233] Referring to **FIGS. 22 and 23**, as stated, each of the slots (242) is defined by the outer surface (244) of the elongated member (234) of the third running and retrieval tool (113) and extends from the lower end (238) thereof. The slots (242) may have any configuration compatible with their intended function as described herein. For instance, the slots (242) may be J-shaped, similar to the slots (214) defined by the fishing neck portion (192). However, preferably, each slot (242) has a V-shape or configuration. Thus, preferably, each V-shaped slot (242) has a first spiral leg (246) and a second longitudinally oriented or straight leg (248). The first spiral leg (246) extends from the lower end (238) of the elongated member (234) in a diagonal direction or at an angle with respect to a longitudinal axis of the elongated member (234) to an upper end (250) of the V-shaped slot (242). The second straight leg (248) extends from the first spiral leg (246) at the upper end (250) of the V-shaped slot (242) towards the lower end (236) of the elongated member (234) in a longitudinally oriented direction or a direction parallel to the longitudinal axis of the elongated member (234). The second straight leg (248) does not extend fully to the lower end (238) but terminates at a slot shoulder (252) which provides an engagement surface for the pin (223) of the fishing neck portion (192). Preferably about a 45 degree angle is provided between the first spiral leg (246) and the second straight leg (248).

[0234] Finally, for the elongated member (234) may define a pin hole (not shown) for receipt of a shear pin (not shown) therein. The shear pin is received in the pin hole when the pins (223) are in a desired position within the V-shaped slots (242), and particularly when the pins (223) engage or abut against the slot shoulders (252), to prevent movement of the elongated member (234) relative to the fishing neck portion (192) when running or positioning the guide (24) within the primary conduit (28). Once the guide (24) is properly positioned, the shear pin is sheared or broken to permit the removal of the third running and retrieval tool (113).

[0235] To utilize the third running and retrieval tool (113), the lower end (238) of the elongated member (234) of the third running and retrieval tool (113) is inserted within the upper end (202) of the fishing neck portion (192) such that the pins (223) are aligned with the first spiral leg (246) of the V-shaped slots (242) at the lower end (238) of the elongated member (234). The elongated member (234) is moved in a downward or downhole direction such that each pin (223) moves upwards through the length of the first spiral leg (246) of its respective V-shaped slot (242) until the pin (223) abuts against the upper end (250) of the slot (242).

[0236] The elongated member (234) of the third running and retrieval tool (113) is then turned or rotated, preferably to the right or in a clockwise direction relative to the wall (206), until further movement is prevented. This rotation moves the pin (223) to align it with the second straight leg (248) of the V-shaped slot (242). The elongated member (234) is then moved in an upward or uphole direction such

that the pin (223) moves downward through the length of the second straight leg (248) until the pin (223) abuts against or engages the slot shoulder (252). During this upward movement, neither the pipe string connected with the third running and retrieval tool (113) nor the guide (24) should turn or rotate. If any rotation is noted, the pins (223) are still located within the first spiral leg (246) and not the second straight leg (248).

[0237] When the pin (223) is in abutment with the slot shoulder (252), preferably a shear pin (not shown) is passed through the wall (206) of the tubular member (200) of the fishing neck portion (192) for insertion through a pin hole (not shown) in the elongated member (234). Thus, the shear pin is preferably provided to minimize the possible disconnection of the elongated member (234) from the fishing neck portion (192) or movement of the pin (223) out of engagement with the slot shoulder (252) while placing the guide (24) in the primary borehole. The guide (24) is then inserted through the primary borehole and within the primary conduit (28) using the pipe string or tubular string connected with the upper end (236) of the elongated member (234) of the third running and retrieval tool (113).

[0238] More particularly, the guide (24) is passed through the primary borehole until the lower end (90) of the guide housing (86), defined by the base plate (96), contacts or abuts the upper end (44) of the lateral conduit (30). Upon contact, the shear pin as described above may shear. The guide (24) is then permitted to rest upon the lateral conduit (30) so that the pipe string weight decreases. The pipe string is then rotated, preferably to the right or clockwise, in order to rotate the guide (24) downhole. Rotation continues until the rotation torque increases and/or the pipe string weight increases, indicating that the lateral conduit (30) has been aligned with the C-shaped recess (98) of the guide housing (86). The guide (24) is then further lowered by the pipe string and the lateral conduit (30) is inserted within the C-shaped recess (98) of the guide housing (86) until the upper end (44) of the lateral conduit (30) contacts the stop collar (100).

[0239] Once the upper end (44) of the lateral conduit (30) contacts the stop collar (100), a further downward force, or force in a downhole direction, may be applied through the elongated member (234) of the third running and retrieval tool (113). This further downward force causes the shearing of the shear pin within the pin hole of the elongated member (234), thus permitting movement of the pins (223) within the V-shaped slot (242).

[0240] To remove the third running and retrieval tool (113) while leaving the guide (24) within the primary conduit (28), a further downward or downhole force is applied through the elongated member (234) to cause each of the pins (223) to move in a upwards or uphole direction within the second straight leg (248) of its respective V-shaped slot (242) away from the slot shoulder (252) towards the upper end (250) of the slot (242). Once the pin (223) abuts the upper end (250) of the slot (242), the elongated member (234) of the third running and retrieval tool (113) is then turned or rotated, preferably to the left or in a counter-clockwise direction relative to the wall (206), until further movement is prevented. This rotation moves the pin (223) to align it with the first spiral leg (246) of the V-shaped slot (242). An upward or uphole force is then applied through the elongated member (234) to cause each of the pins (223) to move in a downwards or in a downward direction through the length of the first spiral leg (246) until the pin (223) exits the slot (242) at the lower end (238) of the elongated member (234). During this upward movement of the elongated member (234), rotation or turning of the pipe string connected with the third running and retrieval tool (113) or the guide (24) confirms that the pin (223) is in the first spiral leg (246). The third running and retrieval tool (113) may then be removed to the surface to permit the insertion of downhole tools or equipment through the primary borehole.

[0241] If required or desired to use the third running and retrieval tool (113) to remove the guide (24) from the junction assembly (20), the operation as described above is repeated. The third running and retrieval tool (113) is connected with the pipe string and passed through the primary borehole to the guide (24) until lower end (238) of the elongated member (234) enters the upper end (202) of the fishing neck portion (192). Upon further downward movement, the pins (223) of the fishing neck portion (192) contact or abut the lower end (238) of the elongated member (234). The third running and retrieval tool (113) is then rotated, preferably to the right or clockwise, until the pins (223) are aligned with the V-shaped slots (242). When the pins (223) and slots (242) are aligned, further rotation may be inhibited or the pipe string weight or torque may increase, signaling the alignment to the operator. The pins (223) of the fishing neck portion (192) are then passed through the first spiral legs (246) of the V-shaped slots (242) by moving the elongated member (234) in a downward or downhole direction. Spiral movement of the pipe string should be noted at the surface as the pins (223) pass through the spiral legs (246). The elongated member (234) is then rotated to the right to align the pins (232) with the second straight legs (248). Finally, the elongated member (232) is moved upward or in an uphole direction to pass or move the pins (223) through the second straight legs (248) for abutment against the slot shoulders (252). No spiral movement or rotation should be evident during this upward movement of the elongated member (234). The guide (24) may then be removed to the surface by further upward or uphole movement of the third running and retrieval tool (113), which will result in shearing of the shear pins (191) to permit shearing of the latch (104) from within the guide housing (86).

[0242] Rotation of the pipe string and the attached second or third running and retrieval tool (113) within the casing string during placement and removal of the guide (24) are not desirable. Further, it is preferable that the casing string be held at the surface in an unlocked position permitting rotation of the casing string within the borehole during placement and removal of the guide (24). Finally, if necessary, fluids may be pumped through the fishing neck portion (192) and the guide (24) during the removal process in order to flush any debris, such as drilling cuttings, from the J-shaped slots (214) or pins (223) and thereby facilitate the engagement with the running and retrieval tool (111, 113).

[0243] In the second preferred embodiment of the removable guide (24), either the second or third running and retrieval tool (111, 113) may be used for placement of the guide (24). However, the third running and retrieval tool (113) is preferably used to remove the guide (24), while the second running and retrieval tool (111) is used only as a back-up in the event of failure of the third running and

retrieval tool (**113**). The third running and retrieval tool (**113**) is preferred due to the configuration of the V-slot (**242**), including the spiral and straight legs (**246**, **248**), which provides a visual cue or indication to the operator, through rotation of the pipe string at the surface, of the status of the tool (**113**) within the fishing neck portion (**192**) downhole.

[**0244**] As described previously, and referring to **FIG. 26**, the within invention is also directed at a method for providing a junction in a borehole, preferably between the primary borehole and an existing or intended lateral borehole. First, the upper end (**32**) of the primary conduit (**28**) is connected with an upper pipe string or upper portion of a casing string (**40**). The lower end (**34**) of the primary conduit (**28**) may also be connected with a lower pipe string or a lower portion of the casing string (**40**). The casing string (**40**) and the junction assembly (**20**) connected with the casing string (**40**) are then positioned at a desired depth in the primary borehole by lowering the upper portion of the casing string (**40**) from the surface to a desired depth. The desired depth is either adjacent a lateral borehole already formed or drilled in the formation or adjacent the location of a lateral borehole to be drilled from the primary borehole.

[**0245**] Once at the desired depth, the orienting device (**22**) is inserted in the upper portion of the casing string (**40**) and lowered through the casing string (**40**) until the orienting device (**22**) selectively engages the junction assembly (**20**). The method is then comprised of obtaining an indication of an orientation of the orienting device (**22**). The junction assembly (**20**) and the casing string (**40**) are then rotated in the primary borehole in order to obtain a desired orientation of the junction assembly (**20**), and particularly a desired orientation of the junction opening (**42**) relative to a desired direction of the lateral borehole. Further, once in the desired orientation, the position of the junction assembly (**20**) within the primary borehole is preferably maintained to maintain the desired orientation of the junction assembly (**20**) in the primary borehole during subsequent operations. For instance, the desired orientation is maintained while introducing a bonding agent into the primary borehole through the orienting device (**22**). Specifically, the orienting device (**22**) permits the conducting of a cementitious slurry therethrough in order to case or cement the primary borehole in the annulus between the wall of the primary borehole and the junction assembly (**20**) and attached casing string. The orienting device (**22**) is then removed from the junction assembly (**20**) and the casing string (**40**) to the surface.

[**0246**] The guide (**24**) is then inserted in the upper portion of the casing string (**40**), preferably by a running and retrieval tool, and lowered downhole such that the guide (**24**) selectively engages the junction assembly (**20**). An object is then inserted in the casing string (**40**) and lowered to the junction assembly (**20**) such that the object is guided into the lateral conduit (**30**) by the guide (**24**). For instance, where drilling of a lateral borehole is required or desired, the object may be comprised of a drilling tool. The drilling tool is inserted through the upper end (**32**) of the primary conduit (**28**) for direction into the upper end (**44**) of the lateral conduit (**30**) such that the drilling tool extends through the junction opening (**42**) in the primary conduit wall (**38**) for drilling the lateral borehole. Where completion of a lateral borehole is required or desired, the object may be comprised of a liner for lining the lateral borehole.

[**0247**] Finally, the method may be comprised of the step of removing the guide (**24**) from the junction assembly (**20**) and the casing string (**40**), preferably by using the running and retrieval tool. In the preferred embodiment, the guide removal step is comprised of shearing a shearing mechanism associated with the junction assembly (**20**).

[**0248**] In order to provide a Level 6 junction, a lateral production tubing or production string (**194**) is preferably hung from the upper end (**44**) of the lateral conduit (**30**), using a liner hanger or packer, for extension within the lateral borehole. Specifically, the lateral production string (**194**) is preferably hung within or from the upper portion (**52**) or no build section of the lateral conduit (**30**): Further, the lateral production string (**194**) is preferably sized to be compatible with the lateral conduit (**30**) and is preferably slotted or perforated at the surface for placement in the lateral borehole. In order to seal the junction between the primary and lateral boreholes, the hanger for the lateral production string (**194**) is preferably adapted for sealing the lateral production string (**194**) with the lateral conduit (**30**).

[**0249**] Preferably, the lateral production string (**194**) ends or terminates at the upper end (**44**) of the lateral conduit (**30**) and does not extend to the surface. Thus, fluids from the lateral borehole may flow or pass within the lateral production string (**194**) for communication through the lateral conduit (**30**) into the primary conduit (**28**) and thus the primary borehole. Within the primary borehole, any gases are permitted to separate from the liquids and rise within the primary borehole to the surface. The gases may then be vented or collected from the primary borehole at the surface. Any liquids from the lateral borehole passing out of the lateral production string (**194**) are permitted to fall within the primary borehole to the bottom of the primary borehole.

[**0250**] A primary production tubing or string (**196**) preferably extends from the surface through the primary conduit (**28**) to a downhole pump (**198**) positioned at the bottom of the primary borehole. Liquids within the primary borehole, including those liquids separating from the fluids passing out of the lateral production string (**194**), are pumped from the primary borehole to the surface by the downhole pump (**198**). Thus, when producing the well, only a single production tubing, being the primary production string (**196**) requiring a single downhole pump, extends to the surface.

[**0251**] However, where desired, the lateral production string (**194**) can extend from the lateral conduit (**30**) to the surface so that fluids from the lateral borehole and the primary borehole may be produced to the surface separately through the lateral production string (**194**) and the primary production string (**196**) respectively.

[**0252**] The specific configuration of the junction assembly (**20**) and the system of the within invention provides a number of advantageous features.

[**0253**] First, as discussed above, the lateral production string (**194**) need not be run to the surface. Rather, the lateral production string (**194**) may terminate at the lateral conduit (**30**) within the junction assembly (**20**). The junction assembly (**20**) may thus be used to control the pressure within the lateral borehole rather than controlling the pressure within the lateral borehole at the surface via a lateral production string extending to the surface. Further, the sealing of the junction within the junction assembly (**20**) inhibits or pre-

vents any leakage from the lateral borehole into the primary borehole other than through the lateral conduit **(30)** of the junction assembly **(20)**. As a result, where necessary, the lateral borehole may be sealed off from the primary borehole by insertion of a plug within the lateral conduit **(30)**.

[0254] Second, in a conventional lateral well, a pump is typically located within the lateral production string for pumping fluids from the lateral borehole directly to the surface through the lateral production string. In this instance, the downhole pump in the lateral borehole is directly in contact with the fluids as they are produced. Accordingly, the pumps contact the downhole gases in the production fluids and the gases are pumped to the surface along with the liquids in the productions fluids. The pump may cavitate due to the presence of the gases, resulting in the pumping of less liquids. Further, as the gases are pumped to the surface, the gases may need to be separated from the liquids at the surface before the liquids can be transferred.

[0255] However, using the junction assembly **(20)**, a pump need not be placed within the lateral production string **(194)** in the lateral borehole. The production fluids from the lateral borehole are permitted to flow freely into the primary borehole through the junction assembly **(20)**. As the fluids enter the primary borehole, the gases start to separate from the liquids and rise to the surface. Liquids fall to the bottom of the primary borehole where they are pumped to the surface by a pump through the primary production string **(196)**. Thus, the pump is primarily pumping liquids from the primary borehole, decreasing the likelihood of cavitation. Since there is a decreased likelihood of pump cavitation, the pump may be able to deliver higher pumping rates of produced liquids. Further, there is a likelihood that less gas separation may be required at the surface.

[0256] Third, the junction assembly **(20)** incorporates a preset kickoff angle in the lateral conduit **(30)**. As the angle is preset and formed in the lateral conduit **(30)**, a relatively high kickoff angle may be provided. As indicated above, up to a 15 degree angle can be achieved relatively safely over a 20 foot distance. This may allow the remaining build angle to be safer and also allow the drill to achieve a relatively shallower lateral borehole.

[0257] Fourth, the orienting device **(22)** allows the junction assembly **(20)** to be oriented in the primary borehole while cementing is taking place. The cementing may be conducted through the orienting device **(22)** at the same time that the orienting device **(22)** maintains the junction assembly **(20)** in the desired orientation. Further, the orienting device **(22)** permits a limited amount of upward and downward motion during cementing while maintaining the orientation.

[0258] Fifth, the guide **(24)** is configured such that the guide **(24)** may be oriented without the need for any separate orienting or directional equipment. Once the junction assembly **(20)** is cemented in place, the guide **(24)** mechanically locks into place within the junction assembly **(20)** and guides the drill bit or other downhole tools or equipment into the lateral production string **(194)** hung from the lateral conduit **(30)**. The guide **(24)** only permits passage into the lateral borehole.

[0259] Sixth, use of the junction assembly **(20)** may be relatively more economical. No milling of steel may be required to drill the lateral borehole. Further, only one downhole pump and production string to the surface is required. As well, gas separation costs at the surface may be lessened.

[0260] While the present invention has been described for what are presently considered the preferred embodiments, the invention is not so limited. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

We claim:

1. A junction device for providing a lateral junction in a borehole, comprising a primary conduit having an upper end portion and a lower end portion, each of which is arranged for attachment with one or more casing members to form a borehole casing string, the primary conduit forming a primary conduit bore, a lateral conduit having a lateral conduit bore, the lateral conduit being anchored to the primary conduit so as to be immovable relative thereto, the primary conduit having a first peripheral region encircling a junction opening formed therein, the lateral conduit having a second peripheral region encircling the lateral conduit bore, the second peripheral region being sealably welded to the first peripheral region so as to form a lateral conduit path which is isolated from the primary bore.

2. A device as defined in claim 1, wherein the first peripheral region includes a first peripheral surface and the second peripheral region includes an upstanding flange which extends at least partway along the junction opening, the upstanding flange including a second peripheral surface, the second peripheral surface lying immediately adjacent the first peripheral surface.

3. A device as defined in claim 2, further including a continuous weld seam joining the first and second peripheral regions adjacent the first and second peripheral surfaces.

4. A device as defined in claim 3, further comprising attachment means for attaching the lateral conduit to the primary conduit in advance of the junction opening.

5. A device as defined in claim 3, the lateral conduit having an outer surface exposed to the primary conduit bore, the primary conduit having an inner surface exposed to the primary conduit bore, attachment means for attaching the lateral conduit to the primary conduit with the outer and inner faces immediately adjacent one another.

6. A device as defined in claim 5, wherein the attachment means includes one or more weld joints between the adjacent lateral and primary conduits.

7. A device as defined in claim 6, wherein the primary conduit has an outer surface to communicate with the borehole and the second peripheral region terminates at or is substantially flush with the outer surface within the first peripheral region.

8. A device as defined in claim 7, wherein the primary conduit is operable to maintain a first fluid pressure ranging from about 0 to about 10 MPA while the lateral conduit is operable to maintain a second fluid pressure ranging from about 30 to 60 MPA.

9. A device as defined in claim 1, wherein the primary conduit includes a primary longitudinal axis and the first

section of the lateral conduit includes a first longitudinal axis which is substantially parallel with but offset from the primary longitudinal axis.

10. A device as defined in claim 9, wherein the second section of the lateral conduit has a second longitudinal axis which is at an angle less than ninety degrees less relative to the primary longitudinal axis.

11. A junction device for providing a lateral junction in a borehole, comprising primary conduit means having an upper end portion and a lower end portion, first attachment means for attaching the upper and lower end portions to one or more casing members to form a borehole casing string, the primary conduit means forming a primary conduit bore, the lateral conduit means having a lateral conduit bore, the lateral conduit means being anchored to the primary conduit means so as to be immovable relative thereto, the primary conduit means having a first peripheral region circumscribing a junction opening formed therein, the lateral conduit means having a second peripheral region circumscribing the lateral conduit bore, second attachment means for sealingly attaching the second peripheral region to the first peripheral region so as to form a lateral conduit path which is isolated from the primary bore.

12. A device as defined in claim 11, wherein the first peripheral region includes a first peripheral surface and the second peripheral region includes an upstanding flange means, the upstanding flange means including a second peripheral surface, the second peripheral surface lying immediately adjacent the first peripheral surface.

13. A device as defined in claim 12, wherein the second attachment means includes a continuous weld seam joining the first and second peripheral regions adjacent the first and second peripheral surfaces.

14. A device as defined in claim 13, further comprising third attachment means for attaching the lateral conduit means to the primary conduit means in advance of the junction opening.

15. A device as defined in claim 14, the lateral conduit having an outer surface exposed to the primary conduit bore, the primary conduit having an inner surface exposed to the primary conduit bore, the third attachment means arranged for attaching the lateral conduit to the primary conduit with the outer and inner faces immediately adjacent one another.

16. A device as defined in claim 15, wherein the third attachment means includes one or more weld joints between the adjacent lateral and primary conduits.

17. A device as defined in claim 16, wherein the primary conduit means has an outer surface to communicate with the borehole and the second peripheral region terminates at or is substantially flush with the outer surface within the first peripheral region.

18. A device as defined in claim 17, wherein the primary conduit is operable to maintain a first fluid pressure ranging from about 0 to about 10 MPA while the lateral conduit is operable to maintain a second fluid pressure ranging from about 30 to 60 MPA.

19. A device as defined in claim 11, the lateral conduit means having a first section which is aligned with the primary conduit means, and a second section adjacent the junction opening which is oriented at a build angle of less than ninety degrees relative to the primary conduit means.

20. A device as defined in claim 19, wherein the build angle ranges from about 5 to about 20 degrees.

21. A device as defined in claim 20, wherein the build angle is about 15 degrees.

22. A device as defined in claim 11, wherein the primary conduit means includes primary longitudinal axis and the first section of the lateral conduit has a first longitudinal axis which is substantially parallel with but offset from primary longitudinal axis.

23. A device as defined in claim 22, wherein the second section of the lateral conduit has a second longitudinal axis which is at an angle less than ninety degrees less relative to the primary longitudinal axis.

24. A method for providing a junction in a borehole, the method comprising the following steps:

(a) positioning a pipe string and a junction assembly connected with the pipe string at a desired depth in the borehole;

(b) inserting an orienting device in the pipe string such that the orienting device selectively engages the junction assembly;

(c) obtaining an indication of an orientation of the orienting device;

(d) rotating the pipe string and the junction assembly in order to obtain a desired orientation of the junction assembly;

(e) maintaining the desired orientation of the junction assembly in the borehole while introducing a bonding agent into the borehole through the orienting device; and

(f) removing the orienting device from the pipe string.

25. The method as claimed in claim 24, further comprising the following steps:

(g) inserting a guide in the pipe string with a running and retrieval tool such that the guide selectively engages the junction assembly; and

(h) inserting an object in the pipe string such that the object is guided into the lateral conduit by the guide.

26. The method as claimed in claim 25, wherein the object is comprised of a drilling tool for drilling a lateral borehole.

27. The method as claimed in claim 25, wherein the object is comprised of a liner for lining a lateral borehole.

28. The method as claimed in claim 25, further comprising the step of removing the guide from the pipe string with the running and retrieval tool.

29. The method as claimed in claim 28, wherein the step of removing the guide from the pipe string is comprised of shearing a shear mechanism associated with the junction assembly.

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