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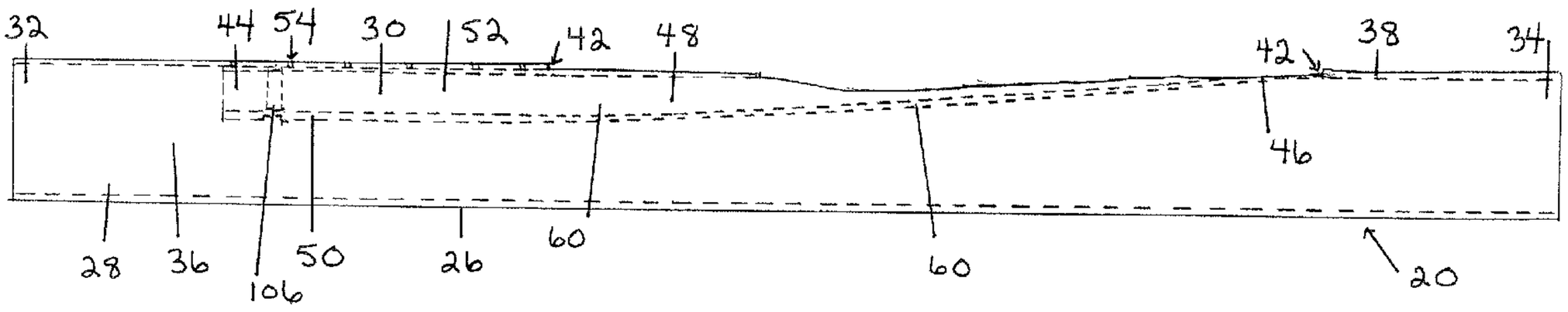

(57) Abrégé/Abstract:
The invention is directed at an apparatus, system and method for providing a junction between a primary borehole and a lateral borehole. The apparatus is comprised of a conduit adapted for insertion in the primary borehole. The conduit includes a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough. The primary conduit wall defines an elongated opening oriented longitudinally between the upper and lower ends of the primary conduit. A lateral conduit is mounted within the bore of the primary conduit. The lateral conduit has an upper end, a lower end and a bore extending therethrough. The lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening.

ABSTRACT OF INVENTION

The invention is directed at an apparatus, system and method for providing a junction between a primary borehole and a lateral borehole. The apparatus is comprised of a conduit adapted for insertion in the primary borehole. The conduit includes a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough. The primary conduit wall defines an elongated opening oriented longitudinally between the upper and lower ends of the primary conduit. A lateral conduit is mounted within the bore of the primary conduit. The lateral conduit has an upper end, a lower end and a bore extending therethrough. The lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening.

APPARATUS, SYSTEM AND METHOD FOR PROVIDING A DOWNHOLE JUNCTION

FIELD OF INVENTION

The present invention relates to an apparatus, system and method for providing a junction between a primary borehole and a lateral borehole extending therefrom. Further, the present invention relates to an apparatus, system and method for the drilling and completion of one or more lateral boreholes extending from a primary borehole.

BACKGROUND OF INVENTION

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.

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.

United States of America Patent No. 5,388,648 issued February 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.

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.

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 for 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.

Thus, there remains a need for an improved apparatus, system and method for providing a junction between a primary borehole and a lateral borehole extending therefrom. Further, there remains a need for an improved apparatus, system and method for drilling and completing one or more lateral boreholes extending from a primary borehole.

SUMMARY OF INVENTION

The present invention relates to an apparatus, system and method for providing a junction between a primary borehole and a lateral borehole extending therefrom. Further, the present invention relates to an apparatus, system and method for drilling and completing at least one lateral borehole extending from a primary borehole. In the preferred embodiment, the within invention preferably provides for a Level 6 junction as defined by the TAML Multi Lateral Well Classification Matrix.

In one aspect of the invention, the invention is comprised of an apparatus for providing a junction between a primary borehole and a lateral borehole to be drilled and / or produced therefrom. The apparatus is preferably comprised of a conduit or joint of pipe adapted to be inserted within the primary borehole. The conduit preferably has a conduit wall defining an elongated opening therein. To utilize the apparatus, the apparatus is positioned within the primary borehole at a desired depth or location and is oriented at a desired orientation such that the elongated opening is positioned adjacent the location or in the desired direction of the lateral borehole.

Upon extending or passing a downhole tool or other equipment through the primary borehole, the apparatus permits or provides for the passage of the tool or equipment from the primary borehole and through the apparatus to extend from the elongated opening in order to access the lateral borehole or to access the desired location of the lateral borehole to be drilled therefrom. For instance, a drilling tool or equipment may be passed through the elongated opening in the apparatus in order to drill the lateral borehole in the direction of the elongated opening. As well, once the lateral borehole is drilled, other downhole tools or equipment, including liners and production equipment, may be passed through the elongated opening of the apparatus for access to the lateral borehole. Thus, the apparatus assists in forming the junction, 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 elongated opening is oriented on the high side of the conduit to facilitate passage of tools and equipment through the conduit to the bottom of the primary borehole along the low side of the conduit.

The apparatus, and more particularly the conduit, may have any configuration or shape compatible with insertion in the primary borehole and adapted to facilitate communication between the primary borehole and the desired lateral borehole. Preferably, communication between the primary and lateral boreholes is achieved by providing for communication between a bore of the conduit, which communicates with the primary borehole, and the elongated opening in the conduit wall, which communicates with the lateral borehole.

In a preferred embodiment of the first aspect, the invention is comprised of an apparatus for insertion in a primary borehole for providing a junction between the primary borehole and a lateral borehole extending therefrom, wherein the apparatus is comprised of a conduit adapted for insertion in the primary borehole comprising:

(a) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(b) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening.

In a second aspect of the invention, the invention is comprised of a system or a kit for providing a junction between a primary borehole and a lateral borehole. Further, the system preferably permits the completion and drilling of the junction through utilization of the various components comprising the system. Preferably, the system is comprised of the apparatus, as described above. Further, the system is preferably comprised of at least one of a removable orienting device and a removable guide.

The removable orienting device is preferably adapted for insertion in the conduit of the apparatus and permits or provides for the apparatus to be oriented in a desired orientation by indicating the orientation of the conduit in the primary borehole. Specifically, the orienting device assists in orienting, or facilitates the orientation of, the elongated opening in the conduit wall adjacent the location of the lateral borehole or in the direction of the desired lateral borehole so that downhole tools or equipment, including a drilling tool or production tool or

equipment, may be passed through the apparatus from the primary borehole to the lateral borehole.

The removable orienting device may be comprised of any removable device or apparatus capable of insertion in the conduit and capable of indicating or providing to a user or operator the orientation of the conduit in the primary borehole such that the conduit may be rotated within the primary borehole to achieve a desired orientation. Preferably, the removable orienting device is adapted for insertion in the primary conduit adjacent the lateral conduit for indicating an orientation of the elongated opening of the primary conduit wall within the primary borehole. Further, the orienting device preferably engages the lateral conduit such that rotation of the primary conduit rotates the orienting device and varies the orientation of the elongated opening indicated thereby.

Similarly, the removable guide is preferably adapted for insertion in the conduit of the apparatus. The guide is provided to guide or direct downhole tools or equipment, including a drilling tool or production tool or equipment, through the apparatus from the primary borehole to the lateral borehole. Thus, the guide preferably guides or directs the tool or equipment from a bore of the conduit of the apparatus through the elongated opening in the conduit wall so that the tool or equipment may extend from or pass through the elongated opening to the lateral borehole.

The removable guide may be comprised of any removable device or apparatus capable of insertion in the conduit and able to guide a tool or other equipment through the apparatus from the primary borehole to the lateral borehole. Preferably, the removable guide is comprised of any removable device or apparatus capable of insertion in the primary conduit of the conduit and able to guide a tool or other equipment from the primary conduit into the lateral conduit for communication with the elongated opening. More preferably, the removable guide is adapted for insertion in the primary conduit adjacent the lateral conduit. Further, the guide is comprised of an upper surface sloped in a direction towards the upper end of the lateral conduit such that a tool inserted through the upper end of the primary conduit is directed into the upper end of the lateral conduit.

In a preferred embodiment of the second aspect, the invention is comprised of a system for providing a junction between a primary borehole and a lateral borehole extending therefrom, the system comprising:

(a) an apparatus comprised of a conduit adapted for insertion in the primary borehole, wherein the conduit is comprised of:

(i) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(ii) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening;

(b) a removable orienting device adapted for insertion in the primary conduit adjacent the lateral conduit for indicating an orientation of the elongated opening of the primary conduit wall within the primary borehole, wherein the orienting device engages the lateral conduit such that rotation of the primary conduit rotates the orienting device and varies the orientation of the elongated opening indicated thereby; and

(c) a removable guide adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the guide is comprised of an upper surface sloped in a

direction towards the upper end of the lateral conduit such that a tool inserted through the upper end of the primary conduit is directed into the upper end of the lateral conduit.

Further, the orienting device is preferably adapted to permit or provide for the conducting of a fluid therethrough while inserted in the primary conduit of the apparatus. Thus, a fluid, such as a slurry of a hardenable or settable liquid, including a cementitious slurry, may be passed through the apparatus following the orientation of the apparatus utilizing the orienting device in order to maintain the position of the apparatus in the primary borehole relative to the location or desired location of the lateral borehole.

Preferably, the orienting device defines a passage therethrough for conducting a fluid through the orienting device while engaged with the lateral conduit. In the preferred embodiment, the orienting device is comprised of:

(a) a device housing adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the device housing has a C-shaped 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 the passage for conducting the fluid through the orienting device.

In addition, the orienting device is preferably comprised of one or more apparatuses or sensors capable of sensing and communicating the orientation of the apparatus such that the actual downhole orientation may be adjusted to achieve the desired orientation of the apparatus. Preferably, the information concerning the orientation, as provided or indicated by the orienting device, is communicated to the surface for use by an operator conducting the drilling or production operation. In the preferred embodiment, the orienting device is further comprised of an orienting tool mounted, affixed, fastened or otherwise associated with the device housing for sensing and communicating the orientation of the device housing. If

desired, the orienting tool 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 orienting tool to sense and communicate the orientation of the device housing.

As well, in the preferred embodiment, the guide is comprised of a guide housing adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the guide housing has a C-shaped recess for receiving the upper end of the lateral conduit, wherein the guide housing has an upper end and wherein the upper surface of the guide is comprised of the upper end of the guide housing such that the upper surface is sloped in a direction towards the C-shaped recess.

The removable orienting device and the removable guide may be inserted in the conduit for use and may be retrieved therefrom following use using any device or apparatus suitable for this purpose and capable of performing the desired operation or function. Preferably, an upper end of the orienting device is connectable with a pipe string, such as a drill string, in order that the orienting device may be selectively lowered within the primary borehole or retrieved therefrom by movement of the pipe string from the surface. In the preferred embodiment, the pipe string is connectable with the tubular member of the orienting device for placement and removal of the orienting device. Further, a fluid may be conducted through the pipe string from the surface to pass through the tubular member of the orienting device to a downhole location in the primary borehole.

The removable guide may similarly be placed within and retrieved from the conduit by a pipe string or other apparatus. However, preferably, the guide is further comprised of a removable running and retrieval tool adapted for engagement with the guide such that the guide may be selectively lowered within the primary borehole or retrieved therefrom utilizing the removable running and retrieval tool. Specifically, the removable running and retrieval tool is adapted to selectively engage and disengage the guide as desired to selectively place and remove the guide within the conduit of the apparatus.

In the preferred embodiment, the removable running and retrieving tool is adapted for engagement with the guide housing for placement and retrieval of the guide within the primary conduit. In this case, the removable running and retrieving tool is referred to herein as a guide running and retrieval tool. As well, the removable guide may be comprised of a fishing neck, also referred to as a fishneck. In this instance, a further removable running and retrieving tool may be provided which is adapted for engagement with the fishing neck for placement and retrieval of the guide within the primary conduit. In this case, the removable running and retrieving tool is referred to herein as a fishneck running and retrieval tool.

In a third aspect of the invention, the invention is comprised of a method for providing a junction between a primary borehole and a lateral borehole extending therefrom. Preferably, the method is performed utilizing the apparatus and system of the within invention as described herein, and particularly, the preferred embodiments of the apparatus and system. However, the method may be performed using any apparatus, system or device suitable for, and capable of, performing the within method.

The method is comprised of the steps of positioning the apparatus, and particularly the conduit, in the primary borehole at a desired depth for the lateral borehole and rotating the conduit in the primary borehole to achieve a desired orientation of the conduit relative to a desired direction of the lateral borehole. Preferably, the conduit is oriented such that the elongated opening in the conduit wall is adjacent the lateral borehole or adjacent the desired direction of the lateral borehole to extend from the primary borehole.

Next, a downhole tool, such as a drilling tool, or other downhole drilling or production equipment, is inserted through the primary borehole and into the bore of the conduit and is directed or guided from the bore through the elongated opening in the conduit wall to access or communicate with the lateral borehole. Preferably, the downhole tool is inserted through the upper end of the primary conduit for direction into the upper end of the lateral conduit such that the downhole tool extends through the elongated opening in the primary conduit wall. Thus, the downhole tool may either access or communicate with the lateral borehole or may exit the elongated opening for drilling the lateral borehole.

Further, in order to facilitate the insertion of the downhole tool through the conduit, the method may further include the step of maintaining the position of the conduit within the primary borehole at the desired orientation. Although any method or apparatus may be used to maintain the conduit position, preferably, a slurry of a hardenable or settable liquid, such as a cementitious slurry, is conducted through the conduit and passed into the primary borehole and into a space or annulus between the conduit and the wall of the primary borehole. Once the slurry sets or hardens, the conduit is fixed in the desired orientation and the hardened slurry forms or provides a portion of the casing string of the borehole. Subsequently, to access the lateral borehole, a drilling tool is used to drill through the portion of the hardened slurry adjacent the elongated opening in the conduit wall.

In a preferred embodiment of the third aspect, the invention is comprised of a method for providing a junction between a primary borehole and a lateral borehole extending therefrom, the method comprising the steps of:

(a) positioning a conduit in the primary borehole at a desired depth for the lateral borehole, wherein the conduit is comprised of:

(i) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(ii) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the

primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening;

(b) rotating the conduit in the primary borehole to achieve a desired orientation of the elongated opening of the primary conduit wall relative to a desired direction of the lateral borehole;

(c) maintaining the position of the conduit within the primary borehole at the desired orientation;

(d) inserting a drilling tool through the upper end of the primary conduit for direction into the upper end of the lateral conduit such that the drilling tool extends through the elongated opening in the primary conduit wall for drilling the lateral borehole.

SUMMARY OF DRAWINGS

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

Figure 1 is a side view of a preferred embodiment of an apparatus of the within invention comprised of a conduit;

Figure 2 is a top view of the conduit shown in Figure 1;

Figure 3 is a cross-sectional view of the conduit taken along lines 3 - 3 of Figure 2;

Figure 4 is a cross-sectional view of the conduit taken along lines 4 - 4 of Figure 2;

Figure 5 is a side view of a preferred embodiment of a removable orienting device of the within invention;

Figure 6 is a top view of the orienting device as shown in Figure 5;

Figure 7 is a front view of a preferred embodiment of a removable guide of the within invention;

Figure 8 is a cross-sectional view of the guide taken along lines 8 - 8 of Figure 7;

Figure 9 is a side view of the guide as shown in Figure 7;

Figure 10 is a top view of the guide as shown in Figure 7;

Figure 11 is a longitudinal sectional view of the guide taken along lines 11 - 11 of Figure 10 showing a latch;

Figure 12 is a perspective view of a preferred embodiment of an inner latch member comprising the latch shown in Figure 11;

Figure 13 is a perspective view of a preferred embodiment of an outer latch member comprising the latch shown in Figure 11;

Figure 14 is a side view of the inner and outer latch members shown in Figures 12 and 13;

Figure 15 is a side view of a preferred embodiment of a removable guide running and retrieving tool of the within invention;

Figure 16 is a schematic cross-sectional view of a casing string showing the configuration schematically of the orienting device and the guide as shown in Figures 5 and 7 respectively within the casing string;

Figure 17 is a schematic cross-sectional view of the conduit shown in Figure 1, showing the configuration schematically of the orienting device and the guide as shown in Figures 5 and 7 respectively within the conduit;

Figure 18 is a perspective view of the guide shown in Figure 7 including a fishing neck attached thereto;

Figure 19 is a cross-sectional view of the fishing neck taken along lines 19 - 19 of Figure 18;

Figure 20 is a side view of a preferred embodiment of a removable fishneck running and retrieving tool of the within invention; and

Figure 21 is a pictorial view of the apparatus shown in Figure 1 positioned within a primary borehole.

DETAILED DESCRIPTION

Referring to Figure 1, the within invention is comprised of an apparatus (20) for insertion in a primary borehole for providing a junction between the primary borehole and a lateral borehole. More particularly, the apparatus (20) provides a pre-formed junction for placement at a desired intersection between the primary and lateral boreholes. Once positioned, and preferably cemented, at the desired point of intersection, the apparatus (20) may be utilized to direct 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 apparatus (20) may be utilized to direct other 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.

Further, referring to Figures 1, 5 and 7, the within invention is directed at a system for providing the junction between the primary borehole and the lateral borehole. In the preferred embodiment, the system is comprised of the apparatus (20), a removable orienting device (22) and a removable guide (24).

Referring to Figures 1 - 4, the apparatus (20) is comprised of a conduit (26) or any suitable tubular member or pipe joint adapted for insertion in the primary borehole. In other words, the outer dimensions of the conduit (26) are selected such that the conduit (26) may be readily inserted within and passed through the primary borehole to the desired depth. The conduit (26) is preferably comprised of a primary conduit (28) and a lateral conduit (30) mounted within the primary conduit (28).

The primary conduit (28) has an upper end (32), a lower end (34) and a 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).

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 conduit (26). In other words, 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.

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 Figure 21. 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, a threaded connection is 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).

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.

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, a threaded connection is 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.

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 apparatus (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 9 5/8 inches (about 24. 45 cm). However, the outside diameter of the primary conduit (28) is preferably about 10 ¾ 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.

In addition, where a multilateral well is desired, greater than one conduit (26) 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).

Further, the primary conduit wall (38) defines an elongated opening (42) therein. The elongated opening (42) is oriented longitudinally between the upper and lower ends (32, 34) of the primary conduit (28).

The conduit (26) is further comprised of the lateral conduit (30) which is mounted, affixed or otherwise attached within the bore (36) of the primary conduit (28). The lateral conduit (30) is preferably rigidly or securely mounted within the primary conduit (28) in any manner and by any means or mechanism. However, in the preferred embodiment, the lateral conduit (30) is welded to the primary conduit wall (38) within the bore (36), as described further below.

The lateral conduit (30) has an upper end (44), a lower end (46) and a 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).

The upper end (44) of the lateral conduit (30) is positioned within the primary conduit (28) for communication with the bore (36) of the primary conduit (28). Thus, tools, equipment and 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 elongated opening (42) in the primary conduit wall (38) for engagement therewith such that the bore (48) of the lateral conduit (30) communicates with the elongated 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 elongated opening (42).

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 elongated opening (42) engaged with the lower end (46).

More particularly, 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 elongated 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 elongated opening (42) such that the lower end (46) of the lateral conduit (30) may engage the elongated opening (42).

Specifically, the upper portion (52) of the lateral conduit wall (50) is preferably welded to the primary conduit wall (38). Referring to Figures 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 Figure 3.

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

For instance, as shown in Figure 2 in the preferred embodiment, the width of the elongated opening (42) and the width of the elongated lower end (46) of the lateral conduit (30) are similar. However, the length of the elongated opening (42) is greater than that of the elongated 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 elongated opening (42) is preferably sealing engaged with the adjacent lateral conduit (30), either the elongated lower end (46) or a portion of the lateral conduit wall (50), as shown in Figures 2 and 4. In the preferred embodiment, a weld (58) is provided between the adjacent surfaces of the elongated opening (42) and the lateral conduit (30).

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 (28). 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).

Second, the lateral conduit (30) is comprised of is 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 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. As a result of the bend or deflection, the lower portion (60) or build angle section engages and may communicate with the elongated opening (42) in the primary conduit wall (38).

Referring to Figure 21, 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 apparatus (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 apparatus (20) may be configured to safely achieve about a 15 degree angle over a distance of about 20 feet (6.096 m).

In manufacturing the conduit (26), the elongated 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 elongated 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 elongated 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 elongated 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 elongated opening (42) is removed so that the lower end (46) no longer extends from the primary conduit (28).

The conduit (26) 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.

As described further below, once the apparatus (20) is positioned and oriented within the primary borehole, it is preferable that the position of the apparatus (20) in the primary borehole be maintained in some manner during subsequent downhole operations. In the preferred embodiment, the apparatus (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 elongated 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.

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 elongated 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).

However, preferably, prior to placing the apparatus (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.

Referring to Figures 5, 6, 16 and 17, the removable orienting device (22) is adapted for insertion in the primary conduit (28) adjacent the lateral conduit (30) for facilitating the orienting of the conduit (26) in the primary borehole relative to the lateral borehole or the desired direction of the lateral borehole. Further, the removable orienting device (22) preferably facilitates the completion of the primary borehole, particularly the cementing of the conduit (26) in the primary borehole at a desired orientation. The orienting device (22) is configured to be receivable within the primary conduit (28) for indicating the orientation of the conduit (26) and for cementing the primary borehole. Further, the orienting device (22) is removable such that the orienting device (22) may be removed from the primary conduit (28) following the desired orientation and completion operations.

The orienting device (22) is adapted to engage the lateral conduit (30) when inserted within the bore (36) of the primary conduit (28). The orienting device (22) is specifically adapted to engage the lateral conduit (30) in a manner such that rotation of the conduit (26) within the primary borehole correspondingly rotates the orienting device (22) contained therein. More particularly, the conduit (26), 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 primary conduit (28) within the

borehole, and more particularly, an indication of the orientation of the elongated opening (42) of the primary conduit wall (38). Accordingly, the primary conduit (28) may be rotated to vary the orientation, as indicated by the orienting device (22), until the desired orientation of the primary conduit (28) within the primary borehole is achieved. Specifically, the desired orientation relates to the orienting of the elongated opening (42) in the primary conduit wall (38) relative to the actual or intended location of the lateral borehole.

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, such as a drill 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 pipe string or 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 pipe string is rotated at the surface using a standard or conventional rotary table or rig table.

Further, where desired to complete the primary borehole, a hardenable or settable slurry, such as a cementitious slurry, may be conducted through the pipe or drill 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 conduit (26) 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 conduit (26) 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.

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).

Thus, to permit the lateral conduit (30) to be closely or securely received by the orienting device (22), the device housing (62) preferably has a C-shaped recess (70) as shown in Figure 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 C-shaped recess (64) is 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 C-shaped recess (64) of the device housing (62) to cause a corresponding rotation of the device housing (62).

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 Figure 16, 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 Figure 18, 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 Figure 17, wherein the lateral conduit (30) has an outside diameter of about 5 inches (12.7 cm).

The device housing (62) may have any length compatible with the apparatus (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), a stop block or stop plate (71) or other mechanism may be 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).

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."

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 drill 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 drill string with the attached orienting device (22) and the casing string are preferably moved simultaneously or concurrently.

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).

As indicated above, a drill string, and particularly an upper portion of the drill string, is preferably engagable with the upper end (74) of the tubular member (72) in a manner permitting fluid communication therebetween. In the preferred embodiment, a threaded connection is preferably provided between the upper end (74) of the tubular member (72) and the adjacent upper portion of the drill string. As shown in Figure 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, such as a drill string, and preferably a lower portion of a drill string. In the preferred embodiment, a threaded connection is provided between the lower end (76) of the tubular member (72) and the adjacent lower portion of the drill string. As shown in Figure 5, the lower end (76) preferably provides a threaded pin connector.

Further, in the preferred embodiment, each of the upper and lower portions of the drill string is comprised of one or more lengths or joints of a 2 7/8 inches (7.3025 cm) drill

pipe. The length of the upper portion of the drill string is selected such that the drill 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 drill 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 drill 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 drill string and the cement floats.

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).

Accordingly, in use or operation, a lower portion of a drill string is threadably connected with the lower end (76) of the tubular member (72). Similarly, an upper portion of a drill 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 drill 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 drill 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.

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 drill 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 drill string. Once the lowermost or downhole end of the lower portion of the drill 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).

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 drill string, the drill string is further lowered within the primary borehole. If further downward movement of the drill 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).

Where the lowermost end of the lower portion of the drill 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 drill 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 drill 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).

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 drill string weight decreases. The drill 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 drill 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 drill string terminates about 1 meter above a cement float associated with the casing string.

Once the orienting device (22) is in position within the primary conduit (28), the orienting device (22) provides an indication of the actual orientation of the primary conduit (28) downhole within the primary borehole. To achieve a desired orientation of the primary conduit (28) within the primary borehole, the upper portion of the pipe string or 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. When the desired orientation of the primary conduit (28) downhole is achieved, rotation of the casing string (40) from the surface ceases. Typically, the primary conduit (28) will be preferably oriented such that the elongated 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 Figure 21, or is otherwise adjacent the desired direction of the lateral borehole. Positioning of the lateral conduit (30) on the high side facilitates passage of subsequent tools or equipment through the primary conduit (28), past the lateral conduit (30), as the tools and equipment will tend to travel along the low side.

In order to provide an indication of the orientation of the primary conduit (28) downhole, the orienting device (22) is preferably further comprised of an orienting tool (82) for

sensing and communicating the orientation of the orienting device (22), preferably to a user or operator at the surface.

Any type or configuration of orienting tool (82) may be used. Further, the orienting tool (82) may be associated with any member or component of the orienting device (22). In the preferred embodiment, the orienting tool (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 orienting tool (82) may be associated with the device housing (62) at any location and in any manner permitting the functioning of the orienting tool (82). For instance, the orienting tool (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 orienting tool (82) to sense and communicate the orientation of the device housing (62). In this case, the orienting sub including the orienting tool (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 drill string. Further, in the preferred embodiment, the orienting tool (82) is comprised of a gyroscope or other surveying sensors and equipment.

Once the conduit (26) is rotated to achieve the desired orientation in the primary borehole, a casing material, 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 drill 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 apparatus (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 apparatus (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 drill string from the surface.

When greater than one conduit (26) is connected together for insertion in the primary borehole to provide a multilateral well, the orientation of each of the conduits (26) relative to each other is predetermined and fixed upon connection of the conduits (26) 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 conduit (26). Use of the orienting device (22) to orient the uppermost conduit (22) will therefore result in the proper orientation of any conduits (26) downhole of the uppermost conduit (26). Further, the lower portion of the pipe or drill string is connected with the uppermost orienting device (22). The lower portion of the drill string extends through each of the lower conduits (26) to the desired location downhole. Thus, again, cementing may be completed through the upper portion of the drill 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 drill string. Following cementing, the orienting device (22) is removed by removal of the drill string from the surface.

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.

Referring to Figures 7 – 11, 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.

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).

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).

Thus, to permit the lateral conduit (30) to be closely received by the guide (24), the guide housing (86) preferably has a C-shaped recess (98) as shown in Figures 8 and 10. In the preferred embodiment, the guide housing wall (92) 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.

Further, as shown in Figures 7 and 9, the guide plate (94) defines the upper surface (84) of the guide (24) which is shaped or configured to guide or direct a downhole tool 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 tool in the desired direction regardless of the specific portion or area of the upper surface (84) that it contacts.

Further, in order to ensure or assist 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), the C-shaped recess (98) preferably includes a stop collar (100) or other structure inhibiting, and preferably preventing, the insertion of the upper end (44) within the C-shaped recess (98) past a desired position. 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).

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 latching mechanism (102) associated with the guide housing (86). In the preferred embodiment, 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.

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).

As will be described in further detail, 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). In order to provide a more secure engagement, the upper end (44) of the lateral conduit (30) preferably defines 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).

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 Figure 17, 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 Figure 18, wherein the primary conduit wall (38) has an outside diameter of about 10.75 inches (27.31 cm).

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 Figure 18, wherein the lateral conduit (30) has an outside diameter of about 5 inches (12.7 cm).

In use or operation, when the lateral conduit (30) is positioned within the C-shaped recess (98) as described, the downhole tool 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 tool towards the C-shaped recess (98). The tool then passes into the C-shaped recess (98) and subsequently the upper end (44) of the lateral conduit (30) which is received therein. The tool is then permitted to pass through the bore (48) of the lateral conduit (30) and out of its lower end (46) and through the elongated opening (42) in the primary conduit wall (38). The tool may then extend into an already drilled lateral borehole or may commence the drilling of the lateral borehole.

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 (86), 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).

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, such as a drill 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) preferably includes a removable running and retrieval tool. In the preferred embodiment, one or more running and retrieval tools as described herein may be used. Specifically, in the preferred embodiment, the invention provides for two running and retrieval tools. First, the within invention provides for a removable "guide" running and retrieval tool (110) as shown in Figure 15. Second, the within invention provides for a removable "fishneck" running and retrieval tool (111) as shown in Figure 20.

The removable guide running and retrieval tool (110) is adapted for engagement with the guide housing (86) such that the guide (24) may be placed within and retrieved from the primary conduit (28). Further, in the preferred embodiment, the guide running and retrieval tool (110) is used to operate the latching mechanism (102).

Referring to Figure 15, the guide 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, such as a drill string, for lowering the guide 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. In the preferred embodiment, the upper end (114) of the elongated member (112) of the guide 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 guide running and retrieval tool (110) is adapted for engagement with the guide housing (86).

More particularly, in the preferred embodiment, the lower end (116) of the elongated member (112) of the guide running and retrieval tool (110) is 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 guide 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.

Further, the lower end (116) of the elongated member (112) of the guide running and retrieval tool (110) is also preferably adapted to operate or act upon the latching mechanism (102) of the guide (24). Specifically, in the preferred embodiment, 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 preferred embodiment, the lower end (116) of the guide 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).

More particularly, referring to Figure 15, in the preferred embodiment, the lower end (116) of the elongated member (112) of the guide running and retrieval tool (110) is comprised of a key (120) for insertion within the guide housing (86) 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).

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).

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 Figure 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).

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 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 guide 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).

Referring to Figures 7 – 11, the guide housing (86) is preferably hollow and includes a tubular guide member (128) mounted therein 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 guide 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 guide 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).

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 guide 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).

In the preferred embodiment, 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 (186) 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 (186) is placed or positioned such that the reinforcement member (186) does not interfere with the movement of the elongated member (112) and key (120) of the guide running and retrieval tool (110) through the tubular guide member (128) as described herein.

To permit the insertion of the lower end (116)of the elongated member (112) of the guide 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 Figures 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).

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).

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 guide 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 Figures 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). Referring to Figures 9 and 11, in the preferred embodiment, 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). In particular, 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.

In the preferred embodiment, 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 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 mounted with the innermost surface of the latch (104) as described further below by any fastener or fastening mechanism, preferably one or more screws or bolts (156).

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).

Referring to Figures 12 – 14, the latch (104) is 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 preferred embodiment, the inner portion (160) comprises the portion of the latch (104) acted upon by the key (120). 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). As well, the outer portion (106) 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).

In the preferred embodiment, the outer portion (162) has an inner surface (164) for mounting with the spring steel (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 with the spring steel (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).

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, in the preferred embodiment, the outer surface (166)

provides a C-shaped recess (174) for securely engaging the indentation (106) in the upper end (44) of the lateral conduit (30).

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) 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).

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).

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 sloped or angled inwardly from the outer surface (178) to the inner surface (176) 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 (106) 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).

To actuate the latching mechanism (102) and to utilize the guide running and retrieval tool (110), the lower end (116) of the elongated member (112) of the guide 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).

The elongated member (112) of the guide 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.

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.

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, such as a drill string, connected with the upper end (114) of the elongated member (112) of the guide 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).

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 drill string weight decreases. The drill 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 drill 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 drill 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).

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 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).

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.

To remove the guide 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 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.

Once positioned below the long slot (140), the elongated member (112) of the guide 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 guide 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.

When it is desired to remove the guide (24) from the conduit (26), the operation as described above is repeated. The guide running and retrieval tool (110) is connected with the drill 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 guide 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 guide 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 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.

Rotation of the drill string and the attached guide 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).

Referring to Figures 18 - 20, the guide (24) is preferably further comprised of a fishing neck or fishneck (190) and a fishneck running and retrieval tool (111) for the reasons discussed below. Any conventional or known fishing neck may be used. However, the fishing neck (190) is selected to be compatible with the desired fishing tool, being the fishneck running and retrieval tool (111), to be used in running and retrieving the guide (24).

Where the guide (24) includes the fishing neck (190), the guide (24) may be positioned or installed within the primary conduit (28) of the apparatus (20) and may be removed from the primary conduit (28) using either the guide running and retrieval tool (110) or the fishneck running and retrieval tool (111) as desired. Preferably, the fishneck running and

retrieval tool (111) is used to install the guide (24), while the guide running and retrieval tool (110) is preferably used to remove the guide (24).

Specifically, 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 guide running and retrieval tool (110) would disturb the grease packing and permit debris to enter the slots (140, 146). Thus, the fishneck running and retrieval tool (111) is preferably used in order to minimize any disturbance to the grease packing in the guide (24) during placement.

However, the latching mechanism (102) of the guide (24) is engaged upon placement of the guide (24) in the primary conduit (28). The key (120) of the guide 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 guide running and retrieval tool (110) is preferably used to remove the guide (24). However, the fishneck running and retrieval tool (111) may be used as a back-up to remove the guide (24) upon failure of the guide running and retrieval tool (110) or following unsuccessful attempts to use the guide running and retrieval tool (110) for any reason. Use of the fishneck running and retrieval tool (111) to remove the guide (24) will result in the shearing of the shearing screws or bolts (156) to permit shearing of the latch (102) from within the guide housing (86). Thus, the guide (24) will require servicing before re-use.

The fishing neck (190) is comprised of a tubular extension to the guide (24) which is connected, attached or otherwise mounted in any manner with the upper end (88) of the guide housing (86). More particularly, in the preferred embodiment, referring to Figures 18 and 19, the fishing neck (190) is comprised of a tubular member (200) having an upper end (202) defining an upper end of the fishing neck (190), a lower end (204) defining a lower end of the fishing neck (190) and a wall (206) extending therebetween. 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 Figure 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 connected, attached or otherwise mounted, in any manner, 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). In the preferred embodiment, the upper end (88) of the guide housing (86) is welded with a lower end (204) of the tubular member (200).

The outer diameter of the fishing neck (190), 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).

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 fishneck 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 (190).

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).

Referring to Figure 20, the fishneck running and retrieval tool (111) is configured for engagement with the J-shaped slots (214) of the fishing neck (190). The fishneck 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, such as a drill string, for lowering the fishneck 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 fishneck 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.

The lower end (226) of the elongated member (111) of the fishneck running and retrieval tool (111) may be adapted for abutment with the upper end (88) of the guide housing (86), without permitting entry within the upper surface opening (136). Further, although the lower end (226) may have any compatible shape or configuration, the lower end (226) is preferably tapered to facilitate its passage within the fishing neck (190). Where desired, the upper end (202) of the fishing neck (190) may have an inwardly sloped surface (228) to guide or direct the tapered lower end (226) of the elongated member (222) within the tubular member (200). Further, to aid or facilitate the centralization of the elongated member (222) within the tubular member (200), the tapered lower end (226) may be sized and shaped to engage the upper surface (84) of the guide (24), at least in part, but is not permitted to pass within the upper surface opening (136) of the guide housing (86).

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 (190). Again, if desired, to assist

in centralizing the elongated member (222) within the tubular member (200) of the fishing neck (190), 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 (190).

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 (190). 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 (190).

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 (190) 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 fishneck running and retrieval tool (111).

To utilize the fishneck running and retrieval tool (111), the lower end (226) of the elongated member (222) of the fishneck running and retrieval tool (111) is inserted within

the upper end (202) of the fishing neck (190) 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).

The elongated member (222) of the fishneck 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).

Finally, the elongated member (222) of the fishneck 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 (190) 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 (190) 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, such as a drill string, connected with the upper end (224) of the elongated member (222) of the fishneck guide running and retrieval tool (111).

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 drill string weight decreases. The drill 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 drill 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 drill 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).

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 fishneck 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).

To remove the fishneck 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 fishneck 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 (190) in order to disengage and remove the pins (232) from the J-shaped slots (214). The fishneck 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.

If required or desired to use the fishneck running and retrieval tool (111) to remove the guide (24) from the conduit (26), the operation as described above is repeated. The

fishneck running and retrieval tool (111) is connected with the drill 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 (190). Upon further downward movement, the pins (232) of the elongated member (222) contact or abut the upper end (202) of the fishing neck (190). The fishneck 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 drill string weight may increase, signaling the alignment to the operator. The pins (232) of the fishneck 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 fishneck running and retrieval tool (111), which will result in shearing of the shearing screws or bolts (156) to permit shearing of the latch (102) from within the guide housing (86).

Rotation of the drill string and the attached fishneck running and retrieval tool (111) 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 (190) and the guide (24) during the removal process in order to flush any debris, such as drilling cuttings, from the J-shaped slots (214) and thereby facilitate entry of the pins (232) into and passage through the J-shaped slots (214).

As described previously, and referring to Figure 21, the within invention is also directed at a method for providing a junction between the primary borehole and the 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. The conduit (26) is then lowered by 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.

As described previously, once at the desired depth, the conduit (26) is rotated in the primary borehole to achieve a desired orientation of the elongated opening (42) of the primary conduit wall (38) relative to a desired direction of the lateral borehole. In order to achieve the desired orientation, the orienting device (22) as described herein is preferably utilized by inserting the orienting device (22) within the primary conduit (28). Further, once in the desired orientation, the position of the conduit (26) within the primary borehole is preferably maintained at the desired orientation during subsequent operations. For this purpose, 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 conduit (26) and attached casing string. The orienting device (22) is then removed from the primary conduit (28) to the surface.

The guide (24) is then inserted through the upper portion of the casing string (40) and into the primary conduit (28) in the manner described previously. Where drilling of a lateral borehole is required or desired, a drilling tool is then 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 elongated opening (42) in the primary conduit wall (38) for drilling the lateral borehole. Following drilling of the lateral borehole, the guide (24) may be removed or allowed to remain in place for the guiding and direction of subsequent production tools and equipment.

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).

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.

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.

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.

The specific configuration of the apparatus (20) and the system of the within invention provides a number of advantageous features.

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 apparatus (20). The apparatus (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 apparatus (20) inhibits or prevents any leakage from the lateral borehole into the primary borehole other than through the lateral conduit (30)of the apparatus (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).

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.

However, using the apparatus (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 conduit (26). 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.

Third, the apparatus (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.

Fourth, the orienting device (22) allows the conduit (26) 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 conduit (26) in the desired orientation. Further, the orienting device (22) permits a limited amount of upward and downward motion during cementing while maintaining the orientation.

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 conduit (26) is cemented in place, the guide (24) mechanically locks into place within the conduit (26) 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.

Sixth, use of the apparatus (20) may be relatively more economical. No milling of steel is 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.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. An apparatus for insertion in a primary borehole for providing a junction between the primary borehole and a lateral borehole extending therefrom, wherein the apparatus is comprised of a conduit adapted for insertion in the primary borehole comprising:

(a) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(b) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening.

2. A system for providing a junction between a primary borehole and a lateral borehole extending therefrom, the system comprising:

(a) an apparatus comprised of a conduit adapted for insertion in the primary borehole, wherein the conduit is comprised of:

(i) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(ii) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening;

(b) a removable orienting device adapted for insertion in the primary conduit adjacent the lateral conduit for indicating an orientation of the elongated opening of the primary conduit wall within the primary borehole, wherein the orienting device engages the lateral conduit such that rotation of the primary conduit rotates the orienting device and varies the orientation of the elongated opening indicated thereby; and

(c) a removable guide adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the guide is comprised of an upper surface sloped in a direction towards the upper end of the lateral conduit such that a tool inserted through the upper end of the primary conduit is directed into the upper end of the lateral conduit.

3. The system as claimed in claim 2 wherein the orienting device defines a passage therethrough for conducting a fluid through the orienting device while engaged with the lateral conduit.

4. The system as claimed in claim 3 wherein the orienting device is comprised of:

(a) a device housing adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the device housing has a C-shaped 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 the passage for conducting the fluid through the orienting device.

5. The system as claimed in claim 4 wherein the orienting device is further comprised of an orienting tool associated with the device housing for sensing and communicating the orientation of the device housing.

6. The system as claimed in claim 2 wherein the guide is comprised of a guide housing adapted for insertion in the primary conduit adjacent the lateral conduit, wherein the guide housing has a C-shaped recess for receiving the upper end of the lateral conduit, wherein the guide housing has an upper end and wherein the upper surface of the guide is comprised of the upper end of the guide housing such that the upper surface is sloped in a direction towards the C-shaped recess.

7. The system as claimed in claim 6 wherein the guide is further comprised of a removable running and retrieving tool adapted for engagement with the guide housing for placement and retrieval of the guide within the primary conduit.

8. A method for providing a junction between a primary borehole and a lateral borehole extending therefrom, the method comprising the steps of:

(a) positioning a conduit in the primary borehole at a desired depth for the lateral borehole, wherein the conduit is comprised of:

(i) a primary conduit having a primary conduit wall extending between a lower end and an upper end adapted for connection with a pipe string and defining a bore therethrough between the upper end and the lower end, and wherein the primary conduit wall defines an elongated opening oriented longitudinally between the upper end and the lower end of the primary conduit;

(ii) a lateral conduit mounted within the bore of the primary conduit, the lateral conduit having an upper end, a lower end and a bore extending therethrough, and wherein the lower end of the lateral conduit is adapted to engage the primary conduit wall about the elongated opening of the primary conduit wall such that the bore of the lateral conduit communicates with the elongated opening;

(b) rotating the conduit in the primary borehole to achieve a desired orientation of the elongated opening of the primary conduit wall relative to a desired direction of the lateral borehole;

(c) maintaining the position of the conduit within the primary borehole at the desired orientation;

(d) inserting a drilling tool through the upper end of the primary conduit for direction into the upper end of the lateral conduit such that the drilling tool extends through the elongated opening in the primary conduit wall for drilling the lateral borehole.

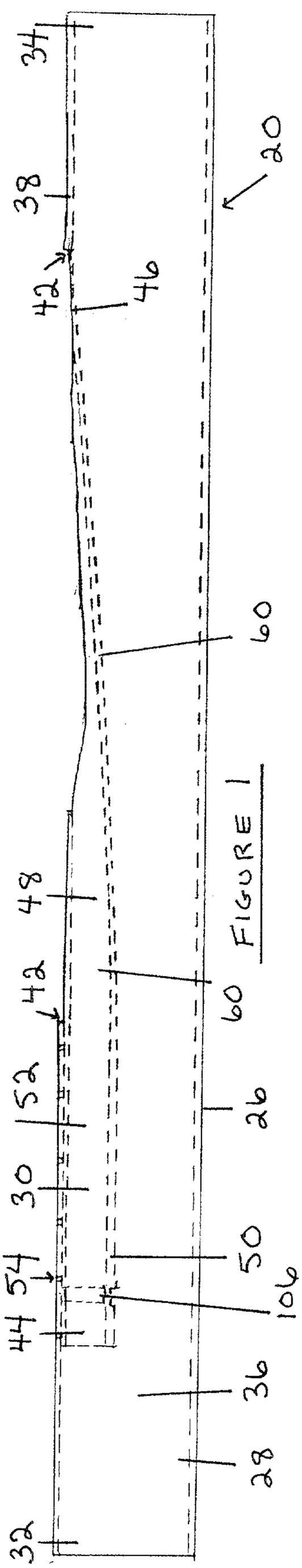

FIGURE 1

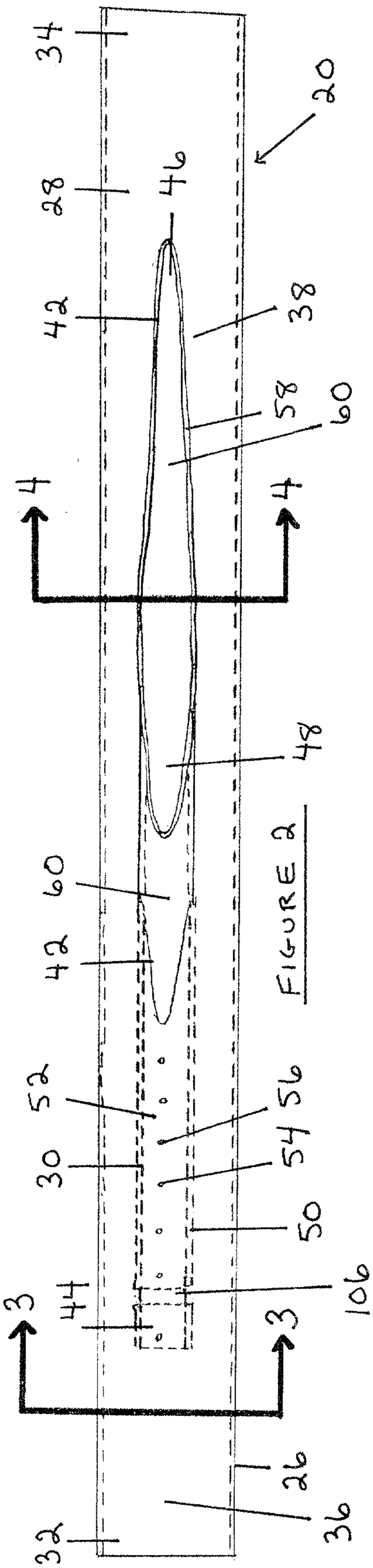

FIGURE 2

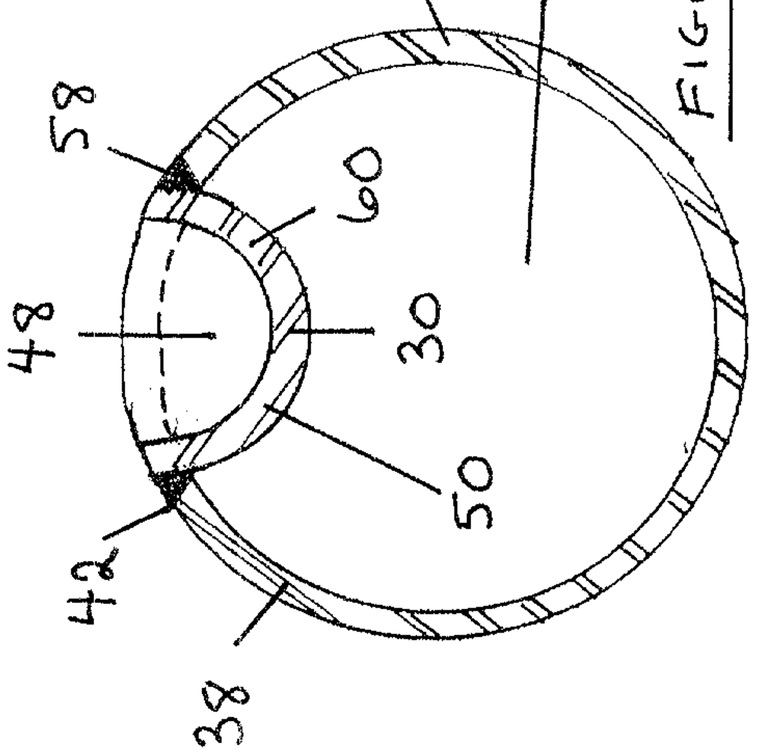

FIGURE 4

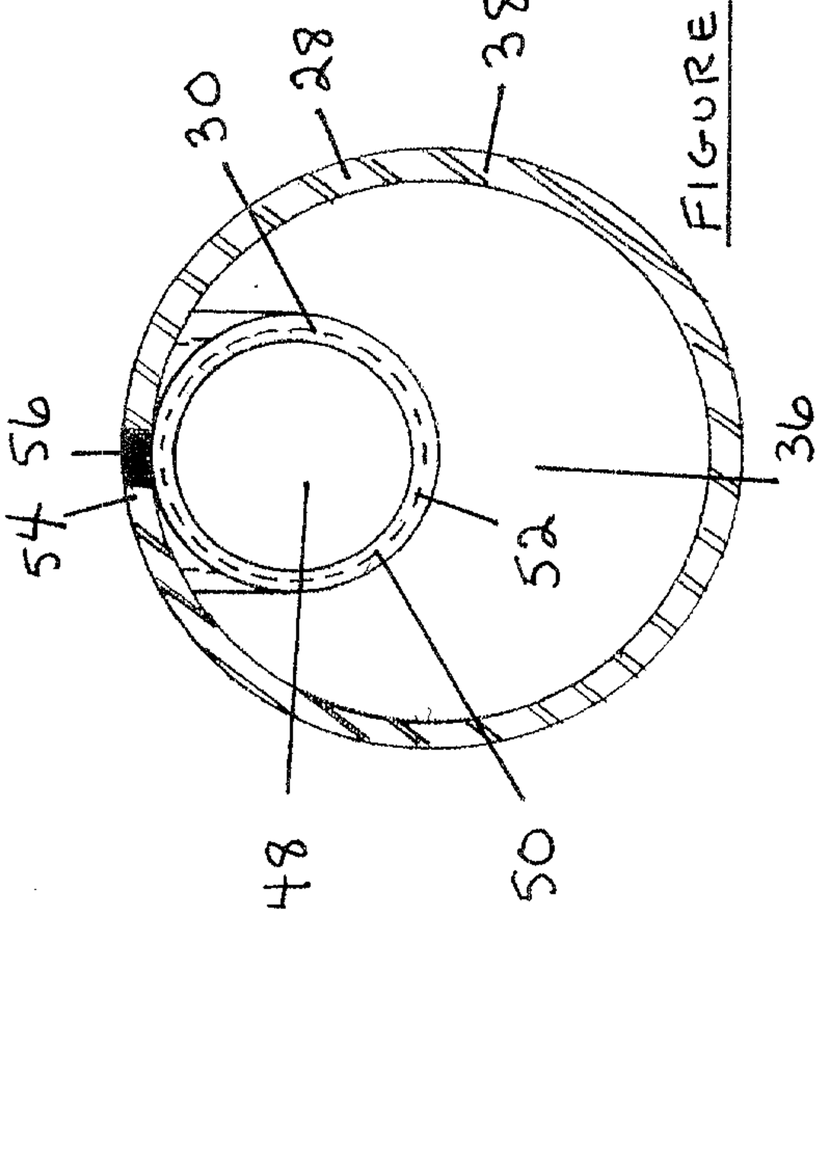

FIGURE 3

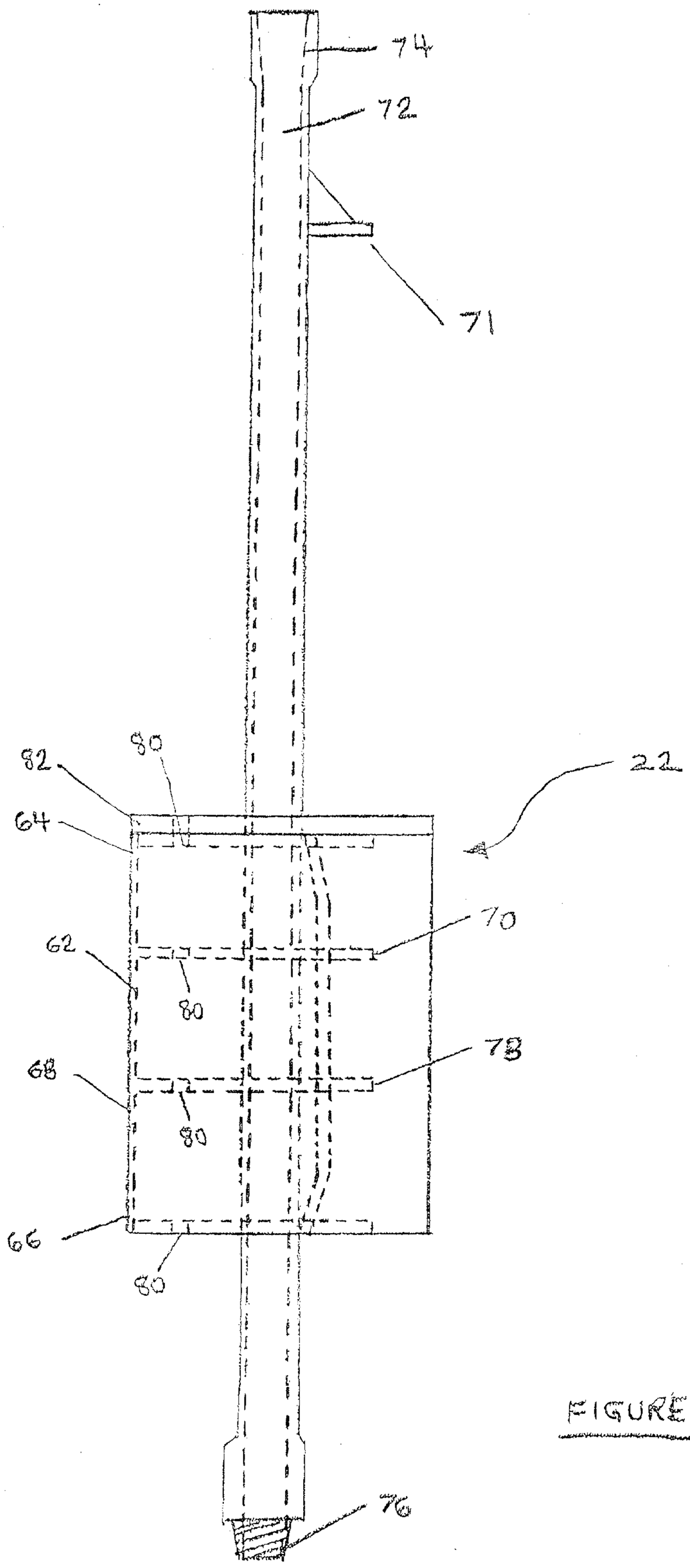

FIGURE 5

FIGURE 6

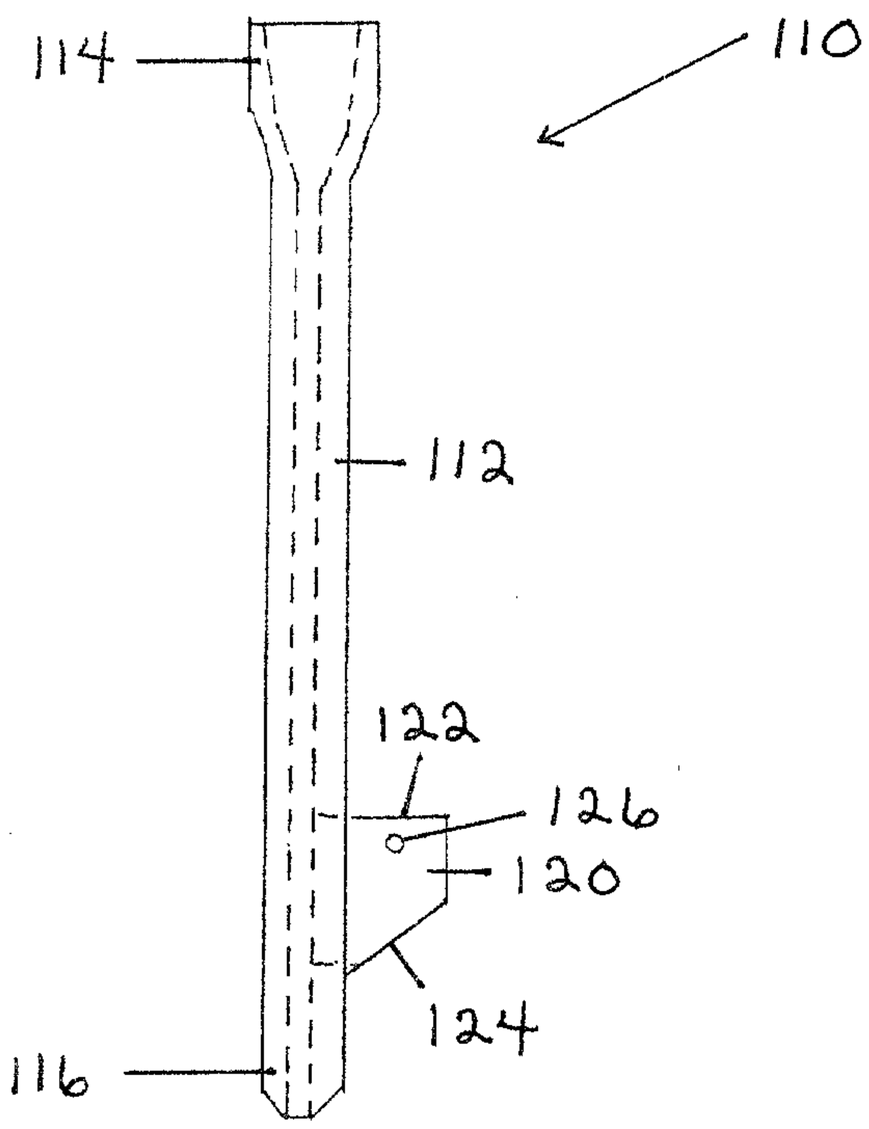

FIGURE 15

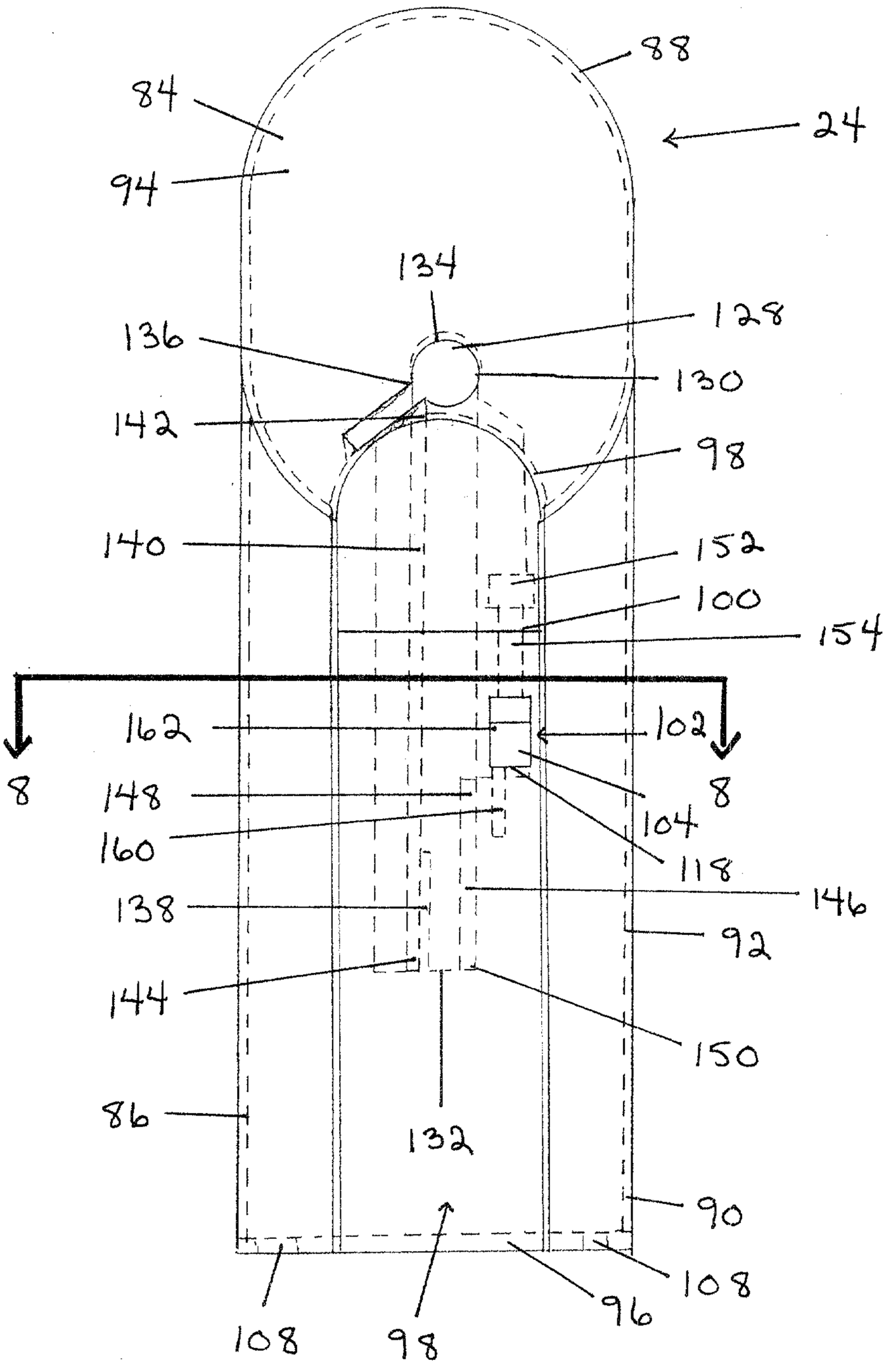
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FIGURE 7

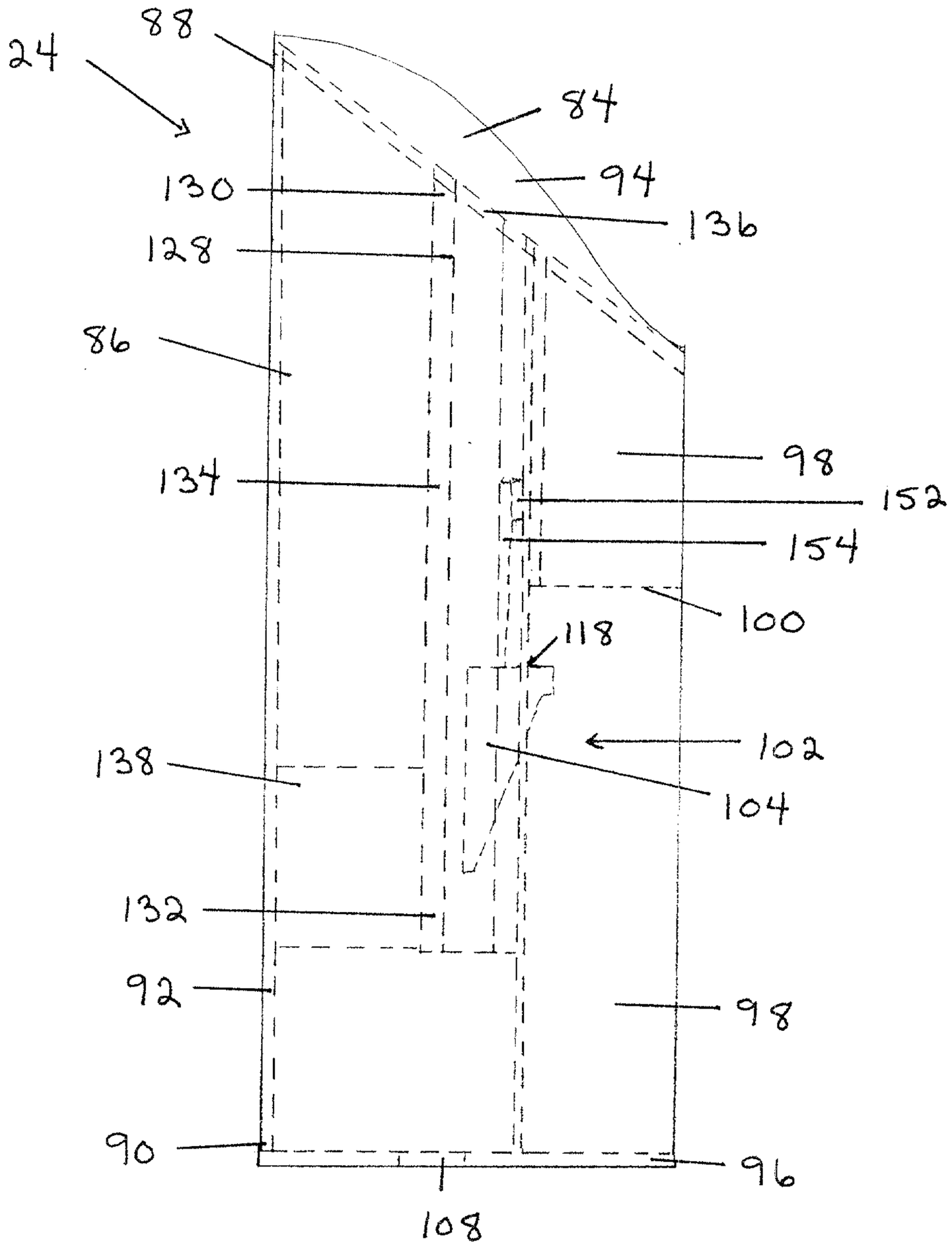
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FIGURE 9

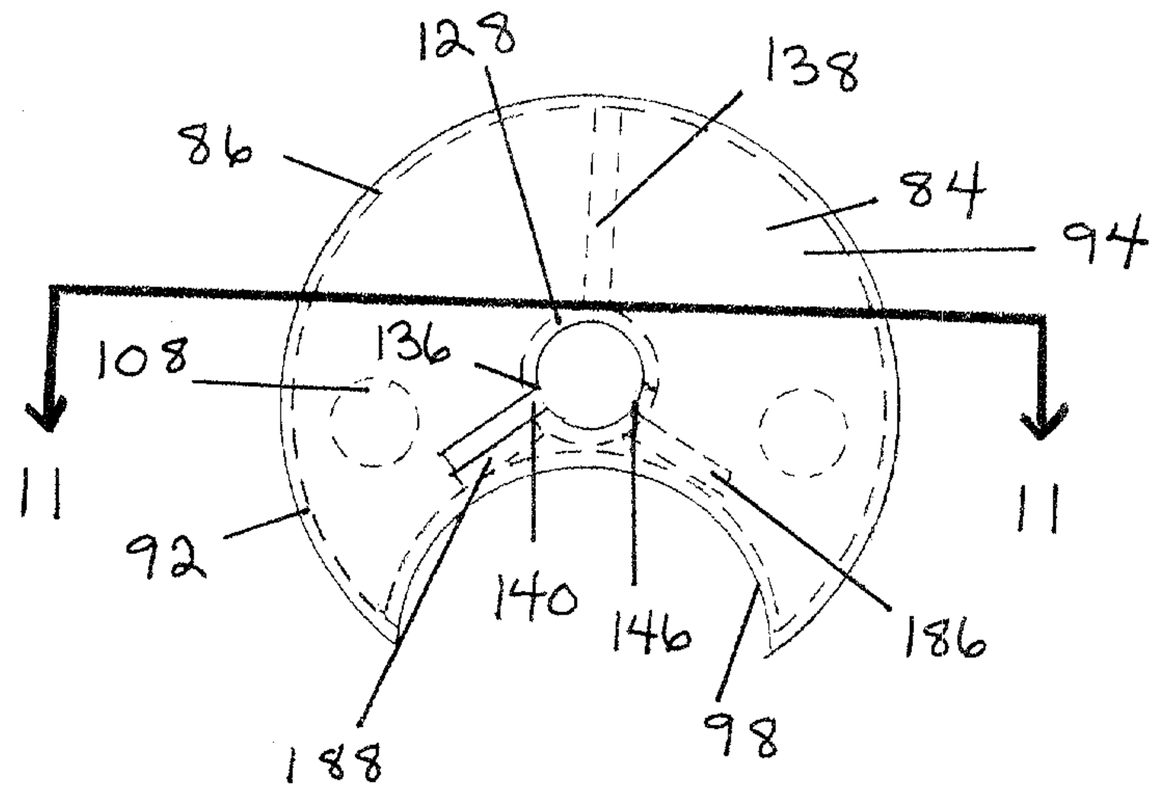
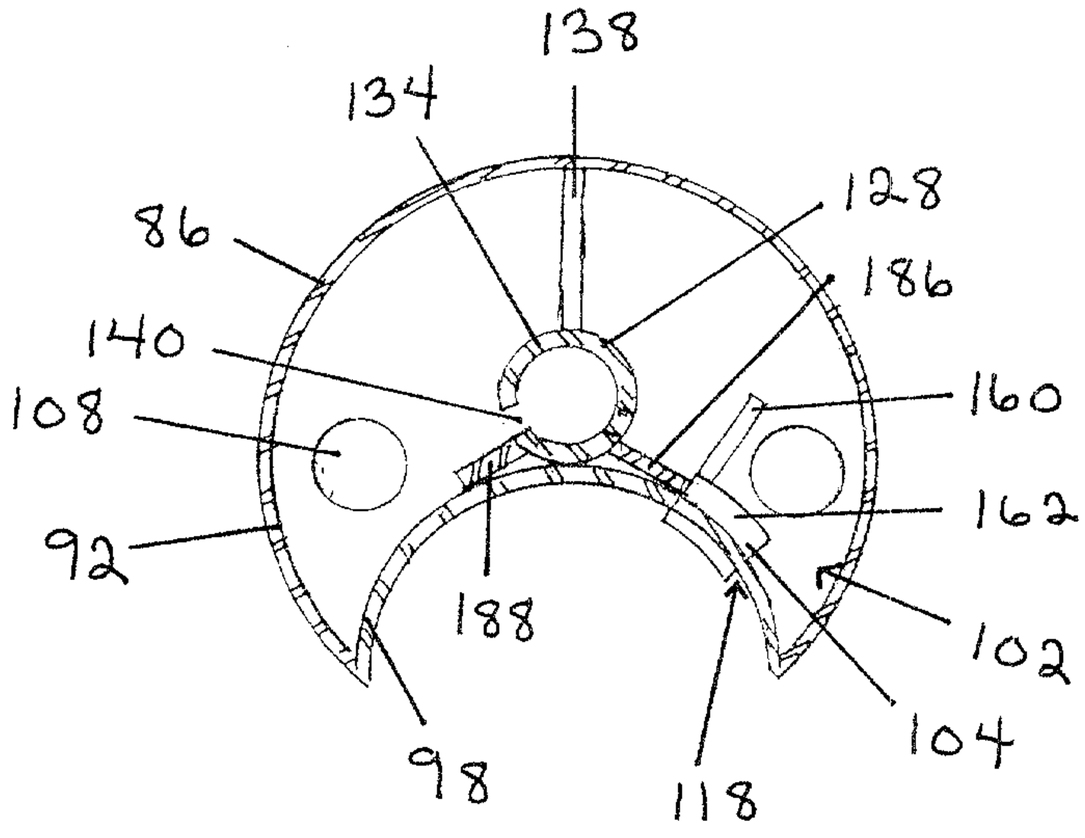


FIGURE 10



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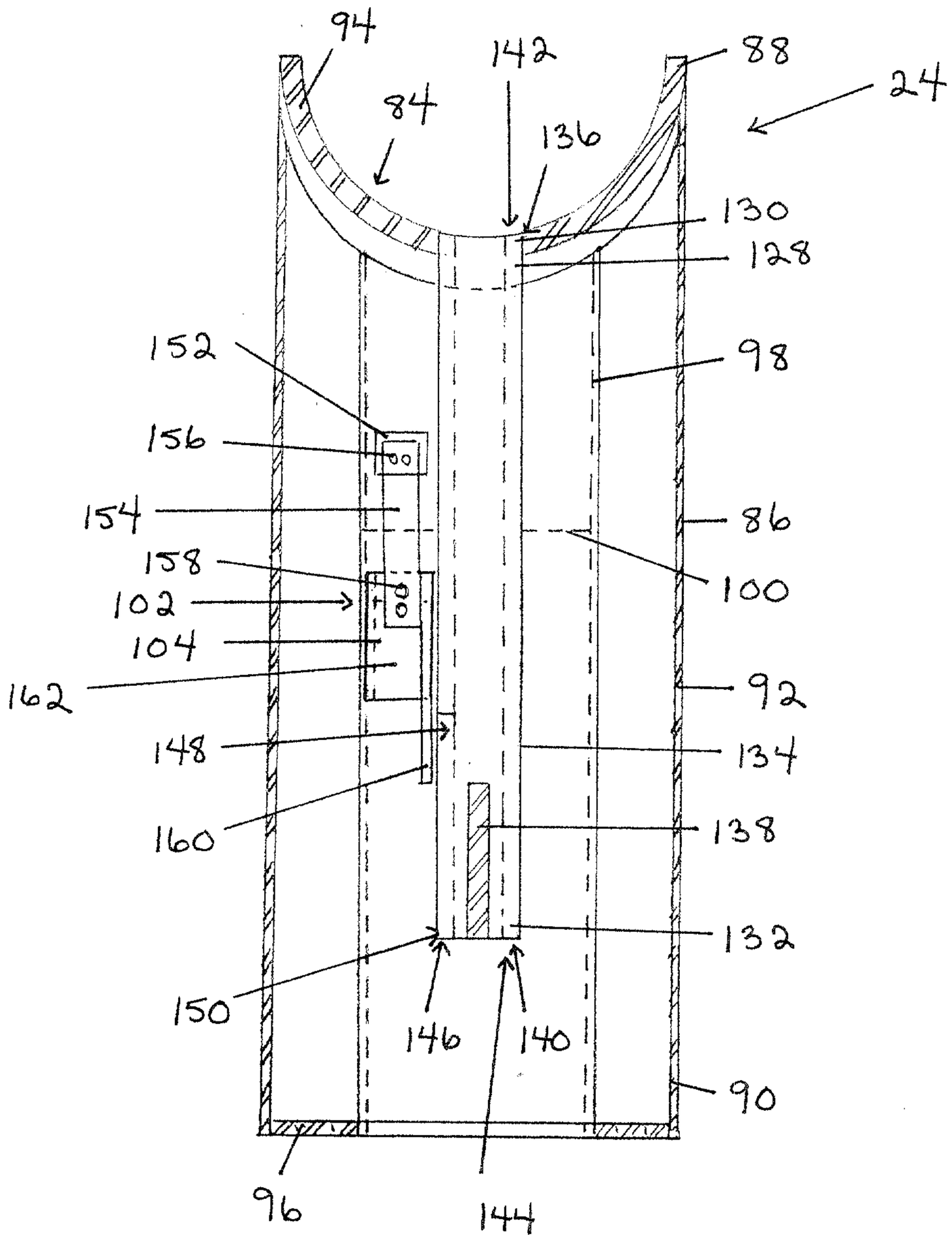
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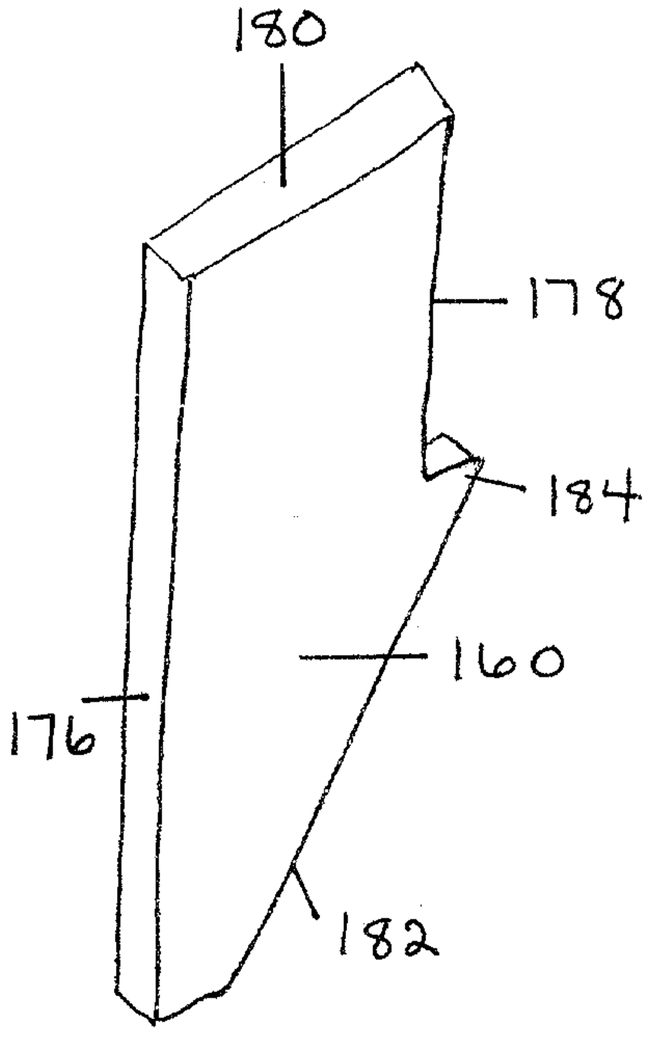
FIGURE 11



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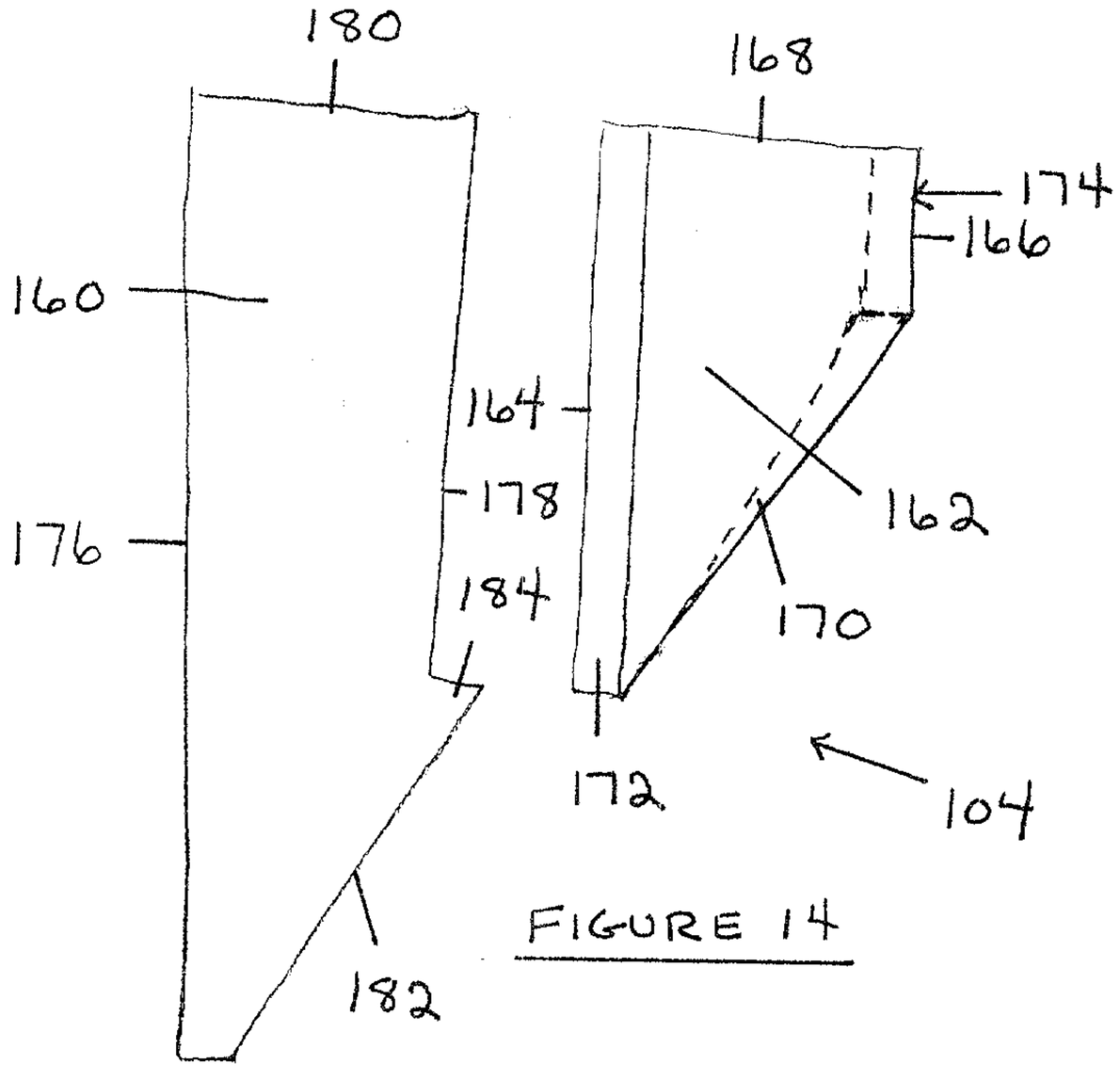


FIGURE 14

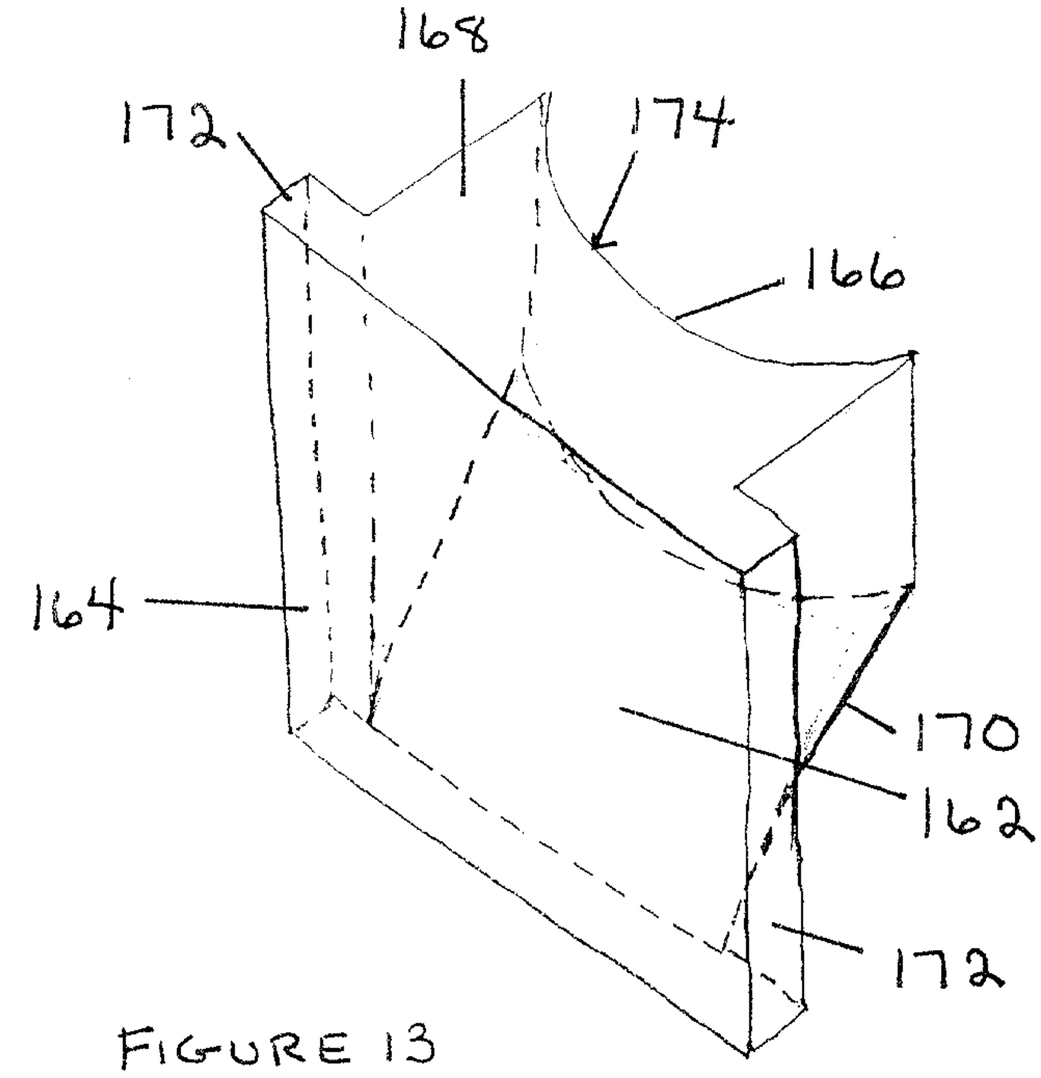


FIGURE 13

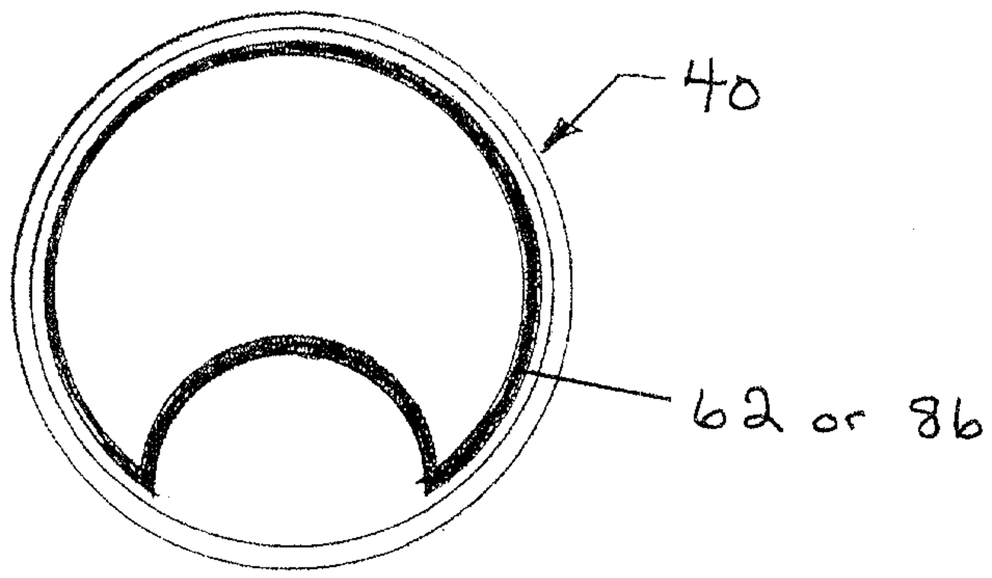


FIGURE 16

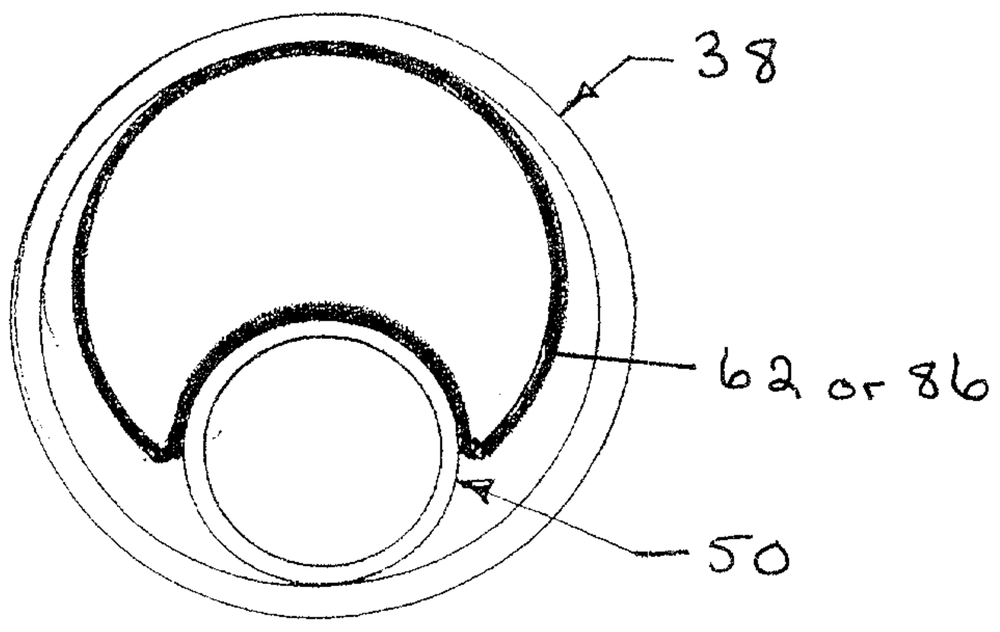


FIGURE 17

FIGURE 18

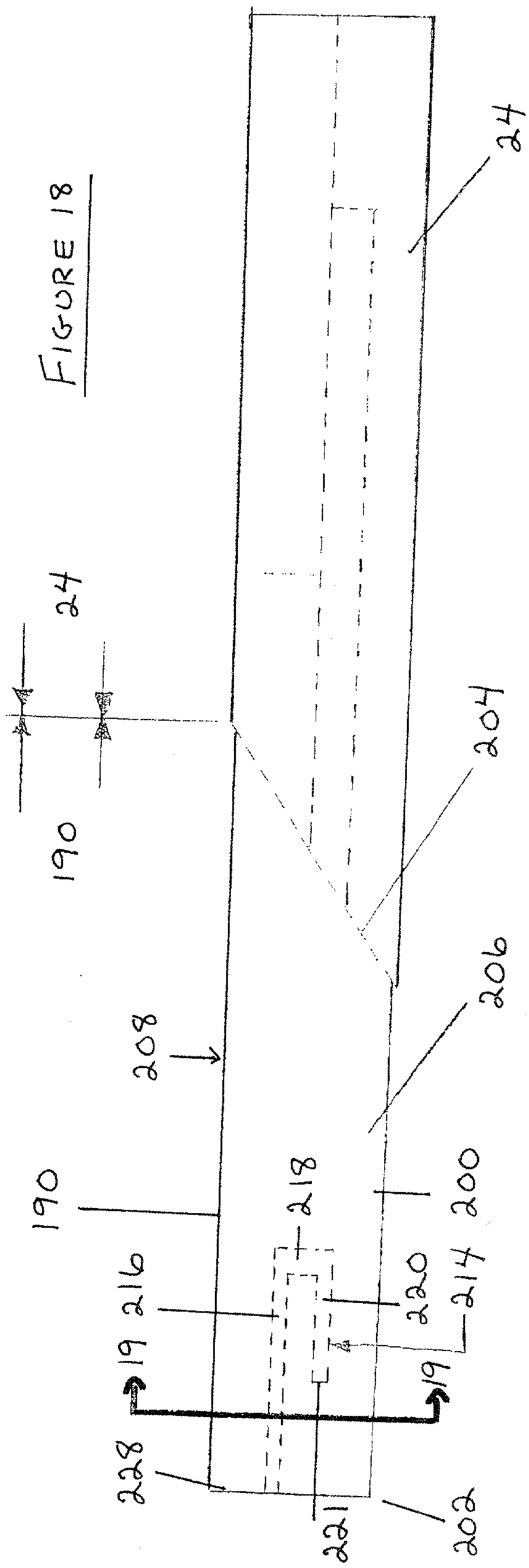
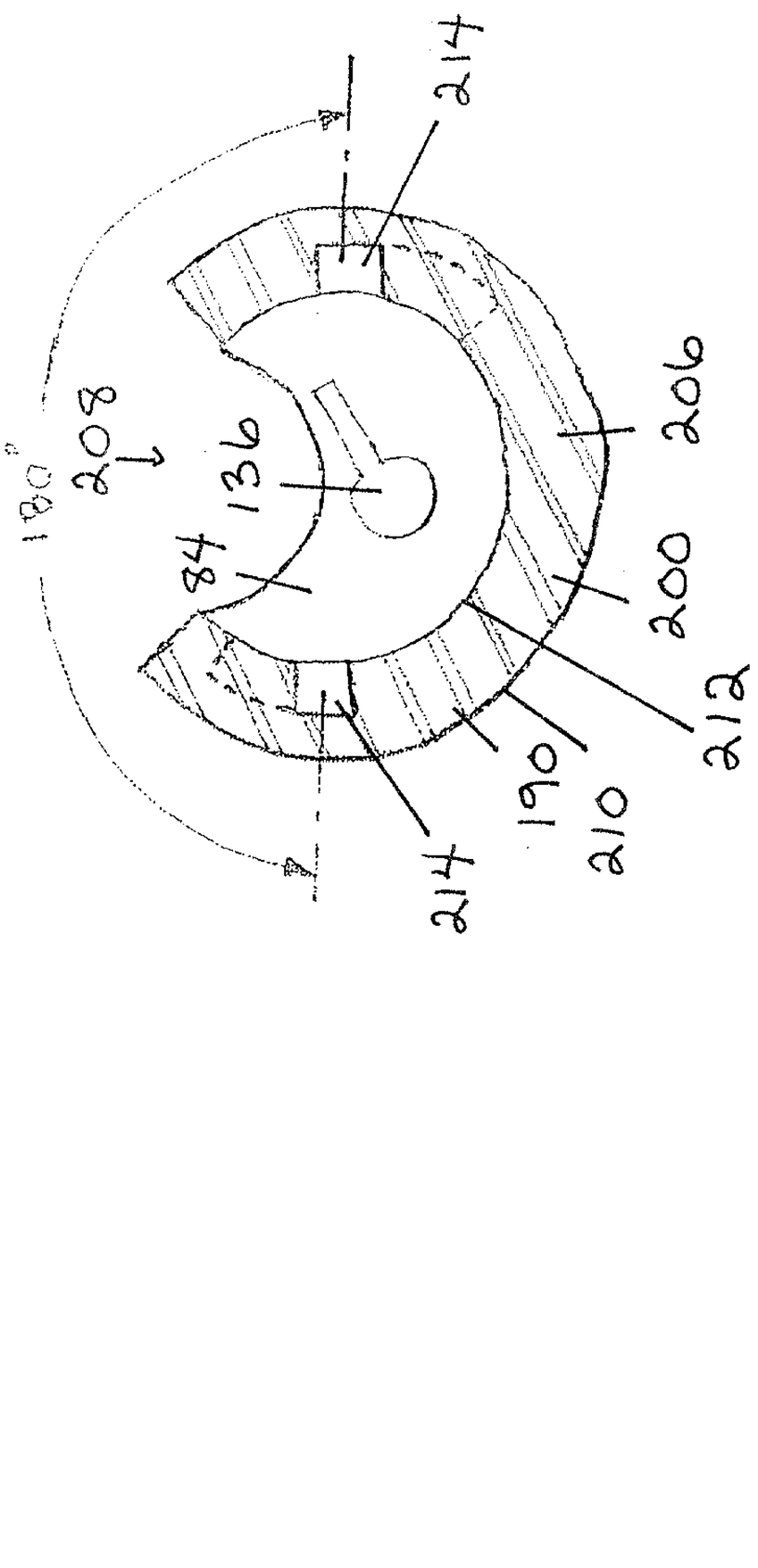


FIGURE 19



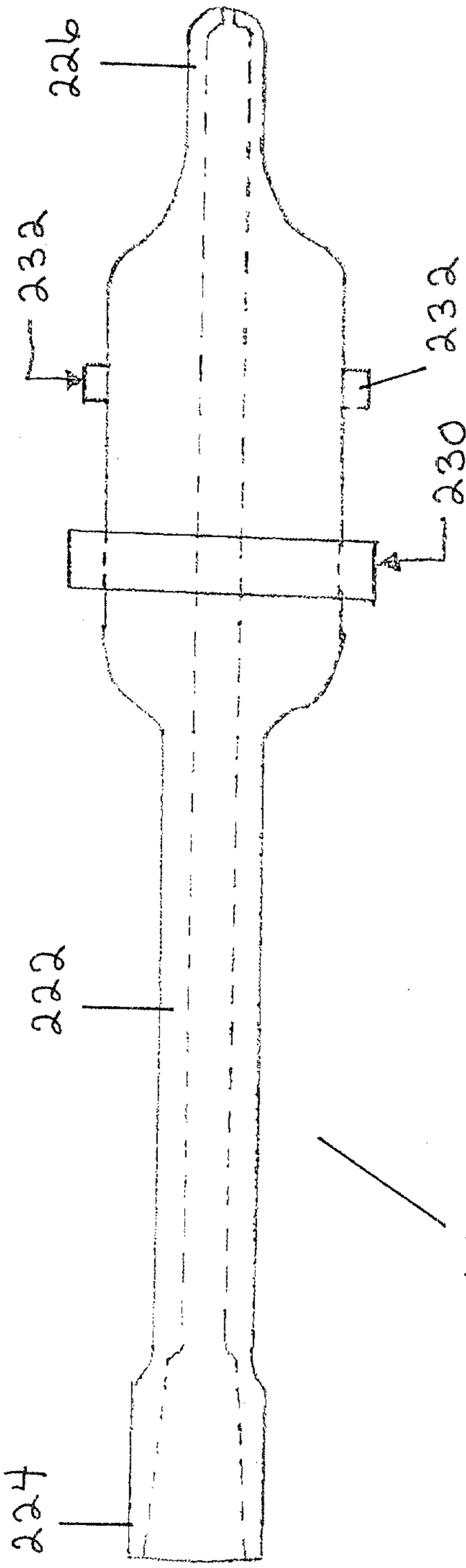
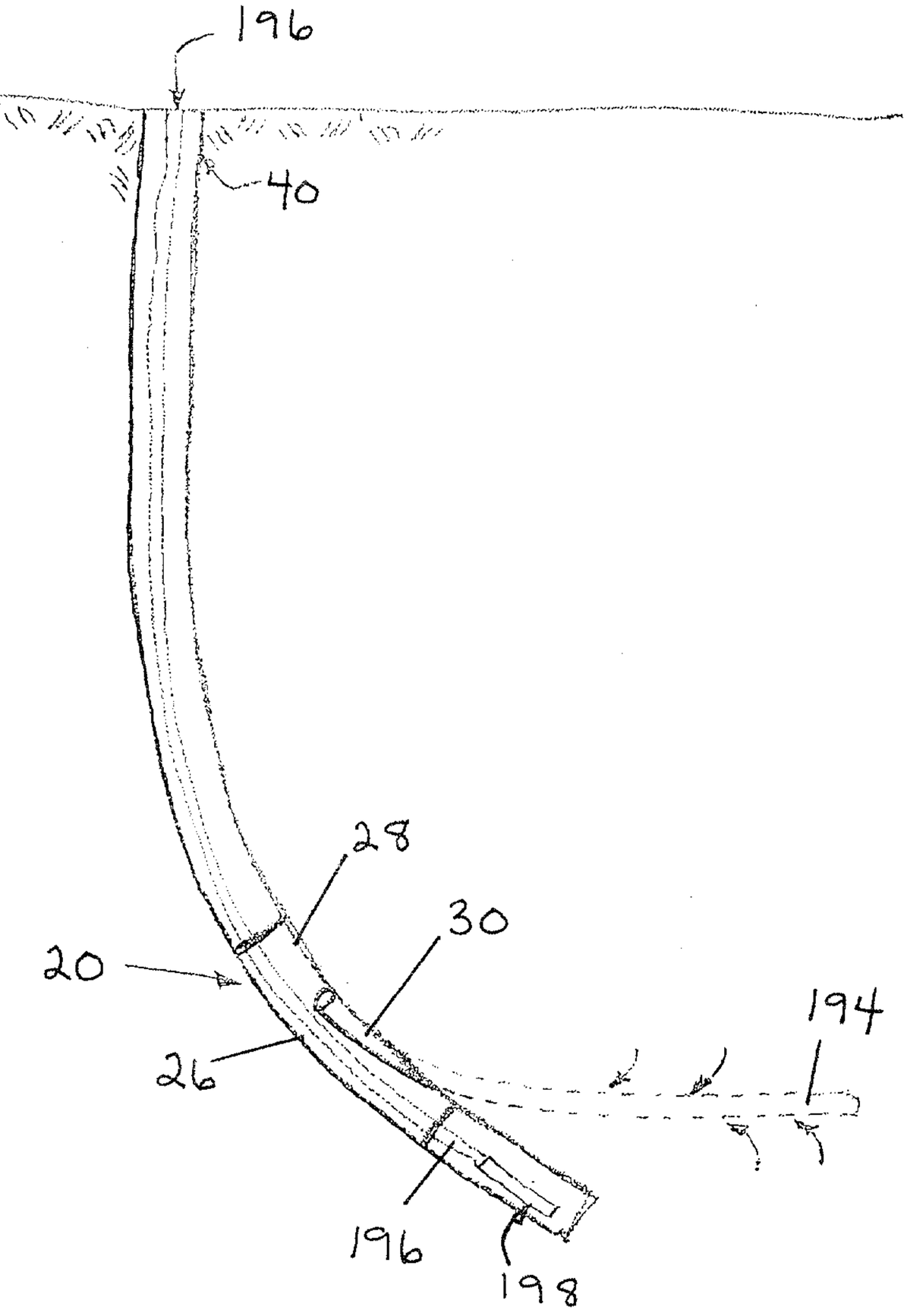


FIGURE 20



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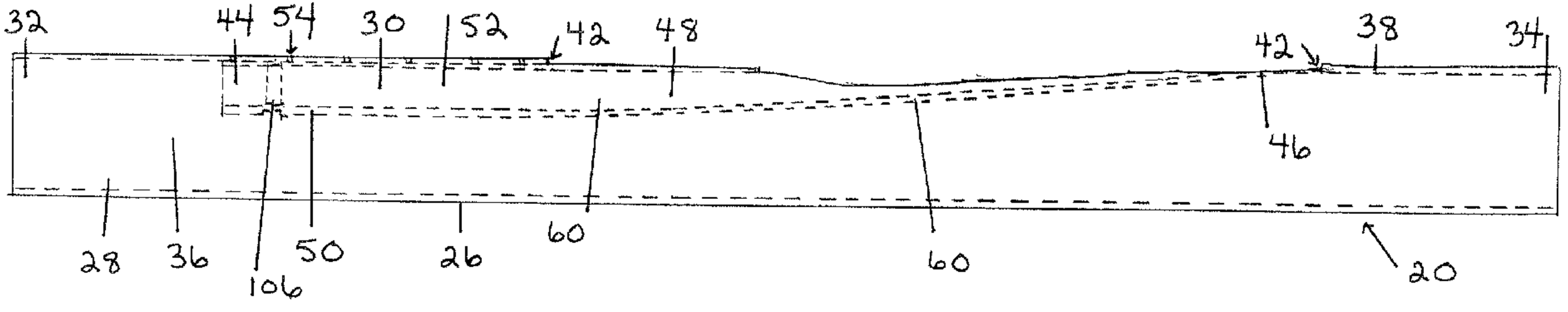
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