Title: PIPE-IN-PIPE WIRED TELEMETRY SYSTEM

Abstract: A system and method for providing a pipe-in-pipe telemetry system is described. The pipe-in-pipe wired telemetry system includes an outer pipe (210) and an inner pipe (210) disposed within the outer pipe. The outer pipe (202) may axially support the inner pipe (210). A conductive element (250) may be coupled to the inner pipe and disposed on an outer surface of the inner pipe (210). The conductive element (250) may be coupled to a first (222) and second (226) connector disposed within the inner pipe, and axially supporting the inner pipe may include providing a biasing force (264) to maintain an electrical coupling between the first and second connector.

[Continued on next page]
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PIPE-IN-PIPE WIRED TELEMETRY SYSTEM

BACKGROUND

The present disclosure relates generally to well drilling operations and, more particularly, to a Pipe-in-Pipe Wired Telemetry System.

Existing well drilling operations require information on formation characteristics to aid in drilling decisions. Numerous measurement techniques are used, including logging while drilling (LWD), measuring while drilling (MWD), and wireline tests. MWD operations, for example, utilize sensors downhole, which may measure certain formation characteristics. These measurements may be transmitted to the surface as telemetry data, which may be used to control drilling operations. Telemetry data is typically transmitted using mud pulses or custom drill pipe with an integrated wired connection. The custom drill pipe can be expensive to manufacture, however, given the pressure requirements for the drill string. Likewise, the mud pulses typically have limited data rates, capping the amount of real-time data that can be sent.

FIGURES

Some specific exemplary embodiments of the disclosure may be understood by referring, in part, to the following description and the accompanying drawings.

Figure 1 illustrates an example drilling system, according to aspects the present disclosure.

Figures 2a-c illustrate a cross-section of an example wired telemetry system, according to aspects of the present disclosure.

Figures 3a-b illustrate a cross-section of an example wired telemetry system, according to aspects of the present disclosure.

While embodiments of this disclosure have been depicted and described and are defined by reference to exemplary embodiments of the disclosure, such references do not imply a limitation on the disclosure, and no such limitation is to be inferred. The subject matter disclosed is capable of considerable modification, alteration, and equivalents in form and function, as will occur to those skilled in the pertinent art and having the benefit of this disclosure. The depicted and described embodiments of this disclosure are examples only, and not exhaustive of the scope of the disclosure.
DETAILED DESCRIPTION

The present disclosure relates generally to well drilling operations and, more particularly, to a Pipe-in-Pipe Wired Telemetry System.

Illustrative embodiments of the present disclosure are described in detail herein. In the interest of clarity, not all features of an actual implementation may be described in this specification. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the specific implementation goals, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of the present disclosure.

To facilitate a better understanding of the present disclosure, the following examples of certain embodiments are given. In no way should the following examples be read to limit, or define, the scope of the disclosure. Embodiments of the present disclosure may be applicable to horizontal, vertical, deviated, multilateral, u-tube connection, intersection, bypass (drill around a mid-depth stuck fish and back into the well below), or otherwise nonlinear wellbores in any type of subterranean formation. Embodiments may be applicable to injection wells, and production wells, including natural resource production wells such as hydrogen sulfide, hydrocarbons or geothermal wells; as well as borehole construction for river crossing tunneling and other such tunneling boreholes for near surface construction purposes or borehole u-tube pipelines used for the transportation of fluids such as hydrocarbons. Devices and methods in accordance with embodiments described herein may be used in one or more of MWD and LWD operations. Embodiments described below with respect to one implementation are not intended to be limiting.

Fig. 1 shows a drilling system 100. The drilling system 100 includes a rig 102 mounted at the surface 122, positioned above a borehole 104 within a subterranean formation 106. The rig 102 may be connected to multiple pipes 118 and 120 via a top drive 126. The drilling system 100 may include a pipe-in-pipe drilling system where an inner pipe 120 is disposed within the outer pipe 118. The outer pipe 118 may comprise a typical drill string that is used in conventional drilling operations. Fresh drilling mud may be pumped downhole toward the drill bit 110 through an annulus 114 between the inner pipe 120 and the drill string 118. The drilling mud may flow within the annulus 114 through bottom hole assembly (BHA) 108 to the drill bit 110. The BHA 108 may include a variety of measurement and logging such as various LWD/MWD elements 112, which are coupled to the outer pipe 118 and inner pipe 120. The
drilling fluid may exit through the drill bit 110, lubricating the cutting surface as the drill bit rotates, and carrying cuttings from the formation back to the surface 122. In certain embodiments, the drilling fluid may return to the surface 122 within annulus 116, or be diverted into inner pipe 120. A control unit 124 at the surface 122 may control the operation of at least some of the drilling equipment.

The drilling system 100 may be controlled, in part, using a telemetry system. A telemetry system may be used to transmit real-time drilling mechanics and formation evaluation information uphole as the well is drilled. In the embodiment shown in Fig. 1, LWD/MWD element 112 may make measurements regarding certain formation characteristics, and the measurements may be modulated or encoded and sent to the control unit 124 at the surface. The control unit 124 may receive the telemetry data or transmit commands/data via the surface flow diverter 128 over a communications cable or via a wireless network connection 130 or other mode of telemetry on surface. The control unit 124 may further demodulate the received data or modulate the transmitted commands or data, and translate the received data to some other useful form. For example, the measurements may be translated to evaluate certain formation characteristics, optimize the drilling system, or steer the drilling system to intersect a target formation. Likewise, the transmitted data or commands can be used to actuate a mechanism such as an under reamer to extend or retract its blades; to adjust the depth of cut with a bit control mechanism, such as a bit jack or other bit actuation mechanisms; to control tests; to control wellbore steering; and to adjust down hole drilling parameters, such as weight on bit and applied torque, by commanding down hole control mechanisms for these parameters. Further the system may be used to relay, exchange or receive data/commands/information to or from other subsurface modules within telemetry range of a secondary down hole transmitter or receiver. In existing systems, telemetry data is typically transmitted to the surface using mud pulses or a wired connection. Mud pulses may be sent to the surface using pressure waves in the drilling mud. Existing wired connections typically require a specially manufactured drill pipe with an integral wire. Unfortunately, the specially manufactured drill pipe is more expensive than standard drill pipe, and can significantly increase the overall costs of drilling operations. The manufacturing costs further may be exacerbated because the drill string is exposed to substantial pressures and torque during drilling, and therefore must be especially robust.

Embodiments of the present disclosure relate to a pipe-in-pipe wired telemetry system, as illustrated in Fig. 1. The pipe-in-pipe wired telemetry system may comprise an outer pipe and an inner pipe disposed within the outer pipe. As will be discussed below, embodiments of the present disclosure may utilize standard drill pipe as the outer pipe, reducing the overall
system cost. A conductive element may be coupled to an outer surface of the inner pipe, disposed within an annulus between the outer surface of the inner pipe and the inner surface of the outer pipe. As will be appreciated by one of ordinary skill in view of this disclosure, the inner pipe of a pipe-in-pipe drilling system does not carry the string weight, which is born by the drill string or outer pipe. Accordingly, the inner pipe elements may be made of cast rather than machined, or with reduced machining effort subsequent to the cast, reducing the system cost.

Figs. 2A and 2B show elements of an example pipe-in-pipe telemetry system 200, according to aspects of the present disclosure. The system 200 may include an outer pipe 202 and an inner pipe 210 disposed within the outer pipe 202. The outer pipe 202 may axially support the inner pipe 210, as will be explained below. A conductive element 250 may be coupled to and disposed proximate to an outer surface of the inner pipe 210, such that it is disposed in an annulus between the inner pipe 210 and the outer pipe 202. The conductive element 250 may comprise, for example a wire or segments of wire with an insulative layer to protect the wire from shorting against the inner pipe 210 or outer pipe 202. In certain embodiments, a conduit may be used to sheath and protect the wire from damage. Telemetry signals may be sent along the conductive element 250. In certain embodiments, telemetry signals may be sent along the conductive element 250 and also along one or both of the inner pipe 210 and outer pipe 202, thus making at least two electrical paths. Alternately a plurality of insulated conductive wires can be grouped together to form at least one conductive wire pair. Such pairs can reside in the same sheath or in separate protective sheaths (not shown). The telemetry signals may propagate in either direction along the conductor paths to and from downhole sensors and a control unit at the surface. As will be described below, locating the conductive element 250 in the annulus between the inner pipe 210 and outer pipe 202 may be advantageous by primarily exposing the conductive element 250 to clean, or mostly clean, drilling mud, instead of drilling mud which carries cuttings that may damage the conductive element 250.

In the embodiment shown, the outer pipe 202 may include a plurality of segments 202a-c mechanically and electrically connected at tool joints 216 and 218. In certain embodiments, some or all of the plurality of segments 202a-c may be standard drill pipe segments that are coupled together to form a drill string, as will be appreciated by one of ordinary skill in view of this disclosure. Segment 202b, for example, may include an upper portion with an outer shoulder 204 and a threaded portion 206 disposed on an inner surface. Segment 202b may also comprise a bottom portion comprising an outer shoulder 212 disposed on an outer surface of the segment 202b, an inner shoulder 208 disposed on an inner surface of
segment 202b, and a fastening portion 214. In certain embodiments, the fastening portion 214 may comprise a threaded portion. In certain embodiments, some or all of the segments of the outer pipe 202, including segments 202a and 202c, may comprise similarly configured upper and lower portions. The inner pipe segments need not be electrically connected to provide a mechanical seal and mechanical support and to prevent fluid exchange between the two fluid flow paths within the pipe-in-pipe drilling system.

In certain embodiments the conductive element 250, whether an insulated wire alone or an insulated wire within with a conduit, can be spiraled around the inner pipe 210 to reduce the likelihood that it will break due to pipe stretch. In other embodiments, the conductive element 250 can include axial lengthwise loops to allow sliding members to expand or contract. The conductive element 250 may further be secured firmly or loosely to the outer surface of the inner pipe 210 with various means of fasteners or laid down in a support groove on or in the inner pipe material.

In certain embodiments, segment 202b may be coupled to adjacent segments 202a and 202c at joints 216 and 218 along the outer pipe 202. Joints along the outer pipes may be characterized by two pipe segments being coupled together. In certain embodiments, segment 202b may be coupled to segments 202a and 202c at joints 216 and 218 using threaded engagements. In the embodiment shown, the fastening portion 206 at the upper portion of segment 202b may engage with a fastening portion at the lower portion of segment 202a.

Likewise fastening portion 214 at the lower portion of segment 202b may engage with a fastening portion at the upper portion of segment 202c. In certain embodiments, joints 216 and 218 may further include compression engagements between shoulders on segment 202b and shoulders on segments 202a and 202c. For example, shoulder 204 of segment 202b may be compressed against an outer shoulder of segment 202a when the segments are coupled together.

As can be seen, at some joints only one shoulder of a pipe segment may be engaged with a corresponding shoulder on an adjacent pipe segment. For example, shoulder 212 of segment 202b may engage with an outer shoulder of segment 202c at joint 216, but the inner shoulder 208 may not engage with a corresponding inner shoulder of segment 202c.

In certain embodiments, the inner pipe 210 may comprise a plurality of inner pipe segments 210a-c, with the segments being coupled at or proximate to joints 216 and 218 of the outer pipe 202. Likewise, the conductive element 250 may comprise a variety of segments 250a-c, each being coupled together at or proximate to joints 216 and 218. As depicted in Figure 2B, the inner pipe 210 may comprise a first collar 220 with a first connector 222 disposed therein. The first connector 222 may comprise, for example, one half of an electric coupling
such as an inductive coupling, a conductive coupling, a capacitive coupling, and a piezo-electromechanical coupling. In certain embodiments, the first connector 222 may comprise a coil of wire that is inserted into an inset on the bottom portion of the first collar 222, coaxial with the inner pipe 210.

The first connector 222 may be coupled to the conductive element 250, which may include being coupled to a segment 250a of the conductive element 250. The conductive element segment 250a may be coupled to the first connector 222 through element 252, which may comprise, for example, a coaxial coupling that corresponds to the geometry of the conductive element segment 250a. In certain embodiment, conductive element segment 250a may comprise a coaxial wire, with the inner wire being coupled to a first end of the coil of wire forming first connector 222, and the insulating jacket of the coaxial cable being connected to a second end of the coil of wire forming first connector 222. Other arrangements are possible, however, depending on the configuration of the connector and the conductive element. A wire 254 disposed within the first collar 220 may couple the conductive element 250b to the first connector 222, such that signals can travel bi-directionally between the conductive element segment 250a and the first connector 222.

The inner pipe 210 may further comprise a second collar 224 with a second connector 226 disposed therein. The second connector 226 may comprise, for example, one half of an electric coupling such an inductive coupling, a conductive coupling, a capacitive coupling, and a piezo-electromechanical coupling, and may correspond to the coupling type of the first connector 222. For example, the second connector 226 may be a coil or partial loop of wire similar to first connector 222, except that it is disposed on a top surface of second collar 224. Likewise, the second connector 226 may be coupled to conductive element segment 250b similar to the way first connector 222 is coupled to conductive element segment 250a. The conductive element 250b may be coupled to the second connector 226 through element 256, which may comprise, for example, a coaxial coupling that corresponds to the geometry of the conductive element segment 250b, and may be similar to element 252. A wire 258 disposed within the second collar 226 may couple the conductive element 250b to the second connector 226, such that signals can travel bi-directionally between the conductive element 250b and the second connector 226.

In certain embodiment, load balancing impedances 280 and 282 may be coupled to wires 254 and 258, respectively. The load balancing impedances 280 and 282 may help reduce signal deflection from the connectors at high data rates. In certain embodiment, the load balancing impedances 280 and 282 may comprise a network of resistors, capacitors, and
inductors that match the load on either end of an inner pipe segment to improve power transfer of the signal and reduce signal reflections.

As can be seen in Fig. 2b, the first collar 220 and the second collar 224 may align to form an electrical coupling between the first connector 222 and the second connector 226. In certain embodiments, the first collar 220 and second collar 224 may be manufactured such that the first connector 222 and second connector 226 automatically align when the inner pipe 210 is assembled. For example, in the embodiment shown, the second collar 224 may be at least partially installed within a bottom opening of the first collar 220, such that they form a substantially constant inner bore. When the second collar is at least partially installed within the first collar 220 the first connector 222 may align with the second connector 226 such that the first connector 222 and second connector 226 form an electrical coupling.

Fig. 2C shows an alternative location for first and second connectors 222 and 226, respectively. As can be seen, instead of being located on an abutting end portion of the first collar 220 and second collar 224, the first and second connectors 222 and 226 may be positioned within grooves on interior or exterior surfaces of the collars. As can be seen, first connector 222 may be located within a groove on an interior surface of the first collar 220. Likewise, second connector 226 may be located on an exterior surface of the second collar 224. When the second collar 224 is installed within the first collar 220, the first connector 222 and second connector 226 may align axially, creating an electrical coupling. Other placements for the first and second connectors 222 and 226 are possible, as would be appreciated by one of ordinary skill in the art in view of this disclosure.

Depending on the type of the first connector 222 and the second connector 226, the electrical coupling may comprise at least one of an inductive coupling, a conductive coupling, a capacitive coupling, and a piezo-electromechanical coupling. In certain embodiments, the first connector 222 and the second connector 226 may be formed within the first collar 220 and second collar 224, respectively. The positioning of the first connector 222 and second connector 226 within collars may ensure that an electrical coupling is formed between the two connections. The electrical coupling may allow bi-directional communications and/or electric power transmission from the conductive element 250a to the conductive element 250b, through the collars 220 and 224. As will be appreciated by one of ordinary skill in the art in view of this disclosure, placing similar couplings throughout the length of the drilling string may effectuate wired telemetric communications with the surface.

In certain embodiments, the outer pipe 202 may axially support the inner pipe 210. Axially supporting the inner pipe 210 may comprise limiting the axial movement of the
inner pipe 210 within the outer pipe 202. In certain embodiments, axially supporting the inner pipe 210 may also include applying a biasing force to the inner pipe 210 to maintain the electrical coupling between the first connector 222 and second connector 226. In the case of an inductive coupling, the biasing force allows the first connector 222 and second connector 226 to align and reduce the air gap between the two connectors. This may improve the magnetic or piezoelectric coupling between the first and second connectors 222 and 226, which may be otherwise difficult to maintain due to downhole pressures during installation and drilling operations.

In certain embodiments, a shoulder 260 may be disposed on an inner surface of the outer pipe 202, and may axially support at least one of the first collar 220 and the second collar 226 on the inner pipe 210. The shoulder 260 may be integral to the outer pipe 202, or may comprise a wedge ring 260a installed within the outer pipe 202 such that in contacts a pipe hanger on an inner surface of the outer pipe 202, as is shown in Figs. 2A and 2B. Axial support for the inner pipe 210 may be provided by a compression member 264 positioned between the at least one of the first collar 220 and the second collar 224 and the shoulder 260. In the embodiment shown, the second collar 224 may comprise a projection 262, which may have a diameter similar to a diameter of an inner surface of the outer pipe 202. The compression member 264 may be positioned between the projection 262 and the shoulder 260, and may comprise a spring stack. As will be appreciated by one of ordinary skill in the art in view of this disclosure, as the inner pipe 210 is installed, the projection 262 may contact the compression member 264, which may impart a first axial force in a first direction on the projection 262 and the second collar 224. The first direction of the first axial force may be opposite a second direction of a second axial force generated by the weight of the inner pipe 210 on the projection 262, thereby urging the first connection 222 toward the second connection 226. Although the projection 262 is shown extending from the second collar 224, other locations are possible, such as one the first collar 220, or on one of the pipe segments.

In certain embodiments, the pipe-in-pipe wired telemetry system 200 may further comprise a tensioning member 266 positioned between the projection 262 and an unengaged shoulder of an outer pipe segment, such as segment 202a. The tensioning member 266 may impart a static load on the compression member 264 when the telemetry system 200 is assembled. For example, before outer pipe segment 202a is coupled to segment 202b, the wedge ring 260a, compression member 264, second collar 224, and tensioning member 266 may be positioned within the outer pipe 202. As the segment 202a is threadedly engaged with segment 202b, the tensioning member 266 may contact an inner shoulder of segment 202a, causing the
tensioning member 266 to impart a static load on the compression member 264. The static load may depend, for example, on a spring force of the compression member 264 and the distance which the tensioning member 266 causes the compression member 264 to compress under static conditions. As will be appreciated by one of ordinary skill in view of this disclosure, the static force may be altered by changing the length of the tensioning member 266. Likewise, the static force may be configured such that the first connection 222 and second connection 226 are urged together with a pre-determined biasing force that corresponds to the force required to maintain the electrical coupling between the first connection 222 and the second connection 226.

Figs. 3A and 3B show elements of an example pipe-in-pipe telemetry system 300, according to aspects of the present disclosure. Like the system 200, the system 300 may include an outer pipe 302 and an inner pipe 310 disposed within the outer pipe 302. The outer pipe 302 may axially support the inner pipe 310. A conductive element 350 may be coupled to and disposed proximate to an outer surface of the inner pipe 310, such that it is disposed in an annulus between the inner pipe 310 and the outer pipe 302. The conductive element 350 may comprise, for example, a wire or segments of wire 350a and 350b with an insulative layer to protect the wire from shorting against the inner pipe 310 or outer pipe 302. Telemetry signals may be sent along the conductive element 350 from downhole sensors to a control unit at the surface. Unlike the system 200, however, the system 300 further comprises one or more signal repeaters 380 (one is shown) coupled to the conductive element 350. The inclusion of the signal repeater 380 in system 300 should not be read the limit the inclusion of the signal repeater 380 in the system 200. Rather, as will be described below, a signal repeater may be included in any pipe-in-pipe telemetry system incorporating aspects of the present disclosure.

The outer pipe 302 may include a plurality of segments 302a-c which are similar to segments 202a-c, and which may be coupled together in a similar fashion. For example, some or all of segments 302a-c may comprise standard drill pipe coupled together to form a drill string. Likewise, the inner pipe 310 may comprise a plurality of inner pipe segments 310a-c which are similar to segments 210a-c described above. Additionally, the inner pipe 310 may comprise a first collar 320 with a first connector 322 disposed therein, and a second collar 324 within a second connector 326 disposed therein, with the first and second connectors 322 and 326, respectively, being positioned and functioning similar to the first and second connectors 222 and 226. The outer pipe 302 may further axially support the inner pipe 310, including providing a biasing force via shoulder 360, projection 362, compression member 364, and tensioning member 366.

In the embodiment shown, the second collar 324 may be elongated to
accommodate the signal repeater 380. As can be seen, the signal repeater 380 may be coupled to the conductive element 350b via wire 370 and element 372. Element 372 may be a coaxial connector similar to element 256 in Fig. 2B. The signal repeater 380 may also be coupled to connector 326 via wire 374. The signal repeater 380 may receive bi-directional communications, and retransmit the signal, boosting the power of the signal and ensuring that a signal of sufficient strength is either reached at the surface or at the following signal repeater. As will be appreciated by one of ordinary skill in the art in view of this disclosure, drill strings may be thousands of feet long, and signals transmitted over a wire may lose signal strength, increasing the signal to noise ratio in the transmission. This may lead to errors in the transmission. By incorporating one or more signal repeaters, the signal strength may be maintained and the transmission errors reduced.

The signal repeater 380 may comprise a controller and a memory element such that it can temporarily buffer and re-transmit the signal. The signal repeater 380 may be coupled to a power source 382 positioned proximate the signal repeater to power the controller and memory element and provide the necessary power to re-transmit the telemetry signal. As will be appreciated by one of ordinary skill in the art in view of this disclosure, the signal repeater 380 may be programmed to accommodate a variety of signals and frequencies, depending on the application.

As can be seen, shoulder 360 of segment 302b may be positioned to accommodate the elongated second collar 324. Segments 202a-c, for example, may comprise standard drill pipe segments with a pipe hangar interface located at substantially the same axial location along the segment. Segment 302b, in contrast, includes an integral shoulder 360 that is positioned axially lower within the segment 302, to allow for the installation of the elongated second collar 324 with the signal repeater 380 while still accommodating compression member 364 and tensioning member 366. Accordingly, the outer pipe 302 may still axially support inner pipe 310, including providing a biasing force, even though custom drill pipe segments are used. As will be appreciated by one of ordinary skill in the art in view of this disclosure, custom drill pipe segments may be included at multiple locations throughout the drill string while still within the scope of this disclosure. Likewise, although the signal repeater 380 is shown positioned within second collar 324, it may be positioned elsewhere within the pipe-in-pipe telemetry system described herein. In certain embodiments, the signal repeater 380 may be installed within a custom outer pipe segment 302b.

A method for a pipe-in-pipe telemetry system is also presented herein. The method may include introducing an outer pipe into a borehole. The outer pipe may comprise
standard drill pipe and introducing the outer pipe into a borehole may comprise attaching additional drill pipe segments to a drill pipe that is at least partially disposed within the borehole. The method may also include positioning an inner pipe within the outer pipe. In certain embodiments, as the outer pipe segments are attached, the inner pipe segments may be positioned and installed within the outer pipe. As described above, positioning the inner pipe within the outer pipe may include using the outer pipe to axially support the inner pipe. As also described above, the inner pipe may include a projection which may be axially supported by at least one of a shoulder, compression member, and tensioning member.

The method may further include coupling a conductive element to the inner pipe. In certain embodiments, the inner pipe may include a first collar with a first connection and a second collar with a second connection. Coupling a conductive element to the inner pipe may comprise coupling a first segment of the conductive element to the first connector and coupling a second segment of the conductive element to the second connector. The first connector and second connector may form an electrical coupling, allowing telemetry signals to be transmitted along the conductive element. A projection of the inner pipe may be disposed on at least one of the first collar and the second collar. As described above, axially supporting the projection may comprise applying a biasing force to the projection to maintain an electrical coupling between the first connector and the second connector. The method may further include transmitting telemetry data through the conductive element.

Therefore, the present disclosure is well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present disclosure may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present disclosure. Also, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee. The indefinite articles "a" or "an," as used in the claims, are defined herein to mean one or more than one of the element that it introduces. Additionally, the terms "couple", "coupled", or "coupling" include direct or indirect coupling through intermediary structures or devices.
What is claimed is:

1. A wired telemetry system, comprising:
   
   an outer pipe;
   
   an inner pipe disposed within the outer pipe, wherein the outer pipe axially supports the inner pipe; and
   
   a conductive element coupled to the inner pipe and disposed within an annulus between the inner pipe and the outer pipe.

2. The wired telemetry of claim 1, wherein:
   
   the inner pipe comprises a first collar with a first connector disposed therein; and
   
   the first connector is coupled to the conductive element.

3. The wired telemetry system of claim 2, wherein:
   
   the inner pipe comprises a second collar with a second connector disposed therein; and
   
   the first collar and the second collar align to form an electrical coupling between the first connector and the second connector.

4. The wired telemetry system of claim 3, wherein the electrical coupling comprises at least one of an inductive coupling, a conductive coupling, a capacitive coupling, and a piezoelectromechanical coupling.

5. The wired telemetry system of claim 3, further comprising a shoulder disposed on an inner surface of the outer pipe, and wherein the shoulder axially supports at least one of the first collar and the second collar.

6. The wired telemetry system of claim 5, further comprising a compression member positioned between the at least one of the first collar and the second collar and the shoulder.

7. The wired telemetry system of claim 6, further comprising a tensioning member, wherein the tensioning member imparts a static load on the compression member.

8. The wired telemetry system of one of claims 1 to 7, further comprising a signal repeater coupled to the conductive element.
9. The wired telemetry system of claim 8, wherein the signal repeater is disposed in at least one of the first collar and the second collar.

10. A method for pipe-in-pipe wired telemetry, comprising:
    introducing an outer pipe into a borehole;
    positioning an inner pipe within the outer pipe, wherein the outer pipe axially supports the inner pipe;
    coupling a conductive element to the inner pipe, wherein the conductive element is disposed within an annulus between the inner pipe and the outer pipe; and
    transmitting telemetry data through the conductive element.

11. The method of claim 10, wherein:
    the inner pipe comprises a first collar with a first connector disposed therein; and
    the first connector is coupled to the conductive element.

12. The method of claim 11, wherein:
    the inner pipe comprises a second collar with a second connector disposed therein; and
    the first collar and the second collar align to form an electrical coupling between the first connector and the second connector.

13. The method of claim 12, wherein the electrical coupling comprises at least one of an inductive coupling, a conductive coupling, a capacitive coupling, and a piezo-electromechanical coupling.

14. The method of claim 12, wherein the outer pipe comprises a shoulder disposed on an inner surface of the outer pipe that axially supports at least one of the first collar and the second collar.

15. The method of claim 14, further comprising positioning a compression member between the shoulder and at least one of the first collar and the second collar.
16. The method of claim 15, further comprising positioning a tensioning member within an annulus between the outer pipe and the inner pipe, wherein the tensioning member imparts a static load on the compression member.

17. The method of claim 12, further comprising coupling a signal repeater to the conductive element.

18. The method of claim 17, wherein the signal repeater is disposed in at least one of the first collar or the second collar.

19. A wired telemetry system, comprising:
an outer pipe, wherein the outer pipe comprises a shoulder disposed on an inner surface;
an inner pipe disposed within the outer pipe, wherein the inner pipe comprises a projection that is axially supported by the shoulder; and
a conductive element coupled to the inner pipe and disposed within an annulus between the inner pipe and the outer pipe.

20. The wired telemetry of claim 19, wherein:
the inner pipe comprises a first collar with a first connector and a second collar with a second connector;
the projection is disposed on at least one of the first collar and the second collar;
and
axially supporting the shoulder comprises applying a biasing force to the projection to maintain an electrical coupling between the first connector and the second connector.
A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B17/02 E21B17/18

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

According to IPC:
E21B17/02
E21B17/18

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>DE 40 02 795 CI (EASTMAN CHRISTENSEN CO.) 23 May 1991 (1991-05-23)</td>
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents:

A: Document defining the general state of the art which is not considered to be of particular relevance

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Authorized officer
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## DOCUMENTS CONSIDERED TO BE RELEVANT

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