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(54) **BESPOKE DEPLOYMENT LINE EXTENSION**

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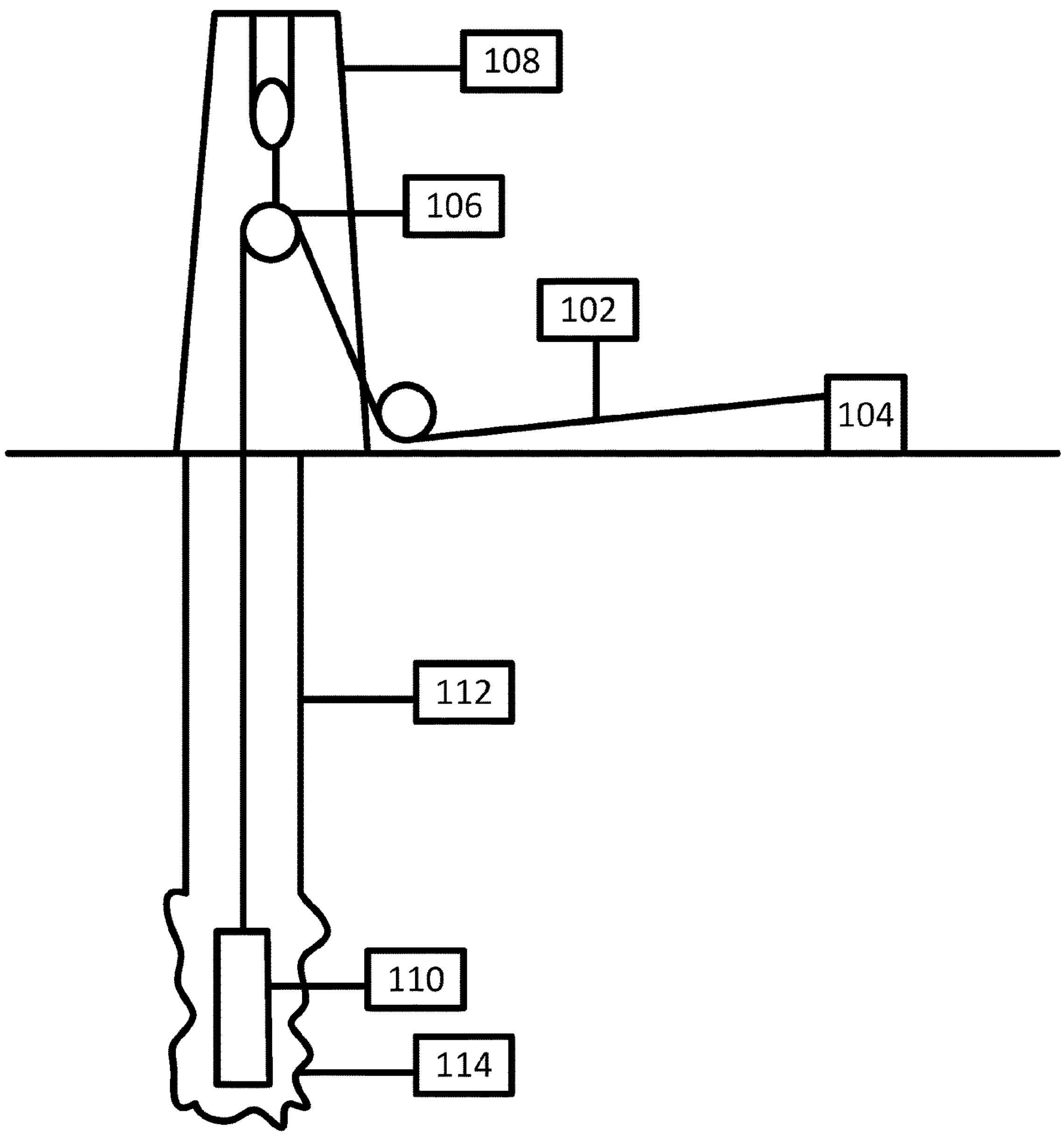
(57) **ABSTRACT**

A downhole tool deployment system including a tool string for insertion into a well, a deployment line configured for attachment to the tool string to lower the tools string into the well, and a line extension configured for attachment to the deployment line and the tool string for insertion between the deployment line and the tool string, the line extension having properties different from or similar to the deployment line.



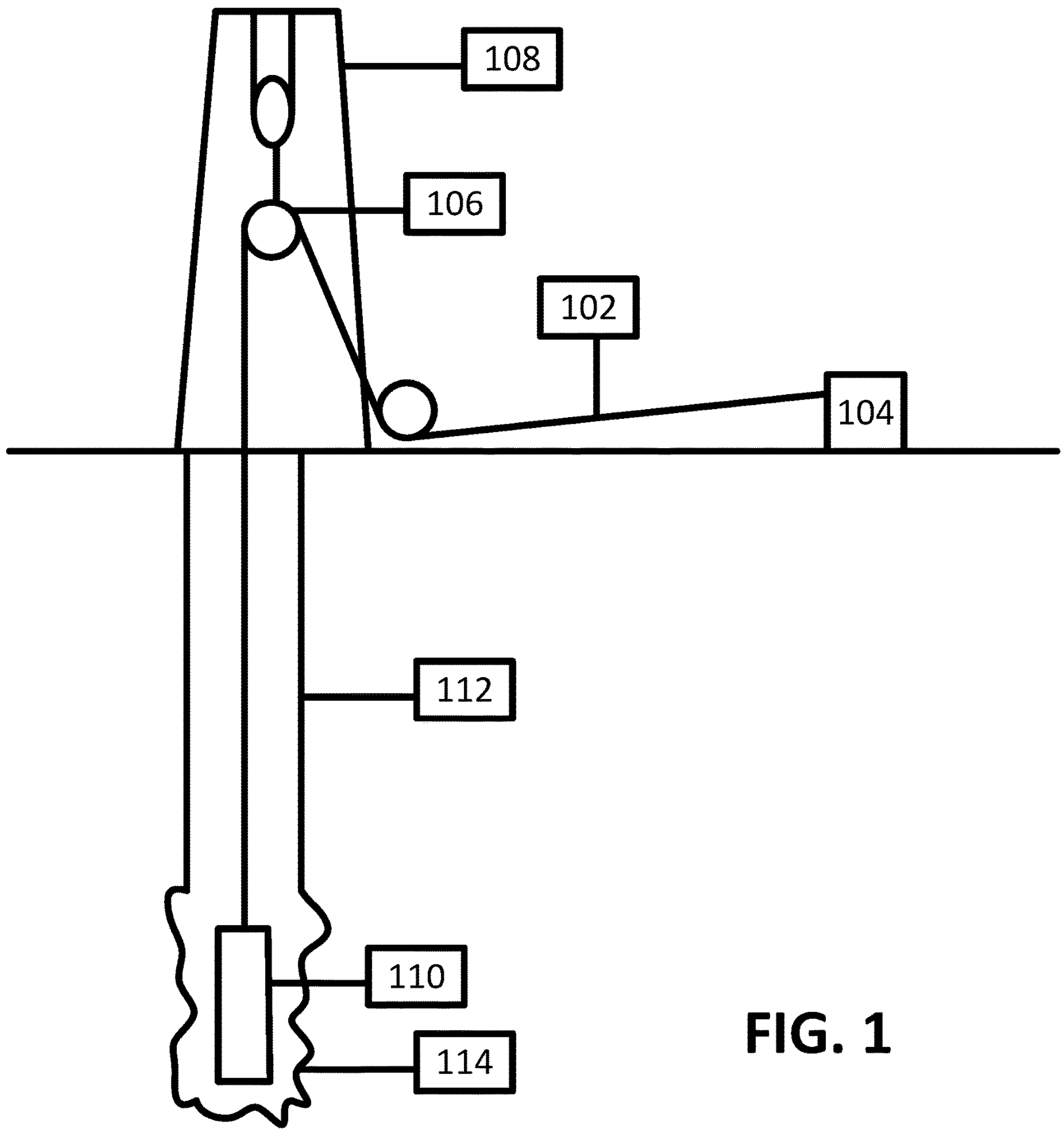



FIG. 1

FIG. 2A

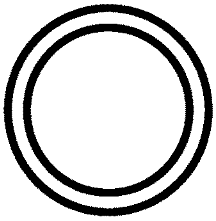


FIG. 2B

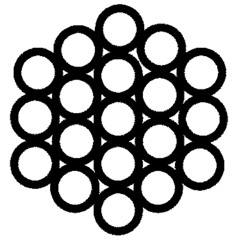


FIG. 2C

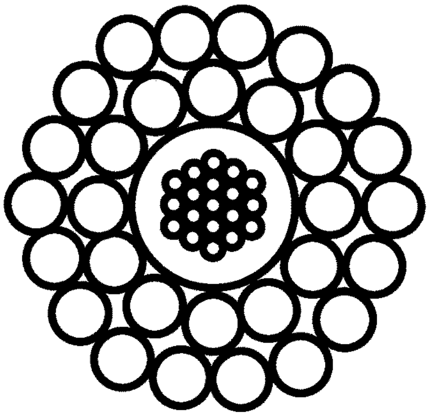


FIG. 2D

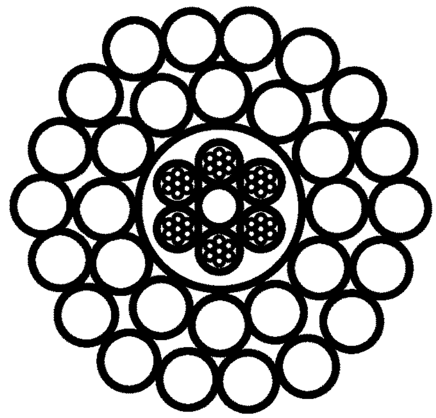


FIG. 2E

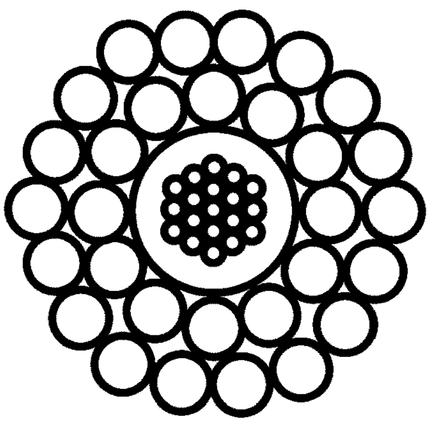


FIG. 2F

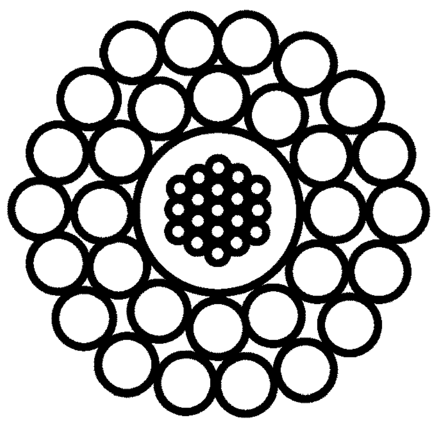


FIG. 2G

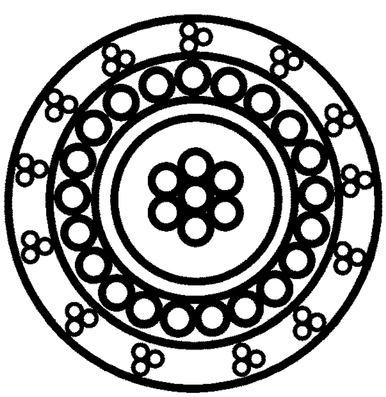


FIG. 2H

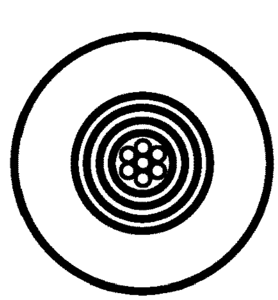


Fig. 3A

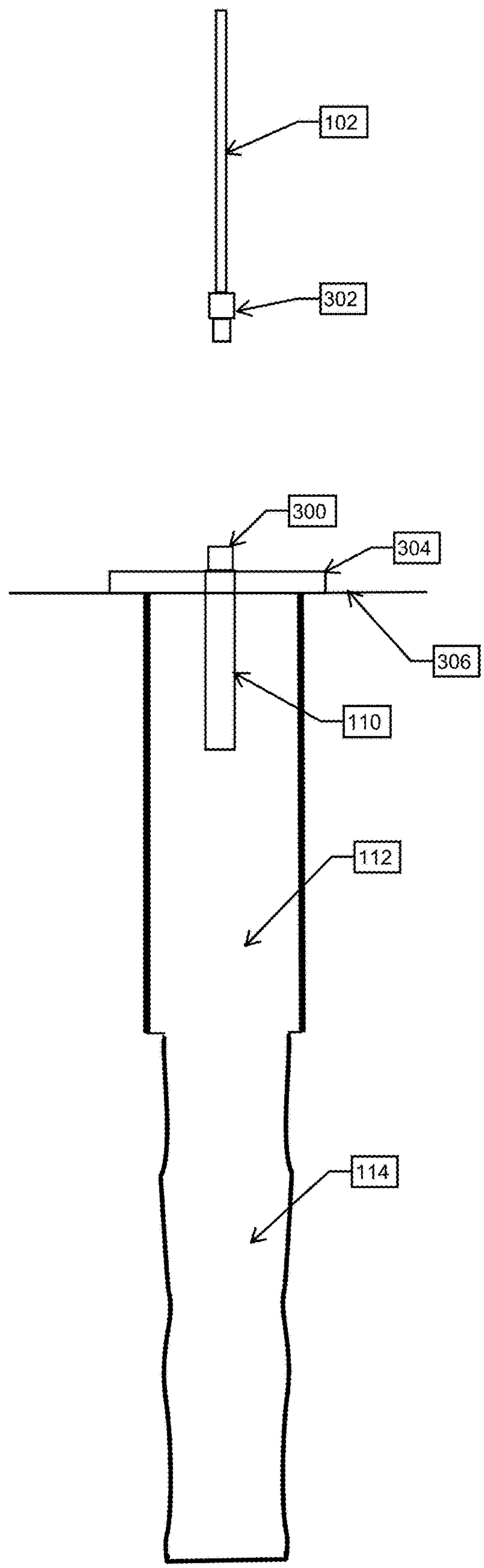



Fig. 3B

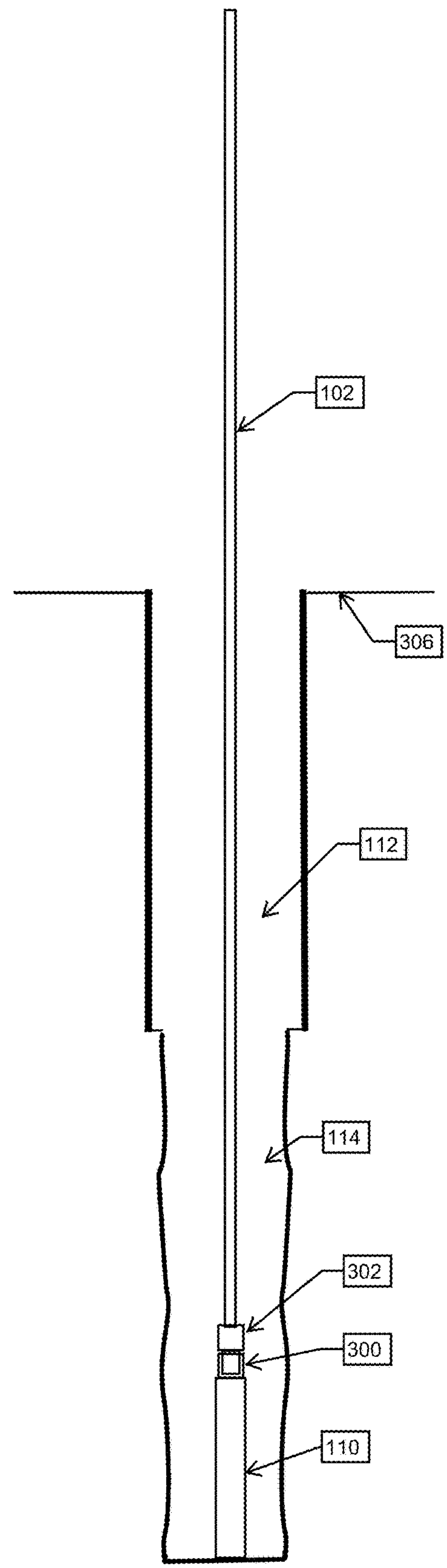


Fig. 4A

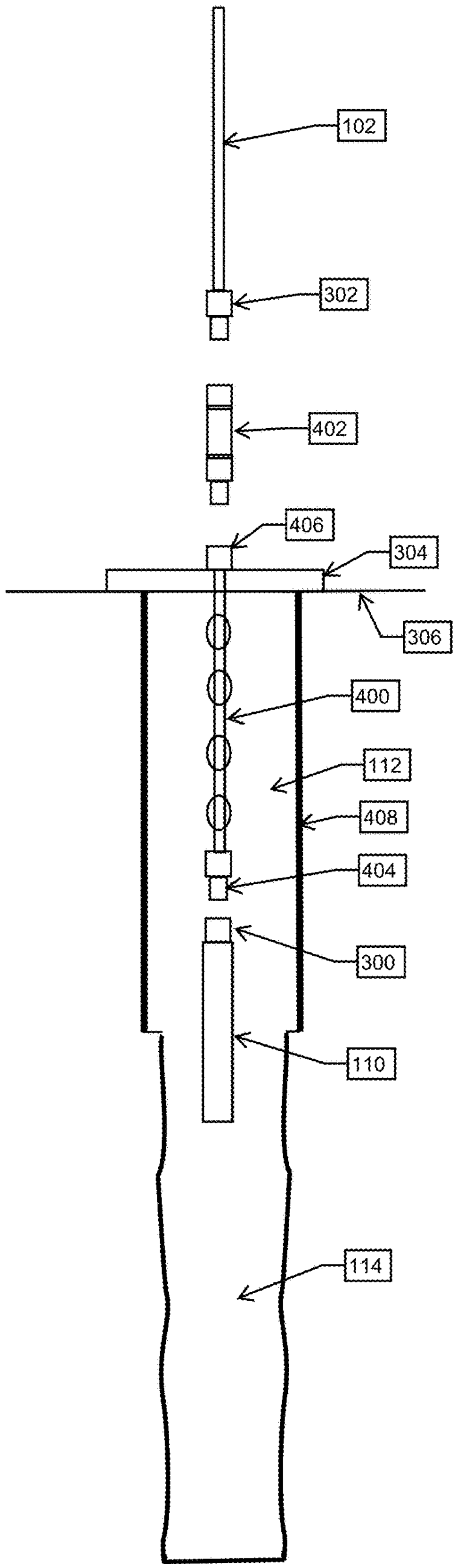

102
302
402
406
304
306
400
112
408
404
300
110
114

Fig. 4B

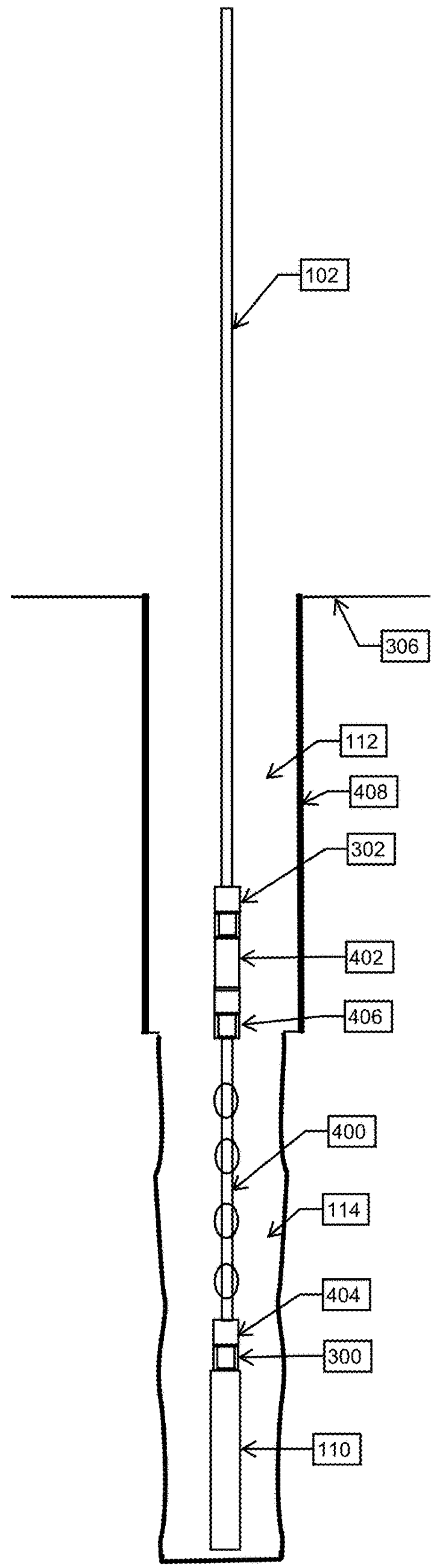

102
306
112
408
302
402
406
400
114
404
300
110

Fig. 5A Fig. 5B Fig. 5C Fig. 5D Fig. 5E

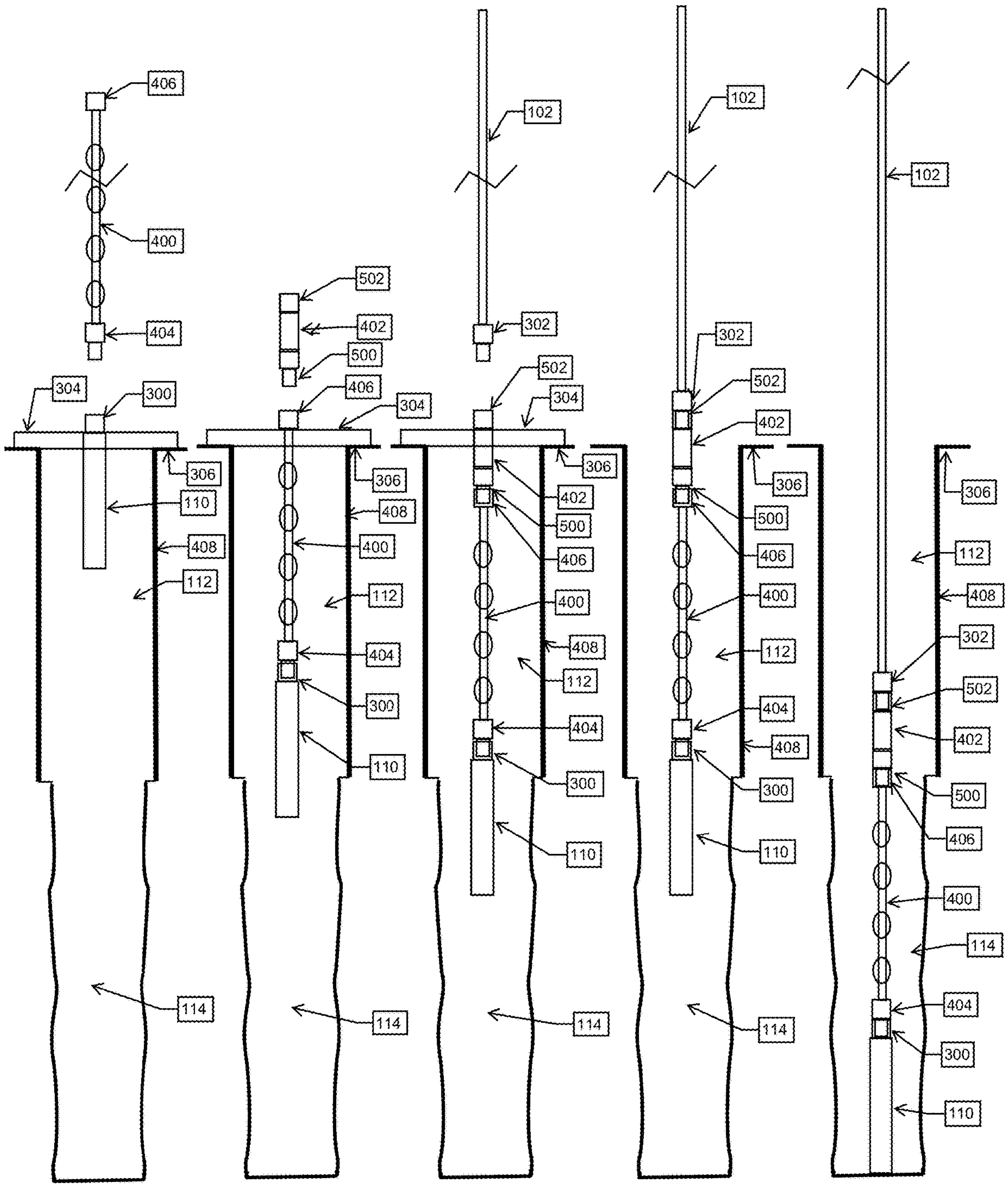


Fig. 6A

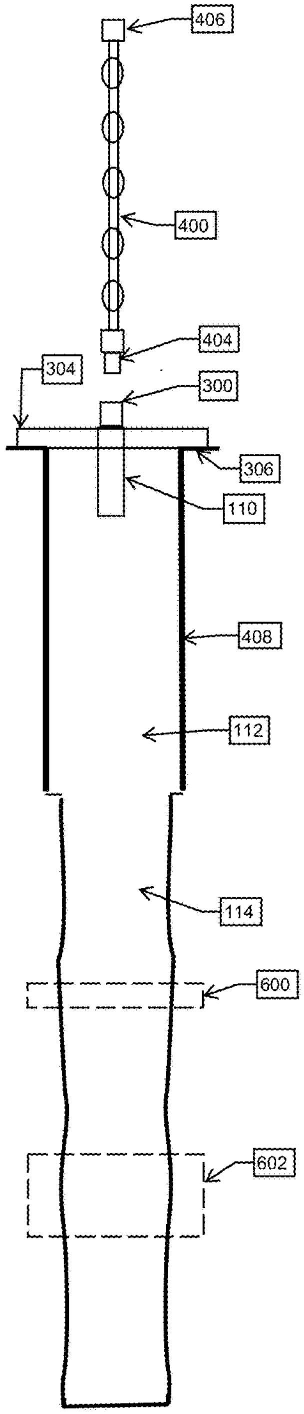



Fig. 6B

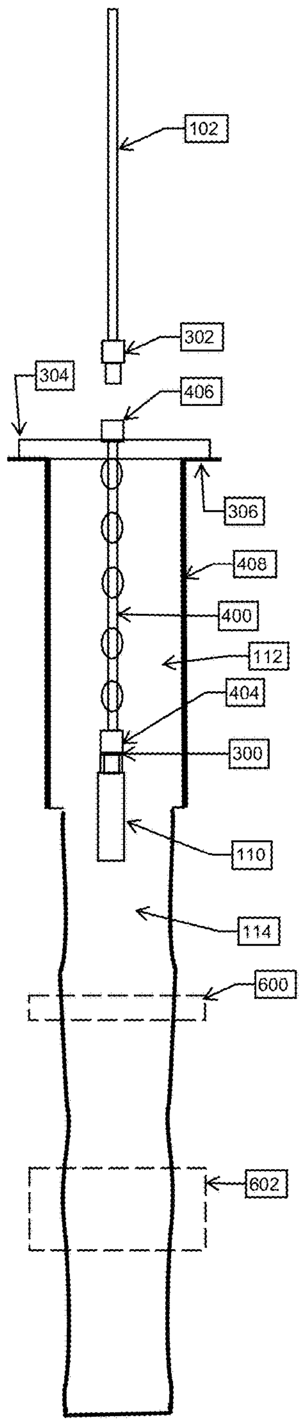



Fig. 6C

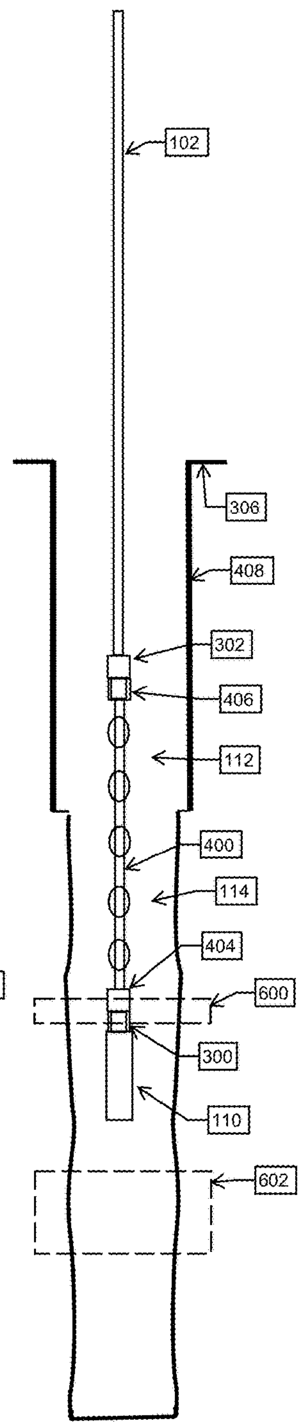
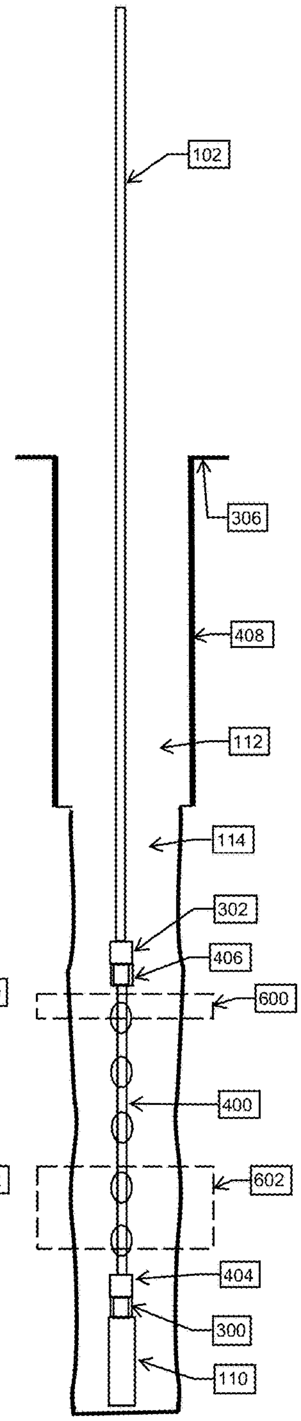



Fig. 6D



# BESPOKE DEPLOYMENT LINE EXTENSION

## FIELD OF THE INVENTION

**[0001]** This invention relates generally to mechanical devices used in wells such as oil and gas wells. More particularly, apparatuses and methods are provided for enabling the deployment of downhole tools in wells with intervals presenting special or hazardous conditions outside the operation envelop of existing deployment lines. A deployment line may be a slickline, braided line, electromechanical line, or a flexible rod.

## DESCRIPTION OF THE RELATED ART

**[0002]** A variety of downhole mechanical devices or tools are used in wells, for such purposes as logging the properties of the fluids in the well or formations surrounding the well, taking samples of the formation rocks or fluids, perforating the formations and/or wellbore casing, performing well interventions, and other purposes.

**[0003]** The deployment line types typically used are referred to as slicklines, braided lines, electromechanical lines, or flexible rods. The most popular deployment lines are electromechanical lines made up of a center package with one or more electrical conductors encapsulated by two layers of armoring steel wires. These lines are commonly referred as "wireline cables."

**[0004]** Slicklines were originally introduced as a metal solid wire used to deploy and retrieve mechanical downhole tools designed to perform mechanical services such as installing or removing downhole equipment. In recent years, variations of slickline with electrical and data transmission capabilities have been introduced. The first variation has an electrical insulation material laid over the wire to allow data transmission to the surface acquisition system from downhole tools operated from batteries. A second variation is a small diameter hollow tube housing one or more electrical conductors that are used to provide the electrical power and data transmission capabilities required by downhole tools.

**[0005]** Braided lines are cables typically made up of two layers of solid wires surrounding a center solid wire. These lines are thicker and stronger than slicklines and are designed for heavy duty operations not possible with slicklines.

**[0006]** Electromechanical lines typically come in two distinctive variations, including those with their external load bearing armor made up with metal armor wires and referred to as "wireline cable" or "e-line," and those made of composite non-metallic materials and referred to as "composite wireline cable" or "composite e-line." Both variations can house a center conductor package containing one or more electrical conductors.

**[0007]** Most wireline cables used in oil and gas wells are made with steel armor wires or special corrosion resistant alloy wires and are used in wells where the presence of corrosive mixes such as those containing $H_2S$ and/or $CO_2$ are expected.

**[0008]** Most wireline cables are designed to operate in wells with downhole temperatures less than about 400 F degrees. For wells with higher downhole temperatures, such as geothermal wells, a variety of "geothermal wireline cables" that include electrical conductors made with high-temperature insulation materials are required.

**[0009]** Composite wireline cables have higher breaking strength tensions, are lighter, and are more buoyant that their steel wireline cable equivalents, and they can operate in corrosive mix environments.

**[0010]** Flexible rods are made with composite materials. They can house a conductor package with one or more conductors, and they can be used to push tools in highly inclined or horizontal wells.

**[0011]** During the planning stage of well logging or intervention operations, the selection of the deployment line type and length is done considering a variety of factors, including but not limited to the well borehole geometry profile, length, and trajectory, the borehole temperature and pressure profiles, the well and formation pressures and fluid properties, the tensions expected along the length of the wireline throughout the job, the speed at which the tool string will need to move through the different well intervals, the expected time the wireline cable will be exposed to hazardous conditions, the type of operations planned, and the electrical requirements of the tools to be deployed. Analysis of these factors might reveal the presence of well intervals with conditions that are unfavorable to the line types commonly available, and the specialty lines and their auxiliary rig up equipment required might not be available in the geographical area of operations. Alternatively, even if the lines are available, they might not be long enough for the target job, or they might be too expensive to buy or rent. Under these circumstances well operators end up using alternative deployment methods that take more time, are more expensive, and/or render outcomes of less quality and completion than those achievable with deployment lines. Examples of alternative deployment methods to operations planned with wireline cables include using Logging-While-Drilling tools deployed with drill pipe during the well drilling stage and using battery-powered logging and intervention tools deployed with tubing.

**[0012]** Examples of hazardous conditions present in cased and open hole intervals of oil and gas wells include borehole temperatures higher than 400 degrees F. that can tend to soften the electrical conductor insulating jackets and result in catastrophic short circuits, and corrosive fluid mixes with high enough concentrations of $H_2S$ and/or $CO_2$ at high-enough hydrostatic pressure to compromise the integrity of the wireline cable's steel armor wires to the point that the cable can break apart. Geothermal wireline cables are effective means of deploying tool strings in hot wells. They are, however, hard to find, expensive, and not available in most oil and gas markets. Wireline cables made with wires of corrosion resistance alloys are popular in markets with known fields producing $H_2S$ and/or $CO_2$ in high concentrations. They are, however, several times more expensive and have lower working tension limits than their steel wire equivalents.

**[0013]** Some well operations in cased well intervals, such as those using ballistic perforating guns, are expected to result in large dynamic loads applied to the wireline cable-tool string anchoring systems. In such operations, using a deployment line of insufficient strength can result in breaking the anchoring point and dropping the tool string into the well. Changing a wireline cable for a thicker stronger one might not be possible if not readily available with the required length because it may require different cable anchoring, rig-up, and pressure control equipment parts, and it may still not survive the job dynamic loads.

**[0014]** Logging or fluid/formation sampling operations performed in open hole intervals that include formations with fluid pressures significantly lower than the hydrostatic pressure in the borehole are effective differential pressure traps where the tool string and the deployment line can become hydraulically attached to the borehole wall. These unwanted conditions are referred to as differentially sticking. Failure to free the stuck deployment line and/or the stuck tool string typically requires the execution of a long and expensive fishing operation using drill pipe. Tool strings can include anti-sticking devices such as roller stand-off subs and jar tools to allow using hard pulls on the deployment line to free the stuck tool string. To prevent wireline cables becoming differentially stuck over a selection of open hole intervals, wireline stand-off subs may be mounted over selected sections of the wireline cable. These wireline stand-off subs also prevent the wireline cable from cutting a groove in soft rocks—a condition referred to as cable key-sitting. If this happens over a permeable formation, the wireline cable will eventually become differentially stuck.

**[0015]** The accessibility to wireline cable stand-off subs is extremely limited. A detailed pre-job analysis is required to determine the open hole intervals where the wireline cable is likely to get key-seated or differentially stuck while performing stationary formation or fluid sampling operations that often take several hours to complete, a condition that makes differentially sticking significantly more likely. Since not all the key information required by the pre-job analysis is known in exploration wells, it may not be possible to know over which sections of the wireline cable the wireline stand-offs should be mounted. The stand-offs are mounted on the wireline cable over the selected intervals while running the tool string in the hole. Stopping the downhole tool string and wireline cable descent to mount one stand-off at a time adds several hours of rig time that drives additional cost and increases the hole degradation since no mud circulation is possible while performing the job. The stand-offs are mounted only over selected sections of the wireline and not over the entire length of the cable deployed within the open hole section of the well. The length of the wireline expected to travel below the selected sticky intervals can become key-seated or differentially stuck since it does not have stand-offs mounted. This makes the use of wireline stand-offs for non-stationary "moving" wireline operations ineffective, which results on these operations being done using alternative expensive and time-consuming drill pipe deployment methods, such as Logging-While-Drilling or Pipe-Conveyed Logging.

## BRIEF SUMMARY OF THE INVENTION

**[0016]** The inventions subject of this document address the shortcomings of the current art listed in the previous section and enable new applications and services by introducing methods and apparatuses to interconnect two or more lengths of the same or different deployment line types, add line extension(s) designed to operate under the anticipated special or hazardous conditions, and insert downhole tools between line lengths using field line and tool connections.

**[0017]** While the embodiments and methods that follow are directed to applications comprising a "wireline cable" having one or more conductors, it should be understood that each embodiment may alternatively comprise other forms of lines allowing the deployment of tool strings, including, but not limited to, slicklines, braided lines, electromechanical lines, flexible rods, or similar means of conveyance.

**[0018]** One aspect of the present technology provides a downhole tool deployment system that includes a tool string for insertion into a well, a deployment line configured for attachment to the tool string to lower the tools string into the well, and a line extension configured for attachment to the deployment line and the tool string for insertion between the deployment line and the tool string, the line extension having properties similar to or different from the deployment line. Certain embodiments may also include an interconnecting tool for insertion between the line extension and the deployment line.

**[0019]** In some embodiments, the interconnecting tool can be an adapter configured to connect the line extension and the deployment line if the line extension and the deployment line are not directly connectable. Furthermore, the interconnecting tool can be at least one logging tool or at least one well intervention tool. In some embodiments, the downhole tool deployment system can further include at least one standoff mounted on the line extension. The at least one standoff can be a short prolate ellipsoid shape. In certain embodiments, the line extension can be designed to operate in high-temperature environments up to 600 F, and/or it can be made using corrosion resistant alloy steel suitable for moderate $H_2S$ and $CO_2$ environments and/or electrical conductors made of nickel-plated wires adhering to ASTMBB355 Class 10 for increase corrosion resistance.

**[0020]** Another aspect of the present technology provides a method of deploying a tool string into a well. The method includes the steps of attaching a deployment line to a line extension, the line extension having similar or different properties than the deployment line, attaching the line extension to the tool string, and inserting the tool string into a well using the deployment line and the line extension. This method can also include attaching at least one stand-off to the line extension.

**[0021]** In some embodiments, the tool string, line extension, and deployment line can be connected with tool connections. In addition, the method can further include the step of inserting an interconnecting tool between the line extension and the deployment line. The interconnecting tool can be an adapter configured to connect the line extension and the deployment line if the line extension and the deployment line are not directly connectable. The interconnecting tool can be at least one logging or at least one intervention tool.

**[0022]** Yet another aspect of the present technology provides a method of logging a well with problematic intervals. The method includes the steps of lowering a deployment line, a line extension, and a tool string into a well, the line extension having different properties than the deployment line, the properties of the line extension configured to allow the line extension to resist conditions in the problematic intervals. The method further includes the steps of passing only the tool string and the line extension into the problematic intervals of the well and performing logging operations at desired locations in the well.

**[0023]** In some embodiments, the problematic intervals can be of a high temperature and/or corrosive. Alternatively, the problematic intervals can have a high-pressure differential. In addition, the deployment line can remain above the problematic intervals in the well during logging operations.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]** The present technology will be better understood on reading the following detailed description of non-limiting embodiments thereof, and on examining the accompanying drawings, in which:

**[0025]** FIG. **1** is a representative system overview of the major components required to deploy a tool string in a well using a deployment line.

**[0026]** FIG. **2**A shows a single strand (slick line) wire that can be used to service oil and gas wells.

**[0027]** FIG. **2**B shows a braided line that can be used to service oil and gas wells.

**[0028]** FIG. **2**C shows a single-conductor wireline cable that can be used to service oil and gas wells.

**[0029]** FIG. **2**D shows a seven-conductor wireline cable that can be used to service oil and gas wells.

**[0030]** FIG. **2**E shows an alternate single-conductor wireline cable that can be used to service oil and gas wells.

**[0031]** FIG. **2**F shows another single-conductor wireline cable that can be used to service oil and gas wells.

**[0032]** FIG. **2**G shows a smooth two-conductor wireline that can be used to service oil and gas wells.

**[0033]** FIG. **2**H shows a flexible rod with a 2-conductor coaxial package that can be used to service oil and gas wells.

**[0034]** FIG. **3**A is a schematic diagram showing the rigging setup to connect a deployment line to a tool string.

**[0035]** FIG. **3**B shows a schematic diagram of the deployment line and tool deployed in a well.

**[0036]** FIG. **4**A is a schematic diagram showing the rigging setup for a deployment system according to an embodiment of the present technology.

**[0037]** FIG. **4**B is a schematic diagram of the deployment system deployed in a well according to an embodiment of the present technology.

**[0038]** FIG. **5**A is a schematic diagram of a tool and line extension connection according to an embodiment of the present technology.

**[0039]** FIG. **5**B is a schematic diagram of an interconnection tool and line extension connection according to an embodiment of the present technology.

**[0040]** FIG. **5**C is a schematic diagram of a deployment line and interconnection tool connection according to an embodiment of the present technology.

**[0041]** FIG. **5**D is a schematic diagram of deployment system that is ready to be deployed to a well according to an embodiment of the present technology.

**[0042]** FIG. **5**E is a schematic diagram of a deployment system according to an embodiment of the present technology that is deployed into a well.

**[0043]** FIG. **6**A is a schematic diagram of a tool and line extension connection according to an embodiment of the present technology.

**[0044]** FIG. **6**B is a schematic diagram of a deployment line and line extension connection according to an embodiment of the present technology.

**[0045]** FIG. **6**C is a schematic diagram of a deployment system according to an embodiment of the present technology that is deployed into a well.

**[0046]** FIG. **6**D is a schematic diagram of a deployment system deployed into problematic intervals within a well according to an embodiment of the present technology.

## DETAILED DESCRIPTION OF THE INVENTION

**[0047]** The foregoing aspects, features and advantages of the present technology will be further appreciated when considered with reference to the following description of preferred embodiments and accompanying drawings, wherein like reference numerals represent like elements. In describing the preferred embodiments of the technology illustrated in the appended drawings, specific terminology will be used for the sake of clarity. The invention, however, is not intended to be limited to the specific terms used, and it is to be understood that each specific term includes equivalents that operate in a similar manner to accomplish a similar purpose.

**[0048]** When introducing elements of various embodiments of the present invention, the articles "a," "an," "the," and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to "one embodiment", "an embodiment", "certain embodiments," or "other embodiments" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Furthermore, reference to terms such as "above," "below," "upper", "lower", "side", "front," "back," or other terms regarding orientation are made with reference to the illustrated embodiments and are not intended to be limiting or exclude other orientations.

**[0049]** The generic deployment configuration included in FIG. **1** illustrates how a wireline cable, or deployment line **102**, originally stored in a cable drum part of a deployment unit **104**, can be rigged up using sheave wheels **106**. In the example shown, one sheave wheel **106** is attached to the drill floor and the other sheave wheel **106** is attached to the traveling blocks of the deployment rig **108**. Also shown is how a tool string **110** can already be lowered into a well **112** while attached to the deployment line **102** to a depth within the open hole section **114** of the well **112**. In this deployment configuration, the cable length adjacent the tool string **110** may be exposed to higher temperatures, higher pressures, corrosive fluids, and different types of rock surfaces than the cable length that remains within the shallow cased hole section of the well during the execution of the operation. In addition, the cable length at the surface going through the sheave wheels can support higher tensions that the cable length closer to the tool string **110** during the deployment and extraction phases of the operation.

**[0050]** The cross sections and images included in FIG. **2** depict geometries and distributions of the load bearing and electrical conductor elements of a variety of deployment lines. For example, FIG. **2***a* shows a single strand wire (slick line) covered with an electrical insulating jacket. This configuration is referred to as a slick-e-line. FIG. **2***b* depicts a braided line made of 19 solid steel strand wires of the same diameter wrapped in a 1, 6 and 12 wire layers configuration. FIG. **2***c* shows a single-conductor wireline cable made with two layers of 12 and 18 solid steel strand wires of the same diameter wrapped over a single electrical conductor made of 21 copper strands and a plastic insulation jacket. FIG. **2***d* shows a seven-conductor wireline cable made with two layers of 15 and 24 solid steel strand wires of different diameters wrapped over a hard-plastic enclosure containing seven electrical conductors, each made of 7 copper strands and a plastic insulation jacket. FIG. **2***e* shows a single-conductor wireline cable made with two layers of 12 and 18 solid strand wires of the same diameter made of a corrosion resistant alloy. These wires are wrapped over a single electrical conductor made of 21 copper strands and a plastic insulation jacket. FIG. **2***f* shows a single-conductor wireline cable made with two layers of 12 and 18 solid steel strand wires of the same diameter wrapped over a single electrical conductor made of 21 copper strands and a high-temperature plastic insulation jacket. FIG. **2***g* shows a smooth two-conductor wireline cable fully embedded within a polymer enclosure that includes an outer layer of **13** 3-strand wires, an inner layer of 21 solid strand wires, and a 2-conductor coaxial package where the center conductor is made of 7 copper strands and the outer conductor is a circular screen made of multiple copper threads. The outer conductor, inner and outer steel strand wires are kept electrically isolated by the enclosure polymer material. FIG. **2***h* shows a flexible rod including a 2-conductor coaxial package where the center conductor is made of 7 copper strands and the outer conductor is a circular screen made of multiple copper threads.

**[0051]** Referring now to FIG. **3***a*, there are shown components used to deploy tool string **110** into well **112** using a wireline cable (deployment line **102**). Tool string **110** can typically include several tools which have compatible tool connections at both ends that allow them to attach to each other. Connection **300** can be a part of the top tool in the tool string **110**. Connection **300** can be any appropriate means to connect between components such as a tool connection or a torpedo splice. The cable head **302**, attached to the deployment line **110**, can include a compatible connection **300**.

**[0052]** FIG. **3***b* shows tool string **110** deployed to the bottom of well **112** attached to the deployment line **102**. The following sequence of tasks can represent how tool strings **110** are currently rigged up and lowered into wells. The first step can be to lift and lower the tool string **110** into the well **112** using a rig hoist line (not shown). A rig up plate **304** can then be positioned below the connection **300** at the top of the tool string **110** such that the rig up plate **304** with tool string **110** can be attached over the rig floor **306**. Additional tool string sections can be vertically added using the rig hoist line to lift the next tool section over the connection **300** of the previous tool string section and connecting the tools together. After removing the rig up plate **304**, the now longer tool string **110** can be lowered to the desired depth. The rig up plate **304** can be repositioned at the connection **300** of the upper tool. This process can be repeated for each additional tool.

**[0053]** The next step is to rig up the deployment line **102** using the rig traveling blocks and sheave wheels **106** (shown in FIG. **1**). The cable head **302** can be lowered on top of the connection **300** to securely engage the connection **300**. The rig up plate **304** can be removed after lifting the tool string **110** sufficiently clear of the rig up plate **304** by pulling the deployment line **102** using the cable drum-winch system part of the deployment unit **104** (shown in FIG. **1**). The tool string **110** can then be lowered to the well interval where the planned operation is to be performed, and subsequently retrieved using the deployment unit **104**. Once the tool string **110** is at the surface, the rig up plate **304** can be used to hang the tool string **110** on the rig floor **306**. The wireline cable head **302** can then be disconnected from the connection **300** so the deployment line **102**, cable head **302**, and sheave wheels **106** can be rigged down. To rig down the tool string **110**, a rig hoist line can be used to lift the tool string sufficiently clear so the rig up plate **304** can be removed and the tool string **110** can be hoisted out of the well **112**.

**[0054]** As shown in FIG. 3B, the arrangement can result in exposure of the deployment line **102** to the environment of the open hole **114**. High temperatures and/or corrosive environments in the open hole **114** may degrade the deployment line **102** in this arrangement. Without stand-offs, the deployment line **102** may also become differentially trapped against the wall of the open hole. Using full deployment lines **102** suitable for these conditions can be expensive, difficult to procure, and may introduce other complications due to lower working tension limits in these specialized deployment lines **102**.

**[0055]** The following descriptions are based on tool string deployments planned with a wireline cable, however equivalent descriptions can be made for operations planned with other types of deployment lines such as slick lines, braided lines, electromechanical lines, and flexible rods.

**[0056]** FIG. **4***a* shows one embodiment of the deployment systems according to the present technology, including the components used to deploy tool strings into wells shown in FIGS. **3***a* and **3***b* and described above. FIG. **4***a* shows additional components including a line extension **400**, schematically depicted with spherical shapes added along its length, and an interconnecting tool **402**.

**[0057]** The line extension **400** can include a set of specific operational properties not provided by the existing deployment line **102**, a cable head **404**, and a top connection **406**. The line extension **400** can be designed with temperature and corrosion resisting properties not present in the deployment line **102**. The line extension **400** may be designed to resist temperatures up to 600 F. For corrosion resistance, the line extension **400** may be made using corrosion resistant alloy steel suitable for moderate $H_2S$ and $CO_2$ environments and/or electrical conductors made of nickel-plated wires adhering to ASTMBB355 Class 10 for increase corrosion resistance. This can provide appropriate protection of the deployment line **102** suitable for downhole environments without requiring that the entire cable is made of the same design. The extension cable head **404** can be any appropriate connection configured for attachment to the connection **300**. The top connection **406** can be any appropriate connection for attachment to the cable head **302** or interconnecting tool **402**.

**[0058]** The line extension **400** can also be a sacrificial cable. In this configuration, the line extension **400** can be designed with similar or different temperature and corrosion resisting properties present in the deployment line **102**. After deployment, the line extension **400** can be disposed of depending on the amount of wear accrued from usage. In this embodiment, only a portion of the cable, the line extension **400**, would need to be inspected and potentially disposed of instead of the entire deployment line **102**.

**[0059]** The interconnecting tool **402** is an optional component that can function as an adapter between the top connection **406** of the line extension **400** and the cable head **302** if need be. The interconnecting tool **402** can also be a separate logging or well intervention tool that operates on its own or that requires the use of one or more conductors of the deployment line **102**.

**[0060]** FIG. **4***b* shows the tool string **110** at the bottom of the well **112** after being deployed using the line extension **400**, interconnecting tool **402** and deployment line **102**. In this drawing the length of the extension line **400** can be sufficient to cover the complete open hole section **114** or the well **112** when the tool string **110** is at the deepest possible position, while the interconnecting tool **402** can be at the bottom of the cased hole section **408**. This configuration can be used when the extension line **400** offers specific operational benefits in the open hole section **114**, such as preventing the deployment line **102** from becoming differentially stuck, or when the purpose of the interconnecting tool **402** is to acquire logging data over the cased hole **408** section of the well **112**.

**[0061]** FIGS. **5***a* through **5***e* show one embodiment of how to deploy the tool string **110** to the bottom of the well **112** using an extension line **400** and interconnecting tool **402**. FIG. **5***a* shows the tool string **110** hanging from the rig up plate **304** and the extension line **400** lifted above the rig floor **304** with extension cable head **404** ready to be connected to the tool string top connection **300**. FIG. **5***b* shows the tool string **110** and extension line **400** hanging from the rig up plate **304** and the interconnecting tool **402** lifted above the rig floor **306** with its bottom connection **500** ready to be connected to the extension line top connection **406**. FIG. **5***c* shows the tool string **110**, the extension line **400**, and the interconnecting tool **402** hanging from the rig up plate **304** and the deployment line **102** lifted above the rig floor **306** with its cable head **302** ready to be connected to the interconnecting tool top connection **502**. FIG. **5***d* shows all components connected and attached to the wireline cable **102** with the well mouth cleared before the cable winch-drum system of the deployment unit **104** is used to lower the tool string **110** into the well **112**. FIG. **5***e* shows the tool string **110** at the bottom of the well **112**. After the planned operation is completed, the deployment line **102** is pulled out of the well until the interconnecting tool **402** is at the surface, as shown in FIG. **5***d*. The operational sequence depicted in FIGS. **5***a*, **5***b* and **5***c* can be executed in reverse order to remove the interconnecting tool **402**, the extension line **400** and the tool string **110** from the well **112**.

**[0062]** FIGS. **6***a* through **6***d* show another embodiment of an extension line **400** used to perform a logging operation in a long open hole section that includes two separate problematic intervals **600** and **602**. Both permeable intervals **600** and **602** can include severe pressure over balance, which can present a high risk of the cable and tool string becoming differentially stuck.

**[0063]** The extension line **400** can have an external profile that includes short prolate ellipsoid shaped stand-offs **604** at pre-defined separation intervals. The stand-offs **604** can result in a significantly smaller area of contact with the borehole wall of the well, which can reduce the pressure differential sticking forces over these intervals. The stand-off **604** can be external stand-off subs which can be mounted and mechanically locked over the extension line **402** at selected intervals. The stand-offs **604** can be built-in subs manufactured with stand-off geometries at selective intervals. The stand-offs **604** can be made of metal or hard plastic segments. The stand-offs **604** can be molded over the extension line **402** with plastic, polymers, or other non-metallic material.

**[0064]** FIGS. **6***a* and **6***b* show one embodiment of the operational sequence to rig up the tool string **110**, extension line **400** that has stand-offs **604** mounted over its entire length, and deployment line **102** in a well **112** that can include an open hole section with problematic intervals **600** and **602**, known to have high differential pressures that will likely result on the deployment line becoming differentially stuck. FIG. **6***c* depicts the depth at which the extension line **400** starts going through the problematic interval **600** while running the tool string **110** into the well **112**. FIG. **6***d* shows the tool string **110** at the bottom of the well with the extension line **400** deployed through both problematic intervals **600** and **602**. The minimum length of the extension line **400** required in this embodiment is the distance from the top of the problematic interval **600** and the bottom of the well minus the length of the tool string **110**. This ensures that no length of the deployment line **102** enters the problematic intervals **600**, **602** which can result in the deployment line **102** becoming differentially stuck.

**[0065]** It is possible to select and use an extension line of this type when no formations pressure data is available, such in new exploration wells. An extension line **400** with a length greater than the difference between the total well depth and the casing depth can ensure that the deployment line **102** cannot enter the open hole section of the well. This can prevent the deployment line **102** from becoming differentially stuck or exposed to high temperatures and/or corrosive environments when well conditions are unknown.

**[0066]** Although the technology herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present technology. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present technology as defined by the appended claims.

**1**. A downhole tool deployment system, the system comprising:
- a tool string for insertion into a well;
- a deployment line configured for attachment to the tool string to lower the tools string into the well;
- a line extension configured for attachment to the deployment line and the tool string for insertion between the deployment line and the tool string, the line extension having the same or different properties from the deployment line.

**2**. The system of claim **1**, further comprising:
- an interconnecting tool for insertion between the line extension and the deployment line.

**3**. The system of claim **2**, wherein the interconnecting tool is an adapter configured to connect the line extension and the deployment line.

**4**. The system of claim **2**, wherein the interconnecting tool comprises at least one logging tool.

**5**. The system of claim **2**, wherein the interconnecting tool comprises at least one well intervention tool.

**6**. The system of claim **1**, further comprising:
- at least one standoff built-in or mounted on the line extension.

**7**. The system of claim **1**, wherein the line extension is designed to operate in high-temperature environments up to 600 F.

**8**. The system of claim **1**, wherein the line extension is made using corrosion resistant alloy.

**9**. The system of claim **1**, wherein the line extension comprises at least one electrical conductor made of nickel-plated wires.

**10**. A method of deploying a tool string into a well, the method comprising:

attaching a deployment line to a line extension at a rig floor, the line extension having the same or different properties than the deployment line;

attaching the line extension to the tool string at the rig floor; and

inserting the tool string into a well using the deployment line and the line extension.

**11**. The method of claim **10**, wherein the tool string, line extension, and deployment line are connected with tool connections.

**12**. The method of claim **10** further comprising:

attaching at least one stand-off to the line extension.

**13**. The method of claim **10**, further comprising:

inserting an interconnecting tool between the line extension and the deployment line.

**14**. The method of claim **13**, wherein the interconnecting tool is an adapter configured to connect the line extension and the deployment line.

**15**. The method of claim **13**, wherein the interconnecting tool comprises at least one logging or intervention tool.

**16**. A method of logging a well with problematic intervals, the method comprising:

lowering a deployment line, a line extension, and a tool string into a well, the line extension having different properties than the deployment line, the properties of the line extension configured to allow the line extension to resist conditions in the problematic intervals;

passing only the tool string and the line extension into the problematic intervals of the well; and

performing logging operations at desired locations in the well.

**17**. The method of claim **16**, wherein the problematic intervals are high temperature.

**18**. The method of claim **16**, wherein the problematic intervals are corrosive.

**19**. The method of claim **16**, wherein the problematic intervals are of a high-pressure differential.

**20**. The method of claim **16**, wherein the deployment line remains above the problematic intervals in the well during logging operations.

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