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Wireline Standoff

Abstract

A wireline standoff that may ameliorate the effects of wireline cable differential sticking, wireline cable key seating, and high cable drags by reducing or eliminating contact of the wireline cable with the borehole wall during the logging operation. An embodiment includes a wireline standoff. The wireline standoff may comprise a pair of opposing assemblies. The opposing assemblies may each comprise a half shell, a cable insert configured to be disposed in the half shell, and external fins coupled to the half shell. The wireline standoff may further comprise one or more fasteners configured to couple the opposing assemblies to one another.

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Background/Summary

[0001] The present application is a continuation of U.S. patent application Ser. No. 18/239,649, filed Aug. 29, 2023, which is a continuation of U.S. patent application Ser. No. 17/576,223, filed Jan. 14, 2022, which is a continuation of U.S. patent application Ser. No. 16/357,398 filed Mar. 19, 2019, which is a continuation of U.S. patent application Ser. No. 15/704,795 filed Sep. 14, 2017, which is a continuation of U.S. application Ser. No. 14/551,928 filed on Nov. 24, 2014, which is a continuation of U.S. application Ser. No. 13/008,337 filed on Jan. 18, 2011, which claims priority to Provisional Application No. 61/296,530, filed on Jan. 20, 2010, entitled “Wireline Standoff,” all of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION
Field of the Invention
[0002] The present invention relates to wireline logging and, more particularly, in one or more embodiments, the present invention relates to a device for improving wireline cable performance during logging operations in a variety of boreholes.
Background
[0003] Wireline logging is a common operation in the oil industry whereby down-hole electrical tools may be conveyed on a wireline (also known as an “e-line”) to evaluate formation lithologies and fluid types in a variety of boreholes. In certain wells there is a risk of the wireline cable and/or logging tools becoming stuck in the open hole due to differential sticking or key-seating, for example.
[0004] Key-seating may occur when the wireline cable cuts a groove into the borehole wall. For instance, this can happen in deviated or directional wells where the wireline cable may exert considerable sideways pressure at the contact points with the borehole. Since the logging tool diameter is generally much bigger than the groove cut by the wireline cable, a keyseat can terminate normal ascent out of the borehole and potentially result in a fishing job or lost tools in hole.
[0005] Differential sticking may occur when there is an overbalance between hydrostatic and formation pressures in the borehole, the severity of which may be related to a number of issues, including: (1) the degree of overbalance and the presence of any depleted zones in the borehole; (2) the character and permeability of the formations bisected by the borehole; (3) the deviation of the borehole, since the sideways component of the tool weight adds to the sticking forces; (4) the drilling mud properties in the borehole, since the rapid formation of thick mud cakes can trap logging tools and the wireline cable against the borehole wall; and (5) the geometry of the toolstring being logged on wireline, since a long and large toolstring presents a larger cross sectional area and results in proportionally larger sticking forces. Additionally, during wireline formation sampling, the logging tools and wireline may remain stationary over permeable zones for

a long period of time which also increases the likelihood of differential sticking.

SUMMARY

[0006] An embodiment includes a wireline standoff. The wireline standoff may comprise a pair of opposing assemblies. The opposing assemblies may each comprise a half shell, a cable insert configured to be disposed in the half shell, and external fins coupled to the half shell. The wireline standoff further may comprise one or more fasteners configured to couple the opposing assemblies to one another.

[0007] Another embodiment includes a wireline assembly. The wireline assembly may comprise a wireline cable and a wireline standoff. The wireline standoff may comprise a pair of opposing assemblies, wherein each of the opposing assemblies may comprise a half shell, a cable insert disposed in the half shell, and external fins coupled to the half shell. The cable insert for each of the opposing assemblies may be coupled to the wireline cable.

[0008] Yet another embodiment may comprise a method for reducing sticking in wireline logging. The method may comprise coupling one or more wireline standoffs to a wireline cable. The one or more wireline standoffs may comprise a pair of opposing assemblies, wherein each of the opposing assemblies may comprise a half shell, a cable insert configured to be disposed in the half shell, and external fins coupled to the half shell.

[0009] The features and advantages of the present invention will be readily apparent to those skilled in the art. While numerous changes may be made by those skilled in the art, such changes are within the spirit of the invention.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These drawings illustrate certain aspects of the present invention and should not be used to limit or define the invention.

[0011] FIG. **1** is an isometric view of a wireline standoff in accordance with one embodiment of the present invention.

[0012] FIG. **2** is an isometric view of a wireline standoff coupled to a section of wireline in accordance with one embodiment of the present invention.

[0013] FIG. **3** illustrates a plurality of wireline standoffs installed on a wireline cable in accordance with one embodiment of the present invention.

[0014] FIG. **4** is a close-up view illustrating a wireline standoff in relation to the borehole wall in accordance with one embodiment of the present invention.

[0015] FIGS. **5** and **6** are isometric views of wireline standoffs with one half-shell removed in accordance with embodiments of the present invention.

[0016] FIGS. **7** and **8** are exploded views of wireline standoffs in accordance with embodiments of the present invention.

[0017] FIG. **9** illustrates cable inserts for use in a wireline standoff in accordance with one embodiment of the present invention.

[0018] FIG. **10** is a cross-sectional view of a wireline standoff in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

[0019] The present invention relates to wireline logging and, more particularly, in one or more embodiments, the present invention relates to a device for improving wireline cable performance during logging operations in a variety of boreholes.

[0020] There may be several potential advantages to the devices and methods of the present invention, only some of which may be alluded to herein. One of the many potential advantages of the present invention is that the present invention may ameliorate the effects of differential sticking and/or key-seating of the wireline cable by reducing or eliminating direct contact of the cable to the borehole wall. In accordance with present embodiments, this may be achieved by coupling a plurality of wireline standoffs onto the wireline cable, resulting, for example, in a lower contact area per unit length of open hole, lower applied sideways pressure of the wireline against the borehole wall, and/or lower cable drag when conveying the wireline in or out of the hole. Another potential advantage is the use of wireline standoffs may also enable more efficient use of wireline jars in the logging string since the standoffs should reduce the cable friction above the jars, allowing firing at lower surface tensions and easier re-rocking of the jars in boreholes where high cable drag is a problem (attenuating the applied surface tension before it can reach the wireline cable head and jars).

[0021] Referring now to FIG. **1**, a wireline standoff **2** is illustrated in accordance with one embodiment of the present invention. In accordance with present embodiments, the wireline standoff **2** may comprise two opposing assemblies **4** which mate together onto the wireline cable. A variety of different fasteners may be used to couple the two assemblies **4** to one another. By way of example, bolts, dowel pins, and combinations thereof may be used. In an embodiment, a combination of dowel pins (illustrated, e.g., by reference number **54** on FIG. **6**) and bolts **6** may be used to couple the assemblies **4** to one another. In one particular embodiment, four cap head bolts **6** and four dowel pins **54** may be used for coupling the assemblies **4**. The dowel pins **54** may be used, for example, to resist shear forces. In an embodiment, the dowel pins **54** are 4×8 mm pins.

[0022] As illustrated, each of the opposing assemblies **4** may comprise a corresponding half shell **8** which contains a cable insert **10**. In the illustrated embodiment, the wireline standoff **2** contains two cable inserts **10** with each of the opposing assemblies **4** contains a corresponding cable insert **10**. In an embodiment, the cable inserts **10** may be secured in their half shells **8** by a fastener, such as, for example, recessed cap head bolt **12**. In an embodiment, contact with the wireline cable exterior may be solely with the cable inserts **10** and not the half shells **8**. In one particular embodiment, the cable inserts **10** may be configured to clamp directly onto the wireline cable using the bolts **6**. In general, the cable inserts **10** should mate to form a central bore **11** through the wireline standoff **2** in accordance with certain embodiments. The cable inserts **10** may be configured to slightly deform around the outer wireline cable armour during installation without physically damaging the wireline cable. There are a large range of cable inserts **10** available to fit the wireline cable, taking into account any manufacturing tolerances and varying degrees of wear or distortion along the length of the wireline cable. Therefore, for a plurality of wireline standoffs **2** installed on the wireline cable, a range of different cable inserts **10** may be employed, for example, to ensure a fit which should not allow slippage along the wireline cable or damage to the wireline cable when coupled. The bolts **6** that can be used to couple the two assemblies **4** together may be torqued to a consistently safe limit with a calibrated torque wrench.

[0023] The half shells **8** may comprise a suitable material, such as stainless steel or other high performance material. In an embodiment, the half shells **8** may constructed from stainless steel. In addition, the half shells **8** may be surface hardened (e.g., vacuum hardened), in certain embodiments, for improved wear resistance during use. A wide range of shell sizes are available for installation on the wireline, from an outside diameter of about 50 mm and greater, for example. In an embodiment, the half shells **8** may have an outside diameter of about 75 mm. In an embodiment, the maximum external diameter of the wireline standoff **2** is less than the size of the internal diameters of the overshot and drill pipe that may be used in fishing operations so that the wireline standoff **2** can safely fit inside a fishing assembly enabling the wireline cable head or tool body to be successfully engaged by the fishing overshot. In this manner, the wireline cable and wireline standoff **2** may then be safely pulled through the drill pipe to the surface when the cable head is released from the logging string.

[0024] The cable inserts **10** may comprise a suitable material, such as aluminum. In an embodiment, the cable inserts **10** may be construed from aluminum. In an embodiment, the cable inserts **10** are disposable. Furthermore, in some embodiments, the cable inserts **10** may be positively secured into each of the half shells **8** by fasteners **12** (e.g., small cap head bolts) that pass through the outside of each of the half shells **8** into tapped holes in the cable inserts **10**. In general, the cable inserts **10** should have no movement inside the half shells **8**, in accordance with present embodiments. For example, a central spigot (see, e.g., anti-rotation spigot **64** on FIG. **7**) may be included to reduce or even eliminate rotation of the cable inserts **10** in the half shells **8**. By way of further example, a central flange (see, e.g., cable insert flange **60** on FIG. **7**) on the cable inserts **10** may be used to ensure little to no axial movement in the half shells **8**.

[0025] The wireline standoff **2** may further include a plurality of fins **14** coupled to the half shells **8**. Among other things, the fins **14** may allow easy movement along the borehole and through mud cake and other debris which may have accumulated in the borehole during drilling. In an embodiment, the fins **14** may be arranged along the length of the half shells **8**. In an embodiment, the wireline standoff may comprise twelve fins **14**. In an embodiment, the fins **14** may be distributed radially along the length of the half shells **8**. The empty space between the fins **14** should allow for circulation of drilling mud inside drill pipe if the wireline cable and wireline standoff **2** are fished using drill pipe. In an embodiment, the fins **14** have a low coefficient of friction. The fins **14** may have a smooth radial cross section to minimize the contact area with the borehole wall and allow for standoff rotation under the action of cable torque. It is believed that this should reduce the differential sticking force acted upon each fin at the contact points with the borehole wall and should also allow for easy rotation of the standoffs if the wireline cable rotates when it is deployed and retrieved from the borehole. It should be noted that it is the general nature of wireline cable to rotate during logging operations due to the opposing lay angles of the inner and outer armours which can induce unequal torsional forces when tensions are applied. The design of the wireline standoffs **2** should allow easy rotation of the wireline cable during the logging operation, avoiding, for example, the potential for damage if excessive torque was allowed to build up.

[0026] In addition, the wireline standoff **2** may further include a plurality of holes **16** in the half shells **8**. In an embodiment, the holes **16** may extend across the half shells for use in installation. By way of example, the holes **16** may be used to connect the wireline standoff **2** to a lanyard during installation to avoid dropped objects on the drill floor during installation on the wireline cable. In an embodiment, each of the half shells **8** may contain four holes **16**.

[0027] FIG. **2** illustrates a section of a wireline cable **18** passing through the central bore **11** (shown, e.g., on FIG. **1**) of the cable inserts **10** in the wireline standoff **2**. As illustrated, bolts **6** hold the half shells together 8 while clamping the cable inserts **10** onto the wireline cable **18**, in accordance with certain embodiments. The diameter of the wireline cable **18** may vary (e.g., about 10 to about 15 mm), for example, depending on the logging vendor. In an embodiment, the cable inserts **10** may be matched to the diameter of the wireline cable **18** regardless of any variations in size or profile that might occur along the length of the wireline cable **18**. As previously mentioned, the cable inserts **10** may comprise aluminum which is considerably softer than the armour material of the wireline cable **18**. It is desirable to reduce the risk of damage to the wireline cable **18** during installation of the wireline standoff **2**. By way of example, an accurate fit of the cable inserts **10** on the wireline cable **18** and, in certain embodiments, the controlled torque of the bolts **6** during installation should reduce the risk of damage to the wireline cable **18** from the cable inserts **10** when the bolts **6** are tightened, pulling the two half shells **8** together and the cable inserts **10** into contact with the wireline cable **18**.

[0028] One or more of the wireline standoffs **2** may be used on a wireline cable **18** in accordance with embodiments of the present invention. An embodiment of the present invention includes installation of a plurality of wireline standoffs **2** on the wireline cable **18** to minimize the wireline cable **18** contact over a selected zone(s) of an open-hole section. The wireline standoffs **2** may be installed on the wireline cable **18**, for example, to either straddle known permeable zones where differential sticking is a risk (e.g., eliminating cable contact 100%) or they can be placed at regular intervals along the wireline cable **18** to minimize key-seating, taking into account, for example, the dogleg severity of the borehole. For boreholes with higher dogleg severity, the spacing between wireline standoffs **2** on the wireline cable **18** may be reduced. In certain embodiments, the spacing of wireline standoffs **2** on the wireline cable **18** may be from about 10 feet to more than 100 feet, depending on the requirements for the particular borehole being logged.

[0029] FIG. **3** illustrates a generic logging operation that includes a plurality of wireline standoffs **2** coupled to the wireline cable **18** in accordance with one embodiment of the present invention. As illustrated, a plurality of wireline standoffs **2** may be clamped onto the wireline cable **18**. The wireline cable **18** may be, for example, stored on the wireline drum **20** and spooled into the well by a winch driver and logging engineer in the logging unit **22**. In the illustrated embodiment, the logging unit **22** is fixed to the drilling rig or platform **24**, and the wireline cable **18** is deployed through the derrick via two or three sheaves **26**, **28** to the maximum depth of the well. The borehole may have a cased-hole section **30** and an open-hole section **32**. As illustrated, the wireline standoffs **2** may be installed on the wireline **18** in the open-hole section **32**. A logging tool **34** may be connected to the lower end of the wireline cable **18** to take, for example, the petro-physical measurements or fluid or rock samples in the open-hole section of the borehole. The number of wireline standoffs **2**, and their positions on the wireline cable **18** may be determined by a number of factors, including for example, the length of the open-hole section **32**, the location of sticky, permeable, or depleted zones, and the overall trajectory of the well, which may be deviated or directional in nature. FIG. **4** is a close-up view illustrating attachment of a wireline standoff **2** to the wireline cable **18** taken along circle **36**. In the illustration of FIG. **4**, the wireline standoff **2** can be seen in relation to the wireline cable **18**, the borehole wall **38**, and the borehole **40**.

[0030] FIG. **5** illustrates one of the opposing assemblies **4** in accordance with one embodiment of the present invention. As illustrated, the assembly **4** includes a half shell **8** with a cable insert **10** disposed therein. In an embodiment, the half shell **8** includes a front portion **42**, a rear portion **44** and a middle portion **46** that interconnects the front portion **42** and the rear portion **44**. In the illustrated embodiment, the front portion **42** and the rear portion **44** are each in the shape of a conic section with the middle portion **46** being generally cylindrical in shape. In the illustrated embodiment, the half shell **8** further includes holes **48** through which fasteners (e.g. bolts **6** shown on FIG. **1**) may be inserted that secure half shells **8** to one another clamping the cable inserts **10** onto the wireline cable **8**. The opposing assembly **4** may further contain fins **14** that extend along the length thereof. As illustrated, each of the fins **14** may in the shape of an arch that spans across at least a portion of the middle portion **46**. Accordingly, there may be a gap **50** between the fins **14** and the middle portion **46** with either end of the fins **14** attached to the half shell **8**. In addition, the fins **14** may be spaced around the middle portion **46** so that there is a gap **52** between each fin **14**.

[0031] FIG. **6** illustrates an alternate embodiment of the opposing assembly **4** in accordance with one embodiment of the present invention. In the embodiment illustrated in this figure, the half shell **8** further includes dowel pins **54** sized to fit into corresponding holes in the other half shell **8** (not illustrated in FIG. **6**). In one particular embodiment, the half shell **8** includes four dowel pins **54**. In certain embodiments, the dowel pins **54**, in conjunction with the bolts **6** (shown, e.g., on FIG. **1**), may, for example, couple the half shells **8** together. As previously mentioned, the dowel pins **54** should assist the wireline standoff **2** in resisting shear stresses.

[0032] FIGS. **7** and **8** illustrate an exploded view of the wireline standoff **2** in accordance with embodiments of the present invention. As illustrated, the wireline standoff **2** includes opposing assemblies **4** that each comprises a half shell **8**, a cable insert **10**, and a plurality of fins **14**. In the embodiment illustrated in FIG. **8**, dowel pins **54** are included in one of the half shells **2** for insertion into corresponding holes (not illustrated) in the other half shell **2**. As illustrated, each of the cable inserts **10** may in the general shape of a hollow, half cylinder. Each of the cable inserts **10** may have a first flanged end **56** and a second flanged end **58**. As illustrated, the first flanged end **56** and the second flanged end **58** may be tapered. In an embodiment, when assembled, the first flanged end **56** and the second flanged end **58** each may extend beyond the half shells **8** that encase at least a portion of the cable inserts **10**. In addition, cable insert flanges **60** may be disposed over at least a portion of a middle portion **62** of each cable insert **10** in accordance with one embodiment. In an embodiment, cable insert flanges **60** are integral with the cable inserts **10**. In an embodiment, the cable insert flanges **60** are not integral with the cable inserts **10**. An anti-rotation spigot **64** may be formed in one or more of the cable insert flanges **60**. As illustrated, each of the half shells **8** includes a through passageway **66** having an inner wall **68**. In general, the through passageway **66** in each half shell **8** is sized to receive a corresponding cable insert **10**. In one embodiment, the inner wall **68** of the through passageway **66** in each of the half shells **8** may have a cut out **70** that receives the corresponding cable insert flange **60** preventing axial movement of the wireline standoff **2** when installed. In addition, a protrusion **72** may extend from the inner wall in the cut out **70** with the protrusion being sized to fit into the anti-rotation spigot **64** to prevent rotation of the wireline standoff **2**. In this manner, cable insert flanges **60** and the anti-rotation spigot **64** may lock the half shells **8** and cable inserts **10**.

[0033] FIG. **9** illustrates an exploded view of the cable inserts **10** in accordance with one embodiment of the present invention. As illustrated, each cable insert **10** includes a first flanged end **56**, a second flanged end **58**, and a middle portion **62**. As further illustrated, the cable inserts **10** each include a cable insert flange **60** disposed over the middle portion **62** of each cable insert **10**. In the illustrated embodiment, the cable insert flanges **60** each include an anti-rotation spigot **64**. In one embodiment, fasteners **74**, such as small cap head screws, may be used to retain the cable inserts **10** in the half shells **8**. As illustrated, the fasteners **74** may be received by openings **76** in the cable insert flanges **60**. For example, through holes may be formed in each half shell **8** that extend through the wall of the cutout **70** in the through passageway **66** for receiving the fasteners **74**.

[0034] FIG. **10** illustrates a cross section of the wireline standoff **2** installed on the wireline cable **18**. As illustrated, the wireline standoff **2** includes opposing assemblies **4** that each comprise a half shell **8**, a cable insert **10**, and a plurality of fins **14**. The half shells **8** each comprise holes **16** that may be used, for example, to connect the wireline standoff **2** to a lanyard during installation. In the illustrated embodiment, the cable insert **10** is in contact with the wireline cable **18**. As illustrated, each cable insert **10** includes a first flanged end **56**, a second flanged end **58**, and a middle portion **62** with cable insert flanges **60** disposed over the middle portion **62**. In the illustrated embodiment, the first flanged end **56** and the second flanged end **58** each extend beyond the half shells **8**. As illustrated, the cable insert flanges **60** may fit into corresponding cut outs **70** in the half shells **8**. In one embodiment, a protrusion **72** in the cutouts **70** fits into the anti-rotation spigot **64** of the cable insert flanges **60**. As further illustrated, fasteners **74** extend through the half shells **8** and into the cable inserts **10**.

[0035] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations may be made herein without departing from the spirit and scope of the invention as defined by the appended claims. Although individual embodiments are discussed, the invention covers all combinations of all those embodiments.

Claims

1. A wireline assembly, comprising: a wireline cable; a jar; and one or more wireline standoffs located on the wireline cable above the jar, wherein each of the one or more wireline standoffs comprises a cable insert disposed between a pair of opposing assemblies, wherein each of the opposing assemblies comprises a half shell, wherein the cable insert comprises a cable insert interior and a cable insert exterior, and wherein the cable insert interior is of a unified diameter, further wherein the cable insert exterior has a raised flange, still further wherein the raised flange is completely enclosed within the half shells, and external fins coupled to the half shell and further wherein the cable insert comprises an anti-rotation spigot.

2. The wireline assembly of claim 1, wherein the jar is configured to fire as a result of a firing tension applied to the wireline cable, and wherein a cable drag imparted to the wireline cable increases the firing tension.

3. The wireline assembly of claim 2, wherein at least one of the one or more wireline standoffs are located on the wireline cable at a distance from the jar which reduces the cable drag.

4. The wireline assembly of claim 2, wherein at least one of the one or more wireline standoffs are located on the wireline cable at a distance from the jar which prevents key-seating of the wireline assembly.

5. The wireline assembly of claim 2, wherein at least one of the one or more wireline standoffs are located on the wireline cable at a distance from the jar which prevents differential sticking of the wireline assembly.

6. A method of reducing cable friction above a jar of a wireline assembly, comprising: providing a wireline assembly comprising a wireline cable and a jar; securing one or more wireline standoffs to the wireline cable above the jar, wherein each of the one or more wireline standoffs comprises a cable insert disposed between a pair of opposing assemblies, wherein each of the opposing assemblies comprises a half shell, wherein the cable insert comprises a cable insert interior and a cable insert exterior, and wherein the cable insert interior is of a unified diameter, further wherein the cable insert exterior has a raised flange, still further wherein the raised flange is completely enclosed within the half shells, and external fins coupled to the half shell and further wherein the cable insert comprises an anti-rotation spigot; conveying the wireline assembly into a borehole; and reducing a cable friction caused by the wireline cable contacting a wall of the borehole, wherein the reducing results from the one or more wireline standoffs lowering an area of contact between the wireline cable and the wall of the borehole.

7. The method of claim 6, further comprising firing the jar by increasing a tension applied to the wireline cable.

8. The method of claim 6, further comprising re-rocking the jar by decreasing a tension applied to the wireline cable.

9. The method of claim 6, further comprising attenuating a tension applied to the wireline cable.

10. The method of claim 6, further comprising preventing key-seating of the wireline assembly.

11. The method of claim 6, further comprising preventing differential sticking of the wireline assembly.

12. A method of assembling a wireline assembly, comprising: a. disposing a wireline assembly comprising a wireline cable and a jar into a borehole; b. placing two parts of a cable insert around the wireline cable at a location above the jar, wherein the cable insert comprises an anti-rotation spigot; c. securing the two parts of the cable insert to each other; d. placing a pair of opposing assemblies around the cable insert; e. securing the pair of opposing assemblies to each other, wherein each of the opposing assemblies comprises a half shell, wherein the cable insert comprises a cable insert interior and a cable insert exterior, and wherein the cable insert interior is of a unified diameter, further wherein the cable insert exterior has a raised flange, still further wherein the raised flange is completely enclosed within the half shells, and external fins coupled to the half shell; and f. repeating steps (b) through (e) at a different location on the wireline cable above the jar.

13. The method of claim 12, herein the location is selected in order to reduce a friction caused by the wireline cable contacting a wall of the borehole.

14. The method of claim 12, wherein the location is selected in order to prevent key-seating of the wireline assembly.

15. The method of claim 12, wherein the location is selected in order to prevent differential sticking of the wireline assembly.

16. The method of claim 12, wherein the location reduces a tension applied to the wireline cable which causes the jar to fire.