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(54) Title: RIGID ATTACHMENT OF OPTICAL FIBER CABLE TO ANOTHER STRUCTURE USING LASER WELDING

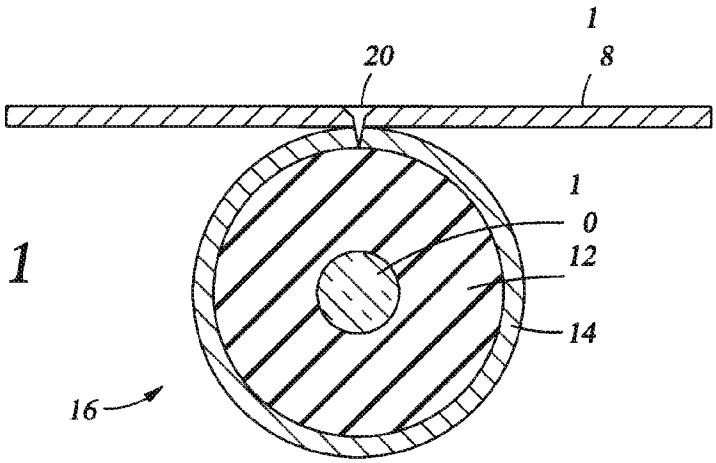

Fig. 1

(57) Abstract: A conductor mounting configuration includes a conductor having a signal carrying portion, and insulative portion radially outwardly disposed of the signal carrying portion and a jacket radially outwardly disposed of the insulative portion; an intermediary material having a thickness selected to accommodate a heat based fusion to the jacket while requiring a heat load of less than that associated with damage to the conductor; and a heat fusion affixing the conductor to the intermediate material and method.

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RIGID ATTACHMENT OF OPTICAL FIBER CABLE TO ANOTHER STRUCTURE USING LASER WELDING

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to United States Provisional Patent Application Serial No. 60/991,420, filed November 30, 2007, the entire contents of which are specifically incorporated herein by reference.

BACKGROUND

[0002] In the hydrocarbon recovery art, there has long been interest in greater monitoring and control of the downhole environment in order to enhance production of target fluids while eschewing those having little or no commercial value. Such interest has over the years led to significant movements toward instrumentation. With instrumentation, conductors are needed to transmit information to remote locations including surface locations. While hydraulic control lines have been a mainstay for connection with the downhole environment, their use requires a large amount of stored excess hydraulic fluid. Such storage increases a footprint of a rig and is thus undesirable. Electrical conductors have helped to eliminate or at least reduce the hydraulic fluid necessary on the rig. Optic fibers have more recently been found to be even of more interest due to higher data speeds and the ability to use the fiber itself as a monitoring device. In order to use optic fiber though, it must be connected in some way to the tool string being run in the hole. While there are many currently existing ways to secure fiber or electric cable to the string, not every situation is addressed. The art will thus continually appreciate new and different ways to secure conductors so that the possibilities available to address particular situations are plentiful and ubiquitous.

SUMMARY

[0003] A conductor mounting configuration includes a conductor having a signal carrying portion, and insulative portion radially outwardly disposed of the signal carrying portion and a jacket radially outwardly disposed of the insulative portion; an intermediary material having a thickness selected to accommodate a heat based fusion to the jacket

while requiring a heat load of less than that associated with damage to the conductor; and a heat fusion affixing the conductor to the intermediate material.

[0004] A method for affixing a conductor to a separate structure includes selecting an intermediary material including at least a portion thereof having a thickness ranging from about equal to a thickness of a jacket of the conductor to about double the thickness of the jacket; bringing the conductor into contact with a portion of the intermediary material having the stated thickness range; inducing a heat fusion between the portion of the intermediary material contacting the jacket and the jacket; and fusing a portion of the intermediary material not fused to the jacket to the separate structure.

[0005] A method for affixing a conductor to a separate structure includes matching an intermediary material thickness of an intermediary material depending from a conductor to a target downhole component thickness; and fusing a portion of the intermediary material not fused to the jacket to the separate structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Referring now to the drawings wherein like elements are numbered alike in the several Figures:

[0007] **Figure 1** is a schematic illustration of an encapsulated conductor fastened to an intermediary structure;

[0008] **Figure 2** is the image of **Figure 1** rotated 180 ° and fastened to an attachment structure; and

[0009] **Figure 3** is a schematic illustration of an alternate intermediate material configuration.

DETAILED DESCRITION

[0010] Referring to **Figure 1**, an optic fiber **10** (or other signal carrying portion or conductor) is illustrated embedded in an insulative material **12**. The insulative material includes a heat dissipative property and in one embodiment may be one of High-

temperature Acrylate, Polyimid, Polyethylethylketone (PEEK), etc., for example. The material may also be formed of a combination of materials as listed or otherwise. Importantly, the material selected must be capable of withstanding a temperature associated with any one of a number of heat based fusion techniques such as, for example, a welding method to be applied. In one embodiment, a laser welding method is employed since such method maintains the temperature of the material surrounding the weld at below about 230°C. Other welding methods that do not cause temperature of the surrounding material to exceed about 230°C are also contemplated. In one embodiment, a temperature range is desirably maintained between 175°C and 215°C. Welding methods that create a higher heat load can also be used but selection of insulative material will change accordingly to one capable of withstanding such higher heat load. Radially outwardly positioned of the insulative material is a tubular structure or jacket **14** comprising a weldable material such as steel, inconel, stainless steel, etc. These three components make up a tubing encapsulated conductor **16**.

[0011] The tubing encapsulated conductor **16** is illustrated in **Figure 1**, adjacent to an intermediary material **18**. The intermediary material comprises a weldable material and in one embodiment, a weldable material that is also compatible with the material of the structure **14**. The material **18** will range in thickness for different embodiments hereof from between about the same thickness as the material of the structure **14** to about double the thickness of the material of the structure **14**. Weld line **20** is visible in **Figure 1** illustrating the penetration thereof through the intermediary material **18** and into the jacket **14** to permanently attach the intermediary material **18** to the conductor **16**. The penetration of the weld is one reason that the range of thickness of the intermediary material **18** is selected as stated. Were the material **18** too thin, it would burn through too easily and have poor fusion with the jacket **14**; were the material **18** too thick, too much heat would be required to liquefy the same in the weld joint and the temperature of the insulative material **12** would exceed its capability for withstanding heat, and consequently potentially damage the optic fiber **10**. In other words, the insulative material has a thickness selected to accommodate a heat based fusion technique while requiring a heat load of less than that associated with damage to the conductor. This will as noted above be in one embodiment less than above 230°C.

[0012] Heat loading of the conductor **16** is also the reason for the existence of the intermediary material. A component of a downhole tool to which the conductor is to be affixed will invariably be of a substantially greater thickness than the material thickness of jacket **14**. This presented a problem that the present inventors solved through the particular construction and method disclosed herein. A conductor undergoing a welding process to a downhole component would experience a heat load well in excess of the capacity of the insulative material simply because in order to melt the downhole component, a lot more heat is necessary. This can potentially result in at least some damage to the fiber **10** and possibly in rupture of the jacket **14**. In the event jacket **14** is ruptured, the resulting shock wave generally breaks the fiber **10** and the conductor **16** is useless, at least beyond the breakage area.

[0013] Due to the controlled thickness of the intermediary material **18**, the heat load is as noted above, controlled. The intermediary material itself provides additional weld area where an effective weld can be used to affix the conductor to the component. In one embodiment, illustrated in **Figure 2**, the intermediary material **18** is welded to a downhole component **24**. Evident is the location of the weld lines **26** and **28**, spaced from the conductor **16**. The spacing allows for the dissipation of the heat necessary to create a melt in the component **24**, thereby joining the intermediary material **18** and conductor **16** therethrough to the component **24**. It is to be appreciated that the thicker the material of component **24**, the thicker the material of intermediate material is desirable within the range as noted above.

[0014] In an alternate embodiment, referring to **Figure 3**, intermediary material **118** does not have a consistent thickness over its surface area but rather is thicker at one or more portions thereof generally not in contact with conductor **16**. In keeping with the foregoing disclosure, that portion of intermediate material **118** that is in contact with and in fact is welded to or will be welded to conductor **16**, will have a material thickness in a range of about equal to the thickness of jacket **14** to about double the thickness of jacket **14** for the same reasons indicated above. Other portions of intermediate material **118**, however, are made thicker in order to appropriately endure the greater heat load required for a weld to penetrate a larger component **24**. It will be appreciated that one or more

sections of intermediary material **18** may have the thicker profile, and that the illustration of **Figure 3** is exemplary rather than restrictive.

[0015] The above combination of conductor **16** and intermediary material **18**, after being welded together, may be installed on one surface of a shroud material that is then helically coiled to produce a tubular structure to be used as a shroud at a downhole tool. One of ordinary skill in the art will be familiar with the helical coiling of a sheet of shroud material to produce a tubular structure. This method for creation of a tubular shroud is well known in the art and does not require any further teaching. The combination disclosed herein is welded linearly onto the strip of shroud material and thus, when the shroud material is coiled into a tubular structure, the combination assumes a helix itself at an inside dimension of the resulting tubular shroud. It is to be appreciated that a shroud is used only as an example, and other downhole components can be substituted therefore.

[0016] While preferred embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

CLAIMS

1. A conductor mounting configuration comprising:

a conductor having a signal carrying portion, and insulative portion radially outwardly disposed of the signal carrying portion and a jacket radially outwardly disposed of the insulative portion;

an intermediary material having a thickness selected to accommodate a heat based fusion to the jacket while requiring a heat load of less than that associated with damage to the conductor; and

a heat fusion affixing the conductor to the intermediate material.

2. The conductor mounting configuration as claimed in claim 1 wherein the signal carrying portion is one or more optic fibers.

3. The conductor mounting configuration as claimed in claim 1 wherein the jacket is metallic.

4. The conductor mounting configuration as claimed in claim 1 wherein the insulative material is one of high-temperature Acrylate, polyimid, Polyethylethylketone and combinations including at least one of the foregoing.

5. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is metallic.

6. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is compatible with the jacket material.

7. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is of a constant thickness over its surface area.

8. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is of non-constant thickness over its surface area.

9. The conductor mounting configuration as claimed in claim 8 wherein the intermediary material is of a thickness at locations in contact with the jacket that are of about the same thickness as the jacket to about double the thickness of the jacket.

10. The conductor mounting configuration as claimed in claim 8 wherein at least one area of the intermediary material not in contact with the jacket is of more than double the thickness of the jacket material.

11. The conductor mounting configuration as claimed in claim 10 wherein the at least one area of thicker intermediary material is of a thickness selected to accommodate a fusion to a material of a component thicker than double the thickness of the jacket.

12. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is of a thickness of about the same thickness as the jacket to about double the thickness of the jacket.

13. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material is the same as the jacket material.

14. The conductor mounting configuration as claimed in claim 1 wherein the insulative material is heat tolerant to about 230°C.

15. The conductor mounting configuration as claimed in claim 1 wherein the intermediary material undergoes a heat based fusion joining with the jacket at about 175°C to about 215°C.

16. The conductor mounting configuration as claimed in claim 1 wherein the heat based fusion is a weld.

17. The conductor mounting configuration as claimed in claim 16 wherein the weld is a laser weld.

18. A method for affixing a conductor to a separate structure comprising:

selecting an intermediary material including at least a portion thereof having a thickness ranging from about equal to a thickness of a jacket of the conductor to about double the thickness of the jacket;

bringing the conductor into contact with a portion of the intermediary material having the stated thickness range;

inducing a heat fusion between the portion of the intermediary material contacting the jacket and the jacket; and

fusing a portion of the intermediary material not fused to the jacket to the separate structure.

19. A method for affixing a conductor to a separate structure comprising:

matching an intermediary material thickness of an intermediary material depending from a conductor to a target downhole component thickness; and

fusing a portion of the intermediary material not fused to the jacket to the separate structure.

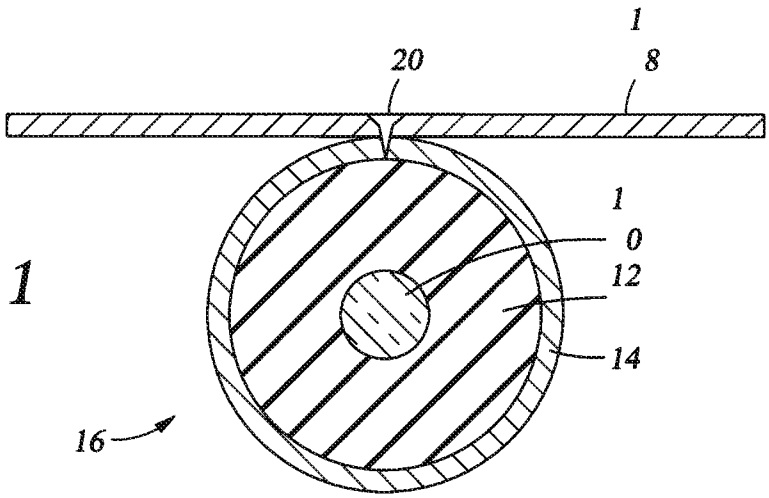

Fig. 1

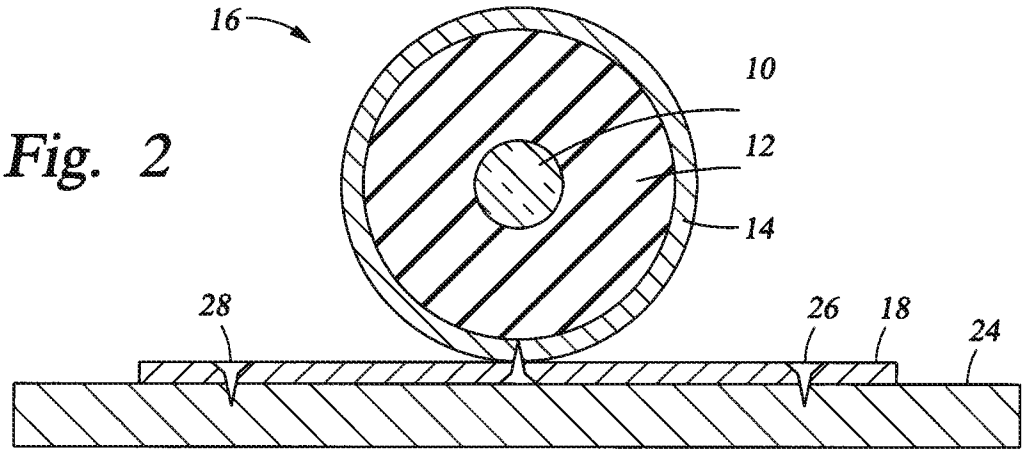

Fig. 2

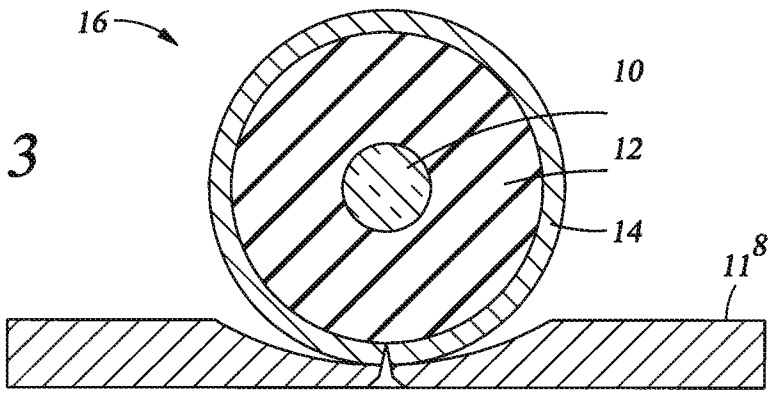

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/084026

A. CLASSIFICATION OF SUBJECT MATTER

G02B 6/44(2006.01)i, G02B 6/46(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 8: G02B 6/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "optical fiber cable", "attach", "hold", "weld"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5530785 A (SAKAMOTO, J. et al.) 25 June 1996 See the abstract; column 7, line 33 - column 9, line 4; figures 1-26.	1-19
A	JP 2002-350649 A (MITSUBISHI CHEMICAL CORPORATION) 04 December 2002 See the abstract; paragraphs [12]-[16]; figures 1-3.	1-19
A	US 6728462 B2 (WU, KUN-TSAN et al.) 27 April 2004 See the abstract; column 2, line 15 - column 2, line 45; figures 1-2.	1-19
A	US 6636680 B2 (WU, KUN-TSAN et al.) 21 October 2003 See the abstract; column 2, line 22 - column 2, line 44; figures 1-5.	1-19
P, X	US 2008-0279513 A1 (CORONADO, M. P. et al.) 13 November 2008 See the abstract; paragraphs [9]-[11]; figures 1-8.	1-3, 5-7, 16-17

☐ Further documents are listed in the continuation of Box C.

☒ 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
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer SONG, Hyun Chae Telephone No. 82-42-481-5786

Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/084026

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JP 2002-350649 A	04.12.2002	None	
US 6728462 B2	27.04.2004	US 2003-0095775 A1	22.05.2003
US 6636680 B2	21.10.2003	US 2003-0086676 A1	08.05.2003
US 2008-0279513 A1	13.11.2008	US 7471860 B2	30.12.2008