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An agency of Industry Canada

CA 2549541 C 2009/08/11

(11)(21) **2 549 541**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(22) Date de dépôt/Filing Date: 2006/06/07
(41) Mise à la disp. pub./Open to Public Insp.: 2006/12/14
(45) Date de délivrance/Issue Date: 2009/08/11
(30) Priorités/Priorities: 2005/06/14 (US60/690,328); 2006/05/23 (US11/419,944)
(51) Cl.Int./Int.Cl. *E21B 17/02* (2006.01)
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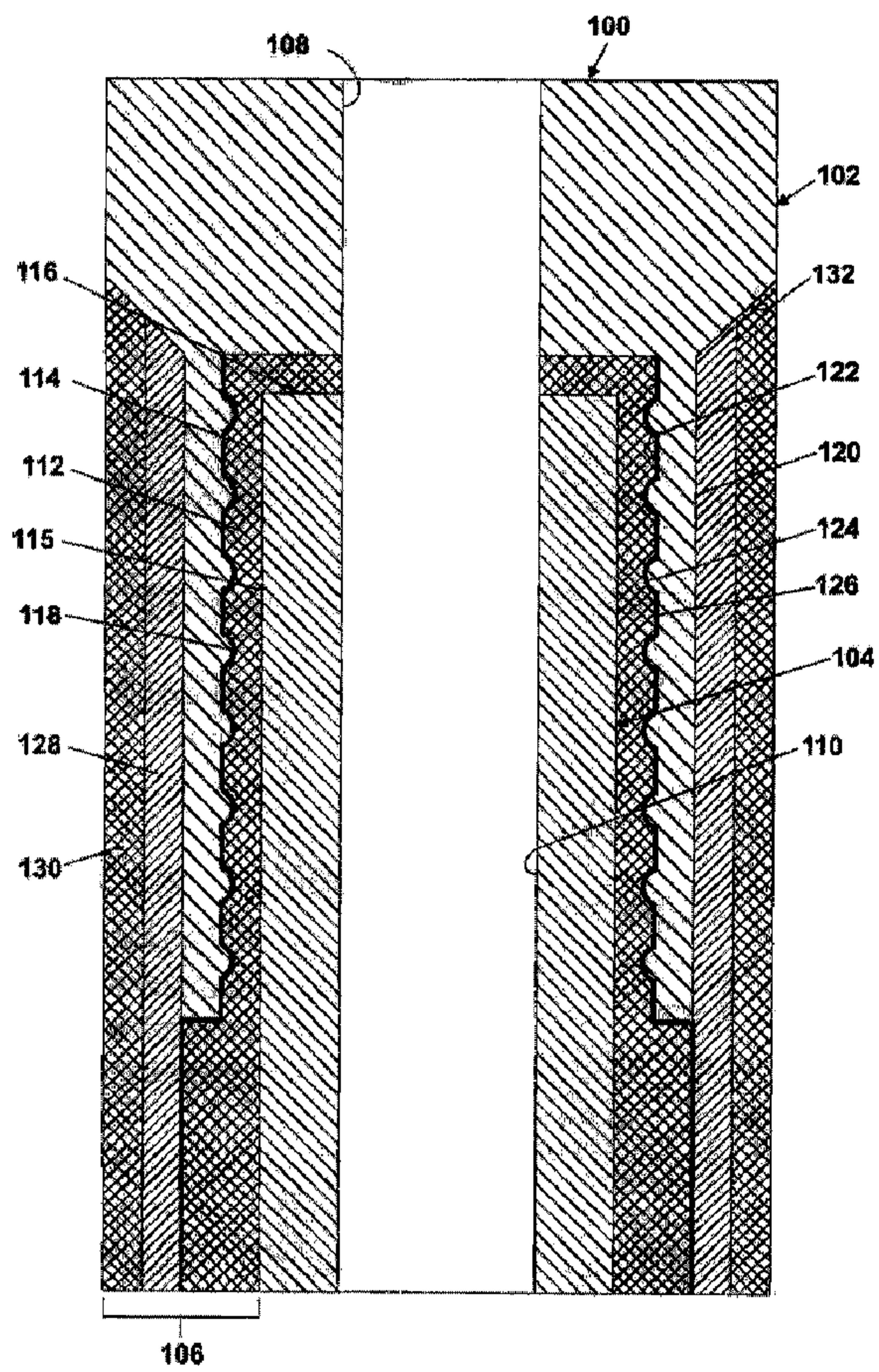
(54) Titre : JOINT D'ISOLATION DE MASSE ASSURANT L'ISOLATION ELECTRIQUE D'UN OUTIL DE FOND DE TROU
(54) Title: MASS ISOLATION JOINT FOR ELECTRICALLY ISOLATING A DOWNHOLE TOOL



(57) Abrégé/Abstract:
A mass isolation joint for electrically isolating a downhole tool includes a first joint section having a distal end in which a first thread is formed, a second joint section, and an insulating composite structure coupling the first joint section to the second joint section,

(57) Abrégé(suite)/Abstract(continued):
wherein at least one of the first and second joint sections is adapted for coupling to the downhole tool. The insulating composite structure includes a first composite layer formed on the second joint section. The first composite layer has a second thread which engages the first thread on the distal end of the first joint section.

MASS ISOLATION JOINT FOR ELECTRICALLY ISOLATING A DOWNHOLE TOOL

ABSTRACT

A mass isolation joint for electrically isolating a downhole tool includes a first joint section having a distal end in which a first thread is formed, a second joint section, and an insulating composite structure coupling the first joint section to the second joint section, wherein at least one of the first and second joint sections is adapted for coupling to the downhole tool. The insulating composite structure includes a first composite layer formed on the second joint section. The first composite layer has a second thread which engages the first thread on the distal end of the first joint section.

MASS ISOLATION JOINT FOR ELECTRICALLY ISOLATING A DOWNHOLE TOOL

BACKGROUND OF THE INVENTION

[0001] The invention relates to a mass isolation joint for electrically isolating a downhole tool from adjacent tools.

[0002] Downhole tools used in hydrocarbon exploration and production are typically made of metallic or conductive bodies. In logging operations, it is common to use these metallic bodies as measure electrodes. For example, a metallic tool body may be used to emit a current signal into a surrounding formation, where the rate at which the current flows from the tool body into the surrounding formation can be measured and related to the resistivity of the formation. In a tool string including several tools, it may be necessary to prevent current generated within one tool having a tool body used as an electrode from migrating to adjacent tools, where the adjacent tools may or may not be used as electrodes. Mass isolation joints are typically used for this electrical isolation. A mass isolation joint typically includes threads on adjacent joint sections and an insulating material between the threads. To be effective, the mass isolation joint must be able to maintain its integrity when subjected to shear and bending forces as the tools are conveyed inside a borehole.

[0003] Logging techniques known in the art include wireline logging, logging while drilling (LWD), measurement while drilling (MWD), and logging while tripping (LWT). Wireline logging involves lowering the instrument into the borehole at the end of an electrical cable to obtain the subsurface measurements as the instrument is moved along the borehole. LWD/MWD involves disposing the instrument in a drilling assembly for to obtain subsurface measurements while a borehole is drilled through subsurface formation. LWT involves disposing sources or sensors within the drill string to obtain measurements while the drill string is withdrawn from the borehole.

[0004] U.S. Patent No. 6,116,337 discloses an articulated connector for connecting two adjacent logging sondes including a mass isolation joint to prevent electrical signals from migrating between the logging sondes. The mass isolation joint includes a first section and a second section arranged coaxially and coupled together by threaded engagement with a coaxial insulator. The first section, second section, and the insulator are generally cylindrical, but the insulator includes an enlarged diameter portion which extends between opposing end faces of the first section and the second section, thereby electrically insulating the first section from the second section. An insulating sleeve is disposed over the first section and second section to protect the joints between the first and second sections and the insulator from wellbore fluids. The insulating sleeve may be formed of a non-conducting material such as fiberglass or epoxy composite.

[0005] There is an ongoing need for a robust mass isolation joint for use in electrically a downhole tool that can withstand shear and bending forces typical of downhole operations.

SUMMARY OF THE INVENTION

[0006] In one aspect, the invention relates to a mass isolation joint for electrically isolating a downhole tool which comprises a first joint section having a distal end in which a first thread is formed, a second joint section, and an insulating composite structure coupling the first joint section to the second joint section, wherein at least one of the first and second joint sections is adapted for coupling to the downhole tool. The insulating composite structure comprises a first composite layer formed on the second joint section. The first composite layer has a second thread which engages the first thread on the distal end of the first joint section.

[0007] In another aspect, the invention relates to a tool string for use in a borehole penetrating a subsurface formation which comprises a plurality of downhole tools and a mass isolation joint, as described above, coupled to at least one of the downhole tools.

In a further aspect, the invention relates to a mass isolation joint for electrically isolating a downhole tool comprising: a first joint section having a distal end in which a first thread is formed; a second joint section; and an insulating composite structure coupling the first joint section to the second joint section, the insulating composite structure comprising a first composite layer formed on the second joint section, the first composite structure having a second thread which engages the first thread on the distal end of the first joint section, the insulating composite structure including a second composite layer formed on the first joint section and a sealant layer disposed between the first and second composite layers; wherein at least one of the first and second joint sections is adapted for coupling to the downhole tool.

In a still further aspect, the invention relates to a tool string for use in a borehole penetrating a subsurface formation, comprising: a plurality of downhole tools; and at least one mass isolation joint coupled to at least one of the downhole tools, the mass isolation joint comprising a first joint section having a distal end in which a first thread is formed; a second joint section; and an insulating composite structure coupling the first joint section to the second joint section, the insulating composite structure comprising a first composite layer formed on the second joint section, the first composite structure having a second thread which engages the first thread, the insulating composite structure including a second composite layer formed on the first joint section and a sealant layer disposed between the first and second composite layers.

[0008] Other features and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings, described below, illustrate typical embodiments of the invention and are not to be considered limiting of the scope of the invention, for the invention may admit to other equally effective embodiments. The figures are not necessarily to scale, and certain features and certain view of the figures may be shown exaggerated in scale or in schematic in the interest of clarity and conciseness.

[0010] FIG. 1 is a longitudinal cross-section of a mass isolation joint for electrically isolating a downhole tool.

[0011] FIG. 2 shows a tool string in a borehole incorporating the mass isolation joint of FIG. 1.

DETAILED DESCRIPTION

[0012] The invention will now be described in detail with reference to a few preferred embodiments, as illustrated in the accompanying drawings. In describing the preferred embodiments, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that the invention may be practiced without some or all of these specific details. In other instances, well-known features and/or process steps have not been described in detail so as not to unnecessarily obscure the invention. In addition, like or identical reference numerals are used to identify common or similar elements.

[0013] FIG. 1 depicts a longitudinal cross-section of a mass isolation joint 100 for electrically isolating a downhole tool. The mass isolation joint 100 includes a first joint section 102, a second joint section 104, and an insulating composite structure 106 coupling the first joint section 102 to the second joint section 104. The first joint section 102 may be a ferrule, which may be coupled to a first tool body or may be an integral part of a first tool body. The first tool body may be a logging sonde, for example, and the first joint section 102 may be coupled to the first tool body through a rigid or flexible joint. The second joint section 104 may be a mandrel, which may be coupled to a second tool body or may be an integral part of a second tool body. The second tool body may be a logging sonde, for example, and the second joint section 104 may be coupled to the second tool body through a rigid or flexible joint. The first and second joint sections 102, 104 may be made of a conductive material, typically a metal or alloy, or a synthetic material. Preferably, the material of the first and second joint sections 102, 104 can withstand conditions in boreholes for hydrocarbon exploration and production. The first and second joint sections 102, 104 may be generally cylindrical (or tubular) and may be provided with bores 108, 110, which may be aligned for passage of wires and tools.

[0014] The insulating composite structure 106 includes an inner composite layer 112 formed on the outer surface 114 of the second joint section 104. The inner composite layer 112 also covers an end face 116 of the second joint section 104, that is, the end face opposing the first joint section 102. Forming the inner composite layer 112 on the second joint section 104 may include winding a composite material in tension about the second joint section 104 manually or using a suitable wrapping device such as a lathe machine. The inner composite layer 112 may include one or more wraps of a composite material. The outer surface 114 of the second joint section 104 may be textured to allow for increased bonding between the inner composite layer 112 and the second joint section 104. Texturing may be provided by sandblasting the outer surface 114 of the second joint section 104 and similar processes. The inner composite layer 112 may be made of any suitable composite material that can withstand the borehole environment. Preferably, the composite material can be machined to form features such as threads. In one example, the composite material is formed of a resin material such as epoxy or fiber-resin material. Useable composite materials include, but are not limited to, fiber-resin composite, polyaryletherketone, such as polyetheretherketone and polyetherketone, and filament wound glass.

[0015] One or more threads 118 are formed on the inner composite layer 112, e.g., by machining. The thread pitch is preferably low, e.g., 3 to 4 threads per inch (2.54 cm), to allow more of the inner composite layer 112 to be used for bearing shearing loads. A distal end 120 of the first joint section 102 is provided with a recess 122. The inner diameter of the recess 122 is such that it can receive a distal end 115 of the second joint section 104 and the inner composite layer 112 formed thereon. One or more threads 124 are formed in the wall of the recess 122 at the distal end 120 of the first joint section 102. The thread(s) 118 on the inner composite layer 112 is used as a gauge for the thread(s) 124 on the first joint section 102 so that the first joint section 102 can engage the inner composite layer 112 via the threads 118, 124. A high temperature adhesive 126 may be injected or inserted between the first joint section 102 and the inner composite layer 112. The high temperature adhesive may be a curable material such as epoxy. The curable material is allowed to cure, thereby providing a bond between the first joint section 102 and the inner composite layer 112 that can withstand high temperature conditions. The inner composite layer 112 provides an insulation layer between the second joint section 104 and the first joint section 102 and thereby prevents migration of currents from the second joint section 104 to the first joint section 102.

[0016] The insulating composite structure 106 further includes a sealant layer 128 formed on the distal end 120 of the first joint section 102 and the inner composite layer 112 on the second joint section 104. An outer composite layer 130 is formed on the sealant layer 128. The sealant layer 128 and the outer composite layer 130 protect the joint between the first joint section 102 and the inner composite layer 112 from borehole fluids. The sealant layer 128 may be made of an elastomer or rubber material or other sealant material suitable for use in a borehole environment. Suitable materials for the sealant layer include, but are not limited to, Neoprene (RTM), Viton (RTM), and Nitrile (RTM). The outer composite layer 130 may also be made of any suitable composite material. For example, the outer composite layer 130 could be made of a fiber-resin composite, fiberglass, or fabric impregnated with resin. Forming the outer composite layer 130 on the sealant layer 128 may include winding a composite material in tension about the sealant layer 128 manually or using a suitable wrapping device such as a lathe machine. The outer composite layer 130 may include one or more wraps of the composite material.

[0017] An outer shoulder 132 of the first joint section 102 that abuts the outer composite layer 130 and the sealant layer 128 may be slanted, as shown, or may be straight. A slanted shoulder provides an increased surface area for the seal. In general, the thickness of the insulating composite structure 106, or the individual layers in the insulating composite structure 106, is selected such that the insulating composite structure 106 is flush with the outer diameter of the first joint section 102.

[0018] FIG. 2 depicts a tool string 200 disposed in a borehole 202 penetrating a subsurface formation 204. The tool string 200 includes downhole tools 206, 208, 210, for example. In one example, the downhole tools 206, 208, 210 are logging tools, such as tools for measuring density, porosity, deep and/or intermediate and/or shallow resistivity, natural gamma radiation, and borehole size in a borehole penetrating a subsurface formation. As an example, which is not intended to be limiting, the downhole tool 208 may be an induction resistivity tool having a tool body 208a for use as a current-emitting electrode. Mass isolation joints 100, as described above, are disposed between the tool body 208a and the adjacent tools 206, 210 in the tool string 200. The mass isolation joints 100 may be coupled to the tools 206, 210 via a rigid joint, as shown at 212, or via a flexible joint, as shown at 214. A rigid joint 212 may be a welded or threaded connection, for example. A flexible joint 214 may include a ball and socket joint, for example. The mass isolation joints 100 prevent currents from migrating from the tool body 208a to the adjacent tools 206, 210 in the tool string 200 and vice versa. The mass isolation joint 100 need not always be between two downhole tools. The mass isolation joint 100 may be disposed at the free end of a downhole tool, for example, to prevent currents from migrating into the downhole tool from that free end. The tool string 200 is supported in the borehole 202 on the end of a wireline 216 in a manner well known in the art. Alternatively, the tool string 200 may be supported in the borehole 202 on the end of a drill string (not shown) including a drill bit (not shown), also in a manner well known in the art. Those skilled in the art will appreciate that embodiments of the invention may be implemented in any type of downhole tool or instrument as known in the art or later developed.

[0019] The disclosed invention provides advantages over conventional structures, including reduced manufacturing costs, compatibility for smaller design circles, and lower failure rates during manufacture. While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein.

CLAIMS:

1. A mass isolation joint for electrically isolating a downhole tool comprising:

a first joint section having a distal end in which a first thread is formed;

a second joint section; and

an insulating composite structure coupling the first joint section to the second joint section, the insulating composite structure comprising a first composite layer formed on the second joint section, the first composite structure having a second thread which engages the first thread on the distal end of the first joint section, the insulating composite structure including a second composite layer formed on the first joint section and a sealant layer disposed between the first and second composite layers;

wherein at least one of the first and second joint sections is adapted for coupling to the downhole tool.

2. The mass isolation joint of claim 1, wherein the distal end of the first joint section includes a recess for receiving the distal end of the second joint section and the first composite layer formed thereon.

3. The mass isolation joint of claim 2, wherein the first thread is formed on a wall of the recess.

4. The mass isolation joint of claim 1, wherein the sealant layer comprises an elastomeric material.

5. The mass isolation joint of claim 1, further comprising a high-temperature adhesive disposed between the first composite layer and the first joint section.

6. The mass isolation joint of claim 5, wherein the high-temperature adhesive is a curable material.

7. The mass isolation joint of claim 1, wherein the first and second joint sections are made of a conductive material.

8. A tool string for use in a borehole penetrating a subsurface formation, comprising:

a plurality of downhole tools; and

at least one mass isolation joint coupled to at least one of the downhole tools, the mass isolation joint comprising a first joint section having a distal end in which a first thread is formed;

a second joint section; and

an insulating composite structure coupling the first joint section to the second joint section, the insulating composite structure comprising a first composite layer formed on the second joint section, the first composite structure having a second thread which engages the first thread, the insulating composite structure including a second composite layer formed on the first joint section and a sealant layer disposed between the first and second composite layers.

9. The tool string of claim 8, wherein the mass isolation joint is disposed between adjacent downhole tools and coupled thereto.

10. The tool string of claim 9, wherein the mass isolation joint is coupled to the adjacent downhole tools via a rigid or flexible joint.

11. The tool string of claim 8, wherein the downhole tools comprise logging tools.

12. The tool string of claim 8, wherein the second thread is formed on a portion of the first composite layer formed on a distal end of the second joint section, and the distal end of the first joint section includes a recess for receiving the distal end of the second joint section and the composite structure formed thereon.

13. The tool string of claim 12, wherein the first thread is formed on a wall of the recess.

14. The tool string of claim 8, wherein the sealant layer comprises an elastomeric material and the second composite layer comprises a resin composite.

15. The tool string of claim 8, further comprising a high-temperature adhesive disposed between the first composite layer and the first joint section.

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PATENT AGENTS

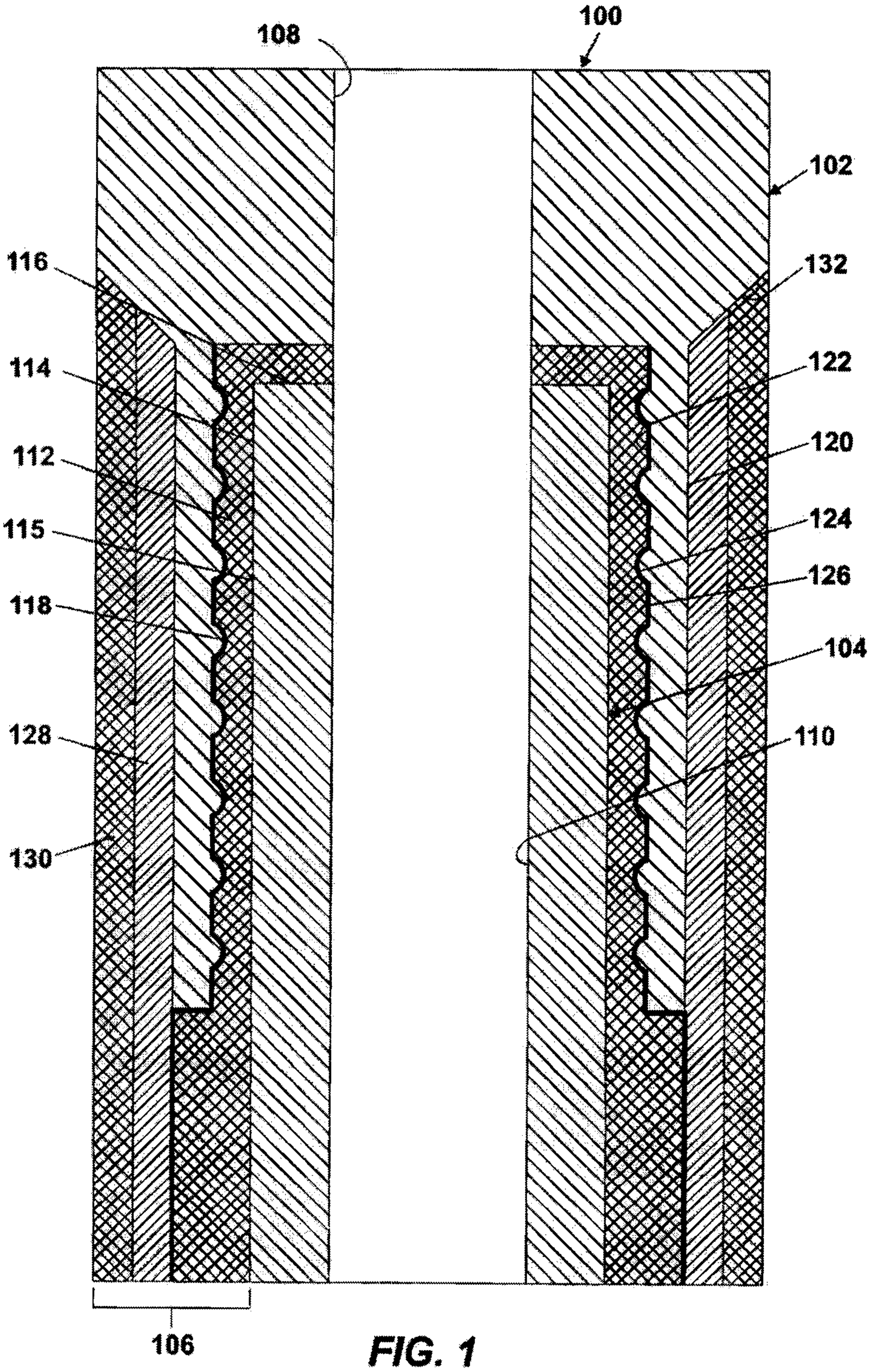
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FIG. 1

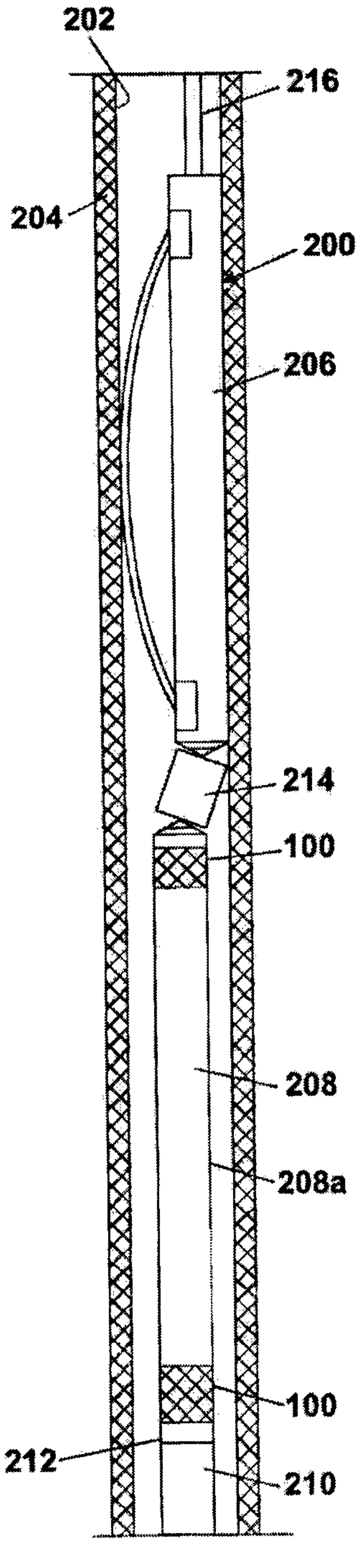
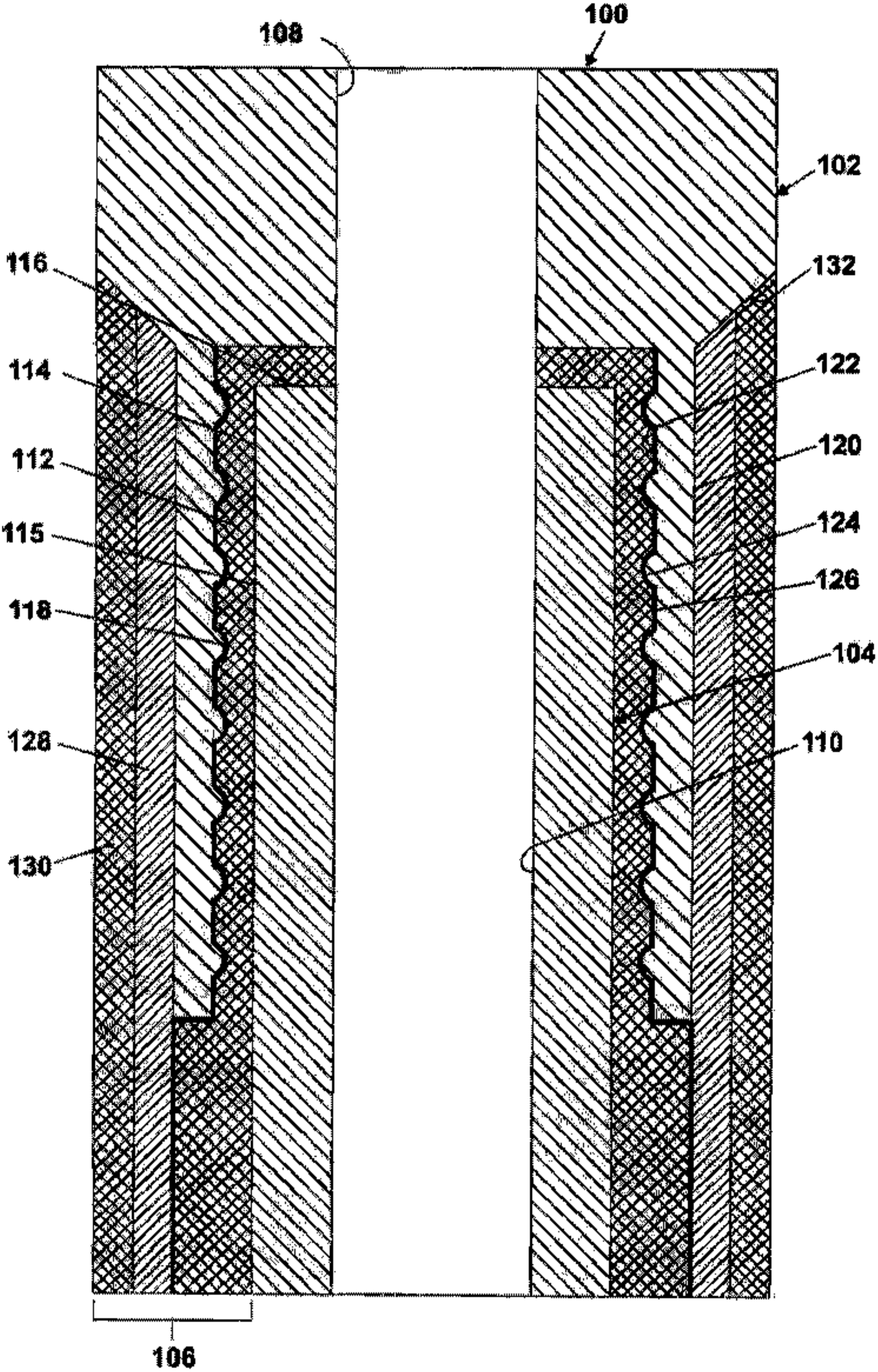


FIG. 2



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