



(51) International Patent Classification:

E21B 21/06 (2006.01) *B01D 19/00* (2006.01)
F04B 43/12 (2006.01)

(21) International Application Number:

PCT/US2025/010033

(22) International Filing Date:

02 January 2025 (02.01.2025)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

63/616,920 02 January 2024 (02.01.2024) US

(71) Applicant (for US only): **SCHLUMBERGER TECHNOLOGY CORPORATION** [US/US]; 300 Schlumberger Drive, Sugar Land, Texas 77478 (US).

(71) Applicant (for CA only): **SCHLUMBERGER CANADA LIMITED** [CA/CA]; 125 – 9 Avenue SE, Calgary, Alberta T2G 0P6 (CA).

(71) Applicant (for FR only): **SERVICES PETROLIERS SCHLUMBERGER** [FR/FR]; 42 rue Saint Dominique, 75007 Paris (FR).

(71) Applicant (for all designated States except CA, FR, US): **SCHLUMBERGER TECHNOLOGY B.V.** [NL/NL]; Parkstraat 83, 2514 JG The Hague (NL).

(72) Inventors: **BELHADJ, Chiraz**; 1 rue Henri Becquerel, 92142 Clamart (FR). **MADHAVAN, Raghu**; 200 Gillingham Lane, Sugar Land, Texas 77478 (US). **COLOMBEL, Emilie**; 1 rue Henri Becquerel, 92142 Clamart (FR). **SAYEGH, Marie Ange**; 46 rue Charles Lorilleux, 92800 Puteaux (FR).

(74) Agent: **DAE, Michael** et al.; Schlumberger, 10001 Richmond Avenue, Room 4720, Houston, Texas 77042 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(54) Title: GAS EXTRACTOR PUMP RUBBER

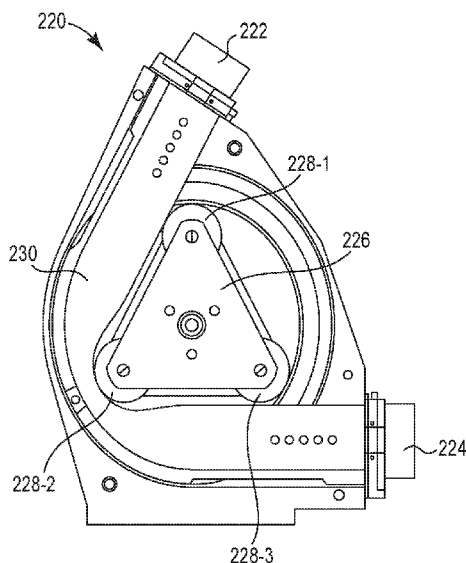


FIG. 2

(57) Abstract: Devices, systems, and methods for a pump rubber of a degasser pump are described herein. In some examples, one or more embodiments include a first number of materials forming an inner surface of the pump rubber and a second number of materials forming an outer surface of the pump rubber. The pump rubber can be configured as a hollowed elongated cylinder. The first number of materials can be configured to provide abrasion resistance to wear from a drilling fluid that is passed through the pump rubber and resistance to thermal and chemical stress from a drilling fluid that is passed through the pump rubber. The second number of materials can be configured to provide fatigue resistance when compressing and decompressing the pump rubber.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

GAS EXTRACTOR PUMP RUBBER

Cross Reference Paragraph

[0001] This application claims the benefit of U.S. Provisional Application No. 63/616,920, entitled "MUTI-LAYERED RUBBER FOR GAS EXTRACTOR PUMP" filed January 02, 2024, the disclosure of which is hereby incorporated herein by reference.

Background

[0002] Wellbores may be drilled into a surface location or seabed for a variety of exploratory or extraction purposes. For example, a wellbore may be drilled to access fluids, such as liquid and/or gaseous hydrocarbons, stored in subterranean formations and to extract the fluids from the formations. Wellbores used to produce or extract fluids may be lined with casing around the walls of the wellbore. A variety of drilling methods may be utilized depending partly on the characteristics of the formation through which the wellbore is drilled.

[0003] A drilling system can provide weight on the bit using one or more drill collars positioned in a bottom hole assembly near the bit. Bottom hole assemblies can also include communication devices to transmit information about the bit and other downhole parameters to receiving devices uphole from the bit.

Brief Description of the Drawings

[0004] Figure 1 is an example schematic representation of a drilling system, in accordance with one or more embodiments of the present disclosure.

[0005] Figure 2 is a perspective view of an example of a degasser pump assembly for use in a drilling system, in accordance with one or more embodiments of the present disclosure.

[0006] Figure 3 is a perspective view of an example of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure.

[0007] Figure 4 is a perspective view of an example of an inner layer of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure.

[0008] Figure 5 is a perspective view of an example of an outer layer of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure.

[0009] Figure 6 is a perspective section view of an example of forming a pump rubber in a mold for use with a degasser pump, in accordance with one or more embodiments of the present disclosure.

Detailed Description

[0010] Drilling operations for fluids such as liquid and/or gaseous hydrocarbons can utilize a drilling system to drill a wellbore to locate such fluids. During such drilling operations, gas may be entrained into the drilling fluid. This gas may be transported from the wellbore to the surface through the drilling fluid. In some examples, such gas may be removed for sampling. However, this gas being present in the drilling fluid may cause a reduction in hydrostatic pressure in the drilling system.

[0011] Samples and/or other removal of this gas may be performed using a degasser. As used herein, a degasser can be a device to remove entrained gas from a drilling fluid. The drilling fluid may be provided to the degasser by a degasser probe. As used herein, a degasser probe can be a device that transports drilling fluid to a degasser. For example, the degasser probe can utilize a degasser pump to generate a negative pressure to transport (e.g., via suction) drilling fluid to the degasser.

[0012] During drilling operations, a drill bit can drill an earth formation to locate and/or access fluids mentioned above. In some examples, the drilling fluid can be transported to the degasser by a degasser pump. The degasser pump can be a peristaltic pump that includes a pump rubber within the degasser pump body. The pump rubber can be the conduit for passing the drilling fluid through the degasser pump to the degasser. The pump rubber can be compressed and decompressed by a number of rollers in the degasser pump as part of the pumping process. Accordingly, the pump rubber can be fatigued and potentially fail due to compression and decompression cycles.

[0013] Also, the pump rubber can be under chemical stress, thermal stress and/or abrasion from the drilling fluid that passes through the pump rubber. The pump rubber can undergo wear and potentially fail due to the chemical and/or thermal stress and abrasion from the drilling fluid. Previous approaches used a single material to form the pump rubber. However, due to the pump rubber undergoing fatigue and/or wear due to compression and decompression cycles by the rollers of the degasser pump along with chemical and/or thermal stress and also abrasion from the drilling fluid, a single material may not be able to provide resistance to both fatigue due to compression and decompression cycles and chemical and/or thermal stress and also abrasion from the drilling fluid.

Embodiments of the present disclosure can include a pump rubber formed of a first number of materials and a second number of materials. The first number of materials can be configured to provide abrasion resistance and chemical and/or thermal stress resistance to wear caused by a drilling fluid that is passed through the pump rubber. The second number of materials can be configured to provide fatigue resistance when compressing and decompressing the pump rubber.

[0014] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the disclosure. These are merely examples and are not intended to be limiting. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments are possible. This description is not to be taken in a limiting sense, but rather made merely for the purpose of describing general principles of the implementations. The scope of the described implementations should be ascertained with reference to the issued claims.

[0015] As used herein, the terms “connect”, “connection”, “connected”, “in connection with”, and “connecting” are used to mean “in direct connection with” or “in connection with via one or more elements”; and the term “set” is used to mean “one

element" or "more than one element". Further, the terms "couple", "coupling", "coupled", "coupled together", and "coupled with" are used to mean "directly coupled together" or "coupled together via one or more elements". As used herein, the terms "up" and "down"; "upper" and "lower"; "top" and "bottom"; and other like terms indicating relative positions to a given point or element are utilized to more clearly describe some elements. Commonly, these terms relate to a reference point at the surface from which drilling operations are initiated as being the top point and the total depth being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal or slanted relative to the surface.

[0016] Language of degree used herein, such as the terms "approximately," "about," "generally," and "substantially" as used herein represent a value, amount, or characteristic close to the stated value, amount, or characteristic that still performs a desired function or achieves a desired result. For example, the terms "approximately," "about," "generally," and "substantially" may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and/or within less than 0.01% of the stated amount. As another example, in certain embodiments, the terms "generally parallel" and "substantially parallel" or "generally perpendicular" and "substantially perpendicular" refer to a value, amount, or characteristic that departs from exactly parallel or perpendicular, respectively, by less than or equal to 15 degrees, 10 degrees, 5 degrees, 3 degrees, 1 degree, or 0.1 degree.

[0017] These embodiments are described in sufficient detail to enable those of ordinary skill in the art to practice one or more embodiments of this disclosure. It is to be understood that other embodiments may be utilized and that process, electrical, and/or structural changes may be made without departing from the scope of the present disclosure.

[0018] As will be appreciated, elements shown in the various embodiments herein can be added, exchanged, combined, and/or eliminated so as to provide a number of additional embodiments of the present disclosure. The proportion and the relative scale of the elements provided in the figures are intended to illustrate the embodiments of the present disclosure and should not be taken in a limiting sense.

[0019] The figures herein follow a numbering convention in which the first digit or digits correspond to the drawing figure number and the remaining digits identify an element or component in the drawing. Similar elements or components between different figures may be identified by the use of similar digits. For example, 111 may reference element “11” in Figure 1, and a similar element may be referenced as 211 in Figure 2.

[0020] As used herein, “a”, “an”, or “a number of” something can refer to one or more such things, while “a plurality of” something can refer to more than one such things. For example, “a number of components” can refer to one or more components, while “a plurality of components” can refer to more than one component.

[0021] Figure 1 is an example schematic representation of a drilling system 100, in accordance with one or more embodiments of the present disclosure. drilling system 100 includes a drill rig 103 used to turn a drilling tool assembly 104 which extends downward into the wellbore 102. The drilling tool assembly 104 may include a drill string 105, a bottom hole assembly 106, and a bit 110 attached to the downhole end of the drill string 105.

[0022] The drill string 105 may include several joints of drill pipe 108 connected end-to-end through tool joints 109. The drill string 105 transmits drilling fluid through a central bore and transmits rotational power from the drill rig 103 to the bottom hole assembly 106. In some embodiments, the drill string 105 may further include additional components such as subs, pup joints, etc. The drill pipe 108 provides a hydraulic passage through which drilling fluid is pumped from the surface. The drilling fluid discharges through selected-size nozzles, jets, or other orifices in the bit 110 for the purposes of cooling the bit 110 and cutting structures thereon, and for lifting cuttings out of the wellbore 102 as it is being drilled.

[0023] The bottom hole assembly 106 may include the bit 110 or other components. An example bottom hole assembly 106 may include additional or other components (e.g., coupled between to the drill string 105 and to the bit 110). Examples of additional bottom hole assembly 106 components include a degasser probe, drill collars, stabilizers, measurement-while-drilling (“MWD”) tools, logging-while-drilling (“LWD”) tools, rotary steerable system (“RSS”) tools, sensor(s),

downhole motors, steering tools, underreamers, section mills, hydraulic disconnects, jars, vibration or dampening tools, other components, and/or combinations thereof.

[0024] In general, the drilling system 100 may include other drilling components and accessories, such as special valves (e.g., Kelly cocks, blowout preventors, and safety valves). Additional components included in the drilling system 100 may be considered a part of the drilling tool assembly 104, the drill string 105, or a part of the bottom hole assembly 106 depending on their locations in the drilling system 100.

[0025] The bit 110 in the bottom hole assembly 106 may be any type of bit suitable for degrading downhole materials. For instance, the bit 110 may be a drill bit suitable for drilling the earth formation 101. Example types of drill bits used for drilling earth formations are fixed-cutter or drag bits. In other embodiments, the bit 110 may be a mill used for removing metal, composite, elastomer, other materials downhole, and/or combinations thereof. For instance, the bit 110 may be used with a whipstock to mill into casing 107 lining the wellbore 102. The bit 110 may also be a junk mill used to mill away tools, plugs, cement, other materials within the wellbore 102, and/or combinations thereof. Swarf or other cuttings formed by use of a mill may be lifted to the surface or may be allowed to fall downhole.

[0026] As mentioned above, the bottom hole assembly 106 can include a drilling bit 111. The drilling bit 111 can transport drilling fluid to a degasser 112. The degasser 112 can remove entrained gas from the drilling fluid retrieved by the drilling bit 111. The degasser 112 can include a suction head, a strainer screen, and a worm screw to filter the drilling fluid and a degasser pump 120 to transport the drilling fluid to the degasser 112. Degasser pump 120 can be a peristaltic pump that is configured to pump the drilling fluid to the degasser 112.

[0027] Figure 2 is a cross sectional view of an example of a degasser pump 220 for use in a drilling system, in accordance with one or more embodiments of the present disclosure. As illustrated in Figure 2, the degasser pump 220 can include a pump rubber 230 coupled to a pump inlet 224 and to a pump outlet 222. The pump rubber 230 can be a conduit for passing drilling fluid and cuttings from the formation rocks through the degasser pump 220. The drilling fluid can enter the degasser

pump 220 through pump inlet 224 and exit the degasser pump 220 through pump outlet 222.

[0028] Degasser pump 220 can include a rotor 226 and a number of rollers 228-1, 228-2, and 228-3 attached to the rotor 226. The pump 220 in Figure 2 illustrates 3 rollers, but embodiments can include any number of rollers. The rotor 226 can be powered and configured to turn on its center axis causing the number of rollers 228-1, 228-2, and 228-3 to rotate and contact the pump rubber 230. The number of rollers 228-1, 228-2, and 228-3 can be configured to contact the pump rubber 230 where the pump rubber 230 is bent within the degasser pump 220. As the wheel rotate around the center axis of the rotor 226, the number of rollers 228-1, 228-2, and 228-3 can compress and decompress the pump rubber 230 to cause the drilling fluid to enter the degasser pump through the pump inlet 224, pass through the pump rubber 230 and exit the degasser pump 220 though the pump outlet 222 at a constant flow rate.

[0029] The pump rubber 230 can be compressed and decompressed by rollers 228-1, 228-2, and 228-3 in the degasser pump as the rollers are rotated in a circular motion by rotor 226 as part of the pumping process. Accordingly, the pump rubber 230 can be fatigued and potentially fail due to compression and decompression cycles. Also, the pump rubber 230 can be under chemical stress, thermal stress and/or abrasion from the drilling fluid that passes through the pump rubber 230. The pump rubber 230 can undergo wear and potentially fail due to the chemical and/or thermal stress and abrasion from the drilling fluid. Pump rubber 230 can be formed of a first number of materials and a second number of materials. The first number of materials can be exposed on the inner surface of the pump rubber 230 to cuttings and drilling fluid and can be configured to provide abrasion and/or fatigue resistance and chemical and/or thermal stress resistance to wear caused by cuttings and drilling fluid that are passed through the pump rubber 230. The second number of materials can be contacted by a number of rollers 228-1, 228-2, and 228-3 that compress and decompress the pump rubber 230 and the outer layer of the pump rubber 230 can be configured to provide fatigue resistance and structural strength when compressing and decompressing the pump rubber 230 with rollers 228-1, 228-2, and 228-3.

[0030] The pump rubber 230 can be configured to be bent at an angle of approximately 60 degrees within the degasser pump 220. The pump rubber 230 can be under tension and compression where the pump rubber is bent within the degasser pump 220. The first number of materials and the second number of materials forming the pump rubber 230 can be configured to provide fatigue resistance for the pump rubber 230 when the pump rubber 230 is compressed and decompressed by the number of rollers 228-1, 228-2, and 228-3 while under tension and compression.

[0031] Figure 3 is a perspective view of an example of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure. The pump rubber 330 can include an inner layer 338 and an outer layer 336 formed as a hollowed elongated cylinder. The hollow elongated cylinder can include a first opening 332 that can be configured to attach to an inlet of the degasser pump and a second opening 334 that can be configured to attach to an outlet of the degasser pump.

[0032] The inner layer 338 of the pump rubber 330 can be formed of a first number of materials. The first number of materials can include a first material that can provide resistance to abrasion from cuttings in the drilling fluid that are passed through the pump rubber 330. The first material can include glass, Kevlar, Aramid, polyester, among other types of materials. The first number of materials can include a second material that can provide resistance to wear from fatigue caused by compressing and decompressing the pump rubber 330 when pumping drilling fluid through the pump rubber 330. The second material can include nitrile, hydrogenated nitrile butadiene rubber (HNBR), and/or neoprene, among other types of materials.

[0033] The outer layer 336 of the pump rubber 330 can be formed of a second number of materials. The second number of materials can provide resistance to wear from fatigue caused by compressing and decompressing the pump rubber 330 when pumping drilling fluid through the pump rubber 330. The second number of materials can include nitrile, hydrogenated nitrile butadiene rubber (HNBR), and/or neoprene, among other types of materials.

[0034] The pump rubber 330 can include an inner surface 340 that can define an opening through pump rubber where the drilling fluid passes through the pump rubber. The inner surface 340 is part of the inner layer 338 formed of the first number of materials. The inner surface 340 formed of the first numbers can provide resistance to abrasion and chemical and/or thermal stress caused by a drilling fluid that contacts the inner surface as the drilling fluid is passed through the pump rubber.

[0035] The pump rubber 330 can include an outer surface 342. The outer surface can be formed of the second number of materials that can provide resistance to wear caused by the rollers attached to the rotor compressing and decompressing the pump rubber 330. The outer surface 342 formed of the second number of materials can also provide resistance to abrasive wear caused by the rollers passing over the outer surface 342 of the pump rubber as the rollers compress and decompress the pump rubber 330.

[0036] Figure 4 is a perspective view of an example of an inner layer of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure. The inner layer 438 of the pump rubber can be formed of a first number of materials. The first number of materials can include a first material 444 that can provide resistance to abrasion from drilling fluid that is passed through the pump rubber. The first material 444 can include glass, Kevlar, Aramid, polyester, among other types of materials. The first material 444 can be a woven fabric and/or formed with openings between the strands of the first material 444. The first number of materials can include a second material 446 that can provide resistance to wear from fatigue caused by compressing and decompressing the pump rubber when pumping drilling fluid through the pump rubber. The second material 446 can include nitrile, hydrogenated nitrile butadiene rubber (HNBR), and/or neoprene, among other types of materials. The second material 446 can be formed in openings between portions of the first material 444. The combination of the first material 444 and the second material 446 can provide resistance abrasion, chemical stress, and thermal stress from the drilling fluid contacting the inner surface 440 of the pump rubber and resistance to wear caused by fatigue due to compressing and decompressing the pump rubber.

[0037] Figure 5 is a perspective view of an example of an outer layer of a pump rubber for use with a degasser pump, in accordance with one or more embodiments of the present disclosure. The outer layer 536 of the pump rubber can be formed of a second number of materials 548. The second number of materials 548 can provide resistance to wear from fatigue caused by compressing and decompressing the pump rubber when pumping drilling fluid through the pump rubber 330. The second number of materials 548 can include nitrile, hydrogenated nitrile butadiene rubber (HNBR), and/or neoprene, among other types of materials.

[0038] The outer layer 536 can be formed on the inner layer. The outer layer 536 can provide additional resistance to wear from fatigue caused by compressing and decompressing the pump rubber along with abrasion resistance to the rollers that contact the outer layer 536 when compressing and decompressing the pump rubber. The outer surface 542 of the outer layer 536 can be formed of the second number of materials that can provide resistance to wear caused by the rollers attached to the rotor compressing and decompressing the pump rubber 330. The outer surface 542 of the outer layer 536 formed of the second number of materials can also provide resistance to abrasive wear caused by the rollers passing over the outer surface 542 of the pump rubber as the rollers compress and decompress the pump rubber 330.

[0039] Figure 6 is a perspective section view of an example of forming a pump rubber in a mold for use with a degasser pump, in accordance with one or more embodiments of the present disclosure.

[0040] Forming the pump rubber 630 can include forming the inner layer 638 by forming a first material of the inner layer 638 to a particular thickness (e.g., inner diameter dimensions), forming a second material in openings between portion of the first material, and forming the outer layer 636 on the first material and the second material of the inner layer 638. The outer layer 636 can be formed to the outer diameter dimensions. The second material of the inner layer 638 and the outer layer 636 can then be cured to bond the inner layer 638 and the outer layer 636 together.

[0041] Forming the pump rubber 630 can include forming the inner layer 638 by forming a first material of the inner layer 638 to a particular thickness and forming the outer layer 636 on the first material and the second material of the inner layer

638. The inner layer 638 can be formed on a mandrel. The inner layer 638 can be placed in mold 650 and the outer layer 636 can be formed on the inner layer 638 in mold 650. The outer layer 636 can then be cured to bond the inner layer 638 and the outer layer 636 together.

[0042] Forming the pump rubber 630 can include forming a first material of the inner layer 638 and a first material of the outer layer 636. Adding a second material to the first material of the inner layer 630 and curing the inner layer 638 to the outer layer 636.

[0043] Although specific embodiments have been illustrated and described herein, those of ordinary skill in the art will appreciate that any arrangement calculated to achieve the same techniques can be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments of the disclosure.

[0044] It is to be understood that the above description has been made in an illustrative fashion, and not a restrictive one. Combination of the above embodiments, and other embodiments not specifically described herein will be apparent to those of skill in the art upon reviewing the above description.

[0045] The scope of the various embodiments of the disclosure includes any other applications in which the above structures and methods are used. Therefore, the scope of various embodiments of the disclosure should be determined with reference to the appended claims, along with the full range of equivalents to which such claims are entitled.

[0046] In the foregoing Detailed Description, various features are grouped together in example embodiments illustrated in the figures for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the embodiments of the disclosure require more features than are expressly recited in each claim.

[0047] Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus, the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

What is claimed is:

1. A degasser pump rubber, comprising:
a first number of materials forming an inner surface of the pump rubber; and
a second number of materials forming an outer surface of the pump rubber;
wherein the pump rubber is configured as a hollowed elongated cylinder and wherein
the first number of materials and the second number of materials form the pump
rubber.
2. The degasser pump rubber of claim 1, wherein the first number of materials
include hydrogenated nitrile butadiene rubber (HNBR) reinforced with Kevlar.
3. The degasser pump rubber of claim 1, wherein the second number of
materials includes HNBR.
4. The degasser pump rubber of claim 1, wherein the first number of materials
are configured to provide abrasion resistance to wear from a drilling fluid that is
passed through the pump rubber.
5. The degasser pump rubber of claim 1, wherein the first number of materials
are configured to provide resistance to wear due to thermal and chemical stress from
a drilling fluid that is passed through the pump rubber.
6. The degasser pump rubber of claim 1, wherein the second number of
materials are configured to provide fatigue resistance when compressing and
decompressing the pump rubber.
7. The degasser pump rubber of claim 6, wherein the first number of materials
are also configured to provide fatigue resistance when compressing and
decompressing the pump rubber.

8. A degasser pump, comprising:
 - a first opening of a pump rubber coupled to an inlet of the degasser pump;
 - a second opening of the pump rubber coupled to an outlet of the degasser pump; and
 - a number of rollers configured to compress and decompress the pump rubber when a rotor is rotated around an axis,
 - wherein the pump rubber includes an inner layer including a first number of materials and an outer layer including a second number of materials.
9. The degasser pump of claim 8, wherein the first number of materials are configured to provide abrasion resistance to a drilling fluid that is passed through the pump rubber by the degasser pump.
10. The degasser pump of claim 8, wherein the second number of materials are configured to provide fatigue resistance to the number of rollers configured to compress and decompress the pump rubber.
11. The degasser pump of claim 8, wherein the pump rubber is configured to be bent at an angle of approximately 60 degrees within the degasser pump. are configured to compressed and bent at an angle providing tension and compression where the pump rubber is bent.
12. The degasser pump of claim 11, wherein the pump rubber is under tension and compression where the pump rubber is bent within the degasser pump.
13. The degasser pump of claim 12, wherein the first number of materials and the second number of materials are configured to provide fatigue resistance for the pump rubber when the pump rubber is compressed and decompressed by the number of rollers while under tension and compression.

14. A method of forming a pump rubber, comprising:
forming a first material on a spindle;
forming a first portion of a second material in openings between portions of the first material; and
forming a second portion of the second material on the first material and the first portion of the second material.
15. The method of claim 14, wherein forming the first material and forming the first portion of the second material forms an inner layer of the pump rubber.
16. The method of claim 14, wherein forming the second portion of the second material forms an outer layer of the pump rubber.
17. The method of claim 14, further including curing the first portion of the second material and the first portion of the second material after forming the second portion of the second material.
18. The method of claim 14, further including placing the first material and the first portion of the second material in a mold and forming the second portion of the second material in the mold.
19. The method of claim 14, wherein forming the first material includes forming a fabric to the inner diameter dimensions of the pump rubber as a hollowed elongated cylinder.
20. The method of claim 19, wherein forming the second portion of the second material includes forming an elastomer material to the outer diameter dimensions of the pump rubber.

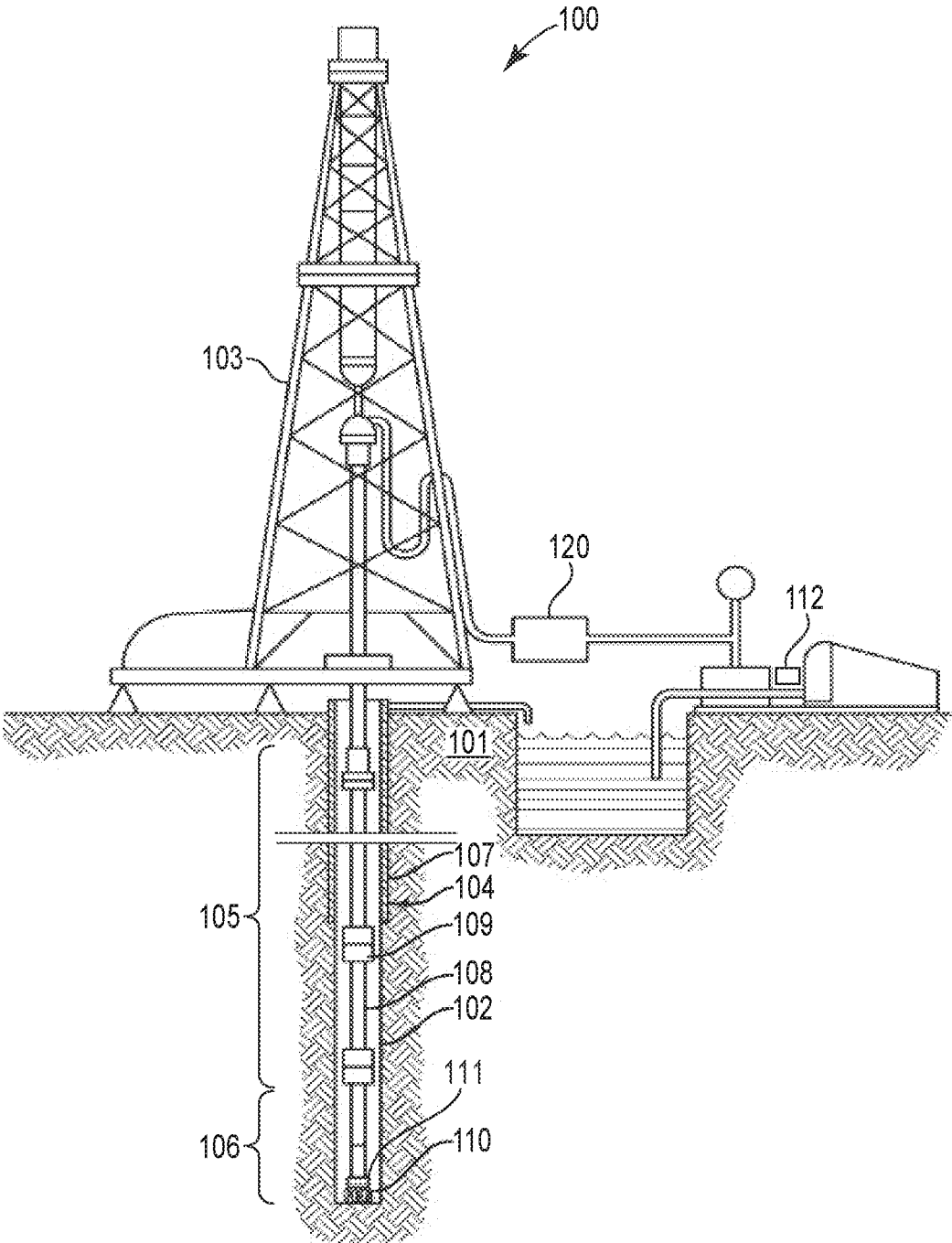


FIG. 1

2/6

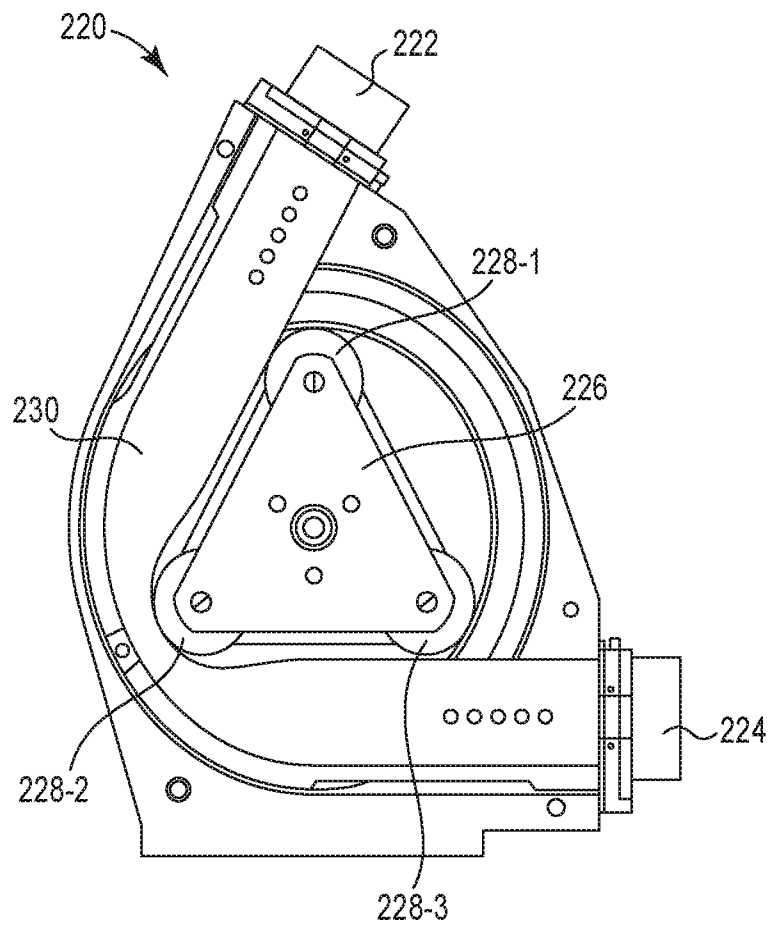


FIG. 2

3/6

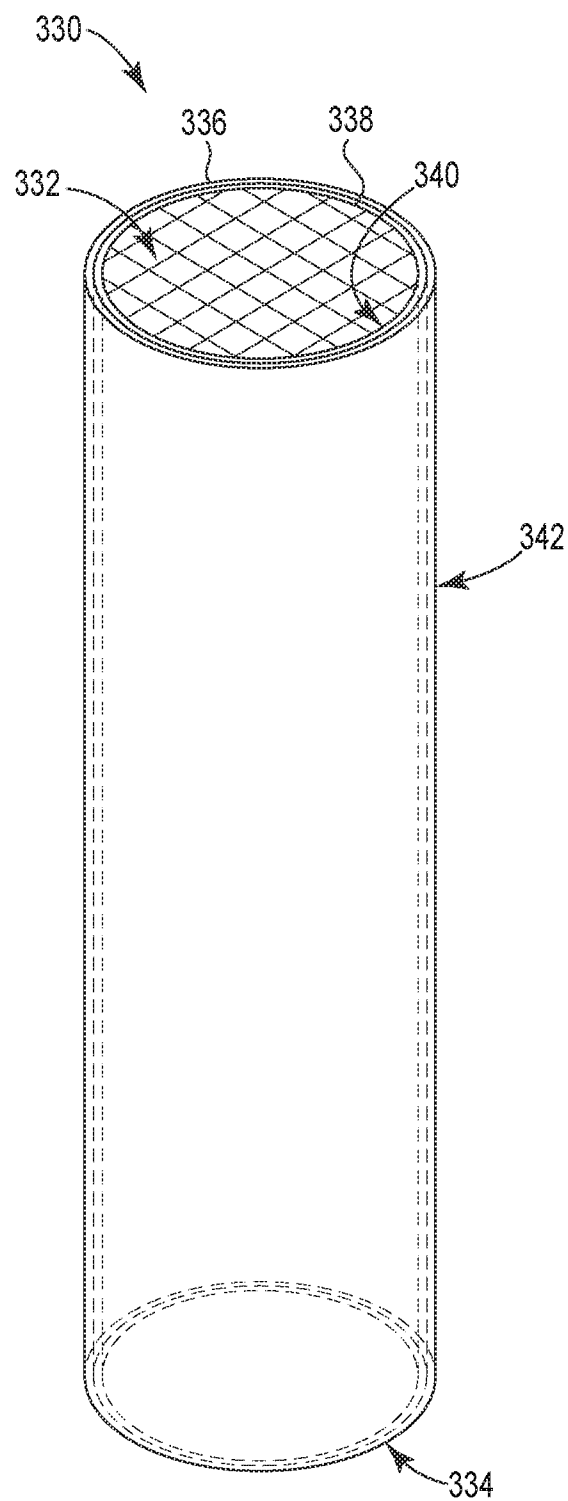


FIG. 3

4/6

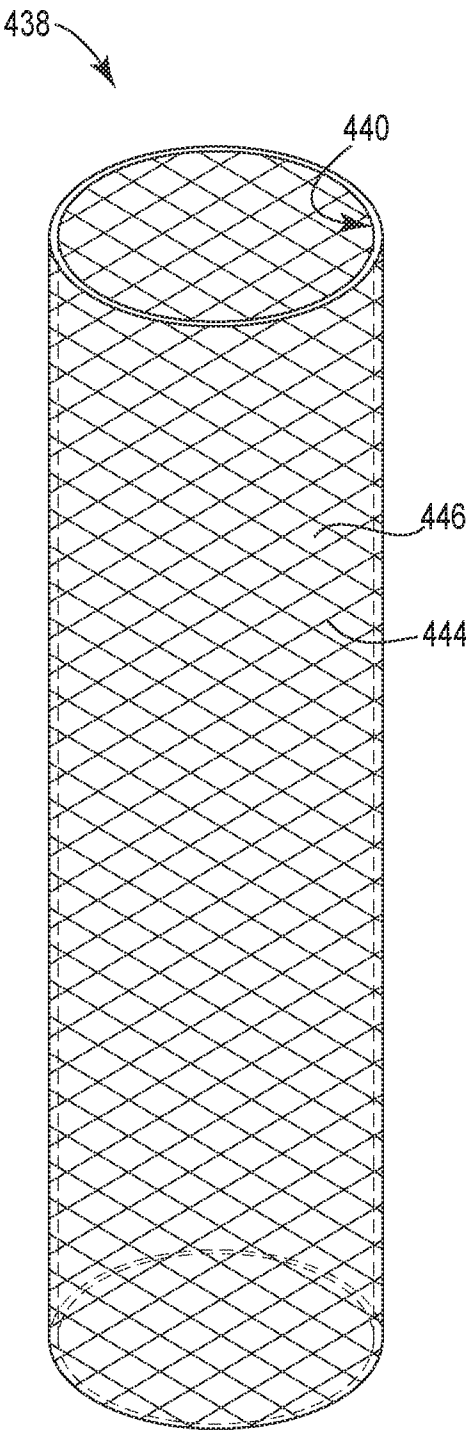


FIG. 4

5/6

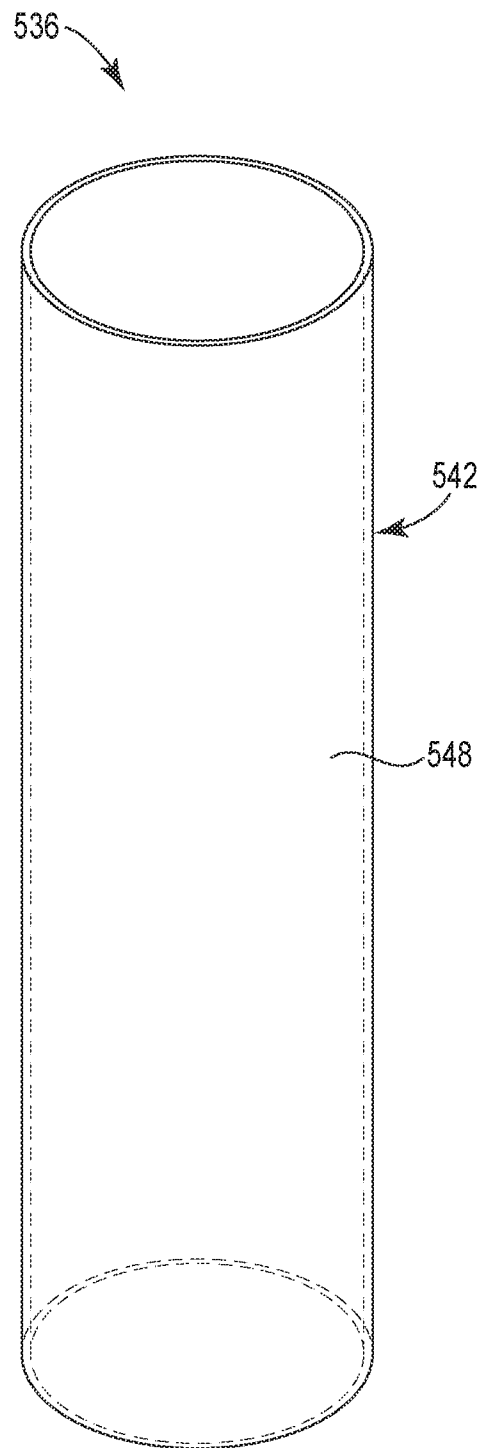


FIG. 5

6/6

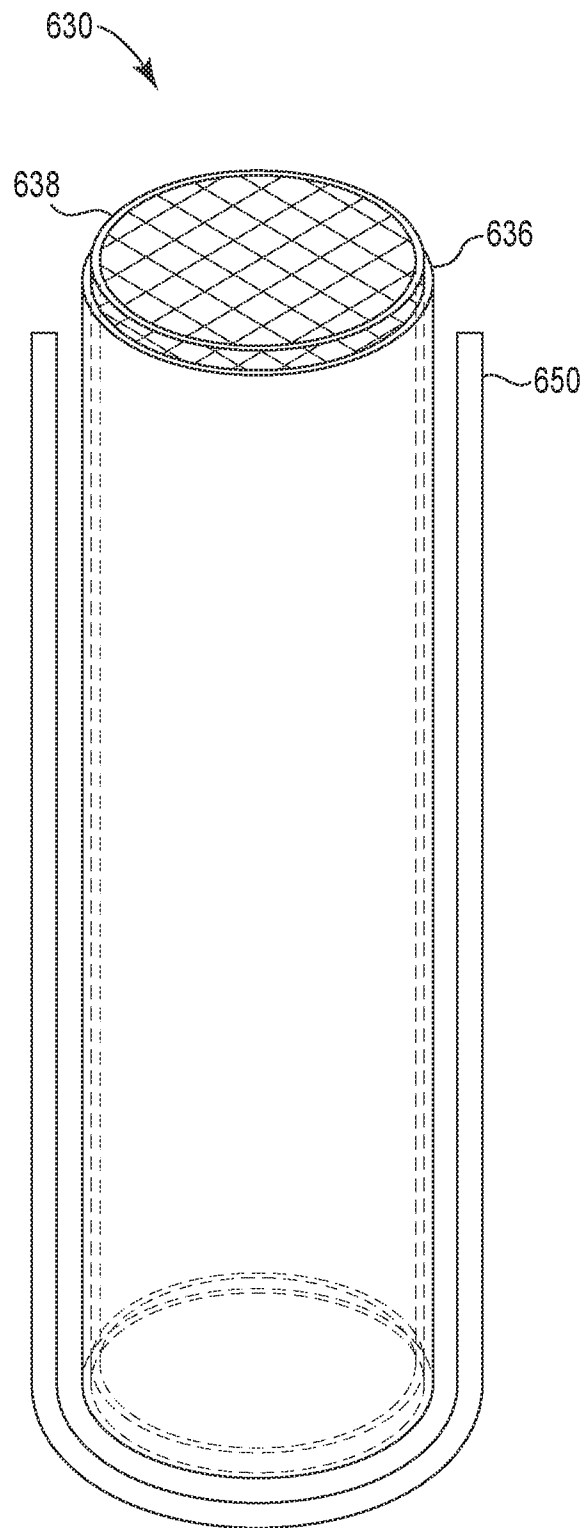


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2025/010033

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: Claims 1-13, directed to a degasser pump rubber.

Group II: Claims 14-20, directed to a method of forming a pump rubber.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: **1-13**

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2025/010033**A. CLASSIFICATION OF SUBJECT MATTER**IPC: **E21B 21/06** (2025.01); **F04B 43/12** (2025.01); **B01D 19/00** (2025.01)CPC: **E21B 21/067**; **F04B 43/0072**; **F04B 43/12**; **B01D 19/00**

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)

See Search History Document

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

See Search History Document

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

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 9,353,621 B2 (HALLIBURTON ENERGY SERVICES, INC.) 31 May 2016 (31.05.2016) Fig 2; col 2, ln 61-67; col 3, ln 18-22, 31-32, 38-41, 46-47; col 6, ln 30-43; col 7, ln 7-16	1-13
Y	US 2007/0048476 A1 (PARK) 01 March 2007 (01.03.2007) Fig 5A; para [0049], [0058]-[0059], [0104], [0107], [0121]	1-13
Y	WO 2022/074442 A1 (ELETTRATECNICA ROLD S.R.L.) 14 April 2022 (14.04.2022) Fig 1-3; pg 4, ln 30-31; pg 7, ln 23-25; pg 10, ln 12-18	2-3
A	US 10,711,573 B2 (WEATHERFORD U.K. LIMITED) 14 July 2020 (14.07.2020) Fig 2; col 9, ln 27-30	1, 8
A	US 10,655,464 B2 (GEOSERVICES EQUIPEMENTS) 19 May 2020 (19.05.2020) entire document	1-13
A	WO 2004/027208 A1 (GEOLOG S.P.A. et al.) 01 April 2004 (01.04.2004) entire document	1-13



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

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“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

27 February 2025 (27.02.2025)

Date of mailing of the international search report

09 May 2025 (09.05.2025)

Name and mailing address of the ISA/US

COMMISSIONER FOR PATENTS
MAIL STOP PCT, ATTN: ISA/US
P.O. Box 1450
Alexandria, VA 22313-1450
UNITED STATES OF AMERICA

Facsimile No. **571-273-8300**

Authorized officer

KARI RODRIQUEZTelephone No. **PCT Help Desk: 571-272-4300**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2025/010033

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01/27474 A1 (WOOD et al.) 19 April 2001 (19.04.2001) entire document	1-13
<hr/>		