Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2843269 A1 2013/01/31

(21) 2 843 269

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2011/07/26
(87) Date publication PCT/PCT Publication Date: 2013/01/31
(85) Entrée phase nationale/National Entry: 2014/01/27
(86) N° demande PCT/PCT Application No.: US 2011/045298
(87) N° publication PCT/PCT Publication No.: 2013/015785

(51) Cl.Int./Int.Cl. *E21B 33/08* (2006.01),
E21B 17/10 (2006.01)

(71) Demandeur/Applicant:
HALLIBURTON ENERGY SERVICES, INC., US

(72) Inventeurs/Inventors:
HOLTZMAN, KEITH E., US;
JEFFRIES, STUART MAXWELL, US;
CLINGMAN, PHILLIP FLOYD, US;
ASHBAUGH, JACK, US

(74) Agent: EMERY JAMIESON LLP

(54) Titre : DISPOSITIF DE REDUCTION DE FROTTEMENT POUR TUYAU DE FORAGE
(54) Title: FRICTION REDUCTION DEVICE FOR DRILL PIPE

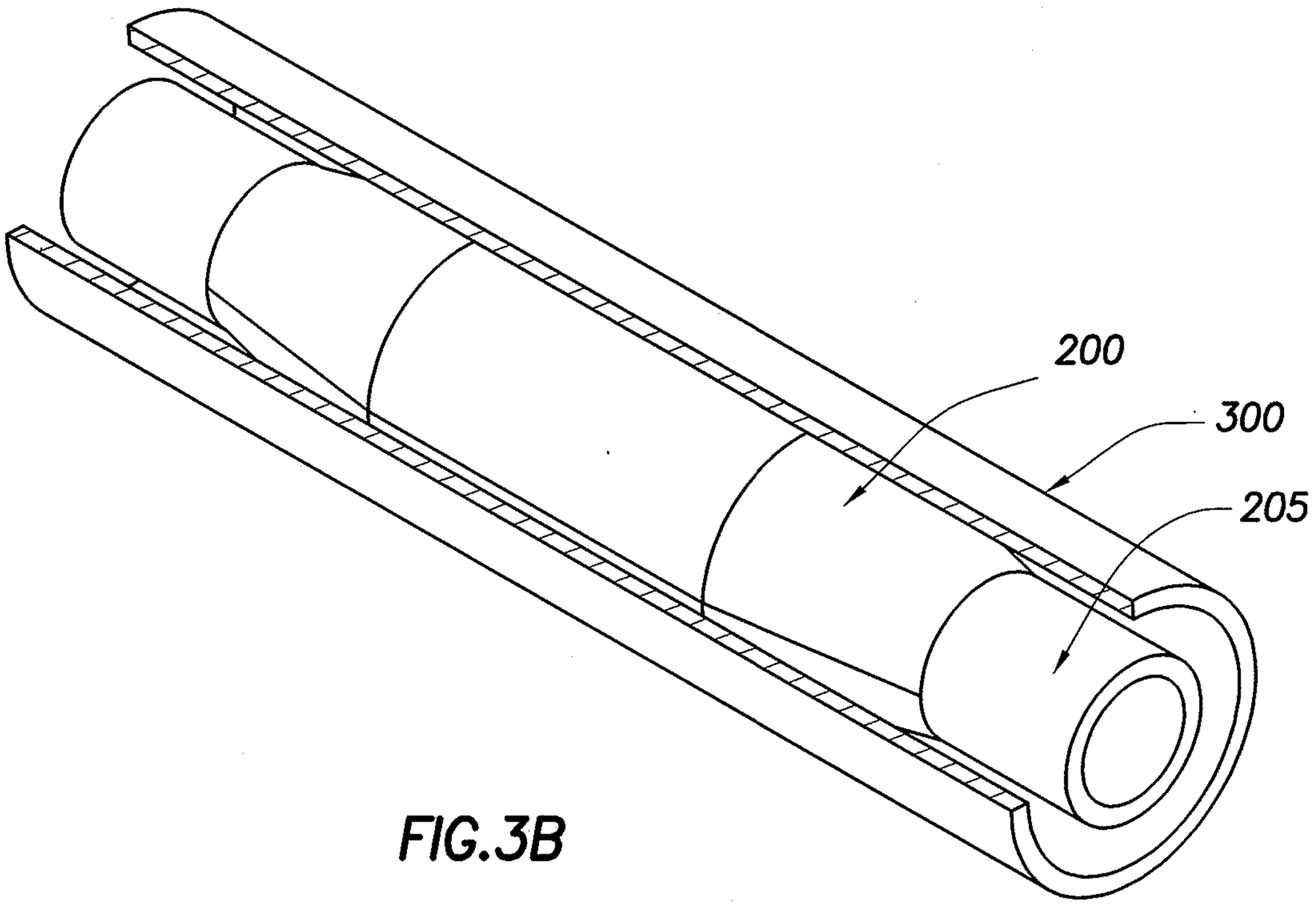

FIG.3B

(57) Abrégé/Abstract:
A device to couple to a rotatable drill pipe to control pressure of a drilling system is disclosed. The device includes an inner surface to wrap around a portion of a rotatable drill pipe and having an inner diameter. A first tapered portion is opposite a second tapered portion, with a middle portion therebetween including an outer diameter greater than the inner diameter. The first and second tapered portions each taper from the outer surface to the inner surface. The middle portion, the first tapered portion, and the second tapered portion form an outer surface to sealingly pass through a seal element of a controlled-pressure drilling system. At least a portion of the outer surface corresponding to the middle portion includes a low-friction material.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 January 2013 (31.01.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/015785 A1

(51) International Patent Classification:
E21B 33/08 (2006.01) *E21B 17/10* (2006.01)

(21) International Application Number:
PCT/US2011/045298

(22) International Filing Date:
26 July 2011 (26.07.2011)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **HALLIBURTON ENERGY SERVICES, INC.** [US/US]; 10200 Bellaire Boulevard, Houston, TX 77072 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **HOLTZMAN, Keith, E.** [US/US]; 8213 Simms Court, Arvada, CO 80005 (US). **JEFFRIES, Stuart, Maxwell** [AU/US]; 2935 Captain Cook Estates Blvd., Anchorage, AK 99518 (US). **CLINGMAN, Phillip, Floyd** [US/US]; 2807 Leawood, Anchorage, AK 99502 (US). **ASHBAUGH, Jack** [US/US]; 206 Herritage, Lafayette, LA 70503 (US).

(74) Agent: **SWEHLA, Aaron**; Baker Botts LLP, 910 Louisiana Street, Houston, TX 77002 (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, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: FRICTION REDUCTION DEVICE FOR DRILL PIPE

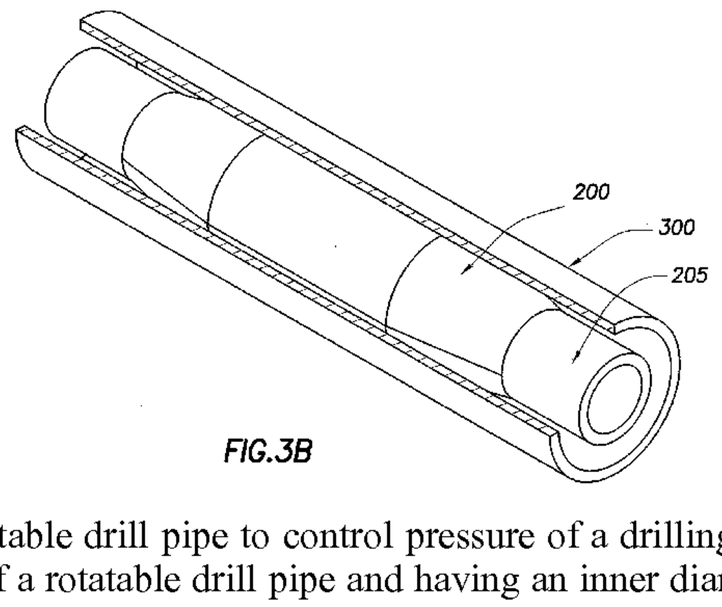

FIG.3B

(57) Abstract: A device to couple to a rotatable drill pipe to control pressure of a drilling system is disclosed. The device includes an inner surface to wrap around a portion of a rotatable drill pipe and having an inner diameter. A first tapered portion is opposite a second tapered portion, with a middle portion therebetween including an outer diameter greater than the inner diameter. The first and second tapered portions each taper from the outer surface to the inner surface. The middle portion, the first tapered portion, and the second tapered portion form an outer surface to sealingly pass through a seal element of a controlled-pressure drilling system. At least a portion of the outer surface corresponding to the middle portion includes a low-friction material.

WO 2013/015785 A1

FRICTION REDUCTION DEVICE FOR DRILL PIPE

BACKGROUND

The present disclosure generally relates to devices for tubulars in a well bore and, more particularly, to mechanical friction reduction devices for drilling tubulars in a well bore.

Managed pressure drilling and underbalanced drilling are well known approaches in the subterranean well drilling and completion art that control pressure downhole in a drilling system. These methods utilize sealing elements to control pressure in the well bore through which tubulars must pass. It is desirable to reduce friction, to reduce wear, and to prevent buckling associated with tubulars in a well bore, while allowing for effective pressure seals in managed pressure drilling and underbalanced drilling systems.

FIGURES

Some specific exemplary embodiments of the disclosure may be understood by referring, in part, to the following description and the accompanying drawings.

Figure 1 is a cross-sectional schematic of part of an example drilling system.

Figure 2 is a side view of a friction reduction device coupled to a rotatable tubular, in accordance with certain embodiments of the present disclosure.

Figure 3A is a cross-sectional view of a friction reduction device coupled to a rotatable tubular disposed within a drill pipe, in accordance with certain embodiments of the present disclosure.

Figure 3B is an isometric cutaway view of the friction reduction device coupled to the rotatable tubular disposed within the drill pipe of Figure 3A, in accordance with certain embodiments of the present disclosure.

While embodiments of this disclosure have been depicted and described and are defined by reference to exemplary embodiments of the disclosure, such references do not imply a limitation on the disclosure, and no such limitation is to be inferred. The subject matter disclosed is capable of considerable modification, alteration, and equivalents in form and function, as will occur to those skilled in the pertinent art and having the benefit of this disclosure. The depicted and described embodiments of this disclosure are examples only, and not exhaustive of the scope of the disclosure.

DETAILED DESCRIPTION

The present disclosure generally relates to devices for tubulars in a well bore and, more particularly, to mechanical friction reduction devices for drilling tubulars in a well bore.

Illustrative embodiments of the present disclosure are described in detail herein. In the interest of clarity, not all features of an actual implementation may be described in this specification. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the specific implementation goals, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of the present disclosure.

To facilitate a better understanding of the present disclosure, the following examples of certain embodiments are given. In no way should the following examples be read to limit, or define, the scope of the disclosure. Embodiments of the present disclosure may be applicable to horizontal, vertical, deviated, or otherwise nonlinear wellbores in any type of subterranean formation. Embodiments may be applicable to injection wells as well as production wells, including hydrocarbon wells.

Figure 1 is a cross-sectional schematic of part of an example drilling system 100 for drilling a borehole traversing earth formations (not shown). The drilling system 100 may be a managed pressure drilling system, an underbalanced drilling system, or any drilling system where a tubular passes through a seal element. In the schematic, only major components are shown, with details of standard type found in typical drilling systems omitted. Managed pressure drilling and underbalanced drilling are well known approaches in the subterranean well drilling and completion art that control pressure downhole in a drilling system. These methods utilize sealing elements to control pressure in the well bore through which tubulars must pass.

A rotatable tubular 105 is shown in an example position in which it may be during a drilling process. The rotatable tubular 105 may be coupled to a drill bit (not shown). In certain applications, the rotatable tubular 105 may be coupled to one or more other rotatable tubulars (not shown) in a drill string. The rotatable tubular 105 may extend through section 110, which may be a riser or a drill pipe, for example. The rotatable tubular 105 also may extend past a seal element 115, which may be any seal element or assembly suitable for the controlled-pressure application of the drilling system 100. For example without limitation, the seal element 115 may be an active or passive sealing element, may include one or more rubber elements, and/or may be part of a safety device that can be closed around the rotatable tubular 105, such as an annular

BOP, a ram BOP, or an active RCD device.

Friction from the rotation of the rotatable tubular 105 and contact with exterior surfaces can reduce the effective torque of the drill string and can cause wear and/or damage. The friction due to the tubular 105 sliding on surfaces during changes in along-hole depth also can cause wear and/or damage and inhibit movement. In addition, the tubular 105 impacting other surfaces due to the variations and vibrations of the drilling process can be another cause of wear and/or damage.

Figure 2 is a side view of a friction reduction device 200 coupled to a rotatable tubular 205, in accordance with certain embodiments of the present disclosure. In certain embodiments, the tubular 205 may correspond to the tubular 105 of drilling system 100. Figure 3A is a cross-sectional view of the friction reduction device 200 coupled to a rotatable tubular 205 disposed within a drill pipe 300, in accordance with certain embodiments of the present disclosure. Figure 3B is a corresponding isometric cutaway view.

The friction reduction device 200 may be generally cylindrical with a cylindrical surface contacting an outer cylindrical surface of the tubular 205. The friction reduction device 200 may be removably attached or fixedly attached to the tubular 205. In certain embodiments, the friction reduction device 200 may be designed as compression fitting sleeve or integrally formed with the tubular 205. In certain embodiments, the friction reduction device 200 may be attached by way of a suitable adhesion and/or catalyst/resin binding process.

The friction reduction device 200 may include a middle or wide portion 210 with an outer diameter 210A and having an outer cylindrical surface 210B. The outer cylindrical surface 210B may be parallel to an inner cylindrical surface 210C of the friction reduction device 200. The outer cylindrical surface 210B may be generally parallel or at least radially exterior to the inner cylindrical surface 210C in certain embodiments. The inner cylindrical surface 210C may abut an outer diameter 205A of the tubular 205. The friction reduction device 200 may include a tapered portion 215A opposite a tapered portion 215B, with the middle portion 210 therebetween. The tapered portions 215A, 215B may taper from the outer cylindrical surface 210A to the inner cylindrical surface 210B, forming a smooth frusto-conical outer surface. As such, the friction reduction device 200 may form a protective sleeve about a portion of the tubular 205.

As depicted, the combined longitudinal length of the tapered portions 215A, 215B may be greater than the longitudinal length of the middle portion 210. In alternative embodiments, the combined longitudinal length of the tapered portions 215A, 215B may be less than or equal to the longitudinal length of the middle portion 210. As depicted, the tapered

portions 215A, 215B may be symmetrical about the middle portion 210. In alternative embodiments, the tapered portions 215A, 215B may be asymmetrical. Moreover, while the friction reduction device 200 is depicted as having a uniform, solid interior, certain alternative embodiments may have interiors that are not uniformly solid. And, while friction reduction device 200 is shown disposed within the drill pipe 300, certain embodiments may be used in applications without an exterior drill pipe, for example, where the rotatable tubular is exposed to a casing or a borehole wall.

The geometry of the friction reduction device 200 allows for an effective pressure seal with seal elements of managed pressure drilling systems and/or underbalanced drilling systems, such as drilling system 100 where the tubular 105 passes through the seal element 115. For example, the tapered portions 215A, 215B and the middle portion 210 may provide a plurality of continuous circular surfaces that facilitate the passage through the seal element 115 while maintaining an effective pressure seal. Maintaining an effective pressure seal is very important in controlling bottom hole pressure in such systems. While providing friction reduction, the friction reduction device 200 coupled to the tubular 205 may sealingly pass through the sealing element 115, *i.e.*, pass without breaking the effective seal of that element and without allowing for pressure bypass that would render managed pressure drilling and underbalanced drilling ineffective.

The friction reduction device 200 may made from any suitable material, including a suitable abrasion-resistant material. During the drilling process, the rotatable tubular 205 may be subject to various forces such as compressive, tensile and shear forces. The geometry and material of the friction reduction device 200 may reinforce the tubular 205 to resist or prevent buckling or other damages due to the forces.

The friction reduction device 200 may or may not include a low-friction material including but not limited to: Teflon, ceramics, poly carbonate, plastics, carbon fiber or resins or any other suitable material with a low coefficient of friction. The low-friction coefficient of one or more of the middle portion 210 and tapered portions 215A, 215B may further facilitate the passage through the seal element 115 while maintaining an effective pressure seal. In certain embodiments, only the middle portion 210 may be made from or include low-friction material. And, in certain embodiments, one or more of the outer surfaces of the friction reduction device 200 may 210B may be made from or include low-friction material and, *e.g.*, may be plated or coated with the low-friction material.

Accordingly, the geometry and low-friction material of the friction reduction device 200 may reduce friction associated with the movement of the rotatable tubular 105. With

the outer diameter of the friction reduction device 200 greater than the diameter 205A of the rotatable tubular 205, the friction reduction device 200 may contact an inner diameter 305A drill pipe 300 instead of the tubular 205 contacting the drill pipe 300. By reducing friction associated with rotation, the friction reduction device 200 allows for increased torque. The friction reduction device 200 also reduces friction associated with traversing along the drill pipe 300 or another surface, thereby facilitating the sliding of the tubular 105. Thus, the friction reduction device 200 increases the efficiency of drilling while facilitating the central alignment of the tubular 205 and protecting the tubular 105 from damage due to abrasion and impacts with the exterior drill pipe 300.

Therefore, the present disclosure is well adapted to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the present disclosure may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular illustrative embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the present disclosure. Also, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee. The indefinite articles "a" or "an," as used in the claims, are defined herein to mean one or more than one of the element that it introduces.

WHAT IS CLAIMED IS:

1. A device to couple to a rotatable drill pipe to control pressure of a drilling system, the device comprising:

an inner surface to wrap around a portion of a rotatable drill pipe and having an inner diameter; and

a first tapered portion opposite a second tapered portion, with a middle portion therebetween comprising an outer diameter greater than the inner diameter;

wherein:

the first and second tapered portions each taper from the outer surface to the inner surface;

the middle portion, the first tapered portion, and the second tapered portion form an outer surface to sealingly pass through a seal element of a controlled-pressure drilling system; and

at least a portion of the outer surface corresponding to the middle portion comprises a low-friction material.

2. The device of claim 1, wherein the middle portion forms an outer cylindrical surface portion.

3. The device of claim 1, wherein the middle portion forms an outer surface portion that is parallel to the inner surface.

4. The device of claim 1, wherein the low-friction material is Teflon.

5. The device of claim 1, wherein the middle portion forms an outer surface portion having a single radius, and the first and second tapered portions each comprise an outer frusto-conical surface portion.

6. The device of claim 1, wherein the outer surface comprises a low-friction material.

7. A reduced-friction rotatable tubular system for a controlled-pressure drilling system, comprising:

a drill pipe to be disposed in a wellbore and having an inside diameter;

a rotatable tubular extending through at least a portion of the drill pipe and having an outside diameter;

a friction reduction device disposed around a portion of the rotatable tubular, wherein the friction reduction device comprises:

an inner surface having an inner diameter; and

a first tapered portion opposite a second tapered portion, with a middle portion therebetween comprising an outer diameter greater than the inner diameter;

wherein the middle portion, the first tapered portion, and the second tapered portion form an outer surface to sealingly pass through a seal element of a controlled-pressure drilling system; and

wherein at least a portion of the outer surface corresponding to the middle portion comprises a low-friction material.

8. The reduced-friction rotatable tubular system of claim 7, wherein the friction reduction device prevents the rotatable tubular from contacting the drill pipe.

9. The reduced-friction rotatable tubular system of claim 7, wherein the first and second tapered portions each taper from the outer surface to the inner surface of the friction reduction device.

10. The reduced-friction rotatable tubular system of claim 7, wherein the middle portion forms an outer cylindrical surface portion.

11. The reduced-friction rotatable tubular system of claim 7, wherein the middle portion forms an outer surface portion that is parallel to the inner surface.

12. The reduced-friction rotatable tubular system of claim 7, wherein the low-friction material is Teflon.

13. The reduced-friction rotatable tubular system of claim 7, wherein the middle portion forms an outer surface portion having a single radius, and the first and second tapered portions each comprise an outer frusto-conical surface portion.

14. The reduced-friction rotatable tubular system of claim 7, wherein the outer surface comprises a low-friction material.

15. A method of reducing friction in a controlled-pressure drilling system, the method comprising:

disposing a drill pipe in a wellbore, the drill pipe having an inside diameter;

extending a rotatable tubular through at least a portion of the drill pipe, the rotatable tubular having an outside diameter;

coupling a friction reduction device to a portion of the rotatable tubular, wherein the friction reduction device comprises:

an inner surface having an inner diameter; and

a first tapered portion opposite a second tapered portion, with a middle portion therebetween comprising an outer diameter greater than the inner diameter;

wherein the middle portion, the first tapered portion, and the second tapered portion form an outer surface to sealingly pass through a seal element of a controlled-pressure drilling system; and

wherein at least a portion of the outer surface corresponding to the middle portion comprises a low-friction material.

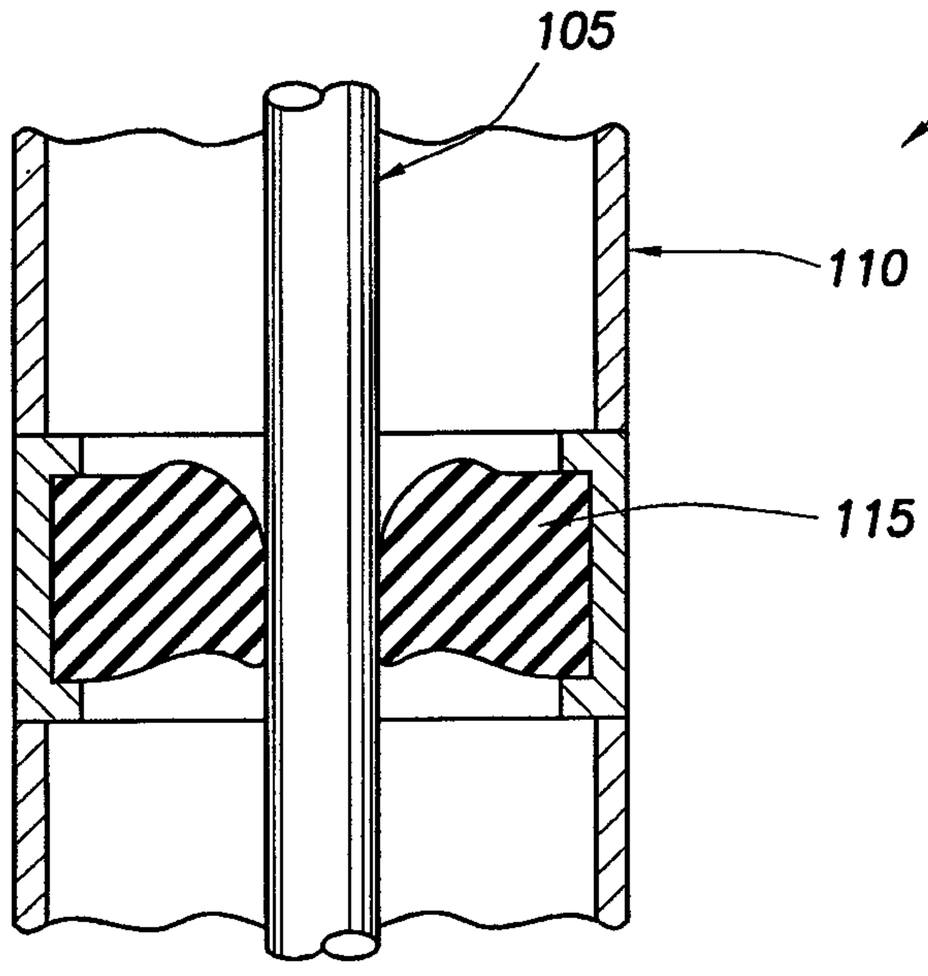

FIG. 1

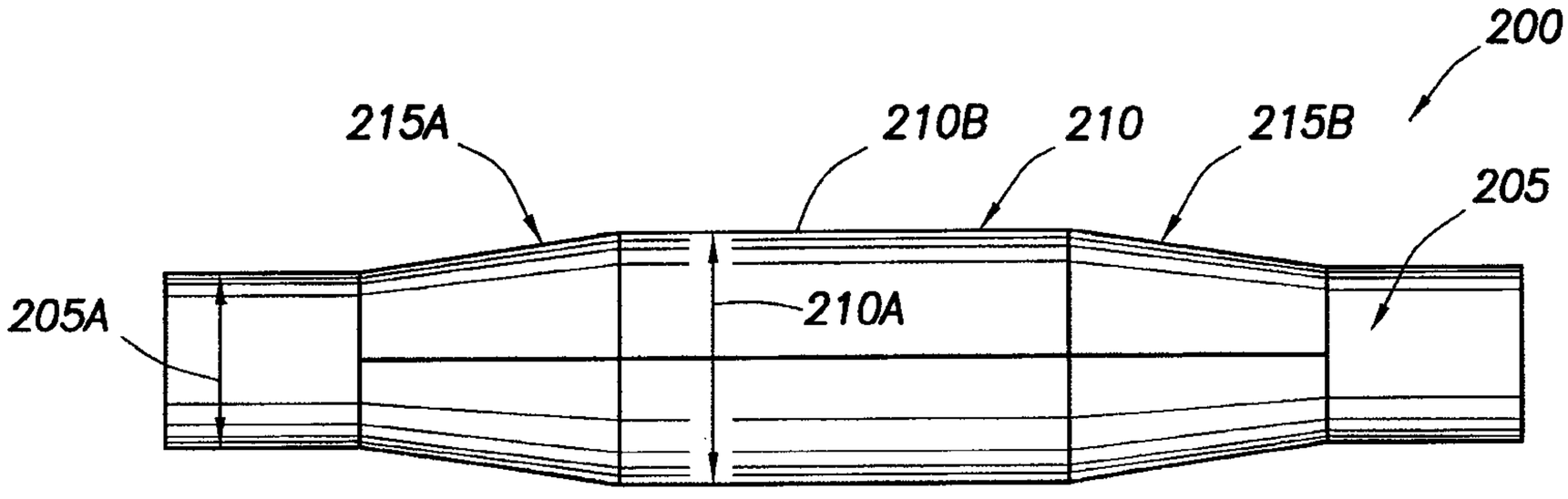

FIG. 2

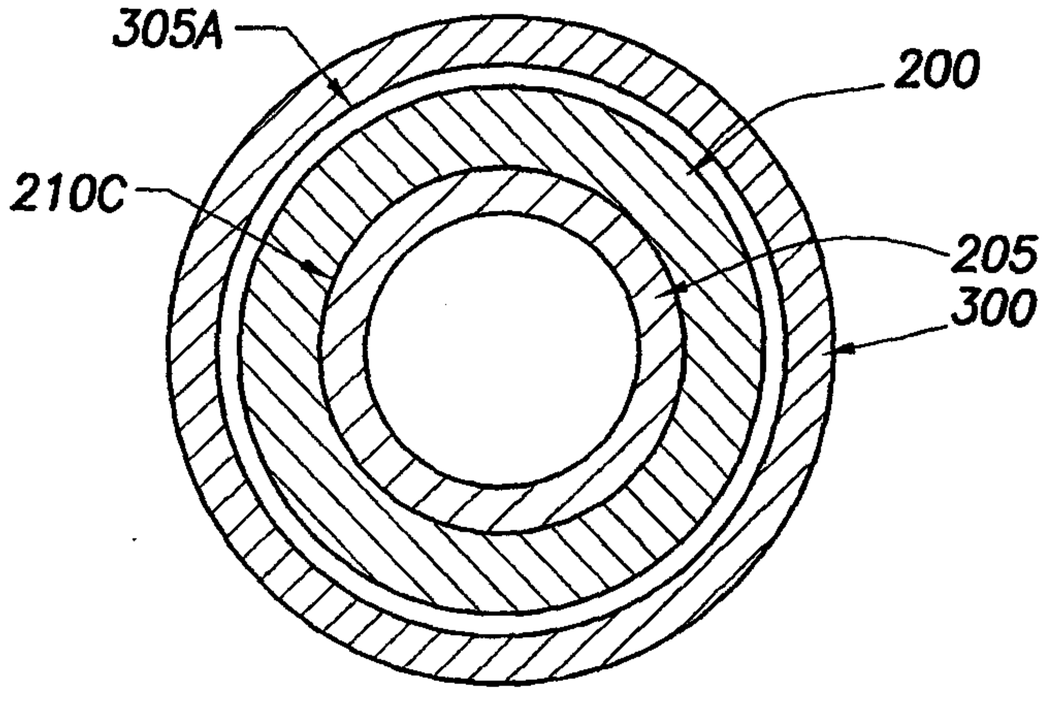

FIG.3A

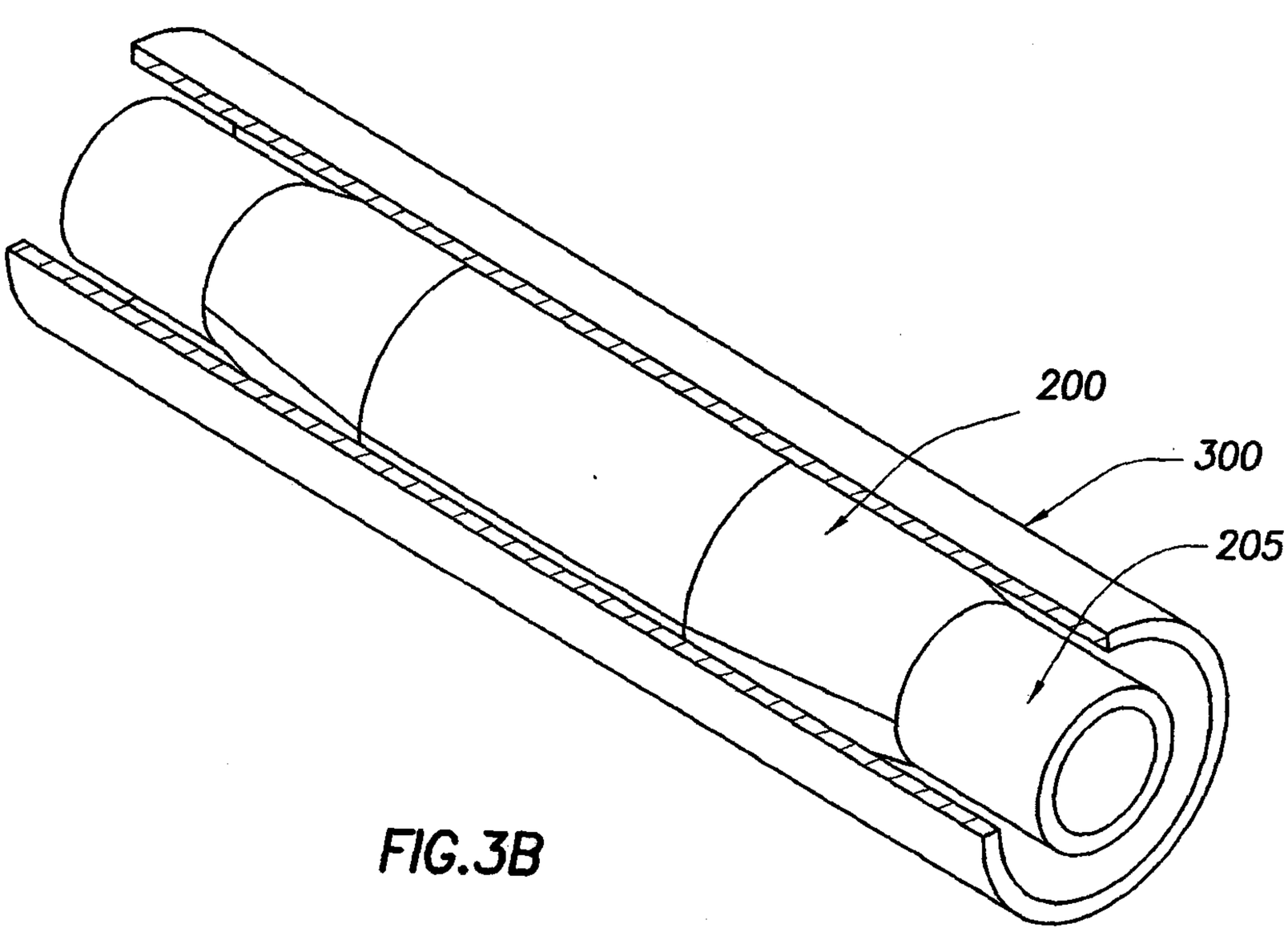

FIG.3B

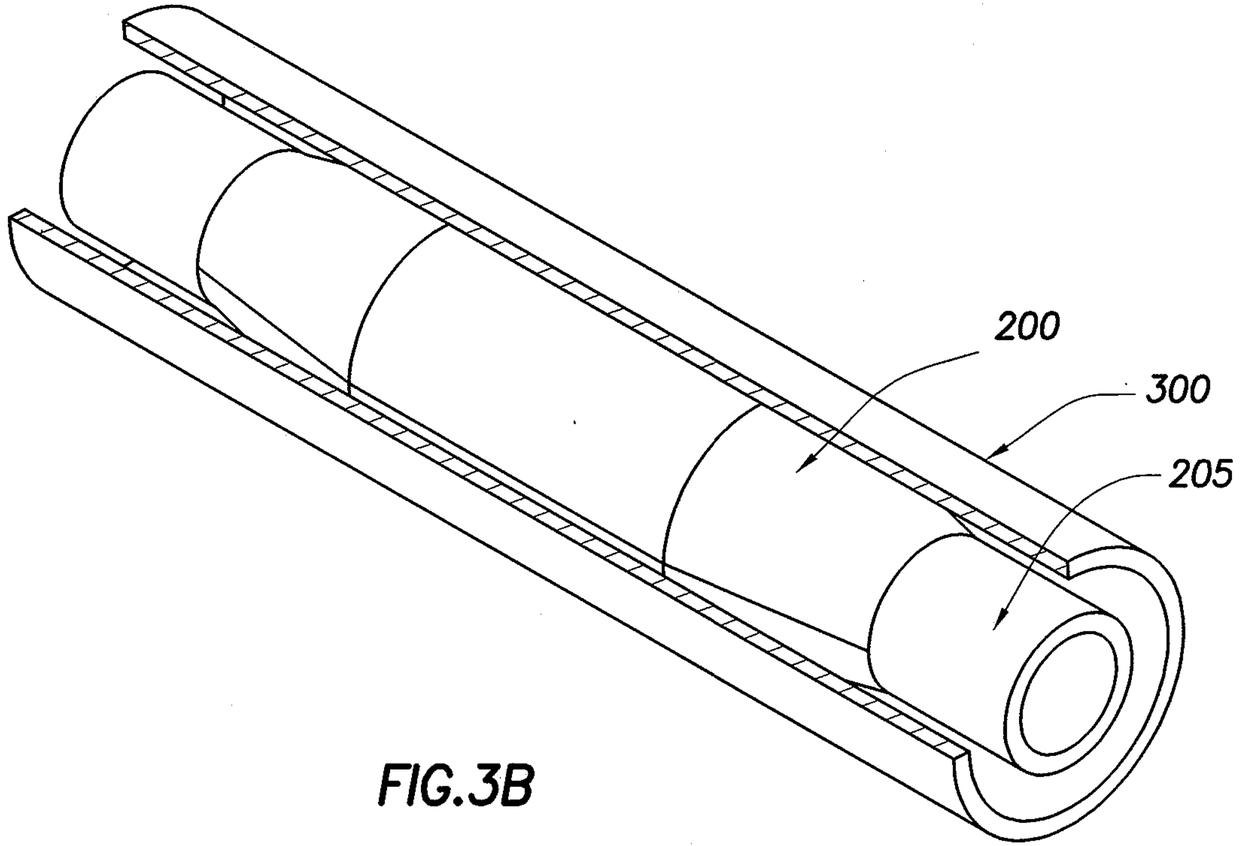

FIG.3B