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(54) **HIGH TEMPERATURE AND PRESSURE PACKER**

nPACKER FÜR HOHEN DRUCK UND TEMPERATUREN

PACKER HAUTE TEMPERATURE ET HAUTE PRESSION

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(56) References cited:
EP-A- 0 959 226
US-A- 3 109 493
US-A- 4 452 463
US-A- 4 457 369
US-A- 5 176 217
US-A- 5 343 946
US-B1- 6 343 791

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Description

[0001] The present invention relates to downhole packers. More particularly, the present invention relates to a high pressure and temperature element system for a downhole packer.

[0002] Downhole packers are typically used to seal an annular area formed between two co-axially disposed tubulars within a wellbore. For example, downhole packers may seal an annulus formed between production tubing disposed within wellbore casing. Alternatively, packers may seal an annulus between the outside of a tubular and an unlined borehole: Routine uses of packers include the protection of casing from pressure, both well and stimulation pressures, as well as the protection of the wellbore casing from corrosive fluids. Other common uses include the isolation of formations or leaks within a wellbore casing or multiple producing zones, thereby preventing the migration of fluid between zones. Packers may also be used to hold kill fluids or treating fluids within the casing annulus.

[0003] Conventional packers typically comprise a sealing element located between upper and lower retaining rings or elements. The sealing element is typically a synthetic rubber composite which can be compressed by the retaining rings to expand radially outward into contact with an inner surface of a well casing there-around. This compression and expansion of the sealing element seals the annular area by preventing the flow or passage of fluid across the expanded sealing element.

[0004] Conventional packers are typically run into a wellbore within a string of tubulars and anchored in the wellbore using mechanical compression setting tools or fluid pressure devices. Conventional packers are also typically installed using cement or other materials pumped into an inflatable sealing element.

[0005] One problem associated with conventional packers arises with high temperature and/or high pressure applications. High temperatures are generally defined as downhole temperatures above 300°F (149°C) and up to 450°F (232°C). High pressures are generally defined as downhole pressures above 7,500 psi (52 MPa) and up to 15,000 psi (103 MPa). At these temperatures and pressures, conventional sealing elements become ineffective. Most often, the physical properties of the sealing element suffer from degradation due to the extreme conditions. For example, the sealing element may experience a loss of elasticity. Alternatively, the sealing element may melt or otherwise decrease in viscosity and flow or extrude.

[0006] Another problem associated with conventional packers occurs during the activation of the conventional packer at high temperatures and pressures. Most often, the sealing element softens and possibly flows before the packer reaches its final destination in the wellbore. Consequently, the sealing element becomes disconfigured and cannot be properly activated. As a result, the sealing element does not adequately seal the annulus.

[0007] US 4457369 discloses a packer having a seal assembly including a plurality of annular elements of different elasiticities mounted between slip assemblies.

[0008] US 3109493 discloses a packer with a retaining system which includes an expansion ring for preventing the extrusion of a packing sleeve.

[0009] Therefore, there is a need for a downhole packer having an element system that can resist or prevent extrusion or degradation in high temperature and/or high pressure applications. There is also a need for a method for actuating a downhole packer that can withstand a high temperature and/or high pressure environment by staging the expansion of a sealing element and minimizing a void within an annulus to be sealed.

[0010] A downhole packer having an element system that can withstand high temperature and high pressure environments is provided. A method for actuating a downhole packer is also provided which can withstand high temperature and high pressure environments by staging the expansion of an element system and minimizing a void within an annulus to be sealed. The packer can withstand temperatures up to 450°F (232°C) and differential pressures up to 15,000 psi (103 MPa).

[0011] In accordance with a first aspect of the present invention there is provided a packer for sealing an annulus in a wellbore, comprising a body, a sealing system disposed about the body including an element having an anti-extrusion ring at an end thereof, the sealing system being compressible in length and expandable in outer diameter to seal the annulus, and an extrusion ring disposed substantially on an inner diameter of the anti-extrusion ring such that flow of the extrusion ring in a direction opposite the element is inhibited by the anti-extrusion ring, wherein the anti-extrusion ring comprises a lip or extrusion disposed thereon arranged to interact with the extrusion ring so that the anti-extrusion ring is carried by the extrusion ring as it flows across the body.

[0012] Further preferred features are set out in claims 2 *et seq.*

[0013] In accordance with a second aspect of the invention there is provided a method for sealing an annulus in a wellbore, comprising running a packer into the wellbore, the packer comprising a body and a sealing system comprising an element and an anti-extrusion ring having a lip, the element being disposed about the body proximate the anti-extrusion ring, an extrusion ring being disposed substantially on an inner diameter of the anti-extrusion ring; flowing the extrusion ring radially outward and axially across the body in a direction opposite the element to fill a portion of the annulus and carry the anti-extrusion ring using the lip; and radially expanding the element to fill a remaining portion of the annulus.

[0014] Some preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a cross section of a packer;

Figure 1A is an enlarged view of a retaining assembly disposed about a body of the packer shown in Figure 1;

Figure 2 is a partial cross section of the packer during a first stage of activation;

Figure 3 is a partial cross section of the packer during a second stage of activation;

Figure 4 is a partial cross section of the packer during a third stage of activation; and

Figure 4A is an enlarged view of the element system disposed about the body of the packer shown in Figure 4 during the third stage of activation.

[0015] Figure 1 is a cross section of a high temperature down hole packer 100. The packer 100 includes a body 102 having a first and second retaining system and an element system disposed there-around. The body 102 may include a longitudinal bore there through, and may include a sealed bore there-through. The retaining systems are disposed at either end of the element system and all are comprised of ring-shaped components concentrically disposed about the body 102. The element system comprises filler rings 320, 620, containment rings 340, 640, anti-extrusion rings 360, 660, back-up rings 380, 680, and an element 500. The first and second retaining system each comprise a slip 200, 400, a cone 220, 420, an expansion ring 260, 460, and a slide ring 300, 600. In operation, the retaining systems secure the packer 100 within a tubular therearound, such as casing for example, and provide the boundaries of an annular area for the element system to expand and seal, thereby providing an effective seal in high temperature and high pressure applications.

[0016] For ease and clarity of description, the packer 100 will be further described in more detail as if disposed within a tubular 700 in a vertical position as oriented in the Figures. It is to be understood, however, that the packer 100 may be disposed in any orientation, whether vertical or horizontal. It is also to be understood that the packer 100 may be disposed in a borehole without a tubular therearound. Additionally, for ease and clarity of description, the first retaining system and an upper portion of the element system will be described since the components of the second retaining system and a lower portion of the element system are substantially identical.

[0017] Considering the retaining system in greater detail, the slip 200 is disposed about the body 102 adjacent a first end 221 of the cone 220. Each slip 200 comprises a tapered inner surface 201 conforming to the first end 221 of the cone 220. An outer surface of the slip 200, preferably includes at least one outwardly extending serration or edged tooth 205, to engage an inner surface of the tubular 700 when the slip 200 is driven radially outward from the body 102 by the movement of the sloped surfaces of the cones thereunder.

[0018] The slip 200 is designed to fracture with radial stress as the cones are driven thereunder. The slip 200 typically includes at least one recessed groove (not shown) milled therein to fracture under stress allowing the slip 200 to expand outwards to engage the inner surface of the tubular 700. For example, the slip 200 may include four evenly sloped segments separated by equally spaced recessed grooves to contact the tubular 700 and become evenly distributed about the outer surface of the body 102.

[0019] The cone 220 is disposed about the body 102 adjacent the slip 200 and is secured to the body 102 by a plurality of shearable members like screws 106. As stated above, the cone 220 comprises a tapered first end 221 which rests underneath the tapered inner surface 201 of the slip 200. The slip 200 travels about the tapered first end 221 of the cone 220, thereby expanding radially outward from the body 102 to engage the inner surface of the tubular 700. Referring to Figure 1A, the cone 220 also comprises a second end 223 which is tapered and abuts a corresponding tapered end 261 of the expansion ring 260.

[0020] Referring to Figures 1 and 1A, the expansion ring 260 is disposed between the cone 220 and the slide ring 300. In the preferred embodiment, the expansion ring 260 includes a male split ring 270 and a female split ring 280. The male and female split rings 260, 270, are disposed about the body 102 so that their respective expandable openings and are not vertically aligned. In this orientation, the male split ring 270 and female split ring 280 provide a solid circumferential barrier against extruded or expanded material of back-up ring 380. The male split ring 270, as depicted in section view, includes three sides. A first side 261 has a sloped surface corresponding to the sloped second end 223 of the cone 240 as described above. A second side is substantially flat or perpendicular to the body 102, with an extension 265 extending therefrom. The female split ring 280 also includes three sides, visible in section view, including a substantially flat or perpendicular first side having a recessed groove 285 disposed therein. The female split ring 280 also includes a second side having a tapered surface 283 to abut a first end of the slide ring 300. The extension 265 disposed on the second side of the male split ring 270 is disposable within the recessed groove 285. The extrusion 265 and recessed groove 285 allow the male and female split ring 270 to engage one another thereby allowing the expansion rings 260, 460, to move radially outward from the body 102 as a single unit 260.

[0021] The slide ring 300 includes a first end having a first 301 and second 303 tapered surface. The first tapered surface 301 corresponds to the second end 283 of the female split ring 280. The second tapered surface 303 is sloped in an opposite direction from the first tapered surface 301 and corresponds to the sloped second end 223 of the cone 240. The slide ring 300 also

includes a second end abutting the filler ring 320 and having an extension or lip 307 disposed thereon. The lip extends axially away from the slide ring 300 toward the element 500 and extends between a portion of an inner surface of the filler ring 320, 620 and an outer surface of the body 102.

[0022] Considering the element system in greater detail, the filler ring 320 comprises two sections, a larger diameter section and a smaller diameter section which form a shoulder 325 at the interface of the two sections. The smaller diameter section of the filler ring 320 is disposed about the extension 307 of slide ring 300. The larger diameter section rests against the outer surface of the body 102. The filler ring 320 may be manufactured from, for example, Teflon® or any flexible plastic or resin material which flows at a predetermined temperature. As will be explained below, the filler ring 320 will expand under high temperature and/or pressure and create a collapse load on the extension 307 of the slide ring 300. This collapse load holds the slide ring 300 firmly against the body 102.

[0023] A spacer ring 310 is disposed about the body 102 between the slide ring 300 and the filler ring 320. The spacer ring 310 serves to accommodate tolerance variations created during the manufacturing of the element system.

[0024] The back-up ring 380 is disposed about the body 102 between the element 500 and the filler ring 320. The back-up ring 380 includes a recessed groove 385 formed in a portion of an outer surface thereof. Similar to the filler ring 320 the back-up ring 380 may be manufactured from, for example, Teflon@ or any flexible plastic or resin material which flows at a predetermined temperature. At high temperatures, the back-up ring 380 expands radially outward from the body 102 and flows across the outer surface of the body 102. As will be explained below, the back-up ring 380 helps to fill a void 550 created between the expansion rings 260, 460, thereby reducing a volume of the void 550 to be filled by the element 500.

[0025] The anti-extrusion ring 360 is disposed in a portion of the groove 385 and extends over the second portion of the filler ring 320. The anti-extrusion ring 360 includes a lip 365 which extends radially inward toward the body 102. The lip 365 is disposed adjacent the shoulder 325 formed between the larger diameter and the smaller diameter sections of the filler ring 320. As will be explained below, the lip 365 prevents the filler ring 320 from flowing or travelling between the anti-extrusion ring 360 and the container ring 340. The lip or extrusion 365 also acts as a carrier when the back-up ring 380 expands and travels over the slide ring 300.

[0026] The containment ring 340 is disposed about an outer surface of the smaller diameter section of the filler ring 320, 620. The containment ring 340 include a first end which abuts the spacer ring 310 and a second end which abuts the anti-extrusion ring 360. As will be explained below, the containment ring 340 holds the filler ring 320 in place and prevents the filler ring 320 from extruding across an outer surface of the slide ring 300.

[0027] The element 500 is disposed about the body 102 between the back-up rings 380, 680. The element 500 may have any number of configurations to effectively seal the annulus created between the body 102 and the casing wall. For example, the element 500 may include grooves, ridges, indentations, or extrusions designed to allow the element 500 to conform to variations in the shape of the interior of the tubular 700 thereabout. The element 500 can be constructed of any expandable or otherwise malleable material which creates a permanent set position and stabilizes the body 102 relative to the wellbore casing. For example, the element 500 may be a metal, a plastic, an elastomer, or a combination thereof. The element 500, however, must withstand temperatures in excess of 450°F (232°C), and pressures in excess of 15,000 psi (103 MPa).

[0028] Referring to Figure 4, the packer 100 further includes a ratchet assembly 800 disposed about a first end of the packer 100 to prevent the components described above from prematurely releasing once the components have been actuated. The ratchet assembly 800 includes a ring housing 810 disposed about a lock ring 830 and is disposed about the body 102 adjacent to and abutting a first end of the slip 200.

[0029] The lock ring 830 is a cylindrical member annularly disposed between the body 102 and the ring housing 810 and includes an inner surface having profiles disposed thereon to mate with profiles formed on the outer surface of the body 102. The profiles formed on the lock ring 830 have a tapered leading edge allowing the lock ring 830 to move across the mating profiles formed on the body 102 in one axial direction while preventing movement in the other direction. The profiles formed on both the outer surface of the body 102 and an inner surface of the lock ring 830 consist of formations having one side which is sloped and one side which is perpendicular to the outer surface of the body 102. The sloped surfaces of the mating profiles allows the lock ring 830 to move across the body 102 in a single axial direction. The perpendicular sides of the mating profiles prevent movement in the opposite axial direction. Therefore, the split ring may move or "ratchet" in one axial direction, but not the opposite axial direction.

[0030] The ring housing 810 comprises a jagged inner surface to engage a mating jagged outer surface of the lock ring 830. The relationship between the jagged surfaces creates a gap there-between allowing the lock ring 830 to expand radially as the profiles formed thereon move across the mating profiles formed on the body 102. A longitudinal cut within the lock ring 830 allows the lock ring 830 to expand radially and contract as it movably slides or ratchets in relation to the outer surface of the body 102. The ring housing 810 also comprises a first end which abuts a first end of the cone 200 thereby transferring movement of the ratchet assembly 800 to the cone 200.

[0031] To set or activate the packer 100, the packer 100 is first run down the hole to a predetermined depth. A setting tool applies an axial load to the outer components of the packer 100 relative to the body 102. Once the axial force reaches a predetermined value, which exceeds the shear strength of the pins 106 the pins 106 release or shear, thereby causing the outer components to move axially across the body 102.

[0032] Figure 2 is a section view of a packer 100 during a first stage of activation. During a first stage of activation, axial movement of the outer components forces the cone 420 underneath the slip 400, thereby forcing the slip 400 radially outward toward the tubular 700. As shown in Figures 2 and 4A, the slip 400 engages the inner surface of the tubular 700 creating an opposing axial force which causes the expansion rings 260, 460, to slide radially outward across the first surface 223 of the cones 240, 440 and across the first tapered surface 301 of the slide rings 300, 600, thereby engaging the inner surface of the tubular 700. The actuation of the expansion rings 260, 460, provides a fixed volume or void space 550 within the annulus to be sealed off by the element 500 and back-up rings 380, 680 and also provides an extrusion barrier on the face of the cones 220, 420, and the inner surface of the tubular 700.

[0033] The axial forces next cause the recessed grooves of the slip 400 to fracture, and divide into equal segments, permitting the serrations or teeth 405 to engage the inner surface of the tubular 700. Once the slip 400 fractures, the axial forces across the body 102 are met by an equal and opposite axial force which causes the malleable outer portions of the packer 100 to compress and expand radially outward.

[0034] Figure 3 shows a second stage of activation which involves extruding the back-up rings 380, 680. As shown, the compressive forces exerted against opposite sides of the back-up rings 380, 680 cause the back-up rings 380, 680, to expand radially outward toward the tubular 700. Expansion of the back-up rings 380, 680, causes the anti-extrusion ring 380, 680 to expand due to the applied hoop stress created by the expanding back-up rings 380, 680. As the anti-extrusion rings 380, 680, yield, the back-up rings 380, 680, are allowed to travel or flow up and over the filler rings 320, 620, the container rings 340, 640, and the slide rings 300, 600, as shown in Figure 4. The increasing pressure exerted by the back-up rings 380, 680, and the element 500 applies a load to the filler ring 320, 620, that applies a collapse load on the extension 307 of the slide ring 300, 600, thereby eliminating any extrusion between the slide ring 300, 600, and the body 102. The lip 365 formed on the first end of the anti-extrusion ring 360, 660, prevents the filler rings 320, 620, from flowing or travelling between the anti-extrusion ring 360, 660, and the container ring 340, 640. The lip 365 also acts as a carrier when the back-up ring 380, 680, expands and travels over the slide ring 300, 600. The anti-extrusion rings 380, 680, also serve to retain the back-up rings 380, 680, until the expansion rings 260, 460, are fully expanded against the tubular 700.

[0035] Figure 4 shows a third stage of activation. During a third stage of activation, the back-up rings 380, 680 flow and fill a substantial portion of the void 550 created by the expansion rings 260, 460, while the element 500 is expanded radially outward toward the tubular 700 to seal off the remaining portion of the void 550. Because the back-up rings 380, 680, occupy a significant portion of the void 550, the element 500 must only expand radially outward, not axially, to fill the remaining void 550. As a result, less stress is placed on the element 500, and the element 500 is less subject to degradation providing a more effective seal for a longer period of time.

[0036] During the final stages of activation, the axial forces cause the ratchet assembly 800 to move or ratchet down the outer surface 102 of the body 300. As described herein, the ratcheting is accomplished when the axial forces against the lock ring 830 cause the profiles formed on the ring 830 to ramp up and over the mating profiles formed on the outer surface of the body 102. Once the profiles of the ring 830 travel up and over the adjoining profiles of the body 102, the first lock ring 830 contracts or snaps back into place, re-setting or interlocking the concentric profiles of the lock ring 830 against the next adjoining profiles formed on the outer surface of the body 102. In this manner, the ratchet assembly 800 moves in a first direction and not in a second, opposite direction.

[0037] In addition to a downhole packer as described above, the element system and the retaining system described herein may be used in conjunction with any other downhole tool used for sealing an annulus within a wellbore, such as a bridge plug, for example.

Claims

1. A packer for sealing an annulus in a wellbore, comprising:

a body (102);
a sealing system disposed about the body including an element (500) having an anti-extrusion ring (360,660) at an end thereof, wherein the sealing system is compressible in length and expandable in outer diameter to seal the annulus; and
an extrusion ring (380,680) disposed substantially on an inner diameter of the anti-extrusion ring such that flow of the extrusion ring in a direction opposite the element is inhibited by the anti-extrusion ring;

characterised in that the anti-extrusion ring comprises a lip or extrusion (365) disposed thereon arranged to interact with the extrusion ring so that

the and-extrusion ring is carried by the extrusion ring as it flows across the body.

2. A packer as claimed in claim 1, wherein the and-extrusion ring (360,660) is movable in the direction opposite the element (500).

3. A packer as claimed in claim 1 or 2, wherein the extrusion ring comprises a filler ring (320,620) and a back-up ring (380,680).

4. A packer as claimed in claim 3, wherein the back-up ring (380,680) is disposed about the body (102) adjacent the element (500) and the filler ring (320,620) is disposed about the body adjacent the back-up ring.

5. A packer as claimed in claim 4, wherein the back-up ring (380,680) is expandable radially outward from the body (102) and axially across the body to fill a portion of a void (550) formed within the annulus.

6. A packer as claimed in claim 5, wherein the and-extrusion ring (360,660) is movable in conjunction with the back-up ring (380,680).

7. A packer as claimed in claim 5 or 6, wherein the element (500) is expandable radially outward from the body (102) to fill a remaining portion of the void (550) formed within the annulus.

8. A packer as claimed in any of claims 3 to 7, wherein a containment ring (340,640) is disposed substantially on an outer diameter of the filler ring (320,620) such that flow of the filler ring across the body (102) is inhibited by the containment ring.

9. A packer as claimed in any preceding claim, wherein the sealing system is disposed about the body (102) between a first (260) and second (460) expansion ring.

10. A packer as claimed in claim further comprising :

a retaining system comprising an expansion ring (260,460) disposed about the body.

11. A packer as claimed in claim 10, wherein the anti-extrusion ring (360,660) is moveable in the direction opposite the element.

12. A packer as claimed in claim 10 or 11, wherein the retaining system comprises a first (260) and second (460) expansion ring arranged so that actuation of the first and second expansion ring forms a void (550) within the annulus.

13. A packer as claimed in claim 12, wherein the extrusion ring (380,680) is expandable radially outward from the body (102) and axially across the body to fill a portion of the void (550), and wherein the anti-extrusion ring (360,660) is movable in conjunction with the extrusion ring.

14. A packer as claimed in claim 13, wherein the element (500) expands radially outward from the body (102) to fill a remaining portion of the void (550).

15. A packer as claimed in any preceding claim, wherein the sealing system comprises a first (360) and second (660) anti-extrusion ring disposed on each end of the element (500) and wherein the first and second anti-extrusion rings are disposed substantially on an outer diameter of a first (380) and second (680) extrusion ring.

16. A method for sealing an annulus in a wellbore, comprising:

running a packer (100) into the wellbore, the packer comprising a body (102) and a sealing system comprising an element (500) and an anti-extrusion ring (360,660) having a lip (365), the element being disposed about the body proximate the anti-extrusion ring, an extrusion ring (380,680) being disposed substantially on an inner diameter of the anti-extrusion ring;
flowing the extrusion ring radially outward and axially across the body in a direction opposite the element to fill a portion of the annulus and carry the anti-extrusion ring using the lip; and
radially expanding the element to fill a remaining portion of the annulus.

17. A method as claimed in claim 16, wherein flowing the extrusion ring (380,680) radially outward and axially across the body (102) is inhibited by the anti-extrusion ring (360,660).

Patentansprüche

1. Dichtungsstück zum Abdichten eines Ringspalts in einer Bohrung, das folgendes umfaßt:

einen Körper (102),

ein um den Körper angeordnetes Dichtungssystem, das ein Element (500) mit einem Anti-Extrusionsring (360, 660) an dem einen Ende desselben einschließt, bei dem das Dichtungssystem in der Länge zusammengedrückt und im Außendurchmesser ausgedehnt werden kann, um den Ringspalt abzudichten, und

einen wesentlich derart an einem Innendurchmesser des Anti-Extrusionsrings angeordneten Extrusionsring (380, 680), daß ein Strömenlassen des Extrusionsrings in einer Richtung entgegengesetzt zu dem Element durch den Anti-Extrusionsring erschwert wird,

dadurch gekennzeichnet, daß der Anti-Extrusionsring eine an demselben angeordnete Lippe oder Extrusion (365) umfaßt, um mit dem Extrusionsring in Wechselwirkung zu treten, so daß der Anti-Extrusionsring durch den Extrusionsring getragen wird, wenn er über den Körper strömt.

2. Dichtungsstück nach Anspruch 1, bei dem der Anti-Extrusionsring (360, 660) in der Richtung entgegengesetzt zu dem Element (500) bewegt werden kann.

3. Dichtungsstück nach Anspruch 1 oder 2, bei dem der Extrusionsring einen Füllring (320, 620) und einen Sicherungsring (380, 680) umfaßt.

4. Dichtungsstück nach Anspruch 3, bei dem der Sicherungsring (380, 680) angrenzend an das Element (500) um den Körper (102) angeordnet wird und der Füllring (320, 620) angrenzend an den Sicherungsring um den Körper angeordnet wird.

5. Dichtungsstück nach Anspruch 4, bei dem der Sicherungsring (380, 680) in Radialrichtung vom Körper (102) nach außen und in Axialrichtung über den Körper ausgedehnt werden kann, um einen Abschnitt eines innerhalb des Ringspalts geformten Hohlraums (550) zu füllen.

6. Dichtungsstück nach Anspruch 5, bei dem der Anti-Extrusionsring (360, 660) in Verbindung mit dem Sicherungsring (380, 680) bewegt werden kann.

7. Dichtungsstück nach Anspruch 5 oder 6, bei dem das Element (500) in Radialrichtung vom Körper (102) nach außen ausgedehnt werden kann, um einen verbleibenden Abschnitt des innerhalb des Ringspalts geformten Hohlraums (550) zu füllen.

8. Dichtungsstück nach einem der Ansprüche 3 bis 7, bei dem wesentlich auf einem Außendurchmesser des Füllrings (320, 620) ein Haltering (340, 640) angeordnet wird derart, daß ein Strömenlassen des Füllrings über den Körper (102) durch den Haltering erschwert wird.

9. Dichtungsstück nach einem der vorhergehenden Ansprüche, bei dem das Dichtungssystem zwischen einem ersten (260) und einem zweiten (460) Erweiterungsring um den Körper (102) angeordnet wird.

10. Dichtungsstück nach Anspruch 1, das außerdem folgendes umfaßt:

ein Haltesystem, das einen um den Körper angeordneten Erweiterungsring (260, 460) umfaßt.

11. Dichtungsstück nach Anspruch 10, bei dem der Anti-Extrusionsring (360, 660) in der Richtung entgegengesetzt zu dem Element bewegt werden kann.

12. Dichtungsstück nach Anspruch 10 oder 11, bei dem das Haltesystem einen ersten (260) und einen zweiten (460) Erweiterungsring umfaßt, so angeordnet, daß eine Betätigung des ersten und des zweiten Erweiterungsrings einen Hohlraum (550) innerhalb des Ringspalts bildet.

13. Dichtungsstück nach Anspruch 12, bei dem der Extrusionsring (380, 680) in Radialrichtung vom Körper (102) nach außen und in Axialrichtung über den Körper ausgedehnt werden kann um einen Abschnitt des Hohlraums (550) zu füllen, und bei dem der Anti-Extrusionsring (360, 660) in Verbindung mit dem Extrusionsring bewegt werden kann.

14. Dichtungsstück nach Anspruch 13, bei dem sich das Element (500) in Radialrichtung vom Körper (102) nach außen ausdehnt, um einen verbleibenden Abschnitt des Hohlraums (550) zu füllen.

15. Dichtungsstück nach einem der vorhergehenden Ansprüche, bei dem das Dichtungssystem einen ersten (360) und einen zweiten (660) Anti-Extrusionsring umfaßt, angeordnet an jedem Ende des Elements (500), und bei dem der erste und der zweite Anti-Extrusionsring wesentlich an einem Außendurchmesser eines ersten (380) und eines zweiten (680) Extrusionsrings angeordnet werden.

16. Verfahren zum Abdichten eines Ringspalts in einem Bohrloch, wobei das Verfahren folgendes umfaßt:

Einfahren eines Dichtungsstücks (100) in das Bohrloch, wobei das Dichtungsstück einen Körper (102) und ein Dichtungssystem umfaßt, das ein Element (500) und einen Anti-Extrusionsring (360, 660) mit einer Lippe (365) umfaßt, wobei das Element nahe dem Anti-Extrusionsring um den Körper angeordnet wird, wobei ein Extrusionsring (380, 680) wesentlich an einem Innendurchmesser des Anti-Extrusionsrings angeordnet wird,

Strömenlassen des Extrusionsrings in Radialrichtung nach außen und in Axialrichtung über den Körper, in einer Richtung entgegengesetzt zu dem Element, um einen Abschnitt des Ring-

spalts zu füllen und den Anti-Extrusionsring unter Verwendung der Lippe zu tragen, und

Ausdehnen des Elements in Radialrichtung, um einen verbleibenden Abschnitt des Ringspalts zu füllen.

17. Verfahren nach Anspruch 16, bei dem das Strömenlassen des Extrusionsrings (380, 680) in Radialrichtung nach außen und in Axialrichtung über den Körper (102) durch den Anti-Extrusionsring (360, 660) erschwert wird.

Revendications

1. Garniture d'étanchéité destinée à établir l'étanchéité d'un espace annulaire dans un puits de forage, comprenant:

un corps (102);

un système d'étanchéité agencé autour du corps, englobant un élément (500) comportant une bague anti-extrusion (360, 660) au niveau d'une extrémité correspondante, le système d'étanchéité pouvant être comprimé en longueur et dilaté dans son diamètre extérieur pour établir l'étanchéité de l'espace annulaire; et

une bague d'extrusion (380, 680) agencée pratiquement sur un diamètre intérieur de la bague anti-extrusion, de sorte que le déplacement par écoulement de la bague d'extrusion dans une direction opposée à l'élément est empêché par la bague anti-extrusion;

caractérisée en ce que la bague anti-extrusion comprend un rebord ou une extrusion (365) qui y est agencé de sorte à coopérer avec la bague d'extrusion, la bague anti-extrusion étant ainsi supportée par la bague d'extrusion lors de son déplacement par écoulement à travers le corps.

2. Garniture d'étanchéité selon la revendication 1, dans laquelle la bague anti-extrusion (360, 660) peut être déplacée dans la direction opposée à l'élément (500).

3. Garniture d'étanchéité selon les revendications 1 ou 2, dans laquelle la bague d'extrusion comprend une bague de remplissage (320, 620) et une bague de support (380, 680).

4. Garniture d'étanchéité selon la revendication 3, dans laquelle la bague de support (380, 680) est agencée autour de corps (102) en un point adjacent à l'élément (500), la bague de remplissage (320, 620) étant agencée autour du corps en un point adjacent à la bague de support.

5. Garniture d'étanchéité selon la revendication 4, dans laquelle la bague de support (380, 680) peut être dilatée radialement vers l'extérieur du corps (102) et axialement à travers le corps pour remplir une partie d'un vide (550) formé dans l'espace annulaire.

6. Garniture d'étanchéité selon la revendication 5, dans laquelle la bague anti-extrusion (360, 660) peut être déplacée ensemble avec la bague de support (380, 680).

7. Garniture d'étanchéité selon les revendications 5 ou 6, dans laquelle l'élément (500) peut être dilaté radialement vers l'extérieur du corps (102) pour remplir une partie restante du vide (550) formé dans l'espace annulaire.

8. Garniture d'étanchéité selon l'une quelconque des revendications 3 à 7, dans laquelle une bague de retenue (340, 640) est agencée pratiquement sur un diamètre extérieur de la bague de remplissage (320, 620) de sorte que le déplacement par écoulement de la bague de remplissage à travers le corps (102) soit empêché par la bague de retenue.

9. Garniture d'étanchéité selon l'une quelconque des revendications précédentes, dans laquelle le système d'étanchéité est agencé autour du corps (102) entre une première (260) et une deuxième (460) bague de dilatation.

10. Garniture d'étanchéité selon la revendication 1, comprenant en outre:

un système de retenue comprenant une bague de dilatation (260, 460) agencée autour du corps.

11. Garniture d'étanchéité selon la revendication 10, dans laquelle la bague anti-extrusion (360, 660) peut être déplacée dans la direction opposée à l'élément.

12. Garniture d'étanchéité selon les revendications 10 ou 11, dans laquelle le système de retenue comprend une première (260) et une deuxième (460) bague de dilatation, agencées de sorte que l'actionnement des première et deuxième bagues de dilatation forme un vide (550) dans l'espace annulaire.

13. Garniture d'étanchéité selon la revendication 12, dans laquelle la bague d'extrusion (380, 680) peut être dilatée radialement vers l'extérieur du corps

(102) et axialement à travers le corps pour remplir une partie du vide (550), la bague anti-extrusion (360, 660) pouvant être déplacée ensemble avec la bague d'extrusion.

14. Garniture d'étanchéité selon la revendication 13, dans laquelle l'élément (500) se dilate radialement vers l'extérieur du corps (102) pour remplir une partie restante du vide (550).

15. Garniture d'étanchéité selon l'une quelconque des revendications précédentes, dans laquelle le système d'étanchéité comprend une première (360) et une deuxième (660) bague anti-extrusion, agencées sur chaque extrémité de l'élément (500), les première et deuxième bagues anti-extrusion étant agencées pratiquement sur un diamètre extérieur d'une première (380) et deuxième (680) bague d'extrusion.

16. Procédé d'établissement de l'étanchéité d'un espace annulaire dans un puits de forage, comprenant les étapes ci-dessous:

descente d'une garniture d'étanchéité (100) dans le puits de forage, la garniture d'étanchéité comprenant un corps (102) et un système d'étanchéité comprenant un élément (500) et une bague anti-extrusion (360, 660) comportant un rebord (365), l'élément étant agencé autour du corps en un point proche de la bague anti-extrusion, une bague d'extrusion (360, 680) étant agencée pratiquement sur un diamètre intérieur de la bague anti-extrusion;

déplacement par écoulement de la bague d'extrusion radialement vers l'extérieur et axialement à travers le corps dans une direction opposée à l'élément pour remplir une partie de l'espace annulaire et supporter la bague anti-extrusion par l'intermédiaire du rebord; et

dilatation radiale de l'élément pour remplir une partie restante de l'espace annulaire.

17. Procédé selon la revendication 16, dans lequel le déplacement par écoulement de la bague d'extrusion (380, 680) radialement vers l'extérieur du corps (102) et axialement à travers celui-ci est empêché par la bague anti-extrusion (360, 660).

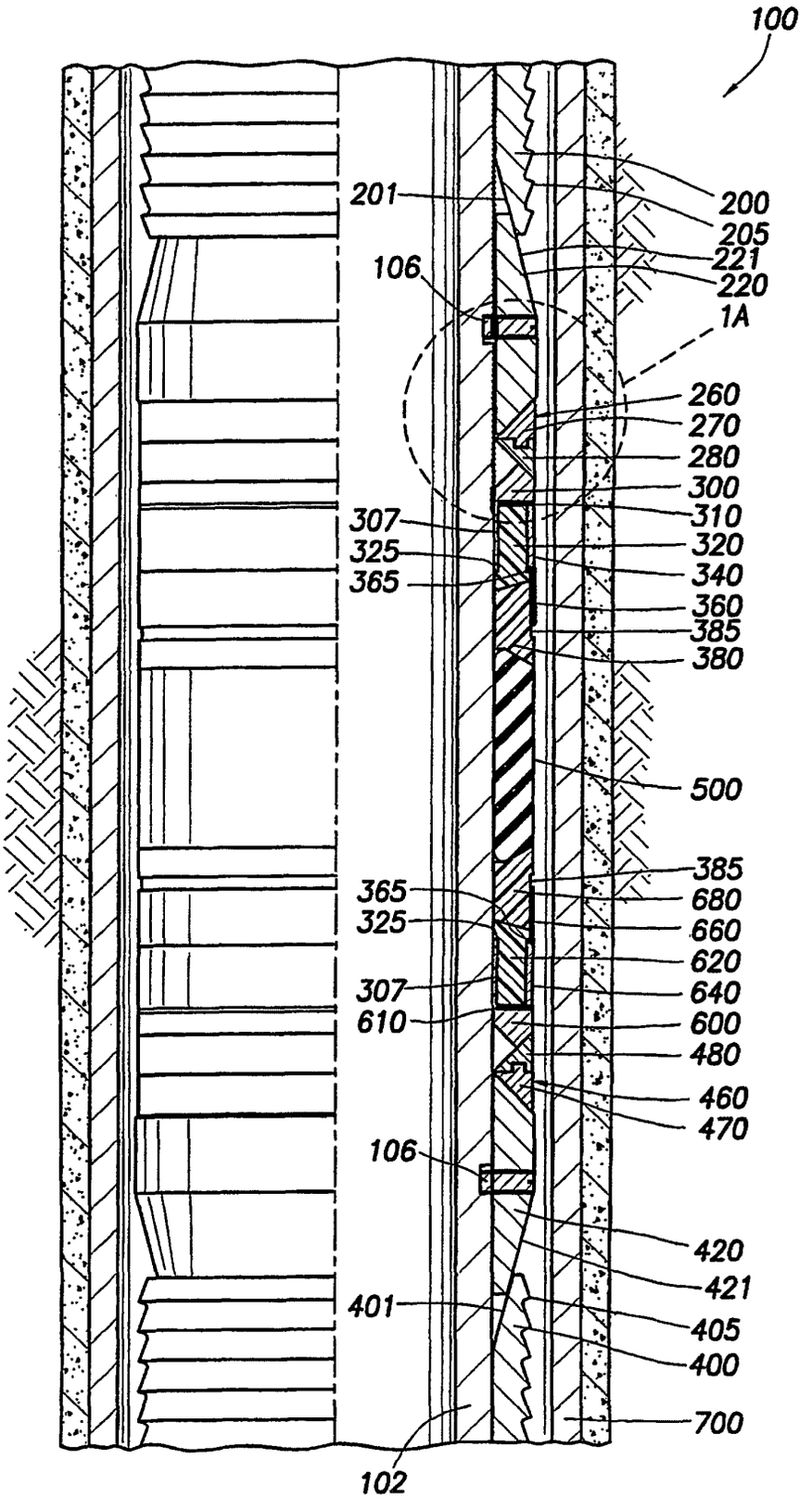

100
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200
205
221
220
106
1A
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270
280
300
310
307
320
325
340
365
360
385
380
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385
365
680
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610
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480
460
470
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420
421
401
405
400
700
102

FIG. 1

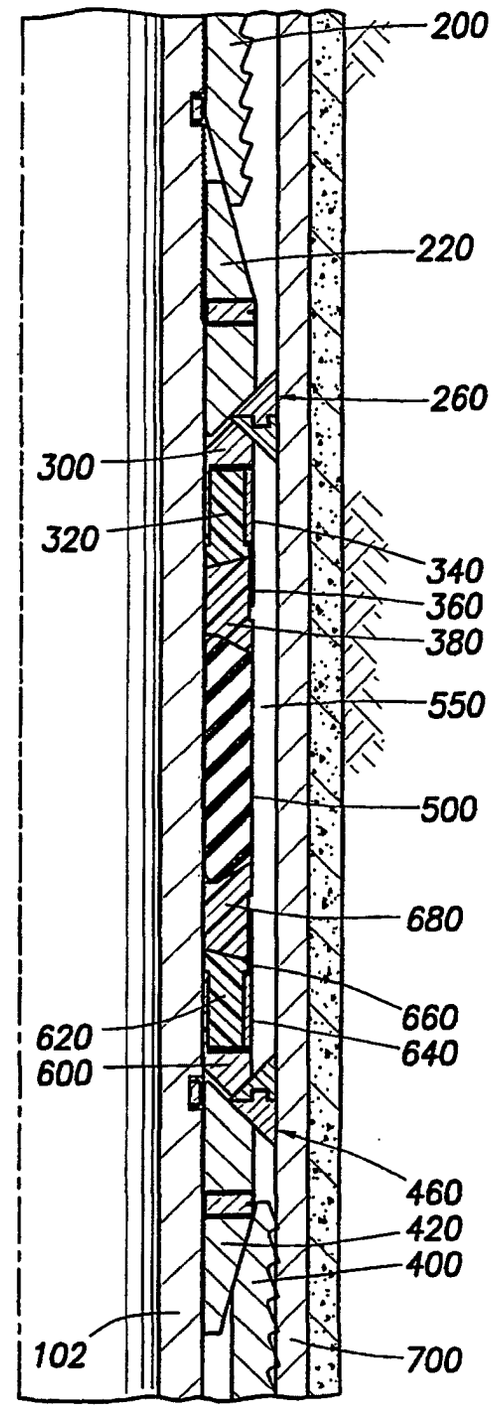

100
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102
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FIG.2

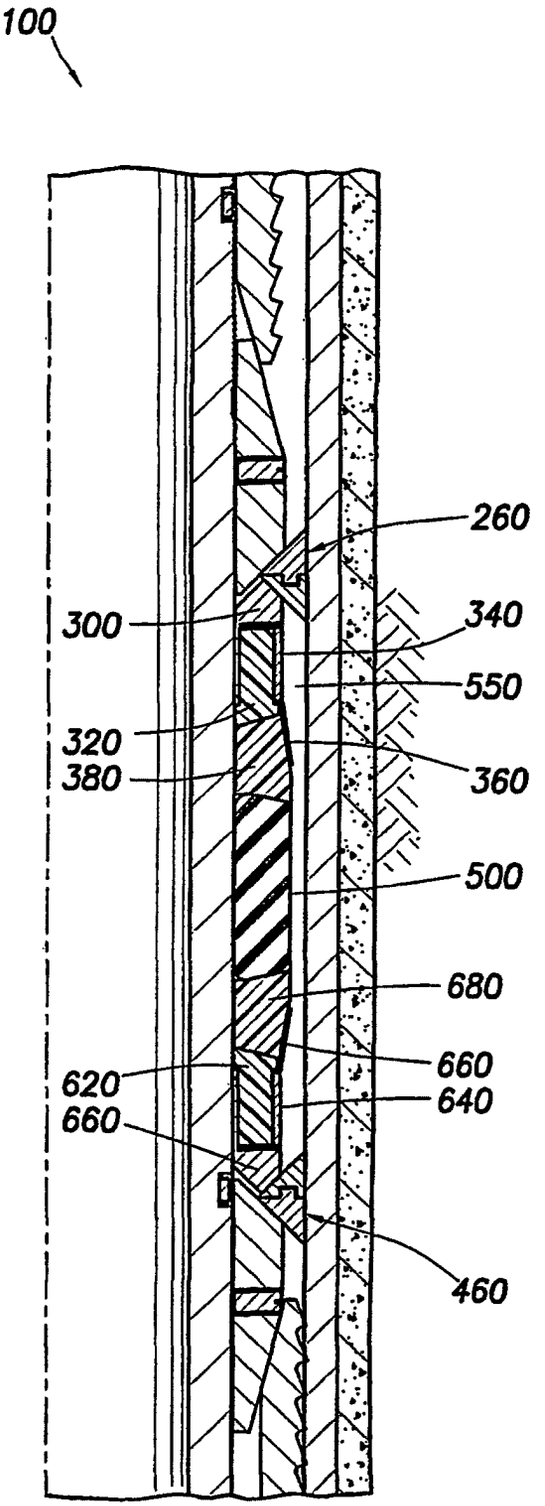

100
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550
320
360
380
500
680
660
620
640
660
460

FIG.3

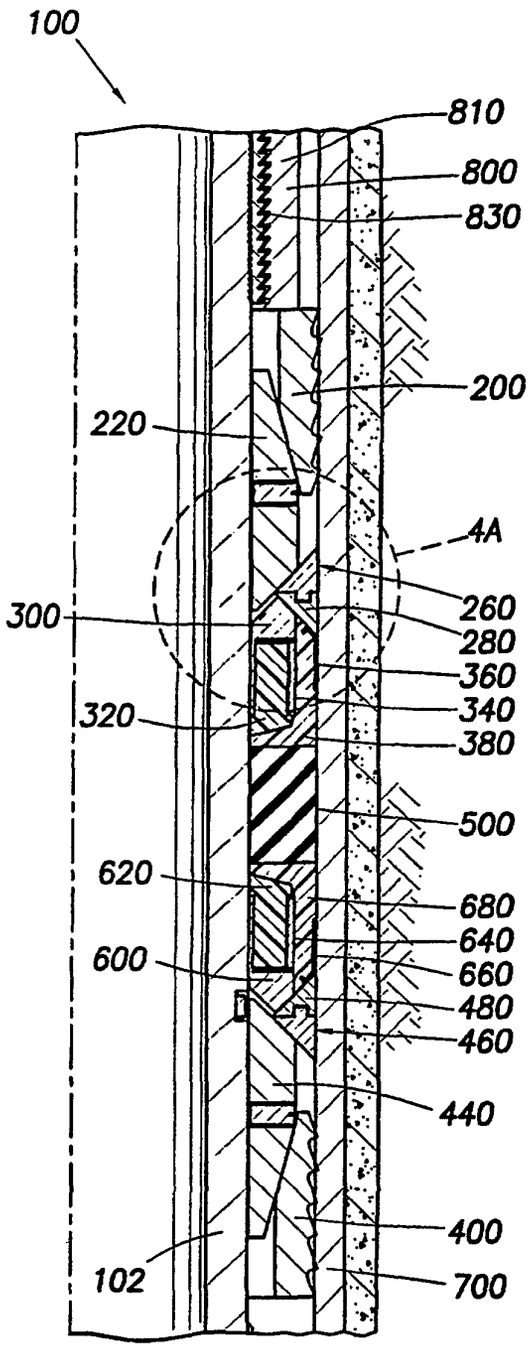


FIG.4

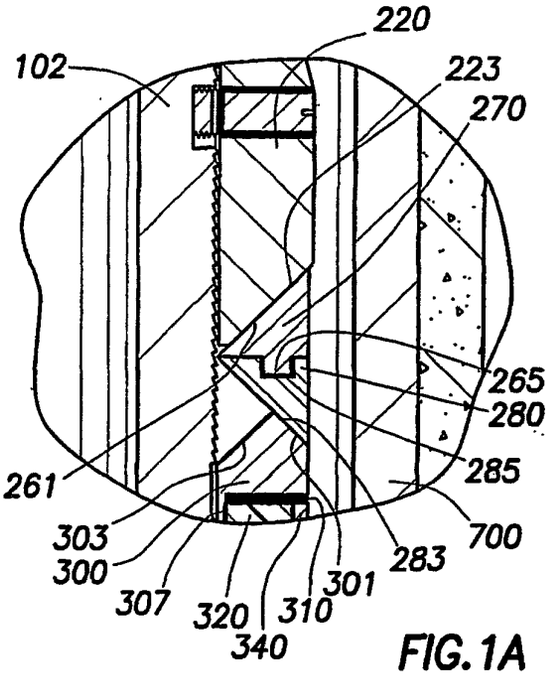


FIG.1A

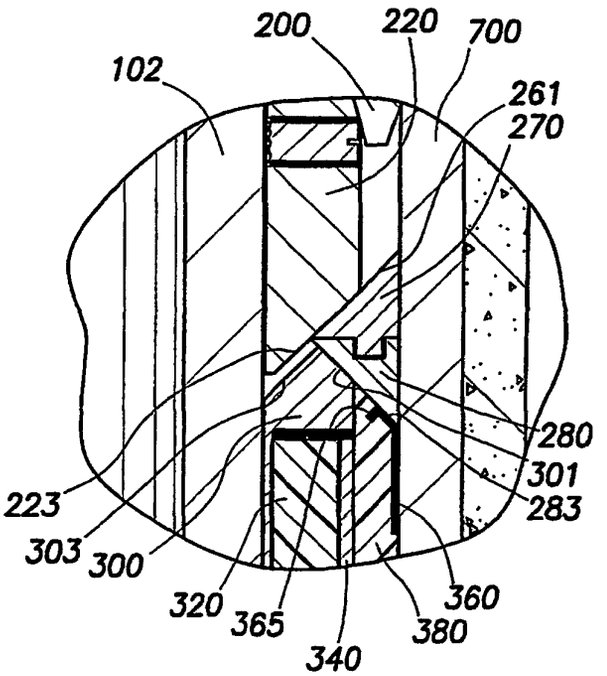


FIG.4A