Description

BACKGROUND

The assembly of the present invention is used to support and seal a pipe or other string within a wellhead.

An example of a prior structure is illustrated in US-A-2,920,909 to H. Allen. In this patent the pipe is supported by slips within a slip bowl which is supported on the tapered interior of the wellhead housing and upper slips are supported above a conical shaped seal ring so that the load of the supported pipe causes the seal ring to expand inward and outwardly into sealing engagement between the exterior of the pipe and the interior of the wellhead housing.

US-A-3,311,168 and 4,390,186 disclose similar structures in which a landing ring supports inner and outer seal rings and the slip bowl engages the seal rings to the pipe load of the slip bowl is transmitted at least in part through the seal rings.

US-A-4,494,778 to C. W. Johnson discloses another similar structure in which the slip bowl is connected to a seal assembly ring above the slip bowl by cap screws so that the seal assembly is moved into the interior of the wellhead housing as the slip bowl is lowered therein. The seal assembly includes spreaders which are forced inwardly as the seal assembly is moved within the housing and this movement of the spreaders compresses the seal ring so that it is moved radially into sealing engagement between the interior of the wellhead housing and the exterior of the pipe string.

US-A-2,824,757 and 3,287,035 are other structures for supporting and sealing a pipe string within a wellhead housing in which the slip bowl is connected to the seal loading so that the seal is set responsive to loading of the slip bowl by its support through its slips of the pipe string.

US-A-3188118 describes a slip and seal assembly comprising a slip bowl and a plurality of slips. The slips and slip bowl have interengageable cam surfaces which are arranged so that relative axial movement between the slips and bowl cams the slips into engagement with a pipe string.

EP-A-327752 describes another slip and seal assembly. This document is relevant only under the provisions of Article 54(3) EPC.

According to the present invention there is provided a wellhead slip and seal assembly for supporting and sealing a string with a housing comprising a sealing assembly, a slip bowl having a downward and inward tapering surface and a plurality of slips having inwardly facing teeth and outer tapered surfaces mating with the slip bowl tapered surface characterised in that the sealing assembly comprises a seal ring having an inner flange with a downwardly facing shoulder and an outer groove, a first resilient sealing ring positioned within said outer groove so that in use it can seal against the housing in which it is to be positioned and a second resilient sealing ring positioned adjacent said shoulder so that in use it can seal against the string to be received therein, the seal ring includes a pair of sealing segments each of which includes a plurality of arcuate elements, and a resilient coating of said arcuate elements binding said elements together to form a segment, the resilient coating and said first and second sealing rings having been formed during embedding of said arcuate elements therein, and wherein the assembly includes

means on said seal ring and said slip bowl providing an interengagement for supporting said slip bowl from said seal ring during the lowering of said assembly into the housing, the the upper end of said slip bowl being positioned below said second sealing ring.

The invention will be described now by way of example only with particular reference to the accompanying drawings. In the drawings:

FIGURE 1 is an elevation view, partly in section, showing the improved wellhead slip and seal assembly of the present invention being lowered into a wellhead housing into which it is to seat and support a string.

FIGURE 2 is a partial sectional view of the improved assembly of the present invention illustrating the initial gripping engagement of the slips on the exterior of the string extending therethrough.

FIGURE 3 is a plan view of one of the seal segments to illustrate the projecting connecting pin and the integral resilient material of the segment.

FIGURE 4 is an elevation view of the seal segment.

FIGURE 5 is a partial sectional view illustrating the toe nailing of the bowl segments together.

FIGURE 6 is a partial elevational view of the toe nailing of the bowl segments.

Improved wellhead slip and seal assembly 10 is shown in FIGURE 1 in surrounding relationship to string 12 and being lowered into wellhead housing 14. Bails 16 are secured to the sides of bowl 18 by screws 20 and are used to control the movement of assembly 10 prior to lowering assembly 10 into its position within housing 14 as hereinafter described.

Assembly 10 includes a pair of bowl segments 22 which are connected to form bowl 18 as hereinafter described, a pair of sealing segments 24 which form seal ring 26 and slips 28. Sealing segments 24 are embedded in a suitable resilient material, such as an elastomer, which joins three of

segments 24 as shown in FIGURE 3 and hereinafter described. Seal ring 26 includes outer groove 30, inwardly directed flange 32 forming downwardly facing shoulder 34 and lower inner annular groove 36. Inner seal 38 which is formed by the resilient material surrounding segments 24, is positioned under shoulder 34 and above the upper end of bowl 18 as shown and has an inner diameter which is smaller than the diameter of the string 12. Inner seal 38 also includes upper and lower inner seal support rings 40 and 42 which are embedded therein to prevent the extrusion of seal 38 from its position between the exterior of string 12 and the interior of seal ring 26. Outer seal 44 which also is formed by the resilient material surrounding segments 24, is positioned within outer groove 30 and includes lips 46 which as shown in FIGURE 1 have a greater diameter than the inner diameter of housing 14. Housing 14 includes upper inner tapered surfaces 48 and 50 which ensure smooth entry of seal 44 within housing bore 55A. The insertion of assembly 10 into housing bore 55A causes the outer diameter of the seal ring 26 to be constricted to the smaller diameter of the housing bore 55A. The diametrical constriction of seal ring 26 in conjunction with the fixed length of arcuate elements 64 of sealing segments causes the end of resilient seal elements 38 and 44 to be pressed together, causing them to seal together forming inner and outer circumferential seals.

Bowl 18 includes outer projection 52 which is positioned within inner groove 36. During initial installation of assembly 10 slips 28 are held in position within bowl 18 by screws 20. The lower surface 54 of bowl 18 is tapered downwardly and inwardly to assist in the entry of assembly 10 within housing 14 and to land on internal housing seat 55 as shown in FIGURE 2. Bails 16 are removed and slips 28 are released for normal operation by the removal of screws 20. Thereafter, assembly 10 slides downwardly on string 12 into housing 14 toward the position illustrated in FIGURE 2. Screws 56 thread into the interior of bowl 18, having their shanks within slots 58 on the interior of slips 28 and their heads 57 within enlarged slots 59 to allow relative freedom of vertical movement between slips 28 and bowl 18 in normal operations and to retain slips 28 within bowl 18. The load of the string of pipe 12 will pull seal ring 26 into housing bore 55A and thereby energize outer seal 44 into tight sealing engagement therewith.

It should be noted that there is no substantial relative vertical movement between bowl 18 and seal ring 26. The effectiveness of seals 38 and 44 are thus not dependent upon an axial compression between upper and lower members of assembly 10 to provide the needed inner and outer sealing but rather provide the radial compression of the seals 38 and 44 to ensure their sealing against the exterior of string 12 and housing bore 55A. The support rings 40 and 42 on inner seal 38 protect it against the relatively large gaps which may be encountered between the exterior of string 12 and the interior of seal ring 26 due to the large casing string outer diameter variations which result from manufacturing tolerances.

Sealing segment 24 is shown in FIGURES 3 and 4 and includes pin 60 projecting from one side and recess 62 on the opposite side. Each segment 24 includes a plurality of arcuate elements 64 which are combined together into segment 24 by encapsulating them in molded rubber or elastomer with the rubber extending along the two ends 75 and 76, and in surrounding relationship to provide sealing between the ends of segments 24 and a coating surrounding the segments 24. The elastomer functions also as inner seal 38 and outer seal 44. Once two segments 24 are in position with their pins 60 in the opposite segment recess 62, they are held in position by entry into housing 14.

Bowl segments 22 are secured in their assembled position by U-shaped toe nails 66 which are driven into openings 68 in adjacent portions of segments 22 as best shown in FIGURES 5 and 6.

Slips 28 are positioned within bowl 18 with their engaging teeth 70 facing inwardly and upwardly for tight gripping and supporting engagement with string 12. Outer surface 72 of slips 28 is tapered downwardly and inwardly and mates with internal tapered surface 74 on bowl 18.

With the positioning of the seal rings 38 and 44 and the slips 28 the application of test pressure to test the seals does not add to the slip loading, does not provide any pressure loading which would increase the crushing of the pipe in the area engaged by the slips and the support of the casing is not dependent on the seals, in fact the seals could be removed without creating any problems in the support of the pipe by the slips.

Claims

1. A wellhead slip and seal assembly for supporting and sealing a string (12) with a housing (14) comprising a sealing assembly (10), a slip bowl (18) having a downward and inward tapered surface (74) and a plurality of slips (28) having inwardly facing teeth (70) and outer tapered surfaces (72) mating with the slip bowl tapered surface (74) characterised in that the sealing assembly comprises a seal ring (26) having an inner flange (32) with a downwardly facing shoulder and an outer groove (30), a first resilient sealing ring (44) positioned within said outer groove (30) so that in use it can seal

segments 24 as shown in FIGURE 3 and hereinafter described. Seal ring 26 includes outer groove 30, inwardly directed flange 32 forming downwardly facing shoulder 34 and lower inner annular groove 36. Inner seal 38 which is formed by the resilient material surrounding segments 24, is positioned under shoulder 34 and above the upper end of bowl 18 as shown and has an inner diameter which is smaller than the diameter of the string 12. Inner seal 38 also includes upper and lower inner seal support rings 40 and 42 which are embedded therein to prevent the extrusion of seal 38 from its position between the exterior of string 12 and the interior of seal ring 26. Outer seal 44 which also is formed by the resilient material surrounding segments 24, is positioned within outer groove 30 and includes lips 46 which as shown in FIGURE 1 have a greater diameter than the inner diameter of housing 14. Housing 14 includes upper inner tapered surfaces 48 and 50 which ensure smooth entry of seal 44 within housing bore 55A. The insertion of assembly 10 into housing bore 55A causes the outer diameter of the seal ring 26 to be constricted to the smaller diameter of the housing bore 55A. The diametrical constriction of seal ring 26 in conjunction with the fixed length of arcuate elements 64 of sealing segments causes the end of resilient seal elements 38 and 44 to be pressed together, causing them to seal together forming inner and outer circumferential seals.

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Sealing segment 24 is shown in FIGURES 3 and 4 and includes pin 60 projecting from one side and recess 62 on the opposite side. Each segment 24 includes a plurality of arcuate elements 64 which are combined together into segment 24 by encapsulating them in molded rubber or elastomer with the rubber extending along the two ends 75 and 76, and in surrounding relationship to provide sealing between the ends of segments 24 and a coating surrounding the segments 24. The elastomer functions also as inner seal 38 and outer seal 44. Once two segments 24 are in position with their pins 60 in the opposite segment recess 62, they are held in position by entry into housing 14.

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With the positioning of the seal rings 38 and 44 and the slips 28 the application of test pressure to test the seals does not add to the slip loading, does not provide any pressure loading which would increase the crushing of the pipe in the area engaged by the slips and the support of the casing is not dependent on the seals, in fact the seals could be removed without creating any problems in the support of the pipe by the slips.

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against the housing in which it is to be positioned and a second resilient sealing ring (38) positioned adjacent said shoulder so that in use it can seal against the string to be received therein, the seal ring (26) includes a pair of sealing segments (24) each of which includes a plurality of arcuate elements (64), and a resilient coating of said arcuate elements binding said elements together to form a segment (24), the resilient coating and said first and second sealing rings (44, 38) having been formed during embedding of said arcuate elements therein, and wherein the assembly includes

means (36, 52) on said seal ring (26) and said slip bowl (18) providing an interengagement for supporting said slip bowl from said seal ring during the lowering of said assembly into the housing, the upper end of said slip bowl being positioned below said second sealing ring.

2. A wellhead slip and seal assembly according to claim 1, wherein said supporting interengagement includes a groove (36) on the interior of said seal ring (26), and a projection (52) of the exterior of said slip bowl positioned within said seal ring inner groove.

3. A wellhead slip and seal assembly according to claim 1 or claim 2, wherein said second sealing ring (38) includes means (40, 42) for preventing extrusion of said seal ring between said shoulder and the string against which it is to be sealed.

4. A wellhead slip and seal assembly according to any preceding claim, including means (16) for supporting said assembly during lowering.

5. A wellhead slip and seal assembly according to claim 4, wherein said supporting means includes bails (16) secured to said assembly by fasteners (20) extending through said bowl (18) and engaging said slips (28) to maintain said slips in retracted position.

6. A wellhead slip and seal assembly according to any preceding claim including means (60, 62) providing interengagement between said segments (24) and means (66) securing the segments (24) together.

Patentansprüche

1. Bohrlochkopf-Abhänge- und Abdichtungselemente zum Abstützen und Abdichten einer Futterrohrkolonne (12) an einem Bohrlochkopfgehäuse (14), bestehend aus einer Abdichtungseinheit (10), einem Gleitbecher (18) mit einer nach unten und innen konisch verjüngten Oberfläche (74) und einer Vielzahl von Gleitelementen (28) mit nach innen gerichteten Zähnen (70) und äußeren, konisch verjüngten Flächen (72), die mit den konisch verjüngten Oberflächen (74) des Gleitbechers zusammenpassen, **dadurch gekennzeichnet,** daß die Abdichtungselemente umfassen: einen Dichtring (26), der einen inneren Flansch (32) mit einer nach unten gerichteten Schulter und einer äußeren Nut (30) aufweist, einen ersten elastischen Dichtring (44), der in der äußeren Nut (30) angeordnet ist, so daß er in Funktion gegenüber dem Gehäuse, in dem er sich befindet, abdichten kann, und einen zweiten elastischen Dichtring (38), der an der Schulter anliegend angeordnet ist, so daß er in Funktion gegenüber der Futterrohrkolonne, die sich in ihm befindet, abdichten kann; daß der Dichtring (26) aus einem Paar Dichtsegmenten (24) besteht, von denen jedes eine Vielzahl von bogenförmigen Elementen (64) aufweist, und eine elastische Beschichtung der bogenförmigen Elemente diese Elemente verbindet und ein Segment (24) bildet, wobei die elastische Beschichtung und die ersten und zweiten Dichtringe (34, 38) während der darin vorgenommenen Einbettung der bogenförmigen Elemente geformt worden sind, und bei denen die Einheit weiterhin umfaßt:
Mittel (36, 52) am Dichtring (26) und am Gleitbecher (18), die eine Verbindung zum Abstützen des Gleitbechers am Dichtring während des Absenkens der Einheit in das Gehäuse gewährleisten, wobei das obere Ende des Gleitbechers unterhalb des zweiten Dichtringes angeordnet ist.

2. Bohrlochkopf-Abhänge- und Abdichtungselemente nach Anspruch 1, **dadurch gekennzeichnet,** daß die abstützende Verbindung aus einer Nut (36) in der Innenseite des Dichtringes (26) und einem Ansatz (52) an der Außenseite des Gleitbechers, der in der innneren Nut des Dichtringes angeordnet ist, besteht.

3. Bohrlochkopf-Abhänge- und Abdichtungselemente nach Anspruch 1 oder 2, **dadurch gekennzeichnet,** daß der zweite Dichtring (38) Mittel (40, 42) zur Verhinderung des Herausquellens des Dichtringes zwischen Schulter und Futterrohrkolonne, gegen die er abdichtet, enthält.

4. Bohrlochkopf-Abhänge- und Abdichtungselemente nach einem oder mehreren der vorher-

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gehenden Ansprüche, **dadurch gekennzeichnet,** daß sie Mittel (16) zur Abstützung der Einheit während des Absenkens enthalten.

5. Bohrlochkopf-Abhänge- und Abdichtungselemente nach Anspruch 4, **dadurch gekennzeichnet,** daß die Mittel zur Abstützung aus Bügeln (16), die mit Befestigungselementen (20), welche durch den Gleitbecher (18) hindurchragen, an dem Gleitelementen (28) angebracht sind, um die Gleitelemente in zurückgezogener Position zu halten.

6. Bohrlochkopf-Abhänge- und Abdichtungselemente nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet,** daß Mittel (60, 62), die eine Verbindung zwischen den Segmenten (24) gewährleisten, und Mittel (66), die die Segmente (24) zusammenhalten, vorgesehen sind.

Revendications

1. Ensemble d'étanchéité à cales pour tête de puits afin de supporter et étancher une colonne de tubes (12), comportant une cage (14) comprenant un ensemble d'étanchéité (10), une cuvette de calage (18) ayant une surface (74) s'amincissant vers le bas et vers l'intérieur et une série de cales (28) ayant des dents (70) tournées vers l'intérieur et des surfaces coniques externes (72) coopérant avec la surface conique (74) de la cuvette de calage, caractérisé en ce que l'ensemble d'étanchéité comprend une bague d'étanchéité (26) ayant une bride interne (32) avec un épaulement tourné vers le bas et une rainure externe (30), une première bague d'étanchéité élastique (44) disposée à l'intérieur de ladite rainure externe (30) de telle sorte qu'en usage, elle puisse coopérer de façon étanche avec la cage dans laquelle elle doit être disposée et une seconde bague d'étanchéité élastique (38) disposée au voisinage dudit épaulement de telle sorte qu'en usage, elle puisse coopérer de façon étanche avec la colonne qui doit y être reçue, en ce que la bague d'étanchéité (26) comprend une paire de segments d'étanchéité (24) dont chacun comprend une série d'éléments arqués (64), et un revêtement élastique desdits éléments arqués reliant lesdits éléments l'un à l'autre pour former un segment (24), le revêtement élastique et lesdites première et seconde bagues d'étanchéité (44, 38) ayant été conformées au cours de l'enrobage desdits éléments arqués dans le revêtement, et l'ensemble comprenant :
des moyens (36, 52) sur ladite bague d'étanchéité (26) et sur ladite cuvette de calage (18) pour fournir un interengagement afin de supporter ladite cuvette de calage à partir de ladite bague d'étanchéité au cours de l'abaissement dudit ensemble dans la cage, l'extrémité supérieure de ladite cuvette de calage étant disposée en dessous de ladite seconde bague d'étanchéité.

2. Ensemble d'étanchéité à cales pour tête de puits selon la revendication 1, dans lequel ledit interengagement de support comprend une rainure (36) à l'intérieur de ladite bague d'étanchéité (26) et une saillie (52) à l'extérieur de ladite cuvette de calage disposée à l'intérieur de ladite rainure interne de la bague d'étanchéité.

3. Ensemble d'étanchéité à cales pour tête de puits selon la revendication 1 ou 2, dans lequel ladite seconde bague d'étanchéité (38) comprend des moyens (40, 42) pour empêcher le fluage de ladite bague d'étanchéité entre ledit épaulement et la colonne avec laquelle elle doit coopérer de façon étanche.

4. Ensemble d'étanchéité à cales pour tête de puits selon l'une quelconque des revendications précédentes, comprenant des moyens (16) pour supporter ledit ensemble au cours de son abaissement.

5. Ensemble d'étanchéité à cales pour tête de puits selon la revendication 4, dans lequel lesdits moyens de support comprennent des anses (16) fixées audit ensemble par des éléments de fixation (20) s'étendant à travers ladite cuvette (18) et s'engageant dans lesdites cales (28) pour mieux maintenir lesdites cales en position de retrait.

6. Ensemble d'étanchéité à cales pour tête de puits selon l'une quelconque des revendications précédentes, comprenant des moyens (60, 62) permettant un interengagement entre lesdits segments (24) et les moyens (66) fixant les segments (24) l'un à l'autre.