Description

The present invention relates to an apparatus to be used in a well structure for testing a blowout preventer under substantial pressures wherein the pressure is exerted under the closed blowout preventer by sealing across the upper end of the hanger. With deep wells having a substantial string suspended from the hanger, the loading of the hanger landing shoulder on the housing landing seat is very substantial and the pressure loading above the hanger increases the landing seat loading well above its design point so that testing pressures will result in a failure of the landing shoulder or seat, damage to the hanger and housing and other future problems in the well.

U. S. Patent No. 2,540,322 discloses the use of a packing seal on the drill string to allow pressure to be diverted into the casing above the packing al for the testing of the blowout preventer.

U. S. Patent No. 3,897,824 discloses an annular structure mounted on a string which is lowered through a blowout preventer which seals against the casing, includes passages extending axially through the structure and has a valve plate which is lowered by the string to close the passages whereby test pressure builds up above the structure to test the sealing of the blowout preventer. The testing load of the structure is transferred to the upper end of the hanger seal assembly.

U. S. Patent No. 3.093,996 discloses another blowout preventer tester which is lowered through an open preventer and seals on the taper of the casing head to deliver pressure thereabove for the testing of the closed blowout preventer.

U.S. Patent No. 4,090,395 discloses a structure which includes the lowering of a seal onto the upper end of the hanger for sealing across the bore the wellhead and the string on which it is lowered delivers pressure to the space above the seal and below the closed blowout preventer. In this structure the pressure load, if not supported by the string is transferred directly to the hanger landing shoulder and the wellhead seat on which the hanger landing shoulder is landed.

US-A-4373380 describes a test apparatus in which a test plug is supported on a restriction integral with a wellhead housing. Pressurised fluid is delivered through the plug to test the wellhead housing sealing surfaces.

None of these prior structures provides the capability for high pressure blowout preventer testing i.e., 15,000 psi (103421 KN/m^2). They do not avoid the imposition of the pressure load through the hanger landing shoulder to the housing seat.

According to the present invention there is provided a wellhead structure for a well comprising:

a wellhead housing positioned within a well and having an internal landing seat and an internal landing support groove above said landing seat,

a hanger having an external landing shoulder engaged on and transmitting hanger loads to said landing seat and having a hanger body with a bore extending therethrough and an upper rim extending above the landing shoulder, and

a blowout preventer secured to the upper upper end of said housing, and characterised by

a closure member having a body with a bore bore therethrough and with an external downwardly facing shoulder,

a support means positioned around said closure body below said downwardly facing closure shoulder, and means responsive to testing pressure between said closure and said blowout preventer for wedging said support means into load transmitting position between said closure downwardly facing shoulder and said internal housing groove so that pressure loads responsive to pressure testing of said blowout preventer are transmitted to said housing groove by said closure shoulder and said support means.

One embodiment of the present invention provides structure for the pressure testing of a blowout preventer to relatively high pressures to which it may be exposed in service and to the sealing structure which is positioned below the blowout preventer and includes its own support through which the pressure loading is transferred to the housing independent of the hanger loading on the housing seat. The closure structure is used in combination with a wellhead housing having an internal landing seat and an internal landing groove above the landing seat, a casing hanger landed within the housing with its external landing shoulder on the internal landing seat of the housing, a blowout preventer secured in position above the hanger to close the housing from above and the closure structure includes a tubular body with a bore therethrough and valving means for closing such bore and being a suitable size to be lowered through the blowout preventer and into the housing above the casing hanger for landing on the upper portion of the casing hanger, said closure structure having landing means for engaging within the internal housing groove and a sliding sleeve on the exterior of the tubular body adapted to slide within said landing means for forcing it outward into engagement within said internal housing groove, a downwardly facing shoulder on the upper portion of said body positioned to engage said landing means when it is engaged within said internal housing groove to transfer the pressure loading to the housing internal groove, which loading force results from the testing pressure above such closure structure within the housing during the testing of the

blowout preventer. It is preferred that the sleeve be landed on the upper end of the casing hanger and that the tubular body move downwardly therein responsive to testing pressure to set said landing means and transfer the loading force of the pressure through the landing means to the housing rather than through the hanger to the housing.

In the present apparatus the downward loading loading force resulting from the blowout preventer testing pressure is not transferred through the casing hanger to the housing internal landing seat. The closure member is responsive to the testing pressure and transfers the pressure load directly to the housing.

The invention will be described now by way of example only, with reference

FIGURE 1 is an elevation partially in section which illustrates the improved wellhead structure with the casing hanger and closure structure being shown in the lower portion of the well housing (FIGURE 1B) and with the blowout preventer being shown connected to the upper portion of the housing (FIGURE 1A).

FIGURE 2 is another view similar to FIGURE 1B which illustrates the improved wellhead structure and the position of the closure structure during the pressure testing of the blowout preventer.

FIGURE 3 is another similar view showing a modified structure which can be used in emergency completions and is shown in its testing position.

Wellhead housing 10 is positioned within a well bore and has blowout preventer 12 connected on its upper end. Internal housing landing seat 14 is provided in the lower portion of housing 10 as shown and casing hanger 16 which has external landing shoulder 18 is landed within housing 10 with shoulder 18 in engagement with seat 14. Groove 20 is positioned within the lower portion of the interior wall of blowout preventer 12. The usual seal and lockdown assembly 22 is positioned in the annular space 24 between the exterior of the upper rim 26 of casing hanger 16 and the interior of wellhead housing 10 above landing seat 14. Assembly 22 provides the seal across the annular space 24 and wedges split ring 28 into latching engagement within groove 30 on the interior of housing 10 a short distance above landing seat 14.

Closure member 32 is lowered through blowout preventer 12 into wellhead housing 10 and has its lower end positioned within the upper interior of casing hanger rim 26 as shown in FIGURE 1. Closure member 32 includes tubular body 34 having internal threaded seat 36 in which back pressure valve 38 is positioned. The lower exterior of tubular body 34 includes external seals 40 for sealing against the interior of hanger rim 26 and keys 42 which are secured in axial orientation on the exterior of body 34 above seals 40. Exterior surface 44 above keys 42 extends upwardly to downwardly facing shoulder 46. Surface 48 ends in upper downwardly facing shoulder 50. Surface 51 above shoulder 50 has a diameter which is smaller than the interior diameter of the lower portion of blowout preventer 12 above and below groove 20. Landing means (split support ring 52) is positioned around body 34 in surrounding relationship to surface 48 and in engagement with shoulder 50. Sleeve 54 is positioned around the exterior of body 34 and includes an upper wedge-shaped end 56 which coacts with tapered surface 58 on the lower inner surface of split support ring 52 so that movement of sleeve 54 upward under ring 52 causes split support ring 52 to be wedged outwardly into internal housing groove 20, as shown in FIGURE 2. Sleeve 54 includes internal upwardly facing shoulder 60 and lower rim 62 which includes slots 64 to receive keys 42. On landing of closure member 32, the lower end of rim 62 of sleeve is in engagement with the upper end of hanger rim 26. Spring 66 is positioned on the interior of sleeve 54 and around the exterior of body 34 below shoulder 46 and around surface 44 above shoulder 60. The spring force is exerted against sleeve shoulder 60 to urge sleeve 54 downwardly with respect to body 34.

Communications to the interior of housing 10 are provided by lower ports 68, intermediate ports 70 and upper ports 72 through the lower portion of blowout preventer housing. Ports 72 would be used to provide a supply of fluid under pressure for the testing of the effective sealing of the rams 74 of blowout preventer 12 as hereinafter explained.

In operation, closure member 32 is lowered through blowout preventer 12 and into housing 10 to the position as shown in FIGURE 1B. Testing of blowout preventer 12 proceeds with the closing of its rams 74 to their position sealing across the bore 76 through blowout preventer 12. Thereafter fluid pressure is supplied through one of the ports 72 and allowed to build up to the testing pressure. As this pressure increases it is exerted on closure member 32 causing it to move downwardly to the position shown in FIGURE 2. The movement of closure member body 34 is downwardly within the interior of hanger upper rim 26 but sleeve 54 is restrained from downward movement by its engagement with the upper end of rim 26. This causes split support ring 52 to move downwardly on the upper end of sleeve 54 and ring 52 is wedged outwardly into tight engagement between the lower shoulder of groove 20 and downwardly facing shoulder 50 on closure body 34 so that all of the pressure load thereafter resulting from the test pressure above closure member 32 is transferred through shoulder 50 to ring 52 and to lower shoulder of groove 20 in blowout preventer 12 into

housing 10. The only additional load which is transitted to hanger 16 is that spring loading resulting from the relative movement of sleeve 54 with respect to body 34.

With this configuration the high pressures which are required for adequate pressure testing of the blowout preventer on deeper and more recent wells can be accomplished without over-loading the landing seat on the well housing and the casing hanger landing shoulder.

A modified form of the present invention is illustrated in FIGURE 3 wherein similar parts are given the same number designation. Thus, closure member 32 is landed with its lower end within upper rim 26 of hanger 16 and has a cup tester 80 threaded into the lower internal threads in tubular body 34 to complete the closure of the bore within hanger 16 below the blowout preventer 12. This would be used in emergency completions with transfer of the load through the seal assembly 22 to housing 10.

With the apparatus positioned as shown in FIGURE 3, the closing of the blowout preventer rams 74 and application of fluid pressure above closure member 32 will cause the completion of the setting of closure member 32 with the pressure load being transferred by shoulder 50 to split support ring 52 onto the lower shoulder of groove 20. In this manner all of the pressure loading is transferred to housing 10 and does not pass through hanger 16 to landing seat 14 on the interior of housing 10.

Claims

1. A wellhead structure for a well comprising:

a wellhead housing (10) positioned within a well and having an internal landing seat (14) and an internal landing support groove (20) above said landing seat,

a hanger (16) having an external landing shoulder (18) engaged on and transmitting hanger loads to said landing seat and having a hanger body with a bore extending therethrough and an upper rim (26) extending above the landing shoulder, and

a blowout preventer (12) secured to the upper end of said housing, and characterised by

a closure member (32) having a body with a bore therethrough and with an external downwardly facing shoulder (50),

a support means (52) positioned around said closure member (32) below said downwardly facing closure shoulder (50), and means (54) responsive to testing pressure between said closure member (32) and said blowout preventer for wedging said support means (52) into load transmitting position between said closure downwardly facing shoulder (50) and said internal landing support groove (20) so that pressure loads responsive to pressure testing of said blowout preventer are transmitted to said housing groove (20) by said closure shoulder (50) and said support means (52).

2. A wellhead structure according to claim 1, including means (38, 80) for closing the flow through the interior of the closure member and wherein said support means (52) is a split support ring disposed immediately below said closure shoulder (50).

3. A wellhead structure according to claim 1 or claim 2, wherein said pressure responsive means comprises a sleeve (54) surrounding said closure member and having a surface to coact with said split support ring (52) so that relative movement of said sleeve within said split support ring wedges said split support ring into supporting engagement for said closure member body with said internal housing groove, said movement of said sleeve within said split support ring being responsive to testing pressure between said blowout preventer and said closure member.

4. A wellhead structure according to claim 2, wherein said means for closing flow through the interior of said closure member includes a back pressure valve (38) mounted within said bore to prevent flow downwardly through said closure member.

5. A wellhead structure according to claim 2, wherein said means for closing flow through the interior of said closure member includes a cup tester (80) secured within the lower portion of the interior of said closure member.

6. A wellhead structure according to any one of claims 3 to 5, wherein said sleeve engages the upper end of said hanger rim and said closure member body is arranged to move downwardly within said hanger bore with said sleeve held against downward movement by its engagement with said rim, whereby said split support ring (52) is moved downwardly on said sleeve to be wedged downward into engagement with said internal landing support groove (20).

7. A wellhead structure according to claim 3, wherein said sleeve is arranged to coact with said support ring (52) in response to downward movement of said closure body and said support ring to wedge said support ring into tight load transmitting engagement with said internal

housing 10. The only additional load which is transitted to hanger 16 is that spring loading resulting from the relative movement of sleeve 54 with respect to body 34.

With this configuration the high pressures which are required for adequate pressure testing of the blowout preventer on deeper and more recent wells can be accomplished without over-loading the landing seat on the well housing and the casing hanger landing shoulder.

A modified form of the present invention is illustrated in FIGURE 3 wherein similar parts are given the same number designation. Thus, closure member 32 is landed with its lower end within upper rim 26 of hanger 16 and has a cup tester 80 threaded into the lower internal threads in tubular body 34 to complete the closure of the bore within hanger 16 below the blowout preventer 12. This would be used in emergency completions with ansfer of the load through the seal assembly 22 to housing 10.

With the apparatus positioned as shown in FIGURE 3, the closing of the blowout preventer rams 74 and application of fluid pressure above closure member 32 will cause the completion of the setting of closure member 32 with the pressure load being transferred by shoulder 50 to split support ring 52 onto the lower shoulder of groove 20. In this manner all of the pressure loading is transferred to housing 10 and does not pass through hanger 16 to landing seat 14 on the interior of housing 10.

Claims

1. A wellhead structure for a well comprising:

a wellhead housing (10) positioned within a well and having an internal landing seat (14) and an internal landing support groove (20) above said landing seat,

a hanger (16) having an external landing shoulder (18) engaged on and transmitting hanger loads to said landing seat and having a hanger body with a bore extending therethrough and an upper rim (26) extending above the landing shoulder, and

a blowout preventer (12) secured to the upper end of said housing, and characterised by

a closure member (32) having a body with a bore therethrough and with an external downwardly facing shoulder (50),

a support means (52) positioned around said closure member (32) below said downwardly facing closure shoulder (50), and means (54) responsive to testing pressure between said closure member (32) and said blowout preventer for wedging said support means (52) into load transmitting position between said closure downwardly facing shoulder (50) and said internal landing support groove (20) so that pressure loads responsive to pressure testing of said blowout preventer are transmitted to said housing groove (20) by said closure shoulder (50) and said support means (52).

2. A wellhead structure according to claim 1, including means (38, 80) for closing the flow through the interior of the closure member and wherein said support means (52) is a split support ring disposed immediately below said closure shoulder (50).

3. A wellhead structure according to claim 1 or claim 2, wherein said pressure responsive means comprises a sleeve (54) surrounding said closure member and having a surface to coact with said split support ring (52) so that relative movement of said sleeve within said split support ring wedges said split support ring into supporting engagement for said closure member body with said internal housing groove, said movement of said sleeve within said split support ring being responsive to testing pressure between said blowout preventer and said closure member.

4. A wellhead structure according to claim 2, wherein said means for closing flow through the interior of said closure member includes a back pressure valve (38) mounted within said bore to prevent flow downwardly through said closure member.

5. A wellhead structure according to claim 2, wherein said means for closing flow through the interior of said closure member includes a cup tester (80) secured within the lower portion of the interior of said closure member.

6. A wellhead structure according to any one of claims 3 to 5, wherein said sleeve engages the upper end of said hanger rim and said closure member body is arranged to move downwardly within said hanger bore with said sleeve held against downward movement by its engagement with said rim, whereby said split support ring (52) is moved downwardly on said sleeve to be wedged downward into engagement with said internal landing support groove (20).

7. A wellhead structure according to claim 3, wherein said sleeve is arranged to coact with said support ring (52) in response to downward movement of said closure body and said support ring to wedge said support ring into tight load transmitting engagement with said internal

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landing support groove (20).

Patentansprüche

1. Ein Bohrlochkopf für ein Bohrloch enthaltend:
ein Bohrlochkopfgehäuse (10), das sich innerhalb eines Bohrloches befindet und einen inneren Anschlagsitz (14) und eine innere Anschlagstütznut (20) oberhalb des Anschlagssitzes hat,
eine Aufhängung (16) mit einer äußeren Anschlagsschulter (18) für die Übertragung von Aufhängerlasten auf den Anschlagssitz und mit einem Aufhängungskörper mit einer Bohrung, die sich quer durch den Aufhängungskörper erstreckt und mit einer oberen Kante (26) oberhalb der Anschlagsschulter und
einem Mechanismus zur Ausströmunterbindung (12), der mit dem oberen Ende des Gehäuses verbunden ist und gekennzeichnet durch
ein Verschlußteil (32), das einen Körper mit einer Bohrung durch den Körper und einer nach unten zeigenden Schulter (50) besitzt,
eine Stützeinrichtung (52), die um das Verschlußteil (52) herum unterhalb der nach unten zeigenden Verschlußschulter (50) angeordnet ist, und Einrichtungen, die auf den Prüfdruck zwischen dem Verschlußteil (32) und dem Mechanismus zur Ausströmunterbindung ansprechen, um die Stützvorrichtung in eine gewichtübertragende Position zwischen der nach unten weisenden Schulter (50) des Verschlusses und der inneren Anschlagstütznut (20) zu zwängen, so daß Drucklasten für die Druckprüfung des Mechanismus zur Ausströmunterbindung durch die Verschlußschulter und die Stützeinrichtung (52) auf die Gehäusenut (20) übertragen werden.

2. Ein Bohrlochkopf nach Anspruch 1, enthaltend Einrichtungen (38, 80) zum Verschließen des Flusses durch das Innere des Verschlußteils, und worin die Stützeinrichtung (52) ein geteilter Stützring ist, der sich direkt unterhalb der Verschlußschulter (50) befindet.

3. Ein Bohrlochkopf nach Anspruch 1 oder Anspruch 2, worin die auf den Druck ansprechende Einrichtung eine Hülse (54) besitzt, die das Verschlußteil umgibt und eine Oberfläche besitzt zur Zusammenwirkung mit dem geteilten Stützring (52), so daß die Relativbewegung der Hülse innerhalb des geteilten Stützrings den geteilten Stützring so beaufschlagt, daß der Verschlußkörper mit der inneren Gehäusenut in tragenden Eingriff gebracht wird, wobei die Bewegung der Hülse innerhalb des geteilten Stützrings auf den Prüfdruck zwischen dem Mechanismus zur Ausströmunterbindung und dem Verschlußteil anspricht.

4. Ein Bohrlochkopf nach Anspruch 2, worin die Einrichtung zum Unterbrechen des Flusses durch das Innere des Verschlußteils ein Rückdruckventil (38), innerhalb des Bohrlochs angebracht, enthält, um den Fluß nach unten durch das Verschlußteil zu unterbinden.

5. Ein Bohrlochkopf nach Anspruch 2, worin die Einrichtung zum Unterbrechen des Flusses durch das Innere des Verschlußteils einen Glockentester (80) enthält, der innerhalb des unteren Bereichs des inneren Verschlußteils gesichert ist.

6. Ein Bohrlochkopf nach einem der drei Ansprüche von 3 bis 5, worin die Hülse am oberen Ende des Aufhängungsrandes angreift und der Verschlußteilkörper so angebracht ist, daß er sich innerhalb der Aufhängungsbohrung nach unten bewegt, wobei die Hülse gegen Bewegung nach unten durch ihre Fixierung mit dem Rand gehalten ist, wodurch der geteilte Stützring (52) auf der Hülse nach unten bewegt wird, um nach unten in Eingriff mit der Anschlagstütznut gedrückt zu werden.

7. Ein Bohrlochkopf nach Anspruch 3, worin die Hülse so angebracht ist, daß sie mit dem Stützring (52) zusammenwirkt, als Reaktion auf die nach unten gerichtete Bewegung des Verschlußkörpers und des Stützrings, um den Stützring in einen festen lastübertragenden Eingriff mit der Anschlagstütznut (20) zu drükken.

Revendications

1. Structure de tête de puits pour un puits comprenant :
une carcasse (10) de tête de puits positionnée dans un puits et ayant un siège de portée intérieur et une gorge (20) de support de portée intérieure (14) au-dessus dudit siège de portée ;
un organe de suspension (16) présentant un épaulement de portée extérieur (18) en appui sur ledit siège de portée et qui transmet les charges de l'organe de suspension audit siège de portée, et présentant un corps d'organe de suspension, traversé par un alésage et muni d'un collet supérieur s'étendant au-dessus de l'épaulement de portée ; et
une vanne d'éruption (12) fixée à l'extrémité supérieure de ladite carcasse et caractéri-

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sée par :

un organe de fermeture ayant un corps traversé par un alésage et muni d'un épaulement extérieur (50) regardant vers le bas,

des moyens de support (52) positionnés autour dudit organe de fermeture au-dessous dudit épaulement de fermeture (50) regardant vers le bas, et des moyens (54) qui répondent à la pression d'épreuve exercée entre ledit organe de fermeture (32) et ladite vanne d'éruption en pressant lesdits moyens de support (52) dans une position de transmission de la charge entre ledit épaulement (50) de la fermeture qui regarde vers le bas et ladite gorge intérieure (20) du support de portée de sorte que les charges de pression qui répondent à l'épreuve de pression de ladite vanne d'éruption sont transmises à ladite gorge (20) de la carcasse par ledit épaulement (50) de la fermeture et lesdits moyens de support (52).

2. Structure de tête de puits selon la revendication 1, comprenant des moyens (38, 80) servant à fermer l'écoulement à travers l'intérieur de l'organe de fermeture et dans lequel lesdits moyens de support (52) sont constitués par une bague support fendue disposée immédiatement au-dessous dudit épaulement (50) de fermeture.

3. Structure de tête de puits selon la revendication 1 ou la revendication 2, dans laquelle lesdits moyens répondant à la pression comprennent un manchon (54) qui entoure l'organe de fermeture et possède une surface destinée à coopérer avec ladite bague support fendue (52), de sorte que le déplacement relatif dudit manchon à l'intérieur de ladite bague support fendue repousse ladite bague support fendue à force, par effet de coincement, pour la mettre en prise d'appui avec ladite gorge intérieure de la carcasse pour supporter le corps dudit organe de fermeture, ledit mouvement dudit manchon dans ladite bague support fendue répondant à la pression d'épreuve qui s'exerce entre la vanne d'éruption et ledit organe de fermeture.

4. Structure de tête de puits selon la revendication 2, dans laquelle lesdits moyens destinés à arrêter l'écoulement à l'intérieur dudit organe de fermeture comprennent une vanne de contre-pression (38) montée dans ledit alésage pour empêcher l'écoulement vers le bas à travers ledit organe de fermeture.

5. Structure de tête de puits selon la revendication 2, dans laquelle lesdits moyens servant à arrêter l'écoulement à travers l'intérieur dudit organe de fermeture comprennent un appareil d'épreuve à coupelle (80), fixé dans la portion inférieure du volume intérieur dudit organe de fermeture.

6. Structure de tête de puits selon une quelconque des revendications 3 à 5, dans laquelle ledit manchon s'appuie contre l'extrémité supérieure dudit collet de l'organe de suspension et le corps dudit organe de fermeture est agencé pour descendre dans ledit alésage de l'organe de suspension alors que le manchon est arrêté dans son mouvement descendant par son arrivée en appui sur ledit collet, de sorte que ladite bague support fendue (52) descend sur ledit manchon pour être repoussée à force en mouvement descendant et être engagée dans ladite gorge de support de charge intérieure (20).

7. Structure de tête de puits selon la revendication 3, dans laquelle ledit manchon est agencé pour coopérer avec ladite bague support (52) en réponse au mouvement descendant dudit corps de fermeture et de ladite bague support pour engager ladite bague support à force en prise sans jeu dans ladite gorge intérieure (20) de support de portée pour la transmission de la charge.

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