## Description

This invention relates to landing seats for wells.

With the increasing depth of wells and the number of casing strings used therein, one of the main concerns with the well housings and other well structures on which hangers and other equipment are landed and supported is the tremendous loading of the landing shoulders and the increasing desire to decrease the load area of these shoulders to avoid as much blockage of the interior of the housing as possible. Another factor in these housings on which casings are supported is that a flow passage is needed to allow circulation and cementing after the hanger has been landed thereon and before the annulus seal is set.

U.S. Patent No. 4,528,738 discloses one hanger structure which is intended to support extremely heavy loads by utilizing an upper and a lower nding ring which coact with each other and with grooves in the wall of the housing against which they are set to distribute the load being supported over a greater area and thus reduces the individual stress in the housing support structure.

U.S. Patent No. 4,595,063 provides the support of a plurality of concentric casing strings directly and totally and independently of all other strings and hangers by a plurality of load ring slips that are components of a packoff assembly.

U.S. Patent No. 4, 615, 544 discloses a subsea well head system including a breech block connection in which the bearing area of the breech block teeth is greater than the bearing area of the housing seat for the casing hanger.

US-A-3902743 describes a well structure which has a well housing with a landing seat ring. The document is concerned principally with the retractability of the seat ring. Similar arrangements are escribed in US-A-4577686, US-A-3438653, DE-A-1299584 and GB-A-975209.

The present invention provides an improved well landing seat which will support extremely heavy casing loads but has only a relatively small surface. According to the present invention there is provided a well structure to be positioned within a well for supporting other well structure therein comprising well housing landed within the well and having an internal annular recess, and a landing seat ring, secured within said internal annular recess of said well housing, characterised in that said seat ring is formed from a material of substantially higher yield strength than that of the housing.

In one form of the invention the high strength landing seat ring is retained and supported between the housing and a housing ring which are in threaded engagement with each other and secure said landing seat ring in its desired position. In another form of the invention, the landing seat ring which is of a high strength material is formed radially outward within insert segments which are supported in an internal cavity within the housing and the forming of the seat ring secures the seat ring and the insert segments securely within said internal cavity. In another form of the invention the landing seat ring which is of a high strength material is segmented and positioned within an annular cavity within the housing and a ring is pressure formed radially outward within the landing seat ring to secure the landing seat ring within the annular cavity.

The high strength landing seat ring can withstand extremely high loading but is not correspondingly expensive nor complicated.

The landing seat ring can be arranged to provide a bypass means for circulation which does not weaken the hanger.

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

FIGURE 1 is a sectional view through one form of the invention and showing a hanger supported on the high strength landing seat ring.

FIGURE 2 is a sectional view through another form of the invention illustrating the structure ready for permanent installation in the housing recess.

FIGURE 3 is a sectional view of the structure shown in FIGURE 2 after it has been formed into secure engagement within the housing recess.

FIGURE 4 is a sectional view of still another form of the invention which has been secured within the housing recess.

### Description of the Preferred Embodiments

Well structure 10 illustrated in FIGURE 1 includes well housing body 12, housing ring 14 which is threaded into the portion of body 12 at a position such that its upper end 16 is spaced a sufficient distance below downwardly facing shoulder 18 on the interior of body 12 to provide internal annular recess 20 in which seat insert ring 22 is positioned. The threaded connection between body 12 and housing ring 14 provides the means by which the seat insert ring 22 may be installed and retained within the internal annular recess 20. When seat insert ring 22 is positioned within body 12 and against downwardly facing shoulder 16, housing ring 14 is threaded therein and tightened to securely engage seat insert ring 22 in its desired position within internal annular recess 20.

Seat insert ring 22 includes high strength ring 24 which includes ports 26 extending radially therethrough and communicating with axially extending external slots 28 and flow bypass ring 30 which is

positioned above ring 22 and coacts therewith. Flow bypass ring 30 includes annular outer recess 32 and axially extending slots 34. High strength ring 24 includes lower surface 36 which engages the upper end 16 of housing ring 14 and upper surface 38 which engages lower surface 40 of flow bypass ring 30. Flow bypass ring 30 also includes upper surface 42 which is slightly spaced apart from downwardly facing shoulder 18 of housing body 12.

Hanger 44 is shown positioned within housing body 12 and has its high strength landing shoulder ring 46 which is secured to its exterior by ring 48 below downwardly facing hanger shoulder 50 landed with its tapered landing surface 52 engaging tapered landing surface 54 of high strength insert landing ring 24. It is preferred that landing ring 24 and landing shoulder ring 46 be made from a suitable alloy to have a yield strength of approximately 130,000 psi (896319 KN/m$^2$) and that flow bypass ring 30 have a yield strength of approximately 60,000 psi (413686 KN/m$^2$). Well housing body 12, housing ring 14, and hanger 44 are preferred to be of a suitable material to have a yield strength of approximately 85,000 psi (586055 KN/m$^2$).

The modified form of the invention shown in FIGURES 2 and 3 includes well housing 60 which includes internal annular recess 62 having lower upwardly facing shoulder 64 and upper downwardly facing shoulder 66. Insert seat ring 68 includes insert segments 70 and high strength seat ring 72 which has its original outer diameter sufficient small to allow it to be inserted into the interior of well housing 60 and be positioned immediately inward of recesses 74 in insert seat ring segments 70. With the components in this position, high strength seat ring 72 is formed radially outwardly into recesses 74 so that segments 70 and seat ring 72 are secured within recess 62 as shown in FIGURE 3.

To provide the annulus flow bypass, ports 76 extend radially through the lower portion of segments 70 and communicate with axially extending slots 78. Slots 78 communicate with the interior of housing 60 above seat ring 72. Seat ring 72 includes tapered landing shoulder 80 on its upper inner surface.

Well structure 90 shown in FIGURE 4 includes housing 92 having internal recess 94 and flowby passages 96. High strength seat member 98 is divided into segments 100 which are positioned within recess 94 and locking ring 102 is formed into recesses 104 on the interior of segments 100 after the segments 100 have been positioned within housing recess 94. This is done by utilizing a non-high strength material for ring 102 so that it may be readily formed radially outward. High strength seat member 98 provides tapered landing shoulder 106 on which a hanger (not shown) may land.

It is preferred that the material used for the high strength landing seat insert be of a high strength steel alloy which has the desired yield strength as set forth above and care should be taken to use materials which also function in the environment of the well bore. For example, tool steel having the desired yield may be used provided that the well does not produce sulfur compounds such as hydrogen sulfide or sulfur dioxide. In such wells it is preferred that a corrosion resistant alloy be used such as a suitable Inconel alloy.

The present invention, as can be seen from the foregoing, provides a building block approach to solve the problem of the limited projected landing shoulder bearing area and spreads the shoulder load over much larger areas in the housing so that the loads are acceptable for the materials of the housing. With such building block construction, differing loads can be accommodated merely by upgrading the material of the insert. This provides a single passive load shoulder that functions every time and eliminates complicated load sharing mechanisms.

It is also an advantage of the present invention to provide the flow area in the housing for cement returns rather than in the hanger. This provides the flow area without the loss of bearing area in the landing shoulder. Also, because the housing has a greater D/t ratio than the hanger it can better handle the stresses caused by the removal of metal for the flow area. This flow area can be made larger both in total area and minimum particle size than can pass therethrough.

## Claims

1. A well structure to be positioned within a well for supporting other well structure therein comprising a well housing (12; 60; 92) landed within the well and having an internal annular recess (20; 62; 94) and a landing seat ring (22; 72; 98) secured within said internal annular recess (20; 62; 94) of said well housing, characterised in that said seat ring (22) is formed from a material of substantially higher yield strength than that of the housing (12).

2. A well structure according to claim 1 wherein said landing seat ring (72) has been formed radially outward into its desired position to secure it within the internal annular recess (62) of said well housing (60).

3. A well structure according to claim 1 including a casing hanger (44) having a high strength landing shoulder ring (46) for engaging the

positioned above ring 22 and coacts therewith. Flow bypass ring 30 includes annular outer recess 32 and axially extending slots 34. High strength ring 24 includes lower surface 36 which engages the upper end 16 of housing ring 14 and upper surface 38 which engages lower surface 40 of flow bypass ring 30. Flow bypass ring 30 also includes upper surface 42 which is slightly spaced apart from downwardly facing shoulder 18 of housing body 12.

Hanger 44 is shown positioned within housing body 12 and has its high strength landing shoulder ring 46 which is secured to its exterior by ring 48 below downwardly facing hanger shoulder 50 landed with its tapered landing surface 52 engaging tapered landing surface 54 of high strength insert landing ring 24. It is preferred that landing ring 24 and landing shoulder ring 46 be made from a suitable alloy to have a yield strength of approximately 130,000 psi (896319 KN/m$^2$) and that flow bypass ring 30 have a yield strength of approximately 60,000 psi (413686 KN/m$^2$). Well housing body 12, housing ring 14, and hanger 44 are preferred to be of a suitable material to have a yield strength of approximately 85,000 psi (586055 KN/m$^2$).

The modified form of the invention shown in FIGURES 2 and 3 includes well housing 60 which includes internal annular recess 62 having lower upwardly facing shoulder 64 and upper downwardly facing shoulder 66. Insert seat ring 68 includes insert segments 70 and high strength seat ring 72 which has its original outer diameter sufficient small to allow it to be inserted into the interior of well housing 60 and be positioned immediately inward of recesses 74 in insert seat ring segments 70. With the components in this position, high strength seat ring 72 is formed radially outwardly into recesses 74 so that segments 70 and seat ring 72 are secured within recess 62 as shown in FIGURE 3.

To provide the annulus flow bypass, ports 76 extend radially through the lower portion of segments 70 and communicate with axially extending slots 78. Slots 78 communicate with the interior of housing 60 above seat ring 72. Seat ring 72 includes tapered landing shoulder 80 on its upper inner surface.

Well structure 90 shown in FIGURE 4 includes housing 92 having internal recess 94 and flowby passages 96. High strength seat member 98 is divided into segments 100 which are positioned within recess 94 and locking ring 102 is formed into recesses 104 on the interior of segments 100 after the segments 100 have been positioned within housing recess 94. This is done by utilizing a non-high strength material for ring 102 so that it may be readily formed radially outward. High strength seat member 98 provides tapered landing shoulder 106 on which a hanger (not shown) may land.

It is preferred that the material used for the high strength landing seat insert be of a high strength steel alloy which has the desired yield strength as set forth above and care should be taken to use materials which also function in the environment of the well bore. For example, tool steel having the desired yield may be used provided that the well does not produce sulfur compounds such as hydrogen sulfide or sulfur dioxide. In such wells it is preferred that a corrosion resistant alloy be used such as a suitable Inconel alloy.

The present invention, as can be seen from the foregoing, provides a building block approach to solve the problem of the limited projected landing shoulder bearing area and spreads the shoulder load over much larger areas in the housing so that the loads are acceptable for the materials of the housing. With such building block construction, differing loads can be accommodated merely by upgrading the material of the insert. This provides a single passive load shoulder that functions every time and eliminates complicated load sharing mechanisms.

It is also an advantage of the present invention to provide the flow area in the housing for cement returns rather than in the hanger. This provides the flow area without the loss of bearing area in the landing shoulder. Also, because the housing has a greater D/t ratio than the hanger it can better handle the stresses caused by the removal of metal for the flow area. This flow area can be made larger both in total area and minimum particle size than can pass therethrough.

## Claims

1. A well structure to be positioned within a well for supporting other well structure therein comprising a well housing (12; 60; 92) landed within the well and having an internal annular recess (20; 62; 94) and a landing seat ring (22; 72; 98) secured within said internal annular recess (20; 62; 94) of said well housing, characterised in that said seat ring (22) is formed from a material of substantially higher yield strength than that of the housing (12).

2. A well structure according to claim 1 wherein said landing seat ring (72) has been formed radially outward into its desired position to secure it within the internal annular recess (62) of said well housing (60).

3. A well structure according to claim 1 including a casing hanger (44) having a high strength landing shoulder ring (46) for engaging the

high strength landing seat ring (22) of said well housing.

4. A well structure according to claim 1 including a plurality of segments (70) positioned within said housing internal annular recess (62) and having a recess (74) for receiving said high strength landing seat ring, (72) said high strength landing seat ring (72) having been pressure formed radially outward into tight engagement within said recess (74) within said segments (70) whereby said segments (70) are secured within said housing internal annular recess.

5. A well structure according to claim 1 including a housing ring (14) threaded to said housing (12) and forming one end of said housing internal annular recess (20) said high strength landing seat ring (22) being positioned within said housing internal annular recess (20) with said housing ring (14) removed and then said housing ring (14) being threaded therein into tight securing engagement with said high strength landing seat ring.

6. A well structure according to claim 1 including an holding ring (102), said high strength landing seat ring (98) being divided into segments (100) which are positioned within said housing internal annular recess (94) and having an annular recess (104) for receiving said holding ring (102), said holding ring (102) having been formed radially outward into tight engagement with the annular recess (104) in said seat ring segments (100) to retain said segments in secure engagement with said housing internal annular recess.

7. A well structure according to claim 1 wherein said landing seat ring (22; 72; 98) has a yield strength of approximately 130000 psi (896319 KN/m$^2$) and the well housing (12; 60; 94) has a yield strength of approximately 85000 psi (586055 KN/m$^2$).

**Patentansprüche**

1. Bohrlochvorrichtung zur Anordnung in einem Bohrloch zum Zwecke der Abstützung anderer Bohrlochvorrichtungen mit einem Bohrlochkopfgehäuse (12; 60; 92), das innerhalb des Bohrloches angeordnet ist und eine innere ringförmige Aussparung (20; 62; 94) besitzt, und mit einem Setzring (22; 72; 98), der in der inneren ringförmigen Aussparung (20; 62; 94) des Bohrlochkopfgehäuses befestigt ist, **dadurch gekennzeichnet**, daß der Setzring (22) aus einem Material wesentlich höherer Formänderungsfestigkeit als das Bohrlochkopfgehäuse (12) geformt ist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** der Setzring (72) radial nach außen in seine gewünschte Lage verformt wird, um ihn in der inneren ringförmigen Aussparung (62) des Bohrlochkopfgehäuses (60) zu befestigen.

3. Vorrichtung nach Anspruch 1, **gekennzeichnet durch** eine Futterrohraufhängung (44), die einen hochfesten Setzschulterring (46) zum Zusammenwirken mit dem hochfesten Setzring (22) des Bohrlochkopfgehäuses besitzt.

4. Vorrichtung nach Anspruch 1, **gekennzeichnet durch** eine Vielzahl von Segmenten (70), die innerhalb der inneren ringförmigen Aussparung (62) des Gehäuses angeordnet sind und eine Aussparung (74) zur Aufnahme des hochfesten Setzringes (72) besitzen, wobei der hochfeste Setzring (72) durch Druckverformung radial nach außen in enge Verbindung mit der Aussparung (74) innerhalb der Segmente (70) gebracht wird, wodurch die Segmente (70) in der inneren ringförmigen Aussparung des Gehäuses befestigt werden.

5. Vorrichtung nach Anspruch 1, **gekennzeichnet durch** ein Gehäuse (14), der in das Bohrlochkopfgehäuse (12) eingeschraubt ist und ein Ende der inneren ringförmigen Aussparung (20) des Bohrlochkopfgehäuses bildet, wobei der hochfeste Setzring (22), bei entferntem Gehäusering (14) in die innere ringförmige Aussparung (20) des Bohrlochkopfgehäuses eingesetzt und danach der Mantelring (14) in engen Kontakt mit dem hochfesten Setzring darin eingeschraubt wird.

6. Vorrichtung nach Anspruch 1, **gekennzeichnet durch** einen Haltering (102), wobei der hochfeste Setzring (98), in Segmente (100) geteilt ist, die innerhalb der inneren ringförmigen Aussparung (94) des Bohrlochkopfgehäuses angeordnet sind, und eine ringförmige Aussparung (104) zur Aufnahme des Halteringes (102) aufweist, und der Haltering (102) radial nach außen in enge Verbindung mit der ringförmigen Aussparung (104) in den Setzringsegmenten (100) verformt wird, um die Segmente in sicherer Verbindung mit der inneren ringförmigen Aussparung des Bohrlochkopfgehäuses zu halten.

* C L M S *

7. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** der Setzring (22; 72; 98) eine Formänderungsfestigkeit von annähernd 130 000 psi (896 319 KN/m ) und das Bohrlochkopfgehäuse (12; 60; 94) eine Formänderungsfestigkeit von annähernd 85 000 psi (586 055 KN/m ) besitzt.

**Revendications**

1. Structure de puits destinée à être positionnée à l'intérieur d'un puits pour supporter une autre structure de puits à l'intérieur du puits, comportant un boîtier de puits (12; 60; 92) appuyé à l'intérieur du puits et ayant un évidement annulaire interne (20; 62; 94), et un anneau (22; 72; 98) formant siège d'appui fixé à l'intérieur dudit évidement annulaire interne (20; 62; 94) dudit boîtier de puits, caractérisée en ce que ledit anneau (22) formant siège est constitué d'un matériau de limite élastique nettement plus élevée que celle du boîtier (12).

2. Structure de puits selon la revendication 1, dans laquelle ledit anneau (72) formant siège d'appui a été mis en forme radialement vers l'extérieur dans sa position voulue pour le fixer dans l'évidement (62) annulaire interne dudit boîtier (60) de puits.

3. Structure de puits selon la revendication 1, comportant un dispositif de suspension (44) de tubage ayant un anneau (46) formant épaulement d'appui à haute résistance destiné à être en contact avec l'anneau (22) formant siège d'appui à haute résistance dudit boîtier de puits.

4. Structure de puits selon la revendication 1, comportant plusieurs segments (70) positionnés à l'intérieur dudit évidement (62) annulaire interne et ayant un évidement (74) destiné à recevoir ledit anneau (72) formant siège d'appui à haute résistance, ledit anneau (72) formant siège d'appui à haute résistance ayant été mis en forme sous pression radialement vers l'extérieur jusqu'à prise serrée à l'intérieur dudit évidement (74) situé dans lesdits segments (70) de telle sorte que lesdits segments (70) sont fixés à l'intérieur dudit évidement annulaire interne du boîtier.

5. Structure de puits selon la revendication 1, comportant un anneau (14) de boîtier vissé sur ledit boîtier (12) et formant une extrémité dudit évidement (20) annulaire interne du boîtier, ledit anneau (22) formant siège d'appui à haute résistance étant positionné à l'intérieur dudit évidement (20) annulaire interne du boîtier, ledit anneau (14) de boîtier étant enlevé,et ensuite ledit anneau (14) de boîtier étant vissé à l'intérieur en prise de fixation serrée avec ledit anneau formant siège d'appui à haute résistance.

6. Structure de puits selon la revendication 1, comportant un anneau (102) de retenue, ledit anneau (98) formant siège d'appui à haute résistance étant divisé en segments (100) qui sont positionnés à l'intérieur dudit évidement (94) annulaire interne du boîtier et ayant un évidement annulaire (104) destiné à recevoir ledit anneau (102) de retenue, ledit anneau (102) de retenue ayant été mis en forme radialement vers l'extérieur pour venir en contact serré avec l'évidement (104) annulaire situé dans lesdits segments (100) d'anneau formant siège pour retenir les segments en prise sûre avec ledit évidement annulaire interne du boîtier.

7. Structure de puits selon la revendication 1, dans lequel ledit anneau formant siège d'appui (22; 72; 98) a une résistance limite d'approximativement 896319 kN/m$^2$ (130000 psi) et le boîtier de puits (12; 60; 94) a une résistance limite d'approximativement 586055 kN/m$^2$ (85000 psi).