Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Description

[0001] The present invention relates to a sealing device and method for sealing a casing. Such casings are for instance used in a wellbore for optionally sealing the casing e.g. to circulate fluid through the casing.

[0002] US 5,632,952 discloses an extendable casing and method for sealing that may be utilised in either a conventional drilling rig, or in a top drive rig. The sealing device is brought into the casing using an extension device after which a packer element is inflated. This inflated packer element is deflated before withdrawal of the sealing device. In another embodiment the sealing device comprises a top cap that is put over the casing.


[0004] Casings that are used in e.g. oil industry show a variation in diameter and/or of their circular shape due to e.g. production tolerances. To bring a sealing device into a casing requires a relatively large gap between the outside diameter of the sealing device and the inside diameter of the casing in order to deal with the variations. Furthermore, there is a variation of nominal diameters between different casings that may increase the opening or gap if these have to be sealed with the same sealing device. This requires additional sealing measures, like an inflatable device, to seal such a gap. Due to the enormous pressure that may occur inside the casing, e.g. in a range of 200-1000 bar due to the e.g. gas pockets, these additional sealing measures may leak, damage etc.. Furthermore, the forces acting on an extendable sealing device may become large, thereby requiring large dimensions of such a sealing device.

[0005] The present invention has for its objects to provide a sealing device for sealing a casing and (partly) obviate at least some of the above problems.

[0006] The present invention provides a sealing device for sealing a casing comprising:

- a housing with an outside diameter;
- a core inside the housing;
- at least two sealing segments in slidable engagement with the core to change the outside diameter of the sealing device on at least one position of the sealing device; and
- at least two wedges in slidable engagement with the core and the sealing segments to seal the sealing device against the casing.

[0007] To seal the casing the sealing device is brought into the casing with the housing of such a sealing device having an outside diameter that, at the time of entering the sealing device into the casing, is smaller than the inside diameter of this casing. Inside the housing a core is located that is provided with sliding surfaces. At least two, but preferably four, sealing segments are in slidable engagement with this core and may slide over the sliding surfaces of the core. In case the sealing device is brought into the casing, and sealing of this casing is required, the sealing segments slide over the sliding surfaces of the core. This sliding will change the outside diameter of the sealing device on at least one position of this sealing device. This is achieved by providing the sliding surfaces such that, when sliding the sealing segments in longitudinal direction of the sealing device, the sealing segments are directed radially from the core. This is achieved by putting the sliding surfaces at an angle with the longitudinal direction of the sealing device, and the casing.

Therefore, if the sealing segments slide further into the casing, they will be pushed outwards in a radial direction towards the sidewall of the casing. This results in the segments being transferred from the smaller outside diameter of the housing to the larger inside diameter of the casing. As the sealing segments are brought on a larger diameter for sealing, these segments do not fully engage the casing over the entire inside periphery. Therefore, at least two wedges, but preferably four wedges, are in slidable engagement with the core and sealing segments. These additional wedges compensate for the larger diameter of the inside casing. In other words, the lack of material of the segments, if brought on the larger diameter, is compensated for by the wedges. With such a sealing device a more mechanical sealing may be achieved by filling the gap between the housing of the sealing device and the inside diameter of the casing with the sealing segments and wedges. A further advantage of the invention is that it is easier to bring a sealing device into a casing, thereby minimizing the time required to achieve the sealing of a casing. A further advantage of the invention is the obtaining of a larger flexibility for the range of nominal casing diameters that may be sealed with one specific sealing device. Furthermore, by reducing the number of parts and allowing a larger flexibility of diameters of the casings a more efficient operation may be achieved.

[0008] According to the present invention the sealing device comprises first actuating means for moving the sealing segments and the wedges relative to the core, and second actuating means for moving the wedges relative to the core and the sealing segments.

[0009] In a first step of sealing a casing, when the sealing device is brought into the casing, first actuating means move the sealing segments and the wedges relative to the core over the sliding surfaces to increase the outside diameter of the sealing device inside the casing. In a second step the lack of material on the outside diameter of the sealing devices is compensated by moving the wedges relative to the sealing segments, thereby adding material on the outside diameter of the sealing device inside the casing. This will result in a more or less mechanical sealing of the casing by the sealing device.

[0010] In a further embodiment according to the
The provision of this, e.g. non-return, valve prevents fluid flowing from the casing into the supply channel. In a preferred embodiment the sealing strip is made of a poly-urethane material that is preferably located into recesses provided in the sealing segments and the wedges. E.g. for a casing with a diameter of about 200 mm a sealing strip may extend about 1 mm outside the sealing segments and wedges. As the sealing segments move relative to the core, the core may be provided with a notch over its outside diameter. This notch may be filled with a sealing ring. Using these relatively small sealing strips a further improved sealing may be achieved by the sealing device according to the invention. A further advantage of these sealing strips is that the sealing device may cope with an even larger range of casing diameters, variances and tolerances.

In a further embodiment according to the present invention the core of the sealing device comprises a supply channel.

The supply channel is used to provide a well-bore with a fluid. This will be relevant when running casing into a hole, as the casing is normally filled with fluid as new joints are added to the casing string to prevent the collapse of the casing during the run-in operation. Also, the fluid may be required to remove sand etc. from the casing. By combining the sealing device with the supply channel a more efficient operation may be achieved, also in case of a casing being stuck in the hole. This combination prevents the use of separate equipment to free a stuck casing. A further advantage of such a combination is that by supplying the liquid, and at the same time sealing the casing, an increased pressure may be realised inside the casing. In a preferred embodiment the sealing device comprises a valve for closing the supply channel. The provision of this, e.g. non-return, valve prevents fluids flowing from the casing into the supply channel. In a further preferred embodiment the valve comprises guiding means to guide the sealing device into the casing. By designing the shape of the relevant parts of the valve this valve may act as guiding means thereby speeding up the sealing operation. In an even further preferred embodiment of the invention the valve of the sealing device comprises spring means. By adding spring means to the valve it is possible to incorporate a safety measure into the sealing device. This safety measure is actuated e.g. in case the pressure inside the supply channel increases. Thus, such a pressure increase will be limited, thereby preventing damage to the sealing device. Preferably, the supply channel is provided with an (threaded) insert on the exit of the supply channel that may be easily replaced. By designing this insert as the weakest part of the sealing device most of the damage will be accumulated in this insert. This will prevent damage to the other parts of the sealing device. As the insert is relatively easily removed and changed with an other insert damage and maintains costs will be reduced.

In a further preferred embodiment according to the present invention the sealing device comprises friction means to hold the sealing devices relative to the casing.

To prevent undesired removal of the sealing device from the casing due to e.g. an enormous pressure occurring inside the casing of e.g. 1000 bar, additional friction means in the form of claws and/or teeth will be provided. As soon as the sealing device is moving or intends to move in an undesired direction these claws or teeth will engage the sidewall of the casing, preferably on the inside, thereby increasing the friction forces acting against movement or even removal of the sealing device. Preferably, the friction means only act on the surface of the casing if the sealing device actually seals the casing.

The invention further relates to a method for sealing a casing.

With this method the same effects and advantages as described before for the sealing device will be obtained.

The invention is further illustrated in the following description with reference to the annexed figures, which show:

- figure 1 a simplified view of a part of a drilling rig with a casing and a sealing device in accordance with the present invention;
- figure 2 the core, sealing segments and wedges of the sealing device from figure 1;
- figure 3A the sealing device of figure 1;
- figure 3B a cross-section of the device from figure 3A over the tooth blocks;
- figure 3C another cross-section of the device from figure 3A over the segment linkages;
- figure 3D a further cross-section of the device from figure 3A over the supply channel;
- figures 4A, B, C and D the supply channel together with the valve.
- figures 5A and B cross-shaped part of the valve from figure 4, and
- figures 6A and B the valve part from figure 4.

A conventional drilling rig 2 (figure 1) comprises the sealing device 4. The rig 2 comprises a lifting device or travelling block 6 capable of transferring the top drive 8. Also, there is provided an elevator 10 provided with hooks 12. The elevator 10 supports in a conventional manner casing 14. The elevator 10 is connected to lifting device 6 by links 16. The sealing device 4 is connected with a liquid or mud supply 18 by connecting part 20 and hoses 22. Preferably, two hoses 22 are provided to have a stable orientation of the sealing device 4. Also, hoses 22 are provided with a sufficient length between connecting part 20 and entry part 24 to allow for a vertical displacement of the sealing device by hoist device 26. Hoist device 26 is connected to the sealing device 4 by con-
The sealing mechanism 36 (figure 2) comprises a core 38 provided with a supply channel 40 for the supply of mud. Core 38 also comprises a notch or groove 39 for a sealing ring. Sealing mechanism 36 further comprises sealing segments 42 and wedges 44. A wedge 44 may slide over sliding surface 48 of core 38. Sealing segment 42 may slide over sliding surface 48 of core 38. Wedge 44 moves relative to the sealing segment 42 over side surface 50 of sealing segment 42. The sealing mechanism 36 may be located into casing 14 to seal this casing. The sliding surfaces 48 are put at an angle with the longitudinal direction of the sealing device 4 and, therefore, transfers the segments 42 radially when sliding over core 38.

The sealing device 4 is provided with connections 30 for oil. Oil is supplied by hoses 32 from an oil supply and controller 34. These hoses 32 are also provided with a length sufficient for vertically displacing sealing device 4.

To seal casing 14 oil is supplied to room 74 by channels or pipes 73, thereby moving segments 42 and wedges 44 downward. When the segments 42 engage the sidewall of casing 14, room 56 is supplied with oil by channels or pipes 55 to move the wedges 44 further downward. To remove the sealing, room 62 is supplied with oil or pipes (not shown). First, the wedges 44 will retract and chamber 56 gets smaller. After wedges 44 have joined segments 42 again, continuing the oil supply to room 62 will retract both the segments 42 and wedges 44. Chamber 56 and 74 will get smaller again and the sealing device 4 may be removed from casing 14.

The mud saver assembly 94 (figure 4) is positioned at the end of core 38 and supply channel 98. The assembly 94 comprises valve parts 96. In the illustrated embodiment there are four valve parts 96. The sealing segments 42 are provided with recesses for sealing strips 92. The assembly 94 further comprises the cross-shaped part 104 that is connected with stop 100 by bolt 102. The stop 100 has sides that are preferably under an angel with the direction of the sealing device 4, thereby guiding the stop 100 into the supply channel 98. Between stop 100 and part 104 there is provided at least one cup spring 114 as a safety measure to prevent undesired over-pressure inside sealing device 4. Valve parts 96 are connected to core 38 by guiding pens 106 through an opening in valve part 96 and core 38. Guiding pen 106 is on one end provided with thread 128 for connection to valve parts 96. The other end of guide pen 106 is put into the core 38. Valve part 96 is connected with sealing segment 42 by bolt 122 through opening 124 in valve part 96. Bushing 108 acts as an insert to the supply channel 98 of the sealing device 4. The outside surface of threaded bushing 108 enables an easy removal or change of insert 108 in the supply channel 98 of the sealing device 4. As wear and/or damage is accumulated in the bushing 108 maintenance and damage costs are limited.

The cross-shaped valve part 104 (figures 5A and B) comprises a slotted hole 115 for guiding pen 106, a central bore 116 for bolt 102 connecting to the stop 100, a recess 118 for stop 100 and bore 120 to spring 114. Each valve part 96 (figures 6A and B) comprises an opening 110 for guiding pen 106, and bores 124 for connecting the valve part 96 with a sealing segments 42.

It is thus the case that after examination of the foregoing many alternative and additional embodiments can occur to the skilled person which all lie within the scope of the invention defined in the appended claims. As an example, although sealing device 4 is illustrated for a conventional drilling rig 2, also other applications in sealing of e.g. casings, hoses, conduits etc. may be realised. Also, changing the number of segments 42 and wedges 44, depending on e.g. the diameter of the casing
14, will be possible. Although the actuating means are illustrated as a hydraulic system, it may be possible to move the sealing segments 42 and wedges 44 relative to the core 38 and each other with e.g. an electronic device. It will also be possible to change the translational movement of the wedges 44 and sealing segments 42 relative to core 38, into a rotational movement, using e.g. a threaded piece for combining this rotational movement with an axial movement, thereby pushing the segments radially outward. Especially for larger diameters it would be possible to provide supply channels in the sealing segments 42, in stead of, or in combination with, the supply channel 96 in core 38.

Claims

1. Sealing device (4) for sealing a casing (14) comprising:
   - a housing with an outside diameter;
   - a core (38) inside the housing;
   - at least two sealing segments (42) in slidable engagement with the core to change the outside diameter of the sealing device on at least one position of the sealing device; and
   - at least two wedges (44) in slidable engagement with the core and the sealing segments to seal the sealing device against the casing,
   characterized by:
   - first actuating means (74) for moving the sealing segments and the wedges relative to the core; and
   - second actuating means (56) for moving the wedges relative to the core and the sealing segments.

2. Sealing device according to claims 1, wherein the sealing segments, the wedges and the core comprising a sealing strip (92).

3. Sealing device according to claims 1 or 2, wherein the core comprising a supply channel (40).

4. Sealing device according to claim 3, wherein the sealing device comprising a valve (96,100) for closing the supply channel (40).

5. Sealing device according to claim 4, wherein the valve comprising guiding means (106) to guide the sealing in the casing.

6. Sealing device according to claims 4 or 5, wherein the valve comprising spring means (114).

7. Sealing device according to any of claims 3-6, wherein the supply channel is provided with an insert (108).

8. Sealing device according to any of claims 1-7, wherein the sealing device comprising friction means (90,92) to hold the sealing device relative to the casing.

9. Method for sealing and removing the sealing of a casing (14), comprising the steps:
   - entering a sealing device (4) into the casing, the sealing device comprising:
     - a housing with an outside diameter;
     - a core (38) inside the housing;
     - at least two sealing segments (42) in slidable engagement with the core to change the diameter of the sealing device; and
     - at least two wedges (44) in slidable engagement with the core and the sealing segments to seal the sealing device against the casing;
   - slidably moving the sealing segments and the wedges relative to the core with first actuating means (74) to increase the outside diameter of the sealing device;
   - slidably moving the wedges (44) relative to the sealing segments with second actuating means (56) to seal the sealing device against the casing;
   - withdrawing the sealing segments and the wedges; and
   - withdrawing the sealing device from the casing.

10. Method according to claim 9, further comprising the step of supplying a fluid to the casing through a supply channel (40) in the core of the sealing device, with the sealing segments and wedges in sealing or non-sealing engagement with the casing.

Patentansprüche

1. Dichtungsvorrichtung (4) zum Abdichten einer Verrohrung (14) mit:
   - einem Gehäuse mit einem Außendurchmesser;
   - einem Kern (38) innerhalb des Gehäuses;
   - mindestens zwei Dichtungssegmenten (42) in gleitfähigem Eingriff mit dem Kern zum Ändern des Außendurchmessers der Dichtungsvorrichtung auf mindestens einer Position der Dichtungsvorrichtung; und
   - mindestens zwei Keilen (44) in gleitfähigem Eingriff mit dem Kern und den Dichtungsseg-
menten zum Abdichten der Dichtungsvorrichtung gegen die Verrohrung.

gekennzeichnet durch:

- ein erstes Betätigungsmittel (74) zum Bewegen der Dichtungssegmente und der Keile relativ zu dem Kern; und
- ein zweites Betätigungsmittel (56) zum Bewegen der Keile relativ zu dem Kern und den Dichtungssegmenten.

2. Dichtungsvorrichtung nach Anspruch 1, bei der die Dichtungssegmente, die Keile und der Kern einen Dichtungsstreifen (92) aufweisen.

3. Dichtungsvorrichtung nach Anspruch 1 oder 2, bei der der Kern einen Lieferkanal (40) aufweist.

4. Dichtungsvorrichtung nach Anspruch 3, bei der die Dichtungsvorrichtung ein Ventil (96, 100) zum Schließen des Lieferkanales (40) aufweist.

5. Dichtungsvorrichtung nach Anspruch 4, bei der das Ventil ein Führungsmitte (106) aufweist zum Führen der Dichtung in der Verrohrung.

6. Dichtungsvorrichtung nach Anspruch 4 oder 5, bei der das Ventil ein Federmittel (114) aufweist.

7. Dichtungsvorrichtung nach einem der Ansprüche 3 bis 6, bei der der Lieferkanal mit einem Einsatz (108) versehen ist.

8. Dichtungsvorrichtung nach einem der Ansprüche 1 bis 7, bei der die Dichtungsvorrichtung ein Reibungsmittel (90, 92) aufweist zum Schließen der Dichtungsvorrichtung relativ zu der Verrohrung.

9. Verfahren zum Abdichten und Entfernen der Dichtung einer Verrohrung (14) mit den Schritten:

- Eingeben einer Dichtungsvorrichtung (4) in die Verrohrung, wobei die Dichtungsvorrichtung aufweist:
  - ein Gehäuse mit einem Außendurchmesser;
  - einen Kern (38) innerhalb des Gehäuses;
  - mindestens zwei Dichtungssegmenten (42) in gleitfähigem Eingriff mit dem Kern zum Ändern des Durchmessers der Dichtungsvorrichtung; und
  - mindestens zwei Keile (44) in gleitfähigem Eingriff mit dem Kern und den Dichtungssegmenten zum Abdichten der Dichtungsvorrichtung gegen die Verrohrung;

10. Verfahren nach Anspruch 9, weiter mit dem Schritt des Liefern eines Fluids zu der Verrohrung durch einen Lieferkanal (40) in dem Kern der Dichtungsvorrichtung, wobei die Dichtungssegmente und die Keile in abdichtendem oder nicht abdichtendem Eingriff mit der Verrohrung stehen.

Revendications

1. Dispositif d’étanchéité (4) pour sceller un boîtier (14), comprenant :

- un logement avec un diamètre externe ;
- une âme (38) à l’intérieur du logement ;
- au moins deux segments d’étanchéité (42) en engagement coulissant avec l’âme pour modifier le diamètre externe du dispositif d’étanchéité sur au moins une position du dispositif d’étanchéité ; et
- au moins deux clavettes (44) en engagement coulissant avec l’âme et les segments d’étanchéité pour sceller le dispositif d’étanchéité contre le boîtier, caractérisé par :
  - des premiers moyens d’actionnement (74) pour déplacer les segments d’étanchéité et les clavettes par rapport à l’âme ; et
  - des seconds moyens d’actionnement (56) pour déplacer les clavettes par rapport à l’âme et aux segments d’étanchéité.

2. Dispositif d’étanchéité selon la revendication 1, dans lequel les segments d’étanchéité, les clavettes et l’âme comprennent une bande d’étanchéité (92).

3. Dispositif d’étanchéité selon la revendication 1 ou 2, dans lequel l’âme comprend un canal d’alimentation (40).

4. Dispositif d’étanchéité selon la revendication 3, dans lequel le dispositif d’étanchéité comprend une souppape (96, 100) pour fermer le canal d’alimentation (40).

5. Dispositif d’étanchéité selon la revendication 4, dans
lequel la soupape comprend des moyens de guidage (106) pour guider le système d'étanchéité dans le boîtier.

6. Dispositif d'étanchéité selon la revendication 4 ou 5, dans lequel la soupape comprend des moyens à ressort (114).

7. Dispositif d'étanchéité selon l'une quelconque des revendications 3 à 6, dans lequel le canal d'alimentation est muni d'un insert (108).

8. Dispositif d'étanchéité selon l'une quelconque des revendications 1 à 7, dans lequel le dispositif d'étanchéité comprend des moyens de frottement (90, 92) pour maintenir le dispositif d'étanchéité par rapport au boîtier.

9. Procédé pour sceller de manière étanche et retirer l'étanchéité d'un boîtier (14), comprenant les étapes consistant à :

   - faire entrer un dispositif d'étanchéité (4) dans le boîtier, le dispositif d'étanchéité comprenant :
     - un logement avec un diamètre externe ;
     - une âme (38) à l'intérieur du logement ;
     - au moins deux segments d'étanchéité (42) en engagement coulissant avec l'âme pour modifier le diamètre du dispositif d'étanchéité ; et
     - au moins deux clavettes (44) en engagement coulissant avec l'âme et les segments d'étanchéité pour sceller le dispositif d'étanchéité contre le boîtier ;

   - déplacer à coulissement les segments d'étanchéité et les clavettes par rapport à l'âme avec un premier moyen d'actionnement (74) pour augmenter le diamètre externe du dispositif d'étanchéité ;
   - déplacer à coulissement les clavettes (44) par rapport aux segments d'étanchéité avec des seconds moyens d'actionnement (56) pour fermer hermétiquement le dispositif d'étanchéité contre le boîtier ;
   - retirer les segments d'étanchéité et les clavettes ; et
   - retirer le dispositif d'étanchéité du boîtier.

10. Procédé selon la revendication 9, comprenant en outre l'étape d'alimentation d'un fluide dans un boîtier via un canal d'alimentation (40) dans l'âme du dispositif d'étanchéité, avec les segments d'étanchéité et les clavettes en engagement d'étanchéité ou de non étanchéité avec le boîtier.
REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader’s convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5632952 A [0002]