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(74) Agent: WILSON, Glen; Harrison Goddard Foote, 106
Hope Street, Glasgow G2 6PH (GB).

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(71) Applicant (*for all designated States except US*): CALEDYNE LIMITED [GB/GB]; Unit A, Hydropark, Tern Place, Denmore Road, Bridge of Don, Aberdeen AB23 8JX (GB).

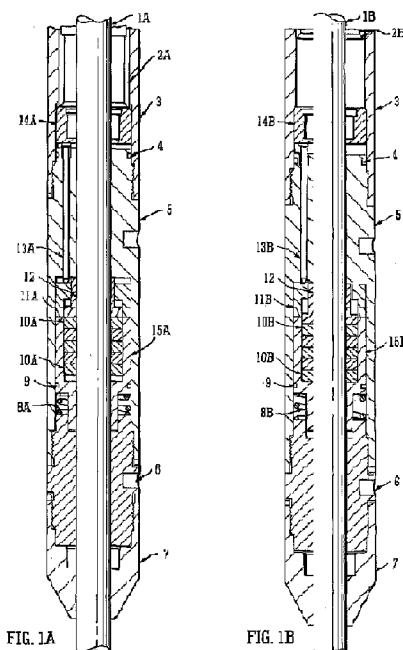
(72) Inventor; and

(75) Inventor/Applicant (*for US only*): MURRAY, Mark [GB/GB]; 10 Hillview Drive, Cults, Aberdeen AB15 9HD (GB).

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(54) Title: SHAFT SEAL FOR DOWN-HOLE TOOLS



(57) Abstract: A sealing apparatus for a downhole tool having a movable member which moves relative to a housing, the sealing apparatus comprising: at least one sealing member having a first position in which the sealing member is spaced from the movable member and a second position in which the sealing member is in contact with the movable member to provide a sealing barrier; and switching means for switching the sealing member between the first and second positions.

Shaft seal for down-hole tools

This invention relates to downhole tools, and a sealing arrangement for such tools. In particular, but not exclusively, the invention relates to downhole tools which have a rotary or reciprocating shaft for use in oil and water/gas well applications and which comprise a seal assembly.

Sealing arrangements for downhole tools which have a component which moves relative to a housing, for example rotary or reciprocating shafts, are known in the industry. A typical example is described in US Patent 5639227, Seal arrangement for the drivehead of a downhole rotary pump.

One limitation of the current state of the art is that these rotary or reciprocating seals can wear out, due to the fact that the surface of the seal is in continuous contact with the shaft. That is, the seal is continually energised or engaged, with an engagement force between the seal surface and the shaft surface. Various surface treatments, lubricants and surface finishes all help to reduce the wear of the seal, extending the useful life of the product, but only to a limited extent. In certain applications, the necessity of the seal to perform a sealing function in a downhole tool may be only a proportion of the time the tool is in operation. In the case of the rotary or reciprocating shaft seal, the duty period may only be 5% of the operational time. However, with the current state of the art the seal will be in contact with the shaft 100% of the time, leading to limited operational life.

According to a first aspect of the present invention there is provided a sealing apparatus for a downhole tool having a movable member which moves relative to a housing, the sealing apparatus comprising:

at least one sealing member having a first position in which the sealing member is spaced from the movable member and a second position in which the sealing member is in contact with the movable member to provide a sealing barrier;
and

switching means for switching the sealing member between the first and second positions.

Preferably the switching means comprises mechanical or hydraulic means. Preferably the sealing apparatus includes biasing means for biasing the sealing member towards the second position. Preferably the switching means comprises means for urging the sealing member towards the first position against the action of the biasing means. The sealing apparatus therefore uses a hold-off mechanism to prevent the seal surface contacting the moving surface of the shaft.

The sealing apparatus may include a fail-safe feature, in that when the activation load is removed, the sealing function is activated.

Alternatively, the sealing apparatus may include biasing means for biasing the sealing member towards the first position. The switching means may comprise means for

urging the sealing member towards the second position against the action of the biasing means.

Preferably, the biasing means comprises a compression spring.

Preferably, the sealing member comprises a plurality of seal rings, which may be of the same or different material, and, which when axially compressed, form a seal on the shaft.

Preferably, the sealing member includes a seal housing which acts as a piston when pressure is applied to the seal housing, to increase the compressive force on the seal rings. Preferably the pressure is applied to the seal housing from below.

According to a second aspect of the present invention there is provided a downhole tool including a sealing apparatus in accordance with the first aspect of the invention.

A particular embodiment of the invention will now be described by way of example only with reference to the accompanying drawing in which:

Figure 1A shows the shaft and activation method with the seals disengaged.

Figure 1B shows the shaft and activation method with the seals engaged.

In the preferred embodiment of the invention, a movable member or shaft 1A is held within a down-hole tool. For the purposes of this application, this tool may be a safety valve as described in PCTGB2005/004216, however the invention is applicable to other down-hole tools. The activation sleeve 2A is held within a housing 3, which is connected to the down-hole tool. A rod housing 5 is connected to the housing 3 and in turn a retainer housing 6 and end cap 7 make up the main external structure of the sealing apparatus.

The activation sleeve 2A is urged downwards by the operation of the downhole tool, via hydraulic or mechanical force. The activation sleeve, while part of the downhole tool, is used to operate the seal. Preferably, the activation sleeve is moved downwards by hydraulic pressure from the surface via a hydraulic control line. The hydraulic line acts on a piston, where the piston seals are so configured as to provide axial movement downwards of the activation sleeve. The activation sleeve may be moved in the opposite direction by a spring, or by another hydraulic piston, biased to axially move the activation sleeve upwards.

The activation sleeve contacts a ring 14A, which in turn contacts a push rod 13A. The push rod 13A contacts a further ring 11A, which is held against a seal housing 15A by the action of biasing means or a spring 8A. With the ring 11A and seal housing 15A urged down by the activation sleeve 2A, the axial gap for the flexible seal rings 10A between the seal housing 15A and seal retaining ring 12 is such that the seal rings do not contact the moving shaft 1A. The components which cause the seal rings to be spaced from the moving shaft 1A form switching means.

The seal ring 10A may be an elastomeric or non-elastomeric material commercially available for many suppliers. The invention may have one or more seal rings of various materials, which form an effective seal once compressed onto the shaft 1B. Seals 4 and 9 form the remainder of the sealing system. These seals 4 and 9 are preferably o-rings, but other seal types are also suitable.

When it is wished to make the seal between the shaft and housing, most likely when the shaft is stationary, the activation sleeve 2B is moved away from the ring 14B. As the activation sleeve 2B is removed, the spring 8B urges the seal housing 15B, ring 11B, push rod 13B against the ring 14B. This reduces the axial gap between the seal housing 15b and the seal retaining ring 12, hence compressing the seal rings 10B. When the seal rings 1B are compressed, pressure differential from below the tool acts across a piston area defined by the seal 9 and the seal ring 10B. This pressure acts on the piston to boost the compressive force on the seal rings 10B, increasing the contact pressure on the shaft 1B and hence increasing the sealing capability.

It can be seen that the sealing mechanism may be activated, de-activated and re-activated a multitude of times, depending on the efficacy of the seal rings 10.

It can be seen to those skilled in the art that various changes may be made to the features within these embodiments, without departing from the scope of the invention.

CLAIMS

1. A sealing apparatus for a downhole tool having a movable member which moves relative to a housing, the sealing apparatus comprising:

at least one sealing member having a first position in which the sealing member is spaced from the movable member and a second position in which the sealing member is in contact with the movable member to provide a sealing barrier; and

switching means for switching the sealing member between the first and second positions.
2. A sealing apparatus as claimed in Claim 1, wherein the switching means comprises mechanical or hydraulic means.
3. A sealing apparatus as claimed in Claim 1 or 2, including biasing means for biasing the sealing member towards the second position.
4. A sealing apparatus as claimed in Claim 3, wherein the switching means comprises means for urging the sealing member towards the first position against the action of the biasing means.
5. A sealing apparatus as claimed in Claim 1 or 2, including biasing means for biasing the sealing member towards the first position.

6. A sealing apparatus as claimed in Claim 5, wherein the switching means comprises means for urging the sealing member towards the second position against the action of the biasing means.
7. A sealing apparatus as claimed in any of Claims 3 to 6, wherein the biasing means comprises a compression spring.
8. A sealing apparatus as claimed in any preceding claim, wherein the sealing member comprises a plurality of seal rings which, when axially compressed, provide the sealing barrier.
9. A sealing apparatus as claimed in any preceding claim, wherein the sealing member includes a seal housing which acts as a piston when pressure is applied to the seal housing to increase the compressive force on the seal rings.
10. A sealing apparatus as claimed in Claim 9, wherein the pressure is applied to the seal housing from below.
11. A downhole tool including a sealing apparatus as claimed in any of Claims 1 to 10.
12. A sealing apparatus substantially as hereinbefore described with reference to the accompanying drawings.
13. A downhole tool substantially as hereinbefore described with reference to the accompanying drawings.

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