Abstract: A wellhead sleeve configured to be removably mounted to a wellhead at or near an annulus of the wellhead. The wellhead sleeve has a body having a bore therethrough, a skirt mounted to the body and an actuator configured to engage with the body and the skirt such that movement of the actuator relative to the body deforms a resiliently flexible portion of the skirt away from the bore.

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The invention relates to a wellhead sleeve. In particular, the invention relates, but is not limited, to a wellhead annulus sleeve made of a suitable wear resistant material, such as ceramic, that can be rotated and replaced as it wears to reduce and mitigate erosion damage typically caused by wellhead outflow abrasion. It is envisaged that the invention is particularly well suited for coal seam gas (CSG) outflow, but it should be appreciated that it could similarly be used for other fluid outflows in different applications.

Reference to background art herein is not to be construed as an admission that such art constitutes common general knowledge.

Wellheads of a common component used in oil and gas operations to provide a structural interface for production equipment. Over time, however, abrasive oil and gas fluids erode portions of the wellhead. One area of notable wear that has been identified is at or around the wellhead annulus. Rates of wear of approximately 30mm in steel over a 7 month period have been observed. This wear can cause various undesirable effects, including reduced structural integrity, reliability, efficiency, safety, pressure resistance, etc.
Once wear of significance has occurred it is necessary to replace the unit which is costly and time consuming. As production typically needs to be stopped to replace the unit, the cost is high both in terms of replacement parts and production losses.

OBJECT OF THE INVENTION

It is an aim of this invention to provide a wellhead sleeve which overcomes or ameliorates one or more of the disadvantages or problems described above, or which at least provides a useful commercial alternative.

Other preferred objects of the present invention will become apparent from the following description.

SUMMARY OF INVENTION

In one form, although it need not be the only or indeed the broadest form, there is provided a wellhead sleeve configured to be removably mounted to a wellhead at or near an annulus of the wellhead, the wellhead sleeve comprising:

- a body having a bore therethrough;
- a skirt mounted to the body; and
- an actuator configured to engage with the body and the skirt;

wherein movement of the actuator relative to the body deforms a resiliently flexible portion of the skirt away from the bore.
Preferably the body is substantially cylindrical. Preferably the body comprises a wear resistant material. Preferably the wear resistant material comprises a ceramic material. Preferably the ceramic material is an alumina ceramic. Preferably at least an internal region of the body adjacent to the bore comprises a wear resistant material. Even more preferably, the entire body is made from a ceramic material. Preferably the body is integrally formed.

Preferably an end of the body is tapered. Preferably the tapered end of the body is tapered to reduce an outer diameter of the body. Preferably the outer diameter of the body is reduced by between 1 and 20%, even more preferably by between about 5 and about 9%, over the tapered portion of the body.

Preferably the sleeve further comprises a compressible seal. Preferably the compressible seal is configured to receive at least a portion of the tapered portion of the body. Preferably the compressible seal is made of a rubber material, even more preferably a silicone rubber material. Preferably the compressible seal extends along at least a majority portion of the tapered portion of the body.

Preferably another end of the body comprises a recessed portion. Preferably an outer diameter of the recessed portion is reduced relative to the adjacent portion of the body. Preferably the recess comprises a thread. Preferably the thread is located on an outer surface of the recessed portion.
Preferably the thread of the recessed portion of the body corresponds to a thread of the actuator.

[0012] Preferably the recess of the recessed portion comprises one or more profiled portions that are shaped to correspond with one or more corresponding profiled portions of the skirt. Preferably the profiled portions comprise one or more of indentations and protrusions. The profiled portions may comprise castellations.

[0013] Preferably an internal diameter of an end of the body is tapered. Preferably the end of the body having a tapered internal diameter is the end of the body comprising the recess. Preferably the internal diameter is tapered between 2° and 20°, more preferably between 4° and 12°, even more preferably between 6° and 10°, and most preferably around 8° relative to an axial axis of the body.

[0014] Preferably the skirt is annular. Preferably the skirt is configured to receive the recessed portion of the body therein. Preferably the skirt comprises a substantially rigid portion and a resiliently flexible portion. Preferably the resiliently flexible portion comprises one or more fingers. Even more preferably the resiliently flexible portion comprises a plurality of fingers. Preferably the plurality of fingers extend axially. Preferably the plurality of fingers are arranged radially with respective longitudinal axes extending parallel to each other and an axial axis of the skirt.
[0015] Preferably an inner surface of the skirt is inclined. Preferably at least the inner surfaces of the fingers are inclined. Preferably the fingers decrease in thickness from the substantially rigid portion of the skirt to their ends. Preferably the plurality of fingers collectively form a cylindrical shape. Preferably the skirt comprises a plurality of slots. Preferably the plurality of slots are arranged radially around the axial axis. Preferably the plurality of fingers are formed from the plurality of slots.

[0016] Preferably the skirt is integrally formed. Preferably the skirt is made of a resiliently flexible material. Preferably the resiliently flexible material is a thermoplastic material, more preferably a polyoxymethylene, even more preferably an acetal resin such as Delrin made by DuPont.

[0017] Preferably the skirt comprises an internal thread. Preferably the internal thread corresponds to an external thread of the locking ring.

[0018] Preferably the skirt comprises one or more gripping portions configured to receive a tool. Preferably the gripping portions assist with the transfer of torque from the tool to the skirt. Preferably the gripping portions are defined by one or more cut outs of the skirt. Preferably a plurality of cut outs are provided.

[0019] Preferably an inner surface of the skirt comprises an annular groove corresponding to a protrusion on the locking ring.

[0020] Preferably an outer surface of the skirt comprises an annular groove for receiving an annular seal. Preferably, an annular seal is located in the
annular groove on the outer surface of the skirt. Preferably the annular seal is an O-ring

[0021] Preferably, an outer surface of the skirt comprises a plurality of apertures and a resiliently flexible member located in each aperture. Preferably, the annular seal is engaged with each resiliently flexible member to secure each resiliently flexible in the respective aperture.

[0022] Preferably the actuator is annular. Preferably the actuator is in the form of a locking ring. Preferably the locking ring is configured to engage with the body and move longitudinally along the body in response to rotation of the locking ring. Preferably the locking ring comprises one or more gripping portions configured to receive a tool. Preferably the gripping portions assist with the transfer of torque from the tool to the locking ring. Preferably the gripping portions are defined by one or more cut outs of the locking ring. Preferably a plurality of cut outs are provided.

[0023] Preferably the actuator comprises an internal thread. Preferably the internal thread corresponds to an external thread of the body. Preferably at least a portion of the actuator is configured to receive at least a portion of the body. Preferably a least a portion of the actuator is configured to be received by the skirt. Preferably the actuator comprises an inclined ramp portion. Preferably the inclined ramp portion of the actuator corresponds to the inclined inner surface of the skirt.
Preferably the actuator is integrally formed. Preferably the actuator is made of thermoplastic material, more preferably a polyoxymethylene, even more preferably an acetal resin such as Delrin made by DuPont.

Preferably the actuator comprises a threaded base portion and an engagement portion. Preferably the engagement comprises one or more fingers. Even more preferably the engagement portion comprises a plurality of fingers. Preferably the plurality of fingers extend axially. Preferably the plurality of fingers are arranged radially with respective longitudinal axes extending parallel to each other and an axial axis of the engagement portion. Preferably the engagement comprises a plurality of slots. Preferably the plurality of slots are arranged radially around the axial axis. Preferably the plurality of fingers are formed from the plurality of slots.

Preferably, the engagement portion comprises one or more gripping portions as described above. Preferably, the fingers and the gripping portions are connected by an annular bearing.

Preferably the threaded base portion comprises a plurality of slots. Preferably the plurality of slots are arranged radially around an axial axis of the threaded base portion. Preferably a plurality of protruding members are formed from the plurality of slots. Preferably, the plurality of slots of the threaded base portion correspond to the plurality of slots of the engagement portion.

Preferably, in use, the skirt is held stationary relative to the body and preferably the actuator is rotatably engaged with the body. Preferably rotation
of the actuator relative to the body in a first direction drives the actuator into the skirt and preferably rotation of the actuator relative to the body in a second, opposite direction draws the actuator out of the skirt.

[0030] Preferably at least a portion of the skirt is configured to expand in response to movement of an operatively engaged actuator. Preferably a resiliently flexible portion of the skirt flares outwards in response to the actuator being driven therein. Preferably the resiliently flexible portion of the skirt recedes inwards as the actuator is drawn thereout. Preferably the resiliently flexible portion of the skirt comprises a plurality of fingers of the skirt.

[0031] Further features and advantages of the present invention will become apparent from the following detailed description.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0032] By way of example only, preferred embodiments of the invention will be described more fully hereinafter with reference to the accompanying figures, wherein:

[0033] Figure 1 illustrates an exploded perspective view of an embodiment of a wellhead sleeve according to the present invention;

[0034] Figure 2 illustrates a side elevation view of a body of the wellhead sleeve of figure 1;

[0035] Figure 3 illustrates an exploded side elevation cross sectional view of the wellhead sleeve of figure 1;
Figure 4 illustrates a side elevation view of an assembled wellhead sleeve of figure 1;

Figure 5 illustrates a side elevation cross sectional view of the assembled wellhead sleeve as shown in figure 4;

Figure 6 illustrates an exploded perspective view of an embodiment of a wellhead sleeve according to the present invention;

Figure 7 illustrates a side elevation view of a body of the wellhead sleeve of figure 6;

Figure 8 illustrates an exploded side elevation cross sectional view of the wellhead sleeve of figure 6;

Figure 9 illustrates a side elevation view of an assembled wellhead sleeve of figure 6; and

Figure 10 illustrates a side elevation cross sectional view of the assembled wellhead sleeve as shown in figure 8.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a wellhead sleeve 10 comprising a main body 100, a skirt 200, and an actuator in the form of a locking ring 300. The body 100 is typically made of a wear resistant material such as, for example, alumina ceramic. The skirt 200 and locking ring 300 are preferably integral and may be made of any suitable material, but are typically made of a thermoplastic material such as, for example, an acetal resin such as Delrin made by DuPont.
When assembled, as shown in figures 4 and 5, the body 100, skirt 200, and locking ring 300 all have aligned axial axes that extend longitudinally through the centre of the sleeve 10.

[0044] The body 100, which is more clearly seen in figure 2, is substantially cylindrical with a first end 102 which is tapered 104 and a second end 106 which has a recessed portion 108. The tapered portion 104 reduces the outer diameter of the body 100 by approximately 7%. In a preferred embodiment, the outer diameter of the body 100 is around 77mm and the outer diameter at the first end 102 after the tapered portion 104 is around 72mm. In preferred implementations of the sleeve 10, the first end 102 is a fluid inlet end of the body 100 and the second end 106 is a fluid outlet end of the body 100.

[0045] A compressible seal 120, seen in figure 2, is preferably mounted to the tapered portion 104 of the body 100. The compressible seal 120 extends along a majority portion of the tapered portion 104 of the body 100. The compressible seal 120 is typically made of an elastomeric material such as silicone rubber. The compressible seal 120 is configured and adapted to reduce vibrations between the body 100 and the wellhead (not shown) that the sleeve 10 is mounted thereto.

[0046] The recessed portion 108 at the second end 106 of the body 100 has a reduced outer diameter relative to the outer diameter of the main body 100. In a preferred embodiment, the outer diameter of the recessed portion 108 is around 69mm. The recessed portion 108 comprises an external thread
located on an outer surface thereof. The external thread 110 of the recessed portion 108 of the body 100 compliments a corresponding internal thread 302 of the locking ring 300.

[0047] The recessed portion 108 has a profiled portion having indentations 112 and protrusions 114 in the form of a circumferential castellation. The indentations 112 and protrusions 114 of the recessed portion 108 compliment corresponding protrusions 202 and indentations 204, respectively, of the skirt 200 such that when operatively engaged the body 100 and skirt 200 are prevented from rotation relative to each other. Although circumferential castellations are the preferred profile shape to prevent relative rotation between the body 100 and skirt 200, it should be appreciated that other shaped profiles could be utilised to achieve a similar effect.

[0048] As seen most clearly in figures 3 and 5, the body 100 has an internal bore 150 extending longitudinally therethrough. The diameter of the bore is constant over a majority of the length of the body 100. At the second end 106 the internal diameter of the body 100 is tapered 116, typically at around 8°, such that the internal diameter of the body 100 is larger at the second end 106 of the body 100. In a preferred form, the internal diameter of the body 100 is around 49mm and tapers outwardly to around 57mm at the second end 106.

[0049] The skirt 200 is annular in shape, being sized and shaped to receive the recessed portion 108 of the body 100 therein (as shown in figures 4 and 5). The skirt 200 has a substantially rigid base portion 206 and a resiliently
flexible portion in the form of a plurality of resiliently flexible fingers 208 that extend substantially parallel to an axial axis of the skirt 200 at rest.

[0050] The fingers 208 are formed between slots 210 that enable distal ends 212 of the fingers 208, relative to the base portion 206, to deform outwardly relative to the axial axis of the skirt 200. An inner surface of the skirt 200, specifically an inner surface of each of the fingers 208, is inclined 214 as seen most clearly in figures 3 and 5. The fingers 208 therefore decrease in thickness from the substantially rigid base portion 206 to their distal ends 212.

[0051] The locking ring 300 is annular and sized and shaped to receive and engage with the body 100, in particular the recessed portion 108 of the body 100. The locking ring 300 has internal thread 302 which corresponds to external thread 110 of the recessed portion 108 of the body 100 such that, once operatively engaged, rotation of the locking ring 300 relative to the body 100 moves the locking ring 300 along the longitudinal axis of the body 100.

[0052] The locking ring has a plurality of gripping portions 304, defined by cut outs 306 of the locking ring 300, shaped to receive a suitable tool (not shown). The gripping portions 304 allow torque from the tool to be transferred to the locking ring 300. The locking ring also has an inclined ramp portion 308 on an outer surface thereof. The inclined ramp portion 308 of the locking ring 300 corresponds to the inclined inner surface of the skirt 200 as seen most clearly in figure 5.
[0053] When assembled, as shown in figures 3 and 5, the skirt 200 is mounted to the recessed portion of the body 100 and the locking ring 300 is threaded onto external thread 110 of the body 100 into contact with the skirt 200. The skirt 200 is held in place on the body 100 by the locking ring 300, which in turn is held in place by the corresponding threads 110 and 302. The skirt 200 is held stationary relative to the body 100 by the indentations 112 and protrusions 114 of the body engaging with the complimentary protrusions 202 and indentations 204 of the skirt 200. The internal inclined surface 214 of the skirt 200 engages with the inclined ramp 308 of the locking ring 300 such that if the locking ring 300 is rotated and driven along the thread of the body 100 into the skirt 200, the fingers 208 of the skirt are urged outward by the inclined ramp 308 of the locking ring.

[0054] In use, the sleeve 10 is inserted into a wellhead at or near the annulus. The sleeve 10 is inserted in a first 'retracted' position, wherein the fingers 208 of the skirt 200 are not expanded outward by the locking ring 300. Once in position in the wellhead, the locking ring 300 is rotated, typically using a suitable tool to engage with the gripping portions 304. Rotation of the locking ring 300 along the external thread 110 of the body drives the locking ring 300 along the body 100 such that the inclined ramp portion 308 is driven into the skirt 200 under the inclined inner surface 214.

[0055] The two inclined surfaces operatively engage to translate the longitudinal force of the locking ring 300 moving along the body 100 into a
transverse force of the fingers 208 of the skirt 200 which causes them to flare outwardly. The deformation of the fingers 208 effectively results in the skirt 200 expanding which, when located in a cavity of the wellhead causes the skirt 200, in particular the outer surface of the fingers 208, to engage with the walls of the cavity and hold the sleeve 10 in place therein.

[0056] Figure 6 illustrates a wellhead sleeve 20 comprising a main body 400, an actuator in the form of a locking ring 500 and a skirt 600. The body 400, locking ring 500 and skirt 600 are all formed as described above in relation to body 100, skirt 200 and locking ring 300.

[0057] The body 400, which is more clearly seen in figure 7, is substantially cylindrical with a first end 402 which is tapered 404 and a second end 406 which has a recessed portion 408. The tapered portion 404 reduces the outer diameter of the body 400 by approximately 7%. In a preferred embodiment, the outer diameter of the body 400 is around 77mm and the outer diameter at the first end 402 after the tapered portion 404 is around 72mm. In preferred implementations of the sleeve 20, the first end 402 is a fluid inlet end of the body 400 and the second end 406 is a fluid outlet end of the body 400.

[0058] A compressible seal 420, seen in figure 6, is preferably mounted to the tapered portion 404 of the body 400 and is substantially similar to compressible seal 420.

[0059] The recessed portion 408 at the second end 406 of the body 400 has a continuous, ungrooved profile 412 and a reduced outer diameter relative
to the outer diameter of the main body 400. In a preferred embodiment, the outer diameter of the recessed portion 408 is around 69mm.

[0060] As seen most clearly in figures 8 and 10, the body 400 has an internal bore 450 extending longitudinally therethrough. The diameter of the bore is constant over a majority of the length of the body 400 and the internal diameter of the body 400 is as described above in relation to body 100 above.

[0061] The locking ring 500 is annular in shape, being sized and shaped to receive the recessed portion 408 of the body 400 therein (as shown in figures 9 and 10). The locking ring 500 has a threaded base portion 502 having a plurality of slots 504 formed between raised portions 506 spaced around the internal circumference of the rigid base portion 502 and an external thread 508 extending circumferentially around the outside of the threaded base portion 502.

[0062] The locking ring 500 also has an engagement portion 510 having a plurality of fingers 512 that extend substantially parallel to an axial axis of the engagement portion 510 at rest. The fingers 512 are formed between slots 514 that enable the fingers 512 to be received within the slots 504 of the threaded base portion 502.

[0063] The engagement portion 510 also has a plurality of gripping portions 516 adjacent the fingers defined by cut outs 518 of the engagement portion 510 and shaped to receive a suitable tool (not shown). Located between and connecting the fingers 512 and the gripping portions 516 is a bearing ring 520.
which allows the gripping portions 516 to move independently of the fingers 512.

[0064] An outer surface of the locking ring 500, and more specifically an outer surface of rigid base portion 502, is inclined 522 as seen most clearly in figures 8 and 10.

[0065] The skirt 600 is annular in shape, being sized and shaped to engage with the body 400 and the locking ring 500 (as shown in figures 9 and 10).

[0066] The skirt 600 has internal thread 602 which corresponds to external thread 508 of the threaded base portion 502 of the locking ring 500 such that, once operatively engaged, rotation of the skirt 600 relative to the body 400 moves the skirt 600 along the longitudinal axis of the body 400.

[0067] The skirt 600 has a plurality of gripping portions 604, defined by cut outs 606 of the skirt 600, shaped to receive a suitable tool (not shown). The gripping portions 604 allow torque from the tool to be transferred to the skirt 600.

[0068] The skirt also has an inclined ramp portion 608 on an inner surface thereof. The inclined ramp portion 608 of the skirt 600 corresponds to the inclined outer surface 522 of the threaded base portion 502 of the locking ring 500 as seen most clearly in figure 10.

[0069] In the outer surface of the skirt is an O-ring groove 610 having an O-ring 612 located therein. In addition, a plurality of apertures 614 are formed in
the skirt 600. These apertures 614 receive a plurality of engaging members in the form of toothed clips 616.

[0070] On the inner surface of the skirt is a bearing groove 618 which receives a protrusion 524 projecting outwardly from the bearing ring 520 of the engagement portion 510 of the locking ring 500.

[0071] When assembled, as shown in figures 8 and 10, the threaded base portion 502 of the locking ring 500 is mounted to the recessed portion 408 of the body 400.

[0072] The engagement portion 510 of locking ring 500 is then inserted into the skirt 600 until the bearing ring 520 engages the bearing groove 618 of the skirt 600, which locks the engagement portion 510 of the locking ring 500 and the skirt 600 together. As a result, as the gripping portions 516 of the engagement portion 510 of the locking ring 500 rotate, the skirt 600 is also forced to rotate with the gripping portions 516. Thus, the gripping portions 516 of the engagement portion 510 and the skirt 600 are rotated together, while the fingers 512 are received in the slots 504 of the threaded base portion 502 and remain stationary as the internal thread 602 of the skirt 600 engages with the external thread 504 of the threaded base portion 502 until the skirt 600 sits flush against the body 400. The skirt 600 is then secured to the body 400 by an adhesive agent, such as an epoxy resin or other suitable adhesive.

[0073] The internal inclined surface 608 of the skirt 600 engages with the inclined ramp 522 of the threaded base portion 502 of the locking ring 500 such
that if the skirt 600 is rotated and driven along and over the thread of the threaded base portion 502, the toothed clips 616 located around the circumference of the skirt 600 are urged outward by the threaded base portion 502.

[0074] In use, the sleeve 20 is inserted into a wellhead at or near the annulus. The sleeve 20 is inserted in a first 'retracted' position, wherein the toothed clips 616 of the skirt 600 are not expanded outward by the threaded base portion 502 of the locking ring 500. Once in position in the wellhead, the skirt 600 and engagement portion 510 are rotated, typically using a suitable tool to engage with the gripping portions 516 and 604. Rotation of the skirt 600 along the external thread 504 of the threaded base portion 502 drives the locking ring 500 along the body 400 such that the inclined ramp portion 522 is driven into the skirt 600 under the inclined inner surface 608.

[0075] The two inclined surfaces operatively engage to translate the longitudinal force of the locking ring 500 moving along the body 400 into a transverse force imparted against the toothed clips 616 of the skirt 600 which causes them to pushed outwardly and away from the skirt, thereby deforming the original shape of the skirt. The deformation of the toothed clips 616 effectively results in the skirt 600 expanding which, when located in a cavity of the wellhead causes the skirt 600, in particular the outer surface of the clips 616, to engage with the walls of the cavity and hold the sleeve 20 in place therein.
As fluids, typically hydrocarbon fluids, flow through the wellhead system the sleeve 10, 20 erodes and wears in place of the wellhead itself, or related hardware of the wellhead, wearing. After a certain amount of wear the sleeve 10, 20 may be loosened, by rotating the locking ring 300, 500 out of the skirt 200, 600, and either replaced in its entirety or, as the wear typically only occurs on a small region of the body 100, 400, rotated so that an 'unworn' portion is moved to the position of wear. It is envisaged that the body 100, 400 can be rotated 180° or 120° to enable it to be used at least twice or three times before needing to be replaced. It should be appreciated that, depending on the wear characteristics of the fluid and wellhead, it may even be possible to get more rotations, such as four rotations at 90° out of a single sleeve 10, 20.

Advantageously the sleeve 10, 20 can be installed without requiring any reworking of the wellhead. The sleeve 10, 20 can be installed under pressure utilising known, safe, and reliable 'hot tap/lubricator' methods of installation. The sleeve 10 is easily inserted, adjusted, and replaced without damaging any of the wellhead 'parent' equipment. The materials are impervious to hydrocarbon and chemical attack and result in a highly wear resistant sleeve.

The ability to rotate the position of wear to a position of no, or reduced, wear effectively and significantly increases the life of the sleeve 10, 20 and allows longer term protection to the wellhead without the need for spare parts, or the like, to replace worn components. All that is required is the
necessary tools to stop fluid flow to the sleeve 10, 20, access the sleeve 10, 20, unlock the locking ring 300, 500, reposition the sleeve 10, 20, lock the locking ring 300, 500, and restart flow thorough the sleeve 10, 20.

[0079] In this specification, adjectives such as first and second, left and right, top and bottom, and the like may be used solely to distinguish one element or action from another element or action without necessarily requiring or implying any actual such relationship or order. Where the context permits, reference to an integer or a component or step (or the like) is not to be interpreted as being limited to only one of that integer, component, or step, but rather could be one or more of that integer, component, or step etc.

[0080] The above description of various embodiments of the present invention is provided for purposes of description to one of ordinary skill in the related art. It is not intended to be exhaustive or to limit the invention to a single disclosed embodiment. As mentioned above, numerous alternatives and variations to the present invention will be apparent to those skilled in the art of the above teaching. Accordingly, while some alternative embodiments have been discussed specifically, other embodiments will be apparent or relatively easily developed by those of ordinary skill in the art. The invention is intended to embrace all alternatives, modifications, and variations of the present invention that have been discussed herein, and other embodiments that fall within the spirit and scope of the above described invention.
In this specification, the terms 'comprises', 'comprising', 'includes', 'including', or similar terms are intended to mean a non-exclusive inclusion, such that a method, system or apparatus that comprises a list of elements does not include those elements solely, but may well include other elements not listed.
1. A wellhead sleeve configured to be removably mounted to a wellhead at or near an annulus of the wellhead, the wellhead sleeve comprising:
   a body having a bore therethrough;
   a skirt mounted to the body; and
   an actuator configured to engage with the body and the skirt;
   wherein movement of the actuator relative to the body deforms a resiliently flexible portion of the skirt away from the bore.

2. The wellhead sleeve as claimed in claim 1, wherein the body comprises a wear resistant material.

3. The wellhead sleeve as claimed in claim 2, wherein the wear resistant material comprises a ceramic material.

4. The wellhead sleeve as claimed in any one of claims 1-3, wherein at least an internal region of the body adjacent the bore comprises a wear resistant material.

5. The wellhead sleeve as claimed in any one of claims 1-4, wherein an end of the body is tapered.

6. The wellhead sleeve as claimed in claim 5, wherein the tapered end of the body is tapered to reduce an outer diameter of the body.

7. The wellhead sleeve as claimed in claim 6, wherein the outer diameter of the body is reduced by between 1 and 20% over the tapered portion of the body.
8. The wellhead sleeve as claimed in any one of claims 1-7, wherein the sleeve further comprises a compressible seal configured to receive at least a portion of the tapered portion of the body.

9. The wellhead sleeve as claimed in claim 8, wherein the compressible seal is made of a rubber material.

10. The wellhead sleeve as claimed in claim 8 or 9, wherein the compressible seal extends along at least a majority portion of the tapered portion of the body.

11. The wellhead sleeve as claimed in claim 6, wherein another end of the body comprises a recessed portion.

12. The wellhead sleeve as claimed in claim 11, wherein an outer diameter of the recessed portion is reduced relative to the adjacent portion of the body.

13. The wellhead sleeve as claimed in claim 11 or claim 12, wherein the recessed portion comprises an external thread located on an outer surface of the recessed portion.

14. The wellhead sleeve as claimed in any one of claims 11-13, wherein a recess of the recessed portion comprises one or more profiled portions that are shaped to correspond with one or more corresponding profiled portions of the skirt.

15. The wellhead sleeve as claimed in claim 14, wherein the profiled portions comprise one or more of indentations and protrusions.
16. The wellhead sleeve as claimed in any one of claims 11-15, wherein an internal diameter of the end of the body having the recess is tapered between 2° and 20°,

17. The wellhead sleeve as claimed in any one of claims 11-16, wherein the skirt is configured to receive the recessed portion of the body therein.

18. The wellhead sleeve as claimed in any one of claims 1-17, wherein the skirt comprises a substantially rigid portion and a resiliently flexible portion.

19. The wellhead sleeve as claimed in claim 18, wherein the resiliently flexible portion comprises a plurality of fingers.

20. The wellhead sleeve as claimed in claim 19, wherein the plurality of fingers extend axially from the substantially rigid portion.

21. The wellhead sleeve as claimed in claim 19 or claim 20, wherein the plurality of fingers are arranged radially with respective longitudinal axes extending parallel to each other and an axial axis of the skirt.

22. The wellhead sleeve as claimed in claim 20 or claim 21 each of the fingers decrease in thickness from the substantially rigid portion of the skirt to their ends.

23. The wellhead sleeve as claimed in any one of claims 19-22, wherein the skirt comprises a plurality of slots arranged radially around the axial axis of the skirt.
24. The wellhead sleeve as claimed in claim 23, wherein the plurality of fingers are formed from the plurality of slots.

25. The wellhead sleeve as claimed in any one of claims 1-24, wherein the skirt is made of a resiliently flexible thermoplastic material.

26. The wellhead sleeve as claimed in any one of claims 1-25, wherein the actuator is in the form of a locking ring configured to engage with the body and move longitudinally along the body in response to rotation of the locking ring.

27. The wellhead sleeve as claimed in claim 26, wherein the locking ring comprises one or more gripping portions configured to receive a tool, wherein the gripping portions assist with the transfer of torque from the tool to the locking ring.

28. The wellhead sleeve as claimed in claim 27, wherein the gripping portions are defined by one or more cut outs of the locking ring.

29. The wellhead sleeve as claimed in claim 13, wherein the actuator comprises an internal thread, wherein the internal thread corresponds to the external thread of the body.

30. The wellhead sleeve as claimed in any one of claims 1-29, wherein at least a portion of the actuator is configured to receive at least a portion of the body and at least a portion of the actuator is configured to be received by the skirt.
31. The wellhead sleeve as claimed in any one of claims 1-30, wherein the actuator is made of thermoplastic material.

32. The wellhead sleeve as claimed in any one of claims 1-31, wherein, in use, the skirt is held stationary relative to the body and preferably the actuator is rotatably engaged with the body.

33. The wellhead sleeve as claimed in claim 32, wherein rotation of the actuator relative to the body in a first direction drives the actuator into the skirt and preferably rotation of the actuator relative to the body in a second, opposite direction draws the actuator out of the skirt.

34. The wellhead sleeve as claimed in any one of claims 1-33, wherein a resiliently flexible portion of the skirt flares outwards in response to the actuator being driven therein.
A. CLASSIFICATION OF SUBJECT MATTER

E21B 33/03 (2006.01)  E21B 17/10 (2006.01)  E21B 33/04 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATENT: IPC / CPC (E21B17/1007, E21B17/1085, E21B17, E21B33/04, E2 1B33/03, E21B33/037, E21B2033/005), keywords (sacrificial, sleeve, adaptor, lining, removal, replacement, wear, wellhead, expansion, retract, bush, skirt, rotate, intermediate, bowl, elastic, deform, ceramic, resistance, finger, landing tool, grip) and the like terms; Applicant(s) and Inventor(s) name search (Espacenet, AusPat, Internal database)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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