reference, provides an alternative solution. The BISEP device may be installed through a branch connection and a seal unit in the form of a spherical or globe seal module rotated to face outboard or upstream and hydraulically or otherwise activated to seal with the pipe upstream of the branch. The branch and the pipe inboard or downstream of the device are then isolated from upstream pipe pressure. The seal module carries a pair of seal elements and the module is configured such that the pressure differential acting across the module further energises the seal elements. Thus, in the event of a failure of the external seal activation, isolation is maintained. Furthermore, an annular chamber between the seal elements may be pressurised to confirm the integrity of both seal elements.

The arrangement of the seal element also permits the BISEP device to be utilised as a weld test tool, by locating the seal elements straddling a weld, and then pressurising the annulus between the seal elements.

Summary of the Invention

According to a first aspect of the present invention, there is provided an isolation assembly according to claim 1~~tool for use in isolating a section of a pipe, the isolation tool comprising:~~

~~a seal unit adapted for location in a section of a pipe via an opening in the pipe wall and comprising at least two seal elements configured to engage the pipe wall to isolate a section of pipe, the seal unit configured for coupling to a lock arrangement operable to prevent de-activation of the seal elements to maintain isolation of the section of the pipe.~~

~~The seal unit may be provided separately from the lock arrangement. Alternatively, part or all of the lock arrangement may be provided together with the seal unit to form an isolation tool assembly.~~ ~~Thus,~~ the seal unit and the lock arrangement may together form an assembly or kit of parts. The assembly may, for example, be configured so as to be interchangeable with an isolation tool seal unit such as described in GB 2,440,275.

~~According to a further aspect of the present invention there is provided an isolation tool assembly for isolating a section of a pipe, the isolation tool comprising:~~

~~a seal unit adapted for location in a section of a pipe via an opening in the pipe wall and comprising at least two seal elements configured to engage a pipe wall to isolate a section of pipe; and~~

~~a lock arrangement operable to prevent de-activation of the seal elements to maintain isolation of the section of the pipe.~~

Embodiments of the present invention provide a double block isolation tool providing a dual seal unit for use in isolating a section of pipe via a single intervention into the pipe. Beneficially, the use of a single bore entry of the type described reduces the operation time and cost involved in isolating the required section of pipe.

Moreover, the lock arrangement may be configured to prevent undesired deactivation of the seal elements where the pressure applied across the seal elements drops below a seal self-energisation pressure (the differential pressure required to provide fail safe activation of the seals). Embodiments of the present invention thus provide the additional benefit of providing fail-safe operation in applications where the pressure acting across the tool is insufficient to maintain self-energisation of the seal elements, for example, facilitating double block and bleed capability in low pressure or ambient pressure pipe isolations.

It will be understood that reference to the term pipe includes any tubular construction including an oil or gas pipeline, whether subsea, above or below ground, downhole tubing, or indeed any other tubular suitable for transport or storage of fluids.

~~The tool may comprise a seal actuator operable to urge the seal elements into sealing engagement with the pipe wall and the lock arrangement may be configured to prevent movement of the seal actuator to a position which would otherwise de-activate the seals.~~

The lock arrangement may be of any suitable form and construction. For example, the lock arrangement may comprise at least one of, or a combination of, a mechanical lock arrangement, hydraulic lock arrangement, pneumatic lock arrangement or the like. In some embodiments, the lock arrangement may comprise a ratchet arrangement, a latch arrangement and/or a tension cable. In particular embodiments, the lock arrangement comprises a combination of mechanical and hydraulic locks.

The lock arrangement ~~may~~ further comprises a lock member formed as part of, coupled to, the seal actuator. The lock member may be of any suitable form and construction. For example, the lock member may comprise a spigot. In particular embodiments, the lock member may comprise a cap screw.

The lock arrangement ~~may~~ further comprises a lock piston for engaging the lock member. In use, the lock piston is~~may be~~ configured to engage the lock member and prevent retraction of the lock member, and the associated seal actuator, to the position which would de-activate the seals. In embodiments where the lock member comprises a cap screw, the lock piston may be configured to engage a head of the cap screw to prevent retraction of the lock member. The lock piston may be radially mounted relative to the lock member and the seal actuator, this providing maximum shear area.

The lock arrangement may be configured to prevent movement of the seal actuator in either direction. However, in preferred embodiments, the lock arrangement may be configured to prevent movement of the seal actuator in one direction, in particular in the direction which would deactivate the seals.

Any suitable means for moving the lock piston for engaging the lock piston may be provided. For example, the lock piston may be moved from the first position to the second position mechanically. In particular embodiments, the lock piston may be moved from the first position to the second position by a fluid pressure force. In use, a pressurised fluid may be inserted into a chamber, insertion of the fluid driving the lock piston into engagement with the lock member.

Any suitable means for unlocking the lock arrangement may be provided. For example, unlocking the lock arrangement may be achieved by at least one of mechanically, hydraulically, pneumatically. In particular embodiments, the lock arrangement may be unlocked hydraulically. In use, a hydraulic pressure force may be applied to the lock piston to disengage the lock piston from the lock member and permit the lock member to move.

The seal actuator may include a fluid piston, the piston being adapted to translate to provide compression of the seal elements. In a preferred embodiment, axial compression of the seal elements deforms the elements radially outwards into contact with the circumferential wall of the pipe to provide a seal therebetween. Alternatively or in addition, the seal actuator may be adapted to translate by application of a pressure differential across the actuator. The pressure differential may be induced by applying or providing an elevated pressure outboard of the seal unit in the pipe. Alternatively, or in addition, the differential pressure may be induced by venting fluid to create a lower pressure region inboard of the seal unit.

The isolation tool assembly may be adapted to be inserted into the pipe through a hot tap or the like, or through an established or existing branch, tee or opening.

At least one of the seal elements may be capable of sealing the section of pipe. In particular, in preferred embodiments of the invention either of the seals may be capable of resisting the full differential pressure between the pressurised portion of the pipe and the isolated portion of the pipe.

At least one of the seal elements may be a bi-directional seal. Accordingly, either or both of the seal elements may provide full sealing capability.

At least one of the seal elements comprises an elastomeric seal.

The clevis, in particular a clevis pin, may be configured to resist back pressure. This allows the inboard pressure, previously isolated, to be raised above the pipeline pressure to facilitate a strength test on the repaired pipework. In use, the bi-directional capability of the seals then provides the facility to pressure test the isolated pipe prior to removing the tool. Venting the annulus between the seals will maintain the sealing pressure under the back pressure test to prevent overloading of the seal actuator.

Where the seal unit is rotatable, the linkage between the seal unit and a support member may be adapted to support loads applied by the seal unit to the support member by abutting faces in addition to any loads transferred between the seal unit and the support member via a pivot pin or hinge.

The seal unit may comprise thea seal actuator and the seal actuator may includeing a fluid piston, the piston being adapted to translate to provide compression of the seal elements. In a preferred embodiment, axial compression of the seal elements deforms the elements radially outwards into contact with the circumferential wall of the pipe to provide a seal therebetween. Alternatively or in addition, the seal actuator may be adapted to translate by application of a pressure differential across the actuator. The pressure differential may be induced by applying or providing an elevated pressure outboard of the seal unit in the pipe. Alternatively, or in addition, the differential pressure may be induced by venting fluid to create a lower pressure region inboard of the seal unit.

The seal unit may comprise an annular ring located around a central portion of the seal unit and between the seal elements.

In use, the seal unit may be adapted to define an annular volume or chamber between the seal elements, the annular ring and the pipe. The annular ring may comprise a fluid conduit adapted for communication with the volume. The fluid conduit may comprise a bleed port adapted to permit fluid to be bled from the annular volume. The seal integrity may be pressure tested by monitoring the pressure in the annular chamber.

The tool may be adapted for isolating a pipe in high pressure applications, for example isolating a pipe section against up to approximately 200 bar differential pressure. Alternatively, the tool may be utilised in low pressure applications.

The tool may be adapted to be removable from the pipe, typically through the opening through which the tool was introduced into the pipe. In a preferred embodiment of the present invention, the seal elements may be deactivated by deactivating a seal actuator, for example by bleeding off fluid from an actuating piston.

Alternatively, or in addition, the seal elements may be adapted to be deactivated by application of pressure on the actuator, for example by application of

pressure on the inboard side of the fluid piston. On equalisation of pressure across the seal unit, the tool may be removed from the pipe.

The tool may be adapted to be removed from the pipe via a hot tap connection.

According to a further aspect of the present invention, there is provided a method according to claim 49~~of isolating a section of a pipe, the method comprising the steps:~~

~~inserting a seal unit into the pipe through an opening in the wall of the pipe, the seal unit comprising at least two seal elements; and~~

~~actuating the seal elements to isolate a section of the pipe; and~~

~~maintaining the isolation of the section of the pipe using a lock arrangement configured to prevent de-activation of the seal elements~~.

The lock arrangement may be configured to prevent the axial compression of the seal elements from releasing, for example in the case of a combination of loss of hydraulic set pressure and the differential pressure across the seal head dropping below the seal energisation pressure necessary to maintain seal activation from differential pressure alone.

Actuating the seal elements may include radially extending the elements from a retracted configuration.

The method may further comprise the step of applying an elevated pressure to a volume between the seal elements to test the pressure integrity of both seal elements.

The method may further comprise the step of rotating the seal unit after insertion into the pipe to align the seal elements with the pipe axis.

The method may further comprise the step of forming an opening in a wall of a pipe, which may be achieved by hot tapping.

It should be understood that the features defined above in accordance with any aspect of the present invention or below in accordance with any specific embodiment may be utilised, either alone or in combination with any other defined feature, in any other aspect of the invention.

Brief Description of the Drawings

These and other aspects of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of an isolation tool assembly according to an embodiment of the present invention;

Figure 2 is a diagrammatic view of the isolation tool assembly shown in Figure 1, shown in deployed configuration;

Claims

1. An isolation tool assembly for ~~use in~~ isolating a section of a pipe, the isolation tool assembly comprising:

a seal unit adapted for location in a section of a pipe via an opening in the pipe wall and comprising at least two seal elements configured to engage the pipe wall to isolate a section of pipe;~~,~~

a~~the~~ seal actuator operable to urge the seal elements into sealing engagement with the pipe wall~~unit configured for coupling to~~; and

a lock arrangement operable to prevent de-activation of the seal elements to maintain isolation of the section of the pipe, the lock arrangement comprising a lock member coupled to or forming part of the seal actuator and a lock piston configured to engage the lock member to prevent movement of the seal actuator to a position which would deactivate the seal elements.

2. The isolation tool assembly of claim 1, wherein the lock piston is radially mounted relative the lock member and the seal actuator~~further comprising a seal actuator operable to urge the seal elements into sealing engagement with the pipe wall~~.

3. The isolation tool assembly of claim 1 or 2, wherein the lock piston~~arrangement~~ is radially moveable to engage the lock member~~configured to prevent movement of the seal actuator to a position which would otherwise de-activate the seal elements~~.

4. The isolation tool assembly of claim 1, 2 or 3, wherein axial compression of the seal elements deforms the seal elements radially outwards into contact with the circumferential wall of the pipe to provide a seal therebetween.

5~~4~~. The isolation tool assembly of any preceding claim ~~1, 2 or 3~~, wherein the lock arrangement comprises at least one of: a mechanical lock arrangement, a hydraulic lock arrangement, and a pneumatic lock arrangement.

6~~5~~. The isolation tool assembly of claim 5~~4~~, wherein the lock arrangement comprises at least one of: a ratchet arrangement, a latch arrangement and a tension cable.

~~6. The isolation tool of any preceding claim, wherein the lock arrangement further comprises a lock member.~~

~~7. The isolation tool of claim 6, when dependent on claim 2, wherein the lock member is formed as part of, coupled to, the seal actuator.~~

78. The isolation tool assembly of any preceding claim ~~6 or 7~~, wherein the lock member comprises a spigot and/or a cap screw.

~~9. The isolation tool of claim 6, 7 or 8, wherein the lock arrangement further comprises a lock piston.~~

810. The isolation tool assembly of any preceding claim ~~9, when dependent on claim 6~~, wherein the lock piston is configured in use to engage the lock member and prevent retraction of the lock member.

911. The isolation tool assembly of claim ~~9 or 10, when dependent on claim 8~~, wherein the lock piston is configured to engage a head of the cap screw to prevent retraction of the lock member.

~~12. The isolation tool of claim 9, 10 or 11 wherein the lock piston is radially mounted relative to the lock member.~~

1013. The isolation tool assembly of any preceding~~one of~~ claims ~~2 to 12~~, wherein the lock arrangement is configured to prevent movement of the seal actuator in either direction.

1114. The isolation tool assembly of any preceding~~one of~~ claims ~~2 to 12~~, wherein the lock arrangement is configured to prevent movement of the seal actuator in one direction.

~~15. The isolation tool of claim 14, wherein the lock arrangement is configured to prevent movement of the seal actuator in a direction which would deactivate the seal elements.~~

1216. The isolation tool assembly of any preceding~~one of~~ claims ~~9 to 15~~, wherein the lock piston is moved from the first position to the second position mechanically.

1317. The isolation tool assembly of any precedingone or claims 9 to 16, wherein the lock piston is moved from the first position to the second position by a fluid pressure force.

1418. The isolation tool assembly of claim 1317, wherein, in use, a pressurised fluid is inserted into a chamber, insertion of the fluid driving the lock piston.

1519. The isolation tool assembly of any preceding claim, wherein unlocking the lock arrangement is achieved at least one of mechanically, hydraulically and pneumatically.

1620. The isolation tool assembly of claim 1519, wherein the lock arrangement is unlocked hydraulically.

1721. The isolation tool assembly of any precedingone of claims 2 to 20, wherein the seal actuator includes a fluid piston.

1822. The isolation tool assembly of any preceding claim, wherein axial compression of the seal elements deforms the elements radially outwards into contact with the circumferential wall of the pipe to provide a seal therebetween.

1923. The isolation tool assembly of any precedingone of claims 2 to 22, wherein the seal actuator is adapted to translate by application of a pressure differential across the actuator.

2024. The isolation tool assembly of claim 1923, wherein the pressure differential is induced by applying or providing an elevated pressure outboard of the seal unit in the pipe.

2125. The isolation tool assembly of claim 1923 or 2024, wherein the differential pressure is induced by venting fluid to create a lower pressure region inboard of the seal unit.

2226. The isolation tool assembly of any preceding claim, wherein the isolation tool is adapted to be inserted into the pipe through a hot tap.

2327. The isolation tool assembly of any precedingone of claims 1 to 26, wherein the isolation tool is adapted to be inserted into the pipe through an established or existing branch opening.

2428. The isolation tool assembly of any preceding claim, wherein at least one of the seal elements is capable of sealing the section of pipe.

2529. The isolation tool assembly of claim 2428, wherein either of the seal elements is capable of resisting the full differential pressure between the pressurised portion of the pipe and the isolated portion of the pipe.

2630. The isolation tool assembly of any preceding claim, wherein at least one of the seal elements comprises a bi-directional seal.

2731. The isolation tool assembly of any preceding claim, wherein at least one of the seal elements comprises an elastomeric seal.

2832. The isolation tool assembly of any preceding claim, wherein at least one of the seal elements comprises a compression seal.

2933. The isolation tool assembly of claim 2832, wherein both seal elements comprise compression seals.

3034. The isolation tool assembly of any preceding claim, wherein the seal elements are adapted to be compliant to the pipe surface.

3135. The isolation tool assembly of any preceding claim, wherein the seal elements are adapted to be self-energising on the seal unit experiencing a predetermined differential pressure.

3236. The isolation tool assembly of any preceding claim, wherein the seal elements are actuated by an actuation force.

3337. The isolation tool assembly of claim 3236, wherein the actuation force comprises at least one of a mechanical actuation force, a hydraulic actuation force and a pneumatic actuation force.

3438. The isolation tool assembly of claim 3236 or 3337, wherein the actuation force is externally applied.

3539. The isolation tool assembly of any preceding claim, wherein the seal elements are adapted to be initially compressed to provide at least initial isolation of the pipe.

3640. The isolation tool assembly of any preceding claim, wherein at least one anti-extrusion spring is provided for each seal element.

3741. The isolation tool assembly of any preceding claim, wherein the seal unit further comprises a location linkage.

3842. The isolation tool assembly of claim 3741, wherein the location linkage comprise a clevis.

3943. The isolation tool assembly of claim 3842, wherein the clevis is configured to resist back pressure.

4044. The isolation tool assembly of ~~any preceding~~ claim 37, 38 or 39, wherein the location linkage includes a support member.

4145. The isolation tool assembly of claim 4044, wherein the support member comprises a padeye.

4246. The isolation tool assembly of any preceding claim, wherein the seal unit is rotatable.

4347. The isolation tool assembly of any preceding claim, wherein the seal unit further comprises an annular ring located around a central portion of the seal unit and between the seal elements.

4448. The isolation tool assembly of claim 4347, wherein the seal unit is adapted to define an annular volume between the seal elements, the annular ring and the pipe.

4549. The isolation tool assembly of claim 4448, wherein the annular ring comprises a fluid conduit adapted for communication with the volume.

4650. The isolation tool assembly of claim 4549, wherein the fluid conduit comprises a bleed port adapted to permit fluid to be bled from the annular volume.

4751. The isolation tool assembly of any preceding claim, wherein the tool is adapted for isolating a pipe in low pressure or ambient pressure applications.

4852. The isolation tool assembly of any preceding claim, wherein the tool is adapted to be removable from the pipe.

~~53. An isolation tool assembly for isolating a section of a pipe, the isolation tool comprising:~~

~~a seal unit adapted for location in a section of a pipe via an opening in the pipe wall and comprising at least two seal elements configured to engage the pipe wall to isolate a section of pipe; and~~

~~a lock arrangement operable to prevent de-activation of the seal elements to maintain isolation of the section of the pipe.~~

4954. A method of isolating a section of a pipe, the method comprising the steps:

inserting a seal unit into the pipe through an opening in the wall of the pipe, the seal unit comprising at least two seal elements; ~~and~~

actuating the seal elements using a seal actuator to isolate a section of the pipe; and

maintaining the isolation of the section of the pipe using a lock arrangement configured to prevent de-activation of the seal elements, the isolation of the section of the pipe being maintained by engaging a lock piston with a lock member coupled to or forming part of the seal actuator, the engagement between the lock piston and the lock member preventing movement of the seal actuator to a position which would deactivate the seal elements.

50. The method of claim 49, comprising moving the lock piston radially to engage the lock member.

5155. The method of claim 49 or 5054, wherein actuating the seal elements includes radially extending the elements from a retracted configuration.

5256. The method of claim 4954, 50 or 5155, further comprising applying an elevated pressure to a volume between the seal elements to test the pressure integrity of both seal elements.

5357. The method of any one of claims 4954, 55 toor 5256, further comprising rotating the seal unit after insertion into the pipe to align the seal elements with the pipe longitudinal axis.

5458. The method of any one of claims 4954 to 5357, further comprising forming an opening in a wall of a pipe.

~~59. An isolation tool substantially as described herein and/or as shown in the accompanying figures.~~

~~60 An isolation tool assembly substantially as described herein and/or as shown in the accompanying figures.~~

~~61. A method of isolating a section of a pipe substantially as described herein and/or as shown in the accompanying figures.~~