A downhole device (10), such as a cement dart, having a body (12) comprising a male end portion (14), a female end portion (16) and a mandrel portion (18) disposed between the male end portion (14) and the female end portion (16). A recess (28, fig 3) is disposed in the outer surface (30) of the male end portion 14, which may be threaded, and is configured to receive a retainer (38) for securing the downhole device (10) to another downhole device (10a).
COUPLING, DOWNHOLE DEVICE, ASSEMBLY AND METHOD

FIELD OF THE INVENTION

The present invention relates to a coupling for a downhole device, a downhole device for use in a wellbore and an assembly for use in a wellbore. More particularly, but not exclusively, embodiments of the present invention relate to a coupling for a downhole cement dart or plug, a downhole cement dart or plug, cement dart or plug assembly. The present invention also relates to a method of construction of a downhole assembly.

BACKGROUND TO THE INVENTION

In the oil and gas production and extraction industry, in order to access a hydrocarbon-bearing formation a wellbore may be drilled from surface, the wellbore typically then being lined with sections of tubing known as casing. In order to secure and support the casing in the wellbore, the casing may be cemented in place, a common cementing operation involving directing a cement slurry or the like through the tubing from surface, the cement exiting the casing at or towards its distal end to fill the annulus defined between the tubing and the wellbore.

During a cementing operation, a number of plugs or darts may be used prior to and subsequent to the passage of the cement. For example, a first dart or plug may be directed through the tubing in advance of the cement slurry, the first dart or plug operable to wipe or clean the inner bore of the tubing prior to passage of the cement slurry. A second plug or dart may be disposed behind the cement slurry, the second plug or dart wiping excess cement from the tubing before engaging the first dart of plug, the engagement causing a pressure event detectable at surface indicating that the cement operation has been completed.

Dart and plugs may take a variety of forms depending on the desired application and the dart or plug may, for example, be constructed from a number of sub-assemblies which are coupled together before being run downhole. While this may provide advantages in assembly and construction, the downhole environment presents a number of challenges for downhole equipment. For example, in addition to the high temperatures and pressures downhole, downhole equipment is typically subject to mechanical loads and vibration which can in some instances result in the dart or plug vibrating apart and causing an obstruction in the casing; requiring additional time and remedial operations to be carried out.
SUMMARY OF THE INVENTION

Aspects of the present invention relate to a coupling for a downhole device, a downhole device for use in a wellbore and a downhole assembly for use in a wellbore.

More particularly, but not exclusively, embodiments of the present invention relate to a coupling for a downhole cement dart or plug, a downhole cement dart or plug, and a cement dart assembly or plug assembly. The present invention also relates to a method of construction of a downhole assembly.

According to a first aspect of the present invention there is provided a downhole device comprising:

a body comprising at least one of:

a male portion configured to couple the device to a female portion of another downhole device, wherein the male portion is configured to receive a retainer for engaging the other downhole device, and wherein the male portion is configured to permit the retainer to move to a smaller configuration when the retainer is engaged by said other downhole device to permit relative axial movement between the downhole device and said other downhole device; and

a female portion configured to couple the device to a male portion of another downhole device, wherein the female portion is configured to permit a retainer to move to a larger configuration, in which larger configuration relative axial separation of the device and said other downhole device is resisted or prevented.

According to a second aspect of the present invention there is provided a downhole device comprising:

a body comprising at least one of:

a female portion configured to couple the device to a male portion of another downhole device, wherein the female portion is configured to receive a retainer for engaging the other downhole device, and wherein the female portion is configured to permit the retainer to move to a larger configuration when the retainer is engaged by said other downhole device to permit relative axial movement between the downhole device and said other downhole device; and

a male portion configured to couple the device to a female portion of another downhole device, wherein the male portion is configured to permit a retainer to move to a smaller configuration, in which smaller configuration relative axial separation of the device and said other downhole device is resisted or prevented.
Beneficially, embodiments of the present invention permit the downhole device to be secured to one or more other devices in a secure manner and which prevents or mitigates the risk that the device and the other device or devices will become separated as they are run downhole.

The male portion may be configured to permit the retainer to move to a smaller configuration when the retainer is engaged by said other downhole device to permit relative axial movement between the male portion and said other downhole device beyond the retainer.

The downhole device may be configured so that engagement between the female portion and the other downhole device and/or the engagement between the male portion and the other downhole device occurs before the retainer is moved to its smaller configuration. Beneficially, this means that the two parts are coaxial and allows easier insertion.

The smaller configuration may comprise a smaller diameter configuration.

The larger configuration may comprise a larger diameter configuration.

The body may be of any suitable form and construction.

The body may comprise a mandrel portion. The mandrel portion may be disposed between the male portion and the female portion.

The body may comprise or define a core of a downhole tool. For example, and in particular embodiments, the body may comprise or define a core of a downhole cement dart or plug.

The body may comprise a solid body. Alternatively, part or all of the body may be tubular.

In particular embodiments, the retainer may be disposed on the male portion.

The male portion may be of any suitable form and construction.

The male portion may comprise a male end portion of the body.

The male portion may extend from the body. The male portion may extend from an end surface of the mandrel portion. The male end portion may have an outer diameter less than an outer diameter of the mandrel portion of the body.

The male portion may comprise a threaded portion. A first, distal, outer surface portion of the male end portion may comprise or define the threaded portion.

The male end portion may comprise a non-threaded portion. A second, proximal, outer surface portion of the male end portion may comprise or define the non-threaded portion.
In use, the threaded portion may be configured to secure the device to the other downhole device. The threaded portion may be configured to secure the device to a female end portion of the other downhole device.

The male portion may comprise or define a shoulder. In use, the shoulder may provide an abutment for engaging the female portion of the other downhole device.

The end of the male portion may be tapered. Beneficially, the tapered end of the male end portion assists in directing the male end portion of the device into engagement with the other device, such as into engagement with the female end portion of the other device.

The male end portion may comprise a recess.

The recess of the male portion may be configured to permit the retainer to move from a first configuration to a second, smaller diameter, configuration.

The recess of the male portion may be disposed in an outer surface of the male portion.

The recess of the male portion may be disposed between the threaded portion of the male portion and the non-threaded portion of the male portion.

The recess of the male portion may be of any suitable form and construction. In particular embodiments, the recess of the male portion may comprise a circumferential groove.

The male portion may be tapered. The male portion may comprise a threaded pin connection.

The female portion may be of any suitable form and construction.

The female portion may comprise a female end portion of the body.

The female portion may comprise a chamber. The chamber may be configured to receive a male portion of another downhole device.

The female portion may comprise a threaded portion. The female portion may comprise a non-threaded portion.

A first inner surface portion of the female portion may comprise or define the threaded portion of the female portion. A second inner surface portion of the female portion may comprise or define the non-threaded portion of the female portion.

The threaded portion of the female portion may be configured to secure the device to the other downhole device. The threaded portion may be configured to secure the device to a male portion of the other downhole device.

The female portion may comprise a tapered entrance.
The tapered entrance of the female portion may comprise or define a lead-in chamfer. Beneficially, the tapered entrance may assist in directing and aligning the male portion of the other downhole device with the female portion, and may assist in assembly.

The female portion may comprise a recess.

The recess of the female portion may be disposed in an inner surface of the female portion.

The recess of the female portion may be disposed between the non-threaded portion and the threaded portion.

The recess of the female portion may be configured to permit the retainer to move from the first configuration to the second, larger, configuration.

The recess of the female end portion may be of any suitable form and construction. In particular embodiments, the recess of the female end portion may comprise a circumferential groove.

The recess of the female end portion may comprise a base. The recess of the female end portion may comprise a first side surface. The recess of the female end portion may comprise a second side surface. The first side surface of the female end portion may be tapered. The angle of taper of the first side surface may be configured to permit the device to be detached from the other device while also preventing or resisting unintended separation of the device and the other device, such as by vibration or the like. In particular embodiments, the angle of taper of the first side surface may be larger than the angle of taper of the tapered entrance. For example, the angle of taper of the first side surface may be 45 degrees and the angle of taper of the tapered entrance may be 20 degrees.

The female end portion may comprise a lip. The lip may be interposed between the tapered entrance and the recess of the female end portion. In use, the lip may engage the retainer to move or compress the retainer to its smaller diameter configuration.

The female end portion may be tapered. The female end portion may comprise a threaded box connection.

The body may be constructed from any suitable material. At least part of the body may be made from metal or metal alloy. In particular embodiments, at least part of the body may be made from aluminium. Alternatively, at least part of the body may be made from a plastic material, a ceramic material.

The device may comprise or be provided in combination with a retainer.
The retainer may be of any suitable form and construction. The retainer may comprise a resilient member. The retainer may comprise an annular member. In particular embodiments, the retainer may comprise a snap ring.

The device may comprise one of the retainers. Alternatively, the device may comprise a plurality of the retainers. The retainer may comprise an inner surface. The retainer may comprise an outer surface. The retainer may comprise an upper surface. The retainer may comprise a lower surface.

The device may be configured so that the retainer is disposed in and extends out of the recess in the male portion.

In use, the retainer may engage the female end portion to prevent or resist separation of the device and the other downhole device.

The device may comprise or may be provided in combination with a plug member or the like.

The plug member may be of any suitable form and construction. The plug member may comprise an elastomeric member. In use, the plug member may be configured to engage a bore, such as a tubing or casing bore. For example, the plug member may be configured to wipe or clean the bore of a casing.

The body may comprise a male portion, such as a male end portion, and a female portion, such as a female end portion.

Alternatively, the device may comprise a male portion and a blank end.

Alternatively, the device may comprise a female portion and a blank end.

Alternatively, the device may comprise two male portions.

Alternatively, the device may comprise two female portions.

According to a further aspect of the present invention there is provided a downhole assembly comprising:

- a downhole device according to the first aspect or the second aspect; and at least one other downhole device.

The other downhole device, or where the assembly comprises a plurality of other downhole devices at least one of the other downhole devices, may be a downhole device according to the first aspect.

According to a further aspect of the present invention there is provided a method comprising:
providing a body comprising at least one of: a male portion configured to permit the retainer to move to a smaller configuration when the retainer is engaged by another downhole device to permit relative axial movement between the downhole device and said other downhole device; and a female portion configured to permit a retainer to move to a larger configuration, in which larger configuration relative axial separation of the device and said other downhole device is resisted or prevented; and
engaging the device with at least other device.

According to a further aspect of the present invention there is provided a method comprising:

providing a body comprising at least one of: a female portion configured to couple the device to a male portion of another downhole device, wherein the female portion is configured to receive a retainer for engaging the other downhole device, and wherein the female portion is configured to permit the retainer to move to a larger configuration when the retainer is engaged by said other downhole device to permit relative axial movement between the downhole device and said other downhole device; and a male portion configured to couple the device to a female portion of another downhole device, wherein the male portion is configured to permit a retainer to move to a smaller configuration, in which smaller configuration relative axial separation of the device and said other downhole device is resisted or prevented; and

engaging the device with at least other device.

According to a further aspect of the present invention there is provided a coupling for securing a downhole device to at least one other downhole device, the coupling comprising:

a recess configured to receive a retainer for securing the downhole device to said other downhole device;

a first profile configured to urge the retainer from a first configuration to a second configuration, in which second configuration relative axial movement of at least one of the downhole device and said other downhole device toward the other of the downhole device and said other downhole device is permitted; and

a second profile configured to permit the retainer to move from the second configuration to a third configuration, in which third configuration relative axial separation of the device and said other downhole device is resisted or prevented.

Beneficially, embodiments of the present invention permit the downhole device to be secured to one or more other downhole device in a secure manner and which
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prevents or mitigates the risk that the device and the other device or devices will become separated as they are run downhole.

The second profile may be configured to urge the retainer from the third configuration to a fourth configuration which permits relative axial separation of the device and said other downhole device.

In the second configuration, the retainer may be disposed further into the recess.

The first configuration may define a first diameter configuration.

The second configuration may define a second diameter configuration.

The third configuration may define a third diameter configuration.

In the first configuration, relative axial movement between the downhole device and said other downhole device may be prevented.

It should be understood that the features defined above in accordance with any aspect of the present invention or below in relation to any specific embodiment of the invention may be utilised, either alone or in combination with any other defined feature, in any other aspect or embodiment 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 a downhole device according to an embodiment of the present invention;

Figure 2 is an enlarged view showing the male end portion of the downhole device shown in Figure 1;

Figure 3 is an enlarged view showing part of the male end portion shown in Figure 2;

Figure 4 is an enlarged view showing the female end portion of the downhole device shown in Figure 1;

Figure 5 is an enlarged view showing part of the female end portion shown in Figure 4;

Figure 6 shows an assembly according to an embodiment of the present invention;

Figure 7 to 10 show a method of assembly according to an embodiment of the present invention; and
Figure 11 shows an assembly according to an embodiment of the invention, wherein each device includes a plug member;

Figure 12 shows a downhole tool according to an alternative embodiment of the present invention;

Figure 13 is an enlarged view showing part of the female end portion shown in Figure 12;

Figure 14 is an enlarged view showing part of the male end portion shown in Figure 12;

Figures 15 and 16 show an assembly according to an alternative embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring first to Figure 1 of the drawings, there is shown a longitudinal section view of a downhole device 10 according to an embodiment of the present invention.

In the illustrated embodiment, the device 10 forms the core of a downhole cement dart, plug or the like for use in the construction of a wellbore, however it will be recognised that the device 10 may be used in a number of different applications.

As shown in the Figure 1, the device 10 comprises a body 12 comprising a male end portion 14, a female end portion 16 and a mandrel portion 18 disposed between the male end portion 14 and the female end portion 16.

The male end portion 14 (right end as shown in the drawings) extends from the body 12 (from an end surface 20 of the mandrel portion 18) and has an outer diameter D1 less than the diameter D2 of the mandrel portion 18 of the body 12.

Referring now also to Figure 2, which is an enlarged view of the male end portion 14 of the body 12, a first, distal, outer surface portion 22 of the male end portion 14 is threaded while a second, proximal, outer surface portion 24 of male end portion 14 is non-threaded. In use, the first outer surface portion 22 engages and secures the male end portion 14 of the device 10 to a female end portion 16a of another device 10a (see Figure 6), which may be identical or similar to the device 10.

The distalmost end 26 of the male end portion 14 is tapered. The distalmost end 26 of the male end portion 14 assists in directing the male end portion 14 of the device 10 into the female end portion 16a of the device 10a, as will be described below.

Referring now also to Figure 3, which is an enlarged view of part of the male end portion 14, a recess 28 is disposed in the outer surface 30 of the male end portion
14. The recess 28 has a base 32, a first, upper, side wall 34 and a second, lower, side wall 36. In the illustrated embodiment, the recess 28 takes the form of a circumferential groove the first side wall 34 and the second side wall 36 being perpendicular or substantially perpendicular to the base 32. The recess 28 is disposed between the threaded outer surface portion 22 and the non-threaded outer surface portion 24.

The recess 28 in the male end portion 14 is configured to receive a retainer 38. In the illustrated embodiment, the retainer 38 comprises a snap ring. The retainer 38 comprises an inner surface 40, an outer surface 42, a first, upper, end surface 44 and a second, lower, end surface 46. As shown, the retainer 38 is disposed in and extends out of the recess 28. In use, and as described further below, the retainer 38 is initially arranged in a run-in configuration in which the retainer 38 is disposed in the recess 28 with the lower surface 40 spaced from the base 32 of the recess 28.

Referring now also to Figure 4, which shows an enlarged view of the female end portion 16 of the body 12, the female end portion 16 comprises a chamber 48 for receiving a male end portion 14b of another downhole device 10b (see Figure 6), which may be identical or similar to the device 10 or 10a.

As shown in Figure 4, the chamber 48 comprises a first inner surface portion 50 which is threaded and a second inner surface portion 52 which is non-threaded and defines the entrance 54 to the chamber 48. The entrance 54 is tapered, the tapered entrance 54 defined by a lead-in chamfer 56. The tapered entrance 54 assists in directing and aligning the male end portion 16b of the other device 10b with the female end portion 14, and assisting in assembly. Moreover, the tapered entrance 54 assists with moving the retainer 38 to its smaller diameter configuration, as will be described further below.

Referring now also to Figure 5, which shows an enlarged view of part of the female end portion 16, a recess 58 is disposed in the inner surface 60 of the female end portion 16. The recess 58 is interposed between the tapered entrance 54 and the threaded inner surface portion 50.

In the illustrated embodiment, the recess 58 takes the form of a circumferential groove. As shown most clearly in Figure 5, the recess 58 comprises a base 62, a first side surface 64 and a second side surface 66. The first side surface 64 is tapered, the tapered first side surface 64 defined by a chamfer 68. The angle of taper of the first side surface 64 is greater than the angle of taper of the tapered entrance 54.

Beneficially, the tapered side surface 64 permits the device 10 to be detached (in the
illustrated embodiment, unscrewed) from the other device 10b but prevents or at least resists the devices 10, 10b from being separated by vibration, such as may be encountered during passage downhole.

The recess 58 is configured to receive a retainer 38b of the device 10b (see Figure 6), the retainer 38b in the illustrated embodiment comprising a snap ring. In use, the retainer 38b engages the recess 58 of the female end portion 16 and expands to a larger configuration which prevents axial separation of the device 10 and the other device 10b.

Beneficially, embodiments of the present invention permit the device 10 to be secured to one or more other device 10a, 10b in a secure manner and prevents or mitigates the risk that the devices 10, 10a, 10b will become separated as they are run downhole.

Referring now to Figures 6 to 10, there is shown a downhole assembly 100 according to an embodiment of the present invention and which employs the coupling of the present invention. In the illustrated embodiment, the assembly 100 – which in Figure 6 is shown in its disassembled state – comprises three identical devices 10, 10a, 10b which are to be secured together to form a string to be run downhole together. However it will be recognised that one or more of the devices 10, 10a, 10b may take other forms. Similarly, while Figures 7 to 10 show the steps involved in assembling two of the devices 10, 10b together, it will be recognised that the same coupling may be used to couple three or more of the devices together.

Referring to Figure 7, there is shown an enlarged view of part of the assembly 100 showing the coupling between the devices 10, 10a in its unassembled state. As shown in Figure 7, the retainer 38 is disposed in and extends out of the recess 28, with the lower surface 40 spaced from the base 32 of the recess 28.

Figure 8 shows an enlarged view of the same part of the assembly 100 as shown in Figure 7, in a second position. In this second position, the male end portion 14 of the device 10 has been engaged with the female end portion 16a of the device 10a, with the threaded outer surface portion 22 of the male portion 14 threadedly engaging the threaded inner surface portion 50a of the female portion 16a. It will be recognised that in the position shown in Figure 8, the retainer 38 is still disposed in and extends out from the recess 28, the inner surface 40 of the retainer 38 being spaced from the base 32 of the recess 28.

Referring now also to Figure 9, there is shown the enlarged view of same part of the assembly 100 as shown in Figures 7 and 8, in a third position. In this third
position, the male end portion 14 of the device 10 has been engaged with the female end portion 16a of the device 10a, with the threaded outer surface portion threadedly engaging the threaded inner surface portion 50a and the outer surface 42 of the retainer 38 has been engaged by the tapered entrance 54a of the female end portion 16a. In the position shown in Figure 9, the retainer 38 has been compressed by the female end portion 16a from the first configuration shown in Figures 7 and 8 to a second, radially compressed, configuration. In the illustrated embodiment, the lower surface 40 of the retainer 38 engages the base 32 of the recess 28, although this need not be the case in other embodiments.

Referring now also to Figure 10, there is shown the enlarged view of same part of the assembly 100 as shown in Figures 7 to 9, in a fourth position. In this fourth position, the male end portion 14 of the device 10 has been engaged with the female end portion 16a of the device 10a, with the threaded outer surface portion 22 threadedly engaging the threaded inner surface portion 50a. In this position, the outer surface 42 of the retainer 38 is no longer compressed by the tapered entrance 54 of the female end portion 16a and so is free to return to its original configuration, extended radially outwards into the recess 62a in the female end portion 16a of the device 10a. In the position shown in Figure 10, the retainer 38 is sufficient to prevent relative axial movement of the devices 10, 10a of the assembly 100 resulting for example from vibration experienced as the assembly 100 is run downhole, while the tapered end surface of the recess also permits the devices 10, 10a to be disassembled when required.

It will be recognised that the device 10 and assembly 100 may be used in a number of different applications. For example, Figure 11 shows an assembly 200 according to an embodiment of the invention, wherein each device 10, 10a includes a plug member P, Pa.

It should be understood that the embodiments described herein are merely exemplary and that various modifications may be made thereto without departing from the scope of the invention.

For example, Figure 12 shows a downhole device 210 according to an alternative embodiment of the present invention. The downhole device 210 is similar to the downhole device 10 described above and like numerals are represented by like numerals incremented by 200. As shown in Figure 12, the device 210 comprises a body 212 comprising a male end portion 214, a female end portion 216 and a mandrel portion 218 disposed between the male end portion 214 and the female end portion
216. However, in this embodiment recess 228 is disposed in the female end portion 216.

Referring now also to Figure 13, which shows an enlarged view of part of the female end portion 216, the recess 228 has a base 232, a first, upper, side wall 234 and a second, lower, side wall 236. In the illustrated embodiment, the recess 228 takes the form of a circumferential groove, the first side wall 234 and the second side wall 236 being perpendicular or substantially perpendicular to the base 232.

The recess 228 is configured to receive a retainer 238. In the illustrated embodiment, the retainer 238 comprises a snap ring. The retainer 238 comprises an inner surface 240, an outer surface 242, a first, upper, end surface 244 and a second, lower, end surface 246. As shown, the retainer 238 is disposed in and extends out of the recess 228. In use, the retainer 238 is initially arranged in a run-in configuration in which the retainer 238 is disposed in the recess 228 with the upper surface 242 spaced from the base 232 of the recess 228.

The female end portion 216 of the body 212 also comprises a chamber 248 having a tapered entrance 254 defined by chamfer 256.

Referring now also to Figure 14, which shows an enlarged view of part of the male end portion 214, a recess 258 is disposed on profiled outer surface 260 of male end portion 214. The recess 258 takes the form of a circumferential groove. As shown most clearly in Figure 14, the recess 258 comprises a base 262, a first side surface 264 and a second side surface 266. The first side surface 264 is tapered, the tapered first side surface 264 defined by a chamfer 268. The recess 258 is configured to receive a retainer 232a of downhole device 210a (see Figure 15), the retainer 238a in the illustrated embodiment comprising a snap ring.

Referring now to Figure 15 and 16, there is shown a downhole assembly 400 according to an embodiment of the present invention and which employs the coupling of the present invention. In the illustrated embodiment, the assembly 400 – which in Figure 15 and 16 is shown in its disassembled state – comprises three identical devices 210, 210a, 210b which are to be secured together to form a string to be run downhole together. However it will be recognised that one or more of the devices 210, 210a, 210b may take other forms.

Coupling of the assembly 400 is substantially the same as for the assembly 200, the difference being that in this embodiment the retainer 238 of downhole device 210 is urged from an initial configuration to a larger configuration on engagement between the downhole device 210 and the downhole device 210b, in which
configuration relative axial movement of one or more of the downhole device 210 and the other downhole device 210b towards the other is permitted. On further engagement between the downhole device 210 and the other downhole device 210b, the retainer is then permitted to move to a smaller configuration, in which configuration separation of the downhole device 210 and the other downhole device 210b is resisted or prevented.

Thus, in this embodiment also, the device 210 may be secured to one or more other device 210a, 210b in a secure manner and prevents or mitigates the risk that the devices 210, 210a, 210b will become separated as they are run downhole.

Whereas in the illustrated embodiments the body is unitary in construction, in other embodiments the body may be modular, comprising a number of components coupled together. For example, at least one of the male end portion, the female end portion, and the mandrel portion may comprise a separate component.

The engagement between the male end portion and the female end portion may alternatively or additionally comprise a quick connector, push connector, or the like.
CLAIMS

1. A downhole device comprising:
   a body comprising at least one of:
   a male portion configured to couple the device to a female portion of another
downhole device, wherein the male portion is configured to receive a retainer for
engaging the other downhole device, and wherein the male portion is configured to
permit the retainer to move to a smaller configuration when the retainer is engaged by
said other downhole device to permit relative axial movement between the downhole
device and said other downhole device; and
   a female portion configured to couple the device to a male portion of another
downhole device, wherein the female portion is configured to permit a retainer to move
to a larger configuration, in which larger configuration relative axial separation of the
device and said other downhole device is resisted or prevented.

2. A downhole device comprising:
   a body comprising at least one of:
   a female portion configured to couple the device to a male portion of another
downhole device, wherein the female portion is configured to receive a retainer for
engaging the other downhole device, and wherein the female portion is configured to
permit the retainer to move to a larger configuration when the retainer is engaged by
said other downhole device to permit relative axial movement between the downhole
device and said other downhole device; and
   a male portion configured to couple the device to a female portion of another
downhole device, wherein the male portion is configured to permit a retainer to move to
a smaller configuration, in which smaller configuration relative axial separation of the
device and said other downhole device is resisted or prevented.

3. The downhole device of claim 1 or 2, wherein the downhole device is
configured so that the engagement between the female portion and the other downhole
device and/or the engagement between the male portion and the other downhole
device occurs before the retainer is moved to its smaller configuration.

4. The downhole device of claim 1, 2 or 3, wherein the smaller configuration
comprises a smaller diameter configuration.
5. The downhole device of any preceding claim, wherein the larger configuration comprises a larger diameter configuration.

6. The downhole device of any preceding claim, wherein the body is of any suitable form and construction.

7. The downhole device of any preceding claim, wherein the body comprises a mandrel portion.

8. The downhole device of claim 7, wherein the mandrel portion is disposed between the male portion and the female portion.

9. The downhole device of any preceding claim, wherein the body comprises or defines a core of a downhole tool.

10. The downhole device of claim 9, wherein the body comprises or defines a core of a downhole cement dart or plug.

11. The downhole device of any preceding claim, wherein the body comprises or defines a solid body or a tubular body.

12. The downhole device of any preceding claim, wherein the male portion comprises a male end portion of the body.

13. The downhole device of any one of claims 7 to 12, wherein the male portion has an outer diameter less than an outer diameter of the mandrel portion of the body.

14. The downhole device of any preceding claim, wherein the male portion comprises at least one of a threaded portion and/or a non-threaded portion.

15. The downhole device of claim 14, wherein a first, distal, outer surface portion of the male end portion comprises or defines the threaded portion.
16. The downhole device of claim 14 or 15, wherein a second, proximal, outer surface portion of the male end portion comprises or defines the non-threaded portion.

17. The downhole device of claim 14, 15 or 16, wherein the threaded portion is configured to secure the downhole device to said other downhole device.

18. The downhole device of any one of claims 14 to 17, wherein the threaded portion is configured to secure the downhole device to a female portion of said other downhole device.

19. The downhole device of any preceding claim, wherein the male portion comprises or defines a shoulder.

20. The downhole device of claim 19, wherein the shoulder provides an abutment for engaging the female portion of said other downhole device.

21. The downhole device of any preceding claim, wherein an end of the male portion is tapered.

22. The downhole device of any preceding claim, wherein the male portion comprises a recess.

23. The downhole device of claim 22, wherein the recess of the male portion is configured to permit the retainer to move from a first configuration to a second configuration.

24. The downhole device of claim 23, wherein the recess of the male portion is configured to permit the retainer to move from a first configuration to a second, smaller, diameter, configuration.

25. The downhole device of claim 22, 23 or 24, wherein the recess of the male portion is disposed in an outer surface of the male portion.
26. The downhole device of claim 23, 24 or 25, when dependent on claim 14, wherein the recess of the male portion is disposed between the threaded portion of the male portion and the non-threaded portion of the male portion.

27. The downhole device of any preceding claim, wherein the female portion comprises a female end portion of the body.

28. The downhole device of any preceding claim, wherein the female portion comprises a chamber configurable to receive a male portion of another downhole device operatively associated with said female end.

29. The downhole device of any preceding claim, wherein the female portion comprises at least one of a threaded portion and/or a non-threaded portion.

30. The downhole device of claim 29, wherein a first inner surface portion of the female portion comprises or defines the threaded portion of the female portion.

31. The downhole device of claim 29 or 30, wherein a second inner surface portion of the female portion comprises or defines non-threaded portion of the female portion.

32. The downhole device of claim 29, 30 or 31, wherein the threaded portion of the female portion is configured to secure the downhole device to said other downhole device operatively associated with said female end.

33. The downhole device of any one of claims 32 to 35, wherein the threaded portion of the female portion is configured to secure the device to a male portion of said other downhole device operatively associated with said female end.

34. The downhole device of any preceding claim, wherein the female portion comprises a tapered entrance.

35. The downhole device of claim 34, wherein the tapered entrance of the female portion comprises or defines a lead-in chamfer.
36. The downhole device of any preceding claim, wherein the female portion comprises a recess.

37. The downhole device of claim 36, wherein the recess of the female portion is disposed in an inner surface of the female portion.

38. The downhole device of claims 36 or 37, when dependent on claim 29, wherein the recess of the female portion is disposed between the non-threaded portion of the female portion and the threaded portion of the male portion.

39. The downhole device of claim 36, 37 or 38, wherein the recess of the female portion is configured to permit the retainer to move from the first configuration to the second configuration.

40. The downhole device of any one of claims 36 to 39, wherein the recess of the female portion comprises a circumferential groove.

41. The downhole device of any one of claims 36 to 40, wherein the recess of the female portion comprises a base.

42. The downhole device of any one of claims 36 to 41, wherein the recess of the female portion comprises a first side surface.

43. The downhole device of claim 42, wherein the first side surface of the female end portion is tapered.

43. The downhole device of any one of claims 36 to 42, wherein the recess of the female portion comprises a second side surface.

44. The downhole device of any preceding claim, wherein the female portion comprises a lip.

45. The downhole device of claim 44, when dependent on claim 34 and 36, wherein the lip is interposed between the tapered entrance and the recess of the female end portion.
46. The downhole device of claims 44 or 45, wherein the lip engages the retainer to move or compresses the retainer to its smaller diameter configuration.

47. The downhole device of any preceding claim, wherein the female portion is tapered.

48. The downhole device of any preceding claim, wherein the downhole device is provided in combination with a retainer or a plurality of retainers.

49. The downhole device of claim 48, wherein the retainer comprises a resilient member.

50. The downhole device of claim 48 or 49, wherein the retainer comprises an annular member.

51. The downhole device of claim 48, 49 or 50, wherein the retainer comprises a snap ring.

58. The downhole device of any one of claims 54 to 57, wherein the retainer is configured so that the retainer is disposed in and extends out of the recess in the male portion.

59. The downhole device of any preceding claim, wherein the device is provided in combination with a plug member.

60. The downhole device of claim 59, wherein the plug member comprises an elastomeric member.

61. The downhole device of claim 59 or 60, wherein the plug member is configured to engage a bore.

62. A downhole assembly comprising:
   a downhole device according any preceding claim; and
   at least one other downhole device.
63. The assembly of claim 62, wherein said other downhole device, or where the assembly comprises a plurality of other downhole devices, at least one of said other downhole devices, is a downhole device according to any preceding claim.

64. A method comprising:
providing a body comprising at least one of: a male portion configured to permit the retainer to move to a smaller configuration when the retainer is engaged by another downhole device to permit relative axial movement between the downhole device and said other downhole device; and a female portion configured to permit a retainer to move to a larger configuration, in which larger configuration relative axial separation of the device and said other downhole device is resisted or prevented; and
engaging the device with at least other device.

65. A method comprising:
providing a body comprising at least one of: a female portion configured to couple the device to a male portion of another downhole device, wherein the female portion is configured to receive a retainer for engaging the other downhole device, and wherein the female portion is configured to permit the retainer to move to a larger configuration when the retainer is engaged by said other downhole device to permit relative axial movement between the downhole device and said other downhole device; and a male portion configured to couple the device to a female portion of another downhole device, wherein the male portion is configured to permit a retainer to move to a smaller configuration, in which smaller configuration relative axial separation of the device and said other downhole device is resisted or prevented; and
engaging the device with at least other device.

66. A coupling for securing a downhole device to at least one other downhole device, the coupling comprising:
a recess configured to receive a retainer for securing the downhole device to said other downhole device;
a first profile configured to urge the retainer from a first configuration to a second configuration, in which second configuration relative axial movement of at least
one of the downhole device and said other downhole device toward the other of the downhole device and said other downhole device is permitted; and

a second profile configured to permit the retainer to move from the second configuration to a third configuration, in which third configuration relative axial separation of the device and said other downhole device is resisted or prevented.

67. The coupling of claim 66, wherein the second profile is configured to urge the retainer from the third configuration to a fourth configuration which permits relative axial separation of the device and said other downhole device.

68. The coupling of claims 66 or 67, wherein in the second configuration, the retainer is disposed further into the recess.

69. The coupling of claim 66, 67 or 68, wherein the first configuration defines a first diameter configuration.

70. The coupling of any one of claims 66 to 69, wherein the second configuration defines a second diameter configuration.

71. The coupling of any one of claims 66 to 70, wherein the third configuration defines a third diameter configuration.

72. The coupling of any one of claims 66 to 71, wherein in the first configuration relative axial movement between the downhole device and said other downhole device is prevented.

73. A downhole device substantially as described herein and/or as shown in the accompanying drawings.

74. An assembly substantially as described herein and/or as shown in the accompanying drawings.

75. A method substantially as described herein and/or as shown in the accompanying drawings.
76. A coupling substantially as described herein and/or as shown in the accompanying drawings.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X,E</td>
<td>1-76</td>
<td>US2014/1380977 A (ANDRIGO) cement plug paras [0020] to [0058] figs 4-5, 8-12; snap ring 52 engages the internal shoulder 26d, the external tapered surface 44e engages the internal tapered surface 26a.</td>
</tr>
<tr>
<td>X</td>
<td>1-76</td>
<td>US2012/234561 A (SMITH INT ET AL) A dual wiper plug system. See whole document, particularly figs 1A-E, paras [0049] to [0057]. The body 160 and the tail portion 162 of the pump down plug 158 comprises separate components coupled together which may be press-fit.</td>
</tr>
<tr>
<td>X</td>
<td>1-76</td>
<td>WO2013/066817 A (HALLIBURTON)Bottom plug with longitudinal body 322 which may be formed from multiple connected components (segments connected by a threaded connection or the like) and wipers 325; Figs 4A-B, paras [0068] to [0074].</td>
</tr>
<tr>
<td>X</td>
<td>1 &amp; 2, at least</td>
<td>EP0259170 A (WEATHERFORD) Wellbore plug with flexible cones 34 threadedly interconnected. Figs 1-5.</td>
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Categories:

- X Document indicating lack of novelty or inventive step
- Y Document indicating lack of inventive step if combined with one or more other documents of same category.
- & Member of the same patent family
- A Document indicating technological background and/or state of the art.
- P Document published on or after the declared priority date but before the filing date of this invention.
- E Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC:

E21B

The following online and other databases have been used in the preparation of this search report:

WPI, EPODOC
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<td>E21B</td>
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