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(54) Title of the Invention: **Plumbing fitting**
Abstract Title: **Plumbing fitting having a grab ring movable from an active state to a passive state**

(57) Plumbing fitting 310 comprising a pipe socket 314 for receiving the free end of a pipe, and a grab ring comprising teeth extending from an annular body, with a mechanism for moving the grab ring from an active state where the teeth engage a pipe and a passive state where the teeth are disengaged from the pipe, the grab ring forming part of a sub-assembly associated with the socket and comprising a housing which supports the grab ring within it, the housing being fixed against rotation relative to the socket, the mechanism comprising a release member 144 movable in an axial direction between first and second positions to move the grab ring from the active to passive states. The grab ring is supported in a housing of a sub-assembly associated with the socket, the housing defining a circumferential shoulder 146 which interacts with a circumferential lip 147 on the release member to retain the release member axially. A locking mechanism comprising serrations 382 which inter-engage with protrusions 384 on the housing may fix, lock or prevent rotation of the housing. The release member may comprise a ramped cam surface which is acted on by a driver.

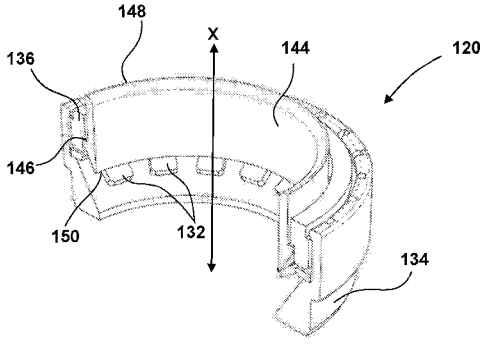

Fig. 9

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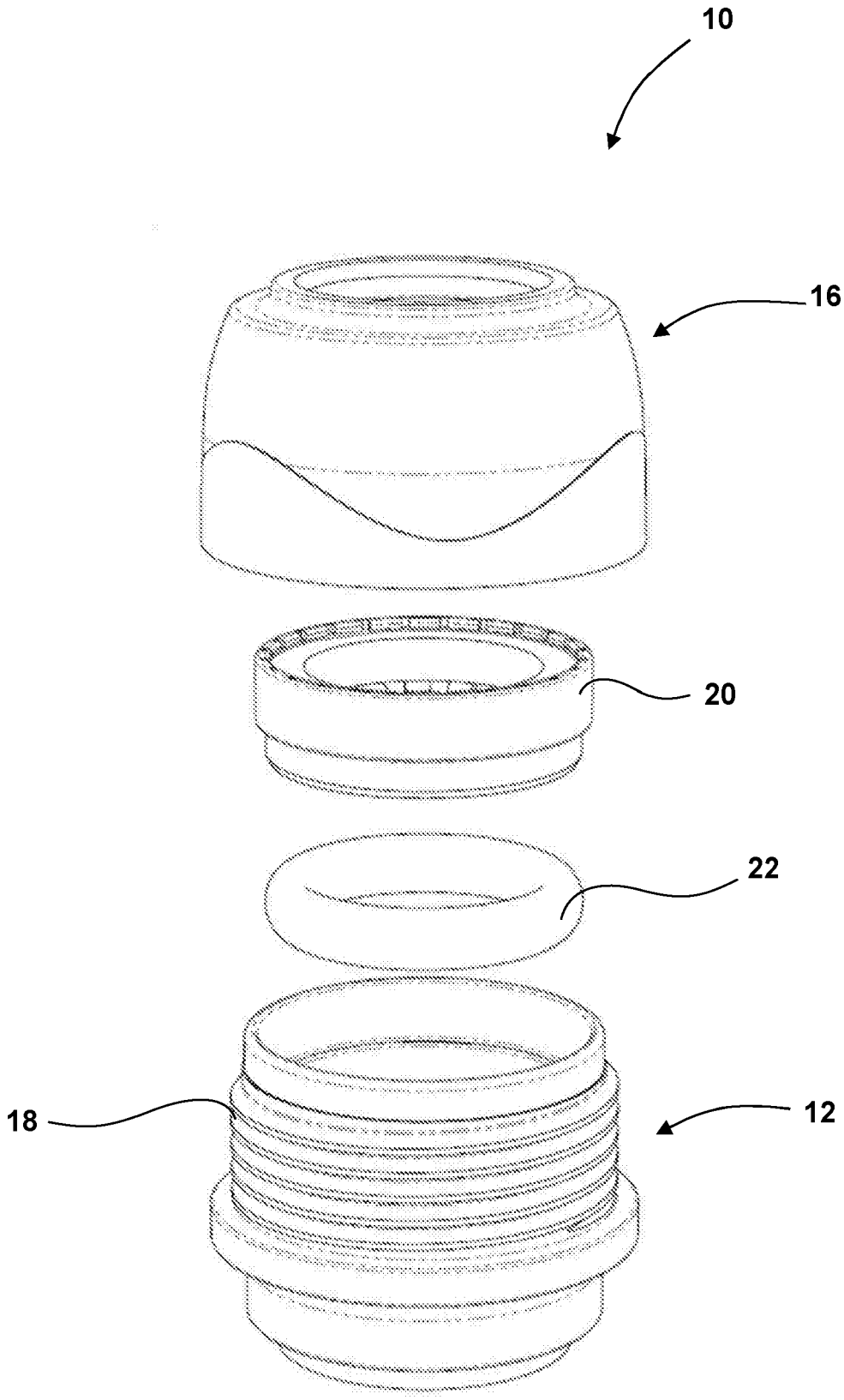


Fig. 1

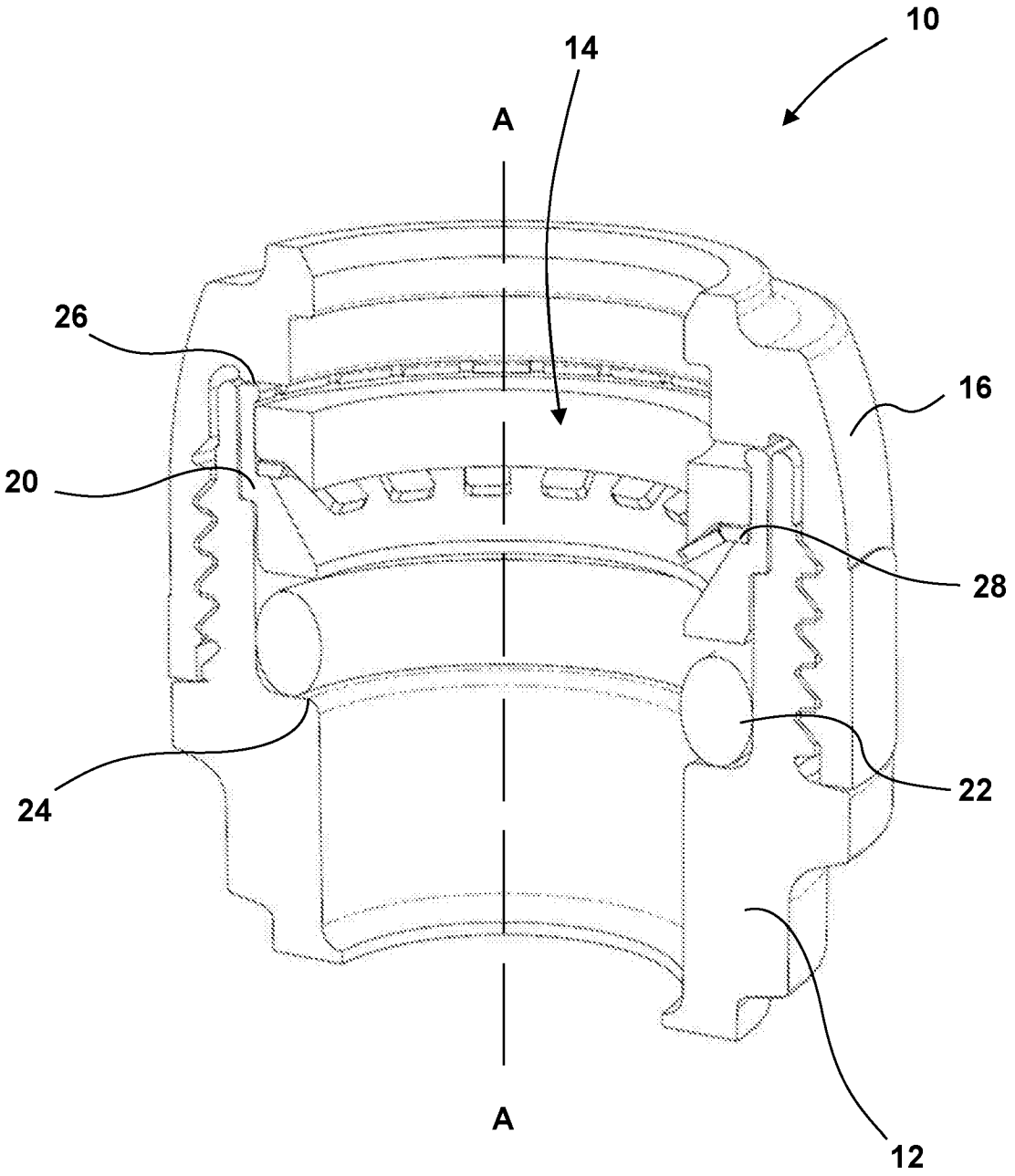
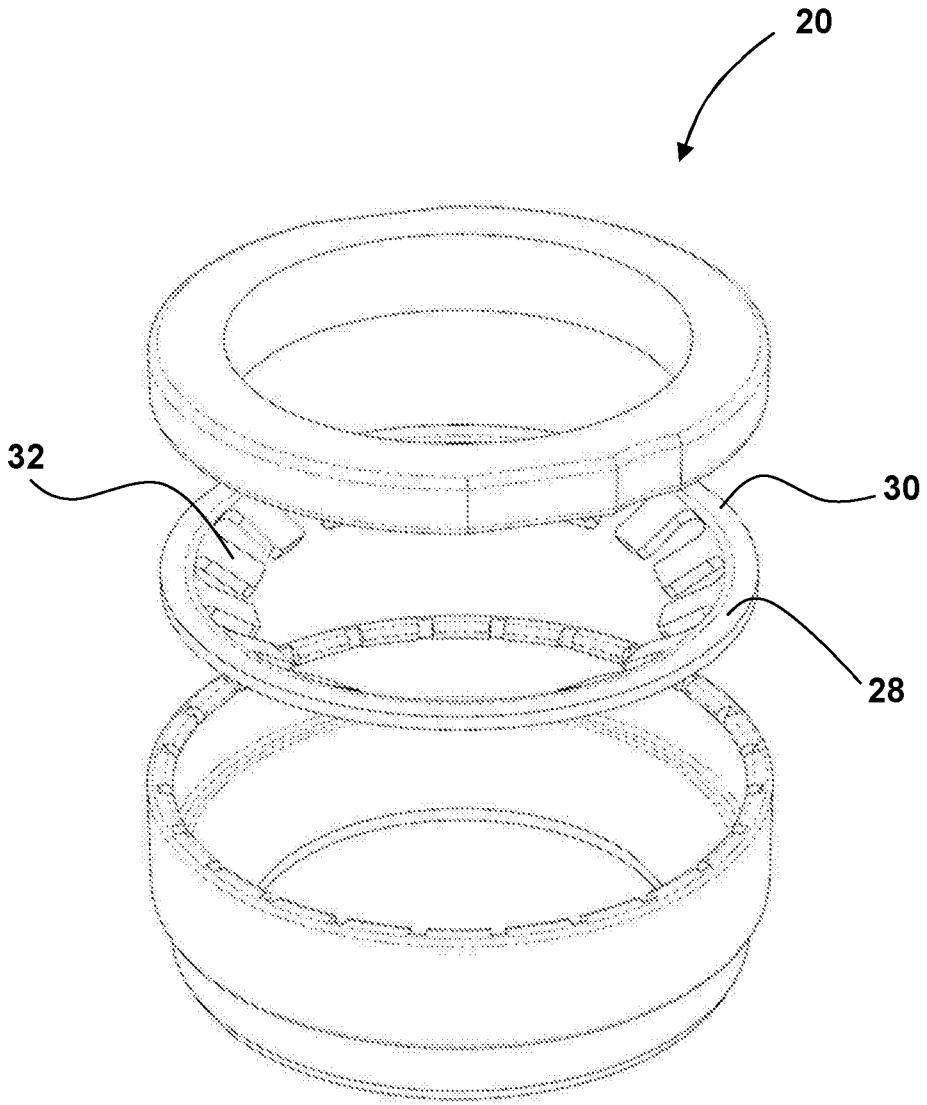


Fig. 2



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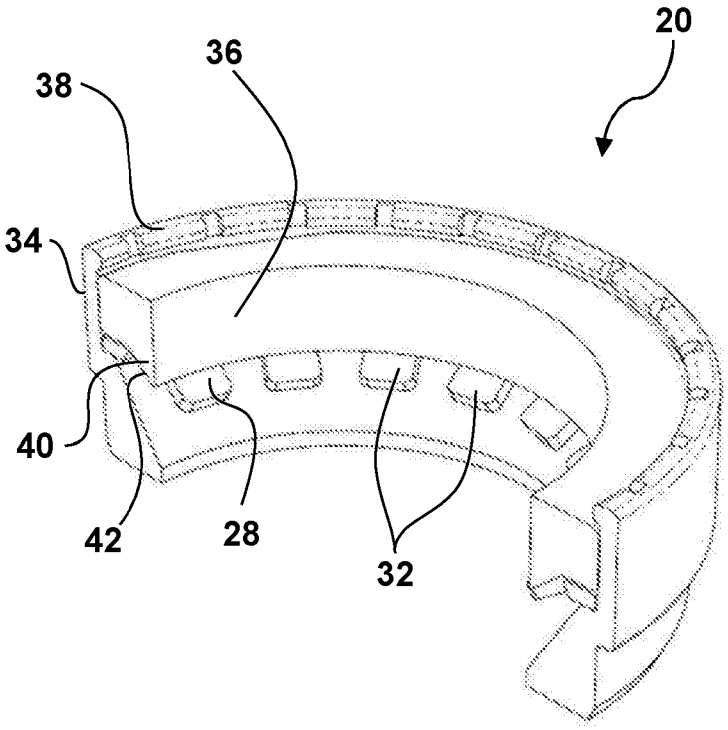
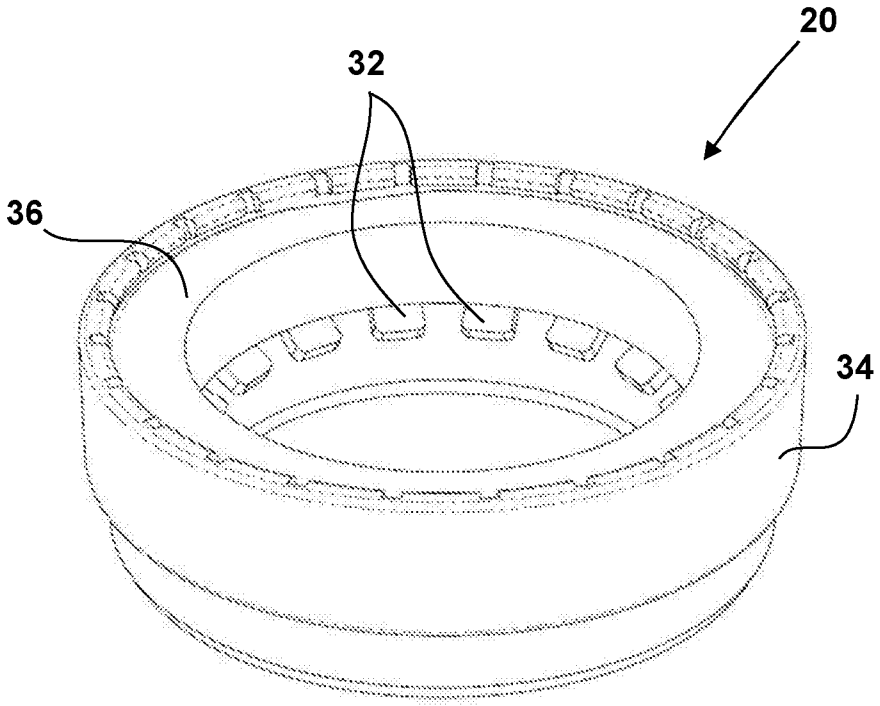


Fig. 4



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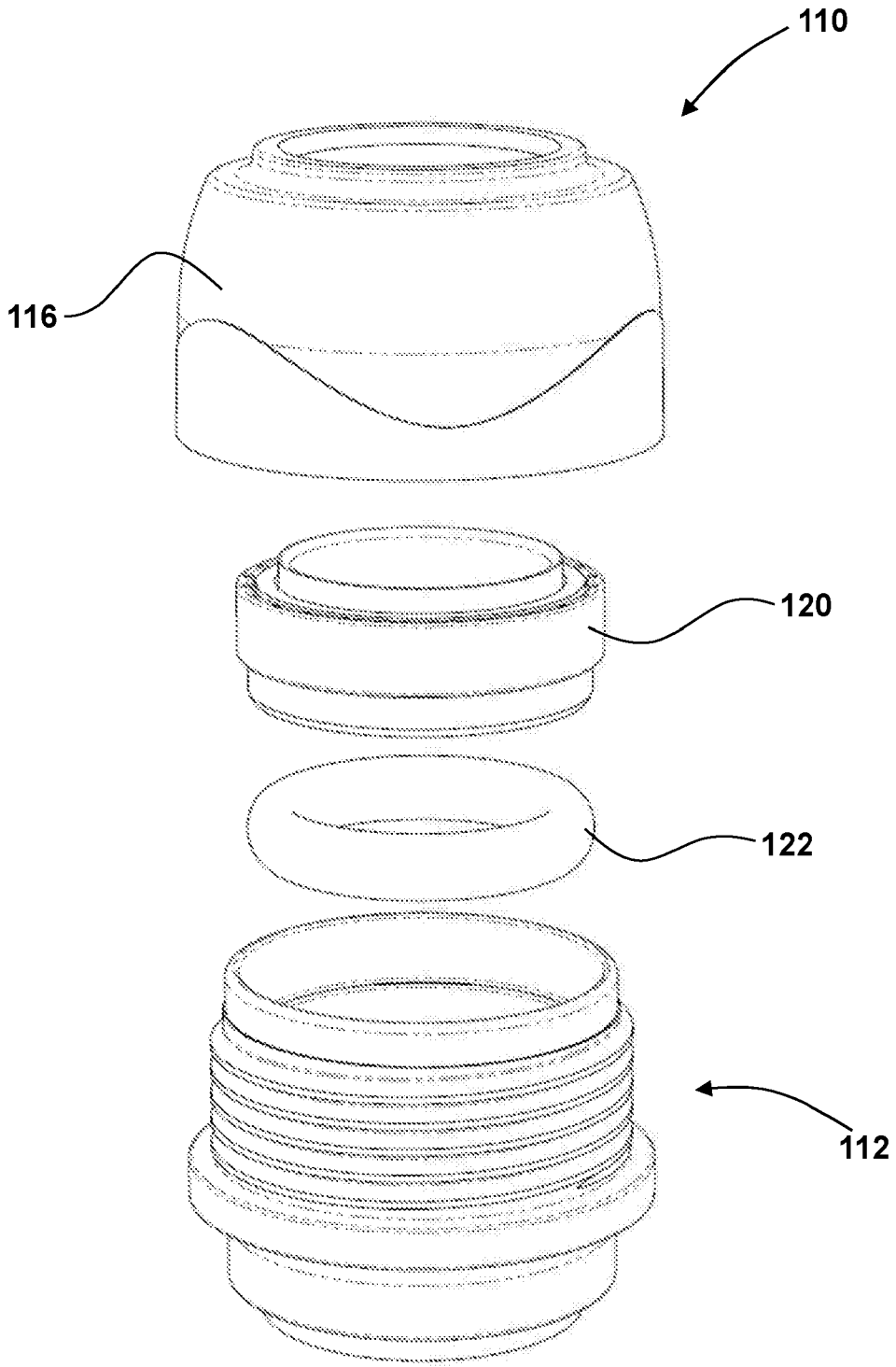

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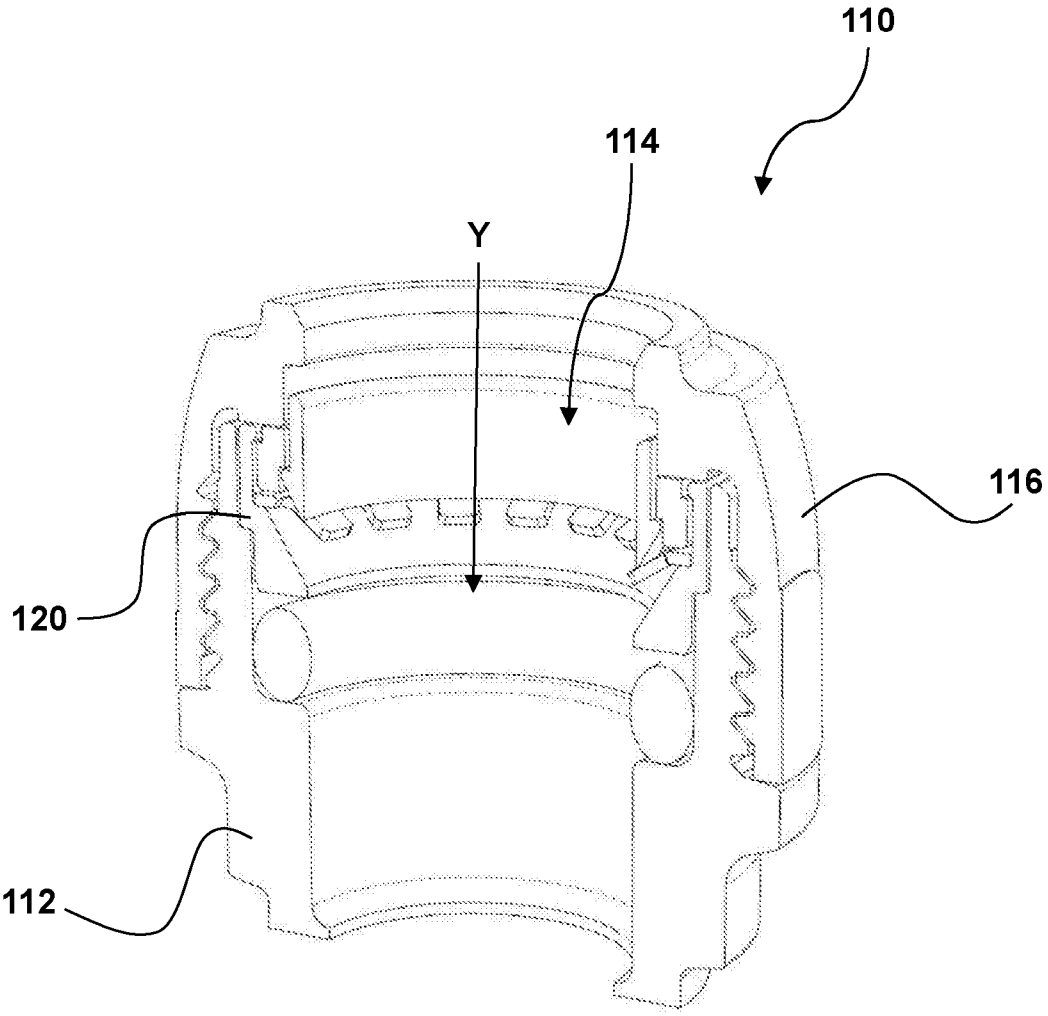


Fig. 7

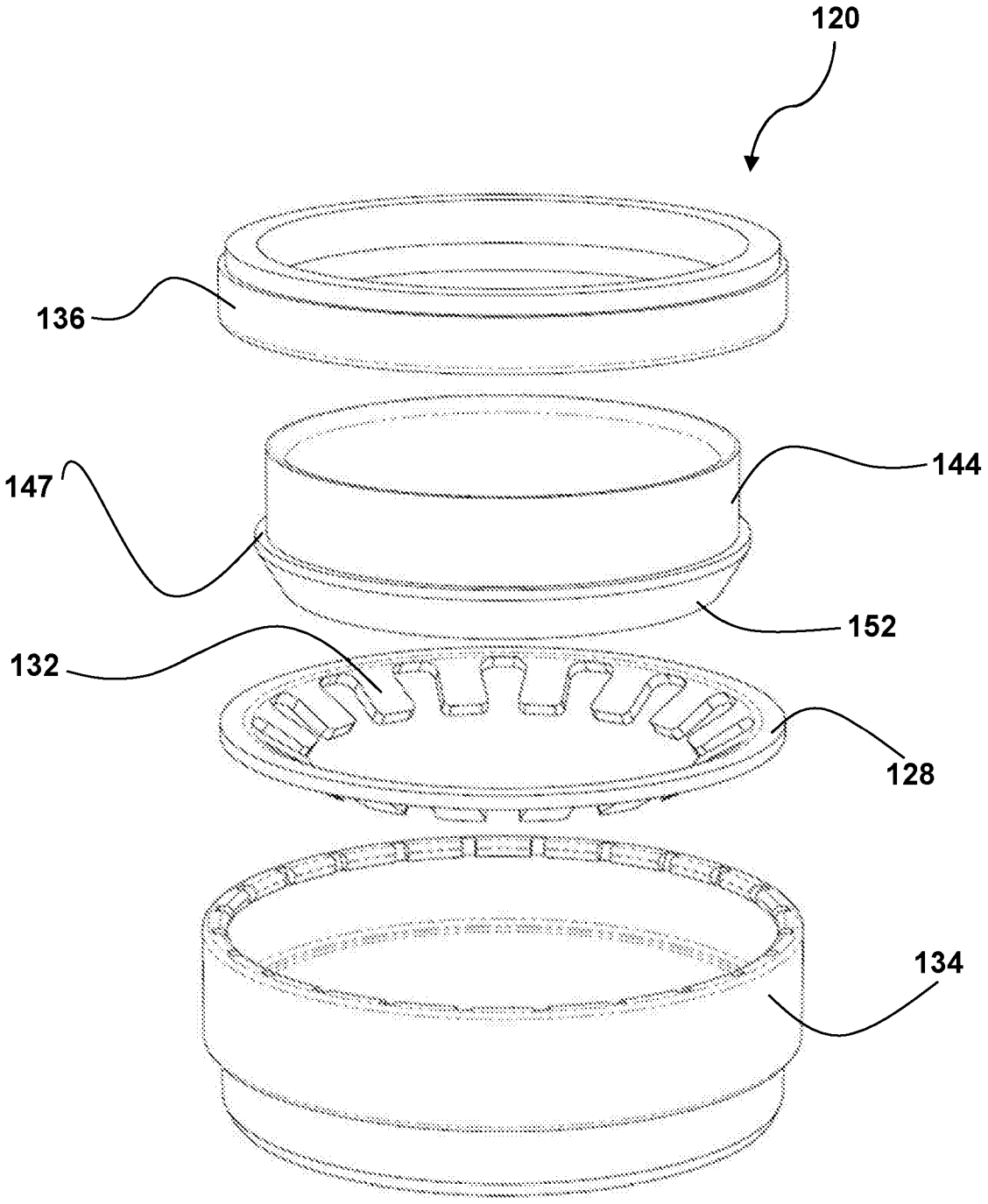
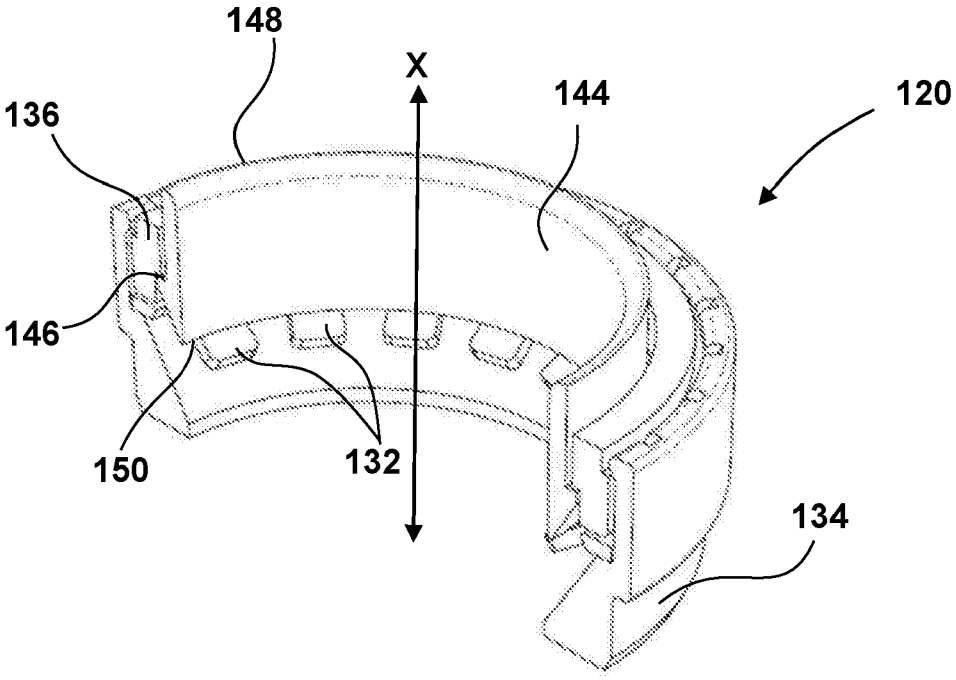


Fig. 8



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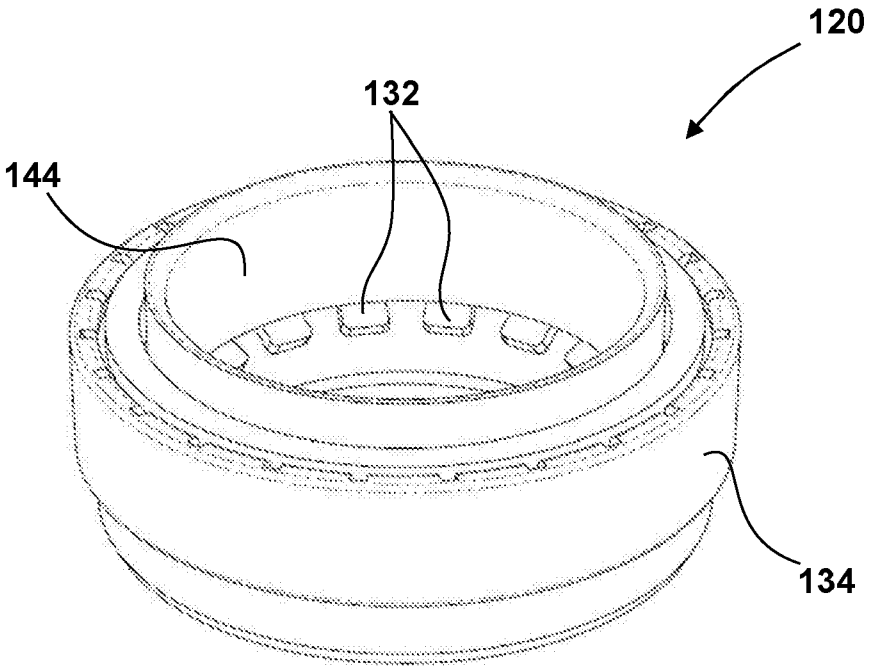

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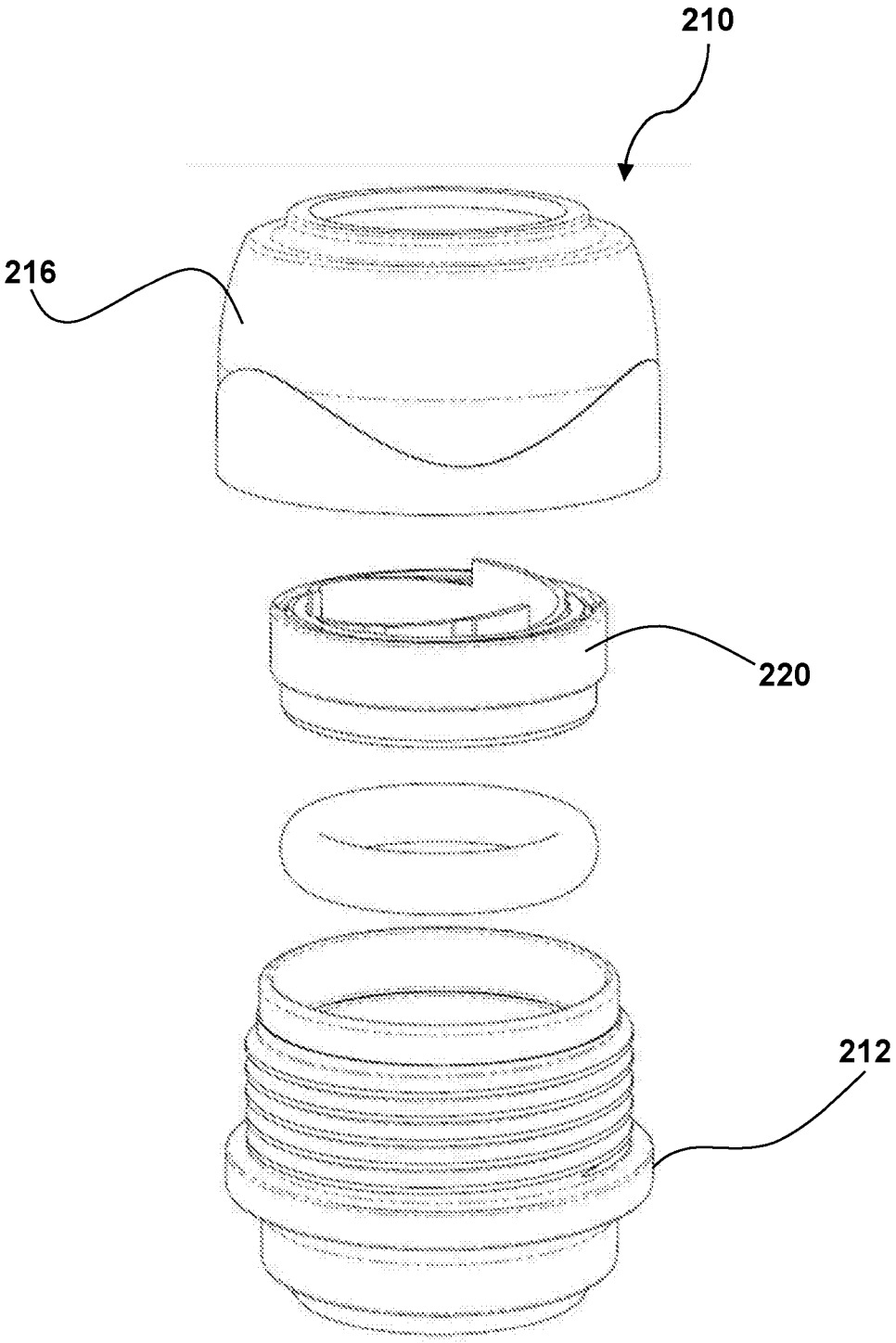

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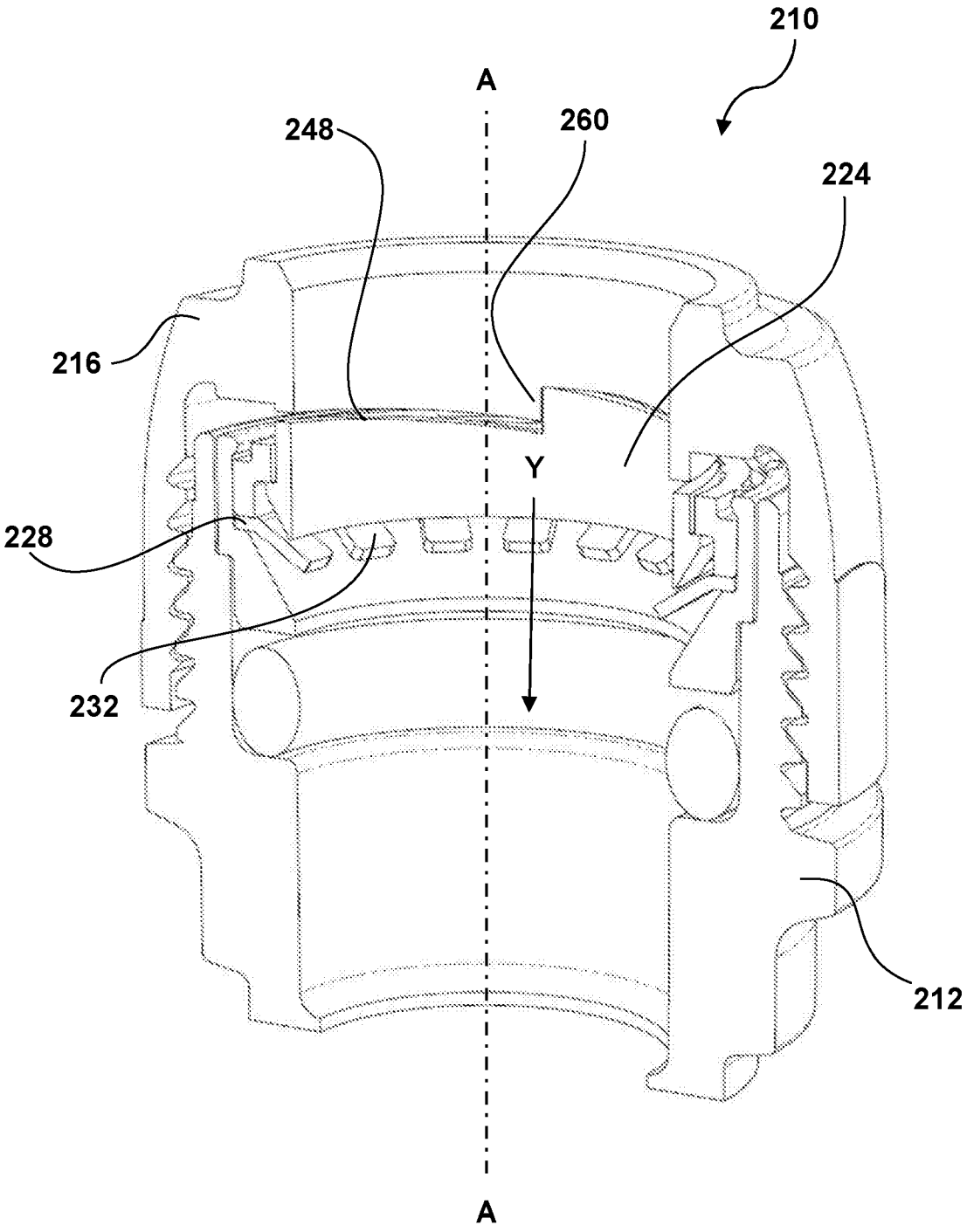


Fig. 12

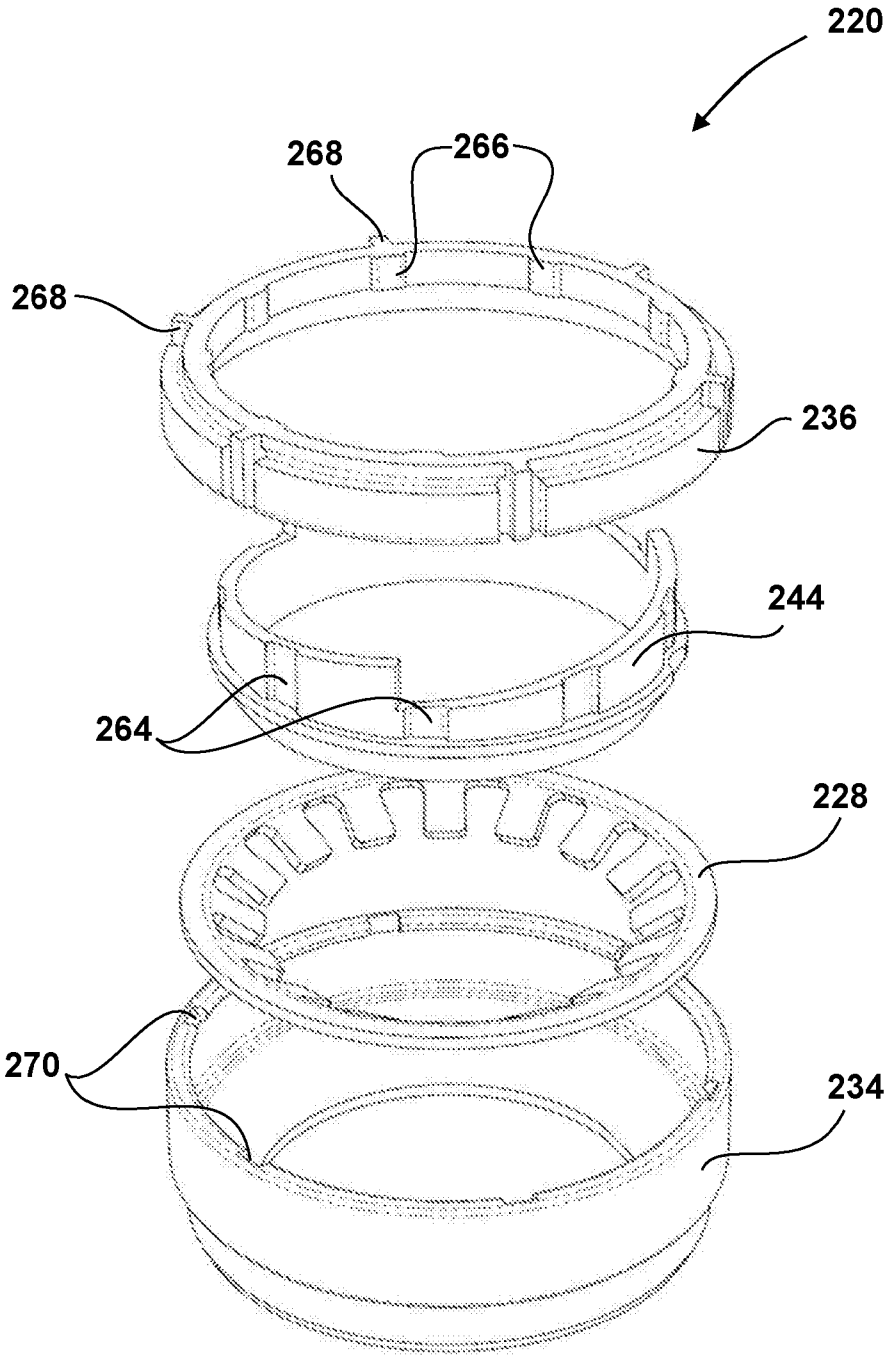
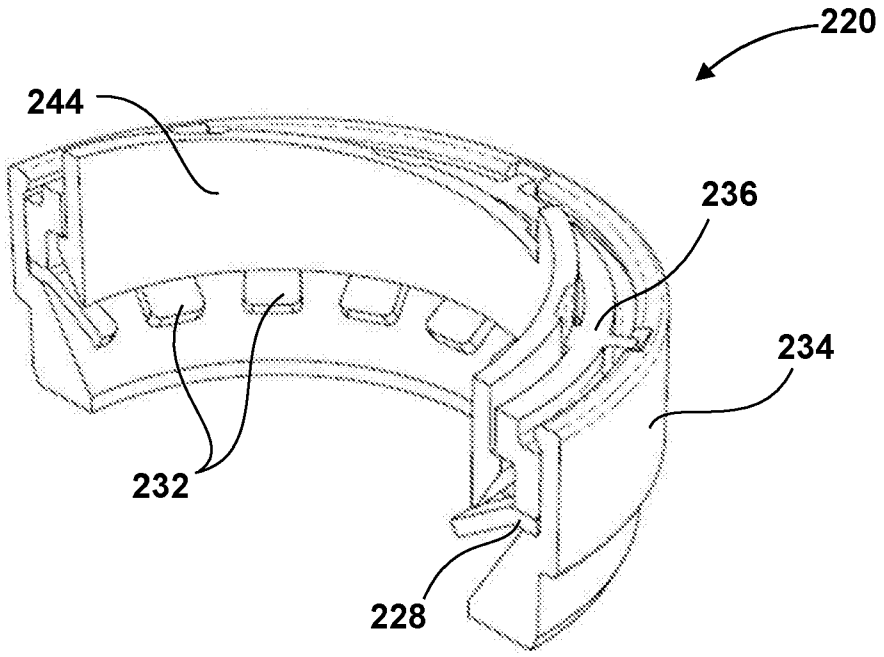


Fig. 13



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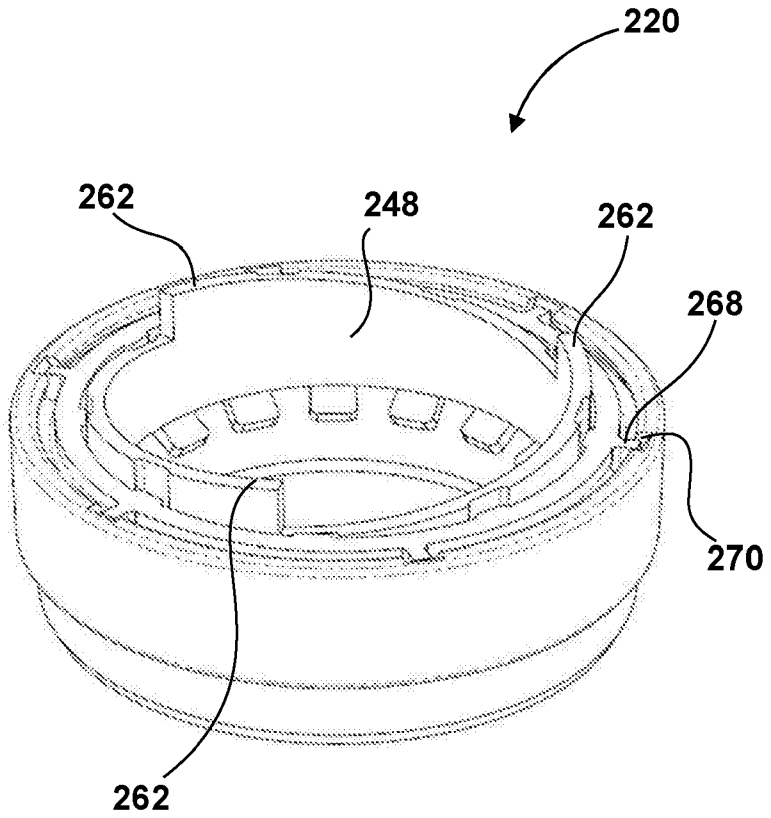

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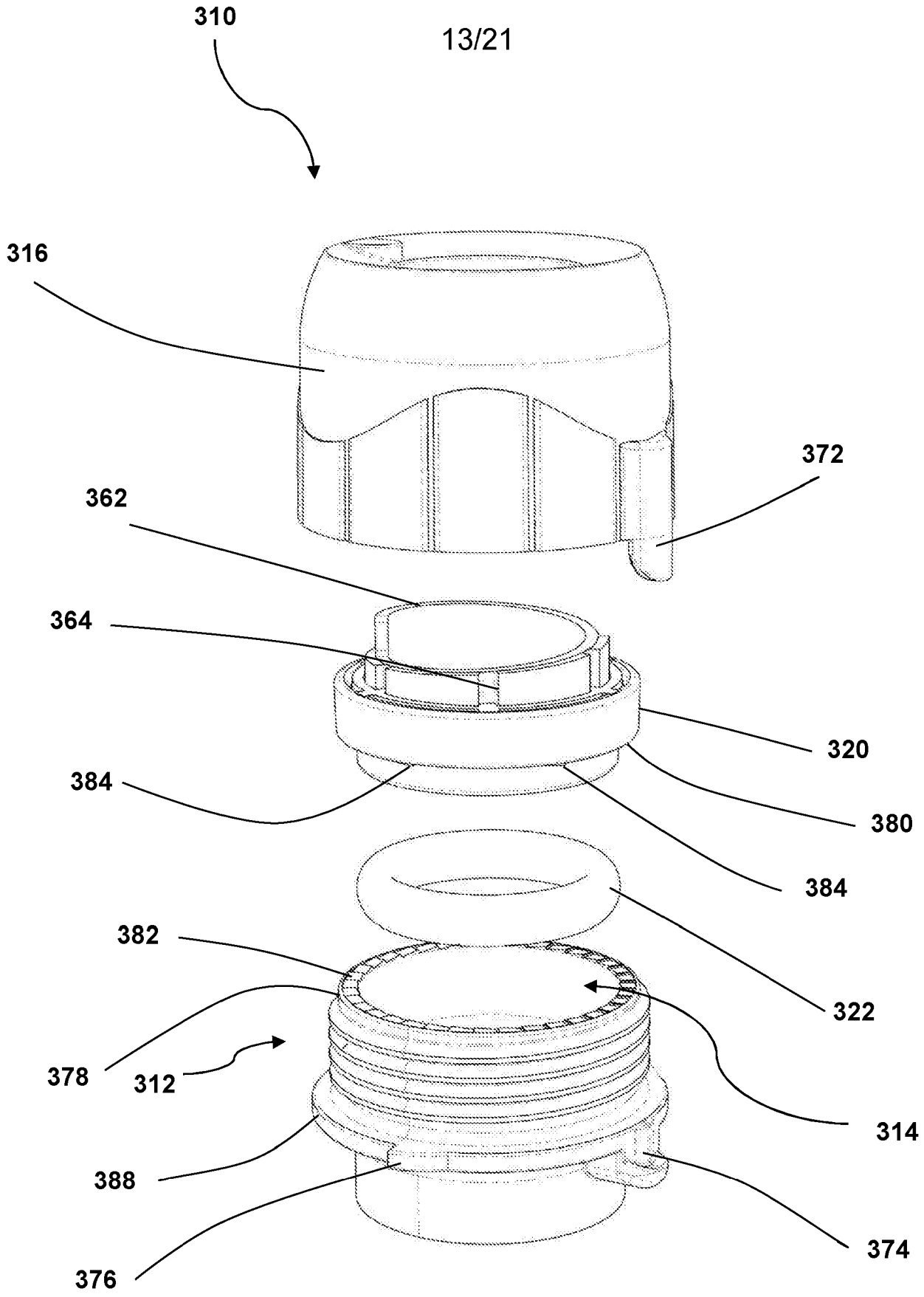
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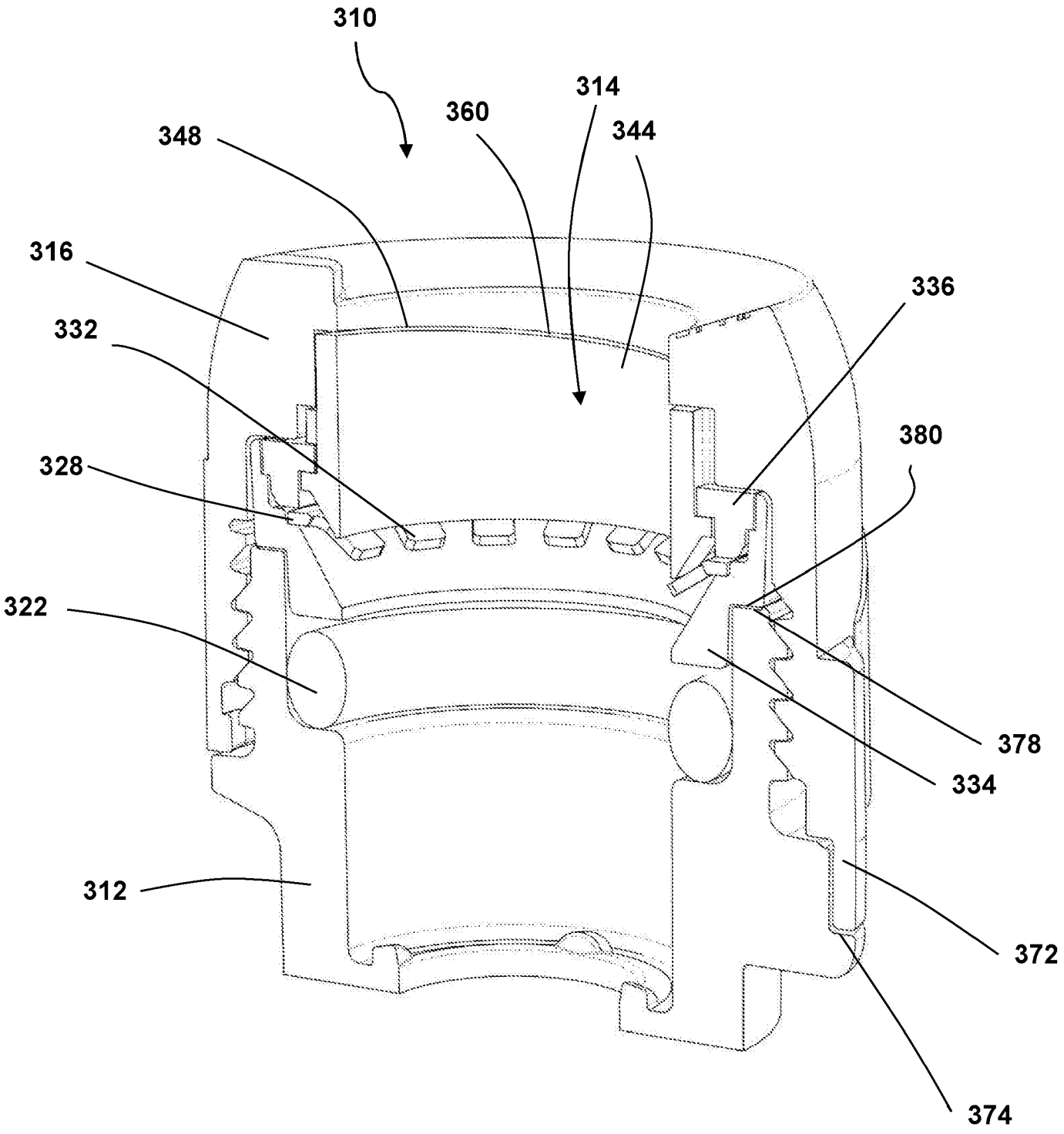
Fig. 16



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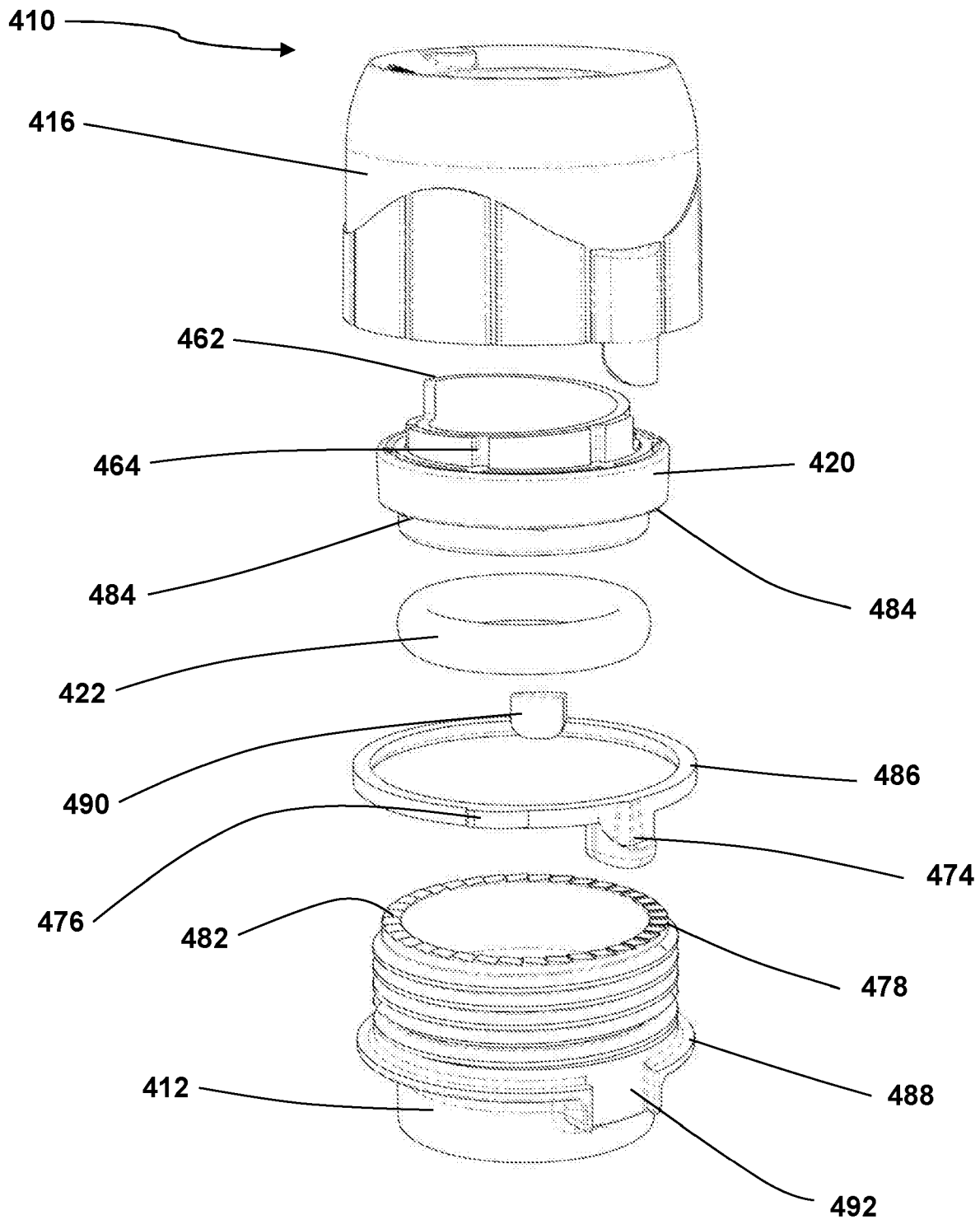
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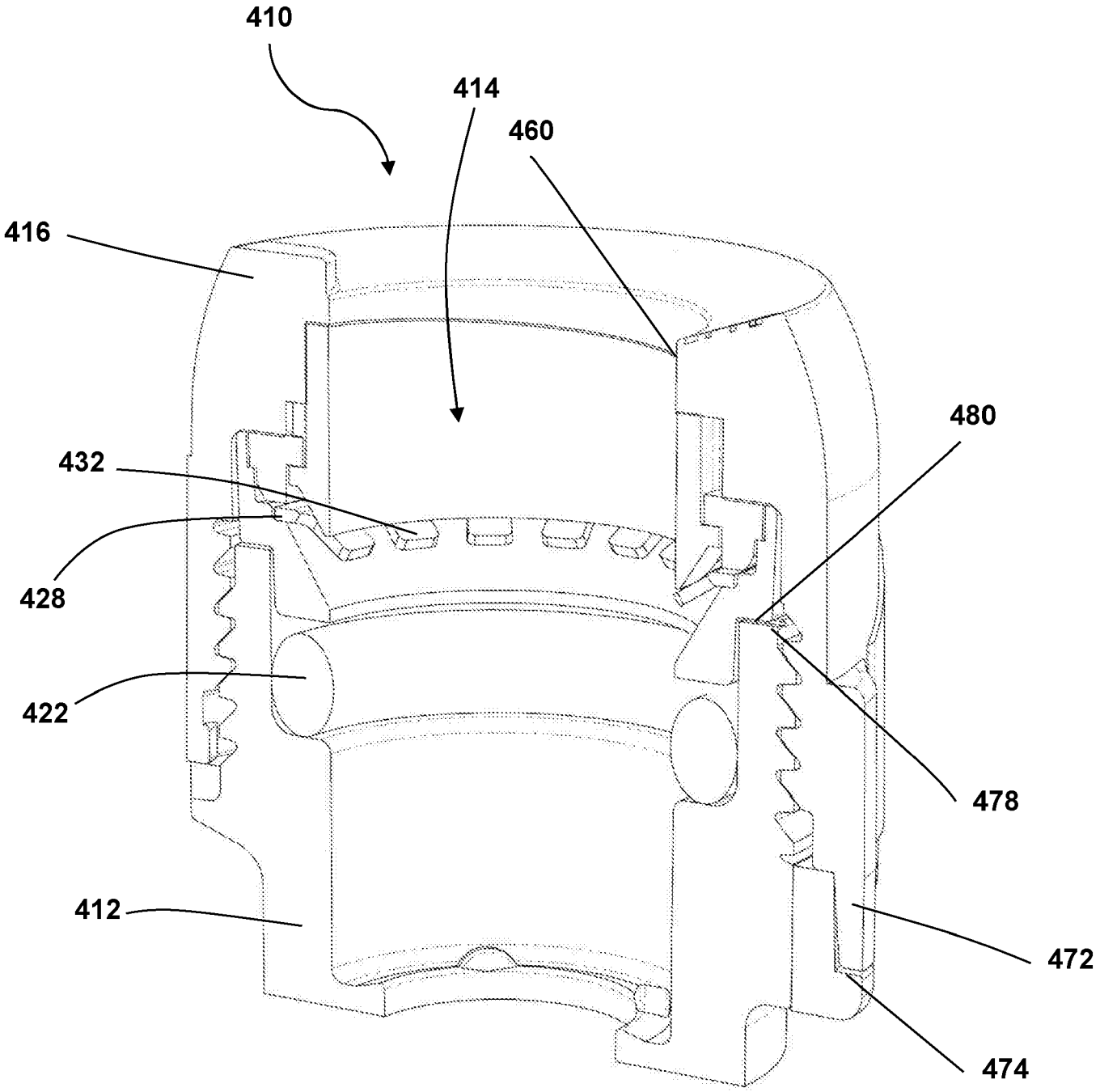
Fig. 18



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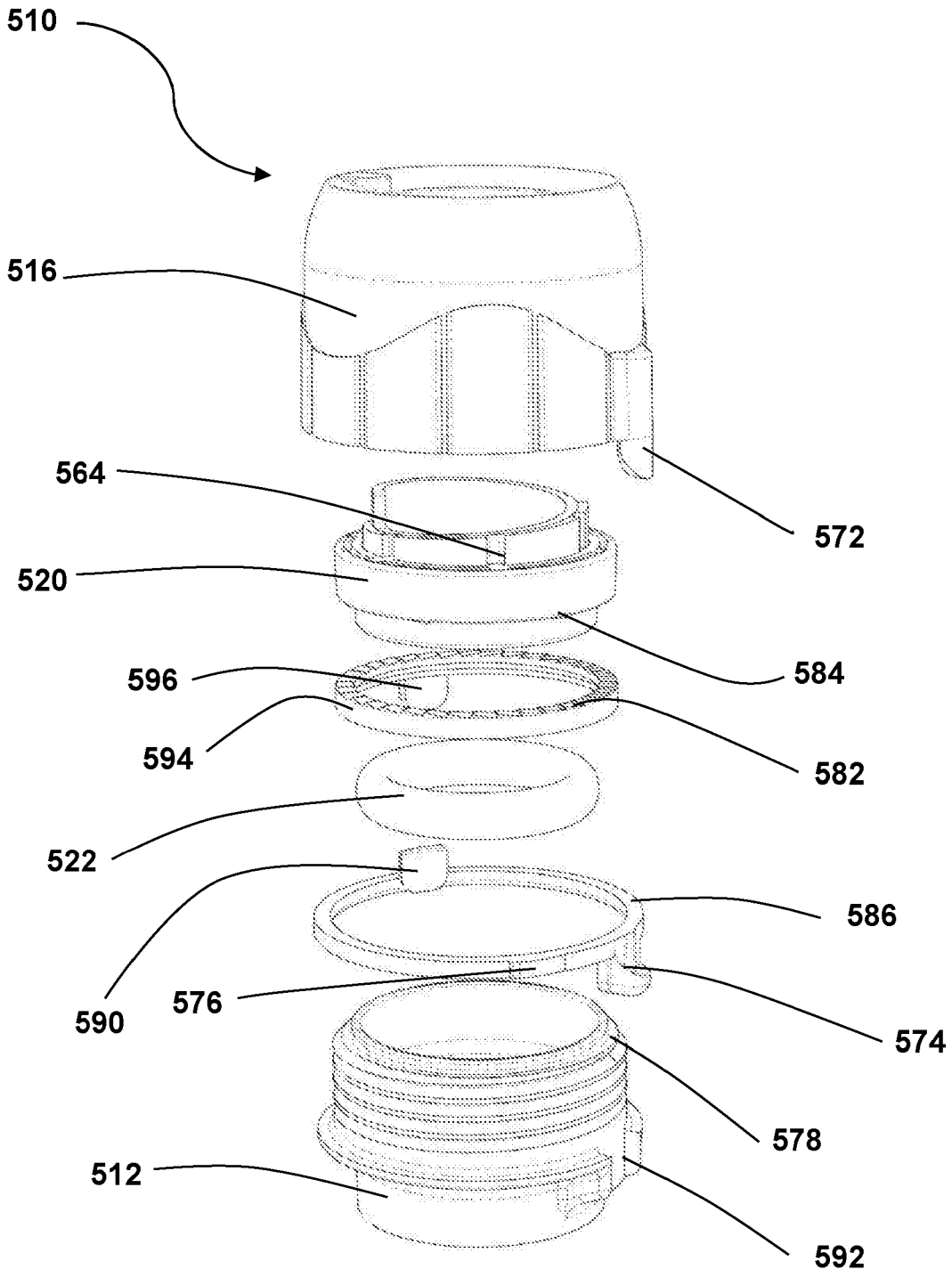
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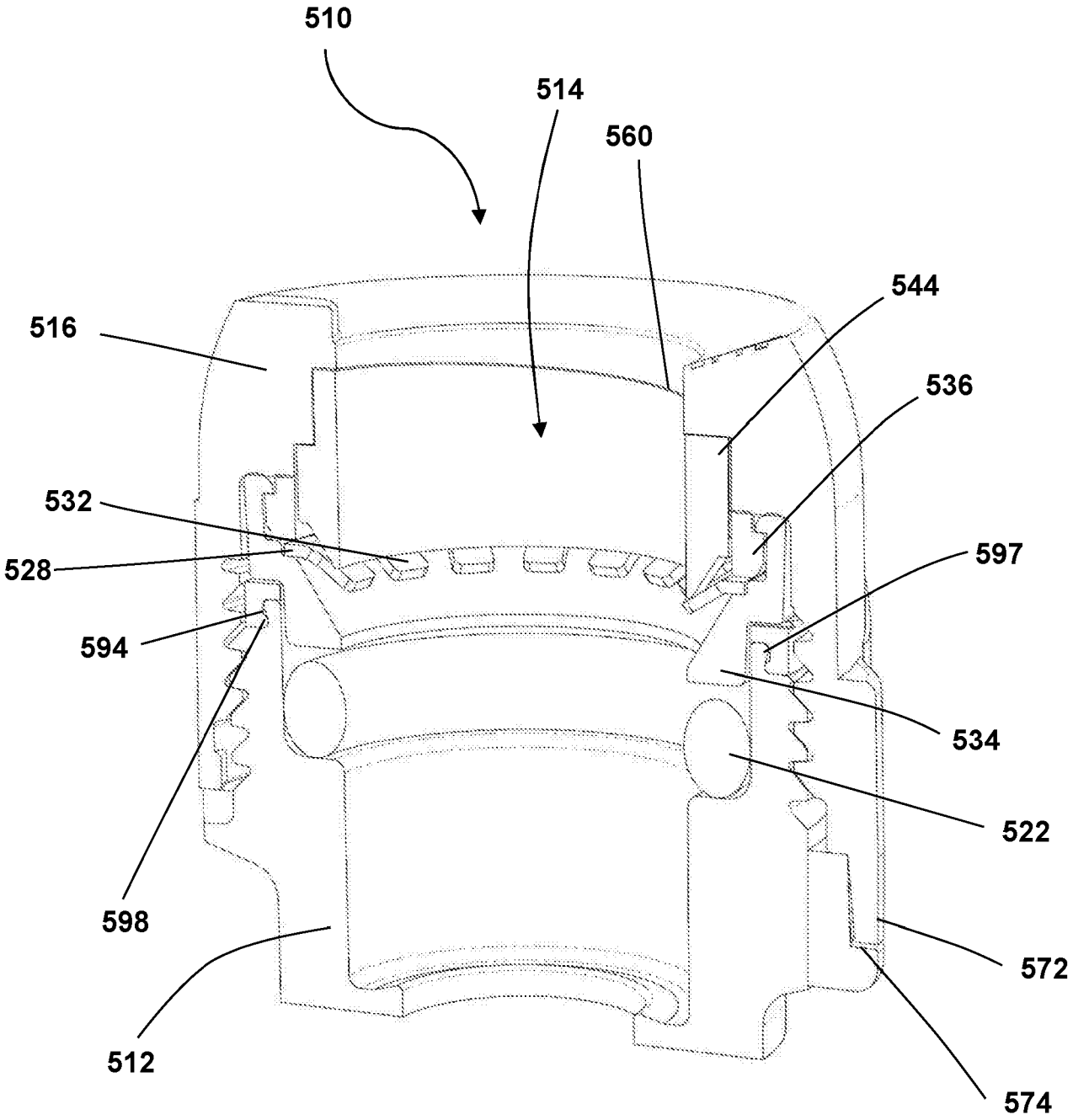
Fig. 20



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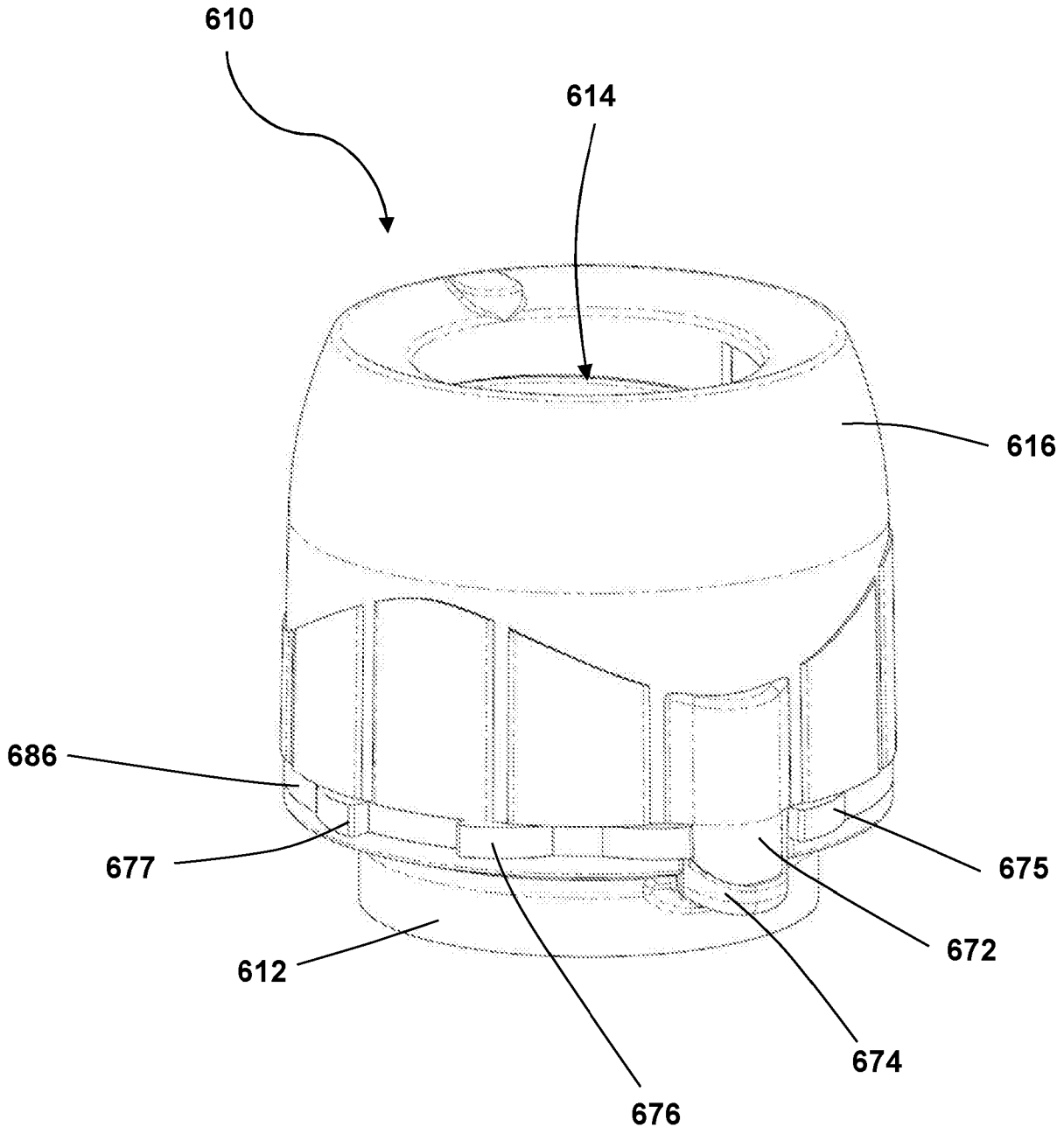

Fig. 22

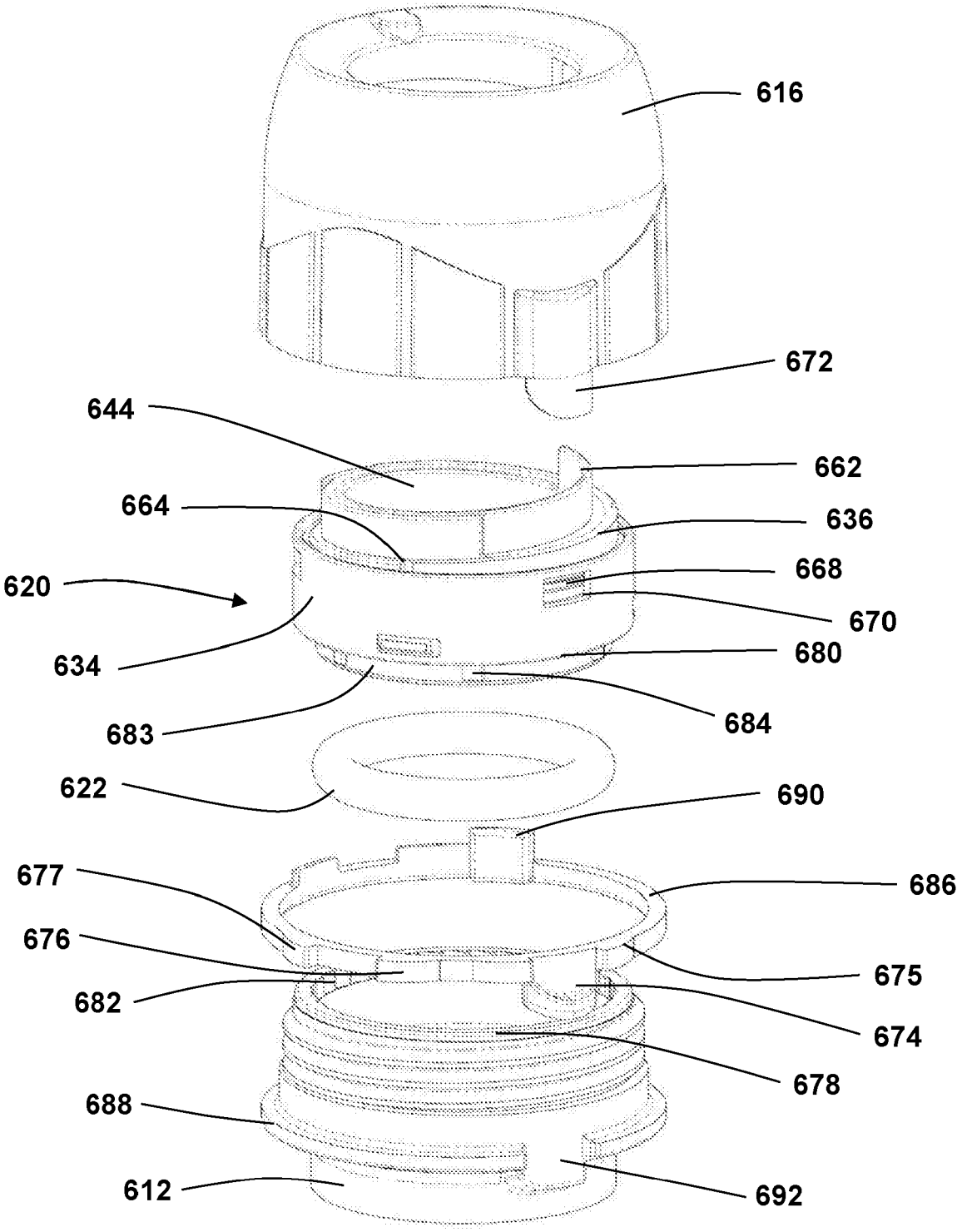
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Fig. 23

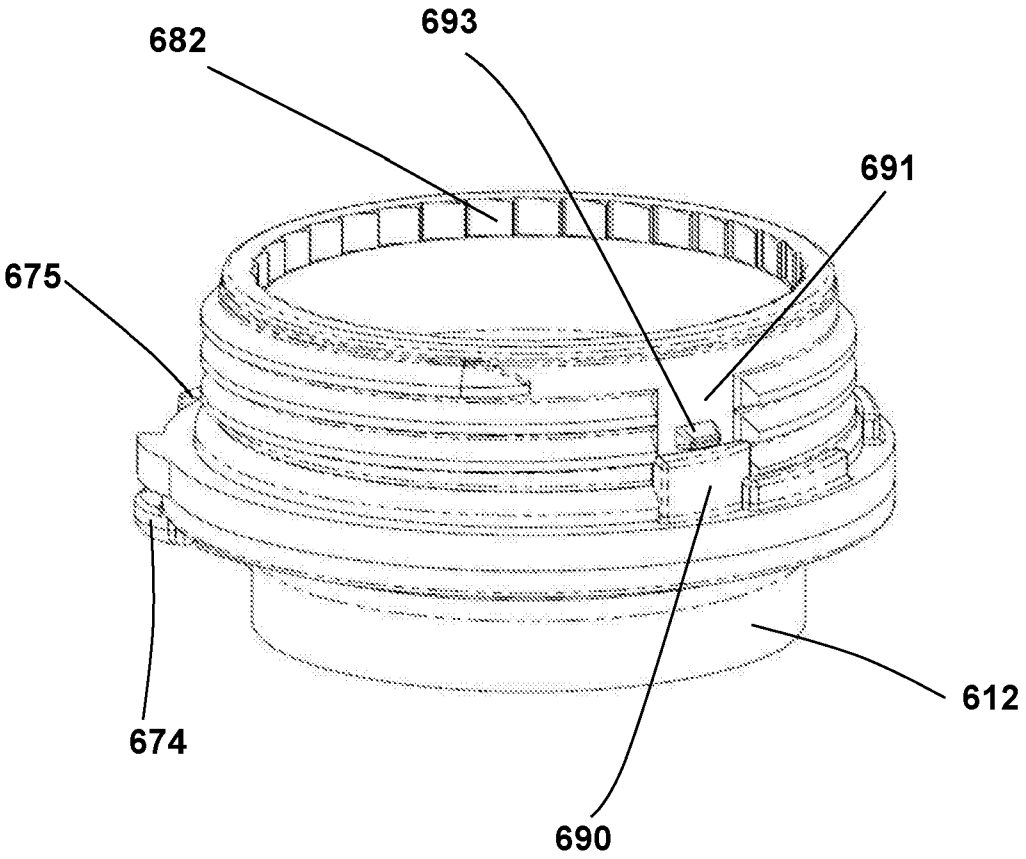

Fig. 24

Plumbing fitting

FIELD OF THE INVENTION

The present invention relates to a plumbing fitting, and to a cartridge for a plumbing fitting.

BACKGROUND OF THE INVENTION

A common type of plumbing fitting takes the form of a body having a socket for receiving the free end of a pipe, e.g. to enable a push joint to be formed between the socket and the pipe. A grab ring is commonly used to aid retention of the pipe within the socket. Such a grab ring usually defines an annular body through which the pipe may pass, and a series of teeth extending inwardly from the body to engage the outer diameter of the pipe.

Typically, a seal will be formed between the socket and the pipe (e.g. via an O-ring arranged within the socket), in order to prevent leakage. If the pipe is not correctly located in the socket (e.g. if the longitudinal axes of the pipe and the socket are not properly co-aligned), the integrity of the seal may be compromised and leakage can occur. However, the use of a grab ring can advantageously aid correct alignment of the pipe within the socket, reducing the likelihood of leakage due to misalignment.

However, there are problems with conventional grab rings, not least as they are often thin and flimsy, and can be easily damaged during fitting of a pipe to the pipe socket. Once damaged, the ability of a grab ring to provide a desired pipe retention may be compromised. Moreover, it can be difficult to ensure that such a grab ring is correctly installed within the socket of a pipe fitting. If the grab ring is incorrectly installed (e.g. misaligned with the longitudinal axis of the socket), the grab ring may block a pipe from correctly entering the socket, or may result in misalignment of the pipe, resulting in inadequate sealing of the pipe within the socket.

A further problem is that the engagement of the grab ring teeth with the pipe can lead to damage to the outer diameter of the pipe. For example, the teeth may score the pipe. This is a particular problem during adjustment of the pipe within the socket, or if an attempt is made to remove the pipe within the socket. Such scoring can compromise the ability of the pipe to create a seal within the socket (e.g. via cooperation of the scored pipe with an O-ring arranged in the socket). Moreover, the teeth of the grab ring can themselves become damaged, so that the grab ring must be replaced, and cannot be re-used.

The present invention seeks to overcome, or at least mitigate, one or more problems of the prior art.

SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided a plumbing fitting comprising: a pipe socket for receiving the free end of a pipe; and a grab ring associated with the socket; the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body, for engagement with a pipe received by the annular body; wherein the grab ring forms part of a sub-assembly for the fitting.

Conventional grab rings tend to be of thin and flimsy construction. Providing the grab ring as part of a sub-assembly for the fitting (i.e. assembled remotely of the fitting and later installed in the fitting as a sub-assembly) makes the grab ring less susceptible to damage through mishandling during installation, as well as easier to locate with respect to the socket.

In exemplary embodiments, the grab ring is carried and retained on the sub-assembly and is rotatable therein.

Advantageously, this overcomes the problem that conventional grab rings are easily dropped and lost during installation operations. Retaining the grab ring on the sub-assembly makes this less likely.

In exemplary embodiments, the grab ring is rotatable within the sub-assembly.

The grab ring being rotatable within the sub-assembly allows the grab ring to move with a pipe as it is manually inserted (since manual insertion will often include a twisting action), preventing damage being caused to the pipe by the grab ring teeth.

In exemplary embodiments, the grab ring is encased within the sub-assembly, with the teeth extending beyond an internal diameter of the housing.

The grab ring being encased by the sub-assembly makes it more robust, so that it is less likely to be damaged on installation. Tampering with the grab ring is also inhibited.

In exemplary embodiments, the sub-assembly is configured to ensure that the grab ring is co-axial with the longitudinal axis of the pipe socket.

The grab ring being co-axial with the pipe socket improves the alignment of a pipe inserted into the pipe socket, and received within the body of the grab ring. The integrity of the seal between the pipe and the socket is therefore not compromised.

In exemplary embodiments, the sub-assembly is a cartridge comprising a housing and the grab ring, wherein the grab ring is supported within the housing.

The housing assists alignment of the grab ring on installation, aiding proper fitting of a pipe with the socket - i.e. so that the pipe is centralised with respect to the socket and integrity of a seal between the pipe and the socket is not compromised.

In exemplary embodiments, the housing is mounted within a bore of the socket. In alternative embodiments, the housing is mounted at the open end of the socket, e.g. abutting an axial end face of the socket (and may or may not extend into the bore of the socket, in such alternative embodiments).

In exemplary embodiments, the housing comprises concentric first and second housing parts, and wherein the grab ring is supported between the first and second housing parts.

In exemplary embodiments, the first housing part comprises a circumferential lip configured to retain the second housing part.

In exemplary embodiments, the second housing part comprises an axial projection configured to bias the grab ring teeth in an axial direction, in the direction of insertion of the pipe, and/or for resisting inversion of the teeth under axial load.

In exemplary embodiments, the first housing part defines a stop, for limiting the degree of deflection that the teeth of the grab ring can undergo during insertion of a pipe into the socket.

In exemplary embodiments, the fitting comprises a body defining the socket, and the fitting comprises a cap removably attached to the body.

In exemplary embodiments, the sub-assembly is removable from the socket.

Advantageously, this configuration means that the sub-assembly can be replaced quickly and easily.

In exemplary embodiments, the sub-assembly is supported within the body, and the sub-assembly is retained by the cap.

In exemplary embodiments, there is a threaded attachment between the cap and the body.

The cap can easily be detached from the body to allow the grab ring sub-assembly to be installed with and/or removed from the fitting.

In exemplary embodiments, the fitting further includes a seal element configured to form a seal between the pipe and the socket, and the cartridge is held between the O-ring and the cap.

According to another aspect of the invention, there is provided a plumbing fitting comprising: a pipe socket for receiving the free end of a pipe; and a grab ring associated with the socket; the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body, for engagement with a pipe received by the annular body; wherein the grab ring forms part of a sub-assembly for the fitting; and wherein the sub-assembly is a cartridge comprising a housing and the grab ring supported within the housing; optionally, wherein the grab ring is carried and retained on the sub-assembly and is rotatable therein; optionally, wherein the fitting includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe; optionally, wherein the mechanism comprises a release member movable between a first position and a second position, in order to move the grab ring from the active state to the passive state; optionally, wherein the release member forms part of the cartridge; optionally, wherein the fitting comprises a body and a cap rotatably mounted on the body and the sub-assembly is supported within the body and retained by the cap.

According to another aspect of the invention, there is provided a cartridge for a plumbing fitting of the kind comprising a pipe socket for receiving the free end of a pipe, the cartridge comprising: a housing; and a grab ring supported within the housing, preferably rotatably; wherein the grab ring comprises an annular body configured to receive a pipe, and a series of teeth extending from the annular body in a direction beyond an inner diameter of the housing; wherein the housing is configured to be associated with a pipe socket as a sub-assembly, with the grab ring body arranged to be coaxial with the socket, for receiving a pipe.

In exemplary embodiments, the grab ring is rotatably supported within the housing.

In exemplary embodiments, the housing comprises concentric first and second housing parts, and the grab ring is supported between the first and second housing parts.

In exemplary embodiments, the first housing part comprises a circumferential lip configured to retain the second housing part.

In exemplary embodiments, the second housing part comprises an axial projection configured to bias the grab ring teeth in an axial direction, in the intended direction of insertion of a pipe.

In exemplary embodiments, the housing is configured to be mounted within a bore of the socket. In alternative embodiments, the housing is configured to be mounted at the open end of the socket, e.g. abutting an axial end face of the socket (and may or may not extend into the bore of the socket, in such alternative embodiments).

According to a further aspect of the invention, there is provided a plumbing fitting comprising: a pipe socket for receiving the free end of a pipe; and a grab ring associated with the socket, the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body for engagement with a pipe received by the annular body; wherein the fitting includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe.

A pipe received within the socket can be removed more easily when the grab ring is in a passive state and the teeth are thus disengaged. Therefore, the risk of damage to the pipe from the grab ring teeth is reduced.

In exemplary embodiments, the mechanism comprises a release member movable between a first position and a second position, in order to switch the grab ring from the active state to the passive state.

Configuring the fitting with said first and second positions for the release member in effect provides defined start/stop positions for switching of the grab ring from the active state to the passive state. This ensures a degree of controlled operation of the grab-ring, which reduces the risk of over-stressing of the grab ring during a 'release' operation.

In exemplary embodiments, the release member is arranged to be moved in an axial direction with respect to the pipe socket in order to move from the first position to the second position.

Biasing the grab ring teeth in this direction allows the pipe to be inserted in the socket more easily, and with less likelihood of damage to the outer diameter of the pipe.

In exemplary embodiments, the release member is moved axially inward with respect to the pipe socket in order to move from the first position to the second position.

In exemplary embodiments, the grab ring forms part of a sub-assembly associated with the socket.

Providing the grab ring as part of a sub-assembly for the fitting (i.e. assembled remotely of the fitting and later installed in the fitting as a sub-assembly) makes the grab ring less susceptible to damage through mishandling during installation, as well as easier to locate with respect to the socket.

In exemplary embodiments, the housing is configured to be mounted within a bore of the socket. In alternative embodiments, the housing is configured to be mounted at the open end of the socket, e.g. abutting an axial end face of the socket (and may or may not extend into the bore of the socket, in such alternative embodiments).

In exemplary embodiments, the sub-assembly is a cartridge comprising a housing and the grab ring, wherein the grab ring is supported within the housing.

In exemplary embodiments, the housing is fixed against rotation relative to the pipe socket.

In exemplary embodiments, the fitting comprises a locking arrangement for preventing rotation of the cartridge housing relative to the pipe socket.

This arrangement secures the cartridge within the housing which helps to reduce the risk of undesired movement of the grab ring between the active and passive states.

In exemplary embodiments, the locking arrangement comprises a first locking formation on the socket and a second locking formation on the cartridge, where the first and second locking formations are configured to inter-engage for preventing rotation of the cartridge relative to the pipe socket.

In exemplary embodiments, the first locking formation, e.g. serrations, is provided on a radially inner surface of the socket, and the second locking formation, e.g. at least one protrusion, is provided on a radially outer surface of the cartridge.

In exemplary embodiments, the grab ring is rotatably supported on the housing (i.e. the grab ring is rotatable within the housing).

In this way, the grab ring will rotate with the pipe, reducing the likelihood of damage being caused on insertion, as described above.

In exemplary embodiments, the release member forms part of the cartridge.

In exemplary embodiments, the release member is annular.

In exemplary embodiments, the release member comprises a trailing end arranged to receive an operating input (e.g. from an auxiliary tool) to move the release member from the first position to the second position.

In exemplary embodiments, the release member comprises a leading end configured to act on the teeth to move the grab ring from the active state to the passive state.

In exemplary embodiments, the fitting further comprises a cam arrangement in association with the release member, said cam arrangement being configured to move the release member from the first position to the second position.

The provision of a cam arrangement for activating/deactivating the release member provides controlled movement of the grab ring between the active and passive states.

In exemplary embodiments, the cam arrangement includes a cam surface on said release member, and a driver configured to act on the cam surface, in order to move the release member from the first position to the second position.

In exemplary embodiments, wherein the driver is arranged for rotation with respect to a longitudinal axis of the release member or the socket, the fitting is configured so that rotation of the driver in a first direction causes movement of the release member in a direction from said first position to said second position.

In exemplary embodiments, the cam surface defines at least one ramp and at least one driver.

In exemplary embodiments, the cam surface at the trailing end defines at least two ramps and a corresponding plurality of drivers.

In exemplary embodiments, the cam surface at the trailing end defines a circumferentially spaced array of ramps.

A plurality of ramps provides better control of the grab ring release action, and use of a circumferentially spaced array of ramps allows pressure to be applied equally around the circumference of the release member, so that pressure is applied equally to the grab ring.

In exemplary embodiments, the release member is fixed against rotation relative to the pipe socket.

In exemplary embodiments, the fitting comprises a body, and a cap rotatably mounted on the body, and the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body.

In exemplary embodiments, the or each driver is provided on the cap.

In exemplary embodiments, the cap is rotatably mounted on the body, and the fitting is configured such that rotating the cap in relation to the body so as to unscrew the cap results in operation of the grab ring from the active state to the passive state.

In exemplary embodiments, the fitting comprises a body, and a cap rotatably mounted on the body.

In exemplary embodiments, the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body.

In exemplary embodiments, the cap is rotatably mounted on the body, wherein rotation of the cap in a first direction serves to loosen engagement between the cap and the body, and rotation in the opposite direction serves to tighten engagement between the cap and the body; and further wherein the grab ring is operable to switch from the active state to the passive state, upon rotation in said first direction.

In exemplary embodiments, the mechanism comprises a release member movable between a first position and a second position, in order to switch the grab ring from the active state to the passive state, and wherein the release member is movable in response to relative rotation between the cap and the body.

In exemplary embodiments, the release member is movable in response to rotation of the cap relative to the body in a first direction.

In exemplary embodiments, the fitting is configured such that rotation in said first direction results in a release movement between the cap and the body.

In exemplary embodiments, the fitting comprises a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state.

The position indicator enables a user to determine the position of the cap relative to the body, and so determine whether the grab ring is in the active state or the passive state, from visual inspection.

In exemplary embodiments, the position indicator arrangement is provided in the form of indicator features on the cap and body, and the indicator features are arranged such that their relative positions indicate whether the grab ring is in the active state or the passive state.

In exemplary embodiments, the position indicator arrangement comprises a formation, e.g. a tab, on the cap and a first indicator feature on the body, and the cap formation and the first indicator feature are arranged to interact, e.g. engage, when the grab ring is in the active state.

This interaction of the cap formation and the first indicator formation has been found to be easily observable by an operator, so as to quickly determine the relative position of the cap with respect to the body. In this arrangement, an operator is quickly able to observe the interaction between the formations to determine that the grab ring is in the active state.

In exemplary embodiments, the first indicator feature is provided as a recess provided on the body, and wherein the cap formation is arranged to be received in said recess, when the grab ring is in the active state.

In exemplary embodiments, the position indicator arrangement comprises a first pre-indicator feature, e.g. a radial abutment on the body, arranged such that during movement of the grab ring from a passive state to an active state, the cap formation interacts with the first pre-indicator feature before interacting with the first indicator feature for providing an indication of movement towards the active state.

Provision of the first pre-indicator feature works to alert, e.g. provide tactile feedback to, an operator that the grab ring is about to enter the active state.

In exemplary embodiments, the interaction between the first pre-indicator feature and the cap formation is configured for providing a tactile indication and/or a resistance to movement in a direction towards the first indicator feature.

In exemplary embodiments, when the grab ring is in the active state, the interaction between the first pre-indicator feature and the cap formation is configured for providing a resistance to movement towards the passive state for preventing accidental movement of the grab ring from the active state to the passive state.

Provision of the first pre-indicator feature to obstruct movement of the cap formation works to prevent accidental movement of the cap formation away from the first indicator formation so as to retain the cap projection next to the first indicator feature. In this way, the first pre-indicator feature works to prevent accidental rotation of the cap moving the grab ring from the active state to the passive state.

In exemplary embodiments, the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the

passive state, upon relative rotation between cap and the body, the fitting further comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state, wherein the position indicator arrangement comprises a formation, e.g. a tab, on the cap and a first channel on the body, and wherein the cap formation is arranged to be received in said first channel, when the grab ring is in the active state.

Locating the cap formation in a channel aids visual inspection of the location of the cap formation, and so aids visual inspection that the grab ring is in the active state.

In exemplary embodiments, the position indicator arrangement comprises a formation, e.g. a tab, provided on the cap and a second indicator feature on the body, e.g. a radial protrusion on a radially outer surface of the body, and the cap formation and the second indicator feature are arranged to interact, e.g. engage, when the grab ring is in the passive state.

This interaction of the cap formation and the second indicator formation has been found to be easily observable by an operator, so as to quickly determine the relative position of the cap with respect to the body. In this arrangement, an operator is quickly able to observe the interaction between the formations to determine that the grab ring is in the passive state.

In exemplary embodiments, the position indicator arrangement comprises a second pre-indicator feature, e.g. a radial abutment on the body, arranged such that during movement of the grab ring from an active state to a passive state, the cap formation interacts with the second pre-indicator feature before inter-acting with the second indicator feature for providing an indication of movement to a passive state.

Provision of the second pre-indicator feature works to alert, e.g. provide tactile feedback to, an operator that the grab ring is about to enter the passive state.

In exemplary embodiments, the interaction between the second pre-indicator feature and the cap formation is configured for providing a tactile indication and/or a resistance to movement in a direction towards the second indicator feature.

In exemplary embodiments, when the grab ring is in the passive state, the interaction between the second pre-indicator feature and the cap formation is configured for providing a resistance to movement towards the active state for preventing accidental movement of the grab ring from the passive state to the active state.

Provision of the second pre-indicator feature to obstruct movement of the cap formation works to prevent accidental movement of the cap formation away from the second indicator formation so as to retain the cap projection next to the second indicator feature. In this way, the first second pre-indicator feature works to prevent accidental rotation of the cap moving the grab ring from the passive state to the active state.

In exemplary embodiments, the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body, the fitting further comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state, wherein the position indicator arrangement comprises a formation, e.g. a tab, on the cap and a second channel on the body, and wherein the cap formation is arranged to be received in said second channel, when the grab ring is in the passive state.

Locating the cap formation in a channel aids visual inspection of the location of the cap formation, and so aids visual inspection that the grab ring is in the passive state.

In exemplary embodiments, the position indicator arrangement is provided in the form of an indicator ring mounted on the body, optionally wherein the indicator ring is positioned between the cap and the body, optionally wherein the indicator ring is configured to engage the body such that the indicator ring is fixed against rotation relative to the body.

According to yet a further aspect of the invention, there is provided a cartridge for a plumbing fitting of the kind comprising a pipe socket for receiving the free end of a pipe, the cartridge comprising: a housing; and a grab ring supported within the housing, preferably rotatably; wherein the grab ring comprises an annular body configured to receive a pipe, and a series of teeth extending from the annular body in a direction beyond an inner diameter of the housing; and wherein the housing is configured to associated with a pipe socket as a sub-assembly, with the grab ring body arranged to be coaxial with the socket, for receiving a pipe; further wherein the cartridge includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe.

In exemplary embodiments, the mechanism comprises a release member movable between a first position and a second position, wherein movement of the release member from the first position to the second position causes the grab ring to switch from the active state to the passive state.

In exemplary embodiments, the release member is arranged to be moved between the first and second positions in an axial direction.

In exemplary embodiments, the release member is annular.

In exemplary embodiments, the release member comprises a trailing end arranged to receive an operating input (e.g. from an auxiliary tool) to move the release member from the first position to the second position.

In exemplary embodiments, the release member comprises a leading end configured to act on the teeth to move the grab ring from the active state to the passive state.

In exemplary embodiments, the cartridge includes a cam surface on said trailing end of the release member, for cooperation with a driver remote from the cartridge, in order to move the release member from the first position to the second position.

In exemplary embodiments, the cam surface defines at least one ramp.

In exemplary embodiments, the cam surface at the trailing end defines at least two ramps.

In exemplary embodiments, the cam surface at the trailing end defines a circumferentially spaced array of ramps.

In exemplary embodiments, release member is fixed against rotation relative to the housing of the cartridge.

According to a yet further aspect of the invention, there is provided a method of pipe handling, comprising the steps of: providing a pipe fitting of the kind comprising a pipe socket for receiving the free end of a pipe; and a grab ring associated with the socket, the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body for engagement with a pipe received by the annular body; wherein the fitting includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe; providing a pipe having a free end configured to be received within the pipe socket: inserting the free end of the pipe into the pipe socket, whereby the free end of the pipe passes through the annular body of the grab ring, such that the teeth of the grab ring engage the outer diameter of the pipe; using said mechanism to move the grab ring from the active state to the passive state, such that the teeth are disengaged from the outer diameter of said pipe; and; removing the pipe from the pipe socket.

Advantageously, the pipe can be removed and replaced, without substantial or undue damage to the pipe or the grab ring.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an exploded view of a plumbing fitting according to a first embodiment of the invention;

Figure 2 is a cross-sectional view through the fitting of Figure 1;

Figure 3 is an exploded view of a cartridge of the fitting of Figures 1 and 2;

Figure 4 is a cross-sectional view through the cartridge of Figure 3;

Figure 5 is a perspective view of the cartridge of Figures 3 and 4;

Figure 6 is an exploded view of a plumbing fitting according to a second embodiment of the invention;

Figure 7 is a cross-sectional view through the fitting of Figure 6;

Figure 8 is an exploded view of a cartridge of the fitting of Figures 6 and 7;

Figure 9 is a cross-sectional view through the cartridge of Figure 8;

Figure 10 is a perspective view of the cartridge of Figures 8 and 9;

Figure 11 is an exploded view of a plumbing fitting according to a third embodiment of the invention;

Figure 12 is a cross-sectional view through the fitting of Figure 11;

Figure 13 is an exploded view of a cartridge of the fitting of Figures 11 and 12;

Figure 14 is a cross-sectional view through the cartridge of Figure 13;

Figure 15 is a perspective view of the cartridge of Figures 13 and 14;

Figure 16 is an exploded view of a plumbing fitting according to a fourth embodiment of the invention;

Figure 17 is a cross-sectional view through the fitting of Figure 16;

Figure 18 is an exploded view of a plumbing fitting according to a fifth embodiment of the invention;

Figure 19 is a cross-sectional view through the fitting of Figure 18;

Figure 20 is an exploded view of a plumbing fitting according to a sixth embodiment of the invention;

Figure 21 is a cross-sectional view through the fitting of Figure 20;

Figure 22 is a perspective view of a plumbing fitting according to a seventh embodiment of the invention;

Figure 23 is an exploded view of the plumbing fitting of Figure 22; and

Figure 24 is a perspective view of the body of the plumbing fitting of Figure 22.

DETAILED DESCRIPTION OF EMBODIMENT(S)

Figures 1 and 2 show a plumbing fitting generally indicated at 10. The fitting 10 has a body 12 defining a pipe socket 14 for receiving the free end of a pipe (not shown). A cap 16 is attached to the body 12. In this embodiment, the cap 16 is releasably attached to the body 12 by a threaded attachment 18. In alternative embodiments, the cap 16 and the body 12 are connected to one another by some alternative attachment. The body 12 and the cap 16 define a flow path to allow fluid to flow through the socket 14.

A grab ring 28 is provided in association with the socket 14, as is shown more clearly in Figures 3 to 5. The grab ring 28 is enclosed within the fitting 10 by the cap 16, in use.

The grab ring 28 has an annular body 30 and a series of teeth 32 extending radially-inwardly from the body 30. The body 30 of the grab ring 28 is configured to receive a pipe, so that the pipe passes through the annulus defined by the body 30, such that the teeth 32 engage the pipe, for the purpose of aiding retention and alignment of the pipe within the socket 14.

In the illustrated embodiments, the grab ring 28 forms part of a sub-assembly or cartridge 20, i.e. as part of an assembly that is assembled remotely of the socket, and then provided as a pre-assembled sub-assembly for the fitting 10. Locating the grab ring 28 in a cartridge 20 makes the grab ring 28 less susceptible to damage through mishandling, as well as easier to locate within the socket 14.

The cartridge 20 has a housing 34, 36, which supports the grab ring 28.

Advantageously, the grab ring 28 is rotatable within the housing, in exemplary embodiments, so as to be rotatable with respect to the socket 14. This means that the

grab ring 28 is free to rotate with a pipe, when the teeth 32 are engaged with a pipe, in use. Thereby, the likelihood of damage being caused to the pipe by the teeth 32 is reduced, e.g. as the pipe is manually inserted into or adjusted within the socket 14 (since manual insertion or adjustment may include a degree of twist or rotation of the pipe relative to the pipe socket).

The body 30 of the grab ring 28 is substantially encased within the housing 34, 36 of the cartridge 20, although the teeth 32 extend radially-inwardly, beyond the internal diameter of the housing 34, 36, so that the teeth 32 are able to engage the pipe.

The housing 34, 36 is configured to allow for optimal orientation of the grab ring 28, so that the grab ring 28 is aligned within the socket 14 to be coaxial with the longitudinal axis A of the socket 14. The housing 34, 36 is annular.

In the illustrated embodiment, an outer wall of the housing is configured to allow the housing 34, 36 to sit coaxially within the bore of the socket 14, e.g. with the outer wall orientated parallel with the bore of the socket, preferably in close proximity to or frictional contact with the bore of the pipe socket.

In alternative embodiments (not illustrated), the housing is configured to be mounted at the open end of the socket, e.g. abutting an axial end face of the socket, rather than being located within the bore of the socket. However, in such alternative embodiments, the housing may still be configured so that one end or part of the housing extends axially into the bore of the socket. Similarly, alternative embodiments of housing may be provided, wherein the grab ring (mounted within the housing) is wholly or substantially located within the bore of the socket, in use, but wherein one end or part of the housing extends axially out of the bore of the socket.

The housing 34, 36 is formed from concentric first and second housing parts 34, 36. As can be seen clearly from Figure 4, the first housing part 34 has a circumferential lip 38 configured to clip and retain the second housing part 36 thereon, with the grab ring 28 supported for rotation between the housing parts 34, 36.

The second housing part 36 has an axial projection 40 configured to bias the grab ring teeth 32 in an axial direction, more specifically in the direction of insertion of a pipe. Biasing the teeth 32 in this direction allows the pipe to be inserted in the socket 14 more easily, and with less likelihood of damage to the outer diameter of the pipe. Biasing the teeth 32 also improves engagement of the teeth 32 with the pipe. The axial projection 40 also serves to support the teeth 32 in the opposite direction, helping them to resist

inversion under axial load. In this embodiment, the axial projection 40 has an angled face 42 that acts on the teeth 32.

The axial projection 40 is, in this embodiment, annular. In an alternative embodiment, the axial projection may extend only part-way around the second housing part 36, and/or may be defined by a series of castellations, or another suitable alternative configuration.

The first housing part 34 defines a stop in the form of an annular ramp on an internal face thereof, which serves to limit the degree of deflection that the teeth 32 of the grab ring 28 can undergo, to prevent undue deformation of the grab ring 28 during insertion of a pipe into the socket.

Referring back to Figures 1 and 2, the fitting 10 further includes an annular seal element, in the form of an O-ring 22 configured to form a seal between the pipe and the socket 14. The cartridge 20 and the O-ring 22 are held in place within the fitting 10 by the cap 16. The body 12 defines a stop, in the form of an internal shoulder 24, against which the O-ring 22 abuts, as shown in Figure 2. The cap 16 also defines a stop, in the form an internal shoulder 26. The cartridge 20 is located between the O-ring 22 and the cap shoulder 26, whereby a degree of rotation of the cartridge 20 may be possible, but wherein the cartridge is prevented from significant axial movement relative to the body 12. The cartridge 20 and/or the O-ring 22 can be easily replaced by unscrewing the cap 16 from the body 12.

In this embodiment, the body 12 and the cap 16 are of plastics material. The grab ring 28 is of suitably pliable metal or plastics material. The housing parts 34, 36 of the cartridge 20 are of suitable plastics material. However, in other embodiments, the cartridge may be of other suitable materials, such as metal, or of a composite metal/plastics construction.

Figures 6 to 10 show a further embodiment of the fitting, wherein features substantially the same as those of the previous embodiment are given corresponding reference numbers with the additional prefix "1".

The fitting 110 of this embodiment is similar to that of the previous embodiment. As with the previous embodiment, the grab ring 128 is rotatable within the cartridge 120. However, the grab ring 128 is operable between an active state, where the teeth 132 are intended to engage an outer diameter of the pipe, and a passive state, where the teeth 132 are intended to be disengaged from the pipe. The passive state of the grab ring 128, when the teeth 132 are disengaged from the pipe, allows the pipe to be adjusted or removed from the socket 114 with a reduced the risk of damage being done to the outer diameter of the pipe. The teeth 132 are resilient and are configured to return to the active state in

the absence of an outside force, whereas movement of the teeth 132 from an active to a passive will be described below.

As will be described in more detail below, the fitting 110 includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from the active state to the passive state.

The cartridge 120 includes a release member 144 (which is annular in this embodiment) arranged to operate the grab ring 128 between the active and passive states. The release member 144 is movable between a first position and a second position. When the release member 144 is in the first position, e.g. as shown in Figures 9 and 10, the grab ring 128 is in the active state. When the release member 144 is in the second position (not shown), the grab ring 128 is in the passive state. In this embodiment, movement of the release member 144 between the first and second positions is in an axial direction, as indicated at X in Figure 9. To that end, the release member 144 is moved axially inwardly with respect to the pipe socket 14, in order to move from the first position to the second position (e.g. as indicated by arrow Y in Figure 7). As such, the release member 144 serves as a piston.

The release member 144 is held between the first and second housing parts 134, 136. The second housing part 136 defines a circumferential shoulder 146 configured to retain the release member 144 in an axial direction. The release member 144 has a circumferential lip 147 at its outer diameter, which is configured to interact with the shoulder 146. The shoulder 146 retains the release member 144 on the cartridge 120. However, it will be understood that the release member 144 is movable away from the second housing part 136 in an axially inward direction Y, so as to be movable from the first position to the second position.

The release member 144 has a trailing end 148 arranged to receive input from an actuator (not shown), e.g. in order to move the release member 144 from the first position to the second position. In exemplary embodiments, the actuator may take the form of an operating tool (not shown), separate from the fitting 110, and configured to apply a force to the trailing end 148 of the release member 144. Such force may be applied by a user, via the operating tool, causing the release member 144 to move to the second position, and the grab ring 128 to be operated to the passive state. On removal of the operating tool and/or force by the user, the resilient bias of the teeth 132 causes the grab ring 128 to be returned to the active state, and the release member 144 to return to the first position.

In this embodiment, the release member 144 has a leading end 150 that is configured to act on the teeth 132 directly, to move them from the active state to the passive state. In other embodiments, one or more additional or intermediate components may be provided to act on the teeth, in response to movement of the release member 144.

As can be seen clearly from Figure 8, the leading end 150 defines an angled face 152 on the outer diameter thereof, whereby the release member 144 narrows towards the leading end 150. The angled face 152 is configured to act on the teeth 132, so as to operate the grab ring 128 from the active state to the passive state. In alternative embodiments, the leading end may define some other suitable geometry.

Figures 11 to 15 show a further embodiment of the fitting, wherein features substantially the same as those of the previous embodiments are given corresponding reference numbers with the additional prefix "2".

The fitting 210, shown in Figures 11 and 12, is similar to that of the second embodiment, but wherein the release member 244 is cam-operated, in order to move the grab ring from an active state to a passive state.

As shown clearly in Figure 12, the fitting 210 has a driver 260 that is configured to act on a cam surface at the trailing end 248 of the release member 244. The driver 260 is actuated in order to move the release member from the first position to the second position, so that the grab ring 228 is operated from the active state to the passive state.

The cam surface at the trailing end 248 defines a series of ramps 262.

In this embodiment, the fitting 210 has a series of drivers 260 arranged in a ring, and each defining a ramp 262 configured to cooperate with the ramps 262 of the cam surface at the trailing end 248, in order to bring about movement of the release member 244.

The drivers 260 are rotatable in relation to the release member 244, about the longitudinal axis A. On rotation, the drivers 260 act on the trailing end 248, so that the release member 244 is moved axially inwardly in the direction Y from the first position to the second position. The grab ring 228 is thus operated from the active state to the passive state, as the release mechanism 244 acts on the teeth 232.

In this embodiment, the release member 244 is fixed against rotation in relation to the socket 214. Moreover, the housing is fixed against rotation in relation to the body 212. However, the grab ring 228 is free to rotate within the cartridge 220, so that the grab ring 228 will rotate with the pipe, reducing the likelihood of damage being caused on insertion, as described above.

As shown in Figures 13, 14, and 15, the release member 244 defines a series of notches 264 about its circumference. The notches 264 correspond to radially inward projections 266 on the inner diameter of the second housing part 236. The interlocking of the notches 264 with the projections 266 prevents the release member 244 from rotating with respect to the second housing part 236. A further system of projections 268 extending radially outwardly from the second housing part 236 (and corresponding notches 270 in the inner diameter of the first housing part 234) prevents the second housing part 236 rotating within the first housing part 234. The release member 244 is thus rotatably fixed with respect to the first housing part 234.

Referring once again to Figures 11 and 12, the drivers 260 are in this embodiment formed on the cap 216. Advantageously, the cap 216 is configured so that rotation of the cap 216 in a direction intended to unscrew the cap 216 results in operation of the grab ring 228 to the passive state. That is, as the cap 216 is unscrewed relative to the body 212 of the fitting 210, the grab ring 228 is operated to release the pipe without the need for a further step. In alternative arrangements, it will be appreciated that the driver 260 may be provided on the body 212 and that the ramp may be provided on the cap 216.

In a further embodiment (not shown), similar to the third embodiment described above, a specific number of ramps and corresponding drivers, in combination with a predetermined configuration of the ramps, is used to indicate the state of the grab ring to a user. For example, two ramps and two drivers of known angles may be provided. Markings on the outside of the cap and the body may be provided to indicate to a user the relative position of the drivers and the ramps. If each driver is at a start point in relation to the ramp, it is known that the grab ring is in an active state. In order to operate the grab ring to a passive state so that a pipe can be removed, the user starts to unscrew the cap and can see from the markings the movement of each driver in respect to each ramp. When the marking on the cap reaches a stop point marked on the body, the user knows that the driver has reached the end point of the ramp, and that the grab ring is in a passive state. The pipe can then be removed.

The grab ring being operable to a passive state advantageously allows a pipe to be removed from or adjusted within the socket without damage being caused to the pipe, avoiding or inhibiting potential compromise to a seal between the pipe and the socket. In described embodiments, operation of the grab ring can be carried out by using a tool, or merely by unscrewing the cap of the fitting, as would be required in any case for adjustment or replacement of components of the fitting. The grab ring itself remains undamaged during removal of the pipe.

The grab ring being included as part of a cartridge reduces the risk of damage due to mishandling. Such a cartridge can be made in a variety of sizes for use with sockets of varying diameters. Colouring of the materials used can be used to indicate the size of each cartridge. The pipe is better supported on insertion and release due to the cartridge carrying the grab ring.

Figures 16 and 17 show a further embodiment of the fitting, wherein features substantially the same as those of the previous embodiments are given corresponding reference numbers with the additional prefix "3" and only differences are discussed.

The fitting 310, shown in Figures 16 and 17, is similar to that of the third embodiment, but differs in that the cam surface includes only a single ramp 362; wherein a position indicator is provided on an external surface of the fitting 310; and wherein a locking arrangement is provided between the cartridge and the pipe socket.

As is shown in Figure 16, the fitting 310 includes a position indicator arrangement. The position indicator enables a user to visually determine the position of the cap relative to the body. Put another way, the position indicator is configured such that an operator can visually determine whether the grab ring is in the active state, or the passive state.

The position indicator arrangement is provided in the form of indicator features on the cap 316 and body 312 to indicate the relative rotational position of the cap 316 and body 312 (e.g. so as to determine the relative position of the driver 360 and the ramp 362). In the illustrated arrangement, the position indicator features are provided on an external surface of both the cap 316 and the body 312.

In the illustrated embodiment, the position indicator includes a formation 372 on the cap 316. In the arrangement shown, the cap formation is provided as a projecting tab 372 on the cap 316. The cap formation 372 extends axially from the cap 316 in a direction towards the body 312, when the fitting 310 is assembled. The cap formation 372 also extends radially outward from the cap 372. This configuration of cap formation 372 has been found to be easily observable by an operator, so as to quickly determine the relative position of the cap 316 with respect to the body 312.

The position indicator also includes first and second indicator features 374, 376. The first and second indicator features 374, 376 are arranged such that their relative position with respect to the cap formation 372 indicates whether the grab ring 328 is in the active state or the passive state.

The first and second indicator features 374, 376 are provided on the body. In the arrangement shown, the first and second indicator features 374, 376 are provided on a

radially outer surface of the body 312. In the exemplary illustrated embodiment, the first and second features 374, 376 are integrally moulded with the body 312.

The first indicator feature 374 is provided in the form of axial extension of the body 312. In the arrangement shown, the first indicator feature 374 is provided as an axial extension of an annular collar 388 at the base of the threaded portion of the body 312. The first indicator feature 374 is positioned and arranged such that the cap formation 372 interacts with the first feature 374, when the grab ring 328 is in the active state. When the cap formation 372 reaches and interacts with, e.g. engages, the first indicator feature 374, the interaction between the surfaces will provide the user with tactile feedback that the driver 360 has reached the end point of the ramp 362, and that the grab ring 328 is in an active state. This tactile feedback can be particularly advantageous if, for example, the fitting is concealed from a user as it will indicate to the user that the pipe is locked within the fitting 310.

In the illustrated embodiment, the first indicator feature 374 is provided as a recess provided on the body 312. The cap formation 372 is arranged to be received in said recess 374, when the grab ring 328 is in the active state

In the illustrated embodiment, the adjacent surfaces of the cap formation 372 and the first indicator feature 374 are shaped to conform to each other. This has been found to aid visual inspection of the indicator arrangement to visually determine that the grab ring 328 is in the active state.

The second indicator feature 376 is positioned and arranged such that the cap formation 372 interacts with the second indicator feature 376, when the grab ring 328 is in the passive state. The second indicator feature is provided as a radial protrusion extending from the body 312. In the illustrated embodiment, the second indicator feature 376 extends radially outward from an annular collar 388 at the base of the threaded portion of the body 312.

If the driver 360 is at a start point in relation to the ramp 362, it is known that the grab ring 328 is in an active state. In order to operate the grab ring 328 to a passive state so that a pipe (not shown) can be removed, the user starts to unscrew the cap 312 and, from the relative positions of the cap formation 372 and the first indicator feature 374, can visually determine the position of the driver 360 with respect to the ramp 362.

The second indicator feature 376 is positioned and arranged such that the cap formation 372 interacts with the second feature 376, when the grab ring 328 is in the passive state. When the cap formation 372 reaches and interacts with the second indicator feature 376,

the interaction between the surfaces will provide the user with tactile feedback that the driver 360 has reached the end point of the ramp 362, and that the grab ring 328 is in a passive state. This tactile feedback can be particularly advantageous if, for example, the fitting is concealed from a user as it will indicate to the user that the pipe can be removed.

As is illustrated in Figure 16, the fitting 310 is further provided with a locking arrangement. The locking arrangement is configured for preventing rotation of the cartridge housing 334, 336 relative to the pipe socket 314. In this way, the locking arrangement reduces the risk of accidental movement of the grab ring 328 from the active to the passive state. The locking arrangement is provided in the form of inter-engaging locking formations on the body 312, e.g. the socket 314, and the cartridge 320.

The locking arrangement includes a first locking 382 formation provided on the body 312, e.g. the socket 314, and a second locking formation 384 provided on the cartridge 320. The first and second locking formations 382, 384 may be provided in the form of one or more corresponding protrusions/recesses on the cartridge 320 and body 312.

The fitting body 312 defines a pipe socket 314 for receiving the free end of a pipe (not shown). An axial end face 378 of the body 312 defines the opening of the pipe socket 314. In the illustrated embodiment, the first locking formation is provided in the form of serrations 382 around the axial end face 378 of the body 312. The second locking formation is provided in the form of axial protrusions 384 on an annular shoulder 380 of the cartridge 320, so as to engage the serrations 382.

The axial end face 378 of the body 312 is arranged to interact with the annular shoulder 380 of the cartridge 320, when the fitting 310 is assembled (as is shown in Figure 17). When the fitting 310 is assembled, the complementary first and second locking formations engage in order to prevent relative rotation between the body 312 and the cartridge 320.

As is shown in Figure 17, the fitting 310 has a driver 360 that is configured to act on a cam surface at the trailing end 348 of the release member 344. The driver 360 is actuated in order to move the release member from the first position to the second position, so that the grab ring 328 is operated from the active state to the passive state.

The cam surface at the trailing end 348 defines a single ramp 362. In this embodiment, the fitting 310 has a single driver 360, formed in a ring, which is configured to cooperate with the ramp 362 of the cam surface at the trailing end 348, in order to bring about movement of the release member 344.

Figures 18 and 19 show a further embodiment of the fitting, wherein features substantially the same as those of the embodiment illustrated in Figures 16 and 17 are given

corresponding reference numbers with the additional prefix "4", and only differences are discussed.

As is shown in Figure 18, the fitting 410 includes a position indicator. The position indicator enables a user to visually determine the position of the cap 416 relative to the body 412. Put another way, the position indicator is configured such that an operator can visually determine whether the grab ring is in the active state, or the passive state.

The fitting 410, shown in Figures 18 and 19, is similar to that illustrated in Figures 16 and 17, but differs in that the position indicator includes a separate indicator ring 486 defining the first and second indicator features 474, 476.

The position indicator arrangement is provided in the form of an indicator ring 486 mounted on the body 412. The indicator ring 486 is positioned between the cap 416 and the body 412. The indicator ring 486 is configured to engage the body 412 such that the indicator ring is fixed against rotation relative to the body 412. In the arrangement shown, the indicator ring 486 extends around the socket 414 of the body 412 and is seated on the annular collar 488 of the body 412.

The first indicator feature 474 is provided on the indicator ring 486. The first indicator feature 474 is provided as a radial extension of the ring 486.

The first indicator feature 474 is positioned and arranged such that the cap formation 472 interacts with the first feature 474, when the grab ring 428 is in the active state. In this arrangement shown, the first indicator feature 474 also includes a radially extending portion, which is configured to interact with the cap formation 472, when the grab ring 428 is in the active state.

When the cap formation 472 reaches and interacts with the first indicator feature 474, the interaction between the surfaces will provide the user with tactile feedback that the driver 460 has reached the end point of the ramp 462, and that the grab ring 428 is in an active state. This tactile feedback can be particularly advantageous if, for example, the fitting is concealed from a user as it will indicate to the user that the pipe is locked within the fitting 410.

The second indicator feature 476 is positioned and arranged such that the cap formation 472 interacts with the second feature 476, when the grab ring 428 is in the passive state. In the illustrated arrangement, the second indicator feature 476 is provided as a radial protrusion on an external surface of the indicator ring 486, which is arranged so as to interact with the cap formation 472 when the grab ring 428 is in the passive state.

When the cap formation 472 reaches and interacts with the second indicator feature 476, the interaction between the surfaces will provide the user with tactile feedback that the driver 460 has reached the end point of the ramp 462, and that the grab ring 428 is in an active state. This tactile feedback can be particularly advantageous if, for example, the fitting 410 is concealed from a user as it will indicate to the user that the pipe is able to be removed from the fitting 410.

The indicator ring 486 further includes a third stop 490. The third stop 490 is provided on a radially inner surface of the indicator ring 486. The third stop extends axially in a direction away from the body 412.

The third stop 490 is arranged to engage a first ring locator (not shown) on the body 412 in order to prevent rotation of the indicator ring 486 with respect to the body 412, when the indicator ring 486 is mounted on the body 412.

The first ring locator may be provided in the form of an axially extending channel through the screw thread of the body 412. In order to prevent rotation of the indicator ring 486 with respect to the body 412, the third stop 490 is received in the axially extending channel in the screw thread.

The body 412 is provided with a second ring locator 492 for preventing rotation of the indicator ring 486 with respect to the body 412, when the indicator ring 486 is mounted on the body 412. In the illustrated embodiment, the second ring locator 492 is provided in the form of an axially extending channel 492 on a radially outer surface of the body 412. In order to prevent rotation of the indicator ring 486 with respect to the body 412, the axial projection defining the first indicator feature 474 is received in the axially extending channel 492.

Figures 20 and 21 show a further embodiment of the fitting, wherein features substantially the same as those of the embodiment illustrated in Figures 18 and 19 are given corresponding reference numbers with the additional prefix "5", and only differences are discussed.

The fitting 510 is further provided with a locking arrangement. The locking arrangement is configured for reducing the risk of undesired rotation of the cartridge housing 534, 536 relative to the pipe socket 514. In this way, the locking arrangement is configured for preventing accidental movement of the grab ring 528 from the active to the passive state.

The fitting 510, shown in Figures 20 and 21, is similar to that illustrated in Figures 18 and 19, but differs in that the first locking formation 582 is provided on a separate locking ring 594. That is, the first locking formation 582 is provided on an annular ring that is separate

from the body 512 and is mountable thereon. The locking arrangement also includes a second locking formation provided on the cartridge 520.

The first and second locking formations 582, 584 may be provided in the form of one or more corresponding protrusions/recesses on the cartridge 520 and body 512 (i.e. the locking ring 594).

In the arrangement shown, the first locking formation is provided in the form of serrations 582 on the locking ring 594. The second locking formation is provided on an annular shoulder 580 of the cartridge 520. The second locking formation is provided in the form of axial protrusions 584 on the shoulder 580 for engaging the serrations 582 on the locking ring 594.

In order to prevent rotation of the locking ring 594 relative to the body 512, the ring 594 is provided with a locking tab 596. The locking tab 596 is configured to engage the body 512 so as to prevent rotation of the locking ring 594.

In the illustrated embodiment, the locking tab 596 is provided as an axial extension of the cap 516, extending in a direction towards the body 512 when the fitting 510 is assembled. The locking tab 596 is arranged to engage a first ring locator (not shown) on the body 512 in order to prevent rotation of the locking ring 594 with respect to the body 512. The first ring locator may be provided in the form of an axially extending channel through the screw thread, where in order to prevent rotation of the locking ring 594 with respect to the body 512, the locking tab 596 is received in the axially extending channel in the screw thread. It will be appreciated that in some arrangements, both the third stop 590 and the locking tab 596 may be received in the same axial channel through the screw thread.

An underside surface of the locking ring 594 is arranged to interact with the axial end face 578 of the body 512. The axial end face 578 is provided with a circumferential lip 597 extending therearound. The underside surface of the locking ring 594 defines an undercut region 598. A snap-fit attachment is provided between the undercut region 598 and the circumferential lip 597 of the body 512. That is, the external dimension of the circumferential lip 597 is slightly larger than the internal dimension of the radially inner face of the undercut region 598. This arrangement has been found to prevent axial movement of the locking ring 596 with respect to the body 512.

Figures 22 to 24 show a further embodiment of the fitting, wherein features substantially the same as those of the embodiment illustrated in Figures 18 and 19 are given corresponding reference numbers with the additional prefix "6", and only differences are discussed.

The fitting body 612 defines a pipe socket 614 for receiving the free end of a pipe (not shown). An axial end face 678 of the body 612 defines the opening of the pipe socket 614.

The cam surface defines a single ramp 662. In this embodiment, the fitting 610 has a single driver 660, formed in a ring, which is configured to cooperate with the ramp 662 of the cam surface, in order to bring about movement of the release member 644.

The release member 644 defines a series of notches 664 about its circumference. The notches 664 correspond to radially inward projections (not shown) on the inner diameter of the second housing part 636. Interlocking of the notches 664 with the projections works to prevent the release member 644 from rotating with respect to the second housing part 636.

The second housing part 636 is configured to engage the first housing part 634 to prevent rotation therebetween. The second housing part 636 is provided with a series of projections 668 extending radially outwardly from the second housing part 636. The projections 668 of the second housing part 636 are configured to engage corresponding recesses 670 in the first housing part 634. This arrangement prevents the second housing part 636 rotating within the first housing part 634. In the arrangement shown, the recesses 670 are provided in the form of a series of apertures in the first housing part 634.

Through the engagement between the release member 644 and the second housing part 636 and between the second housing part 636 and the first housing part 634, the release member is rotatably fixed with respect to the first housing part 634. Put another way, through the interlocking of the notches 664 with the projections, and the interlocking of the projections 668 with the recesses 670, the release member 644 is thus rotatably fixed with respect to the first housing part 634.

As is illustrated in Figure 23, the fitting 610 is further provided with a locking arrangement. The locking arrangement is configured for reducing the risk of undesired rotation of the cartridge 620 relative to the pipe socket 614. In this way, the locking arrangement is configured for preventing accidental movement of the grab ring 628 from the active to the passive state.

The locking arrangement is configured such that the cartridge 620 engages the body 612 to prevent rotation therebetween. The locking arrangement includes a first locking 682 formation provided on the body 612, e.g. the socket 614, and a second locking formation 684 provided on the cartridge 620. The first and second locking formations 682, 684 may be provided in the form of one or more corresponding protrusions/recesses on the cartridge 620 and body 612.

In the arrangement shown, the first locking formation 682 is provided on a radially inner surface of the socket 614. The second locking formation 684 is provided on a radially outer surface of the cartridge 620.

In the exemplary illustrated embodiment, the locking arrangement includes serrations 682 provided on a radially inner surface of the socket 614. The locking arrangement also includes complementary formations in the form of protrusions 684 provided on a radially outer portion of the cartridge 620.

In the arrangement shown, a shoulder 680 of the cartridge is arranged to abut an axial end face 678 of the body 612 (the axial end face 678 of the body 612 defining the opening of the pipe socket 614). The cartridge 620 has an annular portion 683 extending from a shoulder 680, and the protrusions 684 of the locking arrangement are provided 680 is arranged to abut the free end on the annular portion 683 so as to engage the serrations 682.

As is shown in Figure 23, the fitting 610 includes a position indicator arrangement. The position indicator enables a user to visually determine the position of the cap relative to the body. Put another way, the position indicator is configured such that an operator can visually determine whether the grab ring is in the active state, or the passive state.

The position indicator includes features on an external surface of both the cap 616 and the body 612, to indicate the relative rotational position of the cap 616 and body 612 (e.g. so as to determine the relative position of the driver 660 and the ramp 662).

The position indicator includes a separate indicator ring 686 defining the first and second indicator features 674, 676. The indicator ring 686 extends around the socket 614 of the body 612 and is seated on the annular collar 688 of the body 612.

The first indicator feature 674 is provided on the indicator ring 686. The first indicator feature 674 is provided as a radial extension of the ring 686. The first indicator feature 674 also includes a radially extending portion, which is configured to interact with the cap formation 672, when the grab ring 628 is in the active state. When the cap formation 672 reaches and interacts with the first indicator feature 674 on the body 612, the interaction between the surfaces will provide the user with tactile feedback that the driver 660 has reached the end point of the ramp 662, and that the grab ring 628 is in an active state. This tactile feedback can be particularly advantageous if, for example, the fitting 610 is concealed from a user as it will indicate to the user that the pipe is locked within the fitting 610.

The position indicator arrangement includes a first pre-indicator feature 675, e.g. a radial abutment on the body 612. The first pre-indicator feature 675 is arranged such that during movement of the grab ring 628 from a passive state to an active state, the cap formation 672 interacts with the first pre-indicator feature 675 for providing an indication of movement to an active state.

The interaction between the first pre-indicator feature 675 and the cap formation 672 is configured for providing a tactile indication and/or a resistance to movement in a direction towards the first indicator feature. Provision of the first pre-indicator feature works to alert, e.g. provide tactile feedback to, an operator that the grab ring is about to enter the active state.

The interaction between the first pre-indicator feature 675 and the cap formation 672 is configured for providing a resistance to movement in a direction away from the first indicator feature 674. Provision of the first pre-indicator feature to obstruct movement of the cap formation works to prevent accidental movement of the cap formation away from the first indicator formation so as to retain the cap projection next to the first indicator feature. In this way, the first pre-indicator feature works to prevent accidental rotation of the cap moving the grab ring from the active state to the passive state.

The position indicator arrangement includes a first channel on the body 612, and the cap formation 672 is arranged to be received in said first channel, when the grab 628 ring is in the active state. Locating the cap formation in a channel aids visual inspection of the location of the cap formation 672, and so aids visual inspection that the grab ring 628 is in the active state.

The second indicator feature 676 is provided as a radial protrusion on a radially outer surface of the indicator ring 686, which is arranged so as to interact with the cap formation 672 when the grab ring 628 is in the passive state.

When the cap formation 672 reaches and interacts with the second indicator feature 676 on the body 612, the interaction will provide the user with tactile feedback that the driver 660 has reached the end point of the ramp 662, and that the grab ring 628 is in a passive state. This tactile feedback can be particularly advantageous if, for example, the fitting 610 is concealed from a user as it will indicate to the user that the pipe is able to be remove from the fitting 610.

The position indicator arrangement includes a second pre-indicator feature 677, e.g. a radial abutment on the body 612. The second pre-indicator feature 677 is arranged such that during movement of the grab ring 628 from an active to a passive, the cap formation

672 interacts with the second pre-indicator feature 677 for providing an indication of movement to a passive state.

The interaction between the second pre-indicator feature 677 and the cap formation 672 is configured for providing a tactile indication and/or a resistance to movement in a direction towards the second indicator feature. Provision of the second pre-indicator feature 677 works to alert, e.g. provide tactile feedback to, an operator that the grab ring is about to enter the passive state.

The interaction between the second pre-indicator feature 677 and the cap formation 672 is configured for providing a resistance to movement in a direction away from the second indicator feature 676. Provision of the second pre-indicator feature to obstruct movement of the cap formation works to prevent accidental movement of the cap formation away from the second indicator formation so as to retain the cap projection next to the second indicator feature. In this way, the second pre-indicator feature works to prevent accidental rotation of the cap moving the grab ring from the passive state to the active state.

The position indicator arrangement includes a second channel on the body 612, and the cap formation 672 is arranged to be received in said second channel, when the grab 628 ring is in the passive state. Locating the cap formation in a channel aids visual inspection of the location of the cap formation 672, and so aids visual inspection that the grab ring 628 is in the passive state.

The body 612 is provided with a first ring locator 692. In the illustrated embodiment, the first ring locator 692 is provided in the form of an axially extending channel 692 on a radially outer surface of the body 612. In the arrangement shown, the channel 692 is provided through the annular collar 688 of the body 612. In order to prevent rotation of the indicator ring 686 with respect to the body 612, the axial projection defining the first indicator feature 674 is received in the axially extending channel 692.

As is shown in Figure 24, the body 612 is further provided with a second ring locator 691. In the illustrated embodiment, the second ring locator 691 is provided in the form of an axially extending channel 691 on a radially outer surface of the body 612. In the arrangement shown, the channel 691 is provided through the screw thread on the radially outer surface of the socket 614.

The indicator ring 686 includes a third stop 690. The third stop is provided as a protrusion on a radially inner surface of the indicator ring 686. In order to prevent rotation of the indicator ring 686 with respect to the body 612, the protrusion defining the third stop 690

is received in the second ring locator 691 (i.e. in the channel 691 in the screw thread on the body 612).

The body 612 is provided with a ring stop 693 disposed within the channel 691. The ring stop 693 is configured to interact with abut an upper surface of the third stop 690, when the third stop 690 is received in the channel 691, to axially secure the third stop 690 in the channel 691.

Claims

1. A plumbing fitting comprising:

a pipe socket for receiving the free end of a pipe; and

a grab ring associated with the socket, the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body for engagement with a pipe received by the annular body;

wherein the fitting includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe, wherein the mechanism comprises a release member movable between a first position and a second position, in order to move the grab ring from the active state to the passive state;

wherein the grab ring forms part of a sub-assembly associated with the socket;

wherein the sub-assembly comprises a housing and the grab ring is supported within the housing; and

wherein the housing defines a circumferential shoulder configured to retain the release member in an axial direction and the release member has a circumferential lip at its outer diameter, which is configured to interact with the shoulder.

2. A fitting according to claim 1 wherein the release member is arranged to be moved in an axial direction with respect to the pipe socket in order to move from the first position to the second position.

3. A fitting according to any preceding claim wherein the sub-assembly is a cartridge comprising the housing and the grab ring.

4. A fitting according to any preceding claim wherein the housing is fixed against rotation relative to the pipe socket, preferably wherein the grab ring is rotatable within the housing.

5. A fitting according to claim 3 wherein the release member forms part of the cartridge.

6. A fitting according to any one of claims 4 to 5 comprising a locking arrangement for preventing rotation of the cartridge housing relative to the pipe socket.

7. A fitting according to claim 6 wherein the locking arrangement comprises a first locking formation on the socket and a second locking formation on the cartridge, and wherein the first and second locking formations are configured to inter-engage for preventing rotation of the cartridge relative to the pipe socket; optionally, wherein the first locking formation, e.g. serrations, is provided on a radially inner surface of the socket, and the second locking formation, e.g. at least one protrusion, is provided on a radially outer surface of the cartridge.

8. A fitting according to any preceding claim wherein the fitting further comprises a cam arrangement in association with the release member, said cam arrangement being configured to move the release member from the first position to the second position.

9. A fitting according to claim 8 wherein the cam arrangement includes a cam surface on said release member, and a driver configured to act on the cam surface, in order to move the release member from the first position to the second position.

10. A fitting according to claim 8 or claim 9 wherein the cam arrangement defines at least one ramp.

11. A fitting according to any preceding claim wherein the fitting is configured so the release member is fixed against rotation relative to the pipe socket.

12. A fitting according to any preceding claim wherein the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body.

13. A fitting according to claim 12 when dependent upon claim 9 wherein the or each driver is provided on the cap.

14. A fitting according to any one of claims 12 or 13, comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state.

15. A fitting according to claim 14, wherein the position indicator arrangement is provided in the form of indicator features on the cap and body, and wherein the indicator features are arranged such that their relative positions indicate whether the grab ring is in the active state or the passive state.

16. A fitting according to claim 15, wherein the position indicator arrangement comprises a formation, e.g. a tab, on the cap and a first indicator feature on the body, and wherein the cap formation and the first indicator feature are arranged to interact, e.g. engage, when the grab ring is in the active state.

17. A fitting according to claim 16, wherein the first indicator feature is provided as a recess provided on the body, and wherein the cap formation is arranged to be received in said recess, when the grab ring is in the active state.

18. A fitting according to claim 16 or claim 17, wherein the position indicator arrangement comprises a first pre-indicator feature, e.g. a radial abutment on the body, arranged such that during movement of the grab ring from a passive state to an active state, the cap formation interacts with the first pre-indicator feature before interacting with the first indicator feature for providing an indication of movement towards the active state; optionally, wherein the interaction between the first pre-indicator feature and the cap formation is configured for providing a tactile indication and/or a resistance to movement in a direction towards the first indicator feature; optionally, wherein, when the grab ring is in the active state, the interaction between the first pre-indicator feature and the cap formation is configured for providing a resistance to movement towards the passive state for preventing accidental movement of the grab ring from the active state to the passive state.

19. A fitting according to any preceding claim wherein the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body, the fitting further comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state, wherein the position indicator arrangement comprises a formation, e.g. a tab, on the cap and a first channel on the body, and wherein the cap formation is arranged to be received in said first channel, when the grab ring is in the active state.

20. A fitting according to any one of claims 16 to 19, wherein the position indicator arrangement comprises a formation, e.g. a tab, provided on the cap and a second indicator feature on the body, e.g. a radial protrusion on a radially outer surface of the body, and wherein the cap formation and the second indicator feature are arranged to interact, e.g. engage, when the grab ring is in the passive state.

21. A fitting according to claim 20, wherein the position indicator arrangement comprises a second pre-indicator feature, e.g. a radial abutment on the body, arranged such that during movement of the grab ring from an active state to a passive state, the cap formation interacts with the second pre-indicator feature before inter-acting with the second indicator feature for providing an indication of movement to a passive state; optionally, wherein the interaction between the second pre-indicator feature and the cap formation is configured for providing a tactile indication and/or a resistance to movement in a direction towards the second indicator feature; optionally, wherein when the grab ring is in the passive state, the interaction between the second pre-indicator feature and the cap formation is configured for providing a resistance to movement towards the active state for preventing accidental movement of the grab ring from the passive state to the active state.

22. A fitting according to any one of claims 15 to 21, wherein the position indicator arrangement is provided in the form of an indicator ring mounted on the body, optionally wherein the indicator ring is positioned between the cap and the body, optionally wherein the indicator ring is configured to engage the body such that the indicator ring is fixed against rotation relative to the body.

23. A cartridge for a plumbing fitting of the kind comprising a pipe socket for receiving the free end of a pipe, the cartridge comprising:

a housing; and

a grab ring supported within the housing;

wherein the grab ring comprises an annular body configured to receive a pipe, and a series of teeth extending from the annular body in a direction beyond an inner diameter of the housing;

wherein the housing is configured to be associated with a pipe socket as a sub-assembly, with the grab ring body arranged to be coaxial with the socket, for receiving a pipe;

wherein the cartridge includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe, wherein the mechanism comprises a release member movable between a first position and a second position, in order to move the grab ring from the active state to the passive state;

wherein the housing defines a circumferential shoulder configured to retain the release member in an axial direction and the release member has a circumferential lip at its outer diameter, which is configured to interact with the shoulder;

optionally, wherein the grab ring is rotatably supported within the housing.

Claims

1. A plumbing fitting comprising:

a pipe socket for receiving the free end of a pipe; and

a grab ring associated with the socket, the grab ring comprising an annular body configured to receive a pipe, and a series of teeth extending from the body for engagement with a pipe received by the annular body;

wherein the fitting includes a mechanism for cooperation with the grab ring, whereby the grab ring is operable to be moved from an active state in which the teeth engage an outer diameter of a pipe received within the annular body, to a passive state, in which the teeth are disengaged from said pipe, wherein the mechanism comprises a release member movable between a first position and a second position, in order to move the grab ring from the active state to the passive state;

wherein the grab ring forms part of a sub-assembly associated with the socket;

wherein the sub-assembly comprises a housing and the grab ring is supported within the housing; and

wherein the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the release member is movable in response to relative rotation between the cap and the body.

2. A fitting according to claim 1 wherein the release member is arranged to be moved in an axial direction with respect to the pipe socket in order to move from the first position to the second position.

3. A fitting according to any preceding claim wherein the sub-assembly is a cartridge comprising the housing and the grab ring.

4. A fitting according to any preceding claim wherein the housing is fixed against rotation relative to the pipe socket.

5. A fitting according to claim 3 wherein the release member forms part of the cartridge.

6. A fitting according to any one of claims 4 to 5 comprising a locking arrangement for preventing rotation of the cartridge housing relative to the pipe socket.

7. A fitting according to claim 6 wherein the locking arrangement comprises a first locking formation on the socket and a second locking formation on the cartridge, and

wherein the first and second locking formations are configured to inter-engage for preventing rotation of the cartridge relative to the pipe socket.

8. A fitting according to any preceding claim wherein the fitting further comprises a cam arrangement in association with the release member, said cam arrangement being configured to move the release member from the first position to the second position.

9. A fitting according to claim 8 wherein the cam arrangement includes a cam surface on said release member, and a driver configured to act on the cam surface, in order to move the release member from the first position to the second position.

10. A fitting according to claim 8 or claim 9 wherein the cam arrangement defines at least one ramp.

11. A fitting according to any preceding claim wherein the fitting is configured so the release member is fixed against rotation relative to the pipe socket.

12. A fitting according to any preceding claim wherein the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body.

13. A fitting according to claim 12 when dependent upon claim 9 wherein the or each driver is provided on the cap.

14. A fitting according to any one of claims 12 or 13, comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state.

15. A fitting according to claim 14, wherein the position indicator arrangement is provided in the form of indicator features on the cap and body, and wherein the indicator features are arranged such that their relative positions indicate whether the grab ring is in the active state or the passive state.

16. A fitting according to claim 15, wherein the position indicator arrangement comprises a formation on the cap and a first indicator feature on the body, and wherein the cap formation and the first indicator feature are arranged to interact when the grab ring is in the active state.

17. A fitting according to claim 16, wherein the first indicator feature is provided as a recess provided on the body, and wherein the cap formation is arranged to be received in said recess, when the grab ring is in the active state.

18. A fitting according to claim 16 or claim 17, wherein the position indicator arrangement comprises a first pre-indicator feature arranged such that during movement of the grab ring from a passive state to an active state, the cap formation interacts with the first pre-indicator feature before interacting with the first indicator feature for providing an indication of movement towards the active state.

19. A fitting according to any preceding claim wherein the fitting comprises a body, and a cap rotatably mounted on the body, and wherein the grab ring is operable to switch from the active state to the passive state, upon relative rotation between cap and the body, the fitting further comprising a position indicator arrangement configured to indicate whether the grab ring is in the active state or the passive state, wherein the position indicator arrangement comprises a formation on the cap and a first channel on the body, and wherein the cap formation is arranged to be received in said first channel, when the grab ring is in the active state.

20. A fitting according to any one of claims 16 to 19, wherein the position indicator arrangement comprises a formation provided on the cap and a second indicator feature on the body and wherein the cap formation and the second indicator feature are arranged to interact when the grab ring is in the passive state.

21. A fitting according to claim 20, wherein the position indicator arrangement comprises a second pre-indicator feature arranged such that during movement of the grab ring from an active state to a passive state, the cap formation interacts with the second pre-indicator feature before inter-acting with the second indicator feature for providing an indication of movement to a passive state.

22. A fitting according to any one of claims 15 to 21, wherein the position indicator arrangement is provided in the form of an indicator ring mounted on the body.

Intellectual Property Office

Application No:	GB2210258.6	**Examiner:**	Mr Josh Nolan
Claims searched:	1-23	**Date of search:**	23 September 2022

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-7, 11, 23	US2011/088790 A1 (SCHUTTE ET AL), see left hand side of figure 2A, noting grab ring supported within housing 40, 50, aned release member 55 having circumferential lip which interacts with circumferential shoulder on housing portion 50.
X	1-3, 5-7, 11, 23	WO2018/023196 A1 (9352-4585 QUEBEC INC), see figures 5-6, noting grab ring 4 supported within grooves 18 of housing 1, and release member 5 having circumferential lip which interacts with circumferential shoulder 17 on housing.
X	1-7, 11, 23	WO2017/204818 A1 (NIBCO), see pph 18 and figure 1, noting grab ring 140 supported within housing 130, 150 and release member 15 having circumferential lip 168 which interacts with circumferential shoulder 155 on housing portion 150.
X	1-7, 11, 23	US2015/240980 A1 (BOBO ET AL), see pph 15 and figures 2, 4, noting grab ring 60 supported within slots 34, 44 of housing 30, 40, and release member 70 having circumferential lip which interacts with circumferential shoulder 155 on housing portions (see figure 2).
X	1, 2, 4, 6, 11	EP2472161 A2 (KOMOLROCHANAPORN), see figure 4, noting grab ring 14 supported within housing 13, 16, and release member 15 having circumferential lip which interacts with circumferential shoulder on housing portion 16.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	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^{X} :

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

F16L

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

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
F16L	0037/091	01/01/2006
E03C	0001/00	01/01/2006