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(56) Documents Cited:
GB 2106336 A **US 5321205 A**
US 5059139 A **US 4789759 A**

(58) Field of Search:
INT CL **F16B, H02G**
Other: **Online: WPI, EPODOC, TXTE**

(54) Title of the Invention: **Gland assembly**
Abstract Title: **Gland assembly preventing over-tightening and/or preventing loosening**

(57) A gland assembly has a seal member urged to seal around an elongate member 33 extending through the gland assembly in response to tightening a cap nut 5. A cap nut sleeve 7 fits over and around the cap nut for transmitting a torque applied to the cap nut sleeve to the cap nut in a first direction for tightening the cap nut and in a second direction for loosening the cap nut. The cap nut sleeve is configured to rotate relative to the cap nut to prevent over-tightening the cap nut. For example, the sleeve may have fingers (51, Fig 4) which can engage grooves (43, Fig 7) but can ride over them if the torque is too high.
Alternatively, the gland may prevent loosening. For example, a cap nut sleeve 107 may have an internal socket (117, Fig 28) complementary to a hexagonal flange 115 of the cap nut, and may move longitudinally between a position in which it engages the flange and a position in which they can relatively rotate.

Figure 1

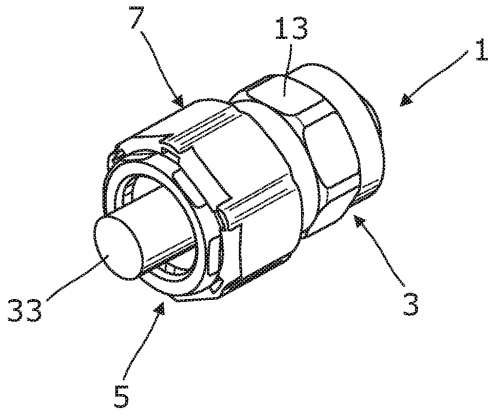
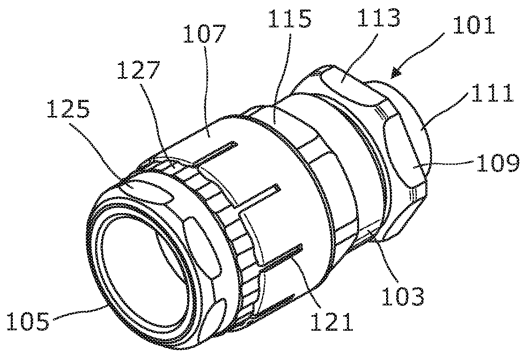


Figure 27



GB 2509727 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

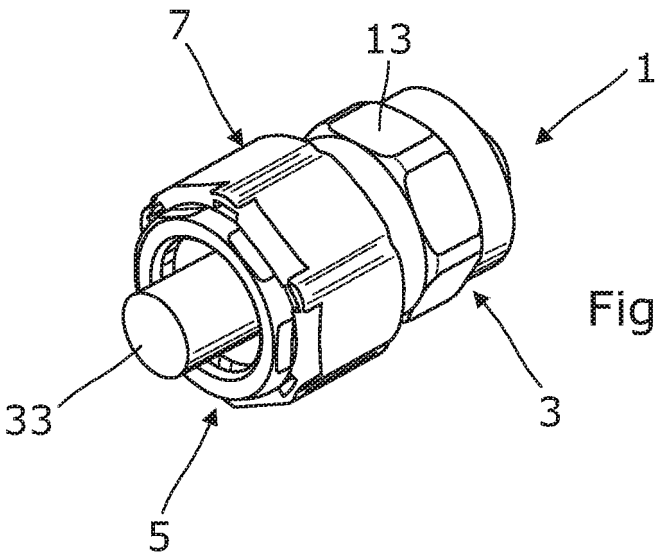


Figure 1

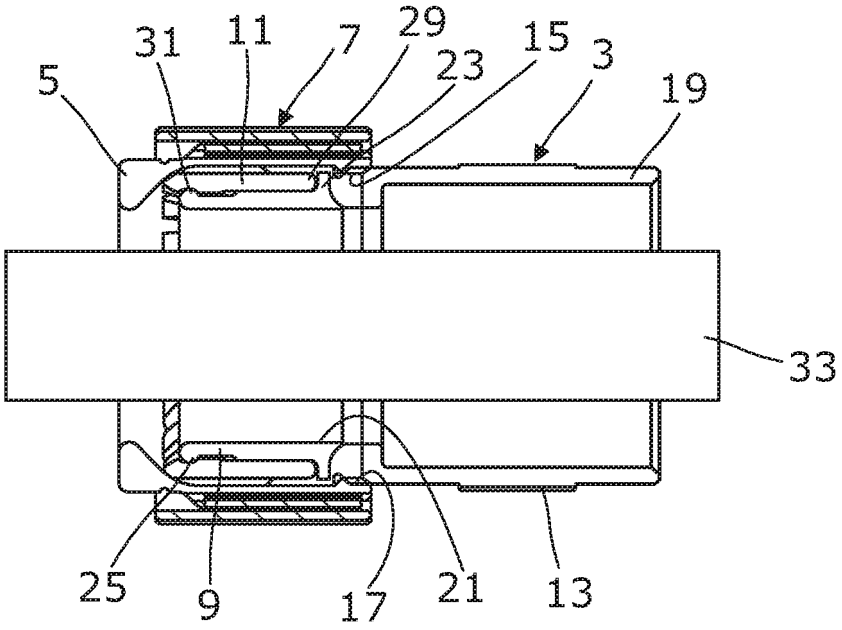


Figure 2

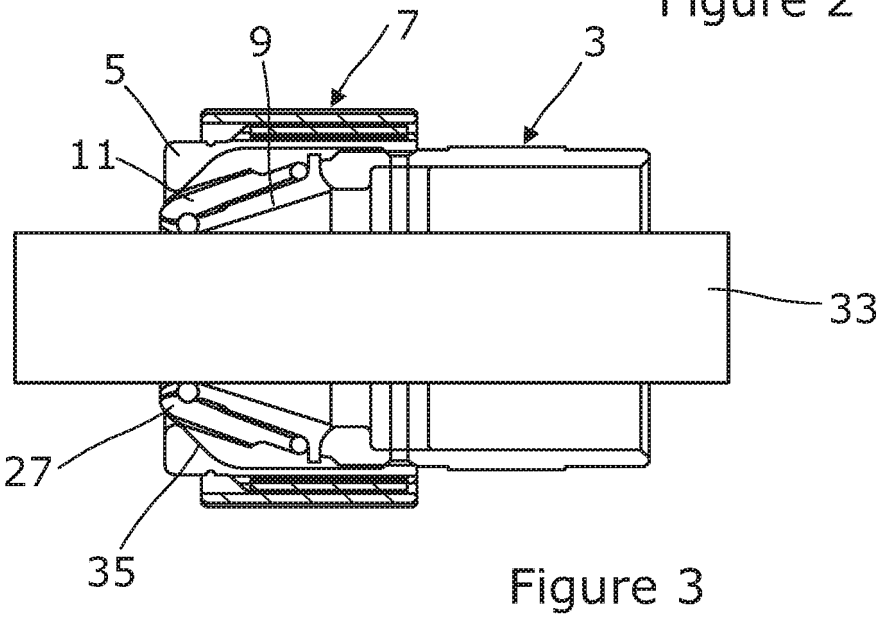


Figure 3

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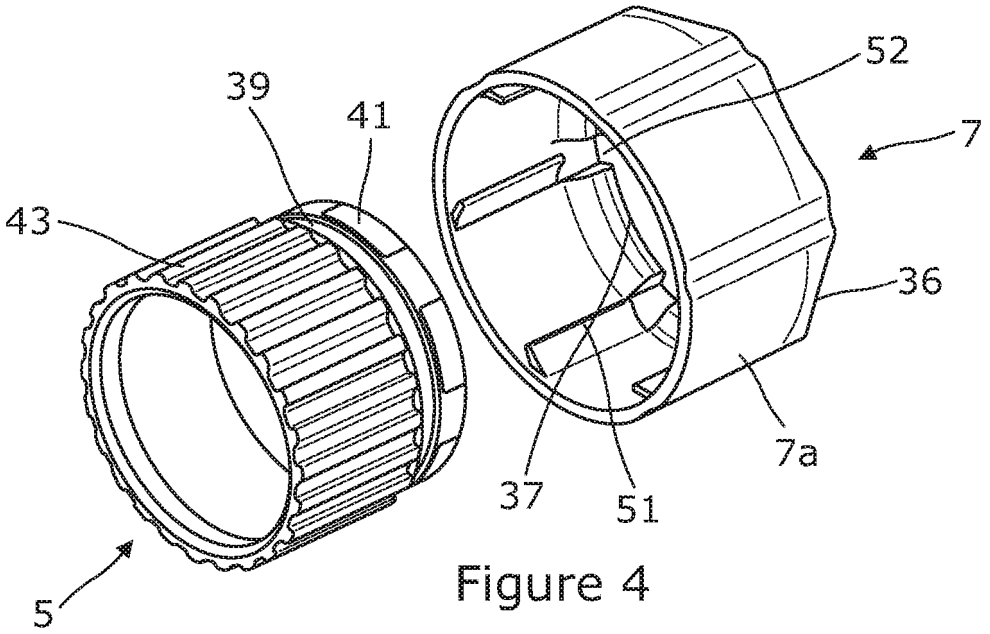
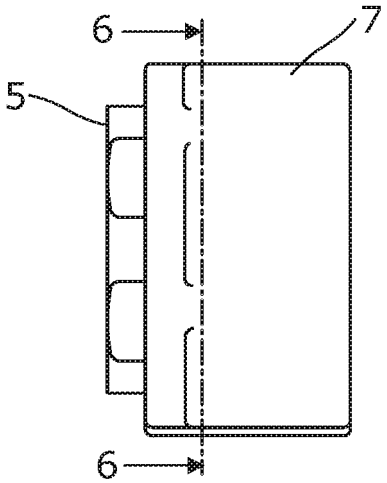


Figure 4



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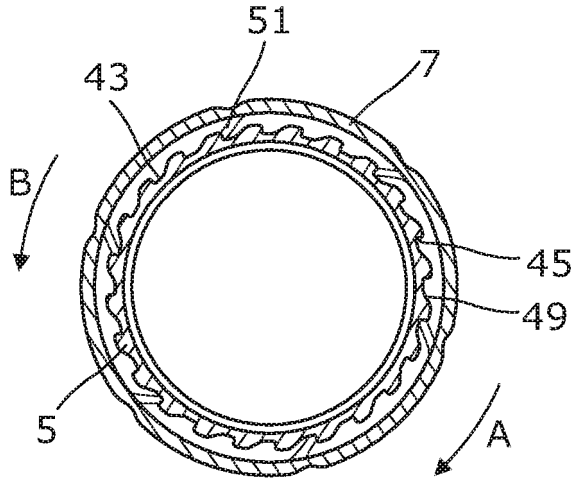

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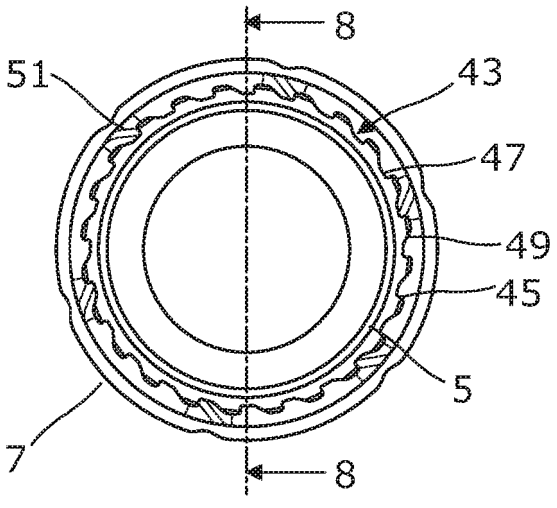

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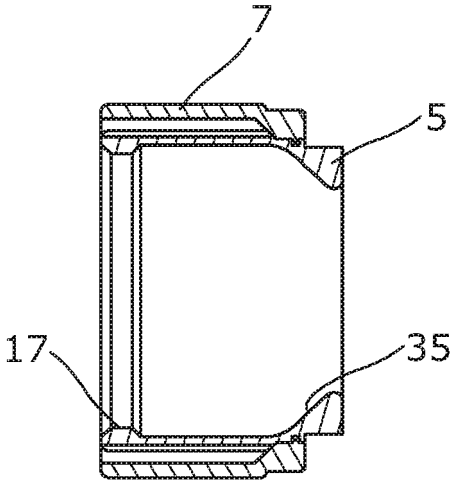

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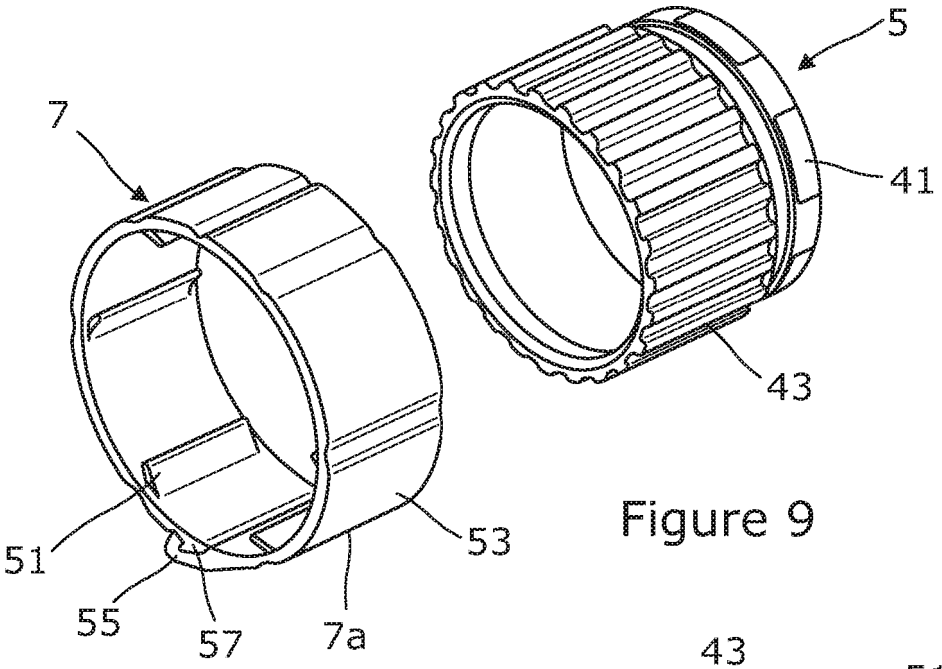

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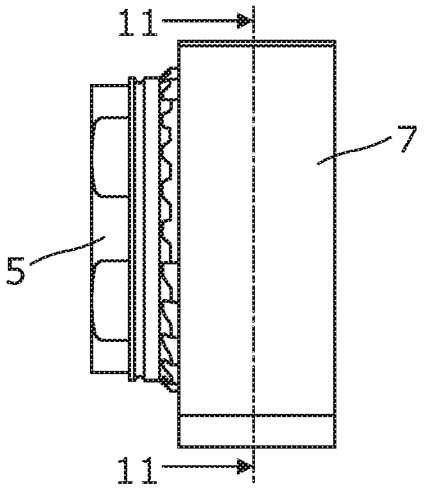

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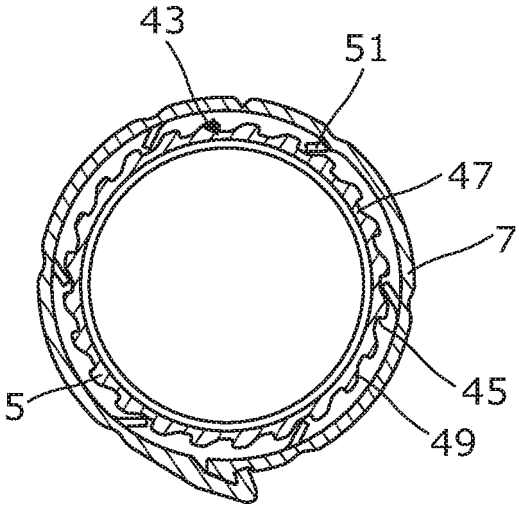

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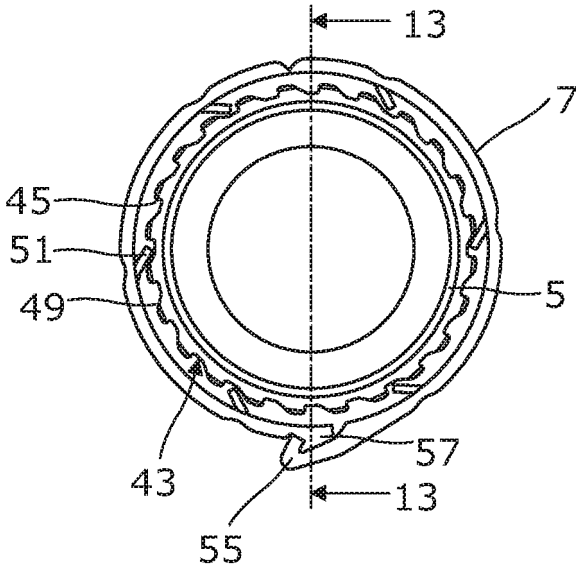

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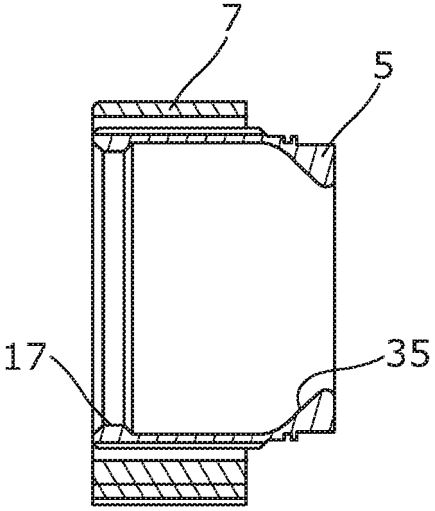
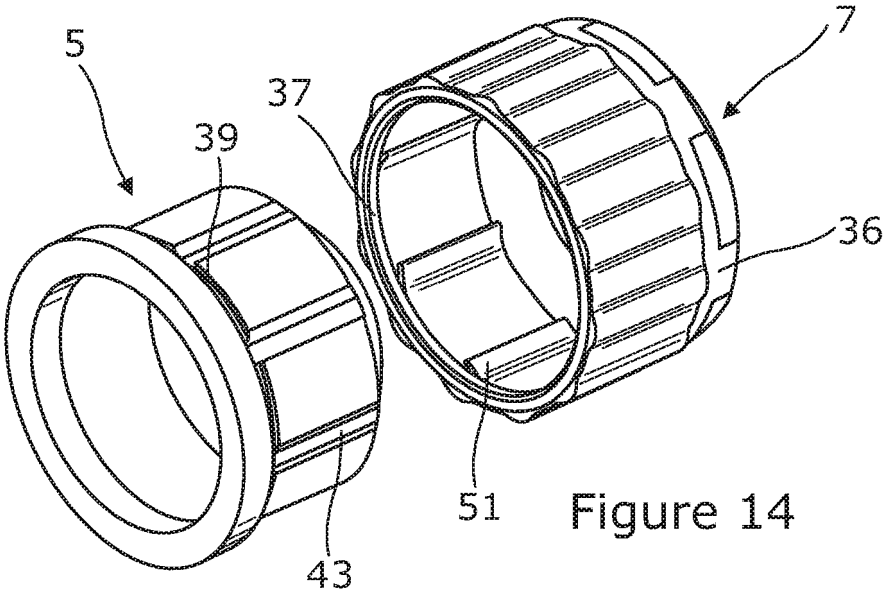


Figure 13



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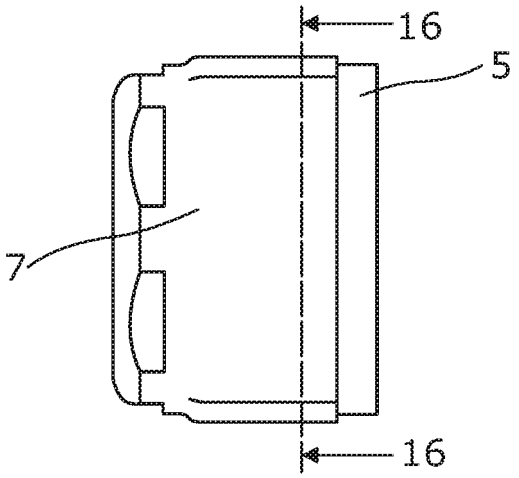

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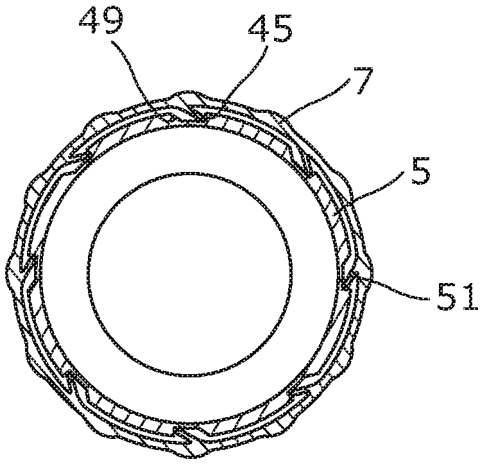

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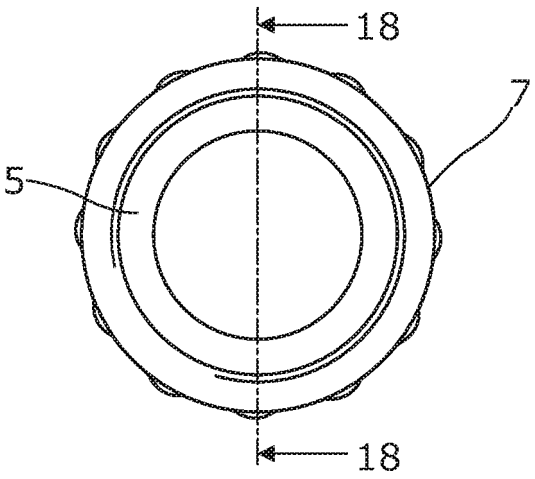

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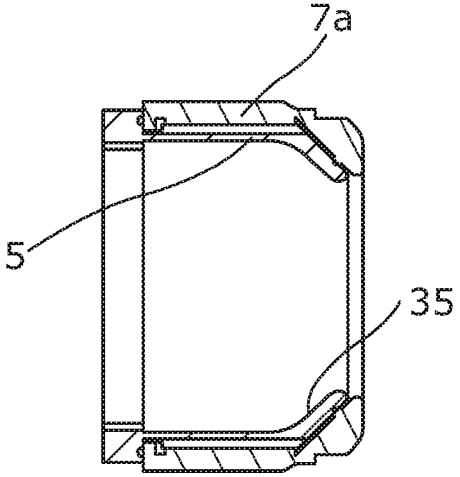

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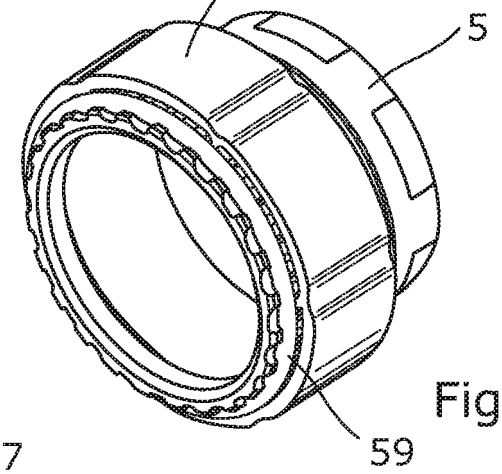

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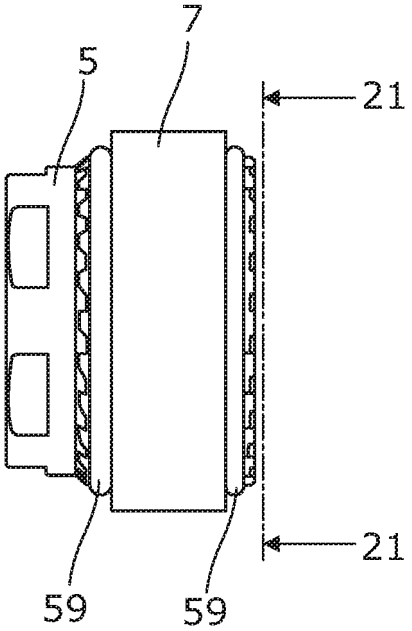

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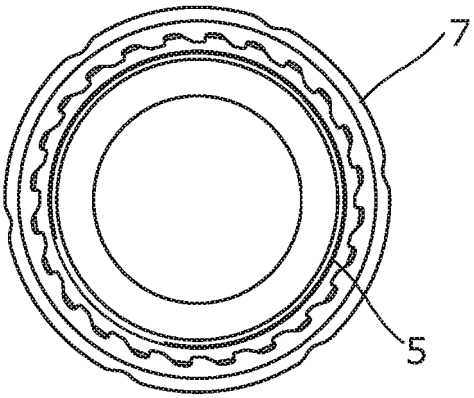

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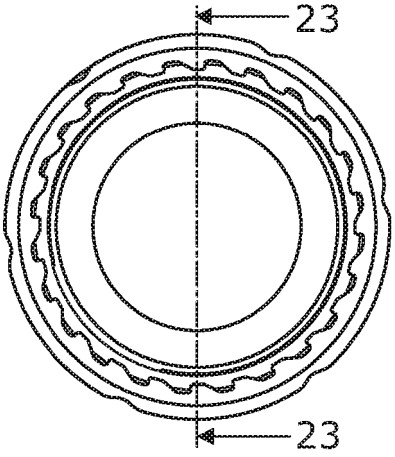

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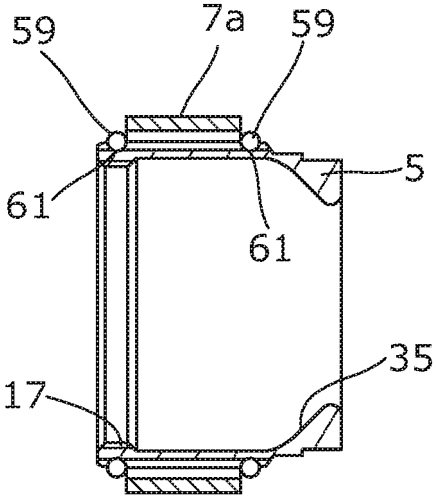

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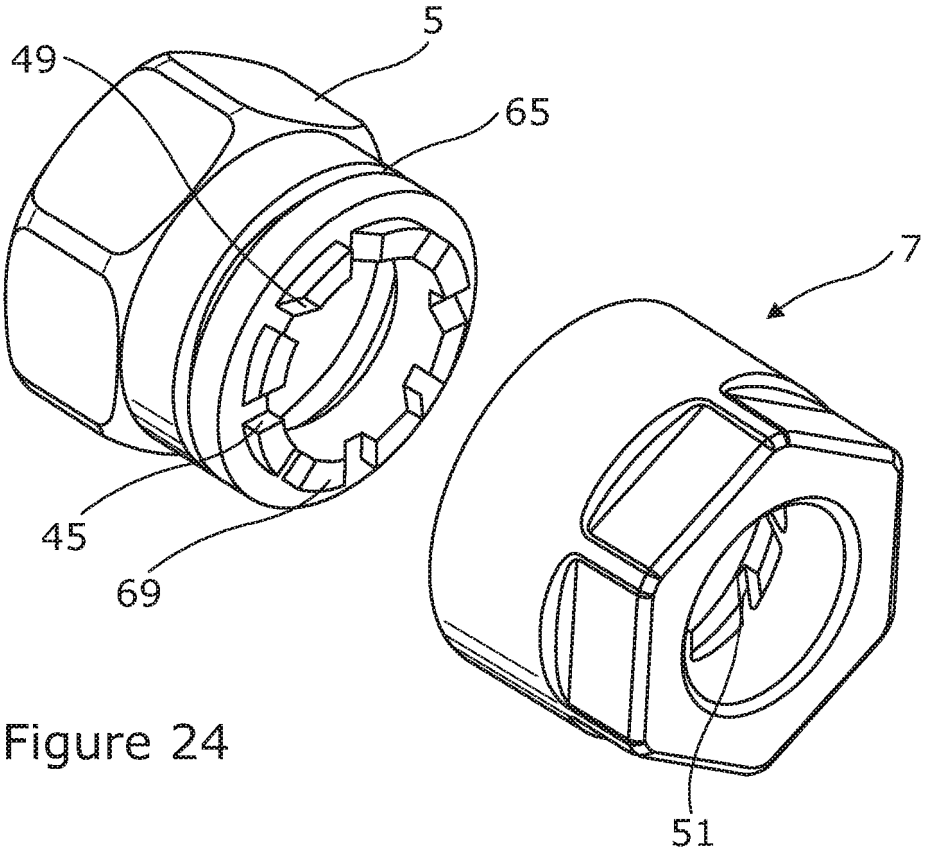

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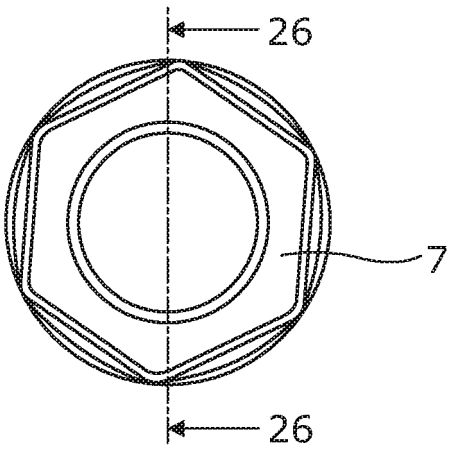

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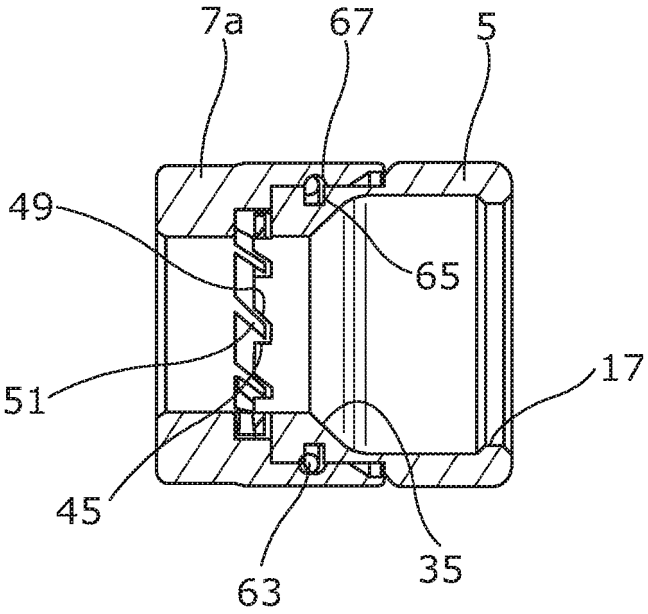

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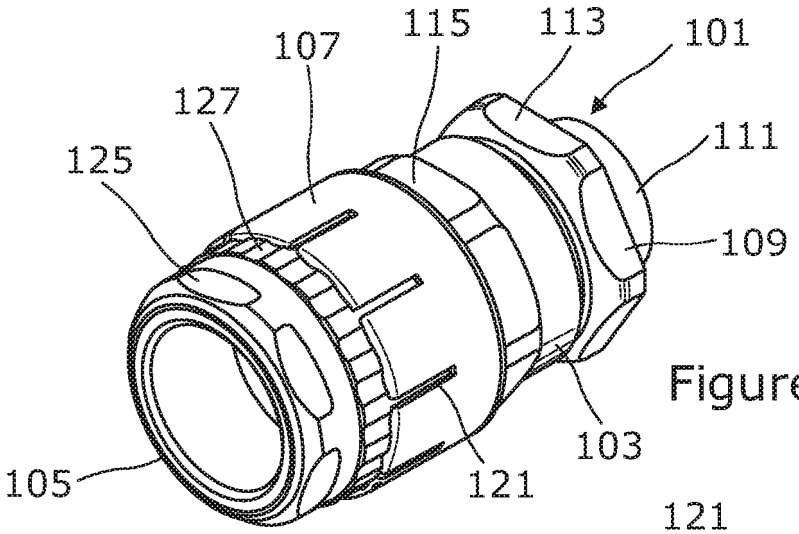

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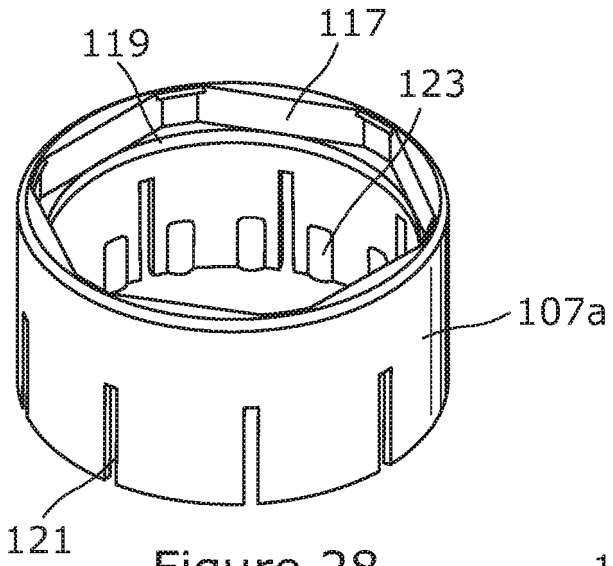

Figure 28

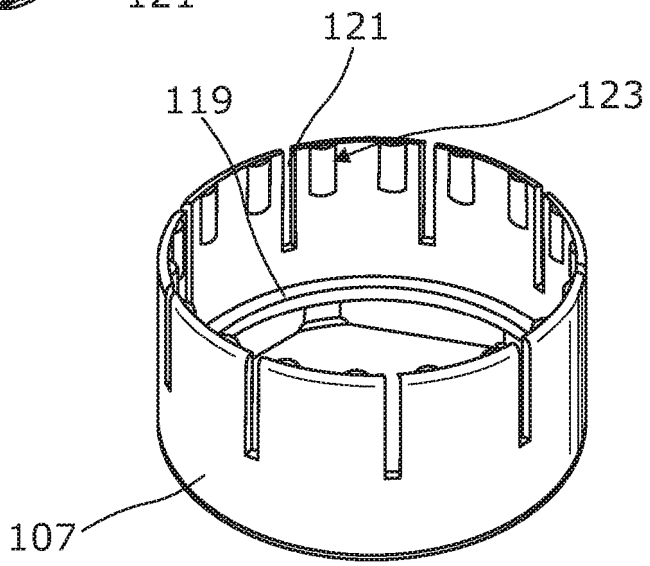

Figure 29

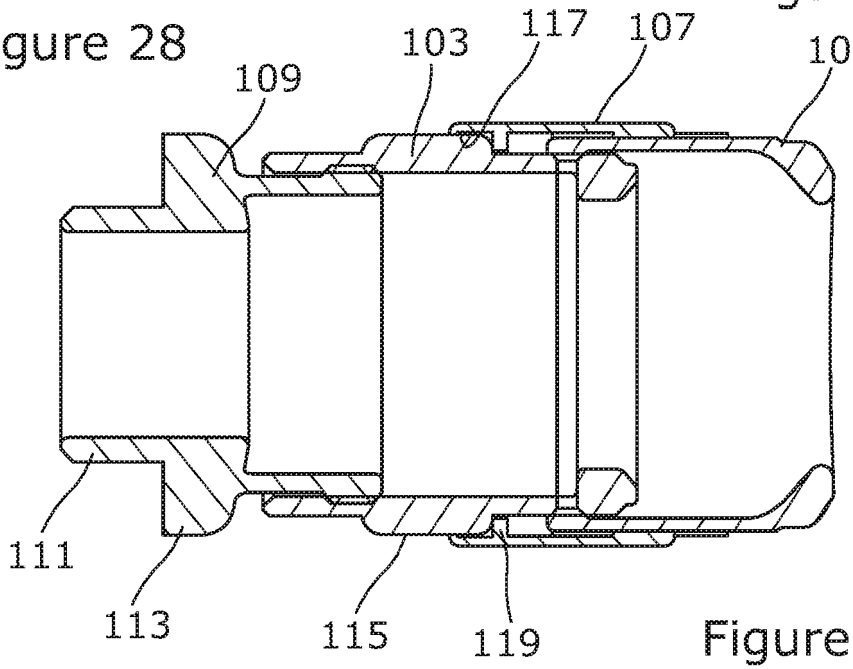

Figure 30

GLAND ASSEMBLY

The present invention relates to gland assemblies. The invention has particular, but not exclusive, application to gland assemblies for sealing around electrical cables. However, the invention also has application to gland assemblies for sealing around fibre optic cables, pipes and other conduits.

Cable gland assemblies are commonly used for sealing around a cable passing through an opening in a wall through which the cable passes. For example, cable gland assemblies may be used to seal around a cable entering an enclosure such as a junction box containing electrical equipment to prevent fluids entering or exiting the enclosure. A typical sealing arrangement employs a seal member that surrounds a cable extending through the gland assembly and is urged inwardly to engage and seal around the cable when two parts of the gland assembly are screwed together. With this type of sealing arrangement, problems can arise due to incorrect tightening of the gland parts.

Thus, over-tightening of the gland parts can cause cold flow of the material forming the outer sheath of the cable under the seal member which can have an adverse effect on the efficiency of the seal obtained. Under-tightening of the gland parts may reduce the efficiency of the seal obtained. The gland parts may also be susceptible to becoming loose due, for example, to vibration reducing the efficiency of the seal obtained.

Controlling tightening of the gland parts can be a particular problem in cable gland assemblies designed for use with a range of cable sizes where the degree of tightening required for different cable sizes may vary with the result that achieving the required degree of tightening depends on the skill and care of the operative installing the gland assembly.

The present invention has been made from a consideration of the foregoing and seeks to provide a gland assembly which overcomes or at least mitigates the aforementioned problems.

It is a desired aim therefore of the present invention to provide a gland assembly in which movement of a gland part by applying a torque to the gland part to create a seal around an elongate member extending through the gland is controlled to prevent over-tightening the gland part regardless of the torque applied.

It is another desired aim of the present invention to provide a gland assembly in which loosening of threadably engaged gland parts is prevented.

According to one aspect of the invention, we provide a gland assembly for an elongate member extending, in use, through the gland assembly, the gland assembly including a gland member that is movable in response to an applied torque to cause a seal member to seal around the elongate member, wherein the gland member is provided with a torque transmitting device operable to inhibit over-tightening the gland member.

By inhibiting over-tightening of the gland member, the force exerted on the seal member by the gland member can be controlled, regardless of the torque applied to the torque transmitting device. In this way, where the elongate member is a cable, for example an electric cable or fibre optic cable, problems due to cold flow of the material of the outer sheath of the cable caused by the seal member when the gland member is over-tightened can be avoided or significantly reduced.

The gland member may be engageable with a further gland member by means of mating screw threads whereby rotation of the gland member by an applied

torque in one direction causes axial movement of the gland member to tighten the gland member and apply a force to the seal member so as to urge the seal member to seal around the elongate member.

The torque transmitting device may comprise a sleeve member that is rotatable with the gland member to transmit torque applied to the sleeve member to the gland member for tightening the gland member and which can rotate relative to the gland member to isolate the gland member from torque applied to the sleeve member for preventing over-tightening of the gland member.

The sleeve member may have one or more formations arranged to engage the gland member so that the sleeve member can rotate with the gland member whereby torque applied to the sleeve member is transmitted to the gland member for tightening the gland member. The or each formation may be capable of deforming to disengage the gland member so that the sleeve member can rotate relative to the gland member whereby torque applied to the sleeve member is not transmitted to the gland member for preventing over-tightening of the gland member.

The or each formation may be engageable with an abutment on the gland member for transmitting torque applied to the sleeve member to the gland member. The or each formation may be configured to ride over the abutments to prevent over-tightening the gland member.

The or each formation may be engageable with a further abutment on the gland member for transmitting torque applied to the sleeve member to the gland member in a direction to release the gland member, i.e. to loosen the gland member. The or each formation may be configured to maintain engagement with the further abutments to release the gland member.

It may be that the gland member is engageable with a further gland member. The sleeve member may be operable to transmit torque for rotating the gland member relative to the further gland member for tightening the gland member on the further gland member. The sleeve member may be operable to inhibit rotation of the gland member relative to the further gland member for maintaining a tightened position of the gland member and inhibiting loosening of the gland member.

The sleeve member may be movable in an axial direction relative to the gland member between a release position for rotation with the gland member relative to the further gland member when tightening the gland member and a locking position for engaging both gland members to inhibit relative rotation of the gland member and further gland member.

According to another aspect of the invention, we provide a method of assembling a gland assembly to control a force exerted on a seal member by a gland member that is movable in response to an applied torque to tighten the gland member and cause the seal member to seal around an elongate member extending through the gland assembly, the method including providing the gland member with a device for transmitting an applied torque to the gland member for tightening the gland member wherein the device is configured to inhibit over-tightening the gland member.

By employing a torque transmitting device to inhibit over-tightening of the gland member, the force exerted on the seal member by the gland member can be controlled regardless of the torque applied to the torque transmitting device so that cold flow of the material of the outer sheath of the cable can be avoided or significantly reduced.

The torque transmitting device may be configured to rotate with the gland member in a direction to tighten the gland member to a required degree and then to rotate relative to the gland member so that over-tightening of the gland member can be avoided.

The torque transmitting device may comprise a sleeve member that can be fitted over the gland member and is provided with one or more formations engageable with the gland member for transmitting torque applied to the sleeve member to the gland member for tightening the gland member, wherein the formations can deform when the gland member has been tightened to the required degree to permit the sleeve member to rotate relative to the gland member.

The method may include, use or provide any of the features of the preceding aspect of the invention.

According to yet another aspect of the invention, we provide a gland nut for a gland assembly, the gland nut being provided with a torque transmitting device to inhibit over-tightening the gland nut.

The gland nut may include, use or provide any of the features of the preceding aspects of the invention.

According to a still further aspect of the invention, we provide a gland assembly for an elongate member extending, in use, through the gland assembly, the gland including two relatively rotatable gland members, and an anti-rotation device operable to inhibit relative rotation of the gland members.

By inhibiting relative rotation of the gland members, loosening of the gland members due to vibration or any other reason may be prevented. It may be

that efficiency of a seal within the gland is controlled by tightening the gland members and that by preventing loosening of the gland members, the seal efficiency may be maintained.

The anti-rotation device may comprise a sleeve member that is co-operable with both gland members to inhibit relative rotation of the gland members.

The sleeve member and a first gland member may have co-operating formations configured to prevent relative rotation therebetween, For example the first gland member may have an external flange of hexagonal or other non-circular form and the sleeve member may have a complementary internal socket in which the flange is received.

The sleeve member and a second gland member may have co-operating formations configured to inhibit relative rotation therebetween. For example one of the sleeve member and the second gland member may have a plurality of axially extending grooves and the other of the sleeve member and the second gland member may have one or more axially extending ribs that are engageable with the grooves.

The co-operating formations may be configured to inhibit relative rotation between the sleeve member and the second gland member if a torque is applied to the sleeve member or the second gland member up to a pre-determined limit, and to allow relative rotation between the sleeve member and the second gland member if a torque is applied to the sleeve member or the second gland member that exceeds a pre-determined limit.

In one arrangement, the sleeve member may be axially slidable along the second gland member from a release position to a locking position. In the release position the sleeve member is disengaged from the first gland member and relative rotation of the gland members is permitted. In the

locking position the sleeve member is engaged with the first gland member and relative rotation of the gland members is inhibited.

In this arrangement, the gland members may be tightened with the sleeve member located in the release position on the second gland member and rotating relative to the first gland member. When the gland members have been tightened, the sleeve member may be rotated on the second gland member if necessary to align the co-operating formations on the sleeve member and the first gland member such that the sleeve member can be slid axially to the locking position to engage the first gland member and secure the gland members so that relative rotation of the gland members to loosen the gland members is inhibited.

In another arrangement, the sleeve member may be located on the first gland member and the second gland member is rotatable relative to the sleeve member and the first gland member to tighten the gland members by applying a torque sufficient to overcome the engagement of the co-operating formations.

In this arrangement, the gland members may be tightened with the sleeve member located on the first gland member and the second gland member rotating relative to the sleeve member. When the gland members have been tightened, the co-operating formations on the sleeve member and second gland member engage to inhibit relative rotation of the gland members so that relative rotation of the gland members to loosen the gland members is inhibited.

The sleeve member may also inhibit over-tightening of the gland members in accordance with preceding aspects of the invention. For example, rotation of the sleeve member may be transmitted to one of the gland members for tightening the gland members up to a required degree at which the sleeve

member is rotatable relative to said one gland member to prevent over-tightening the gland members whereupon the sleeve member is axially slidable to engage the other gland member to lock the gland members together and prevent relative rotation of the gland members to loosen the gland members.

According to another aspect of the invention, we provide a method of assembling a gland assembly including connecting two relatively rotatable gland members and providing a device co-operable with both gland members in a tightened condition that inhibits relative rotation of the gland members to loosen the gland members.

By employing a device to inhibit loosening of the gland members in the tightened condition, efficiency of a seal provided by tightening the gland members can be maintained if the gland assembly is exposed to vibration or other forces tending to loosen the gland members.

The method may include, use or provide any of the features of the preceding aspect of the invention.

According to yet another aspect of the invention, we provide a gland nut for a gland assembly, the gland nut being provided with an anti-rotation device to inhibit loosening the gland nut.

The gland nut may include, use or provide any of the features of the preceding aspects of the invention.

According to a still further aspect of the invention, we provide a gland assembly for an elongate member extending, in use, through the gland assembly, the gland including two gland members that are relatively rotatable in a first direction to tighten the gland members and in a second

direction to loosen the gland members, and a device operable to control relative rotation of the gland members in the first direction and/or the second direction.

It may be that relative rotation of the gland members in the first direction causes a seal member to seal around the elongate member, and the device is operable to inhibit over-tightening the gland members.

Preferably, the gland members are engageable by means of mating screw threads whereby rotation of a first gland member by an applied torque in the first direction causes axial movement of the first gland member to tighten the gland member and apply a force to the seal member so as to urge the seal member to seal around the elongate member.

Preferably, the device comprises a sleeve member that is rotatable with the first gland member to transmit torque applied to the sleeve member to the first gland member for tightening the gland member.

Preferably, the sleeve member can rotate relative to the first gland member to isolate the first gland member from torque applied to the sleeve member for preventing over-tightening of the gland member.

Preferably, the sleeve member has one or more formations arranged to engage the first gland member so that the sleeve member can rotate with the first gland member. In this way, torque applied to the sleeve member can be transmitted to the first gland member for tightening the gland member.

Preferably, the or each formation is capable of deforming to disengage the first gland member so that the sleeve member can rotate relative to the first gland member. In this way, torque applied to the sleeve member is not

transmitted to the first gland member for preventing over-tightening of the gland member.

Preferably, the or each formation is engageable with an abutment on the first gland member for transmitting torque applied to the sleeve member to the gland member.

Preferably, the or each formation is configured to ride over the abutments to prevent over-tightening the gland member.

Preferably, the or each formation is engageable with a further abutment on the first gland member for transmitting torque applied to the sleeve member to the gland member in the second direction to loosen the gland member.

Preferably, the or each formation is configured to maintain engagement with the further abutments.

It may be that the sleeve member is operable to inhibit relative rotation of the gland members for maintaining a tightened position of the gland members and inhibiting loosening of the gland members.

The sleeve member may be movable in an axial direction relative to the first gland member between a first position for rotation with the first gland member relative to the second gland member when tightening the gland members, and a second position for engaging both gland members to inhibit relative rotation of the gland members.

These and other features benefits and advantages of the invention will be apparent from the description hereinafter of embodiments of the invention, provided by way of example only, with reference to the accompanying drawings wherein:-

Figure 1 is a perspective view of a gland assembly according to an embodiment of the invention;

Figure 2 is longitudinal section of the gland assembly of Figure 1 showing the seal member uncompressed;

Figure 3 is a longitudinal section of the gland assembly of Figure 1 showing the seal member compressed;

Figure 4 is a perspective view showing the cap nut and cap nut sleeve of the gland assembly of Figures 1 to 3 disassembled;

Figure 5 is a side view showing the cap nut and cap nut sleeve of Figure 4 assembled;

Figure 6 is a section on the line 6-6 of Figure 5;

Figure 7 is an end view showing the cap nut and cap nut sleeve of Figure 4 assembled;

Figure 8 is a section on the line 8-8 of Figure 7;

Figure 9 is a perspective view showing a modified cap nut and cap nut sleeve disassembled;

Figure 10 is a side view showing the cap nut and cap nut sleeve of Figure 9 assembled;

Figure 11 is a section on the line 11-11 of Figure 10;

Figure 12 is an end view showing the cap nut and cap nut sleeve of Figure 9 assembled;

Figure 13 is a section on the line 13-13 of Figure 12;

Figure 14 is a perspective view showing another modified cap nut and cap nut sleeve disassembled;

Figure 15 is a side view showing the cap nut and cap nut sleeve of Figure 14 assembled;

Figure 16 is a section on the line 16-16 of Figure 15;

Figure 17 is an end view showing the cap nut and cap nut sleeve of Figure 14 assembled;

Figure 18 is a section on the line 18-18 of Figure 17;

Figure 19 is a perspective view showing a further modified cap nut and cap nut sleeve assembled;

Figure 20 is a side view showing the cap nut and cap nut sleeve of Figure 19 assembled;

Figure 21 is a section on the line 21-21 of Figure 20;

Figure 22 is an end view showing the cap nut and cap nut sleeve of Figure 19 assembled;

Figure 23 is a section on the line 23-23 of Figure 22;

Figure 24 is a perspective view showing yet another modified cap nut and cap nut sleeve disassembled;

Figure 25 is an end view showing the cap nut and cap nut sleeve of Figure 24 assembled;

Figure 26 is a section on the line 26-26 of Figure 25;

Figure 27 is a perspective view of a gland assembly according to another embodiment of the invention;

Figure 28 is a perspective view from one end of the sleeve member of the assembly of Figure 27;

Figure 29 is a perspective view from the other end of the sleeve member of the assembly of Figure 27; and

Figure 30 is a sectional view of the gland assembly of Figure 27.

Referring first to Figures 1 to 8 of the accompanying drawings, a cable gland assembly indicated generally at 1 includes a body 3, a cap nut 5, a cap nut sleeve 7, a seal member 9, and a seal urging member 11. Depending on the application, the gland assembly may include other parts such as an adaptor connectable to the body 3 for securing the gland assembly to the wall of an enclosure, a clamping arrangement within the gland assembly for securing cable armour, a barrier sleeve containing a hardenable filler compound within the gland for providing a flameproof seal. These and other features of gland assemblies will be familiar to those skilled in the art and are not described in detail as they do not form part of the present invention. It will be understood that the invention has application to such gland assemblies and

the following description is provided by way of non-limiting example of the application of the invention to the gland assembly depicted in the drawings.

The body 3 and cap nut 5 may typically be made of metal, for example brass, although other materials including plastics and metal/plastics composites may be employed. The cap nut sleeve 7 may typically be made of plastics, for example thermoplastics such as acetal (polyoxymethylene), nylon (polyamide), PBT (polybutylene terephthalate), although other materials including metal and metal/plastics composites may be employed. The seal member 9 may typically be made of elastomeric material, for example silicone, neoprene, natural rubber, although other polymeric materials may be employed. The seal urging member 11 may typically be made of plastics, for example thermoplastics such as acetal (polyoxymethylene), nylon (polyamide), PBT (polybutylene terephthalate) although other materials including metal and metal/plastics composites may be employed.

The body 3 preferably has a feature such as a hexagonal flange 13 between the ends for gripping the body 3 with a tool (not shown) such as a spanner. To one side of the flange 13, the body 3 has an externally threaded portion 15 for engagement with an internally threaded portion 17 of the cap nut 5. To the other side of the flange 13, the body 3 may have an externally threaded portion 19 for securing the body 3 to the wall (not shown) of an enclosure, for example a junction box, by inserting the threaded portion 19 through a hole in the wall and attaching a nut (not shown).

The seal member 9 has a generally cylindrical body 21 with an external flange 23 at one end and an external rib 25 at the other end. The seal urging member 11 has a plurality of fingers 27 arranged in a cylindrical formation on a support ring 29. The seal urging member 11 surrounds the cylindrical body 21 of the seal member 9 with the support ring 29 seated against the

flange 23. The fingers 27 are provided with a recess 31 in which the external rib 25 at the other end of the cylindrical body 21 locates.

Figure 2 shows the cable gland assembly 1 with a cable 33 extending therethrough and the seal member 9 uncompressed and Figure 3 shows the cable gland assembly 1 with the cable 33 extending therethrough and the seal member 9 compressed. The cable 33 may be an electric cable or fibre optic cable. On initial assembly, the flange 23 of the seal member 9 seats against the end of the body 3 and the ends of the fingers 27 seat against an angled internal face 35 of the cap nut 5 with the seal member 9 spaced from the cable 33 as shown in Figure 2.

Each finger 27 is pivotable about the connection to the support ring 29 such that, as the cap nut 5 is screwed onto the body 3, the fingers 27 pivot inwardly and urge the end of the seal member 9 remote from the flange 23 inwardly to engage and seal around the cable 33 as shown in Figure 3. The fingers 27 are relatively stiff and remain substantially straight while pivoting about the connection to the support ring 23, i.e. the fingers will not bend or flex intermediate their ends. The seal member 9 and the seal urging member 11 are disclosed and claimed in our granted European patent No.1362399 to which the reader is directed for further details.

In order to control the degree of tightening of the cap nut 5 and thus the force exerted on the seal member 9 by the cap nut 5 and in turn the pressure exerted on the cable 33 by the seal member 9, the cap nut sleeve 7 is provided. The cap nut sleeve 7 fits over the cap nut 5 and has a feature such as an external hexagonal form 36 at one end for gripping with a tool (not shown) such as a spanner.

The cap nut sleeve 7 and cap nut 5 also have co-operating formations to axially retain the cap nut sleeve 7 on the cap nut 5. For example, the cap nut

sleeve 7 may have an internal flange 37 at the same end that locates in an annular groove 39 in the outer surface of the cap nut 5. The flange 37 may be a snap-fit in the groove 39. The cap nut sleeve 7 may be permanently attached to the cap nut 5 by engagement of the co-operating formations. Alternatively, it may be that the cap nut sleeve 7 may be detachable from the cap nut 5.

To one side of the groove 39, the cap nut 5 has a feature such as an external hexagonal form 41 that is accessible for gripping with a tool (not shown) such as a spanner if required with the cap nut sleeve 7 mounted on the cap nut 5. To the other side of the groove 39, the cap nut 5 has a plurality of axially extending grooves 43. The grooves 43 may be uniformly spaced apart in the circumferential direction. The grooves 43 may extend between the groove 39 and the end of the cap nut 5 remote from the hexagonal form 41.

Each groove 43 has a steep abutment face 45 on one side and a shallow abutment face 49 on the other side. The steep abutment face 45 may extend at approximately 90 degrees to the base 47 of the groove and the shallow abutment face 49 may extend at approximately 45 degrees to the base 47 of the groove 43. These inclinations are not limiting and variations in the inclination of one or both faces 45, 47 can be envisaged.

The cap nut sleeve 7 has a plurality of internal axially extending fingers 51. The fingers 51 may be uniformly spaced apart in the circumferential direction. The fingers 51 may extend between the flange 37 and the end of the cap nut sleeve 7 remote from the hexagonal form 36. The fingers 51 are inclined with respect to the circumferential direction and each finger 51 locates in a groove 43 when the cap nut sleeve 7 is mounted on the cap nut 5. The fingers may be inclined at approximately 45 degrees to the

circumferential direction. This inclination is not limiting and variations in the inclination of the fingers 51 can be envisaged.

In this embodiment, the cap nut 5 has twenty four (24) axial grooves 43 and the cap nut sleeve 7 has six (6) axial fingers 51. It will be understood that this is not limiting and that the number of grooves 43 and fingers 51 may be varied. Generally, however, it is envisaged that the number of grooves 43 will exceed the number of fingers 51 although this may not be essential and there may be equal numbers of grooves 43 and fingers 51.

In use, the fingers 51 engage the shallow abutment face 49 of the grooves 43 in which they are received to transmit torque from the cap nut sleeve 7 to the cap nut 5 to rotate the cap nut 5 in a direction to tighten the cap nut 5 on the body 3 as long as the force required to rotate the cap nut 5 is less than the force required to deform the fingers 51 to ride over the shallow abutment face 49. When the rotational force exceeds the deforming force, the fingers 51 deform and ride over the shallow abutment faces 49 allowing the cap nut sleeve 7 to rotate around the cap nut 5 so that torque is no longer transmitted from the cap nut sleeve 7 to the cap nut 5 in the direction to tighten the cap nut 5 on the body 3. Deformation of the fingers 51 may be assisted by providing cut-outs 52 in the flange 37 aligned with the fingers 51 such that deformation of the cap nut sleeve 7 may also occur to some extent. As a result, over-tightening of the cap nut 5 is prevented by the cap nut sleeve 7 slipping relative to the cap nut 5 in the direction to tighten the cap nut 5, i.e. rotation of the cap nut sleeve 7 in the direction of arrow A in Figure 6. If the direction of rotation of the cap nut sleeve 7 is reversed, i.e. rotation of the cap nut sleeve 7 in the direction of arrow B in Figure 6, the tips of the fingers 51 seat against the steep abutment faces 45 of the grooves 43 in which they are located so that torque is now transmitted from the cap nut sleeve 7 to the cap nut 5 to rotate the cap nut 5 in a direction to loosen the cap nut 5.

As will be apparent, the degree to which the cap nut 5 can be tightened before the cap nut sleeve 7 starts to slip and prevent further tightening of the cap nut 5 will depend on various factors including, for example, the angle of the shallow abutment face 49 on the cap nut 5, the inclination of the fingers 51, the stiffness of the fingers 51, the relative interference between the fingers 51 and grooves 43. Accordingly, by appropriate selection of one or more these factors and/or any other factors affecting transmission of torque between the cap nut sleeve 7 and the cap nut 5, the degree of tightening of the cap nut 5 before slippage occurs can be controlled to prevent the cap nut being over-tightened.

Referring now to Figures 9 to 13 of the drawings, there is shown a modification to the cap nut and cap nut sleeve of the first embodiment. For convenience, like reference numerals are used to indicate the same or similar parts. In this modification, the cap nut sleeve 7 consists of a belt 53 provided with formations 55, 57 at the ends that interlock to form the cap nut sleeve 7. In other respects the operation of the cap nut sleeve 7 to control the degree of tightening of the cap nut 5 and to loosen the cap nut 5 is similar to and will be understood from the description of the first embodiment. It may be that the cap nut sleeve 7 is temporarily attached to the cap nut 5 and can be detached from the cap nut 5. For example the cap nut sleeve 7 may be detached by releasing the formations 55, 57 to open the cap nut sleeve 7 or by sliding the cap nut sleeve 7 in an axial direction relative to the cap nut 5 to disengage the fingers 51 from the grooves 43.

Referring now to Figures 14 to 18 of the drawings, there is shown another modification to the cap nut and cap nut sleeve of the first embodiment. For convenience, like reference numerals are used to indicate the same or similar parts. In this modification, the cap nut 5 and cap nut sleeve 7 are provided with equal numbers of grooves 43 and fingers 51. In other respects the

operation of the cap nut sleeve 7 to control the degree of tightening of the cap nut 5 and to loosen the cap nut 5 is similar to and will be understood from the description of the first embodiment. Also in this modification, the cap nut 5 does not have an external feature for gripping the cap nut 5 with a tool and the cap nut sleeve 7 is configured to fit over the cap nut 5 and substantially conceals the cap nut 5. The hexagonal form 36 may be provided at the outer end of the cap nut sleeve 7. The cap nut sleeve 7 may be axially retained on the cap nut 5 by engagement of co-operating formations such as flange 37 engaging groove 39. The flange 37 may be a snap-fit in the groove 39. The cap nut sleeve 7 may be permanently attached to the cap nut 5 by engagement of the co-operating formations. Alternatively, it may be that the cap nut sleeve 7 may be detachable from the cap nut 5.

Referring now to Figures 19 to 23, there is shown another modification to the cap nut and cap nut sleeve of the first embodiment. For convenience, like reference numerals are used to indicate the same or similar parts. In this modification, the cap nut sleeve 7 is located and retained on the cap nut 5 between a pair of annular rings 59 located in annular grooves 61 in the outer surface of the cap nut 5. In other respects the operation of the cap nut sleeve 7 to control the degree of tightening of the cap nut 5 and to loosen the cap nut 5 is similar to and will be understood from the description of the first embodiment. The cap nut sleeve 7 may be permanently attached to the cap nut 5 by the rings 59. Alternatively, it may be that one or both rings 59 can be released from the associated groove 61 so that the cap nut sleeve 7 can be detached from the cap nut 5 by sliding the cap nut sleeve 7 in an axial direction relative to the cap nut 5.

Referring now to Figures 24 to 26, there is shown another modification to the cap nut and cap nut sleeve of the first embodiment. For convenience, like reference numerals are used to indicate the same or similar parts. In this

modification, the cap nut sleeve 7 is located and retained on the cap nut 5 by an annular ring 63 located in opposed annular grooves 65, 67 in the outer surface of the cap nut 5 and the inner surface of the cap nut sleeve 7. The axial grooves 43 in the outer surface of the cap nut 5 in the first embodiment are replaced by a plurality of protrusions 69 spaced apart in the circumferential direction on the end face of the cap nut 5. Each protrusion 69 is provided with a steep abutment face 45 at one end and a shallow abutment face 49 at the other end. The cap nut sleeve 7 is provided with a plurality of fingers 51 that locate between the protrusions 69. The fingers 51 are inclined similar to the shallow abut faces 49 on the cap nut 5. The fingers 51 co-operate with the shallow abutment faces 49 to transmit torque for tightening the cap nut 5 until the fingers 51 deform and ride over the protrusions 51 to prevent over-tightening the cap nut 5. The fingers 51 co-operate with the steep abutment faces 45 to transmit torque for loosening the cap nut 5.

Referring now to Figures 27 to 30, a cable gland assembly according to another embodiment of the invention is depicted generally at 101 and includes a body 103, a cap nut 105 and a cap nut sleeve 107. The cap nut 105 has an internal thread engageable with an external thread at one end of the body 103 for tightening a seal (not shown) around an elongate member (not shown) extending through the gland assembly in use. The seal may be of the type shown and described with reference to previous embodiments or any other type of seal employed in cable gland assemblies. In this embodiment, an adaptor 109 is shown having an external thread at one end engageable with an internal thread at the other end of the body 103. The adaptor 109 has a spigot 111 at the other end for insertion through a hole (not shown) in a wall of an enclosure (not shown) such as a junction box to which a nut (not shown) may be attached to attach the gland assembly to the enclosure. The adaptor 109 has a feature such as an external flange 113 of hexagonal form for gripping the adaptor 109 with a tool (not shown) such as

a spanner. Depending on the application, the gland assembly may include other parts such as a clamping arrangement within the gland assembly for securing cable armour, a barrier sleeve containing a hardenable filler compound within the gland for providing a flameproof seal. These and other features of gland assemblies will be familiar to those skilled in the art and are not described in detail as they do not form part of the present invention.

The body 103, cap nut 105 and adaptor 109 may typically be made of metal, for example brass, although other materials including plastics and metal/plastics composites may be employed. The cap nut sleeve 107 may typically be made of plastics, for example [thermoplastics such as acetal (polyoxymethylene), nylon (polyamide), PBT (polybutylene terephthalate)], although other materials including metal and metal/plastics composites may be employed. The body 103 has a feature such as an external flange 115 of hexagonal form between the ends for gripping the body 103 with a tool (not shown) such as a spanner.

The cap nut sleeve 107 fits over the cap nut 105 and has a cylindrical form. An internal socket 117 having a form complementary to the external flange 115 on the body 103 is provided at one end of the cap nut sleeve 107. In this embodiment the flange 115 is hexagonal and the socket 117 has a matching hexagonal profile but it will be understood that other shapes may be employed. The cap nut sleeve 107 is also provided with an internal annular flange 119 that defines the base of the socket 117.

A plurality of slots 121 are formed in the wall of the cap nut sleeve 107 that are spaced apart in the circumferential direction and extend in an axial direction from the other end of the cap nut sleeve 107 towards and terminate before the flange 119. Between the slots 121, the cap nut sleeve 107 is provided with one or more internal ribs 123 that are spaced apart in the

circumferential direction and extend in an axial direction. The ribs 123 are shorter than and terminate before the inner end of the slots 121.

The cap nut 105 preferably has a feature such as an external hexagonal form 125 at one end for gripping with a tool (not shown) such as a spanner and a plurality of grooves 127 extending axially to the other end. The grooves 125 may be uniformly spaced apart in the circumferential direction. Each rib 123 is received in a groove 127 when the cap nut sleeve 107 is mounted on the cap nut 105. In this embodiment, the number of grooves 125 exceeds the number of ribs 123 although this may not be essential and there could be equal numbers of ribs 123 and grooves 125.

In use, the cap nut sleeve 107 is mounted on the cap nut 105 with the flange 119 located against the end of the cap nut 105. The cap nut 105 is attached to the body 103 by engagement of the matching screw threads and rotated by engagement of the hexagonal form 125 with a tool to urge a seal (not shown) located between the body 103 and cap nut 105 to engage an elongate element (not shown) such as a cable extending axially through the gland. When the cap nut 105 has been sufficiently tightened to achieve the required seal, the cap nut sleeve 107 can be slid in an axial direction to locate the hexagonal flange 115 in the socket 117 as shown in Figure 30. If necessary, the cap nut sleeve 107 can be rotated relative to the cap nut 105 to align the socket 117 with the flange 115 by applying a rotational force in a clockwise or anti-clockwise direction to the cap nut sleeve 107 sufficient to deform the slotted end of the cap nut sleeve 107 so that the ribs 123 can disengage the grooves 127 allowing the cap nut sleeve 107 to rotate and engage the ribs 123 in the adjacent grooves 127 until the socket 117 is aligned with the flange 115. The cap nut sleeve 107 can then be slid to engage the flange 115 in the socket 117. In this position, the ribs 123 are still received in the grooves 125 and the cap nut sleeve 107 extends between and engages both the body 103 and cap nut 105 so that rotation of the cap

nut 105 relative to the body 103 is inhibited. As a result, loosening of the cap nut 105 by vibration or other forces applied to the gland assembly in situ is inhibited and may be prevented entirely. If it is necessary to dis-assemble the gland for any reason, the cap nut sleeve 107 can be slid back towards the cap nut 105 to disengage the flange 115 from the socket 117 and the cap nut 105 unscrewed from the body 103.

In the above-described embodiment, the cap nut 105 and cap nut sleeve 107 are configured so that the cap nut sleeve 107 can be rotated in either direction relative to the cap nut 105 to align the socket 117 with the flange 115 and the cap nut sleeve 107 provides the function of an anti-rotation device operable to inhibit relative rotation of the cap nut 105 and body 103 when positioned to engage both the cap nut 105 and body 103. It will be understood, however, that cap nut 105 and cap nut sleeve 107 may also be configured so that the cap nut sleeve 107 combines the function of the anti-rotation device with the function of a torque transmitting device operable to control tightening of the cap nut 105 as described for the previous embodiments.

Thus the cap nut sleeve 107 may be provided with a feature such as an external hexagonal form for gripping the cap nut sleeve 107 with a tool such as a spanner and the ribs 123 and grooves 125 configured to transmit torque applied to the cap nut sleeve 105 to the cap nut 105 for tightening the cap nut 105 on the body 103 until the required degree of tightening is obtained whereupon the slotted portions deform allowing the cap nut sleeve 107 to rotate relative to the cap nut 105 to prevent further tightening of the cap nut 105 on the body 103. This rotation may also allow the socket 117 to be aligned with the flange 115 so that the cap nut sleeve 107 can be slid to engage the flange 115 and inhibit relative rotation between the cap nut 105 and the body 103 to loosen the cap nut 105. The ribs 123 and grooves 125 may also be configured to maintain engagement and transmit torque applied

to the cap nut sleeve 107 in the reverse direction to the cap nut 105 for releasing the cap nut 105 when the cap nut sleeve 107 is positioned to disengage the body 103. It will be understood that the cap nut and cap nut sleeve may be provided with any suitable formations for achieving the required operation of the cap nut sleeve.

While the invention has been described with reference to exemplary embodiments, it will be understood that we do not intend the invention to be limited thereto and that various modifications and changes may be made without departing from the principles and concepts of the invention.

For example, the cap nut and cap nut sleeve may be provided with any suitable co-operating formations capable of providing one or more of the following functions

- transmitting torque in one direction of rotation for tightening the cap nut to a required degree
- allowing the cap nut sleeve to slip relative to the cap nut to prevent over-tightening the cap nut
- transmitting torque in the reverse direction of rotation for loosening the cap nut
- allowing the cap nut sleeve to engage the cap nut and another gland part to prevent loosening the cap nut

In at least some of the above-described embodiments, the cap nut sleeve is provided with one or more fingers for transmitting torque to the cap nut where the or each finger is capable of deforming to allow the cap nut sleeve to slip over and rotate relative to the cap nut to prevent over-tightening the cap nut and thus control the pressure exerted on the seal member and in turn control the contact pressure between the seal member and the cable. In other arrangements, it may be that one or more fingers (or other suitable formation(s)) are provided on the cap nut, for example where the cap nut is

made of plastics or a metal/plastics composite. In this case, the cap nut sleeve may be made of metal or a metal/plastics composite or plastics.

In at least some of the above-described embodiments, the seal member is provided with a seal urging device to urge the seal member to engage the cable in response to movement of the cap nut. In other arrangements, it may be that the seal member and seal urging device are replaced by any other suitable seal arrangement responsive to movement of the cap nut to engage the cable.

It will also be understood that the principles and concepts of the invention are not limited to the exemplary embodiments of a cable gland assembly. The provision of the cap nut sleeve configured to prevent over-tightening of the cap nut and/or to prevent loosening of the cap nut may be applied to any threadably engaged parts of a gland assembly. The gland assembly may have a seal of any type that is urged to engage an elongate member extending through the gland in response to relative rotation of two parts of the gland assembly.

For example, the invention has application including but not limited to

- gland assemblies for armoured electric cable or fibre optic cable or pipes or conduits
- gland assemblies for non-armoured electric cable or fibre optic cable or pipes or conduits
- barrier gland assemblies for electric cable or fibre optic cable or pipes or conduits
- non-barrier gland assemblies for electric or fibre optic cable or pipes or conduits

Other modifications and changes that can be made without departing from the principles and concepts described herein will be apparent to those skilled in the art and are covered herein.

It will also be understood that the invention extends to and includes any novel feature or combination of novel features described herein.

CLAIMS

1. A gland assembly for an elongate member extending, in use, through the gland assembly, the gland assembly including a gland member that is movable in response to an applied torque to cause a seal member to seal around the elongate member, wherein the gland member is provided with a torque transmitting device operable to inhibit over-tightening the gland member.

2. The gland assembly of claim 1 wherein the gland member is engageable with a further gland member by means of mating screw threads whereby rotation of the gland member by an applied torque in one direction causes axial movement of the gland member to tighten the gland member and apply a force to the seal member so as to urge the seal member to seal around the elongate member.

3. The gland assembly of claim 2 wherein the torque transmitting device comprises a sleeve member that is rotatable with the gland member to transmit torque applied to the sleeve member to the gland member for tightening the gland member.

4. The gland assembly of claim 3 wherein the sleeve member can rotate relative to the gland member to isolate the gland member from torque applied to the sleeve member for preventing over-tightening of the gland member.

5. The gland assembly of claim 3 or claim 4 wherein the sleeve member has one or more formations arranged to engage the gland member so that the sleeve member can rotate with the gland member whereby torque applied to the sleeve member is transmitted to the gland member for tightening the gland member.

6. The gland assembly of claim 5 wherein the or each formation is capable of deforming to disengage the gland member so that the sleeve member can rotate relative to the gland member whereby torque applied to the sleeve member is not transmitted to the gland member for preventing over-tightening of the gland member.

7. The gland assembly of claim 5 or claim 6 wherein the or each formation is engageable with an abutment on the gland member for transmitting torque applied to the sleeve member to the gland member.

8. The gland assembly of claim 7 wherein the or each formation is configured to ride over the abutments to prevent over-tightening the gland member.

9. The gland assembly of claim 7 or claim 8 wherein the or each formation is engageable with a further abutment on the gland member for transmitting torque applied to the sleeve member to the gland member in a direction to loosen the gland member.

10. The gland assembly of claim 9 wherein the or each formation is configured to maintain engagement with the further abutments to release the gland member.

11. The gland assembly of any of claims 3 to 10 wherein the sleeve member is operable to inhibit rotation of the gland member relative to the further gland member for maintaining a tightened position of the gland member and inhibiting loosening of the gland member.

12. The gland assembly of claim 11 wherein the sleeve member is movable in an axial direction relative to the gland member between a release position for rotation with the gland member relative to the further gland

member when tightening the gland member and a locking position for engaging both gland members to inhibit relative rotation of the gland member and further gland member.

13. A method of assembling a gland assembly to control a force exerted on a seal member by a gland member that is movable in response to an applied torque to tighten the gland member and cause the seal member to seal around an elongate member extending through the gland assembly, the method including providing the gland member with a device for transmitting an applied torque to the gland member for tightening the gland member wherein the device is configured to inhibit over-tightening the gland member.

14. The method of claim 13 wherein the torque transmitting device is configured to rotate with the gland member in a direction to tighten the gland member to a required degree and then to rotate relative to the gland member so that over-tightening of the gland member can be avoided.

15. The method of claim 14 wherein the torque transmitting device comprises a sleeve member that can be fitted over the gland member and is provided with one or more formations engageable with the gland member for transmitting torque applied to the sleeve member to the gland member for tightening the gland member, wherein the formations can deform when the gland member has been tightened to the required degree to permit the sleeve member to rotate relative to the gland member.

16. A gland nut for a gland assembly, the gland nut being provided with a torque transmitting device to inhibit over-tightening the gland nut.

17. A gland assembly for an elongate member extending, in use, through the gland assembly, the gland including two relatively rotatable gland

members, and an anti-rotation device operable to inhibit relative rotation of the gland members.

18. The gland assembly of claim 17 wherein the anti-rotation device comprises a sleeve member that is co-operable with both gland members to inhibit relative rotation of the gland members.

19. The gland assembly of claim 18 wherein the sleeve member and a first gland member have co-operating formations configured to prevent relative rotation therebetween.

20. The gland assembly of claim 19 wherein the first gland member has an external flange and the sleeve member has a complementary internal socket in which the flange is received to prevent relative rotation of the first gland member and sleeve member.

21. The gland assembly of any of claims 18 to 20 wherein the sleeve member and a second gland member have co-operating formations configured to inhibit relative rotation therebetween.

22. The gland assembly of claim 21 wherein one of the sleeve member and the second gland member have a plurality of axially extending grooves and the other of the sleeve member and the second gland member has one or more axially extending ribs that are engageable with the grooves.

23. The gland assembly of claim 22 wherein the co-operating formations are configured to inhibit relative rotation between the sleeve member and the second gland member if a torque is applied to the sleeve member or the second gland member up to a pre-determined limit, and to allow relative rotation between the sleeve member and the second gland member if a torque

is applied to the sleeve member or the second gland member that exceeds a pre-determined limit.

24. The gland assembly of any of claims 18 to 23 wherein the sleeve member is axially slidable along the second gland member from a release position to a locking position.

25. The gland assembly of claim 24 wherein, in the release position, the sleeve member is disengaged from the first gland member and relative rotation of the gland members is permitted.

26. The gland assembly of claim 24 or claim 25 wherein, in the locking position, the sleeve member is engaged with the first gland member and relative rotation of the gland members is inhibited.

27. The gland assembly of any of claims 24 to 26 wherein the gland members can be tightened with the sleeve member located in the release position on the second gland member and rotating relative to the first gland member.

28. The gland assembly of claim 27 wherein, when the gland members have been tightened, the sleeve member can be slid axially to the locking position to engage the first gland member and secure the gland members so that relative rotation of the gland members to loosen the gland members is inhibited.

29. The gland assembly of any of claims 21 to 23 wherein the sleeve member is located on the first gland member and the second gland member is rotatable relative to the sleeve member and the first gland member to tighten the gland members by applying a torque sufficient to overcome the

engagement of the co-operating formations on the sleeve member and the second gland member.

30. The gland assembly of claim 29 wherein the co-operating formations on the sleeve member and second gland member engage to inhibit relative rotation of the gland members so that relative rotation of the gland members to loosen the gland members is inhibited.

31. The gland assembly of any of claims 28 to 30 wherein the sleeve member inhibits over-tightening of the gland members.

32. A method of assembling a gland assembly including connecting two relatively rotatable gland members and providing a device co-operable with both gland members in a tightened condition that inhibits relative rotation of the gland members to loosen the gland members.

33. A gland nut for a gland assembly, the gland nut being provided with an anti-rotation device to inhibit loosening the gland nut.

34. A gland assembly for an elongate member extending, in use, through the gland assembly, the gland including two gland members that are relatively rotatable in a first direction to tighten the gland members and in a second direction to loosen the gland members, and a device operable to control relative rotation of the gland members in the first direction and/or the second direction.

35. The gland assembly of claim 34 wherein relative rotation of the gland members in the first direction causes a seal member to seal around the elongate member, and one of the gland members is provided with a device operable to inhibit over-tightening the gland members.

36. The gland assembly of claim 35 wherein the gland members are engageable by means of mating screw threads whereby rotation of said one gland member by an applied torque in the first direction causes axial movement of said one gland member to tighten the gland member and apply a force to the seal member so as to urge the seal member to seal around the elongate member.

37. The gland assembly of claim 36 wherein the device comprises a sleeve member that is rotatable with said one gland member to transmit torque applied to the sleeve member to the gland member for tightening the gland member.

38. The gland assembly of claim 37 wherein the sleeve member can rotate relative to said one gland member to isolate the gland member from torque applied to the sleeve member for preventing over-tightening of the gland member.

39. The gland assembly of claim 37 or claim 38 wherein the sleeve member has one or more formations arranged to engage said one gland member so that the sleeve member can rotate with the gland member whereby torque applied to the sleeve member is transmitted to the gland member for tightening the gland member.

40. The gland assembly of claim 39 wherein the or each formation is capable of deforming to disengage said one gland member so that the sleeve member can rotate relative to the gland member whereby torque applied to the sleeve member is not transmitted to the gland member for preventing over-tightening of the gland member.

41. The gland assembly of claim 39 or claim 40 wherein the or each formation is engageable with an abutment on said one gland member for transmitting torque applied to the sleeve member to the gland member.

42. The gland assembly of claim 41 wherein the or each formation is configured to ride over the abutments to prevent over-tightening the gland member.

43. The gland assembly of claim 41 or claim 42 wherein the or each formation is engageable with a further abutment on said one gland member for transmitting torque applied to the sleeve member to the gland member in the second direction to loosen the gland member.

44. The gland assembly of claim 43 wherein the or each formation is configured to maintain engagement with the further abutments.

45. The gland assembly of any of claims 37 to 44 wherein the sleeve member is operable to inhibit relative rotation of the gland members for maintaining a tightened position of the gland members and inhibiting loosening of the gland members.

46. The gland assembly of claim 45 wherein the sleeve member is movable in an axial direction relative to said one gland member between a first position for rotation with said one gland member relative to the other gland member when tightening the gland members and a second position for engaging both gland members to inhibit relative rotation of the gland members.

Application No: GB1300454.4 **Examiner:** Paul Nicholls

Claims searched: 1 - 16 **Date of search:** 12 June 2013

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	1-8, 11-16	US 4789759 A (JONES) - See figures 7-14 - rotating nut 100 tightens ferrule 30, but on over-tightening the nut breaks at splits 104, see column 8 lines 4-45; see also column 8 lines 2-3 regarding sealing

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

F16B; H02G

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

WPI, EPODOC, TXTE

International Classification:

Subclass	Subgroup	Valid From
H02G	0015/013	01/01/2006
F16B	0031/02	01/01/2006
H02G	0015/007	01/01/2006

Application No: GB1300454.4 **Examiner:** Paul Nicholls

Claims searched: 17 - 46 **Date of search:** 17 December 2013

Patents Act 1977
Further 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	17, 33, 34	US 5321205 A (BAWA et al) - See figure 2, hub 12, body 16, surfaces 48 and 50, and column 3 lines 36-59
X	17, 33, 34	GB 2106336 A (BICC) - See grooves 4 on body 1 and corners 3 on compressor 2
X	17, 33, 34	US 5059139 A (SPINNER) - See hexagonal head 3a on clamp 3 and hexagonal socket 4a in bush 4

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H02G	0015/007	01/01/2006