(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 184 710 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**28.06.2017 Bulletin 2017/26**

(51) Int Cl.:
***E04C 5/16*** *(2006.01)* ***E04G 21/32*** *(2006.01)*

(21) Application number: **16205694.9**

(22) Date of filing: **21.12.2016**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**MA MD**

(30) Priority: **22.12.2015 AU 2015905335**

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## (54) SAFETY DEVICE

(57) A safety apparatus for fitting to a free end of an elongate member, for example a reinforcing bar, has a sleeve portion defining a receiving space for receiving a free end of the member and providing an opening of the receiving space to allow insertion of the member from a first end of the apparatus, and a covering portion which provides a barrier to prevent passage of the member through a second end of the safety device. The safety apparatus may have a gripping part which is resiliently deformable, so that it is resiliently deformed by insertion of the member so as to securely grip metal member, and so that it returns to substantially its non-deformed shape upon removal of the metal member. The receiving space may be tapered.

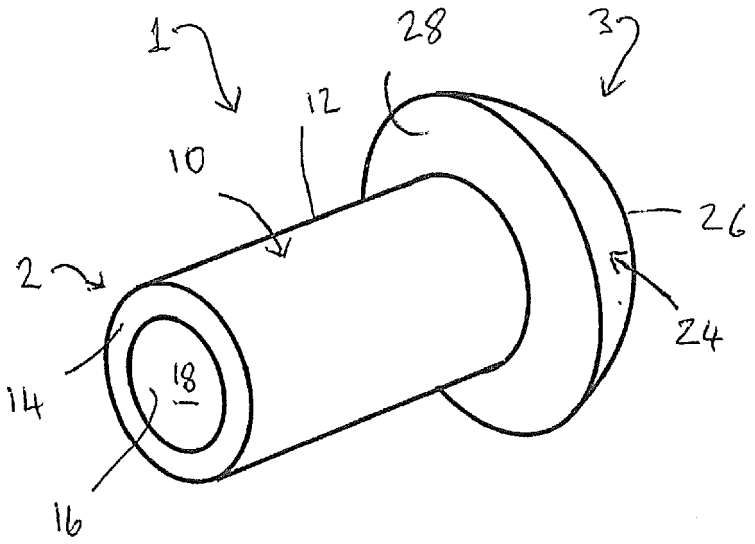


Fig. 1

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## Description

### Field

**[0001]** The present disclosure relates to a safety device and especially, but not exclusively to a safety device in the form of an end cap, for fitting to a free end of a steel reinforcing bar, that reduces the risk of injury to workers in the vicinity of the reinforcing bar.

### Definition

**[0002]** In the specification the term "comprising" shall be understood to have a broad meaning similar to the term "including" and will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps. This definition also applies to variations on the term "comprising" such as "comprise" and "comprises".

### Background

**[0003]** Steel reinforcing bars, often called reo bars, are widely used in construction, to reinforce concrete structures. During construction it is not uncommon for a reinforcing bar to project from a concrete structure or surface, resulting in a free end of the reinforcing bar presenting a significant safety hazard. Reinforcing bars are typically (but not always) generally circular in transverse cross section, and typically have a diameter between about 10 mm and about 40 mm. The free ends of reinforcing bars may include rough, sharp or burred surfaces and can cause injuries if inadvertently walked into, impacted upon or even brushed against. Further, being quite small in transverse cross section and quite stiff, especially in short lengths such as those which project from concrete surfaces on a construction site, reinforcing bars may impale a worker causing serious injury or death if fallen upon.

### Summary

**[0004]** According to a first aspect of the present disclosure there is provided a safety device for fitting to a free end of a reinforcing bar, the safety device comprising:

a sleeve portion defining a receiving space therein for receiving a free end of a reinforcing bar, and providing an opening of the receiving space to allow insertion of a reinforcing bar into the receiving space from a first end of the safety device; and

a covering portion which provides a barrier to prevent passage of a reinforcing bar through a second end of the safety device;

wherein the receiving space is at least partly defined by a wall part which is resiliently deformable such that the wall part is resiliently deformed by insertion of a reinforcing bar into the receiving space, thereby to securely grip the reinforcing bar, and such that the wall part returns to substantially its non-deformed shape upon removal of the reinforcing bar.

**[0005]** In an embodiment the covering portion forms the second end of the safety device.

**[0006]** In an embodiment the wall part defines a generally circular transverse cross section of the receiving space.

**[0007]** In an embodiment the wall part comprises an elastomeric material.

**[0008]** In an embodiment the wall part comprises a polyurethane material.

**[0009]** In an embodiment the wall part extends substantially the length of the sleeve portion.

**[0010]** In an embodiment the wall part is integrally formed with the sleeve portion.

**[0011]** In an embodiment the wall part is integrally formed as part of the sleeve portion.

**[0012]** In an embodiment the sleeve portion and the wall part are formed as a single piece.

**[0013]** In an embodiment the sleeve portion and the wall part are formed as a single, integrally moulded, piece.

**[0014]** In an embodiment at least most of the sleeve portion is made of an elastomeric material.

**[0015]** In an embodiment at least most of the sleeve portion is made of a polyurethane material.

**[0016]** In an embodiment substantially all of the sleeve portion is made of an elastomeric material.

**[0017]** In an embodiment substantially all of the sleeve portion is made of a polyurethane material.

**[0018]** In an embodiment the receiving space is elongate.

**[0019]** In an embodiment the receiving extends from the opening towards the second end of the safety device.

**[0020]** In an embodiment the receiving space is generally cylindrical.

**[0021]** In an embodiment the receiving space is tapered along its length.

**[0022]** In an embodiment the receiving space is tapered substantially uniformly along its length.

**[0023]** In an embodiment the receiving space is tapered in a plurality of steps.

**[0024]** In an embodiment the receiving space is greater in transverse cross sectional size at or adjacent the opening and reduces in cross sectional size as it extends towards the second end of the safety device.

**[0025]** In an embodiment the receiving space tapers by at least 0.5 mm in transverse width.

**[0026]** In an embodiment the receiving space tapers by at least 1 mm in transverse width.

**[0027]** In an embodiment the receiving space tapers by no more than about 6 mm in transverse width.

**[0028]** In an embodiment the receiving space tapers by no more than about 4 mm in transverse width.

**[0029]** In an embodiment the receiving space is generally frustoconical.

**[0030]** In an embodiment the wall part extends substantially the entire length of the receiving space.

**[0031]** In an embodiment the wall part is substantially annular in transverse cross section.

**[0032]** In an embodiment the wall part has a thickness of at least 2 mm.

**[0033]** In an embodiment the wall part has a thickness of at least 2.5 mm.

**[0034]** In an embodiment the wall part has a thickness of at least 3 mm.

**[0035]** In an embodiment the covering portion defines a curved second end surface of the safety device.

**[0036]** In an embodiment the curved end surface provides a rounded second end of the safety device.

**[0037]** In an embodiment the curved end surface rapidly broadens with distance from the second end.

**[0038]** In an embodiment the curved end surface rapidly broadens with distance from the second end, to a transverse size which is greater than the mean transverse size of the sleeve portion.

**[0039]** In an embodiment the curved end surface is part spherical.

**[0040]** In an embodiment the curved end surface is part ellipsoidal.

**[0041]** In an embodiment a wall portion of the covering portion which extends between a closed end of the cavity and the second end of the safety device is thicker than a wall portion of the sleeve portion.

**[0042]** In an embodiment a transversely extending wall portion extends between the curved end surface and an outer surface of the sleeve portion.

**[0043]** In an embodiment the transversely extending wall portion extends between the curved end surface and an outer surface of the sleeve portion.

**[0044]** In an embodiment the transversely extending wall portion is substantially annular.

**[0045]** In an embodiment the receiving space extends past the transversely extending wall portion.

**[0046]** In an embodiment a venting passage extends between a part of the receiving space spaced from the opening and an exterior of the device.

**[0047]** In an embodiment the covering portion is formed integrally with the sleeve portion.

**[0048]** In an embodiment the sleeve portion and the covering portion are formed as a single piece.

**[0049]** In an embodiment the sleeve portion and the covering portion are formed as a single, integrally moulded, piece.

**[0050]** In an embodiment substantially the entire safety device is formed as a single, integrally moulded, piece.

**[0051]** In an embodiment at least most of the safety device is made of an elastomeric material.

**[0052]** In an embodiment at least most of the safety device is made of a polyurethane material.

**[0053]** In an embodiment substantially the entire safety device is made of an elastomeric material.

**[0054]** In an embodiment substantially the entire safety device is made of a polyurethane material.

**[0055]** According to a second aspect of the present disclosure there is provided a safety device for fitting to a free end of a reinforcing bar, the safety device comprising:

a sleeve portion defining a receiving space therein for receiving a free end of a reinforcing bar, and providing an opening of the receiving space to allow insertion of a reinforcing bar into the receiving space from a first end of the safety device; and

a covering portion which provides a barrier to prevent passage of a reinforcing bar through a second end of the safety device;

wherein the receiving space is space is elongate, extends from the opening towards the second end of the safety device, and wherein the receiving space is tapered along its length.

**[0056]** In an embodiment the receiving space is at least partly defmed by a wall part which is resiliently deformable.

**[0057]** In an embodiment the wall part is resiliently deformable such that the wall part is resiliently deformed by insertion of a reinforcing bar into the receiving space, thereby to securely grip the reinforcing bar, and such that the wall part returns to substantially its non-deformed shape upon removal of the reinforcing bar.

**[0058]** It will be appreciated that embodiments of the safety device in accordance with the third aspect may include any one or more of the features or characteristics defined above in relation to embodiments of the first aspect.

**[0059]** According to a third aspect of the present disclosure there is provided a safety apparatus for fitting to a free end of an elongate member, the safety apparatus comprising:

a sleeve portion defining a receiving space therein for receiving a free end of said elongate member, and providing an opening of the receiving space to allow insertion of an end of the elongate member into the receiving space from a first end of the safety apparatus; and

a covering portion which provides a barrier to prevent passage of the end of the elongate member through a second end of the safety device;

wherein the safety apparatus comprises a gripping part which is resiliently deformable, and wherein the gripping part is resiliently deformed by insertion of the elongate member into the receiving space, thereby to securely grip the metal member, and such that the gripping part returns to substantially its non-de-

formed shape upon removal of the elongate member from the receiving space.

**[0060]** In an embodiment the gripping part comprises a wall part which at least partly defines the receiving space.

**[0061]** In an embodiment the safety device is for fitting to a free end of a metal member.

**[0062]** In an embodiment the safety device is for fitting to a free end of a reinforcing bar.

**[0063]** According to a fourth aspect of the present disclosure there is provided a safety apparatus for fitting to a free end of an elongate member, the safety apparatus comprising:

a sleeve portion defining a receiving space therein for receiving a free end of said elongate member, and providing an opening of the receiving space to allow insertion of an end of the elongate member into the receiving space from a first end of the safety apparatus; and

a covering portion which provides a barrier to prevent passage of the end of the elongate member through a second end of the safety device;

wherein the receiving space is space is elongate, extends from the opening towards the second end of the safety apparatus, and wherein the receiving space is tapered along its length.

**[0064]** In an embodiment the safety apparatus comprises a gripping part which is resiliently deformable.

**[0065]** In an embodiment the gripping part is resiliently deformed by insertion of the elongate member into the receiving space, thereby to securely grip the metal member, and such that the gripping part returns to substantially its non-deformed shape upon removal of the elongate member from the receiving space.

**[0066]** Embodiments of the safety devices in accordance with the third or fourth aspects may have any one or more of the features defined above in relation to embodiments of the first aspect.

**[0067]** It will be appreciated that embodiments of the safety devices in accordance with the third or fourth aspects may include any one or more of the features or characteristics defined above in relation to the first aspect and/or embodiments of the first aspect.

**[0068]** Some embodiments of the third and fourth aspects may be for fitting to a free end of an elongate member other than a reinforcing bar: thus references to a "reinforcing bar" used in relation to the first aspect or embodiments thereof should be taken to be to an "elongate member or a "metal member" when considered in relation to the third or fourth aspects, for consistency and in order to properly define or describe features or characteristics of such embodiments.

Brief description of the drawings

**[0069]** Embodiments will be described below, in detail, with reference to accompanying drawings. The primary purpose of this detailed description is to instruct persons having an interest in the subject matter of the invention how to carry the invention into practical effect. However, it is to be clearly understood that the specific nature of this detailed description does not supersede the generality of the statements in the Summary above, but rather relates to examples only. In the accompanying diagrammatic drawings:

Fig. 1 is a perspective view of an embodiment of a safety device in accordance with the present disclosure;

Fig. 2 is a side elevation of the embodiment of Fig. 1;

Fig. 3 is a cross section on III-III of Fig. 2;

Fig. 4 is a cross sectional view of a variation of the embodiment of Fig.1 1 to 3, adapted for fitting to a reinforcing bar of a smaller diameter.

Fig. 5 is a schematic cross sectional illustration of the embodiment of Fig.s 1 to 3 with a reinforcing bar inserted thereinto;

Fig. 6 is a schematic cross sectional illustration of the embodiment of Fig.s 1 to 3, illustrating secure fitting to a reinforcing, even after damage to a region that receives a reinforcing bar;

Fig. 7 is a schematic cross sectional illustration of an alternative embodiment showing a variation to the embodiment illustrated in Fig.s 1 to 3; and

Fig. 8 is a perspective view of a further alternative embodiment;

Fig. 9 is a side elevation of the embodiment of Fig. 8;

Fig. 10 is a cross section on X-X of Fig. 9; and

Fig. 11 is a schematic cross sectional illustration of an embodiment of a two-part mould suitable for injection moulding the embodiment illustrated in Fig.s 1 to 3.

Detailed description of embodiments

**[0070]** With reference to Fig.s 1 to 3 an embodiment of a safety device in accordance with the present disclosure is in the form of a cap 1 for fitting to a free end of a reinforcing bar.

**[0071]** The cap 1 has a first end 2 and a second end 3.

**[0072]** A part of the cap 1 which extends from the first

end 2 towards the second end 3 comprises a sleeve portion which in the illustrated embodiment is in the form of a generally cylindrical portion 10.

**[0073]** The generally cylindrical portion 10 has an outer wall surface 12, an end wall surface 14 which in this embodiment is substantially perpendicular to the outer wall surface, and an inner wall surface 16 which defines a cavity 18. The generally cylindrical portion 10 may thus be considered to comprise a generally cylindrical wall 17, between the outer wall surface 12 and the inner wall surface 16.

**[0074]** The cavity 18 is substantially coaxial with the generally cylindrical portion 10. The cavity 18 is an example of a receiving space for receiving a free end of a reinforcing bar (not shown in Fig.s 1 to 3).

**[0075]** The cavity 18 has an opening 19 at the first end 2 of the cap 1. The opening 19 is defined by the end wall surface 14.

**[0076]** The cavity 18 extends longitudinally most, but not all, of the length of the cap 1. In the illustrated embodiment the cavity 18 extends longitudinally about 80 to 90 per cent of the length of the cap 1. The end of the cavity further from the first end 1 is defined by a cavity end wall surface 21.

**[0077]** In the illustrated embodiment the cavity 18 is somewhat tapered, and has a wider region 20 at or close to the first end 2 of the cap 1 and a narrower region 22, close to where it terminates at the cavity end wall surface 21, further from the first end 2. In the illustrated embodiment the taper of the cavity 18 is smooth and continuous, and the rate of taper is uniform along the length of the cavity. The cavity 18 may be regarded as substantially frustoconical in shape. However, it will be appreciated that in variations the rate of taper need not be uniform and that a stepped configuration of the inner wall 16 could be used if desired.

**[0078]** In the illustrated embodiment the thickness of the wall 17 of the cylindrical portion 10 is approximately 3mm to 6mm at the first end 2 of the cap 1, and the generally cylindrical portion 10 is approximately 30 mm to 70 cm long, and approximately 20 mm to 35 mm in outside diameter. However, it will be appreciated that the proportions and dimensions of variations of the device may be varied as desired and appropriate: for example, the diameter of the generally cylindrical portion may be adjusted to provide a cavity of diameter suitable for any desired size of reinforcing bar; the outer surface of the generally cylindrical portion may be somewhat tapered, if desired; and the length of the generally cylindrical portion may be adjusted to provide a longer or shorter cavity (for receipt of a greater or lesser length of a reinforcing bar) as desired. Variations may be dimensioned to accommodate reinforcing bars of any size desired, including bars which are used to form a steel mesh for reinforcing concrete structures and which may have a diameter of approximately 5 mm. It should also be appreciated that variations may be provided for reinforcing bars with cross sections other than circular cross sections, and cavities of cross sectional shape corresponding to the cross sectional shape of the reinforcing bar (for example square or rectangular cross section)may be provided. A more detailed description of the dimensions of a particular embodiment of the illustrated cap 1 is provided below.

**[0079]** A part of the cap 1, which extends from and defines the second end 3 of the cap 1, comprises a robust end part 24. The end part 24 is substantially solid, although in the illustrated embodiment the cavity 18 extends a short distance into the end part. The end part 24 of the illustrated embodiment is an example of a covering portion which provides a barrier to prevent passage of a reinforcing bar located in the cavity 18 through the second end of the safety device.

**[0080]** The end part 24 has a curved outer surface 26 defining the second end of the safety device.

**[0081]** In the illustrated embodiment the curved outer surface 26 is substantially part-spherical. In the cap 1, the radius of curvature of the substantially part-spherical outer surface 26 is greater than the radius of the generally cylindrical portion 10.

**[0082]** The curved outer surface 26 provides a rounded second end of the safety device and rapidly broadens to a transverse size which is greater than the transverse size of the generally cylindrical portion 10. Thus it should be appreciated that in alternative embodiments the shape of the curved outer surface need not be strictly part-spherical but could, for example, be part-ellipsoidal.

**[0083]** In the cap 1 the radius of curvature of the substantially part-spherical outer surface 26 is greater than the maximum radius of the end part 24. Thus in this embodiment the part-spherical outer surface 26 defines somewhat less than half a sphere.

**[0084]** The solid end part 24 is connected to an end of the generally cylindrical portion 10 which is distal from the first end 2 of the cap 1. Where the end part 24 is connected to the generally cylindrical portion 10 a transversely extending, and in this embodiment, substantially annular, wall surface 28 connects, and extends between, the curved outer surface 26 of the solid end part 24 and the outer wall surface 12 of the generally cylindrical portion 10.

**[0085]** In the illustrated embodiment the cap 1 is formed from a robust elastomeric material, for example a suitable polyurethane polymer. This allows the inner wall surface 16 which defines the cavity 18 to be resiliently deformed by insertion of an end of a reinforcing bar into the cavity 18. Depending on the relative diameters of the cavity 18 and the reinforcing bar, and the force applied, the wall 17 may be deformed across it entire thickness. The resilience of the material biases the inner wall surface 16 towards its non-deformed configuration, which causes it to grip the reinforcing bar. This provides a connection between the reinforcing bar and the cap 1 which is highly resistant to inadvertent removal of the cap 1 from the reinforcing bar, but which allows the cap 1 to be removed from the free end of the reinforcing bar when

desired.

**[0086]** The transversely extending wall surface 28 may provide a convenient surface for a user to grip in order to facilitate removal, for example by pulling the cap 1 off the free end of the reinforcing bar. However, it should be appreciated that in the illustrated embodiment the transversely extending wall surface 28 is fairly small in transverse width (for example about a centimetre in the embodiment illustrated in Fig.s 1 to 3) to minimise the likelihood of it being inadvertently caught on clothing, equipment or carried items of a worker moving past the cap 1.

**[0087]** Further, when the cap 1 is removed from the reinforcing bar (or, equivalently in relation to this description, when the reinforcing bar is removed from the cavity 18), the inner wall surface 16 returns substantially to its non-deformed configuration. The cap 1 can then be reused if desired, for example by fitting to a different reinforcing bar.

**[0088]** In an embodiment the material is UV protected. The UV protection may comprise use of one or more of: a UV absorber, such as for example a benzotriazole; a quencher; and, a stabiliser, such as for example a suitable hindered amine stabiliser. The UV protection may comprise use of a combination of two or more of these three types of protection.

**[0089]** In an embodiment the cap 1 is brightly coloured to make the free end conspicuous in use. The cap 1 may be brightly coloured and/or fluorescent. The cap 1 may be pigmented with a brightly coloured and/or fluorescent pigment. Caps, or more generally safety devices in accordance with the present disclosure, may be coloured such that different colours are used to indicate suitability for fitting to differently sized reinforcing bars. For example, a safety device for fitting to a 15 mm diameter reinforcing bar might be fluorescent orange, and a safety device for fitting to a 13 mm diameter reinforcing bar might be fluorescent yellow.

**[0090]** It will be appreciated that variations of the cap 1 may be made to any appropriate size to allow fitting to a desired size, or diameter of reinforcing bar. The diameter of the cavity 18 varies along the length of the cavity from a diameter slightly greater than the diameter of the reinforcing bar with which it is to be used to a diameter slightly less than the diameter of the reinforcing bar with which it is to be used.

**[0091]** In a practical example, consistent with the embodiment illustrated in Fig.s 1 to 3, the diameter of the cavity 18 varies along the length of the cavity from a diameter about 0.5 mm to 1 mm greater than the diameter of the reinforcing bar with which it is to be used to a diameter about 0.5 mm to 2 mm less than the diameter of the reinforcing bar with which it is to be used.

**[0092]** In one practical example, consistent with the embodiment illustrated in Fig.s 1 to 3, the cap 1 is suitable for fitting to a reinforcing bar of 15 mm diameter. In this example the overall length of the cap 1 is about 68 mm, the length of the cylindrical portion 10 is about 55 mm, the outside diameter of the cylindrical portion 10 is about 25 mm, the cavity 18 extends approximately 3 mm into the end part 24, the wall thickness of the end part 24 (between the end of the cavity 18 and the second end of the cap 1, along the central axis of the cap 1) is about 10mm, and the transverse, or radial, width of the transversely extending wall 28 is about 10 mm. The cavity 18 tapers from a maximum diameter of about 16 mm to a minimum diameter of about 14 mm. As discussed above, dimensions and proportions may be varied if desired, especially in embodiments suitable for fitting to other sizes of reinforcing bar, although it may be desirable to provide a range of caps for fitting to two or more different sizes of reinforcing bar which have the same external dimensions and in which only the dimensions of the cavity (including the associated) opening is varied.

**[0093]** Fig. 4 is a schematic cross sectional illustration of a cap 1A, which is a variation of the cap 1. The cap 1A is identical to the cap 1 in all respects except that it provides a cavity 18A which is smaller in diameter than the cavity 18 of cap 1 and accordingly provides a wall 17A which corresponds to, but is thicker than, the wall 17 of cap 1. The cap 1A is adapted for receipt of a reinforcing bar of smaller diameter than is the cap 1. The similarities between the cap 1A of Fig. 4 and the cap 1 of Fig.s 1 to 3 will not be described in detail, but it is worth noting that the external dimensions of the cap 1A may be the same as corresponding external dimensions of the cap 1, since this is of relevance to manufacture of the caps 1 and 1A as will be described in detail in due course, with reference to Fig. 11. The cap 1A may be suitable for use with a reinforcing bar with a diameter of 13 mm, and the cavity 18A may taper from a maximum diameter of about 14 mm to a minimum diameter of about 12 mm.

**[0094]** Fig. 5 is a schematic cross sectional illustration of the embodiment of Fig.s 1 to 3 in use. As Fig. 5 relates to use of the cap 1, the same reference numerals as are used in Fig.s 1 to 3 are used in Fig. 5 to indicate corresponding parts of the cap 1.

**[0095]** Fig. 5 is a schematic cross sectional illustration of the embodiment of Fig.s 1 to 3 with a reinforcing bar 50 inserted into the cavity 18 of the cap 1. The deformation of the inner wall 16 is illustrated by the slight overlap of the reinforcing bar 50 over the inner wall 16.

**[0096]** In use the cap 1 may be applied to the reinforcing bar 50, by pushing the cap 1 onto the free end of the reinforcing bar 50. Application of an appropriate amount of force will cause at least the inner wall 16 to become deformed by contact with the reinforcing bar 50. That is, at least some of the inner wall 16 is pushed outwards by contact with the reinforcing bar 50. The elastic resilience of the elastomeric material from which the cap is made biases the inner wall 16 towards its non-deformed configuration, thereby causing the inner wall 16 to securely grip the reinforcing bar 50. The strength of the grip may be adjusted by the force with which the cap 1 is pushed onto the reinforcing bar 50. Broadly speaking, pushing the cap 1 onto the reinforcing bar with greater force will

force the reinforcing bar 50 further into the tapered cavity 18, and thus into a transversely smaller part of the tapered cavity 18, resulting in greater deformation of the inner wall 16, greater elastic restoring force, and therefore greater grip.

**[0097]** It should be appreciated that, although not illustrated in Fig. 5, the entire thickness of the wall 17 of the cylindrical portion 10 may be deformed by insertion of the reinforcing bar 50, as described above, although deformation of the outer wall surface will normally be negligible or small (although this will depend upon the thickness of the wall 17, which may vary between embodiments and between caps adapted for use with differently sized reinforcing bars).

**[0098]** It should also be appreciated that, although not illustrated in Fig. 5, reinforcing bars may not have smooth outer surfaces, but that protrusions or ridges may be provided thereon. Provision of protrusions or ridges on a reinforcing bar has not been found to detract substantially from the gripping of a reinforcing bar by the inner wall 16. To the contrary, such irregularities may enhance grip.

**[0099]** It should be appreciated that the taper of the cavity 18 contributes to the cap 1 being able to be securely fitted to a reinforcing bar of a given nominal diameter, even if the actual diameter varies slightly from the nominal diameter, or if there are protrusions or ridges on a reinforcing bar. The taper of the cavity 18 can also allow a user to adjust how securely the cap is connected to a reinforcing bar by adjusting the amount of force used to push the cap 1 onto the reinforcing bar 50. If desired, the cap 1 can be tapped further onto the reinforcing bar with a hammer or the like to increase the security of the attachment.

**[0100]** The use of a suitably robust elastomer, such as a tough polyurethane, makes the cap 1 very durable and resistant to damage in use. Accordingly the cap 1 can be expected to survive a large number of uses. However, the ends of reinforcing bars often include burrs or sharp edges, and despite the toughness of the material damage, scoring or wear of the inner wall 16 may occur in use.

**[0101]** Fig. 6 illustrates use of the cap 1 after damage to the inner wall 16 has occurred. The damaged parts of the inner wall 16 are shown schematically and indicated by the reference numeral 65. The damaged parts 65 are located in the region that accommodates the end of the reinforcing bar 50 in an undamaged cap 1, as can be seen by a comparison of Fig. 6 with Fig. 5.

**[0102]** As shown in Fig. 6, after a considerable number of uses which have resulted in damaged parts 65 of the inner wall 16, the cap 1 can be again reused, and securely fitted to a further reinforcing bar 50A (which may be substantially identical to a reinforcing bar, e.g. reinforcing bar 50, with which the cap 1 has previously been used). This is achieved by simply forcing the cap onto the reinforcing bar 50A until is securely attached. Application of a suitable amount of force moves the cap further onto the reinforcing bar 50A, which effectively forces the reinforcing bar 50A further into the taper of the cavity 18, where the narrower transverse dimensions of the cavity 18 ensure that the end region of the reinforcing bar 50A is adequately gripped, and the connection secure. A firm push on the second end of the cap 1 will often be sufficient, but if necessary or desired the cap 1 can be tapped further onto the reinforcing bar with a hammer or the like. The resilience of the material from which the cap 1, and more specifically the wall 17, is made allows sufficient deformation to accommodate the reinforcing bar 50A further along the cavity 18.

**[0103]** Thus it should be appreciated that the tapered form of the cavity 18 and the elastic resilience of the material from which the wall 17 is made act synergistically to allow considerable adjustment of the security of the connection (of the cap 1 to a reinforcing bar 50, 50A) and multiple uses of the cap 1.

**[0104]** If the cavity were tapered, but an elastically resilient material were not used, the security of the attachment could still be adjusted to some extent by varying the force applied to push the cap onto the reinforcing bar, but some permanent damage to the inner wall defining the cavity would likely occur with each use. Such a cap could also be appropriate for re-use, but the damage to the interior wall would likely increase substantially with each subsequent use in which the cap is forced further onto a reinforcing bar. Thus while such a cap might allow both adjustment of connection strength and re-use, the combination of adjustment of connection strength and a large number of uses would not be as effectively provided as in the described embodiment.

**[0105]** If an elastically resilient material were to be used, but the cavity were not tapered, again the security of the attachment could still be adjusted to some (albeit a lesser) degree by varying the extent to which the cap is forced onto the reinforcing bar, but it would be likely that the cap would be pushed further onto the reinforcing bar in the earliest use or uses, and therefore damage to the inner wall defining the cavity would likely occur closer to the closed end of the cavity earlier than in the illustrated cap 1, reducing the useful life of the cap. Thus, again, while such a cap might allow both adjustment of connection strength and re-use, the combination of adjustment of connection strength and a large number of uses would not be as effectively provided as in the described embodiment.

**[0106]** Thus while the present disclosure extends to safety devices having only one of the tapered cavity and elastically resilient material, it will be appreciated that a further benefit is provided by a safety cap which has both of these characteristics.

**[0107]** Fig. 7 is a schematic cross sectional illustration showing a variation to the embodiment illustrated in Fig.s 1 to 3. As the embodiment of Fig. 7 is generally similar in function and construction to the cap 1 of Fig.s 1 to 3, only the dissimilarities from the cap 1 of Fig.s 1 to 3 are described in detail below.

**[0108]** Fig. 7 is a schematic cross sectional illustration of an embodiment of a safety device in the form of a cap

701, showing a variation to the embodiment illustrated in Fig.s 1 to 3. In this embodiment a venting passage 760 with small transverse cross section, connects cavity 718 (corresponding to the cavity 18 of cap 1) to the outside of an end part 724 (corresponding to the end part 24 of cap 1) of the cap 701. The venting passage 760 avoids an inner end region 722 of the cavity 718 being sealed with respect to the outside of the cap 701 by a reinforcing bar (not shown in Fig. 7) when a free end of the reinforcing bar is within the cavity 718 and in firm contact with an inner wall 716 that defines the cavity 718. The provision of venting passage 760 can thereby avoid creation of a high pressure region in the cavity 718 (during connection) which could provide undesired resistance to attachment of the cap to the reinforcing bar, or of a low pressure region in the cavity 718 (during disconnection, or attempted disconnection) which could provide undesired resistance to separation of the cap 701 from the reinforcing bar.

**[0109]** Fig.s 8 to 10 illustrate an alternative embodiment of a safety device in the form of a cap 800 which is similar in structure and function to the caps 1 and 1A but which differs to some degree in shape and proportions. Only the differences will be described.

**[0110]** An end part 824 of cap 800 corresponds broadly to end part 24 of cap 1, but forms a greater proportion of the length of the cap. The end part provides an end part surface 826 which is substantially hemispherical. The end part 824 is proportionately narrower than the end part 24 of cap 1. A transversely extending wall 828 corresponds broadly to transversely extending wall 28 of cap 1 but is proportionately about 50% narrower than the transversely extending wall 28 of cap 1.

**[0111]** Providing the narrower end part 824 may assist in minimising potential obstructions to users, for example when used in situations where reinforcing bar free ends are close together and workers must move between them. However, the consequent provision of a narrower transversely extending wall 828, may reduce the grip available to a user when removing an end cap. Further the narrower end part might not distribute force as effectively, especially in the case of a direct longitudinal impact.

**[0112]** Providing the longitudinally thicker end part 824, which is more steeply inclined at its sides may assist in deflecting certain impacts, but may also make the end part 824 absorb lateral impacts less gently, and requires use of more material in manufacture, which may increase cost.

**[0113]** The cap 800 may therefore be considered to have some working advantages and some working disadvantages compared to the cap 1. However, the cap 800 shares many of the working advantages of the cap 1.

**[0114]** It should be appreciated that the embodiments described are configured suitably to allow manufacture by injection moulding.

**[0115]** Fig. 11 illustrates schematically an embodiment of a two-part mould 1100, suitable for forming, for example, the cap 1.

**[0116]** The mould 1100 comprises a first mould part 1110 which defines a substantially cylindrical cavity 1112 suitable for forming the generally cylindrical portion 10 of cap 1. Within the cylindrical cavity 1112 of the first mould part 1110 there is provided a void former, which in this embodiment is in the form of a frustoconical element 1118 for providing a void (in an injection moulded product) corresponding to the cavity 18 of cap 1. In the illustrated embodiment the void former is coaxial with the cylindrical cavity 1112, and extends slightly from an open end of the cavity 1112, to correspond to the cavity extending slightly into the end part 24 of cap 1.

**[0117]** The mould 1100 further comprises a second mould part 1120 which defines a substantially part-spherical cavity 1124, suitable for forming the end part 24 of cap 1.

**[0118]** When the first and second mould parts 1110, 1120 are brought together the cavities 1112, 1124 together define a combined cavity with a form corresponding to the form of the cap 1. The combined cavity can be filled with a liquid material which is elastomeric when set (e.g. a molten thermosetting polyurethane), via an injection passage (not shown). The liquid material can then be allowed to set to provide a safety device (for example in the form of cap 1) as a single-piece injection-moulded device.

**[0119]** The first and second mould parts 1110, 1120 can then be separated to allow removal of the injection-moulded safety device.

**[0120]** The void former (frustoconical element 1118, in the illustrated embodiment) for forming a void corresponding to cavity 18 may be removably connected to the first mould part 1110 by a suitable coupling/decoupling arrangement. This allows replacement of the void former with a void former of a different size, for example a void former (not shown) which has a smaller (or greater) transverse size, suitable for forming a smaller (or larger) diameter cavity, such as for example the cavity 18A of the end cap 1A illustrated in Fig. 4. Thus a single mould provided with two or more void formers of different transverse sizes may be used to manufacture safety devices adapted for use with different sizes of reinforcing bar, by selection of the desired void former.

**[0121]** Fig. 11 includes a schematic illustration of an example of a suitable coupling/decoupling arrangement for the void former. As illustrated, the frustoconical element 1118 is provided with a first coupling part, in this embodiment in the form of a projection 1119, which can be removably coupled with, and retained in relation to, a second coupling part, in this embodiment in the form of a socket 1117, provided in the first mould part 1110. The first and second coupling parts may be removably coupled by means of any suitable retention arrangement, such as (but not limited to) a friction fit, a bayonet arrangement, or complementary screw threads. Each void former could be provided with a generally corresponding first coupling part to allow coupling to, and decoupling from, the mould. It should be appreciated that alternative

coupling/decoupling arrangements could be used (for example an arrangement in which a projection of the mould part can be removably inserted into, and retained in, a socket provided in the void former).

**[0122]** As mentioned above the mould 1100 is illustrated schematically, and a practical embodiment may include cavities for moulding several safety devices simultaneously.

**[0123]** It will be appreciated that the embodiments of safety devices described above can substantially reduce the risk of, and/or the seriousness of, injury resulting from inadvertent contact with the free end of a reinforcing bar.

**[0124]** In use the cap 1, 1A is pushed onto the free end of a reinforcing bar to cover the free end of the reinforcing bar. Any burrs or sharp surfaces at or close to the free end of the reinforcing bar are therefore covered by the cap.

**[0125]** The substantially part-spherical outer surface 26 of the solid end part 24 provides a smooth and relatively soft free end, in contrast to the hard, and possibly sharp, free end of the reinforcing bar.

**[0126]** Further the resiliently deformable nature of the elastomeric material from which the end part 24 is formed can effectively cushion impacts on the free end.

**[0127]** The rounded, or part-spherical second end of the cap (which is the 'free' end in use) increases the likelihood of any glancing impact being deflected, rather than resulting in a more direct impact on an end part of a reinforcing bar.

**[0128]** Further, the end part 24 has a greater cross sectional size, in a direction perpendicular to an axis of elongation of the cap 1, than a reinforcing bar which can be received in the cavity 18, and in use distributes force to lessen the severity of an impact with the end of the reinforcing bar.

**[0129]** Use of the cap 1, 1A can therefore greatly reduce the risk of injury from, and can reduce the risk of impalement upon, a free end of a reinforcing bar.

**[0130]** Further the described embodiments provide a safety device which resiliently grips a reinforcing bar, allowing secure engagement of the safety device with the reinforcing bar. This can provide a low risk of inadvertent detachment but allow deliberate removal when desired.

**[0131]** The taper in the cavity can allow a user to adjust how securely the cap is connected to a reinforcing bar. If desired, the cap can be tapped further onto the reinforcing bar with a hammer or the like to provide a very secure attachment.

**[0132]** The transversely extending wall 28 can provide a convenient surface which can be gripped in order to facilitate removal of the cap from a reinforcing bar. If the cap is too securely attached to be removed by hand, the transversely extending wall 28 may be tapped with a hammer or the like, or a tool suitable for bearing against the transversely extending wall 28 may be used. For example, tools which could be applied to bear against diametrically opposed regions of the transversely extending wall 28 without bearing unduly on the cylindrical portion of the cap include, but are not limited to: suitably sized or adjustable spanners or wrenches; suitable pliers especially pliers with a slip-joint and/or suitably curved jaws; and some tools with suitably robust prongs or claws that are spaced apart by a distance equal to or very slightly greater than the diameter of the cylindrical portion of the cap.

**[0133]** Further, once removed from a reinforcing bar the gripping part of each of the described caps returns substantially to its original shape, allowing reuse.

**[0134]** Further, the taper in the cavity (e.g. cavity 18) can assist in allowing reuse of the cap multiple times, even if the interior wall of the cavity has been worn and/or damaged by previous contact with sharp parts of the reinforcing bars with which the cap has previously been used.

**[0135]** In contrast to the described embodiments, a previously attempted way of attaching a device to the end of a rod or bar of circular cross section comprises use of a relatively inelastic plastic (that is, a material less elastic than an elastomer) to provide a cylindrical connection portion with a cylindrical cavity that is greater in diameter than the diameter of the rod or bar to be received, and providing inwardly projecting vanes which project from the internal wall defining the cavity towards the central axis of the cavity. The vanes can assist in stabilising the device on the bar end, but are considered not to provide a connection as secure as that provided by described embodiments. Further, the vanes are typically inelastically deformed by contact with the bar or rod and, especially if deformed sufficiently to provide a connection approaching a secure connection, do not return to their original shapes after removal of the device from the bar or rod. Thus such arrangements are not suitable for re-use, or if reused will typically not provide a secure attachment to the bar or rod.

**[0136]** Furthermore, the size of head or diameter of the safety device or cap can be changed so as to suit various attachments and meet regulatory standards in the industry.

**[0137]** The cap may be made from any suitable material.

**[0138]** The safety device or cap may be presented in any colour or a combination of colours.

**[0139]** Moreover, addition material such as metal or a suitable material may be placed or impregnated into the covering portion or head to make the safety device or cap stronger. Preferably, the metal is impregnated onto the covering portion or head portion of the safety device or cap.

**[0140]** The safety device or cap according to the present invention is not limited for use in scaffolding. The safety device or cap may be modified as required for use in other products to provide safety including star picket fencing.

**[0141]** It should be appreciated that the embodiments and principles described herein may have applicability to provision of a safety end cap for use with free ends of

members other than reinforcing bars. For example, on construction sites projecting free ends of metal pipes metal pipes may present a hazard that may be mitigated by use of a safety device in accordance with the present disclosure.

**[0142]** Modifications and improvements may be incorporated without departing from the scope of the invention described herein.

## Claims

**1.** A safety apparatus for fitting to a free end of an elongate member, the safety apparatus comprising:

a sleeve portion defining a receiving space therein for receiving a free end of said elongate member, and providing an opening of the receiving space to allow insertion of an end of the elongate member into the receiving space from a first end of the safety apparatus; and
a covering portion which provides a barrier to prevent passage of the end of the elongate member through a second end of the safety device;
wherein the receiving space is elongate, the receiving space is at least partly defined by a wall part which is resiliently deformable, extends from the opening towards the second end of the safety apparatus, and wherein the receiving space is tapered along its length.

**2.** The safety apparatus according to claim 1 wherein the safety apparatus comprises a gripping part which is resiliently deformable.

**3.** The safety apparatus according to claim 2 wherein the gripping part is resiliently deformed by insertion of the elongate member into the receiving space, thereby to securely grip a metal member, and such that the gripping part returns to substantially its non-deformed shape upon removal of the elongate member from the receiving space.

**4.** The safety apparatus according to one of claims 1 to 3, wherein the covering portion forms the second end of the safety apparatus.

**5.** The safety apparatus according to one of claims 1 to 4, wherein the wall part defines a generally circular transverse cross section of the receiving space.

**6.** The safety apparatus according to according to one of claims 1 to 5, wherein the receiving space is at least partly defined by a wall part which is resiliently deformable.

**7.** The safety apparatus according to claim 6 wherein the wall part is resiliently deformable such that the wall part is resiliently deformed by insertion of a reinforcing bar into the receiving space, thereby to securely grip the reinforcing bar, and such that the wall part returns to substantially its non-deformed shape upon removal of the reinforcing bar.

**8.** The safety apparatus according to one of claims 1 to 7, wherein the covering portion is impregnated with a metallic component.

**9.** The safety apparatus according to one of claims 1 to 8, wherein the receiving space extends from the opening towards the second end of the safety device, is generally cylindrical or is generally frustoconical.

**10.** The safety apparatus according to one of claims 1 to 9, wherein the receiving space is greater in transverse cross sectional size at or adjacent the opening and reduces in cross sectional size as it extends towards the second end of the safety device, wherein the receiving space tapers by at least 1 mm or 0.5 mm in transverse width or is tapered in a plurality of steps.

**11.** The safety apparatus according to one of claims 1 to 10, wherein the wall part extends substantially the entire length of the receiving space, is substantially annular in transverse cross section, and has a thickness of at least 2 mm.

**12.** The safety apparatus according to one of claims 1 to 11, wherein the covering portion defines a curved second end surface of the safety device.

**13.** The safety apparatus according to claim 12, wherein the curved end surface provides a rounded second end of the safety apparatus, or rapidly broadens with distance from the second end, or rapidly broadens with distance from the second end, to a transverse size which is greater than the mean transverse size of the sleeve portion.

**14.** The safety apparatus according to one of claims 1 to 13, wherein a wall portion of the covering portion which extends between a closed end of the cavity and the second end of the safety device is thicker than a wall portion of the sleeve portion.

**15.** The safety apparatus according to one of claims 1 to 11, wherein a transversely extending wall portion extends between a curved end surface and an outer surface of the sleeve portion, wherein the transversely extending wall portion is substantially annular.

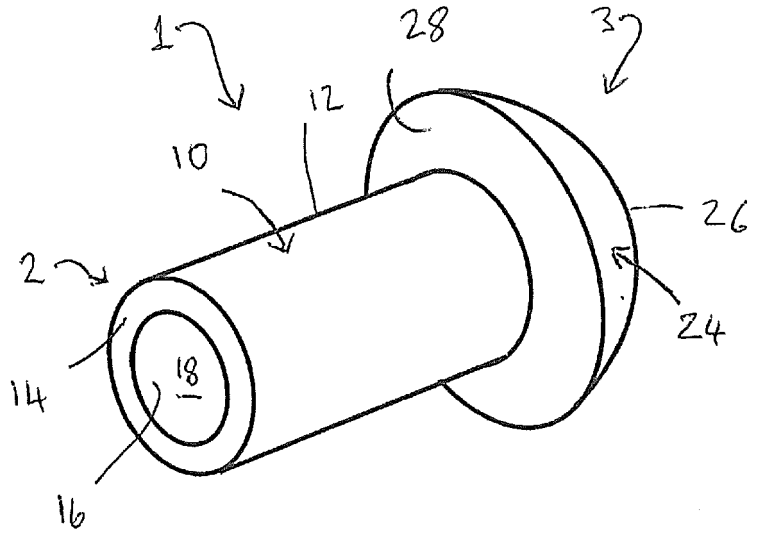


Fig. 1

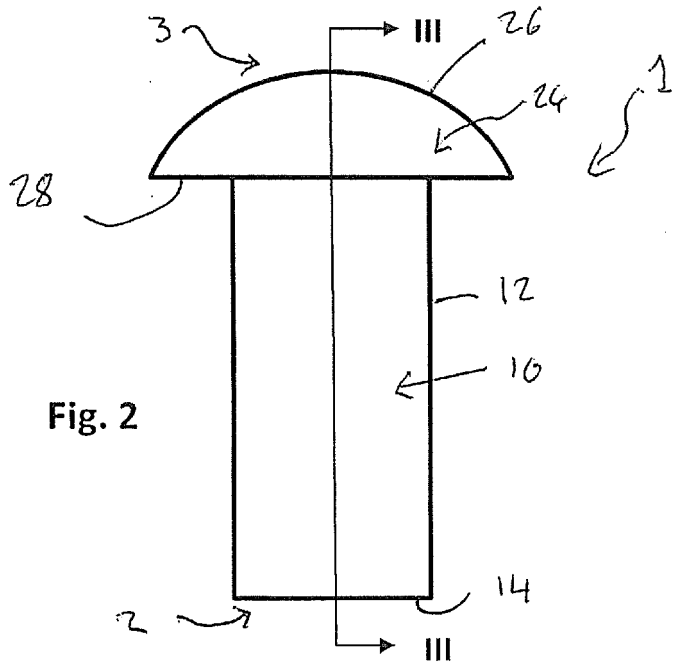


Fig. 2

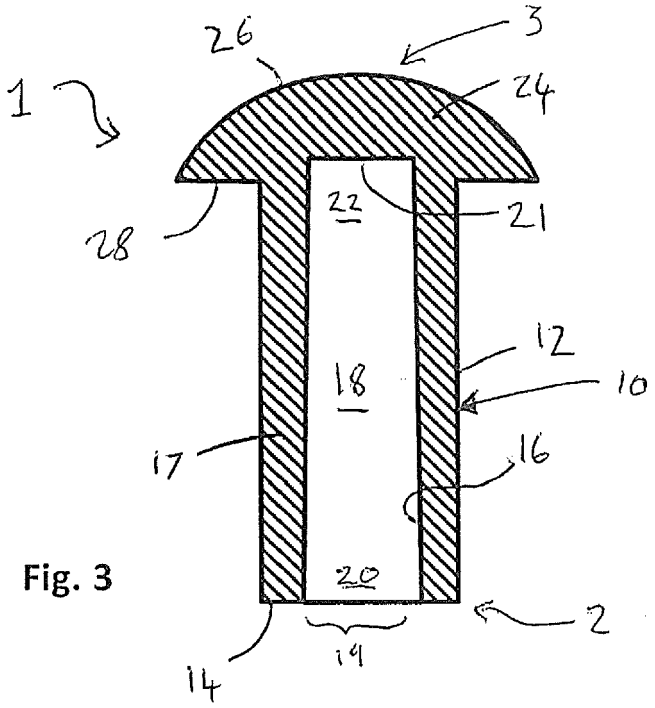


Fig. 3

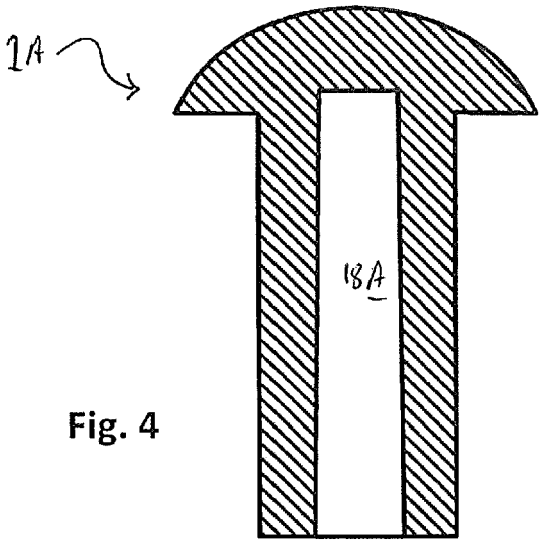


Fig. 4

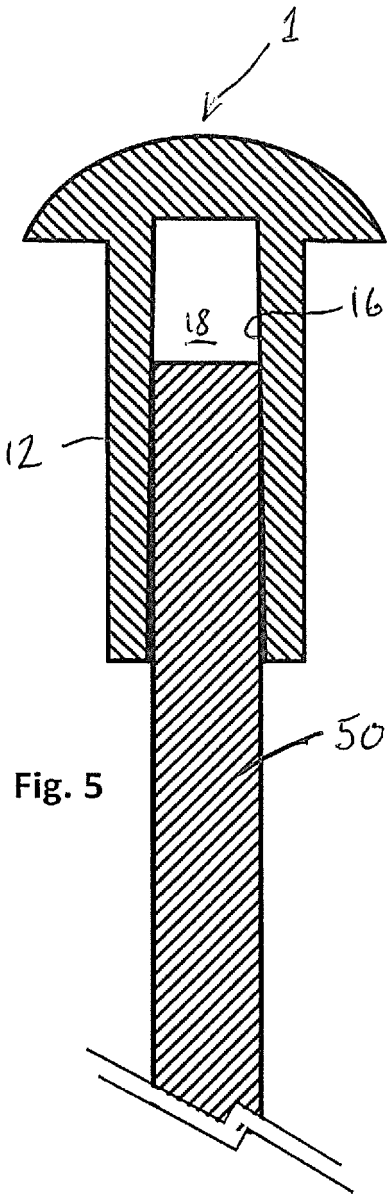


Fig. 5

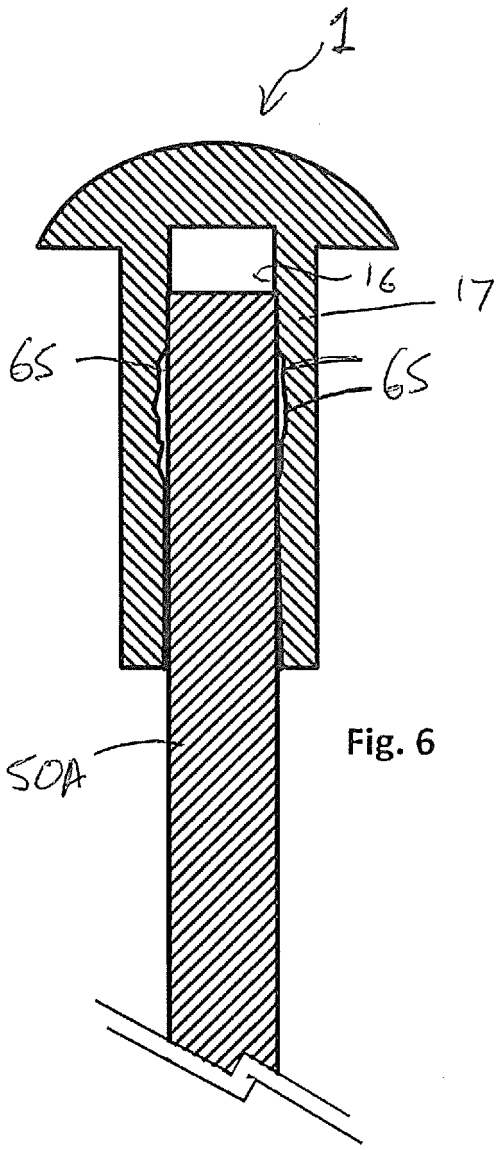


Fig. 6

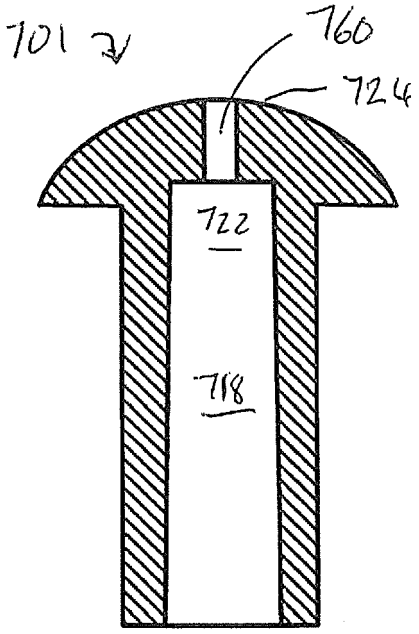


Fig. 7

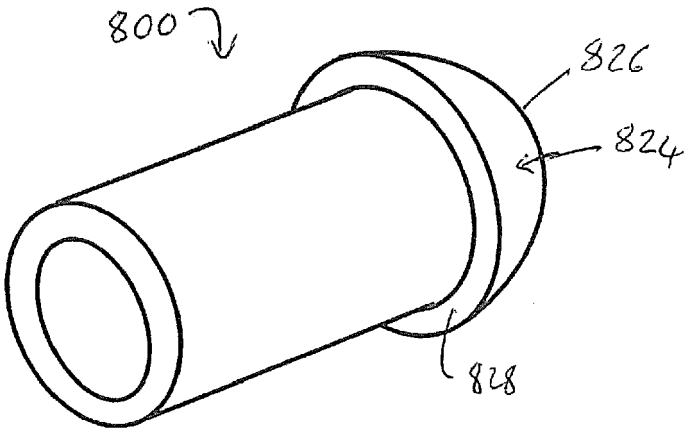


Fig. 8

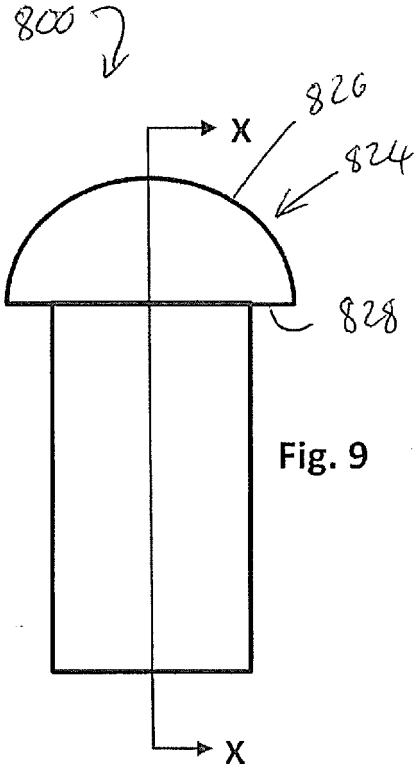


Fig. 9

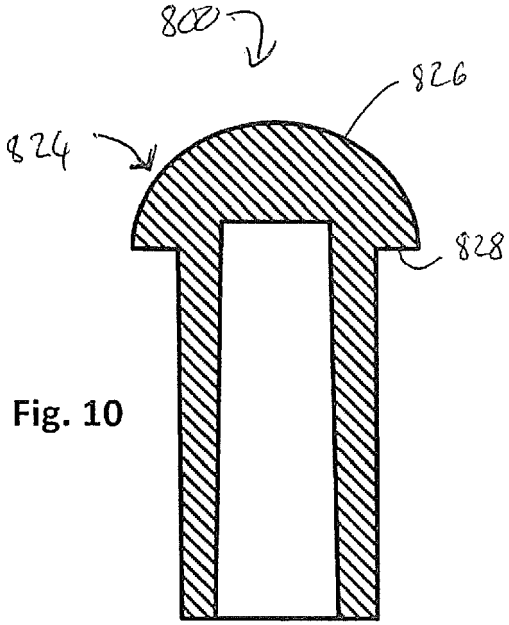


Fig. 10

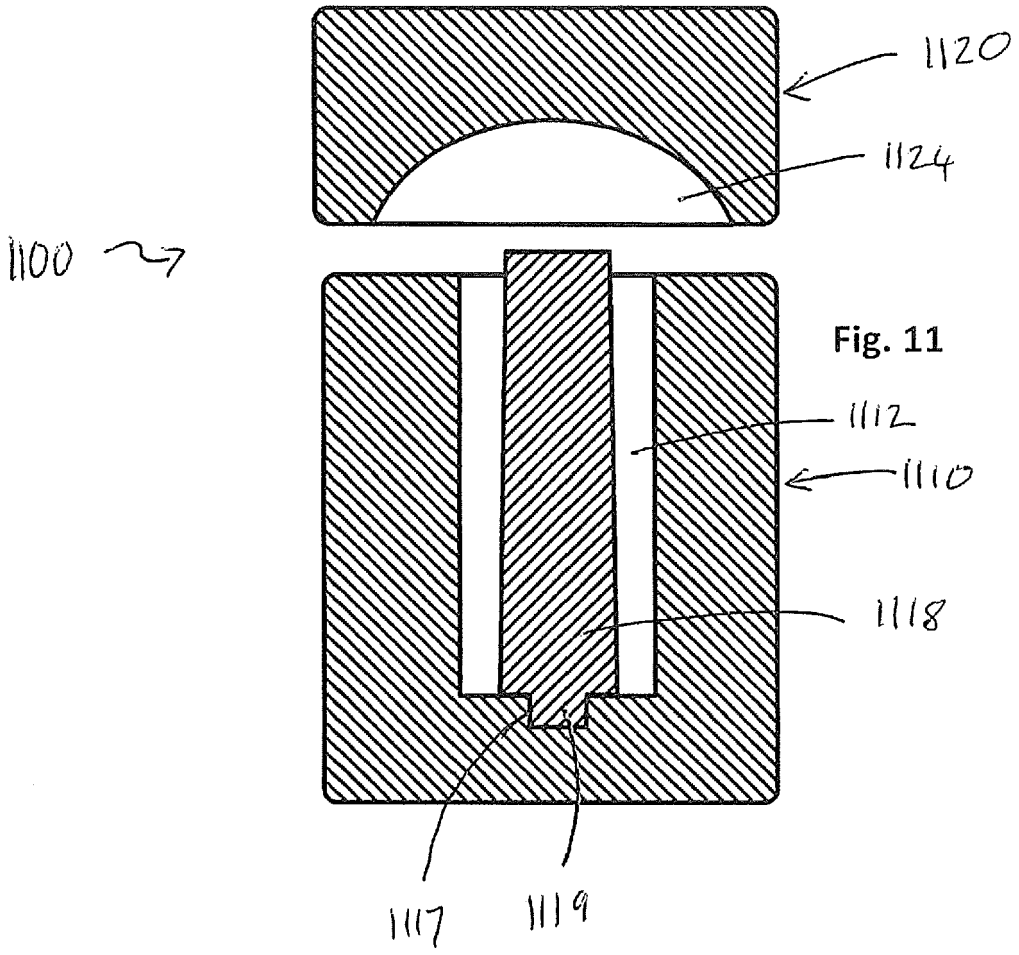


Fig. 11

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# EUROPEAN SEARCH REPORT

Application Number
EP 16 20 5694

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 4 May 2017 | Bauer, Josef |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82