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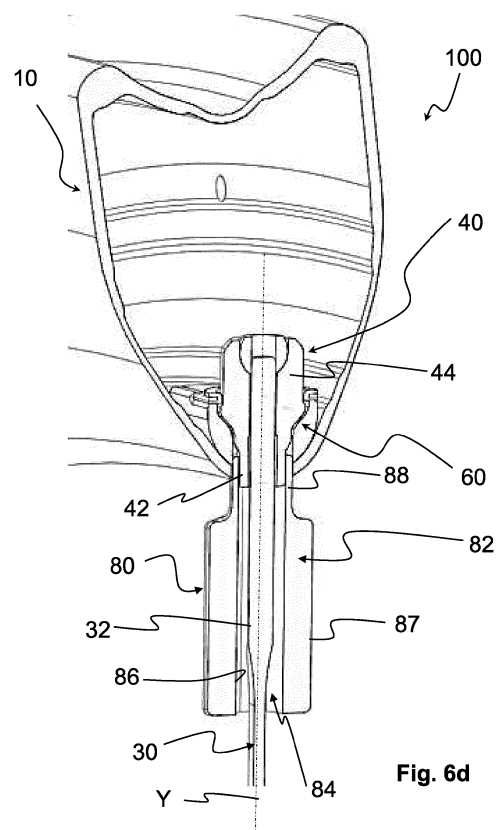
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(54) **ADJUSTMENT TOOL FOR ADJUSTING THE TENSION OF A SPOKE OF A BICYCLE SPOKED WHEEL**

(57) The invention relates to an adjustment tool (80) for adjusting the tension of a spoke (30) of a spoked wheel (100) for bicycle, comprising an elongated body (82) extending along a longitudinal axis (Y) and having a central longitudinal cavity (84) configured to house an end portion (32) of the spoke (30) and a longitudinal through slit (86) configured to allow the housing of said end portion (32) of the spoke (30) in said longitudinal cavity (84). The elongated body (82) comprises a grip portion (87) and a shaped end portion (88) extending along said longitudinal axis (Y) and configured to couple with a stem (42) of a spoke attachment element (40). Said shaped end portion (88) has an outer bulk, defined on a plane perpendicular to the longitudinal axis (Y) of the elongated body (82), smaller than that of said grip portion (87) and smaller than the diameter of a spoke attachment hole (18) provided in a rim (10) of the wheel (100) and in which said stem (42) is inserted.



**Fig. 6d**

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## Description

**[0001]** The present invention relates to an adjustment tool for adjusting the tension of a bicycle spoke connected to a rim of a spoked wheel.

**[0002]** A spoked wheel for bicycle comprises a rim, a hub and a plurality of spokes extending between the hub and the rim, the tension of which must preferably be able to be adjusted at the hub and/or the rim.

**[0003]** In order to allow the adjustment of the tension, a first threading is typically provided at a first end portion of the spokes and a threaded hole is arranged at the hub or the rim. The threaded hole is made directly in the hub or rim, or in a spoke attachment element associated with the hub or rim. The second end portion of the spokes can be provided with a second threading or with a head, for example rectangular or circular, housed in a suitable seat, for example hooked in a flange of the hub or inserted in a bayonet coupling at the rim, as for example described in US 2007/0158996, which is discussed below.

**[0004]** Rims are known having a radially outer tyre coupling channel and a radially inner spoke attachment chamber. More in particular, such rims comprise two side walls connected or joined at one end by a radially inner wall or lower bridge, and in an intermediate point by a radially outer wall or upper bridge or partition, so as to have a substantially inverted A-shaped cross-section. The radially outer portions of the side walls are typically provided with an edge configured to couple with a bead of the tyre and form the tyre coupling channel with the upper bridge or partition, whereas the radially inner portions of the side walls form, with the lower bridge and the upper bridge, a spoke attachment chamber. Such a type of rim is illustrated in US 2007/0158996.

**[0005]** In the present description and in the following claims, the terms "axial", "axially" and similar terms refer to a direction substantially coinciding with or substantially parallel to the rotation axis of the wheel, the terms "radial", "radially" and similar terms refer to a direction perpendicular to the rotation axis of the wheel and incident on the rotation axis of the wheel, and the terms "circumferential", "circumferentially" and similar terms refer to a circumferential direction around the rotation axis of the wheel.

**[0006]** The terms "axially inner" and "axially outer" and similar terms refer to positions respectively closer to, and farther from, a median transversal plane of the wheel, whereas the terms "radially inner" and "radially outer" and similar terms refer to positions respectively closer to, and farther from, the rotation axis of the wheel.

**[0007]** A plurality of spoke attachment holes is made on the lower bridge of the rim. Generally, the spoke attachment holes receive the spoke attachment element provided with a longitudinal cavity having a threading or with a longitudinal cavity having a shaped seat. The longitudinal length of the threading of the longitudinal cavity of the spoke attachment element can be equal to the longitudinal length of the threading of the spoke, or longer

to also allow the adjustment of the tension of the spoke by changing the screwing depth of the spoke in the threaded longitudinal cavity of the spoke attachment element.

**[0008]** The spoke attachment elements are also called "nipples", if they allow the adjustment of the tension of the spoke, or "barrels" if they do not allow it.

**[0009]** Instead of a single spoke attachment chamber, two or more chambers can be provided through one or more partition walls, extending substantially parallel to the upper bridge or substantially transversal to it. Each wall (upper bridge, lower bridge, side walls and partition walls), furthermore, can be shaped in various ways, making an even considerably complex cross section of the rim.

**[0010]** The rims can be made from aluminum (typically by extrusion of a section bar) or from composite material (typically by compression molding).

**[0011]** The Applicant has concentrated its attention on rims made from composite material.

**[0012]** In the rest of the present description and in the following claims, the term "composite material" is used to indicate a material comprising structural fibers incorporated in a polymeric material. The structural fibers are preferably selected from the group comprising carbon fibers, glass fibers, boron fibers, aramid fibers, ceramic fibers and combinations thereof. The polymeric material can be thermoplastic or thermosetting.

**[0013]** US 2007/0158996 A1, to the same Applicant, discloses a rim in which the upper bridge comprises only the hole for the inflation valve of the tyre (and it is therefore also proper for the use with tubeless tyres). Such a document also discloses a process aimed at making a spoked wheel for bicycle. Such a process comprises the step of inserting the spoke attachment element in the spoke attachment chamber through an opening (which can be the aforementioned hole or a different opening suitably made) and guiding the spoke attachment element along the spoke attachment chamber towards and up to a respective spoke attachment hole. The spoke attachment element has a head adapted for being held inside the spoke attachment chamber at the spoke attachment hole and a stem that projects from the lower bridge in a radially inner direction thereof. The process comprises the step of inserting the stem of the spoke attachment element in the spoke attachment hole until the head is brought into abutment against the lower bridge of the rim and the stem is made to project from the lower bridge radially inside the rim (see for example Fig. 9 of such a document).

**[0014]** US 2007/080577 A1 discloses a nipple for a bicycle wheel comprising a head intended to abut against a radially inner wall of the rim and a stem comprising a threaded portion intended to be screwed to a matching threaded portion made at the end of the spoke.

**[0015]** The Applicant has observed that in the aforementioned prior art documents the stems of the spoke attachment elements are sized to project significantly

from the rim in a radially inner direction thereof and the portion of stem projecting from the rim is typically shaped to allow the stem to be gripped by a suitable tool during the mounting and the adjustment of the tension of the spoke. The latter provision is necessary particularly in the cases in which the upper bridge of the rim is not perforated. In such cases, indeed, it is not possible, during the mounting and the adjustment of the tension of the spoke, to hold the spoke attachment element at its head and it is thus necessary to do so at the radially inner area with respect to the rim.

**[0016]** In some rims currently commercialized by the Applicant, the stem projects from the rim by about 7 mm.

**[0017]** The Applicant has noted that, close to the lower bridge of the rim, and more in particular at the areas in which the spokes are connected to the stems of the spoke attachment elements there are changes of diameter between the diameter of the stem and the diameter of the spoke. Such changes of diameter create turbulences during rolling.

**[0018]** The Applicant has observed that the lower bridge of the rim, and in particular the size of its radius of curvature, greatly influences the aerodynamic behavior of the wheel with respect to front or side wind. A wheel with a lower bridge having a small radius of curvature (for example equal to about 5.5 mm) has better performance with the front wind whereas a wheel with a lower bridge having a greater radius of curvature (for example equal to about 9.5 mm) behaves better in case of side wind.

**[0019]** According to the Applicant, the aforementioned turbulences, occurring precisely close to the lower bridge of the rim, significantly and unpredictably change the expected aerodynamic behavior.

**[0020]** Therefore, there is a need to improve the aerodynamics of the wheels at the lower bridge of the rim.

**[0021]** US 7140696 B1 discloses a wheel comprising a rim with nipples arranged entirely inside the spoke attachment chamber. In order to screw the spokes on the nipples, a plurality of holes is made on the upper bridge of the rim.

**[0022]** The Applicant has observed that the wheel of US 7140696 B1 is not suitable for the use with tubeless type tyres.

**[0023]** The Applicant has thought to provide a spoked wheel for bicycle that, the structural strength being equal, has better aerodynamic behavior than that of the wheels of the prior art and that can be used both with tyres provided with air chamber and with tubeless type tyres. Such a spoked wheel is out of the present invention.

**[0024]** Such a bicycle spoked wheel comprises:

- a rim made at least partially from composite material and having at least one spoke attachment chamber provided with a plurality of spoke attachment holes,
- a plurality of spokes coupled with the rim at said spoke attachment holes,
- a spoke attachment element partially inserted in a

respective spoke attachment hole,

- at least one holding element configured to prevent the movement of said spoke attachment element along a radially outer direction and in that said spoke attachment element comprises a holding surface configured to operate in abutment against said at least one holding element.

**[0025]** Advantageously, the provision in the wheel of the aforementioned holding element and, in the spoke attachment element, of the aforementioned holding surface, prevents the spoke attachment element from moving along a radially outer direction during the operations of attachment and tensioning of the spoke. Therefore, it is not necessary to make holes in the upper bridge at every spoke attachment hole in order to hold the spoke attachment element in position during the aforementioned operations, as conversely occurs in the wheel according to US 7140696 B1.

**[0026]** Such a wheel can therefore be used both with tyres provided with air chamber and with tubeless type tyres. In this latter case, the wheel is also indicated, hereinafter, as "of the tubeless type".

**[0027]** The aforementioned bicycle spoked wheel can comprise, singularly or in combination, one or more of the following preferred features.

**[0028]** In a first embodiment, said spoke attachment element does not project radially from the rim internally with respect to the rim.

**[0029]** In this case, preferably, the spoke attachment element comprises a radially inner end portion that is substantially flush with a radially inner surface of the rim. In other words, the radially inner end portion of the spoke attachment element is substantially circumferentially aligned with the radially inner surface of the rim.

**[0030]** In a second embodiment, said spoke attachment element comprises a radially inner end portion that projects radially from the rim internally with respect to the rim by a segment having a length shorter than or equal to the diameter of the spoke at said spoke attachment hole.

**[0031]** In this case, the worsening in terms of aerodynamic behavior of the wheel due to the presence of such a segment projecting from the rim is negligible. In practice, such a segment does not generate additional turbulences with respect to those generated by the spoke.

**[0032]** Preferably, said length is shorter than or equal to about 2 mm.

**[0033]** Preferably, the aforementioned wheel comprises a sealing element coupled with said rim at said respective spoke attachment hole and comprising a through hole in which a radially inner end portion of a respective spoke attachment element is inserted.

**[0034]** Advantageously, the aforementioned sealing element prevents the penetration inside the rim, through the spoke attachment hole, of dirt, mud and water.

**[0035]** The sealing element is preferably made from rubber.

**[0036]** Preferably, said spoke attachment element comprises an abutment surface configured to abut against the rim, or against an insert in abutment against the rim, so as to prevent the movement of said spoke attachment element along a radially inner direction.

**[0037]** Said at least one holding element can be made in a single piece with said rim at said spoke attachment hole or it can be defined in an elastically deformable element coupled with said rim at said spoke attachment hole.

**[0038]** Preferably, said at least one holding element is an elastically deformable element made from silicone material or from EPDM rubber and is defined by a coating applied on the rim at said spoke attachment hole. The aforementioned holding element can however be made from a different material from those mentioned above, provided that it has the desired features of elastic deformability.

**[0039]** Alternatively, the elastically deformable element is an O-ring arranged in a circumferential seat formed at said spoke attachment hole.

**[0040]** Alternatively, said at least one holding element is defined in an insert arranged inside said at least one spoke attachment chamber and in abutment against said rim at said spoke attachment hole.

**[0041]** Advantageously, such an insert acts as local reinforcement and support for the spoke attachment element and allows a better distribution of the stresses on the rim following the tensioning of the spoke.

**[0042]** Preferably, the insert comprises a first through hole arranged coaxially to said spoke attachment hole and crossed by said spoke attachment element.

**[0043]** In a preferred embodiment thereof, the insert comprises a main body on which said first through hole is made and an annular element coupled with said main body and having a second through hole arranged coaxially to said first through hole. More preferably, said at least one holding element is defined by at least one flexible portion of said annular element that projects cantilevered in said second through hole.

**[0044]** Preferably, said annular element is made from metallic material.

**[0045]** Preferably, said flexible portion of said annular element is coated with rubber.

**[0046]** Preferably, said annular element is substantially flat and is co-moulded on a radially outer surface of said main body.

**[0047]** Alternatively, said annular element is substantially flat and is locked on a radially outer surface of said main body through at least one covering layer comprising carbon fibers.

**[0048]** Preferably, at least one insulating layer comprising glass fibers is interposed between said main body and said annular element to prevent galvanic corrosion phenomena being triggered between the metallic material of the aforementioned annular element and the composite material of the rim.

**[0049]** In a variant of the insert, the annular element

comprises a pair of hooking arms each having a folded radially inner free end portion configured to couple with a radially inner surface of said main body.

**[0050]** In this case the coupling between the annular element and the aforementioned main body is of the "snap" type.

**[0051]** Alternatively, said at least one holding element is defined by an O-ring arranged in a circumferential seat formed in said insert in radially inner position with respect to an undercut annular surface of said insert.

**[0052]** Preferably, said circumferential seat is defined in a radially inner portion of said insert or in a radially outer portion of said insert. In both cases, the circumferential seat comprises an undercut radially outer annular surface configured to prevent the movement of the O-ring in radially outer direction and, possibly, an undercut radially inner annular surface configured to prevent the movement of the O-ring in radially inner direction.

**[0053]** Alternatively, the insert comprises a pair of hooking arms that extend along said radially outer direction and each comprising a folded radially outer free end portion defining a respective holding element.

**[0054]** The spoke attachment element is in this case locked on the insert with a hooking of the "snap" type.

**[0055]** In accordance with a further embodiment thereof, the insert comprises a main body on which said first through hole is made and an auxiliary body coupled with a radially outer surface of said main body and having a second through hole arranged coaxially to said first through hole. Preferably, said at least one holding element is defined by an O-ring arranged in a circumferential seat formed in said auxiliary body in radially inner position with respect to an undercut annular surface of said auxiliary body.

**[0056]** Preferably, the wheel described above is of the tubeless type, i.e. its upper bridge comprises only the hole for the inflation valve of the tyre.

**[0057]** The Applicant also provided a spoke attachment element comprising a stem configured to be inserted in a spoke attachment hole of a rim of the wheel and an enlarged head configured to abut against the rim, or against an insert in abutment against the rim, at said spoke attachment hole, wherein said enlarged head or said stem comprises a holding surface configured to abut against at least one holding element defined in said rim or in said insert to prevent the movement of the spoke attachment element along a radially outer direction.

**[0058]** Such a spoke attachment element is used in the wheel described above and it is out of the present invention.

**[0059]** The present invention relates to an adjustment tool for adjusting the tension of a spoke of a bicycle spoked wheel according to claim 1.

**[0060]** Such a tool is used to tension the spokes in the wheel described above.

**[0061]** Preferably, said shaped end portion comprises a plurality of maneuvering appendages projecting from the grip portion parallel to the longitudinal axis and con-

figured to insert between longitudinal ribs formed in the stem of the spoke attachment element.

**[0062]** More preferably, said shaped end portion, at said maneuvering appendages, has an outer bulk substantially equal to that of the spoke attachment hole.

**[0063]** A method for assembling a spoked wheel for bicycle, comprises:

- making a rim having a plurality of spoke attachment holes;
- inserting a spoke attachment element in the rim through an inflation hole or an auxiliary hole specifically provided in the rim;
- taking said spoke attachment element at a respective spoke attachment hole;
- partially inserting said spoke attachment element in said spoke attachment hole;
- coupling a spoke with said spoke attachment element;

wherein the step of partially inserting said spoke attachment element in said spoke attachment hole comprises taking a holding surface defined in said spoke attachment element into a radially inner position with respect to a holding element defined in said wheel so that a movement of said spoke attachment element along a radially outer direction is prevented by an abutment between said holding element and said holding surface.

**[0064]** Such a method is used to assemble the wheel described above and it is out of the present invention.

**[0065]** Advantageously, the abutment between the aforementioned holding element and the aforementioned holding surface makes it possible to stably position the spoke attachment elements inside the rim in a preliminary step to the coupling of the spoke with the rim of the wheel. It is therefore subsequently possible to couple the spoke with the spoke attachment element without needing to hold this latter through for example a gripper or directly with the hands, like is conversely described in US 2007/0158996.

**[0066]** Further features and advantages of the invention will become clearer from the description of some preferred embodiments thereof, made with reference to the attached drawings, where:

- figure 1 is a perspective view of a portion of spoked wheel for bicycle which is out of the present invention;
- figure 2 is a perspective view, enlarged and in an axial section, of the rim of the wheel of figure 1, taken at a spoke attachment hole;
- figure 3 is an enlarged perspective view of a radially lower portion of the rim of figure 2;
- figure 4 is an enlarged perspective view of an insert used in the rim of figures 2 and 3;
- figure 5 is a perspective view of a component of the insert of figure 4;
- figures 6a-6d are perspective view in an axial section

of the wheel of figure 1, taken at a spoke attachment hole, in successive steps of making and mounting of the wheel;

- 5 - figure 7 is a perspective view of a first embodiment of a spoke attachment element used in the wheel of figure 1, such a spoke attachment element being out of the present invention;
- figure 8 is a perspective view of the spoke attachment element of figure 7 mounted on the wheel;
- 10 - figure 9 is a perspective view of the spoke attachment element of figure 7 and of a first embodiment of an adjustment tool according to the present invention which is coupled to such a spoke attachment element;
- 15 - figure 10 is a cross section view of the spoke attachment element and of the tool shown in figure 9, the cross section being taken at the section plane S of figure 9;
- figure 11 is a perspective view of a second embodiment of a spoke attachment element which is out of the present invention;
- figure 12 is a perspective view of the spoke attachment element of figure 11 mounted on the wheel;
- figure 13 is a perspective view of the spoke attachment element of figure 11 and of a second embodiment of an adjustment tool according to the present invention which is coupled to such a spoke attachment element;
- 25 - figure 14 is a cross section view of the spoke attachment element and of the tool shown in figure 13, the cross section being taken at the section plane S1 of figure 13;
- figure 15 is a perspective view of a third embodiment of a spoke attachment element which is out of the present invention;
- 30 - figure 16 is a perspective view of the spoke attachment element of figure 15 and of a third embodiment of an adjustment tool according to the present invention which is partially coupled to such a spoke attachment element;
- 35 - figure 17 is a cross section view of the spoke attachment element and of the tool shown in figure 16, the cross section being taken at the section plane S2 of figure 16;
- 40 - figures 18-22 are perspective views in axial section of five variant embodiments of a spoke attachment element and of an insert which are out of the present invention and which are used in the wheel of figure 1, the sections being taken at a spoke attachment hole;
- 45 - figure 23 is a perspective view of the insert of figure 22;
- figure 24 is a perspective view in axial section of a portion of another embodiment of a wheel which is out of the present invention;
- 50 - figure 25 is a perspective view in axial section of a portion of a further embodiment of a wheel which is out of the present invention.
- 55

**[0067]** With initial reference to figures 1-5, reference numeral 100 wholly indicates a first embodiment of a bicycle spoked wheel which is out of the present invention.

**[0068]** The wheel 100 comprises a rim 10, a hub 20 and a plurality of spokes 30 extending between the hub 20 and the rim 10. The tension of the spokes 30 is adjusted at the rim 10 through spoke attachment elements 40 (figures 2 and 3).

**[0069]** The rim 10 is made at least partially from composite material. Preferably, the rim 10 is made entirely from composite material.

**[0070]** With reference to figure 2, the rim 10 comprises a radially outer tyre coupling channel 12 and a radially inner spoke attachment chamber 14.

**[0071]** The rim 10 is preferably used with a tubeless type tyre (not illustrated).

**[0072]** The rim 10 is formed by two side walls 16a connected or joined at a radially inner end by an inner circumferential wall or lower bridge 16b. The two side walls 16a are further connected in an intermediate point by an outer circumferential wall or upper bridge (or partition) 16c, so as to have a substantially inverted A-shaped cross section (figure 2).

**[0073]** The side walls 16a comprise respective radially outer portions or fins 16d typically provided with a folded end 16e. The fins 16d form, with the upper bridge 16c, the tyre coupling channel 12. More in particular, the tyre, not illustrated for reasons of clarity, is mounted in the tyre coupling channel 12 by inserting the beads thereof in the fins 16d, the folded ends 16e acting to hold the beads in a *per se* known way.

**[0074]** The radially inner portions 16f of the side walls 16a form, with the lower bridge 16b and the upper bridge 16c, the spoke attachment chamber 14.

**[0075]** The rim 10 comprises a pair of holes (not illustrated) for housing an inflation valve of the tyre (not shown). Such holes are made substantially coaxially in the upper bridge 16c and in the lower bridge 16b.

**[0076]** The fins 16d are subject to geometric and dimensional constraints both due to the need to hook the tyre, and due to the need to externally provide a suitable sliding surface of the brake pads. The upper bridge 16c is subject to the constraint, in the case of tubeless type tyre, of making an airtight seal with the tyre and therefore of having only the hole for the valve. For tyres with air chamber, of course, such a constraint does not exist and therefore further holes can be provided in addition to the one for the valve.

**[0077]** On the other hand, the portions 16f of the walls 16a and the lower bridge 16b are not subject to particular geometric or dimensional constraints and can therefore be replaced by a single wall having a cross-section shaped like an arc of circle or by a plurality of walls so as to form a section of more complex shape than the one illustrated, possibly defining a plurality of spoke attachment chambers 14 (not illustrated).

**[0078]** The particular section illustrated in figures 2 and 3 therefore has a merely illustrative and non-limiting pur-

pose.

**[0079]** The spoke attachment chamber 14 is provided with a plurality of spoke attachment seats 17 (figure 2), each of which comprising a spoke attachment hole 18 (figure 1).

**[0080]** The spoke attachment hole 18 is a non-threaded hole.

**[0081]** The spoke attachment seats 17 are illustrated as formed in the lower bridge 16b of the spoke attachment chamber 14, but they can also be formed in one or both of the portions 16f of the side walls 16a.

**[0082]** The spoke attachment seats 17 can be uniformly distributed along the median plane of the rim 10. The number and the distribution of the spoke attachment seats 17 can vary greatly. For example, the seats 17 could be gathered in groups of two or three or four and/or be made on a plurality of planes, different from the median plane of the rim 10.

**[0083]** The spokes 30 are coupled with the rim 10 at the spoke attachment holes 18 using spoke attachment elements 40, each arranged at a respective spoke attachment hole 18.

**[0084]** The spoke attachment element 40 comprises a stem 42 configured to extend through the spoke attachment hole 18 and an enlarged head 44 having a size greater than that of the stem 42 and configured to be held inside the spoke attachment chamber 14.

**[0085]** Preferably, each spoke attachment hole 18 has a substantially circular section, but it could have a different shape, provided that it is configured to house the stem 42 of the spoke attachment element 40.

**[0086]** A first end portion 32 of a spoke 30 is attached to the spoke attachment element 40, the second end portion of the spoke 34 being attached to the hub 20 (figure 1).

**[0087]** The spoke attachment element 40 may or may not allow the adjustment of the tension of the spoke 30.

**[0088]** The spoke attachment elements 40 are preferably nipples (i.e. they allow the adjustment of the tension of the spokes 30), but they could also be barrels (i.e. they do not allow the adjustment of the tension of the spokes 30).

**[0089]** The following description refers to the case in which the spoke attachment elements 40 are nipples.

**[0090]** The spoke attachment elements 40 comprise a threaded through hole 46a having a length such as to allow the screwing to different depths of the first end portion 32 of the spoke 30, which has a threading matching that of the threaded through hole 46a to obtain the adjustment of the tension of the spoke 30.

**[0091]** The spoke attachment element 40 is partially inserted in the spoke attachment hole 18 and comprises a radially inner end portion 41 that, in the specific example illustrated herein, projects radially from the rim 10 internally with respect to the rim 10 by a segment having a length shorter than or equal to the diameter of the spoke 30, measured at the spoke attachment hole 18. More in particular, the aforementioned length is shorter than or

equal to the diameter of the first end 32 of the spoke 30.

**[0092]** In preferred embodiments such a length is shorter than or equal to about 2 mm.

**[0093]** The wheel 100 comprises a holding element 50 configured to prevent the movement of the spoke attachment element 40 along a radially outer direction.

**[0094]** In a first embodiment of the wheel 100 illustrated in figures 1-5 the holding element 50 is defined in an insert 60 arranged inside the spoke attachment chamber 14. The insert 60 is illustrated in figure 4.

**[0095]** As illustrated in figure 2, the insert 60 comprises a first surface portion 61 arranged inside the spoke attachment chamber 14 at the spoke attachment hole 18 and in abutment against an inner surface 14a of the spoke attachment chamber 14. With reference to the mounting position of the insert 60, the first surface portion 61 is therefore a radially inner surface of the insert 60.

**[0096]** The insert 60 comprises a through hole 62 extending along a longitudinal axis X, arranged coaxially to the spoke attachment hole 18 and crossed by the spoke attachment element 40 (figures 2 and 3).

**[0097]** As illustrated in figure 3, the insert 60 also comprises a second surface portion 64, which acts as an abutment for the enlarged head 44 of the spoke attachment element 40, in particular for a radially inner abutment surface 48 of the enlarged head 44. The abutment surface 48 has a shape matching that of the second surface portion 64. In the example of figures 2 and 3, the abutment surface 48 and the second surface portion 64 are frusto-conical in shape.

**[0098]** As illustrated in figures 1 and 3, a sealing element 90, for example a rubber element, is coupled with the rim 10 at the spoke attachment hole 18. The sealing element 90 comprises a through hole in which the radially inner end portion 41 of the spoke attachment element 40 is inserted. The sealing element 90 has a shape matching that of the radially inner end portion 41 of the spoke attachment element 40.

**[0099]** With reference to the mounting position of the insert 60, the second surface portion 64 is therefore a radially outer surface of the insert 60.

**[0100]** The through hole 62 is preferably defined centrally in the first surface portion 61 and in the second surface portion 64 of the insert 60.

**[0101]** The holding element 50 prevents the movement of the spoke attachment element 40 along the longitudinal axis X when the spoke attachment element 40 is in abutment against the second surface portion 64.

**[0102]** The insert 60 comprises a main body 65, on which the aforementioned first surface portion 61 and second surface portion 64 are made, and an annular element 67 coupled with the main body 65 and, in particular, substantially overlapping the main body 65.

**[0103]** The through hole 62 is defined by a first through hole 62a formed in the main body 65 and by a second through hole 62b formed in the annular element 67 coaxially to the first through hole 62a.

**[0104]** The annular element 67 preferably consists of

a substantially flat metallic plate.

**[0105]** The holding element 50 is defined by a flexible portion 67a of the annular element 67 that projects cantilevered in the through hole 62.

5 **[0106]** As illustrated in figure 5, the flexible portion 67a faces towards the second through hole 62b and is made flexible thanks to voids 67b of material that define tongues 67c facing towards the second through hole 62b.

10 **[0107]** The flexible portion 67a has a coating 68 made from flexible material, for example rubber. The function of the rubber is both for holding the moulding resin, which must not pass between the annular element 67 and the main body 65 during the moulding, and for generating friction with the spoke attachment element 40 once mounted.

15 **[0108]** The annular element 67 can be co-moulded on a radially outer portion 65a of the main body 65 or, alternatively, it can be locked on the radially outer portion 65a of the main body 65 through at least one covering layer arranged above the annular element 67 and comprising carbon fibers.

**[0109]** Preferably, at least one insulating layer comprising glass fibers is interposed between the main body 65 and the annular element 67.

25 **[0110]** The spoke attachment element 40 comprises a holding surface 49 configured to operate in abutment against the holding element 50.

**[0111]** In figure 3 the holding surface 49 is defined at a radially outer end portion of a circumferential projection 49a of the enlarged head 44 of the spoke attachment element 40.

**[0112]** The circumferential projection 49a is arranged in a radially outer position with respect to the abutment surface 48.

35 **[0113]** The circumferential projection 49a has a diameter greater than that of the second through hole 62b of the annular element 67.

**[0114]** In the mounting operation, the spoke attachment element 40 is inserted in the through hole 62 of the insert 60 until the abutment surface 48 abuts against the surface portion 64 of the insert 60. During insertion, the circumferential projection 49a of the enlarged head 44 folds the flexible portion 67a until it goes past it. The flexible portion 67a then takes again its undeformed configuration and holds the spoke attachment element 40 thanks to the abutment between holding surface 49 and flexible portion 67a (figure 3).

**[0115]** With reference to figures 6a-6d, subsequent assembly steps of the wheel 100 of figures 1-5 are shown.

40 **[0116]** The wheel 100 made from composite material is typically built by arranging layers of carbon fibers impregnated of resin inside a mould.

**[0117]** The inserts 60 are positioned at the spoke attachment holes 18. Such inserts 60 are coated with at least one perforated layer of carbon fiber in order to be held stationary inside the rim 10.

55 **[0118]** The inserts 60 are made from a material that has features of resistance to fatigue and co-mouldability



with the composite material. Suitable materials are thermoplastic or thermosetting polymers, possibly reinforced with fiber. However, it is also possible to use metallic materials. A particularly preferred material is the polyetherimide, commercialized with the name Ultem 2400 by Sabic, Riyadh.

**[0119]** During the moulding of the rim 10, in order to avoid the resins plugging the spoke attachment holes 18 and the through holes 62 of the inserts 60 and infiltrating in undesired areas, an auxiliary element 70 is used that has the function of a plug (figure 6a). The way of using the auxiliary element 70 is analogous to that described in EP 3225384 A1, to the same Applicant.

**[0120]** The auxiliary element 70 is made from a material that has features of deformability, resistance to the moulding temperatures and pressures of the composite material and of anti-adherence to the composite material. A particularly preferred material is latex or soft silicone rubber, for example a silicone having a Shore A hardness 50.

**[0121]** At the end of moulding the auxiliary element 70 is pulled out from its elongated portion 72 that faces towards the center of the rim 10, and it is thus extracted from the rim 10 (figure 6b).

**[0122]** Subsequently, through the hole for the inflation valve (or from an auxiliary hole) the spoke attachment elements 40 are inserted in the rim 10.

**[0123]** The spoke attachment element 40 has a screw 74 made from metal (typically steel). The screw 74 is screwed in the threaded through hole 46a, with the head 76 of the screw 74 projecting from the stem 42 on the opposite side with respect to the enlarged head 44 of the spoke attachment element 40.

**[0124]** The spoke attachment element 40 with the screw 74 screwed thereto is inserted in the spoke attachment chamber 14 through the hole for the inflation valve (or through an auxiliary hole) and is taken with a magnet (as described in US 2007/0158996) at the through hole 62 of the respective insert 60, until the head 76 of the screw 74 inserts into the through hole 62 and comes out from the rim 10.

**[0125]** At this point the operator pulls the screw 74 radially inwards, until the spoke attachment element 40 is held in the insert 60 (figure 6c) by means of the abutment between abutment surface 48 of the enlarged head 44 of the spoke attachment element 40 and surface portion 64 of the insert 60 and of the abutment between holding surface 49 defined in the enlarged head 44 of the spoke attachment element 40 and holding element 50 defined in the insert 60.

**[0126]** The screw 74 is then unscrewed from the spoke attachment element 40 and it is possible to continue the mounting of the spoke 30 in the spoke attachment element 40, without it being necessary for the operator to hold the spoke attachment element 40 either while the screw 74 is being unscrewed, or while the spoke 30 is being screwed.

**[0127]** In the case the spoke 30 breaks close to the

first end 32, the spoke attachment element 40 remains in the through hole 62 of the insert 60. For its replacement it is sufficient to strike it with a punch and make it come out from the hole for the inflation valve.

**[0128]** For the adjustment of the tension of the spoke 30 a suitable adjustment tool 80 is used, like for example the one illustrated in figure 6d.

**[0129]** The adjustment tool 80 comprises an elongated body 82, extending along a longitudinal axis Y and having a central longitudinal cavity 84 and a longitudinal through slit 86.

**[0130]** The central cavity 84 is configured to house the end portion 32 of the spoke 30. The slit 86 is configured to allow the housing of the end portion 32 of the spoke 30 in the central cavity 84.

**[0131]** The elongated body 82 comprises a grip portion 87 and a shaped end portion 88, extending along the longitudinal axis Y of the elongated body 82 and configured to couple with the stem 42 of the spoke attachment element 40.

**[0132]** The shaped end portion 88 has an outer bulk, defined on a plane perpendicular to the longitudinal axis Y of the elongated body 82, smaller than that of the grip portion 87 and smaller than the diameter of the spoke attachment hole 18 in which the stem 42 is inserted.

**[0133]** In this way, the shaped end portion 88 can insert inside the spoke attachment hole 18 and maneuver the stem 42 in rotation.

**[0134]** The shaped end portion 88 couples with the stem 42 of the spoke attachment element 40 through a surface having a shape matching that of the stem 42.

**[0135]** Figures 7-10, 11-14 and 15-17 respectively illustrate three variant embodiments of the spoke attachment element 40 and three respective variant embodiments of the adjustment tool 80.

**[0136]** In figures 7-17 the components and the portions of the spoke attachment element 40 analogous or functionally equivalent to those of the spoke attachment element 40 of figures 2 and 3 are indicated with the same reference numeral and reference is made to the relative description made above.

**[0137]** The stem 42 of the spoke attachment element 40 of figures 7-10 comprises a plurality of longitudinal ribs 43, extending parallel to a longitudinal axis Z of the spoke attachment element 40. In the non-limiting example illustrated herein, the ribs 43 are four, three of which have a substantially identical circumferential extension, whereas the fourth has a greater circumferential extension.

**[0138]** A respective longitudinal groove 43a is identified between each pair of ribs 43, the groove 43a defining a respective housing seat 43a for a respective maneuvering appendage 89 of the shaped end portion 88 of the adjustment tool 80. The maneuvering appendages 89 project from the grip portion 87 parallel to the longitudinal axis Y of the elongated body 82 and have a shape matching that of the grooves 43a.

**[0139]** In the illustrated non-limiting example, the

grooves 43a and the maneuvering appendages 89 are four, and they have substantially an identical circumferential extension (figure 10).

**[0140]** The maneuvering appendages 89 have for example a longitudinal extension comprised between about 2 mm and 4 mm.

**[0141]** The outer bulk of the maneuvering appendages 89 is substantially equal to that of the ribs 43 of the spoke attachment insert 40, which is substantially equal (slightly smaller) to that of the spoke attachment hole 18. In this way, the free space in the spoke attachment hole 18 is reduced when the spoke attachment element 40 is inserted therein. This reduces the problems caused by possible accumulation of dirt in this free space. On the other hand, the diameter of the adjustment tool 80 at the maneuvering appendages 89 is sufficiently large as to ensure an effective transfer of torque to the ribs 43 of the spoke attachment insert 40 without risks of breaking or deforming the aforementioned maneuvering appendages 89.

**[0142]** The stem 42 of the spoke attachment element 40 of figures 11-14, conversely, unlike that of the spoke attachment element 40 of figures 7-10, comprises an outer toothing 143, extending parallel to a longitudinal axis Z of the spoke attachment element 40. Preferably, the outer toothing 143 has a curved profile. In the non-limiting example illustrated herein the outer toothing 143 comprises six teeth and six valleys.

**[0143]** The shaped end portion 88 in this case comprises a toothed inner surface 189, extending parallel to the longitudinal axis Y of the elongated body 82. The toothed inner surface 189 has a shape matching that of the outer toothing 143 (figure 14).

**[0144]** The toothed inner surface 189 has for example a longitudinal extension comprised between about 2 mm and 4 mm.

**[0145]** The stem 42 of the spoke attachment element 40 of figures 15-17, conversely, unlike that of the spoke attachment element 40 of figures 7-10 and that of the spoke attachment element 40 of figures 11-14, comprises an inner toothing 243, extending parallel to a longitudinal axis Z of the spoke attachment element 40. Preferably, the inner toothing 243 has a curved profile. In the non-limiting example illustrated the inner toothing 243 comprises six teeth and six valleys.

**[0146]** The shaped end portion 88 comprises a toothed outer surface 289, extending parallel to the longitudinal axis Y of the elongated body 82. The toothed outer surface 289 has a shape matching that of the inner toothing 243 (figure 17).

**[0147]** The toothed outer surface 289 has for example a longitudinal extension comprised between about 2 mm and 4 mm.

**[0148]** Figure 24 illustrates a second embodiment of a bicycle spoked wheel 100 which is out of the present invention.

**[0149]** In figure 24 the components and the portions of the wheel 100 analogous or functionally equivalent to

those of the wheel 100 of figures 1-5 are indicated with the same reference numeral and therefore reference is made to the relative description made above.

**[0150]** Unlike the wheel 100 of figures 1-5, the wheel 100 of figure 24 lacks the insert 60 and the holding element 50 is made in a single piece with the rim 10 at the spoke attachment hole 18.

**[0151]** The spoke attachment element 40 of figure 24 has a configuration analogous to that of the spoke attachment element 40 of figure 2.

**[0152]** The rim 10 of figure 24 comprises a through hole 162 having a configuration analogous to that of the through hole 62 of the insert 60 of figure 2.

**[0153]** The rim 10 in this case comprises, close to the lower bridge 16b, an abutment surface 164 against which the abutment surface 48 of the enlarged head 44 of the spoke attachment element 40 abuts.

**[0154]** The abutment surface 164 has a configuration analogous to that of the surface portion 64 of the insert 60 of figure 2.

**[0155]** The holding element 50 of the rim 10 of figure 24 is defined by an annular surface 150 defining an undercut. The annular surface 150 is provided at a radially outer portion of the through hole 162. A radially inner portion of the through hole 162, conversely, defines the spoke attachment hole 18.

**[0156]** The holding element 50 of figure 24 is functionally equivalent to the flexible portion 67a of the annular element 67 of the insert 60 of figures 2 and 3.

**[0157]** In figure 24 the holding surface 49 is defined at a radially outer end portion of a circumferential projection 49a of the enlarged head 44 of the spoke attachment element 40.

**[0158]** Figure 25 illustrates a third embodiment of a bicycle spoked wheel 100 which is out of the present invention.

**[0159]** In figure 25 the components and the portions of the wheel 100 analogous or functionally equivalent to those of the wheel 100 of figure 24 are indicated with the same reference numeral and reference is made to the relative description above.

**[0160]** Unlike the wheel 100 of figure 24, the holding element 50 of the wheel 100 of figure 25 is defined in an elastically deformable element 250 coupled with the rim 10 at the spoke attachment hole 18.

**[0161]** In particular, the elastically deformable element 250 is housed in a circumferential seat 250a formed in the rim 10 close to the lower bridge 16b and defines, at a radially outer portion of the through hole 162, an undercut annular surface.

**[0162]** The elastically deformable element 250 of figure 25 is functionally equivalent to the flexible portion 67a of the annular element 67 of the insert 60 of figures 2 and 3.

**[0163]** In figure 25 the holding surface 49 is defined at a radially outer end portion of a circumferential projection 49a of the enlarged head 44 of the spoke attachment element 40.

**[0164]** The assembly of the wheel 100 of figure 25 is identical to that described above with reference to the wheel 100 of figures 1-5 except for the fact that the holding in position of the attachment element 40 in the rim 10 after the operator has pulled the screw 74 radially inwards occurs by means of the abutment between abutment surface 48 of the enlarged head 44 of the spoke attachment element 40 and abutment surface 164 defined in the rim 10 and of the abutment between holding surface 49 defined in the enlarged head 44 of the spoke attachment element 40 and holding element 50.

**[0165]** Figures 18-23 illustrate five further embodiments of a bicycle spoked wheel 100 which are out of the present invention.

**[0166]** In figures 18-23 the components and the portions of the wheel 100 analogous or functionally equivalent to those of the wheel 100 of figures 1-5 are indicated with the same reference numeral and reference is made to the relative description made above.

**[0167]** Unlike the wheel 100 of figures 1-5, in the wheel 100 of figure 18 the holding element 50 is defined by an O-ring 350 arranged in a circumferential seat 369 formed in the insert 60.

**[0168]** The circumferential seat 369 is arranged adjacent to an undercut annular surface 369a of the insert 60. In particular, the circumferential seat 369 is arranged in a radially inner position with respect to the undercut annular surface 369a.

**[0169]** The circumferential seat 369 is arranged at the through hole 62 and is defined in a first portion 61a of the insert 60 comprising the first surface portion 61. The portion of abutment surface 64 is arranged in a radially outer position with respect to the undercut annular surface 369a.

**[0170]** The O-ring 350 is also arranged in a circumferential seat 342 formed in the spoke attachment element 40. The circumferential seat 342 is formed on the stem 42 of the spoke attachment element 40.

**[0171]** In figure 18 the holding surface 49 is defined at the circumferential seat 342 formed on the stem 42 of the spoke attachment element 40.

**[0172]** In order to make this embodiment it is necessary that in the moulding step of the rim 10 the area of the circumferential seat 342 is protected from possible infiltrations of moulding resin. It must also be ensured that the geometry of the rim 10 is maintained.

**[0173]** For this reason, a suitable shaped protective insert is inserted in the mould inside the through hole 62 of the insert 60. After moulding it can be removed by breaking it.

**[0174]** The subsequent mounting steps of the wheel 100 comprise the mounting of the O-ring 350 on the spoke attachment element 40, the insertion of the spoke attachment element 40 with the O-ring 350 in the insert 60 and finally the mounting of the spokes 30 as described above.

**[0175]** In the case of replacement of the spoke attachment element 40, the O-ring 350 is extracted from the

circumferential seat 342 and replaced with a new one.

**[0176]** Unlike the wheel 100 of figures 1-5, in the wheel 100 of figure 19 the holding element 50 is defined by an O-ring 450 arranged in a circumferential seat 469 formed in the insert 60.

**[0177]** The circumferential seat 469 is arranged adjacent to an undercut annular surface 469a of the insert 60. In particular, the circumferential seat 469 is arranged in a radially inner position with respect to the undercut annular surface 469a.

**[0178]** The circumferential seat 469 is arranged at the through hole 62 and is defined in a second portion 64a of the insert 60 comprising the surface portion 64. The surface portion 64 is arranged in a radially inner position with respect to the circumferential seat 469.

**[0179]** The O-ring 450 is also arranged in a circumferential seat 444 formed in the spoke attachment element 40. The circumferential seat 444 is formed on the enlarged head 44 of the spoke attachment element 40.

**[0180]** The O-ring 450 has an outer diameter greater than the O-ring 350.

**[0181]** In figure 19 the holding surface 49 is defined at the circumferential seat 444 formed on the enlarged head 44 of the spoke attachment element 40.

**[0182]** The insert 60 of this embodiment can be made by a sintering process or by a 3D printing.

**[0183]** The wheel 100 of figure 20 differs from the wheel 100 of figure 19 substantially in that the insert 60 of figure 20 is not in a single piece but comprises a main body 561 and an auxiliary body 564.

**[0184]** A first through hole 562a is made on the main body 561. The auxiliary body 564 is coupled with a radially outer surface 561a of the main body 561 and has a second through hole 562b arranged coaxially to the first through hole 562a.

**[0185]** The through hole 62 of the insert 60 is therefore defined by the first through hole 562a and by the second through hole 562b.

**[0186]** The holding element 50 is defined by the O-ring 450 arranged in a circumferential seat 569 formed in the auxiliary body 564 in an adjacent position (in particular, in a radially inner position) with respect to an undercut annular surface 569a of the auxiliary body 564.

**[0187]** The O-ring 450 is also arranged in a circumferential seat 444 formed in the spoke attachment element 40. The circumferential seat 444 is formed on the enlarged head 44 of the spoke attachment element 40.

**[0188]** In figure 20 the holding surface 49 is defined at the circumferential seat 444 formed on the enlarged head 44 of the spoke attachment element 40.

**[0189]** In this embodiment the locking of the auxiliary body 564 in the moulding step can be carried out by overlapping one or more sheets of carbon fiber.

**[0190]** The wheel 100 of figure 21 differs from the wheel 100 of figure 19 substantially in that the insert 60 of figure 21 comprises a pair of hooking arms 650 that extend parallel to the longitudinal axis X (and therefore in the radial direction) and each comprising a folded radially

outer free end portion 651, defining a respective holding element 50.

**[0191]** The folded free end portion 651 holds the enlarged head 44 of the spoke attachment element 40 at a radially outer surface 644 thereof, which is substantially flat.

**[0192]** In figure 21 the holding surface 49 is defined at the radially outer surface 644 of the enlarged head 44 of the spoke attachment element 40.

**[0193]** In this embodiment a "snap" coupling is obtained thanks to the elasticity of the material with which the insert 60 is made.

**[0194]** The wheel 100 of figures 22 and 23 differs from the wheel 100 of figures 1-5 substantially in that the annular element 67 of the insert 60 of figures 22 and 23 comprises a pair of hooking arms 768 each having a folded radially inner free end portion 768a configured to couple with a radially inner surface of the main body 65 of the insert 60.

**[0195]** The holding element 50 of the insert 60 of figures 22 and 23 is defined by the flexible portion 767a of the annular element 67 that projects cantilevered in the through hole 62.

**[0196]** As illustrated in figure 23, the flexible portion 767a is defined by two opposite tongues facing towards the through hole 62.

**[0197]** The flexible portion 767a is arranged in a circumferential seat 444 formed in the spoke attachment element 40. The circumferential seat 444 is formed on the enlarged head 44 of the spoke attachment element 40.

**[0198]** In figure 23 the holding surface 49 is defined at the circumferential seat 444 formed on the enlarged head 44 of the spoke attachment element 40.

**[0199]** Also in this embodiment it is advisable to ensure that there is no contact between the carbon fiber of the rim 10 and the metallic material of the annular element 67. It is also advisable to prevent that there are infiltrations of moulding resin during the moulding of the rim 10 both in the passage area of the spoke attachment element 40, and under the flexible portion 767a.

**[0200]** Of course, those skilled in the art can bring numerous modifications and variants to the components described above, in order to satisfy specific and contingent requirements, all of which are in any case within the scope of protection defined by the following claims.

**[0201]** It is possible to provide for any combination of the features disclosed with reference to the embodiments and variants described.

**[0202]** For example, the upper bridge of the rim may or may not comprise further perforations in addition to that for the inflation valve of the tyre/air chamber.

**[0203]** Furthermore, it is possible to provide systems configured to avoid the unscrewing of the spoke attachment element 40 from the spoke 30 (due in particular to vibrations). For example it is possible to use glues between the threads of the threaded end portion 32 of the spoke 30 and the threaded through hole 46a or at the

top of the threaded end portion 32 of the spoke 30, and in particular in the threaded through hole 46a, it is possible to insert a perforated ball 95, for example made from nylon (as illustrated in figure 3).

**[0204]** The spoke attachment element 40 can also be made from aluminum.

## Claims

1. Adjustment tool (80) for adjusting the tension of a spoke (30) of a bicycle spoked wheel (100), comprising an elongated body (82) extending along a longitudinal axis (Y) and having a central longitudinal cavity (84) configured to house an end portion (32) of the spoke (30) and a longitudinal through slit (86) configured to allow the housing of said end portion (32) of the spoke (30) in said longitudinal cavity (84), wherein said elongated body (82) comprises a grip portion (87) and a shaped end portion (88) extending along said longitudinal axis (Y) and configured to couple with a stem (42) of a spoke attachment element (40), **characterized in that** said shaped end portion (88) has an outer bulk, defined on a plane perpendicular to the longitudinal axis (Y) of the elongated body (82), smaller than that of said grip portion (87) and smaller than the diameter of a spoke attachment hole (18) provided in a rim (10) of the wheel (100) and in which said stem (42) is inserted.
2. Adjustment tool (80) according to claim 1, wherein said shaped end portion (88) comprises a plurality of maneuvering appendage (89) which project from the grip portion (87) parallel to the longitudinal axis (Y) and configured to be inserted between longitudinal grooves (43a) formed in the stem (42) of the spoke attachment element (40).
3. Adjustment tool (80) according to claim 2, comprising four maneuvering appendage (89).
4. Adjustment tool (80) according to claim 2 or 3, wherein said maneuvering appendage (89) have a substantially identical circumferential extension.
5. Adjustment tool (80) according to any of claims 2 to 4, wherein said maneuvering appendage (89) have a longitudinal extension comprised between about 2 and 4 mm.
6. Adjustment tool (80) according to claim 1, wherein the shaped end portion (88) comprises a toothed inner surface (189) extending parallel to the longitudinal axis (Y).
7. Adjustment tool (80) according to claim 6, wherein the toothed inner surface (189) has a curved profile.

8. Adjustment tool (80) according to claim 6 or 7, wherein the toothed inner surface (189) comprises six teeth and six valleys.
9. Adjustment tool (80) according to any of claims 6 to 8, wherein the toothed inner surface (189) has a longitudinal extension comprises between about 2 mm and 4 mm. 5
10. Adjustment tool (80) according to claim 1, wherein the shaped end portion (88) comprises a toothed outer surface (289) extending parallel to the longitudinal axis (Y). 10
11. Adjustment tool (80) according to claim 10, wherein the toothed outer surface (289) has a curved profile. 15
12. Adjustment tool (80) according to claim 10 or 11, wherein the toothed outer surface (289) comprises six teeth and six valleys. 20
13. Adjustment tool (80) according to any of claims 10 to 12, wherein the toothed outer surface (289) has a longitudinal extension comprises between about 2 mm and 4 mm. 25

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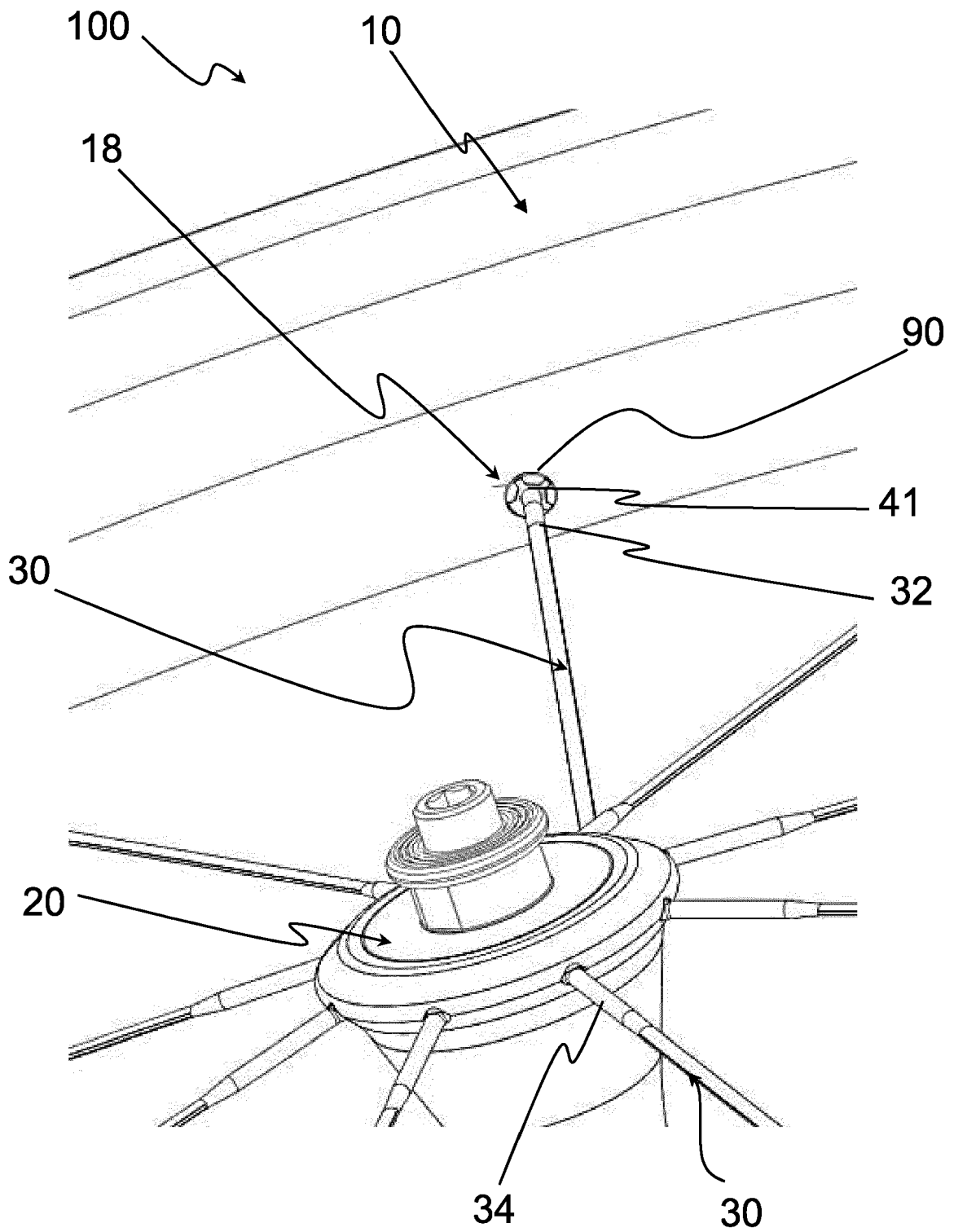
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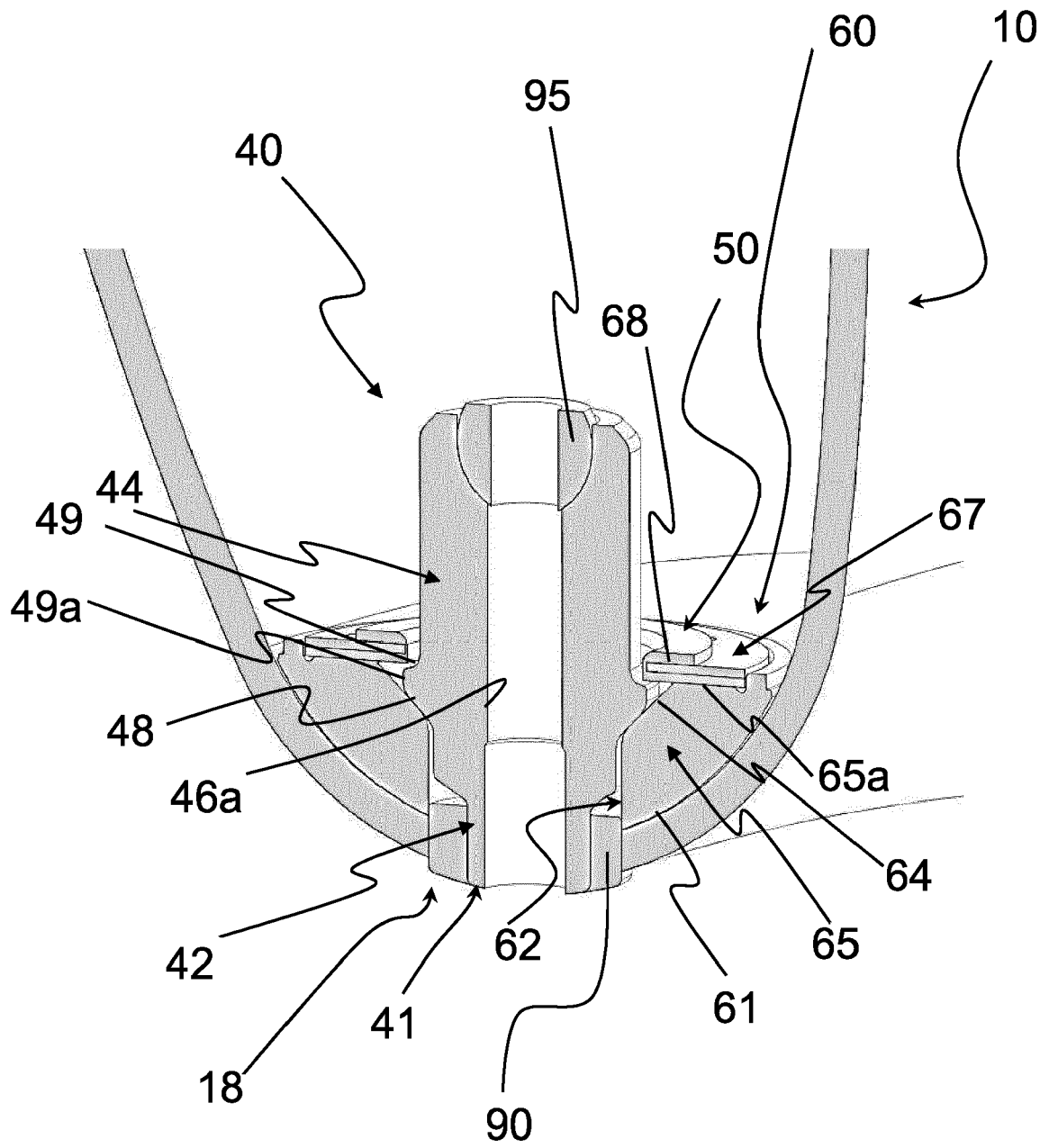
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**Fig. 1**





**Fig. 3**



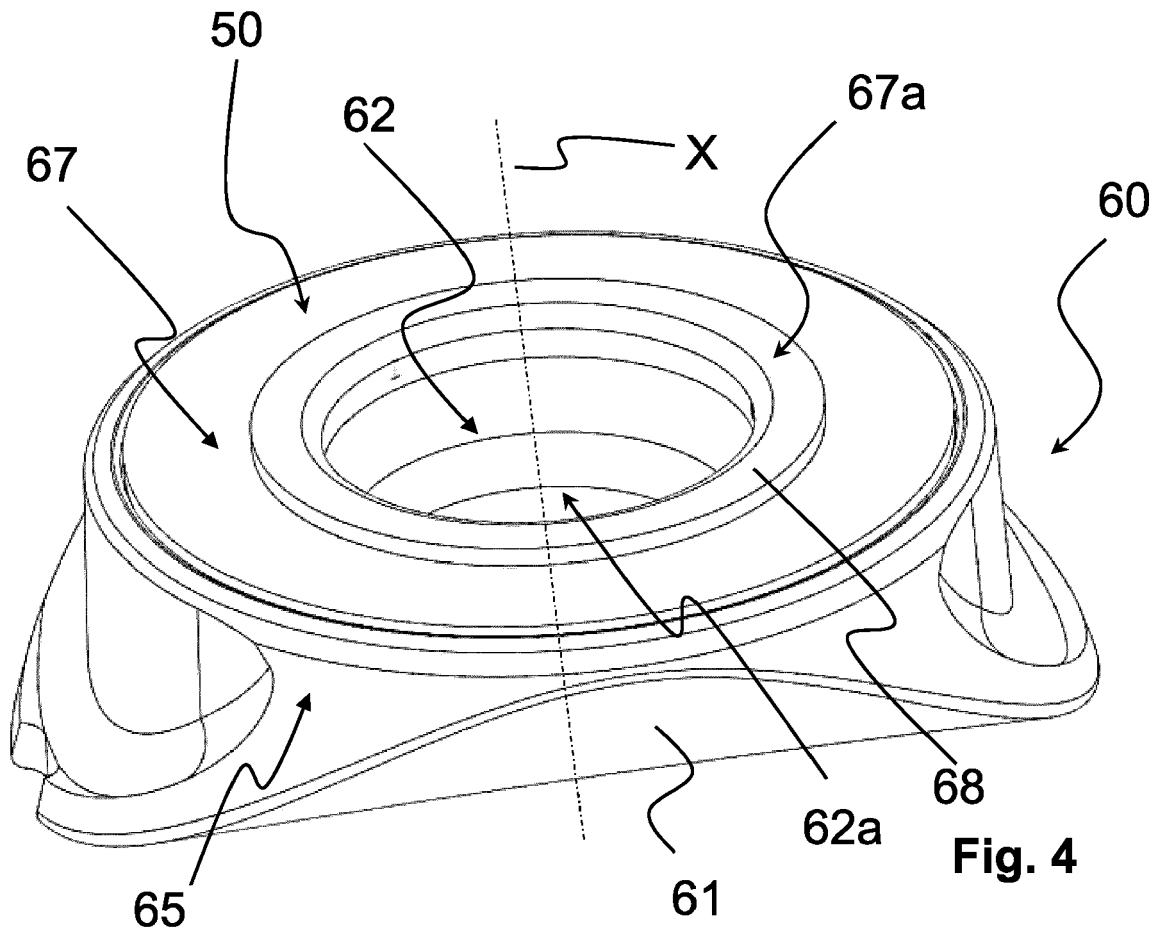


Fig. 4

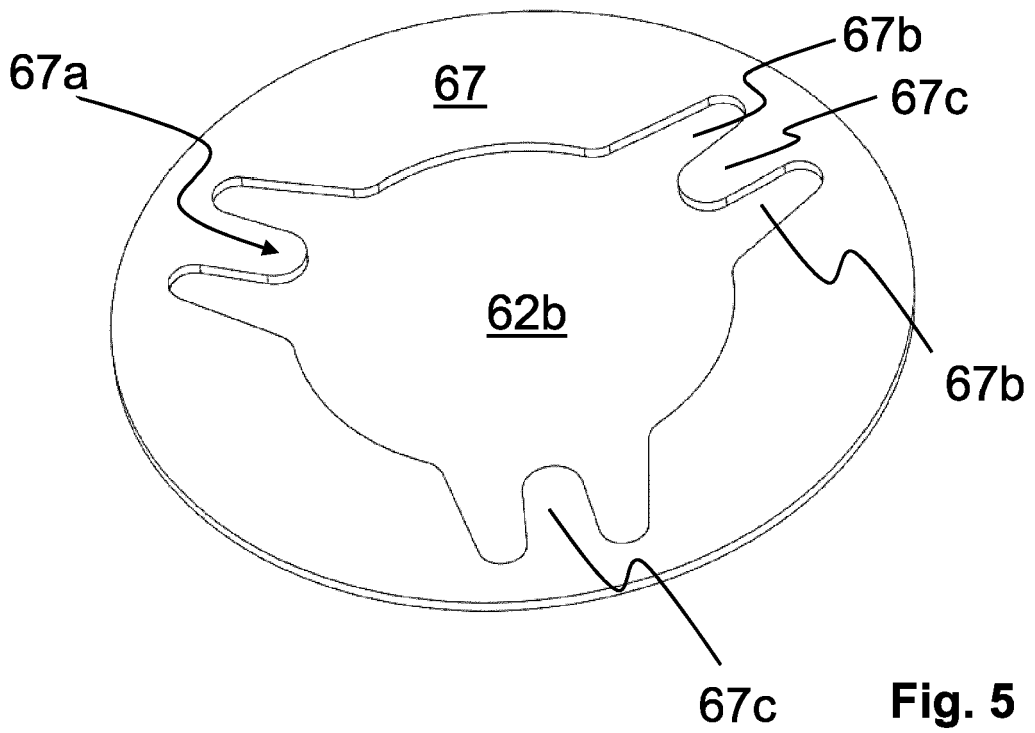
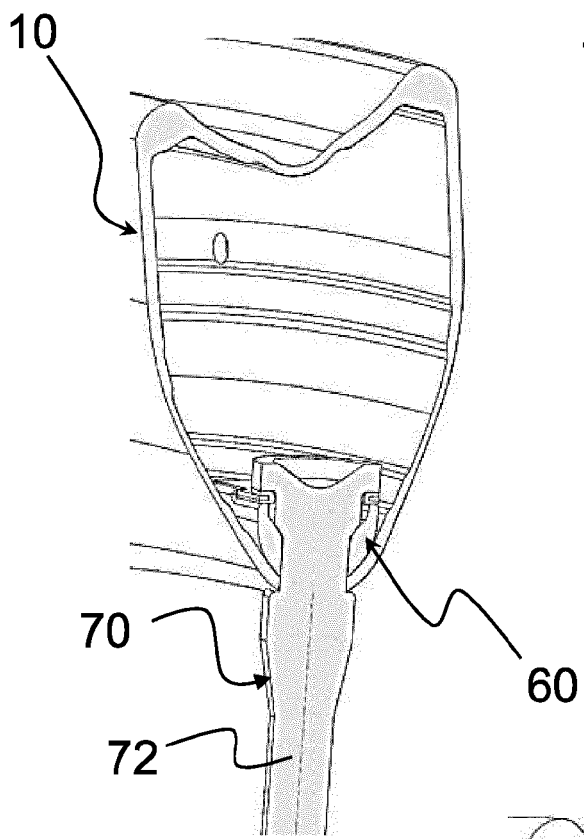
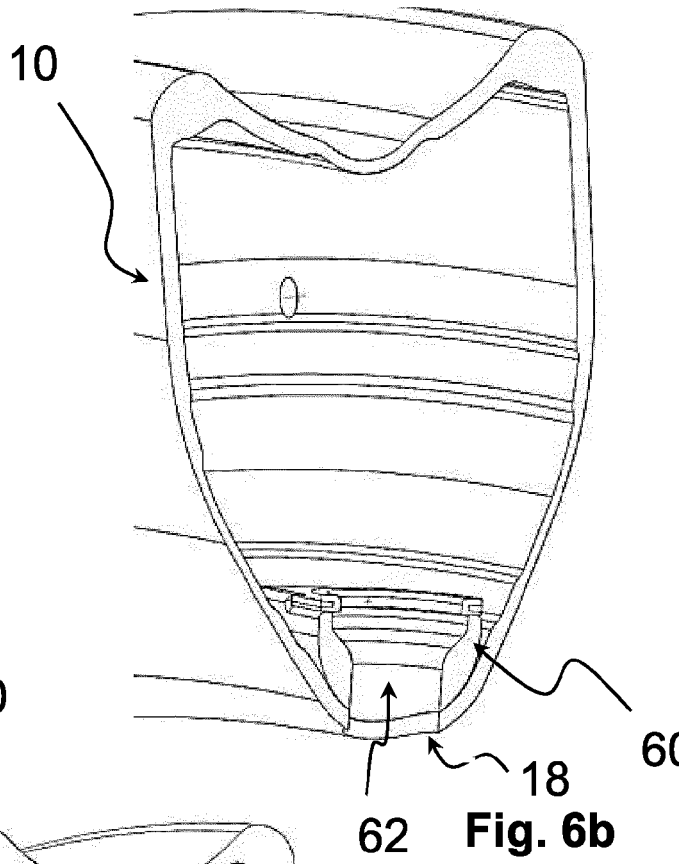


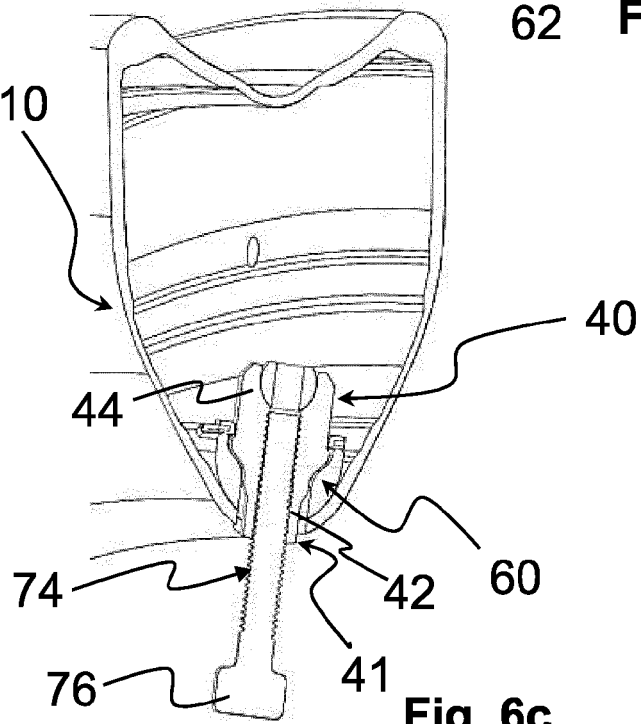
Fig. 5



**Fig. 6a**



**Fig. 6b**



**Fig. 6c**

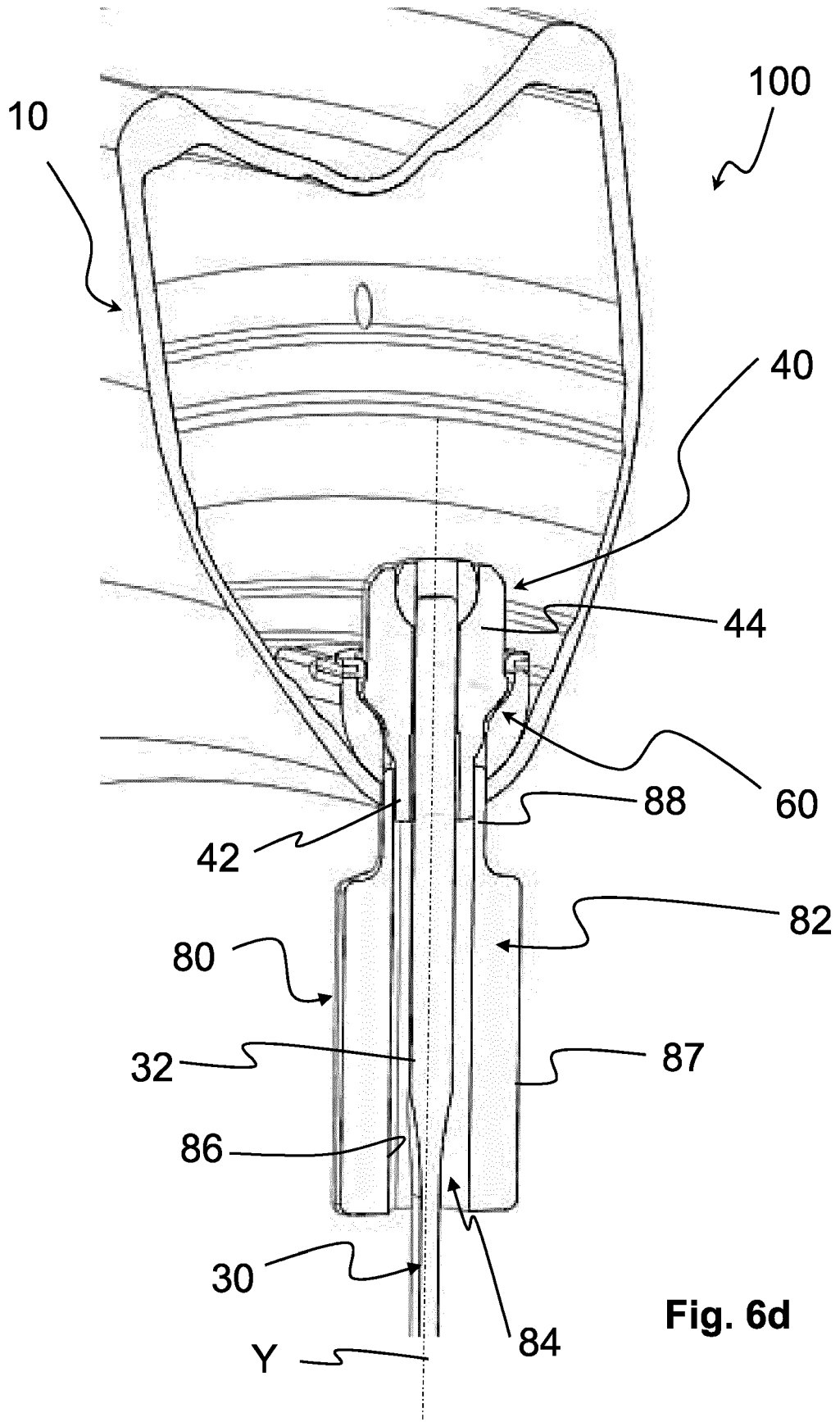
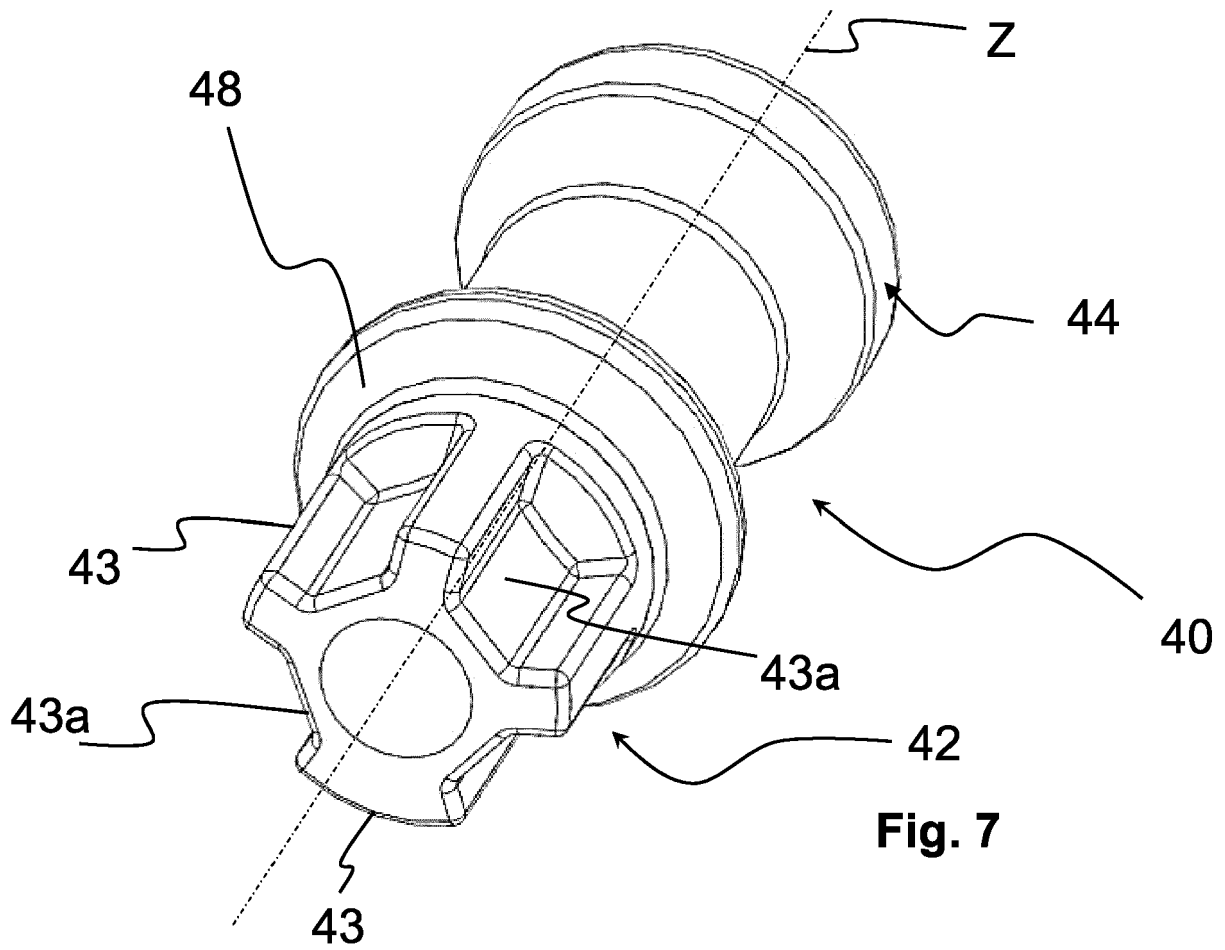
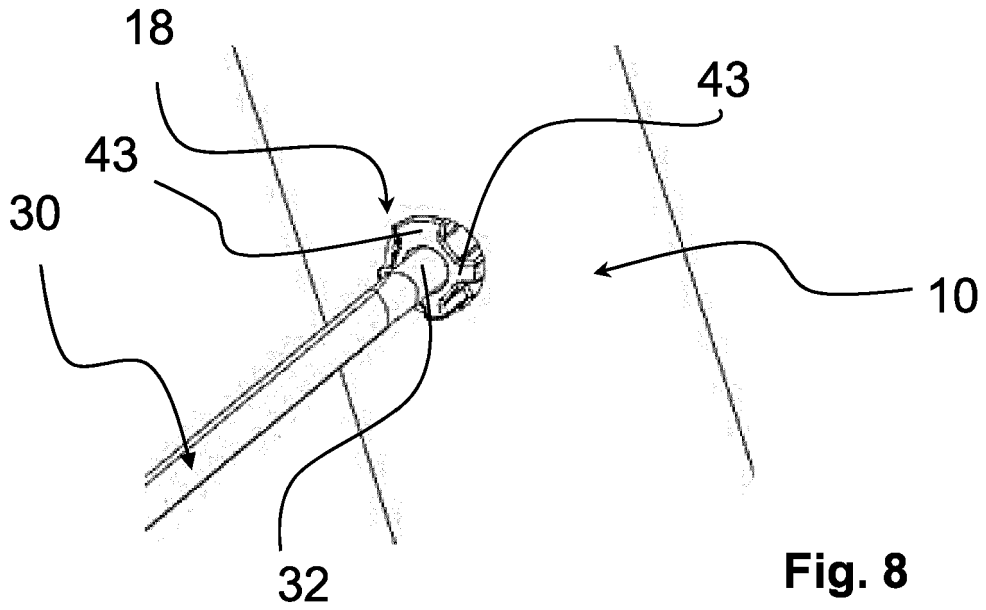


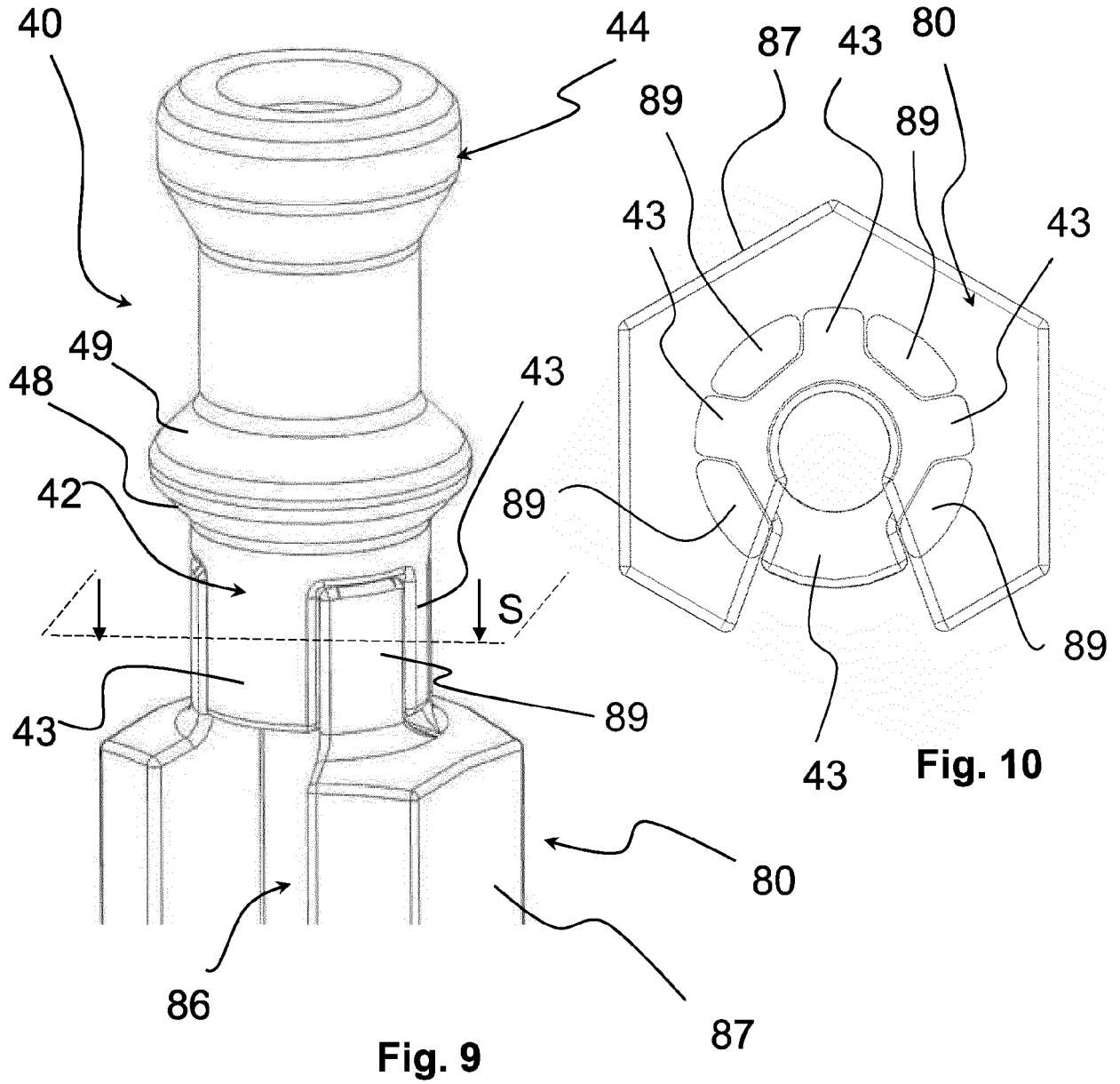
Fig. 6d



**Fig. 7**



**Fig. 8**



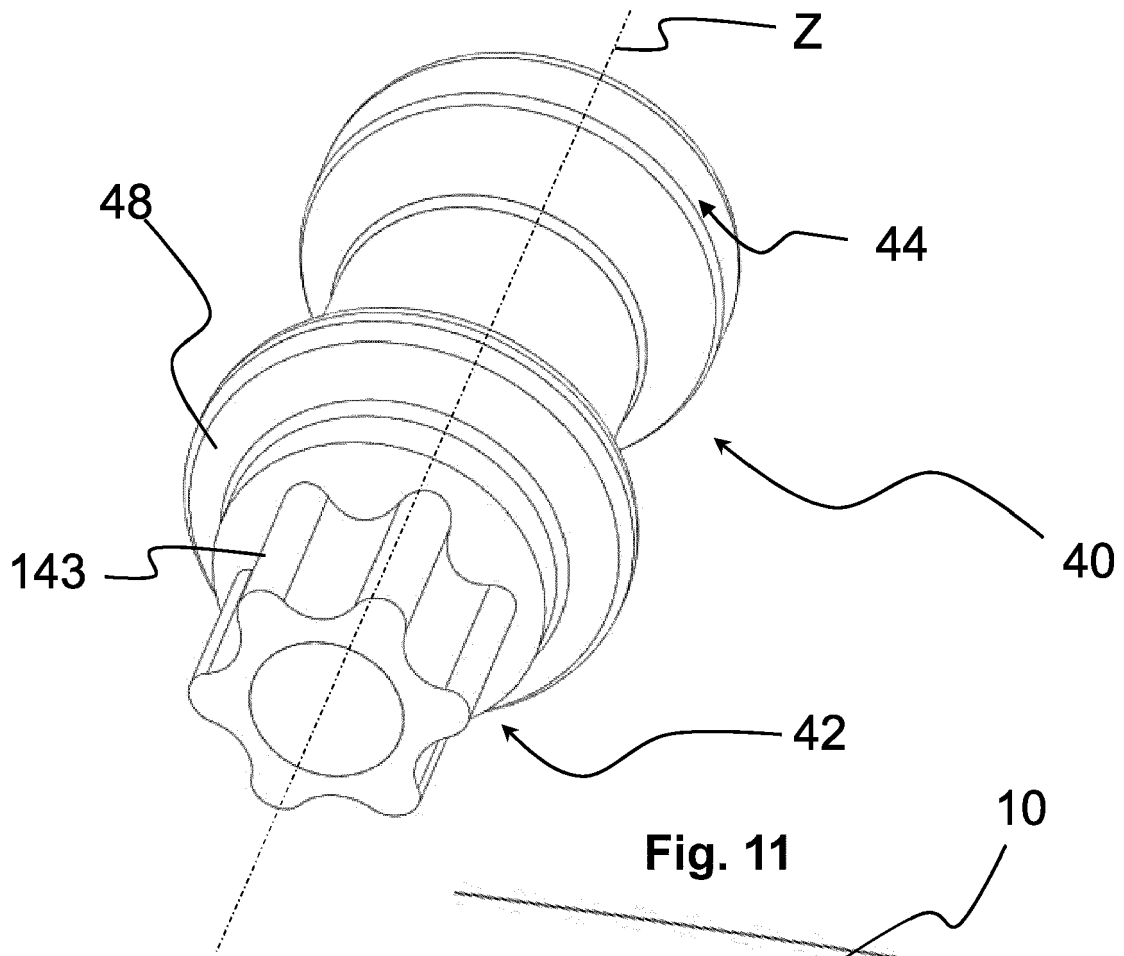


Fig. 11

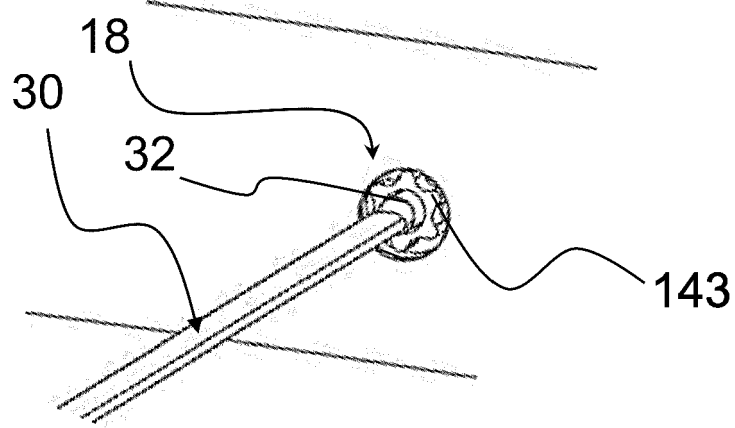
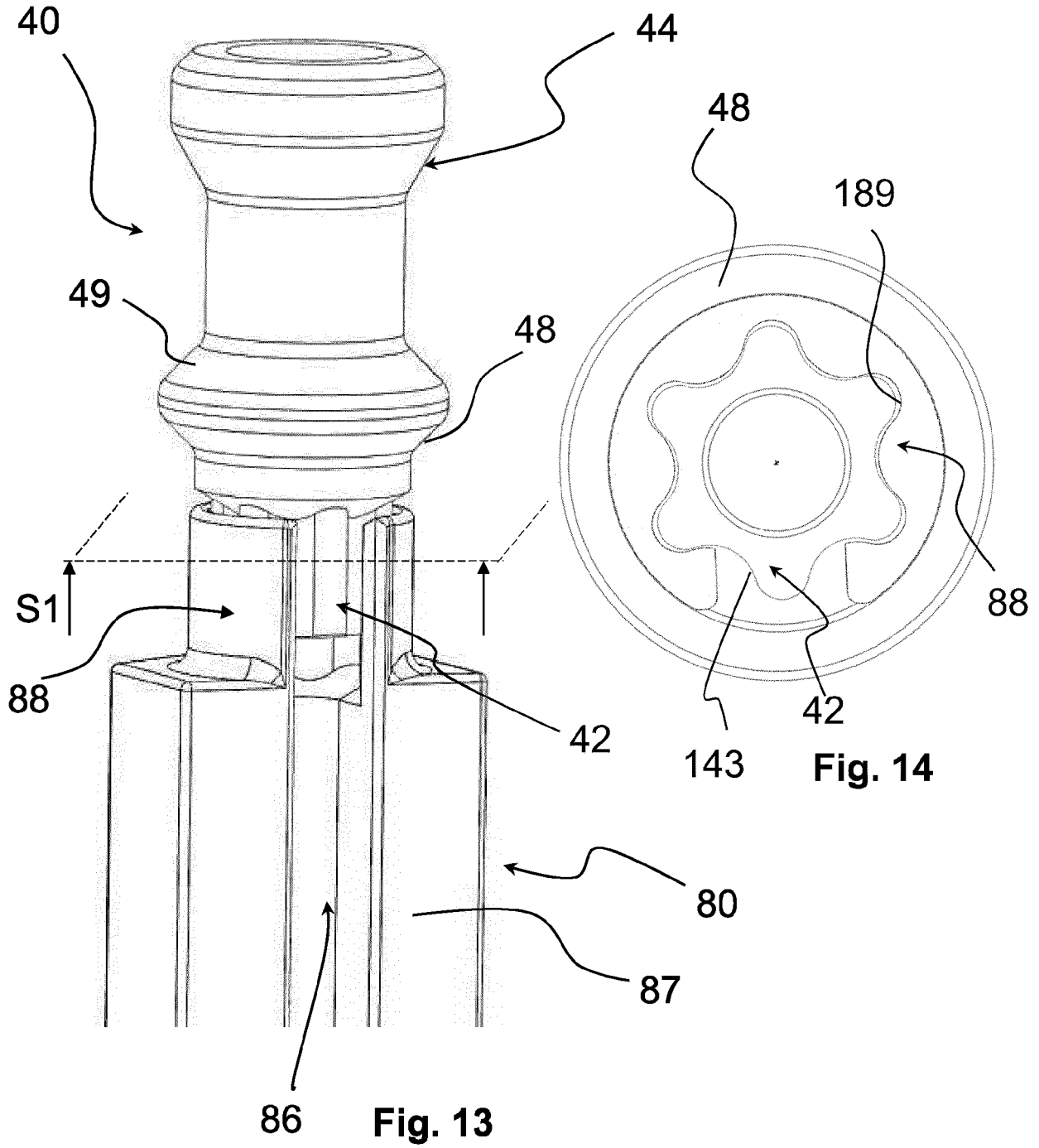
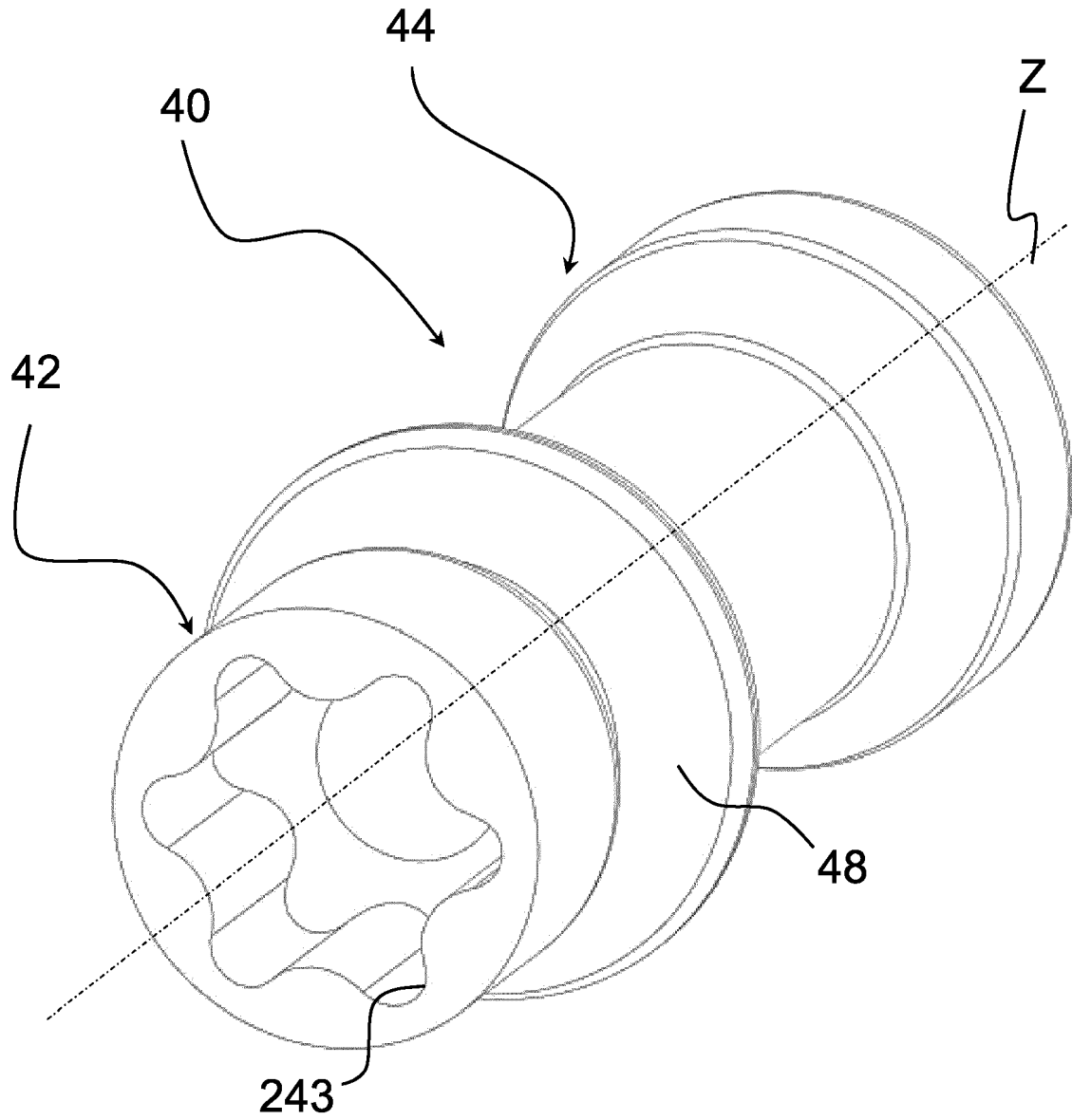


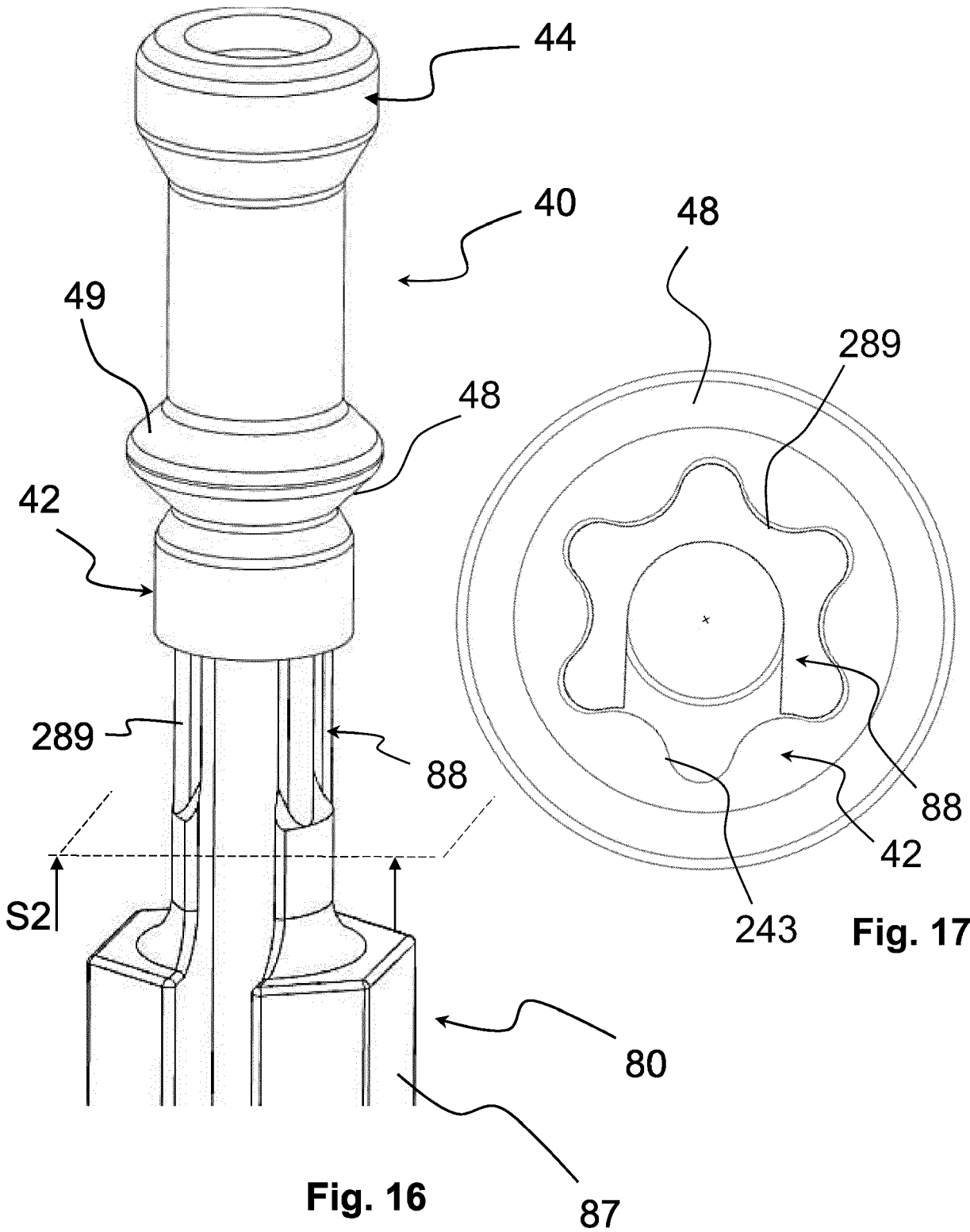
Fig. 12





**Fig. 15**







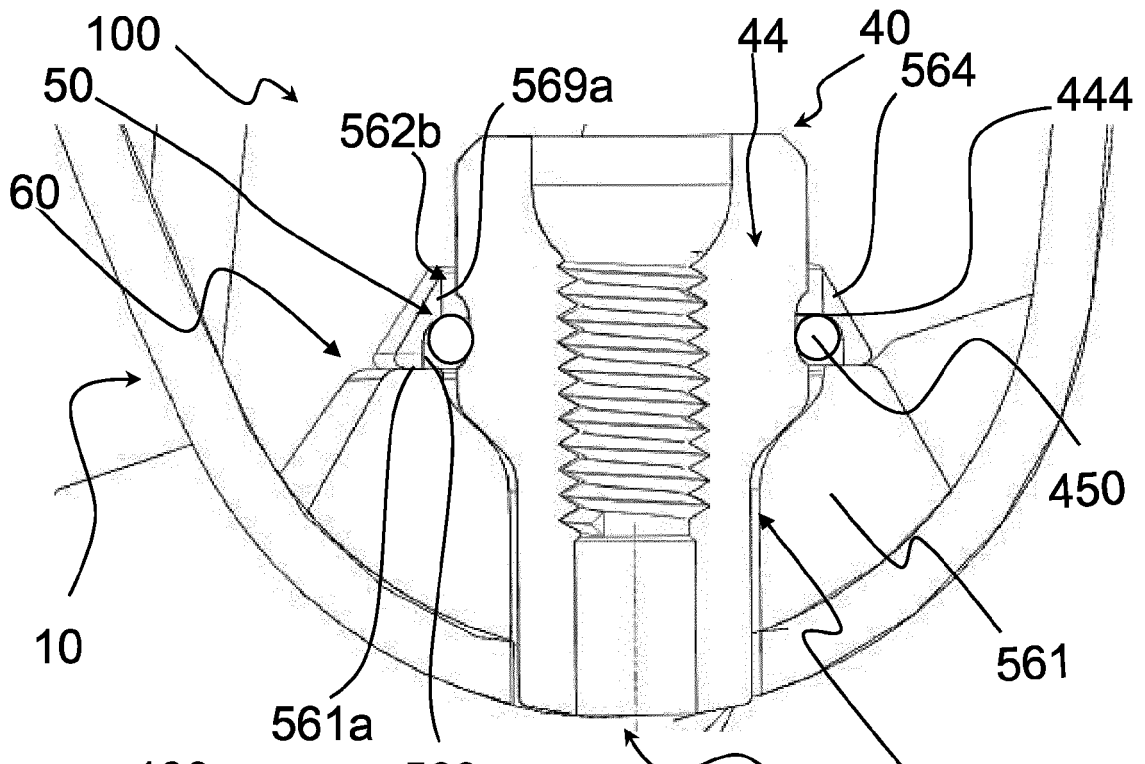


Fig. 20

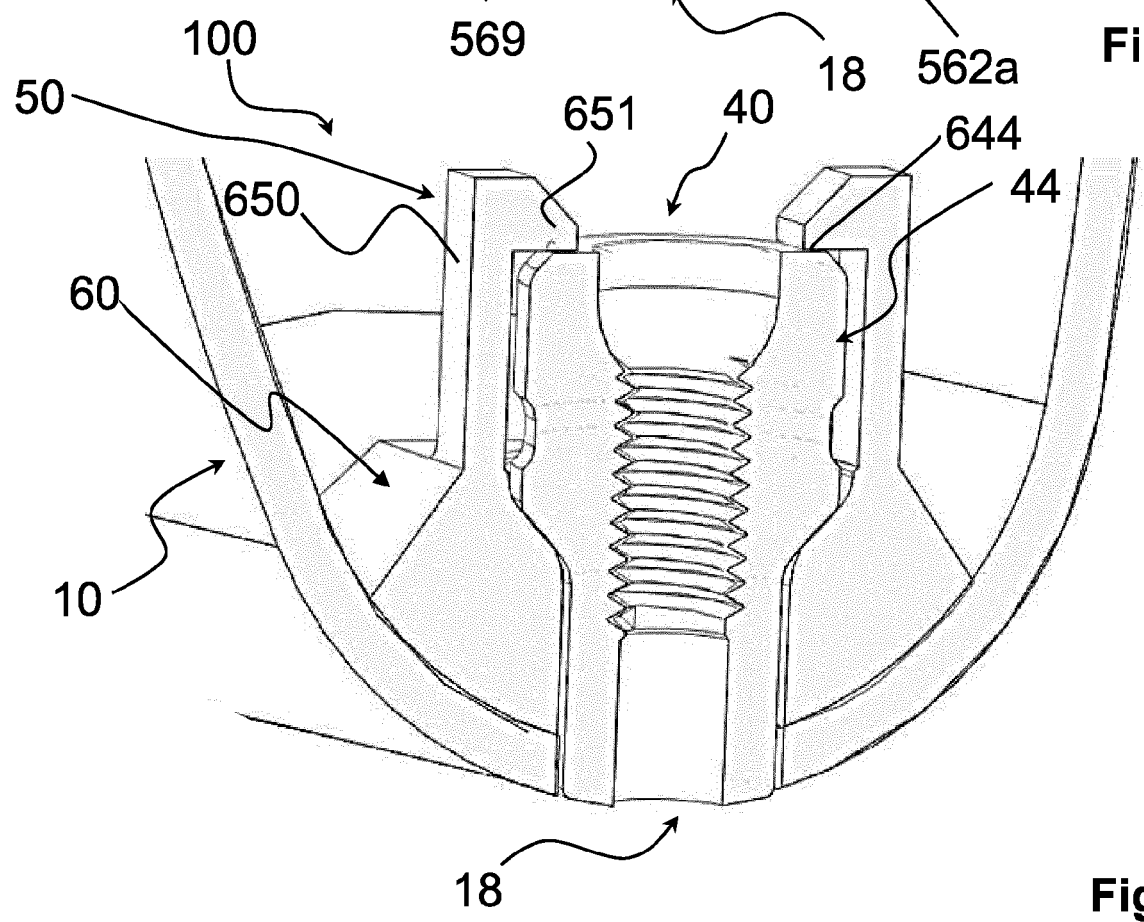


Fig. 21

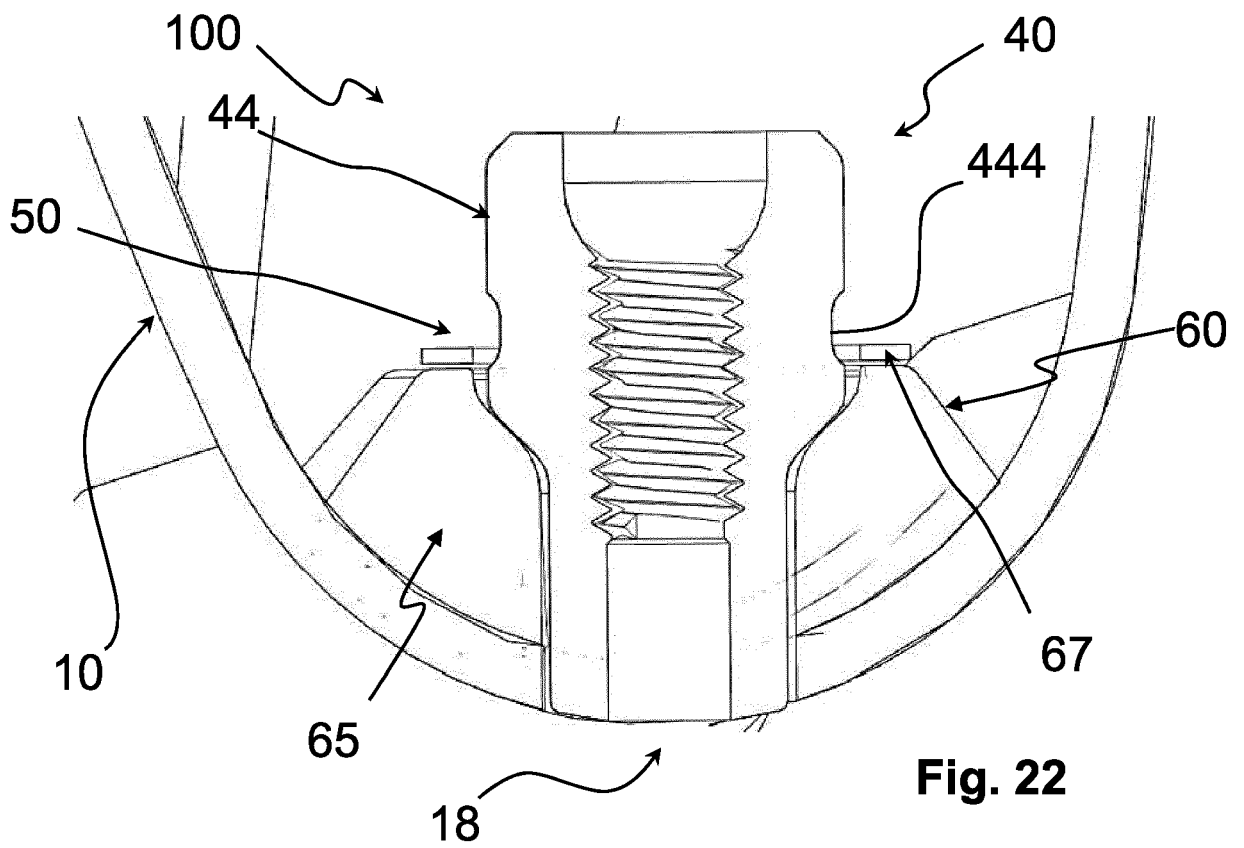


Fig. 22

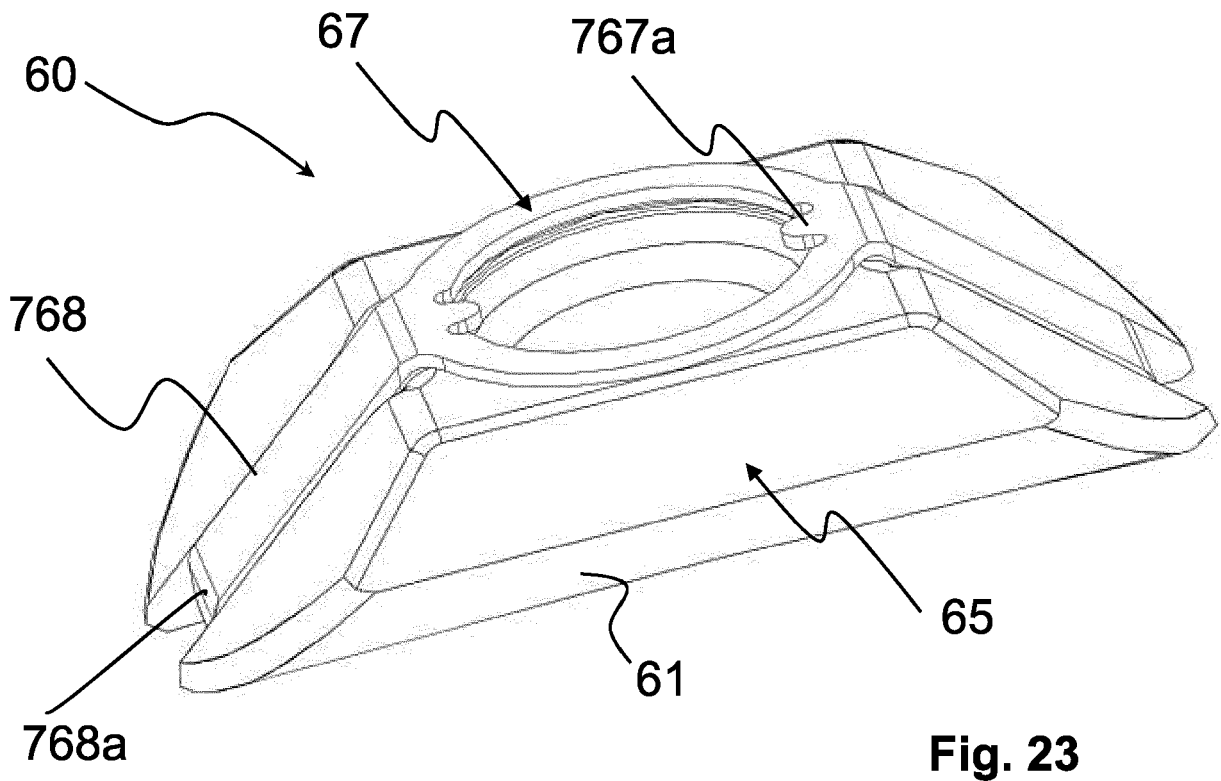
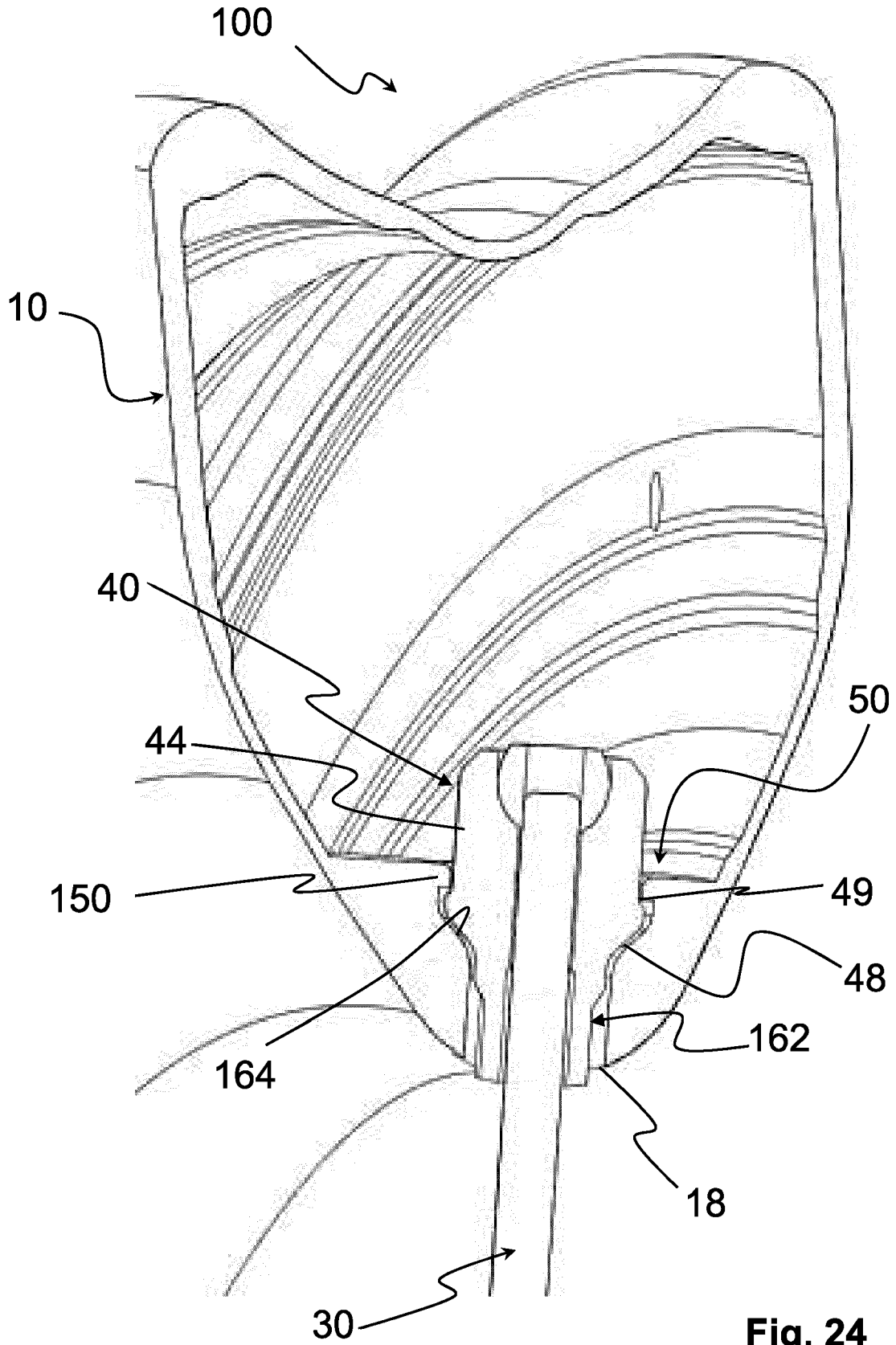
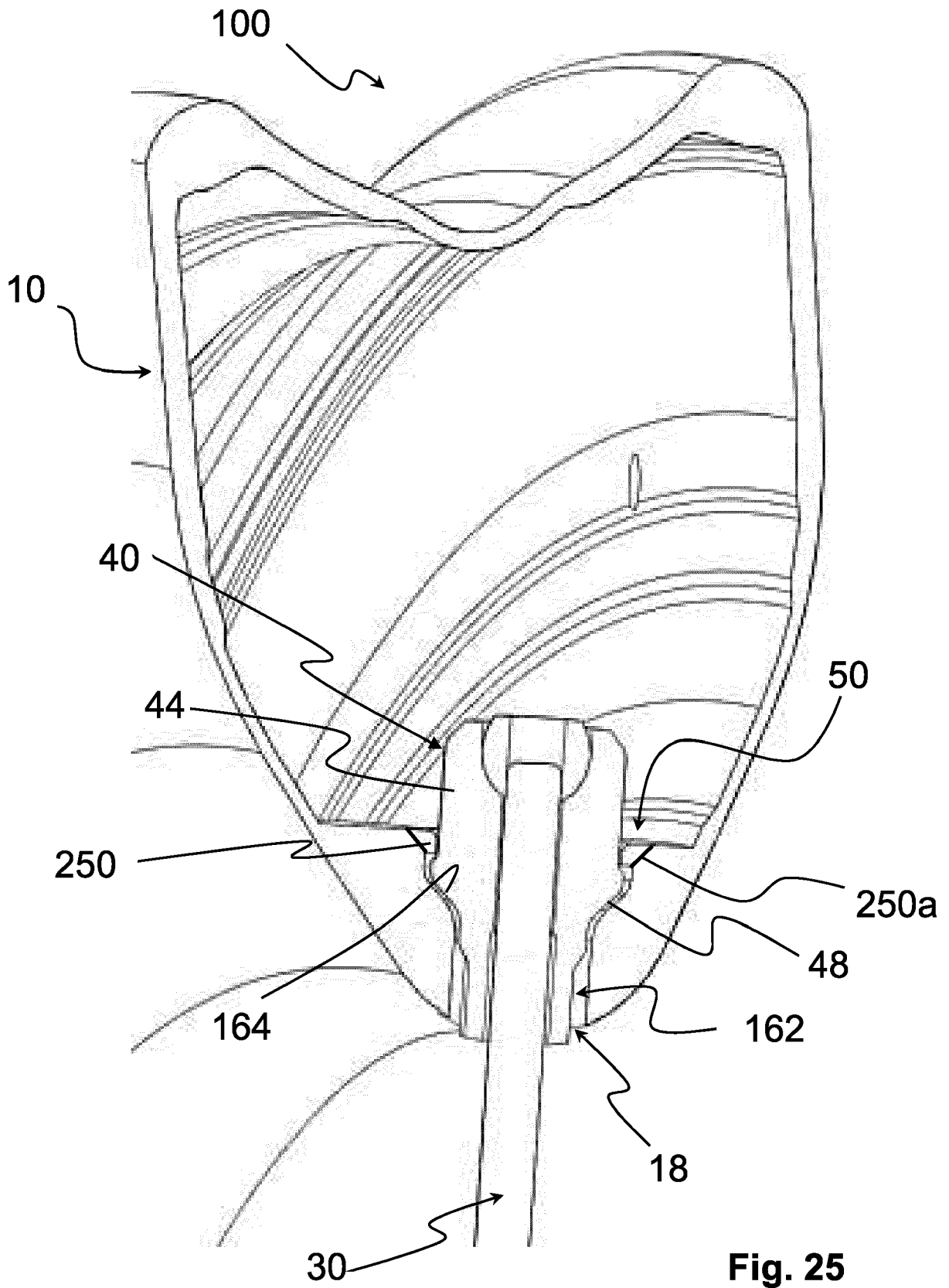


Fig. 23







EUROPEAN SEARCH REPORT

Application Number  
EP 21 20 0283

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 91 02 439 U1 (-) 23 May 1991 (1991-05-23)	1, 6, 10	INV. B60B21/02 B60B1/00 B60B21/06 B25B13/48
Y	* page 3 * * page 6 * * page 7, line 1 - line 20; figures 1,4,5,6 *	2	
Y	----- US 5 894 767 A (WRIDT GERALD A [US] ET AL) 20 April 1999 (1999-04-20)	2	
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