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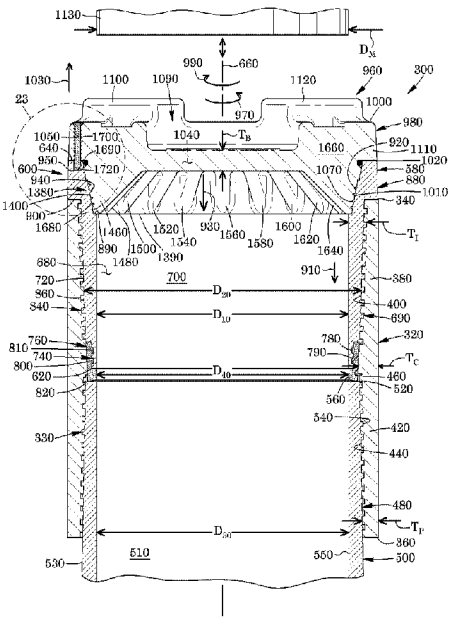
(54) Titre : EMBOUT PROTECTEUR DE FILETAGE DE TUYAU COMPRENANT UN ELEMENT D'EXTREMITE AMOVIBLE, ENSEMBLE D'ETANCHEITE ET BAGUE D'INTERFERENCE, ET ELEMENT D'EXTREMITE ET ENSEMBLE D'ETANCHEITE CONNEXES

(54) Title: PIPE THREAD PROTECTOR WITH REMOVABLE END MEMBER, SEAL ASSEMBLY, AND INTERFERENCE RING, AND END MEMBER AND SEAL ASSEMBLY THEREFOR



(57) Abrégé/Abstract:
There is provided a pipe thread protector with a seal which couples to an inner end of the pipe thread protector and shaped to protect and extend along an outer end surface of the pipe. The seal tapers in a direction extending from a proximal end thereof towards a distal end thereof, and tapers in a direction extending from an outer surface thereof to an inner surface thereof.

There is also provided a pipe thread protector including an inner portion with a first of right-handed and left-handed threading and an outer portion with a second of right-handed and left-handed threading. The pipe thread protector includes an end member with the second of right-handed and left-handed threading via which the end member threadably couples to the outer portion of the tubular body. A locking member selectively enables or inhibits rotation of the end member relative to the tubular body.

## ABSTRACT OF THE DISCLOSURE

There is provided a pipe thread protector with a seal which couples to an inner end of the pipe thread protector and shaped to protect and extend along an outer end surface of the pipe. The seal tapers in a direction extending from a proximal end thereof towards a distal end thereof, and tapers in a direction extending from an outer surface thereof to an inner surface thereof.

There is also provided a pipe thread protector including an inner portion with a first of right-handed and left-handed threading and an outer portion with a second of right-handed and left-handed threading. The pipe thread protector includes an end member with the second of right-handed and left-handed threading via which the end member threadably couples to the outer portion of the tubular body. A locking member selectively enables or inhibits rotation of the end member relative to the tubular body.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# PIPE THREAD PROTECTOR WITH REMOVABLE END MEMBER, SEAL ASSEMBLY, AND INTERFERENCE RING, AND END MEMBER AND SEAL ASSEMBLY THEREFOR

## BACKGROUND OF THE INVENTION

### Field of the Invention

**[0001]** There is provided a pipe thread protector. In particular, there is provided a pipe thread protector with a removable end member, a seal assembly and an interference ring, as well as an end member and seal assembly therefor.

### Description of the Related Art

**[0002]** Oil drillers may require down-hole oil pipes to be "drifted" prior to going into the ground. Drifting the pipe is a process of pulling a drift mandrel through the inside length of a pipe to ensure the inside is clear of debris and within a required tolerance. This process ensures that smaller pipes, tools, and other items can be passed through the pipe during use. Drifting is typically performed at the rig-site, prior to the pipes going into the ground.

**[0003]** Currently, thread protectors on both ends of the pipe are removed prior to running a drift mandrel through the length of the pipe. After the pipe thread protectors have been removed, the pipe is left fully exposed, and a drift mandrel may thereafter be pulled through the inner length of the pipe. As the drift mandrel runs through the pipe, the drift mandrel may drag dirt and debris along with it. Such contaminants may fall onto the exposed female and male threads and stick thereon because these threads are coated with a heavy protective grease or pipe dope. After the drifting process is complete, any contaminated pipe dope will need to be removed and reapplied to the threads. The pipe thread protectors are thereafter coupled to the ends of the pipe once more.



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**[0004]** In view of the above, there may be a need for a pipe thread protector that can stay on the pipe during the drifting process and keep the threads sealed to inhibit contamination thereof. There may also be a need for a driftable protector that can provide a high level of impact resistance and can be produced in a more cost-effective manner.

## BRIEF SUMMARY OF INVENTION

**[0005]** There is provided, and it is an object to provide, an improved pipe thread protector, and seal therefor.

**[0006]** There is accordingly provided a pipe thread protector according to a first aspect. The pipe thread protector includes a tubular body. The tubular body of the pipe thread protector has an open first end and an open second end spaced-apart from the first end thereof. The tubular body of the pipe thread protector has a bore extending from the first end thereof to the second end thereof. The pipe thread protector includes threading extending from the first end of the tubular body of the pipe thread protector towards the second end of the tubular body of the pipe thread protector.

**[0007]** According to a second aspect, the above pipe thread protector includes a seal coupled to the first end of the tubular body. The seal is shaped to protect and extend along an outer end surface of a pipe.

**[0008]** There is further provided a pipe thread protector seal for a pipe thread protector according to a third aspect. The seal is tubular. The seal tapers in a direction extending from a proximal end thereof towards a distal end thereof. The seal tapers in a direction extending from an outer surface thereof to an inner surface thereof.

**[0009]** There is also provided a pipe thread protector seal for a pipe thread protector according to a fourth aspect. The seal is tubular and L-shaped in longitudinal cross-section.



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The seal tapers in a direction extending from an outer surface thereof to an inner surface thereof.

**[0010]** There is further provided a pipe thread protector according to yet a fifth aspect. The pipe thread protector includes a tubular body having a pair of spaced-apart open ends. The pipe thread protector includes threading extending between the open ends of the tubular body. The pipe thread protector includes a seal coupled to one of the ends of the tubular body. The seal is shaped to inhibit inward bulging thereof when axially compressed.

**[0011]** According to a sixth aspect, a coupling further threadably couples together with the pipe thread protector and a male threaded end of a pipe, with the seal being shaped to cover an end surface of the pipe when the coupling so couples together the pipe thread protector and the male threaded end of the pipe.

**[0012]** There is additionally provided a pipe thread protector assembly according to a seventh aspect. The pipe thread protector assembly includes a pipe thread protector. The pipe thread protector assembly includes a coupling via which the pipe thread protector and a male threaded end of a pipe threadably couple together. The pipe thread protector assembly includes a seal coupled to an inner end of the pipe thread protector. The seal is shaped to protect an outer end surface of the pipe.

**[0013]** According to an eighth aspect, the seal functions to abut against the outer end surface of the pipe throughout a make-up tolerance range, where the make-up tolerance is an allowable distance range within which a male threaded end portion of the pipe travels into the coupling.

**[0014]** There is further provided a pipe thread protector assembly according to a ninth aspect. The pipe thread protector assembly includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector assembly includes an end member shaped to removably couple to and extend laterally across a first



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end portion of the tubular body. The pipe thread protector assembly includes a seal coupled to and extending about a second end portion of the tubular body spaced-apart from the first end portion of the tubular body.

**[0015]** There is accordingly provided a pipe thread protector assembly according to a tenth aspect. The assembly includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling and receive a cylindrical member therethrough for drifting the pipe. The assembly includes an impact-absorbing end member connecting to and extending laterally across the tubular body. The end member is selectively removable from the tubular body. The end member is shaped to inhibit inward deformation of the tubular body.

**[0016]** There is accordingly provided a pipe thread protector according to an eleventh aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The tubular body includes an inner portion with a first of right-handed and left-handed threading. The tubular body includes an outer portion with a second of right-handed and left-handed threading. The pipe thread protector includes an end member. The end member includes the second of right-handed and left-handed threading via which the end member threadably couples to the outer portion of the tubular body.

**[0017]** There is also provided a pipe thread protector according to a twelfth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector includes an end member with an inner portion which is frustoconical in outer shape. The end member is configured to extend laterally across and threadably couple to the tubular body.

**[0018]** There is further provided a pipe thread protector according to a thirteenth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector includes an end member shaped to extend laterally across and selectively couple to the tubular body. The end



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member has a thickness that is at least in part equal to or greater than that of the tubular body.

**[0019]** There is additionally provided a pipe thread protector according to a fourteenth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The tubular body has an outer end, an inner end, and a tapered bore which tapers from the outer end thereof towards the inner end thereof. The pipe thread protector includes an end member shaped to be received in part within the tapered bore. The end member extends laterally across and removably couples to the tubular body.

**[0020]** There is yet also provided a pipe thread protector according to a fifteenth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector includes an end member shaped to removably couple to and extend laterally across the tubular body. The pipe thread protector includes a locking member. The locking member has a first position in which removal of the end member from the tubular body is inhibited. The locking member is moveable from the first position thereof to a second position in which the end member is selectively removable from the tubular body.

**[0021]** There is further provided a pipe thread protector assembly according to a sixteenth aspect. The pipe thread protector assembly includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector assembly includes an end member shaped to removably couple to and extend laterally across a first end portion of the tubular body. The pipe thread protector assembly includes a seal coupled to and extending about a second end portion of the tubular body spaced-apart from the first end portion of the tubular body.

**[0022]** There is yet further provided a pipe thread protector according to a seventeenth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of the pipe coupling. The pipe thread protector includes an end member removably



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coupled to the tubular body. The pipe thread protector includes a seal extending about the tubular body and shaped to seal an inner shoulder of the pipe coupling.

**[0023]** There is yet additionally provided pipe thread protector according to an eighteenth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector includes an end member removably coupled to the tubular body. The end member has a central recessed region extending within the tubular body. The end member is shaped to receive a hook at least in part.

**[0024]** There is yet additionally provided a pipe thread protector according to a nineteenth aspect. The pipe thread protector includes a tubular body having an inner end and an outer end spaced-apart from the inner end thereof. The tubular body has an inner surface along which extends threading from the inner end thereof towards the outer end thereof. The pipe thread protector includes a protrusion coupled to and extending radially inwards from the inner surface of the tubular body. The protrusion is configured to deform upon rotatably pipe coupling the tubular body to a male threaded end portion of a pipe. The protrusion so deformed inhibits removal of the pipe from the tubular body thereafter.

**[0025]** There is yet further provided a removable end member for a pipe thread protector. The end member includes a base member shaped to extend laterally across an open outer end of the pipe thread protector. The end member includes one or more protrusions coupled to and extending axially outwards from an outer end of the base member. The end member includes an inner annular member coupled to, extending axially from, and tapering relative to an inner end of the base member.

**[0026]** There is also provided a pipe thread protector according to a twentieth aspect. The pipe thread protector includes a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling. The pipe thread protector includes a seal extending about the tubular body. The seal is triangular in lateral cross-section.



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**[0027]** There is yet also provided a method of transporting and drifting a pipe using the pipe thread protector assembly as herein described and/or described above. The method includes coupling together the tubular body and end member of the pipe thread protector assembly. The method may include moving a locking member into the locked position thereof in which removal of the end member from the tubular body is inhibited. The method includes threadably connecting the tubular body and the end member so coupled together to a threaded end portion of a pipe or a pipe coupling which couples to the threaded end portion of the pipe, with debris being inhibited from contacting the outer end face and interior of the pipe thereby. The method includes transporting the pipe, with the tubular body and the end member so coupled thereto, to a work site.

**[0028]** The method includes drifting the pipe by removing the end member from the tubular body so coupled to the pipe coupling. Within this removal step, the method may include moving the locking member from the locked position to the unlocked position in which the end member is selectively removable from the tubular body. The method thereafter includes biasing the cylindrical member having pre-determined outer diameter through the tubular body and into the pipe. The method includes determining that the pipe is acceptable if the cylindrical member extends therein, and determining that the pipe is unacceptable if the cylindrical member is inhibited from extending therein. The method may further includes after the biasing step, re-connecting the end member to the tubular body, with debris being inhibited from contacting the outer end face and interior of pipe once more.

**[0029]** It is emphasized that the invention relates to all combinations of the above features, even if these are recited in different claims.

**[0030]** Further aspects and example embodiments are illustrated in the accompanying drawings and/or described in the following description.



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## BRIEF DESCRIPTION OF DRAWINGS

**[0031]** The accompanying drawings illustrate non-limiting example embodiments of the invention.

Figure 1 is an outer end, side perspective view of a pipe thread protector according to a first embodiment, the pipe thread protector including a tubular body and a seal coupled thereto;

Figure 2 is an inner end, side perspective view of the pipe thread protector thereof;

Figure 3 is a side elevation view of the pipe thread protector thereof;

Figure 4 is an inner end plan view of the pipe thread protector thereof;

Figure 5 is a side elevation view of the tubular body of the pipe thread protector of Figure 3, with the seal thereof being removed and not shown;

Figure 6 is a proximal end, side perspective view of the seal of the pipe thread protector of Figure 1, with the tubular body of the pipe thread protector being removed and not shown;

Figure 7 is a distal end, side perspective view of the seal of Figure 6;

Figure 8 is a sectional view taken along lines 8 – 8 of the pipe thread protector of Figure 3;

Figure 9 is an outer end, side perspective view of a pipe thread protector assembly comprising the pipe thread protector of Figure 1 and a coupling to which the pipe thread protector threadably couples, as well as an end portion of a pipe to which the coupling threadably couples, with the pipe being shown in fragment;



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Figure 10 is an inner end, side perspective view of the pipe thread protector assembly of Figure 9 together with the end portion of the pipe shown in Figure 9, with the pipe being shown in fragment;

Figure 11 is a sectional view taken along lines 11 – 11 of the pipe thread protector assembly and end portion of the pipe of Figure 9, with the pipe being shown in fragment;

Figure 12 is an enlarged sectional view of the pipe thread protector assembly and end portion of the pipe of Figure 11, with the pipe thread protector, the coupling and the pipe being shown in fragment;

Figure 13 is a sectional view similar to Figure 8 of a pipe thread protector according to a second embodiment;

Figure 14 is a sectional view similar to Figure 13 of a pipe thread protector according to a third embodiment;

Figure 15 is a sectional view similar to Figure 8 of a pipe thread protector according to a fourth embodiment;

Figure 16 is an outer end, bottom, left side perspective view of a pipe thread protector assembly according to a fifth embodiment, together with an end portion of a pipe shown in fragment, the assembly including an open box protector comprising a tubular body with a removable end plug threadably coupled to the tubular body thereof, and a pipe coupling threadably connecting the tubular body and pipe together;

Figure 17 is a bottom plan view thereof;

Figure 18 is an outer end elevation view thereof;



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Figure 19 is an outer end, bottom, left side perspective view of the end plug of the open box protector of Figure 16;

Figure 20 is an inner end elevation view thereof;

Figure 21 is an outer end, bottom, left side perspective view of the tubular body and a pipe-end-face seal of the open box protector of Figure 16;

Figure 22 is a sectional view taken along lines 22 – 22 of the pipe protector assembly, pipe coupling and pipe of Figure 17, with the pipe being shown in fragment;

Figure 23 is an enlarged sectional view taken of the pipe thread protector assembly and coupling of Figure 22 , with the pipe thread protector assembly and pipe coupling being shown in fragment;

Figure 24 is a longitudinal sectional view of a pipe thread protector assembly according to a sixth embodiment, together with an end portion of a pipe shown in fragment, the assembly including an open box protector comprising a tubular body with a removable end plug threadably coupled thereto, a seal coupled to an inner end of the tubular body, and a pipe coupling threadably coupling the tubular body and pipe together;

Figure 25 is an outer end, bottom, left side perspective view of a pipe thread protector assembly according to a seventh embodiment, together with an end portion of a pipe shown in fragment, the assembly including a pin protector threadably coupled to the end portion of the pipe, with the pin protector comprising a tubular body with a removable end plug threadably coupled to the tubular body thereof;

Figure 26 is a bottom plan view thereof;

Figure 27 is an outer end, bottom, left side perspective view of the tubular body of the pin protector of Figure 25;



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Figure 28 is a sectional view taken along lines 28 – 28 of the pipe thread protector assembly and pipe of Figure 26, with the pipe being shown in fragment;

Figure 29 is an enlarged sectional view taken of the pipe thread protector assembly and pipe of Figure 28, with the pipe thread protector assembly and pipe being shown in fragment;

Figure 30 is an outer end, bottom, left side perspective view of a pipe thread protector assembly according to an eighth embodiment, together with an end portion of a pipe shown in fragment, the assembly including a pin protector threadably coupled to the end portion of the pipe, with the pin protector comprising a tubular body with a removable end plug threadably coupled to the tubular body thereof;

Figure 31 is a sectional view taken along lines 31 – 31 of the pipe thread protector assembly and pipe of Figure 30, with the pipe being shown in fragment;

Figure 32 is an enlarged sectional view of the pipe thread protector assembly and pipe of Figure 31, with the pipe thread protector assembly and pipe shown in fragment; and

Figure 33 is a longitudinal sectional view of the pipe thread protector assembly and pipe of Figure 31, together with a hook shown coupling to the pin protector and lifting the pipe thereby.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0032]** Throughout the following description, specific details are set forth in order to provide a more thorough understanding of the invention. However, the invention may be practiced without these particulars. In other instances, well known elements have not been shown or described in detail to avoid unnecessarily obscuring the invention. Accordingly,



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the specification and drawings are to be regarded in an illustrative, rather than a restrictive sense.

**[0033]** Referring to the drawings and first to Figure 9, there is shown a pipe thread protector assembly 30.

**[0034]** The pipe thread protector assembly includes a pipe thread protector 32 best seen in Figure 1. The pipe thread protector has a longitudinal axis 34 and extends about an interior 33. Pipe thread protector 32 includes a tubular body 36 which is coaxial with and which extends along the longitudinal axis. The tubular body of the pipe thread protector is made of a polymer that is at least semi-rigid, in this example comprising a thermoplastic. However, this is not strictly required and tubular body 36 of pipe thread protector 32 may be made of other rigid or semi-rigid materials in other examples.

**[0035]** As seen in Figure 8, the tubular body of the pipe thread protector has an open first or inner end 38, and an open second or outer end 40 longitudinally spaced-apart from the inner end thereof. Tubular body 36 of pipe thread protector 32 has a bore 42 coaxial with and which extends about axis 34. The bore extends from inner end 38 of the tubular body of the pipe thread protector to outer end 40 of the tubular body of the pipe thread protector. Interior 33 and bore 42 of tubular body 36 are in fluid communication with open ends 38 and 40 thereof.

**[0036]** As seen in Figure 1, pipe thread protector 32 includes one or more protrusions, in this example a plurality of circumferentially spaced-apart bumpers 44, 46, 48 and 50. The bumpers couple to and extend axially outwards from outer end 40 of tubular body 36 of the pipe thread protector. Each bumper 44, 46, 48 and 50 is a curved rectangular prism in shape in this example: arc-shaped in lateral cross-section and approximately rectangular in longitudinal cross-section.



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**[0037]** Referring to Figure 8, tubular body 36 of pipe thread protector 32 has an outer surface 52. The tubular body of the pipe thread protector also has an inner surface 54 spaced radially inwards from the outer surface. The inner and outer surfaces are annular in this example and extend from near inner end 38 of tubular body 36 of pipe thread protector 32 towards outer end 40 of the tubular body. The tubular body of the pipe thread protector includes a first or distal sleeve portion 56 that extends from outer end 40 thereof towards inner end 38 thereof. The distal sleeve portion of tubular body 36 of pipe thread protector 32 terminates in an outwardly flared end 58 in this example.

**[0038]** The tubular body of the pipe thread protector further includes a second, intermediate or threaded portion 60 coupled to and extending axially from distal sleeve portion 56 thereof. The threaded portion of tubular body 36 of pipe thread protector 32 is integrally formed with the distal sleeve portion of the tubular body of the pipe thread protector in this example. Threading 62 couples to, extends along and extends outwards from outer surface 52 of threaded portion 60 of the tubular body of pipe thread protector 32. The threading thus extends from near inner end 38 of tubular body 36 towards outer end 40 of the tubular body of the pipe thread protector.

**[0039]** Threaded portion 60 of the tubular body of pipe thread protector 32 has a first or outer end 64 radially inwardly spaced-apart from and adjacent flared end 58 of distal sleeve portion 56 of the tubular body of the pipe thread protector. The threaded portion of tubular body 36 of the pipe thread protector couples to distal sleeve portion 56 of the tubular body of the pipe thread protector via outer end 64 of the threaded portion of the tubular body of the pipe thread protector. The tubular body of pipe thread protector 32 has a first shoulder 66 that extends radially between outer end 64 of threaded portion 60 thereof and flared end 58 of distal sleeve portion 56 thereof in this example. The threaded portion of tubular body 36 of the pipe thread protector has a second or inner end 68 longitudinally spaced-apart from the outer end thereof. Threaded portion 60 of the tubular body of the pipe thread protector tapers in a direction extending from outer end 64 thereof to inner end 68 thereof.



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**[0040]** As seen in Figure 5, tubular body 36 of pipe thread protector 32 further includes a third or end portion 70 coupled to and extending axially outwards from the inner end of threaded portion 60 thereof. The end portion of the tubular body of the pipe thread protector extends from inner end 38 of the tubular body towards outer end 40 of the tubular body of the pipe thread protector. As seen in Figure 8, end portion 70 of the tubular body of pipe thread protector 32 includes one or more protuberances, in this example longitudinally spaced-apart annular tongues 72, 74 and 76. The tongues are rectangular in lateral section in this example and have exterior surfaces 71. The exterior surfaces are annular in this example.

**[0041]** End portion 70 of tubular body 36 of pipe thread protector 32 has a plurality of longitudinally spaced-apart annular grooves 78 and 80. The grooves extend radially inwards from exterior surfaces 71 of and are interposed between respective ones of tongues 72, 74 and 76 in this example. Tubular body 36 of pipe thread protector 32 has a second shoulder 82 that extends radially between tongue 76 and inner end 68 of threaded portion 60 of the tubular body of the pipe thread protector. Referring back to Figure 5, end portion 70 of tubular body 36 of pipe thread protector 32 is radially inwardly spaced-apart from threaded portion 60 of the tubular body of the pipe thread protector. The end portion of the tubular body of the pipe thread protector is coaxial with and extends parallel to longitudinal axis 34 of the tubular body of the pipe thread protector in this example.

**[0042]** Referring to Figure 6, pipe thread protector assembly 30 includes a pipe thread protector seal 84. The seal is made of a different material than tubular body 36 of pipe thread protector 32. Seal 84 is softer and more resilient than the tubular body of the pipe thread protector and in this example is made of an elastomer. However, this is not strictly required and the seal may be made of other resilient and waterproof materials in other embodiments.

**[0043]** Seal 84 is tubular in this example and L-shaped in longitudinal cross-section as seen in Figure 8. Referring back to Figure 6, the seal has an annular first or proximal end



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86 and an annular second or distal end 88 spaced-apart from the proximal end thereof. The seal has a bore 89 that extends from the proximal end thereof to the distal end thereof.

**[0044]** As seen in Figure 8, seal 84 includes a first or proximal sleeve portion 91 that is tubular and longitudinally-extending. The proximal sleeve portion of the seal has a longitudinally-extending length L1 that extends from proximal end 86 of seal 84 towards distal end 88 of the seal. The proximal sleeve portion 91 of the seal tapers from the proximal end of the seal towards the distal end of the seal.

**[0045]** Seal 84 includes a second or distal sleeve portion 93 that is tubular and which extends both longitudinally and radially-inwards relative to proximal sleeve portion 91 thereof. The distal sleeve portion of the seal extends from distal end 88 of the sleeve towards proximal end 86 of the sleeve. Distal sleeve portion 93 of seal 84 extends from inner end 38 of tubular body 36 of pipe thread protector 32 to distal end 88 of the seal. The distal sleeve portion of the seal has a maximum, expanded or non-compressed longitudinally-extending length L2 seen in Figure 8. Proximal sleeve portion 91 and distal sleeve portion 93 of seal 84 are integrally interconnected so as to form a unitary whole in this example.

**[0046]** The distal sleeve portion of the seal is an irregular quadrilateral in cross-section in this example; however, this is not strictly required. Distal sleeve portion 93 of seal 84 extends radially inwards relative to proximal sleeve portion 91 of the seal and towards longitudinal axis 34 of tubular body 36 of pipe thread protector 32. The seal has a shoulder 95 which extends radially and which is interposed between proximal end 86 thereof and distal end 88 thereof. The shoulder of seal 84 is interposed between distal sleeve portion 93 thereof and proximal sleeve portion 91 thereof. The seal so shaped may be referred to as tubular with an inwardly-extending ledge or end flange adjacent a distal end portion thereof.

**[0047]** As seen in Figure 7, seal 84 has an end surface 90 located at distal end 88 thereof and extends about longitudinal axis 34. The seal is planar in this example. As seen in Figure



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8, end surface 90 of seal 84 is slanted relative to longitudinal axis 34 in this example. The seal has an outer surface 92 and an inner surface 94 spaced radially-inwards from the inner surface thereof. The outer and inner surfaces of seal 84 are annular in this example. Outer surface 92 of the seal extends from proximal end 86 of the seal to distal end 88 of the seal. Inner surface 94 of seal 84 extends from the proximal end of seal 84 towards the distal end of the seal.

**[0048]** End surface 90 of the seal radially and axially extends from outer surface 92 of the seal to inner surface 94 of the seal at an angle $\alpha$ relative to lateral axis 101. The end surface slants from the outer surface towards interior 33 at angle $\alpha$ relative to the lateral axis. Angle $\alpha$ is acute in this example. Seal 84 tapers in a radially inwardly-extending direction 990 which extends from the outer surface thereof to the inner surface thereof. End surface 90 of the seal slants radially inwards and towards interior 33 of tubular body 36 of pipe thread protector 32. Still referring to Figure 8, the seal includes an outer peripheral edge portion 97 located adjacent to where distal end 88, outer surface 92 and end surface 90 of the seal come together. The outer peripheral edge portion is annular and triangular in longitudinal cross-section in this example.

**[0049]** As seen in Figure 8, proximal sleeve portion 91 of seal 84 couples to inner end 38 and end portion 70 of tubular body 36 of pipe thread protector 32. Distal sleeve portion 93 of the seal extends from proximal end 86 of the seal to inner end 38 of tubular body 36 of pipe thread protector 32. Seal 84 thus extends in part from the inner end of the tubular body of the pipe thread protector towards outer end 40 of the tubular body of the pipe thread protector. Shoulder 95 of the seal is configured to receive, abut and extend along inner end 38 of tubular body 36 of pipe thread protector 32. The shoulder of seal 84 is shaped to inhibit water and debris from contacting the inner end of the tubular body of the pipe thread protector, in this example by being coextensive with and/or greater in lateral cross-sectional area compared to that of the inner end of the tubular body of the pipe thread protector.



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**[0050]** The seal in this example couples to tubular body 36 of pipe thread protector 32 via one or more tongues and grooves: the seal in this example includes at least one, and in this case a pair of longitudinally spaced-apart, radially inwardly extending protrusions or annular tongues 96 and 98. The tongues are rectangular in lateral section, though this is not strictly required. Tongues 96 and 98 couple to and extend radially inwards from inner surface 94 of seal 84. The tongues are shaped to selectively and snugly fit within corresponding annular grooves 78 and 80 of tubular body 36 of pipe thread protector 32.

**[0051]** Still referring to Figure 8, outer surface 92 of seal 84 aligns with and extends parallel to outer surface 52 of tubular body 36 of pipe thread protector 32 in this example. Distal sleeve portion 93 of seal 84 has an inner surface 104 that is annular and in fluid communication with bore 42 of the tubular body of the pipe thread protector. The inner surface of the distal sleeve portion of the seal aligns with and extends parallel to inner surface 106 of threaded portion 60 of tubular body 36 of pipe thread protector 32. Inner surface 104 of distal sleeve portion 93 of seal 84 flares outwards in a longitudinal direction extending from proximal end 86 of the sleeve towards distal end of the sleeve thereof in this example.

**[0052]** Seal 84, including distal sleeve portion 93 thereof, tapers in a direction 100 extending from outer end 40 of the tubular body of the pipe thread protector towards inner end 38 of the tubular body of the pipe thread protector. The seal, including outer surface 92 thereof, thus tapers in the direction extending from proximal end 86 thereof towards distal end 88 thereof. Seal 84 extends radially outwards in a direction 102 extending from inner end 38 of tubular body 36 of pipe thread protector 32 towards outer end 40 of the tubular body of the pipe thread protector. As seen in Figure 8, distal sleeve portion 93 of the seal has an inner diameter $D_S$.

**[0053]** As seen in Figure 11, pipe thread protector assembly 30 further includes a conduit coupling, in this example a pipe coupling 108. The pipe coupling may be referred to as a coupling and is tubular and sleeve-like in shape in this example. The pipe thread protector 32 and pipe coupling 108 may be referred to collectively as the box end. The pipe



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coupling has a first or outer end 110 and a second or inner end 112 longitudinally spaced-apart from the outer end thereof. Pipe coupling 108 includes a first female member 114 and a second female member 116 coupled thereto. The first female member is integrally interconnected with the second female member so as to form a unitary whole in this example. First female member 114 has inner threading 115 that extends from outer end 110 of pipe coupling 108 towards inner end 112 of the pipe coupling. Second female member 116 has inner threading 117 extends from the inner end of the pipe coupling towards the outer end of the pipe coupling. Pipe coupling 108 has an inner surface, in this example an annular inner surface 119 extending between the first female member thereof and the second female member thereof.

**[0054]** First female member 114 of the pipe coupling is shaped to receive seal 84 and end portion 70 and threaded portion 60 of tubular body 36 of pipe thread protector 32. The first female member is shaped to threadably couple with the threaded portion of the tubular body of the pipe thread protector. Outer end 110 of pipe coupling 108 is configured to extend along and abut shoulder 66 of tubular body 36 of pipe thread protector 32 when the pipe coupling and pipe thread protector are so threadably coupled together. Distal sleeve portion 93 and distal end 88 of seal 84 are positioned adjacent second female member 116 of the pipe coupling when the pipe coupling and tubular body 36 of pipe thread protector 32 are so threadably coupled together. As seen in Figure 12, the extent or depth to which tubular body 36 of pipe thread protector 32 extends within and couples to first female member 114 of pipe coupling 108 is denoted by length L3.

**[0055]** Still referring to Figure 12, second female member 116 of pipe coupling 108 is shaped to receive and threadably couple with a male threaded end portion 118 of a conduit, in this example pipe 120. The extent or depth to which the pipe extends within and couples to the second female member of the pipe coupling is denoted by length L4. This length may vary depending on the torque applied to pipe coupling 108 and/or pipe 120, as well as the tolerance of the pipe. A pipe with a male threaded end portion 118 that is slightly smaller in outer diameter $D_{OP}$ (seen in Figure 11) may screw into pipe coupling 108 further



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and to a greater extent, thus rendering length L4 (seen in Figure 12) longer, compared to a pipe with a male threaded end portion that is slightly larger in outer diameter, for example.

**[0056]** Referring to Figure 12, pipe 120 has a first end 122, a second end (not shown) longitudinally spaced-apart from the first end thereof, and threading 124 that extends from the first end thereof towards the second end thereof. The pipe has an outer end face or surface 126 aligned with and extending along end 122 of the pipe. The end surface is planar and may be referred to as a pipe face. In this example pipe coupling 108 and pipe 120 so coupled together form an annular recess 123.

**[0057]** Distal sleeve portion 93 of seal 84 is shaped to extend between tubular body 36 of pipe thread protector 32 and pipe 120 when the pipe coupling and pipe are so threadably coupled together. The seal extends outwards to abut inner surface 119 of the pipe coupling when the pipe thread protector and the pipe are threadably coupled together via the pipe coupling. Seal 84 so shaped and configured functions to inhibit water, debris and the like otherwise passing through exterior 128 and outer surface 52 of pipe thread protector 32 from reaching threading 124 of pipe 120.

**[0058]** Still referring to Figure 12, the seal is shaped and configured to extend in part into annular recess in this example via outer peripheral edge portion 97 thereof as pipe coupling 108 and pipe 120 are threadably coupled together. Seal 84 so shaped may accommodate variations in the extent to which the pipe threadably couples to the pipe coupling without extending radially inwards. The seal is shaped to inhibit inward bulging thereof when pipe thread protector 32 and pipe 120 are threadably coupled together via pipe coupling 108.

**[0059]** Seal 84, including slanted end surface 90 thereof, so shaped and as herein described is configured to protect and extend along end surface 126 of the pipe when the pipe coupling threadably couples together pipe thread protector 32 and end portion 118 of the pipe. The seal as herein described may function to seal against the pipe face of a male connection throughout a make-up tolerance range. The make-up tolerance is the allowable



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distance range that end portion 118 or male connection of pipe 120 can travel into female member 116 or female connection. End surface 90 of seal 84 is shaped to inhibit water and debris from contacting end surface 126 of the pipe, in this example by being coextensive with and/or greater in lateral cross-sectional area compared to that of the end surface of the pipe.

**[0060]** Referring to Figure 11, seal 84 as herein described thus functions to protect the threaded joint of pipe 120 while also accommodating variations in outer diameter $D_{OP}$ of end portion 118 of the pipe. Referring to Figure 12, the seal functions to protect end surface 126 and threading 124 of the pipe, along with threading 115 and 117 of pipe coupling 108, from debris and/or being damaged. Seal 84 as herein described may thus function to protect both male and female threads from dust and water infiltration during transportation and storage.

**[0061]** The seal may further provide added friction to inhibit inadvertent removal of pipe thread protector 32 from pipe coupling 108. Seal 84 thus inhibits the pipe thread protector from coming loose and loosing its seal.

**[0062]** As seen in Figure 11, pipe thread protector assembly 30 may be used to facilitate receiving a plug (not shown) therein for selectively measuring the inner diameter $D_{IP}$ of pipe 120 without needing to first remove the pipe thread protector assembly. Inner diameter $D_S$ of distal sleeve portion 93 of seal 84 is generally equal to the inner diameter of the pipe and is not more than $1/8^{th}$ smaller the inner diameter of the pipe in one example.

**[0063]** Figure 13 shows a pipe thread protector 32.1 for a pipe thread protector assembly 30.1 according to a second embodiment. Like parts have like numbers and functions as pipe thread protector 32 and pipe thread protector assembly 30 shown in Figures 1 to 12 with the addition of decimal extension ".1". Pipe thread protector 32.1 is substantially the same as pipe thread protector 32 shown in Figures 1 to 12 with the following exceptions.



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**[0064]** Seal 84.1 has an end surface 90.1 that is planar, non-slanted and which extends parallel to lateral axis 101.1. The end surface of the seal extends perpendicular to longitudinal axis 34.1 of tubular body 36.1 of pipe thread protector 32.1 in this example.

**[0065]** Figure 14 shows a pipe thread protector 32.2 for a pipe thread protector assembly 30.2 according to a third embodiment. Like parts have like numbers and functions as pipe thread protector 32 and pipe thread protector assembly 30 shown in Figures 1 to 12 with the addition of decimal extension ".2". Pipe thread protector 32.2 is substantially the same as pipe thread protector 32 shown in Figures 1 to 12 with the following exceptions.

**[0066]** Inner surface 94.2 of seal 84.2 is substantially smooth with no tongues and grooves thereon or extending therefrom. Exterior surface 71.2 of end portion 700.2 of tubular body 36.2 of pipe thread protector 32.2 is substantially smooth with no tongues or grooves thereon or extending therefrom. Proximal sleeve portion 91.2 of seal 84.2 is resilient and slightly smaller in interior span or inner diameter $D_{IS}$ compared to the exterior span or outer diameter $D_{OE}$ of the end portion of the tubular body of the pipe thread protector. The proximal sleeve portion of the seal couples to end portion 700.2 of tubular body 36.2 of pipe thread protector 32.2 via an interference fit in this embodiment.

**[0067]** Figure 15 shows a pipe thread protector 32.3 for a pipe thread protector assembly 30.3 according to a fourth embodiment. Like parts have like numbers and functions as pipe thread protector 32.2 and pipe thread protector assembly 30.2 shown in Figure 14 with decimal extension ".3" replacing decimal extension ".2" and being added for parts not previously having a decimal extension. Pipe thread protector 32.3 is substantially the same as pipe thread protector 32 shown in Figure 14 with the following exceptions.

**[0068]** Pipe thread protector 32.3 includes an adhesive 130. The adhesive is positioned between and extends at least in part along exterior surface 71.3 of end portion 70.3 of tubular body 36.3 of the pipe thread protector and inner surface 94.3 of seal 84.3. The seal couples to the end portion of the tubular body of pipe thread protector 32.2 via adhesive



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130. The adhesive extends circumferentially about exterior surface 71.3 of end portion 70.3 of tubular body 36.3 of pipe thread protector 32.3 in this example.

**[0069]** Figures 16 to 23 show pipe thread protector assembly 300 according to a fifth embodiment. Referring to the drawings and first to Figure 16, there is shown a pipe thread protector assembly 300. The pipe thread protector assembly includes a conduit coupling, in this example pipe coupling 320. The pipe coupling is tubular and has a first or outer end 340 and a second or inner end 360 spaced-apart from the outer end thereof. Pipe coupling 320 has an interior 330 about which the pipe coupling extends.

**[0070]** As seen in Figure 22, pipe coupling 320 includes a first female member 380 and a second female member 420 coupled to the first female member thereof. The first and second female members are integrally connected together so as to form a unitary whole in this example. First female member 380 has inner and in this example right-handed threading 400 that extends from outer end 340 of pipe coupling 320 towards inner end 360 of the pipe coupling. Second female member 420 includes inner threading 440 extending from the inner end of the pipe coupling towards the outer end of the pipe coupling. Pipe coupling 320 has an inner surface, in this example an annular inner surface 460 extending between first female member 380 thereof and second female member 420 thereof. Second female member 420 of the pipe coupling is shaped to receive and threadably couple to a male threaded end portion 480 of a conduit, in this example pipe 500.

**[0071]** The pipe encloses an interior 510 and has an exterior 530. Pipe 500 has a first end 520, a second end (not shown) longitudinally spaced from the first end thereof, and threading 540 that extends from the first end thereof towards the second end thereof. The threading of pipe 500 extends along exterior 530 thereof. The pipe has an interior peripheral surface 550 that is outwardly concave and in fluid communication with interior 510 thereof. Pipe 500 has an outer end face 560 that is planar in this example. The outer end face of the pipe aligns with and extends along end 520 of the pipe. Outer end face 560 of pipe 500 is annular in this example and may be referred to as a pipe face or outer end face.



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**[0072]** As seen in Figure 16, pipe thread protector assembly 300 includes a pipe thread protector, in this example an open box protector 580. As seen in Figure 22, the open box protector includes a tubular body 600. The tubular body is shaped to protect right-handed threading 400 of first female member 380 of pipe coupling 320. Tubular body 600 has a first or inner end 620, a second or outer end 640 spaced-apart from the inner end thereof and a longitudinal axis 660 extending between the ends thereof. Referring to Figure 16, pipe coupling 320 is coaxial with tubular body 600 and extends about axis 660. As seen in Figure 21, tubular body 600 has an interior 680 extending between and in fluid communication with ends 620 and 640 thereof. The tubular body has an exterior 690 radially spaced from the interior thereof.

**[0073]** The tubular body has an inner surface 700 in fluid communication with the interior thereof. Tubular body 600 has an outer surface 720 radially outwardly spaced from the inner surface thereof. The inner and outer surfaces of the tubular body extend between ends 620 and 640 of tubular body 600. Inner and outer surfaces 700 and 720 of tubular body 600 are curved and tubular in shape in this example.

**[0074]** As seen in Figure 22, the tubular body includes a first, proximal or end portion 740 that extends from inner end 620 thereof towards outer end 640 thereof. The end portion of tubular body 600 is sleeve-like in shape. Pipe thread protector assembly 300 includes a first or pipe-end-face seal 760. The seal is softer and more resilient than tubular body 600 and in this example is made of an elastomer. However, this is not strictly required and the seal may be made of other resilient and waterproof materials in other embodiments. Seal 760 is annular in this example and shaped to extend about and couple to end portion 740 of tubular body 600. In this example the seal couples to the end portion of the tubular body via tongues and grooves: in this case the seal includes longitudinally spaced-apart annular tongues 780 and 790 which fit within longitudinally spaced-apart annular grooves 800 and 810 of end portion 740 of the tubular body.

**[0075]** Seal 760 has a distal or inner end portion 820 that is tapered and axially spaced from inner end 620 of tubular body 600. Pipe 500 has an inner diameter $D_{30}$ and seal 760



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has an inner diameter $D_{40}$. The inner diameter of the seal is equal to the inner diameter of the pipe and not more than $1/8^{th}$ smaller the inner diameter of the pipe in one example. Seal 760, as well features, configurations, functionings and variations thereof, are described in more detail in Figures 1 to 15 for seal 84, 84.1, and 84.2.

**[0076]** As seen in Figure 22, tubular body 600 includes a second, intermediate, central or inner portion 840 that extends radially outwards from end portion 740 thereof. The inner portion of the tubular body is sleeve-like in shape. Inner portion 840 of the tubular body extends from end portion 740 of the tubular body towards outer end 640 of the tubular body. As seen in Figure 21, the inner portion of tubular body 600 has a first of left-handed and right-handed threading, in this example right-handed threading 860. Inner portion 840 of the tubular body may be referred to as an inner threaded portion. Right-handed threading 860 extends along exterior 690 of tubular body 600, in this example extending radially outwards from outer surface 720 of the tubular body. The right-handed threading 860 of inner portion 840 of tubular body 600 extends from near inner end 620 of the tubular body towards outer end 640 of the tubular body.

**[0077]** Still referring to Figure 21, the tubular body includes a third, distal or outer portion 880 that couples to inner portion 840 thereof. The outer portion is sleeve-like in shape and may be referred to another or distal end portion of tubular body 600. Outer portion 880 of the tubular body is integrally formed with the inner portion of the tubular body in this example. The outer portion of tubular body 600 extends radially outwards from the inner portion of the tubular body. Outer portion 880 of tubular body 600 extends from outer end 640 of the tubular body towards inner end 620 of the tubular body.

**[0078]** The tubular body has a first or outer shoulder 900 that extends radially between inner portion 840 and outer portion 880 of the tubular body. The shoulder is annular in this example. As seen in Figure 22, the inner portion of tubular body 600 tapers in a direction 910 extending from outer shoulder 900 towards inner end 620 of the tubular body in this example. The tubular body may thus be described as open-ended and sleeve-like in shape, with an enlarged first, distal or flanged end portion 880, a radially-inwardly extending



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second, proximal or tapered end portion 740, and a central portion 840 that tapers in a direction extending from the flanged end portion to the tapered end portion thereof. Inner portion 840 of the tubular body has a cross-sectional thickness $T_I$ adjacent outer portion 880 of the tubular body.

**[0079]** As seen in Figure 23, tubular body 600 has a second or inner shoulder or seat 890 in fluid communication with interior 680 thereof. However, this is not strictly required and in other embodiments the tubular body may extend continuously from outer end 640 thereof towards inner end 620 thereof without a seat, for example. Seat 890 is planar and annular in this example. The seat extends radially between outer portion 880 of tubular body 600 and inner portion 840 of the tubular body in this example. Seat 890 extends from inner surface 700 of tubular body 600 towards outer surface 720 of the tubular body.

**[0080]** Outer portion 880 of tubular body 600 has a longitudinally-extending recess, in this example a socket 950. The socket extends from outer end 640 of the tubular body towards inner end 620 of the tubular body seen in Figure 22. Socket 950 has a diameter $D_S$.

**[0081]** Still referring to Figure 22, outer portion 880 of tubular body 600 has a tapered bore 920 and inner surface 1070. The bore and inner surface taper in a direction 930 extending from outer end 640 of the tubular body towards inner end 620 of the tubular body. The outer portion of the tubular body is trapezoidal in lateral section in this example, in this case being in the shape of a right-angled trapezoid; however, this is not strictly required. Outer portion 880 of tubular body 600 has a second of right-handed and left-handed threading, in this example left-handed threading 940. The left-handed threading is in fluid communication with tapered bore 920. Left-handed threading 940 extends between outer end 640 and seat 890 of tubular body 600. The left-handed threading extends along and radially inwards from inner surface 1070 of outer portion 880 of the tubular body.

**[0082]** First female member 380 of pipe coupling 320 is shaped to receive seal 760 and end portion 740 and inner portion 840 of tubular body 600 of open box protector 580. The



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first female member is shaped to threadably couple to the inner portion of the tubular body of the open box protector via right-handed threading 400 and 860. Outer end 340 of pipe coupling 320 is configured to abut outer shoulder 900 of tubular body 600 of open box protector 580 when the pipe coupling and open box protector are so threadably coupled together. End portion 820 of seal 760 is positioned adjacent second female member 420 of pipe coupling 320 when the pipe coupling and tubular body of the open box protector are so threadably coupled together. The end portion of the seal is shaped to extend along and cover outer end face 560 of pipe 500 when pipe coupling 320 so threadably connects together the pipe and tubular body 600 of open box protector 580.

**[0083]** As seen in Figure 16, pipe thread protector assembly 300 includes an end member that is selectively removable and shaped to absorb impacts, in this example a removable, impact-absorbing plug 960. The plug is generally disc-shaped in this case, though this is not strictly required. Plug 960 is coaxial with tubular body 600 and pipe coupling 320 and extends about longitudinal axis 660 of the tubular body. The plug may be manufactured from cost-effective materials, such as high-density polyethylene (HDPE) resin; however, here too this is not strictly required.

**[0084]** As seen in Figure 22, plug 960 includes a base member 980 that is generally planar in this example. The base member is shaped to extend laterally across outer end 640 of tubular body 600 of open box protector 580. Base member 980 is annular and disc-shaped in this example. The base member has a first, distal or outer end 1000 and a second, proximal or inner end 1020 spaced-apart from the outer end thereof. Base member 980 includes an outer peripheral portion 1110 that is annular. The outer peripheral portion of the base member is coextensive with outer end 640 of tubular body 600 in this example, though this is not strictly required. Inner end 1020 and outer peripheral portion 1110 of base member 980 are shaped to extend across and abut the outer end of the tubular body.

**[0085]** Still referring to Figure 22, the base member of plug 960 has a central, open-ended chamber 1090 and a recessed central portion 1040 in fluid communication with chamber. The chamber and central portion are circular and coaxial with longitudinal axis



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660 of tubular body 600 in this example. Open-ended chamber 1090 of base member 980 of plug 960 is cylindrical in an outer shape, inwardly concave and open in an upwards-facing direction from the perspective of Figure 22 in this example. Recessed central portion 1040 of the base member of the plug has a thickness $T_B$ equal to or greater than the thickness of tubular body 600 at any region thereof in this example, such as wall thickness $T_I$ of inner portion 840 of the tubular body in this example; however, this is not strictly required. Plug 960 thus has a cross-sectional thickness at least in part equal to or greater than that of the tubular body.

**[0086]** Thickness $T_B$ of recessed central portion 1040 of base member 980 of plug 960 is equal to or greater than the thickness of pipe coupling 320 at any region thereof in this example, such as wall thickness $T_C$ of the pipe coupling between female members 380 and 420 and adjacent annular inner surface 460 thereof. However, this is not strictly required. Plug 960 thus has a thickness at least in part equal to or greater than that of the pipe coupling. Thickness $T_B$ of recessed central portion 1040 of base member 980 of plug 960 is equal to or greater than wall thickness $T_P$ of pipe 500 at any region thereof in this example; however, this is not strictly required. The plug thus has a thickness at least in part equal to or greater than that of the pipe. Plug 960 may therefore be said to have a central portion that is enlarged and thicker relative to the thickness of tubular body 600, pipe coupling 320 and/or pipe 500. The axial thickness of the plug is configured to increase impact performance of the plug.

**[0087]** Still referring to Figure 22, base member 980 of plug 960 has an aperture, in this example a threaded aperture 1050. The threaded aperture extends therethrough from outer end 1000 thereof to inner end 1020 thereof. Threaded aperture 1050 extends through outer peripheral portion 1110 of base member 980 of plug 960 and is radially outwardly spaced from longitudinal axis 660 of tubular body 600 and open-ended chamber 1090 of the plug. As seen in Figure 23, the threaded aperture has a diameter $D_A$. The diameter of threaded aperture 1050 is less than diameter $D_S$ of socket 950 in this example.



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**[0088]** As seen in Figure 19, plug 960 includes one or more protuberances, in this example a plurality of bumpers 1060, 1080, 1100 and 1120. The bumpers couple to and extend longitudinally outwards from outer end 1000 of base member 980 of the plug. Bumpers 1060, 1080, 1100 and 1120 are integrally formed with the base member of plug 960 in this example. The bumpers are circumferentially spaced-apart in this example. Each bumper is arc-shaped in top plan view. Bumpers 1060, 1080, 1100 and 1120 are recessed so that a series of open pin or box protectors may be stackable together. In this example, each bumper has an open top 1140, at least one and in this example a pair of chambers 1160 and 1180 in fluid communication with the open top thereof, and a rib 1200 extending between the chambers thereof. However, this is not strictly required. Chambers 1160 and 1180 are arc-shaped sub-portions that are generally triangular in end view in this example; however here too this is not strictly required. The bumpers so shaped and recessed may function to minimize the prospects of pin or box protectors knocking together and coming loose during handling.

**[0089]** Still referring to Figure 19, plug 960 is recessed at least in part to enable a pipe wrench (not shown) or flat bar (not shown) to selectively fit therein and couple with the plug for installation or removal of the plug. To this end and in this example base member 980 of plug 960 has a plurality of peripheral recessed portions 1220, 1240, 1260 and 1280. The peripheral recessed portions are adjacent to and extending circumferentially about recessed central portion 1040 thereof in this example. Peripheral recessed portions 1220, 1240, 1260 and 1280 are positioned between respective ones of bumpers 1060, 1080, 1100 and 1120. Each peripheral recessed portion 1220 of base member 980 of plug 960 is rectangular in top view, with an open top 1300, at least one and in this example a pair of chambers 1320 and 1340 in fluid communication with the open top thereof, and a rib 1360 extending between the chambers thereof. However, this is not strictly required. Bumpers 1060, 1080, 1100 and 1120 extend outwards and upwards from peripheral recessed portions 1220, 1240, 1260 and 1280 of base member 980 of plug 960 in this example and from the perspective of Figure 19. In addition to facilitating installation and removal of plug 960, the peripheral recessed portions of the base member of the plug may further aid in the manufacturing process.



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**[0090]** Referring to Figure 22, plug 960 includes an inner portion 1380 coupled to and extending outwards from base member 980 thereof. The inner portion of the plug extends longitudinally inwards and downwards from the base member from the perspective of Figure 22. Inner portion 1380 of plug 960 is integrally formed with base member 980 of the plug so as to form a unitary whole in this example. The inner portion of the plug is generally annular in shape. Inner portion 1380 of plug 960 is frustoconical in outer shape in this example.

**[0091]** The inner portion of the plug includes an inner annular member 1400 coupled to and extending longitudinally from inner end 1020 of base member 980 of plug 960. The inner annular member tapers in direction 910 extending from the inner end of the base member towards inner end 620 of tubular body 600.

**[0092]** Inner portion 1380 of plug 960 includes a plurality of circumferentially spaced-apart brace or supporting members, in this example supporting ribs 1420, 1440, 1460, 1480, 1500, 1520, 1540, 1560, 1580, 1600, 1620, 1640, and 1660. The ribs couple to and extend radially inwards from inner annular member 1400 of the inner portion of the plug. Ribs 1420, 1440, 1460, 1480, 1500, 1520, 1540, 1560, 1580, 1600, 1620, 1640, and 1660 couple to and extend longitudinally inwards and downwards from base member 980 of plug 960 in this example and from the perspective of Figure 22. The ribs are integrally formed with the base member and inner annular member 1400 of inner portion 1380 of the plug so as to form a unitary whole in this example. Each supporting rib 1420, 1440, 1460, 1480, 1500, 1520, 1540, 1560, 1580, 1600, 1620, 1640, and 1660 thus extends radially in part and longitudinally in part. Each rib is a triangular prism in shape in this example; however this is not strictly required. Ribs 1420, 1440, 1460, 1480, 1500, 1520, 1540, 1560, 1580, 1600, 1620, 1640, and 1660 are shaped to increase impact performance of plug 960 and inhibit the plug from being deformed as a result of outside impact forces.

**[0093]** As seen in Figure 20, inner annular member 1400 of inner portion 1380 of plug 960 has an inner end 1390 that is planar in this example. The inner end is annular and may be referred to as an inner or proximal end of the plug. As seen in Figure 22, inner annular



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member 1400 of inner portion 1380 of plug 960 has an outer surface 1010 that extends from inner end 1020 of base member 980 of the plug to inner end 1390 of the inner portion of the plug. The outer surface is annular and outwardly convex in this example. Outer surface 1010 tapers in direction 910 extending from inner end 1020 of base member 980 of plug 960 to inner end 1390 of inner portion 1380 of the plug in this example. The inner portion of the plug includes the second of right-handed and left-handed threading, in this example left-handed threading 1680. The left-handed threading extends along and radially-outwards from the outer surface 1010 of inner portion 1380 of plug 960. Left-handed threading 1680 is positioned between inner end 1020 of base member 980 of the plug and inner end 1390 of the inner portion of the plug in this example

**[0094]** Still referring to Figure 22, inner annular member 1400 of inner portion 1380 of plug 960 is shaped to be received in part within tapered bore 920 of outer portion 880 of tubular body 600, with inner end 1390 of the inner portion of plug abutting seat 890 of the tubular body. However, as mentioned seat is not strictly required and the inner end of the inner portion of the plug thus need not abut with a seat. Plug 960 is shaped to removably couple to and extend laterally across tubular body 600. In this example, the plug threadably couples to the tubular body; however, this is not strictly required and the plug may removably couple to the tubular body in other manners in other embodiments. Referring to Figure 23, inner annular member 1400 of inner portion 1380 of plug 960 threadably couples to and is selectively removable from outer portion 880 of tubular body 600 via left-handed threading 940 and 1680. As seen in Figure 23, threaded aperture 105 of the plug is configured to align and be coaxial with socket 950 when the plug and tubular body are fully threadably coupled together.

**[0095]** Still referring to Figure 23, inner annular member 1400 of inner portion 1380 of plug 960 has an annular groove 1690. The annular groove is adjacent inner end 1020 of base member 980 in this example. Annular groove 1690 extends radially inwards from outer surface 1010 of inner annular member 1400 of inner portion 1380 of plug 960. The annular groove is trapezoidal in lateral section in this example, in this case being in the shape of a right-angled trapezoid; however, this is not strictly required. Annular groove



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1690 is longitudinally spaced outwards and upwards from left-handed threading 1680 from the perspective of Figure 23. The annular groove is also radially outwardly-spaced from the left-handed threading in this example. Annular groove 1690 of inner annular member 1400 of inner portion 1380 of plug 960 is positioned adjacent to and aligns with socket 950 in this example. The annular groove is radially inwardly spaced from the socket in this example.

**[0096]** Still referring to Figure 23, open box protector 580 includes a locking member, in this example a threaded member, in this case a fastener in the form of a locking screw 1700. The locking screw threadably couples to plug 960 via threaded aperture 1050. As seen in Figure 23, the locking screw has a distal end portion 1720 that is selectively extendable within socket 950 of tubular body 600 of open box protector 580. The socket is thus shaped to receive a threaded member or fastener in part. In this example socket 950 is shaped to receive but avoid threaded engagement with the end portion of locking screw 1700. End portion 1720 of locking screw 1700 thus loosely fits within socket 950 and the socket is larger in span than the end portion of the locking screw. Locking screw 1700 has a first or locked position, shown in solid lines in Figure 23, in which the end portion of the locking screw extends within socket 950. Removal of plug 960 from tubular body 600 is inhibited when the locking screw is in the locked position, as the locking screw so positioned inhibits rotation of the plug relative to the tubular body.

**[0097]** Locking screw 1700 is moveable from the locked position thereof to a second or unlocked position, seen in dotted lines and numerals 1760 and 1770 in Figure 23. The unlocked position of the locking screw may be referred to as an at least partially unthreaded position of the locking screw. End portion 1720 of locking screw 1700 is longitudinally spaced outwards from and is thus no longer in socket 950 when the locking screw is in the unlocked position. The locking screw so positioned clear of the socket enables plug 960 to be rotated relative to tubular body 600. The plug is thus selectively removable from the tubular body in the unlocked position of locking screw 1700. Plug 960 is also fully threadably connectable with tubular body 600 when the locking screw is in its unlocked position.



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**[0098]** In operation and referring to Figure 22, plug 960 thus threadably couples with open box protector 580 by means of left-handed threading 940 and 1680, with the plug being rotated to this end in a first or left-hand direction of rotation, in this example a counter-clockwise direction 970. Locking screw 1700 is then fully threaded through the plug and into socket 950 of the open box protector to lock the plug and tubular body 600 together and inhibit rotation of one relative to the other. Open box protector 580 and plug 960 may then be shipped to a pipe fabricator. The pipe fabricator may then install or threadably connect the open box protector and plug so coupled together, to first female member 380 of pipe coupling 320 seen via right-handed threading 400 and 860. Tubular body 600 is thus installed on the pipe coupling by turning tubular body 600 and plug 960 so coupled together in the conventional second or right-hand direction of rotation, in this example a clockwise direction 990. Although plug 960 has left-handed threading 1680, the plug will remain in place during installation of box protector 580 onto pipe coupling 320 due to the presence of locking screw 1700 in the locked position, which inhibits movement of the plug relative to tubular body 600 of open box protector 580.

**[0099]** When the pipe fabricator or driller wants the plug removed and the open box protector to remain on pipe coupling 320, locking screw 1700 is partially unscrewed or backed off so as to cause the screw to move upwards as shown by arrow 1030 and out of socket 950. Plug 960 is next turned via bumpers 1100 and 1120 in clockwise direction 990. This will cause the plug to be threadably removed from open box protector 580 without also unscrewing and removing open box protector 580 from pipe coupling 320. Plug 960 may then be recycled or reinstalled onto the open box protector after the drifting process at the discretion of the pipe fabricator or driller. Referring to Figure 22, drifting may involve testing the inner diameter $D_{30}$ of the pipe using a cylindrical member, in this example mandrel 1130 having an outer diameter $D_M$. Plug 960 is removed and the mandrel is thereafter is inserted through tubular body 600, pipe coupling 320 and into pipe 500 to test the inner diameters of the same. Outer diameter $D_M$ of mandrel 1130 should be equal to or less than the diameter $D_{30}$ of pipe 500. Drifting and mandrels per se are known to those skilled in the art and will not be described in further detail.



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**[00100]** Tapered surfaces 1010 and 1070, where the plug contacts open box protector 580, provide a snug fit therebetween. This may provide structural support to pipe thread protector assembly 300. Tapered surfaces 1010 and 1070 may further aid in installation of plug 960 and removal thereof, even if the pipe thread protector assembly has been subjected to a high impact force. In addition and referring to Figure 22, the plug as herein described is shaped to protect the open box protector 580 (including functioning to promote and maintain a consistent inner diameter $D_{10}$ thereof) and as well pipe coupling 320 (at least including functioning to promote and maintain a consistent inner diameter $D_{20}$ of first female member 380 thereof) from damage caused from impact.

**[00101]** Pipe thread protector assembly 300 as herein described may thus be said to comprise a two-piece protector assembly containing an impact-absorbing plug 960 that may be readily removed from box protector 580 just prior to drifting. The plug as herein described may increase in impact protection for the steel connection comprising the first female member of pipe coupling 320. Plug 960 is shaped to maintain contact with outer end 640 of protector 580 and provide the otherwise open box protector with structural support, allowing the protector to maintain its inner drift diameter even when subjected to high impact forces.

**[00102]** As seen in Figure 23, open box protector 580 includes a second or plug seal 1780. The plug seal is positioned between tubular body 600 and plug 960. Plug seal 1780 is softer and more resilient than the plug and tubular body and in this example is made of an elastomer. However, this is not strictly required and the seal may be made of other resilient and waterproof materials in other embodiments. Plug seal 1780 is annular and circular in cross-section in this example, in this case comprising an O-ring; however this is not strictly required. The plug seal aligns adjacent outer end 640 of the tubular body and is shaped to be received within annular groove 1690 of inner portion 1380 of the plug. Plug seal 1780 is thus positioned adjacent to socket 950 of tubular body 600 and end portion 1720 of locking screw 1700 in this example. Referring to Figure 22, the plug seal, so positioned between plug 960 and open box protector 580, is configured to inhibit water or other contaminates from entering within interior 680 of tubular body 600 and thus within



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interior 510 of threaded pipe 500 during handling, transportation, and storage. The plug may thus function to seal the inside of pipe 500 from the environment.

**[00103]** There is thus provided a method of transporting and drifting a pipe using the pipe thread protector assembly 300 as herein described. As seen in Figure 22, the method includes coupling together tubular body 600 and plug 960 of the pipe thread protector assembly. The method may include moving locking screw 1700 into the locked position thereof in which removal of the plug from the tubular body is inhibited. The method includes threadably connecting tubular body 600 and plug 960 so coupled together to pipe coupling 320 which couples to threaded end portion 480 of pipe 500, with debris being inhibited from contacting outer end face 560 and interior 510 of the pipe thereby. The method includes transporting the pipe, with the tubular body and the plug so coupled thereto, to a work site.

**[00104]** The method includes drifting pipe 500 by removing plug 960 from tubular body 600 so coupled to pipe coupling 320. Within this removal step, the method may include moving locking screw 1700 from the locked position to the unlocked position in which the plug is selectively removable from the tubular body. The method thereafter includes biasing mandrel 1130 having pre-determined outer diameter $D_M$ through the tubular body and into the pipe. The method includes determining that the pipe is acceptable if the mandrel extends therein, and determining that the pipe is unacceptable if the cylindrical member is inhibited from extending therein. The method may further includes after the biasing step, re-connecting plug 960 to tubular body 600, with debris being inhibited from contacting end face 560 and interior 510 of pipe 500 once more.

**[00105]** Figure 24 shows a pipe thread protector assembly 300.1 according to a sixth embodiment. Like parts have like numbers and functions as pipe thread protector assembly 300 shown in Figures 16 to 23 with the addition of decimal extension ".1". Pipe thread protector assembly 300.1 is substantially the same as pipe thread protector assembly 300 shown in Figures 16 to 23 with at least the following exceptions.



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**[00106]** Pipe coupling 320.1 has an inner shoulder 2000 adjacent and in fluid communication with interior 330.1 thereof and right-handed threading 400.1 of first female member 380.1 thereof. Seal 760.1 is shaped to be received within, extend about and protect the inner shoulder of the pipe coupling when open box protector 580.1 and the pipe coupling are so coupled together.

**[00107]** Figures 25 to 29 show a pipe thread protector assembly 300.2 according to a second embodiment. Like parts have like numbers and functions as the pipe thread protector assembly 300 shown in Figures 16 to 23 with the addition of decimal extension ".2". Pipe thread protector assembly 300.2 is substantially the same as pipe thread protector assembly 300 shown in Figures 16 to 23 with at least the following exceptions.

**[00108]** As seen in Figure 28, pipe thread protector assembly 300.2 includes a pipe thread protector in the form of an open pin protector 580.2. Tubular body 600.2 of open pin protector 580.2 has a first of left-handed and right-handed threading, in this example right-handed threading 860.2 extending along inner surface 700.2 thereof. The right-handed threading is in fluid communication with interior 680.2 of the tubular body. Right-handed threading 860.2 extends from adjacent inner end 620.2 of tubular body 600.2 towards outer end 640.2 of the tubular body. As seen in Figure 27, outer surface 720.2 of the tubular body is smooth and outwardly convex in this example. Referring to Figure 28, tubular body 600.2 (including the outer surface thereof) tapers from end 620.2 thereof towards end 640.2 thereof. The tubular body is shaped to threadably couple directly to and protect threaded end portion 480.2 of pipe 500.2 via right-handed threading 860.2 of the tubular body and right-handed threading 540.2 of pipe 500.2.

**[00109]** Plug 960.2 is substantially the same as plug 960 seen in Figure 19 and may be interchangeable between open box protector 580 seen in Figure 21 and open pin protector 580.2 seen in Figure 27. Plug 960.2 seen in Figure 28 is configured to protect open pin protector 580.2 (including functioning to promote and maintain a consistent inner diameter $D_{1.2}$ thereof), pipe 500.2 (including functioning to promote and maintain a consistent inner diameter $D_{30.2}$ thereof, and outer end face 560.2 of the pipe.



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**[00110]** As seen in Figure 28, outer portion 880.2 of tubular body 600.2 has an inner end 850 longitudinally spaced from outer end 640.2 of the tubular body. Inner surface 1070.2 of the tubular body extends between the inner end of the outer portion of the tubular body and the outer end of the tubular body. Inner end 850 of outer portion 880.2 of tubular body 600.2 at least aligns with or extends radially inwards from inner surface 550.2 of pipe 500.2. The inner end of the outer portion of the tubular body is shaped to abut and/or be adjacent to outer end face 560.2 of the pipe when the pipe is fully threadably coupled to tubular body 600.2. Inner end 850 of outer portion 880.2 of tubular body 600.2 aligns with inner end 1390.2 of inner portion 1380.2 of plug 960.2 in this example when the plug is fully threadably coupled to the tubular body.

**[00111]** Tubular body 600.2 has an inner region, in this example an inner peripheral portion 1810. The inner peripheral portion is adjacent inner end 850 of outer portion 880.2 of the tubular body. Inner peripheral portion 1810 of tubular body 600.2 is annular. The inner peripheral portion of the tubular body tapers in this example in direction 930.2 extending from outer end 640.2 of the tubular body to inner end 850 of the tubular body.

**[00112]** Inner peripheral portion 1810 is defined by a pair of annular surfaces which taper in direction 930.2: in this example inner surface 1070.2 of outer portion 880.2 of tubular body 600.2 and slanted surface or shoulder 1910 of the tubular body. The inner surface and slanted shoulder meet at end 850 and flare longitudinally and radially outwards therefrom in a longitudinally outwards and upwards direction from the perspective of Figure 29 in this example. Inner surface 1070.2 is angled relative to slanted shoulder 1910 by an angle $\beta$ that is acute in this example. The slanted shoulder of tubular body 600.2 extends longitudinally and radially inwards from inner surface 700.2 of the tubular body to inner end 850 of outer portion 880.2 of the tubular body. Inner peripheral portion 1810 of the tubular body is triangular in lateral cross-section in this example. The inner peripheral portion is shaped at least in part to cover, be adjacent to and/or abut outer end face 560.2 of pipe 500.2 when the pipe is fully threadably coupled to tubular body 600.2.



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**[00113]** As seen in Figure 29, tubular body 600.2 of open pin protector 580.2 has an annular and tapered groove 1800. The groove extends radially outwards relative to bore 920.2, relative to inner end 850 of outer portion 880.2 and relative to inner peripheral portion 1810 of the tubular body. Groove 1800 also extends axially or longitudinally outwards and upwards from the inner end of the outer portion of the tubular body from the perspective of Figure 28 and towards outer end 640.2 of tubular body 600.2. Referring back to Figure 29, the groove is triangular in lateral cross-section in this example, in this case in the form of a right-angled triangle; however, this is not strictly required. Groove 1800 is enclosed in part by and in fluid communication with outer end face 560.2 of pipe 500.2 when the pipe is fully threadably coupled to tubular body 600.2.

**[00114]** Still referring to Figure 29, pipe thread protector assembly 300.2 includes a seal 1820 positioned within groove 1800. The seal is shaped to be larger in lateral section or extent compared to the groove in this example. Seal 1820 is annular and circular in lateral cross-section in an uncompressed state (as shown in dotted lines 2010), in this example in the form of an O-ring; however, this is not strictly required and the seal may comprise other shapes in lateral cross-section in other examples. Seal 1820 is softer and more resilient than tubular body 600.2 and in this example is made of an elastomer. However, this is not strictly required and the seal may be made of other resilient and waterproof materials in other embodiments. Seal 1820 is positioned to align with and abut distal end 520.2 of pipe 500.2 and inner peripheral portion 1810 of tubular body 600.2 when the pipe is fully threadably coupled with the tubular body.

**[00115]** As seen in Figure 29, the seal is shaped to cover outer end face 560.2 of the pipe at least in part. This, together with the inner peripheral portion of the tubular body, are shaped and function inhibit water or other contaminates from entering right-handed threading 540.2 of male threaded pipe 500.2 when plug 960.2 is removed. Seal 1820 and inner peripheral portion 1810 of tubular body 600.2 are also configured and function to inhibit water/contaminates from contacting outer end face 560.2 of the pipe. Protection of the pipe face is important because it creases a metal-to-metal seal on the pipe face of the



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next pipe. The seal may be referred to as a pipe end-face seal. Seal 1820 aligns adjacent inner end 1390.2 of inner portion 1380.2 of plug 960.2 in this example.

**[00116]** Groove 1800 and inner peripheral portion 1810 of tubular body 600.2 are shaped to keep deformation of seal 1820 away from interior 510.2 of pipe 500.2, as shown by arrow of numeral 1830. The inner peripheral portion of the tubular body is shaped to compress the seal between the inner peripheral portion of the tubular body and outer end face 560.2 of the pipe in a radially outwards and longidutinally inwards or downwards direction in this example and from the perspective of Figure 29. This may ensure that seal 1820 does not extend out towards the inside of pipe 500.2 and possibly interfere with the drifting process. Groove 1800, inner peripheral portion 1810 and slanted shoulder 1910 are thus shaped to inhibit deformation of the seal into the interior of the pipe. Tubular body 600.2 so shaped (including inner wall 1870 thereof) may function to further promote compression of seal 1820, thereby inhibiting water and other contaminates from contacting outer end face 560.2 and interior 510.2 of pipe 500.2.

**[00117]** Referring to Figure 28, open pin protector 580.2 thus includes a pair of annular, longitudinally spaced-apart seals 1780.2 and 1820. The seals are positioned between tubular body 600.2 and plug 960.2 and positioned between the tubular body and end portion 480.2 of pipe 500.2, respectively.

**[00118]** As seen in Figure 29, open pin protector 580.2 includes an interference-fit protrusion, in this example an interference ring 1840. The interference ring is coupled to and extends radially inwards from inner surface 700.2 of tubular body 600.2 adjacent threading 860.2 of the tubular body. Interference ring 1840 is annular and rectangular in longitudinal section in this example; however, this is not strictly required. The interference ring has a longitudinally-extending length $L_P$ which is less than the longitudinally-extending length $L_T$ of right-handed threading 860.2 of inner portion 840.2 of tubular body 600.2 in this example.



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**[00119]** The threading extends radially inwards a distance $D_T$ from inner surface 700.2 of the tubular body. Interference ring 1840 extends radially/laterally inwards a distance $D_P$ from inner surface 700.2 of tubular body 600.2. Distance $D_P$ of the interference ring is greater than distance $D_T$ of threading 860.2 in this example. Interference ring 1840 is positioned to align near distal end 520.2 of pipe 500.2 and groove 1800 of tubular body 600.2 in this example. Seal 1820 is positioned between slanted shoulder 1910 of the tubular body 600.2 and interference ring 1840 in this example. The seal is adjacent to and positioned in place at least in part via the interference ring. As seen in Figure 28, seal 1820 is thus positioned between interference ring 1840 and outer end 640.2 of tubular body 600.2.

**[00120]** Referring back to Figure 29, the interference ring is configured to deform upon tubular body 600.2 rotatably coupling to threaded end portion 480.2 of pipe 500.2. The interference ring is made of a material configured to deform when rotatably engaging with the pipe. Interference ring 1840 so deformed inhibits removal of the pipe from the tubular body thereafter. The interference ring thus is cut into by a distal or outermost thread portion 1860 of threading 540.2 of pipe 500.2. Interference ring 1840 deformably couples to the outermost thread portion of the pipe. The interference ring is positionable adjacent to outermost thread portion 1860 of pipe 500.2 in this example when the pipe and tubular body 600.2 are fully threadably coupled together.

**[00121]** Still referring to Figure 29, when pipe thread protector assembly 300.2 is installed by the pipe fabricator, outer end 520.2 of male threaded pipe 500.2 thus makes contact with interference ring 1840 located adjacent inner end 1850 of inner wall 1870 of open pin protector 580.2. The interference ring functions as a frictional lock. When installation torque is applied to pipe thread protector assembly 300.2, male threaded pipe 500.2 contacts interference ring 1840 as protector 580.2 screws down, as shown by arrow 1890, causing the interference ring to deform. This deformation provides friction and adds resistance to the open pin protector, thus inhibiting the open pin protector from unscrewing itself from pipe 500.2 inadvertently. The amount of frictional resistance interference ring 1840 provides to the protector may be determined by width/distance $D_P$ and depth/length



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$L_P$ of the interference ring. The interference ring may further function as an edge or seat to hold seal 1820 in place.

**[00122]** There is thus provided a method of transporting and drifting a pipe using the pipe thread protector assembly 300.2 as herein described. As seen in Figure 28, the method includes coupling together tubular body 600.2 and plug 960.2 of the pipe thread protector assembly. The method may include moving locking screw 1700.2 into the locked position thereof in which removal of the plug from the tubular body is inhibited. The method includes threadably connecting tubular body 600.2 and plug 960.2 so coupled together to threaded end portion 480.2 of pipe 500.2, with debris being inhibited from contacting outer end face 560.2 and interior 510.2 of the pipe thereby. The method includes transporting the pipe, with the tubular body and the plug so coupled thereto, to a work site.

**[00123]** The method includes drifting pipe 500.2 by removing plug 960.2 from tubular body 600.2 so coupled to the pipe. Within this removal step, the method may include moving locking screw 1700.2 from the locked position to the unlocked position in which the plug is selectively removable from the tubular body. The method thereafter includes biasing mandrel 1130.2 having pre-determined outer diameter $D_{M.2}$ through the tubular body and into the pipe. The method includes determining that the pipe is acceptable if the mandrel extends therein, and determining that the pipe is unacceptable if the cylindrical member is inhibited from extending therein. The method may further includes after the biasing step, re-connecting plug 960.2 to tubular body 600.2, with debris being inhibited from contacting end face 560.2 and interior 510.2 of pipe 500.2 once more.

**[00124]** Figures 30 to 33 show a pipe thread protector assembly 300.3 according to a third embodiment. Like parts have like numbers and functions as pipe thread protector assembly 300.1 shown in Figures 25 to 29 with the decimal extension ".3" replacing decimal extension ".2" and being added for parts not previously having a decimal extension. Pipe thread protector assembly 300.3 is substantially the same as pipe thread protector assembly 300.1 shown in Figures 25 to 29 with at least the following exceptions.



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**[00125]** As seen in Figure 31, the end member, in this example removable, impact-absorbing plug 960.3 has a central, open-ended chamber 1090.3 that is elongate. Central recessed portion 1040.3 of the plug is spaced-apart below ribs 146.3 and 1660.3. The ribs extend about and extend radially outwards from the chamber. Central recessed portion 1040.3 of plug 960.3 is positioned longitudinally inwardly spaced from outer end face 560.3 of the pipe 500.3 when the pipe is fully threadably coupled to tubular body 600.3 in this example. The central recessed portion of the plug is longitudinally inwardly spaced from seal 1820.3 in this example. Chamber 1090.3 and central recessed portion 1040.3 of plug 960.3 are shaped to extend at least in part within interior 510.3 of pipe 500.3. The chamber and central recessed portion of the plug are shaped to extend at least in part within interior 680.3 and inner portion 840.3 of tubular body 600.3 of pin protector 580.3.

**[00126]** As seen in Figure 33, chamber 1090.3 and recessed portion 1040.3 of the plug are shaped to receive a distal end portion 1900 of a hook 1920. The hook is used to selectively pick up pipe 500.3. Pipe thread protector assembly 300.3 so shaped may thus facilitate manipulation of the pipe, including selectively raising, lowering and moving of the pipe.

**[00127]** As seen in Figure 32, seal 1820.3 is annular and triangular in lateral cross-section in this example in an uncompressed state. The seal is shaped to move towards (as shown by arrow 2030) and fit within tapered groove 1800.3 in the compressed state as shown by dotted lines 1930. The seal has a first or inner face 1940 that is planar in lateral section in this example. The inner face of seal 1820.3 is shaped to cover and extend along outer end face 560.3 of pipe 500.3, thus inhibiting water or other contaminates from entering threading 540.3 of male threaded pipe 500.3 when plug 960.3 is removed. Inner face 1940 of the seal may be coextensive with or greater in extent compared the outer end face of the pipe; however, this is not strictly required. The inner face of seal 1820.3 is radially-extending in lateral section when in the compressed state shown in dotted lines 1930 in this example.



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**[00128]** Seal 1820.3 has a second, radially-outward facing or peripheral face 1960 which is planar in lateral section in this example. The peripheral face of the seal is radially outwardly facing at least in part. Peripheral face 1960 of seal 1820.3 is shaped to extend along inner wall 1870.3 of open pin protector 580.3 adjacent inner end 1850.3 of the inner wall when the seal is in the compressed state by dotted lines 1930. The peripheral face of the seal abuts and may be coextensive with the sub-portion 1950 of the inner wall of the open pin protector; however, this is not strictly required. Peripheral face 1960 of seal 1820.3 may be longitudinally extending in lateral section when in the compressed state shown in dotted lines 1930.

**[00129]** The seal has a third, radially-inward facing or slanted face 1980 which is planar in lateral section. The slanted face is shaped to extend along slanted shoulder 1910.3 of tubular body 600.3 when seal 1820.3 is in the compressed state shown by dotted lines 1930. Slanted face 1980 of seal 1820.3 is slanted in lateral section when in the compressed state. The slanted face of the seal abuts and may be coextensive with slanted shoulder 1910.3 of tubular body 600.3; however, this is not strictly required.

**[00130]** Where a component (e.g. an assembly, device, member, etc.) is referred to herein, unless otherwise indicated, reference to that component (including a reference to a "means") should be interpreted as including as equivalents of that component any component which performs the function of the described component (i.e., that is functionally equivalent), including components which are not structurally equivalent to the disclosed structure which performs the function in the illustrated exemplary embodiments of the invention.

Interpretation of Terms

**[00131]** Unless the context clearly requires otherwise, throughout the description and the claims:



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- “comprise”, “comprising”, and the like are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”;
- “connected”, “coupled”, or any variant thereof, means any connection or coupling, either direct or indirect, between two or more elements; the coupling or connection between the elements can be physical, logical, or a combination thereof;
- “herein”, “above”, “below”, and words of similar import, when used to describe this specification, shall refer to this specification as a whole, and not to any particular portions of this specification;
- “or”, in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list;
- the singular forms “a”, “an”, and “the” also include the meaning of any appropriate plural forms. These terms (“a”, “an”, and “the”) mean one or more unless stated otherwise;
- “and/or” is used to indicate one or both stated cases may occur, for example A and/or B includes both (A and B) and (A or B);
- “approximately” when applied to a numerical value means the numerical value ± 10%;
- where a feature is described as being “optional” or “optionally” present or described as being present “in some embodiments” it is intended that the present disclosure encompasses embodiments where that feature is present and other embodiments where that feature is not necessarily present and other embodiments where that feature is excluded. Further, where any combination of features is described in this application this statement is intended to serve as antecedent basis for the use of exclusive terminology such as "solely," "only" and the like in relation to the combination of features as well as the use of "negative" limitation(s)” to exclude the presence of other features; and
- “first” and “second” are used for descriptive purposes and cannot be understood as indicating or implying relative importance or indicating the number of



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indicated technical features.

**[00132]** Words that indicate directions such as “vertical”, “transverse”, “horizontal”, “upward”, “downward”, “forward”, “backward”, “inward”, “outward”, “left”, “right”, “front”, “back”, “top”, “bottom”, “below”, “above”, “under”, and the like, used in this description and any accompanying claims (where present), depend on the specific orientation of the apparatus described and illustrated. The subject matter described herein may assume various alternative orientations. Accordingly, these directional terms are not strictly defined and should not be interpreted narrowly.

**[00133]** Where a range for a value is stated, the stated range includes all sub-ranges of the range. It is intended that the statement of a range supports the value being at an endpoint of the range as well as at any intervening value to the tenth of the unit of the lower limit of the range, as well as any subrange or sets of sub ranges of the range unless the context clearly dictates otherwise or any portion(s) of the stated range is specifically excluded. Where the stated range includes one or both endpoints of the range, ranges excluding either or both of those included endpoints are also included in the invention.

**[00134]** Certain numerical values described herein are preceded by "about". In this context, "about" provides literal support for the exact numerical value that it precedes, the exact numerical value ±5%, as well as all other numerical values that are near to or approximately equal to that numerical value. Unless otherwise indicated a particular numerical value is included in “about” a specifically recited numerical value where the particular numerical value provides the substantial equivalent of the specifically recited numerical value in the context in which the specifically recited numerical value is presented. For example, a statement that something has the numerical value of “about 10” is to be interpreted as: the set of statements:

- in some embodiments the numerical value is 10;
- in some embodiments the numerical value is in the range of 9.5 to 10.5;



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and if from the context the person of ordinary skill in the art would understand that values within a certain range are substantially equivalent to 10 because the values with the range would be understood to provide substantially the same result as the value 10 then "about 10" also includes:

- in some embodiments the numerical value is in the range of C to D where C and D are respectively lower and upper endpoints of the range that encompasses all of those values that provide a substantial equivalent to the value 10

**[00135]** Specific examples of systems, methods and apparatus have been described herein for purposes of illustration. These are only examples. The technology provided herein can be applied to systems other than the example systems described above. Many alterations, modifications, additions, omissions, and permutations are possible within the practice of this invention. This invention includes variations on described embodiments that would be apparent to the skilled addressee, including variations obtained by: replacing features, elements and/or acts with equivalent features, elements and/or acts; mixing and matching of features, elements and/or acts from different embodiments; combining features, elements and/or acts from embodiments as described herein with features, elements and/or acts of other technology; and/or omitting combining features, elements and/or acts from described embodiments.

**[00136]** As will be apparent to those of skill in the art upon reading this disclosure, each of the individual embodiments described and illustrated herein has discrete components and features which may be readily separated from or combined with the features of any other described embodiment(s) without departing from the scope of the present invention.

**[00137]** Any aspects described above in reference to apparatus may also apply to methods and vice versa.



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**[00138]** Various features are described herein as being present in "some embodiments". Such features are not mandatory and may not be present in all embodiments. Embodiments of the invention may include zero, any one or any combination of two or more of such features. All possible combinations of such features are contemplated by this disclosure even where such features are shown in different drawings and/or described in different sections or paragraphs. This is limited only to the extent that certain ones of such features are incompatible with other ones of such features in the sense that it would be impossible for a person of ordinary skill in the art to construct a practical embodiment that combines such incompatible features. Consequently, the description that "some embodiments" possess feature A and "some embodiments" possess feature B should be interpreted as an express indication that the inventors also contemplate embodiments which combine features A and B (unless the description states otherwise or features A and B are fundamentally incompatible).This is the case even if features A and B are illustrated in different drawings and/or mentioned in different paragraphs, sections or sentences.

## ADDITIONAL DESCRIPTION

**[00139]** Examples of pipe thread protector assemblies have been described. The following clauses are offered as further description.

(1) An apparatus including any new and inventive feature, combination of features, or sub-combination of features as described herein.

(2) A pipe thread protector including any new and inventive feature, combination of features, or sub-combination of features as described herein.

(3) A pipe thread protector seal including any new and inventive feature, combination of features, or sub-combination of features as described herein.

(4) A pipe thread protector assembly including any new and inventive feature, combination of features, or sub-combination of features as described herein.

(5) Methods including any new and inventive steps, acts, combination of steps and/or acts or sub-combination of steps and/or acts as described herein.



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**[00140]** It will be appreciated that many variations are possible within the scope of the invention described herein. The pipe thread protector and coupling may be integrally interconnected so as to form a unitary whole.

**[00141]** It is intended that the following appended claims and claims hereafter introduced are interpreted to include all such modifications, permutations, additions, omissions, and sub-combinations as may reasonably be inferred. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.



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WHAT IS CLAIMED IS:

1. A pipe thread protector comprising:

a tubular body having an open first end, an open second end spaced-apart from the first end thereof, and a bore extending from the first end thereof to the second end thereof; and

threading extending between the first end of the tubular body and the second end of the tubular body.

2. The pipe thread protector of claim 1, further including one or more protrusions coupled to and extending axially outwards from the second end of the tubular body.

3. The pipe thread protector of any one of claims 1 to 2, wherein the threading couples to and extends along an outer surface of the tubular body.

4. The pipe thread protector of any one of claims 1 to 3, further including a seal coupled to the first end of the tubular body.

5. The pipe thread protector of claim 4, wherein the seal extends radially outwards in a direction extending from the first end of the tubular body towards the second end of the tubular body.



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6. The pipe thread protector of any one of claims 4 to 5, wherein the seal tapers in a direction extending from the second end of the tubular body towards the first end of the tubular body.

7. The pipe thread protector of any one of claims 4 to 6, wherein the seal tapers in a direction extending from an outer surface thereof to an inner surface thereof.

8. The pipe thread protector of any one of claims 4 to 6, wherein the seal has an inner surface, an outer surface spaced-apart from the inner surface thereof, and an end surface which extends from the outer surface thereof to the inner surface thereof in a direction extending in part from the first end of the tubular body towards the second end of the tubular body.

9. The pipe thread protector of any one of claims 4 to 8, wherein the inner surface of the seal at least in part aligns with and extends parallel to the inner surface of the tubular body.

10. The pipe thread protector of any one of claims 4 to 9, wherein the outer surface of the seal aligns with and extends parallel to the outer surface of the tubular body.

11. A pipe thread protector comprising:



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a tubular body having an open first end, an open second end spaced-apart from the first end thereof, and a bore extending from the first end thereof to the second end thereof;

threading extending between the first end of the tubular body and the second end of the tubular body; and

a seal coupled to the first end of the tubular body and shaped to protect and extend along an outer end surface of a pipe.

12. The pipe thread protector of claim 11, wherein one or more protrusions couple to and extend axially outwards from the second end of the tubular body.

13. The pipe thread protector of any one of claims 11 to 12, wherein the threading couples to and extends along an outer surface of the tubular body.

14. The pipe thread protector of any one of claims 11 to 12, wherein the seal tapers in a direction extending from an outer surface thereof to an inner surface thereof.

15. The pipe thread protector of any one of claims 11 to 12, wherein the seal has an inner surface, an outer surface radially spaced-apart from the inner surface thereof, and an end surface which extends between and is slanted from the outer surface thereof to the inner surface thereof.



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16. The pipe thread protector of any one of claims 11 to 14, wherein the seal has an end surface which is larger than that of the outer end surface of the pipe.

17. The pipe thread protector of claim 15, wherein the end surface of the seal is larger than that of the outer end surface of the pipe.

18. The pipe thread protector of any one of claims 11 to 14, wherein the seal has an end surface that is at least coextensive with the outer end surface of the pipe when the seal and the pipe are coupled together.

19. The pipe thread protector of claim 15, wherein the end surface of the seal is at least coextensive with the outer end surface of the pipe when the seal and the pipe are coupled together.

20. The pipe thread protector of any one of claims 11 to 12, wherein the tubular body has an inner surface which extends from the first end thereof to the second end thereof and wherein the seal has an inner surface which aligns with and extends parallel to the inner surface of the tubular body.

21. The pipe thread protector of any one of claims 11 to 12, wherein the tubular body has an outer surface between the first end thereof and the second end thereof and



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wherein the outer surface of the seal aligns with and extends parallel to the outer surface of the tubular body.

22. The pipe thread protector of any one of claims 11 to 21, wherein the seal extends radially outwards in a direction extending from the first end of the tubular body towards the second end of the tubular body.

23. The pipe thread protector of any one of claims 11 to 22, wherein the seal functions to abut against the outer end surface of the pipe throughout a make-up tolerance range.

24. The pipe thread protector of claim 23, wherein the make-up tolerance is an allowable distance range within which a male threaded end portion of the pipe travels into the pipe thread protector.

25. The pipe thread protector of any one of claims 4 to 24, wherein the seal couples to the tubular body via one or more tongues and grooves.

26. The pipe thread protector of any one of claims 4 to 25, wherein the seal couples to the tubular body via an interference fit.

27. The pipe thread protector of any one of claims 4 to 26, wherein the seal couples to the tubular body via adhesive.



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28. The pipe thread protector of any one of claims 4 to 27, wherein the seal has an inner diameter equal to or less than an inner diameter of the pipe.

29. The pipe thread protector of claim 28, wherein the inner diameter of the seal is not more than $1/8^{th}$ smaller than the inner diameter of the pipe.

30. A pipe thread protector comprising:

a tubular body having a pair of spaced-apart open ends;

threading extending between the open ends of the tubular body; and

a seal coupled to one of the open ends of the tubular body, the seal being shaped to inhibit inward bulging thereof when axially compressed.

31. A pipe thread protector seal, the seal being tubular, the seal tapering at least in part in a direction extending from a proximal end thereof towards a distal end thereof, and the seal tapering in a direction extending from an outer surface thereof to an inner surface thereof.



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32. A pipe thread protector seal, the seal being tubular, the seal being L-shaped in longitudinal cross-section and the seal tapering in a direction extending from an outer surface thereof to an inner surface thereof.

34. A pipe thread protector seal, the seal being tubular, including a plurality of radially-inwardly extending and longitudinally spaced tongues, and having an enlarged end portion.

35. A pipe thread protector seal, the seal including a proximal sleeve portion and a distal sleeve portion coupled to and extending radially inwards from the proximal sleeve portion thereof, the distal sleeve portion of the seal being an irregular quadrilateral in cross-section.

36. The seal of any one of claims 4 to 35, further including an outer peripheral portion that is annular and triangular in longitudinal cross-section.

37. A seal for a pipe thread protector, the tubular body being of any one claims 1 to 30.

38. A tubular body for a pipe thread protector, the tubular body being of any one claims 1 to 36.

39. A pipe thread protector assembly comprising:



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a pipe thread protector;

a coupling via which the pipe thread protector and a male threaded end of a pipe and threadably couple together; and

a seal coupling to an inner end of the pipe thread protector and shaped to protect an outer end surface of the pipe.

40. The pipe thread protector assembly of claim 39, wherein the seal functions to abut against the outer end surface of the pipe throughout a make-up tolerance range.

41. The pipe thread protector assembly of claim 40, wherein the make-up tolerance is an allowable distance range within which a male threaded end portion of the pipe travels into the coupling.

42. The pipe thread protector assembly of any one of claims 39 to 41, wherein the seal has an end surface which is larger than that of the outer end surface of the pipe

43. The pipe thread protector assembly of any one of claims 39 to 41, wherein the end surface of the seal is at least coextensive with the outer end surface of the pipe when the seal and the pipe are coupled together.



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44. The pipe thread protector assembly of any one of claims 39 to 43, wherein the coupling and the pipe so coupled together form an annular recess and wherein the seal is shaped to extend in part into said annular recess.

45. The pipe thread protector assembly of any one of claims 39 to 44, wherein the seal is shaped to extend outwards to abut the coupling when the pipe thread protector and the pipe are threadably coupled together via the coupling.

46. The pipe thread protector assembly of any one of claims 39 to 45, wherein the seal is shaped to accommodate variations in the extent to which the pipe threadably couples to the coupling without extending radially inwards.

47. The pipe thread protector assembly of any one of claims 39 to 46, wherein the seal is shaped to inhibit inward bulging thereof when the pipe thread protector and the pipe are threadably coupled together via the coupling.

48. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling; and

an end member with an inner portion which is frustoconical in outer shape, configured to extend laterally across and threadably couple to the tubular body.



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49. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling, the tubular body including an inner portion with a first of right-handed and left-handed threading, and the tubular body including an outer portion with a second of right-handed and left-handed threading; and

an end member including the second of right-handed and left-handed threading via which the end member threadably couples to the outer portion of the tubular body.

50. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling; and

an end member shaped to extend laterally across and selectively couple to the tubular body, wherein the end member has a thickness at least in part equal to or greater than that of the tubular body.

51. A pipe thread protector comprising:



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a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling, the tubular body having an outer end, an inner end, and a tapered bore which tapers from the outer end thereof towards the inner end thereof; and

an end member shaped to be received in part within the tapered bore, and extend laterally across and removably couple to the tubular body.

52. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling;

an end member shaped to removably couple to and extend laterally across the tubular body; and

a locking member moveable from a first position, in which removal of the end member from the tubular body is inhibited, to a second position in which the end member is selectively removable from the tubular body.

53. The pipe thread protector of claim 52, wherein the locking member is a fastener threadably coupled to the end member and selectively extendable within a recess of the tubular body.



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54. The pipe thread protector of any of claims 52 to 53, wherein the end member threadably couples to the tubular body.

55. The pipe thread protector of any one of claims 48 to 54, wherein the tubular body has threading extending along an inner surface thereof from an inner end thereof towards an outer end thereof.

56. The pipe thread protector of any one of claims 48 to 55, wherein the tubular body has threading extending along an outer surface thereof via which the tubular body threadably couples to a female threaded end portion of a pipe coupling.

57. The pipe thread protector of any one of claims 48 to 56, further including at least one annular seal positioned between the tubular body and the end member.

58. The pipe thread protector of any one of claims 48 to 57, further including a pair of annular spaced-apart seals, a first said seal aligning adjacent the outer end of the tubular body and a second said seal aligning adjacent the inner end of the end member.

59. The pipe thread protector of any one of claims 48 to 58, wherein the end member has a central portion with a thickness equal to or greater than that of the inner portion of the tubular body.



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60. A removable plug for a pipe thread protector, the plug comprising:

a base member shaped to extend laterally across an open outer end of the pipe thread protector;

one or more protrusions coupled to and extending axially outwards from an outer end of the base member; and

an inner annular member coupled to, extending axially from, and tapering relative to an inner end of the base member.

61. The plug of claim 60 further including one or more supporting ribs coupled to and extending inwards from the annular member.

62. The plug of claim 61, wherein each said supporting rib extends radially in part and axially in part.

63. The plug of any one of claims 61 to 62, wherein each said supporting rib is a triangular prism in shape.

64. The plug of any one of claims 61 to 63, wherein the one or more supporting ribs are circumferentially spaced-apart.



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65. A pipe thread protector comprising:

a tubular body having an inner end, an outer end, and an inner surface along which extends threading from the inner end thereof towards the outer end thereof; and

a protrusion coupled to and extending radially inwards from the inner surface of the tubular body adjacent the threading of the tubular body, whereby the protrusion is configured to deform upon rotatably coupling the tubular body to a male threaded end portion of a pipe, with the protrusion so deformed inhibiting removal of the pipe from the tubular body thereafter.

66. The pipe thread protector of claim 65, further including a seal adjacent to and positioned in place via the protrusion.

67. The pipe thread protector of claim 66, wherein the seal is positioned between the protrusion and the outer end of the tubular body.

68. The pipe thread protector of any one of claims 65 to 67, wherein the seal is annular and positioned to align with a distal end of the pipe.

69. The pipe thread protector of any of one claims 65 to 68, wherein the protrusion is positioned to align with the distal end of the pipe.



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70. The pipe thread protector of any of one of claims 65 to 69, wherein the tubular body has an outer portion that extends from the outer end thereof towards the inner end thereof, extends radially inwards, and has an annular shoulder, and wherein the seal is positioned between the shoulder and the protrusion.

71. The pipe thread protector of any one of claims 65 to 70, wherein the protrusion is annular.

72. The pipe thread protector of any one of claims 65 to 71, wherein the protrusion is rectangular in longitudinal section.

73. The pipe thread protector of any one of claims 65 to 72, wherein the protrusion has a longitudinal length which is less than that of the threading.

74. The pipe thread protector of any one of claims 65 to 73, wherein the protrusion extends radially inwards from the inner surface a distance greater than that of the threading.

75. The pipe thread protector of any one of claims 65 to 74, wherein the protrusion is cut into by threading of the pipe.

76. The pipe thread protector of any one of claims 65 to 75, wherein the protrusion deformably couples to an outermost thread portion of the pipe.



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77. The pipe thread protector of any one of claims 65 to 76, wherein the protrusion is positionable adjacent to an outermost thread portion of the pipe.

78. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling; and

a seal extending about the tubular body, the seal being triangular in lateral cross-section.

79. The pipe thread protector of claim 78, wherein the seal is shaped to extend along an end face of the pipe.

80. A pipe thread protector assembly comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling;

an end member shaped to removably couple to and extend laterally across a first end portion of the tubular body; and



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a seal coupled to and extending about a second end portion of the tubular body spaced-apart from the first end portion of the tubular body.

81. A pipe thread protector assembly comprising:

a tubular body shaped to protect a threaded end portion of a pipe coupling;

an end member removably coupled to the tubular body; and

a seal extending about the tubular body and shaped to seal an inner shoulder of the pipe coupling.

82. A pipe thread protector comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling; and

an end member removably coupled to the tubular body, the end member having a central recessed region extending within the tubular body and being shaped to receive a hook at least in part.

83. A pipe thread protector comprising:



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a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling; and

a seal extending about the tubular body and shaped to seal an end face of the pipe or the pipe coupling, the seal having an inner diameter equal to or less than the inner diameter of the pipe or the pipe coupling.

84. The pipe thread protector of claim 83, wherein the inner diameter of the seal is not more than $1/8^{th}$ smaller than the inner diameter of the pipe or the pipe coupling.

86. The pipe thread protector of any one of claims 83 to 84, further including an end member removably coupled to the tubular body.

87. A pipe thread protector assembly comprising:

a tubular body shaped to protect a threaded end portion of a pipe or a pipe coupling and receive a cylindrical member therethrough for drifting the pipe; and

an impact-absorbing end member connecting to and extending laterally across the tubular body, the end member being selectively removable from the tubular body and the end member being shaped to inhibit inward deformation of the tubular body.



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88. The assembly of claim 87, wherein the end member threadably couples to the tubular body.

89. The assembly of any one of claims 87 to 88, wherein the end member has a thickness that is one or more of at least in part equal to or greater than that of the tubular body

90. The assembly of any one of claims 87 to 88, wherein the end member has a thickness that is equal to or greater in thickness than the tubular body at any region thereof.

91. The assembly of any one of claims 87 to 90, wherein the tubular body has an outer end, an inner end, and a tapered bore which tapers from the outer end thereof towards the inner end thereof, with the end member being shaped to be received in part within the tapered bore.

92. The assembly of any one of claims 87 to 91, wherein the end member includes an inner portion which is frustoconical in outer shape.

92. The assembly of any one of claims 87 to 92, further including a locking member moveable from a first position, in which removal of the end member from the tubular body is inhibited, to a second position in which the end member is selectively removable from the tubular body.



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93. The assembly of claim 92, wherein the locking member is a fastener threadably coupled to the end member and selectively extendable within a recess of the tubular body.

94. The tubular body of the assembly of any one of claims 87 to 93, wherein the tubular body has threading extending along an outer surface via which the tubular body threadably couples to a female threaded end portion of the pipe coupling.

95. The assembly of any one of claims 87 to 94, further including longitudinally spaced-apart first and second seals, the first seal being positioned between the tubular body and the end member and the second seal being positionable between the tubular body and the pipe.

96. The assembly of any one of claims 87 to 94, wherein the tubular body includes a radially and longitudinally inwardly extending peripheral portion shaped to receive the end member, align adjacent to an outer end face of the pipe and receive a seal within a groove thereof, the peripheral portion and the seal being shaped to cover the outer end face of the pipe at least in part.

97. The assembly of any one of claims 87 to 94, further including a seal extending about the tubular body, the seal being annual and triangular in lateral cross-section.



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98. The assembly of any one of claims 87 to 94, further including a seal extending about the tubular body and shaped to seal an inner shoulder of the pipe coupling.

99. The assembly of any one of claims 87 to 93, wherein the tubular body couples to the pipe or the pipe coupling via threading, and wherein the end member has a central recessed region extending within the tubular body so as to align at least in part with said threading.

100. A removable end member for the pipe thread protector of any one of claims 87 to 99, the end member comprising:

a base member shaped to extend laterally across an open outer end of the pipe thread protector;

one or more protuberances coupled to and extending axially outwards from an outer end of the base member; and

an inner annular member coupled to, extending axially from, and tapering relative to an inner end of the base member.

101. The end member of claim 100, further including one or more supporting ribs.



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102. The end of member of claim 101, wherein each said supporting rib couples to and extends inwards from the annular member.

103. The end of member of any one of claims 101 to 102, wherein each said supporting rib extends radially in part and axially in part.

104. The end of member of any one of claims 101 to 103, wherein each said supporting rib is a triangular prism in shape.

105. The end of member of any one of claims 101 to 104, wherein the one or more supporting ribs are circumferentially spaced-apart.

106. A method of transporting and drifting a pipe using the pipe thread protector assembly of any one of claims 87 to 99, the method comprising:

coupling together the tubular body and the end member of the pipe thread protector assembly;

threadably connecting the tubular body and the end member so coupled together to the threaded end portion of the pipe or a pipe coupling of the pipe, with debris being inhibited from contacting outer end face and interior of the pipe thereby;



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transporting the pipe, with the tubular body and the end member so coupled to the threaded end portion thereof, to a work site;

drifting the pipe by removing the end member from the tubular body so coupled to the pipe of the pipe coupling of the pipe and thereafter biasing a cylindrical member having a pre-determined outer diameter through the tubular body and into the pipe; and

determining that the pipe is acceptable if the cylindrical member extends therein, and determining that the pipe is unacceptable if the cylindrical member is inhibited from extending therein.

107. The method as claimed in claim 106, further including after the biasing step, re-connecting the end member to the tubular body, with debris being inhibited from contacting end face and interior of the pipe once more.

108. The method as claimed in any one of claims 106 to 107, wherein the pipe thread protector assembly further includes a locking member, wherein the method includes within the coupling together of the tubular body and the end member step, moving the locking member into a first position in which removal of the end member from the tubular body is inhibited, and wherein the method includes within the drifting the pipe step, moving the locking member from the first position to a



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second position in which the end member is selectively removable from the tubular body.



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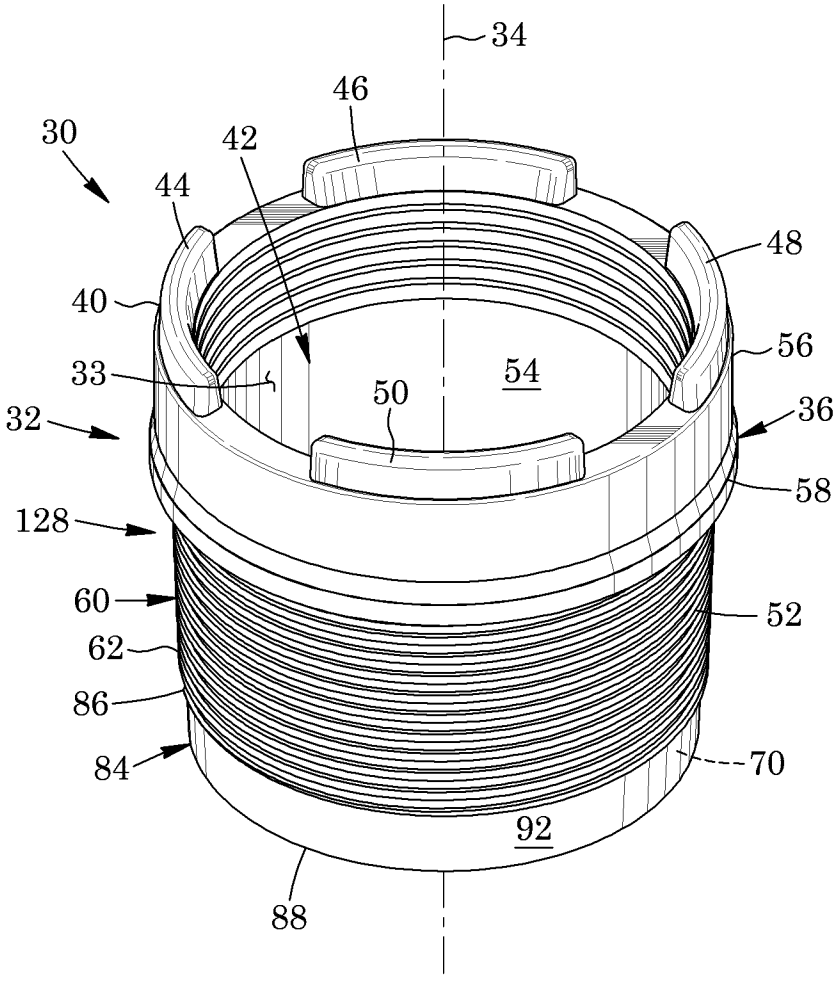


FIG. 1

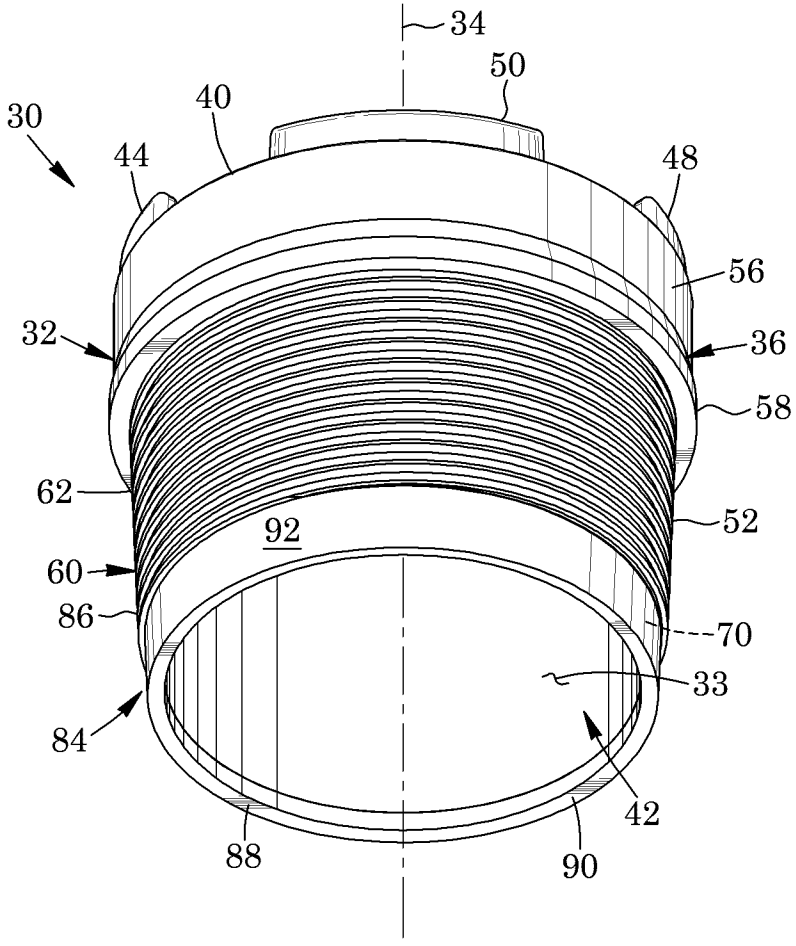


FIG. 2

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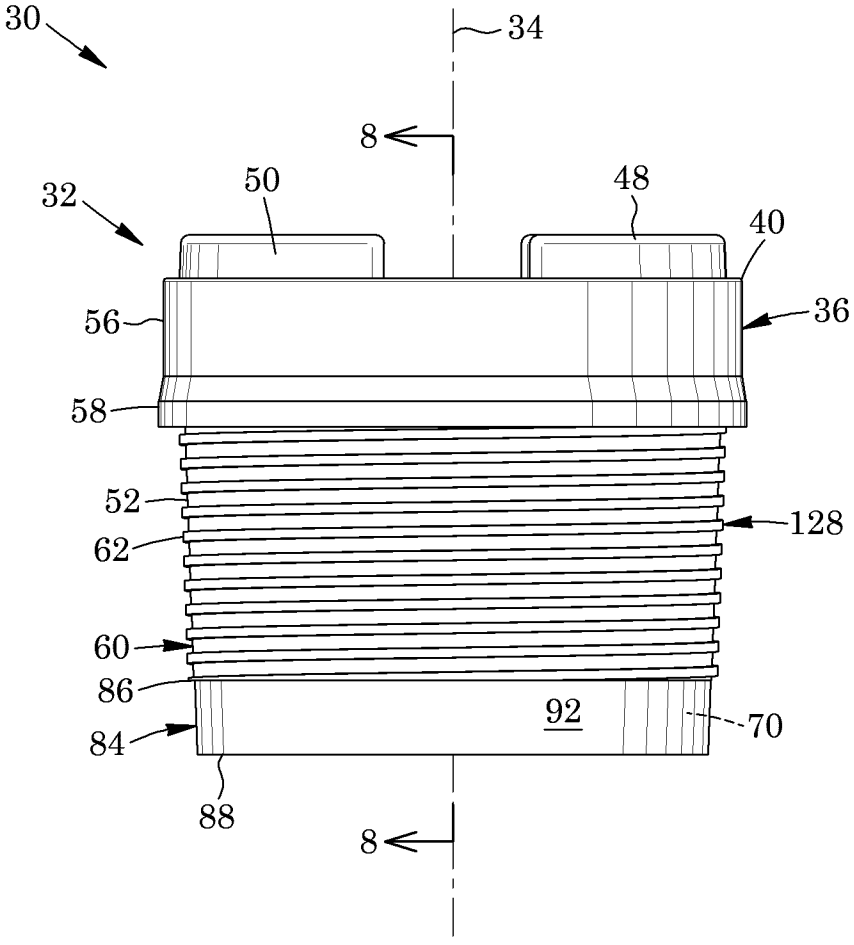


FIG. 3

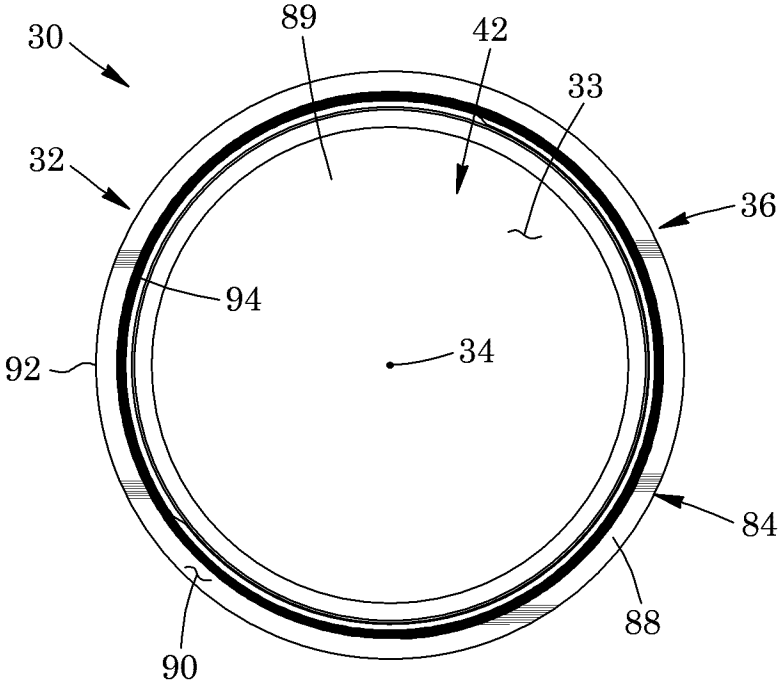


FIG. 4

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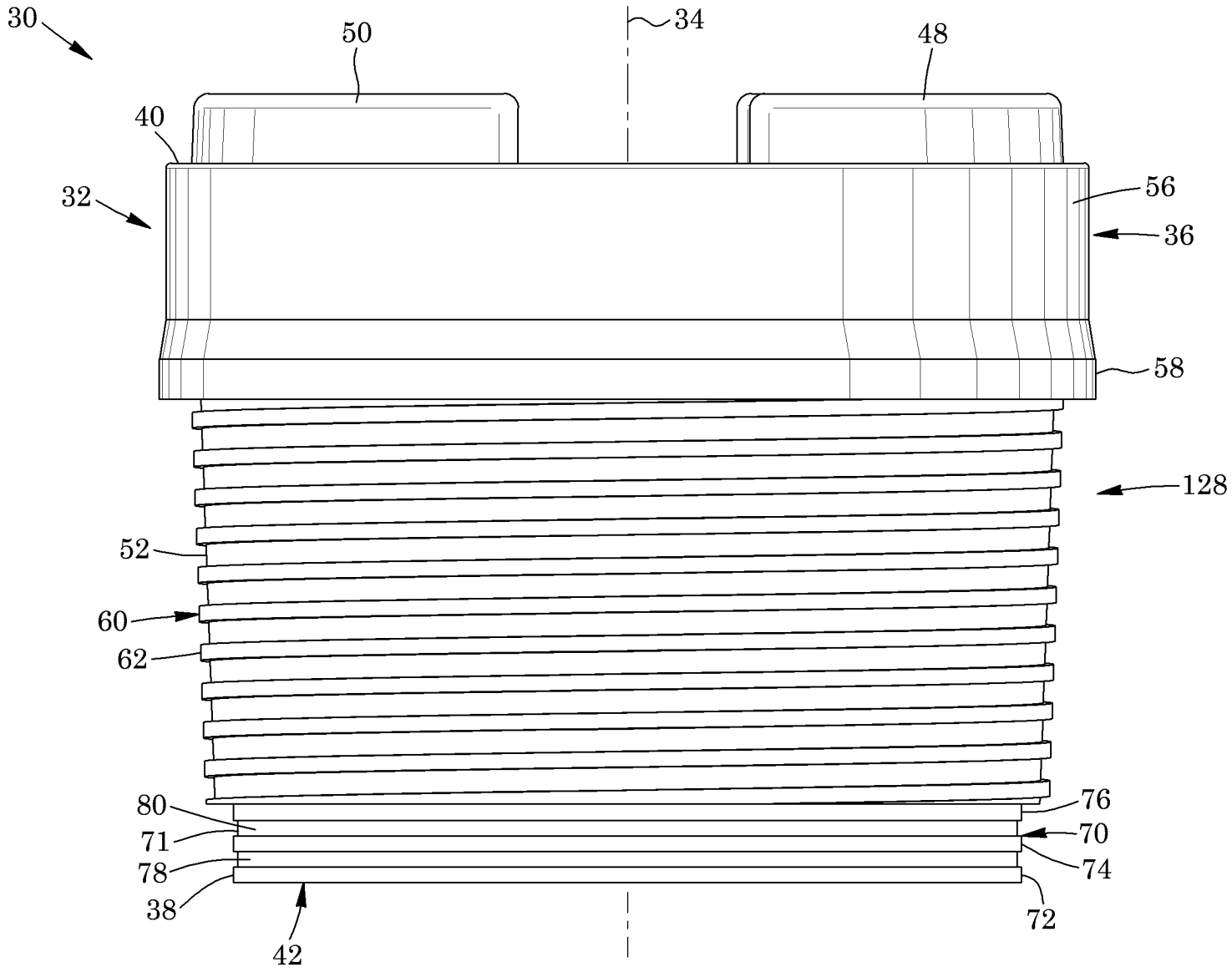


FIG. 5

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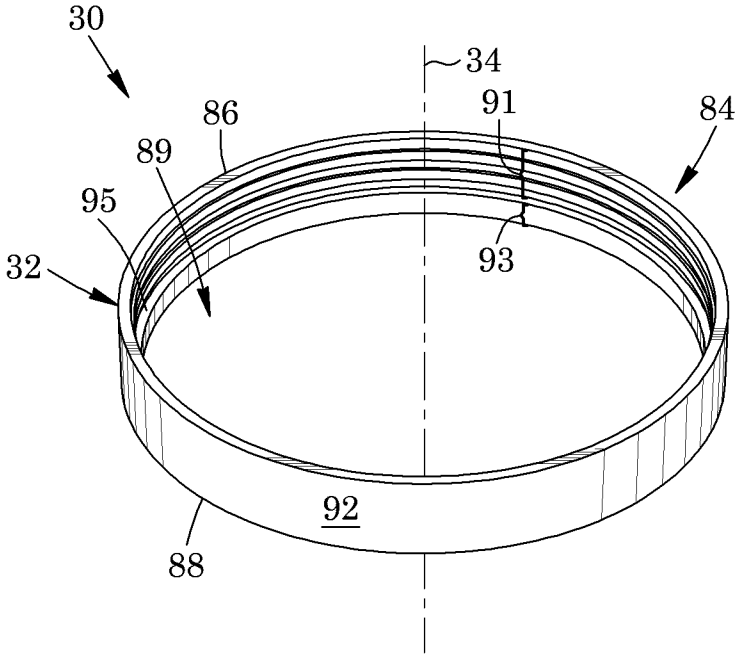


FIG. 6

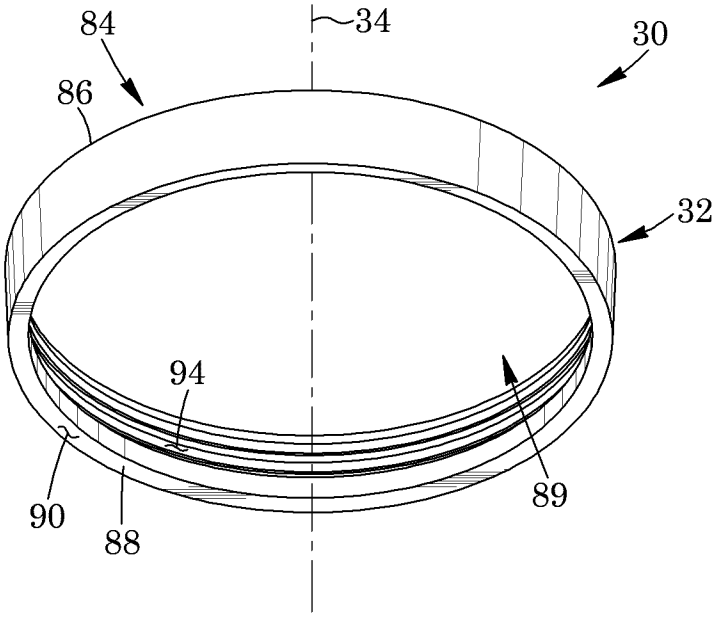


FIG. 7

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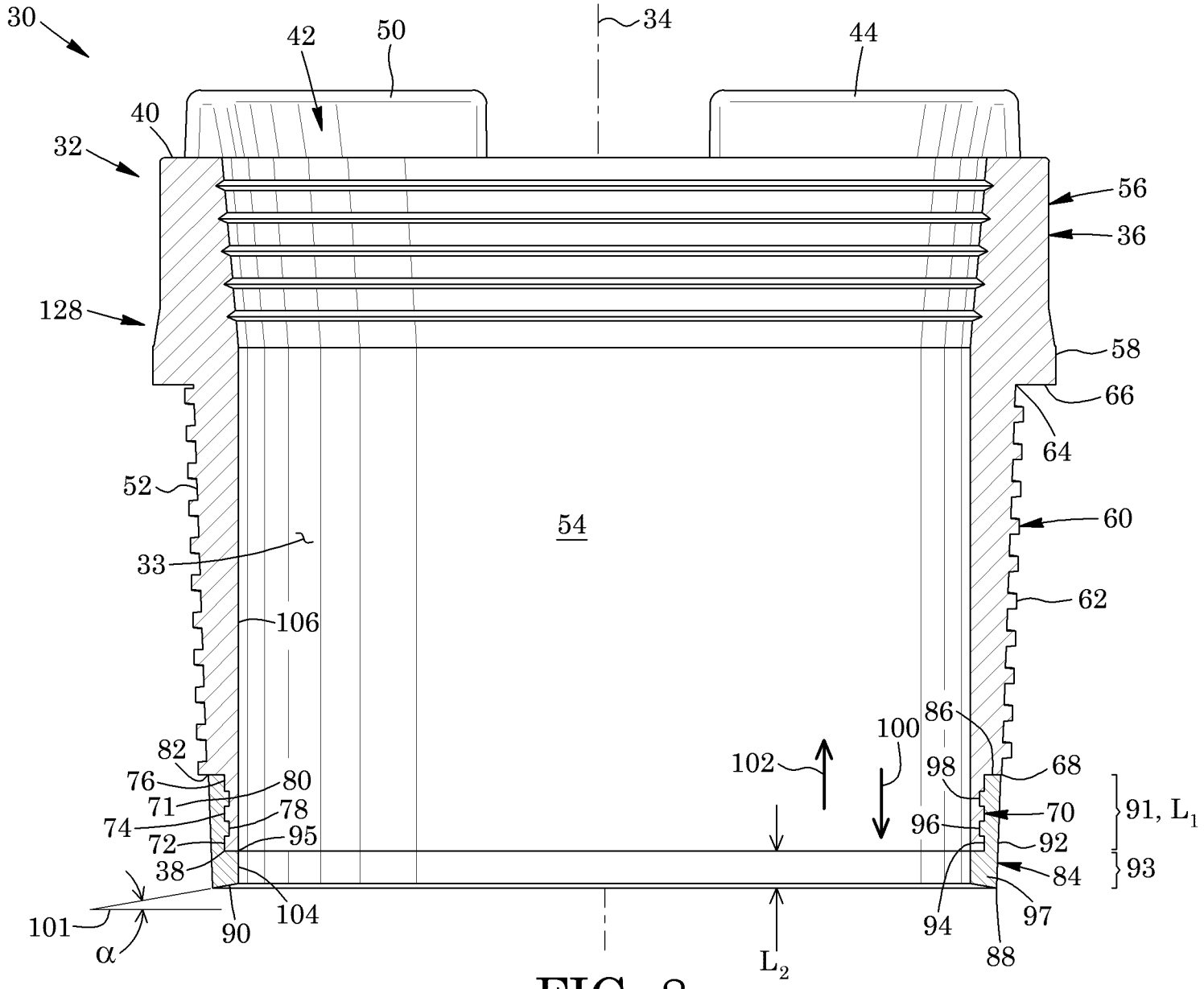


FIG. 8

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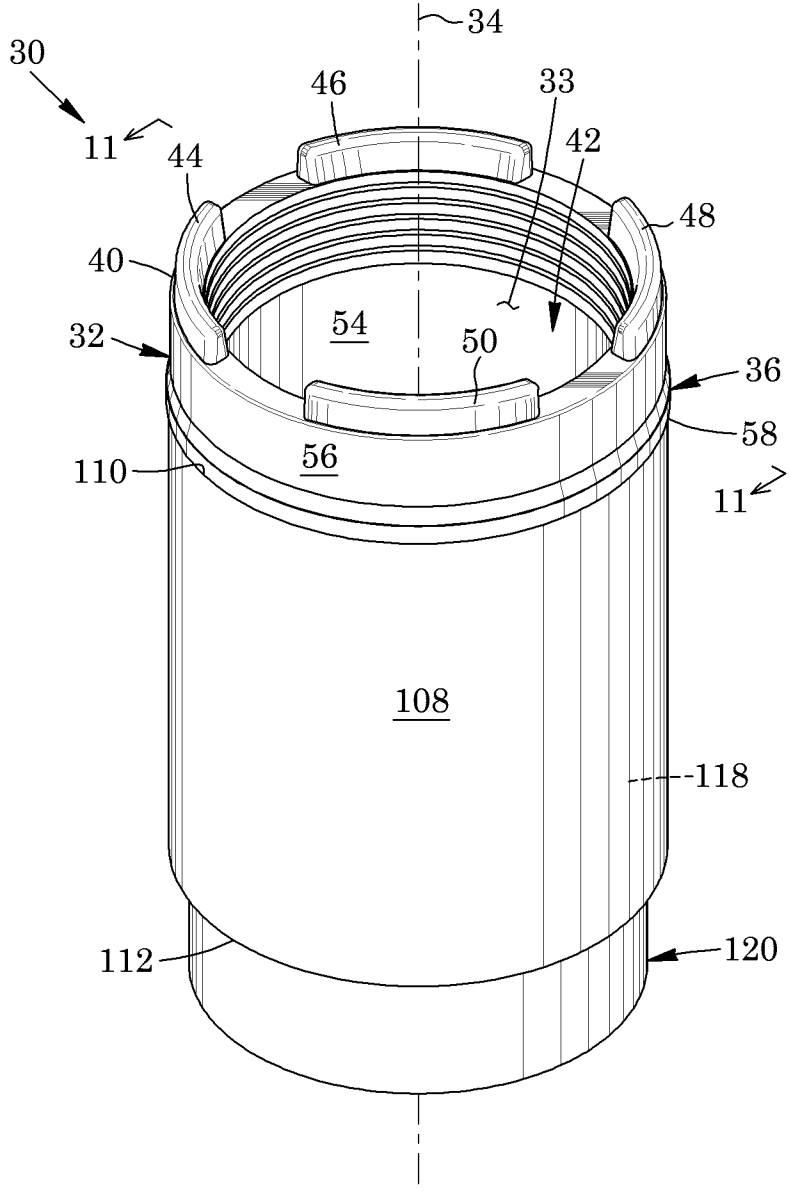


FIG. 9

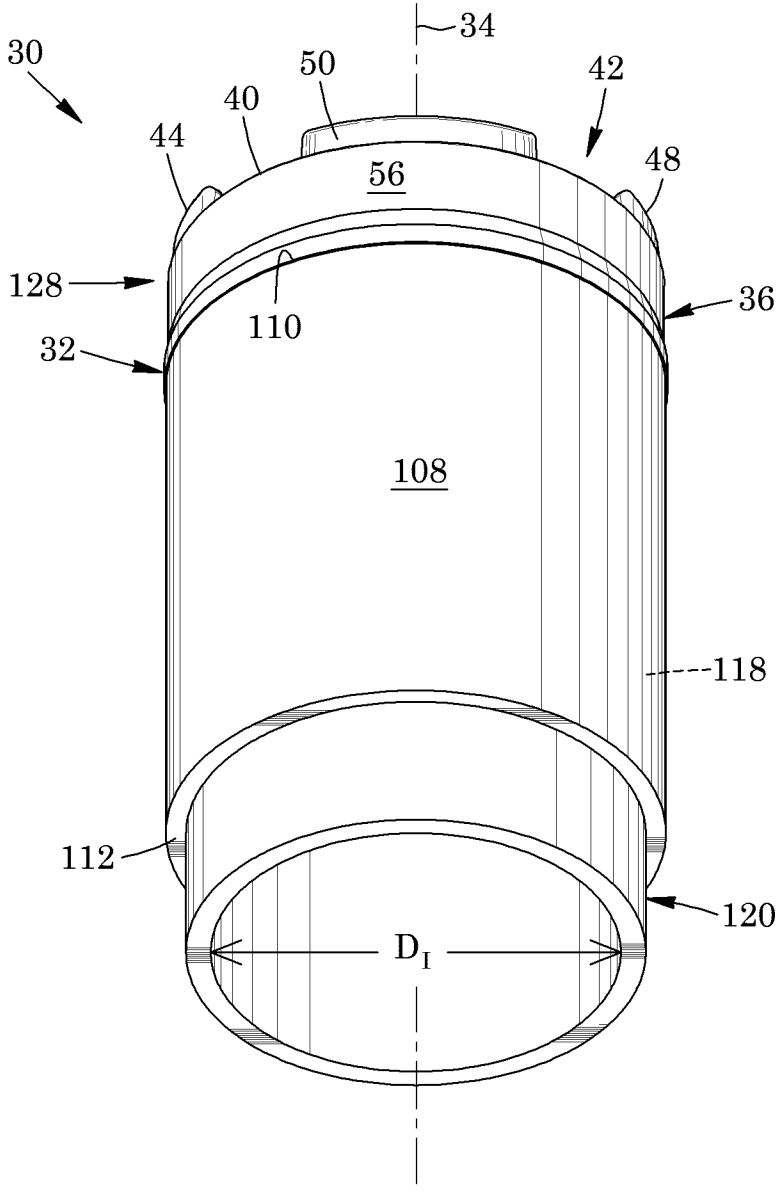


FIG. 10

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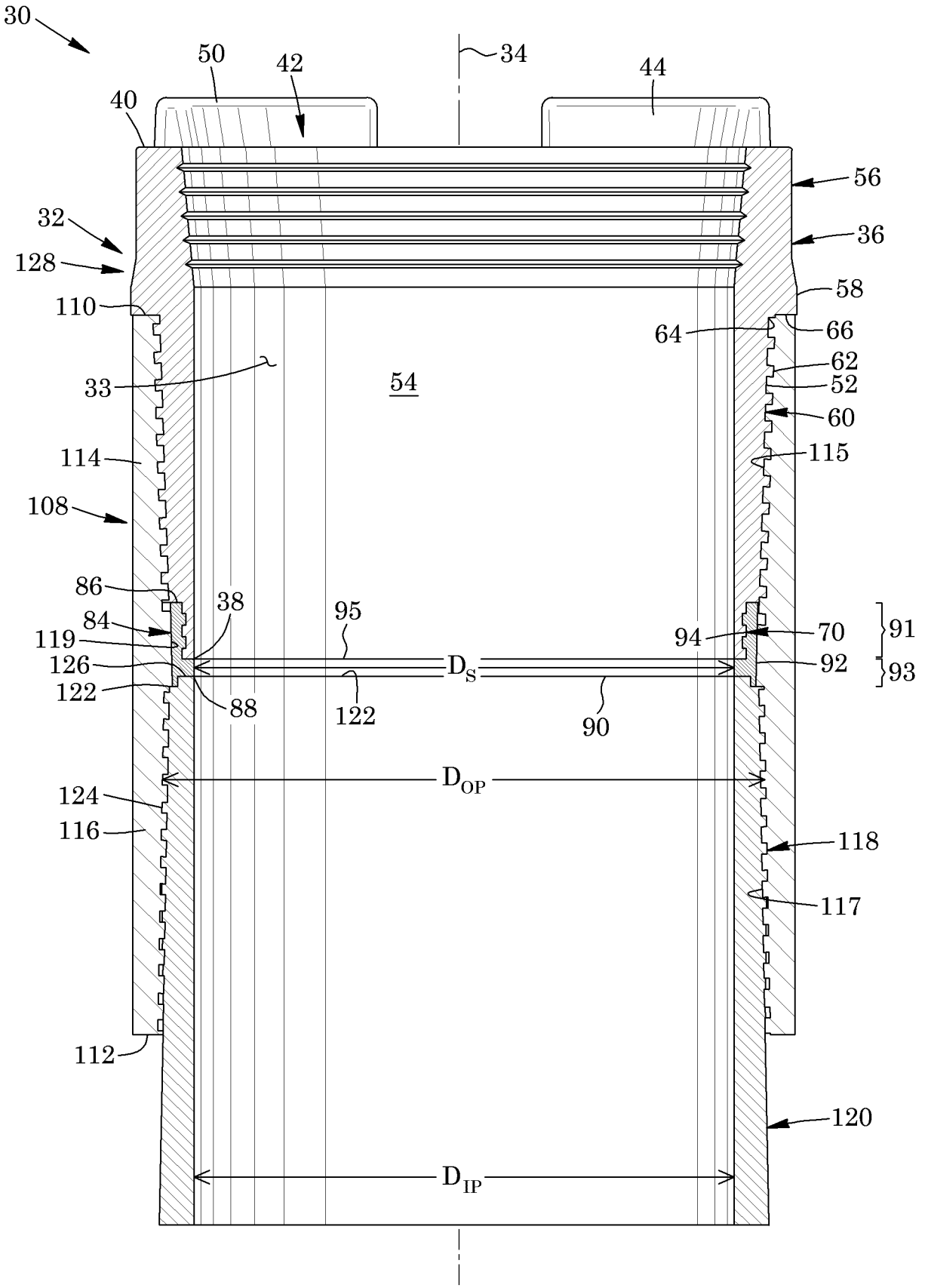


FIG. 11

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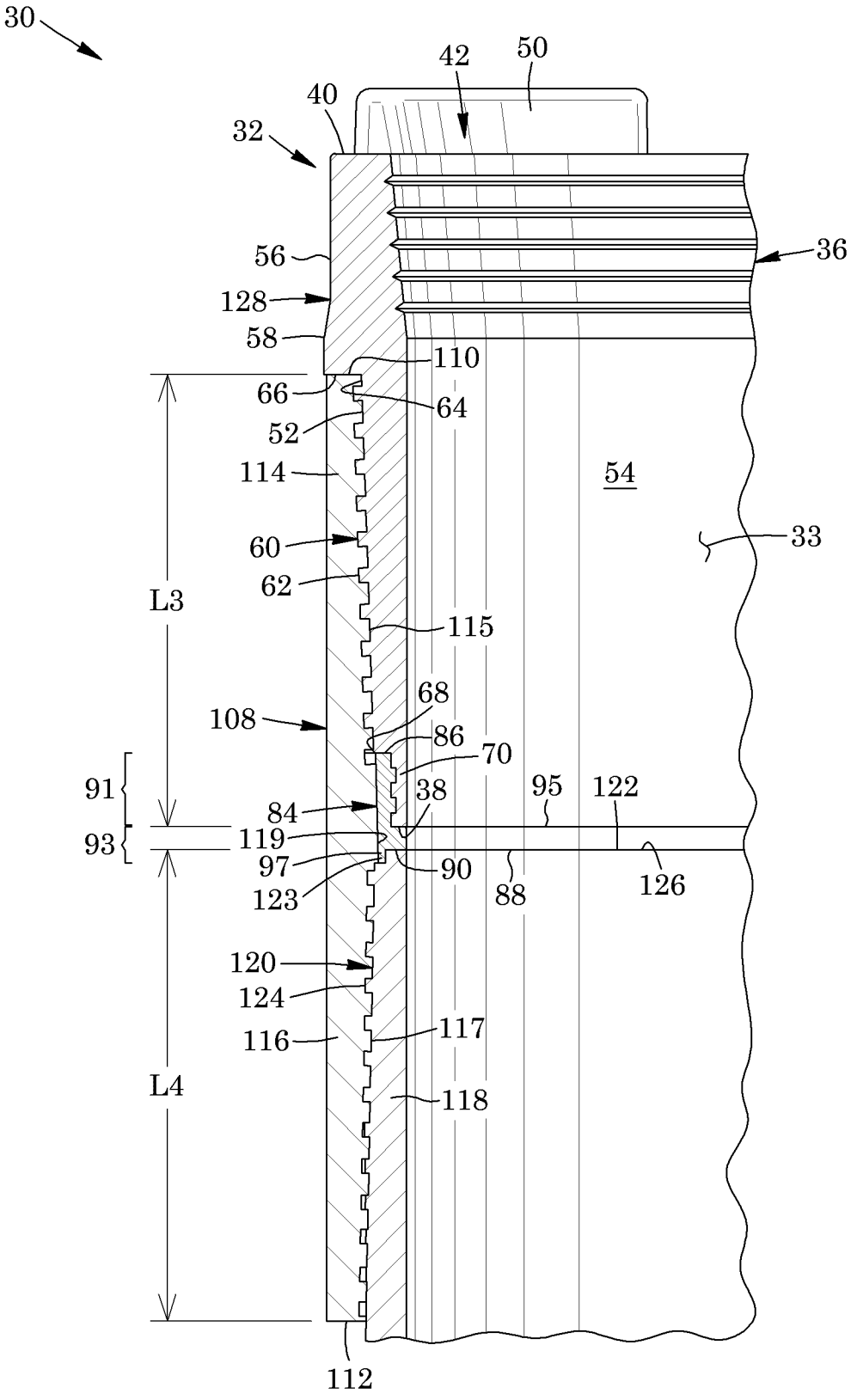


FIG. 12

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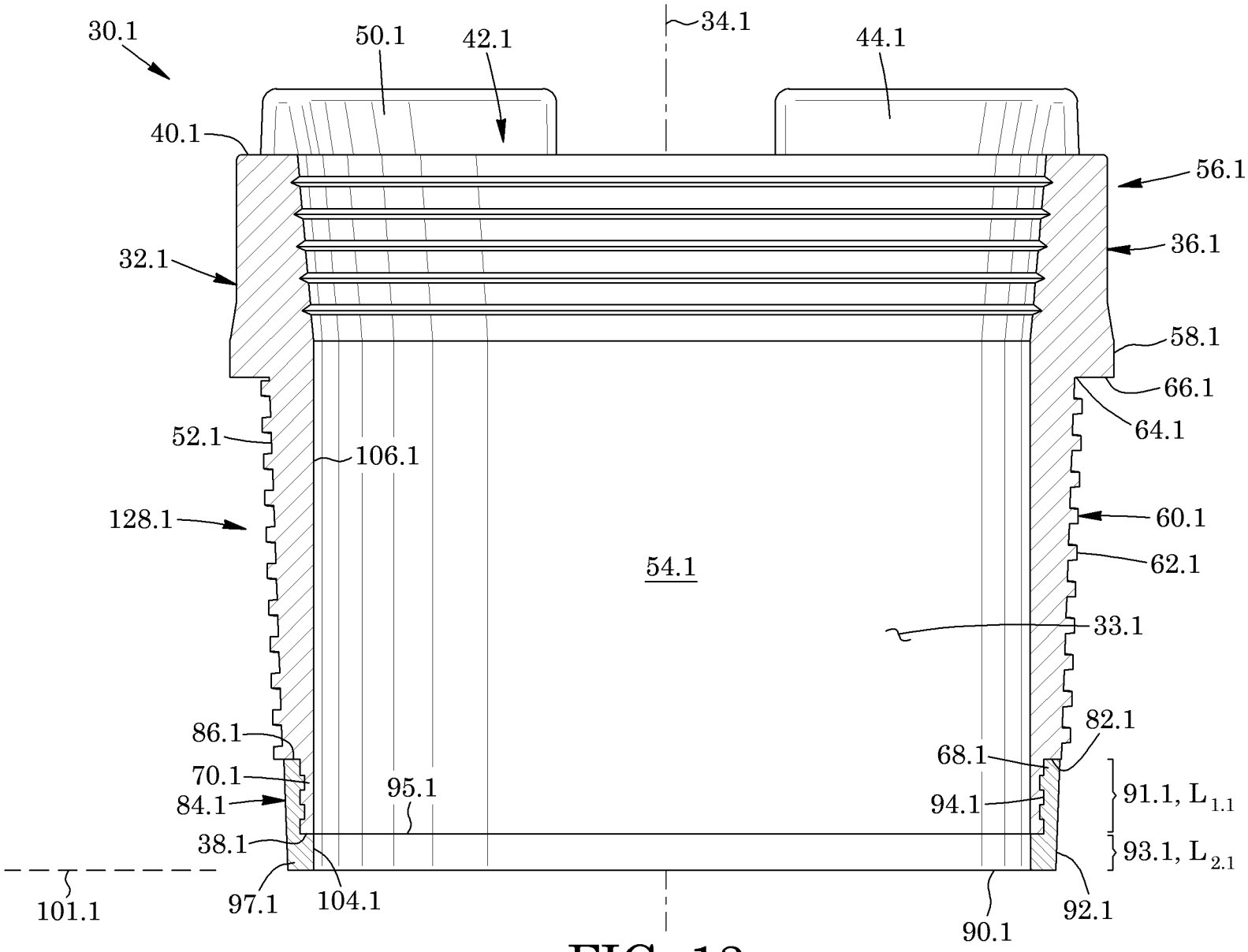


FIG. 13

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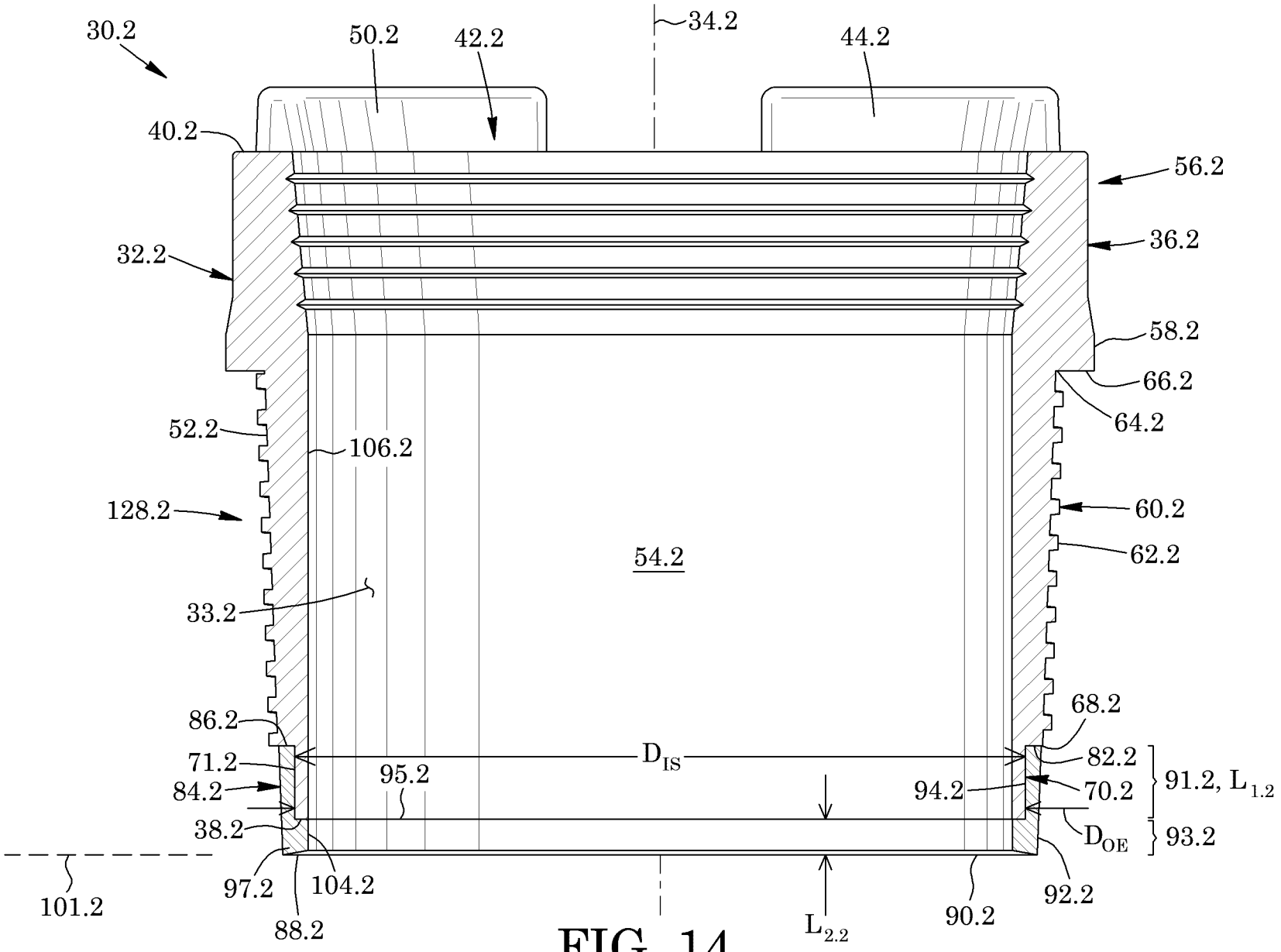


FIG. 14

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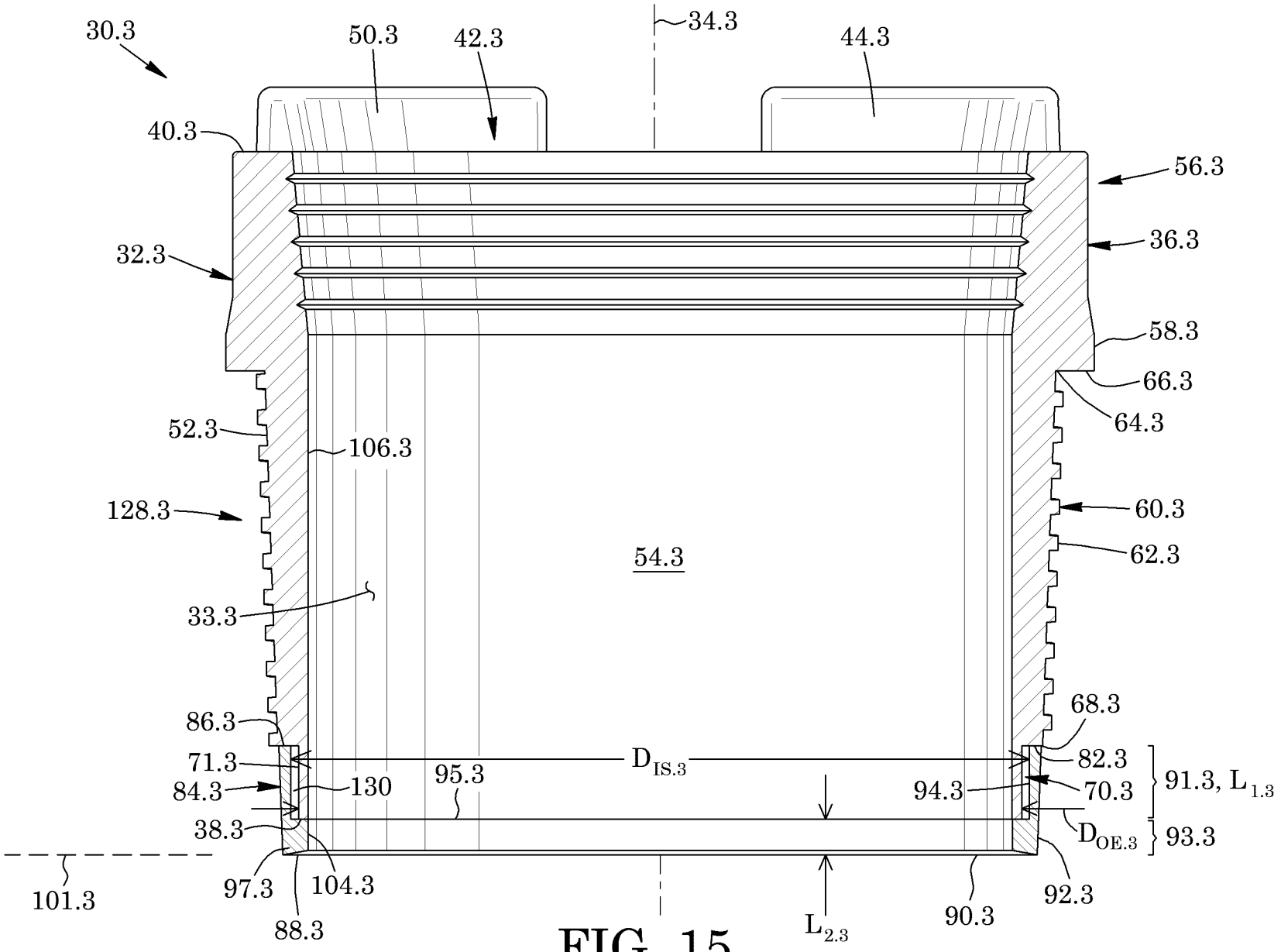


FIG. 15

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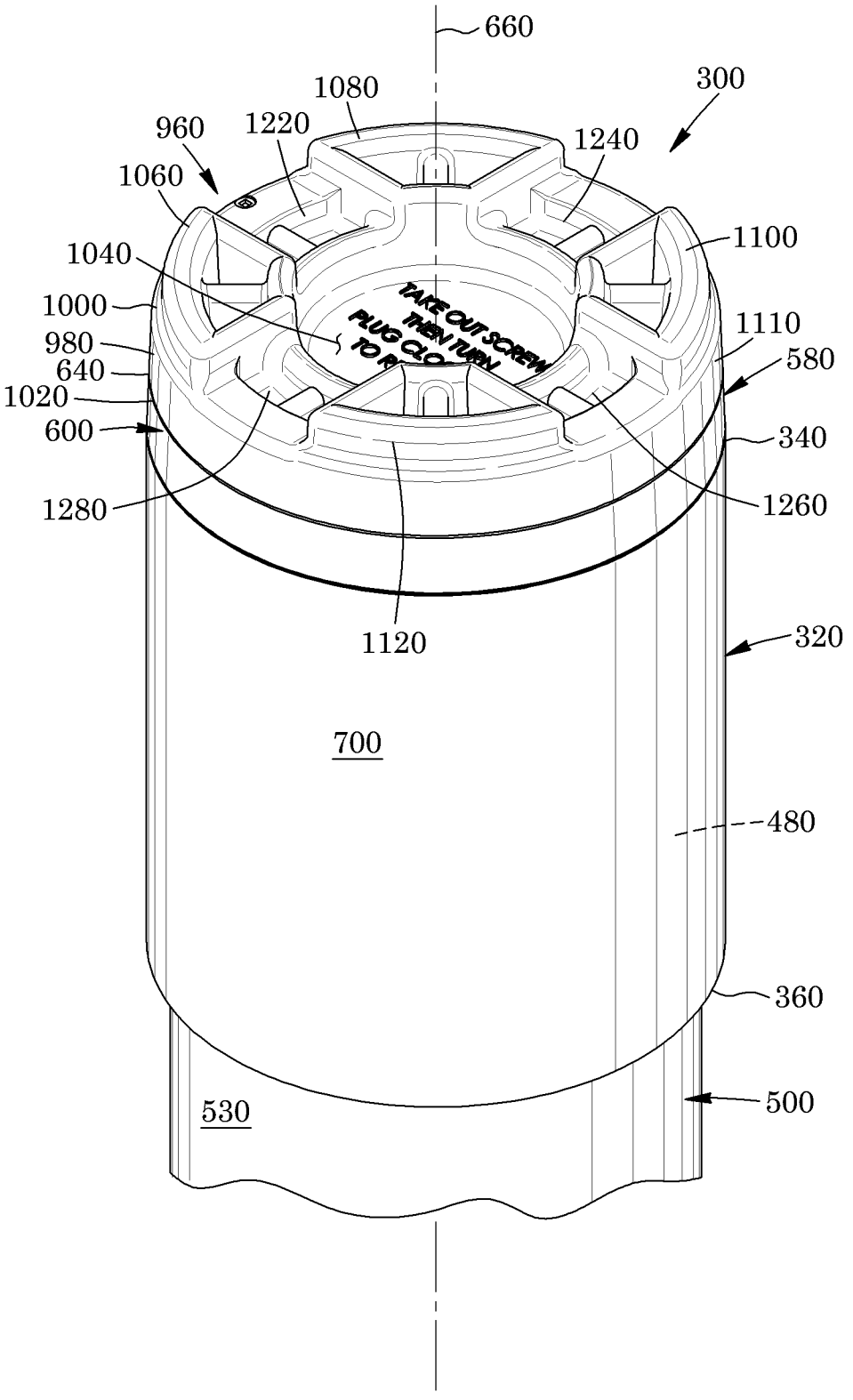


FIG. 16

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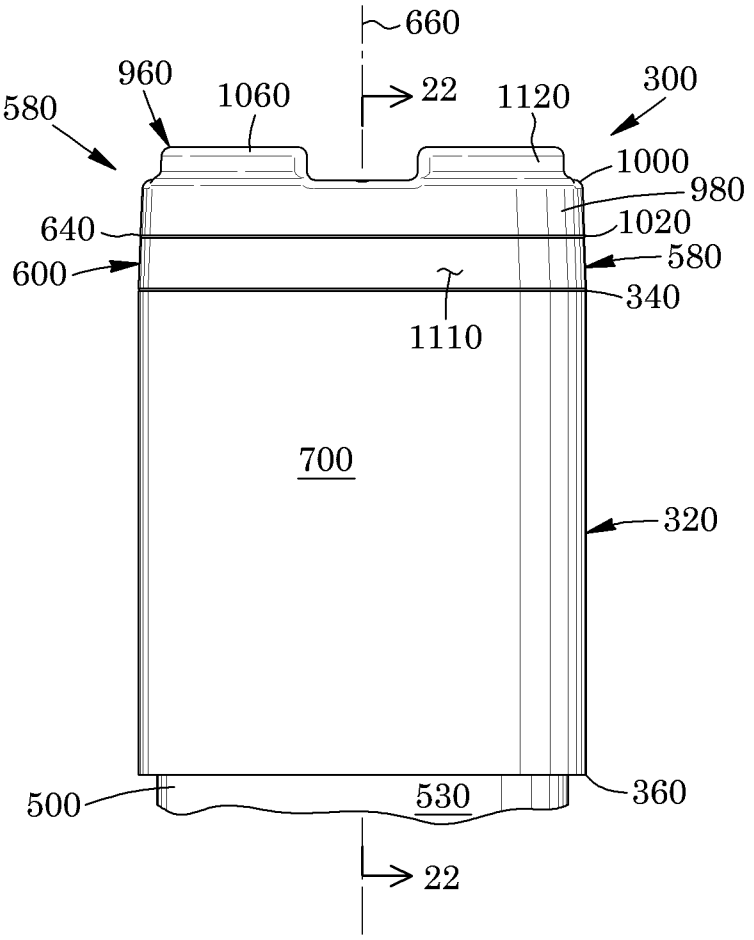


FIG. 17

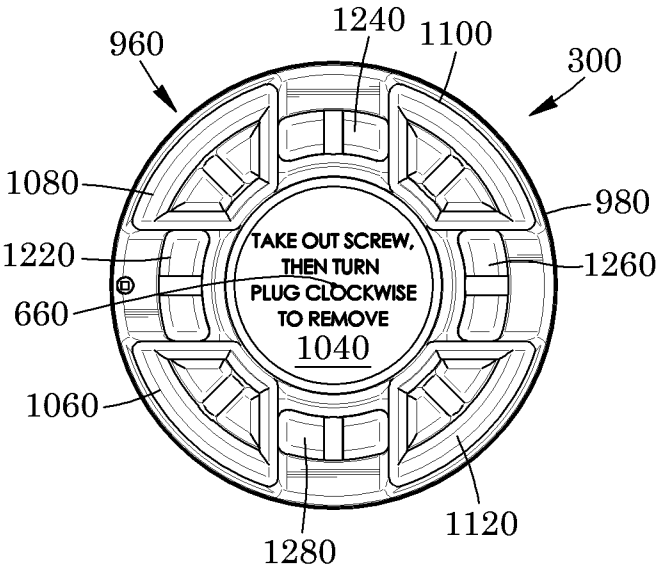


FIG. 18

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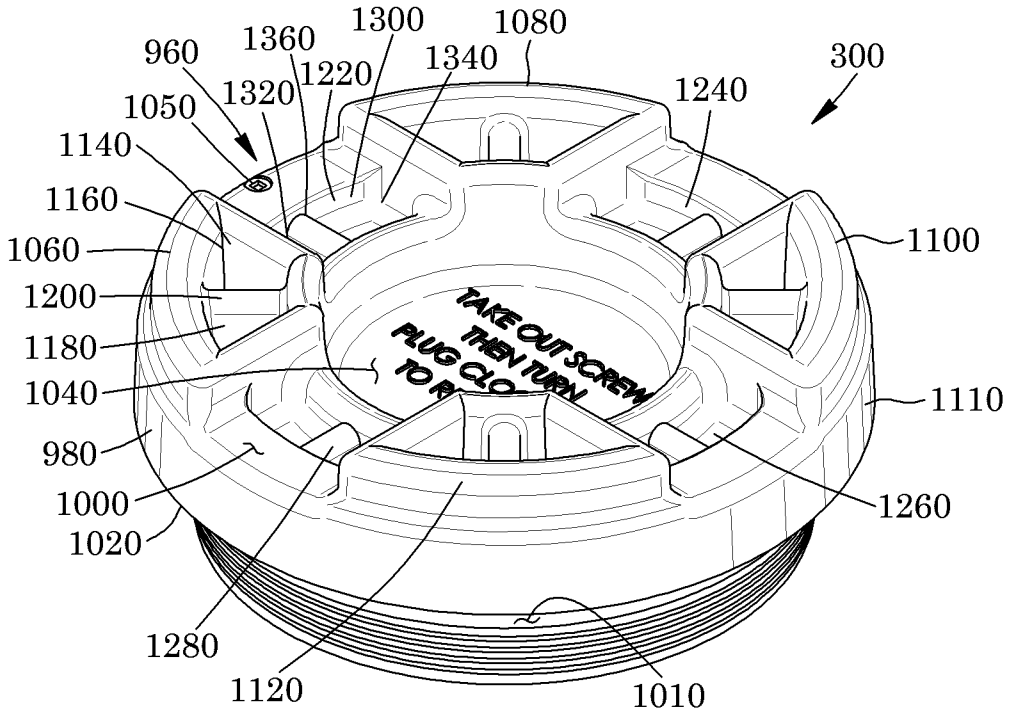


FIG. 19

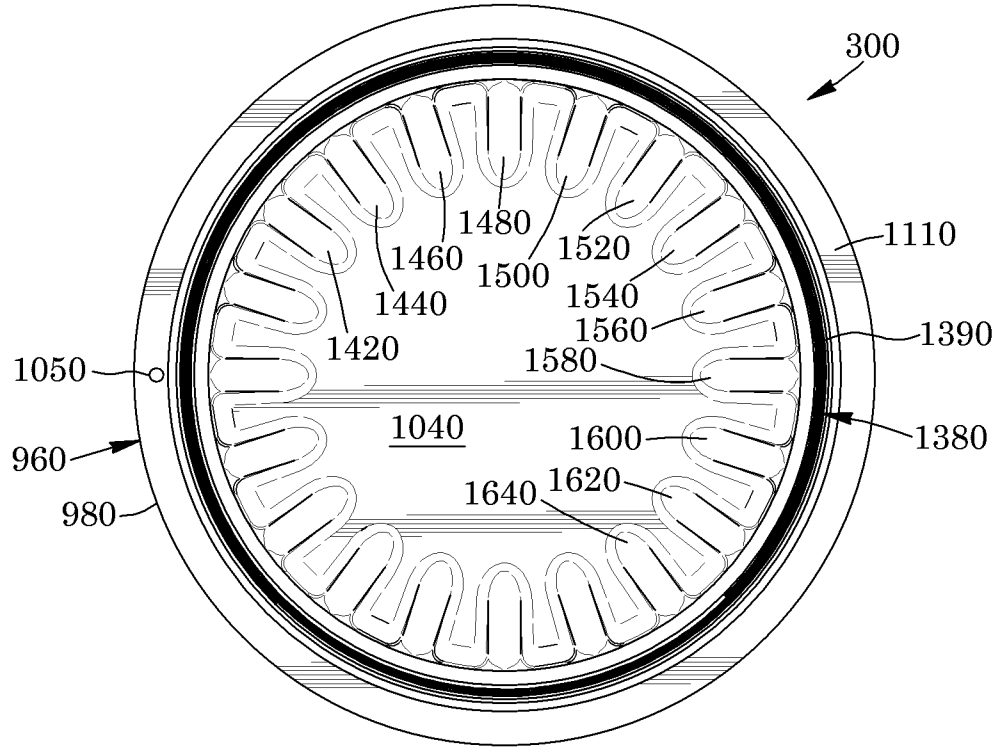


FIG. 20

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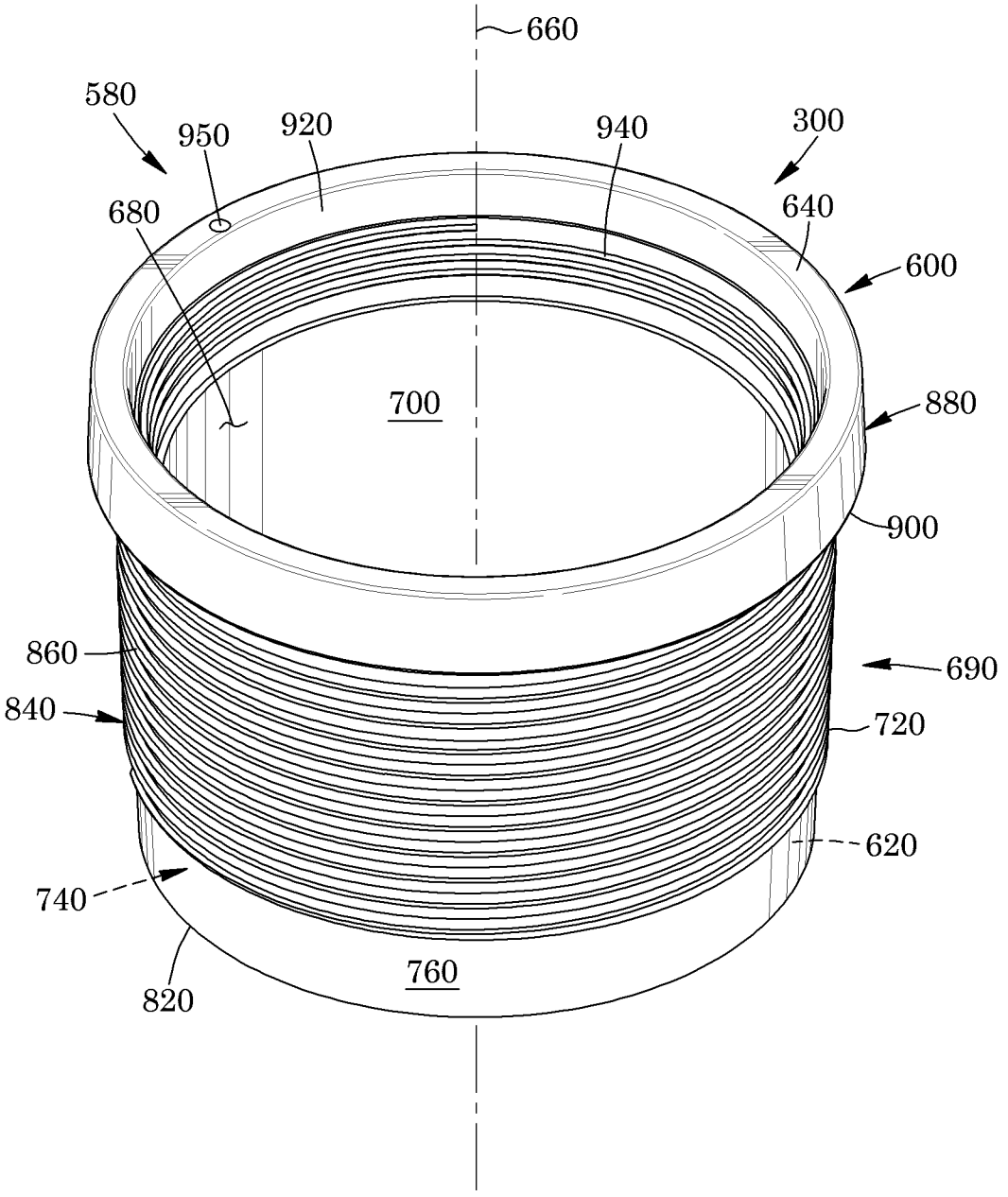



FIG. 21

Date Reçue/Date Received 2022-02-03

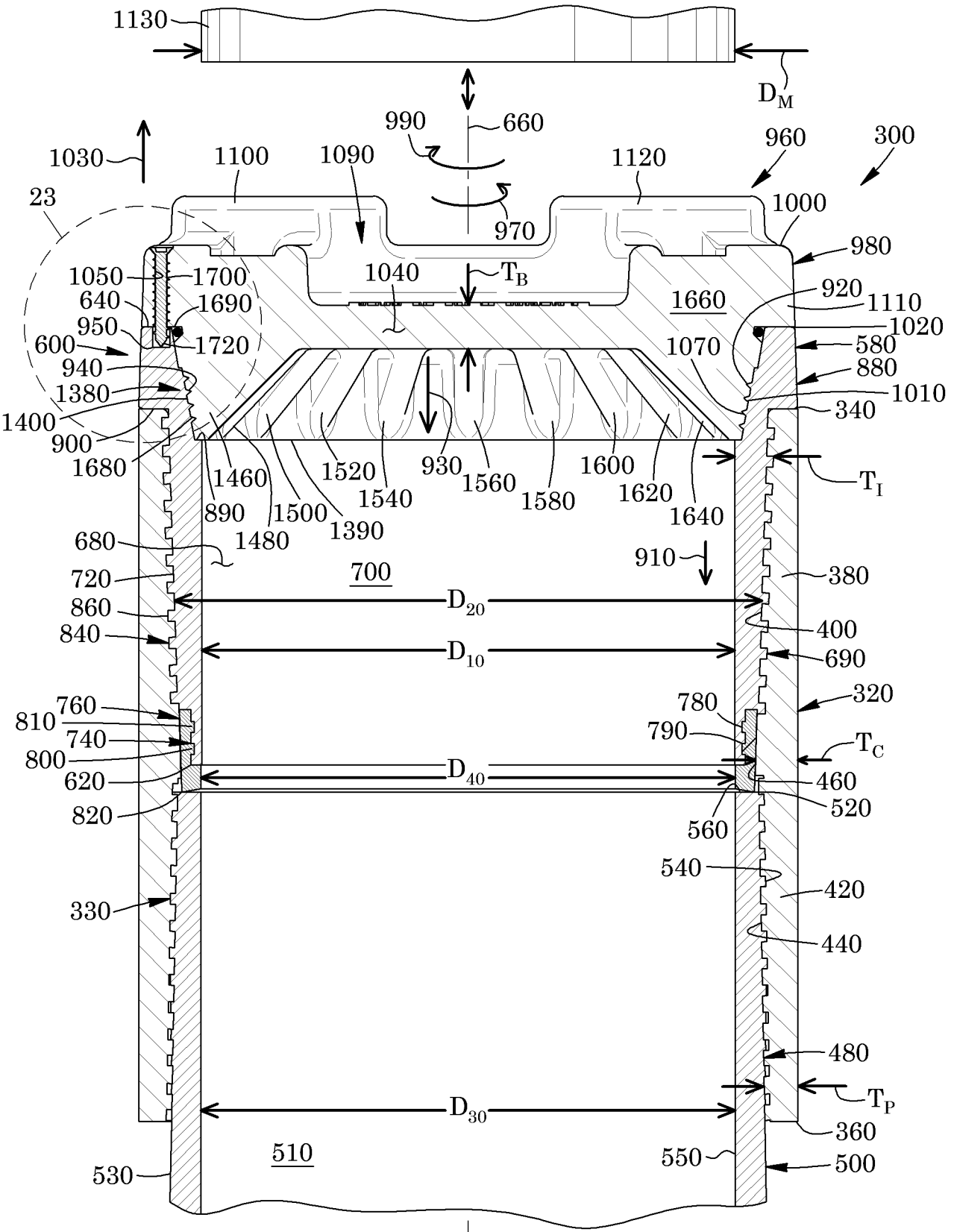



FIG. 22

Date Reçue/Date Received 2022-02-03

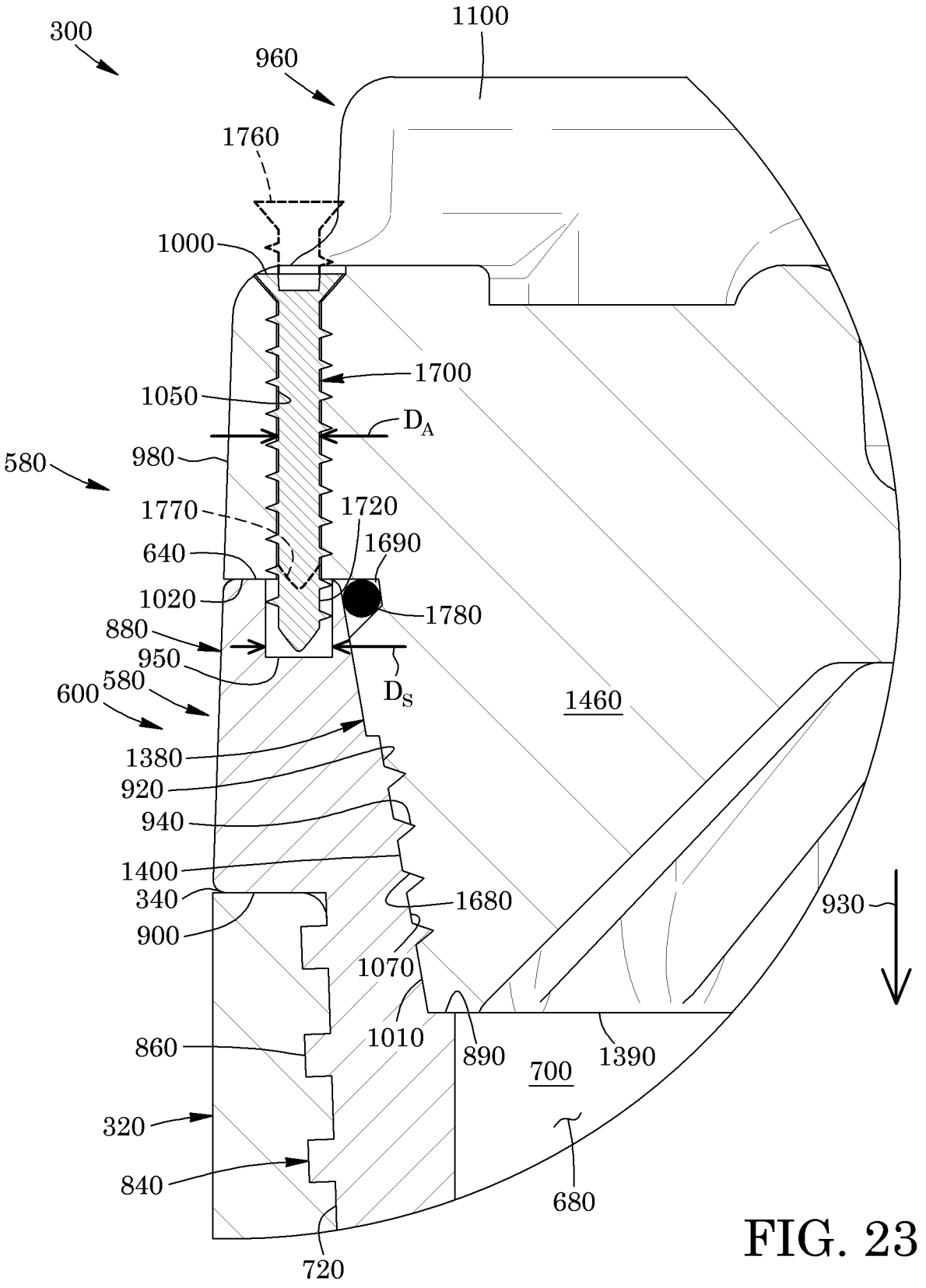



FIG. 23

Date Reçue/Date Received 2022-02-03

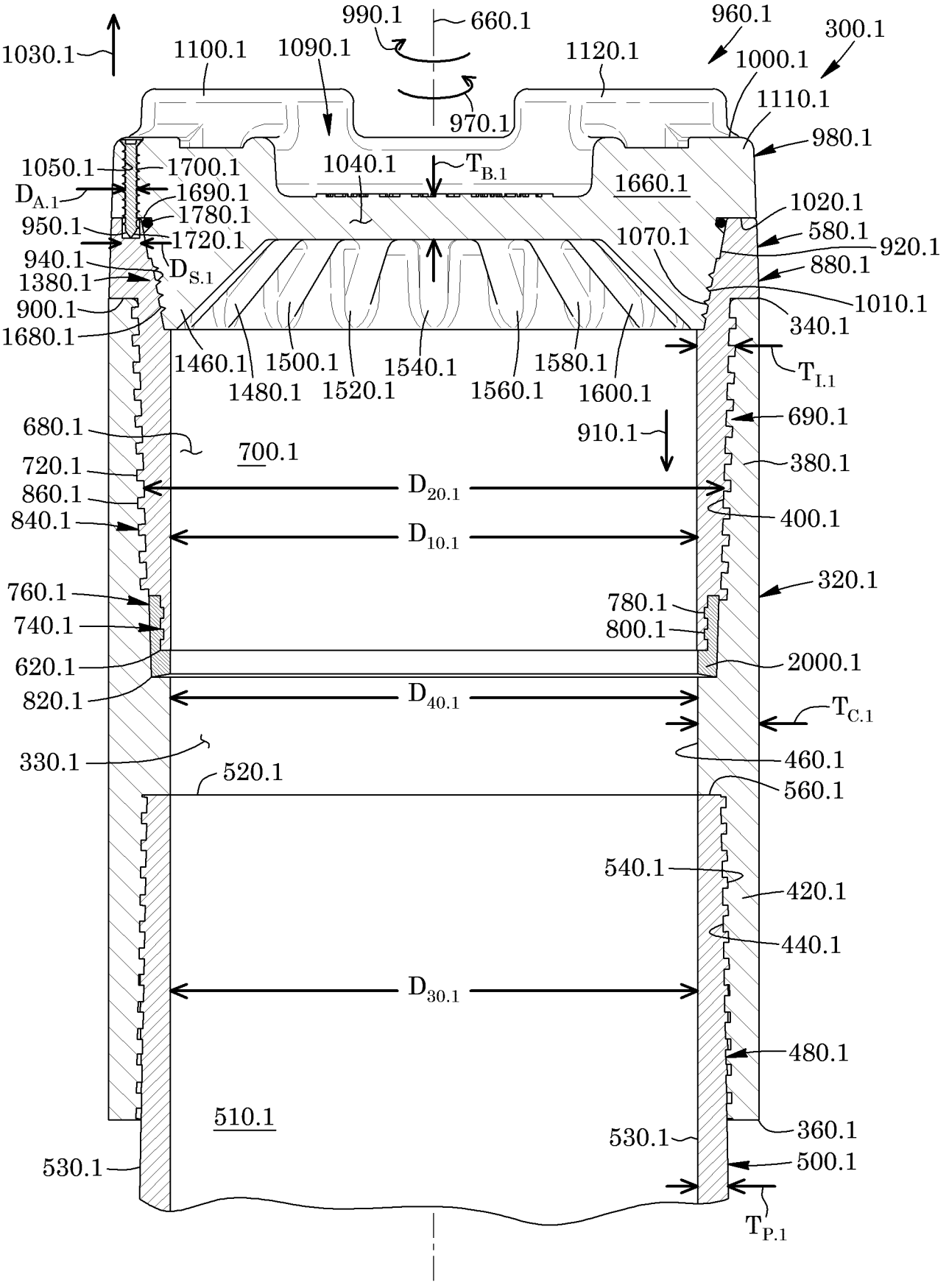



FIG. 24

Date Reçue/Date Received 2022-02-03

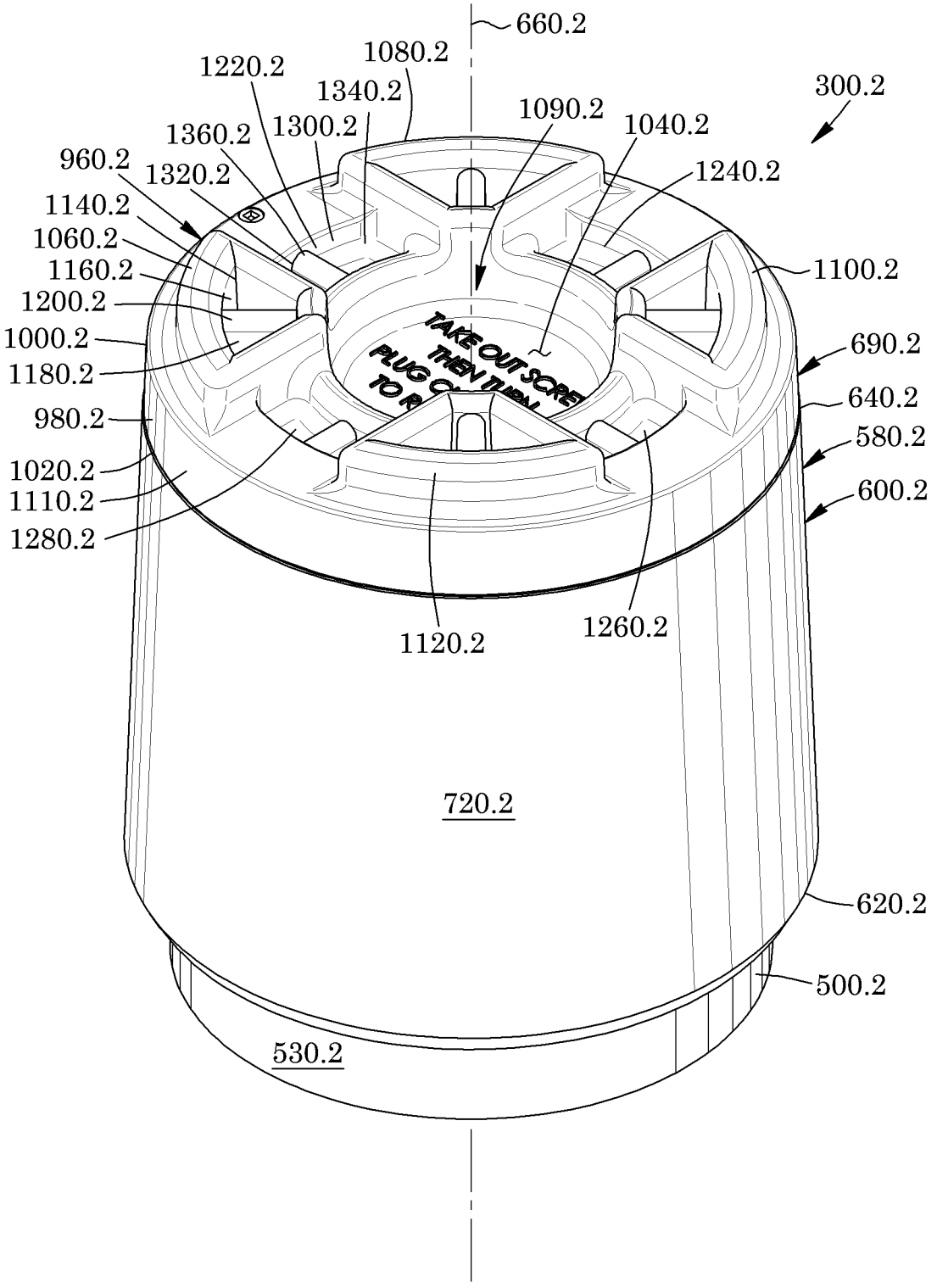



FIG. 25

Date Reçue/Date Received 2022-02-03

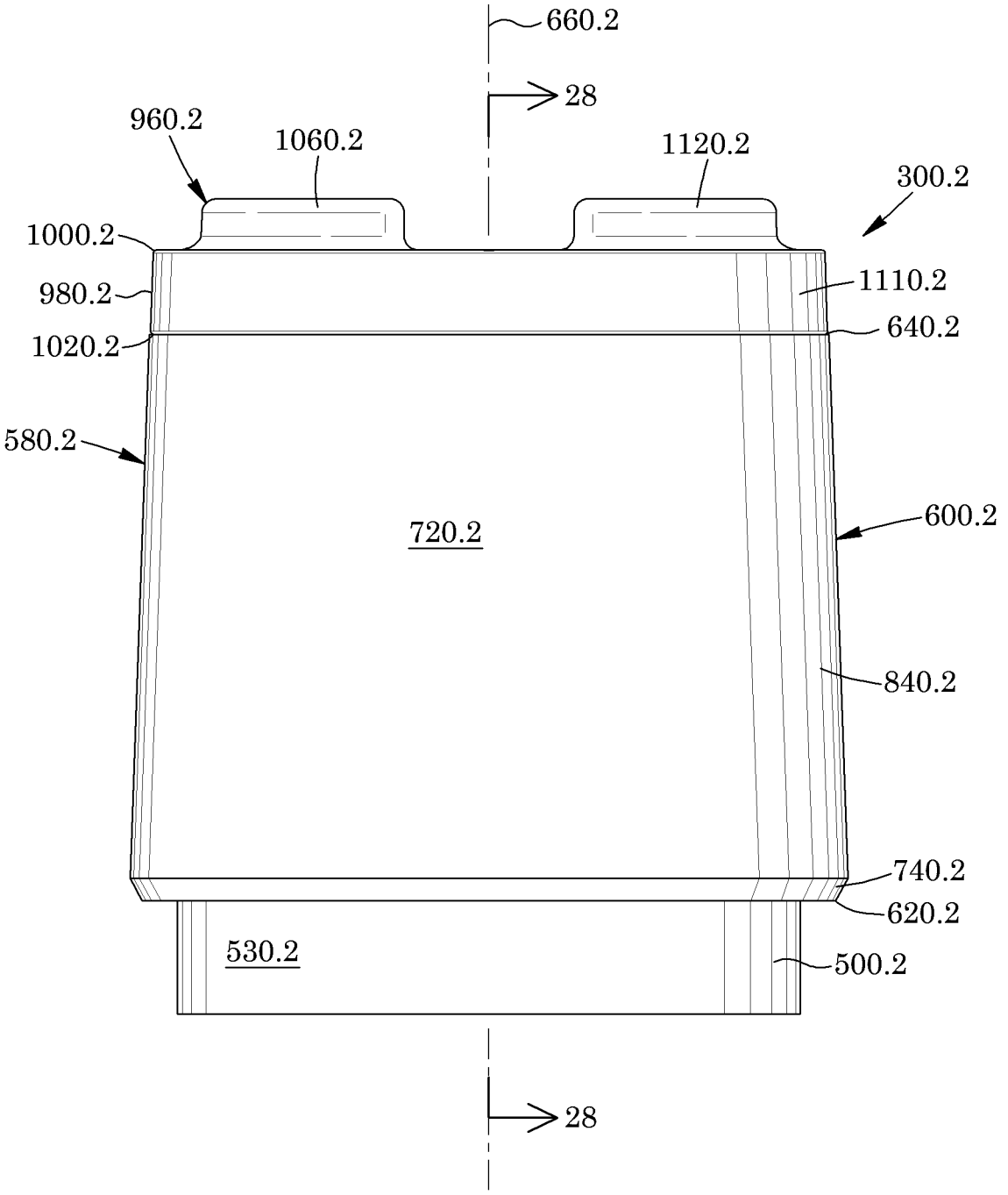



FIG. 26

Date Reçue/Date Received 2022-02-03

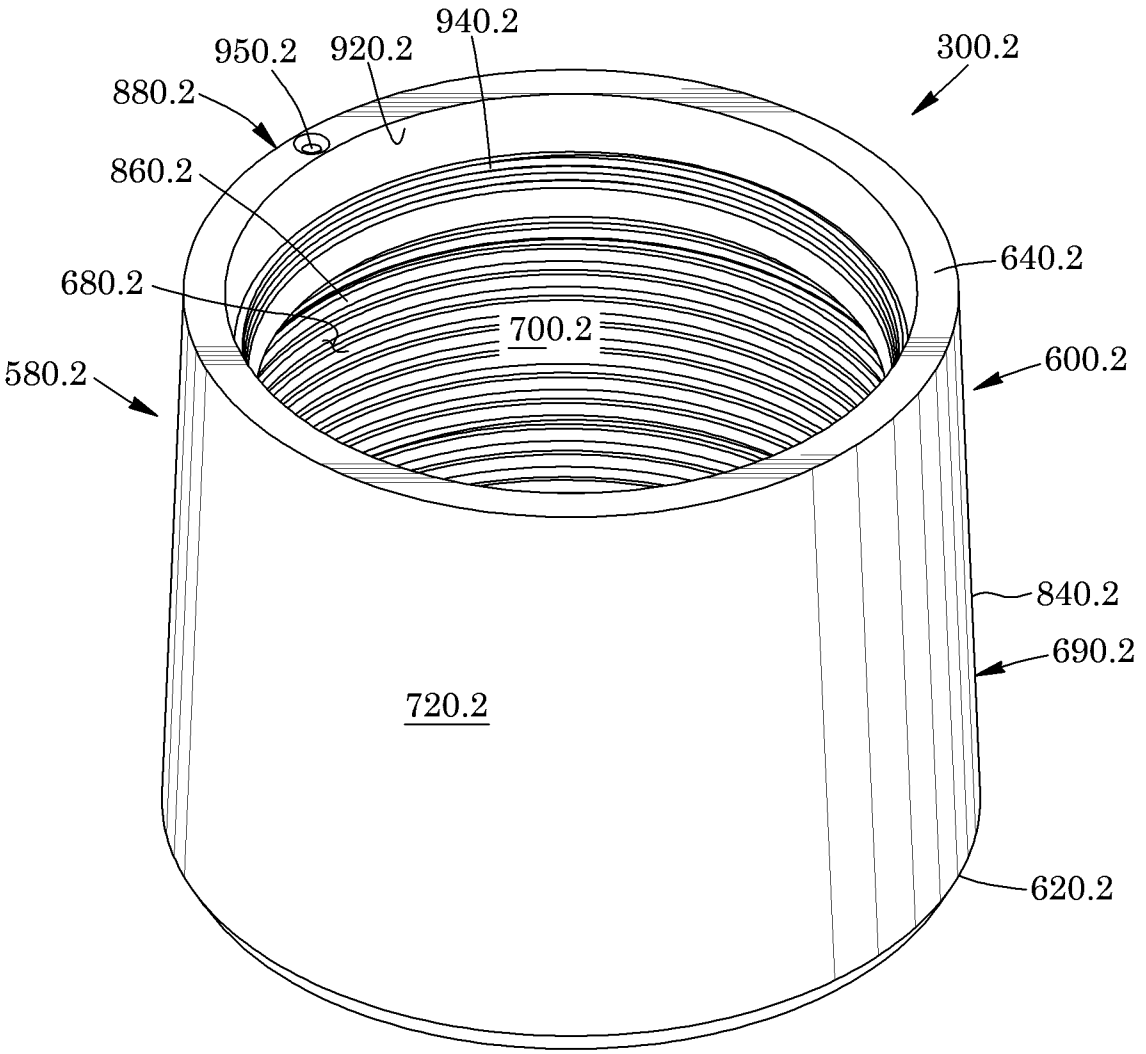



FIG. 27

Date Reçue/Date Received 2022-02-03

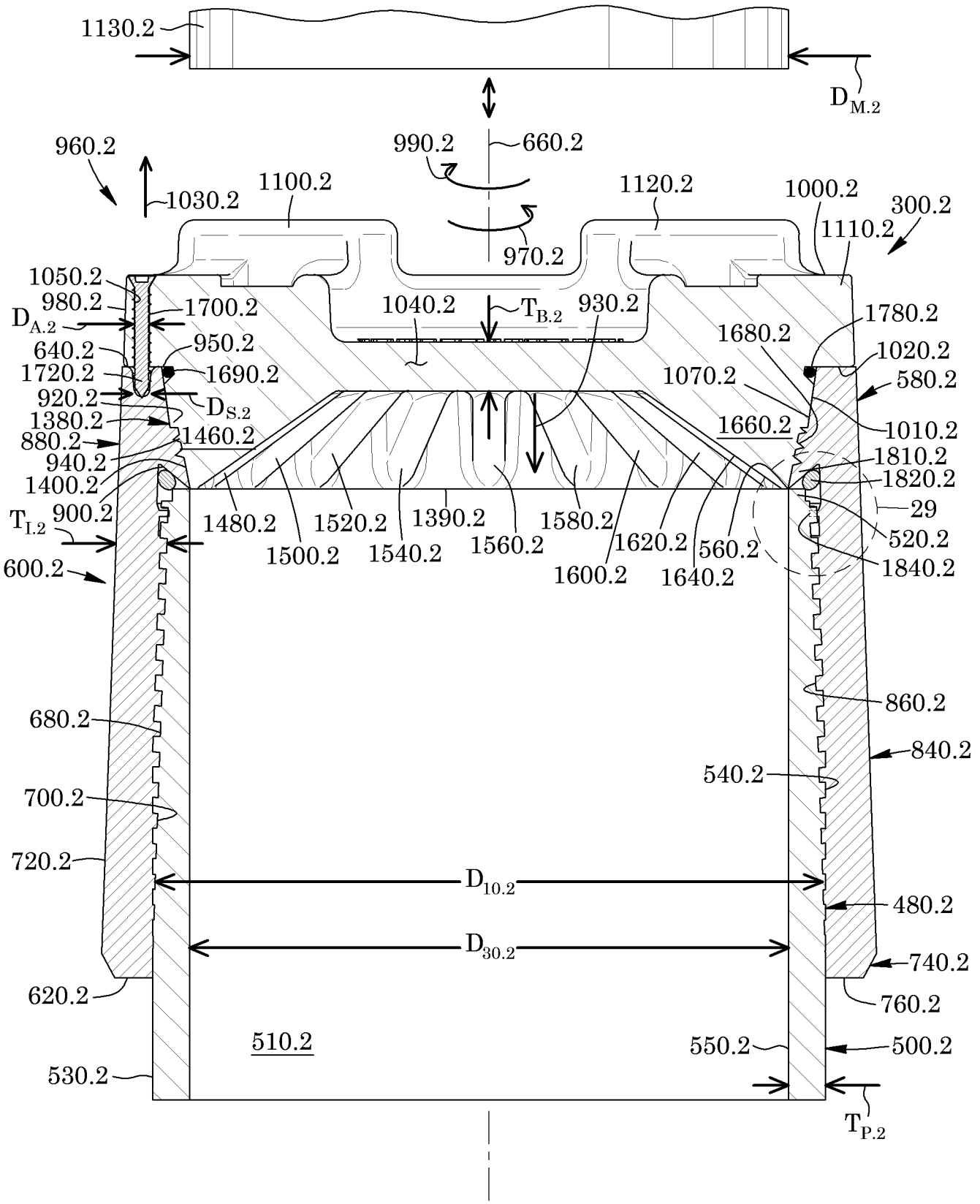



FIG. 28

Date Reçue/Date Received 2022-02-03

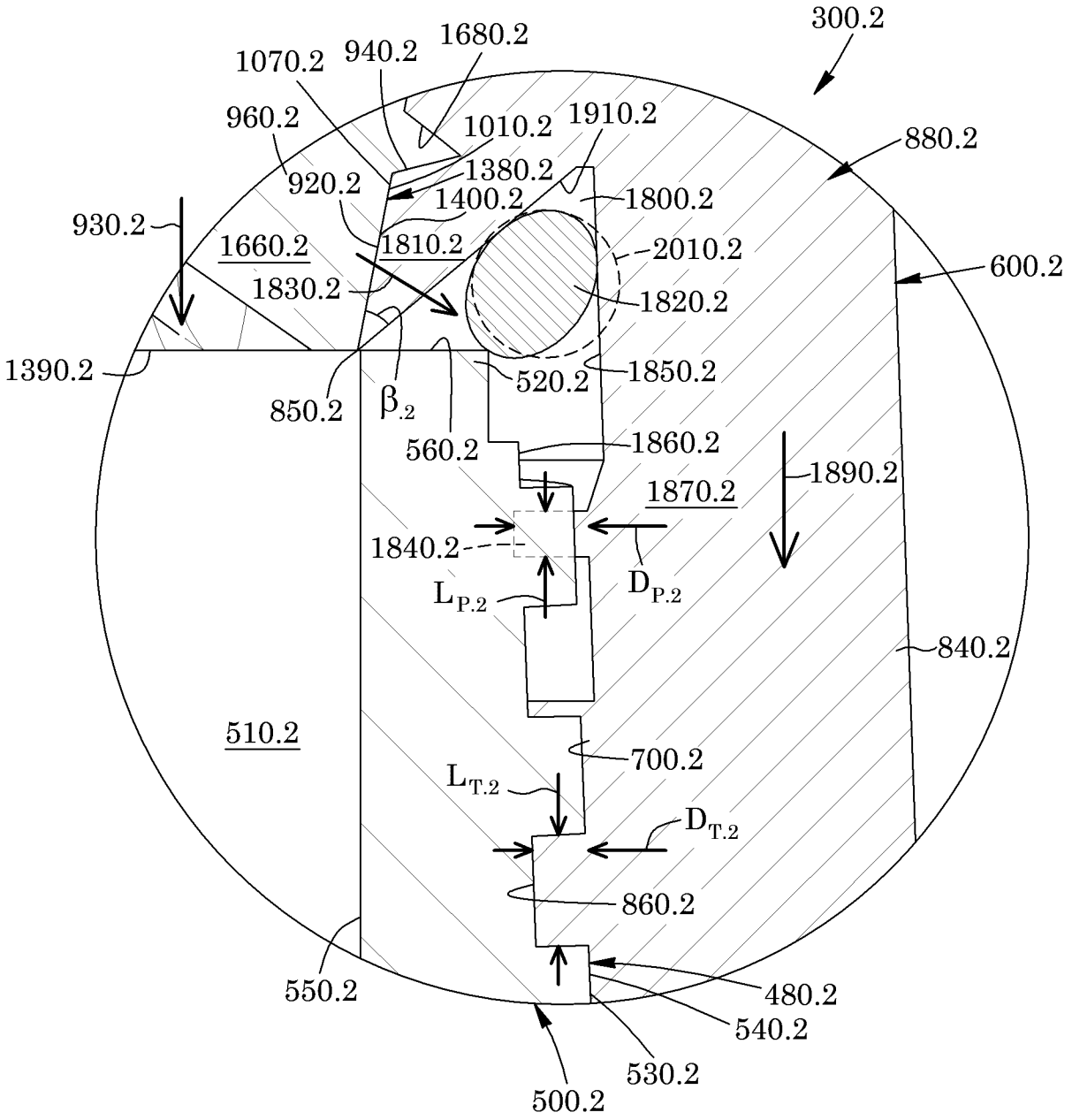



FIG. 29

Date Reçue/Date Received 2022-02-03

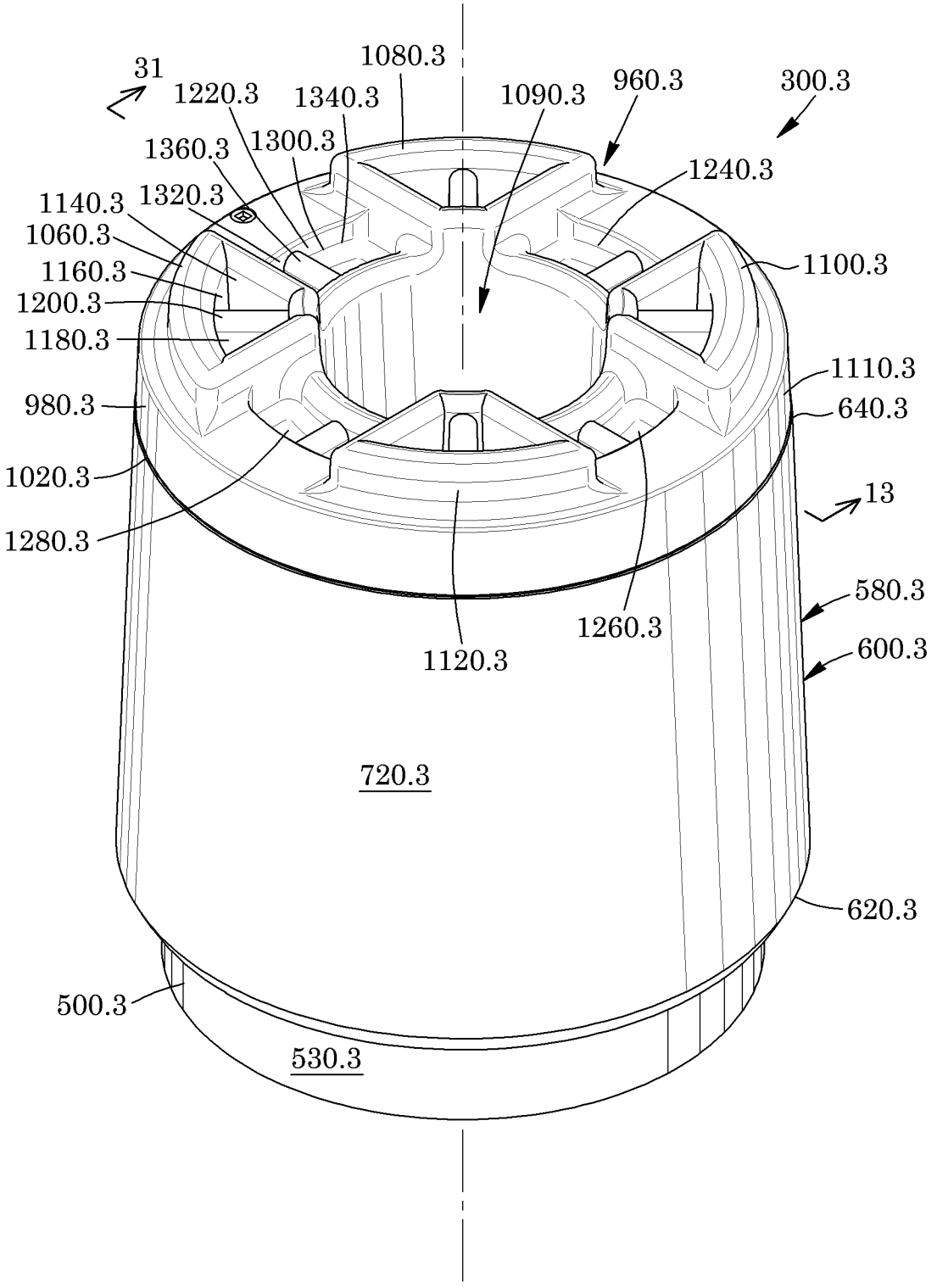



FIG. 30

Date Reçue/Date Received 2022-02-03

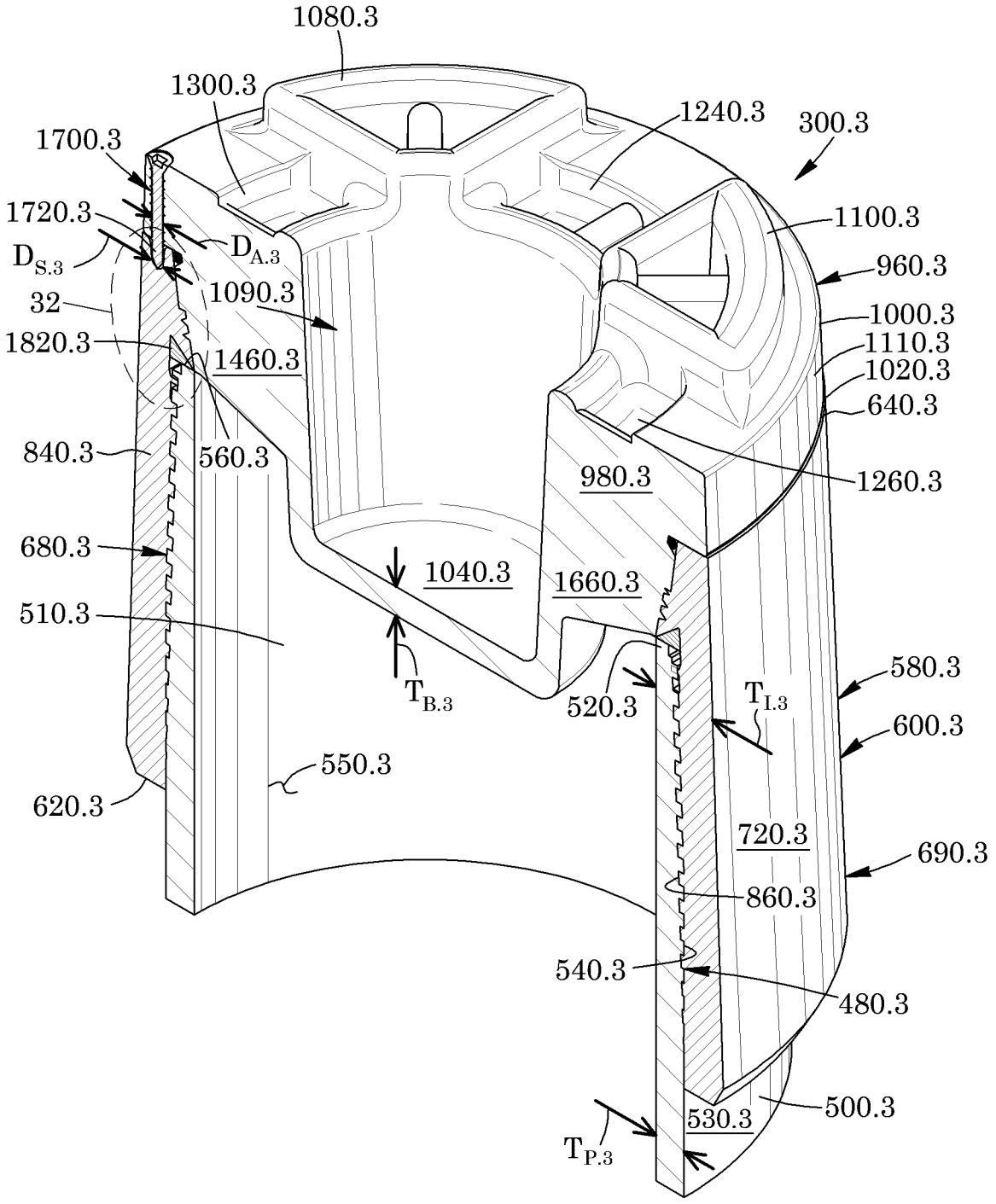



FIG. 31

Date Reçue/Date Received 2022-02-03

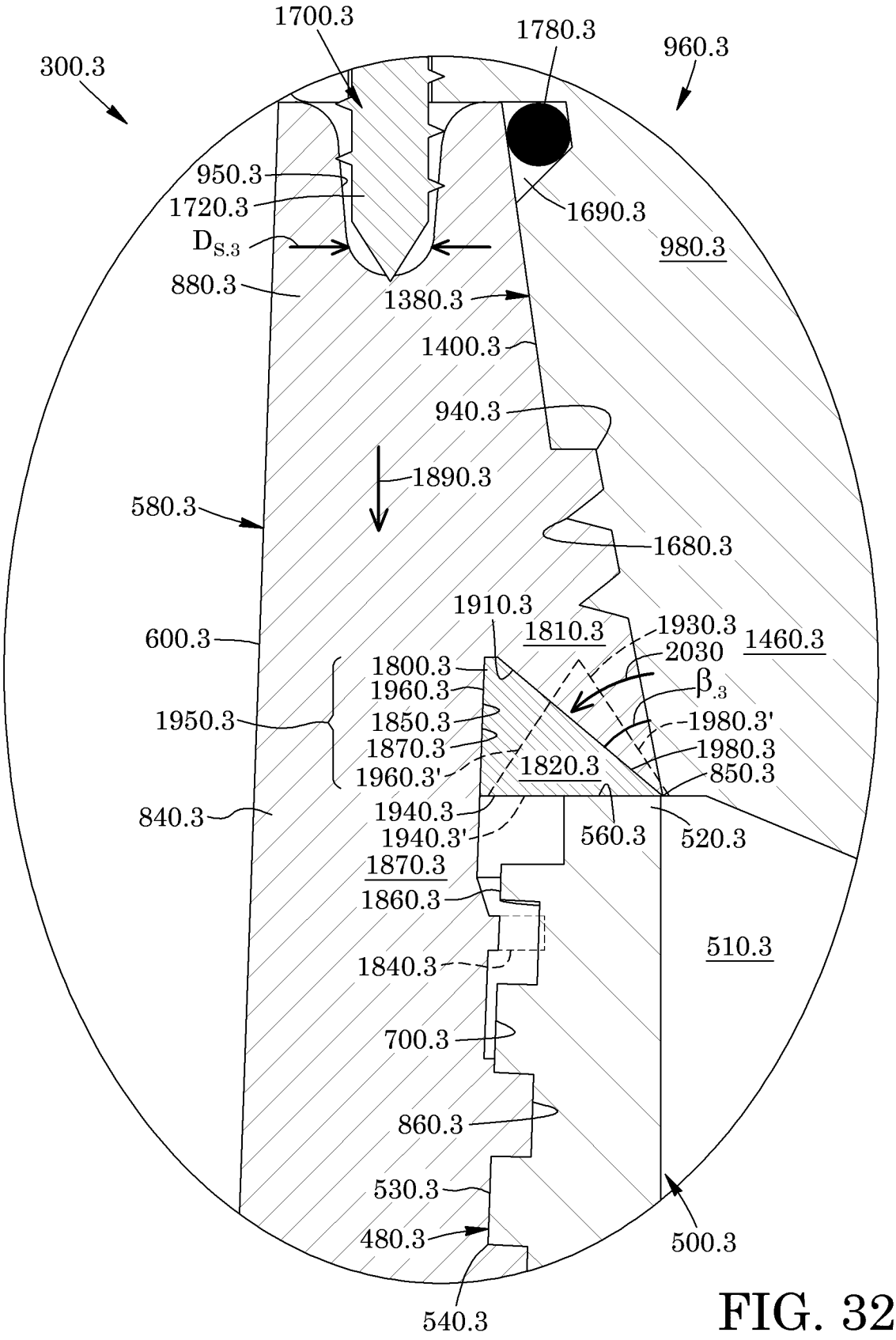



FIG. 32

Date Reçue/Date Received 2022-02-03

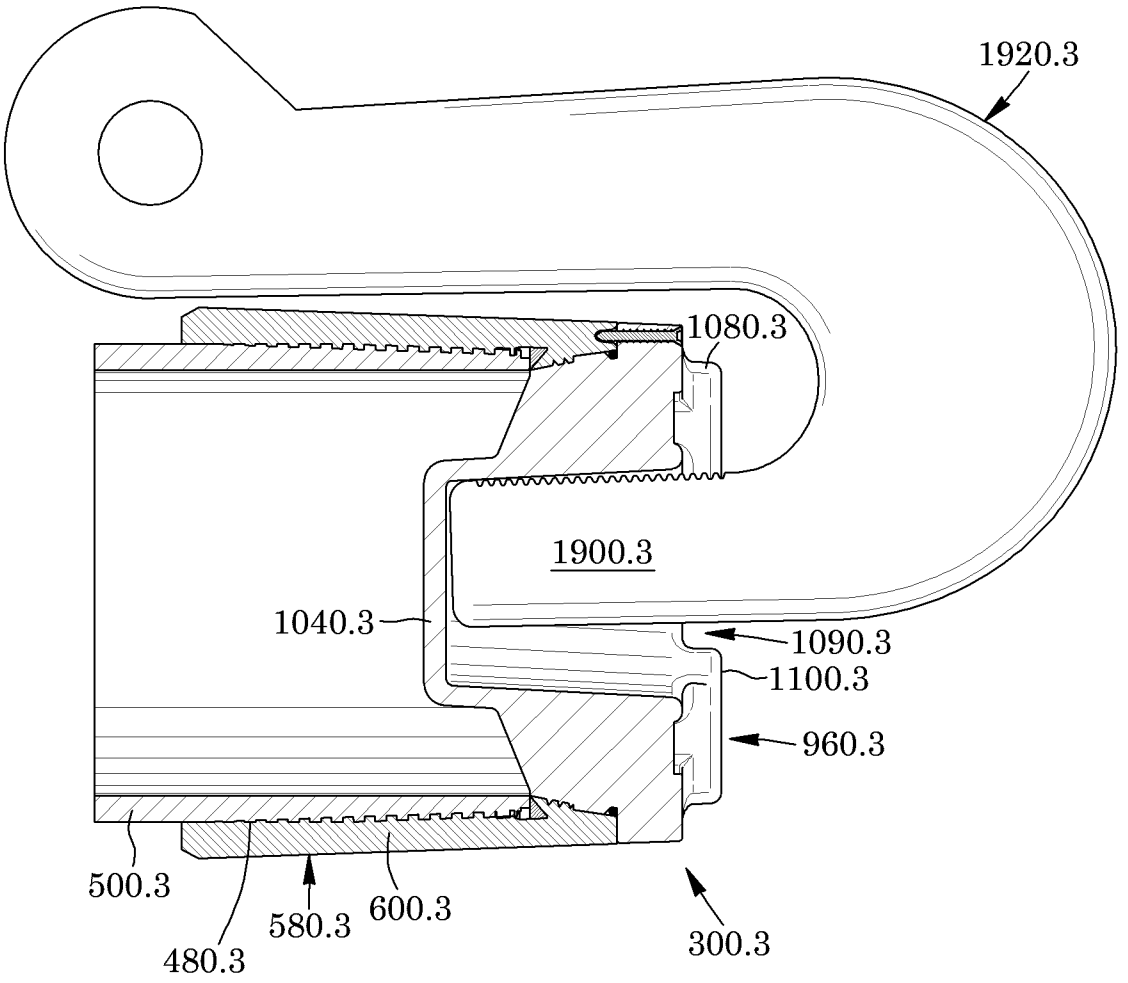
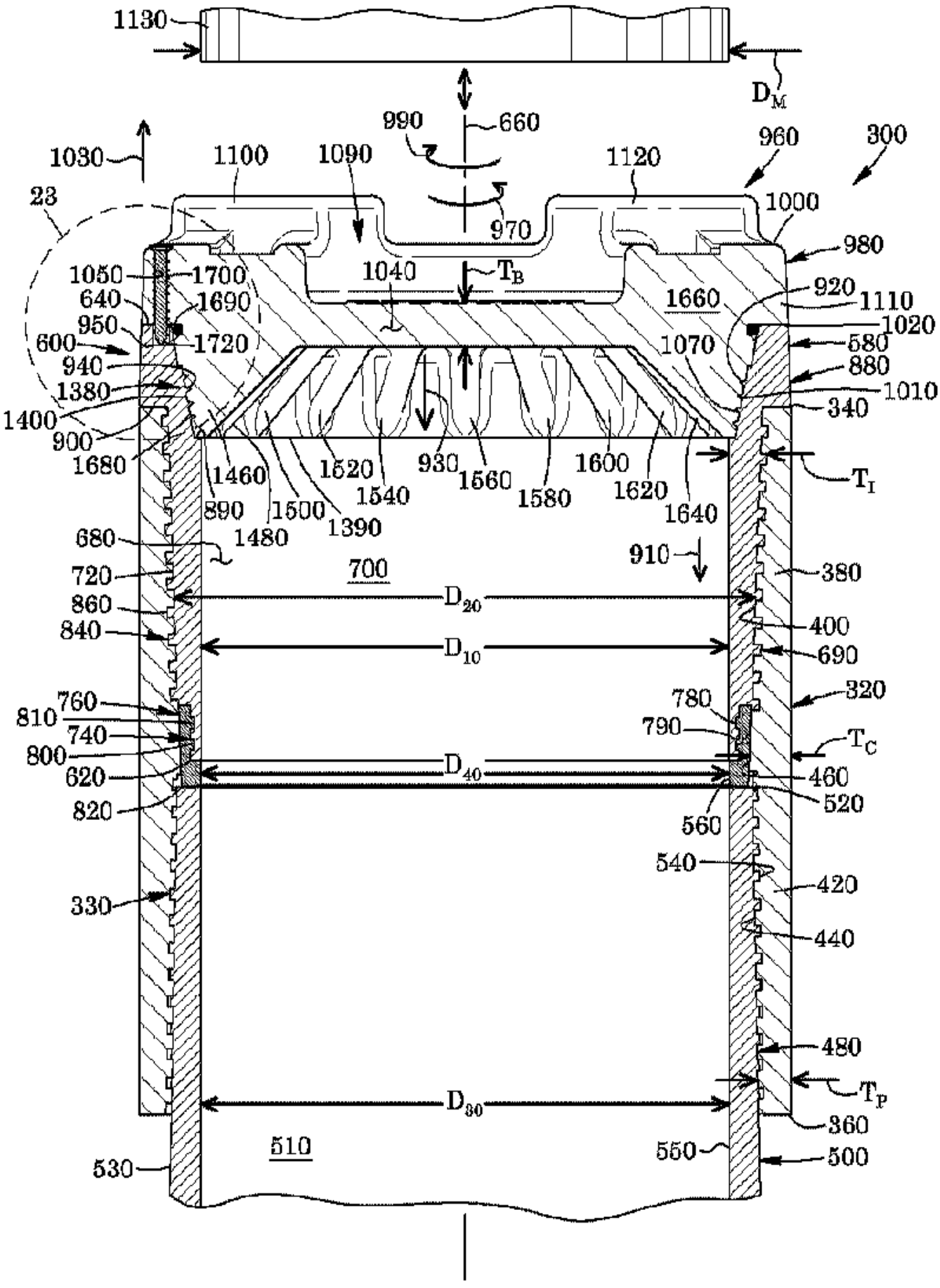



FIG. 33

Date Reçue/Date Received 2022-02-03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