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Canadian Intellectual Property Office

CA 2977581 A1 2018/03/02

(21) 2 977 581

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2017/08/29

(41) Mise à la disp. pub./Open to Public Insp.: 2018/03/02

(30) Priorités/Priorities: 2016/09/02 (US62/383,001); 2017/08/25 (US15/687,106)

(51) Cl.Int./Int.Cl. *F16L 47/22* (2006.01), *F16L 47/00* (2006.01)

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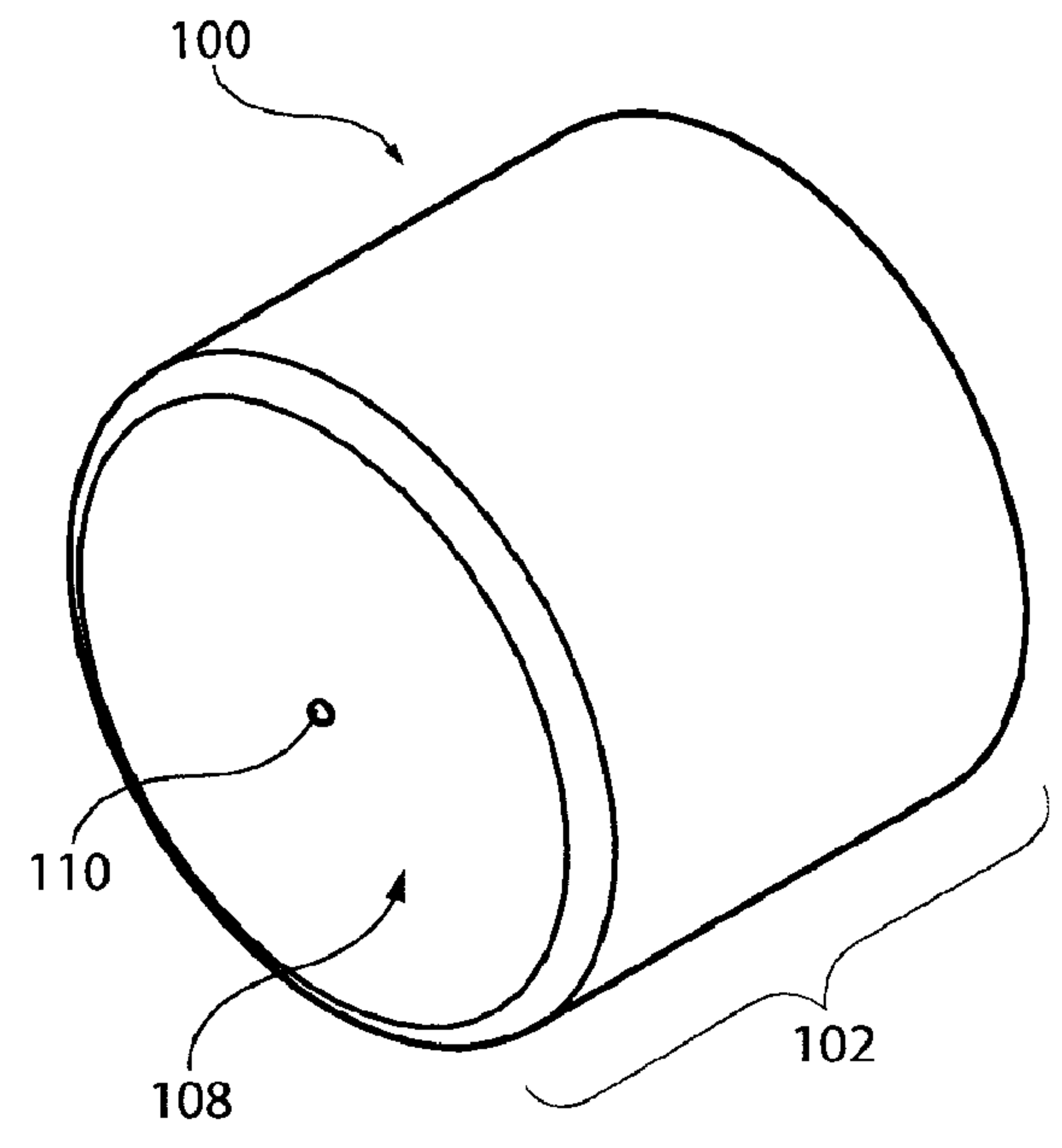
(54) Titre : COLLIER DE COMPRESSION A DILATATION A FROID MOULE PAR INJECTION
(54) Title: INJECTION MOLDED COLD-EXPANSION COMPRESSION COLLAR



A

(57) Abrégé/Abstract:
A compression collar is manufactured for use in reinforcing an interference fit between an end of a pipe and a fitting. A precursor form is injection molded using a cold-expansion material. The precursor form has a tubular body with an initially closed axial end

(57) Abrégé(suite)/Abstract(continued):
and a bore that is initially blind formed in the other axial end. Material is removed from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end that connects to the bore thereby forming the compression collar. The opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore. The collar formed may lack knitlines and may include tabs formed during the removal step which help to position the collar on a pipe.

ABSTRACT

A compression collar is manufactured for use in reinforcing an interference fit between an end of a pipe and a fitting. A precursor form is injection molded using a cold-expansion material. The precursor form has a tubular body with an initially closed axial end and a bore that is initially blind formed in the other axial end. Material is removed from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end that connects to the bore thereby forming the compression collar. The opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore. The collar formed may lack knitlines and may include tabs formed during the removal step which help to position the collar on a pipe.

INJECTION MOLDED COLD-EXPANSION COMPRESSION COLLAR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/383,001 entitled "Injection Molded Cold-Expansion Compression Collar" filed September 2, 2016, the contents of which are incorporated by reference herein in its entirety for all purposes.

STATEMENT OF FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND

[0003] This disclosure relates, in general, to improvements in cold-expansion compression collars or reinforcing rings for making leak-free tube connections. More particularly, this disclosure relates to a method for making compression collars for cold-expansion tubing connections, such as in piping made from polyolefin, polyethylene, cross-linked polyethylene, PEX-a, PEX-b, PEX-c, PERT, or any other similar material.

[0004] Cold-expansion tubing has been used in plumbing applications for decades in Europe and now increasingly in the United States. The principle behind its operation is to manufacture a hollow, tubular material and imbue it with shape memory properties (e.g., through cross-linking, irradiation, steam, etc.) such that when the tubing is stretched or deformed, the tubing returns to the shape set in its memory during the manufacturing process. In use, cold-expansion tubing can be widened or belled at its end and allowed to shrink back to its original shape after mere moments at room temperature. The elastic forces within the cold-expansion tubing material can be applied to any object that interferes with the cold-expansion tubing as it returns to its original shape. Thus, cold-expansion tubing can form interference fits or joints with fittings, other piping, etc.

[0005] It is known in the state of the art that such a cold expansion fitting connection between a pipe and a fitting may be further strengthen by placing a compression collar around the end of the pipe or tubing prior to cold expansion. See e.g., U.S. Patent No. 5,735,554. By forming both the compression collar and the pipe from a cold-expansion material and by placing the compression collar at the axial end of the pipe, both the collar and pipe can be expanded simultaneously, moved over a fitting, and then allowed to return to substantially the same size and shape at room temperature. The addition of compression collar provides additional compressive forces beyond that of just the pipe to create a better seal for the connection and reinforces the interference fit between the pipe and the fitting over which the pipe is received.

[0006] However, more so than just the pipe, the compressive collar is subjected to high loads under elastic deformation. Thus, there is a need to attempt to develop compressive collars having more robust structure and increased strength.

SUMMARY

[0007] The present disclosure is directed to an improved method of manufacturing compression collars or reinforcing rings for a cold-expansion joining system using injection molding. While injection molding has been used to produce compression collars (see e.g., U.S. Patent Application Publication No. 2008/0315579), such conventional injection molding has been known to introduce knitlines. Knitlines are lines within the injection molded part, often not visible by the naked eye, at which two fronts of material have flowed together during the injection molding process. Such knitlines form weak regions which are more prone to failure than otherwise homogeneous areas of the injection molded collar. To reinforce these lines of inherent weakness, it has been proposed to thicken the wall at the knitlines. See again, U.S. Patent Application Publication No. 2008/0315579.

[0008] Disclosed herein is a method of eliminating knitlines altogether in an injection molded compression collar. This elimination of knitlines has the clear advantage of strengthening the part (in comparison to a component having a similar geometry, but with knitlines) and further has the advantage of eliminating thick wall sections which has been proposed by others, thereby reducing material.

[0009] To mold a compression collar without knitlines, a continuous gate is utilized at the axial end of a precursor form from which the compression collar will be formed. As such, the injected material flows from the point or points of injection on the axial end, radially outward to the cylindrical walls, and then down the cylindrical walls without the injected material ever flowing into itself. Thus, this continuous gate initially forms a solid wall or capped end at one axial end of the collar which would otherwise be a substantially hollow cylinder. Once the precursor form is injection molded, the excess gate material is removed from the axial end. The removal of excess gate material can be accomplished, for example, through a trimming or punching operation. While it is possible to remove the gate entirely, in some preferred forms, some amount of the axial end wall remains to function as positioning stops or tabs thereby providing a locating mechanism for the compression collar when placed on the end of the piping.

[0010] According to one aspect, a method is disclosed for manufacturing a compression collar for reinforcing an interference fit between an end of a pipe and a fitting. A precursor form is injection molded using a cold-expansion material, in which the precursor form comprises a tubular body with an initially closed axial end and a bore that is initially blind formed in the other axial end. Material is removed from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end that connects to the bore thereby forming the compression collar. The opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore.

[0011] In many forms, the cold-expansion material may be one or more of a polyolefin, cross-linked polyolefin, polyethylene, cross-linked polyethylene, PEX, PEX-a, PEX-b, PEX-c, and PERT.

[0012] In some forms, because of the manner of injection molding and removed material, the compression collar may include no knitlines. It is contemplated that the injection point(s) may be located at the initially closed axial end, for example at the central axis, such that the injected material flows radially outward along the initially closed end and then axially downward along the tubular sidewalls, such that the front of the injected material never substantially flows into itself to form a knitline. In some forms, the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening may involves removing any injection points on the precursor form used in the step of injection molding the precursor form.

[0013] Although various ways of removing material from the initially closed axial are contemplated, in some forms the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end may involve punching.

[0014] In some forms, the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end may form one or more positioning tabs in the inner periphery of the opening. Such position tabs might be useful to position the compression collar on the end of the pipe on which it will be received so that the collar is not, for example, slid past the axial end of the pipe. If there are multiple positioning tabs, then those tabs may be located at even intervals around the inner periphery.

[0015] It is contemplated that, in some forms, the opening may have an inner periphery with a profile in axial cross section that matches, in part, an adjacent profile in axial cross section of an inner periphery of the bore with a non-matching part of the profiles providing at least one positioning tab in the inner periphery of the opening.

[0016] In some forms, the compression collar may further include a supporting extension or "tail" on the axial end of the compression collar opposite the axial end having the opening that is removed. Such a supporting extension may be configured to reinforce a thinned section of the pipe past the fitting. The supporting extension may have different shapes. For example, in some forms, the supporting extension mat tapers as it extends away from the opening (meaning that the wall thickness decreases). In some other forms, the supporting extension may have a relatively constant wall thickness, although this wall thickness may still be less than the wall thickness of the main portion of the compression collar.

[0017] In some forms, the method may further involve, during injection molding, forming flat surfaces on the inner periphery of the bore of the compression collar that are parallel to a central axis of the compression collar. These flat surfaces may be configured to be tangent to a radially-outward facing surface of the pipe around which the compression collar will be received during its attachment to the end of the pipe in forming a connection.

[0018] In some forms, the method may further include forming a chamfered edge or a curved corner with a radius of curvature in the bore at the axial end of the bore that is opposite the axial end in which opening is removed.

[0019] According to another aspect, a compression collar is disclosed for reinforcing an interference fit between an end of a pipe and a fitting. The compression collar includes a tubular body formed by injection molding a cold-expansion material in which the tubular body has a bore extending axially therethrough and a removed opening on one initially-closed axial end of the tubular body in which the removed opening connects to the bore. The opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore.

[0020] In some forms, the cold-expansion material may be one or more of a polyolefin, cross-linked polyolefin, polyethylene, cross-linked polyethylene, PEX, PEX-a, PEX-b, PEX-c, and PERT.

[0021] In some forms, the compression collar includes no knitlines and no residual injection points from injection molding.

[0022] In some forms, the compression collar may further include flat surfaces on the inner periphery of the bore that are parallel to a central axis of the compression collar such that the flat surfaces are configured to be tangent to a radially-outward facing surface of the pipe around which the compression collar is to be received. In some forms, the removed opening may include positioning tabs and there may be as many flat surfaces on the inner periphery as there are positioning tabs.

[0023] In some forms, the compression collar may further include a supporting extension or "tail" on the axial end of the compression collar opposite the axial end having the opening that is removed. Such a supporting extension may be configured to reinforce a thinned section of the pipe past the fitting. The supporting extension may have different shapes. For example, in some forms, the supporting extension mat tapers as it extends away from the opening (meaning that the wall thickness decreases). In some other forms, the supporting extension may have a relatively constant wall thickness, although this wall thickness may still be less than the wall thickness of the main portion of the compression collar.

[0024] In some forms, the compression collar may further include a chamfered edge or a curved corner with a radius of curvature in the bore at the axial end of the bore that is opposite the removed opening.

[0025] In some forms of the compression collar, the inner periphery of the removed opening includes one or more positioning tabs in which the positioning tab(s) is/are configured to axially position the compression collar on an end of a pipe.

[0026] In some forms, the removed opening may have an inner periphery with a profile in axial cross section that matches, in part, an adjacent profile in axial cross section of an inner periphery of the bore and with a non-matching part of the profiles defining one or more positioning tabs in the inner periphery of the removed opening.

[0027] These and still other advantages of the invention will be apparent from the detailed description and drawings. What follows is merely a description of some preferred embodiments of the present invention. To assess the full scope of the invention the claims should be looked to as these preferred embodiments are not intended to be the only embodiments within the scope of the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIG. 1A is a perspective view of a precursor form with a closed end from injection molding that is further manufactured into a collar.

[0029] FIG. 1B is a side plan view of the precursor form of FIG. 1A.

[0030] FIG. 1C is a cross-sectional side view of the precursor form of FIG. 1A taken through line 1C-1C of FIG. 1B.

[0031] FIG. 2A is a perspective view of the compression collar form from the precursor form of FIGS. 1A-1C after a material removing operation.

[0032] FIG. 2B is a side plan view of the compression collar of FIGS. 2A.

[0033] FIG. 2C is a front axial plan view of the compression collar of FIGS. 2A.

[0034] FIG. 3A is a perspective view of a connection made using another compression collar, after the collar has been put on the end of a pipe, the pipe and collar have been cold expanded and placed over a fitting, and the pipe and collar have compressed around the fitting to form a seal.

[0035] FIG. 3B is a plan side of the connection of FIG. 3A.

[0036] FIG. 3C is a front axial end plan view of the connection of FIG. 3A.

[0037] FIG. 3D is a cross-sectional side view of the connection of FIG. 3A, taken through line 3D-3D of FIG. 3C.

[0038] FIG. 4A is a perspective view of yet another compression collar in which the central bore has flats.

[0039] FIG. 4B is a front axial end plan view of the collar of FIG. 4A.

[0040] FIG. 4C is a cross-sectional side view of the compression collar of FIG. 4A, in which the section is taken through line 4C-4C of FIG. 4B.

[0041] FIG. 4D is a side plan view of the compression collar of FIG. 1A.

[0042] FIG. 4E is a rear axial end plan view of the collar in FIG. 4A.

[0043] FIG. 4F is a detailed view of the compression collar of FIG. 4A taken in area 4F-4F of FIG. 4E, looking into the rear bore end to further impress the positioning of the flat relative to the positioning tab.

DETAILED DESCRIPTION

[0044] FIGS. 1A-1C show one example embodiment of a precursor form 100 which is further processed to form a compression collar 200 which may also be referred to as a reinforcing ring. It is noted that similar features between the precursor form 100 and the collar 200 (which is effectively a further manufactured form of the precursor form 100) will have similar reference numbers, except that the leading "1" or "2" will be alter the reference numbers from the 100 series to the 200 series.

[0045] Looking first at FIGS. 1A-1C, the precursor form 100 is shown as it has been injection molded. The precursor form 100 may be formed from cold-expansion material comprising polyolefin, cross-linked polyolefin, polyethylene, cross-linked polyethylene, PEX, PEX-a, PEX-b, PEX-c, PERT, and/or any other material exhibiting memory properties such that at room temperature the material may be stretched and immediately or shortly thereafter allowed to shrink back down to the material's previous shape before the stretching operation. Materials with this property may be advantageously used in creating interference or frictional fits or joints because of the forces exerted by the material on any object, which is larger than the material's normal shape, and over which the material is stretched, placed, and allowed to shrink. Thus, depending on the amount of stretching and the thickness of the material, strong squeezing forces exerted by the material on an object may cause the object to remain in place and resist becoming dislodged by other forces. Additionally, the high elongation before break or flexibility of the material allows for elastic stretching rather than cracking or tearing.

[0046] The precursor form 100 may have an overall tubular shape with a cylindrical bore formed through one end of the cylindrical shape with an initially closed axial end 108 at the opposing end, having been injection molded with an axial length 102, an inner diameter 104, and an outer diameter 106. This makes the bore initially a blind bore. The cylindrical bore of the precursor form 100 is formed in the one end of the cylindrical shape that will be slid over the end of a section of pipe in use. In order to facilitate sliding the final collar 200 over the pipe, an end chamfer 120 (as illustrated in FIGS. 2B and 2C) may be formed at the opened axial end of the bore of the precursor preform 100. Alternatively, the end chamfer 120 may be formed as a curved corner having a certain radius of curvature. The radius of curvature may vary. The closed axial end 108 is located at the axial opposing end of the precursor form 100 which corresponds to the axial end that will be arranged closest to the end of the piping in use.

[0047] The desired axial length 102 of the precursor form 100 may be based on the inner and outer diameters 104, 106 and/or the intended use of the compression collar 200 manufactured from the precursor form 100. For example, the inner diameter 104 of the precursor form 100 may range from about a 1/4" to about 6" in order to just fit or slide over the outer diameter of standard cold-expansion pipe for residential or commercial applications. Additionally, the compression collar 200 resulting fabricated from the precursor form 100 may be certified under the ASTM F1960 standard and may be used with standard manual pipe expanders or even automatic expander power tools, such as the M12™ 12V Cordless Lithium-Ion ProPEX® Expansion Tool by Milwaukee Electric Tool®, for example.

[0048] The formation of the closed axial end or continuous gate 108 at the end of the precursor form 100 during injection molding may be facilitated by using a fan gate or other similar gate, such as a sprue gate or submarine gate, for example. A fan gate injection point 110 is preferably located at the center of the closed end 108 corresponding with the central axis of the precursor form 100. The mold for the precursor form 100 of the compression collar 200 may be arranged such that the closed end 108 is located at the top. In this way, the injection molding material flowing through the central gate injection point 110 has a single front that flows radially outward and then substantially uniformly down and around the whole mold to fill in the tubular-shaped sidewall of the precursor form 100. Because there is only one material front flowing around and down into the mold, no knitlines are formed where the flowing materials meet. This advantageously eliminates any potential weak points in the final compression collar 200 that may tear when subjected to expanding forces or that may otherwise have to be reinforced.

[0049] After molding, the material comprising the closed axial end 108 of the precursor form 100 is then removed to form an opening (i.e., a removed opening) that is connected to the bore. In order to remove the material from the closed axial end

108 of the precursor form 100, cutting, trimming, punching, or similar known operations may be performed. As a non-limiting example, material may be removed or punched from the initially closed axial end 108 of the precursor form 100 by using a die on a punch press. The die is shaped to match the material to be removed from the closed end 108.

[0050] Rather than remove the closed end 108 material completely, some material may be left to function as positioning tabs or stops 212, as seen in FIGS. 2A-2C. The positioning tabs 212 advantageously position the compression collar 200 on the piping or fitting over which the compression collar 200 is to be placed. Thus, the thickness of the positioning tabs 212 (i.e., the axial thickness of the closed end 108) may be based on the inner diameter 204 and/or the outer diameter 206 of the compression collar 200. Alternatively or additionally, the thickness of the positioning tabs 212 may be based on a thickness and/or outer diameter of the pipe and/or fitting over which the compression collar 200 is to be placed. For example, the positioning tabs 212 may be about 1/96" up to about 1/16" thick for fitting over pipe with a 1/2" outer diameter.

[0051] The positioning tabs 212 may vary in height (measured axially) and are not limited to the embodiment shown in FIGS. 2A-2C. The height of the positioning tabs 212 may be based on the efficiency of the material removal operation and/or the cost of materials. Additionally, the height of the positioning tabs 212 may be based on the nominal inner diameter 204 and/or the outer diameter 206 of the compression collar 200. Alternatively or additionally, the height of the positioning tabs 212 may be based on a thickness and/or outer diameter of the piping and/or fitting over which the compression collar 200 is to be placed.

[0052] Similarly to the height, the shape of the positioning tabs 212 may vary and are not limited to the embodiment shown in

FIGS. 2A-2C. The shape of the positioning tabs 212 may be based on the efficiency of the material removal operation and/or the cost of materials. For example, the positioning tabs 212 may taper to a point moving toward the center of the compression collar 200. As another non-limiting example, the positioning tabs 212 may remain substantially the same width moving toward the center of the compression collar 200. The positioning tabs 212 may each have a different shape and/or alternate shapes. For example, there may be one positioning tab with a tapering shape and the remaining positioning tabs have a more rectangular shape such that the positioning tab with the tapering shape marks one side of the compression collar for orientation, alignment, and/or registration purposes.

[0053] The positioning tabs 212 may vary in width from the embodiment shown in FIGS. 2A-2C. The width of the positioning tabs 212 may be based on the number of positioning tabs 212 to be formed by the material removal operation. For example, a larger width may be employed for a lower number of positioning tabs and/or a smaller width may be employed for a higher number of positioning tabs. The positioning tabs may differ from each other in widths as described above with respect to shape variations of the positioning tabs in the compression collar.

[0054] As an alternative to the plurality of positioning tabs 212, there may be only one positioning tab. The single positioning tab may vary in width from the positioning tabs 212 shown in FIGS. 2A-2C. For example, the single positioning tab may have a width that extends around about a quarter or half of the circumference of the inner bore of the compression collar 200. As another non-limiting example, the single positioning tab may extend around the majority of the circumference of the inner bore of the compression collar.

[0055] FIGS. 3A-3D show a connection 300 formed between another compression collar 400 that has been placed over a pipe 500 which are collectively slid over a fitting 600. Collar 400 is identical to collar 200, except that it further has a supporting extension 422 or "tail." As best seen in FIG. 3D, the compression collar 400 is shown after being placed over the end of a section of pipe 500, being coaxially cold expanded with the pipe 500, being placed over the fitting 600 (i.e., axially slid onto the fitting 600 is a still-expanded condition), and being allowed to shrink back over a fitting 600.

[0056] The compression collar 400 includes positioning tabs 412 as well as a supporting extension 422 that extends beyond a nominal length 406 of the compression collar 400. The supporting extension 422 may taper in wall thickness moving from the region of nominal length 406 toward the end. Alternatively, the supporting extension 422 may maintain the same wall thickness.

[0057] In production, the supporting extension 422 may be incorporated into the compression collar 400 during injection molding, as described above. The combined lengths of the nominal length 406 of the compression collar 400 and the supporting extension 422 may be based on the desired wall thickness and the inner and outer diameters of the compression collar 400, the intended use of the compression collar 400, and/or the type and insertion length of the fitting 600.

[0058] The supporting extension 422 may advantageously provide additional strength and external support for an area 316 of the connection 300 where the pipe 500 meets the axial end of the fitting 600. In this area 316, the wall of the pipe 500 may be stretched or thinned due to the expansion joining process. Thus, providing the compression collar 400 with the supporting extension 220 surrounding this area 316 may reduce the hydrostatic stress in the wall of the pipe 500, increasing the pressure capability of the pipe 500 and bringing the margin of safety for practical applications back up to at least the original design limits. In this way, the compression collar 400 can provide not only extra compressive force at the sealing interface on the fitting 600 to prevent the connection 300 from leaking, but also additional external support for the pipe 500 in the area 316 of potential weakening just beyond the inserted length of the fitting 600.

[0059] FIGS. 4A-4F show yet another exemplary embodiment of a compression collar 700, which is similar to collar 200 (where the reference numbers in the 700 series again correspond to the reference numbers from the 200 series) but in which there are flats 714 form in the radially inward facing surface of the bore. The compression collar 700 may be injection molded and as such is shown after the material removing operation described above with respect to the precursor form 100 and collar 200. The compression collar 700 has an axial length 702, an inner diameter 704, and an outer diameter 706. The compression collar 700 includes positioning tabs 712, as described above, that prevent the end of a section of piping from sliding completely through the collar 700. The end of the compression collar 700 that slides over the end of the piping may include chamfering 720 formed into the inner diameter 704. This chamfering 720 may facilitate initial entry of the piping into the inner diameter 704 of the compression collar 700. Alternatively, the chamfering 720 may be formed as a curved corner having a certain radius of curvature. The radius of curvature may vary.

[0060] Additionally included on the compression collar 700 is one or more flat surfaces or strips 714 that are axially tangent to the pipe over which the collar 700 is placed in use. These flat surfaces 714 may be formed on the inner wall of the cylindrical bore during the injection molding process. The flat surfaces 714 advantageously provide a slight amount of friction for a lightly snug fit between the compression collar 700 and the radially outward facing surface of the pipe that will keep the collar 700 from sliding off the pipe prior to expansion. A further advantage of the flat surfaces 714 is that they are parallel with the central axis of the compression collar 700 such that the same slight amount of friction is applied evenly all along the end of the section of pipe which is inserted into the collar 700.

[0061] The flat surfaces 714 may vary in width and are not limited to the embodiment shown in FIGS. 4A-4F. The width of the flat surfaces 714 may be based on the inner diameter 704 and/or the outer diameter 706 of the compression collar 700. Alternatively or additionally, the width of the flat surfaces 714 may be based on a thickness and/or outer diameter of the pipe and/or fitting over which the compression collar 700 is to be placed. The width of the flat surfaces 714 may be based on the number of flat surfaces 714. For example, a larger width may be employed for a lower number of flat surfaces 714 and/or a smaller width may be employed for a higher number of flat surfaces 714. The flat surfaces 714 may each have a different width and/or alternate widths. For example, there may be one flat surface 714 with a larger width and the remaining flat surfaces 714 have smaller widths such that the flat surface 714 with the larger width marks one side of the compression collar 700 for orientation, alignment, and/or registration purposes.

[0062] The number of flat surfaces 714 may be based on the width of the flat surfaces 714, the inner and outer diameters 704, 706 of the compression collar 700, the outer diameter of the pipe over which the collar 700 is to be placed, and/or the number of positioning tabs 712. The flat surfaces 714 may be

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evenly distributed around the inner diameter 704 of the compression collar 700 or alternatively distributed unevenly. The flat surfaces 714 may be aligned and/or misaligned with the positioning tabs 712. As an alternative to the plurality of flat surfaces 714, there may be only one flat surface. The single flat surface may vary in width from the flat surfaces 314 shown in FIGS. 4A-4F.

[0063] It should be appreciated that various other modifications and variations to the preferred embodiments can be made within the spirit and scope of the invention. Therefore, the invention should not be limited to the described embodiments. To ascertain the full scope of the invention, the following claims should be referenced.

CLAIMS

What is claimed is:

1. A method for manufacturing a compression collar for reinforcing an interference fit between an end of a pipe and a fitting, the method comprising the steps of:

a. injection molding a precursor form using a cold-expansion material, wherein the precursor form comprises a tubular body with an initially closed axial end and a bore that is initially blind formed in the other axial end; and

b. removing material from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end that connects to the bore thereby forming the compression collar;

wherein the opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore.

2. The method of claim 1, wherein the cold-expansion material is at least one of polyolefin, cross-linked polyolefin, polyethylene, cross-linked polyethylene, PEX, PEX-a, PEX-b, PEX-c, and PERT.

3. The method of claim 1, wherein the compression collar includes no knitlines.

4. The method of claim 1, wherein the step of injection molding involves injecting all cold-expansion material at an injection location positioned on the initially closed axial end, such that the cold-expansion material flows radially outward on the initially closed axial end and then axial downward into generally tubular sidewalls of the tubular body without the material front flow into itself or another material front during the step of injection molding.

5. The method of claim 1, wherein the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening involves removing any injection points on the precursor form used in the step of injection molding the precursor form.

6. The method of claim 1, wherein the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end involves punching.

7. The method of claim 1, wherein the step of removing material from the initially closed axial end of the tubular body of the precursor form to form an opening in the initially closed axial end forms at least one positioning tab in the inner periphery of the opening.

8. The method of claim 7, wherein the at least one positioning tab includes a plurality of positioning tabs.

9. The method of claim 8, wherein the plurality of positioning tabs are located at even intervals around the inner periphery.

10. The method of claim 1, wherein the compression collar further comprises a supporting extension on the axial end of the compression collar opposite the opening that is removed, the supporting extension being configured to reinforce a thinned section of the pipe past the fitting.

11. The method of claim 10, wherein the supporting extension tapers as it extends away from the opening.

12. The method of claim 1, further comprising, during injection molding, forming flat surfaces on the inner periphery of the bore of the compression collar that are parallel to a central axis of the compression collar such that the flat surfaces are configured to be tangent to a radially-outward facing surface of the pipe around which the compression collar is received.

13. The method of claim 1, further comprising the step of forming a chamfered edge in the bore at the axial end of the bore that is opposite the axial end in which opening is removed.

14. The method of claim 1, further comprising the step of forming a curved corner with a radius of curvature in the bore at the axial end of the bore that is opposite the axial end in which opening is removed.

15. The method of claim 1, wherein the opening has an inner periphery with a profile in axial cross section that matches, in part, an adjacent profile in axial cross section of an inner periphery of the bore with a non-matching part of the profiles providing at least one positioning tab in the inner periphery of the opening.

16. A compression collar for reinforcing an interference fit between an end of a pipe and a fitting, the compression collar comprising:

a tubular body formed by injection molding a cold-expansion material, the tubular body having a bore extending axially therethrough and a removed opening on one initially closed axial end of the tubular body in which the removed opening connects to the bore;

wherein the opening has an inner periphery with a profile in axial cross section that is different than any profile in axial cross section of an inner periphery of the bore.

17. The compression collar of claim 16, wherein the cold-expansion material is at least one of polyolefin, cross-linked polyolefin, polyethylene, cross-linked polyethylene, PEX, PEX-a, PEX-b, PEX-c, and PERT.

18. The compression collar of claim 16, wherein the compression collar includes no knitlines and no injection points from injection molding.

19. The compression collar of claim 16, further comprising flat surfaces on the inner periphery of the bore of the compression collar that are parallel to a central axis of the compression collar such that the flat surfaces are configured to be tangent to a radially-outward facing surface of the pipe around which the compression collar is received.

20. The compression collar of claim 19, wherein the removed opening includes positioning tabs and there are as many flat surfaces on the inner periphery as there are positioning tabs.

21. The compression collar of claim 16, wherein the compression collar further comprises a supporting extension for reinforcing the piping past the fitting, the supporting extension being positioned on an axial end of the compression collar opposite the removed opening.

22. The compression collar of claim 21, wherein the supporting extension tapers as it extends away from the opening.

23. The compression collar of claim 16, further comprising a chamfered edge in the bore at the axial end of the bore that is opposite the axial end having the removed opening.

24. The compression collar of claim 16, further comprising a curved corner with a radius of curvature at the axial end of the bore that is opposite the axial end having the removed opening.

25. The compression collar of claim 16, wherein the inner periphery of the removed opening includes at least one positioning tab in which the at least one positioning tab is configured to axially position the compression collar on an end of a pipe.

26. The compression collar of claim 25, wherein the at least one positioning tab includes a plurality of positioning tabs.

27. The compression collar of claim 16, wherein the removed opening has an inner periphery with a profile in axial cross section that matches, in part, an adjacent profile in axial cross section of an inner periphery of the bore and with a non-matching part of the profiles defining at least one positioning tab in the inner periphery of the removed opening.

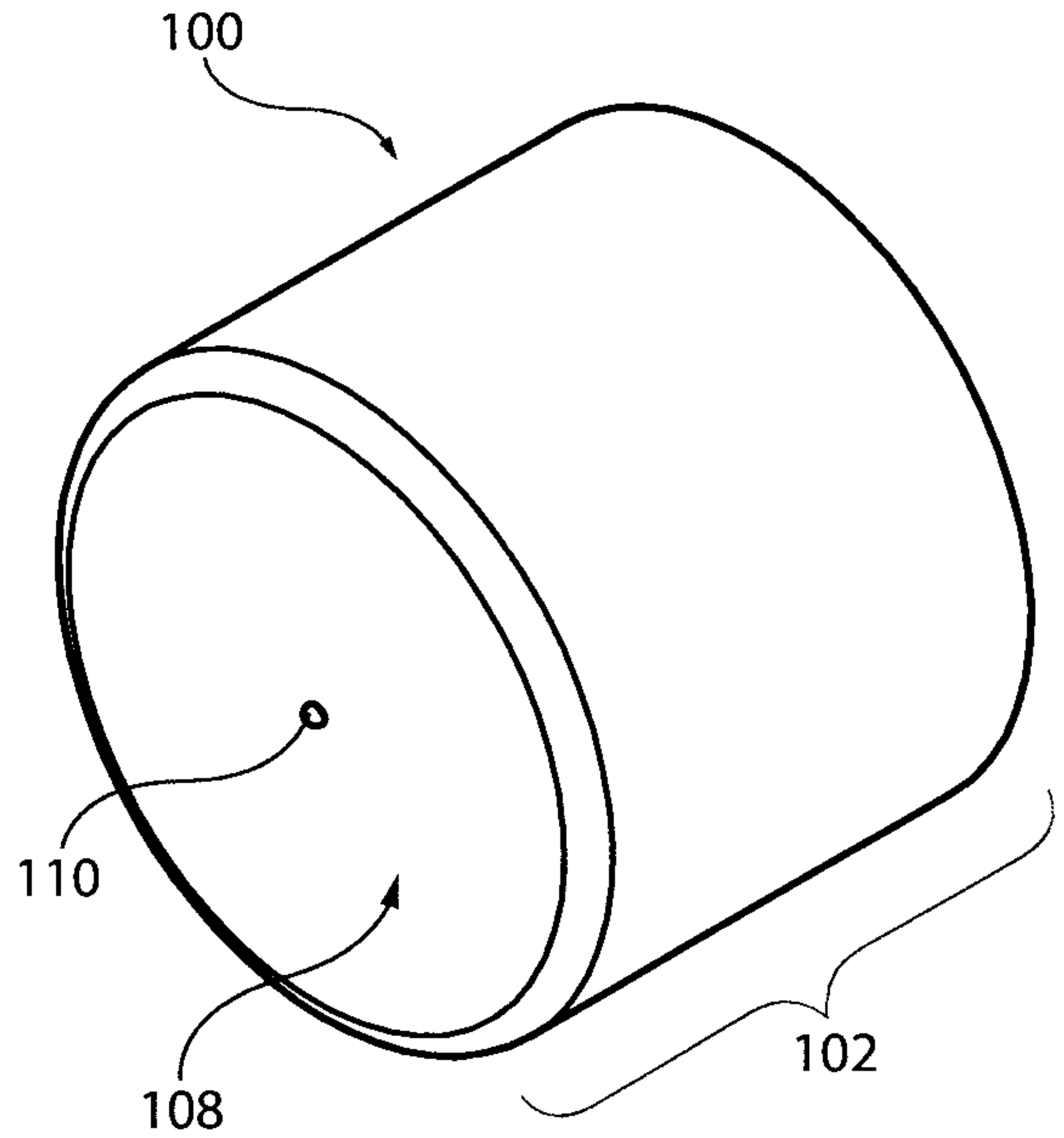


FIG. 1A

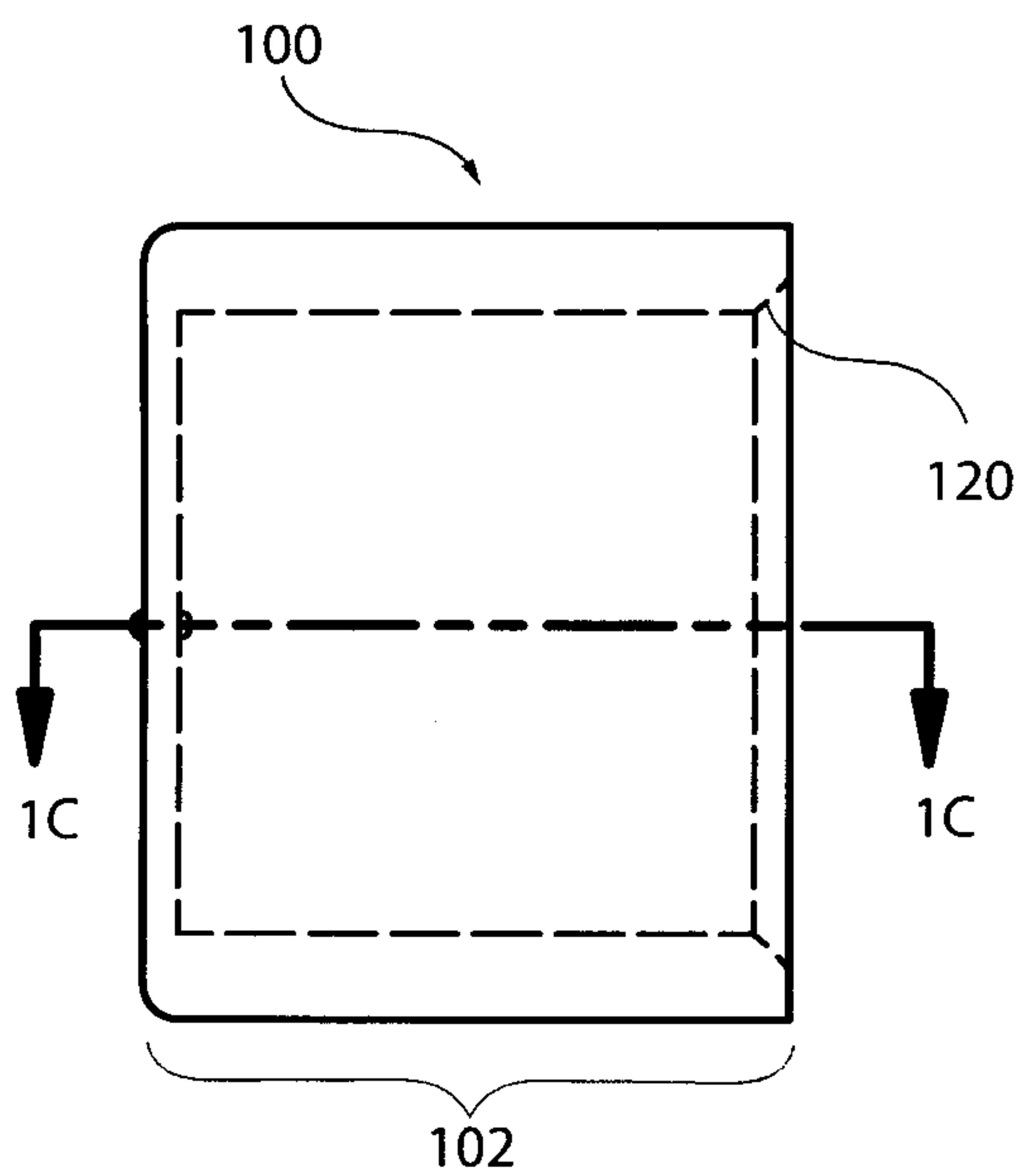


FIG. 1B

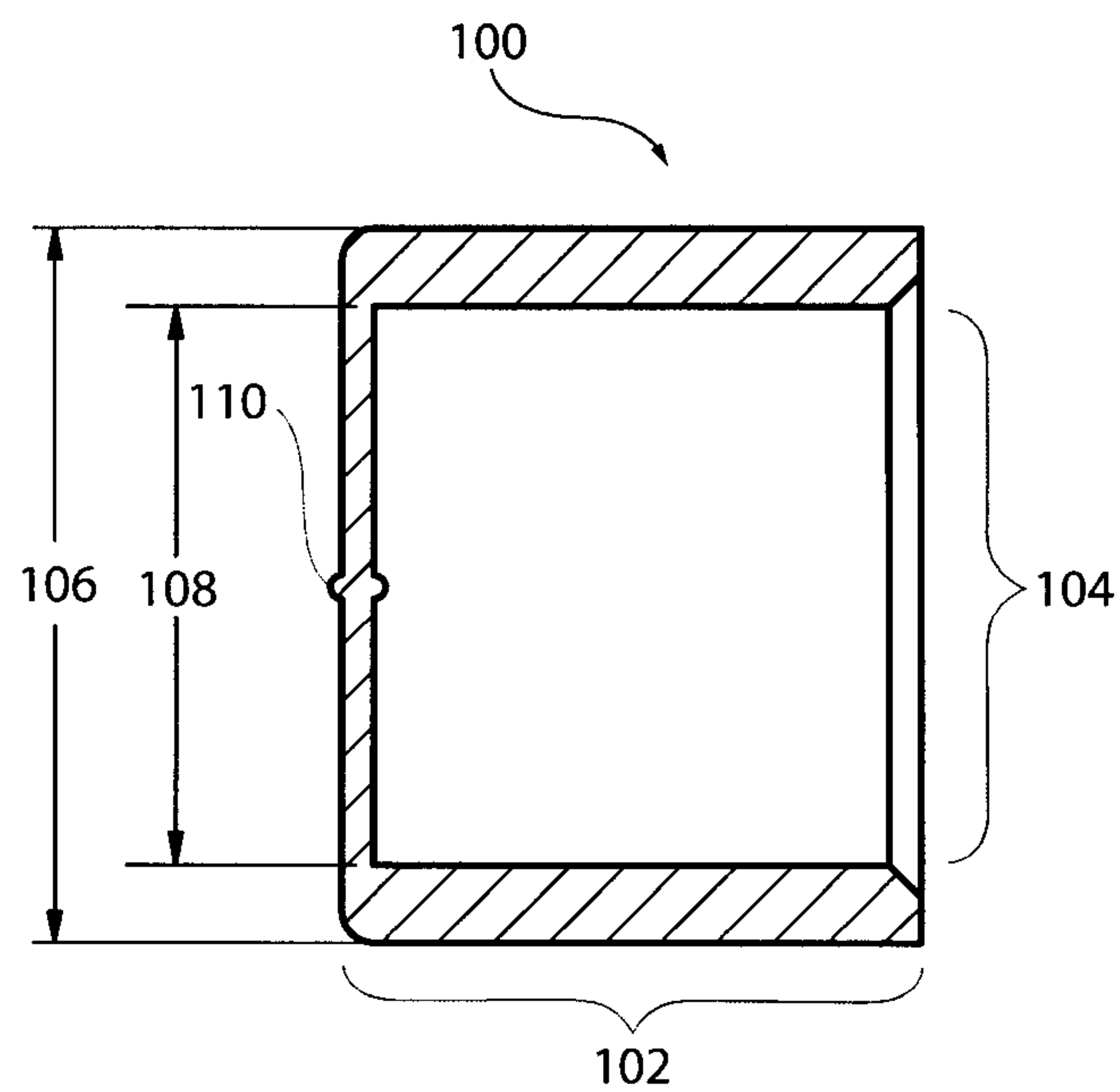


FIG. 1C

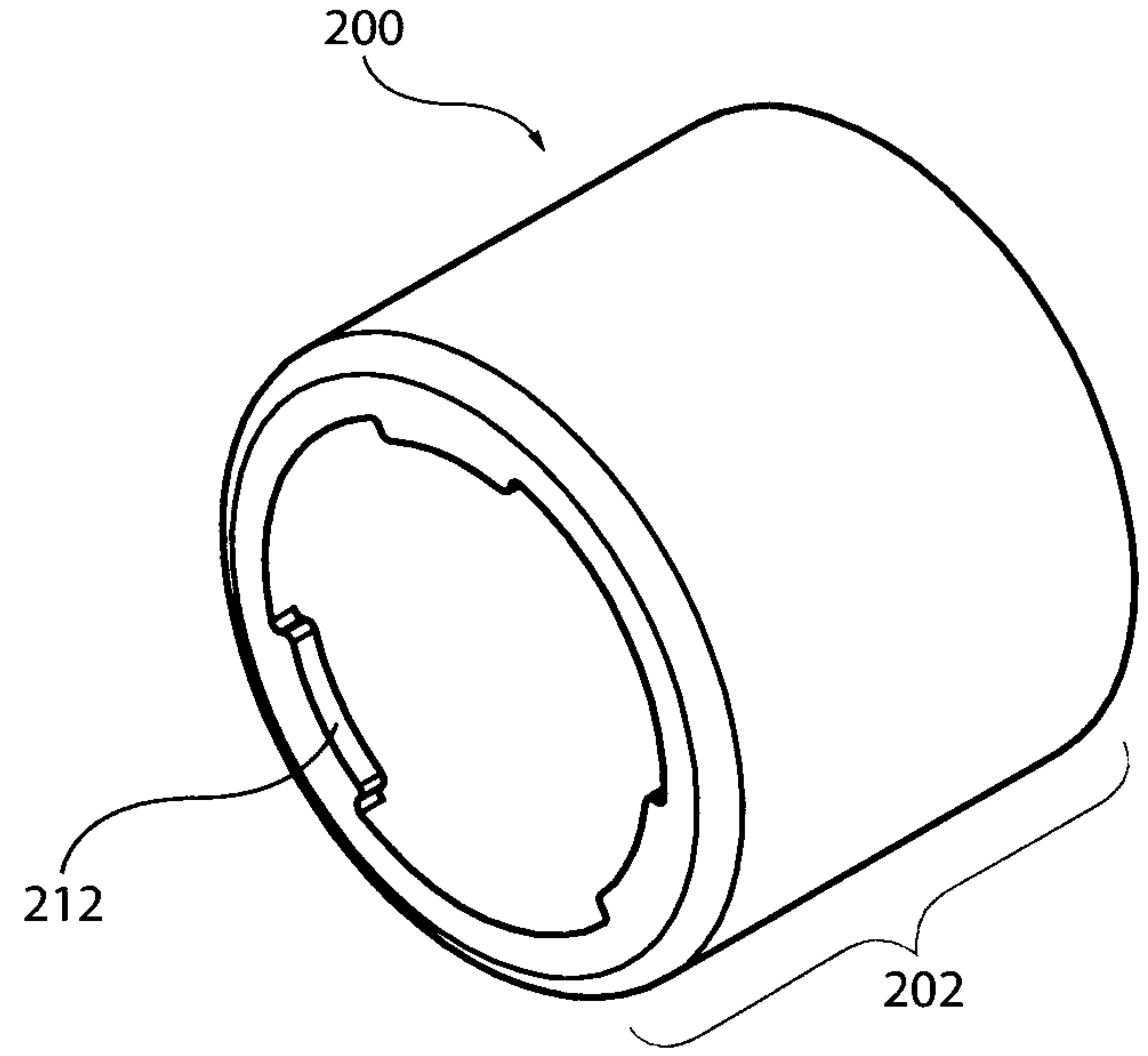


FIG. 2A

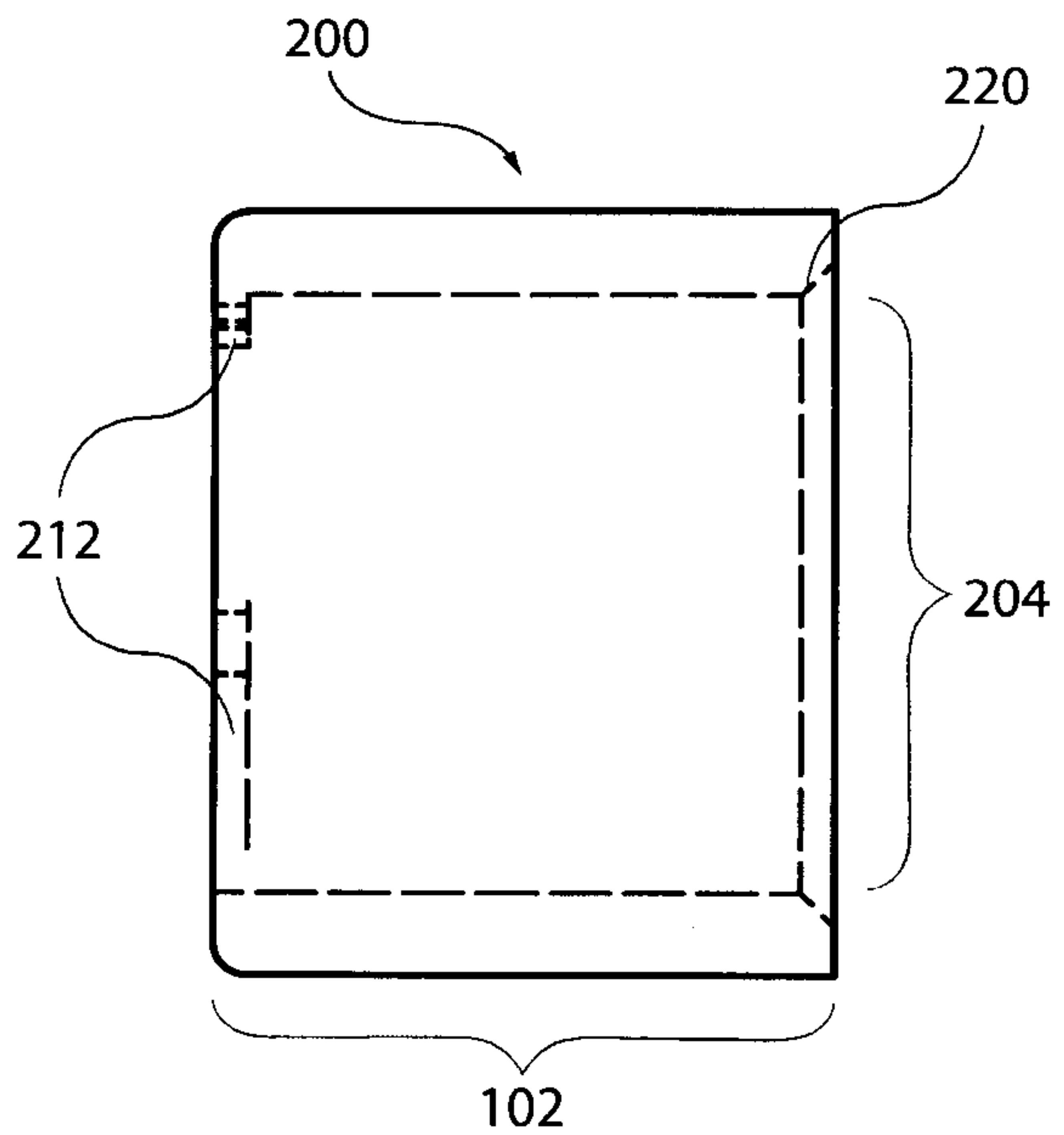


FIG. 2B

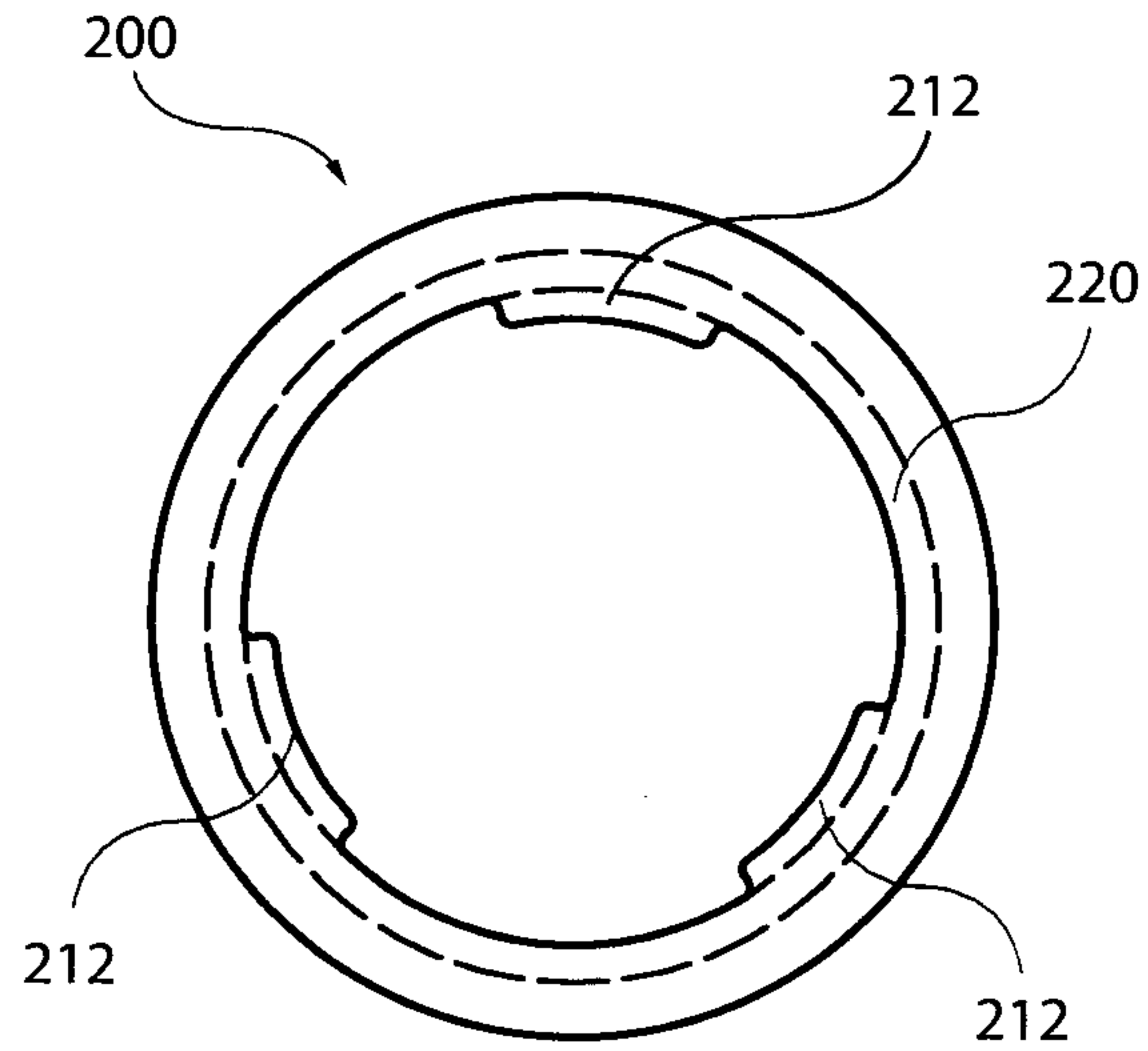


FIG. 2C

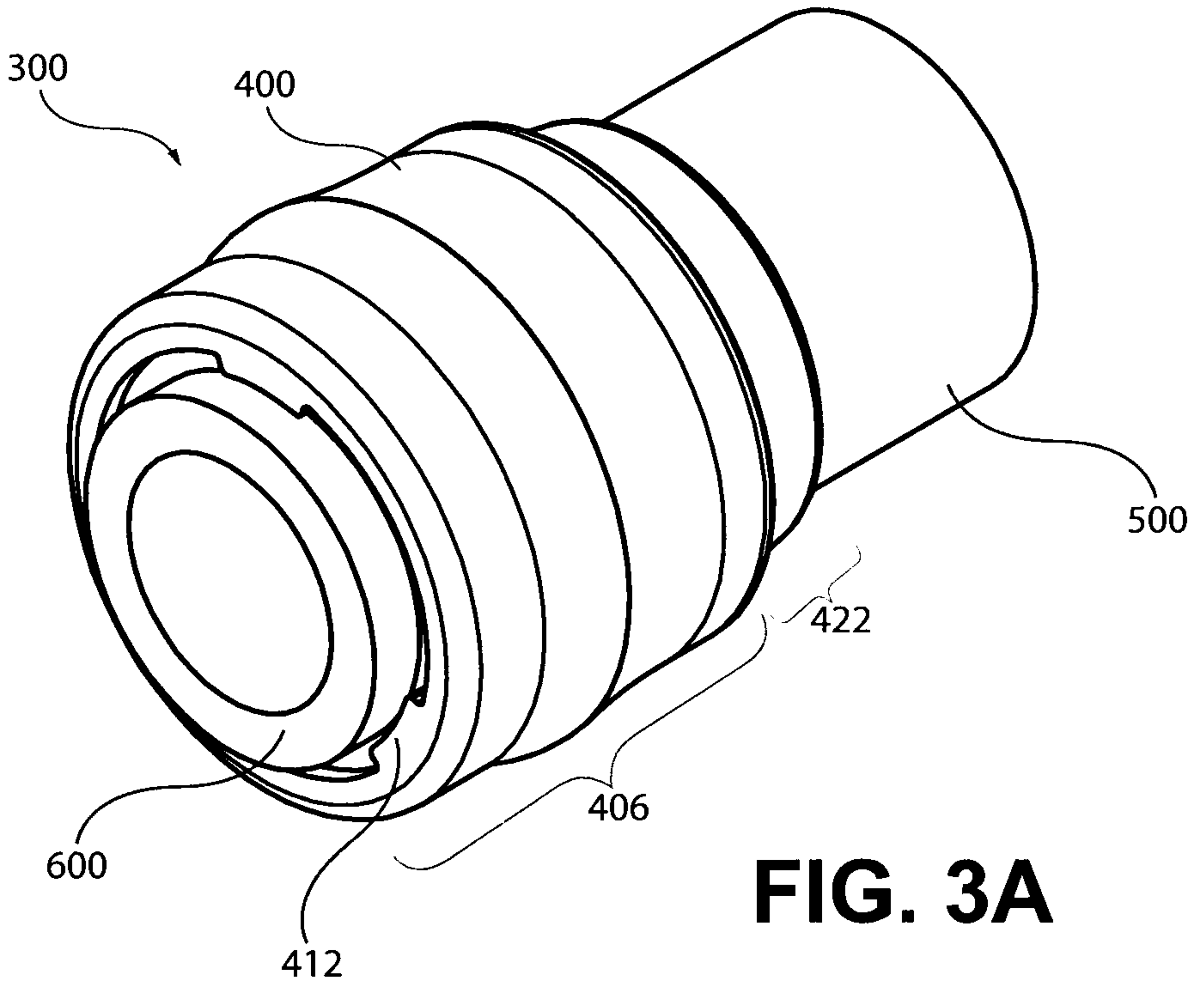


FIG. 3A

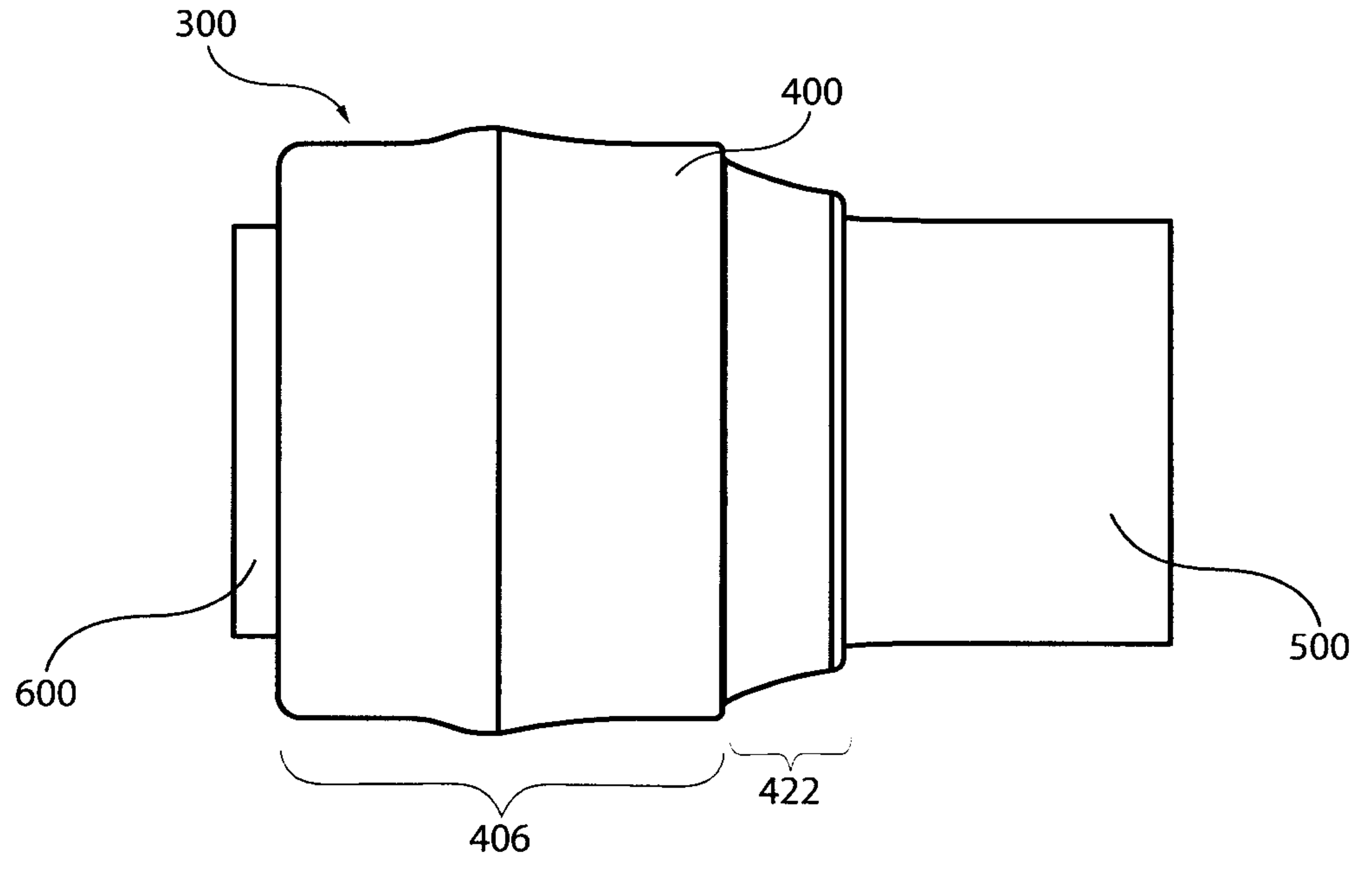


FIG. 3B

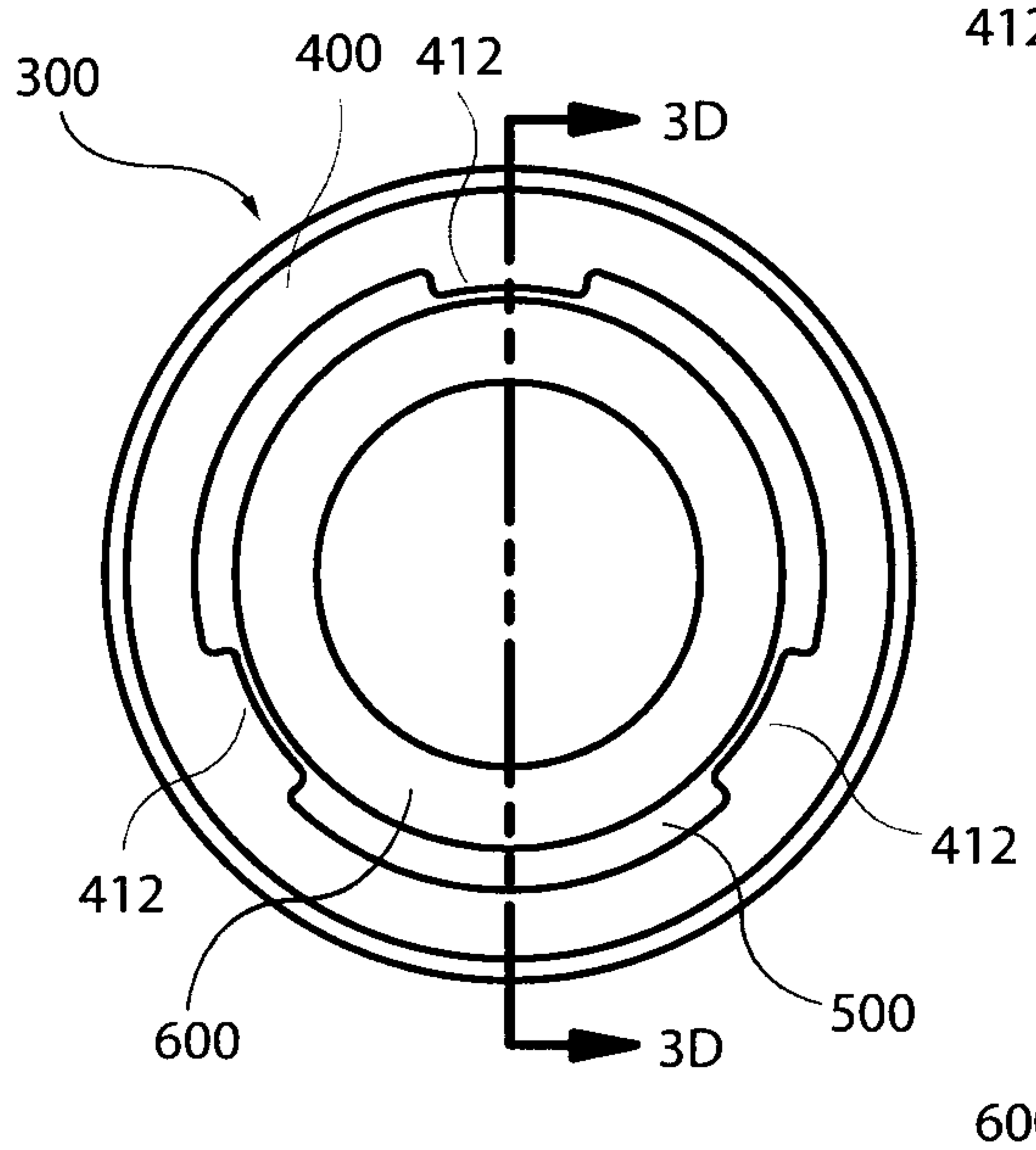


FIG. 3C

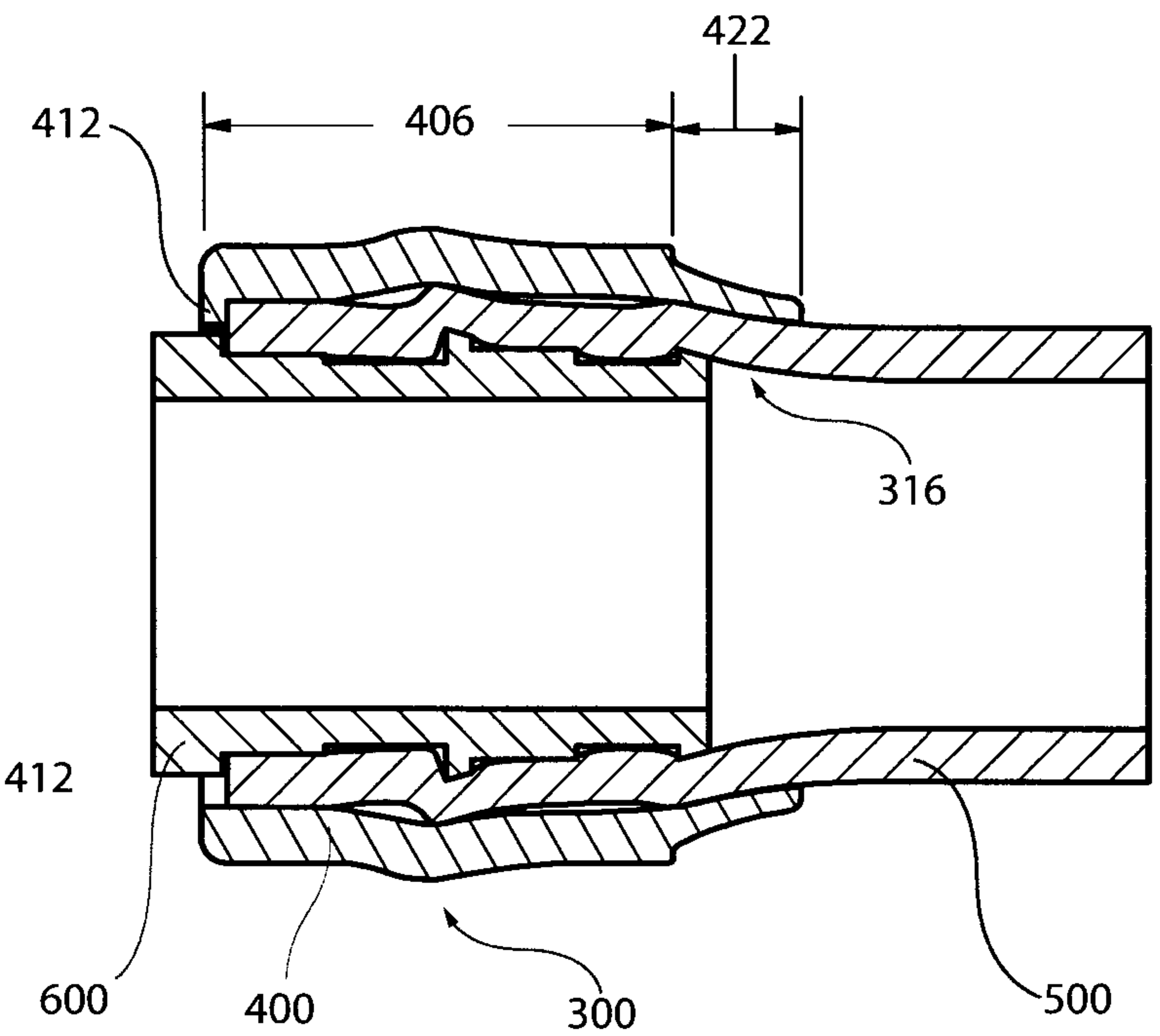


FIG. 3D

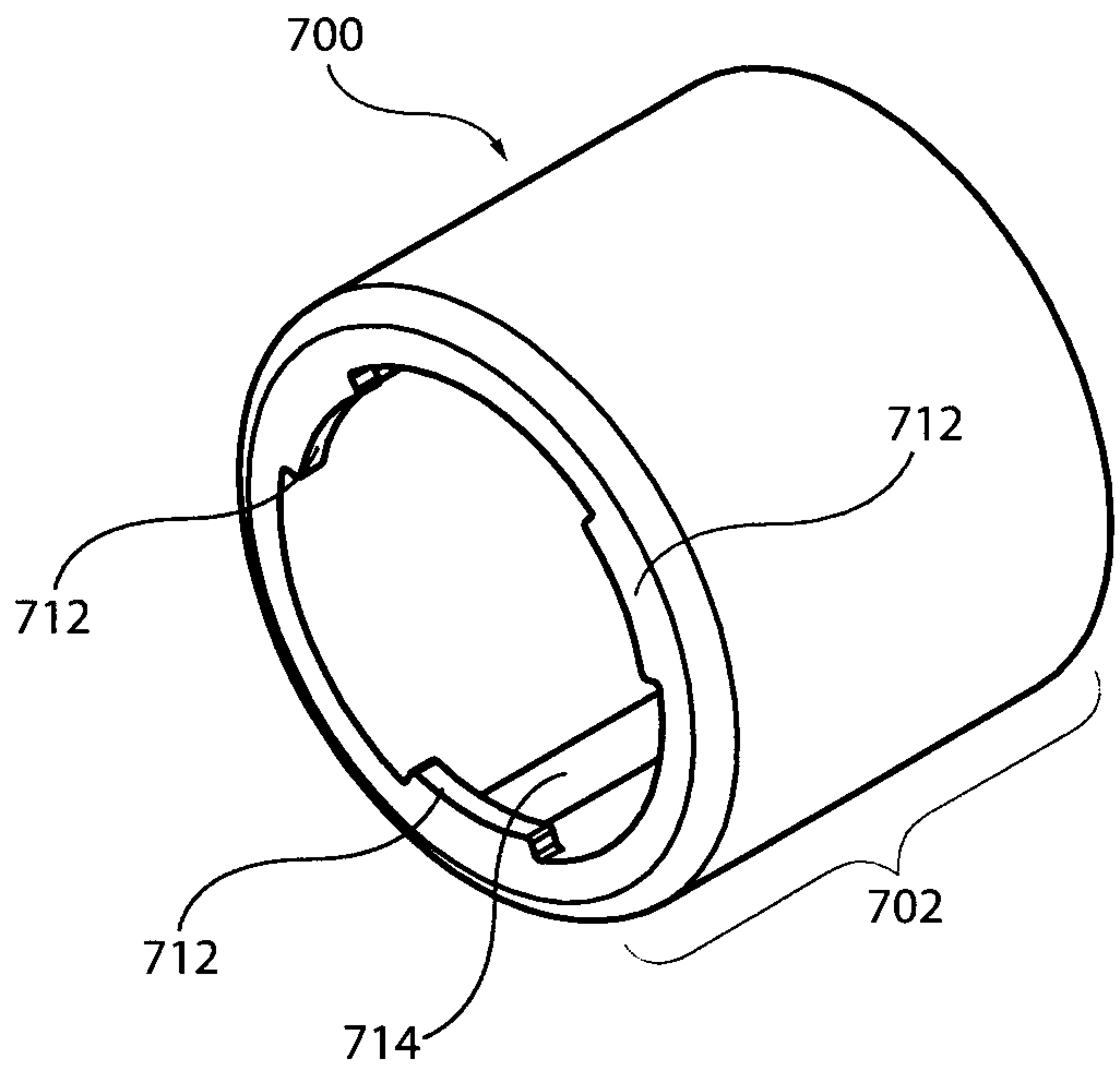


FIG. 4A

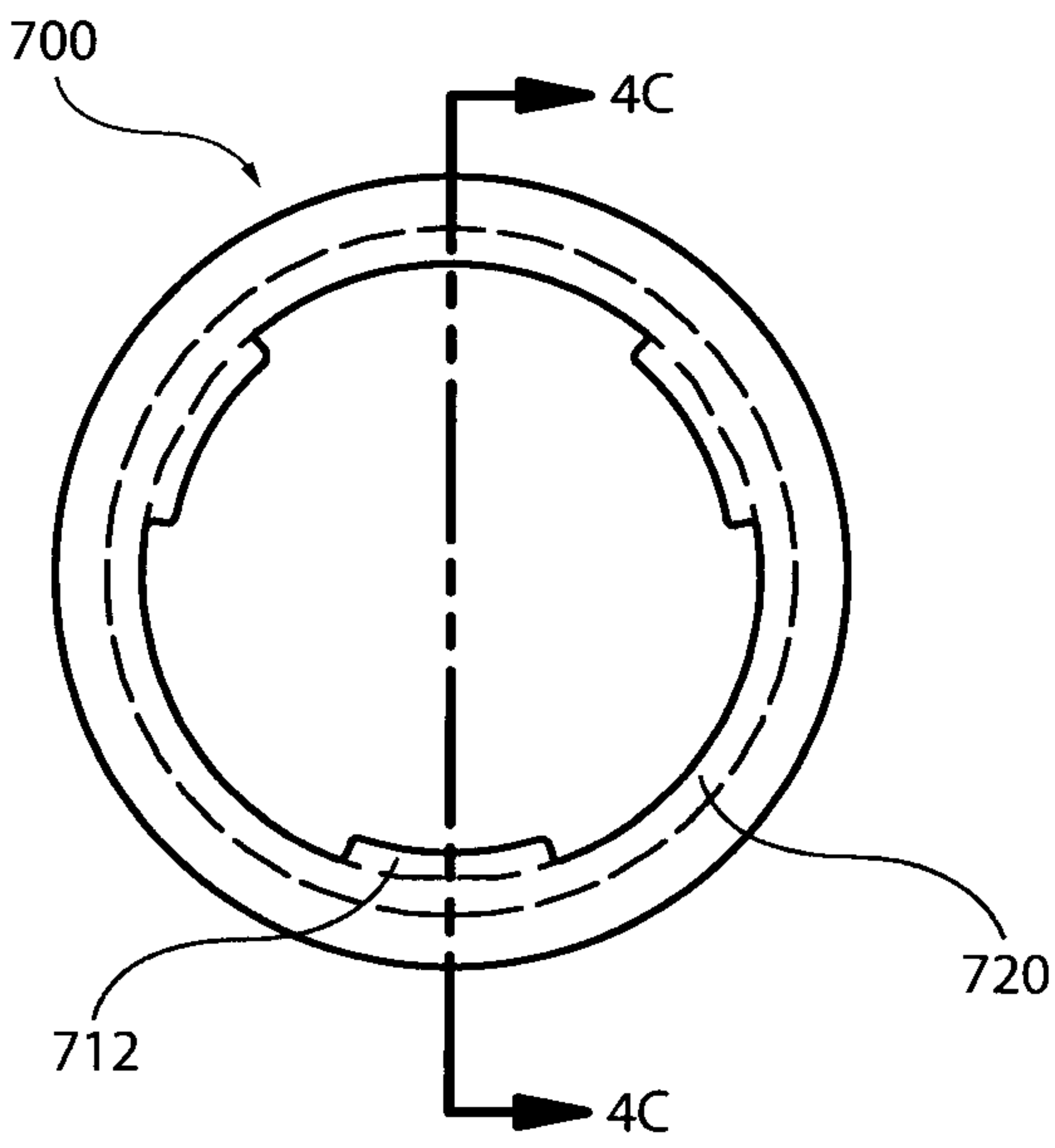


FIG. 4B

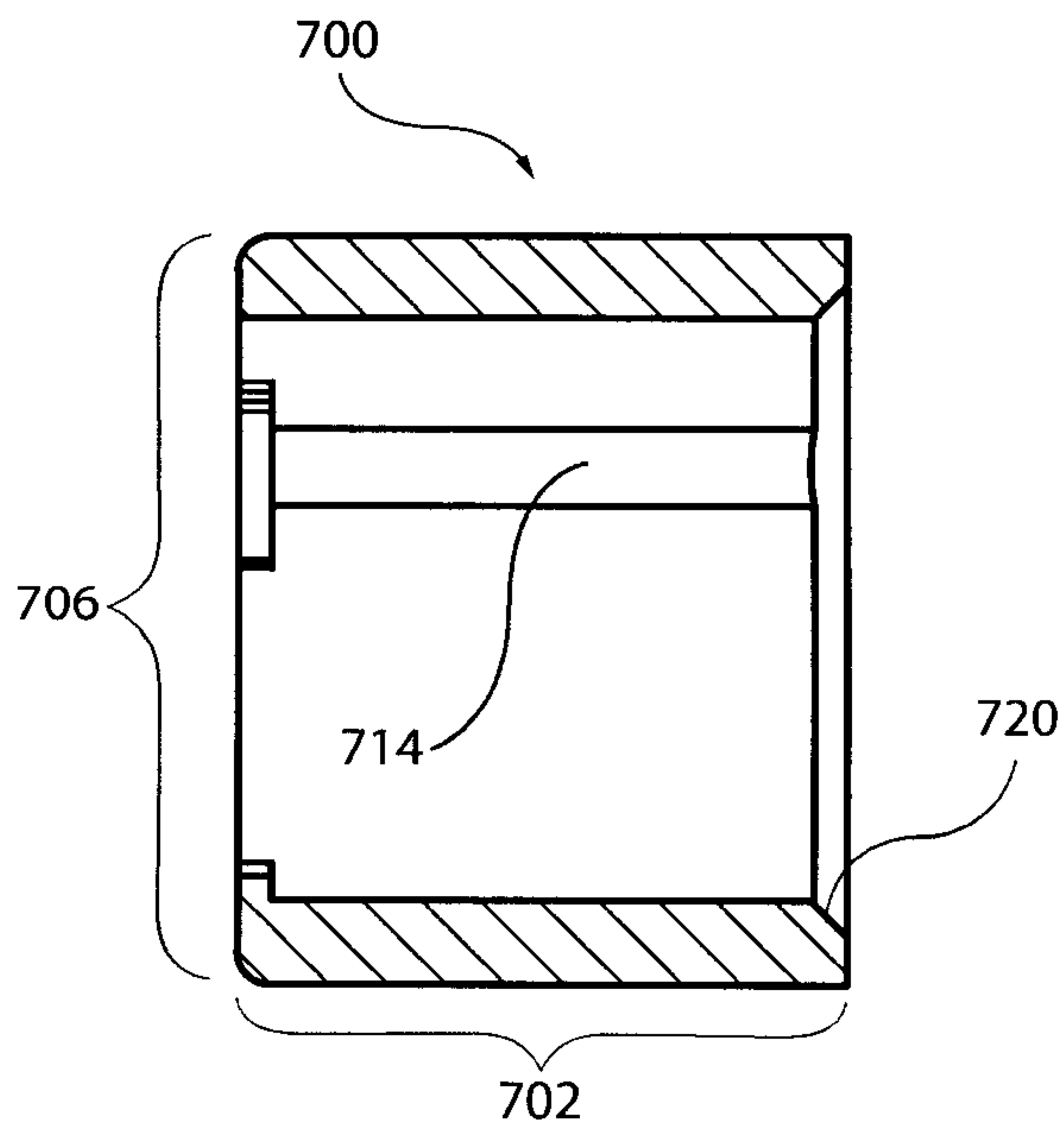


FIG. 4C

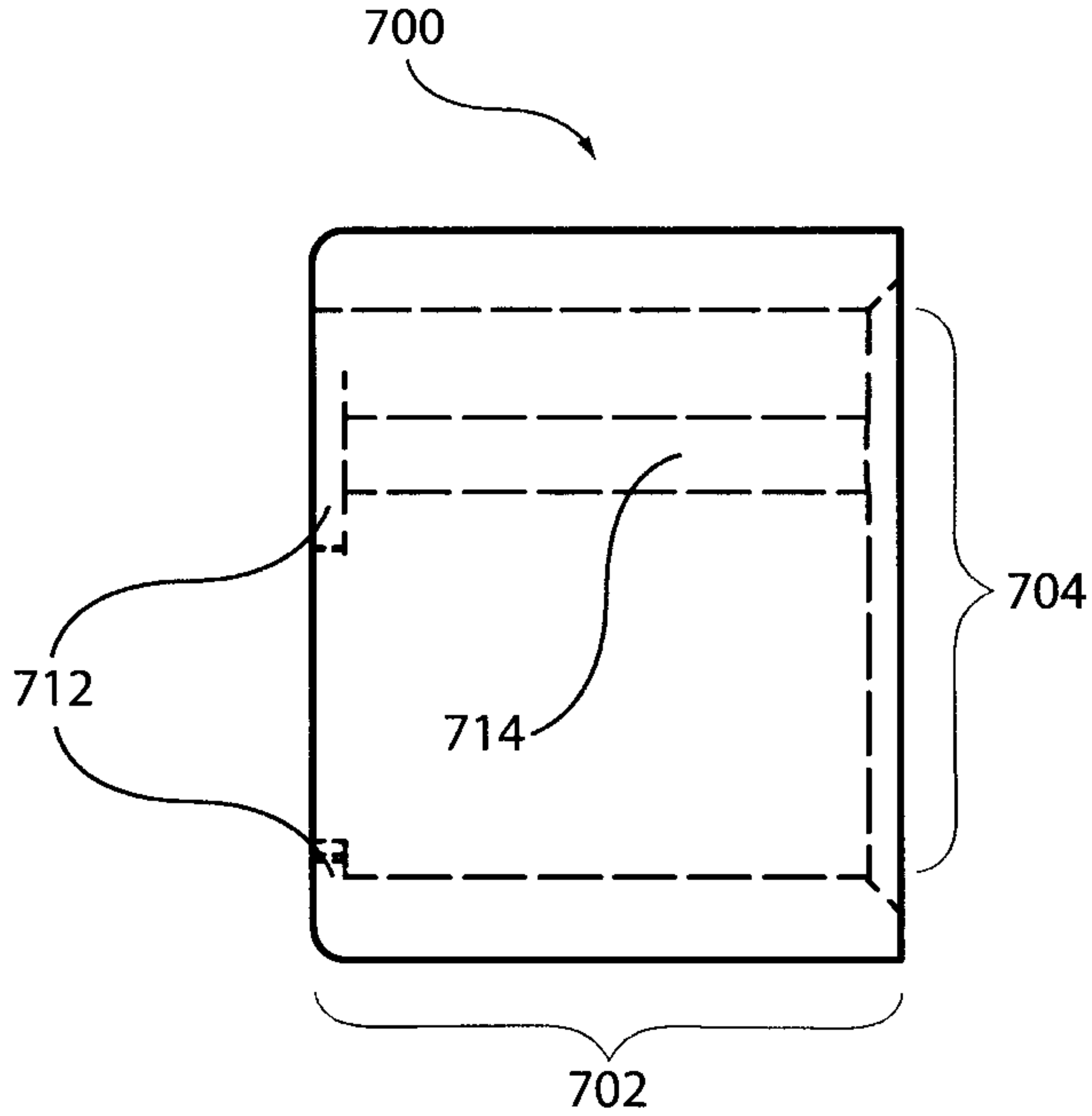


FIG. 4D

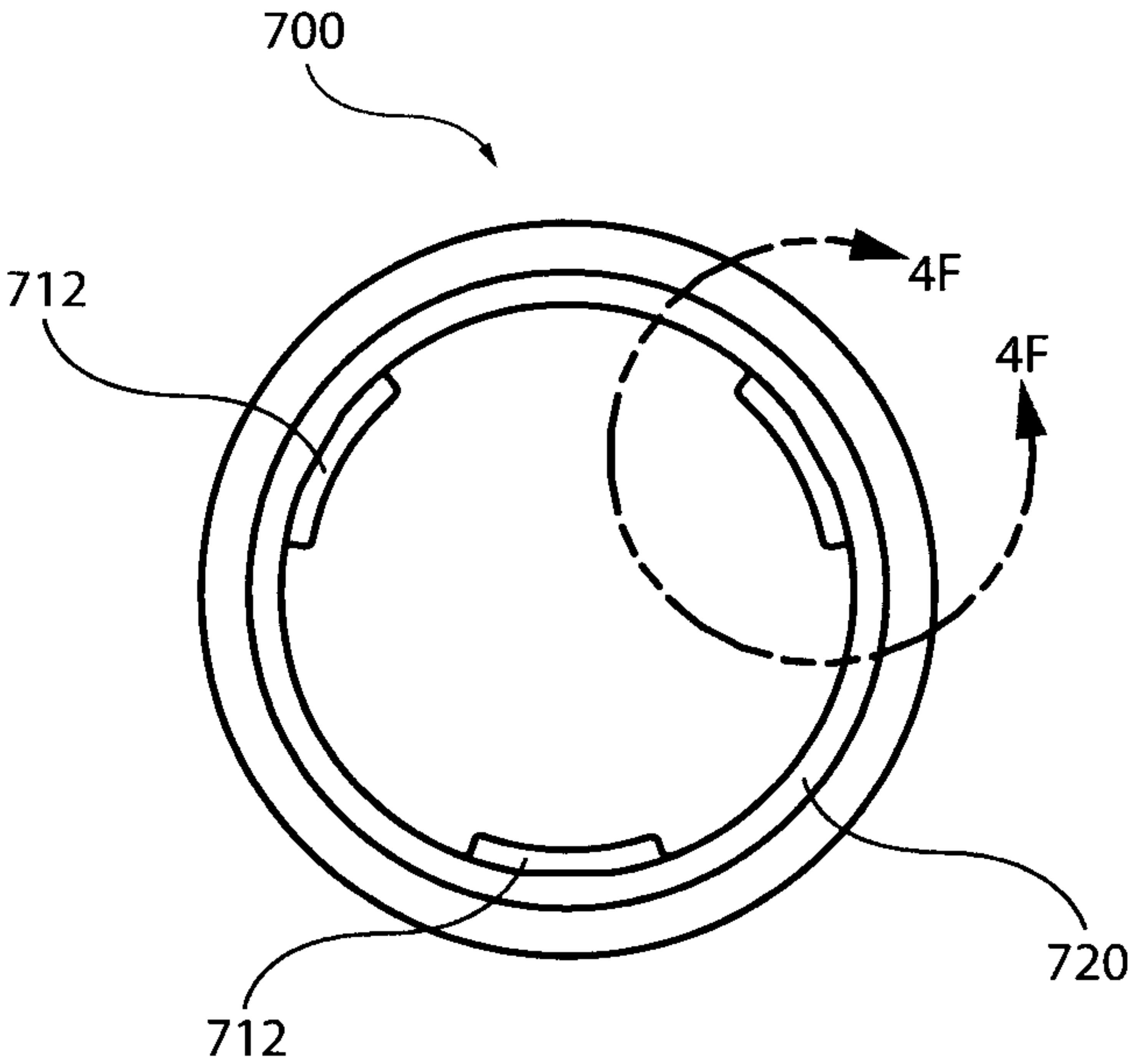


FIG. 4E

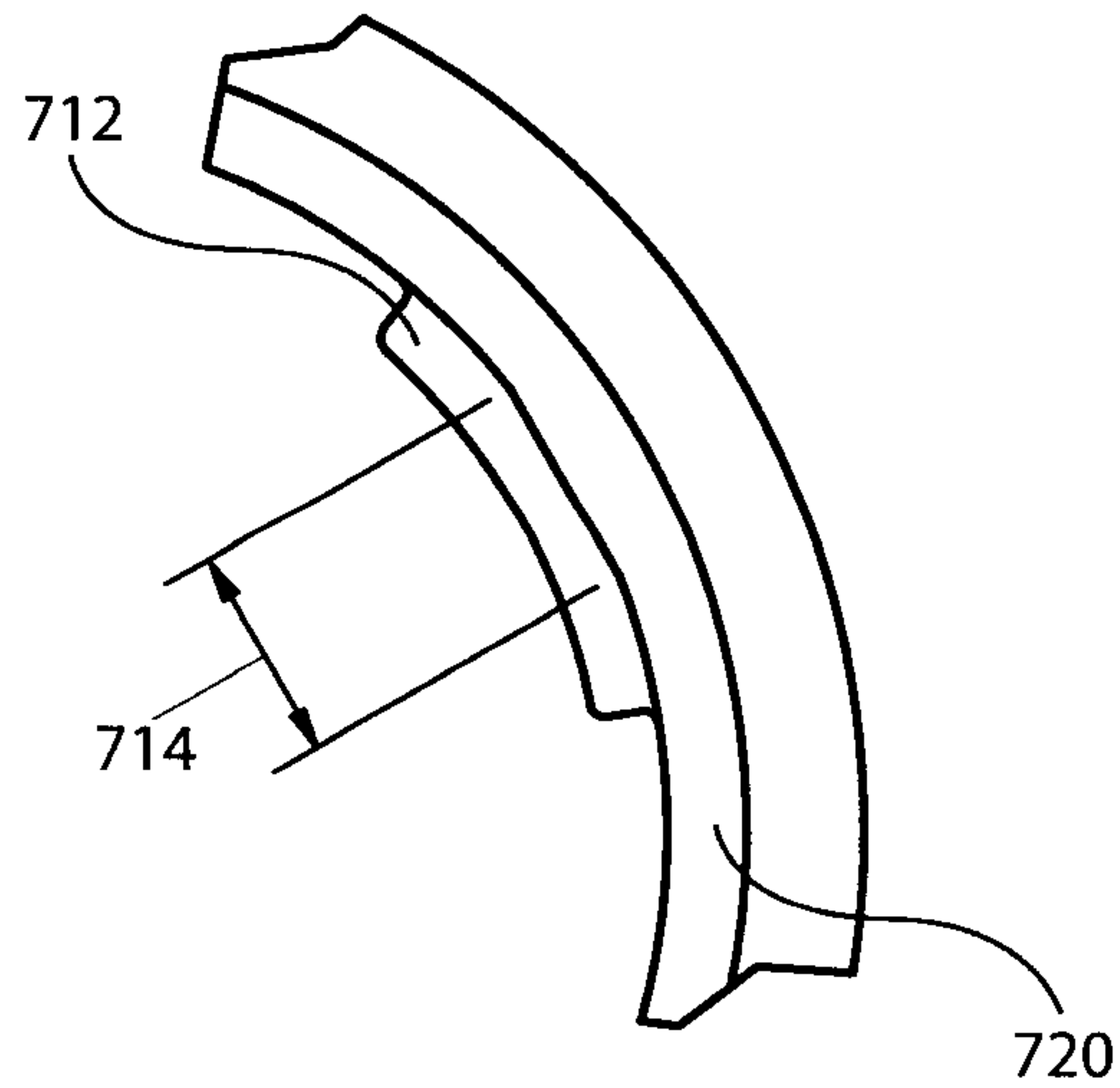
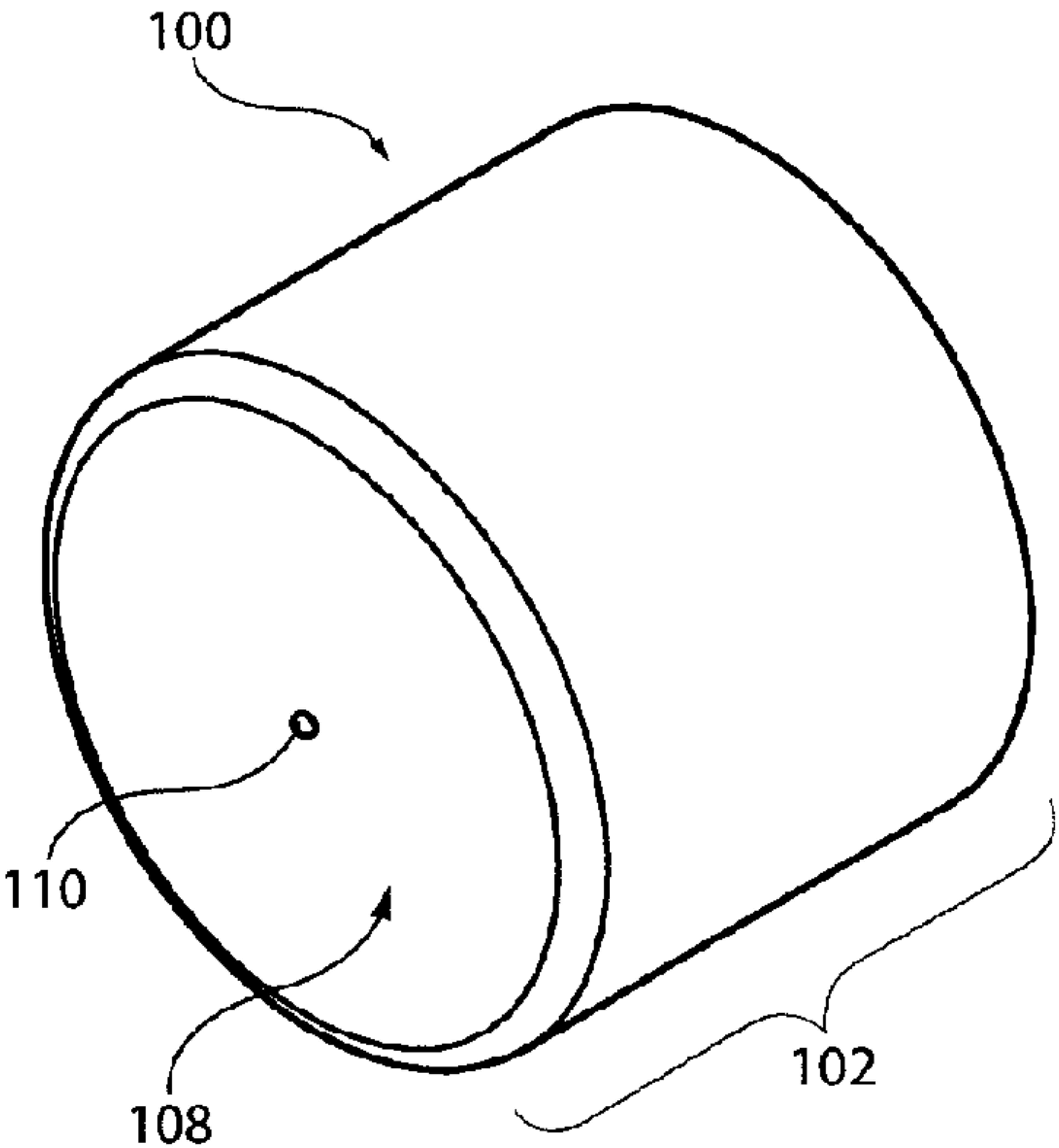


FIG. 4F



A