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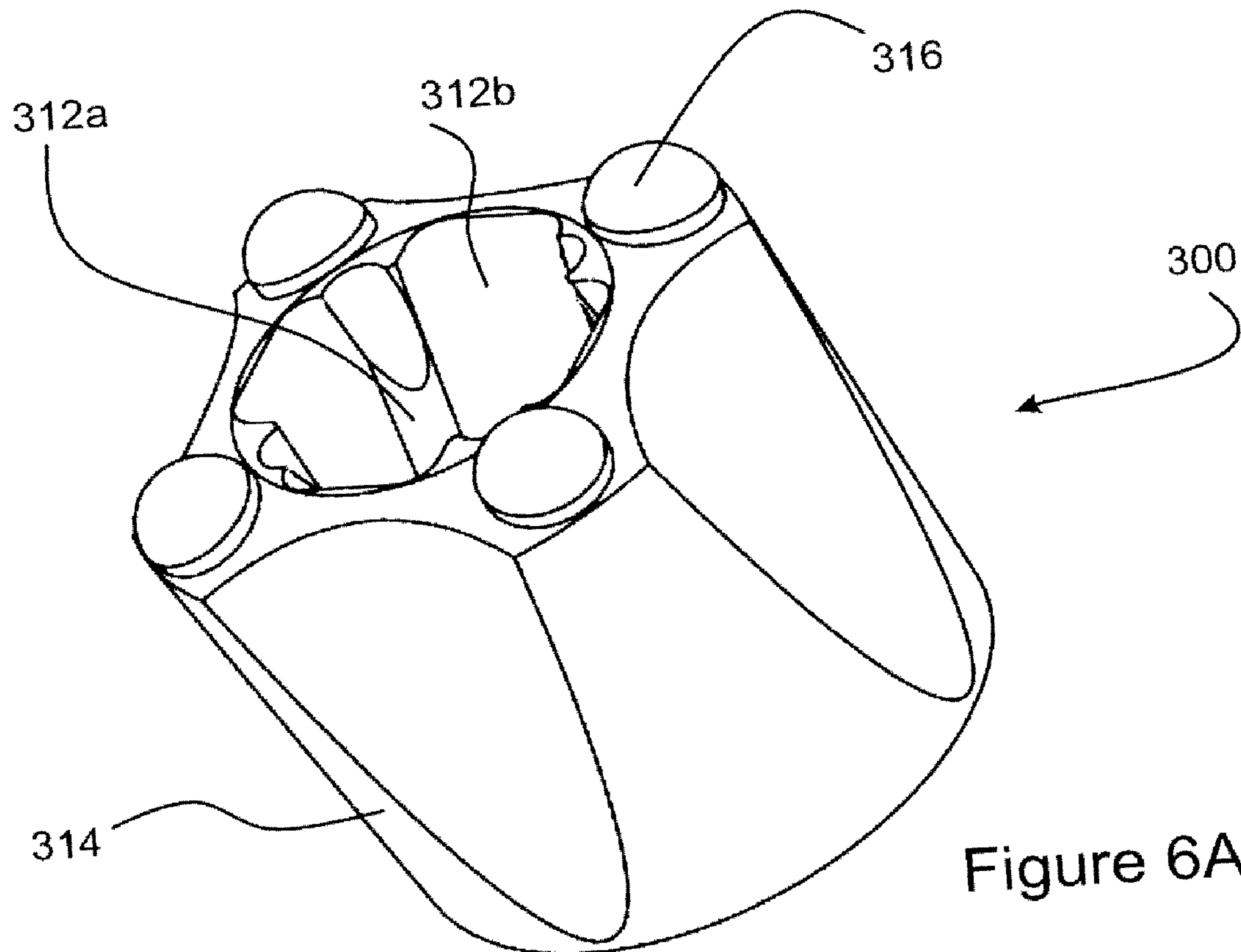
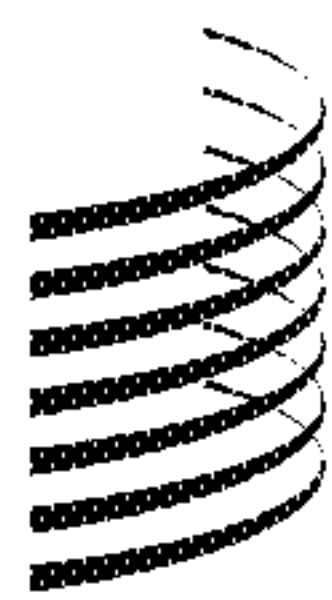


Figure 6A

(57) **Abrégé/Abstract:**

A two part drill bit assembly and to the two drill bits that form the assembly. The drill bits are releasably engageable, to form the assembly, via compatible spiral grooved surfaces on each bit with one of the drill bits being re-useable and the other intended for single use or being made otherwise disposable.

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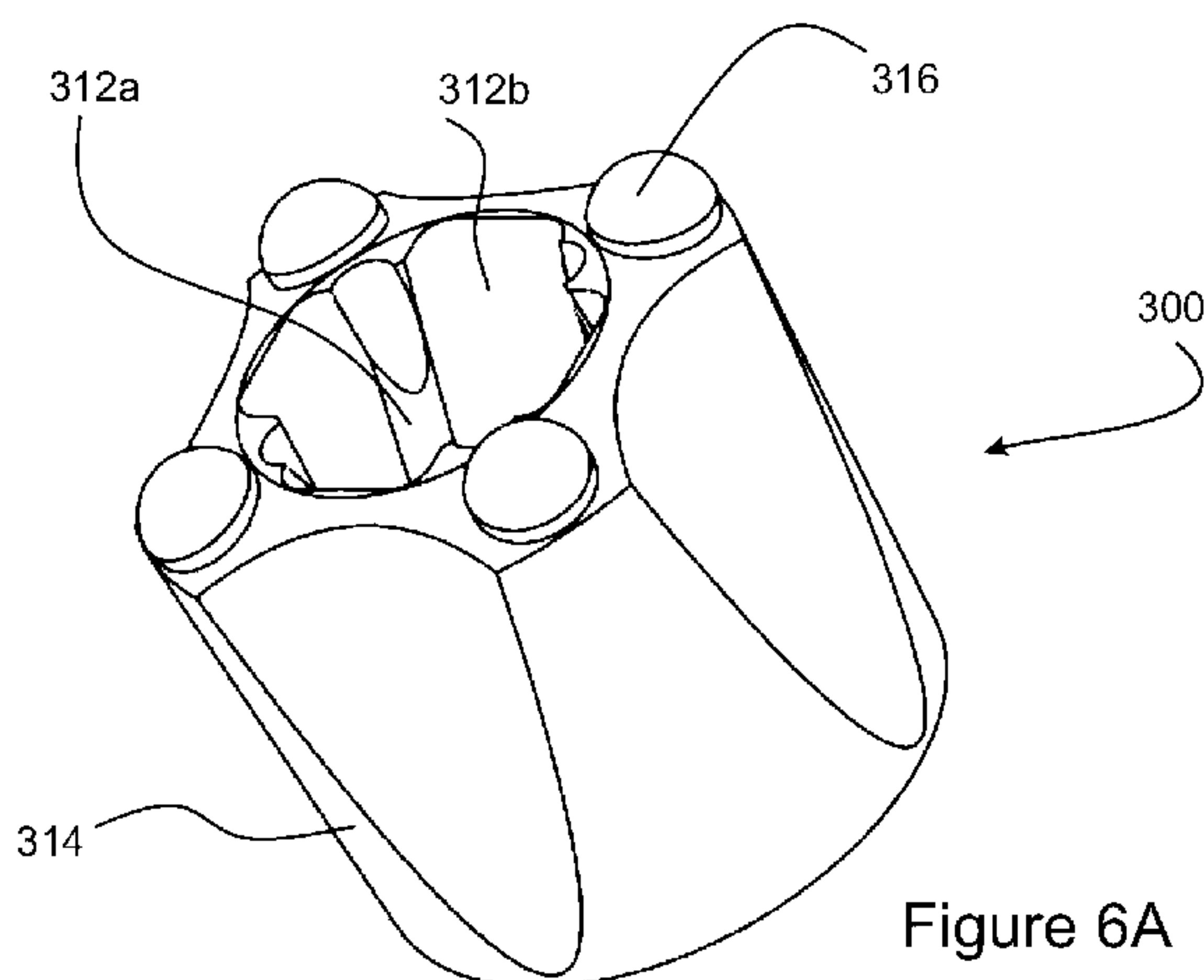


Figure 6A

(57) Abstract: A two part drill bit assembly and to the two drill bits that form the assembly. The drill bits are releasibly engageable, to form the assembly, via compatible spiral grooved surfaces on each bit with one of the drill bits being re-useable and the other intended for single use or being made otherwise disposable.



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Two Part Drill Bit Assembly

Field of the Invention

The present invention relates to drill bits for two part drill bit assemblies and more particularly to a two part drill bit assembly. The present invention also relates to drill bits, drill assemblies, drilling methods, drilling systems and friction bolt assemblies.

Background of the Invention

Drill bits are designed to wear and hence must be replaced or sharpened after a reaching their effective service life. Furthermore, it is not uncommon for drill bits to wear unevenly and the "flat spots" created on a drill bit can impede its performance even when the vast majority of the drill bit remains suitable for use. Using a drill bit that is worn is inefficient and can place additional stress on other drilling equipment and/or parts of the drill string.

The present invention seeks to address the problems with existing drill bits or at least provide a useful alternative to currently available drill bits.

Summary of the Invention

According to a first aspect, the present invention provides a first drill bit for a two part drill bit assembly, the first drill bit having:

- (a) a leading end;
- (b) a trailing end; and
- (c) an annular bit body comprising:
 - (i) a first cutting part disposed at the leading end of the first drill bit;
 - (ii) a spiral grooved inner surface; and
 - (iii) an outer surface;

wherein the first drill bit is adapted to be releasibly received on a shaft defined by a second drill bit via said inner surface.

According to a second aspect, the present invention also provides a second drill bit for a two part drill bit assembly, the second drill bit having:

- (a) a leading end;
- (b) a trailing end; and
- (c) a bit body comprising:
 - (i) a second cutting part disposed at its leading end;
 - (ii) a shaft member with a spiral grooved outer surface; and
 - (iii) a means for operably attaching the second drill bit to a drill string assembly.

wherein the second drill bit is adapted to releasibly receive a first drill bit via said shaft member.

According to a third aspect, the present invention also provides a two part drill bit assembly comprising:

- (a) a first drill bit having a leading end, a trailing end, and an annular bit body comprising a first cutting part disposed at the leading end of the first drill bit, a spiral grooved inner surface and an outer surface;
- (b) a second drill bit with a leading end and a trailing end and having a bit body comprising a shaft member comprising a second cutting part disposed at its leading end and a spiral grooved outer surface;

wherein the first drill bit is adapted to be releasibly received on the shaft member of the second drill bit via said inner surface of the first drill bit.

According to a fourth aspect of the present invention there is provided a drill assembly comprising a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the present invention.

According to a fifth aspect, the present invention also provides a drilling system comprising:

- (a) a drill string;
- (b) a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the present invention; and
- (c) a drive means for imparting rotational and/or percussive force on the drill string.

According to a sixth aspect the present invention provides a method of drilling into a formation, the method comprising the steps of:

- (a) providing a drill assembly including a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the invention;
- (b) drilling a hole in the formation using the drill assembly; and
- (c) withdrawing the drill bit assembly from the hole.

According to a seventh aspect the present invention provides a friction bolt comprising a first drill bit according to a first aspect of the present invention.

Brief Description of the Drawings

Figure 1A is a perspective view of a drill bit for a two part drill bit assembly according to a first embodiment of the first aspect of the present invention;

Figure 1B is another perspective view (showing the trailing end of the drill bit) of the drill bit in Figure 1A;

Figure 1C is a side view of the drill bit in Figure 1A;

Figure 1D is an end view (of the leading end) of the drill bit in Figure 1A;

Figure 1E is an end view (of the trailing end) of the drill bit in Figure 1A;

Figure 2A is a perspective view of a drill bit for a two part drill bit assembly according to a first embodiment of the second aspect of the present invention;

Figure 2B is a side view of the drill bit in Figure 2A;

Figure 2C is an end view (of the leading end) of the drill bit in Figure 2A;

Figure 2D is cross section view of the drill bit in Figure 2B through line A-A;

Figure 3A is a perspective view of a drill bit for a two part drill bit assembly according to a second embodiment of the first aspect of the present invention;

Figure 3B is another perspective view (showing the trailing end of the drill bit) of the drill bit in Figure 3A;

Figure 3C is a side view of the drill bit in Figure 3A;

Figure 3D is an end view (of the leading end) of the drill bit in Figure 3A;

Figure 3E is an end view (of the trailing end) of the drill bit in Figure 3A;

Figure 4A is a perspective view of a drill bit for a two part drill bit assembly according to a second embodiment of the second aspect of the present invention;

Figure 4B is a side view of the drill bit in Figure 4A;

Figure 4C is an end view (of the leading end) of the drill bit in Figure 4A;

Figure 4D is cross section view of the drill bit in Figure 4B through line A-A;

Figure 5 illustrates a preferred way of determining the angle of a spiral or helix;

Figure 6A is a perspective view of a drill bit for a two part drill bit assembly according to a third embodiment of the first aspect of the present invention;

Figure 6B is a perspective view from the trailing end of the drill bit in Figure 6A;

Figure 6C is a side view of the drill bit in Figure 6A;

Figure 6D is an end view (from the leading end) of the drill bit in Figure 6A;

Figure 6E is a perspective view of cross-sectional view E-E in Figure 6D in the direction of the arrows;

Figure 6F is the view of cross-sectional view F-F in Figure 6D in the direction of the arrows;

Figure 7A is a perspective view of a drill bit for a two part drill bit assembly according to a third embodiment of the second aspect of the present invention;

Figure 7B is a side view of the drill bit in Figure 7A;

Figure 7C is an end view (from the leading end) of the drill bit in Figure 7A;

Figure 7D is the view of cross-sectional view L-L in Figure 7C in the direction of the arrows;

Figure 7E is a perspective view of cross-sectional view M-M in Figure 7C in the direction of the arrows; and

Figure 7F is a perspective view of cross-sectional view K-K in Figure 7C in the direction of the arrows.

Detailed Description of the Invention

According to a first aspect, the present invention provides a first drill bit for a two part drill bit assembly, the first drill bit having:

- (a) a leading end;
- (b) a trailing end; and
- (c) an annular bit body comprising:
 - (i) a first cutting part disposed at the leading end of the first drill bit;
 - (ii) a spiral grooved inner surface; and
 - (iii) an outer surface;

wherein the first drill bit is adapted to be releasibly received on a shaft member defined by a second drill bit via said inner surface to form the two part drill bit assembly.

For the purposes of the present invention the terms “leading” and “following” for example in the phrases “leading end” and “following end” refer to positions relative to the drilling process. “Leading” as used herein refers to a feature or part thereof that is closest or proximal to the drilling interface whereas “following” refers to a feature or part thereof that is furthest or distal to the drilling interface.

Preferably, the first drill bit is single use or disposable.

The spiral grooved inner surface is designed to allow the first drill bit to be received on the shaft member in a sufficiently positive manner to allow the two part drill bit assembly to operate during drilling but also allow an operator to remove the first drill bit from the shaft member and replace it, as required.

The spiral grooved inner surface may be tapered. Preferably, the spiral grooved inner surface tapers towards the leading end of the first drill bit.

The angle of the spiral groove of the spiral groove inner surface may be at least 50° , 60° , 70° , 80° or 85° . In one particular form of the invention, the angle of the spiral groove is about, 70° - 89° , 70° - 78° , 72° - 76° , 73° - 75° or about 74° . The spiral groove may define a helix. Preferably, the spiral grooved inner surface defines a screw thread, such as a gentle screw thread. Preferably, the spiral grooved inner surface extends longitudinally. Even more preferably, the spiral grooved surface extends between the trailing and leading ends of the first drill bit.

For the purposes of the present invention the angle of a spiral or spiral groove is the angle between the spiral and an axial line on its right, circular cylinder or cone. Preferably, the angle of the spiral is determined according to the Figure 5 herein.

The annular bit body may comprise a taper and thus may comprise a tapered socket.

Preferably, the outer surface of the annular bit body or the tapered socket tapers towards the trailing end of the first drill bit.

The outer surface of the annular bit body may include at least one groove or cut out section extending between the leading and trailing end of the first drill bit. This groove may be in the form of a cut out section in the outer surface of the annular bit body and may be spiral shaped. The cut out section may also taper towards the trailing end of the first drill bit.

Preferably, the first cutting part comprises a button or blade type cutting element or a combination thereof.

Preferably, the leading end of the first drill bit defines an opening adapted to fit the leading end of the shaft member of the second drill bit such that the leading ends of each part of the two part drill bit together form a single cutting surface. The opening at the leading end of the first drill bit may have an outer cross sectional shape that defines a reuleaux polygon, a blunt reuleaux polygon or a reuleaux triangle. Alternatively, the opening at the leading end of the first drill bit may have an outer cross sectional shape that is generally circular. In one particular form of the invention, the opening at the leading end of the first drill bit has an outer cross sectional shape that is generally circular with a plurality of irregular shaped projections evenly spaced around the perimeter thereof.

Preferably, the first drill bit has an outer cross sectional shape selected from elliptical, circular, oval, polygonal, triangle, square or rectangle.

According to a second aspect, the present invention provides a second drill bit for a two part drill bit assembly, the second drill bit having:

- (a) a leading end;
- (b) a trailing end; and
- (c) a bit body comprising:
 - (i) a second cutting part disposed at its leading end;
 - (ii) a shaft member with a spiral grooved outer surface; and

- (iii) a means for operably attaching the second drill bit to a drill string assembly.

wherein the second drill bit is adapted to releasibly receive the first drill bit via said shaft member.

Preferably, the second drill bit is multi-use or reusable.

The shaft member with the spiral grooved outer surface is designed to receive the first drill bit thereon in a sufficiently positive manner to allow the two part drill bit assembly to operate during drilling but also allow an operator to remove the first drill bit from the shaft member and replace it, as required.

The spiral grooved outer surface may be tapered. Preferably, the spiral grooved outer surface tapers towards the leading end of the second drill bit. The angle of the spiral groove may be at least 50° , 60° , 70° , 80° or 85° . In one particular form of the invention, the angle of the spiral is about 70° - 89° , 70° - 78° , 72° - 76° , 73° - 75° or about 74° . The spiral grooved outer surface may define a helix. Preferably, the spiral grooved outer surface defines a gentle screw thread.

Preferably, the second cutting part comprises a button or blade type cutting element or a combination thereof. The cutting element may define a smooth or an angular cutting surface. The hardness of the cutting element may be at least 6, 7, 8, 9 or 10 on the Mohs scale of hardness. Examples of material suitable for the cutting element include, cobalt steel, carbides such as tungsten carbide and polycrystal diamond (PCD).

Preferably, the leading end of the second drill bit is adapted to fit into the first drill bit such that the leading ends of each part of the two part drill bit together form a cutting surface.

Preferably, the shaft member has an outer cross sectional shape that defines a reuleaux polygon, a blunt reuleaux polygon or a reuleaux triangle. Alternatively, the shaft member may have an outer cross sectional shape that is elliptical, circular, oval, polygonal, triangle, square or rectangle or generally "X" shaped.

The means for operably attaching the second drill bit to a drill string assembly may be varied and includes a suitably shaped thread or gentle screw thread arrangement.

According to a third aspect the present invention also provides a two part drill bit assembly comprising a first drill bit according to a first aspect of the invention and a second drill bit according to a second aspect of the invention wherein the first drill bit is adapted to be releasibly received on the second drill bit via an inner surface of the first drill bit and an outer surface of the second drill bit.

According to one form of the third aspect of the present invention there is provided a two part drill bit assembly comprising:

- (a) a first drill bit having a leading end, a trailing end, and an annular bit body comprising a first cutting part disposed at the leading end of the first drill bit, a spiral grooved inner surface and an outer surface;
- (b) a second drill bit having a shaft bit body with a leading end and a trailing end, said shaft bit body comprising a second cutting part disposed at its leading end and a spiral grooved outer surface;

wherein the first drill bit is adapted to be releasibly received on the shaft bit body of the second drill bit via said inner surface of the first drill bit and said outer surface of the second drill bit.

Preferably, the spiral grooved inner surface of the first drill bit and the spiral grooved outer surface of the second drill bit have opposite directions so that they can releasibly interlock.

Preferably, the hardness of the first cutting part is less than the hardness of the second cutting part.

The two part drilling assembly may further comprise at least one conduit for delivering fluid to the interface between the two part drill bit assembly and the material being drilled. Preferably, the at least one conduit extends through the second drill bit.

The second drill bit may further comprise a shank member at its following end adapted to operably engage with a drill string. Preferably, the shank member is threaded.

Preferably, the interface between the shaft bit body and the shank member defines an abutment surface that is adapted to abut with the trailing end of the first drill bit, when fitted.

According to a fourth aspect of the present invention there is provided a drill assembly comprising a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the present invention.

Preferably, the drill assembly further comprises a friction bolt defining a longitudinal axial passage.

Preferably, the first drill bit according to a first aspect of the invention is sized so as to be incapable of passing through the longitudinal axial passage in the friction bolt, for example, when the friction bolt is in its stressed configuration.

Preferably, the second drill bit according to a second aspect of the invention is sized so as to be capable of passing through the longitudinal axial passage in the friction bolt, for example, when the friction bolt is in its stressed configuration.

For the purposes of the present invention the term "friction bolt" refers to a generally cylindrical structure adapted to be inserted into a rock or other formation to provide reinforcement. Friction bolts employ a range of measures to enable them to be deployed and provide the required reinforcement, the vast majority of which are based on the friction bolt being able to exert outward pressure on the hole into which they have been inserted. One particular type of friction bolt that the drill bits of the present invention can be used with has a configuration when inserted into a formation or *in situ* ("stressed configuration") where the width or diameter of the longitudinal axial passage therein is reduced relative to the width or diameter of the longitudinal axial passage prior to insertion of the friction bolt ("relaxed configuration").

As indicated above, it is preferred that the second drill bit according to the second aspect of the invention is adapted to pass through the longitudinal axial passage in the friction bolt *in situ* i.e. when the friction bolt has been inserted into a formation. Thus, it is preferred that the largest diameter or width of the second drill bit according to the second aspect of the invention is sized to enable the second drill bit to pass through the longitudinal axial passage in the friction bolt when the friction bolt is inserted into a body of rock or other material. With this in mind it is preferred that the largest diameter or width of the second drill bit according to the second aspect of the invention is less than or equal to the largest diameter or width of the remainder of the drill bit.

According to a fifth aspect the present invention provides a drilling system comprising:

- (a) a drill string;
- (b) a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the invention; and
- (c) a drive means for imparting rotational and/or percussive force on the drill string.

Preferably, the drilling system further comprises a friction bolt defining a longitudinal axial passage.

According to a sixth aspect the present invention provides a method of drilling into a formation, the method comprising the steps of:

- (a) providing a drill assembly including a drill bit according to a first or second aspect of the present invention or a two part drill bit assembly according to a third aspect of the invention;
- (b) drilling a hole in the formation using the drill assembly; and
- (c) withdrawing the drill bit assembly from the hole.

The method may further comprise the step of disengaging a first drill bit according to a first aspect of the present invention from the drill assembly. Preferably, the first drill bit is disengaged by applying a percussive force to the drill assembly. Even more preferably, the first drill bit is disengaged after the drill assembly has been withdrawn from the hole.

The method step of withdrawing the drill assembly from the hole may further comprise the step of maintaining a rotational force on the drill assembly. In this regard, continuing to rotate the drill assembly while withdrawing it from the hole will decrease the likelihood of the first drill bit disengaging.

Preferably, the drill assembly comprises a friction bolt.

When the drill assembly comprises a friction bolt, the method may further comprise the step of disengaging the friction bolt from the drill assembly.

When the drill assembly comprises a friction bolt, the step of retrieving the drill assembly may further comprise the step of retrieving the second drill bit through the friction bolt.

It will be appreciated that by allowing the first drill bit according to first aspect of the present invention to be detached, this part of the two part drill bit can be replaced independently of the second drill bit. This should confer substantial in use and economic advantages.

According to a seventh aspect the present invention provides a friction bolt comprising a first drill bit according to a first aspect of the present invention.

Preferably, the first drill bit is releasibly engaged on the leading end of the friction bolt by a friction fit. Preferably, the outside diameter or width of the first drill bit is greater than the inside diameter of the longitudinal axial passage. Even more preferably, the first drill bit further comprises a circumferential groove on its outer surface that is adapted to releasibly engage with the leading end of the friction bolt via a friction fit.

General

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. The invention includes all such variation and modifications. The invention also includes all of the steps and features referred to or indicated in the specification, individually or collectively and any and all combinations or any two or more of the steps or features.

Each document, reference, patent application or patent cited in this text is expressly incorporated herein in their entirety by reference, which means that it should be read and considered by the reader as part of this text. That the document, reference, patent application or patent cited in this text is not repeated in this text is merely for reasons of conciseness. None of the cited material or the information contained in that material should, however be understood to be common general knowledge.

The present invention is not to be limited in scope by any of the specific embodiments described herein. These embodiments are intended for the purpose of exemplification only. Functionally equivalent products and methods are clearly within the scope of the invention as described herein.

The invention described herein may include one or more range of values (e.g. size etc). A range of values will be understood to include all values within the range, including the values defining the range, and values adjacent to the range which lead to the same or substantially the same outcome as the values immediately adjacent to that value which defines the boundary to the range.

Throughout this specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout. Unless otherwise defined, all technical terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which the invention belongs.

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Detailed Description of the Preferred Embodiments

A first drill bit for a two part drill assembly according to a first embodiment of the first aspect of the present invention is depicted in Figure 1A and generally indicated by the numeral 10. The first drill bit 10 has an annular bit body in the form of ring shaped socket member, formed of a suitable metal such as a 4140 grade metal, that defines a tapered spirally grooved inner surface including a series of ridges 12a and troughs 12b, an outer surface 14 and a first cutting part disposed at the leading end of the drill bit including tungsten carbide buttons 16. The opening of the ring shaped socket member at the leading and trailing ends has a reuleaux triangle shaped cross section. The outer surface 14 tapers towards the trailing end of the drill bit 10 and includes a scalloped or shaped surface including cut-outs 20.

The first drill bit 10 is adapted to releasibly engage with a second drill bit (see Figures 2A-2D) via ridges 12a and troughs 12b formed on the spirally grooved inner surface that are shaped and sized to fit with a compatibly shaped surface on the other drill bit i.e. the ridge on the surface of one drill bit engages with the trough on the surface of the other drill bit (see Figures 2A-2D). The first drill bit 10 also includes an abutment surface 18 at its trailing end adapted to abut with a compatible surface 58 on the second drill bit 50 (see Figures 2A-2D).

A second drill bit for a two part drill assembly according to a first embodiment of the second aspect of the present invention is depicted in Figure 2A and generally indicated by the numeral 50. The second drill bit 50 has a bit body 51 including a second cutting part disposed at its leading end in the form of tungsten carbide buttons 52, a shaft with a tapered spirally grooved outer surface including a series of troughs 54a and ridges 54b. Troughs 54a and ridges 54b are shaped and sized so

as to releasibly engage with ridges 12a and troughs 12b on drill bit 10 (see Figures 1A-1E). The spirals of the grooved outer surface include a relatively gentle turn or angle (as opposed to a tight turn/angle) of about 80° – see angle X in Figure 2A.

The second drill bit 50 also includes a means for operably attaching the second drill bit to a drill assembly or drill string in the form of threaded shank 56. The interface between the threaded shank 56 and the drill bit body 51 defines an abutment surface 58 adapted to abut with the abutment surface 18 on the first drill bit 10 (see Figures 1A-1E).

Second drill bit 50 also includes conduits 60 for delivering fluid to the interface between the second drill bit 50 and the material being drilled during use.

A first drill bit for a two part drill assembly according to a second embodiment of the first aspect of the present invention is depicted in Figures 3A-3E. The main difference between the embodiment in Figures 3A-3E and 1A-1E is the shape of the tapered spirally grooved inner surface. The ridges 12a in the second embodiment are narrower than those in the first embodiment and the troughs 12b in the second embodiment are wider than those in the first embodiment. Thus, the numbering from Figures 1A-1E has been carried over to Figures 3A-3E and the description provided above in relation to Figures 1A-1E applies to Figures 3A-3E.

A second drill bit for a two part drill assembly according to a second embodiment of the second aspect of the present invention is depicted in Figures 4A-4D. The main difference between the embodiment in Figures 4A-4D and 2A-2D is the shape of the tapered spirally grooved outer surface. The troughs 54a in the second embodiment are wider than those in the first embodiment and the ridges 54b in the second embodiment are narrower than those in the first embodiment. Thus, the numbering from Figures 2A-2D has been carried over to Figures 4A-4D and the description provided above in relation to Figures 2A-2D applies to Figures 4A-4D.

Figure 5 illustrates the determination of the angle of a spiral or helix as the angle 100 between the spiral 102 and an axial line 104 on its right, circular cylinder 106. It is apparent from Figure 5 that a gentle spiral will have a spiral angle approaching 90° and a tight spiral will have a spiral angle approaching 1° . Whilst Figure 5 illustrates a right handed spiral or helix it will be appreciated that it can be inverted or reversed to

reflect a left handed spiral or helix i.e. the “handedness” of the spiral or helix is not essential or as important as the quantum or size of the angle of the spiral or helix as described herein.

A first drill bit for a two part drill assembly according to a third embodiment of the first aspect of the present invention is depicted in Figures 6A-6F and generally indicated by the numeral 300. The first drill bit 300 has an annular bit body in the form of ring shaped socket member, formed of a suitable metal, that defines a tapered spirally grooved inner surface including a series of ridges 312a and troughs 312b, an outer surface 314 that tapers towards the trailing end of the drill bit 300 and a first cutting part disposed at the leading end of the drill bit including four tungsten carbide buttons 316.

The main difference between the third embodiment and other embodiments is the shape or profile of the inner surface. In this regard, the ring shaped socket member has an inner surface with a profile that defines a generally X shaped socket incorporating a gentle spiral along its length.

The first drill bit 300 is adapted to releasibly engage with a second drill bit (see Figures 7A-7F) and generally indicated by the numeral 400 via ridges 312a and troughs 312b formed on the spirally grooved inner surface that are shaped and sized to fit with a compatibly shaped surface on the second drill bit 400 i.e. the ridge on the surface of one drill bit engages with the trough on the surface of the other drill bit. The first drill bit 300 also includes an abutment surface 318 at its trailing end adapted to abut with a compatible surface 458 on the second drill bit 400.

The second drill bit 400 has a bit body 451 including a second cutting part disposed at its leading end in the form of four tungsten carbide buttons 452, a shaft member in the form of a shaft 455 with a tapered spirally grooved outer surface including a series of troughs 454a and ridges 454b. Troughs 454a and ridges 454b are shaped and sized so as to releasibly engage with ridges 312a and troughs 312b on first drill bit 300 (see Figures 6A-6F). The spirals of the grooved outer surface include a relatively gentle turn or angle of about 74° .

The second drill bit 400 also includes a means for operably attaching the second drill bit 400 to a drill assembly or drill string in the form of threaded shank 456. The

interface between the threaded shank 456 and the drill bit body 451 defines an abutment surface 458 adapted to abut with the abutment surface 318 on the first drill bit 300.

Second drill bit 400 also includes a central conduit 460 that is in fluid communication with four secondary conduits 462a and 462b (only 2 shown) for delivering fluid to the drilling interface during use.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims.

Claims

1. A first drill bit for a two part drill bit assembly, the first drill bit having:
 - (a) a leading end;
 - (b) a trailing end; and
 - (c) an annular bit body comprising:
 - (i) a first cutting part disposed at the leading end of the first drill bit;
 - (ii) a spiral grooved inner surface; and
 - (iii) an outer surface;wherein the first drill bit is adapted to be releasibly received on a shaft defined by a second drill bit via said inner surface.
2. A first drill bit according to claim 1 wherein the spiral grooved inner surface is tapered.
3. A first drill bit according to claim 1 wherein the spiral grooved inner surface tapers towards the leading end of the drill bit.
4. A first drill bit according to any one of claims 1 to 3 wherein the spiral groove has an angle of at least 50°, 60°, 70° 80° or 85°.
5. A first drill bit according to any one of claims 1 to 3 wherein the spiral groove has an angle of 70°-89°.
6. A first drill bit according to claim 1 wherein the spiral grooved inner surface defines a helix.
7. A first drill bit according to any one of the preceding claims wherein the outer surface of the annular drill bit body tapers towards the trailing end of the drill bit.
8. A first drill bit according to any one of the preceding claims wherein the outer surface of the annular drill bit body includes at least one groove extending between the leading and trailing end of the drill bit.

9. A first drill bit according to claim 8 wherein the groove is spiral shaped.
10. A first drill bit according to claim 8 wherein the groove tapers towards its trailing end.
11. A first drill bit according to any one of the preceding claims wherein the first cutting part comprises a button or blade type cutting element or a combination thereof.
12. A first drill bit according to any one of the preceding claims wherein the leading end defines an opening adapted to fit the leading end of the other part of the two part drill bit assembly such that the leading ends of each part of the two part drill bit together form a cutting surface.
13. A first drill bit according to claim 12 wherein the opening has an outer cross sectional shape that defines a reuleaux polygon.
14. A first drill bit according to claim 12 wherein the opening has an outer cross sectional shape that defines a blunt reuleaux polygon.
15. A first drill bit according to claim 13 or 14 wherein the reuleaux polygon is a reuleaux triangle.
16. A first drill bit according to any one of the preceding claims with an outer cross sectional shape selected from elliptical, circular, oval, polygonal, triangle, square or rectangle.
17. A second drill bit for a two part drill bit assembly, the second drill bit having:
 - (a) a leading end;
 - (b) a trailing end; and
 - (c) a bit body comprising:
 - (i) a second cutting part disposed at its leading end;
 - (ii) a shaft member with a spiral grooved outer surface; and

(iii) a means for operably attaching the drill bit to a drill string assembly.

wherein the drill bit is adapted to releasibly receive a first drill according to any one of claims 1 to 17 via said shaft member.

18. A second drill bit according to claim 17 wherein the spiral grooved outer surface is tapered.
19. A second drill bit according to claim 17 wherein the spiral grooved outer surface tapers towards the leading end of the drill bit.
20. A second drill bit according to claim 17 wherein the spiral grooved outer surface defines a helix.
21. A second drill bit according to claim 17 wherein the helix has a helix angle of at least 50° , 60° , 70° or 80° .
22. A second drill bit according to claim 17 wherein the helix has a helix angle of 70° - 89° .
23. A second drill bit according to any one of claims 17 to 22 wherein the second cutting part comprises a button or blade type cutting element or a combination thereof.
24. A second drill bit according to any one of claims 17 to 23 wherein the leading end is adapted to fit into the other part of the two part drill bit assembly such that the leading ends of each part of the two part drill bit together form a cutting surface.
25. A second drill bit according to any one of claims 17 to 24 wherein the shaft member has an outer cross sectional shape that defines a reuleaux polygon.
26. A second drill bit according to claim 25 wherein the shaft member has an outer cross sectional shape that defines a blunt reuleaux polygon.
27. A second drill bit according to claim 25 or 26 wherein the reuleaux polygon is a reuleaux triangle.

28. A second drill bit according to any one of claims 17 to 27 wherein the shaft member has an outer cross sectional shape selected from , "X"-shaped, elliptical, circular, oval, polygonal, triangle, square or rectangle.

29. A two part drill bit assembly comprising:

- (a) a first drill bit according to any one of claims 1 to 16;
- (b) a second drill bit according to any one claims 17 to 28;

wherein the first drill bit is adapted to be releasibly received on the second drill bit via said inner surface of the first drill bit and said outer surface of the second drill bit.

30. A two part drill bit assembly according to claim 29 wherein the second drill bit further comprises a shank member at its following end adapted to operably engage with a drill string.

31. A two part drill bit assembly according to claim 30 wherein the interface between the shaft bit body and the shank member defines an abutment surface that is adapted to abut with the trailing end of the first drill bit.

32. A two part drill bit according to claim 30 or 31 wherein the shank member is adapted to be threaded on to a drill string.

33. A drill assembly comprising a drill bit according to any one of claims 1 to 28 or a two part drill bit according to any one of claims 29-32.

34. A drill assembly according to claim 33 comprising a friction bolt defining a longitudinal axial passage.

35. A drilling system comprising:

- (a) a drill string;
- (b) a drill bit according to any one of claims 1 to 28 or a two part drill bit assembly according to any one of claims 29-32; and

(c) a drive means for imparting rotational and/or percussive force on the drill string.

36. A method of drilling into a formation, the method comprising the steps of:

- (a) providing a drill assembly including a drill bit according to any one of claims 1 to 28 or a two part drill bit assembly according to any one of claims 29-32;
- (b) drilling a hole in the formation using the drill assembly; and
- (c) withdrawing the drill bit assembly from the hole.

37. A friction bolt comprising a drill bit according to any one of claims 1 to 16.

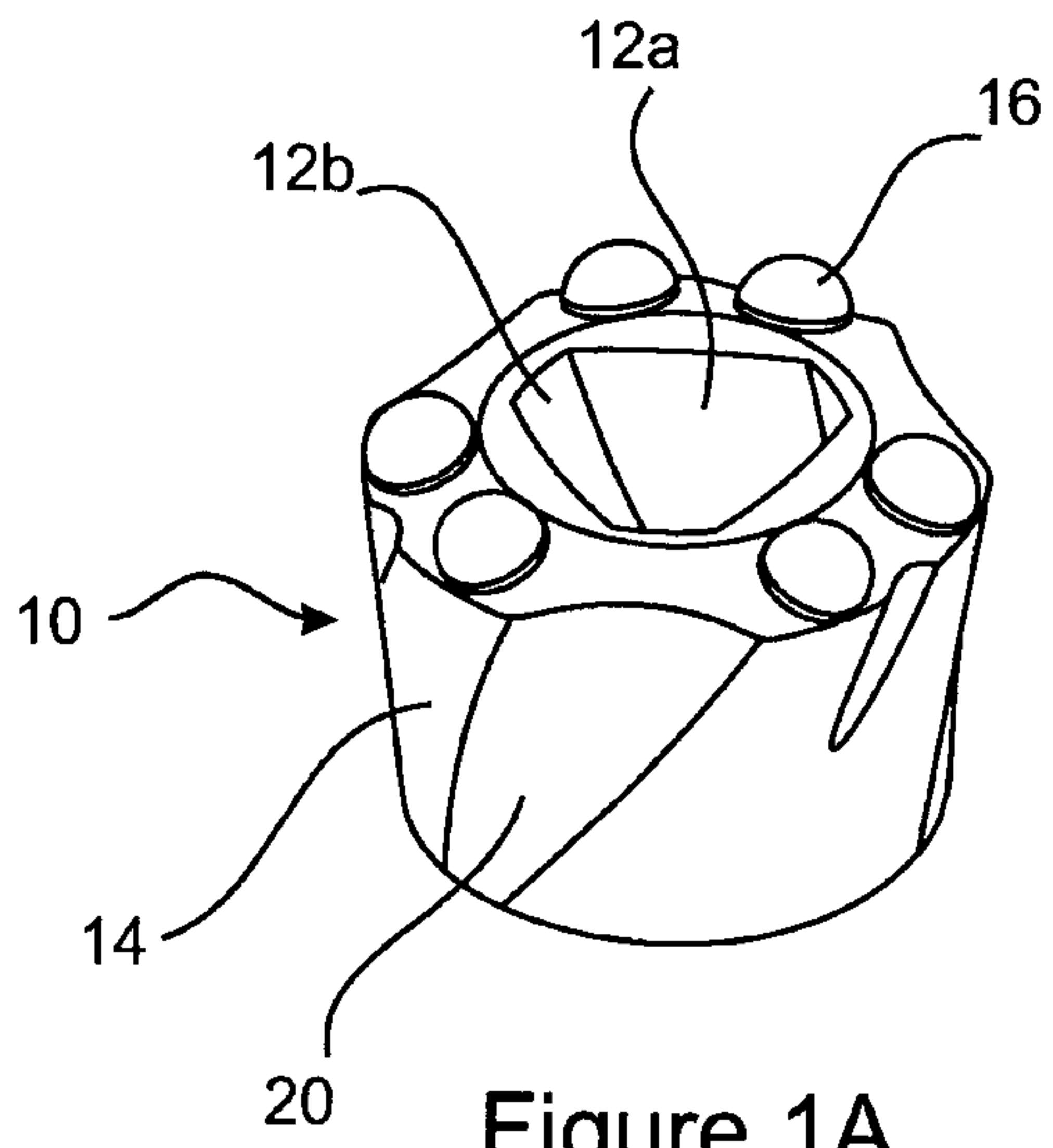


Figure 1A

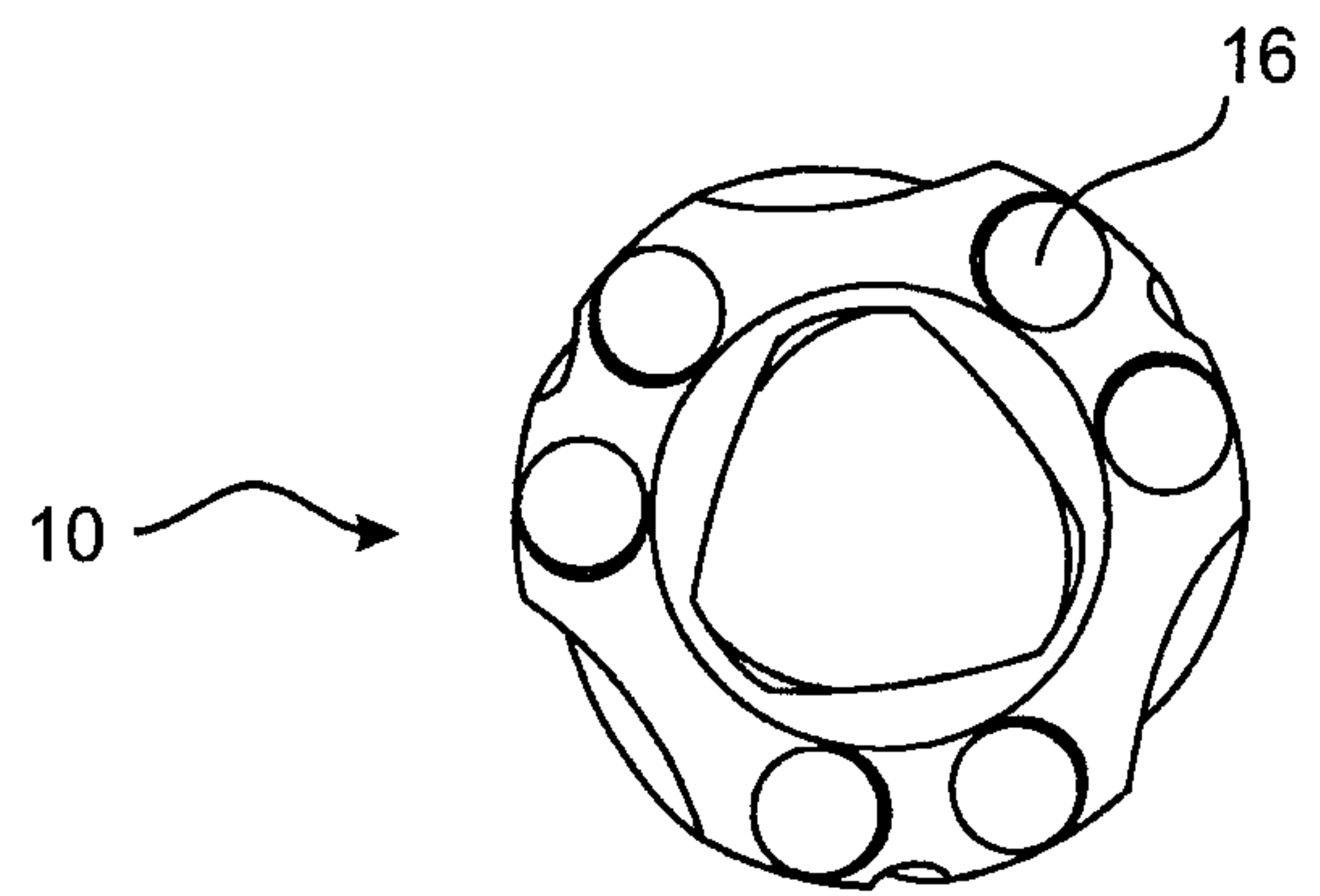


Figure 1D

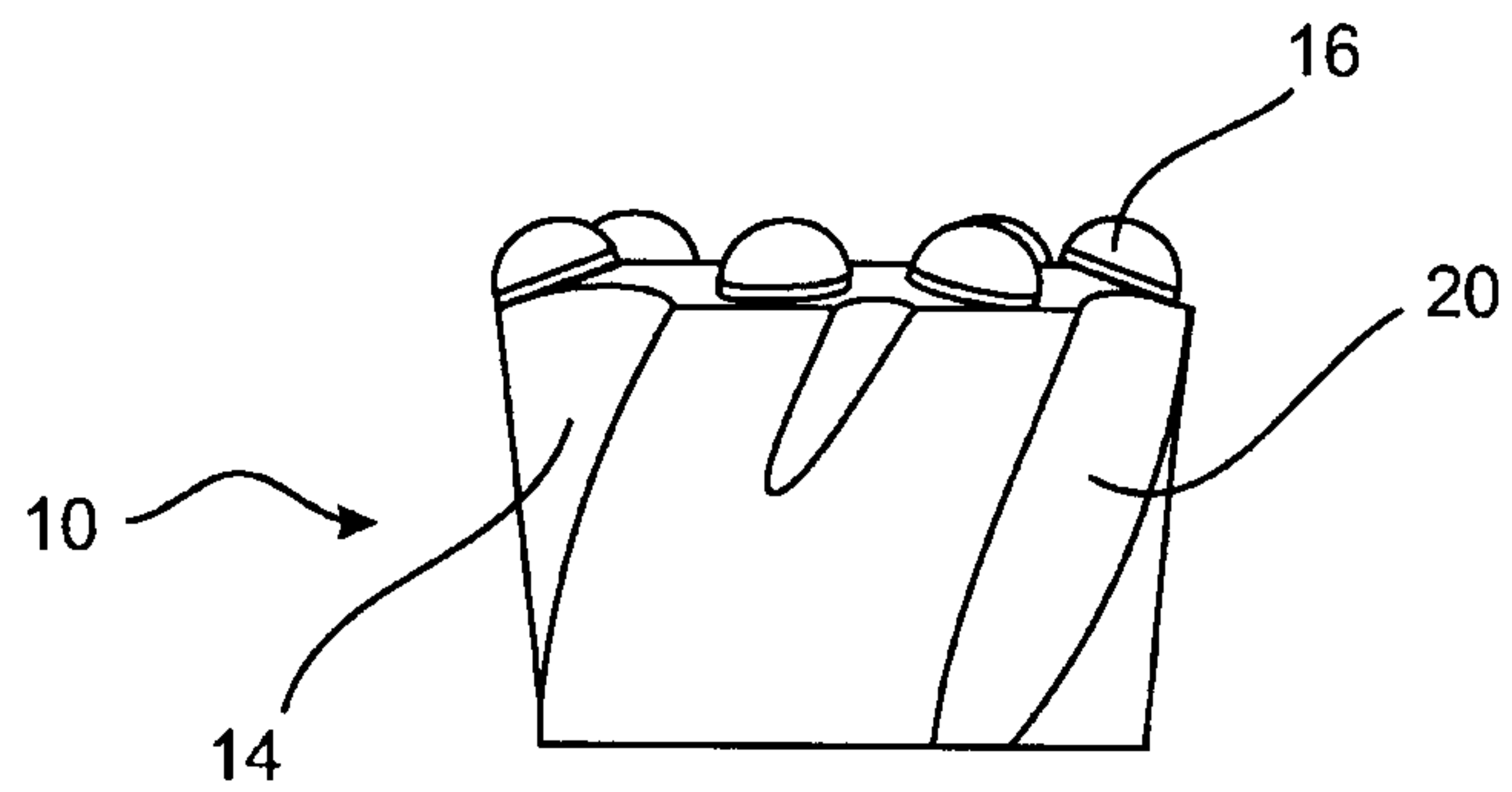


Figure 1C

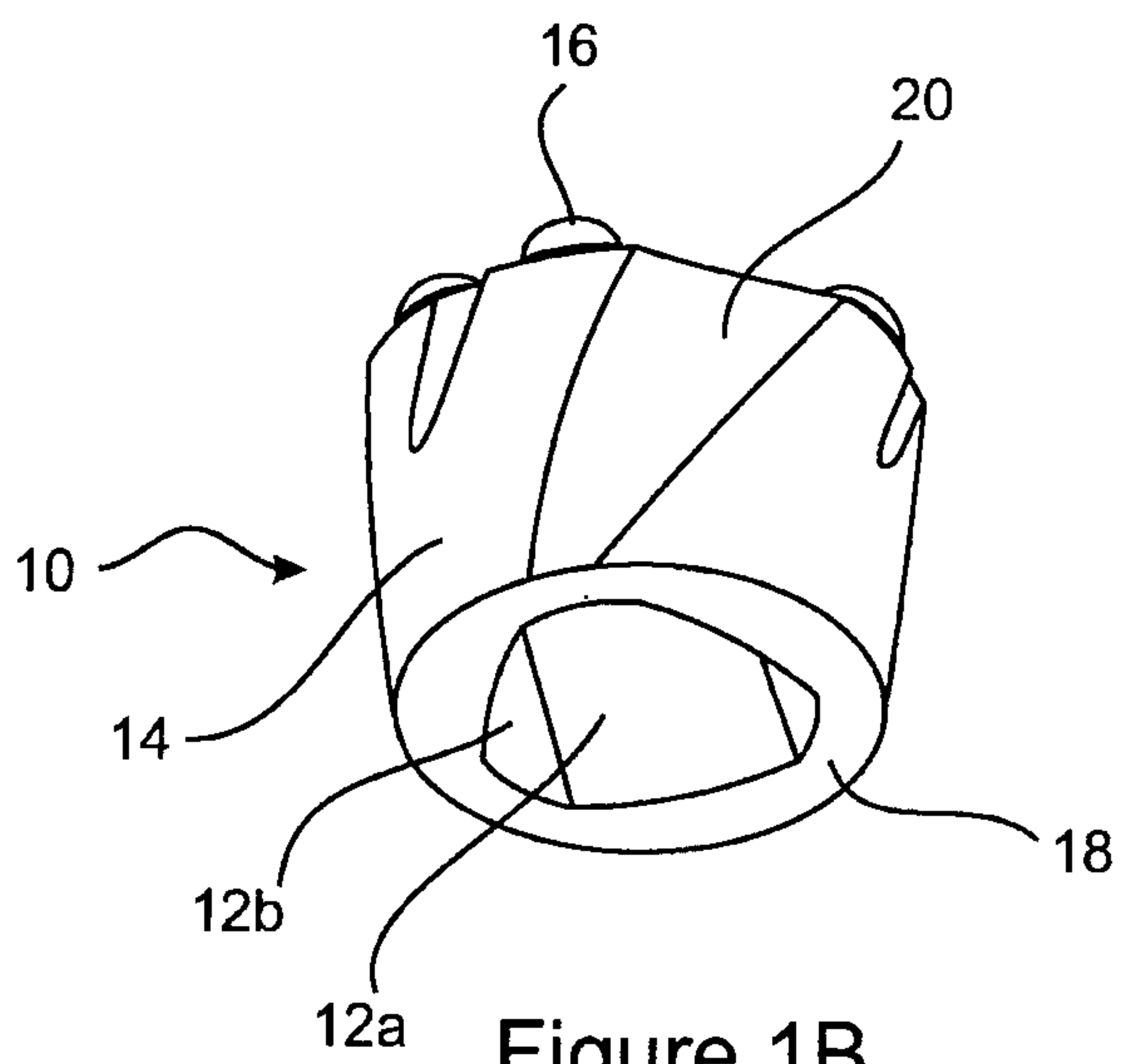


Figure 1B

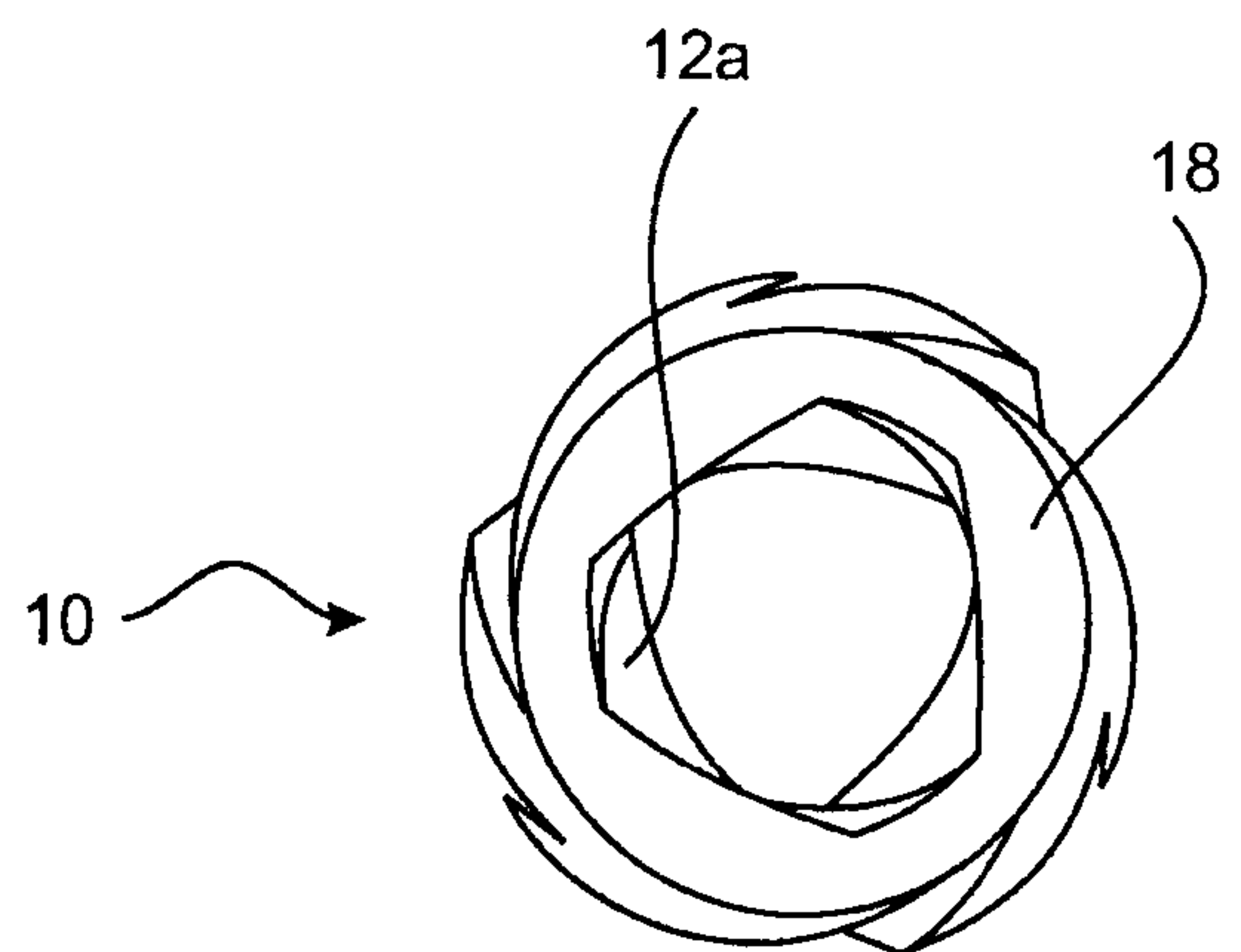


Figure 1E

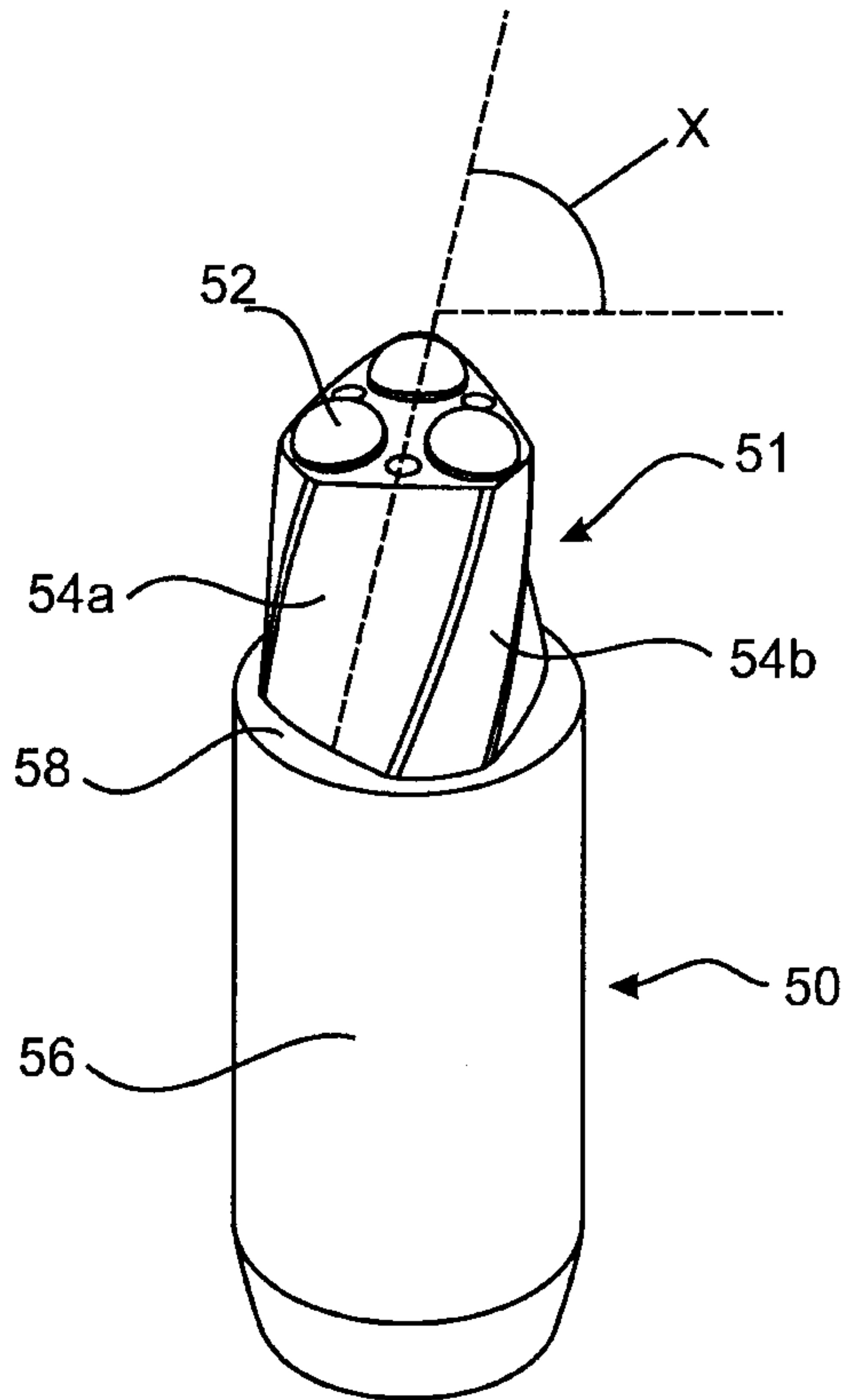


Figure 2A

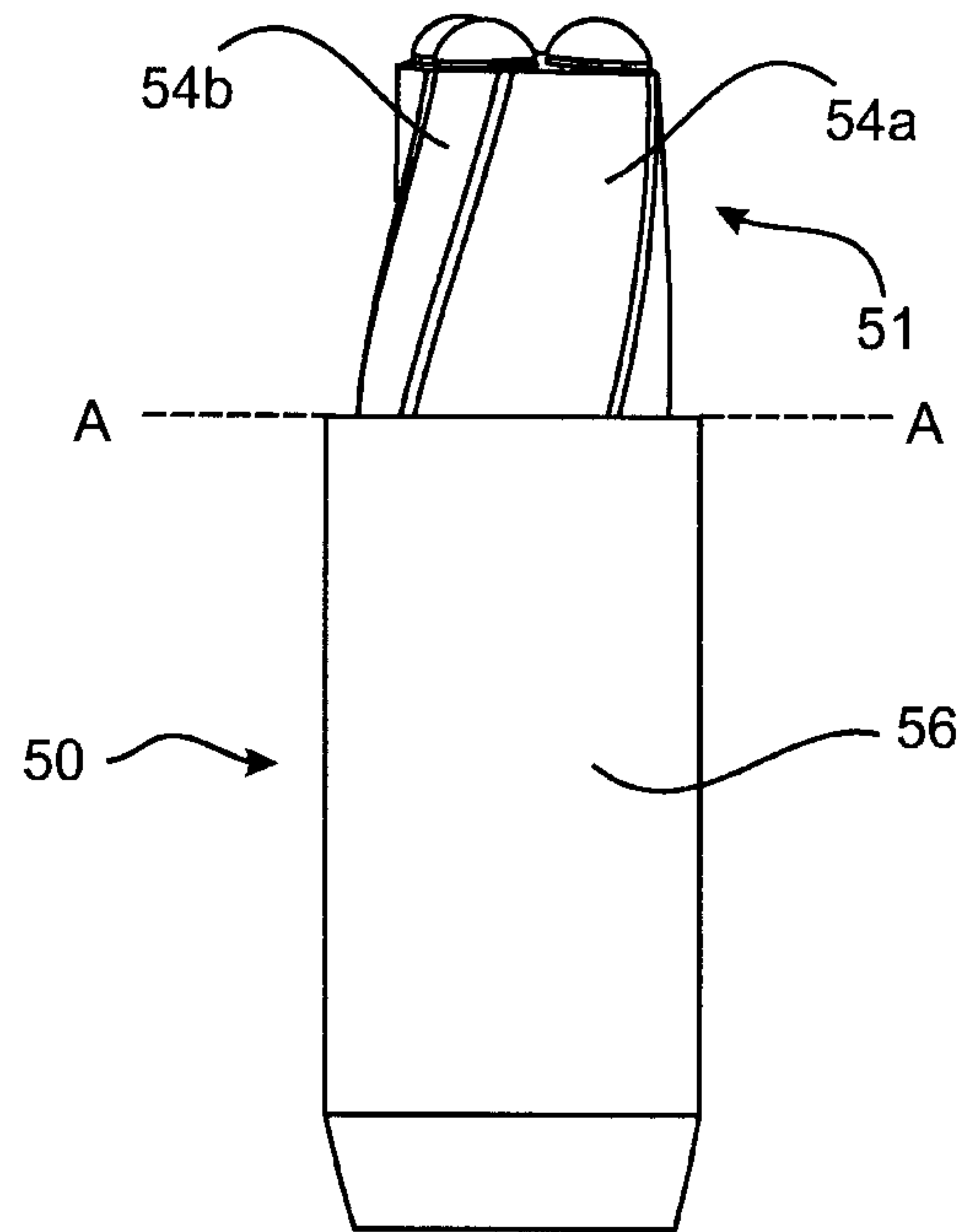


Figure 2B

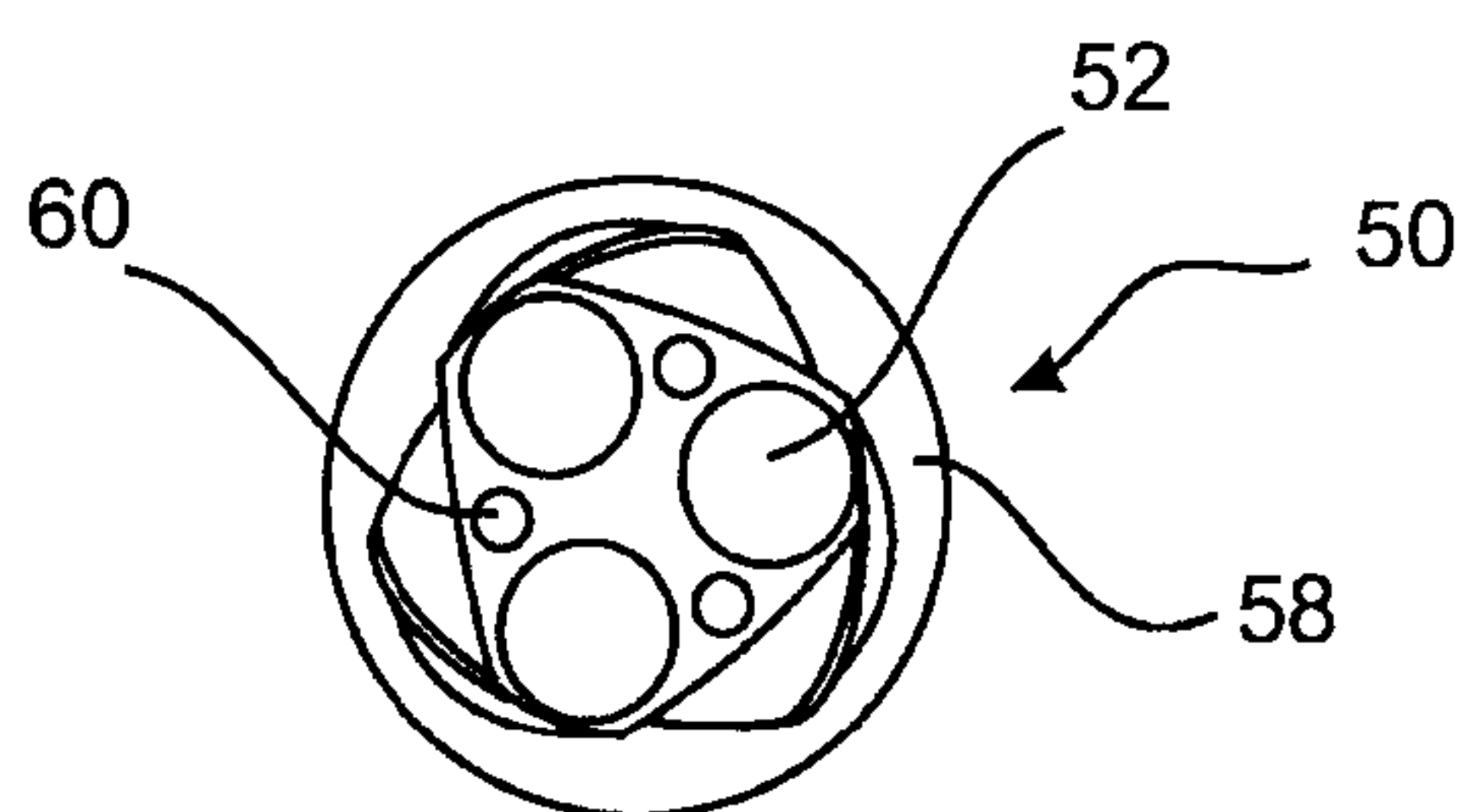


Figure 2C

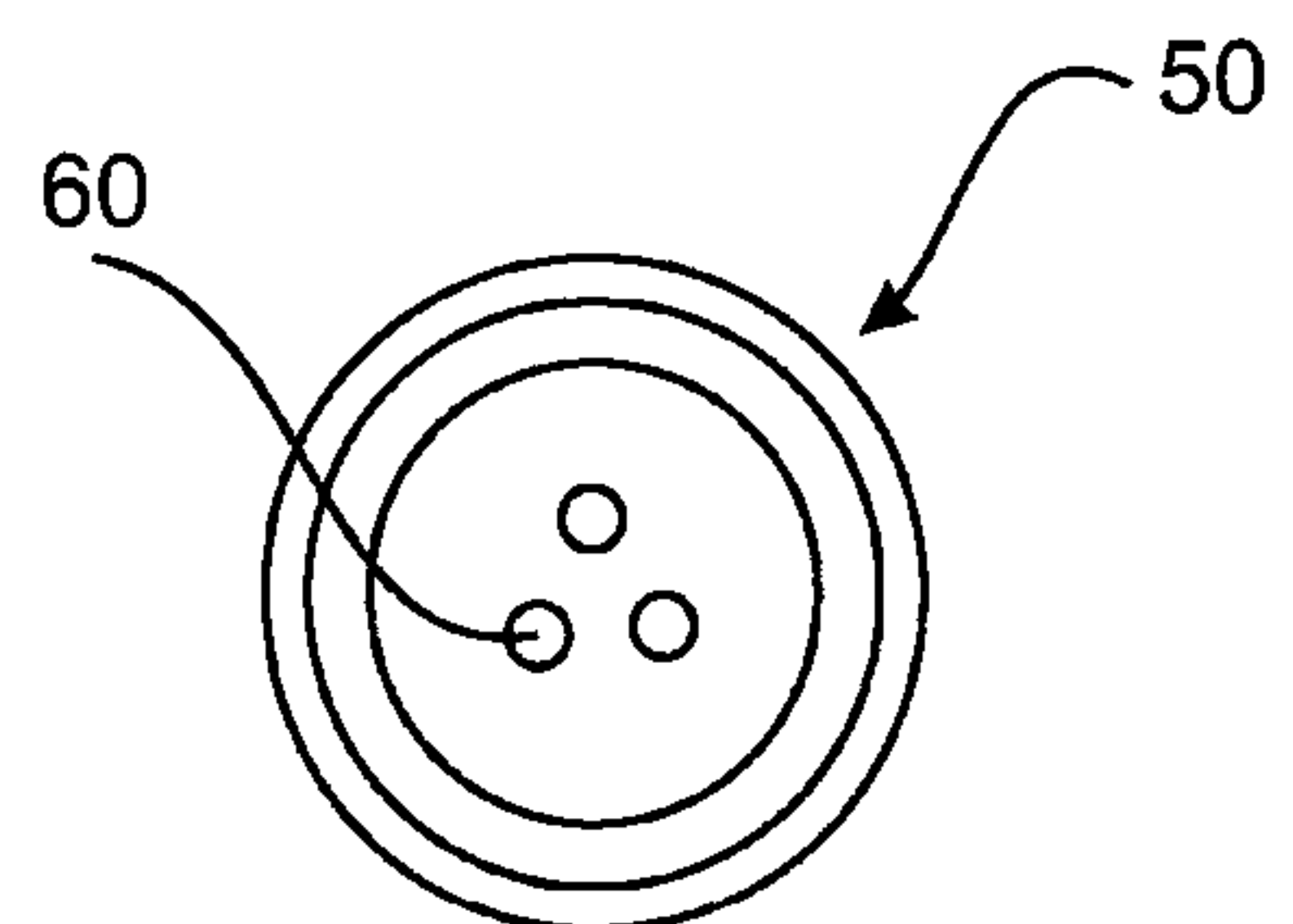


Figure 2D

3 / 11

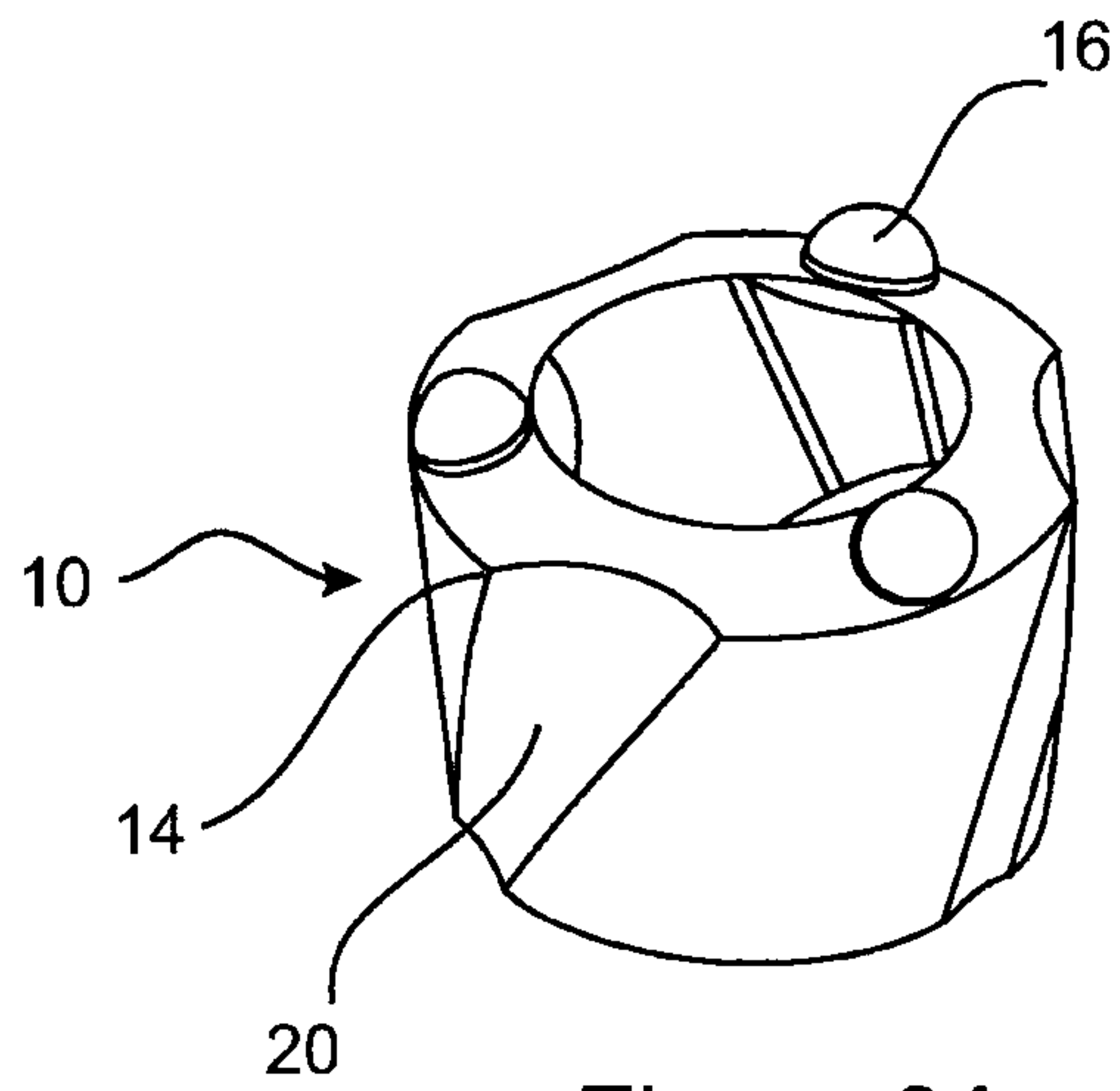


Figure 3A

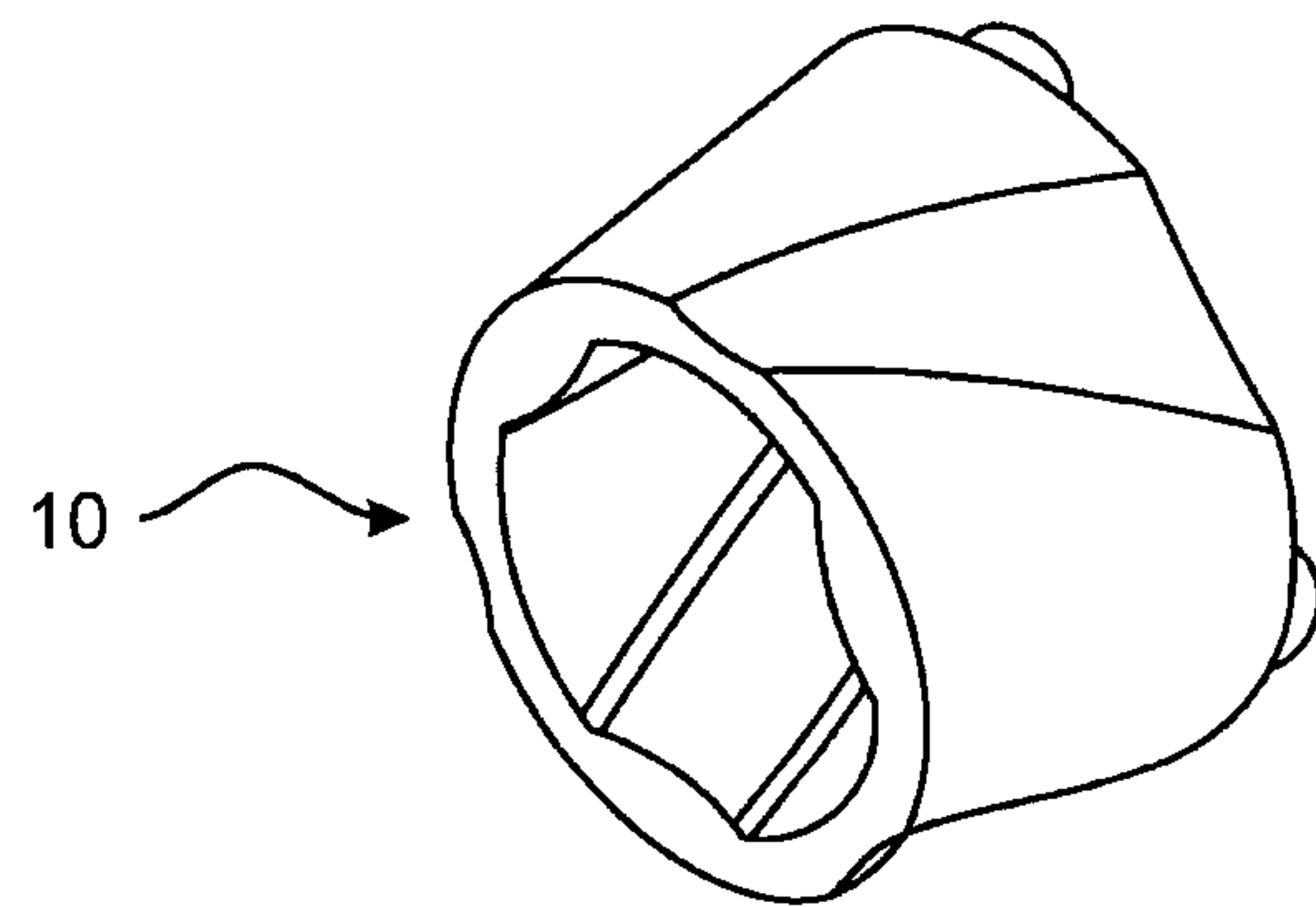


Figure 3B

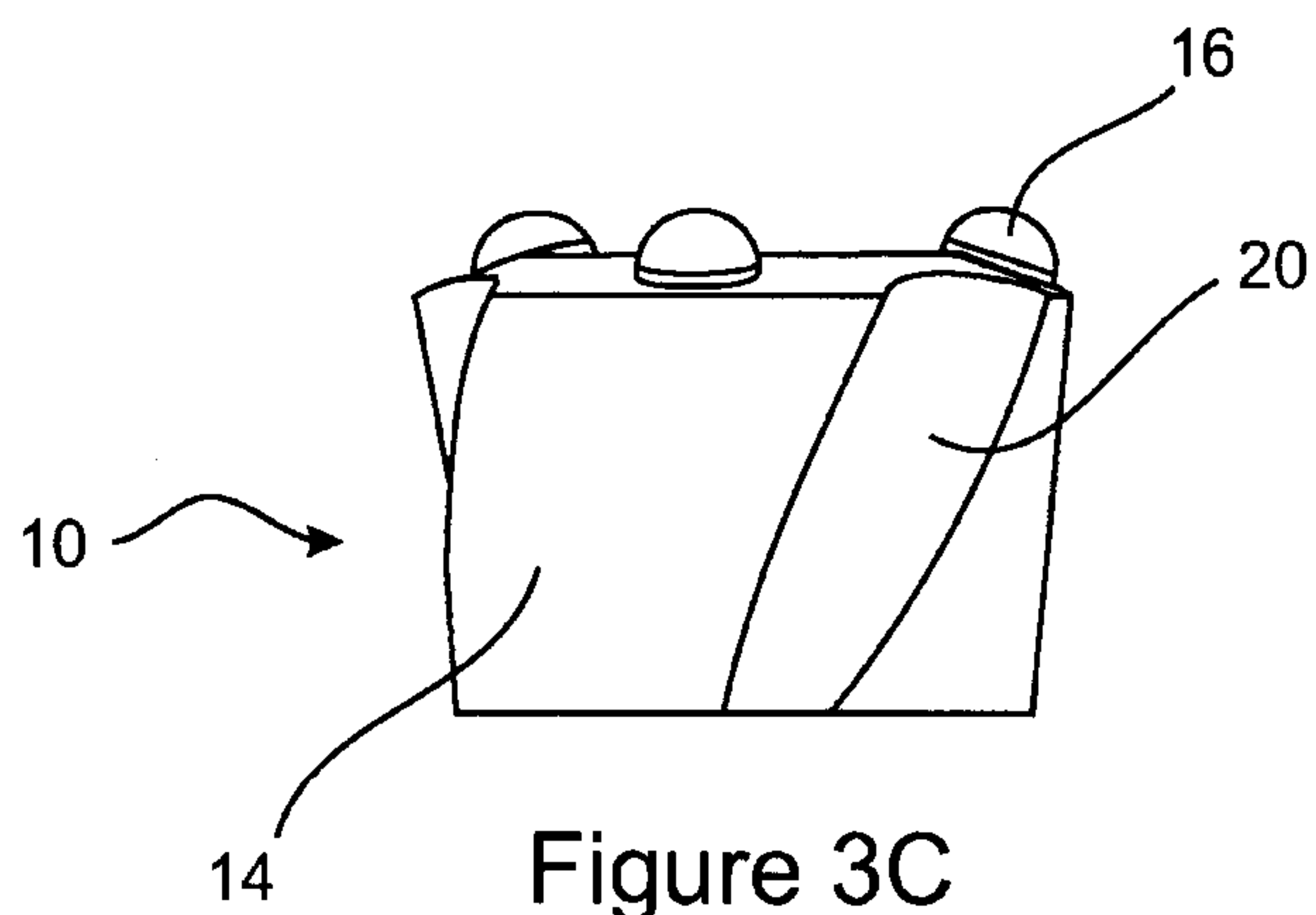


Figure 3C

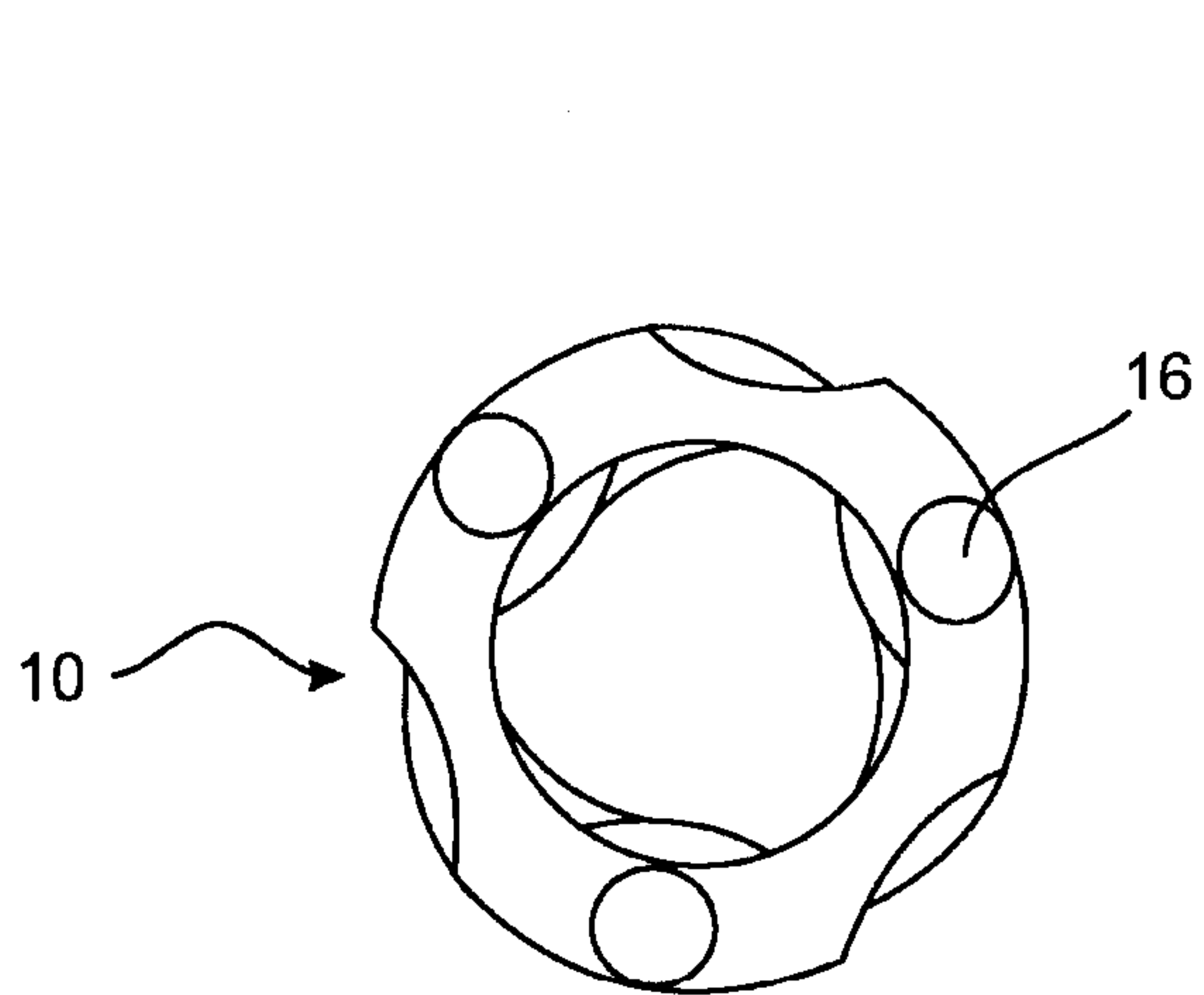


Figure 3D

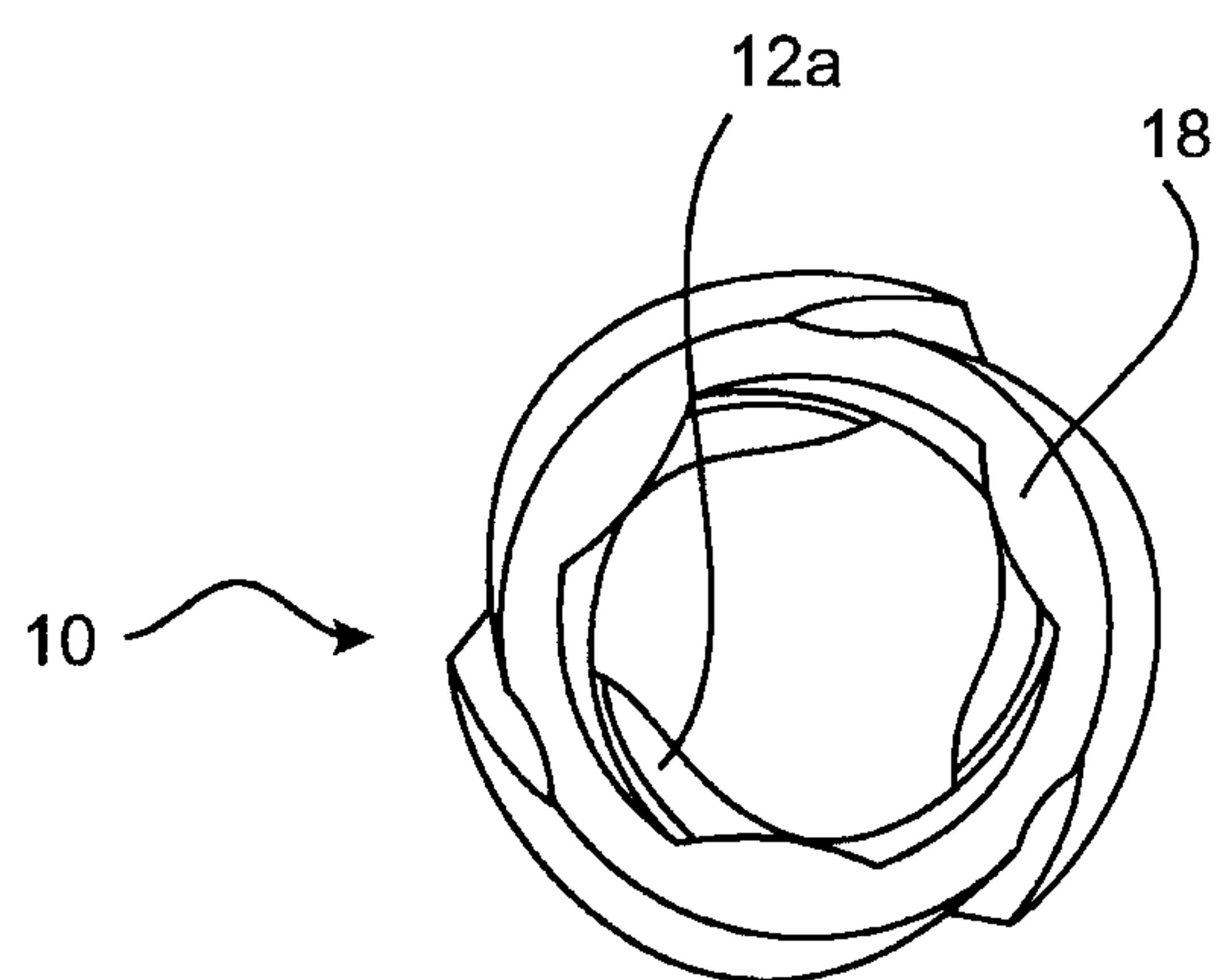


Figure 3E

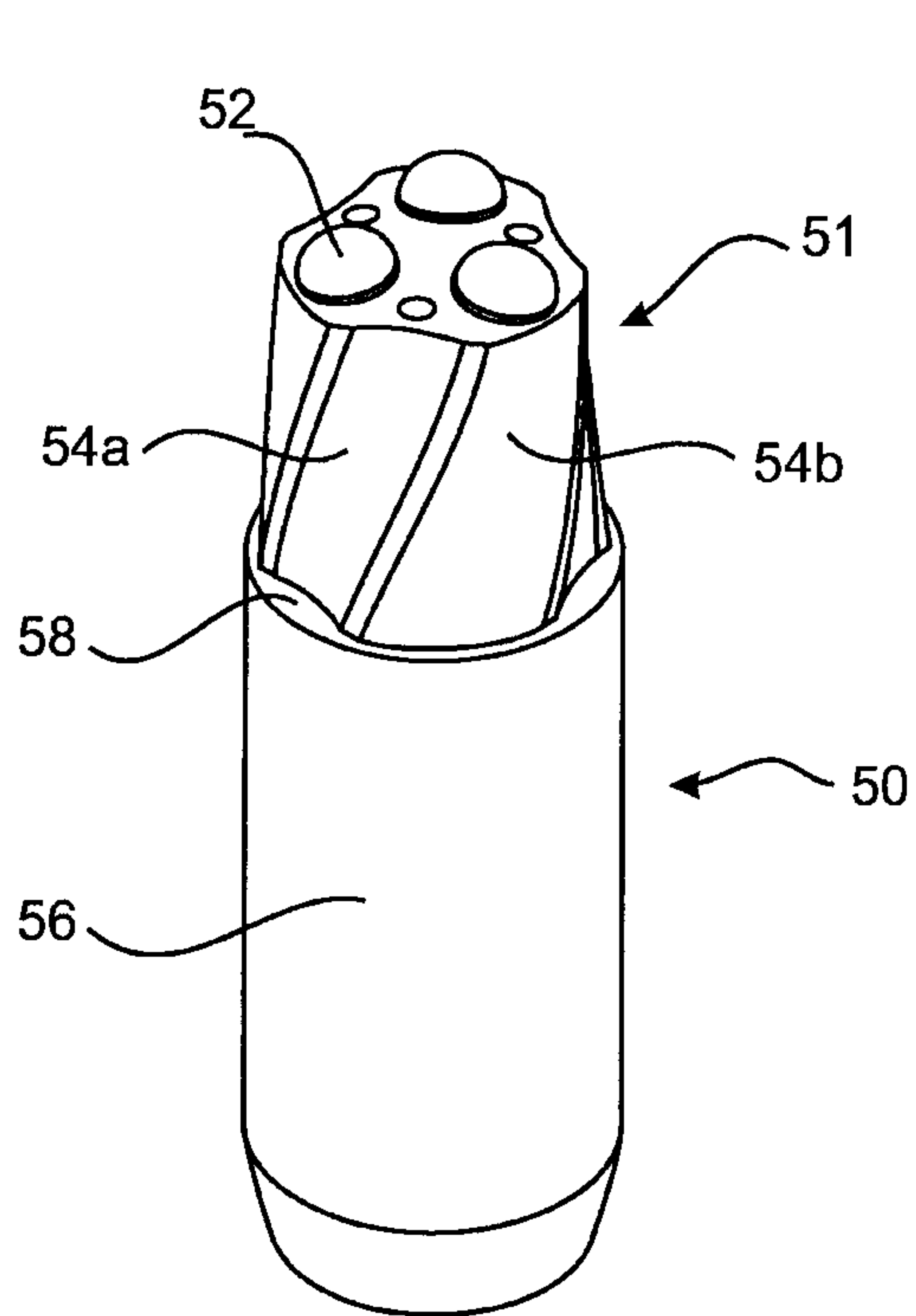


Figure 4A

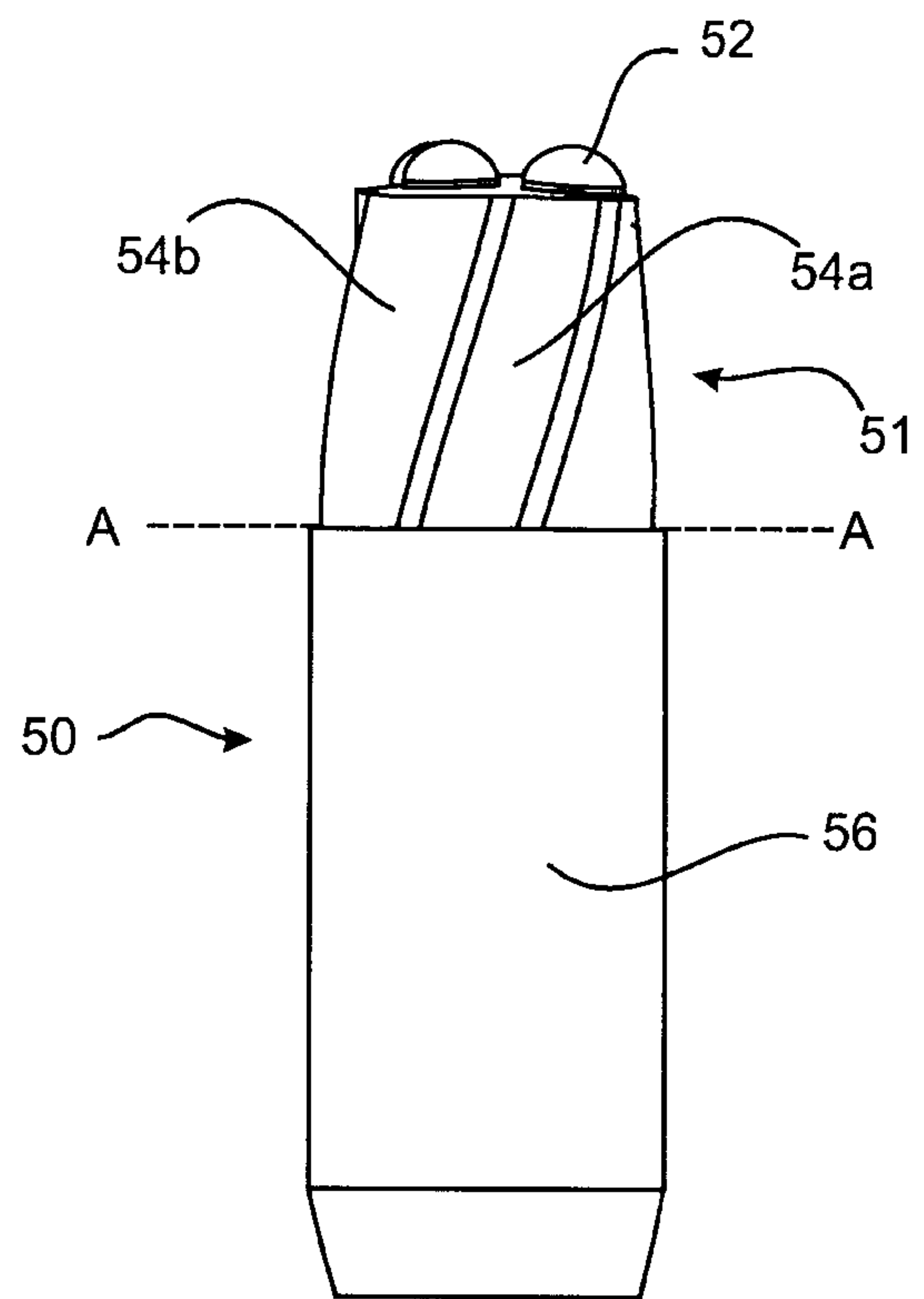


Figure 4B

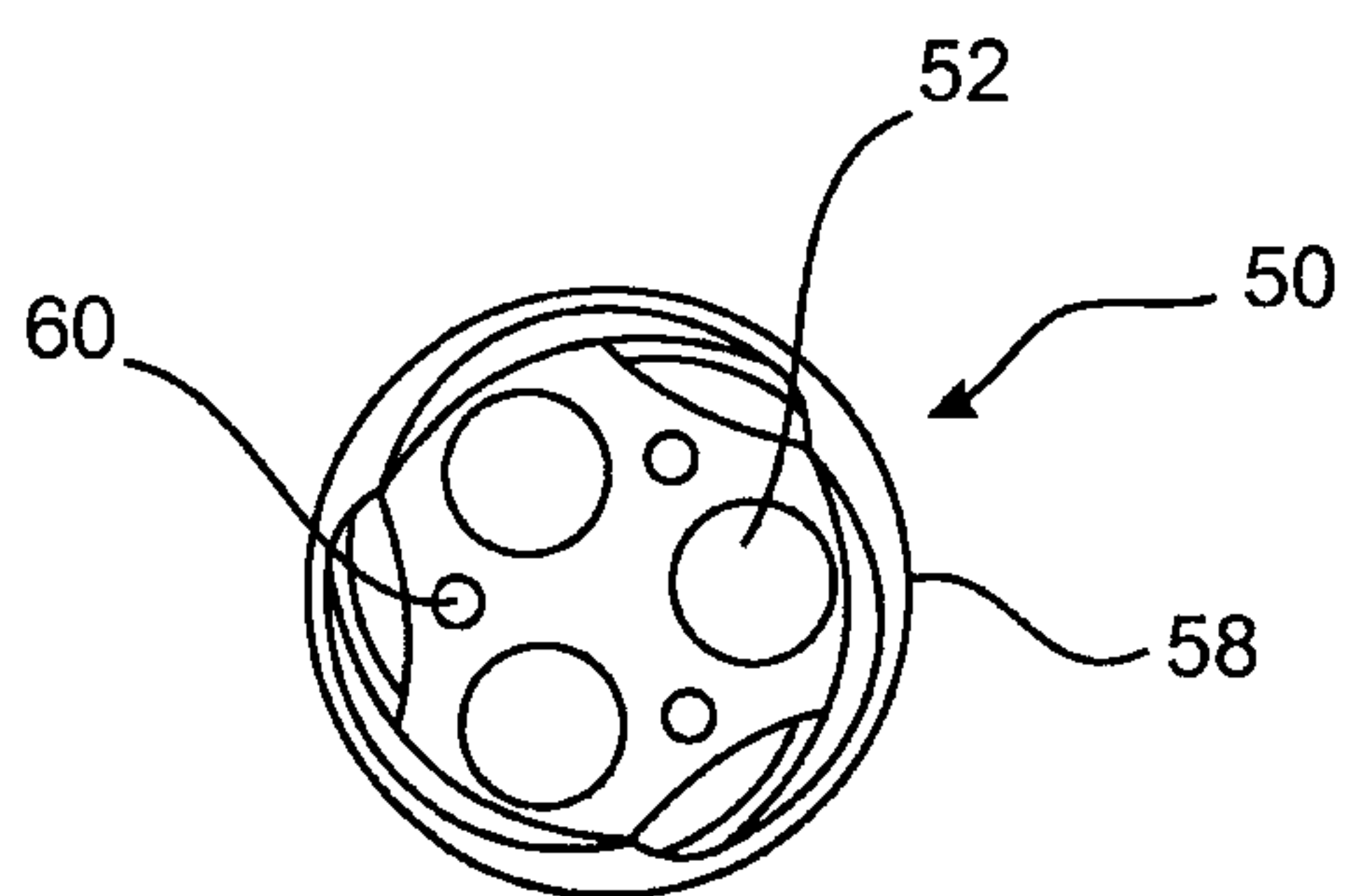


Figure 4C

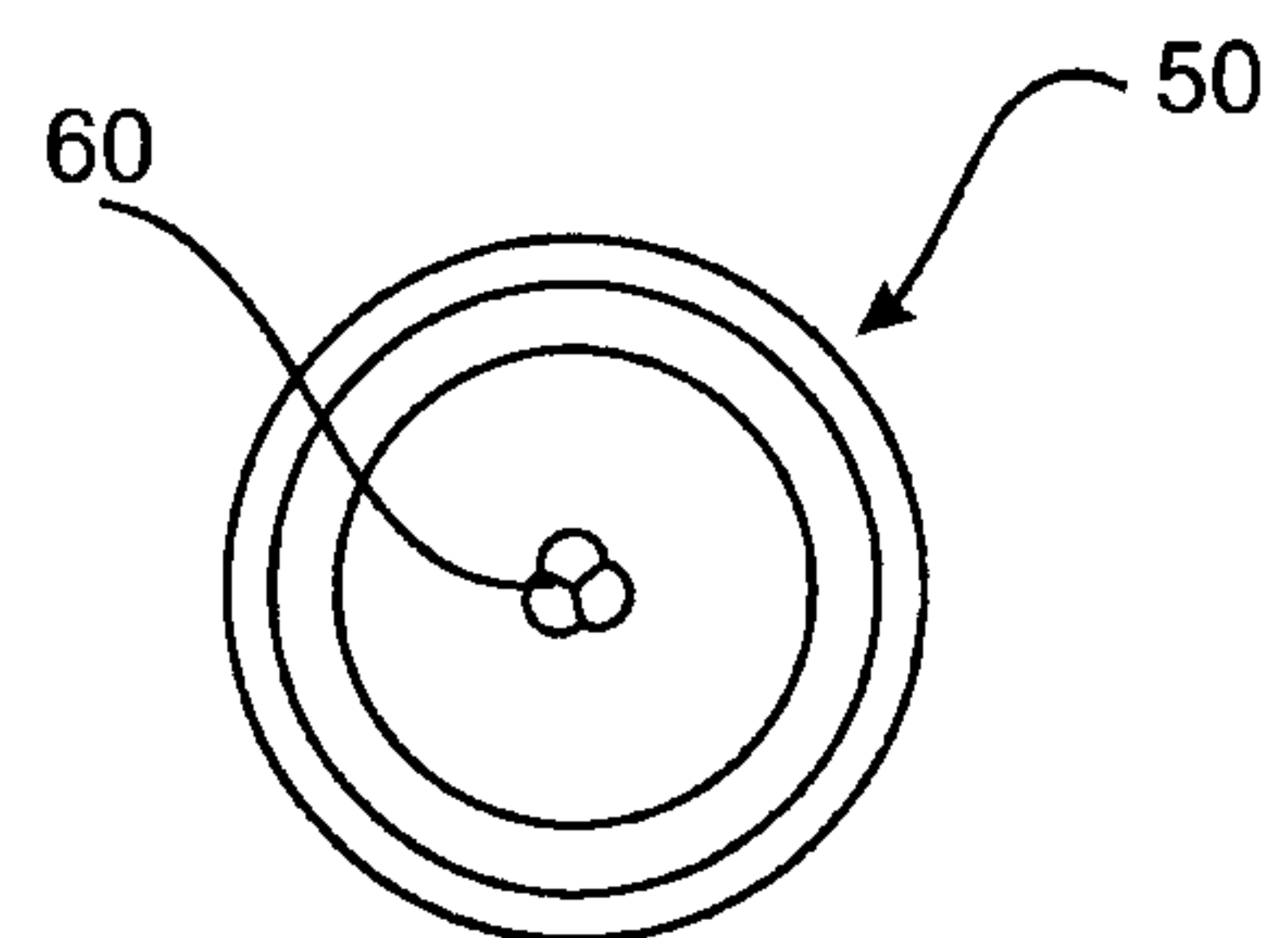


Figure 4D

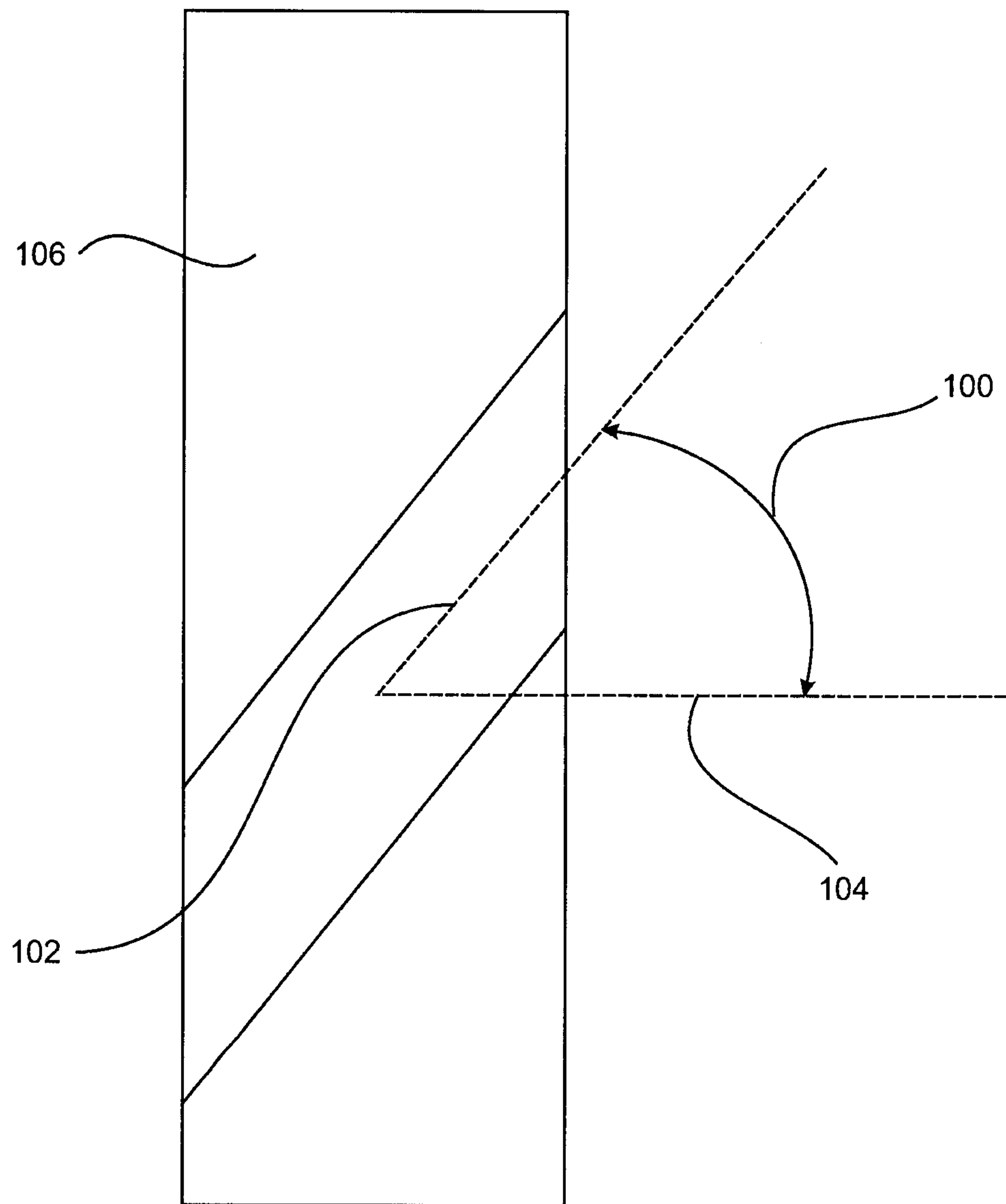


Figure 5

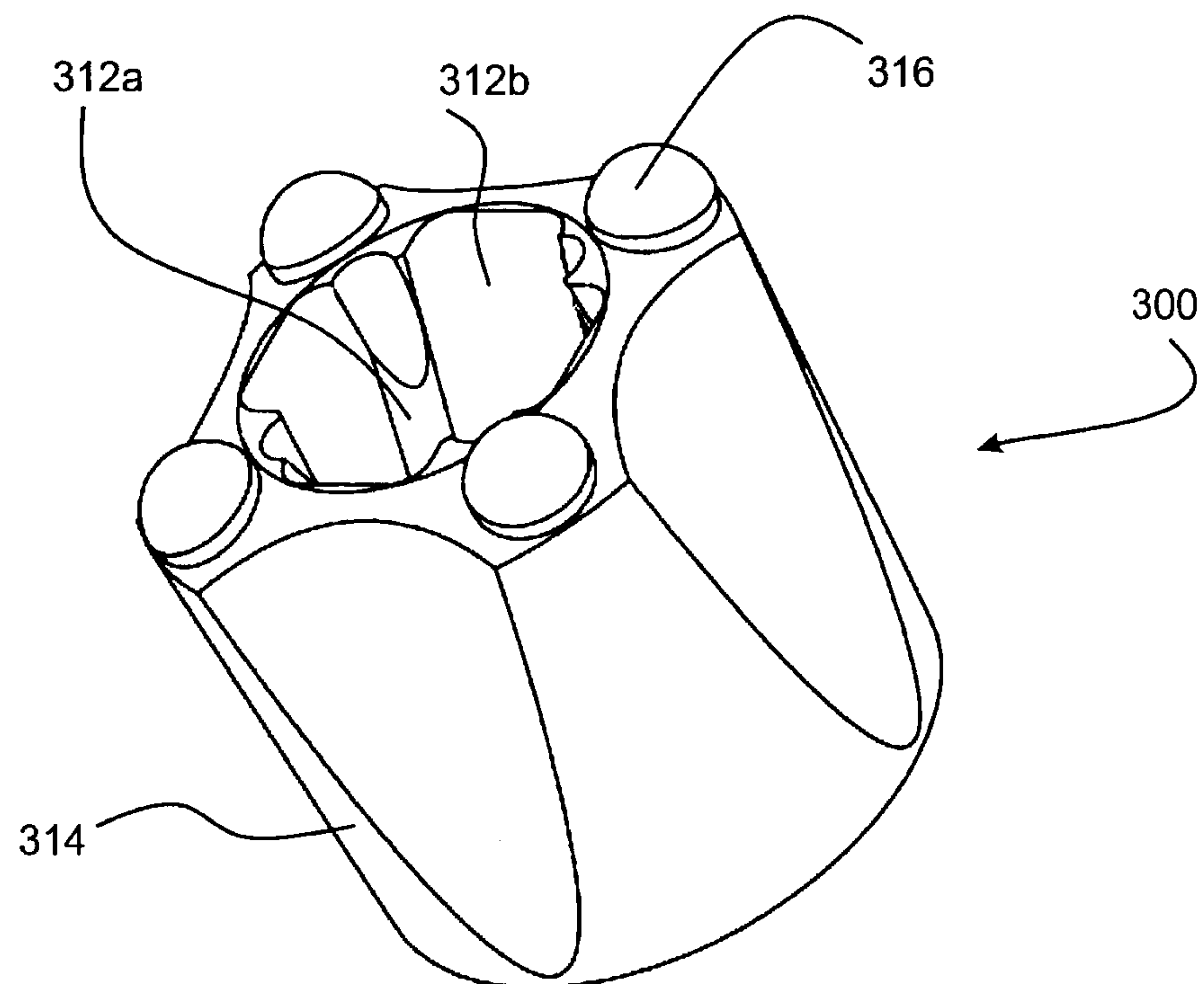


Figure 6A

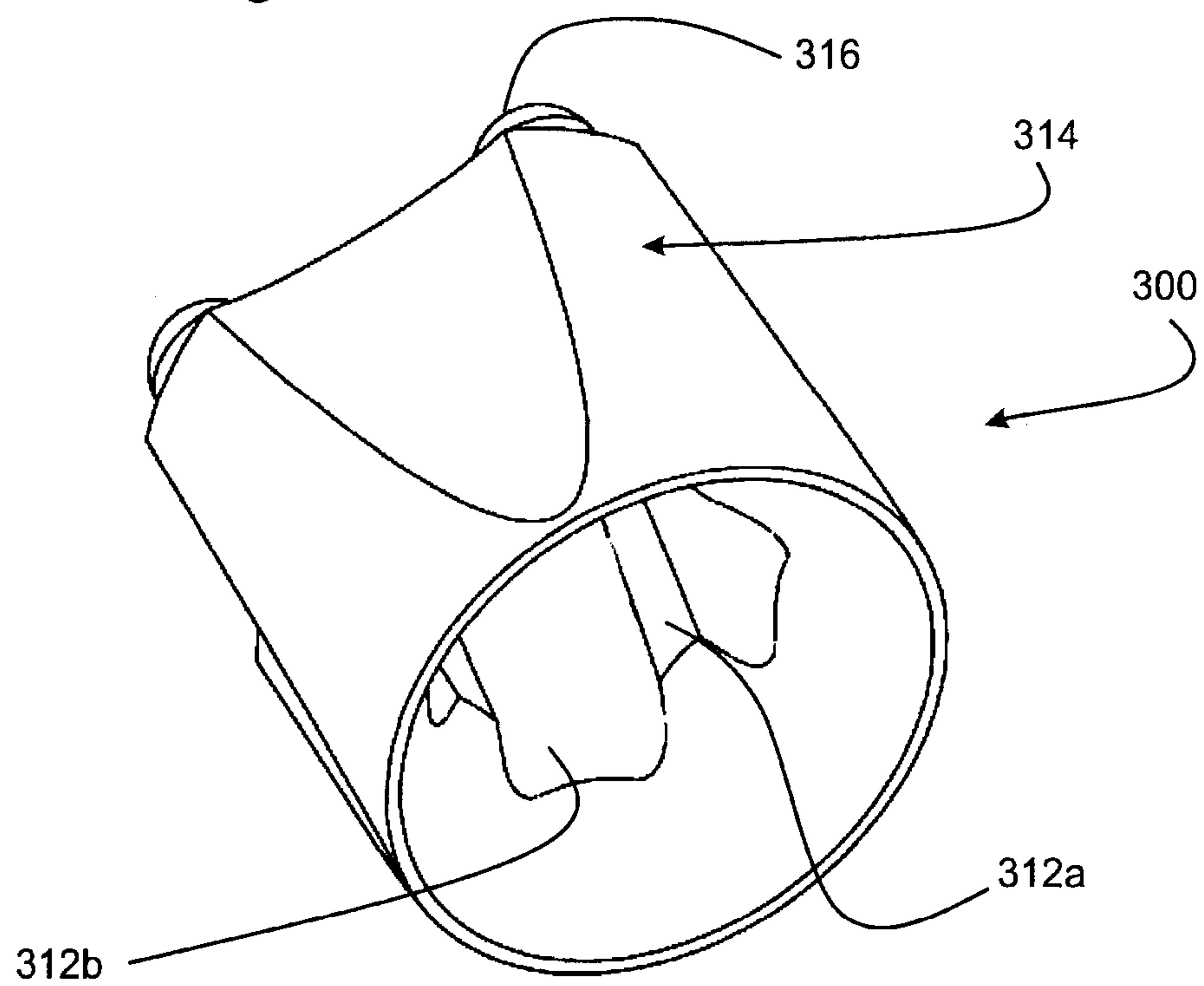


Figure 6B

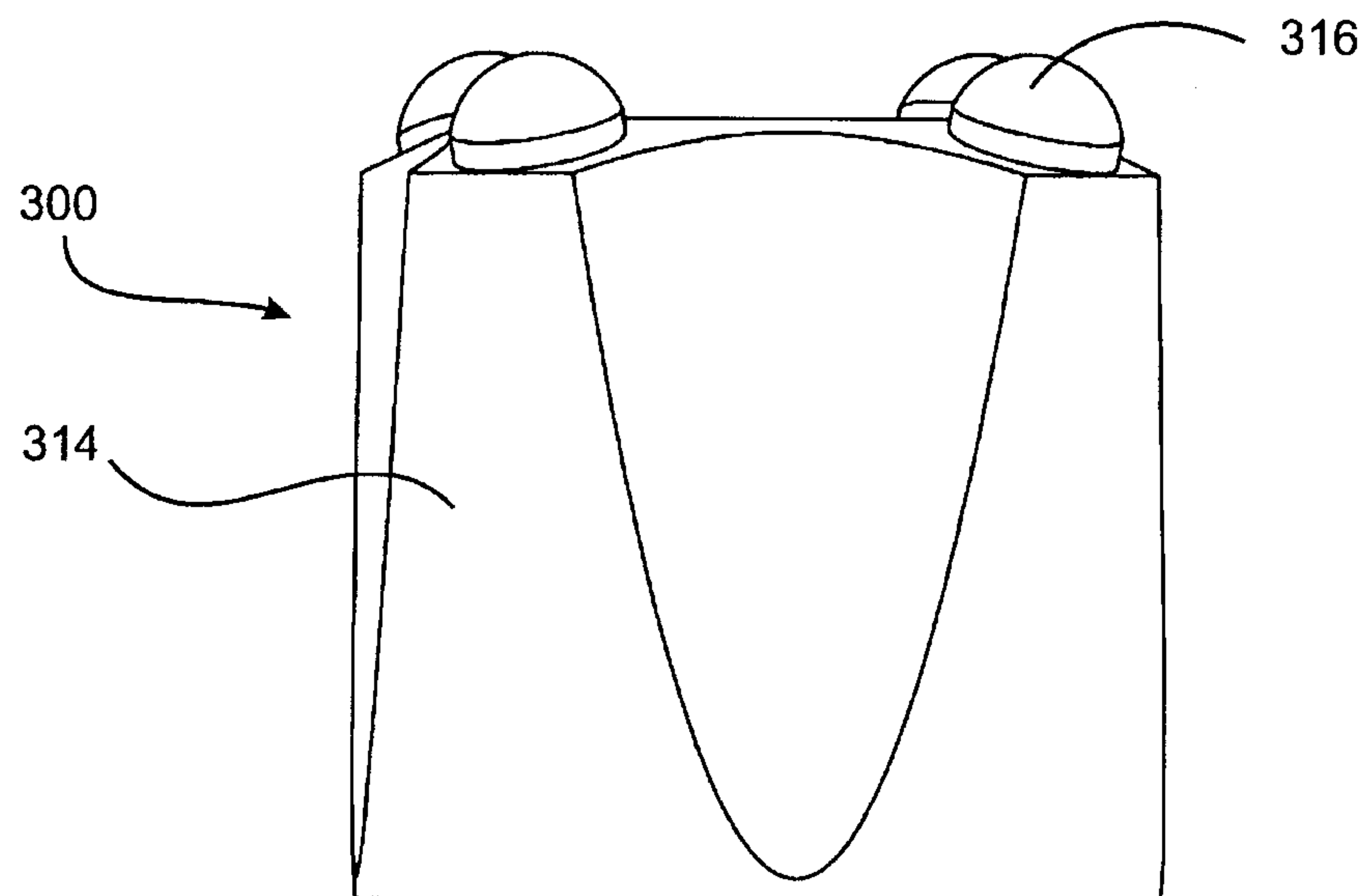


Figure 6C

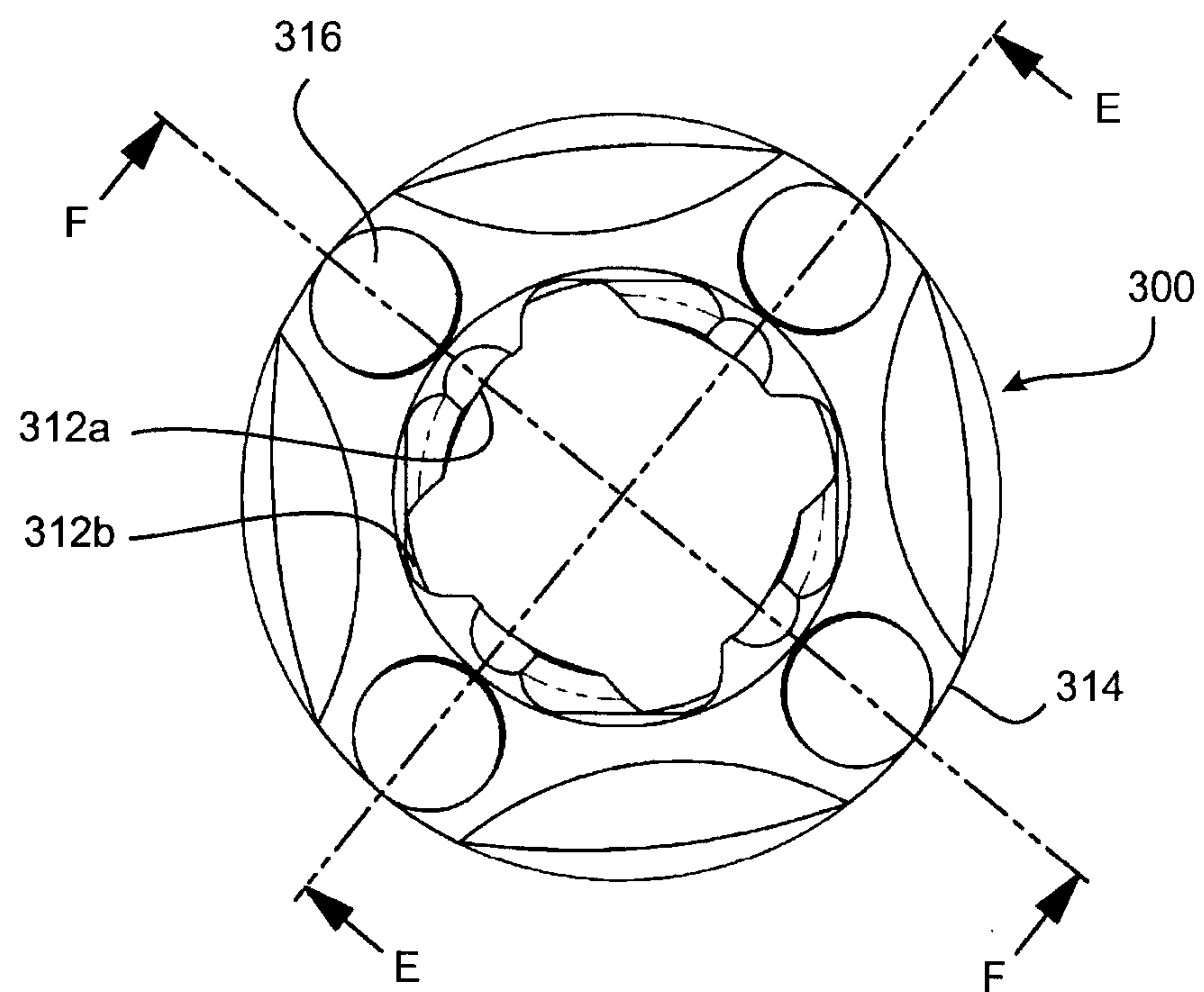


Figure 6D

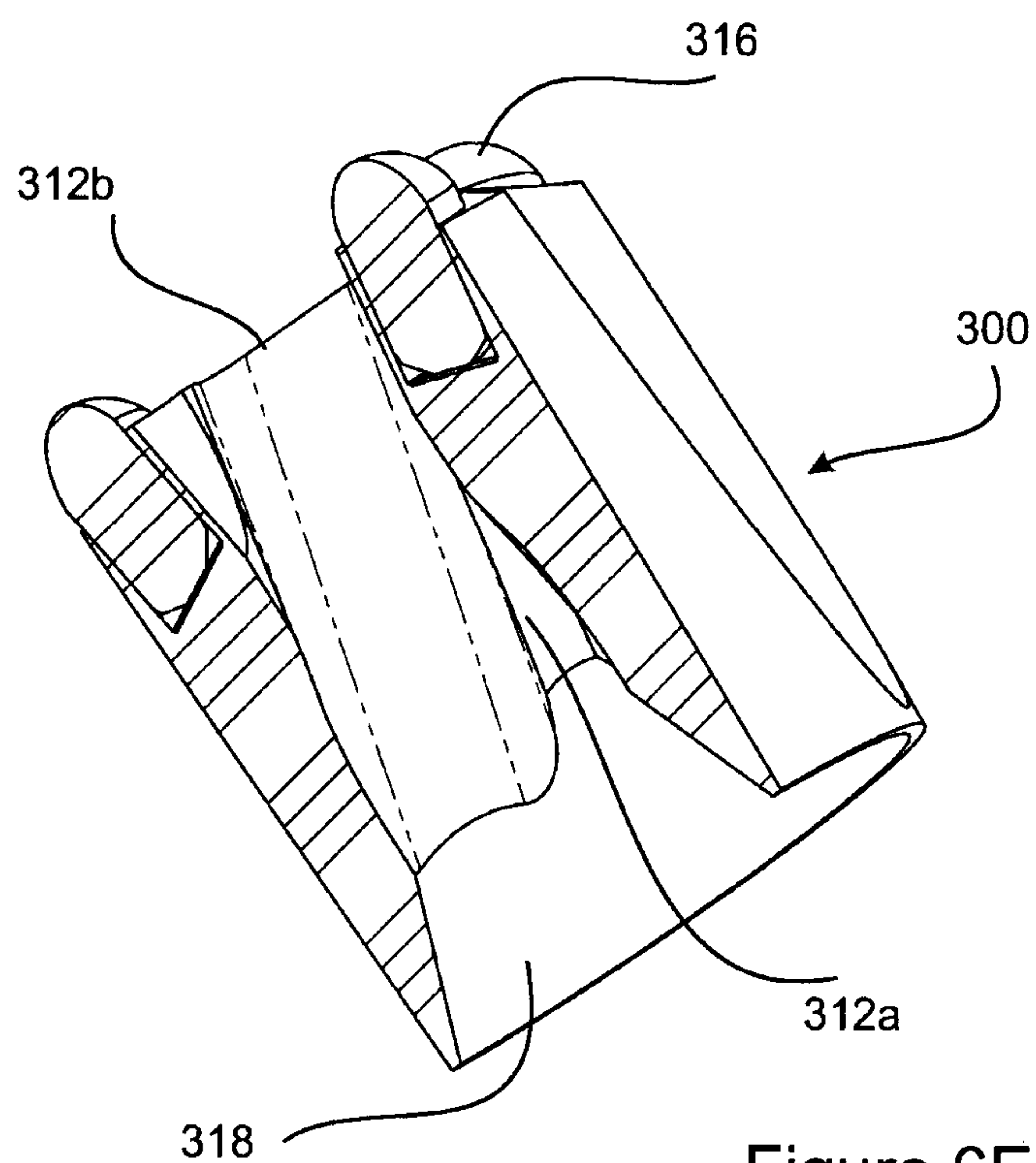


Figure 6E

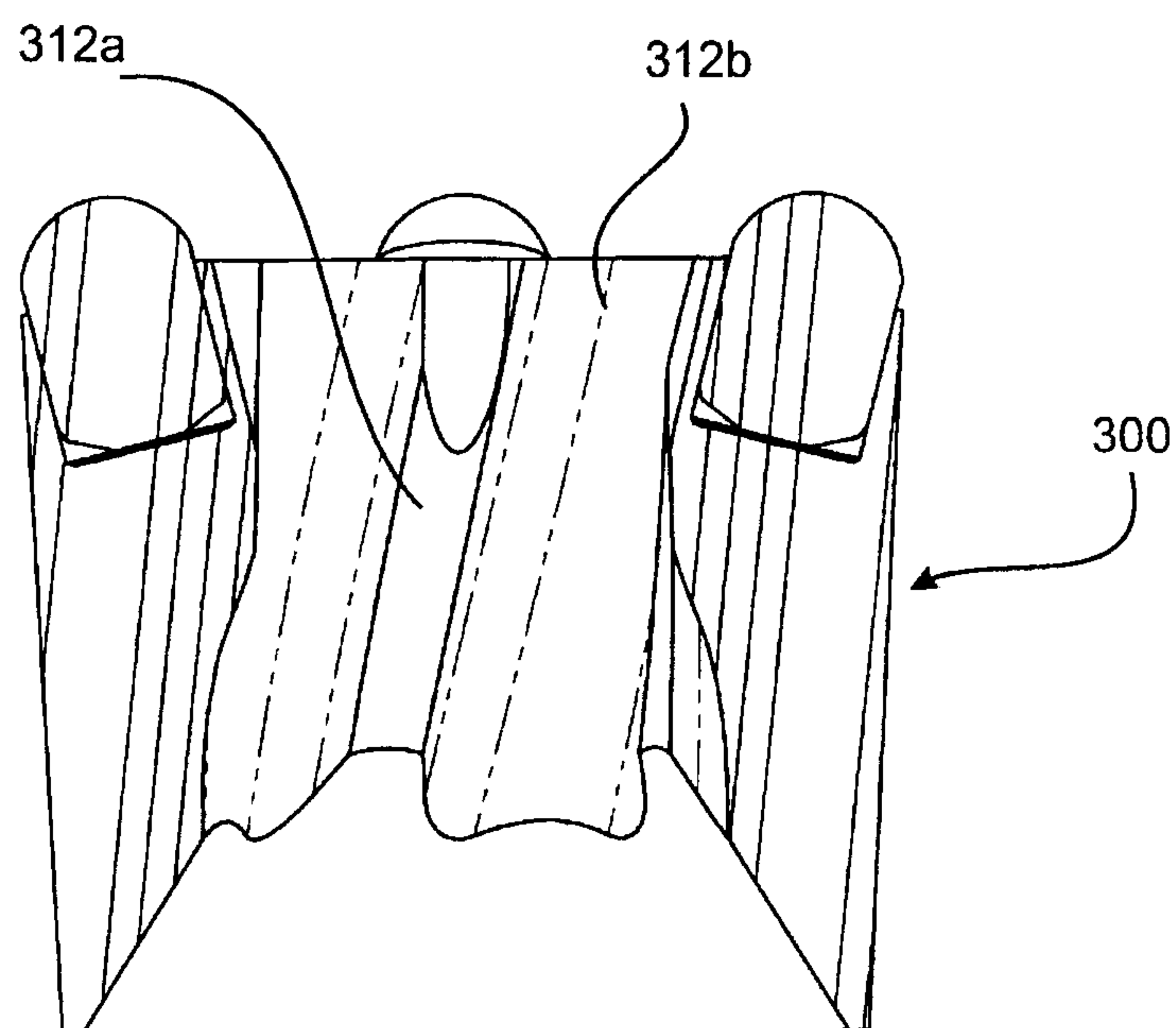


Figure 6F

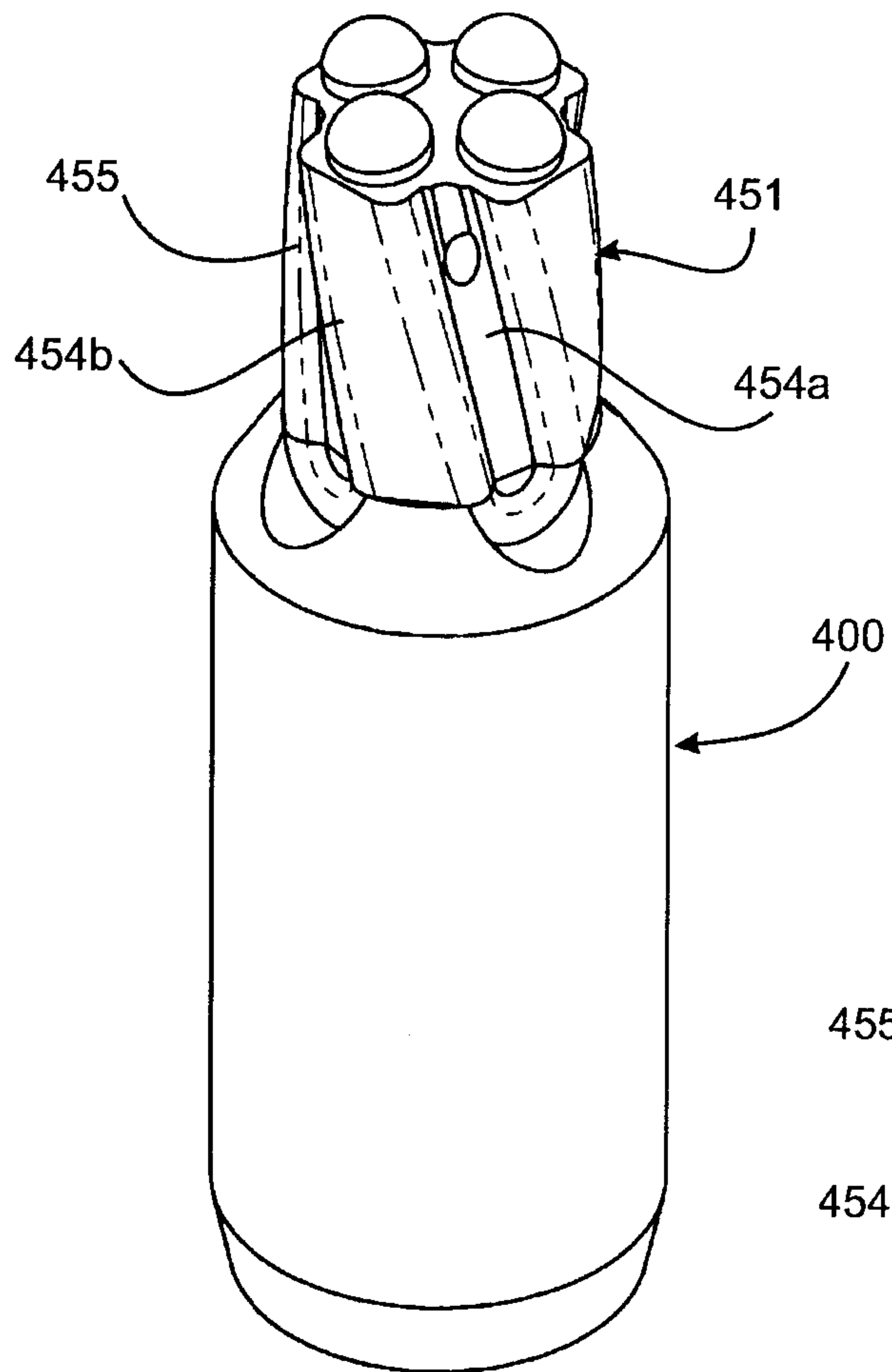


Figure 7A

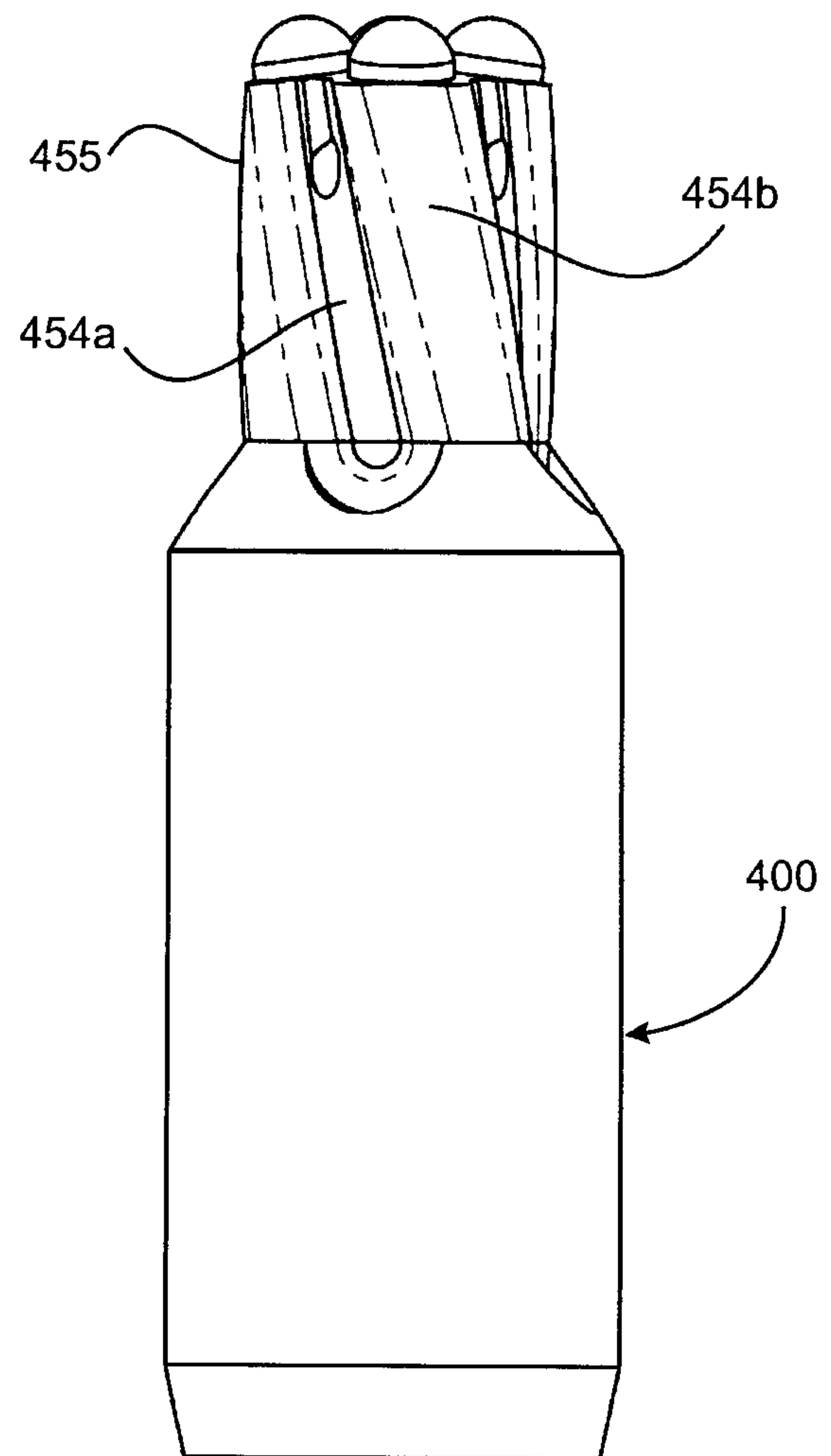


Figure 7B

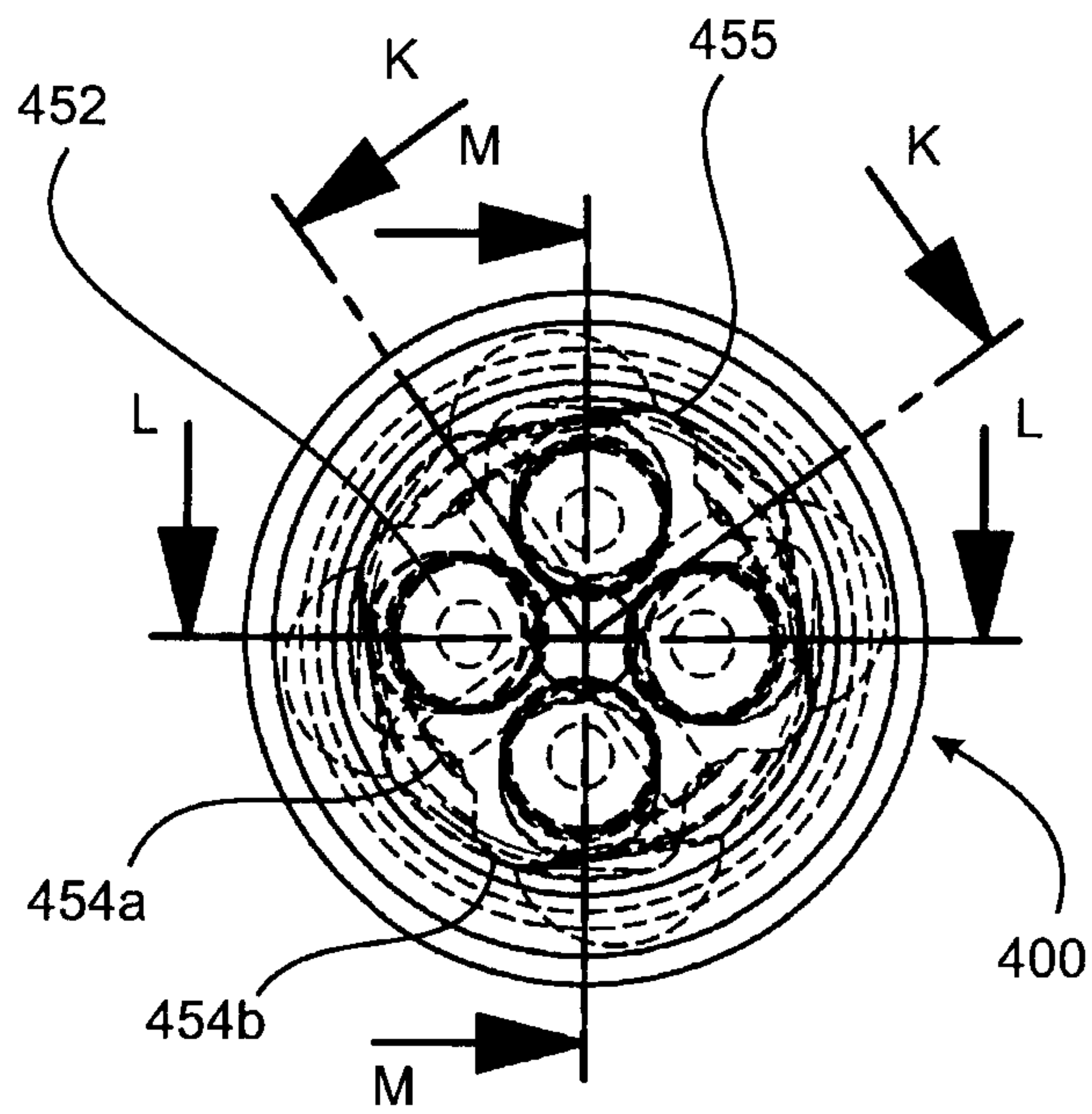


Figure 7C

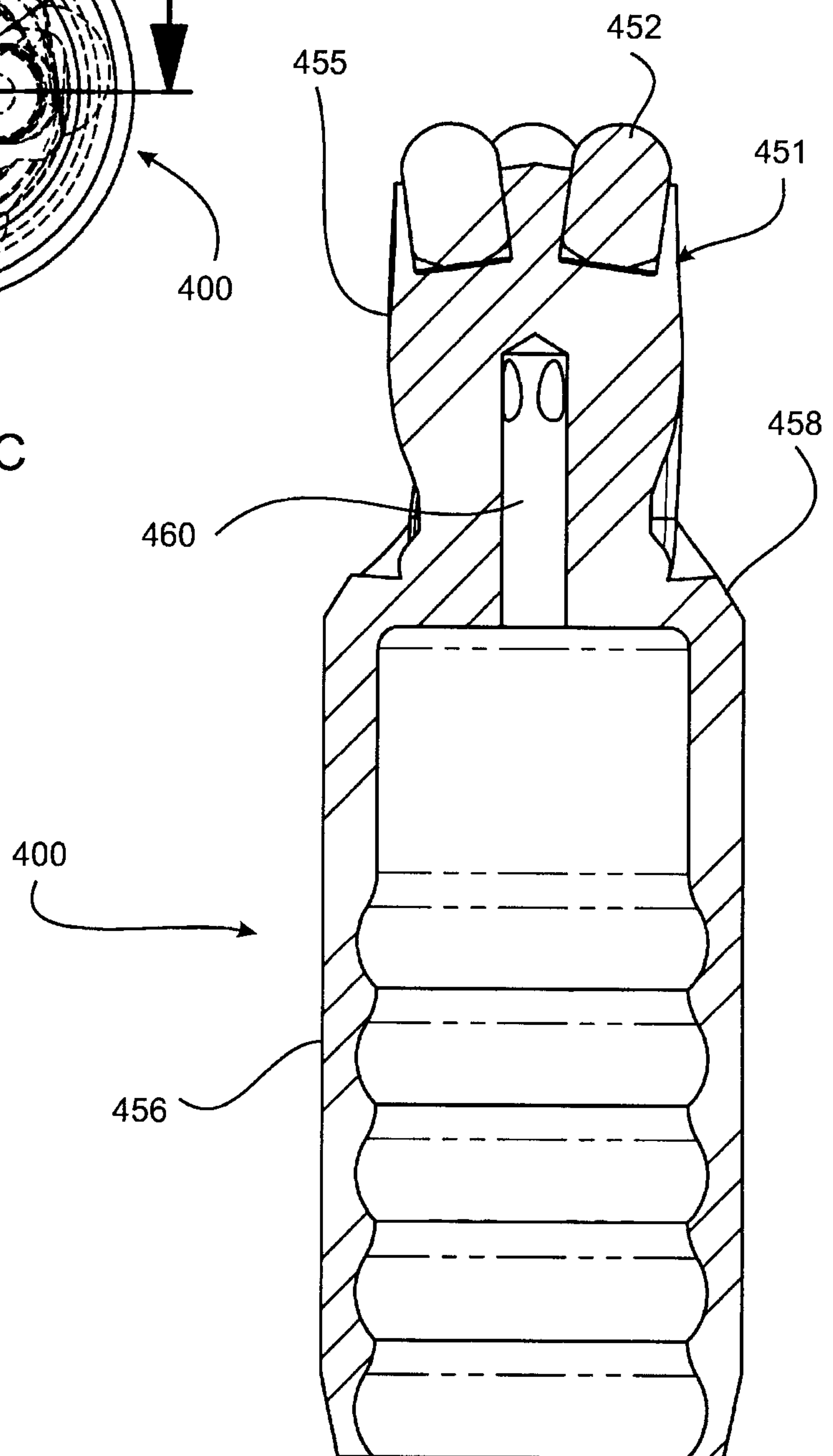


Figure 7D

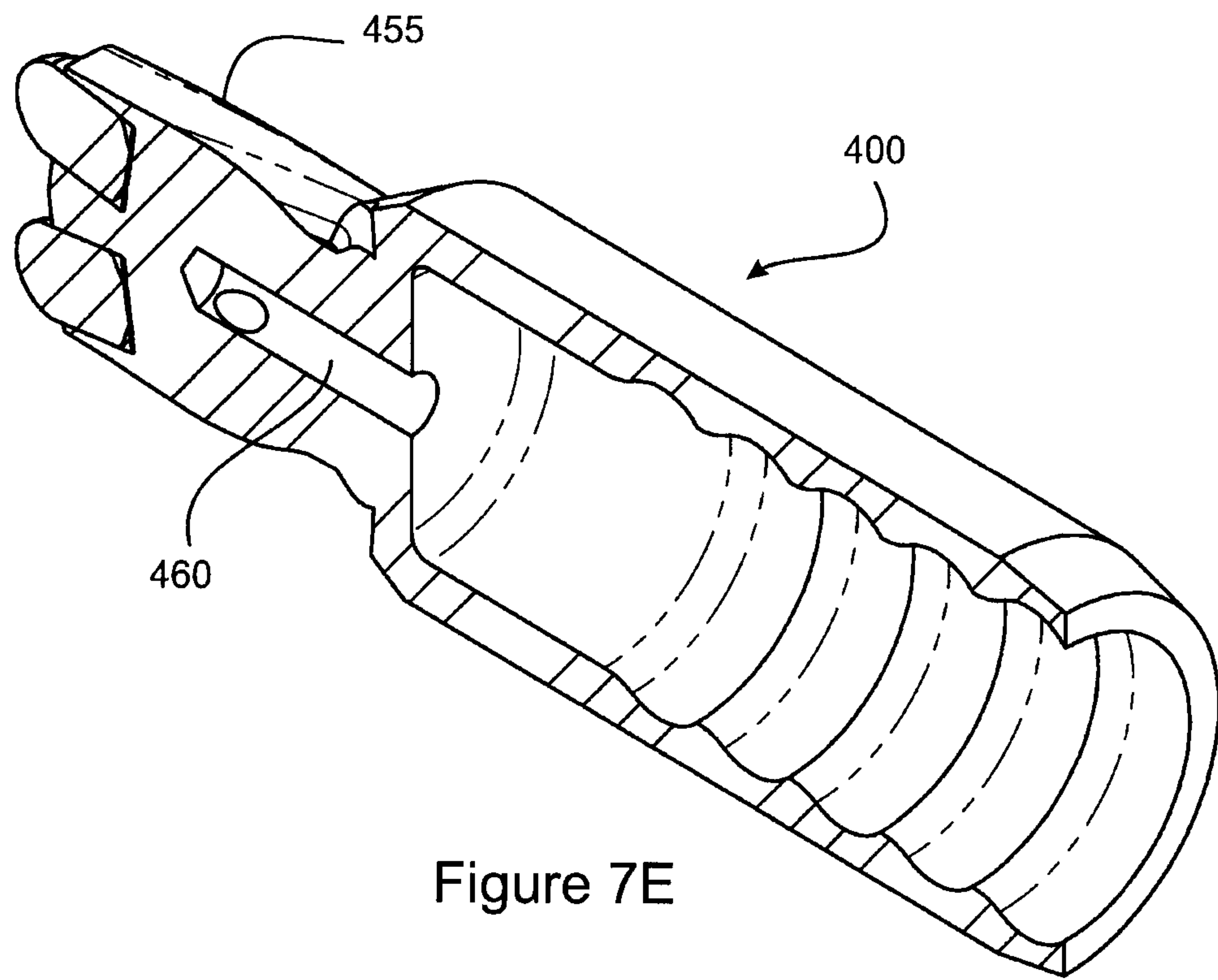


Figure 7E

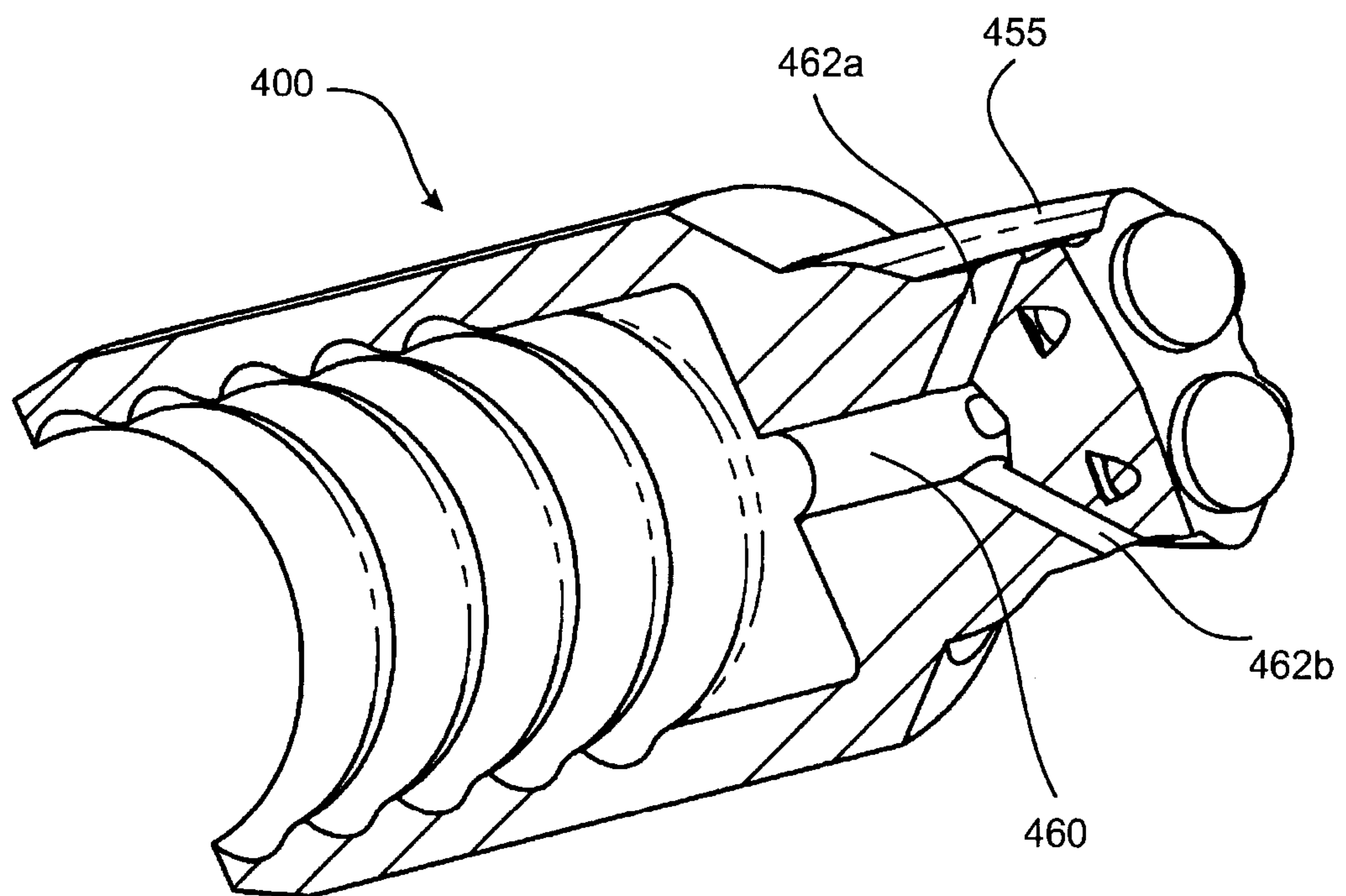


Figure 7F

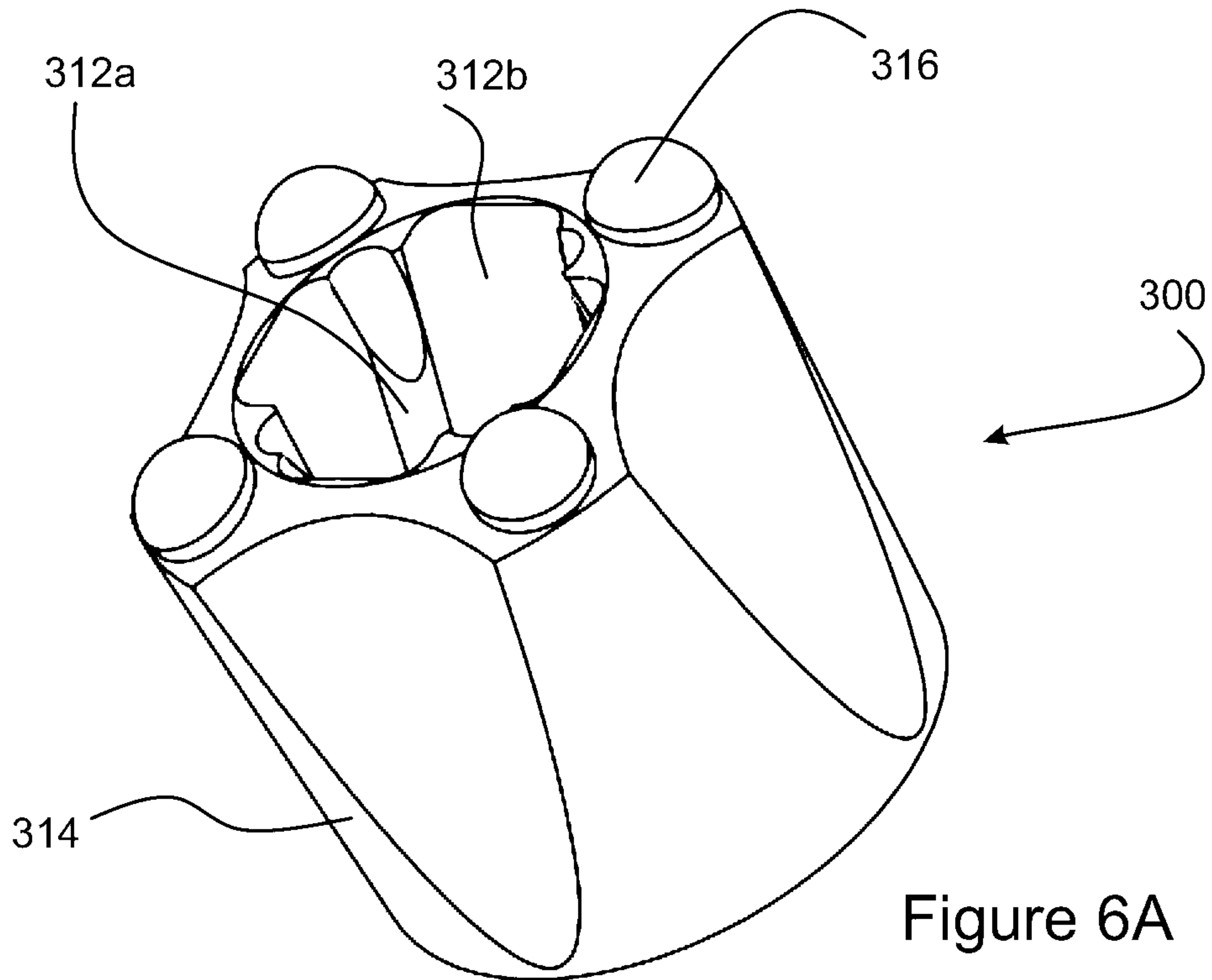


Figure 6A