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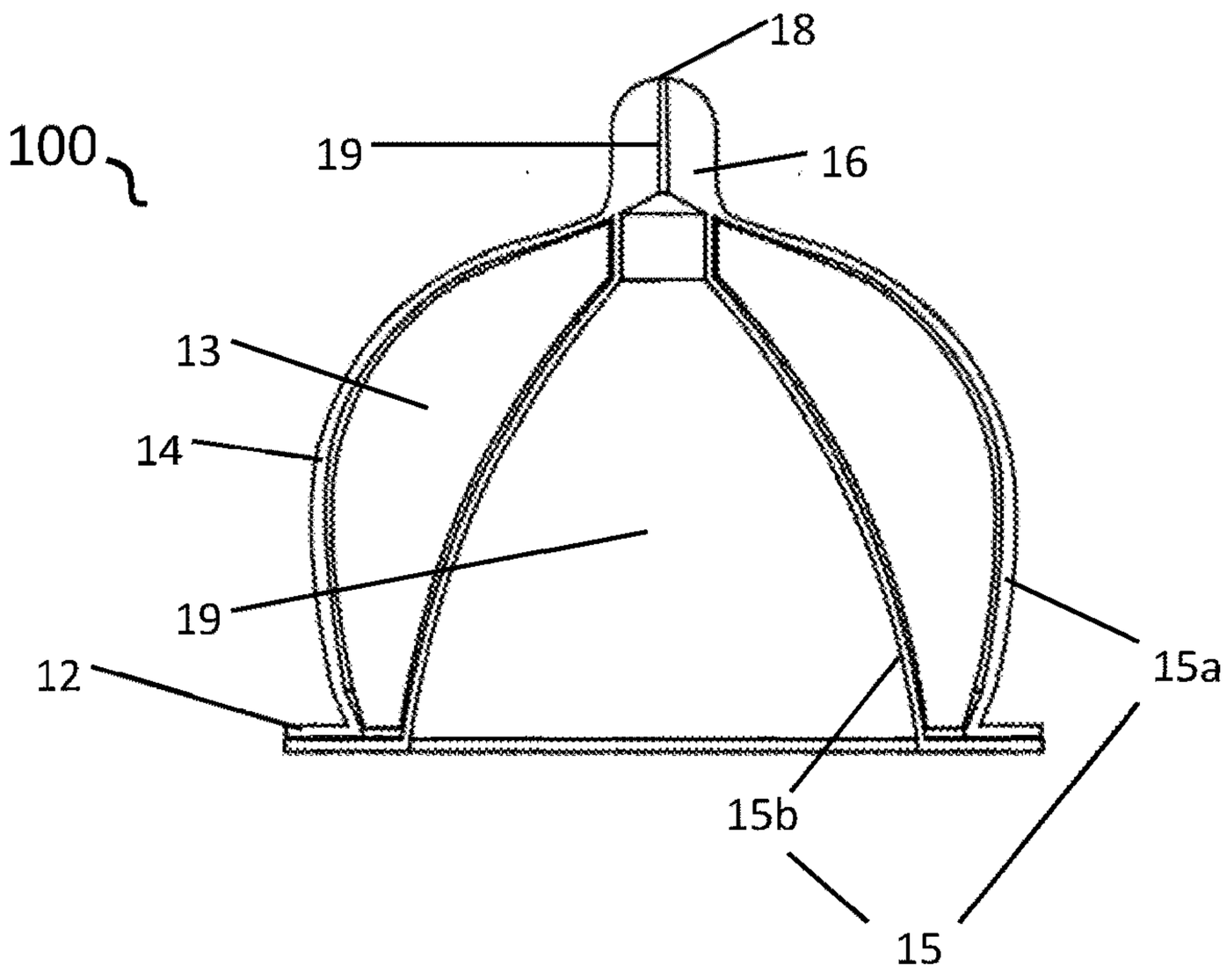
GB 2477185 A
WO 2014/105452 A
US 3797521 A
JP S6324948
GB 1553939 A
WO 2010/046812 A1

(58) Field of Search:
INT CL **A61J, F16K**
Other: **WPI, EPODOC, Patent Fulltext**

(54) Title of the Invention: **A teat**
Abstract Title: **Milk bottle teat made of a compressible material intended to imitate a human breast**

(57) A teat 100 for a milk bottle is provided. The teat 100 comprises an attachment portion 12 for attaching the teat to a milk bottle. The teat is primarily formed of a compressible material 13, which is enclosed (within and without) by a flexible skin 15. A milk flow pathway 19 runs from the attachment portion through the body of the teat and out through a nipple 16, which comprises an outlet 18; in this way milk from a milk bottle attached to the attachment portion 12 may pass through the teat. The teat may be generally dome-shaped and intended to imitate a human breast. Also disclosed is a method of manufacturing such a teat, as well as claims to a teat not having a flexible skin, and a one-way valve.

Fig 4



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig 1

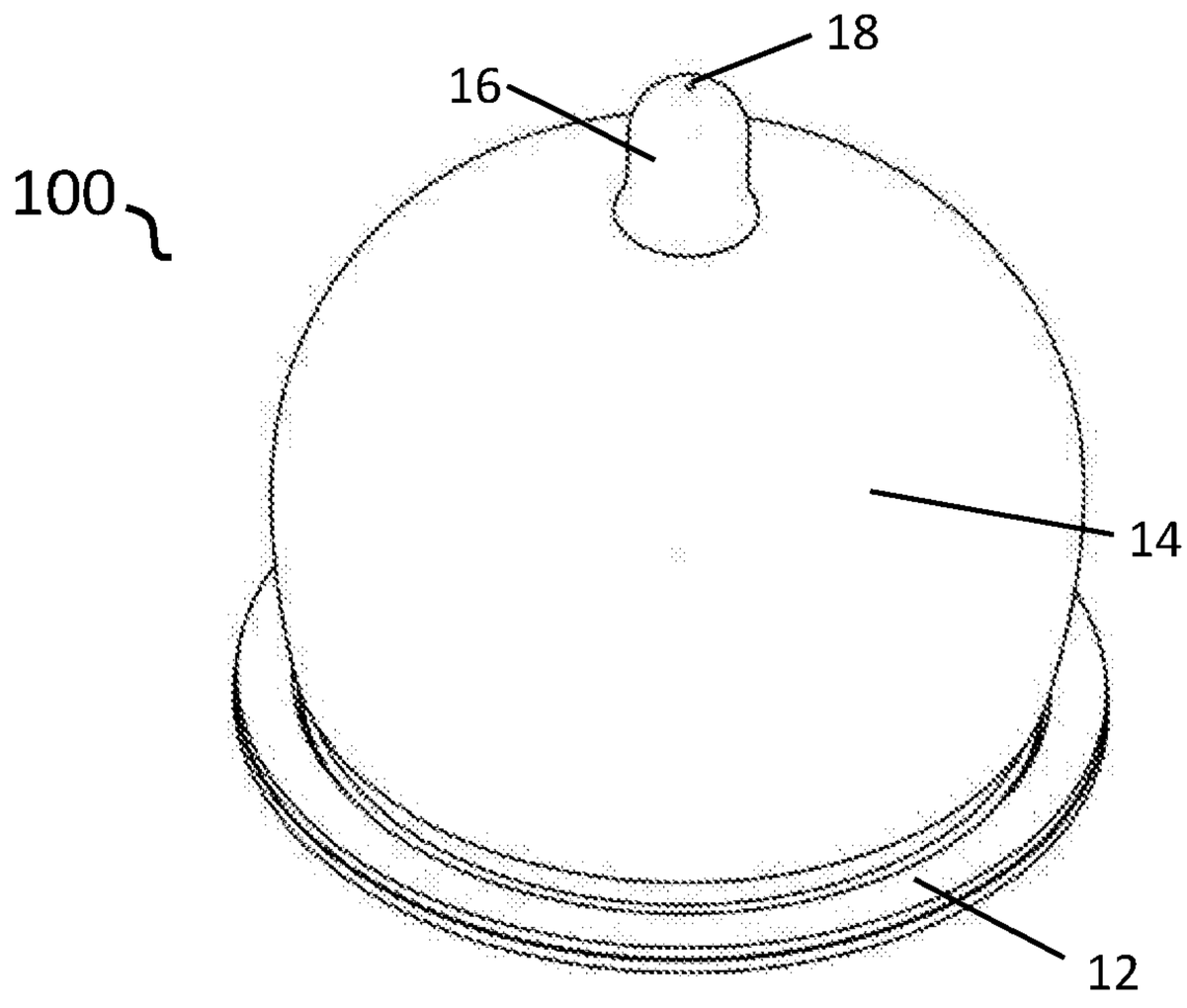

Fig 2

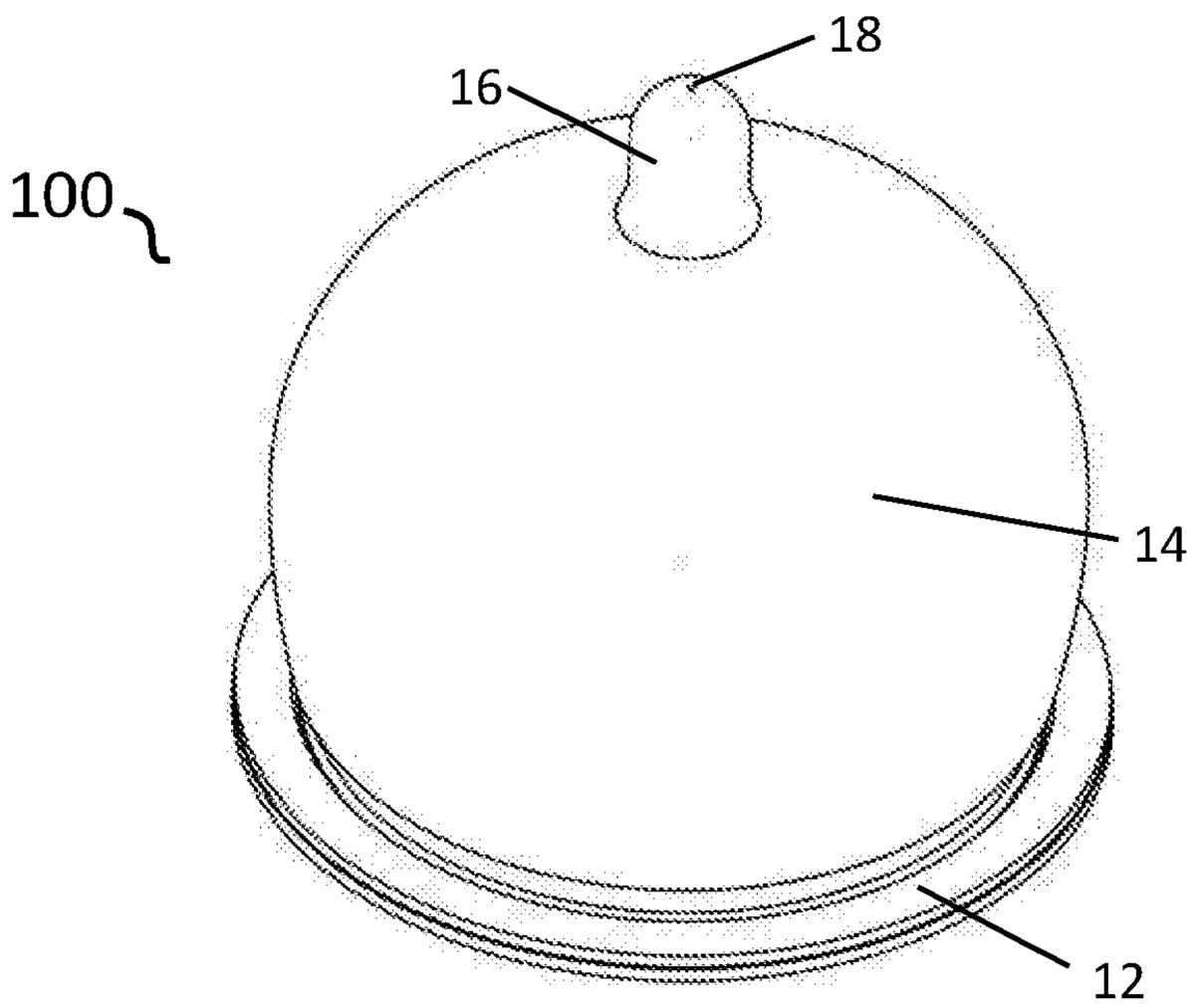

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Fig 3

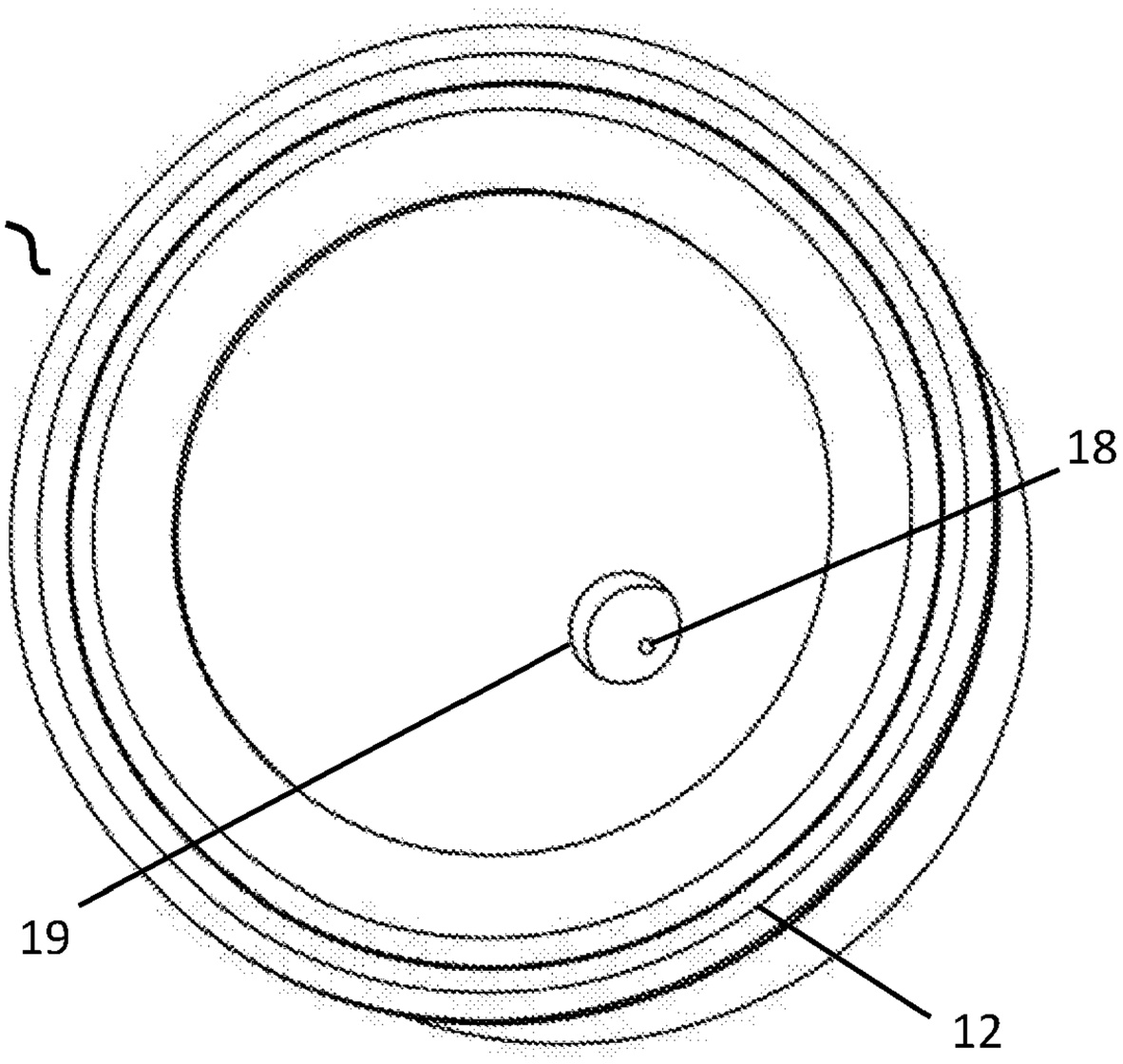

Fig 4

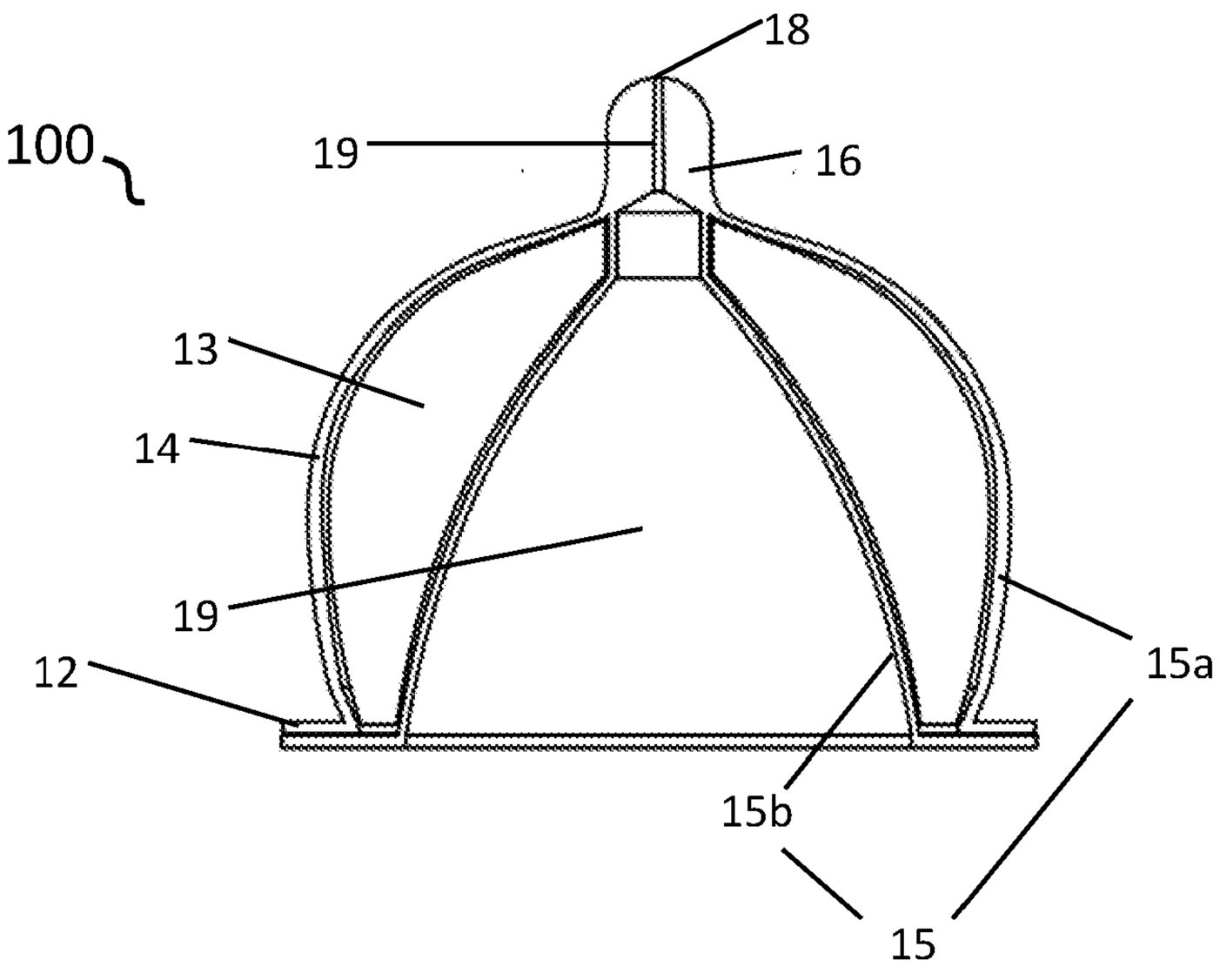

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Fig 5

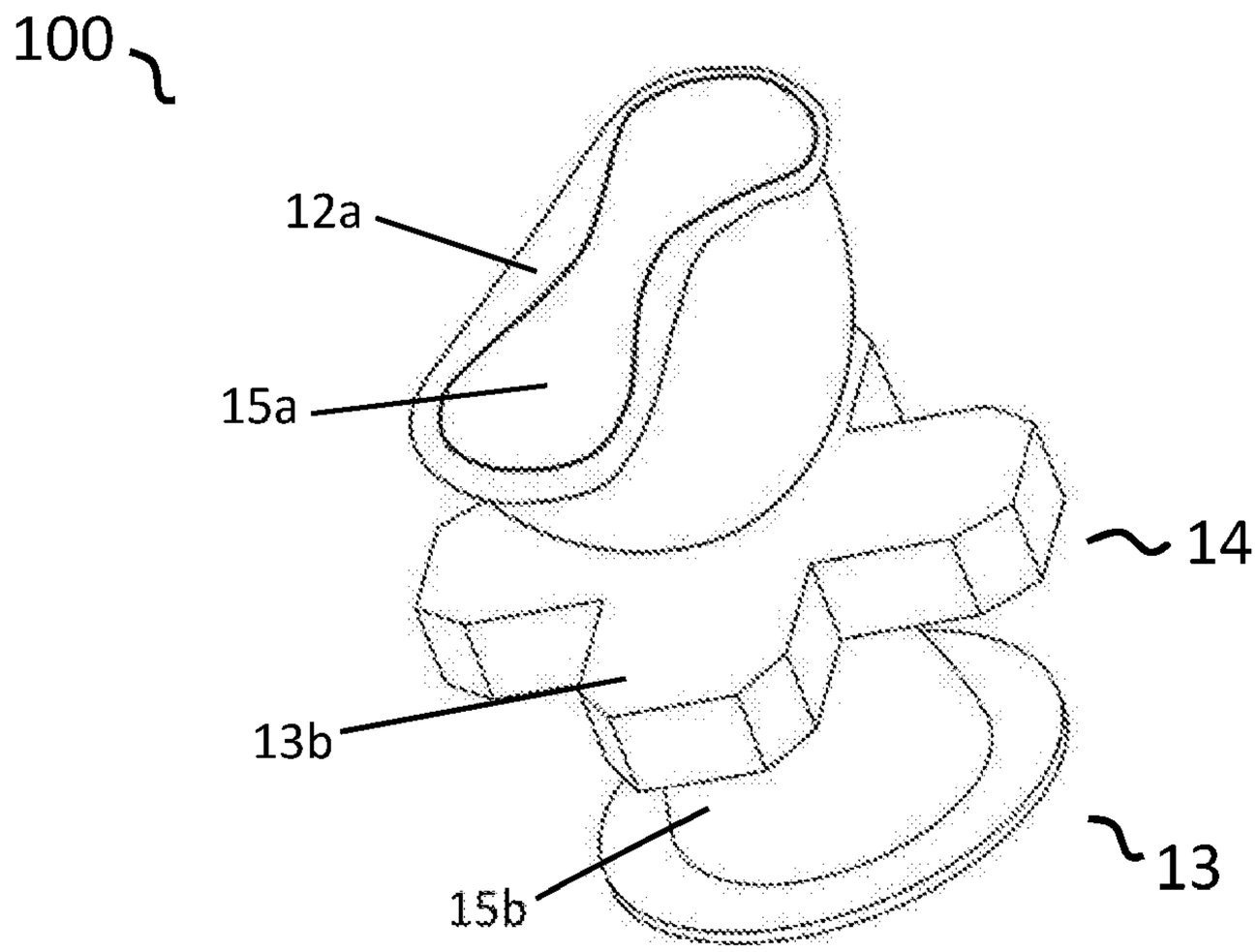

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Fig 6

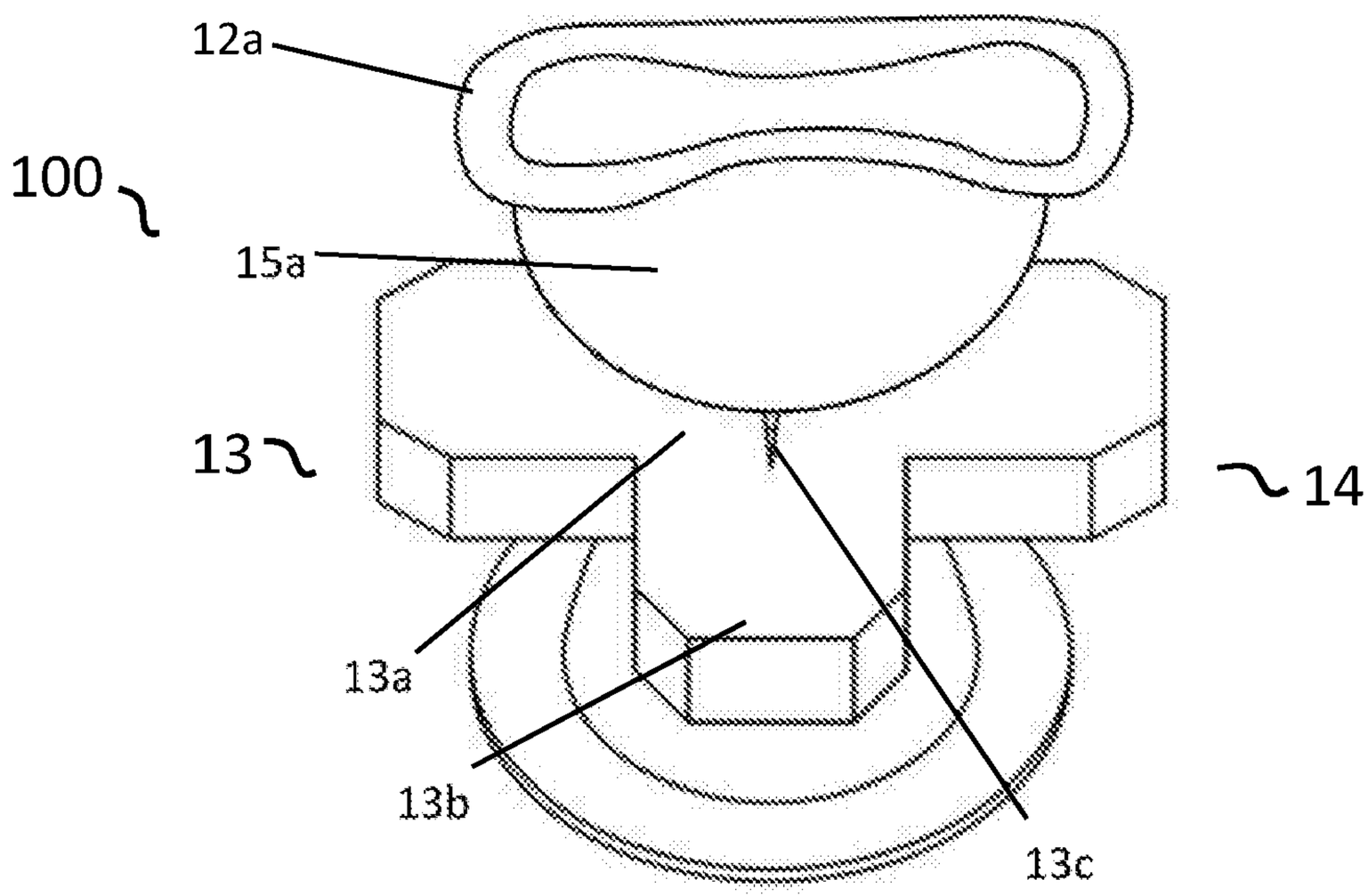

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Fig 7

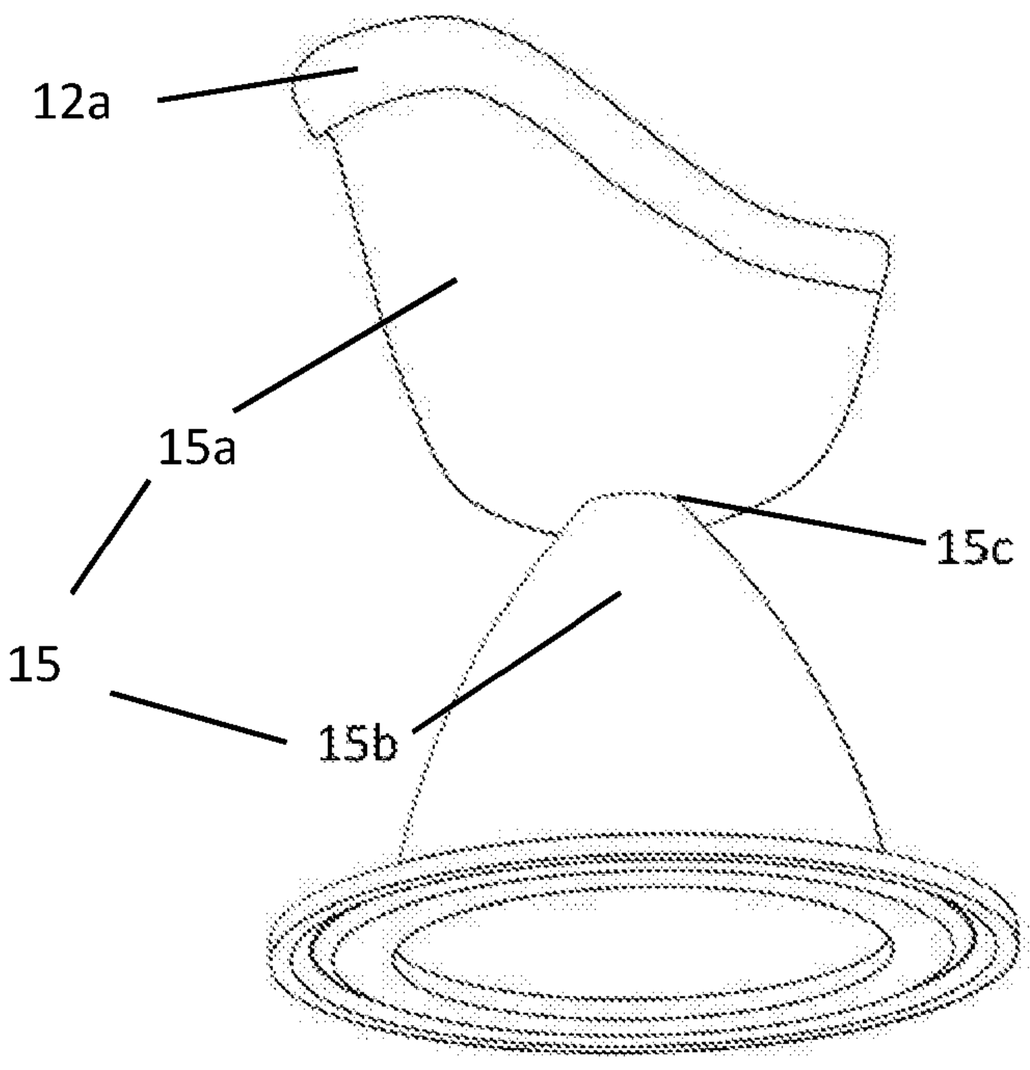

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Fig 8

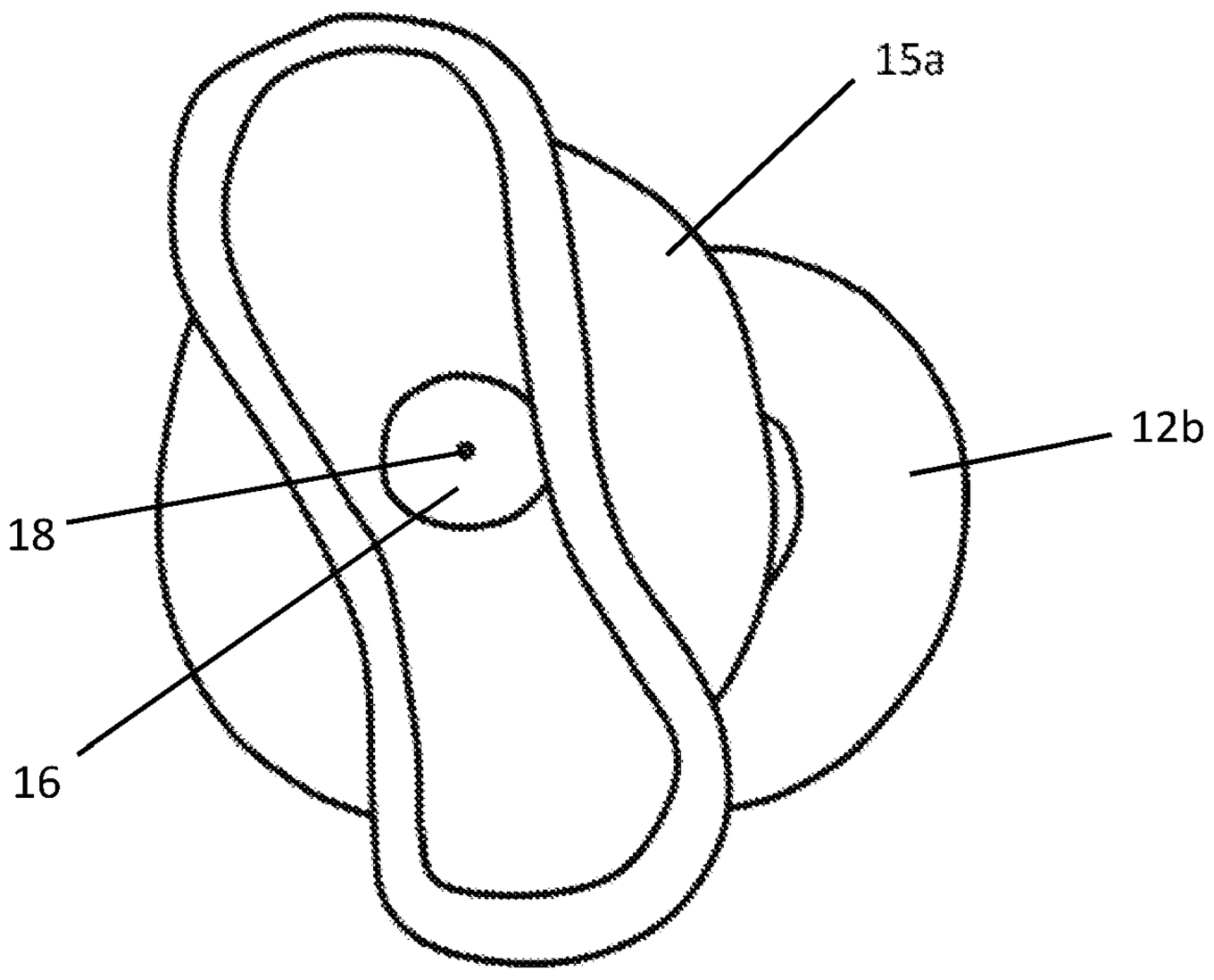

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Fig 9

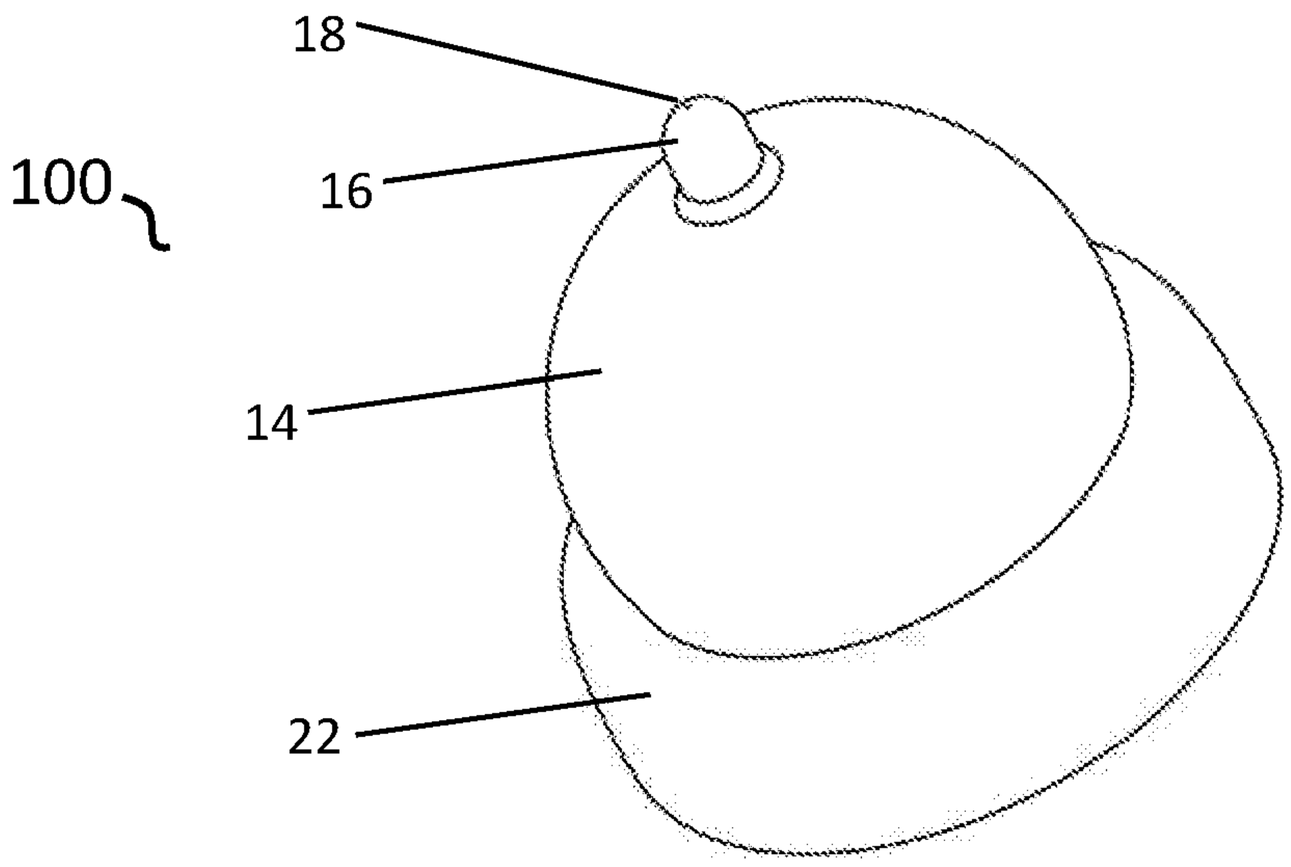

Fig 10

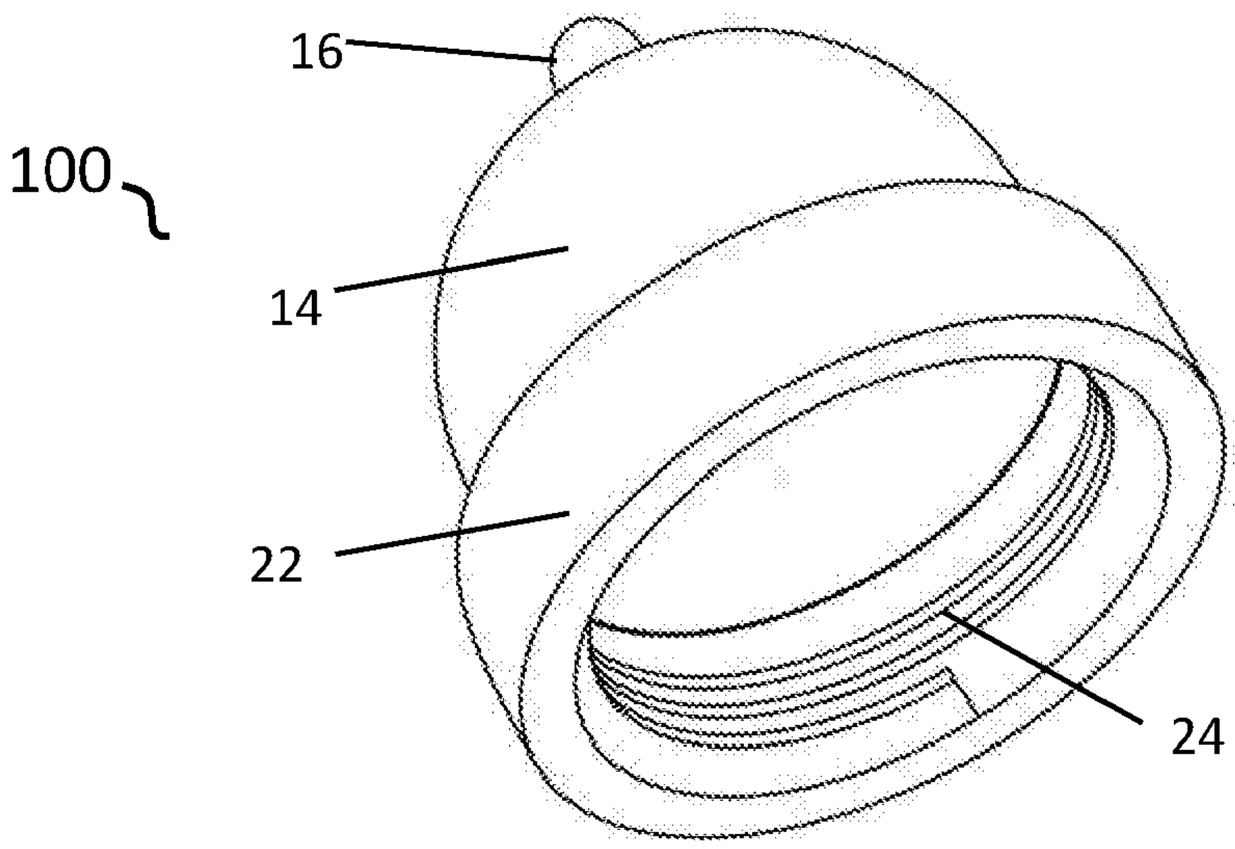

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Fig 11

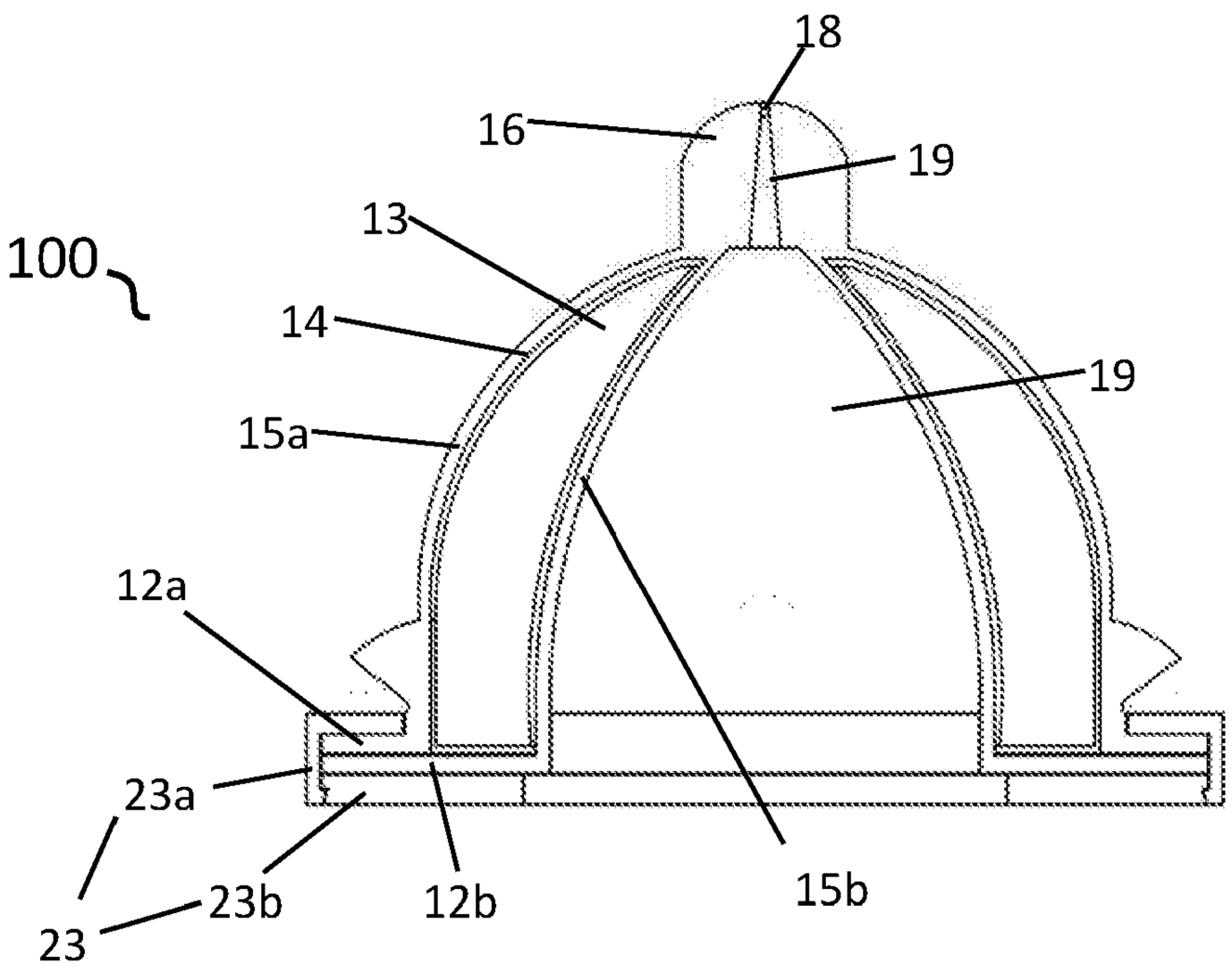

Fig 12

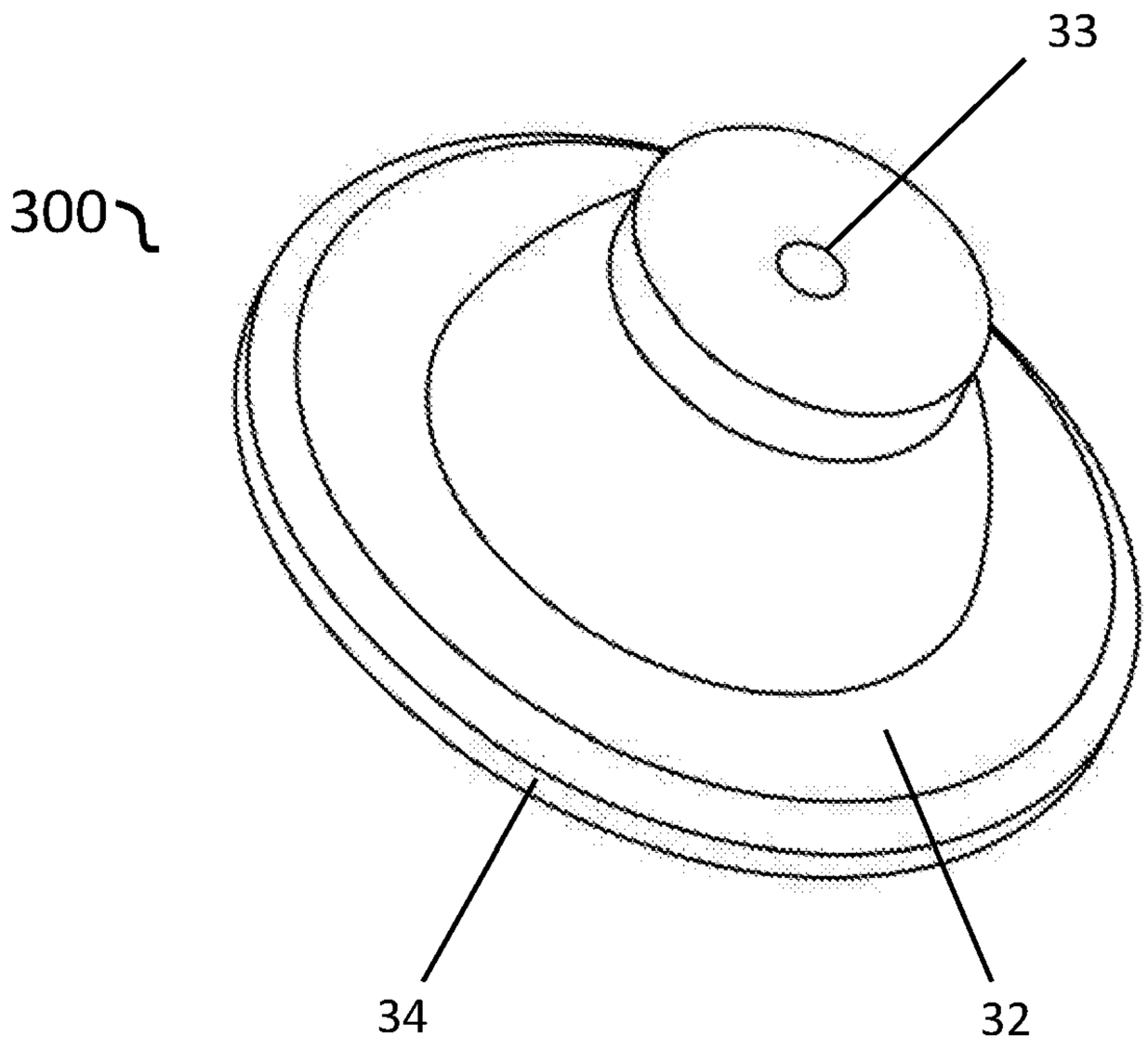

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Fig 13

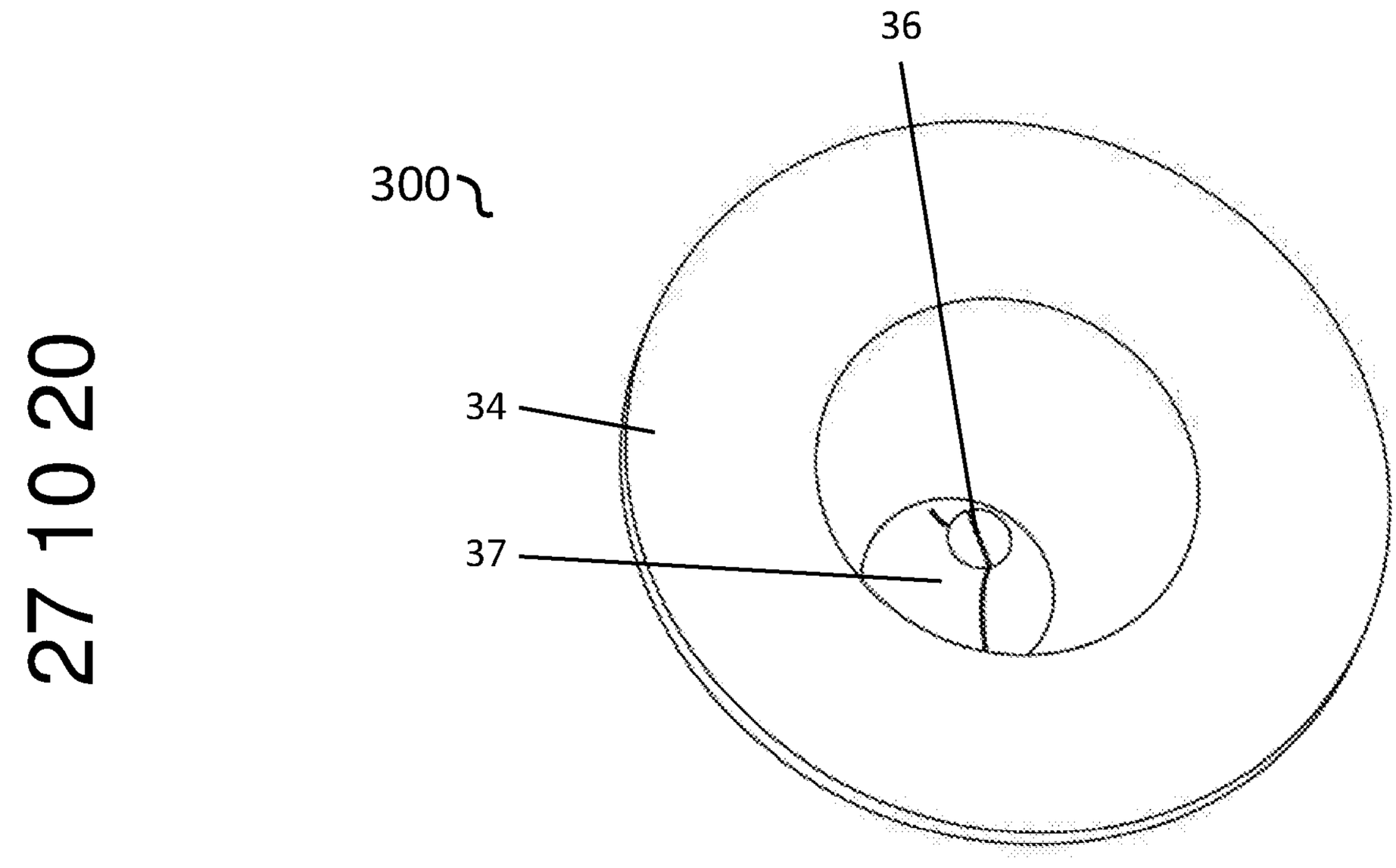

Fig 14

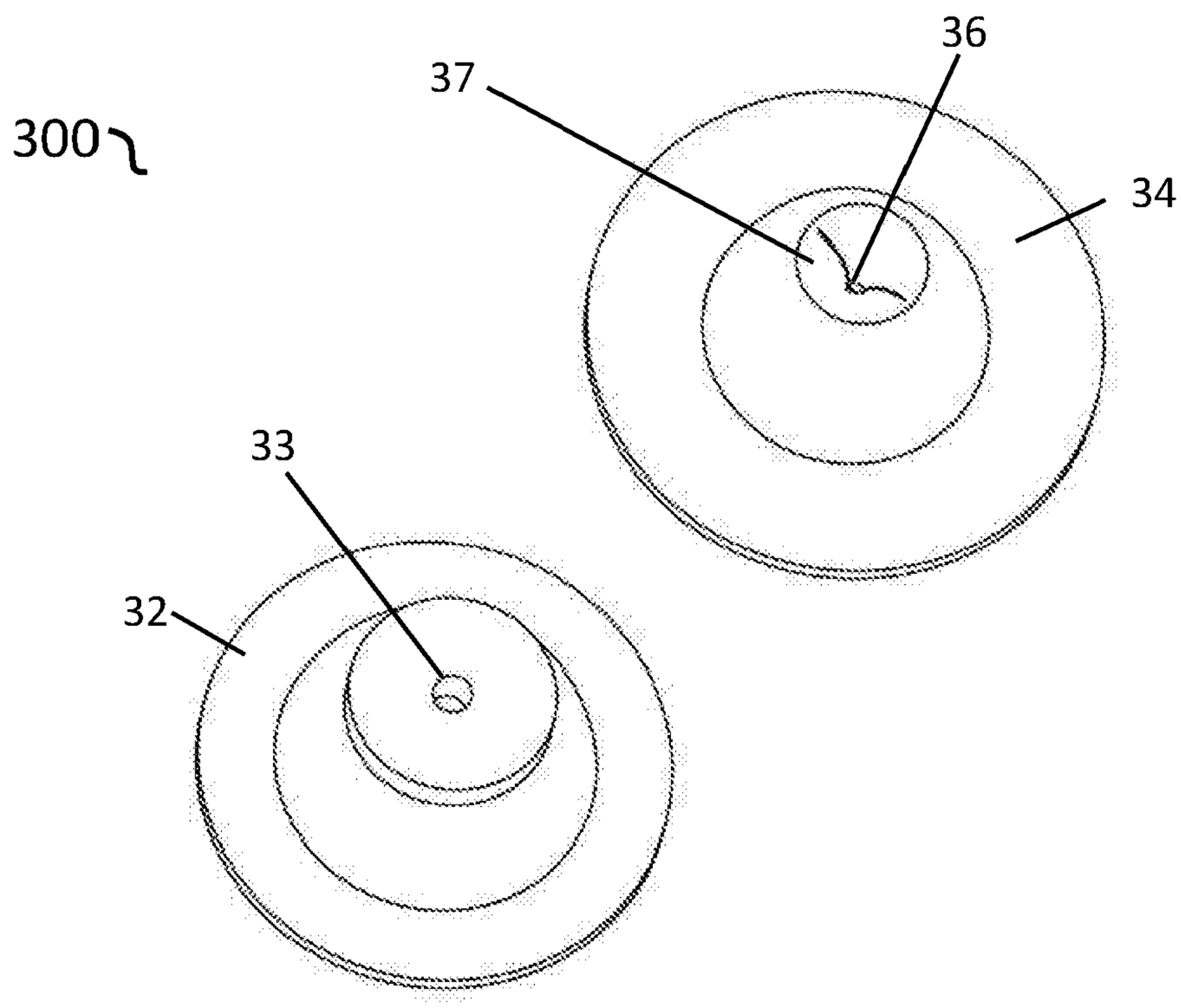

Fig 15

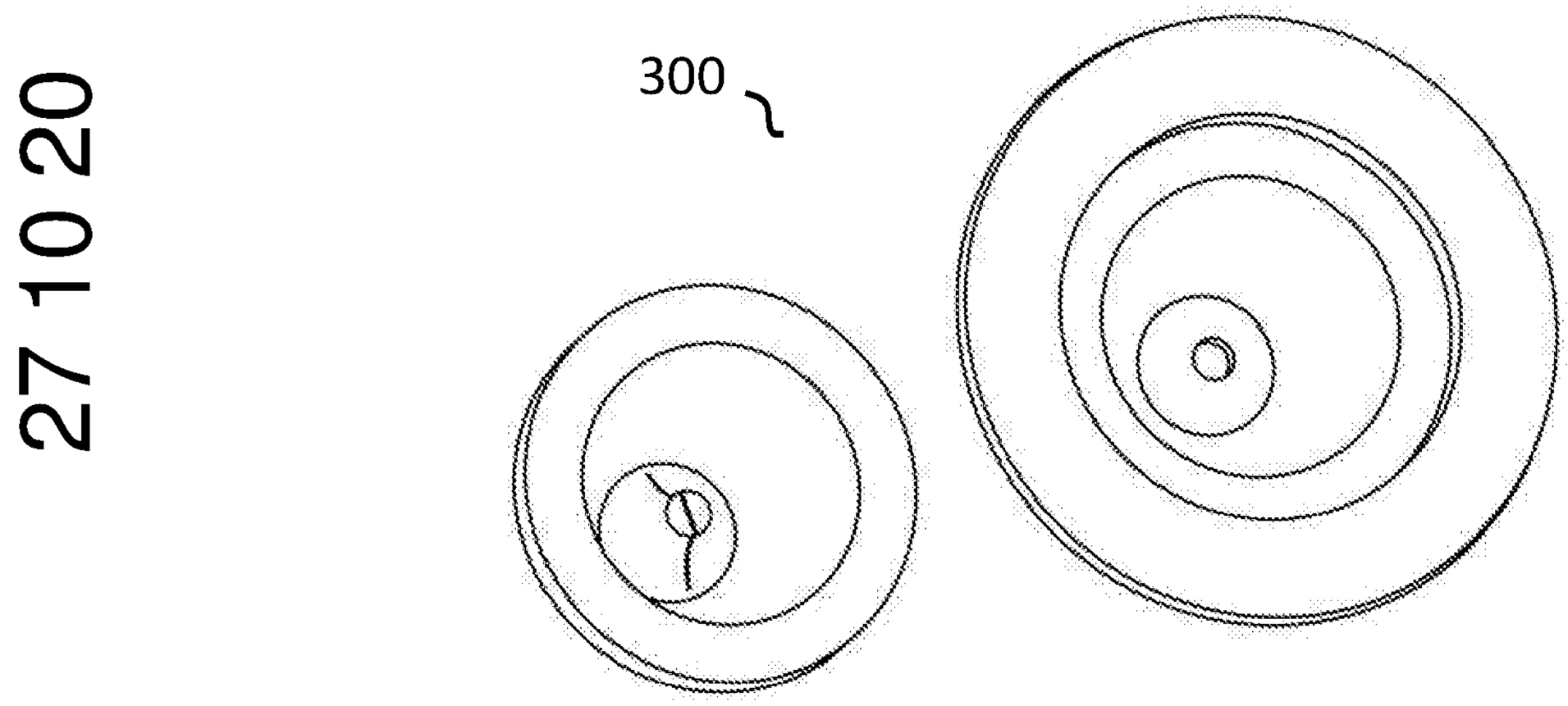

Fig 16

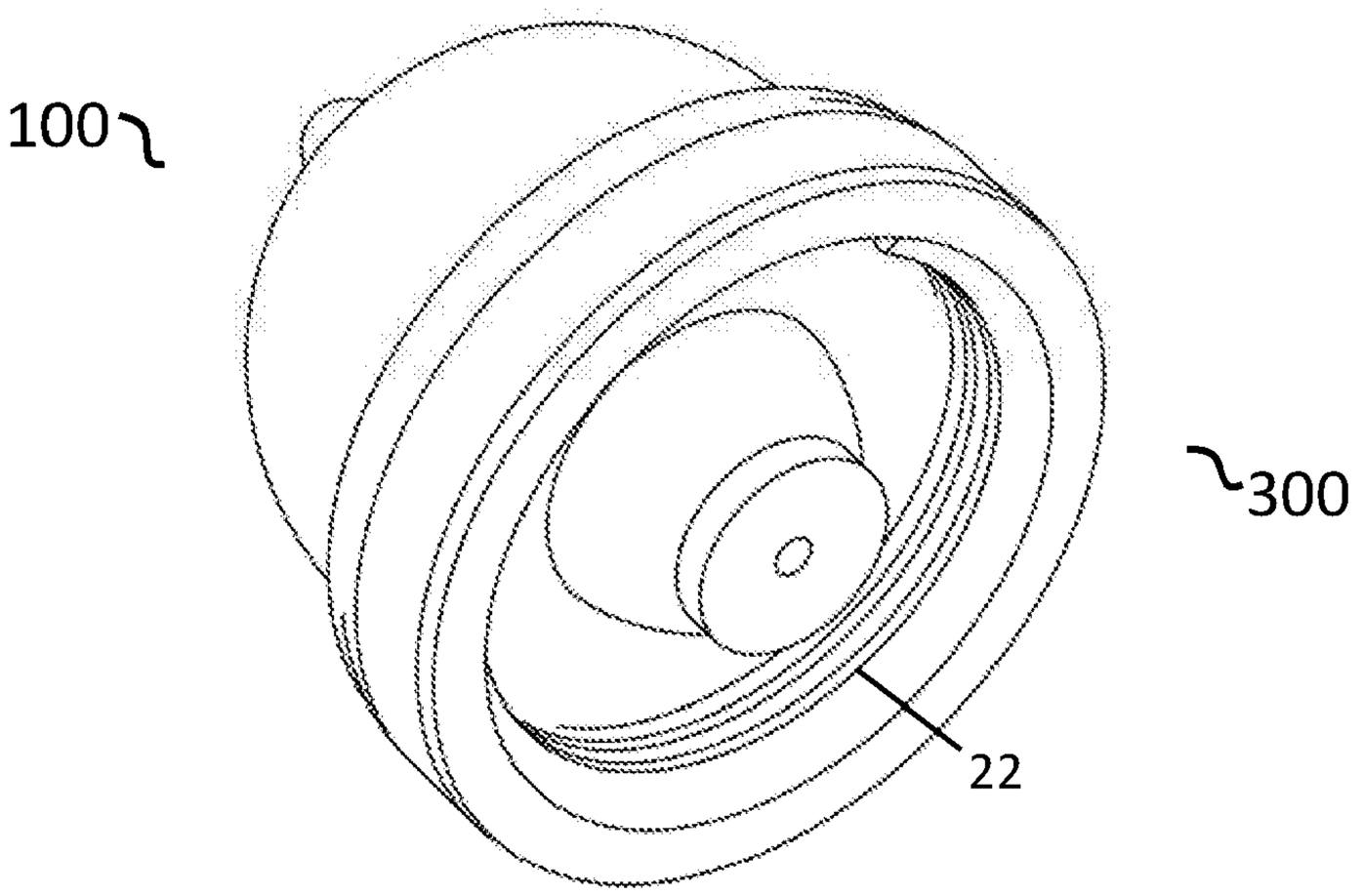

Fig 17

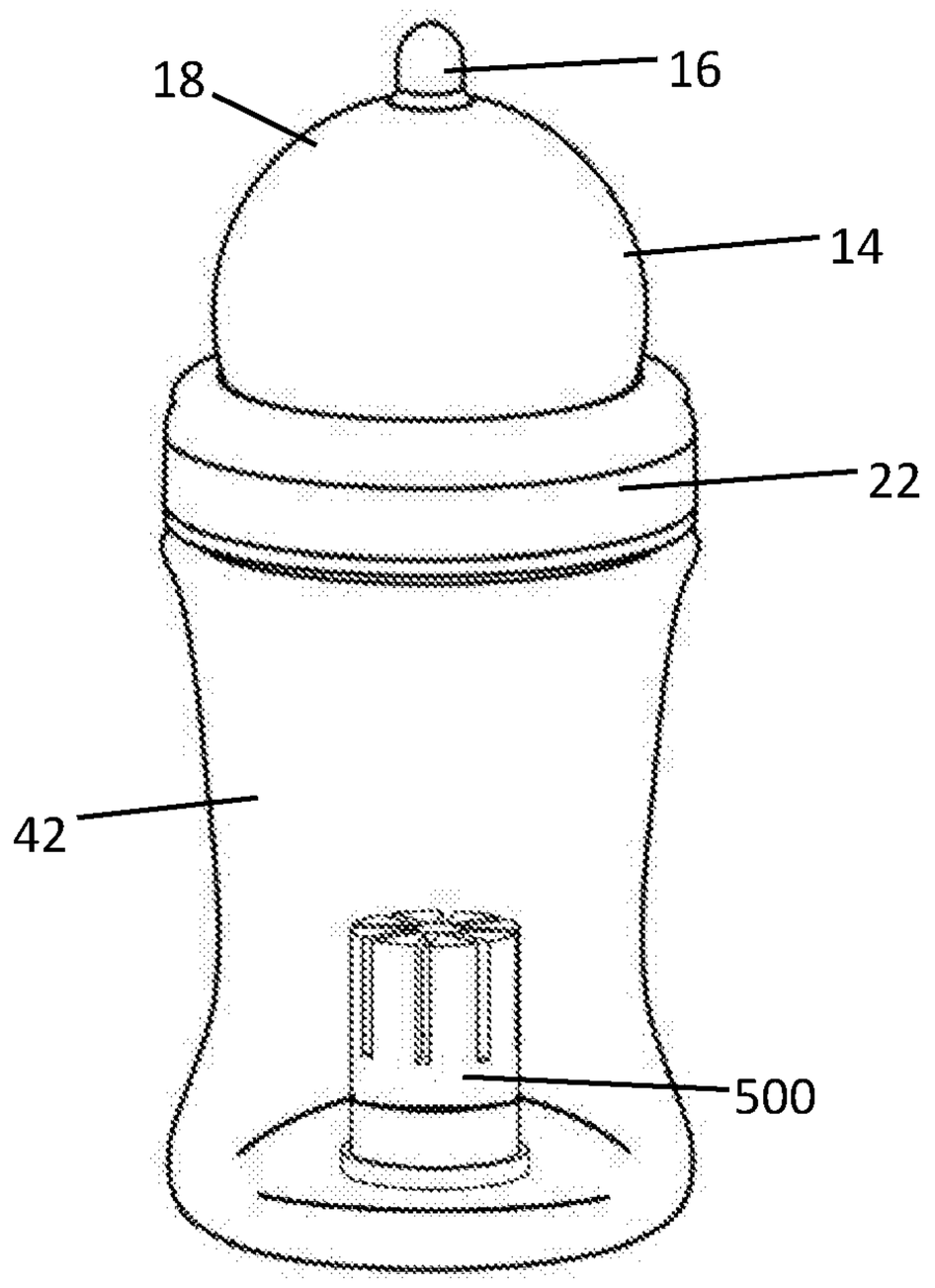

Fig 18

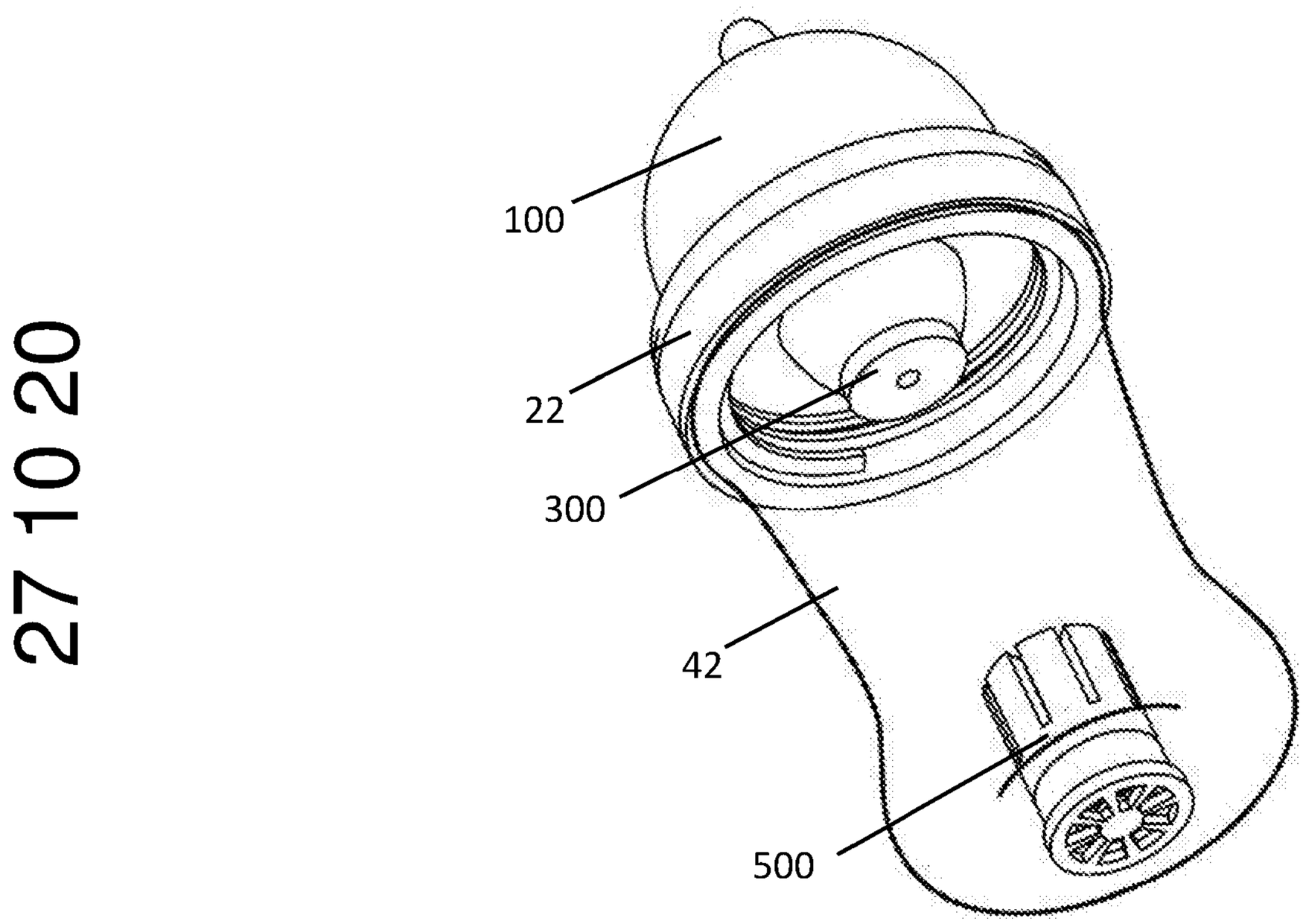

Fig 19

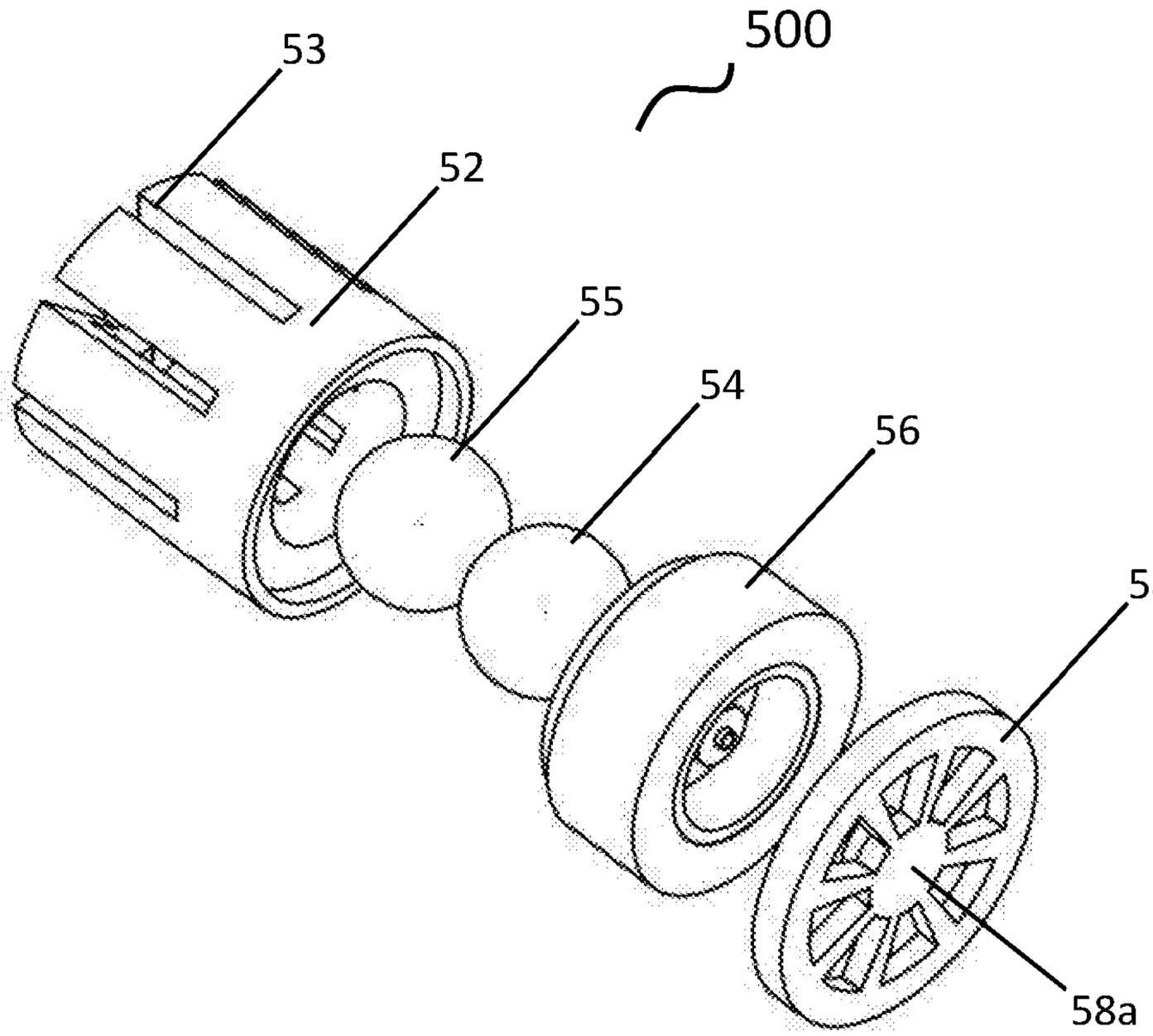

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Fig 20a

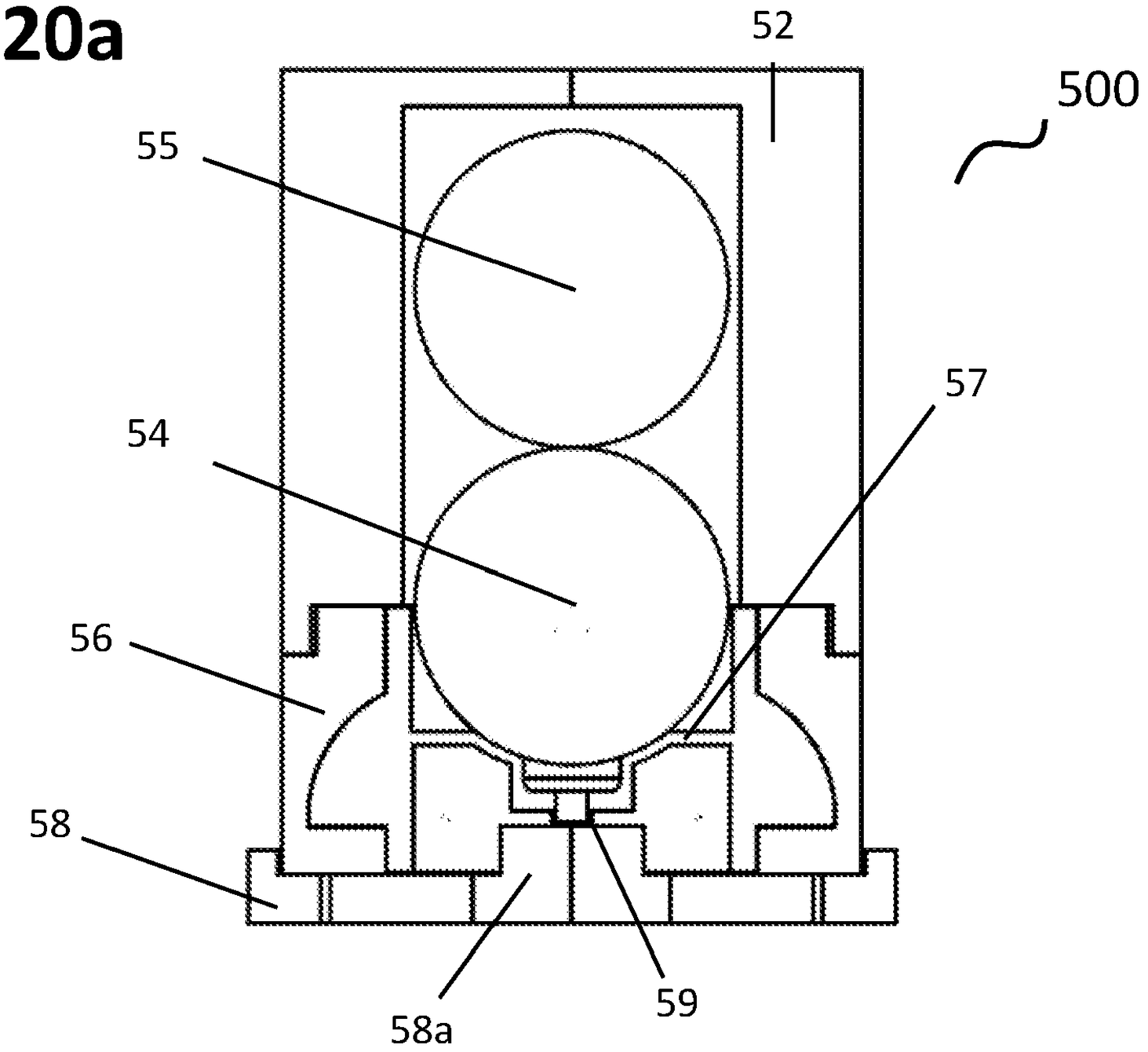

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Fig 20b

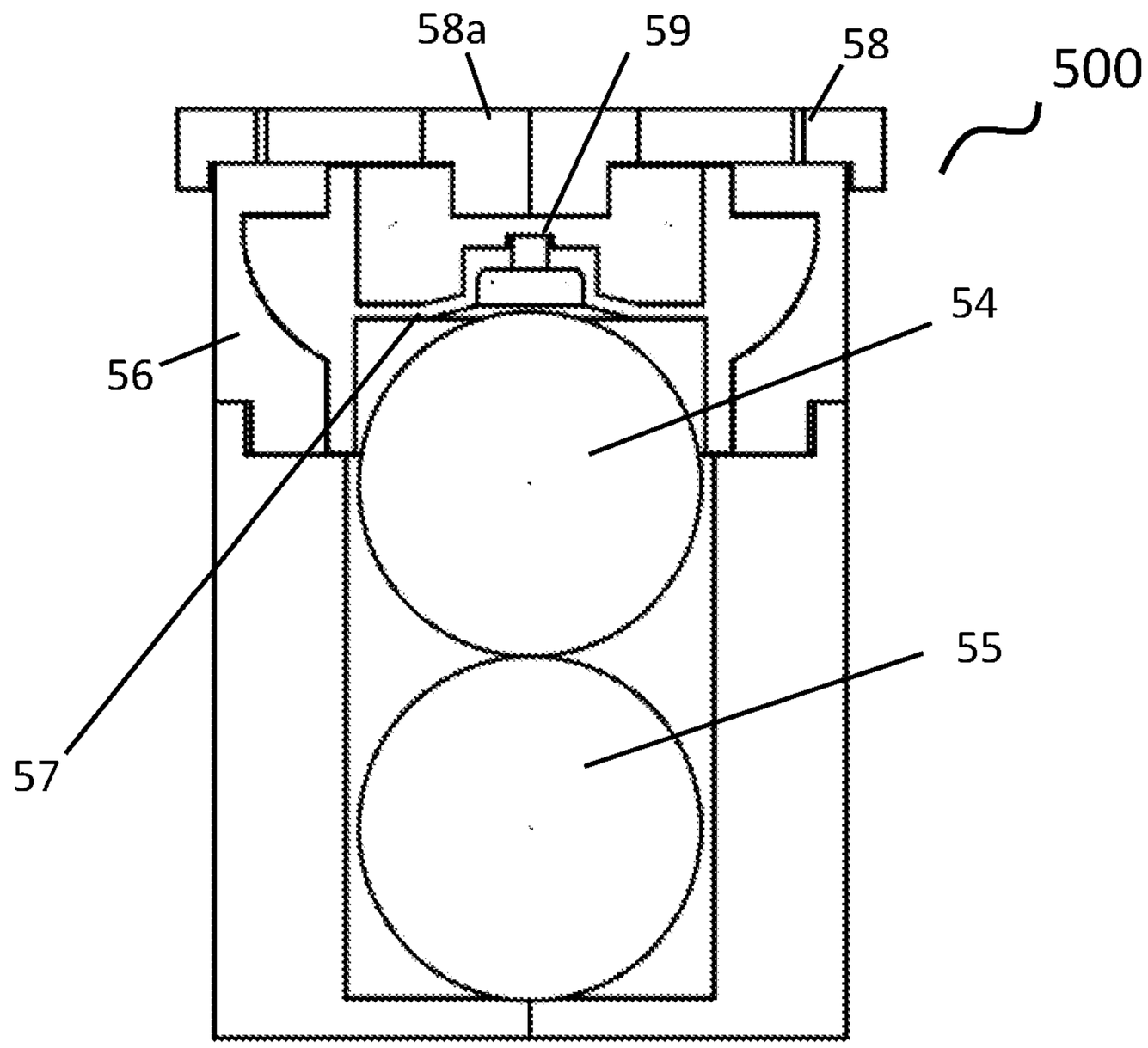

Fig 21

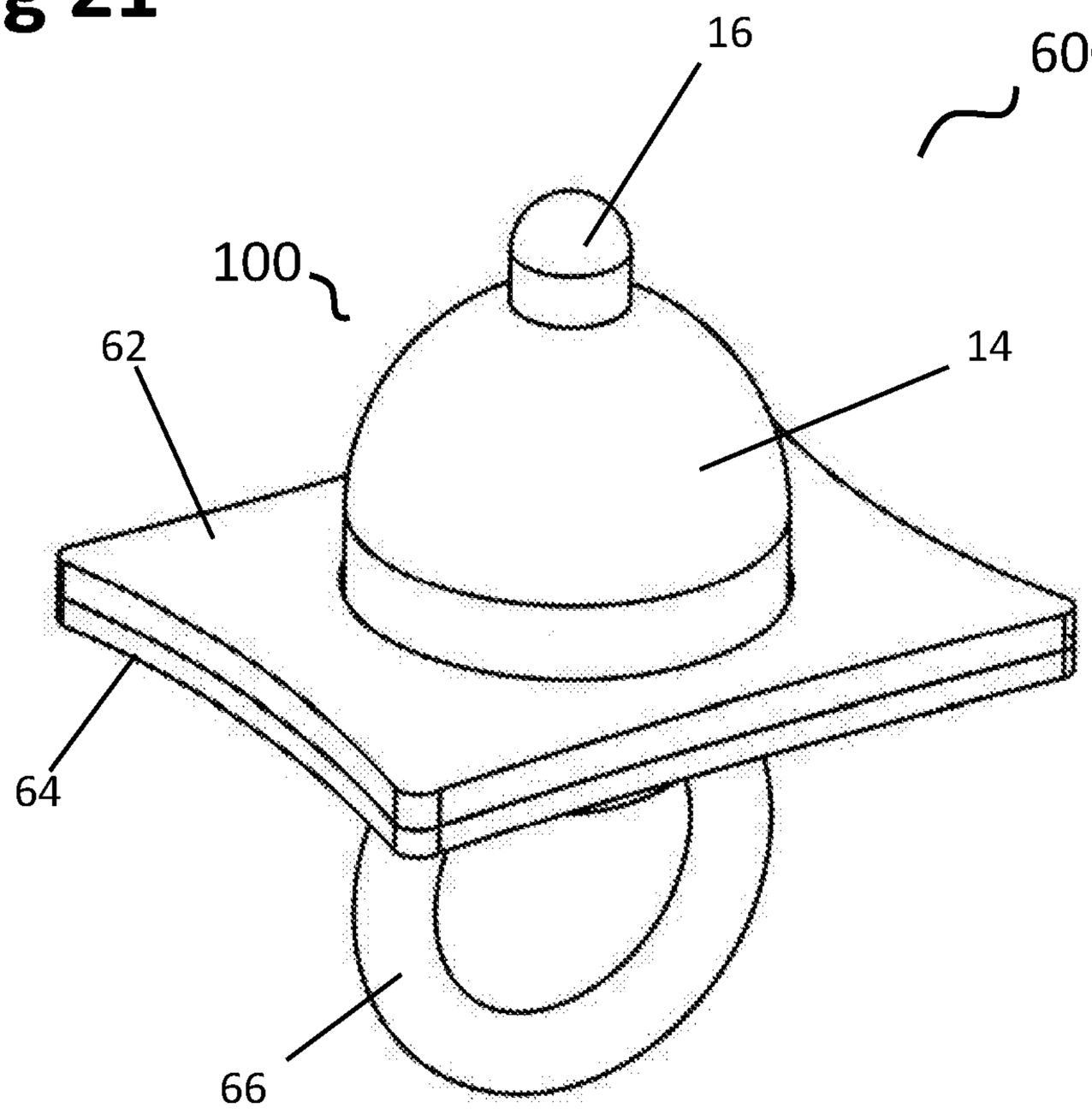

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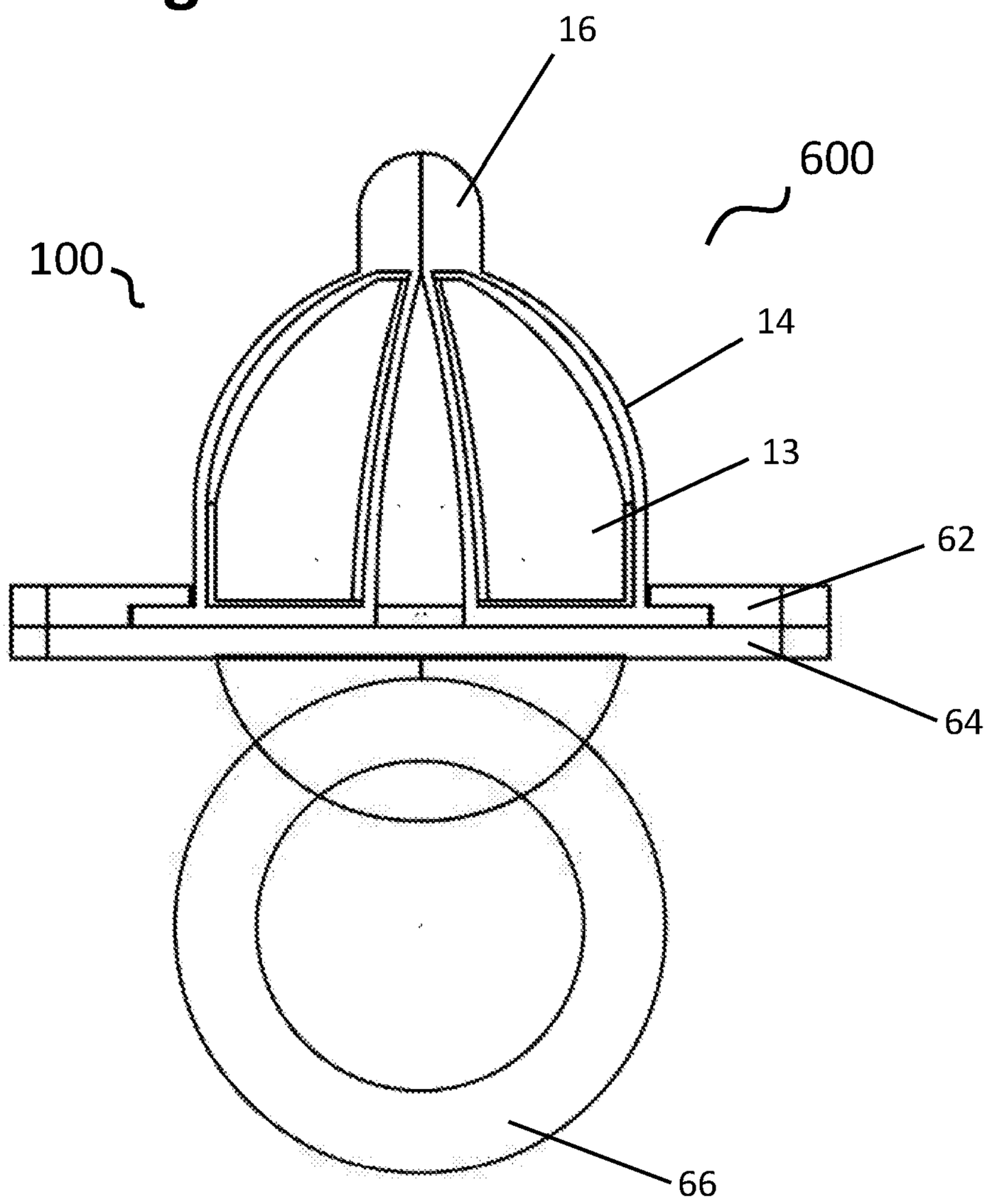
Fig 22



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A TEAT

It is well known to use bottle feeding as a supplement or alternative to breast feeding of infants and young children. This may be due to medical or logistical reasons or for personal choice. Given the concern for children's long term health and development, there is much debate in the field as to the relative merits of breastfeeding and bottle feeding and the implications thereof.

Two areas where bottle feeding may cause issues lie in what is known as "*nipple confusion*" and the initiation of malocclusion. Nipple confusion is a common problem among young infants which are fed via a mix of breast feeding and bottle feeding. The World Health Organisation recommends at least 6 months of exclusive breast feeding followed by a continuation as long as the mother and infant are happy to do so.

However, this is not always possible for various reasons such as work commitments, lack of milk, or health issues relating to breast feeding. It is therefore very common that parents provide a mixture of breast feeding and bottle feeding. However, this mixed feeding regime may cause issues for the infant. In particular, they may not accept the mixed feeding regime and reject one of the breast or the bottle, or they may encounter adaptation problems caused by the difference between the two. This is known as nipple confusion and can manifest in the infant having difficulties in latching and suckling from the breast if they are frequently exposed to the bottle while they are still learning. Once the feeding behaviour has been established the infant may refuse either of the bottle or the breast. This can therefore cause problems as the infant may be unable to drink from one of the bottle or breast and hence any possible flexibility is removed.

Malocclusion is the misalignment or incorrect relation between the teeth of the two dental arches when they approach each other as the jaws close. It is well established in the scientific community that breastfeeding encourages a proper development of the infant's mouth and reduces the development of malocclusion. This is set out, for example, in the article Breastfeeding, Bottle Feeding Practices and Malocclusion in the Primary Dentition; a Systematic Review of Cohort Studies of Hermont et al., the entire contents of which are hereby incorporated by reference, which presents a meta-analysis of the field. This malocclusion results in poor alignment of the teeth and a distorted architecture of the facial bones. This is caused by an improper development of the infant's skull. Environmental factors such as breastfeeding, feeding behaviours in general and breathing habits can have

a large impact on the development of the bones in the face and mouth of the infant and as such, any change to these can result in improper or insufficient stimulation which may initiate or encourage malocclusion.

Both of the above issues arise due to the fundamental differences between teats for infant milk bottles which are presently on the market and the human breast. These teats are typically formed of a hollow teat component made of silicon. The consistency and overall mechanical properties and response of these teats is completely different to the properties and response of a breast. As a result, the method in which the infant activates their muscles to obtain milk from the bottle is completely different to the method in which they activate their muscles to extract milk from the breast. A seminal study of this is set out in Reduction of Masseter Muscle Activity in Bottle-Fed Babies of Inoue et al., the entire contents of which is herein incorporated by reference. In this study, it was shown that the activation of the muscles of the mouth is different between bottle and breastfeeding in a quantitative and qualitative way.

In particular, during breastfeeding there is a major activation of the masseter muscle. The masseter muscle connects the mandible (lower jaw bone) and the cheek bone and plays a major role in the chewing of solid foods. As such, this is one of the main mastication muscles and one of the strongest in the infant's body. This muscle provides the infant the strength to suck the milk from the breast.

During bottle feeding the masseter muscle does not play a significant role and instead other muscles are engaged for this task. For example, the buccinators muscle plays a major part. The buccinators muscle acts to compress the cheeks and is a relatively small muscle. This different activation of muscles is the underlying cause for the issues described above.

Fundamentally, nipple confusion arises as the infant is required to perform a completely different muscle performance when feeding from the bottle compared to breastfeeding. While adult human beings can cope with such changes in behaviour across different situations, infants have a limited capacity of adaption and may struggle to understand the difference between the two.

The link to malocclusion lies in how the development of the mouth, face and muscles is reliant at least partly upon the environment. Breastfeeding reduces the development of dental issues as it encourages muscular function which is similar to a tougher natural diet. Historically, infants were breast-fed for a long period of time and this may have generated an evolutionary link to proper development of the facial muscles.

There is therefore a need for an improved teat for a milk bottle which address these issues.

Similar malocclusion issues may arise from the use of a pacifier (also known as a dummy, soother or teether) by the infant as summarised, for example, in The effect of pacifier sucking on orofacial structures: a systematic literature review of Schmid et al., the entire contents of which is hereby incorporated by reference. The teat portions on pacifiers are also very similar to traditional teats for bottles. Thus, the same issues regarding nipple confusion arise with the use of pacifiers.

US 1 048 459 A discloses a cheap throw-away feeding nipple for babies. This nipple includes a plug of sponge retained within a nipple portion. The purpose of this disclosure is for milk to flow through the sponge. In preferred embodiments the sponge is an open-celled sponge to avoid clogging (as the milk can flow multiple ways through the sponge, it does not matter if any get clogged). In a less-preferred embodiment a closed-celled sponge is provided with an open channel extending therethrough. Again, the milk directly contacts the sponge. Similar designs are provided in GB 2 285 621 A and CN 2158270 Y.

US 2009/0139950 A1 discloses a teat for feeding bottles with a suction body formed as an integral moulded component, i.e. it is not hollow. A rigid head made of a hard plastic is provided as an attachment mechanism for the suction body. As such the portion of the suction body around the rigid head will be less compressible than the nipple portion.

The present invention provides a teat for a milk bottle according to claim 1. This teat for a milk bottle more accurately simulates the natural breast and the muscle activation required to extract milk therefrom. The encompassing of the foam within the flexible skin ensures that the device is easier to use and clean as no milk contacts the foam and hence cannot get lodged or stuck therein. This further ensures that the skin is the only component which must be food grade and/or medically approved as the milk will not contact the foam during use. This allows a greater variety of foams to be used, in particular those where it is difficult

to obtain food grade and/or medical approval given the lack of certifications issued by manufacturers of foam.

The flexible skin may be formed of first and second bonded segments, the first segment extending around an outer surface of the compressible material and the second section extending around an inner surface of the compressible material. This is a convenient and effective way to enclose the compressible material.

The flexible skin may be a single integral piece of material. This can simplify the manufacturing process

An outer surface of the breast portion may be substantially dome shaped, in particular preferably substantially breast shaped. This further reduces any nipple confusion for an infant feeding from the teat.

The dome or breast may have a radius of at least 2 cm, preferably at least 3 cm. These are suitable sizes for typical baby bottles and provide a suitable shape to simulate a breast.

The skin may be formed of a silicone. Silicone is particularly suitable as it is readily available in food-grade compositions and has similar mechanical properties to human skin.

The compressible material may be an expanded foam or a silicone. These materials may have similar mechanical properties to the underlying tissue of a human breast.

The compressible material may have a Shore OO of between 45 to 70. This range may be most similar to a human breast's mechanical properties.

The nipple portion may be less compressible than the compressible material. This further reduces nipple confusion as the woman's nipple is relatively harder than the breast tissue.

The present invention further provides a method of manufacturing a teat for a milk bottle according to claim 10.

The present invention further provides a teat for a milk bottle according to claim 11.

The present invention further provides a teat for a milk bottle according to claim 12. This teat may help reduce nipple confusion as it has more similar mechanical properties to a human breast than existing teats, in particular due to the mechanical response of the breast portion and the relatively harder nipple.

The portion of the milk-flow pathway may extend through the nipple portion has a diameter no greater than 20% of the maximum diameter of the nipple portion, preferably no greater than 10%, most preferably no greater than 5%. This relatively thick nipple portion ensures that it is suitably rigid so as to more closely mimic a human nipple during breastfeeding.

The nipple portion may be at least an upper 0.5 centimetres of the teat, preferably at least an upper 1 centimetre of the teat. This is similar in size to a human nipple, thereby further reducing nipple confusion.

The teat may further comprise a flexible skin fully enclosing the compressible material and separating the compressible material from the milk-flow pathway. This ensures that the skin is the only component which must be food grade approved as the milk will not contact the foam during use as discussed above in relation to the first embodiment.

The nipple portion may be formed as a thick segment of the flexible skin, the portion of the milk-flow pathway extending through the nipple portion formed as a bore through the thick segment of the flexible skin. This is a convenient way to form the nipple portion compared to connecting separate components.

The nipple portion may be formed of a material having a shore A hardness of 15 to 30. This is similar to the human nipple during breastfeeding.

The present invention further provides a teat assembly for a milk bottle according to claim 18. This provides a more similar mechanical response and feel during the suckling motion of an infant by inhibiting milk from being returned to the bottle.

The one-way valve may be formed as a slit in a flexible material. This is a simple way to form the valve.

The flexible material may be supported by a rigid frame. This ensures that the valve returns to the correct shape to control milk flow in the intended manner.

The teat of the teat assembly may be according to any of claims 1 to 9 or 11 to 17. This combines the benefits discussed in relation to these teats with the benefits of the one-way valve.

The present invention further provides an assembly according to claim 22.

The present invention further provides a kit according to claim 23.

The present invention further provides a teat for a pacifier (also known as a dummy, soother or teether) according to claim 24. This teat for a pacifier more accurately simulates the natural breast and hence avoids confusing the infant. Further, this can help prevent malocclusion caused by conventional pacifier teats.

The present invention further provides a pacifier according to claim 25.

The present invention further provides a one-way valve according to claim 26. This is a simple, but effective one-way vale that provides a reliable seal. In particular, this valve may be mounted on the bottom of a milk bottle and thereby selectively allow air to enter the milk bottle as it is tilted to help prevent an infant from ingesting air and hence developing colic. This valve may be used with any bottle or teat discussed in the present application.

The valve element may a ball valve element, preferably a ball bearing. This is a reliable arrangement, and the valve elements may be mounted in a cage for easy operation of the valve.

The present invention will now be described, by way of example only, with reference to the accompanying figures in which:

Figure 1 shows a perspective view of a teat according to the present invention;
Figure 2 shows a further perspective view of the teat of Figure 1;
Figure 3 shows a bottom view of the teat of Figure 1;
Figure 4 shows a cross-sectional schematic of the teat of Figure 1;

Figure 5 shows a perspective view the teat of Figure 1 in a partially disassembled state;

Figure 6 shows a side view of the partially disassembled teat of Figure 5;

Figure 7 shows a side view of the teat of Figure 1 in a further partially disassembled state, with further components disassembled to Figure 5;

Figure 8 shows a top view of the further partially disassembled teat of Figure 7;

Figure 9 shows a perspective view of an assembly of the teat of Figure 1 attached to a milk bottle top;

Figure 10 shows a lower view of the assembly of Figure 9;

Figure 11 shows a cross-sectional schematic of an alternative teat according to the present invention;

Figure 12 shows a perspective view of a non-return valve for use with the teat of Figure 1;

Figure 13 shows a lower view of the non-return valve of Figure 12;

Figure 14 shows a perspective view of the non-return valve of Figure 12 in a disassembled state;

Figure 15 shows a lower view of the non-return valve of Figure 12 in the disassembled state of Figure 13;

Figure 16 shows a further assembly with the non-return valve of Figure 12 inserted into the assembly of Figure 9;

Figure 17 shows another assembly of the teat of Figure 1 combined with the non-return valve of Figure 12 attached to an infant milk bottle;

Figure 18 shows a bottom perspective view of the assembly of Figure 17;

Figure 19 shows an exploded view of a one-way air valve as used in the assembly of Figure 17;

Figure 20A and 20B show the one-way air valve of Figure 19 in a closed and open position respectively;

Figure 21 shows a perspective view of a teat according to the present invention incorporated into a pacifier; and

Figure 22 shows a cross-sectional view of the pacifier of Figure 21.

Figures 1 to 4 show a teat 100 according to and incorporating aspects of the present invention. The teat 100 is generally dome shaped. In particular, the teat 100 is generally breast shaped in order to more closely mimic the shape of a human breast. The teat 100 comprises an attachment portion 12. The attachment portion 12 of the depicted

embodiment consists of a radially extending flange which can be retained by a bottle top portion which attaches to a milk bottle, for example by screwing onto a threaded portion of a milk bottle. The attachment portion 12 may however be any suitable means for attaching the teat 100 to a milk bottle. Preferably, the attachment portion 12 is a generic attachment means which can interact with any generic milk bottle available commercially. Alternatively, the attachment portion 12 may be specific to a proprietary milk bottle.

Extending from this attachment means 12 is a breast portion 14. This breast portion 14 is the primary generally dome shaped portion intended to closely mimic the human breast. A nipple portion 16 then extends from this breast portion 12. The nipple portion 16 is also preferably dome shaped and generally arranged to mimic a human nipple during breastfeeding. The nipple portion 16 further comprises an outlet 18. In use, the infant's mouth will extend around the nipple portion 16 and a section of the breast portion 12 and milk will be expelled from the outlet 18 for the infant to consume. In particular embodiments, more than 30% of the outer surface area of the breast portion 12 may be received within the infant's mouth, preferably more than 50%.

As best shown in Figure 4, the breast portion 14 is formed of a flexible skin 15 which fully encloses a compressible material 13. The compressible material 13 may be, in any embodiment, an elastically deformable material. That is, a material which returns to substantially the original shape after the compressing force is removed. In particular embodiments, the flexible skin may comprise an outer flexible skin 15a in which extends across an outer face of the compressible material 13 and an inner compressible skin 15b which extends across the inner face of the compressible material 13. The outer flexible skin 15a is outermost of the teat 100 and is the portion of the flexible skin 15 that the infant will contact in order to latch onto the teat 100. The outer and inner faces 15a, 15b may be separate faces which are bonded together during manufacture. Alternatively, the outer and inner faces 15a, 15b may parts of a single integral sheet of flexible material 15.

The compressible material 14 is selected to have a compressive resistance similar to a human breast. In particular, the compressible material 13 is selected to have similar mechanical and elastic properties as the breast tissue. For example, the compressible material 13 may be an open cell foam material such as a sponge. Suitable materials may include one or more of polyurethane foam, polyether foam, silicon in the form of rubber or foam, natural sponge, gel foam, polyethylene foam, ethylene copolymer foam, expanded

polystyrene foam, expanded polyethylene foam, fluoropolymer foam, polyester foam, polyetherimide foam, polyolefin foam, hydrogels, rubbers and elastomers either synthetic or natural.

"*Synthetic Rubber*" is intended to mean any artificial elastomer. Typically, these are polymers synthesised from petroleum byproducts. Exemplary synthetic rubbers include styrene-butadiene copolymer, nitrile rubber, neoprene, ethylene-propylene-diene-monomer rubber, silicon rubber and butyl rubber.

"*Natural Rubber*" is intended to mean a rubber obtained from non-petroleum sources. Typically, natural rubber is a biosynthetic polymer obtained from a tree called "*Hevea brasiliensis*" as an aqueous solution. Natural rubber is mainly poly-cis-isoprene containing typically up to about 5 wt% of other materials such as protein, fatty acids, resins and inorganic salts.

The compressible material 13 may be a hyper-elastic solid as breast tissue is often modelled as such a solid. In particular, the compressible material 13 may be a foam with a Shore OO hardness of 45 to 70. Alternatively, the compressible material 13 may be a rubber with a shore A hardness of 15 to 30.

The thin skin layer 15 then mimics the human skin. In particular embodiments, the thin skin layer 15 may be a silicon layer. Alternatively, the skin layer 15 may be any elastomeric material with similar mechanical properties to human skin. This includes polyurethane, polyisoprene, and polybutadiene. The skin layer 15 may have a thickness of between 0.8 to 2 millimetres in the breast portion 14 of the teat 100. The elastomeric material forming the skin layer 15 may have a shore A hardness value of 15 to 30.

A milk flow pathway 19 is thus defined which extends from the attachment portion 12 to the bottle through to the outlet 18 of the nipple portion 16. Milk exiting the teat 100 will pass along this flow path 19. The compressible material 13 is fully separated from the milk flow path 19 by virtue of the flexible skin 15. In particular, in the breast portion 14 of the teat 100, the inner section of flexible skin 15b defines the milk flow path.

The nipple portion 16 may be less compressible than the compressible material 13. In particular, the nipple portion 16 may have a Shore A hardness value of15 to 30. In

particular embodiments, the nipple portion 16 may be formed as a solid component. This may be a solid amount of the material for the flexible skin 15, such as silicone. The milk-flow pathway in the nipple portion 16 may have a diameter which is no greater than 20% of the diameter of the nipple portion, preferably no greater than 10%, most preferably no greater than 5%. In particular embodiments, the milk pathway may have a diameter of between 0.2 to 0.5 millimetres. In some of these embodiments the nipple portion 16 may have a diameter of approximately 10 millimetres and hence the milk pathway has a diameter of between 2 to 5% of the diameter of the nipple portion 16. These diameters are defined generally in a direction transverse or perpendicular to the milk-flow pathway 19. The nipple portion 16 may be an upper 0.5 cm of the teat 100, preferably an upper 1 cm of the teat 100. The "*upper*" direction is defined in the direction of milk-flow from the bottle to the infant. That is, the upper part is the region the infant latches to in use.

Recent studies such as Biomechanics of Milk Extraction During Breastfeeding by Elad et al., the entire contents of which is hereby incorporated by reference, have characterised the breastfeeding motion in great detail. In order for the infant to affectively extract milk from the breast, they first must establish a latch on a wide area of the breast. Following this latch, they develop a sub-atmospheric pressure within their mouth. This in turn deforms the breast tissue in the latch region in order to adjust it to the contours of the infant's mouth and tongue. The extraction of milk is then caused by a pressure gradient that is generated in the infant's mouth by varying the volume of the infant's mouth. Essentially, the infant rhythmically opens and closes the mouth in a motion similar to chewing. This varies the mouth volume and hence encourages milk from the breast. This varying of mouth volume is mostly caused by the masseter muscle discussed above in the background to the invention. The use of the compressible material 13 and flexible skin 15 of the present invention allows this action to be affectively mimicked by the infant when bottle feeding. In particular, as the material and shape of the teat 100 more precisely matches the mechanical properties of the human breast, the same action is possible to extract milk from the bottle. The harder nipple portion 16 also allows the teat 100 to be more similar to a breast.

Figures 5 to 8 show how the compressible material 13 is affixed and enclosed within the flexible skin 15 to form the teat 100. As shown in Figure 7, the first and second sections of the flexible skin 15 narrow towards a neck portion. The nipple portion 16 then extends from this neck portion. The milk-flow pathway 19 passes through an interior of this neck portion.

The compressible material 13 is then provided between these first and second skin segments as shown in Figures 5 and 6. In the particular embodiment of these Figures, the flexible material 13 is a foam and is formed generally in the shape of a cross or plus symbol. This is to allow the foam to effectively fill the required space without generating undesired lumps. Each of the first and second sections of the flexible skin 15 includes first and second flange portions 12a and 12b which bond together to enclose the flexible material 13 and provide the attachment portion 12. As such, the compressible material 13 is entrirely sealed away from the milk flow pathway 19.

Figures 9 and 10 show the teat 100 retained within a screw-top 22 for a milk bottle. The screw top lid 22 includes an inner threaded portion 24 for attaching to an outer threaded portion of a milk bottle (not shown). The screw top 22 includes an opening at its upper end into which the teat 100 is inserted from below. This opening then retains the attachment portion 12 of the teat 100 as shown in Figures 9 and 10. This assembly of screw top portion 22 and teat 100 is then ready to be attached to a milk bottle.

Figure 11 depicts a schematic cross-sectional view of an alternative embodiment of a teat 100. This teat 100 is generally as described above with respect to Figures 1 to 10. However, the flange portions 12A, 12B of the inner and outer skins 15A, 15B are not affixed to one another, or sealed together during manufacture. Instead, the flange portions 12A, 12B are free and are held together by a fixing body 23.

The fixing body 23 may be formed of first 23A and second 23B body components which are attachable to one another to thereby press the flange portions 12A, 12B together. For example, as shown in Figure 11, the first and second body components 23A, 23B may be attachable via a mechanical lock, such as a press-fit arrangement. These first and second body components 23A, 23B may be fixed together, for example via an adhesive or soldering.

This alternative teat 100 may then be attached to a milk bottle via a screw top lid 22 as described above. In alternative embodiments, the fixing body 23 may be integral to or attachable to the screw top lid 22.

A method of manufacturing the teat 100 is also provided. First, the compressible material 13 is provided. A passage extends therethrough. This passage is then lined by the flexible

skin 15 to define the milk-flow pathway 19.The flexible skin 15 encloses the compressible material 13 there-within to form a breast portion 14. Thus the flexible skin 15 separates the compressible material 13 from a milk-flow pathway.

Figures 12 to 15 show a one-way valve 300 for use in a milk bottle assembly, in particular it may be used with the teat 100 previously described. The one-way valve 300 is also known as a non-return valve. The valve assembly 300 comprises an outer rigid component 32 and an inner flexible component 34. The outer rigid component 32 includes a central projection 36 which plateaus to a flat section with an opening 33. The inner flexible component 34 has a generally matching shape. In use, the inner flexible component 34 is retained within the outer rigid component 32, with a central projection of the inner flexible component 34 within the central projection 36 of the outer rigid component 32.

The inner flexible component 34 is best shown in Figures 13 and 14 and comprises a corresponding inner projection. This corresponding inner projection extends within the projection of the rigid portion 32 and maintains its shape therein. The top of this inner projection then extends back towards the flat flange of the flexible portion 34 with a slope section 37. At the apex of this slope section 37 is a slit valve 36. That is, the valve 36 is formed as a slit within the flexible material. When the flexible portion 34 is mounted within the rigid portion 32 the assembly 300 then acts as a non-return valve. This non-return valve is mounted within the screw top 22 as shown in Figure 16.

In alternative embodiments, the valve 300 could be mounted on an opening to a bottle, via the outer flat flange of the rigid portion 32. That is, the flange of the rigid portion would be supported by a rim of the opening. This would be easily removable for filling the bottle or cleaning.

This valve 300 allows milk to flow from the bottle to the teat 100 but not from the teat 100 back into the bottle. This allows the teat 100 to more accurately mimic a human breast where milk cannot flow back into the breast. As such, the teat 100 will have a more realistic feel and mechanical response during the suckling motion of the infant.

Figures 17 and 18 show the teat 100 attached via a screw top 22 to a bottle 42 in an assembled state. This bottle 42 will be filled with milk (or any other liquid) and this is the assembly in which an infant may use the teat 100 for bottle feeding. As milk is expelled

from the bottle 42 a vacuum would otherwise form as the empty volume of the bottle 42 where the milk used to be used to be is created. In order to address this it is necessary for the infant to un-latch from the teat 100 to allow air back into the bottle. This is not a desired motion as doing so causes the infant to ingest air and can induce colic in the infant. As such, there is a need to allow air into the milk bottle 42 to prevent this. This further allows the use of the teat 100 to more accurately mimic a human breast as this un-latching is not necessary for a human breast.

In order to achieve this, a one-way air valve 500 is provided within a milk bottle 42. This valve may be any conventional mechanism known to allow air into the milk bottle 44. For example, in one particular embodiment, an inner sleeve may be provided within the milk bottle 43 containing the milk. The air valve 500 may then allow air into the area surrounding this inner sleeve. The inner sleeve is formed of a flexible, deformable, material and hence as the milk leaves the inner sleeve it deforms and shrinks under pressure. Air is allowed into the area surrounding the flexible sleeve to maintain a constant pressure as the milk is drank. The valve 500 in this embodiment does not need to provide any metering or directional control and can be as simple as a hole in the milk bottle.

A particular embodiment of the air valve 500 is shown in Figures 19, 20A and 20B. The air valve 500 is formed of a valve unit 56 comprising a valve seat 57. A ball valve element 54 are provided for selectively sealing with the valve seat 57 to seal the air valve 500. In particular embodiments, a second ball 55 is provided. This provides additional weight to the primary ball valve element 54 to aid in the closing of the air valve 500 under gravity. The ball valve element(s) 54, 55 are retained within a cage 52 that allows them to move a small amount towards and away from the valve seat 57. The cage 52 comprises a plurality of slots 53 extending therethrough to allow for a passage of air through the valve 500. The cage 52 is attached to the valve unit 56 and extends into the milk bottle.

In a resting position, the milk bottle is placed on a surface with its lower end facing downwards. As the valve 500 is provided on this lower end, the force of gravity acts to bias the ball valve element 54 towards the valve seat 57 as shown in Figure 20A, thereby sealing the valve 500. As the bottle is lifted and tilted upwards so as to feed the infant, the valve 500 is inverted as shown in Figure 20B. As a result, the force of gravity acts to bias the ball valve element 54 away from the valve seat, thereby allowing air to flow through the valve 500 into the milk bottle.

In particular embodiments, the valve seat 57 may be provided with a secondary sealing mechanism. In such embodiments, the valve seat 57 comprises a central projection 59 extending on an opposite side of the valve seat 57 to the ball valve element 54. The flow pathway through the valve seat 57 passes through this central projection 59. A sealing element 58 is provided, attached to an opposite side of the valve unit 56 to the cage 52. The sealing element 58 comprises a central secondary valve seat 58A. In such embodiments, the valve seat 57 is a deformable, flexible component. For example, the valve seat 57 may be formed of silicone and retained within the valve unit 56.

In such embodiments, in the resting position, the weight of the ball valve element(s) 54, 55 acts to deform the valve seat 57 towards the sealing element. As a result, the central projection 59 contacts the secondary valve seat 58A, thereby blocking the flow pathway at a second point. Accordingly, flow through the valve 500 is blocked in two locations for a more reliable valve 500. The opening of this valve 500 is as described above, with the addition that the valve seat 57 deforms away from the central projection 59.

An assembly may be provided of the teat 100 attached to a milk bottle 42. The assembly may further include the non-return valve 300. Likewise, a kit of parts may be provided of the teat 100 and a milk bottle 42. The kit of parts may further include the non-return valve 300.

In a further embodiment of the present invention, a teat 100 substantially similar to that described above may be a sub-component of a pacifier 600 (also known as a dummy, soother or teether) as shown in Figures 21 and 22.

The teat 100 forms the portion of the pacifier 600 that the infant receives in their mouth. Instead of a bottle attachment portion 12, the teat 100 may comprise a guard 64 and/or guard attachment portion 62 for attaching the teat 100 to a guard 64. The guard 64 may be a component integral to the teat 100 or may be a separate component that the teat 100 is attached to. The guard 64 acts to prevent an infant from accidentally swallowing the pacifier 600.

Typically, the pacifier 600 will further comprise a ring 66 extending from the guard.

The teat 100 may not include the milk-flow pathway in such embodiments as it is not necessary in the embodiment for a pacifier 600. Instead, the compressible material 13 may extend across the entire inner area of the breast portion 14. Likewise, the nipple portion 16 may be a solid component with no milk-flow pathway extending therethrough. Alternatively, the teat 100 may be substantially identically arranged, but with no milk-flow pathway extending through the nipple portion 16. That is, the nipple portion 16 may be a solid component.

In alternative embodiments, the teat 100 may be identical to those as described above, and may be able to connect to a pacifier 600 via the bottle attachment portion 12. In such embodiments, the same teat 100 may be used for bottle feeding and for a pacifier 600. Thus only a single teat 100 needs to be transported and can be switched between the two uses as necessary.

The teat 100 and associated components described above provide a more accurate simulation of the human breast which has significant advantages in bottle feeding and pacifier sucking.

CLAIMS:

1. A teat for a milk bottle, comprising:

an attachment portion for attaching the teat to a milk bottle;

a breast portion extending from the attachment portion;

a compressible material substantially filling the breast portion

a nipple portion extending from the breast portion and being narrower than the breast portion, the nipple portion comprising an outlet; and

a milk-flow pathway extending through the breast portion, the compressible material and the nipple portion for the passage of milk from a milk bottle attached to the attachment portion to the outlet,

wherein the breast portion comprises a flexible skin fully enclosing the compressible material, the flexible skin separating the compressible material from the milk-flow pathway.

2. The teat of any preceding claim, wherein the flexible skin is formed of first and second bonded segments, the first segment extending around an outer surface of the compressible material and the second section extending around an inner surface of the compressible material.

3. The teat of claim 1, wherein the flexible skin is a single integral piece of material.

4. The teat of any preceding claim, wherein an outer surface of the breast portion is substantially dome shaped, in particular preferably substantially breast shaped.

5. The teat of claim 4, wherein the dome or breast has a radius of at least 2 cm, preferably at least 3 cm.

6. The teat of any preceding claim, wherein the skin is formed of a silicone.

7. The teat of any preceding claim, wherein the compressible material is an expanded foam or a silicone.

8. The teat of any preceding claim, wherein the compressible material has a Shore OO of between 45 to 70.

9. The teat of any preceding claim, wherein the nipple portion is less compressible than the compressible material.

10. A method of manufacturing a teat for a milk bottle comprising the steps of:

providing a compressible material having a passage extending therethrough;

enclosing the compressible material within a flexible skin to form a breast portion of the teat, the skin extending through the passage and separating the compressible material from a milk-flow pathway.

11. A teat for a milk bottle manufactured according to the method of claim 10.

12. A teat for a milk bottle, comprising:

an attachment portion for attaching the teat to a milk bottle;

a breast portion extending from the attachment portion, the breast portion comprising a compressible material substantially filling the breast portion;

a nipple portion extending from the breast portion and being narrower than the breast portion, the nipple portion comprising an outlet and being less compressible than the filling material; and

a milk-flow pathway extending through the breast portion and the nipple portion for the passage of milk from a milk bottle attached to the attachment portion to the outlet.

13. The teat of claim 12, wherein the portion of the milk-flow pathway extending through the nipple portion has a diameter no greater than 20% of the maximum diameter of the nipple portion, preferably no greater than 10%, most preferably no greater than 5%.

14. The teat of claim 12 or 13, wherein the nipple portion is at least an upper 0.5 centimetres of the teat, preferably at least an upper 1 centimetre of the teat.

15. The teat of any of claims 12 to 14, further comprising a flexible skin fully enclosing the compressible material and separating the compressible material from the milk-flow pathway.

16. The teat of claim 15, wherein the nipple portion is formed as a thick segment of the flexible skin, the portion of the milk-flow pathway extending through the nipple portion formed as a bore through the thick segment of the flexible skin.

17. The teat of any of claims 12 to 16, wherein the nipple portion is formed of a material having a shore A hardness of 15 to 30.

18. A teat assembly for a milk bottle, comprising:

a teat comprising:

an attachment portion for attaching the teat to a milk bottle; and

a milk-flow pathway for a flow of milk from the milk bottle;

a one-way valve configured to permit milk flowing from a milk bottle attached to the attachment portion to the milk-flow pathway and inhibit milk flowing from the milk-flow pathway to the bottle.

19. The teat assembly of claim 18, wherein the one-way valve is formed as a slit in a flexible material.

20. The teat assembly of claim 19, wherein the flexible material is supported by a rigid frame.

21. The teat assembly of any of claims 18 to 20, wherein the teat is according to any of claims 1 to 9 or 11 to 17.

22. An assembly comprising:

a milk bottle; and

a teat according to any of claims 1 to 9 or 11 to 17 or a teat assembly according to any of claims 18 to 21, the teat or teat assembly attached to the milk bottle via the attachment portion.

23. A kit comprising:

a milk bottle; and

a teat according to any of claims 1 to 9 or 11 to 17 or a teat assembly according to any of claims 18 to 21.

24. A teat for a pacifier, comprising:

an attachment portion for attaching the teat to a pacifier;

a breast portion extending from the attachment portion;

a compressible material substantially filling the breast portion

a nipple portion extending from the breast portion and being narrower than the breast portion,

wherein the breast portion comprises a flexible skin fully enclosing the compressible material.

25. A pacifier comprising:

a guard for inhibiting an infant from swallowing the pacifier;

a teat according to any of claims 1 to 9, 11 to 17 or 24, extending from the guard.

26. A one-way valve comprising:

a valve unit comprising:

a first valve seat, comprising a flow pathway extending from the first valve seat to an opening in a central projection, wherein the first valve seat is deformable in the direction of the central projection;

a valve element, moveable towards and away from the first valve seat and sealingly engageable therewith; and

a second valve seat arranged to seal with the central projection,

wherein the valve seat is configured to deform from a force applied by the first valve element towards the second valve seat to thereby seal the opening in the central projection against the second valve seat.

27. The one-way valve of claim 26, wherein the valve element is a ball valve element, preferably a ball bearing.

Intellectual Property Office

Application No:	GB1912695.2	**Examiner:**	Mr Henry You
Claims searched:	1-11	**Date of search:**	10 January 2020

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-11	JP S6324948 A (NAKAJIMA et al.), see Figure 3
X	1-11	WO 2010/046812 A1 (KONINKLIJKE PHILIPS ELECTRONICS NV), see Figures 1 and 2

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A61J

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
A61J	0011/00	01/01/2006

Intellectual Property Office

Application No: GB1912695.2 **Examiner:** Mr Henry You

Claims searched: 26 and 27 **Date of search:** 1 July 2020

Patents Act 1977
Further Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	26 and 27	US 3797521 A (KING), see Figures 3 and 4 and column 3, line 54 - column 4, line 31, noting the circular ridge in valve seat 62
X	26 and 27	GB 1553939 A (DAIMLER BENZ AG), see Figure 1 and WPI abstract
A	-	WO 2014/105452 A (EATON CORP), see Figure 5
A	-	GB 2477185 A (FONG), see Figures 7 and 8

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A61J; F16K

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, Patent Fulltext

International Classification:

Subclass	Subgroup	Valid From
A61J	0011/00	01/01/2006