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(54) **SOUND-ATTENUATING DEVICE AND METHOD OF USE THEREOF**

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Related U.S. Application Data

(63) Continuation of application No. 18/132,964, filed on Apr. 10, 2023, now Pat. No. 12,236,930, which is a continuation of application No. 17/151,579, filed on Jan. 18, 2021, now abandoned, which is a continuation-in-part of application No. 16/373,646, filed on Apr. 3, 2019, now Pat. No. 10,897,666.

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(51) **Int. Cl.**

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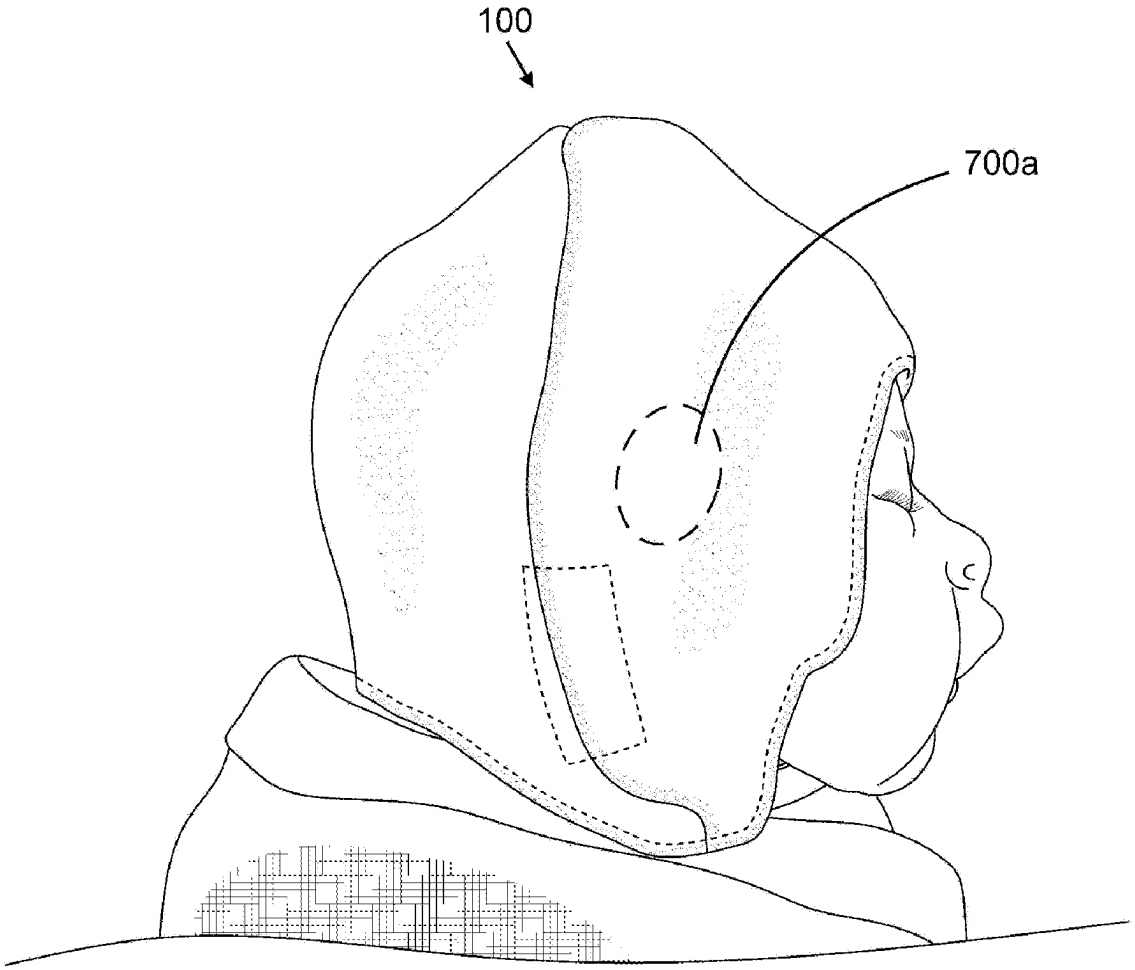
A42B 1/06	(2021.01)
H04R 1/10	(2006.01)
H04R 5/033	(2006.01)

(52) **U.S. Cl.**

CPC ***G10K 11/168*** (2013.01); ***A42B 1/06*** (2013.01); ***H04R 1/1008*** (2013.01); ***H04R 1/1058*** (2013.01); ***H04R 1/1083*** (2013.01); ***H04R 1/1091*** (2013.01); ***H04R 5/0335*** (2013.01); *H04R 2460/15* (2013.01)

(57) **ABSTRACT**

A sound-attenuating assembly may have a headpiece and two covered dampening assembly that may be detachably attached to the locations of the headpiece that oppose a wearer's ear; the dampening assembly may have a padded member member that may be in contact with a dividing member that may be in a contact with a compressible member which may be disposed within a concave member; the dampening assembly may be disposed within a cover such a fastener of the cover detachably attaches to a fastener of the headpiece.



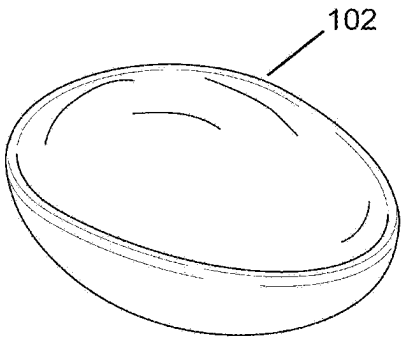


FIG. 1A

FIG. 1B

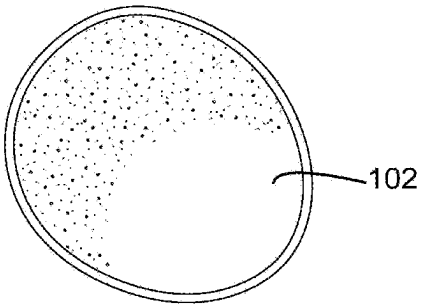


FIG. 1C

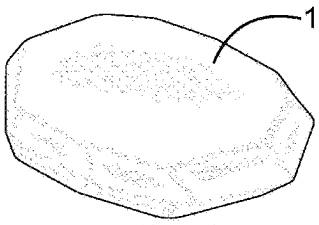


FIG. 2A

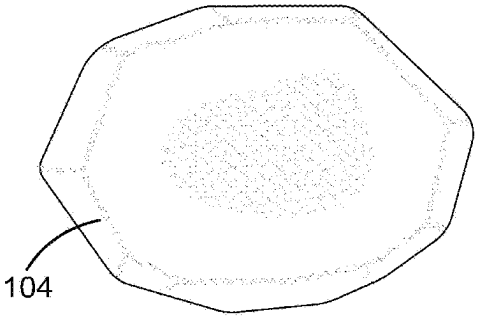


FIG. 2B

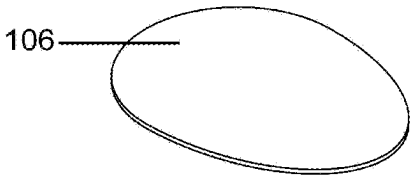


FIG. 3A

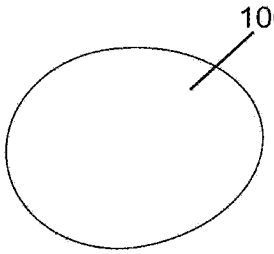


FIG. 3B

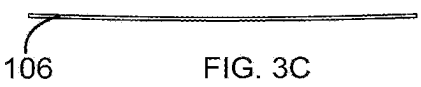


FIG. 3C

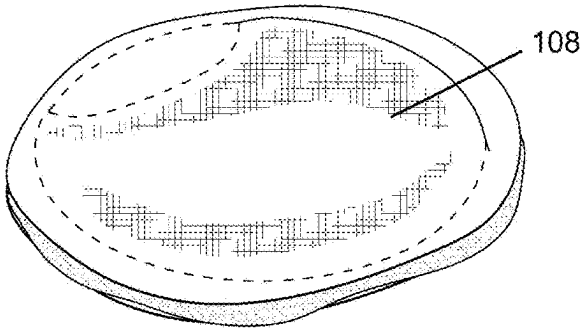


FIG. 4A

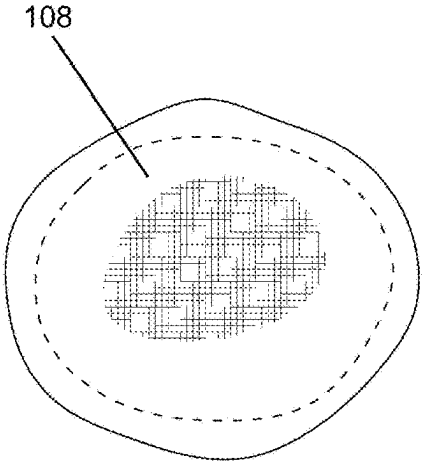


FIG. 4B

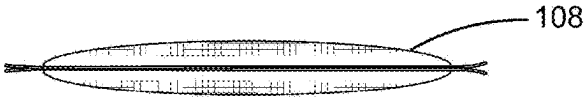


FIG. 4C

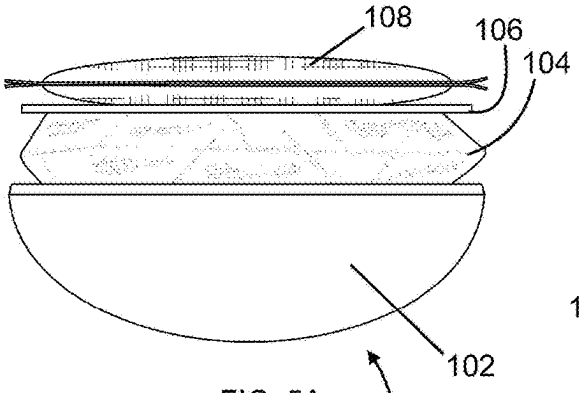


FIG. 5A

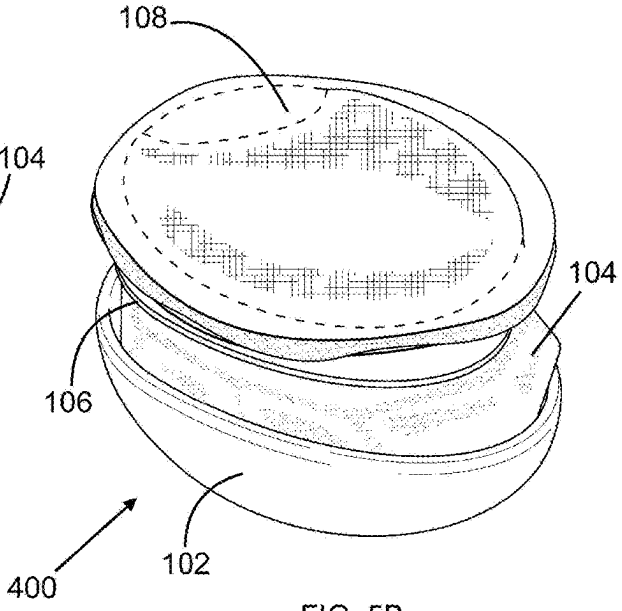


FIG. 5B

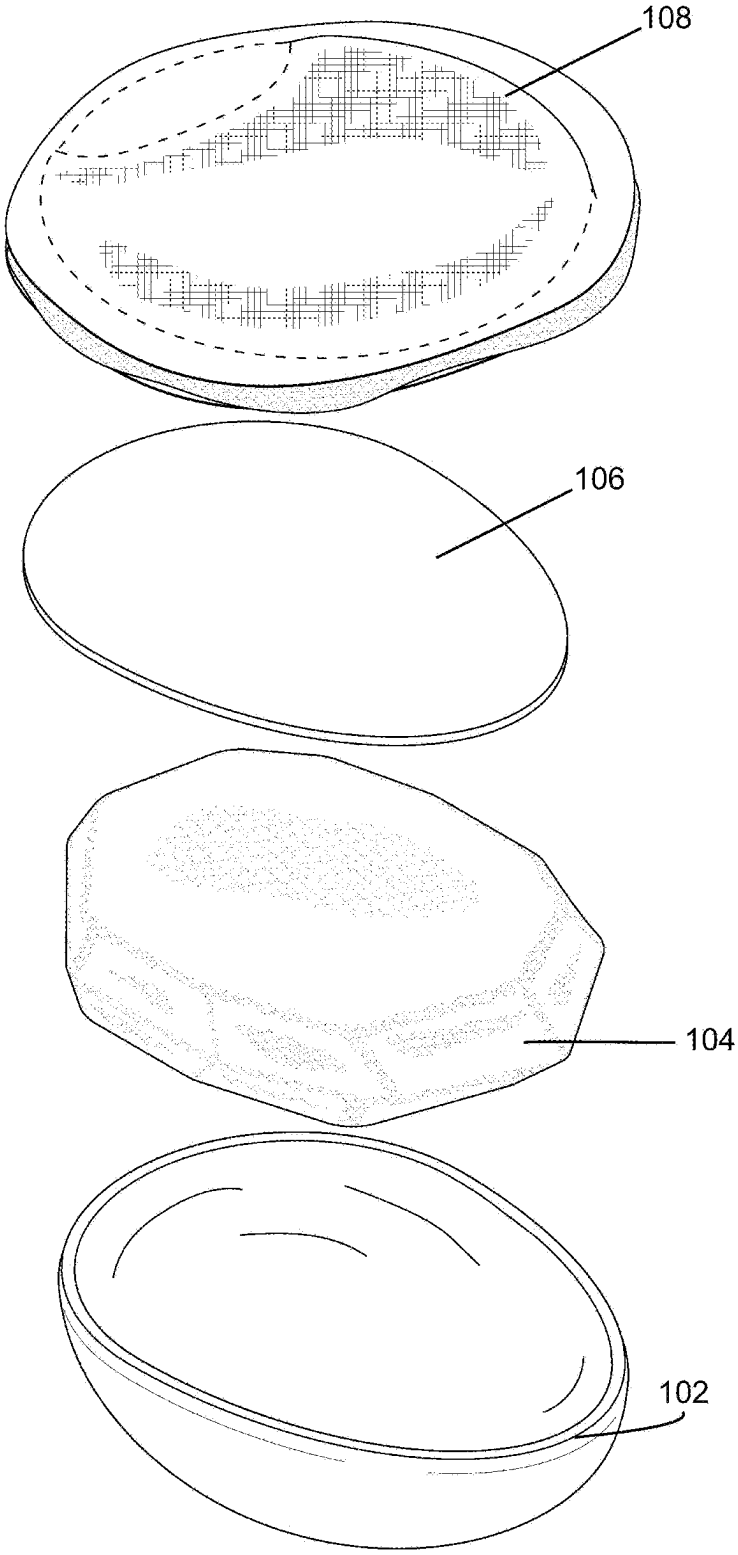


FIG. 6

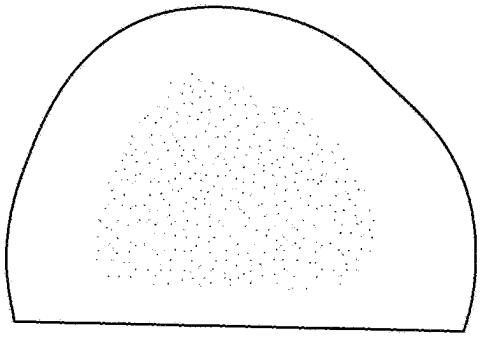


FIG. 7A

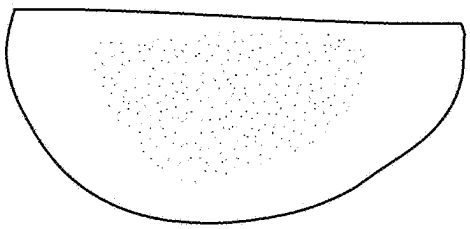


FIG. 7B

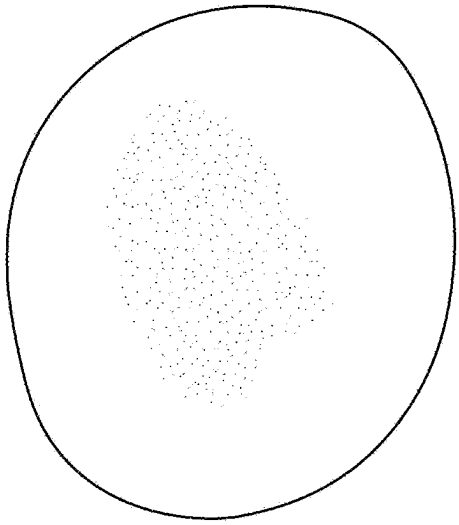


FIG. 8

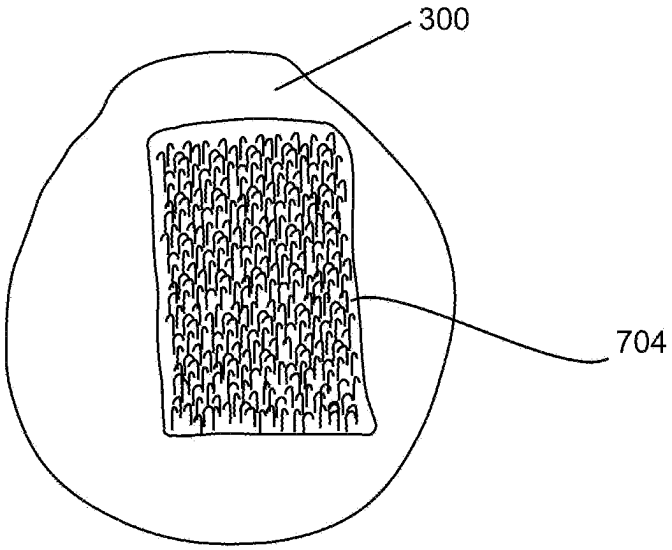


FIG. 9

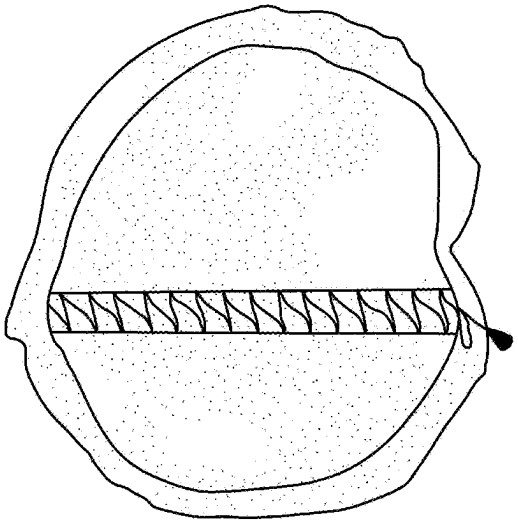


FIG. 10

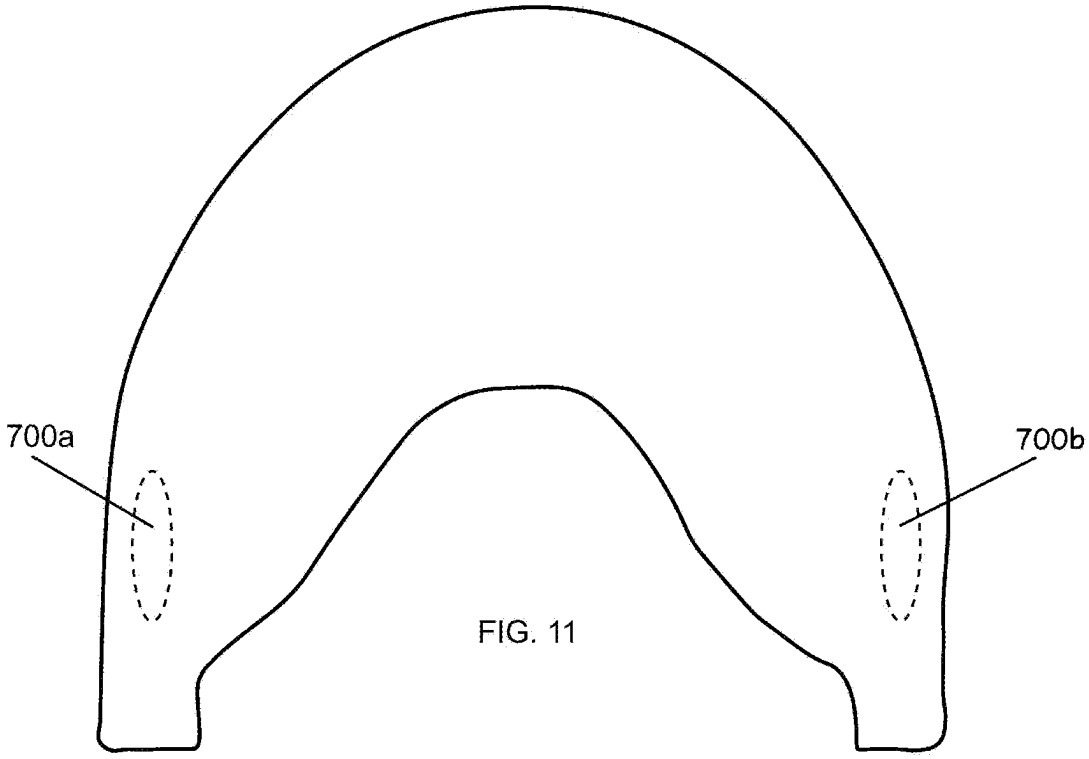


FIG. 11

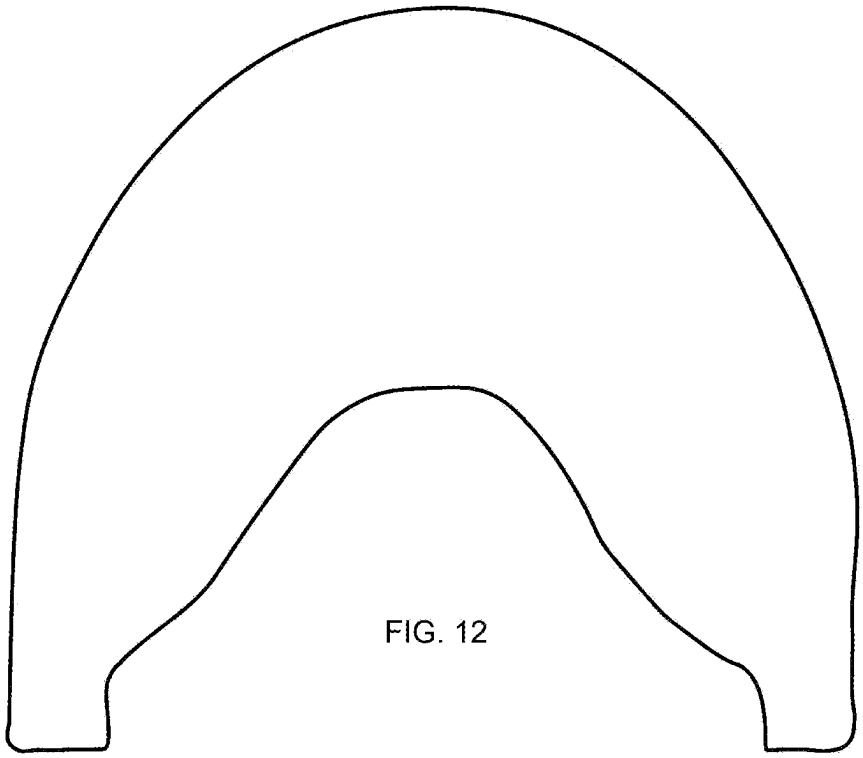


FIG. 12

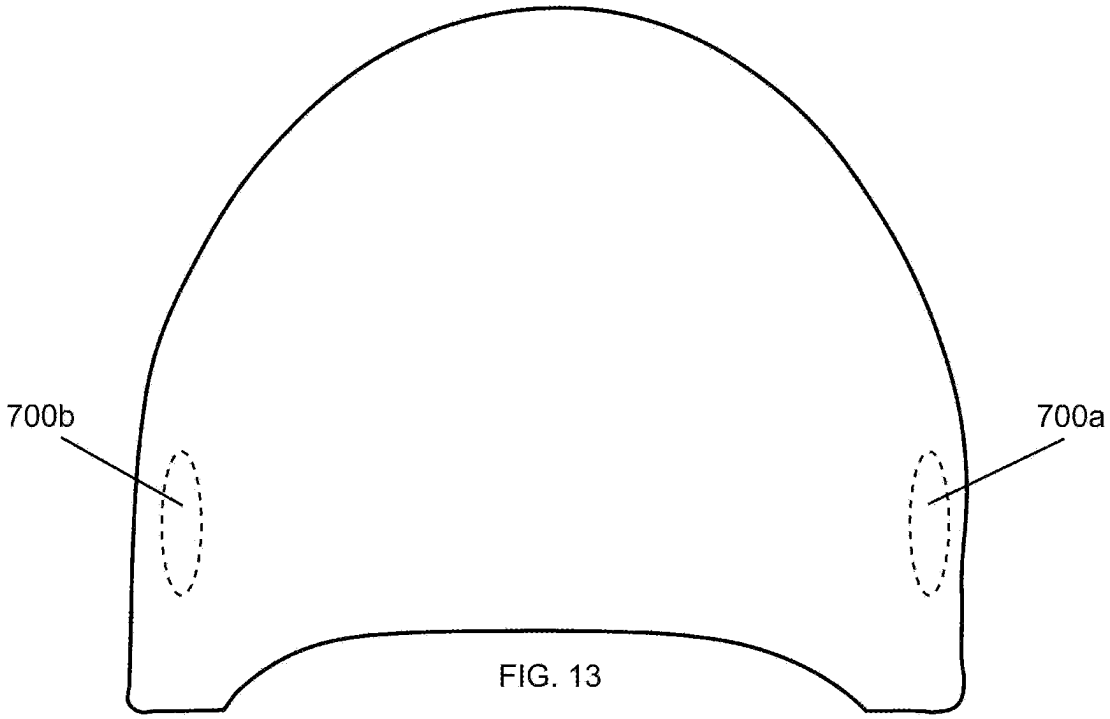


FIG. 13

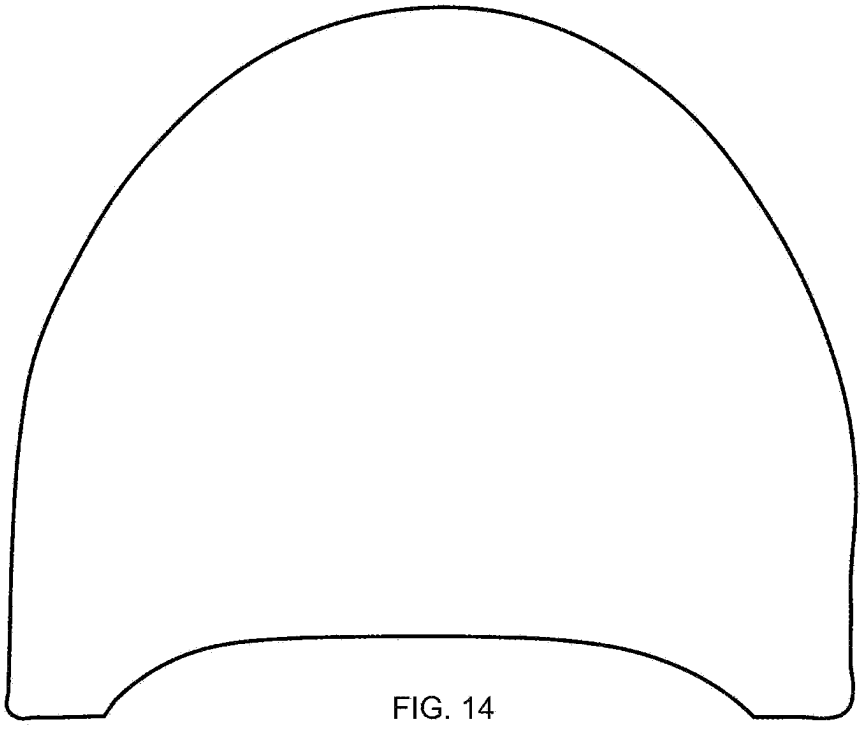


FIG. 14

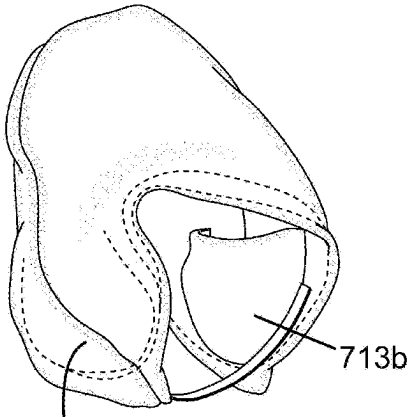
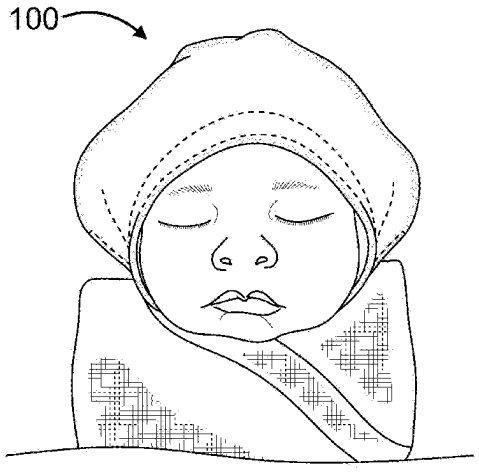


FIG. 15



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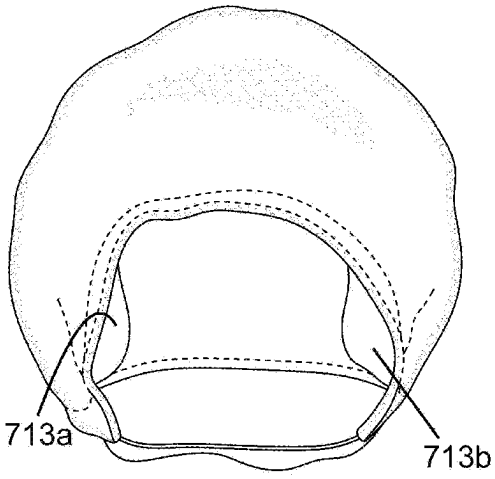


FIG. 17A

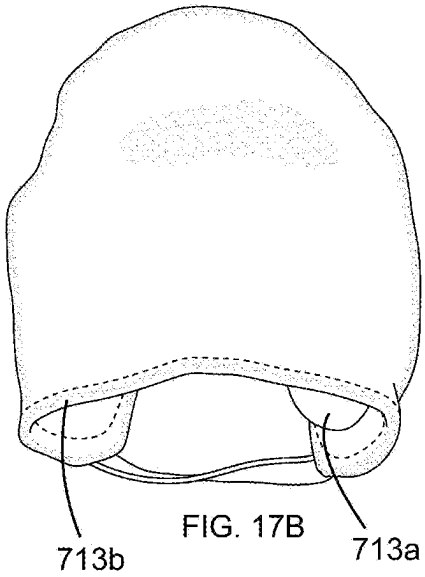


FIG. 17B

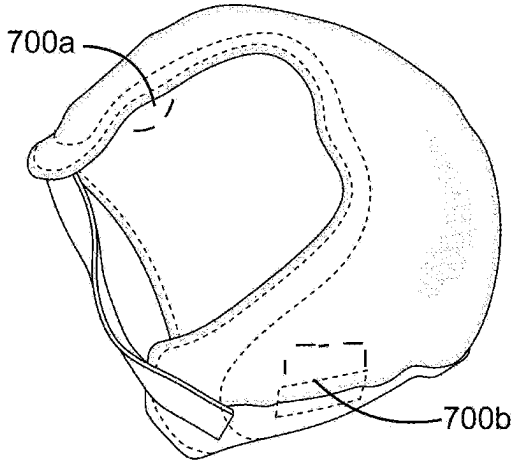


FIG. 18A

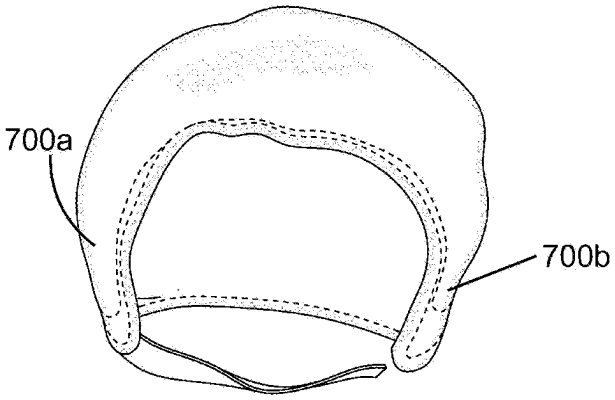


FIG. 18B

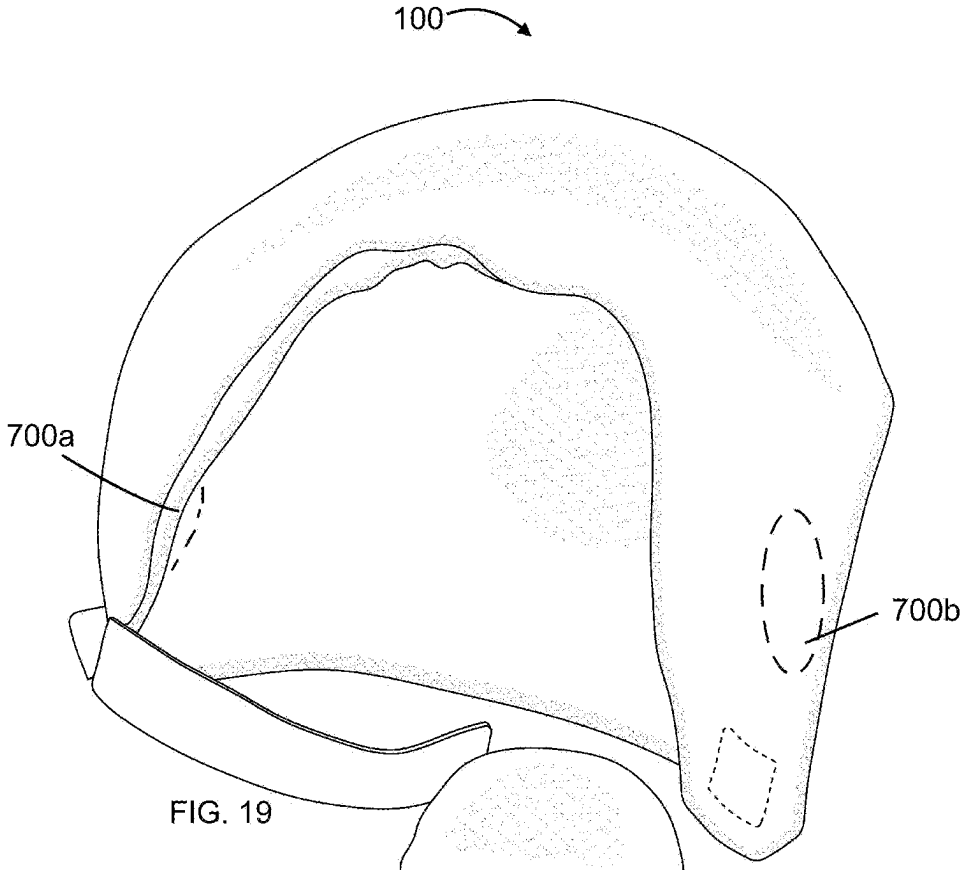


FIG. 19

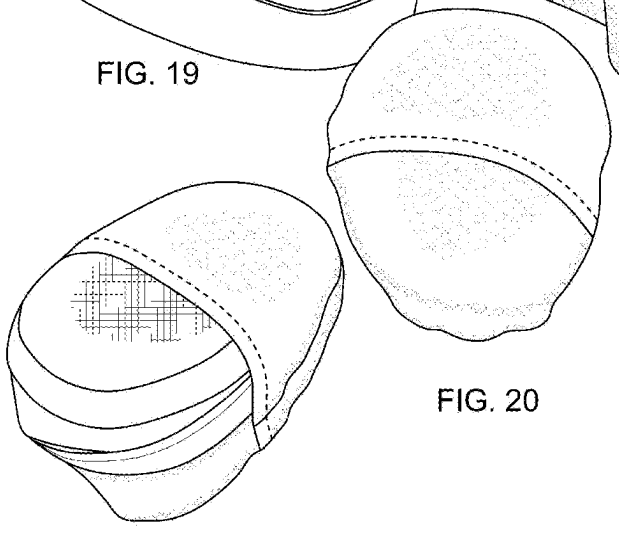


FIG. 20

FIG. 21

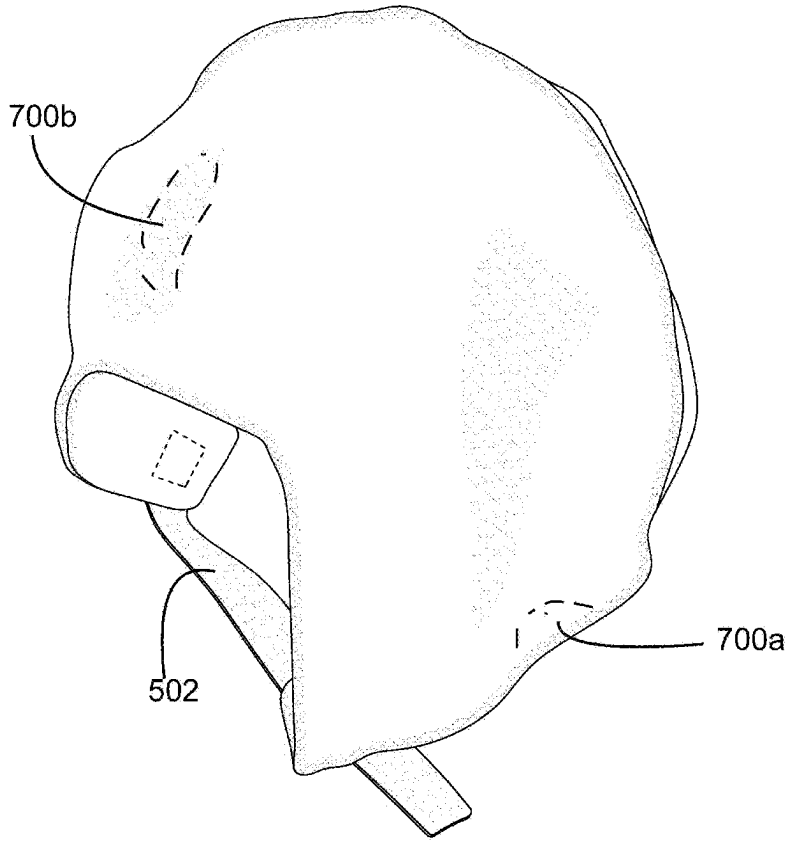


FIG. 22A

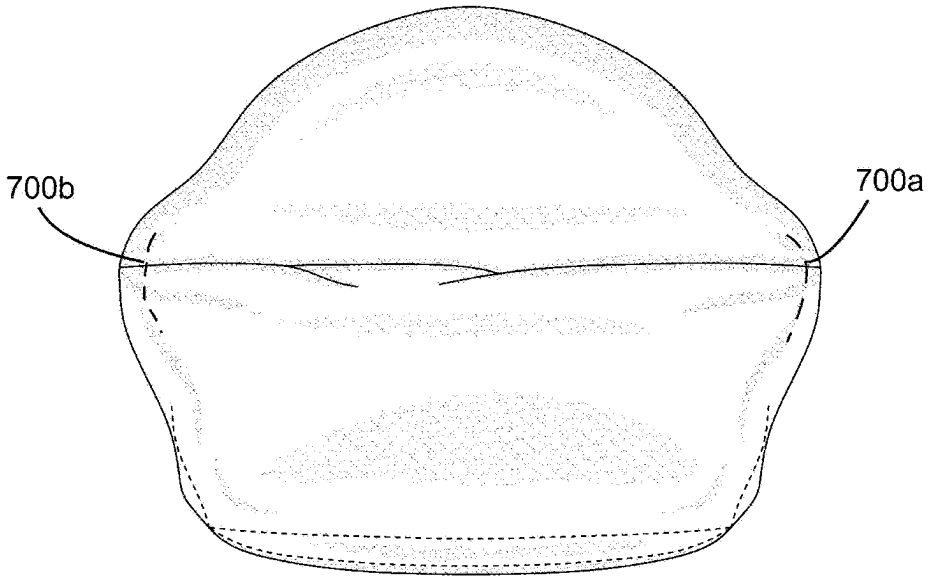


FIG. 22B

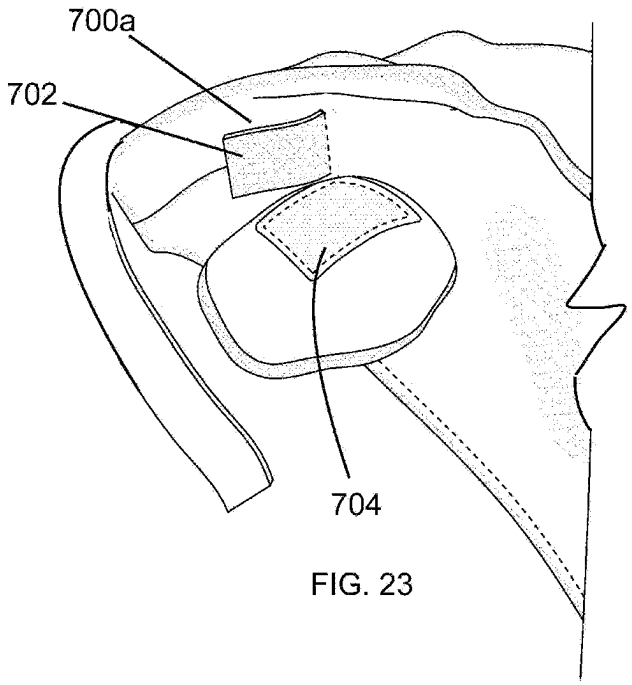


FIG. 23

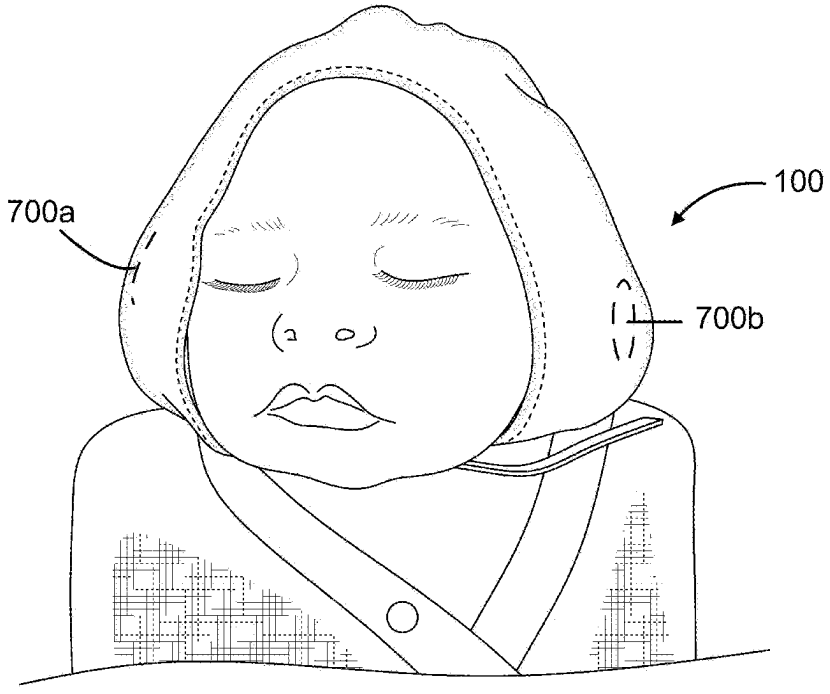


FIG. 24

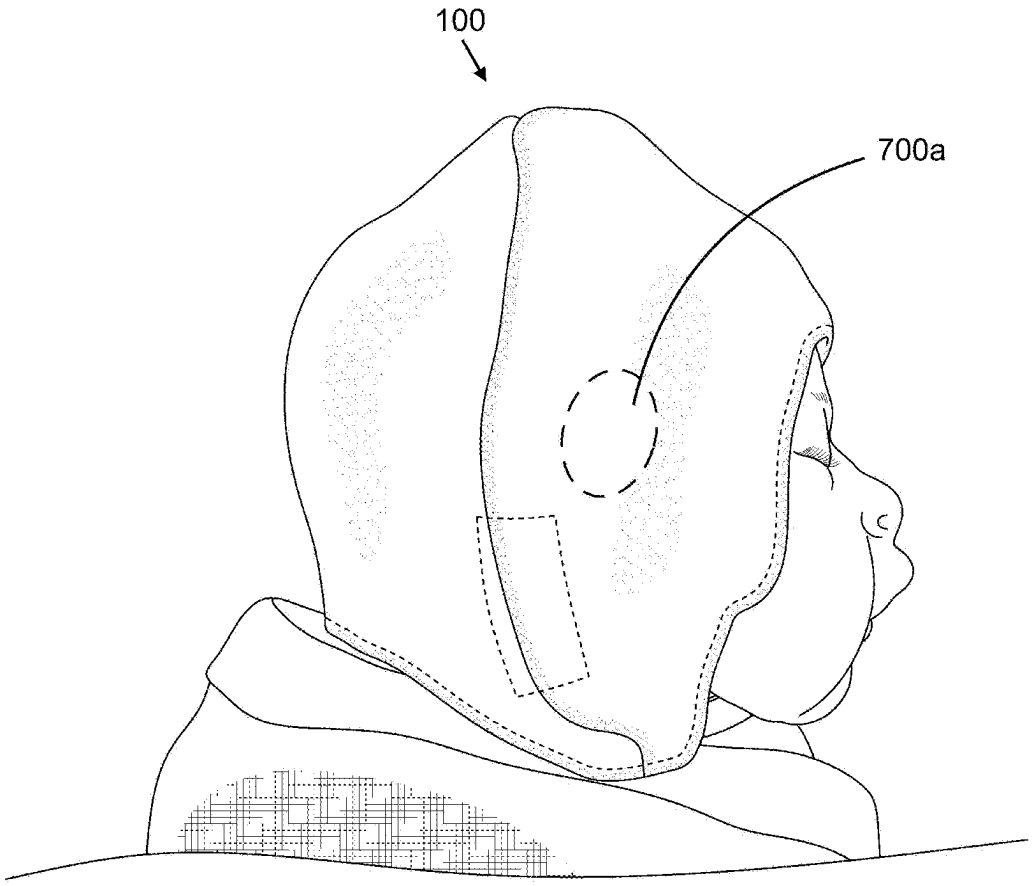


Fig. 25A

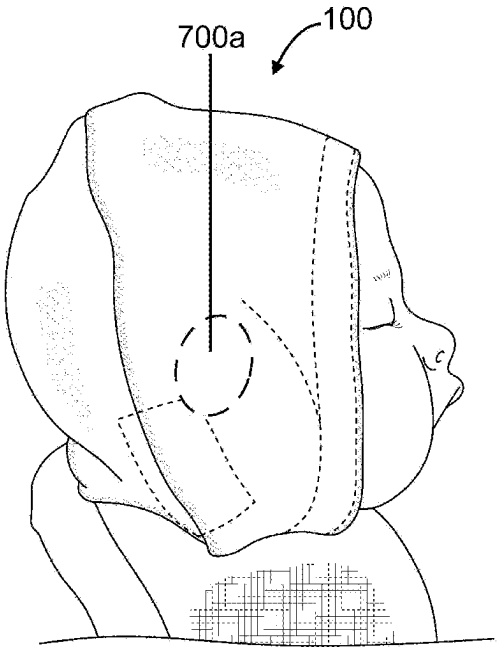


FIG. 25B

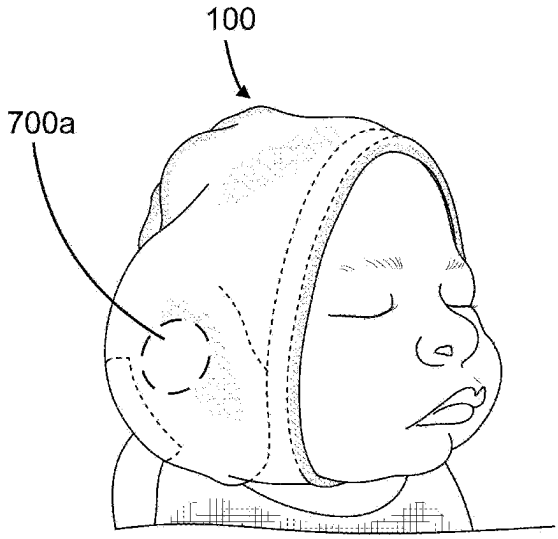


FIG. 25C

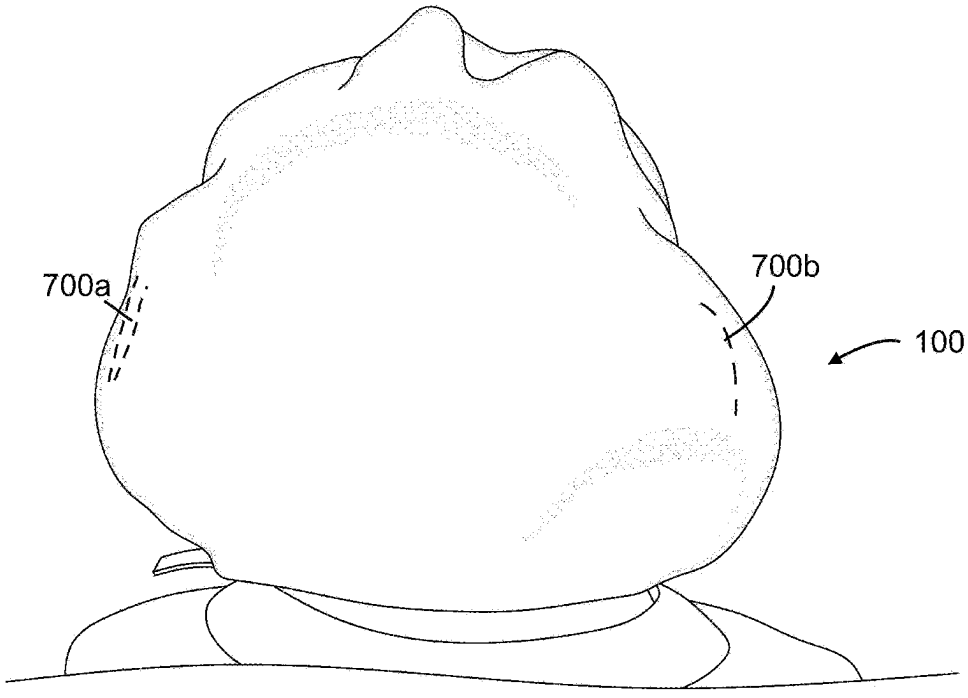


FIG. 25D

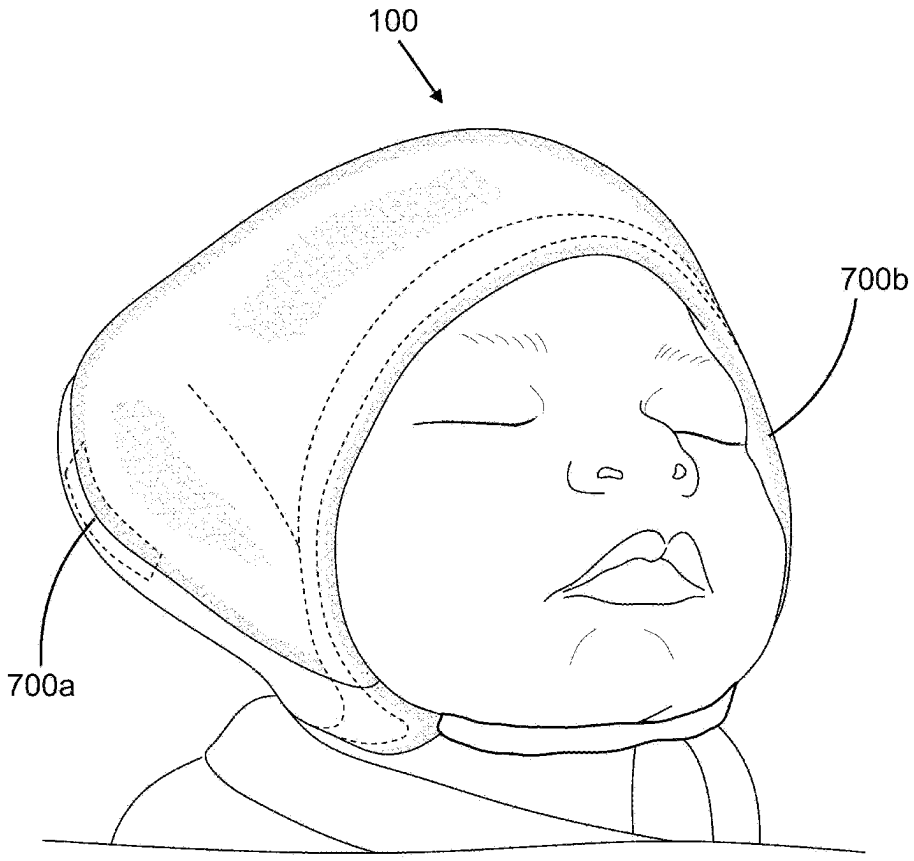


FIG. 25E

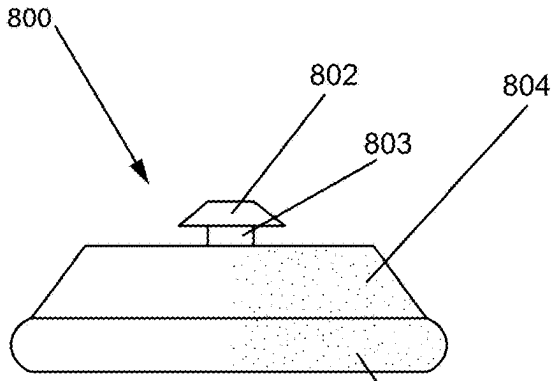


FIG. 26A

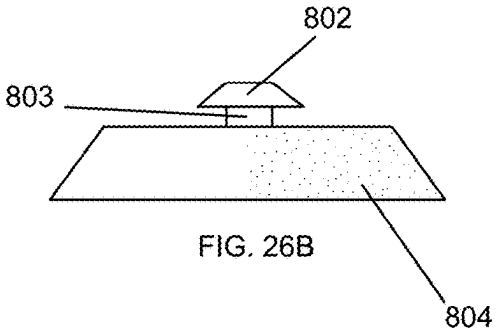


FIG. 26B

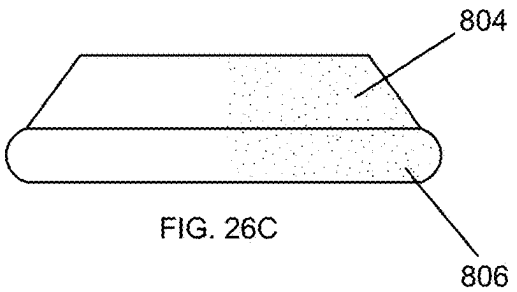
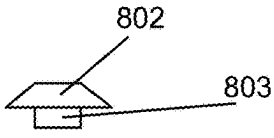


FIG. 26C



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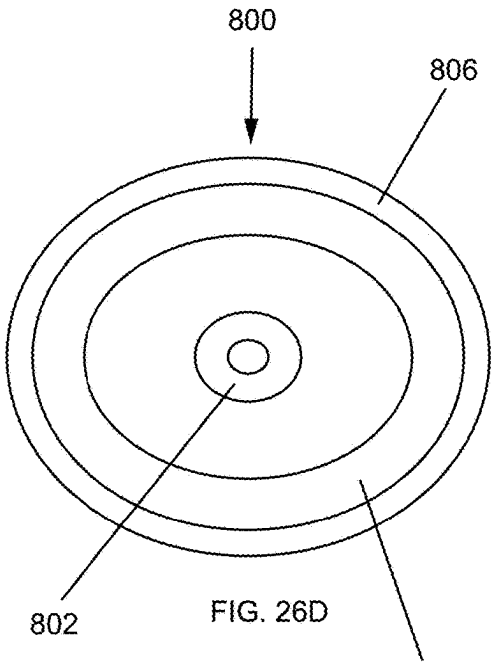


FIG. 26D

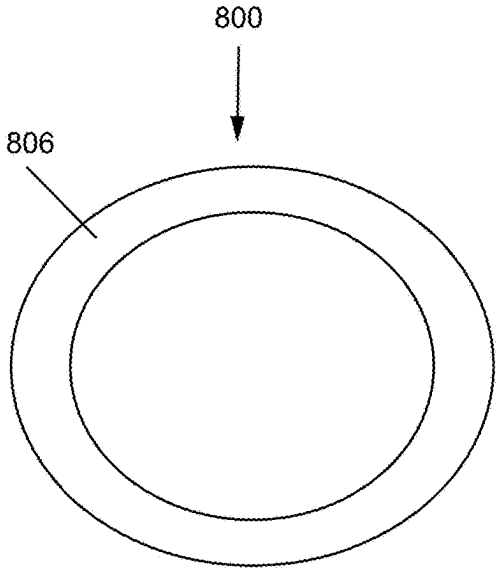


FIG. 26E

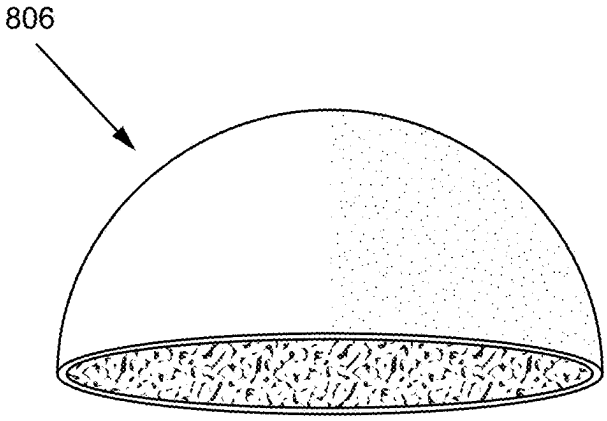


FIG. 27A

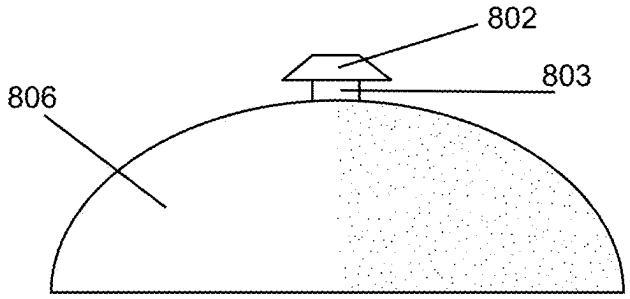


FIG. 27B

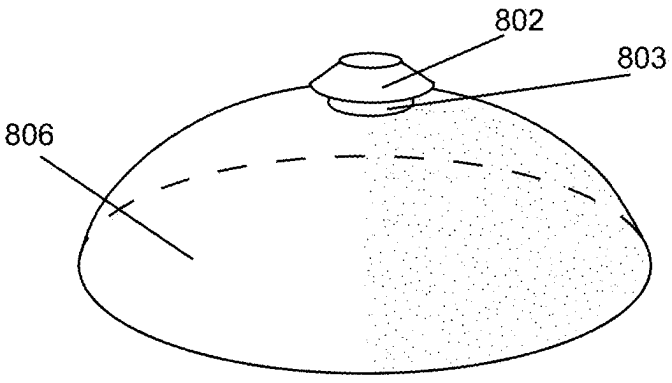
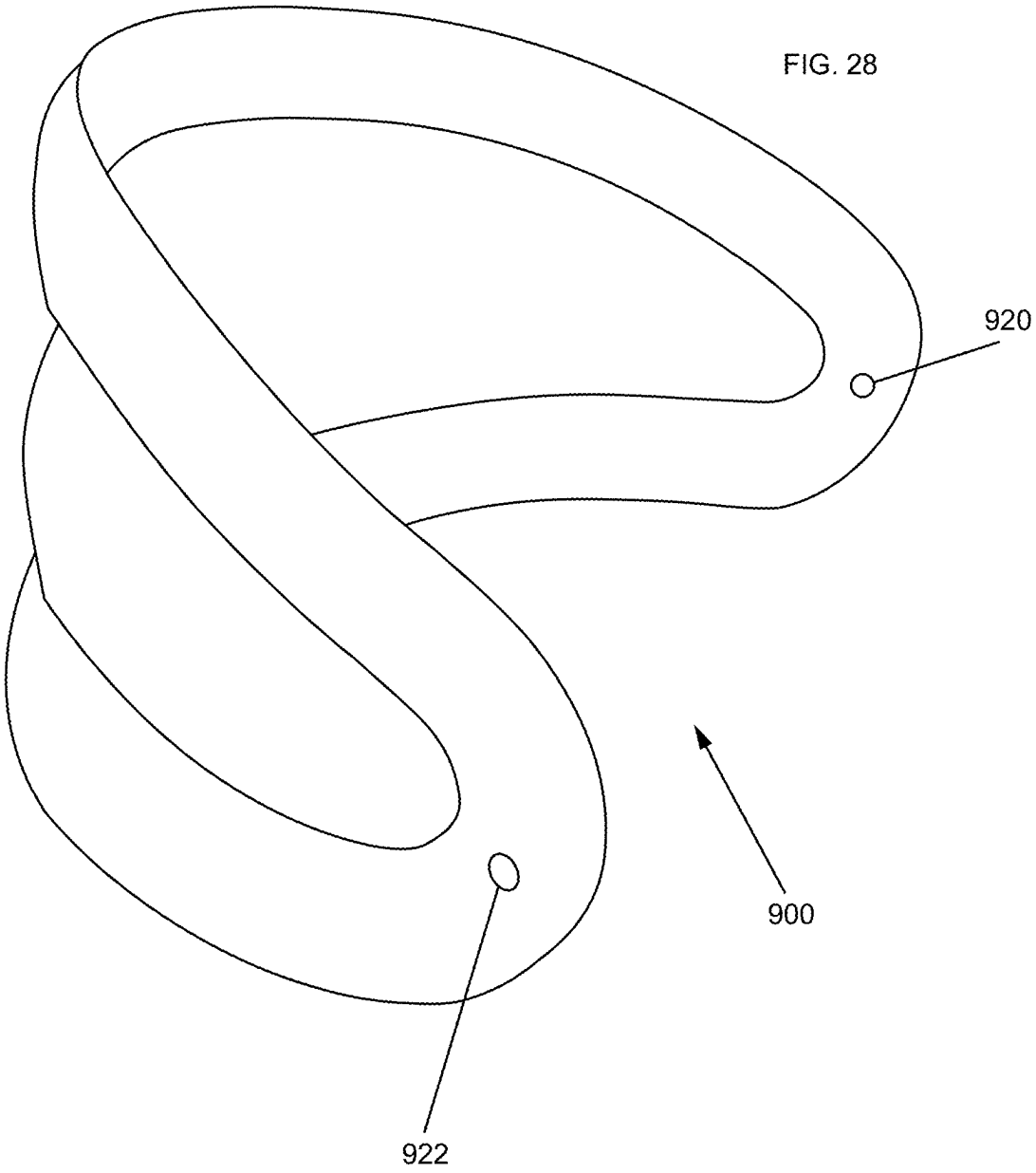


FIG. 27C

FIG. 28



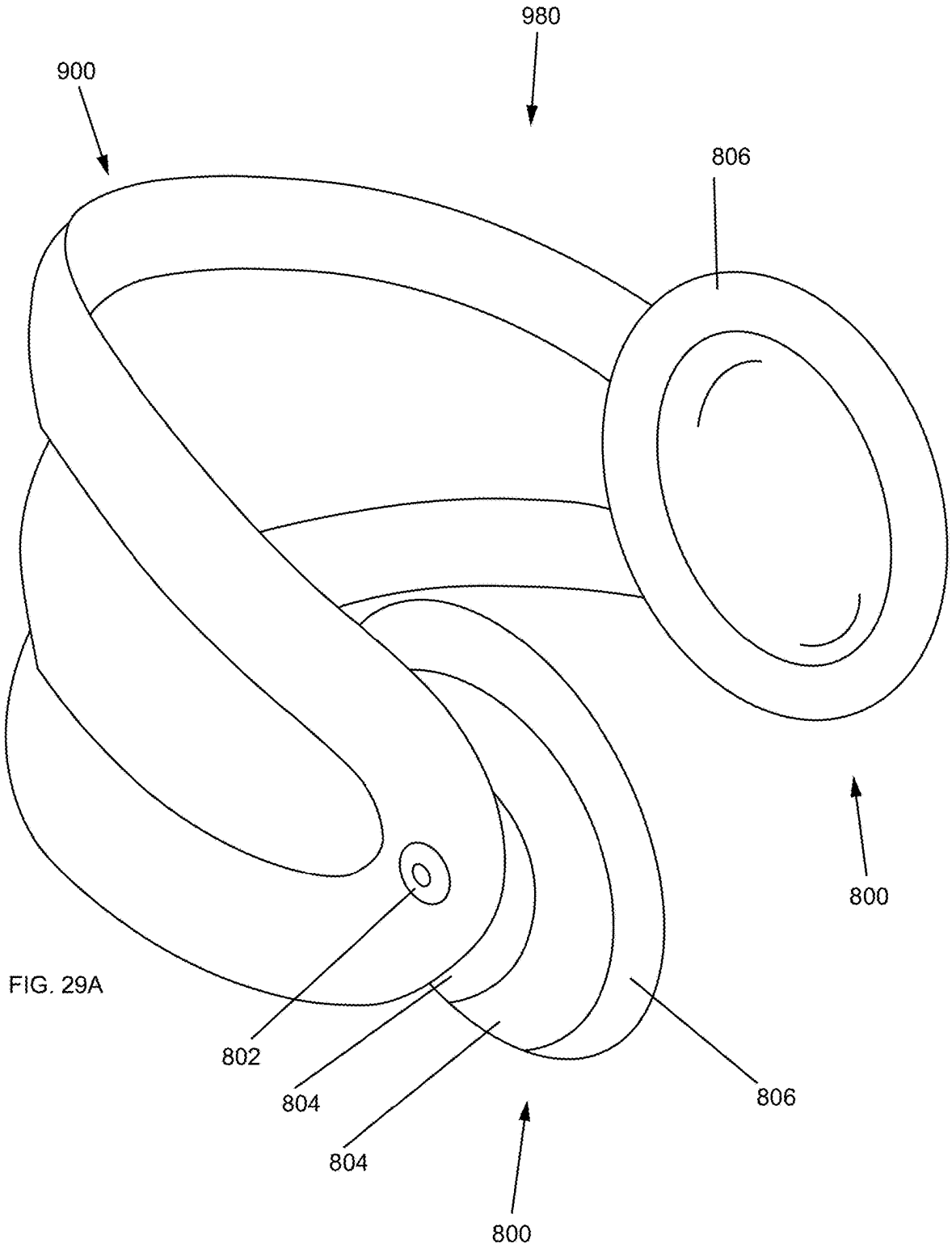


FIG. 29A

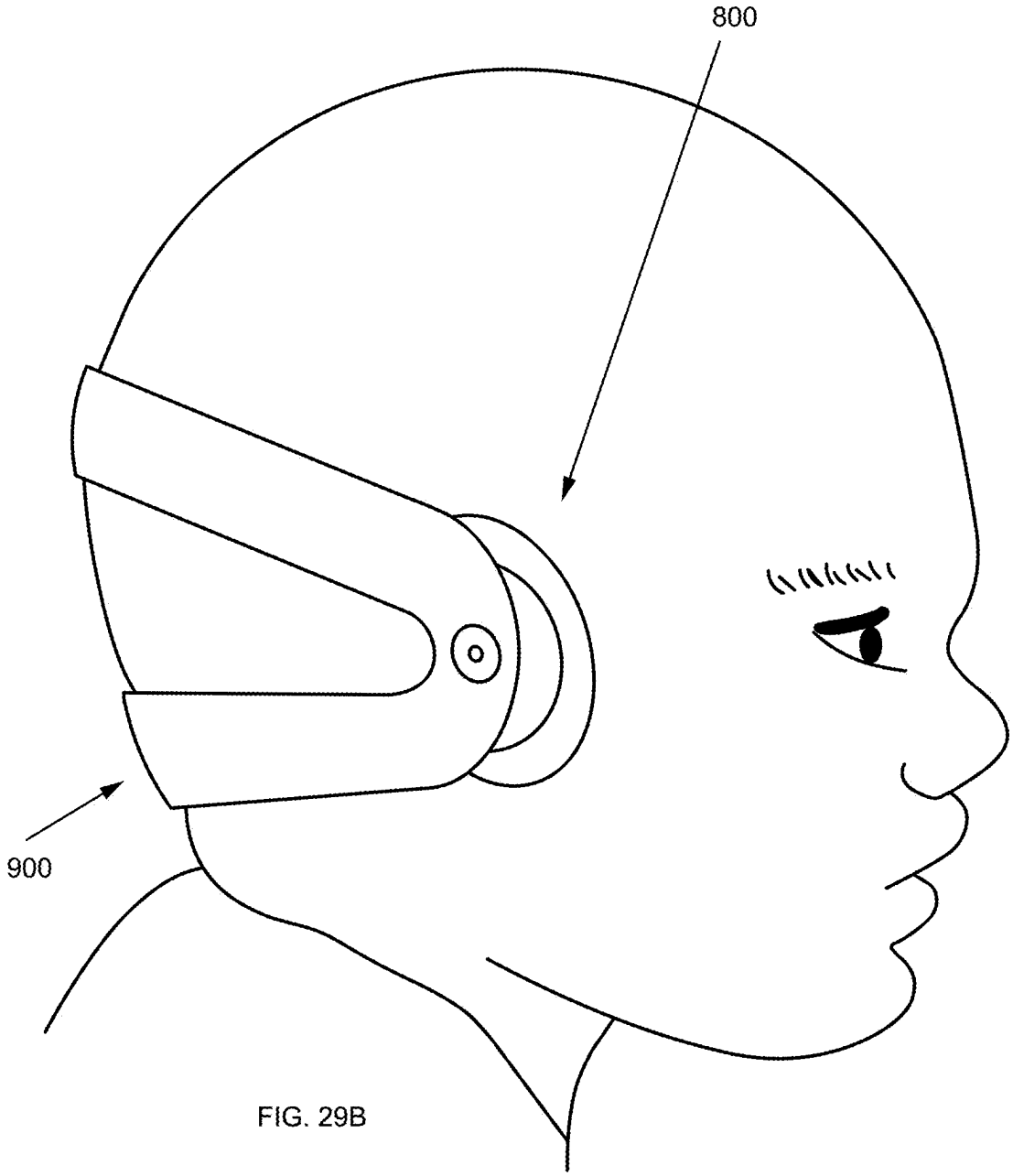


FIG. 29B

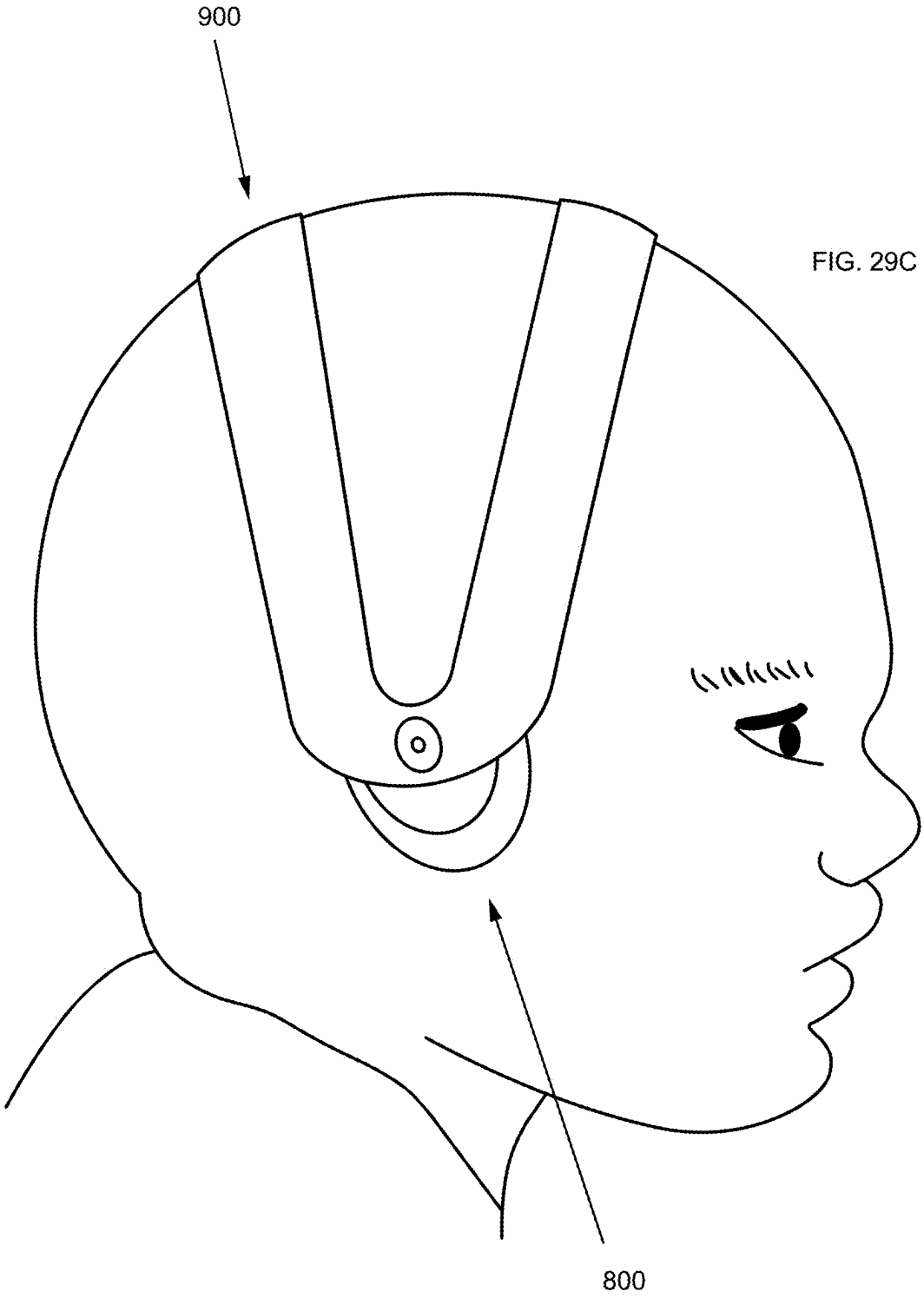


FIG. 29C

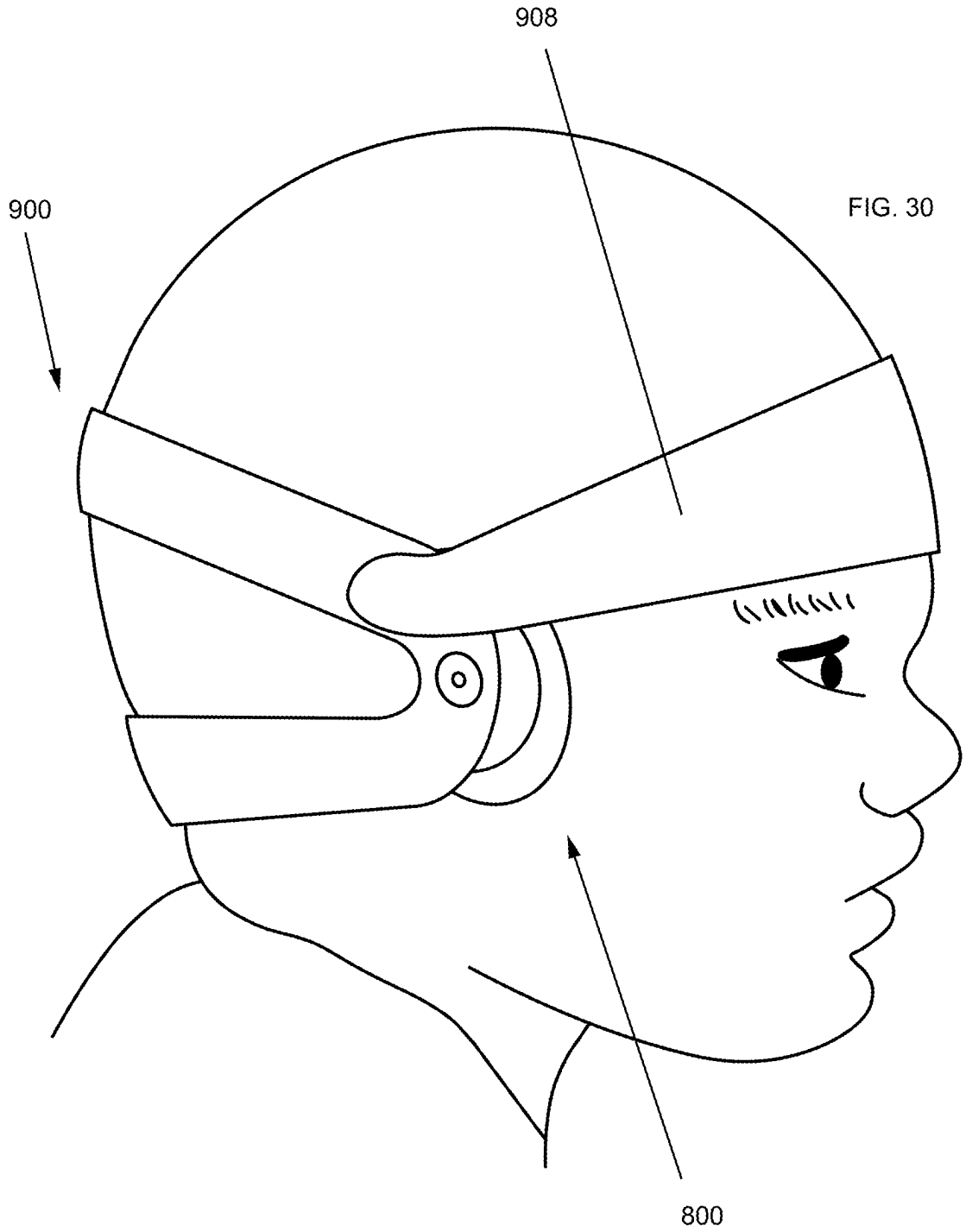


FIG. 30

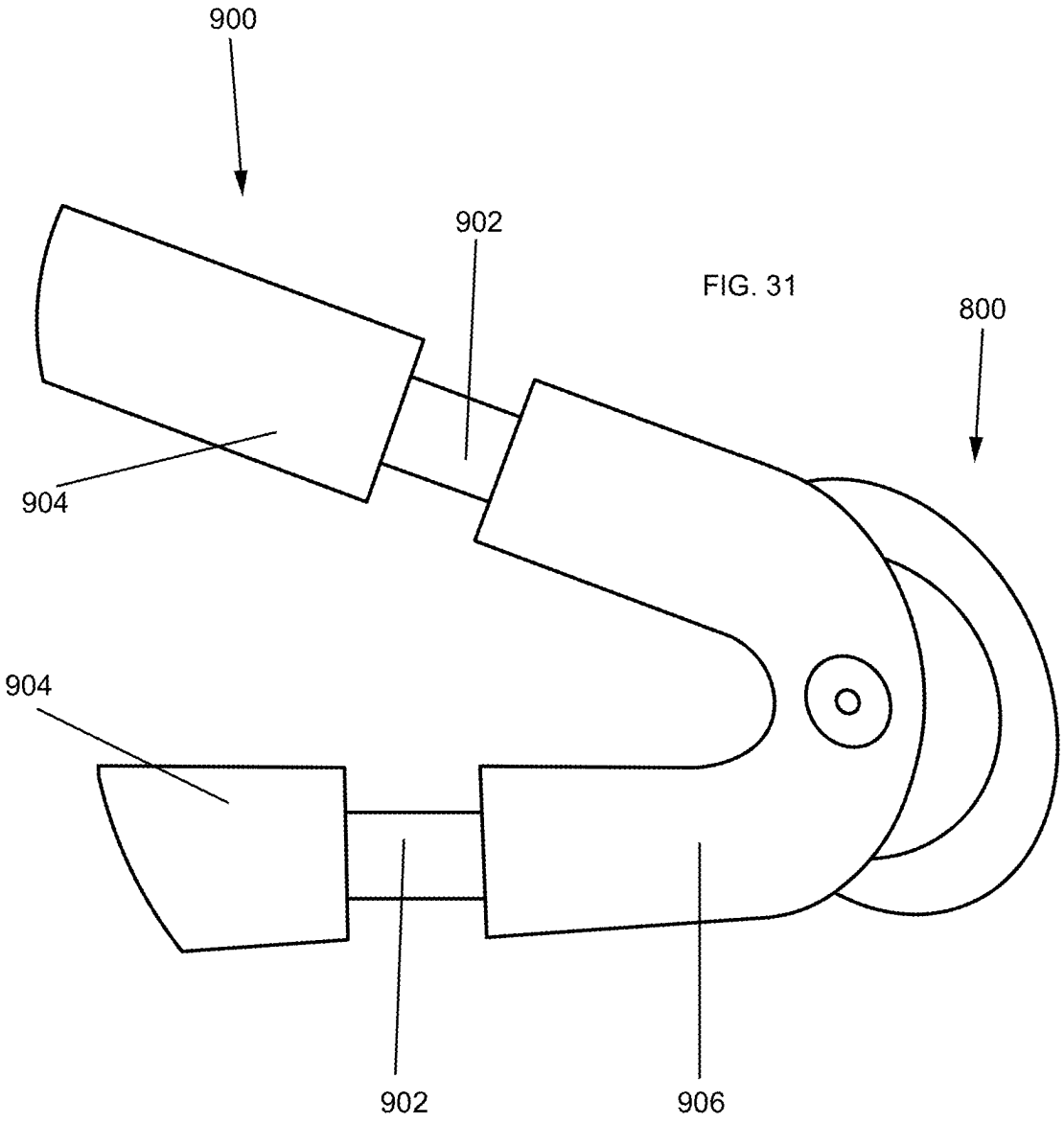


FIG. 31

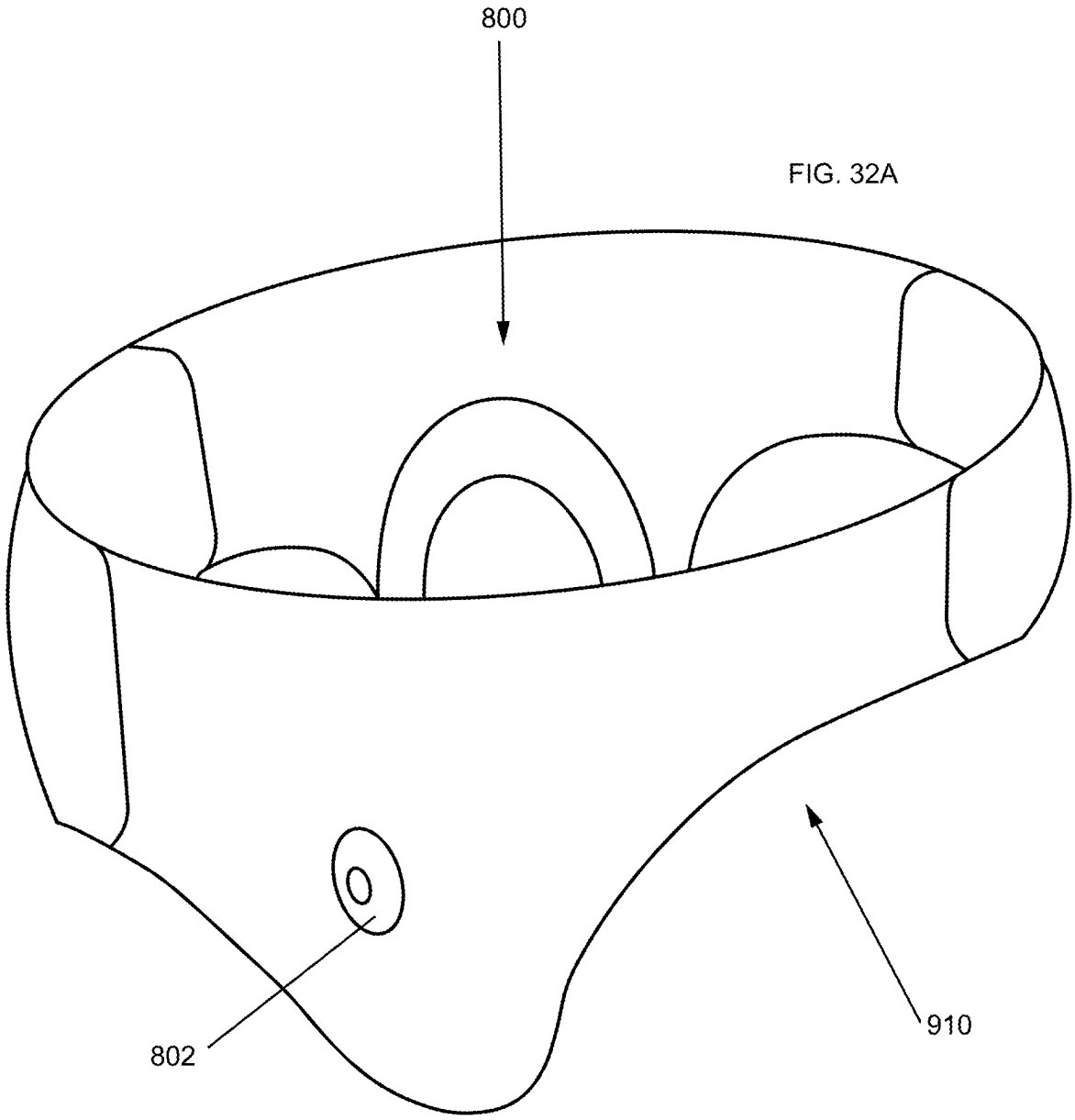


FIG. 32A

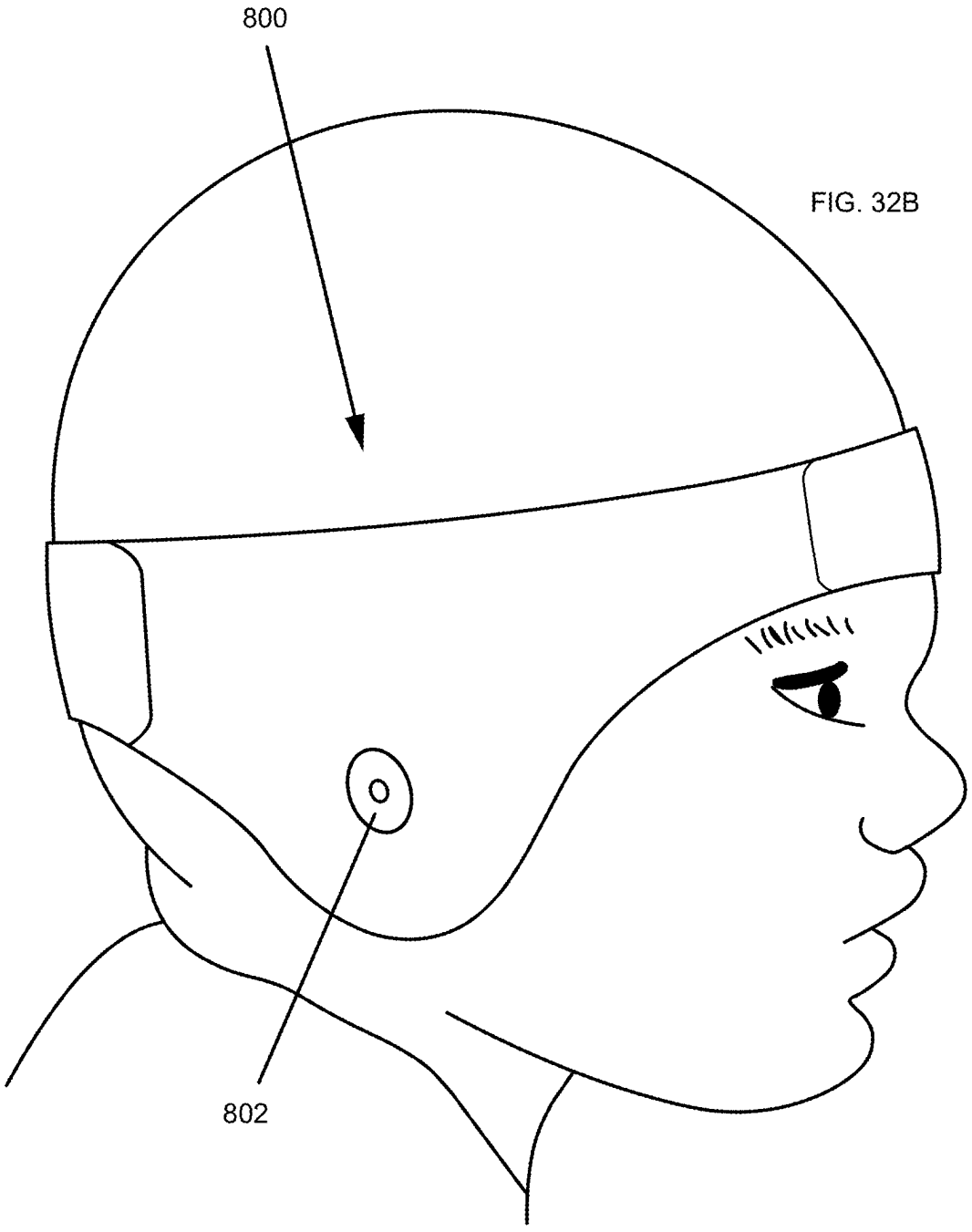


FIG. 32B

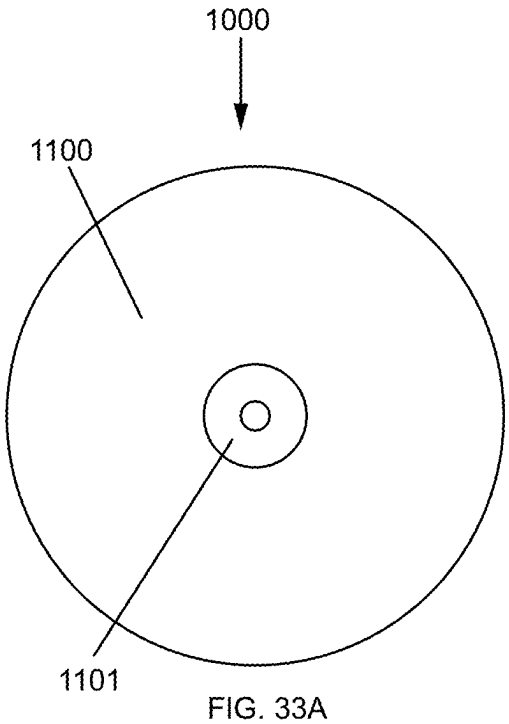


FIG. 33A

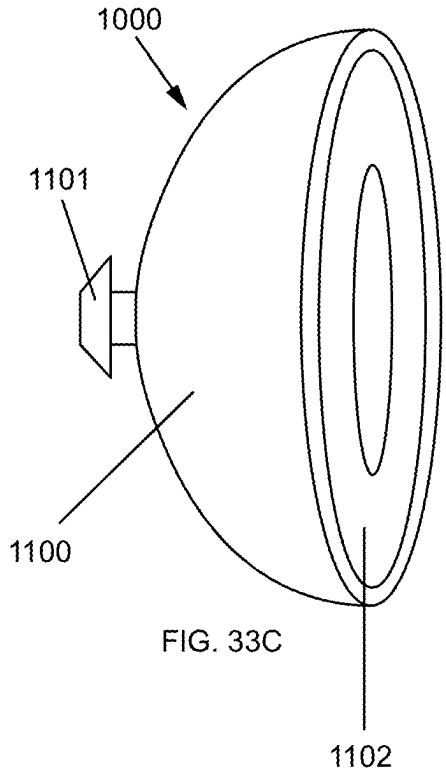


FIG. 33C

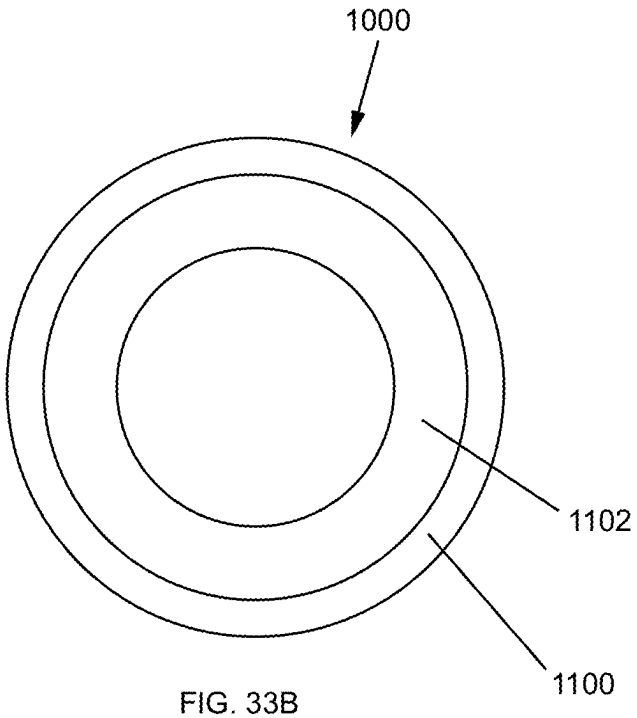


FIG. 33B

FIG. 34

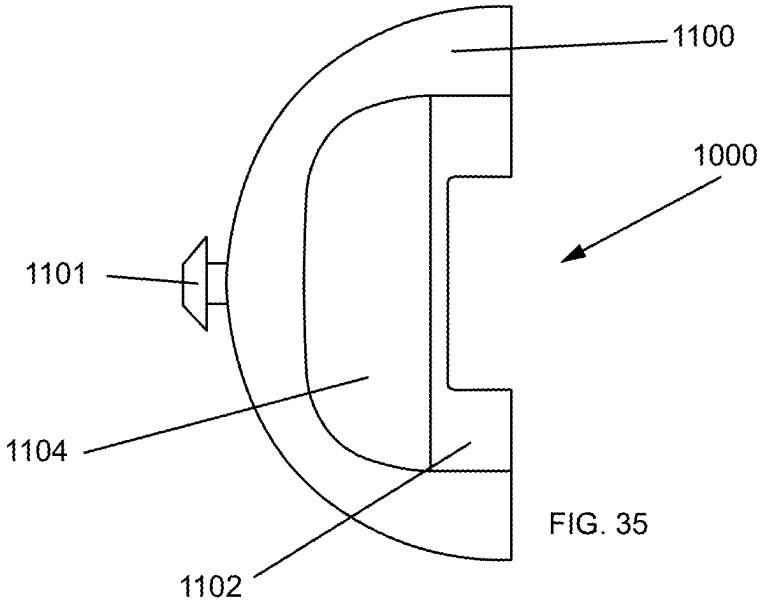


FIG. 35

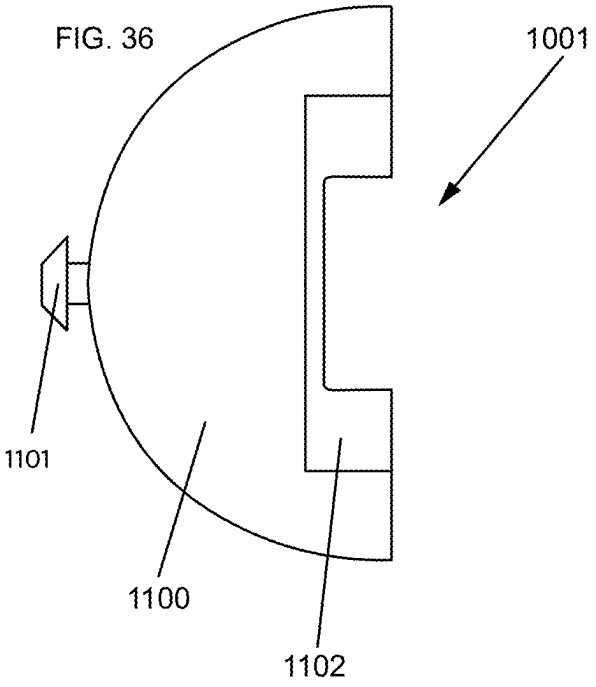


FIG. 36

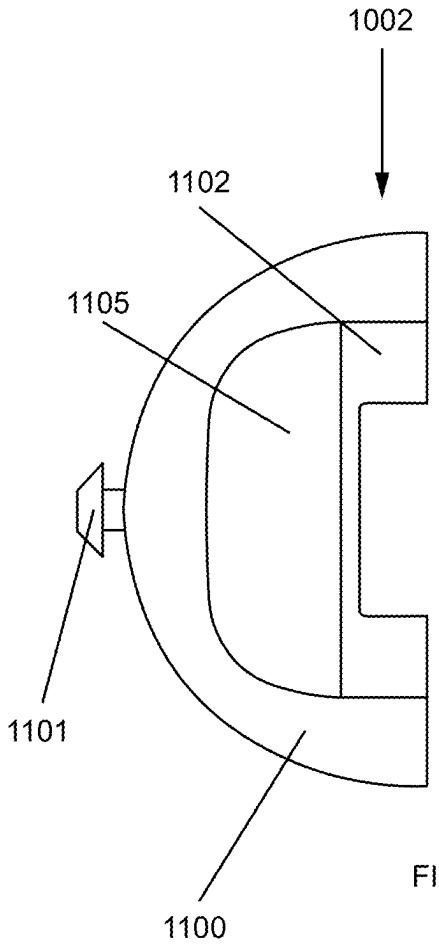


FIG. 37

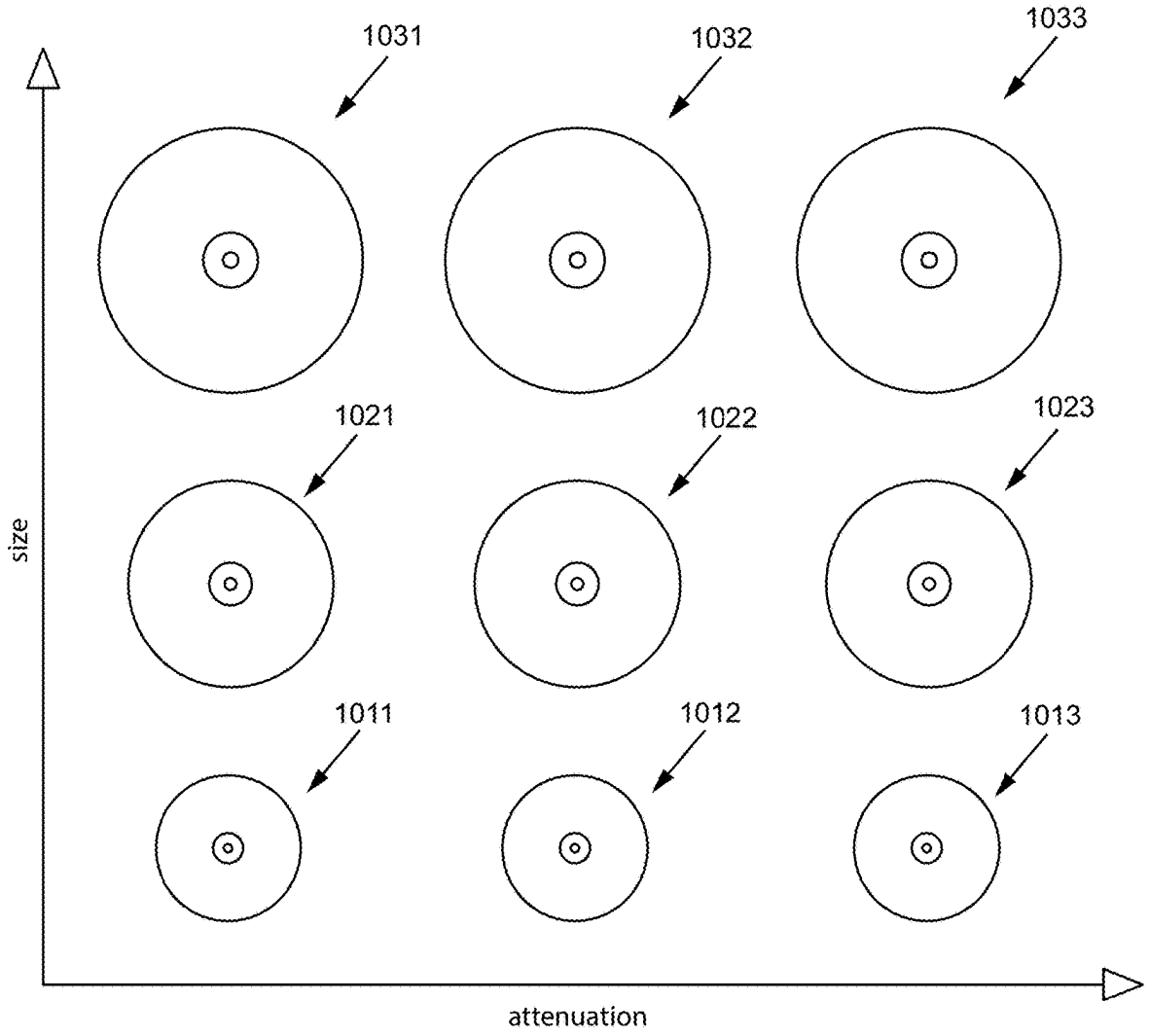

1031
1032
1033
1021
1022
1023
1011
1012
1013
size
attenuation

FIG. 38

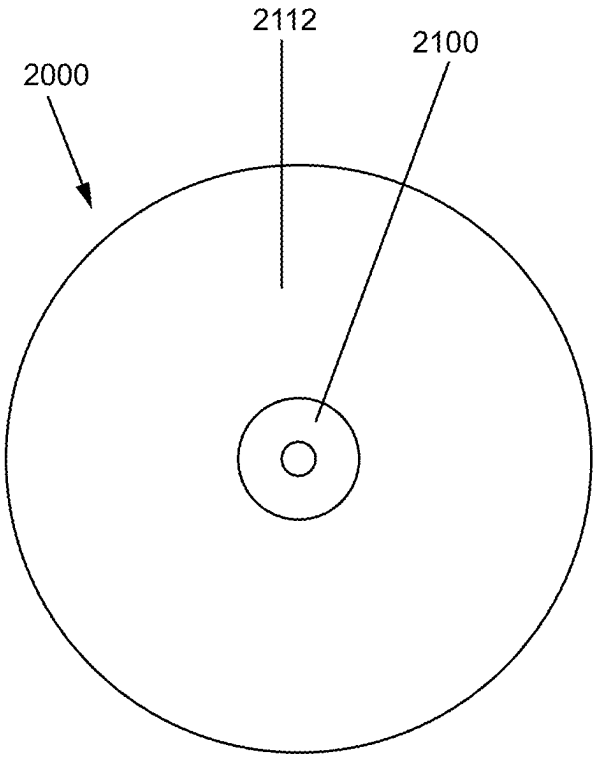


FIG. 39A

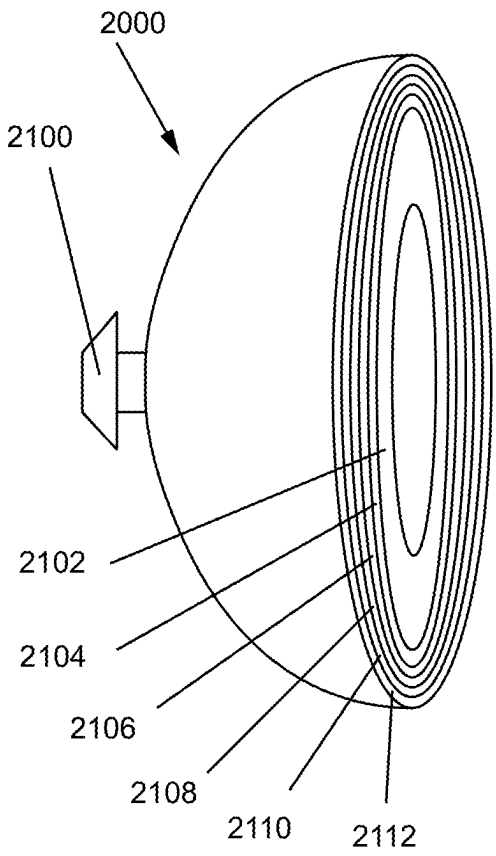


FIG. 39C

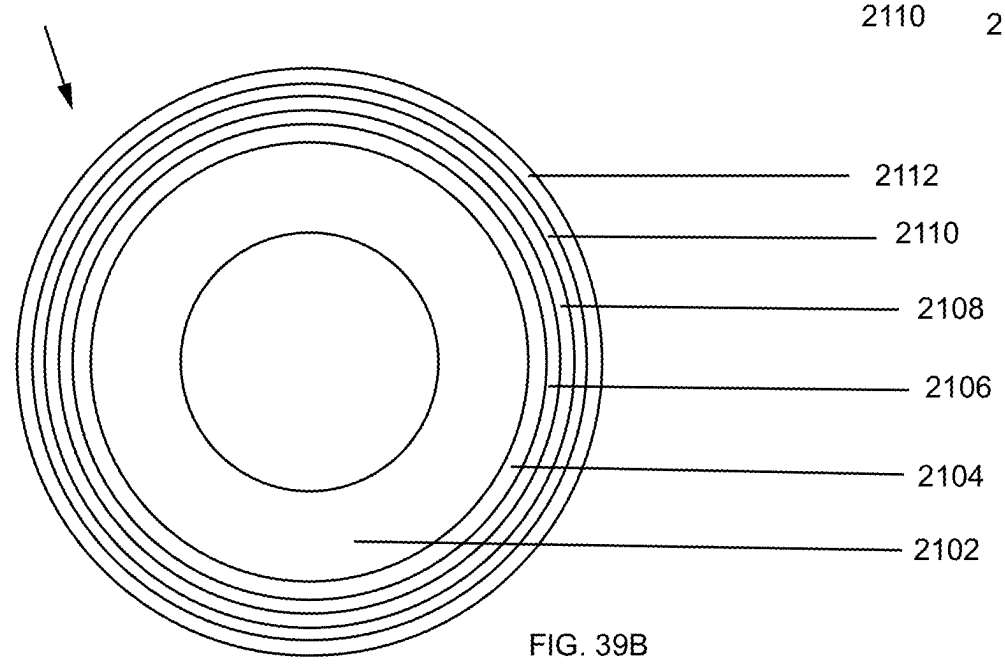


FIG. 39B

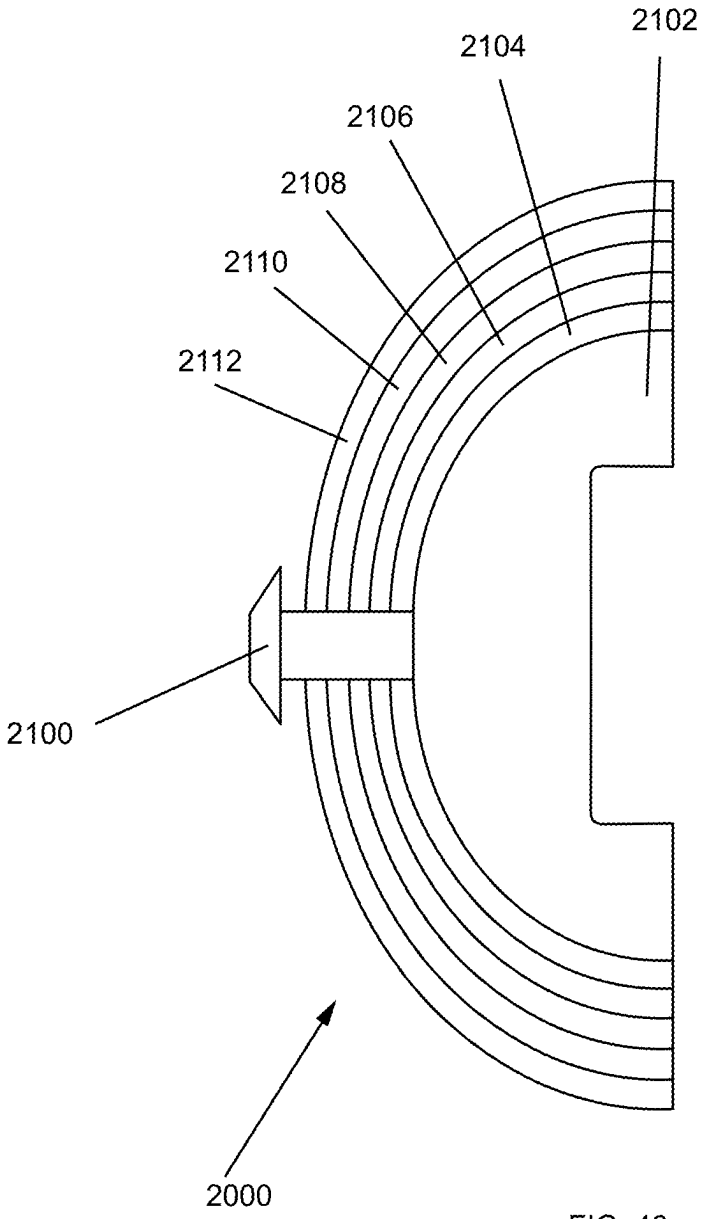


FIG. 40

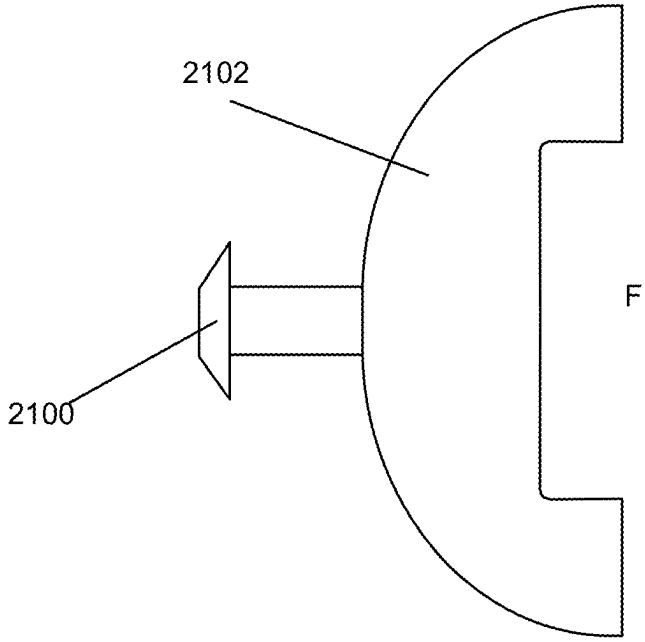


FIG. 41A

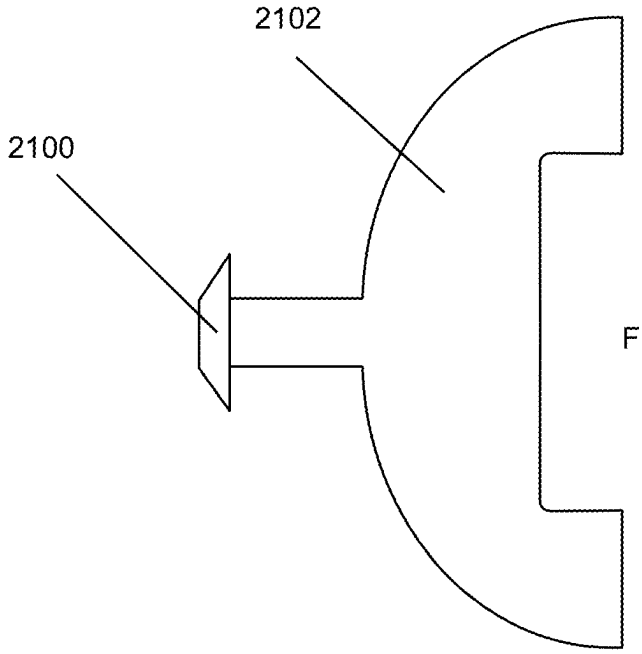


FIG. 41B

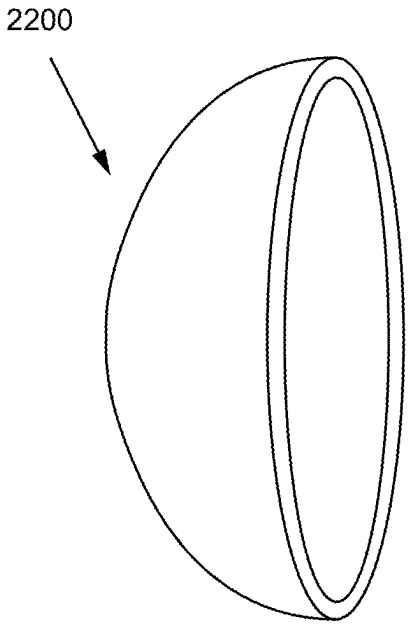


FIG. 42A

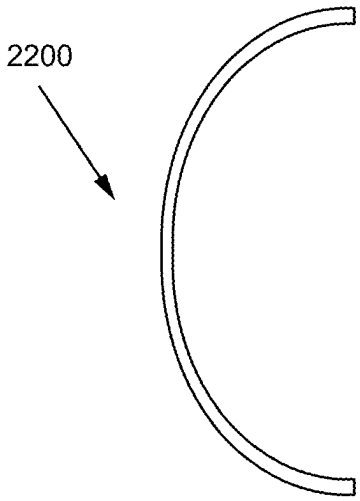


FIG. 42B

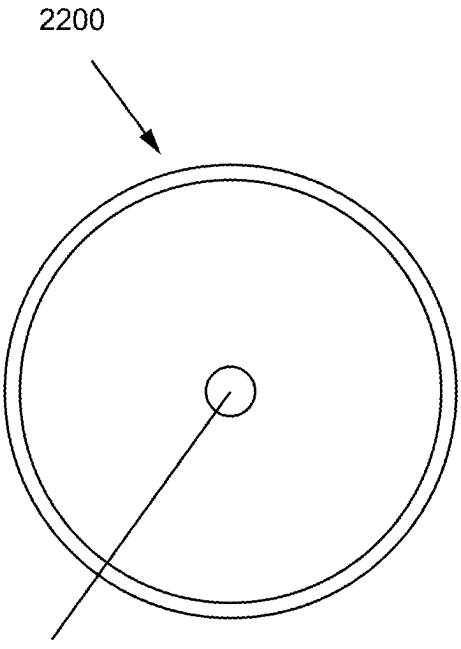


FIG. 42C

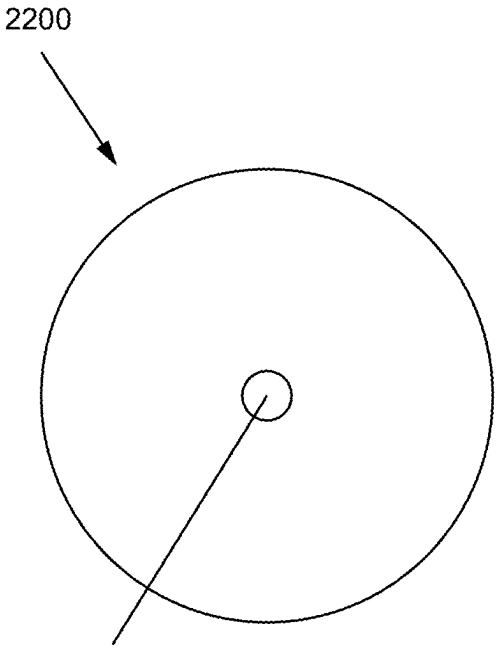


FIG. 42D

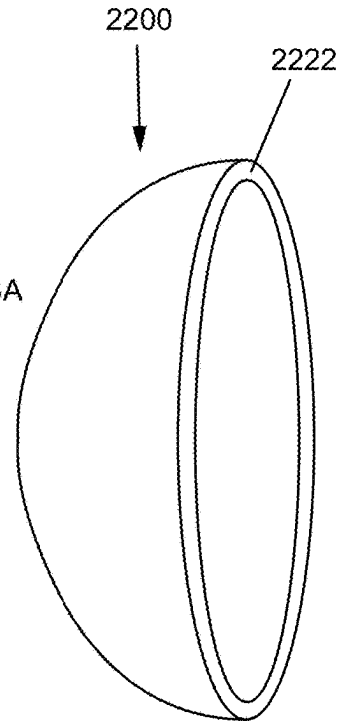


FIG. 43A

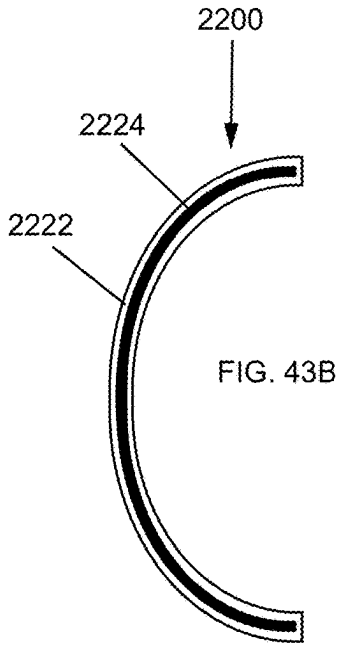


FIG. 43B

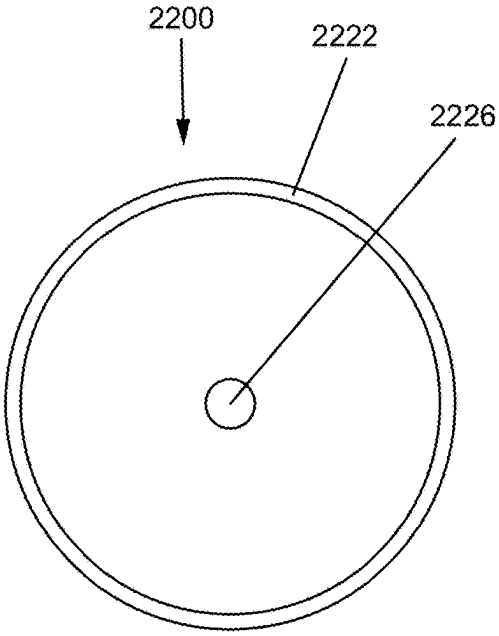


FIG. 43C

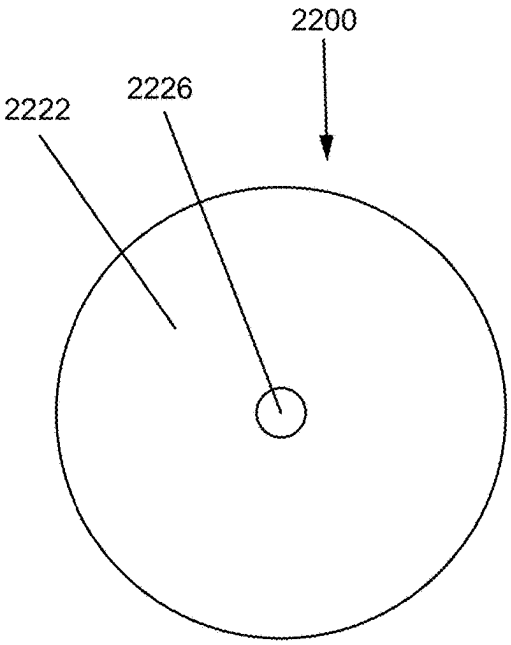


FIG. 43D

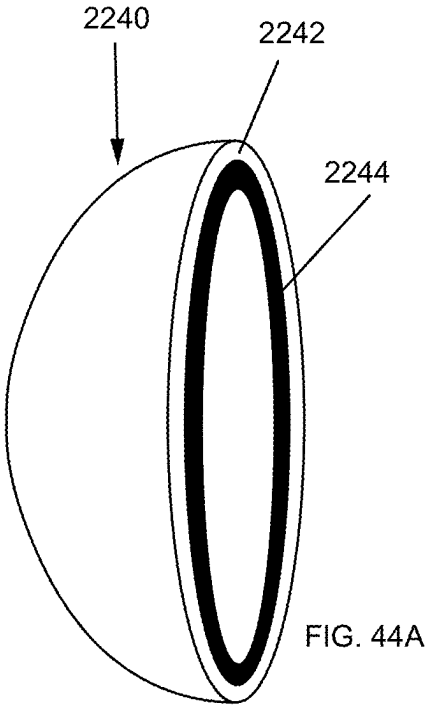


FIG. 44A

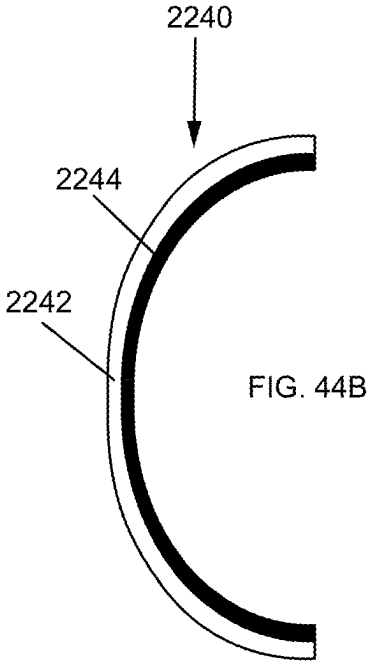


FIG. 44B

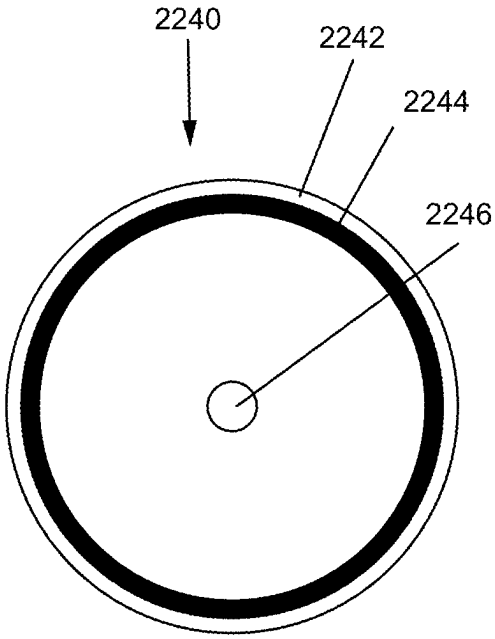


FIG. 44C

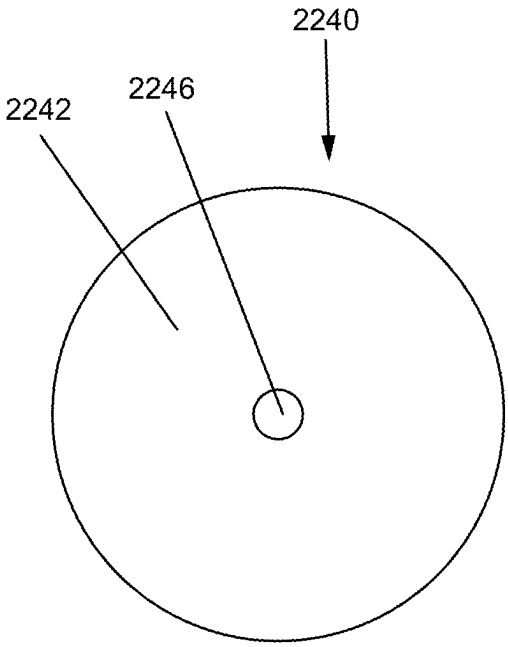


FIG. 44D

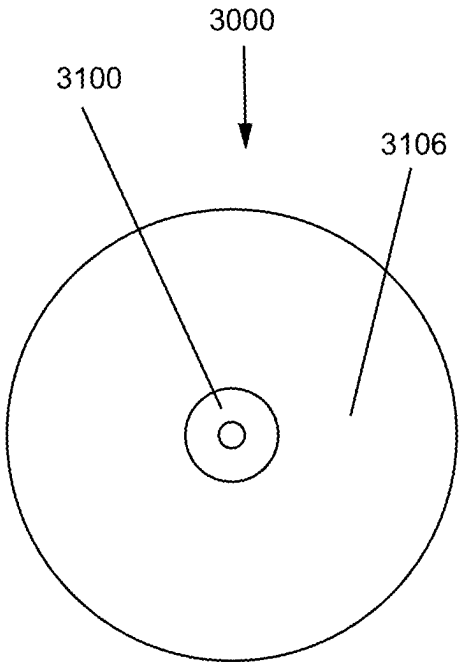


FIG. 45A

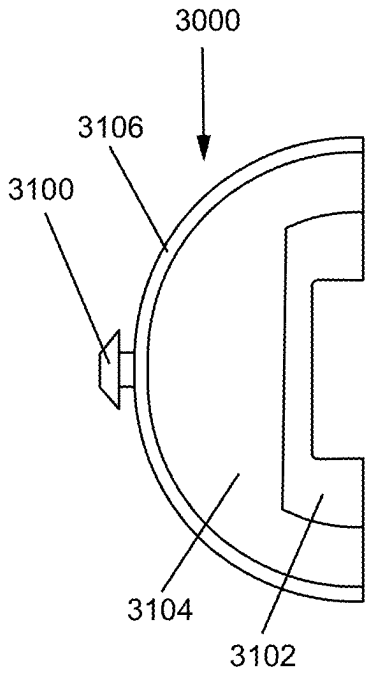


FIG. 45B

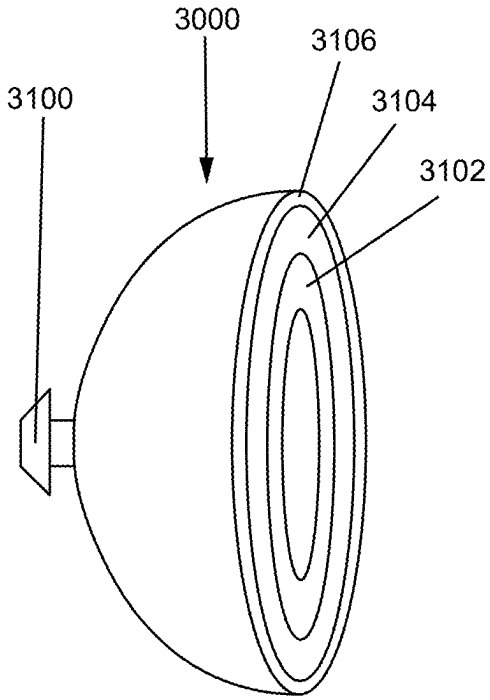


FIG. 45C

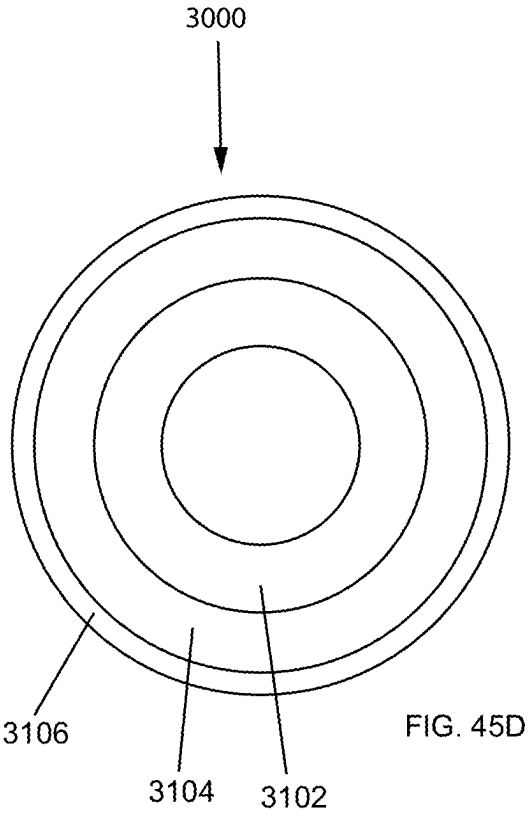


FIG. 45D

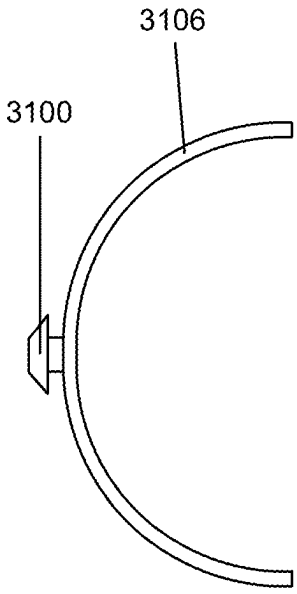


FIG. 46A

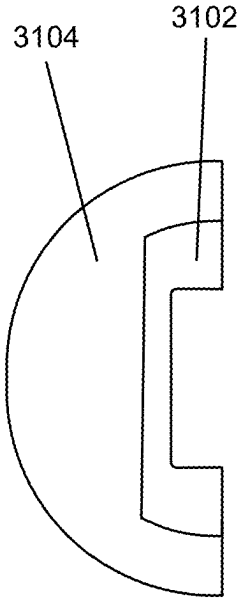


FIG. 46B

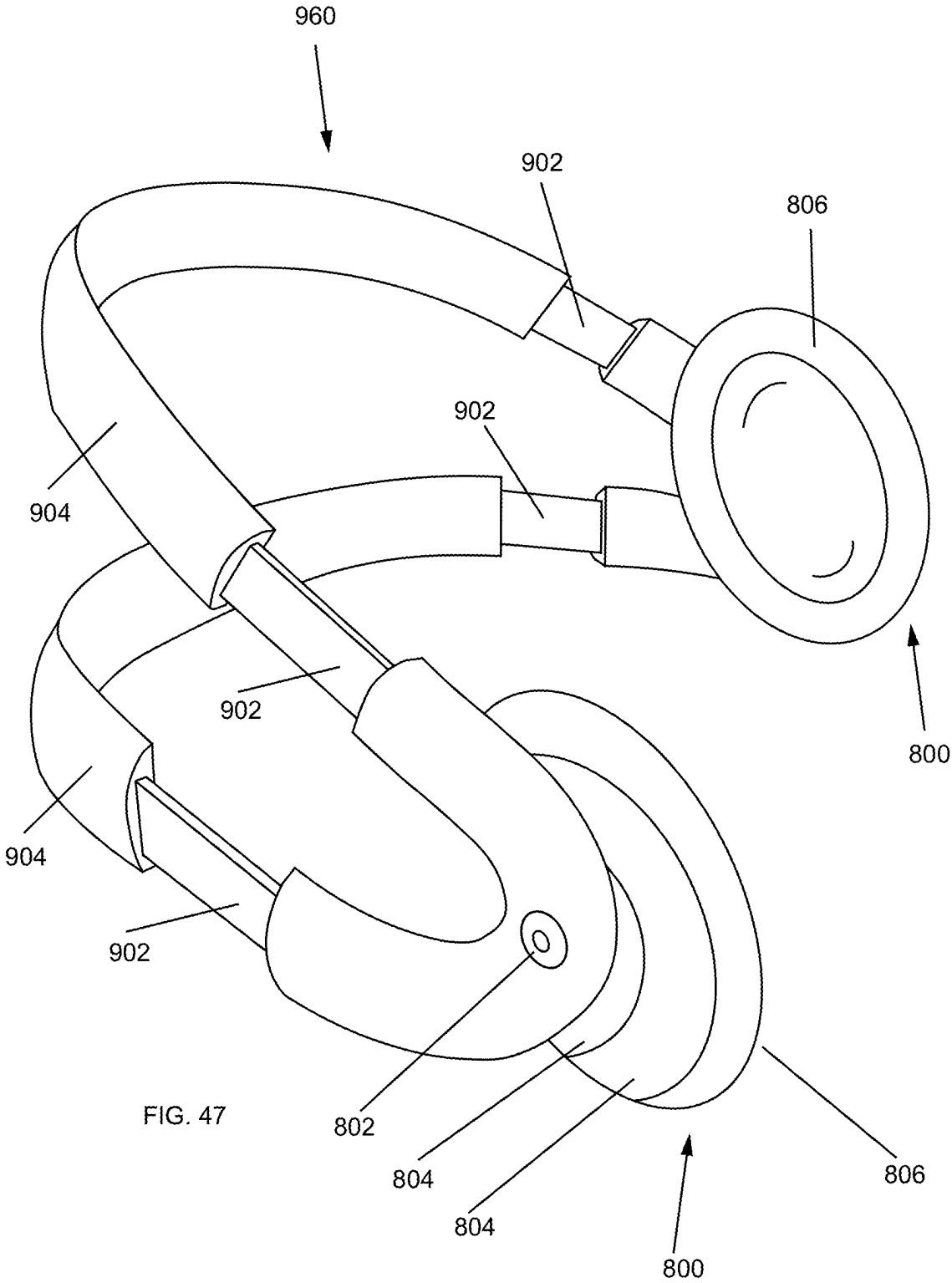


FIG. 47

SOUND-ATTENUATING DEVICE AND METHOD OF USE THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. patent application Ser. No. 18/132,964, entitled Sound-Attenuating Device and Method of Use Thereof, which was filed on Apr. 10, 2023. U.S. patent application Ser. No. 18/132,964 is a continuation of U.S. patent application Ser. No. 17/151,579, which was filed on 2021 Jan. 8, which is a continuation-in-part of U.S. patent application Ser. No. 16/373,646, which was filed on 2019 Apr. 3 (and was issued as U.S. patent Ser. No. 10/897,666, which was issued on 2021 Jan. 19), which claimed the benefit of the following two Provisional Patent Applications: 1) U.S. Provisional Patent Application No. 62/826,994, which was filed on 2019 Mar. 30, and 2) U.S. Provisional Patent Application No. 62/652,238, which was filed on 2018 Apr. 3. The benefit of priority to the filing dates of these applications is hereby claimed. The subject matter of all of these applications is expressly incorporated herein by reference in their entirety for all purposes.

BACKGROUND OF THE INVENTION

The Field of the Invention

[0002] The present invention relates generally to sound attenuating devices for ears, and more specifically to a sound attenuating device for a neonatal device; certain embodiments may be used for individuals who are greater in age than an infant such as a child, adolescent, or adult.

[0003] The figures are illustrative, give examples, and are not supposed to be limiting. First 15 pages of drawings deleted due to space issues.

2. Background

[0004] When an infant is in the womb, it is protected from potentially damaging ambient noise by the mother's body. More specifically, the mother's body suppresses sound by approximately 15 dB in the mid to high frequency range. Such sound protection is especially important during the last trimester, since auditory neural pathways begin to form at that time. The auditory neural pathways develop gradually with the infant in the womb 19-27 weeks being able to respond to 500 Hz and attenuate sound below 500 Hz; an infant 33-40 weeks being able to respond to 1000 Hz and attenuate sound below 1000 Hz; and an infant full term being able to respond to 400-4000 Hz and attenuate sounds below 4000 Hz. "The period from 25 weeks' gestation to 5 to 6 months of age is most critical to the development of the neurosensory part of the auditory system." (Stanley N. Graven & Joy V. Browne, Auditory Development in the Fetus and Infant, 8 Newborn and Infant Nursing Reviews 187 (2008)). Unfortunately, some infants are born prematurely and must be maintained in a neonatal intensive care unit (NICU) of a hospital. Because of the nature of the NICU, much noise throughout the frequency spectrum is generated from the activity of nurses, phones, bells, alarms, etc. Noise levels in the NICU may range from 60 dB to 120 dB; 60 dB is around the sound level of normal conversation, and 120 dB may be the level of an ambulance siren. Sound levels in the NICU may be above the safe range for infants over 70% of the time. Such noises may adversely affect the infant in many ways, such as by leading to stress which may lead to tachycardia and hypoxia. Such an exposure may lead to long term issues such as Auditory Processing Disorder, and infants that spend time in the NICU are more likely to develop learning disabilities. For example, the infant's reactions to the stress burns many calories, thus potentially adversely affecting its growth during a critical phase of its life. The noise may keep the infant from getting much needed sleep, and, if antibiotics are administered to the infant, the noise could promote antibiotic attack on sensory mechanisms in the auditory system. Thus, protecting neonatal infants from harmful sounds which arise in the NICU environment is very desirable. On the other hand, since auditory neural pathways are being formed at that time, it is not desirable to attenuate too much sound, because overly isolating the infant from sound may inhibit neural development.

[0005] At this point in time, certain devices have been disclosed or published, such as U.S. Pat. No. 5,243,709; US Pat Appl. Pub. 2018/0177641; US20130046219A1; US20130133671A1; US20090178177A1; and, US20100014686A1.

SUMMARY OF INVENTION

Brief Description of the Drawings

[0006] The preferred embodiments of the present invention will be described in conjunction with the appended drawings. Various sizes and shapes and configurations of the parts of the mountable watering assembly are contemplated; various sizes of fasteners may be used depending on size and spacing of the rails of a railing system, such as a railing system that may be installed on a deck. Like designations denote like elements, and (APPLICANT WITHDRAWS THE FIRST 15 PAGES OF THE DRAWINGS DUE TO FILE SIZE ISSUES):

[0007] FIG. **1**A depicts a perspective view of an embodiment of a concave member **102**.

[0008] FIG. **1**B shows a side view of the embodiment shown in FIG. **1**A.

[0009] FIG. **1**C shows a top view of the embodiment shown in FIG. **1**A.

[0010] FIG. **2**A shows a perspective view of an embodiment of a compressible member.

[0011] FIG. **2**B shows a top view of the compressible member of FIG. **2**A.

[0012] FIG. **3**A shows a perspective view of an embodiment of a dividing member **106**.

[0013] FIG. **3**B shows a top view of the embodiment of shown in FIG. **3**A.

[0014] FIG. **3**C shows a side view of the embodiment of shown in FIG. **3**A.

[0015] FIG. **4**A depicts an embodiment of a padded member.

[0016] FIG. **4**B depicts a top view of the embodiment of shown in FIG. **4**A.

[0017] FIG. **5**A depicts a side view of a dampening assembly.

[0018] FIG. **5**B depicts a perspective view of the embodiment of shown in FIG. **5**A.

[0019] FIG. **6** depicts an exploded view of the embodiment of shown in FIG. **5**A.

[0020] FIG. **7**A depicts a first front cover.

[0021] FIG. **7**B depicts a second front cover.
[0022] FIG. **8** depicts a back cover.
[0023] FIG. **9** depicts a back view of a covered dampening assembly.
[0024] FIG. **10** depicts a front view of the covered dampening assembly of FIG. **9**.
[0025] FIG. **11** depicts a first front piece of a headpiece **113**.
[0026] FIG. **12** depicts a second front piece of a headpiece **113**.
[0027] FIG. **13** depicts a first back piece of a headpiece **113**.
[0028] FIG. **14** depicts a second back piece of a headpiece **113**.
[0029] FIG. **15** depicts an embodiment of a headpiece **113**.
[0030] FIG. **16** depicts the embodiment of the headpiece **113** of FIG. **15** being worn by an infant.
[0031] FIG. **17**A depicts the front view of the headpiece **113** of FIG. **15**.
[0032] FIG. **17**B depicts a back view of the headpiece **113** of FIG. **15**.
[0033] FIG. **18**A depicts a perspective view of an embodiment of a headpiece **113**.
[0034] FIG. **18**B depicts a front view of the embodiment of the headpiece **113** of FIG. **18**A.
[0035] FIG. **19** depicts a partial perspective view of the embodiment of the headpiece **113** of FIG. **18**A.
[0036] FIG. **20** depicts an embodiment of a covered dampening assembly.
[0037] FIG. **21** depicts an embodiment of the covered dampening assembly of FIG. **20**.
[0038] FIG. **22**A depicts a perspective back view of the embodiment shown in FIG. **18**A.
[0039] FIG. **22**B shows a top view of the embodiment shown in FIG. **18**A.
[0040] FIG. **23** shows a partial view of the embodiment of FIG. **18** as well as a perspective back view of a covered dampening assembly.
[0041] FIG. **24** shows an infant wearing the embodiment of the headpiece shown in FIG. **18**A.
[0042] FIG. **25**A shows an embodiment of a side view of what is shown in FIG. **24**.
[0043] FIG. **25**B shows an embodiment of a side perspective view of what is shown in FIG. **25**A;
[0044] FIG. **25**C shows an embodiment of a front-side perspective view of what is shown in FIG. **25**B.
[0045] FIG. **25**D shows an embodiment of a back view of what is shown in FIG. **25**C.
[0046] FIG. **25**E shows an embodiment of a frontal upward facing view of what is shown in FIG. **25**D.
[0047] FIG. **26**A depicts an embodiment of the sound-attenuating earpiece assembly.
[0048] FIG. **26**B depicts an embodiment of a portion of the sound-attenuating earpiece assembly.
[0049] FIG. **26**C depicts an embodiment of a portion of the sound-attenuating earpiece assembly.
[0050] FIG. **26**C depicts an embodiment of a portion of the sound-attenuating earpiece assembly.
[0051] FIG. **26**D depicts a top view of the embodiment of the sound-attenuating earpiece assembly **800** shown in FIG. **26**A.
[0052] FIG. **26**E depicts a bottom view of the embodiment shown in FIG. **26**A.
[0053] FIG. **26**F depicts the button as an embodiment of the earpiece assembly shown in FIG. **26**A.
[0054] FIG. **27**A depicts an embodiment of the second dampening layer earpiece dampening assembly
[0055] FIG. **27**B depicts an embodiment of the second dampening layer.
[0056] FIG. **27**C depicts a top-oblique view of the second dampening layer and the button of the embodiment shown in FIG. **27**B.
[0057] FIG. **28** depicts an embodiment of a behind-the-head headband without earpieces coupled to it.
[0058] FIG. **29**A depicts an embodiment of a behind-the-head headband with 2 earpieces coupled to it.
[0059] FIG. **29**B depicts an infant wearing the embodiment as shown in FIG. **29**A.
[0060] FIG. **29**C depicts an infant wearing the headband with the earpieces attached as shown in FIG. **29**A, with the headband oriented so it is on top portion of the head.
[0061] FIG. **30** depicts an infant wearing the embodiment shown in FIG. **29**B with an attached forehead strap **908**.
[0062] FIG. **31** depicts the side view of an embodiment of the headband shown in FIG. **29**A that is adjustable in size.
[0063] FIG. **32**A depicts an embodiment of a full circular headband.
[0064] FIG. **32**B depicts an infant wearing the embodiment shown in FIG. **32**A.
[0065] FIG. **33**A: depicts the top view of an earpiece **1000** that can be swapped out to allow the headband shown in the figures above to attenuate different amounts of sound.
[0066] FIG. **33**B: depicts the bottom view of FIG. **33**A
[0067] FIG. **33**C depicts the perspective view of FIG. **33**A
[0068] FIG. **34** depicts the button **1101**.
[0069] FIG. **35** depicts a cross section of FIG. **33**A.
[0070] FIG. **36** an embodiment of FIG. **35** where there is only one type of attenuating material.
[0071] FIG. **37** depicts an embodiment of FIG. **35** where the inner attenuating material **1105** is made of a composite of materials **1100** and **1104**.
[0072] FIG. **38** depicts a number of different embodiments of the ear piece **1000** with different sizes and attenuation amounts.
[0073] FIG. **39**A depicts another embodiment of the ear piece **1000** from the top.
[0074] FIG. **39**B depicts the bottom view of FIG. **39**A.
[0075] FIG. **39**C depicts a perspective view of FIG. **39**A.
[0076] FIG. **40** depicts a cross-section view of an embodiment of the earpiece **2000** shown in FIG. **39**A.
[0077] FIG. **41**A depicts just the padding member **2102** and the button **2100**.
[0078] FIG. **41**B depicts what is shown in FIG. **41**A, but where the button and the padding member are the same piece.
[0079] FIG. **42**A depicts one type of layer used in the ear piece **2000**. This layer may be made up of one type of attenuating material.
[0080] FIG. **42**B depicts what is shown in FIG. **42**A but from a cross-section view.
[0081] FIG. **42**C depicts a bottom view of FIG. **42**A.
[0082] FIG. **42**D depicts a top view of FIG. **42**A.
[0083] FIG. **43**A depicts another embodiment of the attenuating layers used in the ear piece **2000**. This type of layer is made up of 2 or more different materials with one of them being on the outside, and the others are embedded inside the outer layer

[0084] FIG. **43**B depicts a cross section of FIG. **43**A where **2224** is the inner material and **2222** is the outer material.

[0085] FIG. **43**C depicts the bottom view of FIG. **43**A.

[0086] FIG. **43**D depicts the top view of FIG. **43**A.

[0087] FIG. **44**A depicts a third embodiment of the attenuating layers used in the ear piece **2000**. In this embodiment, each layer is composed of 2 sublayers. Each sublayer may be a different attenuating material. For example, **2224** might be a compressible material and **2242** might be silicone.

[0088] FIG. **44**B. depicts a cross section of this embodiment in FIG. **44**A.

[0089] FIG. **44**C. depicts a bottom view of FIG. **44**A.

[0090] FIG. **44**D. depicts a top view of FIG. **44**A.

[0091] FIG. **45**A depicts another embodiment of the earpiece from the top.

[0092] FIG. **45**B depicts a cross section of the earpiece from **45**A. In this embodiment, the button **3100** and the outer attenuating layer **3106** are coupled together and detachably coupled to the inner attenuating layer **3104** and the padding attenuating member **3102**. For this embodiment the outer layer **3106** is supposed to be permanent, while the inner layer **3104** and **3102** can be replaced. They are coupled temporarily using an adhesive, friction, or a magnet, or other method to couple them together temporarily.

[0093] FIG. **45**C depicts a perspective view of FIG. **45**A.

[0094] FIG. **45**D depicts the bottom view of FIG. **45**A.

[0095] FIG. **46**A shows the outer layer detached from the inner layer.

[0096] FIG. **46**B shows the inner layer detached from the outer layer. In practice, the object shown in FIG. **46**B will be removed and may have different attenuating properties. Swapping it out can change the attenuating properties of the headpiece.

[0097] FIG. **47** shows a perspective view of the adjustable headband **960** shown in FIG. **31**.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0098] In this disclosure the following figures, which will first be discussed may be deemed by some to be the focus of this disclosure; after discussing figures with greater figure numbers, a discussion concerning the figures with lesser figure numbers will then occur so as to provide additional context.

[0099] Referring to FIG. **26**A, which depicts an embodiment of the sound-attenuating earpiece assembly **800**. Referring to FIG. **26**A, which depicts an embodiment of the sound-attenuating earpiece assembly **800**. The sound-attenuating earpiece assembly **800** may be rotatable around the button stem **803** when the sound-attenuating earpiece assembly **800** is coupled to a headpiece **900**.

[0100] Referring to FIG. **26**B, which depicts a portion of the sound-attenuating earpiece assembly **800**, which may include an embodiment of the first dampening layer **804**, which may be comprised of silicone material, disposed below an embodiment of a button **802** of some embodiments of an earpiece dampening assembly, wherein the button **802** may comprise a button stem **803** extending from a buttonhead.

[0101] Referring to FIG. **26**C, which depicts a portion of the sound-attenuating earpiece assembly **800** comprising the first dampening layer **804** coupled to the second dampening layer **806**; in some embodiments the first dampening layer **804** is a silicone layer, and in some embodiments the second dampening layer **806** is viscoelastic foam layer configured to be detachably coupled to a neonatal user; the second dampening layer **806** may be one of the following: round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical and may be two or more of the following when geometrically possible: round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical. A second dampening layer **806** may be coupled to the first dampening layer **804** and the first dampening layer **804** may be disposed between the second dampening layer **806** and the button **802**.

[0102] Referring to FIG. **26**D, which depicts a top view of the embodiment of the sound-attenuating earpiece assembly **800** shown in FIG. **26**A. The second dampening layer **806** of the sound-attenuating earpiece assembly **800** may stretch further in the radial direction than the first dampening layer **804**. The button **802** may be positioned in the center and extended radially outward.

[0103] Referring to FIG. **26**E, which depicts a bottom view of the embodiment shown in FIG. **26**A. Here, an embodiment of the second dampening layer **806** is depicted as the outside layer of the sound-attenuating earpiece assembly **800** and may be round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical and may be two or more of the following when geometrically possible: round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical.

[0104] Referring to FIG. **26**F, which depicts the button as an embodiment of the earpiece assembly shown in FIG. **26**A. In the earpiece dampening assembly the button comprises two parts: the button head **802** and button stem **803**. The button head **802** may taper from the top to the bottom where the bottom is larger than the top until it attaches to the button stem **803**; the button head **802** may be round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical and may be two or more of the following when geometrically possible: round, ring-shaped, arcuate, oval, circular, or elliptical. The button stem **803** is narrower than the bottom of the button **802** and connects to the bottom of the button **802** and may be round, ring-shaped, arcuate, rectangular, oval, circular, or elliptical and may be two or more of the following when geometrically possible: round, ring-shaped, arcuate, oval, circular, or elliptical.

[0105] Referring to FIG. **27**A, which depicts an embodiment of the second dampening layer earpiece dampening assembly **806**, which may be comprised of outer silicone layer. The second dampening layer earpiece dampening assembly **806** may be half of a sphere, oval shaped, rounding, or rectangular with a flat surface on the bottom.

[0106] Referring to FIG. **27**B, which depicts an embodiment of the second dampening layer **806** coupled to the button **802**.

[0107] Referring to FIG. **27**C, which depicts a top-oblique view of the second dampening layer **806** and the button **802** of the embodiment shown in FIG. **27**B.

[0108] Referring to FIG. **28**, which depicts an embodiment of a behind-the-head headband **900** without earpieces coupled to it. The headband **900** may have an attachment hole over left ear **920** positioned at the end of the left side of the headband **900**, and an attachment hole over the right ear **922** positioned at the end of the right side of the headband **900**. These attachment holes **920** and **922** may be used to receive the button **802**. The button **802** may latch in such a way that allows the user to adjust the positioning of the headband **900** while keeping the earpiece **800** stationary.

[0109] Referring to FIG. **29**A, which depicts an embodiment of FIG. **28** attached to two 2 earpieces. The embodiment of a behind-the-head headband attaches to an earpiece through a hole element **922** (see FIG. **28**) defining a hole in the headband **900** past the top of the button **802** to rest on the button stem **803**. The hole **922** (see FIG. **28**) is slightly smaller than the bottom of the button **802** and slightly larger than the width of the button stem **803**.

[0110] FIG. **29**B depicts an infant wearing the headband **900** with the earpiece assembly **800** without the forehead strap **908** and the headband on the back of the head of the infant.

[0111] Referring to FIG. **29**C, which depicts an infant wearing the headband with the ear pieces attached shown in FIG. **29**A, with the headband oriented so it is on top portion of the head.

[0112] Referring to FIG. **30**, which depicts an infant wearing the embodiment of the headband **900** shown in FIG. **29**B with an attached forehead strap **908**. The forehead strap **908** attaches to headband **900** slightly above the hole **922** on both sides. The forehead strap width is largest in the middle and slightly tappers to the ends where it attaches to the headband **900**.

[0113] FIG. **31** depicts an adjustable forehead strap based off the embodiment shown in FIG. **28**A. The headband **900** may include an inner support shaft **902** that allows for an extension between the first outer support **906** and the second outer support **904**. This extension mechanism allows for the headband **900** to vary in length to accommodate different sizes of infant heads.

[0114] FIG. **32**A depicts an of embodiment of a full circular headband **910**.

[0115] Referring to FIG. **32**B, which depicts an infant wearing the embodiment as shown in FIG. **32**A.

[0116] FIG. **33**A depicts the top view of an earpiece assembly **1000** that may be detached from the headband **900** to be replaced with another earpiece **1000** that has the same attenuating properties or another earpiece **1000** that has higher or lower sound attenuating properties. This top view shows the button **1101** and outer attenuating material **1100**.

[0117] FIG. **33**B depicts the bottom of the earpiece assembly **1000**. The outer layer of attenuated material is shown **1100** next to an inner layer of padding **1102**.

[0118] FIG. **33**C depicts a side view of the earpiece assembly **1000**. The button **1101** attaches to the outer layer of attenuating material **1100**, which gradually slopes down in a round shape to the bottom where it is flat. Inside the outer layer **1101** the padding **1102** may be attached as seen from the bottom view in FIG. **33**B.

[0119] FIG. **34** depicts an embodiment of a button **1101**.

[0120] FIG. **35** shows a cross-section view of the earpiece **1000** shown in FIG. **33**A where the outer attenuating layer **1100** is a different attenuating material from the inner attenuating layer **1104**.

[0121] FIG. **36** shows a cross-section view of another embodiment of the earpiece **1000** shown in FIG. **35** where the outer attenuating layer **1100** is the primary attenuating material. The padding member **1102** may also help attenuating sound and may be coupled to the outer attenuating layer **1100** and made of a different material than the outer attenuating layer **1100**.

[0122] FIG. **37** is another cross-section view of an embodiment of the earpiece **1000** shown in FIG. **35** with an outer attenuating material **1100** and an inner attenuating material **1105** which may be a composite of materials **1100** and **1104** shown in FIG. **35**.

[0123] FIG. **38** depicts earpieces with different sizes and materials and how size and material may affect attenuation: **1011** represents an earpiece with small size and low attenuation; **1021** represents an earpiece with medium size and low attenuation; **1031** represents an earpiece with large size and low attenuation; **1012** represents an earpiece with small size and medium attenuation; **1022** represents an earpiece with medium size and medium attenuation; **1032** represents an earpiece with large size and medium attenuation; **1013** represents an earpiece with small size and high attenuation; **1023** represents an earpiece with medium size and high attenuation; and **1033** represents an earpiece with large size and high attenuation.

[0124] FIG. **39**A depicts another embodiment of an earpiece with a plurality of peelable layers **2000**. **2112** represents the fifth or outermost attenuating layer of the earpiece. **2100** represent a button that attaches to the headband **900**.

[0125] FIG. **39**B depicts the bottom view of earpiece **2000**. **2102** represents a padding layer. Each of the following embodiments may represent a separate attenuating layer: **2104** the first and innermost layer that may be next to padding **2102**; **2106** may be the second attenuating layer; **2108** may be a third attenuating layer; **2110** may be a fourth attenuating layer; and **2112** may be a fifth attenuating layer. There may be more or less than 5 layers.

[0126] FIG. **39**C depicts a perspective view of FIG. **39**A. The button **2100** may be in the center of the earpiece with the attenuating material represented by **2112**, **2110**, **2108**, **2106**, and **2104** sloping or rounding down from the button **2100**. The sloping or rounding may stop and may be flat with padding material **2102** inside. FIG. **40** depicts a cross section view of **2000**, FIG. **39**A. The button **2100** may be permanently coupled to the padding member and may be detachably coupled to each of the attenuating layers, which may be temporary. All of the ear pieces **2000** may have the innermost attenuating layer **2104**, but may have a variable number of layers between the innermost attenuating layer **2104** and the outermost attenuating layer **2112**. To achieve a lower attenuating amount for the ear piece **2000**, layers (**2104**, **2106**, **2108**, **2110**, **2112**) are removed until the desired attenuating amount is reached. The maximum attenuating amount may be achieved by having the maximum number of layers. The minimum attenuating amount may be achieved by having only the innermost layer. The layers may be attached together using an adhesive, friction, magnets, or other binding means.

[0127] FIG. **41**A depicts the padding member **2102** and the button **2100** which may be permanently attached to each other.

[0128] FIG. **41**B depicts an alternative design where the button **2100** and the padding member **2102** may be the same piece.

[0129] FIG. **42**A depicts one of the attenuating layers (**2104**, **2106**, **2108**, **2110**, or **2112**) depicted in FIG. **40**. This embodiment of the attenuating layer **2200** is made up of one type of attenuating material, usually silicone.

[0130] FIG. **42**B depicts a cross-section view of FIG. **42**A and shows the attenuating material **2200** may be the same thickness throughout.

[0131] FIG. **42**C depicts a bottom view of FIG. **42**A. **2206** depicts that the **2200** attenuating layer may have a hole that

may be used to fit a button **2100** through. The **2206** hole may be in the center of the attenuating layer.

[0132] FIG. **42**D depicts a top view of FIG. **42**A with the hole **2206** that may be in the center of the top.

[0133] FIG. **43**A depicts another embodiment of the attenuating layers (**2104**, **2106**, **2108**, **2110**, or **2112**) depicted in FIG. **40**. This embodiment of the attennuating layer may be a layer comprising two or more different materials with an outer attenuating layer **2222**, and the inner material **2224** is embedded inside the outer attenuating layer **2222**.

[0134] FIG. **43**B depicts a cross section of FIG. **43**A where **2224** is the inner attenuating material and **2222** is the outer attenuating material.

[0135] FIG. **43**C depicts the bottom view of FIG. **43**A. **2226** depicts a hold that may be used for a button that may be in the center of the outer attenuating material **2222**.

[0136] FIG. **43**D depicts the top view of FIG. **43**A where the hole **2226** may be in the center of the outer attenuating material **2222**.

[0137] FIG. **44**A depicts another embodiment of the attenuating layers used in the ear piece **2000**. In this embodiment **2240**, each layer may be composed of 2 sublayers. Each sublayer is a different attenuating material. For example, layer **2224** might be a compressible material and layer **2242** might be silicone.

[0138] FIG. **44**B. depicts a cross section of this embodiment **2240** in FIG. **44**A.

[0139] FIG. **44**C depicts the bottom of the attenuating sublayers where **2242** and **2244** may be different materials. An element **2246** defining a hole that may be used for a button and may be in the center of the attenuating sublayers **2242** and **2244**.

[0140] FIG. **44**D depicts a top view of FIG. **44**A where the hole **2246** may be in the center of the attenuating sublayers **2242** and **2244**. Attentuating sublayer **2242** may be comprise material that is disposed in an outer location and is shown on top in this figure.

[0141] FIG. **45**A depicts an embodiment of the earpiece where the outer attenuating layer is permanent and not replaced **3000**. **3100** depicts a button that may be in the center of attenuating layer **3106**, which may be used to attach the earpiece to the headband **900**. **3106** depicts an outermost permanent attenuating layer.

[0142] FIG. **45**B is a cross-section view of FIG. **45**A. The outer layer may include the button **3100** and a permanent attenuating layer **3106**. The inner layer may include inner attenuating material **3104**, which may be different material than the outer attenuating material **3104**, and padding **3102**.

[0143] FIG. **45**C depicts another view showing the same elements found in FIG. **41**B.

[0144] FIG. **45**D depicts a bottom view of the earpiece **3100** found in FIG. **45**A.

[0145] FIG. **46**A depicts the outer layers of the earpiece **3000** depicted in FIG. **46**A where there is a button **3100** and outer attenuating layer **3106**.

[0146] FIG. **46**B depicts the inner layers of the earpiece **3000** where **3104** represents inner attenuating material and **3102** represents padding.

[0147] Referring to FIG. **47**, which depicts an embodiment of the headband with earpieces attached as shown in FIG. **29**A, but are adjustable for size. The neonatal sound attenuation system of claim **4**, wherein:

[0148] the first portion of the headpiece is extendably coupled to a third portion of the headpiece via a first slidable bar, wherein the third portion of the headpiece securely and slidably surrounds the first slidable bar having a compressible-expandable tip, wherein the third portion of the headpiece further comprises a first lip configured to frictionally prevent the compressible-expandable tip from moving beyond the first lip when a mature user pulls on the first portion of the headpiece without exertion, wherein the first portion of the headpiece is configured to securely position the first sound-attenuating earpiece against the first ear of the user; and,

[0149] The second portion of the headpiece is extendably coupled to a fourth portion of the headpiece via a second slidable bar, wherein the fourth portion of the headpiece securely and slidably surrounds the second slidable bar having a compressible-expandable tip, wherein the fourth portion of the headpiece further comprises a second lip configured to frictionally prevent the compressible-expandable tip from moving beyond the second lip when a mature user pulls on the second portion of the headpiece without exertion, wherein the second portion of the headpiece is configured to securely position the second sound-attenuating earpiece against the second ear of the user.

[0150] The auditory neural pathways develop gradually with the infant in the womb 19-27 weeks being able to respond to 500 Hz and attenuate sound below 500 Hz (it is contemplated that for this time period of gestational age (regardless of whether the infant has been born but calculated from the estimated date of gestation), a claimed device or method will be used to provide a high-level or maximum level of attenuation); an infant 33-40 weeks being able to respond to 1000 Hz and attenuate sound below 1000 Hz (it is contemplated that for this time period of gestational age (regardless of whether the infant has been born but calculated from the estimated date of gestation), an claimed device or method will be used to provide a medium level of attenuation); and an infant full term being able to respond to 400-4000 Hz and attenuate sounds below 4000 Hz (it is contemplated that for this time period of gestational age (regardless of whether the infant has been born but calculated from the estimated date of gestation), a claimed device and method will be used to provide a low-level of sound attenuation).

[0151] Any reference to a button may include a knob or handle. Padded member **108** may be made from a quilted wool/cotton blend, the stuffing of padded member **108** may be also made from a quilted wool/cotton blend; the stuffing of padded member **108** may be made of cotton, batting, a cotton-blend or some other compressible material including foam.

[0152] The foam may have one or more of the following properties: elasticity, porosity, thickness, and cell size.

[0153] Reclosable fasteners may be used; and the fastening patch **500** may be coupled by sewing or other means such that the fastening patch is not easily dislodged when an infant, who is wearing the headpiece **113** having the fastening patch, tosses and turns.

[0154] In some embodiments, materials used in the assembly or devices preferably lower sound levels between 20-30 dB. Materials that are used in the assembly or devices preferably dampen sound instead of deadening sound; in other words, materials preferably attenuate sound instead of

completely canceling sound or noise. Some materials which may be incorporated in the assembly or device maybe medical grade materials. In the preferred embodiments, materials which are used in the assembly or device are not overly rigid and have some degree of flexibility.

[0155] In the preferred embodiments, headpiece **113** and the sound attenuating assembly may be configured to be compatible with the use of medical devices such as tubes and CPAP oxygen machines. The use or disclose invention is not limited to prematurely born infants and different embodiments of the invention may be used with infants, prematurely born infants, children, adolescents, adults, senior citizens and disabled people, and consequently, the sound attenuating assembly **100** and its components may be of various sizes and shapes. Premature babies may vary greatly in size, weight, and head circumference. In preferred embodiments a baby or individual may lay on top of the sound attenuating assembly and its components without being damaged. In the preferred embodiments the components of the sounds in the assembly **100** are not substantially bulky. In the preferred embodiments, the headpiece is configured to fit snuggly with an individual such as a baby. In the preferred embodiments the headpiece is not configured to fit so tightly that the user experiences great discomfort or has decreased blood flow areas in the areas that are contacted by the headpiece.

[0156] In some embodiments, the headpiece may be of a size that fits a premature baby of various sizes or an individual regardless of the individuals age or size.

[0157] In the preferred embodiments, the dampening assembly, which is the portion that may attenuate sound, may be sized to cover an entire ear of an individual. Preferably, two dampening assembly may be used so that each ear may be covered. Preferably headpiece **113** does not cover the eyes or nose of an individual or prematurely born infant. Preferably nurses or other caretakers may remove headpiece **113** and its component with substantial ease. Preferably headpiece **113** and its component do not interfere, or only minimally interfere, with medical devices that may be in use with a prematurely born infant who may be using IVs, feeding tubes, bilirubin glasses, oxygen, ventilator, nasal canula, CPAP, head sensors, incisions, etc.

[0158] Any listed measurements are only exemplary; preferable ranges may fall within −10% and +10% of the stated measurement values; preferable ranges fall may within −30% and +30% of the stated measurement values; some ranges fall may within −50% and +50% of the stated measurement values; some ranges fall may within −90% and +1000% of the stated measurement values.

[0159] The following components may be included individually or in combination with other components which are listed herein; details are exemplary and nonlimiting.

[0160] Referring to FIGS. **7**A, **7**B, and **8**, the first front cover of FIG. **7**A may be coupled to the back cover so as to form a pocket, and the second front cover of FIG. **7**B may be coupled to the back cover so as to form a pocket overlapping with a portion of the first front cover and being above the first front cover; vice-versa scenarios are also contemplated by this disclosure such that the first front cover is overlapping with a portion of the second front cover and also is disposed above the second front cover.

[0161] FIGS. **19**, **20**, and **21** depict an embodiment of a sound attenuating assembly **100**. headpiece **113** may have one or more pockets (**713***a*, **713***b*) or may have a fastener patch, such as a hook-and-loop patch that may attach to a dampening assembly's corresponding fastener patch or a covered dampening assembly's corresponding fastener patch.

[0162] Any component with the word "member", such as concave member **102** or compressible member **104**, may be of any shape; in the preferred embodiments, may be circular, oval, squarish, rectangular, ear-shaped, or elliptical,

[0163] Sound attenuating assembly **100** may include a dampening assembly that may include a concave member **102**, which may be large enough for other components to be disposed within concave member **102**; a compressible member **104**, a dividing member **106** (which is not present in some embodiments); a padded member **108**

[0164] Compressible member **104** may be made of foam or other compressible material.

[0165] Dividing member **106** may be made of card stock;

[0166] A padded member **108** may be included;

[0167] headpiece **113** may cover the ears, at least some of the neck and at least some of the head of a wearer;

[0168] A cover **300** may be made from cloth or some other material.

[0169] An embodiment of dampening assembly **400** is shown in FIG. **5**B.

[0170] 4 pieces may be used to make the headpiece **113**; 3 pieces may be used to make the pocket. Dampening assembly and covered dampening assembly may reduce sound levels between 10 and 100 db with a target reduction of 30-50 db.

[0171] Cardstock may be the 140 lb type; height of dividing member **106** may be 3.2 cm and the width of dividing member **106** may be 3 cm.

[0172] concave member **102** may be a silicone egg mold or any other concave object that is large enough to engulf or partially engulf compressible member **104**. The width of concave member **102** may be 4.2 cm; the length of concave member **102** may be 4.2 cm. The thickness of concave member **102** may be between 0.1 mm and 100 mm.

[0173] The length by width dimensions of padded member **108** may be 4.5 cm by 4 cm.

[0174] Foam may be used as the main material of the compressible member **104**; in some embodiments the length by width dimensions of the compressible member **104** may be 3.9 cm by 3.4 cm and may be 1.5 cm in thickness.

[0175] Upper circumference of headpiece **113** may be 18.1 cm. headpiece **113** may have an upper central horizontal width of 11.4 cm; bottom horizontal width may be 14 cm; a band of material with a fastener on one end that may attach detachably to a fastener of the head piece may be coupled to an opposing side of the headpiece to form a chinstrap **502**.

[0176] Cover **300** may be 4.5 cm by 5.2 cm.

[0177] Width circumference of cover **300** may be 12 cm.

[0178] Height circumference of cover may be 13 cm.

[0179] Sound attenuating assembly **100** may have removeable and adjustable earpieces to ensure proper fit. It may also have an adjustable chin strap to ensure that the sound attenuating assembly is fitted snugly around a wearer so as to form a substantial seal around the ear.

[0180] Ear covering may be worn by babies/children/adults to decrease the noise level. It may work by having materials that attenuate sound placed over the ear and may include a headpiece **113**; headpiece **113** may be a band or headband or it may be a head covering with a neck covering portion and one or more ear flaps.

[0181] Each part of the earpiece may serve a function of assist with serving a function of lowering sound levels, attenuating sound levels, or providing comfort to a user wearing the earpiece. Earpiece may include one or more materials to provide attenuation or comfort. The design may include various materials such as a silicone convex ear piece, viscoelastic foam, cardstock, wool or cotton organic material blend. The neonatal sound attenuating system may include at least one pocket for receiving and storing earpiece materials. The pocket may contain hook and loop fastener for adjustment of ear piece placement. The pocket may detach and be adjusted for proper fit around the ear. Materials may also be removed from pocket for washing of pocket. An earpiece may be on each side of a neonatal sound attenuating assembly for placement over each ear. A headpiece may provide comfortable fit around the head and may include a hook and loop fastener strip to attach the earpiece. The headpiece **113** may also contain a strap, which may be hook and latch, to ensure proper fit of the earpieces over the ear. The headpiece **113** may also include designer elements such as bows. The earpieces and head piece may be sized to fit various head sizes.

[0182] The ear piece and its materials may contribute sound attenuation and comfort.

[0183] The headpiece and its parts may act to hold the ear piece in its proper place to ensure proper attenuation over the ears.

[0184] The headpiece may be used as a headpiece **113** for warmth or style, yet also may serve to support the earpieces.

[0185] The materials in the earpiece work to attenuate sound and may be comfortable.

[0186] The headpiece may hold the earpieces in place over the ears and may provide a surface for allowing for the adjustment of earpieces.

[0187] At least a portion of the sound attenuating materials may be preferably placed over the ear to attenuate, decrease, or lower the sound level. Headpiece **113** may have a strap or other member for holding a dampening assembly or covered dampening assembly in its proper place. The upper portion of the head piece may be substantially elevated so as to not cover or obstruct the eyes or nose. The head piece may also provide sufficient fit and covering to properly hold/support the earpieces in their proper placement over the ears.

[0188] The earpiece may be of various shapes, and the earpiece may be configured to receive and engulf, or at least partially engulf at least one neonatal ear; in some embodiments, the earpiece may be configured to be disposed near at least one ear of a neonatal user so as to transmit sounds via bone conduction. The earpiece may include materials that are known to have sound attenuating properties.

[0189] Various designs and patterns may be used for the head piece; in the preferred embodiments, the head piece may use a fastener with detachable-attachable properties, such as a hook loop fastener or other type of adhesive or detachably adhesive material that may be located in the area of the headpiece that would touch or be facing a wearers ear; and a patch with a fastener may also be coupled to that location so that a covered dampening assembly with a fastener **704** on the outer surface (or a dampening assembly without a cover that has a fastener on the outer surface of the concave member **102**) may then be adjustably coupled to the patch such that the covered dampening assembly may be coupled with the head piece **13** or held in place against the head piece; the location **700** at which such a patch **702** for coupling the covered dampening assembly **400** to the head piece is shown in the figures; the shape of the patch **702** may be rectangular, elliptical, or some other shape. A patch **702** may be coupled to one side of the headpiece **113** and a second patch may be coupled to an opposing side of the headpiece **113** since most individuals have two ears and would usually benefit from having a dampening assembly **400** or covered-dampening assembly **200** attached to the patch **702** and a second dampening assembly **400** or a second covered-dampening assembly **200** also being attached to a second patch. In the preferred embodiments an adhesive or detachably adhesive material is located on the outer surface of the ear piece and substantially couples with a support strip that is made of a material that allows for the adhesive or detachably adhesive material of the outer surface of the ear piece to attach of detachably attach to the support strip. The support strip may be coupled to the inner surface of the device.

[0190] Listed materials are nonlimiting. The parts in the ear piece, also known as a dampening assembly or covered dampening assembly, may be of a type of material that is not explicitly listed in this patent application. If another material or combination of materials is found to provide similar attenuation and comfort. The ear piece cannot be eliminated. The design and pattern of the head piece could change as long as it provides support for the earpieces. The cover may have a back portion and two front portions; the two front portions may overlap but also may be open such that a dampening assembly may be slid into an inner cavity of the cover and be substantially engulfed by the combination of the back portion of the cover and the two front portions; a zipper may be used or a fastener may be used such as a button or hook-loop fastener system having a first hook loop fastener opposed to a mateable second hook loop fastener to reclosably close the opening of the cover.

[0191] Embodiments may include bone conduction piece that would play sounds similar to what may be heard in the womb including mother's voice, heartbeat, and other ambient sounds. Bone conduction is the way a fetus hears sound in utero. It may also include the use of developmentally appropriate sounds to improve auditory development.

[0192] Any of the members or layers may be removed. It is possible the cardstock could be left out of the ear piece as it may lose its support integrity over time and use.

[0193] The product could be used on babies outside of the NICU or hospital setting or full-term babies. It could also be used for small children, children, adults or anyone with a need for sound attenuation from loud environments. The product may be sized for various head sizes. The earpieces may be worn over the ears and may be held in place as to stay over the ear continuously.

[0194] The earpieces may be made with materials that attenuate sound and are feasible and comfortable in the wear of the product. The head piece may be made of material that is soft and flexible for ease and comfort in wearing.

[0195] Wearing the ear piece over the ears and being held in place to create proper fit is preferred. Cotton may be used for the headpiece **113**; concave member **102** may be made of silicone and some embodiments a silicone mold such as a Wilton silicone egg mold may be used for concave member **102**.

[0196] Some embodiments consist of two main portions: the earpiece and the headpiece. The earpiece is configured

for sound attenuation, and the headpiece holds the earpieces in place. Below are descriptions of the earpiece and headpiece embodiments.

[0197] As disclosed in applicant's previous applications, positioning of earpieces and increased effectiveness of earpiece are desirable. The present application discloses an earpiece embodiment that reduces sliding movements or movements of the earpiece or the headpiece; an embodiment is disclosed that goes around the outside of the ear to provide a concave shape around the ear and also to create space around the ear, which puts little to no pressure on the ear.

[0198] The material of the earpiece may consist of the original outer silicone layer (FIG. **11***b*), followed by a layer of viscoelastic foam (FIG. **11***c*). Both materials may provide sound attenuation. The earpiece may consist of an exterior sound attenuating shell (silicone material) (FIG. **11***b*), the inner sound attenuating layer (viscoelastic foam material) (FIG. **11***c*), and padded oval-ring shaped ear cushions that are configured to be pressed around the ear on the skull (foam material) (FIG. **11***c*). The additional two layers of cardstock or wool-cotton blend material may be eliminated in some embodiments. By using silicone and foam materials, the layers may be molded and blown into one piece in the manufacturing process (FIG. **11***a*), which will allow for ease in manufacturing and assembly. Another benefit includes being more easily cleaned by surface wiping the earpiece rather than disassembly and washing of material. This allows for increased sanitation in the hospital setting. The original level of sound attenuation that consisted within the original 4 materials can be achieved through increasing the thickness of the silicone layer and foam and by creating a light seal around the ear with the improved embodiment. The thickness of the silicone outer layer may be between 1-3 ml thick. The thickness of the foam layer may be less than 2 cm in thickness or the density of the material will be increased.

[0199] A plurality of sizes of the earpiece may be manufactured and used depending on the size and growth of the infant.

The Exterior Shell

[0200] The exterior shell may be composed of silicone that is pliable for comfort and flexibility. The silicone material provides both structure to the earpiece and sound attenuation. The thickness of the silicone outer layer may be between 1-3 ml thick.

[0201] From the top (FIG. **11***d*) and side view (FIG. **11***a*), the shape of the earpiece may be a round shape, such as an oval shape, as disclosed herein. The shape of the earpiece may extend diagonally to define a conal shape or generally conal shape from the outer edge of the oval ring and the edge may be configured to have a more flattened shape to allow for proper attachment of the button, which exists to attach to the headpiece.

[0202] From the bottom view (FIG. **11**E), it may be an oval and concave shape that may circle around the outside of the entire ear and cups around the ear. The exterior back of the outer shell may flatten. The exterior back of the earpiece embodiment may also include a button that may be a small, soft, flexible button that may be attachable to the headpiece and may allow for adjustment on the headpiece. The button may allow for pivotal adjustment on the earpiece at a plurality of degrees depending on the shape and placement of the ear. The button may consist of the same silicone material used on the outer shell of the earpiece and may be attached via a mold in the manufacturing process (FIG. **11***b*). The button may have a stem that may be less than 0.5 centimeters in height and 0.5 centimeters in width. The stem may attach to the upper button which may help hold the earpiece in place so as to not pop out of location on the headpiece. The upper button portion may be less than 1 centimeter diameter and less than 0.5 centimeters height. It may also have a flat or dome shape.

Inner Sound Attenuating Layer

[0203] The inner layer may be composed of a sound attenuating foam (such as viscoelastic or antimicrobial polyurethane), additional silicone, or flexible plastic, or combination of materials to provide sound attenuation and comfort around the ear (FIG. **11***c*). The inner layer of the earpiece may be adhered to the exterior silicone shell via manufacturing. The shape may be concave as to allow room for the ear to fill the space when it is placed on/around the ear. The thickness of the foam layer may be less than 2 cm in thickness or the density of the material will be increased. The foam material may be placed in some embodiment as a separate piece that required assembly and may be placed in other embodiments as a single piece. By adhering the outer silicone layer and inner foam layer, it creates an ease in manufacturing, ease of cleaning and sanitation, and improved function.

Outer Ring

[0204] The oval ring of the earpiece will extend around the outside of the ear to create a ring around the ear (FIG. **11***c*). The material may consist of a soft foam for comfort and flexibility allowing the placement to follow the curvature of the skull. The ring may function to create light gentle pressure so as to not create any excessive pressure on the soft skull bones around the ear. The oval ring will include a rounded cushion to decrease any pressure points and evenly distribute the light pressure around the ear. The light seal also creates sound attenuation by decreasing the amount of sound that gets through the earpiece which thus increases the effectiveness of the sound attenuation creating a sound level more appropriate for the infant. The ring may also function to hold the earpiece in place over the ear to prevent movement and sliding of the earpiece. The thickness of the ring may be approximately 1 cm thick and less than 1 cm wide.

Sound Level Sensor

[0205] An audio sensor may be included in the earpiece that allows for data tracking of the infant's dB level exposure. The sensor may be placed inside the concave earpiece to measure the sound level the infant is exposed. The concave shape of the earpiece allows for placement of the sensor within the earpiece without touching or pressuring the ear. The data tracking allows for increased awareness of environmental sound levels and the effectiveness of the earpiece in attenuating the sound to acceptable developmental levels. The sensor may include a microphone on the inside of the earpiece to capture the sound level and a sensor or probe device that is exposed to the outside of the earpiece to capture the environmental sound level. Through wireless, wireless-technology for proximate or distant communica-

tion, or other connection technology, data may be tracked to improve the auditory environment and outcome of the infant.

Original Earpiece

[0206] The original earpiece may be changed to have a silicone button molded to the exterior back of the silicone outer layer (FIG. **12***a*). The button may be used for attachment to the headpiece. The button allows for pivotal adjustment on the earpiece at a plurality of degrees to accommodate the placement of the ear and ensure proper placement of the earpiece over the ear. The button may consist of the same silicone material used on the outer silicone layer of the earpiece and will be attached via a mold in the manufacturing process (FIG. **12***b*). The button may have a stem that may be less than 0.5 centimeters in height and 0.5 centimeters in width. The stem may attach to the upper button which will help hold the earpiece in place so as to not pop out of location on the headpiece. The upper button portion may be less than 1 centimeter diameter and less than 0.5 centimeters height. It may also have a flat or dome shape. The outer material cover of the earpiece will have an elastic hole allowing for the silicone button to pop through for attachment to the headpiece.

Headpiece

[0207] Upon testing the original headpiece (cap style embodiment) on premature babies in a neonatal intensive care unit, additional embodiment options were developed to overcome the constraints of the cap embodiment. There may be a plurality of headpiece embodiments needed to meet the needs of the infant depending on size, ability to maintain temperature, medical equipment in use, and oxygen needs (nasal cannula, Continuous Positive Airway Pressure machines, ventilator, etc.). Because different equipment, particularly oxygen equipment, requires various levels of access to the forehead and top of head area, cap wearing may be challenging in certain situations. Also, the goal is to have the infant maintain body heat on its own, so cap wearing for long periods of time is discouraged in some NICU settings. A plurality of headpieces may need to be utilized depending on the many factors of the infant including, but not limited to size of head and ears, ability to maintain temperature, medical equipment in use, and oxygen needs (nasal cannula, cpap, ventilator, etc.). For this reason, a plurality of headpiece embodiments have been developed to meet the medical needs of the infant.

Behind-the-Head Headpiece

[0208] One of the alternative headpiece embodiments utilizes the back of the head with a behind-the-head headband. It may form a semi-circular shape on the back of the head that attaches to the outer side of each earpiece via a silicone button on the earpiece (FIG. **13***a*). The headband includes an upper band and lower band that join together with a curved U-shape where the earpieces attach (FIG. **13***a*). From the U-shape, the upper and lower band diverge at approximately 30 degrees and wrap around and cradle the back side of the head, creating light pressure, which acts to keep the earpieces in place (FIG. **13***b*). The middle portion, between the upper and lower band, may comprise a breathable mesh elastic fabric or other breathable material for structure (FIG. **13***a* & *b*). The upper and lower band of the behind-the-head embodiment increase the support to keep the earpieces in place without interfering with most medical equipment. The upper band may be disposed at the aforementioned angle to lay below the lower fontanel on the head as to not create any pressure on the soft spot. The headband embodiment also allows for evenly distributed pressure as to not create hot spots or excessive pressure on any one spot of the skull (FIG. **13***b*).

[0209] The upper and lower bands may adjust to allow for sizing to various head sizes and proper contouring to the head and to create light pressure to properly hold the earpieces against the head (FIG. **13***c*). The upper and lower bands may consist of a slide mechanism comprising an inner band (made of a flexible plastic or metal material) that is firmly encased in an outer sleeve (made of a flexible plastic or metal material). The outer band may firmly encase the inner band as to maintain the adjusted size and hold in place the inner band. The inner band slides into the outer band allowing for adjustability for different head sizes. The adjustability allows the bands to follow the curvature of the head and lay properly against the head for comfort. The outer sleeve may have a lip at the ends to stop the inner band from slipping out. The outer sleeve of both the upper and lower bands may be covered in a soft padded material such as neoprene to ensure comfort against the infant head. Adjustments may be made by lightly pulling on the headpiece near the earpiece for the slide adjustment to move.

[0210] Both earpiece embodiments (original and improved embodiment) may attach to the behind-the-head headband via the silicone button. A small hole in the neoprene fabric allows the button to slip through and be held snug. The button attachment may allow for the angle of the earpieces to be adjusted (FIG. **13***a*)

[0211] The headband may also consist of an additional strap that can attach to the side of the headpiece via latch or velcro and adjust toward the forehead for additional support if equipment allows (FIG. **13***d*). The strap may also consist of a neoprene material (or other soft cushioned material) that attaches to the outer sides of the earpieces and wraps around the forehead for added stability of the earpieces. In some situations, the strap may be removable and optional.

Full Circular Headpiece

[0212] An additional headpiece embodiment may be a full circular headband that wraps around the back of the head and meets at the forehead with velcro straps for adjustability (FIG. **14***b*). The headband may also have velcro adjustability in the back for further sizing up or down if needed and for proper placement of the earpieces over the ears (FIG. **14***b*). The headband may be made of stretchable and cushioned material such as, but not limited to neoprene fabric. The headband may fully cover or partially cover a length of the forehead and may create light pressure over the earpieces to keep the earpieces from moving or sliding around (FIG. **14***a*). The headband may angle above the eyes to rest on the forehead for maximum stability and to not obstruct the eyes of the infant (FIG. **14***b*).

[0213] Some earpiece embodiments may attach to a full circular headband via a silicone button. A small hole in the neoprene or other headband fabric may allow the button to slip through a portion of the headband and the button may be held snug by headband fabric or other materials of the

headband. The button attachment may allow for the angle of the earpieces to be adjusted for proper placement around the ear (FIG. **14***b*).

Cap

[0214] The cap may be a soft beanie-style embodiment made of various materials including mesh, cotton, polyester, and/or spandex. The cap may secure the earpieces against creating light pressure so the earpieces stay in proper position over the ears (FIG. **15**). The cap may be secured with a chin strap.

[0215] Some earpiece embodiments may attach to the cap via the silicone button. A reinforced hole cap fabric, which may be a small hole, may allow the button to slip through the cap and may be held snug. The button attachment may allow for the angle of the earpieces to be adjusted for proper placement around the ear. The silicone button attachment may replace the velcro attachment seen in the original embodiment (FIG. **15**).

The disclosure contemplates various combinations of the claims as well as various incorporation of disclosed matter.

[0216] The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated.

Reference Number	Exemplary Part name
100	sound attenuating assembly
102	concave member
104	compressible member
106	dividing member
108	padded member
300	covering back portion
302	covering front portion
304	stitching
320	first front piece
322	second front piece
324	first back piece
326	second back piece
400	dampening assembly
502	chinstrap
702	patch
704	fastener
800	ear piece
802	button
804	silicone layer
806	foam layer
900	headband
902	inner support
904	first outer support
906	second outer support
908	forehead strap
910	another embodiment of a headband
1000	ear piece
1001	ear piece with only padding and one type of attennuating material
1002	ear piece with outer attenuating material, and the inner attenuating material is a composite of 1100 and 1104
1011	ear piece, small size, low attenuation

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Reference Number	Exemplary Part name
1012	ear piece, small size, medium attennuation
1013	ear piece, small size, high attennuation
1021	ear piece, medium size, low attenuation
1022	ear piece, medium size, medium attenuation
1023	ear piece, medium size, high attenuation
1031	ear piece, large size, low attenuation
1032	ear piece, large size, medium attenuation
1032	ear piece, large size, high attenuation
1100	outer attenuating material
1101	button
1102	papdding member
1104	inner attenuating material
1105	composite attenuating material made of 1100 and 1104
2000	another embodiment of an ear piece that has a plurality of peelable layers
2100	button that attaches to the headband
2102	padding member
2104	first attenuating layer (innermost attenuating layer)
2106	second attenuating layer (inner attenuating layer)
2108	third attenuating layer (inner attenuating layer)
2110	fourth attenuating layer (inner attenuating layer)
2112	fifth attenuating layer (outermost attenuating layer)
2200	embodiment of an attenuating layer (2104, 2106, 2108, 2110, 2112) that may made of one type of attenuating material
2206	a hole in the attenuating layer allowing the button to fit (may or may not have the hole)
2220	embodiment of an attenuating layer (2200) made of 2 layers of materials
2222	outer attennuating material
2224	inner attenuating material
2226	hole in the attenuating layers allowing the button to fit
2240	embodiment of a layer for 2000 that involves 2 separate sub layers
2242	first sub layer
2244	second sub layer
2246	hole for the button
3000	embodiment of the earpiece which consists of an outer permanent shell that is not replaced each time
3100	button to attach the earpiece to the headband
3102	padding member
3104	attenuating material
3106	outer permanent shell
700a	first ear-adjacent location
700b	second ear-adjacent location
713a	right pocket
713b	left pocket
(?)	(?)
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1. A neonatal sound attenuation system for attenuating sound in a first ear of a neonatal user and in a second year of a neonatal user comprising:

a headpiece configured to be worn by a neonatal user;

a first sound-attenuating earpiece assembly; and,

a second sound-attenuating earpiece assembly.

2. The neonatal sound attenuation system of claim **1**, wherein the first sound-attenuating earpiece assembly comprises:

an outer shell made of a firm material and configured in a concave shape to surround the user's ear;

an amount of padding surrounding the user's ear; and,

an internal attenuating material positioned within the outer shell, wherein the attenuating material is composed of foam or composite material;

wherein the second sound-attenuating earpiece assembly comprises:

an outer shell made of a firm material and configured in a concave shape to surround the user's ear;

an amount of padding surrounding the user's ear; and,

an internal attenuating material positioned within the outer shell, wherein the attenuating material is composed of foam or composite material.

3. The neonatal sound attenuation system of claim **1**,

the first sound-attenuating earpiece assembly further comprising a first dampening layer comprising material selected from silicone, wherein the first dampening layer is coupled to a second dampening layer comprising material selected from viscoelastic and foam; wherein the second dampening layer is concave shaped and extends radially beyond the first dampening layer; and,

the second sound-attenuating earpiece assembly further comprising a first dampening layer comprising material selected from silicone, wherein the first dampening layer is coupled to a second dampening layer comprising material selected from viscoelastic and foam; wherein the second dampening layer is concave shaped and extends radially beyond the first dampening layer.

4. The neonatal sound attenuation system of claim **1**, further comprising:

wherein the first sound-attenuating earpiece assembly comprises a button-stem assembly; wherein a button of the button-stem assembly is coupled to an outer edge of an opening element defining a first opening of the headpiece, wherein the stem of the button-stem comprises a major longitudinal axis and is rotatably coupled to a first portion of a headpiece wherein the first sound-attenuating assembly is rotatable about the major longitudinal axis; and,

wherein the second sound-attenuating earpiece assembly comprises a button-stem assembly; wherein the button of the button-stem assembly is coupled to an outer edge of an opening element defining a first opening of the headpiece, wherein the stem of the button-stem comprises a major longitudinal axis and is rotatably coupled to a second portion of the headpiece wherein the first sound-attenuating assembly is rotatable about the major longitudinal axis.

5. The neonatal sound attenuation system of claim **1**, wherein:

the headpiece comprises a mesh net or a flexible material designed to maintain comfort and stability on a neonatal user's head.

6. The neonatal sound attenuation system of claim **4**, wherein:

the first portion of the headpiece is extendably coupled to a third portion of the headpiece via a first slidable bar, wherein the third portion of the headpiece securely and slidably surrounds the first slidable bar having a compressible-expandable tip, wherein the third portion of the headpiece further comprises a first lip configured to frictionally prevent the compressible-expandable tip from moving beyond the first lip when a mature user pulls on the first portion of the headpiece without exertion, wherein the first portion of the headpiece is configured to securely position the first sound-attenuating earpiece against the first ear of the user; and,

The second portion of the headpiece is extendably coupled to a fourth portion of the headpiece via a second slidable bar, wherein the fourth portion of the headpiece securely and slidably surrounds the second slidable bar having a compressible-expandable tip, wherein the fourth portion of the headpiece further comprises a second lip configured to frictionally prevent the compressible-expandable tip from moving beyond the second lip when a mature user pulls on the second portion of the headpiece without exertion, wherein the second portion of the headpiece is configured to securely position the second sound-attenuating earpiece against the second ear of the user.

7. The neonatal sound attenuation system of claim **1**, wherein:

the first sound-attenuating assembly is configured to provide maximum sound attenuation to the neonatal user;

a third sound attenuating assembly, swappable with the first sound-attenuating assembly and swappable with a fourth sound-attenuating assembly, is configured to provide medium sound-attenuation to the neonatal user;

a fourth attenuating assembly, swappable with the first sound-attenuating assembly and swappable with the third sound-attenuating assembly, is configured to provide minimal sound-attenuation to the neonatal user.

8. The neonatal sound attenuation system of claim **5**, wherein:

the first sound-attenuating assembly is configured such that a sound-attenuation level is adjustable when a mature user removably peels off at least one sound-attenuating layer, of the first sound-attenuating assembly, to achieve medium attenuation for the neonatal user and such that the sound-attenuation level is further adjustable when a mature user removably peels off at least one sound-attenuating layer, of the first sound-attenuating assembly, to achieve low-sound attenuation for the neonatal user.

9. The neonatal sound attenuation system of claim **6**, wherein:

a total number of removable attenuating layers is greater than three, allowing for finer control over sound attenuation levels.

10. The neonatal sound attenuation system of claim **1**, wherein:

an inner attenuating material comprises viscoelastic foam or antimicrobial polyurethane foam.

11. The neonatal sound attenuation system of claim **1**, wherein:

a plurality of attenuating layers comprises:

a durable sound-attenuating silicone-based outer layer;

a middle sound-attenuating composite layer; and,

an inner sound-attenuating viscoelastic layer.

12. A method for neonatal sound attenuation comprising:

wherein a first sound-attenuating assembly is configured to provide maximum sound attenuation to the neonatal user;

providing a first sound-attenuating earpiece assembly comprising:

an outer shell made of a firm material and configured in a concave shape to surround an ear of the neonatal user;

an amount of padding surrounding the ear of the neonatal user; and,

an internal attenuating material positioned within the outer shell, wherein the attenuating material is composed of foam or composite material;

securing the headpiece onto a neonatal user; and,

adjusting the sound-attenuating earpiece assembly to ensure proper fit and sound-proper attenuation for the neonatal user.

13. The method of claim **12**, further comprising:

waiting until the neonatal user is at least 33 weeks old as calculated by gestational age;

securing to at least one ear of a neonatal user a third sound-attenuating assembly, swappable with the first sound-attenuating assembly and swappable with a fourth sound-attenuating assembly, wherein the third sound-attenuating assembly is configured to provide medium sound-attenuation to the neonatal user;

waiting until the neonatal user is full term gestational age;

securing to the at least one ear of the neonatal user a fourth sound-attenuating assembly, swappable with the first sound-attenuating assembly and swappable with the third sound-attenuating assembly, wherein the fourth sound-attenuating assembly is configured to provide minimal sound-attenuation to the neonatal user.

14. A method for using a customizable neonatal sound attenuation system comprising:

providing a neonatal sound attenuation system comprising

a headpiece configured to be worn by a neonatal user;

a first portion of the headpiece is extendably coupled to a third portion of the headpiece via a first slidable bar, wherein the third portion of the headpiece securely and slidably surrounds the first slidable bar having a compressible-expandable tip, wherein the third portion of the headpiece further comprises a first lip configured to frictionally prevent the compressible-expandable tip from moving beyond the first lip when a mature user pulls on the first portion of the headpiece without exertion, wherein the first portion of the headpiece is configured to securely position a first sound-attenuating earpiece against a first ear of the user;

a second portion of the headpiece is extendably coupled to a fourth portion of the headpiece via a second slidable bar, wherein the fourth portion of the headpiece securely and slidably surrounds the second slidable bar having a compressible-expandable tip, wherein the fourth portion of the headpiece further comprises a second lip configured to frictionally prevent the compressible-expandable tip from moving beyond the second lip when a mature user pulls on the second portion of the headpiece without exertion, wherein the second portion of the headpiece is configured to securely position the second sound-attenuating earpiece against the second ear of the user; and,

a first sound-attenuating earpiece assembly comprising removable attenuating layers for a first ear of the neonatal user; and,

a second sound-attenuating earpiece assembly comprising removable attenuating layers for the second ear of the neonatal user;

waiting until the neonatal user is at least 33 weeks gestational age;

peeling off at least one attenuating layer to reduce attenuation to a mid-level;

waiting until the neonatal user is at least full-term gestational age; and,

peeling off an additional layer to further reduce attenuation of sounds to below 4000 Hz in an average environment of the neonatal user.

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