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(54) Title: A DEVICE HAVING ROTATABLE LEGS (57) Abstract A device including a band (12) and legs (14) that are rotatable relative to the band (1). Each leg (14) includes a first leg end (18) and a second leg end (20). The first leg end (18) is rotatably coupled to the band (12) to allow the leg (14) to rotate relative to the band (12). The second leg end (20) is receptive to a hearing protector (101), whereby the device functions as a hearing protection device. Alternatively, the second leg end (20) is receptive to an electronic device (300), whereby the device functions as a headset. Rotating the legs (14) varies the distance between the hearing protectors (101) (or electronic devices (300)) mounted in the second leg ends (20). The device can accommodate head sizes ranging from the fifth percentile of women to the ninety-fifth percentile of men.		

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A DEVICE HAVING ROTATABLE LEGS

Field of the Invention:

The invention relates generally to hearing protection devices and in particular to a hearing protection device including rotatable legs for adjusting the position of hearing protectors.

5 Prior Art:

Hearing protectors fall generally into three categories, including protectors that cap the entrance to the ear canal; protectors which enter the ear canal and seal the ear canal prior to the bend in the ear canal (usually referred to simply as semi-insert devices); and protectors that enter the ear canal and take the bend in the ear canal (sometimes referred to as banded earplugs). Semi-insert hearing protectors generally protect similarly to earplugs, but usually to a lesser level. Semi-insert hearing protectors are also referred to as semi-aural hearing protectors. Semi-insert hearing protectors which enter the ear canal to a greater degree offer better protection but are somewhat less comfortable than those which simply cap the ear. Products which cap the ear have some of the attributes of both earplugs and earmuffs. Typically, they are used for intermittent noise exposures where lighter weight and improved low frequency

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attenuation are desirable. As used herein, "hearing protectors" refers generally to hearing protectors falling into one of the three categories described above.

FIGURE 14 is a front view of a conventional hearing protection device disclosed in U.S. Patent 4,461,290. The hearing protection device includes a U-shaped headband 1 having affixed to each of the opposed end portions 3 and 5 an inwardly directed ear obturating pod 2. A pair of balls 7 and 9 engage a socket formed in the pods 2 and attach the pods 2 to the headband 1. While well-suited for its intended purposes, the conventional headband 1 may have certain drawbacks and deficiencies. For example, the shape of the headband is such that when the pods 2 are mounted in the wearer's ears, portions of the headband 1 are close to or touching the wearer's head. This can be irritating and uncomfortable to the wearer. In addition, there is no mechanism for adjusting the headband to allow for varying head sizes. A wearer with a large head requires a large distance between the headband ends 3 and 5. Unfortunately, as the distance between the headband ends 3 and 5 increases, so does the tension in the headband 1. Accordingly, wearers with large heads may experience discomfort due to this high tension in the headband 1. In order to accommodate varying head sizes, the headband 1 must be manufactured in multiple sizes which increases manufacturing costs. Accordingly, there is a perceived need in the art for a hearing protection device that can comfortably fit a wide variety of head sizes.

Summary of the Invention:

The above-discussed and other drawbacks and deficiencies of the prior art are overcome or alleviated by the hearing protection device of the invention. The hearing protection device includes a frame having a band and a pair of leg supports. A pair of legs are rotatably coupled to the leg supports. Each leg has a first leg end rotatably coupled to a respective leg support and a second leg end for receiving a hearing protector. Each second end has a mating means (preferably an opening) for receiving a stem portion of the hearing protector. In an alternative embodiment, the frame of the hearing protection device includes a band portion and a pair of reverse curve portions

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integral with the band portion. The reverse curve portion has an oblique angle formed therein and reverse curve ends for receiving hearing protectors. An important feature of the alternative embodiment that as a result of the reverse curve portions, the hearing protectors at the ends of the band will not come in contact with a surface after having
5 been placed thereon; thereby leading to improved sanitary conditions since the hearing protectors will be less likely to be contaminated.

The hearing protector in accordance with this invention provides several important features and advantages relative to the prior art. For example, the rotatable legs allow the band to accommodate virtually any head size and provide the wearer with
10 both comfort and a variety of wearing positions.

The above-discussed features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following description and drawings.

15 Brief Description of the Drawings:

Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

FIGURE 1 is a front view of a frame of a hearing protection device in a first embodiment of the invention;

20 FIGURE 2 is a top view of the frame of FIGURE 1;

FIGURE 3 is a bottom view of the frame of FIGURE 1;

FIGURE 4 is a side view of the frame of FIGURE 1;

FIGURE 5 is a view taken along line 5-5 in FIGURE 1;

FIGURE 6 is a cross-sectional view of one end of a band shown in FIGURE 1;

25 FIGURE 7 is a cross-sectional view of a leg shown in FIGURE 1;

FIGURE 8 is a front view of the frame of FIGURE 1 fitted with a first type hearing protector;

FIGURE 9 is a front view of the frame of FIGURE 1 fitted with a second type of hearing protector;

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FIGURE 10 is a front view of the frame of FIGURE 1 fitted with a third type of hearing protector;

FIGURES 11A-11B are a cross-sectional views of a hearing protectors for use with the hearing protection device of FIGURE 1;

FIGURE 12 is a front view of a frame of a hearing protection device in a second embodiment of the invention;

FIGURE 13A is a view taken along line 13A-13A of FIGURE 12;

FIGURES 13B-13C are side views of the frame of FIGURE 12 placed on a surface;

FIGURE 14 is a front view of a conventional hearing protection device;

FIGURES 15A-C are perspective views depicting the hearing protective device of this invention in three different positions on a wearer's head;

FIGURES 16A-16C are front views of the frame fitted with a variety of hearing protectors;

FIGURE 17 is a cross-sectional view of a frequency attenuating hearing protector for use with the present invention;

FIGURE 18 is an exploded view of an alternative system for mounting a hearing protector to the frame;

FIGURE 19 is a partial cross-sectional view of a hearing protector mounted to the frame using the system of FIGURE 18;

FIGURE 20 is a front view of the frame of FIGURE 1 fitted with an electronic device;

FIGURE 21 is a cross sectional view of a leg of FIGURE 20; and

FIGURE 22 is a front view of the frame of FIGURE 12 fitted with an electronic device.

Detailed Description of the Invention:

FIGURE 1 is a front view of the frame of the hearing protection device in a first embodiment of the invention. The frame is shown generally at 10. The frame 10

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includes a band 12 and a pair of legs shown generally at 14. The band 12 is generally U-shaped and is made from a resilient, flexible material such as plastic. The band 12 has two leg supports 16, each of which forms one half of a swivel or rotating joint between the band 12 and the leg 14. The leg support 16 is integral with the band 12 and in an exemplary embodiment is a spherical segment. The leg 14 includes a first leg end 18 which is integral with leg 14 and, in an exemplary embodiment, is a spherical segment. The flat faces of the first leg end 18 and the leg support 16 are placed opposite each other to form a swivel joint. The details of the swivel joint are described below with reference to FIGURES 6 and 7. The swivel joint allows the first leg end 18 to rotate relative to the leg support 16 thereby allowing the leg 14 to rotate relative to the band 12. The band 12 lies substantially in a plane and as the legs 14 are rotated, a plurality of angles are defined between the leg 14 and the plane. It is understood that the band 12 and leg supports 16 need not lie in the same plane as shown in FIGURE 4. Indeed, as shown in FIGURES 15 A, B and C (and discussed hereafter) the leg supports 16 may lie in a plane different than the band 12 and each leg 14 will rotate through a plurality of angles between the leg 14 and the plane of the leg supports 16. The leg 14 includes a second leg end 20 for receiving a hearing protector 100 (shown in FIGURES 11A and 11B). In an exemplary embodiment, the second leg end 20 is a spherical segment. It will be appreciated that second leg end 20 may comprise any other desired functional shape such as ovular, triangular, etc. The outer dimension of the second leg end 20 is preferably equal to the average concha bowl opening so that the second leg end 20 cannot be inserted into the ear canal but is preferably insertable (and rests in) the concha bowl (so that the earplug attached to end 20 is permitted to freely articulate in the ear canal). FIGURES 2-5 are various views of the frame of the hearing protection device of FIGURE 1 and are self-explanatory.

FIGURE 6 is a cross-sectional view of the leg support 16 and FIGURE 7 is a cross-sectional view of the leg 14. The leg 14 includes first leg end 18, second leg end 20 and leg body 22. The first leg end 18 has a planar surface 28 and a post 24 substantially perpendicular to the planar surface 28. The post 24 has a neck region 26

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where the diameter of the post 24 is smaller than the diameter of the end of the post 24 away from the planar surface 28. The leg support 16 includes a hole 32 formed therethrough for receiving the post 24. The neck 26 snap-lockedly engages a ridge 30 formed in the hole 32. The ridge 30 has an inner diameter that is smaller than the inner diameter of the hole 32. That is, the ridge 30 extends away from the inner wall of the hole 32. The interference fit between the neck 26 and the ridge 30 holds the leg 14 to the band 12 while allowing the post 24 to rotate within the hole 32. Because the band 12 and the leg 14 are made from a resilient material, such as plastic, the interference fit between the neck 26 and the ridge 30 can be defeated by pulling the post 24 out of the hole 32 if necessary.

The planar surface 28 of the first leg end 18 is at an oblique angle relative to the major axis of the leg body 22. This causes the leg 14 to be angled towards the interior of the U-shaped band 12 as shown in FIGURE 1. This results in the second leg ends 20, which hold the hearing protectors as shown in FIGURES 8-10, being close to the wearer's head and the band 12 being away from the wearer's head. Because the band 12 is positioned away from the wearer's head, it is less likely that the band 12 will contact and irritate the wearer. Thus, the comfort of the hearing protection device is improved over the prior art.

In addition, as the legs 14 are rotated, the distance between the second leg ends 20 varies. Therefore, the tension on the band 12 can remain approximately the same for varying head sizes. In the device shown in FIGURE 14, the only way to adjust the distance between the hearing protectors 2 is to flex the band 1. This results in increasing tension as the wearer's head size increases. The frame 10 shown in FIGURE 1 allows the distance between the hearing protectors to be adjusted without flexing the band 12. Thus, wearers with different head sizes can achieve approximately the same tension in the band 12. In this way, the frame 10 can comfortably accommodate head sizes ranging from, for example, the 5th percentile of women to the 95th percentile of men. The legs 14 may be rotated while the hearing protection device is being worn to allow modification of the fit without removing the hearing protection device. In

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addition, the hearing protection device can be worn with the band 12 under the chin (as shown in FIGURE 15A), over the top of the head (as shown in FIGURE 15B), or behind the back of the head based on the wearer's preference (as shown in FIGURE 15C).

5 The second leg end 20 includes a hole 34 formed therein for receiving various hearing protectors 101-103 as shown in FIGURES 8-10. As mentioned above, the hearing protectors may be protectors that cap the entrance to the ear canal; protectors which enter the ear canal and seal the ear canal prior to the bend in the ear canal; or protectors that enter the ear canal and take the bend in the ear canal. FIGURES 16A-
10 16C illustrate additional hearing protectors 110-112 that may be mounted to the second leg end 20. FIGURE 17 is a cross-sectional view of a hearing protector 113 that may be mounted to the second leg end 20. The hearing protector 113 attenuates sound over a wide frequency range uniformly. Additional details of the hearing protector in FIGURE
15 17 are provided in U.S. Patent 5,113,967, the full contents of which are incorporated herein by reference. The hearing protection device of the present invention provides a comfortable fit regardless of the size or shape of the hearing protectors mounted in the second leg ends 20.

As shown in FIGURES 11A and 11B, a hearing protector 100 comprises a foam portion 106 coupled to a stem 104. The hearing protector in FIGURE 11A is a
20 conventional hearing protector in which the foam portion 106 is glued to the stem 104. The hearing protector shown in FIGURE 11B is an improved design in which the stem 104 is made from a porous material and the foam 106 interpenetrates the pores in the stem 104 to form a mechanical bond. This hearing protector shown in FIGURE 11B is described in additional detail below.

25 In an exemplary embodiment, the foam portion 106 is a dynamically stiff foam. A suitable dynamically stiff foam is described in commonly assigned U.S. Patent 5,420,381, the contents of which are incorporated herein by reference. Alternatively, the foam portion 106 may comprise any other conventional earplug foam material such as the foam disclosed in U.S. Reissue Patent 29,487, all of the contents of which are

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also incorporated herein by reference. The stem 104 is placed in the hole 34. The use of hole 34 and stem mounted hearing protector 100 allows the wearer to change hearing protectors easily. Hole 34 includes a tapered area 36 (shown in FIGURE 7) that eases placement of the hearing protector 100 in hole 34. The stem 104 is preferably flexible so that it flexes as the wearer moves their head. A non-pliable stem may cause discomfort as the wearer moves their head. By using a flexible stem 104, an extra degree of freedom is introduced into the hearing protection device. The foam portion 106 moves along with the wearer's head and provides additional comfort.

To provide a tight fit in the hole 34, the stem 104 should be made from a compressible, resilient material and have a diameter slightly larger than the diameter of hole 34. When the stem 104 is positioned in hole 34, the stem 104 will press against the wall of hole 34 and provide a friction fit. The hole 34 need not be formed completely through the second leg end 20 for the stem 104 to be securely mounted to the second leg end 20. However, if the hole 34 is formed all the way through the second leg end 20, the stem 104 can be pushed out of the second leg end 20 to aid removal of the hearing protector 100 if necessary.

As previously mentioned with reference to FIGURE 11B, in an exemplary embodiment, the stem 104 is made from a porous material, such as that disclosed in the U.S. Patent Application filed contemporaneously herewith entitled "Hearing Protective Device Comprising a Foam and a Porous Component, and Method of Manufacturing Thereof" which is incorporated herein by reference. The porous material is both flexible and compressible. The porous material is preferably a polymer or combination of polymers in the form of small particles of one or more size ranges bonded in such a way as to leave voids or pores within the material. The pores may be of varying sizes. Preferably, the pore volume is in the range from about ten percent to about ninety percent of the total volume, with the most preferred pore volume being in the range from about thirty to about sixty percent of the total volume. A particularly preferred porous component is Swab-002 made from INTERFLO®, available from Interflo

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Technologies, Brooklyn, NY. The foam 106 interpenetrates the pores in the porous stem 104 to mechanically bond the foam portion 106 to the stem 104.

It will be appreciated that an ear protective device may be mounted to the ends of legs 14 in any suitable manner in addition to the hole 34 with mating stem 104 approach shown in the preferred embodiments. For example, a foam or other earplug device could be attached using a ball and socket configuration as in prior art FIGURE 14, or any other approach may be used whereby the earplug is attached to leg 14.

FIGURE 12 is a front view of an alternative frame for a hearing protection device. The frame is shown generally at 50 and includes a band portion 52 and reverse curve portions 54. The reverse curve portions are integral with the band portion 52. The center of gravity 56 is located within the band portion 52. The reverse curve portions 52 each includes a reverse curve end 20' which is similar to the leg second ends 20 described above with reference to FIGURES 1-7. The reverse curve portion 54 includes an oblique angle α . The angle α directs the reverse curve ends 20' of the reverse curve portions 54 towards the wearer's head. This provides additional space between the band 52 and the wearer's head which reduces the likelihood that the band 52 will contact or irritate the wearer.

FIGURE 13A is a view of the frame 50 taken along line 13A-13A of FIGURE 12. The reverse curve ends 20' of the reverse curve portions 54 receive the stem 104 of the hearing protector 100 as shown in FIGURE 11B. The use of a hearing protector 100 having a flexible stem 104 is also advantageous to the fit of the hearing protection device shown in FIGURE 12. As described above, this allows the foam portion 106 of the hearing protector 100 to move relative to the reverse curve end 20', and provides a more comfortable fit.

The reverse curve portions 54, along with the location of the center of gravity 56 within the band 52, reduce the likelihood that the hearing protectors mounted in reverse curve ends 20' will become contaminated when the frame 50 is placed on a surface. As shown in FIGURES 13B and 13C, when the frame 50 is placed on a surface in either orientation, the reverse curve ends 20' are positioned above the surface. This reduces

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the likelihood that the hearing protectors mounted in the reverse curve ends 20' will become contaminated and thereby leads to improved sanitary conditions.

FIGURE 18 is an exploded view of an alternative system for mounting a hearing protector to the frame. A shaft 210 includes a first ball 212 and a second ball 216 joined by a shaft neck 218. The first ball 212 engages a socket 202 (shown in FIGURE 19) formed in the frame end 200. The socket 202 may be formed in either the second leg end 20 shown in FIGURE 1 or the reverse curve end 20' shown in FIGURE 12. The second ball 216 engages a hearing protector 220. The hearing protector 220 shown in FIGURE 18 is a multiple flange earplug similar to the earplug described in U.S. Patent 4,867,149, the full contents of which are incorporated herein by reference. It is understood, however, that any hearing protector may be configured for use with shaft 210.

FIGURE 19 is a partial cross sectional view of the hearing protector 220 mounted to the frame end 200 through shaft 210. The first ball 212 is placed within socket 202. The socket 202 includes a lip 204 that extends into the socket 202 to reduce the diameter of the opening of the socket 202. The outer diameter of the first ball 212 is slightly smaller than the inner diameter of the socket 202. The frame end 200 is made from a resilient material (e.g., plastic) and the lip 204 flexes to allow the first ball 212 to be placed within the socket 202. The lip 204 then returns to its original position once the first ball 212 is placed in the socket 202. The interference fit between the lip 204 and the first ball 212 retains the shaft 210 in the frame end 200. As previously mentioned, either the second leg end 20 or the reverse curve end 20' may include the socket 202 and lip 204. The hearing protector 220 is then placed on the shaft 210 and retained on the shaft by the interference fit between the second ball 216 and the hearing protector 220.

The mounting system of FIGURES 18 and 19 allows the hearing protector 220 to rotate way from a center line of the socket 202 by an angle α . FIGURE 19 illustrates the hearing protector 220 in three different positions. In an exemplary embodiment, α equals 27° . The use of the ball and socket mounting system shown in FIGURES 18

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and 19 introduces additional degrees of freedom in the hearing protection device. This allows the wearer to finely adjust the position of the hearing protectors for a more comfortable fit.

The frame 10 shown in FIGURE 1 has applications beyond hearing protection. FIGURE 20 is a front view of the frame 10 fitted with an electronic device 300. The frame 10 may include wire clips 304 formed on the exterior of the frame 10 to retain the wire 302 near the frame 10 and prevent the wire 302 from becoming tangled. The wire 302 may be comprised of a plurality of individual, insulated wires depending upon the requirements of the electronic device 300. FIGURE 21 is a cross-sectional view of the leg of the frame shown in FIGURE 20. The electronic device 300 is connected to a mounting tube 306. The mounting tube 306 fits within the opening formed in the second end 20 of the leg. The wire 302 is run through the opening in the second end 20 and through the mounting tube 306 to connect to the electronic device 300. Because the frame 10 provides a comfortable fit for a variety of head sizes, mounting electronic devices 300 to the frame 10 is ideal for occupations which require long periods of time wearing a headset (e.g. operator, telephone marketing, etc.).

The electronic devices 300 includes electronic components 320 that may vary depending upon the particular application. For example, the electronic components 320 may include a speaker for providing audio to the wearer for recreational purposes or for communications. The electronic components 320 may also comprise active noise cancellation circuitry which detects ambient noise and emits a signal to cancel the ambient noise. Other electronic components 320 may be attached to the frame 10 and the above embodiments should be considered exemplary. In addition, the shape of the exterior of the electronic device 300 is not limited to that shown in FIGURE 20. Any of the hearing protector profiles described herein, or other hearing protector configurations not shown or described herein, may include the electronic components 320.

FIGURE 22 is a front view of the frame 50 shown in FIGURE 12 fitted with electronic devices 300. The mounting of the electronic devices 300 to the reverse curve

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ends 20' of frame 50 is the same as shown in FIGURE 21. Wire clips 304 may be included on the frame 50 to hold the wire 302 near the frame 50.

The present invention provides a hearing protection device that comfortably fits head sizes ranging from the 5th percentile of women to the 95th percentile of men.

5 This is accomplished through legs having a first end rotatably coupled to a band and a second end for receiving hearing protectors. As the legs are rotated, the distance between the hearing protectors varies. This allows wearers with differing head sizes to achieve the substantially the same band tension. To increase comfort, the hearing protector may be mounted on a flexible stem which allows the hearing protector to
10 move relative to the leg. Alternatively, a ball and socket mounting system may be used to allow the wearer to finely adjust the position of the hearing protectors relative to the frame.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit
15 and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.

What is claimed is:

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CLAIM 1. A frame for a hearing protection device, said frame comprising:

a band having a pair of ends; and

a pair of legs, each of said legs having a first end rotatably coupled to one of said band ends and a second end for receiving a hearing protector, said legs being rotatable with respect to said band while said hearing protection device is worn.

5

CLAIM 2 The frame of claim 1 wherein said band ends each includes a first hole formed therein and each of said first ends includes a post for engaging said first hole to rotatably couple said first end to said band end.

CLAIM 3. The frame of claim 2 wherein said post comprises a neck having a diameter less than the diameter at a tip of said post, and said first hole includes a ridge having a diameter smaller than the diameter of said first hole, wherein said ridge engages said neck when said post is placed within said first hole.

CLAIM 4. The frame of claim 1 wherein each of said legs further comprises a leg body connecting said first end and said second end, said first end further comprising a planar surface at an oblique angle relative to said leg body.

CLAIM 5. The frame of claim 4 wherein each of said band ends comprises a first hole formed therein and each of said first ends includes a post for engaging said first hole, said post extending away from and perpendicular to said planar surface.

CLAIM 6. The frame of claim 5 wherein said post comprises a neck having a diameter less than the diameter at a tip of said post, and said first hole comprises a ridge having a diameter smaller than the diameter of said first hole, wherein said ridge engages said neck when said post is placed within said first hole.

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CLAIM 7. The frame of claim 1 wherein the hearing protector includes a stem and said second end has a second hole formed therein for receiving the stem.

CLAIM 8. The frame of claim 7 wherein said second hole is formed completely through said second end.

CLAIM 9. The frame of claim 1 wherein said band lies substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 10. The frame of claim 1 wherein said band ends lie substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 11. The frame of claim 1 wherein each of said second ends includes a socket formed therein.

CLAIM 12. A hearing protection device comprising:

a band having a pair of ends;

a pair of legs, each of said legs having a first end rotatably coupled to one of said band ends and a second end for receiving a hearing protector, said legs being
5 rotatable with respect to said band while said hearing protection device is worn; and

a hearing protector coupled to the second end of each leg.

CLAIM 13. The hearing protection device of claim 12, wherein said hearing protector caps an entrance to a wearer's ear.

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CLAIM 14. The hearing protection device of claim 12, wherein said hearing protector is a semi-insert device.

CLAIM 15. The hearing protection device of claim 12, wherein said hearing protector enters an ear canal and takes a bend in the ear canal.

CLAIM 16. The hearing protection device of claim 12, wherein said hearing protector includes a stem and a foam portion connected to said stem.

CLAIM 17. The hearing protection device of claim 16, wherein said stem is made from a porous material.

CLAIM 18. The hearing protection device of claim 17, wherein said stem includes pores and said foam portion interpenetrates said pores to mechanically bond the foam portion to said stem.

CLAIM 19. The hearing protection device of claim 12 wherein said band lies substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 20. The hearing protection device of claim 12 wherein said band ends lie substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 21. The hearing protection device of claim 12 wherein said hearing protector includes a stem and each of said second ends includes a hole for receiving said stem.

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CLAIM 22. The hearing protection device of claim 12 further comprising a shaft having a ball on a first shaft end and said hearing protector coupled to a second shaft end, wherein said second end includes a socket for receiving said ball.

CLAIM 23. A hearing protection device comprising:

a band having a pair of ends, each of said ends having an opening formed therein; and

5 a hearing protector mounted to each of said ends, said hearing protector including a stem for insertion in said opening.

CLAIM 24. The hearing protection device of claim 23, wherein said hearing protector caps an entrance to a wearer's ear.

CLAIM 25. The hearing protection device of claim 23, wherein said hearing protector is a semi-insert device.

CLAIM 26. The hearing protection device of claim 23, wherein said hearing protector enters an ear canal and takes a bend in the ear canal.

CLAIM 27. The hearing protection device of claim 23, wherein said hearing protector includes a foam portion connected to said stem.

CLAIM 28. The hearing protection device of claim 27, wherein said stem is made from a porous material.

CLAIM 29. The hearing protection device of claim 28, wherein said stem includes pores and said foam portion interpenetrates said pores to mechanically bond the foam portion to said stem.

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CLAIM 30. A hearing protection device comprising:

a band having a pair of ends, each of said ends having a socket formed therein;
a shaft having a ball formed on a first end for engaging said socket; and
a hearing protector mounted to a second end of said shaft.

CLAIM 31. The hearing protection device of claim 23, wherein said hearing protector caps an entrance to a wearer's ear.

CLAIM 32. The hearing protection device of claim 23, wherein said hearing protector is a semi-insert device.

CLAIM 33. The hearing protection device of claim 23, wherein said hearing protector enters an ear canal and takes a bend in the ear canal.

CLAIM 34. A frame for a hearing protection device, said frame comprising:

a band; and

a pair of reverse curve portions integral with said band, said reverse curve portions each including a reverse curve end for receiving a hearing protector.

CLAIM 35. The frame of 34, wherein each of said reverse curve portions has an oblique angle formed therein.

CLAIM 36. The frame of 34, wherein the hearing protector includes a stem and each of said reverse curve ends includes an opening for receiving the stem.

CLAIM 37. The frame of claim 34 wherein each of said reverse curve ends includes a socket formed therein.

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CLAIM 38. A hearing protection device comprising:

a band;

a pair of reverse curve portions integral with said band, said reverse curve portions each including a reverse curve end; and

5 a hearing protector coupled to each reverse curve end.

CLAIM 39. The hearing protection device of 38, wherein each of said reverse curve portions has an oblique angle formed therein.

CLAIM 40. The hearing protection device of claim 38, wherein said hearing protector caps an entrance to a wearer's ear.

CLAIM 41. The hearing protection device of claim 38, wherein said hearing protector is a semi-insert device.

CLAIM 42. The hearing protection device of claim 38, wherein said hearing protector enters an ear canal and takes a bend in the ear canal.

CLAIM 43. The hearing protection device of claim 38, wherein said hearing protector includes a stem and a foam portion connected to said stem.

CLAIM 44. The hearing protection device of claim 43, wherein said stem is made from a porous material.

CLAIM 45. The hearing protection device of claim 44, wherein said stem includes pores and said foam portion interpenetrates said pores to mechanically bond the foam portion to said stem.

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CLAIM 46. The hearing protection device of claim 38 wherein said hearing protector includes a stem and each of said second ends includes a hole for receiving said stem.

CLAIM 47. The hearing protection device of claim 38 further comprising a shaft having a ball on one end and said hearing protector coupled to the other end, wherein said second end includes a socket for receiving said ball.

CLAIM 48. A frame for a hearing protection device, said frame comprising:

a band having a pair of ends; and

a pair of legs, each of said legs having a first end rotatably coupled to one of said band ends and a second end for receiving a hearing protector;

5 wherein said band lies substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 49. A headset comprising:

a band having a pair of ends; and

a pair of legs, each of said legs having a first end rotatably coupled to one of said band ends and a second end, said legs being rotatable with respect to said band while said hearing protection device is worn; and

5 an electronic device coupled to at least one of said second ends.

CLAIM 50. The headset of claim 49 wherein said band ends each includes a first hole formed therein and each of said first ends includes a post for engaging said first hole to rotatably couple said first end to said band end.

CLAIM 51. The headset of claim 50 wherein said post comprises a neck having a diameter less than the diameter at a tip of said post, and said first hole includes a ridge having a diameter smaller than the diameter of said first hole, wherein said ridge engages said neck when said post is placed within said first hole.

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CLAIM 52. The headset of claim 49 wherein each of said legs further comprises a leg body connecting said first end and said second end, said first end further comprising a planar surface at an oblique angle relative to said leg body.

CLAIM 53. The headset of claim 52 wherein each of said band ends comprises a first hole formed therein and each of said first ends includes a post for engaging said first hole, said post extending away from and perpendicular to said planar surface.

CLAIM 54. The headset of claim 53 wherein said post comprises a neck having a diameter less than the diameter at a tip of said post, and said first hole comprises a ridge having a diameter smaller than the diameter of said first hole, wherein said ridge engages said neck when said post is placed within said first hole.

CLAIM 55. The headset of claim 49 further comprising a mounting tube connected to the electronic device, wherein said second end has a second hole formed therein for receiving the mounting tube.

CLAIM 56. The headset of claim 55 wherein said second hole is formed completely through said second end.

CLAIM 57. The headset of claim 49 wherein said band lies substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

CLAIM 58. The headset of claim 49 wherein said band ends lie substantially in a plane and an angle exists between said each of said legs and said plane, said angle varying as said leg is rotated.

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CLAIM 59. The headset of claim 49 wherein a wire is connected to said electronic device and further comprising clips for holding the wire.

CLAIM 60. The headset of claim 59 wherein said clips are formed on said legs.

CLAIM 61. The headset of claim 59 wherein said clips are formed on said band.

CLAIM 62. The headset of claim 49 wherein said electronic device comprises a speaker for providing audio to the wearer.

CLAIM 63. The headset of claim 49 wherein said electronic device comprises noise cancellation circuitry.

CLAIM 64. A headset comprising:

a band;

a pair of reverse curve portions integral with said band, said reverse curve portions each including a reverse curve end: and

5 at least one electronic device mounted to one of said reverse curve ends.

CLAIM 65. The headset of claim 64 wherein each of said reverse curve portions has an oblique angle formed therein.

CLAIM 66. The headset of claim 64 further comprising a mounting tube connected to the electronic device, wherein said reverse curve end has a hole formed therein for receiving the mounting tube.

CLAIM 67. The headset of claim 64 wherein a wire is connected to said electronic device and further comprising clips for holding the wire.

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CLAIM 68. The headset of claim 67 wherein said clips are formed on said reverse curve portions.

CLAIM 69. The headset of claim 67 wherein said clips are formed on said band.

CLAIM 70. The headset of claim 64 wherein said electronic device comprises a speaker for providing audio to the wearer.

CLAIM 71. The headset of claim 64 wherein said electronic device comprises noise cancellation circuitry.

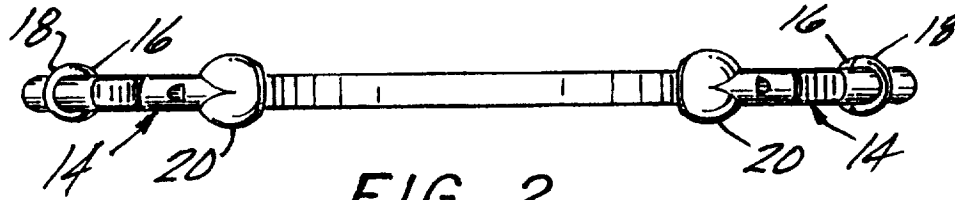


FIG. 2

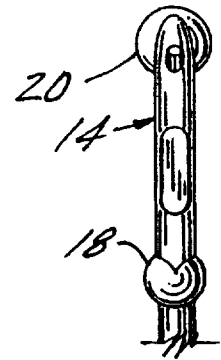


FIG. 5

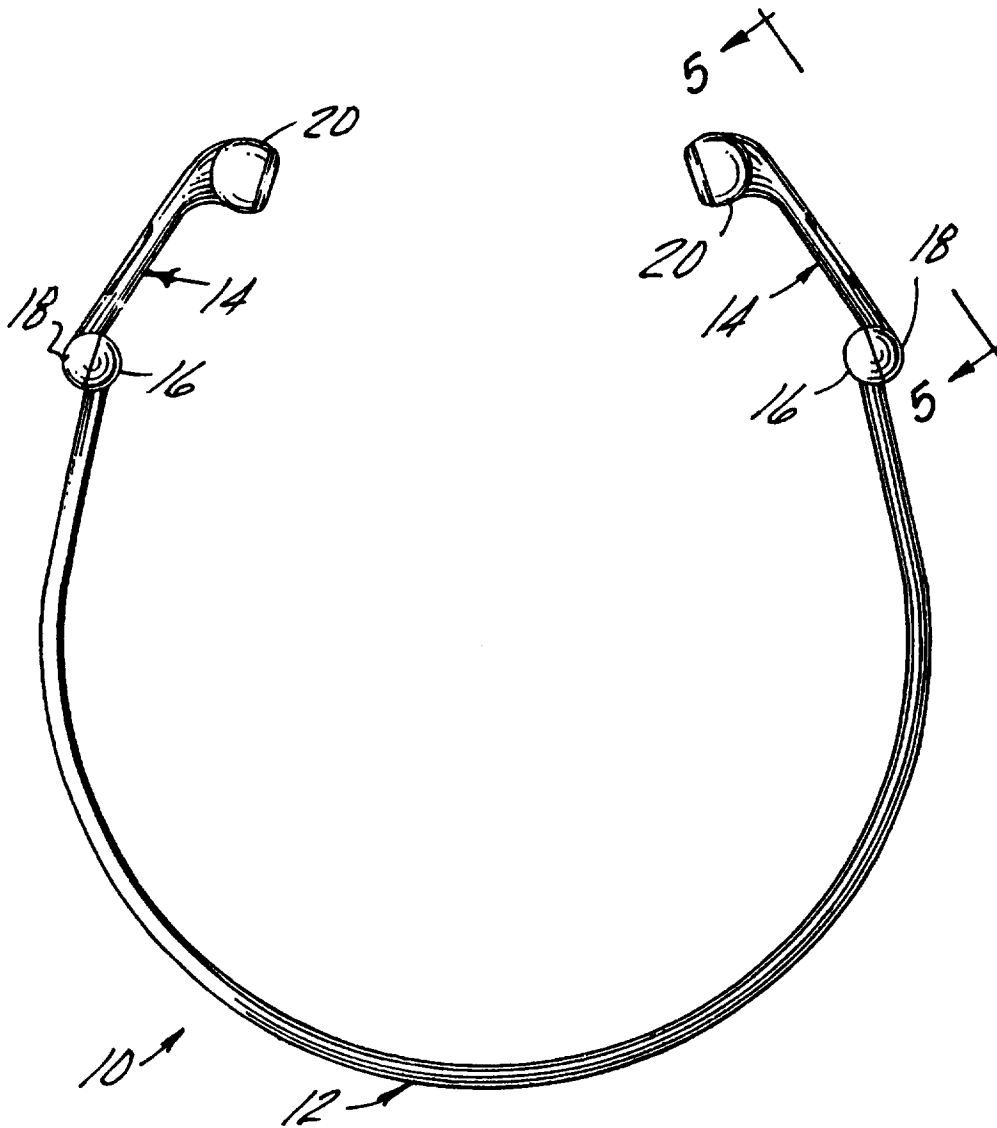


FIG. 1

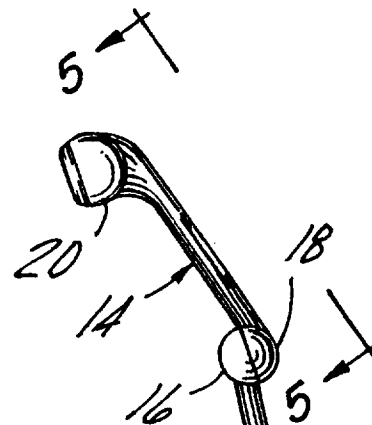


FIG. 3

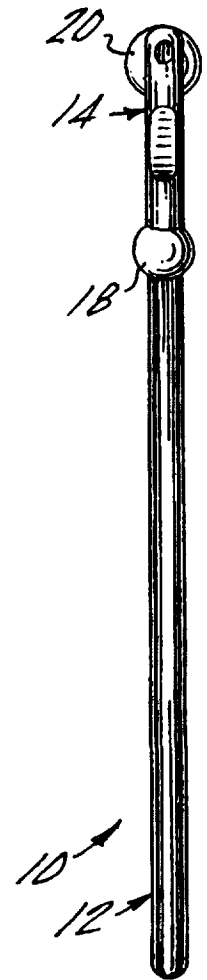
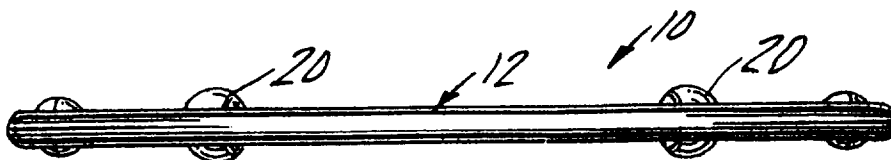


FIG. 4



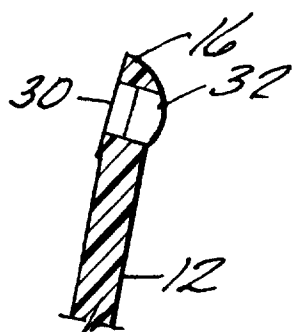


FIG. 6

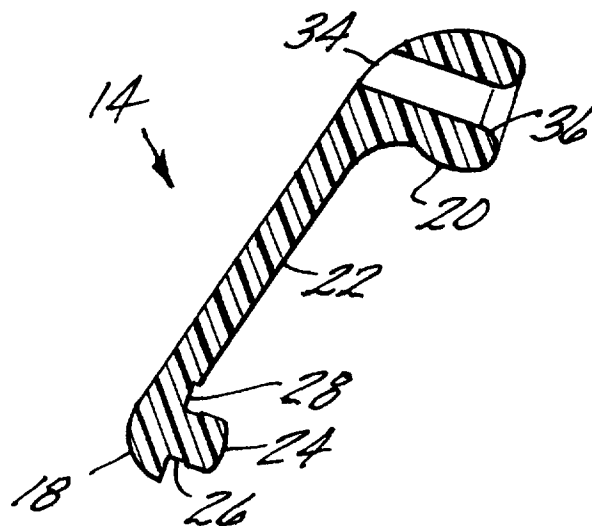


FIG. 7

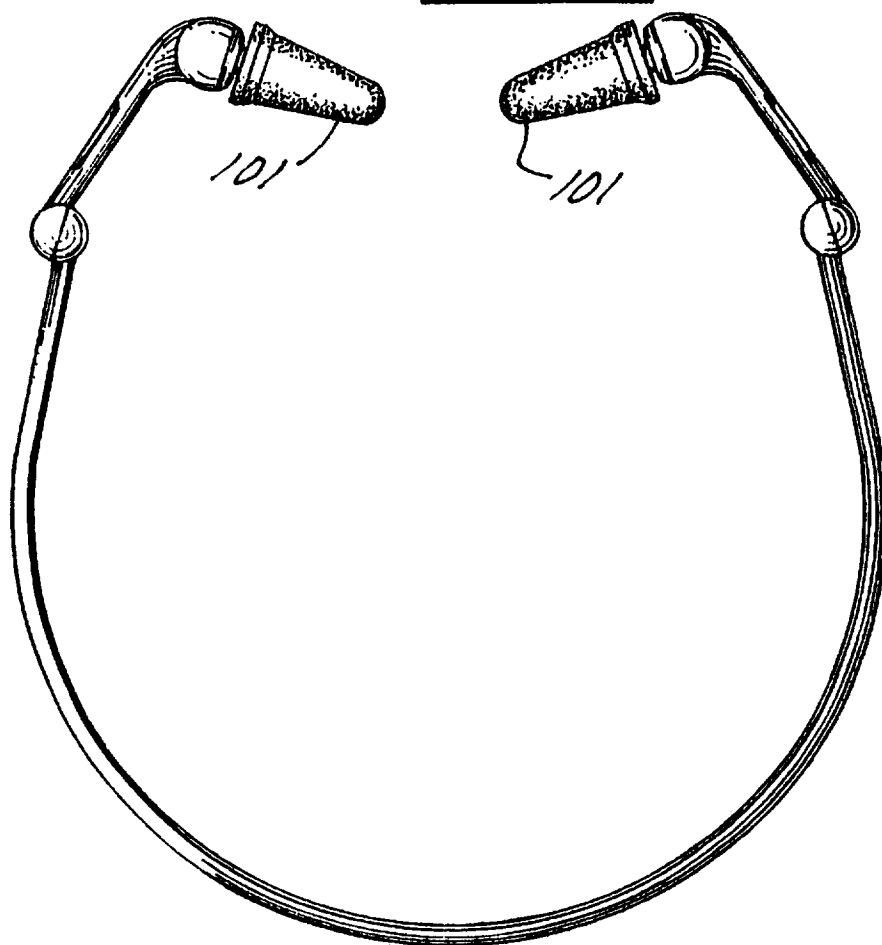


FIG. 8

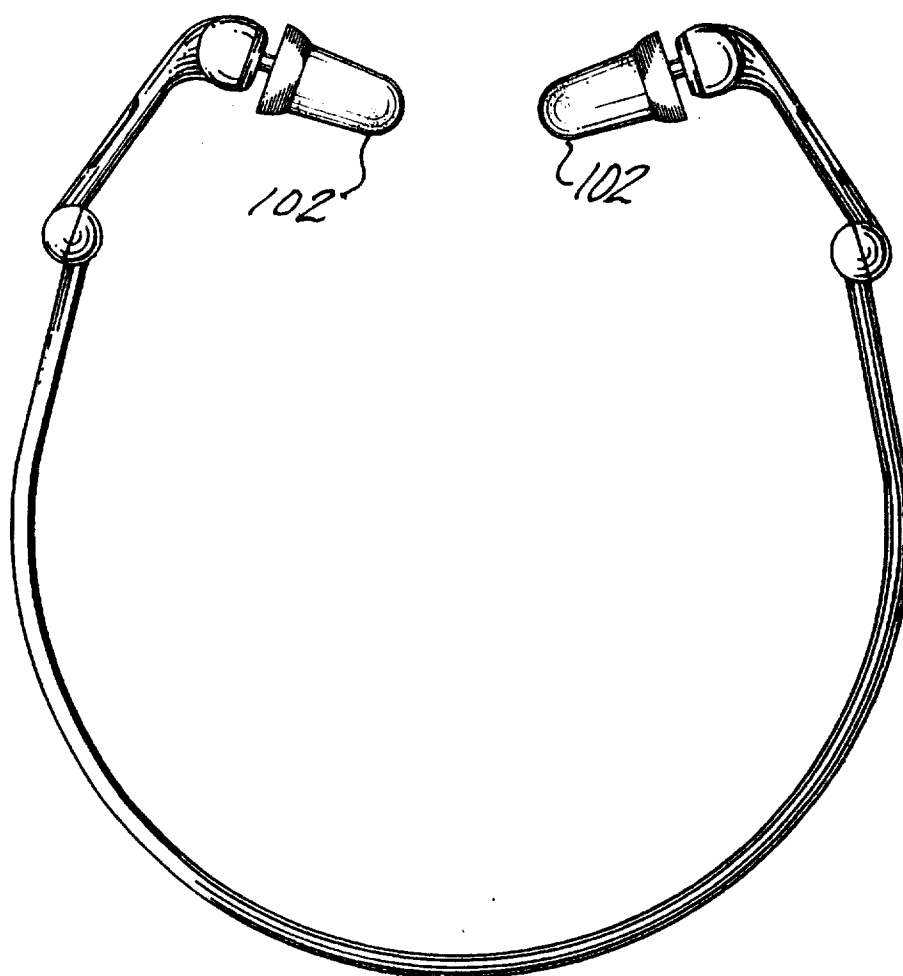


FIG. 9

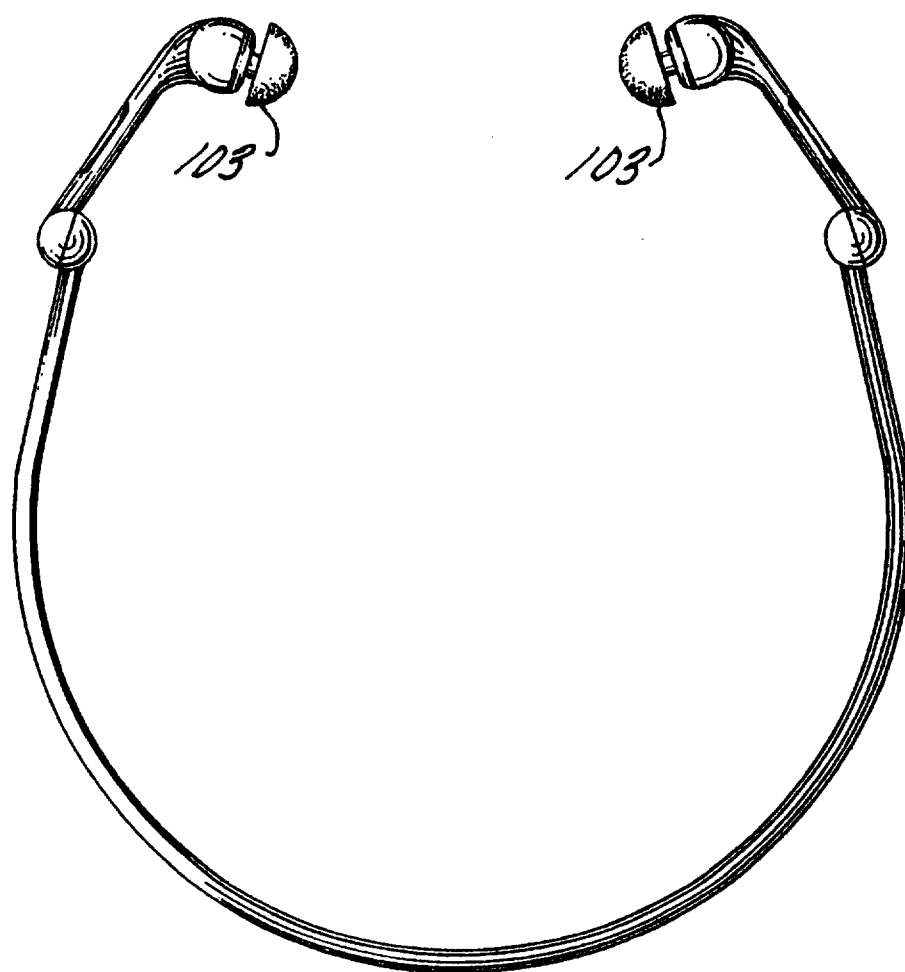
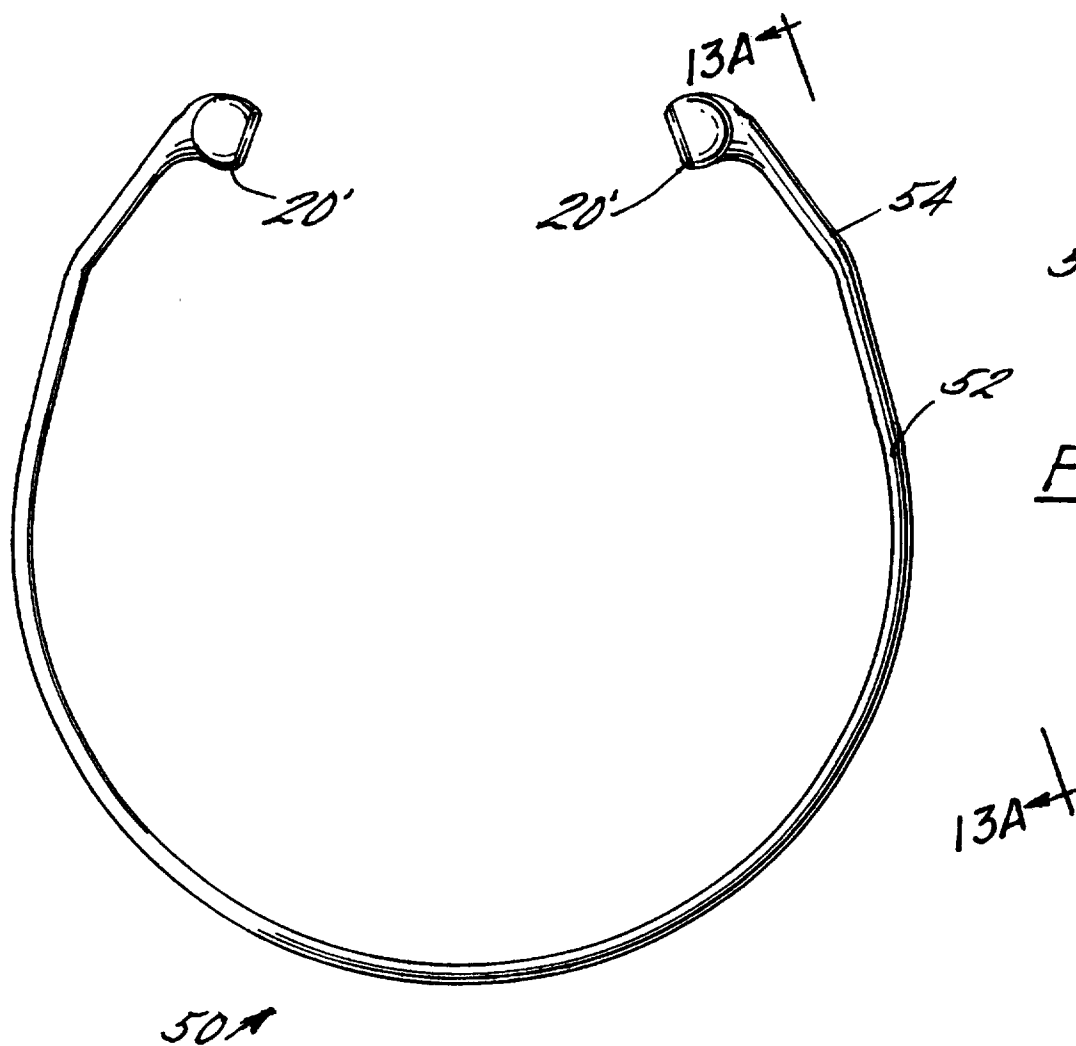
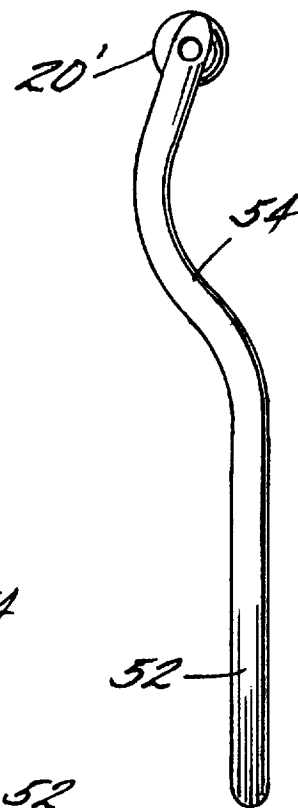
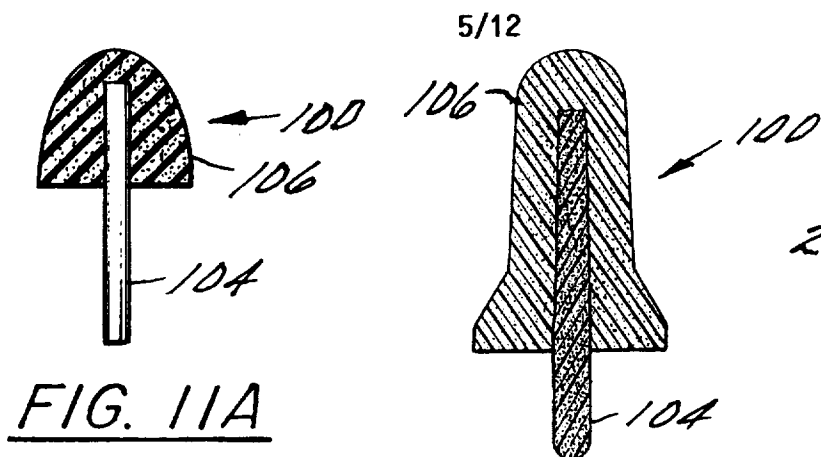


FIG. 10



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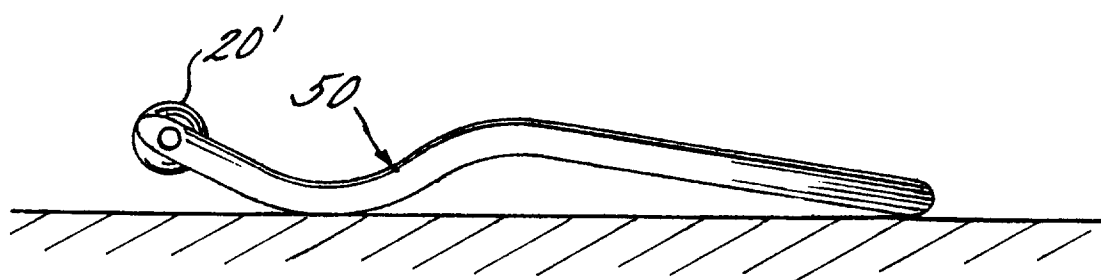


FIG. 13B

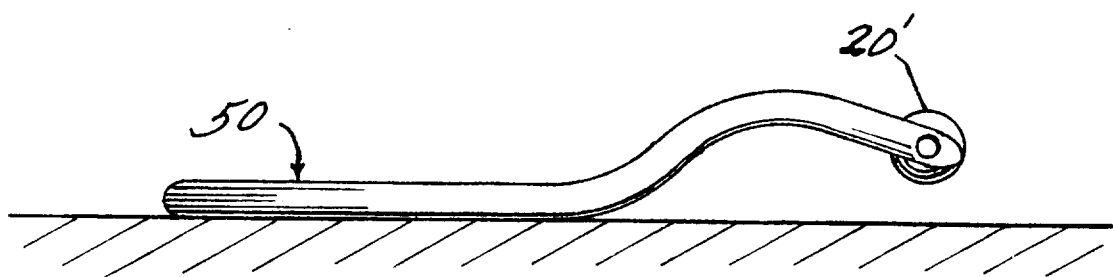


FIG. 13C

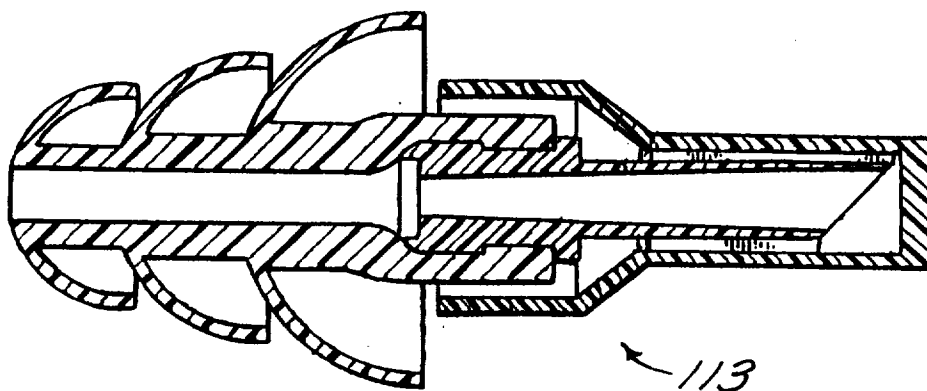


FIG. 17

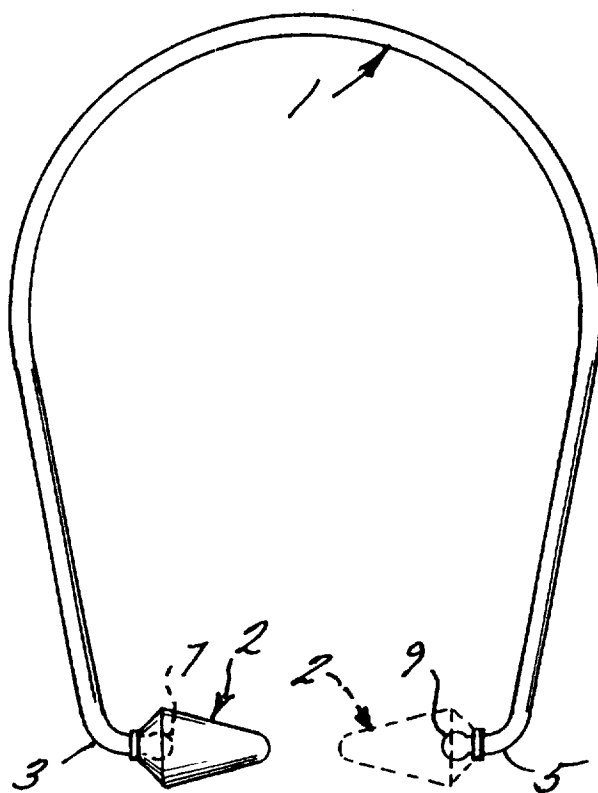


FIG. 14
(PRIOR ART)

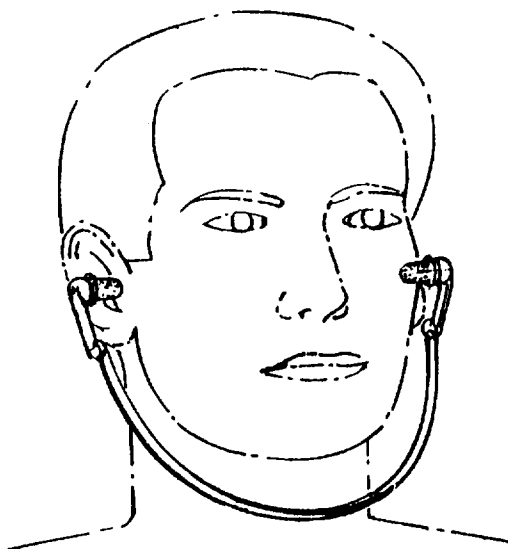


FIG. 15A

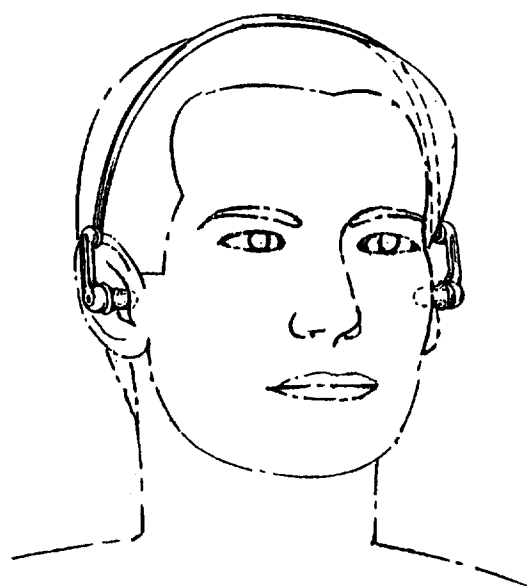


FIG. 15B

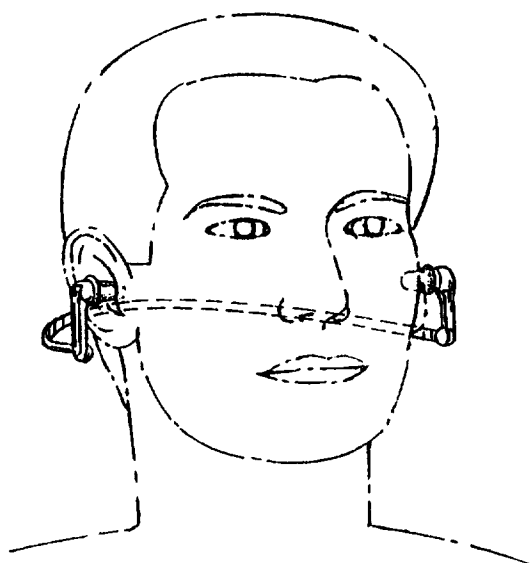


FIG. 15C

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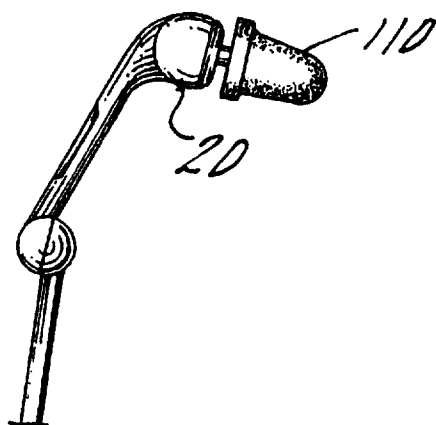


FIG. 16A

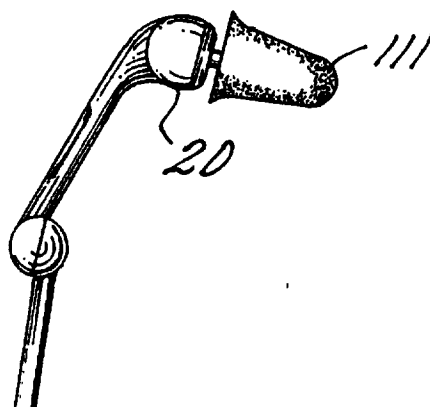


FIG. 16B

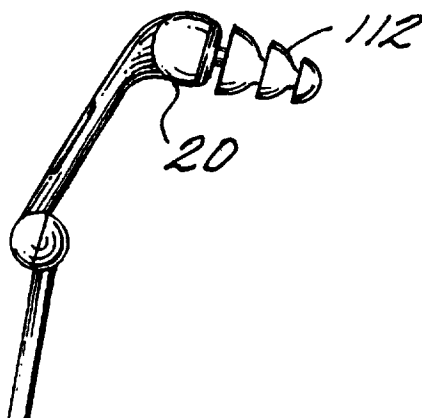
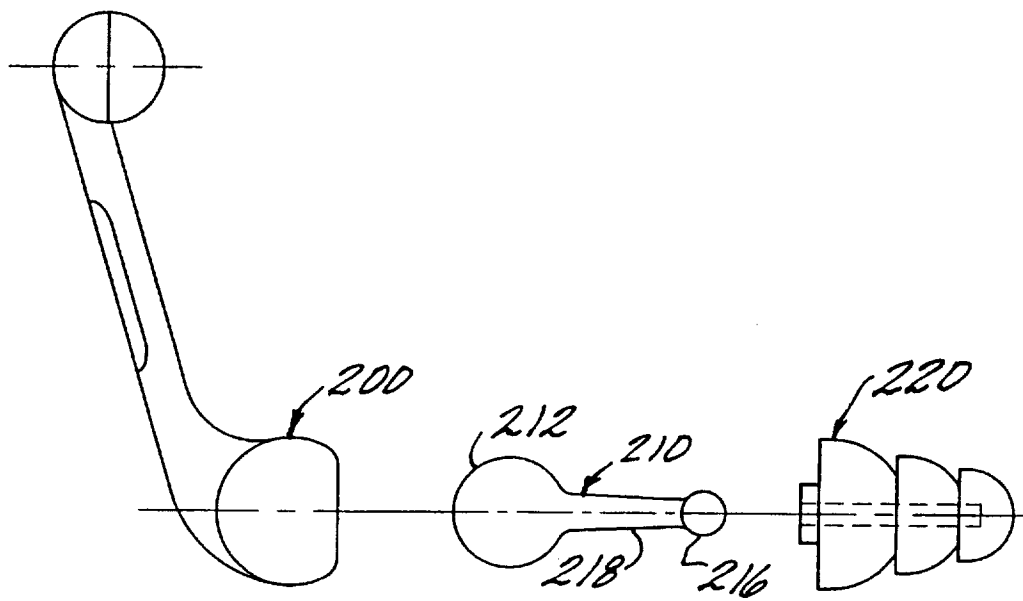
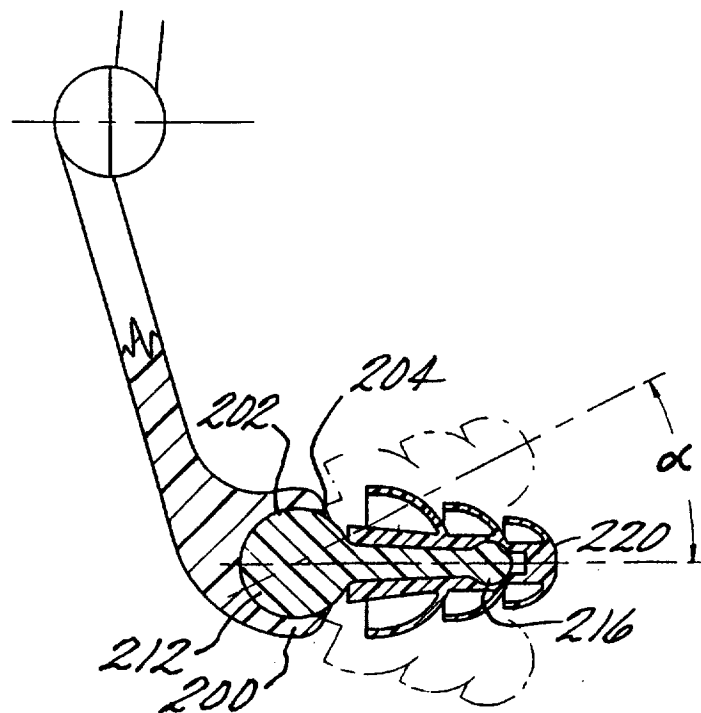
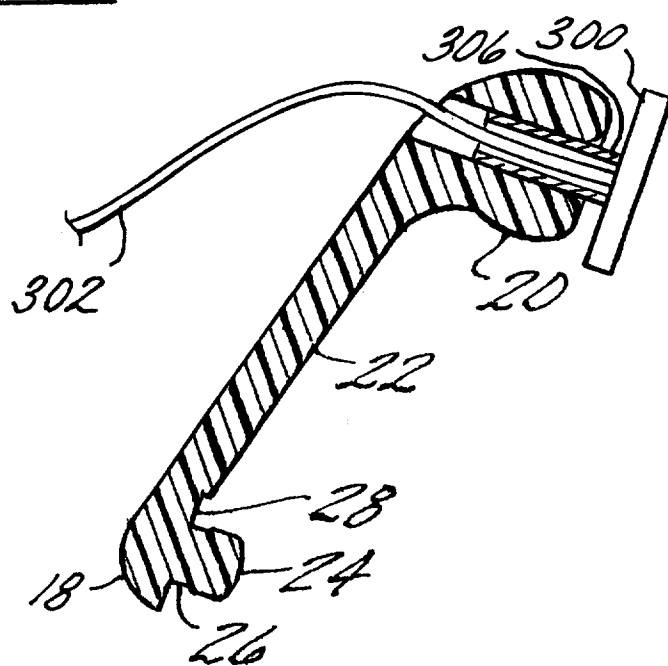
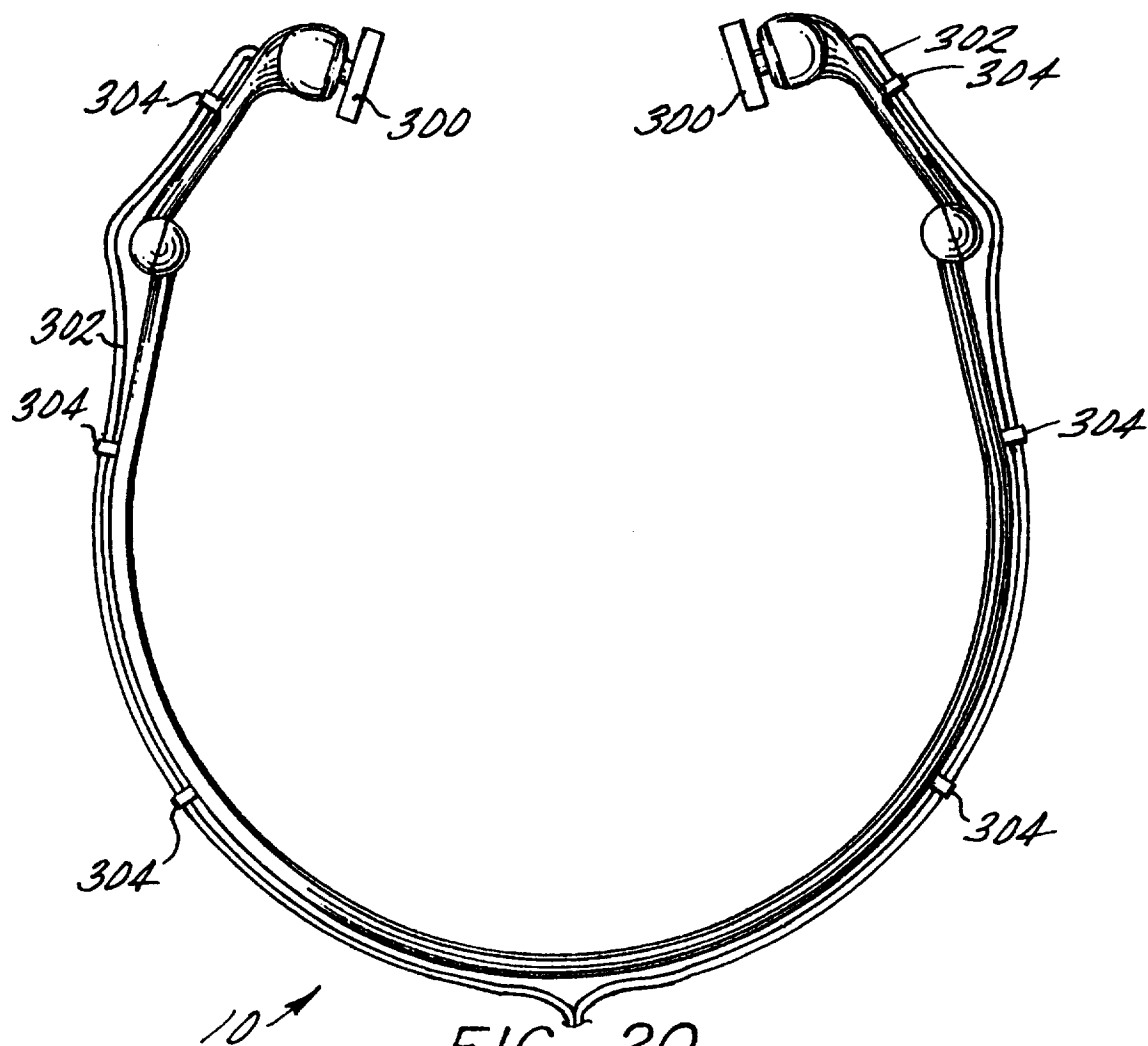


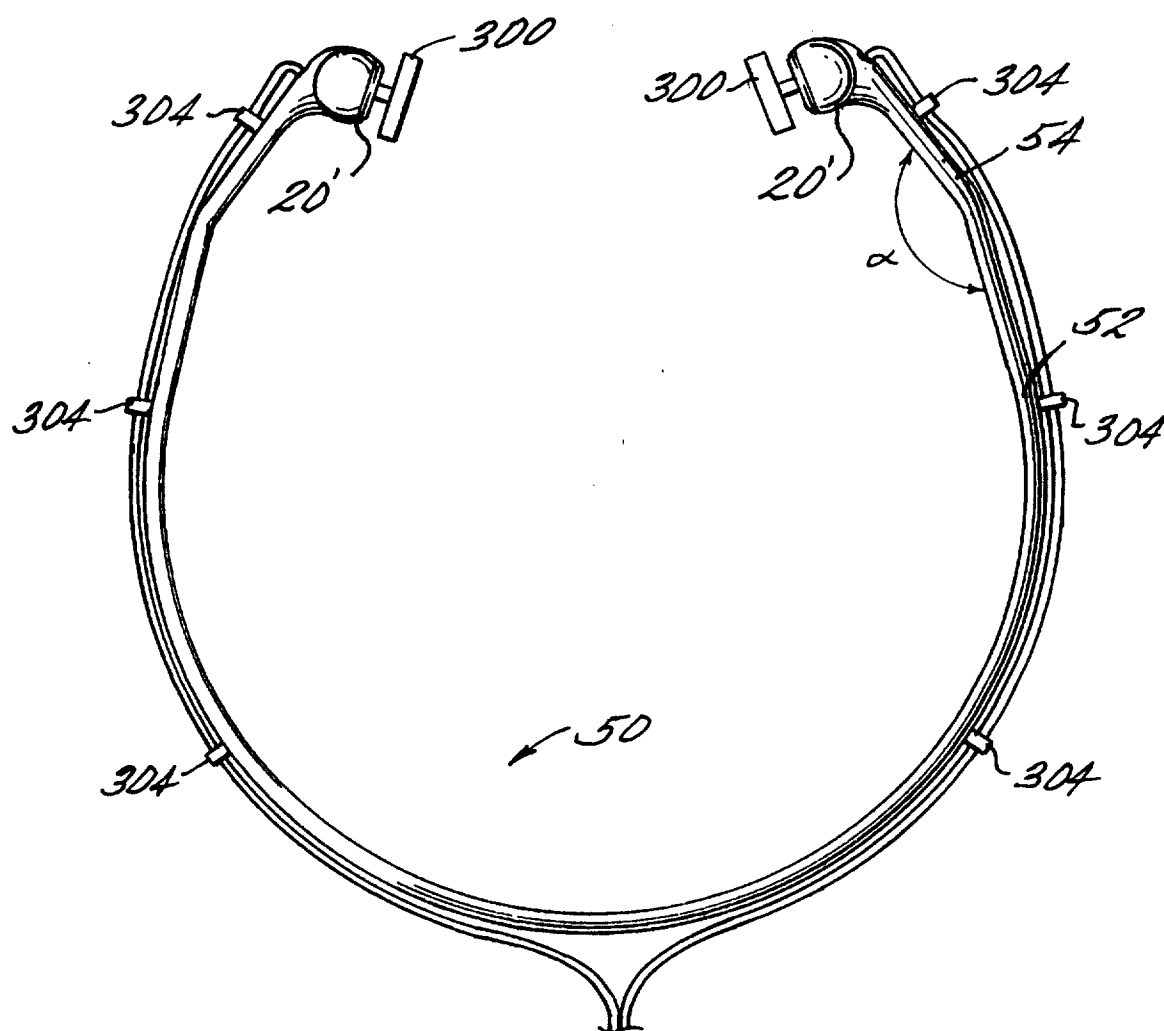
FIG. 16C

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FIG. 18FIG. 19

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FIG. 22

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/US97/14216

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A61F 11/12

US CL : 2/209; 128/864

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 2/209; 128/864

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2,420,245 A (HURST) 06 May 1947, see entire document.	1, 9, 10, 12, 13, 19, 20, 23, 24, 30, 31, and 48
X ----- Y	US 1,066,511 A (MARKOFF) 08 July 1913, see entire document.	1, 2, 9, 10, 12-15, 19, 20, 23-26, 31-33, and 48 ----- 16-18 and 27-29
Y	US 4,671,265 A (ANDERSSON) 09 June 1987, see entire document.	16-18 and 27-29

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A*	document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means		
P document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

15 SEPTEMBER 1997

Date of mailing of the international search report

15 OCT 1997

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Authorized officer

for DIANA BIEFELD

Telephone No. (703) 308-0861

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/14216

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,188,123 A (GARDNER, JR.) 23 February 1993, see entire document.	16-18, 27-29, 44, and 45
X	US 4,461,290 A (GARDNER, JR. et al) 24 July 1984, see entire document.	34, 35, 38-43
----- Y		----- 44 and 45