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(54) Title: PERSONAL RECHARGEABLE PORTABLE IONIC AIR PURIFIER

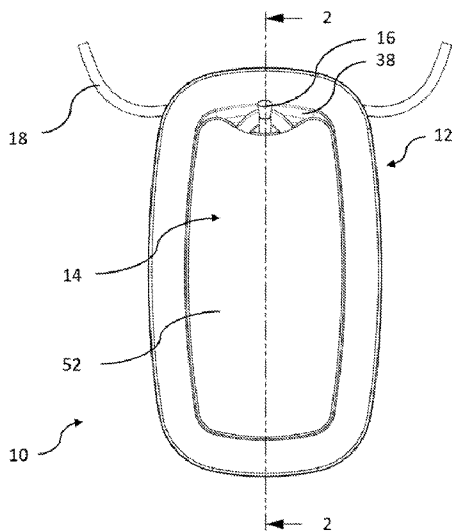


Figure 1

(57) Abstract: A portable rechargeable personal ionic air purifier energizing a personal airspace and cleaning particulate pollutants therefrom provides removable attachment of ion emitter and housing subassemblies by magnetic attraction, provides an electrically grounded conductive member external to the housing that releasably clips a lanyard or article of clothing, includes a decorative surround and provides an external ground plate for use with a desktop mount, armband or other accessory.



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2 **PERSONAL RECHARGEABLE PORTABLE IONIC AIR PURIFIER**3 CROSS-REFERENCE TO RELATED INVENTIONS

4 This application is related to United States patent 9,737,895 entitled Personal
5 Rechargeable Portable Ionic Air Purifier, issued August 22, 2017 to Genereux *et al.*; to
6 United States patent 7,215,526 entitled Ion Generator with Open Emitter and Safety Feature,
7 issued May 8, 2007 to Joannou; and to United States patent 6,919,053 entitled Portable Ion
8 Generator and Dust Collector, issued July 19, 2005 to Joannou, each incorporated herein by
9 reference.

10 FIELD OF THE INVENTION

11 The present invention relates to ion generators, and more particularly, to battery-
12 operated portable ion generators for personal use and for air purification.

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BACKGROUND OF THE INVENTION

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Portable ionic air purifiers are called upon to controllably provide ions to energize and to clean a polluted personal airspace such as that of a taxicab or airplane cabin or other environ of viruses, pollen, smoke, mold, dust mites, and other particulate pollutants while posing little or no personal shock risk, and among other things to exhibit a long battery life and to be manufacturable at low cost. Genereux *et al.*, United States patent 9,737,895, entitled Personal Rechargeable Portable Ionic Air Purifier, discloses a high-efficiency ionization circuit, lanyards that plug-in to portable housing to establish them at ground potential, and different protectable ion emitter embodiments. Joannou, United States patent 7,215,526, entitled Ion Generator with Open Emitter and Safety Feature, discloses an ion emitter, a safety circuit and an analog ionization circuit, and Joannou, United States patent 6,919,053, entitled Portable Ion Generator and Dust Collector, discloses, among other things, a pendant pin emitter on a housing and an energization circuit.

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The plug-in lanyards of Genereux *et al.* include plugs that at each of its ends plug into mating receptacles provided therefor on the portable housing thereof by means of which the lanyard is removably attached to the housing and electrically grounded. The plugs carried by the lanyard, and/or their mating receptacles, however, are subject to soiling and/or deformation from handling and use which may result in poor connectivity or failure to achieve the requisite mechanical attachment or to establish the lanyard at ground potential. In addition, the specialized plug and receptacle hardware not only adds to material costs but also precludes the use of any lanyards except specialized lanyards having plug ends.

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The protectable ion emitter embodiments of Genereux *et al.* allow the replacement of ion emitters that are consumed in use and include different movable cover and slide embodiments to protect the ion emitter when not in use to prevent unwanted contact with the ion emitter that may result in damage and/or impaired operability. The different movable

1 cover and slide embodiments disclosed therein, however, are subject to deformation from
2 handling and use which may result in sticking or other loss of functionality with the result of
3 poor or failed ion emitter protection. In addition, the movable cover and slide embodiments
4 disclosed therein add to material and manufacturing costs undesirably increasing overall
5 product costs.

6 SUMMARY OF THE INVENTION

7 One object of the present invention is to disclose a personal rechargeable portable
8 ionic air purifier having a lanyard by which it is worn that is plug-less and not subject to
9 soiling and/or deformation induced mechanical attachment or electrical grounding failure.

10 In accord therewith, the personal air space cleaner of the present invention includes a
11 wearable housing having external surfaces and of such dimension and weight as to be
12 comfortable when worn; an electronic circuit that is powered by battery power and that
13 provides both a ground potential and an excitation potential; an ion emitter connected to said
14 electronic circuit that is excited to emit ions when it is energized at said excitation potential;
15 a conductive lanyard; and a conductive member electrically connected to said ground
16 potential and mechanically connected to said wearable housing that extends externally to said
17 external surfaces thereof and is adapted to receive the lanyard and to removably attach it to
18 said wearable housing to which said conductive member is mechanically connected, thereby
19 electrically grounding the lanyard by contact with said conductive member electrically
20 connected to said ground potential when said lanyard is received thereby.

21 In one presently preferred embodiment, the conductive member is a resiliently biased
22 jaw attached to the housing that is adapted to resiliently open so as to receive the lanyard
23 between it and the confronting surface of the housing and to resiliently close so as to capture
24 it between the jaw and the confronting surface of the housing, thereby electrically grounding

1 the wearer's body when the wearable housing is supported about the neck by said lanyard
2 captured by said jaw provided by said conductive member electrically connected to said
3 ground potential.

4 The jaw of the presently preferred embodiment of the conductive member external to
5 said wearable housing may also be used to attach to an article of clothing.

6 Any conductive member geometry so long as it captures and electrically grounds the
7 lanyard externally of the housing and supports the housing about the head and neck and/or
8 provides for housing attachment to articles of clothing and the like may be employed.

9 Another object of the present invention is to disclose a personal rechargeable portable
10 ionic air purifier that provides for ion emitter protection when not in use and ion emitter
11 replacement without requiring movable covers or slides or other moving parts and that is not
12 subject to deformation or sticking.

13 In accord therewith, the personal air space cleaner of the present invention includes a
14 wearable housing subassembly of such dimension and weight as to be comfortable when
15 worn having external surfaces and including an electronic circuit that is powered by battery
16 power that provides an excitation potential; a first member mounted to one of said surfaces of
17 said wearable housing; an ion emitter subassembly having external surfaces and an ion
18 emitter that is excited to emit ions when it is energized at said excitation potential; a second
19 member mounted to one of said surfaces of said ion emitter subassembly; wherein at least
20 one of said first and second members magnetically attracts the other of said first and second
21 members; and wherein said second member mounted to one of said surfaces of said ion
22 emitter subassembly cooperates with said first member mounted to one of said surfaces of
23 said wearable housing subassembly to removably mount said ion emitter subassembly to said
24 wearable housing subassembly by action of magnetic attraction of the first and second
25 members.

1 DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED
2 EMBODIMENTS

3 It is to be understood that the invention is not limited in its application to the details
4 of construction or to the arrangements of the components set forth in the following
5 description or illustrated in the drawings. The invention is capable of other embodiments and
6 of being practiced and carried out in various ways. Also, it is to be understood that the
7 phraseology and terminology employed herein are for the purpose of the description and
8 should not be regarded as limiting.

9 Turning now descriptively to the drawings, in FIGURE 1 illustrated generally at 10 is
10 the portable, rechargeable, personal ionic air purifier 10 of the present invention. The purifier
11 10 includes a wearable housing subassembly generally designated 12 of material, weight,
12 construction and dimension adapted to be comfortably worn and/or personally carried
13 without any noticeable burden. An ion emitter subassembly generally designated 14 is
14 removably mounted in a manner to be described to the wearable housing subassembly 12.
15 The ion emitter subassembly 14 includes a carbon brush 16. The user hangs the purifier 10
16 around their neck using a conductive cord or lanyard 18 mounted in a manner to be described
17 to the wearable housing subassembly 12 and turns the purifier 10 "on" using a switch, not
18 shown. A cloud of ions, also not shown, is thereby produced off of carbon brush 16 or other
19 ion emitter directed towards the facial area, not shown, to energize the personal airspace with
20 ions and remove particulates therefrom. These ions attract opposite charged particles in the
21 air and are then attracted together towards the nearest ground source. The conductive cord 18
22 ensures that the ground source is the body of the user and not the breathable air stream, thus
23 effectively cleaning the breathable air stream of contaminants in the air and/or producing
24 negative ions.

1 The purifier 10 cleans the air, typically about a three-foot sphere about the head when
2 the purifier is worn about the neck using the lanyard 18, of viruses, pollen, smoke, mold, dust
3 mites and other particulate-pollutants. The purifier can also be placed, for example, on a
4 night stand, so that the air around the pillow area is purified of pollutants, or located nearby
5 on a table, seat or anywhere else energization by negative ions and/or purification may be
6 desired or necessary. An armband, wristband and the like may be used to mount the device
7 10 to the body in lieu of the lanyard in a manner to be described.

8 It is known from United States patent 6,919,053 that a grounded surface in proximity
9 of a high voltage ion source increases the production of ions. Ideally an electrical connection
10 is formed between the ground terminal of the high voltage source and the surface in question.
11 In the case of a personal air purifier, this connection can be achieved through a conductive
12 fabric lanyard which is in contact with the user's skin. The fabric is ideally composed of
13 ordinary fabric with conductive elements interweaved. The conductive elements produce an
14 electrical connection between the user and one side of a high voltage power circuit output
15 providing an energization signal at ionization potential. The conductivity of the fabric can be
16 achieved using a multitude of methods, some of which will desirably provide a more
17 comfortable user experience than others. As appears more fully below, the purifier 10 of the
18 instant invention may also employ an otherwise ordinary metal necklace such as of gold or
19 silver in a manner to be described.

20 The conductive grounding neck strap allows for the device to use the body of the
21 person wearing the purifier as a ground source. This has the effect of providing a large
22 ground plane and a significant increase in ion output from the purifier. The strap is generally
23 of cotton construction with interwoven layers of conductive materials. It is connected directly
24 to the floating ground in the device and concurrently to the individual user while hanging
25 around the neck and/or in contact with bare skin.

26 The ground cord may be constructed of any type of conductive materials. A ground
27 plate in contact with the body of the user to be described may be used in a desk mount or a

1 bedstead, arm or wrist band or other mounting embodiments. Other grounding means may
2 also be employed.

3 Referring now to FIGURE 2, generally designated at 30 is an exploded sectional view
4 of the portable rechargeable personal ionic air purifier in accord with the present invention
5 taken along the lines 2-2 of FIGURE 1. The wearable housing subassembly 12 includes a
6 battery 32 and printed circuit board 34 mounted therewithin. The battery 32 supplies the
7 electrical circuitry carried by the circuit board 34 with power. The circuitry defines electrical
8 ground and provides an output signal at ionization potential. Any suitable electrical circuitry
9 to convert the battery power to ionization potential such as the safe, and high-efficiency,
10 electrical circuitry shown and described in USP 9,737,895, incorporated herein by reference,
11 may be employed to controllably energize the ion emitter 16 to safely emit ions at ionization
12 potential. Non-rechargeable battery sources may also be used for operation of this purifier.

13 The wearable housing subassembly 12 includes a front surface generally designated
14 36 having a peripheral wall 38 (best seen in FIGURE 1) defining a recess generally
15 designated 40 and a high-voltage magnet 42 mounted to the housing 12 flush with the
16 recessed surface 40 thereof. A high-voltage wire connector 44 connects the signal at
17 ionization potential produced by the high-voltage circuitry 34 to the high-voltage magnet 42.
18 A magnet 46 is mounted to the housing 12 flush with the recessed surface 40 in spaced-apart
19 relation to the magnet 42. A ground plate 48 is mounted to the rear surface generally
20 designated 50 of the wearable housing subassembly 12.

21 The ground plate 48 is of conductive material and is electrically connected to ground
22 potential. The ground plate 48 preferably protrudes such that ground is readily accessible
23 when the housing 12 is received in an armband or wristband or other accessory to hold it in
24 contact with the body. It is also an efficient way to transfer ground to other accessories such
25 as desk or bed mounts.

1 Referring now to FIGURES 1 and 2, the ion emitter subassembly 14 includes a
2 generally flat cover member 52 dimensioned to fit into the recess 40 of the wearable housing
3 subassembly 12. An elongated carbon brush wire 54 is mounted to the cover member 52 such
4 that brush 16 is exposed at its distal end at the top of the cover member 52. The proximate
5 end of the elongated carbon brush wire 54 is mechanically and electrically connected to a
6 magnetic material conductive contact plate 56 by solder or weld 58. The magnetic material
7 conductive contact plate 56 is itself adhesively or otherwise fastened to the inside surface of
8 the cover member 52.

9 When the subassembly 14 is inserted in the recess 40 provided therefor in the
10 wearable housing subassembly 12, the conductive magnetic members 42, 46 contact the
11 conductive magnetic member 56. As will be readily appreciated by those of skill in the art,
12 on the one hand, the ion emitter subassembly 14 is thereby removably attached to the
13 wearable housing subassembly 12, by action of the magnetic attraction that subsists
14 therebetween, and on the other hand, the ion emitter 16 is energized at ionization potential,
15 by completion of an electrical circuit defined between the brush 16, crimp 58, conductive
16 magnetic plate 56, and conductive magnet 42 connected via the high voltage wire connector
17 44 to ionization potential at the high-voltage output of the ion energization circuit carried by
18 the printed circuit board 34.

19 Whenever the carbon brush 16 becomes consumed, the ion emitter subassembly 14
20 may be replaced by a replacement subassembly by the simple expedient of removal of one
21 ion emitter subassembly 14 and replacement with another by magnetic action of catch and
22 release. The carbon brush 16 is protected within the recess 40 from damage due to handling
23 and/or storage.

24 Although a recess receiving the ion emitter subassembly is presently preferred, other
25 means may be employed to provide the intended alignment of the carbon brush. For example,
26 the placement of the magnets could provide alignment, or, to take another exemplary

1 embodiment, a round plate on a round body, not shown, may be employed to point the carbon
2 brush emitter in any desired direction.

3 In the presently preferred embodiment, the ion emitter and wearable housing
4 subassemblies 12, 14 each include magnetic conductive members to provide both removable
5 attachment and the completion of the electrical circuit between the carbon brush emitter and
6 the ionization circuit. In alternative embodiments in accord with the present invention, an
7 electrical plug and receptacle or other connection arrangement, not shown, may be provided,
8 separate from the magnetic members, to complete the electrical circuit. In alternative
9 embodiments in accord with the present invention, a different number and arrangement of
10 magnetically conductive and/or magnetic members may be provided by any arrangement
11 suitable to removably attach the ion emitter and wearable housing subassemblies by magnetic
12 action.

13 Referring now to FIGURE 3, generally designated at 70 is a back pictorial view of the
14 portable rechargeable personal ionic air purifier in accord with the present invention. An
15 elongated conductive member 72 is attached to the back surface 38 of the wearable housing
16 subassembly 12 and electrically connected to electrical ground. In the presently preferred
17 embodiment, the elongated conductive member 72 is shaped to provide a resilient conductive
18 jaw external to the housing 12 at ground potential, although it could be differently configured
19 without departing from the inventive concepts. The lanyard 18 is captured by the conductive
20 member 72, which, because the conductive member is electrically grounded, is also
21 electrically grounded, and which, when the lanyard 18 is worn about the neck, establishes the
22 body of the user, not shown, at the same potential as the ground potential. The lanyard 18 is
23 as easily removed as it is inserted into the resilient jaw.

24 Since no specialized plug ends and mating plugs are required, the lanyard 18 may be a
25 simple loop of conductive material. The lanyard 18 may also be, for example, the user's own
26 silver and/or gold neckwear. The resilient jaw provided by conductive member 72 of the
27 presently preferred embodiment is capable of receiving an article of clothing between it and

1 the confronting surface 50 of the wearable housing 12, which permits the mounting of the
2 portable wearable housing 12 on an article of clothing, such as a T-shirt or sleeve or other
3 article of clothing, not shown. When the article of clothing of whatever variety is removably
4 received by the resilient jaw provided by the conductive member 72, the ground plate 48
5 contacts the confronting portion of the surface of the body of the user, which establishes the
6 body of the user, not shown, at the same potential as the ground potential. The article of
7 clothing is as easily removed as it is inserted into the resilient jaw provided by the conductive
8 member 72. The conductive member may be variously configured to releasably grasp the
9 lanyard and/or an article of clothing without departing from the inventive concepts.

10 The ground plate 48 in alternative embodiments may be employed to transfer ground
11 to a desk mount, or a bed stand, or may even be used with a wristband, or armband, or other
12 device for attaching the wearable housing to an intended body part, all not shown.

13 Referring now to FIGURE 4A, generally designated at 90 is a front pictorial view of
14 the portable rechargeable personal ionic air purifier 10 with an exemplary decorative
15 surround generally designated 92 of silicone or other pliable or other material in accord with
16 the present invention. The decorative surround 92 can be made colorful and can be shaped to
17 resemble a bear, as shown, or any desired shape, or to define a logo, or to bear a pattern or
18 graphics or to have textual features. A colorful, aesthetically shaped silicone or other
19 surround makes the device more appealing to various populations, such as children, and the
20 surround may also serve as a marketing tool.

21 The decorative surround 90 has open front and back sides generally designated 94,
22 and 96 (best seen in FIGURE 4B). The open front 94 allows to access the removable emitter
23 brush subassembly 14. The open back 96 does not interfere with the external ground
24 provided by the clip 72, lanyard 18 or ground plate 48.

25 As will be readily appreciated, the combination of text and graphics on the front of
26 the cover member 52 of the ion emitter subassembly 14 and the shape and color and

1 informational content of the decorative surround 92 can be integrated and cooperative, or
2 independent, without departing from the inventive concepts.

3 Many modifications of the presently disclosed embodiment will become apparent to
4 those of skill in the art without departing from the inventive concepts.

1 WHAT IS CLAIMED IS:

1 1. A personal air space cleaner, comprising:

2 a wearable housing having external surfaces and of such dimension and weight as to
3 be comfortable when worn;

4 an electronic circuit that is powered by battery power and that provides both a ground
5 potential and an excitation potential;

6 an ion emitter connected to said electronic circuit that is excited to emit ions when it
7 is energized at said excitation potential;

8 a conductive lanyard; and

9 a conductive member electrically connected to said ground potential and
10 mechanically connected to said wearable housing that extends externally to said external
11 surfaces thereof and is adapted to receive the lanyard and to removably attach it to said
12 wearable housing to which said conductive member is mechanically connected, thereby
13 electrically grounding the lanyard by contact with said conductive member electrically
14 connected to said ground potential when said lanyard is received thereby.

1 2. The personal air space cleaner of claim 1, wherein said conductive member is a resiliently
2 biased jaw attached to the housing that is adapted to resiliently open so as to receive the
3 lanyard between it and the confronting surface of the housing and to resiliently close so as to
4 capture it between the jaw and the confronting surface of the housing, thereby electrically
5 grounding the wearer's body when the wearable housing is supported about the neck by said
6 lanyard captured by said jaw provided by said conductive member that is electrically
7 connected to said ground potential.

1 3. The personal air space cleaner of claim 1, wherein said conductive member is a resiliently
2 biased jaw attached to the housing that is adapted to removably receive an article of clothing
3 between it and the confronting surface of the housing and adapted to contact the body portion
4 confronting the article of clothing, thereby electrically grounding the body when said
5 wearable housing is mounted to said article of clothing by said jaw and said jaw is in contact
6 with the body portion confronting the article of clothing.

1 4. The personal air space cleaner of claim 1, wherein said electronic circuit is mounted within
2 said housing.

1 5. The personal air space cleaner of claim 1, further including a second conductive member
2 electrically connected to said ground potential and mounted to an external surface of said
3 housing.

1 6. The personal air space cleaner of claim 5, further including an armband adapted to mount
2 the housing to an arm of a user with said second conductive member confronting said arm
3 thereby electrically grounding the arm by contact with said second conductive member
4 electrically connected to said ground potential when said wearable housing is worn on said
5 arm by said armband.

1 7. A personal air space cleaner, comprising:

2 a wearable housing subassembly of such dimension and weight as to be comfortable
3 when worn having external surfaces and an electronic circuit that is powered by battery
4 power that provides an excitation potential;

5 a first member mounted to one of said surfaces of said wearable housing;

6 an ion emitter subassembly having external surfaces and an ion emitter that is excited
7 to emit ions when it is energized at said excitation potential;

8 a second member mounted to one of said surfaces of said ion emitter subassembly;

9 wherein at least one of said first and second members magnetically attracts the other
10 of said first and second members; and

11 wherein said second member mounted to one of said surfaces of said ion emitter
12 subassembly cooperates with said first member mounted to one of said surfaces of said
13 wearable housing subassembly to removably mount said ion emitter subassembly to said
14 wearable housing subassembly by action of magnetic attraction of the first and second
15 members.

1 8. The personal air space cleaner of claim 7, wherein said first and said second members are
2 of conductive material, wherein said first member of conductive material is connected to
3 receive said excitation potential provided by said electronic circuit, wherein said second
4 member of conductive material is connected to said ion emitter, and wherein said first and
5 second conductive members supply said ionization potential to said ion emitter by conduction
6 through said first and second members when said ion emitter subassembly is mounted to said
7 wearable housing subassembly by action of magnetic attraction of the first and second
8 members.

1 9. The personal air space cleaner of claim 7, wherein said surfaces of said housing
2 subassembly include opposing front and back sides, said back side thereof adapted to seat on
3 the confronting surface of a person wearing the wearable housing subassembly, said front
4 side including a recess defined by a peripheral wall adapted to receive said ion emitter
5 subassembly, and wherein said first member is mounted in said recess.

1 10. A personal air space cleaner, comprising:

2 a wearable first housing that is light in weight and comfortable when worn;

3 an ion emitter mounted to said wearable first housing;

4 an energization circuit mounted to said wearable first housing for energizing said ion
5 emitter at potential to emit ions and defining ground potential;

6 a conductive lanyard adapted to suspend the wearable first housing about the neck of
7 a person wearing the same that is connected to said ground potential for grounding the body
8 of a person wearing the wearable first housing by contact with the conductive lanyard to
9 provide a potential difference between the ion emitter and the body of the person wearing the
10 wearable first housing that draws to the body at ground potential the ions emitted by said ion
11 emitter when energized at said ionization potential through the personal air space entraining
12 particulates and thereby cleaning the air being breathed by the person wearing the wearable
13 first housing; and

14 a second housing having first wall portions defining decorative or informational
15 features and second wall portions adapted to removably receive said wearable first housing.

1 11. The personal airspace cleaner of claim 10, wherein said second wall portions define a
2 central opening adapted to receive and removably retain said wearable first housing within
3 said central opening and wherein said first wall portions of said second housing defining
4 decorative or informational features surround said central opening.

1 12. The personal airspace cleaner of claim 10, wherein said ion emitter is removably mounted
2 to said wearable first housing and includes an exposed front surface adapted to bare graphics
3 or text.

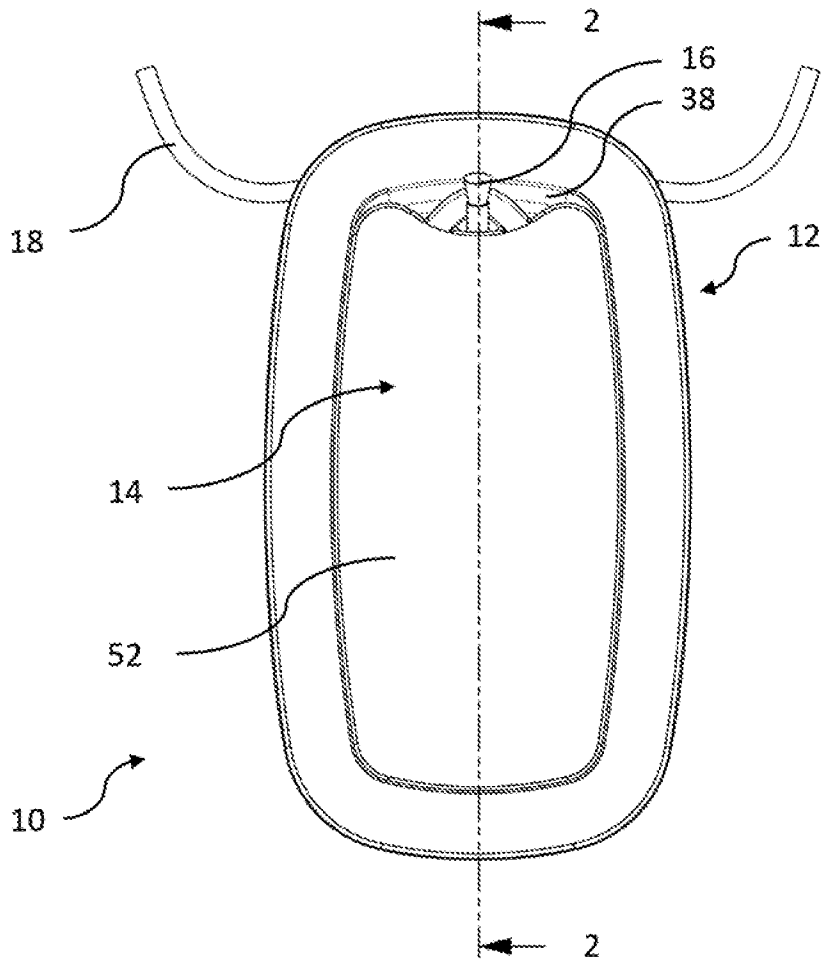


Figure 1

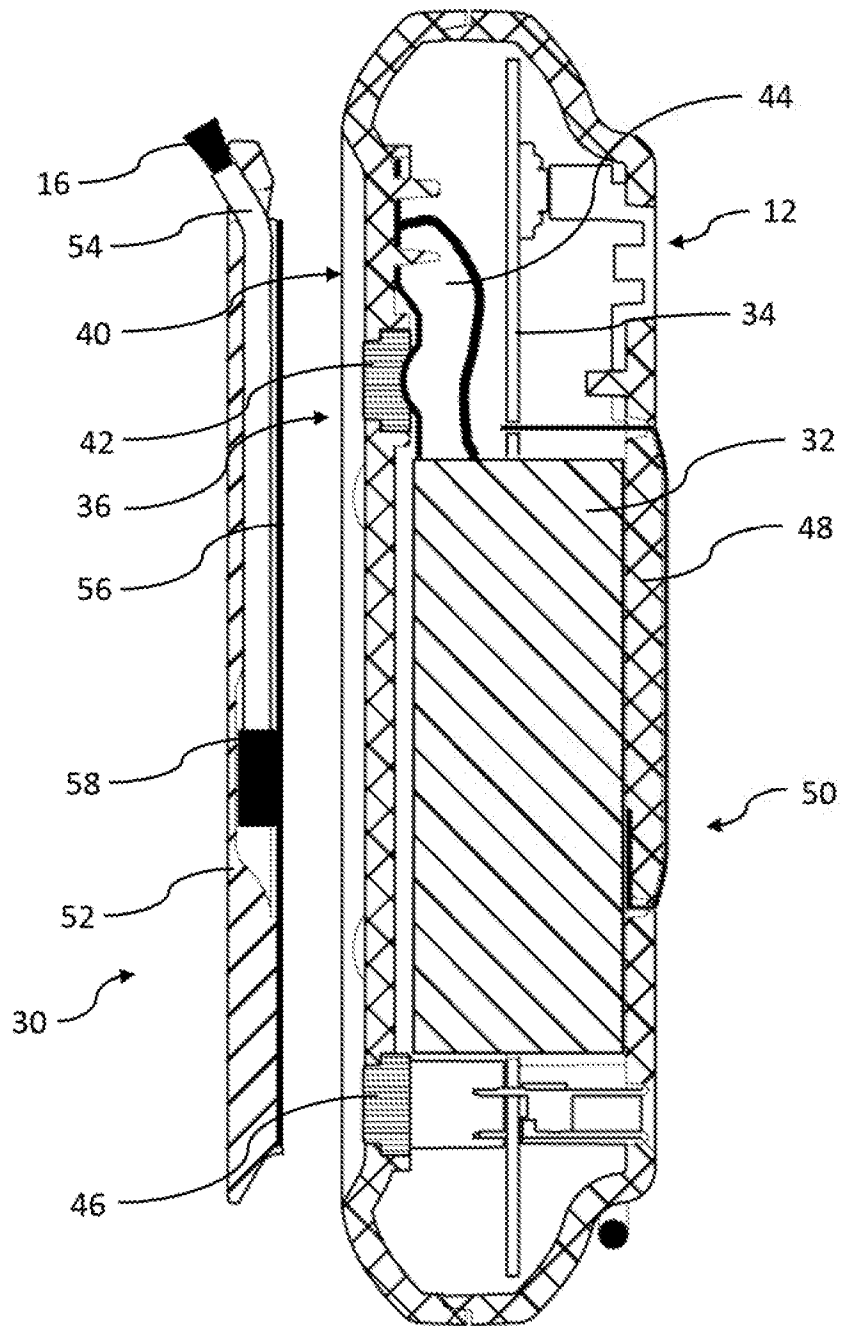


Figure 2

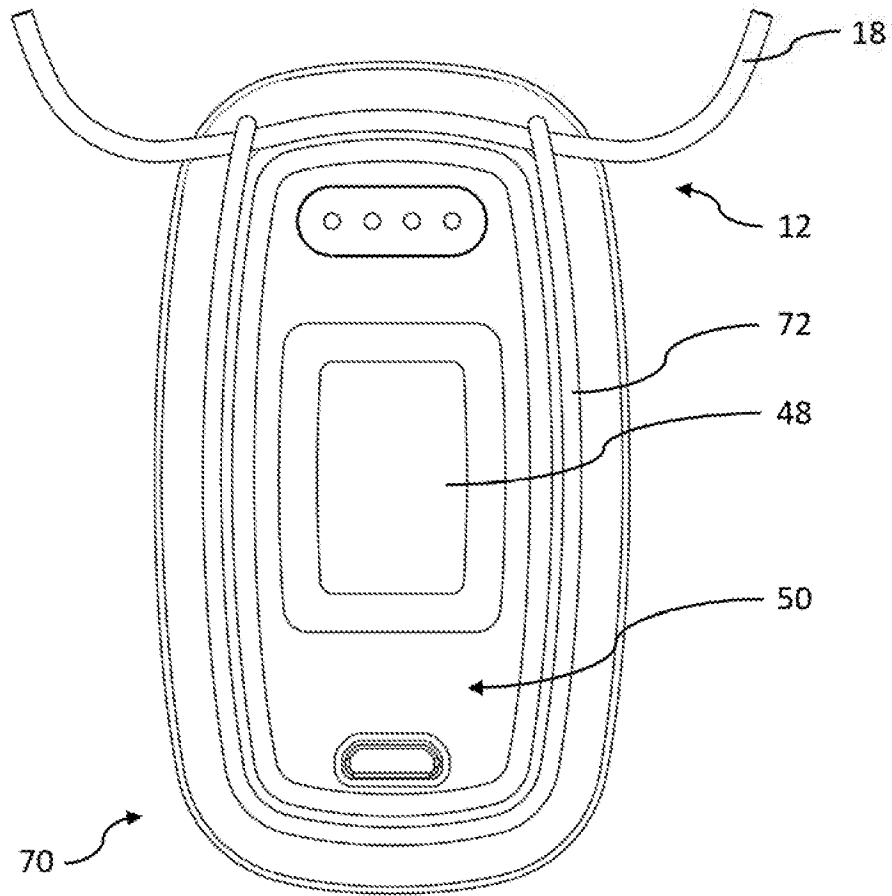


Figure 3

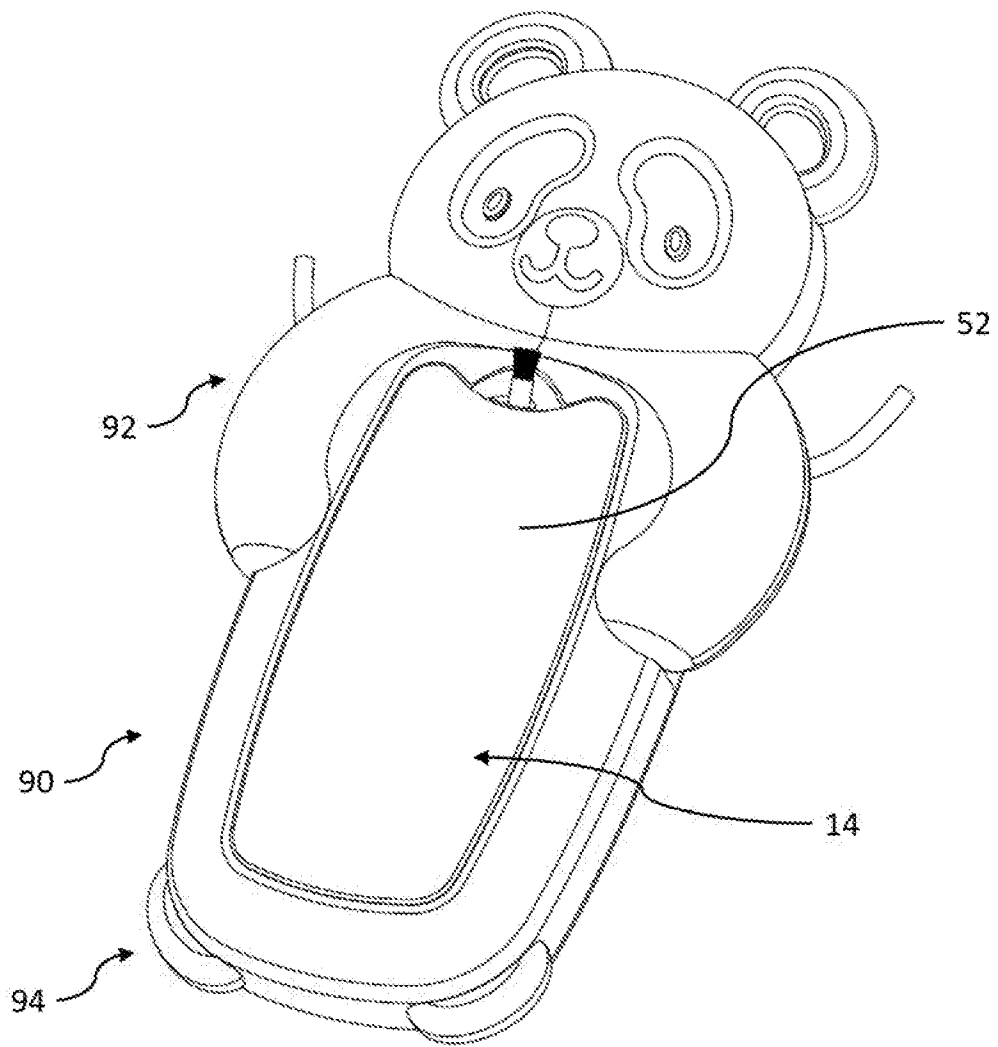


Figure 4A

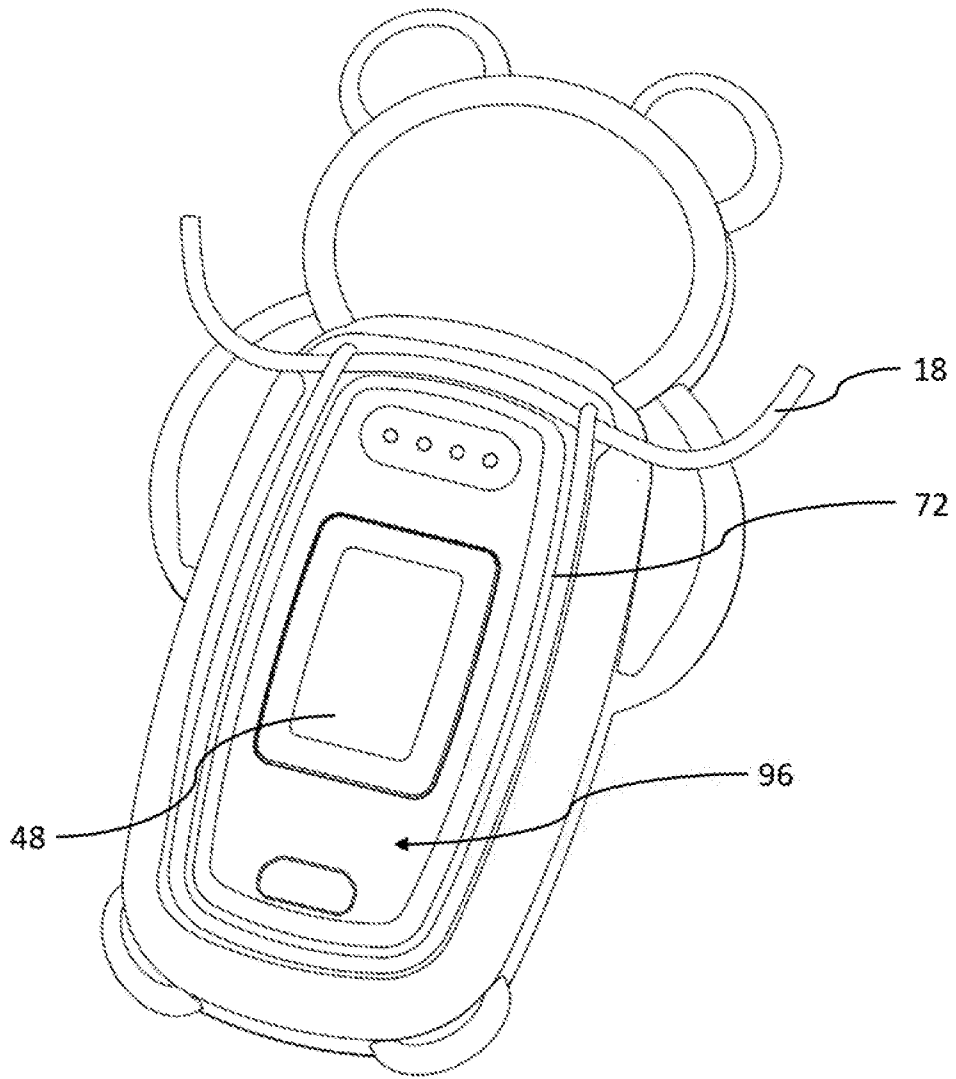


Figure 4B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2019/020637

<p>A. CLASSIFICATION OF SUBJECT MATTER</p> <p style="text-align: center;"><i>A61L 9/22 (2006.01)</i> <i>B03C 3/41 (2006.01)</i> <i>H01T 23/00 (2006.01)</i></p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>																											
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols)</p> <p style="text-align: center;">A61L 9/22, B03C 3/41, H01T 23/00</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p> <p style="text-align: center;">PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, Information Retrieval System of FIPS</p>																											
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y A</td> <td>US 9737895 B2 (HEADWATERS, INC) 22.08.2017, abstract, claims 1, 4, columns 2-5, 7, 9, fig. 1, 5-6, 10-11</td> <td>7, 10 1-6, 8, 9, 11, 12</td> </tr> <tr> <td>Y</td> <td>CN 206771521 U (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO LTD et al) 19.12.2017, abstract, claims 1, 3, fig. 4</td> <td>7, 10</td> </tr> <tr> <td>Y</td> <td>US 2005/0188987 A1 (PETER SILTEX YUEN) 01.09.2005, abstract, claims, paragraphs [0020]-[0024], fig. 1</td> <td>10</td> </tr> <tr> <td>Y</td> <td>US 9534570 B2 (MANN+HUMMEL GMBH) 03.01.2017, abstract, claim 7, columns 3-4, fig. 1</td> <td>10</td> </tr> </tbody> </table> <p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p> <p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>“A” document defining the general state of the art which is not considered to be of particular relevance</td> <td>“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</td> </tr> <tr> <td>“E” earlier document but published on or after the international filing date</td> <td>“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</td> </tr> <tr> <td>“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)</td> <td>“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</td> </tr> <tr> <td>“O” document referring to an oral disclosure, use, exhibition or other means</td> <td>“&” document member of the same patent family</td> </tr> <tr> <td>“P” document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y A	US 9737895 B2 (HEADWATERS, INC) 22.08.2017, abstract, claims 1, 4, columns 2-5, 7, 9, fig. 1, 5-6, 10-11	7, 10 1-6, 8, 9, 11, 12	Y	CN 206771521 U (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO LTD et al) 19.12.2017, abstract, claims 1, 3, fig. 4	7, 10	Y	US 2005/0188987 A1 (PETER SILTEX YUEN) 01.09.2005, abstract, claims, paragraphs [0020]-[0024], fig. 1	10	Y	US 9534570 B2 (MANN+HUMMEL GMBH) 03.01.2017, abstract, claim 7, columns 3-4, fig. 1	10	“A” document defining the general state of the art which is not considered to be of particular relevance	“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	“E” earlier document but published on or after the international filing date	“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	“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)	“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	“O” document referring to an oral disclosure, use, exhibition or other means	“&” document member of the same patent family	“P” document published prior to the international filing date but later than the priority date claimed	
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<p>Date of the actual completion of the international search</p> <p style="text-align: center;">27 May 2019 (27.05.2019)</p>		<p>Date of mailing of the international search report</p> <p style="text-align: center;">13 June 2019 (13.06.2019)</p>																									
<p>Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37</p>		<p>Authorized officer</p> <p style="text-align: center;">A. Kubasov</p> <p>Telephone No. (495) 531-64-81</p>																									