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(54) Title: DIAPERLUX

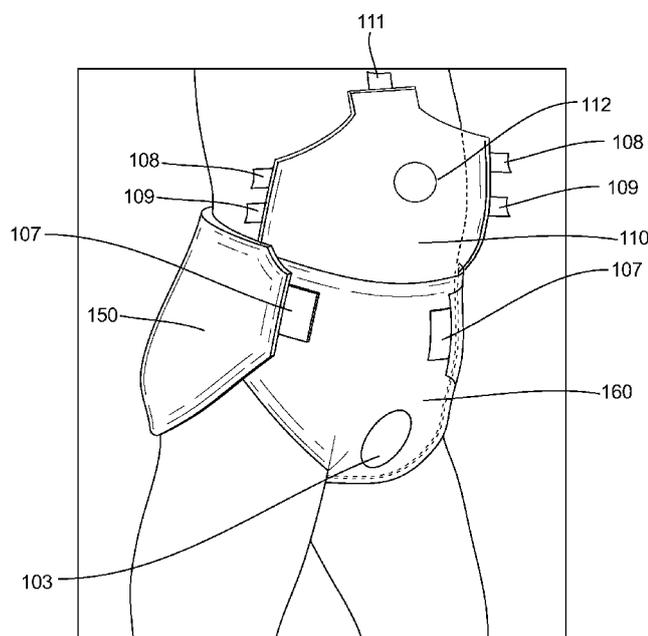


FIG. 7

(57) Abstract: The invention consists of a diaper adapted to keep the genitalia (scrotum in male and vulva in female) exposed to the ambient temperature (to a certain degree), thereby allowing the scrotum, testicles and vulva to be cooled by sweating and exposure of the scrotum and vulva surface to ambient air, as in the case of an unclothed baby/adult. The diaper is made using several sections. The innermost section has back and front parts, and is shaped so as to surround the legs and be gathered around the waist as in a conventional diaper. This section has a frontal opening adapted to allow the penis, scrotum and vulva to project out through this opening. A second front section again with a hole is used to allow the scrotum, but not the penis to extend outside it.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

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DiaperLux

Field of the Invention

The present invention relates generally to the field of diapers.

Background of the Invention

The diaper is an undergarment that allows the wearer (such as an infant or incontinent adult) to urinate or defecate without a toilet, by absorbing or containing waste products. Most diapers in use today are disposable, and most of these are made of plastic fibers, contain absorbent chemicals and are thrown away after one use.

The plastic (and usually waterproof) outer layers of a modern disposable diaper are impermeable and insulating with regards to heat and vapor exchange, and are fitted tight to the body. These diapers therefore retain the body heat generated by the wearer, as well as the heat released by bodily fluids excreted. In the case of infants (and adults as well), elevated genital temperature may have negative effects after puberty upon the reproductive potential of the individual wearing the diaper. In males, it is postulated that this is due to prolonged heating of the scrotum. In the normal situation, the scrotum temperature is naturally nearly 3 degrees lower than that of the body's core, and this lower temperature is obligatory for normal testicular function, normal proliferation level of germ (spermatogonia) cells at infancy, and sperm cell production after puberty. Therefore prolonged heating of the scrotum, even in an infant, may possibly prevent the normal development of fertility capacity in males. There is scientific evidence that supports this line of thought which suggests that increased temperature of the testicle/s during infancy may cause permanent damage to male fertility after puberty, in adults (Hadziselimovic and Herzog, *The importance of both an early orchidopexy and germ cell maturation for fertility*. Lancet 2001; 358:1156-1157).

The standard design of diapers has been associated with three well-established phenomena: increase in the temperature of the genitalia area by 2-4°C; free passage of feces causing poor hygiene in infants and adults due to leakage of feces into the anterior area; and use of non-environmentally friendly materials.

Summary of the Invention

The invention is a diaper attended to resolve all three problems mentioned above.

The invention is a diaper adapted to keep the scrotum (in male) and vulva (in female) exposed to the ambient temperature (to a certain degree), thereby allowing the genitalia of both sexes to be aerated and hence cooled as in the case of an unclothed person, and also to prevent genitalia from fecal contamination that also may be involved in fertility problems (for infants) and morbidity plus mortality (for adult users and geriatric ages).

The diaper is constructed in several sections, with one back and two or alternatively three front sections. The back section is designed as in conventional diaper. The back and first front section may be of one piece, and in any case includes leg holes such that, once fastened in its intended configuration, the diaper may be gathered around the wearer's waist, covering the buttocks. Unlike regular diapers, the first frontal section also has a frontal opening adapted to allow the genitalia (penis and scrotum in the case of male infants, and vulva in the case of female) to project out through this opening. In a preferred embodiment of the present invention, a second front section with a hole is used to allow the scrotum to extend outside it, and this second front section is attached to the first front section. The second front section may be used without any hole as long as it is provided with a cooling system, as it is described further below. As the penis is disposed between the first frontal and second frontal sections of material, any urine released will enter the pocket formed between these sections of material.

In the case of female infants, the same diaper may be used, in this case the openings allowing the largely free passage of air to the genitals.

The first front section may be attached to the back section by means of tape, hooks-and-loops, other attachment means, or it may be made of the same piece of material, as in a conventional diaper. Generally the first frontal section does not contain absorbent chemicals on either side, although it may contain absorbent chemicals on the outward (frontward) facing side (faced to genitals) and hydrophobic materials on the inward side (closest to the body).

The second front section may contain absorbent chemicals on its inward (proximal or genital-facing side).

An option for the second front-section is incorporation of a highly gas-permeable cover, which is attached to the second section, to entirely over the scrotum (or vulva) from the front and yet still allow for proper aeration of the scrotum from the sides. Alternatively, a gaseous permeable cover may be incorporated as a part of the second front section. This section is in some embodiments gas permeable only near or covering the area of the scrotum. An additional alternative to maintain a lower physiological temperature of the scrotum and vulva is utilization of any kind of cooling material (such as phase change materials [PCM]) for example, incorporated into the second front section of diaper (in case without hole).

As will be appreciated, the invention allows for the physical separation of the reproductive organs from feces, and also largely from urine (to the extent that the urine is absorbed by the material of the second frontal section or alternatively, both the outer side of the first frontal section and inner side of the second frontal section.

The first (back) section contains pockets designed to capture and prevent travel of feces from the back side to the frontal genital side. The connection area (shown as a line 180 in Fig. 1A, B and 180) between the first and second sections has a physical barrier or roller (seen for instance in Fig. 1 D), which also may prevent the movement of feces to the frontal area.

An additional useful adaptation/device that may be incorporated in the inner side (facing the skin/body) of the back and first front sections is biological glue or other adhesive or attachment means (for instance around the edges of the diaper) for better contact and sealing with skin and, in this way, better preventing contact between genitalia and feces.

The main advantage of the patent lies in that the genitals are kept aerated and (in the case of male infants) far from the body in a natural manner, and that the testicles or vulva are exposed to free convection of the ambient air to some degree, allowing it to cool to much lower than body temperature.

The foregoing embodiments of the invention have been described and illustrated in conjunction with systems and methods thereof, which are meant to be merely illustrative, and not limiting. Furthermore, just as every particular reference may

embody particular methods/systems, yet not require such, ultimately such teaching is meant for all expressions notwithstanding the use of particular embodiments.

Brief Description of the Drawings

Embodiments and features of the present invention are described herein in conjunction with the following drawings:

Fig. 1A shows the first front and back sections of the diaper of the invention.

Fig. 1B shows another embodiment of the first front and back sections of the inventive diaper, in this case both being made of the same piece of material.

Fig. 1C shows another embodiment of the first front and back sections of the inventive diaper, along with the second front section, in this case all being made of the same piece of material.

Fig. 1D shows the diaper of Fig. 1C in side view.

Fig. 2 shows another embodiment of the second front section of the invention, including a hole.

Fig. 3 shows an optional second front section of the diaper without the hole, which can alternatively be used as an optional third front section.

Fig. 4 shows a baby wearing the first frontal section of the diaper of the invention, with penis and scrotum exposed.

Fig. 5 again shows a baby wearing the first frontal section of the diaper of the invention, this time with the hole closed by attachment means.

Fig. 6 shows a baby wearing the first and second front sections of the diaper of the invention, with penis covered (between both front sections) and scrotum exposed.

Fig. 7 shows a user wearing the back, first front and second front sections of the diaper of the invention, with second section as yet unattached to the first front section.

Fig. 8 shows a user wearing the back, first front and second front sections of the diaper of the invention, with second section now attached to the first front section.

Detailed Description of Preferred Embodiments

The present invention will be understood from the following detailed description of preferred embodiments, which are meant to be descriptive yet not limiting. For the sake of brevity, some well-known features, methods, systems, procedures, components, circuits, and so on, are not described in detail.

The invention is a diaper adapted to keep the genitalia (scrotum and vulva) exposed to the ambient temperature (to a certain degree), thereby allowing the genitals to be aerated and cooled by the ambient air/cooling material, nearly as much as in the case of a naked body.

The sweating process constitutes only a small part of the heat exchange between the scrotum and the ambient. The main heat exchange mechanism serving to decrease the temperature of the testicles is the surface capillary network of the scrotum, by which the ambient temperature decreases the scrotal venous temperature. In this way the pampiniform plexus (the venous network surrounding the testicular artery) decreases the temperature of the arterial blood supply from the body to the testicles. The exposure of the scrotum surface to ambient air is thus crucial for cooling of the testicles. In the female, it is speculated that heat exchange is also relevant for normal ovarian function (shown in bovine model; Morita et al., *Establishment of long-term chronic recording technique of in vivo ovarian parenchymal temperature in Japanese Black cows*. J. Reprod. Develop. 2020; 66:271-275.) and also could be important for normal bacterial type population in the genitalia.

The diaper of the invention may be made by conventional materials such as cloth or plastic; compounds that replace plastic with eco-friendly solutions (e.g. biodegradable plastic), may also be used. The diaper is, in some embodiments, made in several sections. The back section is designed as in a conventional diaper. The first front section (closest to the body) is preferably of a non-absorbing material. Alternatively this section may comprise absorbing material on the external side of this front section. In any case, this section has an opening adapted to allow the genitalia (penis and scrotum in male and vulva in female) to project out through it.

The inner sections of the diaper may be constructed from planar material cut into the form as shown by Fig. 1A, as in a conventional diaper. Although this part may

be composed of a single piece of material, it is convenient to define a back section 150 and front section 160, the back section ultimately covering the buttocks and the front section covering the front of the baby. The front section 160 is provided with a hole 103, as also shown in Fig. 1A, B, C allowing the scrotum and penis to extend outside this layer. This section 160 may optionally have a slit 104 (Fig. 1B, C) extending from hole 103 (optionally running all the way to the material edge), allowing the person applying the diaper to more easily fit it, and sealing the layer around penis and scrotum -or vulva-. In order to close the front section 160 around penis and scrotum (or vulva), attachment means such as tape or hooks-and-loops 105 may be used to close the material after fitting genitalia through the hole 103. Attachment means such as tape 108, 109 (Fig. 1C, Fig. 2, 3) may be provided as part of the diaper or may be added by the user, so as to close the front and back sections around the user.

The material of back section 150 is preferably made of a hygroscopic or otherwise absorptive material adapted for absorbing any liquids contained within the feces, while the material of front section 160 (specifically, the side facing the body) may be non-hygroscopic or moisture-repellent, to prevent urine from being absorbed here and promote its absorption elsewhere – ideally, in the outer side of the first front section 160 and inner side of the second front section 110. Pockets 170 of the back section 150 are designed to trap and hold feces, preventing it from traveling within the diaper and facilitating cleanup. A raised area 180 further prevents travel of feces from the posterior section of the diaper to the anterior.

The second front section of material 110 has a hole 112 as in Fig. 1C and Fig. 2, through which the scrotum but not the penis extends. As the penis is now encased between two front sections of material 160 and 110, any urine released will enter the pocket formed between these sections of absorption material. The material of the second front section 110 is preferably made of a hygroscopic substance, to encourage the absorption of urine by this second section and not by the body-facing side of section 160, thus reducing contact of urine with the body. Section 160 may comprise absorbent material on its exterior or distal side.

The second front section 110 may be attached to the first front section 160 by means of tape, hooks-and-loops, pins, or other attachment means as will be known to those skilled in the art. The second front section 110 may be attached by the user at one

or more points, or may in some embodiments be provided already-attached to the first front section as shown in Fig. 1C (side view, Fig. 1D). In this latter case, the attachment may be accomplished by any means known in the art, for instance by machine sewing, heat welding, or simply cutting all sections from the same piece of material.

The inner side (proximal, facing the body/skin) of first front section 160 may include liquid-resistant medical glue, such as that supplied by 3M adapted to help its attachment to the body, making it difficult the fecal contamination of frontal area.

In some embodiments of the invention, a third front section (Fig. 3) may be attached to the second front section in a similar manner as the previous two sections (Fig. 3).

Fig. 4 shows the baby after the back section 150 and front section 160 has been affixed to the baby, with penis 113 and scrotum 114 exposed.

Fig. 5 shows the same situation but with tape 105 closing the top sections of the first front section 160.

Fig. 6 shows the diaper of the invention after the second front section 110 has been attached to the first front section using tape or hooks-and-loops 111 and 109 (or simply folded down, in the case that second front section 110 is made of the same piece of material as 160), with scrotum 114 alone exposed.

Fig. 7 shows a diaper of the invention, with the integral second front section 110 attached to first front section 160. This second section 110 has not yet been folded down and attached to the first front layer 160.

Fig. 8 shows a diaper of the invention, with the integral second front section 110 attached to first front section 160 now folded down and attached to the first front layer 160 by means of tape 109, 108.

As will be appreciated, the invention allows for the physical separation of the reproductive organs from feces, and also largely from urine (to the extent that the urine is absorbed by the pocket material of the first and second front sections).

A key advantage of the patent lies in that the scrotum is at the natural distance from the body and exposed to free convection of the ambient air to some degree, thereby allowing the scrotum (and testicles) in male and vulva in female to cool to significantly lower than body temperature, as would be the case for instance with an unclothed, naked person.

The diaper can take the form of a normal disposable or reusable diaper, for example being comprised of conventional materials such as cotton, polyurethane, polyester, or hemp or other. Use of new compounds that replace "old fashioned" material with eco-friendly materials is also within provision of the invention.

Moisture-repellent or hydrophobic properties of the front section 160 may be provided by means known in the art such as impregnation of conventional materials with hydrophobic surfactants (e.g. precipitated calcium carbonate, silica, or fluoropolymers). Likewise, the hygroscopic properties of the second front section 110 may be provided by means known in the art, beginning with properties of the material of the layer itself (e.g. by use of moisture-absorbent fabric for this section) and possibly including coatings and surfactants.

It is within provision of the invention to make use of phase-change material, which may possibly also be hygroscopic, to stabilize the temperature of their environment. As will be clear to those skilled in the art, such phase change material may be obtained or synthesized in the form of nanocapsules with which fabric can be coated easily. Cloth treated in such a way has been shown to have excellent thermal stability (see *Nanoencapsulation of phase change materials (PCMs) and their applications in various fields for energy storage and management*, Advances in Colloid and Interface Science 283 (2020) 102226.)

The foregoing description and illustrations of the embodiments of the invention has been presented for the purposes of illustration. It is not intended to be exhaustive or to limit the invention to the above description in any form.

Any term that has been defined above and used in the claims, should be interpreted according to this definition.

The reference numbers in the claims are not a part of the claims, but rather used for facilitating the reading thereof. These reference numbers should not be interpreted as limiting the claims in any form.

CLAIMS

1. A diaper consisting of:

a. a first section of material shaped to surround an infant's waist, having openings for the legs, and further provided with a front hole for the penis and scrotum of a male, or vulva of a female, to project therethrough;

b. a second front section of material, adapted to be attached to said first section on the anterior side of said diaper, said second front section having a hole for the scrotum or vulva to project through; whereby the scrotum or vulva is thereby substantially exposed to free convection of ambient air, and whereby the penis (in the case of a male infant) is encased between said first section and said second front section thereby trapping urine in the space between said sections.

2. The diaper of claim 1 wherein said second front section of material comprises hygroscopic materials such as superabsorbent polymers adapted to absorb moisture.

3. The diaper of claim 1 wherein said first and second front sections are composed of materials selected from the group consisting of: cotton, hemp, bamboo, microfiber, plastic fibers such as polylactic acid or polyurethane, polyethylene, superabsorbent polymers, hygroscopic materials, and water-repellent materials.

4. The diaper of claim 1 wherein the inner (body-facing) side of said first section comprises water-repellent materials.

5. The diaper of claim 1 wherein the outer (distal) side of said first section comprises hygroscopic materials.

6. The diaper of claim 1 wherein said second front section comprises hygroscopic materials.

7. The diaper of claim 1 wherein said second front section is further provided with a flap or pouch adapted to cover the genitalia.

8. The diaper of claim 1 further comprising phase-change material increasing the temperature stability of said diaper.

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9. The diaper of claim 1 wherein the posterior portion of said first section is further provided with pockets, so located and adapted as to entrap and hold feces.

10. The diaper of claim 1 wherein said first section is further provided with a raised area 180 between the posterior and anterior sections of said innermost layer, which prevents travel of feces from the posterior section of said diaper to the anterior section of said diaper.

11. The diaper of claim 1 wherein said first and second sections are formed from a single piece of material.

12. The diaper of claim 1 with a further third front section attached anteriorly to said second front section, said third front section optionally provided with a adapted to partially expose the scrotum or vulva.

13. A diaper for males, having a substantially low water absorbing capacity and substantially high gas and water permeability in areas of said diaper that, when worn, are in proximity to a male scrotum or a female vulva.

14. A method for preventing overheating of the genitalia while wearing a diaper, consisting of exposing the genitalia to ambient air flow by means of openings in layers of said diaper through which the genitals project and through which air may flow.

15. The method of claim 14 wherein said diaper consists of a first section of material shaped to surround an infant's waist, having openings for the legs, and further provided with a front hole for the penis and scrotum of a male, or vulva of a female, to project therethrough; and a second front section of material, adapted to be attached to said first section on the anterior side of said diaper, said second front section having a hole for the scrotum or vulva to project through;

whereby the scrotum or vulva is thereby substantially exposed to free convection of ambient air.

16. The method of claim 15 wherein said second front section of material comprises hygroscopic materials such as superabsorbent polymers adapted to absorb moisture.

17. The method of claim 15 wherein said first and second front sections are composed of materials selected from the group consisting of: cotton, hemp, bamboo, microfiber, plastic fibers such as polylactic acid or polyurethane, polyethylene, superabsorbent polymers, hygroscopic materials, and water-repellent materials.

18. The method of claim 15 wherein the inner (body-facing) side of said first section layer comprises water-repellent materials.
19. The method of claim 15 wherein the outer (distal) side of said first section comprises hygroscopic materials.
20. The method of claim 15 wherein said second front section comprises hygroscopic materials.
21. The method of claim 15 wherein said second front section is further provided with a flap or pouch adapted to cover the genitalia.
22. The method of claim 15 further stabilizing temperature by disposing phase-change material into the material of said diaper.
23. The method of claim 15 further providing a third front section attached anteriorly to said second front section, said third front section optionally provided with a adapted to partially expose the scrotum or vulva.

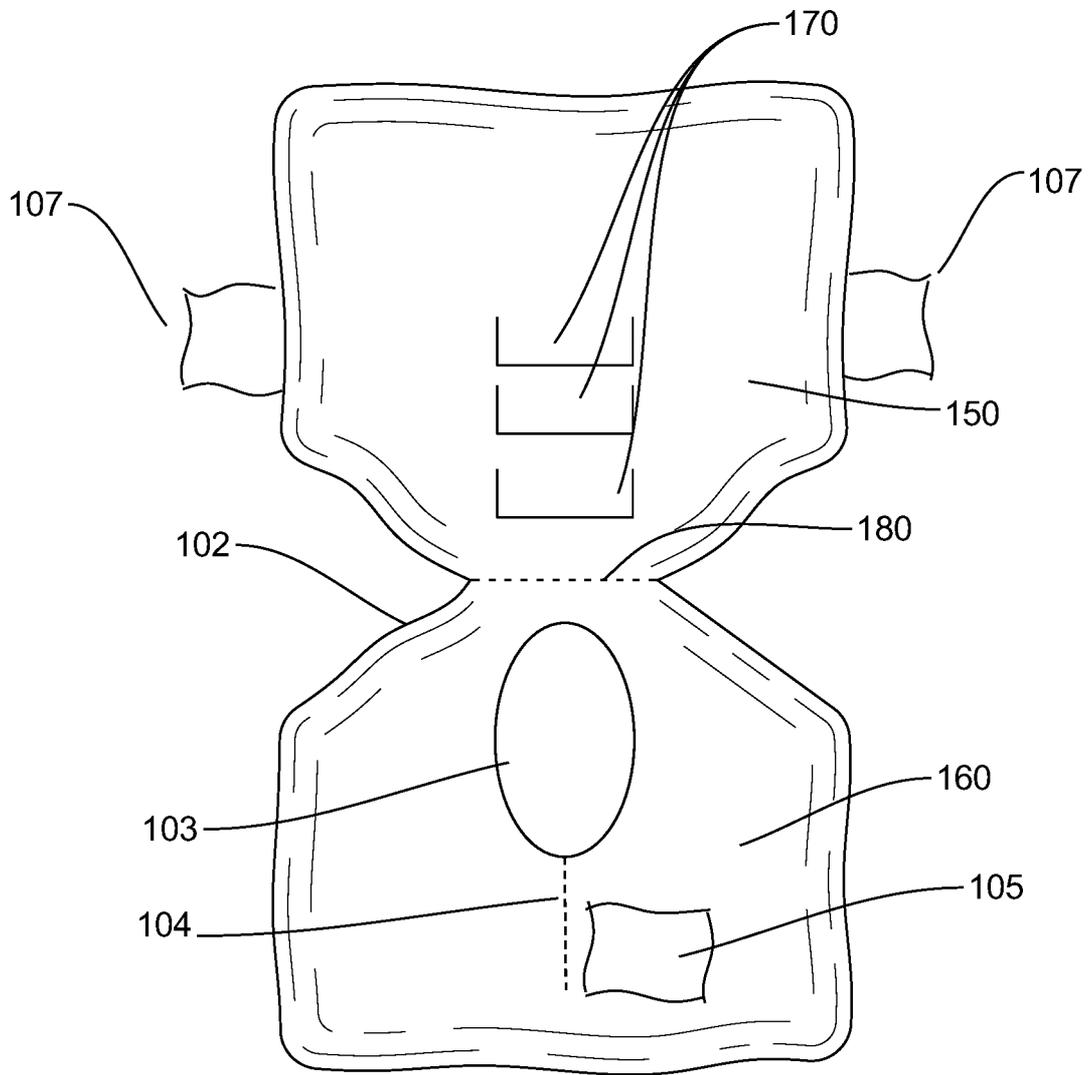


FIG. 1A

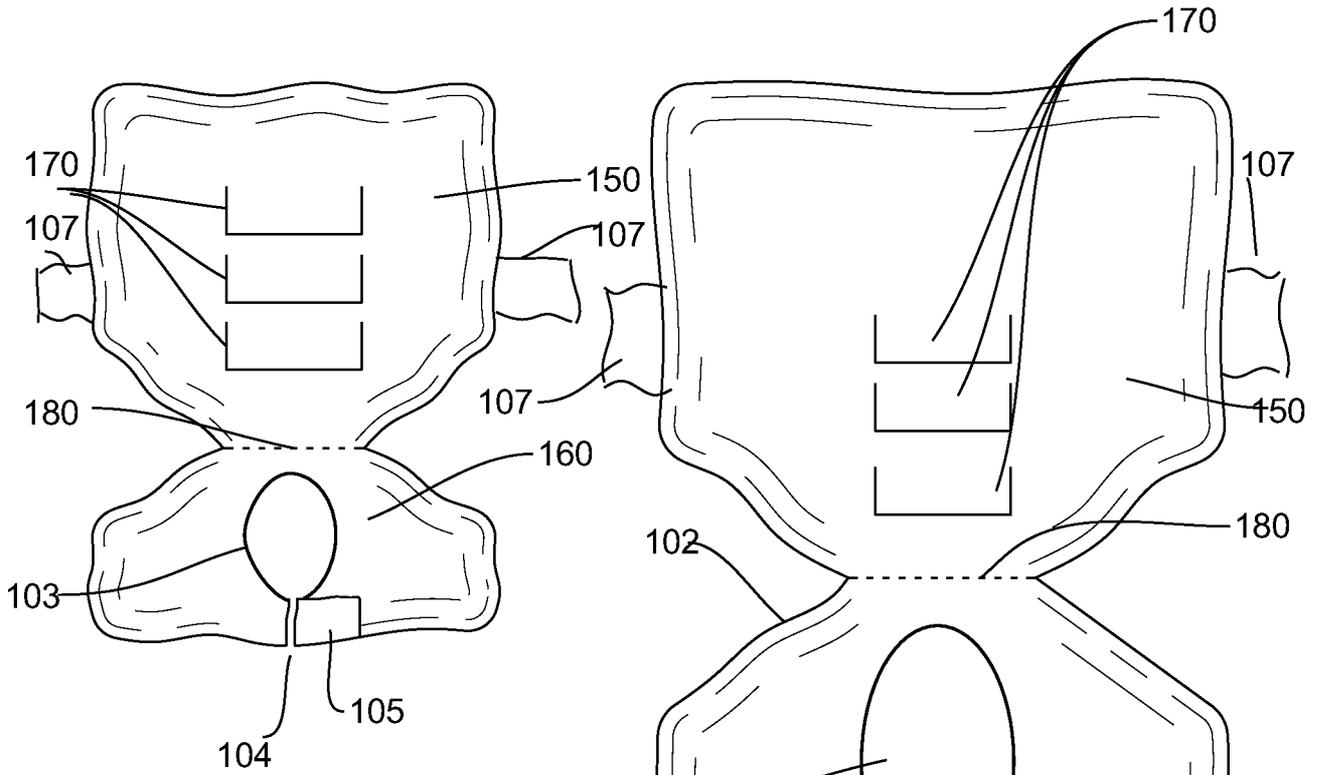


FIG. 1B

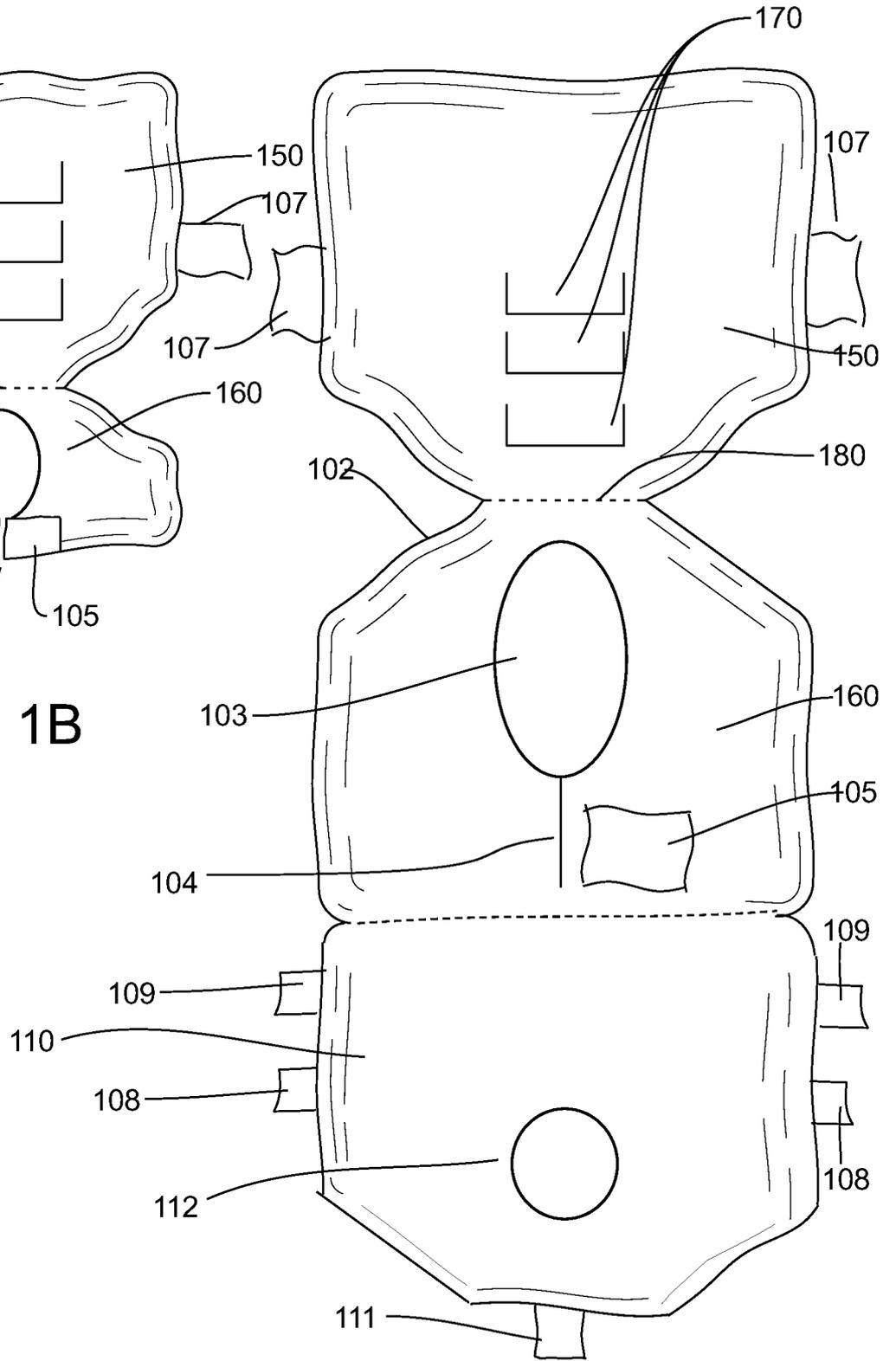


FIG. 1C

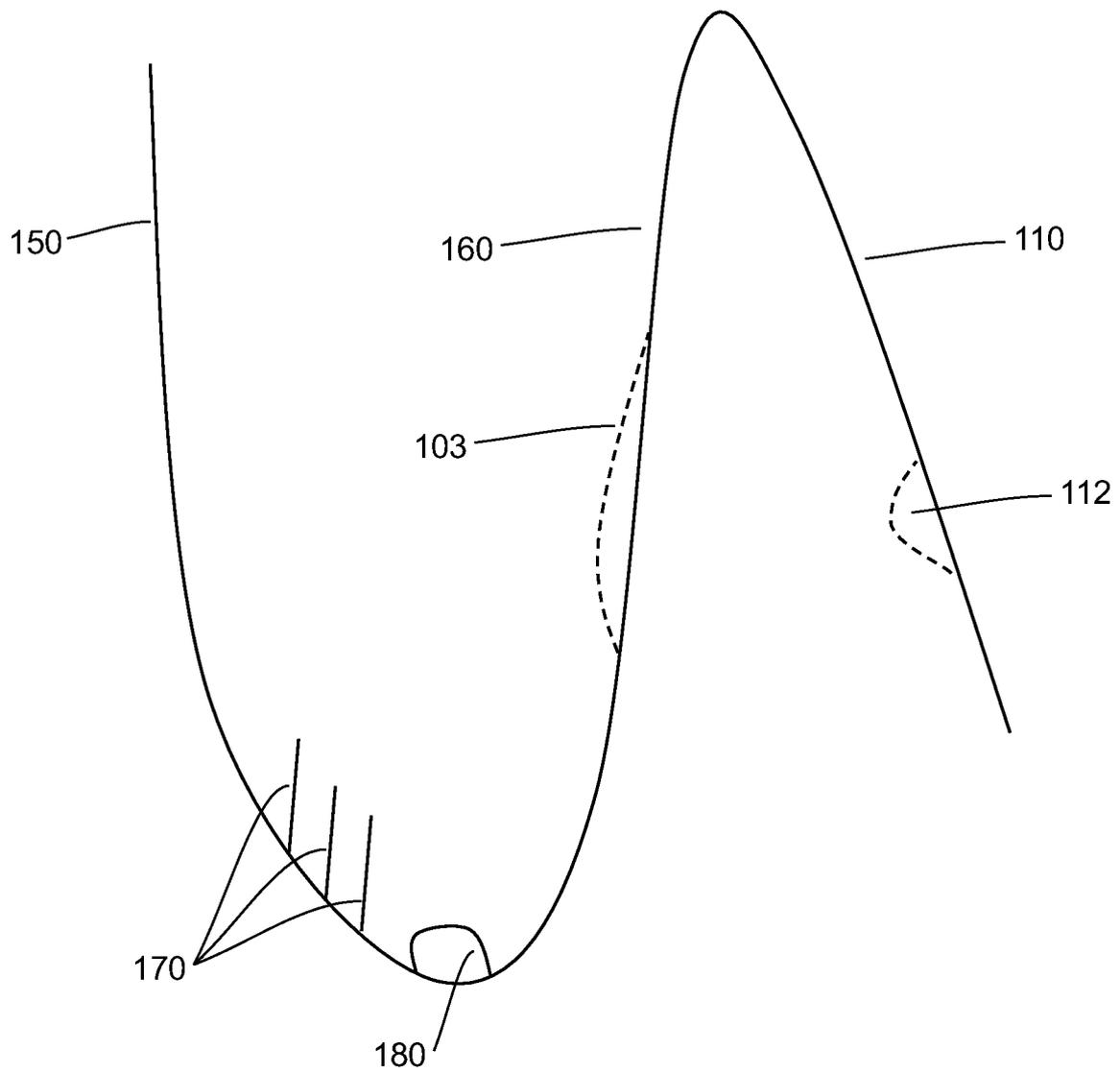


FIG. 1D

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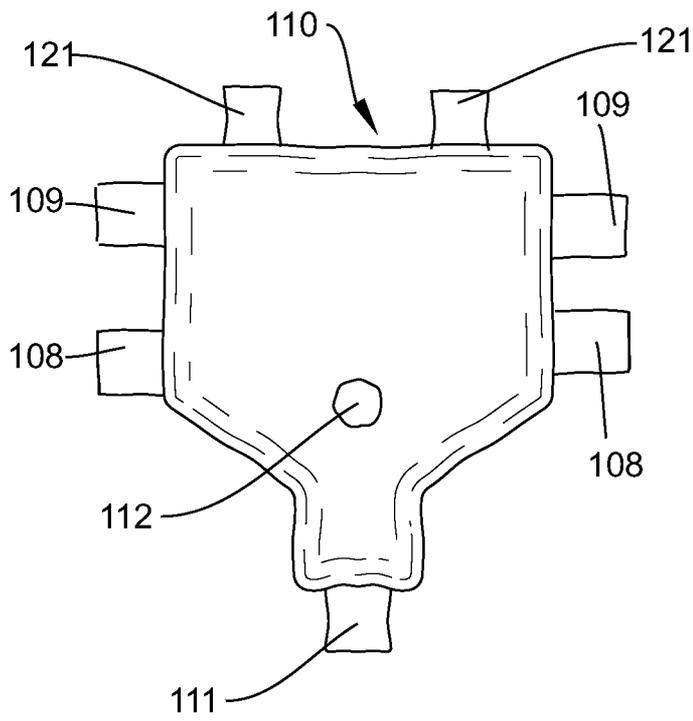


FIG. 2

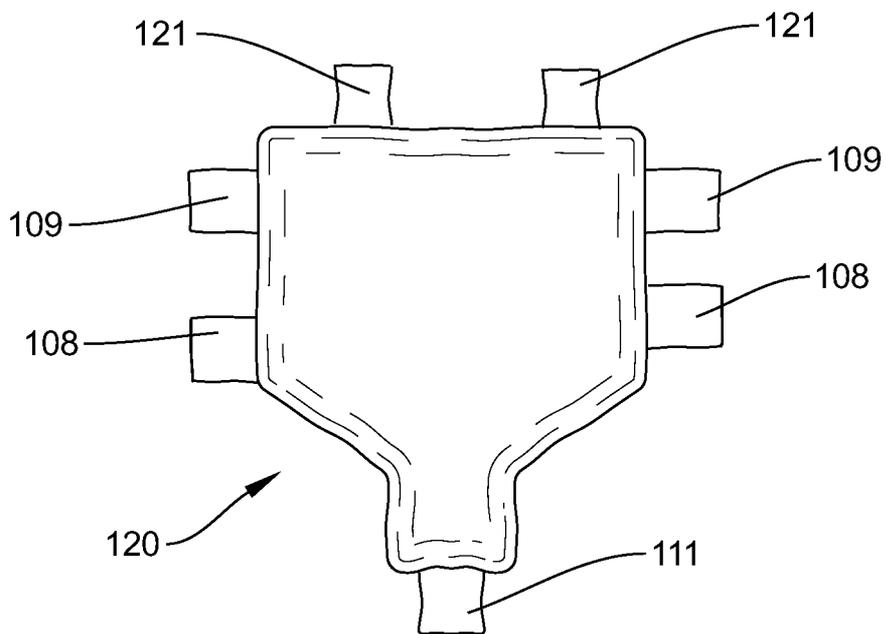


FIG. 3

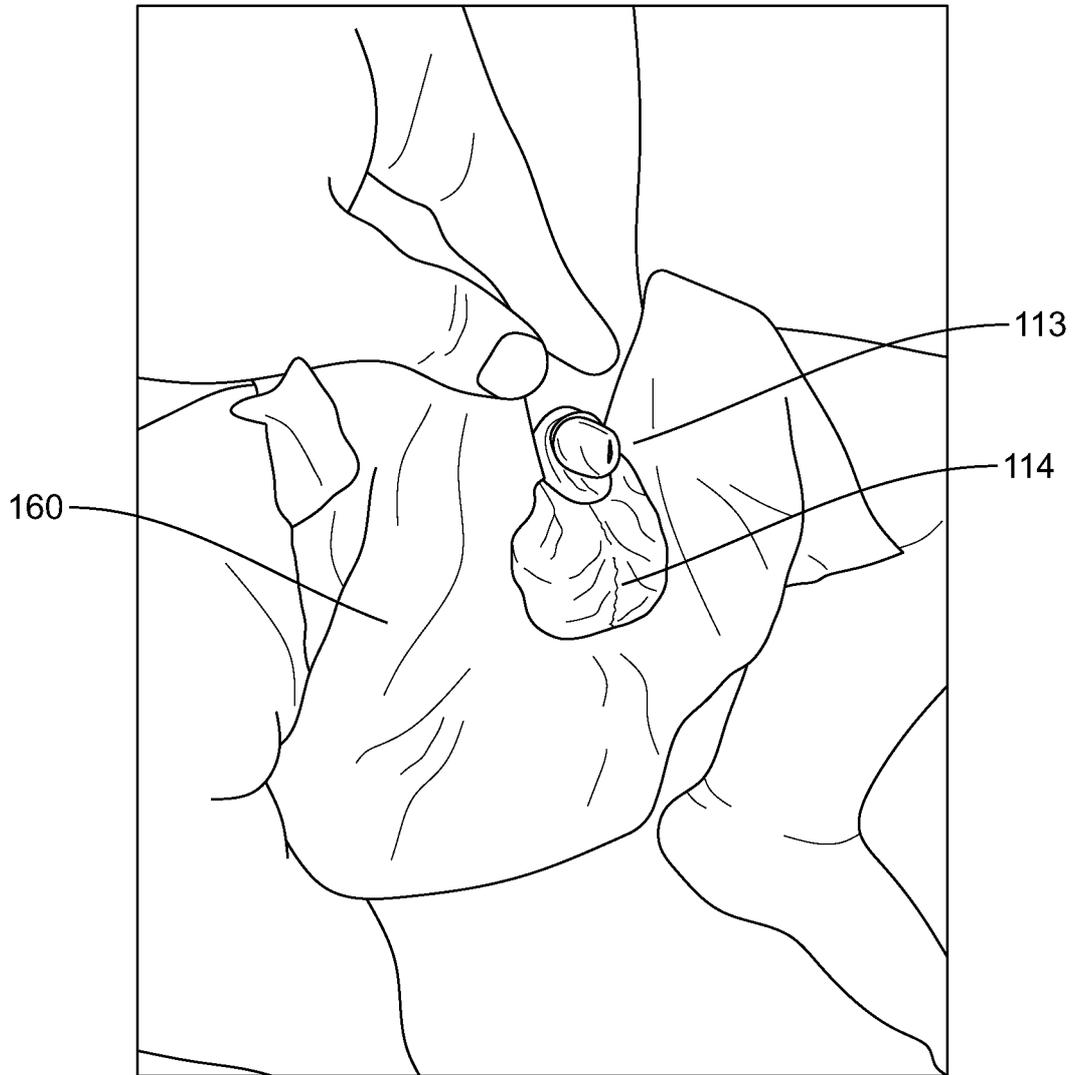


FIG. 4

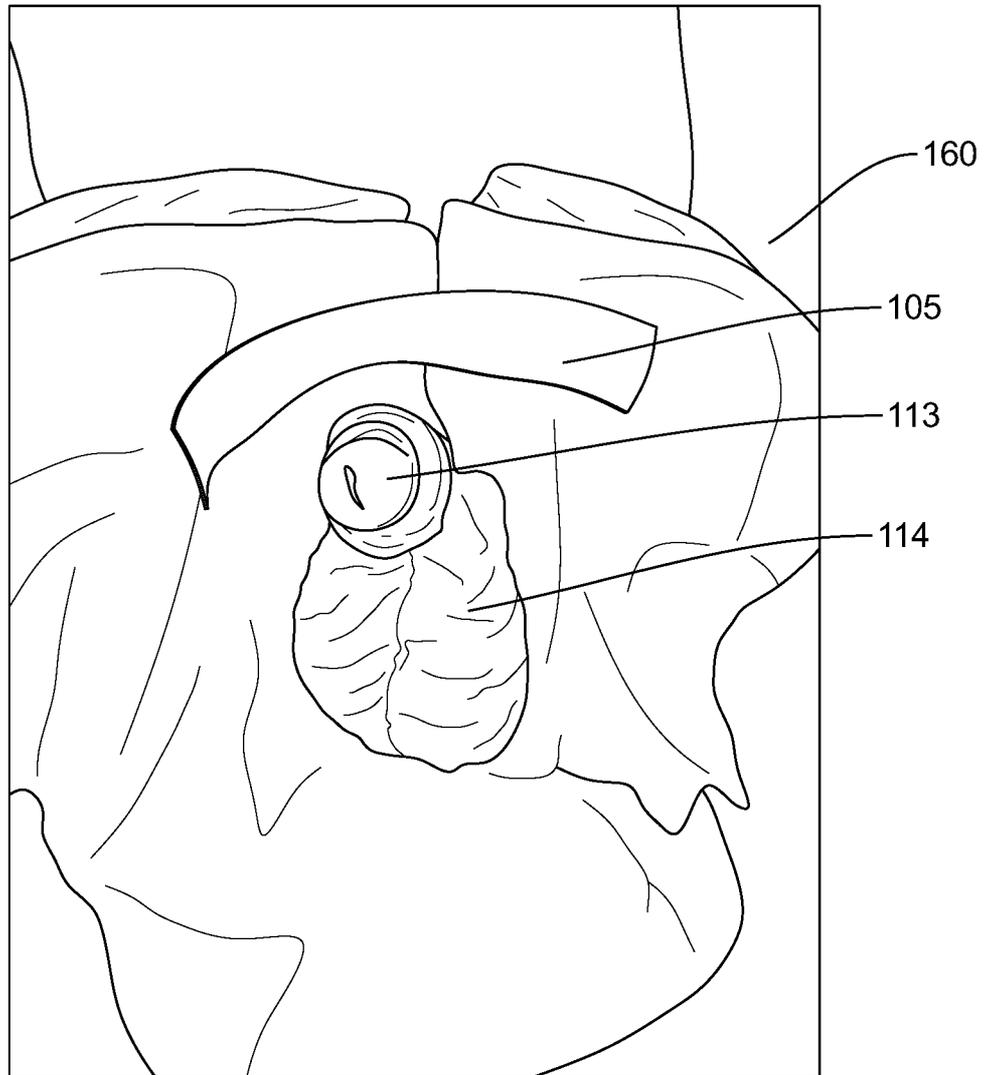


FIG. 5

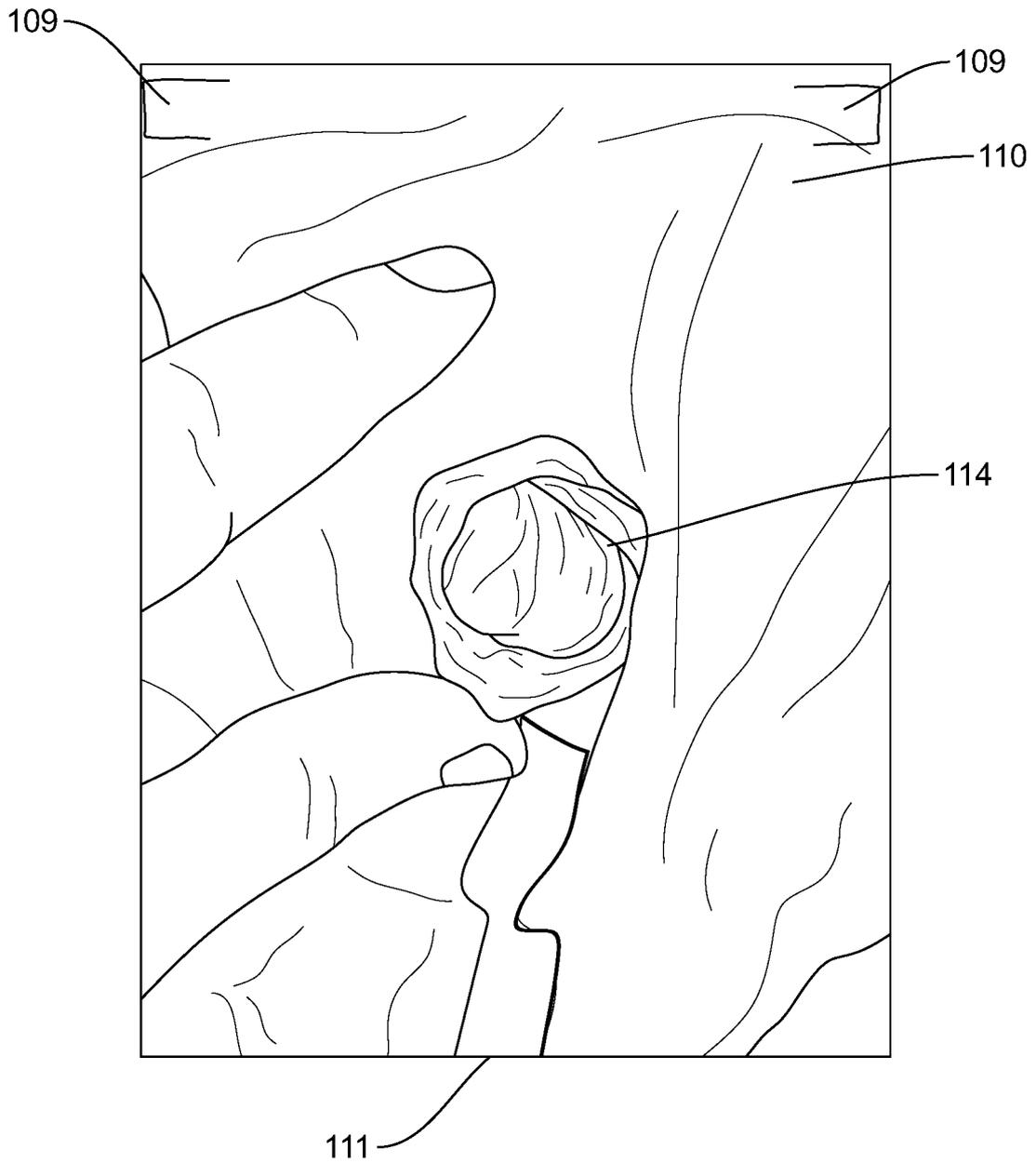


FIG. 6

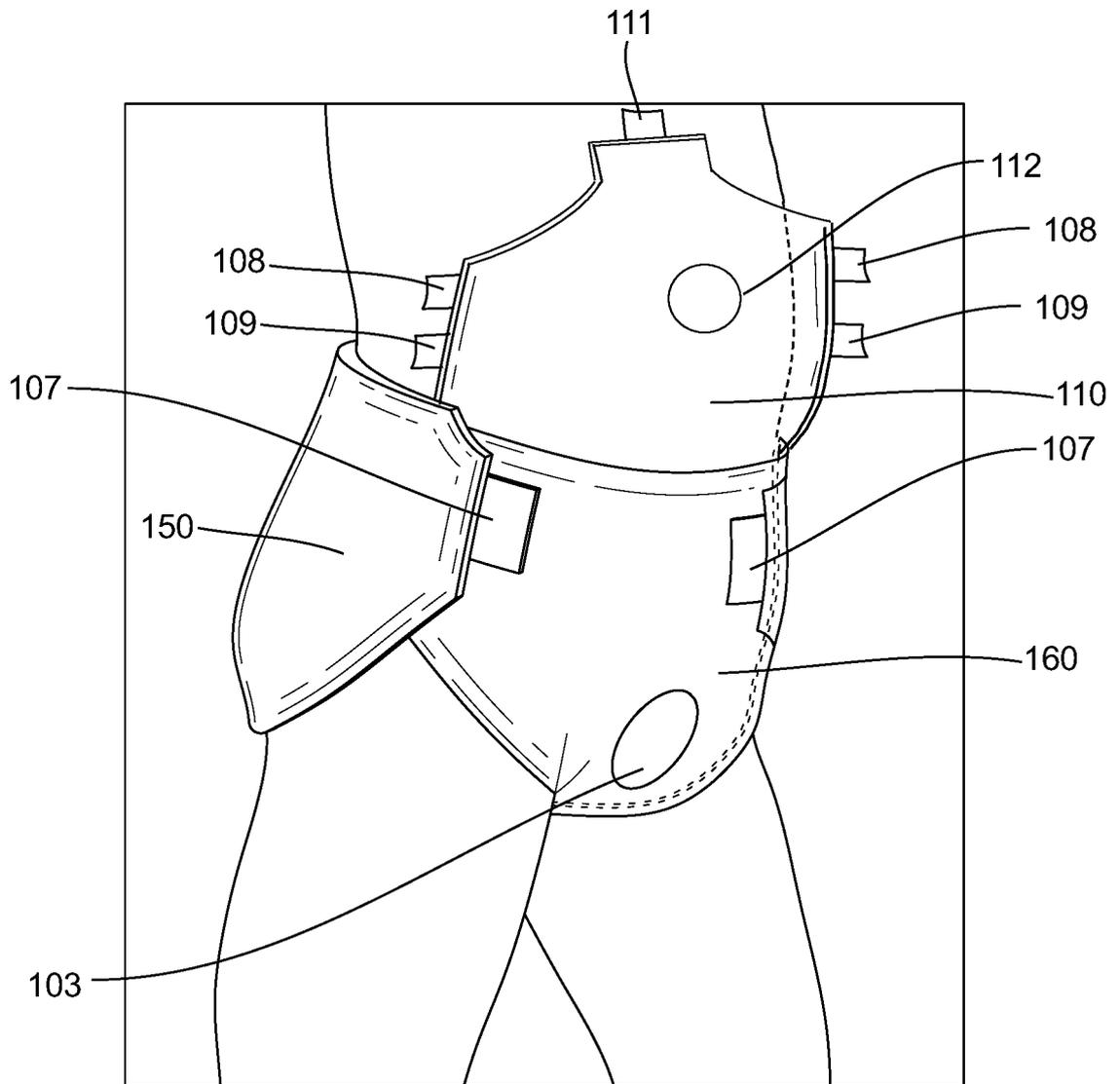


FIG. 7

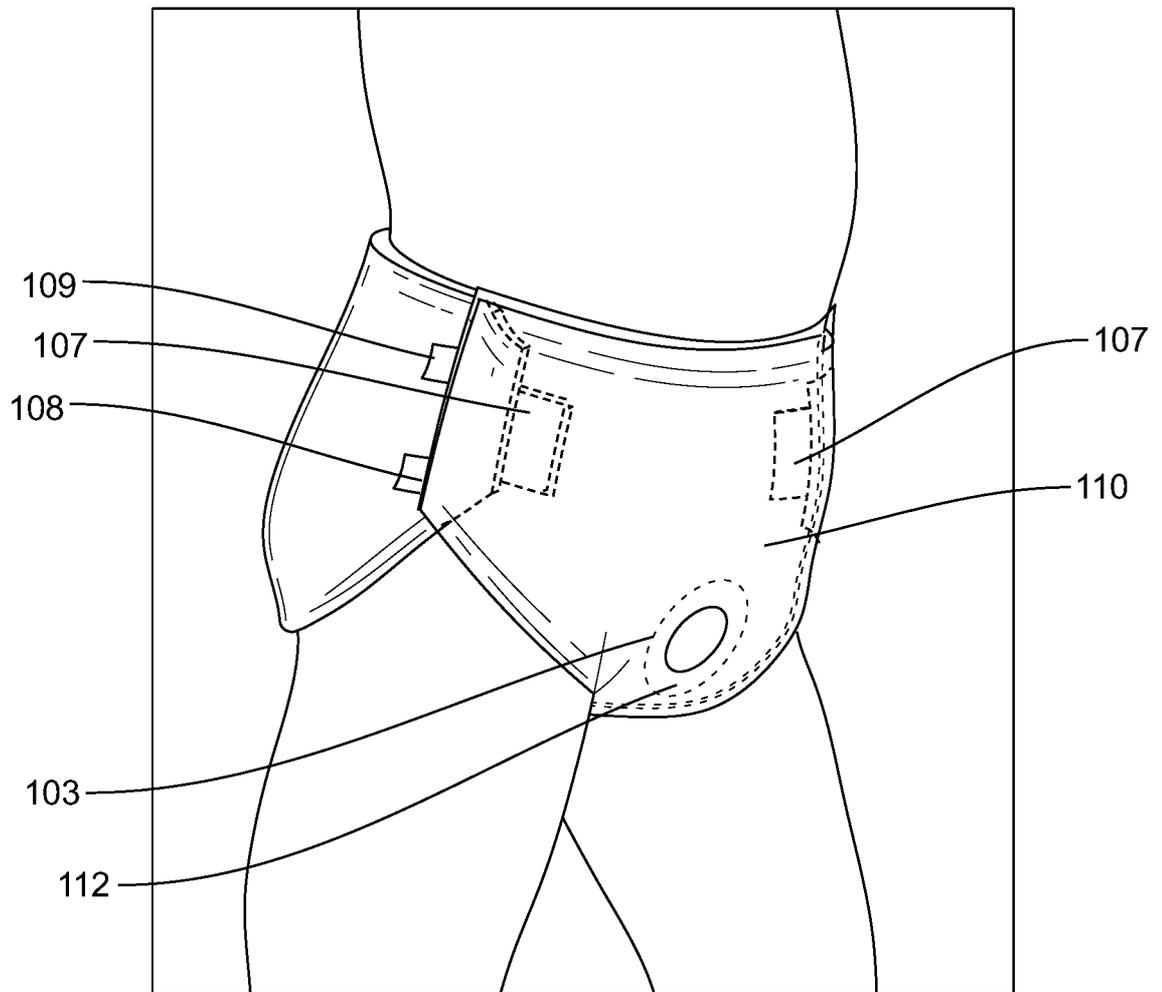


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2021/051550

A. CLASSIFICATION OF SUBJECT MATTER		
A41B 9/02(2022.01)i; A61F 13/15(2022.01)i; A61F 13/471(2022.01)i; A61F 13/49(2022.01)i; A61F 13/45(2022.01)i CPC:A41B 9/023; A41B 9/026; A61F 13/15; A61F 13/471; A61F 13/49; A61F 13/45		
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) A41B 9/02; A61F 13/15; A61F 13/471; A61F 13/49; A61F 13/45 CPC:A41B 9/023; A41B 9/026; A61F 13/15; A61F 13/471; A61F 13/49; A61F 13/45		
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) Databases consulted: Esp@cenet, Google Patents, Orbit, Similari (AI-based)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2014084979 A1 (PROTECTIVE DIAPER, LLC) 05 June 2014 (2014-06-05) The whole document	1-23
Y	US 5556393 A (MOLNLYCKE AB) 17 September 1996 (1996-09-17) The whole document	1-23
A	US 2020315863 A1 (KANGCHENG INTERNATIONAL CO., LTD) 08 October 2020 (2020-10-08) The whole document	1-23
P,A	US 2021315745 A1 (Concepts for Success) 14 October 2021 (2021-10-14) The whole document	1-23
A	KR 200464213 Y1 (Nam jin) 18 December 2012 (2012-12-18) The whole document	1-23
A	CN 203986144 U (ZHENG QIMING) 10 December 2014 (2014-12-10) The whole document	1-23
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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) "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 "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 "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 "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 "&" document member of the same patent family		
Date of the actual completion of the international search 15 March 2022		Date of mailing of the international search report 15 March 2022
Name and mailing address of the ISA/IL Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Israel Telephone No. 972-73-3927197 Email: pctoffice@justice.gov.il		Authorized officer GREENFIELD Liora Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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