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(54) Improvements in or relating to clasps

(57) The present invention relates to improvements in or relating to a child-supporting shoulder harnesses, and an improved clasp therefor. The invention also relates to detachable child supports. In particular, the present invention relates to which can be used to assist in the securing of a child to a harness. Baby carriers have been available since time immemorial. Sheets and various swaddling clothes have been arranged so that a mother could go about her business, whilst staying in intimate contact with a child. Nowadays, with the widespread use of buggies, push-chairs, prams, baby car

seats and the like it is not particularly practical to support a child in such an arrangement. Today, there are many child supports which comprise a harness arrangement which, together with buckles, clips and straps secure the harness to a single piece of padded material, which is used to secure a child. However, the clasps that are used to retain the parts are often the weakest point and can cause much anguish in their deployment. The present invention seeks to provide an improved clasp and to improved child support arrangement arising therefrom.

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DescriptionField of Invention

[0001] The present invention relates to improvements in or relating to clasps. In particular the present invention relates to clasps operable to secure child-supports relative to a harness, chair, pram or similar. In particular, the present invention relates to an improved clasp which can be used to assist in the securing of a child within a pouch or support to a harness, chair or other.

Background to the Invention

[0002] Baby carriers have been available since time immemorial. Sheets and various swaddling clothes have been arranged so that a mother could go about her business, whilst staying in intimate contact with a child. Typically many children need to be supported from birth (when the head of a baby needs to be carefully supported) to two years or more: children will want to walk alongside parents and other people, but will soon tire and provision for the carrying of three-to four- year olds needs to be considered for some.

[0003] Nowadays, with the widespread use of buggies, push-chairs, prams, baby car seats and the like it is not particularly practical to support a child in such an arrangement. Indeed there are many types of child support devices whereby a parent or carer act as one. There are several types which rely upon a single piece of padded material with apertures for legs and arms of a child; the child can be huddled closely against the adult or may face forwardly. EP 1 055 382 teaches of a simple material based carrier which uses straps connected thereto to provide a rucksack-like baby carrier, as can be seen from Figures 1a and 1b; there are several other rucksack - like baby carriers which employ a metal frame and the child is supported that he or she can look-over the shoulder of the adult carrying them. Today, there are many child supports which comprise a harness arrangement which, together with buckles, clips and straps secure the harness to a single piece of padded material, which is used to secure a child.

[0004] WO-92/12656 discloses a baby carrier which includes two closed strap loops which are mutually connected on the rear side of the carrying person, and which are detachably connected on the carrying person's front side to respective upper and lower attachment points on a piece of material or carrier which forms a pouch on a front side of the baby carrier. The carrier piece is provided with two longitudinally spaced attachment points at the bottom of said piece, so as to enable the pouch to be adjusted to two predetermined different depths.

[0005] Figures 2a and 2b show such an arrangement; the fasteners may be simple, but are numerous. The fasteners of this teaching comprise a duffel fastener and ring, connected to respective parts to the fastened to each other, via an anchoring strap. The anchoring strap also has two mutually cooperating press-button coupling members. Fastener means of this kind are highly expensive, due partly to the cost of the individual components, and partly due to the cost of securing the components to the baby carrier. Furthermore, the pouch can only be adjusted to two different depths. There is also a tendency for the fastener devices (the rings/duffel fasteners) to be clamped or squeezed against the carrying person's chest and thereby cause discomfort.

[0006] The harness, as attached to an adult, is known in several basic configurations, and can comprise - in a simple form - of two loops, conveniently adjustable, which are joined at a rear part, which during use is adjacent an upper back of a wearer, with the loops worn at the base of the arms, depending at a lower point, adjacent a lower part of the body, where it is attached to the baby pouch, with straps extending to and being connected to the harness at either side. The baby carrying part is attached to the harness by a snap buckle or similar, which simultaneously connects each loop of the harness to the baby carrying part. The lower part of the baby carrying part has a front wall which includes at least one upper free side edge, to which the straps referred to extend. Each side of the upper edge can be respectively released from and fastened to the harness respectively through the medium of a connecting device that functions to support the front wall from the harness and to define between the free side edge of the front wall and the harness beneath the connecting device an opening for receiving the legs of a baby and located. The connecting device includes a hook fastener which comprises a male part that has a downwardly pointing finger on the front wall, and a closely situated finger-receiving female part carried by the harness.

[0007] One problem with a harness of this description is that the opening that accommodates the baby's legs is defined by the side edge of the front wall and the adjacent part of the harness strap, along a distance from the connection point between the hook fastener and the bottom connection of the front wall to the harness. The connection between the male part of the hook fastener and the front piece defines the upper baby support level of the front wall, where a baby is carried by the harness.

[0008] However, when this front piece is sufficiently high, there is a risk that the leg opening will be so large as to allow both legs of a small baby to pass through one leg opening and the baby falling therethrough. Furthermore the uses of simple clips and duffel connectors are not quite so easy to manipulate, especially when there is a child present.

[0009] To overcome this disadvantage, in EP 0 752 220, a further baby support is described, wherein the size of the

leg opening was reduced while maintaining the advantage of being readily able to use a hook fastener that can be established quickly and securely with a single, easily effected coupling operation, by the use of strap loops that are releasably connected to the lower end-part of the pouch by means of a clasp which includes an insert lock for each strap loop, and a bar lock for adjusting the free length of the lower belt-like end-part of the pouch.

[0010] However, such a harness can become unwieldy to use; there are too many connections which can take time to connect - which can be critical with a baby that is either wriggling or is asleep and should not be disturbed.

Object to the present invention

[0011] The present invention seeks to overcome the problems of the prior art with the provision of, and, in conjunction with, a simple coupling device.

Statement of Invention

[0012] In accordance with a first aspect of the invention, there is provided a clasp for coupling first and second parts of a baby carrier and support, the clasp comprising first and second components, associated respectively with the baby carrier and support, wherein: the first component has a mating surface and extending outwardly therefrom an extending element like a pin having at a proximal end a shaft of a first diameter with an increased diameter portion at a distal end and an abutment element; the second component has a mating surface, which in operation faces the mating surface of the first component, and has a channel; wherein the channel has an aperture and a rebate of sufficient size to accept insertion of the distal portion of the extending element and to enable the distal end portion of the pin to be slid along the channel from the aperture along a first rectilinear section, through a second generally hook-like section to an engagement position, wherein movement of said distal end portion within the channel towards said engagement position is generally lateral with respect to a direction of load, until the respective abutment element abuts at least a portion of said aperture of the channel upon engagement, whereby, movement of the distal end portion is limited in the load direction. For a reliable connection between both coupling parts the abutment element provides an angular shaped shaft which engages in a flush manner with edges at the aperture of the channel, so that any movements between both coupling parts around an axis which is perpendicular to said mating surfaces are suppressed. Further the channel provides at the engagement position also a rectilinear section which is aligned perpendicular to the first rectilinear section near by the aperture. In this engagement position the extending element rests very stable and the shaft of the extending element abuts one-sided to the channel wall.

[0013] In a preferred embodiment the channel provides a little continuation in the engagement position which again is directed perpendicular to the rectilinear section and which follows up in direction to the first rectilinear section. In case of uncontrolled vertical movements the extended element moves into the vertical continuation of this channel portion and will be fixed and stopped immediately along said section. This provides a further protection against uncontrolled release of both coupling parts.

[0014] Thus, in use, the distal end of the first component is inserted into the aperture and is slid along the channel until said distal end approaches the engagement position. When used in conjunction with a baby carrier and harness, up and down movement of the respective movement is unlikely to disconnect the components since the movement does not correspond with a release movement. As will be appreciated, gravitation pull assists in safe retention of the first clasp element relative to the other. It will also be realised that first and second components can be interchanged with respect to carrier and harness subject to the parts being inverted in orientation, since the load of a baby pouch or carrier will generally be acting downwardly with respect to the harness.

[0015] Disengagement is possible, when the distal end is in the engaged position, by effecting an initial movement along the channel in a direction perpendicular to the load direction and then allowing the distal portion to move along the channel to the other end of the channel.

[0016] The clasp can conveniently have a channel generally in the form of an upstanding hockey stick or in the form of an inverted "question mark" punctuation symbol. Conveniently the clasp components can be manufactured from plastics materials such as polypropylene.

[0017] In accordance with other aspects of the invention, there can be provided a baby-carrier arrangement and a coupling element, wherein the baby-carrier can be fastened securely with respect to chairs, prams and the like, wherein the baby-carrier surrounds the baby, providing apertures for legs and optionally for arms, depending on the size of the baby. That is to say, a baby, which has been carried around with a parent or carer may be simply detached from a harness and then be transferred to a baby-buggy, stroller, high-chair or similar, the receiving device having a corresponding coupling element whereby the child may be safely be received and retained in such a device, optionally employing further connector straps. Specifically:

[0018] In accordance with a second aspect of the invention, there is provided a baby carrier to be used by an adult, comprising a separable coupling device, a pouch and a harness, wherein; the separable coupling device comprises a

clasp in accordance with the first aspect of the invention; the pouch comprises a piece of material having a front portion with an upper edge; a rear portion with an upper edge, and a reduced width seat portion, between the front and rear portions, whereby, in use, a bottom of the baby can lie against the seat portion of the pouch, with a leg of the baby depending either side of the reduced width seat portion of the pouch, the pouch having a first attachment means comprising a first element of the coupling device and another attachment means; the harness comprises an arrangement operably worn by the adult such that a second element of the coupling device extends outwardly from the adult and the harness further provides a stay element for the other attachment means, wherein, in use a baby is placed within the pouch, the first element of the coupling device is inserted into the second element of the coupling device and the other attachment means is fastened whereby to enable secure retention of the baby, within the pouch relative to the harness.

Conveniently, further elements of the pouch limit sideways movement of a baby, once placed therein; such further elements can comprise straps, which may be adjustable, for example, they may be fastened by hook and loop fasteners. **[0019]** The harness can comprise a tabard like element such that a second element of the coupling device extends outwardly from the adult; alternatively, the harness conveniently can comprise a belt portion, depending upwardly therefrom are two straps, arranged to pass over the shoulders of a wearer and connect at secondary fastening points of the belt. The other attachment means can comprise a single strap which, in operation extends from a distal portion of the pouch relative to the first attachment means to the harness; alternatively, the other attachment means comprises two straps which, in operation, extend from respective distal portions of the pouch relative to the first attachment means to the harness.

[0020] In accordance with a further aspect of the invention, there is provided a baby carrier to be attached to a chair, pram, push chair or like product, comprising a separable coupling device and a pouch, wherein; the separable coupling device comprises a clasp in accordance with the first aspect of the invention; the pouch comprises a piece of material having a front portion with an upper edge; a rear portion with an upper edge, and a reduced width seat portion, between the front and rear portions, whereby, in use, a bottom of the baby can lie against the seat portion of the pouch, with a leg of the baby depending either side of the reduced width seat portion of the pouch, the pouch having a first attachment means comprising a first element of the coupling device and another attachment means; wherein the chair, pram, push chair or like product comprises an arrangement operably securely attached to the chair, pram, push chair or like product such that a second element of the coupling device extends outwardly from the chair, pram, push chair or like product and the chair, pram, push chair or like product further provides a stay element for the other attachment means, wherein, in use a baby is placed within the pouch, the first element of the coupling device is inserted into the second element of the coupling device and the other attachment means is fastened whereby to enable secure retention of the baby, within the pouch relative to the chair, pram, push chair or like product. Additional straps can be provided as described with respect to the harness arrangement.

[0021] The arrangement can be operably securely attached to the chair, pram, push chair or like product comprises either a single element or separate elements which is/are separately fastened to the chair, pram, push chair or like product by one or more of straps, adhesive, thread, screw fastening means, rivets or other fastening means.

[0022] The harness conveniently comprises a belt portion, depending upwardly therefrom are two straps, arranged to pass over the shoulders of a wearer and connect at secondary fastening points of the belt.

Brief Description of the Figures

[0023] For a better understanding of the present invention, reference will now be made, by way of example only, to the Figures as shown in the accompanying drawing sheets, wherein:

Figures 1a and 1b	illustrate front and rear views of a known baby-carrier in use;
Figures 2a and 2b	show the front part of a known baby-carrier and use of such;
Figure 3	illustrates a first example of a baby-carrier in accordance with the invention;
Figures 4a and 4b	illustrate one of the types of clasp made in accordance with the invention;
Figures 5 and 5a	detail aspects of a first type of clasp connector made in accordance with the invention.
Figures 6 and 7	detail how the clasp elements cooperate; and
Figure 8	shows another embodiment of the invention.

Detailed description of the Preferred Embodiments

[0024] There will now be described, by way of example only, the best mode contemplated by the inventors for carrying out the present invention. In the following description, numerous specific details are set out in order to provide a complete understanding to the present invention. It will be apparent to those skilled in the art, that the present invention may be put into practice with variations of the specific.

[0025] Referring to Figure 3, there is shown a first embodiment of the invention, wherein a baby-carrier arrangement

10 is shown. The baby carrier comprises a harness arrangement 11 and a baby support 16. The baby support 16 is connectable with respect to the harness 11 by a clasp or connector elements 12, 17 which cooperates with two further connectors, 13, conveniently being attached by flexible straps 18 to the baby support 16, to provide additional support, for example when a person carrying a child is walking over uneven surfaces, which might make a single clasp unsuitable - in that such a clasp may be too large for convenience.

[0026] Baby support 16 is conveniently manufactured from a flexible material such as a plastics/cotton material and comprises a front portion 20, which can conveniently abut the stomach of a child, to restrain movement in a forward direction; this front portion 20 being connected via a seat portion 21 to a rear portion 19 of the support. In this Figure the connector or clasp element 17 is retained within the material of the rear portion. In some models, there may be front and rear clasps whereby to enable a child to face a parent or carer carrying them. Buckle and strap arrangement 22 enables the dimension of the child support to be varied, whereby to accommodate differences in size of child. In use an outwardly extending member of the clasp element 17 is inserted in a generally arcuate channel of the corresponding clasp element associated with the harness of the child support; as the outwardly extending element passes downwardly, a hook-like abutment means engages with a top edge of the clasp element surrounding the channel, the movement of the extending element being transverse as the extending element comes to a stop, whereby vertical movement between the two clasp elements 12, 17 is restricted, such that the clasp elements are securely fastened with respect to one another. In order to enable release, then the two clasp elements have to be twisted with respect to each other such that the extending element passes up the channel, whereby the abutment hook member is raised/separated from the top edge of the channel defining member.

[0027] Referring now to Figure 4a and 4b, clasp element 17 comprises a hook-like abutment portion 28, having an inside face 31 operable to abut an edge portion of the other clasp when connected. Further the abutment portion 28 provides angular flanks 28' which abut in flush manner with flanks 28" of the aperture section 26 described below. Also the extending element 29 has a shaft 30 and a distal portion 29' which is of greater diameter than the shaft 30. Both the hook-like abutment portion 28 and the extending element 29 are arranged in line along which a load acts in use of the clasp.

[0028] Figure 5a details features of clasp element 12. A planar face member 24 provides a rebated channel 25, which is arcuate, the channel 25 extending from an aperture 26 which is bordered by two flanks 28" enclosing an angle of more than 90° but less than 180°. The channel 25 further provides a rectilinear section 25' followed by a second generally hook-like section 25" to an engagement position 25"', which also rectilinear. Finally the channel at the engagement position 25"' provides a further a small continuation channel 23 which is directed perpendicular to the rectilinear shaped engagement position 25"' and which follows up in direction to the first rectilinear section 25'. In case of uncontrolled vertical movements the extended element moves into the vertical continuation 23 of this channel portion and will be fixed and stopped immediately along said section.

[0029] When the two clasp elements 12, 17 are brought into a co-operating relationship, the broader distal end portion 29' of the extending element 29 is inserted into the rebated portion 25 of the channel. The rebate may arise by virtue of the face portion 24 being a thin planar element. Figure 5a shows an alternative channel 25a wherein the channel is similar in outline to a hockey stick.

[0030] Figure 6 shows how clasp 17 can be retained in clasp element 12. Both clasp elements are shown in the engagement position in a longitudinal section view. At the top side the abutment portion 28 is positioned in the aperture section 26 and abuts the flanks of the aperture (not shown) and overlaps further the rear side of the face portion 24 with its proximal portion which is plate like. This ensures that the clasp element 17 can not tilt away from the clasp 17. Also in case of an abrupt vertical movement the shaft of the extending element 29 moves slightly into the rectilinear continuation 23 of the channel 25 and is fixed and stopped safely without loosening from the engagement. It will be appreciated that this contributes to the security of the fastener.

[0031] Figure 7 shows a reverse view of clasp 12. The inside face of face 24 is identified as face 32: the distal end 29' of extending element 29 of clasp element 17 is seen protruding: there is little chance of movement in an axial direction defined by reference D. The abutment portion 28 which provides a overhang portion is seen in close proximity to the inside face 32 which assists the arrangement in providing a simple yet secure two part clasp. Also the shaft 30 of the abutment portion 28 provides as mentioned before angular flanks 28' which coincident concerning the inclination with the edge portion 26 of the recess opening in the planar face member 24. This ensures, that the baby support 16 to which the clasp element 17 is fixed can not swing around a horizontal axis in use.

[0032] The clasp components can be manufactured from a variety of components, but it has been found that poly propylene plastics materials provide easy to mould characteristics with a sufficient frictional fit between components to satisfy a requirement that slippage between the clasps is low. The materials for the different clasp components may be different to help achieve this goal.

[0033] As many parents will advise, the transfer of a wriggling child can be difficult at times, for example, can be difficult if it is desired to place them within a child support - or when they are asleep, one may wish not to disturb the child. A further aspect of the invention can assist in such times: the child support can be in a support in its own right, without necessarily being connected to a harness. Such a child support is shown in Figure 9 where the rear portion 19 extends

upwardly so as to provide fixtures 40 which cooperate with corresponding elements 13 on harness 11 (see figure 3). Straps 41 connect with buckles on the front portion of the child support. In such a fashion, a baby can be enclosed by the child support on its own, without the need for a harness. This can have many other significant benefits: the child support could be connected to a chair. Equally, the design could be extended to seats for push-chairs, strollers and the like.

[0034] Further alternatives are possible. For example, by having the baby support provided with two clasps, to the front and to the rear a child could be positioned facing towards or away from the person carrying the child. Equally, a harness may have front and rear clasps or it may be wearable in a first, forward facing direction, or in a second, rearward facing direction. The distal portion, if made from a resilient material, in whole or in part, may assist in resilient retention of the distal portion in the engagement position.

List of reference numerals

[0035]

10	Baby-carrier arrangement
11	Harness arrangement
12	Connector element, clasp element
13	connector
14	n.n.
15	n.n.
16	Baby support
17	Connector element, clasp element
18	Flexible strap
19	Rear portion
20	Front portion
21	Seat portion
22	Buckle and strap arrangement
23	Continuation channel
24	planar face member, mating surface
25	rebated channel
25'	rectilinear section
25"	hook-like section
25'''	engagement position
26	aperture
27	Mating surface
28	hook-like abutment portion
28'	Angular flanks
28"	flanks
29	Extending element
29'	Distal portion
30	Shaft
31	inside face
32	Face
40	Fixtures
41	strap

Claims

1. A clasp for coupling first and second parts of a baby carrier and support, the clasp comprising first (17) and second (12) components, associated respectively with the baby carrier and support, wherein:

the first component (17) has a mating surface (27) and extending outwardly therefrom an extending element (29) having at a proximal end a shaft (30) of a first diameter with an increased diameter portion at a distal end (29') and an abutment element (28);

the second component (12) has a mating surface (24), which in operation faces the mating surface (27) of the first component (17) and has a rebated channel (25),

wherein the channel (25) has an aperture and a rebate of sufficient size to accept insertion of the distal end portion (29') of the extending element (29) and to enable the distal end portion (29') of the extending element (29) to be slid along the channel (25) from the aperture along a first rectilinear section (25'), through a second generally hook-like section (25'') to an engagement position (25'''), wherein movement of said distal end portion (29') within the channel (25) towards said engagement portion (25''') is generally lateral with respect to a direction of load, until the respective abutment element (28) abut at least a portion of said aperture of the channel (25) upon engagement, whereby, movement of the distal end portion (29') is limited in the load direction.

2. A clasp according to claim 1 wherein the aperture (26) is bordered by at least two flanks (28') enclosing an angle α with $90^\circ \leq \alpha < 180^\circ$.
3. A clasp according to claim 1 or 2, wherein the channel (25) provides a continuation (23) at the engagement portion (25''') which is rectilinear and orientated parallel to the first rectilinear section (25').
4. A clasp according to one of claims 1-3, wherein the engagement portion (25''') of the channel (25) is rectilinear in shape.
5. A clasp according to one of claims 1 - 4, wherein the abutment element (28) provides a shaft having at least two flanks (28'') enclosing an angle β which is $90^\circ \leq \beta < 180^\circ$.
6. A clasp according to claim 2 and 5, wherein $\alpha = \beta$.
7. A clasp according to one of claims 1 - 6, wherein the abutment element (28) provides an overhang portion which at least turns to the extending element (29) which is arranged in line with the abutment element (28) along which load is acting in use of said clasp.
8. A clasp according to one of claims 1 - 7 wherein the hook shaped channel (25) is in the form of an upstanding hockey stick.
9. A clasp according to claim 1 wherein the hook shaped channel (25) is in the form of an inverted "question mark" punctuation symbol.
10. A clasp according to any one of claims 1 -9 wherein, the clasp components are manufactured from plastics materials.
11. A baby carrier to be used by an adult, comprising a separable coupling device, a pouch and a harness, wherein; the separable coupling device comprises a clasp in accordance with any one of claims 1 -10; the pouch comprises a piece of material having a front portion with an upper edge; a rear portion with an upper edge, and a reduced width seat portion, between the front and rear portions, whereby, in use, a bottom of the baby can lie against the seat portion of the pouch, with a leg of the baby depending either side of the reduced width seat portion of the pouch, the pouch having a first attachment means comprising a first element of the coupling device and another attachment means; the harness comprises an arrangement operably worn by the adult such that a second element of the coupling device extends outwardly from the adult and the harness further provides a stay element for the other attachment means, wherein, in use a baby is placed within the pouch, the first element of the coupling device is inserted into the second element of the coupling device and the other attachment means is fastened whereby to enable secure retention of the baby, within the pouch relative to the harness.
12. A baby carrier according to claim 11, wherein the harness comprises a tabard like element such that a second element of the coupling device extends outwardly from the adult.
13. A baby carrier according to claim 11, wherein the harness comprises a belt portion, depending upwardly therefrom are two straps, arranged to pass over the shoulders of a wearer and connect at secondary fastening points of the belt.
14. A baby carrier according to one of claims 11-13, wherein the other attachment means comprises a single strap which, in operation extends from a distal portion of the pouch relative to the first attachment means to the harness.

15. A baby carrier according to one of claim 11-13, wherein the other attachment means comprises two straps which, in operation, extend from respective distal portions of the pouch relative to the first attachment means to the harness.

16. A baby carrier to be attached to a chair, pram, push chair or like product, comprising a separable coupling device and a pouch, wherein;

the separable coupling device comprises a clasp in accordance with any one of claims 1 -10;

the pouch comprises a piece of material having a front portion with an upper edge; a rear portion with an upper edge, and a reduced width seat portion, between the front and rear portions, whereby, in use, a bottom of the baby can lie against the seat portion of the pouch, with a leg of the baby depending either side of the reduced width seat portion of the pouch, the pouch having a first attachment means comprising a first element of the coupling device and another attachment means;

wherein the chair, pram, push chair or like product comprises an arrangement operably securely attached to the chair, pram, push chair or like product such that a second element of the coupling device extends outwardly from the chair, pram, push chair or like product and the chair, pram, push chair or like product further provides a stay element for the other attachment means, wherein, in use a baby is placed within the pouch, the first element of the coupling device is inserted into the second element of the coupling device and the other attachment means is fastened whereby to enable secure retention of the baby, within the pouch relative to the chair, pram, push chair or like product.

17. A baby carrier according to claim 16, wherein the arrangement to be operably securely attached to the chair, pram, push chair or like product comprises separate elements which are separately fastened to the chair, pram, push chair or like product by one or more of straps, adhesive, thread, screw fastening means, rivets or other fastening means.

18. A baby carrier according to claim 16, wherein the arrangement to be operably securely attached to the chair, pram, push chair or like product comprises a single element which is fastened to the chair, pram, push chair or like product by one or more of straps, adhesive, thread, screw fastening means, rivets or other fastening means.

19. A baby carrier according to one of claims 16 - 18, wherein the other attachment means comprises a single strap which, in operation extends from a distal portion of the pouch relative to the first attachment means to the chair, pram, push chair or like product.

20. A baby carrier according to one of claims 16-18, wherein the other attachment means comprises two straps which, in operation, extend from respective distal portions of the pouch relative to the first attachment means to the chair, pram, push chair or like product.

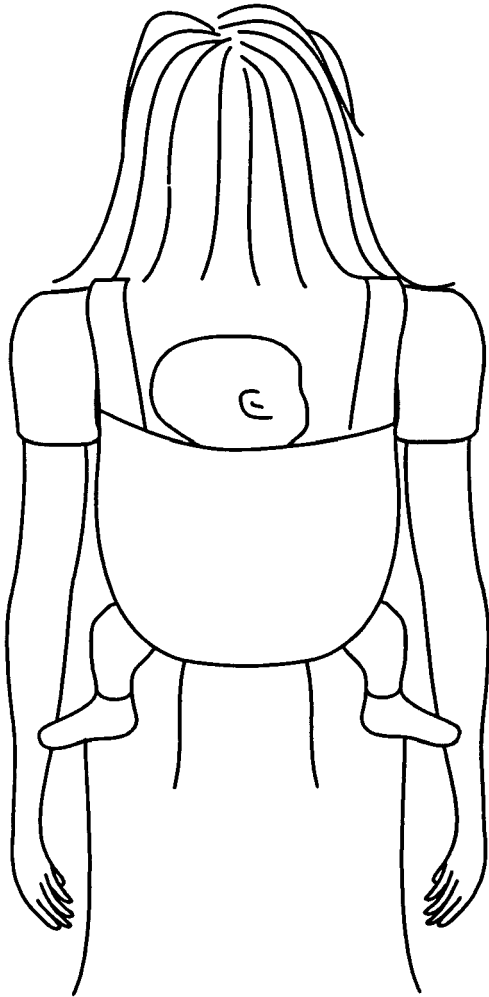


Fig. 1a

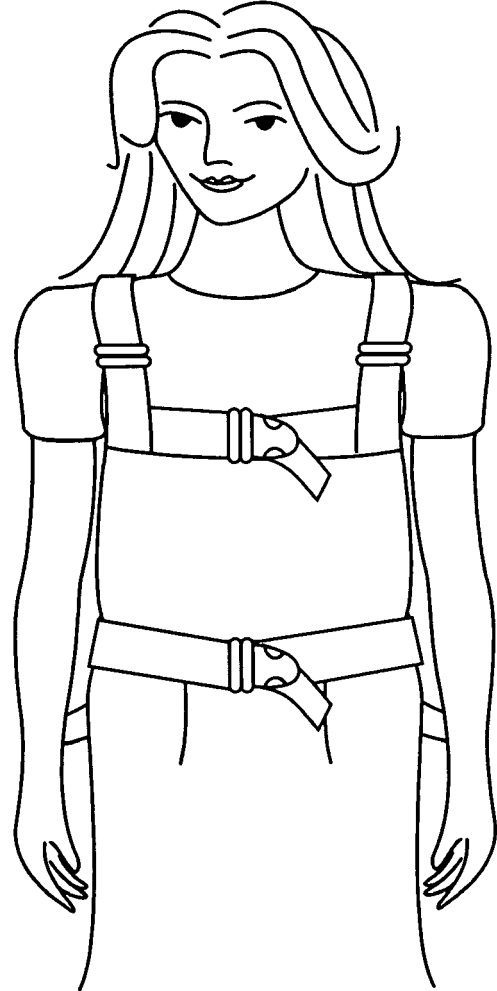


Fig. 1b

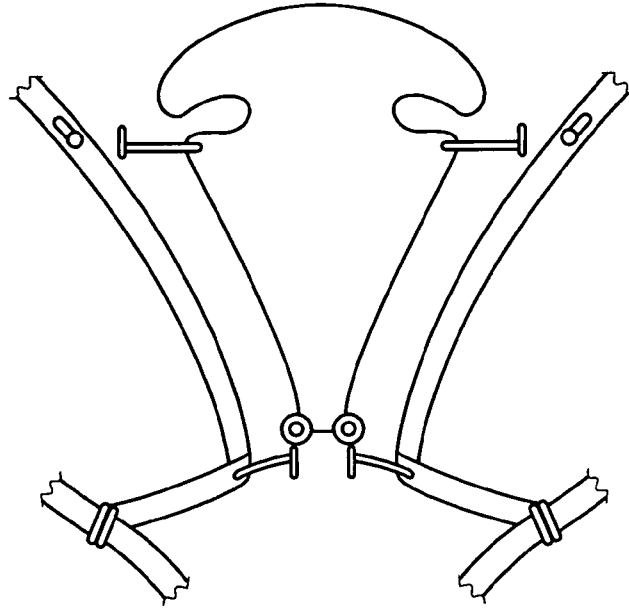


Fig. 2a

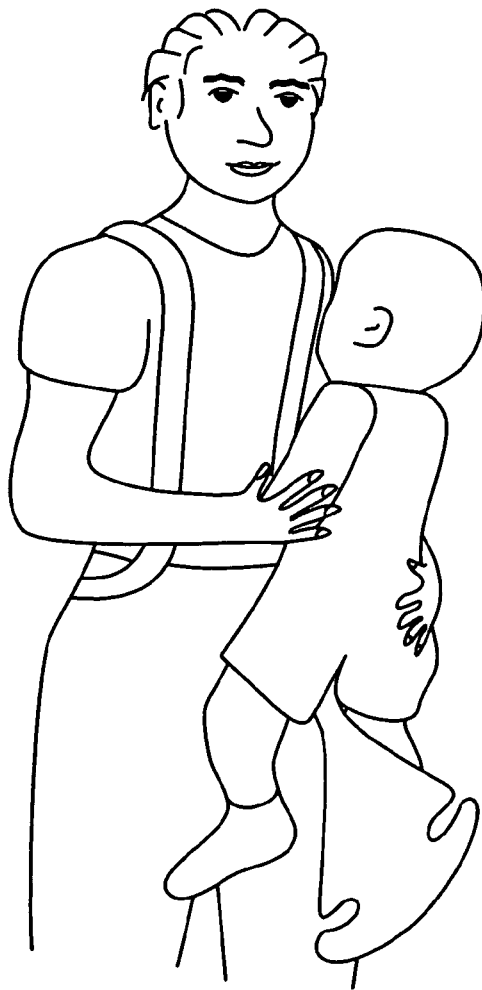


Fig. 2b

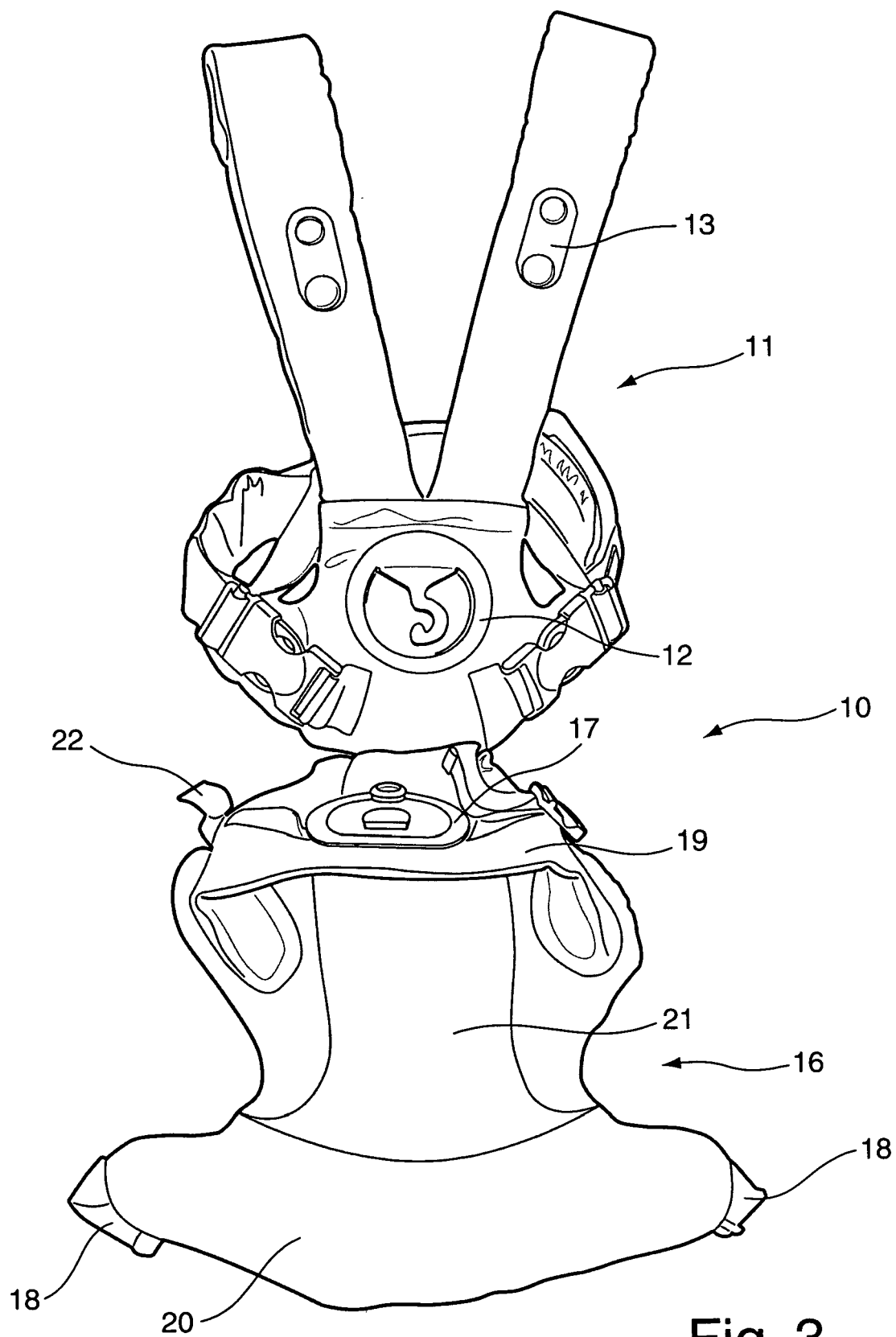


Fig. 3

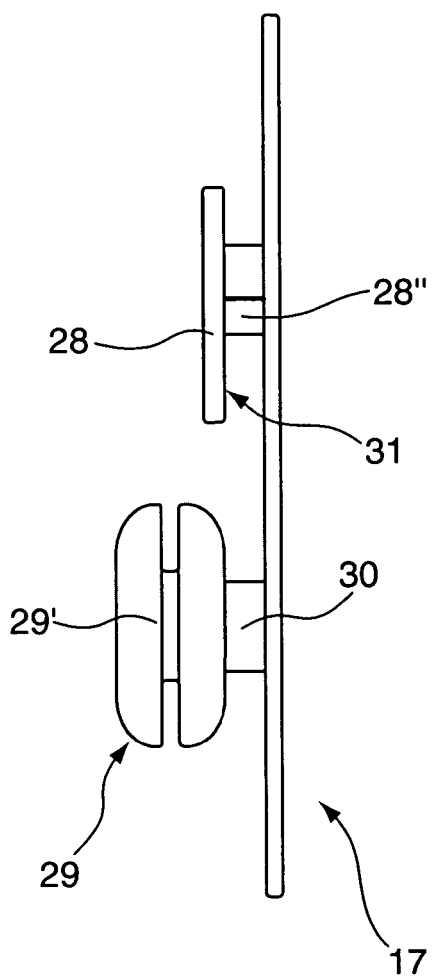


Fig. 4a

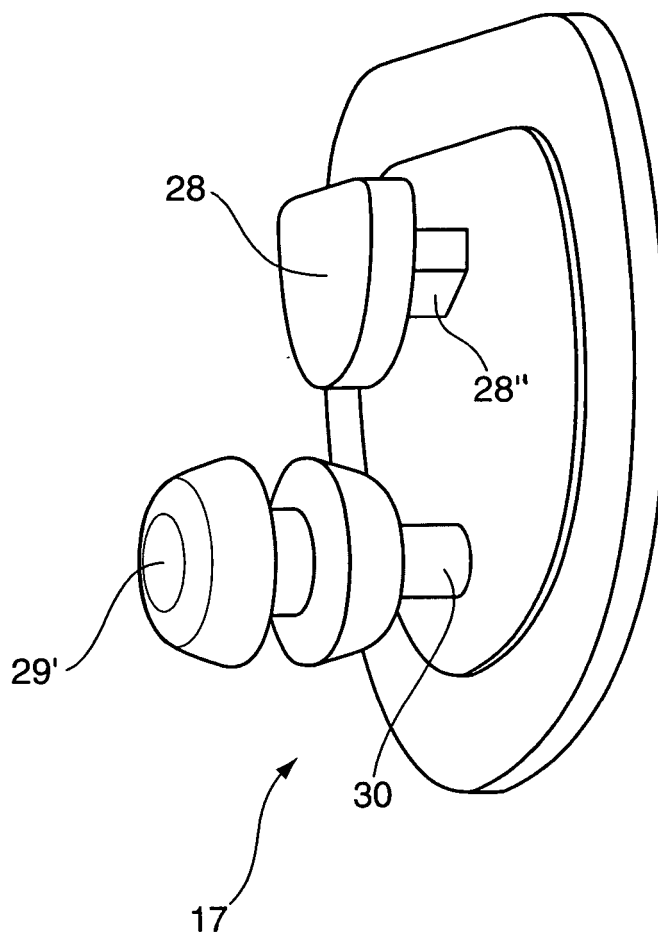


Fig. 4b

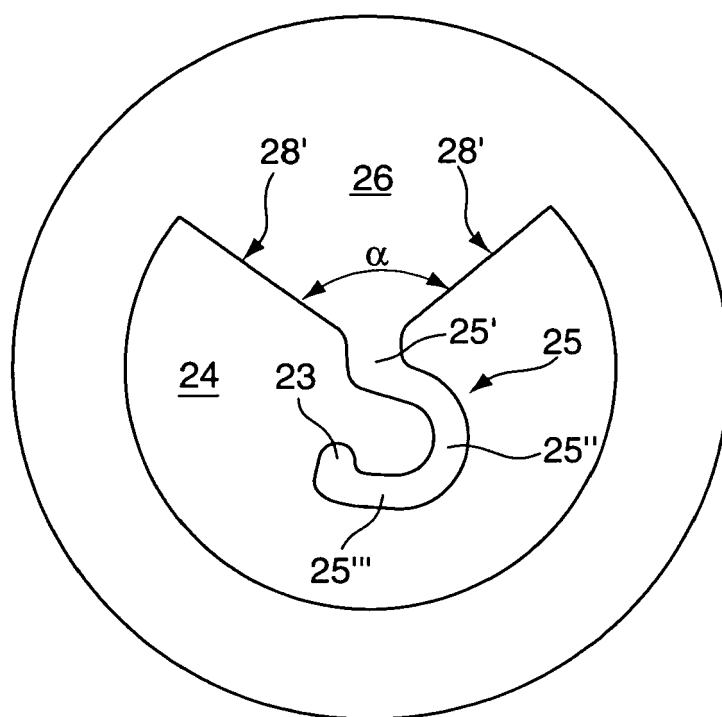


Fig. 5a

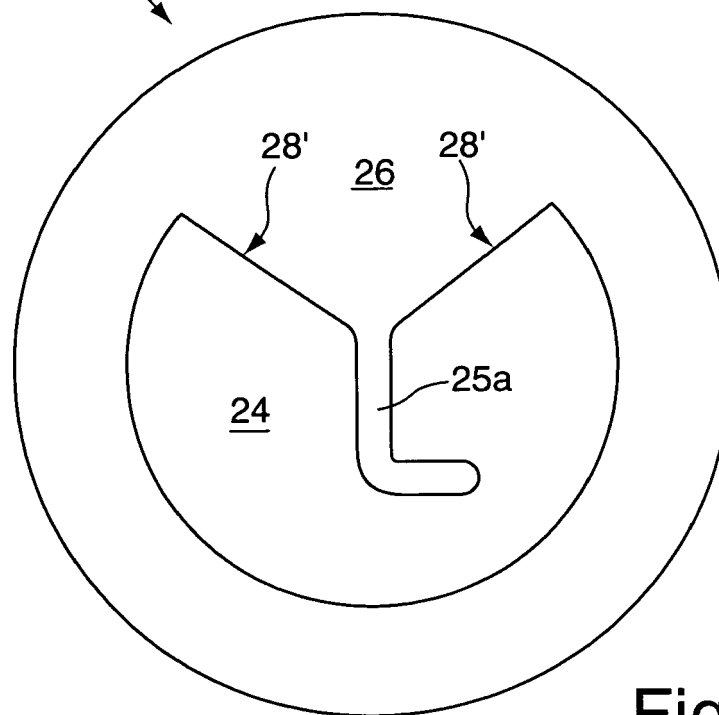
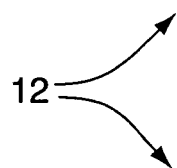


Fig. 5b

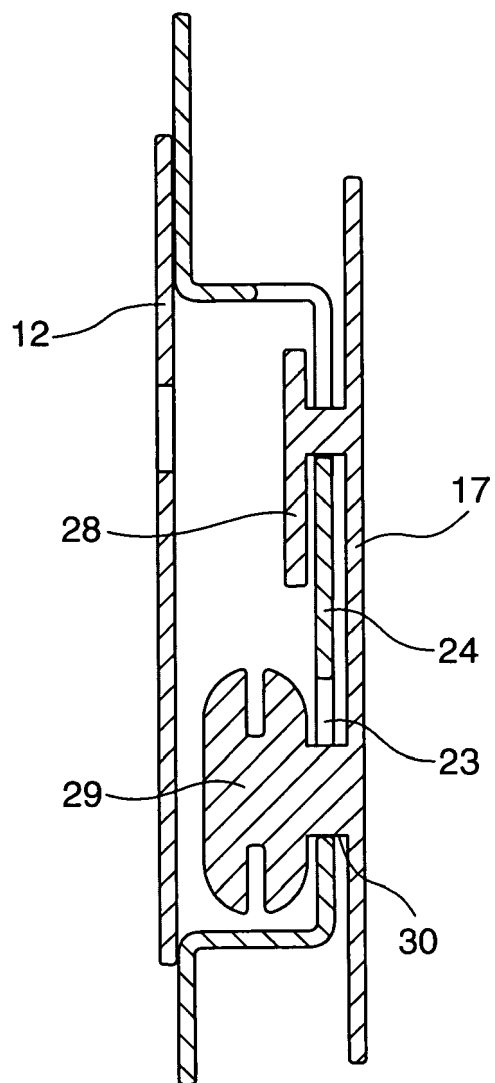


Fig. 6

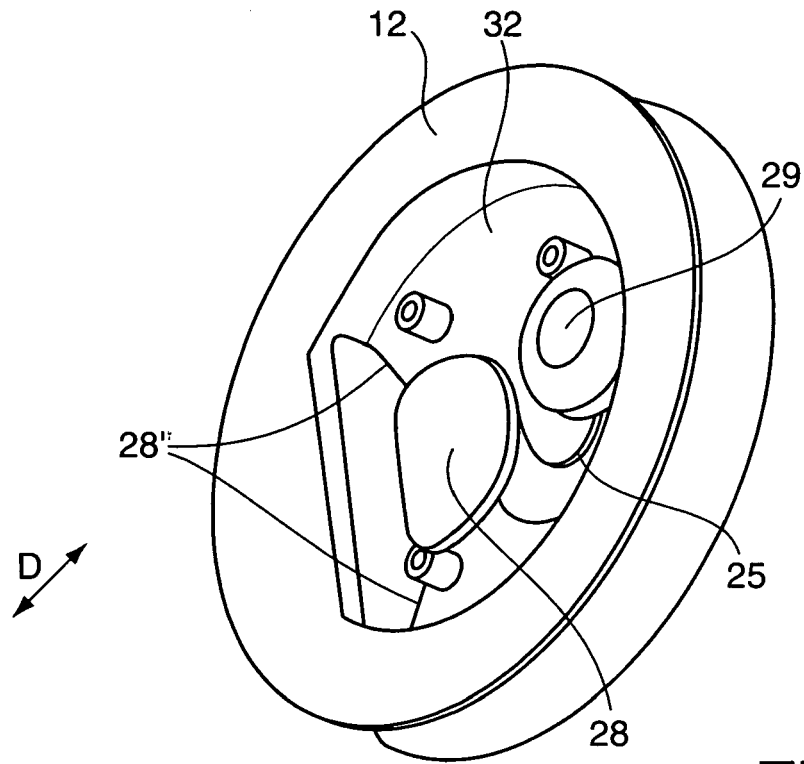


Fig. 7

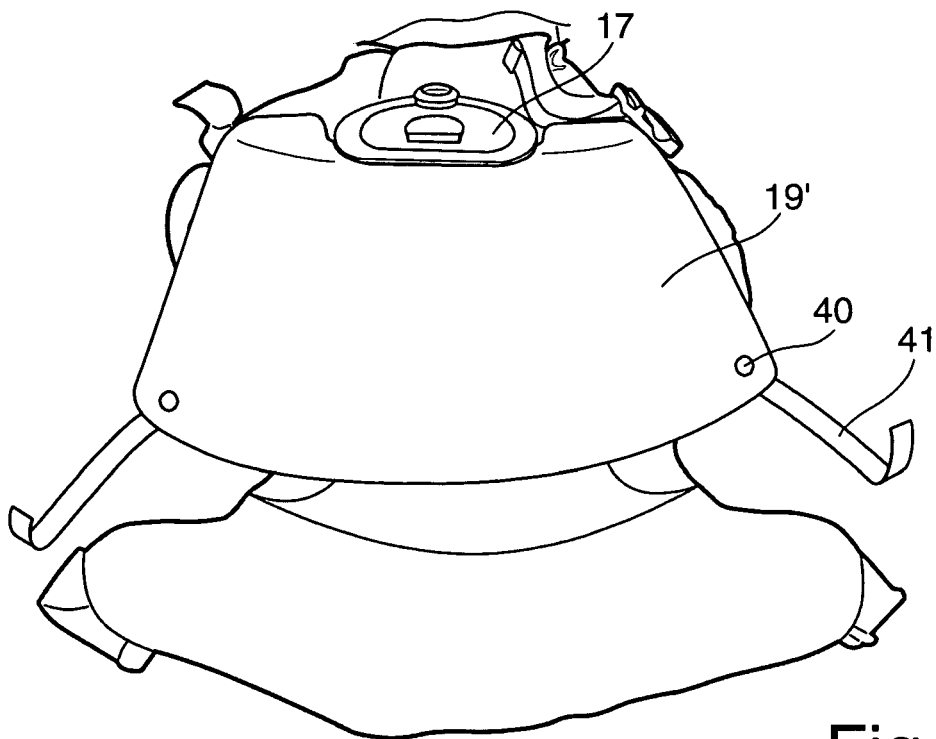


Fig. 8



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