United States Patent [19]

Miller

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[45] **Mar. 18, 1975**

[54] **PELVIC BRACE**

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[52] **U.S. Cl.** ..... **128/78,** 128/89 R, 264/222

[51] **Int. Cl.** **A61f 5/02**

[58] **Field of Search** 128/78, 89, 90, 87, 91, 128/157, 69; 2/44, 69, 243; 264/222

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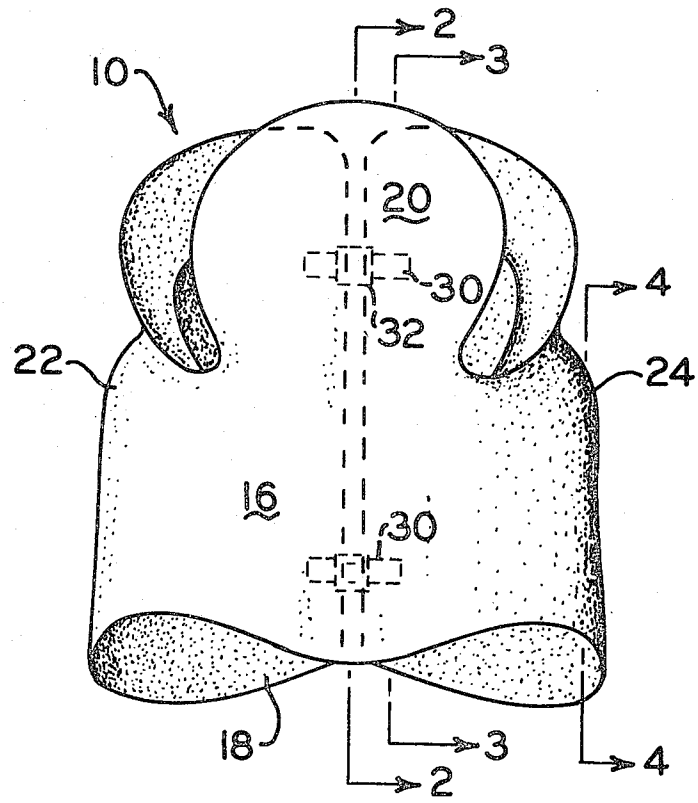
Assistant Examiner—J. Yasko
Attorney, Agent, or Firm—Oldham & Oldham Co.

[57] **ABSTRACT**

A pelvic girdle comprising an outer layer of a hard substantially rigid plastic material and an inner layer of soft compressible plastic material bonded to the outer layer, the girdle being shaped to engage a person's pelvis and including an anterior and a vertically split posterior portion, the girdle having an upper anterior portion separated laterally from the remainder of the girdle and curving outwardly thereof, and connecting upper side portions on the girdle connecting the anterior and posterior portions thereof and including inwardly curved sections in both layers of the girdle for engaging the iliac crests of the wearer and which sections have appreciably thicker compressible inner layers thereon.

8 Claims, 18 Drawing Figures



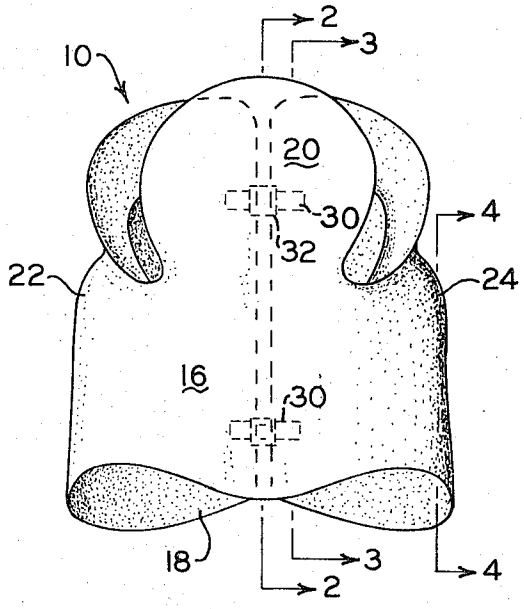


FIG - 1

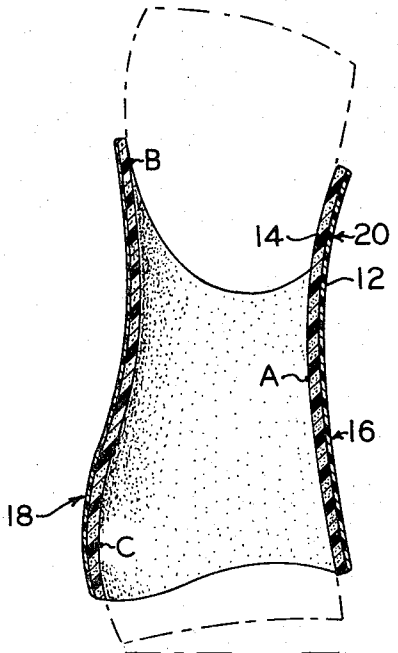


FIG - 2

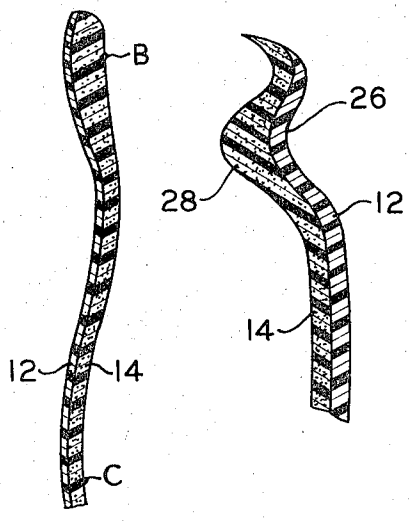


FIG - 3 FIG - 4

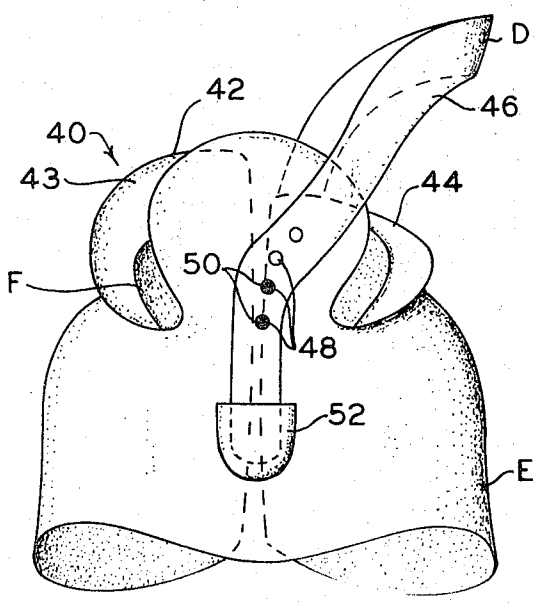


FIG - 5

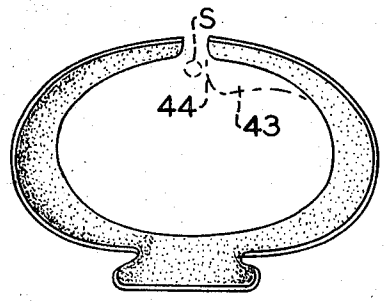


FIG - 6

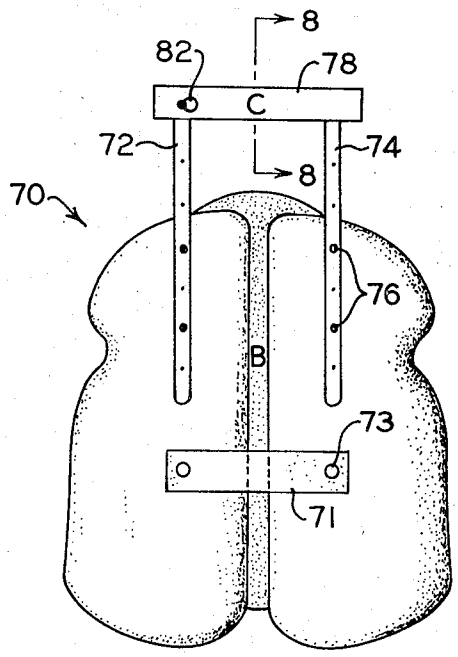


FIG - 7

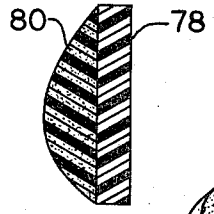


FIG - 8

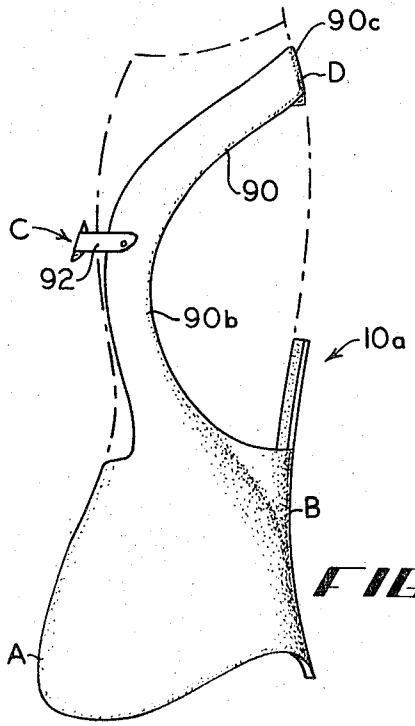


FIG - 9

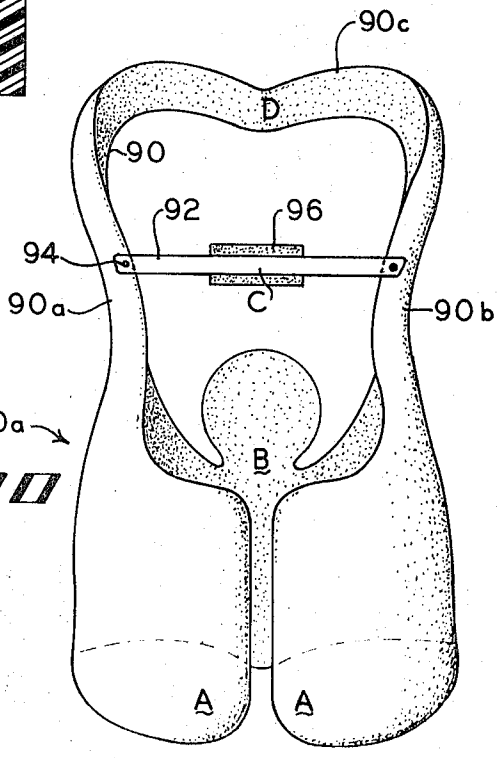


FIG - 10

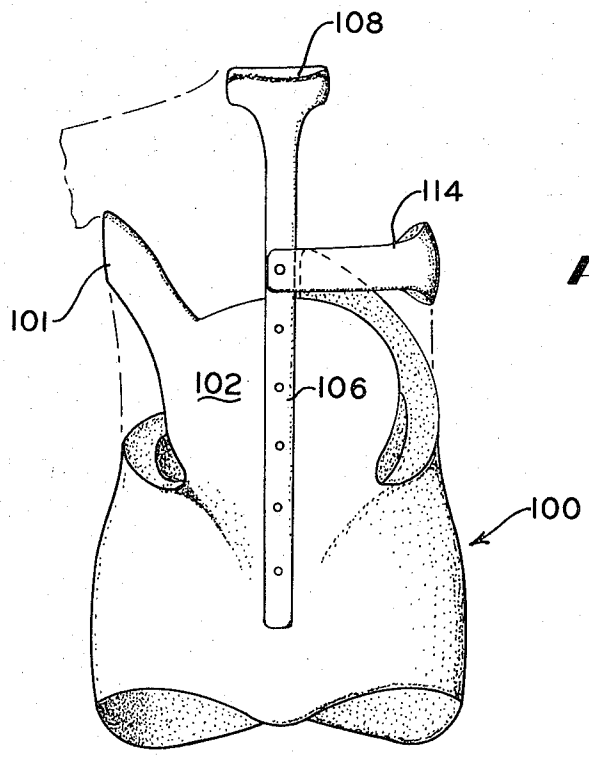


FIG-11

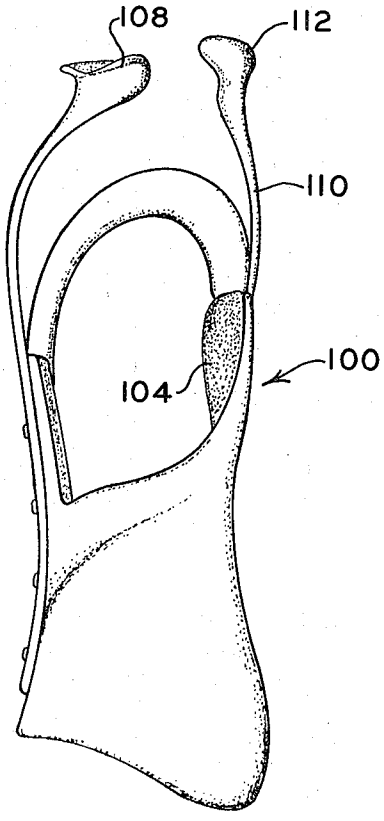


FIG-12

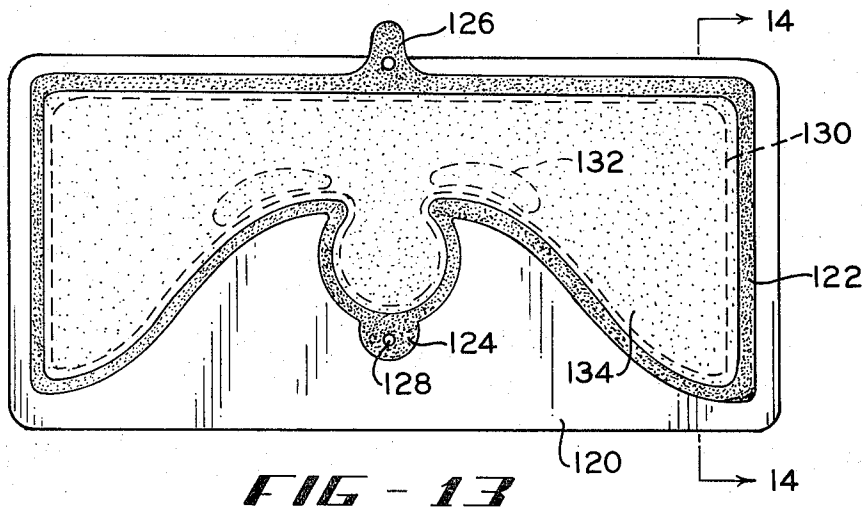


FIG - 13

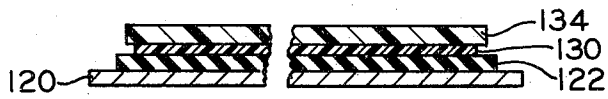


FIG - 14

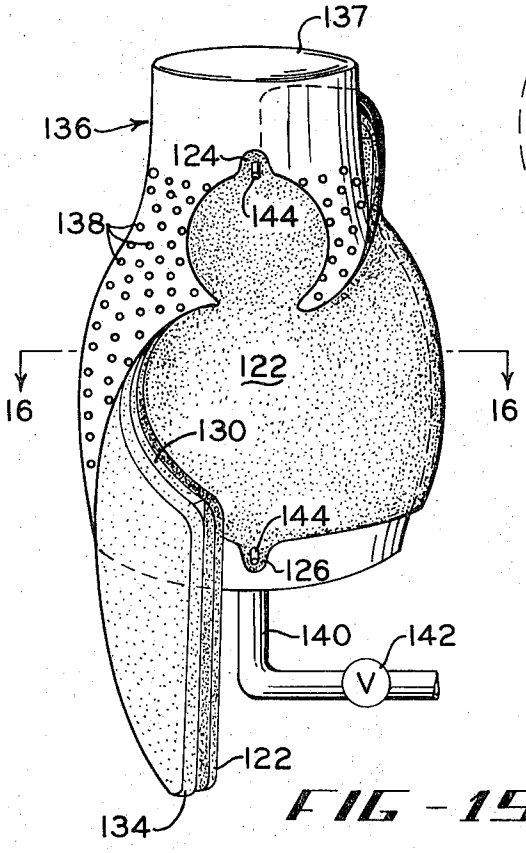


FIG - 15

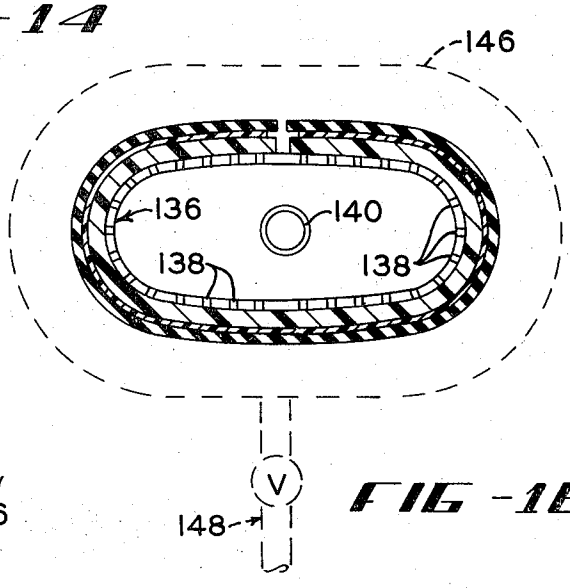


FIG - 16

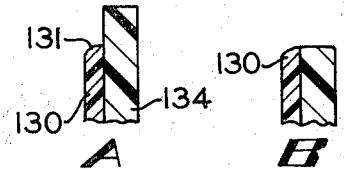


FIG - 17

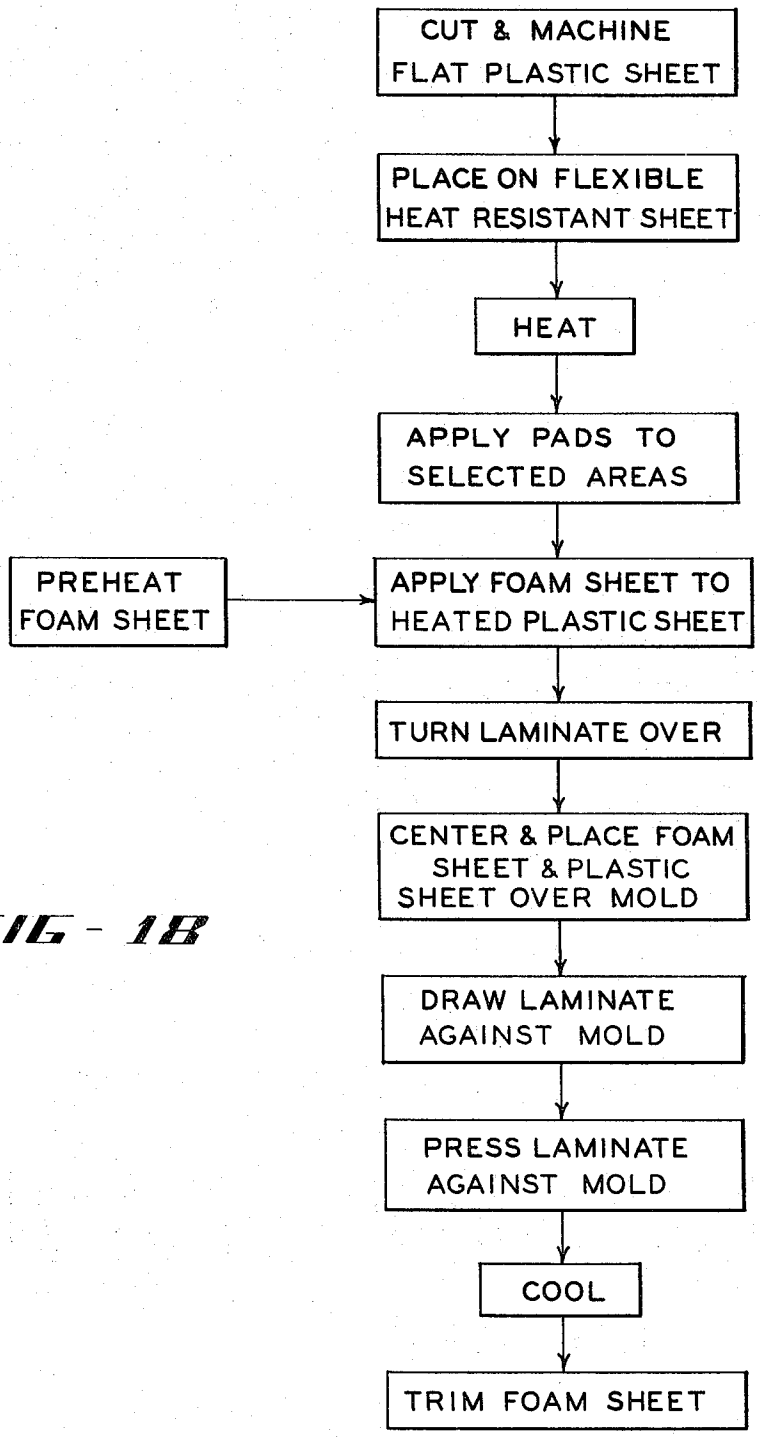

CUT & MACHINE FLAT PLASTIC SHEET
PLACE ON FLEXIBLE HEAT RESISTANT SHEET
HEAT
APPLY PADS TO SELECTED AREAS
PREHEAT FOAM SHEET
APPLY FOAM SHEET TO HEATED PLASTIC SHEET
TURN LAMINATE OVER
CENTER & PLACE FOAM SHEET & PLASTIC SHEET OVER MOLD
DRAW LAMINATE AGAINST MOLD
PRESS LAMINATE AGAINST MOLD
COOL
TRIM FOAM SHEET

FIG - 1B

PELVIC BRACE

BACKGROUND OF INVENTION

Heretofore there have been various types of braces proposed for use in correcting various deformities of the spine, such as lordosis and other improper curvatures of the spine.

One of these braces used heretofore for achieving spinal corrections is a "Milwaukee" brace. Such braces normally are made to individual measurements corresponding to the individual wearer of the brace. The production of the individual braces has included taking casts from the potential wearer's body, and then working from these casts to form the individual rigid pelvic girdle for engaging the person and carrying one or more uprights thereon to position support pads on the wearer adjacent the back of his neck and his chin, when required. Obviously these individually formed and produced braces have been costly to make and they have been slow to produce, as well as being rigid and uncomfortable to wear.

The general object of the present invention is to form pelvic girdles from a number of standard symetrical molds of varying sizes and wherein the molds represent correct spinal positions and uniform body structures, and wherein pelvic girdles including a soft compressible inner layer and a relatively rigid plastic outer layer are produced in a variety of sizes for meeting most standard requirements of patients requiring a pelvic girdle.

Another object of the invention is to form pelvic girdles from thermoplastic plastic materials and layers of foam material and wherein the foam padding, being on the inside of the girdle, can be made appreciably thicker in certain areas for aiding in producing pressures on the patient's body or for aiding in supporting the girdle on the person without skin breakdown.

Another object of the invention is to provide pelvic girdles with attachments therefor, which attachments can be integrally molded with the girdle or can be formed separately and attached thereto as desired.

Another object of the invention is to provide a basic pelvic girdle formed from plastic layers and wherein the girdle can readily have attachments secured thereto for aid in correcting all common back disorders including kyphosis and scoliosis, as well as lordosis.

Another object of the invention is to provide pelvic girdles at reduced costs and to provide pelvic girdles adapted to individual measurements of the wearer rapidly and conveniently from a plurality of standard symetrical molds corresponding to normal spinal conditions.

A further object of the invention is to provide a novel method of forming a pelvic girdle or other brace means made from a soft flexible liner material and a substantially rigid plastic outer layer.

Other objects of the invention are to provide special heating, laminating and molding steps to combine a closed cell plastic layer and special padding members, when desired, with a relatively rigid plastic outer sheet to form a shaped pelvic girdle therefrom with localized padding provided therein; to provide a low-cost, practical method of molding pelvic girdles to standard sizes and to facilitate the attachment of special braces or padding means thereto; to provide a bonding action between a preheated thermoplastic carrier sheet and a heated, soft, flexible lining layer; and to mold the resulting laminate when the carrier sheet is at an elevated temperature and quite soft for mold-shaping action.

Further objects of the invention will be made apparent from the following specification.

Reference now is made to the accompanying drawings, wherein:

FIG. **1** is a front elevation of a pelvic girdle embodying the principles of the present invention;

FIG. **2** is a vertical section through the center of the girdle of FIG. **1**;

FIG. **3** is a vertical section of a back portion of the girdle adjacent the opening in the back;

FIG. **4** is a fragmentary vertical section of the side upper end of the girdle;

FIG. **5** is a front elevation of a modified girdle of the invention having an upwardly extending side engaging section carried by the girdle;

FIG. **6** is a plan of the pelvic girdle shown in FIG. **5** with the side engaging section removed;

FIG. **7** is a rear elevation of a further modified type of pelvic girdle particularly adapted for treatment of a lordosis condition;

FIG. **8** is a fragmentary section taken on line **8—8** of FIG. **7**;

FIG. **9** is a side elevation of a further modification of the pelvic girdle of the invention;

FIG. **10** is a rear elevation of the girdle of FIG. **9**;

FIG. **11** is a front elevation of a further modification of the girdle of the invention showing further supports secured thereto;

FIG. **12** is a right side elevation of the girdle of FIG. **11**;

FIG. **13** is an elevation showing a step in the method of making the pelvic girdles of the invention prior to the molding thereof;

FIG. **14** is a fragmentary section taken on line **14—14** of FIG. **13**;

FIG. **15** is a plan of the laminated material of FIG. **13** as applied to a mold and prior to complete engagement of the laminate with the mold surface;

FIG. **16** is a vertical section through the mold with the laminate material engaged therewith;

FIG. **17** A and B are fragmentary edge sections of the girdle produced by the molding action; and

FIG. **18** is a block diagram of the method of the invention.

When referring to corresponding members shown in the drawings and described in the specification, corresponding numerals are used to identify the parts to facilitate comparison therebetween.

Reference now is made to the details of the structure shown in the accompanying drawings, and a pelvic girdle is indicated as a whole by the numeral **10.** This pelvic girdle is shaped to engage with a person's pelvic area for applying pressures thereto for aid in correcting deformities of the spine. The girdle is formed from a substantially rigid outer layer **12** of a suitable thermoplastic plastic material, such as polypropylene. The outer layer may be about ⅛ to 3/16 inch thick, while an inner layer **14** is bonded to the outer layer over the entire surface thereof and such inner layer is formed from a soft compressible plastic material, such as closed cell foam latex rubber, polyurethane, or the like, and this soft inner layer is about 3/16 inch to ¼ inch thick as a uniform layer bonded to the outer layer of the girdle. However, the inner layer can be suitably reinforced, padded, or thickened at desired pressure

points or other portions of the girdle, as hereinafter described.

The girdle includes a continuous anterior portion **16** and a vertically split posterior portion **18.** For engagement with a person's pelvis, the girdle has a center anterior upper portion **20** which if formed to extend up to the base of the sternum of the wearer and such upper portion, or in effect, the entire anterior portion is so shaped and curved that the upper portion thereof is curving outwardly of the wearer at an angle of about 20° to about 40° to the vertical, but with the vertically intermediate portion of the anterior of the girdle being smoothly curved and being inwardly extending to exert a backward pressure on the wearer. Such outward curve can be varied and usually is about 40°. This upper portion **20** is separated at its lateral margins from the other anterior portions of the pelvic girdle and has a relatively rigid, but yet flexible construction wherey a resilient pressure applying section or portion is formed by this area of the girdle.

Upper side portions **22** and **24** extend between the anterior and posterior portions of the girdle for connecting the same and relatively sharply inwardly curved sections **26** are provided on each of these upper side portions of the girdle and these are curved to extend inwardly of the girdle for engaging the iliac crests at the hips of a wearer. FIG. 4 indicates that the padding **28** on these edges as they are pressing inwardly against the body have an appreciably thickened, soft, compressible inner layer thereon for aiding in good engagement with the hips of the wearer and applying pressures thereto.

To aid in securing the pelvic girdle **10** to a wearer, a flexible securing means, such as a strap **30** and a buckle **32,** or equivalent members, are secured to the adjacent posterior portions of the girdle for extending therebetween in a removable manner.

FIG. **2** of the drawings shows how the pelvic girdle **10** is adapted to provide a plurality of vertically spaced pressure points for determining the pressure engagement of the girdle with the wearer. Thus the anterior portion **16** has a center pressure point or area indicated at "A" for applying rearwardly directed distortion or compression forces to one's pelvis, whereas the posterior portions of the girdle have vertically spaced pressure points thereon at the areas indicated at "B" and "C" whereby the girdle is adapted to press inwardly on the spine in the lumbar curve area thereof so as to apply forward pressures on the lumbar area of the back at these areas "B" and "C" of the girdle whereby forces tending to straighten the lumbar area of the spine and to overcome a lordosis condition existing therein are provided by the girdle of the invention.

FIG. **5** of the drawings shows a modified pelvic girdle **40** very similar to the girdle shown in FIG. **1** with the exception that the girdle at its posterior upper end portions indicated at **42** and **44** of the drawings, it is seen that the end **44** terminates appreciably below the adjacent end **42,** and the rear end or corner **42** is provided with an additional thickness of padding **43** thereon. This padding **43** tapers inwardly in a downward direction to be of maximum thickness at the upper end **42** of the girdle, and it also tapers downwardly in thickness to a feather edge as it extends laterally of the girdle.

A feature of the girdle **40** is that it is particularly adapted for correcting a curvature of the spine out of the vertical in a lateral direction. Such spinal curvature is called scoliosis. The girdle **40** has a separate attachment loop **46** secured thereto and extending upwardly therefrom. This loop or pressure strap is made from the same laminate of a relatively rigid hard plastic material on the outer surface and a soft plastic foam material on its inner surface just like the primary girdle **10.** The pressure strap **46** can have a plurality of holes **48** therein whereby it can be secured to the girdle **40** in a vertically adjustable manner as by screws or rivets **50** or the like. The lower end of the pressure strap **46** can be received in a positioning pocket **52** provided in the lower portion of the anterior wall of the girdle **40.** The rear end of the pressure strap **46** would be secured in similar manner to the rear wall **44** of the girdle adjacent the vertically extending split in the girdle. This pressure strap **46** extends upwardly and laterally of the wearer and then back down to the girdle so that it provides pressure at the axilla at the level of the apex of the thoracic curvature of the spine. Hence, the girdle of the invention, which is in general, similar to the girdle **10** in engaging the pelvic area of a wearer, would have vertically and laterally spaced pressure points provided on the wearer. The upper end of the pressure strap **46** as indicated at "D" would be a pressure point as would the lateral lower area of the girdle on the same side as the section "D" of the strap, and indicated at "E", would provide two vertically spaced pressure points and then the opposite pressure point, indicated at "F," would be provided by the girdle at the opposite lateral margin of the girdle normally that engages the iliac crest of the wearer whereby forces would be exerted on the spine to endeavor to correct the curvature thereof in a lateral direction out of vertical. Further, the padding **43** presses in on the back adjacent the spine S at the vertical margin **44** of the pad to apply further corrective lateral pressure on the spine.

The girdle shown in FIG. **5** can have the laterally reinforcing strap **46** molded as a unit therewith, when desired. By making the strap a separate unit, it can be adjusted vertically of the basic carrier girdle **40** to fit individual patient requirements.

FIG. **6** shows the girdle **40** with the brace **46** removed. The relation of the pressure pad **43** to the wearer's spine S is indicated so that a laterally directed pressure can be applied to the spine.

FIGS. **7** and **8** of the drawings show another modification of the girdle **10** of the invention. In general, a girdle **70** is shown which can be very similar, if not identical, to the girdle **10.** However, in this instance, a vertically upwardly extending attachment is provided for the girdle to aid in providing corrective pressure to the back. Thus, a pair of uprights **72** and **74** are secured to the posterior sections of the girdle **70** and these uprights normally are vertically adjustably engageable with back portions of the girdle as by screws or rivets **76** engaging vertically spaced holes provided in the uprights. A cross bar **78** or a similar pressure applying member is suitably secured to the uprights **72** and **74** at their upper ends and extends therebetween. This cross member may comprise a plastic strip or bar, or it can be a canvas strip and buckle combination supporting a pressure pad thereon. Thus, FIG. **8** shows that a carrier bar or member **78** has a pressure pad **80** on the inner surface thereof, which pressure pad is flexible and compressible and normally would be made from foam material. The cross bar **78,** as well as the uprights **72** and **74,** can be made from metal or preferably are made from the laminate of a rigid plastic material and

a foam interlayer thereon as in the other components of the girdle. One end of the cross bar **78** preferably has a keyhole shaped slot **82** therein in which a headed rivet member or the like can be received for detachable engagement of one end of the cross bar with one of the uprights to facilitate applying the girdle to a wearer and removal from the wearer.

By the modified girdle **70** of the invention, it will be seen that the upper pressure point on the back, corresponding to the point "B" shown in FIG. **2** would now be provided by the cross bar **78.** This just provides a pressure at the thoracic level to aid in reducing the curvature of lordosis of the spine. Naturally, the thickness of the pressure pads on the cross bars **78** can be varied to modify the corrective action of the girdle.

FIGS. **9** and **10** show a modified girdle **10***a* having the same basic lower construction as the girdle **10** but in this instance, an upwardly and forwardly curved reinforcing strap **90** is formed integral with the upper lateral portions of the pelvic girdle to engage the sides and chest of the wearer. This strap **90** would be formed from the same laminate as the remaining portion of the girdle. The strap **90** includes anterior lateral uprights or sections **90***a* and **90***b* on opposite lateral portions of the girdle that smoothly blend into a forwardly and upwardly extending section **90***c* on the strap **90** to provide a sternal pressure area in the girdle structure. Normally a flexible band or a belt **92** is removably secured to and extends between the lateral uprights **90***a* and **90***b* in a removable manner, as by the use of companion snaps **94** or the like, provided on the band and on the strap **90** and a suitable resilient pressure pad **96** is secured on the inner surface of this band **92.**

By the basic pelvic and iliac engaging lower portion of the girdle **10***a*, a wearer's pelvis is flexed to reduce lordosis, and the pressure forces applied to the spine by the posterior pressure pad **96** at the thoracic level aids in reducing the curvatures of kyphosis and/or lordosis of the wearer.

The pressure points on the girdle construction **10***a* to aid in reducing lordosis, would be considered to be the back pressure pad "C," the buttocks engaging posterior portion of the girdle indicated at "A," and the front pelvic engaging area "B" of the girdle. Pressure points for aiding in reducing kyphosis would include the same pressure points "B" and "C" of the girdle in combination with the upper pressure point "D" provided by the center upper section **90***c* of this strap **90.** Obviously, when desired, the sternal section of the girdle can have an additional resilient pressure pad provided on the inner surface thereof at "D", which pad can be bonded to the strap.

It naturally is possible to form the loop or strap **90** from a separate molded member and to attach it in a vertically and/or laterally adjustable manner to the basic pelvic engaging girdle to support such strap portion of the brace of the invention.

Yet a further modified type of a girdle is shown in FIGS. **11** and **12** and the girdle is indicated by the number **100.** This girdle **100** is basically the same as the girdle **40** of FIG. **5** but with a laterally extending reinforcing brace, loop, or strap **101** being formed as an integral portion of the pelvic engaging section of the girdle, such loop **101** extends upwardly and laterally from the upper anterior portion **102** of the girdle up around the axilla area of the wearer and back down to engage one of the posterior sections of the girdle at its upper margin.

This girdle **100** preferably has posterior portions of different vertical extents, like the girdle **40,** and again a special tapered pad **104** is provided on the higher posterior section of the girdle at the vertical edge thereof to apply laterally directed pressures to the spine as done by the girdle **40** and shown in FIGS. **5** and **6.**

The girdle **100** is adapted to have any desired number of vertically extending reinforcements or supports provided thereon, and laterally extending flexible supports or pressure pads can also be carried by the vertical extending supports in the girdle. In the construction shown, an upwardly extending support bar **106** is shown in vertical adjustable engagement with the anterior portion of the pelvic section of the girdle and it preferably extends up to and immediately adjacent the wearer's chin so that an enlarged chin engaging section **108** is provided at the upper end of this bar **106** and it can be curled outwardly for comfortable engagement with the wearer's chin to increase vertical extension of the wearer's spine. A similar vertically upwardly extending support bar **110** is carried by the one posterior portion of the girdle and extends up to the occipital area of the wearer and has a suitable section at its upper end, as indicated at **112,** for comfortable engagement with the wearer's neck and head area. The reinforcing brace bar **110** aids in increasing vertical extension of the spine of the wearer by encouraging the wearer to stretch upwardly and to avoid pressure contact with the chin and neck portions **108** and **112** on the vertically upwardly extending reinforcing bars.

FIG. **11** of the drawings indicates that a flexible strap **114** can be removably secured to and extended between the front and rear brace bars **106** and **110** so that any suitable pressure pads (not shown) can be secured to the inner surface of this strap **114** to provide a lateral pressure point on the wearer whereby a lateral pressure force can be applied to thee spine of the wearer to aid in correcting curvatures therein. Naturally, both the front and back support or brace bars **106** and **110** normally would be vertically adjustably engaged with the pelvic portion of the girdle for individual adjustment to the wearer's spinal problems and the corrective actions required. Such girdle **100** would have the various pressure points as referred to hereinbefore but with at least two additional pressure points being provided by the chin and neck engaging portions **108** and **112** to provide for spinal extension action.

The flexibility of the girdle **100** in corrective action can be varied by varying the size of the corrective pad **104** provided on the posterior portion thereof, and even by positioning it on the opposite of the girdle, when desired. Likewise, the heights of the posterior portions of the girdle can be altered to reverse the relationship of the posterior portions of the girdle as shown in the drawings. Of course, other types of flexible straps like strap **114** can be secured to and extended between the vertical support or brace bars for laterally corrective forces at the required location of the spine, and pads as required may be provided on the inner surface of the loop **101.**

METHOD OF BRACE MANUFACTURER

In making the various braces of the invention, a metal carrier plate **120** is provided and a heat resistant flexible rubber or synthetic sheet **122** is placed on the plate

120. The sheet 122 can be made from a silicone rubber or other conventional types of flexible, heat resistant materials. This rubber sheet has lobes or ears 124 and 126 on opposed edges thereof and centering appertures 128 are formed therein for a purpose hereinafter to be described. A sheet 130 of the thermoplastic material used to form the relatively rigid outer surface of the pelvic girdle of the invention is first processed by being cut or machined to the required size and shape, and then the edges of such plastic sheet are further machined or ground away to provide a smoothly curved outer edge on the sheet. By processing the plastic sheet 130 when it is flat, the machining and the cutting thereof is simplified, and it is shaped to a flat layout of the brace or girdle to be made. The metal carrier sheet 120 with the rubber sheet 122 and plastic sheet 130 thereon is then placed into a suitable oven and heated to a temperature of approximately 400° Farenheit. Usually the metal sheet 120 would have a non-stick surface, such as a teflon coat. The rubber sheet used as a carrier medium is temperature resistant up to a temperature of approximately 500° to withstand repeated heating actions.

After the stacked laminate has been heated to raise the sheet to approximately 400° Farenheit, then the metal carrier sheet and laminate thereon is withdrawn from the heating oven and special pads 132 are pressed against the exposed surface of the plastic sheet in the area to form the hip or iliac crest engaging area in the finished girdle. These pads 132 naturally have flat base surfaces and crowned upper surfaces to fit smoothly against the plastic sheet. The metal carrier sheet is next re-inserted into the oven for just a few seconds such as from about four or five to eight to ten seconds to aid in bonding the pads 132 to the plastic sheet.

A closed cell polyurethane foam layer 134 is preferably separately pre-heated to about 150° Farenheit and then, while heated, placed on the heated laminate carried by the rubber sheet 122. Light pressure can be applied to the foam layer 134 to smooth or press it into tight engagement with the plastic sheet 130 over the entire upper surface thereof. The foam layer 134 is formed to the same outline as the plastic sheet 130 but with the foam layer 134 usually being slightly larger than the plastic and extending therebeyond a short distance at all margins thereof, as indicated in FIG. 14.

A mold 136 which is of the size and shape of a wearer's torso is separately formed. Such mold 136 has a plurality of holes 138 therein and the mold has ends 137 to form a closed inner chamber. A vacuum line 140 connects to the chamber in the mold and it has a suitable valve 142 therein whereby vacuum forces can be applied over substantially the entire surface of the mold 136 when the valve 142 is opened. The line 140 connects to any desired source of vacuum supply. The mold 136 also has a pair of vertically upwardly extending centering pins or posts 144 secured to it beyond its operative margins. In order to apply the laminate formed of the rubber sheet 122, plastic sheet 130, and foam layer 134 to the mold, the rubber sheet 122 is grasped at its end and/or edge portions, the rubber sheet is turned over, and the centering pins 144 are engaged with the appertures 128 formed in the lobes extending from the rubber sheet whereby the laminate is centered with relationship to the mold. The rubber sheet and the heated plastic sheet will adhere for this action and the heated plastic sheet, being flexible at that time, will drape over the surfaces of the mold, and light manual pressure, if necessary, can be applied to the dependant portions of the laminate to press them up against the mold while the vacuum is applied thereto to obtain full operative engagement with the mold. Thereafter, the mold 136 usually has external pressure applied thereto and it is moved into a pressure chamber indicated at 146, or a portable pressure chamber is moved to encircle the mold and the laminates thereon, and pressure then is applied to the chamber 146 through a pressure supply line 148 whereby the laminate is forced into tight operative engagement with the mold for setting the plastic sheet 130 into the desired configuration. The air pressure supplied through the line 148 is cool or at atmospheric temperature to aid in cooling the plastic on the mold and obtain a relatively rapid setup of the same. Or cooling air could be flowed over the mold 136 with the laminate operatively engaged therewith.

In the molded article, FIG. 17*a* shows that the foam layer 134 extends slightly beyond the adjacent edge of the plastic sheet 130 which has a smoothly rounded edge 131 provided thereon by its initially shaping and retained throughout the brace or girdle forming action. Thereafter the edge of the plastic and foam layers are brought into alignment by trimming the foam layer as indicated in 17*b*.

When initially engaging the rubber carrier sheet and members thereon with the mold 136, at that time the plastic sheet will have some adhesive afinity to the rubber sheet because of the contacting surfaces of the hot plastic-hot rubber sheet. Such rubber carried sheet 122 can have a rough textured surface thereon to provide a complimentary textured surface on the shaped girdle on the outer surface thereof.

Of course, the girdle formed can be removed from the mold readily by first removing the rubber sheet 122 from the outer surface of the laminate and then removing the resilient girdle from the mold after the plastic sheet has been cooled sufficiently to retain its given shape. Such sheet 122 can be peeled off of the plastic sheet after such plastic sheet has been partially cooled if desired.

In the girdle 70 shown in FIG. 7, an attachment strap 71 is also shown that removably connects to suitable members, or includes suitable means, such as snaps 73 thereon that are adapted to engage with companion members carried by the posterior portions of the girdle. Thus, when a person is applying the girdle, the retainer strap 71 can be released from one end thereof and then be reconnected to the companion snap members for retaining the girdle in good tight association with the wearer. The cross bar 78 can also be made in the form of a flexible strap or the like and be releasably secured to its carrier uprights. Obviously, any type of securing means can be provided on the separated posterior portions of the girdle for entry and disengagement purposes. Likewise, all of the other structures of invention normally would have a similar removable attachment strap, or two of such straps provided on the posterior portions of the girdle for attaching same to the wearer but permitting convenient disengagement therefrom when desired.

It should be realized that various types of braces and/or pelvic girdles can be made by the method or process of the invention. By forming a unitary shaped structure from the relatively rigid outer plastic layer having a soft

compressible inner lining layer thereon, a comfortable brace can be provided and these braces can be formed in a number of predetermined sizes. Then by attaching removable brace securing means to a girdle or brace of the correct size, the braces will readily be adapted to fit onto individual wearers for the specific brace or corrective action required. Attachments also can be secured to the molded girdle or brace as required.

Various known types of back braces particularly are adapted to be formed by the method of the invention wherein, in each instance, a flat layout of the brace is made and the initial flat plastic sheet is cut and/or machined to predetermined size. Such sheet is then processed by building up a laminate therefrom and applying to a mold for permanent shaping action. Naturally the particular type of a mold used for brace shaping action can be varied with the individual braces to be produced, but the same method steps or operations would be required or used to make the different braces as desired. Special localized pads can be applied as desired in building the laminate.

When localized pads, as the pads **132,** are applied to the plastic sheet, they preferably are spaced from the margins of the plastic sheet and their upper surfaces smoothly blend into the top surface of the plastic sheet. Hence, the foam cover layer **134** retains, or aids in retaining the pad or pads in position by such layer's lamination to the plastic sheet.

In making up the mold forms of the invention by which vacuum forces are applied to the laminate used in forming the brace of the invention, obviously the vacuum applying holes provided in the mold normally are made of sufficiently small diameter that the closed cell foam layer thereadjacent will not be excessively distorted or drawn into the mold during the article shaping action. The molds naturally are of a size for full operative engagement with the unitary brace to be produced.

Obviously, in forming the various uprights attached to the pelvic girdle of the invention such as the strap member **46** of FIG. **5,** or the uprights **106** and **110** as shown in FIGS. **11** and **12,** any suitable type of a plastic material can be used. Thus, more rigid material than polypropylene can be used and it can be preformed to suitable shape, have a number of holes drilled or otherwise formed therein for vertically adjustable engagement with the carrier pelvic girdle. Of course, other substantially rigid thermoplastic materials as conventionally known can be used in place of the polypropylene as referred to hereinbefore for forming the outer layer **12** of the pelvic girdle as shown and described.

Standard size braces of the invention can readily be modified to the individual wearer's requirements by taking one of the standard pelvic girdles of the invention and by applying attachments thereto, and/or by applying special pressure pads to localized areas of the girdles or to attachments thereon as would be required for individual corrective and/or support or brace action.

Braces of the invention, especially those as shown in FIGS. **9** and **10** and also FIGS. **11** and **12** of the drawings have been particularly desirable in treatment and correction of spinal problems inasmuch as corrective forces can be applied to the patient without the use of neck rings as have been required in previous styles of braces. The embodiment of the invention shown in FIGS. **11** and **12** is particularly suitable when modified to use only an anterior strut in the brace. The hyper extension brace of FIGS. **9** and **10** embodies the standard five point pressure principle to manage both the lumbar lordosis and the thoracic kyphosis. It can be worn easily under clothing and is very effectively used in the post operative period following spinal fusion for kyphosis of the thoracic spine.

Use of braces and the process of the invention shortens delivery time, makes the braces more comfortable to wear, and does not lose any of the effectiveness of previous styles of braces known for use in correction and treatment of spinal problems.

From the foregoing, it is believed that the objects of the invention have been achieved and that a novel and improved girdle has been provided by the invention and also that a new and improved method has been provided for forming pelvic girdles, back braces and the like. Thus, the objects of the invention are thought to be achieved.

While several complete embodiments of the invention have been described herein, it will be appreciated that modification of these particular embodiments of the invention may be resorted to without departing from the scope of the invention.

What is claimed is:

1. A pelvic girdle shaped to engage a person at his pelvis and comprising an outer layer of a hard substantially rigid layer of a plastic material and an inner layer of a soft compressible plastic material bonded to said outer layer, which inner layer has localized areas of varied thickness,

the girdle including anterior and posterior portions and being vertically split in its posterior portion and including releasable fastening means secured to the adjacent posterior portions, the girdle also having a center anterior upper portion adapted to extend up to about the base of the sternum of the wearer and curved outwardly of the girdle, which upper portion is separated at its lateral margins from other anterior portions of the pelvic girdle and is free to flex slightly, the girdle having upper side portions connecting the anterior and posterior portions and including inwardly curved sections adapted to engage the iliac crests and having appreciably thicker compressible inner layers on such sections.

2. A pelvic girdle as in claim **1** where one of said posterior portions has an inner layer thereon of tapered thickness at the upper end of its edge at said split and of maximum depth at said edge to form a back pressure point laterally of the wearer's spine.

3. A pelvic girdle as in claim **1** where said girdle has a continuous upwardly and laterally extending brace member operatively connecting at its ends to anterior and posterior portions of the girdle to provide an upper lateral pressure area for engaging a wearer's axilla at the level of the apex of the thoracic curvature of the spine.

4. A pelvic girdle as in claim **3** where anterior and posterior uprights are vertically adjustably secured to said girdle and extend upwardly therefrom, and a pressure means is removably secured to and extends between said uprights to provide a lateral pressure area on a wearer substantially opposed to the lateral pressure area of said brace member.

5. A pelvic girdle as in claim **1** where said girdle has a generally upwardly and forwardly extending loop por-

tion operatively connecting to the upper lateral sections of the girdle, which loop portion is adapted to extend over a wearer's sternum to form a pressure area there.

6. A pelvic girdle as in claim **5** where said loop portion is formed integrally with said girdle and has a resilient inner layer, and a removable transverse pressure pad is secured to and is adapted to extend between horizontally opposed parts of said loop portions at the thoracic level of the wearer.

7. A pelvic girdle as in claim **2** where said one of said posterior portions extends vertically further than the other of said posterior portions.

8. A pelvic girdle as in claim **3** where said girdle has said continuous upwardly and laterally extending brace member extending laterally of the brace in one direction, and the posterior portion of the girdle positioned in the girdle in the other lateral direction from the girdle vertical center axis extends vertically further than the posterior portion positioned in said one direction from said center axis.

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