

Jan. 15, 1952

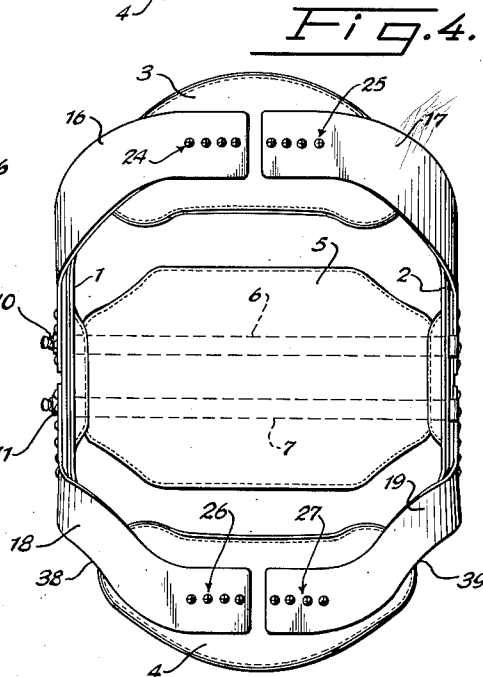
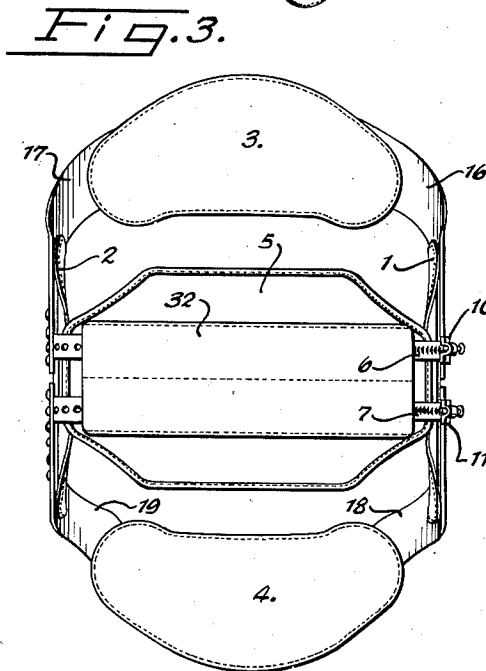
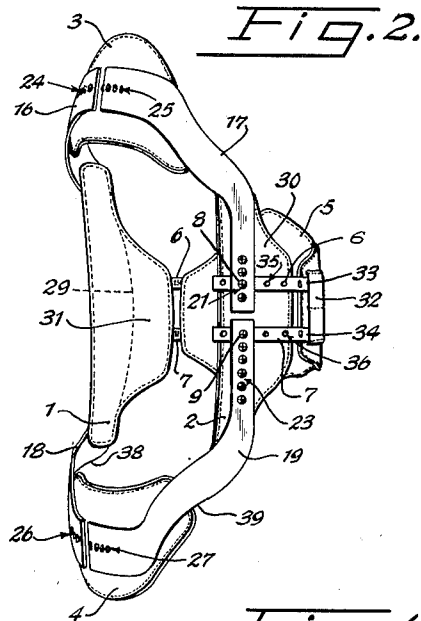
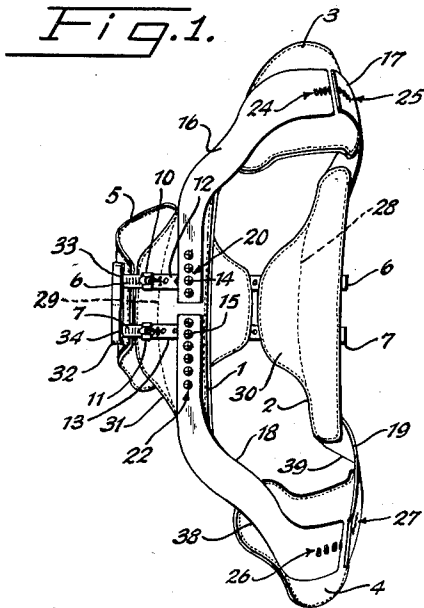
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2,582,930

SURGICAL BRACE

Filed May 5, 1949

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

Fig. 5.

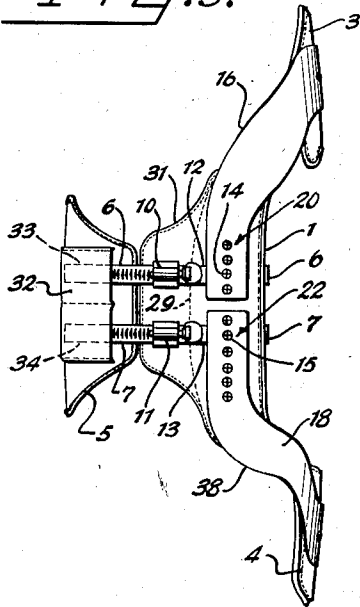


Fig. 6.

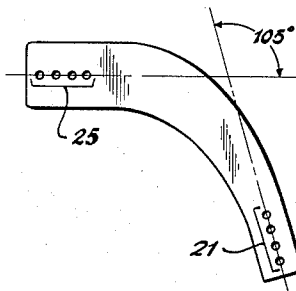


Fig. 7.



Fig. 8.

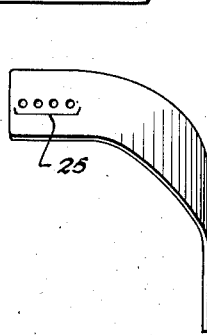


Fig. 9.



Fig. 12.

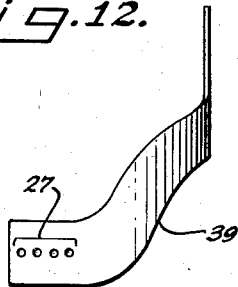


Fig. 10.

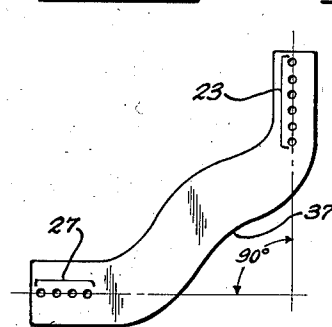
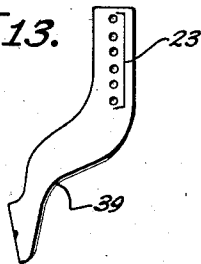


Fig. 11.



Fig. 13.



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2,582,930

SURGICAL BRACE

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Application May 5, 1949, Serial No. 91,559

11 Claims. (Cl. 128—78)

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The invention relates to surgical braces, more particularly a back brace embodying the three-point leverage principle. The brace is especially (though not restrictively) intended for use in maintaining desired degrees of hyperextension of the lower dorsal and lumbar portions of the spine, following reduction of compression or wedged fractures of one or more of the vertebral bodies from the mid-dorsal through the last lumbar segment, without the inconveniences hitherto incident to use of plaster casts. The brace in its more preferred forms is also intended to be capable of being fitted directly and without delay to torsos of varying dimensions and proportions, irrespective of whether the variances be in the vertical dimension only, the side to side dimension only, or in differing combinations of such and/or other dimensions.

Among the objects of the invention are reduction of weight and bulk of brace parts, provision of desired lumbar support without resort to posterior rigid bars or plates, minimization of parts opaque to X-rays in the affected area, advantageous distribution of pressure applied by the support surfaces, ready facility for putting on and taking off the brace and conforming its fit to changes in bodily weight and proportions, and provision for freedom of bodily movement, particularly in the regions of the groins and armpits during sitting and rising and in the areas affected by breathing and the ingestion of food.

Further objects include the designation of materials which are resistant to bodily excretions and yet provide lightness of weight together with resilient rigidity of framework.

Still further objects will become apparent hereinbelow.

In the drawings (which are intended as diagrammatic only, unless otherwise apparent):

Fig. 1 is a perspective of the right side and a portion of the front of a brace forming a presently preferred embodiment of the invention;

Fig. 2 is a perspective of the left side and a portion of the front of the brace of Fig. 1;

Figs. 3-5 respectively are rear, front, and right side elevations of the brace of Fig. 1;

Figs. 6-7 respectively are front and side views of the more fully shown one of the two sternal pad support bars appearing in Fig. 2, before the final twisting and bending in its fabrication;

Figs. 8-9 respectively are front and side views of the bar of Figs. 6-7 after final twisting and bending;

Figs. 10-11 respectively are front and side views of the more fully shown one of the two pubic

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support bars appearing in Fig. 2, before the final twisting and bending in its fabrication;

Figs. 12-13 respectively are front and side views of the bar of Figs. 10-11 after final twisting and bending;

Referring to the drawings in detail:

The brace unitarily represented in Figs. 1-5 comprises right and left torso side contacting pads 1 and 2, sternal and pubic pads 3 and 4, a relatively flexible lumbar support pad 5, and substantially non-stretchable multi-apertured bands 6 and 7. These bands are respectively affixed, at their left ends, to left side pad 2 by screws 8 and 9 (Fig. 2) which penetrate a rigid plate (understood) which is inside and imparts rigidity to the forward portion of said pad, and threaded at their right ends into tightening mechanisms 10 and 11 (best seen in Fig. 5). These multi-apertured bands and tightening mechanisms may be those of the hose clamps of U. S. P. 1,397,508; 1,776,850; 2,386,629; or 2,395,273; but for a detailed description of them and their functioning in the presently most preferred form of the brace reference should be made to the disclosure of the last cited patent, particularly its "clamping band—21," "holding and tightening screw 28," and the parts associated with them, said members "21" and "28" of the patent being respectively the same as members 6-7 and 10-11 of the brace of Figs. 1-5.

The tightening mechanisms 10 and 11 are fixedly carried by lumbar band anchors 12 and 13 (Figs. 1, 5) which are affixed to right side pad 1 by screws 14 and 15 penetrating a rigid plate (understood) which is inside and imparts rigidity to the forward portion of said pad.

Inside of and substantially co-extensive with sternal and pubic pads 3 and 4 are rigid plates (understood) which serve to impart rigidity to them.

All four of said rigid plates respectively inside pads 1-4 are detachably but rigidly interconnected by resilient non-torso-contacting framework consisting of right and left sternal support bars 16 and 17 and right and left pubic support bars 18 and 19, which, through the media of vertically aligned screws series 20 (Figs. 1, 5), 21 (Fig. 2), 22 (Figs. 1, 5), 23 (Fig. 2), and horizontally aligned screws series 24-27 (Figs. 1, 2, 4), are rigidly affixed to, and in turn interconnected by, said plates. Outwardly-from-the-torso facing surfaces of pads 1-4 consist of leather coverings, and inwardly, toward-the-torso ones of plastic coverings, said coverings overlying the plates inside the pads. These leather and plastic cover-

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ings are united, as by stitching, along the edges of the rigid plates, though in the case of side pads 1—2 the covering fabrics continue rearwardly from the stitching at the rear edges of the plates (such stitching being depicted by dash lines 28 and 29 in Figs. 1, 2, 5) to now enclose cushioning (understood) rather than rigid plates, and thus provide torso-side-contacting flaps 30 and 31 (Figs. 1, 2, 5).

Both vertical faces of the lumbar pad comprise plastic composition, e. g. with a relatively thin layer of cushioning enclosed between them, except that leather stripping 32 additionally is affixed, as by stitching, to the posterior face to provide sleeves or channels 33 and 34 for lumbar band members 6 and 7.

In assembling the brace the relative elevation of the sternal pad is determined by selectively aligning series 20 and 21 screw holes in sternal bars 16 and 17 with complementarily vertically spaced screw holes (understood) in the upper portions of the plates inside pads 1 and 2, and then fastening the bars to the plates by screws inserted through the pairs of holes thus brought into alignment. Similarly, the relative elevation of the pubic pad is determined by selectively aligning series 22 and 23 screw holes in pubic bars 18 and 19 with complementarily vertically spaced screw holes (understood) in the lower portions of said plates inside pads 1 and 2, and again fastening bars to plates by screws, etc.

Setting of the relative side-to-side dimensions of the brace is done on the same general principles. That is, selective alinement of series 24—25 and/or series 26—27 screw holes in, respectively, the horizontal upper portions of sternal bars 16 and 17 and/or the horizontal lower portions of pubic bars 18 and 19, is made with complementarily horizontally spaced holes (understood) in the plates inside the sternal and/or pubic pads, and fastening through pairs of holes thus brought into alinement effected by screws as before.

It will be noted that the aforesaid relative elevations and dimensions optionally can each be individually selected and set, independently of any one or more of the others; also, that no varying of a front-to-rear dimension is concomitantly necessary.

Equally independent is the similar setting of the relative elevations of the individual lumbar bands. That is, the height of lumbar band 6 will vary according as which of the vertically aligned fastener screws passing through screw holes in, respectively, series 21 and 20 are used for affixation of its left end and of anchor 12 (with which its right end is connected by tightening mechanism 10). Likewise, as regards the height of lumbar band 7 and selection of which of the vertically aligned fastener screws passing through screw holes in, respectively, series 23 and 22, are to be used for affixation of its left end and of anchor 13 (with which its right end is connected by tightening mechanism 11).

Variation of the effective overall length of either or both lumbar bands may be similarly independently determined, through the choosing of which of the horizontal series of holes 35 in band 6 and 36 in band 7 (Fig. 2) are to be used in the affixation of the bands to the plate inside pad 2 (e. g. as illustrated in the case of screws 8 and 9, in Fig. 2). Supplementarily, however, tightening mechanisms 10 and 11 may be used for further regulating, in as fine gradations as desired, said effective length, via taking up or letting out on the right end portions of bands 6 and 7 which run

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posteriorly from the points of their affixation to the plate inside pad 2 and partly engird the torso side and rear until gripped by tightening mechanisms 10 and 11, respectively.

Absence of rigid supports of substantial vertical extent in or in conjunction with the lumbar pad 5 is to be particularly noted, together with the fact that no force other than that of the flexible bands 6 and 7, operating through flexible lumbar pad 5, bears against the region of the back that overlies the erector spinae group of lumbar muscles.

A desired form-fitting degree of rearward tilt can be imparted to sternal pad 3 by fashioning its support bars 16 and 17 in the manner represented by Figs. 6—9. Thus, a piece of ductile strap metal having two series of aligned holes such as series 21 and 25 hereinabove described, and having an elbow angle of, say, about 100—110° (or approximately 105° as shown in Fig. 6, for average cases) between the respective alinements, extended, of said series (such alinements being shown in Fig. 6 as coinciding with the respective axes of the corresponding portions of the piece of strap metal) can be twisted 90° about the axis of the portion carrying the series 21 holes, besides being bent (conveniently concomitantly) in the region of the elbow, to reduce the 105° angle to 90° as well as accomplish the further changes in front view outline shown in Fig. 8 (as contrasted with that in Fig. 6) and in side view outline shown in Fig. 9 (as contrasted with that in Fig. 7). The result, when embodied in each of the sternal bars of the assembled brace, is reflected in a desired degree of tilt of the sternal pad 3 as exemplified in Figs. 1, 2, 5.

Applying a related procedure, represented by Figs. 10—13, substantial clearance between pubic bars 18 and 19 and the wearer's groins during bodily motion, e. g. sitting down or rising, can be insured. Thus, a piece of ductile strap metal having two series of aligned holes such as series 23 and 27 hereinabove described, and having an elbow angle of 90° between the respective alinements, extended, of said series (such alinements being shown in Fig. 10 as coinciding with the respective axes of the corresponding portions of the piece of strap metal), and also being upwardly bow-shaped in its mid-portion as designated by 37 in Fig. 10, can be twisted 90° about the axis of the portion carrying the series 23 holes, besides being bent (conveniently concomitantly) in the region of the elbow, to accomplish the changes in front view outline shown in Fig. 12 (as contrasted with that in Fig. 10) and in side view outline shown in Fig. 13 (as contrasted with that in Fig. 11). The result, when embodied in each of the pubic bars of the assembled brace, is reflected in upwardly bow-shaped contours in the vicinity of the wearer's groins, as designated by 38 and 39 in, e. g., Figs. 1, 2, 4.

One of the particular advantages of the foregoing method of fabricating the sternal and pubic connector bars is that no edge-bending is required, but only flat-bending of a mid-portion of the work, i. e. coupled with axial twisting of the vertical one of its two terminal portions.

Although the brace of this invention can be supplemented, if desired, by auxiliary supports such as shoulder or other straps (e. g. where the wearer particularly dislikes pressure on the symphysis pubis or lower lumbar regions) or crutch-like appendages and/or a pelvic band annexed to its framework to prevent lateral motion or collapse of any part of the spine, the brace charac-

teristically derives essentially its sole support from self-cancelling pressure interaction of the five above mentioned support portions, i. e. the sternal, pubic, lumbar, and two side pads. Since they are all substantially vertically disposed (except for slight components of obliquity in the case of the first two), they exert essentially horizontal components of pressure only. This makes it especially desirable, in the interest of comfort in wear, that the shapes and sizes of the pressive areas be such as to promote adequate or optimum distribution of the pressures involved.

The side pads, e. g., accordingly are advantageously of equal size and shape, and vertically aligned in mutually parallel "center-side" relationship, with the areas of the faces of the rigid plate containing portions of each about equally divided, anteriorly and posteriorly of the mid-axillary line. This conduces to a direct counterbalancing of their pressures on the sides of the torso, besides helping to counteract rotative stresses. In addition, the vertical extent of each of said portions desirably may be at least about $\frac{1}{4}$ (better $\frac{1}{3}$, still better $\frac{3}{8}$) the overall top-to-bottom dimension of the brace, and the front-to-rear horizontal width, midway of said dimension, at least about $\frac{1}{2}$ (better $\frac{1}{4}$, still better $\frac{1}{3}$) such vertical extent (or, in actual measurement, e. g., at least about $1\frac{1}{4}$ (better $1\frac{1}{2}$, still better 2) inches).

Generally it will be found desirable to give each of the side pads enlarged front-to-rear breadth in the region of its mid-height, as well as an overall area of at least about $\frac{1}{3}$ (better $\frac{2}{5}$, still better $\frac{1}{2}$) that of the pubic pad.

For reasons analogous to those in the case of the side pads, the horizontal extents of the rigid sternal and pubic torso contacting support portions (whether or not equal to each other) advantageously are each at least about $\frac{1}{3}$ (better $\frac{2}{5}$, still better $\frac{1}{2}$) the overall side-to-side width of the brace, taken at a level midway therebetween; and their top-to-bottom breadths, midway of said width, advantageously are at least about $\frac{1}{7}$ (better $\frac{1}{6}$, still better $\frac{1}{5}$) the overall top-to-bottom dimension of the brace.

Even if applied to the pubic support only, the preferred ranges and ratios in the next preceding paragraph will be found useful, since desirability of distributing a pad's pressive contact over an area of substantial size is generally more pronounced in the case of the pubic than in that of the sternal pad. But in any event it will be advantageous to have the area of the rigid portion of the sternal support pad at least about $\frac{1}{8}$ (better $\frac{1}{4}$, still better $\frac{3}{8}$) that of the rigid pubic support pad, and the area of the latter greater than that of the rigid portions of either side pad, as well.

In contradistinction to the four said members of the subject group of five pads, the fifth or lumbar one advantageously has markedly less rigidity, even though it nevertheless is called upon to counterbalance the combined front-to-rear pressures of the sternal and pubic pads. Consequently, besides being located at least substantially entirely between the level of the mid-portion of the lower horizontal periphery of the former and that of the mid-portion of the upper horizontal periphery of the latter, it advantageously has a torso contacting area in excess of that of either of them (or, as well, horizontal and vertical dimensions each respectively in excess of those of either of them). In addition, as shown e. g. in Figs. 1, 2, 5, its lateral edges normally

are in such close proximity to the rear edges of posterior flaps 30 and 31 that they and it together furnish an approximation of a very broad posterior half-belt.

The pliancy or flexibility of the lumbar pad may well be about that of the average soles of ladies' leather shoes, or of the walls of an average leather brief case, or of tarpaulin, or the like, but the flaps may well have substantially more flexibility than that.

In general the sum of the areas of all five of the subject torso contacting pads (including with the areas of the side pads those of their respective flaps) will advantageously be at least about two-thirds as great as that of a rectangle bounded by sides equal respectively to the overall top-to-bottom and overall side-to-side dimensions of the brace.

In computing the areas aforesaid, any porosities or discontinuities in them (due e. g. to spaced "breather" or ventilative apertures, if provided) may generally be disregarded; as may also any discontinuities in rigid members inside the pads.

With the breadths or widths of said members and their interconnective framework structure of the proportions above indicated, it becomes readily possible to give them correspondingly less thickness. E. g. (assuming appropriate selection of materials from among those commonly available) the thicknesses of said rigid members can be kept less than about $\frac{1}{8}$ (or, say, even $\frac{1}{16}$) inch, with the result that the overall thickness of substantially the whole of each torso contacting portion can be less than, say, about $\frac{1}{4}$ (better $\frac{3}{8}$, still better $\frac{1}{2}$) inch. Qualities of streamlinedness (so to speak) and non-bulkiness thus will be enhanced.

On this score it will be noted that in the Figs. 1-5 embodiment of the invention all exposed (i. e. non-covered) rigid framework structure (as e. g. of metal) will be entirely out of contact with the torso during normal wear.

When a pair of lumbar bands are used they advantageously may be about $\frac{1}{2}$ to $1\frac{1}{4}$ inch in width ($\frac{3}{4}$ inch having proved particularly desirable from the standpoint of optimum support combined with minimum interference with the X-raying of an affected area) and spaced from each other a distance at least about equal to such width. Also, as presently preferred, the distance between the upper edge of a top lumbar band and the lower edge of a bottom lumbar band will be about $\frac{1}{4}$ to $\frac{1}{2}$ (better, $\frac{1}{3}$) the maximum distance between the upper edge of the lumbar pad and its lower edge.

In addition, just as symmetry is a preferred characteristic of the brace of the invention in respect of the front-to-rear plane passing through its vertical axis (as inspection of Figs. 1-5 will have shown), so the lumbar band or bands preferredly will be disposed at an elevation such as to provide analogous symmetry in respect of their locations relative to the horizontal axis of the lumbar support or pad.

As an aid in ascertaining brace dimensions in ordinary cases the following suggestions may be found useful:

Let x and y be the respective distances, taken on the front of the torso but with the back in hyperextension, from the sternal notch to the umbilicus (to give x) and from there to the bottom of the symphysis pubis (to give y). Then make the overall top-to-bottom dimension of the brace x plus y ; in which case the approximate

locus, during wear, of the topmost point of the sternal pad will be brought to about one inch (more or less) below the V-point of the sternal notch by fixing the horizontal axis (or mid-height line) of the lumbar pad in the same horizontal plane with that of the meeting point of x and y . Next, for the side-to-side dimensions, take the projected ("taut-tape") distances cross-wise of the torso between its side extremity points at, respectively, the level of the top point of x and that of the mid-height center point of the pubis bone. Finally, take a fairly representative "center-side" to "center-side" measurement across the front of the torso at any appropriate height, and let that measurement be the approximate length of the lumbar band or bands, i. e. from their anchor screws in one side pad to those in the other.

Generally the sternal pad will contribute comparatively more support per unit of area than the other pads, i. e. acting in conjunction with the lumbar pad (which itself will tend to seek its own level during wear). In any case, however, (and despite the above described upwardly bow-shaped contours of the pubic bars 18 and 19) contacting of the upper thigh margins or groins by the bottom of the pubic pad during the motion of sitting down will be apt to cause a slight upward excursion of the brace. This will ordinarily not be more than an inch or so however, and will likely be found not only unobjectionable in itself, but actually beneficial, as helping to alleviate points of pressure between support pads and body.

Even through the brace lends itself to easy installation and removal from the torso, hygienic factors as a rule will make it advisable that underwear (advantageously cotton) be worn between the brace pads and the body. In fact, materials generally inert to perspiration, sebaceous products, etc. are preferably used in all the parts of the brace.

For the rigid parts of the brace aluminum alloys of the sort known as 24ST have proven especially satisfactory. That particular alloy is understood to be 93.4% aluminum, 4.5% copper, 1.5% magnesium, and 0.6% manganese. In formation as to its preparation, including suitable heat treatment etc., is contained in Federal Specification QQ-A-355a dated November 28, 1941.

Alternative choice of equivalent or substitute alloys, metals, or other products will depend on characteristics of ductility, resilience, strength, weight, corrosion resistance, etc. E. g. at a sacrifice of susceptibility to being bent into optimum final body fit after installation on the torso (whether e. g. by special techniques or merely by self-molding in response to stresses during wear) stainless steel might be used.

The ductile form of titanium may be found particularly advantageous, in view of its ready workability, high corrosion resistance, and excellent strength-to-weight ratio (40% lighter than stainless steel yet having a tensile strength upwards of 80,000 lbs./in.² at room temperature).

Plastics of appropriate thermoplasticity for the heat of the body during wear to induce a desired degree of self-molding (but without unwanted distortion) also may be used. And material such as nylon injection-molded from melt (e. g. in view of its low weight (density=about 1), high strength, inertness, etc.) similarly come into consideration, e. g. if reinforced with reticular fabric or network of ductile metal em-

bedded in them, and/or provided with rigidizing ribs.

Stainless steel is presently preferred for the lumbar band or bands (of which there usually are not over two), although for reasons aforesaid titanium may be found especially suitable.

A material particularly adapted for serving the function of the leather and plastic composition coverings referred to in the description of Figs. 1-5 is the product (provided with a special protective coating or flock adapting it for personal wear next or near the skin) which is described in U. S. P. 2,290,685.

Also of special utility for the same function is fabric such as described in U. S. P. 2,210,774, as well as the "leatherette material" of Example II of U. S. P. 2,322,779, which is therein described as "remarkably resistant to perspiration."

If desired, corrosion and bodily excretion resistance can be supplied by inert metal coatings, e. g. thin layers of rare metal electrodeposited on aluminum alloy with known techniques, or by the use of stainless steel or rubber-surfaced aluminum alloys prepared, respectively, as in U. S. P. 2,171,040 or 2,320,999. Or any of a wide variety of commercially available leather, leatherlike or plastic coverings or coatings may be found suitable.

Removable pad covers, to be slipped on or off during wear (and equipped e. g. with zipper fasteners so disposed as to be insulated from the body by the brace parts) also may be provided in place of permanently adherent coatings or facings.

Generally speaking, the same plastics which are suitable as coverings for the rigid portions of the pads (including materials such as nylon) are also suitable for the lumbar pad, when molded in the form of semi-rigid sheets of appropriate thickness. And they characteristically undergo self-molding into conformity with the wearer's particular spinal curvature, as a result of the constant pressure of the lumbar bands or band across the back.

As a cushioning filler for the lumbar pad and/or side flaps (such as 30 and 31), cotton, felt, feathers, or etc. can be used.

For rigid parts whose subjection to flexing stresses would be sufficiently slight, certain categories of high strength-to-weight materials developed in comparatively recent research in aircraft or like fields may be considered. Cf. e. g. the multi-ply balsa wood core products described in U. S. P. 2,414,125 (col. 5), the metal-faced "sandwich material" with "balsa-core" (i. e. "Metalite") or the "honeycomb"-cored material publicized in 19 Machine Design (March 1947) at pages 142-6, or the composite sheet metal product described in U. S. P. 2,423,870.

Irrespective of the nature of the materials used, however, the cumulative effect of a number of design variations, minor in themselves, may lead to a considerable saving in weight, with consequent minimization of any discomfort in wear. Thus, up to a certain point, increase in the number of apertures in a brace member (e. g. holes for screws, lacings, or other fasteners) reduces weight without sacrifice of strength in equal proportion (besides effecting a saving in the amount of alloy or other material used, and providing increased number of air vents for ventilation). And diminution in the size of lumbar band adjusters or tightening mechanisms such as 10 and 11 (i. e. even without making them or their keys separately portable) contributes its

modicum of weight reduction. Likewise, as to the omission of accessories such as straps, belts, rigid lumbar support bars, and the like.

On the other hand, decreasing of weight should not be carried to the point of e. g. cutting down the support pads' breadth of bearing surfaces to the point of impairing their performance of the function of counteracting any tendency of the brace to slide up and down or to rotate on the trunk of the body.

Alternative devices for serving the purpose of the above described and presently preferred forms of lumbar bands, tightening mechanisms and adjusters include, e. g. ordinary belts and buckles, bands with turnbuckle or right and left screw link means for adjusting them, complementary sliding segments (whether serrated or merely smooth surfaced) with set screw, clamp, toggle and cotter pin, or other means for securing them in fixed adjustment; substantial absence of stretchability being preferred in all cases, however.

Where the adjusters are operated by screw action it may be desired to prevent accidental or unwanted change in their adjustment by making them turn so hard as to be operable only by a special tool; or resort may be had to the common expedient of using two nuts in place of one, the outer one being a locking nut.

In the appended claims references to the length, breadth, thickness or corresponding dimensions of the brace have reference, respectively, to the dimensions of the longitudinal, side-to-side, and front-to-rear axes of the brace, said axes being taken as those of an imaginary oblong whose top and bottom faces lie in horizontal planes passing respectively through the highest and lowest points of the brace (assuming it in place on an erect torso, e. g. disposed as in Figs. 5, 3 and 4), whose side faces lie in parallel vertical planes passing through the rightmost and leftmost points of the brace, and whose front and rear faces lie in parallel vertical planes passing through the frontmost and rearmost points of the brace, all six of said faces being rectangular. Similarly, expressions such as upper, lower, vertical, horizontal, level, downward, upward, forward, rearward, etc. are intended as relative and to be interpreted on the basis of the positions of the parts of the brace when it is in place on an erect torso.

It will be apparent that minor changes in the physical embodiments of the invention and its novel aspects may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A body brace comprising right and left torso side contacting rigid support portions, sternal and pubic rigid support portions, a non-stretching lumbar support portion having continuous flexibility across the region overlying the erector spinae group of lumbar muscles, framework rigid throughout interconnecting said rigid support portions, said brace also comprising means carried by said framework to sustain said lumbar support portion, said means being loosenable to facilitate installation and de-installation of the brace.

2. The brace of claim 1 in which said lumbar support portion comprises a flexible horizontal substantially nonstretchable band with means allowing the adjustment of its effective length and a lumbar back contacting pliant fabric whose vertical dimension is substantially in excess of

that of said band and which comprises a flexible sleeve for slip-fittingly receiving said band.

3. A 3-point hyperextension back brace comprising right and left torso side contacting rigid pads and sternal and pubic rigid pads, and a flexible lumbar pad, said rigid pads being rigidly interconnected by framework comprising means allowing the adjustment of solely the breadth of the brace and means allowing the adjustment of solely the length of the brace, each of said means being optionally operable independently of the other.

4. The brace of claim 3 in which the horizontal dimensions of said sternal and pubic rigid pads are each at least about $\frac{3}{4}$ the width of the brace, and their top-to-bottom dimensions midway of said width are at least about $\frac{1}{2}$ the length of the brace.

5. The brace of claim 4 in which the vertical dimension of each of said torso side contacting rigid pads is at least about $\frac{1}{4}$ the length of the brace, and the front-to-rear horizontal dimension of each of them, midway of said vertical dimension, is at least about $\frac{1}{2}$ the latter.

6. In the brace of claim 2, spiral-threaded means, for gradually effecting said adjustment of the effective length of said band.

7. The brace of claim 1 which comprises means for varying the distance between said sternal pad and said pubic pad while retaining unchanged the fixed angle between the up and down axes, respectively extended, of said sternal and pubic pads; said means being comprised in and operable at the sides of said framework.

8. A body brace comprising right and left torso side contacting rigid support portions of enlarged front-to-rear dimension in the region of their mid-heights, sternal and pubic rigid support portions, a lumbar support portion, and resilient rigid framework supporting said portions, said brace also comprising means for varying the fixed breadth of the brace, said means being comprised in and operable at the sternal and pubic portions of said framework.

9. A 3-point suspension back brace comprising a pair of rigid side plates whose vertical dimensions are greater than their front-to-rear dimensions, an upper anterior pad, a lower anterior pad, a lumbar band, upper anterior pad supporting bars plus means immovably but detachably affixing them to said side plates, lower anterior pad supporting bars plus means immovably but detachably affixing them to said side plates, and lumbar band anchor portions plus means immovably but detachably affixing them to said side plates, each of said means being optionally operable, independently of the others, to vary the brace dimensions.

10. A 3-point hyperextension back brace comprising rigid sternal and rigid pubic support portions and a lumbar pad having continuous flexibility across the region overlying the erector spinae group of lumbar muscles, the overall side-to-side and top-to-bottom dimensions of said pad being in excess of those of each of said sternal and pubic rigid support portions; said brace also having torso-contacting flexible flaps affixed to its sides and extending posteriorly therefrom toward and approximately to the respectively adjacent ends of said lumbar pad, the maximum overall thickness of substantially the whole of each of said rigid portions of the brace as well as that of substantially the whole of said lumbar pad and said flaps being less than about $\frac{7}{16}$ inch, the weight of the brace being less than about

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3¼ pounds, and rigid portions of the brace being formed of aluminum alloy 24ST or similar light weight resiliently rigid material.

11. A back brace comprising right and left torso side contacting rigid support portions, sternal and pubic rigid support portions, and flexible lumbar cushioning, said cushioning being carried by at least a pair of thin horizontal stainless steel bands respectively about ½ to 1¼ inch in width, each of said bands being anchored to the sides of the brace, each of said bands being slip-fittingly sleeved through a flexible channel in said cushioning, and each of said bands being provided with screw means for adjusting its effective length independently of that of the other; said brace also comprising means for

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selectively adjusting the fixed elevation of and vertical spacing between said bands.

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The following references are of record in the file of this patent:

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Number	Name	Date
2,162,189	Williams	June 13, 1939

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