

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
3 March 2005 (03.03.2005)

PCT

(10) International Publication Number
WO 2005/018510 A1

(51) International Patent Classification⁷: **A61F 5/01**

(21) International Application Number:
PCT/US2004/026114

(22) International Filing Date: 12 August 2004 (12.08.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/639,832 13 August 2003 (13.08.2003) US

(71) Applicant (for all designated States except US): **BEIERS-DORF, INC.** [US/US]; Wilton Corporate Center, 187 Corporate Center, Wilton, CT 06897 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MCCORMICK,**

Scott, D. [US/US]; 4226 34th Avenue, Cincinnati, OH 45209 (US). **HINDS, Sherry** [US/US]; 1760 Liberty Woods Drive, Goshen, OH 45122 (US).

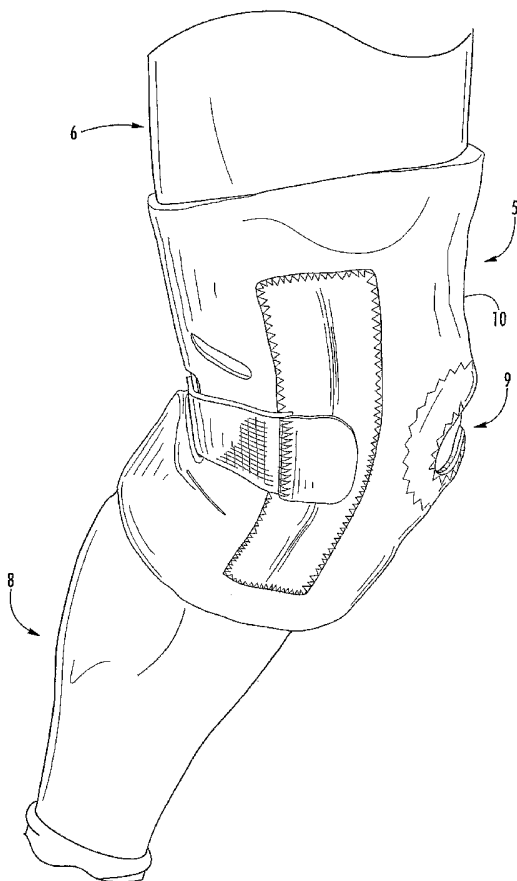
(74) Agents: **CARLIN, Gregory, J.** et al.; Alston & Bird LLP, Bank of America Plaza, 101 South Tryon Street, Suite 4000, Charlotte, NC 28280-4000 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: ADJUSTABLE KNEE STABILIZER



(57) Abstract: An adjustable knee stabilizer (5) is provided having a body (10) and a pair of integrated upper and lower straps (11, 12), and a middle strap (17) that is affixed to the body and extending away from the body and integrated straps. A pair of flexible stays (19) are positioned about a patellar opening (14), and a pair of openings (16) are defined in the body for collapsing during normal flexion of the knee.



GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ADJUSTABLE KNEE STABILIZER

BACKGROUND OF THE INVENTION

The present invention relates to knee supports and, more specifically, to an adjustable knee support or stabilizer adapted for preventing injuries to the knee
5 and/or supporting a knee that has been injured without unduly restricting circulation to the knee area or movement thereof.

It is well known that knee injuries are quite common among athletes and, perhaps not as frequently, among the general population as well. The knee area supports a wearer's body during walking, running, climbing, etc., and often
10 becomes sore or damaged through overuse or an abnormal movement. Because it is exceptionally difficult to completely rest an injured knee, most people continue to walk, travel, and exercise on the injured knee, which typically extends the recovery time of the knee. In some cases, the knee requires additional support for an extended period of time for support and healing, sometimes permanently,
15 depending on the activity. As such, a variety of knee braces and supports have been developed over the years.

A common knee support employs plastic or metal hinges on the lateral and medial sides of the knee. These supports are quite large and costly, and are typically reserved for extreme injuries that require exceptional support. Other
20 supports employ a resilient sleeve, such as a sleeve made from neoprene or the like, that slips over the knee and provides compressive forces to the knee area. However, these sleeves do not provide adjustability and can be quite restrictive to circulation and movement of the knee.

Other braces and supports have been developed that can be wrapped about
25 a wearer's knee and incorporate one or more straps that help secure the brace thereto. For example, U.S. Patent No. 3,804,084 to Lehman discloses a knee

support that includes a panel of padded felt material having top and bottom edges that are sized to extend around the thigh and calf, respectively. Openings are defined near the side edges that come together to form an opening for registration with the kneecap. A central overlock strap is provided that stretches over the
5 kneecap in use to provide compressive force to the knee.

Another knee brace is shown in U.S. Patent No. 5,759,167 to Shields, Jr. et al., which discloses a support wrap that includes a body and a pair of legs that extend laterally from the body. Connector tabs project from the legs and carry hook material so as to be connectable to loop material on the body portion.

10 Another knee support is shown in U.S. Patent No. 5,865,777 to Detty, which discloses a knee support having a central portion and three integral mounting tabs. An opening is defined in the central portion for receiving the kneecap. Two cover strips hold respective stays and are configured to extend across the front of the knee and pass through a corresponding buckle. One
15 disadvantage of the Detty support and similar braces is that the straps are integral to the body of the brace. This creates manufacturing deficiencies because the unique shape of the braces creates excessive waste during the cutting step of the manufacturing process. Another problem with braces having integral straps is that the straps are of the same material as the body of the brace and thus have the same
20 functional properties, which may not be desirable for the straps, particularly considering the different functions that the straps play compared to the body of the brace.

Accordingly, while these knee braces provide satisfactory support, improvements can be made. In particular, the number, location, and material of the
25 straps in the prior art leave room for significant advancements in terms of adjustability and manufacturing of the brace. In addition, advancements can be made for providing additional comfort and stability of the knee.

BRIEF SUMMARY OF THE INVENTION

30 The adjustable knee stabilizer of the present invention balances the need for support of the knee area with the adjustability and comfort that is desirable and advantageous in order for a person to wear the stabilizer. The adjustable knee stabilizer of the present invention is easy to apply about the knee area, can be

manufactured with improved efficiency of materials and less cost, and provides excellent support for the knee area without causing discomfort.

More specifically, an adjustable knee stabilizer according to one embodiment of the present invention comprises a body having a center portion, 5 opposing lateral ends, and opposing top and bottom edges. The center portion defines a patellar opening for registration with the patella or kneecap. The body also defines a pair of collapsible openings proximate one of the lateral ends. In one embodiment, the openings have an elliptical shape and are positioned at a predetermined angle such that they collapse under knee flexion. The outer surface 10 of the body is formed of a loop material, such as a VELCRO®-type loop material.

The knee stabilizer also includes a pair of integrated straps that are spaced apart and extend from one of the lateral ends of the body to preferably resemble a “U” shape. The straps include an upper strap adapted for wrapping about a wearer’s leg above the patellar opening, and a lower strap adapted for wrapping 15 about a wearer’s leg below the patellar opening. Each strap has a hook material tab, such as VELCRO®-type hook material, for releasably attaching the straps to the body of the stabilizer by pulling the upper and lower straps around the knee stabilizer and the wearer’s knee in use and adjustably securing the tabs to the outer surface of the body. The opposite outer side of the hook material tabs may include 20 a retroreflective material that improves night visibility and safety of the knee stabilizer.

The knee stabilizer also includes a center strap that is affixed to the body and extending from the opposite side of the body as the upper and lower straps. Advantageously, the center strap is formed from an elastic material that is 25 preferably distinct or different than the body material and affixed to the body after the body has been formed. This process creates manufacturing benefits that are discussed more fully herein. According to one embodiment, the middle strap includes a hook material tab at its end, and is adapted for stretchably extending or wrapping behind a wearer’s knee in use. The hook material tab of the center strap 30 is releasably attached to the loop material outer surface of the body. As such, the patellar opening is not covered by the middle strap, and the center strap provides extra and balanced support for the knee.

The knee stabilizer of the present invention also includes a plurality of flexible stays adjacent the patellar opening on the lateral and medial sides of the body. The stays provide resistance to excessive knee flexion, and in one embodiment comprise a pair of stays on each side of the patellar opening. The stays may be straight or have a slightly curved shape or arc that is biased towards the patellar opening, which therefore allows a slight bend in the knee without excessive resistance. The stays are resiliently flexible, and are preferably formed of either an overlapping metal coil or an elongate polymeric member. In one embodiment, the stays are covered or encapsulated by stay covers that are attached to the outer surface of the body. The stay covers may be divided into sections in order to accommodate and separate more than one stay per cover.

Methods of manufacturing a knee stabilizer are also provided. The methods further distinguish the present invention and demonstrate the manufacturing efficiencies presented by forming a knee stabilizer according to the present invention.

Accordingly, the adjustable knee stabilizer of the present invention provides a protective support means for a wearer's knee that balances the need for support of the knee area with ease of manufacturing and adjustability that is desirable and advantageous in order for a person to wear the stabilizer with comfort.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 is a perspective view of an adjustable knee stabilizer in an in-use configuration according to one embodiment of the present invention;

Figure 2 is a front plan view of the adjustable knee stabilizer of Figure 1 in a laid-out configuration;

Figure 3 is a side elevation view of the adjustable knee stabilizer of Figure 1; and

Figure 4 is a rear plan view of the adjustable knee stabilizer of Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, these inventions may be embodied in many
5 different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

Turning now to the figures, Figures 1, 2, and 4 illustrate an adjustable knee stabilizer **5** for supporting a wearer's knee during exercise or normal activity. The
10 knee stabilizer **5** is designed to wrap around a wearer's knee **9** between the wearer's thigh **6** and calf **8**. The knee stabilizer **5** is adjustable through a plurality of straps that allow the knee stabilizer to be custom fitted depending on the size of the wearer's leg. In addition, the knee stabilizer **5** is easy to fit and remove, as the knee stabilizer is a generally planar structure that is wrapped around the wearer's
15 leg instead of being pulled up the wearer's leg like a sleeve.

As shown in Figures 2 and 3, the knee stabilizer **5** according to one embodiment includes a body **10** constructed of a laminate material having multiple plies, including a soft inner layer **28**, a neoprene middle layer **26**, and a loop material outer layer **24**. Advantageously, the inner layer is worn against the skin
20 and has a low skin irritant, soft feel, and can have moisture-wicking properties, while the outer layer allows attachment of hook type fasteners, as discussed below. A preferable material for the inner layer is a 100% nylon knit jersey material. Laminated or otherwise attached to the inner layer **28** is a neoprene layer **26** comprising a backing preferably constructed of a blend of 70% styrene butadiene
25 rubber and 30% neoprene, although other neoprenes and neoprene blends may also be used. The outer layer **24** is preferably constructed of a loop material, such as a generic version of VELCRO® that is known in the art. The combined thickness of the body **10** is preferably about 0.205 inch +/- 15% at 0.5 psi, although other thicknesses are possible depending on the desired characteristics and application of
30 the brace. In one embodiment, the material forming the body **10** has a weight of 30.0 oz/yd² +/- 5%, an 85% elongation +/- 15% in the cross machine direction, and a maximum shrinkage of 3%.

The body **10** includes opposing lateral ends **34**, **38** and opposing top and bottom edges **32**, **36**, respectively. According to one embodiment, the area defined by the lateral ends and edges is approximately 10"x10", although the sizing may vary depending on the application and desired wearer of the knee stabilizer **5**.

5 However, it is preferred that the body **10** as defined above remains generally square in dimension. Advantageously, the lateral end **34** is generally flat or linear and preferably forms right angles to the edges **32**, **36**. In one embodiment, the opposing side edges are substantially parallel to one another, although a slight taper occurs at a pair of integrated straps **11**, **12**, as discussed below. The body **10**
10 also defines a patellar opening **14** that is located generally in the center of the body. In one embodiment, a patellar reinforcement ring **15** is sewn or secured to the inside surface **28** of the body for providing additional support to the patella or kneecap. In one embodiment, the reinforcement ring **15** is constructed of a distinct and separate layer of laminate material having a foam core, such as the middle
15 layer **26** of the body **10**. It is also possible that the knee stabilizer **5** may be constructed out of different materials and have more or less layers depending on many factors, including cost, use or application, and the like.

The knee stabilizer **5** also includes a pair of laterally extending top and bottom straps **11**, **12**, respectively, that are integral with the body **10** and extend
20 from the lateral end **38** of the body and define a gap **40** therebetween. In one embodiment, each of the integrated straps has a hook material tab **13** attached thereto. The hook material tab **13** is also a generic version of a VELCRO® strap material and is known in the art. In one embodiment, one or more of the hook material tabs **13** have an outer surface **21** that is highly retroflective, such that an
25 illumination is effected when struck by light in a dark ambient environment such that the light is directed back towards the source. As mentioned above, the integrated straps **11**, **12** have a slightly tapering outer edge. The inner edge of edge of the straps **11**, **12** is also tapering or curved such that the straps meet to define the lateral end **38** of the body **10**. The gap **40** according to one embodiment is about 4
30 inches at the widest point, which is near the hook material tabs **13** of the straps **11**, **12**.

In addition, the body **10** defines one or more openings **16** positioned generally near the base of the integrated straps **11**, **12** and adapted for collapsing

during knee flexion to eliminate bunching or binding of the knee stabilizer **5** during activity. In one embodiment, the openings **16** are approximately 1 inch elliptical openings and positioned at approximately 45° to an imaginary lateral axis extending through the patellar opening of the body **10**. Other shapes are possible
5 for the openings **16**, such as trapezoidal or circular.

The knee stabilizer **5** also includes a plurality of flexible stays **19** that are housed or encapsulated, according to one embodiment, in respective stay covers **18**. It is also possible that the flexible stays are integrated into the body **10** or fastened or secured using other devices, such as additional straps, pads of hook
10 material on the stays **19**, or the like. As shown, however, the flexible stays **19** are encapsulated in respective stay covers **18** that are sewn or secured to the outer surface **24** of the body **10**. The stay covers **18** are constructed of a loop material, such as a lightly napped knit or unbroken loop material with a 73 cup backing, such as style 1760 produced by Gehring Tricot Corp of Dolgeville, NY. The stay
15 covers **18** are preferably compatible with hook style fasteners as described herein. The stay covers **18** may have a straight or curved shape for receiving the stays, and the stay covers preferably extend along the medial and lateral sides of the patellar opening **14**. In one embodiment, the stay covers **18** have a curved or angled shape toward the patellar opening **14**, i.e., where the base of the curve is towards the
20 patellar opening. Other shapes are possible for the stay covers **18** and the pockets formed by the stay covers for receiving the stays **19** depending on the desired size and shape of the stays. In one embodiment, each stay cover **18** is separated, such as by stitching, into respective pockets for receiving a pair of flexible stays.

As shown in the drawings, the flexible stays **19** are at least partially, and
25 preferably completely, encapsulated or housed inside the stay covers **18**. In this manner, the stays **19** are rendered relatively immobile on the medial and lateral sides of the body **10** and provide reinforcement for the knee. In addition, the stays **19** act as a supplement to the wearer's proprioception, allowing the wearer to sense and react to excessive bending of the knee **9**. The flexible stays **19** are preferably
30 formed of a metal or polymer, such as nylon or polyethylene. Specifically, one preferred embodiment of the flexible stays includes an overlapping metal coil **20** that is straight or somewhat arcuate or curved for allowing flexion of the knee and a normal leg position. Similarly, another preferred embodiment for the flexible

stay includes an elongate polymeric member **22** having a plurality of ribs or ridges along a straight or curved or arcuate shape that allows for flexion and a curve resembling normal leg position. As shown, the flexible stays **19** and stay covers **18** have a somewhat biased shape, such as a 5°-15° bend on each end, biased toward the patellar opening **14** such that when the knee stabilizer **5** is around the wearer's knee the stays conform to a more natural position compared to flat or linear stays. However, it may also be possible for the stays **19** to be straight, but held in a bent or curved shape by the stay covers **18**. Preferably, the each of the stays **19** has a thickness of about 0.10 inch, a width of about .38 inch, and a length of about 7.5 inches, although these dimensions can vary according to the particular size and requirements of the brace and the intended wearer.

The knee stabilizer **5** also includes a third, middle strap **17** that extends from the lateral edge **34** of the body **10** in a direction opposite the integrated straps **11**, **12** and arranged to wrap behind a wearer's knee and overlap the lateral edge **38** in the gap **40** defined by the upper and lower straps. Advantageously, the middle strap **17** is not integrally formed with the body, but rather is formed of a separate material and affixed, which is defined herein as being sewn or otherwise secured to the body **10**, such as by gluing or fastening, in a subsequent processing step. In one embodiment, the middle strap **17** is a 2 inch wide nylon monofilament/polyester knit elastic material, such as PN 805N or 893N, supplied by George C. Moore Co., Greensboro, NC, and has an elongation capacity of at least 50%. Preferably, the middle strap **17** has an elongation capacity greater than that of the body **10**. In addition, the middle strap **17** of the knee stabilizer **5** includes a hook material tab **13** sewn to its distal end and secured at its proximate end to the outer surface **24** of the body **10**. In a preferred embodiment, the middle strap **17** is secured to the body **10** at a position spaced inwardly from the lateral edge **34**, which allows for greater adjustability and control when applying the knee stabilizer **5**. More specifically, the middle strap **17** is secured to the outer surface **24** of the body **10** such that the proximate end of the strap is interposed between one of the stay covers **18** and the body **10**, whereby the middle strap **17** and the stay cover share the same stitching and therefore create manufacturing efficiencies.

Advantageously, these and other manufacturing efficiencies that are obtained would not be present if the middle strap were formed as part of the body

10. More specifically, the manufacture of the knee stabilizer **5** includes cutting the body **10** of the knee stabilizer from a wide and flexible sheet of laminate material, whereby multiple body pieces are arranged across the width of the sheet of laminate material and cut or punched therefrom. In conventional knee supports, the middle strap that is formed integrally with the body results in excessive overall length of the body, and therefore typically only two body pieces can be placed across the laminate sheet. By forming the middle strap **17** as a separate piece and securing it to the body **10** in a later manufacturing step, the overall dimensions of the body **10** are smaller and simpler, whereby three or more body pieces can be placed across the laminate sheet. This greatly reduces waste and improves efficiency of the manufacturing process, particularly by eliminating wasted material that would be present around an integrated middle strap. Accordingly, substantial costs savings are effected by practicing the methods of the present invention.

By way of example, an integrated middle strap having a dimension of 2x5 inches and a body having a width of 10 inches would create two generally rectangular areas of waste having dimensions of 4x5 inches, which greatly adds to the cost and complexity of manufacturing such a brace. A further advantage of the middle strap **17** being a separate piece of material is that a more advantageous material may be used having properties different than those of the body **10** and integrated straps **11**, **12** that would not be available to conventional knee supports.

The knee stabilizer **5** is applied to a wearer's knee area by positioning the stabilizer such that the patella registers with the patellar opening **14**, and then wrapping the straps **11**, **12** about the wearer's leg such that the upper strap **11** is positioned above the patellar opening and the lower strap **12** is positioned below the patellar opening. The middle strap **17** is then wrapped behind the knee until the hook material tab **13** of the middle strap overlaps lateral edge **38** and is secured to the outer surface **24** of the body **10**. In one embodiment, the stay covers **18** have a loop material outer surface similar to that of the outer surface **24** of the body **10**, such that the hook material tabs **13** can be secured to the outer surface of the body **10** and/or the outer surface of the stay covers **18**. In this regard, the hook material tabs **13** of the upper and lower straps **11**, **12** can be adjusted to the wearer's leg size by releasably securing the hook material tabs **13** to the outer surface **24** of the body

10 and/or the outer surface of the stay covers 18. Once in place, the flexible stays 19 provide resilient bending resistance with flexion of the knee in order to support the knee area and prevent excessive movement thereof. During such flexion, the openings 16 collapse so that the body 10 and straps 11, 12 do not bunch or hinder
5 the wearer's comfort.

Accordingly, the knee stabilizer 5 of the present invention provides advantageous performance and manufacturing features that are not present in conventional knee supports. In particular, the middle strap 17 is formed from a separate and distinct material and is affixed or attached to the body 10 of the knee
10 stabilizer 5, while the integral top and bottom straps 11, 12 extend in the opposite direction than the middle strap 17 so that overall compressive force is balanced among the straps without unduly restricting circulation or knee flexion. In addition, medial and lateral flexible stays 19 are positioned on opposite sides of the patellar opening 14 and preferably biased in the direction of knee flexion.

15 Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other
20 embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

THAT WHICH IS CLAIMED:

1. An adjustable knee stabilizer, comprising:
a body having a center portion, opposing lateral ends, and opposing top and bottom edges, the center portion defining a patellar opening;
5 a pair of integrated straps spaced apart and extending from one of the lateral ends of the body, the pair of integrated straps including an upper strap adapted for wrapping around a wearer's leg and being positioned above the patellar opening in use, the pair of integrated straps including a lower strap adapted for wrapping about a wearer's leg and being positioned below the patellar opening in
10 use;
a middle strap affixed to the body and extending therefrom opposite the pair of integrated straps, the middle strap adapted for wrapping behind a wearer's knee in use and being positioned opposite the patellar opening such that the patellar opening is exposed; and
15 a plurality of flexible stays adjacent the patellar opening and disposed between the top and bottom edges, the flexible stays being adapted for resiliently bending with a wearer's knee.
2. An adjustable knee stabilizer according to Claim 1, wherein the
20 body further defines at least one collapsible opening proximate one of the lateral ends.
3. An adjustable knee stabilizer according to Claim 1, wherein the
25 body is a laminate comprising a neoprene layer and a loop material outer layer.
4. An adjustable knee stabilizer according to Claim 3, wherein the
body is a laminate comprising a nylon inner layer, a neoprene blend middle layer, and a loop material outer layer.
- 30 5. An adjustable knee stabilizer according to Claim 3, further comprising respective hook material tabs attached to the upper strap, middle strap, and lower strap, the hook material tabs being adapted for releasably attaching the

straps to the body to maintain tightness of the knee stabilizer in use about a wearer's leg.

5 6. An adjustable knee stabilizer according to Claim 5, wherein the tabs have a retroflective outer surface.

 7. An adjustable knee stabilizer according to Claim 1, wherein the middle strap is sewn to the body.

10 8. An adjustable knee stabilizer according to Claim 1, further comprising a pair of opposing stay covers attached to an outer surface of the body, the stay covers at least partially encapsulating the flexible stays and extending in an arc towards the patellar opening.

15 9. An adjustable knee stabilizer according to Claim 8, wherein the opposing stay covers have a loop material outer surface.

 10. An adjustable knee stabilizer according to Claim 8, wherein at least one of the opposing stay covers is divided into two pockets for accommodating a pair of flexible stays.

20 11. An adjustable knee stabilizer according to Claim 8, wherein the middle strap is affixed to the body at one end such that the end is interposed between one of the stay covers and the body.

25 12. An adjustable knee stabilizer according to Claim 1, wherein the middle strap comprises an elastic material having an elongation capacity of at least 50%, the middle strap being formed from a material distinct from the layers forming the body.

30 13. An adjustable knee stabilizer according to Claim 1, wherein the flexible stays comprise at least one of a group consisting of an overlapping metal coil and an elongate polymeric member.

14. An adjustable knee stabilizer according to Claim 2, wherein the at least one collapsible opening includes a pair of collapsible openings having an elliptical shape and arranged such that the openings collapse in use during flexion of a user's knee.

15. An adjustable knee stabilizer according to Claim 1, further comprising a patellar reinforcement ring attached to an inner surface of the body and coaxial with the patellar opening defined by the body.

16. An adjustable knee stabilizer according to Claim 1, wherein the plurality of flexible stays include a pair of flexible stays on the medial side of the patellar opening and a pair of flexible stays on the lateral side of the patellar opening.

17. An adjustable knee stabilizer according to Claim 16, wherein each of the flexible stays is at least 6 inches in length and is curved at each end about 5°-15°.

18. An adjustable knee stabilizer, comprising:
a laminate body having a center portion, opposing lateral ends, and opposing top and bottom edges, the center portion defining a patellar opening and a pair of collapsible openings proximate one of the lateral ends, the body comprising an inner layer, a neoprene middle layer, and a loop material outer layer;
a pair of integrated straps spaced apart and extending from one of the lateral ends of the body, the pair of integrated straps including an upper and a lower strap, each strap having a distal end with a hook material tab attached thereto, the upper strap adapted for wrapping around a wearer's leg and being positioned above the patellar opening in use, and the lower strap adapted for wrapping around a wearer's leg and being positioned below the patellar opening in use such that the hook material tabs releasably attach the upper and lower straps to the body to maintain tightness of the knee stabilizer about the wearer's leg;

a middle strap affixed to the body and extending therefrom opposite the pair of integrated straps, the middle strap having a distal end with a hook material tab attached thereto and adapted for wrapping behind a wearer's knee and being positioned opposite the patellar opening in use such that the patellar opening is exposed; and

a plurality of opposing stay covers attached to an outer surface of the body, each stay cover encapsulating at least one flexible stay that is adapted for resiliently bending with a wearer's knee, the stay covers having a loop material outer surface adapted for receiving the hook material tabs.

10

19. An adjustable knee stabilizer according to Claim 18, wherein the middle strap is affixed to the body at one end such that the end is interposed between one of the stay covers and the body.

15

20. An adjustable knee stabilizer according to Claim 18, wherein the tabs have a retroflective outer surface.

20

21. An adjustable knee stabilizer according to Claim 18, wherein the at least one flexible stay is selected from a group consisting of an overlapping metal coil and an elongate polymeric member.

25

22. An adjustable knee stabilizer according to Claim 18, wherein the pair of collapsible openings have an elliptical shape and arranged such that the openings collapse in use during flexion of a user's knee.

30

23. An adjustable knee stabilizer according to Claim 18, further comprising a patellar reinforcement ring attached to an inner surface of the body and coaxial with the patellar opening defined by the body.

24. An adjustable knee stabilizer according to Claim 18, wherein the at least one flexible stay comprises a flexible polymeric member having a plurality of ribs and a radius of curvature adapted for resiliently bending with a wearer's knee,

and wherein the stay covers have a similar radius of curvature as the at least one flexible stay.

25. An adjustable knee stabilizer according to Claim 18, wherein the at
5 least one flexible stay is straight and at least one of the stay covers has a curved shape.

26. An adjustable knee stabilizer according to Claim 18, wherein the at
least one flexible stays includes a pair of flexible stays on the medial side of the
10 patellar opening and a pair of flexible stays on the lateral side of the patellar opening.

27. An adjustable knee stabilizer according to Claim 26, wherein at
least one of the pair of flexible stays is at least 6 inches in length and is curved at
15 each end about 5°-15°.

28. A method of manufacturing an adjustable knee stabilizer,
comprising:
providing a flexible sheet of laminate material having at least a
20 neoprene layer;
cutting a body of the knee stabilizer from the flexible sheet, the
body portion defining a patellar opening and having a flat lateral end and opposing
top and bottom edges, the body extending into a pair of integral straps opposite the
flat lateral end that define a gap therebetween;
25 securing at least one flexible stay to a lateral and medial side of the
patellar opening; and
affixing a middle strap to the body such that the middle strap
extends from the body opposite the pair of integral straps and positioned across the
body from the gap defined by the integral straps.

30 29. A method according to Claim 28, wherein the providing step
includes providing a laminate material also having an inner layer and a loop
material outer layer.

30. A method according to Claim 29, further comprising securing corresponding hook material tabs to each of the middle strap and integral straps that cooperate with the loop material layer of the body.

5

31. A method according to Claim 29, wherein the securing step includes attaching a respective stay cover to the loop material layer of the body such that the stay cover at least partially encapsulates the flexible stay.

10

32. A method according to Claim 28, wherein the affixing step includes sewing the middle strap to the body proximate the flat lateral end, the middle strap being formed from a material distinct from the layers forming the body and having an elongation capacity greater than that of the body.

15

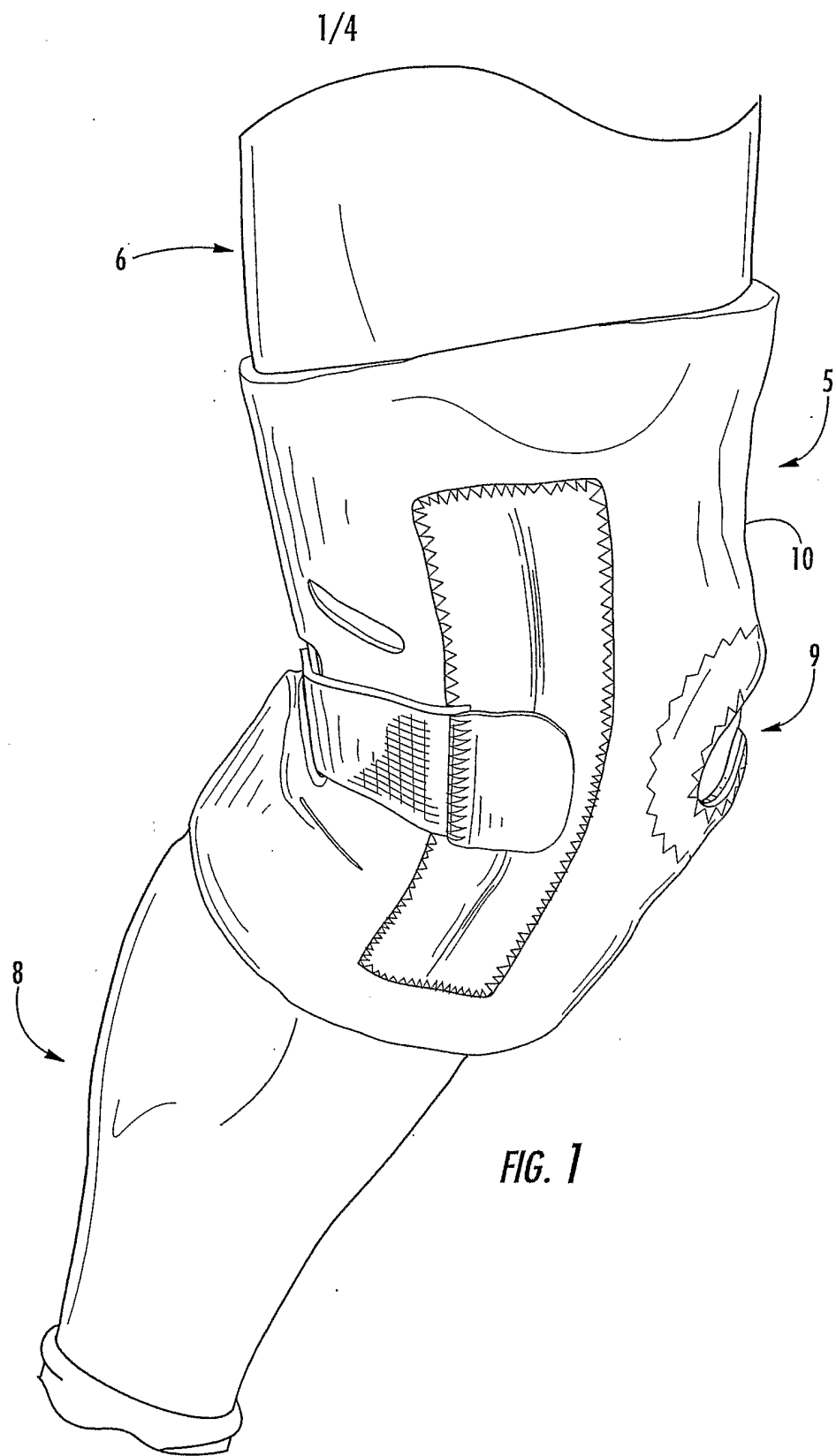
33. A method according to Claim 31, wherein the affixing step includes sewing the middle strap to the body and the stay cover such that the middle strap is interposed therebetween.

20

34. A method according to Claim 30, further comprising attaching a retroflective material to at least one of the hook material tabs.

25

35. A method according to Claim 28, wherein the cutting step includes cutting at least one opening in the body proximate the integral straps, the opening positioned and adapted for collapsing during use of the knee stabilizer about a wearer's knee.



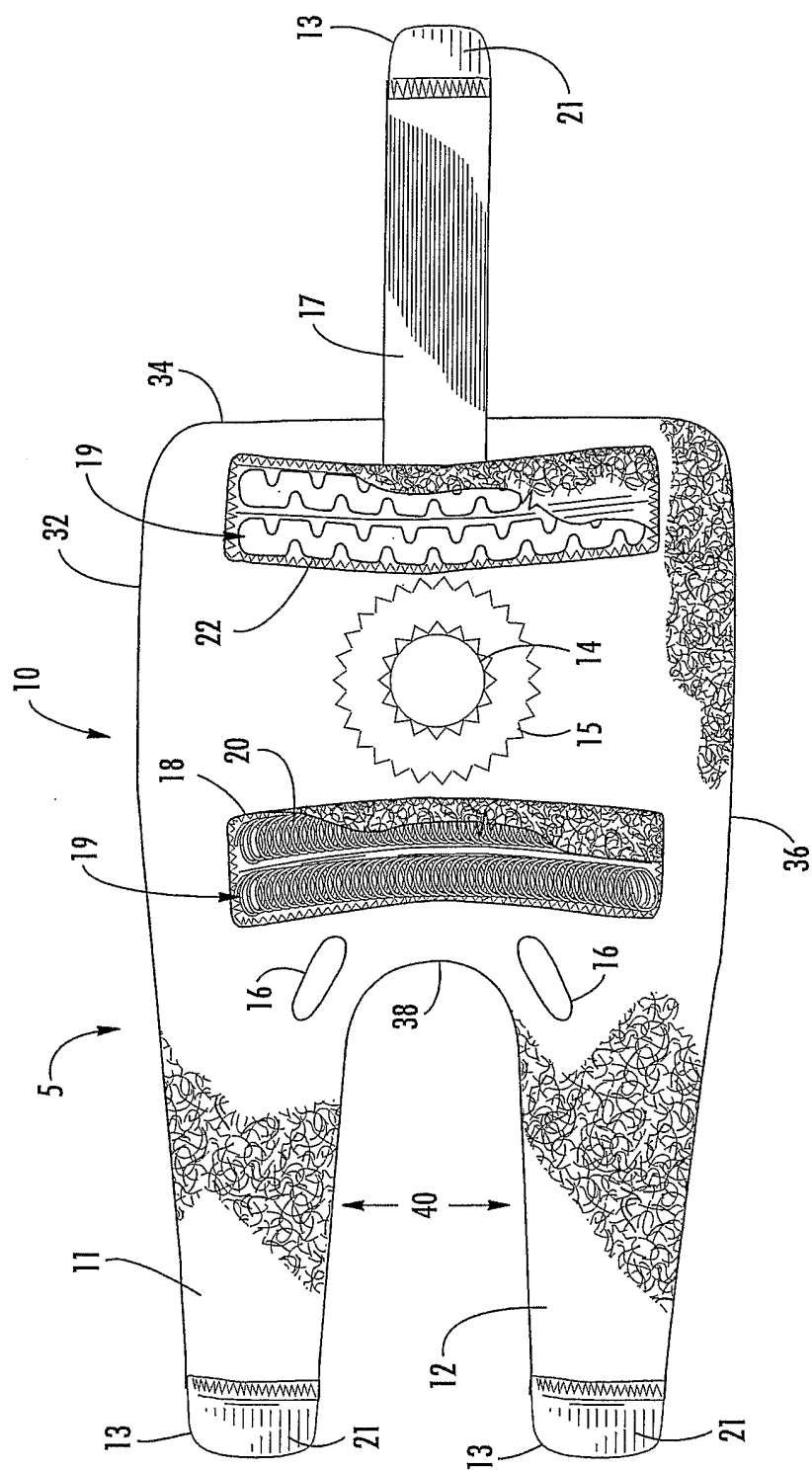


FIG. 2

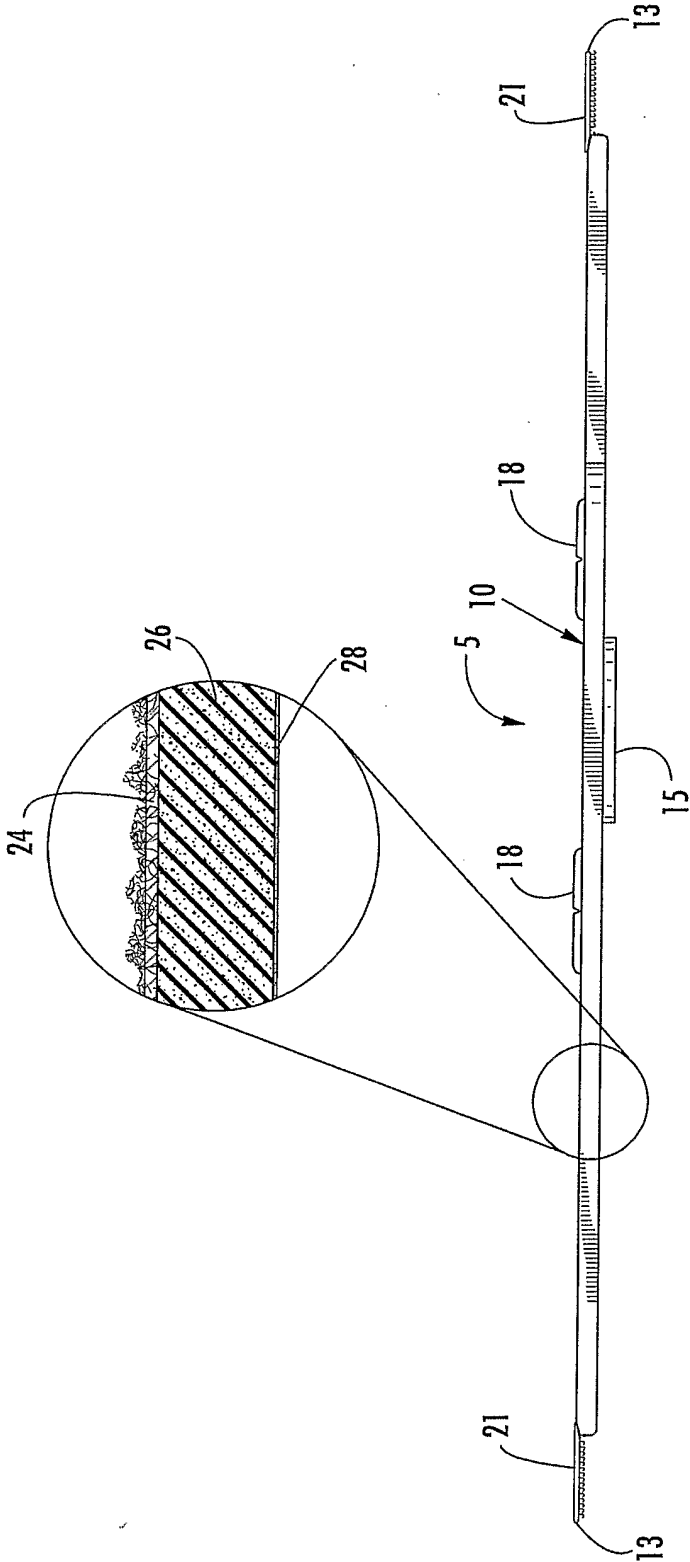
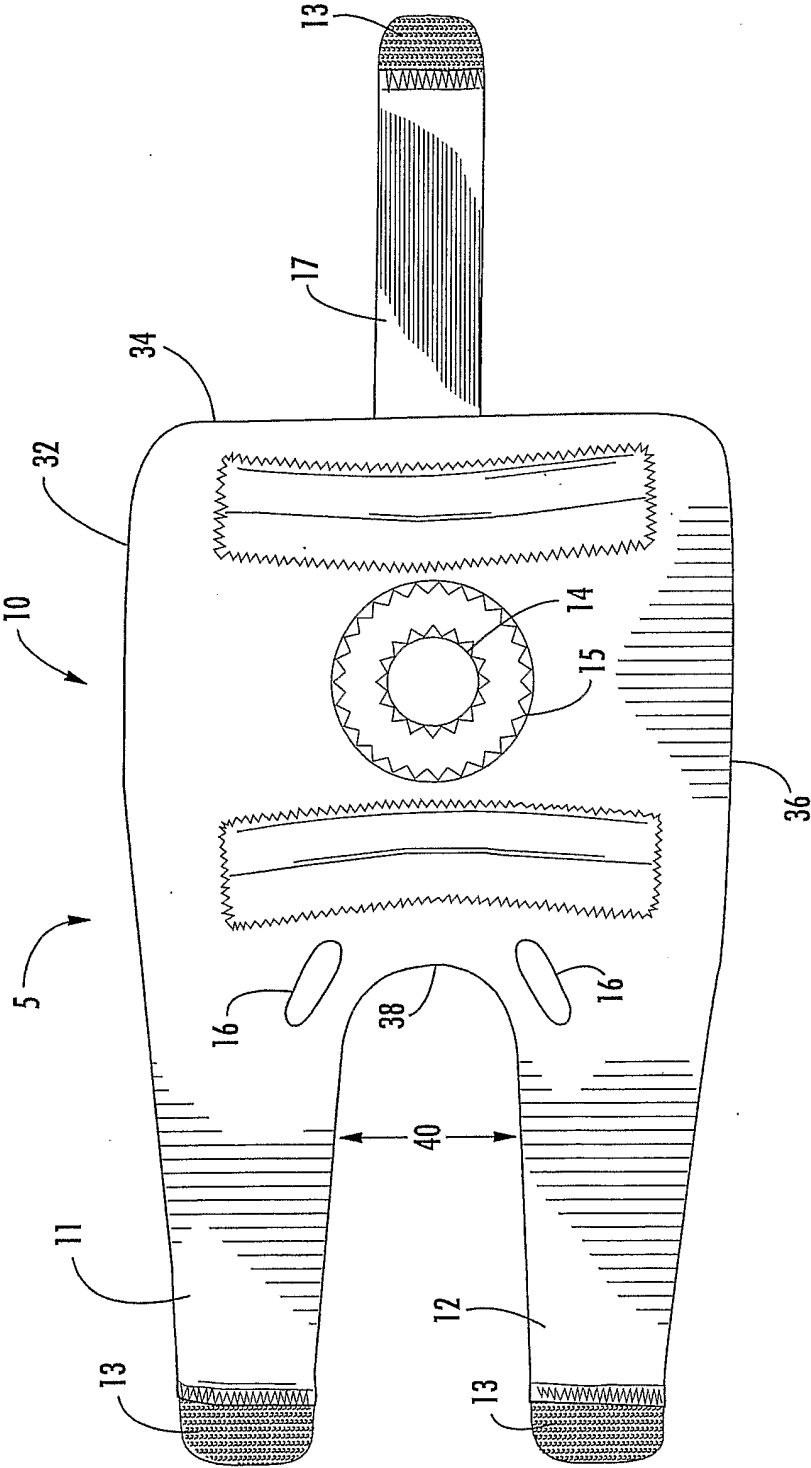


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/026114

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61F5/01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 865 777 A (DETTY GERALD D) 2 February 1999 (1999-02-02) cited in the application	1,3-5,7, 13,15, 16,28-31 2,8-11, 17
Y	column 3, line 2 - column 5, line 46; figures 1-3 column 7, line 60 - column 8, line 20 -----	
Y	US 5 139 477 A (PETERS HELENA) 18 August 1992 (1992-08-18) column 5, line 30 - line 40; figure 3 -----	2
Y	US 5 656 023 A (CAPRIO JR LOUIS ET AL) 12 August 1997 (1997-08-12) figures 1,3 ----- -/--	8-11,17

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

7 January 2005

Date of mailing of the international search report

17/01/2005

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
.NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Lickel, A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/026114

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 463 147 A (STUBBS FRANK F) 26 August 1969 (1969-08-26) column 4, line 22 - line 48; figure 3 -----	8-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/026114

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5865777	A	02-02-1999	NONE	
US 5139477	A	18-08-1992	AU WO	1876492 A 9219188 A1
US 5656023	A	12-08-1997	US US CA DE DE EP ES JP JP WO	5399153 A 5221252 A 2121342 A1 69216108 D1 69216108 T2 0608354 A1 2096775 T3 2651953 B2 7502425 T 9307837 A1
US 3463147	A	26-08-1969	NONE	