



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.04.2019 Bulletin 2019/17

(51) Int Cl.:
A43B 13/12 (2006.01) **A43B 13/18 (2006.01)**
A43B 5/06 (2006.01)

(21) Application number: **18210977.7**

(22) Date of filing: **15.04.2016**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **17.04.2015 US 201514689300**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
16165610.3 / 3 081 110

(71) Applicant: **Wolverine Outdoors, Inc.**
Rockford, MI 49351 (US)

(72) Inventors:
• **JESSIMAN, Alexander W.**
Newton, MA 02464 (US)

- **WHITE, J. Spencer**
North Easton, MA 02356 (US)
- **PAULSON, Andrea A.**
Arlington, MA 02474 (US)
- **MAHONEY, Christopher J.**
Concord, MA 01742 (US)
- **O'MALLEY, Patrick G.**
Newton, MA 02460 (US)

(74) Representative: **Haseltine Lake LLP**
Lincoln House, 5th Floor
300 High Holborn
London WC1V 7JH (GB)

Remarks:

This application was filed on 07.12.2018 as a divisional application to the application mentioned under INID code 62.

(54) **SOLE ASSEMBLY FOR AN ARTICLE OF FOOTWEAR**

(57) A footwear construction having a strobil-stitched bottomed upper and a sole assembly with a topsole disposed above the strobil board. The topsole is manufactured from a foam having an average modulus at a stress of 535 kilopascals of from about 750 kilopascals to about 950 kilopascals. The foam also has an energy efficiency of at least about 78%, and a dynamic compression set of less than about 10%. The sole assembly may include an inner sole disposed above the topsole. The inner sole may be manufactured from EVA foam. The topsole may have a thickness of at least 1mm, the inner sole may have a thickness of at least 3mm, and the total thickness of the topsole and inner sole may be at least 5mm. The sole assembly may include a midsole, and possibly an outsole, disposed below the strobil board.

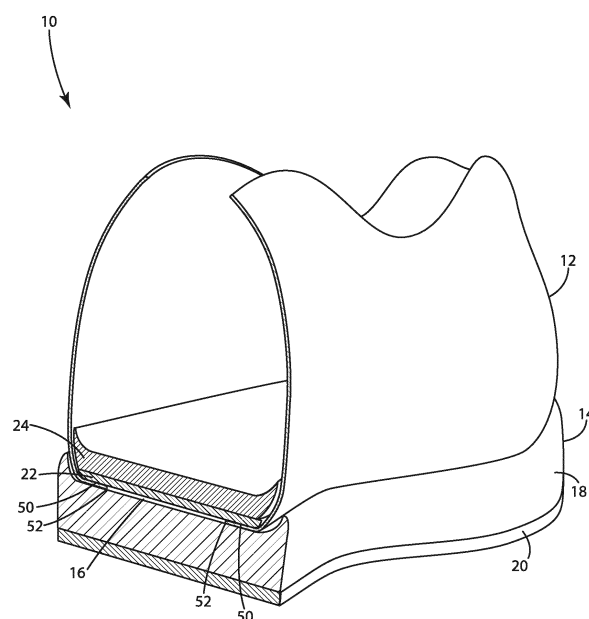


Fig. 3

Description**BACKGROUND OF THE INVENTION**

[0001] The present invention relates to footwear and more particularly to a sole assembly for an article of footwear.

[0002] Because footwear is so ubiquitous, it is easy to underestimate the complexity of the engineering required to meet the ever-increasing demands placed on footwear. This is particularly true with respect to performance footwear intended for use in high performance applications, such as sports and other athletic endeavors.

[0003] Running shoes are one of the most advanced types of footwear. Running is a demanding activity in which footwear plays an important role. It is important for running shoes to meet high technical specifications for cushioning and energy return, while still being light weight and highly durable. One of the roles of running shoes is to protect the runner's body from excessive local loads generated during the ground contact phase of the stride. Elastomeric foams are an example of materials that are utilized in the sole of the shoe to absorb some of the impact energy of the collision between the foot and the ground. Typically even greater forces are generated during the propulsion phase of contact, when the runner is pushing against the ground to lift herself up into the air. These forces are applied by the forefoot of the runner. The primary role of the cushioning materials under the forefoot in this phase of the stride is not to reduce these forces, but to reduce local peak pressures by conforming to the shape of the foot. The sole under the forefoot also performs a secondary action by compressing and decompressing in response to the runner's stride dynamics.

[0004] Typical shoe constructions create a layer of non-stretch fabric cemented to the sole located under the runner's foot. Commonly in athletic footwear construction, the upper is fitted onto a last to form it into the desired three dimensional shape, and then the bottom of the upper is closed with a flat piece that is roughly the shape of the bottom of the last. This can be done with a variety of techniques including board lasting, slip lasting, and strobels stitching. The closing stitch in a strobels-stitched bottomed upper can be realized, for example, with a zigzag stitch or a strobels-stitch from a Strobels stitching machine. The "Strobels Board" in this technique can be made of many materials, typically textiles (non-wovens, wovens, knit). One typical requirement for a strobels board is that it maintains the shape of the upper; ideally the board does not stretch appreciably, particularly in the fore-aft direction. This relatively rigid layer limits the ability of the shoe to conform to the runner's foot at the loads typically applied during running.

[0005] A conventional running shoe will often include an inner sole (also referred to as an "insole," a "footbed" or a "sockliner") that is positioned within the foot-receiving cavity in the upper above the strobels board. The inner sole is typically manufactured from ethylene vinyl acetate or "EVA". The inner sole typically enhances comfort because it provides a layer of cushioning material that is directly below the foot above the relatively rigid strobels board. In some applications, a thin foam layer is positioned above the strobels board and below the inner sole. The primary purpose of this thin foam layer is to improve the local pressure distribution of the wearer's foot to the sole of the shoe. For example, a thin (e.g. 1-3 mm) sheet of foam (often EVA) can be laminated to the textile of the strobels board to form a foam-strobels board laminate. Experience has revealed that the laminated foam layer can provide a degree of improved comfort. Regardless of whether the sole includes an inner sole and/or a strobels board laminate, conventional sole constructions that include only EVA and other similar cushioning materials above the strobels board have a limited ability to create a truly comfortable platform. This deficiency arises for a number of reasons, including thickness limitations of the foam layer, mechanical stiffness property limitations of the foam layer, mechanical breakdown (particularly with respect to non-durable foams) and/or compression limitations of the foam layer imparted by lamination of the foam layer to non-stretch strobels material. For example, constructions that include only a foam-strobels board laminate are too thin to adequately conform to the shape of the forefoot during the propulsion phase of the running stride when typically the highest ground reaction forces are generated. Quite simply, there isn't enough thickness/material to account for total impact deformation such that the forefoot (or a portion thereof) will "bottom out" on the underlying strobels board. Further, the strobels does not extend to the full width of the forefoot, so the foam-strobels laminate does not cover the full contact area of the foot. As another example, with constructions that include an inner sole of conventional EVA foam (alone or combined with a foam-strobels board laminate), the inner sole (and foam-strobels board laminate) suffers from irreversible plastic deformation over time such that it is unable to adequately rebound. As a result, a construction incorporating conventional EVA foam above the strobels board will either be too thin to fully conform to the forefoot under peak load or be so thick that the permanent compression set caused by repeated loading will materially change the fit of the shoe.

SUMMARY OF THE INVENTION

[0006] The present invention provides a footwear construction having a strobels-stitched bottomed upper and a sole assembly with a topsole disposed above the strobels board. The topsole is manufactured from a foam having an average modulus at a stress of 535 kilopascals (kPa) or from about 750 to about 950, about 800 to about 950, about 850 to about 950, or about 875 to about 950 kPa. The foam also has an energy efficiency of at least about 78%, at least about 80%, or at least about 82%. Moreover, the foam has a dynamic compression set of less than about 10%, less than about 8%,

or less than about 6%.

[0007] The topsole may extend beyond the strobil board, for example, to cover the entire area that is loaded by the forefoot. In one embodiment, the topsole extends beyond the periphery of the strobil board to cover the strobil stitching through the forefoot region. In another embodiment, the topsole extends the full width of the last in the forefoot region. In yet another embodiment, the topsole extends the full length and width of the last through the forefoot, arch and heel regions.

[0008] In various embodiments, the topsole is laminated to the strobil board. The topsole typically has an average thickness of from about 1mm to about 10mm, about 2mm to about 7mm, or about 2mm to about 5mm, in the forefoot region. It is to be appreciated that thickness of the topsole may be uniform or may vary, based e.g., on configuration of the footwear, the end user, etc. For example, the topsole may be thicker in the forefoot region than in the arch region and the heel region.

[0009] In one embodiment, the footwear construction includes a sole assembly having an outsole and a midsole disposed below the strobil board, and a topsole and inner sole disposed above the strobil board. The midsole may be manufactured from conventional midsole foam, such as EVA or polyurethane ("PU"). The thickness of the midsole may vary from application to application, but is typically in the range of about 6mm to about 30mm in the forefoot region and in the range of about 8mm to about 35mm in the heel region. The inner sole may be manufactured from conventional inner sole foam, such as EVA or PU, typically, having a thickness of between about 3mm and about 7mm.

[0010] In one embodiment, the topsole varies in thickness from region to region. In one implementation, the topsole may be thicker in the forefoot region than in the arch region and the heel region. The thickness of the topsole may be in the range of about 2mm to about 10mm in the forefoot region, in the range of about 1mm to about 7mm in the arch region and in the range of about 1mm to about 7mm in the heel region.

[0011] In one embodiment, the strobil board may define an opening that allows more direct interaction between the topsole and the sole components below the strobil board, such as a midsole. The size, shape and configuration of the opening may vary. The opening may extend through the forefoot, arch and heel region. Alternatively, the opening may be defined in the forefoot region. In another alternative, the strobil board may define multiple openings, such as one in the forefoot region and one in the heel region. In some implementations, the material of the topsole may extend through the opening or openings in the strobil board. In implementations of this nature, the midsole may define one or more recesses intend to receive the topsole material that extends downwardly through the strobil board.

[0012] In another aspect, the present invention provides a method for manufacturing an article of footwear including the general steps of forming an upper, bottoming the upper using a strobil board, affixing a sole to the undersurface of the strobil board and inserting a topsole into the upper above strobil board, wherein the topsole is manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and 950 kPa and an energy efficiency of at least about 78% and a dynamic compression set of less than about 10%. The method may include in the step of laminating the topsole to the strobil board. The laminating step may include molding the foam directly onto the strobil board or it may include joining the topsole to the strobil board using adhesive. The topsole may be laminated to the strobil board before or after the strobil board is joined to the upper. The method may also include the step of defining an opening in strobil board. The topsole may extend into and/or through the opening in the strobil board. The method may also include the step of varying the thickness of the topsole in different regions.

[0013] The present invention provides a footwear construction that provides high performance and enhanced comfort. The topsole is manufactured from foam that provides comfort and support characteristics believed to be unavailable in conventional strobil construction. Given the physical characteristics of the topsole foam, the topsole (or topsole/inner sole combination) can be manufacture with sufficient thickness to conform to the shape of the forefoot even during the propulsion phase of the running stride without concern about premature break-down or excessive compression set. The topsole can be incorporating into the article of footwear in various ways, thereby providing flexibility in the design and manufacture of footwear. If desired, the topsole may extend downwardly through an opening in the strobil board to accommodate additional topsole material.

[0014] These and other objects, advantages, and features of the invention will be more fully understood and appreciated by reference to the description of the current embodiment and the drawings.

[0015] Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited to the details of operation or to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention may be implemented in various other embodiments and of being practiced or being carried out in alternative ways not expressly disclosed herein. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof. Further, enumeration may be used in the description of various embodiments. Unless otherwise expressly stated, the use of enumeration should not be construed as limiting the invention to any specific order or number of components. Nor should the use of enumeration be construed as excluding from the scope of the invention any additional steps or components that might be combined with or into

the enumerated steps or components. Any reference to claim elements as "at least one of X, Y and Z" is meant to include any one of X, Y or Z individually, and any combination of X, Y and Z, for example, X, Y, Z; X, Y; X, Z; and Y, Z.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a perspective view of an article of footwear incorporating a topsole in accordance with an embodiment of the present invention.

Fig. 2 is an exploded view of the article of footwear.

Fig. 3 is a sectional view of the article of footwear taken along line 3-3 of Fig. 1.

Fig. 4A is a top view of the sole assembly of the article of footwear with portions removed.

Fig. 4B is a section view of the article of footwear taken along line 4B-4B of Fig. 4A.

Fig. 5 is a section view of the article of footwear taken along line 5-5 of Fig. 4A.

Fig. 6 is an exploded view of an article of footwear in accordance with an alternative embodiment.

Fig. 7 is a sectional view of the alternative article of footwear similar to Fig. 3.

Fig. 8 is a sectional view of a first alternative foam-strobel board laminate.

Fig. 9 is a sectional view of a second alternative foam-strobel board laminate.

DESCRIPTION OF THE CURRENT EMBODIMENT

Overview.

[0017] An article of footwear incorporating an embodiment of the present invention is shown in Fig. 1. The article of footwear 10 generally includes an upper 12 and a sole assembly 14. The upper 12 is manufactured using a strobel construction, and is bottomed with a strobel board 16. The sole assembly 14 generally includes an outsole 20 and midsole 18 positioned below the strobel board 16, as well as a topsole 22 positioned above the strobel board 16. The topsole 22 may be laminated or otherwise affixed to the strobel board 16. An inner sole 24 (or sockliner) may be positioned above the topsole 22. The topsole 22 is manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and about 950 kPa and an energy efficiency of at least about 78% and a dynamic compression set of less than about 10%.

[0018] Although the current embodiments are illustrated in the context of athletic or running shoes, they may be incorporated into any type or style of footwear, including performance shoes, hiking shoes, trail shoes and boots, hiking boots, all-terrain shoes, barefoot running shoes, sneakers, conventional tennis shoes, walking shoes, multisport footwear, casual shoes, dress shoes or any other type of footwear or footwear components. It also should be noted that directional terms, such as "vertical," "horizontal," "top," "bottom," "upper," "lower," "inner," "inwardly," "outer" and "outwardly," are used to assist in describing the invention based on the orientation of the embodiments shown in the illustrations. Further, the terms "medial," "lateral" and "longitudinal" are used in the manner commonly used in connection with footwear. For example, when used in referring to a side of the shoe, the term "medial" refers to the inward side (that is, the side facing the other shoe) and "lateral" refers to the outward side. When used in referring to a direction, the term "longitudinal direction" refers to a direction generally extending along the length of the shoe between toe and heel, and the term "lateral direction" refers to a direction generally extending across the width of the shoe between the medial and lateral sides of the shoe. The use of directional terms should not be interpreted to limit the invention to any specific orientation.

[0019] Further, as used herein, the term "arch region" (or arch or midfoot) refers generally to the portion of the footwear or sole assembly corresponding to the arch or midfoot of the wearer's foot; the term "forefoot region" (or forefoot) refers generally to the portion of the footwear forward of the arch region corresponding to the forefoot (for example, including the ball and the toes) of a wearer's foot; and the term "heel region" (or heel) refers generally to that portion of the footwear rearward of the arch region corresponding to the heel of the wearer's foot. The forefoot region 60, arch region or midfoot region 62 and heel region 64 are generally identified in Fig. 4A, however, it is to be understood that delineation of these regions may vary depending upon the configuration of the sole assembly and footwear.

Topsole Foam.

[0020] As noted above, it is desirable for the topsole 22 to be manufactured from foam having certain defined mechanical properties that are suitable for use above the strobel board. For example, it is desirable for the topsole 22 foam to be compliant, resilient, durable and highly conformable. Also, because the topsole 22 foam can be laminated to the strobel board, it would also be beneficial for the topsole 22 foam to be capable of being stitched through.

[0021] With regard to modulus, it is desirable for the topsole 22 foam to have a lower modulus than conventional

midsole foams, such as EVA midsole foams. There are practical limitations on the use of lower modulus EVA foam in footwear because lower modulus EVA foam breaks down quickly under the loads created during the peak forefoot loading. Examples of breakdown include failure to rebound after load (e.g. permanent compression), tearing, etc. To prevent premature breakdown, lower modulus EVA foam can only be used in relatively thin (e.g. 1-3 mm) layers. Unfortunately, the use of a thin foam layer limits conformability, which is an important objective for the sole under the forefoot. Therefore, it is desirable for the topsole 22 foam to be sufficiently durable to use in a layer that is thick enough to conform to the foot during forefoot loading and concomitant flex without losing its properties over repeated cycles. In various embodiments, the topsole 22 is free of EVA foam.

[0022] With these objectives in mind, the topsole 22 is manufactured from a soft and highly resilient (energy efficient) and durable material. Examples of suitable foams for purposes of this disclosure include certain expanded thermoplastic polyurethane ("E-TPU") foams and thermoplastic elastomer ("TPE") foams. In certain embodiments, the topsole 22 comprises, consists essentially of, or consists of E-TPU foam. In other embodiments, the topsole 22 comprises, consists essentially of, or consists of TPE foam.

[0023] Specific examples of suitable foams include "180SD" E-TPU foam, which is commercially available from Guo Sheng of Chidian Town, Jinjiang City, Fujian Province, China; High Rebound TPE PH-60 foam commercially available from Ecocell of Nan-Cheng, Dongguan city, Guangdong, China; "X-Bounce 45" foam, which is commercially available from Fine Chemical of Kimhae-City, Gyeongnam, South Korea; "S-Lite" foam, which is commercially available from Superfoam of Dongguan City, Guangdong, China; and "Infinergy™" foam, which is commercially available from BASF Corporation of Florham Park, NJ.

[0024] The topsole 22 foam is highly resilient, and more compliant than EVA foam at lower stresses (for example those encountered during standing) and more resistant to change in thickness after repeated impacts. In particular, the topsole 22 foam can provide superior performance over EVA strobil board foams particularly in the forefoot. Softness of the topsole 22 foam allows for increased conformability and supplemental impact absorption during forefoot strikes. Furthermore, the topsole 22 foam provides a benefit during propulsion. Specifically, the topsole 22 foam absorbs shear forces during landing that is released during toe off. The increased energy efficiency of the topsole 22 foam can create a more efficient stride.

[0025] The foam used to manufacture the topsole 22 has "softness," "resilient" and "durable" mechanical properties defined by impact testing on material samples. For example, the mechanical properties of foams may be measured with an electromagnetically driven impact test device (ElectroPuls E3000, Instron, Norwood MA). The protocol may be a modified version of ASTM F1614-99(2006) "Standard Test Method for Shock Attenuating Properties of Materials Systems for Athletic Footwear Procedure C." The principle modification is the use of a 45 mm disk shaped sample (as opposed to a 3 inch minimum square sample).

[0026] The loading curve is controlled to simulate a foot strike. Samples are approximately 20 mm thick (and resultant data is normalized by thickness). Mechanical attributes of interest include Average Stiffness, Energy Efficiency, Dynamic Compression Set, and Average Stiffness of the foam at 535 kilopascals (kPa). Here, 535 kPa is chosen as a typical peak stress during a foot strike. In order for the topsole 22 foam to be "soft" and "resilient", the notable mechanical attributes of interest are Average Modulus and Energy Efficiency. Average Stiffness is normalized as Average Modulus by factoring in the cross-sectional area of the impact tup (using a 45 mm diameter tup or "striker") and multiplying by the thickness of the sample. Energy Efficiency is the ratio of energy returned by the sample divided by the energy absorbed by the sample.

[0027] Each of the foam samples is impact tested 1,000 times to get a baseline measurement of mechanical characteristics. The 980th, 990th, and 1,000th impact cycle are averaged to determine properties.

[0028] As a measure of durability, Dynamic Compression Set is used. Dynamic Compression Set is the change in thickness of a sample for a given number of impacts. Each of the foam samples is impact tested 1,000 times to get a baseline measurement of mechanical characteristics (including Average Modulus and Energy Efficiency), then impact tested 100,000 times (with the same loading profile) to simulate extended loading cycles, and then impact tested 1,000 more times to get a measurement of mechanical characteristics after loading.

[0029] In various embodiments, the foam utilized to manufacture the topsole 22 of this disclosure has an average modulus of from about 750 to about 950, about 800 to about 950, about 850 to about 950, or about 875 to 950, kPa. The average modulus is analyzed at a stress of 535 kPa according to the modified version of ASTM F1614-99(2006). The foam also has an energy efficiency of at least about 78, at least about 80, or at least about 82, %. The energy efficiency is analyzed according to the modified version of ASTM F1614-99(2006). Moreover, the foam has a dynamic compression set of less than about 10, less than about 8, or less than about 6, %. The dynamic compression set is analyzed according to the modified version of ASTM F1614-99(2006). An Asker C Durometer Gage can be utilized to determine Asker C hardness values.

[0030] Because of the material properties of the topsole 22 foams, they can be used in a greater thickness without prematurely losing their mechanical properties. Not only do the topsole 22 foams provide enhanced mechanical properties, but by positioning the topsole 22 above the strobil board 16, the topsole 22 also moves the relatively rigid, non-

conformable layer created by the strobil board 16 and cement further away from the foot.

[0031] In various embodiments, the topsole 22 has an average thickness of from about 1mm to about 10mm, about 2mm to about 7mm, or about 2mm to about 5mm, in the forefoot region. It is to be appreciated that thickness of the topsole 22 may be uniform or may vary, based e.g., on the configuration of the footwear, the end user, etc. The thickness of the topsole 22 may vary from region to region in the shoe. For example, in the forefoot region, the topsole 22 may have a thickness in the range of about 2mm to about 10mm or in the range of about 3mm to about 7 mm, and in the heel region, the topsole 22 may have a thickness in the range of about 1mm to about 7mm or in the range of about 2mm to about 5mm. In the embodiment of Fig. 1, the topsole 22 has a maximum thickness of approximately 5 mm in the central forefoot region and a thickness of approximately 3 mm throughout the heel region. The topsole 22 may gradually transition between 5 mm and 3 mm through the arch region.

[0032] Examples of the soft, resilient, and durable foams suitable for purposes of this disclosure, as well as examples of conventional foams not suitable for purposes of this disclosure, are illustrated in Tables I-IV below. Specifically, Examples 1-4 are deemed comparative examples, while Examples 5-8 are deemed invention examples suitable for forming the topsoles 22 of this disclosure.

[0033] Each of the foam samples for the respective example are tested as described above. An Asker Durometer can be utilized to determine Asker C hardness values of each of the foam samples. Asker Durometers are readily available from a number of commercial suppliers and use thereof is understood by those in the art. Each of the examples is described in greater detail immediately below.

Example 1 is an EVA foam that is conventionally used for midsoles having a hardness of 52 Asker C, commercially available from Fine Chemical of Kimhae-City, Gyeongnam, South Korea.

Example 2 is an EVA foam that is conventionally used for strobil board lamination having a hardness of 42 Asker C, commercially available from Xie Li of Gaobu Town, Dongguan City, China.

Example 3 is polyurethane foam that is in the stiffness range for midsoles having a hardness of 35 Asker C, commercially available from Jones and Vining of Brockton, Massachusetts under the designation "U-2".

Example 4 is a softer conventional polyurethane foam having a hardness of 25 Asker C, commercially available from Jones and Vining of Brockton, Massachusetts under the designation "U-14 Soft".

Example 5 is an E-TPU foam available from Guo Sheng of Chidian Town, Jinjiang City, Fujian Province, China under the designation "180SD".

Example 6 is a TPE foam having a hardness of 47 Asker C, commercially available from Ecocell of Nan-Cheng of Dongguan City, Guangdong, China under the designation "PH-60".

Example 7 is a foam having a hardness of 45 Asker C, commercially available from Fine Chemical of Kimhae-City, Gyeongnam, South Korea under the designation "X-Bounce 45".

Example 8 is a TPE blended foam having a hardness of 52 Asker C, commercially available from Superfoam of Dongguan City, Guangdong, China under the designation "S-Lite".

Example 9 is an E-TPU foam available from Guo Sheng of Chidian Town, Jinjiang City, Fujian Province, China under the designation "160SD".

[0034] Average Modulus of each example is determined according to the modified version of ASTM F1614-99(2006) as described above. A limit of about 750 to about 950 kPa is chosen as the threshold for Average Modulus. Example foams encompassed within the range are deemed to have a desirable softness and example foams falling outside the range are deemed to have undesirable softness. Results are illustrated in Table I below.

TABLE I

Example Number	Average Modulus @ 535 kPa (kPa)	Limit (approx.)	Pass? (Yes/No)
1	1,027	750-950	No
2	872	750-950	Yes
3	1015	750-950	No
4	879	750-950	Yes
5	903	750-950	Yes
6	945	750-950	Yes
7	893	750-950	Yes
8	917	750-950	Yes
9	770	750-900	Yes

EP 3 473 123 A1

[0035] As illustrated in Table I above, each of Examples 1 and 3 fall outside the Average Modulus range. In sum, each of Examples 1 and 3 have undesirable softness, whereas each of Examples 2 and 4-9 have desirable softness.

[0036] Energy Efficiency of each example is also determined as described above. A limit of at least about 78% is chosen as the threshold for Energy Efficiency. Example foams encompassed within the range are deemed to have a desirable resiliency (i.e., a desirable energy returned/energy absorbed ratio) and example foams falling outside the range are deemed to have poor resiliency. Results are illustrated in Table II below.

TABLE II

Example Number	Energy Efficiency (%)	Limit (approx.)	Pass? (Yes/No)
1	76.6	≥ 78	No
2	76.5	≥ 78	No
3	61.8	≥ 78	No
4	56.5	≥ 78	No
5	83.3	≥ 78	Yes
6	82.6	≥ 78	Yes
7	81.7	≥ 78	Yes
8	88.1	≥ 78	Yes
9	85.5	≥ 78	Yes

[0037] As illustrated in Table II above, each of Examples 1-4 fall outside the Energy Efficiency range. In sum, each of Examples 1-4 have poor resiliency, whereas each of Examples 5-9 have desirable resiliency.

[0038] Dynamic Compression Set of each example is also determined as described above. A limit of less than about 10% is chosen as the threshold for Dynamic Compression Set. Example foams encompassed within the range are deemed to have a desirable durability and example foams falling outside the range are deemed to have poor durability. Results are illustrated in Table III below.

TABLE III

Example Number	Dynamic Compression Set (%)	Limit (approx.)	Pass? (Yes/No)
1	11.8	< 10	No
2	17.0	< 10	No
3	0.1	< 10	Yes
4	1.8	< 10	Yes
5	4.1	< 10	Yes
6	7.6	< 10	Yes
7	7.9	< 10	Yes
8	6.4	< 10	Yes
9	3.7	< 10	Yes

[0039] As illustrated in Table III above, each of Examples 1 and 2 fall outside the Dynamic Compression Set range. In sum, each of Examples 1 and 2 have poor durability, whereas each of Examples 3-9 have desirable durability.

[0040] All of the results are tabulated and presented in Table IV below. In sum, each of Examples 1-4 have one or more properties that make them undesirable for purposes of this disclosure, whereas each of Examples 4-9 possess the properties that make them suitable for forming the topsole 22 of this disclosure.

TABLE IV

Example Number	Tabulated Results
1	Unacceptable
2	Unacceptable
3	Unacceptable
4	Unacceptable
5	Acceptable
6	Acceptable
7	Acceptable
8	Acceptable
9	Acceptable

Footwear Construction.

[0041] As noted above, the article of footwear 10 shown in Fig. 1 generally includes an upper 12 and a sole assembly 14. The upper 12 is manufactured using a strobrel construction, and is bottomed with a strobrel board 16. The sole assembly 14 generally includes a midsole 18 and an outsole 20 positioned below the strobrel board 16, as well as a topsole 22 positioned above the strobrel board 16. The topsole 22 may be laminated or otherwise affixed to the strobrel board 16. An inner sole 24 (or sockliner) may be positioned above the topsole 22. The topsole 22 of the illustrated embodiment is manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and 950 kPa and an energy efficiency of at least about 78% and a dynamic compression set of less than about 10%. The topsole 22 is of sufficient thickness to conform to the shape of the foot throughout the forefoot region during the propulsion phase of contact. For example, in the illustrated embodiment, the topsole 22 has a thickness of about 5 mm through the center of the forefoot region.

[0042] The upper 12 is a generally conventional upper, the bottom of which is closed by a strobrel board 16. Although the construction of the upper 12 may vary from application to applications, the upper 12 of Fig. 1 generally includes a vamp 40 (or toe box), a tongue 42 and one or more quarters 44. The vamp 40 generally forms the forefoot portion of the upper 12 and may be manufactured from any combination of pieces of upper material. The tongue 42 may be joined to the vamp 40 and extend rearwardly to underlie the laces (not shown). As with the vamp 40, the tongue 42 may be manufactured from any combination of pieces. The tongue 42 may be padded, which in part helps to protect the wearer's foot from the laces. The quarter or quarters 42 form the heel portion of the upper 12 and may be manufactured from any combination of pieces of upper material. The interior of the vamp 40, tongue 42 and quarters 44 may be covered by a lining material, such as a layer of DriLex, Cambrelle or other lining materials. The various pieces of the upper 12 may be manufactured from any of a wide range of materials, such as leather, synthetic leather, mesh, canvas, textile (e.g. woven, knit, bonded), fabric and molded components. The upper 12 may include various trim, cushioning and reinforcing elements. For example, a heel counter (not shown) may be fitted into the heel region to reinforce the heel cup and increase support. As another example, a toe cap (not shown) may be provided to reinforce the vamp 40. Further, padding may be sandwiched between the layers of the upper 12, such as between the vamp 40 and the lining material. Reinforcing elements may be affixed to the upper 12 to reinforce the portions of the upper 12 that receive the laces. The construction of the illustrated upper 12 is merely exemplary, and the present invention may be incorporated into footwear that includes essentially any upper construction.

[0043] In the illustrated embodiment, the bottom of the upper 12 is closed by a strobrel board 16 or strobrel textile (these terms are used interchangeably herein). The strobrel board 16 is typically manufactured from a non-stretch fabric or textile (i.e. does not stretch appreciably). For example, the strobrel board 16 may be manufactured from a non-woven textile, a woven textile or a knit textile. Given that the strobrel board 16 is intended to maintain the shape of the upper 12, the strobrel board 16 does not stretch appreciably, particularly in the fore-aft direction. The strobrel board 16 may be a composite construction manufactured from a combination of different materials that provide the strobrel board 16 with different characteristics in different regions. For example, a composite strobrel board 16 of this type may have a forefoot region and a heel region that are manufactured from different materials. This may allow the strobrel board 16 to provide different mechanical properties in different regions, such as a more flexible forefoot or a more rigid arch or more rigid heel. In the illustrated embodiment, the bottom end of the upper 12 terminates in a lasting allowance 50 that is wrapped inwardly and is joined to the strobrel board 16. In the illustrated embodiment, the lasting allowance 50 is secured to the strobrel board 16 in a butt-seam by stitching 52 (See Figs. 2 and 4A), such as a zig-zag stitch or a strobrel-stitch from a Strobrel stitching machine. Although the illustrated embodiment includes a strobrel construction, the present invention may be incorporated into other footwear constructions that could benefit from the use of a topsole, such as board lasted

constructions or slip lasted constructions. In these alternative lasted constructions, the topsole may be laminated to the lasting board (for example, formed directly onto the lasting board or formed first and then secured to the lasting board) or it may be separate from the lasting board.

[0044] The sole assembly 14 of Fig. 1 can be of a two-piece construction as mentioned above, generally including the midsole 18 and outsole 20. The midsole 18 can be constructed from a material having a density that is generally less dense than the density of the outsole 20. The first density can optionally be about 5 pounds per cubic foot to about 20 pounds per cubic foot, and further optionally about 9 pounds per cubic foot to about 15 pounds per cubic foot, or other densities depending on the application. Generally, the density of the midsole is such that it compresses relatively easily to provide cushion to the wearer's foot. The midsole material also can have a durometer, optionally about 30 Asker C to about 55 Asker C, further optionally about 42 Asker C to about 48 Asker C, and even further optionally about 45 Asker C or about 43 Asker C. The midsole can be constructed from ethyl vinyl acetate (EVA), polyurethane, latex, foam, a gel or other materials.

[0045] The midsole 18 can include an upper surface 30 and an opposing lower surface 32. Generally, the upper surface 30 can be joined directly to the undersurface of the closed upper 12. For example, the midsole 18 can be joined to the undersurface of the strobil board 16 and the inwardly-turned marginal allowance of the upper 12. The upper surface 30 can be contoured to closely follow the natural contours of the bottom of a wearer's foot. For example, in the heel region, the midsole 18 can be shaped to define a heel cup that generally extends around and receives a portion of the wearer's heel therein when the footwear is worn by a wearer. The heel cup can include an upwardly extending flange 34 that is a substantially continuous wall bounding and surrounding the rearward portion of the wearer's heel. This upwardly extending flange or wall 34 also can extend upwardly along the lowermost portion of the upper 12 when the upper is joined with the sole assembly 14. The flange 34 can extend upwardly optionally about 1.0 mm to about 10.0 mm, further optionally about 2.0 mm to about 6.0 mm, or other distances as desired. In the illustrated embodiment, the flange 34 gradually tapers down toward the toe end of the sole assembly 14. The flange 34 can offer some reinforcing support to the upper in the heel region, and generally resist lateral or medial rolling of the heel.

[0046] The outsole 20 can be disposed below the midsole 18 and the upper 12. In the illustrated embodiment, the outsole 20 is manufactured from a single, one-piece layer that is generally coextensive with the undersurface 32 of the midsole 18. The outsole 20 may, however, be manufactured from a plurality of discrete segments that are separately secured to the undersurface 32 of the midsole 18 (See, for example, the alternative embodiment shown in Fig. 5). The outsole 20 can be constructed from one or more materials, and the current embodiment can be constructed from a mixture of foam and rubber. Alternatively, it can be constructed from a thermoplastic polyurethane elastomer (TPU), rubber, nylon or other polymer blend that includes nylon and/or TPU. These materials are merely exemplary, and the outsole 20 can be constructed from essentially any relatively wear resistant polymer, elastomer and/or natural or synthetic rubber or other materials capable of providing the desired functional characteristics. The outsole also can be constructed to include thermoplastic elastomers and/or thermoset elastomers. Other materials such as fiber-reinforced polymers can be used. These can include epoxy, polyethylene, polyester, thermosetting plastic reinforced with carbon, glass and/or aramid fibers.

[0047] The outsole 20 of Figs. 1-4 is shown with a generally smooth bottom, ground-engaging surface. As shown in connection with the alternative embodiment of Fig. 5, the bottom surface of the outsole 20 can include multiple lugs 36' (or cleats, grooves, channels, treads, siping, etc.). The lugs 36' can be in essentially any form and may be textured or have surface features through the portions that engage the ground. As noted above, the outsole 20 can be a single continuous section of material or it may be formed from a plurality of discrete outsole segments. The outsole 20 or individual outsole segments can also include one or more flex contours 38'. The flex contours 38' can generally be disposed in the forefoot, between the ball of the foot and the toes, to enable the toes to flex independently and more easily relative to the ball of the foot. Generally, the flex contours 38' can be a region where the thickness of the outsole is reduced relative to the thickness of the outsole (or entirely absent) in the ball of the foot and/or the toes or a region.

[0048] The midsole 18 and outsole 20 may be manufactured as a unit sole, and the unit sole may be secured to the bottom of the upper 12 after lasting. Alternatively, the midsole 18 may be joined to the bottom of the upper 12 first, and the outsole 20 may be joined to the bottom of the midsole 18 after the midsole 18 has been joined to the upper 12.

[0049] As noted above, the article of footwear 10 includes a topsole 22 disposed above the strobil board 16. The topsole 22 is manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and about 950 kPa and an energy efficiency of at least about 78% and a dynamic compression set of less than about 10%. However, these values may vary from application to application as set forth above. For example, the average modulus at a stress of 535 kPa may be between about 750 and about 950, or between about 800 and about 950, or between 850 and about 950 or about 875 and about 950 kPa. Further, the energy efficiency may be at least about 78%, at least about 80% or at least about 82%. Finally, the dynamic compression set may be less than about 10%, less than about 8% or less than about 6%.

[0050] In the illustrated embodiment, the topsole 22 is laminated to the upper surface of the strobil board 16. For example, the topsole 22 may be adhesively secured to the top of the strobil board 16 after the upper 12 and strobil

board 16 have been joined. However, the topsole 22 may be cemented to the strobrel board 16 before or after lasting. As an alternative to cementing, the topsole 22 may be formed in place directly on the top surface of the strobrel board 16. For example, the laminate may be formed by placing the strobrel board 16 in a mold, introducing the topsole foam into the mold and causing the topsole foam to cure in place within the mold in intimate contact with the strobrel board 16. With this alternative, the topsole 22 may be molded in place on the strobrel board 16 prior to joining the strobrel board 16 to the bottom of the upper 12. In some applications, it may be possible to mold the topsole 22 in place on the strobrel board 16 after lasting. It is not necessary for the topsole 22 to be laminated to the strobrel board 16. For example, in some applications, the topsole 22 may be loosely fitted into the upper 12 atop the strobrel board 16 without any direct connection between the two components. This option may be more feasible in applications where the topsole 22 has sufficient inherent structural rigidity to maintain its shape without being joined to the strobrel board 16.

[0051] As noted above, the strobrel board 16 closes the bottom of the upper 12. In the illustrated embodiment, the strobrel board 16 is generally continuous extending through the forefoot region, the arch region and the heel region. In this embodiment, the strobrel board 16 is formed without openings and substantially fills the entire opening in the bottom of the upper, which is defined around its perimeter by the terminating edge of the lasting allowance 50. The size, shape and configuration of the lasting allowance 50 may vary from application to application, which may in turn result in variations in the size, shape and configuration of the strobrel board 16.

[0052] If desired, the foot receiving cavity within the upper 12 may be enlarged in whole or in part to accommodate the topsole 22. For example, with regard to the embodiment of Figs. 1-4, the last may be enlarged through the length of the last to accommodate the extra thickness of the topsole 22. The enlargement may be uniform through the last or it may vary. For example, the amount of enlargement may be proportional to the thickness of the topsole 22. As another example, the last may be enlarged only in the forefoot region or other regions where the topsole 22 may be thickest.

[0053] In this embodiment, the topsole 22 forms the bottom of the foot receiving space on the interior of the upper 12. As shown, the topsole 22 is essentially coextensive with the bottom of the upper 12 and the sole assembly 14 extending from toe to heel and from lateral side to medial side. In this embodiment, the topsole 22 covers the lasting allowance 50 and the strobrel board 16 (See Fig. 3 and 4B). The topsole 22 may vary in size, shape and configuration. For example, the topsole 22 may extend through only select regions, such as the forefoot region, and be absent in other regions, such as the heel region. As another example, the topsole 22 may have one or more apertures or openings at select locations. The apertures or openings may be vacant or they may be filled by a different material, such as a cushioning material with different mechanical properties.

[0054] As perhaps best shown in Fig. 2, the topsole 22 of the illustrated embodiment is generally uniform in thickness from toe to heel. In the illustrated embodiment, the topsole 22 is about 3mm in thickness. The topsole 22 may alternatively have a thickness of between about 1mm and about 10mm, or between about 2mm to about 7mm or between about 2mm to about 5mm. As an alternative to uniform thickness, the topsole may vary in thickness through different regions of the sole. For example, as shown in Fig. 5, the topsole 22' may be thicker in the forefoot region than in the arch region or in the heel region. In the embodiment of Fig. 5, the topsole 22' has a maximum thickness of approximately 5 mm through much of the forefoot region and a thickness of approximately 3 mm through the heel region. The topsole 22' includes a gradual transition between these two thicknesses in the arch region. The thickness of the topsole 22' may, however, vary from application to application and from region to region. For example, the topsole may have a thickness in the forefoot region in the range of about 1mm to about 10mm or in the range of about 2mm to about 7mm or in the range of about 2mm to about 5mm, in the arch region in the range of about 1mm to about 7mm or in the range of about 1mm to about 5mm and in the heel region a thickness in the range of about 1mm to about 7mm or in the range of about 1mm to about 5mm.

[0055] An inner sole 24 may be fitted into the upper 12 above the topsole 22. The inner sole 24 may extend the full length and width of the foot receiving space. The inner sole 24 may be manufactured from a material having a density that is generally less dense than the density of the midsole 18. The inner sole density can optionally be about 5 pounds per cubic foot to about 15 pounds per cubic foot, and further optionally about 7.5 pounds per cubic foot to about 12.5 pounds per cubic foot, or other densities depending on the application. The inner sole 24 material also can have a durometer, optionally about 15 Asker C to about 50 Asker C, further optionally about 20 Asker C to about 45 Asker C, and even further optionally about 25 Asker C to about 35 Asker C. The inner sole 24 can be constructed from EVA, polyurethane, latex, foam, a gel or other materials. In the illustrated embodiment, the inner sole 24 is manufactured from EVA and has a thickness of approximately 3mm to 7mm, but its thickness may vary from application to application. For example, the inner sole may have a thickness in the range of about 2mm to about 10mm or about 1mm to about 12mm. The inner sole 24 of the illustrated embodiment is uniform in thickness, but may vary in thickness from application to application as desired. For example, the inner sole 24 may be thicker in the heel region. The inner sole 24 may be loosely fitted into the upper 12 so that it can be easily installed and removed, or it may be adhesively secured within the upper 12. For example, the inner sole 24 may be cemented to the top surface of the topsole 22. Although referred to as an "inner sole", the inner sole 24 may also be known as insole, footbed or sockliner.

[0056] In alternative embodiments, the strobrel board may include one or more openings. For example, an alternative

embodiment is shown in Figs. 6-7. To facilitate disclosure, the embodiment of Figs. 6-7 will include reference numerals corresponding with those of Figs. 1-4, except followed by the double prime symbol (i.e. "). As perhaps best shown in Figs. 6 and 7, the article of footwear 10" includes a strobil board 16" that defines a central opening 54" (the perimeter of which is shown in broken lines in Fig. 6). In this illustration, the central opening 54" extends through at least portions of the forefoot region 60", arch region 62" and heel region 62". The number, size, shape, location and configuration of strobil board openings may, however, vary from application to application. For example, the strobil board 16" may include an opening only in the forefoot region 60". As another example, the strobil board 16" may include separate openings in the forefoot region 60" and in the heel region 64". Returning now to the embodiment of Fig. 6, the central opening 54" may be formed by removing a central portion of the strobil board 16" by die cutting after lasting. Alternatively, the strobil board 16" may be formed with perforations or another line of weakening about the perimeter of the central opening 54" so that the strobil board material occupying the central opening 54" can be torn away from the strobil board 16" after lasting. In the embodiment of Figs. 6-7, the topsole 22" extends downwardly through the central opening 54" and terminates in alignment with the bottom surface of the strobil board 16". This configuration is merely exemplary and the topsole may extend to different positions relative to the strobil board. For example, in those applications in which there is an opening in the strobil board, the topsole 22" may extend down through the opening 54" as shown in Fig. 8, or the topsole 22" may extend over the opening 54" in the strobil board 16" as shown in Fig. 9. The embodiment of Fig. 8 may be particularly useful in applications where it is desirable to include additional topsole material and to provide more direct interaction between the topsole 22" and the midsole 18". In this embodiment, the topsole 22" extends outwardly beyond the perimeter of the strobil board 16", which allows it to cover the lasting allowance and butt seam. The embodiment of Fig. 9 may be particularly useful when the topsole 22" is die cut from a sheet of topsole foam of uniform thickness. For example, in this embodiment, the topsole 22" may be die cut and then cemented to the top surface of the strobil board 16". In this embodiment, the topsole 22" and the strobil board 16" are coterminous in the sense that they share the same outer boundary. The coterminous configuration may be useful in applications where it is unnecessary for the topsole 22" to extend beyond the strobil board 16" to cover a lasting allowance.

[0057] The above description is that of current embodiments of the invention. Various alterations and changes can be made without departing from the spirit and broader aspects of the invention as defined in the appended claims, which are to be interpreted in accordance with the principles of patent law including the doctrine of equivalents. This disclosure is presented for illustrative purposes and should not be interpreted as an exhaustive description of all embodiments of the invention or to limit the scope of the claims to the specific elements illustrated or described in connection with these embodiments. For example, and without limitation, any individual element(s) of the described invention may be replaced by alternative elements that provide substantially similar functionality or otherwise provide adequate operation. This includes, for example, presently known alternative elements, such as those that might be currently known to one skilled in the art, and alternative elements that may be developed in the future, such as those that one skilled in the art might, upon development, recognize as an alternative. Further, the disclosed embodiments include a plurality of features that are described in concert and that might cooperatively provide a collection of benefits. The present invention is not limited to only those embodiments that include all of these features or that provide all of the stated benefits, except to the extent otherwise expressly set forth in the issued claims. Any reference to claim elements in the singular, for example, using the articles "a," "an," "the" or "said," is not to be construed as limiting the element to the singular.

[0058] Any ranges and subranges expressly disclosed in connection with the various embodiments of the present invention should be interpreted to also describe, contemplate, encompass and disclose all subranges within such ranges and subranges, including whole and/or fractional values therein, even if such values are not expressly written herein. Accordingly, expressly enumerated ranges and subranges should be interpreted to disclose and provide support for all possible subranges within the enumerated ranges and subranges. This includes, but is not limited to, ranges and subranges that are divisions of the enumerated ranges and subranges, such as delineation into fractional segments, such as halves, thirds, quarters, fifths, and so on. As just one example, express disclosure of a range "of from 0.1 to 0.9" should be interpreted to inherently disclose any and all possible values and subranges within the range of 0.1 to 0.9, including any individual value between 0.1 and 0.9, as well as any subrange of values bounded on the lower end by any value between 0.1 and 0.9 and bounded on the upper end by any value between 0.1 and 0.9. It should also be interpreted to include all subranges that are derived by delineating the range into fractional segments, such as into a lower third, i.e., from 0.1 to 0.3, a middle third, i.e., from 0.4 to 0.6, and an upper third, i.e., from 0.7 to 0.9. Accordingly, the express enumeration of a range or subrange should be interpreted (individually and/or collectively) to provide adequate support for any and all claim language directed to any value or subrange of values within the expressly enumerated range. In addition, with respect to the language which defines or modifies a range, such as "at least," "greater than," "less than," "no more than," and the like, it is to be understood that such language includes subranges and/or an upper or lower limit. As another example, a range of "at least 10" should be interpreted to include a subrange of from at least 10 to 35, a subrange of from at least 10 to 25, a subrange of from 25 to 35, and so on. As a further example, a disclosed range or subrange should be interpreted to disclose and provide support for any individual number within that range or subrange. To illustrate, a range "of from 1 to 9" should be interpreted to include any individual value from 1 to 9, including individual

integers, such as 3, as well as numbers including a decimal point (or fraction), such as 4.1. The present disclosure extends to the following numbered statements, which are useful for understanding the present invention:

Statement 1. An article of footwear, comprising:

an upper having a bottom closed by a strobrel board, said upper having a lasting allowance joined to said strobrel board in a butt-seam by a stitch;
a midsole disposed below said strobrel board;
a topsole disposed above said strobrel board, said topsole manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and 950 kPa and an energy efficiency of at least about 80% and a dynamic compression set of less than about 8%; and
an inner sole disposed above said topsole.

Statement 2. The article of footwear of Statement 1 wherein:

said topsole has a thickness of at least 1 millimeter and said inner sole has a thickness of at least 3 millimeters; said topsole and said inner sole having a combined thickness of at least 5 millimeters in a central portion of a forefoot region of the article of footwear; and/or
said topsole has a thickness of at least 3 millimeters and a combined thickness of said topsole and said inner sole is at least 5 millimeters in a central portion of a forefoot region of the article of footwear.

Statement 3. The article of footwear of Statement 1 or 2 wherein said topsole extends through a forefoot region, an arch region and a heel region of the article of footwear.

Statement 4. The article of footwear of any of the preceding Statements wherein:

said topsole is laminated to said strobrel board; and/or
said topsole is formed directly on said strobrel board.

Statement 5. The article of footwear of any of the preceding Statements wherein:

said strobrel board defines an opening, said topsole generally disposed above said strobrel board and having a downward extension extending into said opening; and/or
said strobrel board defines an opening, said topsole generally disposed above said strobrel board and having a downward extension extending through said opening to a distance substantially below said strobrel board.

Statement 6. A sole assembly for an article of footwear having an upper bottomed with a strobrel board, comprising:

a midsole disposed below the strobrel board;
a topsole disposed above the strobrel board, said topsole manufactured from foam having an average modulus at a stress of 535 kPa of between about 750 and about 950 kPa and an energy efficiency of at least about 80% and a dynamic compression set of less than about 8%; and
an inner sole disposed above said topsole.

Statement 7. The sole assembly of Statement 6 wherein said topsole has a thickness of at least 1 millimeter and said inner sole has a thickness of at least 3 millimeters; said topsole and said inner sole having a combined thickness of at least 5 millimeters in a central portion of a forefoot region of the article of footwear.

Statement 8. The sole assembly of Statement 6 or 7 wherein said inner sole is manufactured from EVA.

Statement 9. The sole assembly of any of Statements 6 to 8 wherein said inner sole is manufactured from foam having an energy efficiency of less than about 80% and a dynamic compression set of greater than about 10%.

Statement 10. The sole assembly of any of Statements 6 to 9 wherein said topsole is laminated to said strobrel board.

Statement 11. The sole assembly of any of Statements 6 to 10 wherein said topsole has a first thickness in forefoot region and a second thickness in a heel region, said first thickness being greater than said second thickness.

Statement 12. The sole assembly of any of Statements 6 to 11 wherein said strobrel board defines an opening, optionally wherein said topsole extends into said opening.

Statement 13. An article of footwear comprising:

an upper having a closed bottom, said upper defining a foot-receiving space above said closed bottom;
a topsole disposed in said foot-receiving space, said topsole manufactured from foam having an average mod-

ulus at a stress of 535 kPa of between about 750 and 950 kPa and an energy efficiency of at least about 80% and a dynamic compression set of less than about 8%; and

an inner sole disposed in said foot-receiving space above said topsole, said inner sole manufactured from a foam having an energy efficiency of less than about 80% and a dynamic compression set of greater than about 10%;

wherein said topsole has a thickness of at least 1 millimeter and said inner sole has a thickness of at least 3 millimeters; said topsole and said inner sole having a combined thickness of at least 5 millimeters in a central portion of a forefoot region of the article of footwear. Statement 14. The article of footwear of Statement 13 wherein said upper is closed by a strobrel board, said topsole being joined to said strobrel board, optionally wherein said upper includes a lasting allowance, said strobrel board joined to said lasting allowance in a butt seam, said topsole extending over said strobrel board, said butt seam and said lasting allowance.

Statement 15. The article of footwear of Statement 13 or 14 wherein said topsole is an expanded TPU foam or a TPE foam.

Claims

1. An article of footwear comprising:

an upper having a closed bottom, said upper defining a foot-receiving space above said closed bottom; a topsole disposed in said foot-receiving space, said topsole manufactured from a first foam, wherein the first foam is an expanded thermoplastic polyurethane foam, or a thermoplastic elastomer foam; and an inner sole disposed in said foot-receiving space above said topsole, said inner sole manufactured from a second foam having an energy efficiency of less than about 80% and a dynamic compression set of greater than about 10%;

wherein said topsole has a thickness of at least 1 millimeter and said inner sole has a thickness of at least 3 millimeters; said topsole and said inner sole having a combined thickness of at least 5 millimeters in a central portion of a forefoot region of the article of footwear;

characterized in the said first foam has an average modulus at a stress of 535 kPa of from about 750 to about 950 kPa and an energy efficiency of at least about 78% and a dynamic compression set of less than about 10%.

2. The article of footwear of claim 1, wherein said upper is closed by a strobrel board, said topsole being joined to said strobrel board, optionally wherein said upper includes a lasting allowance, said strobrel board joined to said lasting allowance in a butt seam, said topsole extending over said strobrel board, said butt seam and said lasting allowance.

3. The article of footwear of claim 1 or 2, wherein the first foam of said topsole is the expanded thermoplastic polyurethane foam.

4. The article of footwear of claim 1 or 2, wherein the first foam of said topsole is the thermoplastic elastomer foam.

5. The article of footwear of claim 1, wherein said topsole extends through a forefoot region, an arch region and a heel region of the article of footwear.

6. The article of footwear of claim 2, wherein:

said topsole is laminated to said strobrel board; and/or
said topsole is formed directly on said strobrel board.

7. The article of footwear of claim 1, wherein the second foam said inner sole is ethylene vinyl acetate foam.

8. The article of footwear of claim 1, wherein said topsole has a first thickness in the forefoot region and a second thickness in a heel region, said first thickness being greater than said second thickness.

9. The article of footwear of claim 2, wherein said strobrel board defines an opening, optionally wherein said topsole extends into said opening.

10. The article of footwear of claim 2, further comprising a midsole disposed below said strobel board.

11. The article of footwear of claim 1, further defined as an athletic or running shoe.

5

10

15

20

25

30

35

40

45

50

55

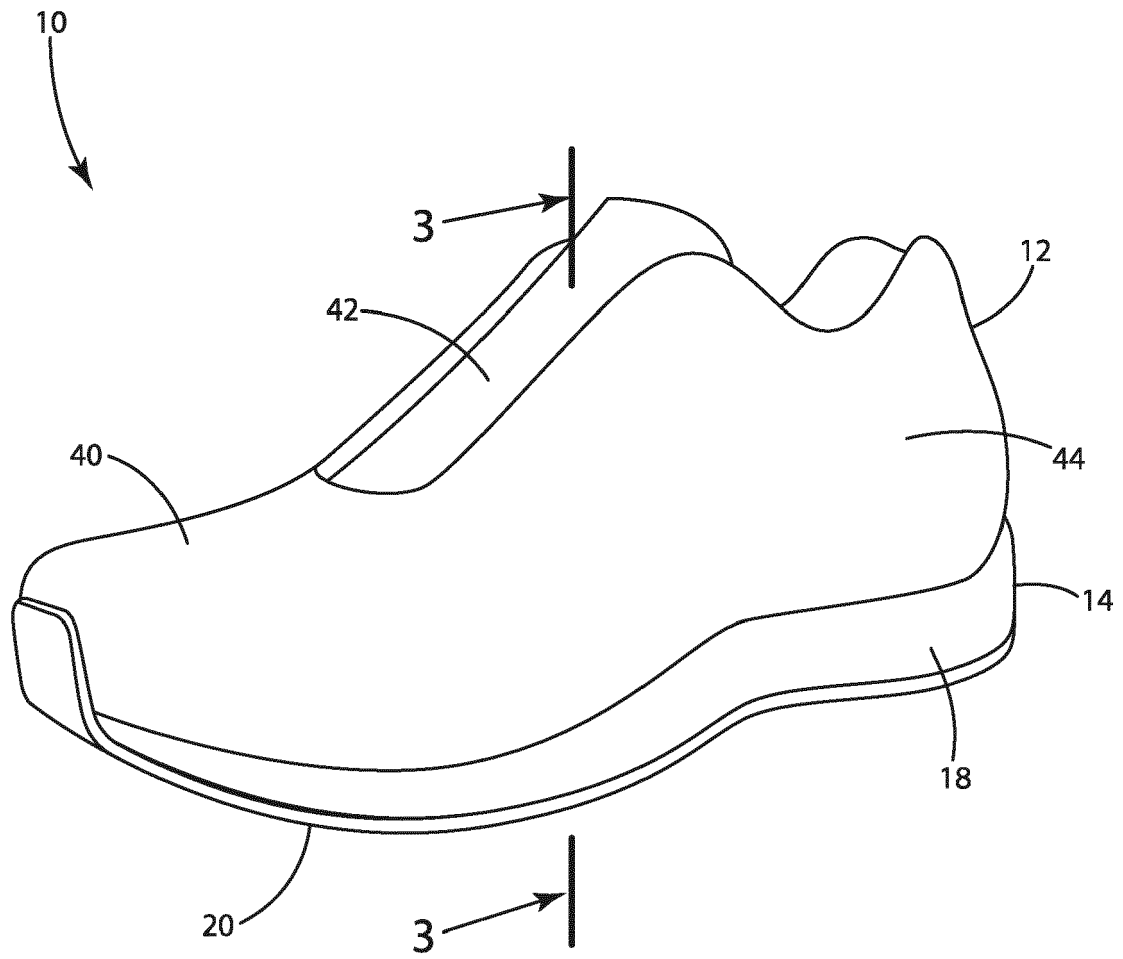


Fig. 1

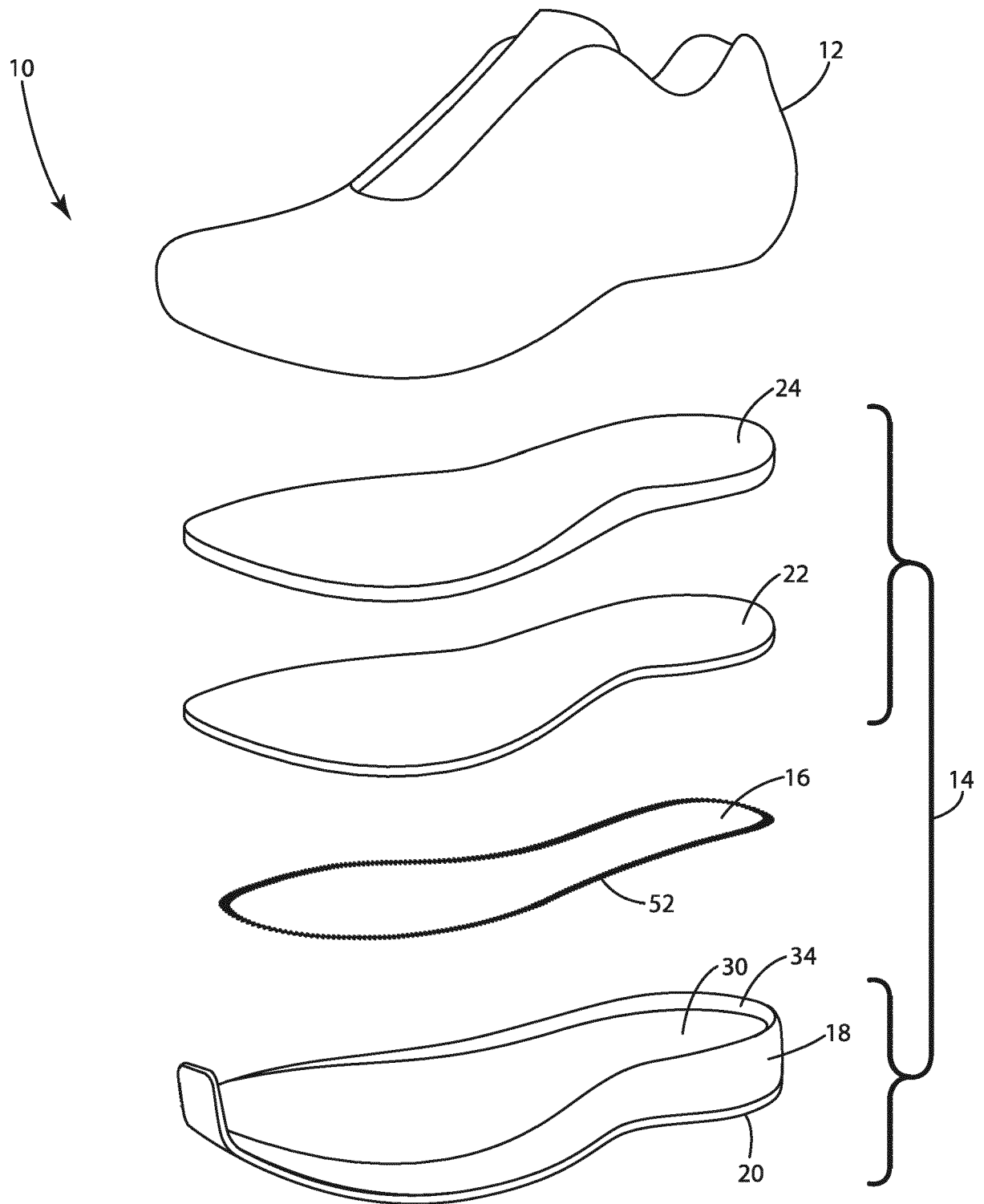


Fig. 2

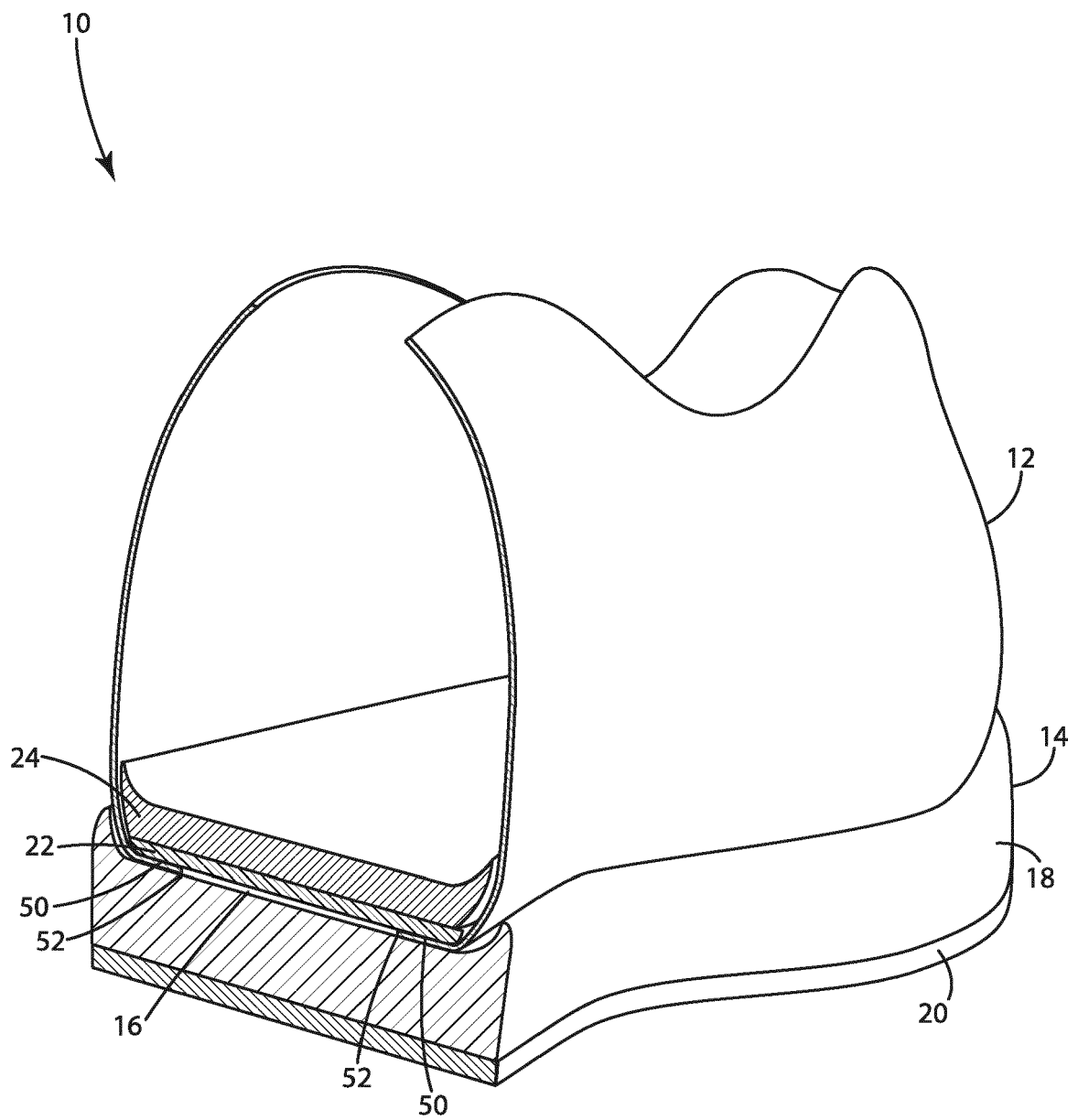
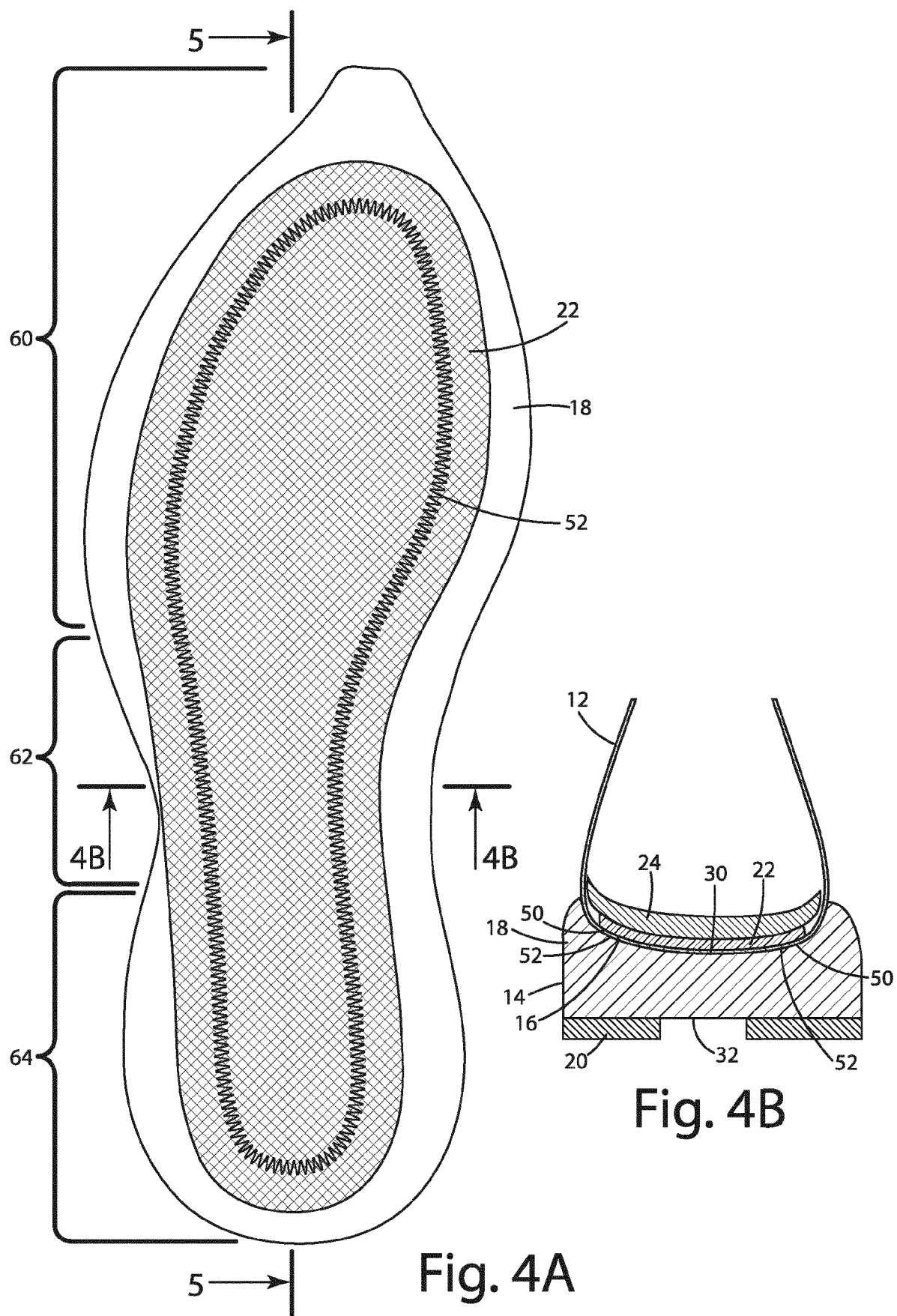


Fig. 3



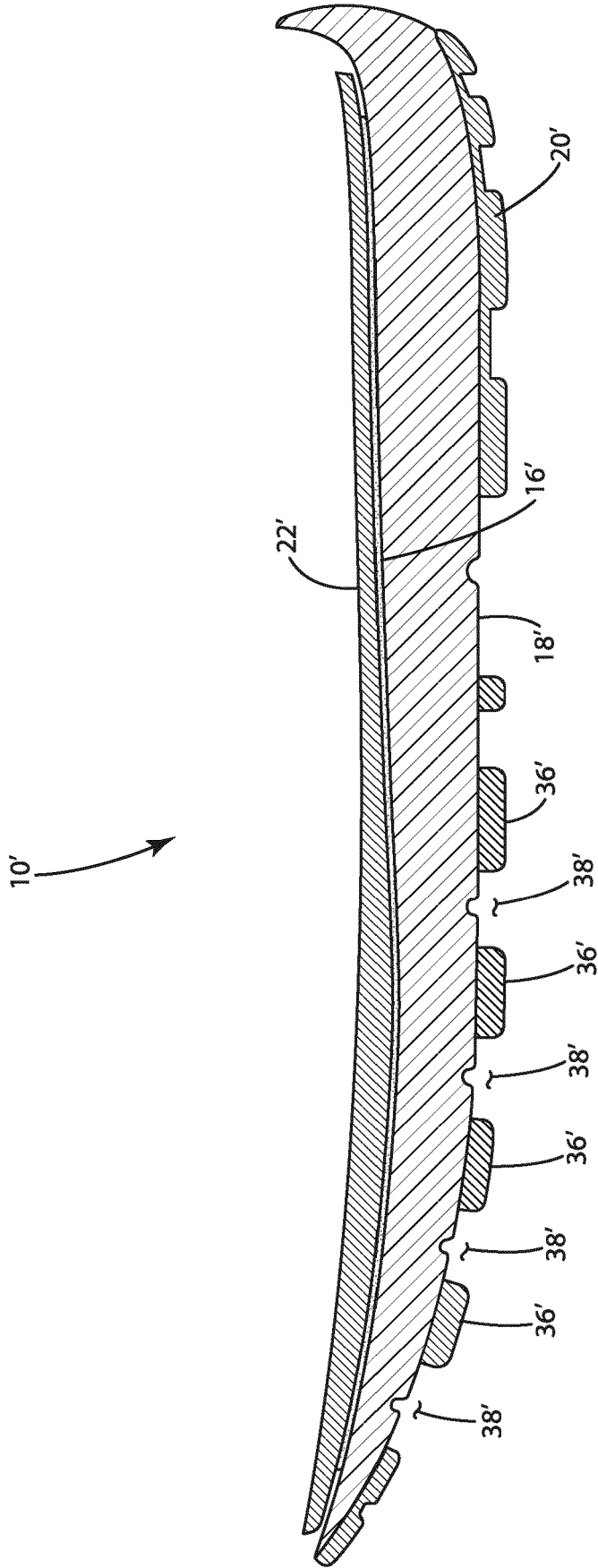


Fig. 5

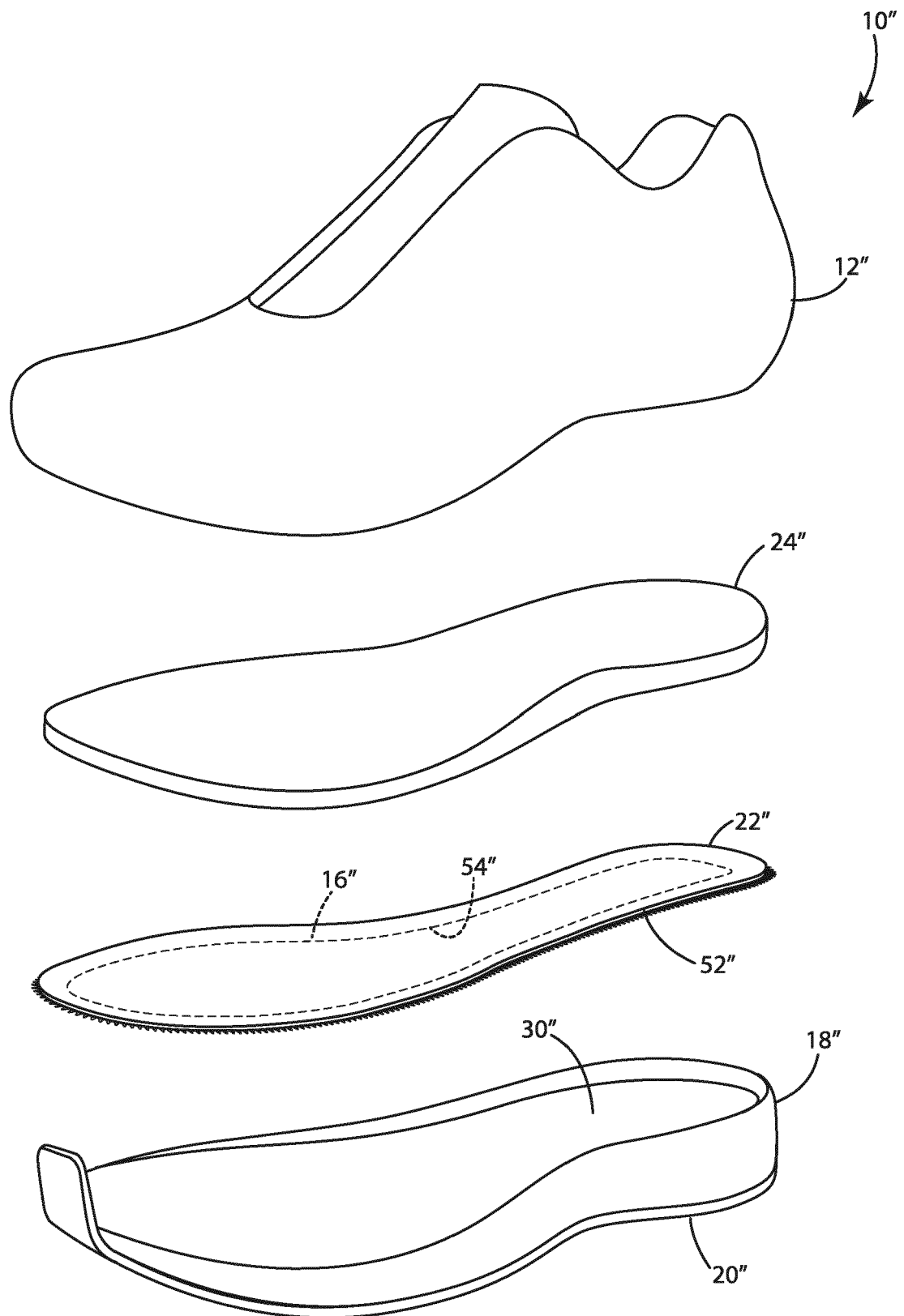


Fig. 6

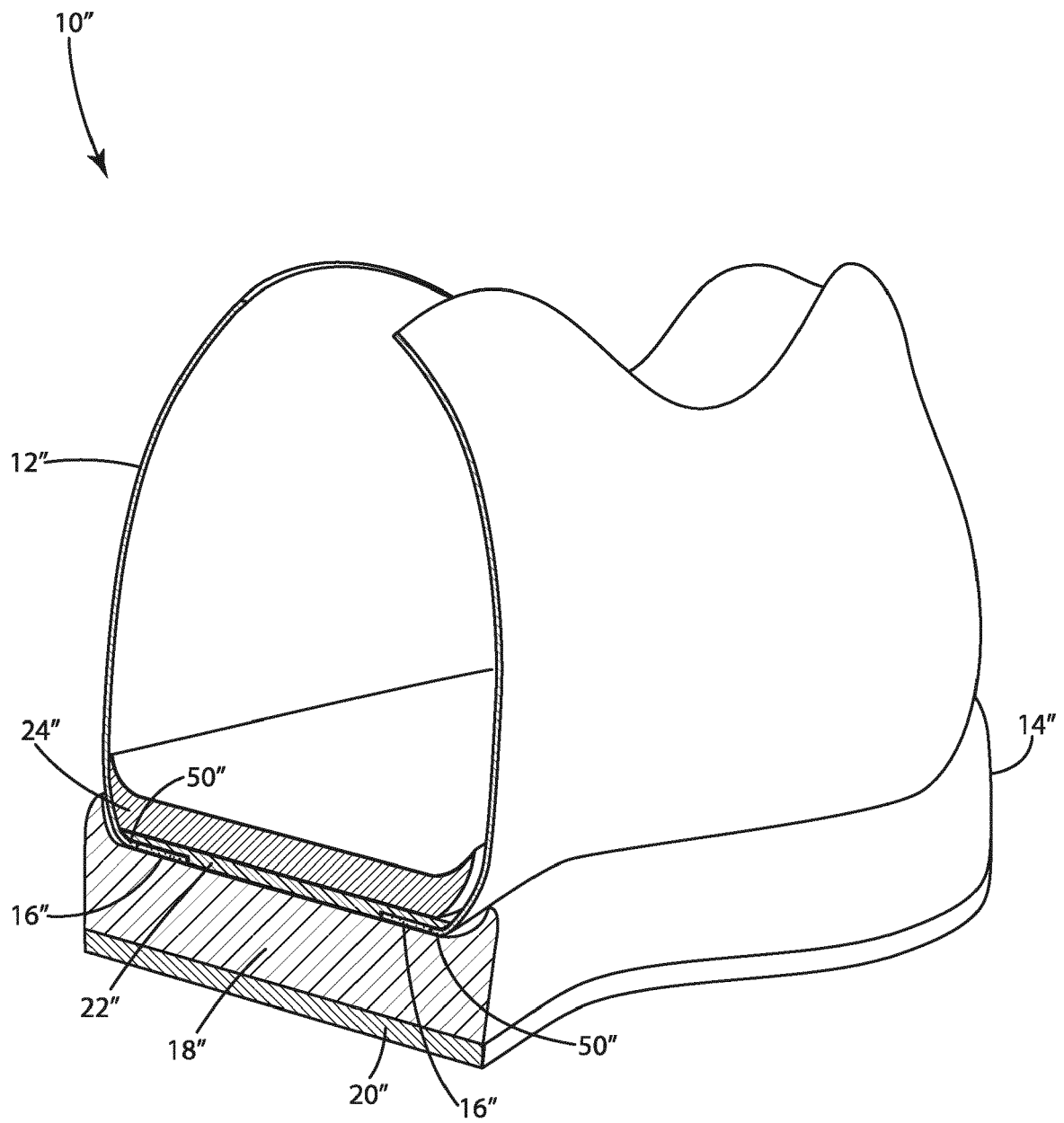


Fig. 7

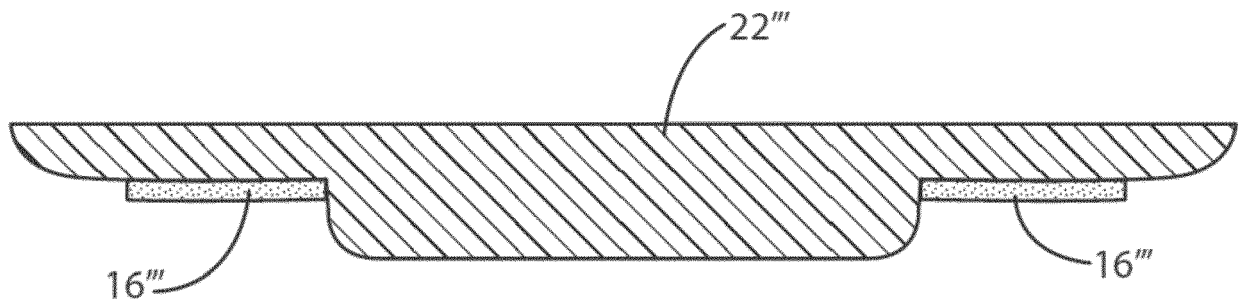


Fig. 8

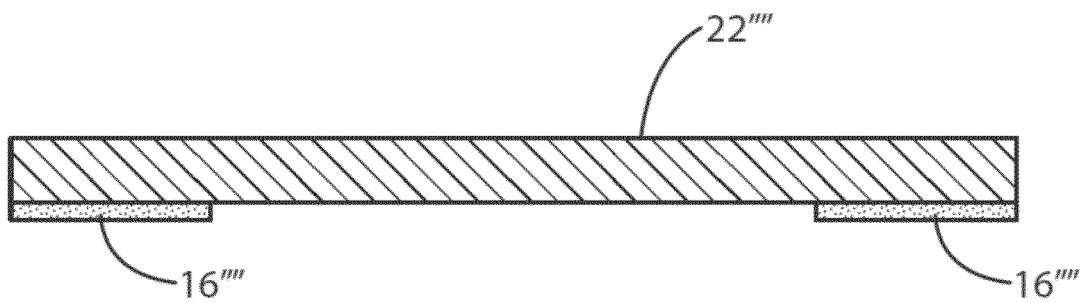


Fig. 9



EUROPEAN SEARCH REPORT

Application Number
EP 18 21 0977

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2011/162239 A1 (BIER CHRISTIAN [DE] ET AL) 7 July 2011 (2011-07-07) * the whole document *	1-11	INV. A43B13/12 A43B13/18 A43B5/06
A	WO 2007/104525 A1 (HIDDE AXEL R [DE]; KLOSE ODO [DE]) 20 September 2007 (2007-09-20) * the whole document *	1-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			A43B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 March 2019	Examiner Chirvase, Lucian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 21 0977

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011162239 A1	07-07-2011	CA 2727138 A1	17-12-2009
		CA 2727142 A1	17-12-2009
		CN 102056502 A	11-05-2011
		CN 102112018 A	29-06-2011
		CN 103976502 A	13-08-2014
		CN 104757729 A	08-07-2015
		CN 104799476 A	29-07-2015
		DE 102008027856 A1	24-12-2009
		DK 2317885 T3	05-12-2016
		DK 2328435 T3	28-11-2016
		EP 2317885 A1	11-05-2011
		EP 2328435 A1	08-06-2011
		EP 3117727 A1	18-01-2017
		HK 1158904 A1	17-04-2014
		HK 1201702 A1	11-09-2015
		HK 1209989 A1	15-04-2016
		HK 1212564 A1	17-06-2016
		JP 5180372 B2	10-04-2013
		JP 5291191 B2	18-09-2013
		JP 2011522646 A	04-08-2011
		JP 2011522647 A	04-08-2011
		KR 20110017443 A	21-02-2011
		KR 20110017444 A	21-02-2011
		KR 20120132587 A	05-12-2012
		PL 2317885 T3	31-01-2017
		PL 2328435 T3	31-01-2017
		US 2011162239 A1	07-07-2011
		US 2011167677 A1	14-07-2011
		US 2013199060 A1	08-08-2013
		US 2016073727 A1	17-03-2016
		US 2016073728 A1	17-03-2016
		WO 2009149886 A1	17-12-2009
		WO 2009149887 A1	17-12-2009
WO 2007104525 A1	20-09-2007	DE 202006004030 U1	18-05-2006
		EP 2081459 A1	29-07-2009
		WO 2007104525 A1	20-09-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82