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(54) **SUPPORT GARMENT**

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(52) **U.S. Cl.**  
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(56) **References Cited**

U.S. PATENT DOCUMENTS

3,478,739 A 11/1969 Librande  
4,607,640 A 8/1986 Mccusker  
(Continued)

FOREIGN PATENT DOCUMENTS

CN 2479753 Y 3/2002  
CN 2730163 Y 10/2005  
(Continued)

OTHER PUBLICATIONS

Extended European Search Report received for European Patent Application No. 23176932.4, mailed on Oct. 6, 2023, 7 pages.  
(Continued)

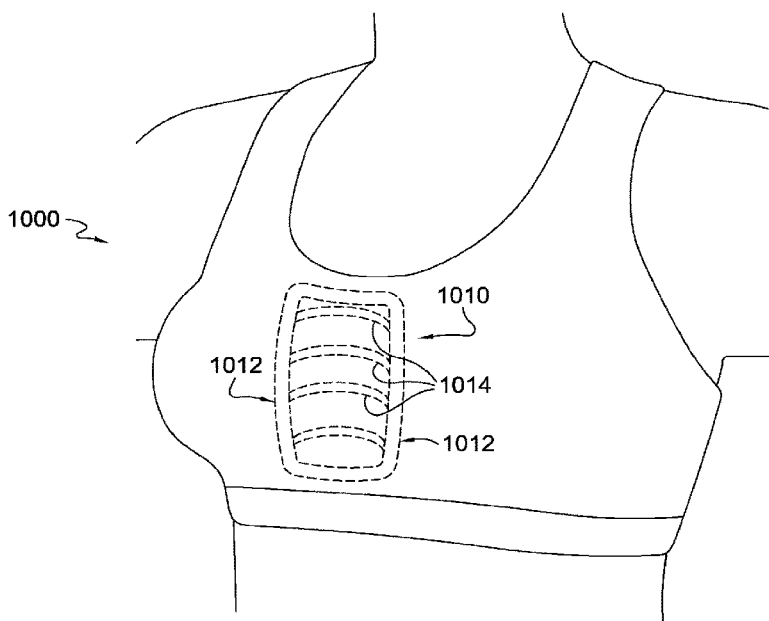
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(57) **ABSTRACT**

Aspects herein provide for a support garment having a vibration damping structure that is positioned between the breast contacting surfaces of the support garment. The vibration damping structure has a shape and/or material characteristics that enable it to substantially fill the space defined by a medial aspect of the wearer's breasts and the wearer's sternum. This positioning and placement facilitate the damping structure's ability to absorb and dissipate impact forces generated at least through the medial-to-lateral movement of the wearer's breasts during, for example, athletic activities.

**20 Claims, 8 Drawing Sheets**



**Related U.S. Application Data**

- continuation of application No. 15/901,651, filed on Feb. 21, 2018, now Pat. No. 11,317,658.
- (60) Provisional application No. 62/463,286, filed on Feb. 24, 2017.
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*A41D 7/00* (2006.01)  
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- (52) **U.S. Cl.**  
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(56) **References Cited**

U.S. PATENT DOCUMENTS

|              |     |         |                           |  |
|--------------|-----|---------|---------------------------|--|
| 5,244,432    | A   | 9/1993  | Moy et al.                |  |
| 6,083,080    | A   | 7/2000  | Lawson et al.             |  |
| 6,688,942    | B2  | 2/2004  | Holliday                  |  |
| 6,723,401    | B1  | 4/2004  | Mcknight et al.           |  |
| 6,755,717    | B2  | 6/2004  | Smith                     |  |
| 6,769,955    | B1  | 8/2004  | Fisher                    |  |
| 6,880,269    | B2  | 4/2005  | Falone et al.             |  |
| 7,001,239    | B2  | 2/2006  | Russell                   |  |
| 7,044,829    | B1  | 5/2006  | Jagaric et al.            |  |
| 7,442,110    | B2  | 10/2008 | Gaudet et al.             |  |
| 7,669,251    | B2  | 3/2010  | Hammons et al.            |  |
| 8,047,892    | B1  | 11/2011 | Dempsey                   |  |
| 8,075,368    | B2  | 12/2011 | Puyaubreau                |  |
| 8,845,388    | B1  | 9/2014  | Dempsey                   |  |
| 9,055,771    | B2  | 6/2015  | Deguchi et al.            |  |
| 9,681,691    | B1  | 6/2017  | Hubbs                     |  |
| 11,317,658   | B2* | 5/2022  | Brandt ..... A41D 7/00    |  |
| 11,533,955   | B2* | 12/2022 | Middleton ..... A41C 3/12 |  |
| 11,690,410   | B2* | 7/2023  | Brandt ..... A41C 3/12    |  |
|              |     |         | 450/93                    |  |
| 2005/0037688 | A1  | 2/2005  | Russell                   |  |
| 2007/0123145 | A1  | 5/2007  | Chang et al.              |  |

|              |    |         |                |  |
|--------------|----|---------|----------------|--|
| 2007/0155283 | A1 | 7/2007  | Mcqueer        |  |
| 2007/0190896 | A1 | 8/2007  | Yu             |  |
| 2009/0258571 | A1 | 10/2009 | Tyrer          |  |
| 2010/0015886 | A1 | 1/2010  | Waitz et al.   |  |
| 2011/0065358 | A1 | 3/2011  | Fleeton        |  |
| 2013/0316615 | A1 | 11/2013 | Hurd           |  |
| 2014/0287652 | A1 | 9/2014  | Deguchi et al. |  |
| 2016/0044971 | A1 | 2/2016  | Randall et al. |  |
| 2016/0120235 | A1 | 5/2016  | Scotto         |  |
| 2018/0242653 | A1 | 8/2018  | Brandt et al.  |  |
| 2020/0383392 | A1 | 12/2020 | Brandt et al.  |  |

FOREIGN PATENT DOCUMENTS

|    |                 |    |         |  |
|----|-----------------|----|---------|--|
| CN | 200997918       | Y  | 1/2008  |  |
| CN | 102652581       | A  | 9/2012  |  |
| CN | 103153100       | A  | 6/2013  |  |
| CN | 106136350       | A  | 11/2016 |  |
| GB | 2551534         | A  | 12/2017 |  |
| JP | 57-34511        | U  | 2/1982  |  |
| JP | 3-4511          | A  | 1/1991  |  |
| JP | 11-81735        | A  | 3/1999  |  |
| JP | 2003-202048     | A  | 7/2003  |  |
| JP | 2003-278060     | A  | 10/2003 |  |
| JP | 2009-52097      | A  | 3/2009  |  |
| JP | 2014-163018     | A  | 9/2014  |  |
| JP | 2014-167195     | A  | 9/2014  |  |
| KR | 94-8016         | Y1 | 11/1994 |  |
| KR | 10-2013-0056215 | A  | 5/2013  |  |
| WO | 02/079558       | A1 | 10/2002 |  |
| WO | 2009/149529     | A1 | 12/2009 |  |
| WO | 2012/133132     | A1 | 10/2012 |  |
| WO | 2015/048180     | A2 | 4/2015  |  |
| WO | 2015/106620     | A1 | 7/2015  |  |

OTHER PUBLICATIONS

Spot Enell sports bra high strength we damping adjustable sports underwear no rims bra large yards, Best Store, Online, beststore-online.com, Code: 26499600437, Sep. 2016, 12 pages.

Sunweb Women Sports Bra Breathable Comfort Underwear Women Seamless Bra Push Up Bra Gym Running Damping Sport Bra Top (Grey), Lazada, lazada.com, SKU: OE702SPAA4631TANMY-8284381, Sep. 2016, 9 pages.

Elliott, Elizabeth, "Find the best sports bra for cycling", BikeRadar, bikeradar.com, May 18, 2015, 7 pages.

Notice of Allowance received for Canadian Patent Application No. 3,116,262, mailed on Jan. 22, 2024, 1 page.

\* cited by examiner

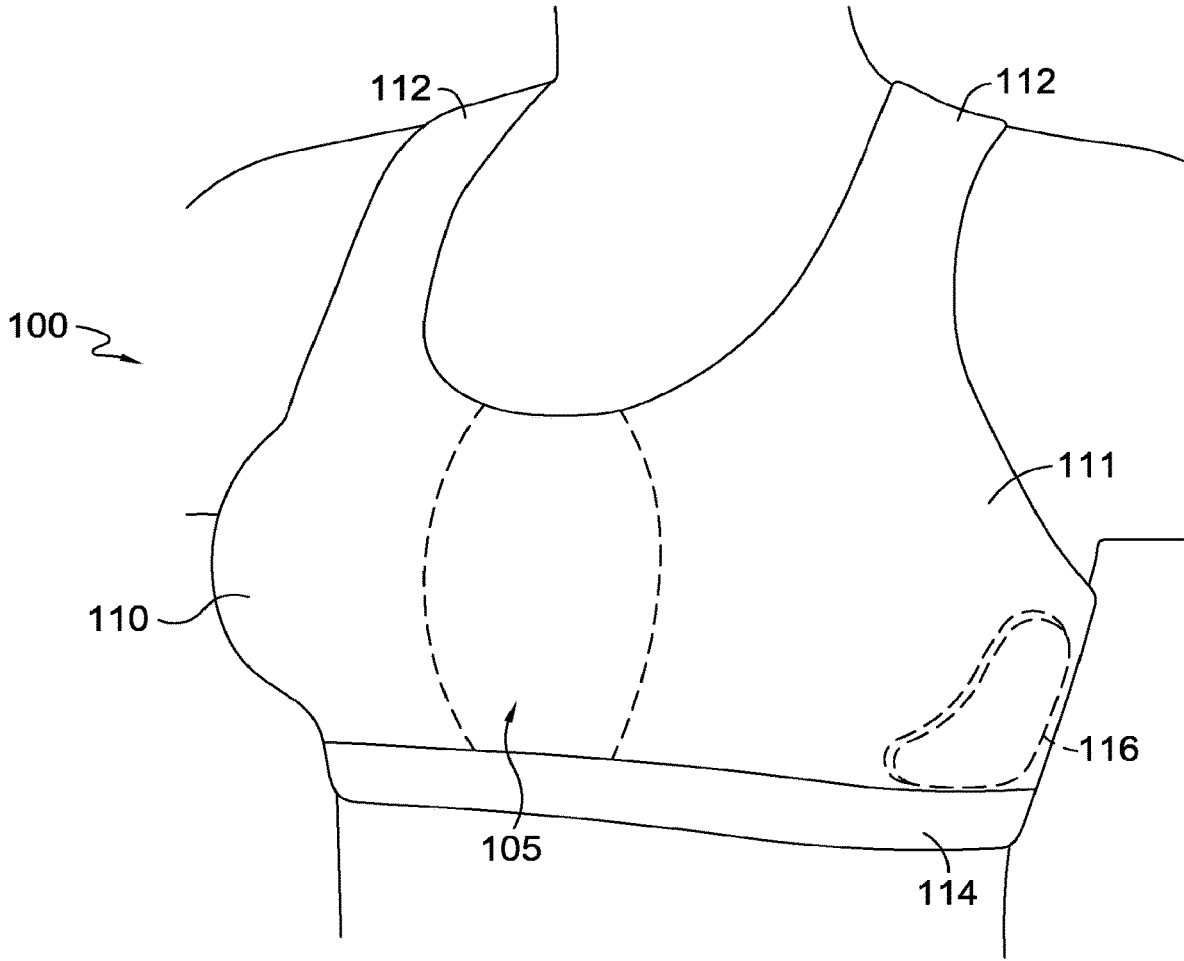


FIG. 1.

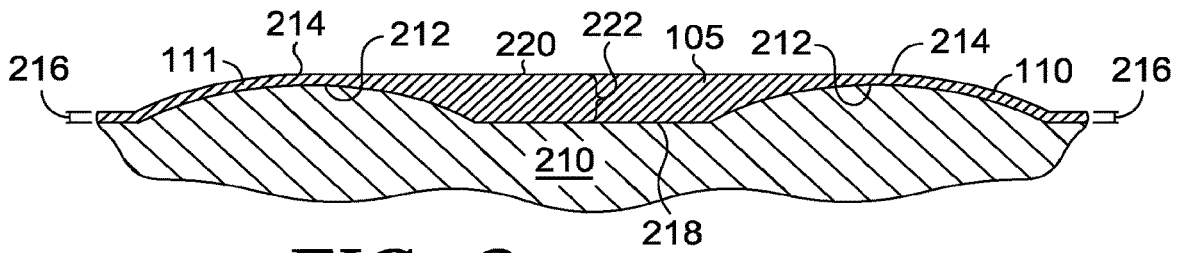


FIG. 2.

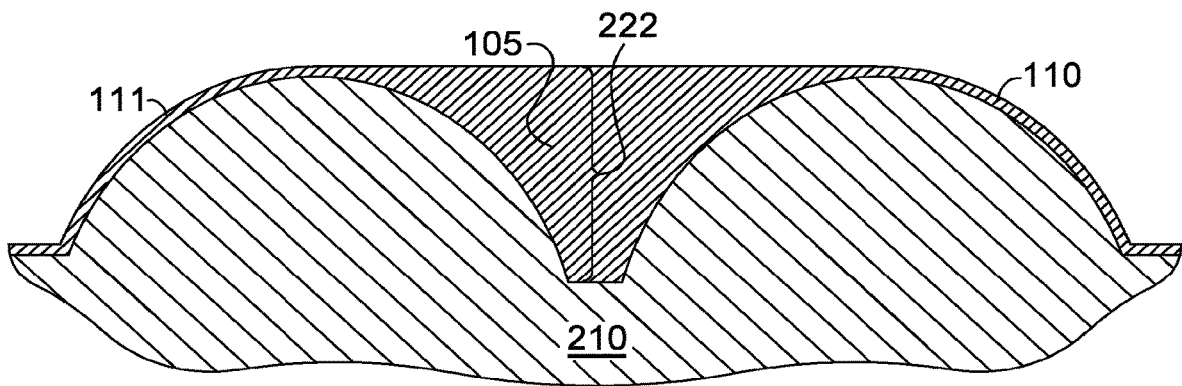


FIG. 3.

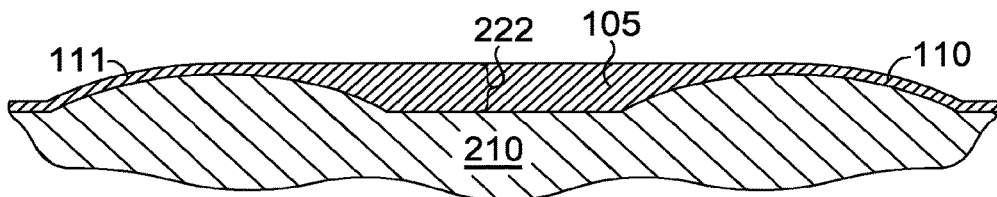


FIG. 4.

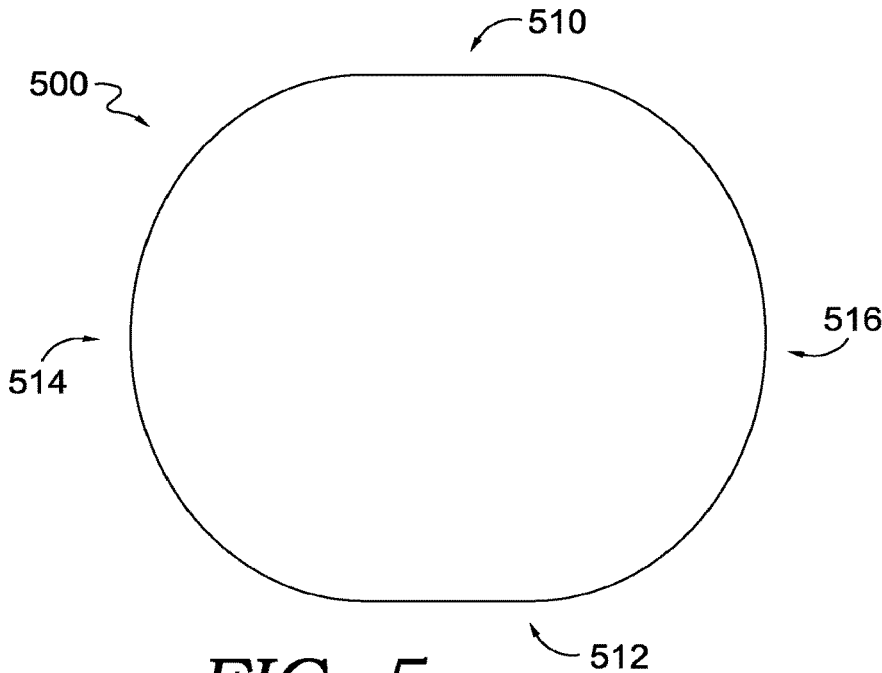


FIG. 5.

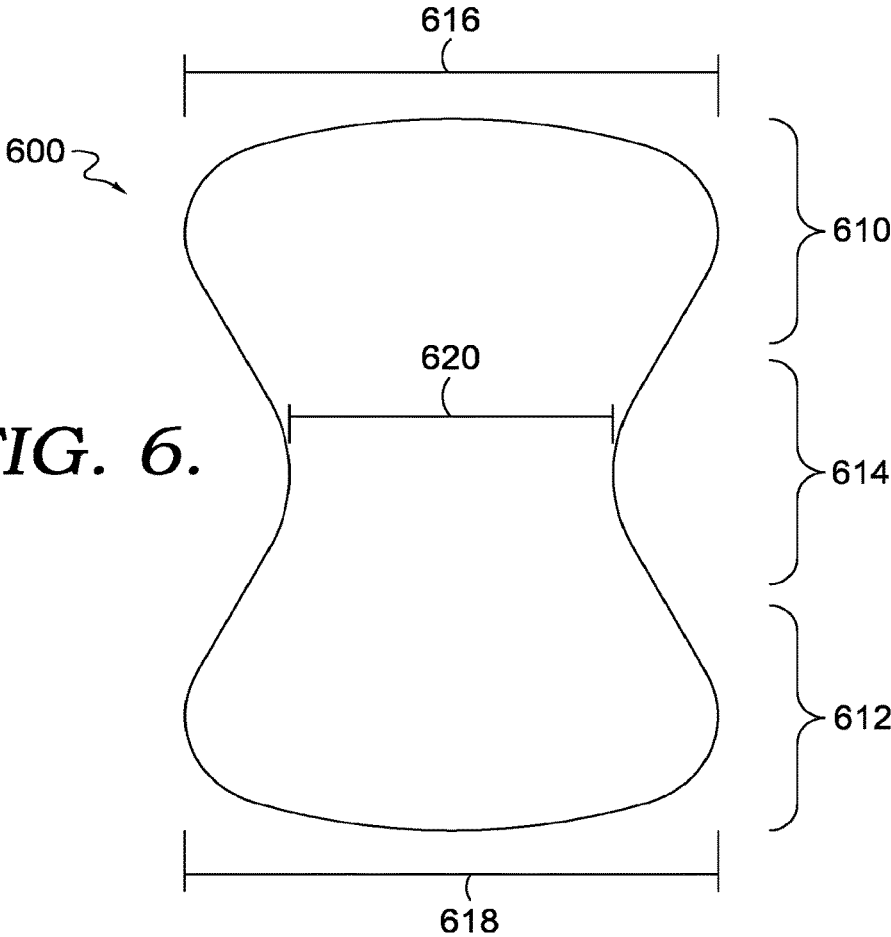
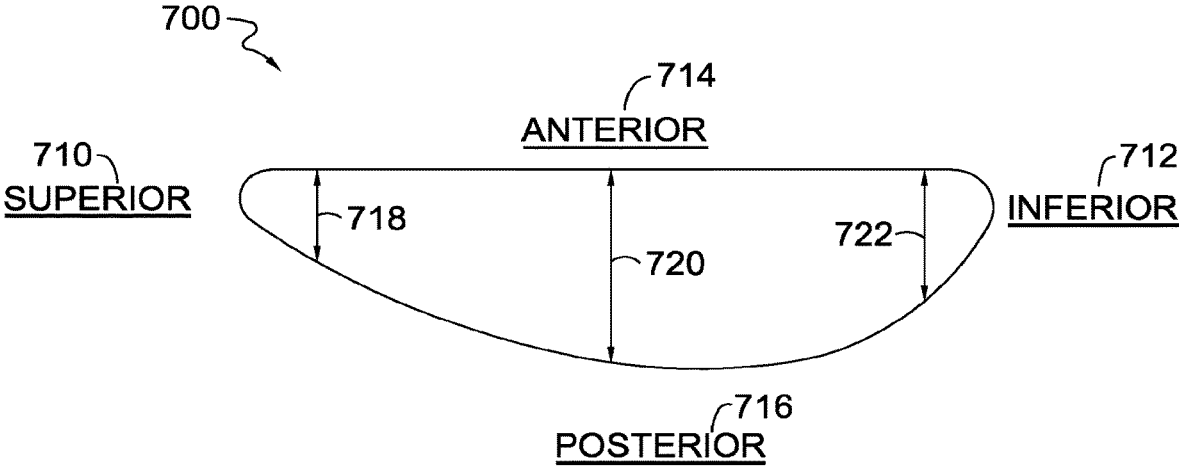


FIG. 6.



*FIG. 7.*

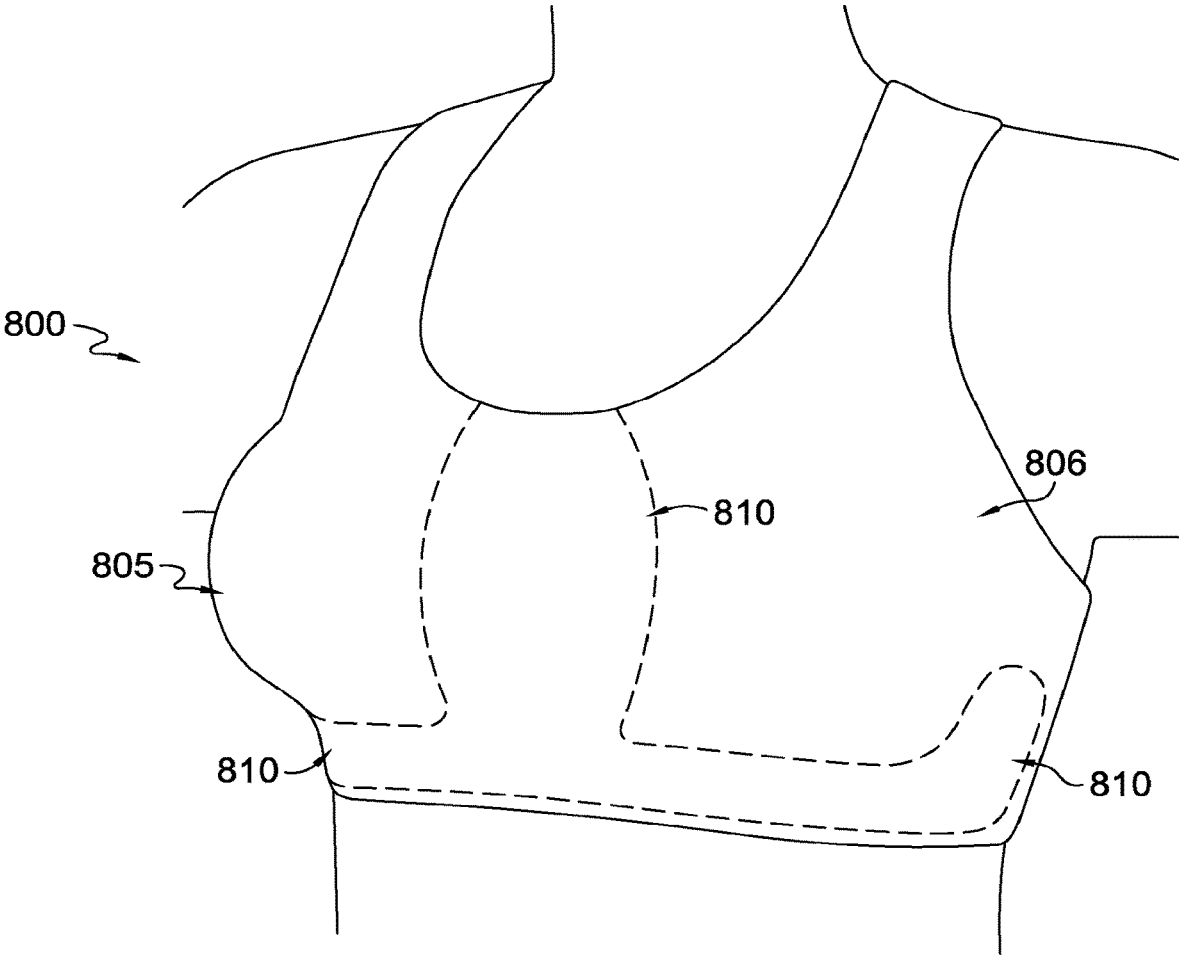
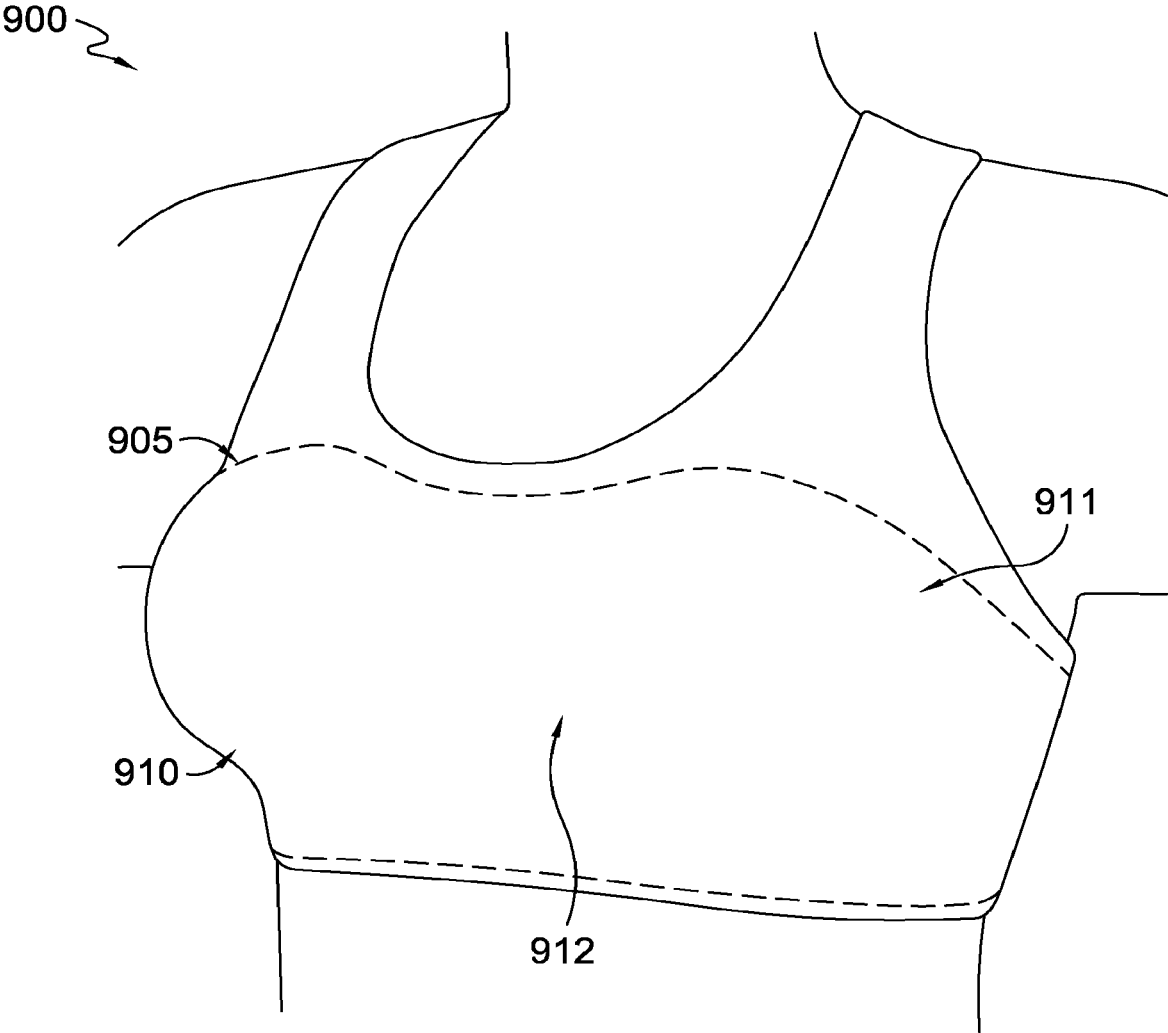


FIG. 8.



**FIG. 9.**



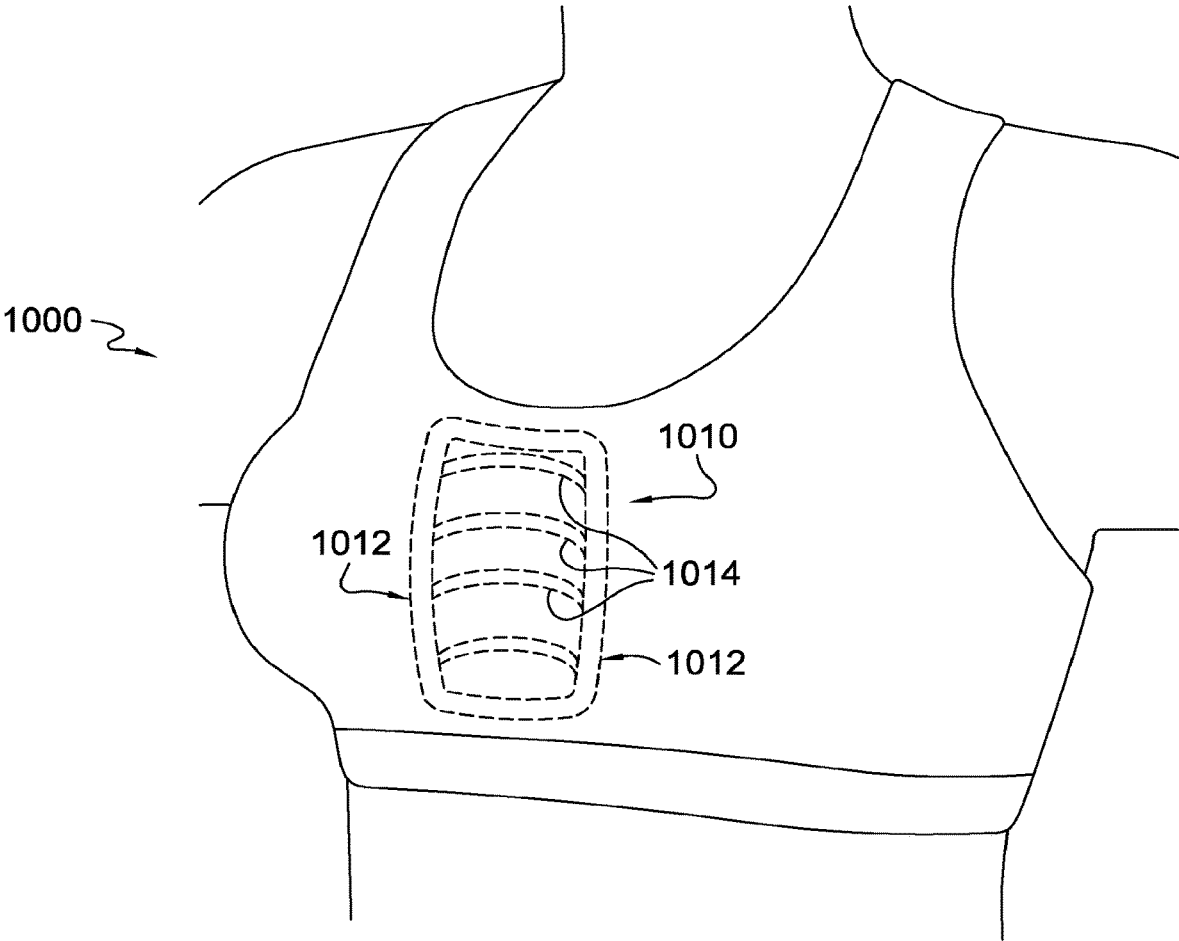
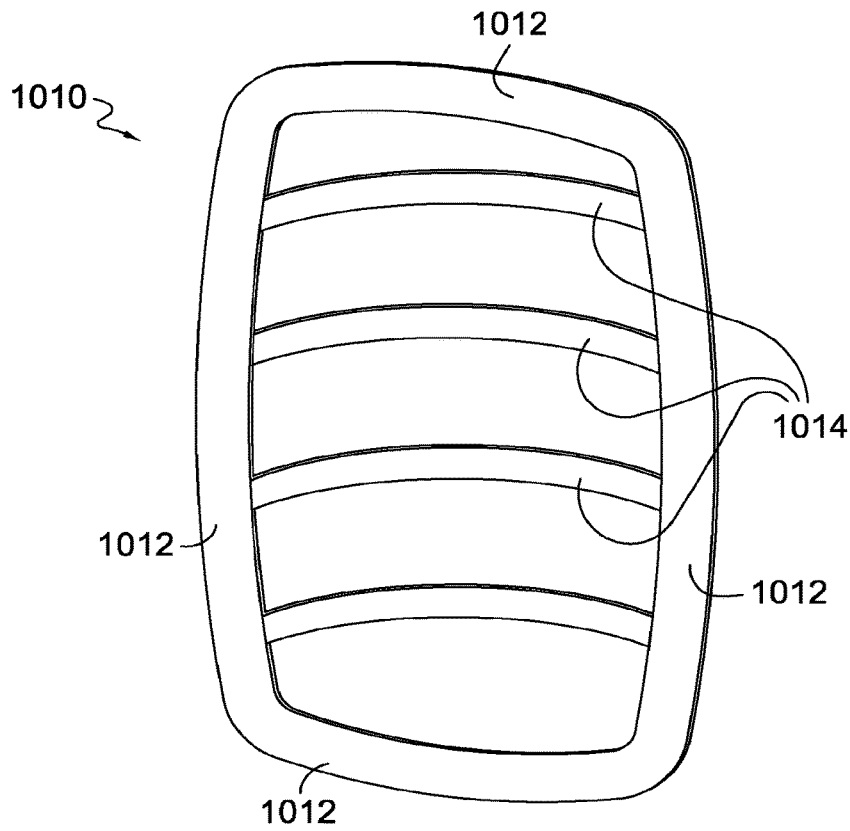
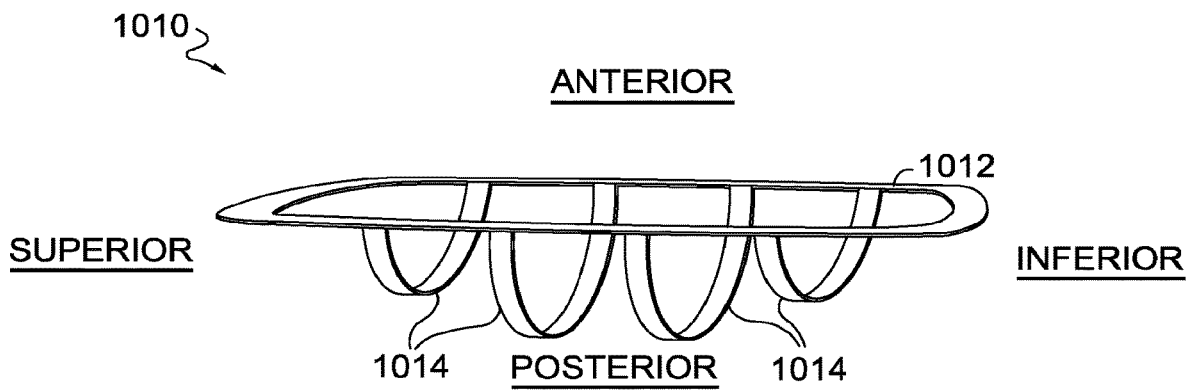


FIG. 10.



**FIG. 11.**



**FIG. 12.**

## SUPPORT GARMENT

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application entitled "Support Garment," is a continuation application of U.S. Pat. No. 11,690,410, entitled "Support Garment," and filed Aug. 24, 2020, which is a continuation application of U.S. Pat. No. 11,317,658, entitled "Support Garment," and filed Feb. 21, 2018, which claims the benefit of priority to U.S. Prov. App. No. 62/463,286, entitled "Support Garment," and filed Feb. 24, 2017. The entireties of the aforementioned applications are incorporated by reference herein.

## TECHNICAL FIELD

Aspects herein relate to a support garment configured to support a wearer's breasts.

## BACKGROUND

Conventional support garments, including those configured to provide support during athletic activities, such as bras, generally provide support through encapsulation and/or compression of a wearer's breasts.

## BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the present invention are described in detail below with reference to the attached drawing figures, wherein:

FIG. 1 illustrates a support garment having an exemplary vibration damping structure in accordance with aspects herein;

FIGS. 2-4 illustrate exemplary partial cross sections of a support garment having a vibration damping structure as worn by a wearer in accordance with aspects herein;

FIGS. 5-6 illustrate exemplary front views of different shape configurations for a vibration damping structure for use in a support garment in accordance with aspects herein;

FIG. 7 illustrates an exemplary side view of a vibration damping structure in accordance with aspects herein;

FIGS. 8-9 illustrate additional examples of support garments having exemplary vibration damping structures in accordance with aspects herein;

FIG. 10 illustrates a support garment having an alternative exemplary vibration damping structure in accordance with aspects herein;

FIG. 11 depicts a front perspective view of the exemplary vibration damping structure of FIG. 10 in accordance with aspects herein; and

FIG. 12 depicts a side view of the exemplary vibration damping structure of FIG. 11 in accordance with aspects herein.

## DETAILED DESCRIPTION

The subject matter of the present invention is described with specificity herein to meet statutory requirements. However, the description itself is not intended to limit the scope of this disclosure. Rather, the inventors have contemplated that the claimed or disclosed subject matter might also be embodied in other ways, to include different steps or combinations of steps similar to the ones described in this document, in conjunction with other present or future technologies. Moreover, although the terms "step" and/or

"block" might be used herein to connote different elements of methods employed, the terms should not be interpreted as implying any particular order among or between various steps herein disclosed unless and except when the order of individual steps is explicitly stated.

At a high level, aspects herein relate to a support garment, such as a bra, having a vibration damping structure configured to reduce at least medial-to-lateral sway, movement, or vibration of a wearer's breasts during, for instance, athletic activities. The vibration damping structure may also be configured to reduce superior-to-inferior movement, bounce, or vibration during athletic activities. In exemplary aspects, the support garment comprises breast contacting surfaces configured to cover the wearer's breasts, and the vibration damping structure may be positioned between the breast contacting surfaces. The vibration damping structure has a shape configuration and/or material characteristics such that it is configured to occupy, or at least partially occupy, the space defined at least by the medial aspect of the wearer's breasts and the wearer's sternum (commonly known as the wearer's cleavage).

In exemplary aspects, the vibration damping structure is composed of a material that exhibits mechanical characteristics that facilitate its ability to absorb and dissipate forces transmitted to the material by the wearer's breasts. For instance, the material may be selected to be more compressible (i.e., less stiff) than breast tissue so that the material deforms to a greater extent than the wearer's breast tissue when the wearer's breasts contact the material. This is important for allowing the transmission of the impact force from the wearer's breasts to the material and the subsequent absorption and dissipation of the impact force by the material. An exemplary stiffness for the material may be less than or equal about 15 N/mm. The material may also be selected to exhibit a relatively high rate of energy return (i.e., the percentage of input energy that is recovered during rebound). For example, the material may be selected to exhibit an energy return of from about 70% to about 90%. Having a relatively high percentage of energy return enables the material to "mold" to the shape of the wearer's breasts so that the vibration damping structure not only fills the space between the wearer's breasts but also conforms or molds at least partially around the medial aspects of the wearer's breasts. By being in contact with the wearer's breasts, the vibration damping structure is better able to absorb and dissipate forces generated by the breasts during movement.

Accordingly, aspects herein are directed to a support garment comprising at least a front portion. The front portion comprises a pair of breast contacting surfaces configured to cover a wearer's breasts when the support garment is in an as-worn configuration and a vibration damping structure positioned between the pair of breast contacting surfaces so that when the support garment is in the as-worn configuration the vibration damping structure is configured to occupy a space defined at least by the medial aspect of the wearer's breasts and the wearer's sternum.

Another aspect herein provides for a support garment comprising at least a front portion comprising a pair of breast contacting surfaces configured to cover a wearer's breasts when the support garment is in an as-worn configuration, and a first vibration damping structure positioned between the pair of breast contacting surfaces, where the vibration damping structure has a stiffness less than or equal about 15 N/mm and an energy return characteristic from about 70% to about 90%.

Yet another aspect herein provides for a support garment comprising at least a front portion. The front portion comprises a pair of breast contacting surfaces, each breast contacting surface having an inner-facing surface and an outer-facing surface opposite the inner-facing surface, the inner-facing surface and the outer-facing surface of each breast contacting surface defining a first average thickness therebetween, and a vibration damping structure positioned between the pair of breast contacting surfaces, the vibration damping structure having an inner-facing surface and an outer-facing surface opposite the inner-facing surface, the inner-facing surface and the outer-facing surface of the vibration damping structure defining a second average thickness therebetween, wherein the second average thickness is greater than the first average thickness.

Positional terms used herein such as “superior,” “inferior,” “medial,” “lateral,” and the like are to be given their common anatomical meaning with respect to the support garment being worn as intended by a hypothetical wearer standing in anatomical position. The phrase “configured to contact” or other similar phrases as used when describing the location of a structure on the support garment with respect to a wearer is to be construed based on a support garment appropriately sized for the wearer. The term support garment as used herein relates to any style or type of support garment used to support breast tissue. Exemplary support garments may comprise bras as that term is known in the art (sport bras, conventional bras, and the like), camisoles, swimwear, or other garments with built-in support. Further, the term “breast contacting surface” is meant to encompass any type of structure that is in contact with the wearer’s breasts. For instance, each breast contacting surface may comprise a breast cup such as a molded cup, or an unmolded cup. The breast contacting surfaces may comprise separate distinct components with each contacting surface configured to cover a separate breast, or the breast contacting surfaces may comprise a unitary or continuous band of material that makes contact with both of the wearer’s breasts. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

Turning now to FIG. 1, a front perspective view of an exemplary support garment **100** with a vibration damping structure **105** is shown being worn by a wearer in accordance with aspects herein. In exemplary aspects, the support garment **100**, shown in the form of a bra, may comprise a pair of breast contacting surfaces **110** and **111** configured to cover a wearer’s right and left breasts respectively, a pair of shoulder straps **112** configured to extend over the wearer’s shoulders, and an underband **114** configured to be positioned under the wearer’s breasts when the support garment **100** is worn. In exemplary aspects, the shoulder straps **112** may be optional. For example, the support garment **100** may be constructed as a bandeau-style garment. Moreover, although shown as a distinct component, the underband **114** may also be optional. For instance, when the support garment **100** is in the form of a top, the underband **114** may not be present or may comprise a bottom margin of the top. Any and all aspects, and any variations thereof, are contemplated as being within aspects herein.

Continuing, although not shown, the support garment **100** further comprises a back portion connected to the front of the support garment **100** via, for instance, the shoulder straps **112** and/or the underband **114** as it extends circumferentially around the torso of a wearer. Further, the back portion of the support garment **100** may be configured as a racerback-style,

a conventional style, and the like. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

In exemplary aspects, the support garment **100** comprises the vibration damping structure **105** (shown in dashed lines to indicate it is hidden from view). The vibration damping structure **105** is configured to be positioned between the breast contacting surfaces **110** and **111**. More particularly, the vibration damping structure **105** is positioned between a medial aspect of the right breast contacting surface **110** and a medial aspect of the left breast contacting surface **111**. As will be explained more fully below, the vibration damping structure **105** has a shape configuration and/or has material characteristics that enable it to fill the void or space between the wearer’s breasts. That is, the vibration damping structure **105** has a shape configuration and/or has material characteristics that enable it to completely fill or at least substantially fill the space or void defined by at least the medial aspects of the wearer’s breasts and the wearer’s sternum (i.e., the wearer’s cleavage) so that when the support garment **100** is in an as-worn configuration, at least the medial aspects of the wearer’s breasts are configured to be in contact with the vibration damping structure **105**.

In another aspect, the support garment **100** may also optionally have vibration damping structures **116** positioned at a lateral aspect of the right and left breast contacting surfaces **110** and **111** (only the vibration damping structure **116** adjacent to the lateral aspect of the left breast contacting surface **111** is shown in FIG. 1 due to the perspective view). The vibration damping structures **116** may be used to help absorb and dissipate forces imparted by the wearer’s breasts when moving in a lateral direction.

Continuing, and as shown in FIG. 8, in yet another aspect, a support garment **800** may comprise an exemplary vibration damping structure **810** comprising a unitary and continuous structure extending from between breast contacting surfaces **805** and **806**, inferior to the breast contacting surfaces **805** and **806** and terminating along the lateral sides of the breast contacting surfaces **805** and **806**. In still yet another aspect, and as shown in FIG. 9, a support garment **900** may comprise an exemplary vibration damping structure **905** having a unitary and continuous structure extending across the substantially all of the front portion of the support garment **900** (i.e., between breast contacting surfaces **910** and **911** as indicated by reference numeral **912**, across the breast contacting surfaces **910** and **911**, and extending over the lateral aspects of the breast contacting surfaces **910** and **911**). With respect to the support garment **900**, the thickness of the vibration damping structure positioned adjacent to the breast contacting surfaces **910** and **911** is contemplated as being thinner than the thickness of the vibration damping structure positioned between the medial aspects of the breast contacting surfaces **910** and **911** (indicated by reference numeral **912**) so as not to substantially increase the overall weight of the bra and/or produce an undesired aesthetic.

Returning to FIG. 1, in exemplary aspects, the vibration damping structure **105** is configured to absorb and dissipate impact forces imparted to the structure **105** by the wearer’s breasts as commonly occurs during, for example, athletic activities. The absorption and dissipation of the impact forces may occur through mechanical deformation of the vibration damping structure **105** (i.e., passive damping). More particularly, due to the positioning of the vibration damping structure **105** between the wearer’s breasts, the damping structure **105** may be optimized to dissipate impact forces generated through the medial-to-lateral movement of the wearer’s breasts. Further, as will be more fully explained

below, the vibration damping structure **105** may also have a shape configuration optimized to additionally absorb and dissipate impact forces generated through the superior-to-inferior movement of the wearer's breasts.

Continuing, to be able to both absorb and dissipate the forces, materials for the vibration damping structures **105** and/or **116** are selected to exhibit certain mechanical characteristics. For example, in exemplary aspects, the material selected to form the vibration damping structures **105** and/or **116** may exhibit a stiffness less than or equal to about 15 N/mm (the term "about" as used herein means within  $\pm 10\%$  of a given value). Stiffness may be defined as the extent to which a material resists deformation in response to an applied force. In general, the stiffness of the material used to form the vibration damping structures **105** and/or **116** is selected to be less than the average stiffness of breast tissue. As such, the material of the damping structures **105** and/or **116** may be selected to deform (e.g., undergo mechanical deformation) to a greater extent than the breast tissue upon contact of the breast tissue with the material, thereby enabling the material to absorb and/or dissipate any impact forces from the breast tissue. It is contemplated herein, that the stiffness of the material used to form the vibration damping structures **105** and/or **116** may be customized depending on the likely size and/or firmness of the breasts that will be supported by the support garment **100**. For example, larger and/or more firmer breasts may generate larger impact forces as compared to smaller breasts. As such, a material with a greater stiffness (e.g., a stiffness between, for instance, from about 7 N/mm to about 15 N/mm) may be selected for support garments configured for large-breasted women and/or woman who may have firmer breast tissue.

Another mechanical characteristic that contributes to the ability of the damping structures **105** and/or **116** to dampen breast vibrations is its energy return where energy return may be defined as the amount of energy stored by the vibration damping structures **105** and/or **116** that is returned when the load is removed (as opposed to dissipating as heat). In exemplary aspects, the material used to form the vibration damping structures **105** and/or **116** is selected to have an energy return from about 70% to about 90%. Having a relatively high rate of energy return may enable the vibration damping structures **105** and/or **116** to conform or mold around a wearer's breasts. For instance, the vibration damping structure **105**, due to having a high energy return, may be configured to mold around at least the medial aspect of the wearer's breasts, and the vibration damping structure **116** may be configured to mold around at least a portion of the lateral aspect of the wearer's breasts. This, in turn, facilitates the damping structures **105** and/or **116** being able to absorb and dissipate forces transmitted to the structures **105** and/or **116** by the wearer's breasts.

An additional mechanical property that may be exhibited by the material forming the vibration damping structures **105** and/or **116** is its ability to withstand normal loads or forces imparted by the wearer's breast tissue during impact without plastically deforming. For example, the vibration damping structures **105** and/or **116** may have a maximum limit load of about 10 Newtons (N), 20 N, 30 N, 40 N, 50 N, 60 N, 70 N, 80 N, 90 N, or 100 N (and/or values in between) before undergoing plastic deformation.

Exemplary materials selected to form the vibration damping structures **105** and/or **116** may comprise open cell foams, closed cell foams, spacer mesh materials, spring-like structures (e.g., resilient coil structures), beads (e.g., Styrofoam beads), hollow and flexible pipe structures formed from, for instance, monofilaments and other yarns, non-woven mate-

rials such as, for example, Breathair™ manufactured by Toyoba Co., Ltd. of Osaka, Japan, air-filled pillows or bladders, injected molded materials, extruded materials, three-dimensional printed structures, and the like. All of these materials are capable of undergoing some type of mechanical deformation in response to an impact force. Besides exhibiting the mechanical characteristics described above, materials may also be selected to promote breathability (i.e., the transmission of moisture vapor through a material) of the vibration damping structures **105** and/or **116**.

The vibration damping structures **105** and/or **116** may be incorporated into the support garment **100** in a number of ways. In one example, the vibration damping structures **105** and/or **116** may be integrated directly into the support garment **100** by affixing the structures **105** and/or **116** directly to inner-facing surfaces of the breast contacting surfaces **110** and **111** and/or the support garment **100**. Affixing may occur by stitching, bonding, adhesives, welding, use of buttons, snaps, hook-and-loop fasteners, and the like. Affixing may comprise permanently or releasably affixing the vibrations damping structures **105** and/or **116** to the support garment **100**.

In a second example, the vibration damping structures **105** and/or **116** may be enclosed between layers of fabric, and the layers of fabric may be affixed to inner-facing surfaces of the breast contacting surfaces **110** and **111** and/or support garment **100**. In this example, the damping structures **105** and/or **116** may not be directly affixed to the breast contacting surfaces **110** and **111** but, instead, be indirectly affixed to the breast contacting surfaces **110** and **111** via the fabric layers. In yet another example, when the breast contacting surfaces **110** and **111** are formed from two or more layers of fabric, the damping structures **105** and/or **116** may be positioned between the fabric layers. It is contemplated herein, that in one aspect, the fabric selected to form the outer-facing portion of the vibration damping structure **105** may be a non-stretch material so as to limit expansion of the vibration damping structure **105** in an anterior direction. This not only facilitates wearer comfort but may improve the aesthetics of the support garment **100**. As well, limiting anterior expansion of the damping structures **105** and/or **116** may help to maintain the overall stiffness and energy return of the damping structures **105** and/or **116**.

In another aspect, the vibration damping structures **105** and/or **116** may comprise integral extensions of the breast contacting surfaces **110** and **111**. For instance, a knitting, weaving, and/or molding process used to form the breast contacting surfaces **110** and **111** may be modified to form the vibration damping structures **105** and/or **116**. In this aspect, the damping structures **105** and/or **116** would comprise one or more of the same yarns or materials used to form the breast contacting surfaces **110** and **111**.

Continuing, in yet another aspect, the support garment **100** may comprise pockets into which the vibration damping structures **105** and/or **116** may be inserted when needed. Thus, when the wearer is not engaging in athletic activities, the wearer may choose not to insert the structures **105** and/or **116** into their respective pockets. However, when the wearer engages in athletic activities, the wearer can insert one or both of the structures **105** and/or **116** into their respective pockets. With respect to the vibration damping structure **105**, in some aspects, the support garment **100** may comprise straps configured to be positioned over the vibration damping structure **105** when the wearer engages in athletic activities. For instance, in some aspects, the vibration damping structure **105** may be configured to not completely fill

the space between the wearer's breasts to improve wearer comfort when the wearer is not exercising. When the wearer wishes to exercise, the wearer can position the straps (or other types of tensioning structures) over an outer-facing surface of the vibration damping structure **105**. The tension imparted by the straps helps to position the vibration damping structure **105** so that it substantially fills (e.g., fills about 60%, 70%, 80%, 90%, and/or 100%) the space between the wearer's breasts. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

FIGS. 2-4 are provided to illustrate how an exemplary vibration damping structure, such as the vibration damping structure **105** of FIG. 1, is configured to fill, or substantially fill, the space defined by the medial aspects of the wearer's breasts and the wearer's sternum in accordance with aspects herein. FIGS. 2-4 represent partial cross-sections taken at the approximate top (superior part) of the wearer's breasts, the approximate mid-point of the wearer's breasts, and at the approximate lower part (inferior part) of the wearer's breasts respectively. With respect to FIGS. 2-4, the wearer's body is indicated by the reference numeral **210**.

Using FIG. 2 as a representative example, in exemplary aspects, each breast contacting surface **110**, **111** comprises an inner-facing surface **212** configured to face toward the wearer's body surface **210** and an outer-facing surface **214** configured to face away from the wearer's body surface **210**. The inner-facing surface **212** and the outer-facing surface **214** define a first thickness **216** extending between these two surfaces.

Continuing, the vibration damping structure **105** also comprises an inner-facing surface **218** and an outer-facing surface **220**. The inner-facing surface **218** and the outer-facing surface **220** of the vibration damping structure **105** define a second thickness **222** extending between the two surfaces **218** and **220**. In exemplary aspects, the outer-facing surface **220** of the vibration damping structure **105** may be generally co-planar with the outer-facing surface **214** of the breast contacting surfaces **110** as measured from, for instance, an apex region of the breast contacting surfaces **110** and **111** (the region extending the furthest anteriorly when the support garment **100** is in an as-worn configuration).

In exemplary aspects, the second thickness **222** varies from a superior aspect of the vibration damping structure **105** (best seen in FIG. 2), to an approximate mid-point of the vibration damping structure **105** (best seen in FIG. 3), to an inferior aspect of the vibration damping structure **105** (best seen in FIG. 4) to produce an overall average thickness **222**. More particularly, the second thickness **222** may gradually increase from the superior aspect of the damping structure **105** to the approximate mid-point of the vibration damping structure **105** and then gradually decrease from the approximate mid-point of the damping structure **105** to the inferior aspect of the vibration damping structure **105**. This gradation in thickness is meant to mimic the normal anatomy of a wearer's cleavage. By varying the second thickness **222** of the vibration damping structure **105** as described, the damping structure **105** can organically fill the space between the wearer's breasts. In exemplary aspects, the average thickness **222** of the vibration damping structure **105** (averaged over the superior, middle, and inferior portions of the structure **105**) is greater than the first thickness **216** of the breast contacting surfaces **110** and **111**. For instance, the average thickness **222** of the vibration damping structure **105** may be at least about two times, three times, four times, five times, or greater than the thickness of the breast contacting surfaces **110** and **111**. This is opposed to most

traditional bra structures where the thickness of the center portion that connects the two breast contacting surfaces is generally the same as, or even less than, the thickness of the breast contacting surfaces.

It is contemplated herein that the varying thickness **222** of the vibration damping structure **105** may not be symmetrical with respect to the approximate horizontal mid-point of the damping structure **105**. For example, most breasts generally have a greater volume of tissue towards the inferior aspect of the breasts as compared to a superior aspect of the breasts when the wearer is standing. Thus, the thickness of the damping structure **105** may be generally greater at the inferior portion of the vibration damping structure **105** and thinner at the superior portion of the vibration damping structure **105**. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

FIGS. 5-7 depict some exemplary shapes for vibration damping structures such as the vibration damping structure **105** in accordance with aspects herein. FIGS. 5-6 depict front views of exemplary vibration damping structures, and FIG. 7 depicts a side view of an exemplary vibration damping structure. With respect to FIG. 5, an exemplary vibration damping structure **500** is defined by a perimeter shape comprising a superior margin **510**, an inferior margin **512**, and opposing lateral margins **514** and **516**. The superior margin **510** is configured to be positioned at a superior aspect of a wearer's breasts, the inferior margin **512** is configured to be positioned at an inferior aspect of the wearer's breasts, and the lateral margins **514** and **516** are configured to be positioned adjacent to a medial aspect of the wearer's breasts. As shown in FIG. 5, the lateral margins **514** and **516** extend convexly away from a vertical midline of the damping structure **500**. By extending convexly away from the vertical midline, the lateral margins **514** and **516** may be configured to fully contact the medial aspect of the wearer's breasts when the vibration damping structure **500** is incorporated into a support garment.

FIG. 6 depicts an alternative shape configuration for a vibration damping structure **600** in accordance with aspects herein. The vibration damping structure **600** has a perimeter shape that mimics an hourglass shape. That is, a superior portion **610** and an inferior portion **612** of the damping structure have a greater width than a mid-portion **614** of the structure **600**. More particularly, as shown in FIG. 6, width **616** of the superior portion **610** and width **618** of the inferior portion **612** are generally greater than width **620** of the mid-portion **614**. It is contemplated herein that the width **616** of the superior portion **610** may be the same as, greater than, or less than the width **618** of the inferior portion **612**.

Continuing, the shape configuration of the damping structure **600** may be optimized to provide damping to impact forces generated not only through medial-to-lateral movement of the wearer's breasts but also to impact forces generated through superior-to-inferior movement of the wearer's breasts. For instance, the shape configuration of the structure **600** is such that the superior portion **610** may extend along and be in contact with at least a portion of the superior aspect of the wearer's breasts, and the inferior portion **612** may extend along and be in contact with at least a portion of the inferior aspect of the wearer's breasts. Thus, the superior and inferior portions **610** and **612** may be positioned to help absorb and dissipate impact forces generated by the wearer's breasts during superior-to-inferior movement of the breasts.

FIG. 7 illustrates a side view of an exemplary vibration damping structure **700** in accordance with aspects herein. The vibration damping structure **700** may comprise, for

example, the vibration damping structure **105** of FIG. **1** or the vibration damping structures **500** and **600** of FIGS. **5** and **6**. The vibration damping structure **700** may comprise a superior aspect **710**, an inferior aspect **712**, an anterior aspect **714**, and a posterior aspect **716** in relation to the damping structure **700** being incorporated into a support garment worn by a wearer. As described above with respect to FIGS. **2-4**, the vibration damping structure **700** may have a first thickness **718** at its superior aspect **710**, a second thickness **720** at a point generally mid-way between the structure's superior aspect **710** and inferior aspect **712**, and a third thickness **722** at its inferior aspect **712** to produce an overall average thickness. As shown the thickness towards the mid-point and inferior aspect **712** of the structure **700** is generally greater than the thickness **718** at the superior aspect **710** to mimic the natural breast shape of the wearer's breasts. It is contemplated herein, that the structure **700** may have other configurations. For instance, the thickness of the superior and inferior aspects **710** and **712** may be generally the same, where both of these thicknesses may be less than the thickness **720**. Alternatively, the structure **700** may have a uniform thickness from its superior aspect **710** to its inferior aspect **712**. Any and all aspects, and any variation thereof, are contemplated as being within the scope herein.

Turning now to FIGS. **10-12**, an alternative construction for a vibration damping structure is depicted in accordance with aspects herein. In an additional aspect, and as shown in FIG. **10**, a support garment **1000** may comprise an exemplary vibration damping structure **1010** comprising a frame **1012** and a series of series of cross-linking elements **1014** extending between the borders of the frame **1012**. The frame **1012** and the cross-linking elements **1014** may have similar mechanical properties as described for the vibration damping structures **105** and **116**. As shown in FIG. **10**, the vibration damping structure **1010** is positioned between breast contacting surfaces of the support garment **1000** such that it fills or substantially fills the space defined by the medial aspects of the wearer's breasts and the wearer's sternum when the support garment **1000** is in an as-worn configuration. It is contemplated herein, that the vibration damping structure **1010** may be fixedly attached to the support garment **1000** or removably attached to the support garment **1000**. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein.

A view of the vibration damping structure **1010** in isolation is shown in FIGS. **11** and **12**. With respect to FIG. **11**, which illustrates a front perspective view of the vibration damping structure **1010**, it is contemplated herein that the frame **1012** may extend continuously around the vibration damping structure **1010**. That is, it may extend continuously from a superior end of the vibration damping structure **1010**, along lateral sides of the vibration damping structure **1010**, and along the inferior end of the vibration damping structure. It is also contemplated herein, that the frame **1012** may comprise the lateral sides without the superior and inferior ends. The frame **1012** may be formed of, for instance a flexible plastic material (commonly known as "boning") although other flexible materials are contemplated herein.

Continuing, the series of cross-linking elements **1014** extend transversely across the frame **1012** from a first lateral side of the frame **1012** to a second lateral side of the frame **1012**. In exemplary aspects, the cross-linking elements **1014** may also be formed from a flexible plastic material (or other flexible material). Further, it is contemplated herein that the frame **1012** and the cross-linking elements **1014** may comprise a unitary and continuous structure formed through, for instance, a molding process. It is also contemplated herein,

that the cross-linking elements **1014** may comprise separate structures that are joined to the frame **1012** using affixing technologies know in the art. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein. When the vibration damping structure **1010** is used within a support garment such as the support garment **1000**, it is contemplated herein that the vibration damping structure may be sandwiched between or positioned between layers of material (e.g., a fabric) before being incorporated into the support garment.

As shown in FIGS. **10** and **12**, the cross-linking elements **1014** extend posteriorly with respect to the frame **1012** such that they bow or curve inwardly to at least partially occupy the space defined by the medial aspect of the wearer's breasts and the wearer's sternum. Similar to the vibration damping structure **700** of FIG. **7**, it is contemplated herein that cross-linking elements **1014** positioned near the superior end of the vibration damping structure **1010** may not extend as far posteriorly as the cross-linking elements **1014** positioned generally midway between the superior and inferior ends of the vibration damping structure **1010**, or the cross-linking elements **1014** positioned near the inferior end of the vibration damping structure **1010**. As well, the cross-linking elements **1014** positioned near the inferior end of the vibration damping structure **1010** may not extend as far posteriorly as the cross-linking elements **1014** positioned generally midway between the superior and inferior ends of the vibration damping structure **1010**. Any and all aspects, and any variation thereof, are contemplated as being within aspects herein. The configuration of the vibration damping structure **1010** not only helps to prevent medial-to-lateral sway of the wearer's breasts during movement, but also facilitates the movement of air and moisture vapor through the vibration damping structure **1010** helping to keep the wearer cool.

Aspects of the present disclosure have been described with the intent to be illustrative rather than restrictive. Alternative aspects will become apparent to those skilled in the art that do not depart from its scope. A skilled artisan may develop alternative means of implementing the aforementioned improvements without departing from the scope of the present invention.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations and are contemplated within the scope of the claims. Not all steps listed in the various figures need be carried out in the specific order described.

What is claimed is:

1. A support garment comprising:
  - a pair of breast contacting surfaces; and
  - a vibration damping structure positioned between the pair of breast contacting surfaces, the vibration damping structure comprising:
    - a first lateral side and a second lateral side, and a set of cross-linking elements, each cross-linking element extending transversely across from the first lateral side to the second lateral side.
2. The support garment of claim 1, wherein the vibration damping structure comprises a stiffness of less than or equal to 15 N/mm.
3. The support garment of claim 2, wherein the vibration damping structure comprises an energy return of from 70% to 90%.
4. The support garment of claim 1, wherein the vibration damping structure comprises a frame that includes the first lateral side and the second lateral side, and wherein each

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cross-linking element extends transversely across the frame from the first lateral side to the second lateral side of the frame.

5 5. The support garment of claim 4, wherein the frame and the set of cross-linking elements comprise a unitary and continuous molded structure.

6. The support garment of claim 4, wherein the set of cross-linking elements bow inwardly and in a posterior direction with respect to the support garment.

10 7. The support garment of claim 4, wherein the set of cross-linking elements bow inwardly and in a posterior direction with respect to the support garment.

8. The support garment of claim 1, wherein the vibration damping structure is removably attached to the support garment.

15 9. The support garment of claim 1, wherein the vibration damping structure is at least partially positioned between at least a first layer of material and a second layer of material.

10. The support garment of claim 1, wherein the vibration damping structure is fixedly attached to the support garment.

20 11. The support garment of claim 1, wherein the vibration damping structure comprises a flexible plastic material.

25 12. The support garment of claim 1, wherein the vibration damping structure is configured to occupy a space defined at least by a medial aspect of a wearer's breasts and the wearer's sternum.

30 13. A vibration damping structure configured for use in an upper-body support garment, the vibration damping structure comprising:

- at least a first lateral side and a second lateral side; and
- a set of cross-linking elements, each cross-linking element extending transversely across from the first lateral

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side to the second lateral side, wherein the vibration damping structures is configured to be positioned between a pair of breast contacting surfaces of the upper-body garment.

14. The vibration damping structure of claim 13, wherein the set of crosslinking elements are formed from a flexible material.

15. The vibration damping structure of claim 14, wherein the flexible material comprises a plastic material.

16. The vibration damping structure of claim 13, wherein the set of cross-linking elements comprise at least three cross-linking elements.

17. The vibration damping structure of claim 13, wherein the frame further comprises a superior end extending between the first lateral side and the second lateral side and an inferior end extending between the first lateral side and the second lateral side.

18. The vibration damping structure of claim 13, wherein the set of cross-linking elements bow in a common direction with respect to the frame.

19. The vibration damping structure of claim 18, wherein at least one cross-linking element of the set of cross-linking elements is longer than one or more other cross-linking elements in the set of cross-linking elements.

20. The support garment of claim 13, wherein the vibration damping structure further comprises a frame that includes the first lateral side and the second lateral side, and wherein each cross-linking element extends transversely across the frame from the first lateral side to the second lateral side of the frame.

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