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(54) **SPRING CORE WITH INTEGRATED CUSHIONING LAYER**

(71) Applicant: **Sealy Technology LLC**, Trinity, NC (US)

(72) Inventors: **Darin T. Thomas**, Salisbury, NC (US); **Stephen Wallace**, Duffield, VA (US); **Christina Pollock**, Greensboro, NC (US)

(73) Assignee: **SEALY TECHNOLOGY LLC**, Trinity, NC (US)

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A47C 27/045	(2006.01)
A47C 27/05	(2006.01)
A47C 27/06	(2006.01)
A47C 27/20	(2006.01)

(52) **U.S. Cl.**
CPC ***A47C 27/20*** (2013.01); ***A47C 23/04*** (2013.01); ***A47C 27/0456*** (2013.01); ***A47C 27/056*** (2013.01); ***A47C 27/064*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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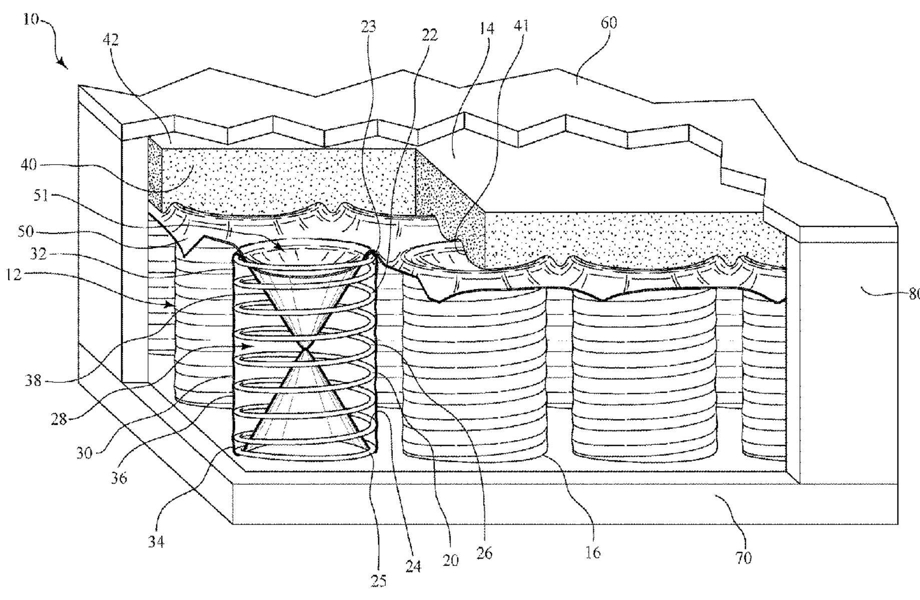
Primary Examiner — Justin C Mikowski
Assistant Examiner — Ifeolu A Adeboyejo
(74) *Attorney, Agent, or Firm* — Stites & Harbison, PLLC; Terry L. Wright

(57) **ABSTRACT**

A spring core is provided that includes a plurality of coil springs having an upper portion and a lower portion that collectively define an interior cavity. The spring core further includes a continuous upper fabric layer that covers each coil spring and defines a recess in the interior cavity of each coil spring. A cushioning layer is positioned atop the continuous upper fabric layer and extends into the recess in the interior cavity of each coil spring. A mattress assembly is further provided that includes the spring core, an upper body supporting layer, and a lower foundation layer. Methods of producing a spring core are further provided.

14 Claims, 6 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 62/005,361, filed on May 30, 2014.

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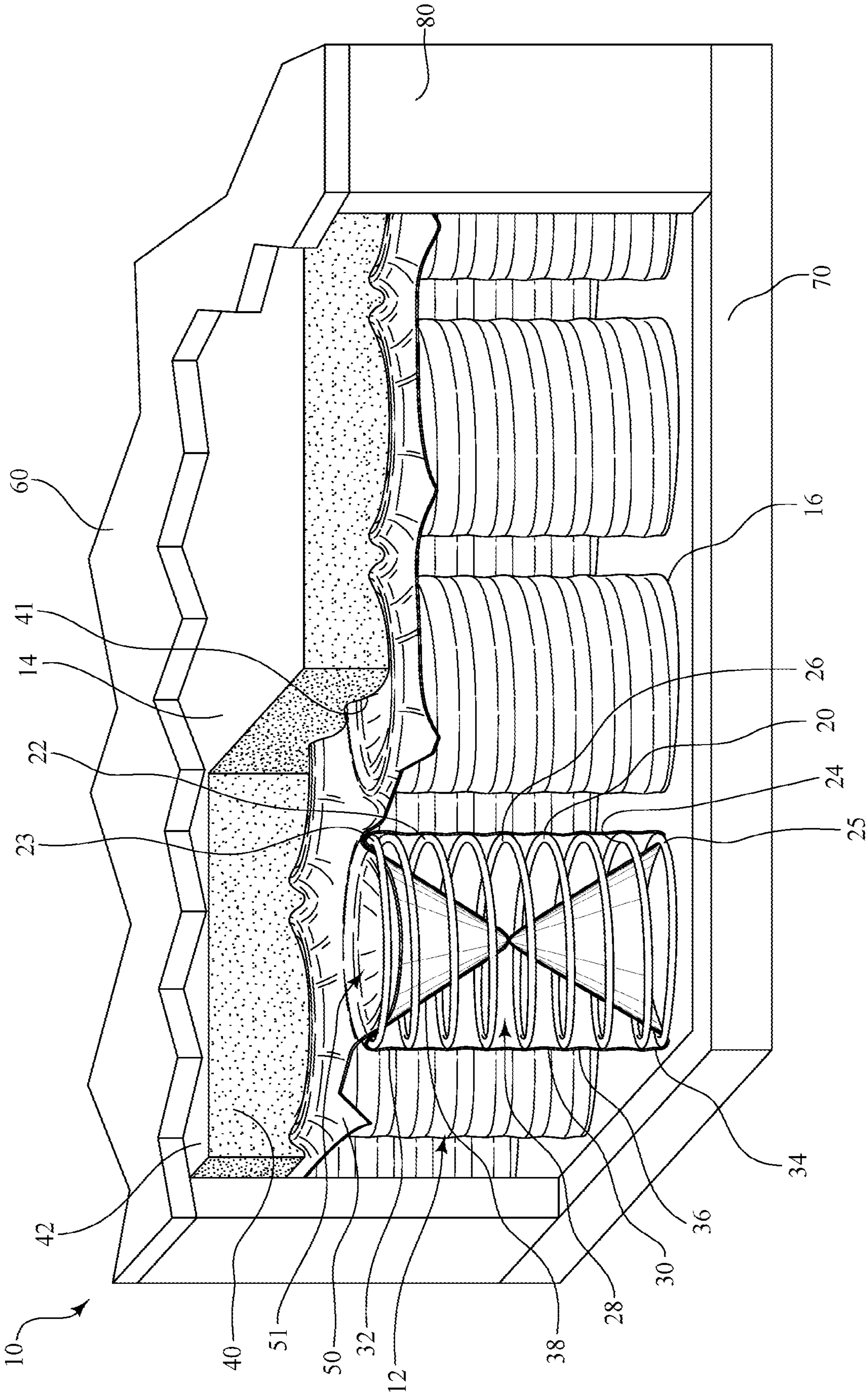

FIG. 1

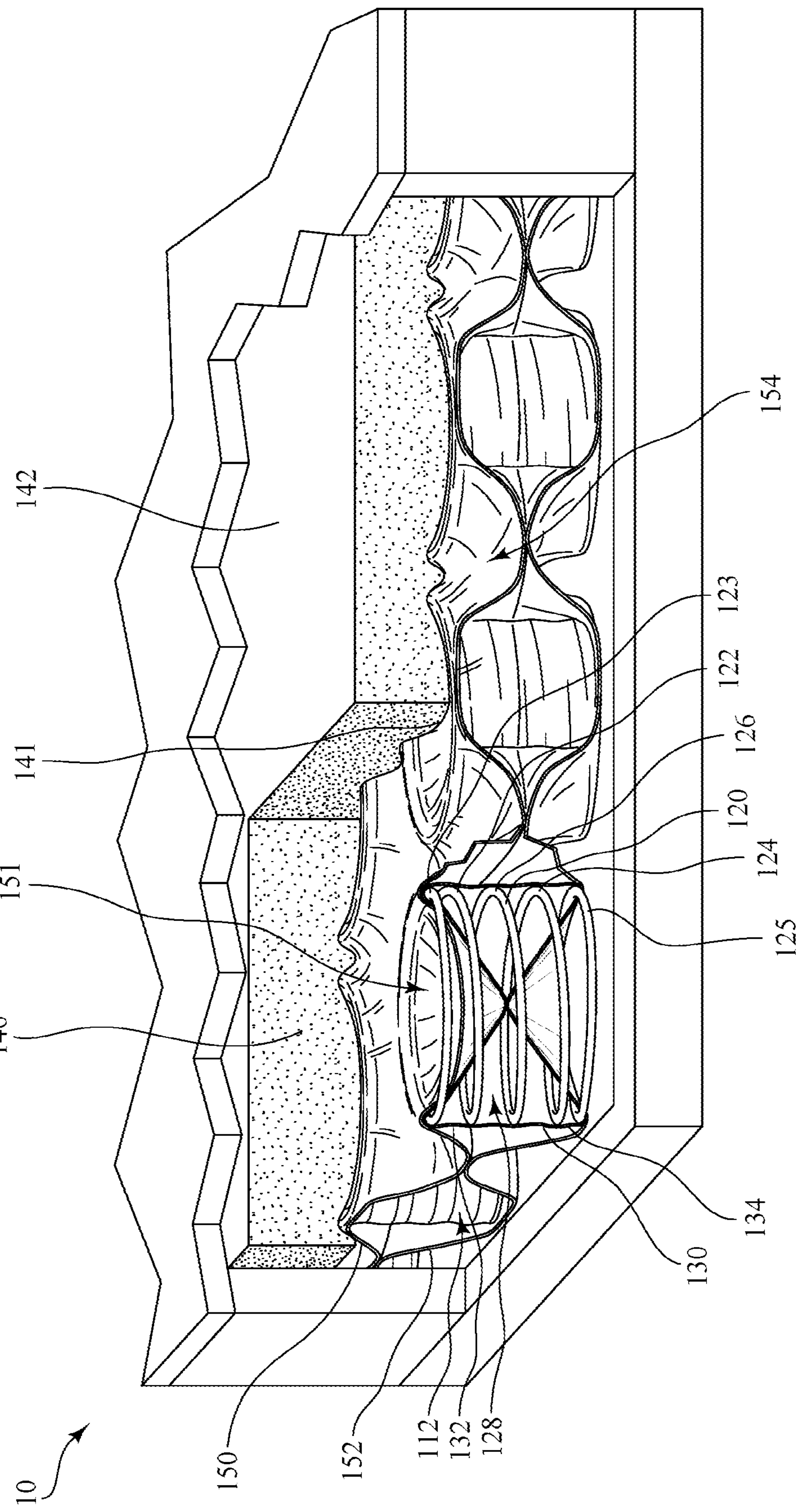

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FIG. 2

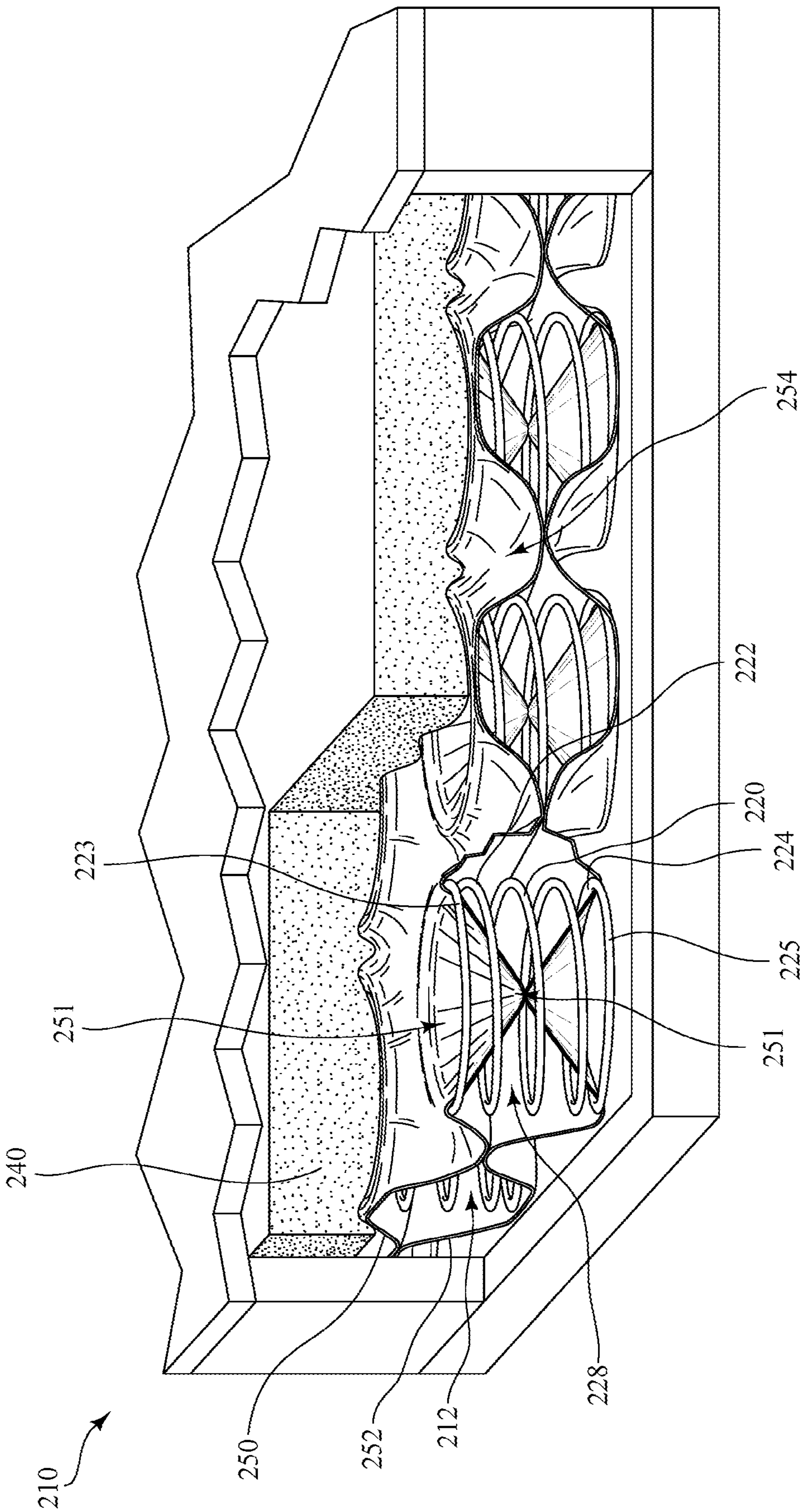

FIG. 3

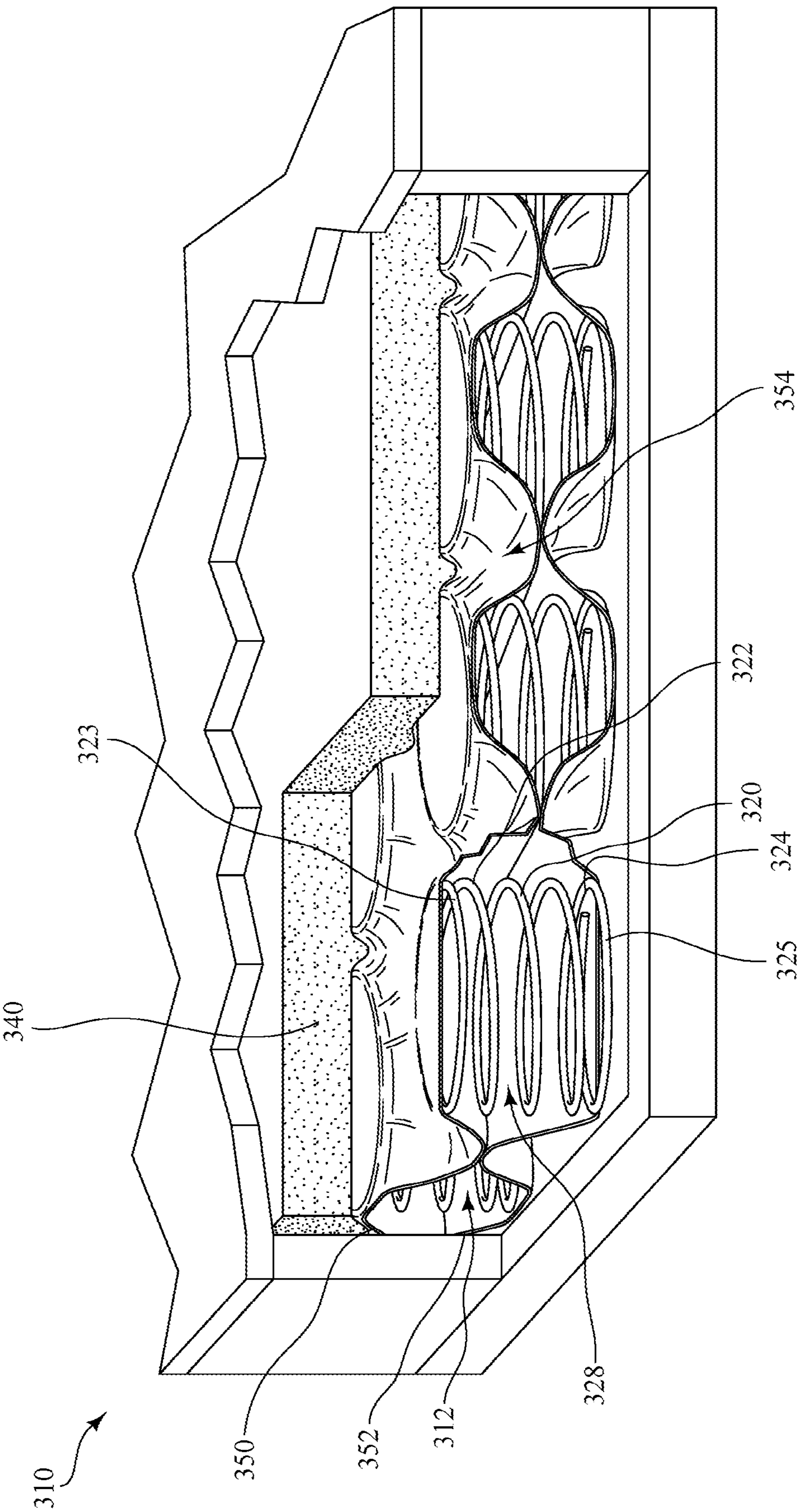

FIG. 4

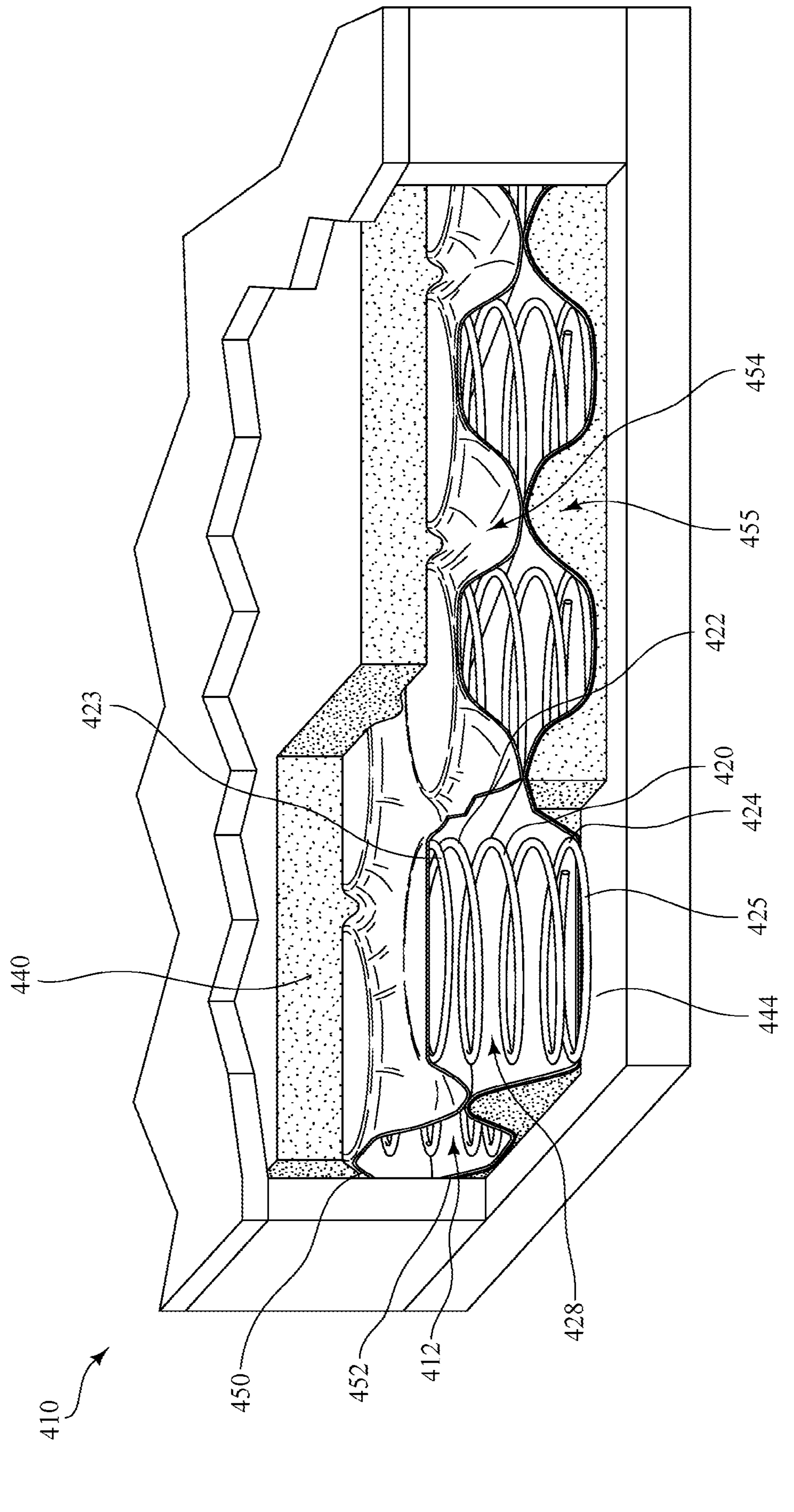

FIG. 5

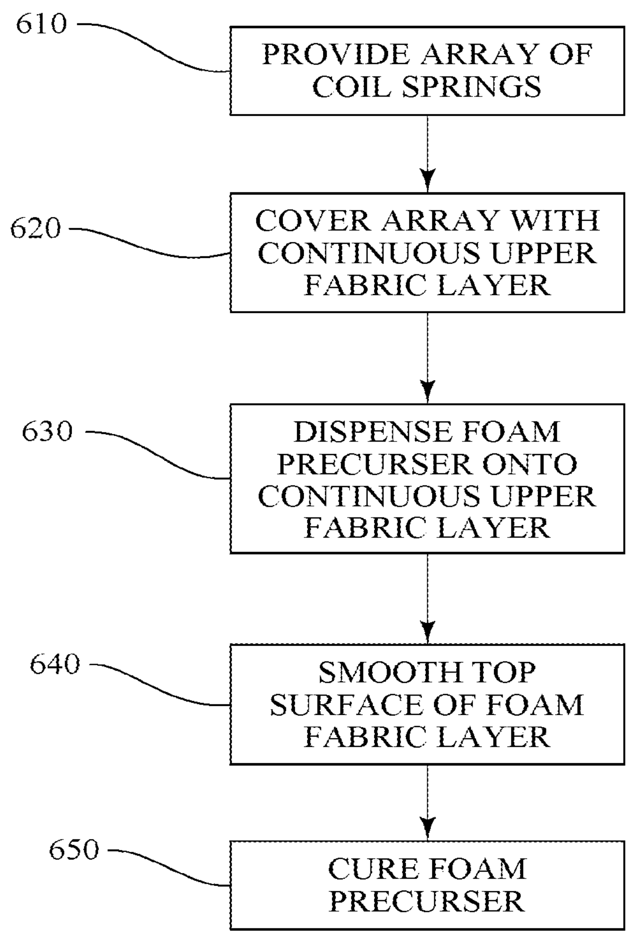
610
PROVIDE ARRAY OF COIL SPRINGS
620
COVER ARRAY WITH CONTINUOUS UPPER FABRIC LAYER
630
DISPENSE FOAM PRECURSER ONTO CONTINUOUS UPPER FABRIC LAYER
640
SMOOTH TOP SURFACE OF FOAM FABRIC LAYER
650
CURE FOAM PRECURSER

FIG. 6

SPRING CORE WITH INTEGRATED CUSHIONING LAYER

RELATED APPLICATIONS

This Divisional Patent Application claims priority to and benefit of, under 35 U.S.C. § 121, U.S. Divisional patent application having Ser. No. 17/354,498, filed Jun. 22, 2021, which claims priority to and benefit of, under 35 U.S.C. § 121, U.S. Continuation-In-Part patent application having Ser. No. 15/210,780, filed Jul. 14, 2016, which claims priority to U.S. patent application having Ser. No. 14/717,245, now issued as U.S. Pat. No. 9,936,815, filed May 20, 2015, and which claims priority to U.S. Provisional Application Ser. No. 62/005,361, filed May 30, 2014, the entire disclosures of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to spring cores having an integrated cushioning layer. In particular, the present invention relates to spring cores that include a plurality of coil springs and a cushioning layer that is positioned atop the coil springs and that extends below an upper end convolution of each coil spring.

BACKGROUND

Spring assemblies that make use of pocket coil springs, which are also known as wrapped coils, encased coils, encased springs, or Marshall coils, are generally recognized as providing a unique feel to a mattress when used as a part of a spring assembly because each discrete coil is capable of moving independently to support the body of a user, or a portion thereof, resting on the mattress. In particular, in spring cores including a plurality of pocket coil spring assemblies, each coil is wrapped in a fabric pocket and moves substantially independently of the other coils in the spring core to thereby provide individualized comfort and contouring to the body of a user. Moreover, as a result of moving substantially independently from one another, the pocket coils also do not directly transfer motion from one pocket coil to another, and, consequently, the movement of one user resting on a mattress assembly using pocket coils will not disturb another user resting on the mattress assembly. In this regard, mattress assemblies constructed with a spring core using pocket coil springs are generally recognized as providing a soft and luxurious feel, and are often more desirable than a traditional inner spring mattress. Accordingly, a spring core that makes use of pocket coil springs and that further improves the unique feel and support provided by traditional pocket coil springs would be both highly desirable and beneficial.

SUMMARY

The present invention includes spring cores having an integrated cushioning layer. In particular, the present invention includes spring cores that are comprised of a plurality of coil springs and a cushioning layer that is positioned atop the coil springs and that extends below an upper end convolution of each coil spring.

In one exemplary embodiment of the present invention, an exemplary spring core is provided as part of a mattress assembly, which further includes an upper body supporting layer, a lower foundation layer, and a side panel extending between the upper body supporting layer and the lower

foundation layer and around the entire periphery the spring core. The spring core itself is comprised of a plurality of coil springs with each of the coils having an upper portion and a lower portion that collectively define an interior cavity of the coil spring. Each of the coil springs is encased by a fabric pocket that includes a top area, which covers the upper portion of each coil spring, as well as a bottom area, which covers the lower portion of each coil spring. The spring core further includes a continuous upper fabric layer that covers the upper portion of each coil spring and that defines a recess in the interior cavity of each coil spring, an intermediate recess between each coil spring, or both. Additionally included in the spring core is a cushioning layer that is positioned atop each of the coil springs and that includes a bottom surface extending into each recess defined by the continuous upper fabric layer and a substantially planar top surface. In this regard, the top surface of the cushioning layer thus forms the first support surface of the spring core, while the bottom area of the fabric pockets along with the lower portion of each of the coil springs forms the second support surface of the spring core.

With respect to the fabric pockets, in some embodiments, the top area of each fabric pocket is connected to the bottom area of each fabric pocket within the interior cavity of the coil spring. The top area of the fabric pocket (i.e., the portion of the continuous upper fabric layer which forms the top area of the fabric pocket) can be connected to the bottom area of the fabric pocket by any number of means, including a tuft, a staple, a weld, and the like. By connecting the top area of the fabric pocket to the bottom area of the fabric pocket within the interior cavity of a coil spring, not only is it possible to impart a desired level of pre-compression, stability, and/or stretchability to the coil spring, but the connection of the top area of the fabric pocket to the bottom area of the fabric pocket also creates an additional recess that is defined by the top area of the fabric pocket and that, in certain embodiments, extends into the interior cavity of the coil spring to about half of the total height of the coil spring. In this regard, by joining the top area of a fabric pocket to the bottom area of a fabric pocket, the additional recess provides a suitable area in which the continuous upper fabric layer can extend and thereby defines the recess that is formed by the continuous upper fabric layer and that provides a suitable area onto which a liquid foam precursor can be directly dispensed and allowed to react to form the cushioning layer.

In another exemplary embodiment of the present invention, a spring core is included in an exemplary mattress assembly and comprises a plurality of mini coil springs that are each encased by a fabric pocket. The spring core further comprises a continuous upper fabric layer that extends across an upper portion of each of the plurality of mini coil springs and defines a recess in an interior cavity of each of the coil springs. The spring core then includes a continuous lower fabric layer that extends across the lower portion of each of the plurality of mini coil springs. The continuous lower fabric layer is connected to the continuous upper fabric layer around and between each of the plurality of mini coil springs, such that the continuous upper fabric layer and the continuous lower fabric layer collectively form a plurality of intermediate recesses between each of the mini coil springs. In this regard, when a liquid foam precursor is dispensed onto the continuous upper fabric layer, the resulting bottom surface of the cushioning layer extends into each of the recesses in the interior cavity of each of the mini coil springs and into each of the intermediate recesses between each of the mini coil springs.

As an even further refinement to the spring cores of the present invention that make use of a continuous upper fabric layer and a continuous lower fabric layer, in another embodiment, an exemplary spring core is includes a plurality of mini coil springs similar to the embodiment described above, but which are each not surrounded by a fabric pocket. Instead, in the further spring core, the continuous upper fabric layer and the continuous lower fabric layer are connected to one another between each of the mini coil springs and to one another within the interior cavity of each of the mini coil springs to define both a recess in the interior cavity of each of the mini coil springs and a plurality of intermediate recesses between each of the mini coil springs.

Still further provided are methods for producing a spring core. In one exemplary implementation of a method for producing a spring core, a pocketed coil array is first provided and is covered by a continuous upper fabric layer to define a recess in the interior cavity of each coil spring. A foam precursor is then dispensed onto the continuous upper fabric layer, for example, by moving the pocketed coil array through a flowing vertical curtain of foam precursor, and the top surface of the foam precursor is subsequently smoothed. The pocket coil array with the foam precursor dispensed on the continuous upper fabric layer is then cured, such as by advancing the array through an infrared curing oven or by other means for curing the foam (e.g., humidity, ultraviolet light, etc.) where the time spent in curing the foam is predetermined to adequately cure the foam precursor into the set foam layer. After the foam precursor has reacted for an appropriate amount of time and the foam precursor has set, the edges of the set foam are then trimmed to produce the exemplary spring core of the present invention.

Further features and advantages of the present invention will become evident to those of ordinary skill in the art after a study of the description, figures, and non-limiting examples in this document.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. I is a perspective view of an exemplary mattress assembly made in accordance with the present invention, with a portion of the mattress assembly removed to show a spring core in the interior of the mattress assembly;

FIG. **2** is a perspective view of another exemplary mattress assembly made in accordance with the present invention, with a portion of the mattress assembly removed to show a spring core in the interior of the mattress assembly;

FIG. **3** is a perspective view of another exemplary mattress assembly made in accordance with the present invention, with a portion of the mattress assembly removed to show a spring core in the interior of the mattress assembly;

FIG. **4** is a perspective view of another exemplary mattress assembly made in accordance with the present invention, with a portion of the mattress assembly removed to show a spring core in the interior of the mattress assembly;

FIG. **5** is a perspective view of another exemplary mattress assembly made in accordance with the present invention, with a portion of the mattress assembly removed to show a spring core in the interior of the mattress assembly; and

FIG. **6** is a flowchart showing an exemplary a method of producing a spring core in accordance with the present invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

The present invention includes spring cores having an integrated cushioning layer. In particular, the present invention includes spring cores that are comprised of a plurality of coil springs and a cushioning layer that is positioned atop the coil springs and that extends below an upper end convolution of each coil spring.

Referring first to FIG. **1**, in one exemplary embodiment of the present invention, an exemplary spring core **12** is provided as part of a mattress assembly **10**. The spring core **12** includes a plurality of coil springs **20** with each of the coil springs **20** having an upper portion **22** and a lower portion **24** that collectively define an interior cavity **28** of the coil spring **20**. Each of the coil springs **20** is encased by a fabric pocket **30** that includes a top area **32**, which covers the upper portion **22** of the coil spring **20**, as well as a bottom area **34**, which covers the lower portion **24** of the coil spring **20**. The spring core **12** further includes a continuous upper fabric layer **50** that covers and, consequently, operably connects the upper portions **22** of each coil spring **20** to one another and that defines a recess **51** in the interior cavity **28** of each coil spring **20**. Additionally included in the exemplary spring core **12** is a cushioning layer **40** that is positioned atop each of the coil springs **20** and that includes a bottom surface **41** extending into each recess **51** defined by the continuous upper fabric layer **50** and a substantially planar top surface **42** extending over each of the coil springs **20**. In this regard, the top surface **42** of the cushioning layer **40** thus forms the first support surface **14** of the spring core **12**, while the bottom area **34** of each of the fabric pockets **30** along with the lower portion **24** of the coil springs **20** forms the second support surface **16** of the spring core **12**.

With respect to each of the coil springs **20**, each exemplary coil spring **20** shown in FIG. **1** is made of a continuous wire that extends from an upper end convolution **23** at the upper portion **22** of the coil spring **20** to a lower end convolution **25** opposite the upper end convolution **23** at the lower portion **24** of the coil spring **20**. In the coil spring **20**, there are seven intermediate convolutions **26** that helically spiral between the upper end convolution **23** and the lower end convolution **25**, such that the coil spring **20** is made of a total of nine convolutions or turns. Of course, various other springs, such as coil springs having a different number of convolutions, could also be used in an exemplary pocket coil spring assembly without departing from the spirit and scope of the present invention.

With respect to the fabric pockets **30**, in the exemplary spring core **12** shown in FIG. **1**, the top area **32** and the bottom area **34** of each of the fabric pockets **30** extend along the outside of the coil spring **20** and form a generally cylindrical (or tubular) side surface **36** of the fabric pocket **30**. In this regard, the fabric pocket **30** is preferably made of a non-woven fabric which can be joined or welded together by heat and pressure (e.g., via ultrasonic welding or by a similar thermal welding procedure) to form such a cylindrical structure. For example, suitable fabrics that can be used for the fabric pocket **30** can include one of various thermoplastic fibers known in the art, such as non-woven polymer-based fabric, non-woven polypropylene material, or non-woven polyester material.

With further respect to the fabric pocket **30** and referring still to FIG. **1**, which shows a portion of the side surface **36** of one of the fabric pockets **30** removed to reveal the coil spring **20** and interior of the fabric pocket **30**, the top area **32** of the fabric pocket **30** is connected to the bottom area **34** of the fabric pocket **30** within the interior cavity **28** of the coil spring **20**. The top area **32** of the fabric pocket **30** can be connected to the bottom area **34** of the fabric pocket **30** by any number of means, including a tuft, a staple, a weld, glue, stitches, clamps, hook-and-loop fasteners, and the like.

By connecting the top area **32** of the fabric pocket **30** to the bottom area **34** of the fabric pocket **30** within the interior cavity **28** of the coil spring **20**, not only is it possible to impart a desired level of pre-compression, stability, and/or stretchability to the coil spring **20**, but the connection of the top area **32** of the fabric pocket **30** to the bottom area **34** of the fabric pocket **30** also creates an additional recess **38** that is defined by the top area **32** of the fabric pocket **30** and that extends into the interior cavity **28** of the coil spring **20** to about half of the total height of the coil spring **20**. In the exemplary embodiment shown in FIG. **1**, the top area **32** of the fabric pocket **30** is connected to the bottom area **34** of the fabric pocket **30** at approximately the center of the interior cavity **28** of the coil spring **20**, such that the additional recess **38** that is formed has a substantially conical shape. It is of course appreciated that depending on the manner in which the top area **32** of the fabric pocket **30** is joined to the bottom area **34** of the fabric pocket **30**, the additional recess **38** can also be made to have a different shape. For example, by increasing the size of the connected portion within the interior cavity **28** of the coil spring **20**, a recess could be formed in the shape of a truncated cone, cylinder, or the like. Regardless of the particular shape of the additional recess **38**, however, by joining the top area **32** of the fabric pocket **30** to the bottom area **34** of the fabric pocket **30**, the additional recess **38** provides a suitable area in which the continuous upper fabric layer **50** can extend below the upper end convolution **23** of the coil spring **20** and thereby define the recess **51** that is formed by the continuous upper fabric layer **50** and that provides a suitable area onto which a liquid foam precursor can be directly dispensed and allowed to react to form the cushioning layer **40**, as described in further detail below.

Referring still to FIG. **1**, the cushioning layer **40** included in the spring core **12** of the mattress assembly **10** is generally comprised of a type of flexible foam having a density suitable for supporting and distributing pressure from a user's body, or portion thereof, resting on the mattress assembly **10**. Such flexible foams include, but are not limited to: latex foam; reticulated or non-reticulated visco-elastic foam (sometimes referred to as memory foam or low-resilience foam); reticulated or non-reticulated non-visco-elastic foam; high-resilience polyurethane foam; expanded polymer foams (e.g., expanded ethylene vinyl acetate, polypropylene, polystyrene, or polyethylene); and the like. In the exemplary embodiment shown in FIG. **1**, the cushioning layer **40** is comprised of a two-part polyurethane foam that can be dispensed as a liquid foam precursor directly onto the continuous upper fabric layer **50** and into the recess **51** defined by the continuous upper fabric layer **50** such that the liquid reacts and bonds to the continuous upper fabric layer **50**.

With respect to hardness, the flexible foam used in the cushioning layer **40** of the spring core **12** can, in some embodiments, have a hardness of at least about 10 N to no greater than about 80 N, as measured by exerting pressure from a plate against a sample of the material to a compression of at least 40% of an original thickness of the material at approximately room temperature (i.e., 21° C. to 23° C.), where the 40% compression is held for a set period of time as established by the International Organization of Standardization (ISO) 2439 hardness measuring standard. In some embodiments, the flexible foam used in the cushioning layer **40** included in spring core **12** of the mattress assembly **10** has a hardness of about 10 N, about 20 N, about 30 N, about 40 N, about 50 N, about 60 N, about 70 N, or about 80 N to provide a desired degree of comfort and body-conforming or supporting qualities.

With respect to density, the flexible foam used in the cushioning layer **40** of the spring core **12** can, in some embodiments, also have a density that assists in providing a desired degree of comfort and body-conforming qualities, as well as an increased degree of material durability. In some embodiments, the density of the flexible foam used in the cushioning layer **40** included in the spring core **12** of the mattress assembly **10** has a density of no less than about 30 kg/m^3 to no greater than about 150 kg/m^3. In some embodiments, the density of the flexible foam used in the cushioning layer **40** of the spring core **12** is about 10 kg/m^3, about 20 kg/m^3, about 30 kg/m^3, about 40 kg/m^3, about 50 kg/m^3, about 60 kg/m^3, about 70 kg/m^3, about 80 kg/m^3, about 90 kg/m^3, about 100 kg/m^3, about 110 kg/m^3, about 120 kg/m^3, about 130 kg/m^3, about 140 kg/m^3, or about 150 kg/m^3. In some embodiments, the density of the flexible foam used in the cushioning layer **40** of the spring core **12** is about 10 kg/m^3 to about 80 kg/m^3. Of course, the selection of a flexible foam having a particular density will affect other characteristics of the foam, including its hardness, the manner in which the foam responds to pressure, and the overall feel of the foam. In this regard, it is also appreciated that a flexible foam having a desired density and hardness can readily be selected for a particular mattress assembly or application as desired. However, regardless of the particular properties of the cushioning layer **40**, a user's body, or portion thereof, resting on the mattress assembly **10** will be supported by both the cushioning layer **40** as well as the coil springs **20**, and thus, will provide a user with the contact feel of foam along with the durability and support of a spring.

Furthermore, and as indicated above, the cushioning layer **40** in the exemplary spring core **12** shown in FIG. **1** is typically formed from a two-part polyurethane foam, but it is appreciated that other materials can also be used in addition to or instead of a foam, such as a gel or a fibrous fill material. For example, in some embodiments, the cushioning layer can comprise a latex foam that is dispensed as a liquid latex composition which is then cured into a solid latex foam, according to methods known in the art. Such latex foam embodiments can also be made to have a desired density and hardness that can readily be selected for a particular mattress assembly or application as desired.

In other embodiments, the cushioning layer can comprise an elastomeric gelatinous material that is capable of providing a cooling effect by acting as a thermal dump or heat sink into which heat from a user's body, or portion thereof, positioned on the cushioning layer can dissipate. For example, in such embodiments, the cushioning layer can be comprised of a polyurethane-based gel made by combining Hyperlast® LU 1046 Polyol, Hyperlast® LP 5613 isocyanate, and a thermoplastic polyurethane film, which are each manufactured and sold by Dow Chemical Company Corp. (Midland, MI), and which can be combined to produce a gel having a thermal conductivity of 0.1776 W/m*K, a thermal diffusivity of 0.1184 mm2/s, and a volumetric specific heat of 1.503 MJ (/m3K) as established by the International Organization of Standardization (ISO) 22007-2 volumetric specific heat measuring standard.

Furthermore, it is appreciated that the wire gauge, spring constant, pre-compression, and overall geometry of the coil spring used in a particular mattress assembly can also be readily varied and used to impart a particular feel or characteristic in an exemplary mattress assembly without departing from the spirit and scope of the present invention.

Referring still to FIG. **1**, and as noted above, the exemplary spring core **12** is typically provided as part of a mattress assembly **10** made in accordance with the present invention. In this regard, in addition to the spring core **12**, the exemplary mattress assembly **10** further comprises an upper body supporting layer **60** positioned adjacent to the first support surface **14** of the spring core **12**, and a lower foundation layer **70** positioned adjacent to the second support surface **16** of the spring core **12**. A side panel **80** then extends between the upper body supporting layer **60** and the lower foundation layer **70** and around the entire periphery of the spring core **12** such that the plurality (i.e., the matrix) of the coil springs **20** is surrounded.

In the exemplary embodiment shown in FIG. **1**, the upper body supporting layer **60** is comprised of a visco-elastic foam, however, it is contemplated that the upper body supporting layer **60** can alternatively be comprised of some combination of foam, upholstery, and/or other soft, flexible materials known in the art. Furthermore, the upper body supporting layer **60** can also be comprised of multiple layers of material configured to improve the comfort or support of the upper body supporting layer **60**. In contrast to the upper body supporting layer **60**, the lower foundation layer **70** is generally comprised of a piece of wood, or other similarly rigid member, and is configured to support the plurality of coil springs **20**.

As a refinement of the spring cores and mattress assemblies of the present invention, rather than making use of a plurality of coil springs encased by fabric pockets and then covered by a continuous upper fabric layer that only connects the upper portions of each coil spring to one another, it is also contemplated that a plurality of coil springs can be covered by both a continuous upper fabric layer and a continuous lower fabric layer that are then connected to each other to provide a more unitary spring core construction. For example, and referring now to FIG. **2**, in another exemplary embodiment of the present invention, an exemplary spring core **112** is provided as part of another exemplary mattress assembly **110** made in accordance with the present invention. The spring core **112** is comprised of a plurality of mini coil springs **120** that, similar to the coil springs **20** in the spring core **12** shown in FIG. **1**, each have an upper portion **122** and a lower portion **124** that collectively define an interior cavity **128** of each mini coil spring **120**. Each of the mini coil springs **120** is also made of a continuous wire that extends from an upper end convolution **123** at the upper portion **122** of each mini coil spring **120** to a lower end convolution **125** opposite the upper end convolution **123** at the lower portion **124** of each mini coil spring **120**. Each of the mini coil springs **120** is also encased by a fabric pocket **130** that includes a top area **132**, which covers the upper portion **122** of each mini coil spring **120**, and a bottom area **134**, which covers the lower portion **124** of each mini coil spring **120**. However, unlike the coil springs **20** described above with reference to FIG. **1**, there are only three intermediate convolutions **126** that helically spiral between the upper end convolution **123** and the lower end convolution **125**, such that each mini coil spring **120** shown in FIG. **2** is made of a total of five convolutions or turns and has a height that is substantially less than the height of each of the coil springs **20** shown in FIG. **1**.

Referring still to FIG. **2**, the exemplary spring core **112** further includes a continuous upper fabric layer **150** which covers the upper portion **122** of each of the plurality of mini coil springs **120** and extends below the upper end convolution **123** of each mini coil spring **120** to define a recess **151** in the interior cavity **128** of each of the mini coil springs **120**. Like the spring core **12** shown in FIG. **1**, a cushioning layer **140** having a bottom surface **141** and a top surface **142** is additionally included in the spring core **112**, and is positioned atop the mini coil springs **120**. Unlike the coil springs **20** described above with reference to FIG. **1** though, the cushioning layer **140** does not extend below the upper end convolutions **123** of each mini coil spring **120** into only the recess **151** defined by the continuous upper fabric layer **150** in the interior cavity **128** of each of the mini coil springs **120**. Rather in the spring core **112**, a continuous lower fabric layer **152** is further included that extends beneath the lower portion **124** of each of the plurality of mini coil springs **120**, and is connected to the continuous upper fabric layer **150** around and between each of the plurality of mini coil springs **120** to define intermediate recesses **154** between each of the mini coil springs **120**. In this regard, and as described in further detail below, when a liquid foam precursor is directly dispensed onto the continuous upper fabric layer **150** in order to form the cushioning layer **140**, the resulting bottom surface **141** of the cushioning layer **140** extends below the upper end convolutions **123** of each mini coil spring **120** into each of the recesses **151** in the interior cavity **128** of each of the mini coil springs **120** and additionally into each of the intermediate recesses **154** between each of the mini coil springs **120**.

As an even further refinement to the spring cores of the present invention that make use of a continuous upper fabric layer and a continuous lower fabric layer to provide a spring core having a more unitary construction, and referring now to FIG. **3**, an exemplary spring core **212** is provided as part of a mattress assembly **210**, where the spring core **212** includes a plurality of mini coil springs **220** having an upper portion **222** with an upper end convolution **223** of the mini coil spring **220** and a lower portion **224** with a lower end convolution **225** of the mini coil spring **220**. The upper portion **222** and the lower portion **224** of the mini coil spring **220** collectively define an interior cavity **228** of each mini coil spring **220**. The spring core **212** additionally includes a cushioning layer **240**, a continuous upper fabric layer **250**, and a continuous lower fabric layer **252** similar to the spring core **112** described above with respect to FIG. **2**. Unlike the spring core **112** shown in FIG. **2**, however, each of the mini coil springs **220** are not surrounded by a fabric pocket. Instead, in the spring core **212**, the continuous upper fabric layer **250** and the continuous lower fabric layer **252** are connected to one another between each of the mini coil springs **220** and are connected to one another within the interior cavity **228** of each of the mini coil springs **220** to define both a recess **251** in the interior cavity **228** of each of the mini coil springs **220** and a plurality of intermediate recesses **254** between each of the mini coil springs **220**. Accordingly, and as shown in FIG. **3**, the cushioning layer **240** extends below the upper end convolution **223** of the mini coil springs **220** into the recess **251** in the interior cavity **228** of each of the mini coil springs **220**, and additionally into the plurality of intermediate recesses **254** between each of the mini coil springs **220**.

In some embodiments of the present invention, however, there is no recess in the interior cavity of each coil spring and the cushioning layer extends below the upper end convolution of the coil springs only into the plurality of intermediate recessed between each of the coil springs. For instance, and referring now to FIG. **4**, in another exemplary spring core **312** that is provided as part of a mattress assembly **310**, the spring core **312** includes a plurality of coil springs **320** having an upper portion **322** with an upper end convolution **323** of the coil spring **320** and a lower portion **324** with a lower end convolution **325** of the coil spring **320**. The upper portion **322** and the lower portion **324** of the coil spring **320** collectively define an interior cavity **328** of each coil spring **320**. The spring core **312** additionally includes a cushioning layer **340**, a continuous upper fabric layer **350**, and a continuous lower fabric layer **352** similar to the spring cores **112**, **212** described above with respect to FIGS. **2** and **3**. Also similar to the spring cores **112**, **212** described above with respect to FIGS. **2** and **3**, in the spring core **312** of FIG. **4**, the continuous upper fabric layer **350** and the continuous lower fabric layer **352** are connected to one another between each of the mini coil springs **320**. However, in the mattress assembly **310**, the continuous upper fabric layer **350** and the continuous lower fabric layer **352** are not connected to one another within the interior cavity **328** of each of the coil springs **320**. As such, in the exemplary spring core **312**, there are a plurality of intermediate recesses **354** between each of the coil springs **320**, but there is no recess in the interior cavity **328** of the coil springs **320**. Instead, and as shown in FIG. **4**, the continuous upper fabric layer **350** extends substantially flat across the upper portion **322** of each of the coil springs **320**. Accordingly, the cushioning layer **340** extends below the upper end convolution **323** of each coil spring **320** only in the intermediate recesses **354** between each of the coil springs **320** and not into the interior cavity **328** of the coil springs **320**.

As a further refinement of the spring cores and mattress assemblies of the present invention, rather than the spring core having only one cushioning layer that is positioned atop the continuous upper fabric layer, it is contemplated that the spring core can further includes a second cushioning layer positioned below the continuous lower fabric layer such that both sides of the spring core provide suitable support and distribution of pressure from a user's body, or portion thereof, resting thereon. For example, in another embodiment of the present invention and referring now to FIG. **5**, an exemplary spring core **412** is provided as part of a mattress assembly **410**, where the spring core **412** includes a plurality of coil springs **420** having an upper portion **422** with an upper end convolution **423** of the coil spring **420** and a lower portion **424** with a lower end convolution **425** of the coil spring **420**. The upper portion **422** and the lower portion **424** of the coil spring **420** collectively define an interior cavity **428** of each coil spring **420**. The spring core **412** additionally includes a continuous upper fabric layer **450** and a continuous lower fabric layer **452** in a manner similar to the spring core **312** described above with respect to FIG. **4**. That is to say, the continuous upper fabric layer **450** and the continuous lower fabric layer **452** in FIG. **5** are not connected to one another within the interior cavity **428** of each of the coil springs **420** and so the continuous upper fabric layer **450** defines a plurality of upper intermediate recesses **454** between each of the coil springs **420**, but there is no recess in the interior cavity **428** of each of the coil springs **420**. Furthermore, the continuous lower fabric layer **452** also defines a plurality of lower intermediate recesses **455** between each of the coil springs **420** that correspond to the plurality of upper intermediate recesses **454**. The spring core **412** further includes a first cushioning layer **440** positioned atop the continuous upper fabric layer **450** and a second cushioning layer **444** positioned below the continuous lower fabric layer **452**. As shown in FIG. **5**, the first cushioning layer **440** positioned atop the continuous upper fabric layer **450** is substantially similar to the cushioning layer **340** shown in FIG. **4** and extends below the upper end convolution **423** of each coil spring **420** and into the upper intermediate recesses **454** between each of the coil springs **420**. The second cushioning layer **444** similarly extends above the lower end convolution **425** of each coil spring **420** and into the lower intermediate recesses **455**. Of course, a second cushioning layer similar to the one shown in FIG. **5** can also be included in any of the other exemplary spring cores and mattress assemblies of the present invention described above with respect to FIGS. **1-4**.

As shown in FIGS. **1-5**, each exemplary cushioning layer is shown having a thickness such that the substantially planar top surface is positioned a distance away from the underlying coil springs. It is contemplated, however, that in some embodiments of the present invention, the cushioning layer is formed with a much smaller thickness such that the planar top surface is substantially even with the upper end convolutions of the coil springs. In such embodiments, the cushioning layer is still positioned atop a continuous upper fabric layer and extends into the respective recess defined in the interior cavity of each coil spring and/or intermediate recess defined between each coil spring, but there is minimal, if any, of the cushioning layer positioned above the coil springs.

As described above, and regardless of the particular configuration of the coil springs and fabric layers utilized in the exemplary spring cores described herein, each of the spring cores are generally produced by making use of a process in which a foam precursor is applied directly to the continuous fabric layer, or layers, covering each of the coil springs. In one exemplary implementation of a method for producing a spring core, such as the spring core **12** described above, and referring now to FIG. **6**, an array of coil springs (e.g., pocket coil springs) is first provided with each of the coiled springs defining an interior cavity, as indicated by step **610**. Upon providing the coil spring array, the coil spring array is then covered with a continuous upper fabric layer to thereby define a recess in the interior cavity of each coil spring, between each coil spring, or both, as indicated by step **620**. A foam precursor is then dispensed onto the continuous upper fabric layer, as indicated by step **630**. In this regard, in some implementations of the methods for producing a spring core in accordance with the present invention, the foam precursor is dispensed onto the continuous upper fabric layer by pouring the foam precursor onto the continuous upper fabric layer as the coiled spring array is moved linearly (e.g., by linearly moving the coil spring array through a flowing vertical curtain of foam precursor) in order to evenly dispense a sufficient amount of the foam precursor onto the continuous upper fabric layer. Of course, as would be recognized by those of skill in the art, such foam precursors are generally a liquid composition that includes one or more polymeric precursors and that, upon curing, forms a solid foam product (e.g., a cushioning layer). For instance, in some implementations, the foam precursor that is dispensed onto the continuous upper fabric layer can be a visco-elastic foam precursor that is comprised of isocyanate, polyol, and other additives known in the art, and that, upon curing, is capable of forming a visco-elastic cushioning layer have a desired density and hardness. As previously stated, the foam precursor can also, in some other embodiments, be a liquid latex composition, or comprise an elastomeric gelatinous material.

Regardless of the particular composition of the foam precursor, by dispensing the foam precursor as a liquid onto the continuous upper layer, the liquid foam precursor is thus capable of not only evenly covering the entirety of the continuous upper fabric layer, but the foam precursor is also capable of completely filling the recesses defined by the continuous upper layer and extending below the upper end convolution of each coil spring into the interior cavity of each coil spring and/or between each coil spring. Then, once applied, a top surface of the foam precursor can be smoothed, as indicated by step **640**, by making use of a knife blade edge, or other similar device, to create a planar top surface on the foam precursor and, eventually, the resultant set foam layer (i.e., the cushioning layer). After dispensing and smoothing the foam precursor onto the continuous upper fabric layer, the foam precursor is then allowed to cure and bond to the continuous upper fabric layer such that the foam precursor forms a set foam or cushioning layer, as indicated by step **650**. For instance, in some implementations, the coil spring array with the foam precursor can be advanced through an infrared curing oven or can be cured via other means (e.g., humidity, ultraviolet light, etc.) where the time spent in curing the foam is predetermined to adequately cure the foam precursor into the set foam layer. After the foam precursor has reacted for an appropriate amount of time and the foam precursor has set, the edges of the set foam can then be trimmed as desired to produce an exemplary spring core of the present invention that provides the contact feel of foam with the underlying support of a coiled spring.

As a further refinement of the method for producing a spring core, in some implementations, it is contemplated that rather than smoothing the foam precursor prior to curing, the foam precursor can, in some embodiments be allowed to partially cure before rollers are applied to the upper surface of the partially cured foam to provide a smooth upper surface. The foam is then allowed to fully cure and set into the cushioning layer. Furthermore, in some other embodiments the foam precursor is allowed to fully cure and then the set foam is planarized (i.e., an upper portion of the set foam layer is removed) to leave a substantially planar top surface of the cushioning layer.

Of course, in some other exemplary methods for producing a spring core, such as the spring core **412** with a first cushioning layer **440** positioned atop the continuous upper fabric layer **450** and a second cushioning layer **444** positioned below the continuous lower fabric layer **452** described above, the first cushioning layer is formed according to the steps **610-650** outlined above. Then, the spring core with the first cushioning layer already formed is turned over and the second cushioning layer is formed by dispensing foam precursor onto the continuous lower fabric layer, substantially the same as described above with respect to step **630**. Then, once applied, a top surface of the foam precursor can be smoothed, substantially the same as described above with respect to step **640**. After dispensing and smoothing the foam precursor onto the continuous lower fabric layer, the foam precursor is then allowed to cure and bond to the continuous lower fabric layer such that the foam precursor forms the second cushioning layer, substantially the same as described above with respect to step **650**, and the resulting spring core provides the contact feel of foam with the underlying support of a coiled spring on both sides of the spring core.

Throughout this document, various references are mentioned. All such references are incorporated herein by reference, including the references set forth in the following list:

REFERENCES

1. U.S. Pat. No. 4,439,977 to Stumpf, issued Apr. 3, 1984, and entitled "Method and Apparatus for Making a Series of Pocketed Coil Springs."

2. U.S. Pat. No. 4,609,186 to Thoenen, issued Sep. 2, 1986, and entitled "Mattress Spring Core with Open Ended Coils."
3. U.S. Pat. No. 6,260,223 to Mossbeck et al., issued Jul. 17, 2001, and entitled "Pocketed Coil Spring Units."
4. U.S. Pat. No. 7,185,379 to Barman, issued Mar. 6, 2007, and entitled "Foam Encased Innerspring with Internal Foam Components (Triple Case)."
5. U.S. Pat. No. 7,805,790 to DeMoss, issued Oct. 5, 2010, and entitled "Foam Springs and Innerspring Combinations for Mattresses."
6. U.S. Pat. No. 7,908,693 to DeMoss, issued Mar. 22, 2011, and entitled "Coil-in Coil Springs and Innersprings."

One of ordinary skill in the art will recognize that additional embodiments are also possible without departing from the teachings of the present invention or the scope of the claims which follow. This detailed description, and particularly the specific details of the exemplary embodiments disclosed herein, is given primarily for clarity of understanding, and no unnecessary limitations are to be understood therefrom, for modifications will become apparent to those skilled in the art upon reading this disclosure and may be made without departing from the spirit or scope of the claimed invention.

What is claimed is:

1. A method of producing a spring core, comprising the steps of:

providing an array of coil springs, each coil spring having an upper end convolution and defining an interior cavity;

covering the array of coil springs with a continuous upper fabric layer to define a recess in the interior cavity of each coil spring, an intermediate recess between each coil spring, or both the recess in the interior cavity of each coil spring and the intermediate recess between each coil spring; and

dispensing a foam precursor onto the continuous upper fabric layer such that, upon curing the foam precursor, a cushioning layer is formed atop and bonded to the continuous upper fabric layer and extends below the upper end convolution of each coil spring.

2. The method of claim **1**, wherein the step of dispensing the foam precursor onto the continuous upper fabric layer comprises pouring the foam precursor onto the continuous upper fabric layer as the array of coil springs is moved linearly.

3. The method of claim **1**, further comprising the step of smoothing the foam precursor, such that, upon curing, the cushioning layer has a substantially planar top surface.

4. The method of claim **1**, further comprising the step of advancing the array of coil springs through an infrared curing oven subsequent to dispensing the foam precursor onto the continuous upper fabric layer.

5. The method of claim **1**, further comprising the step of planarizing the cushioning layer subsequent to curing the foam precursor such that the cushioning layer has a substantially planar top surface.

6. The method of claim **1**, wherein each coil spring includes a lower portion with a lower end convolution, and further comprising, prior to dispensing the foam precursor, the step of covering the lower portion of each coil spring with a continuous lower fabric layer to define the intermediate recess.

7. The method of claim **6**, further comprising, prior to dispensing the foam precursor, the step of connecting the continuous lower fabric layer to the continuous upper fabric layer around each coil.

8. The method of claim **7**, wherein, upon dispensing the foam precursor onto the continuous upper fabric layer, the cushioning layer extends into the intermediate recess.

9. The method of claim **6**, further comprising connecting the continuous lower fabric layer to the continuous upper fabric layer in the interior cavity of each coil to define a recess.

10. The method of claim **9**, wherein, upon dispensing the foam precursor onto the continuous upper fabric layer, the cushioning layer extends into the interior cavity.

11. A spring core, comprising:

a plurality of coil springs, each coil spring having an upper portion with an upper end convolution and a lower portion with a lower end convolution;

a continuous upper fabric layer covering the upper end convolution of each coil spring;

a continuous lower fabric layer covering the lower end convolution of each coil spring; and

a cushioning layer defined by a precursor that is poured on to the continuous upper fabric layer wherein the precursor forms the cushioning layer and bonds to the continuous upper fabric layer, the cushioning layer being positioned atop the continuous upper fabric layer and extending below the upper end convolution of the plurality of coil springs.

12. The spring core of claim **11**, wherein the continuous upper fabric layer is connected to the continuous lower fabric layer between each coil spring to thereby define an intermediate recess between each coil spring, and the cushioning layer extends into the intermediate recess.

13. The spring core of claim **11**, wherein the upper portion and the lower portion of each coil spring collectively define an interior cavity of each coil spring, wherein the continuous upper fabric layer is connected to the continuous lower fabric layer within the interior cavity of each coil spring to thereby define a recess in the interior cavity of each coil spring, and wherein the cushioning layer extends into the recess of each coil spring.

14. The spring core of claim **11**, further comprising a second cushioning layer positioned below the continuous lower fabric layer and extending above the lower end convolution of the plurality of coil springs.

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