

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
1 December 2011 (01.12.2011)

(10) International Publication Number
WO 2011/150080 A1

(51) International Patent Classification:
A47C 23/00 (2006.01)

(21) International Application Number:
PCT/US2011/037935

(22) International Filing Date:
25 May 2011 (25.05.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/348,233 25 May 2010 (25.05.2010) US

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

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(54) Title: INDEPENDENT MATTRESS UNITS WITH TRANSITION ZONE

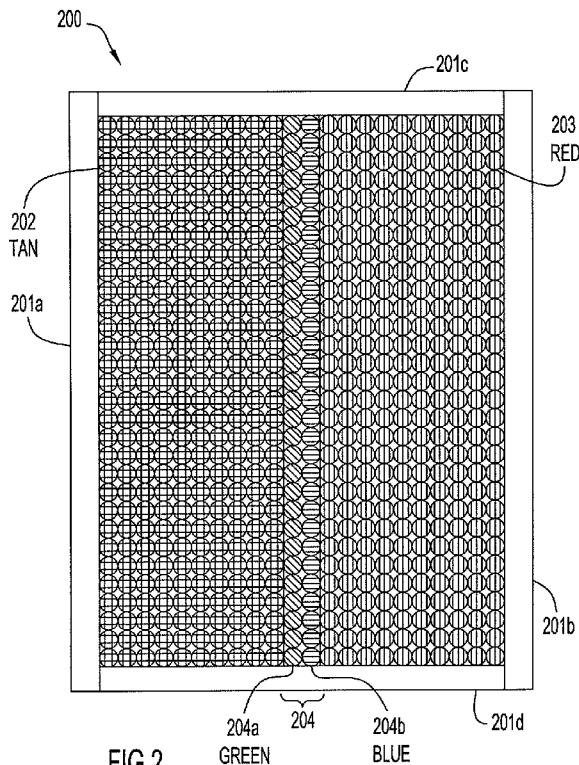


FIG. 2

(57) Abstract: A mattress includes a first spring unit having a first degree of firmness, a second spring unit having a second degree of firmness different from the first degree of firmness, and a transition zone that is disposed between the first and second spring units. A foam perimeter surrounds the first and second spring units and the transition zone. The transition zone has a first row of springs adjacent to the first spring unit and has a degree of firmness between the first and second degrees of firmness that is closer to the first degree of firmness than the second degree of firmness. The transition zone also has a second row of springs adjacent to the second spring unit and has a degree of firmness between the first and second degrees of firmness that is closer to the second degree of firmness than the first degree of firmness.

WO 2011/150080 A1

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, — *with amended claims and statement (Art. 19(1))*
GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

INDEPENDENT MATTRESS UNITS WITH TRANSITION ZONE

Cross-reference to Related Applications

This application claims the benefit of U.S. Provisional Application No. 61/348,233, filed May 25, 2010.

Field of the Invention

The invention relates to mattress systems having separate mattress support units of the same or varying firmnesses and a transition zone that provides an area of transitional support between the mattress support units.

BACKGROUND OF THE INVENTION

Spring coil mattresses have been known in the art for many years. A variety of attempts have been made to provide mattresses that have different firmness zones within the same mattress. An example of such a mattress is described in U.S. Patent Publication No. 2008/0072382 to James. This patent application describes a mattress that has a foam perimeter surrounding two sections with a flexible spacer placed between the two sections, the flexible spacer being constructed of foam. Arrays of springs are placed in the two sections and the foam flexible spacer is described as restricting translation of movement between the adjacent sections of the mattress. This flexible spacer is also described as being rather small, generally significantly less than the width of the perimeter rail.

Another attempt at providing a mattress with varying firmness is a hybrid mattress having portions with different support characteristics, as described in U.S. Patent No. 5,740,574 to Piraino. This hybrid mattress is described as having two individual support means with differential deflection coefficients, such as two inner spring supports, and a comfort means which is a unitary casing of foam rubber having two pouches sized to snugly receive the individual support means. This casing structure of the comfort means is described as also having an internal interface member. The internal interface member is described as a piece of rigid foam connecting the top and bottom surface members and creating the two pouches in which the individual support means fit. The interface member is further described as being part of the unitary comfort means that allows the hybrid mattress to act as a single unit without coming apart or shifting during use. This foam interface member which is part of the casing structure is stated to alleviate problems in the prior art of traversing the change in support rating from one unit to the other.

These prior attempts at creating a mattress rely on a piece of foam that acts as a flexible spacer or interface member to separate the two support units.

SUMMARY OF THE INVENTION

An embodiment of the present invention are directed to a mattress that has two independent mattress units with support characteristics that differ from one another, and that has a transition zone disposed between the two mattress units. Each of the independent mattress units can be an array of springs that has a degree of firmness that is different from the degree of

firmness of the other independent mattress unit. The transition zone is formed by one or more rows of compression of springs having a degree of firmness that is between the degrees of firmness of the two mattress units.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the present invention will now be described by reference with the following figures, in which:

FIG. 1 is a diagram of a conventional multi-firmness mattress having two coil units of different firmness, with a thin foam separator rail.

FIG. 2 shows an embodiment of the invention in which a mattress has two independent mattress units of different firmnesses with a transition zone of two rows of springs each with a different firmness between the firmness of the two independent mattress units.

FIGS. 3(A)-3(D) illustrate a plurality of mattress units with different firmnesses.

FIGS. 4(A)-4(F) show various transition zone spring units having more than one row of springs with each row having either the same or a different firmness than the firmness of the other row.

FIGS. 5(A)-5(J) show various configurations of a mattress having independent mattress units of the same or differing firmnesses with a transition zone of springs disposed therebetween.

FIG. 6 is a flowchart illustrating the steps in a method to make a mattress that has two independent mattress units of different firmnesses with a transition zone disposed therebetween, according to an embodiment of the invention.

DETAILED DESCRIPTION

FIG. 1 shows a conventional mattress 100 in the related art that has a foam casing made up of side rails 101a and 101b, head rail 101c, and foot rail 101d, and two spring units 102 and 103 of different firmnesses, which are support units for supporting a person during sleep. Disposed between the spring units is a thin foam rail 104.

A well known type of bedding employs a spring assembly that includes a number of discrete coil springs, each of which is enclosed in a fabric pocket in a length of folded fabric material. Longitudinal axes of the coil springs are generally parallel with one another so that the top and bottom end turns of the coil springs define top and bottom faces of the spring assembly. A row of such pocketed springs is known in the industry as a string of pocketed springs. A bedding product can be fabricated from such strings of pocketed springs by binding or adhering the individual rows or strings of pocketed springs together to form a spring assembly which may be padded and encased in an upholstered covering. This type of spring assembly is commonly referred to as a pocketed spring assembly due to the fact that each spring is contained within an individual pocket of fabric material. The construction of strings of

pocketed coil springs in each pocket is well known in the art and, for example, is disclosed in U.S. Pat. No. 4,439,977, which is hereby incorporated by reference in its entirety. The system disclosed in that patent includes a spring coiler which forms a coil spring which is subsequently compressed and inserted between the plies of folded pocketing fabric material.

For ease of description, and without limitation, different firmnesses of the springs are assigned the name of a color and will be referred to by that color. For example, spring units made of 14 gauge wire will be referred to by the color red (R). Spring units made of 14.5 gauge wire will be referred to by the color blue (B). Spring units made of 15 gauge wire will be referred to by the color green (G). Spring units made of 16 gauge wire will be referred to by the color tan (T). Generally, the larger the gauge of wire from which a spring is constructed, the firmer the spring and more support it will provide. It will be understood that the gauges of wire described here are merely examples and other gauges can be used.

FIG. 2 shows a mattress 200 according to an embodiment of the present invention which has two independent mattress units of different firmnesses with a transition zone having two rows of springs. The mattress 200 is formed by a foam perimeter made up of side rails 201a and 201b, a head rail 201c, and a foot rail 201d. A first spring unit 202 is a support unit that has a first firmness made of a plurality of strings of pocketed springs with coils of 16 gauge wire and is referred to as a tan spring unit. A second spring unit 203 is a support unit that is formed of a plurality of strings of pocketed

springs with coils made from a heavier gauge wire, namely 14 gauge wire, and therefore is firmer than spring unit 202, and is referred to as a red spring unit. A transition zone of springs 204 is formed from two transition strips 204a and 204b which, according to the present embodiment, are strings of pocketed springs, each string of pocketed springs also being referred to as a row of springs, with firmnesses that transition from a firmer spring (blue) to a softer spring (green). Together the two transition spring rows 204a and 204b form the transition zone. The firmer row of springs in the transition zone, in this case the blue row of springs 204b, is disposed adjacent to the firmer spring unit, namely the red spring unit 203. The less firm, or softer row of springs in the transition zone, in this case the row of green springs 204a, is disposed adjacent to the softer spring unit, namely the tan spring unit 202.

The transition zone springs 204 can be attached to either one or both of the spring units 202, 203 by conventional methods, such as by gluing or hog-ringing. The transition zone is attached to at least one of the spring units prior to the spring units being inserted into the space formed by the foam perimeter 201a-201d. The foam perimeter surrounds the spring units 202, 203 and the transition zone 204. The mattress 200 is then covered by suitable top covering materials to form a mattress suitable for use by two people. Accordingly, the resulting mattress with independent spring units is suitable for a person desiring a relatively firm mattress, corresponding to the spring unit made of heavier gauge wire such as red spring unit 203, and by a person desiring a less firm, or softer mattress corresponding to the spring unit made of lighter gauge

wire such as tan spring unit 202. And the mattress has a transition zone 204 that has a firmness that transitions in a relatively continuous manner from the firmer spring unit (red) to the softer spring unit (tan), making the change in firmness between the spring units less noticeable than in conventional mattresses.

The mattress can be a suitable size for comfortable sleeping by two people, such as a king or queen size mattress. However, the techniques described here can be used with other size mattresses.

Selection of the appropriate spring units can be made in conjunction with automatic mattress recommendation systems such as those described in U.S. Patent Nos. 6,571,192, 6,741,950, and 6,990,425 to Hinshaw, et al., which are incorporated herein by reference. Based on customers' selection or recommendation of the appropriate firmness for each side of the mattress, a suitable mattress can be built using the appropriate spring units with the selected or recommended firmness for each person. Based on the spring units to be used in the mattress, a transition zone is determined that appropriately blends the firmness from one side of the mattress to the other. The transition zone, according to the present embodiment, has two rows of springs with the firmness of the springs in each row selected based on the firmness of the different mattress units. The firmness of the coils making up the transition zone are selected to provide a gradual transition from the firmness of one mattress unit to the firmness of the other mattress unit. In the following embodiment, the firmnesses ranges from the most firm, being a 14 gauge red

(R) spring coil, to a 14.5 gauge blue (B) spring coil, to a 15 gauge green (G) spring coil, to the softest spring coil, tan (T), made of a 16 gauge wire. As illustrated in FIGS. 3(A)-3(D), mattress units, or support units, are made of a plurality of strings of pocketed springs in which the springs are coils of the same firmness. For example, FIG. 3(A) shows a spring unit made of ten strings of pocketed springs connected together as a spring unit. Each of the springs in the spring unit shown in FIG. 3(A) is a tan (T) type spring of 16 gauge wire making the spring unit shown in FIG. 3(A) the softest spring unit of the present embodiment. FIG. 3(B) shows a somewhat firmer spring unit made of a plurality of strings of pocketed springs in which the springs are made of green (G) springs of 15 gauge wire. FIG. 3(C) shows an even firmer spring unit made of a plurality of strings of pocketed springs in which the springs are made of blue (B) springs of 14.5 gauge wire. And FIG. 3(D) shows the firmest spring unit made of a plurality of strings of pocketed springs in which the springs are made of red (R) springs of 14 gauge wire.

The spring coils used to make the transition zone rows are selected to have a firmness that transitions from the firmness of one of the mattress units to the firmness of the other mattress unit. For example, the mattress shown in FIG. 2 has a relatively soft tan (T) mattress unit 202 made of 16 gauge wire. Red (R) mattress unit 203 is made of 14 gauge spring coils. The transition zone is formed by a row of blue (B) springs 204b of 14.5 gauge wire and a row of green (G) springs 204a of 15 gauge wire. The row of blue springs is disposed next to the firmer mattress unit, the red (R) unit 203, and the row of

green springs is disposed next to the softer mattress unit, the tan (T) unit 202. This provides an gradual easing of the firmness of coils going from the firmer side of the mattress to the softer side of the mattress, that is, going from the red (R) mattress unit to the tan (T) mattress unit. This results in a more subtle transition from the firm mattress unit to the softer mattress unit, and is more pleasing and desirable to the users than in conventional mattress support structures having differing firmnesses. In the mattress shown in FIG. 2, the blue and green rows of springs in the transition zone have a firmness that is between the firmness of the red and tan spring units and therefore provides for a continuous transition in firmness in the transition zone 204.

The different firmnesses of the spring units, described here as red, blue, green and tan, can be considered degrees of firmness. A red spring unit and a blue spring unit differ by one degree of firmness. Similarly, a red spring unit and a green spring unit differ by two degrees of firmness. And a red spring unit and a tan spring unit differ by three degrees of firmness. Likewise, a blue spring unit and a green spring unit differ by one degree of firmness, and a blue spring unit and a tan spring unit differ by two degrees of firmness. And a green spring unit and a tan spring unit differ by one degree of firmness. Similarly, rows of springs for the transition zone differ in degrees of firmness in the same manner.

In general, the degrees of firmness of the springs used in the rows of the transition zone are chosen to provide a gradual change in firmness that is as continuous as possible, going from one spring unit to another. There are

some configurations where either one of two degrees of firmness can be chosen to provide this gradual or near-continuous transition. In certain embodiments of the invention, when such a choice is to be made, the firmer degree of spring is chosen. The firmer row of springs is chosen because the person desiring firmer support often will be the larger of the two partners using the mattress and may require more mattress area.

FIGS. 4(A)-4(F) show various configurations of rows of springs for a transition zone. For example, six different transition zones are shown in these figures: two rows of tan springs shown in FIG. 4(A), two rows of green springs shown in FIG. 4(B), two rows of blue springs shown in FIG. 4(C), two rows of red springs shown in FIG. 4(D), one row of green springs with one row of blue springs shown in FIG. 4(E), and one row of blue springs with one row of red springs shown in FIG. 4(F).

Various combinations of mattress units and transition zones are shown in FIGS. 5A-J.

FIG. 5A shows a configuration with two green mattress units which have no difference in firmness and therefore the transition zone is formed from two rows of green springs. FIG. 5B shows the configuration shown in FIG. 2, in which the mattress units differ by three degrees of firmness. Accordingly, the transition zone is formed by a row of blue springs positioned adjacent to the red spring unit, and a row of green springs positioned adjacent to the tan spring unit. FIG. 5C shows a configuration with a blue mattress unit and a tan mattress unit, which differ by two degrees of firmness. Because only one type

of spring has a firmness between the firmness of the blue and the tan spring units, namely a green spring unit, the row of coils in the transition zone disposed closest to the firmer mattress unit, namely the blue mattress unit, is chosen to be the same as the firmer mattress unit. So in this case, a blue row of springs is selected for the transition zone to be positioned next to the blue mattress unit. This is because the firmer mattress unit is likely to support a larger size person who may need more area on the mattress for firm support. A green coil is selected for the second row of the transition zone and it is positioned next to the tan unit to provide a transition from blue to tan. In FIG. 5D, green and tan mattress units are selected. Since those two mattress units are adjacent in degrees of firmness, both rows of springs of the transition zone are selected to be the same firmness as the more firmer mattress unit, namely green springs. This provides more area for the person desiring the firmer coil mattress.

The remaining mattresses shown in FIGS. 5(E)-(J) show various combinations and configurations of spring units and transition zones.

A method of making a mattress with a plurality of support zones of different firmnesses and a transition zone between the support zones, is illustrated in FIG. 6. In this method, a mattress is made with two support zones suitable for supporting two people, in which each support zone supports one of the two people according to that person's physical and sleep characteristics. In step 601, the first person's physical and sleep characteristics are analyzed. For example, the techniques described in U.S.

Patent Nos. 6,571,192, 6,741,950, and 6,990,425 to Hinshaw, et al., can be used to analyze the person's physical and sleep characteristics. In the present embodiment, a computer programmed with an algorithm as described in those patents, and incorporated herein by reference, performs the analysis. In step 602, a similar analysis is performed for the second person. In step 603, a first support unit, having a first firmness, is selected according to the analysis of the first person's physical and sleep characteristics. In step 604, a second support unit, having a second firmness, is selected according to the analysis of the second person's physical and sleep characteristics. In step 605, a transition zone, having two transition strips, is selected based on the selected first and second support units. The firmness of the transition strips is selected according to the guidance described above. The transition strips can be connected to one another to form the transition zone. Each transition strips can be a string of pocketed springs.

The transition zone is then connected to at least one of the support units, such as the first support unit, as shown in step 606. In step 607, the components of the mattress are arranged such that the selected transition zone is disposed between the first and second support units with the firmer transition strip of the transition zone being placed adjacent to the firmer support unit. In step 608, a foam perimeter is placed around the arranged first support unit, transition zone, and second support unit. The assembly is covered with one or more layers of mattress covering materials.

The present invention is not restricted to spring coil type support members but can use other types of members as well such as foam mattress units, etc. For example, the support units can be made of foam rubber having the appropriate firmness and the transition strips also can be formed of foam rubber having the appropriate firmness. In embodiments using coils, the coils can be made from any type of suitable inner spring type coil conventionally used for sleep products such as pocketed coils, a Bonnell coil or other continuous wire units, although the invention is not limited to these type of coils. Combinations of types of support units and transition strips can be used depending on the application.

While the invention has been particularly shown and described with reference to certain embodiments thereof, it would be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A mattress comprising:
 - a first spring unit having a first degree of firmness;
 - a second spring unit having a second degree of firmness different from the first degree of firmness;
 - a transition zone disposed between the first and second spring units;
 - a foam perimeter surrounding the first and second spring units and the transition zone;
 - the transition zone comprising:
 - a first row of springs adjacent to the first spring unit and having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness; and
 - a second row of springs adjacent to the second spring unit and having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness.
2. The mattress according to claim 1, wherein the first and second rows are each a string of pocketed springs.
3. A bedding product, comprising:
 - a first support unit having a first degree of firmness;
 - a second support unit have a second degree of firmness different from the first degree of firmness;

a transition zone disposed between the first and second support units;
a perimeter zone surrounding the first and second support units and the transition zone;

the transition zone comprising:

a first transition strip adjacent to the first support unit and having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness; and

a second transition strip adjacent to the second support unit and having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness.

4. The bedding product according to claim 3, wherein at least one of the first and second support units is a spring unit comprised of springs.
5. The bedding product according to claim 4, wherein at least one of the spring units is comprised of a string of pocketed springs.
6. The bedding product according to claim 5 wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.
7. The bedding product according to claim 3, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

8. A method of making a bedding product, comprising:
 - selecting a first support unit having a first degree of firmness;
 - selecting a second support unit have a second degree of firmness different from the first degree of firmness;
 - making a transition zone by selecting a first transition strip having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness, by selecting a second transition strip having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness, and by disposing the first and second transition strips adjacent to one another; and
 - disposing the transition zone between the first and second support units wherein the first transition strip is disposed adjacent to the first support unit and the second transition strip is disposed adjacent to the second support unit.
9. The method according to claim 8, wherein at least one of the first and second support units is a spring unit comprised of springs.
10. The method according to claim 9, wherein at least one of the spring units is comprised of a string of pocketed springs.
11. The method according to claim 10, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

12. The method according to claim 8, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

WHAT IS CLAIMED IS:

1. A mattress comprising:
 - a first spring unit having a first degree of firmness;
 - a second spring unit having a second degree of firmness different from the first degree of firmness;
 - a transition zone disposed between the first and second spring units;
 - a foam perimeter surrounding the first and second spring units and the transition zone;
 - the transition zone comprising:
 - a first row of springs adjacent to the first spring unit and having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness; and
 - a second row of springs adjacent to the second spring unit and having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness.
2. The mattress according to claim 1, wherein the first and second rows are each a string of pocketed springs.
3. A bedding product, comprising:
 - a first support unit having a first degree of firmness;
 - a second support unit have a second degree of firmness different from the first degree of firmness;

a transition zone disposed between the first and second support units;
a perimeter zone surrounding the first and second support units and the transition zone;

the transition zone comprising:

a first transition strip adjacent to the first support unit and having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness; and

a second transition strip adjacent to the second support unit and having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness.

4. The bedding product according to claim 3, wherein at least one of the first and second support units is a spring unit comprised of springs.

5. The bedding product according to claim 4, wherein at least one of the spring units is comprised of a string of pocketed springs.

6. The bedding product according to claim 5 wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

7. The bedding product according to claim 3, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

8. A method of making a bedding product, comprising:
- selecting a first support unit having a first degree of firmness;
 - selecting a second support unit have a second degree of firmness different from the first degree of firmness;
 - making a transition zone by selecting a first transition strip having a degree of firmness between the first and second degrees of firmness and closer to the first degree of firmness than the second degree of firmness, by selecting a second transition strip having a degree of firmness between the first and second degrees of firmness, and closer to the second degree of firmness than the first degree of firmness, and by disposing the first and second transition strips adjacent to one another; and
 - disposing the transition zone between the first and second support units wherein the first transition strip is disposed adjacent to the first support unit and the second transition strip is disposed adjacent to the second support unit.
9. The method according to claim 8, wherein at least one of the first and second support units is a spring unit comprised of springs.
10. The method according to claim 9, wherein at least one of the spring units is comprised of a string of pocketed springs.
11. The method according to claim 10, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.

12. The method according to claim 8, wherein at least one of the first and second transition strips is comprised of a string of pocketed springs.
13. The mattress according to claim 1, wherein the degree of firmness of the first row of springs is noticeably different from the first degree of firmness, and
wherein the degree of firmness of the second row of springs is noticeably different from the second degree of firmness.
14. The mattress according to claim 1, wherein the first row of springs is adjacent to the second row of springs, with no rows of springs between the first row of springs and the second row of springs.
15. The mattress according to claim 1, wherein the degree of firmness of the first row of springs is approximately halfway between the first degree of firmness and the degree of firmness of the second row of springs.
16. The mattress according to claim 15, wherein the degree of firmness of the second row of springs is approximately halfway between the second degree of firmness and the degree of firmness of the first row of springs.

STATEMENT UNDER ARTICLE 19(1)

New claims 13-16 have been added to describe the invention more particularly. No new matter has been added.

Respectfully submitted,

/ Andrew J. Taska /

Andrew J. Taska
Reg. No. 54,666

Encls. (Pages 14-17)

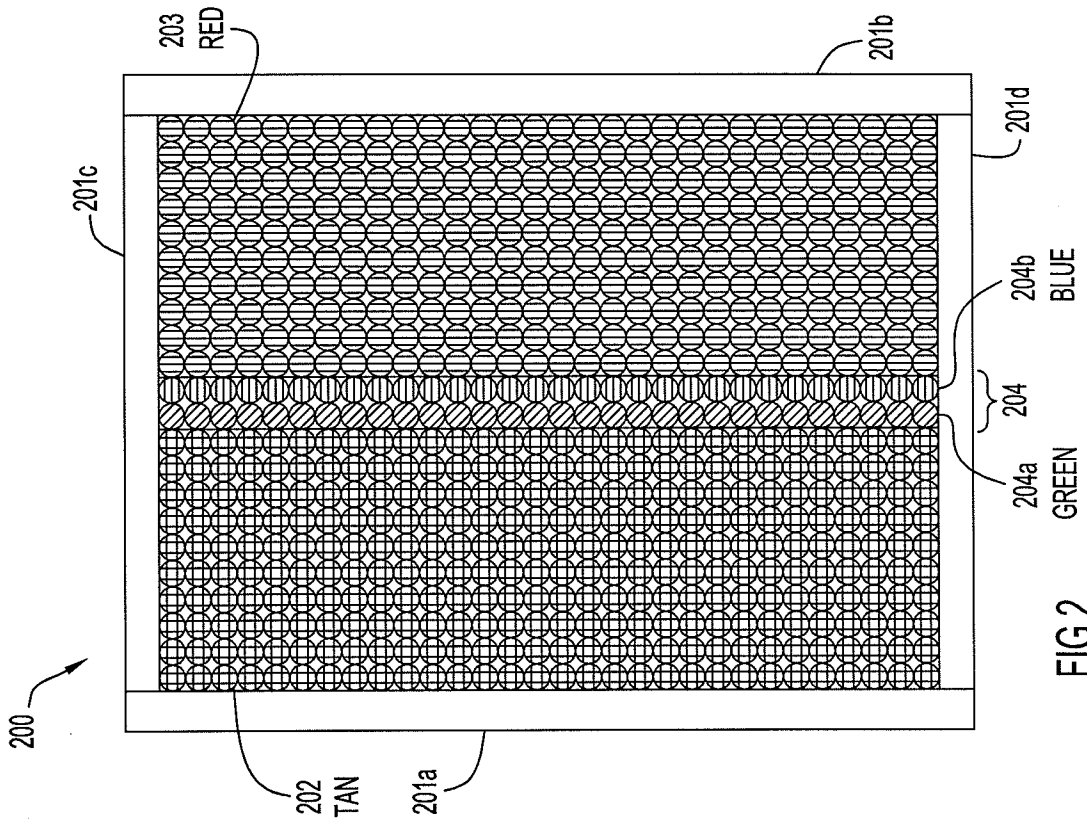


FIG. 2

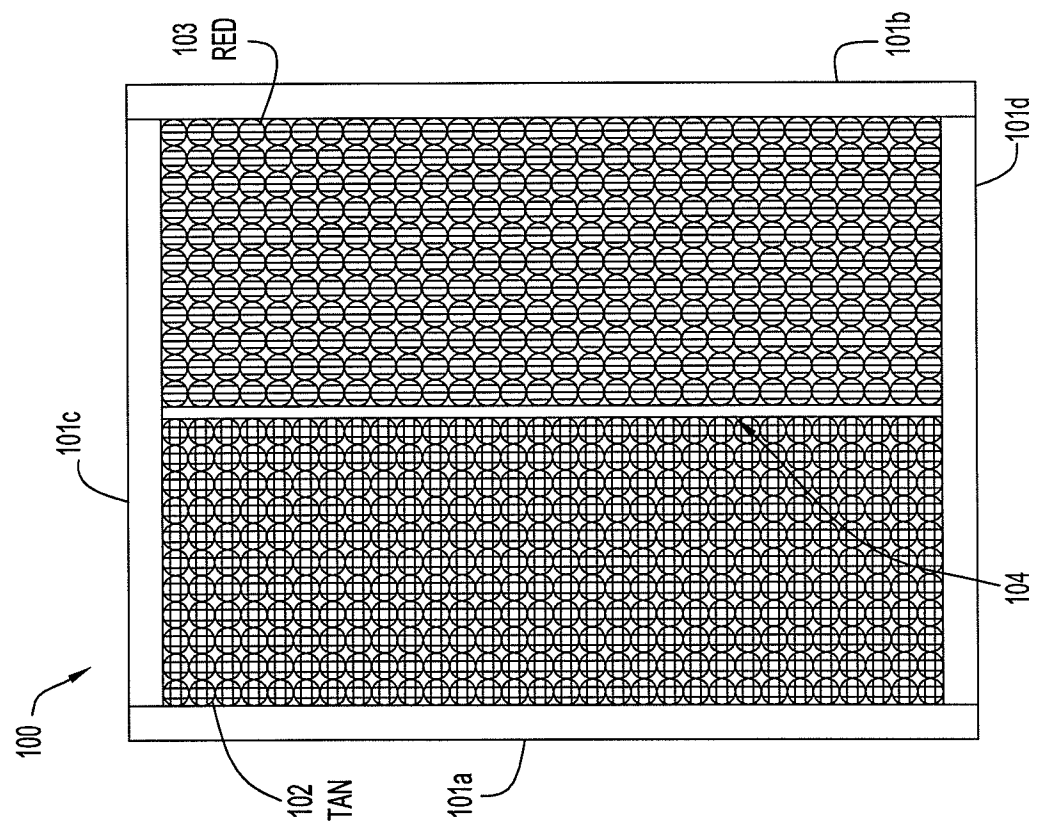
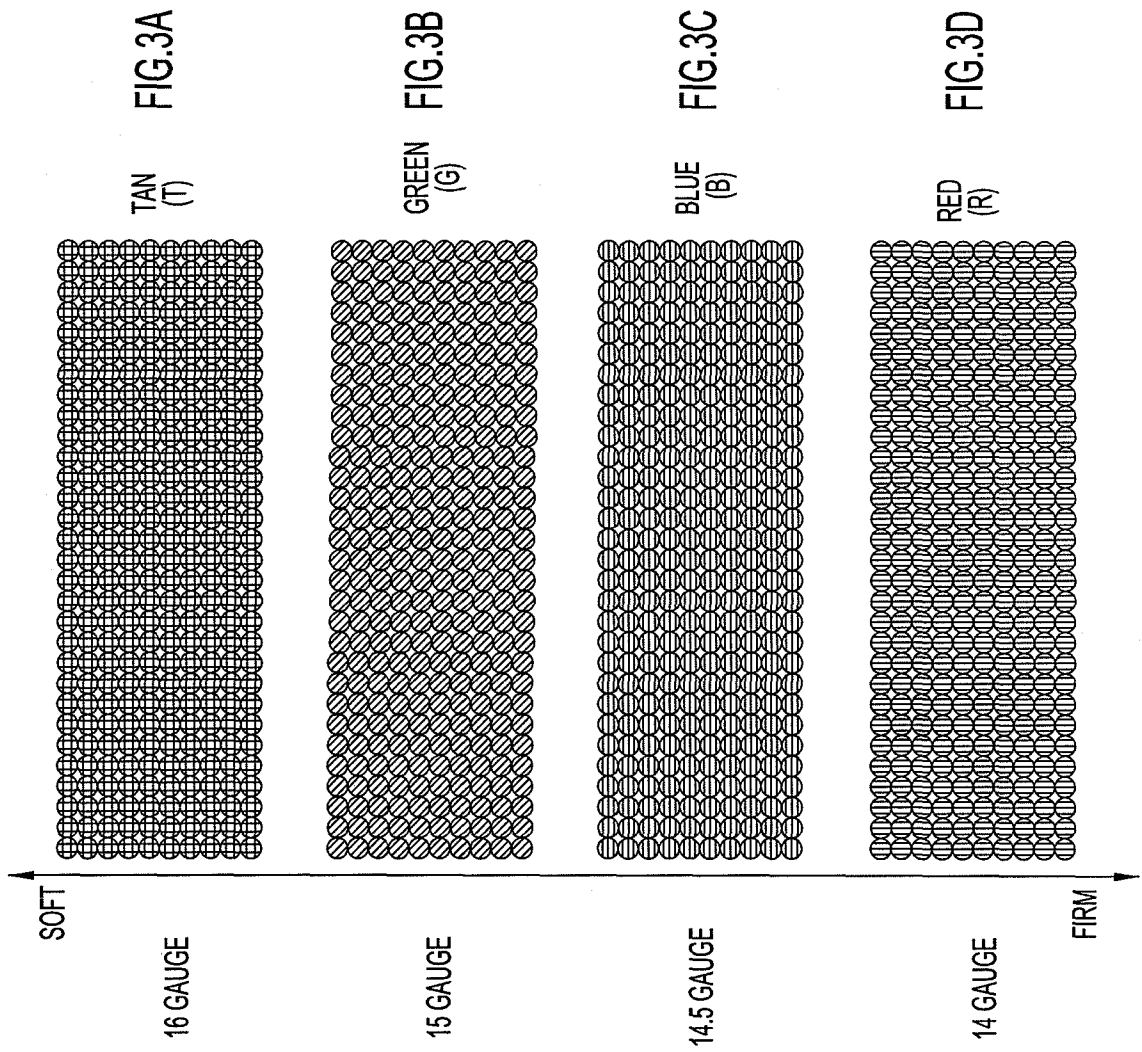
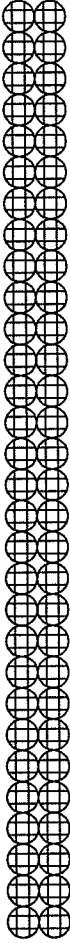
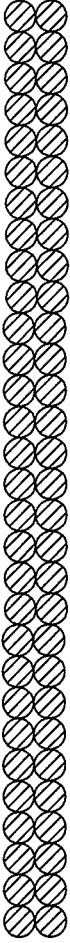


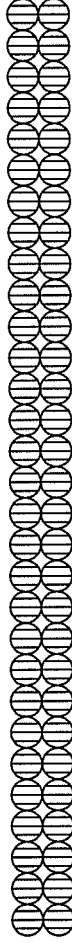
FIG. 1



2-ROW 16 GAUGE  FIG.4A

2-ROW 15 GAUGE  FIG.4B

2-ROW 14.5 GAUGE  FIG.4C

2-ROW 14 GAUGE  FIG.4D

1-ROW 15 GAUGE
1-ROW 14.5 GAUGE  FIG.4E

1-ROW 14.5 GAUGE
1-ROW 14 GAUGE  FIG.4F

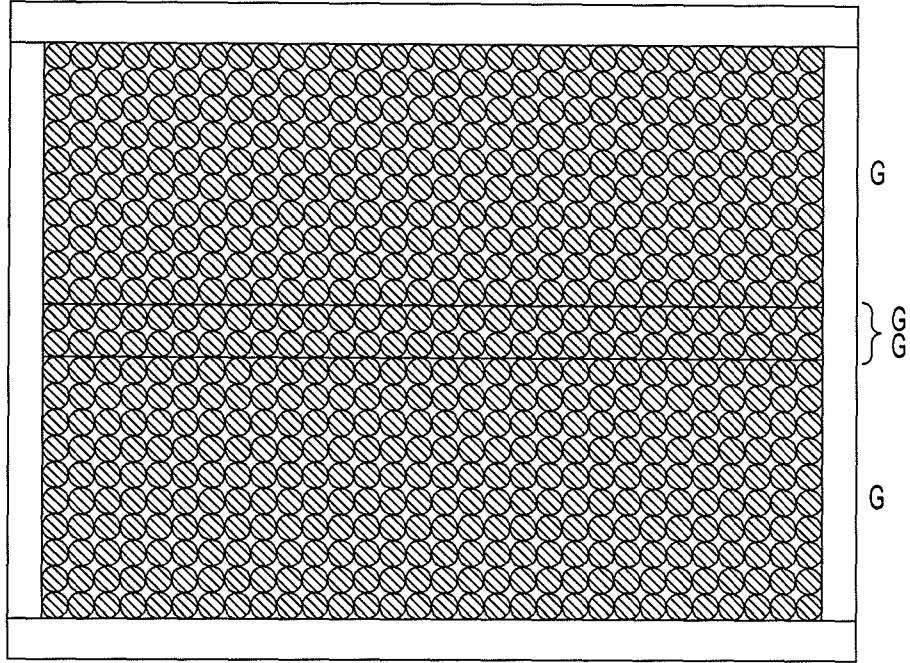


FIG.5A

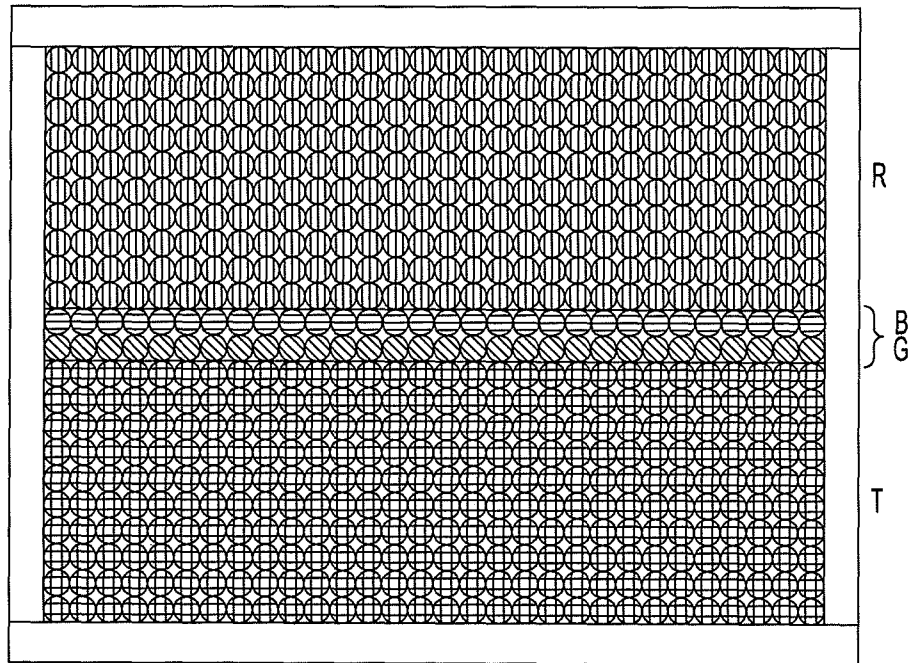


FIG.5B

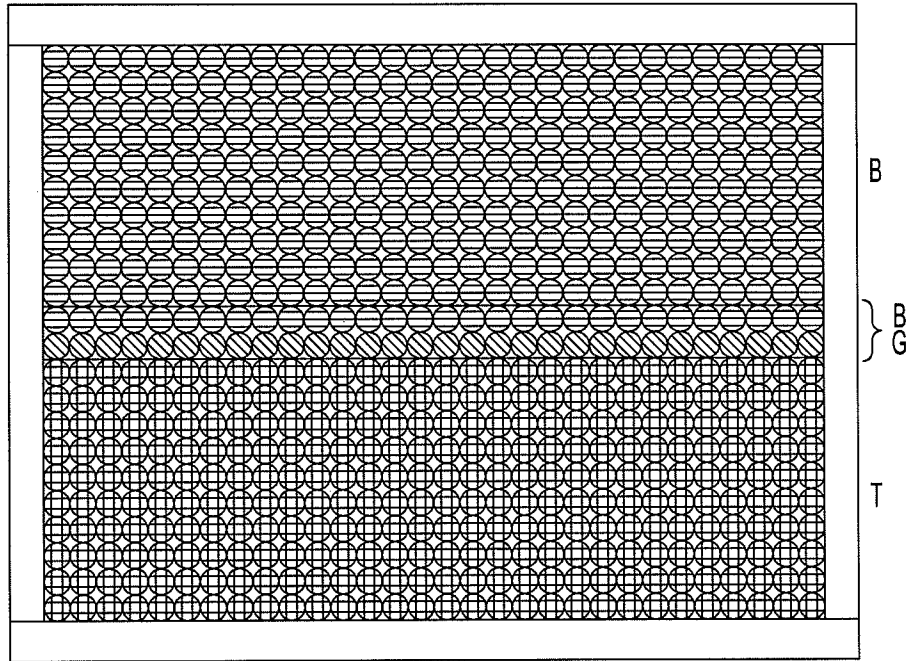


FIG.5C

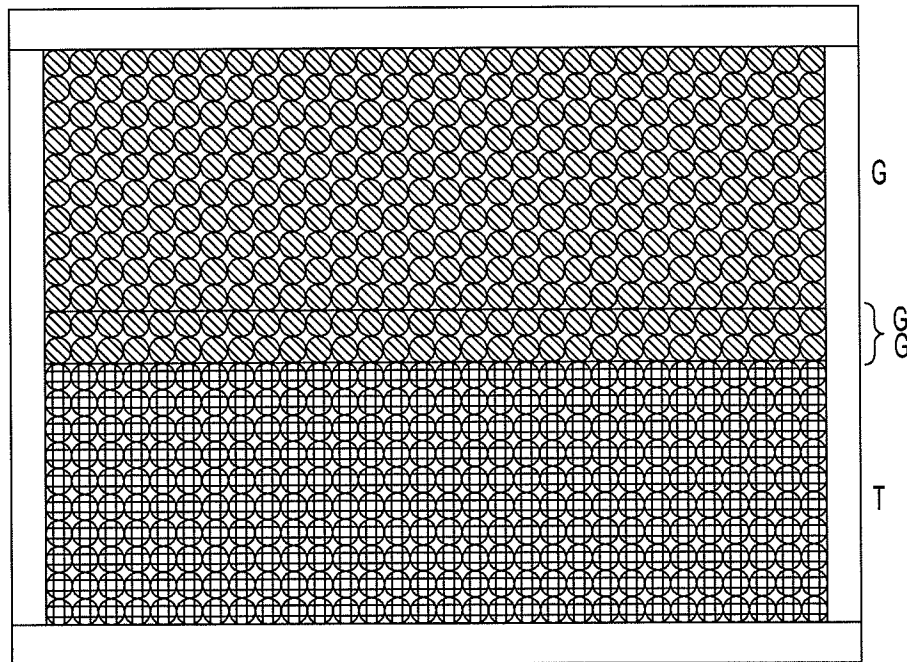


FIG.5D

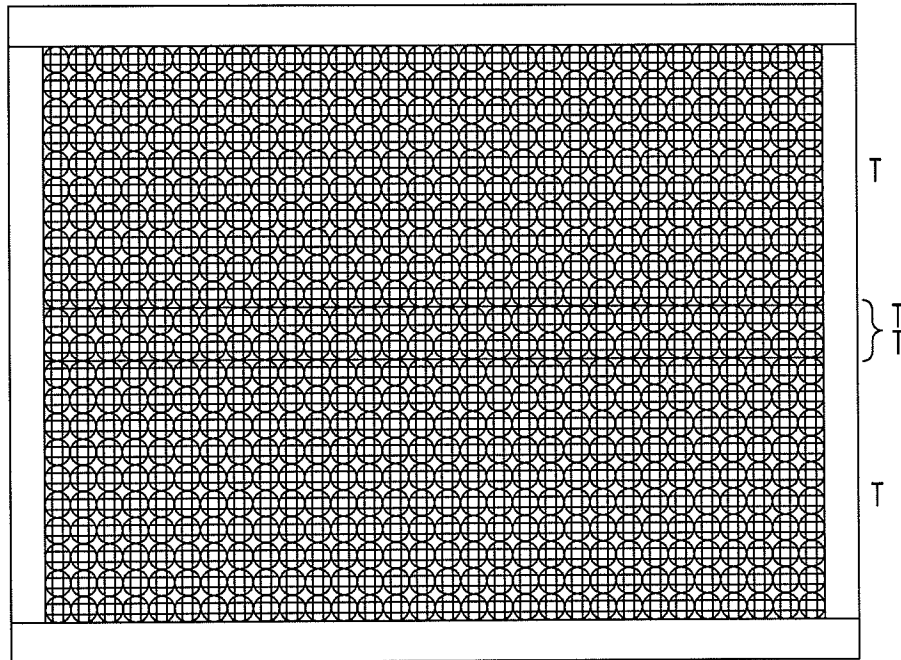


FIG.5E

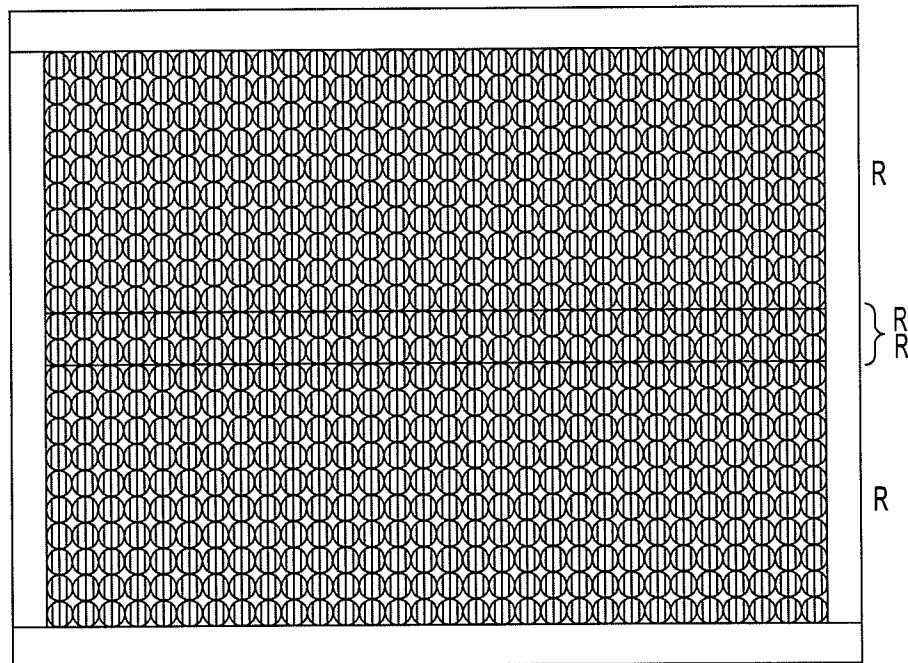


FIG.5F

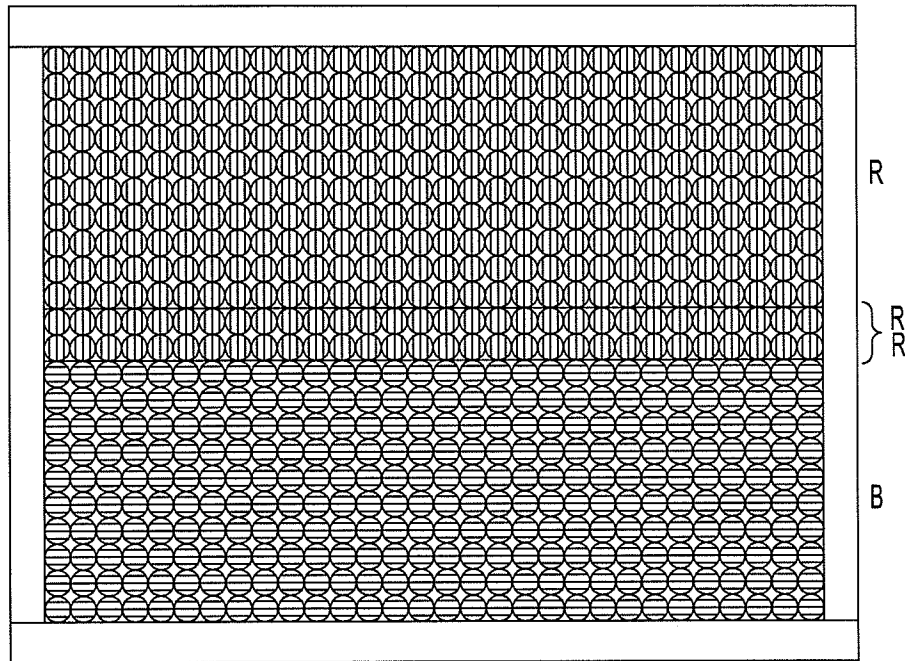


FIG. 5G

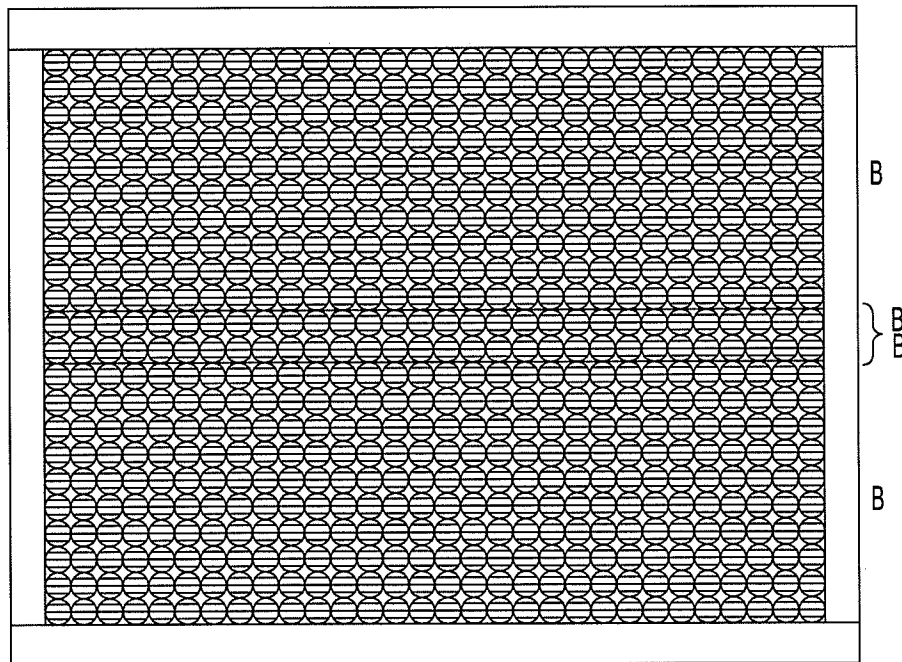


FIG. 5H

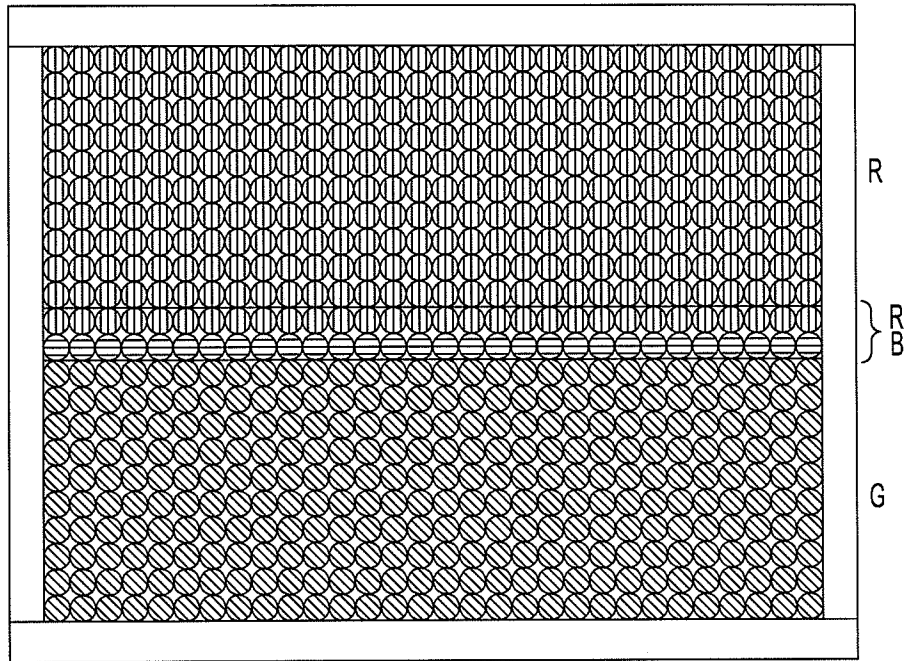


FIG. 5I

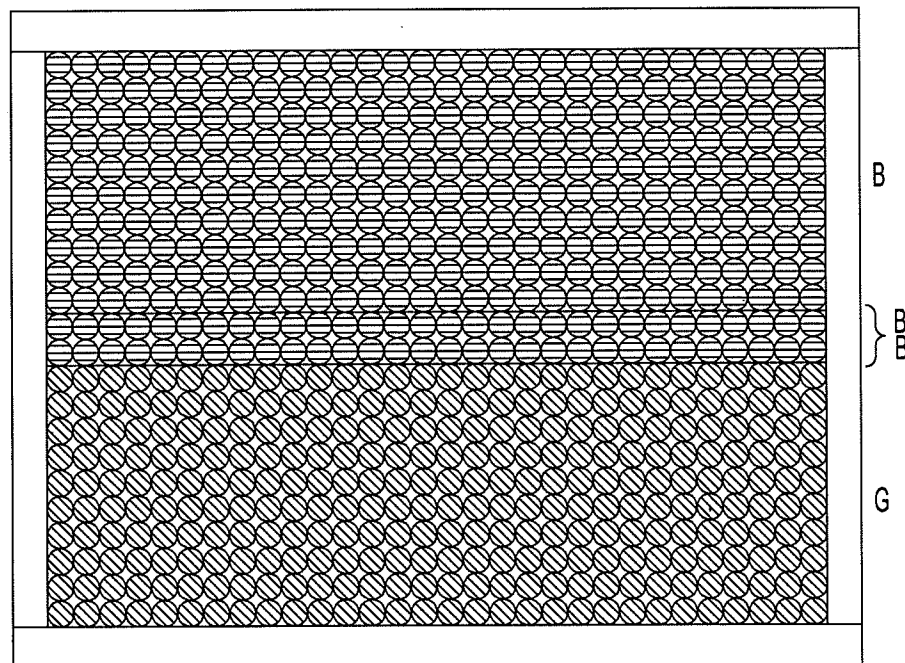


FIG. 5J

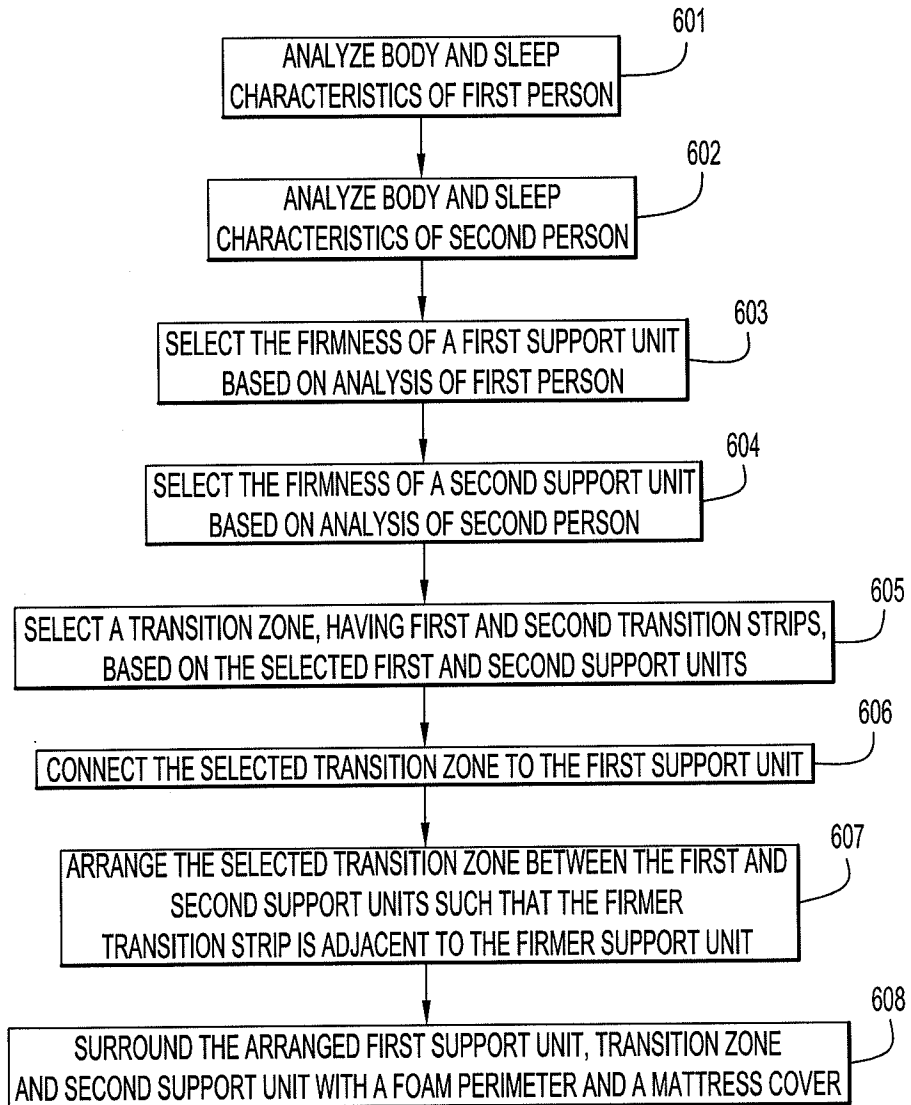


FIG.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/037935

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A47C 23/00 (2011.01)
USPC - 5/727
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A47C 23/00, 23/04 (2011.01)
USPC - 5716, 717, 718, 720, 727, 728, 729, 730; 267/142, 143, 249

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPTO EAST System (US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT), PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,213,214 A (GILHOOLY) 22 July 1980 (22.07.1980) entire document	3, 4, 8, 9
-		
Y		1, 2, 5-7, 10-12
Y	US 7,287,291 B2 (CARLITZ) 30 October 2007 (30.10.2007) entire document	1, 2
Y	US 5,987,678 A (AYERS) 23 November 1999 (23.11.1999) entire document	2, 5-7, 10-12
A	US 2008/0072382 A1 (JAMES) 27 March 2008 (27.03.2008) entire document	1-12
A	US 6,684,435 B1 (WELLS) 03 February 2004 (03.02.2004) entire document	1-12
A	US 2008/0093784 A1 (RAWLS-MEEHAN) 24 April 2008 (24.04.2008) entire document	1-12

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
 "A" document defining the general state of the art which is not considered to be of particular relevance
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 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed
 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
 "&" document member of the same patent family

Date of the actual completion of the international search 31 August 2011	Date of mailing of the international search report 08 SEP 2011
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