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(71) Applicant: **Delta Tooling Co., Ltd.**
Hiroshima 736-0084 (JP)

(72) Inventors:
- **FUJITA, Etsunori**
Hiroshima-shi, Hiroshima 736-0084 (JP)
- **OGURA, Yumi**
Hiroshima-shi, Hiroshima 736-0084 (JP)
- **IKEDA, Minako**
Hiroshima-shi, Hiroshima 736-0084 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) PILLOW

(57) A pillow having high air permeability and is capable of ensuring a comfortable sleep. It is structured by using at least one cushioning member 10 formed by stacking plural sheets of three-dimensional solid knitted fabrics 11 and 12 as a filler 3 filled in a covering member 2 having air permeability. Since a member prepared by stacking plural sheets of the three-dimensional solid knitted fabrics 11 and 12 is used as the cushioning member 10, air can easily move not only in the right and left, back and forth directions but also in the vertical direction around the head so that high air permeability can be ensured. When an air cushion 20 capable of aspirating and discharging air by change of a load is overlaid on the cushioning member provided with three-dimensional solid knitted fabrics 11 and 12 and used, air is automatically aspirated and discharged according to movement of the head. Accordingly, the flow of air passing through the space between yarns of the three-dimensional solid knitted fabric is promoted, which results in further enhancement in aeration function.

F I G. 1 A

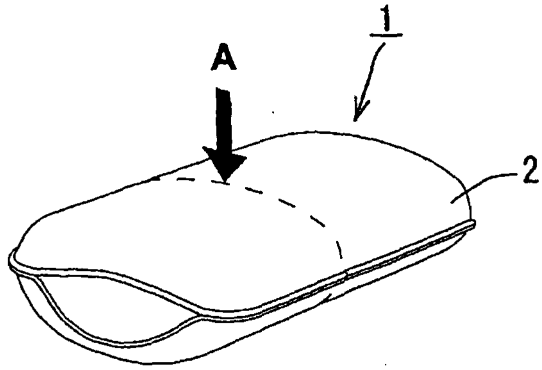

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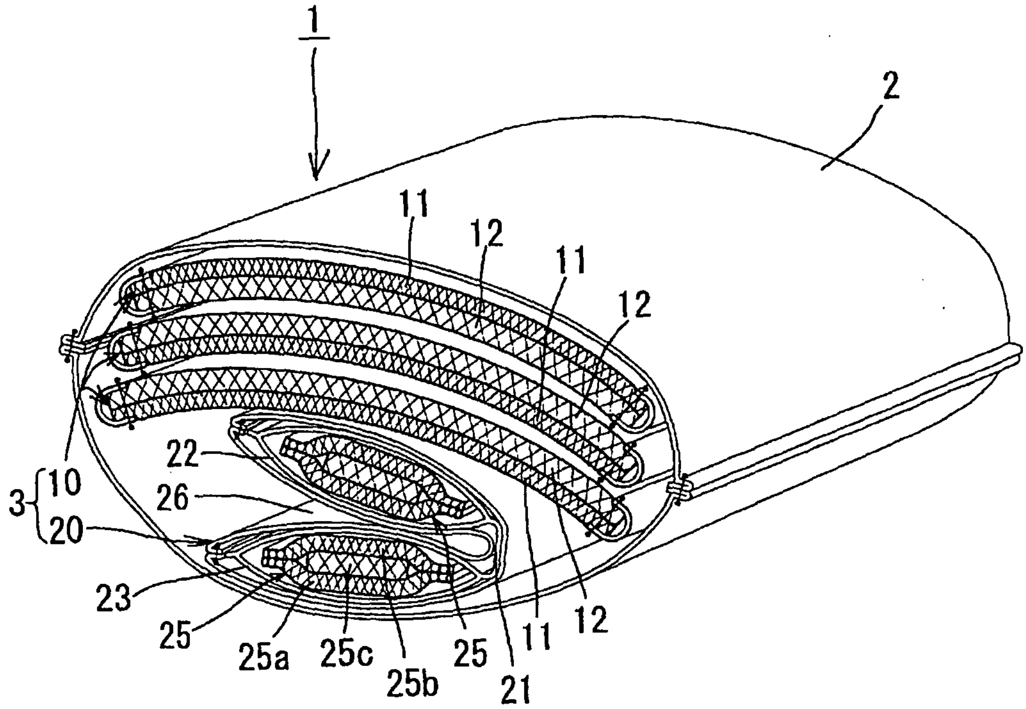
FIG. 1B



Description

Technical Field

[0001] The present invention relates to pillows.

Background Art

[0002] For the purpose of realizing comfortable sleep, Patent Document 1 discloses a pillow which is composed of a low-repulsive urethane foam member covered with a multiple spacer cloth (three-dimensional solid knitted fabric). It claims that compared with the case of placing the head on low-repulsive urethane foam directly, the air permeability of the structure can be enhanced through spaces of yarns because of the three-dimensional solid knitted fabric.
Patent Document 1: Japanese Utility Model Registration No. 3094910

Disclosure of the Invention

Problem to be solved by the Invention

[0003] The pillow disclosed in Patent Document 1, however, has a structure utilizing mainly elasticity of a low-repulsive urethane foam, and the three-dimensional solid knitted fabric is basically used only for ensuring air permeability. As the three-dimensional solid knitted fabric, therefore, only a usage example using one sheet of the three-dimensional solid knitted fabric so as to cover the surface of the low-repulsive urethane foam is disclosed. Since this kind of pillows uses the low-repulsive urethane foam to have depressed so as to run parallel to along the shape of a head, if plural sheets of the three-dimensional solid knitted fabric are used in piles, the function of depression along the head shape exhibited by the low-repulsive urethane form is spoiled. Accordingly, usage of only one sheet of thin three-dimensional solid knitted fabrics is a limit to realize the invention in Patent Document 1, and it ensures the air permeability of only the right and left and front and back around the head.

[0004] In general, the ideal temperature in a bed is said to 29 degree centigrade. The temperature below the head excepting contact surfaces is the same. The ideal pillow is one that can reduce excessive temperatures when movement of the body is small and can restrain heat accumulation by rapid diffusion of air when tossing about in bed so that it can keep the temperature as close as possible to about 29°C. However, it is difficult to realize this situation with the structure described in Patent Document 1.

[0005] The present invention is achieved considering the above circumstances, and the object is to provide a pillow with higher air permeability, and to ensure comfortable sleep by using a three-dimensional solid knitted fabric as a cushioning member to be accommodated in a covering member. Another object is to provide a pillow through which the air permeability is further enhanced, and which can support the head with stability and comfort not only by the action of spring character of the three-dimensional solid knitted fabric but also by the action of damping function through air exhaust by combining an air cushion capable of automatically aspirating and discharging air only by change of a load with a cushioning member provided with a three-dimensional solid knitted fabric.

Means to solve the problems

[0006] In order to solve the problems, the present invention provides a pillow which is provided with a covering member having air permeability and a filler housed in the covering member, in which at least one cushioning member prepared by stacking plural sheets of a three-dimensional solid knitted fabric is used as the filler.
Further the present invention provides a pillow in which the filler includes at least one cushioning member prepared by stacking plural sheets of the three-dimensional solid knitted fabrics and at least one piece of air cushion capable of aspirating and discharging air responding to change in load, the air cushion being overlaid on the cushioning member.
Yet further, the present invention provides a pillow in which the cushioning member prepared by stacking plural sheets of the three-dimensional solid knitted fabric is formed by stacking the cushioning members which are different in spring constant when pressed in the thickness direction.
Still further, the present invention provides a pillow in which the air cushion includes an air bag main body provided with an air outlet and inlet to aspirate and discharge air, and a three-dimensional solid knitted fabric disposed in the air bag main body.
Further, the present invention provides a pillow in which the air cushion is provided with a plurality of air bag main bodies sandwiching a border part, the three-dimensional solid knitted fabric is disposed in each inside of the air bag main body respectively, and the air bag is usable in a developed state or in a folded state at the border part.
Yet further, the present invention provides a pillow in which the air cushion is provided with two pieces of the air bag main bodies.
Still further, the present invention provides a pillow in which the air cushion is formed in a size narrower in width than that of the cushioning member prepared by stacking plural sheets of the three-dimensional solid knitted fabrics when overlaying the air bag main bodies by folding at the border part, the air cushion is disposed at a bottom layer in a folded state at the border part and the cushioning member formed by stacking plural sheets of the three-dimensional solid knitted fabrics is disposed at an upper layer so that the upper layer can be swung back and forth, making the air cushion disposed at the bottom layer serve as a fulcrum according to the position of contact with the head.

Effect of the Invention

[0007] The pillow of the present invention uses at least one cushioning member prepared by stacking plural sheets of a three-dimensional solid knitted fabric as a filler filled in a covering member which has air permeability. Since a member prepared by stacking plural sheets of the three-dimensional solid knitted fabric is used as a cushioning member, air can easily move not only in the right and left, back and forth directions but also in the vertical direction around the head so that high air permeability can be ensured.

[0008] Further, when an air cushion capable of aspirating and discharging air by change of a load is overlaid on the cushioning member provided with a three-dimensional solid knitted fabric and used, air is automatically aspirated and discharged according to head movement. Accordingly, the flow of air passing through the space between yarns of the three-dimensional solid knitted fabric is promoted, which results in further enhancement in aeration function. Furthermore, when the load created by the head is applied, air corresponding to the load is automatically discharged from the air cushion. Accordingly, in addition to the spring character of a three-dimensional solid knitted fabric, the damping function works due to the air discharge. Owing to this function, a pillow of the present invention can enhance cushioning capacity when supporting the head and can stably support while fitting suitably for the head.

[0009] Furthermore, in the present invention, since either of a cushioning member prepared by stacking plural sheets of a three-dimensional solid knitted fabric or an air cushion is used as a filler filled in a covering member, it is possible to adjust the number of sheets filled or its combination, so that it can easily realize the characteristics matching to the user's tastes.

Brief Description of Drawings

[0010]

FIGs. 1A and 1B are views showing a pillow relating to an embodiment of the present invention, in which FIG. 1A is a view showing the external appearance, and FIG. 1B is a view showing the section taken along the arrow A in FIG. 1A;

FIG. 2 is a view showing the diagrammatic structure of the air cushion;

FIG. 3 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49011D is placed on a measuring table and is pressurized in the width direction to the pressure 100N by a compression board of 30 mm in diameter at the speed of 50 mm per minute;

FIG. 4 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49011D is placed on a measuring table and is pressurized in the width direction to the pressure 100N by a compression board of 98 mm in diameter at the speed of 50 mm per minute;

FIG. 5 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49011D is placed on a measuring table and is pressurized in the width direction to the pressure 1000N by a compression board of 200 mm in diameter at the speed of 50 mm per minute;

FIG. 6 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49013D is placed on a measuring table and is pressurized in the width direction to the pressure 100N by a compression board of 30 mm in diameter at the speed of 50 mm per minute;

FIG. 7 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49013D is placed on a measuring table and is pressurized in the width direction to the pressure 100N by a compression board of 98 mm in diameter at the speed of 50 mm per minute;

FIG. 8 is a view showing a load to displacement characteristic taken for the time when a three-dimensional solid knitted fabric relating to the product number 49013D is placed on a measuring table and is pressurized in the width direction to the pressure 1000N by a compression board of 200 mm in diameter at the speed of 50 mm per minute;

FIGs. 9A and 9B are views for explaining the measuring method for test example 1 measuring the load to displacement characteristic of the whole pillow in the above-described embodiment, in which FIG. 9A shows the case of filling an air cushion in a covering member in a developed state, and FIG. 9B shows the case of filling the air cushion folded in two in the covering member;

FIG. 10 is a view showing the load to displacement characteristic of the test example 1 when pressurized to 100N by a compression board of 30 mm in diameter at the speed of 50 mm per minute;

FIG. 11 is a view showing the load to displacement characteristic of the test example 1 when pressurized to 100N by a compression board of 98 mm in diameter at the speed of 50 mm per minute;

FIG. 12 is a view showing the load to displacement characteristic of the test example 1 when pressurized to 1000N by a compression board of 200 mm in diameter at the speed of 50 mm per minute.

FIGs. 13A and 13B are views showing a measurement result of test example 2, in which FIG. 13A shows the measurement result at a temperature condition nearly similar to the temperature in summer time, and FIG. 13B shows the measurement result at a temperature condition nearly similar to that in winter time;

FIGs. 14A and 14B are views showing a measurement result of test example 3, in which FIG. 14A shows the measurement result in the case of using a net pillow according to the present invention, and FIG. 14B shows that using a urethane pillow in a comparative example;

FIGs. 15A and 15B are views showing a measurement result of test example 4 measuring fluctuations in temperature of the face of a subject and fluctuations in temperature of both hands of the subject, in which FIG. 15A is a view showing a measurement result of the case of using the net pillow of the present invention, and FIG. 15B is that when using the urethane pillow (expressed as "a low-repulsive pillow" in the drawing) of the comparison example;

FIG, 16 is a view showing differences in temperature between the face and the right hand during the first half of the experiment (200 seconds to 400 seconds after starting the experiment) for all subjects in test example 4 and those in the latter half of the experiment (average data during 1400 seconds to 1600 seconds after starting the experiment);

FIGs. 17A and 17B are graphs showing fluctuations in the amount of bloodstream of a female in her 20's who is one of the subjects in test example 4, and FIGs. 17C and 17D are graphs showing fluctuations in the amount of bloodstream of a male A in his 20's who is similarly one of the subjects in test example 4. FIGs. 17A and 17C show the measurement results when using the net pillow in the present invention, and FIGs 17B and 17D show those when using the urethane pillow (expressed as "a low-repulsive pillow" in the drawing) of the comparison example;

FIG. 18 is a view showing comparisons of temperatures at different positions between the net pillow of the present invention and the urethane pillow of the comparison example (expressed as "a low-repulsive pillow" in the drawing) in test example 4;

FIG. 19A is a view showing time series waveforms of a brain wave distribution rate when using the net pillow of the present invention and FIG. 19B is a view showing a time series waveform of a heart beat frequency at that time in test example 4;

FIG. 20A is a view showing time series waveforms of a brain wave distribution rate when using the urethane pillow of the comparison example and FIG. 20B is a view showing a time series waveform of a heart beat frequency at that time in test example 4;

FIG. 21A is a view showing a frequency analysis result for a time series waveform of the inclination of a power value determined from the time series signal of a fingertip volume pulse wave when a female subject in test example 4 in her 20's uses the net pillow of the present invention, and FIG. 21B is a view showing a frequency analysis result for a time series waveform of the inclination of a maximum Liapunov index;

FIG. 22A is a view showing a frequency analysis result for a time series waveform of the inclination of a power value determined from a time series signal of a fingertip volume pulse wave when a female subject in test example 4 in her 20's uses the urethane pillow of the comparison example, and FIG. 22B is a view showing a frequency analysis result for a time series waveform of the inclination of a maximum Liapunov index;

FIG. 23A is a view showing a frequency analysis result for a time series waveform of the inclination of a power value determined from a time series signal of a fingertip volume pulse wave when a male subject A in test example 4 in his 20's uses the net pillow of the present invention, and FIG. 23B is a view showing a frequency analysis result for a time series waveform of the inclination of a maximum Liapunov index;

FIG. 24A is a view showing a frequency analysis result for a time series waveform of the inclination of a power value determined from a time series signal of a fingertip volume pulse wave when a male subject A in test example 4 in his 20's uses the urethane pillow of the comparison example, and FIG. 24B is a view showing a frequency analysis result for a time series waveform of the inclination of a maximum Liapunov index; and

FIGs. 25A and 25B are comparisons among the variations in the heart beat frequency of four subjects, in which FIG. 25A is a view showing the case of using the net pillow, and FIG. 25B is a view showing the case of using the urethane pillow (expressed by "a low-repulsive pillow" in the drawing).

Explanation of Symbols and Numerals

[0011]

1	PILLOW
2	COVERING MEMBER
3	FILLER
10	SOLID KNITTED FABRIC MULTILAYER CUSHIONING MEMBER
11, 12	THREE-DIMENSIONAL SOLID KNITTED FABRIC
20	AIR CUSHION
21	BORDER PART
22, 23	AIR BAG MAIN BODY
22a,23a	TUBE
25	RESTORING MEMBER
25a, 25b, 25c	THREE-DIMENSIONAL SOLID KNITTED FABRIC
26	COVERING MEMBER

Best Mode for Carrying out the Invention

[0012] Hereinafter, the present invention will be explained in more detail based on the embodiments of the present invention shown by the drawings. A pillow 1 of the present embodiments includes a covering member 2, a filler 3 accommodated in the covering member 2.

[0013] It is sufficient for the covering member 2, if it has air permeability and has a cylindrical shape or a bag shape capable of accommodating the filler 3. For instance, it may be an ordinary woven cloth, nonwoven cloth, two-dimensional net material, or the like, or it may be made of a three-dimensional solid knitted fabric.

[0014] In the present embodiment, the filler 3 includes a cushioning member (solid knitted fabric multilayer cushioning member) 10 prepared by stacking plural sheets of the three-dimensional solid knitted fabric, and an air cushion 20. The solid knitted fabric multilayer cushioning member 10 is prepared by stacking two sheets of three-dimensional solid knitted fabrics 11 and 12 and by unifying them through sewing along the peripheries or the like.

[0015] Here, the three-dimensional solid knitted fabrics 11 and 12 are fabrics that have a solid three-dimensional structure including a pair of ground knitted fabrics disposed separately from each other, and a number of connecting yarns for connecting both by reciprocating between the pair of ground knitted fabrics. One ground knitted fabric is made of, for instance, a flat knitted structure (small mesh) connected in both directions of wale direction and course direction from yarns made of a twisted monofilament. The other ground knitted fabric, on the other hand, is formed, for instance, in a stitched structure having a honey comb shaped (hexagonal shape) mesh from yarns made of twisted short fibers. Needless to say, the knitted fabric structure is optional, and it can adopt any knitted structure excepting a small mesh structure or a honey comb structure. The combination of structures is also optional, such as adoption of a small mesh structure for both. The connecting yarn is to be knitted between the pair of ground knitted fabrics so that one ground knitted fabric and the other knitted fabric can keep a prescribed interval, and it gives a prescribed stiffness to the three-dimensional solid knitted fabric. The thickness of the ground yarn for forming the ground knitted fabric is selected so as to give a waist stiffness necessary for the three-dimensional solid knitted fabric, and in the range so that it doesn't give difficulties to the knitting work.

[0016] As a raw material for the ground yarn or the connecting yarn, a synthetic fiber or a regenerated fiber such as polypropylene, polyester, polyamide, polyacrylonitrile, rayon or the like, a natural fiber such as wool, silk, cotton or the like can also be listed. These materials can be used alone, or may be used in combination optionally. Preferable materials are thermoplastic polyester resins such as polyethylene terephthalate (PET), polybutylene terephthalate (PBT) or the like, polyamide resins such as nylon 6, nylon 66 or the like, polyolefin resins such as polyethylene, polypropylene or the like, polytrimethylene terephthalate (PTT), or resins prepared by combining two or more kinds of these resins. Note that polyester resins are suitable because of their excellent recycling ability. In addition, the shape of yarns of the ground yarn or the connecting yarn are not limited, they may be circular sections or oddly shaped sections.

[0017] The connecting yarn may form a looped stitch between the ground knitted fabrics at the front and bottom surfaces, and may have a structure in which the connecting yarn is hooked on the ground knitted fabrics on the front layer and the bottom layer. In any cases, it is preferable that at least two connecting yarns connect between the knitted fabrics between the front surface and the bottom surface in a cross shape (x-shape) or in a truss shape slantwise in opposite directions to each other, because this connection improves the shape retention characteristics of the three-dimensional solid knitted fabric.

[0018] Note that the three-dimensional solid knitted fabric can be prepared with a knitting machine having two lines of needle beds facing each other. As such a knitting machine, a double Russell knitting machine, a double circular knitting machine, a weft knitting machine having a V bed or the like can be listed. It is preferable to use the double Russell knitting machine for obtaining a three-dimensional solid knitted fabric excellent in size stability. The three-dimensional solid knitted fabric is completed by processing a knitted-up raw fabric through scouring, dying, heat setting or the like. The heat setting is conducted by hot-air drying at 150°C for one minute and completed in a flat sheet having a smooth surface. A finish processed three-dimensional solid knitted fabric is available in a roll as a raw fabric for instance, and when it is used, the rolled raw fabric is unwound to the prescribed length and cut to the prescribed shape and size.

[0019] Since two sheets of three-dimensional solid knitted fabrics 11 and 12 forming the solid knitted fabric multilayer cushioning member 10 have such a structure, the ground knitted fabric located on the contacting surface between both is relatively hard layer compared with respective layers composed of the connecting yarn placed above and below the ground knitted fabric, so that the connecting yarn layer placed above serves as a soft spring layer to reduce the feel of contact, and the connecting yarn layer placed below serves as a support spring layer which elastically supports the hard layer and the soft spring layer and reduces bottom touch. As a result, two spring layers are to be connected in series, a composite spring constant becomes smaller than that in the case of using the respective three-dimensional solid knitted fabrics 11 and 12 separately, so that a spring characteristic smaller in reaction force can be produced. As the respective three-dimensional solid knitted fabrics 11 and 12 forming two spring layers, it is preferable to use those having different spring constants when pressed in the thickness direction, in other words, to use the three-dimensional solid knitted fabrics in which one has a relatively higher spring constant, and the other has a relatively lower spring constant. Thus, it is possible to establish a spring characteristic suitable to a user by adjusting the front and the back in this manner. It should be noted that the spring constant can be adjusted from the thickness of yarn for ground knitted fabric or connecting yarn, the stitch of ground knitted fabric, the density of connecting yarn, the thickness of three-dimensional solid knitted fabric.

[0020] As the three-dimensional solid knitted fabrics 11 and 12, the followings can be used for instance.

[0021] (1) product number: 49011D (manufactured by Suminoe Textile Co., Ltd)
Material:

ground knitted fabric (warp) ... 600 decitex/192f polyethylene terephthalate fiber temporary twisted finished yarn
ground knitted fabric (weft) ... 300 decitex/72f polyethylene terephthalate fiber temporary twisted finished yarn
connecting yarn .... 800 decitex/1f polyethylene terephthalate monofilament
width of raw fabric: 1040 mm
thickness: 12 mm

[0022] (2) product number: 49013D (manufactured by Suminoe Textile Co., Ltd)
Material:

ground knitted fabric ... 450 decitex/144f polyethylene terephthalate fiber temporary twisted finished yarn
connecting yarn .... 350 decitex/1f polyethylene terephthalate monofilament
width of raw fabric: 1040 mm
thickness: 9.8 mm

[0023] The disposition density of the connecting yarn of product number 49011D is lower than that of product number 49013D. Accordingly, when the load to displacement characteristics of these two three-dimensional solid knitted fabrics are compared, product number 49011D is always lower than 49013D in spring constant when pressed with any compression boards of 30 mm, 98 mm, and 200 mm in diameter as shown in FIG. 3 to FIG. 8, and product number 49011 has soft spring characteristics.

[0024] As shown in FIG. 1B, although three sets of the above-described solid knitted fabric multilayer cushioning member 10 are used in a stack in the present embodiment, the number of stacks is optional and can be adjusted to match to the user's tastes.

[0025] As shown in FIG. 2, the air cushion 20 is provided with two air bag main bodies 22 and 23 on both sides of a border part 21 in the present embodiment. The border part 21 and two air bag main bodies 22, 23 are formed in one piece by placing two sheets of plastic sheet one upon another, uniting the peripheries and portions along the center line of a prescribed width. Tubes 22a and 23a serving as an air inlet and outlet are disposed at one end in the longitudinal direction of the respective air bag main bodies 22 and 23. In the inside of the respective air bag main bodies 22 and 23, appropriate number of three-dimensional solid knitted fabrics are disposed as a restoring member 25 as shown in FIG. 1B. The restoring member 25 in the present embodiment is formed in a cylindrical shape by welding both sides of two sheets of three-dimensional solid knitted fabrics 25a and 25b, and a strip of a three-dimensional solid knitted fabric 25c is housed in the inside thereof. The restoring member 25 functions such that after air is discharged by compression of the air bag main bodies 22 and 23, the respective three-dimensional solid knitted fabrics 25a to 25c regain their shapes as compression load is reduced, which makes the air bag main bodies 22 and 23 expand so that the air bag main bodies 22 and 23 automatically aspirate air through the tube 22a and 23a.

[0026] When a load is applied to the air bag main bodies 22 and 23, the air bag main bodies 22 and 23 discharge air according to the load, which results in operation of damping function. Accordingly, by combining and using the air bag main bodies 22 and 23 with the solid knitted fabric multilayer cushioning member 10, the spring characteristic of the solid knitted fabric multilayer cushioning member 10, the damping characteristic at the time of air discharging of the air bag main bodies 22 and 23, and the spring characteristic of the restoring member 25 which is disposed in the air bag main bodies 22, 23 and is made of a three-dimensional solid knitted fabric, work synergistically, so that it is possible to operate cushioning characteristics which have soft spring characteristic with a small reaction force, and are excellent in shock absorbency.

[0027] The air bag main body which forms the air cushion 20 may be one piece, when a plurality of air bag main bodies, preferably two air bag main bodies 22 and 23 as in the present embodiment, are provided, it becomes possible to use them in a developed state while being housed in the covering member 2, or to use them in an overlaying state of the air bag main bodies 22 and 23 by folding at the border part 21 so that cushioning characteristics, height, and the like can be adjusted to match the user's taste. Note that the air cushion 20 in the present embodiment is structured such that two air bag main bodies 22 and 23 are covered with an optional covering member 26 for exterior use made of a woven cloth, nonwoven cloth or the like as shown in FIG. 1B and FIG. 2. This is because the decorativeness of external appearance is taken into account for the case of making a deal in the air cushion 20 alone. However, it is preferable to use a thin three-dimensional solid knitted fabric for the covering member 26 for further softening the cushioning characteristics of the air cushion 20.

[0028] Though the whole size of the air cushion 20 is not limited so far as it can be housed in the covering member 2, it is preferable that the width during folding into two at the border part 21 is narrower than the width of the solid kitted fabric multilayer cushioning member 10. As shown in FIG. 1B, the air cushion 20 folded into two is disposed at the bottom layer, and the above-described solid knitted fabric multilayer cushioning member 10 is disposed at an upper layer thereon. Then, the multilayer cushioning member 10 can swing back and forth depending on the way of application of the load, making the air cushion 20 disposed at the bottom layer serve as a fulcrum according to the position of contact of the head. As a result, air in the space created on both sides of the air cushion 20 folded into two can easily move in the covering member 2, the air permeability can be further enhanced.

[0029] According to the present embodiment, the solid knitted fabric multilayer cushioning member 10 prepared by stacking the three-dimensional solid knitted fabrics 11 and 12 is used as the filler 3 to be filled in the covering member 2. Accordingly, since air can smoothly move not only in the horizontal direction and in the longitudinal direction of the head, but also in the thickness direction of the solid knitted fabric multilayer cushioning member 10, high air permeability can be ensured. In addition, since spring layers different in spring constant are connected in series, it can be fitted to the head with a soft spring feeling. Furthermore, in the present embodiment, since it is combined with the air cushion 20, the impact at the time of coming into contact with the head can be absorbed by the damping function, and also air flow is promoted.

Test Example 1

[0030] As shown in FIG. 9, three sets of the solid knitted fabric multilayer cushioning members 10 in the above-described embodiment are stacked and filled in the covering member 2 made of a three-dimensional solid knitted fabric of 3.1 mm in thickness, and load to displacement characteristic is measured by pressurizing them with compression boards of 30 mm, 98 mm, and 200 mm in diameter for the cases of filling the air cushion 20 thereunder using a three-dimensional solid knitting fabric of 3.1 mm in thickness as the covering member 26 in a developed state (FIG. 9A), and in a state of being folded into two (FIG. 9B). The results thereof will be shown in FIG. 10 to FIG. 12. Note that in FIGs 10 and 11 which show the load to displacement characteristic when pressurized with compression boards of 30 mm and 98 mm in diameter, a load to displacement characteristic when the muscle of adult male buttocks are pressurized with compression boards of 30 mm and 98 mm in diameter will be shown.

[0031] As shown in FIGs. 10 to 12, in any load cases for filling the air cushion 20 in a developed state (housed in flat) and filling it in a folded state into two (housed in a folded into two), the spring constant is low and a soft spring characteristic is shown for the case of folding the air cushion into two. Accordingly, it is found that it is possible to adjust to the cushioning characteristics matching to the user's tastes depending on a manner of housing the air cushion 20. When the load to displacement characteristic pressurized with the compression boards of 30 mm and 98 mm in diameter is checked, both cases show that the spring constant is low or nearly equal to, compared with the load to displacement characteristic of the muscle of the buttocks. In other words, it has a tendency close to the load to displacement characteristic of a human muscle in any cases. Accordingly, it is found that the external pressure and the internal pressure to a blood vessel are similar to each other, and little in oppression to the blood vessel, so that the bloodstream problems are unlikely to occur.

Test Example 2

[0032] A Japanese adult male in his 30's was positioned as a subject on a net pillow of the present invention in which the air cushion 20 is folded into two and filled in the covering member 2 in the Test Example 1, and a pillow (a urethane pillow) of the comparison example made of commercial low-repulsive urethane, had him left from the bed when the surface temperature of the pillows contacting with the head come to 35°C, and checked the temperature fluctuation on the pillow surface thereafter. Note that the same members are used for both cases as the covering member 2. FIG. 13A shows the case of controlling inside the testing room at 24°C, and FIG. 13B shows the case of controlling at 20°C. The former is assumed as a temperature condition in the summer and the latter is assumed to be that in winter.

[0033] From FIGs 13A and 13B, it is found that the net pillow of the present invention approaches near 29°C, the temperature inside a bed, at which a comfortable sleep can be realized, faster than the urethane pillow in any cases after the subject left the bed. In other words, when the subject tosses about in bed from a prescribed recumbent attitude, the net pillow of the present invention allows the temperature to lower more rapidly. Accordingly, it is excellent in feeling when returning back to the recumbent attitude again, and can be said to provide a comfortable sleep.

Test Example 3

[0034] The same subject as in the Test Example 2 was laid down on the net pillow of the present invention and the urethane pillow of the comparison example which was used in Test Example 2, and a sleep experiment for 50 minutes was conducted. An electroencephalograph (manufactured by Nihon Kohden Corporation) was installed on the subject, and the sleep level was measured. The result will be shown in FIGs. 14A and 14B. As shown in FIG. 14A, the net pillow of the present invention reaches the sleep level 3 to 4 in 30 minutes, and thus, a deeper sleep can be obtained in a shorter time. On the contrary, in the case of the urethane pillow of the comparison example, as shown in FIG. 14B, the test result only moves between the sleep levels of 1 and 2 repeatedly, which means only a light sleep is given compared with the case of the net pillow of the present invention.

Test Example 4

[0035] Although it was found that a comfortable sleep can be provided by the net pillow of the present invention from the test example 2, in order to confirm it further, a sleep experiment was further conducted with a plurality of subjects. The subjects were total 4 persons of a healthy Japanese female in her 20's (oversensitive to cold), healthy Japanese males A and B in their 20's, and a healthy Japanese male in his 30's. Each subject was laid down using the net pillow of the present invention and the urethane pillow of the comparison example used in the test example 2, and allowed them to sleep for 30 minutes. Note that every bedding is made of three-dimensional solid knitted fabric, the laboratory was a quiet room controlled at temperatures of 25°C to 27°C, and humidity of 50% to 60%. The test was conducted between one and four o'clock in the afternoon in August to September. The results of the sleep experiment are shown giving nearly similar tendency for all four subjects. The results will be explained below, using representative examples according to the circumstances.

[0036] FIGs. 15A and 15B show comparisons between the temperature of hand in the peripheral system and the temperature near the head (face), and the data is for the female in her 20's. FIG. 15A is the case of using the net pillow of the present invention and FIG. 15B is the case of using the urethane pillow.

[0037] From FIG. 15A, in the case of the net pillow of the present invention, the temperature on the face is kept at relatively low temperature of around 35 degrees, and the temperature of right and left hands stays nearly stably at around 36.5 degrees to 37 degrees higher than the temperature on the face, which shows that a comfortable sleeping circumference is ensured. On the contrary, from FIG. 15B, the temperature of the face is kept at relatively high temperature of around 37.5 degrees, and the temperature of each hand in the peripheral system is kept at a temperature lower than the temperature of the face and has a tendency to lower as the time passes. Accordingly, it is hard to say it a good bloodstream is ensured, and found that a comfortable sleeping circumference is difficult to obtain.

[0038] FIG. 16 is a view showing differences in temperature between the face and the right hand during the first half of the experiment (200 seconds to 400 seconds after starting the experiment) for all four subjects and those in the latter half of the experiment (average data during 1400 seconds to 1600 seconds after starting the experiment). From these drawings, it is found that the temperature on the face is higher than that of the right hand for all subjects and in addition the temperature difference between the face and the right hand increases as time passes with the urethane pillow of the comparison example (expressed as "a low-repulsive pillow" in the drawing). In contrast, with the net pillow of the present invention, the temperature of the right hand is higher than that on the face. In other words, it is conceived that the net pillow of the present invention reduces lowering of temperature on hand and foot in the peripheral system, and is effective for countermeasures against oversensitiveness to cold.

[0039] FIGs. 17A and 17B are graphs showing fluctuations in the amount of bloodstream of a female in her 20's, and FIGs. 17C and 17D are graphs showing fluctuations in the amount of bloodstream of a male A in his 20's. From these graphs it is seen in all cases that when the net pillow of the present invention was used, the amount of bloodstream was kept in a stable state, but when the urethane pillow (expressed as "a low-repulsive pillow" in the drawing) of the comparison example was used, the bloodstream showed tendency to be reduced or to be fluctuated. More in detail, in the case of the female in her 20's in FIG. 17B, the amount of bloodstream is decreasing as time passes owing to her oversensitiveness to cold, the quality of sleep is found to be poor compared with the case of using the net pillow of the present invention. In the case of the male in his 20's in FIG. 17D, the amount of bloodstream increases rapidly on the way of the experiment. This is because he turned over in his sleep from sleepless in bed and tried to transfer his head due to stuffiness caused by the urethane pillow (low-repulsive pillow), which can be also said that the quality of sleep is worse than that in the case of using the net pillow of the present invention. The net pillow has a tendency to have the absolute value of the amount of bloodstream greater than that in the case of using the urethane pillow of the comparison example.

[0040] FIG. 18 is a view showing comparisons of temperatures at different positions between the net pillow of the present invention and the urethane pillow of the comparison example (expressed as "a low-repulsive pillow" in the drawing). This is data of the average values for four subjects. In the net pillow, heat transfers from the surface to the center soon after starting the experiment, which makes the temperature difference between the surface and the center small. The heat transfer from the surface to the bottom is small, which makes the temperature difference between the surface and the bottom great at the time even just before the end of the experiment. In other words, it is found that the net pillow of the present invention has also a heat retaining property though it has high heat diffusion ability. In contrast, the urethane pillow (low-repulsive pillow) of the comparison example is found to have small heat transfer from the center to the bottom and has a tendency to accumulate heat on the surface and is more stuffy than the net pillow.

[0041] In order to verify a sleeping state of the subject, a electroencephalograph (manufactured by Nihon Kohden Corporation) is put on the subject to also measure the brain wave at the time of this test, and the time series change in distribution rate of a θ wave, an α wave, and a β wave, is determined and the time series change in heart beat frequency is determined. FIGs. 19A and 19B are the result for the net pillow of the present invention and FIGs. 20A and 20B are the result for the urethane pillow of the comparison example.

[0042] When the time series changes of the brain waves in FIG. 19A and FIG. 20A are compared, it is found that the distribution rate of the θ wave is higher with the net pillow of the present invention, and the distribution rate of the β wave which mainly appears at the time of awakening is rapidly lowered. Meanwhile, it is found that in the case of the urethane pillow of the comparison example, the sleep of the subject is light because although the β wave decreases after once increased, the distribution rate is about 10% or more, and the distribution rate of the θ wave is kept low.

[0043] In addition, when the time series changes of the heart beat frequency in FIG. 19B and FIG. 20B are compared, in the case of the net pillow of the present invention, the heart beat frequency is shifted around 1.1 wherein the stable frequency of the heart beat at the time of sleeping is 1.1. Meanwhile, in the case of the urethane pillow of the comparison example, the time series changes are between 1.2 and 1.05 and unstable. From above, it is found that the net pillow of the present invention gives a deep sleep better than the urethane pillow of the comparison example.

[0044] FIG. 21A to FIG. 24B show the analytical results of fingertip volume pulse waves of the subject, which are taken during the experiment. The time series waveform of the power value inclination and the time series waveform of the maximum Liapunov index inclination were prepared using the time series signals of collected fingertip volume pulse wave and the frequency analysis for the obtained time series waveforms were conducted and shown in graphs. Note that the calculation of the time series waveforms for the inclination of the power values and the inclination of the maximum Liapunov index is conducted using a method proposed by the present applicant in Japanese Patent Application Laid-open No. 2004-344612. More concretely, for the time series signals of the detected fingertip volume pulse wave, the maximum value and the minimum value are determined respectively by smooth differentiation developed by Savitzky and Golay. Then, the maximum values and the minimum values for every five seconds are taken out and the averages for both are determined respectively. The square of difference between respective averages of the determined maximum value and minimum value is taken as a power value. The power value is plotted at every five seconds to form a time series waveform of the power values. In order to read the global change of the power value from the time series waveform, the inclination of the power value is determined for a certain time width Tw (180 sec.) using a least square method. Then, the next time width Tw is similarly calculated with an overlap time Tl (162 sec.) and the result is plotted. The results obtained by repeating this calculation (slide calculation) successively forms the time series waveform of the inclination of the power value. The time series waveform of the inclination of the maximum Liapunov index can be obtained similarly as follows. The time series signals of the detected fingertip volume pulse wave are subjected to chaos analysis respectively to calculate the maximum Liapunov indexes. Then, the maximum values and the minimum values are determined by the smooth differential method, and the time series waveform of the inclination of the maximum Liapunov index is obtained by slide calculation of the above.

[0045] The time series waveform of the inclination of the power value is mainly related to the change of state in the pulse pressure, and the time series waveform of the inclination of the maximum Liapunov index is mainly related to the change of state in the amount of bloodstream. In these frequency analyses, when the awakening states before sleep and after sleep are compared, if either the frequency value or the power spectrum of a peak value in an awakening state after sleep is changing to become larger than the peak value in the awaken state before sleep, it means that the subject is physically or mentally activated by the sleep, and if it changes in the opposite direction, it means that a physical or mental fatigue is created and the anatomical function is lowering.

[0046] In the case of the female subject in her 20's, when using the net pillow, as shown in FIGs. 21A and 21B, values in any frequency analyses change in the direction of getting large, in other words, the peak value shifts to a higher frequency or the value of the power spectrum changes in the direction of getting large, which shows that she is activated by taking a sleep of good quality. In contrast, when using the urethane pillow, as shown in FIGs. 22A and 22B, any values change in the direction of getting small, in other words, the peak value shifts to a lower frequency or the value of the power spectrum changes in the direction of getting smaller, which shows that a sleep of good quality could not be taken. FIGs. 23A and 23B, and FIGs. 24A and 24B are the results of frequency analysis of the male subject A in his 20's, and these graphs show nearly similar tendency to that of the female subject in her 20's.

[0047] FIGs. 25A and 25B are views showing the comparison between the fluctuations of the heart beat frequencies of four subjects. In the case of the net pillow in FIG. 25A, the frequencies of all four subjects are gradually lowered and become stable little by little, but in the case of the urethane pillow (expressed as "a low-repulsive pillow" in the drawing) in FIG. 25B, the frequency fluctuations for all subjects are great. This is due to any movement such as tossing about in bed for the purpose of diffusing heat accumulated in the head.

Industrial Availability

[0048] A structure using the solid knitted multilayer cushioning member 10 relating the above-described embodiment, and a structure of combining the solid knitted multilayer cushioning member 10 with the air cushion 20 are applicable not only to a pillow but also to various human body supporting structures such as a mattress, an overlay putting on a mattress, a sleeping mat or the like. Moreover, although in the above-embodiment, the air cushion 20 which discharges air when a load is applied and automatically aspirates air as the compressing load is lowered, not the one that always aspirates or discharges air, it is also possible that an airtight-structured air-cushion (not shown) which stores a prescribed amount of air is enclosed further in a covering member in one or more pieces or in an appropriately folded state. Disposition of such an airtight-structured makes it possible to easily adjust the height of a pillow by adjusting the amount of air filled in the air cushion with a pump (not shown) and at the same time to adjust the air cushion characteristics.

Claims

1. A pillow comprising:

a covering member having air permeability, and
a filler housed in the covering member,

wherein at least one cushioning member prepared by stacking plural sheets of a three-dimensional solid knitted fabric is used as the filler.

2. The pillow according to claim 1,
wherein said filler comprises:

at least one cushioning member prepared by stacking plural sheets of said three-dimensional solid knitted fabrics; and
at least one air cushion capable of aspirating and discharging air responding to change in load, the air cushion being overlaid on the cushioning member.

3. The pillow according to claims 1 or 2, wherein said cushioning member prepared by stacking plural sheets of said three-dimensional solid knitted fabric is formed by stacking the cushioning member different in spring constant when pressed in the thickness direction.

4. The pillow according to claim 2,
wherein said air cushion comprises:

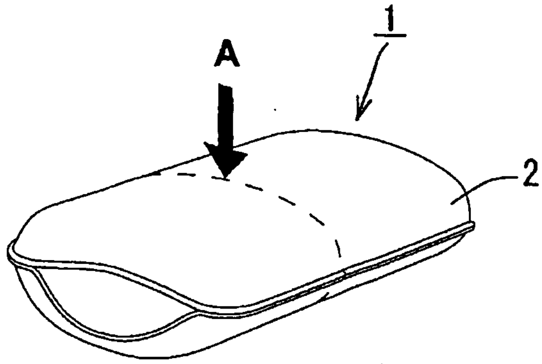
an air bag main body provided with an air outlet and inlet to aspirate and discharge air, and
a three-dimensional solid knitted fabric disposed in the air bag main body.

5. The pillow according to claim 4, wherein said air cushion is provided with a plurality of air bag main bodies sandwiching a border part, the three-dimensional solid knitted fabric is disposed in each inside of the air bag main body respectively, and the air bag is usable in a developed state or in a folded state at the border part.

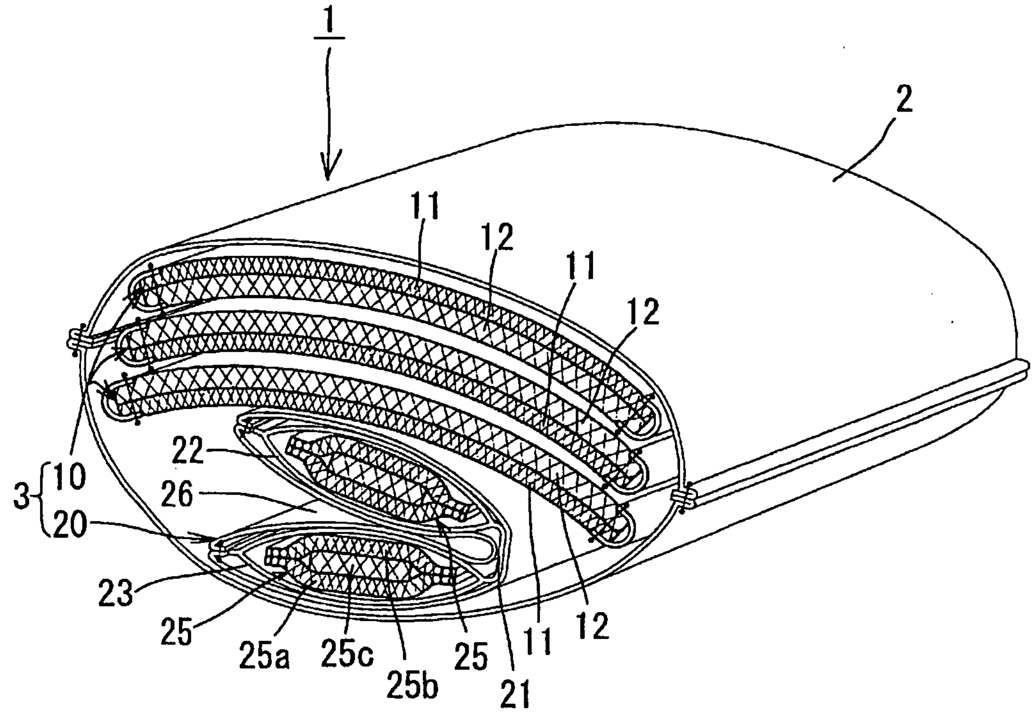
6. The pillow according to claim 5, wherein said air cushion is provided with two pieces of the air bag main bodies.

7. The pillow according to claim 5 or claim 6, wherein said air cushion is formed in a size narrower in width than that of the cushioning member prepared by stacking plural sheets of the three-dimensional solid knitted fabric when overlaying the air bag main bodies by folding at the border part; and
said air cushion is disposed at a bottom layer in a folded state at the border part and the cushioning member formed by stacking plural sheets of the three-dimensional solid knitted fabric is disposed at an upper layer,
so that the upper layer can be swung back and forth, making the air cushion disposed at the bottom layer serve as a fulcrum according to the position of contact with the head.

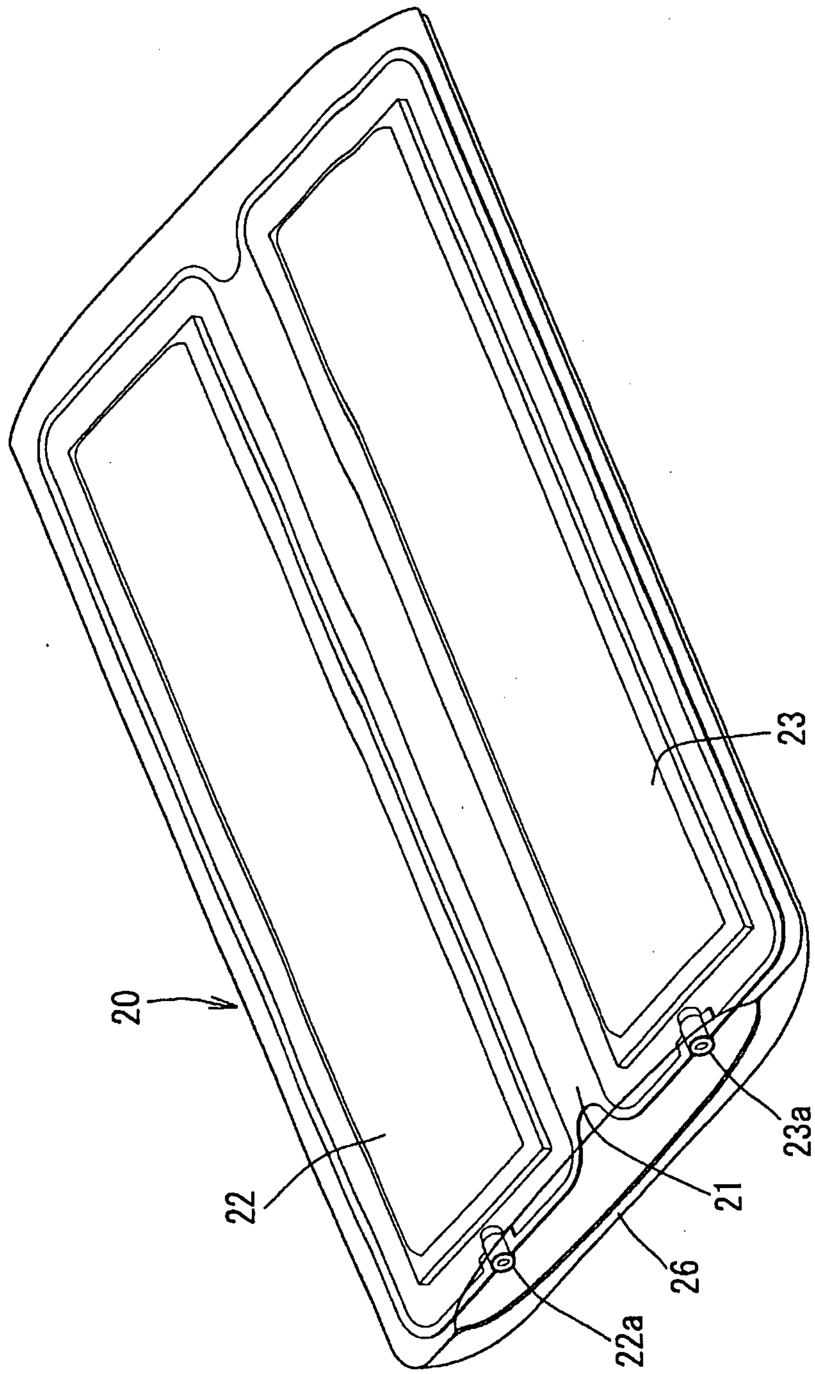
F I G. 1 A



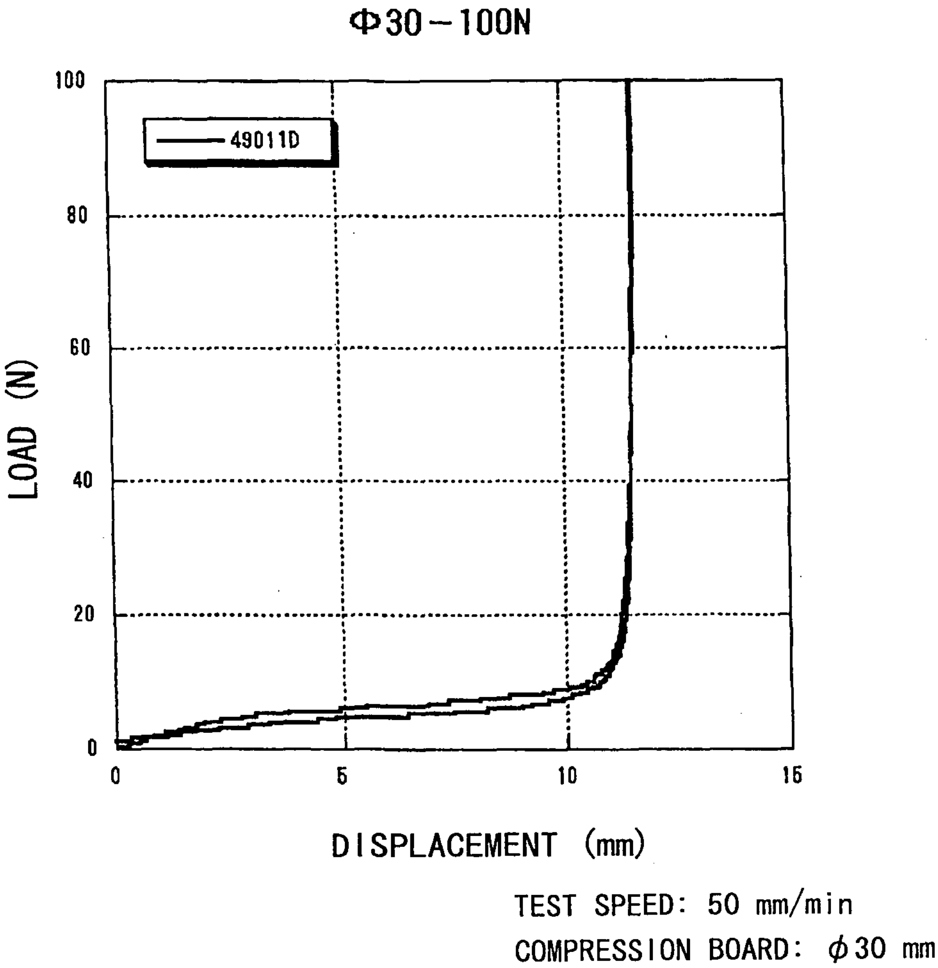
F I G. 1 B



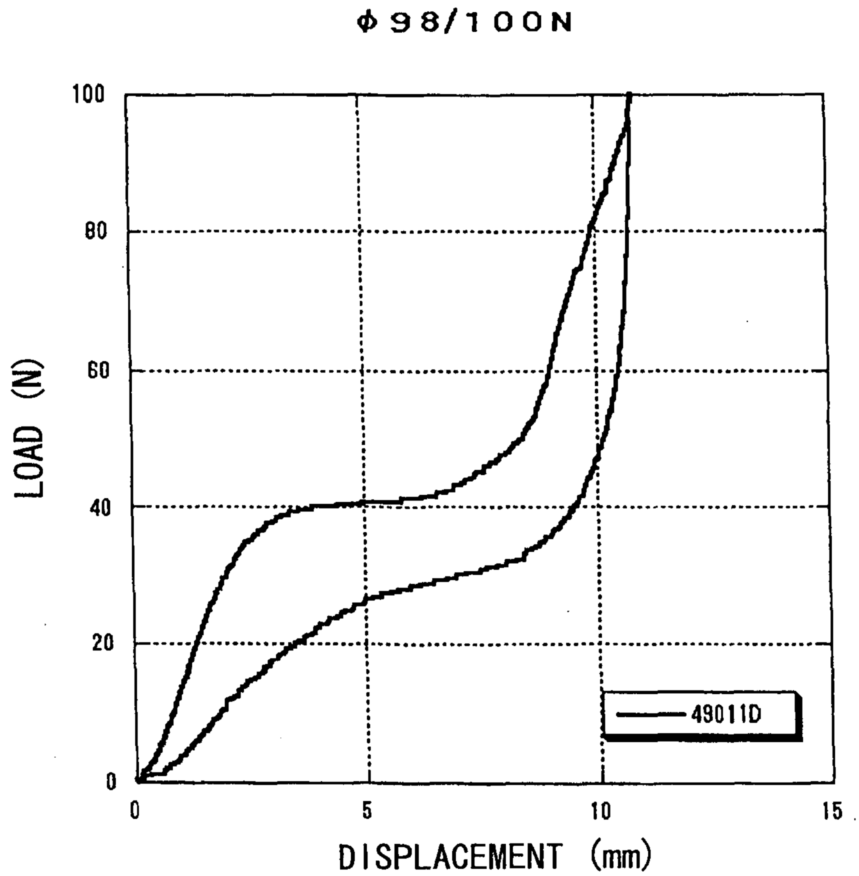
F I G. 2



F I G. 3


Φ30－100N
100
80
60
40
20
0
LOAD (N)
49011D
0
5
10
15
DISPLACEMENT (mm)
TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ30 mm

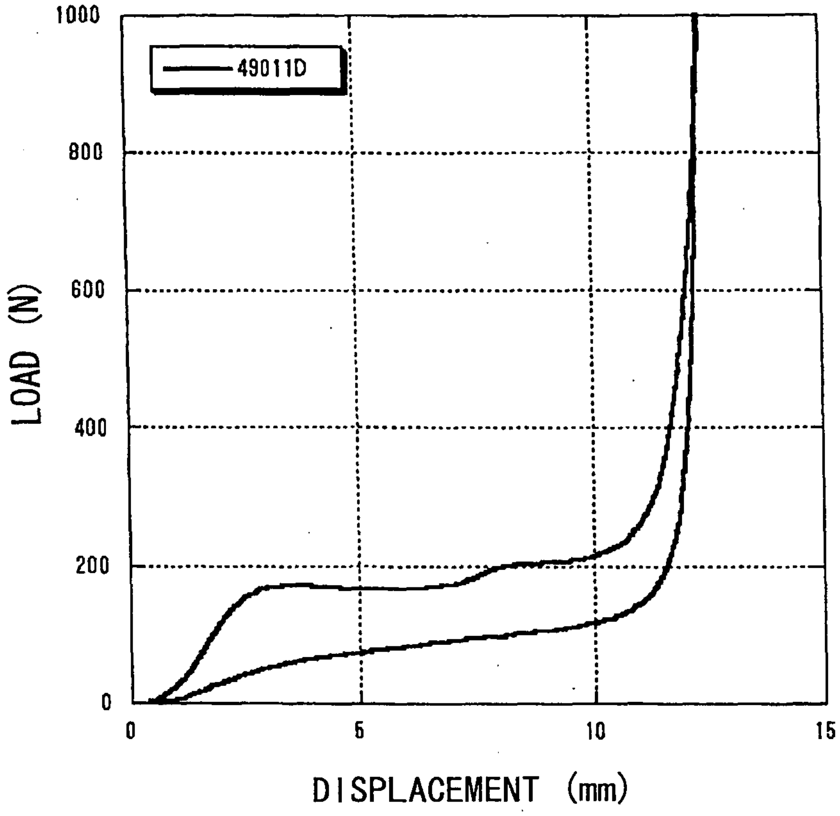
F I G. 4



TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ98 mm

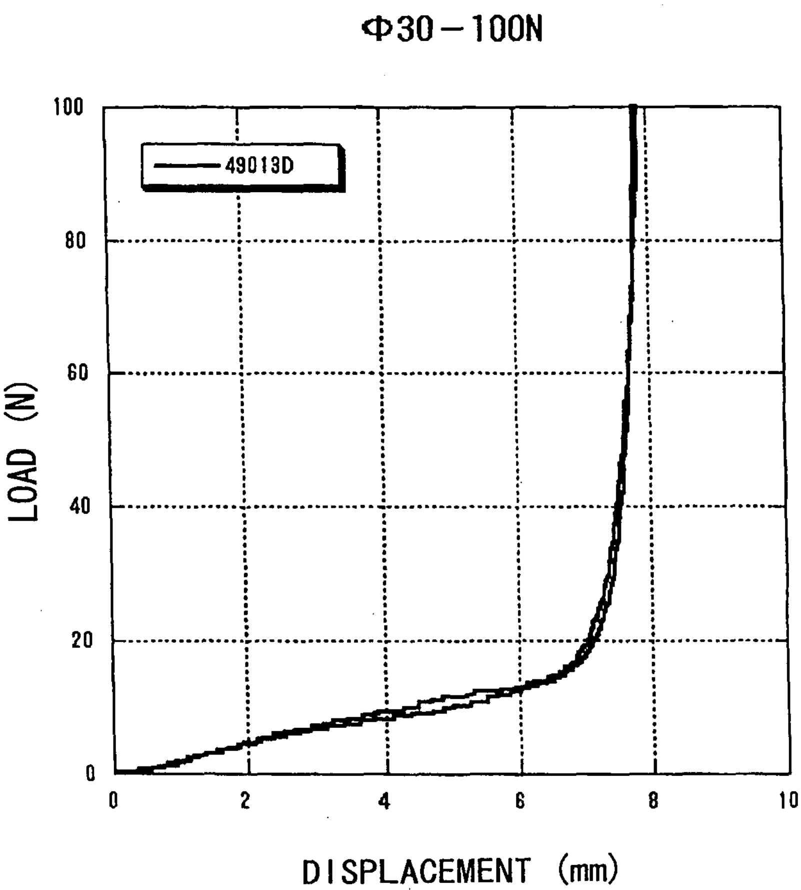
F I G. 5

ϕ200/1000N



TEST SPEED: 50 mm/min
COMPRESSION BOARD: ϕ200 mm

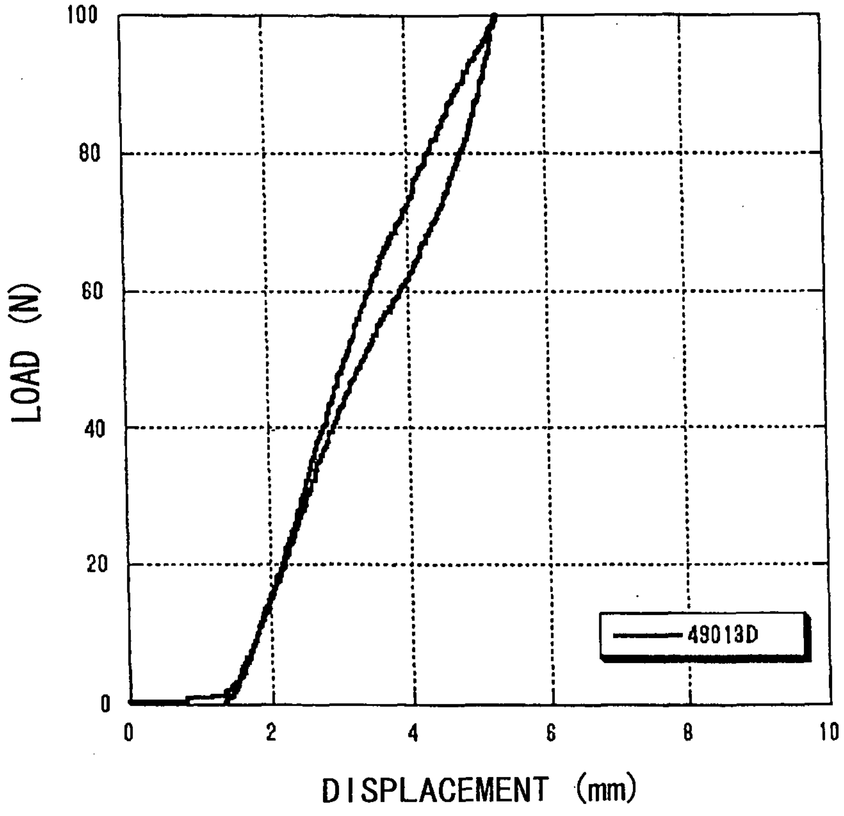
F I G. 6



TEST SPEED: 50 mm/min
COMPRESSION BOARD: ϕ30 mm

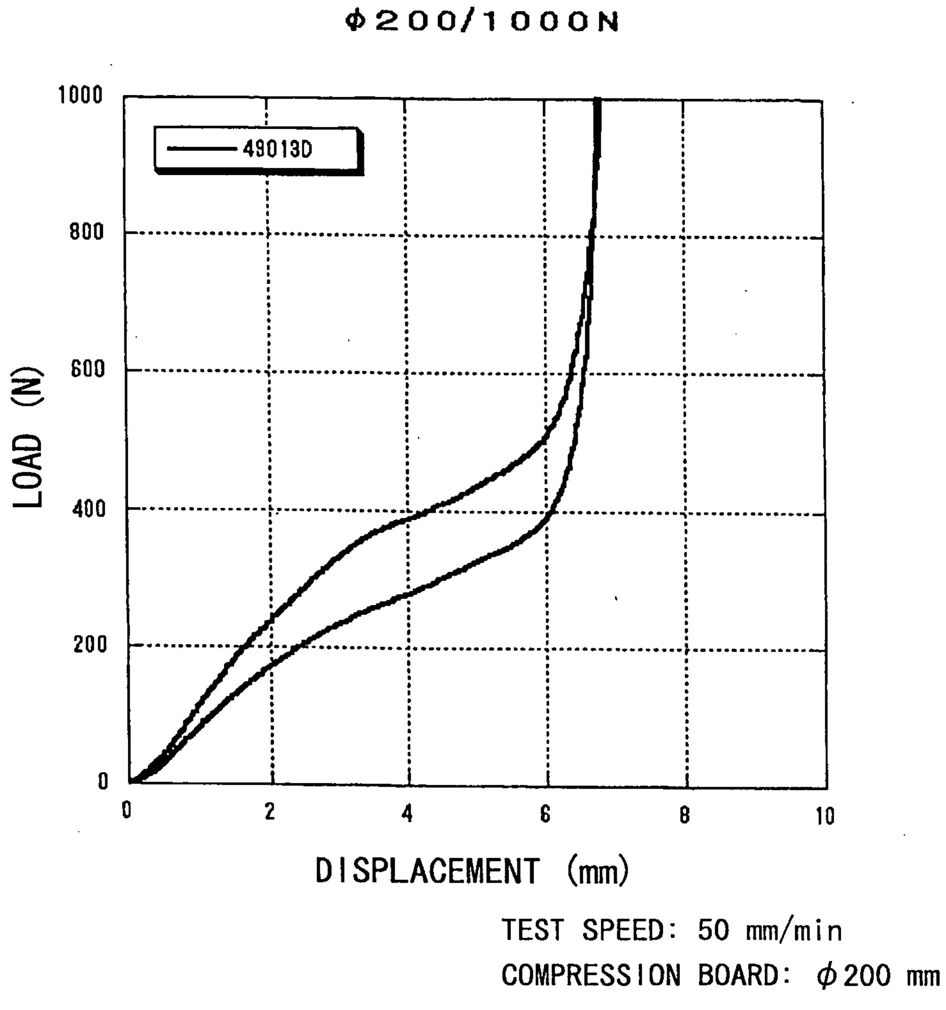
F I G. 7

Φ98/100N

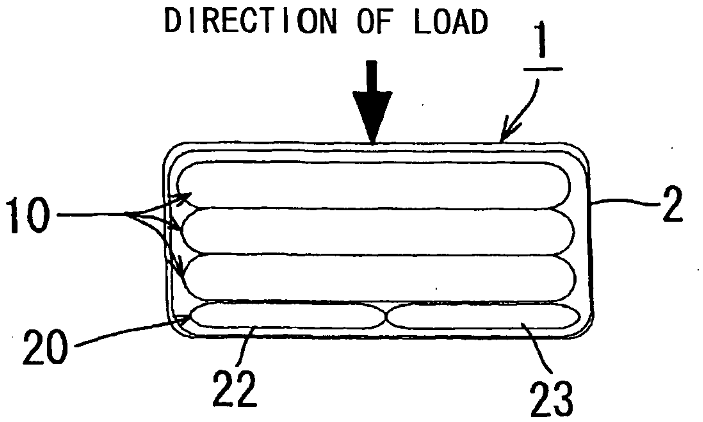


TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ98 mm

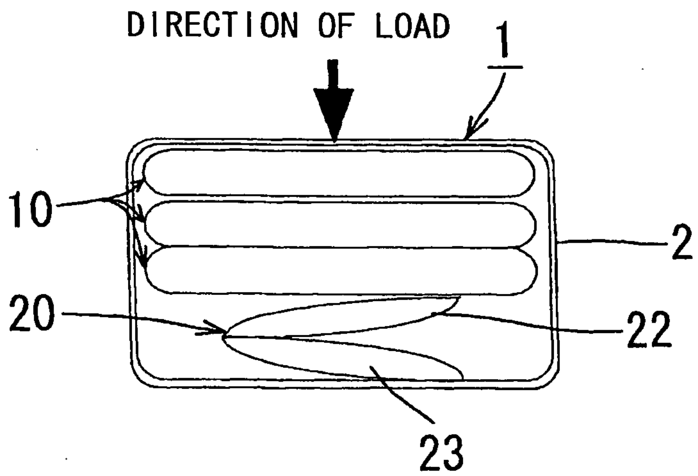
F I G. 8


Φ200/1000N
1000
800
600
400
200
0
LOAD (N)
49013D
0
2
4
6
8
10
DISPLACEMENT (mm)
TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ200 mm

F I G. 9A

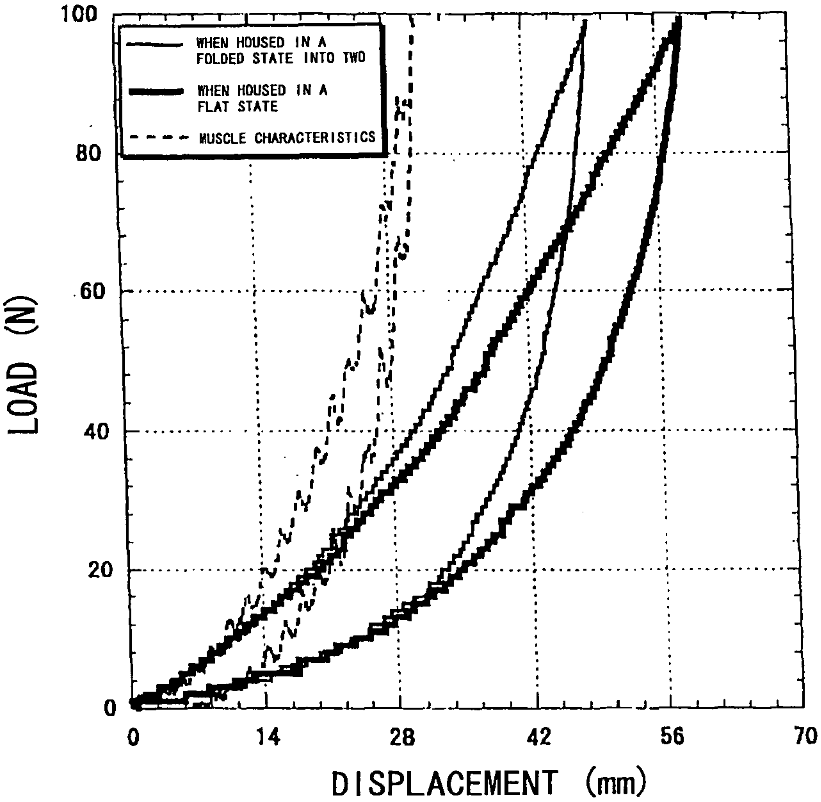

DIRECTION OF LOAD
1
10
2
20
22
23

F I G. 9B


DIRECTION OF LOAD
1
10
2
20
22
23

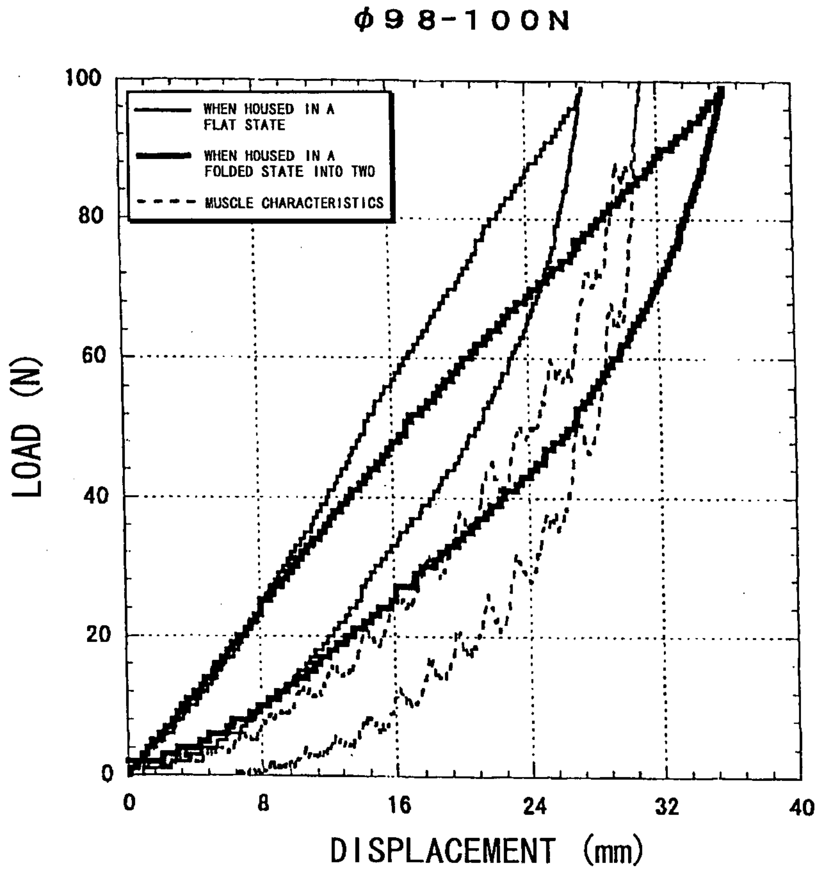
F I G. 1 0

φ30-100N



TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ30 mm

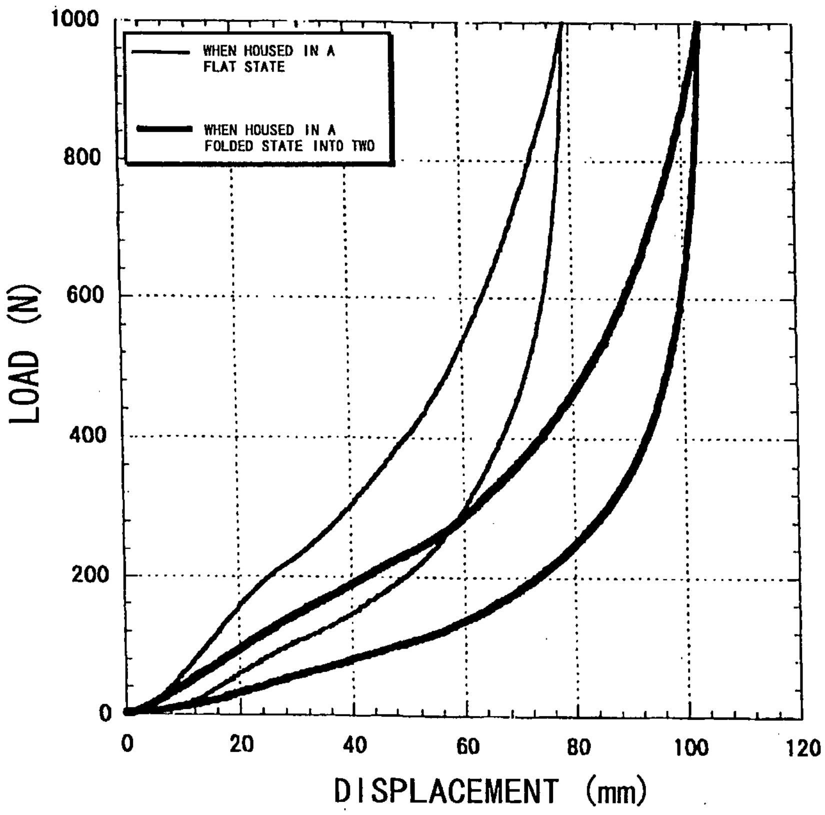
F I G. 1 1



TEST SPEED: 50 mm/min
COMPRESSION BOARD: φ98 mm

FIG. 12

ϕ200-1000N



TEST SPEED: 50 mm/min
COMPRESSION BOARD: ϕ200 mm

FIG. 13A

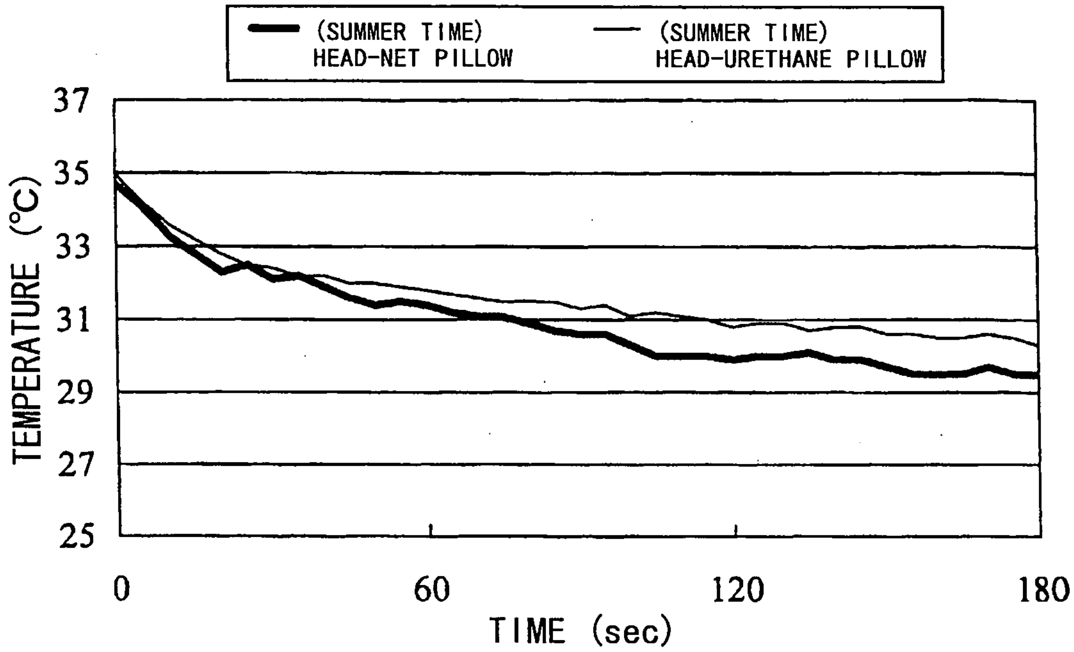


FIG. 13B

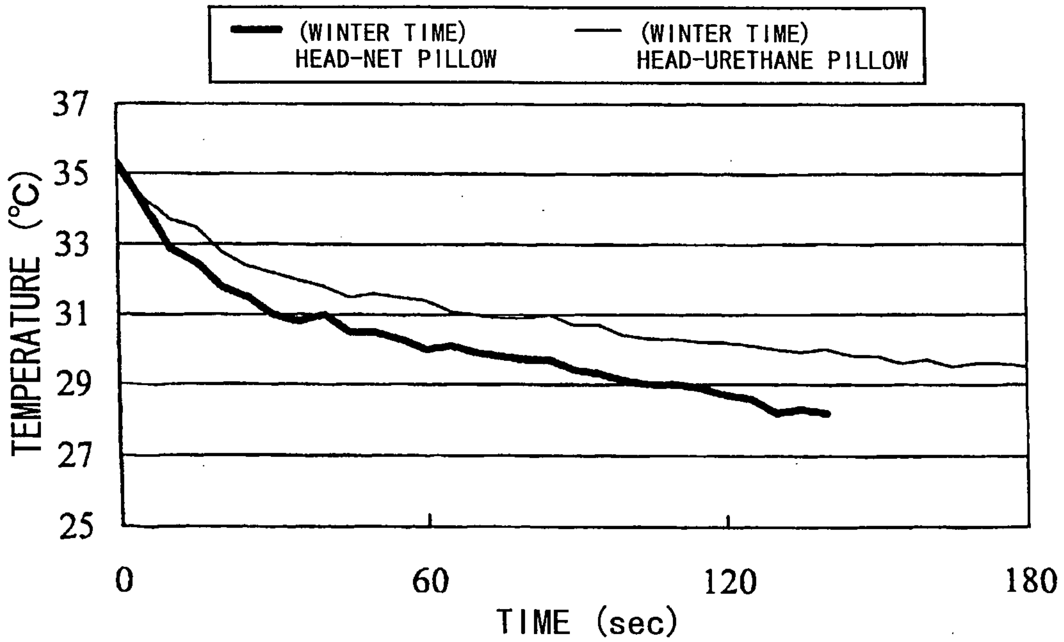


FIG. 14A

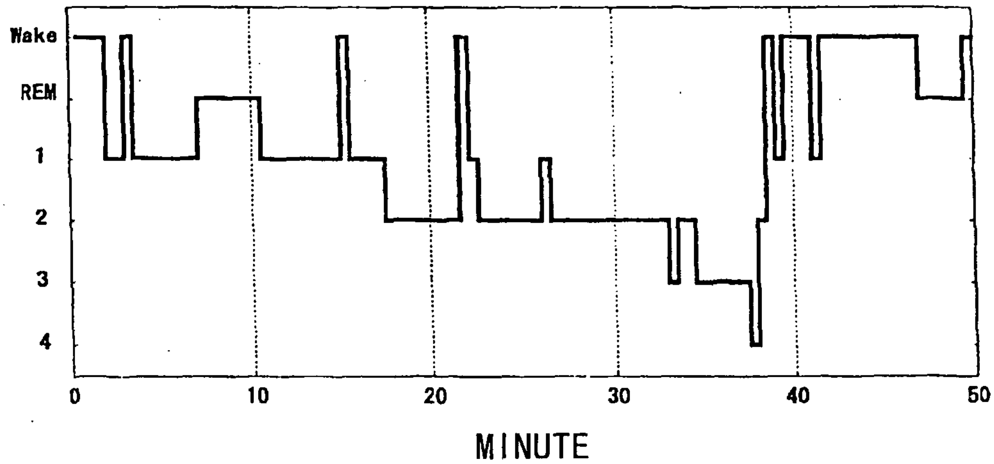


FIG. 14A

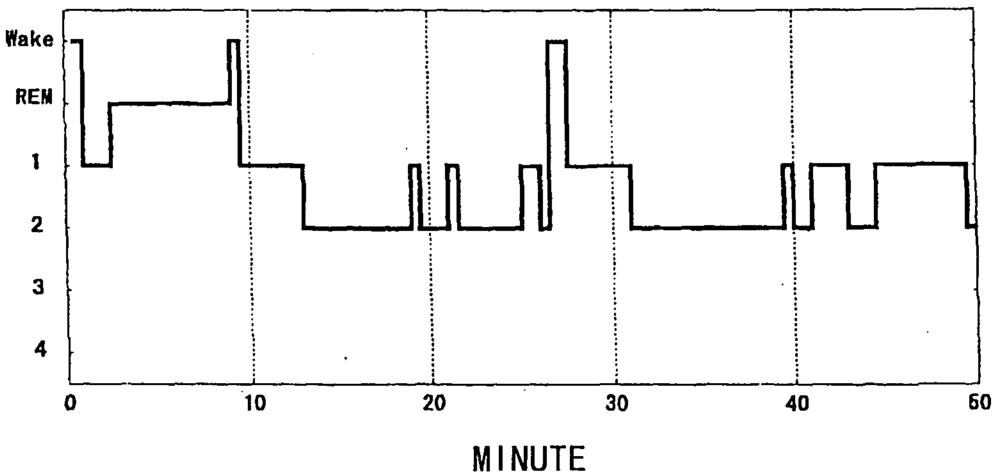
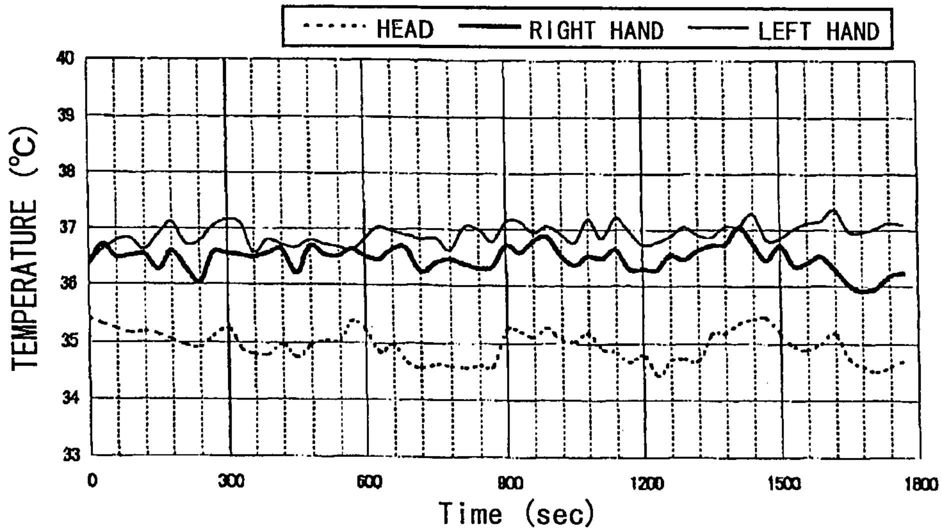
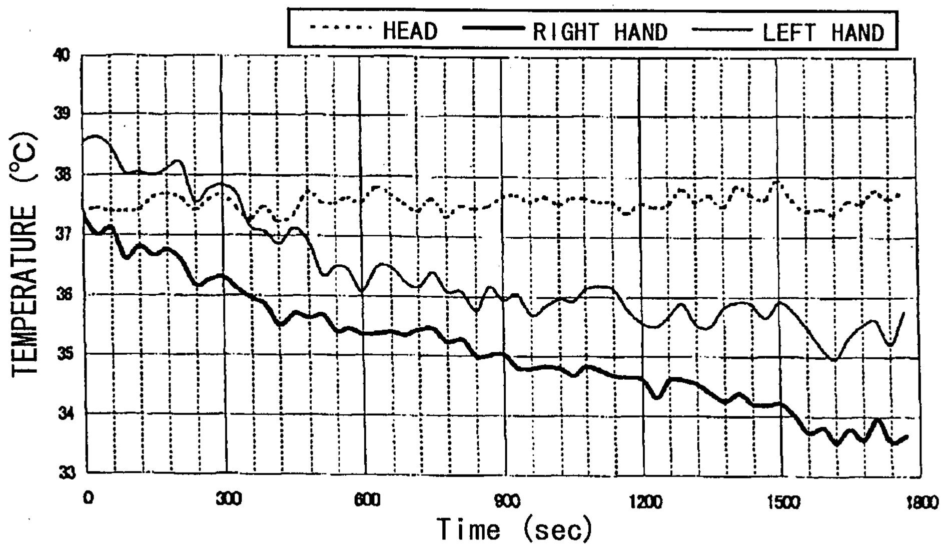


FIG. 15A



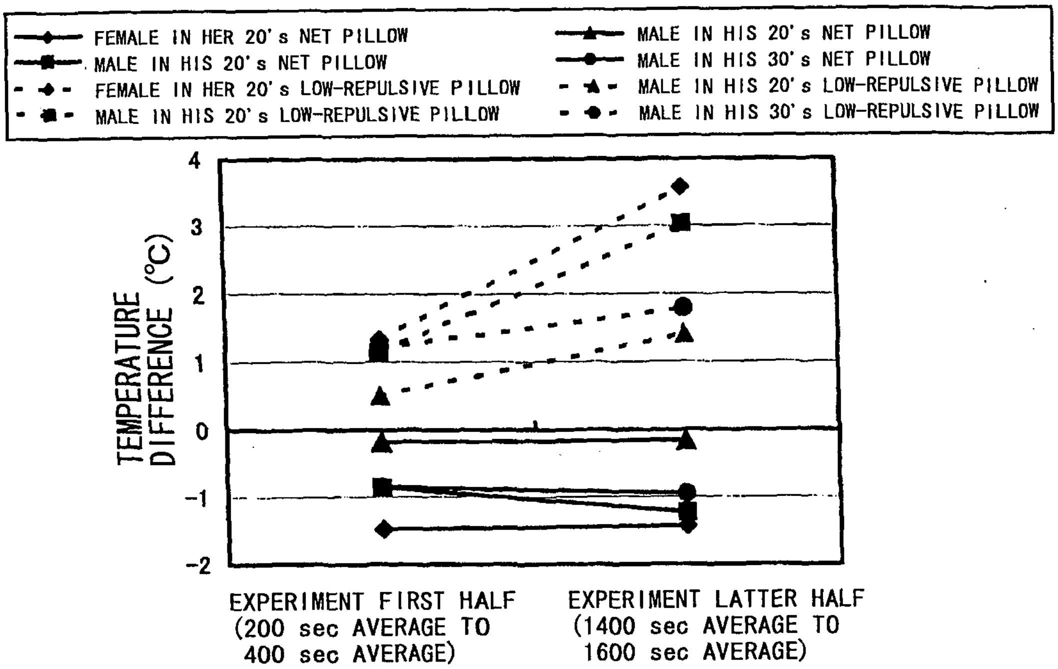
TEMPERATURE FLUCTUATION TIME SERIES WAVEFORM (THERMOGRAPH)

FIG. 15B

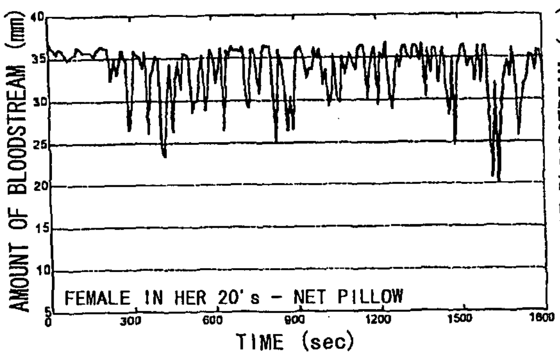


TEMPERATURE FLUCTUATION TIME SERIES WAVEFORM (THERMOGRAPH)

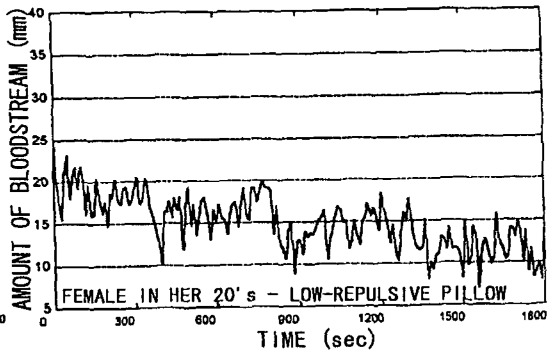
F I G. 1 6



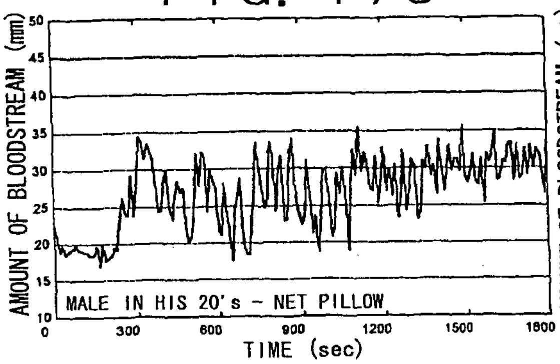
F I G. 1 7 A



F I G. 1 7 B



F I G. 1 7 C



F I G. 1 7 D

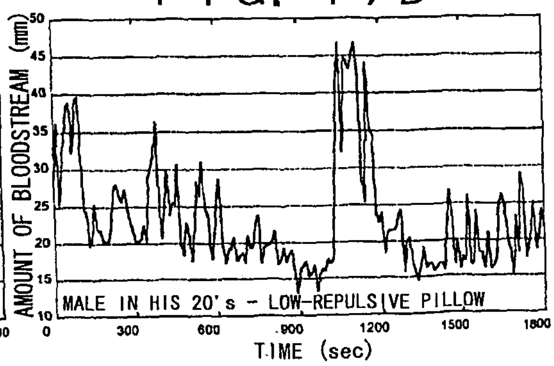
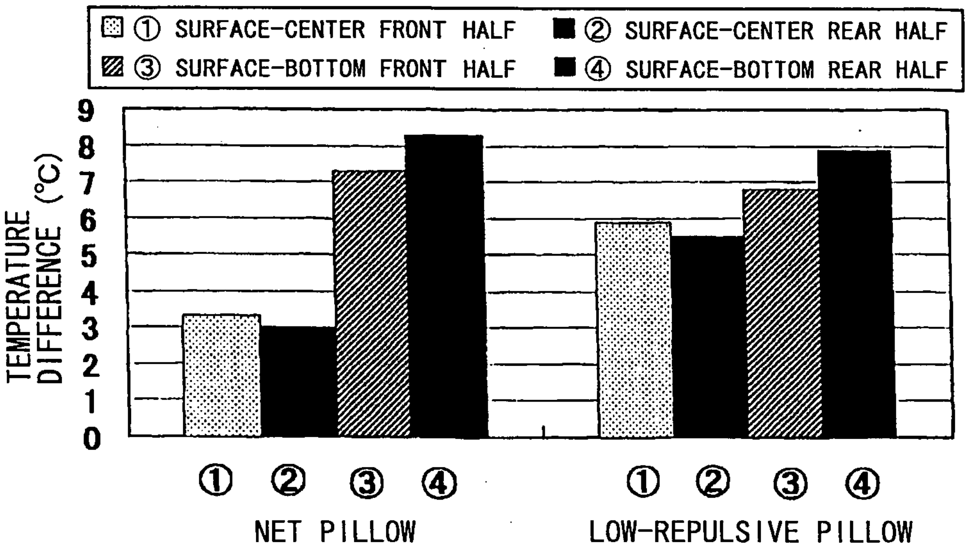
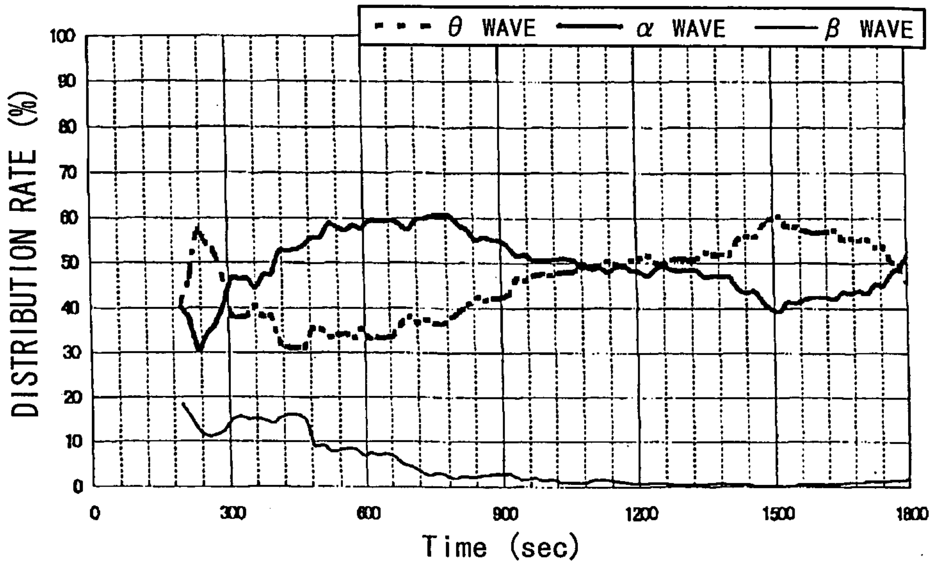


FIG. 18

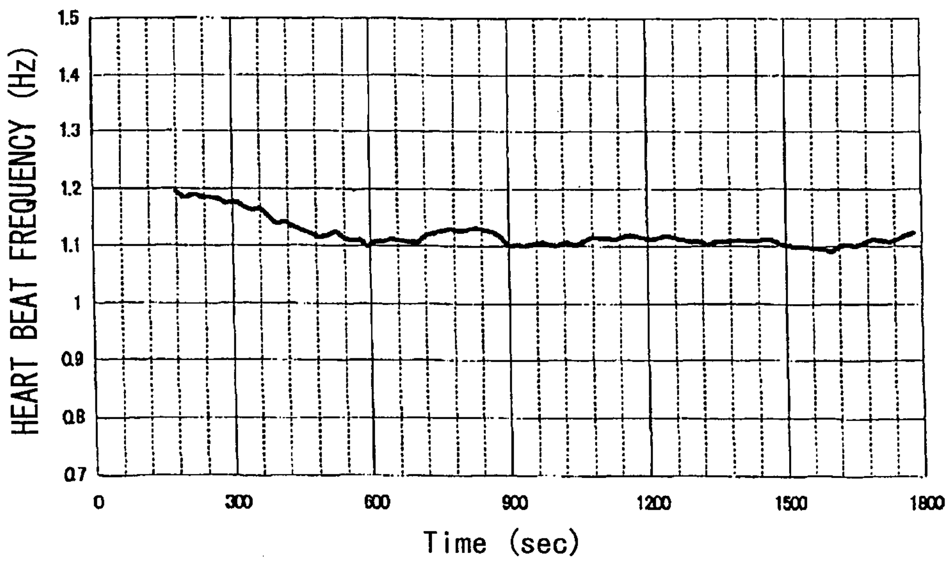

① SURFACE-CENTER FRONT HALF
② SURFACE-CENTER REAR HALF
③ SURFACE-BOTTOM FRONT HALF
④ SURFACE-BOTTOM REAR HALF
TEMPERATURE DIFFERENCE (°C)
9
8
7
6
5
4
3
2
1
0
① ② ③ ④
NET PILLOW
① ② ③ ④
LOW-REPULSIVE PILLOW

F I G. 1 9 A



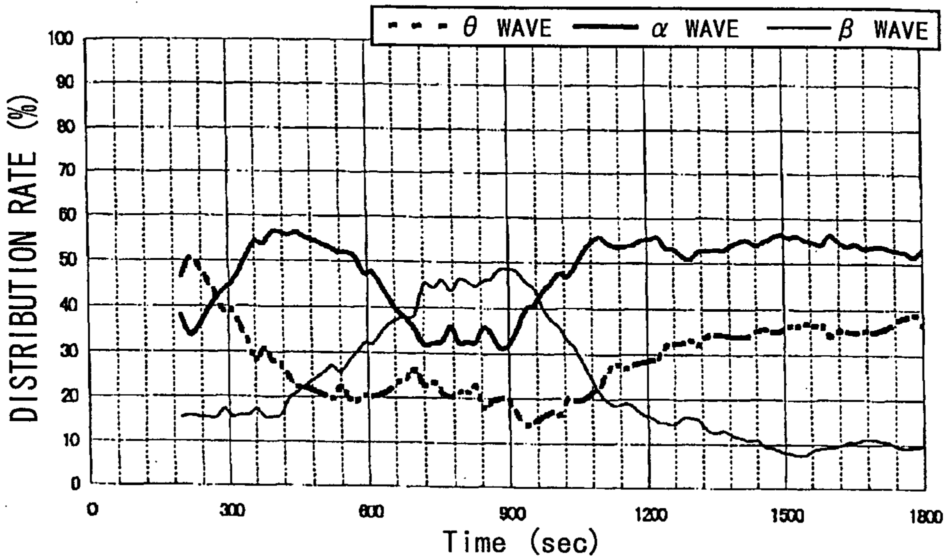
BRAIN WAVE DISTRIBUTION RATE TIME SERIES WAVEFORM

F I G. 1 9 B



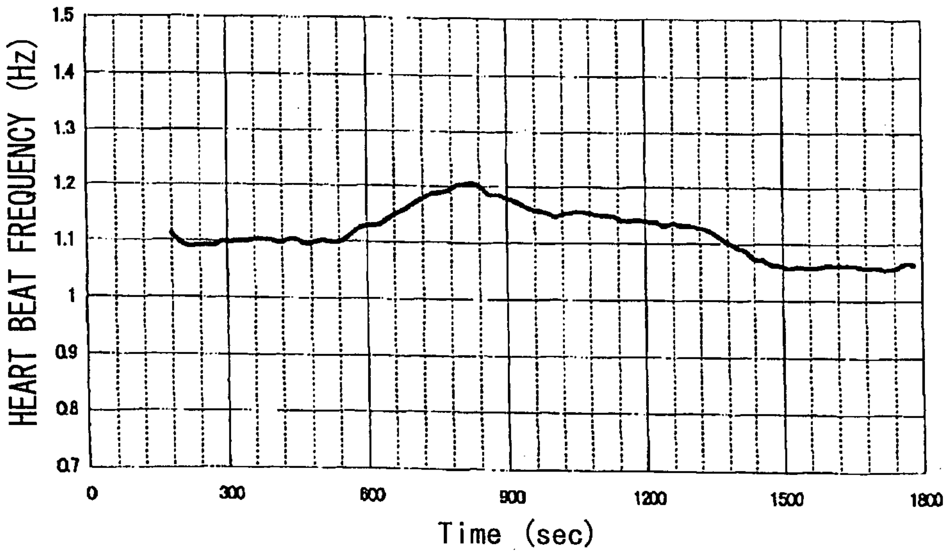
HEART BEAT FREQUENCY TIME SERIES WAVEFORM

F I G. 2 0 A



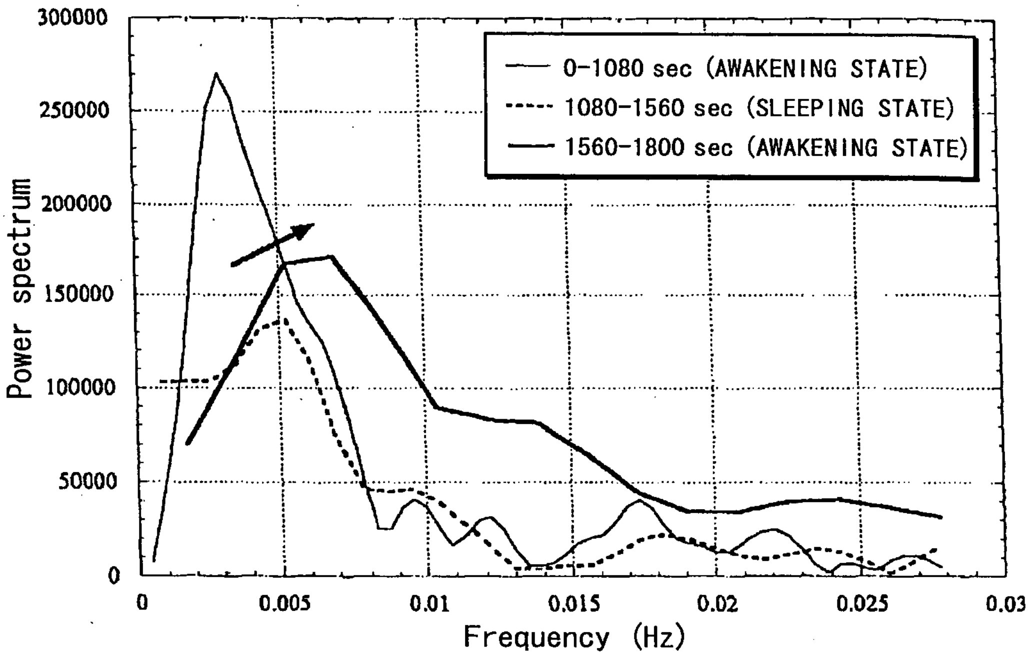
BRAIN WAVE DISTRIBUTION RATE TIME SERIES WAVEFORM

F I G. 2 0 B



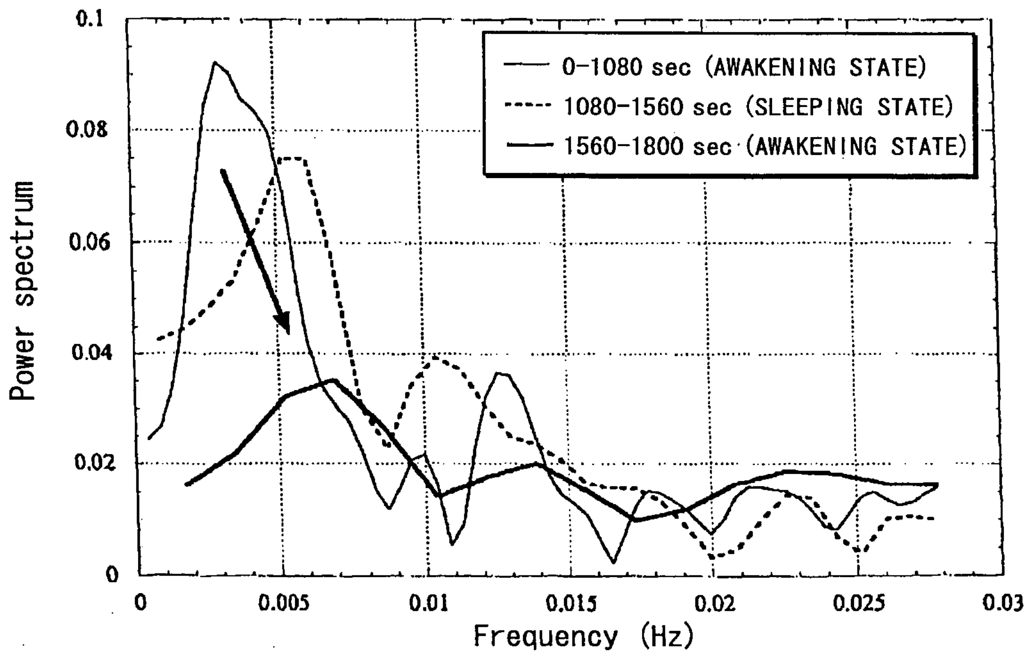
HEART BEAT FREQUENCY TIME SERIES WAVEFORM

F I G. 2 1 A



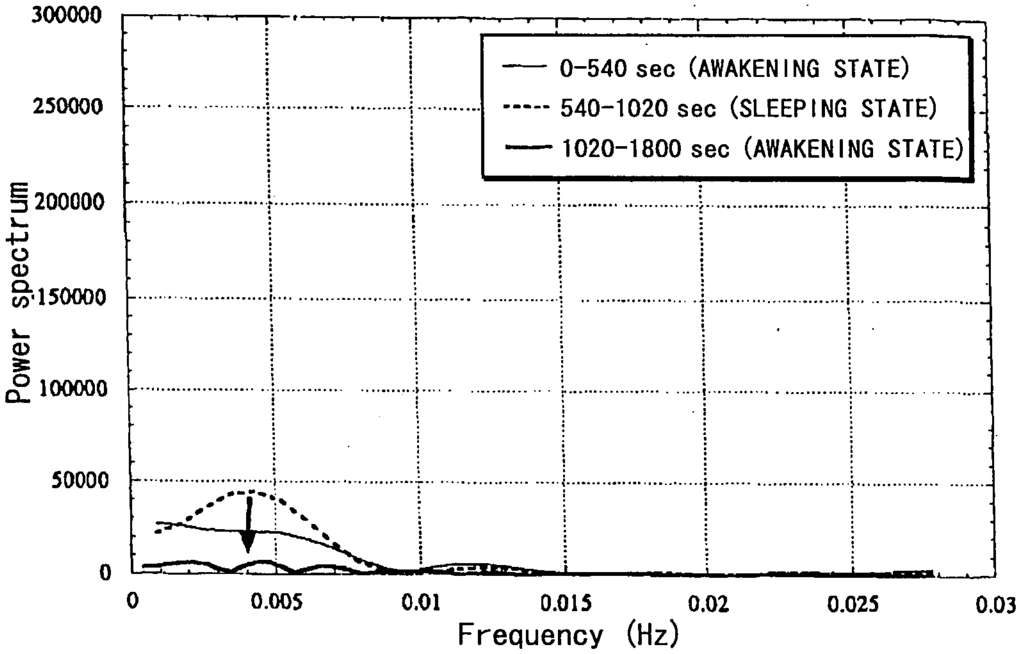
FINGERTIP VOLUME PULSE WAVE POWER VALUE INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 1 B



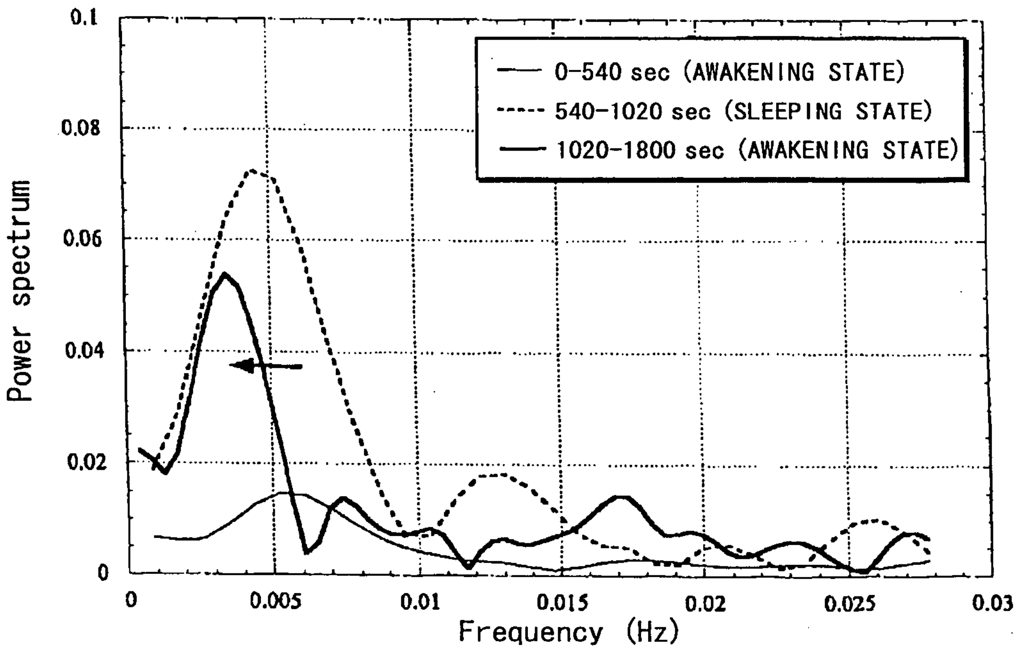
FINGERTIP VOLUME PULSE WAVE MAXIMUM LIAPUNOV INDEX INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 2 A



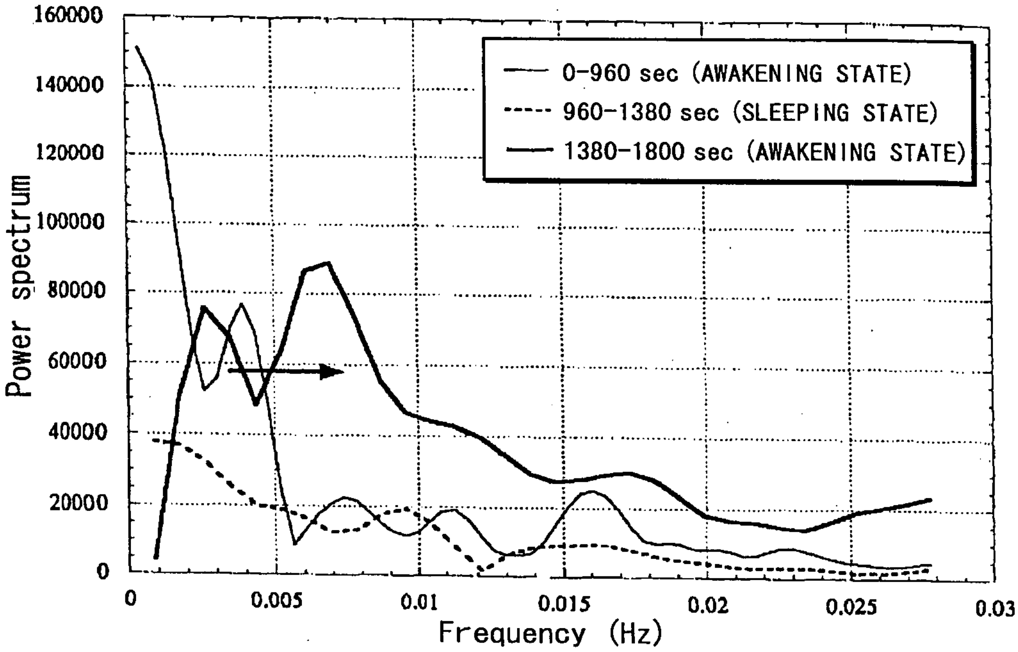
FINGERTIP VOLUME PULSE WAVE POWER VALUE INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 2 B



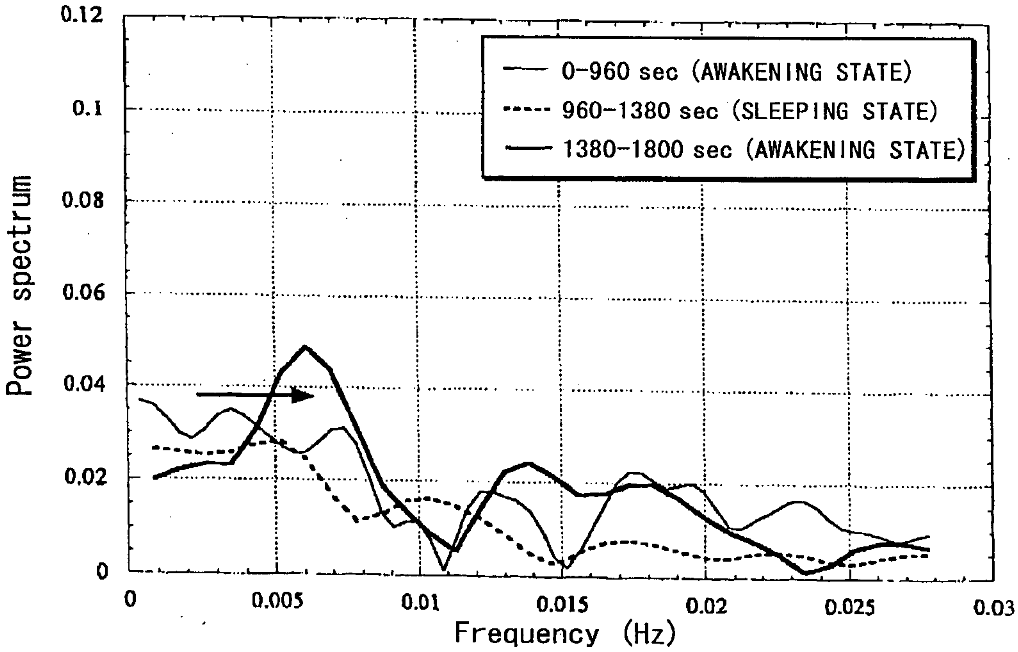
FINGERTIP VOLUME PULSE WAVE MAXIMUM LIAPUNOV INDEX INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

FIG. 23A



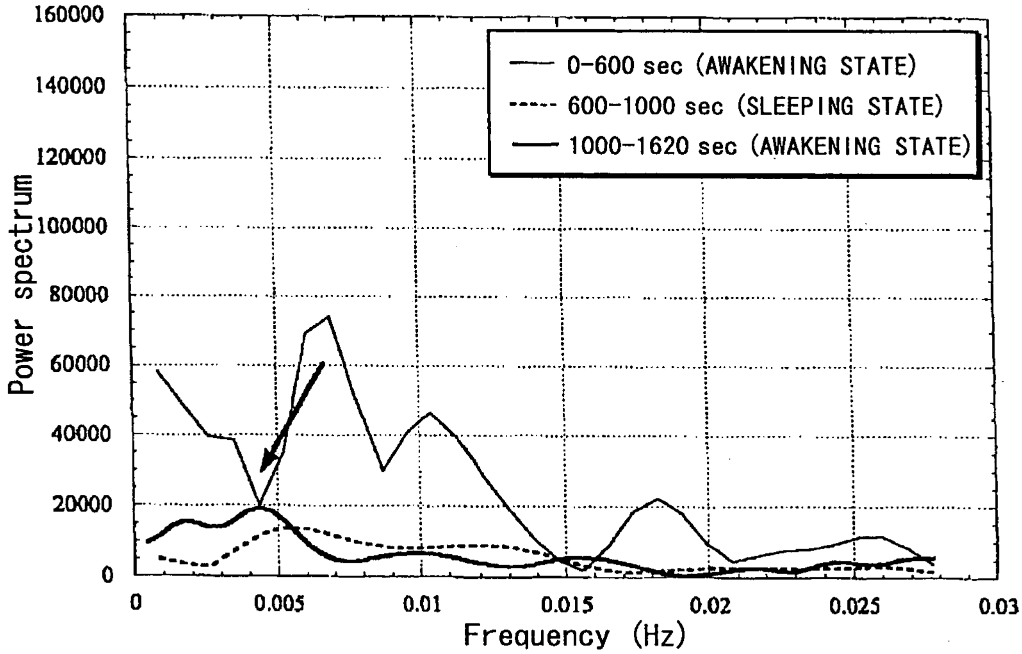
FINGERTIP VOLUME PULSE WAVE POWER VALUE INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

FIG. 23B



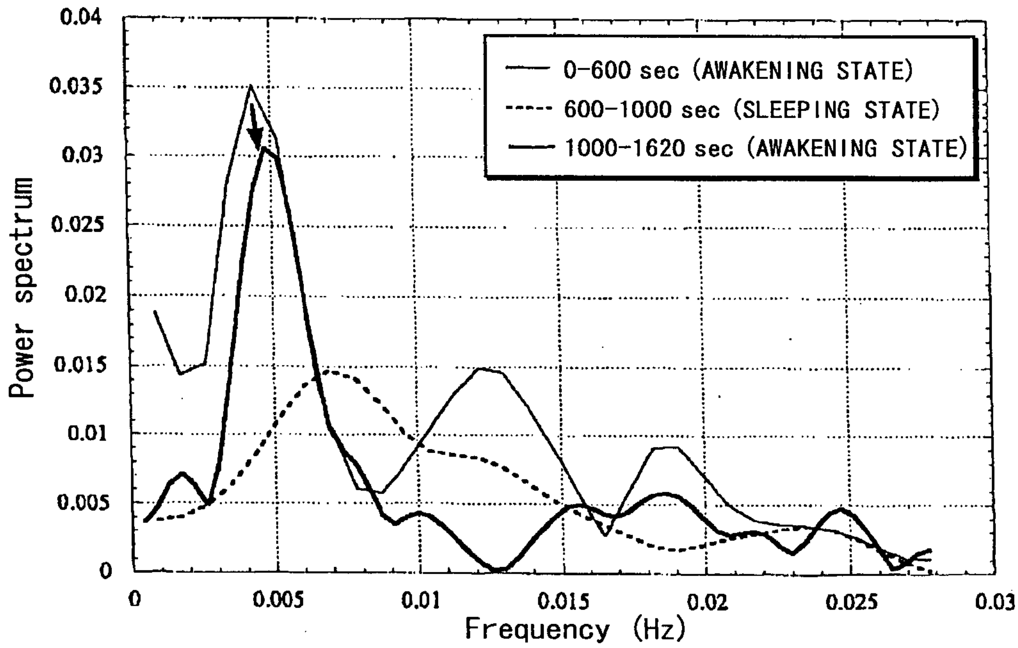
FINGERTIP VOLUME PULSE WAVE MAXIMUM LIAPUNOV INDEX INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 4 A



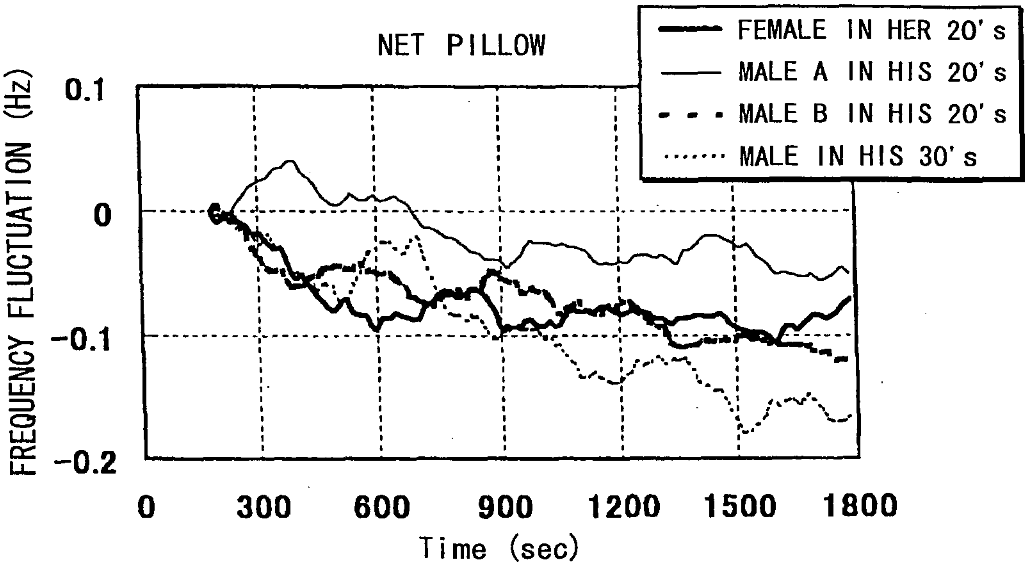
FINGERTIP VOLUME PULSE WAVE POWER VALUE INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 4 B

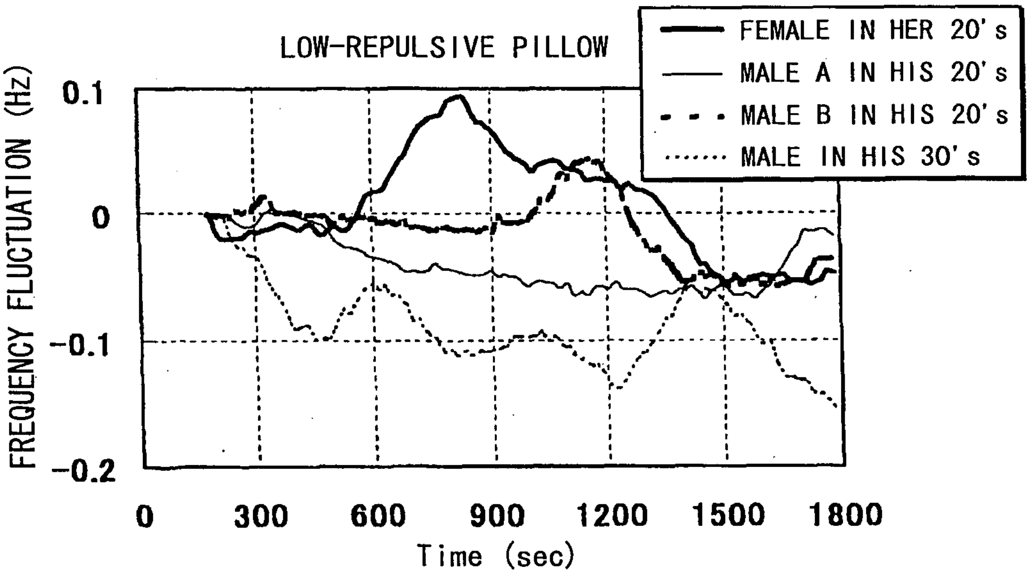


FINGERTIP VOLUME PULSE WAVE MAXIMUM LIAPUNOV INDEX INCLINATION TIME SERIES FREQUENCY ANALYSIS COMPARISON

F I G. 2 5 A



F I G. 2 5 B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/321966

A. CLASSIFICATION OF SUBJECT MATTER
A47G9/10(2006.01)i

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)
A47G9/10

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y Y A	JP 2003-038326 A (Toshio KIYAMA), 12 February, 2003 (12.02.03), Par. Nos. [0008] to [0012] (Family: none)	1,3 2,4 5-7
Y	JP 3106520 U (Tokyo Ka Sen Kabushiki Kaisha et al.), 27 October, 2004 (27.10.04), Par. No. [0006] (Family: none)	1,3
Y	JP 2004-249088 A (Kazuo KOSHIBA et al.), 09 September, 2004 (09.09.04), Full text; all drawings (Family: none)	2,4

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"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
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Date of the actual completion of the international search 15 November, 2006 (15.11.06)	Date of mailing of the international search report 28 November, 2006 (28.11.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/321966

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 105974/1991(Laid-open No. 46380/1993) (Yugen Kaisha Kyokuto Kenki Sabisu), 22 June, 1993 (22.06.93), Full text; all drawings (Family: none)	5-7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3094910 B **[0002]**
- JP 2004344612 A **[0044]**