

(19) Japanese Patent Office (JP)

(12) Patent Publication (B2)

(11) Patent Number

JP, 4817757, B2

(P4817757)

(45) Date Issued: November 16, Heisei 23 (2011.11.16)

(24) Registration Date: September 9, Heisei 23 (2011.9.9)

(51) Int. Cl.

FI

A47G 9/10 (2006.01)

A47G 9/10

Z

Number of claims: 3 (11 pages total)

(21) Application Filing No.: *Tokugan* 2005-245344
(P2005-245344)

(22) Application Filing Date: August 26, Heisei 17
(2005.8.26)

(65) Laid-open Disclosure No.: JP, 2007-54466,A
(P2007-54466A)

(43) Laid-open Date: March 8, Heisei 19 (2007.3.8)
Examination requested on:
August 20, Heisei 20 (2008.8.20)

(73) Patentee: 000119232

INOAC Corporation

2-13-4 Meiekinami, Nakamura Ward,
Nagoya City, Aichi Prefecture

(74) Agent: 100098752

Rikio Yoshida, Patent Attorney

(72) Inventor: Tanto Ohta

c/o: INOAC Corporation Anjo Office

3-1-36 Imaikecho, Anjo City, Aichi Prefecture

(72) Inventor: Takenori Kusakabe

c/o: INOAC Corporation Anjo Office

3-1-36 Imaikecho, Anjo City, Aichi Prefecture

Cont'd to the last page . . .

(54) TITLE OF THE INVENTION:

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS

(57) CLAIMS

CLAIM 1

A method for the production of perforated pillows, said method being characterized by producing perforated pillows by forming small through-holes in foam bodies, producing perforated pillows by forming through-holes in foam bodies, doing so by forming multiple through-holes concurrently through the following steps:

Polyol (A) with an average hydroxyl value of 90 to 250 mg KOH/g and polyisocyanate (B) are caused to react at an isocyanate index of 60 to 90 in the presence of a foaming agent and a catalyst so as to form a memory-foam body with a rebound resilience of 30% or less and hardness of 80 N or less, said polyol (A) consisting of the following components at the weight ratio of 50:50 to 80:20:

Polyol (A-1) with a hydroxyl value of 150 to 300 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5, and

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(2)

Polyol (A-2) with a hydroxyl value of 30 to 100 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5, followed by the steps below:

A compression step, in which the foam body is placed between two press bodies comprising multiple punching holes and is then compressed between the aforementioned two press bodies,

A punching/extrusion step, in which multiple punching blades are driven into the foam body as they are inserted into the punching holes provided in one of the press bodies and move toward the punching holes provided in the other press body so that the aforementioned punching blades punch holes through said foam body situated between the two press bodies while concurrently pushing the punched-out portions out of the aforementioned foam body and extruding them through the aforementioned punching holes provided in the other press body, thus forming through-holes in the aforementioned foam body, and

A compression release step, in which the aforementioned two press bodies are caused to move away from each other to thereby release the compression on the foam body.

CLAIM 2

The method for the production of perforated pillows according to Claim 1, wherein said foam body is a workpiece formed with a mold.

CLAIM 3

The method for the production of perforated pillows according to Claim 1 or Claim 2, wherein said foam body is compressed between said two press bodies at a compression rate of 5% to 40%.

DETAILED DESCRIPTION OF THE INVENTION

TECHNOLOGICAL FIELD

[0001]

The present invention pertains to a method for the production of perforated pillows that have through-holes formed therein.

BACKGROUND ART

[0002]

Some foam pillows are made of perforated foam that is pierced with holes to prevent the oppressive, muggy feeling during use. Additionally, memory foam is used for some of the recently proposed pillows.

[0003]

In the conventional production of perforated pillows, a foam body is placed on a support platform, to which a die-cutting blade is lowered from above so that the blade is pressed into the foam, thus punching through the foam as it forms holes in the shape of the die-cutting blade, followed by the removal of the die-cutting blade from the foam, thus completing the formation of through-holes in the foam.

[0004]

However, with such a punching method involving the use of a die-cutting blade, the scrap portions of the foam body thus punched out remain in the foam body even after the die-cutting blade is pulled out of the foam. Consequently, the punched-out portions must be manually removed from the foam body afterward, making the production process cumbersome and thus costly.

[0005]

There is another method used to form such through-holes, whereby a drill, etc., is used to form through-holes in the foam body one hole at a time. However, such a method poses a problem in that forming multiple through-holes is time-consuming and thus leads to increased costs.

[0006]

Furthermore, not only does memory foam have low rebound properties, but it is also characterized by slow recoverability, i.e., it takes time for the shape to be restored to its original state after it is deformed under pressure. Due to these characteristics, the foam body tends to cling to the blade during drilling and cutting steps, making it difficult to process.

[0007]

[Patent Document 1] JP,2004-243044,A

[Patent Document 2] JP,2002-233441,A

DISCLOSURE OF THE INVENTION

OBJECTIVE TO BE ACHIEVED BY THE INVENTION

[0008]

The present invention was achieved in view of the aforementioned issues. Accordingly, the purpose of the present invention is to produce perforated pillows efficiently and at a low cost.

MEANS FOR ACHIEVING THE OBJECTIVE

[0009]

The invention according to Claim 1 is characterized by producing perforated pillows by forming through-holes in foam bodies, doing so by forming multiple through-holes concurrently through the following steps:

Polyol (A) with an average hydroxyl value of 90 to 250 mg KOH/g and polyisocyanate (B) are caused to react at an isocyanate index of 60 to 90 in the presence of a foaming agent and a so as to form a memory-foam body with a rebound resilience of 30% or less and hardness of 80 N or less, said polyol (A) consisting of the following components at the weight ratio of 50:50 to 80:20:

Polyol (A-1) with a hydroxyl value of 150 to 300 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5, and

Polyol (A-2) with a hydroxyl value of 30 to 100 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5, followed by the steps below:

A compression step, in which the foam body is placed between two press bodies comprising multiple punching holes and is then compressed between the aforementioned two press bodies,

A punching/extrusion step, in which multiple punching blades are driven into the foam body as they are inserted into the punching holes provided in one of the press bodies and

move toward the punching holes provided in the other press body so that the aforementioned punching blades punch holes through said foam body situated between the two press bodies while concurrently pushing the punched-out portions out of the aforementioned foam body and extruding them through the aforementioned punching holes provided in the other press body, thus forming through-holes in the aforementioned foam body, and

A compression release step, in which the aforementioned two press bodies are caused to move away from each other to thereby release the compression on the foam body.

[0012]

The invention according to Claim 2 is characterized by Claim 1, wherein said foam body is a mold-formed workpiece.

[0013]

The invention according to Claim 3 is characterized by Claim 1 or Claim 2, wherein the aforementioned foam body is compressed between the aforementioned two press bodies at a compression rate of 5% to 40%.

EFFECTS OF THE INVENTION

[0014]

According to the invention of Claim 1, punching blades are used to punch holes through a foam body situated between two press bodies while concurrently pushing the punched-out portions out of the aforementioned foam body extruding them through the aforementioned punching holes on the other side, thus forming through-holes in the aforementioned foam body. This makes it possible to eliminate the post-processing of removing the punched-out pieces (while such removal is necessary when die-cutting blades are used for punching), thus making it possible to produce perforated pillows efficiently and at a low cost. It also becomes possible to significantly improve the operational efficiency as compared to the method that uses a drill or the like to form through-holes in a foam body one hole at a time. Moreover, a foam body is placed between two press bodies and subjected to the punching operation in the state in which the foam body is compressed between the two press bodies. Thus, the foam body is compressed and thus becomes thinner exhibiting increased hardness during the punching operation. This makes it possible to inhibit irregular deformation of the foam body (irregular deformation tends to occur when the punching operation is performed without compression), thus allowing the through-holes to be formed correctly. It also makes it possible to reduce the

amount of back-and-forth movement of the punching blades, thus allowing the punching operation to be carried out efficiently.

[0015]

The invention of Claim 1 eliminates the need for the task of removing punched-out pieces, thus making it possible to produce perforated pillows efficiently, even when the foam body is a memory-foam body with a rebound resilience of 30% or less.

[0016]

According to the invention of Claim 2, the foam body is a mold-formed workpiece. Accordingly, by pre-forming the workpiece in the shape of a pillow with a mold, it becomes possible to eliminate the step of forming the foam body into the pillow shape through a cutting step after the foaming step, etc., thereby improving the operational efficiency, thus making it possible to produce perforated pillows at low cost.

[0017]

According to the invention of Claim 3, the ratio of compression on the foam body between the two press bodies is between 5% and 40%, which reduces the thickness of the foam body while increasing the hardness, thereby inhibiting the irregular deformation of the foam body during the punching operation with punching blades, thus allowing through-holes to be formed correctly.

BEST MODES FOR IMPLEMENTATION OF THE INVENTION

[0018]

The following is an explanation of embodiments of the present invention: Figure 1 shows a schematic cross-sectional view of a foam body placed on a press body according to one embodiment of the present invention. Figure 2 shows a schematic cross-sectional view of said embodiment in the state in which the foam body is compressed. Figure 3 shows a schematic cross-sectional view of said embodiment in the state in which holes have been punched through the foam body. Figure 4 shows a schematic cross-sectional view of said embodiment in the state in which the punching blades have been pulled out of the foam body. Figure 5 shows a schematic cross-sectional view of said embodiment in the state in which the foam body has been released from the compressed state. And Figure 6 shows a perspective view of a perforated pillow obtained through the production method according to said embodiment.

[0019]

According to the method for the production of perforated pillows, as claimed by the present invention, a perforated pillow is produced by subjecting a foam body through a compression step, a punching/extrusion step, and a compression release step.

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(7)

[0020]

The foam body used in this invention is preferably a polyurethane foam body obtained by molding foam through the reaction of polyol (a) and polyisocyanate (B) in the presence of a foaming agent and a catalyst, such a polyurethane foam body having a rebound resilience of 30% or less (compliant to JIS K 6400) but more preferably a rebound resilience of 0% to a maximum of 20% (compliant to JIS K 640). Furthermore, a polyurethane foam body with a hardness of 80 N or less (compliant to JIS K 640), particularly a polyurethane foam body with a hardness of 10 to 70 N, is more suitable for the method for the production of perforated pillow according to the present invention.

[0021]

The aforementioned polyol (A) preferably has an average hydroxyl value of 90 to 250 mg KOH/g, as obtained by using the following components at the weight ratio of 50:50 to 80:20:

Polyol (A-1) with a hydroxyl value of 150 to 300 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5, and

Polyol (A-2) with a hydroxyl value of 30 to 100 mg KOH/g, with the cardinal number of functional groups being 1.5 to 4.5.

The aforementioned polyols (A-1) and (A-2) used herein may be any publicly known polyols used for molded polyurethane foam. Examples of ether-based polyols include:

Polyhydric alcohols, such as ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, butylene glycol, neopentyl glycol, glycerin, pentaerythritol, trimethylolpropane, sorbitol, and sucrose;

Polyether polyols obtained by adding alkylene oxides, such as ethylene oxide or propylene oxide, to said polyhydric alcohols; and

The polymer polyols,

Etc.

[0022]

The aforementioned polyol (A-1), when its cardinal number of functional groups is less than 1.5, does not produce a three-dimensional network structure and therefore does not produce a foam body. In contrast, when the cardinal number of functional groups exceeds 4.5, the viscosity of the polyol increases, resulting in poor formability and workability, making it impossible to obtain a flexible foam body. Additionally, when the hydroxyl value is less than 150 mg KOH/g, the rebound resilience of the foam body increases. In contrast, when the hydroxyl value exceeds 300 mg KOH/g, the temperature dependency of the foam body increases.

[0023]

The aforementioned polyol (A-2), when its cardinal number of functional groups is less than 1.5, does not produce a three-dimensional network structure and therefore does not produce a resin foam body. In contrast, when the cardinal number of functional groups exceeds 4.5, the viscosity of the polyol increases, resulting in poor formability and workability, making it impossible to obtain a flexible foam body. Additionally, when the hydroxyl value is less than 30 mg KOH/g, it leads to poor reactivity, thus making it impossible to obtain a satisfactory foam body. In contrast, if the hydroxyl value exceeds 100 mg KOH/g, the foam body formed through the use of polyol (A-1) and polyol (A-2) becomes highly temperature-dependent.

[0024]

At least two types of polyols with different molecular weights must be blended in order to ensure that the foam body exhibits low rebound properties. If the molecular weight distribution of the polyol mixture expands, the foam body thus obtained will have multiple glass transition points, making it possible to obtain a foam body with high viscosity and high shock absorption relative to temperature variation. Additionally, the foam body composed of such a polyol mixture is a slow recovery foam that demonstrates lagged-recovery effects, as it takes time for its original shape to be restored after the application of pressure. Typically, such a lagged recovery shall take five seconds or longer.

[0025]

As such, if the weight ratio between polyol (A-1) and polyol (A-2) deviates from the 50:50 to 80:20 range, the molecular weight distribution of the polyol mixture becomes narrower, thus making it impossible to obtain a memory-foam body. Additionally, the aforementioned polyol (A) composed of polyols (A-1) and (A-2) will have low reaction activity if the average hydroxyl value is less than 90 mg KOH/g, thus making it impossible to obtain a foam body in the sufficiently foamed state. In contrast, if the average hydroxyl value exceeds 250 mg KOH/g, it will result in a high cross-linking density, making it impossible to obtain a foam body with the desired physical property values.

[0026]

Polyisocyanate (B) used in the present invention may be any publicly known polyisocyanates used for molded polyurethane foam. More specific examples include aliphatic or aromatic polyisocyanates having two or more isocyanate groups, the mixture thereof, and modified polyisocyanates obtained by modifying said polyisocyanates or the mixture thereof, etc. Examples of aliphatic polyisocyanates include hexamethylene diisocyanate, isophorone diisocyanate, dicyclohexamethane diisocyanate, and the like. Examples of aromatic polyisocyanates include toluene diisocyanate (TDI), diphenylmethane diisocyanate (MDI), naphthalene diisocyanate, xylylene diisocyanate, polymeric polyisocyanate (crude MDI), etc. Incidentally, other prepolymers may also be used herein. In the present invention, the amount of polyisocyanate (B) is determined in such a way that the value of the isocyanate index ($[\text{Isocyanate group} / \text{Active hydrogen group} \times 100]$) is 60 to 90.

If the isocyanate index is below 60, there will be many unreacted hydroxyl groups, resulting in a sticky foam body. In contrast, If the isocyanate index exceeds 90, the "soft, gooey feel" specific to memory foam will be lost, making it impossible to obtain the desired physical properties, such as slow recoverability.

[0027]

The foaming agent used in the present invention may be any publicly known forming agent used for molded polyurethane foam. For example, water or hydrocarbons such as pentane may be used independently or in combination. In the case of water, carbon dioxide is generated during the reaction of polyol and polyisocyanate, and the carbon dioxide gas causes the foaming. The amount of foaming agent may be determined as appropriate. However, in the case of water, it is preferably about 0.5 to 4 pts. wt. per 100 pts. wt. of polyol.

[0028]

The catalyst used in the present invention may be any publicly known catalyst used for molded polyurethane foam. Examples include amine-based catalysts such as triethylamine and tetramethylguanidine, tin-based catalysts such as stannous octoate, and metal catalysts such as phenylmercuric propionate and lead octoate (also called an organometallic catalyst). The typical amount of catalyst is about 0.01 to 6 pts. wt. per 100 pts. wt. of polyol.

[0029]

Additionally, it is preferable to add a foam stabilizer as appropriate. The foam stabilizer may be any publicly known forming agent used for molded polyurethane foam. Examples include silicone-based foam stabilizers, foam stabilizers based on fluorine-containing compounds, and publicly known surfactants. The typical amount of the foam stabilizer is 1 to 6 pts. wt. per 100 pts. wt. of polyol. In the present invention, appropriate amounts of auxiliary

agents, such as flame retardants, colorants, plasticizers, etc., may be further added to the formulation.

[0030]

The aforementioned foam body is formed through a publicly known molding process, more specifically, through the following method that uses a mold (molding die) with a pillow-shaped molding cavity:

The following components are mixed at a predetermined ratio in a publicly known foam-molding machine:

A polyol component obtained by mixing, at a predetermined ratio, the aforementioned polyol (A), a foaming agent, a catalyst, and further auxiliary agents (such as a foam stabilizer, etc.) added on an as-needed basis, and

The aforementioned polyisocyanate (B).

The mixture is poured into the aforementioned cavity to the full level, in which the reaction between polyol (A) and polyisocyanate (B) is induced so as to cause the mixture to foam into the shape of said cavity, thus forming a pillow-shaped foam body, which is then removed from the mold.

[0031]

As shown in figures 1 and 2, in the step of compressing the foam body thus formed, foam body 11 is first placed between two press bodies 21 and 31 comprising punching holes 22 and 32 that are formed at the positions corresponding to each other. Then, foam body 11 is compressed between said two press bodies. In the example shown in the figures, the aforementioned foam body 11 is placed on one of the press bodies (i.e., press body 21), which is mounted horizontally on support legs 41. In this state, the other press body 31 situated above the aforementioned foam body 11 is lowered with a press apparatus (not shown) so as to press and thus compress foam body 11. The aforementioned support legs 41 are provided at the four corners of said one of the press bodies (i.e., press body 21) so as to form gap 45 for the extrusion of the punched-out portions under the aforementioned press body 21. Additionally, in the example shown in the figures, the aforementioned press bodies 21 and 31 have plate-like structures with a size that is large enough to compress at least the area of the aforementioned foam body 11 subject to the formation of holes. The shape of said press bodies

21 and 31 may be adapted to that of said foam body 11's surface subject to compression. For example, if foam body 11's surface subject to compression has a concave shape, the shape of press bodies 21 and 31 may be convex to match the concave shape of said foam body.

[0032]

The size, number, and positions of the punching holes 22 and 32 in the aforementioned press bodies 21 and 31 shall correspond to those of the through-holes to be formed in the target perforated pillow. In particular, if the punching holes 22 and 32 are too large, the portions of foam body 11 that are situated in the areas corresponding to the positions of punching holes 22 and 32 will bulge outward significantly when said foam body 11 is pressed between press bodies 21 and 31, thus leading to a low level of compression, which may adversely affect how the punching blades punch holes in the subsequent step. Or, if the punching holes 22 and 32 are too small, it will become difficult to insert the punching blades into punching holes 22 and 32. Accordingly, the size of the punching holes, if they are round, should be 3 to 10 mm or preferably 4 to 7 mm in diameter. Incidentally, the shape of punching holes 22 and 32 is not limited to a round shape but may be elliptical or polygonal, such as a rectangle or pentagon shape, etc.

[0033]

For the compression of foam body 11 between the aforementioned press bodies 21 and 31, the compression rate is preferably 5% to 40%, as calculated with the following formula:

$$\left[\frac{\text{Thickness of foam body 11 in the compressed state}}{\text{Thickness of foam body 11 before compression}} \times 100 \right]$$

If the compression ratio is below 5%, a greater force will be required for the compression of press foam body 11 between the aforementioned press bodies 11 and 21, which may make it difficult for foam body 11 to restore its original shape after the compression. In contrast, if the compression rate exceeds 40%, foam body 11 will not be compressed sufficiently, making it difficult to benefit from the intended effects of compression.

[0034]

In the punching/extrusion step shown in figures 2 and 3, punching blades 51 are driven with pressure so as to be inserted into punching holes 32 of one of the aforementioned press bodies 21 and 31 (i.e., press body 31 herein) and then into punching holes 22 of the other press body (i.e., press body 21 herein) in the state in which foam body 11 is compressed between the aforementioned two press bodies 21 and 31. Thus, punching blades 51 punch holes through foam body 11 situated between the aforementioned two press bodies 21 and 31 while pushing

punched-out portions 13 out of the aforementioned foam body 11 and extruding them through punching holes 22 of the other press body 21, thereby forming through-holes 12 in said foam body 11. In the example shown in the figures, the aforementioned punching blades 51 are provided on the underside of the ascending/descending plate 55 in such a way that they are situated on the imaginary lines that extend upward from punching holes 22 and 32 of press bodies 21 and 31 so that punching blades 51 are inserted into punching holes 32 of upper press body 31 when a lifting/lowering apparatus (not shown) lowers the aforementioned ascending/descending plate 55. Punching blades 51 are formed with a diameter that can be fit into punching holes 22 and 32 of the press bodies 21 and 31 and the length that is long enough to penetrate through foam body 11 in the state in which foam body 11 is compressed between press bodies 21 and 31. Incidentally, after the aforementioned punching step, the ascending/descending plate 55 is lifted so that punching blades 51 are pulled out of foam body 11, as shown in Figure 4. Tips 52 of the aforementioned punching blades 51 may or may not constitute sharpened edges. Even if not sharpened, they can still punch holes through a foam body as they push through it with the pressing force applied during the punching operation.

[0035]

In the compression release step shown in Figure 5, the aforementioned two press bodies 21 and 31 are caused to move away from each other to thereby release the compression on the aforementioned foam body 11, thus completing perforated pillow 10 shown in Figure 6.

WORKING EXAMPLES

[0036]

Foam bodies for use in the production of perforated pillows according to working examples 1 to 4 were formed by pouring polyurethane starting materials for memory foams into the respective molds to the full level, said polyurethane starting materials consisting of the following raw materials in the formulations shown in Table 1 (the numeric value of each raw material is in parts by weight). The molding cavity of each mold is made in a pillow shape with dimensions of 80 mm × 350 mm × 500 mm.

[0037]

(Raw Materials Used)

- Polyol (A-1): Polyether polyol, average cardinal number of functional groups = 3, hydroxyl value = 250 mg KOH/g, product name = “G-250” by Takeda Pharmaceutical Company Limited

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(13)

- Polyol (A-2): Polyether polyol, average cardinal number of functional groups = 3, hydroxyl value = 36 mg KOH/g, product name = “MF-78” by Takeda Pharmaceutical Company Limited
- Polyisocyanate: TDI/MDI mixture, NCO% = 44%, product name = “C-1021” by Nippon Polyurethane K.K.
- Catalyst: Triethylenediamine, product name "LV33" by Chukyo Yushi Co., Ltd.
- Foaming agent: water (ion-exchange water)
- Foam stabilizer: Silicone-based foam stabilizer, product name "SF2969” by Dow Corning Toray Silicone Co., Ltd.

[0038]

[TABLE 1]

	Working Example				Reference Example
	1	2	3	4	5
Polyol (A-1)	50	60	70	80	A commercially available foam body ^(*1) cut into the size of 80 x 350 x 500 mm
Polyol (A-2)	50	40	30	20	
Average hydroxyl value (mg KOH/g)	143	164	185	207	
Catalyst	0.7	0.7	0.7	0.7	
Foaming agent	1.3	1.3	1.3	1.3	
Foam stabilizer	1.1	1.1	1.1	1.1	
Isocyanate index	70	60	80	90	
Density (kg/m ³)	85	90	95	100	
Rebound resilience (%)	3	3	7	10	
Hardness (N)	39	45	52	70	
With compression during punching operation?	Yes	Yes	Yes	Yes	Yes
Compression rate (%)	7	10	15	25	15
Punchability	◎	◎	◎	◎	◎

(*1) Product number ER-20 by INOAC Corporation

[0039]

The density (kg/m³), rebound resilience (%), and hardness (N) of each perforated pillow foam were measured in accordance with JIS K 6400 upon removal from the molds. And the perforated pillows according to working examples 1 to 4 were produced by subjecting the foam bodies for the perforated pillows through the compression, punching/extrusion, and

compression release steps through the use of two press bodies (comprising punching holes formed therein) and punching blades as shown in figures 1 through 5. Then, an evaluation was conducted to examine their performance in terms of punchability. The punching holes formed in the press bodies were 5mm in diameter. The number of holes was 119, which were arranged at 15mm intervals. The punching blades were 50 mm in length. They were implanted in the underside of the ascending/descending plate in alignment with the positions of the respective punching holes in the press bodies. The following criteria were used for the evaluation of punchability:

- ◎ when holes were satisfactorily punched through the foam body without leaving burrs, etc., in the through-holes;
- when there are a small amount of burrs, etc., left in the through-holes;
- △ when there are a lot of burrs, etc., left in the through-holes; and
- × when the foam body clung to the punching blades preventing the blades from punching holes.

Additionally, as Reference Example 5, a commercially available polyurethane foam body with high rebound resilience and relatively high hardness (rebound resilience of 41% and hardness of 49N; product number ER-20 by INOAC Corporation) was cut into a pillow shape of 80 x 350 x 500 mm and used to produce a perforated pillow in the same way as working examples 1 through 4. Then, an evaluation was conducted to examine their performance in terms of punchability. Table 1 shows the measurement results of their density, rebound resilience, and hardness, as well as the results of punchability evaluation.

[0040]

Additionally, perforated pillows according to comparative examples 1 to 5 were produced by punching holes in the same foam bodies for perforated pillows as those in working examples 1 to 4 and Reference Example 5 in the same way as in the previous examples, except that the aforementioned compression step was not performed. Furthermore, a perforated pillow according to Comparative Example 6 was produced by punching holes in a foam body for a perforated pillow consisting of a polyurethane foam body with a low rebound resilience

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(15)

and high hardness (a rebound resilience of 16% and hardness of 175 N; product number EGR-2 by INOAC Corporation), doing so without the compression step in the same way as in comparative examples 1 to 5. Additionally, a perforated pillow according to Comparative Example 7 was produced by punching holes in a foam body for a perforated pillow consisting of a polyurethane foam body with high rebound resilience and hardness (rebound resilience of 47% and hardness of 92 N; product number ERG-S by INOAC Corporation; typically used for mattresses), doing so without the compression step in the same way as in comparative examples 1 to 5.

Table 2 shows the punchability of the perforated pillows according to comparative examples 1 to 7 during their production.

[0041]

[TABLE 2]

	Comparative Example						
	1	2	3	4	5	6	7
Polyol (A-1)	50	60	70	80	A commercially available foam body ^(*1) cut into the size of 80 x 350 x 500 mm	A commercially available foam body ^(*2) cut into the size of 80 x 350 x 500 mm	A commercially available foam body ^(*3) cut into the size of 80 x 350 x 500 mm
Polyol (A-2)	50	40	30	20			
Average hydroxyl value (mg KOH/g)	143	164	185	207			
Catalyst	0.7	0.7	0.7	0.7			
Foaming agent	1.3	1.3	1.3	1.3			
Foam stabilizer	1.1	1.1	1.1	1.1			
Isocyanate index	70	60	80	90			
Density (kg/m ³)	85	90	95	100	28	85	45
Rebound resilience (%)	3	3	7	10	41	16	47
Hardness (N)	39	45	52	70	49	175	92
With compression during punching operation?	No	No	No	No	No	No	No
Compression rate (%)	—	—	—	—	—	—	—
Punchability	×	×	×	△	×	○	○

(*1) Product number ER-20 by INOAC Corporation

(*2) Product number EGR-2 by INOAC Corporation

(*3) Product number ERG-S by INOAC Corporation

[0042]

As is evident from Table 1, satisfactory through-holes were formed by means of punching in all working examples 1 to 4 and Reference Example 5. Moreover, punched-out portions can be pushed out of the foam body, meaning removing the portions to be extruded from the foam body in the subsequent step is no longer necessary.

[0043]

However, with any of the comparative examples 1 to 3 and 5 (which were prepared by punching holes in the same foam bodies as those of working examples 1 to 3 and Reference Example 5 but without compression), the foam bodies clung to the punching blades, thus

preventing holes from being formed in a satisfactory manner. As to Comparative Example 4, because of its relatively high hardness, the foam body was less likely to cling to the punching blades than in the comparative examples 1 to 3, but burr residues were found in the through-holes. Furthermore, in Comparative Example 6 (comprising a foam body with low rebound resilience but with high hardness) and Comparative Example 7 (comprising a foam body with high rebound resilience and high hardness, i.e., a type of foam body commonly used for mattresses), the formation of through-holes was relatively satisfactory even without compression. This means that a foam body with low rebound resilience and low hardness, more specifically, with a rebound resilience of 41% or less and hardness of 90 N or less, particularly, with a rebound resilience of 30% or less (more preferably a rebound resilience of 20% or less) and hardness of 80 N or less (more preferably 10 to 70 N or less), can ensure that holes are punched through in a satisfactory manner while allowing punched-out pieces to be pushed out of the foam body.

[0044]

Additionally, characteristics such as low rebound properties and moderately low hardness are included in the market requirements (functional requirements) for blank material for pillows made of a foam body. Such characteristics make it extremely difficult to process the foam body during the secondary fabrication, i.e., the punching and cutting steps, etc. However, the present invention allows for extremely satisfactory hole formation even with a low-rebound, high-hardness blank material for pillows. Moreover, removing the punched-out pieces in the subsequent step is no longer necessary.

BRIEF EXPLANATION OF THE DRAWINGS

[0045]

Figure 1 shows a schematic cross-sectional view of a foam body placed on a press body according to one embodiment of the present invention.

Figure 2 shows a schematic cross-sectional view of said embodiment in the state in which the foam body is compressed.

Figure 3 shows a schematic cross-sectional view of said embodiment in the state in which holes have been punched through the foam body.

Figure 4 shows a schematic cross-sectional view of said embodiment in the state in which the punching blades have been pulled out of the foam body.

METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(17)

Figure 5 shows a schematic cross-sectional view of said embodiment in the state in which the foam body has been released from the compressed state.

Figure 6 shows a schematic view of a perforated pillow obtained through the production method according to said embodiment.

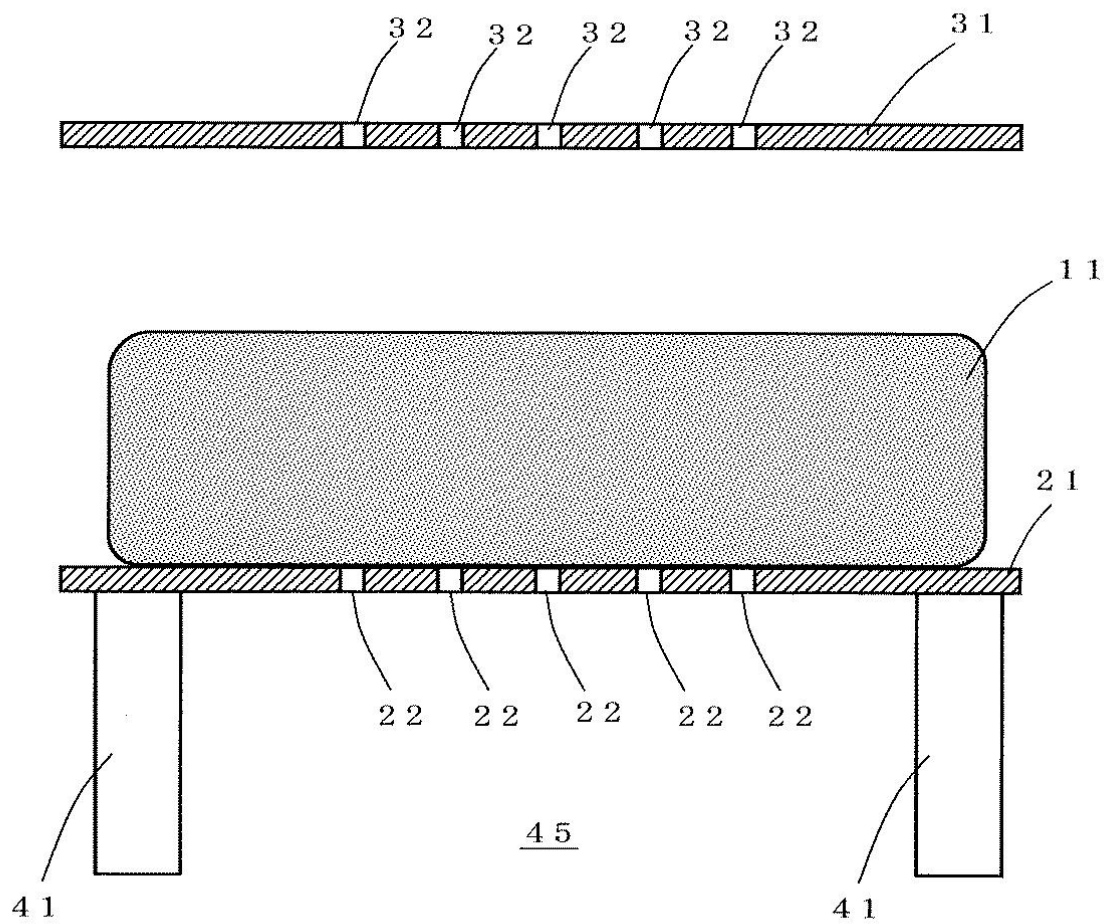
EXPLANATION OF REFERENCE CODING

[0046]

- 10 Perforated pillow
- 11 Foam body
- 12 Through-hole
- 13 Punched-out portions
- 21, 31 Press body
- 22, 32 Punching holes
- 51 Punching blades

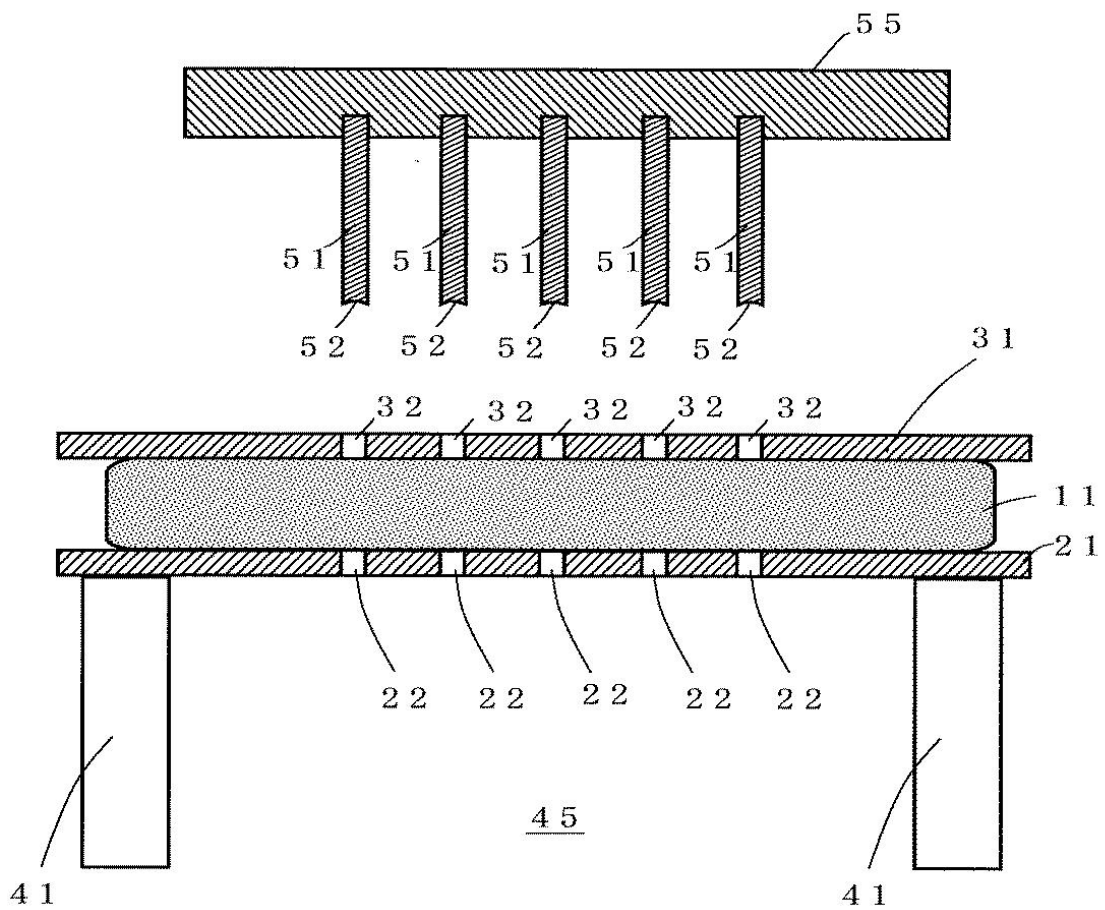
METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(18)

Figure 1



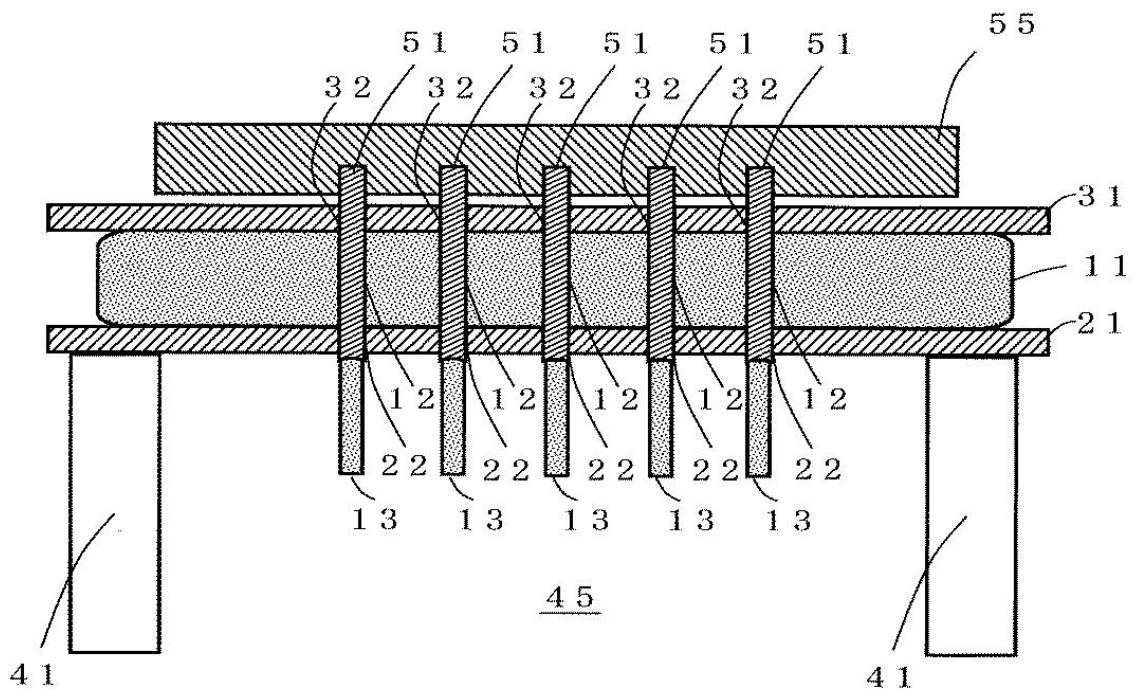
METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(19)

Figure 2



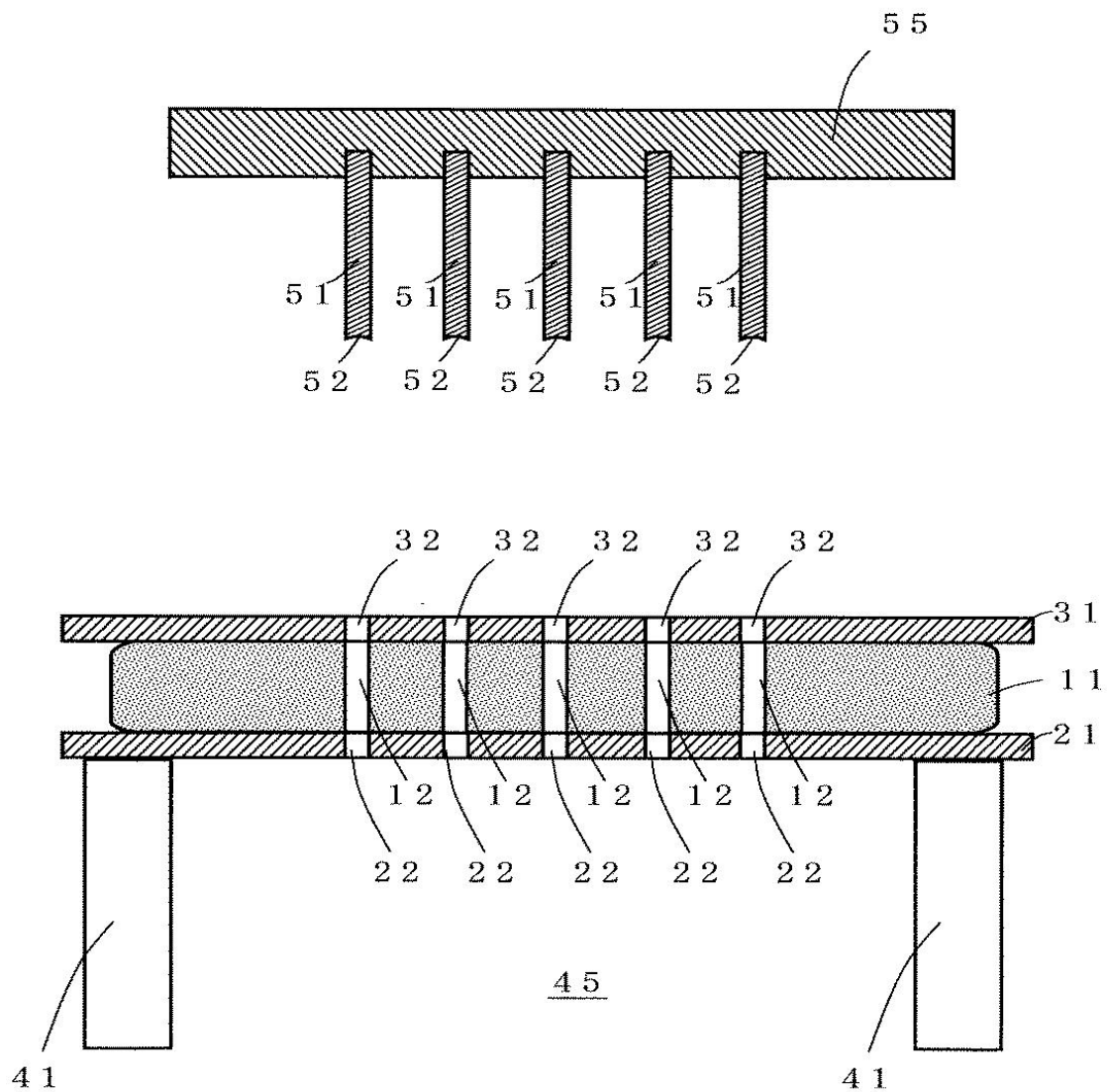
METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(20)

Figure 3



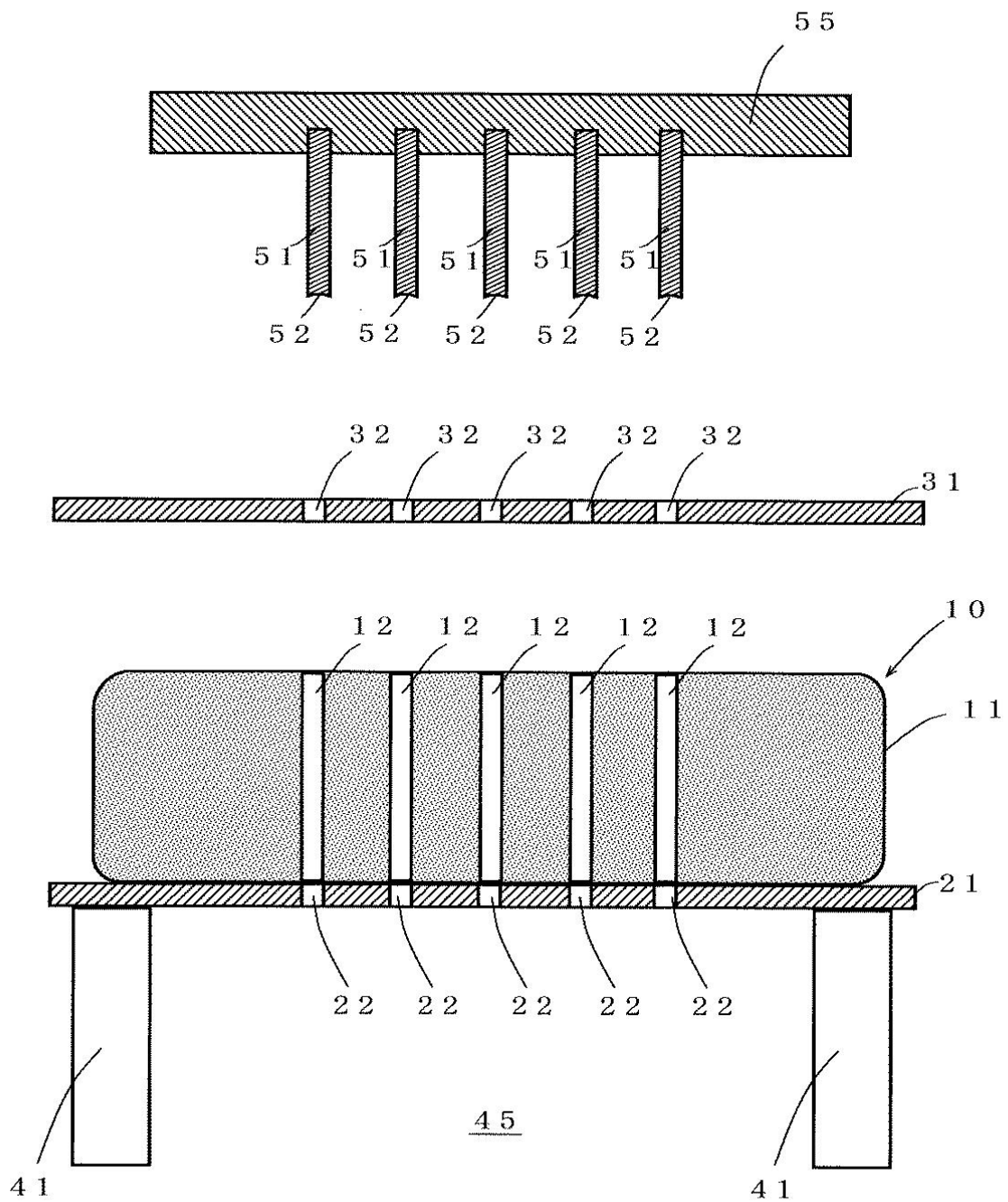
METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(21)

Figure 4



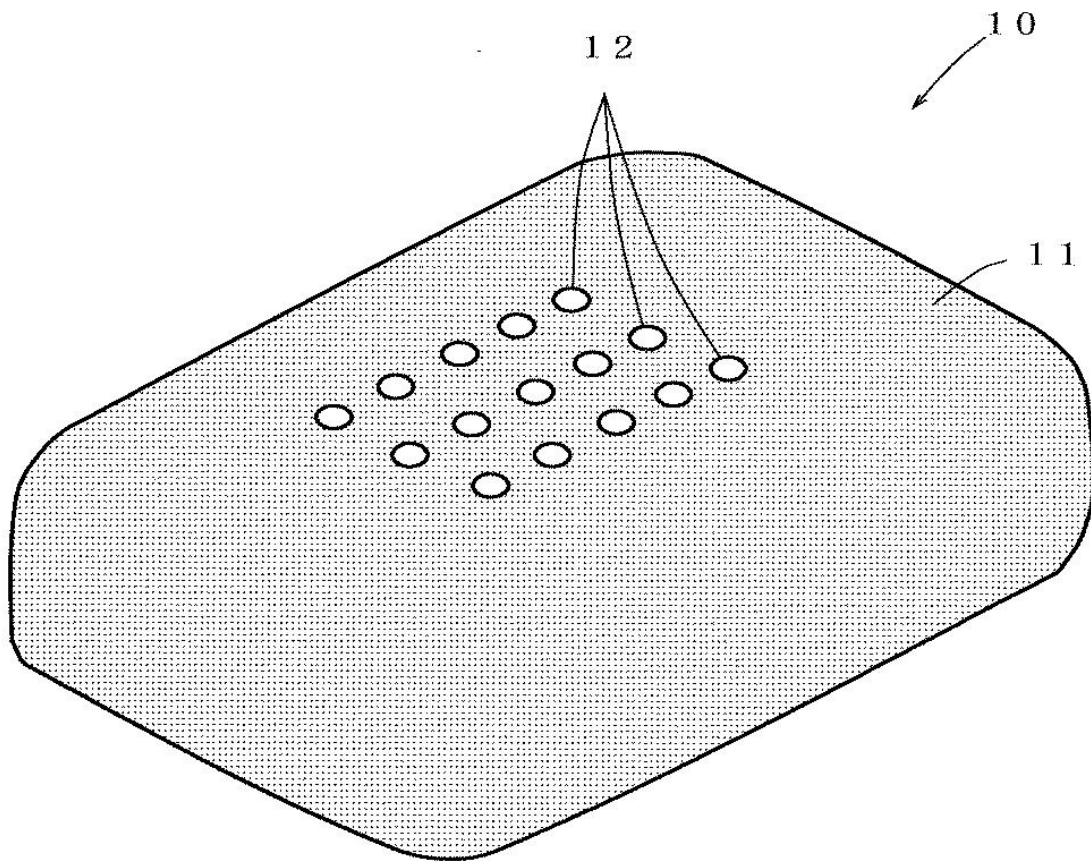
METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(22)

Figure 5



METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(23)

Figure 6



METHOD FOR THE PRODUCTION OF PERFORATED PILLOWS
(24)

Examiner: Shinichi Kawaguchi

(56) References: Japanese Patent Unexamined Application Laid-Open Disclosure No. H08-126997 (JP, A)
Japanese Patent Unexamined Application Laid-Open Disclosure No. 2004-358137 (JP, A)
Utility Model Registration No. 3112514 (JP, U)
Japanese Patent Unexamined Application Laid-Open Disclosure No. H03-163126 (JP, A)
Japanese Patent Unexamined Application Laid-Open Disclosure No. H08-311149 (JP, A)
Japanese Patent Unexamined Application Laid-Open Disclosure No. H11-240933 (JP, A)
Japanese Patent Unexamined Application Laid-Open Disclosure No. 2004-339269 (JP, A)
Japanese Patent Unexamined Application Laid-Open Disclosure No. H08-052747 (JP, A)

(58) Searched Fields (Int. Cl. and DB Names)
A47G 9/10



legaltranslations.biz

(Division of Nelles Translations)

3 Grant Square - Suite 336 - Hinsdale, IL 60521 - 630-567-8730

Certification

This is to certify that the foregoing translation of the patent document JP4817757B2 was made from Japanese to English from the document by a competent translator well acquainted with both languages, and that, to the best of our knowledge and belief, it is a true and complete rendering into English of the selected text.

Date: July 18, 2023

Donald W. Hanley, CEO