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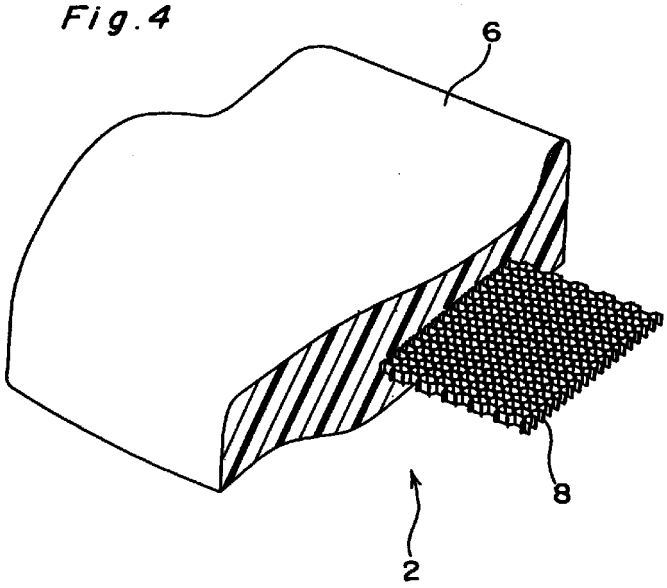
(54) Cushion structure having a three-dimensional net

(57) A cushion structure (2) includes a pad material (6) and a three-dimensional net (8) embedded in the pad material. The three-dimensional net includes upper and lower mesh layers and a pile layer having a large number of piles for connecting the upper and lower mesh layers. The pad material (6) is foamed with the three-dimensional net (8) embedded therein.

Fig.4



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Description

BACKGROUND OF THE INVENTION

(Field of the Invention)

[0001] The present invention relates to a cushion structure for use in seats, beds or the like.

(Description of the Related Art)

[0002] Conventional automobile seats generally include spring members such as coil springs, S-shaped springs, or formed wire springs mounted on a seat frame, a pad material such as a foamed material, rocking material, or cotton placed thereon, and a skin such as a vinyl leather, woven cloth, or leather covered thereon.

[0003] In order to enhance the elasticity or shock-absorbing properties, those in which a viscoelastic material is embedded in the pad material have been proposed.

[0004] On the other hand, seats or beds other than the automobile seats generally include a pad material placed on the frame and covered with a skin, and some of them also include spring members for enhancing the cushioning characteristics.

[0005] Although the spring members or the pad material acts to provide desired cushioning characteristics, conventional seats or beds are mostly thick, heavy and costly.

SUMMARY OF THE INVENTION

[0006] The present invention has been developed to overcome the above-described disadvantages.

[0007] It is accordingly an objective of the present invention to provide an inexpensive, thin and lightweight cushion structure having various spring constants and desired cushioning characteristics.

[0008] In accomplishing the above and other objectives, the cushion structure according to the present invention includes a pad material and a three-dimensional net embedded in the pad material. The three-dimensional net includes upper and lower mesh layers and a pile layer having a large number of piles for connecting the upper and lower mesh layers. The pad material is foamed with the three-dimensional net embedded therein.

[0009] By this construction, the spring properties of the pad material is covered by the three-dimensional net and, hence, even if the cushion structure is thin and lightweight, it can ensure desired cushioning characteristics.

[0010] The pad material may be impregnated into the three-dimensional net. By so doing, the pad material adheres to each of the piles constituting the three-dimensional net to increase the rigidity thereof, making it possible to provide a cushion structure having a large spring constant.

[0011] Alternatively, the upper or lower mesh layer is covered with an impregnation prevention sheet. The impregnation prevention sheet acts to prevent the pad material from being impregnated into the three-dimensional net and to create an air layer inside the three-dimensional net, making it possible to provide a cushion structure having a small spring constant.

[0012] It is preferred that the impregnation prevention sheet be made of thermoplastic polyurethane elastomer. Such impregnation prevention sheet is integrated with the pad material without being hardened and, hence, a seat occupant does not have a feeling of foreign substances.

[0013] Prior to foaming, a wire may be inserted into the three-dimensional net. The wire acts to increase the spring constant and enlarge the region in which the three-dimensional net withstands a load, thus relieving the bottom-end shock.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The above and other objectives and features of the present invention will become more apparent from the following description of preferred embodiments thereof with reference to the accompanying drawings, throughout which like parts are designated by like reference numerals, and wherein:

Fig. 1 is a perspective view of a seat in which a cushion structure according to a first embodiment of the present invention has been employed;
Fig. 2 is a side view of the seat of Fig. 1;
Fig. 3 is a front view of the seat of Fig. 1;
Fig. 4 is a perspective view, partly in section, of a seat cushion constituting the seat of Fig. 1;
Fig. 5 is a fragmentary front view, on an enlarged scale, of a three-dimensional net embedded in the seat cushion

of Fig. 4;

Fig. 6 is a fragmentary side view of the three-dimensional net of Fig. 5;

Fig. 7 is a graph showing a load-deflection curve of a three-dimensional mesh knit used for the three-dimensional net;

Fig. 8A is a schematic view of a fabric base texture used for upper and lower mesh layers of the three-dimensional net, particularly depicting a honeycomb-shaped (hexagonal) mesh shown in Fig. 5;

Fig. 8B is a view similar to Fig. 8A, but particularly depicting a diamond-shaped mesh;

Fig. 8C is a view similar to Fig. 8A, but particularly depicting a chain-inserted texture;

Fig. 9A is a schematic view of a pile texture connecting the upper and lower mesh layers, particularly depicting a generally straight texture corresponding to Fig. 6;

Fig. 9B is a view similar to Fig. 9A, but particularly depicting a generally straight texture in the form of a figure "8";

Fig. 9C is a view similar to Fig. 9A, but particularly depicting a cross texture;

Fig. 9D is a view similar to Fig. 9A, but particularly depicting a cross texture in the form of a figure "8";

Fig. 10 is a view similar to Fig. 4, but depicting a modification thereof;

Fig. 11 is a view similar to Fig. 4, but depicting a cushion structure according to a second embodiment of the present invention;

Fig. 12 is a view similar to Fig. 11, but depicting a modification thereof;

Fig. 13 is a view similar to Fig. 11, but depicting another modification thereof;

Fig. 14A is a view similar to Fig. 4, but depicting a cushion structure according to a third embodiment of the present invention;

Fig. 14B is an exploded perspective view of the three-dimensional net embedded in the cushion structure of Fig. 14A;

Fig. 15 is a perspective view, partly in section, of a cushioning member in which a pad material has been foamed into a generally rectangular shape with the three-dimensional net embedded therein;

Fig. 16 is a top plan view of the cushioning member of Fig. 15;

Fig. 17 is a cross-sectional view taken along line XVII-XVII in Fig. 16;

Fig. 18 is a view similar to Fig. 15, but depicting a modification thereof;

Fig. 19 is a top plan view of the cushioning member of Fig. 18;

Fig. 20 is a cross-sectional view taken along line XX-XX in Fig. 19;

Fig. 21 is a graph showing the static characteristics of a cushion structure in which a pad material has been impregnated into the three-dimensional net indicated by No. 09002D in Table 2;

Fig. 22 is a graph showing the static characteristics of a cushion structure in which a pad material has been impregnated into the three-dimensional net indicated by No. 90012-2 in Table 2;

Fig. 23 is a graph showing the static characteristics of a cushion structure in which no pad material has been impregnated into the three-dimensional net indicated by No. 90012-2 in Table 2;

Fig. 24A is a top plan view of a seat cushion, particularly depicting the position where the three-dimensional net was embedded and the position where the static characteristics of Figs. 21 to 23 were measured;

Fig. 24B is a fragmentary side view of the seat cushion of Fig. 24A; and

Fig. 25 is a graph showing the dynamic characteristics of the cushion structures that exhibit the static characteristics of Figs. 21 to 23 and those of a cushion made of only urethane.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] This application is based on application No. 11-21463 filed January 29, 1999 in Japan, the content of which is incorporated hereinto by reference.

[0016] Figs. 1 to 3 depict a seat S having a cushion structure according to a first embodiment of the present invention. This seat S includes a seat cushion 2 and a seat back 4 pivotally mounted on the seat cushion 2.

[0017] As shown in Fig. 4, the seat cushion 2 includes an urethane-based pad material 6 and a three-dimensional net (hereinafter referred to as a 3-D net) 8 embedded in a central portion of the pad material 6. The pad material 6 is expanded or foamed with the 3-D net 8 embedded therein. During foaming, the pad material 6 is impregnated into the 3-D net 8.

[0018] Figs. 5 and 6 depict a three-dimensional mesh knit forming the 3-D net 8. A fabric base is formed into a honeycomb-shaped (hexagonal) mesh. The mesh knit is of a three-layered solid truss structure in which an upper mesh layer 10 and a lower mesh layer 12 are connected to each other by a pile layer having a large number of piles 14.

[0019] Each yarn of the upper mesh layer 10 and the lower mesh layer 12 is formed by twisting a number of fine threads, while each of the piles 14 is formed of a single thick string to provide the three-dimensional mesh knit with rigidity.

[0020] Table 1 shows physical values of various materials used for the upper mesh layer 10, the lower mesh layer

12, and the piles 14 forming the pile layer.

Table 1

Item \ Item No.		D80032C	D80050	D80052	D80052-B	D80055	D80053
Material		Polypropylene	Polyester *A	←	Polyester	←	Polyester *A
Weight g/m²		663	480	483	496	481.6	454.4
Density	warp/inch	7	5	5	6	6	6
	weft/inch	14	15	15	15	15	14
Fiber Thickness (d/f)	ground	210d/60f	150d/48f	←	←	250d/48f	150d/48f
	pile	380d/1f *double	600d/1f black	←	600d/1f	←	600d/1f black
Pull Strength (kg/5cm)	warp	41.9	10.8	10.2	15.1	29.0	11.2
	weft	20.0	5.4	6.6	6.98	14.2	9.0
Elongation (%)	warp	49.5	50.4	49.5	34.2	37.7	61.7
	weft	178.0	126.2	114.1	153.8	134.4	71.0
Pile Texture		cross	straight	cross	cross	cross	cross

[0021] In Table 1, "*A" means that the material was colored to black. Character d represents a denier, and 1d is a

unit of thickness when 1 gram of thread has been pulled by 9,000 meters. 210d is a thickness when 1 gram of thread has been pulled by 9,000/210=42.9 meters. Character f represents a filament that is a unit indicating the number of fine threads forming a yarn, and 60f means that a yarn is made of 60 fine threads. The pulling strength "kg/5cm" is a strength when a mesh having a width of 5 cm has been pulled in the longitudinal direction. Furthermore, "straight" in the pile texture means that hexagons of the upper mesh layer 10 and those of the lower mesh layer 12 completely overlap each other as viewed from above, while "cross" means that they deviate from each other.

[0022] Thermoplastic resins are preferably used as the material of the three-dimensional mesh knit, and it is sufficient if the material can be formed into fibers. When textiles are made of such material, it is sufficient if it provides a strength required for a sheet stock. Typical examples are thermoplastic polyester resins such as polyethylene terephthalate (PET), polybutylene terephthalate (PBT), etc., polyamide resins such as nylon 6, nylon 66, etc., polyolefin resins such as polyethylene, polypropylene, etc., and resins in which more than two kinds of such resins are mixed.

[0023] The fiber thickness of each pile 14 is greater than 380d and, preferably, greater than 600d so that the load of a seat occupant applied to the three-dimensional mesh knit can be supported by deformation of the hexagonal meshes and by inclination of the piles, thereby providing a soft structure that causes no stress concentration.

[0024] Fig. 7 depicts a load-deflection curve of a three-dimensional mesh knit employed in the 3-D net 8.

[0025] This curve is a curve obtained by cutting off the three-dimensional mesh knit so as to have a circumferential length of 653 mm and by pressing a ϕ 76-plate against it. This curve is a smooth non-linear curve compared with a curve of elastic material such as urethane. Because the three-dimensional mesh knit has a large hysteresis, when it is employed in an automobile seat, it can absorb external vibration energy effectively.

[0026] Figs. 8A to 8C schematically depict several fabric base textures used for the upper and lower mesh layers 10, 12. In particular, Fig. 8A depicts a honeycomb-shaped (hexagonal) mesh shown in Fig. 5, Fig. 8B a diamond-shaped mesh, and Fig. 8C a chain-inserted texture.

[0027] Figs. 9A to 9D schematically depict several pile textures connecting the upper and lower mesh layers 10, 12. In particular, Fig. 9A depicts a generally straight texture corresponding to Fig. 6, Fig. 9B a generally straight texture in the form of a figure "8", Fig. 9C a cross texture, and Fig. 9D a cross texture in the form of a figure "8".

[0028] Table 2 shows physical values of the material used for the upper mesh layer 10, the lower mesh layer 12 and the piles 14 forming the pile layer, and those of other various materials.

Table 2

Item \ Item No.		09001-D	09002D	09006D	D80053-2	D90028-5	90012-2
Material		Polyester	←	←	←	←	←
Weight g/m²		1027	1101	1280	784	840	648
Density	warp/inch	7	8	8	7.5	10	6.0
	weft/inch	15	15	14	13	14	14.0
Fiber Thick. (d/f)	ground	1300d/96f	1300d/96f 500d/70f	1300d/96f	1300d/96f 500d/70f	← ←	1300d/96f
	pile	800d/1f	←	←	600d/1f	←	300d/1f
Pull Strength (kg/5cm)	warp	129.2	156.8	96.7	156.9	201.1	107.7
	weft	89.0	68.6	143.2	62.1	121.1	85.2
Elongation (%)	warp	68.2	70.0	73.1	56.2	47.9	39.8
	weft	98.4	96.6	65.0	66.4	102.8	102.6
Tear Strength (kg)	warp	87.5	96.2	87.0	87.9	99.9	72.7
	weft	63.7	54.8	82.5	49.2	70.3	56.1
Load (*1) 200 g/cm² Ordinary State	thick. mm	11.1	11.7	12.3	—	—	—
	compress. %	16.2	13.3	11.6	—	—	—
	elasticity %	92.6	91.3	89.9	—	—	—
Strain After Repeated Load (%)	warp	2.8	1.6	2.5	2.6	2.3	3.0
	weft	2.0	5.2	1.8	10.6	10.6	31.0
Surface Wearability Grade	warp	4.5	3.5	4	4.5	4.5	4.5
	weft	4	3.5	4	4	4	4
Fastness to Light Grade	150H	4.5	4.5	4.5	—	—	—
	250H	4	4.5	—			
Fastness to Rubbing Grade	dry cloth	4.5	4.5	4.5	—	—	—
	wet cloth	4.5	4.5	4.5			

Remarks (*1) : Sample Size: 50×50mm
Loading Time: 10 minutes
Shelf Time: 10 minutes

[0029] Fig. 10 depicts a modification 2A of the seat cushion 2 according to the first embodiment of the present invention. The seat cushion 2A includes an urethane-based pad material 6 and a 3-D net 8 embedded in a lower portion of the pad material 6. The pad material 6 is expanded or foamed with the 3-D net 8 embedded therein. During foaming,

the pad material 6 is impregnated into The 3-D net 8.

[0030] Fig. 11 depicts a seat cushion 2B employing a cushion structure according to a second embodiment of the present invention. The seat cushion 2B includes an urethane-based pad material 6 and a 3-D net 16 embedded in a central portion of the pad material 6. Although the pad material 6 is expanded or foamed with the 3-D net 16 embedded therein, the pad material 6 is not impregnated into the 3-D net 16.

[0031] More specifically, the seat cushion 2B includes upper and lower impregnation prevention sheets 18, 18 made of thermoplastic polyurethane elastomer and covered on the upper and lower surfaces of the 3-D net 8, respectively. After the entire circumferential portions of the upper and lower impregnation prevention sheets 18, 18 have been joined together by vibration welding, urethane is foamed together with the 3-D net 16. During foaming, the impregnation prevention sheets 18, 18 prevent The pad material from being impregnated into the 3-D net 8.

[0032] A thermoplastic polyurethane elastomer spunbonded fabric having a structure of three-dimensional entanglement of 100% polyurethane fine plastic filaments is preferably used for the impregnation prevention sheets 18, 18. The use of this thin film integrates the pad material 6 and the 3-D net 16. Accordingly, when a user sits on the seat cushion 2B, he or she does not have any unpleasant feeling with the 3-D net 16.

[0033] Furthermore, because no pad material is impregnated into the 3-D net 8, the spring constant in a normal use region including a balance point decreases as a whole, as described later.

[0034] Fig. 12 depicts a modification 2C of the seat cushion 2B shown in Fig. 11. The seat cushion 2C shown therein includes an urethane-based pad material 6 and a 3-D net 16A embedded in a lower portion of the pad material 6. Prior to foaming, the upper surface of the 3-D net 8 is covered with the sheet 18, while the lower surface of the 3-D net 8 is covered with no sheet.

[0035] Fig. 13 depicts another modification 2D of the seat cushion 2B shown in Fig. 11. The seat cushion 2D shown therein includes an urethane-based pad material 6 and a 3-D net 16B embedded in an upper portion of the pad material 6. Prior to foaming, the upper surface of the 3-D net 8 is covered with no sheet, while the lower surface of the 3-D net 8 is covered with the sheet 18.

[0036] Fig. 14A depicts a seat cushion 2E employing a cushion structure according to a third embodiment of the present invention. This seat cushion 2E includes an urethane-based pad material 6 and a 3-D net 8 embedded in a central portion of the pad material 6. In making the seat cushion 2E, a U-shaped wire 20 is inserted into the circumferential portions of the 3-D net 8, as shown in Fig. 14B, and the pad material 6 is then foamed with the 3-D net 8 embedded therein.

[0037] In this construction, deformation of the 3-D net 8 is restricted by the U-shaped wire 20 and, hence, an increase in spring constant enlarges the region in which the 3-D net 8 withstands a load, thus relieving the bottom-end shock.

[0038] In the above-described embodiments, an urethane-based pad material 6 is foamed with the 3-D net 8, 16, 16A, or 16B embedded therein. However, in the case where the pad material 6 contains the 3-D net 8 embedded in a lower portion thereof, as shown in Fig. 10 or 12, the 3-D net 8 may be embedded in an urethane-based pad material 22 foamed into a generally rectangular shape, as shown in Figs. 15 to 17. In that case, the pad material 22 is received in a generally rectangular recess defined in a lower portion of the seat-shaped pad material 6.

[0039] In place of the 3-D net 8 shown in Figs. 15 to 17, the 3-D net 16A may be embedded in the generally rectangular urethane-based pad material 22, as shown in Figs. 18 to 20.

[0040] In the construction shown in Fig. 11 or 13, the fabric base texture in the form of honeycomb-shaped mesh shown in Fig. 8A and the chain-inserted fabric base texture shown in Fig. 8C may be used for the upper mesh layer 10 and the lower mesh layer 12 of the 3-D net 8, respectively. Because the chain-inserted fabric base texture has smaller meshes than the honeycomb-shaped fabric base texture, even if the lower surface of the 3-D net 8 is not covered with the sheet 18 prior to foaming of the pad material 6 together with the 3-D net 8, the pad material 6 is not impregnated into the 3-D net 8.

[0041] Fig. 21 depicts the static characteristics of the cushion structure according to the present invention when a pad material was impregnated into the 3-D net indicated by No. 09002D in Table 2. Fig. 22 depicts the static characteristics of the cushion structure when a pad material was impregnated into the 3-D net indicated by No. 90012-2 in Table 2, while Fig. 23 depicts those of the cushion structure when no pad material was impregnated thereinto. These graphs were obtained by pressing a ϕ 98-plate against the cushion structure at a speed of 50mm/min so that the cushion structure may be compressed by 24.8mm. In the figures, k1 to k6 indicate the spring constants. The spring constants shown in Tables 3, 4, and 5 correspond to the static characteristics shown in Figs. 21, 22, and 23, respectively.

Table 3

Unit: N/mm						
	k1	k2	k3	k4	k5	k6
3-D net	90.20	118.90	393.00	-	-	-
Urethane	8.81	3.76	9.15	29.15	84.03	-
3-D net + Urethane	5.68	5.52	22.28	135.92	337.57	334.20

Table 4

Unit: N/mm						
	k1	k2	k3	k4	k5	k6
3-D net	37.20	14.30	90.30	-	-	-
Urethane	8.81	3.76	9.15	29.15	84.03	-
3-D net + Urethane	4.89	5.57	14.71	40.94	62.17	96.93

Table 5

Unit: N/mm						
	k1	k2	k3	k4	k5	k6
3-D net	37.20	14.30	90.30	-	-	-
Urethane	8.81	3.76	9.15	29.15	84.03	-
3-D net + Urethane	6.82	4.77	12.11	18.21	25.69	113.53

[0042] Figs. 24A and 24B depicts the position where the 3-D net was embedded and the position (point H) where the static characteristics of Figs. 21 to 23 were measured. The point H corresponds approximately to the tuber ischiadicum of a seat occupant.

[0043] Fig. 25 depicts the dynamic characteristics of the cushion structures that exhibit the static characteristics of Figs. 21 to 23 and those of a cushion made of only urethane. The graph of Fig. 25 was obtained by inputting a random wave into the cushion and cushion structures using a triaxial exciter (subject weight: 94kg).

[0044] As can be seen from the graph of Fig. 25, the cushion structure in which urethane has been impregnated into the 3-D net has a relatively large spring constant as a whole and, in particular, the cushion structure employing No. 09002D can withstand a large load and has superior damping characteristics in a low-frequency region, though it has not good damping characteristics in a high-frequency region. On the other hand, the cushion structure in which no urethane has been impregnated into the 3-D net has a relatively small spring constant as a whole and exhibits good characteristics against high-frequency vibrations.

[0045] As described above, the cushion structure according to the present invention can provide arbitrary spring constants by making use of a combination of various 3-D nets and urethane. Accordingly, in employing the cushion structure according to the present invention in automobile seats, any suitable cushion structure can be selected depending on the rigidity of the chassis.

[0046] Although the static characteristics shown in Figs. 21 to 23 are those for the cushion structures in which a 3-D net has been impregnated into a lower portion of a pad material, the cushion structures in which the 3-D net has been impregnated into an upper portion of the pad material enhance the air permeability of seats, while the cushion structures in which the 3-D net has been impregnated into a central portion of the pad material can regulate the length of

stroke by appropriately selecting the 3-D net.

[0047] Because the cushion structure according to the present invention employing the three-dimensional mesh knit as the 3-D net includes honeycomb-shaped upper and lower mesh layers and a large number of piles each made of a single thick string, and is of a truss structure, it has the following advantages.

(1) Because each pile is elastic, the hardness, elasticity or fitness can be controlled by changing the quality of the material, fiber thickness, texture or physical characteristics thereof.
(2) By making use of the shape memory function of the honeycomb shape, the restoring capability and the resistance to deformation can be both enhanced.
(3) The truss structure makes it possible to provide a thin and hard-to-deform elastic structure having good pressure dispersing and moderating capabilities and improved fitness.
(4) Because the cushion structure is of a uniform honeycomb-shaped truss structure in which each part is independent it is excellent in body pressure dispersion (low and uniform body pressure distribution) and can accommodate physical differences. For thin and fleshless men, the cushion structure can prevent a frontward slip by concentrating, at low pressures, the body pressure on the tuber ischiadicum that is relatively insensitive to fatigue. Also, the cushion structure is excellent in weight movement and easy to change the attitude, and reduces the frictional shear force.
(5) The honeycomb-shaped truss structure does not bring about the state similar to a hammock (the state in which pressures are locally concentrated and strong side pressures are received), enables a user to take a natural attitude, and reduces a feeling of foreign substances by the effect of the elastic honeycomb structure.
(6) When no urethane has been impregnated, an air layer is formed inside the honeycomb-shaped truss structure, enhancing the moisture permeability and air permeability.
(7) The honeycomb-shaped truss structure increases the strength.

[0048] Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless such changes and modifications otherwise depart from the spirit and scope of the present invention, they should be construed as being included therein.

Claims

1. A cushion structure comprising:

a pad material; and
a three-dimensional net embedded in said pad material and comprising;

upper and lower mesh layers; and
a pile layer having a large number of piles for connecting said upper and lower mesh layers;

wherein said pad material is foamed with said three-dimensional net embedded therein.

2. The cushion structure according to claim 1, wherein said pad material has been impregnated into said three-dimensional net.

3. The cushion structure according to claim 1, wherein at least one of said upper and lower mesh layers is covered with an impregnation prevention sheet so that said impregnation prevention sheet prevents said pad material from being impregnated into said three-dimensional net.

4. The cushion structure according to claim 3, wherein said impregnation prevention sheet is made of thermoplastic polyurethane elastomer.

5. The cushion structure according to claim 1, wherein prior to foaming, a wire is inserted into said three-dimensional net.

Fig. 1

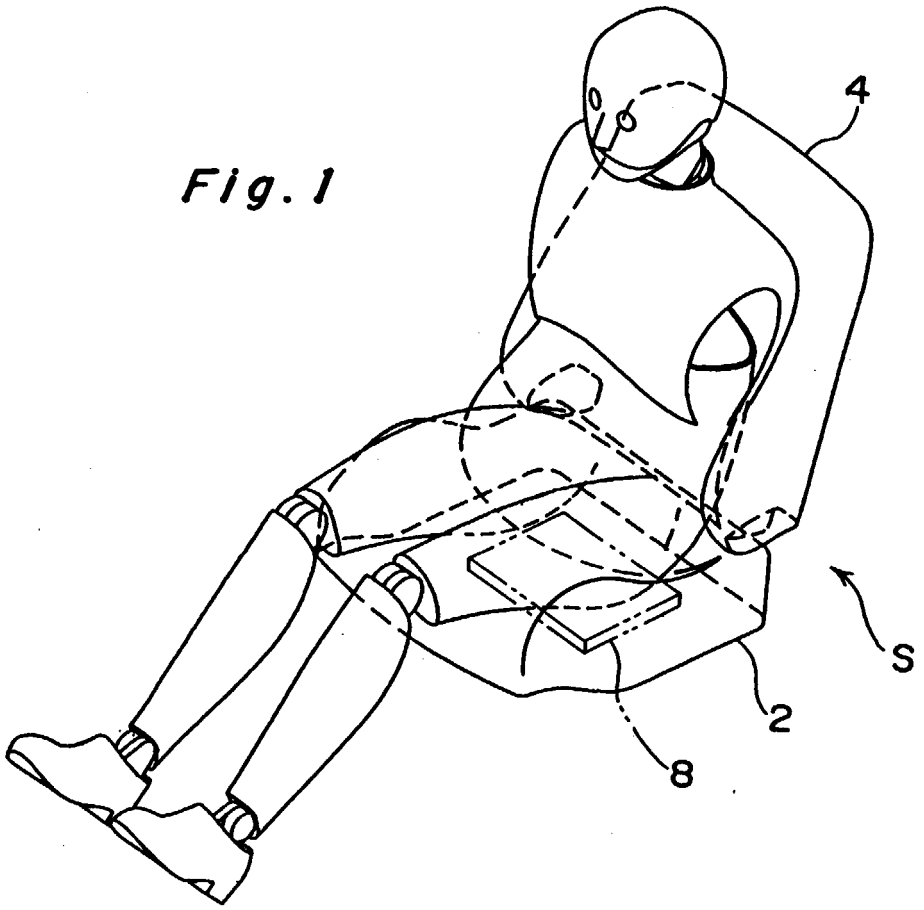


Fig. 2

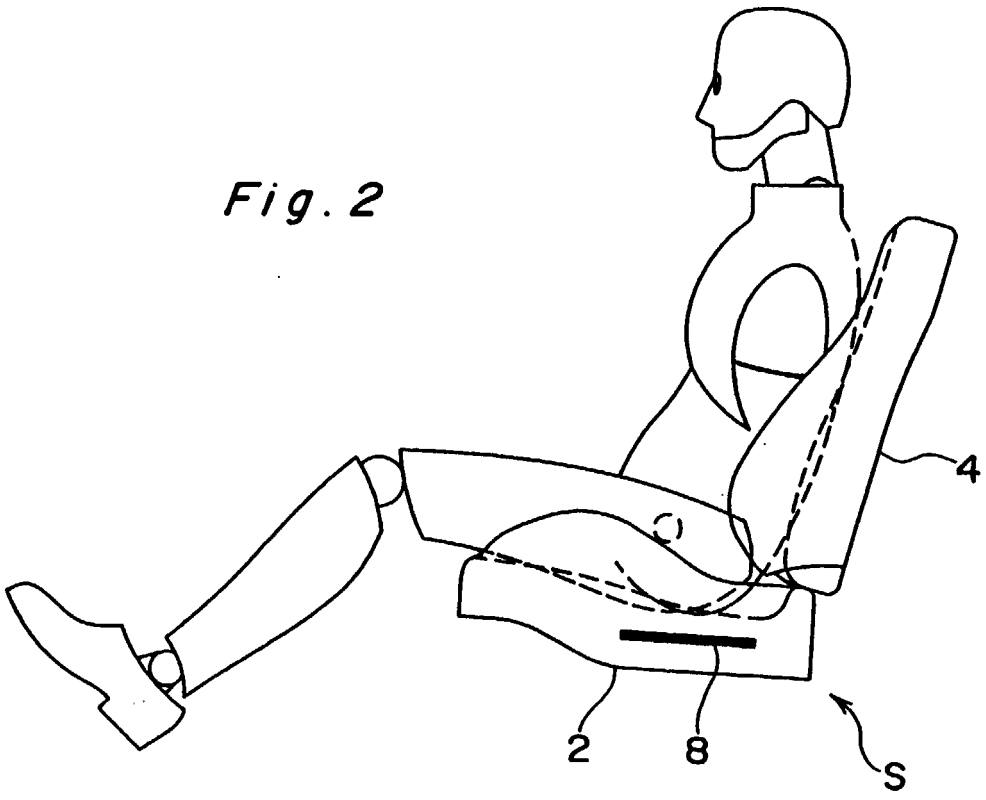


Fig. 3

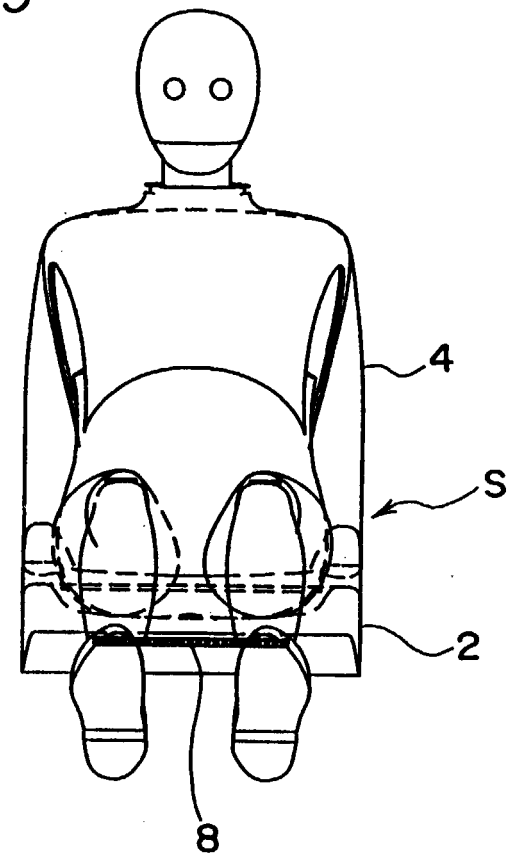


Fig. 4

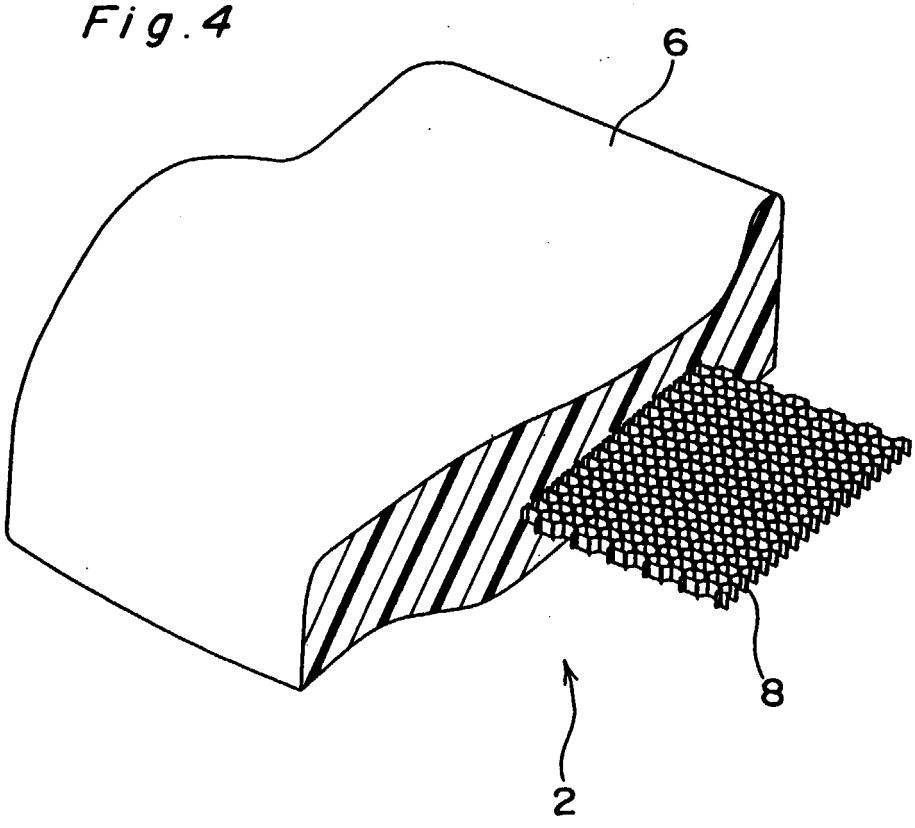


Fig. 5

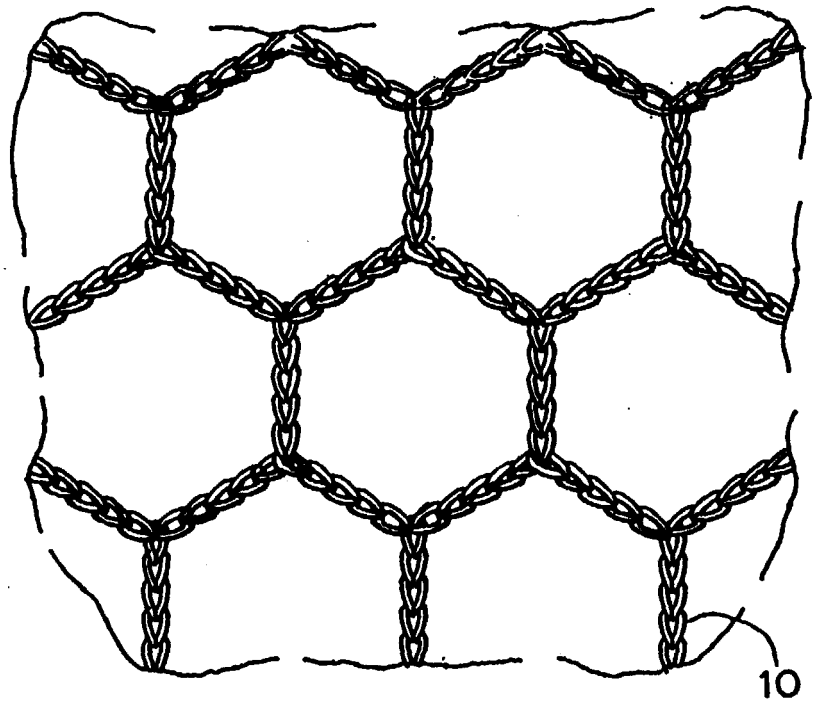


Fig. 6

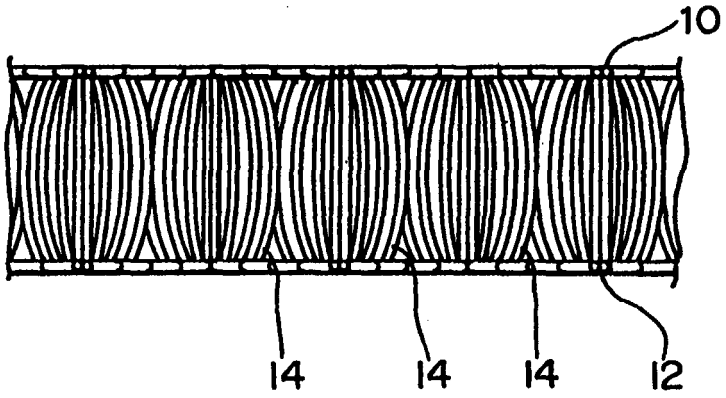


Fig. 7

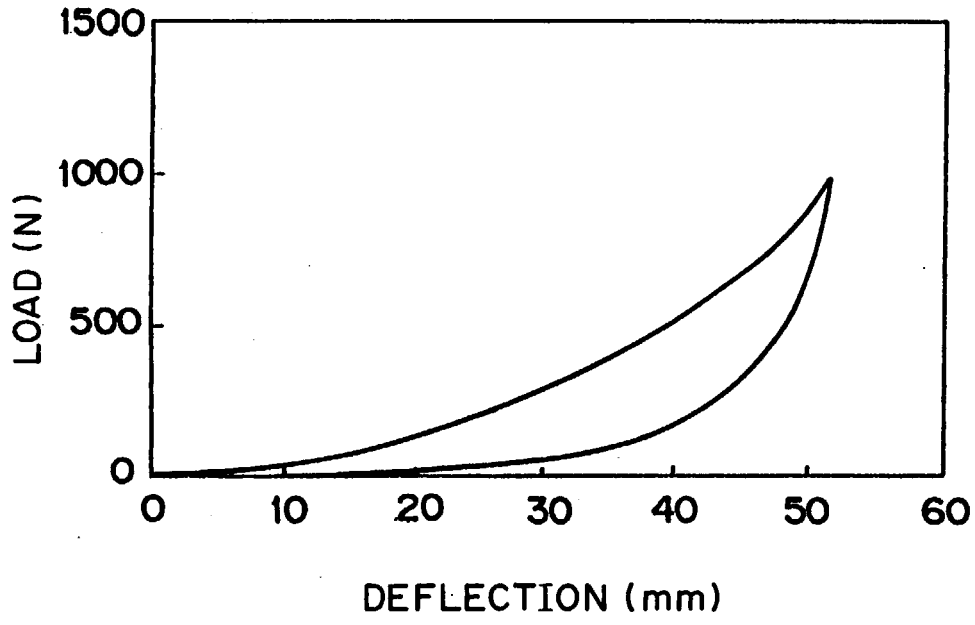


Fig. 8A

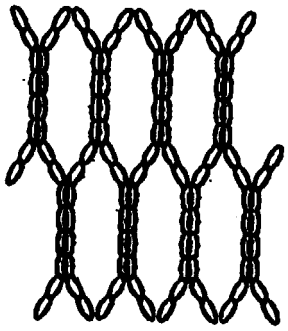


Fig. 8B

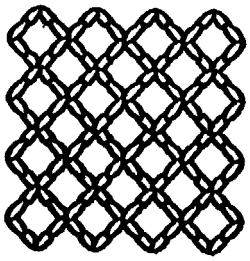


Fig. 8C

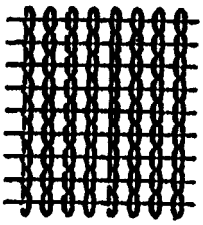


Fig. 9A

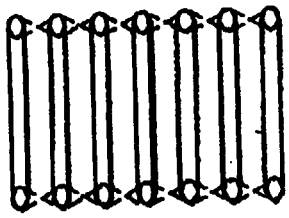


Fig. 9B

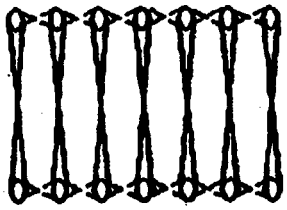


Fig. 9C

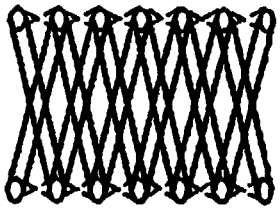
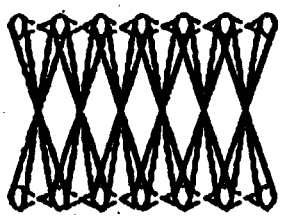


Fig. 9D



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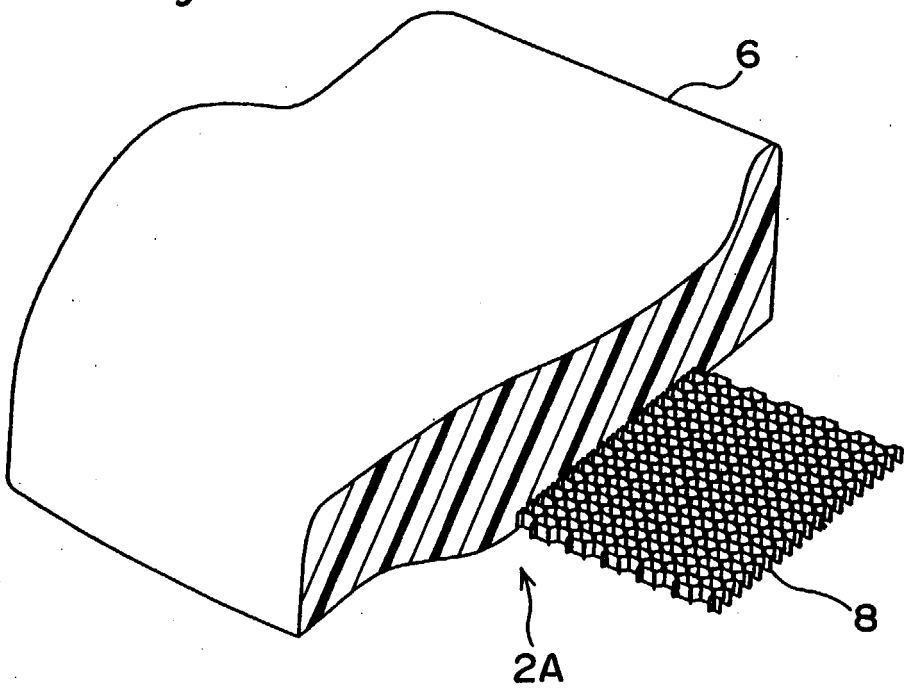


Fig. 11

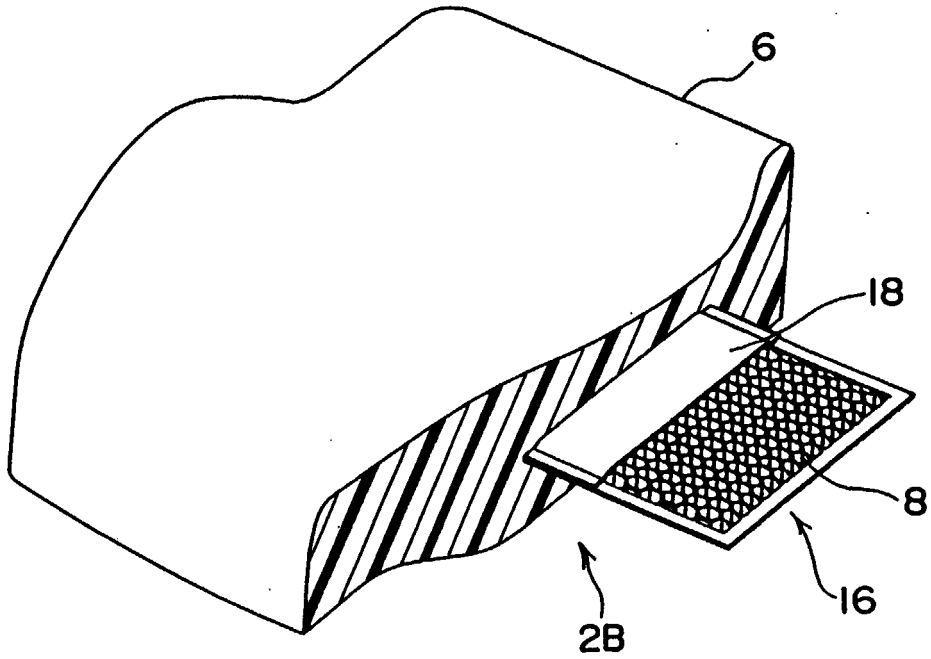


Fig. 12

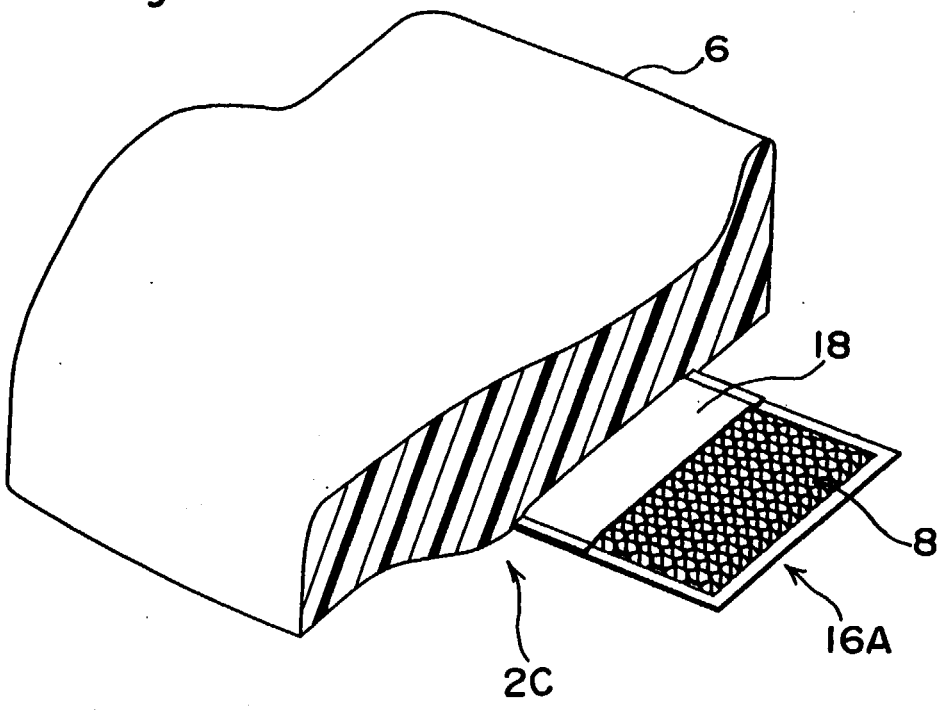


Fig. 13

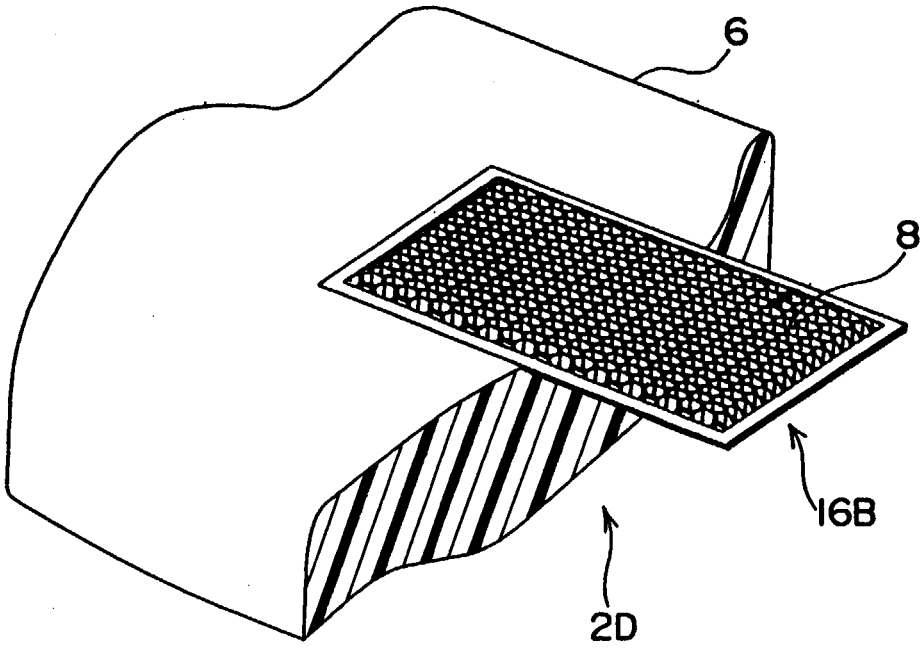


Fig. 14A

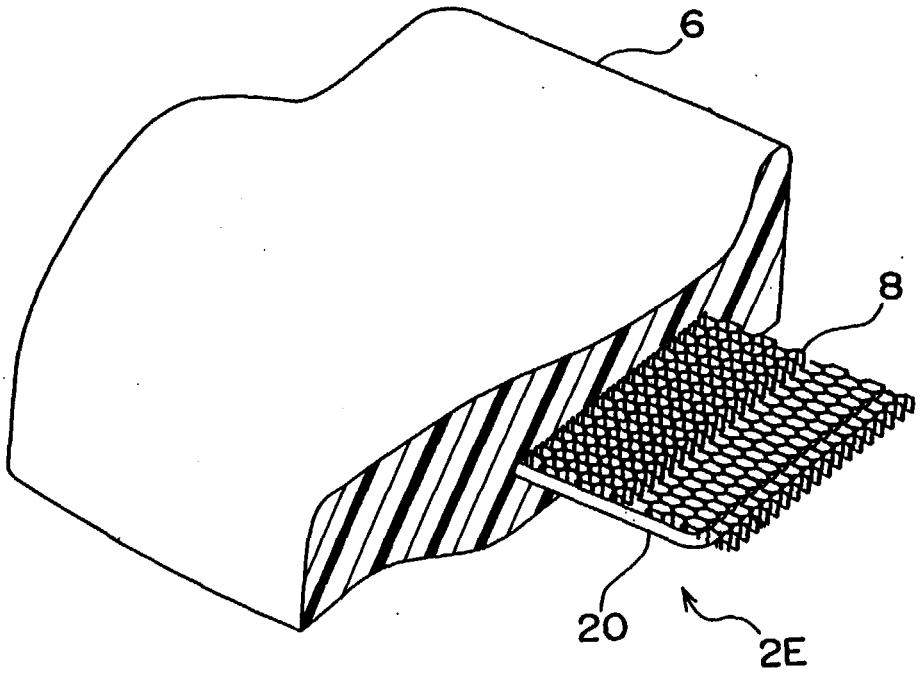


Fig. 14B

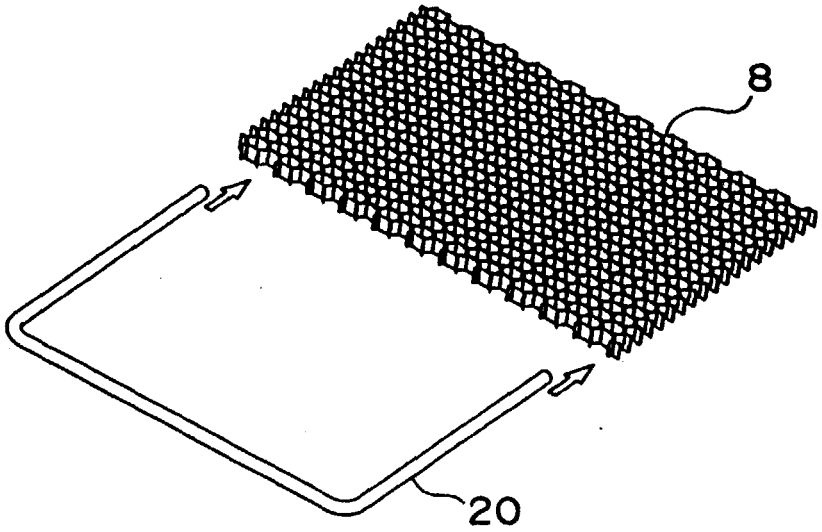


Fig. 15

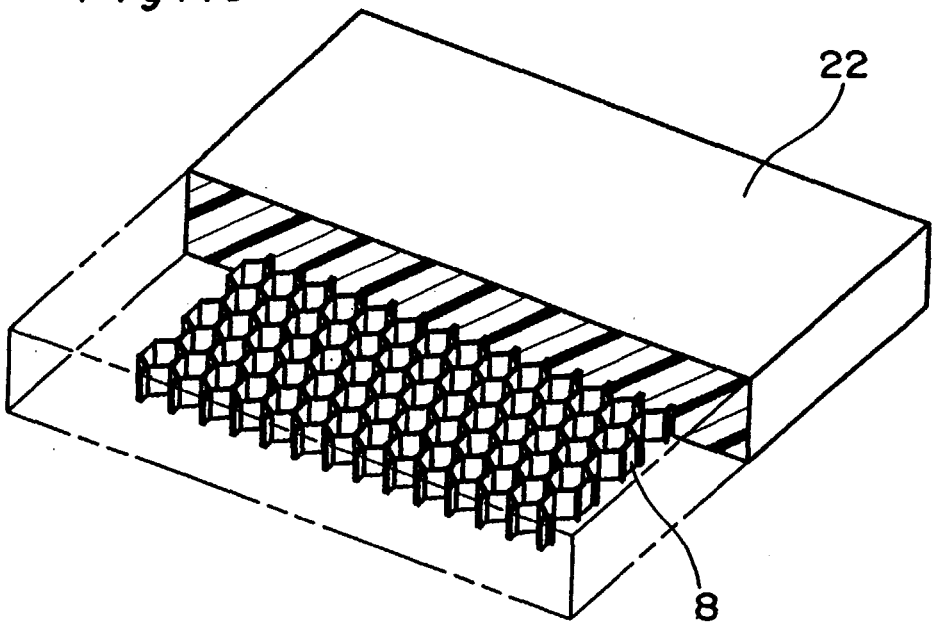


Fig. 16

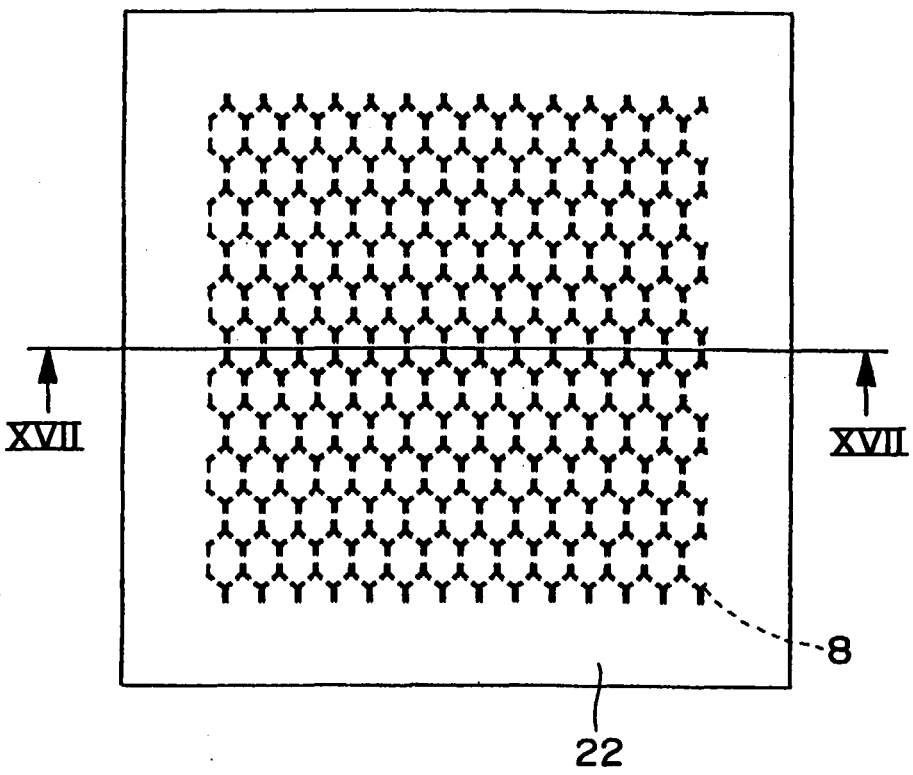


Fig. 17

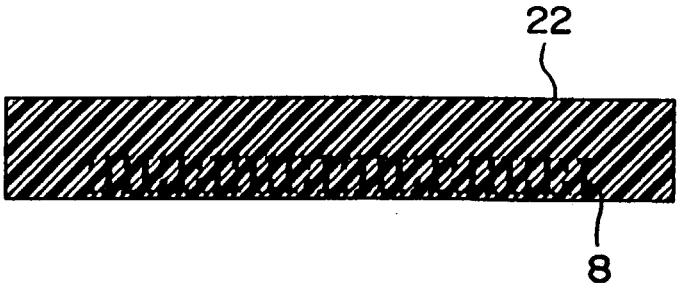


Fig. 18

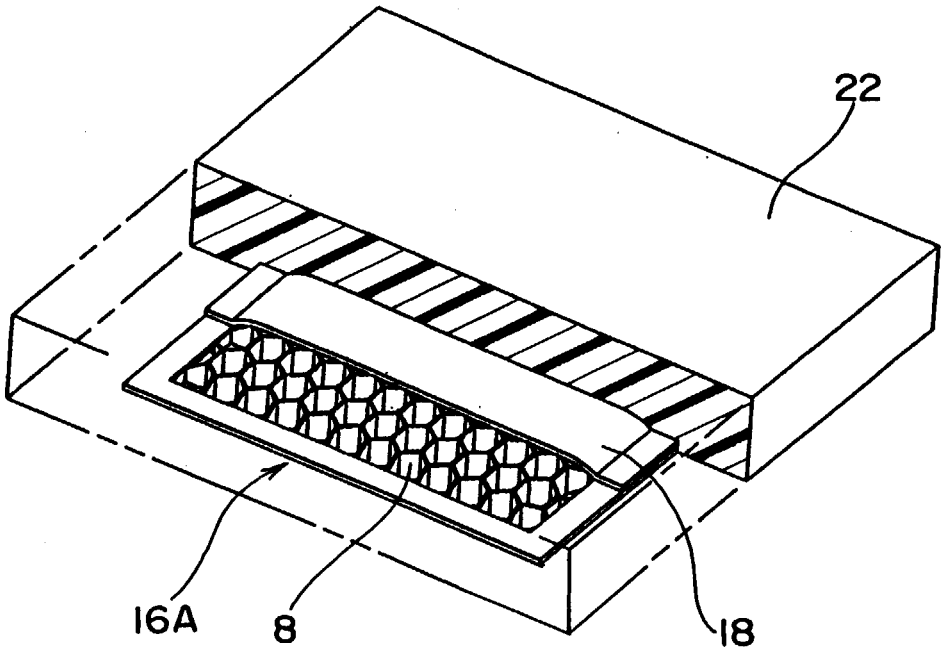


Fig. 19

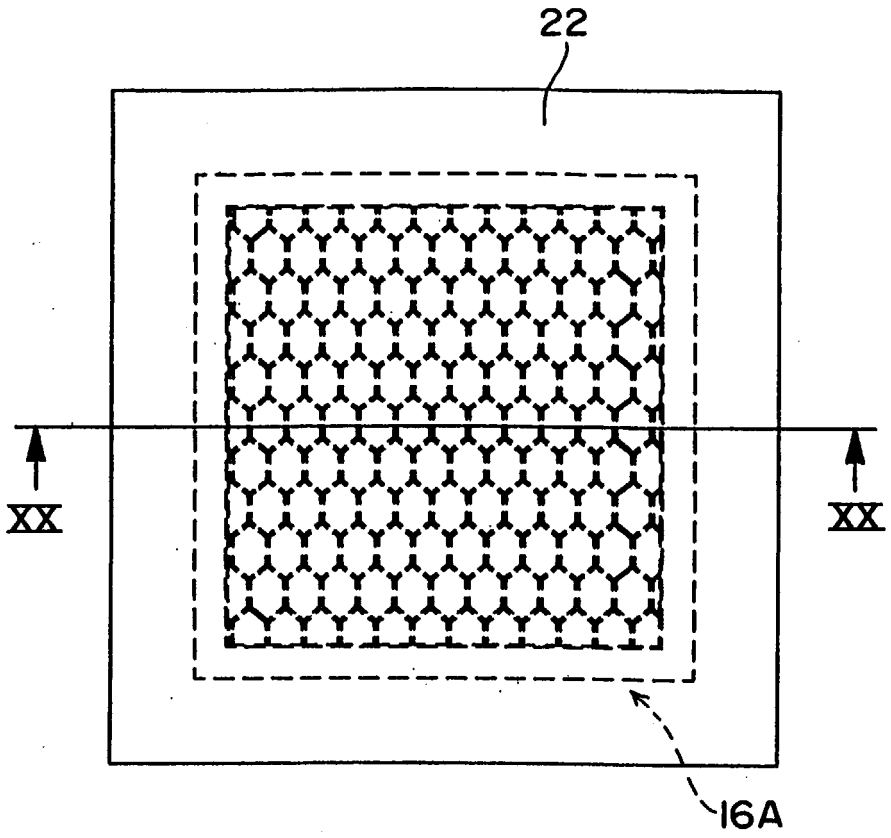


Fig. 20

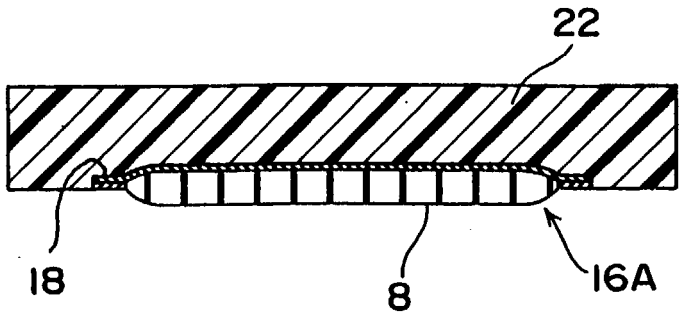
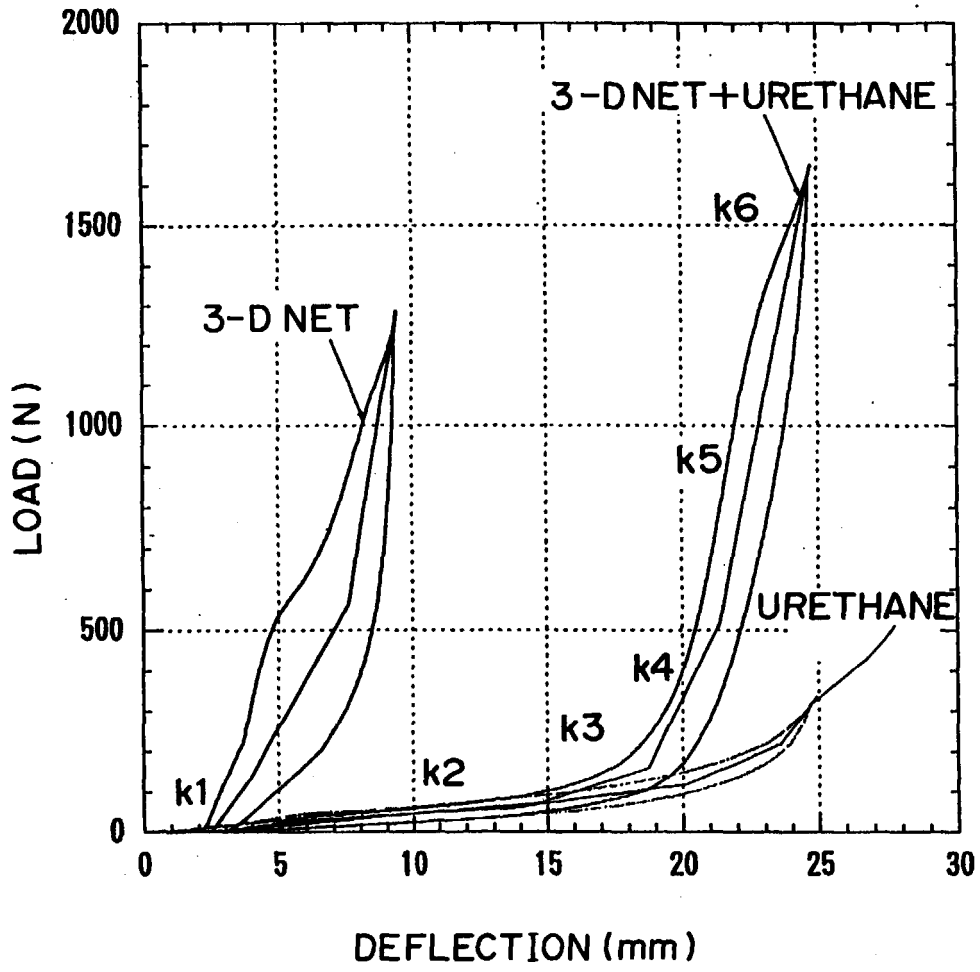


Fig. 21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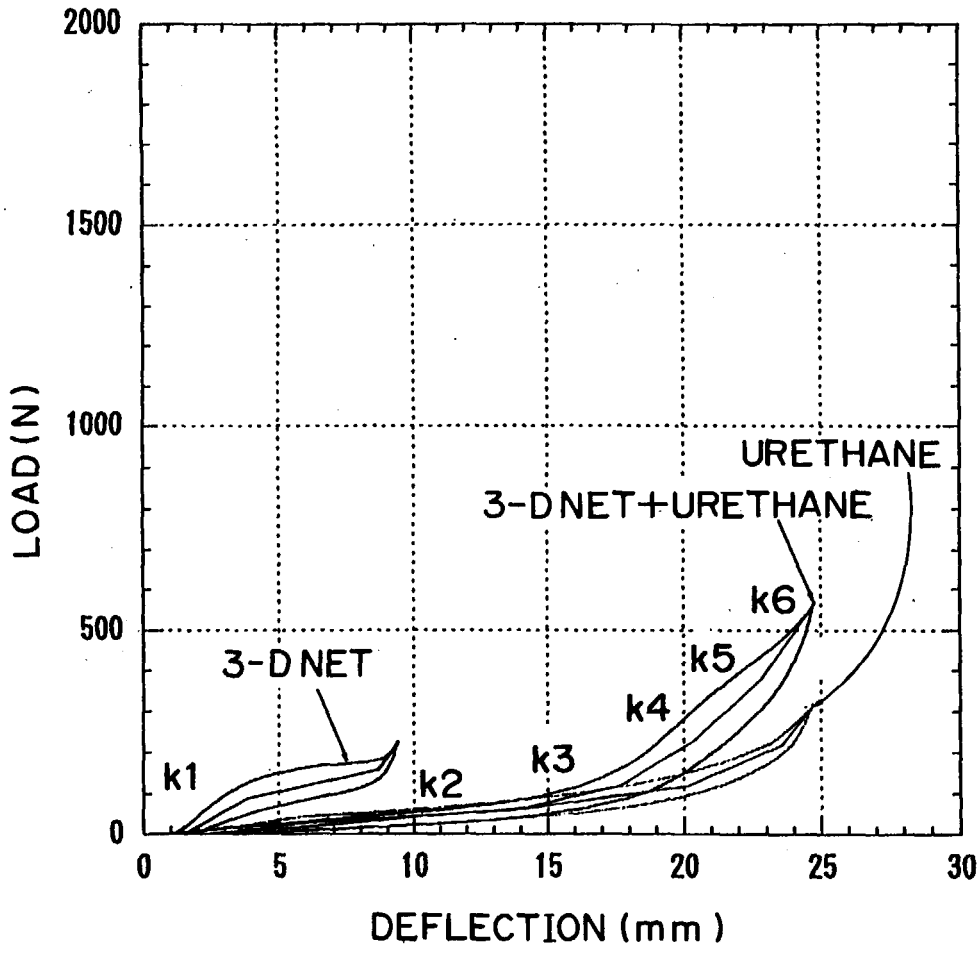
URETHANE
k4
k3
k2
k1

Fig. 22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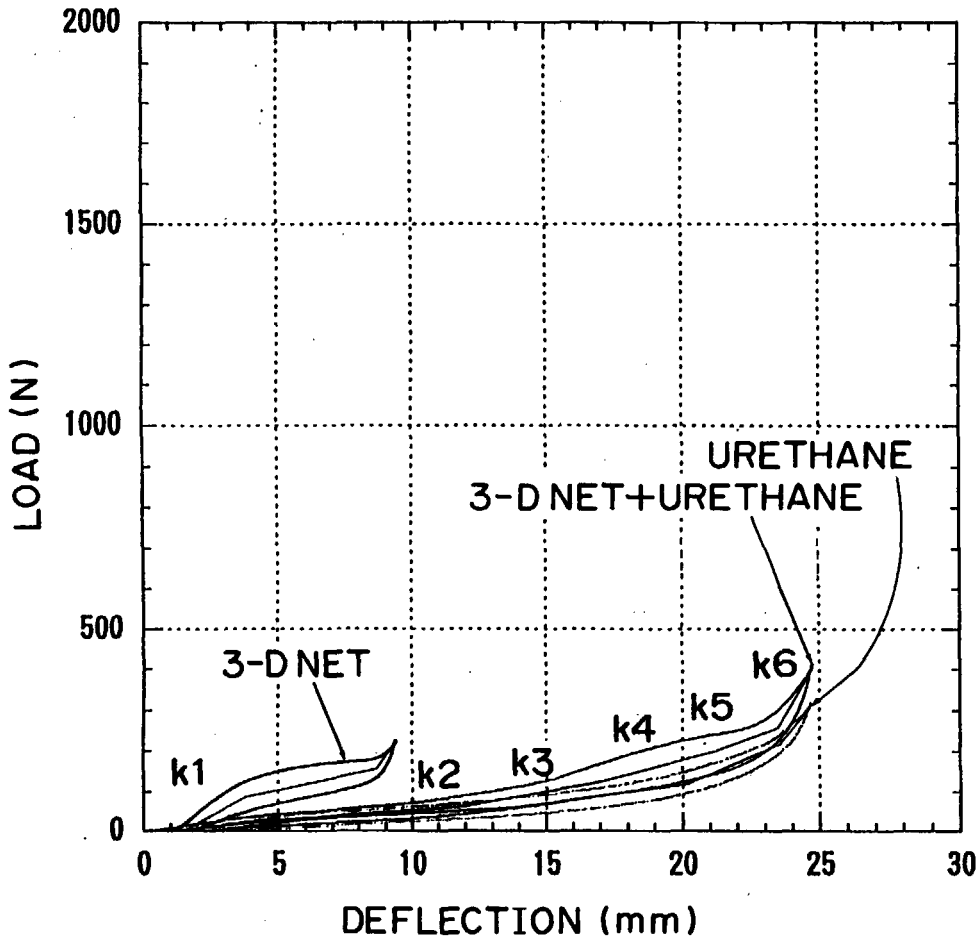
k5
k4
k3
k2
k1
3-D NET

Fig. 23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k1
k2
k3
k4
k5
k6

Fig.24A

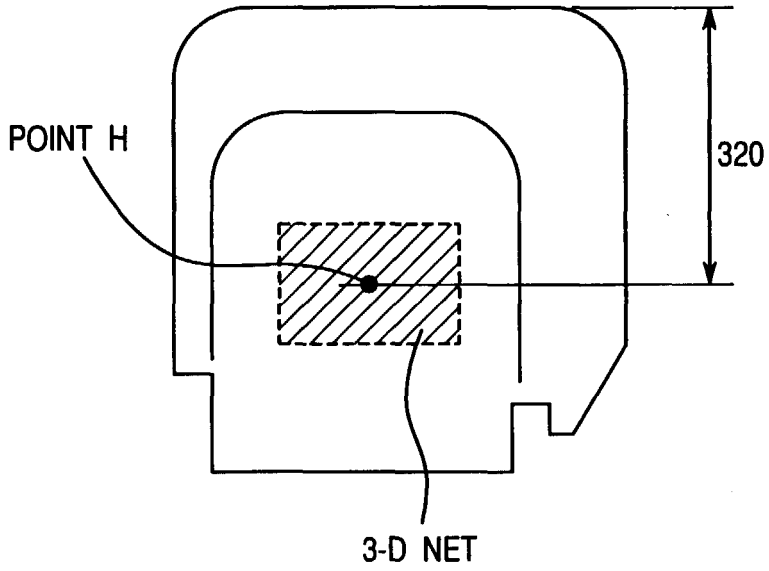


Fig.24B

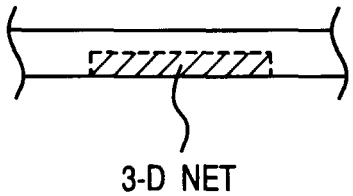
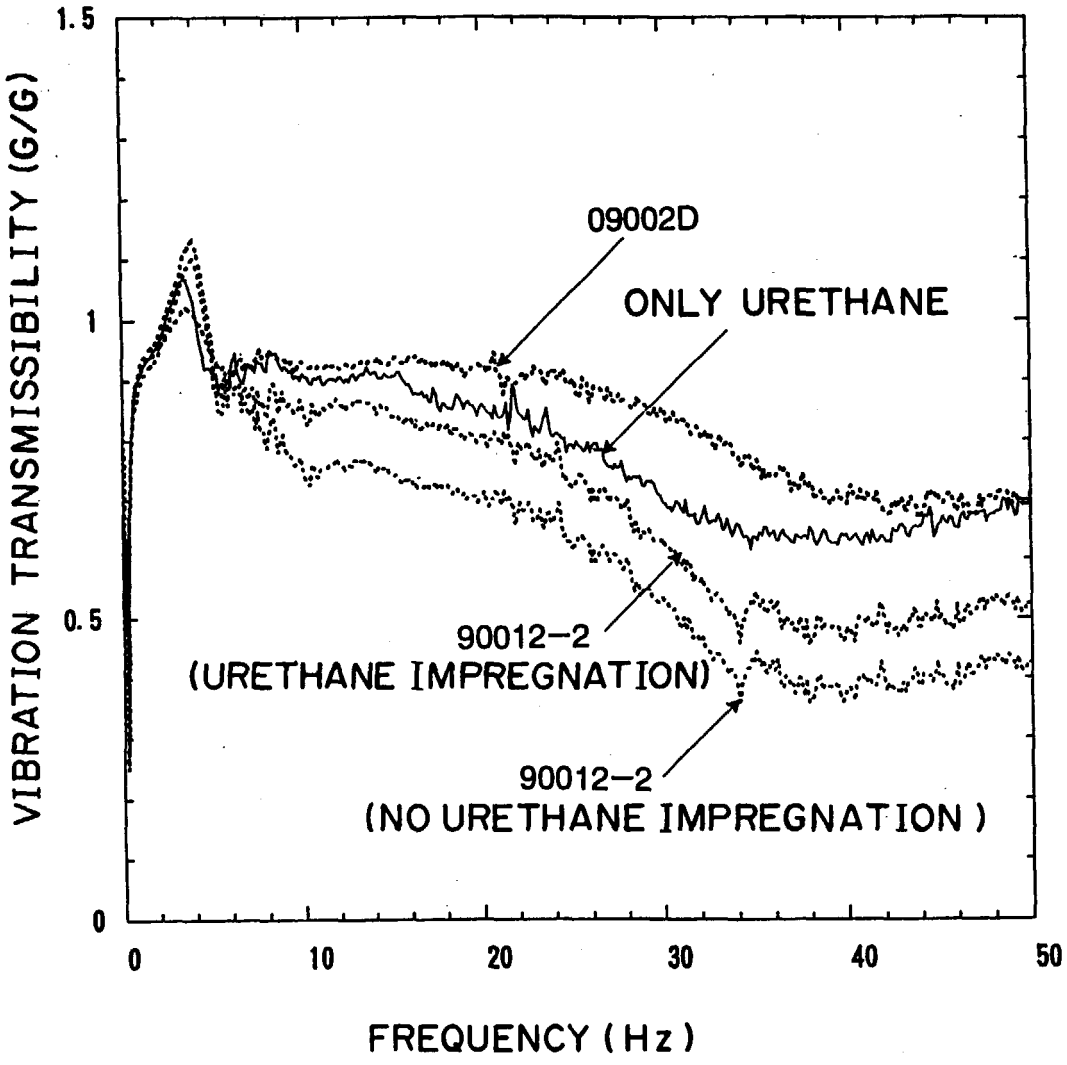


Fig. 25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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 0789

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X	WO 98 06553 A (CELLBOND COMPOSITES LIMITED ET AL) 19 February 1998 (1998-02-19) * abstract *	1,2	
A	* page 5, line 26 - page 8, line 28; claims 1-13; figures 1,2 *	3-5	
A	US 5 194 311 A (FARUK BAYMAK ET AL.) 16 March 1993 (1993-03-16) * abstract * * column 5, line 51 - column 7, line 49; figures 3,7-9 *	1,2	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	26 April 2000	Cuny, J-M

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