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(72) Inventor: **Takagaki, Takanari,**
Toyoda Boshoku Corporation
Kariya-shi, Aichi-pref. 448-8651 (JP)

(74) Representative:
Winter, Brandl, Fűrnis, Hübner, Röss, Kaiser,
Polte Partnerschaft
Patent- und Rechtsanwaltskanzlei
Alois-Steinecker-Strasse 22
85354 Freising (DE)

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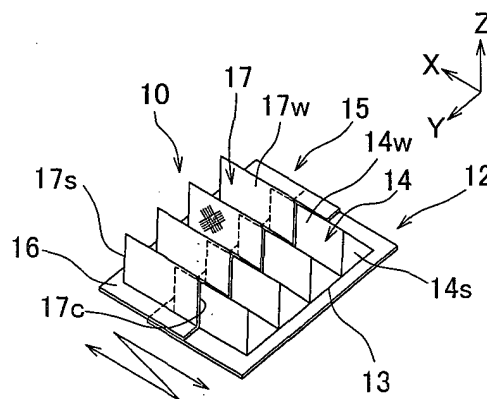
(71) Applicant: **Toyoda Boshoku Corporation**
Kariya-shi Aichi-pref., 448-8651 (JP)

(54) **Three-dimensional non-woven fabric, mold and method used therefore**

(57) A method for manufacturing a three-dimensional non-woven fabric according to the invention is a method in which semi-molten fibers are spun on a forming surface of a mold to form the three-dimensional non-woven fabric. The method includes a step of preparing a plurality of mold pieces (12, 15), which can be mutually overlapped and a step of forming a mold (10) including

forming surfaces (13, 14, 16, 17) in a certain size by partly mutually overlapping a plurality of the mold pieces (12, 15) and adjusting the area in which the mold pieces are mutually overlapped. This makes it possible to form plural types of three-dimensional non-woven fabrics whose sizes are different using only one unit of mold (10).

FIG. 1C



Description

BACKGROUND OF THE INVENTION

1. Field of Invention

[0001] The invention relates to a method for manufacturing a three-dimensional non-woven fabric in which semi-molten fibers are spun on a mold to form the three-dimensional non-woven fabric, a mold used for the method, and the three-dimensional non-woven fabric manufactured using the method and the mold.

2. Description of Related Art

[0002] As a related art, a method for manufacturing a three-dimensional non-woven fabric is disclosed in Japanese Patent Laid-Open Publication No.49-100374, and a side view or the like of a manufacturing apparatus used for an implementation of the method is shown in FIG. 6.

[0003] A manufacturing apparatus 90 for the three-dimensional non-woven fabric includes a chain conveyor 91. A plurality of molds 94 arranged in a moving direction is fitted on the conveyor 91. Each of the molds 94 is manufactured in accordance with a shape of the three-dimensional non-woven fabric. Also, a spinning nozzle 96 for spinning semi-molten fibers F is provided above the chain conveyor 91, and a spray gun 97 for spraying a binder or the like for binding each of the fibers F and a heating furnace 98 for drying the fibers are provided downstream of the spinning nozzle 96.

[0004] When a certain amount of the fibers F is spun out of the spinning nozzle 96 with the chain conveyor 91 driven at a constant speed, the fibers F are stacked on a forming surface 94f of the mold 94 at a constant thickness. Then, the binder is sprayed on the stacked fibers F and the fibers F are dried with the binder in the heating furnace 98, whereby each of the stacked fibers F are bonded with to form the three-dimensional non-woven fabric FC in a product shape. The three-dimensional non-woven fabric FC is removed from the forming surface 94f of the mold 94, and developed into a product after an unnecessary portion is removed.

[0005] However, according to the above-mentioned method, since the molds 94 specially manufactured for the shape of the three-dimensional fabric FC are used, when plural types of three-dimensional fabrics whose sizes are different are to be formed, plural types of the molds 94 are required as well. This increases a cost of molds when plural types of the three-dimensional non-woven fabrics are formed.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to reduce a cost of molds when plural types of three-dimensional non-woven fabrics whose sizes are different are formed.

[0007] A first aspect of the invention relates to a method for manufacturing a three-dimensional non-woven fabric in which semi-molten fibers are spun on a forming surface of a mold, and are formed into the three-dimensional non-woven fabric. The method includes the steps of preparing at least two mold pieces including a first mold piece, and a second mold piece which can be mutually overlapped with the first mold piece and whose area mutually overlapping with the first mold piece is adjustable, and forming a mold including a forming surface in an desired size by partly mutually overlapping the first mold piece with the second mold piece and adjusting the area in which the two mold pieces are mutually overlapped.

[0008] According to the first aspect of the invention, the size of the forming surface of the mold can be changed by changing the area in which the first mold piece and the second mold piece, which constitute the mold, are mutually overlapped. That is, plural types of three-dimensional non-woven fabrics whose sizes are different can be formed using only one unit of mold. This results in a cost reduction in the molds when plural types of three-dimensional non-woven fabrics are formed.

[0009] The area in which the two mold pieces are mutually overlapped may be adjusted by sliding the first mold piece with respect to the second mold piece.

[0010] The area in which the two mold pieces are mutually overlapped may be adjusted by changing the number of portions in which a plurality of concave portions formed on the first mold piece are fitted to a plurality of convex portions formed on the second mold piece. This makes it easy to adjust the area in which the two mold pieces are mutually overlapped. When the three-dimensional non-woven fabric includes a main portion and a peripheral portion which is provided on a periphery of the main portion, the concave portions and the convex portions may be provided on the forming surface of the mold which forms the main portion.

[0011] A second aspect of the invention relates to a mold which is used for a method for manufacturing a three-dimensional non-woven fabric in which semi-molten fibers are spun on a forming surface of a mold to form the three-dimensional non-woven fabric. This mold includes at least a first mold piece, and a second mold piece which can be mutually overlapped with the first mold piece and whose area mutually overlapping with the first mold piece is adjustable.

[0012] At least one of the first mold piece and the second mold piece may be formed by press molding or injection molding with resin or formed from a non-woven fabric.

[0013] The three-dimensional non-woven fabric manufactured using the method according to the first aspect and the mold according to the second aspect is included in the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The foregoing and further objects, features and advantages of the invention will become apparent from the following description of preferred embodiment with reference to the accompanying drawings, wherein like numerals are used to represent like elements and wherein:

FIG. 1A is a general perspective view of a mold which is used for a method for manufacturing a three-dimensional non-woven fabric (filter) according to embodiment of the invention.

FIG. 1B is an exploded perspective view of the mold shown in FIG. 1A.

FIG. 1C is a general perspective view when a width of the mold shown in FIG. 1A is expanded.

FIG. 2A is an exploded perspective view showing a first modified example of the mold according to the embodiment.

FIG. 2B is a general perspective view of the mold shown in FIG. 2A.

FIG. 3A is an exploded perspective view showing a second modified example of the mold according to the embodiment.

FIG. 3B is a general perspective view of the mold shown in FIG. 3A.

FIG. 4A is an exploded perspective view showing a third modified example of the mold according to the embodiment.

FIG. 4B is a general perspective view of the mold shown in FIG. 4A.

FIG. 5A is a perspective view in schematic form showing manufacturing equipment of a filter.

FIG. 5B is a longitudinal sectional view showing the manufacturing equipment shown in FIG. 5A.

FIG. 6 is a side view showing a common method for manufacturing the filter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] Hereafter, a method for manufacturing a three-dimensional non-woven fabric according to an embodiment of the invention will be explained with reference to FIGS. 1A to 5B. The embodiment relates to a method for manufacturing a filter as an example of the three-dimensional non-woven fabric. In the following description, a width direction of the manufacturing equipment is referred to as an X direction, a longitudinal direction thereof is referred to as a Y direction and an altitudinal direction thereof is referred to as a Z direction.

[0016] As shown in FIG. 5A, manufacturing equipment 1 for the filter includes a level conveyor 2, and a plurality of molds 10 (only one unit is shown in FIG. 5A) for forming the filter is arranged on the conveyor 2 in orderly manner.

[0017] Also, a spinning nozzle 4 is provided at a pre-

determined position above the conveyor 2. The spinning nozzle 4 is a nozzle which employs, for example, a melt blow method, and spins fiber type resin F (hereinafter referred to as fibers F) injected from an extruder (not shown) onto the whole mold 10 in which a right mold piece 12 and a left mold piece 17 are mutually overlapped. The fibers F spun out of the spinning nozzle 4 are semi-molten. The fibers F are stacked on the forming surface or the like of the mold 10, whereby the fibers F are bonded together to form the non-woven fabric.

[0018] As shown in FIG. 1B, the mold 10 for forming the filter is formed by mutually overlapping the right mold piece 12 and a left mold piece 15. The right mold piece 12 includes a square frame portion 13 with a constant width. A right mold main portion 14 is formed inside the square frame portion 13. The right mold main portion 14 includes a bellows portion 14w having a shape formed by sequentially arranging triangular ridges with substantially triangular side surfaces, and triangular side plate portions 14s which block right end surfaces of the bellows portion 14w. Note that left end portions 14c of the bellows portion 14w are open.

[0019] The left mold piece 15 includes an edge portion 16 formed to have a plane U-shape with a constant width. A left mold main portion 17 is formed inside the edge portion 16. The left mold main portion 17 also includes a bellows portion 17w having a shape formed by sequentially arranging triangular ridges with substantially triangular side surfaces, and triangular side plate portions 17s which block left end surfaces of the bellows portion 17w. Note that right end portions 17c of the bellows portion 17w are open.

[0020] Dimensions of vertical sections of the bellows portion 14w in the right mold piece 12 and the bellows portion 17w in the left mold piece 15 are set at the same value so that the right mold piece 12 and the left mold piece 15 can be mutually overlapped.

[0021] Namely, crest portions of the bellows portion 14w seen from a direction opposite to the Z direction can be regarded as convex portions of the invention, and trough portions of the bellows portion 17w seen from the Z direction can be regarded as concave portions of the invention.

[0022] The mold 10 for forming the filter is formed into the same shape as an desired shape of the filter by overlapping the right mold main portion 14 and the square frame portion 13 of the right mold piece 12 with the left mold main portion 17 and the edge portion 16 of the left mold piece 15, respectively. Namely, the left mold main portion 17 of the left mold piece 15 and the right mold main portion 14 of the right mold piece 12 function as forming surfaces for forming a filtration portion of the filter. The edge portion 16 of the left mold piece 15 and the square frame portion 13 of the right mold piece 12 function as the forming surfaces for forming a peripheral portion of the filter. Therefore, hereafter, the left mold main portion 17 of the left mold piece 15 and the right mold main portion 14 of the right mold piece 12 are re-

ferred to as first forming surfaces 14, 17, and the edge portion 16 of the left mold piece 15 and the square frame portion 13 of the right mold piece 12 are referred to as second forming surfaces 13, 16. The filtration portion of the filter can be regarded as a main portion of a three-dimensional non-woven fabric of the invention. The peripheral portion of the filter can be regarded as a peripheral portion of a three-dimensional non-woven fabric of the invention.

[0023] Both of the mold pieces 12, 15 are configured to be relatively slidable in the width direction (X direction) with the right mold piece 12 mutually overlapped with the left mold piece 15. Therefore, as shown in FIG. 1A, widths of the forming surfaces 13, 14, 16, 17 of the mold 10 can be narrowed by increasing the area in which the right mold piece 12 is mutually overlapped with the left mold piece 15. Also, as shown in FIG. 1C, the widths of the forming surfaces 13, 14, 16, 17 of the mold 10 can be widened by reducing the area in which the right mold piece 12 is mutually overlapped with the left mold piece 15. When the mold 10 is formed, the square frame portion 13 of the right piece 12 is fastened to the edge portion 16 of the left mold piece 15 with a clip or the like (not shown) so that they are retained firmly. As a result, displacement between the right piece 12 and the left mold piece 15 is prevented.

[0024] The mold 10 is formed from, for example, a wire net, a resin net or the like which has an air permeability. Then, when the mold 10 is formed from a resin net or the like, a mold-releasing agent is applied to the mold 10 in order to prevent the fibers F from adhering to the mold 10.

[0025] It is to be noted that the bellows portions 14w, 17w having four triangular ridges are exemplified in FIGS. 1A to 1C for the purpose of simplification of the figures. However, the actual number of the triangular ridges can be set at any value.

[0026] Secondary, a method for manufacturing the filter will be explained.

[0027] First, the right mold piece 12 and the left mold piece 15 of the mold 10 are relatively slid in the width direction (X direction), and width dimensions of the forming surfaces 13, 14, 16, 17 of the mold 10 are adjusted to an desired width dimension of the filter. Then, the square frame portion 13 of the right mold piece 12 is fastened to the edge portion 16 of the left mold piece 15 with a clip or the like to be retained firmly to prevent displacement between the right piece 12 and the left mold piece 15.

[0028] When the mold 10 is formed in the above-mentioned manner, each of the molds 10 is set on the conveyor 2. Then, an approximately constant amount per unit of time of the fibers F is spun out of the spinning nozzle 4, and the conveyor 2 is driven at a constant speed. Thus, the mold 10 moves below the spinning nozzle 4 at a constant speed. Then, as shown in FIG. 5B, semi-molten fibers F are stacked on the first forming surfaces 14, 17 and the second forming surfaces 13, 16

of the mold 10 at an approximately constant thickness sequentially starting from an end side (left end in the figure) in the Y direction.

[0029] The fibers F stacked on the first forming surfaces 14, 17 of the mold 10 and the fibers F stacked on the second forming surfaces 13, 16 of the mold 10 are fusion bonded with each other to form the non-woven fabric. Then, the non-woven fabric formed from the fibers F stacked on the first forming surfaces 14, 17 constitute the filtration portion of the filter. Also, the non-woven fabric formed from the fibers F stacked on the second forming surfaces 13, 16 constitute the peripheral portion of the filter.

[0030] When the filter is formed in the above-mentioned manner, a clip or the like is removed, and the right mold piece 12 of the mold 10 is moved with respect to the left mold piece 15 in a direction of narrowing the width of the mold 10. In this state, the filter is removed from the mold 10. The filter removed from the mold 10 is completed after an unnecessary portion thereof is removed.

[0031] According to the method for manufacturing the filter according to the embodiment, the mold 10 including the forming surfaces 13, 14, 16, 17 in a certain size is formed by partly overlapping a pair of the mold pieces 12, 15 and adjusting the area in which the mold pieces are mutually overlapped. Therefore, the width dimension of the forming surfaces 13, 14, 16, 17 of the mold 10 can be changed by changing the area in which the pair of mold pieces 12, 15 constituting the mold 10 are mutually overlapped. That is, plural types of filters whose width dimensions are different can be formed using only one unit of mold 10. This results in a cost reduction in the molds when plural types of filters are formed.

[0032] Note that, in the embodiment, an example of making the width dimension of the mold 10 changeable by relatively sliding the pair of the mold pieces 12, 15 in the width direction (X direction) is shown. Also, a linear dimension of a forming surface of a mold 20 can be changed by changing the number of the triangular ridges of a bellows portion 22w of a front mold piece 22 fitted to the triangular ridges of a bellows portion 25w of an end mold piece 25, as shown in FIG. 2B.

[0033] Also, as shown in FIGS. 3A and 3B, the width dimension and the linear dimension of forming surface of a mold 30 can be changed by constructing the mold 30 using four mold pieces 31, 32, 33, 34, which are arranged in a longitudinal direction and a lateral direction.

[0034] Also, the area in which the right mold piece 12 is overlapped with the left mold piece 15 may be easily adjusted by providing a convex portion on a top surface along the X direction of the square frame portion 13 of the right mold piece 12 and also providing a concave portion on a bottom surface along the X direction of the edge portion 16 of the left mold piece 15. Namely, filters in the same size can be manufactured without measuring the area (length) in which the right mold piece 12 is

overlapped with the left mold piece 15 each time the filter is manufactured.

[0035] FIGS 4A and 4B show modified examples of the mold 10 or the like.

[0036] A mold 40 shown in FIG. 4B includes a first mold piece 41 and a second mold piece 42, which are in the same shape.

[0037] As shown in FIG. 4A, the first mold piece 41 includes a square flat plate portion 41f and a plurality of convex portions 41t formed on a surface of the flat plate portion 41f. The convex portion 41t is formed in a frustum container shape whose bottom portion is open. An opening of the convex portion 41t (not shown) is formed on a rear surface of the flat plate portion 41f. A thickness of the convex portion 41t is formed to be substantially equal to the thickness of the flat plate portion 41f. The convex portions 41t are arranged at certain intervals in a longitudinal direction and a lateral direction in the first mold piece 41. Note that since the second mold piece 42 is in the same shape as the first mold piece 41, explanation thereof will be omitted.

[0038] The first mold piece 41 and the second mold piece 42 are manufactured by pressing a steel plate or the like into shape or injection molding with resin. When the mold and the three-dimensional non-woven fabric are integrated, that is, when the three-dimensional non-woven fabric is not removed from the mold, the first mold piece 41 and the second mold piece 42 may be formed from the non-woven fabric.

[0039] As shown in FIG. 4B, the mold 40 is formed by fitting a part of the convex portion 41t of the first mold piece 41 into the inside (concave portion) of the convex portion 42t of the second mold piece 42. Therefore, the area in which the first mold piece 41 is overlapped with the second mold piece 42 may be changed by changing the number of the portions where the convex portions 41t of the first mold piece 41 are fitted in the concave portions of the second mold piece 42.

[0040] Note that although an example of arranging the first mold piece 41 and the second mold piece 42 in the longitudinal direction and mutually overlapping each of the end portions along the Y direction is shown in FIG. 4B, it is also possible to arrange the first mold piece 41 and the second mold piece 42 in the lateral direction and mutually overlap each of the end portions along the X direction.

[0041] Also, in the embodiment, an example of manufacturing the filter as an example of the three-dimensional non-woven fabric is shown. However, not only the filter but also a buffer material, an acoustic material or the like can be produced.

[0042] Also, an example of forming the cross sections of the bellows portions 14w, 17w of the mold pieces 12, 15 into a triangular shape is shown. The cross sections may be formed into a semicircular or polygonal shape. In addition, an example of forming the convex portions 41t, 42t of the mold piece 41, 42 into a frustum shape is shown. However, the convex portions may be formed

into a hemispherical shape or a polyangular frustum shape.

[0043] According to the embodiment and the modified examples thereof, plural types of three-dimensional non-woven fabrics whose sizes are different can be formed using only one unit of mold. This results in a cost reduction in the molds when plural types of three-dimensional non-woven fabrics are formed.

[0044] While the invention has been described with reference to preferred embodiments thereof, it is to be understood that the invention is not limited to the preferred embodiments or constructions. To the contrary, the invention is intended to cover various modifications and equivalent arrangements. In addition, while the various elements of the preferred embodiments are shown in various combinations and configurations, which are exemplary, other combinations and configurations, including more, less or only a single element, are also within the spirit and scope of the invention.

Claims

1. A method for manufacturing a three-dimensional non-woven fabric in which semi-molten fibers are spun onto a forming surface of a mold (10; 30; 40) to form the three dimensional non-woven fabric, **characterized by** comprising the steps of:

preparing at least two mold pieces (12, 15; 22, 25; 31, 32, 33, 34; 41, 42) including a first mold piece, and a second mold piece which can be mutually overlapped with the first mold piece and whose area mutually overlapping with the first mold piece is adjustable, and forming a mold including a forming surface in an desired size by partly mutually overlapping the first mold piece with the second mold piece and adjusting the area in which the two mold pieces are mutually overlapped.

2. The method according to claim 1, **characterized in that**

the area in which the two mold pieces are mutually overlapped is adjusted by sliding the first mold piece with respect to the second mold piece.

3. The method according to claim 1, **characterized in that**

the area in which the two mold pieces are mutually overlapped is adjusted by changing the number of portions where a plurality of concave portions (17w) formed on the first mold piece is fitted to a plurality of convex portions (14w; 41t) formed on the second mold piece.

4. The method according to claim 3, **characterized in that**

the three-dimensional non-woven fabric includes a main portion and a peripheral portion which is provided on a periphery of the main portion, and the concave portions and the convex portions are provided on the forming surface (14, 17) of the mold which form the main portion. 5

5. A mold used for a method for manufacturing a three-dimensional non-woven fabric in which semi-molten fibers are spun on a forming surface of a mold to form the three dimensional non-woven fabric, **characterized by** comprising at least 10
 - a first mold piece, and
 - a second mold piece which can be mutually overlapped with the first mold piece and whose area mutually overlapped with the first mold piece is adjustable. 15
6. The mold according to claim 5, **characterized in that** 20
 - at least one of the first mold piece and the second mold piece is formed by press molding.
7. The mold according to claim 5, **characterized in that** 25
 - at least one of the first mold piece and the second mold piece is formed by injection molding with resin.
8. The mold according to claim 5, **characterized in that** 30
 - at least one of the first mold piece and the second mold piece is formed from a non-woven fabric.
9. The three-dimensional non-woven fabric manufactured using the method according to any one of claims 1 to 4. 35
10. The three-dimensional non-woven fabric manufactured using the mold according to any one of claims 5 to 8. 40

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FIG. 1A

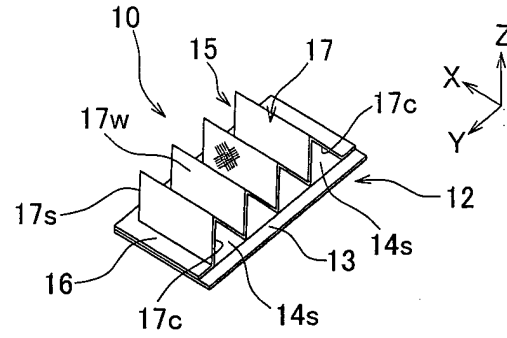


FIG. 1B

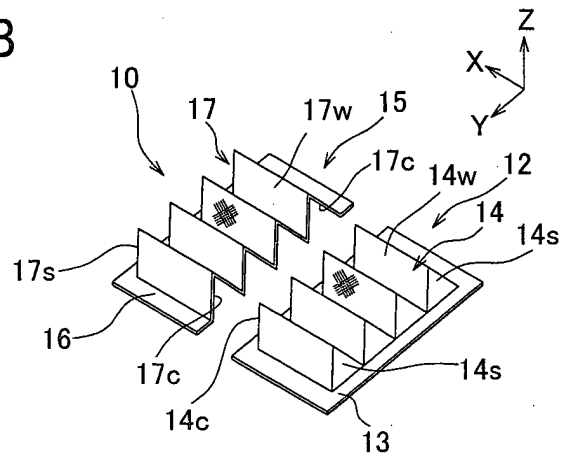


FIG. 1C

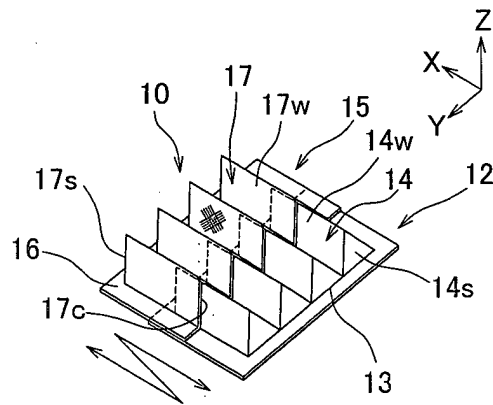


FIG. 2A

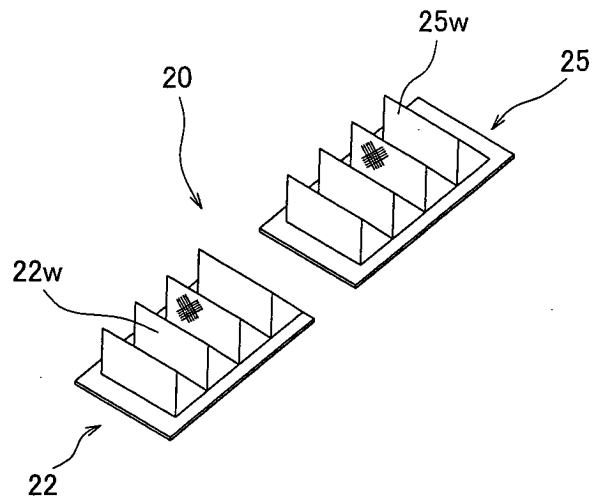


FIG. 2B

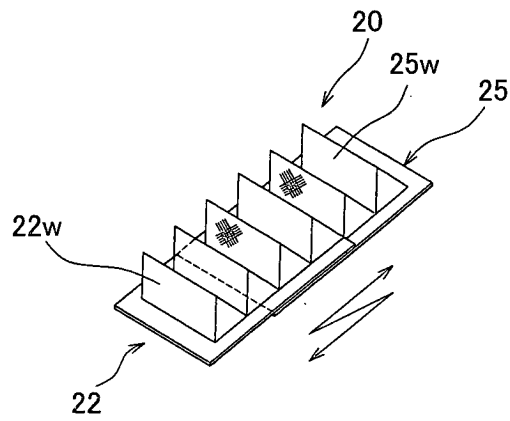


FIG. 3A

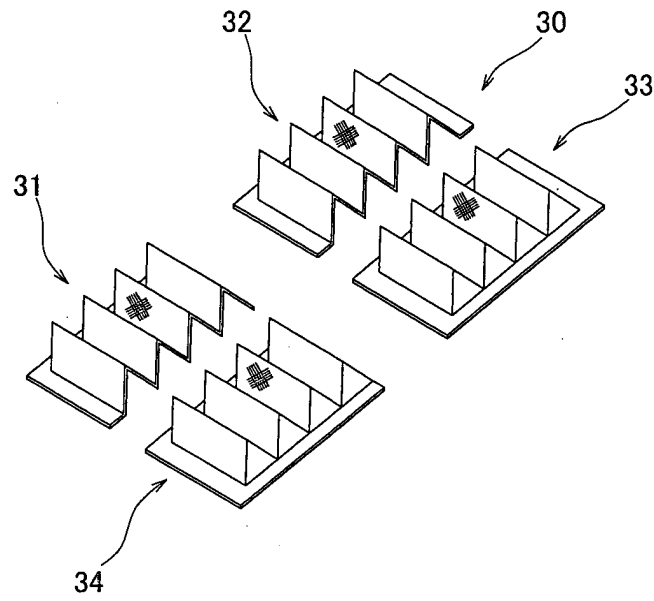


FIG. 3B

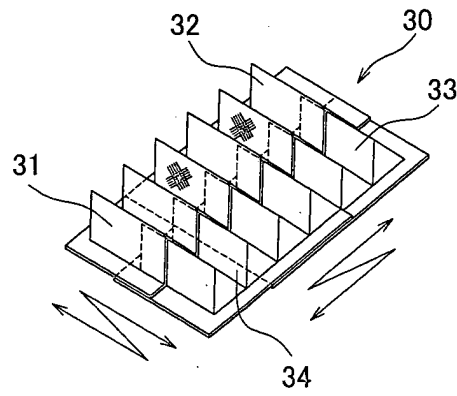


FIG. 4A

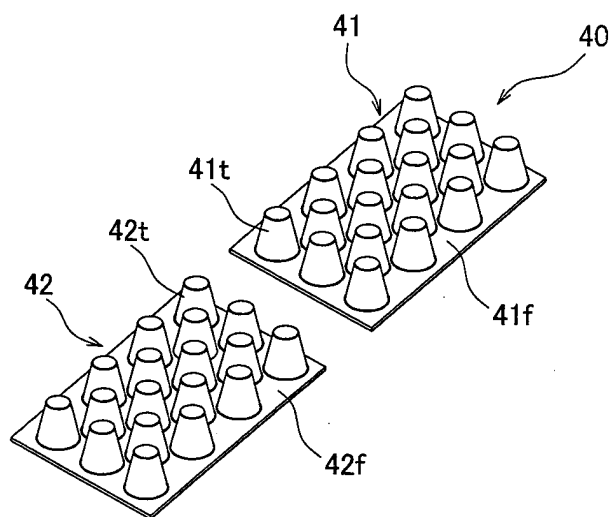


FIG. 4B

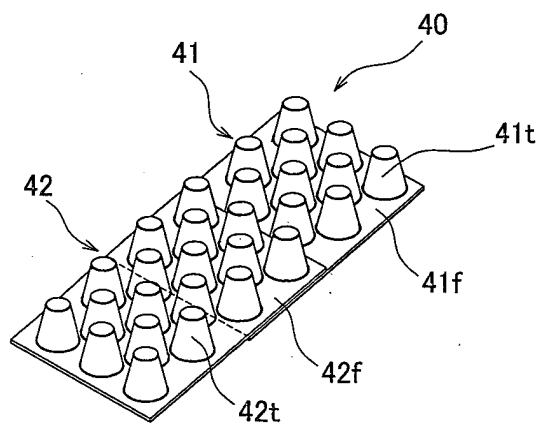


FIG. 5A

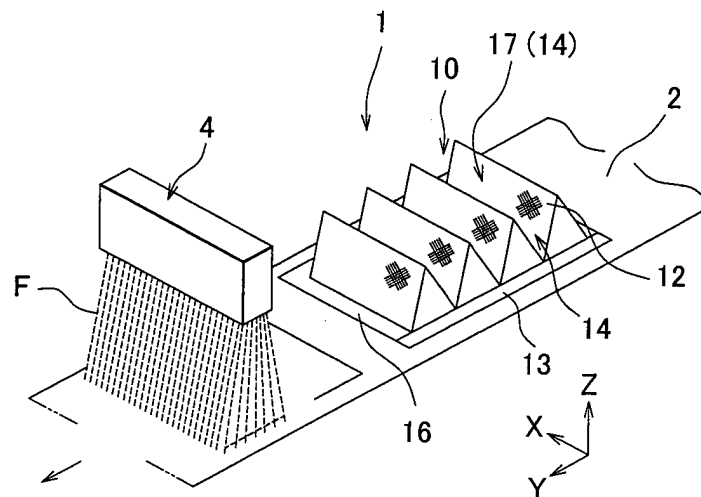


FIG. 5B

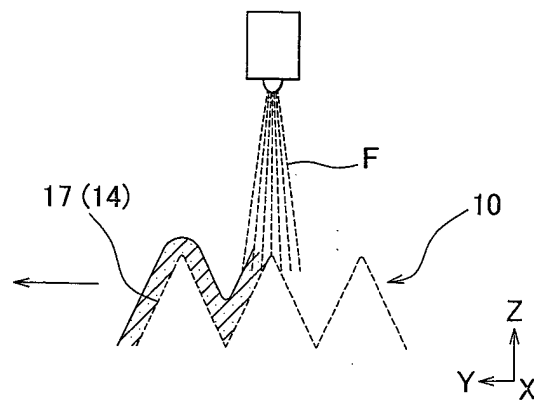


FIG. 6

RELATED ART

