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(71) Applicant: **NIPPON ELECTRIC GLASS CO., LTD**
Otsu-shi,
Shiga 520-8639 (JP)

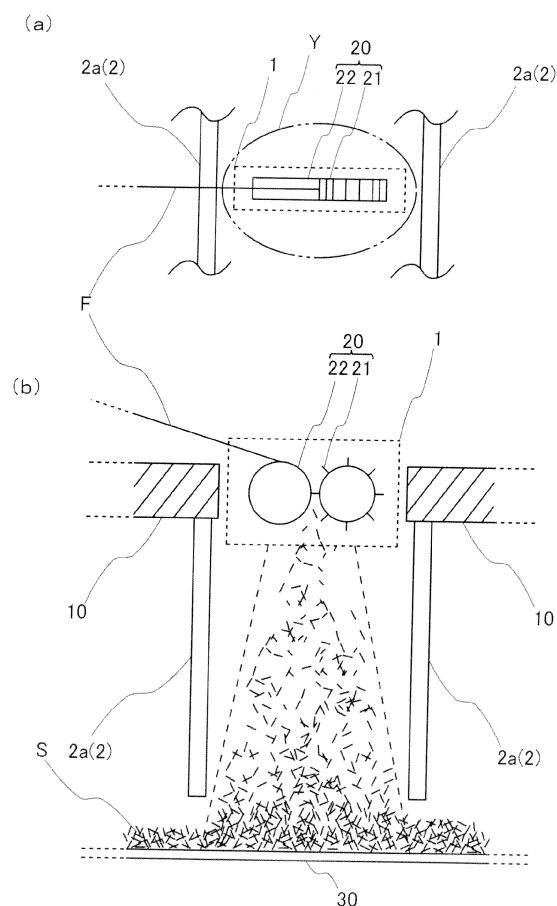
(72) Inventors:
• **Seko, Tsuyoshi**
Otsu-shi, Shiga 520-8639 (JP)
• **Nishie, Satoshi**
Otsu-shi, Shiga 520-8639 (JP)

(74) Representative: **Berbinau, Pierre Jean Marie et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **Method and apparatus for manufacturing glass chopped strand mat**

(57) A technique of manufacturing a high-quality glass chopped strand mat (particularly, a lightweight glass chopped strand mat) which is applicable to a molded ceiling material for recent cars which have excellent design and a reduced weight, is established. A method for manufacturing a glass chopped strand mat by shaping, into a sheet, glass chopped strand (S) obtained by cutting a glass fiber (F), includes a distribution and putting step of distributing and putting the glass chopped strands (S) while allowing the glass chopped strands (S) to fall in a chamber (10), and an adjustment step of adjusting a state of the falling glass chopped strands (S). The chamber (10) includes a plurality of supply units (20) for supplying the glass chopped strands (S), and a partition member (2) for separating the plurality of supply units (20) from each other. The adjustment step is performed so that the glass chopped strands (S) do not contact the partition member (2) when the glass chopped strands (S) are falling.

[Figure 5]



Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to methods and apparatuses for manufacturing a glass chopped strand mat by shaping, into a sheet, glass chopped strands obtained by cutting a glass fiber.

BACKGROUND ART

10 **[0002]** A glass chopped strand mat is conventionally used as a reinforcement member in a glass fiber reinforced plastic (GFRP) molded product, such as a bathtub or a septic tank. The glass chopped strand mat is also employed as a reinforcement base in a car molded ceiling material. The car molded ceiling material in which the glass chopped strand mat is attached to the front and rear sides of a foamed polyurethane sheet has been developed.

15 **[0003]** The glass chopped strand mat is manufactured as follows. Initially, a glass fiber is cut into pieces having a predetermined length using a plurality of cutters provided at a ceiling portion of a chamber, to obtain glass chopped strands. Next, the glass chopped strands are allowed to fall in the chamber so that the glass chopped strands are distributed and deposited on a conveyor to form a sheet. The glass chopped strands are subjected to a plurality of steps while being conveyed by the conveyor. For example, the steps include spraying a binder to the glass chopped strands, heating the glass chopped strands to which the binder adheres, and cooling and pressing the glass chopped strands after the heating, and the like. The glass chopped strand mat produced by these steps is wound around a core into a roll by a winding machine or the like before shipment.

20 **[0004]** The glass chopped strands falling in the chamber may not be uniformly deposited on the conveyor due to an influence of airflow, a position relationship between the cutters, or the like. If there is a local region in which a smaller or larger amount of glass chopped strands is deposited on the conveyor, the resulting glass chopped strand mat may have a non-uniform thickness. A thinner region of the glass chopped strand mat may have a lower tensile strength, and a thicker region may have a lower flexibility. Therefore, in order to stably manufacture a high-quality glass chopped strand mat, it is important to deposit the glass chopped strands in a uniform thickness on the conveyor.

25 **[0005]** Conventionally, there is a known glass chopped strand mat manufacturing method in which the distribution of mass is measured continuously throughout a glass chopped strand mat which has been produced, using a mass detector, and if a portion of the glass chopped strand mat which has a mass distribution lower than a predetermined reference value has been detected, glass chopped strands are additionally supplied to that portion (see, for example, Patent Document 1). Patent Document 1 describes that a glass chopped strand mat having a uniform mass distribution can be obtained.

30 **[0006]** There is also a known glass chopped strand mat manufacturing method in which a rectangular chamber is provided below a plurality of cutters for cutting a glass fiber, and a partition plate is provided in the chamber in a width direction for each cutter (see, for example, Patent Document 2). Patent Document 2 describes that a glass chopped strand mat having less variations in mass, particularly in the width direction, can be obtained.

CITATION LIST

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PATENT DOCUMENTS

[0007]

45 Patent Document 1: Japanese Unexamined Patent Application Publication No. H07-138861
Patent Document 2: Japanese Unexamined Patent Application Publication No. H07-016836

DISCLOSURE OF THE INVENTION

50 PROBLEM TO BE SOLVED BY THE INVENTION

[0008] In the glass chopped strand mat manufacturing method of Patent Document 1, if a portion having a lower mass distribution than the reference value is detected in a previously produced glass chopped strand mat, such a portion is predicted to occur in glass chopped strand mats which will be subsequently produced. However, there is a time lag between the previously produced glass chopped strand mat and the currently produced glass chopped strand mat, and therefore, the prediction by the mass detector is not always correct. Also, measures have not been particularly taken to form a uniform thickness in a thick region of a glass chopped strand mat. Therefore, the method of Patent Document 1 may fail to manufacture a glass chopped strand mat having a uniform thickness. Note that the previously produced glass

chopped strand mat is discarded because the prediction by the mass detector has not been performed. Therefore, a waste glass chopped strand mat which will not be a final product occurs.

[0009] In the glass chopped strand mat manufacturing method of Patent Document 2, the partition plate is provided to take measures against the sticking together of glass chopped strands obtained by adjacent cutters, the disturbance in the falling direction of glass chopped strands due to airflow in the chamber, and the like. However, if a glass chopped strand contacts the partition plate, the glass chopped strand adheres to the partition plate and does not fall. If this state is continued, more and more glass chopped strands adhere to the partition plate, so that the amount of glass chopped strands falling on the conveyor decreases. As a result, a local region occurs in which a smaller amount of glass chopped strands is deposited. When a glass chopped strand mat having light weight (as used herein, the term "weight" with respect to a glass chopped strand mat refers to mass per unit area) for which there has been an increasing demand is manufactured, the reduction in the amount of falling glass chopped strands may lead to a hole, a break, or the like in the completed glass chopped strand mat (a glass chopped strand mat having light weight is also referred to as a "lightweight glass chopped strand mat").

[0010] Thus, at present, a technique of depositing glass chopped strands in a uniform thickness on a conveyor has not yet been developed. The present invention has been made in view of the above problems. It is an object of the present invention to establish a technique of a high-quality glass chopped strand mat (particularly, a lightweight glass chopped strand mat) which is applicable to a molded ceiling material for recent cars which have excellent design and a reduced weight.

MEANS FOR SOLVING PROBLEM

[0011] To achieve the object, a glass chopped strand mat manufacturing method according to the present invention is a method for manufacturing a glass chopped strand mat by shaping, into a sheet, glass chopped strand obtained by cutting a glass fiber, including a distribution and putting step of distributing and putting the glass chopped strands while allowing the glass chopped strands to fall in a chamber, and an adjustment step of adjusting a state of the falling glass chopped strands. The chamber includes a plurality of supply units for supplying the glass chopped strands, and a partition member for separating the plurality of supply units from each other. The adjustment step is performed so that the glass chopped strands do not contact the partition member when the glass chopped strands are falling.

[0012] As described in the above PROBLEM TO BE SOLVED BY THE INVENTION section, in the conventional art, variations are likely to occur in the thickness of glass chopped strands deposited on the conveyor. This is because the state of falling glass chopped strands and the putting of glass chopped strands on the conveyor are not particularly taken into consideration.

In this regard, the glass chopped strand mat manufacturing method of this configuration includes the distribution and putting step of distributing and putting the glass chopped strands while allowing the glass chopped strands to fall in the chamber, and the adjustment step of adjusting the state of the falling glass chopped strands. The chamber includes the plurality of supply units for supplying the glass chopped strands, and the partition member for separating the plurality of supply units from each other. The adjustment step is performed so that the glass chopped strands do not contact the partition member when the glass chopped strands are falling. As a result, the glass chopped strands can be prevented from contacting and adhering to the partition member when the glass chopped strands are falling in the chamber. Therefore, the decrease and variations in the amount of the glass chopped strands which fall due to the adhering to the partition member can be prevented. Therefore, the glass chopped strands can be put in a uniform thickness. As a result, a glass chopped strand mat having a uniform thickness can be reliably manufactured. In particular, the glass chopped strand mat manufacturing method of this configuration including the adjustment step is effective when a lightweight glass chopped strand mat is manufactured, in which a hole, a break, or the like is likely to occur due to variations in the amount of glass chopped strands deposited.

[0013] In the glass chopped strand mat manufacturing method of the present invention, the plurality of supply units are preferably accommodated in respective separate cells separated by the partition member, and the adjustment step is preferably performed so that the glass chopped strands fall to a portion in the vicinity of a center of the cell as viewed from above.

[0014] In the glass chopped strand mat manufacturing method of this configuration, the plurality of supply units are accommodated in the respective separate cells separated by the partition member, and the adjustment step is performed so that the glass chopped strands fall to a portion in the vicinity of a center of the cell as viewed from above. As a result, the glass chopped strands are reliably prevented from contacting and adhering to the partition member when the glass chopped strands are falling. Therefore, the decrease and variations in the amount of the glass chopped strands which fall due to the adhering to the partition member can be more reliably prevented. Therefore, the glass chopped strands can be reliably put in a uniform thickness. As a result, a glass chopped strand mat having a uniform thickness can be more reliably manufactured.

[0015] In the glass chopped strand mat manufacturing method of the present invention, the plurality of supply units

are preferably arranged and equally spaced in the chamber.

[0016] In the glass chopped strand mat manufacturing method of this configuration, the plurality of supply units are arranged and equally spaced in the chamber. As a result, the glass chopped strands can be put so that the thickness of the entire glass chopped strands which have been deposited to form a sheet is reliably caused to be uniform. As a result, a glass chopped strand mat having a uniform thickness can be more reliably manufactured.

[0017] To achieve the object, a glass chopped strand mat manufacturing apparatus according to the present invention is an apparatus for manufacturing a glass chopped strand mat by shaping, into a sheet, glass chopped strand obtained by cutting a glass fiber, including a chamber including a plurality of supply units for supplying the glass chopped strands, and a partition member for separating the plurality of supply units from each other, distribution and putting means for distributing and putting the glass chopped strands while allowing the glass chopped strands to fall in the chamber, and adjustment means for adjusting a state of the falling glass chopped strands. The adjustment means adjusts the state of the falling glass chopped strands so that the glass chopped strands do not contact the partition member when the glass chopped strands are falling.

[0018] The glass chopped strand mat manufacturing apparatus of this configuration has substantially the same advantages as those of the glass chopped strand mat manufacturing method. Specifically, the glass chopped strand mat manufacturing apparatus of this configuration includes the chamber including the plurality of supply units for supplying the glass chopped strands, and the partition member for separating the plurality of supply units from each other, the distribution and putting means for distributing and putting the glass chopped strands while allowing the glass chopped strands to fall in the chamber, and the adjustment means for adjusting the state of the falling glass chopped strands. The adjustment means adjusts the state of the falling glass chopped strands so that the glass chopped strands do not contact the partition member when the glass chopped strands are falling. As a result, the glass chopped strands can be prevented from contacting and adhering to the partition member when the glass chopped strands are falling in the chamber. Therefore, the decrease and variations in the amount of the glass chopped strands which fall due to the adhering to the partition member can be prevented. Therefore, the glass chopped strands can be put in a uniform thickness. As a result, a glass chopped strand mat having a uniform thickness can be reliably manufactured. In particular, the glass chopped strand mat manufacturing method of this configuration including the adjustment step is effective when a lightweight glass chopped strand mat is manufactured, in which a hole, a break, or the like is likely to occur due to variations in the amount of glass chopped strands deposited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

[FIG. 1] FIG. 1 is a diagram schematically showing an overall configuration of a glass chopped strand mat manufacturing apparatus according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is an enlarged view of a main portion of the glass chopped strand mat manufacturing apparatus of the embodiment of the present invention.

[FIG. 3] FIG. 3 is a top view of a main portion of a glass chopped strand mat manufacturing apparatus according to a first embodiment.

[FIG. 4] FIG. 4 is a top view of a main portion of a glass chopped strand mat manufacturing apparatus according to a second embodiment.

[FIG. 5] FIG. 5 (a) is an enlarged top view of one cutting device which cuts a glass fiber, and FIG. 5(b) is a side view of the cutting device.

DESCRIPTION OF EMBODIMENTS

[0020] Two embodiments relating to a method and apparatus for manufacturing a glass chopped strand mat according to the present invention will be described hereinafter with reference to FIGS. 1 to 5. Note that, for the sake of convenience, the glass chopped strand mat manufacturing apparatus is described before the glass chopped strand mat manufacturing method. Note that the present invention is not intended to be limited to the embodiments described below or configurations shown in the drawings.

[0021] FIG. 1 is a diagram schematically showing an overall configuration of an apparatus 100, 200 for manufacturing a glass chopped strand mat M according to the embodiment of the present invention (hereinafter simply referred to as a "manufacturing apparatus"). FIG. 1 is a diagram common to the first and second embodiments described below. In FIG. 1, a region X enclosed by a dashed line is a main portion of the manufacturing apparatus 100, 200. FIG. 2 is an enlarged view of the region X (the main portion). The manufacturing apparatus 100, 200 is an apparatus for manufacturing the glass chopped strand mat M from glass chopped strands. The manufacturing apparatus 100, 200 includes a chamber 10, a plurality of cutting devices (supply units) 20, a distribution conveyor (distribution and putting means) 30, adjustment

means 1 which adjusts a state of falling glass chopped strands, a partition plate (partition member) 2, a binder sprayer 40, a first conveyor 50, a second conveyor 60, a heating furnace 70, a cold press roller 80, a winding machine 90, and the like. Of these components, the partition plate 2, the chamber 10, the cutting devices 20, the distribution conveyor 30, and the adjustment means 1 have characteristic features of the present invention, and are main components of the present invention. The components will be described hereinafter.

[0022] In the manufacturing apparatus 100, 200, a direction (indicated with an arrow in FIG. 1) in which glass chopped strands are conveyed is defined as a flow direction. The distribution conveyor 30, the first conveyor 50, and the second conveyor 60 are successively positioned in this stated order from upstream to downstream. These conveyors are driven by respective motors D. The conveying speeds (the movement speeds of the belts) of the conveyors are controlled by a computer (control means) 11. Note that a worker may manually adjust the conveying speed of each conveyor as appropriate.

[0023] The distribution conveyor 30 includes a belt on which glass chopped strands are distributed and put. The distribution conveyor 30 is positioned below the chamber 10 which accommodates glass chopped strands. The cutting devices 20 which cut a glass fiber F described below to produce glass chopped strands are attached to a glass fiber inlet 10c provided in a ceiling portion of the chamber 10. The cutting devices 20 have a role in supplying glass chopped strands to the chamber 10, and are equally spaced. As used herein, the term "equally spaced" with respect to the cutting devices 20 means that the cutting devices 20 are substantially uniformly arranged at the ceiling portion of the chamber 10. The cutting devices 20 may each be a single cutting device or may be a group of single cutting devices equally spaced in a line. Therefore, when a plurality of "single cutting devices" are equally spaced, the single cutting devices are uniformly arranged throughout the ceiling portion of the chamber 10. When a plurality of "cutting device groups" are equally spaced, the lines of cutting devices are equally spaced in the ceiling portion of the chamber 10.

[First Embodiment]

[0024] FIG. 3 is a top view of a main region X1 of the manufacturing apparatus 100 of the first embodiment. As shown in FIG. 3, eight cutting device groups 20A to 20H are arranged in the ceiling portion of the chamber 10 and equally spaced in a direction in which glass chopped strands are conveyed. The cutting device groups 20A to 20H each include 12 cutting devices 20 which are equally spaced in a line. The cutting devices 20 each include a cutter roller 21 and a rubber roller 22. The glass fiber F which has been pulled out of a glass cake C is fed into between the rotating cutter roller 21 and rubber roller 22 to be continually cut, whereby glass chopped strands S having a length of about 50 mm are produced. The glass chopped strands S fall by their own weight in the chamber 10 and are substantially uniformly distributed and put on a belt of the distribution conveyor 30. The belt of the distribution conveyor 30 has a width which is large enough to allow the glass chopped strands S falling in the chamber 10 to be reliably put on the belt of the distribution conveyor 30, as viewed from above. A lower end portion of the chamber 10 is separated from the distribution conveyor 30 so that the deposited glass chopped strands S can pass therebetween.

[0025] A partition plate 2a is provided between each of the cutting device groups 20A to 20H arranged side by side so that the cutting device groups 20A to 20H are separated from each other. An optimum material for the partition plates 2a is aluminum, ceramic, or the like, whose surface is smooth and which is difficult to charge with static electricity. Lower end portions of the partition plates 2a are separated from the distribution conveyor 30 so that the deposited glass chopped strands S can pass therebetween. The partition plates 2a are attached to the ceiling portion of the chamber 10, and are connected to an intersecting internal wall 10b. As a result, separate cells for accommodating the respective cutting device groups 20A to 20H are formed, as viewed from above. The partition plates 2a can prevent, for example, the glass chopped strands S which have been obtained using adjacent ones in the conveying direction of the cutting device groups 20A to 20H from sticking together, and the direction in which the glass chopped strands S fall from being disturbed due to airflow in the chamber 10.

[0026] The cutting devices 20 included in the cutting device groups 20A to 20H each include the adjustment means 1 which adjusts a state of the falling glass chopped strands S in the chamber 10. The adjustment means 1 adjusts the state of the falling glass chopped strands S so that the glass chopped strands S do not contact the partition plates 2a as the glass chopped strands S fall. As a result, the glass chopped strands S can be prevented from contacting and adhering to the partition plates 2a as the glass chopped strands S fall in the chamber 10, whereby the decrease and variations in the amount of the glass chopped strands S which fall due to the adhering to the partition plates 2a can be prevented. Therefore, the adjustment by the adjustment means 1 allows the glass chopped strands S to be put in a uniform thickness. Note that a suction device 33 described below can adjust the state of the falling glass chopped strands S, to some extent, using force which causes air to be suctioned. Therefore, the suction device 33 may be included in the adjustment means 1.

[0027] A binder sprayer 40 is provided above the first conveyor 50 to spray a binder (resin powder) A toward the glass chopped strands S on the belt of the first conveyor 50. The binder A is preferably a powder of thermoplastic resin (e.g., powdered polyester resin (NEW TRACK 514 manufactured by Kao Corporation)). Other examples of the available

thermoplastic resin powder include resin powders of nylon, polyethylene, polystyrene, polypropylene, and polyvinyl chloride.

[0028] Note that a water sprayer (not shown) may be effectively provided above or below the first conveyor 50 and upstream of the binder sprayer 40 in order to allow the binder A to more easily adhere to the glass chopped strands S. The water sprayer sprays water toward the glass chopped strands S on the belt of the first conveyor 50. If the glass chopped strands S are previously wetted with water, the binder A more easily adheres to the surfaces of the glass chopped strands S due to the action of the surface tension of the water, and therefore, the glass chopped strands S stick together more effectively.

[0029] A vibrator 51 is provided below the belt of the first conveyor 50 on which the glass chopped strands S are deposited. The belt of the first conveyor 50 is vibrated by the vibrator 51. This causes the binder A sprayed to the surfaces of the glass chopped strands S to enter gaps between the glass chopped strands S which have been deposited to form a sheet. As a result, the binder A adheres uniformly to all the glass chopped strands S.

[0030] The heating furnace 70 is provided halfway through the second conveyor 60, surrounding the belt on which the glass chopped strands S have been deposited. The heating furnace 70 performs a heating treatment on an object on the second conveyor 60 which is being moved through the heating furnace 70. The temperature of atmosphere in the heating furnace 70 is controlled by the computer 11 to be appropriately adjusted to a temperature higher than or equal to the melting point of the synthetic resin included in the binder A, depending on the type of the sprayed binder A. Note that the temperature of the heating furnace 70 may be manually adjusted by a worker. Because the belt of the second conveyor 60 is exposed to high temperature, the belt is formed of a heat resistant material, such as a metal.

[0031] The cold press roller 80 is provided downstream of the second conveyor 60. The cold press roller 80 presses a heated object while cooling the object. The cold press roller 80 includes a pair of rollers. The glass chopped strands S' (the glass chopped strands S after being heated are referred to as "glass chopped strands S'" to discriminate from those before being heated) with the melted binder A are conveyed to the cold press roller 80 and passed through the nip. The glass chopped strands S' are cooled and pressed by being passed through the cold press roller 80, whereby the glass chopped strands S' are bound together. As a result, the glass chopped strand mat M is produced. Here, the cold press roller 80 air-cools the glass chopped strands S'. Alternatively, the glass chopped strands S' may be actively cooled with cooling water flowing inside the cold press roller 80.

[0032] The glass chopped strand mat M produced by passing the glass chopped strands S' through the cold press roller 80 is wound around the core of the winding machine 90 to form a roll product. Instead of winding the glass chopped strand mat M around the core, the winding machine 90 may wind the glass chopped strand mat M on surface rollers while the glass chopped strand mat M is being rotated on the surfaces of the surface rollers.

[Second Embodiment]

[0033] FIG. 4 is a top view of a main region X2 of the manufacturing apparatus 200 of the second embodiment. The manufacturing apparatus 200 of the second embodiment is similar to the manufacturing apparatus 100 of the first embodiment, except that a plurality of partition plates 2b are provided in parallel to the conveying direction of the glass chopped strands S in addition to the partition plates 2a. Therefore, the components other than the partition plates 2b will not be described in detail.

[0034] In the first embodiment, the partition plates 2a can prevent the glass chopped strands S obtained by ones of the cutting device groups 20A to 20H which are adjacent to each other in the conveying direction of the glass chopped strands S from sticking together. However, the glass chopped strands S obtained by adjacent cutting devices 20 in each cutting device group may stick together. Therefore, in the second embodiment, in each of the cutting device groups 20A to 20H, the partition plates 2b are newly provided to separate the cutting devices 20 from each other. By providing the partition plate 2 of the second embodiment including the partition plates 2a and 2b, separate cells which accommodate the respective cutting devices 20 are formed as viewed from above (i.e., one cell for each cutting device 20). Therefore, the glass chopped strands S obtained by adjacent cutting devices 20 can be substantially perfectly prevented from sticking together, and the direction in which the glass chopped strands S fall can be substantially perfectly prevented from being disturbed by airflow in the chamber 10. As in the first embodiment, lower end portions of the partition plates 2b is separated from the distribution conveyor 30 so that the glass chopped strands S which have been deposited on the distribution conveyor 30 can pass therebetween. The partition plates 2b are attached to the ceiling portion of the chamber 10, and are connected to an intersecting internal wall 10a.

[Glass Chopped Strand Mat Manufacturing Method]

[0035] A glass chopped strand mat manufacturing method (hereinafter simply referred to as a "manufacturing method") according to the present invention can be performed using the manufacturing apparatus 100 or 200 of the first or second embodiment. In the manufacturing method of the present invention, the glass chopped strand mat M is manufactured

by a glass chopped strand preparation step, a distribution and putting step, an adjustment step, a binder spraying step, a heating step, a cold press step, and a winding step. Of these steps, the distribution and putting step and the adjustment step have characteristic features of the present invention and are main steps of the present invention. The steps will be described hereinafter.

<preparation Step>

[0036] As a preliminary step of the manufacture of the glass chopped strand mat M, the glass chopped strands S are prepared from the glass fiber F. The glass fiber F extracted from a glass cake C is cut into pieces having a length of about 50 mm (i.e., the glass chopped strands S) by the cutting devices 20 provided at the ceiling portion of the chamber 10. The glass chopped strands S do not necessarily need to be prepared immediately before the manufacture of the glass chopped strand mat M, and alternatively, may be previously prepared. In this case, the glass chopped strands S which are accommodated in a container (e.g., a flexible container) are put directly into the chamber 10 through the glass fiber inlet 10c.

<Distribution and Putting Step>

[0037] The glass chopped strands S obtained by the preparation step fall in the chamber 10 and are put on the belt of the distribution conveyor 30 to form a sheet. As described above, the cutting devices 20 or the cutting device groups 20A to 20H are equally spaced. As a result, variations in the thickness of the entire glass chopped strands S which have been deposited to form a sheet are reduced. If the number of cutting devices or cutting device groups is increased, the amount of the glass chopped strands S (i.e., the amount of the glass fiber F processed) which are produced per unit time by each of the cutting devices 20 or each of the cutting device groups 20A to 20H can be reduced. A suction device 33 including a suction duct 31 and a blower 32 is provided below the belt on which the glass chopped strands S are deposited so that a negative pressure is applied to the belt. As a result, the glass chopped strands S are attracted to a surface of the belt while being substantially uniformly distributed and put on the belt of the distribution conveyor 30, and therefore, are settled without being scattered around.

<adjustment Step>

[0038] FIG. 5 (a) is a top view of one of the cutting devices 20 which cuts the glass fiber F, showing an enlarged view of a portion of a separate cell (indicated by the region Z in FIG. 3) formed by the partition plates 2a. FIG. 5(b) is a side view of FIG. 5(a). A region Y enclosed by a dash-dot-dot line of FIG. 5 (a) indicates a range within which the glass chopped strands S fall when the glass chopped strands S are produced by one cutting device 20. The adjustment means 1 which adjusts the state of the falling glass chopped strands S performs the adjustment step so that the glass chopped strands S fall to a region in the vicinity of the center of the cell, as viewed from above. For example, by setting the rotational speeds of the cutter roller 21 and the rubber roller 22 to be lower than a predetermined speed, the glass chopped strands S are prevented from being scattered around immediately after being cut. Alternatively, the cutting devices 20 are each positioned so that a portion where the cutter roller 21 and the rubber roller 22 contact each other is located at a middle point between the adjacent partition plates 2a (the partition plate 2a and the inner wall 10a of the chamber 10 for the cutting device groups 20A and 20H), whereby the glass chopped strands S obtained by the cutting are allowed to fall to a portion directly below that portion, i.e., a portion in the vicinity of the center of the cell. As shown in FIG. 5(b), the adjustment step allows the glass chopped strands S which fall in the chamber 10 to be deposited on the belt of the distribution conveyor 30 without contacting the partition plates 2a. Thus, the glass chopped strands S can be reliably prevented from adhering to the partition plates 2a, whereby the decrease and variations in the amount of the glass chopped strands S which fall due to the adhering to the partition plates 2a can be reliably prevented. Therefore, the glass chopped strands S can be reliably put in a uniform thickness. The glass chopped strands S which have been deposited on the belt of the distribution conveyor 30 to form a sheet are conveyed to a downstream point for the next step.

<Binder Spraying Step>

[0039] The glass chopped strands S which have been deposited to form a sheet are moved to the first conveyor 50. The binder sprayer 40 is provided above the first conveyor 50. The binder sprayer 40 sprays the binder (resin powder) A to the surfaces of the glass chopped strands S. The addition of the binder A1 to the glass chopped strands S allows the glass chopped strands S to stick together by a heating treatment described below, so that the mat shape can be maintained.

<Heating Step>

[0040] The glass chopped strands S with the binder A are moved to the second conveyor 60. The glass chopped strands S are subjected to a heating treatment while being passed through the heating furnace 70, so that the binder A1 is softened and melted. As a result, the glass chopped strands S stick together (the resulting glass chopped strands S are referred to as the "glass chopped strands S").

<Cold Press Step>

[0041] The glass chopped strands S' after the heating treatment are passed through the cold press roller 80 which is provided downstream of the second conveyor 60 (cold press step). The glass chopped strands S' are cooled and pressed by the cold press roller 80 into the glass chopped strand mat M.

<winding Step>

[0042] Finally, the glass chopped strand mat M is wound by the winding machine 90 which is provided downstream of the cold press roller 80 (winding step). The glass chopped strand mat M is wound around the core of the winding machine 90 to form a roll product.

[Example]

[0043] As an example, a glass chopped strand mat manufacturing test was performed using the glass chopped strand mat manufacturing method of the present invention.

[0044] In this example, a manufacturing apparatus including a chamber having a rectangular shape of 3 m (width direction) $\times$ 5 m (conveying direction) as viewed from above, which is of the same type as that of the manufacturing apparatus 100 of the first embodiment of FIG. 1, was used. Initially, four cutting device groups (lines of cutting devices) each including 12 cutting devices are provided in the ceiling portion of the chamber and aligned side by side in the glass chopped strand conveying direction. Next, the number of cutting device groups (lines of cutting devices) was increased one by one, and finally, a manufacturing apparatus having eight cutting device groups (lines of cutting devices) was used. In each example, the same steps as those described in the above "Glass Chopped Strand Mat Manufacturing Method" section were performed. Note that the amount of the binder A sprayed by the binder sprayer 40 per unit time was the same among the example manufacturing apparatuses.

[0045] Tests 1 to 5 were performed under five sets of conditions including different numbers of cutting device groups (lines of cutting devices), different numbers of cutting devices per unit area, and different amounts of glass chopped strands produced per unit time by one cutting device. Tests 6 and 7 were performed under two sets of conditions including the same number of cutting device groups (lines of cutting devices) and number of cutting devices per unit area as those of Test 5, and different amounts of glass chopped strands produced per unit time by one cutting device. A total of seven sets of conditions were used. Under these conditions, glass chopped strand mats having a weight (mass per unit area of glass chopped strands) of 142 g/m² (Tests 1 to 5), 90 g/m² (Test 6), and 80 g/m² (Test 7) were manufactured. After the end of the test manufacture, the standard deviation of the weights of the glass chopped strand mats obtained by the manufacture tests was measured. The standard deviation of the weight was obtained by cutting a sheet of completed glass chopped strand mat into 60 square pieces with 300-mm sides and measuring the mass of each glass chopped strand mat piece. The present inventors have empirically determined that the standard deviation of the weight is preferably 7.5 or less.

The manufacture conditions and results of Tests 1 to 7 are shown in the following table.

[0046]

[Table 11]

Test No.	1	2	3	4	5	6	7
Number of Cutting Device Groups (Lines of Cutting Devices) (lines)	4	5	6	7	8	8	8
Number of Cutting Devices Per Unit Area (devices /m ²)	3.2	4.0	4.8	5.6	6.4	6.4	6.4
Amount of Glass Chopped Strands Produced Per Unit Time by One Cutting Device (kg/min/device)	0.72	0.60	0.50	0.43	0.38	0.24	0.21
weight (g/m ²)	142	142	142	142	142	90	80

(continued)

Test No.	1	2	3	4	5	6	7
Standard Deviation of Weight	9.5	7.5	6.5	5.0	4.5	6.1	5.0

[0047] According to the test results (Tests 1 to 7), if the number of cutting devices per unit area is 4.0 devices/m² or more, the amount of glass chopped strands produced per unit time by one cutting device is 0.60 kg/min/device or less, and therefore, it is unlikely that glass chopped strands are scattered to contact the partition member as glass chopped strands are falling. Therefore, the standard deviation of the weight is 7.5 or less, and a glass chopped strand mat which has less variations in thickness and a high commercial value can be manufactured. According to the results of the tests (Tests 5 to 7) in which the weight was changed, if the number of cutting device groups (lines of cutting device) and the number of cutting devices per unit area are the same, then when the weight is reduced to as low as 90 g/m² or 80 g/m², the standard deviation of the weight tends to increase. However, the value of the standard deviation is maintained at 7.5 or less. Therefore, even when the weight is reduced to such a low level, a glass chopped strand mat which has less variations in thickness and a high commercial value can be manufactured. In the case of the chamber having a size of 3 m (width direction) × 5 m (conveying direction) as viewed from above (described in this example), if a cutting device group includes 12 cutting devices, at least 5 cutting device groups (lines of cutting devices) need to be provided in order to manufacture a glass chopped strand mat having less variations in thickness.

[0048] Thus, according to the glass chopped strand mat method and apparatus of the present invention, a glass chopped strand mat having less variations in thickness can be manufactured. In particular, the manufacturing technology of the present invention in which the state of falling glass chopped strands is adjusted is effective when a lightweight glass chopped strand mat is manufactured, in which a hole, a break, or the like is likely to occur due to variations in the amount of glass chopped strands deposited.

INDUSTRIAL APPLICABILITY

[0049] The glass chopped strand mat manufactured by the method and apparatus of the present invention is applicable to car molded ceiling materials, and in addition, interior materials for other vehicles and buildings and other structures.

DESCRIPTION OF REFERENCE CHARACTERS

[0050]

1	ADJUSTMENT MEANS
2	PARTITION PLATE (PARTITION MEMBER)
10	CHAMBER
20	CUTTING DEVICE (SUPPLY UNIT)
30	DISTRIBUTION CONVEYOR (DISTRIBUTION AND PUTTING MEANS)
40	BINDER SPRAYER
50	FIRST CONVEYOR
60	SECOND CONVEYOR
70	HEATING FURNACE
80	COLD PRESS ROLLER
90	WINDING MACHINE
100, 200	GLASS CHOPPED STRAND MAT MANUFACTURING APPARATUS
F	GLASS FIBER
S, S'	GLASS CHOPPED STRAND
A	BINDER (RESIN POWDER)
M	GLASS CHOPPED STRAND MAT

Claims

1. A method for manufacturing a glass chopped strand mat (M) by shaping, into a sheet, glass chopped strand (S, S') obtained by cutting a glass fiber (F), **characterized in that** it comprises:

a distribution and putting step of distributing and putting the glass chopped strands (S, S') while allowing the

glass chopped strands to fall in a chamber (10); and

an adjustment step of adjusting a state of the falling glass chopped strands (S, S'),

wherein

the chamber (10) includes a plurality of supply units (20) for supplying the glass chopped strands (S, S'), and

a partition member (2) for separating the plurality of supply units (20) from each other, and

the adjustment step is performed so that the glass chopped strands (S, S') do not contact the partition member (2) when the glass chopped strands (S, S') are falling.

2. The method of claim 1, wherein

the plurality of supply units (20) are accommodated in respective separate cells separated by the partition member (2), and the adjustment step is performed so that the glass chopped strands (S, S') fall to a portion in the vicinity of a center of the cell as viewed from above.

3. The method of claim 1 or 2, wherein

the plurality of supply units are arranged and equally spaced in the chamber.

4. An apparatus (100, 200) for manufacturing a glass chopped strand mat (M) by shaping, into a sheet, glass chopped strand (S, S') obtained by cutting a glass fiber (F), **characterized in that** it comprises:

a chamber (10) including a plurality of supply units (20) for supplying the glass chopped strands (S, S'), and a partition member (2) for separating the plurality of supply units (20) from each other;

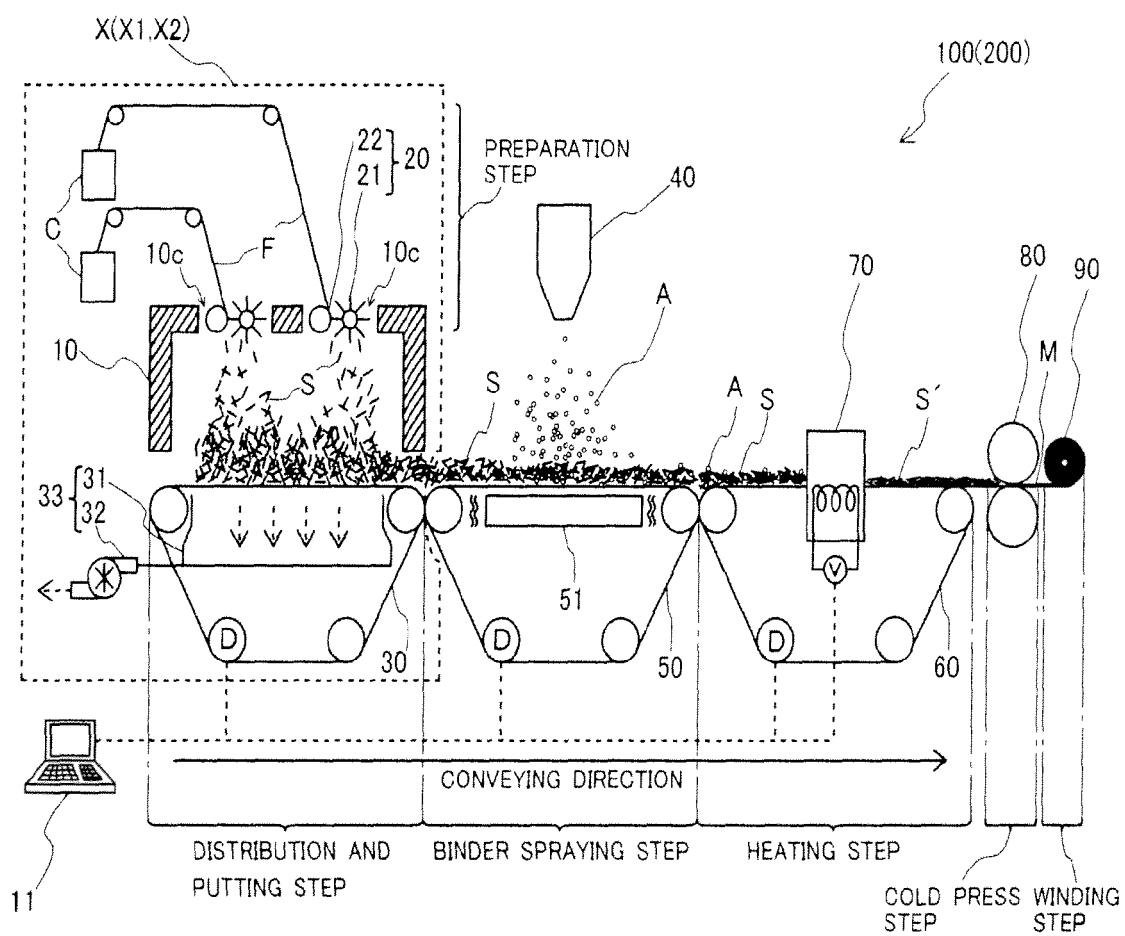
distribution and putting means (30) for distributing and putting the glass chopped strands (S, S') while allowing the glass chopped strands to fall in the chamber (10); and

adjustment means (1) for adjusting a state of the falling glass chopped strands (S, S'),

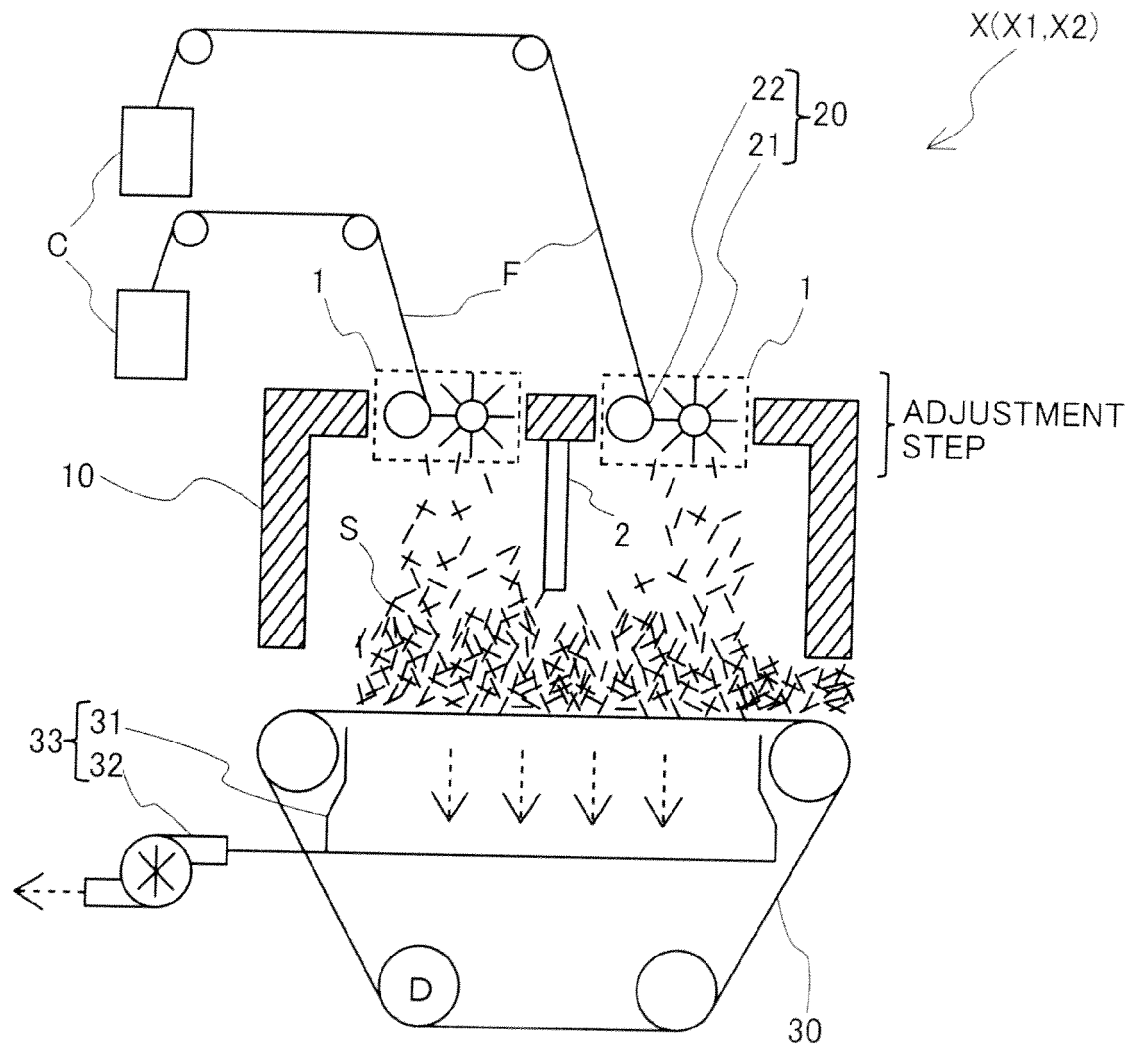
wherein

the adjustment means (1) adjusts the state of the falling glass chopped strands (S, S') so that the glass chopped strands do not contact the partition member (2) when the glass chopped strands are falling.

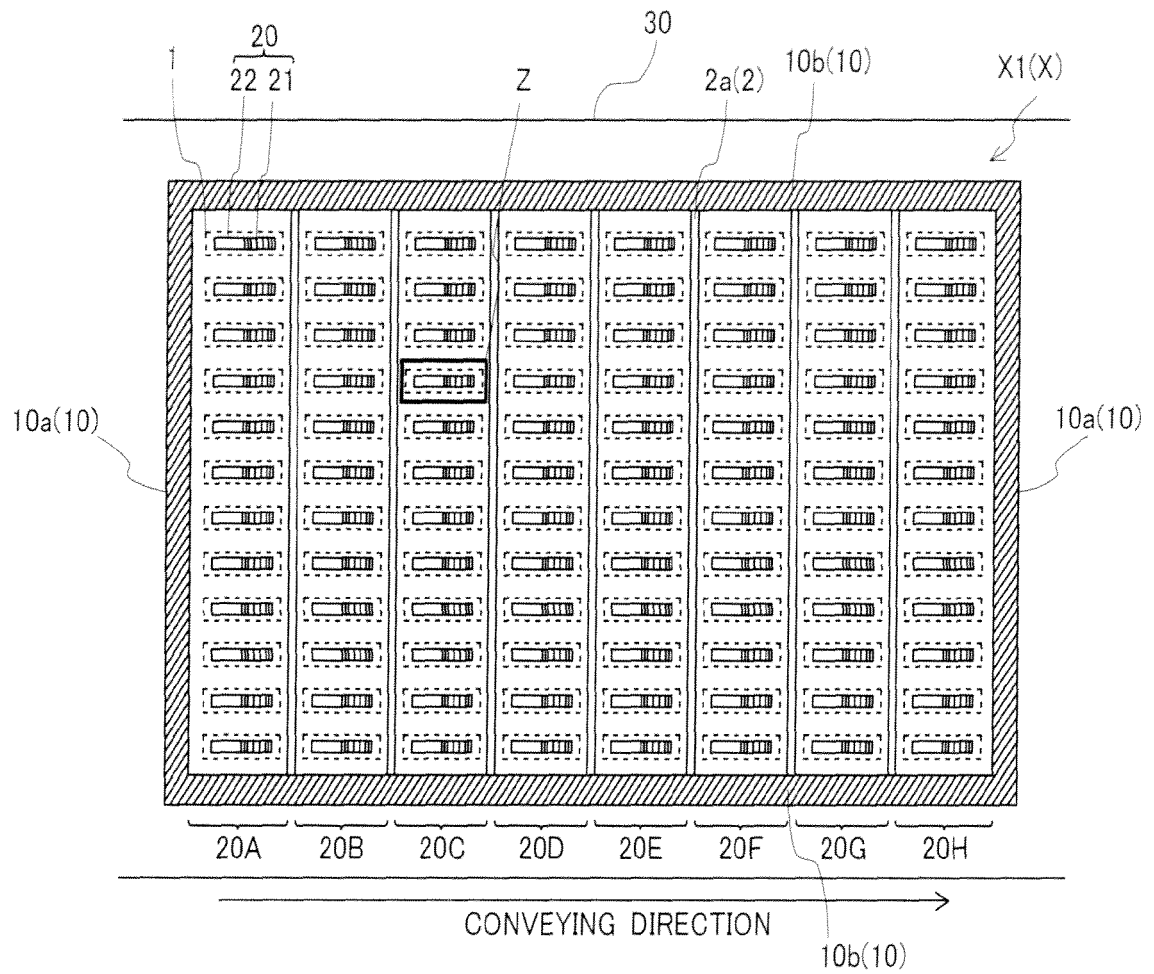
[Figure 1]



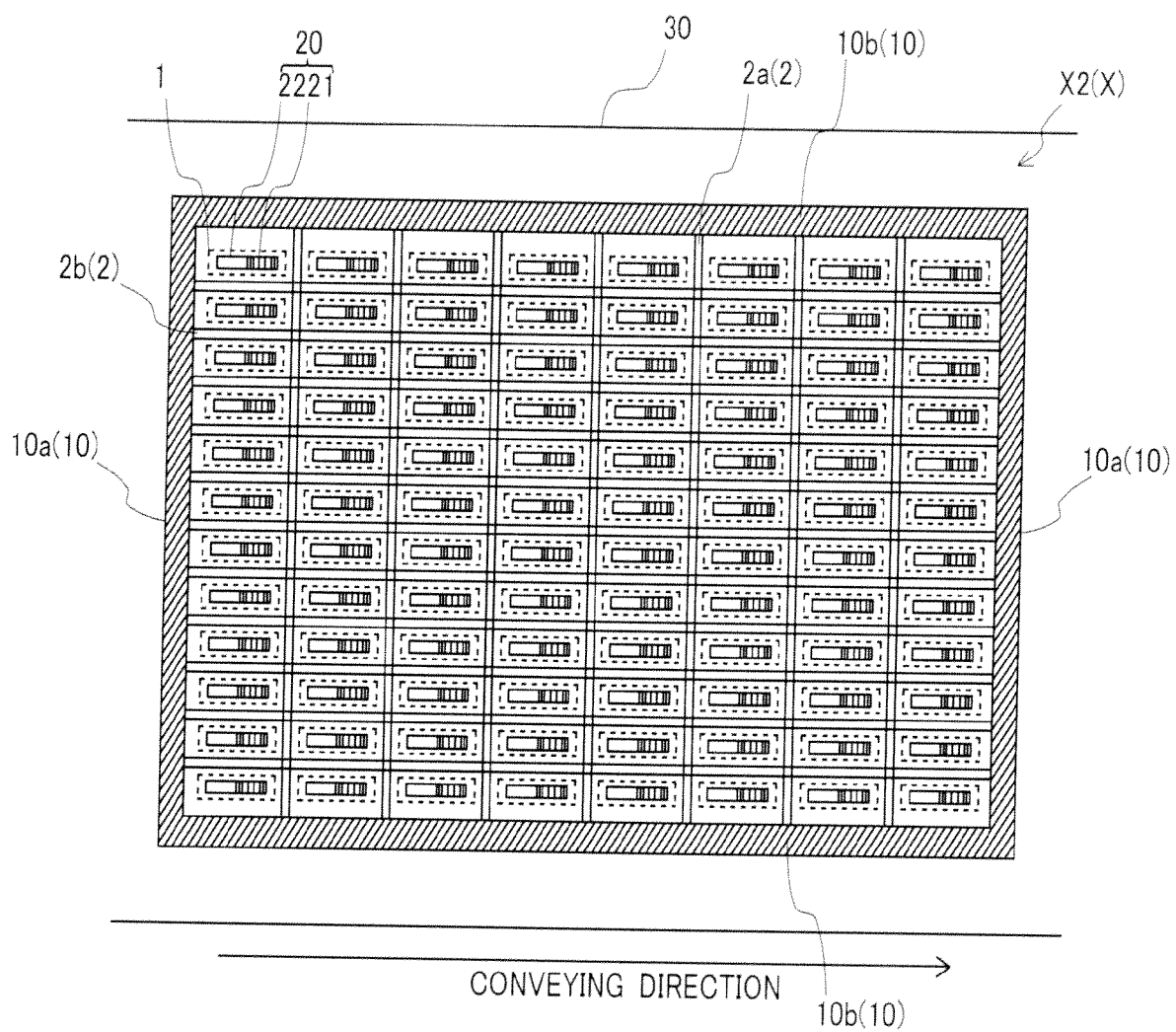
[Figure 2]



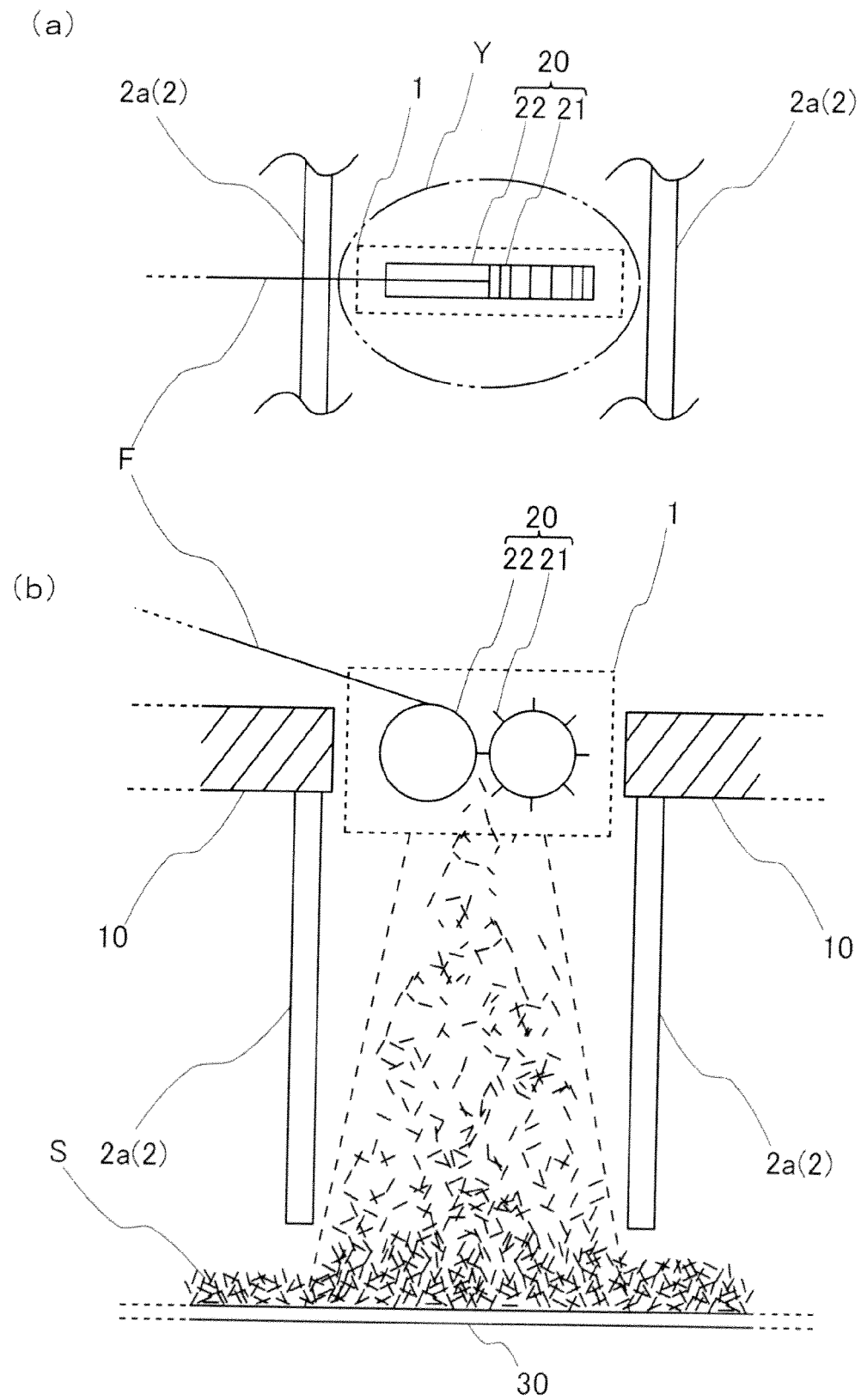
[Figure 3]



[Figure 4]



[Figure 5]





EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9714

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Place of search The Hague		Date of completion of the search 25 January 2013	Examiner Barathe, Rainier
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