(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 604 732 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**19.06.2013 Bulletin 2013/25**

(21) Application number: **12197105.5**

(22) Date of filing: **14.12.2012**

(51) Int Cl.:
***D04H 1/60*** *(2006.01)* ***D04H 1/736*** *(2012.01)*
***D04H 1/4218*** *(2012.01)* ***D04H 1/4226*** *(2012.01)*
***B65H 18/20*** *(2006.01)* ***B65H 23/00*** *(2006.01)*
***B65H 23/195*** *(2006.01)* ***B65H 37/00*** *(2006.01)*

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**

(30) Priority: **16.12.2011 JP 2011276452**

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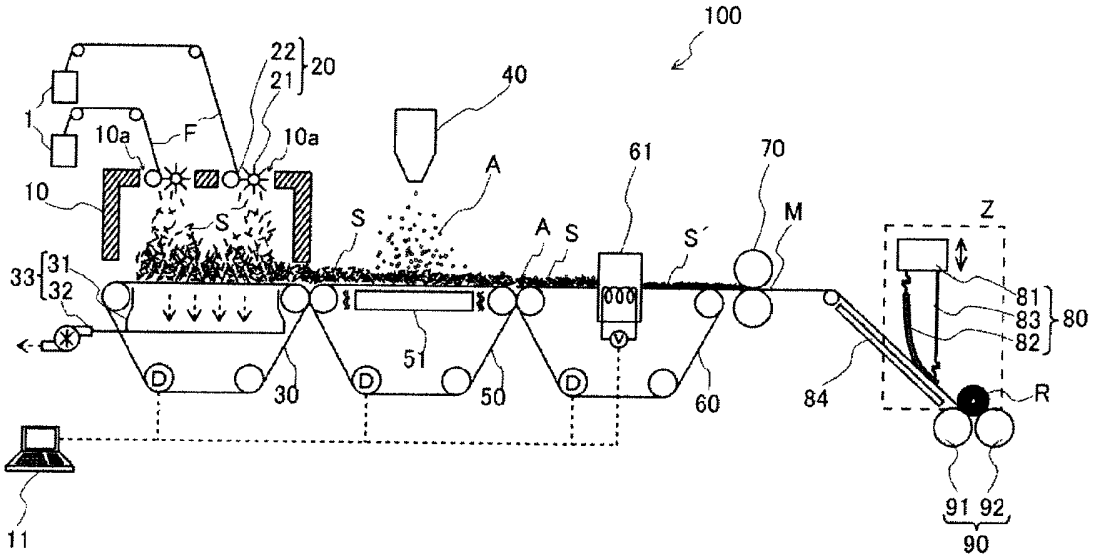
## (54) Apparatus and method for manufacturing glass chopped strand mat

(57) A glass chopped strand mat manufacturing apparatus and method capable of manufacturing a light-weight glass chopped strand mat for which there has in recent years been an increasing demand, are provided which can manufacture a high-quality (i.e., wrinkle-free) product at low cost. The apparatus is an apparatus for manufacturing a glass chopped strand mat M having a weight of 300 g/m$^2$ or less from glass chopped strands S, including wrinkle preventing means 80 for smoothing out wrinkles occurring on the glass chopped strand mat M, and winding means 90 for winding, into a roll, the glass chopped strand mat M on which the wrinkles have been smoothed out.

[Figure 1]

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to apparatuses and methods for manufacturing a glass chopped strand mat having light weight from glass chopped strands.

### BACKGROUND ART

**[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 both sides of a foamed polyurethane sheet has been developed. In recent years, advances in car weight reduction have led to a demand for a reduction in the weight of the car molded ceiling material. Therefore, there is an increasing demand for 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) which contains a reduced amount of glass chopped strands which are a material for the glass chopped strand mat (a glass chopped strand mat having light weight is also referred to as a "lightweight glass chopped strand mat").

**[0003]** The glass chopped strand mat is manufactured as follows. Initially, a glass fiber is cut into pieces having a predetermined length to obtain glass chopped strands. Next, the glass chopped strands are distributed and deposited on conveying means such as 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 into a roll by a winding machine or the like before shipment.

**[0004]** Here, when a lightweight (i.e., thin) glass chopped strand mat is manufactured, the following problem may occur. A glass chopped strand mat expands or contracts to some extent during manufacture. The lightweight glass chopped strand mat has a thin thickness and therefore has difficulty in sufficiently accommodating such expansion or contraction. Therefore, the expansion or contraction which has not been accommodated causes wrinkles which remain on the glass chopped strand mat. The wrinkles are likely to occur, particularly between the step of cooling and pressing the glass chopped strands and the step of winding the glass chopped strand mat using the winding machine. If the glass chopped strand mat having wrinkles is directly wound into a roll, the wrinkles directly remain in the roll. In this case, even when the roll is unwound, the wrinkles appear on the surface of the glass chopped strand mat. The glass chopped strand mat having wrinkles has a low commercial value. If a molded product is manufactured using such a glass chopped strand mat, defects such as a molding defect, delamination, and insufficient strength are likely to occur.

**[0005]** Conventionally, there is a well-known technique of removing wrinkles occurring in a sheet-like material, in which the wrinkles are smoothed out by sliding a member, such as a split bar or an expander roll, on the sheet-like material (see, for example, Patent Document 1). Patent Document 1 describes an apparatus for winding a band-like material (sheet-like material), in which an expander roll is provided at a position close to a roll into which the band-like material is wound, and the band-like material is tentered or stretched (wrinkles are smoothed out) immediately before being wound into a roll, whereby removing wrinkles occurring on the band-like material.

### CITATION LIST

### PATENT DOCUMENT

**[0006]** Patent Document 1: Japanese Unexamined Patent Application Publication No. S63-196445

### DISCLOSURE OF THE INVENTION

### PROBLEM TO BE SOLVED BY THE INVENTION

**[0007]** However, for the glass chopped strand mat, various problems would arise if the expander roll is used to try to smooth out wrinkles. The glass chopped strand mat is a molded product formed of glass chopped strands which are obtained by cutting a glass fiber into pieces having a predetermined length and are held together by a thermoplastic resin (binder). In other words, the glass chopped strand mat is a mixture of the glass fiber and the thermoplastic resin. Therefore, if a surface of the glass chopped strand mat is violently rubbed with a sliding member such as an expander roll, the thermoplastic resin contained in the glass chopped strand mat is melted due to frictional heat, so that the product quality of the glass chopped strand mat is likely to decrease. In particular, if an expander roll is used for a lightweight glass chopped strand mat, the entire glass chopped strand mat is highly likely to be excessively heated by heat caused by friction with the expander roll because the glass chopped strand mat has a thin thickness. Therefore, a trouble may occur, e.g., the glass chopped strand mat may be damaged or the melted thermoplastic resin may stick firmly to the surface of the expander roll (so-called "gum-up"). Also, the expander roll is allowed to be provided only at a position in the movement path of the glass chopped strand mat where tension may occur in a direction intersecting the movement direction (e.g., a corner portion at which the movement direction of the glass chopped strand mat is bent or changed). Moreover, the

expander roll itself costs high. Thus, the use of the expander roll has constraints on apparatus configuration, leading to a complicated design of equipment and an increase in the cost of equipment.

**[0008]** Thus, at present, a technique has not yet been established which can reliably and easily remove wrinkles occurring during manufacture without damaging a glass chopped strand mat, particularly a lightweight glass chopped strand mat. The present invention has been made in view of the above problems. It is an object of the present invention to provide an apparatus and method for manufacturing a wrinkle-free (i.e., high-quality) glass chopped strand mat (particularly, a lightweight glass chopped strand mat for which there has in recent years been an increasing demand) at low cost. As used herein, the lightweight glass chopped strand mat refers to one that has a weight of 300 g/m$^2$ or less.

## MEANS FOR SOLVING PROBLEM

**[0009]** 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 having a weight of 300 g/m$^2$ or less from glass chopped strands, including wrinkle preventing means for smoothing out a wrinkle or wrinkles occurring on the glass chopped strand mat, and winding means for winding, into a roll, the glass chopped strand mat on which the wrinkle or wrinkles have been smoothed out.

**[0010]** The weight of a glass chopped strand mat is, for example, defined as 300 to 600 g/m$^2$ in the Japanese Industrial Standards (JIS R3411 (2006)). In JIS R3411 (2006), a glass chopped strand mat is defined as a product produced by cutting an E-glass strand into pieces having a length of about 50 mm, piling up the E-glass strand pieces in random directions to a uniform thickness, and shaping the pile of the E-glass strand pieces into a mat using a binder. Therefore, conventionally, most glass chopped strand mat products have a weight exceeding 300 g/m$^2$. The products having a relatively high weight have a relatively large thickness, and therefore, wrinkles do not occur significantly. However, a lightweight (300 g/m$^2$ or less) glass chopped strand mat lacks the ability to stretch and shrink, and therefore, wrinkles are likely to occur thereon during manufacture. For the lightweight glass chopped strand mat, it is not preferable to smooth out the wrinkles using a sliding member such as an expander roll. On the other hand, if a molded product is manufactured using a glass chopped strand mat from which wrinkles have not been sufficiently removed, defects such as a molding defect, delamination, and insufficient strength are likely to occur. Therefore, in order to maintain the quality of the molded product, it is desirable to remove wrinkles before the glass chopped strand mat is wound into a roll.

In this regard, the glass chopped strand mat manufacturing apparatus having this configuration includes the wrinkle preventing means which smoothes out wrinkles occurring on the glass chopped strand mat. With the wrinkle preventing means, substantially all wrinkles occurring on the glass chopped strand mat can be removed before the glass chopped strand mat is wound into a roll by the winding means. Alternatively, the occurrence of wrinkles on the glass chopped strand mat can be prevented. As a result, when a molded product is manufactured using the glass chopped strand mat, defects such as a molding defect do not occur, and therefore, high-quality products can be obtained.

**[0011]** In the glass chopped strand mat manufacturing apparatus of the present invention, the wrinkle preventing means is preferably pressing means for pressing the glass chopped strand mat.

**[0012]** According to the glass chopped strand mat manufacturing apparatus having this configuration, wrinkles which have occurred on the glass chopped strand mat can be easily removed only by pressing the glass chopped strand mat using the pressing means. The pressing means damages the glass chopped strand mat to a less extent compared to a sliding member such as an expander roll. Also, if the pressing means is employed, a high-cost component such as an expander roll is not required. Therefore, the apparatus configuration is simplified, and constraints on the place where the apparatus will be set up are reduced, resulting in a decrease in equipment cost.

**[0013]** In the glass chopped strand mat manufacturing apparatus of the present invention, a pressing force of the pressing means is preferably set to 0.5 to 3 g/cm$^2$.

**[0014]** According to the glass chopped strand mat manufacturing apparatus having this configuration, the pressing force of the pressing means is set to 0.5 to 3 g/cm$^2$, whereby wrinkles occurring on the glass chopped strand mat can be reliably removed without substantial damage to the glass chopped strand mat.

**[0015]** In the glass chopped strand mat manufacturing apparatus of the present invention, the pressing means is preferably positioned to be accommodated within a full width of the glass chopped strand mat, and a width of the pressing means is preferably set to 70% or more and 100% or less of the full width of the glass chopped strand mat.

**[0016]** According to the glass chopped strand mat manufacturing apparatus having this configuration, the pressing means is positioned to be accommodated within the full width of the glass chopped strand mat, and the width of the pressing means is set to 70% or more and 100% or less of the full width of the glass chopped strand mat. Therefore, wrinkles occurring on the glass chopped strand mat are smoothed out by the pressing means to escape or move to opposite sides of the pressing means, i.e., opposite sides of the glass chopped strand mat. As a result, a flat (i.e., wrinkle-free) glass chopped strand mat can be obtained.

**[0017]** In the glass chopped strand mat manufacturing apparatus of the present invention, a surface of the glass chopped strand mat opposite to a surface thereof which

the pressing means contacts and presses, is preferably in a non-contact state.

**[0018]** According to the glass chopped strand mat manufacturing apparatus having this configuration, the surface of the glass chopped strand mat opposite to the surface thereof which the pressing means contacts and presses, is in a non-contact state. Therefore, the glass chopped strand mat is not rubbed by other members. As a result, a trouble such as gum-up (a binder sticks firmly to a member) can be prevented from occurring. The area where the glass chopped strand mat makes contact with other members is reduced. As a result, the binder contained in the glass chopped strand mat is not melted or separated due to friction, so that the glass chopped strand mat can be in good condition when the glass chopped strand mat is wound by the winding means.
Note that when the glass chopped strand mat is in the non-contact state (i.e., floating above) with respect to other members as in this configuration, substantially no tension occurs in a direction perpendicular to the movement direction of the glass chopped strand mat, and therefore, a sliding member such as an expander roll cannot be used. Therefore, the pressing means of this configuration is particularly effective which can remove wrinkles only by contacting and pressing the glass chopped strand mat.

**[0019]** 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 having a weight of 300 g/m$^2$ or less from glass chopped strands, including a wrinkle preventing step of smoothing out a wrinkle or wrinkles occurring on the glass chopped strand mat, and a winding step of winding, into a roll, the glass chopped strand mat on which the wrinkle or wrinkles have been smoothed out.

**[0020]** According to the glass chopped strand mat manufacturing method of this configuration, advantages similar to those of the above-described glass chopped strand mat manufacturing apparatus are obtained. Specifically, according to the glass chopped strand mat manufacturing method of this configuration, by performing the wrinkle preventing step of smoothing out wrinkles occurring on the glass chopped strand mat, substantially all wrinkles occurring on the glass chopped strand mat can be removed before the winding step of winding the glass chopped strand mat into a roll. Alternatively, the occurrence of wrinkles on the glass chopped strand mat can be prevented. As a result, when a molded product is manufactured using the glass chopped strand mat, defects such as a molding defect do not occur, and therefore, high-quality products can be obtained.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]**

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

[FIG. 2] FIG. 2 is a diagram schematically showing pressing means in the first embodiment of the present invention.

[FIG. 3] FIG. 3 is a diagram schematically showing pressing means in a second embodiment of the present invention.

## DESCRIPTION OF EMBODIMENTS

**[0022]** An apparatus and method for manufacturing a glass chopped strand mat according to the present invention will be described hereinafter with reference to FIGS. 1 to 3. Note that the present invention is not intended to be limited to the embodiments described below or the configurations shown in the drawings.

**[0023]** FIG. 1 is a diagram schematically showing an overall configuration of the glass chopped strand mat manufacturing apparatus (hereinafter simply referred to as a "manufacturing apparatus") 100 of the present invention. The glass chopped strand mat manufacturing method of the present invention is performed using the manufacturing apparatus 100. The manufacturing apparatus 100 can manufacture a glass chopped strand mat having a weight of, for example, as low as 300 g/m$^2$ or less from glass chopped strands. The manufacturing apparatus 100 includes, as major components, a chamber 10, a distribution conveyor 30, a first conveyor 50, a second conveyor 60, a cold press roller 70, wrinkle preventing means 80, a winding machine 90, and the like. Of these components, the configuration of a main portion Z including the wrinkle preventing means 80 and the winding machine 90 enclosed by a dashed line in FIG. 1 has a characteristic feature of the present invention and is essential to the present invention.

**[0024]** 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 corresponding 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.

**[0025]** 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. A cutting device 20 which cuts a glass fiber F described below is attached to a glass fiber inlet 10a provided at a ceiling portion of the chamber 10. The cutting device 20 includes a cutter roller 21 and a rubber roller 22. The glass fiber F which has been pulled out of a glass cake 1 is fed into between the rotating cutter roller 21 and rubber roller 22 to be continually cut, whereby glass chopped strands S are produced. The glass chopped strands S fall by their own weight in the chamber 10 and are substantially uni-

formly distributed and put on the belt of the distribution conveyor 30 to form a sheet. 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.

**[0026]** Next, the glass chopped strands S are moved from the distribution conveyor 30 to the first conveyor 50. 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 addition of the binder A to the glass chopped strands S allows the glass chopped strands S to stick together by a heating treatment described below, whereby the glass chopped strands S can be maintained in the shape of a mat. 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. 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. Note that a water sprayer (not shown) may be provided above or below the first conveyor 50 and upstream of the binder sprayer 40. 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. The glass chopped strands S on the first conveyor 50 are conveyed to the downstream second conveyor 60 with the binder A uniformly adhering to the glass chopped strands S.

**[0027]** A heating furnace 61 is provided to the second conveyor 60, surrounding the belt. The temperature of atmosphere in the heating furnace 61 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 61 may be manually adjusted by a worker. The glass chopped strands S with the binder A on the belt of the second conveyor 60 are subjected to a heating treatment while being passed through the heating furnace 61, whereby the binder A is softened and melted. As a result, the glass chopped strands S stick together (the glass chopped strands S after being heated are referred to as "glass chopped strands S'" to discriminate from those before being heated). Because the belt of the second conveyor 60 is thus exposed to high temperature, the belt is formed of a heat resistant material, such as a metal.

**[0028]** The cold press roller 70 and the winding machine 90 are provided downstream of the second conveyor 60. The cold press roller 70 includes a pair of rollers. The glass chopped strands S' with the melted binder A are conveyed to the cold press roller 70 and passed through the nip. The glass chopped strands S' are cooled and pressed by being passed through the cold press roller 70, whereby the glass chopped strands S' are bound together. As a result, a glass chopped strand mat M is produced. Here, the cold press roller 70 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 70. The glass chopped strand mat M thus produced is wound into a roll R by the winding machine 90 in a winding step of the present invention. The winding machine 90 includes two surface rollers 91 and 92. The glass chopped strand mat M is wound on the surface rollers 91 and 92 to form the roll R. The glass chopped strand mat M of the roll R is a product having a weight of as low as 300 g/m$^2$ or less.

**[0029]** Here, as described in the BACKGROUND ART section, wrinkles are likely to occur on the glass chopped strand mat M which is being moved between the cold press roller 70 and the winding machine 90. The occurrence of wrinkles is significant particularly in 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), which is encompassed by the present invention. If no measures are taken to remove the wrinkles, a molding defect, delamination, insufficient strength, and the like are likely to occur in a molded product which employs the glass chopped strand mat. Therefore, in the present invention, the wrinkle preventing means 80 is provided between the cold press roller 70 and the winding machine 90 to perform a wrinkle prevention step of smoothing out wrinkles occurring on the glass chopped strand mat M.

**[0030]** The wrinkle preventing means 80 has a function of smoothing out wrinkles occurring on the glass chopped strand mat M. Specifically, the wrinkle preventing means 80 of this embodiment is configured as pressing means 80 which presses the glass chopped strand mat M. The pressing means 80 includes an elevating portion 81 which adjusts a height position with respect to the glass chopped strand mat M, a pressing sheet 82 which presses directly the glass chopped strand mat M, and a support portion 83 which lifts up the pressing sheet 82, for example, when the manufacture of the glass chopped strand mat M is interrupted. The pressing sheet 82 is a rectangular plate-like member, one end of which is suspended from the elevating portion 81 and the other end of which is connected to the support portion 83. A predetermined range extending from the other end of the pressing sheet

82 is a contact surface of the pressing sheet 82 which contacts and presses the glass chopped strand mat M. When the wrinkle prevention step is performed, the elevating portion 81 is moved up and down so that pressing force applied from the pressing sheet 82 to the glass chopped strand mat M is adjusted to 0.5 to 3 g/cm$^2$. Note that the weight of the pressing sheet 82 may be used as the pressing force, and in this case, the weight and the contact surface of the pressing sheet 82 are adjusted so that the pressing force falls within the above-described range. If the pressing force falls within the above-described range, the glass chopped strand mat M is not substantially damaged by the pressing means 80. The pressing sheet 82 is preferably formed of an elastic material, such as rubber. By imparting an appropriate elasticity to the pressing sheet 82, the pressing sheet 82 can follow quickly a rough surface of the glass chopped strand mat M or vibration during the manufacture, and therefore, the pressing force can be reliably applied to the glass chopped strand mat M.

**[0031]** A plate member 84 which guides the glass chopped strand mat M and prevents the pressing sheet 82 from hanging low, is provided on the opposite side of the glass chopped strand mat M with respect to the pressing means 80. During the manufacture of the glass chopped strand mat M, the glass chopped strand mat M is not in contact with the plate member 84 (in a non-contact state, i.e., floating above the plate member 84) due to tensile force caused by winding performed by the winding machine 90. Therefore, the binder contained in the glass chopped strand mat M is prevented from adhering to the plate member 84, i.e., a trouble such as gum-up do not occur. The area in which the glass chopped strand mat M makes contact with other members is reduced, and therefore, the binder contained in the glass chopped strand mat M is not melted or separated due to friction, so that the glass chopped strand mat M can be in good condition when the glass chopped strand mat M is wound by the winding machine 90. Note that when the glass chopped strand mat M is floating above the member, substantially no tension occurs in a direction perpendicular to the movement direction of the glass chopped strand mat M, and therefore, a sliding member such as an expander roll cannot be used. Therefore, the pressing means 80 is particularly effective which can remove wrinkles only by contacting and pressing the glass chopped strand mat M. After the glass chopped strand mat M has been completely wound, the glass chopped strand mat M is not present below the pressing sheet 82. In this case, the pressing sheet 82 tries to hang low, however, the pressing sheet 82 makes contact with the plate member 84 and therefore is prevented from hanging excessively low. Therefore, a task of preparation for resuming the manufacture of the glass chopped strand mat M is facilitated. When the manufacture is resumed, the support portion 83 is lifted up to separate the pressing sheet 82 from the plate member 84, and thereafter, a new glass chopped strand mat M pulled out from the cold press roller 70 is guided along the plate member 84. Thus, the glass chopped strand mat M can be easily guided from the cold press roller 70 to the winding machine 90.

**[0032]** In order to allow the pressing means 80 to reliably remove wrinkles occurring on the glass chopped strand mat M, it is necessary to take a size of the pressing sheet 82 into considerations, and the pressing sheet 82 needs to be appropriately pressed against the glass chopped strand mat M. In this regard, a preferable example configuration of the pressing sheet 82 will be described in first and second embodiments described below.

<First Embodiment>

**[0033]** FIG. 2 is a schematic diagram of the pressing means 80 according to a first embodiment of the present invention, showing a partly see-through view of a region Z enclosed by a dashed line of the overall configuration diagram of the manufacturing apparatus 100 of FIG. 1, as viewed from the outside of the pressing means 80. In FIG. 2, a region (pressing region) where the pressing sheet 82 included in the pressing means 80 contacts the glass chopped strand mat M is indicated by a reference character X. A region (wrinkle region) where wrinkles may occur on the glass chopped strand mat M is indicated by a reference character Y. The wrinkle region Y may extend largely from a middle of the glass chopped strand mat M toward opposite ends thereof.

**[0034]** The pressing sheet 82 for removing wrinkles occurring on the glass chopped strand mat M is positioned to be accommodated within a full width of the glass chopped strand mat M, preferably positioned at a center of the full width. In this embodiment, the pressing sheet 82 is positioned so that a center line of the pressing sheet 82 coincides with a center line of the glass chopped strand mat M. In FIG. 2, the center lines indicated by a dash-dot line of the pressing sheet 82 and the glass chopped strand mat M coincide with each other. Here, a width B of the pressing region X is set to 70% or more and 100% or less of the full width A of the glass chopped strand mat M. When the wrinkle prevention step is performed using the pressing sheet 82 having such an arrangement and size, the wrinkle region Y of the glass chopped strand mat M is pressed and stretched by the pressing region X of the pressing sheet 82 as the glass chopped strand mat M is moved, so that the wrinkle region Y escapes or moves to opposite ends of the pressing sheet 82 (i.e., the opposite ends of the glass chopped strand mat M) as indicated by arrows. As a result, the wrinkles of the glass chopped strand mat M are eliminated, whereby the flat (i.e., wrinkle-free) glass chopped strand mat M is obtained behind or downstream of the pressing region X. Note that even if the pressing sheet 82 is positioned slightly away from the center of the full width of the glass chopped strand mat M, then when there is a space on each of the opposite sides of the pressing sheet 82 into which the wrinkle region Y can be moved,

the wrinkles of the glass chopped strand mat M are substantially eliminated by the pressing region X of the pressing sheet 82, whereby the flat glass chopped strand mat M can be obtained.

**[0035]** Note that a distance d between the pressing region X and the roll R of the glass chopped strand mat M is preferably set to be as short as possible within the range in which the pressing means 80 does not interfere with the roll R even when the diameter of the roll R becomes large. By reducing the distance d, the glass chopped strand mat M immediately after wrinkles have been removed can be reliably wound into the roll R.

<Second Embodiment>

**[0036]** FIG. 3 is a schematic diagram of the pressing means 80 according to a second embodiment of the present invention, showing a partly see-through view of a region Z enclosed by a dashed line of the overall configuration diagram of the manufacturing apparatus 100 of FIG. 1, as viewed from the outside of the pressing means 80. In FIG. 3, as in the first embodiment, the pressing region X and the wrinkle region Y are shown. In the second embodiment, a glass chopped strand mat M' having a width which is about twice times as large as that of the first embodiment, is formed and then divided into two equal portions separated at a middle of the glass chopped strand mat M'. The wider glass chopped strand mat M' is cut into two glass chopped strand mats M with a cutter 85.

**[0037]** Pressing sheets 82 are provided to remove wrinkles from the respective glass chopped strand mats M after the cutting, and are positioned to be accommodated within the full widths of the respective glass chopped strand mats M, preferably positioned at centers of the full widths of the respective glass chopped strand mats M. In this embodiment, the pressing sheets 82 are positioned at two points so that a center line of each of the pressing sheets 82 coincides with a center line of the corresponding one of the glass chopped strand mats M. In FIG. 3, the center lines indicated by a dash-dot line of each of the pressing sheets 82 and the corresponding one of the glass chopped strand mats M coincide with each other. Here, the sum of widths B1 and B2 of the two pressing regions X are set to be 70% or more and 100% or less of a full width A of the glass chopped strand mat M' before the cutting. With such an arrangement and size, a wrinkle region Y extending over the two glass chopped strand mats M is pressed and stretched by the pressing regions X of the pressing sheets 82 as the glass chopped strand mats M is moved, so that the wrinkle region Y escapes or moves to opposite sides of each pressing sheet 82 (i.e., opposite sides of each glass chopped strand mat M) as indicated by arrows. As a result, the wrinkles of the glass chopped strand mats M are eliminated, whereby the flat (i.e., wrinkle-free) glass chopped strand mats M are obtained behind or downstream of the pressing regions X. Note that even if the pressing sheets 82 are positioned slightly away from the centers of the full widths of the respective glass chopped strand mats M, then when there is a space on each of the opposite sides of each of the pressing sheets 82 into which the wrinkle region Y can be moved, the wrinkles of the glass chopped strand mats M are substantially eliminated by the pressing regions X of the respective pressing sheets 82, whereby the flat glass chopped strand mats M can be obtained. In this embodiment, one of the pressing sheets 82 may be positioned at the center of the full width of the corresponding one of the glass chopped strand mats M while the other pressing sheet 82 may be positioned away from the center of the full width of the corresponding one of the glass chopped strand mats M. Also in this case, by providing a space on each of the opposite sides of each of the pressing sheets 82 into which the wrinkle region Y can be moved, the flat glass chopped strand mats M can be obtained.

**[0038]** When, as in this embodiment, a plurality of glass chopped strand mats M are produced from a wider glass chopped strand mat M', the wider glass chopped strand mat M' is preferably cut at a point upstream of the pressing regions X. If the wider glass chopped strand mat M' is cut at a point downstream of the pressing regions X, new wrinkles may occur, due to the cutting, on the flat mats from which wrinkles have been removed by the pressing sheets 82. If wrinkles remain on the glass chopped strand mats M after the cutting, end portions of the glass chopped strand mats M arranged side by side may overlap, and the overlap portion may be entangled together when rolls R are formed, so that the rolls R may be stuck together and therefore may not be separated from each other. However, if the cutting has been completed before the pressing regions X, substantially all wrinkles are removed by the pressing regions X, whereby, at the same time, the rolls R can be prevented from being stuck together due to the overlapping of the glass chopped strand mats M.

## INDUSTRIAL APPLICABILITY

**[0039]** The glass chopped strand mat manufacturing apparatus of the present invention, and the glass chopped strand mat obtained by the manufacturing method, are applicable to car molded ceiling materials, and in addition, interior materials for other vehicles, interior materials for buildings and other structures.

## DESCRIPTION OF REFERENCE CHARACTERS

**[0040]**

10 CHAMBER

20 CUTTING DEVICE

30 DISTRIBUTION CONVEYOR

40 BINDER SPRAYER

50 FIRST CONVEYOR

60 SECOND CONVEYOR

70 COLD PRESS ROLLER

80 PRESSING MEANS (WRINKLE PREVENTING MEANS)

81 ELEVATING PORTION

82 PRESSING SHEET

83 SUPPORT PORTION

90 WINDING MACHINE

100 GLASS CHOPPED STRAND MAT MANUFACTURING APPARATUS

F GLASS FIBER

S GLASS CHOPPED STRAND

A BINDER (RESIN POWDER)

M GLASS CHOPPED STRAND MAT

R ROLL

**Claims**

**1.** An apparatus (100) for manufacturing a glass chopped strand mat (M) having a weight of 300 g/m$^2$ or less from glass chopped strands (S), **characterized in that** it comprises:

wrinkle preventing means (80) for smoothing out a wrinkle or wrinkles occurring on the glass chopped strand mat (M); and
winding means (90) for winding, into a roll, the glass chopped strand mat (M) on which the wrinkle or wrinkles have been smoothed out.

**2.** The apparatus (100) of claim 1, wherein
the wrinkle preventing means (80) is pressing means for pressing the glass chopped strand mat (M).

**3.** The apparatus (100) of claim 2, wherein
a pressing force of the pressing means is set to 0.5 to 3 g/cm$^2$.

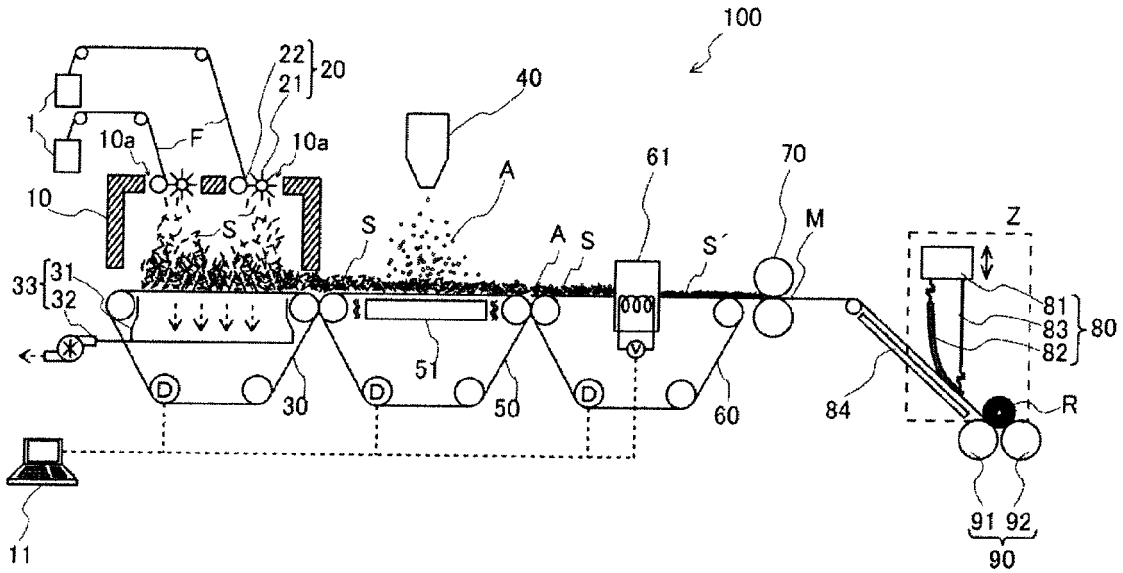
**4.** The apparatus (100) of claim 2 or 3, wherein
the pressing means is positioned to be accommodated within a full width of the glass chopped strand mat (M), and a width of the pressing means is set to 70% or more and 100% or less of the full width of the glass chopped strand mat (M).

**5.** The apparatus of any one of claims 2 to 4, wherein a surface of the glass chopped strand mat (M) opposite to a surface thereof which the pressing means contacts and presses, is in a non-contact state.

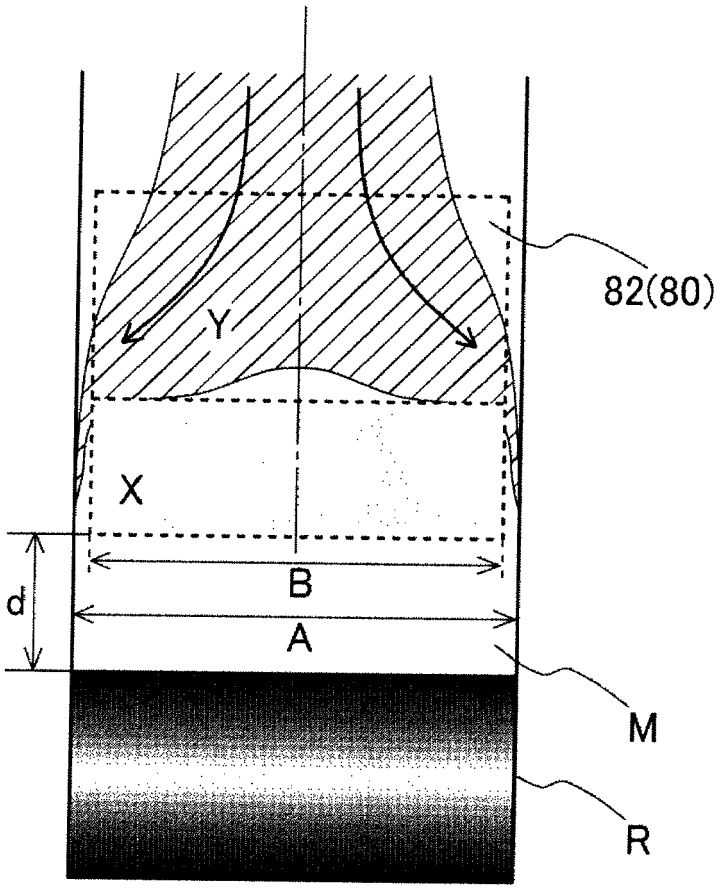
**6.** A method for manufacturing a glass chopped strand mat (M) having a weight of 300 g/m$^2$ or less from glass chopped strands (S), **characterized in that** it comprises:

a wrinkle preventing step of smoothing out a wrinkle or wrinkles occurring on the glass chopped strand mat (M); and
a winding step of winding, into a roll, the glass chopped strand mat (M) on which the wrinkle or wrinkles have been smoothed out.

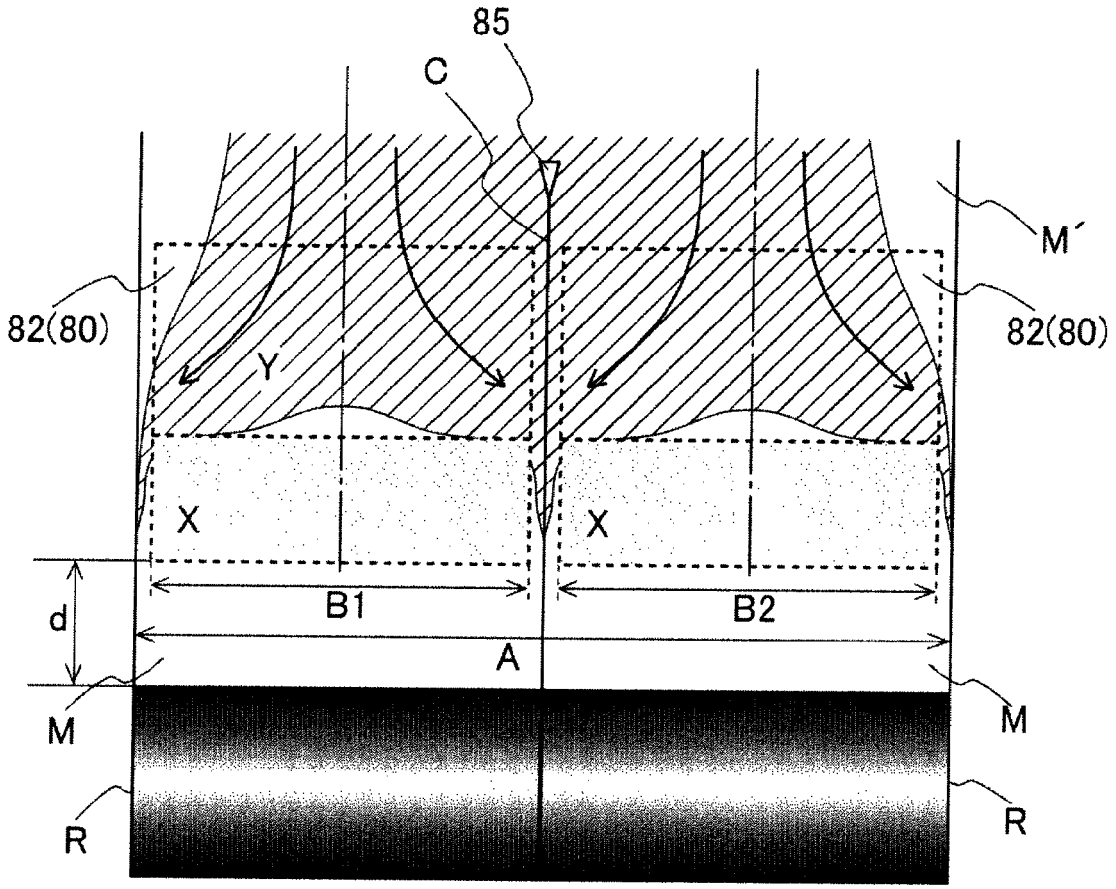
[Figure 1]


100
22
21
20
40
1
10a
F
10a
10
A
61
70
Z
S
S
A
S
S'
M
33
31
32
81
83
82
80
51
30
50
60
84
R
91
92
90
11

[Figure 2]



[Figure 3]



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# EUROPEAN SEARCH REPORT

Application Number
EP 12 19 7105

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The present search report has been drawn up for all claims

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|---|---|---|
| The Hague | 30 January 2013 | Barathe, Rainier |

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X : particularly relevant if taken alone
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