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

(11) **EP 4 382 654 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.06.2024 Bulletin 2024/24

(21) Application number: **23214003.8**

(22) Date of filing: **04.12.2023**

(51) International Patent Classification (IPC):
D06B 3/10 *(2006.01)* ***D06B 19/00*** *(2006.01)*
D06C 3/06 *(2006.01)* *B32B 27/12* *(2006.01)*
D06B 1/10 *(2006.01)* *D06B 11/00* *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D06B 3/10; D06B 19/007; D06C 3/06; B32B 27/12; D06B 1/10; D06B 11/0059

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **05.12.2022 KR 20220167778**
21.11.2023 KR 20230162234

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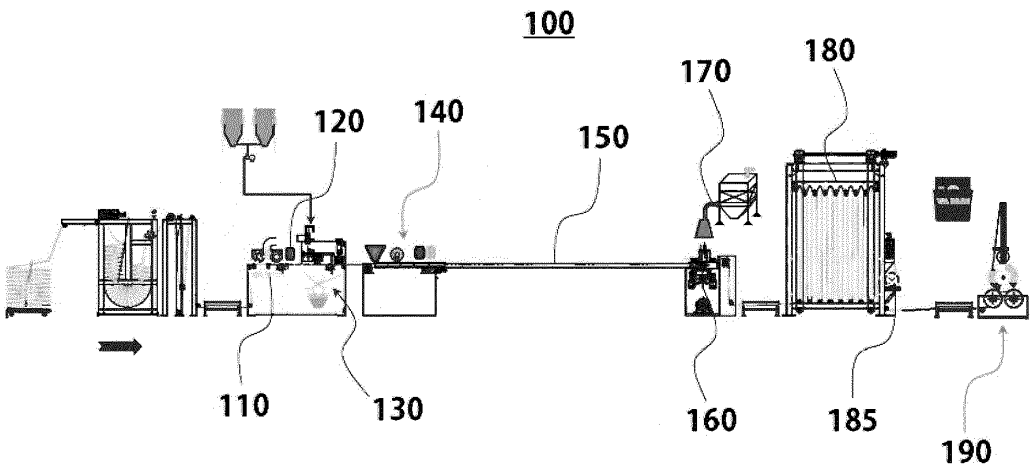
(54) HYBRID COATING AND CURING SYSTEM

(57) The present invention provides a hybrid coating and curing system. The hybrid coating and curing system comprise a cleaner configured to remove foreign matter from a woven fabric web, an ultraviolet (UV) irradiator configured to irradiate the fabric web, from which the foreign matter has been removed, with UV light, a coating part configured to apply a coating liquid onto the fabric web which has been irradiated with the UV light, a rolling and curing part configured to roll and cure the fabric web onto which the coating liquid has been sprayed, a tenter configured to move the cured fabric web at a predetermined speed, a perforator configured to form a plurality of drainage holes in the moved fabric web, a dust collector configured to collect foreign matter, generated in a process of forming the plurality of drainage holes, from the fabric web, a folder configured to fold the fabric web from which the foreign matter has been removed and a roller part configured to package the folded fabric web while fixing a bending direction of the folded fabric web.

Fig. 1



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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a hybrid coating and curing system, and more particularly, to a hybrid coating and curing system that can optimize physical performance of a finished product while simplifying a process by applying a coating agent, which uses a polymer resin, and the hybrid coating and curing system.

2. Discussion of Related Art

[0002] Among conventional fiber type fabric webs (fabric webs w) with a thick coating layer applied thereon, carpets and artificial turf, in particular, are mostly cured with high-temperature hot air after materials thereof are coated with liquid styrene-butadiene rubber (SBR) latex or polyurethane (PU). Accordingly, there is a problem in that fuel energy, such as liquefied petroleum gas (LPG) or liquefied natural gas (LNG), and electrical energy are consumed in large amounts.

[0003] Therefore, there is a need for research on a hybrid coating and curing system that can optimize physical performance of a finished product while simplifying a process by applying a coating agent, which uses a polymer resin, and the hybrid coating and curing system.

[Related Art Document]

[0004] (Patent Document 1) Korean Patent Registration No. 10-1676843

SUMMARY OF THE INVENTION

[0005] The present invention is directed to a hybrid coating and curing system that can optimize physical performance of a finished product while simplifying a process by applying a coating agent, which uses a polymer resin, and the hybrid coating and curing system.

[0006] The present invention is also directed to a hybrid coating and curing system in which a hybrid curer is provided to cure a coating agent and allow an internal structure of the coating agent, which uses a polymer resin or a compound, to be densely packed.

[0007] According to an aspect of the present invention, there is provided a hybrid coating and curing system including: a cleaner configured to remove foreign matter from a woven fabric web; an ultraviolet (UV) irradiator configured to irradiate the fabric web, from which the foreign matter has been removed, with UV light; a coating part configured to apply a coating liquid onto the fabric web which has been irradiated with the UV light; a rolling and curing part configured to roll and cure the fabric web onto which the coating liquid has been sprayed; a tenter configured to move the cured fabric web at a predetermined speed; a perforator configured to form a plurality of drainage holes in the moved fabric web; a dust collector configured to collect foreign matter, generated in a process of forming the plurality of drainage holes, from the fabric web; a folder configured to fold the fabric web from which the foreign matter has been removed; and a roller part configured to package the folded fabric web while fixing a bending direction of the folded fabric web, wherein the rolling and curing part includes a non-contact roller configured to spray compressed air onto the coated fabric web, a roller configured to roll the fabric web onto which the compressed air has been sprayed, and a hybrid curer configured to irradiate the rolled fabric web with infrared light and UV light, the non-contact roller has a manifold provided above the fabric web, which moves forward, to spray compressed air onto the fabric web, the compressed air is sprayed across a width of the fabric web through a plurality of air spraying nozzles attached to the manifold, the compressed air has a temperature in a range of 3 °C to 40 °C and a wind speed in a range of 10 m/sec to 50 m/sec, the roller is provided to not have a pattern or have at least one of a linear pattern, an embossed pattern, and a wavy pattern, a pressure applied to the roller is in a range of 0.07 MPa to 0.7 MPa, the UV irradiator is provided in the form of a lamp above the fabric web moving forward, a wavelength of the lamp is in a range of 150 nm to 260 nm, the hybrid curer includes a housing provided in the shape of a box with one open surface, an infrared lamp coupled to the inside of the housing to irradiate the fabric web with infrared light, a UV lamp coupled to the inside of the housing to irradiate the fabric web with UV light, and a reflective shade coupled to the inside of the housing to reflect infrared light and UV light, which are irradiated in another direction, toward the fabric web, the hybrid curer further includes a temperature sensor provided on one point of the housing and configured to detect a temperature of the fabric web and a sensor monitoring part provided on one point of the housing and configured to determine that the temperature sensor has failed in a case where an average error of the temperature sensor calculated by [Equation 1] below is greater than a predetermined error limit,

[Equation 1]

$$A_{err} = T_{aver} - (P_{aver} - 1.96 \times \frac{T_{\sigma}}{\sqrt{n}})$$

(here, A_{err} represents the average error, T_{aver} represents the total average of values detected by the temperature sensor, P_{aver} represents a partial average relating to n values detected by the temperature sensor, and T_{σ} represents the overall standard deviation of the values detected by the temperature sensor), and

the cleaner includes two brushes provided to be spaced a predetermined distance apart from each other, the two brushes sweep and collect foreign matter and dust from the fabric web, and a suction port disposed between the two brushes suctions air to remove the foreign matter and dust.

[0008] Also, according to one embodiment of the present invention, the two brushes may be provided as a combination of a primary brush and a secondary brush.

[0009] Also, according to one embodiment of the present invention, the primary brush may be provided as at least one of a channel spiral type, a punched roller type, a punched roller spiral type, a strip channel type, a twist brush single type, and a twist brush double type, and the secondary brush may be provided as at least one of a hook type, a sponge type, an embossed type, the channel spiral type, the punched roller type, the punched roller spiral type, and the strip channel type.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The above and other objects, features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing exemplary embodiments thereof in detail with reference to the accompanying drawings, in which:

FIG. 1 is a view illustrating a hybrid coating and curing system according to one embodiment of the present invention;
FIG. 2 is a view illustrating a cleaner according to one embodiment of the present invention;
FIG. 3 is a view illustrating an ultraviolet (UV) irradiator according to one embodiment of the present invention;
FIG. 4 is a view illustrating a non-contact roller according to one embodiment of the present invention;
FIG. 5 is a view illustrating a roller according to one embodiment of the present invention;
FIG. 6 is a view illustrating a hybrid curer according to one embodiment of the present invention;
FIG. 7 is a view illustrating a perforator and a dust collector according to one embodiment of the present invention;
FIG. 8 is a view illustrating a primary brush and a secondary brush according to one embodiment of the present invention;
FIG. 9 is a view illustrating an upper coating nozzle according to one embodiment of the present invention;
FIG. 10 is a view illustrating a line coating mold according to one embodiment of the present invention;
FIG. 11 is a view illustrating a fabric web coated with the line coating mold according to one embodiment of the present invention;
FIG. 12 is a view illustrating types of coating that is performed from above according to one embodiment of the present invention;
FIG. 13 is a view illustrating types of coating that is performed from below according to one embodiment of the present invention;
FIG. 14 is a view illustrating arrangement of UV lamps for different wavelengths according to one embodiment of the present invention;
FIG. 15 is a view illustrating the perforator according to one embodiment of the present invention;
FIG. 16 is a view illustrating filters of the dust collector according to one embodiment of the present invention; and
FIG. 17 is a view illustrating a width cutter according to one embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0011] Hereinafter, specific embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, the spirit of the present invention is not limited to the embodiments presented below, and those of ordinary skill in the art who understand the spirit of the present invention may easily propose other less advanced inventions or other embodiments falling within the scope of the spirit of the present invention through adding,

changing, or omitting components within the scope of the same spirit, and such inventions or embodiments also belong to the scope of the spirit of the present invention.

[0012] Hereinafter, a hybrid coating and curing system 100 according to the present invention will be described in detail with reference to FIGS. 1 to 7.

[0013] FIG. 1 is a view illustrating the hybrid coating and curing system 100 according to one embodiment of the present invention.

[0014] Referring to FIG. 1, the hybrid coating and curing system 100 according to one embodiment of the present invention may include a cleaner 110, an ultraviolet (UV) irradiator 120, a coating part 130, a rolling and curing part 140, a tenter 150, a perforator 160, a dust collector 170, a folder 180, and a roller part 190.

[0015] The cleaner 110 may remove foreign matter from a woven fabric web w. The fabric web w may be put into the cleaner 110 via a junction box (J-box). The cleaner 110 will be described in more detail with reference to FIG. 2.

[0016] FIG. 2 is a view illustrating the cleaner 110 according to one embodiment of the present invention.

[0017] Referring to FIG. 2, the cleaner 110 according to one embodiment of the present invention may include two brushes 111 provided to be spaced a predetermined distance from each other. First, the two brushes 111 may sweep and collect foreign matter, dust, and the like remaining on the fabric web w. Then, a suction port 112 disposed between the two brushes 111 may suction air to remove the foreign matter, dust, and the like. Also, as illustrated in FIG. 8, the two brushes 111 may be provided as brushes of different types. For example, the two brushes 111 may be provided as a combination of a primary brush A made of strong bristles to separate coarse foreign matter such as pieces or fragments of yarn piles and a secondary brush B made of fibers to separate particulate matter. According to a state of foreign matter attached to the fabric web w, both the primary brush and the secondary brush may be used, or only the secondary brush may be selectively used. Any one of a channel spiral type brush, a punched roller type brush, a punched roller spiral type brush, a strip channel type brush, a twist brush single type brush, and a twist brush double type brush may be selected for use as the primary brush made of strong bristles, and any one of a hook type brush, a sponge type brush, an embossed type brush, the channel spiral type brush, the punched roller type brush, the punched roller spiral type brush, and the strip channel type brush may be selected for use as the secondary brush. Any one of nylon, polypropylene, polyethylene, boar hair, horsehair, wool, anti-static bristles in which nylon and carbon fibers are mixed, anti-static bristles in which nylon and stainless steel are mixed, and anti-static bristles produced by coating nylon pile bristles with an anti-static agent may be selected for use as a material of the primary brush, and any one of polyester, polyvinyl alcohol (PVA), nylon, polypropylene, polyethylene, anti-static bristles in which nylon and carbon fibers are mixed, anti-static bristles in which nylon and stainless steel are mixed, and anti-static bristles produced by coating nylon pile bristles with an anti-static agent may be selected for use as a material of the secondary brush. Also, the pile bristles of the primary brush may have a diameter in a range of about 0.05 mm to 0.5 mm and a height in a range of about 10 mm to 60 mm, and the pile bristles of the secondary brush may have a size in a range of about 20 deniers to 250 deniers based on a single thread and a height in a range of about 5 mm to 45 mm.

[0018] Referring back to FIG. 1, the UV irradiator 120 may irradiate the fabric web w, from which the foreign matter has been removed, with UV light. The UV irradiator 120 will be described in more detail below with reference to FIG. 3.

[0019] FIG. 3 is a view illustrating the UV irradiator 120 according to one embodiment of the present invention.

[0020] Referring to FIG. 3, the UV irradiator 120 according to one embodiment of the present invention may be provided in the form of a lamp above the fabric web w moving forward and may irradiate the fabric web w with UV light. A wavelength of the lamp may be in a range of 150 nm to 260 nm or in a range of about 175 nm to 200 nm, a height from the fabric web w to the lamp may be in a range of about 70 mm to 370 mm but may be adjusted according to the material, thickness, or process speed of the fabric web w, and the fabric web w may be irradiated with UV light across its entire width which is in a range of 1.0 m to 5.0 m. Due to the UV irradiator 120, a bonding strength between a coating agent and a coating surface of the fabric web w may be increased. Also, any one of a mercury lamp, an ozone (O_3) lamp, and a light emitting diode (LED) lamp may be used as the lamp.

[0021] Referring back to FIG. 1, the coating part 130 may apply a coating liquid (coating agent) onto the fabric web w irradiated with UV light. The coating part 130 may be provided so that a coating agent conveyed from a coating agent reservoir by a pump is ejected through an upper coating nozzle 131, which is positioned above the fabric web w, and applied onto the fabric web w. Here, in a case where the fabric web w is a fabric in which intervals between piles woven in the longitudinal direction of the fabric are relatively wide and are about 7 mm to 13 mm, a line coating mold 132 may be used to perform a function of coating only the rows of piles that are woven. The upper coating nozzle 131 will be described in more detail with reference to FIG. 9.

[0022] FIG. 9 is a view illustrating an upper coating nozzle according to one embodiment of the present invention.

[0023] Referring to FIG. 9, for a coating liquid to be sufficiently and evenly applied in fixed amounts across the entire width of the fabric web w, in the upper coating nozzle 131 according to one embodiment of the present invention, a coating liquid hose 1312 having a coating liquid nozzle 1311 provided at one end is moved leftward and rightward using a linear driving part 1313 and a plastic chain 1314, and the amount of applied coating liquid may be precisely controlled by controlling a height difference between a doctor blade and the fabric web w to ensure that the coating liquid may be

applied at a predetermined amount. The doctor blade may be made of any one material of stainless steel, tungsten, vanadium, molybdenum alloy steel, bronze, a ceramic, and polyethylene in consideration of wear resistance, chemical resistance, oxidation resistance, solvent resistance, pH influence, durability, damage to the fabric web w, and the like. In order to reduce damage to the fabric web w and allow the applied coating agent to be more uniformly dispersed, the material of the doctor blade may be covered with a fiber material in which pile bristles made of nylon, polyester, polyethylene, or the like are exposed to a height of 5 mm or more. When coating is performed from above, a method of applying a coating agent and a method of controlling the amount of applied coating agent may be any one of a knife-on-roller type, a knife-on-air type, and a slot die type which are illustrated in FIG. 12. Also, as illustrated in FIG. 10, the line coating mold 132 may have oblong holes 1321 arranged in series and spaced at predetermined intervals. The line coating mold 132 may be made of any one material of stainless steel, tungsten, vanadium, molybdenum alloy steel, bronze, a ceramic, polyethylene, and polypropylene in consideration of wear resistance, chemical resistance, oxidation resistance, solvent resistance, pH influence, damage to the fabric web w, and the like. Also, the fabric web w coated using the line coating mold 132 is illustrated in FIG. 11.

[0024] Also, according to circumstances, coating may be performed from below. A rolling and coating device used when coating is performed from below includes coating rollers and a coating agent reservoir configured to hold a coating liquid and may be any one of a gravure type, a kiss roller type, and a reverse roller type, which are illustrated in FIG. 13, according to the arrangement of the rollers. Also, a polymer resin of the coating liquid may be any one of polyethylene (PE), polypropylene (PP), polyolefin (PO), polyethylene terephthalate (PET), polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), a blend resin thereof, and a compound obtained by mixing the polymer resin with an organic or inorganic compound as a functional additive. Also, the amount of coating agent applied onto the fabric web w may be selected according to the purpose of a finished product and an external environment where the product is to be used and may be set within a range of 350 g/m^2 to 1,200 g/m^2 based on the weight of the fabric web w at the time of applying a coating liquid onto the fabric web w.

[0025] The rolling and curing part 140 may roll and cure the fabric web w onto which the coating liquid has been sprayed. The rolling and curing part 140 may include a non-contact roller 141, a roller 142, and a hybrid curer 143.

[0026] The non-contact roller 141 may spray compressed air onto the coated fabric web w. The non-contact roller 141 will be described in more detail with reference to FIG. 4.

[0027] FIG. 4 is a view illustrating the non-contact roller 141 according to one embodiment of the present invention.

[0028] Referring to FIG. 4, the non-contact roller 141 according to one embodiment of the present invention may have a manifold 1411 provided above the fabric web w, which moves forward, to spray compressed air 1412 onto the fabric web w. The compressed air 1412 is provided in a dry state and is evenly sprayed across the entire width of the fabric web w through a plurality of air spraying nozzles attached to the manifold. The compressed air may have a temperature set in a range of about 3 °C to 40 °C and a wind speed set in a range of about 10 m/sec to 50 m/sec. Also, a height from the fabric web w to the air spraying nozzles may be in a range of about 80 mm to 430 mm but may be adjusted according to the type of the coating agent coated on the fabric web w, the temperature of the coated fabric web w, the amount of applied coating agent, or a process speed. Any one of stainless steel, copper, aluminum, acrylonitrile butadiene styrene (ABS), nylon, and PP may be used as a material of the air spraying nozzles. Each nozzle may have a circular shape or flat shape, but since even distribution of air pressure, rather than concentration thereof, is more effective, any flat type low-noise nozzle may be selected for use as the air spraying nozzles. Due to the non-contact roller 141, pressure may be formed while the coating liquid is solidified.

[0029] The roller 142 may further roll the fabric web w onto which the compressed air has been sprayed. The roller 142 will be described in more detail with reference to FIG. 5.

[0030] FIG. 5 is a view illustrating the roller 142 according to one embodiment of the present invention.

[0031] Referring to FIG. 5, the roller 142 according to one embodiment of the present invention may be provided to not have a pattern or have at least one of a linear pattern, an embossed pattern, a wavy pattern, and the like. Due to the roller 142, the coating agent may be more strongly bonded to the fabric web w. The roller 142 is for obtaining a bonding pressure between the coating agent and the fabric web w by contact therebetween. Any one of polyvinylidene fluoride (PVDF) and polytetrafluoroethylene (PTFE) may be used as a material of the roller 142, and a pressure applied to the roller may be in a range of 0.07 MPa to 0.7 MPa.

[0032] The hybrid curer 143 may irradiate the rolled fabric web w with infrared light and UV light. The hybrid curer 143 will be described in more detail with reference to FIG. 6.

[0033] FIG. 6 is a view illustrating the hybrid curer 143 according to one embodiment of the present invention.

[0034] Referring to FIG. 6, the hybrid curer 143 according to one embodiment of the present invention may include a housing 1431, an infrared lamp 1432, a UV lamp 1433, and a reflective shade 1434.

[0035] The housing 1431 may be provided in the shape of a box with one open surface.

[0036] The infrared lamp 1432 may be coupled to the inside of the housing 1431 to irradiate the fabric web w with infrared light. The infrared lamp 1432 may emit far infrared (FIR) light having a wavelength in a range of 50 μm to 900 μm that is effective when the color of the coating agent is bright and may emit mid-infrared (MIR) light having a wavelength

in a range of 2 μm to 15 μm that may be universally used regardless of the color of the coating agent. A height from the fabric web w to the infrared lamp 1432 may be in a range of about 70 mm to 370 mm but may be adjusted according to the type of the coating agent coated on the fabric web w, the temperature of the coated fabric web w, the amount of applied coating agent, or a process speed. Any one of an LED lamp, a mercury lamp, a metal halide lamp, and a xenon lamp may be selected for use as the infrared lamp 1432.

[0037] The UV lamp 1433 may be coupled to the inside of the housing 1431 to irradiate the fabric web w with UV light. A wavelength of the UV lamp 1433 will be described in more detail with reference to FIG. 14.

[0038] FIG. 14 is a view illustrating arrangement of UV lamps for different wavelengths according to one embodiment of the present invention.

[0039] Referring to FIG. 14, the UV lamp 1433 may emit UVA light having a wavelength in a range of 340 nm to 460 nm. A height from the fabric web w to the UV lamp 1433 may be in a range of about 70 mm to 370 mm but may be adjusted according to the type of the coating agent coated on the fabric web w, the temperature of the coated fabric web w, the amount of applied coating agent, or a process speed. Any one of an LED lamp, a mercury lamp, a metal halide lamp, a gallium lamp, and a xenon lamp may be selected for use as the UV lamp 1433. A plurality of UV lamps 1433 may be arranged in a combination in which different wavelengths are distinguished. Specifically, wavelengths A1 in a range of 340 nm to 370 nm, wavelengths A2 in a range of 371 nm to 400 nm, wavelengths A3 in a range of 401 nm to 430 nm, and wavelengths A4 in a range of 431 nm to 460 nm may be distinguished, and only the wavelengths A1 may be used, or wavelengths in two different ranges, three different ranges, or four different ranges may be simultaneously used.

[0040] Referring back to FIG. 6, the reflective shade 1434 may be coupled to the inside of the housing 1431 to reflect infrared light and UV light, which are irradiated in another direction, toward the fabric web w.

[0041] Due to the hybrid curer 143, a coating agent may be cured, and an internal structure of the coating agent, which uses a polymer resin or a compound, may be densely packed.

[0042] Also, the hybrid curer 143 may further include a temperature sensor (not illustrated).

[0043] The temperature sensor may be provided on one point of the housing 1431 and may detect a temperature of the fabric web w.

[0044] Meanwhile, in order to maintain reliability of the temperature sensor, the hybrid curer 143 may further include a sensor monitoring part (not illustrated) configured to determine whether the temperature sensor has failed.

[0045] The sensor monitoring part (not illustrated) may determine that the temperature sensor has failed in a case where an average error (A_{err}) of the temperature sensor calculated by [Equation 1] below is greater than a predetermined error limit (S_{err}).

[Equation 1]

$$A_{err} = T_{aver} - (P_{aver} - 1.96 \times \frac{T_{\sigma}}{\sqrt{n}})$$

[0046] Here, A_{err} represents the average error, T_{aver} represents the total average of values detected by the temperature sensor, P_{aver} represents a partial average relating to n values detected by the temperature sensor, and T_{σ} represents the overall standard deviation of the values detected by the temperature sensor.

[0047] More specifically, T_{aver} represents the total average of values detected by the temperature sensor and represents a value obtained by collecting multiple pieces of data for a predetermined period (e.g., a month) during which the temperature sensor operates normally and calculating the total average of detected temperature values, and T_{σ} represents a value obtained by collecting multiple pieces of data for the predetermined period (e.g., a month) and calculating the overall standard deviation of the detected temperature values.

[0048] Also, P_{aver} represents a partial average relating to n values detected by the temperature sensor and may be referred to as "partial average" because it corresponds to an average of some temperature values that is obtained by receiving a predetermined number of temperature values (n temperature values) in real time and calculating an average of the predetermined number of temperature values (n temperature values) in a process in which the temperature sensor is installed on site and used.

[0049] Here, when an estimated average value is calculated with 95% reliability using the partial average, an estimated

$$(P_{aver} - 1.96 \times \frac{T_\sigma}{\sqrt{n}}) \leq \mu \leq (P_{aver} + 1.96 \times \frac{T_\sigma}{\sqrt{n}})$$

average value (μ) has a range of .

[0050] Accordingly, the average error (A_{err}) which is a difference value between the total average (T_{aver}) and the upper limit or lower limit of the estimated average value (μ) may be calculated using [Equation 1] above.

[0051] Therefore, when the average error (A_{err}) calculated by [Equation 1] above is greater than the predetermined error limit (S_{err}), it indicates that the predetermined number of temperature values (n temperature values) received in real time are highly likely to have been erroneously input due to a failure of the temperature sensor. Thus, when the average error (A_{err}) is greater than the predetermined error limit (S_{err}), the sensor monitoring part (not illustrated) may determine that the temperature sensor has failed.

[0052] Referring back to FIG. 1, the tenter 150 may move the cured fabric web w at a predetermined speed.

[0053] Next, the perforator 160 and the dust collector 170 will be described in more detail with reference to FIG. 7.

[0054] FIG. 7 is a view illustrating the perforator 160 and the dust collector 170 according to one embodiment of the present invention.

[0055] The perforator 160 may form a plurality of drainage holes h in the moved fabric web w. The perforator 160 may use any one method selected from a method using an electric soldering iron, a method using an electric drill, and a method of punching using an eyelet. A drill bit may be set so that the drainage holes are formed with a diameter in a range of about 1.5 mm to 3.0 mm in the fabric web w. The perforator 160 will be described in more detail with reference to FIG. 15.

[0056] FIG. 15 is a view illustrating the perforator according to one embodiment of the present invention.

[0057] Referring to FIG. 15, the perforator 160 may include a mount including a plurality of perforating units.

[0058] Referring back to FIG. 1, the dust collector 170 may collect foreign matter, generated in a process of forming the plurality of drainage holes h, from the fabric web w. Fine particles and an odor generated due to the perforator 160 may be collected in the dust collector 170 via a dust collection hood and may be discharged after being purified through a multi-stage filter having various materials and particulate structures. More specifically, foreign matter may be suctioned into a collection device by vacuum using an air suction motor, purified through a filter, and then discharged as clean air. As illustrated in FIG. 16, the filter used here may be made of a combination of polyester fibers, glass fibers, microglass fibers, activated carbon fibers, and the like. The filter may have a structure divided to separately filter particles having a size in a range of 3 μm to 100 μm and particles having a size of 2.5 μm or less in consideration of sizes of particles passing through the filter. The filter may have a detachable structure to allow cleaning and washing of the filter.

[0059] The folder 180 may fold the fabric web w from which the foreign matter has been removed. Also, a width cutter 185 may be provided at one side of the folder 180. The width cutter 185 will be described in more detail with reference to FIG. 17.

[0060] FIG. 17 is a view illustrating the width cutter according to one embodiment of the present invention.

[0061] The width cutter 185 may be freely adjusted across the entire width of the fabric web w using a sliding assembly, may use a rotary circular blade (cutting blade) configured to rotate by a motor, and may be covered with a safety cap to ensure safety of a worker from fragments of particles generated during cutting.

[0062] Referring back to FIG. 1, the roller part 190 may package the folded fabric web w while fixing a bending direction of the folded fabric web w.

[0063] The roller part 190 may include a tension roller (not illustrated) and a winding roller (not illustrated).

[0064] The tension roller may maintain the bending direction of the folded fabric web w in any one direction (process direction).

[0065] The winding roller may wind the fabric web w that has gone through the tension roller.

[0066] For reference, in the overall process of coating, curing, and drying the fabric web w, the fabric web w may be conveyed at a speed in a range of about 1.5 meters/minute to 4.5 meters/minute and may be set to have a width in a range of 1.0 m to 5.0 m.

[0067] As described above, a hybrid coating and curing system according to one embodiment of the present invention has an advantageous effect in that it can optimize physical performance of a finished product while simplifying a process by applying a coating agent, which uses a polymer resin, and the hybrid coating and curing system.

[0068] Also, by providing a hybrid curer, the hybrid coating and curing system according to one embodiment of the present invention has an advantageous effect in that it can cure a coating agent and allow an internal structure of the coating agent, which uses a polymer resin or a compound, to be densely packed.

[0069] The present invention has been described above using only some embodiments and the drawings. Embodiments of the present invention are not limited to the above-described embodiments, and those of ordinary skill in the art to which the present invention pertains may make various modifications and changes to the above-described embodiments. Therefore, embodiments of the present invention should be understood only from the claims below, and their equivalents

or equivalent modifications also belong to the scope of the spirit of the present invention.

Claims

1. A hybrid coating and curing system comprising:

a cleaner (110) configured to remove foreign matter from a woven fabric web (w);
an ultraviolet (UV) irradiator (120) configured to irradiate the fabric web (w), from which the foreign matter has been removed with UV light;
a coating part (130) configured to apply a coating liquid onto the fabric web (w) which has been irradiated with the UV light;
a rolling and curing part (140) configured to roll and cure the fabric web (w) onto which the coating liquid has been sprayed;
a tenter (150) configured to move the cured fabric web (w) at a predetermined speed;
a perforator (160) configured to form a plurality of drainage holes (h) in the moved fabric web (w);
a dust collector (170) configured to collect foreign matter, generated in a process of forming the plurality of drainage holes (h), from the fabric web (w);
a folder (180) configured to fold the fabric web (w) from which the foreign matter has been removed; and
a roller part (190) configured to package the folded fabric web (w) while fixing a bending direction of the folded fabric web (w),
wherein the rolling and curing part (140) includes a non-contact roller (141) configured to spray compressed air onto the coated fabric web (w), a roller (142) configured to roll the fabric web (w) onto which the compressed air has been sprayed, and a hybrid curer (143) configured to irradiate the rolled fabric web (w) with infrared light and UV light,
the non-contact roller (141) has a manifold (1411) provided above the fabric web (w), which moves forward, to spray compressed air (1412) onto the fabric web (w), the compressed air (1412) is sprayed across a width of the fabric web (w) through a plurality of air spraying nozzles attached to the manifold (1411), and the compressed air (1412) has a temperature in a range of 3 °C to 40 °C and a wind speed in a range of 10 m/sec to 50 m/sec,
the roller (142) is provided to not have a pattern or have at least one of a linear pattern, an embossed pattern, and a wavy pattern, and a pressure applied to the roller (142) is in a range of 0.07 MPa to 0.7 MPa,
the UV irradiator (120) is provided in the form of a lamp above the fabric web (w) moving forward,
a wavelength of the lamp is in a range of 150 nm to 260 nm,
the hybrid curer (143) includes a housing (1431) provided in the shape of a box with one open surface, an infrared lamp (1432) coupled to the inside of the housing (1431) to irradiate the fabric web (w) with infrared light, a UV lamp (1433) coupled to the inside of the housing (1431) to irradiate the fabric web (w) with UV light, and a reflective shade (1434) coupled to the inside of the housing (1431) to reflect infrared light and UV light, which are irradiated in another direction, toward the fabric web (w),
the hybrid curer (143) further includes a temperature sensor provided on one point of the housing (1431) and configured to detect a temperature of the fabric web (w) and a sensor monitoring part (not illustrated) provided on one point of the housing (1431) and configured to determine that the temperature sensor has failed in a case where an average error (A_{err}) of the temperature sensor calculated by [Equation 1] below is greater than a predetermined error limit (S_{err}), [Equation 1]

[Equation 1]

$$A_{err} = T_{aver} - (P_{aver} - 1.96 \times \frac{T_{\sigma}}{\sqrt{n}})$$

(here, A_{err} represents the average error, T_{aver} represents the total average of values detected by the temperature sensor, P_{aver} represents a partial average relating to n values detected by the temperature sensor, and T_{σ} represents the overall standard deviation of the values detected by the temperature sensor),
the cleaner (110) includes two brushes (111) provided to be spaced a predetermined distance from each other, and
the two brushes (111) sweep and collect foreign matter and dust from the fabric web (w), and a suction port (112) disposed between the two brushes (111) suctions air to remove the foreign matter and dust.

2. The hybrid coating and curing system of claim 1, wherein the two brushes (111) are provided as a combination of a primary brush (A) and a secondary brush (B).

3. The hybrid coating and curing system of claim 2, wherein the primary brush (A) is provided as at least one of a channel spiral type, a punched roller type, a punched roller spiral type, a strip channel type, a twist brush single type, and a twist brush double type, and the secondary brush (B) is provided as at least one of a hook type, a sponge type, an embossed type, the channel spiral type, the punched roller type, the punched roller spiral type, and the strip channel type.

Fig. 1

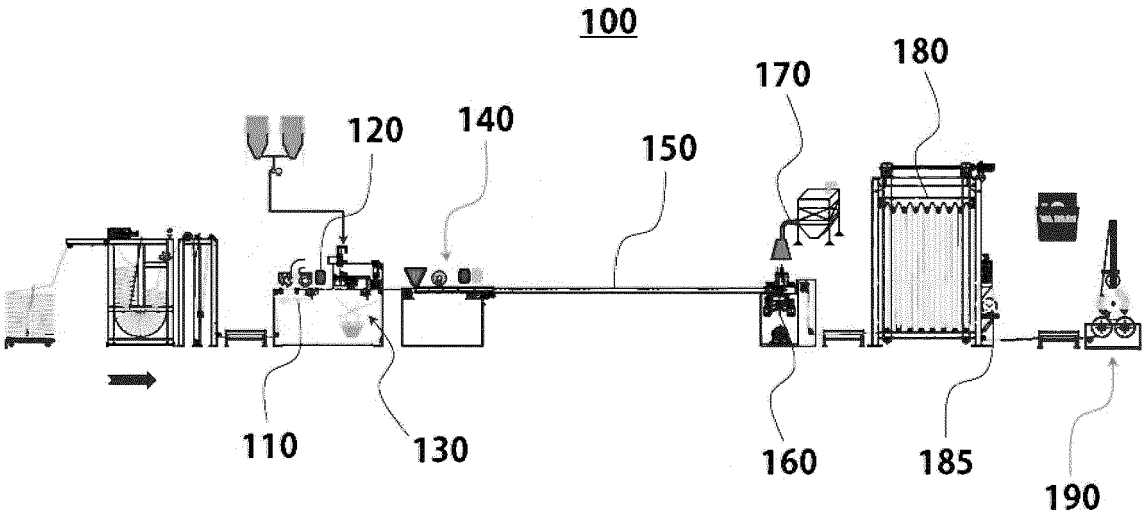

100
120
140
150
170
180
110
130
160
185
190

Fig. 2

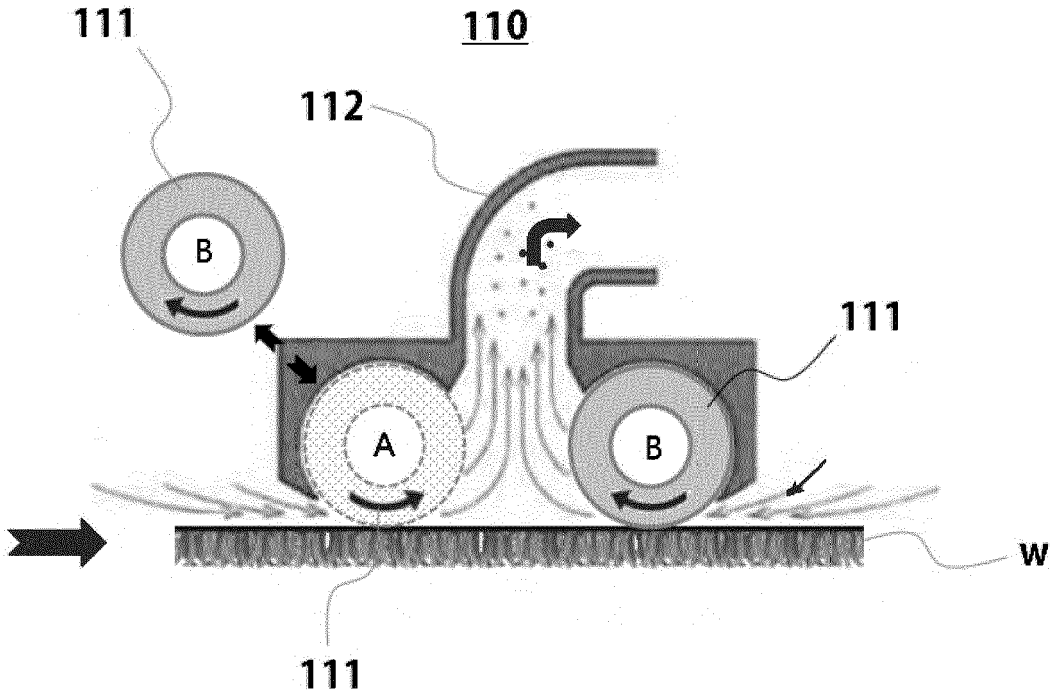

111
110
112
B
111
A
B
W
111

Fig. 3

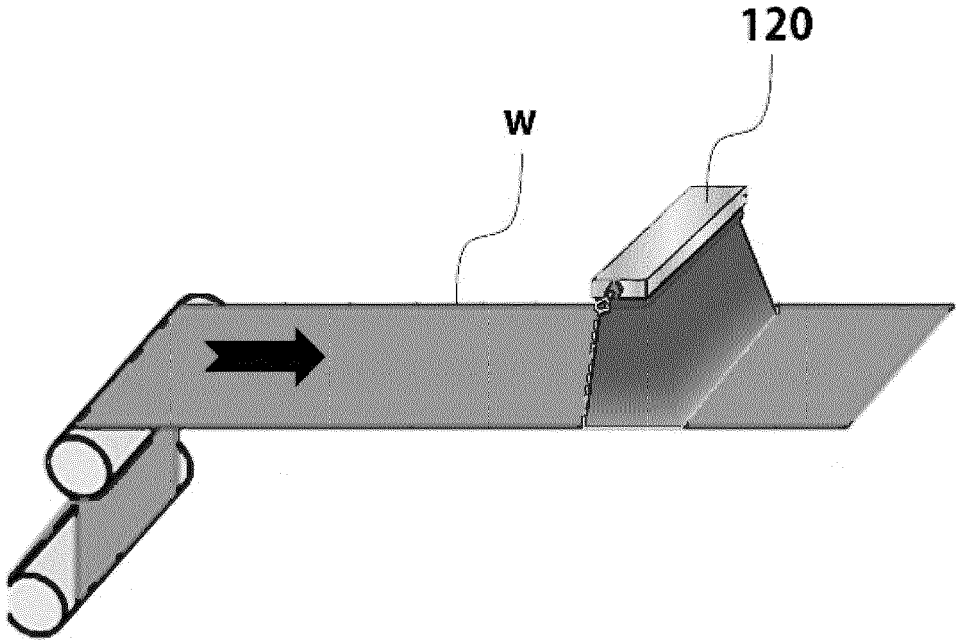


Fig. 4

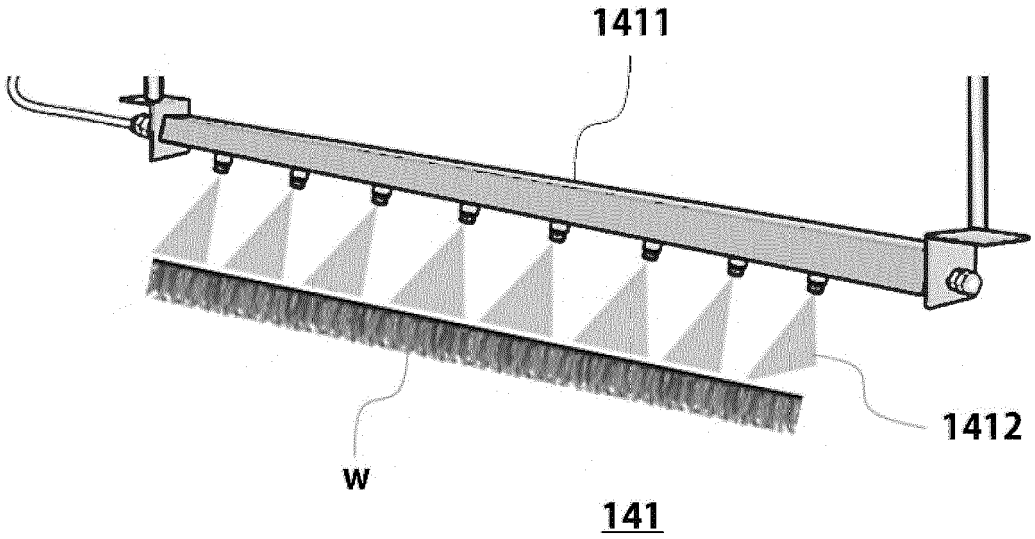


Fig. 5

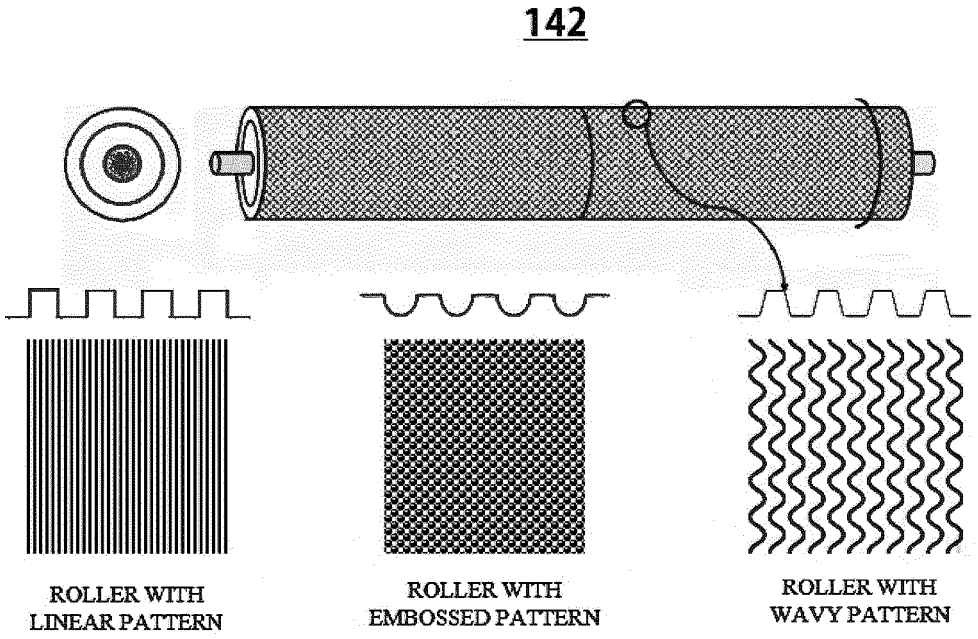

142
ROLLER WITH LINEAR PATTERN
ROLLER WITH EMBOSSED PATTERN
ROLLER WITH WAVY PATTERN

Fig. 6

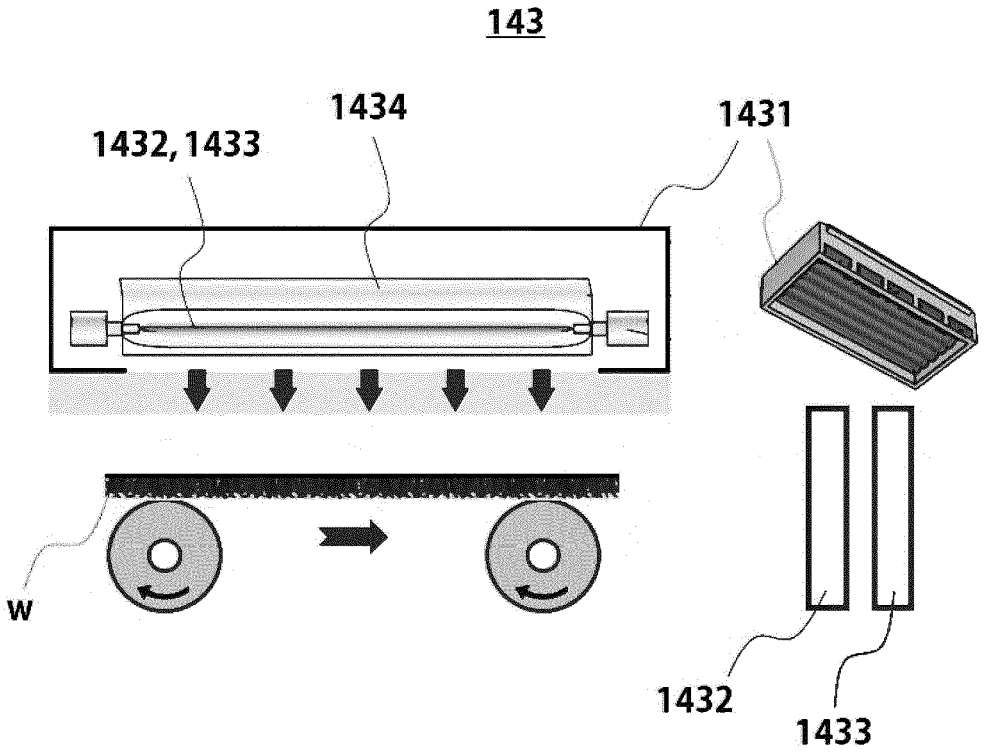

143
1434
1432, 1433
1431
W
1432
1433

Fig. 7

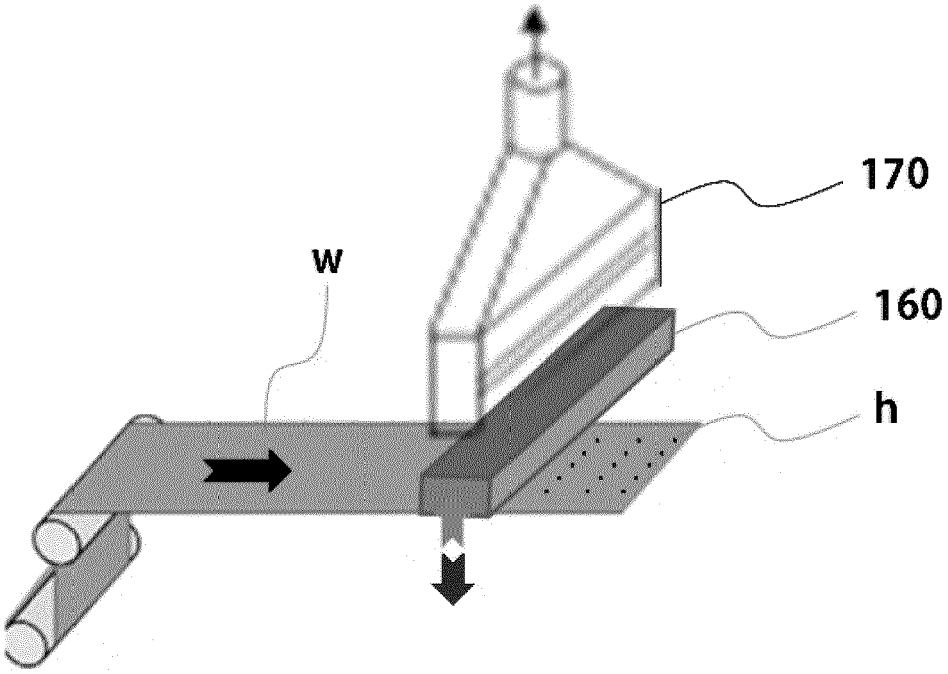


Fig. 8

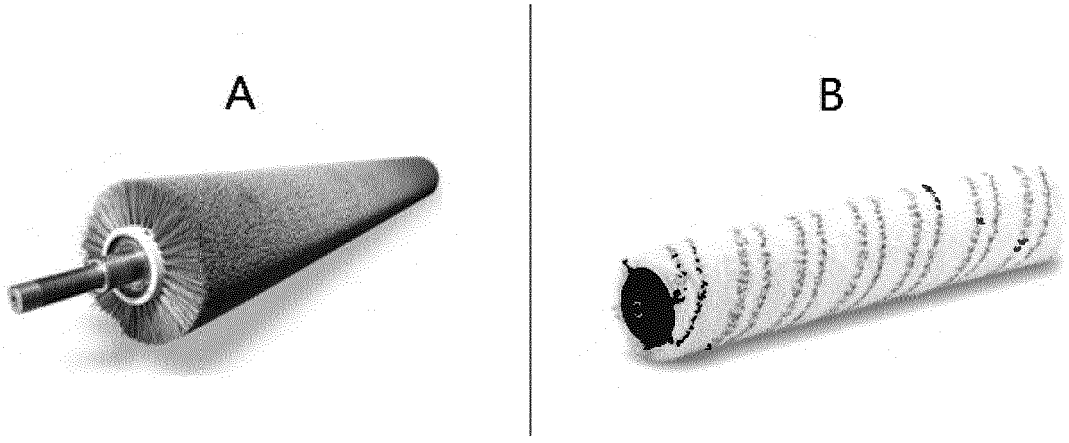


Fig. 9

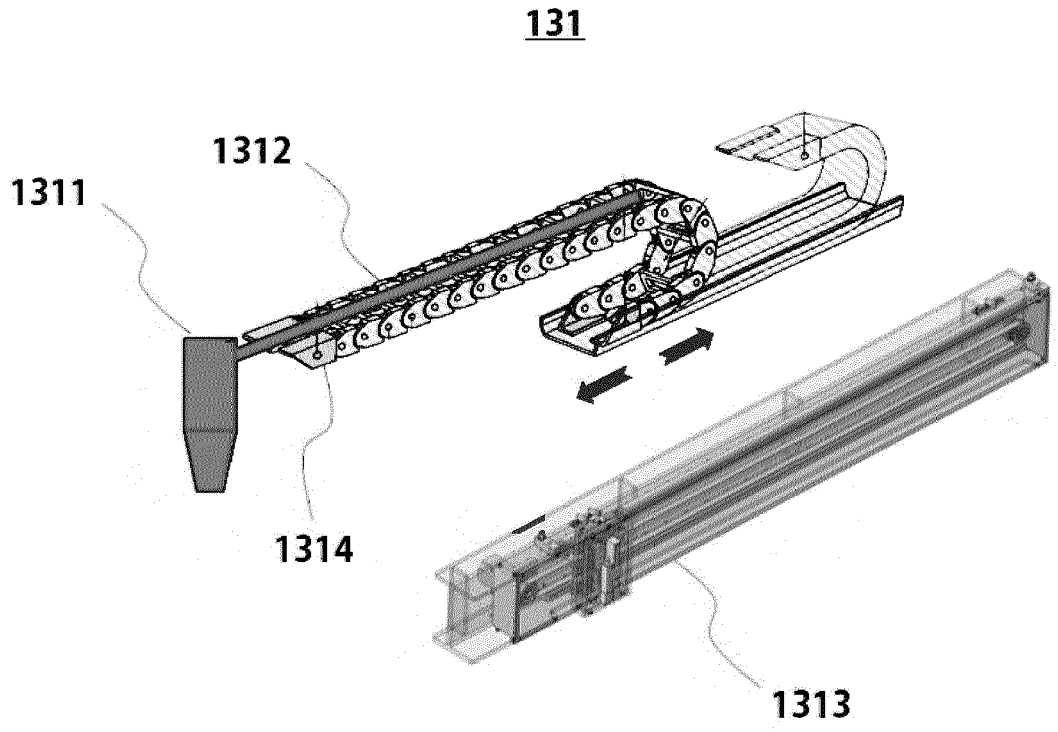


Fig. 10

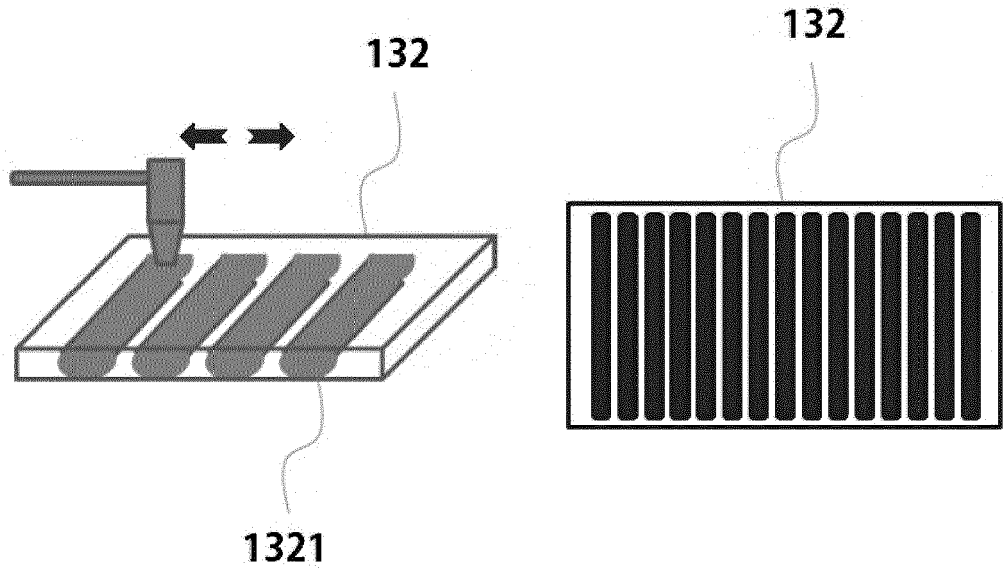


Fig. 11

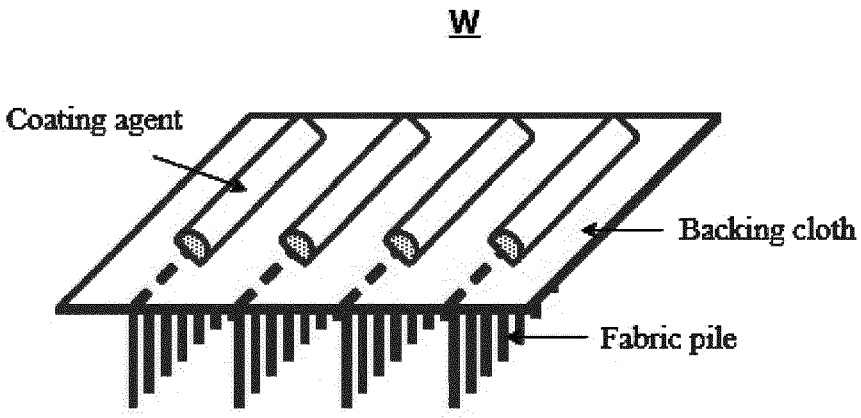

W
Coating agent
Backing cloth
Fabric pile

Fig. 12

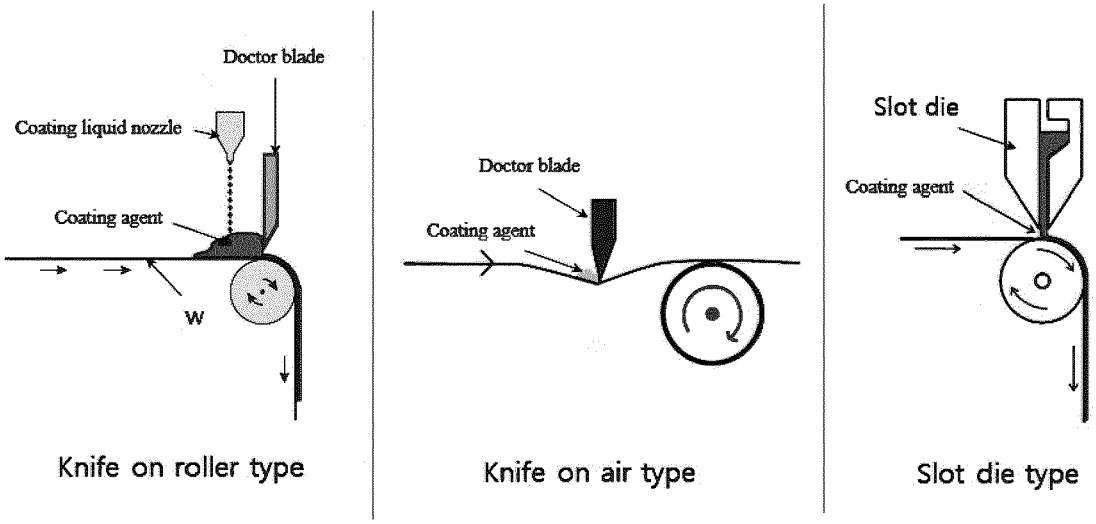
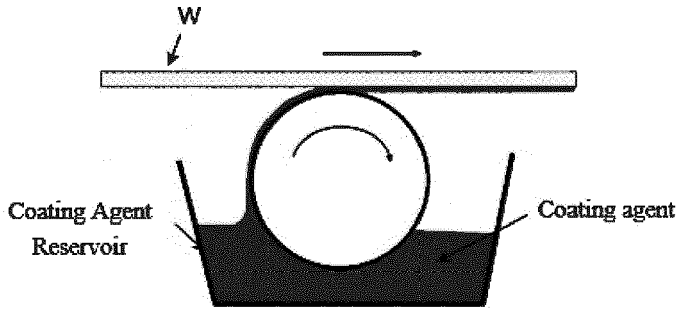
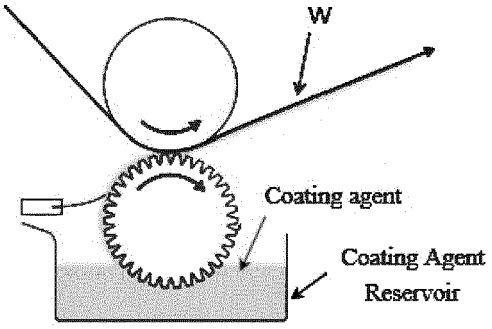

Doctor blade
Coating liquid nozzle
Coating agent
W
Knife on roller type
Doctor blade
Coating agent
Knife on air type
Slot die
Coating agent
Slot die type

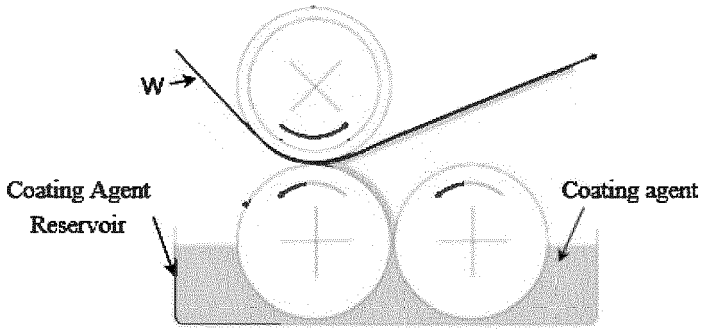
Fig. 13



Kiss roller type



Gravure type roller



Reverse roller type

Fig. 14

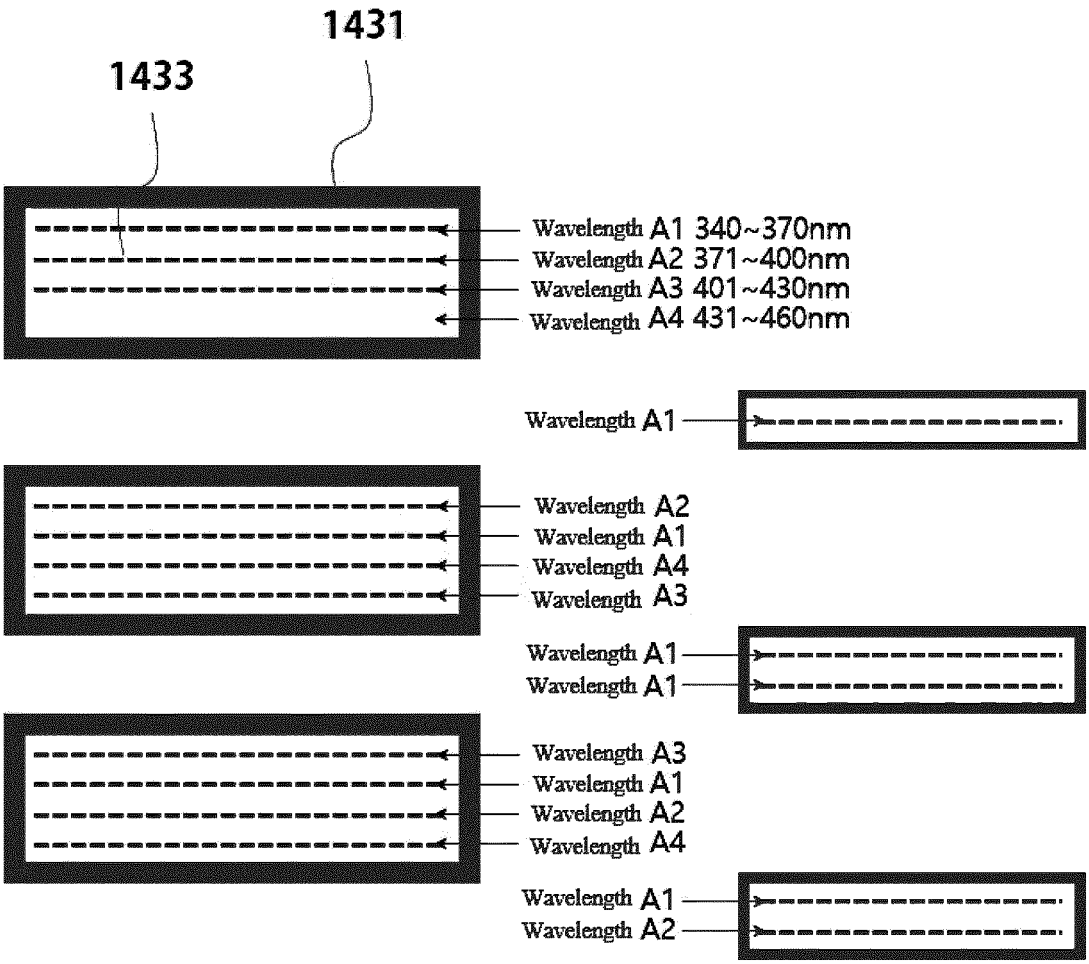

1431
1433
Wavelength A1 340~370nm
Wavelength A2 371~400nm
Wavelength A3 401~430nm
Wavelength A4 431~460nm
Wavelength A1
Wavelength A2
Wavelength A1
Wavelength A4
Wavelength A3
Wavelength A1
Wavelength A1
Wavelength A3
Wavelength A1
Wavelength A2
Wavelength A4
Wavelength A1
Wavelength A2

Fig. 15

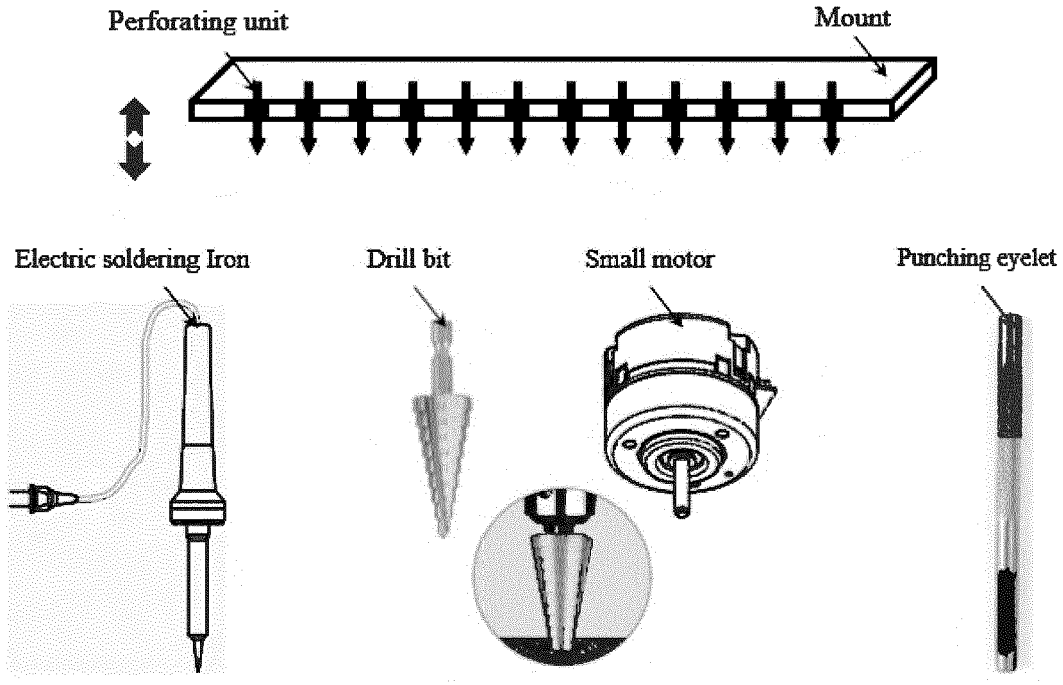

Perforating unit
Mount
Electric soldering Iron
Drill bit
Small motor
Punching eyelet

Fig. 16

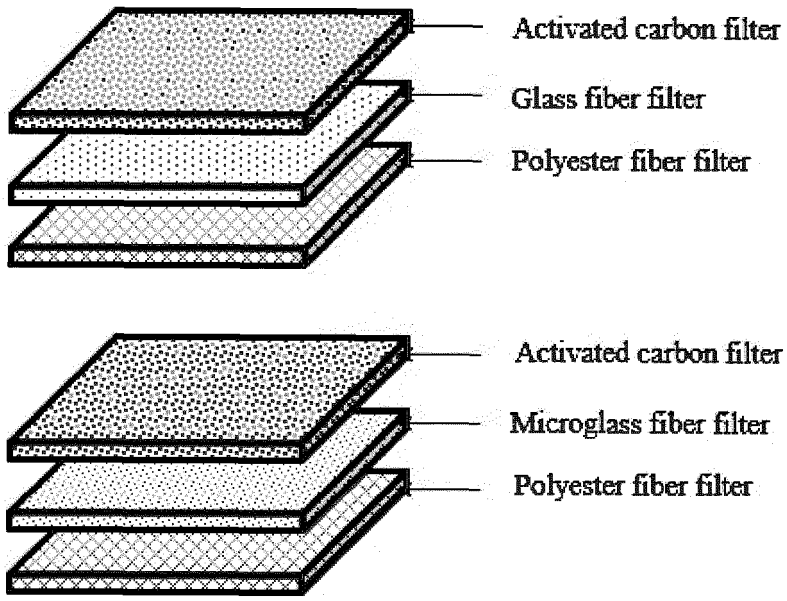
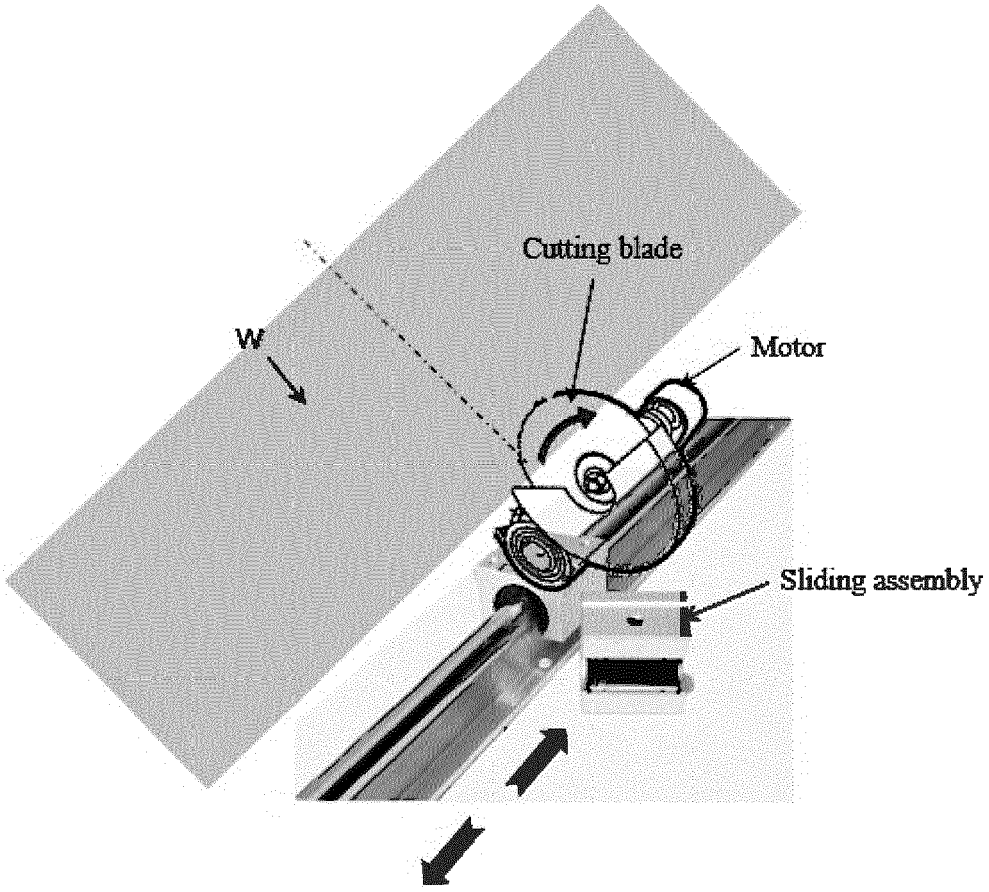

Activated carbon filter
Glass fiber filter
Polyester fiber filter
Activated carbon filter
Microglass fiber filter
Polyester fiber filter

Fig. 17



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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 4003

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2007/034981 A1 (FUJIFILM CORP [JP]; OGAWA SHOTARO [JP] ET AL.) 29 March 2007 (2007-03-29) * claim 1; figure 1 *	1-3	INV. D06B3/10 D06B19/00 D06C3/06
A	US 9 180 483 B2 (KOREA MACH & MATERIALS INST [KR]) 10 November 2015 (2015-11-10) * claim 1; figure 1 *	1-3	ADD. B32B27/12 D06B1/10 D06B11/00
A	KR 200 268 579 Y1 (.) 16 March 2002 (2002-03-16) * paragraph [0060]; claim 1; figure 1 *	1	
X,P	KR 102 555 184 B1 (NATURE GREEN CO LTD [KR]) 13 July 2023 (2023-07-13) * anstract; claim 1; figures 1-17 *	1-3	

TECHNICAL FIELDS SEARCHED (IPC)

D06B
B32B
D06C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 April 2024	Iamandi, Daniela

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02-04-2024

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Patent documents cited in the description

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