



(11) **EP 2 366 826 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.09.2011 Bulletin 2011/38

(51) Int Cl.:
D06B 1/02 (2006.01) D06B 5/14 (2006.01)

(21) Application number: **10380039.7**

(22) Date of filing: **18.03.2010**

(84) Designated Contracting States:
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 SE SI SK SM TR
Designated Extension States:
AL BA ME RS

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(54) **Process and installation for the continuous treatment of bulk solid fibrous materials**

(57) The invention relates to a process and installation for the continuous treatment of bulk solid fibrous materials. The process for the continuous treatment of solid fibrous materials comprises the incorporation of a flow of finely ground concentrated treating substance to a fluidized flow of solid fibrous material inside a turbine. The turbine has multiple functions since it simultaneously performs a homogeneous mixing of the treating substance with the solid fibrous material and serves as a fluidization

and transport system of the solid fibrous material generating the required stream of air.

The incorporated treating substances can be liquids, gases or powder solids.

The installation comprises a turbine (1) with an inlet (11) for the solid fibrous materials and an outlet (12) for said treated materials, at least one dispensing device (2) for dispensing the treating product being located in the feeding area of said turbine (1).

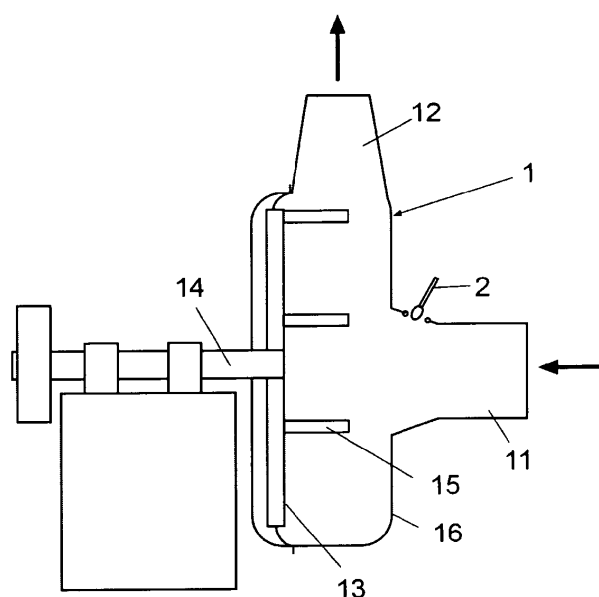


Fig. 1

Description

Field of the Invention

[0001] The present invention relates to a process and installation for the continuous treatment of bulk solid fibrous materials by means of adding finely ground concentrated treating substances to a fluidized flow of solid fibrous material inside a turbine. The turbine has multiple functions since it simultaneously performs a homogeneous mixing of the treating substance with the solid fibrous material and serves as a fluidization and transport system of the solid fibrous material generating the necessary stream of air.

[0002] The incorporated treating substances can be liquid, gaseous or solid powder substances.

Background of the Invention

[0003] The treatments of fibrous materials on an industrial scale are commonly performed in baths in which the treating substances are diluted. Subsequently the fibrous material is subjected to mechanical wringing and finally drying must be performed to eliminate the excess water absorbed in the fibrous material.

[0004] For the purpose of preventing the excess dilution entailed in the mentioned treatments there are topical treatments of fibers which use spraying in the state of the art, and the following patents are mentioned by way of example: US20040006826, on a textile material and GB630666 with spraying inside a closed chamber.

[0005] Patent EP1428922 describes a process for the treatment of fibers consisting of several rotary and/or oscillating drums in which the fibers are impregnated with different formulations of liquids to confer different effects in each case. This patent EP1428922 does not specify that the incorporation of treating liquid is by spraying.

[0006] Patent GB1002361 discloses a method for treating asbestos fibers based on the spraying of liquid sodium silicate solutions on asbestos fiber subjected to aeration inside a Fiberizer (hammer mill which cracks asbestos rock into fibers).

[0007] Patent GB763823 discloses another method for treating fibers by means of specially design equipment in which wet fluidized fibers are treated with air and with the addition of sprayed liquid.

[0008] The present invention substantially improves the last three mentioned patents which are considered to be the closest to the present invention.

[0009] Patent EP1428922 requires wringing the fiber, higher contact times, subsequent drying and it generates aggregates which must be opened. The present invention does not require any wringing, the impregnation time of the treating liquids is comparatively instantaneous, fiber aggregates are not generated and there is no need of drying. In the event that the variant allowing it is chosen, the moisture content to be removed is comparatively much lower. A wrung fiber can have values of moisture

content on dry fiber of the order of 50% by weight whereas in fibers treated with the present invention, moisture contents of less than 20%, preferably less than 10%, are obtained, which represents a great technical advantage since it allows omitting drying in many cases.

[0010] Another drawback of patent EP1428922 is that the moisture after wringing the fiber means that the soluble substances migrate during the drying operation towards the outer surface of the agglomerates which were formed, giving rise to solid efflorescences. The solid efflorescences easily detach from the fiber in subsequent operations, causing an undesired loss of effectiveness and homogeneity of the treatment.

[0011] The present invention intends to provide technical advantages involving substantial improvements with respect to patents GB1002361 and GB763823, as it presents much lower energy consumption per mass unit of treated fibrous material given the lower mechanical stress to which the fibrous material is subjected.

[0012] Another additional common advantage of the present invention with respect to patents GB1002361 and GB763823 is that the process of the present patent does not reduce the length of the fibrous material as occurs in the high shear equipment described in these patents.

[0013] Another additional common advantage of the present patent with respect to patents GB1002361 and GB763823 is that it provides for the recycling of the air for fluidizing and transporting the fibrous materials. The recycling of the air maximizes the use of the treating substances, the energy and moisture contained in the air are recovered when operating at a temperature, suspended particles are not released into the environment and the amount of movement of the recycled air is not wasted.

[0014] Another additional common advantage of the present invention with respect to patents GB1002361 and GB763823 is that it is multi-step, allowing successive treatments to obtain different effects in the fibrous material.

[0015] Another additional common advantage of the present invention with respect to patents GB1002361 and GB763823 is that it allows the incorporation of solid treating substances whereas the other ones do not allow it.

Description of the Invention

[0016] The process and installation for the continuous treatment of bulk solid fibrous materials, object of this invention, has technical particularities intended for being able to perform said treatment in a more efficient and clean manner, with a lower energy consumption, and offering a total incorporation of the treating substances virtually without generating residues.

[0017] The present invention describes a new process for the continuous treatment of bulk solid fibrous materials. The process comprises the simultaneous incorporation of a flow of solid fibrous materials floating in a stream

of air with another sprayed flow of treating substances in a device, such as a specially designed turbine.

[0018] The turbine generates a flow of air which fluidizes, mixes and transports the fibrous materials with a homogeneous incorporation of the treating substances or materials.

[0019] The use of turbines has been shown to be surprisingly effective to achieve a homogeneous treatment of the solid fibrous material.

[0020] The high efficiency found when using turbines is most likely due to the fact that a turbulent mixture of the different components therein, an aerosol of treating substances, open fibers and air which generates a high degree of collisions, contacts and interfiber penetration of the substances or treating substances occurs, creating a homogeneous surface distribution of the incorporated treating substances.

[0021] Wool, cotton, synthetic fiber blends, jute, flax, hemp, alpaca and paper are among the materials which have been treated with the technology and which successful experiments have been conducted. The process is not limited to these materials, as feathers, straw, wood chips, sawdust or other materials with a fibrous structure can be effectively treated.

[0022] The purpose of the incorporation of substances and materials to the fibrous material is to improve the use properties or features of the fibrous material.

[0023] The process has been shown to be suitable for performing the following operations:

- Bleaching and/or tinting light colored animal fibers with formulations containing hydrogen peroxide.
- Discoloring light colored animal fibers with formulations containing hydrogen peroxide
- Bleaching plant fibers with formulations containing hydrogen peroxide.
- Disinfecting by incorporating substances and/or subsequent heat treatment which eliminates the microorganisms present in the original fibrous substrate
- Fireproofing by incorporating fireproofing substances which are anchored to the fibrous material.
- Treatments to confer resistance to the attack or which prevent the survival in the treated fibrous medium of living beings such as fungi, bacteria, insects (moth, mites or the like) and even animals (mice...).
- Waterproofing and/or oil-proofing conferring to the fiber properties of repellence to wetting by water or by oil.
- Treatments for incorporating binding materials which allow a subsequent shaping of the fibrous material.
- Coloring by incorporating dyes and/or pigments to confer color to the fibrous material.
- Modifying the tact of the material making it smoother or rougher by incorporating substances which modify this feature.
- Modifying the apparent volume occupied by the fibrous material by adding substances which increase

or reduce the degree of packing of the fibrous material.

- Modifying the elasticity of the fibrous material by adding substances which make a higher or lower recovery of the shape of the fibrous material possible.
- Modifying the shape of the fibrous material by adding substances which make, for example, obtaining fibers in the form of pellets possible.
- Incorporating substances which improve the fastness to light or to weathering of the treated fibrous material by ultraviolet radiation absorption or by free radical scavengers.
- Incorporating aromas or other substances which modify or eliminate the odor and make the treated fibrous material more attractive.
- Treatment for conferring to the mixture a character which prevents the subsequent separation of the components from the mixture. This treatment allows that the added treating products remain adhered to the fibrous materials, which allows not generating areas with different compositions in a subsequent handling of the mixture. If the mentioned adhesion did not exist, a separation of the different components would occur due to the different sizes, densities and shapes existing among them.
- Treatments with incorporation of chemically reactive materials on the fibrous material. Chemical reactions by means of adding the reagents by means of the present invention make it possible to efficiently treat the fibrous materials and reduce the costs of the conventional processes which are carried out in liquid phase. The fibrous materials are bulky, which means that the chemical reactions occur at low concentrations of reactants. This relatively low concentration of reactants, in comparison with the proposed process, entails a lower rate of reaction which is compensated with a greater reactor volume, higher consumptions of reagents and higher reaction temperatures, factors that all make the process more expensive. Other additional factors that make the conventional processes in liquid phase more expensive are a greater generation of residues both of non-reacted reagents and of water contaminated with fiber and byproducts. Other additional factors that make the conventional processes in liquid phase more expensive are the need for squeezing and drying processes after the reaction. The latter entails high energy consumption since the moisture content present in the treated fibers is usually high.

[0024] The materials incorporated to the fibrous material can be added in liquid, solid or gaseous state.

[0025] The incorporation of the treating substances to the process is performed by spraying thereof with nozzles, in the case of liquid substances this is preferably performed with the use of compressed air or water vapor assisted sprayers since they offer a smaller drop size. The solid treating substances are added in a fluidized

manner. The stream of air with suspended solids is obtained by adding a mass flow rate of the solid to the inlet of a Venturi which suctions and fluidizes it in a stream of air with a higher flow rate. The treating solids which are incorporated to the process will preferably be in the form of finely ground powder.

[0026] The incorporation of treating substances to the fibrous material can be from a pure physical incorporation without chemical reaction with the fibrous material or with chemical reaction. The process allows incorporating substances which react to one another to the fibrous material.

[0027] The incorporation of the treating substances to the fibrous material can give rise to a final purely surface coating or to a subsequent diffusion thereof towards the interior of the fibrous material giving rise to a deep and homogeneous impregnation.

[0028] These and other features of the invention will be described below in detail in the preferred embodiment.

Description of the Drawings

[0029] To complement the description being made and for the purpose of aiding to better understand the features of the invention a set of drawings is attached to the present specification in which the following has been depicted with an illustrative and non-limiting character:

- Figure 1 shows a schematic view of the installation with a longitudinally sectioned axial turbine.
- Figure 2 shows a schematic view of the installation with the turbine seen from the front without the cover.
- Figures 3, 4 and 5 show diagrams of the process for preparing the treating substances according to the liquid, solid or gaseous physical form, respectively, in which they are added to the process of treatment.
- Figure 6 shows a block diagram of the installation with multiple turbines and with recirculation of the stream of air.
- Figure 7 shows a block diagram of the installation in a simplified open process without recirculation of the stream of air.

Preferred Embodiment of the Invention

[0030] As can be observed in the mentioned figures, the installation comprises a turbine (1) to carry out the process, this turbine (1) is of the axial type, with high flow rate and low pressure. A scheme of a suitable turbine (1) is shown in Figure 1, showing a longitudinal section view of the turbine, and in Figure 2, showing a front view of the turbine without the cover.

[0031] The turbine (1) starts a stream of air with suspended fibrous material which is suctioned by the inlet (11) of the turbine (1), the sprayed treating substance is

simultaneously fed into the feeding area of the turbine by means of a dispensing device (2). The fibrous material already impregnated with the treating substance is discharged through the outlet (12) of the turbine (1).

[0032] The runner (13) of the turbine (1) is provided with a shaft (14) which is actuated by a pulley connected by means of a belt to a motor that has not been depicted. The shaft (14) is secured to two bearings integral with the support of the turbine (1).

[0033] The runner (13) of the turbine (1) is formed by a base in the form of a disc which has a set of blades (15) welded thereto. There is a low number of blades (15), ranging from a minimum of four to a maximum of ten, preferably from a minimum of six to a maximum of eight. The preferred shape of the blades (15) is with blunt edges which are slightly curved in the rotation direction.

[0034] The allowance between the cover (16) or casing of the turbine (1) and the end of the blades (15) is small along its entire periphery, from a minimum of 2 millimeters up to a maximum of 30 millimeters, preferably between a minimum of 5 millimeters and a maximum 15 millimeters.

[0035] The design of the turbine (1) shown prevents the accumulation of fiber deposits and of treating substance in the surfaces of the inner elements of the turbine which would block the turbine were this to occur.

[0036] Another important feature of the turbine (1) is that the temperature of the parts in contact with the fibrous material and that can be cooled upon being exposed to the external ambient air are coated with heat tracing (not depicted), with controllable and adjustable temperature between a minimum of 10°C and a maximum of 140°C.

[0037] Another important feature of the turbine (1) is that the surfaces provided with heat tracing are provided with a heat-insulating coating (not depicted).

[0038] The interior of the turbine (1) is easily accessible since the cover (16) can be removed to facilitate the thorough cleaning of the installation and/or remove a possible obstruction that may occur therein.

[0039] The turbine (1) shown is merely indicative and it must be adapted depending on the features of the fibrous materials and on the treatments to be performed; to that end, adjustments and modifications thereof which are included within the present invention, as they are confined to the essence thereof, will be required.

[0040] The process for treating the fiber can be divided in two steps, the first one, depicted in Figures 3, 4 and 5, comprises preparing the treating substances to be sprayed and the second one, depicted in Figures 6 and 7, comprises applying the treating substances on the fibrous material and subsequent operations.

[0041] The preparation of the liquid treating substances to be added on the fibrous material, according to what is depicted in Figure 3, comprises formulations of liquid treating substances that can be solutions, dispersions, or emulsions. The starting components of these formulations are solids and/or liquids.

[0042] The formulations of liquid treating substances must have a non-excessive viscosity which makes a sufficiently small drop size of the sprayed liquid possible.

[0043] The temperature of the storage tank (21) of the bath of liquid treating substance can be from ambient temperature up to the required temperature in order to be able to apply a treating substance in liquid form coming from a molten solid.

[0044] It is a common practice to operate with liquid solutions and/or dispersions using a solvent, normally water. Care is taken so that the concentration of solvent is sufficiently low so that, where appropriate, the need for drying during the process of treating the fibrous material is prevented or the costs related to the drying and/or a greater use of solvent are reduced.

[0045] The treating liquid is continuously suctioned by a positive displacement pump (22) of the storage tank (21) of the bath of liquid treating substance. The storage tank (21) or bath is provided with stirring and the temperature of the liquid is adjusted and controlled to assure the homogeneity of the formulation and of the temperature. When the liquid leaves the storage tank (21) of the bath, it is filtered in a filter (23). The mass flow rate is adjusted to the desired mass flow rate by placing the pump (22) at the required revolutions.

[0046] The assembly of elements forming part of this installation, from the storage tank (21) of the bath to the dispensing device (2), has a heat tracing and insulation to control the temperature of these surfaces and minimize the heat losses to the environment.

[0047] The mass flow rate of liquid is sprayed by means of the dispensing devices (2) which are sprayers which disperse the liquid in fine drops by means of using compressed air or vapor. When the liquid is applied under hot conditions, a practice used to increase the concentration of solids, the use of water vapor is preferred for spraying since it provides the moisture and a higher temperature which favor the diffusion of the treating substances.

[0048] Figure 4 depicts the preparation for formulated treating substances which will be added to the fibrous material in solid form. The preferred solid form is powder although other forms of larger particle size are not discarded for special effects. The powder solid treating substances offer two normally desired characteristics which are, a great ease of fluidization in air and better distribution of the treating substances on the surface of the fibrous material.

[0049] The solid formulations, if they are of several components, are prepared in a solid mixer, not shown, and stored in a tank (24). The solid formulation is added by a weight loss metering device (25) which allows fixing and controlling the mass flow rate of solid treating substance which is continuously added to the process. The metered solid formulation is suctioned by a Venturi (27) fed by a flow of air generated by a blower (26) which fluidizes the treating substance. Another optional operation of the Venturi (27) is by means of a flow of pressu-

rized water vapor. The flow of air with suspended solid is incorporated to the process by means of a dispensing element (2).

[0050] Figure 5 shows the preparation intended for the use of formulated treating substances to be added onto the fibrous material in gas form. The gaseous treating substances can be substances which are gases at ambient temperature or evaporated liquids. The regulation of the mass flow rate of gaseous treating substance is achieved by fixing the pressure and temperature in the transport pipeline by means of a regulator (28) from the supply source (20), since the flow rate of a gas through a hole of a given nozzle depends only on the pressure and temperature of this gas.

[0051] Gaseous treating substances at ambient temperature will be first and foremost be used with total recirculation of the air of the turbine to maximize the incorporation of this gas to the fibrous material and minimize the environmental impact which the release of a fraction of the gas to the atmosphere can entail.

[0052] The process of application of the treating substances on the fibrous material, depicted in Figure 6, starts with the feeding of the fibrous material to the feeder / metering device assembly (31) which allows fixing and selecting a continuous mass flow rate of fibrous material.

[0053] The fibrous material is continuously fed by a conditioner to a fiber opening assembly (32). The fiber opening assembly (32) can be formed by textile equipment such as an inclined beater followed by an opening willow or other combinations of equipment which pursue the same purpose of feeding and regulating the flow rate of solid fibrous material.

[0054] The function of this step is to break up the fiber agglomerates and attempt to increase the separation between fibers such that the resistance to the passage of air between the fibers is as small as possible and that the probability of air coming into contact with each fiber and with each piece of its length is as equal as possible for the entire set of fibers of the fibrous material at a given time. In other words, the purpose is to prevent as much as possible the existence of fibers or areas thereof which have a very high probability of being impregnated with the treating substance whereas other areas are occluded or shaded by other fibers and do not come into contact with the stream of air carrying the treating substances. This step is of vital importance to achieve a good distribution of the treating substances.

[0055] During this step of the process non-fibrous solid substances or short fibers present in the original fibrous material are easily separated. The separation of these substances from the flow of fibrous material is recommendable if the presence thereof is not desired in the treated final fibrous material. With it the uniformity and quality of the treatment is improved, and furthermore the extra cost of having to treat a mass fraction of raw material which is a residue is avoided.

[0056] The continuous flow coming out the fiber opening assembly (32) passes through a metering valve, such

as a rotary valve (33) acting as a continuous feeder to the turbine (1a) and as a system for closing the stream of recirculated air coming from a cyclone (41) which is described below. The design of this rotary valve (33) is such that it minimizes or prevents a pulsating flow of fibrous material into the turbine (1a).

[0057] In an embodiment depicted in Figure 6, the constant flow of solid fibrous material suspended in the stream of air passes through several turbines (1a, 1b, 1c) which define several steps. The solid fibrous material in a turbulent movement regime is suctioned by a first turbine (1a) and shortly after its inlet (11) the first sprayed treating substance is introduced through a dispensing device (2). The air feeding the assembly of turbines, through the turbine (1a), is in its entirety recirculated air which has been separated from the stream of fibrous material treated by means of a cyclone (41) once the last treatment is conducted in the turbine (1c) has been performed.

[0058] The outlet (12) of the first turbine (1a) is connected to the inlet (11) of the following second turbine (1b) by means of a conduit. A second treating substance is added in this second turbine (1b).

[0059] The outlet (12) of the second turbine (1b) is connected to the inlet (11) of the third turbine (1c) where the third treating substance is added to it. The number of turbines of the installation can be raised up to a maximum of eight, or be reduced to a single turbine, depending on the complexity of the treatment and of the incompatibilities between the different treating substances.

[0060] The outlet (12) of the third and last turbine (1c), is connected to the cyclone (41) which, by the action of centrifugal force, separates the treated fibrous material from the stream of air, this stream of air being sent through a conduit to the first turbine (1a).

[0061] In each turbine (1a, 1b, 1c) there is the possibility of performing simultaneous sprayings of the same or other treating substances by means of different dispensing devices (2).

[0062] The recirculated air can be heated if the treatment of the fibrous material is under hot conditions by means of adding water vapor to the inlet (11) of a turbine (1).

[0063] The treated fibrous material falls through the cyclone (41) onto a rest unit (42) with a retention time which can be regulated between zero and sixty minutes. The function of the rest unit (42) is to allow the treated fibrous material to remain for a relatively long time under suitable conditions of temperature and moisture which allow a correct diffusion and/or reaction of the treating substances with the fibrous material.

[0064] The cyclone (41), the rest unit (42) and all the conduits and turbines (1a, 1b, 1c) are heat-insulated and provided with heat tracing which allows controlling the temperature of the surfaces of these pieces of equipment and reducing the heat losses.

[0065] The treated fibrous material coming out of the cyclone (41) of the rest unit (42) can be dried in a dryer

(43) if the remaining moisture is excessive and subsequently directly cooled by a stream of ambient air in a cooler (44) or directly cooled without needing an intermediate drying if the remaining moisture of the treatment is already suitable. The drying in the dryer (43) is performed with hot air preferably coming from a direct combustion of natural gas.

[0066] The treated and cooled fibrous material is sent to a press (45) for its packaging.

[0067] An alternative process variant for the steps of the process corresponding to the rest unit (42), to the dryer (43) and to the cooler (44) which operate continuously is the successive batchwise performance in one and the same piece of equipment. In such case will be two pieces of batch equipment which, acting alternately and arranged in parallel, will be able to link with the previous continuous process, thus having a semi-continuous joint process.

[0068] A simplified variant of the method of treatment of fibrous materials is the one shown in Figure 7, in this case there is a single turbine (1) and there is no recirculation of air, whereby the need for the existence of the aforementioned rotary valve (33) disappears. It also allows the possibility of omitting the steps of drying (43) and cooling (44).

[0069] The two installations depicted in Figures 6 and 7 are indicative for a general process, having to be adapted to the specific characteristics of some fibrous materials and of some specific desired treatments, to that end it is possible that improvements and/or modifications of the process which are included within the present invention as they confined to its essence, may be advisable.

[0070] Having sufficiently described the nature of the present invention as well as a preferred embodiment, it is stated for whatever purposes that the materials, shape, size and arrangement of the described elements can be modified, provided that this does not involve an alteration of the essential features of the invention which are claimed below.

Claims

1. A process for the continuous treatment of bulk solid fibrous materials, **characterized in that** it comprises the incorporation to a flow of fluidized solid fibrous materials inside a stream of air of another flow of treating substances, said mixture being performed inside a turbine which fluidizes, homogeneously mixtures and transports the solid fibrous materials; and **in that** the treating substances are incorporated to the process of treatment in a finely divided form, such as sprayed liquid, powder or gas.
2. The process according to claim 1, **characterized in that** it comprises an operation of previous preparation of liquefying the originally solid and/or liquid treating substances before their dispensing, consist-

ing of the preparation of a solution, an emulsion, a dispersion or a fusion.

3. The process according to claim 1, **characterized in that** it comprises the recirculation of the stream of air used for the incorporation of the treating substances to the solid fibrous materials, said recirculation allowing minimizing the use of heat and kinetic energy, optimizing the efficiency of the treating substances and minimizing the environmental impact of the process. 5
4. The process according to claim 1, **characterized in that** it comprises the previous conditioning for breaking up and opening the solid fibrous materials to facilitate the homogeneity of the treatment and the fluidized transport thereof inside the stream of air. 10
5. The process according to claim 1, **characterized in that** it comprises the addition of several treating substances in an independent manner in one and the same turbine or in several turbines which operate in line using the same fluidizing air. 15
6. The process according to claim 1, **characterized in that** it comprises a controllable rest time from zero up to a maximum of 60 minutes of the solid fibrous materials once the treating substances have been incorporated which allows completing the diffusion and/or the reaction improving the homogeneity of the preformed treatment. 20
7. The process according to claims 1, 2, 3 and 6, **characterized in that** the outer surfaces of the pieces of equipment in contact with the stream of air and/or fibrous material are provided with a heat tracing which allows maintaining them at a controlled temperature greater than the ambient temperature which prevents the condensations and the consequent formation of fouling. 25
8. The process according to claim 1, **characterized in that** it comprises a drying of the solid fibrous materials once the treating substances have been incorporated for the purpose of eliminating, where appropriate, an excessive remaining moisture present in the treated fibrous material. 30
9. The process according to any of claims 1, 2, 3, 5, 6, 7 and 8, **characterized in that** the outer surfaces of the pieces of equipment in contact with the stream of air and/or fibrous material are provided with heat insulation which minimizes the heat losses of the process. 35
10. The process according to any of claims 1 and 6, **characterized in that** it comprises a cooling with air of the solid fibrous materials once the treating sub- 40

stances have been incorporated to the solid fibrous materials.

11. An installation for the continuous treatment of bulk solid fibrous materials, **characterized in that** it comprises at least one turbine (1) with an inlet (11) for the solid fibrous materials and an outlet (12) for said treated materials, at least one dispensing device (2) for dispensing the treating product, in sprayed liquid, fluidized solid or gas form, being associated with the cover (16) or casing of said turbine (1). 45
12. The installation according to claim 11, **characterized in that** the dispensing device (2), in the event that the treating substance is a liquid or a gas, is made by means of a spraying nozzle. 50
13. The installation according to claim 12, **characterized in that** the spraying nozzle for liquid treating substances is assisted by pressurized vapor or compressed air, for the purpose of achieving smaller drop sizes. 55
14. The installation according to claim 11, **characterized in that** the dispensing device (2) is the point of addition of the fluidized treating solid inside a stream of air coming from a Venturi (27), in the event that the treating substance is a solid incorporated as such.
15. The installation according to claim 11, **characterized in that** the turbine (1) comprises a runner (13) configured by a disc with blades (15) welded on its front face and which on its rear face has an axial shaft (14) for connection with the motor.
16. The installation according to claim 11, **characterized in that** the runner (13) has between 4 and 10 blades (15).
17. The installation according to claim 11, **characterized in that** the turbine (1) has the outer surfaces in contact with the stream formed by air and fibrous material coated with heat tracing, which allows maintaining them at a controlled temperature greater than the ambient temperature preventing condensations and the consequent formation of fouling.
18. The installation according to claim 17, **characterized in that** there is a heat-insulating coating on the heat tracing.
19. The installation according to claim 11, **characterized in that** it comprises a conditioner of the solid fibrous material to be introduced in the turbine (1); said conditioner comprising: a metering feeder (31) for solid fibrous material, a fiber opener (32) and a rotary valve (33) or equivalent lock system.

20. The installation according to claim 11, **characterized in that** it comprises several turbines (1a, 1b, 1c), arranged in series to carry out the incorporation of several treating substances in an independent manner in several steps. 5
21. The installation according to claim 11, **characterized in that** in a turbine (1) it comprises multiple dispensing devices (2) for dispensing similar or different treating substances. 10
22. The installation according to claim 11, **characterized in that** it comprises a cyclone (41) separating the stream of fluidizing air from the flow of treated fibrous material and allows, where appropriate, a complete recycling of the fluidizing air minimizing the use of heat and kinetic energy, optimizing the efficiency of the treating substances and minimizing the environmental impact of the process. 15
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23. The installation according to claim 22, **characterized in that** after the cyclone (41) it is provided with a rest unit (42) for the treated solid fibrous materials which allows completing the diffusion and/or reaction of the treating substances, improving the homogeneity of the treatment which allows regulating the retention time between zero and 60 minutes. 25
24. The installation according to any of claims 22 and 23, **characterized in that** after the rest unit (42) there is arranged a dryer (43) which allows eliminating, where appropriate, excessive remaining moisture present in the treated fibrous material. 30
25. The installation according to any of claims 22, 23 and 24, **characterized in that** in the outlet of the rest unit (42) and/or of the dryer (43) it comprises an optional cooler (44) which allows, by means of adding a stream of air, cooling the treated solid fibrous materials. 35
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26. An alternative installation according to any of claims 22, 23, 24 and 25, **characterized in that** the steps of resting, of drying and of cooling are carried out in one and the same unit successively. 45

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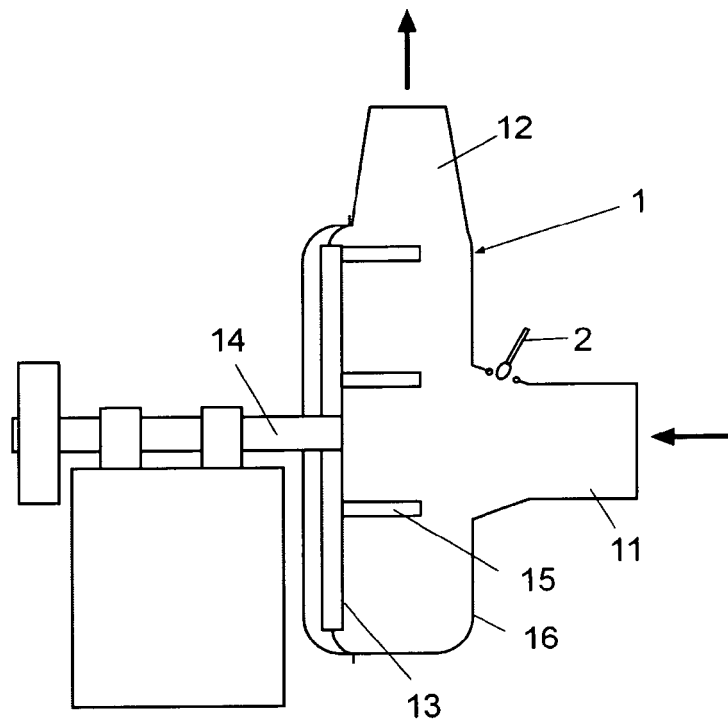


Fig. 1

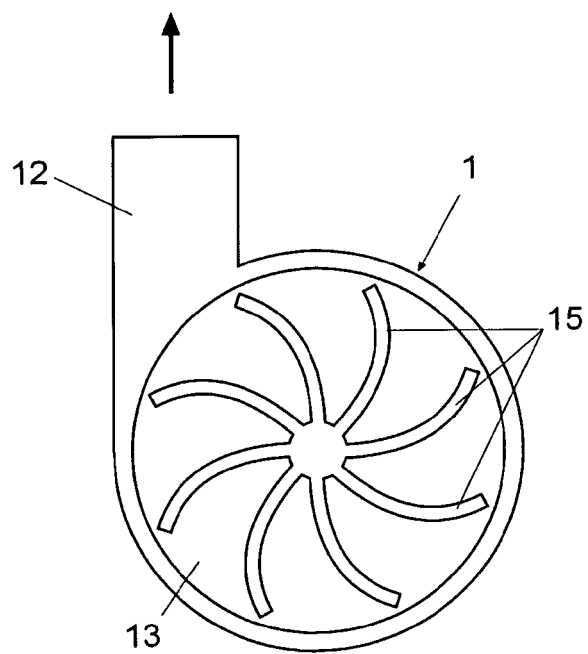


Fig. 2

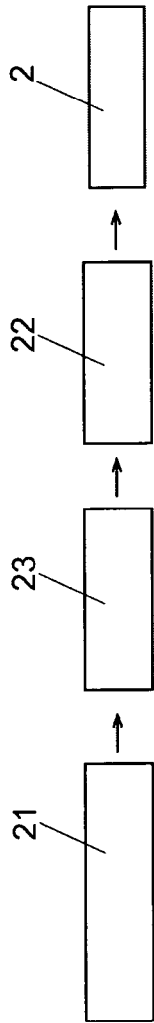


Fig. 3

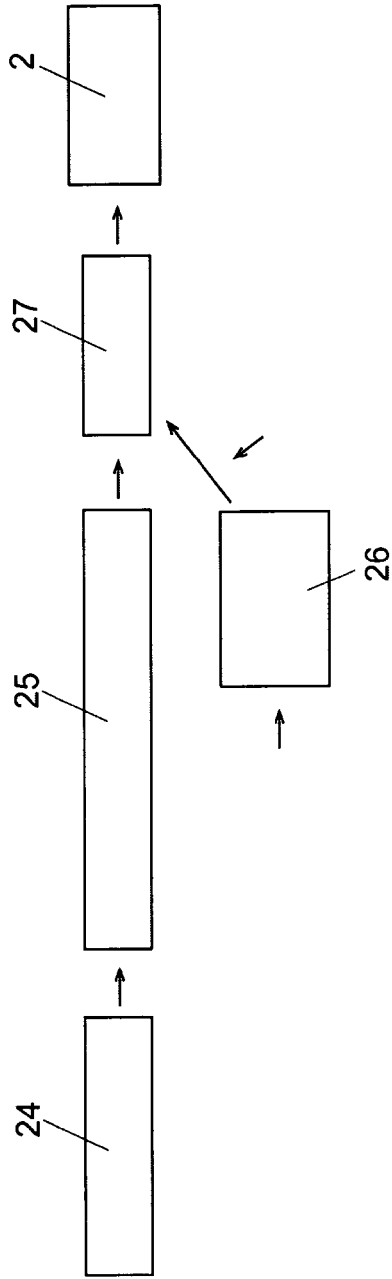


Fig. 4



Fig. 5

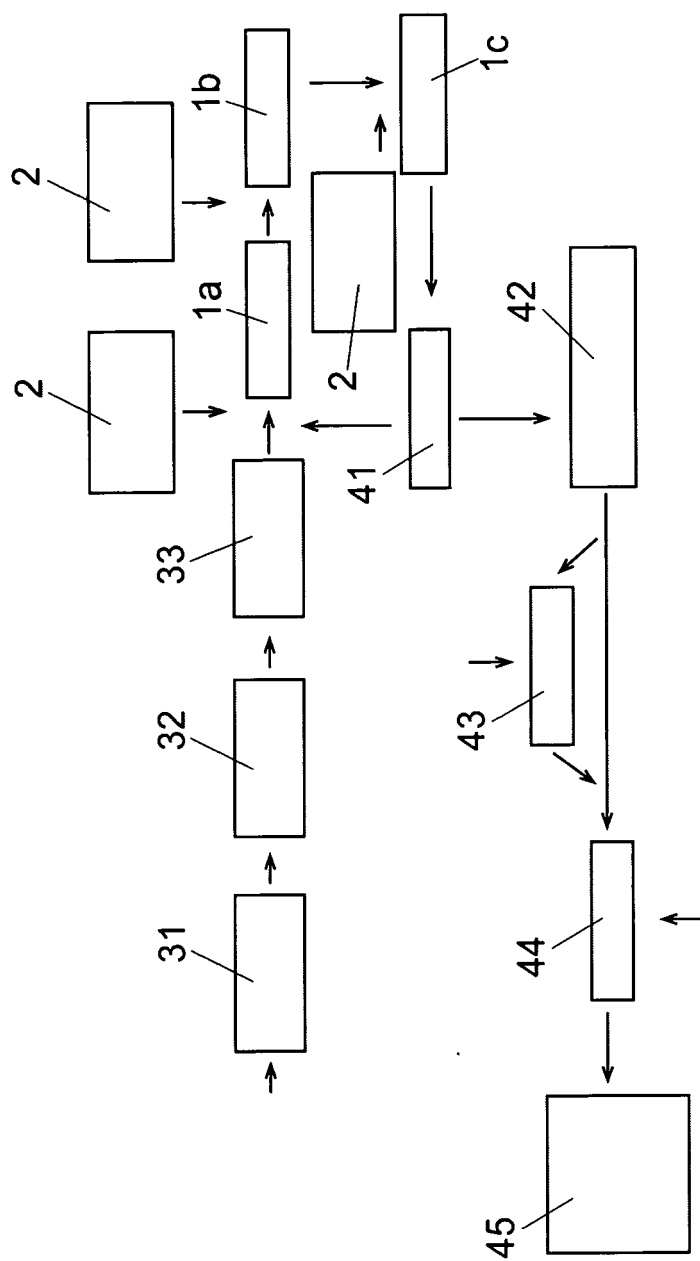


Fig. 6

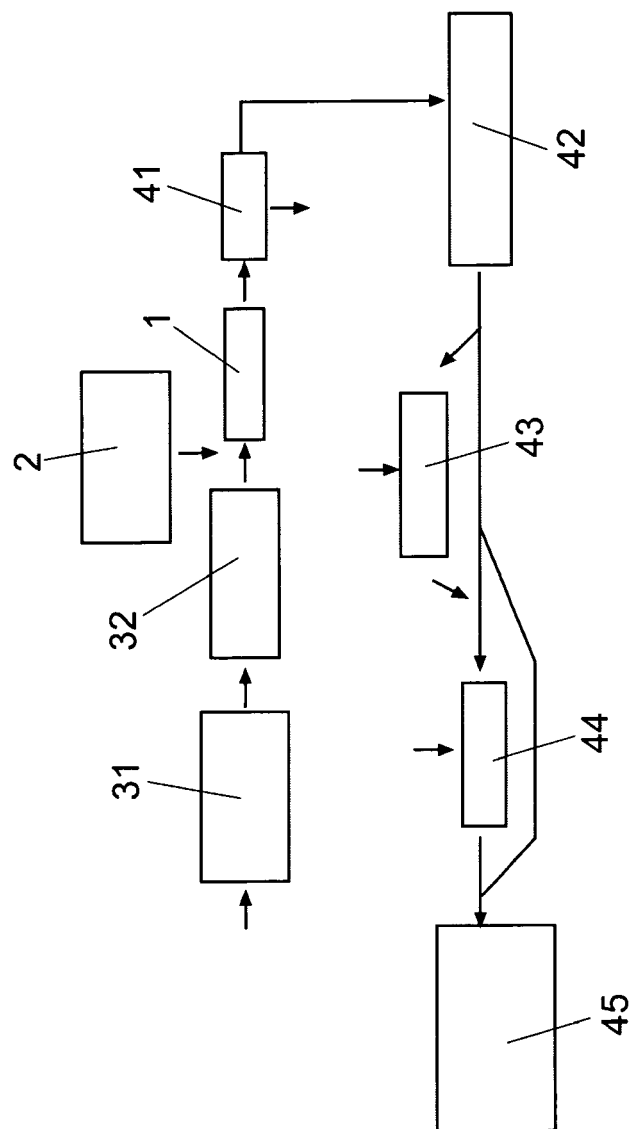


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 10 38 0039

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 1 289 631 A (DILLIES) 20 September 1972 (1972-09-20) * the whole document *	1,2,11,12	INV. D06B1/02 D06B5/14
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			TECHNICAL FIELDS SEARCHED (IPC)
			D06B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 August 2010	Examiner Bichi, Marco
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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06-08-2010

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