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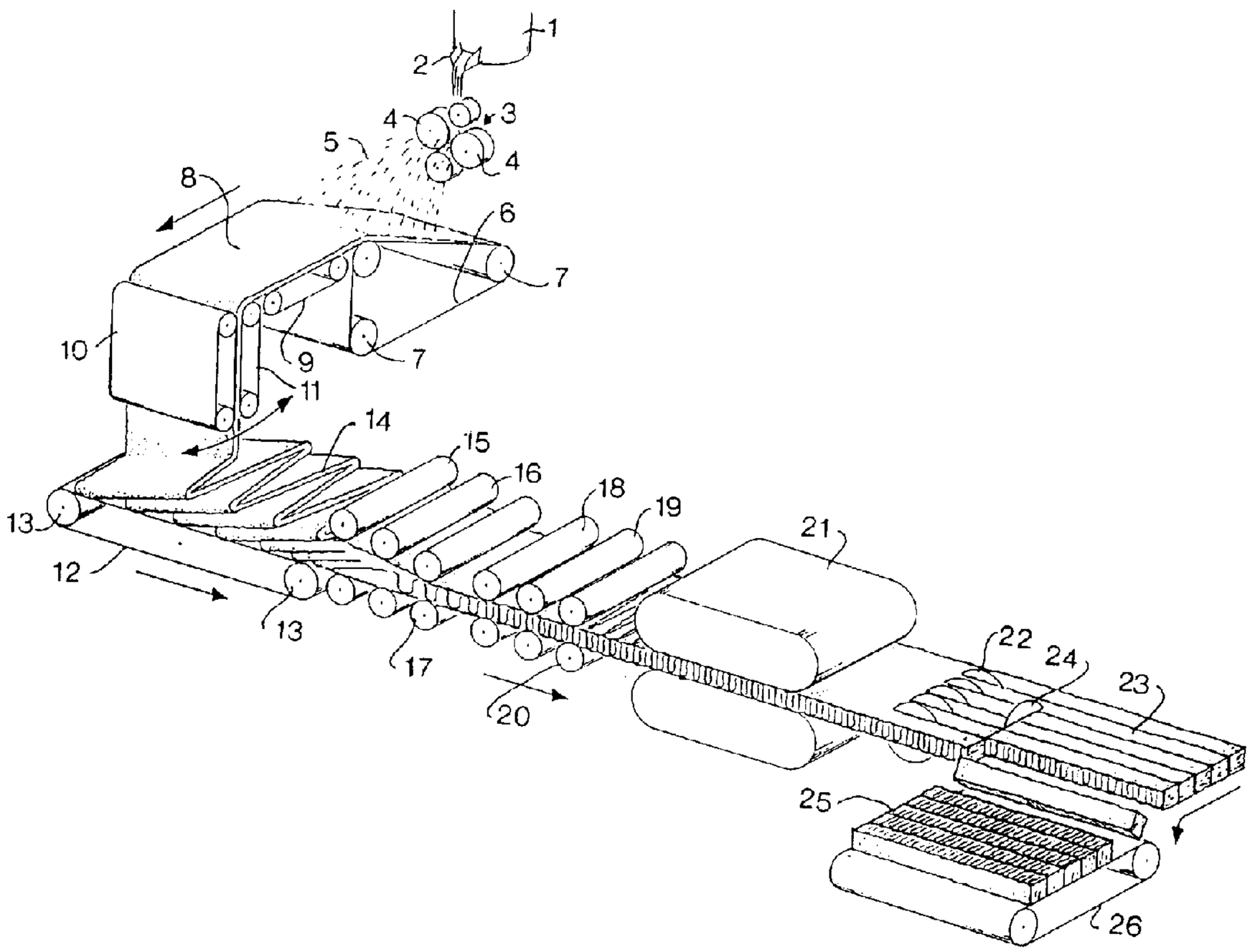
(54) **METHODE DE FABRICATION DE PANNEAUX ISOLANTS COMPOSES D'ELEMENTS DE FIBRES MINERALES EN FORME DE TIGES, RELIES ENTRE EUX**

(54) **METHOD OF MANUFACTURING INSULATING BOARDS COMPOSED OF INTERCONNECTED ROD-SHAPED MINERAL FIBRE ELEMENTS**



(57) Procédé de fabrication d'éléments de panneau isolant, composés de lamelles de fibres minérales réciproquement reliées, qui consiste à convertir en fibres une masse fondue d'un matériau de départ formant des fibres minérales, à ajouter un produit liant auxdites

(57) A method of manufacturing insulating board elements composed of interconnected mineral fibre lamellae comprising converting a melt of mineral fibre forming starting material into fibres, supplying a binder to said fibres, causing the fibres to form a fibre web,

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fibres, à les amener à former une bande continue de fibres, à couper la bande de fibres dans le sens longitudinal pour former des lamelles, à couper lesdites lamelles à leur longueur souhaitée, à les tourner de 90° sur leur axe longitudinal et à lier ensemble les fibres pour former des panneaux, les lamelles ayant été soumises à une compression de surface suivie d'une compression longitudinale soit avant soit après que la bande de fibres a été coupée en lamelles.

cutting the fibre web in the longitudinal direction to form lamellae, cutting said lamellae into desired lengths, turning the lamellae 90° about their longitudinal axis and bonding the fibres together to form boards, the lamellae having been subjected to a surface compression followed by a longitudinal compression either before or after the fibre web is cut into lamellae.

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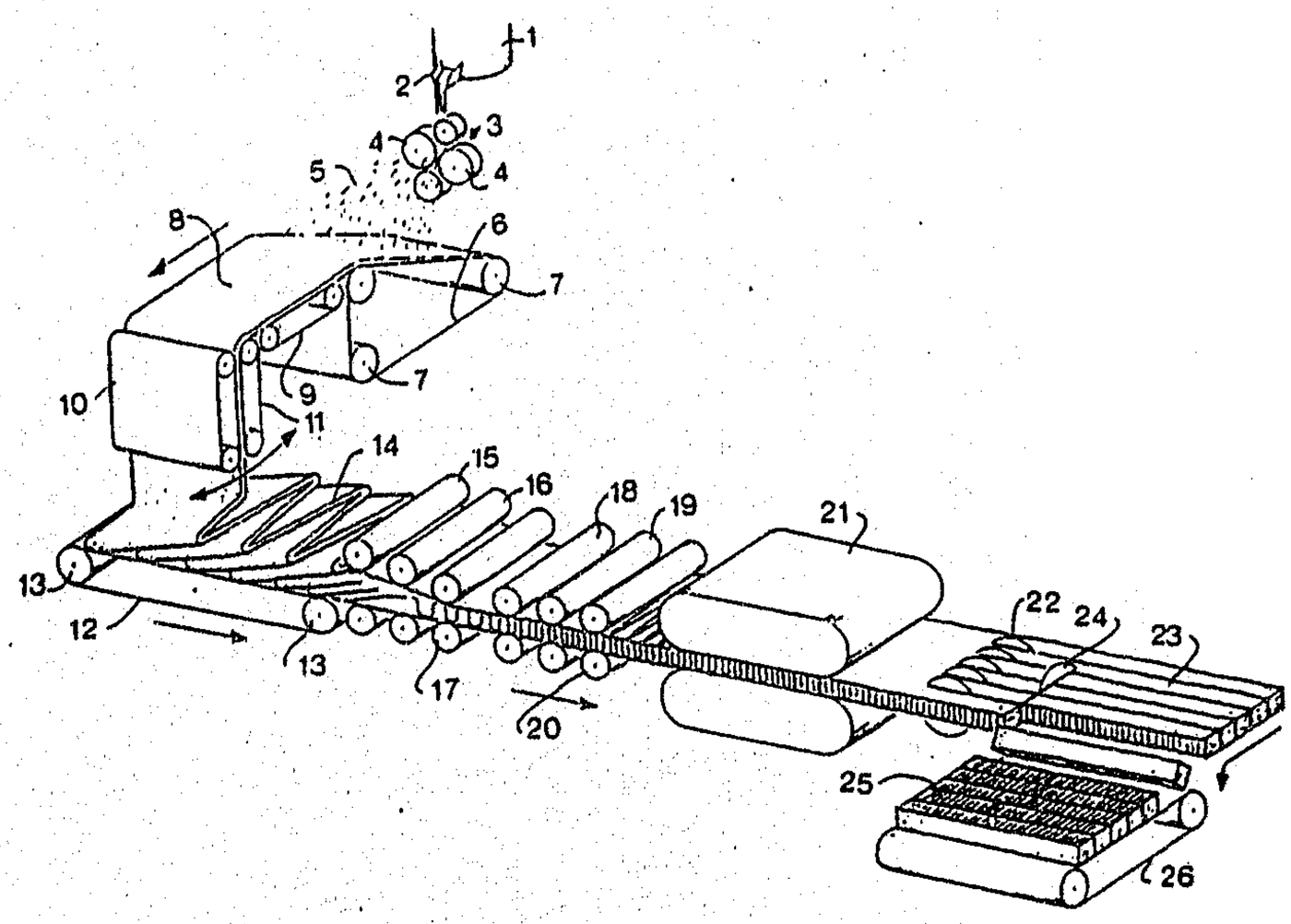

(57) Abstract

A method of manufacturing insulating board elements composed of interconnected mineral fibre lamellae comprising converting a melt of mineral fibre forming starting material into fibres, supplying a binder to said fibres, causing the fibres to form a fibre web, cutting the fibre web in the longitudinal direction to form lamellae, cutting said lamellae into desired lengths, turning the lamellae 90° about their longitudinal axis and bonding the fibres together to form boards, the lamellae having been subjected to a surface compression followed by a longitudinal compression either before or after the fibre web is cut into lamellae.

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Method of manufacturing insulating boards composed of interconnected rod-shaped mineral fibre elements

This invention relates to a method of manufacturing insulating boards composed of interconnected rod-shaped mineral fibre elements (in the following referred to as lamellae) comprising converting a melt of a mineral fibre forming starting material into fibres, supplying a binder to said fibres, collecting the fibres on a conveyor belt so as to form a primary fibre web.

A method of the type defined above is disclosed in DE patent publication No. 2307577 C3. In this prior art method the melt is converted into fine mineral fibres by being thrown out from one or more rapidly rotating spinning wheels under the simultaneous supply of a binder capable of being cured, and the fibres thus formed are caught on an endless belt in the form of a fibre web wherein the fibres predominantly are oriented parallel to the surface of the web. In this prior art method the fibre web is cut longitudinally into lamellae and the lamellae thus formed are turned 90° about their longitudinal axis whereafter the lamellae thus oriented are bonded together to form a web-like product which is then cut into desired lengths to form board elements. Due to the turning of the lamellae the fibres of the finished boards will predominantly be oriented in a plane perpendicular to the surfaces of the boards and as a result thereof boards having a considerable stiffness and strength perpendicularly to the surfaces of the boards are obtained.

CA-A-1209893 discloses a method of producing a fibrous material product made from a laminar mat of glass fibres containing a bonding substance and having fibre lamination extending parallel to the surface of the mat, said method comprising the steps of a) crimping the mat in the longitudinal direction so as to dispose a major portion of said laminations in directions extending across the thickness of the mat, b) heat-curing the bonding substance, c) cutting the mat in the longitudinal direction to form mat strips, d) rotating the strips 90° and e) securing adjacent strips to each other to form a board.

In the longitudinal compression of the mat an inner folding

structure is produced in the fibre web, the foldings extending perpendicularly to the longitudinal direction of the fibre web.

When such a web is cut longitudinally into lamellae and the lamellae are turned 90° and bonded together to form a lamella board, each lamella will exhibit a folded layer structure, the folds extending perpendicularly to the main surfaces of the lamella board and thereby imparting a greater stiffness and strength (area strength) to the lamella board than in the case where a lamella board is composed of rectilinear layers.

Boards produced by the prior art methods described above are suitable for many applications, but for certain applications, e.g. exterior insulation of roofs and/or building fronts and insulation of floors, the boards possess an insufficient stiffness or strength and/or insulating property.

It has now been found that these properties can be considerably improved so as to allow the boards to be used for purposes for which the prior art boards are not suitable by using the method of the invention which is characterized in forming a secondary fibre web by doubling of the primary web by laying it in a number of layers transversely to the longitudinal direction of said secondary web, cutting the secondary fibre web in the longitudinal direction to form lamellae, cutting said lamellae into desired lengths, turning the lamellae 90° about their longitudinal axis and bonding them together to form boards, and subjecting the lamellae to a surface compression followed by a longitudinal compression either before or after the fibre web is cut into lamellae.

The invention is based on the discovery that a board, wherein both the foldings formed by a longitudinal compression of the web to be cut to form lamellae and the individual fibres are positioned perpendicularly to the plane of the board, has superior stiffness and strength over a board, wherein only foldings extend perpendicularly to the surface of the board, whereas the fibres are positioned with arbitrary orientation in a plane perpendicular to the surface of the board.

Also, the invention is based on the discovery that a board having such a construction may be provided by using lamellae made from a secondary fibre web formed by transverse doubling of a primary web having a fibre orientation parallel to the surface of the web and predominantly in the longitudinal direction of the web.

The method of the invention has provided a possibility of producing a lamella board having a greatly increased stiffness and area strength compared to lamellae boards made from primary fibre webs, wherein the fibres are positioned with arbitrary orientation in a plane parallel to the plane of the web.

A particularly high stiffness is obtained with boards made from lamellae obtained by cutting a secondary web longitudinally and subsequently turning them 90° about their longitudinal axis because the fibres being predominantly oriented transversely to the secondary web will be positioned perpendicularly to the plane of the board.

By compressing the fibre web longitudinally before turning the lamellae 90°, the compressive strength of the finished lamellae is increased and the above mentioned increase in stiffness and the increase in compression strength appear to support one another, which is evidenced by the fact that the two measures apparently produce a total effect which is greater than the sum of effects produced by the measures separately.

Instead of increasing the strength it may be desirable to reduce the density as this may cause an increase in the insulating capacity. Thus, it is well known that boards of rock wool made from lamellae having a content of shots of about 30%, the shots being greater than 63 µm, have an optimum insulating capacity at a density of about 40 kg/m³.

It is well known that a fibre web can be produced by initially producing a relatively thin primary web and subsequently doubling the primary web to form a secondary relatively thick fibre web comprising partially overlapping layers of the primary web, see DE patent

publication No. 3501897.

When a fibre web is doubled the fibres are collected on a high-velocity conveyor belt, e.g. running with a velocity of 130 m/min, in the form of a thin fibre layer, e.g. having a weight of 0.3 kg/m². When collected in this manner, the fibres will be deposited on the conveyor belt in directions parallel to the surface of the web and predominantly parallel to the direction of movement of the belt. As a result thereof the fibre web will obtain a tensile strenght which is about twice as high in the longitudinal direction of the fibre web as in the transverse direction. The secondary fibre web is formed by laying by means of pendulum belts the thin primary web in a number of layers, e.g. 20, transversely to the longitudinal direction of the secondary web, the number of layers being determined by the desired area weight of the secondary web.

In the doubled web the fibres are predominantly oriented transversely to the web when the layers of the primary web extend transversely to the secondary web.

The purpose of doubling a fibre web is ordinarily to obtain a secondary web having a relatively great thickness and having a small variation in density in the longitudinal direction.

In the method according to the invention lamellae made from a doubled fibre web comprising from 4 to 25 layers and having a surface weight of from 1 to 8 kg/m² are preferably used.

Methods for longitudinally compressing fibre webs are known per se. In a preferred prior art method, cf. CH patent specification No. 620861, a mineral fibre web is introduced into the space between two parallel conveyor belts which travel with a velocity V_1 and subsequently into the space between two further conveyor belts which travel with a velocity V_2, which is lower than V_1. Depending on the relationship between V_1 and V_2, the fibre web is more or less compressed longitudinally. The relationsship between V_1 and V_2 is selected so that folds are formed by the longitudinal compression, said folds extending transversely to the longitudinal direction of the web. In another preferred method, cf. US patent specification No. 2,500,690, the longitudinal compression is effected by means of a row of roller sets, said rollers rotating with a velocity which decreases in the longitudinal direction of the fibre web.

It is preferred to compress the fibre web longitudinally before cutting it into lamellae but the longitudinal compression may also be effected when the web has been cut into lamellae..

For use in the method according to the invention lamellae made from fibre webs which have been compressed longitudinally in a ratio of from 1.5:1 to 4:1 are preferred.

As mentioned above, the longitudinal compression should be effected following the vertical compression and when using a heat curable binder, the said longitudinal compression is effected before the fibre web is introduced into a curing oven.

Methods for subjecting a fibre web to a surface compression are also

well known. In such a prior art method the fibre web to be compressed is introduced into the space between the rollers in a series of roller sets, the spacing between the rollers in the roller sets decreasing in the direction of movement of the fibre web.

For use in the method according to the invention lamellae made from a fibre web which has been surface compressed in a ratio of from 3:1 to 6:1 are preferred.

The cutting of the fibre web to form lamellae is preferably effected by means of saws which may have the form of compass saws, cf. DE patent publication No. 2307577, or circular saws, cf. SE published patent application No. 441764 and DE patent publication No. 2032624.

In a preferred embodiment of the method according to the invention the rod-shaped fibre elements are cut into desired lengths before being turned 90° and combined into lamella boards. Such turning may e.g. be effected in connection with the transfer of the cut lamellae from one conveyor belt upon which they are advanced in the longitudinal direction of the lamellae onto another conveyor belt moving perpendicularly to the first belt and upon which the lamellae are conveyed in a direction perpendicularly to their longitudinal direction.

This embodiment is advantageous in that the apparatus used for such turning of the lamellae requires little space.

Alternatively the turning of the lamellae can be effected during the cutting of the web into lamellae, e.g. as described in DE patent publication No. 2307577 or DE 2032624.

The properly oriented lamellae which are to form a lamella board can be bonded together, preferably by means of a binder which is applied to the upper side of the fibre web and optionally to the lower side thereof, and preferably before the web is cut into lamellae.

However, it is not necessary to add an additional binder as the binder which is supplied to the fibres in connection with their formation is also present at the surfaces of the lamellae and it may

be sufficient to bond together the lamellae if they are pressed intimately together during the curing of the binder in the curing oven, cf. DK patent application No. 3526/75.

If a heat curable binder has been supplied to the fibres in connection with their formation and if a heat curable binder is also used for bonding together the lamellae, the binders can be cured in one step by conveying the properly oriented and combined lamellae through a curing oven in which they are heated to curing temperature, which is preferably between 210 and 260°C when phenol formaldehyd resin is used as a binder.

However, the binder for bonding together the lamellae may also be supplied after the fibre web/lamellae have been heated in a curing oven to cure the binder supplied to the fibres in connection with their formation.

By supplying binder after the curing oven other binders than heat curable binders can be used.

The invention will now be described in further detail with reference to the drawing which schematically shows a plant for carrying out the method according to th invention.

In the drawing 1 designates an oven for manufacturing a mineral fibre forming melt which is supplied to a spinner 3 having four rapidly rotating spinning wheels 4 via a melt outlet 2. Simultaneously with the introduction of melt onto the outer surfaces of the spinning wheels and binder is sprayed, a strong gas stream is passed across the surfaces of the spinning wheels in the axial direction, thereby causing the formation of fibres 5 which are collected on an endless perforated conveyor belt 6 which is supported by three rollers 7, one of which is driven by driving means (not shown). As a result thereof a fibre web 8 (the primary web) is formed and this web is introduced into the space between two pendulum belts 10 and 11 by means of a further endless conveyor belt 9. The lower ends of the pendulum belts are located pivotally in a direction perpendicularly to the direction of movement of a further endless conveyor belt 12 which is supported by two rollers 13, one

of which is driven by driving means (not shown).

The amplitude of the oscillation of the lower part of the pendulum belts 10 and 11 corresponds to the width of the conveyor belt 12 and a doubled fibre web 14 of partially overlapping fibre layers 8 is thus formed on the belt 12.

The fibre web 14 is subsequently introduced into a surface compression section consisting of three sets of co-operating rollers 15, 16 and 17, the spacing between the rollers in the roller sets decreasing in the longitudinal direction of the fibre web. Subsequently the fibre web 14 is introduced into the longitudinal compression section which also consists of three roller sets 18, 19 and 20, the rollers of the latter sets of rollers rotating with the same velocity, which velocity is lower than that of the sets of rollers 15, 16 and 17.

The fibre web which has been compressed longitudinally is then introduced into a curing oven 21 in which it is heated to a temperature which is sufficiently high to cure the binder and to fix the fibres relatively to one another.

After having passed the curing oven the heat treated fibre web 14 is cut in the longitudinal direction by means of saws 22 so as to form lamellae 23 which are subsequently cut transversely by means of a transverse saw 24. The lamellae 23 thus cut are then turned 90° and combined to form a board element 25 on a conveyor belt 26 and at the same time a binder is applied to the contact surfaces by means of an application apparatus (not shown) to bond together the lamellae 23.

As indicated in the drawing the fibre layers formed from the primary web 8 extend substantially perpendicularly to the surface of the finished board element, and as they are also folded they are highly resistant against compression.

Instead of being bonded together the lamellae can be joined together by means of e.g. strips, strings, non-woven fabric or paper on one side or both sides of the boards.

Patent claims

1. A method of manufacturing insulating board elements composed of interconnected rod-shaped mineral fibre elements comprising converting a melt of a mineral fibre forming starting material into fibres, supplying a binder to said fibres, collecting the fibres on a conveyor belt so as to form a primary fibre web, characterized in forming a secondary fibre web by doubling of the primary web by laying it in a number of layers transversely to the longitudinal direction of said secondary web, cutting the secondary fibre web in the longitudinal direction to form lamellae, cutting said lamellae into desired lengths, turning the lamellae 90° about their longitudinal axis and bonding them together to form boards, and subjecting the lamellae to a surface compression followed by a longitudinal compression either before or after the fibre web is cut into lamellae.

2. A method according to claim 1, characterized in using lamellae which have been compressed longitudinally in a ratio of from 1.5:1 to 4:1.

3. A method according to claim 1 or 2, characterized in using lamellae which have been subjected to a surface compression in a ratio of from 3:1 to 6:1.

4. A method according to any of the claims 1-3, characterized in that the fibre web is cut into lamellae having desired lengths before being turned 90° and combined into lamella boards.

5. A method according to any of the claims 1-4 and comprising supplying to the fibres a heat curable binder, characterized in that the surface compression and the longitudinal compression are effected before the fibre web is subjected to a heat treatment to cure the binder.

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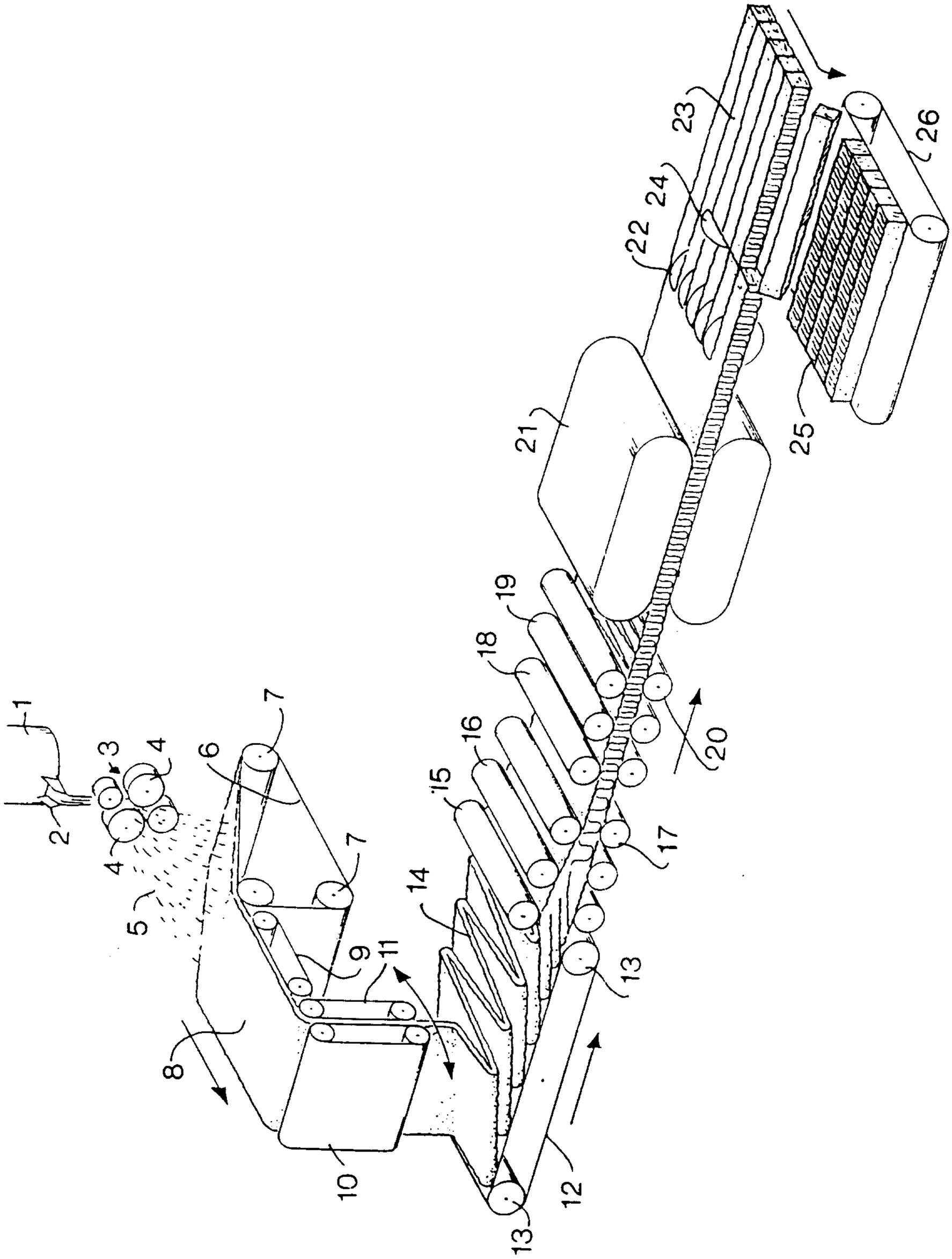

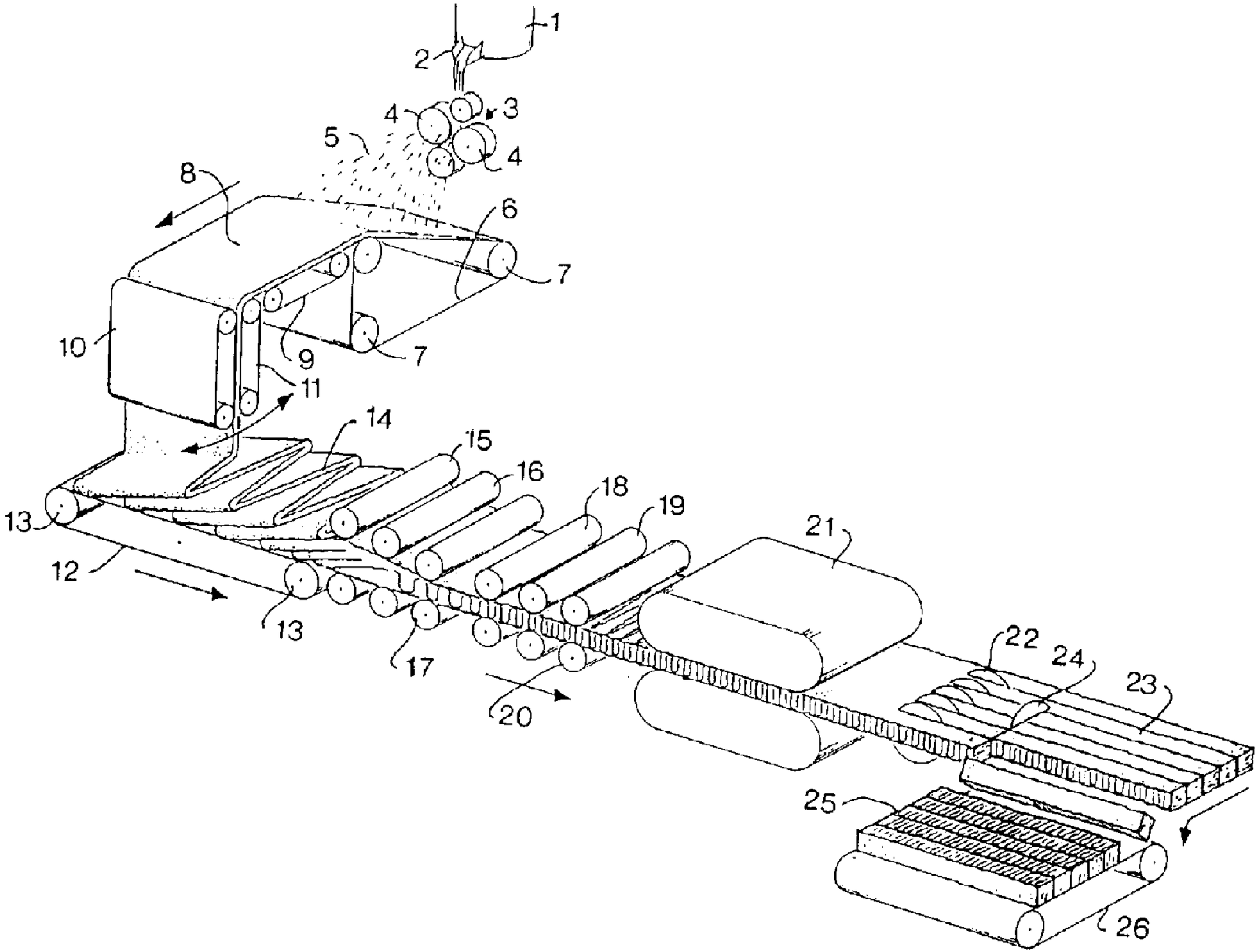
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