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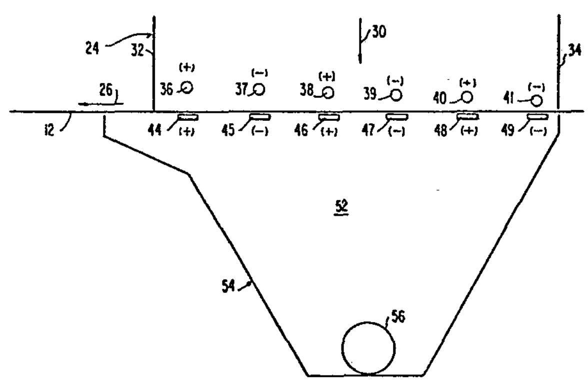
(54) **Method and apparatus for orientation and deposition of fibres in the manufacture of fibreboard.**

(57) Elongated rod electrodes (36 to 41) are predeterminedely spaced over the area of fibre deposition in apparatus for orientation and uniform deposition of fibres to establish an electric field exerting a torque on discrete fibres tending to orient longitudinal axes of the fibres in the plane of the mat being formed on a web (12) and aligned with the machine forming direction (26) for such mat. Placement of the rod electrodes and controlled rotation about their longitudinal axes yield a combination of electrical and mechanical forces to provide desired orientation and uniformity of deposition over the full area of deposition. The deposited mat of fibres is then compressed and cured to produce fibreboard



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DESCRIPTION

METHOD AND APPARATUS FOR ORIENTATION AND DEPOSITION OF FIBRES IN THE MANUFACTURE OF FIBREBOARD.

This invention relates to fibreboard manufacture and, more particularly, to orientation and deposition of fibres in continuous-line formation of fibreboard having physical properties that are stronger in one direction.

Particleboards made from wood flakes, chips, and the like have been largely limited to floor underlay or furniture core uses. However, wood materials used for structural purposes take into consideration inherent directional properties of wood in its various levels of organization to provide adequate strength to handle long-term loads under a variety of conditions.

Sawn timber in its various structural uses takes advantage of the orthotropic nature of wood. However, sawn timber utilizes only a fraction of the forest resources; a significant portion remains as residual. Some of the residual may be converted to pulp and paper or comminuted wood panel product.

In the manufacture of panel product, wood particles have been assembled in a random fashion due to the nature of the processes used. However, the properties of a comminuted wood panel can be greatly affected by orientation of elongated wood particles in a preferred direction. As the degree of orientation increases, the panel properties exhibit more of the orthotropic properties of timber because of better alignment of the longest dimension of such wood particles with the grain direction.

Methods and apparatus have been advanced for use in alignment of certain wood particles. However, the particulate furnish produced from selected cellulosic raw materials by attrition in disc-refiners using heat or steam at atmospheric or elevated pressures is difficult to handle and orient properly. It is light in weight, about 16 to about 64 kg m^{-3} (one pound to four pounds per cubic foot), with the bulk of the furnish comprising extremely fine, hair-like fibres. It has not been practicable when working with such lightweight fibrous furnish to obtain desired levels of fibre orientation and uniformity at commercially economic production rates with prior art methods and apparatus.

Orientation chambers have been equipped with electrically charged walls, and/or partitions, arranged in vertically perpendicular relationship to a horizontal deposition surface, for electrostatic orientation purposes. However, charged fibres adhere to such planar electrodes and protrude such that build-up occurs. This build-up eventually reaches a point where the mass becomes too great and random avalanching onto the mat surface occurs. As a result, neither the appearance of, nor the weight distribution in, the mat is uniform.

An object of the present invention is to avoid these and other drawbacks and disadvantages of the prior art in providing desired orientation of fibres and uniformity of deposition at production rates which are commercially economic.

The present invention provides a continuous-line method for orienting and depositing lightweight furnish, including fibrous material with curable binder, in the manufacture of fibreboard having directional properties, in which a web presenting an extended surface area for deposition of furnish is moved continuously in a forming direction, and lightweight furnish, including elongated fibres moving along a flow path which is substantially normal to such surface for deposition of furnish, are guided towards such web, and in which the fibres being so guided are oriented and deposited with preferred orientation utilizing electrical and mechanical forces by establishing electrical potential in a plurality of elongated electrically conductive rods disposed in spaced relationship from each other along such forming direction and in predetermined contiguous relationship to the web, with longitudinal axes of such elongated rods being in transverse relationship to the forming direction, to attract fibres to the rods and establish an electric field which exerts a force on fibres moving towards the web, tending to orient longitudinal axes of such elongated fibres in parallel relationship to the plane of the mat being formed and aligned with the forming direction, and the elongated electrically charged rods are controllably rotated about their respective axes to deposit fibres adhering to such rods.

The invention includes apparatus for use in continuous-line manufacture of fibreboard from light-weight furnish including fine textured elongated fibres and curable binding material, comprising a forming conveyor including a continuously moving web presenting an extended surface area for deposition of furnish, means for establishing a flow path and delivering the furnish substantially uniformly distributed over the surface area for deposition with the fibres in discrete form substantially free of fibre clusters, a plurality of elongated electrically conductive rods located in the flow path of such furnish towards the surface area for deposition and in preselected spaced relationship above the surface area for deposition, the electrically conductive rods being mounted for rotation with their longitudinal axes in transverse relationship to the direction of movement of the surface area for deposition and in substantially parallel relationship to such surface area, whereby the rods are contiguous to a mat-forming surface presented by deposition of fibres on the surface area for deposition and being spaced along the direction of movement of such surface area across the flow path of furnish in approaching deposition, means for applying an electrical potential to the rods to establish an electric field which includes lines of force tending to align longitudinal axes of such fibres with the direction of movement of the surface of deposition and into substantially parallel relationship with such mat forming surface, means for rotating the electrically conductive rods, and means for controlling the electrical potential of the rods.

Fibres, presented in individualized form, are attracted towards the rods and the mat being formed; orientation and deposition of the fibres are controlled by a combination of electrical and mechanical forces.

Those fibres which are electrically attracted to the rods adhere in spoke-like fashion to the rods. Rotation of the rods and movement of the mat-forming surface are controlled so as to brush the fibres against the mat surface presented. Contact with the mat surface and centrifugal force created by rotation of the rods breaks the electrical adhesion to the rods and the fibres are deposited in a controlled manner to help attain a desired orientation ratio.

In addition, control of electrical polarity and the placement of the rods establish an electric field with lines of force extending in the machine-forming direction and substantially parallel to the forming surface on which the furnish is deposited. This electric field exerts a torque on the fibres approaching and falling between the rods tending to align axes of the fibres in the direction of movement of the mat forming surface and parallel to that surface.

The invention is further described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of apparatus for continuous-line manufacture of fibreboard in accordance with the present invention;

Figure 2 is a schematic view in cross-section, taken along the machine forming direction, of orientation and deposition means of the apparatus;

Figure 3 is a schematic representation in cross section along the machine forming direction of the electric field produced in the apparatus;

Figure 4 is a schematic representation in cross section along the machine forming direction of the effect of the electric field on the fibrous material; and

Figure 5 is a view in elevation showing structure for placement and rotation of the electrostatic field producing means of the apparatus.

In the handling of the lightweight furnish before fibre orientation, the furnish is metered, distributed and separated into discrete fibres as it approaches the orientation and deposition apparatus. In the continuous-line apparatus for manufacture of fibreboard shown in Fig.1, a furnish supply 10 is located in vertically spaced relationship above a forming conveyor 11 presenting a web 12 on which a mat of the fibrous material is to be formed. From the furnish supply 10, the furnish descends into distribution means 14 for distribution transverse to the direction of movement of furnish towards web 12; e.g. distribution means 14 imposes a substantially uniform distribution of furnish over a distance correlated to the lateral dimension of the board measured in the plane of the board perpendicularly to the machine forming direction (indicated by arrow 26).

The laterally distributed furnish is accumulated in a feed chamber 16 and moved forward towards the web 12 by metering means 18. The metered furnish is distributed, in the direction of web travel, by longitudinal distribution means 20 over a preselected dimension which, with the established lateral dimension, determines the area of deposition of the mat-forming fibrous material.

The furnish, substantially uniformly distributed over the preselected area for deposition, moves in the direction of the web 12 through fibre separation means 22. Fibre clusters are broken up into discrete fibres by passage through the fibre separation means 22 as the furnish is delivered in the direction of web 12.

Furnish feed, distribution, metering, and fibre separation means are provided to deliver furnish at a suitable production flow rate over the area of deposition with the discrete fibres moving in the direction of the mat-forming surface substantially free of air turbulence effects.

The fibres move through an open-ended flow-through chamber 24 for orientation and deposition; the web 12 is moving in a continuous manner in the machine forming direction, as indicated by arrow 26, under the control of guide and drive roll means. The mat formed on the continuous web 12 then moves onto a conveyor 28 for transfer to a press; typically, the mat is subjected to heat and pressure which will polymerize a binder system; at the same time the mat is compressed into desired board density.

The furnish is moved through the orientation and deposition chamber 24 substantially free of pneumatic turbulence which would have an undesirable effect on orientation. The electrical forces imposed by energizing rod electrodes (to be described) in chamber 24 tend to orient the fibres in the plane of the fibreboard mat and with longitudinal axes of the fibres substantially aligned with the forming direction. A combination of electrical and mechanical forces is used to achieve desired orientation and substantially uniform deposition over the predetermined area.

Referring to Fig.2, the orientation and deposition chamber 24 includes guide walls defining an open-ended flow-through structure into which the furnish is moving as indicated by arrow 30. The guide walls of the flow-through chamber define the area of deposition. Referring to the direction of movement of web 12 indicated by arrow 26, guide wall 32 is located at the leading end of the area of deposition and guide wall 34 is located at the trailing end of the area of deposition.

Desired orientation is carried out uniformly over the full area of deposition. Electrically conductive rods 36 to 41 are selectively positioned and supported in close proximity to the web 12. The rods 36 to 41 are elongated with their longitudinal axes disposed in transverse relationship to the forming direction and parallel to the deposition area. Electrical polarity of the rods is selected; in the preferred embodiment, the rods 36 to 41 are electrically charged so that, at any instant, each next adjacent rod is of opposite polarity; for example, rod 36 is connected to be of positive polarity while rod 37 is connected to be of negative polarity.

The electrically charged elongated rods 36 to 41 are predeterminedly spaced above web 12 in the direction of approach of furnish. Each rod is contiguous to the mat-forming surface on web 12 with the predetermined spacing of the rods from the surface of web 12 taking into account the increasing thickness of the mat as the web 12 travels longitudinally towards the leading end of the structure 24. Therefore, rods located near the leading end of the area of deposition in structure 24 will be spaced a greater distance above the support surface of the web 12 of the transport conveyor than those at the trailing end of the area of deposition. The contiguous relationship of the peripheral surface of the rods and the exposed surface of the mat being formed remains substantially the same regardless of the depth of the mat.

The web 12 of the forming conveyor can comprise a continuous foraminous belt woven from nylon or similar material. Support and electrical contact of the undersurface of web 12 is achieved with electrical conductor bars 44 to 49 which are elongated with their longitudinal axes extending in transverse relationship to the direction of movement of the web 12. Preferably these bars present a flat surface for support of the web. In the array shown, such bars are connected so that each next adjacent bar, at any instant, is of opposite polarity; for example, bar 44 is positive and bar 45 is negative, etc.

Although web 12 is essentially non-conductive, the voltage level is such that a small current is established through the fibre mat and the forming belt. Dielectric properties of the mat may vary depending on the moisture content of the fibrous materials or additives to the furnish. The effect of mat current is to hold the fibrous material to the web and maintain desired alignment of fibres. Selective control of instantaneous polarity of the undersurface electrical conductor bars is provided along with selective placement in relation to the separate electric field-producing rods above the web.

Also, as shown in Fig.2, a chamber 52 may be positioned below the web 12. As defined by wall structure 54, chamber 52 can extend over the full area of deposition. A fan 56 of any suitable design can be connected to chamber 52 to help prevent random escape of dust. A representative negative pressure level would be about 62.3 Pa (0.25 inch of water vacuum). This slight negative pressure may be used to conveniently reduce ambient dust about the structure without causing air turbulence forces in the flow-through chamber 24 which would adversely affect desired orientation of fibres. Orientation ratios can be reduced below desired levels at greater negative pressures.

Fig.3 is an enlarged view of a portion of Fig.2 showing the electrical field generated by charged rods 36 to 39 in predeterminedly spaced relationship above web 12. By use of opposite polarities in next adjacent rods 36 to 39, the field strength between the rods is increased to the algebraic sum of the voltages established in each rod. The on-site voltage available for these rods has an effect in selecting longitudinal spacing, i.e. along the mat-forming direction. Higher voltages permit greater longitudinal spacing between the rods.

The electric field includes lines of force extending substantially horizontally between the rods. For example, in a plane through the mid-points of rods 36 and 37, electric field lines of force extend parallel to the mat forming surface in the forming direction. Above and below these centre-plane lines of force, between the adjacent electrically conductive rods, electric field lines of force arch slightly, as indicated, while maintaining alignment with the forming direction with a major component of the lines of force in parallel relation to the mat-forming surface.

The effect, generated by rotating the rods of the electric field on discrete fibres moving in the direction of mat 12 is represented in Fig.4 which is an enlarged view of a portion of Fig.2. Mat-forming surface 60 is presented by the mat 62 being formed on web 12; next adjacent rods 36 and 37 are of opposite polarity with rod 36 being positive and rod 37 being negative.

Fibres descend from upper portions of the flow-through chamber 24 along a flow path which is substantially normal to the web 12. In area 64, approaching the effective electric field, the fibres are randomly oriented with axes of individual fibres in any of three dimensions; that is, individual fibres may be descending with their longitudinal axes at any angle between substantially normal to the plane of the web or substantially parallel to the plane of the web and also with their longitudinal axes at any angle between alignment with the direction of movement of the mat and 90° to that direction.

Fibres which are attracted to and adhere to the electrically charged rods are radially disposed in spoke-like fashion about each rod. This disposition of fibres adhering to the rods can be extended in length. Such fibre "whiskers" include fibres adhering to and extending longitudinally from a first tier of fibres in contact with the rods. As the rods rotate, in the direction shown, through the upper quadrants and through the quadrant approaching the mat-forming surface, these spoke-like protrusions of fibres become extended in length and closely adjacent. As the rotating rods take these adhering fibres through the final quadrant approaching the web 12, the fibres contact the mat-forming surface 60. Both the rotational centrifugal force and the continued rotation of the rods which causes fibre contact with the mat-forming surface 60 contribute to the breaking of the electrical attraction of the spoke-like fibres to the rods; these fibres are deposited with preferred direction orientation in the plane of the mat.

The direction of rod rotation is such that a rod, and its adhering fibres, appear to "climb" the mat as it moves in the direction shown. The rods are positioned so that the bottom peripheral surface of each rod is contiguous to the surface of the mat being formed; because of attraction to the energized rods, the web 12 may be lifted slightly as it travels under a rod. The contiguous relationship clears fibres from the rods so that a portion of the first quadrant of a rod, after passage of its closest point to the mat surface, is initially free of fibres. The speed of rotation of the rods is selected to maximize orientation and avoid any build-up of fibres on the rods.

In addition to those fibres adhering to the rods, fibres falling towards and between the rods are subjected to the electric field generated by the rods, tending to orient fibres with their axes substantially parallel to the plane of the mat being formed and with their longitudinal axes in substantially the same direction as the direction of movement of web 12; such orientation is represented by the fibres in portion 66 of the chamber structure 24.

The subsurface electrical means, bars 44 to 49 as shown in Fig.2, help maintain a separate electric force in the mat being formed by establishing a slight current in the mat.

Means for positioning, rotating, and electrically connecting the elongated electrically conductive rods are shown in Fig.5. In this embodiment, a support frame 70 extends in the machine forming direction along opposite sides of the forming chamber 24. Support frame 70 holds the mounting and electrical contact bearings, e.g. 74, 75 at the leading end and 76, 77 at the trailing end, for the axles 78, 79 and 80, 81, respectively, of the rods. As shown, the spacing between the web 12 and the rod axes increases in the direction of movement of web 12. Drive means 84 provides for controlled rotation of the rods.

Additional features which can be utilized to enhance fibre orientation at increased production rates while maintaining consistent results include: maximizing the electrostatic field strength while avoiding arcing, providing for maximizing the effect of the field strength including monitoring moisture content of the fibres and addition of materials to affect physical properties of the fibres, such as electrical conductivity, selection of the quantity, type, and state of binder resin included in the furnish, control of speed of rotation and size of the electrically conductive rods for producing the electric field, and control of the longitudinal movement of the conveyor support belt for the mat being formed.

The invention finds special application in working with lightweight fibrous materials. The pressure-refined wood furnish on which data is presented below had presented special problems to the prior art in obtaining desired orientation and commercial production rates. The wood is broken down closer to individual fibres in a pressurized steam refiner than under atmospheric attrition mill conditions. Various refining processes for preparing lightweight fibrous furnishes are known in the art (see e.g. "Modern Particleboard and Dry Process Fibreboard" by Thomas M. Maloney, pp. 98, 99, 212).

A predominant part of the bulk of pressurized steam refined wood furnish comprises extremely fine, hair-like fibres which can be less than 0.0254 mm (one mil) in diameter. These hair-like fibres can vary in length up to as much as 19 mm (three-fourths inch) but are predominantly about 6.35 to about 12.7 mm (one-quarter to one-half inch) in length. A tendency to cluster exhibited by the furnish, similar to that observed with cotton fibres, results from the nature of these extremely fine hair-like fibres. A significant percentage by weight of such pressurized disc refined furnish comprises heavier, elongated splinter-like pieces of wood having diameters up to about 0.0508 mm (two mils). Some of these exhibit fibre-like qualities being longitudinally pliable while others are more rigid. The balance of the weight of such furnish comprises dust-like particles.

Field strengths established by the rotating rods exhibiting voltage gradients of 101 to 404 volts per millimetre (2,500 to 10,000 volts/inch) provide suitable orientation conditions (the voltage gradient in volts per millimetre is equal to the positive polarity voltage at any instant supplied to an electrode plus the negative polarity voltage supplied at that instant to an adjacent electrode divided by the distance in millimetres between the electrodes). The voltage supply can be conventional; while AC or DC can be operational, DC is preferred because of better fibre orientation results. The voltage gradient should stay below the point where arcing can take place. The voltage gradient where arcing can take place in air varies from about

473 to about 670 volts per millimetre (12,000 to 17,000 volts/inch) depending on the relative humidity. Also current leakage increases more rapidly at field strengths above 404 volts per mm. A typical voltage gradient when working with lightweight furnish is about 315 volts per millimetre (8,000 volts/inch).

Control of rod spacing along the machine forming direction of the electrically charged rods above the web is partially dependent on the high voltage power supply connections. The field strength can be increased by utilizing two voltage power supplies of opposite polarity connected to adjacent rods. With 50,000 volt D.C. power supplies and 216 mm (eight and one-half inches) spacing between the rods in the machine forming direction, a voltage gradient up to about 473 volts per millimetre can be achieved. The voltage output of the power supply is adjustable. With lower voltage output capability, the spacing between the rods can be reduced to maintain the desired voltage gradients. Orientation ratio increases gradually in a substantially linear fashion as the voltage gradient increases.

Within the above range of values, rod diameter of about 19 mm (three quarters of an inch) provides optimum orientation results. Smaller or larger diameter rods, e.g. from about 12.7 mm, can be used. However, use of rods of 31.8 mm (one and one-quarter inches) diameter and larger, can result in lower orientation ratios with the lightweight wood furnish described. The nature of the rod metallurgy has little effect as long as the rod is a good conductor. Rod rotation, with the lightweight furnish described, is controlled in the range of about 100 to 300 r.p.m.

The improved orientation ratios and production rates are made available over a significantly wider range of moisture contents of the lightweight pressure refined furnish than what was previously considered practical with planar electrodes of the wall and partition type. For example, improved orientation ratios are available with moisture contents from about 5% to about 15% by weight. This significantly increases permissive selectivity available in the furnish and in the resin binder system used while maintaining consistency of results. With the chamber wall and partition type of electrodes of the prior art, the range of moisture contents of the furnish which could be used was more restricted; little orientation effect could be produced when the moisture content varied below an optimum percentage; e.g. 15% or higher moisture contents were generally considered to be better suited for obtaining orientation.

In practice of the present invention, moisture contents in the range of about 7-1/2% to about 10% are preferred although desired orientation ratios can be achieved over a much wider range of moisture contents. It has been found, however, that as moisture content approaches 20%, adhesiveness or so-called "tack level" of certain resins can interfere with proper mat formation. Moisture content of the furnish, using conventional measureing means, can be monitored for better selection of electric field strength. Moisture content monitoring means can be mounted along the furnish handling line to activate a water spray solenoid valve to hold moisture content during periods when very low moisture content is exhibited by the particular furnish.

In practice, a variety of suitable binder systems exists which do not significantly inhibit achievement of proper orientation. Resin types include urea formaldehyde, phenol formaldehyde, isocyanate, and tannin formaldehyde. The resins can be applied in powder or liquid form. Percent of resin may typically run from about 4% to about 10% by weight of the dry fibre depending on the application and the product. Some liquid resins, such as urea formaldehyde, may cause tack and consequent clumping or balling of the fibres. Lower tack resins can be selected to avoid problems which could interfere with proper alignment and uniform deposition.

The effect of the electric field on the furnish can be modified, e.g. by controllably adding a salt, which enhances conductivity, to the fibrous material in order to improve orientation ratios. When the manufacturing process requires very low moisture contents, inclusion of a salt, such as sodium chloride, is beneficial. However, for most applications the moisture content preferred in the particular fibreboard manufacturing process provides adequate conductivity for desired orientation when using the method of the present invention.

While numerous factors can enter into evaluating characteristics of directionality in fibreboard, bending stiffness, also referred to as the modulus of elasticity in bending, provides a convenient measure of effective fibre orientation ratio achievement. Methods and means for measurement of the properties of oriented particleboard are known in the art; see e.g. "Electrically Aligned Particleboard and Fibreboard" by John W. Talbott, presented at the Eighth Washington State University Symposium on Particleboard of March 1974.

With random orientation, the ratio of particles in the "X" direction (direction of forming) to the number of particles in the "Y" direction (perpendicularly transverse to the direction of forming) is one to one. With fibre orientation in the direction of forming, this ratio increases. The index of the degree of orientation achieved with fibres is based on the ratio of the modulus of elasticity in the cross machine forming direction (E_x) to the modulus of elasticity in the cross machine direction (E_y). Ratios (E_x/E_y) of 1.2:1 and higher are achieved through use of the method of the present invention with pressure-refined wood furnish which has been considered the most difficult to handle of the lightweight furnishes described.

It has been demonstrated that the present invention is capable of providing desired orientation ratios with the lightweight furnish, produced by pressurized refining, at economically acceptable production rates over commercially practical forming areas. For example at an 8170 kg per hour (18,000 lbs. per hour) flow rate of furnish, electric field fibre orientation to desired ratios can readily be achieved when depositing fibres from 0.081 to above 0.407 kg m^{-2} s^{-1} (one to above five lbs. per square foot per minute) over a deposition surface of about 6.96 m^2 (seventy-five square feet).

With a flow rate of about 27.6 kg s^{-1} (300 lbs. per minute) and a deposition area of about 6.96 m^2, fibreboard having 801 kg m^{-3} (fifty lb. per cubic foot) density and a 3.18 mm (one-eighth inch) thickness after curing can be formed with desired orientation ratios at the rate of 0.254 m s^{-1} (fifty linear feet per minute). When the final thickness desired is 6.35 mm (one-fourth inch), such fibreboard can be produced at 0.127 m s^{-1} (twenty-five linear feet per minute). In practice, the actual deposition rate of the dry fibre exceeds such figures since pre-cured deposition of furnish will ordinarily be in excess of press capacity. For purposes of more efficient handling and more uniform distribution of fibres, the furnish is provided, distributed, oriented, and deposited at an optimum rate and, where the deposition exceeds press capacity, a portion of the mat can be shaved off prior to entry into the curing press and returned to the furnish supply and distribution line.

While specific structure, physical characteristics, and dimensional values have been set forth for purposes of describing one particular embodiment, it should be recognized that, in the light of the above description, modifications within the scope of the invention will be available to those skilled in the art.

CLAIMS

1. Continuous-line method for orienting and depositing lightweight furnish, including fibrous material with curable binder, in the manufacture of fibreboard having directional properties, in which a web presenting an extended surface area for deposition of furnish is moved continuously in a forming direction, and lightweight furnish, including elongated fibres moving along a flow path which is substantially normal to such surface for deposition of furnish, are guided towards such web, and in which the fibres being so guided are oriented and deposited with preferred orientation utilizing electrical and mechanical forces by establishing electrical potential in a plurality of elongated electrically conductive rods, disposed in spaced relationship from each other along such forming direction and in predetermined contiguous relationship to the web, with longitudinal axes of such elongated rods being in transverse relationship to the forming direction, to attract fibres to the rods and establish an electric field which exerts a force on fibres moving towards the web, tending to orient longitudinal axes of such elongated fibres in parallel relationship to the plane of the mat being formed and aligned with the forming direction, and the elongated electrically charged rods are controllably rotated about their respective axes to deposit fibres adhering to such rods.

2. A method as claimed in claim 1, in which the electrically charged rods are predeterminedly positioned above the moving web in the direction of approach of fibres, with spacing above the moving web of rods located towards the leading longitudinal end of the area of fibre deposition being greater than correspon-ding spacing of rods located towards the trailing

longitudinal end of the area of fibre deposition to maintain a substantially uniform spacing between respective rods and adjacent mat-forming surface being presented by the web in travelling from the trailing longitudinal end towards the leading longitudinal end of the area of deposition.

3. A method as claimed in claim 1 or 2, in which the speed of rotation of the elongated electrically charged rods about their respective axes is coordinated with rate of longitudinal movement of the web.

4. A method as claimed in claim 1, 2 or 3, in which electrical potential and polarity in said rods are controlled in order to control electric field strength longitudinally of the web.

5. A method as claimed in any of claims 1 to 4, in which elongated electrically conductive bars, positioned beneath the web with their longitudinal axes in transverse relationship to the longitudinal axis of the web and distributed longitudinally along the web in contact with the surface of the web opposite to the surface of deposition of furnish, are controllably energized to establish a current in the mat being formed.

6. Apparatus for use in continuous-line manufacture of fibreboard from lightweight furnish including fine textured elongated fibres and curable binding material, comprising a forming conveyor including a continuously moving web (12) presenting an extended surface area for deposition of furnish, means (14, 16, 18, 20, 22, 24) for establishing a flow path and delivering the furnish substantially uniformly distributed over the surface area for deposition with the fibres in discrete form substantially free of fibre clusters, a plurality of elongated electrically conductive rods (36 to 41) located in the flow path of such furnish towards the

surface area for deposition and in pre-selected spaced relationship above the surface area for deposition, the electrically conductive rods being mounted for rotation with their longitudinal axes in transverse relationship to the direction of movement of the surface area for deposition and in substantially parallel relationship to such surface area, whereby the rods are contiguous to a mat-forming surface presented by deposition of fibres on the surface area for deposition and being spaced along the direction of movement of such surface area across the flow path of furnish in approaching deposition, means for applying an electrical potential to the rods to establish an electric field which includes lines of force tending to align longitudinal axes of such fibres with the direction of movement of the surface of deposition and into substantially parallel relationship with such mat forming surface, means (84) for rotating the electrically conductive rods, and means for controlling the electrical potential of the rods.

7. Apparatus as claimed in claim 6, further including a plurality of elongated electrically conductive bars (44 to 49) located in under surface contact with the continuously moving web (12), the longitudinal axes of the elongated electrically conductive bars being in transverse relationship to the direction of movement of such web and in parallel relationship to the surface area for deposition, and means for establishing electrical potential in said bars (44 to 49) to establish an electric current in the mat being formed on the surface area for deposition.

8. Apparatus as claimed in claim 6 or 7, in which the means for establishing a flow path provide substantially uniform lateral and longitudinal distribution controlled flow of furnish as substantially

individualized fibres moving towards the web for orientation and deposition purposes, and include guide wall means defining a flow-through structure (24) for passage of furnish towards the web, the flow-through structure (24) having cross-sectional lateral and longitudinal dimensions measured transversely to the flow path of furnish, which dimensions are correlated with corresponding dimensions of the deposition area for the fibres, the electrically conductive rods (36 to 41) being located in said flow-through structure

9. Apparatus as claimed in claim 8, in which the guide wall means define leading and trailing longitudinal ends (32,34) of the mat-forming surface presented for deposition of fibres with the electrically conductive rods (36 to 41) being located towards the leading longitudinal end (32) being spaced a greater distance from the web (12) than rods located towards the trailing longitudinal end (34).

10. Apparatus as claimed in any preceding claim, in which the electrically conductive rods (36 to 41) are spaced from the mat-forming surface presented by the web (12) such that elongated fibres adhering electrostatically to the rods contact the mat-forming surface upon rotation of the rods.

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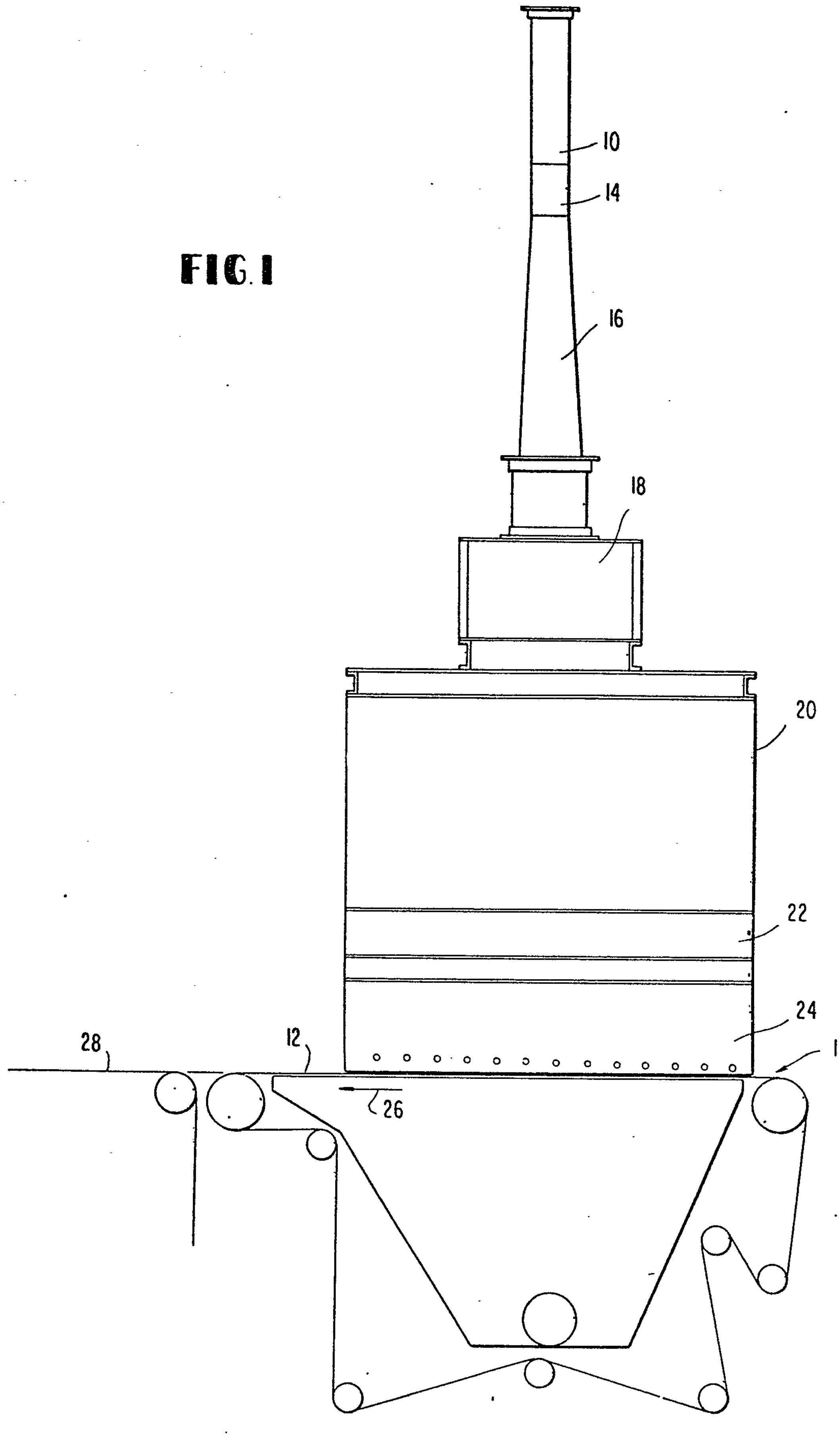
FIG. 1



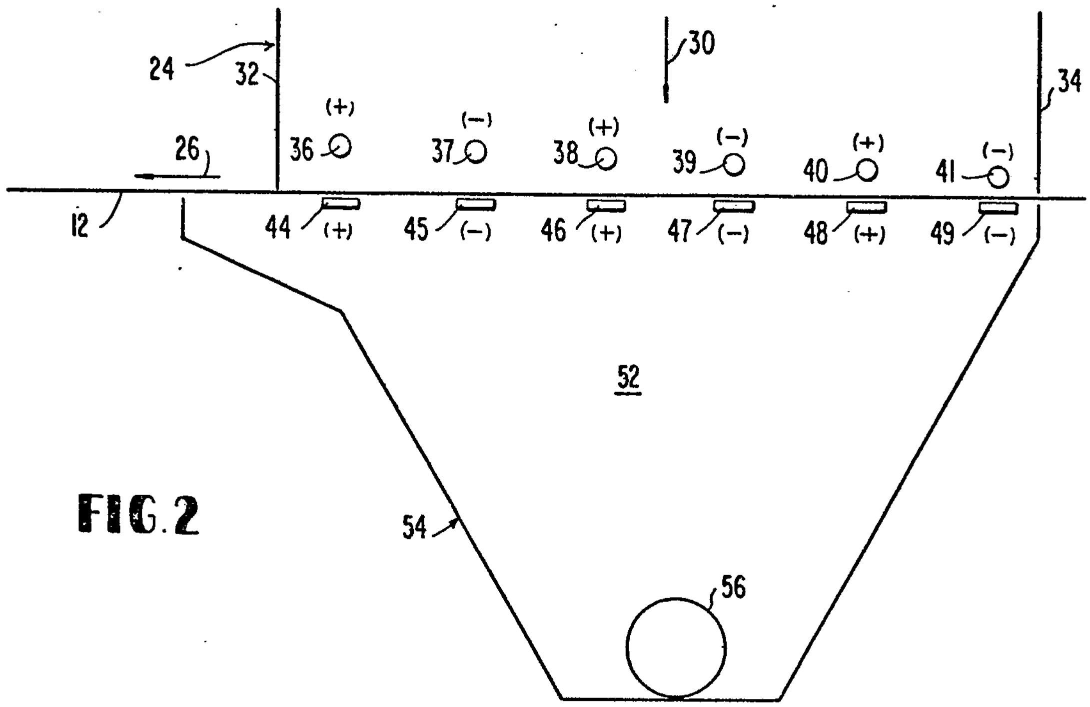
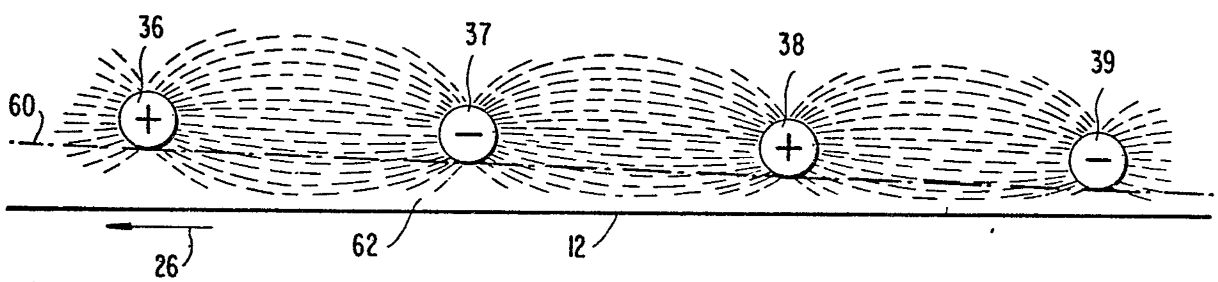


FIG.2

FIG.3



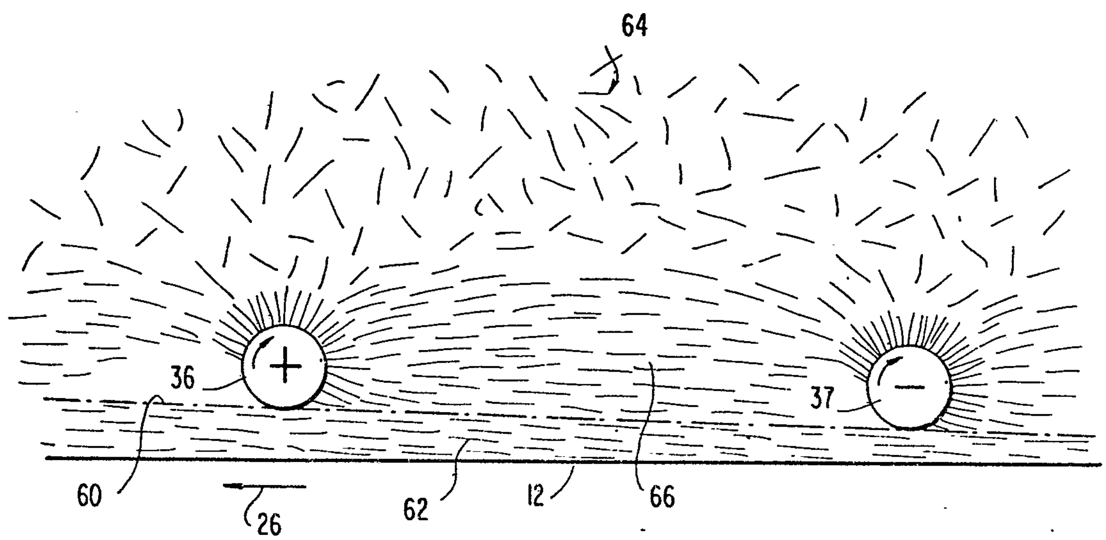


FIG.4

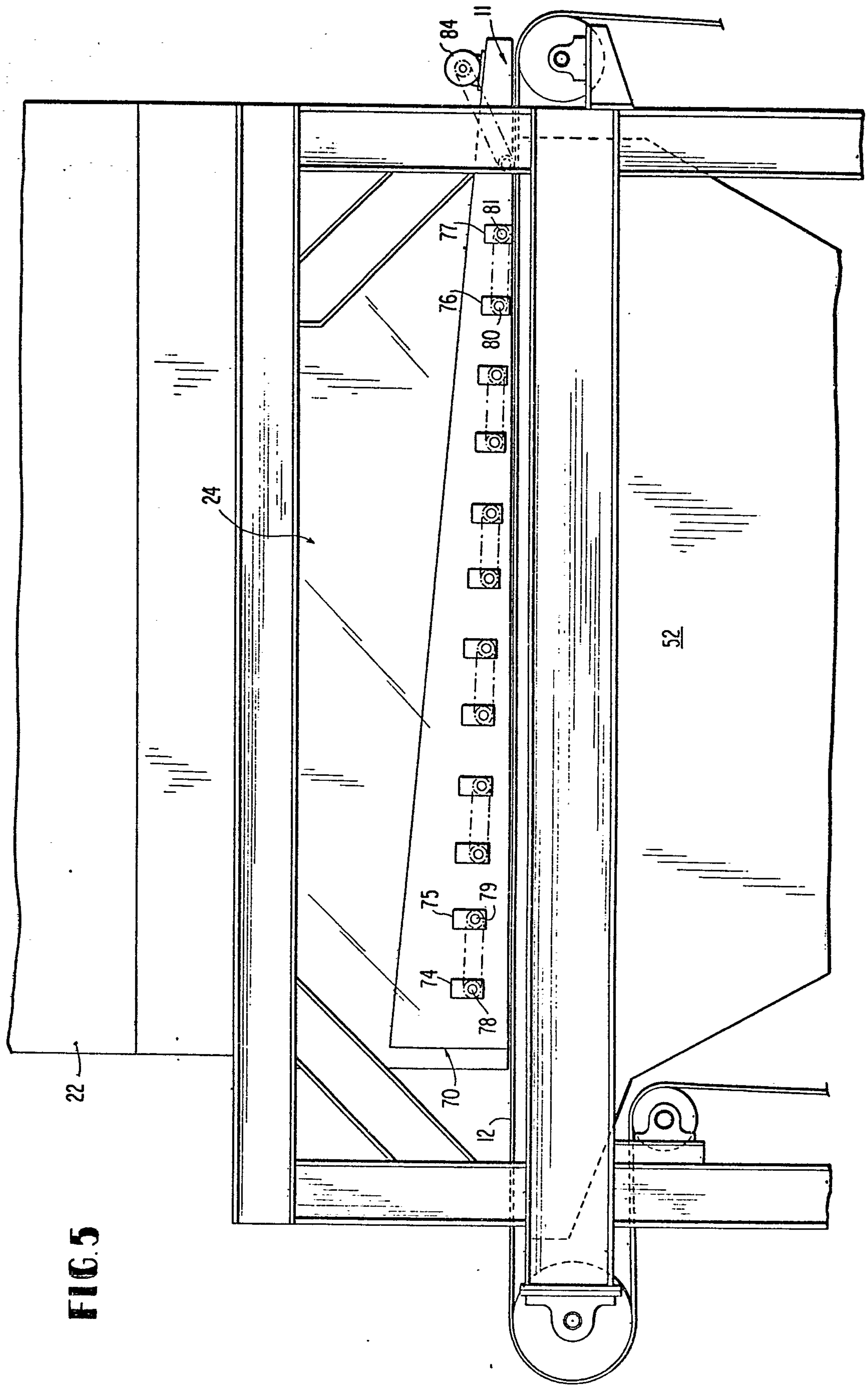


FIG.5

European Patent Office

EUROPEAN SEARCH REPORT

0054586

Application number
EP 80 30 4611.9

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	US - A - 4 111 294 (C.TH. CARPENTER et al.) * claim 1 * --	1,6	B 29 J 5/04
A	US - A - 4 113 812 (J.W. TALBOTT et al.) * abstract * --		
A	US - A - 3 954 364 (J.W. TALBOTT et al.) * claim 1 * --		TECHNICAL FIELDS SEARCHED (Int. Cl.³)
A	US - A - 3 843 756 (J.W. TALBOTT et al.) * claim 1 * --		B 29 J 5/00
A	US - A - 4 045 528 (U.A. URMANOV) * abstract * ----		

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	30-07-1981	BITTNER

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