

Aug. 6, 1957

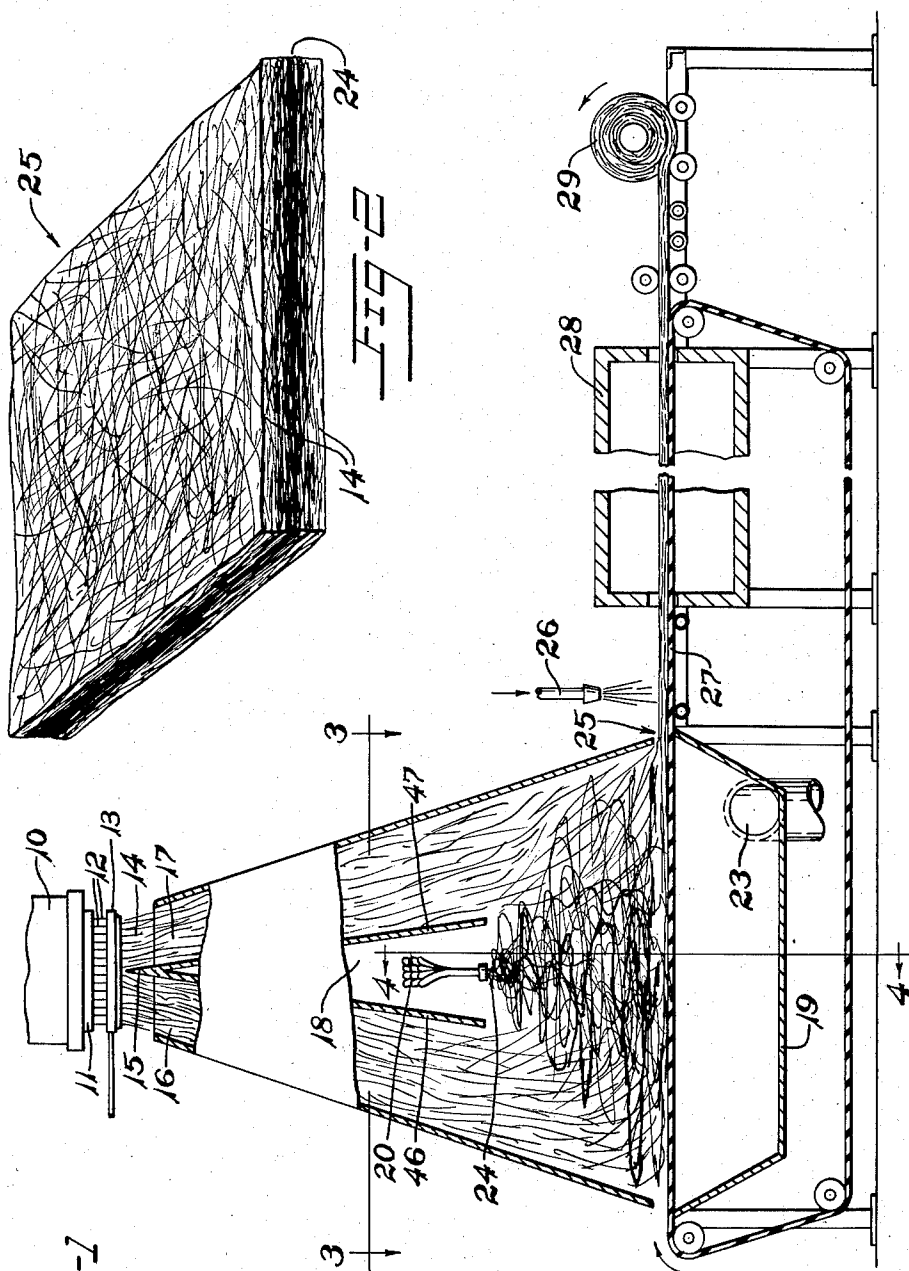
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2,801,673

FIBROUS GLASS MATS AND MANUFACTURE THEREOF

Filed Jan. 4, 1954

3 Sheets-Sheet 1



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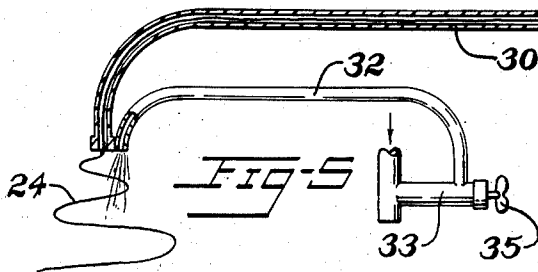
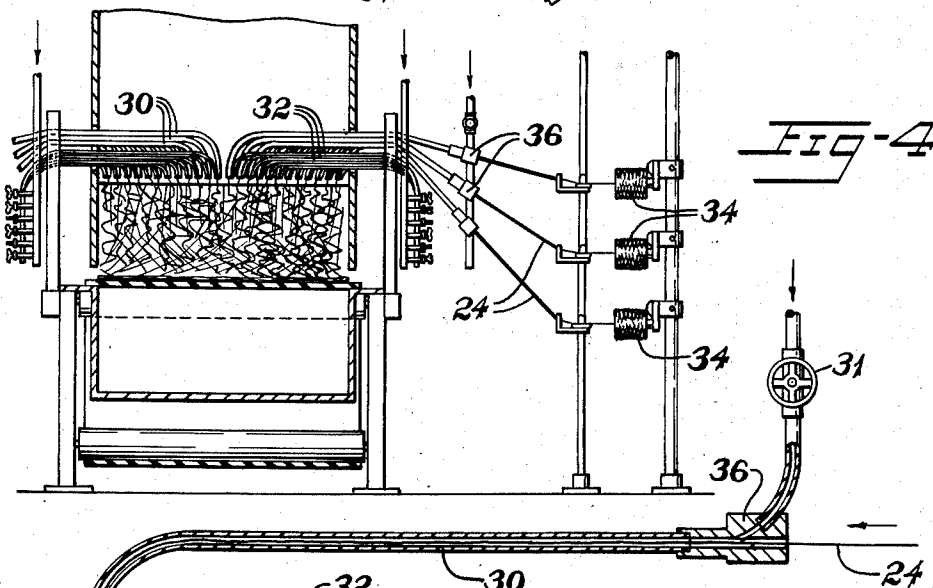
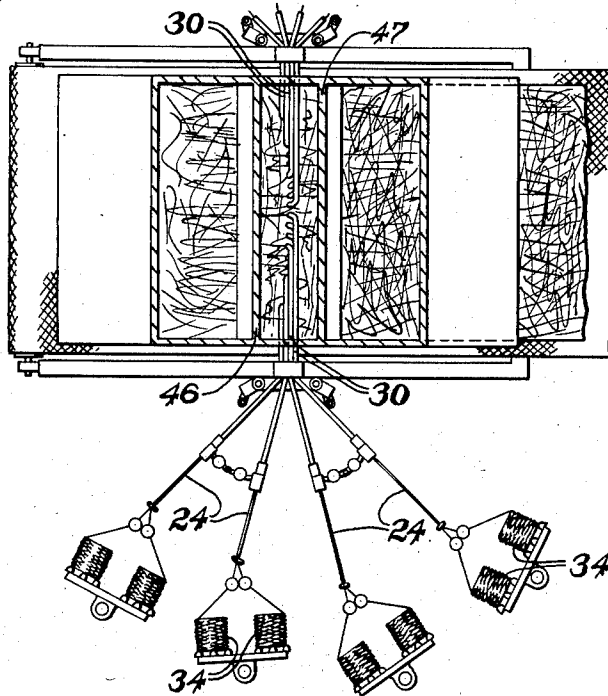
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FIBROUS GLASS MATS AND MANUFACTURE THEREOF

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3 Sheets-Sheet 2

FIG-3



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FIBROUS GLASS MATS AND MANUFACTURE THEREOF

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3 Sheets-Sheet 3

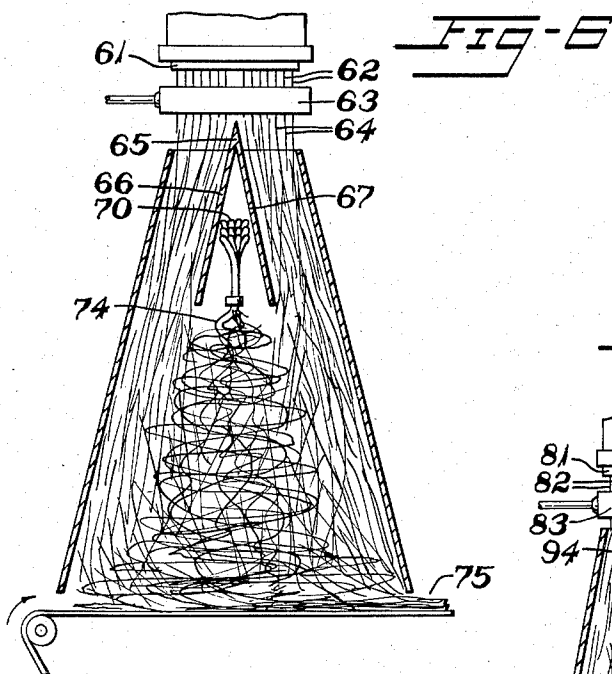


Fig-6

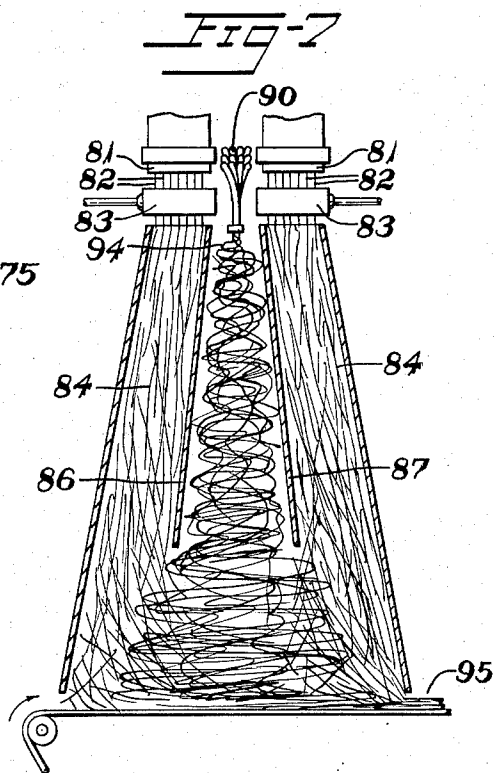


Fig-7

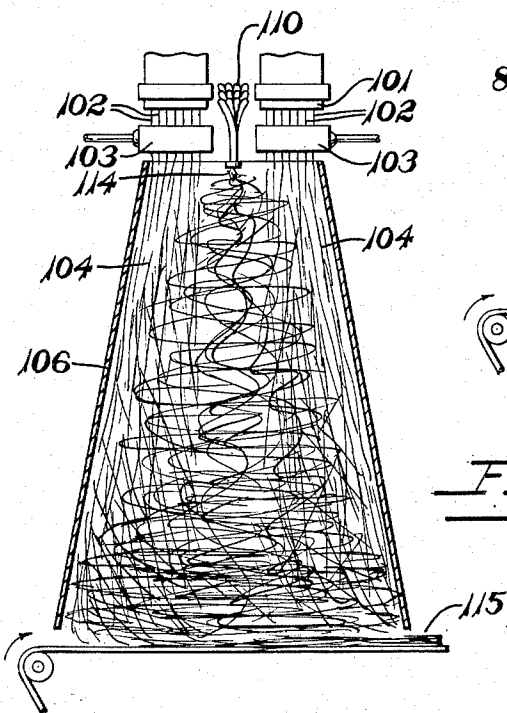


Fig-8

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2,801,673

FIBROUS GLASS MATS AND MANUFACTURE THEREOF

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Application January 4, 1954, Serial No. 401,932

17 Claims. (Cl. 154—29)

This invention relates to fibrous glass mats and more particularly to fibrous glass mats made by intermingling mass accumulations of fibers in both continuous and discontinuous form.

In the manufacture of mats of glass fibers, many applications dictate the need for incorporation of fibers grouped in strand-like forms by reason of characteristics such as greater tear and burst strengths offered by such incorporation. Fibers in both strand-like groupings or forms and in individual discontinuous form, however, have their particular advantages in the manufacture of fibrous glass mats. Fibers in textile forms such as continuous strands or yarns, besides lending strength to the product, also increase the mass integrity thereof by reason of their ability to establish a bonded relation with widely separated portions of the yarn or strand into which they are made.

Establishment of such a bonded relationship between different portions of the fibers produces a closely inter-associated accumulation of the fibers in crisscross and looped form with consequent provision of a large number of interstices. Because of the physical proportions and dimensions of the strand-like forms, however, these interstices become relatively large and the mat product is of a highly porous nature and somewhat coarse in appearance.

Since discontinuous fibers can be made extremely small in diameter, accumulations thereof can be provided a soft, fluffy and a much finer finish than accumulations of strand-like forms. In addition, a much larger number of interstices can be incorporated within a given volume of such fibers and thus any of a wide range of porosities can be controllably imparted thereto. This invention deals with a new manner of associating the individual fibers and fibers in strand-like forms so as to provide an improved mat product as well as a method and means by which such improved mat can be manufactured in individual-fiber forming operation.

Fibrous glass mats made of fibers in strand-like groupings in combination with discontinuous individual fibers for smoothness of finish have heretofore been combined in such manner that the individual fibers are usually accumulated as separate layers between which the fibers in strand form are interposed. The integrity of mats of this type are not all that is to be desired, however, since the finished surface layers of individual fibers can usually be easily separated from associated textile layers on application of forces such as those to which the mat might be subjected in compression or on bending. Such conditions arise because of difficulty experienced in positively distributing the strands through the individual fibers. Instead, the layers of individual fibers and strands are required to be bonded together by binder alone rather than by being assisted by an intermingling relation of the individual fibers and strand.

In view of the foregoing, it is an object of the present invention to provide a method and means for manufacture

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of a novel mat combining individual glass fibers and fibers in textile groupings in such a manner that a mat is produced of high integrity throughout without delamination tendencies while still incorporating the desired strength and finish properties of the fibers.

It is another object of this invention to provide a yarn-reinforced mat of discontinuous individual fibers in which mass integrity is promoted throughout by the reinforcing yarn, but which has a fine surface free of loose or extraneous loops of yarn.

It is a feature of the invention that manufacture of the novel mat may be readily and economically accomplished in fiber-forming processes.

The mat produced according to this invention is essentially a mat of individual discontinuous glass fibers reinforced by strands or yarns of glass fibers randomly distributed throughout the thickness of the mat but concentrated in the center and gradually diminishing in concentration toward the outer layers. Thus, another feature of the invention is the fact that another variable, namely yarn-density distribution through the thickness of the mat is added to the controllable factors in the manufacture of mats, thereby making it possible to produce fibrous glass mats having a wider range of properties.

Other objects and figures which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, in both organization and manner of construction, together with further objects and advantages thereof may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a partly broken away side-elevational view of apparatus for producing mats according to the principles of this invention;

Figure 2 is a perspective view of a mat of individual and textile fibers embodying the principles of this invention;

Figure 3 is a cross-sectional view of the top of part of the machine of Figure 1 as taken on line 3, 3;

Figure 4 is a cross-sectional view taken of the back of the apparatus shown in Figure 1 as taken on line 4, 4;

Figure 5 is an enlarged view partly in cross section of a textile blowing gun which may be utilized in the apparatus shown in Figures 1, 3 and 4;

Figure 6 is a cross-sectional elevational view of apparatus comprising a second embodiment of the invention;

Figure 7 is a cross-sectional elevational view of apparatus comprising a third embodiment of the present invention; and

Figure 8 is a cross-sectional elevational view of other apparatus for making composite mats of textile and individual fibers.

The terms "yarn" and "strand" in the present description are used in their broad sense and interchangeably to designate a grouping of a multiplicity of glass fibers integrated in either straight, twisted or plied condition, and as such, each is meant to refer to both strands and yarns.

Referring to the drawings in greater detail, Figure 1 shows a source of molten glass such as a forehearth 10 of a glass melting tank associated with a steam blower 13 and a divided hood structure including channel sections 16 and 17 which direct discontinuous fibers for collection in a mat 25 on a foraminous chain-type conveyor 27. The molten glass is supplied in the form of streams 12 emitted from a feeder 11. The streams are disrupted into discontinuous fibers of varying lengths by blasts of high-pressure steam or air from a blower 13 supplied with steam or air under pressure from an external source not shown. The fibers 14 are divided into two groups or masses by a divider wall 15 formed by the

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juncture of the two adjacent walls 46 and 47 of the channels 16 and 17, respectively, and are carried through the channels with the gaseous blasts drawn downwardly therethrough. The portion of the conveyor 27 immediately below the hood structure has a lower than atmospheric pressure established therein by a suction box 19 connected by a duct 23 to suitable evacuating means such as a negative-pressure blower.

The channels 16 and 17 extend slightly outwardly from each other to form a space 18 defined by the walls 46 and 47 which extend downwardly for approximately two-thirds of the distance from the blower 13 to the conveyor 27. An assembly 20 of yarn-blowing guns 30 is located in the bottom portion of the divider space 18 to introduce a plurality of yarns 24 into the hood for accumulation with the individual fibers 14 on the conveyor 27.

The yarns 24 are caused to be directed primarily downwardly to the conveyor but are also caused to oscillate back and forth and to some degree sidewise on passage to the conveyor. The oscillation or moving dispersion results in formation of loops on the conveyor some of which are wide sweeping loops extending completely across the hood from the back to the front wall while others are only short loops more centrally collected in the hood. In general, the distribution across the cross section of the hood might be considered as being affected in accordance with the laws of probability, the greatest concentration of yarn being introduced to the conveyor more centrally in the hood because both the short and long loops pass therethrough while only the extremely long loops extend over to the back and front walls of the hood before collection on the conveyor. Because of this probability distribution of yarn in intermingled relation with the individual fibers passing through the hood, the mat 25 formed on the conveyor has a greater concentration of yarn in the center with a lesser and lesser concentration as the top and bottom layers are approached, leaving the individual fibers to form the exposed finished surfaces of the mat.

The distribution of both the textile fibers 24 and the individual fibers 14 within the mat 25 is illustrated in Figure 2 by the darkened midportion while the exposed surfaces composed predominantly or solely of individual fibers is illustrated by lighter shading.

On being carried from under the hood by the conveyor, the accumulation of fibers is sprayed with a binder by one or more binder guns 26 which supply enough binder to the mat to establish the integrity desired. Any of a wide variety of binders may be used including materials such as phenol formaldehyde, polyvinyl acetate, urea formaldehyde and many others. The percent of solids in the liquid binder may be varied as may be necessary in forming handleable emulsions or dispersions of the different materials used. In general, emulsions or dispersions of resin may vary from 1/4 percent to 40 percent total solids depending upon the resin used. The percent of binder in the finished product may vary considerably, but in general, the total weight of binder will vary from about 5 to 20 percent resin.

After being sprayed with binder, the composite mat is carried forward through a binder-curing oven 28 where the binder is raised in temperature for a final set. Oven temperatures may vary according to the particular binder used. The temperatures will generally vary, however, from about 180° F. to about 700° F. and possibly as high as 1000° F. Upon leaving the oven, the mat is passed through a pair of feed and guide rolls to a set of support rolls on which the mat is rolled into a roll 29 preparatory to shipment and use.

Figures 3 and 4 illustrate the manner in which the yarns 24 are withdrawn from packages 34 and introduced to the yarn-blowing guns 30 for distribution in the mat. Figure 5 illustrates the type of pneumatic-blowing gun which may be utilized to effect the wide distribution desired. Air is introduced to the yarn-conveying barrel of

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the gun from an air main through a regulating valve 31 and connecting block 36. The yarn is introduced into a strand inlet in the rear of the block 36 and has air directed thereagainst at the juncture of the air inlet and yarn channel. The air is directed against the side of the yarn and carries the yarn with it through the barrel to be emitted from the discharge end of the barrel disposed above the conveyor. Although the gun may consist of a single tube alone thus described, an auxiliary blowing tube 32 having its mouth disposed adjacent the yarn-discharge end may be utilized to establish a controlled turbulence for the desired wide dispersion of yarn. The air emitted from the auxiliary tube is regulated by a valve 33 controlled by a thumb-screw 35. Since the air emitted from the gun is supplied under pressure from two tubes in close proximity to each other, turbulence is established in the space where the yarn is emitted, and the desired wide and random distribution in loop form is effected in accordance with the degree of turbulence permitted. Yarn may be ejected from a single pneumatic gun at the rate of 1,000 to 10,000 feet per minute or more.

The dispersing blowing guns 30 are grouped into the assembly 20 centrally located between the front and back of the hood at the lower end of the divider space 18. The guns are introduced from opposite sides of the hood into the divider space, each drawing yarns from package 34 conveniently located in creels on opposite sides of the hood. By locating the discharge ends of the guns a distance above the conveyor, the disturbed yarn has an opportunity to develop at least some full length loops extending between the front and back walls of the hood. If the discharge ends are close to the conveyor, insufficient room exists for full oscillation of the yarn which results in formation of undesired laminated mats having definite and separable layers of individual fibers in the outer surfaces thereof.

The walls 46 and 47 which are inclined slightly outwardly from each other to form the space 18 are designed to have an angular disposition such as to prevent hangup of fibers on the interior of the channels 16 and 17. By reason of the walls covering the bank of blower guns, hangup of fibers on the guns is also prevented. The walls 46 and 47 also determine somewhat the distribution of individual fibers within the oscillating mass of yarns and consequently the orientation and distribution of individual fibers through the yarn in the mat. The streams of gas and fibers emitted from the mouths of channels 16 and 17 tend to converge below the bottom edges of the walls 46 and 47 because of the relatively low pressure under the guns 30 compared to the higher pressures established within the channels by the gaseous blasts therein.

In addition, the drawing forces of the suction box 19 aid in establishing the converging relation. As a result, a good proportion of individual fibers are intermixed with the yarn deposited on the conveyor.

Figure 6 illustrates another embodiment of this invention in which a mat 75 is formed under a hood having a bank of guns 70, similar to that of the previous embodiment, disposed in aligned relationship with their discharge ends located about two-thirds of the way up between the conveyor and the blower 63 associated therewith. Streams of glass 62 emitted from a feeder 61 are disrupted into discontinuous individual fibers 64 on passage through a blower 63. The mass of fibers thus formed are centrally divided into two groups by a divider 65 formed by juncture of the two short-length channel walls 66 and 67. The walls 66 and 67 extend only down as far as is required to cover the bank of blowing guns and prevent interference of the yarn discharge by the streams emitted from the discontinuous fiber channels.

Because the yarn 74 is introduced at points relatively high in the hood, the yarn has a much better opportunity to develop into a probability distribution with lesser disruptive force than is required to effect the desired distribution in the previous embodiment.

Figure 7 illustrates still another embodiment of this invention in which a mat 95 is formed under a hood having two spaced feeders 81 and blowers 83 associated therewith. A bank of blower guns 90 are interposed between a pair of channels formed within the hood between the back and back walls thereof and a pair of walls 86 and 87, respectively, which extend downwardly for a distance of substantially two-thirds the length of the hood. A midchannel is thus formed between the walls 86 and 87 within which yarns 94 ejected from the guns are guided on being dispersedly distributed before reaching the conveyor. Discontinuous individual fibers 84 formed by disruption of the streams 82 emitted from the feeders 81 are carried through the outer channels of the hood. On reaching the lower edges of the walls 86 and 87 some of them are drawn somewhat inwardly toward the center of the hood to be intermingled with the yarns being deposited on the conveyor. It will be noted that the mat formed by this arrangement has more fibers laid in the bottom and top surfaces of the mat by reason of a somewhat more restricted distribution of the yarns 94 by the walls 86 and 87. The length of these walls is such, however, that the discontinuous fibers are caused to flow through the moving distribution of yarns to cause an intermingling therewith which diminishes toward the center of the mat having the greater concentration of fibers in the form of yarns or strands.

Figure 8 shows another form of apparatus for making fibrous mats of discontinuous fibers and fibers in continuous textile groupings. A bank or assembly of fiber guns 110 is located between a pair of feeders 101 for ejection of yarns 114 from between a pair of gaseous blowers 103 into an unpartitioned hood 106. The yarn is ejected into the hood in a position intermediate to two streams of discontinuous fibers 104 formed by the disruption of streams 102 by the blowers 103. As the yarns pass down through the hood 106, they increase in their width of distribution to a point where they are substantially thoroughly and uniformly distributed throughout the hood before being deposited on the conveyor. Thus, the mat 115 of which the yarns form a part, correspondingly has a uniform distribution of fibers in textile form. The streams of discontinuous individual fibers 104, on passage through the hood, converge in intermingled relation with the yarns and also become substantially uniformly distributed. The final mat 115, therefore, accordingly comprises in general, a uniform distribution of yarns and discontinuous fibers. A mat of this type, however, has the disadvantage that a large number of loops usually exist at the surfaces of the product. Such loops become easily snagged and separated or loosened from the main body of the mat, particularly because of a lack of fill-in as well as lack of coverage by the discontinuous fibers, thereby resulting in a corresponding absence of a smooth finish in the surfaces.

While I have shown certain particular forms of my invention, it will be understood that I do not wish to be limited thereto since many modifications may be made within the concepts of the invention and I, therefore, contemplate by the appended claims to cover all such modifications which fall within the true spirit and scope of my invention.

I claim:

1. As an article of manufacture comprising a mass of haphazardly related individual glass fibers, and a reinforcing medium therefor including fibers in yarn form distributed transversely through said mass of individual fibers, said fibers in yarn form having a greatest concentration in a predetermined plane within the thickness of said mass and varying in concentration in predetermined manner at successive point distances away from said plane toward the surfaces of said mass.

2. As an article of manufacture, a mat comprising a mass of haphazardly related individual glass fibers, and a reinforcing medium therefor including fibers in

yarn form distributed transversely through the thickness of said mass of individual fibers, said fibers in yarn form having a greater concentration generally in the center of the thickness dimension of said mat and a gradually diminishing concentration at successive point distances away from the center of said dimension toward the main outer surfaces of said mat.

3. As an article of manufacture a mat comprising a mass of haphazardly related individual glass fibers, and a reinforcing medium therefor including fibers in yarn form distributed transversely in non-oriented relationship through the thickness of said mass of individual fibers, said fibers in yarn form being more concentrated generally in the center of the thickness dimension of said mat and substantially none being provided in the outer surfaces of said mat, the concentration of said fibers in yarn form varying gradually according to a predetermined pattern of change between the center and the major outer surfaces of said mat.

4. The method of producing a fibrous mat product including the steps of forming a mass of haphazardly related individual fibers, subdividing said individual fibers into spaced groups, introducing fibers in yarn form from between said groups of individual fibers into the adjacent groups of fibers and assembling both individual fibers and fibers in yarn form as a unitary product with varying concentration of the yarn form through the thickness of said product according to a predetermined pattern of variation.

5. The method of producing and assembling glass fibers into a fibrous product including the steps of attenuating streams of molten glass into a mass of individual fibers, introducing into said mass fibers in yarn form, randomly dispersing said fibers in yarn form in a manner whereby some portions thereof extend throughout the mass of said individual fibers, and assembling both type of fibers into a single layer having a varying concentration of fibers in yarn form through the thickness thereof corresponding to the distribution of fibers in yarn form through said individual fibers, collecting both said types of fibers in a collection zone, moving said layer from said collection zone, and applying a bonding material to said layer.

6. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten fiberizable material from a supply, means engageable with said streams of molten material for attenuating the streams into fibers, a chamber into which said fibers are directed, means for subdividing the attenuated fibers into spaced groups in said chamber, means for introducing fibers in yarn form randomly into said chamber between said groups, means for collection of said groups of fibers and yarn to form a product, and means for providing the product with a fiber-bonding medium.

7. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, means engageable with said streams for attenuating the streams into fibers, a chamber into which said fibers are directed, partitioning means in said chamber for subdividing the attenuated fibers into spaced groups, means between said groups for introducing fibers in yarn form randomly into said chamber between and within said groups, means including a movable conveyor for collection of said groups of fibers and yarn to form a non-laminated product, and means for providing the product with a fiber-bonding medium.

8. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, gaseous blower means forming gaseous streams engageable with said streams of glass to attenuate them into individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for subdividing the attenuated fibers into groups

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and channelling them therein as groups in spaced relation, said partitioning members being joined at the top to form a fiber-sheltered space within said hood, means within said space for introducing fibers in yarn form randomly into said chamber, means including a movable conveyor for collection of said groups of fibers and yarn to form a non-laminated product, and means for providing the product with a fiber-bonding medium.

9. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, gaseous blower means forming gaseous streams for attenuation of said streams of glass into individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for subdividing the attenuated fibers into groups and channelling them therein as groups in spaced relation, said partitioning members being joined at the top immediately under said blower to form a fiber-sheltered space within said hood, means within said space for introducing fibers in yarn form randomly into said chamber, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

10. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, gaseous blower means forming gaseous streams for attenuation of said streams of glass into individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for subdividing the attenuated fibers into groups and channelling them therein as groups in spaced relation, said partitioning members being joined at the top and extending downwardly at least to midlevel of said chamber, means between said partition members for introducing fibers in yarn form randomly into said chamber, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

11. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, gaseous blower means forming gaseous streams for attenuation of said streams of glass into individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for subdividing the attenuated fibers into groups and channelling them therein as groups in spaced relation, said partitioning members being joined at the top and extending downwardly only to points above midlevel of said chamber, means between said partition members for introducing fibers in yarn form randomly into said chamber, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

12. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, gaseous blower means forming gaseous streams engageable with said streams of glass to attenuate them into individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for subdividing the attenuated fibers into groups and channelling them therein as groups in spaced relation, said partitioning members being joined at the top to form a fiber-sheltered space within said hood, means within said space for introducing fibers in yarn form randomly into said chamber, means for dispersing portions of said yarn transversely through said chamber and portions of said groups of fibers, means including a movable conveyor for collection of said groups of fibers and yarn to form a non-laminated product, and means for providing the product with a fiber-bonding medium.

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13. Apparatus for producing a fibrous mat product comprising in combination, means for forming spaced groups of streams of molten glass from a supply, gaseous blower means associated with each group of glass streams forming gaseous streams engageable with said streams of glass to attenuate them into spaced groups of individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for channelling said groups of fibers in spaced relation part way through said chamber, means for introducing fibers in yarn form randomly into said chamber in the space between said groups of fibers, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

14. Apparatus for producing a fibrous mat product comprising in combination, means for forming spaced groups of streams of molten glass from a supply, gaseous blower means associated with each group of glass streams forming gaseous streams engageable with said streams of glass to attenuate them into spaced groups of individual discontinuous fibers, a chamber into which said fibers are directed, partitioning members for channelling said groups of fibers in spaced relation part way through said chamber, means between said blowers for introducing fibers in yarn form randomly into said chamber in the space between said groups of fibers, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

15. Apparatus for producing a fibrous product comprising in combination, means for forming streams of molten glass from a supply, means for attenuating said streams into fibers, a chamber into which said fibers are directed, means in said chamber for channelling said fibers as groups in spaced relation part way through said chamber, means for introducing fibers in yarn form from between said spaced groups randomly into said chamber, means following said channelling means acting to draw said groups of fibers in non-spaced relation, means including a conveyor movable in the direction of spacing of said groups for collection of said groups of fibers and yarn, and means for providing the product with a fiber-bonding medium.

16. As an article of manufacture, a mat comprising a mass of haphazardly related individual glass fibers, and a reinforcing medium therefor including fibers in yarn form distributed transversely through said mass of individual fibers, the concentration of said individual fibers being a minimum in the center of the thickness dimension of said mat and gradually increasing at successive point distances away from said center to a maximum concentration at the major outer surfaces of the mat.

17. The method of producing a fibrous mat product comprising the steps of forming a mass of haphazardly related individual fibers, directing said fibers to a collection surface, subdividing said fibers into spaced groups before collection, introducing fibers in yarn form between said groups of individual fibers, directing said yarn in random dispersed relation to extend portions thereof into the path of the groups of fibers, collecting the groups of fibers on said collection surface while moving said surface.

References Cited in the file of this patent

UNITED STATES PATENTS

2,528,091	Slayter	Oct. 31, 1950
2,635,301	Schubert et al.	Apr. 21, 1953
2,639,759	Simison	May 26, 1953
2,704,734	Draper et al.	Mar. 22, 1955