

March 22, 1955

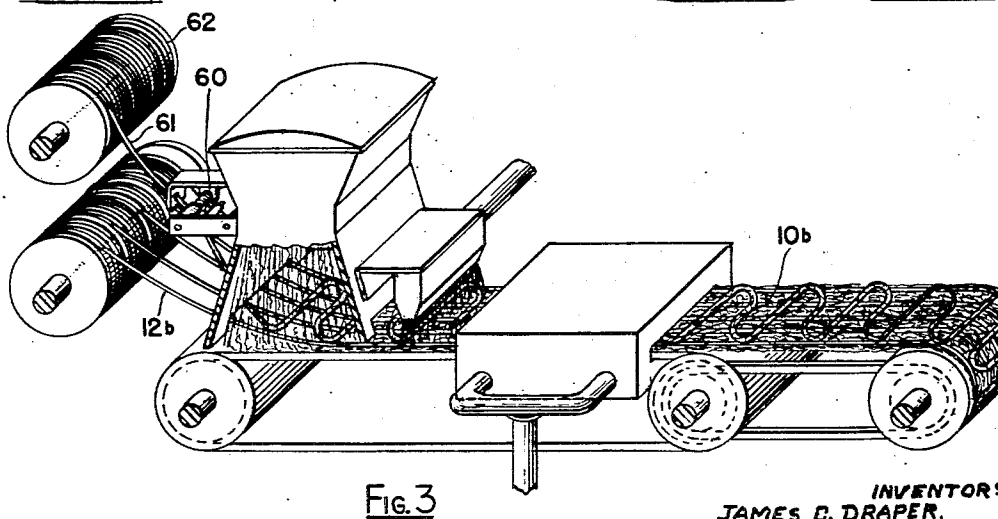
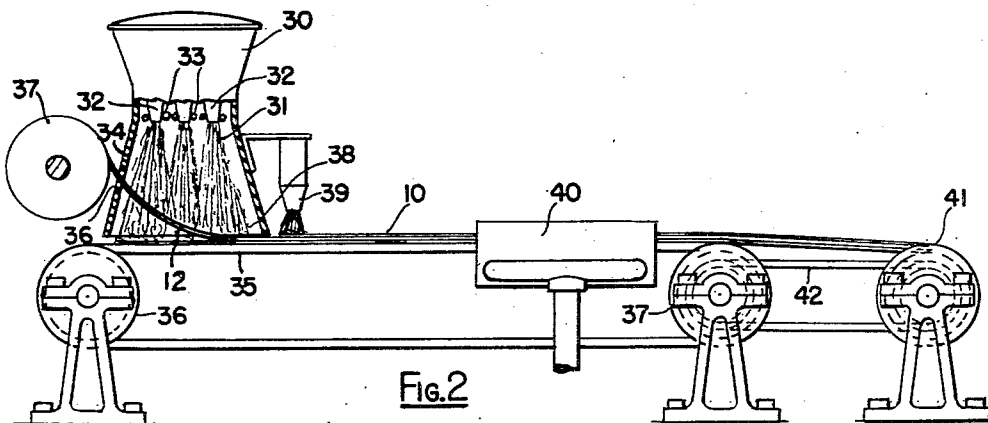
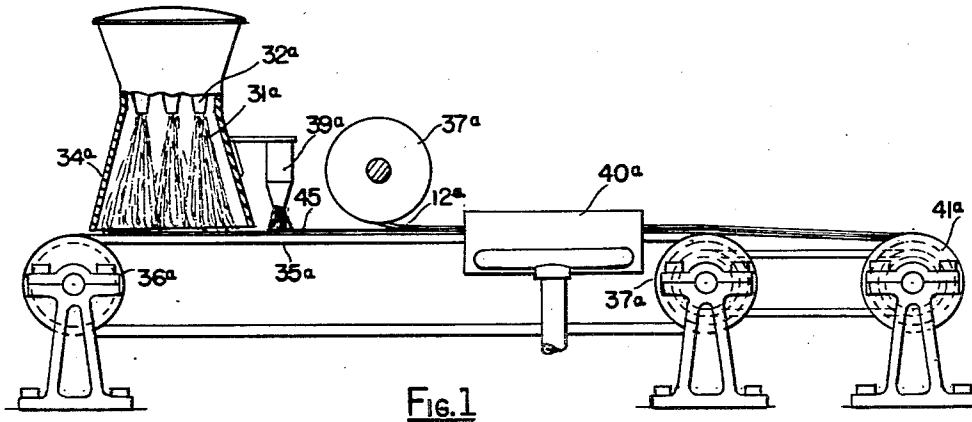
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2,704,734

METHOD FOR PRODUCING NON-WOVEN GLASS FABRIC

Filed Nov. 16, 1949

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

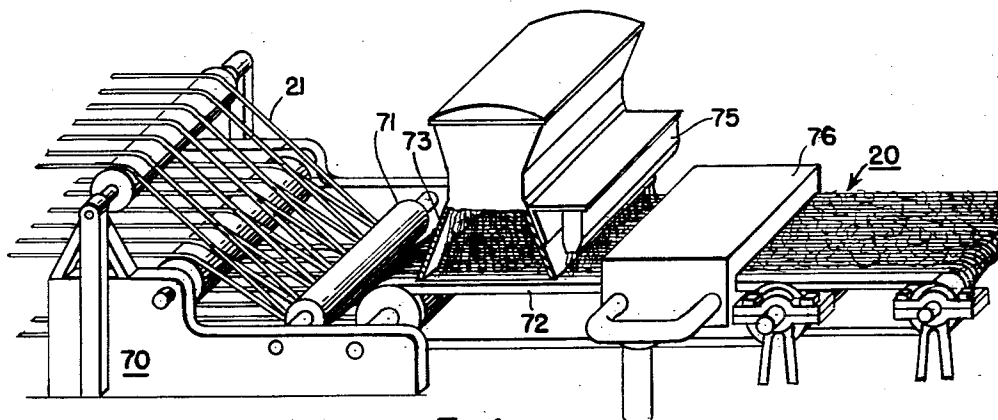


Fig. 4

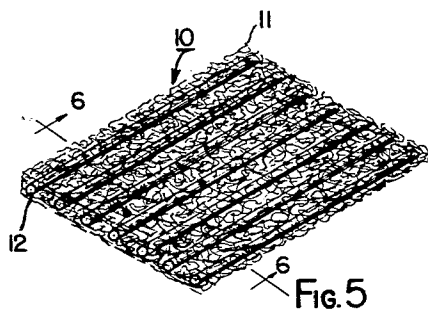


Fig. 5

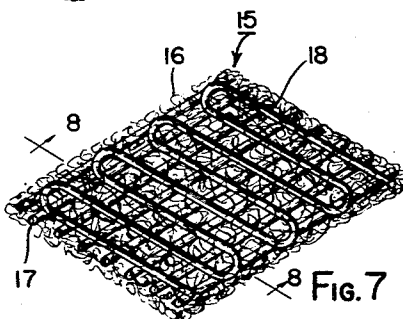


Fig. 7



Fig. 6



Fig. 8

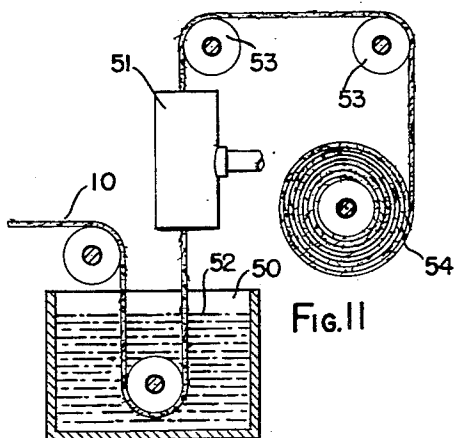


Fig. 11

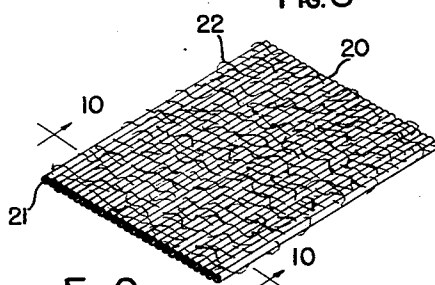


Fig. 9

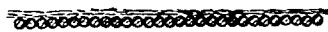


Fig. 10

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METHOD FOR PRODUCING NON-WOVEN GLASS FABRIC

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1 Claim. (Cl. 154—93)

This invention relates to a method and apparatus for producing a reinforced non-woven glass fabric or cloth or mat.

When speaking of non-woven glass fabric or cloth or mats herein it is intended to include such products as mats or bats that are composed of a plurality of glass fibers either staple or continuous length fibers arranged at random relative to each other in such a manner that they are interfelted and loosely matted together. Such a mat may have the individual glass fibers bonded together by a suitable binding agent that is placed upon the surface of the fibers so that the mat can be readily handled without tearing apart. Also, the mats can be composed of a plurality of strands of glass fiber, each of which strands consists of a plurality of individual glass fibers, the strands being suitably dispersed at random relative to one another to obtain an interfelted or matted condition of them, and which strands can be bonded together by a suitable binding agent.

Also, the term non-woven glass fabric or cloth or mats as used herein is intended to include a product that is composed of a plurality of glass strands, each of which consists of a plurality of individual glass fibers that are laid parallel to one another, and against one another to form a relatively solid mat or cloth-like material. This cloth-like material is bonded together by dispersing glass fibers at random over the surface of the mat or non-woven cloth, the fibers being coated with a bonding agent which binds them to the parallel laid strands, and thus bind the strands together into a cloth-like material which can be readily handled.

It is therefore an object of this invention to provide a method and apparatus for producing a non-woven glass fabric or cloth or mat that consists of a plurality of parallel laid strands and random-laid glass fibers.

It is another object of the invention to provide a method and apparatus for producing a product of the kind referred to above wherein the random-laid glass fibers compose the major part of the non-woven glass fabric or cloth or mat.

It is another object of the invention to provide a method and apparatus for producing a product of the kind referred to above wherein the parallel-laid glass strands compose the major part of the non-woven glass fabric or cloth or mat.

It is still another object of the invention to provide a method and apparatus for producing a mat of random-laid glass fibers reinforced by a plurality of glass strands that extend longitudinally and/or transversely of the mat to impart strength to the mat to resist tearing of the same in the direction of the length of the strands as laid in the mat.

It is still another object of the invention to provide a method and apparatus for producing a product of the kind referred to in the foregoing object wherein the reinforcing strands are placed within the body of the mat, or wherein the reinforcing strands are placed on the surface of the mat.

It is still another object of the invention to provide a thin web of random-laid or interfelted glass fibers that are surface-bonded together so that the web can be readily handled, and to provide the web with a plurality of glass strands laid in or on the web in the direction or directions in which it is desired to increase the tensile strength of the web.

It is still another object of the invention to provide a method and apparatus to obtain the products referred

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to in any of the foregoing objects as a continuous process whereby to make a web of non-woven glass fabric or cloth or mat of indeterminate length.

Further objects and advantages will become apparent from the drawings and the following description.

In the drawings:

Figure 1 illustrates a machine for producing a mat or web of random-laid glass fibers having reinforcing glass strands placed on top of the web or mat.

Figure 2 illustrates a machine for producing a mat or web of random-laid glass fibers having reinforcing glass strands positioned within the body of the web or mat.

Figure 3 illustrates a machine for producing a web or mat like that produced on the machine illustrated in Figure 2, but wherein additional glass fibers are laid transversely of the mat or web.

Figure 4 illustrates a machine for producing a non-woven web of glass strands wherein the glass strands are positioned against one another and are bound together by random-laid glass fibers.

Figure 5 is a perspective view illustrating a product made on the machine illustrated in Figure 2.

Figure 6 is a cross-sectional view taken along line 6—6 of Figure 5.

Figure 7 is a perspective view illustrating a product made on the machine illustrated in Figure 3.

Figure 8 is a cross-sectional view taken along line 8—8 of Figure 7.

Figure 9 is a perspective elevational view of a product made on the machine illustrated in Figure 4.

Figure 10 is a cross-sectional view taken along line 10—10 of Figure 9.

Figure 11 illustrates a machine for impregnating a non-woven web of glass fiber with a synthetic resin or other material.

In this invention the term "glass fiber" is intended to mean the individual fibers that are drawn, extruded or blown from the small orifices provided in a forming crucible. The manufacture of small glass fibers is a well-known process, hence it is not believed that any description of the process of forming the individual glass fibers need be incorporated herein.

The term "glass strand" as used herein shall mean that strand of glass fibers that are collected together as they leave the melting crucible whereby a strand of substantially parallel-laid glass fibers is gathered into a thread-like strand. Broadly, the term "strand" may also include twisted strands or threads which are composed of a plurality of strands twisted together, but the term "thread" shall mean only those strands that are composed of a plurality of individual strands twisted together.

In Figures 5 to 10 inclusive there are illustrated several variations of a product composed of a plurality of parallel laid glass strands or threads and random-laid glass fibers, the products illustrated showing the two extremes of the non-woven glass fabric or cloth or web that can be produced according to the use of this invention.

In Figure 5 there is illustrated a non-woven web of random-laid glass fibers forming a thin mat or web wherein glass strands or threads are laid parallel to one another to reinforce the web of random-laid glass fibers and increase its resistance to tearing. This is one extreme of the kind of product that can be produced according to this invention wherein the product is relatively loose and lacy and has relatively low tensile strength except as reinforced by the glass strands or threads.

In Figure 9 there is illustrated the other extreme of the product composed of a combination of parallel laid glass strands or threads and random-laid glass fibers wherein the glass strands or threads compose the major part of the web and the random-laid glass fibers are used for bonding the glass strands or threads together sufficiently to permit handling of the web as a cloth. In the arrangement of the product shown in Figure 9 the glass strands or threads are laid against one another so that a substantially solid material or cloth-like material is obtained, in distinction to the open web-like material illustrated in Figure 5.

In Figure 5 the non-woven web 10 of glass cloth

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consists of the random-laid glass fibers 11 and the parallel-laid glass strands or threads 12. The parallel-laid strands 12 can be placed either in the body of the web 10, as illustrated in Figure 5, or on the upper or lower surface of the web.

In Figure 7 there is illustrated a product consisting of the web 15 which is comprised of the glass fibers 16 and the parallel-laid strands or threads 17. The strands 17 of the web 15 and the strands 12 of the web 10 are laid in the web or on the web longitudinally thereof to increase the longitudinal tensile strength of the web.

To increase the transverse tensile strength of the web, there is shown in Fig. 7 the use of transversely extending strands or threads 18. The strand 18 may be made to traverse the width of the web 15 in any spaced relationship to obtain the desired transverse tensile strength.

In Figure 9 there is illustrated a non-woven glass cloth or web 20 wherein the glass strands or threads 21 are laid immediately against one another, and thereby compose the major part of the web 20. The random-laid glass fibers 22 are used for bonding the strands 21 together to permit handling of the strands as a cloth-like material.

In Figure 2 there is illustrated a method and apparatus for producing a product like that disclosed in Figure 5. In the apparatus shown in Figure 2 there is provided a glass melting chamber 30 in which molten glass is retained, or in which batch material can be introduced for melting. It is understood that suitable heating apparatus may be provided for either melting the glass materials in the melting chamber 30, or to maintain molten glass in its molten condition in the chamber.

In accordance with the well-known practice, glass fibers 31 are drawn from small orifices provided in the forming nozzles 32. These forming nozzles 32 are each provided with a plurality of small openings through which molten glass from the melting chamber 30 exudes. As the molten glass exudes through the small orifices or openings in the forming nozzles 32, a gas blast supplied through the conduits 33 placed on opposite sides of the forming nozzles 32 will draw the molten glass into attenuated glass fibers of very small diameter. Depending upon the temperature of the molten glass, and the force of the air blast, the fibers can be drawn either as continuous small diameter fibers or they can be broken up into short-length fibers or staple. Also the fibers can be drawn mechanically.

Apparatus for attenuating glass materials into fine fibers is well known in the art, and since any of these devices can be used in this invention, it is not considered that a detailed description of the apparatus for producing this attenuation is required.

However, the forming nozzles 32 are placed within a hood 34 so that the glass fibers can be collected upon a moving belt 35 that extends between the rolls 36 and 37. Since the air blasts which attenuate the glass fibers are also retained within the hood 34, the belt 35 is preferably a porous nature to permit the air to pass through the belt, and also distribute the attenuated fibers over the surface of the belt beneath the hood 34 in a uniform manner to obtain a uniform density of the mat or web formed on the belt 35.

To place glass strands or threads 12 within the body of the web 10 formed on the belt 35, the glass strands or threads are introduced into the hood 34 through openings 36 positioned a substantial distance above the belt 35. The strands or threads 12 are taken from one or more spools 37 that may be driven at a correct speed to feed the strands 12 at the rate of movement of the belt 35, or if desired, the threads 12 may be pulled from the spools 37.

In Figure 2 it will be noted that the strands or threads 12 engage the belt 35 near the forward end 38 of the hood 34. Since the strands 12 are spaced some distance apart from one another, as shown in Figure 5, some of the glass fibers 31 will fall onto the belt 35 to the rear of the engagement of the strands 12 with the belt 35 and thereby form a thin mat or web of random-laid or interfelted glass fibers on the belt 35. With this web of material laid upon the belt 35 before the strands 12 approach or engage the belt, it

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will be seen that the strands 12 will be laid upon the web formed to the rear of the strands 12.

Those glass fibers 31 which are laid upon the belt 35 after the strands 12 engage the partially formed web will lie upon the top of the strands 12. Thus, the strands or threads 12 will be imbedded within the interfelted body of the web 10, as shown in Fig. 5.

As the web 10 leaves the hood 34 a suitable bonding or binding agent can be sprayed upon the formed web by means of spray-heads 39. If desired, the binding agent can be sprayed within the hood 34 to coat the glass fibers 31 before they settle onto the belt 35.

The web 10, and the coated glass fibers therein, are conducted through a heating chamber 40 whereby to set the binder and thereby bond the random-laid glass fibers together, and bond the parallel-laid strands or threads 12 within the body of the web 10.

The finished web 10 may be wound upon a reel 41 which may be driven at the same speed as the roll 37 through means of an interconnecting belt 42.

The strands or threads 12 may consist of either parallel-laid fibers previously stranded, or may consist of a plurality of strands twisted together to form a thread or yarn.

In Figure 1 there is illustrated an apparatus like that disclosed in Figure 2 except that the reels that supply the strands or threads are positioned forwardly of the hood in which the glass fibers are collected so as to place the threads or strands upon the surface of the formed web or mat.

In the arrangement of the device in Fig. 1 the glass fibers 31a are drawn or attenuated through the nozzles 32a. The fibers are collected on the belt 35a that extends between the rolls 36a and 37a.

As the web of random-laid fibers 45 discharges from beneath the hood 34a, it is sprayed with a binding agent through the nozzle 39a.

Reels 37a are positioned forwardly of the hood 34a so that the strands or threads 12a can be laid upon the surface of the web of random-laid fibers 45. The web 45 with the threads or strands 12a thereupon is conducted through a heating chamber 40a to bond the random-laid fibers together, and to bond the threads 12a to the surface of the web 45. The finished web may be received upon a reel 41a.

If desired, the spray-head or nozzle 39a can place the spray upon the web 45 after the threads or strands 12a are laid upon the web just as readily as before they are placed on the web.

The product produced on the apparatus disclosed in either Figures 1 or 2 provides a plurality of reinforcing strands or threads of glass that extend longitudinally of the web of random-laid glass fibers, thereby greatly increasing the tensile strength of the web in a longitudinal direction.

This is particularly advantageous when it is desired to impregnate or coat a web of random-laid glass fibers with a liquid material for it gives to the web sufficient longitudinal tensile strength that the web can carry itself through a vertical heating chamber without tearing.

As shown in Figure 11, when it is desired to impregnate or otherwise treat a web of random-laid glass fibers with a liquid material, the web 10 may be carried into a dipping tank 50 whereby to impregnate or otherwise treat the web 10. Upon leaving the dipping tank 50 the web 10 may be conducted through a drying chamber 51 wherein the liquid vehicle 52 in the tank 50 may be dried or the solvent evaporated so as to coat the fibers of the web 10 with a desired material, or to thoroughly impregnate the web 10. From the drying chamber 51 the web 10 can be carried over the rolls 53 and wound upon a receiving roll 54.

In Figure 3 there is illustrated an apparatus for producing a product like that disclosed in Figure 7, hence the elements of the machine that correspond to the elements of the machine shown in Figure 2 on which the product of Figure 5 is produced, are referred to by like numerals except that they are given the suffix "b."

In the apparatus of Figure 3, however, additional apparatus is provided for laying a thread or strand transversely of the web. This apparatus may consist of a traversing mechanism 60 that receives a strand or thread 61 from a reel 62. The traversing mechanism 60 is so constructed and operated that the thread or strand 61 will traverse

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over the strands or threads **12b** in a serpentine fashion, as shown. Thus, the strand or thread **61**, when imbedded in the body of the web **10b**, or when placed on the surface of the web will increase the transverse tensile strength of the web. It is, of course, understood that other arrangements of threads can be provided in or on the web of random-laid glass fibers to provide for any desired directional increase in tensile strength or reinforcement of the web.

In Figure 4 there is illustrated an apparatus for producing the product shown in Figure 9 wherein the glass strands or threads constitute the body of the web and the random-laid glass fibers constitute the binding fibers to hold the body strands or threads together.

In the apparatus of Figure 4 there may be provided a warp frame **70** through which a plurality of warp threads or strands **21** are conducted, the warp strands or threads **21** coming from suitable spools or reels. The warp threads **21** will be collected together at a roll **71** so that they will all lay upon the surface of a belt **72** in immediate side-by-side engagement.

The thus collected warp strands or threads **21** are carried beneath a hood **73** which is like the hood **34** shown in Figure 2. Glass fiber forming apparatus, such as that disclosed in Figure 2, delivers glass fibers into the hood **73**. The glass fibers that are collected within the hood **73** are laid upon the warp strands or threads **21** in a random or inter-felted arrangement, as shown in Figure 9.

The fibers that are collected upon the warp strands **21** may be sprayed with a binding agent while within the hood **73**, or as illustrated in Figure 4, the composite web **20** may be sprayed with a binding agent immediately after the composite web leaves the hood **73**, a spray-head **75** being provided for this purpose.

The composite web is then carried through a heating chamber **76** to set the binding agent whereby to bond the warp strands **21** together by means of the inter-felted fibers **22**, see Figure 9.

The product produced by the method and on the machine illustrated in Figure 4 may be used and handled in much the same manner as a glass cloth having both warp and woof threads. The non-woven fabric or cloth **20** of Figure 9 is particularly useful in manufacture of plastic laminates for the reason that the glass fibers in the strands **21** of which the non-woven cloth is composed are all laid substantially parallel to one another, thus eliminating any unnecessary bending of the individual glass fibers and greatly reducing the tendency of the fibers to break.

In the method of making the products illustrated in Figures 5, 7 and 9 it will be noted that the glass fibers are inter-felted with the strands or threads extending through the inter-felted body of the web, as shown in Figures 5 and 7, or as shown in Fig. 9, the inter-felted mat of glass fibers is bonded to the warp threads **21** to

bond them together so that the material can be handled as a conventional cloth-like material.

The method of making the non-woven glass fabric or cloth or webs is one in which the products can be made in a continuous manner and of indeterminate length, thereby greatly reducing the cost of manufacture of such products.

While the use of a single fiber forming apparatus has been disclosed and described, yet a plurality of such devices can be employed to produce the fibers for placing on the belt **35**. In this circumstance the parallel laid strands can be deposited in the web on the belt **35** between the fiber forming devices.

While the method and apparatus disclosed and described herein illustrate preferred arrangements and processes, yet modifications may be incorporated in the methods and in the apparatus without departing from the spirit of the invention, and it is intended that all such modifications that fall within the scope of the appended claim shall be included herein.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent is:

The method of making a non-woven glass fabric that comprises, forming staple glass fibers, collecting the so formed fibers within a collecting chamber and directing them through the chamber in a single direction, collecting the so directed fibers at the discharge end of the collecting chamber in a mat of random laid interfelted staple fibers, directing a plurality of completely independent glass strands in spaced parallel arrangement through the collecting chamber transversely of the movement of staple fibers therethrough and into engagement with the mat of staple fiber formed at the end of the collecting chamber before the mat so formed leaves the collecting chamber, arranging other spaced glass strands upon the parallel arrangement of glass strands transversely thereof during entry of the parallel arrangement of glass strands into the collecting chamber whereby the combined arrangement of glass strands becomes imbedded in a felted body of the mat of staple fiber formed at the end of the collecting chamber with the staple fibers felting throughout the thickness of the mat and around the strands, and applying an adhesive to the composite web bonding together the glass staple fibers and the glass strands.

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