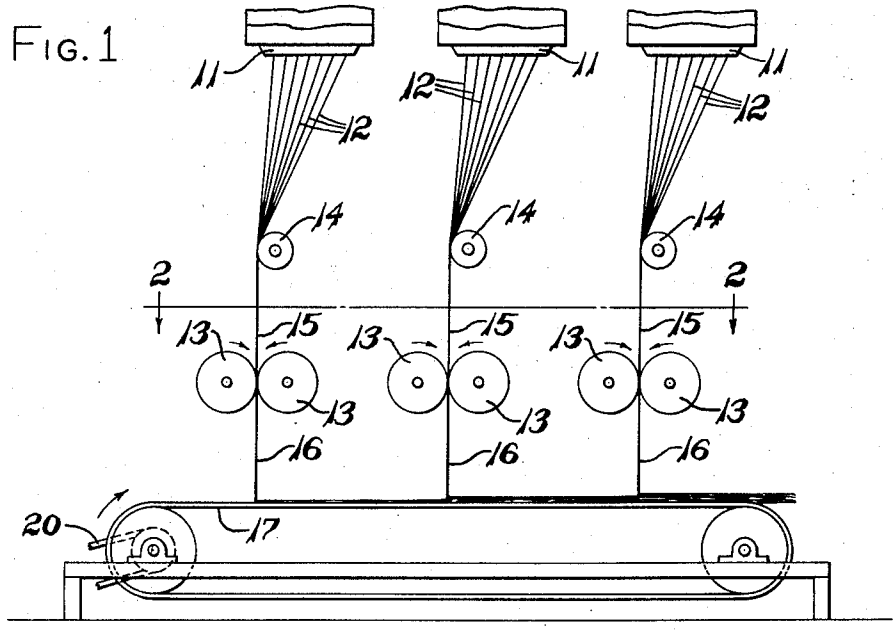
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FIBROUS MAT AND METHOD OF MAKING

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FIG. 1



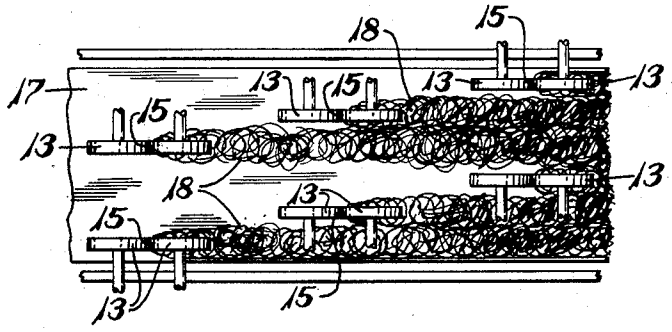


FIG. 2

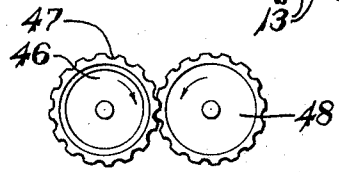
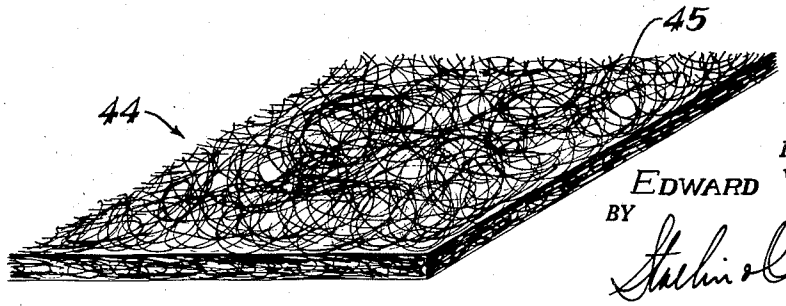


FIG. 7

FIG. 6



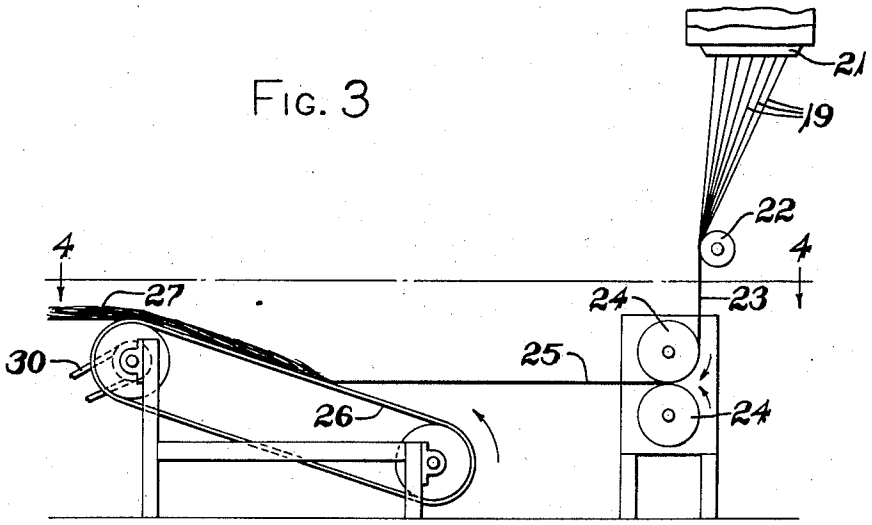
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FIBROUS MAT AND METHOD OF MAKING

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FIG. 3



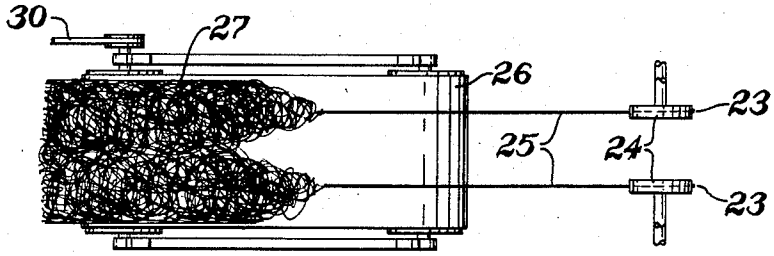


FIG. 4

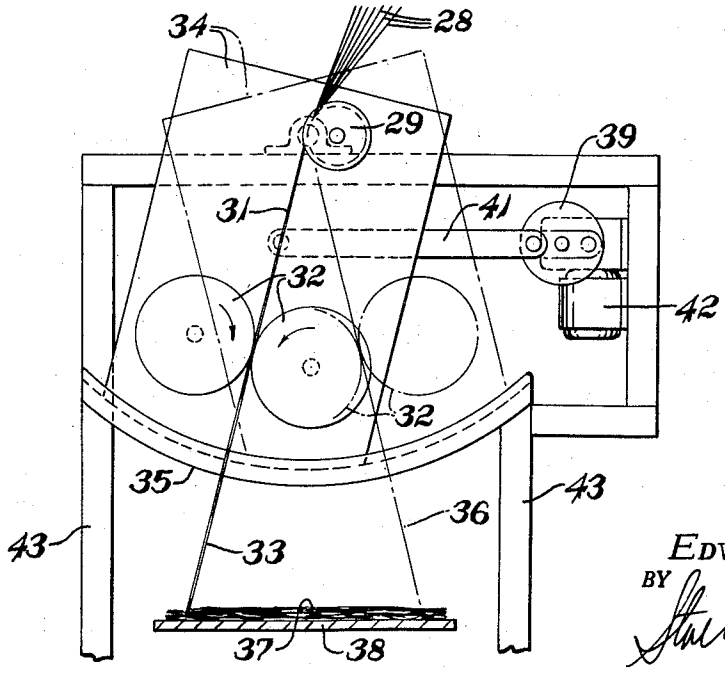


FIG. 5

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2,855,634

FIBROUS MAT AND METHOD OF MAKING

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Application December 22, 1954, Serial No. 477,004

4 Claims. (Cl. 19—155)

This invention relates to mats and particularly to fibrous mat comprising textile fibers laid down in random patterns.

In the past mats have been produced of naturally occurring and man-made fibers. The mats so produced have a binder included in their make-up, which binder maintains the individual fibers in position with respect to one another to provide an integral product.

It is an object of this invention to provide an integral mat of fibers which does not depend upon a binder to provide product integrity.

It is a further object to provide a method and apparatus for producing a mechanically bonded mat.

It has been discovered that an integral mat is produced by directing a driven strand toward a collecting device whereupon the strand forms loops and swirls. As the continuous strand is collected, it interlocks with the material that formed the first loops and swirls to form an integral product.

The invention will be better understood with reference to the drawings, in which:

Figure 1 is an elevational view of one form of the apparatus used in carrying out the invention;

Figure 2 is a view on line 2—2 of Figure 1;

Figure 3 is an elevational view showing a second embodiment of the invention;

Figure 4 is a view on line 4—4 of Figure 3;

Figure 5 is an elevational view of a third embodiment;

Figure 6 is an enlarged view of the integral mat produced according to the invention; and

Figure 7 is a view of scalloped pulling wheels, one wheel having a rubber tread.

In Figure 1 is shown multiple feeders **11**, **11** adapted for forming fibers **12**, **12**. The fibers are formed by directing molten glass through a plurality of orifices to form a plurality of streams of molten glass which are then attenuated by the force imparted to the molten streams by a pair of pulling wheels **13**, **13**. The fibers as they are formed are gathered upon gathering wheel **14** to form a strand **15** which is introduced into the "bite" of the pulling wheels **13**, **13**. The strand passes between the pulling wheels and is driven downwardly at speeds of about 10,000 feet per minute or more. The driven strand **16** proceeds in a generally straight line; however, it may assume a wave pattern if the pulling wheels **13**, **13** have a scalloped tread as is sometimes provided, see Figure 7. Both pulling wheels may be provided with rubber treads; however, it has been found that one pulling wheel **46** having a rubber tread **47** is satisfactorily mated with a scalloped, all metal wheel **48**. Two scalloped all metal wheels having wide rubber bands stretched about their peripheries are used together satisfactorily. The bands remain stretched over the crests of the scallops except at the point at which the wheels mesh. The bands are then pressed downwardly into the troughs of the scallops. It is advantageous to traverse the gathering wheel in order to distribute the wear of the strand on the tread across the width of the tread. The gathering wheel is traversed a short distance by mounting it upon a spring loaded push rod which is actuated by a motor driven cam.

The driven strand **16** from each of the pair of pulling wheels passes downwardly until it impinges upon conveyor belt **17**. The conveyor belt has a flat and smooth surface such as that provided by rubber, tightly woven screen, canvas, paper, or the like. The strand as it impinges upon the flat surface of the conveyor belt **17** lays down in the form of swirls and loops to form a pattern substantially as shown in Figure 2. The strand folds and loops upon itself to form overlapping patterns **18**, **18** upon conveyor belt **17**.

Conveyor belt **17** driven by belt **20** moves forward rather slowly in relation to the speed of the strand so that the driven strand **16** piles upon itself to form inter-locking loops of strand which become an integral mat having unusual properties.

The six pairs of pulling wheels shown in Figure 2 were used to obtain complete coverage of the conveyor belt in order to get a mat of the desired width. Subsequent sets of wheels may be used when greater thicknesses of mat are to be built up. Another expedient which can be used in order to provide a thick mat is to slow up the forward speed of the conveyor belt in order to allow sufficient build-up of strand from each of the pairs of pulling wheels shown in Figure 2. Adjusting the relative speeds of the strand and the conveyor belt regulates the thickness of the mat and production rates.

The apparatus of Figures 1 and 2 provides a product comprising strands of fibrous glass in the form of interlocked loops and swirls. An integral mat is provided without any introduction of binder or other treatments. Although this method and apparatus requires no binder to obtain an integral product, size or binder compositions may be introduced upon the mat after it is formed or while it is being formed, if such treatments are desirable. For instance, after treatments are used on the mat to couple the glass surfaces with the resin when producing reinforced plastic products.

Another embodiment of the invention is shown in Figures 3 and 4 where fibers **19**, **19** issuing from feeder **21** are gathered together upon gathering wheel **22** to form a strand **23** which is then introduced between a pair of pulling wheels **24**, **24**. The driven strand **25** from the pulling wheels is directed toward inclined conveyor **26** and is collected thereupon in the form of loops and swirls of strand which form of pattern as shown in Figure 4. These overlapping patterns form a mat **27** which is an integral mat of interlocked strands comprising loops, swirls and folds of the driven strands. The conveyor belt is driven by belt **30** and power means not shown. The apparatus shown in Figures 3 and 4 tends to form folds and swirls which are not as tight as those formed in the apparatus shown in Figures 1 and 2. Depending upon the end use to which the mat is to be put, a less tightly packed mat may be desirable and such a product is produced upon the apparatus shown in Figures 3 and 4.

Although multiple pulling wheel set ups have been shown in Figures 1, 2, 3 and 4, it should be understood that a driven strand from the pulling wheels may be oscillated across the collecting means in order to give the desired width of mat. An apparatus capable of oscillating the driven strand is shown in Figure 5 where the individual fibers **28**, **28** issuing from a feeder, which is not shown, are gathered upon gathering wheel **29** in the form of a strand **31**. This strand passes between pulling wheels **32**, **32** and emits from the pulling wheels in the form of a driven strand **33**. Pulling wheels **32**, **32** and gathering wheel **29** are mounted upon a plate **34** cradled upon track **35**. Plate **34** is oscillated so that the pulling wheels assume the position shown in dotted lines, the

strand emitting from the pulling wheels when in this position has been given numeral 36. The strand emitting from pulling wheels 32, 32 forms an integral mat 37 upon collecting belt 38. Plate 34 is oscillated by the action of drive wheel 39 and connecting rod 41. Drive wheel 39 is driven through a gear train by motor 42.

A single set of pulling wheels 32, 32 mounted upon frame 43 above collecting belt 38 is used to provide a mat of the desired width. Other sets of wheels which are similar to those shown may be stationed at positions along the length of the collecting belt if it is desirable to increase production rates. The apparatus shown in Figure 5 produces integral mat requiring no binder or size to impart integrity.

A mat 44 comprising haphazardly arranged loops and swirls 45 of continuous strand is produced by the disclosed apparatus and methods of this invention, see Figure 6.

Other pulling devices may be used to form the fiber being collected in the form of a mat. Pulling rolls, pulling wheels, air guns, jets of liquid or combinations of these are used to form the fiber, monofilament or strand and simultaneously direct it onto the conveyor.

Although this invention has been described in relation to fibrous glass forming methods, it should be understood that other strand or monofilaments may be processed into integral mat products using the same techniques, i. e., directing a strand or monofilament onto a generally smooth, flat collecting surface in such a manner that the strand or monofilament loops and folds upon itself to provide an interlocked and integral product. If desirable, the driven strand may be formed by unwinding a package of strand or monofilament which was formed previous to the mat forming operation. This is accomplished by mounting a plurality of packages of strand or monofilament over the conveyor and directing the strand from these packages downwardly by any suitable pulling device including pulling wheels, air guns, jets of liquid, or the like. The strand, yarn, thread, monofilament, or the like may comprise glass, thermosetting or thermoplastic resin, or any of the natural occurring or synthetic fibers.

The products of this invention have sufficient integrity so that the mat can be rolled up in any desired size roll or the product can be directed into a final product such as a reinforced resin product.

The advantages of a mat requiring no binder or size to provide integrity are manifold. First of all, there is a possibility of a great reduction in cost since no binder need be applied. Furthermore, it is often times advantageous to have no binder or size upon the fiber surfaces when the mat is to be used in specific applications. For instance, when applying certain after treatments to fibrous glass, it is necessary to heat clean the fibrous glass product before it is given the after treatment. This may be necessary in order to get the sufficient and required bond between the fibrous glass surface and the after treatment. Obviously no heat treatment or heat cleaning is necessary when no binder or size is applied.

Water may be applied at the gathering wheel in the methods described in order to import integrity to the strand. This water is easily removed by air drying or by elevating the temperature of the mat after it is formed. Application of water or other materials to the strand or to the mat is purely optional however, since integrity is imparted to the mat by the interlocking of the loops, folds, and swirls of the strand as they are laid down one upon the other in the mat forming operation.

Several fibers or strands may be directed at more than one angle at the collecting surface if a product having folds of varying tightness is desired. For instance, one or more strands impinge the conveyor belt at an angle of 90° and one or more impinge at an angle of about 30°.

The swirls, loops, and folds formed by the strand impinging at 90° will tend to be tighter than those formed by the strand impinging at an angle of 30°.

Obvious variations and modifications may be made within the spirit and scope of the appended claims.

I claim:

1. A method of producing a binderless, mechanically bonded mat comprising flowing a plurality of streams of molten glass from a supply thereof, attenuating the streams into filaments of glass, gathering the filaments into a bundle of filaments, advancing said bundle of filaments at a speed which imparts sufficient kinetic energy thereto to provide a driven bundle of filaments, collecting said bundle of filaments being propelled through the air upon a belt in the form of loops, folds and swirls, advancing the collected loops, folds and swirls slowly to allow subsequently formed filaments to interlock with those loops, folds and swirls already collected, and removing the integral mat from said belt.

2. A method of producing mat comprising forming fibers from a molten bath of fiberizable material, gathering said fibers into advancing bundles of fibers which are collected in the form of loops, swirls and folds of bundles of fibers, driving said bundles of fibers along a defined path at a speed which imparts sufficient kinetic energy to said bundles of fibers to drive them into interlocking engagement with the loops, swirls and folds of the bundles of fibers already collected, and oscillating the path of the bundles of fibers to produce an integral mat.

3. Method of producing a mat comprising advancing a plurality of fibers gathered into a compact strand of generally parallel fibers at sufficient velocity with respect to the mass of the strand to drive the strand along a defined path, interrupting the advancing strand to form loops and swirls of strand, and continuing the advancement of strand at sufficient velocity with respect to the mass of the strand to drive the strand forceably into interlocking engagement with loops and swirls of strand already collected to form an integral mat.

4. Method of producing an integral mat of fibrous glass comprising advancing a strand of generally parallel fibers at sufficient velocity with respect to the mass of the strand to cause the strand to follow a defined path, abruptly interrupting the strand so advanced to form loops of strand upon an advancing collecting surface, and continuing the advancement of the strand to drive the strand forceably into interlocking engagement with the strand already collected to form an integral mat requiring no binder.

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