

Sept. 19, 1967

F. STUTZ

3,342,664

APPARATUS FOR PRODUCING NONWOVEN FABRIC

Filed June 15, 1964

2 Sheets-Sheet 1

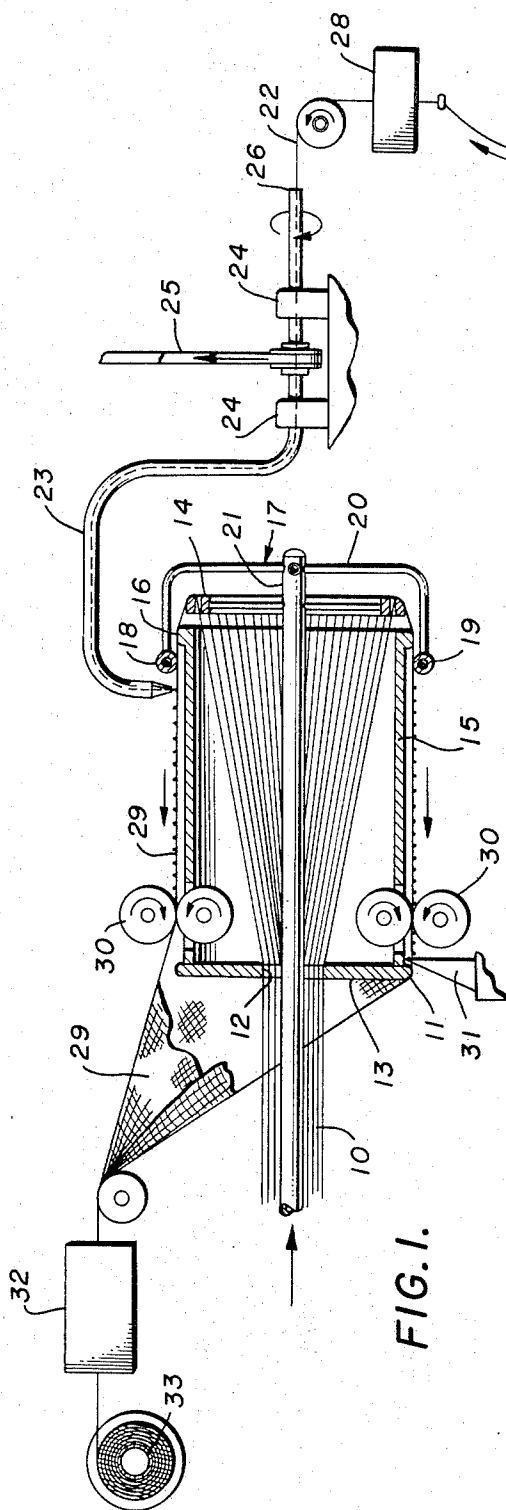


FIG. 1.

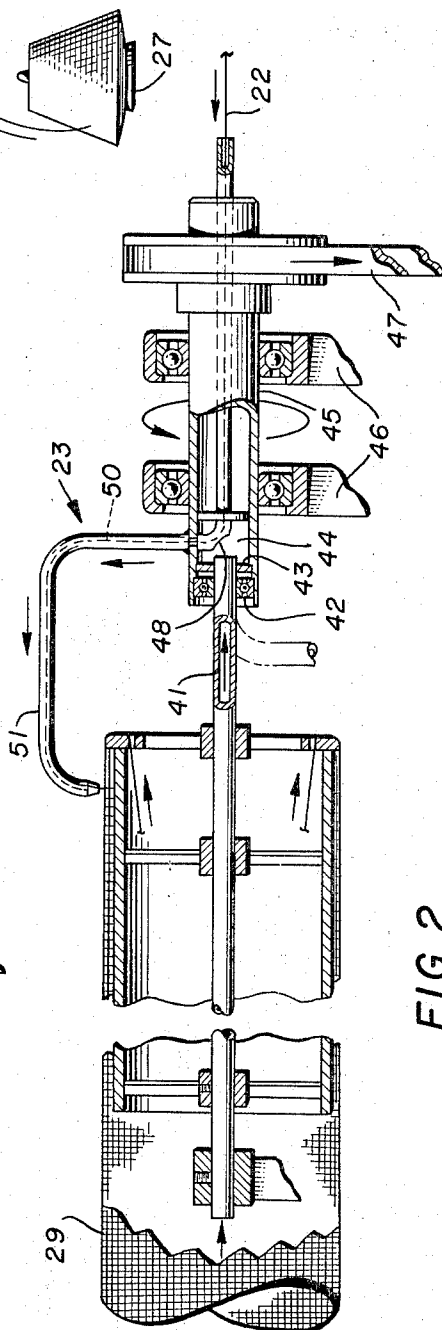


FIG. 2.

INVENTOR.
FRANK STUTZ

BY
Robert L. Brad
ATTORNEY

Sept. 19, 1967

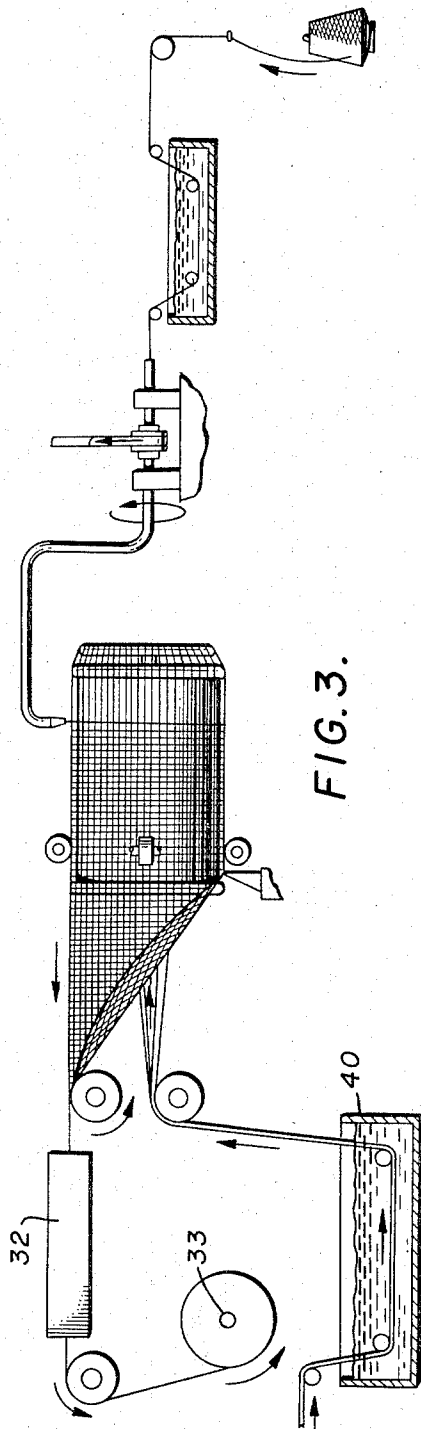
F. STUTZ

3,342,664

APPARATUS FOR PRODUCING NONWOVEN FABRIC

Filed June 15, 1964

2 Sheets-Sheet 2



INVENTOR.
FRANK STUTZ

BY

Robert L. Burd
ATTORNEY

1

3,342,664

APPARATUS FOR PRODUCING NONWOVEN FABRIC

Frank Stutz, Pensacola, Fla., assignor to Monsanto Company, St. Louis, Mo., a corporation of Delaware
Filed June 15, 1964, Ser. No. 374,937
2 Claims. (Cl. 156-441)

ABSTRACT OF THE DISCLOSURE

An apparatus for aligning continuous fibers in grid form to produce a nonwoven fabric comprised of a drum through which, and back over which, warp fibers pass. Weft fibers are positioned circumferentially on the warp fibers as the warp fibers pass back over the drum.

These novel fibers are bonded only at the points of contact and because of this, the fabric exhibits many of the characteristics of a typical woven fabric. Thus the products of this invention combine good tensile strength with porosity, air-permeability, flexibility, softness and the appearance and hand of a woven fabric. This fabric is similar to a woven fabric in as much as it consists of two systems of substantially straight threads which cross each other at approximately right angles. It is also expected that this particular arrangement will considerably reduce creep and permanent set of the fabric when under tensional load and that the production rate will be at least as great as or greater than many modern warp knitting machines.

The prior art discloses many methods and apparatuses for the production of nonwoven fabrics but nowhere does the art teach the particular relationships as herein disclosed. The prior art teaches the use of arranging in a predetermined pattern a layer of irregularly arranged fibers in overlapping engagement but there has not been a disclosure of a method and apparatus for arranging the weft fibers perpendicularly to the warp fibers. Such an invention substantially contributes to the art. Therefore, an object of this invention is to provide an apparatus for the production of nonwoven fabric having the characteristics of woven fabric.

Another object of this invention is to provide a method for continuously producing a nonwoven fabric by arranging a selected number of fibers in a position perpendicular to another group of selected fibers and by bonding the selected fibers together at their points of contact.

A further object of this invention is to provide a fabric which has its weft fibers superposed perpendicularly on its warp fibers, the warp fibers and the weft fibers being joined at their points of contact.

Other objects and advantages of this invention will become apparent when the following detailed description is read in conjunction with the appended drawings, specifications and claims. Preferred embodiments of this invention will now be described with reference to the accompanying drawings, wherein

FIGURE 1 is an elevational, sectional view of the apparatus showing the warp fibers being joined to the weft fibers;

FIGURE 2 is a sectional, elevational view of the apparatus showing another mode of applying the bonding composition to the fibers; and

FIGURE 3 is a view of the apparatus showing the bonding composition being applied to the fibers by running the same through a bath.

One embodiment of this present invention contemplates using a drum having an indented exterior surface as a means for receiving a plurality of parallel fibers (these fibers are called, for convenience, the warp fibers). The

2

warp fibers enter through a restriction in the drum and flare out forming a lopped cone with one extremity of the drum. Mounted on that extremity are separators which serve to uniformly distribute the warp fibers around the periphery of the drum. The fibers are pulled by the separators and then back along the outer surface of the drum and in a direction parallel with the central axis of the drum. The weft fibers are laid on and perpendicular to the warp fibers and become bonded or glued thereto at the points of contact. To lay the weft fibers on the warp fibers, a weft fiber is pulled from a source, through a bath containing a solvent or adhesive and through a hollow tube which is mounted for rotation, the orifice of which traces a circle upon the rotation of the tube. The bath may contain a solvent, bonding agent or glue; it has been found that the solvent gives the best results for, in effect, the fibers are welded together upon evaporation of the solvent. The warp fibers are also run through a solvent bath and by the time the two fibers are drawn into contact, the surfaces become jelly-like and the molecules of each intermix. After the solvent is removed, the fibers at their points of contact have fused giving one integrated fabric. Since the fabric is in tube form, it is cut by any suitable means so that the fabric may be taken from the apparatus and put into the proper form for shipment.

The invention is illustrated in connection with the accompanying drawings in which the figures are illustrative of the preferred embodiment of the invention.

Referring to FIGURE 1, warp fibers 10 are pulled from a source (not shown) and enter a drum 11 through a restriction 12 which is a round opening located in a wall 13 of drum 11. The warp fibers 10 flare out in a cone shape after leaving restriction 12 and are spaced around the periphery of drum 11 by separator 14. Separators 14 may be holes in a plate, needle dividers or the like. The fibers are then pulled back over the annular surface 15 of drum 11 and are raised therefrom by ridge 16, the ridge 16 being an integral part of drum 11 extending outwardly and circumferentially therearound. Upon leaving ridge 16, the warp fibers pass under a solvent applicator 17 which is comprised of a wick 18 covering a perforated annular pipe 19 that is connected to supply tubes 20. Supply tubes 20 connect to a reservoir (not shown) by means of a tube 21. Tube 21 besides feeding supply tubes 20 also acts to receive separator 14. It is contemplated that needle-like fingers (not shown) may be mounted on the inside of drum 11 to space the warp fibers 10; however, this particular embodiment discloses a separator which can be easily removed for cleaning purposes and the like.

The wick 18 which receives a fluid from annular pipe 19 through small perforations therein lightly touches warp fibers 10 and coats the same with any composition adapted to join two fibers. Whereas some adhesives may be effectively used, it has been found that a solvent is more suitable for this invention for the problems of handling glue are eliminated. One excellent solvent for acrylonitrile-based fibers is ethylene carbonate. When ethylene carbonate is applied to a fiber, the outer layer begins to dissolve and upon joining a plurality of such coated fibers, molecular chains which comprise the fibers intertwine and become permanently set by evaporating the ethylene carbonate. The ethylene carbonate in no way adversely affects the characteristics of the fibers for the fibers are essentially welded together at the points of contact. Other solvents may be used, namely, zinc fluoroborate; however, this solvent and most others leave undesirable characteristics, such as, a tacky surface or the like. For nylon, formic acid or any of the Hoffmeister series of compounds are good solvents. Where cotton or wool is used, an adhesive especially one having a latex base may be used to bond the touching fibers together. In general, any adhesive or

solvent may be used which does not interfere with the utility of the resulting fabric.

Weft fibers 22 are laid on warp fibers 10 by a crooked-shaped tube 23 which is rotatably mounted in bearings 24. Crooked tube 23 is turned in bearings 24 by any convenient means such as a pulley belt arrangement 25. One end 26 of crooked tube 23 receives a weft fiber 22 from a source such as a cone 27 having the fibers wound thereon. At some stage in the laying on of the weft fibers 22, they must be emersed, padded or the like with a solvent or adhesive. FIGURE 1 teaches the use of a bath 28 for applying the solvent or adhesive to weft fiber 22. Where a solvent is used to bond touching fibers, it is desirable to have a small lapse of time between the laying on of the weft fiber and the coating of the same for depending upon the concentration of the solvent, the outer layers of the fibers must have become at least partially dissolved in order that its molecules may mix with the molecules of the warp fibers.

After the weft fibers 22 are laid on warp fibers 10 thereby forming a fabric 29, the fabric 29 is pulled back along the drum 15 by positively driven rollers 30. It may be desirable to have a stream of hot air directed on fabric 29 (not shown) for the bonding agent, either adhesive or solvent, must join the fibers with sufficient strength to withstand the advancing force applied to fabric 29 by advancing rollers 30. The rollers 30 by pulling the fabric 29 advance warp fibers 10 through drum 11 and through separators 14. By varying the rotation rate of rollers 30, the number of weft fibers 22 are laid on per inch may be varied where the rotation of crooked tube 23 is held constant. The number of weft fibers 22 laid per inch of warp fibers 10 may also be varied by increasing or decreasing the rotating speed of crooked tube 23 while maintaining the constant rate of the warp fibers 10.

In order to remove the bonded fabric 29 from drum 11, a knife 31 is positioned so as to sever weft fibers 22 along a path parallel to warp fibers 10. The fabric 29 after being cut is pulled through a heater or evaporator 32 by a take up roll 33. The heater 32 drives off the remaining ethylene carbonate which remains on the fibers and at the points of contact. If a resin or some other bonding agent is substituted for ethylene carbonate, the heater may be used to cure that composition rather than evaporate the same.

An alternative method of applying the solvent to warp fibers 10 is by emersing the same in a bath 40 as illustrated in FIGURE 3. By using a bath as described the wick apparatus 18 and supporting parts may be eliminated. The bath 40 more uniformly coats warp fibers 10 with a solvent; however, where an adhesive is used as the bonding agent such a bath be impractical for warp fiber 10 would have a tendency to stick together when passing over the rolls spaced between the bath and the restriction 12.

An alternative method of applying a solvent to the weft fibers 22 is shown in FIGURE 2. A solvent supply pipe 41 which serves as a mount for drum 11 extends through bearings 42 which is journaled thereon, through a sealing barrier 43 and into a cavity 44 which is located in a rotatably mounted receptacle 45. Receptacle 45 is journaled in bearing mounts 46 and is rotated by any conventional means such as a pulley and belt arrangement 47. Crooked tube 23 is rigidly mounted in and extends through the surface of receptacle 45; therefore, when receptacle 45

turns, crooked tube 23 is rotated. Crooked tube 23 has a cut-away portion 48 which allows the solvent to associate therewith. A selected amount of solvent can be applied to the fiber by filling cavity 44 to a level which will also allow the desired amount of solvent to enter the cut-away portion 48 and run down an arm 50 of crooked tube 23 into the crook 51 of crooked tube 23. Upon rotation, crook 51 is filled with solvent and the solvent is held there by centrifuged force.

It is contemplated that a tubular nonwoven fabric may be made on this apparatus by eliminating knife 31 and by drawing the nonwoven tube off of drum 15 and over the warp yarn supply and through the solvent bath. These may be supported by structure extending from and connected to drum 15. The need for tubular, non-sutured fabric is obvious.

Many different embodiments of this invention may be made without departing from the scope and spirit thereof. It is to be understood that this invention is not to be limited to the specific embodiments shown and described herein, except as defined in the appended claims.

I claim:

1. An apparatus for aligning continuous fibers in grid form comprising:

- a. a drum, said drum having a restriction at one end through which enter a number of continuous fibers,
- b. a separator mounted at one end of said drum, said separator receiving and distributing said continuous fibers over the surface of said drum in an alignment parallel with the axis thereof,
- c. a receptacle containing a solvent positioned to bathe said continuous fibers before proceeding through said restriction of said drum,
- d. a crooked tube mounted for rotation and having a portion thereof cut away, said crooked tube providing a passageway for a second continuous fiber which is laid on said continuous fibers perpendicular to all of said continuous fibers at the point of contact thereby forming a fabric,
- e. a solvent supply pipe mounted so as to supply said solvent to said second continuous fiber through said cutaway portion of said crooked tube,
- f. pairs of positively driven rollers mounted on said drum, each pair positioned to engage and advance said fabric, and
- g. an evaporator positioned to receive said fabric and functioning to remove any solvent which remains thereon.

2. An apparatus according to claim 1 wherein the drum has a ridge as an integral part thereof which extends outwardly and circumferentially therearound to raise the fibers therefrom after they leave the separators.

References Cited

UNITED STATES PATENTS

2,985,220	5/1961	Fry	156—181
3,041,230	6/1962	Diehl	156—181 X
3,053,609	9/1962	Miller	156—307
3,275,489	9/1966	Talv	158—181

FOREIGN PATENTS

1,018,058	8/1952	France.
-----------	--------	---------

EARL M. BERGERT, *Primary Examiner.*

J. P. MELOCHE, *Assistant Examiner.*