Feb. 20, 1968 F. KALWAITES 3,369,276

APPARATUS FOR SPREADING CONTINUOUS FILAMENT SHEETS

Filed July 16, 1965 2 Sheets-Sheet 1

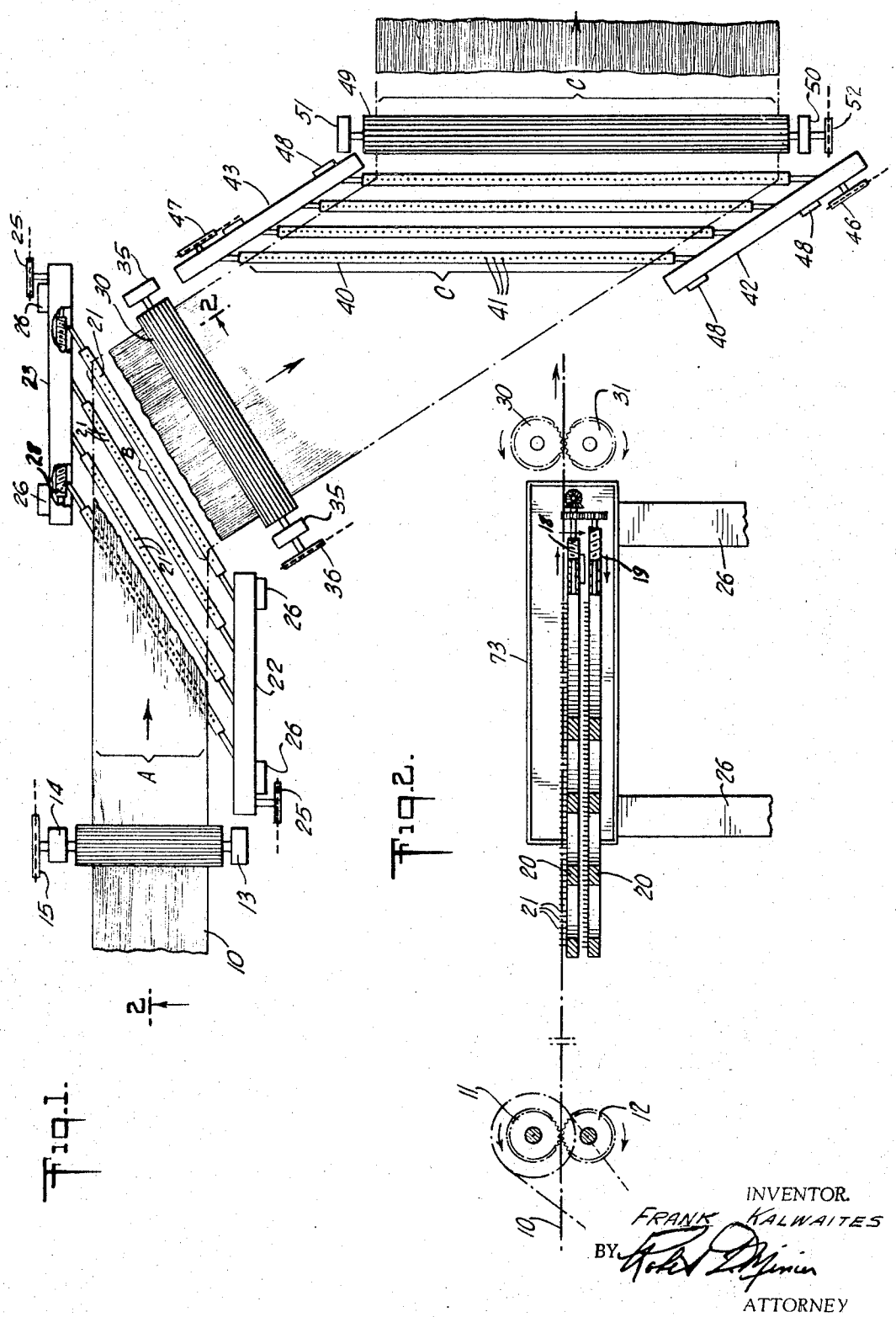


Fig. 1.

Fig. 2.

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Fig. 3.

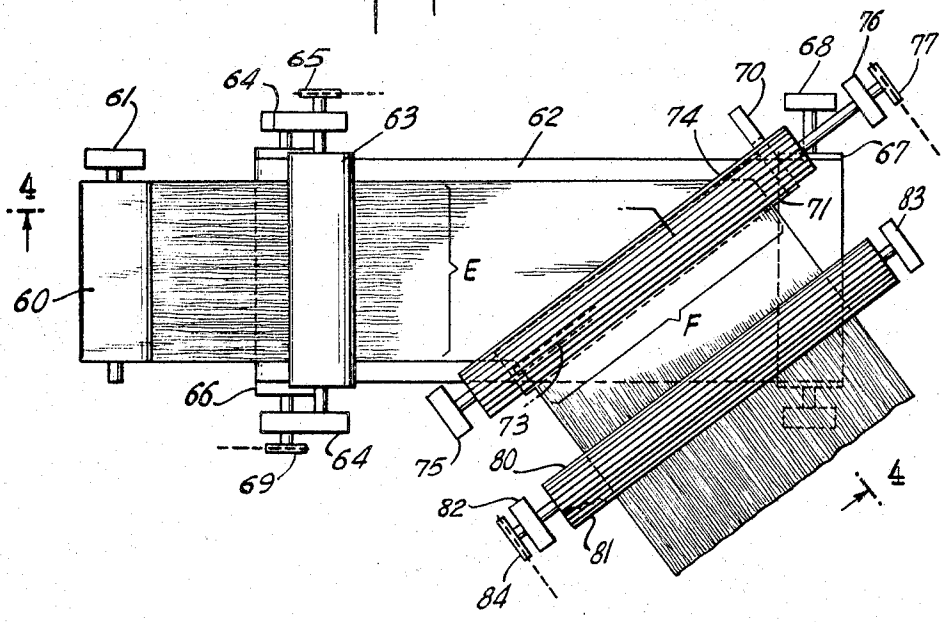
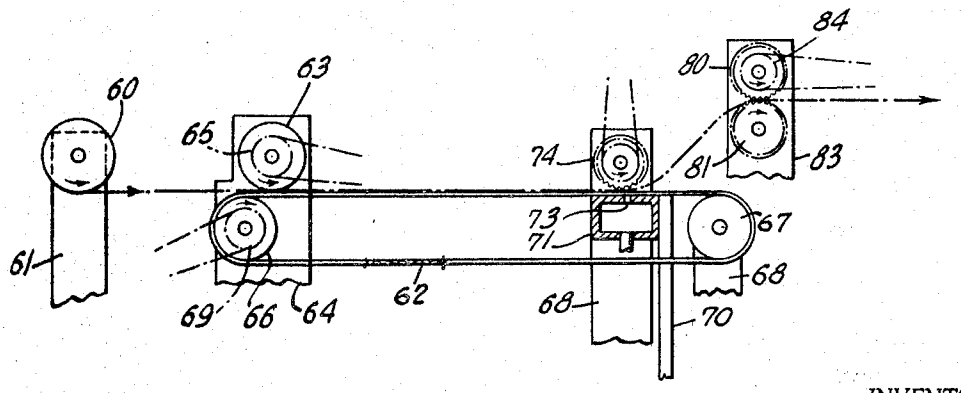


Fig. 4.



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APPARATUS FOR SPREADING CONTINUOUS FILAMENT SHEETS

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ABSTRACT OF THE DISCLOSURE

Apparatus for spreading sheets of continuous filament into wider sheets comprising means for moving the sheet of filaments in a first direction, means for controlling said movement at a diagonal to the width of the sheet and means for moving the sheet of filaments in a second direction perpendicular to the diagonal.

The present invention relates to methods for manufacturing unitary webs and for apparatus for practicing such methods. More particularly this invention relates to methods of manufacturing fibrous webs of continuous synthetic textile filaments and apparatus for carrying out such methods. These textile filaments are known man-made materials, being artificial or synthetic in nature as hereinafter indicated, as distinct from natural fibers, such as cotton, wool, etc. For convenience herein they will hereinafter be referred to as "synthetic filaments" and/or "synthetic textile filaments."

As used herein the term "web" means a thin, flimsy fibrous sheet of indefinite length as distinguished from ribbons or batts which have considerable thickness.

Heretofore fibrous webs have been made from staple length fibers and/or short papermaking fibers, that is, fibers less than about 2 inches in length. Such webs are made by card engines or by papermaking or air-laying machines. These machines produce a thin sheet or web of overlapping, intersecting, randomly arranged fibers which are held together by the frictional entanglement of the fibers, and the sheet is quite weak.

Nonwoven fabrics are produced from these prior art sheets by plying a number of the sheets together and applying adhesive to the laminates to bond the same to a unitary structure.

The present invention contemplates a method for making a nonwoven unitary web from synthetic textile filaments. The filaments in the web may have an irregular sinuosity throughout their length. Very often the filaments may be parallel, and the resulting web is of substantially uniform construction throughout its entire area. The resulting web is most suitable for laminating either with similar webs at angles to each other or with standard nonwoven webs of staple length fibers, and it is most suitable as a reinforcing means for such webs of staple length fibers.

In accordance with the present invention a tow of continuous filaments in the form of a ribbon is conveyed in a first direction. The tow is then conveyed in a second direction at an angle to said first direction while controlling the ribbon across the entire width thereof in a direction perpendicular to the direction of movement in said second direction and immediately prior to said ribbon being conveyed in said second direction whereby the width of the ribbon as it passes in said second direction is equal to the length of the diagonal under which it was controlled.

In accordance with the present invention apparatus for spreading a ribbon of tow comprises means for conveying a ribbon of tow of continuous filaments in a first path, means for controlling the direction of movement of said spread tow across its width at an angle to the direction of movement and means for conveying said ribbon of tow perpendicular to said angle whereby the width of the tow is increased so that its new width is equal to the length of the diagonal at which it is controlled. Innumerable similar steps may be added dependent upon the desired final width.

In carrying the invention into practice any suitable conveying means, such as an endless conveyor, pin conveyor, etc., may be used as a conveying means and the control means may be any of those known in the art, such as pin bars, gill boxes, suction means, nip roll control, or other suitable means for controlling the entire width of the ribbon of tow.

The invention will be more fully described in conjunction with the accompanying drawings wherein:

FIGURE 1 is a plan view of one form of apparatus for carrying the present invention into practice,

FIGURE 2 is a schematic cross-sectional view taken along line 2—2 of FIGURE 1,

FIGURE 3 is a plan view of another form of apparatus for carrying the present invention into practice, and

FIGURE 4 is a schematic cross-sectional view taken along line 4—4 of FIGURE 3.

Referring to the drawings in FIGURES 1 and 2, there is shown a ribbon or narrow sheet **10** of continuous filaments. This sheet may be fed from many suitable mounting means capable of carrying the roll of sheet material. The narrow sheet is fed to a pair of nip rolls **11** and **12** mounted on frame **13** and **14**. The rolls are mounted in bearings in the frame and are mounted for rotation. The top roll is driven by the drive **15** which in turn drives roll **12** or the bottom roll. The pair of nip rolls may have virtually any surface, that is, smooth, texturized, knurled, fluted, sand-blasted, etc. It is preferred that the surface be slightly roughened to provide better control of the narrow sheet.

Upon passing through the nip formed by the pair of rolls, the sheet of continuous filaments is engaged by a gill box, which is a standard piece of equipment utilized in the woolen and worsted industry. The gill box comprises a number of faller bars **20**. The upper surface of each of these faller bars has a row of pins **21**. The faller bars move in the direction shown by the arrow by means of a pair of screws **18** and **19** mounted in each of the enclosures **22** and **23**. These screws are driven by their respective drives **25**. The faller bars and the screws are mounted from the frame **26** so that the upper level of the faller bars is just under the sheet of filaments and hence the pins of this upper level penetrate the narrow sheet of filaments. In operation the faller bars are conveyed along their upper level until they reach the end of the upper flight at which point they drop to the lower level and the faller bars are conveyed back to the start of the upper level. At this point they are raised up to the upper level by cam **28**. The speed of the faller bars as they pass along their upper level may vary over wide ranges. The faller bars may move at a slower rate of speed than the sheet of filaments is moving, at the same rate of speed, or if desired at a high rate of speed. The main difference between this gill box and the standard gill box utilized

in the woolen and worsted industry is that the faller bars are positioned at an angle to the width of the sheet of continuous filaments rather than parallel to the width as is normally the case. It is this angle at which the faller bars are positioned that determines the increase there will be in width of the sheet of filaments. Positioned adjacent the end of the upper level of the faller bars is a second pair of nip rolls **30** and **31**. This pair of nip rolls is parallel to the faller bars. The nip rolls are mounted from frames **35** and are mounted for rotation in bearings mounted in the frames. The upper nip roll is driven by the drive **36**. This pair of nip rolls may also have virtually any type surface such as smooth, slightly roughened, fluted, knurled, etc. It is preferred that the surfaces be slightly roughened to give a more positive grip on the sheet of filaments. After passing through the nip of the second set of nip rolls, the sheet of filaments passes through another gill box similar to the one previously described with the exception that the second gill box of course is wider than the first in order to accommodate the sheet of filaments which now has increased width. The second gill box comprises faller bars **40** on which there are pins **41**. The faller bars are mounted on a pair of screws in each of the enclosures **42** and **43** and move in the direction shown and are driven by the drives **46** and **47**. These enclosures are mounted from suitable framing **48**. Immediately adjacent the gill box parallel to the faller bars is a third set of nip rolls **49**. The third set of nip rolls are mounted for rotation in bearings mounted in the frames **50** and **51** and are driven by the drive **52**.

In operation the narrow sheet of continuous filaments is fed through the first pair of nip rolls. The narrow sheet is then engaged by the faller bars set at the angle to the width A of the narrow sheet. Immediately upon leaving the last faller bars, the sheet is conveyed away in a direction perpendicular to the faller bars by a second pair of nip rolls parallel to said faller bars whereby the width of the sheet is increased so it is equivalent to the diagonal B at which the faller bars are set. The widened sheet is conveyed to a second set of faller bars set at an angle to the width B of the sheet of filaments. Upon leaving the last faller bar, the sheet is again conveyed away in a direction perpendicular to the width B of the sheet now increased equivalent to the diagonal C formed by the faller bars. Virtually any number of gill boxes and pairs of nip rolls may be set up one after the other at suitable angles to the width of the filaments being fed to the gill box to get any desired final width.

Referring to FIGURES 3 and 4 in the drawings there is shown another form of apparatus for carrying the invention into practice. A roll of material **60** to be spread is mounted on a suitable frame **61**. The roll is allowed to freely rotate. The roll is fed onto a permeable conveyor **62** by means of a nip roll **63** rotating in the direction shown. The nip roll way have any suitable surface though a slightly roughened surface is desired to provide a positive feed. The nip roll is mounted from the frame **64** and is mounted in bearings therein for rotation and is driven by the drive **65**. The conveyor is mounted about the two rolls **66** and **67** which are mounted for rotation in the frames **64** and **68**. The conveyor is driven in the direction shown by the drive **69**. Mounted from frame **70** is a suction tube **71** having a suction slot **73** immediately beneath the upper reach of the conveyor. The suction slot is at an angle to the width of the conveyor and hence at an angle to the width of the sheet of filaments. Mounted at this same angle and immediately above the upper reach of the conveyor directly over this suction tube is a roll **74**. The roll is mounted from the frame **75** and **76** and is mounted for rotation therein and driven by the drive **77** in the direction shown by the arrow. The roll may be in a position exactly over and aligned with the suction slot or it may be positioned parallel to the suction slot immediately prior to it. Mounted parallel to the roll **74** and the suction slot **71** and closely adjacent thereto are a pair of nip rolls **80** and **81**. These rolls are mounted in the frames **82** and **83** and are mounted for rotation therein and are driven by the drive **84**.

In operation a sheet of continuous filaments is fed onto the conveyor under the first nip roll. The sheet passes along the conveyor between the nip formed by the suction slot and roll **74**. The sheet of continuous filaments is conveyed away from the suction slot perpendicular thereto by a pair of nip rolls placed parallel thereto to increase the width from its original width E to a width F equivalent to the diagonal formed by the suction slot. A number of the suction slots and nip rolls may be spaced at angles in succession to spread the web and increase its width to that desired.

The web produced by the method and apparatus of the invention may be produced by any of the known filaments including artificial filaments. Suitable examples are viscose rayon; cuprammonium rayon, ethyl cellulose; cellulose acetate; polyamides, i.e., nylon; polyesters, i.e., "Dacron"; acrylics, i.e., "Orlon," "Acrilan" and "Dynel"; polyolefins, i.e., polyethylene, polypropylene; polyvinylidene chloride, i.e., saran; polyvinyl chloride; polyurethanes, etc. These synthetic filaments may be used alone or in combination with one another.

The weights of the webs range from about 25 grains per square yard to 200 grains per square yard and preferably from about 35 grains per square yard to 100 grains per square yard.

The denier of the filaments used to produce the webs is in the range of from about 1 denier or somewhat less to 10 denier. It is preferred that the filaments have a denier in the range of from about 1½ to 6. For example viscose rayon filaments from about 1½ to 3 denier have produced excellent results in the production of fabrics according to the invention.

Although all the various motors, pulleys, belts, gears, or like mechanical means including suitable framing, etc., have not been illustrated completely in the drawings or described in the specification for driving or supporting the various rotating cylinders, rolls, faller bars in their desired or required speeds or with the rotation or movement indicated by their direct arrows, it is to be appreciated that such elements have been omitted to keep the drawings and the description succinct and to avoid the introduction or matters which are well known expedients in the art. The mechanical driving means and the various frames which are used are conventional and merely involve the application of well-known mechanical principles.

The above-detailed description of this invention has been given for clearness of understanding only. No unnecessary limitations should be understood therefrom and modifications will be obvious to those skilled in the art.

What is claimed is:

1. Apparatus for increasing the width of a sheet of continuous filaments comprising: a first pair of nip rolls for conveying said sheet in a first direction, a plurality of rods adjacent said nip rolls, said rods having pins on their upper surface positioned to penetrate said sheet of filaments, means for moving said rods in an endless path in the same direction as said sheet is moving and said rods positioned at an acute angle to the width of said sheet and a second set of nip rolls spaced closely adjacent and parallel to said rods, the nip of the second set of nip rolls being in the same plane as the nip of said first set to convey said sheet of filaments away from said rods in a direction perpendicular thereto whereby the width of said sheet of filaments is increased.

2. Apparatus for increasing the width of a sheet of continuous filaments comprising: an endless permeable conveyor for conveying said sheet in a first direction, a first rotatable roll positioned at the start of said conveyor for feeding the sheet of filaments to said conveyor, suction means beneath the upper flight of said conveyor and

spaced from said first roll, a second rotatable roll positioned above said conveyor and adjacent said suction means and parallel thereto, said suction means and second roll positioned at an acute angle to the width of said sheet and a set of nip rolls spaced closely adjacent and parallel to said suction means and second roll to convey said sheet of filaments away from said suction means and second roll in a direction perpendicular thereto whereby the width of said sheet of filaments is increased.

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