March 14, 1972 M. M. BOLLES 3,649,411

APPARATUS FOR THE PRODUCTION OF A BONDED TEXTILE FABRIC

Filed Feb. 3, 1969 2 Sheets-Sheet 1

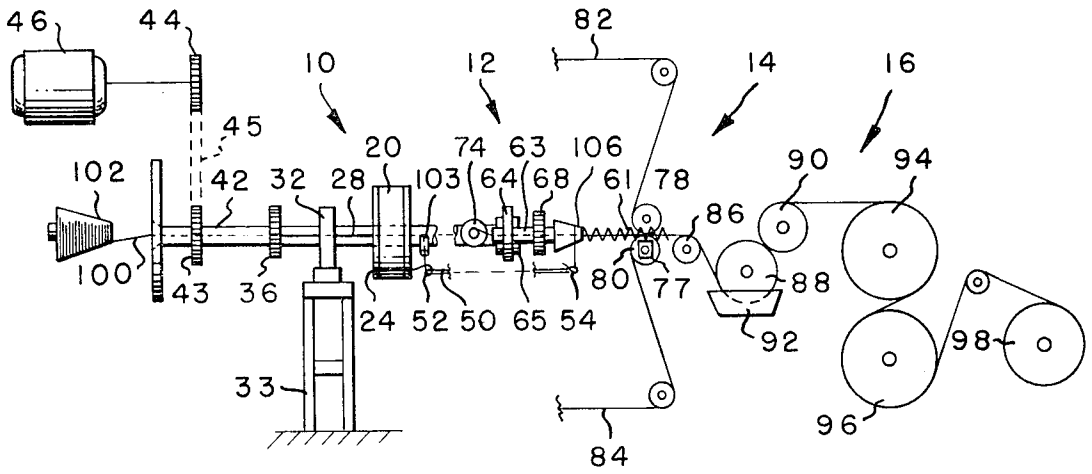

FIG. -1-

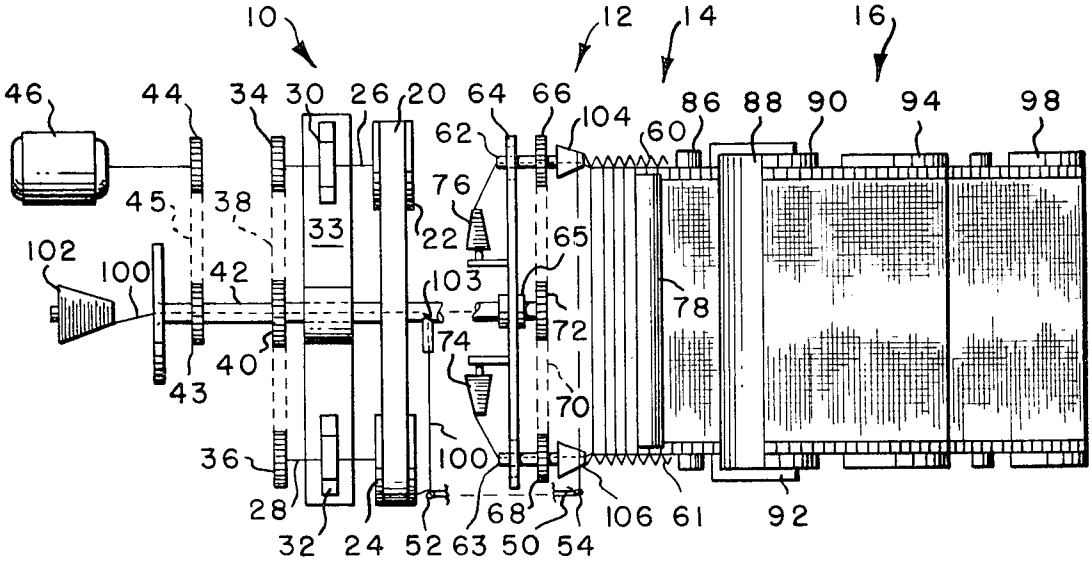

FIG. -2-

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APPARATUS FOR THE PRODUCTION OF A BONDED TEXTILE FABRIC

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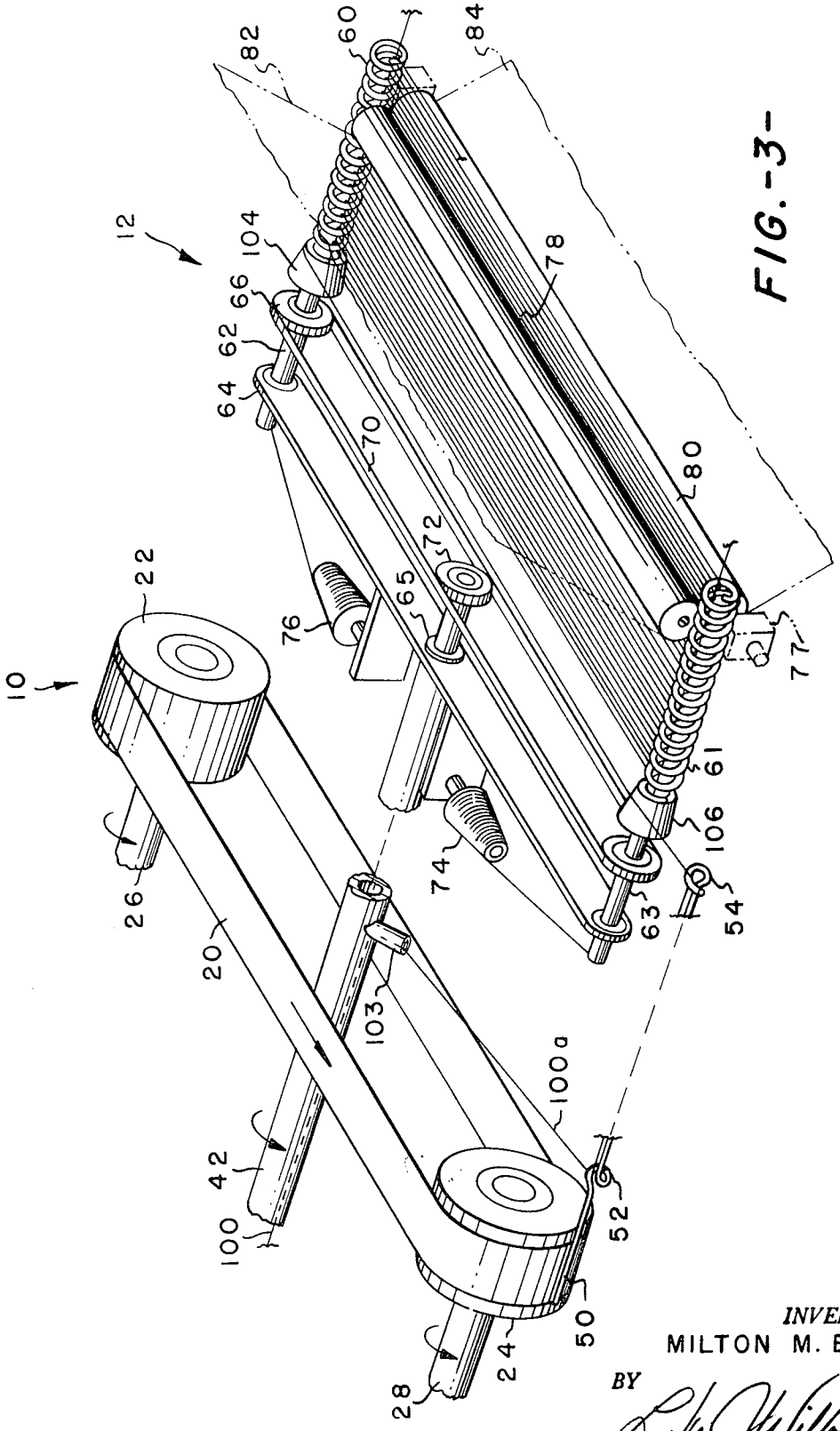

FIG. -3-

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APPARATUS FOR THE PRODUCTION OF A BONDED TEXTILE FABRIC

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U.S. Cl. 156—391 3 Claims

ABSTRACT OF THE DISCLOSURE

A process and apparatus for the production of non-woven net textile fabrics composed of warp and weft sheets of threads adhered in contiguous co-planar relation, wherein the weft sheet is formed by winding a continuous thread about spaced thread support members to form a plurality of generally parallel reaches therebetween, which reaches are laterally advanced to form the weft sheet, and wherein the continuous thread is wound about the support members from guide means moving in a generally elliptical path around the members.

This invention relates to the production of textile fabrics and, more particularly, to an improved process and apparatus for the formation of non-woven net fabrics.

In French Pat. No. 1,208,968 there is disclosed a process and apparatus for the production of textile non-woven net fabrics wherein one or more continuous threads are wound about a pair of spaced thread support members in a plurality of parallel loops or reaches which are moved laterally therealong to form a weft sheet. One or more sheets of warp threads are brought into contiguous co-planar relation with the moving weft sheet and are adhesively secured thereto to form a composite non-woven net fabric. These fabrics are widely used as reinforcement in various laminated products, such as synthetic polymeric sheets and film, paper sheets, and the like, and as a support backing for carpets and multi-part materials, such as ceramic or wooden floor tiles. Such fabrics are also useful as packing materials, and as screening material for windows, doors, and the like.

In the aforementioned French patent, the continuous threads which form the weft sheet are wound on the spaced thread support members by the use of a cylindrical bobbin-support ring which is disposed outside the support members and is continuously rotated to wrap one or more ends of thread from the bobbins thereon about the support members, thereby forming the parallel reaches of the weft sheet. Due to the fact that the bobbins are supportably positioned at appreciable distances from the axis of rotation, the support rings are necessarily of a relatively heavy construction, and the resulting weight and mass of the rings cause undesirable vibration, inertial, and imbalance problems, making it difficult and quite expensive to adequately support and uniformly drive the ring, particularly at the high rotational speeds desired for most economical operation of the apparatus. Additionally, the necessary location of the ring outside the edges of the weft sheet to properly wind the thread about the weft-forming spaced support members requires such large ring sizes that it substantially prohibits the use of such a bobbin-support ring arrangement in the production of relatively wide width net fabrics.

To overcome some of the problems incident to the use of the above described bobbin-support ring in the production of non-woven net fabrics, French Addition Pat. No. 79,765 discloses an improved apparatus for forming the fabrics wherein the bobbin-support ring is replaced by a rotating circular disc on which is peripherally mounted an outwardly extending thread-guide tube. In this apparatus, stationary thread packages positioned near the axis of the rotation of the disc and tube supply a continuous thread to a central opening in the disc. The thread passes radially outwardly along the disc and through the hollow tube to be laid about the spaced thread support members during rotation.

Although positioning the thread packages adjacent or on the axis of rotation of the disc and guide tube reduces, to an extent, the weight and balance problems present in the use of the rotating bobbin-support ring, the disc and tube arrangement also has certain disadvantages in operation. Since the outer end of the guide tube, just as the bobbin-support ring, must pass in a circular path radially outside the spaced thread support members to properly form the weft sheet, there must be sufficient clearance both above and below the path of the sheet to permit free passage of the arm during its rotation. With relatively wide fabrics this greatly increases the vertical space requirements for proper operation of the apparatus and correspondingly increases the overall cost of production. In addition, at high rotational speeds, forces acting on the large diameter, relatively thin disc and guide tube create stresses which tend to structurally weaken the components, thereby limiting the effective life of the apparatus and increasing the chances of injury to operating personnel due to structural failure of the winding means.

It is therefore an object of the present invention to provide an improved process and apparatus for producing non-woven net fabrics which overcome the problems of the prior art.

It is another object of the invention to provide an improved process and apparatus to produce relatively wide width non-woven net fabrics at high speeds.

It is another object to provide an apparatus of the type described which is of durable, economical construction, is highly stable during operation, and can be operated with minimum danger to operating personnel due to structural failure of its components.

It is a further object to provide an apparatus of the type described which may be employed to produce wide width non-woven net fabrics with minimum space requirements for the operational components of the winding mechanism of the apparatus.

The above as well as other objects of this invention are accomplished by providing an apparatus for producing non-woven net fabrics wherein the winding means for laying a continuous thread about the spaced support members to form the weft sheet comprises an endless flexible element having a thread guide thereon, the element and guide being mounted for movement in a generally elliptical path closely adjacent the plane of the weft sheet, such that the width of the net fabric produced may be indefinitely increased without increasing the space required above and below the sheet for operation of the winding means. More particularly, the endless flexible element and guide are mounted for movement on spaced, rotatable drive elements to define a generally racetrack-shaped path of movement, the major axis of which is generally parallel to the plane of the spaced support members and weft sheet formed thereon.

By avoiding the use of the circular bobbin support ring or circular disc and guide arm which have heretofore been employed to wind the thread on the thread support members, inertial and space requirement problems inherent in their operation are eliminated, and the moving belt and guide winding means of the present invention permits effective high speed operation of the apparatus to produce non-woven net fabrics of wide width construction.

Further details of the invention may be best explained and understood by reference to the accompanying drawings, in which:

FIG. 1 is a schematic line drawing of a side elevation of an apparatus for producing non-woven net fabrics including the novel features of the present invention;

FIG. 2 is a schematic plan view of the apparatus of FIG. 1, with portions of the warp thread path shown in FIG. 1 omitted for convenience; and

FIG. 3 is an enlarged and somewhat exaggerated perspective view of the winding and weft sheet forming sections of the apparatus in FIG. 1, showing in greater detail the construction and arrangement of the thread winding means of the apparatus.

Referring more specifically to the drawings, FIG. 1 shows an apparatus for continuously forming non-woven net fabrics which generally comprises a thread winding section **10**, a weft sheet forming section **12**, a warp and weft sheet combining section **14**, and a section, generally indicated at **16**, for securing the sheets in contiguous co-planar relation to form a non-woven net fabric. As presented in the drawings, the relative size of the components of the winding section **10** and the weft sheet forming section **12** have been altered, and the two sections have been exploded away from each other, as will be explained, in order to better show the operative relation of the components in the two sections in initially forming the weft sheet.

As seen in FIGS. 1 and 2, thread winding section **10** includes thread winding means comprising an endless flexible element or belt **20** which is mounted for movement in a generally elliptical and more particularly a racetrack-shaped path by spaced rotatable elements or pulleys **22, 24**. Supporting shafts **26, 28** of the respective pulleys **22, 24** are rotatably mounted in bearings **30, 32**, respectively, secured to a support frame **33**. Sprockets **34, 36** on the ends of the pulley shafts **26, 28** are interconnected by an endless chain **38** to a drive sprocket **40** mounted on a hollow drive shaft **42** which is, in turn, drivingly connected by sprockets **43, 44**, and an endless chain **45** to the drive shaft of a motor **46** which is operated to move the belt **20** in a substantially racetrack-shaped path during operation of the apparatus.

Mounted on the surface of belt **20** for movement therewith is a thread guide **50** which extends outwardly from the belt beyond pulleys **22, 24** and has a pair of spaced, thread guiding eyelets **52, 54** therein. The distance between the eyelets of the guide is shown greatly exaggerated in length in the drawings to retain them in proper relative position with respect to the components of the weft sheet-forming section **12**, which components are shown relatively enlarged and separated a distance from the winding section **12**, as will be explained.

The weft sheet-forming section **12** includes a pair of spaced elongate thread support members, shown as helical springs **60, 61**. A hollow support shaft **62, 63** on the end of each spring is rotatably supported on a cross arm **64** which is centrally mounted by a bearing **65** surrounding the hollow drive shaft **42**. The helical springs **60, 61** are continuously rotated about their longitudinal axes by means of sprockets **66, 68** which are drivingly interconnected by an endless chain **70** to a central drive sprocket **72** on the hollow drive shaft **42**. Continuous threads from packages **74, 76** pass through the hollow support shafts and the center of each spring to form a selvage thread in each edge of the weft sheet, as will be explained, which serve to strengthen the non-woven net fabric product. The cross arm **64** and springs **60, 61** are prevented from rotating about the drive shaft **42** by engagement of the springs with a pair of suitably supported stop members or blocks **77** positioned beneath the springs.

During operation of the apparatus, the weft sheet which is formed in the weft sheet forming section **12** is advanced through a pair of nip construction rolls **78, 80** where it is sandwiched between and thereby combined in contiguous co-planar relation with a pair of warp thread sheets **82, 84** (FIG. 1) which continuously are fed thereto from a suitable supply source, not shown. The combined sheets thereafter pass over a guide roll **86** to the securing section **16** where they are passed by squeeze rolls **88, 90** through an adhesive bath **92**, after which they travel about a pair of heated drying rolls **94, 96** to a collection roll **98**. During the drying of the adhesive on the sheets, the sheets are secured in contiguous co-planar relation to form the composite non-woven net fabric product.

To form the weft sheet, a continuous thread **100** is passed from a suitably supported supply package **102** through the hollow support shaft **42** and a radially disposed outlet **103** in its wall. Thread **100** from outlet **103** passes through guiding eyelets **52** and **54** of the moving thread guide **50** and is wound thereby in a series of loops or reaches about the spaced support springs **60, 61** to form a plurality of thread reaches therebetween. The cooperative relationship of the components of the thread winding and weft sheet forming sections may best be explained by reference to FIG. 3 which is an enlarged, somewhat exaggerated perspective view of the major components of the two sections. As in FIGS. 1 and 2, the components of the weft sheet forming section **12** shown in FIG. 3 have been relatively enlarged and the two sections have been separated from each other along a line parallel to the general direction of movement of the weft sheet (note the dashed or broken lines) to better show the components and describe the operation of the sections. In actual construction, the selvage thread packages **74, 76** and supporting cross arm **64** could be positioned closer to the moving belt **20** and its support pulleys for compactness, with the clearance between the two sections limited only to that necessary to allow free passage of the trailing portion **100***a* of the thread therebetween during movement of the guide **50** about the support springs **60, 61**.

During movement of belt **20** and thread guide **50**, thread guiding eyelet **54** is positioned in overlying or overlapping relation with the end portions of the helical springs **60, 61** to wind the leading portion of the continuous thread thereabout. To facilitate proper placement of the thread in the helices of the support springs **60, 61**, each of the springs may be provided with a cone-shaped guide **104, 106** at its supported end which engages and slidingly directs the thread from eyelet **54** between the helices of the springs. As the springs are continuously rotated, each loop end of the thread reaches is engaged by a helix of the spring and the reaches are laterally advanced along the length of the spring to form the weft sheet. As the reaches approach the ends of the springs, they are engaged by and pass between the construction rolls **78, 80** and thereafter advance off the springs to be supported between the warp thread sheets **82, 84**. The selvage threads passing through the springs **60, 61** are engaged by and disposed within the loop ends of the weft thread reaches to support the weft sheet and reinforce the fabric product.

In like manner, guiding eyelet **52** is spaced inwardly along the guide **50** a sufficient distance to position the trailing portion **100***a* of the thread between the belt **20** and the springs **60, 61** and their support members to ensure its free passage therebetween during the winding operation. As endless belt **20** is moved by support pulleys **22, 24** to pass the thread guide **50** repeatedly about the helical support springs, **60, 61**, the thread outlet **103** in drive shaft **42** rotates therewith to prevent the trailing portion **100***a* of the continuous thread from being wrapped about shaft **42**. To insure that the outlet **103** makes one revolution for every traverse of thread guide **50** about the racetrack path of the belt, the relative speed of the bell **20** and the shaft **42** can be readily synchronized by adjustment of the size of the sprockets **34** and **36** which drive pulleys **22, 24** supporting belt **20**.

Although the guide means for properly positioning the leading portion of the continuous thread on the helical support springs while passing the trailing portion **100***a*

of the thread behind the cross bar **64** and selvage packages **74, 76** are shown as spaced guiding eyelets **52, 54** other means might readily be provided to insure that the thread does not engage and entangle in the support and drive elements of the helical springs. For example, an inverted V-shaped guide plate may be disposed above the selvage packages **74, 76** and ends of the cross arm **64**, with a single guiding eyelet positioned on guide **50** in line with the apex of the V so that the leading and trailing portions of the thread will fall on opposite sides of the arm during movement of the guide above the springs.

Although helical springs **60, 61** have been shown and described as being supported and driven by the central hollow shaft **42**, other means may be substituted therefor to rotate the springs, in which cases other appropriate means could be provided to guide the continuous thread from the package **102** through the inside of the path defined by the belt **20** to the moving thread guide **50** to prevent its engagement with support pulleys **22, 24** during the winding operation.

The threads employed in the present apparatus to form the non-woven net fabrics may be composed of any continuous filament or spun yarns of natural or synthetic fiber composition. If high strength is desired in the fabric product, mineral threads, such as fiber glass, are especially desirable for use in the formation of the fabrics.

As can be appreciated, the endless belt winding means of the present invention may be readily adjusted to permit the construction of non-woven fabrics of various widths, it only being necessary to adjustably reposition the pulleys **22, 24** of the belt at varying distances from each other and employ endless belts of corresponding lengths therebetween. In producing various width fabrics, the length of the cross arm **64** and drive chain **70** of the weft-forming section **12** would also be altered to correspond to the width of the fabric produced.

From the foregoing description of the invention, it can be seen that the nonwoven fabric-forming apparatus containing the endless belt winding mechanism herein disclosed can be employed to produce wide width non-woven fabrics without increasing the vertical space requirements of the apparatus, and can also be employed to produce non-woven fabrics at high operational speeds without the vibration and inertial problems inherent in such apparatus of the prior art.

The foregoing drawings and specification have set forth a preferred embodiment of the invention and, although specific terms have been employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being limited only by the extent of the following claims.

That which is claimed is:

1. In apparatus for forming non-woven net fabrics comprising

(a) a pair of spaced apart generally parallel elongated thread support members,

(b) means for rotating each of said support members about its longitudinal axis,

(c) means for winding a continuous thread about the rotating support members to form a plurality of generally parallel thread reaches extending therebetween,

(d) said thread support members comprising means for moving the reaches generally laterally along the longitudinal axis of said members in spaced relation to form a sheet of weft threads,

(e) means for positioning a selvage thread within and along each edge of the weft sheet,

(f) means for combining one or more sheets of warp threads with the sheet of weft threads in contiguous coplanar relationship, and

(g) means for bonding the contiguous sheets together to form a non-woven net fabric;

the improvement wherein said winding means comprises an endless flexible element having a thread guide mounted thereon, means mounting said element spaced from said thread support members with said guide extending therefrom for movement in a generally elliptical path about the support members, said guide having means located in overlapping relation to said thread support members to position a continuous thread thereon and means located between said support members and said flexible element to guide the trailing portion of the continuous thread therebetween during movement of said thread guide about the support members.

2. Apparatus as defined in claim **1** including means for guiding the continuous thread from a supply thereof through the space bounded by the elliptical path during winding to prevent its engagement with said flexible element and said flexible element mounting means.

3. Apparatus as defined in claim **1** wherein said flexible element mounting means comprise a spaced pair of rotatable elements supportably engaging said flexible element to define end portions of said generally elliptical path.

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28—1 CL; 156—177, 179, 439, 440, 450