METHOD AND APPARATUS FOR MAKING NON-WOVEN TWILL WEBS

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Fig. 1

Fig. 2

Fig. 3

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METHOD AND APPARATUS FOR MAKING NON-WOVEN TWILL WEBS

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This invention relates generally to the manufacture of non-woven web or fabric material, wherein the weave or network includes threads or yarns arranged diagonally of the length of the material. Such twill or biased webs or fabrics possess certain advantageous properties, as known to those skilled in the art, such as a remarkable elasticity and deformability, in both longitudinal and transverse directions, owing to the diagonal arrangement of the yarns by which it is made. Such twill webs are advantageously used, for example, as reinforcement for tires, as reinforcement and support for artificial leather, plastic sheets and other pliable sheet compound material such as upholstery covering, and so on.

According to current procedures, said twill webs are cut from conventionally produced fabrics, wherein weft and warp yarns are arranged lengthwise and transversely of the manufactured woven or non-woven networks.

Such procedures lead to a substantial waste of material and the cut portions are confined within the dimension of a diagonal of the produced network.

It is therefore an object of this invention to provide a new method of producing a twill web wherein the several network forming yarns are evenly diagonally arranged in respect of the length of the article of manufacture.

Another object of the invention is to provide a method of producing a continuous strip material having parallel side edges and including a network of yarns or threads arranged diagonally to and intercrossing in the space defined by said side edges in superimposed relationship, to form a non-woven twill web.

A further object of this invention is to provide a new and advantageous apparatus for continuous manufacture of such non-woven twill web, and capable of continuous mass production thereof, in which reciprocating parts are not included; in which continuously moving spool carrier means are thus permitted a plane based on the height of parallel side yarns or cords; and in which the yarns or threads continuously supplied by a plurality of spools supported by said spool carrier are guided by alternate diagonal directions between and about the parallel side yarns or cords.

More particularly the invention provides a method of forming a non-woven twill web, which comprises feeding at a given speed two straight parallel essentially inextensible and stress resisting side yarns at locations defining the parallel side edges of the network to be produced, continuously revolving or circulating yarns, of which the forming yarn supplies along a path encircling both said yarns, guidelly feeding the web forming yarns, at locations essentially adjacent to the plane defined by said said side yarns and continuously circulating about said plane—whereby each web forming yarn is caused to be wound about both said side yarns and to be arranged essentially as a flat helical coil thereabout—moving the fed forming yarns together with said side straight yarns in said plane, and joining together the resulting superimposed and intercrossing web forming yarns at a number of locations where said latter yarns intercross.

The connection to each other of said web forming yarns at said number of locations, and preferably at all points where said yarns intercross, can be made by applying current knowledge of the art, and therefore such step of the method will not hereinafter be described in detail. For example, suitable binding agents may be used therefor.

In the case that such yarns consist of thermoplastic material, such connection may be performed by combined heating and pressure application, by feeding the produced network between counter-rotating rollers or conveyer or conveyors, for example. Still further, the action of heat and/or pressure may be combined with the use of suitable solvents and/or binding agents, according to the nature of the web forming yarns.

In the case that the considered non-woven web is designed to be made use of as reinforcement of a reinforced sheet material, the sheet material or materials of the compound article of manufacture may be made use of for securing the intercrossing yarns of the web in their relative arrangement. Therefore the said non-woven web may be fed, concurrently with said sheet material or materials, into the nip of counter-rotating rollers or conveyors, according to current knowledge, and bound thereto, by means of binding agents and/or upon combined action of heat and pressure, according to the nature and character of the combined yarn and sheet material.

These and other objects and advantages of this invention will be better understood from the following specification in conjunction with the accompanying drawing, wherein,

FIGURE 1 is a somewhat diagrammatical view from above of an apparatus constructed and operated according to the invention;

FIGURE 2 is a similar side view thereof;

FIGURE 3 is a vertical sectional view taken through line 3 3 of FIG. 1.

Referring now to the drawing, the apparatus includes guide and feeding means for continuously moving two side yarns 10 and 11, in the direction indicated by arrows A, at a given speed. Such yarns extend parallel to each other and define a horizontal plane therebetween and including these side yarns, and are made of tension resisting material, such as a twine or cord of suitable natural or man-made fibers or filaments. Metallic wire might be made use of for forming said side yarns 10 and 11, if desired. Known means (not shown) may be used for suitably keeping under tension said side yarns 10 and 11, which are fed in the working portion of the apparatus through tubular parallel components 12 and 13, respectively.

The means for drawing said side yarns 10 and 11 are not shown or described in detail, as such means are well known to those skilled in the art. For example, the drawing means may be of the type shown and described in Holland U.S. Patent No. 2,696,243 wherein endless bands 38 supported by and continuously revolving about pulleys 24, 34, 40 and 42 are shown and described for defining parallel side edge components which are moved concurrently with an unwoven web formed thereabout.

Such tubular components 12 and 13, in addition, define the shafts of symmetrical sets of pulleys or of gears 14 and 15, respectively, driven at another given speed, and supporting and driving conveyors 16 which are continuously revolved, in direction B for example, at said another given speed, about and essentially parallel to opposite surfaces of the plane defined by said side yarns 10 and 11. Conveyors 16, the number of which might of three, for example, act as carrier means for a plurality of web forming supplies, such as bobbins 17, for example, and of shaped or bent guide tubes 19, each having an inlet located adjacent to a bobbin 17 to receive the yarn supplied therefrom, and an outlet located substantially adjacent the plane defined by said side yarns 10 and 11.

The structural details of the conveyors and their driving means have not been shown, as they are well known to those skilled in the art. For example, a web holding
endless conveyor is shown in British Patent No. 440,191 of 1935. In this British patent, a weft holding conveyor is shown as comprising an endless chain structure, conveyor means comprising upper and lower straight portions interconnected by substantially circular end portions.

Upon rotation of said conveyors 16, therefore, each guide tube outlet will continuously travel along a closed path describable by the plane, and which includes two straight parallel legs above and respectively below the said plane defined by side yarns 10 and 11, and two short radius half-circle portions having their centers in or essentially in said side yarns.

It will be understood, however, that the terms “above” and “below,” as referred to the plane defined by said side yarns 10 and 11, are to be assumed as meaning above and beneath said plane, supposing that such plane would be horizontal, as shown in the accompanying drawing. Such arrangement of said plane, i.e., the arrangement of said side yarns 10 and 11 horizontal and at the same level, is believed convenient but not critical in view of carrying out the invention. Differing arrangements, such as a vertical arrangement of downwardly fed side yarns, is, however, possible and even convenient for facilitating feeding of web forming yarns together with said side yarns at said given speed, for example.

The terms above considered terms “above” and “below” will be taken, as this description proceeds and in the appended claims, in their broadest meaning, and in particular as generally indicating the one and respectively the other surface of said plane, however arranged with respect to the horizontal.

Supposing now that the said straight and parallel side yarns 10 and 11 are continuously lengthwise progressed in direction A at a given speed, and that said conveyors 16 and therefore said spools 17 and guide tubes 19 are continuously circulated in direction B at another given speed, the web forming yarns likewise continuously unwound from and supplied by spools 17 will in turn fed at 18 from the outlets of guide tubes 19 and helically wound about the side yarns 10 and 11, to form flat helical coils including straight portions 20 and 21 above and respectively below said plane as shown in FIG. 1.

The pitch of said coils will be a function of the ratio of the given speed of feeding in direction A, of said yarns 10 and 11 and the speed of the helically arranged web forming yarns wound therewith and carried thereby, namely of the speed at which the outlets of guide tubes 19 in the straight legs of the conveyer paths, above and below the plane. In the case that said given speed of feeding in direction A and of traveling in direction B above and below said plane are equal, both portions 20 and 21 of each formed coil will form an angle of 45° with respect to the said edge forming side yarns 10 and 11 and therefore with respect to the length of the web thus produced. By suitable adjustment of the speed ratio, the inclination of the diagonally arranged web forming yarns may be modified at will.

The means for insuring concurrent driving of endless chain conveyors 15-17, rollers 23 and 24, described hereinafter, and side yarns 10 and 11 have not been shown or described in detail. Such means are known to those skilled in the art of mechanical driving of rotary components, and preferably can consist of conventional gear means by which the shafts of gears 14 and 15, the shafts of rollers 23 and 24, and the pulleys (not shown) about which the side yarns are moved, are mechanically interconnected. The gear means can include conventional gear boxes having replaceable or interchangeable gears, such as commonly used in machine tools, for modifying, at will, the transmission ratio between the various shafts and therefore providing the desired ratios between the speeds A and B.

For example, if a more rigid network is desired, the speed at which the conveyor means moves the bobbin and guide means in direction B may be increased with respect to the speed at which the formed non-woven network is moved in direction A. The portions 20 and 21 of the flat coils formed by each web forming yarns will form a greater angle with respect to the side yarns 10 and 11. A web transversely more rigid will be therefore produced, such web being, however, more resilient as to its longitudinal direction. Such latter result may be obtained, if deemed objectionable, may be overcome by providing additional parallel straight lengthwise arranged reinforcing yarns, such as diagrammatically indicated at 22 in FIG. 1, for example.

Any web forming yarn, as moved outside its respective guide tube 19, will assume its desired coil arrangement about the side yarns 10 and 11, as laid at 18 in the plane or essentially in the plane defined by said side yarns. The near the web formation or working zone at 18, counter-rotating rollers 23 and 24 are located and the web is fed in the nip of rollers 23 and 24, whereby the portions 20 of said web forming yarns, above the said plane, are pressed against the underlying portions 21 to form the desired flat network, wherein the intercrossing diagonal portions 20 and 21 of the web yarns are caused to contact to one another, preparatory to interconnection of the non-woven network components.

Such interconnection may be performed by applying current knowledge, by heat process and/or by using proper binding agents. Said interconnection may be performed upon passage between said rollers 23 and 24, for example, or downstream of said rollers and upon passage of the network between conveyors (not shown), for example, for ensuring proper pressure to the superimposed components until setting of the heat and/or binder processed web material.

In the nip of rollers 23 and 24, suitable sheet material, such as a synthetic film material, may be fed above and/or below the network formed at 18, if desired, and bound to said network components.

The number of the intercrossing portions 20 and 21 in the thus formed non-woven web is obviously a function of the number of spools or other web forming yarn supplies carried by the circulating spool carrier conveyor means, such as embodied by conveyors 16, and the closeness of the network, i.e., the spacing between its components, is a function of the spacing between the outlets of the guide tubes 19. For simplicity and clearness sake, in the figures of the accompanying drawings there is diagrammatically shown an apparatus assembly of which supports relatively few and spaced spools 17 and related guide tubes 19. It will be evident to those skilled in the art that such spool carrier assembly might be suitably constructed for supporting and circulating a much greater number of spools and guide tubes, placed close to each other, within the limits or diameters dimension of individual web forming yarns supplies.

In addition, while in the accompanying drawing there is shown an apparatus having a spool carrier circulating assembly adapted to carry one range of spools 17, it will be evident that such assembly might include two or more ranges of said spools, suitably arranged in the direction in which the formed web is fed, each spool in any range being provided with a related guide tube, and each guide tube being provided with an outlet located to supply the web forming yarn from the related spool in the location indicated at 18 where the non-woven web is formed about the side yarns 10 and 11.

It will be noted that the desired mechanism does not include reciprocating parts or components for supplying and arranging the several yarns in the non-woven network and, therefore, to provide such mechanism with a largely dimensioned and heavy spool and guide means carried assembly will not be prejudicial in view of manufacturing the considered webbed material in a single continuous operation at high production speeds.

From the above, and upon a consideration of the ac-
companying drawing it will be evident to those familiar with the art that the invention provides a new and advantageous method for economically mass producing a twill or biased web or fabric by continuously feeding a plurality of web forming yarns along a closed path transverse to and circumscribing an ideal strip-like plane defined by parallel side edges, materially embodied by parallel stretched side yarns, by causing each web forming yarn to be collared about said plane, namely about said stretched side yarns, in an essentially flat helical arrangement, by causing the portions of said web forming yarns, laid at one side of said plane, to contact intercrossing portions of the web forming yarns, laid at the opposite side of said plane, and by joining together such portions where intercrossing—whereby a non-woven twill including intercrossed yarns arranged diagonally with respect to the side edges thereof is produced—while all said yarns are continuously fed in the plane and in the direction defined by said side edges.

The side portions of the web, wherein the said side yarns are enclosed within the collared web forming yarns, do not obviously possess the resiliency and the ability of meeting substantial deformations, as typically biased fabrics do, may be obviously cut off upon setting of the web in its final configuration, namely as the overlapping web forming yarns thereof are joined to each other where intercrossing.

It is further evident that this invention provides a new, simple and continuously operating apparatus for producing a non-woven web material in the form of a continuous sheet having a given width, and consisting of evenly arranged pluralities of intercrossing web forming yarns, said apparatus comprising means for continuously circulating yarn supplies and guide means in a closed path circumscribing two parallel material edge defining side yarns for winding said web forming yarns about said side yarns, means for continuously progressing all said web forming and side yarns in the direction defined by said side yarns, so that web forming yarns will assume the configuration of coils flattened in the plane defined within said side yarns, and means for causing the overlapping portions of said web forming yarns to contact to each other, preparatory to connection to each other where intercrossing.

It is further believed to be evident that the present invention provides a plurality of advantageous features, and it will be understood that each of the new features described and shown and any combination thereof may also find useful application in other methods and manufacturing procedures, differing from the one described, by applying present knowledge.

Having thus described the invention, what I claim as new and desire to have protected by Letters Patent is:

1. In the method of continuously producing a non-woven web having parallel side edges and a network of web-forming yarn portions diagonally arranged with respect to the side edges and overlapping and intersecting in the plane defined by the side edges, and in which yarns, including a pair of straight side yarns extending parallel to the side edges of the plane defining the side edges, are progressively drawn from supplies thereof longitudinally and in substantially parallel relation to the side edges of the plane, a plurality of web-forming yarn supplies are continuously circulated in a closed path circumscribing the plane defined by the side yarns and transversely of the side yarns, the web-forming yarns are continuously drawn from the supplies thereof and progressively drawn longitudinally with the side yarns, while being laid diagonally of the side yarns on opposite surfaces of the plane extending between the side yarns, and diagonally extending, and web-forming yarns on opposite surfaces of the plane are subjected to bonding pressure at intersections thereof of said web-forming yarns to form the flattened helices; the improvement in which the web-forming yarn supplies are continuously circulated in a closed path including a pair of rectilinear portions parallel to and immediately adjacent opposite surfaces of said plane and including semicircular short radius portions extending about said parallel side edges and interconnecting said rectilinear portions.

2. The improvement as claimed in claim 1, including the steps of moving said longitudinal and web-forming yarns in said plane at a first given speed; circulating said supplies of web-forming yarns around said path at a second given speed; and adjusting the ratio of said first and second given speeds to obtain a selected pitch of said flattened helices and, correspondingly, a selected angle between said web-forming yarns and said longitudinal yarns.

3. An apparatus for continuously producing a non-woven web having parallel side edges and a network of web-forming yarn portions diagonally arranged with respect to the side edges and overlapping and intersecting in the plane defined by the side edges, and of the type including means for drawing longitudinal yarns, including means for drawing and guiding yarns extending parallel to the side edges of the plane, including a pair of straight side yarns defining the side edges, progressively from supplies thereof and longitudinally and in substantially parallel relation to the side edges of the plane, a plurality of web-forming yarn supplies, respective guide means associated with said yarn supplies, means continuously circulating said web-forming yarn supplies and respective guide means in a closed path circumscribing the plane defined by the side yarns and extending transversely of the said yarns, means for continuously drawing web-forming yarns for the supplies thereof through the respective guide means and progressively drawing the web-forming yarns longitudinally with the side yarns to lay the web-forming yarn diagonally of the side yarns on opposite surfaces of the plane extending between the side yarns to form flattened helices embracing the side yarns and the plane extending therebetween, and means applying bonding pressure to the diagonally extending web-forming yarns on opposite surfaces of the plane at intersections thereof to interconnect the same at such intersections to form the flattened helices; the improvement comprising, in combination, said guide means comprising respective tubular guides each extending substantially parallel to said plane and to said side yarns, each tubular guide having a yarn exit end curved toward said plane and terminating closely adjacent a surface of said plane.

4. The improvement as claimed in claim 3, said means for guiding said pair of side yarns defining the opposite longitudinal side edges of the web formation comprising a pair of relatively elongated guide tubes each axially aligned with a respective side edge of said formation plane, each side edge defining longitudinal yarn extending in guided relation through a respective guide tube; said means circulating said supplies of web-forming yarns comprising endless conveyor means extending around rotary conveyor members rotatable about said guide tubes as axes.

5. The improvement as claimed in claim 3, in which said means applying pressure to the intersecting helices comprises a pair of counter rotating rollers extending transversely of said plane, each roller being adjacent a respective opposite surface of the web and said rollers conjointly defining a nip through which said longitudinal and web-forming yarns extend.

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