CONTINUOUS WEB REINFORCING MACHINE

John M. LeBolt, Highland Park, and Richard 0. Rupp, Chicago, Ill., assignors to The Cromwell Paper Company, Chicago, Ill., a corporation of Illinois


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7 Claims

ABSTRACT OF THE DISCLOSURE

A machine for forming a fabric of continuous criss-crossed reinforcing filaments between a pair of continuous webs of sheet material being laminated between a pair of pressure rolls, said machine comprising an endless filament distributing chain encompassing longitudinally extending marginal selvage strands in a plane normal to said strands and having the filaments in engagement with the selvage strands at a fixed point located a predetermined distance forwardly of said delivery chain plane, the machine being movable longitudinally to adjust the distance between said fixed point and the nip of the pressure rolls for varying the width of said fabric between the selvage strands.

Machines of this kind are well known in the art, as exemplified by U.S. Patents 1,951,301, 2,575,666, and 2,614,054, and in such machines the reinforcing strands are fed from a rotary creel, carrying a spool of the strand material for each strand of the reinforcing fabric, to an endless distributing chain or strand layer, traveling an orbital path parallel with the bite of the laminating rolls, and thence into the said bite between the webs to be reinforced along paths that extend obliquely of the webs as they are being laminated.

A problem in the operation of such machines, however, has been that of adequate control of the reinforcing filaments or strands at the edges of the webs where reversal of the strand paths occur, particularly when the strands are turned over a selvage string fed under tension between the laminating rolls adjacent the edges of the continuous webs of sheet material, not only with respect to eliminating slack in the reinforcing strands at the turn but also with respect to the tendency of the oblique strands to pull the selvage strands toward each other and thus cause a “necking” inwardly of the reinforcing fabric.

Therefore, it is an object of this invention to provide improved means for guiding the obliquely extending reinforcing strands onto the selvage strand; to provide such a means whereby the obliquely extending strands are engaged with the selvage strings substantially at the bite of the laminating rolls; and to provide such a means whereby the extent of “necking in” of the selvage strands can be precisely controlled.

Another problem with machines of this type is that of the extensive periods of shut-down time required whenever the width of sheet material web is changed. In such cases it is necessary to remove the filament distribution conveyor or chain and replace it with another designed particularly for the new web width, and to then re-thread the reinforcing material filaments or strands into the guide eyelets of the conveyor and thence into the laminating rolls.

Therefore, further objects of this invention are to provide a filament distributing means, or strand layer system, which can quickly be adjusted to accommodate different widths of sheet material webs which are to be reinforced by a fabric extending substantially from edge to edge of the web; to provide such a system having a removable filament-reversal guide means which can be changed quickly and easily to adjust the width of the reinforcing fabric produced by the conveyor; and to provide an improved means for weaving a fabric of reinforcing filaments whereby the fabric width can be precisely controlled and adjusted to accommodate various widths of laminating webs without changing the strand conveyor or weaving head.

A specific embodiment of this invention is shown in the accompanying drawings in which:

FIGURE 1 is an elevational view showing a reinforcing fabric weaving machine embodying our invention;

FIG. 2 is an elevational view, partly broken away, showing a reinforcing filament weaving head and direction reversal guide means according to the invention;

FIG. 3 is a plan view of the same, as seen from the plane of line 3—3 of FIG. 2, showing its operative relation with the laminating webs at the nip of the laminating rolls;

FIG. 4 is a similar view, with parts broken away showing the operative relation of the weaving head and the nip of the laminating rolls when a web of smaller width is being reinforced;

FIG. 5 is a sectional view of the weaving head or strand layer, as on line 5—5 of FIG. 2, showing the means for supporting and guiding the reinforcing filaments into engagement with the selvage strands, upon reversal of filament feed direction, at an adjustable predetermined distance in advance of the nip of the laminating rolls.

As shown in the drawings, a continuous-web paper-reinforcing machine with which out invention may be carried out comprises a rotary creel 10 having a plurality of storage discs 12 each of which carries a plurality of angularly spaced spools 14 of the filament or reinforcing strand material, for example spun glass, a distributing wheel 16, a strand layer or weaving head 18, and a movable carriage 20 having wheels 22 riding on suitable rails 24. The storage discs 12 and distributing wheel 16 of the creel 10 are mounted on a rotatable quill shaft 26 mounted in support columns 28 and turning on a stationary shaft, not shown, which is fixed at its rear end in a support column 30. The filaments are led from the spools 14 to the periphery of the distribution wheel 16 by means of individual flexible tubes 32 and from the wheel 16 the filaments run directly to the eyelets of the weaving head 18, to be later described, as indicated at 33 in FIG. 1. An extension 34, on the said fixed shaft, projects forwardly through a gear box 35 and provides the entire support for the weaving head 18. The gear box 35 is fixed to the extension 34 and mounts
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spools 36 which provide the selvage strands 37 for the reinforcing fabric for the paper webs. The reinforcing strands 38 and 39, to be laminated and reinforced, are supplied from suitably mounted rolls thereof. Only one being shown as at 40 in FIG. 1, and these webs are brought together at the nip of laminating pressure rollers 41 and 42, which are mounted for rotation on axes disposed so that the nip of the rolls will be substantially in a plane which includes the axes of the creel shaft 26 and the conveyor chain sprockets of the weaving head 18. As shown in FIG. 1, the web 39 is provided with a coating of adhesive material by means of a roller 43, rotating in a trough 44, prior to its entry into the nip of the pressure rollers 41-42 and the reinforcing strands 33 are led into the adhesive coated surface of the web 39 at the nip of the pressure rolls where the said strands are embedded between the laminated webs 38-39. The reinforcing strands are thus pulled from the creel 10 by the pressure rolls 41-42 and are under considerable tension over their entire run from the respective spool to the pressure line at the nip of the laminating rolls.

The reinforcing strands are carried, back and forth, transversely of the webs 38-39 by the strand layer or weaving head 18, as the strands are being drawn between the pressure rolls 41-42, so as to reinforce the reinforcing fabric. As shown in FIG. 2, the weaving head 18 comprises an endless chain 45, trained around sprockets 46 and 47 a respective ends of a horizontal support bar 48, and a plurality of uniformly spaced eyelet fingers 49 mounted on the outer side of the chain 45 so as to project radially outward therefrom. An eyelet finger 49 is provided for each strand 33 of reinforcing material, and each finger has an eyelet grommet 50 adjacent its outer end through which the strand extends (see FIGS. 2 and 10).

As indicated in FIGS. 1 and 2 the reinforcing strands 33 are drawn from the spools 12 on the creel 10 through suitable outlets, not shown, of the feed tubes 32, at the periphery of the distributing wheel 16, and thence through respective eyelets 50, in the fingers 49 on the endless chain 45 of the weaving head 18, into the nip of the pressure rolls 41-42. As the strands are pulled by the pressure rolls, the creel and distributing wheel are rotated at a predetermined speed and the chain 45 of the distributing head is driven so as to orbit the eyelets 50 about the sprockets 46-47 at the same angular speed as the web or strand. The strand is pulled directly across the path of the webs being laminated, first in one direction and then oppositely, and since the strands are uniformly spaced along the entire length of the conveying chain 45, half of the number will be running in the other direction. Thus, in the well known manner, the several strands will be "woven" to form the reinforcing fabric between the laminated webs.

As herein shown, the selvage strands 37 supplied from the spools 36 are led to the laminating rolls 41-42 through the centers of the weaving head sprockets 46-47 which, generally, are spaced apart a distance substantially equal to the width of the widest web to be reinforced by the weaving head. Thus the selvage strands enter the nip of the rolls 41-42, parallel with the path of travel of the webs 38-39 through the rolls and under a constant tension and pull.

The manner of selvage strand feed is a distinctive feature of our improved continuous web reinforcing machine and the arrangement for doing so is shown in FIGS. 1 to 6 wherein a feed tube 55 is indicated to extend axially through each of the sprockets 46-47. Thus, the filaments comprising each selvage strand are gathered at the entering end of the respective feed tube 55 and are pulled axially therethrough directly into the nip of the pressure or laminating rolls and between the web 38-39 to extend along the margins thereof, preferably as close to the edge of the webs as practicable.

Details of an arrangement for driving one of the weaving head sprockets, in this case the sprocket 47. As shown, the quill shaft 57 has a rearward extension 59 on which a bevelled pinion 60 is mounted to mesh with a pinion 61 fast on a drive shaft 62. The drive shaft 62 is carried on a bearing 63 (see FIG. 11) extending forwardly from one side of the gear box 35 where the power shaft 63 is directly actuated by the creel shaft 26 through suitable gearing not shown. In this manner the weaving head conveyor chain 45 is driven in timed relation with the rotation of the creel 10 and the distributing wheel 16. In the form shown, the weaving head is driven at one end only and the gearing and drive shaft are enclosed in a suitable housing 64 for safety purposes.

In the operation of machines of this kind wherein the digitally running strands or filaments of the reinforcing material is "weaved" the reinforcing fabric, the conveyor chain passes around the end sprockets, they are brought to bear upon a respective one of the selvage strands and because of the tension on the said diagonal strands they tend to pull the selvage strands inwardly toward the middle of the pressure rolls. The extent of this inward pull, or "necking," of the selvage strands varies directly with the distance between the nip of the pressure rolls 41-42 and the nearest point of positive support for the selvage strands. Also, the amount of "necking" of the selvage strands is directly affected by the number of diagonal strands pulling inwardly on the selvage strands in advance of the nip of the rolls. While this "necking" action of the selvage strands has heretofore been a disadvantage, requiring elaborate means for delivering the transversely running filaments, independently of the selvage strands, to a point as close as possible to the nip of the pressure rolls, we have found a way to take advantage of this characteristic to not only simplify the mechanisms involved, but also to make a single weaving head do the work of several, insofar as handling various webs of the webs to be reinforced is concerned. This we do by use and adjustment of the "necking" characteristic of the selvage strands.

Since, by means of the delivery tube 55, the selvage strands can be supported to within less than one inch from the nip of the pressure rolls, the first step for "necking" control is to support the diagonal strands, coming from the weaving head or strand layer, independently of the selvage strands and until they reach an unsupported length of the selvage strands at a predetermined distance from the pressure rolls nip, in such a manner as to maintain a substantially constant tension on each of the selvage strands during the entire reversal of run direction and avoid the formation of wide loops at the margins of the webs being reinforced.

Means for accomplishing this result comprises a weaving strand guide device 65 mounted on the weaving head at each end thereof and having a forwardly projecting element 66 extending diagonally in the plane of the selvage strands and the nip of the pressure rolls from adjacent the pitch circle of the strand layer eyelets 50, at the ends of the weaving head 18, to at least the end of the selvage strand delivery tube 55.

As shown in FIGS. 1 to 6, the weaving strand guide device 65 is mounted on a bracket member 67 bolted to the front face of the support bar 48 and adapted to straddle the delivery tube 55, and the nut 56' which holds the sprocket 46 on the sprocket shaft 57. The arm element 66 is arranged so that its rearward end is disposed as close as practicable to the pitch circle of the eyelets 50, at the
plane of travel of the fingers 49, and so that its forward end extends at an angle so as to intersect the axis of the respective sprocket at a distance, forwardly of the sprocket, about equal to the diameter of the said pitch circle. Thus as the distributing chain fingers carry the web reinforcing filaments 33, one after the other, around the chain sprockets, to reverse the filament run, the filaments are successively engaged with and supported by the angled arm of the guide device and pulled forwardly therealong by the laminating rolls until they drop off onto the selvage strand and are carried thereby into the nip of the laminating rolls. Meanwhile, and during the entire 180° turn of direction over the distributing chain sprocket, the tension on the filaments has been maintained constantly.

When the reinforcing filaments engage the selvage strands, the tension of the filaments immediately exerts an inward pull on the selvage strands tending to pull them toward the center of the laminating webs. Thus, by varying the unsupported length of the selvage strands, rearwardly of the nip of the laminating rolls, the actual extent of inward movement of the selvage strands under the pull of the reinforcing web filaments can be accurately adjusted.

In this manner a weaving head 18, of a given size, can be made to weave a reinforcing fabric having as much as 12 inches less width than the center-to-center spacing of the sprockets 46–47. For example, a weaving head having a sprocket center spacing of 84 inches can be used to provide edge to edge reinforcement for laminated webs of any width between 84 inches and 72 inches by merely adjusting the distance between the forward end of the selvage strand feed tubes 55 and the nip of the rolls 41–42. As herein shown, such adjustment is accomplished by moving the carriage 20 toward or away from the laminating rolls 41–42, according to whether the web width is to be increased or decreased, and for this purpose the track 24 is indexed as at 68 and a pointer 69 is provided on the carriage for quick determination of the desired setting.

Similar ranges of adjustment can be had for weaving heads of other sizes, i.e. center-to-center sprocket spacings of 72 inches and 60 inches. Thus 3 weaving heads sizes can be made to handle web widths of any size between 48 and 84 inches.

FIGURE 3 illustrates the maximum fabric width disposition of the weaving heads 18 with respect to the nip line 70 of the laminating rolls. As shown the guide means arm 66 and feed tube 55 extend as close as possible to the nip line, where the reinforcing filaments 33 are gripped between the webs being laminated, and as disposed the selvage strands 37 are delivered from the feed tubes 55 with a minimum of unsupported length to the nip and hence a minimum of "necking." At this position of the weaving head 18 the web width can be substantially the same as the center-to-center spacing of the sprockets 46–47 and the selvage strands will be laid just enough inside the edges of the web to be completely sealed between the laminated sheets.

FIG. 4 illustrates the relationship of the weaving head 18 and the nip line 70 when a reinforcing fabric of less width than the spacing of the sprockets 46–47 is desired, as when a narrower width of web 38 is being worked. In this case the weaving head 18 has been retracted from the nip 70 so as to leave an unsupported length of the selvage strand 37, between the nip 70 and the forward end of the feed tube 55, sufficient for the filaments 33 to act to cause "necking in" of the selvage strand to the extent necessary to cause it to enter the nip 70 just inside the edge of the web 38.

In FIGS. 3 and 4 it should be understood that the filaments 33 are being carried transversely of the webs 38–38' by the conveyor chain 45 of the weaving head 18, simultaneously with the forward travel of the webs, which action causes the inward pull on the selvage strands 37.

The guide arms 66 may be of any suitable form that will engage the filaments at the turn and then support them as they slide forwardly to engage the selvage strand, and may be made of any material which can have sufficient rigidity and a minimal coefficient of friction for the filaments sliding thereon. As shown in FIGS. 2, 3 and 4, the guide arm is formed of a metal rod doubled upon itself and with the legs diverging from the looped forward end 71. The legs are then welded, adjacent their rearward ends, to lateral members 72 which are connected to the bracket 67. The filament engaging surfaces of the guide arm are highly polished or otherwise treated, to minimize friction and preferably the distal end of the arm is curved inwardly across the path of the selvage strand adjacent the end of the feed tube 55 to avoid interference with the said strand when it is deflected by the "necking-in" process.

FIGURES 6 and 7 show another form of filament transfer guide device wherein the forwardly projecting element 73 is made to include a segment of a right conical surface for its contact with the selvage strand. The longitudinal axis of rotation of such a cone is mounted on a bracket member 74, which is apertured at 75 to clear the nut 56 and the feed tube 55, and the bracket is mounted on the distributing head frame 48 in substantially the same manner as the device of FIGS. 2 and 3. As shown in FIGS. 6 and 7, the distal end of the feed tube 55 extends to, and is coincident with the forward tip 76 of the cone element 73.

FIGURES 8 and 9 show still another form of filament transfer guide device wherein the forwardly projecting element is a solid bar 77 having a rounded outer surface on which the filaments are engaged. This bar is disposed in the same manner as the guide device of FIGS. 2 and 3 and is attached to a mounting bracket, like that for the cone element of FIGS. 6 and 7, by means of a lateral member 78.

As in the case of the guide device of FIGS. 2 and 3, the filament engaging surfaces of the forwardly projecting element, regardless of its form, is highly polished, or otherwise treated, to minimize friction.

Also it should be understood that in special cases, where a certain weaving head is to be used to weave a reinforcing fabric of lesser width than the center-to-center spacing of the conveyor chain sprockets, the guide tube 55 may be angled inwardly from the sprocket axis and the filament turn-over guide element may be extended to the delivery and of the guide tube. FIGURE 8 shows such an arrangement.

FIGURE 11 illustrates the manner in which our improved reinforcing fabric weaving machine is driven. Power is taken from the drive for the laminating rolls, not shown, through a shaft 75, clutch 76 and driving shaft 77. The drive shaft 77 connects with a speed change device 78 by belts 79, running over pulleys 80 and 81, and the speed change device is drivenly connected to the main quill shaft 26 by belts 82 running over pulleys. The quill shaft 26 turns the creel 10 and, as before mentioned, also drives the weaving head 18, at the same angular speed, through the gear box 35 and the shaft 63. Thus, by means of the speed change device 78 (the speed of the weaving head can be adjusted as may be desired to vary the mesh or density of the web reinforcing fabric.

We claim

1. In a machine for forming a reinforcement fabric on a continuously moving web of sheet material, a weaving head comprising

(A) An endless conveyor disposed to travel transversely of the said web around a pair of laterally spaced
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pulleys and having a plurality of uniformly spaced radially projecting eyelet fingers thereon for guiding filaments of reinforcing material.

(B) means for driving said conveyor at a predetermined speed,

(C) means for feeding a selvage strand forwardly from said conveyor along the axes of each of said pulleys,

(D) and fixed guide means projecting forwardly from each pulley and extending inwardly from adjacent the pitch circle of said eyelet fingers toward the pulley axis for supporting reinforcing material filaments turned thereon by the orbiting eyelet fingers on said conveyor while guiding said filaments into engagement with said selvage strands.

2. A machine as defined by claim 1 wherein the filaments and selvage strands are under a constant tension.

3. A machine as defined by claim 1 wherein the fixed guide means comprises elements of a cone having its apex located adjacent the axis of the respective pulley and its base adjacent the plane of the endless conveyor.

4. A machine as defined by claim 1 wherein the fixed guide means comprises elements of a cone disposed with its axis intersecting the axis of the respective pulley and lying in a plane common to the axes of both pulleys.

5. In a mechanism for forming and laying a fabric of reinforcing material upon a continuously moving continuous web of sheet material comprising continuously moving means for laying spaced filaments upon said web diagonally of the direction of movement thereof and including an endless conveyor which travels around a pair of laterally spaced sprockets and orbits filament carrying eyelets in a plane substantially normal to the direction of web movement, and means for feeding a selvage strand to said moving web along the axis of rotation of each of said sprockets, the improvement comprising forwardly and inwardly projecting guide means extending from adjacent the pitch circle of the orbiting eyelets at each sprocket to intersect the respective sprocket axis at a fixed distance forwardly of the orbit plane of said eyelets for supporting said filaments as said eyelets turn about the sprocket axes and delivering said filaments onto the respective selvage strand at said fixed distance from the said orbit plane.

6. A mechanism as defined by claim 5 including a pair of laminating rolls for pulling said web of sheet material and between which said filaments and selvage straps are drawn into engagement with said web, and means for adjusting the distance between said endless conveyor and the plane of the laminating roll axes.

7. A mechanism as defined by claim 6 wherein the said conveyor has a pitch length greater than twice the width of said web of sheet material.

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HAROLD ANSHER, Primary Examiner

D. J. FRITSCH, Assistant Examiner

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