Feb. 9, 1965 D. W. VAN NESS ETAL 3,169,087

APPARATUS FOR MAKING REINFORCED WEBS

Filed June 29, 1962

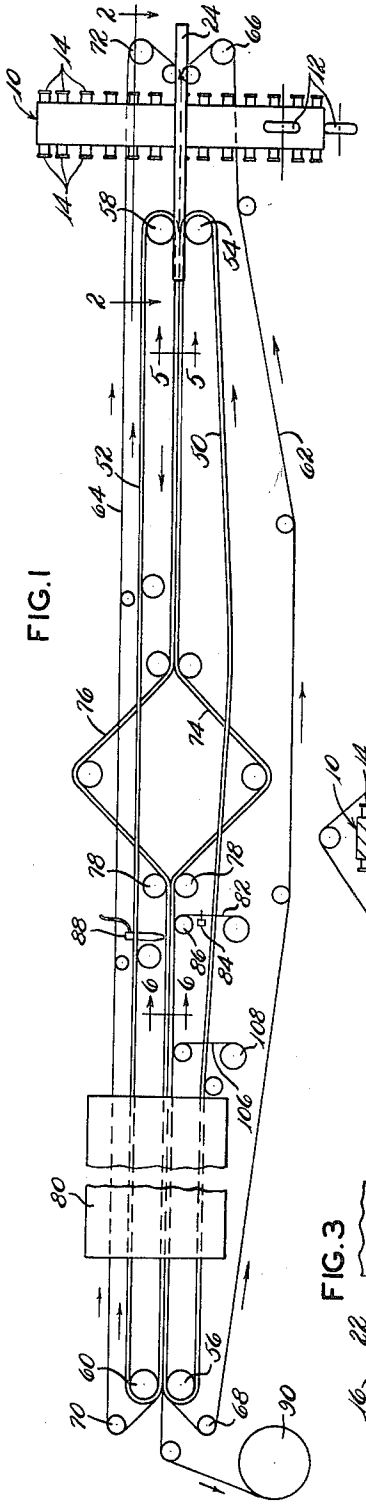


FIG. 1

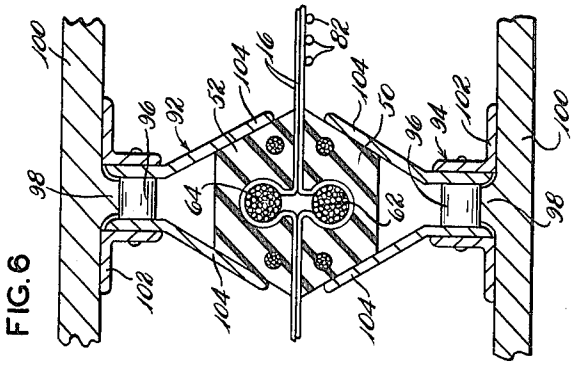


FIG. 6

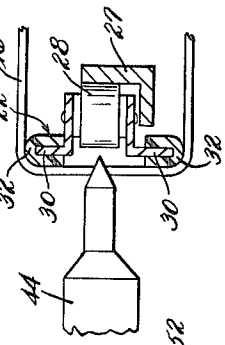


FIG. 4

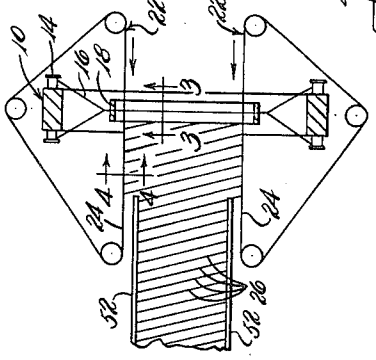


FIG. 2

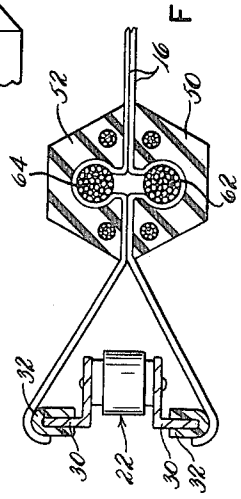


FIG. 5

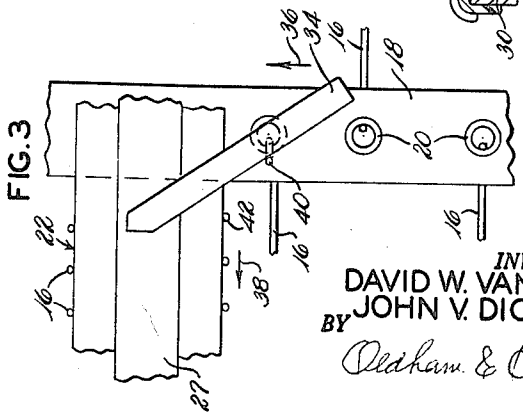


FIG. 3

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APPARATUS FOR MAKING REINFORCED WEBS

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6 Claims. (Cl. 156—431)

This invention relates to apparatus for making open mesh webs including strands of high strength material, such as Fiberglas, nylon, and the like, the webs being utilized to reinforce paper, plastic films, or other similar materials.

U.S. Patent No. 2,691,852 discloses a method and apparatus for spinning a continuous strand helically around moving belts positioned to define substantially a cylinder, together with means for severing the convolutions of the strand at circumferentially spaced points to form strands of relatively short length.

U.S. Patent Nos. 2,954,816 and 2,954,817 spin fiber strands helically around substantially cylindrically positioned advancing belts or about flatly positioned advancing belts, the strands being separated at each convolution, the strand ends being gripped between special locking belts and positioned to form weft cords, followed by feeding in warp cords, and usually with paper then being applied to opposite sides of the warp and weft cords.

It is the general object of the present invention to improve upon the method and apparatus of the aforesaid patents by the provision of a more efficient, faster, more easily operated apparatus in which the strands forming the reinforcement for the web are better aligned and held.

Another object of the invention is to put the spinner in vertical position so that it can carry a greater number of spindles.

Another object of the invention is to provide in apparatus of the character described a pair of chains upon which the convolutions of the reinforcing strand are wound and from which they are transferred to the endless carrier belts after diametrically severing each convolution of strand.

Another object of the invention is to provide stationary guide means in association with the spinner which acts to pick up each strand from the spinner and move it into accurately spaced position upon the pair of carrier chains.

Another object of the invention is to provide electrically heated means for severing the convolutions of strands, rather than an abrasive knife, so that the ends of each strand are sealed and will not fray.

Another object of the invention is to support the strand carrying belts with backup endless Caterpillar chains during the time that the strands are sprayed with an adhesive or binder to join them to warp strands, with both the warp and weft strands thereby being more accurately positioned and held during the application of the adhesive binder and during the passage of the web through a drying or curing oven.

Another object of the invention is the provision of apparatus of the type described in which the carrier belts are inverted so as to bring separate planes of weft strands together and to allow the use of the endless Caterpillar chains to back up the carrier belts.

The foregoing objects of the invention and other objects which will become apparent as the description proceeds, are achieved by the provision of apparatus for making strand reinforced webs including a spinner ring rotatable in a vertical plane, a plurality of planes of strand carrying spools on the ring, a pair of opposed endless belts having parallel reaches about which the strands are wound as the spinner ring rotates, means for rotating the ring, means for advancing the parallel reaches of the belts, fixed guide means against which each strand in turn strikes as

the ring rotates to lay the strands on the parallel reaches in properly spaced relation, rubber belt means for gripping the edges of the strand near the end of the parallel reaches of the belts, electrically heated means for cutting the strands adjacent the belts after the strands have been gripped, movable caterpillar support means engaging behind the rubber belt means to assist the rubber belt means to hold the strands, means for supplying warp threads to the strands to define a web, means for spraying the threads and strands with a plastic material, and means for curing the plastic material.

In the drawings:

FIG. 1 is a side elevation in diagrammatic form of one embodiment of apparatus incorporating the principles of the invention.

FIG. 2 is a fragmentary horizontal cross-sectional view taken substantially on line 2—2 of FIG. 1 and illustrating the pair of carrier chains receiving the strand convolutions from the spinning apparatus.

FIG. 3 is an enlarged fragmentary view taken substantially on line 3—3 of FIG. 2 and showing the stationary guide for guiding each strand elements from the spinning apparatus to the carrier chains to insure uniform spacing of the strand elements;

FIG. 4 is an enlarged fragmentary view taken substantially on line 4—4 of FIG. 2 and illustrating one of the carrier chains with a strand convolution thereon, the convolution being severed by a hot iron;

FIG. 5 is an enlarged fragmentary view taken substantially on line 5—5 of FIG. 1 and illustrating the carrier belts gripping the strand elements before these fully leave the carrier chain; and

FIG. 6 is an enlarged fragmentary view taken substantially on line 6—6 of FIG. 1 and illustrating the backing up of the carrier belts with endless supporting Caterpillar chains whereby the strand elements are very positively held during spraying and curing or drying of the sprayed adhesive.

For a better understanding of the invention reference should be had in greater detail to the accompanying drawings wherein the numeral **10** indicates generally a spinning ring rotatably mounted in a vertical plane upon a plurality of rubber-tired rollers **12**, at least one of which is driven at an adjustably controlled speed to effect the rotary movement of the spinning ring. Mounted on each side of the spinning ring **10** are a plurality of strand carrying spools **14** whereby a very considerable plurality of strands, each indicated by the numeral **16** can be supplied to an inner guide ring **18** carried with the spinning ring **10**.

The inner guide ring **18** carried with the spinning ring **10** is provided, as best seen in FIG. 3, with a plurality of circumferentially spaced friction reducing eyelets **20**, with a strand element **16** extending radially inwardly through each eyelet **20**.

Associated with the spinner ring **10** and guide ring **18**, and as best seen in FIGS. 1 and 2, are a pair of endless horizontally directed chains **22** providing opposed parallel reaches **24** inside the guide ring **18** and about which the strand elements **16** are wound in flat helical convolutions as indicated at **26** in FIG. 2. The carrier chains **22** are driven in the direction as shown by the arrows at an adjustable constant speed so that as the spinning ring **10** and guide ring **18** rotate about the opposed reaches **24** of the carrier chains the strand elements **16** are laid down, as aforesaid, as flat helical convolutions around the opposed reaches **24** of the carrier chains **22**.

FIG. 3 illustrates, as does FIG. 4, that each carrier chain **22** is supported over a considerable portion of the reach **24** with a fixed guide **27** with which the rollers **28** of carrier chain **22** engage. FIG. 4 shows the convolute form that the strands **16** form in relation to the carrier

chains 22. The chains 22, as best seen in FIG. 4, have every other link formed with a short right angle flange 30, and to these flanges are secured continuous U-shaped channels 32 of rubber or plastic which serve to actually support the convolutions of the strand 16.

FIG. 3 illustrates that every other strand element 16 comes to the guide ring 18 from one side thereof, and with alternate strand elements 16 coming into the guide ring 18 and the eyelets 20 from the other side thereof. With some play between each strand element 16 and the eyelet 20 through which it passes, and with the strand elements coming from opposite directions to the respective eyelets, this means that the strand elements would not be laid down upon the reaches 24 of the carrier belts 22 with a uniform spacing. In order to overcome this difficulty the invention provides a fixed guide 34 which is carried by the stationary support 27 for the carrier chains 22. Thus, as the guide ring 18 rotates in the direction of the arrow 36 and with the carrier chains 22 moving in the direction of the arrow 38, each strand 16 in turn strikes the stationary guide 34, slides down the guide 34 and is deposited in turn on the carrier chain in a spaced relation of the same distance to each adjacent strand. FIG. 3 shows at 40 a strand 16 engaging with the guide 34 and beginning to slide down it, and the numeral 42 indicates a strand element just previously deposited upon the carrier chain 22.

Referring again to FIG. 4 hot knife means 44 are used to sever the strands 16 at the ends of each convolution immediately adjacent the carrier chains 22. In one embodiment of the invention the hot knife means 44 takes the form of an electric soldering iron fixed in position and heated to a temperature so that as each convolution of the strand 16 is carried by the forward movement of the chains 22 against the hot knife 44, the strand is severed, and with the hot knife means normally melting and sealing together the ends of the cut strands so that there will not be any fraying of individual filaments forming the strand. The hot knife means described is particularly adapted for use with high strength plastic strands, such as nylon or rayon, but may also be used with Fiberglas strands.

Just before the hot knife 44 cuts each convolution 26 of the strand element 16 the strand elements are picked up by a double pair of endless carrier belts 50 and 52 extending, respectively, over pulleys 54–56 and 58–60. These carrier belts are of the type indicated by the numerals 5 and 6 in U.S. Patents No. 2,954,817. In other words, each of the carrier belts 50 and 52 is of V-belt shape in cross section and is formed with a longitudinal slot of keyhole shape into which frictionally fits an endless cable 62 and 64 respectively. The endless cables 62 and 64 are a double pair, one pair on each side, and are mounted upon pulleys 66–68 and 70–72. The cables 62 and 64 correspond to the cables 15 and 16 of the structure of U.S. Patent No. 2,954,817.

Accordingly, and as best seen in FIG. 5, the top strand 16 of each convolution has each end near the carrier chains gripped between the belt 52 and the cable 64, and the bottom strand element 16 of each convolution is gripped at its end near the carrier chain 22 by means of the belt 50 and the cable 62. Note that as best seen in FIG. 1, the cables 62 and 64 extend from the right end of the apparatus into the inside of the convolutions 26 of the strand elements so that when the cables 62 and 64 are moved into the keyholde shaped grooves of the carrier belts 50 and 52 adjacent the pulleys 54 and 58, with the hot knife 44 substantially simultaneously cutting the ends of each convolution, that the ends of the strand elements will be frictionally held substantially as shown in FIG. 5. In actual practice, the cables 62 and 64 engage the ends of the strands 16 and hold them down against the grooves in the carrier belts 50 and 52, immediately thereafter the hot knife 44 severs each strand convolution, and the cables move on into the keyhole shaped grooves in each carrier belt carrying the strand ends therewith to end up as seen in FIG. 5.

It will be noted from FIG. 5 that a feature of the invention constituting an improvement over Patent No. 2,954,817 is that the belts 50 and 52 are back to back, bringing the separate planes of the strands 16 together.

With the top and bottom strand elements held as in FIG. 5 one of the set of belts is made to travel a greater distance than the other, all as described in the aforesaid U.S. Patent No. 2,954,817, so as to bring the strand elements to the desired weft-forming position. The repositioning of the belts and of the strand elements carried thereby is diagrammatically indicated in FIG. 1 by the different paths 74 and 76 that the respective pairs of belts make. The belts are brought back together by a double pair of pulleys 78 at some distance in advance of a drying or curing oven 80. The strand elements can be repositioned in the manner described to position the strands directly laterally, or at some selected lateral angle, for example 45 degrees, so as to best perform the desired weft reinforcing action desired.

At some point between the pulleys 78 and the oven 80 a plurality of warp-forming strand elements 82 can be fed over a comb 84 and a roller 86 into engagement with the underside of the weft strands, and with the warp strands taking any desired lateral spacing in relation to each other. Additional warp strands can be fed into the top of the weft strands in similar fashion from the top thereof, should this be desired.

Spray heads 88 positioned in the manner shown in FIG. 1 between the pulleys 78 and the oven 80, or other suitable means for applying an adhesive or a binding medium now function to apply a binder to the weft and warp strands. A typical binder is a vinyl plastisol or other suitable flexible resin capable of being set up under heat so that during the passage of the strands through the oven 80 the binding medium is cured or set up to produce a web having longitudinally directed, laterally spaced high strength warp strands and laterally directed weft strands which are longitudinally spaced and which are positioned and at a desired angle, all suitably secured together with the flexible fully cured binder to provide a web which can be applied to paper, vinyl resin, or other films or sheets to provide a liminate which is very resistant to tearing. FIG. 1 illustrates the finished reinforcing web being wound up on a roll 90.

A feature of the invention is illustrated in FIG. 6 which shows that the belts 50 and 52 are supported substantially between the pulley 78 and the discharge end of the oven 80 by means of endless Caterpillar chains indicated as a whole by the numerals 92 and 94. Each of these endless chains includes rollers 96 engaging with ribs 98 formed on the top and bottom guide plates 100. Certain of the chain links are provided with flanges 102 having sliding support on the guide plates 100, and alternate lengths are formed with V-shaped flanges 104 which engage with the tapered sides of the belts 50 and 52 to thereby give a very strong support action to the belts 50 and 52 between the pulleys 78 and the discharge end of the oven 80. This means that the strand elements 82 and 16 are very positively held in proper alignment and in engagement during the application of the binding medium thereto and during the curing up of this binding medium in the oven 80. This insures the uniformity of the positioning of the strand elements in relation to each other and improves the quality and appearance of the finished product.

It is also possible, as taught in U.S. Patent No. 2,954,817 to apply paper, plastic film, and the like, to the strand elements before or after passage thereof through the oven 80. By way of example, FIG. 1 illustrates a plastic film 106 being supplied from a roll 108 and fed to the underside of the strand elements after the application of the binding medium thereto and just prior to the passage of the assembly into the oven 80. A similar film could, if desired, be fed in upon the top of the strands.

While a certain representative embodiment and details have been shown for the purpose of illustrating the

invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. In an apparatus for making strand reinforced webs the combination of

a spinner ring rotatable in a vertical plane,

a plurality of planes of strand carrying spools on the ring,

a first pair of opposed endless belts having parallel reaches passing through the spinner ring about which the strands are wound as the spinner ring rotates,

means for rotating the ring,

means for advancing the parallel reaches of said first pair of opposed endless belts,

a fixed non-rotatable guide means positioned adjacent the spinner ring against which each strand in turn strikes as the ring rotates to lay the strands on the parallel reaches of said first pair of belts in equally spaced relation,

a second pair of opposed endless belt means having parallel reaches for gripping the strands adjacent to the parallel reaches of said first pair of opposed endless belts so as to move the strands into adjacent relationship to each other and all lying in the same plane,

means for advancing the parallel reaches of said second pair of opposed endless belts,

electrical heater means for cutting the strands where they are wound around said first pair of opposed endless belts after the strands have been gripped by said second pair of opposed endless belts,

movable endless Caterpillar chain means engaging behind said second pair of endless belts to assist said second pair of endless belts to hold the strands in fixed relationship thereto,

means for supplying warp threads to the strands to define a web,

means for applying a binder to the web, and

means for curing the binder.

2. Apparatus as set forth in claim 1 which includes means for spraying the warp threads and strands with a plastic material, and

means for supplying and securing a sheet to the web.

3. In an apparatus for making strand reinforced webs the combination of

a spinner ring rotatable in a vertical plane,

a plurality of strand carrying spools on the ring,

a first pair of opposed endless belts having parallel reaches passing through the spinner ring about which the strands are wound as the spinner ring rotates,

means for rotating the ring,

means for advancing the parallel reaches of said first pair of opposed belts,

a fixed non-rotatable guide means positioned adjacent the spinner ring against which each strand in turn strikes as the ring rotates to lay the strands on the parallel reaches of said first pair of belts in equally spaced relation,

a second pair of opposed endless belts having parallel reaches for gripping the strands adjacent to the parallel reaches of said first pair of opposed endless belts so as to move the strands into adjacent relationship to each other and so that all strands lie in the same plane,

means for supplying warp threads to the strands to define a web,

means for spraying the threads and strands with a plastic material, and

means for curing the plastic material.

4. Apparatus as set forth in claim 3 wherein electrically heated means are provided for cutting the strands where they are wound around said first pair of opposed endless belts after the strands have been gripped.

5. Apparatus as set forth in claim 3 which includes movable endless Caterpillar chain means engaging behind said second pair of opposed endless belts to assist said belts to hold the strands in fixed relationship with each other, which Caterpillar chain means include

a pair of top and bottom guide plates in substantially parallel adjacent relationship with the second pair of opposed endless belts and to each other,

a pair of endless chain means associated with each pair of top and bottom guide plates directed in opposed relationship and engaging said second pair of opposed endless belts to force them into biased engagement with each other, and to provide support against lateral, twisting, and flexing movement thereof, and

roller means between said endless chains and said top and bottom guide plates to provide sliding movement therebetween.

6. In an apparatus for making strand reinforced webs the combination of

a spinner ring,

a plurality of planes of strand carrying spindles mounted on said spinner rings,

a guide ring carried with the spinner ring,

a plurality of eyelet guides circumferentially spaced around the guide ring with each eyelet directing a strand therethrough from alternating sides of the guide ring,

a pair of endless carrier chains having parallel reaches extending through the guide ring and about which the strands are wrapped as convolutions upon rotation of the spinner ring,

stationary guide means for directing each strand from the guide ring in equal spaced relation to the parallel reaches of said endless carrier chains,

adjustable speed means for rotating the spinner ring,

adjustable speed means for advancing the parallel reaches of the chains,

means for cutting the convolutions in turn substantially adjacent each of the parallel reaches of the chains,

means for gripping the convolutions substantially as they are cut so they remain in the same relation as before they were cut,

a web,

means for positioning the cut convolutions of strands on the web as weft strands,

means for supplying warp strands to the web,

means for supplying a binder to the strands, and

means for curing the binder and securing the strands therein.

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