

July 15, 1958

R. S. OWENS

2,842,932

APPARATUS AND METHOD FOR MAKING TWISTED FIBER PRODUCTS

Filed July 29, 1954

4 Sheets-Sheet 1
TO BY-PASS TWISTER

FIG. 1.

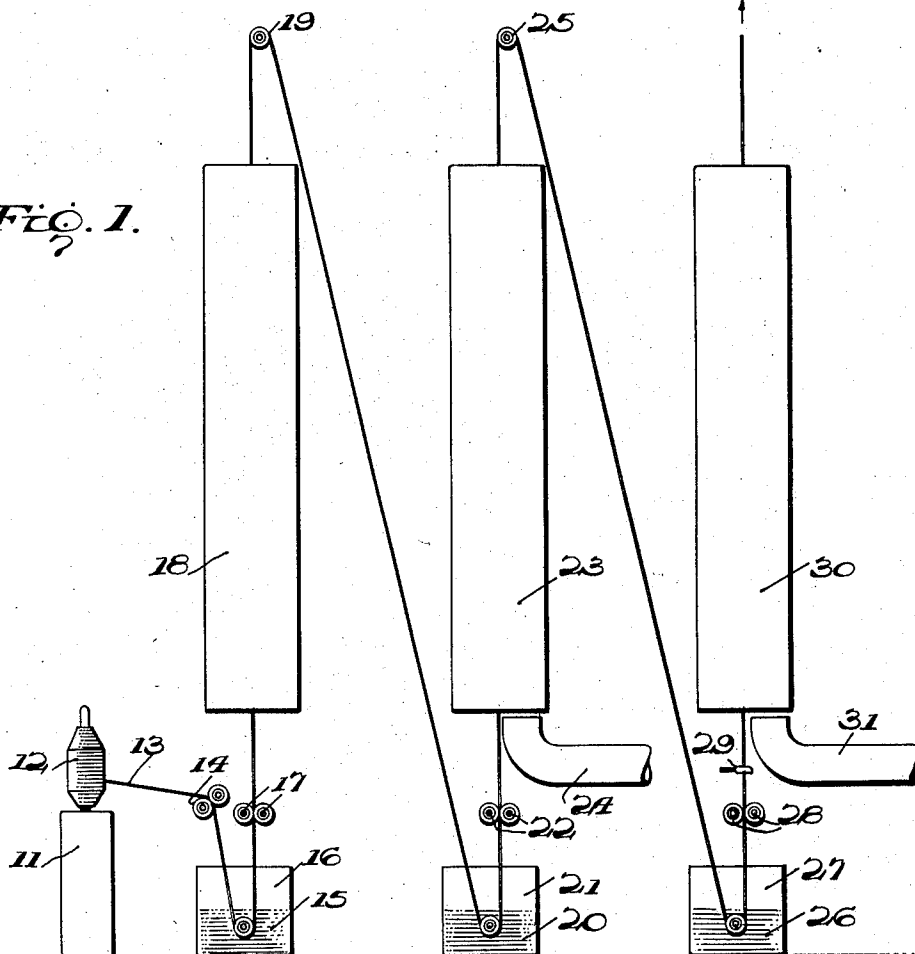
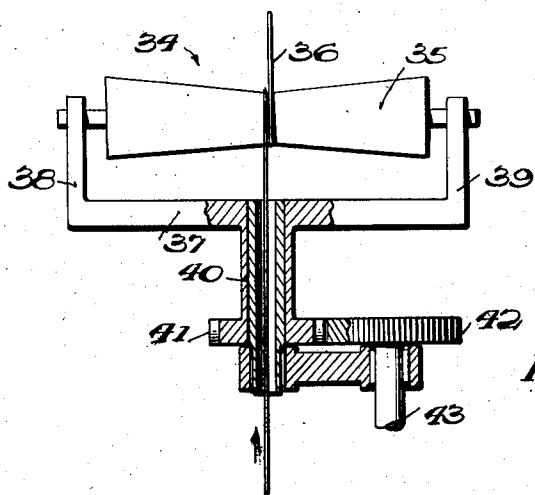


FIG. 7.



INVENTOR.

Robert Stuart Owens
BY

H. J. Eccleston
ATTORNEY

July 15, 1958

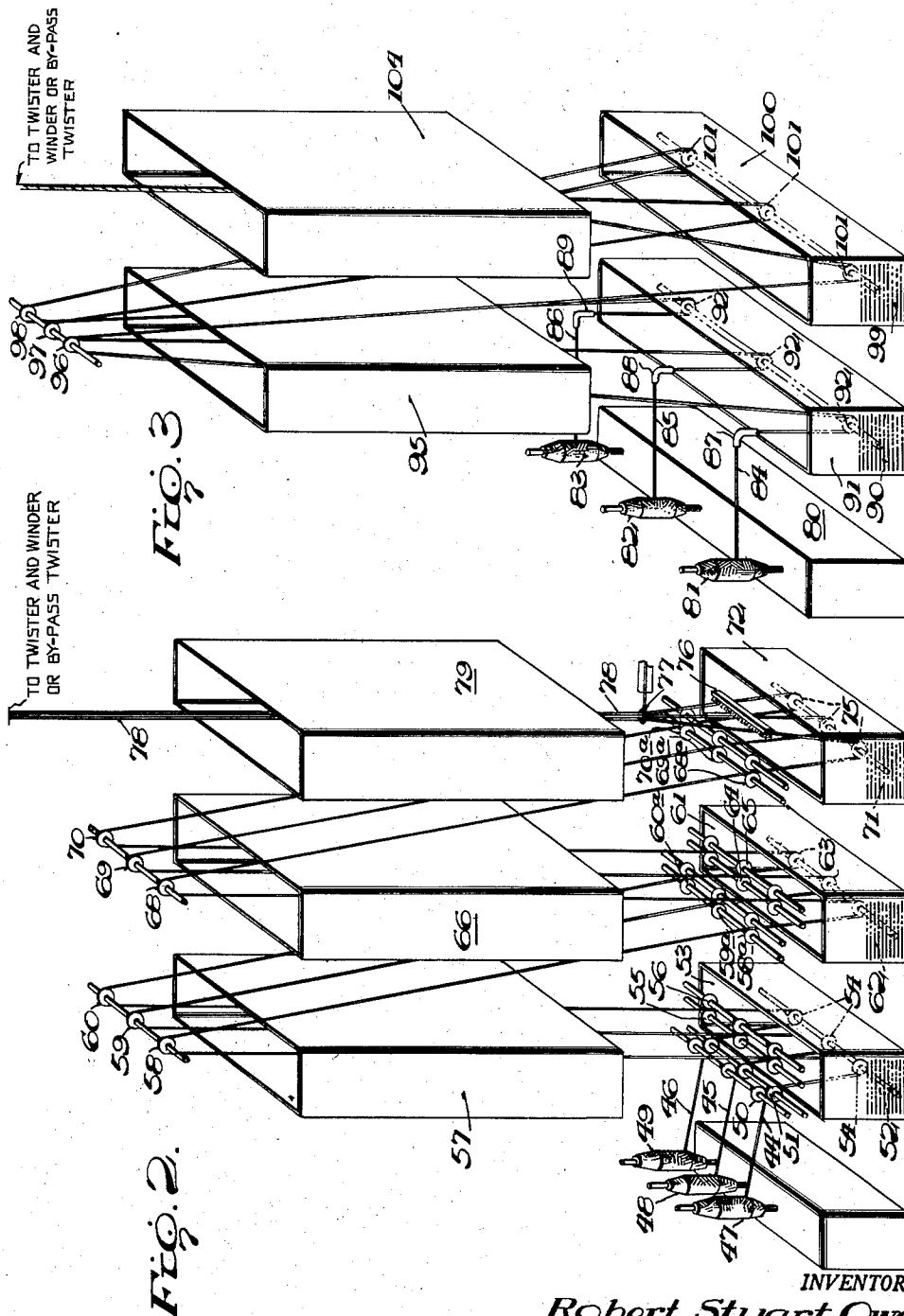
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Robert Stuart Owens
BY

BY

W. J. Eccleston
ATTORNEY

ATTORNEY

July 15, 1958

R. S. OWENS

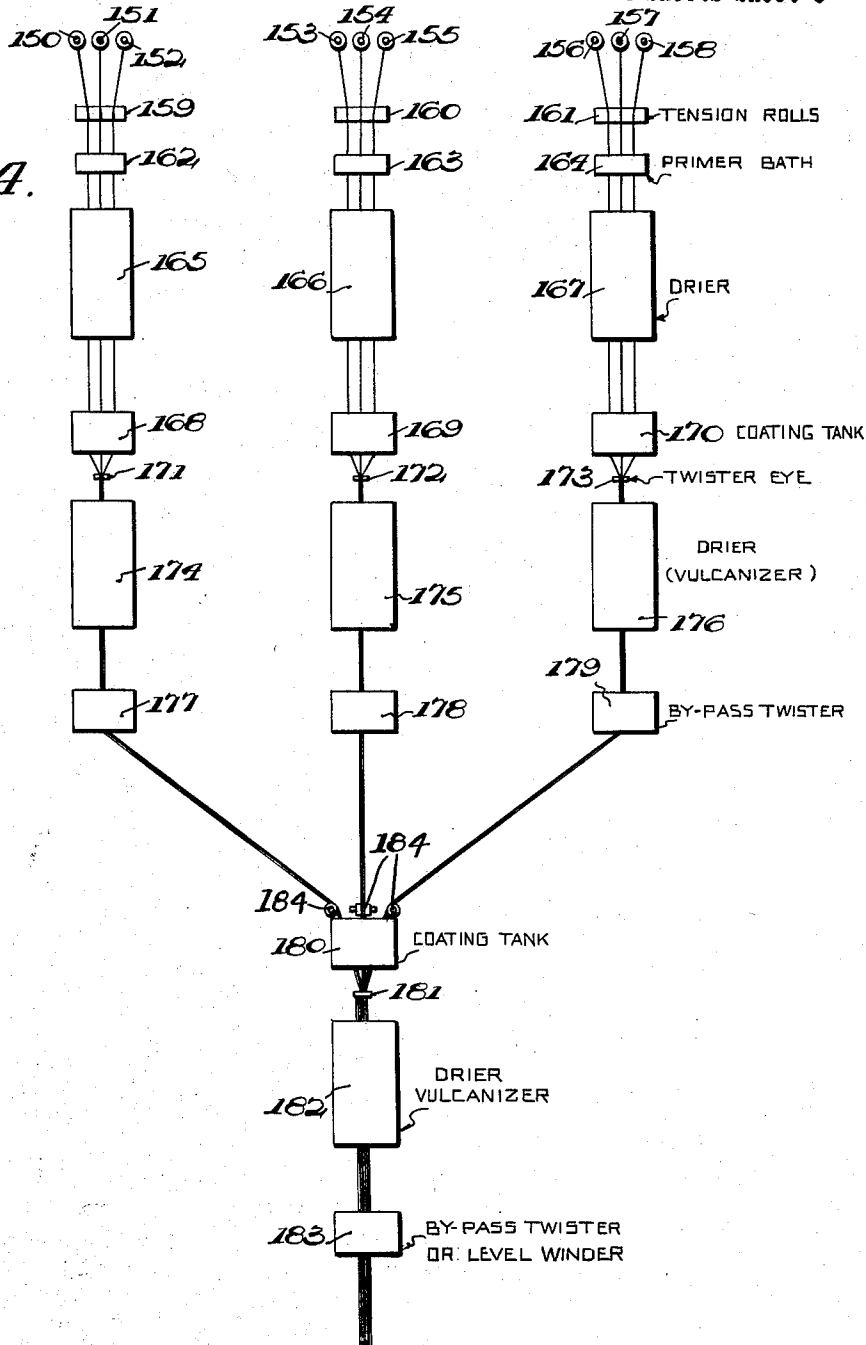
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FIG. 4.



INVENTOR.

Robert Stuart Owens

BY

W. J. Eccleston,
ATTORNEY

July 15, 1958

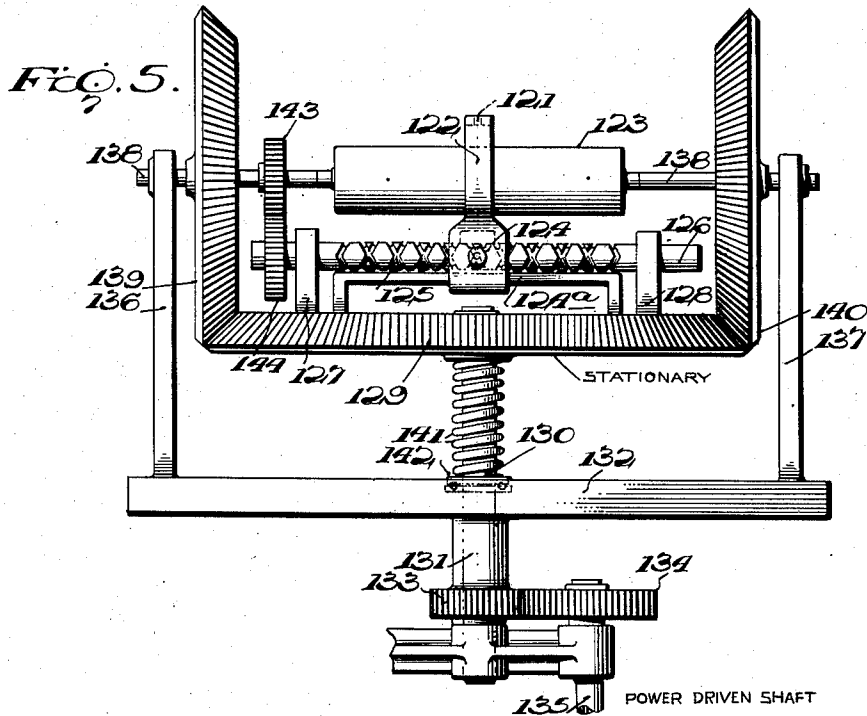
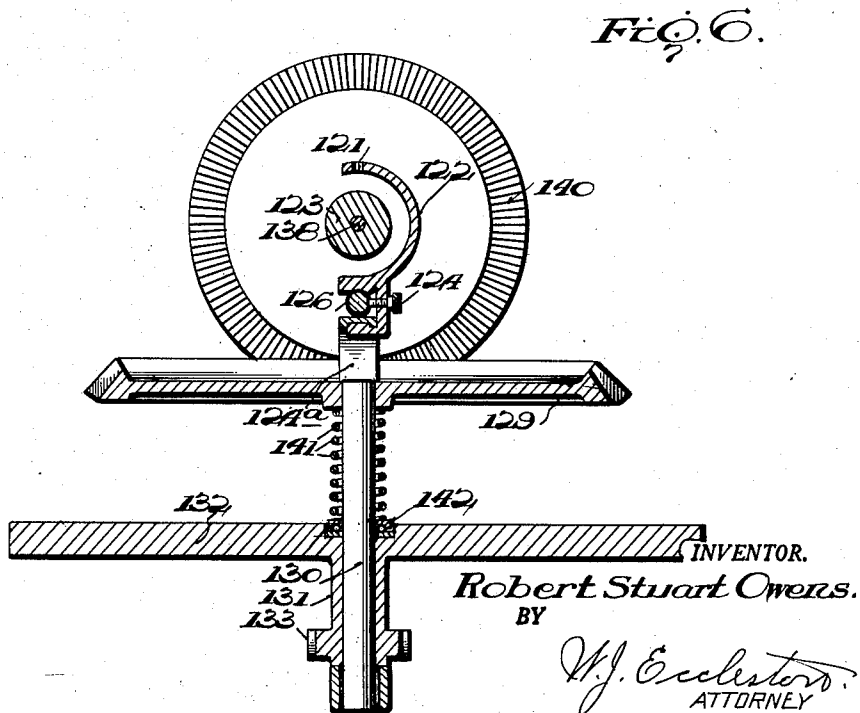
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APPARATUS AND METHOD FOR MAKING TWISTED FIBER PRODUCTS

Robert S. Owens, Charlottesville, Va.

Application July 29, 1954, Serial No. 446,505

13 Claims. (Cl. 57—35)

The present invention relates to the coating, twisting and assembling of yarns, cords and ropes into multi-ply structures. To produce such yarns, it is essential that the coating, twisting and winding of coated yarns be so synchronized that the product resulting from each step in the operation will be ready for the subsequent processing step incidental to the production of end products of a predetermined nature, in order that the processing can be carried on with continuous lengths of the fibers.

In commercial textile practice, single ply yarn coatings are usually applied by means of a "slasher" wherein the coated yarns after passing around the last drying drum are split up and move on to suitable equipment to make sure that the coated yarns are not all "starched" together. Plyed or twisted yarns are practically never sized.

The twisters commonly used in commercial practice consist of a bobbin centrally mounted in a frame containing a stationary ring with bobbin therein. As the bobbin rotates, the twisted yarns are wound on. The yarn to be wound on the bobbin comes from spools in a creel through tension rolls to a traveller, which rotates around the bobbin by means of a foot operating in a recess milled in the periphery of the ring. The yarn is conducted from the tension rolls in a plane approximately parallel to the axis of the bobbin to an eye in the traveller. When the yarn reaches the traveller eye, it makes a right angle bend and proceeds on to the bobbin. The number of twists imparted to the yarn is a function of the speed at which the yarn passes through the tension rolls and the speed at which the traveller rotates around the bobbin. The speed of the bobbin determines the flow of yarn through the tension rolls. The speed of the traveller is so set as to give the number of twists desired. The creel, tension rolls, traveller eye and bobbin are all mounted on a frame in close proximity to each other and with no provision made for any special treatment of the yarn between the time it leaves the creel and is wound up on the bobbin, other than the application of the twist. In some types of construction, the yarn after passing through the gathering-twister eye passes through a tube bent in the shape the yarn normally takes in its passage from the gathering eye to the traveller. Twistors of this type are known as "flyers." When they are employed, the whipping action of the yarn, caused by centrifugal force, is controlled. Flyer-type twisters are constructed on frames similar to the conventional type twisters and without any provision being made for special treatment of the yarn between the time it leaves the creel and is wound on the bobbin. The right angle bends and the passage of the yarn through eyes are not suited for the passage of a shroud coated material and are found in both types of twisters.

Winders commonly used by textile mills are designed to function as individual units and not as integrated components of a twisting operation. The function of commercial winders is to rewind the products which have previously been accumulated on spinning and twisting bobbins, or on spools for subsequent industrial purposes.

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Winders as they are used in the trade are not intended to function as an intermediate step in a manufacturing operation where it is desired to produce plied yarns wherein the individual filaments comprising the plied product are definitely bonded together in the form of a unit structure, nor are they intended to provide a facility in which the twisting and winding must be performed while the coating is still in a pasty or possibly tacky condition.

The coating, twisting and winding operations in the manufacture of coated plied yarns by facilities which are presently being employed are performed by separate and distinct pieces of equipment, each designed to operate as a separate unit, individually. The coating equipment, twisters and winders presently available were not designed with a view to correlating the several functions into one composite unit capable of handling a variety of coatings and having as the end product a yarn, cord or rope consisting of a desired number of twisted and plied filaments with predetermined properties.

It is one of the objects of this invention to provide a novel process and apparatus whereby the desired plied, twisted and coated yarns can be produced on a continuous basis, with each step in the processing capable of being synchronized and correlated with all other previous and subsequent operations. It is a further object of this invention to present a novel twisting mechanism assembly of component parts whereby the primary objective as noted above can be accomplished. Another object is to provide a novel by-pass twister which is highly useful in connection with the inventive process. Other objects will be apparent from the following description.

In the accompanying drawings forming a part of this specification,

Fig. 1 is a diagram of an apparatus for applying three coats to a single fiber and then drying or vulcanizing the coatings;

Fig. 2 is a diagram of an apparatus for applying three coats simultaneously to each of three strands;

Fig. 3 is a diagram of an apparatus for applying two coats simultaneously to three strands;

Fig. 4 is a diagram in the nature of a flow sheet showing how a nine-ply strand is made from three strands each consisting of three fibers, each fiber being coated twice;

Fig. 5 is a somewhat diagrammatic elevation of a twister and winder such as may be used with any of the apparatuses shown in Figs. 1, 2, 3 and 4;

Fig. 6 is a diagrammatic view in sectional elevation of the twister and winder of Fig. 5; and

Fig. 7 is a diagrammatic view in side elevation of a by-pass twister assembly such as may be used with the apparatuses shown in Figs. 1, 2, 3 and 4.

Referring first to Fig. 1, the diagram shows a creel 11 on which a spool 12 of fiber or yarn 13 is supported. Fiber 13 passes between tension rolls 14, then down into a primer bath 15 in a primer tank 16, then up between two wiping rolls 17, through a drying chamber 18 (which may be a vertical chamber open at both ends and hence subjected to a natural draft therethrough), thence up over a pulley or roll 19 which may be power-driven or may be an idler. After passing over pulley or roll 19 the primed fiber changes its direction and extends into a coating bath 20 in a tank 21, then up between two wiping rolls 22, then through a vertical elongated drying chamber 23 that is open at both ends and has a source of hot air 24, such as a commercial spot heater, blowing hot air into its lower end. Above the upper end of drying chamber 23 the coated fiber passes over a pulley or roll 25, changes its direction, and extends into a second coating bath 26 in a tank 27, then up between two wiping rolls 28, then through an eye 29 which is a die means for

controlling the thickness of the shroud coating and aids in producing smooth finishes. Then the fiber enters the lower end of a vertical elongated drying chamber 30 having a source of hot air 31 blowing heated air into its lower end. Chamber 30 may be a vulcanizing chamber. All three chambers 18, 23 and 30 may be about 30 ft. long but other dimensions may give better results under certain conditions. As the baths 15, 20 and 26 may contain volatile liquids such as water dispersions or organic solvents, the tanks 16, 21 and 27 may have covers (not shown) to retard evaporation, with perforations in the covers to permit free passage of the traveling fibers. The coated fiber finally passes out the upper end of chamber 30 and may go to a by-pass twister 34 such as is shown in Fig. 7. The by-pass twister 34 includes an idler roll or spool 35 about which the coated strand 36 is wrapped at least one full turn, so that the idler roll is rotated on its axis by said strand, a plate 37 supporting roll 35 by means of arms 38, 39 having bearings, a hollow shaft 40 supporting and driving plate 37, the coated strand 36 passing up through the center of the hollow shaft, and gearing 41, 42 driving the hollow shaft and hence rotating roll 35 in a horizontal plane. Roll 35 preferably is of least diameter at its middle and of greatest diameter at either end, this shape causing the strand 36 to return constantly to the middle of the roll as the strand travels in the direction indicated by the arrow. Gearing 41, 42 is connected with any source of power such as a motor-driven shaft 43. Beyond the by-pass twister the coated strand may be united with two other coated strands and will be further processed, for example as explained in connection with Fig. 4.

The same general arrangement of parts is shown in Fig. 2, where three fibers 44, 45, 46 are unwound from spools 47, 48, 49 respectively, then pass between pairs of tension sheaves 50, 51 (which may be power driven), then down into a priming bath 52 in a tank 53. Idler sheaves 54 in bath 52 change the direction of fibers 44, 45, 46 and said fibers move upwardly, passing between pairs of wiper rolls 55, 56, thence up through an elongated vertical drying chamber 57 (like chamber 18). After emerging from the drying chamber 57 the primed fibers pass over three direction-changing sheaves 58, 59, 60 and travel down to guiding sheaves 58a, 59a, 60a above a coating tank 61 containing a coating bath 62. Then the strands move around direction-changing sheaves 63 and travel upwardly between pairs of wiper rolls 64, 65 into a second elongated drying chamber 66. A source of hot air (like source 24, but not shown) blows heated air into the lower end of drying chamber 66 and as said chamber may be about 30 ft. high, the coated fibers are substantially dry by the time they emerge from the upper end. Radiant heat may be used in lieu of heated air currents. Direction-changing sheaves 68, 69, 70 are located above said upper end, so that the coated fibers may pass down to guiding sheaves 68a, 69a, 70a, then into a second coating bath 71 in a tank 72. Direction-changing sheaves 75 in tank 72 cause the three fibers to move upwardly after immersion and then pass to a rubbing contact with a wiping bar 76. Immediately above the wiping bar is an eye 77 whose function is the same as that of eye 29. The three strands, now parallel and in contact as indicated at 78, enter a third vertical elongated drying chamber 79 where they are twisted to form a single three-ply strand. Chamber 79 is heated by a heater (like 24) and is sufficiently long to cause a complete drying or vulcanizing of the second coating; and when the three ply strand emerges at the upper end, it may pass to a twister and winder such as is shown in Figs. 5 and 6, or to a by-pass twister assembly like the one described above and shown in Fig. 7. A by-pass twister will be employed if the three-ply strand of Fig. 2 is to be united with other multi-ply strands as shown in Fig. 4.

Referring to Fig. 3, a creel 80 is shown supporting three spools 81, 82, 83 from which fibers 84, 85, 86 respectively

are unwound by tension imparted by a twister and winder assembly (to be described) at the other end of the apparatus. Fibers 84, 85, 86 pass through direction-changing tubes 87, 88, 89 (which may be of glass or similar smooth material) then move down into a priming bath 90 contained in a tank 91. Direction-changing sheaves 92 in tank 91 reverse the direction of the fibers and they may travel up between wiper rolls (not shown but like rolls 55, 56), or they may directly enter a vertical drying chamber 95 which is like chamber 18. Emerging in a tack-free or surface-dry condition from the upper end of chamber 95, the impregnated fibers pass around sheaves 96, 97, 98, then travel downwardly into a coating bath 99 in a coating tank 100, move around direction-changing sheaves 101, may pass between wiping rolls (not shown) or they may directly enter a drying chamber 104 which is like chamber 23 and has a source of heat such as a blower or a radiant heating coil, not shown. In the drying chamber 104 the coated fibers are brought together and twisted by the action of a twister-winder assembly (which will be described later on) or by a by-pass twister (Fig. 7).

Referring to Fig. 4, nine spools 150-158 inclusive are shown from which nine fibers are drawn by means of rotating tension rolls arranged in pairs designated at 159, 160 and 161. From the tension rolls the fibers pass to primer baths 162, 163, 164 respectively, then to driers 165, 166, 167 respectively, and then to coating tanks 168, 169, 170. After coating, the three fibers of each group are brought together by the corresponding twister eye (171, 172 or 173) as shown in Fig. 4, or they may be combined to form a single strand while passing through a drier or vulcanizer (174, 175 or 176) by the twisting action of a by-pass twister (177, 178, 179) as will be understood from Fig. 3. The by-pass twisters twist the several strands in the same direction, that is, all three three-ply strands have an S-twist, for example. The three ply twisted strands then go to a single coating tank 180, are coated, then pass through an eye 181 (like eye 29) and the composite strand passes into a drier or vulcanizer 182 and then to a level winder 183 (as will be described) or to a by-pass twister (Fig. 7) if the coated strand is to be united with other like strands to form strands containing more plies.

It should be explained that the continuous operation diagrammatically illustrated in Fig. 4 would not be possible unless means were provided to permit the coated and twisted yarns to move beyond the by-pass twisters 177, 178 and 179 for subsequent treatment. Each by-pass twister functions as a fixed point, the other fixed point being the spools 150-158 in the creels. The twist is imparted by the rotation, in a horizontal plane, of twister spool 35 (Fig. 7). Referring again to Fig. 4, the tendency to untwist is overcome by setting the resin of the coatings while the yarns are under tension, and this setting takes place in the driers or vulcanizers and prior to the time that the coated yarns reach the by-pass twisters. The stress set up in the coating material which is bonded to the yarn compensates for the forces which tend to cause untwisting. The twisted coated yarn on reaching spool 35 (Fig. 7) slips as it is pulled around the spool and in effect spool 35 acts as the initial fixed point together with the directional guiding sheaves 184 adjacent tank 180 (Fig. 4). Such an arrangement will only be possible where the strands of a multi-ply yarn are firmly bonded and held in situ by a resin which possesses sufficient elasticity to compensate for the tendencies of non-treated twisted strands to untwist.

In the arrangement of Fig. 4, the twist imparted by by-pass twister or level winder 183 is the reverse of the twists imparted by the by-pass twisters 177, 178 and 179. Thus the primary plying imparts an S twist and then in one continuous operation a Z twist is imparted in the secondary plying. Such an operation, it will be clear, is only possible when the strands of the primary plying

are coated with an elastomer that has been bonded to the fibers. Furthermore, the elastomer must be set before the strands reach the twister or twister-winder for the secondary plying. To accomplish the desired result provision must be made to cause the yarn to slip around the twister spool 35 so that in effect the initial fixed point is transferred to the twister spool. In some cases it may be necessary to use a lubricant on the spool in order to insure this slippage.

Referring to Figs. 5 and 6, a twister-winder assembly is shown which is adapted to twist and wind on a spool a single coated multi-ply strand, such as will be delivered by the apparatus of Fig. 1. If three coated yarns are delivered to the twister-winder assembly, a gathering eye like eye 181 may be used to collect and unite the yarns prior to passing to the winder. The multi-ply strand extends to an eyelet 121 on the upper end of a guide 122 that is arcuately curved and extends at its upper end over the spool 123 on which the strand is to be wound. The lower end of guide 122 is slidably mounted on a guiding rod 124a (which is fixed to gear 129 to be described) and carries a key 124 whose end engages a double-spiral track 125 milled in a rotating shaft 126 which is parallel to the axis of spool 123. Shaft 126 is supported above guiding rod 124a in bearings 127, 128 which are fixed to the upper face of a horizontal bevel gear 129. Bevel gear 129 is stationary, being supported on the upper end of a stationary vertical rod 130. A sleeve 131 is rotatably mounted on rod 130 and is attached to and may be integral with a disc or plate 132. Spur gear 133, which is fixed to sleeve 131, meshes with a spur gear 134 fast to a power-driven shaft 135 which is preferably driven by a variable speed motor, not shown. If desired, the motor may be reversible or may rotate shaft 135 through reversing gearing. Thus the disc or plate 132 is rotated at the desired speed in a horizontal plane. A pair of arms 136, 137 have bearings for supporting a two-part shaft 138 on which spool 123 is mounted. Preferably the spool is detachably connected to shaft 138 by means of a known lock-pin and coil spring arrangement (not shown) which permits an operator to remove a wound spool by hand and substitute an empty one. A bevel gear 139 is fixed to shaft 138 and meshes with the stationary bevel gear 129, and another bevel gear 140 is loosely mounted on shaft 138 on the opposite side of the spool to aid in balancing the assembly and to aid in supporting and centering the spool. A coil spring 141 is mounted on the stationary rod 130 and its upper end bears against the underside of stationary bevel gear 129, while its lower end bears against a ball bearing 142 mounted at the center of rotating disc or plate 132. As the disc or plate rotates, arms 136, 137 will rotate, carrying shaft 138 and spool 123 around, and bevel gears 139, 140 will travel around the stationary bevel gear 129. Thus shaft 138 is rotated on its axis and spool 123 is likewise rotated. A spur gear 143 on shaft 138 drives a similar gear 144 fixed upon shaft 126, so that the latter shaft is driven synchronously with the spool. Guide 122 thus moves back and forth over the spool and guides the strand over the spool to wind it on uniformly, as will be understood by those skilled in the art. The rotation of the assembly in a horizontal plane due to the power derived from shaft 135 causes the strand to be twisted at a rate determined by the speed of rotation of the spool and the rotative speed of the assembly. Both the twisting and winding speeds may be changed as desired to vary the number of turns per inch of the twisted strand. The assembly preferably is dynamically balanced by means not shown to permit high speed rotation about the axis of vertical rod 130.

It will be understood that many variations in the apparatus may be resorted to and that the diagrammatic drawings are merely for the purpose of giving those skilled in the art a clear understanding of my invention, the scope of which is defined by the appended claims.

The present application is a companion to my pending application Ser. No. 391,439 filed Nov. 12, 1953 now Patent No. 2,800,761. The yarn made by my process is claimed in divisional application Ser. No. 557,912 filed January 9, 1956.

What I claim is:

1. A continuous process of making multi-ply coated strands which comprises passing a plurality of separated strands simultaneously through a liquid coating bath consisting of an elastomeric resin dissolved or dispersed in a volatile vehicle, then immediately passing the coated strands under tension through a drying or vulcanizing chamber with concomitant twisting together of the strands so that the strands carrying the coating act as pressure pads to bring about an impregnation of the individual strands, the pressure exerted increasing as the vehicle carrying the resin is evaporated within said chamber; and controlling the time interval and heat which the strands are subjected to within the drying or vulcanizing chamber so that the coating material is set while the multi-ply strand is under tension in and traveling through said chamber.

2. A process of making multi-ply coated strands in one continuous operation which comprises passing a plurality of separated strands simultaneously through a liquid coating bath, then immediately passing the coated strands under tension through a drying or vulcanizing chamber with concomitant twisting together of the strands so that the strands carrying the coating act as pressure pads to bring about an impregnation of the individual strands, controlling the time interval and temperature to which the strands are subjected within the drying or vulcanizing chamber so that the coating is set while the multi-ply strand is under tension in and traveling through said chamber, then passing a plurality of said coated multi-ply strands while separated through a liquid coating bath, then immediately passing the plurality of multi-ply strands through a second drying or vulcanizing chamber with concomitant twisting together of the multi-ply strands in the opposite direction, controlling the time interval and temperature to which the multi-ply strands are subjected within the second drying or vulcanizing chamber so that the coating on the secondary ply is set while the several multi-ply strands are within said second chamber.

3. Apparatus for making coated strands comprising, in combination, means for feeding a plurality of strands; a priming bath through which the strands travel; a drying chamber through which the primed strands travel immediately after said priming; a resinous coating bath through which the dry primed strands travel; a drying or vulcanizing chamber through which the coated strands travel in converging lines immediately after said coating; and a power-driven strand-twisting device rotatably mounted near the discharge end of the drying or vulcanizing chamber and operating to impart a twist to the coated strands within the drying or vulcanizing chamber and beyond the discharge end of said chamber before the coatings thereon have dried; the drying chamber and strand-twisting device co-acting to cause the resin to set while the strands are under tension and are in a fixed position relative to each other.

4. A process of making multi-ply coated strands in one continuous operation which comprises passing a plurality of groups of separated strands simultaneously through a liquid coating bath, then immediately passing the groups of coated strands under tension through a drying or vulcanizing chamber with concomitant twisting together in the same direction of the strands of each group, the strands during the twisting acting as pressure pads to bring about an impregnation of the individual strands, controlling the time interval and temperature to which the strands are subjected within the drying or vulcanizing chamber so that the coating is set while the multi-ply strand is under tension in and traveling

through said chamber, then passing a plurality of said coated multi-ply strands while separated through a liquid coating bath, then immediately passing the plurality of multi-ply strands through a second drying or vulcanizing chamber with concomitant twisting together of the multi-ply strands in the opposite direction from that of the first twist aforesaid, controlling the time interval and temperature to which the multi-ply strands are subjected within the second drying or vulcanizing chamber so that the coating on the secondary ply is set while the several multi-ply strands are within said second chamber.

5. A process for making continuous lengths of composite multi-ply coated strand from a plurality of primary strands comprising simultaneously uniformly advancing a plurality of said primary strands along separate courses, effecting the application of an elastomeric coating material in liquid form to said primary strands during the course of their advance, twisting together liquid elastomeric coated strands while advancing the same under tension to form a plurality of intermediate multi-ply strands each including substantially the same number of primary strands, subjecting said twisted intermediate strands to a treatment effective to set the elastomeric coating and thereby fix the twist in said intermediate strands while continuing uniformly to advance the same, uniformly advancing the plurality of intermediate strands thus formed beyond the twisting and setting zones while overcoming imposition of reverse twist in the said strands as they advance out of said zones, applying an elastomeric coating material in liquid form to said intermediate strands, twisting said plurality of liquid coated intermediate strands together to form a unitary multi-ply composite strand while continuing to advance the same under tension and subjecting said twisted together intermediate strands to a treatment effective to set the said elastomeric coating and thereby permanently fix the twist in the composite multi-ply strand thus formed.

6. The process defined in claim 5 wherein the primary strands in said intermediate strands are all twisted together in the same direction and the intermediate strands in said composite multi-ply strand are twisted together in the opposite direction.

7. The process defined in claim 5 wherein forward movement under tension is imparted to said composite multi-ply strand by a pull thereon which is transmitted to said intermediate strands and through said intermediate strands to said primary strands.

8. A process for making continuous lengths of composite multi-ply coated strand from a plurality of separate primary strands comprising simultaneously uniformly advancing a plurality of primary strands under tension along separate parallel courses, successively priming said strands to receive a coating of an elastomeric coating material and applying a coating of said material in liquid form to said strands while the strands advance along said separate courses, twisting together a plurality of groups of advancing liquid-coated primary strands to form a plurality of intermediate multi-ply strands each including substantially the same number of primary strands while advancing the grouped primary strands under tension along separate predetermined courses through treating zones effective permanently to set said coating, so that the pressure generated between the said twisted tensioned strands effects substantially uniform distribution of coating material in and between the tensioned primary strands in each intermediate strand and the twist is permanently fixed by said coating as the latter sets, uniformly advancing the said permanently set intermediate multi-ply strands while overcoming the tendency for reverse twist to be imposed therein by the twisting performed in said twisting zone, substantially simultaneously coating all of said advancing intermediate multi-ply twisted strands with a liquid elastomeric coating material and twisting together said liquid coated intermediate strands while advancing the same under tension through

a treating zone effective permanently to set said coating, so that the pressure generated between the said tensioned strands effects substantially uniform distribution of the coating material between the said intertwisted intermediate strands and the twist in the composite strand thus formed is permanently fixed by said coating as the latter sets.

9. A process for making continuous lengths of multi-ply coated strand from a plurality of primary strands comprising simultaneously uniformly advancing a plurality of said primary strands along separate courses, coating each of said plurality of strands with a bonding agent and drying said bonding agent while continuing to advance said strands, applying an elastomeric coating in liquid form to said primary strands subsequent to the drying of the bonding agent while continuing to advance the same, twisting together said liquid elastomeric coated strands while advancing the same under tension through a treating zone effective to set said coating so that the pressure generated between said twisted tensioned strands effects uniform distribution of the coating material in and between the said strands and the twist in said strands is permanently fixed by said coating as the latter sets to thereby form a unitary multi-ply strand and advancing the said coated multi-ply strand beyond the said zone while overcoming the tendency for reverse twist to be imposed in the said strand as it advances beyond the zone of twisting.

10. Apparatus for making continuous lengths of multi-ply coated strand from a plurality of primary strands comprising means to supply a plurality of primary strands for longitudinal movement in a forward direction along separate predetermined courses, means for successively coating said primary strands with an agent capable of bonding an elastomeric coating thereto drying said coating and coating the said strand with a liquid elastomeric material as said strands advance over said predetermined courses, mechanism for twisting said liquid-coated primary strands together under tension while continuing to advance the same over a predetermined course so that the coating material is substantially uniformly distributed in and between the primary strands in the multi-ply strand thus formed and means for subjecting said multi-ply strand to a treatment effective to set the said coating while the twist is imposed therein and while continuing to advance the said multi-ply strand over a predetermined course so that the twist is permanently fixed therein, said twisting mechanism including means to compensate for the tendency for reverse twist to be imposed in the portion of the twisted multi-ply strand thus formed as the latter advances beyond said twisting means.

11. Apparatus for making continuous lengths of composite multi-ply coated strand from a plurality of primary strands comprising a plurality of duplicate strand-processing mechanisms each including means to supply a plurality of primary strands for longitudinal movement in a forward direction along separate predetermined courses, means for coating each of said primary strands moving over said courses with a liquid elastomeric material, mechanism for twisting the liquid coated primary strands moving over said courses together under pressure to form a multi-ply intermediate strand and means for subjecting said intermediate strand to a treatment effective to set the said liquid coating material while the twist is imposed in the said primary strands so that the twist is permanently fixed in the said intermediate strand, said twisting mechanism including means to prevent reverse twisting of said intermediate strand after it advances beyond the said twisting mechanism and each of said processing mechanisms operating simultaneously at uniform rates continuously to produce intermediate strands at a uniform rate, means to constrain the said intermediate strands thus formed by said strand processing mechanisms for movement in a forward direction along predetermined courses including means for coating the

intermediate strands with a liquid elastomeric material, means for twisting said liquid coated intermediate strands together under tension to form a multi-ply composite strand, means for subjecting said intertwisted intermediate strands to a treatment effective to set said liquid coating material while the twist is imposed therein so that the twist is permanently fixed in the composite strand thus formed and means for causing said primary, intermediate and composite strands to advance through the said apparatus as aforesaid.

12. Apparatus as defined in claim 11 wherein the means for twisting together primary strands in each of the duplicate strand processing mechanisms twists the primary strands together in one and the same direction and the means for twisting the intermediate multi-ply strands together twists these latter strands in the opposite direction.

13. Apparatus as defined in claim 11 wherein the intermediate strand twisting means includes means for reeling up the composite multi-ply strand after the coating thereon has set so that a pull is applied to the said composite strand which is transmitted back to said primary strands through said intermediate strands so that

said primary, intermediate and composite strands are advanced through the said apparatus under tension.

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