

Sept. 27, 1932.

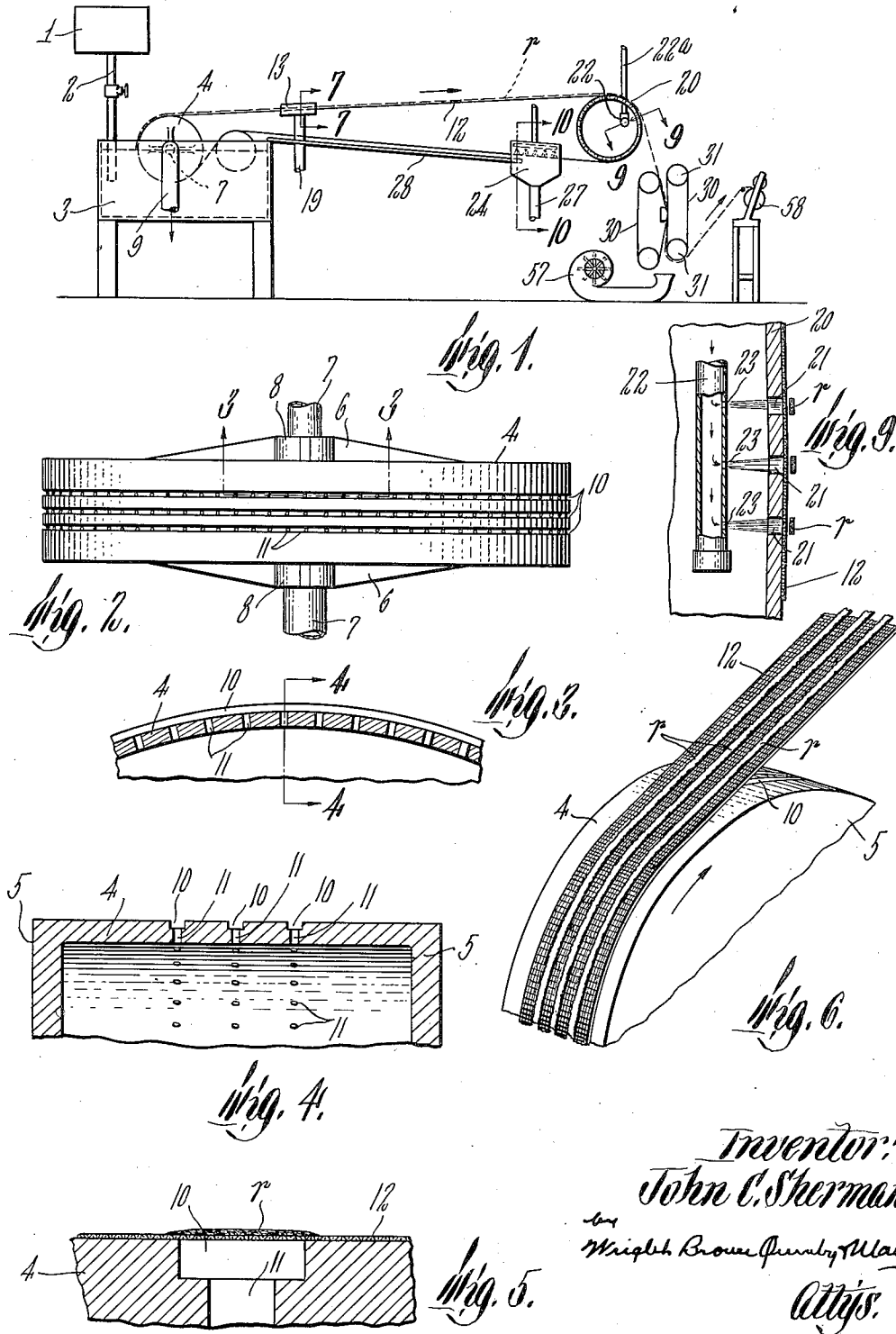
J. C. SHERMAN

1,880,056

MANUFACTURE OF ROVINGS, YARNS, TWINES, AND THE LIKE

Filed Feb. 6, 1930

3 Sheets-Sheet 1



Inventor:
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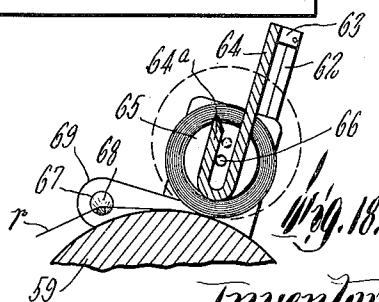
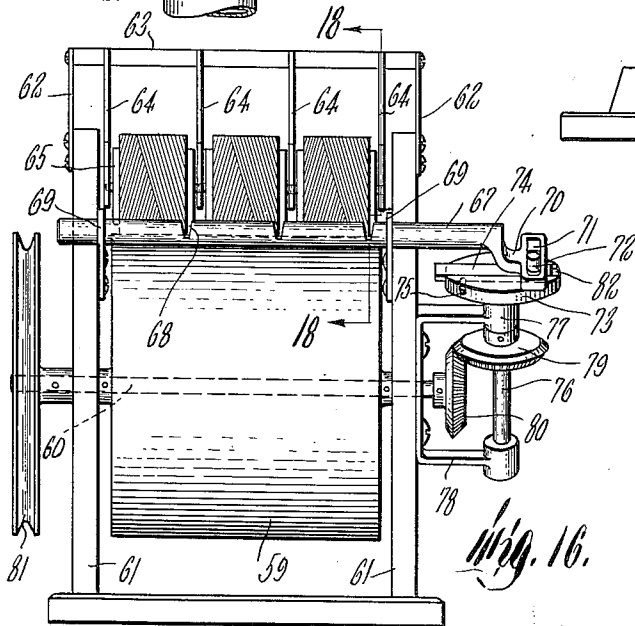
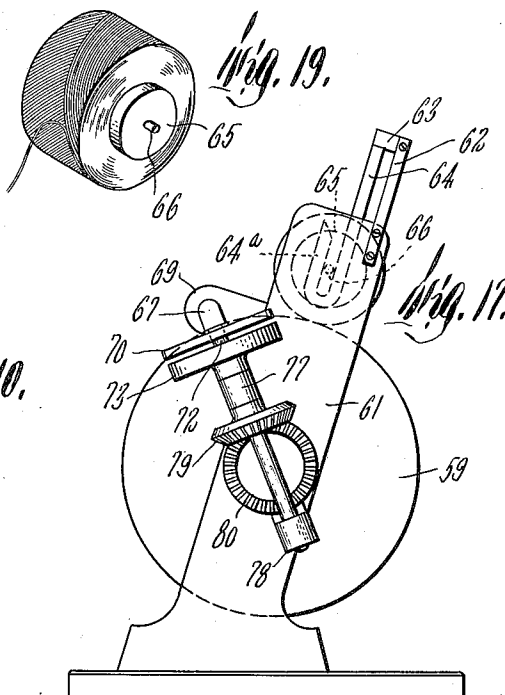
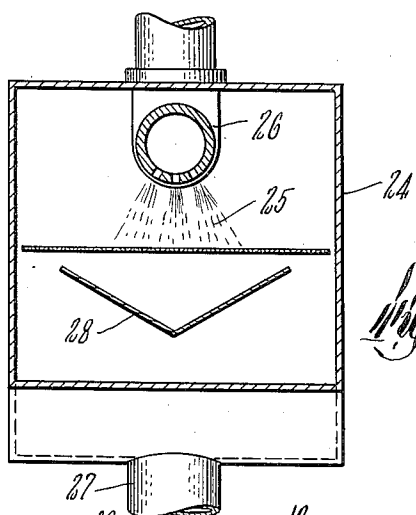
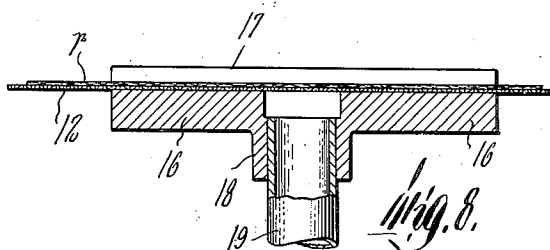
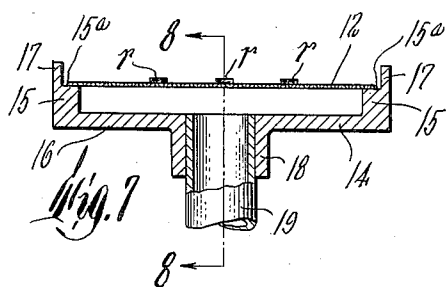
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MANUFACTURE OF ROVINGS, YARNS, TWINES, AND THE LIKE

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3 Sheets-Sheet 2



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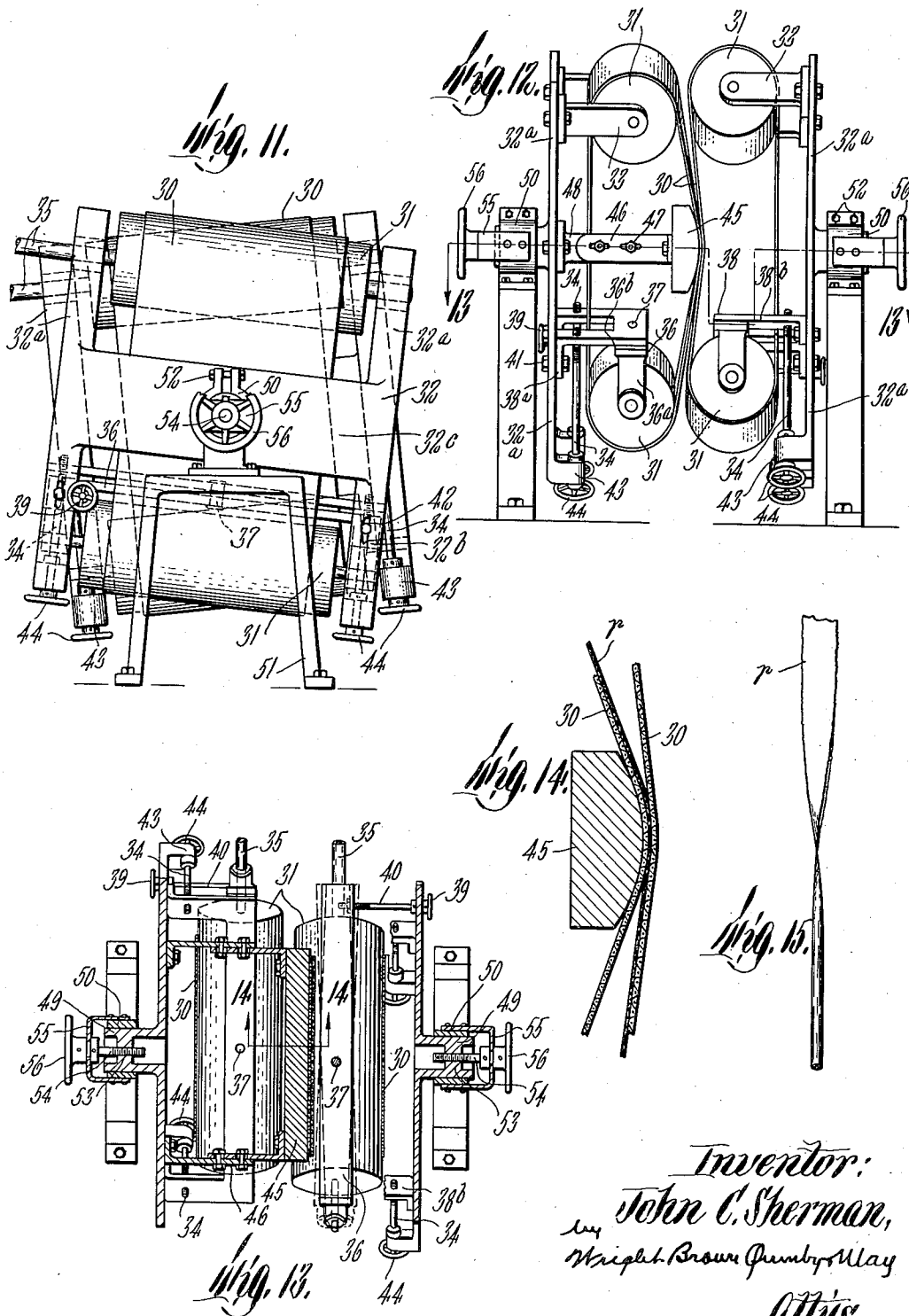
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MANUFACTURE OF ROVINGS, YARNS, TWINES, AND THE LIKE

Filed Feb. 6, 1930

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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MANUFACTURE OF ROVINGS, YARNS, TWINES, AND THE LIKE

Application filed February 6, 1930. Serial No. 426,273.

This invention relates to the manufacture of fibrous strands such as are used in twines or fabrics. Such products have heretofore been produced from fibrous material of long staple, such as cotton, on carding and drawing machinery, but such machinery is capable of operating successfully only upon comparatively long fibers. An object of the present invention is to make possible the use of the enormous and comparatively inexpensive supplies of short-fibered raw materials, such as the chemical wood pulps, in the manufacture of fibrous strand material such as rovings, yarns, and twines. Another object is to provide an inexpensive method of and apparatus for manufacturing large quantities of such fibrous strands having characteristics comparing so favorably with strands made from fibrous material of long staple on textile machinery, as to be capable of replacing the usual product in various fields, for instance, as wrapping or "grocery" twines.

In attaining the foregoing objects in accordance with the present invention, the short-fibered raw material is initially suspended in water and is progressively deposited as continuous, separate ribbons of wet pulp on a moving, endless, foraminous carrier, such as a Fourdrinier wire. While on the wire, the ribbons of pulp are partially dewatered, as by suction and/or drying, to a water content at which they are self-sustaining, whereupon they are rolled or furled into strands. Preferably, rolling or furling is effected at an angle to the center line of the strips, as this results in uniform strands of maximum strength. It is desirable to permit the wet strands or rovings to fall or to be conveyed from the angular rolling operation into cans such as are commonly used in the textile arts. In this event, it is not essential to rotate the cans, since the angular rolling has given to each roving a torsional stress under which the freely falling roving will coil itself in the can, even if the can itself is stationary. Depending upon the angle at which the rolling operation is performed and upon the quality and condition of the fibrous material itself, the radius of the coil so formed can be made either long or short, as may be desired;

and it is desirable to use cans of internal radius comparable thereto, especially if stationary cans are used. With rotating cans, the radius of the can may be, and preferably is, materially larger than that of the coil. Subsequent to such coiling in cans, the wet strands may be increased in strength by twisting, whereupon two or more strands may be brought together and twisted into coarser yarns of higher strength. As an alternative to the use of cans, the employment of which requires no pictorial representation, it is sometimes convenient to accumulate the wet rovings as delivered from the rolling operation, directly to cores, bobbins, or jack spools. Such delivery of wet rovings, either to cans or to jack spools, permits the running of the strand-forming apparatus at a speed independent of that of the twisting machines, and further makes possible easy and accurate control of the moisture content of the strands for twisting. This last feature is desirable, in that the moisture content at which twisting operations are most successfully conducted usually differs from that of the wet strands undergoing accumulation. By first suitably accumulating the wet strands as they come from the strand-forming apparatus, not only may they be stored to provide stock for the twisting machines when the strand-forming apparatus is idle, but they may be permitted to dry and then be moistened to a condition at which they undergo uniform and permanent twisting without breakage. It is not desirable, however, to dry the rovings completely at any stage prior to final twisting. If complete drying does occur, it is necessary to rewet the rovings in preparation for final spinning or twisting, since it appears that the best tensile strength and other qualities in the finished string or yarn is reached only when the rovings are to some extent wet while being twisted.

While the method of the present invention lends itself to practice with apparatus subject to considerable variation, I shall hereinafter deal largely with a particular apparatus which has been found to give eminently satisfactory results in actual practice. Briefly

stated, the apparatus may comprise a suction roll constructed to allow passage of water into the roll only over comparatively narrow, spaced, circumferential zones. An endless, moving Fourdrinier wire passes about the roll, which is rotated partially submerged in a pulp suspension. The water of the pulp suspension, in passing into the roll, progressively deposits the wet pulp as spaced, continuous ribbons on the wire, which carries the ribbons out of contact with the pulp suspension. The ribbons are then dewatered while supported on the wire to the moisture content desired for rolling or furling. The rolling or furling of the strips is preferably effected by their delivery between two endless belts, which move angularly in contact with each other so as to roll or furl the strips at an angle to their center lines.

Various factors of importance have been determined in carrying out the method of the present invention. It has been found that the pulp suspension used in forming the ribbons should be of a concentration such that ribbons of a thickness in the order of magnitude of .001 to .005 of an inch are deposited on the wire. The particular concentration of pulp suspension used depends, among other factors, upon the rate of travel of the wire and the suction maintained in the roll over which the wire passes. The ribbons may be of a width of about $7/32$ of an inch or less, and their edges are preferably irregular or ragged, and thinner than their main body portions, as these qualities in the edges conduce to strands which maintain their rolled form well by reason of the locking or bonding to the main body portions of the fibers of the edge portions. The ribbons are preferably rolled at a moisture content of less than about 75%. My process is contingent upon the maintenance in the ribbon during the rolling operation of a suitable water content. My process, is however, tolerant of a wide range in the percentage of water present in the ribbon. The optimum percentage is broadly fifty, taken in the sense that equal weights of water and of bone-dry fiber are present. However, it is economically essential that the ribbons be formed at relatively high speed, and, wherefore, the character of the product is dependent upon the speed of ribbon formation. Thus, at a rate of manufacture of 200 linear feet per minute, my ribbons are of high quality, but at such speed it is difficult to dewater the ribbons to 50% without the use of special dewatering equipment. In such case, my furling mechanism may receive ribbons containing 75% of water, i. e., 3 pounds of water to 1 pound of bone-dry fiber, and deliver a satisfactory roving. Such degree of dewatering is conveniently reached, with the particular fibers I employ, by the agency of suction alone. I may, if desired, reduce the

water content of the ribbon to 50% by squeezing and/or drying by heat.

At the stage of wetness represented by the upper and lower limits of 75% and 50% wetness, my ribbons are in a condition quite different from that of dried paper ribbons which have been rewetted, and they are capable of conversion into textile products of much better quality. Evidently colloidal or gelatinized cellulose is present in the pulp to augment the strength of the strands by its binding qualities. Once dried, the gelatinized cellulose evidently does not regain its binding qualities in the presence of water, as attested by the fact that strands made from previously-undried pulp ribbons are invariably stronger than those made from dry paper or pulp strips which have been wetted with water.

With these and other objects and features in view, the invention will now be more completely described in conjunction with the accompanying drawings, wherein

Figure 1 is a more or less diagrammatic view of the apparatus as a whole.

Figure 2 is a plan view of the suction roll over which the Fourdrinier wire passes.

Figure 3 is a fragmentary section on the line 3—3 of Figure 2.

Figure 4 is a similar section along the line 4—4 of Figure 3.

Figure 5 is an enlarged section axially of the roll through a section zone and shows the screen passing over the roll and carrying a pulp ribbon.

Figure 6 is a perspective of a fragment of the roll and the overlying wire carrying continuous ribbons of pulp from the pulp suspension.

Figure 7 represents a section on the line 7—7 of Figure 1 and shows a suction box over which the wire and superposed pulp ribbons pass.

Figure 8 is a section on the line 8—8 of Figure 7.

Figure 9 is a section on the line 9—9 of Figure 1 and shows means for removing the ribbons from the wire for delivery to the belts.

Figure 10 is a section on the line 10—10 of Figure 1 and shows means for washing residual fiber from the screen before its return to the suction roll.

Figure 11 is a front view of the mechanism for rolling or furling the ribbons to round form.

Figure 12 is a side view of the same.

Figure 13 represents a section on the line 13—13 of Figure 12.

Figure 14 is a somewhat enlarged section along the line 14—14 of Figure 13, showing the contacting areas of the belts.

Figure 15 illustrates the manner in which a ribbon is rolled or furled to round form as it passes between the contacting surfaces of the belts.

Figure 16 is a front view of the mechanism for accumulating the strands as they issue from between the belts.

Figure 17 is a side view of the mechanism.

Figure 18 represents a section on the line 18—18 of Figure 16.

Figure 19 shows in perspective the strand material wound on a core.

Referring in detail first to Figure 1 of the drawings, 1 represents a tank in which a supply of pulp suspension may be maintained at a consistency suitable for forming the pulp ribbons. The suspension may be withdrawn from the tank through a valved pipe 2 feeding at the desired rate into a vat 3 in which a suction roll 4 rotates partially submerged in the pulp suspension. As shown in Figure 2, the roll consists of a hollow cylinder closed at its ends. It may be cast as a unit from suitable metal, such as bronze, and have ends 5 reinforced by radial ribs 6. The roll is provided with trunnions 7 whose inner ends 8 are shown enlarged and fixed in suitable openings formed through the ends of the roll. The trunnions pass through the side walls of the vat 3 and are rotatably journaled in pipes 9 which communicate with a suction pump (not shown). The peripheral wall of the roll is of substantial thickness, so that a plurality of spaced, circumferential grooves 10 may be formed therein and a series of spaced apertures 11 preferably of a diameter somewhat smaller than the width of the grooves may be drilled from the bases of the grooves to the interior or hollow of the roll. These apertures constitute channels for the passage of water into the roll, so that when an endless Fourdrinier wire 12 is moved in tight contact about the roll, as illustrated in Figure 1, pulp ribbons *r* are formed on the wire in the wire zones riding over the grooves 10. The edges of the ribbons, as shown in Figures 5 and 15, are thinner than their main body portions and are irregular or ragged, as there is no sharp line where deposition of pulp leaves off. The pulp ribbons carried on the screen are partially dewatered as they pass over the unsubmerged portion of the cylinder mould, but they are too wet at this stage to be self-sustaining. Accordingly, they are subjected to more dewatering and, as shown, this is accomplished by passing the wire over a suction box 13. The suction box shown consists of a trough 14 having upstanding wall portions 15, against the upper edges 15a of which the marginal portions of the wire are supported. The wire is guided to and from the box over suitable aprons 16, projecting forwardly and rearwardly of the box and whose surfaces are on the same plane as that of the edges 15a. A substantial lateral displacement of the wire while passing over the box is prevented by rails 17 projecting upwardly from the upper edges of the wall 15. The bottom of the box has a nipple 18 pro-

jecting therefrom for the reception of a suction pipe 19 communicating with a suitable suction pump (not shown). Various degrees of suction may be applied to dewater the ribbons; and I may employ a plurality of suction boxes or their equivalent. In any event, the suction applied to the ribbons is preferably sufficient to reduce the water content to an upper limit not exceeding about 75%. The wire carries the partially dewatered ribbons from the suction box 13 over a drum 20, which is provided with rows of perforations 21 circumferentially thereof and so arranged that as the wire passes over the drum, the ribbons may be removed from the wire by air blasts directed through the perforations. The air blasts may issue from a pipe 22 arranged inside of the drum 20 and having apertures 23 in line with the apertures 21. Compressed air may be supplied to the pipe 22 from a pipe 22a which communicates with a suitable air pump (not shown). The screen passes from the drum 20 through a chamber 24, wherein water sprays 25 impinge thereon from a pipe 26, to wash residual fibers therefrom. The wash water falling to the bottom of the chamber may be carried away through a drain pipe 27 and water carried by the wire from the chamber 24 may be caught in an inclined trough 28 discharging into the chamber 24. The wire completes its travel by passing over the guide roll 29 to the suction roll 4.

The pulp ribbons removed from the wire are led downwardly between a pair of endless belts 30 moving in substantially vertical planes into contact with each other at the desired angularity. As the pulp ribbons pass into the nip of the belts, they are rolled or furled under pressure, so that they emerge from the nip of the belts in round form, as illustrated in Figures 14 and 15. Belts of such materials as rubber and leather may be employed, but canvas belts such as made from two-ply, 12-ounce duck, have been found to be particularly satisfactory, in that they remove excess moisture from the ribbons, require low pressure of contact to roll out the ribbons, produce strands of uniformity and strength, and withstand the stresses of use. The angle at which belts are run may be varied, but an angle of about 9° to 10° not only produces the desired rolling or furling action upon the ribbons, but no trouble is experienced as a result of one ribbon being brought into contact with another. Each belt is mounted on a pair of spaced, parallel rolls 31, slightly inclined to the horizontal, the rolls for one belt being inclined at a positive angle, and the rolls for the other belt at a negative angle, so that angularity of motion between the belts represents the sum of both angles. The rolls for each belt are carried by a single frame 32, which, as shown, takes the form of an H. The upper roll of each pair is journaled for rotation in a pair

of brackets 33 projecting from the uprights 32a of one frame toward the opposite frame. The shaft 35 at one end of an upper roll may extend sufficiently beyond this bracket so that a pulley or other suitable driving means (not shown) may be affixed thereto. Both the upper rolls are driven at the same rate of speed and serve to drive the belts and the lower rolls, but, if desired, the lower rolls may be the driven ones. The lower roll of each pair is journaled for rotation in a bracket which, as best shown in Figure 12, takes the form of a stirrup 36, the legs 36a of which receive the shaft of the roll, and the horizontal portion 36b of which is fastened by a swivel 37 to a hanger 38 projecting from the frame 32. Swinging of this roll is prevented by a horizontal screw member 40, one end of which is in threaded engagement with a leg 36a of the stirrup 36, and the other end of which is rotatably fixed in the frame 32 and is provided with a hand-wheel 39, which may be turned to make accurate adjustment of one end of the roll toward and from the opposing roll and thus to produce uniformity of pressure over the contacting areas of the belts. The hanger 38 is fixed to the frame in a manner to permit change of the angularity of the lower roll out of parallelism with the upper roll and thus to keep the belts properly centered on the rolls if they have a tendency to ride to one side. To this end, the hanger is in the form of a horizontal, U-shaped member having down-turned leg portions 38a which are fixed to the uprights 32b of the frame by bolts 41 passing through vertical slots 42 formed in the uprights. By loosening the bolts, either end of the roll may be raised or lowered, as desired. In order to make possible small, accurate adjustments, the raising or lowering of the roll is effected through screw members 34, the upper ends of which are in threaded engagement with the horizontal portions 38b of the hanger, and the lower end portions of which are fixed for rotation in bearing members 43 forming part of the frame. The lower end portions of the screw members 34 project sufficiently beyond the bearing members 43 so that hand-wheels 44 may be affixed thereto for the turning of the screw members. The frame members 32 are so spaced from each other that there would normally be a substantial clearance between the confronting stretches of the belts, but one of the belts passes over a board 45 arranged to cause its bulging into contact with the other belt. The surface of the board 45 over which one of the belts passes is smoothly finished to a convex curvature designed to minimize frictional wear on the belt, and the board is of sufficient width to establish the desired area of contact between the belts. The board is shown fixed at its ends to horizontal brackets 46, which, in turn,

are adjustably fixed as by bolts 47 to horizontal brackets 48 extending from the adjacent frame 32.

The frames 32 are so mounted that the pressure of contact between the belts and their angularity may be quickly varied. To this end, the cross-member 32c of the frame 32 is provided with a hub portion 49 which is clamped in a member 50 fixed to a standard 51 which is shown fastened to the floor. The clamp member comprises bolts 52 which when loosened permit a horizontal and angular movement of the frame. The hub 49 comprises a bridge element 53, which is in threaded engagement with the inner end of a screw member 54 rotatably fixed in a bracket 55 suitably secured to the clamp member 50. The outer end of the screw member 54 is provided with a hand-wheel 56, which may be turned to effect an adjustment of the pressure of contact between the belts.

The strands emerge from between the belts with practically the same moisture content as when they entered therebetween. They may be increased in strength for the accumulating operation by drying, and, as illustrated in Figure 1, this may be accomplished by passing them through a current of warm air delivered from a suitable air blower 57. The strands are then delivered to a suitable accumulating device 58. The drawings chosen for this disclosure are based on the use of jack spools to be now more fully described, but it should be remembered that I may omit the jack spool and substitute therefor the familiar roving can, either rotating or stationary, as stated above, for each roving, or group of rovings. The device employed, as best shown in Figure 16, comprises a rotary drum 59, the shaft 60 of which is journaled for rotation in suitable spaced frames 61. Projecting from the upper end portions of the frames are a pair of uprights 62, which are tied together at their upper ends by a cross-bar 63 from which depend a series of hook-shaped members 64. The strands may be delivered to suitable cores or spools 65 having spindle ends 66 engageable in the hook portions 64a of the member 64, which permit the rotation of the cores and their upward movement. The cores bear against the periphery of the drum 59, so that as the drum rotates it causes winding of the strands on the cores and gradual upward movement of the cores as the thread bodies build up thereon. The strands may be wound diagonally on the cores by suitably guiding them as they are being wound. The guiding mechanism shown comprises a reciprocatory bar 67 arranged in parallel relation to the axes of the cores and having notches 68 formed therein for directing the strands to the cores. The bar 67 passes through suitable openings formed in supports 69 projecting angularly from the framework 61, and may advance

tageously derive its motion from the rotation of the drum 59. To this end, the bar terminates in a slotted portion 70 in the slot 71 of which is loosely engaged a pin 72 eccentrically fixed to a disc 73. The pin may form part of a key 74, which is fixed in a slot 82 in the disc 73, as by a set screw 75, which may be loosened to adjust the eccentricity of the pin. By changing the eccentricity of the pin, reciprocatory travel of the bar may be varied so as to increase or decrease the width of the thread bodies being wound on the cores. The disc 73 forms the end portion of a shaft 76 which is journaled in brackets 77, 78 projecting outwardly from the framework 61. Between the brackets 77, 78, to the shaft 76 is fixed a bevel gear 79 meshing with a bevel gear 80 fixed to one end of the drum shaft 60. To the other end of the shaft 60 is fixed a pulley 81 which may be driven from a suitable source of power (not shown).

One of the many advantages of a method and apparatus such as described is that the initial fibrous formation or texture of the pulp ribbons remains undisturbed until the rolling or furling operation. This is made possible by avoiding bringing the ribbons into contact with instrumentalities such as pick-up felts, which tend to weaken the pulp ribbons, particularly when they are associated with considerable water and are hence in a tender state. The pulp ribbons which I produce on the Fourdrinier wire are not subjected to substantial pressures while they are on the wire, and, after removal from the wire are fed directly between the rolling or furling belts, which produce uniform strands of greatly increased strength.

The strand material accumulated on the cores (if not already dry) may be dried, but, before being twisted, should be moistened in order to effect a uniform and permanent twist. It has been found that a twist of about 11.7 turns per inch results in strands of maximum strength with most chemical wood pulps. The twisted single strands may then be united and twisted into multi-ply yarns, a three-ply yarn preferably being given a twist of about 8.5 turns per inch. The multi-ply yarns have tensile strengths comparable to that of cotton "grocery" twine of the same weight, and are hence eminently suitable for such use. The twines may be treated with agents which impart such properties as softness, waterproofness, and strength thereto. For example, they may be impregnated with glycerine, which softens them considerably, or with waterproofing and strengthening materials, such as latex or dispersed asphalt. Various types of cellulose pulps may be used as a raw material, each type of pulp giving a product having a particular set of characteristics. The various chemical wood pulps, including kraft and sulphite pulp, may be successfully employed, but those wood pulps

which have especially good papermaking characteristics, such as the strong, refined wood pulps of substantial pentosan content, have been found to give the best products, some of which even excel cotton products of equivalent weight. Preferably, the pulp is used in unbeaten condition, as the length of fibers is thereby preserved to yield products of maximum strength.

I claim:

1. A method which comprises progressively depositing directly on a foraminous carrier from an aqueous pulp suspension continuous separate strips of interfelted fibers, removing said strips from said carrier, and rolling said strips as self-sustaining units into strand form while they are in practically the same condition of formation or texture as on the carrier at their removal.
2. A method which comprises progressively depositing from an aqueous pulp suspension continuous ribbons of wet pulp directly on a moving, endless, foraminous carrier, dewatering the ribbons while supported on said carrier to a moisture content at which they are self-sustaining, removing the ribbons from the carrier, and directly rolling the ribbons as self-sustaining units at an angle to their lengths into strand form while in practically the same condition of formation or texture as on the carrier at their removal.
3. A method which comprises progressively depositing from an aqueous pulp suspension continuous ribbons of wet pulp on a moving, endless, foraminous carrier, dewatering the ribbons to a moisture content of about 50% to 75%, removing the ribbons from the carrier, and rolling the ribbons as self-sustaining units into strand form in practically the same condition of formation or texture as on the carrier at their removal.
4. A method which comprises forming continuous, self-sustaining ribbons of wet pulp having continuously irregular edge portions, and rolling said self-sustaining ribbons into strands consisting of pulp throughout.
5. A method which comprises forming continuous, self-sustaining ribbons of wet pulp having continuous edge portions thinner than their main body portions, and rolling said self-sustaining ribbons into strands consisting of pulp throughout.
6. A method which comprises forming continuous, self-sustaining ribbons of wet pulp having edge portions which are continuously irregular and thinner than their main body portions, and rolling said self-sustaining ribbons into strands consisting of pulp throughout.
7. Apparatus of the class described, comprising in combination an endless, foraminous carrier, means for progressively depositing continuous separate ribbons of pulp on said carrier, means for removing the ribbons as self-sustaining units from said car-

rier, and means for rolling said self-sustaining ribbons into strands directly upon the removal of said ribbons from said carrier.

8. Apparatus of the class described, comprising in combination, an endless foraminous carrier, means for progressively depositing continuous, separate ribbons of pulp on said carrier, a rotary drum over which said carrier passes, means for removing the ribbons from the carrier as it passes downwardly over said drum, and a pair of belts for rolling said ribbons into strands moving in substantially vertical planes into contact with each other and into the nip of which said ribbons pass from said drum.

9. Apparatus of the class described, comprising in combination, an endless foraminous carrier, means for progressively depositing continuous, separate ribbons of pulp on said carrier, a rotary drum over which said carrier passes, perforations in the periphery of said drum in line with the zones of the carrier on which said ribbons are supported, air blasts directed through said perforations to remove the ribbons from said carrier as it passes downwardly over said drum, and a pair of belts for rolling said ribbons into strands moving in substantially vertical planes into contact with each other and into the nip of which said ribbons pass from said drum.

10. Apparatus of the class described, comprising in combination a vat for containing an aqueous pulp suspension, a roll partially submerged in said pulp suspension and allowing passage of water thereinto over comparatively narrow, spaced, circumferential zones, an endless, foraminous carrier passing over said roll and through which the water of the pulp suspension may pass into said roll to deposit continuous ribbons of pulp on said carrier, means for dewatering the pulp ribbons while carried by said carrier, means for removing the ribbons from the carrier, and means for rolling the pulp ribbons into strands.

11. A hollow suction roll comprising a peripheral wall having a plurality of spaced, circumferential grooves therein and a series of spaced apertures of a diameter less than that of the width of the grooves formed through the wall from the bases of the grooves.

12. Mechanism of the class described comprising a pair of endless belts arranged to move in contact with each other at an angle, a pair of rolls for supporting each belt, supports for said rolls and with which at least one of each pair of rolls is in swivelling engagement, said swivelled roll being capable of swinging movement to bring an end thereof toward and from the corresponding roll of the other pair, and thus to adjust the pressure of contact between the belts.

13. Mechanism of the class described, comprising a pair of endless belts arranged to

move in contact with each other at an angle, a pair of rolls fixed in parallel relation for supporting each belt, and means for moving at least one roll of each pair out of parallelism with the other roll of the pair.

14. Mechanism of the class described, comprising a pair of endless belts arranged to move into contact with each other at an angle, a pair of rolls for supporting each belt, stationary opposing frames on each of which a pair of said rolls is carried, and means for adjusting at least one of said frames angularly and toward and from the opposing frame.

15. A hollow roll comprising a peripheral wall having a plurality of spaced, circumferential grooves therein and a series of spaced apertures formed through the wall from the bases of the grooves.

16. Apparatus of the class described, comprising in combination a hollow roll whose peripheral wall is circumferentially grooved and is apertured through the bases of said grooves to provide channels from the exterior of said roll into its hollow, an endless wire cloth passing over said roll, and means for feeding an aqueous pulp suspension onto said wire cloth as it passes over said roll, whereby water of said pulp suspension is caused to pass through said channels from the exterior of said roll into its hollow and to deposit ribbons of pulp on said cloth.

In testimony whereof I have affixed my signature.

JOHN C. SHERMAN.