Sept. 25, 1956 W. P. DOOLEY 2,764,012

FLUID PROCESSING SYSTEM FOR RUNNING STRAND

Filed Aug. 5, 1953 2 Sheets-Sheet 1

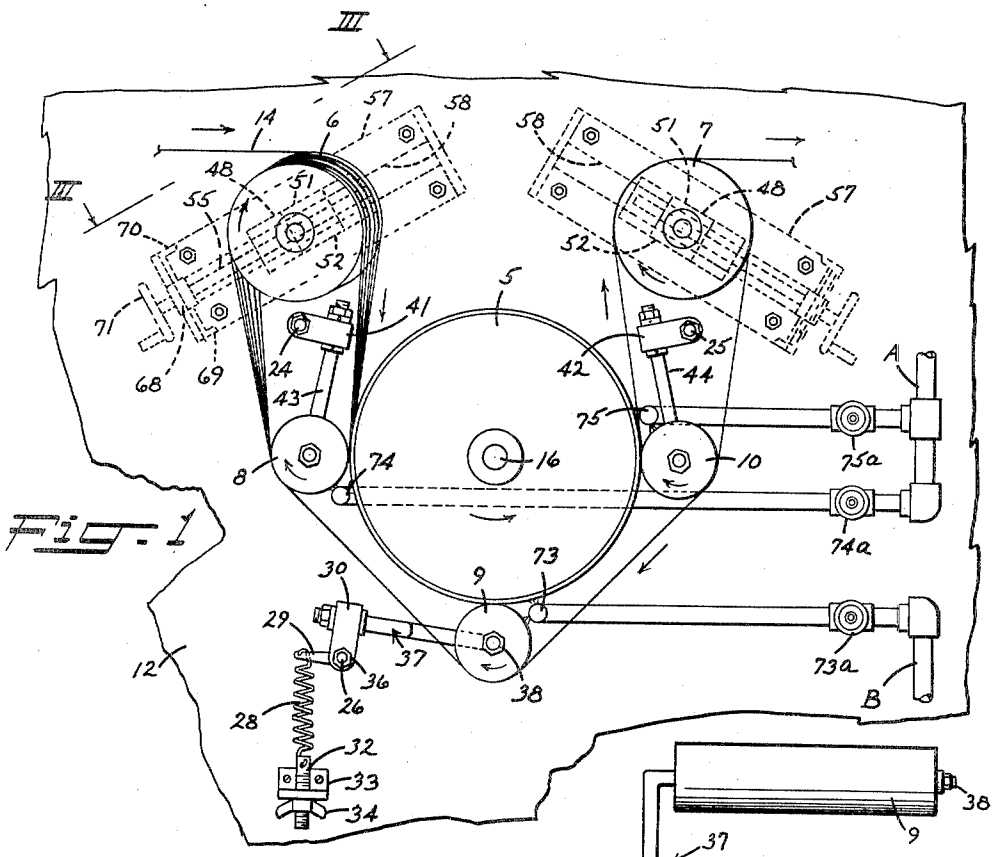


Fig. 1

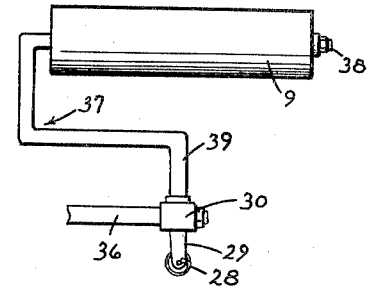


Fig. 5

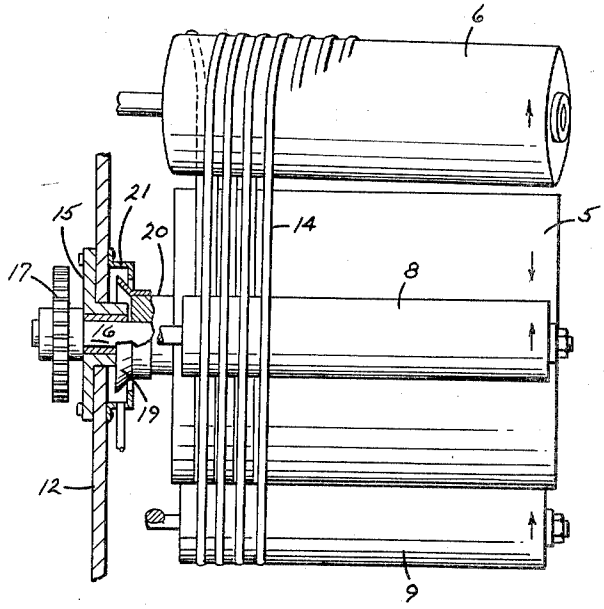


Fig. 2

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FLUID PROCESSING SYSTEM FOR RUNNING STRAND

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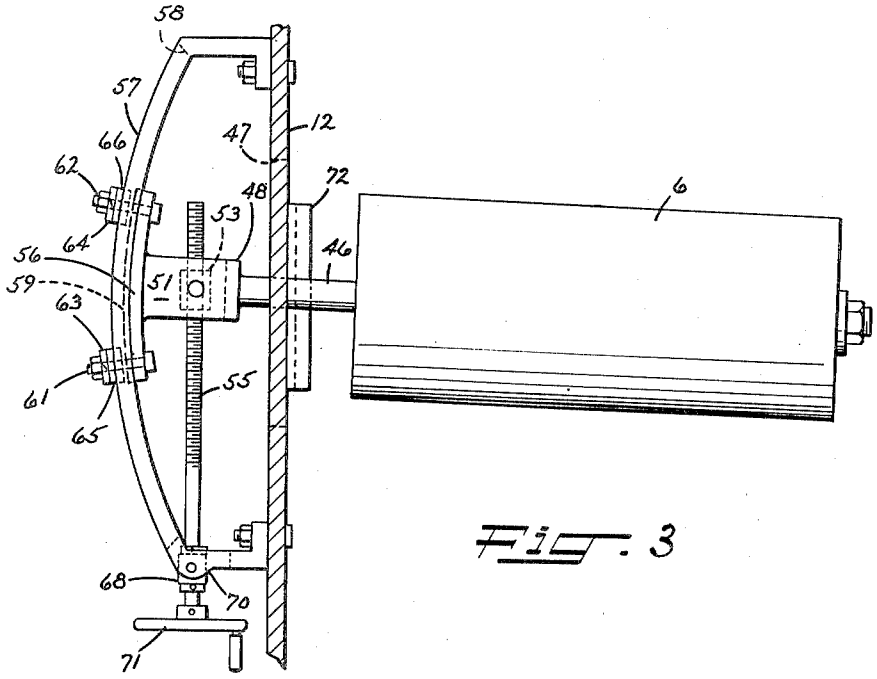


Fig. 3

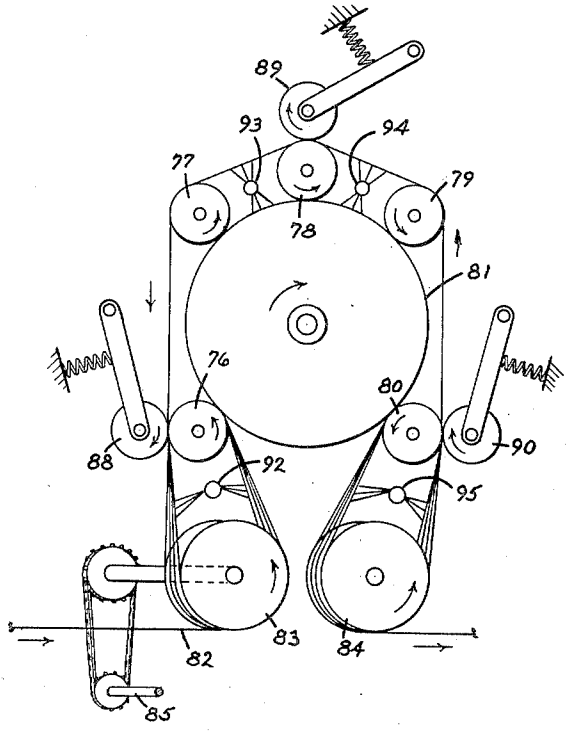


Fig. 4

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FLUID PROCESSING SYSTEM FOR RUNNING STRAND

William P. Dooley, South Charleston, W. Va., assignor to American Viscose Corporation, Philadelphia, Pa., a corporation of Delaware

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10 Claims. (Cl. 68—205)

The present invention relates to processing of running strands and particularly to the storage of a considerable quantity of a textile strand within a relatively small space while maintaining all portions of the stored strand in continuous advancement.

The problem that most frequently arises in using the strand-storage thread-advancing systems of the prior art is the difficulty of storing sufficient yardage of the strand within one or a plurality of adjacent treatment regions. Sufficient storage usually entails simply the provision of thread-advancing reels or other storage devices for running yarn of such size or area as required to support a desired yardage of yarn. If the length of yarn to be stored is large, e. g., such yarn length as needed to carry out the liquid treatment, then storage reels or rolls of sufficient size must be provided with due consideration for the size and capacity of housings therefor, liquid-feeding systems, and driving equipment for such strand storage devices. Moreover, a plurality of treatments applied to a textile strand usually involves duplication or extension of the equipment required for each treatment.

An important object of the invention is to provide a storing and advancing system for a running strand capable of storing a considerable length of the strand within less space than required for conventional systems. It is another object to provide a liquid-treating system wherein a large length of a running strand may be subjected to a plurality of cycles of liquid application, and stripping of the liquid from the strand within such cycles within a relatively small space. It is still another object to provide apparatus in accordance with either one or both of the above mentioned objects wherein the strand is stored in a plurality of parallel convolutions which are advanced laterally relative to the length of the strand whereby the strand is continuously fed into and discharged from the apparatus, such apparatus being readily adjustable to change the relative spacing of the convolutions. A further object is to provide an apparatus for carrying out the foregoing objects that is readily laced. It is furthermore required that such apparatus be simple in construction and easily maintained. Other objects, features, and advantages will become apparent from the following description of the invention and the drawing relating thereto in which:

Fig. 1 is a front elevation of apparatus in accordance with one embodiment of the invention;

Fig. 2 is a fragmentary elevation of the apparatus illustrated in Fig. 1 with portions of the apparatus shown in section;

Fig. 3 is a fragmentary section view taken along line III—III of Fig. 1;

Fig. 4 is a schematic elevation of a modification of the invention; and

Fig. 5 is an enlarged plan view of the lowest squeeze roll assembly as shown in Fig. 1.

Briefly stated, the invention concerns a strand-advancing and storing system which comprises a plurality of rolls disposed to distribute the strand in one or more

complete convolutions extending progressively over the inner periphery and the outer periphery of a U-shaped region. The U-shaped disposition of the strand is obtained by a plurality of squeeze rolls supported on substantially parallel axes along the periphery of a main or central roll having an axis substantially parallel to the squeeze roll axis, and a pair of spaced guide rolls disposed at the ends of the U-shaped regions and having their strand-supporting surfaces in generally laterally spaced co-extensive relation with the strand-supporting periphery of the central roll which functions also as a guide roll within the thread-advancing system.

The guide rolls and the central roll or any one, or any two or more of these rolls may be driven whereby the entire system is driven when laced with the strand by the friction thereof with the non-positively driven rolls. One or more spray or liquid-discharging devices may be disposed within the U-shaped region whereby liquid may be discharged against the rolls or into the yarn transversing the inner periphery as well as the outer periphery of this region.

Fig. 1 illustrates in front elevation a system in accordance with one embodiment of the invention which comprises a central process roll 5, a pair of guide rolls 6 and 7, and three squeeze rolls 8, 9, and 10. All of the rolls are supported in cantilever fashion from a panel 12. In this particular embodiment, the roll 5 is driven and when a strand 14 is laced around the rolls through a number of U-shaped convolutions as indicated by Figs. 1 and 2, the entire system is driven by frictional transmission of power from the roll 5 to the strand and the transmission from the latter to the other rolls by friction in the manner of a conventional belt drive.

From Fig. 2 it may be seen that the roll 5 is preferably rotatably supported by the panel 12 and a bearing 15 secured thereto having a bore through which the shaft 16 on which the roll 5 is mounted extends. The shaft 16 supports a means, such as a gear 17 keyed on the shaft, for connecting the roll in driving relation with a motor or power supply shaft. To protect the bearing from the liquid applied to the strand, a baffle system surrounding the bearing is provided which comprises a conical collar 19 attached to the hub 20 of the roll 5 and an annular collar 21 attached to the panel 12.

The squeeze rolls 8, 9, and 10 are supported so as to be self-aligning with respect to the periphery of the roll 5 and yet be held with their axes of rotation parallel with the axis of the roll 5 when urged into substantial contact with the periphery thereof or against convolutions of the strand 14 extending around the roll.

It is desired during operation that the squeeze rolls be self-aligning with their axes substantially parallel to the axis of the roll 5 so that the squeeze rolls bear with uniform pressure against all convolutions of the strand. These rolls are held in contact with the periphery by the portion of the strand passing along the outer periphery of the U-shaped region enclosed by the strand convolutions. The swing axes of the squeeze rolls at 24 and 25 may be disposed as shown so that the rolls 8 and 10 may hang in a natural position of rest practically in contact with the roll 5 without exerting pressure thereagainst. At this position, the axis of each roll (8, 10) will extend approximately within a separate plane for each axis containing the axis of the roll 5. This arrangement produces equal pressure of the rolls against the strand passing along opposite sides thereof.

The weight of the roll 9 and its supporting assembly tends to carry it downwardly away from the roll 5 whereby greater pressure is exerted on the strand passing along the under surface of the squeeze roll 9, than on that passing between it and the periphery of the roll 5. Such weight is counteracted by a suitable load-applying

device, such a tension spring 28 which extends between an eye portion 29 of a bearing block 30 and a bolt 32. The bolt is adjustable relative to a stationary bracket 33 through an aperture thereof by a wing nut 34 to increase or decrease the tension exerted, by the spring. The tension of the spring may be changed to obtain equal pressure on the strand passing along the opposite sides of the roll 9 or greater pressure on one side than the other in any manner desired. Obviously the force provided by the spring 28 to counteract the weight of the roll 9 and a supporting axle 37 therefor may be supplied by means such as counterweights or a pneumatic cylinder.

The bearing block 30 has two bores extending in spaced relationship and at right angles with respect to each other. One bore receives a stationary shaft 36 extending from the panel 12 with respect to which the bearing block is freely rotatable, and the other bore receives the axle 37 which is freely rotatable with respect to the bearing block. The axle 37 is of generally T shape and has a portion 38 extending coaxially through the roll 9 at right angles with the portion 39 of the axle which extends through the bearing block 30. Preferably the longitudinal axis of the portion 39 approximately bisects the length of the strand supporting surface of the roll 9. Thus, in a manner similar to rolls 8 and 10, the roll 9 is held in an alignment, while adjacent the roll 5, in which the axis of the squeeze roll 9 remains approximately in a plane containing the axis of the roll 5 even though the axle 37 may turn about its axis through the bearing block 30, and the axle and the roll 9 as a whole may pivot with respect to the axle 36. Thus, the roll 9 is self-aligning with respect to the periphery of the roll 5 or the strand disposed therearound and may assume any alignment necessary to bring uniform pressure on the strand disposed between the rolls 5 and 9 in response to pressure of the strand passing around the outside of the squeeze rolls.

The squeeze rolls 8 and 10 have mountings similar to that of 9 with the exception that axles 43 and 44 are L-shaped, and bearing blocks 41 and 42 may be similar, as shown, to the bearing block 30 except for the eye portion 29.

The strand 14 is formed in a number of U-shaped convolutions with the rolls 6 and 7 enclosed within the ends of the legs of the U-shaped region and the central roll in cooperation with the rolls 6 and 7 defining the central space partly surrounded by such regions. Thread advancement is obtained by canted relationship between the central roll and one or both of the guide rolls. Both guide rolls may be provided, as shown in Fig. 1, with the mechanism shown in Fig. 3 for determining the cant of each roll with respect to the central roll. It is well within the scope of the invention to change the alignment of the driven roll 5 with respect to the guide rolls 6 and 7 to obtain thread advancement. However, the preferred embodiment is that illustrated wherein the axial alignment of the guide rolls may be changed. The guide roll 6 is shown canted and roll 7 is shown with its axis parallel to the axis of the roll 5 although the roll 7 is supported by a mounting which may be adjusted to change the cant of its axis.

The adjustable mounting for roll 6 (same as that for roll 7) comprises, as shown in Fig. 3, a shaft 46 for supporting the roll extends through the panel 12. The shaft terminates in a yoke or saddle 48 having legs 51 and 52 between which is supported a nut 53 in threaded engagement with an adjusting screw 55. The nut 53 has a pair of coaxial trunnions, each of which extends through a leg of the yoke 48 in bearing pivotable relation therewith. The yoke 48 has an arcuate base portion 56 which fits the inner side of an arcuate frame 57. The frame 57 has a slot 58 which extends the entire length of its arcuate portion displacing a middle section thereof. The base of the yoke has a ridge 59 which fits partly into the slot 58. The yoke base 56 is held tightly against the frame 57 by bolts 61 and 62 of which the nuts are turned down tightly against lock washers 63 and 64. Washers 65 and 66 are interposed between the lock washers and the outer surface of a frame 57 to enable the yoke to be adjusted longitudinally of the arcuate portion of the frame while the lock washers 63 and 64 are under some compression.

An arcuate portion of the frame 57 has a radius extending to a center disposed approximately midway along the length of the strand-supporting surface of the roll 6. This arrangement allows adjustment of the roll 6 to change the rate of thread advancement within the system shown with a minimum dislocation of the roll 6 with respect to the rolls 5 and 7. The screw 55 has rotatable bearing relationship with a collar 68 which has coaxial trunnions extending through spaced portions 69 and 70 of the frame 57. The screw is provided with a crank wheel 71 by which the mounting of the roll 6 may be adjusted longitudinally of the arcuate portion of the frame 57. The nuts of the bolts 61 and 62 may be tightened down solidly for rigidity of the mounting during operation. It will than be necessary to loosen such nuts when a change is made in the axial cant of the roll. A bearing plate 72 bolted or otherwise secured to the panel 12 provides additional surface for absorbing wear and maintaining the rigidity of the roll shaft 46.

Liquid is supplied to the convolutions in the strand 14 by liquid distributors such as the three shower devices 73, 74, and 75. Devices 74 and 75 are connected to a common supply line A whereas device 73 is connected to a supply line B. The rate of discharge from the shower devices may be controlled by respective valves 73*a*, 74*a*, and 75*a*. The disposition of the liquid distributors, as shown, is not critical and any disposition desired may be employed to obtain a desired pattern of liquid treatment of the strand convolutions.

In the embodiment of the invention hereinbefore described and illustrated by Fig. 1, the yarn 14 enters the strand storage and advancing system by being drawn initially upon the periphery of the roll 6 to form the U-shaped wrap nearest the panel 12. The strand passes around an approximately 90° section at the periphery of the roll 6 and thereafter engages the periphery of the roll 5. It extends in the direction of its advancement between the roll 5 and rolls 8, 9, and 10, and in continuous contact with the roll 5, thereafter extending tangentially from the roll 5 onto a portion of the periphery of the roll 7 adjacent the panel 12. As shown, the axis of the roll 7 is not canted with respect to the axis of the roll 5 and thus the exteriorly disposed return portion of the first wrap extends in diametrically superposed relationship with the inner portion of the first wrap over outwardly facing peripheral portions of the rolls 10, 9, and 8 in the order named. As the roll 6 is canted with respect to the roll 5, the strand extends around the roll 6 into another wrap further removed from the panel 12. The succeeding wraps of the strand are progressively disposed away from the panel 12 and extend through the roll system in the same manner just described for the first wrap until the desired number of wraps is obtained. The yarn is thereupon lead from the system in a direction indicated by an arrow from the top peripheral portion of the roll 7. Such a strand storage system greatly increases the length of running strand which may be stored within a selected space over that which may be stored on, for example, a single thread-advancing reel or a pair of canted rolls. It also provides extensive fully-exposed sections of strand supported free of any surface whereby such sections are readily accessible for the application thereto of liquids etc.

In Fig. 4, a modified thread-storage and thread-advancing system is shown schemetaically in which five squeeze

rolls 76, 77, 78, 79 and 80, are disposed and mounted as hereinabove described with respect to squeeze rolls 8, 9, and 10, around a main or central guide roll 81. The strand 82 is received by a guide roll 83 and discharged from the system by another guide roll 84. The system may be driven by driving the roll 83 by means such as a chain and sprocket system shown connected with a drive shaft 85. The main roll 81 may be driven in the manner of the embodiment of Fig. 1 hereinabove described, or allowed to idle and be driven by contact with the windings of yarn. Both offset guide rolls, as shown, are slightly canted with respect to the axis of the central roll 81; thus each of the rolls 83 and 84 contribute to lateral advancement of the strand convolutions through the system.

The stripping of liquid from the strand may be promoted along outwardly-facing peripheral portions of the squeeze rolls 76, 78, and 80, by additional pressure rolls 88, 89, and 90 acting on the outer sides of rolls 76, 78, and 80 respectively. The pressure exerted by any one of the pressure rolls is transmitted to the inner portions as well as the outer portions of strand convolutions as the result of the free pivotal suspension of the squeeze rolls. Pressure rolls typified by rolls 88, 89, and 90 may be employed in particular where different types of treatment liquids are applied and it is desired to carefully isolate the various zones of treatment and prevent the carrying of liquid by the strand from one zone to the other. As shown, liquid distributors 92, 93, 94, and 95 apply liquid to sections of the strand passing along the inner periphery as well as the outer periphery of the U-shaped region enclosed by the convolutions of the strand.

It is to be noted from the illustration, as depicted in Figs. 1 and 4, of the two embodiments herein described, that the guide rolls, i. e., rolls 6 and 7 of Fig. 1 and rolls 83 and 84 of Fig. 4, are disposed between two lines of which each line extends in tangency with a pair of the squeeze rolls on opposite sides of a line or plane which passes through the axis of the central roll and between the pair of guide rolls associated therewith. Each line of tangency is tangent to the pair of squeeze rolls nearest the guide roll on the side of the middle line on which such guide roll and such squeeze rolls are disposed. By this arrangement, contact of the yarn or strand with the outer side of the squeeze roll nearest the guide roll on the same side of the central line is assured. It is in accordance with the general concept of the present invention and the preferable arrangement thereof that the opposite sides of each squeeze roll contact simultaneously with substantial pressure the yarn along the inner periphery as well as the outer periphery of the U-shaped region enclosed by the yarn convolutions. In the embodiment illustrated in Fig. 1, the pairs of squeeze rolls determining the lines of tangency share a common roll, i. e., roll 9. However, in the embodiment of Fig. 4, the pairs of squeeze rolls divided by a plane, or a line such as defined above, each pair tangent to one of two lines disposed at opposite sides of the middle line, are rolls 76 and 77 on the one side of such a plane or line and rolls 79 and 80 on the other side.

The arrangements of rolls found in the embodiments herein described not only provide greater storage of running yarn per unit of space than conventional systems but provide greater contact of the roll surface with the peripheral area of a yarn, that is, opposite sides of the strand are repeatedly contacted as the yarn passes through the system. For this reason, the thread-advancing system as herein described is excellent for carrying out liquid treatments of freshly spun yarn or tows, such as washing and bleaching, regenerating and plasticizing with hot liquid, or dyeing a strand of filamentary material. Moreover since the strand surface is more efficiently contacted by the rolls of the system, rolls thus arranged may function more satisfactorily as drying drums than a pair of relatively-canted thread-advancing rolls of the conventional type. It will be understood, of course, that a plurality of units may be constructed in accordance with, for example, the embodiment illustrated in Fig. 1, and arranged in series relationship whereby different treatments may be progressively applied to the same running strand.

While preferred embodiments of the invention have been shown and described, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A thread-advancing and thread-storing system comprising a main roll, a roll in spaced relation with the main roll with the axis of one of said rolls canted out of parallel relation with that of the other roll, a plurality of additional rolls disposed in series spaced relationship within a region extending from the second-named roll and partly around the periphery of the main roll, the length of the strand-supporting surfaces of all of the rolls as measured lengthwise of the axis being generally co-extensive, means for movably supporting the rolls of said series for movement into and out of contact with the periphery of the main roll, the rolls of the series being of such size and number as to space that outer portion of the path of a yarn which extends over the outwardly-facing portions of the peripheries of such rolls away from the periphery of the main roll, and means for driving one of the rolls.

2. A thread-advancing and thread-storing system comprising a main roll, a roll in spaced relation with the main roll with the axis of one of said rolls canted out of parallel relation with that of the other roll, a plurality of additional rolls disposed in series spaced relationship within a region extending from the second-named roll and partly around the periphery of the main roll, the lengths of the strand-supporting surfaces of all of the rolls as measured lengthwise of their axes being generally co-extensive, means for movably supporting the rolls of said series for movement into and out of contact with the periphery of the main roll, said supporting means comprising means for aligning each roll of said series with its axis extending approximately within a separate plane for the axis of each roll of said series containing the axis of the main roll when the periphery of such roll and that of the main roll are closely adjacent, the rolls of the series being of such size and number as to space that portion of the path of a yarn which extends over the outwardly-facing portions of the peripheries of such rolls away from the periphery of the main roll, and means for driving at least one of the rolls.

3. A liquid-treating system for a running yarn comprising a main roll, a roll in spaced relationship with the main roll with the axis of one of said rolls canted out of parallel relation with that of the other roll, a plurality of rolls disposed in series spaced relation within a region extending from the second-named roll and partly around the periphery of the main roll, the lengths of the strand-supporting surfaces of the rolls as measured lengthwise of their axes being generally axially co-extensive, means for movably supporting the rolls of said series for movement into contact with the periphery of the main roll, said supporting means comprising means for aligning each roll of said series with its axis extending approximately within a separate plane for the axis of each roll of said series containing the axis of the main roll when the peripheries of such roll and the main roll are closely adjacent, the rolls of the series being of such size and number as to space that portion of the path of yarn extending over outwardly-facing peripheral portions of such rolls from the periphery of the main roll, all of said rolls cooperatively supporting during operation a section of strand extending as a series of convolutions along the entire periphery of said region, liquid distributing means disposed within said region between at least one pair of rolls of said series, and means for driving one of the two earliest named rolls.

4. A thread-advancing and thread-storing system comprising a main roll, a roll in spaced relation with the main roll, the axis of one roll being canted out of parallel relation with that of the other roll, a plurality of rolls disposed in series relationship within a generally concavo-convex region extending from the second-named roll and partly around the periphery of the main roll, the lengths of the strand-supporting surfaces of all the rolls as measured lengthwise of their axes being generally co-extensive, means for movably supporting the rolls of said series for movements into and out of contact with the periphery of the main roll, said supporting means comprising means for aligning each roll of said series with its axis extending approximately within a separate plane for the axis of each roll of said series containing the axis of the main roll when the peripheries of such roll and the main roll are closely adjacent, the rolls of the series being of such size and number as to space that portion of the path of yarn which extends over the outwardly-facing peripheral portions of such rolls from the periphery of the main roll, and means for driving one of the two earliest named rolls.

5. A thread-advancing and thread-storing system as defined in claim 4 wherein the convex portion of the periphery of the concavo-convex region is defined by outwardly-facing arcuate peripheral sections of the strand-supporting surfaces of the rolls of said series and interconnecting straight sections extending tangentially to and between said arcuate peripheral sections.

6. A thread-advancing and thread-storing system which comprises a main roll, a pair of guide rolls, a plurality of squeeze rolls disposed about the main roll, the guide rolls being spaced from each other having strand-supporting peripheries extending in generally axially co-extensive and spaced relationship with the strand-supporting surface of the main roll, adjustable means for supporting at least one of the guide rolls, said means being adjustable to change the alignment of the axis of the guide roll with respect to the axis of the main roll, separate freely movable means for supporting each squeeze roll with the strand-engaging surfaces thereof in adjacent substantially co-extensive relation with the strand-supporting surface of the main roll, each of said movable means being movable to carry its respective squeeze roll toward and away from the periphery of the main roll, each squeeze roll being pivotable with respect to its respective supporting means approximately within a separate plane for the axis of each squeeze roll containing the axis of the main roll and that of the squeeze roll, and means for driving at least one of the rolls.

7. A thread-advancing and thread-storing system as defined in claim 6 wherein the outer portion of the path for the yarn extends over peripheral portions of guide rolls and the squeeze rolls facing away from the main roll and the inner portion of said path extends in part between the periphery of the main roll and the portions of the peripheries of the squeeze rolls facing toward the main roll, said guide rolls and the squeeze rolls being disposed to extend the yarn path around a substantial portion of the periphery of the main roll, the guide rolls being separated by a plane containing the axis of the main roll, the section of said outer path portion extending between a guide roll and the nearest squeeze roll

making an angle with the nearest straight path section extending between said squeeze roll and the next adjacent squeeze roll on the same side of the plane.

8. A thread-advancing and thread-storing system which comprises three spaced guide rolls and a plurality of squeeze rolls supported adjacent one of the guide rolls with their axes substantially parallel to that of said guide roll, separate freely movable means for supporting each squeeze roll with the strand surfaces thereof in substantially coextensive relation with the strand supporting surface of said guide roll, each of said movable means being movable in a direction to carry its respective squeeze roll toward and away from said guide roll, each squeeze roll being pivotable with respect to its respective supporting means approximately within a separate plane for the axis of each squeeze roll containing the axis of said guide roll and that of the squeeze roll, the other two guide rolls and the squeeze rolls being disposed within a generally U-shaped region surrounding said guide roll wherein the other two guide rolls constitute extremities of the legs of the U-shaped region, all of said rolls having peripheral strand-supporting surfaces that are generally-axially co-extensive, said U-shaped region being defined by a continuous path for the strand comprising an inner portion extending in part along the inner periphery of the region between the first-named guide roll and the squeeze rolls and an outer portion extending along the outer periphery of the region over outwardly-facing peripheral portions of the squeeze rolls and around a portion of the periphery of each of said two guide rolls, the squeeze rolls being of such size and number as to space the outer portion of the path from the periphery of the first-named guide roll, at least one of the guide rolls having its axis canted out of parallel relation to the axis of another guide roll to produce axial advancement of the strand with respect to the rolls of the system, and means for driving one of the rolls.

9. A thread-advancing and thread-storing system as defined in claim 8 wherein the outer portion of said strand path includes outwardly-facing arcuate peripheral surfaces of the squeeze rolls connecting intervening strand portions whereby strand passing along said path exerts pressure on the squeeze rolls in a direction extending inwardly of the periphery of the first-named guide roll.

10. A liquid-treating system comprising the thread-advancing and thread-storing system defined in claim 8, and liquid showering means disposed within the U-shaped region between the outer and inner portions of said path.

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