Feb. 12, 1952 E. S. BALTHROP, JR 2,585,424

METHOD OF TRANSFERRING YARN AND APPARATUS THEREFOR

Filed June 19, 1946 3 Sheets-Sheet 1

Fig. 1.

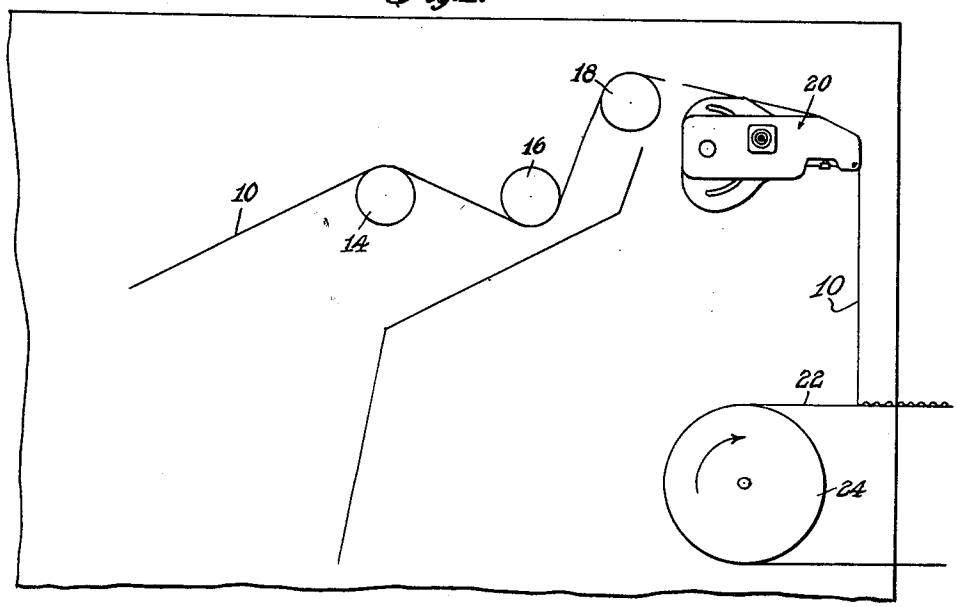
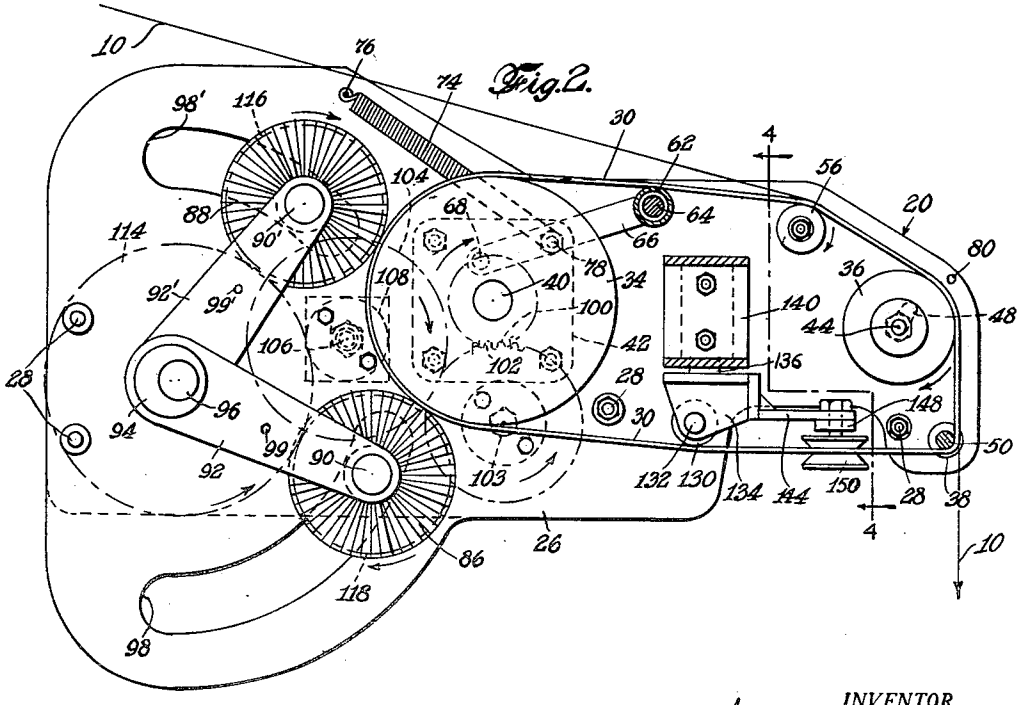


Fig. 2.



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METHOD OF TRANSFERRING YARN AND APPARATUS THEREFOR

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Fig. 3.

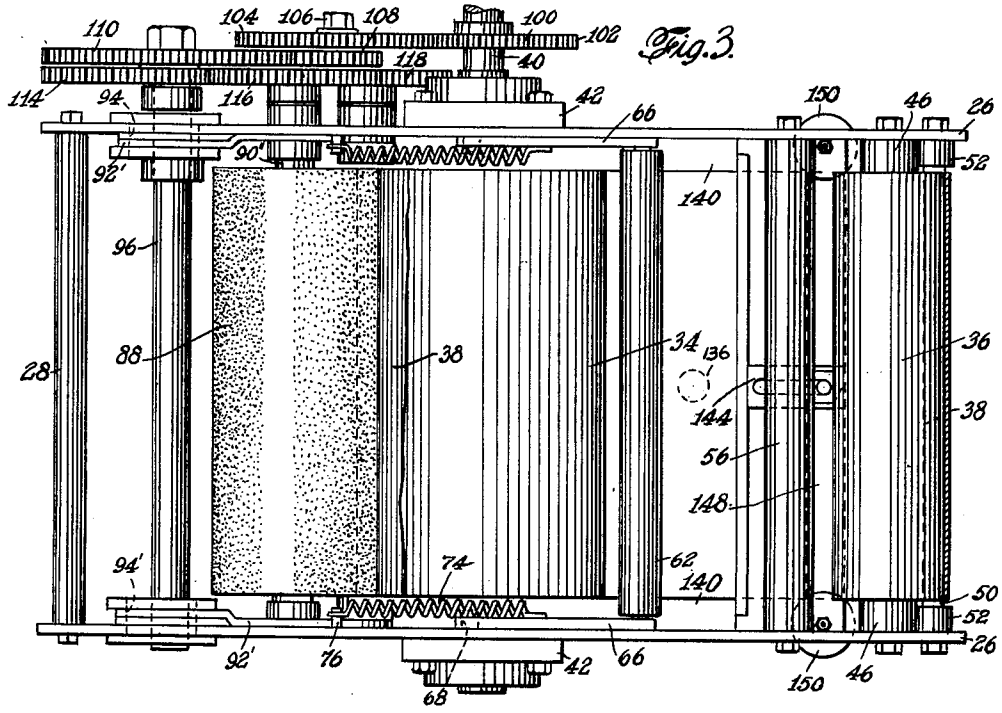
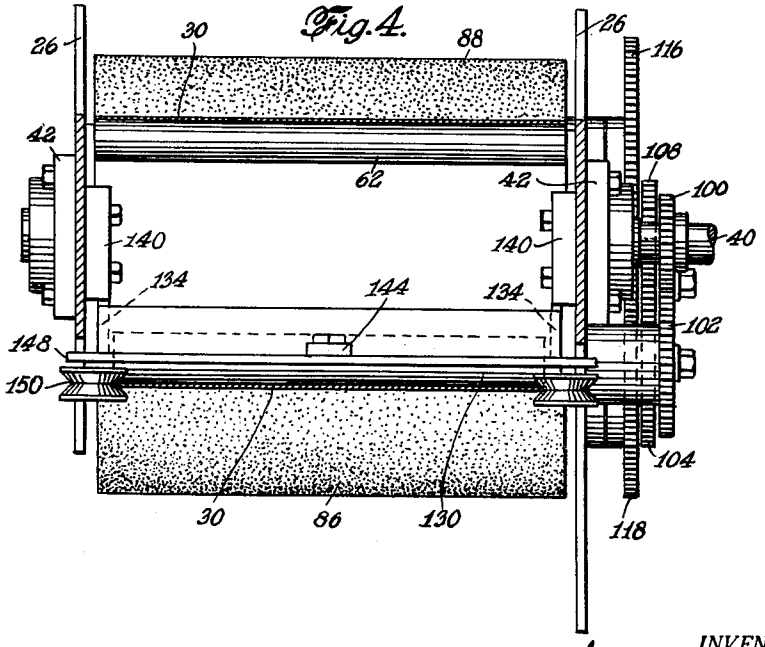


Fig. 4.



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METHOD OF TRANSFERRING YARN AND APPARATUS THEREFOR

Filed June 19, 1946 3 Sheets-Sheet 3

Fig. 5.

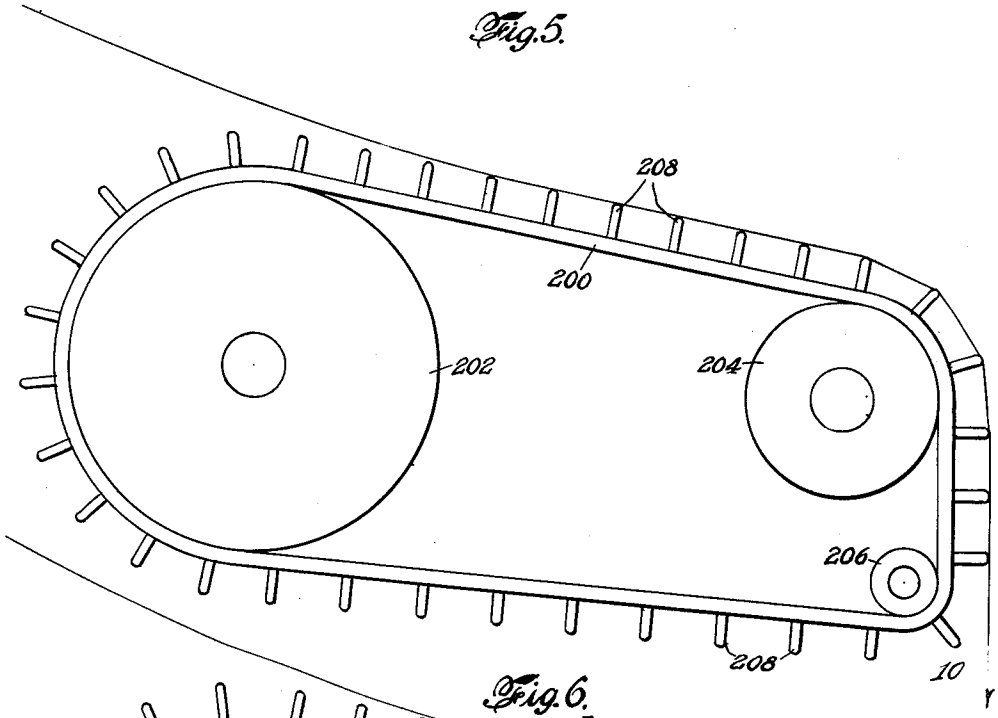


Fig. 6.

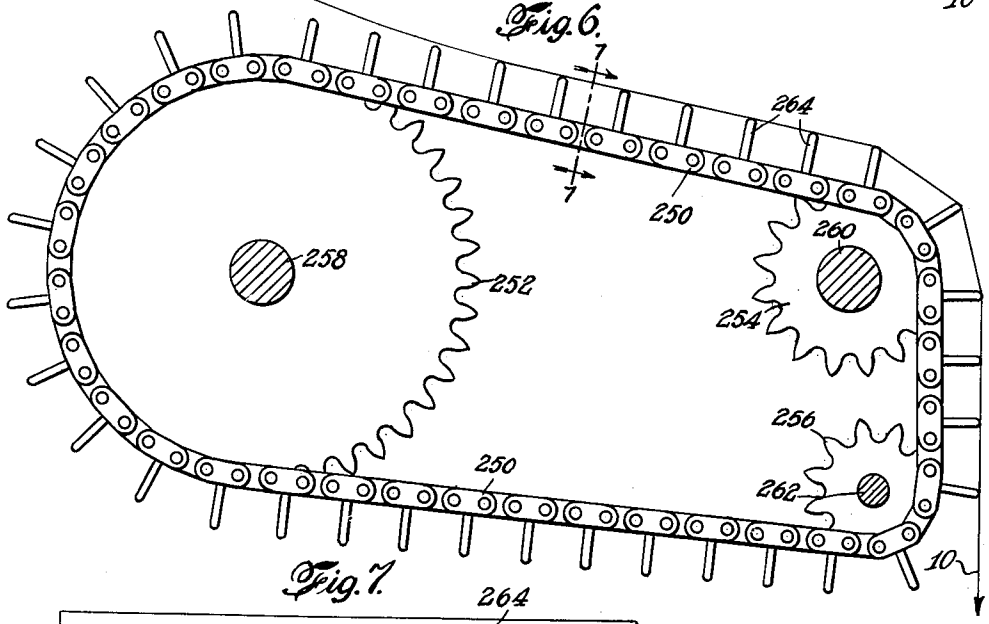
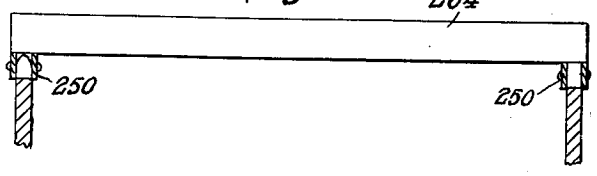


Fig. 7.



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Patented Feb. 12, 1952

2,585,424

UNITED STATES PATENT OFFICE

2,585,424

METHOD OF TRANSFERRING YARN AND APPARATUS THEREFOR

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Application June 19, 1946, Serial No. 677,890

12 Claims. (Cl. 28—71.5)

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This invention relates to a new and improved method and apparatus for transferring yarn from an element where the yarn is at a positive tension to an element where the yarn assumes a substantially zero tension. More particularly, it relates to a method and apparatus for transferring wet viscose rayon yarn from positively driven process rolls to a yarn-collecting surface positioned beneath the yarn-transfer mechanism.

An object of this invention is to provide a new and improved method and apparatus for transferring yarn to a collection surface.

Another object of this invention is to provide a new and improved method and apparatus for transferring yarn from a positive tension to a substantially zero tension.

An additional object of this invention is to provide a new and improved method and apparatus for transferring yarn from a positive tension to a substantially zero tension wherein the formation of wraps about the transfer mechanism is eliminated and continuity of operation is obtained.

A further object of this invention is to provide a new and improved method and apparatus for causing yarn to descend by its own weight in a substantially vertical path directly to a collecting surface.

Other and additional objects will become apparent hereinafter.

The objects of the invention are accomplished, in general, by delivering the yarn onto a contacting surface which both supports and advances the yarn into a straight path in line with the collecting surface before discharge, rapidly counteracting the forces which tend to retain the yarn on such contacting surface at the point of discharge, and applying a force to strip the yarn from the contacting surface so that the yarn is discharged from the transfer mechanism in a vertical path, at the terminus of which the yarn rests at substantially zero tension on the collecting surface. The counteracting forces are produced by introducing a momentary increase in speed of the yarn contact point (relative to the yarn) immediately preceding and during yarn discharge.

The force stripping the yarn from its support can be the weight of the yarn itself, centrifugal force, a force based on the rigidity of the yarn, or any combination thereof.

The yarn-transfer mechanism is positioned between the element where the yarn is at a positive tension and the collecting surface on which the yarn is to be collected, the collecting surface being disposed beneath the yarn-transfer mechanism.

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In one embodiment of the invention, yarn is delivered to a relatively thin, flat, endless belt which is given a motion of translation and rotation in a defined path of travel to dispose and advance the yarn thereon in a direction perpendicular to the floor, whereby the yarn is disposed in the direction of a straight line of travel to the collecting surface before the point of discharge. Immediately preceding and during discharge, the speed of a yarn carrying surface point on the belt relative to the yarn thereon is increased, and the centrifugal force developed is sufficient to strip the yarn from the belt. In this embodiment, the desired results are obtained when the belt at the point of discharge of the yarn is caused to pass over a roll of small radius.

In another embodiment of the invention, the yarn-transfer mechanism comprises an endless belt provided with a plurality of spaced, raised, crosswise yarn-contacting bars which are given a motion of translation and rotation in a defined path of travel to dispose and advance the yarn before discharge in a vertical path directed toward the yarn-receiving surface. Immediately prior to and during yarn transfer or discharge, means are provided to rapidly introduce a momentary increase in speed of the contact points on the yarn-contacting bars, whereby the forces which tend to retain the yarn on the bars are rapidly overcome, and a force, such as any of those described above, is applied to strip the yarn from the bar so that the yarn freely falls in a vertical path onto the collecting surface.

In a specific form, the belt with the raised bars, after having been advanced so that the yarn is disposed, prior to discharge, in a straight line path to the receiver, is caused at the point of discharge to pass around a roll of small radius. As a consequence, at the point of discharge the speed of the yarn contact points on the bars and dimensional spacing of the bars are rapidly increased, independently of the other bars, to overcome the forces tending to retain the yarn on the bars, and the gravitational force of the free-falling yarn is sufficient to strip the yarn from the bars and keep it from clinging thereto.

The combined paths of motion of each of the yarn-contacting surfaces in translation describe a path of continuous rotary motion about a plane figure of regular or irregular shape, such as a polygon, circle or ellipse. The projection of such figure, in a direction perpendicular to translation (producing a solid figure of varying depths to suit the conditions of yarn spacing and number of

yarns to be accommodated), permits the simultaneous handling of a plurality of yarns side by side upon the contacting surfaces.

The motion of the yarn-contacting surfaces in translation provides traction to draw the yarn by frictional contact and under positive tension to the transfer mechanism and at the required constancy of speed.

The details of the invention will be more clearly apparent by reference to the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1 is a diagrammatic side elevation illustrating the yarn transfer mechanism in position to receive the yarn under a positive tension from processing rolls and deliver the yarn onto a yarn-collecting device where it assumes substantially zero tension;

Figure 2 is a side elevation of one embodiment of the transfer mechanism, with one of the side plates removed;

Figure 3 is a top plan view of the transfer device shown in Figure 2, showing both of the side plates but with the belt removed in order to show certain details more clearly;

Figure 4 is a section taken on the line 4—4 of Figure 2;

Figure 5 is a side elevation of a modified form of yarn-transfer mechanism with the side plates and drive omitted;

Figure 6 is a side elevation of still another modified form of the yarn transfer device with the side plates and drive omitted; and

Figure 7 is a section taken on the line 7—7 of Figure 6.

Referring now to the drawings wherein like reference numerals designate like parts, and particularly to Figure 1, the reference numeral 10 designates a wet yarn being drawn, from a series of stretching rollers on which it has been subjected to high tension, by means of positively driven rollers 14, 16 and 18. The yarn 10 is delivered to the transfer device, generally designated by the reference numeral 20, from which it is discharged to a moving collecting belt 22 positioned beneath the yarn transfer mechanism 20. The collecting belt 22 is of the continuous type trained over a pair of spaced rollers 24, only one of which is shown, and conveys the yarn for further processing, such as washing and purification.

Referring now to Figure 3, a pair of spaced side plates 26 are secured together by a plurality of tie rods 28 (see Figure 2) to form the supporting frame of the yarn-transfer mechanism.

The yarn-transfer mechanism shown in Figures 2, 3 and 4 consists essentially of a thin, flat, endless belt 30 trained over a plurality of spaced cylindrical rolls 34, 36 and 38. The roll 34 is mounted on a shaft 40 carried in bearings 42 secured to the side plates 26. The shaft 40 is driven (by means not shown) at an appropriate speed, as hereinafter more fully explained, and constitutes the drive means for the unit. The roll 36 is mounted on a shaft 44, the ends of which are rotatably mounted in bearings 46 adjustably mounted in slots 48 in the side plates 26. The roll 38 is mounted on a shaft 50, the ends of which are rotatably mounted in bearings 52 carried by the side plates 26.

The surface of the belt 30 as it leaves the roll 34 is at a small angle, such as 4° to 12°, with respect to the floor of the room in which the apparatus is positioned, and, in one embodiment of the invention, the rolls 34 and 36 are positioned so that the belt 30 will travel at such angularity in its passage from the roll 34 to the roll 36.

In the embodiment shown in Figure 2, the belt 30, in its travel to the roll 36, passes over an idler roll 56 appropriately mounted in the side plates 26. The idler roll 56 is positioned so that the belt 30 will be delivered thereto at substantially the same angularity at which it leaves the roll 34.

The idler roll 56 is also positioned relative to the roll 36 so that the angularity of the belt 30, as it passes from said idler to said roll 36, is substantially increased to, for example, 29°. Intermediate the roll 34 and the idler 56, there is provided a belt tightener which, in the form shown, comprises a roll 62 carried on a shaft 64 rotatably mounted at the ends thereof between a pair of oppositely positioned arms 66. Each arm 66 is pivotally mounted on a stud 68 carried by the plate 26 adjacent thereto. A pin, not shown, maintains the arm 66 on the stud 68. Pressure is exerted on each arm 66 to force the roll 62 upwardly. In the form shown in Figures 2 and 3, a spring 74, having one end thereof secured to a pin 76 carried by the side plate and the other end secured to one of the arms 66 intermediate its ends, as at 78, normally urges such arm 66 upwardly. A similar spring is similarly secured to the side plate and other arm.

The belt 30 passes from roll 36 in a downward direction onto roll 38, about which the belt 30 make a 90° turn. It is to be noted that the section of the belt between the rolls 36 and 38 is substantially perpendicular to the floor and the yarn is disposed in the direction of a straight line path from roll 36 to the receiver (conveyor belt 22). The roll 38 is of a small diameter so that when the belt 30 passes therearound, making a 90° turn, the angular speed of the belt becomes comparatively high. The yarn is discharged from the belt in a vertical path directed toward the yarn-collection device.

In order to improve the uniformity of transfer, water is supplied to a pipe 80 having a series of perforations so that streams of water will pass therefrom. The pipe 80 is positioned above the periphery of roll 36 so that the streams issuing from the perforations thereof are directed along that face of the belt 30 making the downward pass and in such a manner that a stream of water is played upon the belt surface parallel to the yarn travel and within approximately ¼'' of each side of the yarn.

Generally, means are utilized in transfer devices employing flat belts of the type above described to remove foreign deposits and prepare a water film of uniform thickness over the belt surface and to break up droplets which follow around the under-pass of the belt to the top-pass thereof. The effect of these droplets or of any irregularity in water film causes the various yarns which are supported and transferred side by side by the unit to be discharged irregularly. Such irregularity results because the moisture on the yarn causes its weight to change and also because variations in liquid thickness produce greater or less distance in water film depth through which the yarn must shear to leave the belt. These forces vary sufficiently when droplets occur to change the path of discharge to a non-uniform and poorly controlled transfer.

In the embodiment shown in Figures 2 and 3, a pair of spaced rotary positively-driven cylindrical brushes 86 and 88 constitute the means to remove foreign deposits and to smooth out water films from the belt 30. As shown in Figure 2,

the brushes 86 and 88 successively cooperate with the belt 30 as it passes around the roll 34 and prior to the delivery of the yarn on the belt. Brush 86 is mounted on a shaft 90, which is rotatably mounted between a pair of spaced arms 92. Each arm 92 is mounted on an eccentric bushing 94 loosely positioned on a shaft 96. Each end of the shaft 90 cooperates with and extends through an arcuate slot 98 in the side plate adjacent thereto. A pin, through a hole in the respective side plate and the aperture 99 in each arm 92, secures each arm in position so that the brush 86 is in operative relationship with belt 30.

Brush 88 is mounted similarly to brush 86. Thus, brush 88 is mounted on a shaft 90' rotatably mounted between a pair of spaced arms 92', each arm 92' being mounted on an eccentric bushing 94' loosely positioned on the shaft 96, and the ends of the shaft 90' cooperate with and extend through an arcuate slot 98'. Each arm 92' is secured in position to dispose the brush 88 in operative position by a pin passing through a hole in the respective side plate and a hole 99' in each arm 92'.

The brushes 86 and 88 are gear-driven through a gear train from the main drive shaft 40, as will now be described.

Shaft 40 carries a gear 100 which meshes with a gear 102 carried on a shaft 103 appropriately mounted in the side plates. Gear 102 meshes with a gear 104 carried on a shaft 106 appropriately mounted in the side plates. On the shaft 106 is a gear 108 which meshes with a gear 110 on the shaft 96. On the shaft 96, there is another gear 114 which meshes with a gear 116 on the shaft 90', and thus imparts rotation to the brush 88. The gear 114 also meshes with a gear 118 on the shaft 90, whereby rotary movement is imparted to the brush 86.

When the brushes 86 and 88 are desired to be moved to inoperative position, as is necessary for cleaning, the respective securing pins are removed and the arms carrying the brushes swing about their pivots in the appropriate direction whereby the teeth of the respective gears are disengaged.

The belt in its travel from the roll 38 to the roll 34 cooperates with a suitable steering mechanism whereby the belt passes onto the roll 34 in proper position.

In the steering mechanism shown in Figures 2 and 4, a tracking roll 130 is rotatably mounted on an axle 132 carried in a frame 134. The roll 130 is disposed so that it bears against the inner side of the belt 30 in its pass from the roll 38 to roll 34. Since the tracking of the belt 30 upon roll 34 depends upon the inclination of roll 130, the frame 134 is pivotally mounted at 136 in a stationary bracket 140 appropriately mounted on the frame so that it, and hence the tracking roll 130, pivots about a point midway between the two ends of roll 34 and at 90° to the center line of the roll. The tracking roll 130 can be adjusted in pivoting on this mid-point so that either end moves closer to the face of the roll. To move the roll 130 in this manner, the frame 134 at its mid-point is provided with a tongue 144, to which a cross-bar 148 is secured. The cross-bar 148 is disposed parallel to the axle 132 and is of a length as to overhang both edges of the belt 30. Grooved rollers 150 are rotatably mounted in each end of the cross-bar 148 and disposed to engage the opposite edges of the belt 30.

In operation, if the belt 30 wanders to either edge of roll 38, due to the cooperation of the belt 30 and the rollers 150, the cross-bar 148 will be shifted to that edge and will steer the roll 130 askew of the belt 30. By virtue of the tendency of a belt to approach a roll or sheave in a plane perpendicular and at right angles to the center of the roll, belt 30 will attempt to align itself at 90° to the center line of roll 130. To do this, it must travel laterally in the direction that roll 130 is inclined. Since the edge of belt 30 bears against opposite roller 150, a compensating action occurs. Depending upon the adjustment of the edge rolls 150, the cross-bar 148, the tongue 144, and the frame 134, the roller can be made to return to parallel adjustment in center line with the center line of roll 34, and any tendency of the belt to travel laterally to either end of roll 34 will be countered by a corresponding askewed relationship of roll 130 to bring it back into line.

The efficiency of the transfer unit is increased by projecting the yarn-supporting surfaces into the form of spaced crosswise raised bars upon the belt surface. Such a construction increases the speed of the transfer surface at the point of discharge of the yarn as the bars pass around the 90° turn at the transfer point. Since such bars have their yarn-contacting edges located further out on the radius from the instantaneous center of rotation than is the pitch line intersection of the belt with this radius of belt flexing, the speed and the dimensional spacing of these bars are altered relative to the yarn in passing around the roller at the terminus of the vertically downward belt travel. The spacing between the bars becomes greater with a decrease in radius of belt flexing and increase of bar height.

Figure 5 discloses an embodiment of the type referred to immediately hereinbefore and wherein the belt is provided with raised bars. Referring now to Figure 5, the reference numeral 200 discloses an endless belt trained over the rolls 202, 204 and 206. Rolls 202, 204 and 206 are substantially the same as rolls 34, 36 and 38 of the embodiment disclosed in Figure 2, and roll 202 is also driven from a suitable source of power. The belt 200 is provided with a plurality of transversely extending and equidistantly spaced cleats 208, the upper edges of which are rounded and constitute the yarn-contacting surfaces. Generally, the cleats 208 at the top thereof are of smaller cross-section than at the bottom thereof.

Though Figure 5 does not illustrate a belt tightener or an idler roll cooperating with the belt in its upper flight, a belt idler similar to 62 of Figure 1 and an idler roll similar to 56 may be employed. Similarly, a device to steer and properly position the belt as it travels from the roll 206 to the roll 202 can be utilized.

Another embodiment of the invention comprises utilizing a pair of spaced continuous parallel chains 250 in place of the belts previously described. In such construction, each of the rolls are replaced by two sprockets 252, 254 and 256 spaced apart on the respective common shafts 258, 260 and 262, and each chain passes over one of the sprockets of each pair. Shaft 258 is driven and movement of the chains thereby obtained. Metal bars 264 constitute the yarn-contacting surfaces. In the form shown, the bars 264 are welded on edge between the two chains and at 90° to their pitch lines. As shown in Figure 6, the bars 264 are equidistantly spaced and extend transversely of the unit.

In the embodiments shown in Figures 5 and 6, it is not essential to employ any means, such as

brushes similar to those shown in Figure 1, since on belts employing raised bars or crosswise strips the quantity of water on each bar is controlled by centrifugal force much more efficiently than on the smooth flat belt. However, brushes can be used and, when used, they add the advantage of keeping the bar edges free of sludge deposits.

In the embodiments shown in Figures 5 and 6, the yarn is delivered to the transfer mechanism so that it contacts the top surfaces of the spaced projections (cleats or bars) on the belt in essentially a plane or an arc whose radius approaches infinity. Due to the arrangement of the parts, the mechanism bends the yarn out of the arc into a straight line. In other words, the yarn, between rolls **204** and **206** in Figure 5 and between sprockets **254** and **256** in Figure 6, is disposed in the direction of a straight line travel to the conveyor belt. In the vertical position, the yarn is held in contact with the supporting surfaces by surface tension forces alone, since gravity is tending to pull the yarn downward in a straight line. The distance between the projections remains constant during this passage so that the surface or angular velocity of the yarn and the yarn-supporting surfaces of the projections remain constant except for a small amount of slippage of the yarn over such surfaces. In other words, when the yarn reaches the point of discharge, the important forces to be overcome in order to have the yarn fall freely are the surface tension forces. These forces are overcome by rapidly increasing the speed of the supporting surfaces by changing the direction rapidly through an arc with a small radius. This rapid change in direction increases greatly the surface velocity of the projections and thereby breaks the water film by a shearing action, and the gravitational force acting on the free-falling yarn is then sufficient to strip the yarn from the projections and keep it from clinging to the contact surfaces. The shearing through or redistributing of the water film at the point of transfer is accomplished by an increased forward velocity of the projection just as it begins to deflect away from the yarn, whereby the water film thickness is reduced by a wiping action to a point where the surface tension force of the remaining moisture is less than the resistance of the yarn to bending out of a straight line. The increasing of the distance between the tops of the bars (increase in dimensional spacing) in the turn around the roll of small radius exceeds the elongation of a yarn, and any frazzled or stripped back filaments in a yarn of poor quality cannot bridge the gap between the bars. Filament wraps are avoided, since these ends will be gathered back into the yarn and transferred. The yarn contacts the belt or the projections thereon while the belt is making its upper pass, and the belt, during such pass, constitutes the tensioning section of the supporting and advancing means.

As shown in Figure 1, a considerable length of yarn extends from the roll 18 of the machine to the transfer mechanism and forms a catenary. The tension on the input to the transfer unit can be adjusted by controlling the speed of rotation of the transfer unit with respect to the speed of yarn furnished to it.

Yarn tensions at the input may vary up to almost the breaking tension. The lowest tension is that supplied by the weight of the yarn alone. The highest tension can be obtained by increasing the length of the flat upper pass of the belt and combining it with means such as a second fluted or flat belt to simulate a squeeze roll. Tensions of 1,000 or more grams can be readily obtained.

The transfer of the yarn does not depend on any critical position of the upper belt surface. However, the travel of the belt in a vertical direction and the maintenance of the yarn in the vertical direction immediately before discharge are important.

The length of contact between the yarn and the belt is not critical between 10'' and 3'' prior to the turn around the roll from which the belt and yarn pass in a substantially vertical downward direction. The turn (change in direction) around this roll should not be less than 45°, but can be as much as 180°. Similarly, the length of contact prior to the turn around the roll from which the belt and yarn pass downwardly in a substantially vertical direction can be greater than 10'' and depends on the length of the catenary as compared with the length of fall from the discharge point.

The angularity of the turn around the roll from which the belt passes downwardly in a substantially vertical direction and the speed and relative weight of yarn suspended on each side of the transfer unit should be such that slippage does not occur during the turn. By making the free-fall length great enough so that it gives sufficient traction (in the turn about the roll from which it passes in the vertically downward direction) to properly tension the catenary, the catenary can be increased to any length desired. Satisfactory results are obtained when the transfer distance (free fall) of yarns of 250, 1100 and 2200 denier is between 6'' and 39½''. With yarns of a denier of 1100 or more, the transfer distance may be shortened to about 1''. With such a denier (100 or more), wraps will not form at any transfer distance. If the distance becomes too short, the yarn will be thrown directly off the flat upper pass of the belt and will not bend into a vertical pass before transfer.

The invention can also be used with yarns of deniers less than 250. With 150-denier yarns, the contour of the contacting and supporting bars may require modification to reduce the surface tension between them and the yarn and the transfer distance increased to above 39½''. The upper limit is not critical on denier, and operation becomes less critical as denier is increased.

Though excellent results have been obtained when the speed of transfer was from 3700'' to 6000'' per minute, the invention is not restricted to such speeds. Speed of transfer depends on the speed that the yarn is supplied to the unit and the rate of speed the unit is operated. With a properly constructed unit capable of withstanding continuous operation, the speed of transfer can be in excess of 10,000'' per minute.

The invention is particularly suitable with viscose rayon tire cord yarn, but can be used in general for the transfer of yarn from a positive tension level to a collection device at substantially zero tension level.

Moisture content of the yarn is not critical and can be from essentially zero to the maximum which the yarn will absorb and entrain. However, transfer is more effective when the yarn contains 150% to 300% of moisture.

The elements of the apparatus are constructed from materials which are resistant to the treating solutions to which the yarn was subjected prior to transfer. In the case of viscose yarn, the elements of the apparatus should be resistant

to water, dilute acids, complex sulfur compounds, and mineral salt solutions. Examples of such construction materials are hard rubber, stainless steel, plastics, glass, and enameled steel. Preferably, the material used for the yarn-contacting surfaces is capable of taking a high polish and is resistant to abrasion.

The elements which move and support the yarn have good bearings and these are adequately lubricated and enclosed to prevent wear and oil-contamination by water. Rigidity and lightness are prime requisties in the assembly in order to reduce wear and to give smooth operation at high speeds. It is desirable to produce a large change in angular velocity of the yarn-contacting members at the point of yarn discharge, and, consequently, the mass of these surfaces and their supports should be kept low, and the pivoting surfaces are arranged so as to be affected as little as possible by the sudden application of the force to produce this change in velocity. The mechanism can be made so as to support any number of yarns.

The invention provides a method and apparatus for transferring yarn from a positive tension to an essentially zero tension in a manner which avoids formation of wraps on the transfer mechanism whereby continuity of operation is assured.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited thereto except as set forth in the appended claims.

I claim:

1. A method of transferring yarn from an element where the yarn is at a positive tension to an element where the yarn assumes a substantially zero tension which comprises delivering the yarn onto a supporting surface moved in a closed, defined route by a plurality of rollers which surface supports and advances the yarn in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to a yarn collection device; and rapidly changing the direction of movement of said supporting surface at the point of discharge by passing said surface bearing said yarn over a roller of small diameter whereby the forces which tend to retain the yarn on said supporting surface are counteracted and the yarn is discharged therefrom.

2. A method in accordance with claim 1 in which the said yarn is delivered from the said element where said yarn is at positive tension to said supporting surface so that the yarn therebetween is in the form of a catenary.

3. A method of transferring yarn from an element where the yarn is at a positive tension to an element where the yarn assumes a substantially zero tension which comprises delivering the yarn onto a supporting surface moved in a closed, defined route by a plurality of rollers which surface supports and advances the yarn in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to a yarn collection device; and rapidly increasing the surface speed of said supporting surface relative to the yarn in the vicinity of the point of discharge by passing said surface bearing said yarn over a roller of small diameter whereby the forces which tend to retain the yarn on said supporting surface are reduced and the yarn is discharged therefrom by the action of gravity.

4. A method in accordance with claim 3 in which the said yarn is delivered from the said element where said yarn is at positive tension to said supporting surface so that the yarn therebetween is in the form of a catenary.

5. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt constituting a yarn-supporting surface onto which the yarn is delivered and held by retaining forces; a plurality of rollers adapted to rotate said surface in a closed, defined route and advance the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn-collection device, one of said rollers being of small diameter and located at the discharge point.

6. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt constituting a yarn-supporting surface onto which the yarn is delivered and held by retaining forces; a plurality of rollers adapted to rotate said surface in a closed, defined route and advance the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn-collection device, one of said rollers being of small diameter and located at the discharge point to reduce the forces which tend to retain the yarn on said supporting surface.

7. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt constituting a yarn-supporting surface onto which the yarn is delivered and held by retaining forces; a plurality of rollers adapted to rotate said surface in a closed, defined route and advance the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn-collection device, one of said rollers being of small diameter and located at the discharge point to rapidly change the direction of movement of said yarn-supporting surface to reduce the forces which tend to retain the yarn on said surface so that the yarn is discharged therefrom by gravity.

8. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt constituting a yarn supporting surface onto which the yarn is fed and held by retaining forces; a plurality of rollers to guide said belt together with the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said collection device; and a roller of small diameter at the point of discharge about which the vertically moving belt passes to reduce the forces tending to retain the yarn on the belt so that the yarn is discharged therefrom.

9. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt; a plurality of spaced raised bars on said belt which support said yarn and onto which the yarn is fed and held by retaining forces;

a plurality of rollers adapted to rotate said belt in a closed, defined route and to advance the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn-collection device; and a roller of small diameter at the point of discharge about which said belt passes to increase the spacing between said bars, thereby reducing the forces tending to retain the yarn thereon and discharging said yarn by action of gravity.

10. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a continuous belt; a plurality of spaced raised bars on said belt which support said yarn and onto which the yarn is fed and held by retaining forces; a plurality of rollers adapted to rotate said belt in a closed, defined route and to advance the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn-collection device; and a roller of small diameter at the point of discharge about which said belt passes to increase the spacing between said bars and the speed of the yarn contact points, thereby reducing the forces tending to retain the yarn thereon and discharging said yarn by action of gravity.

11. A method of transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises delivering the yarn onto a plurality of spaced, raised bars moved in a closed, defined route by a plurality of rollers which raised bars support and advance the yarn in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn collection device; and rapidly increasing the surface speed of said raised bars relative to the yarn in the vicinity of the

point of discharge by passing said raised bars bearing said yarn over a roller of small diameter whereby the forces which tend to retain the yarn on said raised bars are reduced and the yarn is discharged therefrom by the action of gravity.

12. Apparatus for transferring yarn from an element where the yarn is at a positive tension to a yarn collection device where the yarn assumes a substantially zero tension which comprises a yarn collection device; a continuous belt supporting a plurality of spaced, raised bars onto which the yarn is fed and held by retaining forces; a plurality of rollers to guide said belt together with the yarn thereon in a path which changes from an approximately horizontal path to a vertical path to deliver said yarn vertically downward to said yarn collection device; and a roller of small diameter at the point of discharge about which the vertically moving spaced, raised bars pass to reduce the forces tending to retain the yarn on the bars so that the yarn is discharged therefrom.

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