PATENTED AUG 29 1972

3,686,853

SHEET 1 OF 5

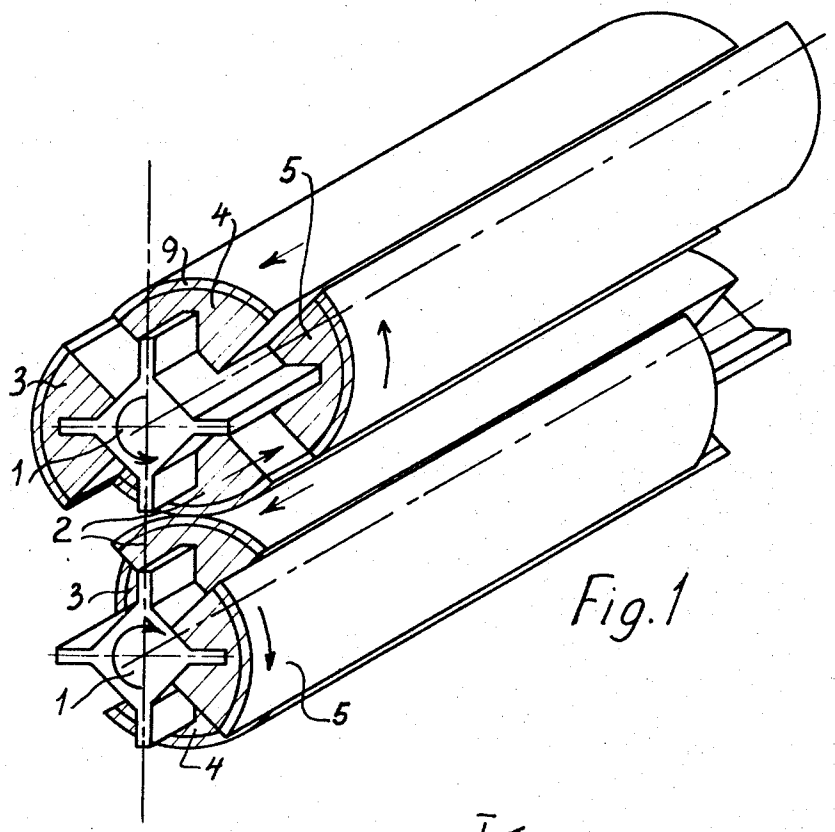

Fig. 1

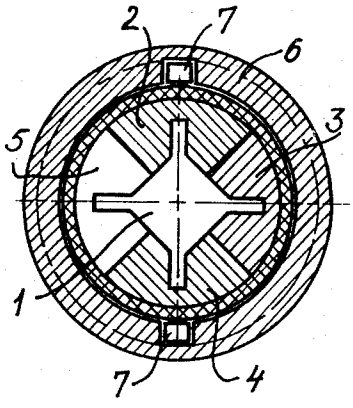

Fig. 3

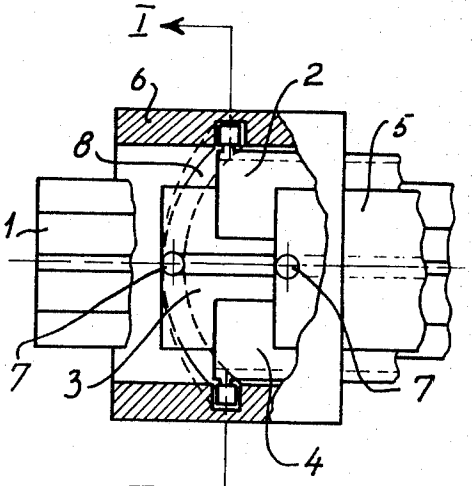

Fig. 2

United States Patent

Rasmussen et al.

[15] **3,686,853**

[45] **Aug. 29, 1972**

[54] **APPARATUS FOR THE ROLLING OR TWISTING OF YARN OR RIBBON-LIKE STRUCTURES ABOUT THEIR LONGITUDINAL AXIS**

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[21] Appl. No.: **21,341**

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March 20, 1969 Denmark.....1541/69
Aug. 11, 1969 Denmark.....4304/69

[52] **U.S. Cl.**.....**57/77.42,** 57/34 HS, 57/51.6
[51] **Int. Cl.**.....**Do1h 7/92,** D02g 1/08
[58] **Field of Search** ..57/34 HS, 77.4, 77.42, 157 TS, 57/51.6

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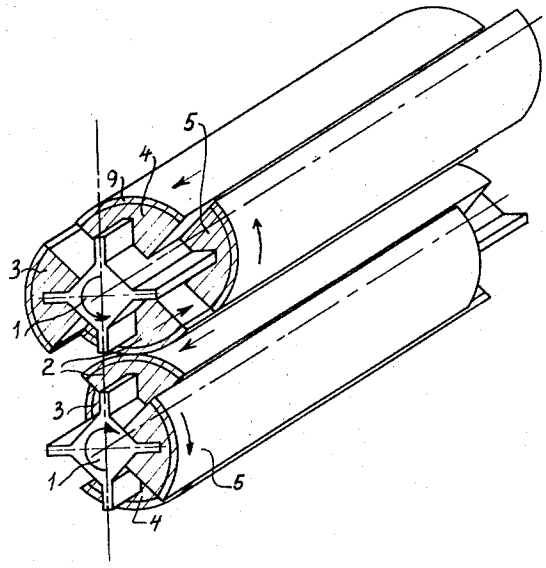
[57] **ABSTRACT**

Textile structures, such as yarns or ribbons, are twisted or rolled by moving the rubbing surfaces of two rubbing rollers relative to one another transversely of the longitudinal direction of the structure passing therebetween, at least one of said rubbing rollers comprising a plurality of peripheral segments or sections which are successively engaged with the other rubbing roller and while so engaged are moved axially, i.e., transversely, of the feeding direction of the structure and are returned to their initial positions during the periods of non-engagement with the other rubbing roller.

9 Claims, 8 Drawing Figures



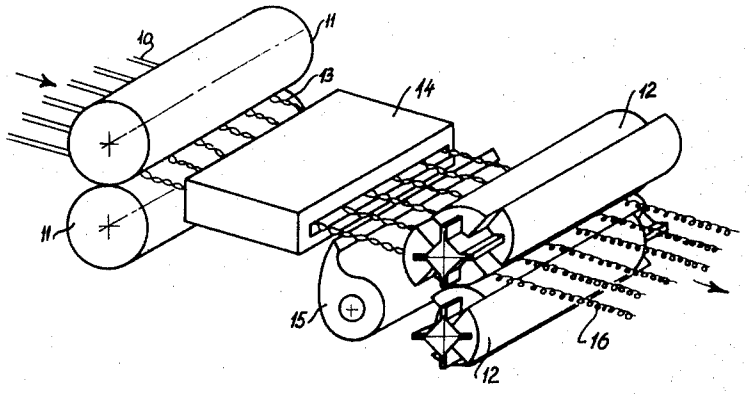

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Fig. 4

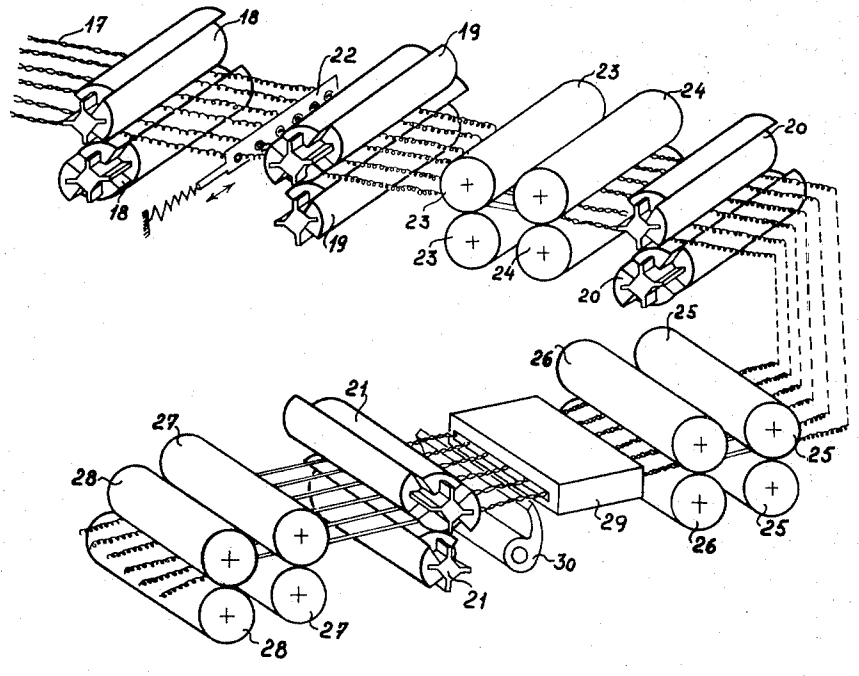
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Fig. 5

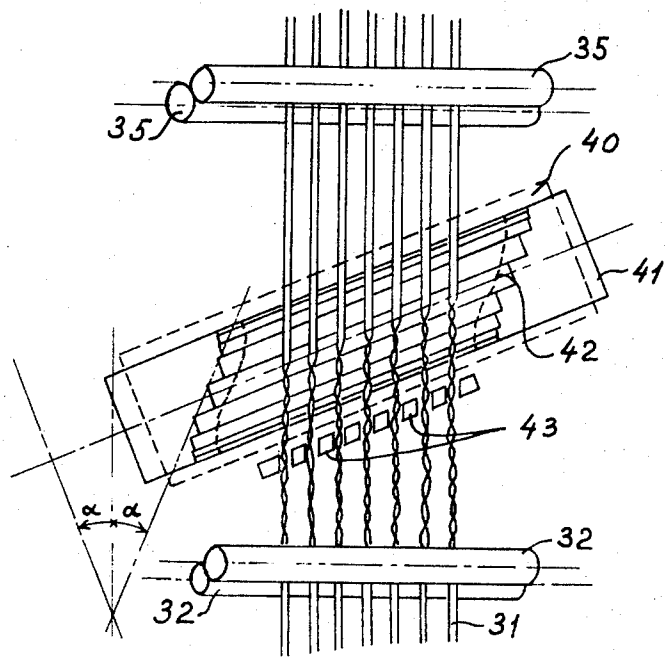

Fig. 6

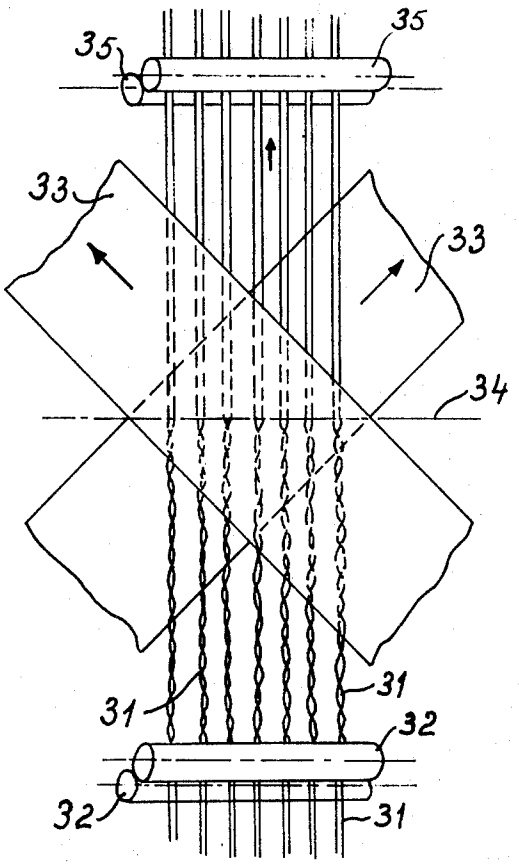

Fig. 7

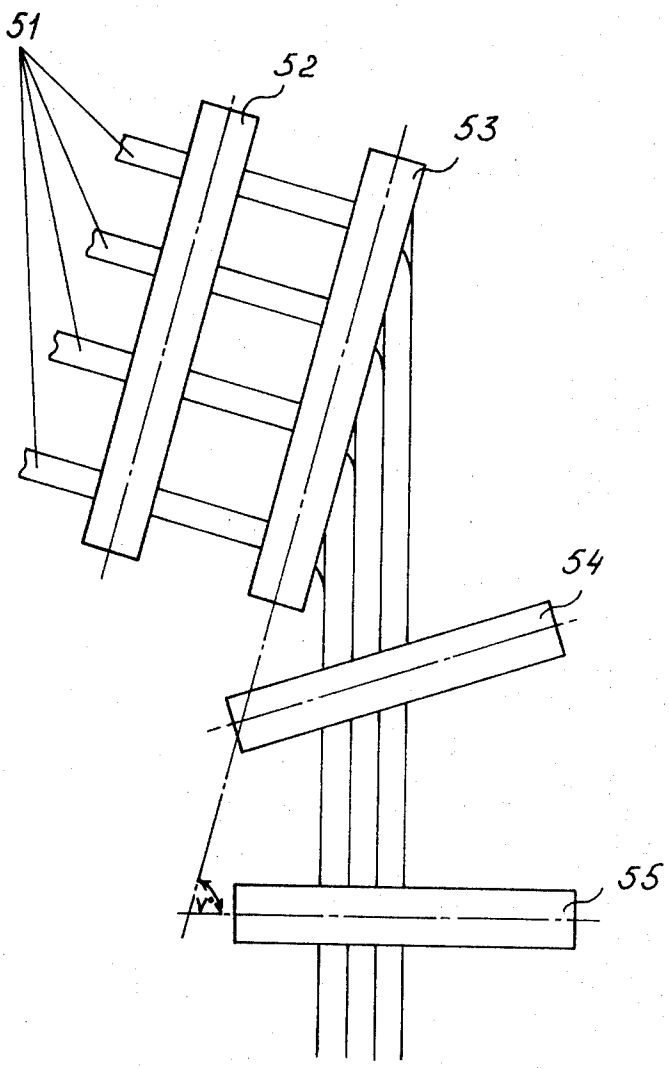

Fig. 8

APPARATUS FOR THE ROLLING OR TWISTING OF YARN OR RIBBON-LIKE STRUCTURES ABOUT THEIR LONGITUDINAL AXIS

BACKGROUND OF THE INVENTION

Strand rolling processes are in general known for various purposes within the textile industry and relates industries. It is i.e. known to perform such a rolling in combination with the spinning of staple yarn, the rolling being performed on the raw yarn in order to increase the coherence between the individual fibers and to make the cross section of the yarn more circular. The rolling is also employed in the yarn texturizing, where it is known to utilize such a rolling for producing a strong twist which is combined with a heat treatment or other fixing process capable of giving the material an inclination to revert to the twisted state when thereafter relaxed. Finally, it is known to use such a rolling process in the production of split or fibrillated fibers wherein orientated foil strips are split or fibrillated, usually under a relatively heavy pressure, into fibers, which still cohere in the form of a yarn. The orientation required for this purpose may e.g. be produced by a strong molecular orientation (although this as is well known does not always produce sufficient splittability), or it may be produced by a strong stretching of a mixed structure in molten state.

A rolling of the type under consideration has been produced by means of two rubber rollers, which are separately reciprocated along their axes, while at the same time being rotating to feed the strand forward longitudinally, or by similar means. However, the effect of these known rolling means is relatively non-uniform, which is of particular disadvantage in the production of split fibers where variation of the fineness of the fibers will result, and where the process is particularly critical owing to the required relatively high roller pressures. These drawbacks may to some extent be remedied either by feeding the yarn very slowly in relation to the time of reciprocation or by using a very large number of such rolling stations after one another. This, however, will tend to make the process relatively uneconomical.

It is an object of the invention to remedy these drawbacks and in such a way as to permit a particularly high speed of production.

SUMMARY OF THE INVENTION

According to the invention, there is used at least one rubbing body comprising a plurality of rubbing elements which are successively engaged with another rubbing body and, while being so engaged, are moved transversely of the feeding direction of the textile structure said rubbing elements being restored to their initial position during the periods of non-engagement with the other rubbing body.

Thus, according to the invention the rolling or twisting of the textile is performed structure in a substantially continuous process with substantially constant rolling in the same direction, whereby the rolling effect will be uniform and the treatment can be carried out in a practical way and at a high feeding speed.

The minimum number of rubbing elements is two, but it is preferred to use a greater number, e.g., 8–15, because it then becomes possible to use higher speeds without substantial complication of the construction of the required apparatus.

The other rubbing body located on the opposite side of the structure may e.g., be a rotating roller having a rubbing surface or, in a very simple embodiment, a stationary body having a rubbing surface. However, to obtain the highest possible speed of rotation in the rolling operation the other rubbing body preferably likewise comprises a plurality of rubbing elements, which are successively engaged with the first rubbing body, the rubbing elements at any time engaged with each other being moved in opposite directions.

In a preferred embodiment of the invention at least, one and both preferably rubbing bodies consists of a roller having a plurality of separately axially displaceable peripheral segments or sections, each extending over part of the circumference of the roller.

The rubbing surfaces may be sand blasted or finely fluted metal surfaces or rubber coatings which are attached directly to the rubbing elements. However, in one manner of carrying out the process, the transverse movement of the rubbing elements is applied to the structure through the medium of an endless bands. In this way the lifetime of the rubbing surfaces is increased. To avoid transverse slipping between the bands and the rubbing elements, the side of the bands, which is in direct contact with the elements, may be longitudinally fluted and the surfaces of the rubbing elements may be similarly fluted for engagement with the fluting pattern of the band.

For splitting and texturizing purposes, the rubbing surfaces are advantageously moved at relatively different speeds in the structure feeding direction. In this manner, a displacement action is imparted to the structure simultaneously with the rolling, which displacement action all the time affects the surfaces of the structure in opposite directions, an influence constantly taking place on different parts of the surfaces of the structures.

An apparatus for carrying out the invention may comprise means for establishing a substantially linear zone between two rubbing bodies with the structure gripped therebetween, and means for moving the rubbing elements provided on at least one of the bodies relative to one another transversely of the structure, while the same is being fed forward, according to the invention at least one of said rubbing bodies comprises a plurality of rubbing elements, together with means for successively engaging said rubbing elements with the other rubbing body, and means for displacing said rubbing elements transversely of the feeding direction of the structure during the period of their engagement with the opposed rubbing body and for restoring said rubbing elements to their initial position during the periods of their non-engagement with the opposed rubbing body.

Advantageously at least one of said rubbing bodies consists of a roller comprising a plurality of separately axially displaceable roller segments or sections, each extending over part of the periphery or circumference of the roller.

According to another preferred embodiment of the invention, said other rubbing body also comprises a plurality of rubbing elements, and means are included for successively engaging said rubbing elements with said first rubbing body, and means for moving the rubbing elements while in engagement with each other in opposite directions.

In the case where at least one rubbing body is in the form of a sectional roller, the rubbing elements may be carried by a core portion in such a manner as to be displaceable relative to this core portion in the longitudinal direction of the roller. The roller is also provided with means for reciprocating the sections synchroneously with the rotation of the roller. These means may advantageously consist of one or more stationary guiding tracks or guiding curves and one or more corresponding cams or guide members on each of the said sections.

The apparatus of the invention may also be constructed in other ways. For example the rubbing elements may be mounted on a set of endless carriers, which are so arranged that the rubbing elements are moved transversely of the feeding direction of the structure, which in this case may be the direction of the carriers.

The invention has utility in connection with the molecular orientation of thermoplastic polymers in the form of one or more ribbon-like structures or strips, the structures being heated and stretched within a predetermined zone up to several times their original length.

A stretching for the molecular orientation of thermoplastic polymers is usually carried out by means of two sets of rollers, one of which being located at one end of the stretching zone and the other being located at the other end of the zone, the first mentioned set of rollers being rotated at a lower circumferential rate of speed than the last mentioned set of rollers.

It is customary to localize the position of the stretching zone accurately by means of a friction body (smooth metal surfaces will normally provide sufficient friction for this purpose), and moreover the input rollers may be replaced by friction bodies, the speed of the material across these bodies being then controlled by adjustment of the frictional effect.

To facilitate the stretching, the material is, as mentioned above, frequently heated either by means of a hot-air oven in the stretching zone or by heating the input rollers or the intermediate friction body.

The apparatus of the invention is helpful in reducing risk of rupture during the stretching operation just described.

Thus the structure are subjected or structures in a continuous succession of operations, to a twisting before or while being stretched in heated condition, the twist thereby inserted being thereafter entirely or partly removed. The twisting is preferably carried out by rolling the structures about their longitudinal axes in the manner previously described, but other twisting methods, known per se, may alternatively be used.

It has been found that by the combined twisting and stretching a considerable reduction of the frequency of ruptures at a certain stretching ratio is obtained particularly where the material has distinct defective spots, e.g., resulting from occluded air blisters, an inhomogenous distribution of relatively high molecular and relatively low molecular components, a nonuniform thickness or notches at the edge of the ribbon-like structure or structures. By the twisting the structure assume a more compact character, the individual portions of a cross section through the structure or structures being held together by frictional forces, whereby an initial rupture will have less possibility of developing. It is essential that heating should be carried out before the material is subjected to twisting, since it takes considerably longer time to heat the material in a twisted state.

For practical reasons, it is preferable to produce the twist by rolling the structures between a pair of rubbing bodies located at the output end of the stretching zone. Usually a plurality of ribbon-like structures will be stretched simultaneously, and eventually these will be coiled in the form of individual packages. It is not necessary to provide a separate twisting member for each structure, but a plurality of structures may according to the invention preferably be twisted by means of the same pair of rubbing bodies in different areas of their rubbing surfaces.

For carrying out the combined twisting and stretching operation the apparatus may comprise means for subjecting one or more ribbon-like structures to localized heating and means for subjecting such structures to a stretching of several times their original length plus means for subjecting such structures continuously to twisting before or while they are being stretched in a heated state and for thereafter entirely or partly removing this twist.

When treating relatively wide foil strips, e.g., of a width of 3–30 cm, the danger of rupture may be further reduced by arranging the longitudinal axes of the input or heating rollers, and the auxiliary or stretching rollers respectively at an angle to each other. Hereby the twisting will take place sooner after the ribbon-like structures have left the last one of the sets of input rollers, whereby a possible notch or notch formation will be blocked before a rupture ensues. Likewise the resulting twisting of the structures will be more uniform. It has also been found that at a given stretching ratio the angle between the axes of the rollers should preferably have a value such that its cosine is approximately equal to or smaller than the square route of the stretching ratio, defined as the ratios between the speeds of travel at the input and output ends, respectively, of the stretching zone by selecting the angle such as to fulfil the condition, the danger of rupture at a given stretching ratio may be very considerably reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows diagrammatically, in a perspective view, a set of rollers for use in carrying out the process according to the invention, the reciprocating means for the peripheral segments being omitted to simplify the illustration,

FIG. 2 shows the reciprocating means for a roller of the kind illustrated in FIG. 1, as viewed in front elevation with certain parts in section,

FIG. 3 is a cross section taken along the line I—I in FIG. 2,

FIG. 4 is diagrammatic perspective view of a processing apparatus using the rubbing means of the invention for false twisting and, if desired, simultaneously splitting,

FIG. 5 is an apparatus similar to FIG. 4 for use in the splitting of ribbon-like structures in four stages,

FIG. 6 illustrates a stretching operation in which the twisting is produced by means of a different kind of sectional roller cooperating with another roller,

FIG. 7 illustrates diagrammatically an alternative system similar to FIG. 6 in which the twisting or rubbing action is transmitted by means of endless rubber bands placed between the rubbing roller (omitted for clarity) and the structure twisted, and

FIG. 8 illustrates diagrammatically another arrangement for the stretching of ribbon-like structures.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1, 2 and 3, 1 is a roller core, which is rotated by drive means not shown, and 2, 3, 4 and 5 are peripheral segments or sections constituting the outer roller circumference. The core 1 and the sections 2, 3, 4 and 5 are so constructed that the sections are forced to rotate with the core, but are free to reciprocate in the longitudinal direction of the roller. The illustration is greatly simplified and in practice the sliding movement should preferably be aided through bearings, which can, e.g., be rows of rollers. The sections are held together by means of collars, one of which, is shown at 6 in FIGS. 2 and 3. As another possibility the sections and the core could be assembled by means of dovetail connections or the like. FIGS. 2 and 3 also illustrate the provision of guiding pins or cam followers 7 on each section and a corresponding guiding groove or cam 8 in the ring 6. This construction too is shown in simplified form and in practice the connections should be established by means of bearings. For example each pin 7 may be in the form of a ball or roller bearing. Each section is provided with a rubber coating 9.

In FIG. 1, the directions of rotation of the two rollers and the longitudinal directions of movement of the sections 2 and 4 of each roller are indicated by arrows. The sections 3 and 5 are stationary in the moment they occupy the extreme opposite end positions. When the rollers have made one fourth of a revolution, the section 2 of the upper roller has been displaced by smooth sliding movement to the position assumed in the drawing by the section 5. Thus, each section is caused to perform a reciprocating movement, which is synchronized with the rotation of the roller. If relatively few sections are used, such as illustrated in the drawing — and on principle it is possible to use as few as two sections — the guiding groove 8 should have a substantially constant pitch over a relatively long distance over the region in which it guides the movement in the clamping zone. The guiding groove should have a configuration such that the roller sections are moved at a constant sliding speed at least from the moment when the leading edge of a section reaches the clamping zone to the time the trailing edge of the same section leaves the clamping zone, i.e., during one fourth of a revolution when four sections are used as illustrated. If, on the other hand, *10* or more sections are used, it is usually permissible to let the speed change gradually.

In the apparatus illustrated in FIG. 4, a group of yarns or strips of plastic film (for clarity film strips are shown) is fed through a set of ordinary rubber rollers 11 and then through a set of sectional rollers 12 performing a rolling by successive influences resulting from rubbing elements, each carrying out a predetermined cycle. Instead of a set of sectional rollers, it is possible to use, e.g., one sectional roller co-operating with an ordinary roller. It is also possible to use a combination of an ordinary roller and an array of sections, which are advanced in a closed path by means of endless chains or belts and at the same time carry out transverse movements analogous with those of the roller sections described above.

When the yarns or strips 10 are introduced in non-twisted state, the rolling will cause them to be twisted when leaving the rollers 11. The twisted yarns or strips are denoted by 13. This twisted state is fixed thermally, the material being heated in an oven 14 and subsequently cooled by means of a blower 15 before entering the set of rollers 12. After the rolling the material is passed on for coiling or spooling (not shown).

The twist inserted at 13 will be removed at 16 and the effect on the material of the set of rollers 12 is a so-called false twisting so that the material when relaxed will tend to return to the twisted state in which it was heat-set. If the material consists of strongly orientated strips, splitting or fibrillation may take place at the same time and will be effected to a lesser extent in the zone where the strips are twisted, i.e., when they leave the rollers 11, and to a greater extent in the zone where they are subjected to rolling by the rollers 12.

Splitting may, however, also be effected without maintaining any false twist in the final product, the heat setting or other fiber fixation treatments illustrated being then omitted. When the present improvement is also to be used for splitting, it is advantageous to repeat the rolling several times by means of several stations of the same kind arranged in immediate succession. This is illustrated in FIG. 5. In the splitting system illustrated in FIG. 5, ribbon-like strips 17 are first split by pure rolling about their longitudinal axes without any displacement along the longitudinal axes taking place at the same time. This has been found to be preferably for the starting of the splitting. This treatment takes place by means of a set of rollers 18 constructed with displaceable sections such as explained above with reference to FIGS. 1, 2 and 3. A series of subsequent sets of rollers 19, 20 and 21 is also constructed with displaceable sections, but during the passage through these a combined rolling about the longitudinal axes of the structures and a displacement along these axes takes place.

To determine the operating conditions when the structures are to be subjected to a pure rolling about their longitudinal axes, and when they are at the same time to be subjected to displacement along the longitudinal axes, respectively, the resultant (i.e., vector sum) of the circumferential speed of rotation and the speed of displacement should be considered for each of the two rubbing surfaces engaging one another. If this resultant is numerically equal (but oppositely directed) for the two rubbing surfaces, the structures are subjected to a pure rolling about the longitudinal axes. If on the other hand the two resultants have opposite numerical values (and different directions), a displacement from the longitudinal axes of the yarns takes place at the same time. It can be observed that it is possible without substantial drawbacks to select the speed of rotation and displacement of the roller sections in such a manner that the feeding direction of the structures varies considerably from a direction perpendicular to the axis of the rollers.

Immediately before moving into the set of rollers **19**, the structures travel through eyes of a reciprocating rod **22** and are thereby introduced into the clamping zone in a zig-zag pattern, which in this stage usually promotes splitting. After splitting in the set of rollers **19**, there follow two ordinary sets of rollers **23** and **24**, which subject the structures to a stretching in order to remove kinks and the like that may be formed when the structures are subjected to displacement from their longitudinal axes. The same function is performed by two additional sets of rollers **25** and **26**, which are arranged after the set of rollers **20**, as well as two further sets of rollers **27** and **28**, which are arranged after the set of rollers **21**. Moreover, an oven **29** is provided immediately before the set of rollers **21** and serves to soften the material immediately before it reaches the last splitting station. The heating in this oven and the cooling, which is effected by means of a blower **30** and takes place after the splitting station and while the split fiber yarns are held in a relatively slack state, serves to fix the ruffled state, into which the fibers are brought by the splitting action when they are subjected to displacement from the longitudinal axes of the structures. Eventually the yarns are spooled.

In the arrangement illustrated in FIG. **7**, a plurality of ribbon-like structures or strips **31** to be orientated are moved in flat non-twisted state through a heated pair of rollers **32** (the heating means not being shown) and thereafter to modified rubbing station. Here, pairs of segmented rubbing rollers are used as before but instead of these rollers directly contacting the textile structures to be treated, an endless rubber belt **33** is interposed between each roller and the structure. In this way, the frictional effect is transmitted through the rubber belt which therefore receives the resultant wear. In FIG. **7**, the set of rubbing rollers have been omitted to better reveal the belt arrangement but the position of the roller set is indicated diagrammatically by the dot-dash line **34**. It will be understood that one roller of the set will be situated above the upper of the belts **33** in pressing contact therewith and the other below the lower of these belts. The sections of the rollers contacted by the belts are reciprocated at a rate consistent with the angle made by the paths of travel of the belts with respect to the direction of travel of the structures. Preferably the rubbing rollers used here are of the type shown in detail in FIG. **6** hereinafter described. A lubricant may be applied between these clamping means and the rubber belts if desired.

The two rubber belts are moved at an angle to each other and thereby cause the strips clamped therebetween to be rolled. At the same time the strips are pulled forward by the rubber belts at a speed equal to the component of speed of the rubber belts in the longitudinal direction of the machine. The pair of rollers **32** rotate at a lower circumferential speed, the ratio between the said component of speed and the circumferential speed being substantially equal to the desired stretching ratio. The strips are thereby simultaneously stretched and twisted. Both stretching and twisting take place predominantly in the zone adjacent the rollers **32** immediately after the strips have left these rollers. A set of rollers **35** rotates at a circumferential speed corresponding to the said component of the movement of the rubber belts and thereby reinforce the stretching effect they impart. If these rollers were not provided, it would be necessary to clamp the rubber belts particularly tightly against one another, which would be unpractical. The twisting produced by the rubber belts will be at any rate substantially removed when the strips leave the clamping zone between the rubber bands. In addition to the heating of the rollers **32** a hot air oven may be arranged between these rollers and the clamping zone of the rubber belts. The stretching zone and the twisting zone may thereby be extended, whereby it becomes possible to use higher feeding speeds.

In FIGS. **6**, the numbers **31**, **32** and **35** have the same significance as in FIG. **7**. In FIG. **6**, however, the rubber belts have been omitted leaving only the set of rollers **40**,**41**. The roller **40** is shown in dotted lines and is located between the strips **31** and the observer and may be an ordinary roller. The roller **41** on the other side of the strips is a peripherally segmented or sectional roller of the same kind as that shown in FIGS. **1**, **2** and **3**. The roller **40** however, consists of a relatively great number of segments or sections, which is usually advantageous. In the arrangement of FIG. **6**, the roller set **40**,**41** is shown disposed at an oblique angle to the direction of travel of the structures instead of at right angles thereto as in FIG. **7** as indicated by the center line. Line **42** also indicates the projection of the composite movement performed by any particular point of any particular section. The guiding means which displace the sections longitudinally of the roller are not shown. When the pitch of the path described by each point of a section in the clamping zone is to be 2α, it is usually advantageous to arrange the rollers **40** and **41** at an angle α to the rollers **32** and **35** moreover, the composite speed of the frictional surface of the sections in the clamping zone should be equal to the circumferential speed of the roller **40**. Since the feeding direction becomes the bisecting line of the angle between the movements of the two roller surfaces, the strips will on principle travel linearly through the stretching apparatus. To prevent them from drifting longitudinally of the rollers, it is, however, advantageous in practice to control the introduction of the strips into the clamping zones by means of a comb **43**.

To give the rollers a sufficient frictional surface, they may be sand blasted or rubber coated, but it is also possible to transfer the transverse movements from these rollers to the strips through endless rubber belts as mentioned in connection FIG. **7**. The rubber belts and the roller surfaces may then be in engagement with each other by means of a pattern of flutes or grooves preventing transverse slipping.

The system illustrated in FIG. **8** serves for the stretching of wide strips in such a manner as to reduce the risk of rupture of the strips, which result is obtained by arranging the longitudinal axis of the main preheating roller set and the drawing rollers at an angle to each other. Ribbon-like foil strips **51** pass through a set of preheating rollers **52** and a set of main preheating rollers **53**, whereafter they are twisted in a set of rollers **54**, one roller of which consists of two or more axially reciprocable roller sections each extending over part of the periphery of the roller, while the other is a roller performing a pure rotational movement. After leaving these twisting rollers, the strips, which are now entirely

or partly twisted, travel through a set of auxiliary or stretching rollers **55**, the circumferential speed of which is equal to the sum of the components in the direction of travel of the circumferential and axial speeds of the sections of the first mentioned roller **54** in the nip zone and also equal to the component in the direction of travel of the circumferential speed of the other roller **54**. As illustrated in the drawing, the twisting of the individual strips will start immediately after these have left the pair of rollers **53**.

We claim:

1. An apparatus for twisting or rolling an advancing textile strand generally about its axis which comprises a pair of opposed rollers defining a nip through which said textile strand passes, at least one of said rollers having its periphery surface constituted of a plurality of peripheral segments, each mounted for individual movement parallel to the roller axis and for bodily rotational movement with the remainder of the roller, driving means for rotating said roller pair, reciprocating means for imparting axial movement to said peripheral segments as they successively contact said strand and in time relation to the linear speed of travel of the segment surfaces contacting said strand, and means for advancing at least one textile strand to and for withdrawing said strand from said pair of opposed rollers along a generally rectilinear path, said roller pair having the locus of the nip thereof extending across said path.

2. The apparatus of claim **1** wherein both of said opposed rollers have their peripheral surfaces constituted of said peripheral segments and said reciprocating means reciprocates the segments of both said rollers.

3. The apparatus of claim **2** wherein said reciprocating means moves the segments of the respective rollers in opposite axial directions at substantially equal speeds.

4. The apparatus of claim **2** wherein said reciprocating means moves the segments of the respective rollers in opposite axial directions at unequal speeds whereby said strand is both twisted and laterally displaced.

5. The apparatus of claim **1** wherein said pair of opposed rollers is arranged with their axes extending at an oblique angle to the path of advance of the strand.

6. The apparatus of claim **5** wherein each surface of a segment while in contact with said strand is moved axially at a pitch substantially twice said oblique angle.

7. The apparatus of claim **1** wherein said segmented roller includes a center core adapted to be rotatively driven by said driving means, said core carrying a plurality of axially extending tracks, each in mating engagement with one of said peripheral segments, permitting individual axial reciprocation of said segments coincidental with bodily rotation thereof.

8. The apparatus of claim **1** wherein each of said peripheral segments has a cam follower fixedly associated therewith and said reciprocating means comprises a cam track engaging said cam followers.

9. An apparatus for twisting or rolling an advancing textile strand generally about its axis which comprises a plurality of elongated elements each having a surface region for frictionally contacting the strand and arranged generally transversely to the direction of advance of the strand, said elements being mounted for individual movement to and fro along their longitudinal axes and for bodily movement at an angle to said longitudinal axes in a cyclical path, an opposed strand contacting surface maintained in closely spaced relation to one locus on the path of bodily movement of said elements and cooperating with at least one element at said locus to tightly engage the strand therebetween, means for driving said elements along said cyclical path, means for moving each such element passing through said locus in a given longitudinal direction in timed relation to the bodily movement of the element through said cyclical path and subsequently along said cyclical path moving said elements in the opposite longitudinal direction, and means for advancing at least one textile strand to and withdrawing the strand from said locus along a generally rectilinear path, said element at said locus having its longitudinal axis extending generally across said strand path.

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