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METHOD AND APPARATUS FOR CRIMPING TEXTILE FIBROUS MATERIAL

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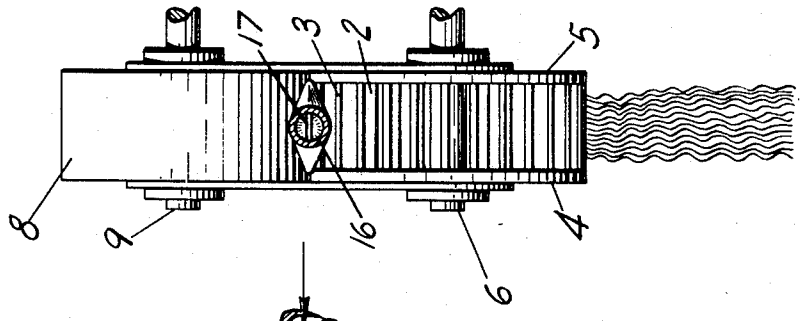


Fig. 2.

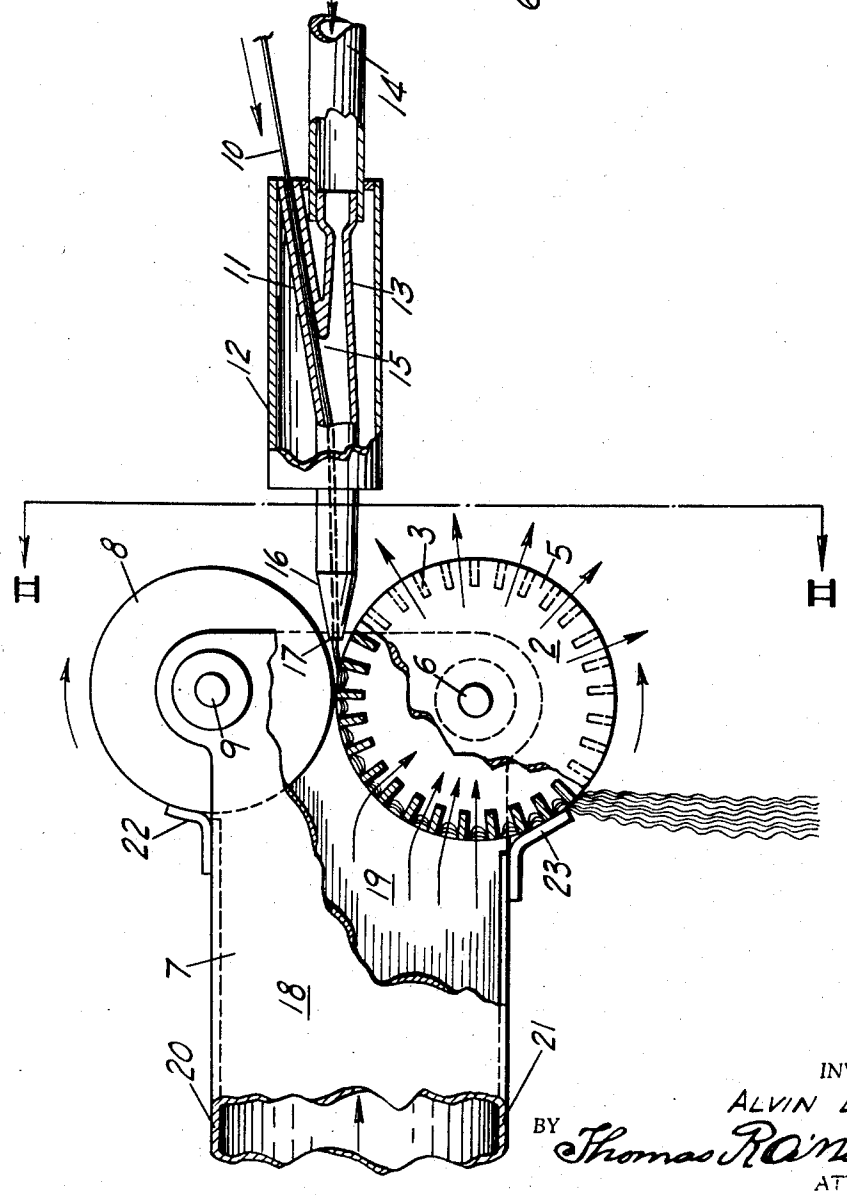


Fig. 1.

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METHOD AND APPARATUS FOR CRIMPING TEXTILE FIBROUS MATERIAL

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This invention relates to the crimping or similar distorting of textile fibrous materials in the form of filaments, yarn, tow, or staple fibers.

It is an object of the invention to provide a novel method of crimping yarn and the like in accordance with which the yarn is fed into the nip between a pair of moving pressing surfaces at a more rapid rate than that at which the surfaces move.

An additional object of the invention is to employ a stream of softening agent for directing the tow into the nip at the rate desired.

A further object of the invention is to set or harden the crimped yarn before any appreciable recovery of shape can occur.

It is a further object of the invention to provide a novel form of apparatus to carry out the method.

Other objects and advantages will become apparent from the description, drawing, and the claims.

In the drawing, illustrative of the invention,

Figure 1 is an elevational view with parts broken away showing a preferred embodiment of the invention, and

Figure 2 is an end view of the preferred embodiment with the feeding device in cross-section taken on line II—II in Figure 1.

The method of the invention consists essentially in delivering softened yarn or the like into the nip formed between two material surfaces pressed together and moving continuously at such a rate that the yarn is fed into the nip at a greater linear speed than the speed at which the surfaces move away from the nip. A stream of softening agent for the yarn may be used to feed it into the nip. After crimping, the yarn is hardened before it has had an opportunity to lose its shape. The drawing illustrates one arrangement for carrying out the method.

In the particular form of device shown in the drawing, a cage-like drum 2 having radial ribs 3 extending between its end faces 4 and 5 at their peripheries is secured to a shaft 6 rotatably mounted at the lower corner of the otherwise open end of a hollow channel 7. A roll 8 having a resilient and somewhat flexible peripheral surface is secured to a shaft 9 mounted rotatably in the upper corner of the channel 7 thereby closing the upper portion of the end of the channel. The drum 2 is rotated by a suitable means not shown in the direction indicated by the arrow in the drawing, while the roll 8 may either be driven positively so that it has the same surface speed as the drum 2 at the point of contact or

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the roll 8 may be an idler and reliance for rotation thereof may be placed solely upon the frictional engagement thereof with the drum 2.

The yarn, tow, or the like, 10 is fed to the device from any suitable supply, such as a bobbin, a spinning machine, a guide pulley, a metering godet, etc. not shown, to a tube 11 within a casing 12 containing a nozzle 13 into which a stream of a softening agent, such as steam, atomized vapors of water, plasticizers, etc., may be directed by means of a pipe 14. The internal end of the tube 11 through which the yarn, tow or the like is drawn opens at 15 into the nozzle 13 at an obtuse angle with respect to the direction of flow of the softening agent through the nozzle 13, and the stream of softening agent forces the yarn, tow or the like entering the nozzle 13 directly into the nip between the cage-like drum 2 and the roll 8 through an orifice 17 of the fan-shaped discharge end 16 of the nozzle 13, which orifice is of the shape of an elongated slit to assist the fanning out, opening, and uniform distribution of the filaments of the yarn, tow or the like so that they are laid out in an opened condition across the full width of the cage-like drum 2.

The channel 7 is in the form of a duct of rectangular cross-section, the side plates 18 and 19 of which extend beyond the termination of the top and bottom plates 20 and 21 respectively as shown in Figure 1. The top plate 20 extends to a point in proximity to the surface of the roll 8 and a sealing flange 22 may be attached thereto as shown in the drawing. Similarly, a sealing flange 23 may be attached to the end of the bottom plate 21. The hollow channel 7 is supplied with a stream of a hardening or a setting agent for the yarn. The disposition of the roll 8 in the upper corner of the end of the channel 7 is such as to deflect the flow of the hardening agent down through the yarn which is distributed in crimped or distorted form over the cross-ribs 3 of the cage-like drum 2. The hardening or setting agent may consist of a stream of liquid or hot air or any other suitable liquid or hot gas. The direction of flow of the gas or liquid through the drum is indicated generally by the arrows.

In operation of the device, the speed of rotation of the cage-like drum 2 is adjusted so that the peripheral speed is slower than the lineal speed of the yarn directed thereto by the nozzle arrangement 13. If the yarn is supplied from a metering guide pulley or godet, it is operated in such a manner that the yarn is delivered therefrom at a velocity which is greater than the lineal peripheral velocity of the cage-like drum 2. A

stream of softening agent draws the yarn into the nozzle 13, softens it therein, and forces it through the orifice 17 of the tip 16 directly into the nip between the cage-like drum 2 and the roll 8 at a higher velocity than that of the drum 2, thus causing a distortion or crimping of the individual fibrous elements of the yarn, which is further accentuated by the action of the resilient-faced roll 8 pressing the distorted fibers at spaced points corresponding to the ribs 3 in the drum 2. This is shown generally in the drawing. As the drum 2 turns in a counterclockwise direction, the force of the stream of hardening agent, whether in liquid or gaseous state, tends to maintain, if not accentuate the distortion or crimping in the yarn by virtue of the fact that the stream of setting agent tends to force the individual filamentary members of the yarn more deeply into the spaces between the ribs 3. As shown in the drawing, the crimped yarn falls from the drum 2 as soon as it passes the sealing member 23 on the bottom plate 21 of the channel 7. Should the yarn tend to adhere to the ribs 3 through a greater arc, the increased resistance to the flow of the stream of hardening agent through the exit ports between the ribs 3 of the drum 2 quickly builds up sufficient pressure to finally blow the yarn from the ribs 3 before it can again approach the nip between the drum 2 and roll 8.

While the drawing is illustrative of a preferred form of the invention, modifications may be made therein and different means may be employed to perform the method. For example, a pair of belts could be substituted for the roll and the cage-like drum, one of the belts presenting a fully closed face and the other presenting transverse openings throughout its length respectively. In place of having ribs 3 extending straight across the peripheral face of the drum 2 as shown, ribs of any other character, such as an intersecting network having two series of parallel lines extending at any angle, though preferably at 45° or more, to the side plates 4 and 5 of the cage-like drum, may be employed. The cross ribs or other network need not present flat faces at the peripheral surface of the drum, but they may taper so that they present their peaks in the form of lines or intersecting lines in the peripheral surface of the drum.

The roll 8 or its peripheral surface may be made of any suitable resilient and somewhat flexible material, such as rubber, leather, etc. Any form of nozzle 13 may be employed and the duct or channel 7 for the hardening fluid may have any suitable form or shape, it being arranged in such a manner at its end that the crimping drum 2 and roll 8 substantially close the opening in the end, except for the ports formed between the ribs 3 in the drum 2.

The yarn may be drawn into and through the nozzle 13 by means of any suitable softening agent for the yarn in the form of a liquid, gas, vapor, or atomized liquid or in the form of a liquid, gas, vapor or atomized liquid containing as a component thereof a softening agent for the yarn. For example, a blast of heated air or hot air of high humidity or a blast of a mixture of steam and air or a blast of air containing an atomized spray of a chemical compound having plasticizing properties for the particular fibrous material of which the tow is constituted are all suitable. Alternatively, freshly spun artificial filaments such as of cellulose acetate, which are still plastic by virtue of the fact that they still contain a certain amount of the solvent medium

with which they are spun (e. g., acetone) may be drawn into the nozzle 13 with a fluid, either liquid or gaseous, which may be entirely inert insofar as softening effect upon the yarn, tow or the like is concerned. Similarly incompletely coagulated filaments of viscose or of synthetic materials of other nature may be drawn into the nozzle by an inert fluid, the coagulation being allowed to progressively occur during the crimping and treatment with the hardening and setting means described.

The hardening means is preferably in the form of a gas which may be blown through the duct against the crimped tow upon the drum 2 such as the hot air mentioned above. However, if desired, a liquid hardening agent or a solution of a liquid or solid hardening agent may be supplied to the duct 7 preferably at such a rate that the level does not approach the top of the drum 2. In those cases where a liquid or a solution of a setting agent is employed, the drum 2 may have its lower course extend into a washing tank or spray to remove any residual hardening agent from the drum to prevent it from exerting any influence upon the softened yarn before it has been crimped or distorted.

This invention is applicable to the distortion of yarns, tow, filaments, bundles of fibers, whether twisted or untwisted, and whether of continuous or discontinuous lengths. The fibrous material constituting the yarn, etc., may consist of any natural or artificially produced fibers, such as viscose, cellulose acetate, ethyl cellulose, etc. The yarn or the like to be treated may consist of unmodified fibrous material or it may contain plasticizers, pigments, fillers, dyes, lakes, fire-retardants, de-electrifiers, sizes, lubricants, or mixtures of these either as coatings or as a component part of the fibers incorporated therein.

In the claims, the expression "textile fibrous material" is intended generically to include the various forms of the filaments contemplated by the invention, examples of which are indicated in the preceding paragraph. This expression is further intended to exclude woven fabrics, the invention contemplating such materials as tow, yarn, individual continuous filaments, unwoven fibers, etc. suitable for subsequent manufacture into textile fabrics.

While a preferred embodiment of the invention has been disclosed, it is to be understood that changes and variations may be made without departing from the spirit or scope of the invention as defined by the appended claims.

What I claim is:

1. In a method of crimping a textile fibrous material, the steps of continuously moving two material surfaces through approximately tangentially related paths at least one of which is arcuate into substantial contact to form a nip between successively approaching points on said two surfaces and feeding said fibrous material longitudinally into said nip at a linear speed sufficiently in excess of the rate of motion of said surfaces to surcharge the nip.

2. In a method of crimping textile fibrous material, the steps of continuously moving two material surfaces through approximately tangentially related paths at least one of which is arcuate into substantial contact to form a nip between successively approaching points on said two surfaces and feeding said fibrous material by means of a fluid stream containing a softening agent for the fibrous material longitudinally into said

nip at a linear speed in excess of the rate of motion of said surfaces.

3. In a method of crimping freshly spun artificial textile fibrous material, the steps of continuously moving two material surfaces through approximately tangentially related paths at least one of which is arcuate into substantial contact to form a nip between successively approaching points on said two surfaces, feeding said fibrous material while still in a plastic condition by means of an inert fluid stream containing a softening agent for the fibrous material longitudinally into said nip at a linear speed in excess of the rate of motion of said surfaces, and then treating the material as it is discharged from the nip with a hardening agent therefor.

4. In a method of crimping a textile fibrous material, the steps of continuously moving a perforated material surface with an imperforate material surface through adjacent paths at least one of which is arcuate into a substantially tangential relationship to form a nip between successively approaching points on said two surfaces and feeding said fibrous material longitudinally into said nip at a linear speed sufficiently in excess of the rate of motion of said surfaces to surcharge the nip.

5. In a method of crimping a textile fibrous material, the steps of continuously moving a perforated material surface with an imperforate material surface through adjacent paths at least one of which is arcuate into a substantially tangential relationship to form a nip between successively approaching points on said two surfaces and feeding said fibrous material with a stream containing a softening agent for the fibrous material longitudinally into said nip at a linear speed in excess of the rate of motion of said surfaces.

6. In a method of crimping a textile fibrous material, the steps of continuously moving a perforated material surface with an imperforate material surface through adjacent paths at least one of which is arcuate into a substantially tangential relationship to form a nip between successively approaching points on said two surfaces, feeding said fibrous material with a stream containing a softening agent for the fibrous material longitudinally into said nip at a linear speed in excess of the rate of motion of said surfaces, and then treating the material as it is discharged from the nip with a hardening agent therefor.

7. In a method of crimping textile fibrous material, the steps of continuously moving a perforated material surface beneath an imperforate material surface through adjacent paths at least one of which is arcuate into a substantially tangential relationship to form a nip between successively approaching points on two said surfaces and then moving said surfaces in said paths to separate them, feeding said fibrous material with a stream containing a softening agent for the fibrous material longitudinally into said nip at a linear speed in excess of the rate of speed of said surfaces, and directing a stream of hardening agent for the fibrous material therethrough as it is discharged from said nip.

8. In an apparatus of the character described, means for continuously moving two material surfaces through approximately tangentially related paths at least one of which is arcuate means for continuously pressing the successively opposed portions of the two material surfaces into contact to form a nip and means for feeding a fibrous material longitudinally into said nip at a linear speed

in excess of that of the motion of said surfaces, said feeding means comprising means for directing a stream of fluid toward said nip and means for guiding said fibrous material into the path of said stream of fluid.

9. In an apparatus of the character described, means for continuously moving two material surfaces through approximately tangentially related paths at least one of which is arcuate means for continuously pressing the successively opposed portions of the two material surfaces into contact to form a nip and means for feeding a fibrous material longitudinally into said nip at a linear speed in excess of that of the motion of said surfaces, said feeding means comprising means for directing a stream of fluid containing a softening agent for said fibrous material toward said nip and means for guiding said fibrous material into the path of said stream of fluid.

10. In an apparatus of the character described, a movable perforated material surface, a movable imperforate material surface, means for continuously moving the two material surfaces through approximately tangentially related paths at least one of which is arcuate means for pressing the successively opposed points on said two surfaces into contact to form a nip, and means for feeding a fibrous material longitudinally into said nip at a linear speed in excess of that of the motion of said surfaces, said feeding means comprising means for directing a stream of fluid toward said nip and means for guiding said fibrous material into the path of said stream of fluid.

11. In an apparatus of the character described, a movable perforated material surface, a movable imperforate material surface, means for continuously moving the two material surfaces through approximately tangentially related paths at least one of which is arcuate means for pressing the successively opposed points on said two surfaces into contact to form a nip, and means for feeding a fibrous material longitudinally into said nip at a linear speed in excess of that of the motion of said surfaces, said feeding means comprising means for directing a stream of fluid containing a softening agent for said fibrous material toward said nip and means for guiding said fibrous material into the path of said stream of fluid.

12. In an apparatus of the character described, a movable perforated material surface, a movable imperforate surface, means for continuously moving the two material surfaces through approximately tangentially related paths at least one of which is arcuate means for pressing the successively opposed points on said two surfaces into contact to form a nip, means for feeding a fibrous material longitudinally into said nip at a linear speed in excess of that of the motion of said surface, said feeding means comprising means for directing a stream of fluid containing a softening agent for said fibrous material toward said nip and means for guiding said fibrous material into the path of said stream of fluid, and means for applying a hardening agent to the fibrous material as it is discharged from said nip.

13. In an apparatus of the character described, a relatively hollow drum having a plurality of openings extending through its cylindrical periphery, a rotatable member thereabove having its cylindrical surface arranged in substantial tangential relationship with the cylindrical periphery of said drum, means for directing a stream of softening agent into the nip between

said drum and member, means for guiding a fibrous material into the path of said stream at a point in front of said nip, means for rotating said drum at a peripheral speed less than the lineal speed of the fibrous material imparted by said stream, and means for applying a hardening agent to the fibrous material discharged on said drum from said nip.

14. In an apparatus of the character described, a duct having mounted in its end a drum having a plurality of radially extending openings therethrough and a rotatable member above said drum, the drum and said member being arranged in substantial tangential relationship with respect to their cylindrical surfaces and being so arranged as to substantially close the end of said duct except for the openings through said drum, means for directing a stream of softening agent into the nip between said drum and member, means for guiding a fibrous material into the path of said stream at a point in front of said nip, means for rotating said drum at a peripheral speed less than the lineal speed of the fibrous material imparted by said stream, and means for supplying said duct with a hardening agent for said fibrous material.

15. In an apparatus of the character described, a duct having mounted in its end a drum having a plurality of radially extending openings therethrough and a rotatable member above said drum, the drum and said member being arranged in substantially tangential relationship with respect to their cylindrical surfaces and being so arranged as to substantially close the end of said duct except for the openings through said drum, a nozzle opening in proximity to said nip, means for supplying a stream of softening agent to said nozzle, means for guiding a fibrous material into the path of said stream at a point in front of said nip, means for rotating said drum at a peripheral speed less than the lineal speed of the fibrous material imparted by said stream and means for supplying said duct with a stream of hardening agent for said fibrous material.

16. In a method of crimping filaments of cellulose acetate, the steps of continuously moving a perforated material surface with an imperforate material surface through adjacent paths at least one of which is arcuate into substantially tangential relationship to form a nip between successively approaching points on said two surfaces and feeding said filaments while still in a plastic condition by virtue of a small content of spinning solvent therein by means of a fluid stream into said nip at a lineal speed in excess of the rate of motion of said surfaces.

17. In an apparatus of the character described, a hollow drum having a plurality of openings extending through its cylindrical periphery, a rotatable member thereabove having its cylindrical surface arranged in substantial tangential relationship with the cylindrical periphery of said drum, means for directing a stream of fluid into the nip between said drum and member, means for guiding a fibrous material into the path of said stream at a point in front of said nip, and means for rotating said drum at a peripheral speed less than the lineal speed of the fibrous material imparted by said stream.

18. In an apparatus of the character described, a hollow drum having a plurality of openings extending through its cylindrical periphery, a rotatable member thereabove having its cylindrical surface arranged in substantial tangential relationship with the cylindrical periphery of said drum, means for directing a stream of fluid into the nip between said drum and member, means for guiding a fibrous material into the path of said stream at a point in front of said nip, means for rotating said drum at peripheral speed less than the lineal speed of the fibrous material imparted by said stream, and means for applying a fluid to the fibrous material discharged on said drum from said nip.

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