July 19, 1966 A. KUNZLE 3,261,155

METHOD AND APPARATUS FOR TREATMENT OF YARNS

Filed Dec. 18, 1963 3 Sheets-Sheet 1

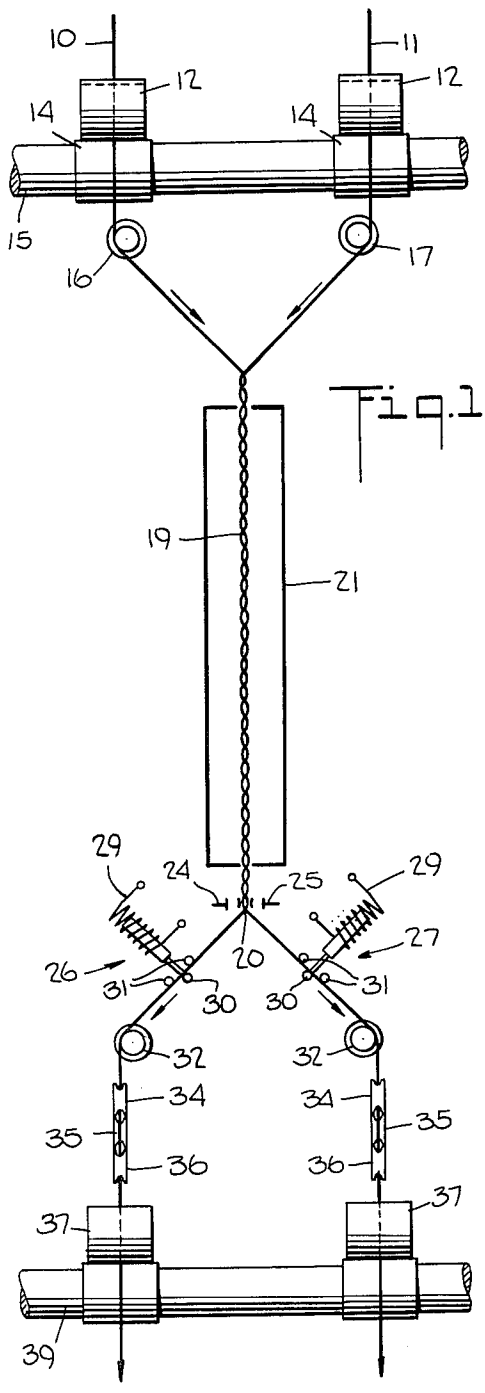


Fig. 1.

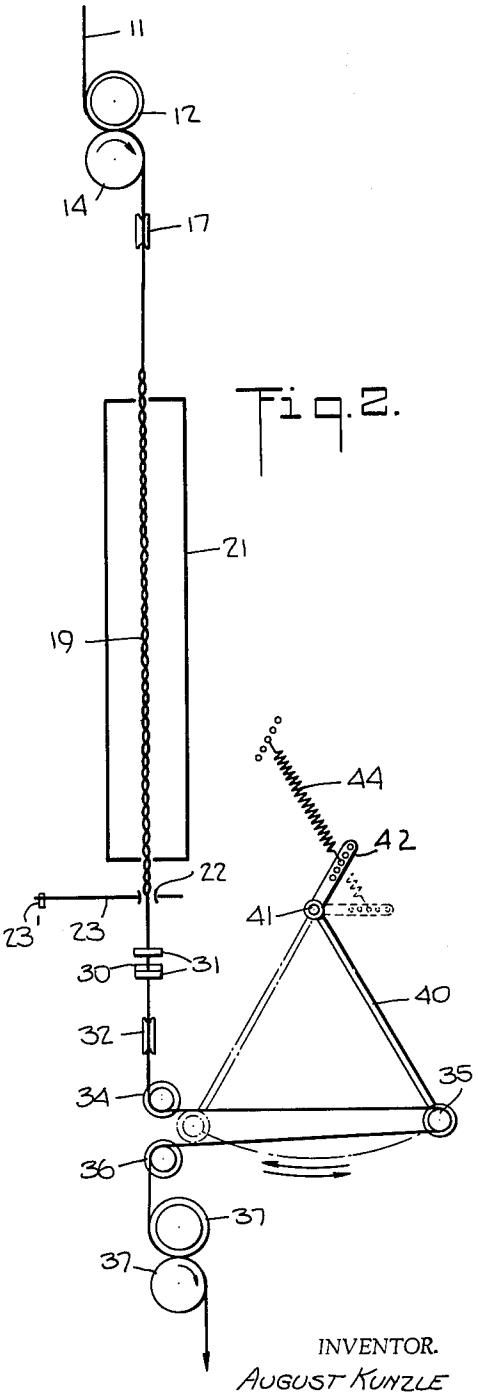


Fig. 2.

INVENTOR.
AUGUST KUNZLE

BY

Ward, Neal, Haselton, Cruse & McElhannon
ATTORNEYS

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METHOD AND APPARATUS FOR TREATMENT OF YARNS

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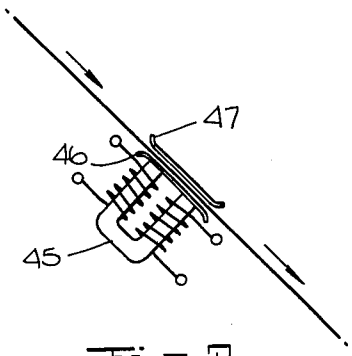


Fig. 3.

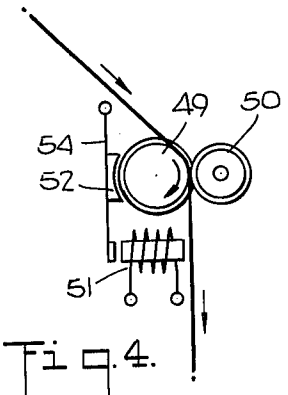


Fig. 4.

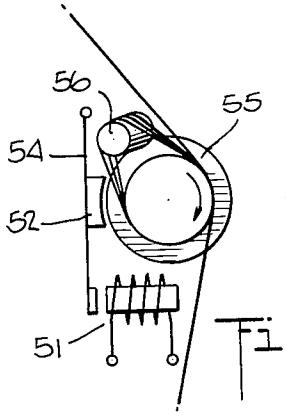


Fig. 5.

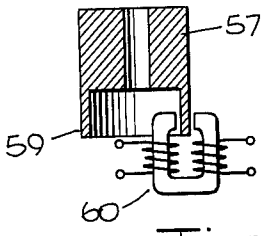


Fig. 6.

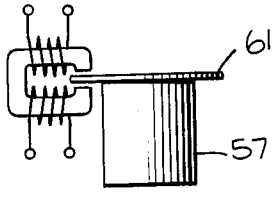
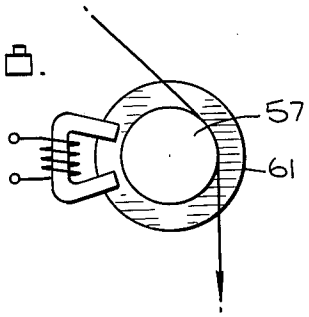


Fig. 7.

Fig. 8.



INVENTOR.
AUGUST KUNZLE

BY

Ward, Neal, Haselton, Olive & McElhannon
ATTORNEYS

July 19, 1966 A. KUNZLE 3,261,155

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Fig. 10.

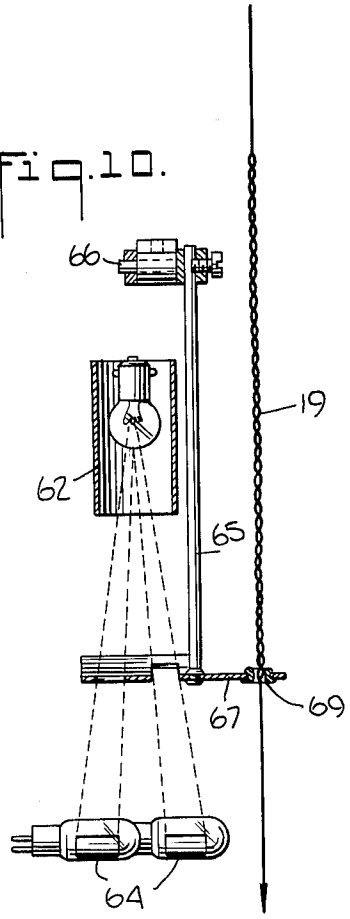


Fig. 9.

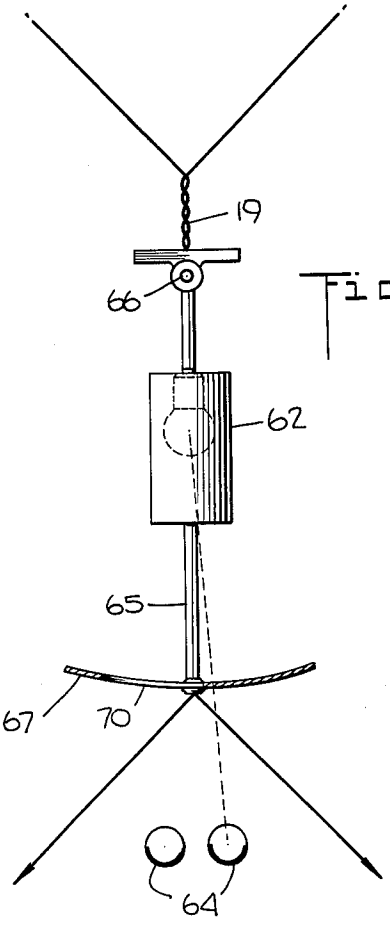


Fig. 12.

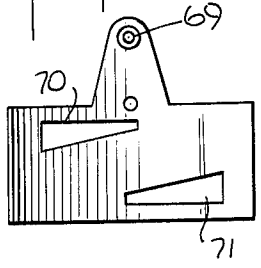
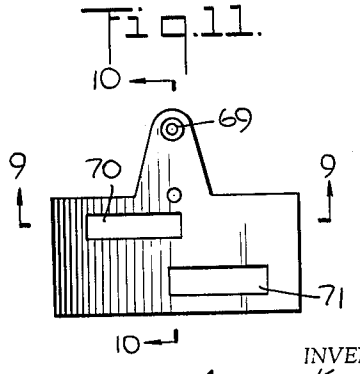


Fig. 11.



INVENTOR.
AUGUST KUNZLE

BY

Ward, Hall, Hamilton, Owen & McElhannon
ATTORNEYS

United States Patent Office

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METHOD AND APPARATUS FOR TREATMENT OF YARNS

August Kunzle, Wattwil, Switzerland, assignor to Heberlein Patent Corporation, New York, N.Y., a corporation of New York

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Claims priority, application Switzerland, Feb. 1, 1963, 1,277/63
13 Claims. (Cl. 57—34)

This invention relates to the treatment of textile yarns, and, more particularly, to a method and apparatus for crimping yarns by twisting several yarns together, heat fixing the yarns while in the twisted condition, and separating the yarns.

Apparatus and processes for the crimping of textile yarns are known according to which two or more yarns are taken from spools, are twisted together along a selected length, are subjected to heat fixation while in the twisted condition, and are then separated into individual yarns by being pulled apart in different directions and at the same speed. When yarn is treated in this way, it has been observed that certain forces are often set up which overstress the yarn and cause it to break. Thus, for example, the respective yarns that are twisted together during heat fixation may suffer contraction to a different degree, wherefore the point of separation of the yarns deviates laterally as the yarns are pulled apart and breakage may occur.

Efforts to maintain the separation point constant have included the use of conical-shaped yarn withdrawal rollers so that as the point of separation tends to move laterally either way from its central position, each yarn will shift appropriately relatively to its conical withdrawal roller to increase or decrease the speed of withdrawal of one yarn relatively to the other, thus to maintain substantially constant tension on each yarn, and the point of separation in a constant central position.

Such expedients are not completely satisfactory, being not altogether reliable in operation, particularly at the exceedingly high lineal speeds at which the yarns are moved in such apparatus, i.e. speeds of the order of 1000 meters per minute or more. Accordingly, I have conceived by my invention a method and apparatus by which I am able reliably to overcome the foregoing difficulties and disadvantages.

In essence, my invention encompasses a method and apparatus for permanently crimping textile yarns according to which at least two yarns are delivered from spools and are twisted together along a selected distance, are subjected to heat fixation while in twisted condition, and are again separated by being pulled apart at the same speed and each under a tension that is regulated by the application of a braking force to one or another of the yarns whenever the separation point tends to deviate from its central or middle position.

As an important feature of my invention, I provide an electrically operated yarn tension regulator in the zone between the point of yarn separation and a winding or take-up device for each respective yarn; and means in the twisting zone which are affected by the lateral deviation of the separation point to control the electrically operated tension regulators. I am thus able to effect substantially instantaneous regulation of the yarn tension, a factor which is of considerable importance when it is realized that the maximum linear speed of yarn being treated is limited by the reaction speed of the tension control apparatus.

As a further feature of my concept, I am able to withdraw the yarns at the same speed even though the braking force is applied to one of them. Thus, I provide oscillatable rollers over which loops of the yarn are passed subsequent to passing the brakes. These rollers are maintained in position by resilient means so that when one of the brakes is applied, the yarn to which it is applied is taken up at a substantially constant rate by reason of the fact that the size of the loop of that yarn passing over its oscillatable roller is reduced as the roller shifts under the yarn tension, against the force of the resilient means.

The process and apparatus of the present invention are especially suited to the treatment, both of endless threads or bundles of filaments, as well as of staple fiber yarns of thermoplastic fiber material, especially those of polyamides such as polyhexamethyleneadipamide and condensates of epsilon-caprolactam or 11-aminoundecaroic acid, polyesters such as polyethyleneglycol terephthalate, vinyl base material such as polyacrylinitril, or polyolefines such as polypropylene, as well as of mixed yarns of thermoplastic fibers and non-thermoplastic natural fibers.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of the invention. It is important, therefore, that the claims be regarded as including such equivalent construction as do not depart from the spirit and scope of the invention.

A specific embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a schematic elevational view illustrating apparatus according to the present invention;

FIG. 2 is a profile view of the apparatus of FIG. 1;

FIG. 3 is a detail view illustrating one form of yarn tension regulator or braking mechanism according to the present invention;

FIG. 4 is a detail view illustrating another form of tension regulator;

FIG. 5 is a detail view illustrating yet another form of regulator;

FIG. 6 is a detail view illustrating an eddy current brake for regulating yarn tension;

FIG. 7 is a plan view of a modified form of eddy current regulator;

FIG. 8 is an elevational view of the eddy current regulator shown in FIG. 7;

FIG. 9 is a schematic elevational view illustrating a system for sensing deviation of the yarn separation point from its central position;

FIG. 10 is a profile view of the apparatus of FIG. 9;

FIG. 11 is a detail view of a portion of the apparatus of FIGS. 9 and 10; and

FIG. 12 is similar to FIG. 11 but illustrates a modified structural detail.

Referring now to the drawings, and particularly to FIGS. 1 and 2, there are shown two yarn ends **10** and **11** emanating from delivery spools (not shown) and each passing respectively between a pair of feed rollers **12** and **14**, one of each pair of which is driven by a drive shaft **15**. The yarns are then passed over rollers **16** and **17**, respectively, are brought towards one another and are twisted together along a continuous vertical length **19** which terminates at its lower end in a separation point **20** (FIG. 1).

While in the mutually twisted state, i.e. while moving along through the continuous length **19**, the yarns are subjected to heat fixation by means of a heating apparatus which may take the form of a plate **21** over which the twisted yarns are passed.

Immediately before the separation point **20**, the twisted yarns pass a thread carrier **22** which is mounted on a lever **23** pivoted as at **23'** for swinging movement in a horizontal plane. This thread carrier **22**, together with a pair of contact plates **24** and **25** form the means controlling electrical circuits which, in turn, control the yarn tension regulators or brakes **26** and **27**.

The regulators **26**, **27** each comprise solenoids **29**, the armatures of which are connected to pins or rollers **30** which are respectively centrally positioned between a pair of stationary pins or rollers **31** between each of which and their respective rollers **30**, one of the yarns passes after leaving the separation point **20**.

After passing the yarn regulators **26**, **27**, the yarns **10**, **11** pass respectively over diverting rollers **32** and **34**, oscillating rollers **35** and diverting rollers **36**, then between pairs of feed rollers **37**, one of each of which is driven by a drive shaft **39** and from whence the yarns pass on to a winding or take-up device (not shown). Actually, the oscillating rollers **35** are rotatably mounted at the lower ends of arms **40**, the other ends of which are pivoted as at **41** and connected to levers **42** loaded by springs **44** to bias the arms **40** away from the rollers **34** and **36**, as shown in solid lines in FIG. 2.

In the operation of the structure thus far described, it will be seen that if the separation point **20** deviates from its central position to one side or the other, the thread carrier **22** will come physically into contact with one of the contact plates **24** or **25**, depending upon the direction of deviation. Such contact serves to close an electrical actuation circuit, as will be readily understood by those skilled in the art, to actuate one of the solenoids **29** whereupon the respective armature and pin **30** is drawn towards the solenoid coil to effect a braking action upon the yarn passing between that pin **30** and its cooperating stationary pins **31**. For example, if uneven tensions in the yarns causes the separation point **20** to deviate to the right as seen in FIG. **1**, the carrier **22** contacts the plate **25** energizing the solenoid **29** and applying a braking force to the yarn **11**. This reduces the drawing tension of that yarn between the brake and the separation point **20**, wherefore the latter moves back to its central or normal position de-energizing the solenoid **29** of brake **27** as soon as contact between carrier **22** and plate **25** is broken.

It will be noted that when one of the brakes operates, the tension in the regulated yarn between that brake and the feed rollers **37**, will increase. But this increase is offset by the respective oscillating roller **35**, if the elasticity of the yarn itself is not sufficient to this end. Thus, the appropriate roller **35** swings towards the diverting rollers **34**, **36** against the force of the spring **44** which returns the roller **35** to its normal position when the braking force on that particular yarn is relieved. The take up speed of the yarns is therefore maintained substantially constant even while a braking force is applied to it.

The tension regulator or brake of FIG. 3 is actuated in the same manner as are regulators **26**, **27**; but consists of an electromagnet **45** adjacent the yarn, a thin plate **46** of non-magnetic material such as aluminum, positioned on the same side of the yarn, and a braking plate **47** of magnetic material such as soft iron. This latter plate **47** is positioned parallel to the plate **46** but on the other side of the yarn so that the yarn normally passes freely between the plates. However, if the separation point deviates and the electromagnet **45** is energized, the plate **47** is drawn towards the plate **46** and exerts a frictional braking force on the yarn passing therebetween.

The tension regulator of FIG. 4 comprises a pair of rollers **49**, **50** between which the yarn passes, an electromagnet or solenoid **51** and a brake shoe **52** mounted on an arm **54** pivoted at one end, and operable by the solenoid to apply the shoe to the roller **49**. When the solenoid is energized, the arm **54** is drawn towards the roller **49** and the shoe **52** is applied to the roller, thus braking it and the yarn as well.

In FIG. 5 a tension regulator is shown which is similar to that of FIG. 4 except that a friction roller **55** is utilized instead of the pair of rollers **49**, **50**. The yarn is threaded several times around the roller **55** and a smaller roller **56**; and the solenoid **51**, shoe **52** and brake arm **54** operate as in FIG. 4 to effect braking of the roller **55** upon deviation of the separation point.

In the structure illustrated in FIG. 6, a roller **57**, shown in section, is one of a pair of rollers serving as a yarn guiding device and is formed with a cylindrical rim **59** positioned between the poles of an electromagnet **60**. When deviation occurs, the magnet will be energized to produce eddy currents in the roller **57**, thus effecting a braking action on the yarn.

FIGS. 7 and 8 show a similar construction except that the roller **57**, instead of being formed with a cylindrical portion, has a radial flange or braking disc **61** which passes between the poles of the electromagnet.

It will be understood, of course, that the eddy current brakes shown in FIGS. 6 to 8 may also be utilized in similar fashion in connection with friction rollers.

Turning now to FIGS. 9 and 10, there is illustrated another form of regulator control means in which the lateral deviations of the separation point affect the relationship between light beams and photoelectric cells. Thus, a light source **62** is positioned behind the length **19** of twisted yarn and light sensitive photoelectric cells **64** are positioned in the path of beams from the light source and below, but to each side of the separation point. An arm **65** is pivoted at its upper end about a pin **66** and carries, at its lower end, a shield **67**, details of which are shown in FIG. 11. The shield **67** normally prevents light beams from the source **62** from impinging upon the cells **64**. The shield has an opening **69**, which serves as a yarn guide, and two slits **70** and **71** through which light beams may pass. If the separation point deviates to one side of its normal, central position, the shield is swung with it by the action of the yarn which passes through the opening **69**, and allows light to pass through one of the slits **70** or **71** to the appropriate cell **64**. An electrical impulse is thus generated in the cell and is used to effect operation of a yarn tension regulator or brake.

FIG. 12 shows a shield as in FIG. 11, but with modified slits **70**, **71**.

From the foregoing description it will be seen that I have conceived a method and apparatus by which I am able reliably and substantially instantaneously to sense deviations of the separation point of yarns twisted together and advancing linearly and then separated by being pulled apart, and for regulating the tension of the yarns by applying a braking force to one or the other of the yarns when the tension in such yarn is increased, as when deviation of the separation point occurs. It will also be seen that my concept includes a method and means for withdrawing the yarns at the same speed even though a braking force is applied to one of them.

I believe that my novel method and apparatus for the crimping of textile yarns will now be understood, and that my invention will be fully appreciated by those persons skilled in the art.

I now claim:

1. Method of permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are subjected to heat fixation while in this condition and then separated at a separation point by being drawn apart in different directions at the same speed, characterized in that the tension of each of the separated

yarns is regulated by sensing difference between the tensions in the respective yarns being separated, and applying a braking force to the separated yarn of higher tension.

2. Method of permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are subjected to heat fixation while in this condition and then separated at a separation point by being drawn apart in different directions at the same speed, characterized in that the tension of each of the separated yarns is regulated by sensing lateral deviations of the separation point of the twisted yarns due to differences in tension in the respective yarns, and applying a braking force responsive to such deviation to the yarn of higher tension.

3. Method of permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are subjected to heat fixation while in this condition and then separated at a separation point by being drawn apart in different directions at the same speed, characterized in that the tension of each of the separated yarns is regulated by effecting completion of an electric circuit upon lateral deviation of the separation point of the twisted yarns due to differences in tension in the respective yarns, and energizing yarn braking means upon completion of such circuit to brake the yarn of higher tension.

4. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are heat fixed while in twisted condition and are then separated at a separation point by being drawn apart in different directions at the same speed comprising means adjacent the length of twisted yarns sensing differences in tension in the respective yarns drawn apart and yarn tension regulator means operable by said sensing means applying a braking force to the yarn of higher tension.

5. Apparatus according to claim 4, wherein said sensing means comprises switch contacts and said tension regulator comprises an electromagnetic yarn brake.

6. Apparatus according to claim 4, wherein said yarn tension regulator comprises roller means engaging each of said yarns and electromagnetic means inducing eddy currents in said roller means.

7. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance and are heat fixed while in twisted condition and are then separated at a separation point by being drawn apart in different directions at the same speed comprising electrical contact means adjacent the length of twisted yarns effecting an electrical circuit upon lateral deviation of the twisted yarns due to differences in tension in the respective yarns drawn apart, and braking means including cooperating elements on opposite sides of the yarn of higher tension and means drawing said elements together upon energization of said circuit to apply a braking force to said yarn.

8. Apparatus according to claim 7, wherein said elements comprise a plate of non magnetic material on one side of the yarn and a second plate of magnetic material on the other side of the yarn, and said drawing means includes an electromagnetic for shifting the magnetic plate towards the non magnetic plate upon energization of said circuit.

9. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance and are heat fixed while in twisted condition and are then separated at a separation point by being drawn apart in different directions at the same speed comprising electrical contact means adjacent the length of twisted yarns effecting an electrical circuit upon lateral deviation of the twisted yarns due to differences in tension in the respective yarns drawn apart, and braking means for each yarn including roller means engaging the yarn, a brake shoe for frictionally engaging the roller means and electromagnetic means effecting operation of said shoe upon energization of said circuit.

10. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are heat fixed while in twisted condition, and are then separated at a separation point by being drawn apart in different directions at the same speed comprising an electrical circuit including a yarn guide movable laterally upon lateral deviation of the twisted yarns due to differences in tension in the respective separated yarns, contact plates adjacent said yarn guide and a yarn tension regulator for each such yarn operable upon contact of said yarn guide and one of said contact plates to apply a braking force to the yarn of higher tension.

11. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are heat fixed while in twisted condition, and are then separated at a separation point by being drawn apart in different directions at the same speed comprising an electrical circuit including means including a shield movable laterally upon lateral deviation of the twisted yarns due to differences in tension in the respective separated yarns, openings in said shield, a pair of photoelectric cells on one side of said shield, a stationary light source on the other side of said shield arranged to actuate one or the other of said cells by light from said source upon lateral movement of said guide and shield, and yarn tension control means operable by said cells to apply a braking force to the yarn of higher tension.

12. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are heat fixed while in twisted condition and are then separated at a separation point by being drawn apart in different directions at the same speed comprising means adjacent the length of twisted yarns sensing differences in tension in the respective yarns drawn apart, yarn tension regulator means operable by said sensing means applying a braking force to the yarn of higher tension, and resilient means positioned subsequent to said regulator means and engaged by loops of said yarns for shifting to reduce the size of one of said loops, thus permitting take-up of the yarns at a constant rate.

13. Apparatus for permanently crimping textile yarns in which at least two yarns are twisted together along a selected distance, are heat fixed while in twisted condition and are then separated at a separation point by being drawn apart in different directions at the same speed comprising means adjacent the length of twisted yarns sensing differences in tension in the respective yarns drawn apart, yarn tension regulator means operable by said sensing means applying a braking force to the yarn of higher tension, a pair of stationary rollers for each yarn subsequent to said regulator means, and a spring biased roller between each pair of stationary rollers and spaced laterally thereupon to guide said yarns in a looped path whereby the loop is reduced when braking force is applied to permit take-up at a constant rate.

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STANLEY N. GILREATH, *Primary Examiner.*

MERVIN STEIN, *Examiner.*

D. E. WATKINS, *Assistant Examiner.*