United States Patent

Gilchrist

[15] **3,656,288**

[45] **Apr. 18, 1972**

[54] FALSE TWIST TEXTURIZING METHOD AND APPARATUS

[72] Inventor: **Reginald Selby Gilchrist,** Welwyn Garden City, England

[73] Assignee: **The Klinger Manufacturing Company, Ltd.,** London, England

[22] Filed: **Dec. 11, 1969**

[21] Appl. No.: **884,080**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 789,653, Dec. 26, 1968, abandoned, which is a continuation of Ser. No. 661,319, Aug. 17, 1967, abandoned.

[30] **Foreign Application Priority Data**

Sept. 3, 1966 Great Britain 39,491/66
Dec. 16, 1968 Great Britain 59,749/68

[52] **U.S. Cl.** ..... **57/34 HS,** 57/77.4, 57/157 TS
[51] **Int. Cl.** **D02g 1/02**
[58] **Field of Search** ..... 57/34 HS, 77.3, 77.4, 157 TS, 57/157 HS

[56] **References Cited**

UNITED STATES PATENTS

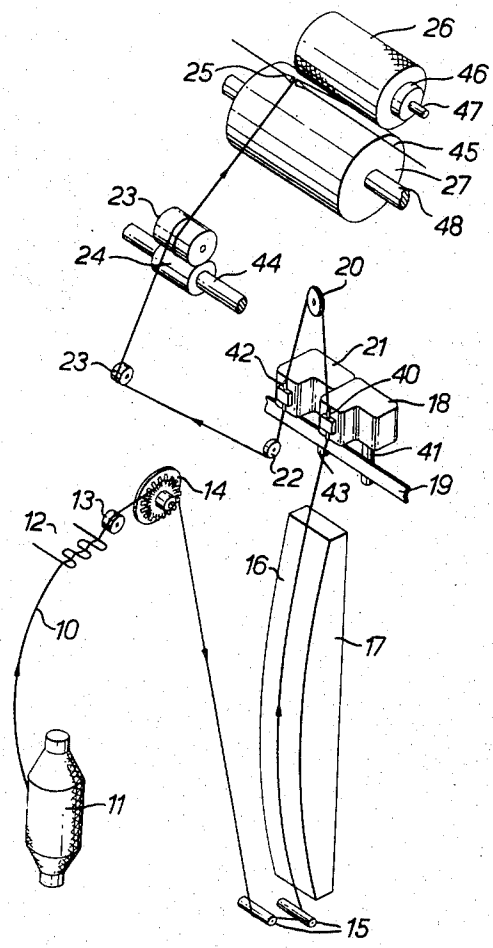
3,403,566	10/1968	Mattingly	57/77.45 X
3,516,240	6/1970	Fain	57/157
2,477,909	8/1949	Stockly	57/34
3,009,312	11/1961	Seem et al.	57/157
3,029,591	4/1962	Scragg et al	57/34 X
3,035,397	5/1962	Hammond et al	57/77.4 X
3,318,083	5/1967	Gilchrist	57/157

Primary Examiner—Stanley N. Gilreath
Assistant Examiner—Werner H. Schroeder
Attorney—Nolte and Nolte

[57] **ABSTRACT**

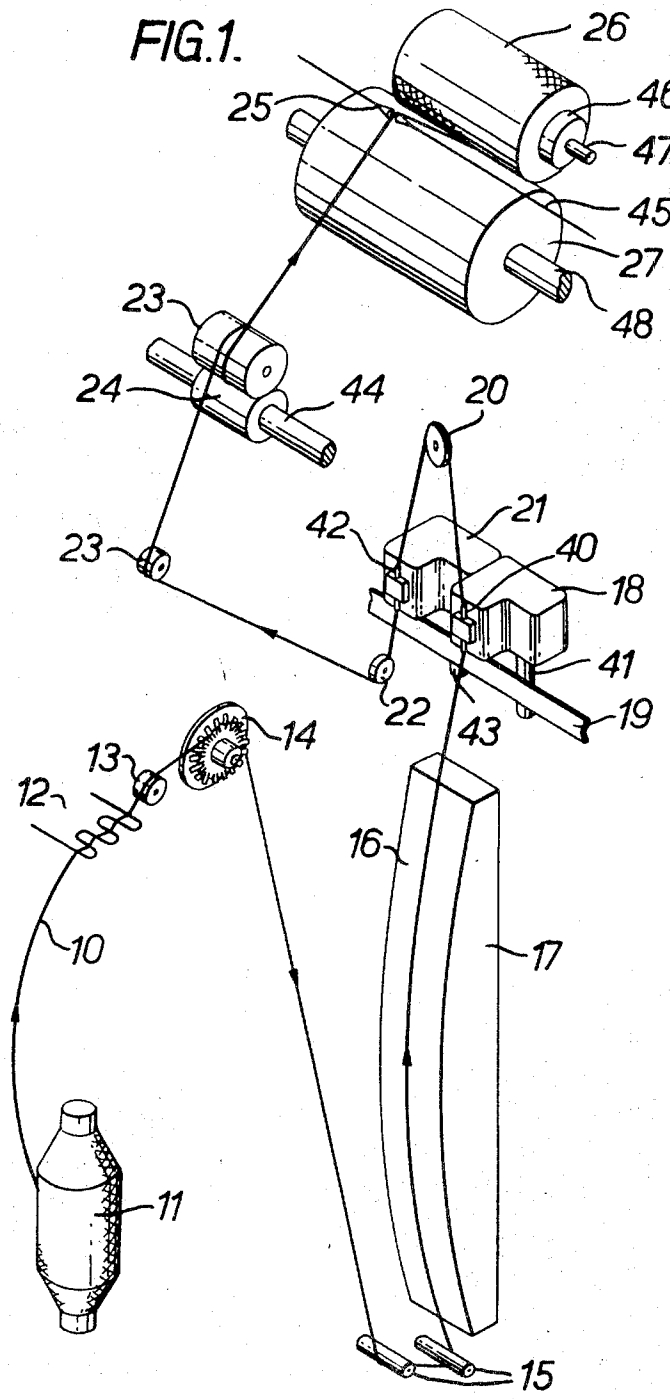
Yarn is false twisted first in one sense and then in the opposite sense to produce an essentially zero torque texturized yarn. For this purpose, false twist spindles are provided to twist the yarn in opposite senses.

17 Claims, 7 Drawing Figures



PATENTED APR 18 1972 3,656,288

FIG.1.

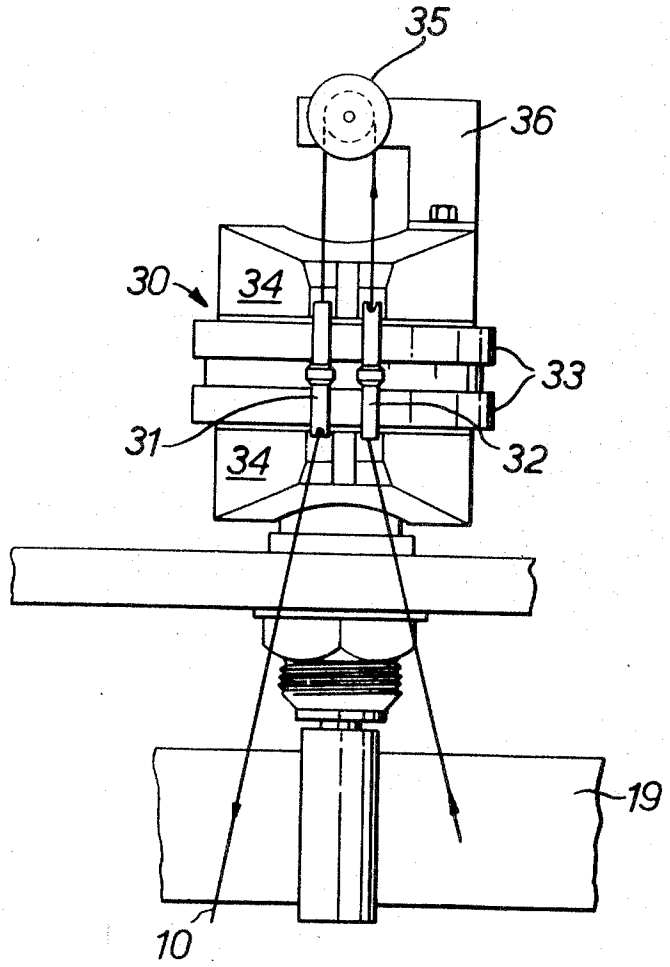


INVENTOR
REGINALD SELBY GILCHRIST

BY

Nolte & Nolte
ATTORNEYS

FIG. 2.



INVENTOR
REGINALD SELBY GILCHRIST
BY
Nolte & Nolte
ATTORNEYS

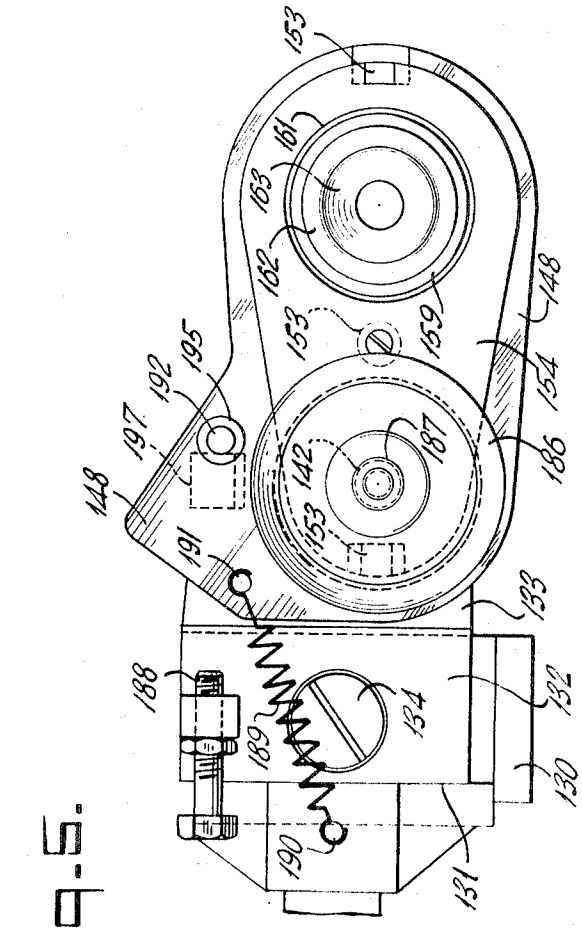


FIG. 5.

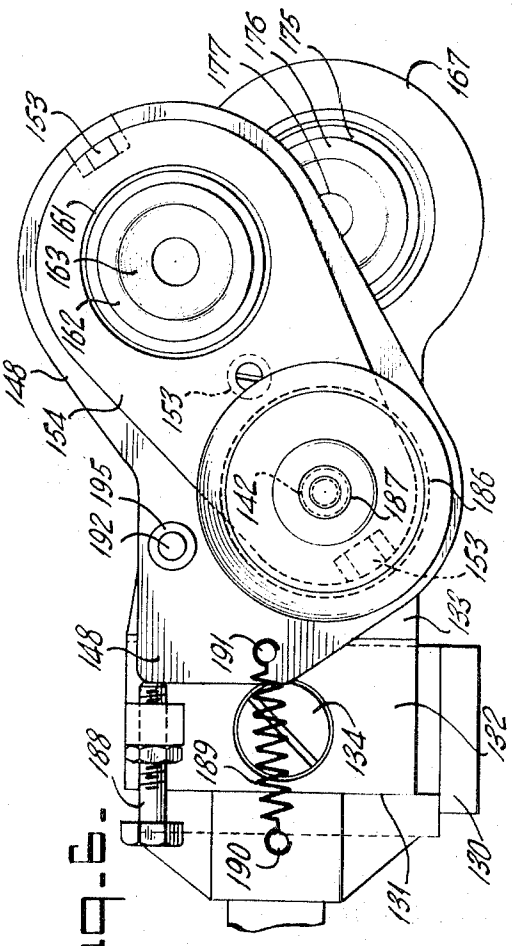


FIG. 6.

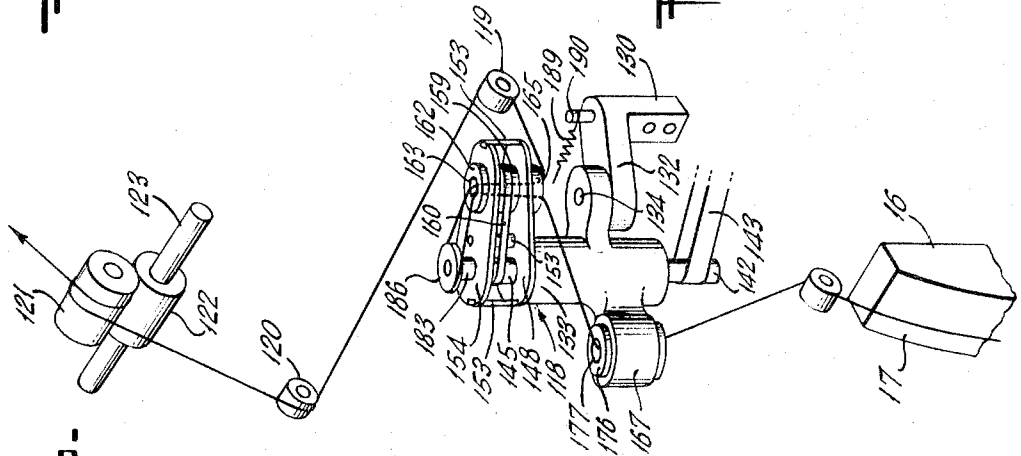


FIG. 7.

INVENTOR
REGINALD SELBY GILCHRIST
BY Nolte & Nolte
ATTORNEYS

FIG-7-

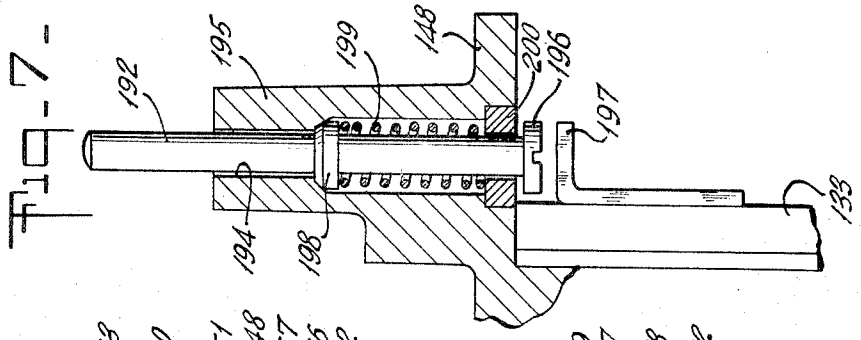
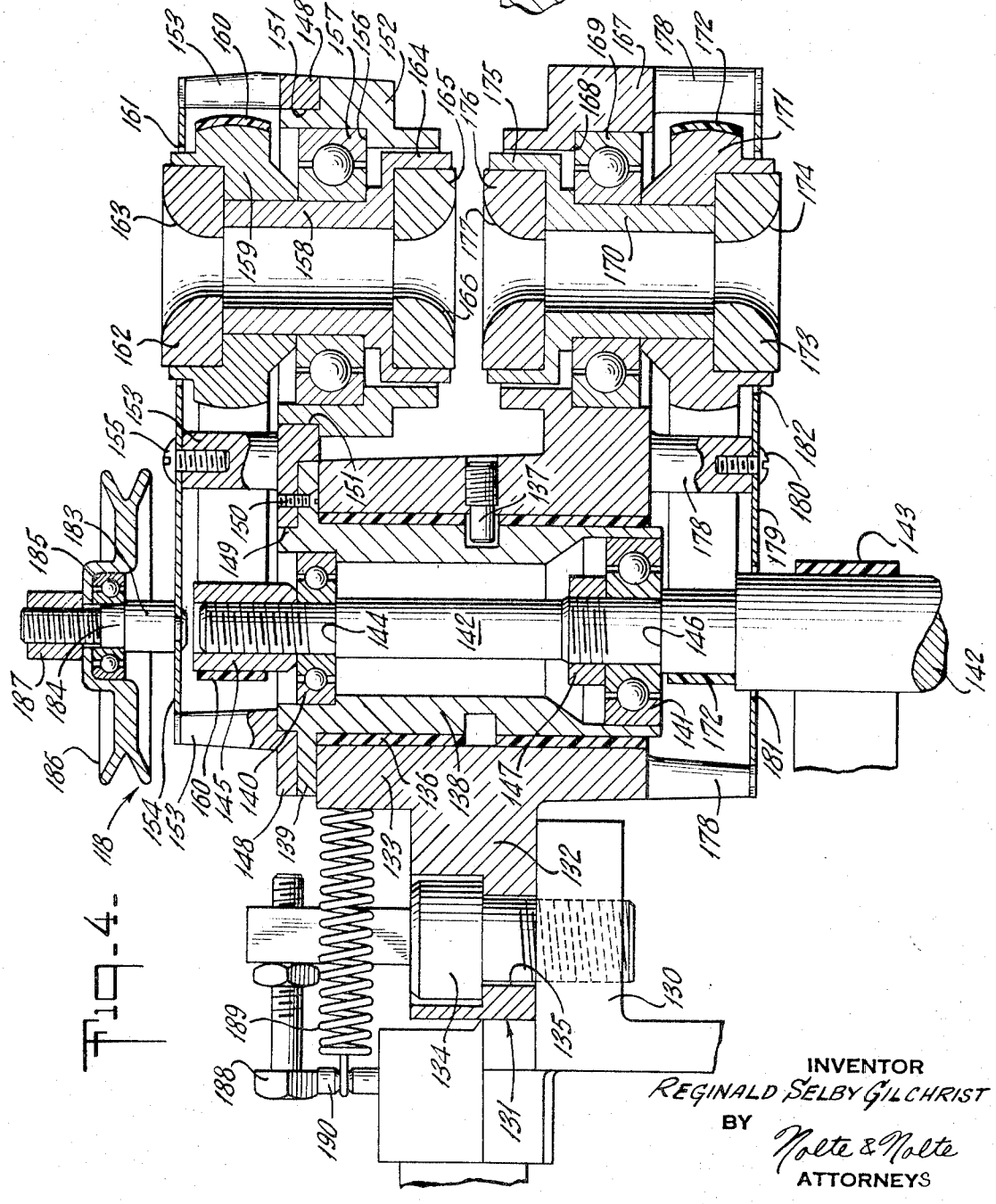


FIG-4-



INVENTOR
REGINALD SELBY GILCHRIST
BY
Nolte & Nolte
ATTORNEYS

FALSE TWIST TEXTURIZING METHOD AND APPARATUS

This application is a continuation-in-part of Ser. No. 789,653, filed Dec. 26, 1968, now abandoned, which in turn is a continuation of Ser. No. 661,319, filed Aug. 17, 1967, now abandoned.

This invention relates to a method and apparatus for crimping yarn on the run and is particularly, although not exclusively, applicable to thermoplastic yarn.

It is well known to crimp yarn such as continuous filament polyamide or polyester yarn by passing the yarn over a heater and then through a false twist device which imparts a twist in the yarn as it travels over the heater, whereby the yarn is set in its twisted configuration, and then untwists the yarn as it leaves the device.

Yarn crimped in this manner has superior bulkiness, and handling and knitting properties compared to uncrimped yarn. Such yarn, however, has the disadvantage that it tends to be of high stretch, and that it tends to snarl easily. It also has the disadvantage that it has high torque so that it tends, when knitted, to produce a fabric of high spirality by which is meant that a tube, for example, of fabric knitted on a circular knitting machine will have successive courses displaced circumferentially from one another, so that the tube as a whole will be twisted spirally overall.

Attempts have been made to overcome these disadvantages by various forms of heat treatment of the yarn subsequent to the false twist crimping. However, it has been found that such post heat treatment often has the effect of considerably reducing the bulk of the crimped yarn produced, and in some cases does not sufficiently reduce the torque in the yarn to enable fabric of satisfactorily low spirality to be produced therefrom.

It is an object of the present invention to provide methods and apparatuses for producing false twist crimped yarn in which at least some of the above disadvantageous characteristics are eliminated or reduced.

According to one aspect of the invention, a method of crimping yarn on the run includes false twisting the yarn a first time on one direction and heating the yarn while twisted, and then false twisting the yarn a second time in the opposite direction without heating the yarn between the first and second false twisting steps.

According to the invention, it is found surprisingly that by subjecting the yarn to a false twist crimping operation and then subjecting the yarn to an opposite false twist operation without further heating, it is possible to produce a yarn which is bulky, has low stretch, and knits into fabric having little or no spirality.

It is believed that this is because the yarn, contrary to prior belief on the matter, is in a condition immediately after the conventional false twisting operation to be still readily susceptible to further permanent distortion by mechanical forces without application of a heat setting step. This may be because there is sufficient internal heat retained in the yarn to enable these further distortions to be heat set without the addition of further heat if immediately inserted, particularly when these further distortions are effected by twisting.

According to another aspect of the present invention a method of crimping yarn on the run includes heating the yarn, subjecting the yarn to a first false twisting operation in one direction so that the yarn is heated in its first twisted configuration, and then subjecting the yarn to a second false twisting operation in the opposite direction without further heating, the yarn being oppositely twisted by the second false twisting operation while it possesses sufficient heat to be at least partly permanently deformable.

According to yet another aspect of the present invention, a method of crimping yarn on the run includes heating and false twisting the yarn a first time in one direction so that the yarn is in a twisted configuration when being heated, immediately false twisting the yarn a second time in the opposite direction so that the yarn is twisted in the opposite direction by the second false twisting simultaneously with being detwisted from the twist in said one direction imparted by the first false twisting.

It is believed that twisting the yarn in one direction by one false twisting operation and then immediately twisting the yarn in the opposite direction by a second false twisting operation as the first twist is removed is an important physical factor in the production of yarn having the desirable characteristics mentioned above, in that it causes the yarn to be twisted directly from a twist in one direction to a twist in the opposite direction, this violent reverse twist treatment of the yarn assisting the permanent deformation of the yarn by the second twisting operation.

The yarn may be subjected to a temperature of from about 150° to about 250° C. when being heated.

The twists imparted by the two false twisting operations may be equal in magnitude, and each may be within the range of 50 to 100 turns per inch. However, the number of twists imparted by the second false twisting operation may be less or greater than the number of twists imparted by the first, depending upon the characteristics required in the crimped yarn.

Optionally, the yarn may be provided with additional heat during the second, i.e., reverse, false twisting operation to augment the heat retained by the yarn from the prior heating.

According to a further aspect of the present invention, apparatus for crimping yarn comprises a first false twist device arranged to rotate the yarn in one direction, a heater so disposed as to heat the yarn as it travels to the first false twist device, a second false twist device arranged to rotate the yarn in the opposite direction, and guide means for guiding the yarn without further heating from the first false twist device to the second false twist device.

The first and second false twist devices may be separate false twist heads.

Alternatively, the two false twisting devices may comprise one false twist having two twist tubes.

According to a still further aspect of the present invention apparatus for carrying out a method as described above comprises a first twist stopper, a heater, a first false twist device for twisting the yarn in one direction and causing this twist to run back past the heater to the first twist stopper, a second false twist device for twisting the yarn in the opposite direction on leaving the first false twist device, and a second twist stopper for stopping the running back of the twist inserted by the second false twist device, characterized in that the second twist stopper is formed by the first false twist device.

In another aspect of the invention, each of the false twisting operations is carried out by frictionally engaging the running yarn with at least one surface moving in a direction having a component transverse to the direction of movement of the yarn.

The invention also provides an apparatus for crimping yarn comprising a false twist device having an endless movable track provided with a surface for frictionally engaging the yarn, means for advancing yarn under tension from a supply of yarn, guide means for guiding the yarn so that it crosses said surface substantially transversely to the direction of movement of the surface first in one direction and then in the opposite direction whereby a first twist can be imparted to the yarn in one direction and a second twist can be imparted to the yarn in the opposite direction, and a heater for heating the yarn passing in said one direction to the surface of the endless track.

There may be provided a further movable endless track having a surface for frictionally engaging the yarn and cooperating with the first such endless track, the yarn path being adjustable and the further track being movable so that the surface thereon moves transversely to the path of movement of the yarn in a direction for twisting the yarn in the same direction as the first twist or in the same direction as the second twist.

The endless track or tracks may comprise an annular member or members the inner surface or surfaces of which are adapted for engaging the yarn.

In the case where two annular members are provided the members may be mounted for rotation about parallel axes spaced so that the openings in the members are out of register with one another.

In one embodiment of the invention, the annular members may be mounted for relative movement towards and away from one another whereby their respective openings can be brought into and out of register with one another.

In any of the arrangements referred to above in which said endless tracks are formed by annular members, the annular members may be mounted at adjacent ends of two hollow cylindrical members mounted for rotation about spaced parallel axes and axially displaced with respect to one another and, the remote ends of said cylinders may have additional annular members mounted therein having inner surfaces for engaging the yarn.

The inner surfaces of the annular members may be convexly curved to provide smoothly curved paths for said yarn passing over said inner surfaces.

In any of the arrangements referred to above, there may be provided a twist stopper for engaging the yarn prior to the heater.

According to another aspect of the invention, an apparatus for crimping yarn comprises a false twist device having at least two endless movable tracks formed with surfaces for frictionally engaging the yarn, means for advancing yarn under tension along a path which successively crosses said surfaces transversely to their respective directions of movement and which tracks are movable so that in use their respective surfaces impart twist in opposite directions to the yarn, there being a twist stopper for engaging the yarn before it engages the first of said surfaces and a heater for heating the yarn between the twist stopper and the first of the surfaces.

In some instances, between the heater and the first false twisting, there may be provided means to impede cooling of the yarn over this part of the yarn path.

In order that the invention may be more readily understood, embodiments thereof will now be described by way of example with reference to the accompanying Figures, in which:

FIG. 1 is a perspective view of one embodiment of apparatus for crimping yarn according to the invention;

FIG. 2 is a front elevation of part of a second embodiment of apparatus for crimping yarn according to the invention;

FIG. 3 is a perspective view of another apparatus for crimping yarn according to the invention;

FIG. 4 is a part elevation, part sectional view of the apparatus shown in FIG. 3;

FIG. 5 is an end view of the apparatus shown in FIG. 4;

FIG. 6 is an end view of a swingable part of the apparatus shown in FIG. 5, shown in a different attitude; and

FIG. 7 is a sectional view of a locking mechanism for the swingable part of the apparatus.

Referring to FIG. 1, it will be seen that yarn **10** is supplied from a package **11** and passes via a wire finger tensioner **12**, ceramic guide **13** and an adjustable magnetically restrained tensioning and twist stopping pulley **14** of a known kind to ceramic guides **15** at the lower end of a heater **17**. The pulley **14**, in addition to preventing twist in the yarn running back to the supply package **11**, also serves to control the tension in the yarn during its upward passage over a heating surface **16** of the heater **17**.

The heater **17** is heated by means of electrical resistance wires (not shown) and its heating surface **16** is provided with grooves (not shown) within which the yarn passing over the heater is guided.

After passing over the heating surface **16**, the yarn passes through a twist tube **40** of a false twist head **18** of the kind disclosed in U.S. Pat. No. 3,355,870, in which the tube **40** is held in contact with a driving pulley by means of a permanent magnet. The head **18** is driven by means of a continuous belt, part of which is shown at **19**, engaging a driving spindle **41** of the head **18**. The belt **19** is driven in a known manner by means of an electric motor (not shown). The tube **40** is provided at its yarn exit end in a known manner with a diametrical twisting bail (not shown) around which the yarn is wrapped.

The yarn is passed from the tube **40** around a guide **20** and then through a twist tube **42** of a false twist head **21** which is of the same kind as head **18**. The head **21** is driven by the belt **19** via a driving spindle **43** so as to rotate the tube **42** in the same direction as the tube **40**, but it is to be noted that because the yarn travels through the tube **42** in the direction opposite to its direction of travel through the tube **40**, the two heads apply false twist in opposite directions to the yarn travelling through them.

We have found that we obtain good crimping results in practice if the heads **18** and **21** and twist tubes **40** and **42** are identical so that the false twist imparted by each is equal.

However, it is possible, if desired, by using driving spindles or driving pulleys or twist tubes of different diameters for the two heads to impart unequal false twist to the yarn. Alternatively, the heads can be driven by separate bolts travelling at different speeds to provide unequal false twisting.

The twist imparted by the tube **42** runs back in the yarn **10** over the guide **20** to the bail (not shown) at the yarn exit end of the tube **40**. The bail in the tube **40** acts as a twist stopper for the twist in the yarn running back from the tube **42**.

In practice, we have found it desirable, in order to insure that the bail in tube **40** does effectively act as a twist stopper, to wrap the yarn twice around this bail, while we have found it sufficient to wrap the yarn only once around the bail of the tube **42**.

After passing through twist tube **42**, the yarn passes over a guide **22** and over a further guide **23**. The yarn is passed a number of times (only one shown) around a rubber surfaced roller **23**, and between the nip of the roller **23** and a steel roller **24** pressed into engagement therewith. The roller **24** is mounted on a driving shaft **44** driven in a known manner by means of an electric motor through suitable gearing (not shown). The yarn is gripped by the rollers **23**, **24** which are operable to draw the yarn from the supply package **11**. The yarn then passes over a traverse guide **25** onto a take-up package **26**.

It is to be observed that by means of the rollers **23** and **24**, the yarn is drawn under tension through both of the false twist operations. Hence, the yarn during both the first and the second false twist operation, i.e., prior to passing through tube **40** and also when passing between tubes **40** and **42**, is subjected to positive tension. Further, the tension in the yarn during the second false twist operation is higher than during the first false twist operation.

The traverse guide **25** is mounted on a wire traverse member **45** forming part of a yarn traverse mechanism of the kind disclosed in British Pat. No. 885,473.

The package **26** is wound onto a bobbin **46** disposed on a mandrel **47**. The mandrel is in turn arranged to be rotatably mounted in the framework (not shown for the sake of clarity) so that the package **26** rests on and is driven by a cork covered roll **27**. The roll **27** is mounted on a shaft **48** which is driven by an electric motor via gearing (not shown).

In operation, the false twist applied by the head **18** runs back in the yarn over the heater **17** as far as the tensioner **14**, so that twisted yarn is subjected to heat setting as it passes over the heater **17**. The equal and opposite false twist applied by head **21** runs back from the head **21** to the point at which it is detwisted in the tube **40**, i.e., at the bail in tube **40**. We believe that at this point the yarn after being twisted in one direction is detwisted and then immediately twisted in the opposite direction while still in a condition to be permanently deformable to some extent. As the yarn travels to the head **42** we believe it is further set in its oppositely twisted configuration, whereby a further crimping is superimposed on the crimping provided by the first false twisting and heating operation.

To effect this further superimposed crimping on the first crimping we have found that the temperature of the heater **17**, the length of yarn path between the exit end of the heater **17** and the tube **40**, and the through-put speed of the yarn are all variable factors which should be arranged and correlated such that the yarn at the point of detwisting is in a condition to be still capable of at least some permanent deformation. However, we have surprisingly found that with each of these three

factors having values directly comparable with values used for producing conventional single false twist crimped yarn, we have obtained by means of the present invention crimped yarn which, compared to conventional single false twist crimped yarn, has greatly reduced or even zero torque, less stretch but good bulkiness, and which has no tendency to snarl.

The length of the yarn path between the twist tubes **40** and **42** can be adjusted by raising or lowering the yarn guide **20**. This adjustment allows the temperature or condition of the yarn entering the second twist tube **42** to be controlled.

The second embodiment of apparatus according to the invention, part of which is shown in FIG. **2**, is in the main part the same as that illustrated in FIG. **1**, but instead of using two separated twisting heads **18** and **21** (FIG. **1**) to carry and rotate two twist tubes **40** and **42**, a single false twist head **30** having two twist tubes **31** and **32** (as disclosed in greater detail in our U.S. Pat. No. 3,403,566 is provided. The tubes are driven by a pulley **33** driven in turn from belt **19** and are maintained in position by a magnet arrangement **34**. A guide **35** is supported above the tubes **31** and **32** to guide the yarn **10** from one tube **32** to the other. The guide **35** is mounted on a nonmagnetic bracket **36** secured to the magnet arrangement **34**.

Referring to FIG. **3** of the drawings, which illustrates another apparatus for carrying out the methods herein described, after passing over the heating surface **17** the yarn passes through a false twisting apparatus indicated generally by the reference numeral **118**, the apparatus being shown in greater detail in FIGS. **4** to **7**. The parts of the apparatus not illustrated in FIGS. **3** to **7** are the same as in FIGS. **1** and **2**.

The yarn after leaving the false twisting apparatus passes over a guide **119** and a further guide **120**.

Referring now to FIG. **4** of the drawings, the false twisting apparatus **118** of FIG. **3** is shown to an enlarged scale in greater detail. The apparatus comprises a base plate **130** which is adjustably mounted on a supporting structure not shown. The upper face of the plate **130** is formed with a step indicated by the reference numeral **131** against which a lug **132** formed on one side of a vertically extending hollow cylindrical housing **133** abuts. The lug **132** is secured to the upper face of the plate **130** by a single large Allen screw **134** located in a stepped bore **135** formed in the lug **132**, the underside of the head of the screw abutting the step in the bore to clamp the lug to the plate **130**.

Located within the hollow cylindrical housing **133** is a self lubricating bush **136** supported in the housing by an inwardly extending spigot **137** fixed in the wall of the housing. A hollow cylindrical sleeve **138** is rotatably mounted in the bush **136** and is formed at its upper end with an annular flange **139** which overlies and engages with the upper end of the housing **133**. Secured in the remote ends of the housing **138** are roller bearings **140**, **141** respectively which rotatably support a vertically extending shaft **142** which extends into the housing from the lower end thereof. The lower end of the shaft located outside the housing **142** is drivably engaged by a belt **143** movably driven in known manner. The inner annulus of the bearing **140** abuts an upwardly facing shoulder **144** formed adjacent the upper end of the shaft and is secured thereto by an internally screw threaded sleeve **145** which is in screw threaded engagement with the upper end of the shaft. The inner annulus of the bearing **141** abuts a further shoulder **146** formed on the shaft and is secured thereto by an internally screw threaded collar **147** which engages the other side of the inner annulus and is in screw threaded engagement with a screw threaded part of the shaft.

A plate **148** having an opening **149** which encircles the upper end of the sleeve **138** is secured to the flange **139** on the sleeve by means of screws **150**. The plate **148**, the shape of which is best seen in FIGS. **5** and **6**, extends to one side of the housing **133** and is formed with a further opening **151** in which is shrunk the upper end of an annular housing **152**. The plate **148** is formed with a number of spaced projecting bosses **153** which support a cover plate **154** secured by a screw **155** to the boss **153** at the centre of the plate.

The annular housing **152** is formed around its inner periphery with an upwardly facing shoulder **156** against which the outer annulus of a roller bearing **157** abuts. The inner annulus of the bearing encircles and is secured to a generally cylindrical housing **158**. The upper end of the cylindrical housing **158** is encircled by a ring **159**, the outer periphery of which is drivably connected by a belt **160** to the sleeve **145** secured to the shaft **142**. Rotation of the shaft **142** thereby effects rotation of the cylindrical housing **158**. The upper end of the ring **159** projects through an opening **161** formed in the aforesaid plate **154** and located in a cup-shaped housing formed in the upper end of the ring is an annular member **162** formed in "Prescallin" the inner surface of which is bell-mouthed as indicated by the reference numeral **163**. A similar cup-shaped housing **164** is formed at the lower end of the cylindrical housing **158** in which a similar "Prescallin" annular member **165** is located.

Integrally formed to one side of the cylindrical housing **133** is a further hollow cylindrical housing **167**. The inner surface of the housing **167** is formed with a step **168** against which abuts the outer race of a ball bearing **169**. The inner annulus of the ball bearing supports a cylindrical housing **170** which is similar to the aforesaid housing **158**. The housing **170** is encircled at its lower end by a ring **171** which is drivably connected by a belt **172** to the part of the shaft **142** below the shoulder **146** thereon. The housing **170** is thereby rotated by the shaft. The lower end of the ring **171** is formed with a cup-shaped housing in which an annular member **173** formed in "Prescallin" is located. The inner surface of the annular member **173** is bell-mouthed as indicated by the reference numeral **174**. The upper end of the cylindrical member **170** is formed with a cup-shaped housing **175** in which a further "Prescallin" annular member **176** is located having a bell-mouthed inner surface indicated by the reference numeral **177**. Formed on the lower side of the housing **133** and adjacent housing **167** are projecting bosses **178** against the lower faces of which a plate **179** abuts and is secured to the center boss by a screw **180**. The plate is formed with openings **181** and **182** for the shaft **142** and lower end of the ring **171** respectively.

Secured to the upper face of the aforesaid plate **154** and in axial alignment with the shaft **142** is a spigot **183**. The spigot is formed with a shoulder **184** against which abuts a roller bearing **185** on which a pulley wheel **186** is mounted. The roller bearing is secured the shoulder **184** by means of an internally screw threaded sleeve **187** secured to the upper end of the spigot **183**.

As indicated earlier, the cylindrical sleeve **138** is rotatably mounted in the housing **133**. Swinging movement of the plate **148** which is secured to the housing **133** is limited in one direction by engagement of the plate with an adjustable screw **188** mounted on the lug **132** as shown in FIG. **6** of the drawings. In this position, the aforesaid cylindrical housings **158** and **170** are out of axial alignment with one another. A tension spring **189** is secured at its end to upstanding posts **190** and **191** on the plate **130** and plate **148** respectively and acts to swing the plate into the position shown in FIG. **6**. A locking mechanism for locking the plate in the position shown in FIG. **5** in which the cylindrical housings **158** and **159** are in axial alignment is shown in FIG. **7** and comprises a plunger **192** which is slidably mounted in a stepped bore **194** formed in a cylindrical boss **195** on the plate **148**. The lower end of the plunger **192** is formed with a head **196** which is engageable with a laterally extending bracket **197** secured to one side of the housing **133** when the plate **148** is moved into a position in which the cylindrical housings **158**, **170** are in axial alignment. The plunger **192** is formed in the bore **194** with a collar **198** which abuts the step in the bore on one side thereof and is engaged on the other side thereof by one end of a compression spring **199** the other end of which acts against a ring **200** secured at the end of the bore **194** in the plate **148**. Depression of the plunger **192** against the action of the spring **199** brings the head **196** of the plunger into engagement with the bracket **197** when, as indicated above, the plate **148** is in the position with the housings **158**, **170** in axial alignment.

Release of the head **196** of the plunger from the bracket **197** allows the spring **189** to swing the plate **148** into the position shown in FIG. **6** in which, as indicated above, the cylindrical housings **158, 170** are out of axial alignment.

It is convenient in loading the false twisting apparatus with yarn to arrange the cylindrical housings **158, 170** in axial alignment. The yarn **10**, after passing over the heater **17**, is then fed through the housing **170**, the housing **158**, around the wheel **186** and back through the housing **58** and then to the ceramic guide **119**. The plunger **192** is then released from the bracket **197** to allow the plate **148** to swing into the position shown in FIG. **6** so that the cylindrical housings **158, 170** are moved out of axial alignment. As shown in FIG. **3** of the drawings, the outlet end of the heating surface **17** is disposed to one side of the annular member **174** so that the yarn when tensioned by the rollers **121, 122** engages the curved surface **174** of the member **173**. The yarn then passes over the curved surface **177** of the annular member **176** to the curved surface **166** of the annular member **165** and then over the curved surface **163** of the annular member **62** to the wheel **186**. The surfaces **174, 177, 166** and **163** which the yarn engages roll the yarn to effect a first twisting of the yarn. Twist thus formed in the yarn runs back to the aforesaid yarn twist stopper **14** so that the twist in the part of the yarn adjacent the heating surface **17** is set in the yarn. The yarn after leaving the wheel **186** again passes without any further heating over the surface **163** of the member **62** and the surface **166** of the annular member **165** but this time in the opposite direction so that the yarn is twisted in the opposite direction. Residual heat left in the yarn from heating by the hater **16** causes the second twist to be set in the yarn.

It will be appreciated that the embodiment of the false twisting apparatus described above, the cylindrical housings **158, 159** are rotated at the same speed by the shaft **142**.

The following examples are given to illustrate the invention and to provide comparison of crimped yarn produced by the invention with conventional single false twist crimped yarn.

EXAMPLE 1

A. Single end 150-denier 30-filament polyester yarn was crimped by means of the apparatus illustrated in FIG. **1**. The rotational speed of both twist tubes **40** and **42** was 260,000 r.p.m., and the yarn through-put speed was adjusted so that the yarn was twisted to 70 turns per inch by each twist tube. The tension in the yarn before the heater was arranged to be approximately 8 gms. The yarn path length between the heads **18** and **20** was approximately 12 inches, and the yarn path between the heater **17** and the false twist head **18** was approximately 10 inches.

Yarn samples were produced at four different heater temperatures and the Dry Heat Retraction of each sample and the spirality of fabric formed from each sample was measured with the following results:

Temperature	Dry Heat Retraction	Spirality
235°C	33%	4° z direction
215°C	28%	3° z direction
195°C	23%	2° z direction
175°C	16%	6° s direction

B. The same procedure as in (A) was adopted except that the yarn after passing through the tube **40** of head **18** was guided, without passing through tube **42**, directly to the feed rollers **23, 24** then to the take-up package **26**, so that the yarn was in fact subjected to a conventional single false twist crimping operation. In this case the results were as follows:

Temperature	Dry Heat Retraction	Spirality
235°C	42%	19° S direction
215°C	61%	20° S direction
195°C	58%	13° S direction
175°C	52%	15° S direction

EXAMPLE 2

The same procedure was adopted as in Example 1 except that the rotational speed of tubes **40** and **42** was 200,000 r.p.m., and in this case the results were as follows for yarn crimped by means of the invention:

Temperature	Dry Heat Retraction	Spirality
235°C	37%	3° Z direction
215°C	33%	3° S direction
195°C	30%	5° S direction
175°C	28%	8° S direction

In comparison, the results for conventional single false twist crimped yarn in this example were as follows:

Temperature	Dry Heat Retraction	Spirality
235°C	56%	20° S direction
215°C	62%	20° S direction
195°C	58%	16° S direction
175°C	46%	22° S direction

EXAMPLE 3

The same procedure was adopted as in Example 1 except that 75-denier 16-filament polyester yarn was used, the rotational speed of tubes **40** and **42** was 325,000 r.p.m., the yarn through-put speed was adjusted so that the yarn was twisted to 80 turns per inch by each twist tube, and the tension in the yarn before the heater was arranged to be approximately 10 gms.

In this case the results were as follows for yarn crimped by means of the invention:

Temperature	Dry Heat Retraction	Spirality
235°C	30.5%	1° Z
215°C	26.5%	4° S
195°C	21%	7° S
175°C	26%	9° S

In comparison the results for conventional single false twist crimped yarn in this example were as follows

Temperature	Dry Heat Retraction	Spirality
235°C	52%	48° S
215°C	47%	48° S
195°C	47%	49° S
175°C	39%	53° S

EXAMPLE 4

The same procedure was adopted as in Example 1 except that 200-denier 20-filament nylon yarn was used, the rotational speed of tubes **40** and **42** was 150,000 r.p.m., the yarn through-put speed was adjusted so that the yarn was twisted to 50 turns per inch by each twist tube, and the tension in the yarn before the heater was arranged to be approximately 10 gms.

In this case the results were as follows for yarn crimped by means of the invention:

Temperature	Pre-Relaxed Crimp Rigidity	Spirality
235°C	20.5%	0°
215°C	15%	1.5° Z
195°C	8%	4.0° Z
175°F	8.5%	10.0° Z

In comparison the results for conventional single false twist crimped yarn in this example were as follows:

Temperature	Pre-Relaxed Crimp Rigidity	Spirality
235°C	30%	28° S
215°C	21.5%	32° S
195°C	20.5%	35° S
175°C	14.5%	40° S

In the above examples the Dry Heat Retraction was measured by forming the yarn into a hank of 47 wraps, loading the hank with 14 grams, (to provide a load of 0.0001 gms/den.) Dry Heat Retraction was the percentage decrease in length of the hank after heating.

The spirality was measured by knitting the yarn on a 300-needle circular machine into a tubular swatch, scouring and dyeing the swatch and then measuring the angle of the wale line to the longitudinal axis of the swatch, this angle being the spirality angle.

The pre-relaxed crimp rigidity was measured by relaxing a 300-meter length of yarn in hank form in water at 80° C. for 20 minutes, drying the hank in the atmosphere, forming the yarn into a new hank of 20 wraps, loading the hank under water with 400 gms., and then with 8 gms., the contraction in length upon reducing the loading to 8 gms. divided by the length under the 400 gm loading giving the crimp rigidity.

It is to be noted that in these examples S direction spirality in the fabric is the spirality resulting from the effect of the first false twist operation, while Z direction spirality is the spirality resulting from the second false twist operation. Fabric of zero spirality, i.e., incorporating completely non-torque yarn, is produced when the spirality effects of the two false twist operations exactly cancel out. It is also to be noted that where yarn was crimped in accordance with the invention in the examples, substantially non-torque crimped yarn was produced.

What is claimed is:

1. A method of crimping yarn on the run including the steps of heating the yarn, subjecting the yarn to a first false twisting operation in one direction so that the yarn is heated in its first twisted configuration, and then subjecting the yarn to a second false twisting operation in the opposite direction without further heating, the yarn being oppositely twisted by the second false twisting operation while it still possesses sufficient heat to be at least partly permanently deformable.

2. A method as claimed in claim 1 wherein cooling of the yarn after said heating and before the first false twisting operation is impeded.

3. A method as claimed in claim 1 wherein the yarn is subjected during heating to a temperature of the order of 150° to 250° C.

4. A method as claimed in claim 1 wherein the twists imparted by the two false twisting operations are equal in magnitude.

5. Apparatus for crimping yarn comprising a first false twist device arranged to rotate the yarn in one direction, a heater so disposed as to heat the yarn as it travels to the first false twist device, a second false twist device arranged to rotate the yarn in the opposite direction, and guide means for guiding the yarn without further heating from the first false twist device to the second false twist device, each of the false twist devices comprising means defining an endless movable track provided with a surface for frictionally engaging the yarn, means for driving the track, and means for guiding the yarn into frictional engagement with the surface in a direction such that the surface moves transversely to the direction of movement of the yarn.

6. Apparatus for crimping yarn, comprising means defining an endless movable track provided with a surface for frictionally engaging the yarn, means for driving the track, and means for guiding the yarn into frictional engagement with the surface in a first direction such that the surface moves transversely to the direction of movement of the yarn to twist the yarn in a predetermined sense and for then guiding the yarn into frictional engagement with the surface in a second direction such that the surface moves transversely to the direction of movement of the yarn to twist the yarn in the opposite sense.

7. An apparatus for crimping yarn comprising a false twist device consisting of an endless movable track having a surface for frictionally engaging the yarn, means for advancing yarn under tension from a supply of yarn, guide means for guiding the yarn so that it crosses said surface substantially transversely to the direction of movement to the surface first in one direction whereby a first twist is imparted to the yarn in one direction and then in the opposite direction whereby a second twist is imparted to the yarn in the opposite direction, and a heater for heating the yarn passing in said one direction to the surface of the endless track.

8. A method of crimping yarn on the run including the steps of false twisting the yarn a first time in one direction and heating the yarn while twisted, and then false twisting the yarn a second time in the opposite direction, the yarn being untwisted from the first false twisting operation and oppositely twisted by the second false twisting operation while it possesses sufficient heat to be at least partly permanently deformable.

9. A method of crimping yarn on the run including the steps of heating the yarn, subjecting the yarn to a first false twisting operation in one direction so that the yarn is heated in its first twisted configuration, and then subjecting the yarn to a second false twisting operation in the opposite direction, the yarn being untwisted from the first false twisting operation and oppositely twisted by the second false twisting operation while it possess sufficient heat to be at least partly permanently deformable.

10. A method as claimed in claim 9 further including the step of impeding any cooling of the yarn before the first false twisting operation.

11. A method as claimed in claim 9 wherein the yarn is subjected during heating to a temperature of the order of 150° to 250° C.

12. A method as claimed in claim 9 wherein the twists imparted by the two false twisting operations are equal in magnitude.

13. A method of crimping yarn on the run including the steps of heating and false twisting the yarn a first time in one direction so that the yarn is in a twisted configuration when being heated, and immediately false twisting the yarn a second time in the opposite direction so that the yarn is twisted in the opposite direction by the second false twisting simultaneously with being detwisted from the twist in said one direction imparted by the first false twisting, the yarn being oppositely twisted by the second false twisting operation while it still possesses sufficient heat to be at least partly permanently deformable.

14. A method according to claim 8, in which the yarn is comprised of a thermoplastic material.

15. A method according to claim 14, in which said thermoplastic material is a polyester or a polyamide.

16. A method of crimping yarn on the run including the steps of false twisting the yarn a first time in one direction and heating the yarn while twisted, and then false twisting the yarn a second time in the opposite direction without heating the yarn between the first and second false twisting steps, the yarn being oppositely twisted by the second false twisting operation while it still possesses sufficient heat to be at least partly permanently deformable.

17. A method of crimping yarn on the run including the steps of heating the yarn, subjecting the yarn to a first false twisting operation in one direction so that the yarn is heated in its first twisted configuration, and then subjecting the yarn to a second false twisting operation in the opposite direction without further heating, the yarn being oppositely twisted by the second false twisting operation while it still possesses sufficient heat to be at least partly permanently deformable.

* * * * *