United States Patent

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[31] P 17 65 452.3

[54] APPARATUS AND A METHOD FOR STRANDING A TWISTED UNIT OF A CABLE

23 Claims, 8 Drawing Figs.

[52] U.S. Cl. 57/34 AT, 57/59, 57/156
[51] Int. Cl. H01b 13/02
[50] Field of Search 57/34, 59, 34 AT, 60, 156, 3, 12, 160, 62

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ABSTRACT: For SZ stranding, the stranding elements which remain united in the stranding or twisted unit are led in a stretched twisted condition to a twisting device which twists the twisted unit in sections, each of a multiple of stranding strokes. The twisting device is positioned closer to the takeup point than to the payout point of the twisted unit. A longitudinal section of the twisted unit has a minimum length equal to the distance between the takeup point and the twisting device and a maximum length equal to three times the distance between the twisting device and the payout point.

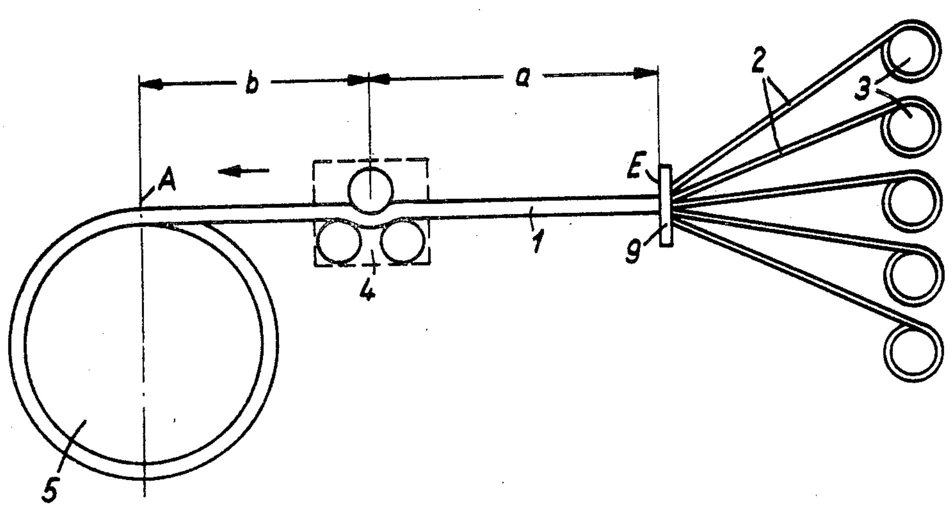


Fig. 1

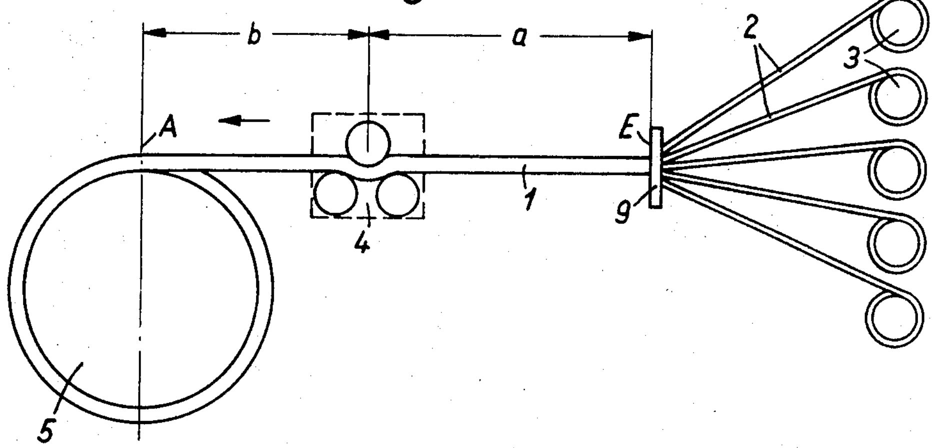


Fig. 2

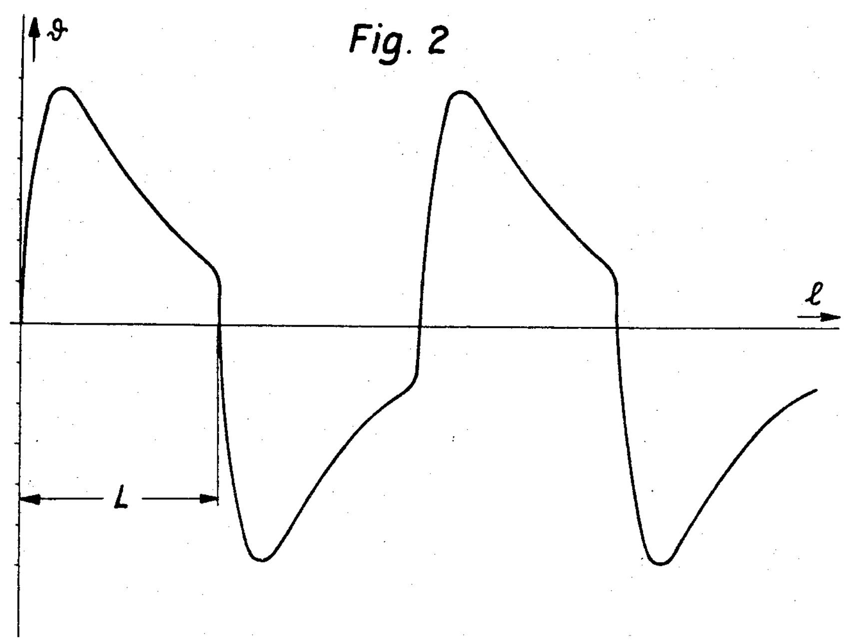


Fig. 3

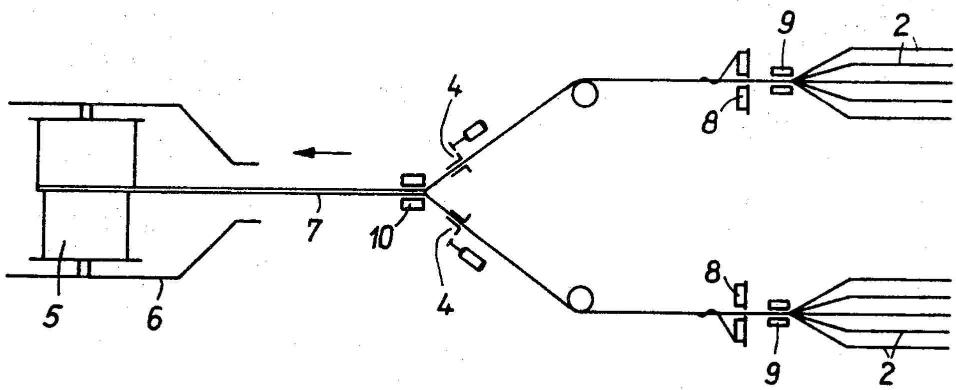


Fig. 4

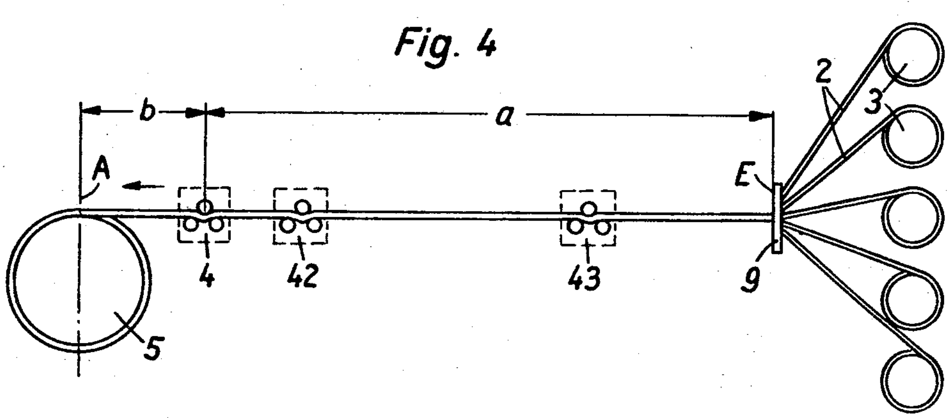


Fig. 5

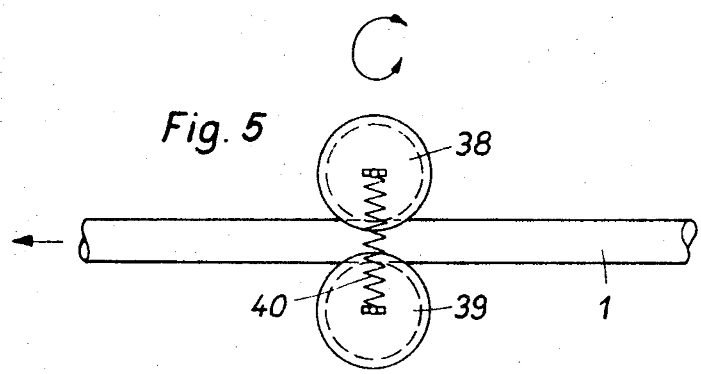


Fig. 6

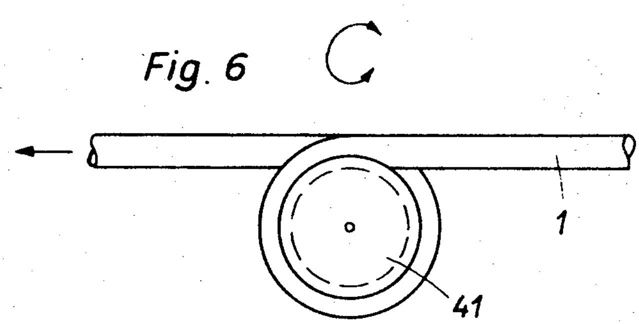


Fig. 7

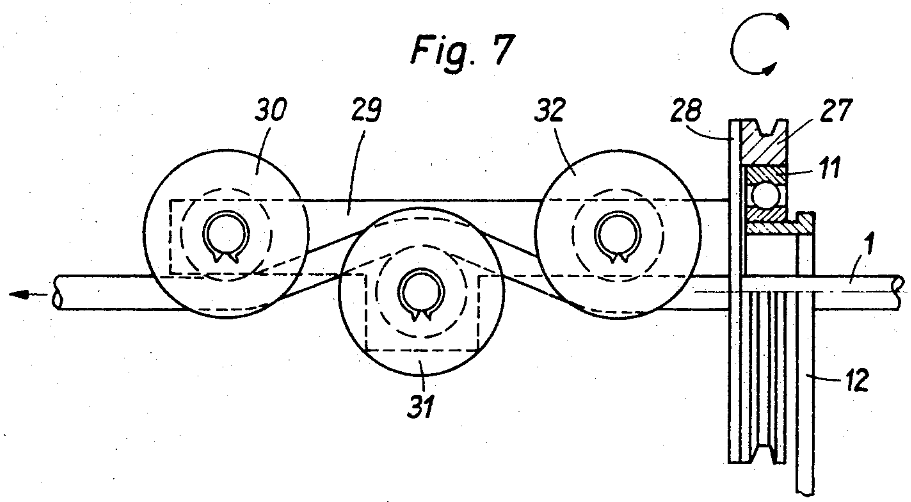
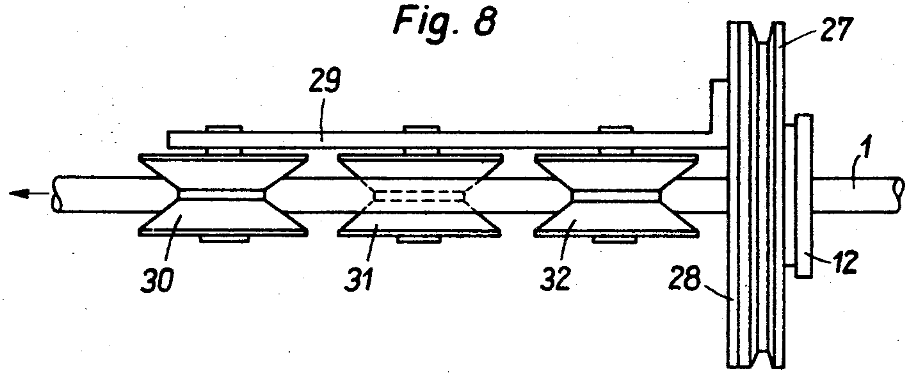


Fig. 8



APPARATUS AND A METHOD FOR STRANDING A TWISTED UNIT OF A CABLE

DESCRIPTION OF THE INVENTION

The present invention relates to apparatus and a method for stranding a twisted unit of a cable. More particularly, the invention relates to apparatus and a method for stranding a twisted unit of a cable in different directions of stranding for individual lengths.

Recent technical development in the manufacture of common cables is connected with the concentration of stranding or twisting operations which have previously been undertaken separately. These operations are, for example, stranding or twisting of basic units and main units into one work operation in order to enhance efficiency. For this purpose, stranding processes are required to assist the stranding of the twisted units. Each twisted unit comprises a plurality of twisted elements. The twisted units are stranded or twisted alternately with a left-hand lay or S-twist and a right-hand lay or Z-twist in continuous lengths. All stranding or twisting of this type, known as oscillated twisting, and lately known as SZ twisting, has the advantage that the elements to be twisted may be paid out from stationary supply sources and that further processing of the twisted unit, which is formed by twisting such elements, may be undertaken immediately after twisting during the same work operation utilizing the SZ twisting process.

Heretofore, as a rule, the proposed or known processes for SZ twisting have utilized rotating cradles having a twofold function. These cradles function simultaneously as take up containers for storing the twisted unit and pay out containers for supplying the elements. During this process, the direction of stranding or twisting must be rotary at intervals in accordance with the lengths in the cradles.

A device described in German Pat. No. DAS 1,197,144 for stranding telephone cables operates without the aforedescribed cradles. In such well-known device, the wire pairs pulled from stationary payout reels in groups are led through a single oscillating disc each. The oscillating discs swing back and forth or oscillate in alternating sequence thereby turning alternately in one direction and then in the other. The oscillating twisting or stranding discs may not, however, be turned by more than ±180°. If the oscillating discs were turned by more than 180°, the wire groups would twist too much in front of said discs and the pretwisted elements pulled against the oscillating discs when they are moved from the payoff reels would break off or be damaged. The maximum phase angle of twist thus remains small. Furthermore, the twists attained have proven to be insufficient for electrical decoupling of the twisted elements of telephone cables.

The principal object of the present invention is to provide a new and improved process and apparatus for stranding a twisted unit of a cable in different directions of stranding for individual lengths.

An object of the present invention is to provide a process and apparatus for stranding a twisted unit of a cable in different directions of stranding with rapidity, efficiency, effectiveness and reliability.

An object of the present invention is to provide a process and apparatus for stranding a twisted unit of a cable in different directions of stranding, which process and apparatus overcome the disadvantages of known processes and apparatus of similar type.

An object of the present invention is to provide apparatus of simple structure for stranding a twisted unit of a cable in different directions of stranding.

In accordance with the present invention, a twisted unit of a cable such as, for example, a communication cable comprising a plurality of elements, is stranded with different twisting directions for each section. The elements of the twisted unit are led to a stationary payout point at which the twisted unit is formed from such elements. The twisted unit is then led from the payout point to a twisting device in a switched rotatable condition perpendicular to the axis of the twisted unit. The twisting device grasps the twisted unit and turns said twisted unit by a multiple of twists sectionwise between the payout point and a stationary takeup point at which a different twist of the twisted unit is provided sectionwise. The distance between the takeup point and the point at which the twisting device grasps the twisted unit is smaller than the distance between the point at which the twisting device grasps the twisted unit and the payout point. A single length section having the same twist direction of the twisted unit has a minimum length equal to the distance between the takeup point and the point at which the twisting device grasps the twisted unit and a maximum length equal to three times the distance between the point at which the twisting device grasps the twisted unit and the payout point.

The process and apparatus of the present invention insures that each length section of the twisted unit having a different direction of twisting is provided with a sufficient number of twists, whereas simultaneously the periodic variation in the direction of twisting and/or the speed of the twisting device is undertaken so rapidly that any significant decrease in the turning of the length section of the twisted unit passing through the twisting device, resulting from the operation of the twisting device because of the twisted unit approaching too close to the buildup condition, is avoided. The twisted unit is twisted between the payout point and the point at which the twisting device grasps the twisted unit. Only a portion of the twisted unit may slip through the twisting device during the process.

If the direction of rotation of the twisting device remains the same, the twisting of the twisted unit increases continuously between the payout point and the point at which the twisting device grasps the twisted unit. Thus, if the speed of the twisting device remains constant, an equilibrium condition occurs between the twisting of the twisted unit led to the twisting device and the twist per length section provided by the twisting device. In this case, the torsion of the part of the twisted unit in front of the twisting device would attain an end value. However, the twisting of the part of the twisted unit in the pulloff direction behind the twisting device would be equal to zero.

The apparatus and method of the present invention are based upon the conception that the end value is provided by the uniformity of twisting provided per length section by the twisting device on one hand, and the twisting of the twisted unit led to the twisting device on the other hand. The invention is also based on the conception that up to the instant the end value is reached, the length section of the twisted unit passing through the twisting device is provided with a twist in the same direction. Before the end value is reached, a new end value is provided by changing the direction of rotation and/or speed of the twisting device. Twisting of the twisted unit is then continued to a later instant before the new end value is reached.

In the apparatus of the present invention, the distance between the takeup point and the point of engagement of the twisting device with the twisted unit is made essentially shorter than the distance between the point of engagement of the twisting device with the twisted unit and the payout point. This results in an extraordinarily high degree of efficiency, so that a relatively small speed of the twisting device is sufficient to guarantee adequate twisting of the twisted unit led to the takeup point. The relation between the distance between the takeup point and the point of engagement of the twisting device with the twisted unit and the distance between the point of engagement of the twisting device with the twisted unit and the payout point is varied continuously or in stages during the twisting process.

In accordance with the present invention, apparatus for stranding a twisted unit of a cable in different directions of stranding for individual lengths comprises a plurality of cable elements. A fixed payout point forms a twisted unit from the cable elements. A twisting device engages the twisted unit in a nonpositive manner perpendicular to the axis of the twisted unit. The twisted unit is led to the twisting device in stretched rotatable condition. The twisting device rotates the twisted unit a number of twists between the payout point and the takeup point and provides a different direction of stranding of the twisted unit for individual section lengths. The twisting device engages the twisted unit at a point closer to the takeup point than to the payout point. A section of the twisted unit having the same direction of stranding has a minimum length which is the length between the takeup point and the engagement point of the twisting device and a maximum length which is three times the length between the engagement point and the payout point.

The twisting device is positioned as close as possible to the takeup point.

The twisted unit is stranded at the takeup point and one of the speed and direction of rotation of the twisting device is regulated in accordance with the stranding of the takeup point during the passage through the twisting device of a section of the twisted unit having the same direction of stranding. The regulation of the one of the speed and direction of rotation provides stranding which is as constant as possible over the entire section of the twisted unit having the same direction of stranding. A stranding device is provided between the twisting device and the takeup point for stranding a plurality of twisted units. The regulation of the one of the speed and direction of rotation provides resultant stranding of the stranding device of uniform size and length.

The speed of the twisting device is increased during the passage through the twisting device of a section of the twisted unit having the same direction of stranding. The speed of the twisting device is varied during the passage through the twisting device of a section of the twisted unit having the same direction of stranding.

The twisting device rotates in a single direction during twisting of the twisted unit. The twisting device rotates intermittently in a single direction during twisting of the twisted unit. The twisting device is rotated after reaching a specific minimum during the stranding of the section of the twisted unit. The twisting device is rotated and engages in a nonpositive manner a length of twisted unit perpendicular to the axis of the twisted unit preventing spreading thereof. The length of engaged twisted unit is shorter than the length of twisted unit to be twisted in the direction of rotation of the twisting device. The twisting device comprises spaced components on both sides of the twisted unit and the components contact the twisted unit with a pressure which does not hinder the passage of the twisted unit through the twisting device. The twisting device functions as a lever relative to the axis of the twisted unit and transfers force to the twisted unit in the direction of rotation of the twisting device by deflection of the twisted unit. The twisting device comprises three spaced rollers mounted for coplanar rotation with their axes positioned in a manner whereby the twisted unit passes in contact with each of the rollers in curvilinear fashion.

An additional twisting device between the payout point and the twisting device provides homogeneous stranding of the section of the twisted unit between the payout point and the twisting device. The twisting device and the additional twisting device rotate in the same direction at increasing speeds relative to the advancing of the twisted unit.

In accordance with the present invention, a process for stranding a twisted unit of a cable in different directions of stranding for individual lengths comprises the steps of forming a twisted unit from a plurality of cable elements at a payout point and twisting the twisted unit in a nonpositive manner perpendicular to the axis of the twisted unit a number of twists at a point between the payout point and a takeup point and providing a different direction of stranding of the twisted unit for individual section lengths when the twisted unit is in stretched rotatable condition at a point closer to the takeup point than to the payout point. A section of the twisted unit having the same direction of stranding has a minimum length which is the length between the takeup point and the twisting point and a maximum length which is three times the length between the twisting point and the payout point.

The distance between the takeup point and the twisting point is considerably smaller than the distance between the twisting point and the payout point. The relation of the distance between the takeup point and the twisting point and the distance between the twisting point and the payout point is varied.

The process further comprises the step of stranding a plurality of twisted units, each twisted by twisting a corresponding one of a plurality of twisted units. Each of the twisted units is twisted at a varying one of speed and direction of rotation. The variation of twisting occurs at a time different from that of the others. Each of the twisted units is twisted at a different one of speed and direction of rotation from that of the others. Each of the twisted units is twisted at a twisted point a distance from a corresponding takeup point and a distance from a corresponding payout point which have a different relation to each other from the others.

In order that the present invention may be readily carried into effect, it will now be described with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of an embodiment of the apparatus of the present invention for performing the process of the present invention;

FIG. 2 is a graphical presentation of the stranding process of the present invention;

FIG. 3 is a schematic diagram of another embodiment of the apparatus of the present invention;

FIG. 4 is a schematic diagram of another embodiment of the apparatus of the present invention;

FIG. 5 is a schematic diagram of an embodiment of a twisting device;

FIG. 6 is a schematic diagram of another embodiment of a twisting device;

FIG. 7 is a schematic diagram of another embodiment of a twisting device; and

FIG. 8 is a top view of the twisting device of FIG. 7.

In the FIGS., the same components are identified by the same reference numerals.

The basic unit of a communication cable having unit-type design is assumed to be the twisted unit. The twisted unit comprises elements or strands **2**. As shown in FIG. **1**, a plurality of payout stands or sources provide the elements or strands **2**. In FIG. **1**, five strands **2** are led to a payout point E. A nipple **9** at the payout point E combines the five elements **2** into a basic twisted unit **1**.

The twisted or basic unit **1** is led to a twisting device **4** in a stretched rotatable or twisted condition. The twisting device **4** engages the twisted unit **1** perpendicularly to the axis of said twisted unit in a nonpositive manner. The twisted unit **1** is then led in the direction of the arrow to the takeup point A where it is wound on a take up reel **5**. The takeup point A is determined so that it fixes the different twisting directions of the twisted unit **1** sectionwise.

In accordance with the present invention, the distance b between the takeup point A and the point of engagement of the twisting device **4** with the twisted unit **1** is smaller than the distance a between the point of engagement of twisting device **4** with the twisted unit and the payout point E. In accordance with the present invention, the relation $a:b$ is generally greater than 5, although satisfactory results have been obtained with a ratio $a:b=5$. The greater the ratio $a:b$, the greater the efficiency. In practical operation, the following values have proven to be suitable.

$a=10$ meters
$b=0.3$ meter

Other suitable values are:

$a=18$ meters
$b=0.5$ meter

If the twisting device **4** rotates in the same direction at a specific speed, the part of the twisted unit **1** between the takeup point A and said twisting device is twisted in one direction and the part between the payout point E and the twisting device 4 is twisted in the opposite direction. Since the twisted unit 1 also moves through the twisting device 4 at a definite speed of advance, as a result of the rotation of the takeup reel 5, part of the twisting provided between the payout point E and the twisting device 4 on the twisted unit 1 continuously slips through the said twisting device, so that twisting of said twisted unit at the takeup point A does not increase proportionally with the speed of rotation of said twisting device.

Twisted units of cable such as, for example, the twisted unit 1, are generally not ideally elastic as far as torsion is concerned. Thus, twisting of the part of the twisted unit 1 between the payout point E and the twisting device 4 is nonhomogeneous. This nonhomogeneous condition is dependent upon the makeup and, particularly, on the diameter of the twisted unit 1. When the twisted or basic unit 1 comprises five elements or strands, as assumed for the illustration of the present invention, nonhomogeneous conditions have occurred when the distance or length a is greater than 5 meters.

For the aforementioned reasons, the twisting of the twisted unit 1 at the take up point A is not constant, in accordance with the present invention. This is explained in FIG. 2 by indicating the length l as the abscissa and indicating the twisting θ as the ordinate. The curve of FIG. 2 is for a wire pair twisted in accordance with the SZ twisting process, utilizing the apparatus of FIG. 1.

The following values were chosen for the distances a and b, the speed of rotating n of the twisting device 4 and the speed of advance v of the twisted unit 1:

a=5 meters
b=1 meter
n=1000 r.p.m.
v=20 meters per minute

The direction of rotation of the twisting device 4 was changed at intervals L of 10 meters.

As indicated by the twisting values θ in FIG. 2, the twisting within a length L is n the same direction and increases initially to its maximum value and then decreases gradually to its minimum value. The direction of rotation of the twisting device 4 is therefore reversed in sufficient time before reaching the buildup state, which buildup state means a twisting value θ equal to zero.

It is advantageous to provide an additional stranding operation in the same work operation immediately succeeding the process of the present invention. In order to achieve this, a plurality of twisted units are twisted in a plurality of parallel operations in the SZ twisting process in a single continuous operation to the next successive stranding stage in accordance with the present invention.

FIG. 3 illustrates apparatus for twisting a common cable. The strands or elements 2 and 2′ are led from stationary supply stands or sources (not shown in FIG. 3) to corresponding nipples 9, 9′, and so on, in groups of five strands. Each of the nipples 9, 9′, and so on, forms a twisted or basic unit 1 which is then wound by an open holding helix with the assistance of a spinner 8, 8′, and so on. The twisted units 1, 1′, and so on, are led to a stranding point via guide pulleys 21, 21′, and so on, and twisting devices 4, 4′, and so on. A nipple 10 is positioned at the stranding point. The nipple 10 combines the twisted units 1, 1′, and so on, into a main unit 7. The main unit 7 is wound on the takeup reel 5′ in a stranding yoke 6.

The twisted units 1, 1′, and so on, of which only the twisted units 1 and 1′ are shown in FIG. 3 in order to enhance the clarity of illustration, pass through the corresponding twisting devices 4, 4′, and so on, of which only the twisting devices 4 and 4′ are shown in FIG. 3, before being led to the nipple 10. The twisted units 1 are stranded or twisted between the nipples 9, 9′, and so on, where they are formed from the elements or strands 2, and the nipple 10 which strands or twists the twisted units 1, 1′, and so on, into the main unit 7, by periodic variation of the speed and/or direction of rotation of the twisting devices 4, 4′, and so on. The twisting devices 4, 4′, and so on, are positioned as close as possible to the nipple 10. As a result of the periodic variation of the speed and/or direction of the twisting devices 4, 4′, and so on, the twisted units 1, 1′, and so on, are led to the nipple 10 with a specific type of stranding. After the twisted units 1, 1′, and so on, have passed through the nipple 10, the influence of the twisting devices 4, 4′, and so on, on the additional stranding or twisting of said twisted units is eliminated by the stranding of said twisted units into the main unit 7.

In the same manner as illustrated by FIG. 3 for the stranding of a main unit of a common cable formed of elements and twisted units, it is possible to twist or strand wire groups comprising, for example, wire pairs. In such a case, the twisting device twists the wire groups comprising wire pairs before the wire pairs are led to the nipple which twists them, in the same work operation.

During the stranding or twisting of a cable in which a plurality of twisted units are stranded in parallel work operations to the next succeeding or next higher stranding stage in the same work operation, in accordance with the process of the present invention, the speed and/or direction of rotation of the twisting device of each of the parallel work operation apparatus may be varied or changed at a time different from that of the others. This insures electrical decoupling of the twisted units strained together. This may also be achieved by operating the twisting devices of the parallel work operation apparatus at speeds and/or directions of rotation which are different from each other.

In the apparatus of each of the parallel work operations, the distance between the takeup point of the twisted unit and the point of engagement of the twisting device with the twisted unit and/or the distance between the point of engagement of the twisting device with the twisted unit and the payout point of the twisted unit may be selected differently.

As hereinbefore described, with reference to FIG. 2, stranding in the individual lengths L of a twisted unit is not constant in the process of the present invention. It is, however, often desired that stranding or twisting be as constant as possible within the sequential length of a twisted unit. To attain this, the speed or, if necessary, the direction of rotation, of the twisting device may be regulated during the time in which a length of the twisted unit, in completed condition having the same direction of lay in accordance with the stranding, is provided at the takeup point. The speed of the twisting device may be increased continuously, for example, or in stages, while a length of a twisted unit having the same stranding direction passes through said twisting device. It is, however, also possible to vary the speed of advance while a length of the twisted unit having the same stranding direction is passing through the twisting device.

The switching or energization of the twisting device may be delayed after the periodic variation in the speed and/or direction of rotation of said twisting device has commenced, so that the stranding or twisting which has accumulated in front of said twisting device in the direction of advance of the twisted unit may gradually diminish.

The regulation of the speed and, if necessary, the direction of rotation of the twisting device may be provided in a manner whereby during the period that a length of the twisted unit having the same direction of stranding is passing through the twisting device, stranding is as constant as possible over said entire length of the twisted unit. It is also possible to provide speed or direction of rotation regulation in a manner whereby the resultant combined stranded units such as, for example, the main units, each of which comprises a plurality of twisted units, are as equal to each other as possible in size in each section. In order to provide stranding with reversed directions of stranding in successive sections of the twisted unit, the direction of rotation of the twisting device may be reversed at periodic reversal points, that is, after a length L of the twisted unit has passed through the twisting device. It is also possible to rotate the twisting device in only one direction during twisting of the entire twisted unit. In such a case, it is advisable to rotate the twisting device intermittently in the same direction.

It is preferable that the length of the twisted unit positioned between the payout point E and the twisting device 4 does not become torsion free. If such length of the twisted unit does not become torsion free, a sufficient compactness of the elements **2** forming the twisted unit **1** is insured. It is therefore advisable, for practical reasons, that the drive of the twisting device be switched on again after a specific minimum length of the twisted unit **1** between the twisting device **4** and the payout point E has been reached.

If the twisting device **4** rotates counterclockwise, for example, the section of the twisted unit is twisted to the right in front of said twisting device and the section of said twisted unit behind said twisting device is twisted to the left in accordance with the change in the right-hand twist. If the twisting device is then deenergized or stopped, the section of the twisted unit having the right-hand twist slips through said twisting device unaltered. In this way, the section of the twisted unit behind the twisting device in the direction of advance toward the take up point A, has a right-hand twist. At the same time, the right-hand twist of the section in front of the twisting device is decreased. The decrease in the right-hand twist is interrupted, however, at the proper instant by the reenergization or restarting of the twisting device. The twisting device then rotates again to the right and again increases the right-hand torsion in the section of the twisted unit in front of said twisting device, thereby providing a left-hand torsion behind said twisting device. The constant torsion in the section between the payout point E and the twisting device continuously holds the elements together in the twisted unit. This insures a smooth advance of the twisted unit so that, if desired, the speed of advance may be increased. Furthermore, the smooth advance of the twisted unit is favorable to electrical decoupling of said twisted unit.

In another embodiment of the apparatus of the present invention, additional twisting devices, besides the twisting device **4**, are provided between the payout point E and the twisting device **4**. The additional twisting devices support the formation of a homogeneous stranding of the section of the twisted unit between the initial twisting device **4** and the pay out point E. In this manner, nonhomogeneous properties of the stranding due to lack of torsional elasticity of the twisted unit are avoided in those cases where the distance *a* between the twisting device **4** and the payout point E in FIG. **1** is relatively long.

The embodiment of the present invention utilizing additional twisting devices is illustrated in FIG. **4**. The embodiment of FIG. **4** is a modification of the embodiment of FIG. **1**. In FIG. **4**, additional twisting devices **42** and **43** are positioned between the initial twisting device **4** and the payout point E. Thus, the additional twisting devices **42** and **43** are distributed over the distance *a*. The twisting devices **42** and **43** support stranding of the section of the twisted unit **1** between the initial twisting device **4** and the payout point point E. This results in the provision of an extension of the freely twistable section of the twisted unit **1**.

The additional twisting devices **42** and **43** need not be evenly spaced in the distance *a*. On the contrary, as indicated in FIG. **4**, the additional twisting devices **42** and **43** may be unevenly spaced between the initial twisting device **4** and the payout point E.

In order to insure homogeneous stranding of the twisted unit **1**, it is preferable to permit the speeds of the twisting devices **42**, **43** and **4** to increase in the same direction of rotation with reference to the direction of advance of the twisted unit **1**. The utilization of suitable gearing permits a single drive for all of the twisting devices **4**, **42** and **43**. The gearing may be particularly simple if all the twisting devices are rotated and are driven intermittently during the entire stranding process of the twisted unit **1**.

In accordance with the present invention, it is preferable that a length of the twisted unit **1** be engaged in a nonpositive manner without spreading said twisted unit perpendicularly to its axis by the portions of the twisting device which are shorter than the length of said twisted unit in the direction in which said twisting device is rotated. This means that positive contact only exists perpendicularly to the axis of the twisted unit between the twisting device and said twisted unit, whereas said twisted unit is not hindered in the direction of its axis, independently of the effected twisting. Consequently, the stranding or twisting of the twisted unit already provided in front of the twisting device has no effect on the tensile stress and on the length of the twisted unit advancing through said twisting device and having the same direction of rotation.

The transfer of force from the twisting device to the twisted unit in the direction of rotation of said twisting device is executed advantageously by contact pressure which does not influence the passage of said twisted unit to any great extent. Thus, for example, two rollers may be positioned perpendicularly to the axis of the twisted unit and may be utilized for this purpose. The rollers may be in contact with the twisted unit positioned between them and may be elastically urged toward each other. The rollers are rotated about the axis of the twisted unit.

FIG. **5** illustrates a pair of rollers functioning as a twisting device. The twisted unit **1** comprises a plurality of elements **2**, as provided in the embodiment of FIG. **1**, for example. The twisting device of FIG. **5** comprises two rollers **38** and **39** coplanarly positioned opposite each other in a plane perpendicular to the axis of the twisted unit **1**. A spring **40** is affixed at one end to the rotary shaft of the roller **38** and is affixed at its outer end to the rotary shaft of the roller **39**. The spring **40** functions to urge the rollers **38** and **39** toward each other elastically and thereby urges said rollers into elastic contact with the twisted unit **1**. Each of the rollers **38** and **39** has a peripheral groove or channel formed around its circumference and the twisted unit **1** fits into said channels or grooves.

The rollers **38** and **39** are rotated about the axis of the twisted unit **1**, which twisted unit is advanced to the left, so that the twisting device comprising said rollers is rotated due to the stranding of said basic unit. It is of primary importance that the contact pressure of the rollers **38** and **39** on the twisted unit **1** resulting from the force of the spring **40** does not practically hinder the passage of said twisted unit through the twisting device.

Another advantage of the twisting device is that the transfer of force from said twisting device to the twisted unit is provided in the direction of rotation of said twisting device via a deflection of said twisted unit which functions as a lever relative to its axis. The twisting device includes guide elements fixed by the direction of advance. FIG. **6** illustrates such a twisting device.

In FIG. **6**, the twisted unit **1** is advanced in the direction of the arrow, toward the left, around a roller **41**. The roller **41** has a peripheral groove or channel formed in its circumference to accommodate the twisted unit **1** and is mounted for rotation on a rotary shaft positioned perpendicularly to the axis of the twisted unit **1**. The roller **41** is rotated about the axis of the twisted unit **1** determined by the direction of advance of said twisted unit so that said twisted unit is stranded.

FIGS. **7** and **8** illustrate an embodiment of a twisting device which has proven to be especially adaptable and suitable in field tests. In the twisting device of FIGS. **7** and **8**, the transfer of force is effected by a deflection of the twisted unit functioning as a lever. In this case, the twisting device comprises three rollers **30**, **31** and **32** coplanarly positioned. The rollers **30**, **31** and **32** are mounted with their axes so positioned that the twisted unit **1** passes between them in a waving fashion.

Each of the rollers **30**, **31** and **32** has a peripheral groove or channel formed around its circumference to accommodate the twisted unit **1**. In the illustration of FIGS. **7** and **8**, the axis of the roller **31** is positioned between and beneath the axes of the rollers **30** and **32**, so that the twisted unit passes between said rollers in a manner whereby said twisted unit is above the roller 31 and beneath the rollers 30 and 32. Any suitable number of rollers may be utilized.

The twisting device is mounted on a stationary or fixed frame 12 via a roller bearing 11. A flange 27 is fitted onto the rotatable peripheral part of the roller bearing 11 and is affixed to a disc 28 which functions as a chain or drive wheel. The disc 28 may thus be driven via the flange 27 in any direction of rotation and at any desired speed via a drive chain, belt, or the like.

A support member 29 supports the three rollers 30, 31 and 32 which are mounted thereon. The support member 29 is affixed to the disc 28. The twisted unit 1 is deflected between the rollers 30 and 32, since it passes between said rollers and the roller 31 in a waving fashion, so that a leverlike force is produced perpendicularly to said twisted unit; said twisted unit being engaged by the three rollers of the twisting device and being thereby twisted or stranded.

It is preferable to fasten the roller support members to the frame of the apparatus with adjusting screws so that the diameter of the twisted unit 1 to be stranded may be correspondingly adjusted. A further improvement is to cover the guiding channels or grooves of the rollers, which contact the twisted unit 1, with elastic material such as, for example, rubber. It is also advisable to flute the guiding channels or grooves of the rollers, preferably in V-shaped configuration corresponding to the diameter of the twisted unit 1. The surfaces of the guiding channels or grooves of the rollers may also be provided with mutually parallel grooves parallel to the axis of the twisted unit, such grooves being considerably smaller than half the diameter of an element of said twisted unit.

The guide rollers utilized to transfer force in the direction of rotation of the twisting device may additionally be rotated about their axes. This facilitates the passage of the twisted unit 1 to be stranded through the twisting device.

While the invention has been described by means of specific examples and in specific embodiments, we do not wish to be limited thereto for obvious modifications will occur to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. Apparatus for stranding a twisted unit of a cable in different directions of stranding for individual lengths, comprising

a plurality of cable elements;

a fixed payout point for forming a twisted unit from said cable elements;

a takeup point; and

twisting means engaging said twisted unit in a nonpositive manner perpendicular to the axis of said twisted unit, said twisted unit being led to said twisting means in stretched rotatable condition, said twisting means rotating said twisted unit a number of twists between said payout point and said takeup point and providing a different direction of stranding of the twisted unit for individual section lengths, said twisting means engaging said twisted unit at a point closer to said takeup point than to said payout point, a section of said twisted unit having the same direction of stranding having a minimum length which is the length between said takeup point and the engagement point of said twisting means and a maximum length which is three times the length between said engagement point and said payout point.

2. Apparatus as claimed in claim 1, wherein said twisting means is positioned as close as possible to said takeup point.

3. Apparatus as claimed in claim 1, wherein said twisted unit is stranded at said takeup point and one of the speed and direction of rotation of said twisting means is regulated in accordance with the stranding at said takeup point during the passage through said twisting means of a section of said twisted unit having the same direction of stranding.

4. Apparatus as claimed in claim 3, wherein the regulation of said one of said speed and direction of rotation provides stranding which is as constant as possible over said entire section of said twisted unit having the same direction of stranding.

5. Apparatus as claimed in claim 3, further comprising stranding means between said twisting means and said takeup point for stranding a plurality of twisted units, and wherein the regulation of said one of said speed and direction of rotation provides resultant stranding of said stranding means of uniform size and length.

6. Apparatus as claimed in claim 1, wherein the speed of said twisting means is increased during the passage through said twisting means of a section of said twisted unit having the same direction of stranding.

7. Apparatus as claimed in claim 1, wherein the speed of said twisting means is varied during the passage through said twisting means of a section of said twisted unit having the same direction of stranding.

8. Apparatus as claimed in claim 1, wherein said twisting means rotated in a single direction during twisting of said twisted unit.

9. Apparatus as claimed in claim 1, wherein said twisting means rotate intermittently in a single direction during twisting of said twisted unit.

10. Apparatus as claimed in claim 1, wherein said twisting means is rotated after reaching a specific minimum during the stranding of the section of the twisted unit.

11. Apparatus as claimed in claim 1, wherein said twisting means is rotated and engages in a nonpositive manner a length of twisted unit perpendicular to the axis of said twisted unit preventing spreading thereof, the length of engaged twisted unit being shorter than the length of twisted unit to be twisted in the direction of rotation of said twisting means.

12. Apparatus as claimed in claim 11, wherein said twisting means comprises spaced components on both sides of said twisted unit and said components contact said twisted unit with a pressure which does not hinder the passage of said twisted unit through said twisting means.

13. Apparatus as claimed in claim 12, wherein said twisting means functions as a lever relative to the axis of said twisted unit and transfers force to said twisted unit in the direction of rotation of said twisting means by deflection of said twisted unit.

14. Apparatus as claimed in claim 1, further comprising additional twisting means between said payout point and said twisting means for providing homogeneous stranding of the section of said twisted unit between said payout point and said twisting means.

15. Apparatus as claimed in claim 14, wherein said twisting means and said additional twisting means rotate in the same direction at increasing speeds relative to the advancing of said twisted unit.

16. Apparatus as claimed in claim 15, wherein said twisting means comprises three spaced rollers mounted for coplanar rotation with their axes positioned in a manner whereby said twisted unit passes in contact with each of said rollers in curvilinear fashion.

17. A process for stranding a twisted unit of a cable in different directions of stranding for individual lengths, comprising the steps of

forming a twisted unit from a plurality of cable elements at a payout point; and

twisting the twisted unit in a nonpositive manner perpendicular to the axis of said twisted unit a number of twists at a point between the payout point and a takeup point and providing a different direction of stranding of the twisted unit for individual section lengths when said twisted unit is in stretched rotatable condition at a point closer to the takeup point than to the payout point, a section of the twisted unit having the same direction of stranding having a minimum length which is the length between the takeup point and the twisting point and a maximum length which is three times the length between the twisting point and the payout point.

18. A process as claimed in claim 17, wherein the distance between the takeup point and the twisting point is considerably smaller than the distance between the twisting point and the payout point.

19. A process as claimed in claim 17, wherein the relation of the distance between the takeup point and the twisting point and the distance between the twisting point and the payout point is varied.

20. A process as claimed in claim 17, further comprising stranding a plurality of twisted twisted units, each twisted by twisting a corresponding one of a plurality of twisted units.

21. A process as claimed in claim 20, wherein each of the twisted units is twisted at a varying one of speed and direction of rotation, the variation of twisting occurring at a time different from that of the others.

22. A process as claimed in claim 20, wherein each of the twisted units is twisted at a different one of speed and direction of rotation from that of the others.

23. A process as claimed in claim 20, wherein each of the twisted units is twisted at a twist point a distance from a corresponding takeup point and a distance from a corresponding payout point which have a different relation to each other from the others.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,593,509 Dated July 20, 1971

Inventor(s) Wolfgang Feese, Heinz Oberender and Heinz Badura

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the address of the second and third inventors, the name of the town should read --Neustadt/Coburg--

Signed and sealed this 8th day of February 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents