United States Patent

Strelow et al.

[15] **3,664,108**

[45] **May 23, 1972**

[54] INTERMEDIATE STORER FOR APPARATUS FOR STRANDING A TWISTED UNIT OF A CABLE

[72] Inventors: **Alfred Strelow; Klaus Hascher,** both of Berlin, Germany

[73] Assignee: **Siemens Aktiengesellschaft,** Berlin and Munich, Germany

[22] Filed: **July 22, 1969**

[21] Appl. No.: **843,664**

[30] **Foreign Application Priority Data**

July 23, 1968 Austria ..... A 7117/68
July 23, 1968 Austria ..... A 7118/68

[52] **U.S. Cl.** ..... **57/34 AT,** 57/59, 57/66
[51] **Int. Cl.** **H01b 13/04**
[58] **Field of Search** ..... 57/34, 34 AT, 59, 66, 66.5

[56] **References Cited**

UNITED STATES PATENTS

3,169,360	2/1965	Corrall et al.	57/34
3,412,544	11/1968	Sugi et al.	57/34
3,481,127	12/1969	Vogelsberg	57/34
3,491,525	1/1970	Sugi	57/34
3,507,108	4/1970	Yoshimura et al.	57/34

Primary Examiner—John Petrakes
Attorney—Curt M. Avery, Arthur E. Wilfond, Herbert L. Lerner and Daniel J. Tick

[57] **ABSTRACT**

An intermediate storer positioned between a take up point for forming a twisted unit from cable elements and a pay out point engages and rotates the twisted unit about an axis of rotation a number of twists and provides a different direction of stranding of the twisted unit for individual section lengths. A take up reel at the take up point supplies the twisted unit to the storer in the direction of the axis of rotation of the storer and a pay out reel at the pay out point and on the axis of rotation removes the twisted unit from the storer in the direction of the axis of rotation.

4 Claims, 8 Drawing Figures

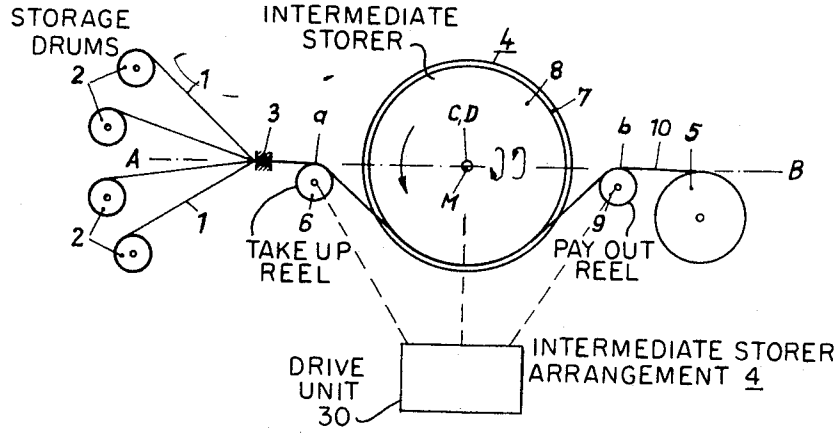


Fig. 1

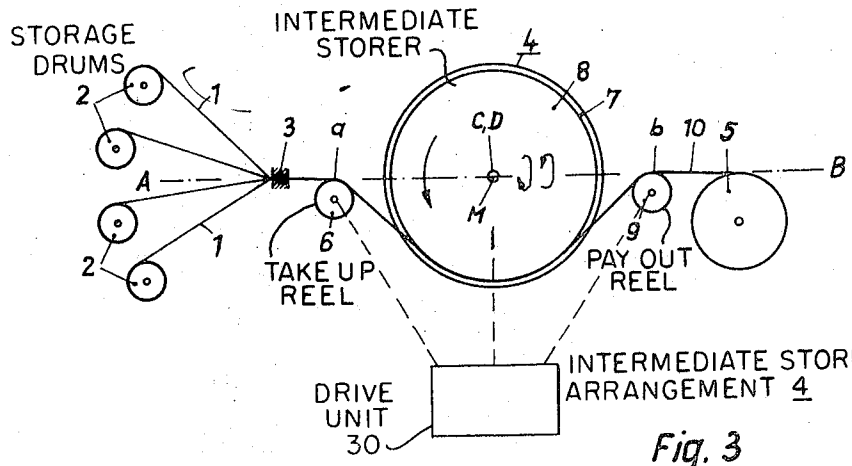


Fig. 2

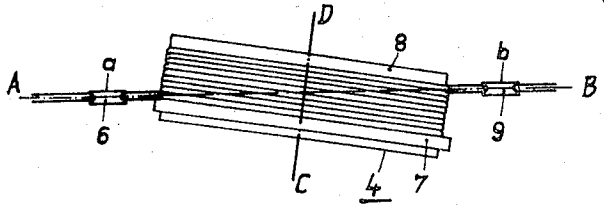


Fig. 3

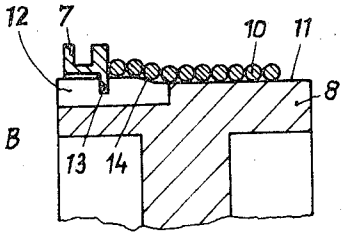


Fig. 6

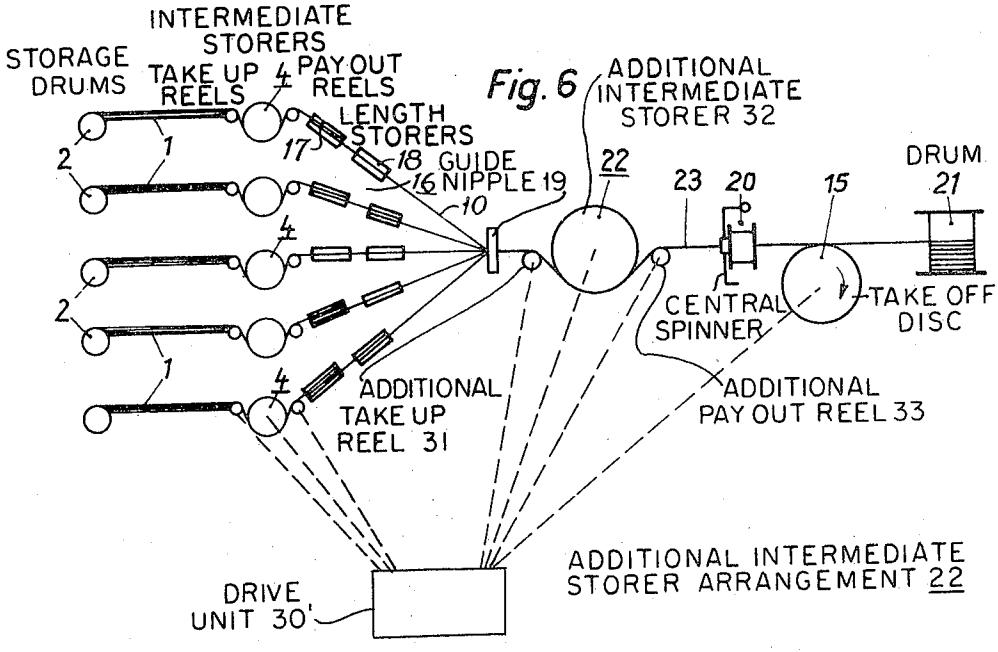


Fig. 4

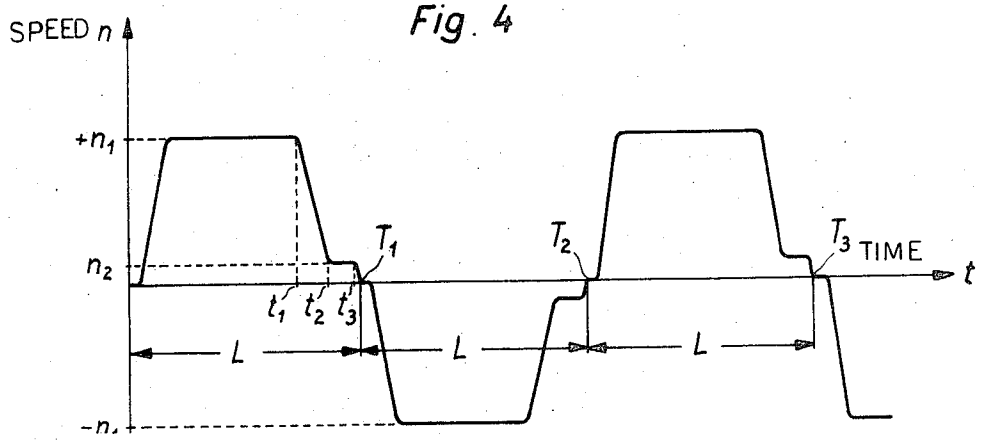
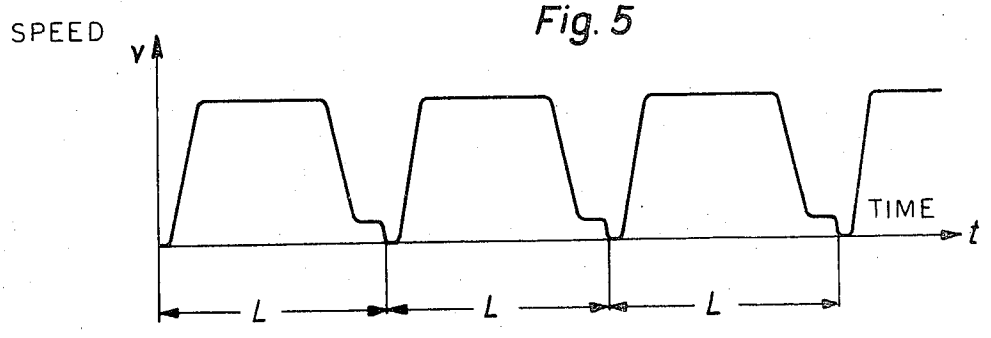


Fig. 5



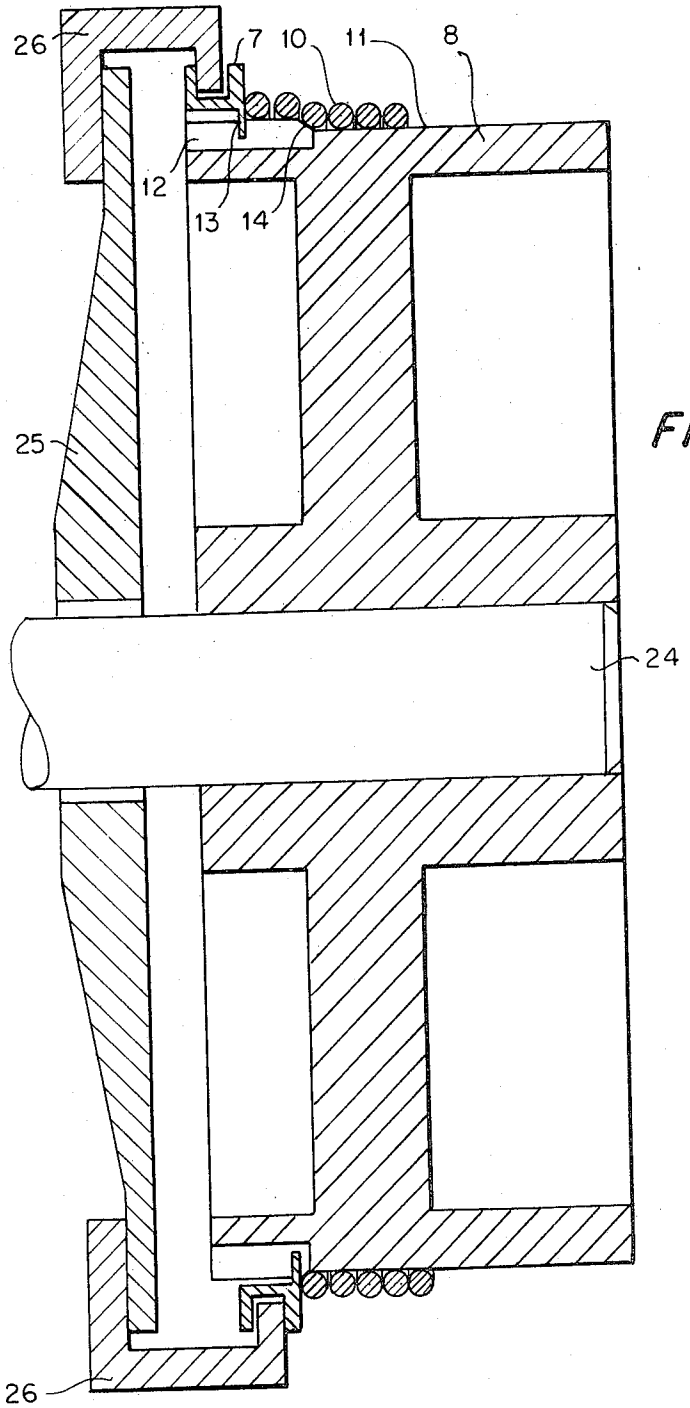


Fig. 7

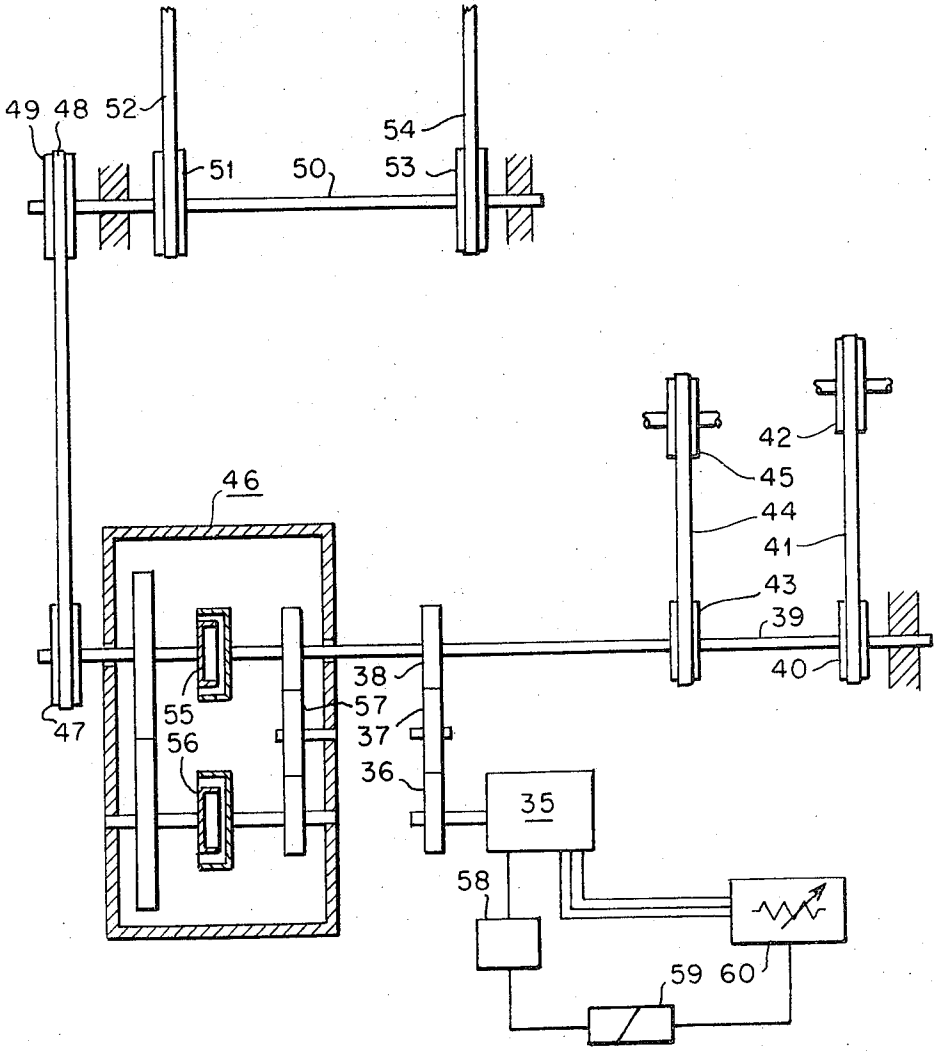

49
48
52
51
50
54
53
42
45
44
41
43
39
40
46
38
57
37
36
55
56
47
35
58
59
60

Fig.8

INTERMEDIATE STORER FOR APPARATUS FOR STRANDING A TWISTED UNIT OF A CABLE

DESCRIPTION OF THE INVENTION

The present invention relates to apparatus for stranding a twisted unit of a cable. More particularly, the invention relates to an intermediate storer for apparatus for stranding a twisted unit of a cable.

The present production of communication cables is concerned with combining a plurality of stranding or twisting operations, which heretofore have been undertaken separately, in a single working operation in order to increase the efficiency and economy of production. The twisting or stranding operation involves the twisting or stranding of spiral or quad cables and modular bunching or combining of the twisted cables. In order to accomplish a single working operation, twisting devices are required which would enable the stranding of the twisted units previously stranded from a plurality of cable elements, in successive sections of length, alternating between a left hand or S twist and a right hand or Z twist. Stranding operations of this type, referred to as pendulum stranding or SZ stranding, have the advantage of permitting the elements to be twisted to be run off or removed from stationary take up stands. Furthermore, further processing of a twisted unit produced by SZ twisting of the cable elements may be squarely effected during the same operation.

The devices previously utilized for SZ stranding generally utilize longitudinal storers or intermediate storers which provide a double function. The intermediate storers simultaneously function as take up devices for the supplied incoming length section of the twisted unit and as pay out devices for the removal of the outgoing length section. The direction of twisting is thereby alternated at intervals depending upon the length content of the intermediate storer. An intermediate storer is described, for example, in U.S. Pat. No. 3,169,360. The intermediate storer described in the aforementioned patent comprises a disc having a groove for guiding the twisted unit.

The principal object of the present invention is to provide new and improved apparatus for stranding a twisted unit of a cable.

More particularly, an object of the present invention is to provide apparatus for stranding a twisted unit of a cable in different directions of stranding.

An object of the present invention is to provide a new and improved intermediate storer for apparatus for stranding a twisted unit of a cable.

An object of the present invention is to provide an intermediate storer for apparatus for stranding a twisted unit of a cable, which intermediate storer functions with efficiency, effectiveness and reliability.

An object of the present invention is to provide an intermediate storer for apparatus for stranding a twisted unit of a cable, which intermediate storer is economical in production and operation.

An object of the present invention is to provide an intermediate storer for apparatus for stranding a twisted unit of a cable, which intermediate storer insures a reliable supply to and removal from the intermediate storer of the twisted unit.

The present invention is based upon our recognition that in an intermediate storer, which stores a twisted unit comprising a plurality of adjacent turns, the take up turn of the twisted unit is displaced a specific interval relative to the pay out turn of said twisted unit. During the rotation of the intermediate storer about its axis of rotation, which extends in the direction of the twisted unit supplied to the intermediate storer, or parallel to the twisted unit at a specific distance from said intermediate storer, the take up portion of the cable elements and/or the pay out portion of the twisted unit would undertake a rotary motion about the axis of rotation. This would result in particular difficulties during the supply of the cable elements or the take up of the twisted unit to the intermediate storer, or during the removal of the twisted unit from the intermediate storer.

The foregoing difficulties may be overcome, for example, by guiding the cable elements or the twisted unit through a plurality of deflection rollers in a manner whereby they may be supplied to the intermediate storer in the axis of rotation and may be removed from the intermediate storer in the axis of rotation. In accordance with the present invention, however, the intermediate storer is of considerably more simple construction and structure and imposes considerably less stress or strain upon the cable elements. The intermediate storer of the present invention insures a reliable supply to and removal from the intermediate storer of the twisted unit.

In accordance with the present invention, apparatus for stranding a twisted unit of a cable in different directions of stranding comprises a plurality of cable elements. A take up point forms a twisted unit from the cable elements. An intermediate storer arrangement is positioned between the take up point and a pay out point and engages the twisted unit. The intermediate storer arrangement rotates the twisted unit about an axis of rotation a number of twists between the take up point and the pay out point and provides a different direction of stranding of twisted unit for individual section lengths. The intermediate storer arrangement comprises an intermediate storer. A take up reel at the take up point supplies the twisted unit to the intermediate storer in the direction of the axis of rotation of the intermediate storer. A pay out reel at the pay out point and on the axis of rotation of the intermediate storer removes the twisted unit from the intermediate storer in the direction of the axis of rotation.

The intermediate storer comprises a disc. It is particularly expedient to provide the axis of rotation of the intermediate storer through the center of gravity thereof, since this provides the smoothest possible run for the rotating intermediate storer.

The intermediate storer comprises a disc having a storage surface for the twisted unit. Grooves are formed in the storage surface of the disc and extend in the direction of the axis of revolution for at least part of the altitude of the storage surface. A tumbling deflector ring has teeth extending therefrom and engaged in the grooves of the storage surface. The tumbling deflector ring displaces the section of the twisted unit stored on the storage surface. The deflector ring continually displaces the turns of the twisted units stored on the storage surface of the intermediate storer, so that subsequent turns may be taken up by said intermediate storer without superposition on the turns already stored.

The engagement of the deflector ring with the grooves in the storage surface of the disc prevents the clamping of the twisted unit between said deflector ring and said storage surface. This is due to the fact that the twisted unit, stored on the storage surface of the disc and displaced by the deflector ring, may comprise, for example, a spiral quad stranded from very thin wires. Since there must be a short distance between the deflector ring and the storage surface of the disc in order to enable the deflector ring to tumble on said disc, there is a possibility that during the displacement of the twisted unit by the deflector ring, a stranded element such as, for example, a wire from the spiral quad, may become clamped between said deflector ring and said storage surface. This may result in damage to the insulation of the wire. This type of damage cannot occur in the intermediate storer of the present invention.

A section of the twisted unit in which the cable elements are twisted in the same direction is stored on the intermediate storer, which is utilized for SZ twisting, and is subsequently removed from said intermediate storer in a different twisting direction. Since the reversal of the direction of rotation of the intermediate storer is not sudden, but occurs within a specific period of time, the number of twisting strokes produced per unit length of the twisted unit is decreased to zero and is subsequently increased to the predetermined number of revolutions for the specific direction of rotation. This results in sections of the twisted unit which are not sufficiently stranded

and which may be readily twisted under the force exerted upon the cable elements.

In accordance with the present invention, in order to eliminate the foregoing difficulties involving undesirable twisting, the intermediate storer arrangement includes a drive unit coupled to the intermediate storer for rotating the intermediate storer about its axis of rotation in periodically different directions and coupled to each of the take up reel and the pay out reel for rotating each of the reels at a speed proportional to the speed of rotation of the intermediate storer. The speed of supply and the speed of removal of the twisted unit to and from the intermediate storer is thus proportional to the rotary speed of said intermediate storer. The speed of supply and removal of the twisted unit thus varies in proportion to the speed of rotation of the intermediate storer. This insures that the twisting of a section of length of the twisted unit, having the same twisting direction, is constant along the entire section. The twisted unit is thus sufficiently stranded relative to the reverse direction of twisting, so that there is no need to provide additional devices for preventing undesirable twisting of the twisted unit.

The variation in the direction of rotation of the intermediate storer must occur at the exact instant at which a new section of length of the twisted unit starts to pay out from said intermediate storer. If there is a difference between these two instants of time, the section of the twisted unit removed from the intermediate storer during the difference period of time will be stressed with a twist in an undesired direction, superimposed upon the existing twist. This may produce sections of the twisted unit having a very weak twist or no twist at all. Prior to the present invention, the precise coincidence of both instants of time created problems because the intermediate storer had to be decreased in speed to zero, from a relatively high speed of rotation, at an exact instant determined by the length of a section of the twisted unit having the same direction of twisting.

In accordance with the present invention, the foregoing difficulties are overcome by rotating the intermediate storer at a substantially constant speed, then decreasing the speed uniformly when the time for changing the direction of rotation approaches. The intermediate storer is then rotated at a substantially constant low speed for a short period of time and its speed is then decreased uniformly to zero. The drive unit then maintains the intermediate storer at zero speed of rotation for a short period of time. This insures precise coincidence of the aforedescribed two instants of time. A particular advantage of maintaining the intermediate storer at zero speed of rotation for a short period of time is that such operation results in a very smooth reversal of the direction of rotation. This, in turn, results in very little stress on the elements of the twisted unit and therefore enhances the operation of the apparatus of the present invention.

In accordance with the present invention, apparatus for stranding a twisted unit of a cable in different directions of stranding comprises a plurality of groups of cable elements. Each of a plurality of take up points forms a twisted unit from the cable elements of a corresponding one of the groups of cable elements. Each of a plurality of pay out points cooperates with a corresponding one of the take up points. Each of a plurality of **106** out parallel-operating intermediate storer arrangements is positioned between a corresponding cooperating take up point and pay out point and engages a corresponding twisted unit. Each of the intermediate storer arrangements rotates the corresponding twisted unit about an axis of rotation a number of twists between the corresponding take up point and the corresponding pay out point and provides a different direction of stranding of the corresponding twisted unit for individual section lengths. Each of the intermediate storer arrangements comprises an intermediate storer. A take up reel at the corresponding take up point supplies the corresponding twisted unit to the intermediate storer in the direction of the axis of rotation of the intermediate storer. A pay out reel is provided at the corresponding pay out point and on the axis of rotation of the intermediate storer for removing the corresponding twisted unit from the intermediate storer in the direction of the axis of rotation. An additional take up point forms a resultant twisted unit from the twisted units of a plurality of intermediate storer arrangements. An additional intermediate storer arrangement operating in series with the plurality of intermediate storer arrangements is positioned between the additional take up point and an additional pay out point and engages the resultant twisted unit.

The additional intermediate storer arrangement comprises an additional intermediate storer. An additional take up reel at the additional take up point supplies the resultant twisted unit to the additional intermediate storer in the direction of the axis of rotation of the additional intermediate storer. An additional pay out reel at the additional pay out point and on the axis of rotation of the additional intermediate storer removes the resultant twisted unit from the additional intermediate storer in the direction of the axis of rotation.

The intermediate storer arrangements and the additional intermediate storer arrangement include a driving unit coupled to each of the intermediate storers and to the additional intermediate storer for rotating the intermediate storers and the additional intermediate storer about their axes of rotation in periodically different directions. The drive unit is coupled to each of the take up reels and the additional takeup reel and to each of the pay out reels and the additional pay out reel for rotating each of the reels at a speed proportional to the speed of rotation of the intermediate storers and the additional intermediate storer.

In accordance with the present invention, a method of stranding a twisted unit of a cable in different directions of stranding comprises forming a twisted unit from the cable elements at a take up point. The twisted unit is engaged between the take up point and a pay out point. The twisted unit is rotated about an axis of rotation a number of twists between the take up point and the pay out point and a different direction of stranding of the twisted unit is provided for individual section lengths. The twisted unit is supplied for engagement and rotation in the direction of the axis of rotation. The twisted unit is removed in the direction of the axis of rotation after rotation.

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;

FIG. **2** is a top view of an embodiment of the intermediate storer arrangement of the present invention;

FIG. **3** is a radial sectional view of part of an embodiment of the intermediate storer of the present invention;

FIG. **4** is a graphical presentation of the speed of rotation of the intermediate storer of the present invention;

FIG. **5** is a graphical presentation of the speed of supply to and removal from the intermediate storer of the twisted cable;

FIG. **6** is a schematic diagram of a modification of the apparatus of FIG. **1** of the present invention;

FIG. **7** is a diametrical sectional view of the intermediate storer of FIG. **3**; and

FIG. **8** is a schematic diagram of an embodiment of the drive unit **30'** of the apparatus of FIG. **6**.

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

The apparatus of FIG. **1** twists a plurality of stranding or cable elements into a twisted unit, the twisting direction of which changes for each section of length. Thus, for example, in FIG. **1** four cable elements or wires are twisted into a spiral quad. In FIG. **1**, the cable elements **1** are supplied from storage drums **2** to a nipple **3**. The nipple **3** combines the cable elements **1** and supplies them to an intermediate storer arrangement **4**. The twisted unit removed from the intermediate storer arrangement **4** is then wound on the drum **5**.

The cable elements from the nipple 3 are supplied to a take up reel 6 of the intermediate storer arrangement 4. The take up reel 6 supplies the twisted unit formed by the take up reel 6 to the intermediate storer 8 of the intermediate storer arrangement 4. The intermediate storer 8 has a tumbling deflector ring 7 mounted thereon. The twisted unit is removed from the intermediate storer 8 to a pay out reel 9. The intermediate storer 8 may be rotated in a counter-clockwise direction, as indicated by the single arrow, about an axis C–D, passing through the center M of the intermediate storer 8. The intermediate storer 8 is driven about the axis C–D by the twisted unit wound on its storage surface (FIG. 3).

The intermediate storer arrangement 4, which comprises the take up reel 6, the intermediate storer 8 and the pay out reel 9, is rotatable about an axis of rotation A–B, in both clockwise and counter-clockwise directions, as indicated by the pair of arrows in FIG. 1. During the stranding of the cable elements 1 to form the twisted unit 10, said elements are twisted in a specific direction while they are being taken up by the take up reel 6 at a point *a*. The intermediate storer arrangement 4 rotates about its axis of rotation A–B and periodically changes its direction of rotation. The twisted unit is then supplied by the take up reel 6 to the intermediate storer 8 and is wound a plurality of times on said intermediate storer in accordance with the desired position of a section of length of said twisted unit. Each section of length of the twisted unit has the same direction of twist or twist direction.

The number of windings of the twisted unit on the intermediate storer 8 varies in accordance with the capacity of the intermediate storer arrangement 4, which depends upon the length of a section of said twisted unit, twisted in the same direction. When the full capacity of the intermediate storer arrangement 4 is utilized by a length section of the twisted unit, twisted in the same direction, the direction of rotation of said intermediate storer arrangement is reversed. As a result of the reversal of the direction of rotation, the twisted unit is removed to a point *b*, where the pay out reel 9 is positioned, with an additional twist in the same direction, during the run off of said twisted unit from the intermediate storer 8. The pay out reel 9 superimposes the additional twist on the initial twist.

Simultaneously with the removal of the twisted unit to the pay out reel 9, a new length section of twisted unit is supplied to the intermediate storer arrangement 4 and is stranded with a twist in the opposite direction. When the full capacity of the intermediate storer arrangement 4 is utilized by the new length section, the direction of rotation of said intermediate storer arrangement is again reversed, so that said new length section is also provided with an additional twist in the same direction, during its removal from the intermediate storer 8. The additional twist is superimposed upon the next-preceding twist. In this manner, the twisted or cable elements 1 are alternately provided in sections of length with two opposite twists of equal magnitude.

In order to prevent the necessity for reversing the direction of rotation of the intermediate storer arrangement 4, said intermediate storer arrangement must have a maximum storage capacity. The maximum storage capacity is provided in the apparatus of the present invention by winding the twisted unit on the storage surface of the intermediate storer disc 8 in a plurality of adjacent turns (FIGS. 2 and 3). The intermediate storer 8 is in the configuration of a disc of, for example, I cross sectional configuration (FIG. 3). The storage surface of the disc is the cylindrical peripheral outer surface.

The turn of the twisted unit supplied to the intermediate storer 8 and the turn of said twisted unit removed from said intermediate storer are mutually displaced relative to a plane perpendicular to the axis C–D (FIG. 2). Thus, rotation of the intermediate storer 8 about the axis of rotation A–B perpendicular to the axis C–D would produce a rotary movement of the supplied portion of the twisted unit, including the take up reel 6, and the removed portion of said twisted unit, including the pay out reel 9, about said axis of rotation. This would result in supplying the twisted elements or cable elements and in taking up or supplying and removing or running off the twisted unit to or from the intermediate storer 8.

As shown in FIG. 2, the axis of rotation A–B of the intermediate storer arrangement 4 is so selected that the take up reel 6 is positioned at the take up point *a* and the pay out reel 9 is positioned at the pay out point *b* on said axis of rotation. The twisted unit is supplied by the take up reel 6 to the intermediate storer 8 in the direction of the axis of rotation A–B and said twisted unit is removed from said intermediate storer to the pay out reel 9 in said direction. This results in a satisfactory and protected supply system for the cable elements 1 to the intermediate storer arrangement 4. The dimensions of the intermediate storer 8 are such that its axis C–D and its axis of rotation A–B are at an angle of less than 90° with each other (FIG. 2).

The section of the twisted or stranded unit taken up by the intermediate storer or storage disc 8, must be constantly shifted on the storage surface 11 of said intermediate storer, which surface serves as a storage area, in order to make room for the new sections of the twisted unit which are being taken up. To accomplish this, the intermediate storer or storage disc 8 is provided with the deflection ring 7, which, as shown in FIGS. 3 and 7, is so positioned that is effects a tumbling movement, relative to the storage disc. The tumbling movement is produced through several sliding blocks 26, as shown in FIG. 7, equiangularly distributed along the periphery, which are firmly affixed to a stationary star-shaped carrier disc 25 and which engage the U-shaped deflection ring 7 in the manner described in our copending patent application Ser. No. F–4167. The parts of the sliding blocks which engage the U-shaped deflection ring 7 are mutually displaced in axial direction of the intermediate storer 8, so that when said intermediate storer rotates, the deflection ring 7, taken along by said intermediate storer, carries out a back and forth movement, on the storage surface of said intermediate storer.

In order to prevent the twisted elements or cable elements 1 of the twisted unit 10 such as, for example, the wires of a spiral quad, from becoming clamped in the space between the deflector ring 7 and the storage surface 11 of the intermediate storer 8, which clamping could damage the insulation of said wires, said storage surface 11 has a plurality of grooves 12 formed therein. The grooves 12 extend in directions parallel to the axis C–D of the intermediate storer 8 and are equidistantly spaced around the storage surface 11. Each of the grooves 12 extends for at least part of the altitude of the storage surface 11. The deflector ring 7 has a plurality of teeth 13 extending therefrom. The teeth 13 of the deflector ring 7 are engaged in the grooves 12, which grip said teeth.

The deflector ring 7 is thus affixed to the storage surface 11 of the intermediate storage 8 in the manner of a comb, in the area wherein the twisted unit is displaced or shifted by said deflector ring. The stranded or cable elements of the twisted unit 10 are thus prevented from being clamped between the deflector ring 7 and the storage surface 11. The distance between next-adjacent grooves 12 is preferably equal to the width of a groove. This provides a good bearing for the twisted unit on the storage surface 11 and a good bearing of said twisted unit against the deflector ring.

A stage, step or inclination 14 is provided in the storage surface 11 of the intermediate storer 8, as shown in FIG. 3. The turns of the twisted unit, taken up by the intermediate storer 8, are displaced or shifted by the deflector ring 7 across the inclination 14. As a result, the force with which the twisted unit is first wound upon the storage surface 11 is decreased during the displacement of the respective turn of the twisted unit across the inclination 14, until said twisted unit only bears loosely on the intermediate storer 8. This considerably decreases the forces required for displacing or shifting the twisted unit. This is particularly important for a gentle handling or treatment of the twisted elements during the movement of the intermediate storer arrangement, since the rotation of the intermediate storer 8, and thus also the displacement of the twisted unit, is effected by forces exerted upon the

twisted elements or cable elements by a removable device, not shown in the figures.

The storage surface **11** of the intermediate storer **8** may be of conical configuration, rather than having the inclination **14** formed therein. A conical storage surface enables a gradual decrease of the pulling force in the twisted elements when the twisted unit is displaced on said storage surface.

FIG. **4** illustrates the rotary speed, in revolutions per minute, of the intermediate storer arrangement **4**. In FIG. **4**, the abscissa represents time and the ordinate represents the speed n of the intermediate storer arrangement **4**. In accordance with the present invention, the speed n of the intermediate storer arrangement is always proportional to the supply and removal or take off speed v of the twisted or cable elements **1**, even when such speed is varied.

As shown in FIG. **4**, the speed n fluctuates, within a period L, between two magnitudes $+n_1$ and $-n_1$. The transition from one direction of rotation (+ to − or − to +) to the other occurs as follows. A drive unit **30**, as shown in FIG. **1**, may comprise any suitable driving arrangement for producing the desired driving operation. The drive unit **30** is coupled to each of the take up reel **6**, the intermediate storer **8** and the pay out reel **9**.

The drive of the intermediate storer arrangement **4**, including the take up reel **6**, the intermediate storer **8** and the pay out reel **9**, is discontinued at the instant t_1 provided by a counter device which registers the number of rotations of said intermediate storer arrangement. The speed n is first uniformly decreased due to friction forces, until the instant t_2. At the instant t_2, the speed n has a small magnitude n_2, controlled by a speedometer or speed indicator. The drive is subsequently reinstituted for a brief period of time, at, for example, a decreased torque. The intermediate storer **8** is permitted to rotate for a short period of time at a speed having a magnitude n_2, as shown in FIG. **4**. The drive provided by the drive unit **30** is then discontinued at the instant t_3, which is determined by a counter device, and the intermediate storer arrangement **4** decreases uniformly in speed to zero. The speed of the intermediate storer arrangement is zero at the instant T_1.

After a brief period of standstill, at zero speed, the intermediate storer arrangement **4** begins to rotate in the opposite or reverse direction. The speed n is uniformly accelerated until it reaches its magnitude $-n_1$. During the continuation of the operation, the variation in the direction of rotation occurs at the commencement of each new period L, at the time instants T_2, T_3, and so on. The period L thereby corresponds to the period in which a length of the twisted elements or a twisted unit corresponding to the storage capacity of the intermediate storer arrangement **4** is supplied to said intermediate storer arrangement. Since the supply and removal speed v of the twisted elements is proportional to the speed n of the intermediate storer arrangement **4**, the period L corresponds in the same manner to the period during which said intermediate storer provides a constant number of rotations for a length section having the same direction of twisting or stranding.

The graphical indication or curve of the speed of rotation of the intermediate storer arrangement **4** initially decreases uniformly in magnitude, is then constant for a brief period, then decreases uniformly again in magnitude for a very brief period, and is then at zero for a very brief period, as hereinbefore described, and permits very exact adherence to the twisting period L. This is necessary to enable the variation in the direction of rotation of the intermediate storer to occur at the exact instant at which a new section of length of the twisted unit commences to run off from said intermediate storer. If there is a difference between these two instants, the section of twisted unit which is run off from the intermediate storer **8** during this period is stressed with a twist in an undesired direction. The undesired twist is superimposed upon the twist in the twisted unit. This produces a section of length of twisted unit in which the twist is very weak or there is no twist at all.

FIG. **5** illustrates the speed v at which the twisted unit is supplied to and removed from the intermediate storer arrangement **4**. In FIG. **5**, the abscissa represents the time t and the ordinate represents the speed v. In accordance with the present invention, the speed v of the supply to and the removal from the intermediate storer arrangement of the twisted unit or twisted elements is always proportional to the speed of rotation n of said intermediate storer arrangement. This is also true when the speed of rotation of the intermediate storer arrangement varies. This relation between the speed v and the speed n is apparent from a comparison of FIGS. **4** and **5**. The proportionality of both magnitudes of speed v and n results in the provision of the twisting of a length section of the twisted unit having the same direction over the entire length section. The twisted unit is thus sufficiently stranded relative to the twisting direction and the reverse twisting direction, so that there is no need for additional devices for preventing twisting in an undesired direction.

In a modification of the embodiment of FIG. **1** of the present invention, apparatus for stranding cable elements, particularly communication cables, comprises a plurality of systems of the type shown in FIG. **1**. The systems operate in parallel with each other and each corresponds to the embodiment of FIG. **1**. An additional intermediate storer arrangement operates in series with the plurality of intermediate storer arrangements to twist the resultant twisted unit supplied by said plurality of intermediate storer arrangements. It is thus possible to combine two stranding or twisting processes in the same working operation. The stranding or twisting apparatus which is connected in series with the plurality of intermediate storer arrangements, may, in accordance with the present invention comprise a rotating additional take up reel for stranding the resultant twisted unit from said intermediate storer arrangements in a stranding nipple. An additional intermediate storer and an additional pay out reel are also provided and function together with the additional take up reel as the additional intermediate storer.

It is especially preferable that the supply to and removal from the additional intermediate storer arrangement of the resultant twisted unit have the same speed relation to the speed of rotation of the intermediate storer arrangements as in the embodiment of FIG. **1**.

FIG. **6** illustrates the modification of the embodiment of FIG. **1**, wherein a plurality of intermediate storer arrangements **4** are provided in a manner whereby they operate in parallel. An additional intermediate storer arrangement **22** is provided in a manner whereby it operates in series with the parallel-connected intermediate storer arrangements **4** to strand or twist the resultant twisted unit provided by said parallel-connected intermediate storer arrangements.

In FIG. **6**, five intermediate storer arrangements **4** are illustrated. In each of the apparatus for the intermediate storer arrangements **4**, communication cable elements or wires **1** are supplied by a storage drum **2** to the corresponding immediate storer arrangement. Each of the intermediate storer arrangements **4** produces a spiral quad **10** simultaneously with the others. The twisted units or spiral quads **10** are combined to a resultant twisted unit by the additional take up reel **31**. The resultant twisted unit is then twisted into modular bunches or units **23** by the additional intermediate storer arrangement **22**. The speed of removal of the twisted, twisted unit **23** from the additional intermediate storer arrangement **22** is determined by the speed of rotation of a take off disc **15**.

Each of the intermediate storer arrangements **4** periodically alternates its direction of rotation and therefore its direction of twisting. When they are combined to form the resultant twisted unit, the individual twisted units **10** are stranded together in a specific direction. Preferably, the speed of rotation and, if necessary, the direction of rotation, of the intermediate storer arrangements **4** are made to vary. This provides electrical decoupling of the twisted unit or spiral quad **10** which is a component of the twisted, twisted unit or modular bunch **23**. When an intermediate storer arrangement **4** is filled to capacity with a section of length of twisted unit having the same direction of twisting, the direction of rotation of such in-

termediate storer arrangement is reversed. The intermediate storer arrangements 4 rotate in the same direction, so that they are reversed in direction at the same time.

As a result of the change in direction of the rotation of the intermediate storer arrangements 4, the twisted units **10** are provided with an additional twist, in the same direction, which is superimposed upon the initial twist provided prior thereto during the supply of the twisted unit to the intermediate storer arrangement. Simultaneously, new sections of twisted units are supplied to the intermediate storer arrangements 4 and are twisted in the opposite direction. When the intermediate storer arrangements 4 are filled to capacity with the new sections of length of twisted units, the direction of rotation of said intermediate storer arrangements is again reversed, so that such new sections are also provided, during their run off from the intermediate storer arrangements, with an additional twist, in the same direction, which is superimposed upon the preceding twist. In this manner the twisted units or spiral quads are alternately provided, in length sections, with two opposite twists of equal magnitude.

After the twisted unit **10** is provided by an intermediate storer arrangement 4, said twisted unit is supplied to a corresponding longitudinal or length storer **16**. Each length storer **16** comprises two deflection rollers **17** and **18** positioned in sequence. The individual twisted units are wound on the deflection rollers **17** and **18** at different rates. Therefore, each of the twisted units **10** has a different path length in its extension from the corresponding intermediate storer arrangement 4 to a guide nipple **19**. This results in the points of the individual twisted unit at which the direction of twist alternates, being non-adjacent following the twisting of the resultant twisted unit into the twisted, twisted unit **23**. These points are mutually displaced.

After the five twisted units **10** are provided by the corresponding length storers **16**, they are supplied, via the guide nipple **19** which combines them into the resultant twisted unit, to the additional intermediate storer arrangement **22**. The additional intermediate storer arrangement **22** is the same as each of the intermediate storer arrangements 4 and comprises the additional take up reel **31**, an additional intermediate storer **32** and the additional pay out reel **33**. The additional intermediate storer arrangement rotates at a speed in accordance with the twisting which is customary in producing stranding or twisted, twisted units or modular bunches. The additional intermediate storer arrangement **22** operates in the same manner as each of the intermediate storer arrangements 4. The twisted, twisted unit **23** is thus alternatively provided in sections of length with twists of the same magnitude in opposite directions.

The twisted, twisted unit **23** is supplied to a central spinner **20** which functions to provide the SZ twisted, twisted unit with the helical marker. The twisted, twisted unit **23** is then wound on a take off disc **15** and a drum **21**. The take off disc **15** rotates in clockwise direction, as indicated by the arrow.

The speed of rotation of the take off disc **15** determines an equally high supply and removal speed for the twisted units relative to the intermediate storer arrangements 4. The supply and removal speeds are determined in a manner whereby they are proportional to the speed of rotation of the intermediate storer arrangements 4. Thus, every variation in the speed of rotation of the intermediate storer arrangements 4 and the additional storer arrangement **22** occurs at the same instant. Furthermore, the speed of rotation of each intermediate storer arrangement 4 and the additional intermediate storer arrangement **22** has a constant relationship to the speed of rotation of every other intermediate storer arrangement at any instant. This enables each of the intermediate storer arrangements 4, the additional intermediate storer arrangement **22** and the take off disc **15** to be driven by a drive unit **30'**, essentially similar to the drive unit **30** of FIG. **1**. The drive unit **30'** may comprise any suitable driving arrangement, which may operate from a single drive source, for driving the take up reels, pay out reels and intermediate storers of the intermediate storer arrangements at the desired speeds and for rotating the take off disc **15** at the desired speed.

In actual operation of the apparatus of FIG. **6**, we found it expedient to select the length of a section of the twisted unit, having the same direction of twist, as 20 meters. Each of the intermediate storer arrangements 4 was rotated at an average speed of 500 rpm. The additional intermediate storer arrangement **22** was rotated at approximately 170 rpm. The twisted, twisted unit was produced at the rate of approximately 50 meters per minute.

FIG. **8** is a drive unit which may be utilized as the drive unit **30'** of FIG. **6** and which may serve as the drive unit **30** of FIG. **1**. With the exception of the rotation of the take-up drum **21**, all rotational movements of the SZ twisting device, shown in FIG. **6**, are controlled by a motor **35**. The motor **35** of FIG. **8** controls the rotational movements of the intermediate storers 4, the additional intermediate storer arrangement **22**, the central spinner **20** and the take off disc **15**.

As shown in FIG. **8**, the motor **35** drives the shaft **39**, via a gear comprising toothed wheels **36**, **37** and **38**. A belt pulley **40** is affixed to the right end of the shaft **39**. The belt pulley **40** drives a belt pulley **42**, via a belt **41**. The belt pulley **42** is mechanically coupled to the shaft of the take off disc **15** (FIG. **6**).

A belt pulley **43** is also affixed to the shaft **39** and drives a belt pulley **45** via a belt **44**. The belt pulley **45** is mechanically coupled to and drives or rotates the central spinner **20** (FIG. **6**).

Switchover apparatus **46** is mounted on the left side of the shaft **39**. The switchover apparatus **46** which alternately changes the direction of rotation, by sections, of a belt pulley **47** affixed to the shaft **39** at its left end, the belt pulley **47** drives a belt pulley **49** via a belt **48**. The belt pulley **49** is affixed to, and drives, a shaft **50**. Two belt pulleys **51** and **53** are affixed to the shaft **50** and are therefore driven by the belt pulley **49**. The intermediate storers 4 (FIG. **6**) are driven by the belt pulley **51** via a belt **52**. The additional intermediate storer arrangement **22** (FIG. **6**) is driven by the belt pulley **53** via a belt **54**.

The switchover apparatus **46** comprises a pair of couplings **55** and **56**, of which one is engaged at any time. When the coupling **55** is engaged, the belt pulley **47** is rotated in the direction in which the shaft **39** is driven by the motor **35**. When the coupling **56** is engaged, the direction of rotation of the belt pulley **47** is reversed, via a gear wheel **57**. The switchover or reversal of the couplings **55** and **56** is effected at times T_1, T_2, T_3, indicated in FIG. **4**.

The speed n_2 of the motor **35**, indicated in FIG. **4**, is controlled by a control circuit comprising a speed controller **58**, a relay switch **59** and a variable resistor **60**. When the speed of the intermediate storer 4, or the additional intermediate storer arrangement **22**, is decreased, in accordance with FIG. **4**, from $+n_1$ or from $-n_1$, the speed of the motor **35** is supervised by the speed controller **58**. When the speed $+n_2$ or $-n_2$ is reached the speed controller **58** responds and connects the variable resistor **60** into the current circuit of the motor **35**, via the relay switch **59**. The motor **35** then rotates at the speed determined by the variable resistor **60**, until it is switched off by counting apparatus not shown which counts the number of revolutions of the intermediate storers 4, or the additional intermediate storer arrangement **22**. The switch-off occurs at t_3 and the motor **35** comes to a standstill at T_1.

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. An intermediate storer arrangement having an axis of rotation and being rotatably mounted for rotation about the axis of rotation for stranding stranded cable elements of a cable into a twisted unit having alternating stranding directions in successive sections of length, said intermediate

storer arrangement comprising an intermediate storer having an axis transverse to the axis of rotation of the intermediate storer arrangement, a single take up reel having a roller surface tangential to the axis of rotation of the intermediate storer arrangement for supplying the twisted unit to the intermediate storer in a direction of the axis of rotation of the intermediate storer arrangement in a plurality of windings substantially parallel to a plane including the axis of rotation of the intermediate storer arrangement, and a single pay out reel having a roller surface tangential to the axis of rotation of the intermediate storer arrangement for removing the twisted unit from the intermediate storer, said intermediate storer comprising a disc having a storage surface for said twisted unit, an axis of rotation transverse to the axis of rotation of the intermediate storer arrangement, grooves formed in the storage surface of said disc and extending in the direction of said axis of rotation for at least part of the altitude of said storage surface, and a tumbling deflector ring having teeth extending therefrom and engaged in the grooves of said storage surface for displacing the section of said twisted unit stored on said storage surface.

2. Apparatus as claimed in claim 1, wherein said intermediate storer means includes driving means coupled to said intermediate storer for rotating said intermediate storer about its axis of rotation in periodically different directions and coupled to each of said take up reel and said pay out reel for rotating each of said reels at a speed proportional to the speed of rotation of said intermediate storer.

3. Apparatus as claimed in claim 2, wherein said driving means rotates said intermediate storer at a substantially constant speed, then decreases said speed uniformly when the time for changing the direction of rotation approaches, then rotates said intermediate storer at a substantially constant low speed for a short period of time, and then decreases said speed uniformly to zero.

4. Apparatus as claimed in claim 3, wherein said driving means maintains said intermediate storer at zero speed of rotation for a short period of time.

* * * * *