United States Patent

Gilmore

[15] **3,672,142**

[45] **June 27, 1972**

[54] **WINDING APPARATUS AND METHOD**

[72] Inventor: **William J. Gilmore,** Manitou Beach, Mich.

[73] Assignee: **American Chain & Cable Company, Inc.,** New York, N.Y.

[22] Filed: **March 27, 1970**

[21] Appl. No.: **23,432**

[52] **U.S. Cl.** **57/17, 57/19, 57/166**

[51] **Int. Cl.** **D07b 3/04**

[58] **Field of Search** 57/17, 19, 3, 6, 9, 13, 15, 57/139, 144, 145, 156, 160, 161, 166, 137, 138, 18, 59

[56] **References Cited**

UNITED STATES PATENTS

2,036,393	4/1936	Briggs	57/9
1,972,290	9/1934	Conner	57/9
2,292,971	8/1942	Rairden	57/161 X
1,906,543	5/1933	Conner	57/9
3,142,145	7/1964	Blanchard	57/9
1,843,075	1/1932	Angell	57/17
2,416,076	2/1947	Uhler	57/17
2,805,539	9/1957	Burr	57/18
2,920,437	1/1960	Stark	57/17

Primary Examiner—Donald E. Watkins
Attorney—Pennie, Edmonds, Morton, Taylor and Adams

[57] **ABSTRACT**

Method and apparatus are disclosed for producing a composite multiwire structure by helically wrapping at least one wire structure about a core element and, prior thereto, imparting undulating longitudinal movement to the wire structure at a point located closely to the point of wrapping to effectively control torsion naturally induced in the wire structure during the wrapping operation.

11 Claims, 3 Drawing Figures

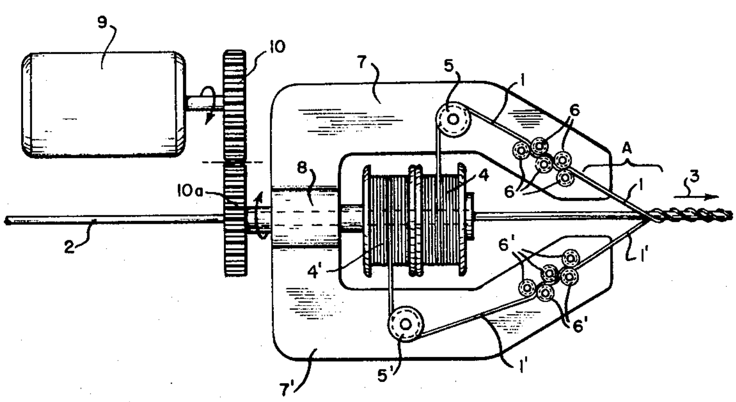


FIG. 1

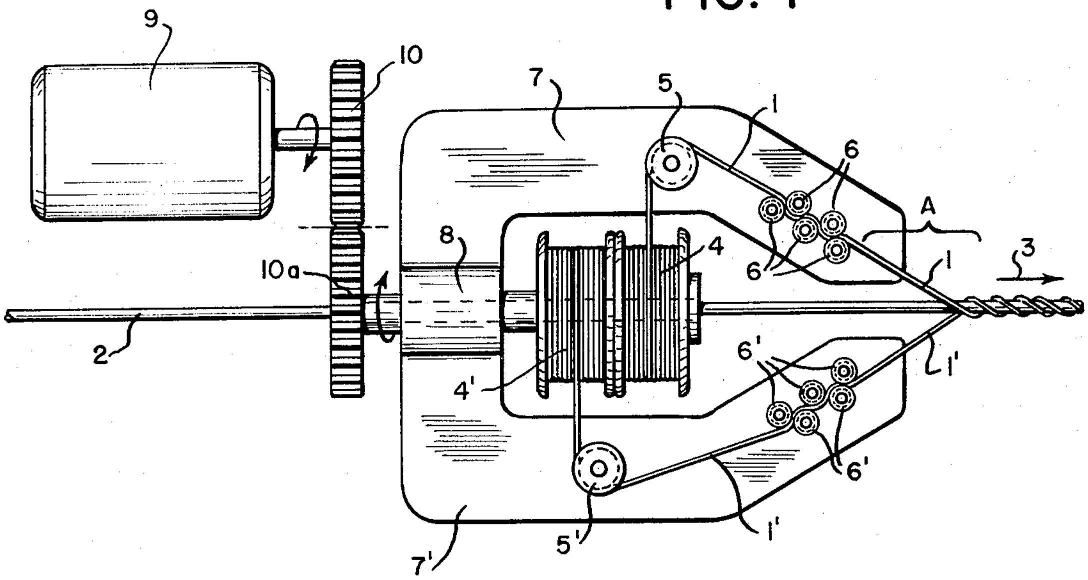


FIG. 2

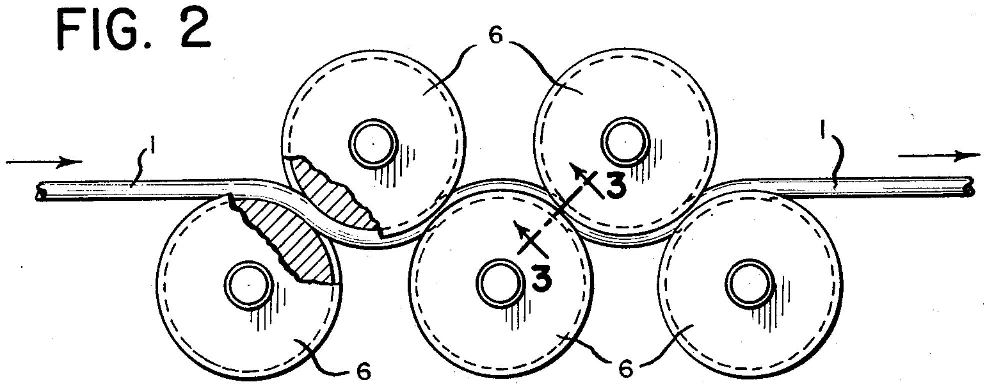
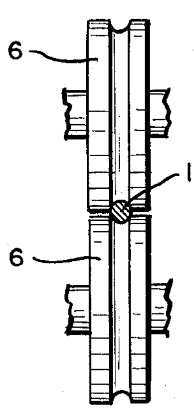


FIG. 3



INVENTOR
William J. Gilmore
BY
Pennie, Edmonds, Morton, Taylor, Adams
ATTORNEYS

WINDING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

Multiwire strands generally include an inner load bearing core element and a plurality of round wires wrapped helically in one or more layers about the core element. For mechanical application, the round wires are usually made of high yield strength material. Typically, a plurality of these strands are themselves wrapped helically about a suitable core element which may itself be a multiwire strand to produce a wire rope or cable structure.

In the fabrication of multiwire strands or multistrand ropes of the type described, a twisting action is imparted to the individual wire or strand between the point of closing and the supply spool as it is being wrapped about the core element. This twisting action results in the build-up of induced torsional stress in the wire or strand; and this stress becomes additive creating the danger of eventual breakage, snarling or other malfunction of the wire or strand during the stranding operation. To overcome this problem stranding equipment normally associated with the wire rope industry presently utilize what is commonly referred to as "planetary action" to accomplish basic stranding and closing of wire and strand elements about a core element. With planetary action, a line drawn radially outward from the center axis of the wire or strand to intersect a given point on the circumference of the wire or strand would always extend in the same direction as the wire or strand is being wound about the core element. In other words, if a line were scribed on the top of the wire or strand as it was being payed out from the supply spool, that line would contact the surface of the core element (at its lowest point) only once in every lay length and would be spaced farthest i.e. at a distance equal to the diameter of the wire or strand) from the surface of the core element at 180° of wrap or one half the lay length as measured from the point at which the scribed line contacts the core element.

Costly and complex cradles and planetary devices used in planetary winding machines restrict their usefulness from the standpoint of general application and render the use of such machines economically feasible only for large production runs and large manufacturing concerns. In addition, because conventional planetary winders of the type described are quite large in size and mass the speeds at which they can be operated is likewise restricted thus making their general use and installation even more economically unattractive.

SUMMARY OF THE INVENTION

In accordance with the teachings of the present invention, method and apparatus are provided for making a composite multiwire structure by continuously wrapping one or more wire structures helically about a longitudinal axis in a simple, efficient, and economical manner. The wrapping of each wire structure is effected in a non-planetary fashion and in such a way that the build-up of induced torsion in the wire structure is effectively controlled. Each wire structure of the composite multiwire structure which is wrapped in this manner may be a single wire or, in certain cases, a multiwire structure.

In the presently preferred embodiment of this invention the composite multiwire structure is formed by helically wrapping at least one wire structure about a longitudinal axis defined by a longitudinally moving core element as the wire structure is advanced along a predetermined path converging with the path of movement of the core element. Advantageously, a plurality of single element wire structures are helically wrapped in side-by-side relationship about the core element to form a single layer of a composite strand structure. The actual wrapping is accomplished by simultaneously moving the core element in a longitudinal direction and rotating each wire structure in a non-planetary fashion about the moving core element to effect the helical wrap at the point of convergence of the wire structures and the core element.

For controlling the amount of torsion induced in the wire structure due to its rotational movement about the core element, torsion isolation means through which each wire structure is directed is disposed in the path of travel of the wire structure between its supply spool and the point at which it converges with the core element. This means is located in closely spaced relationship to the point of convergence between the wire structure and the core element and comprises a plurality of pressure rollers engaging either side of the wire structure. These rollers exert pressure on the wire structure in generally opposing directions transverse to the direction of movement of the wire structure toward the core element. Also, the rollers engaging one side of the wire structure are disposed alternately in relation to the rollers engaging the other side of the wire structure in such a manner that undulating movement is imparted to the wire structure in a zone located upstream and relatively near to the point at which the wire structure is wrapped about the core element.

With this arrangement, the torsion induced in the individual wire structure is contained in the zone between the pressure rollers and the point of convergence or closing. This forces the wire structure to absorb the torsional stress as it is being wrapped about the core element. Also, because of the relatively short distance between the pressure rollers and the point of closing, the induced torsion does not become additive and hence it is possible to continuously wrap the wire structure about the core element without danger of breakage of the wire structure in torsion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic illustration of apparatus constructed in accordance with the teachings of this invention.

FIG. 2 is an enlarged elevation view, partially broken away, of the apparatus employed to isolate torsion induced in the wire structure as it is being wrapped about the core element.

FIG. 3 is a cross-sectional view taken along the lines 3—3 of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

With reference to FIG. 1, there is shown apparatus for continuously wrapping two wire structures 1 and 1′ about a longitudinal axis in helical relationship to produce a composite multiwire structure. In the presently preferred embodiment of this invention the wire structures 1 and 1′ are wrapped about a core element 2 which is disposed along the longitudinal axis. As is clear from FIG. 1, the apparatus for wrapping the wire 1′ is substantially identical to that for wrapping the wire 1. Accordingly, the parts of the apparatus for wrapping wire 1′ corresponding to like parts of the apparatus for wrapping wire 1 will be designated by the same reference numerals with the suffix prime (′). Also, the following description of the invention will be made primarily with respect to wrapping of the wire 1, it being understood that such description applies equally to the wrapping of wire 1′.

The wire structure 1 is made of high yield strength material and may comprise a single round wire or, alternatively, a multiwire structure comprising a plurality of helically wound single round wires. Likewise, the core element 2 may comprise a single wire or a multiwire construction. The wire structure 1 is made of high yield strength material in the sense that it resists bending or will not easily take a permanent set. An example of such material is steel. Where the wire structure 1 is multiwired, as for example with a strand, wrapping about the core will, depending on the direction of wrap of the individual wires of the strand, tend to either tighten the wires of the strand or unwrap them. Accordingly, this should be taken into account when wrapping strands about the core so that the strands chosen will have the proper characteristics permitting such wrapping.

The core element 2 is moved longitudinally in the direction indicated by arrow 3 by suitable drive means (not shown). The wire structure 1 is fed from supply spool 4 and trained around guide sheave 5 and then directed through torsion isolation means, comprising a plurality of rollers 6, in a path converging toward a predetermined point along the path of movement of the core element. At the point of convergence, the wire structure 1 is helically wrapped about the core element as shown in FIG. 1.

The supply spool 4 is advantageously mounted for rotation about an axis coincident with the axis of the core element 2. The guide sheave 5 and rollers 6 are rotatably mounted on a support member 7 disposed in radically spaced relation to the core element and extending generally parallel to the direction of movement of the core element. The support member 7 is mounted for rotation about the moving core elemen t by a bearing support 8 disposed concentrically about the core element. Drive motor 9 is operatively connected by suitable gearing 10, 10*a* to the support member 7 to rotate it about the core element. Advantageously driven gear 10*a*, bearing support 8, and spool 4 are hollow through their central portion to permit free passage of the core element 2.

With the construction described above, the rotating wire structure 1 is payed out from the supply spool 4 and helically wrapped about the core element at the point at which it converges with the core element (point of convergence or closing). However, the supply spool 4 has no planetary motion about the core element; and only the wire structure after being directed radially away from the spool, is rotated about the core element to effect the wrapping.

As the wire structure 1 is rotated about the cored element 2 in the manner described to effect the helical wrap, it has a tendency to become twisted. This twist is initially confined to a vicinity near the point of closing. However, upon continued rotation of the wire structure about the core element, this twist gradually tends to work itself back to the supply spool 4 and cause a build-up of resulting torsional stress over the entire length of the wire structure between the supply spool 4 and its point of convergence with the core element. If this torsional stress is not effectively controlled, the wire structure will eventually be caused to break at some point along its length, become unalterably snarled, or otherwise interrupt proper operation of the stranding apparatus.

With the present invention, torsion isolation means comprising the plurality of grooved pressure rollers 6 effectively controls the torsion induced in the wire structure during the wrapping operation and prevents undesirable torsional feedback through the apparatus. As shown in the drawings, the pressure rollers engage either side of the wire structure 1 at a closely spaced location relative to the point of convergence or closing of the wire structure 1 with the moving core element 2. The rollers engaging one side of the wire structure are disposed in relation to the rollers engaging in opposite side of the wire structure in such a manner as to produce an undulating movement to the wire structure 1. Due to the location of the rollers, this undulation is produced in a zone located upstream and relatively near the point at which the wire structure is wrapped about the core element. As shown, the rollers engaging one side of the wire structure are also arranged alternately with respect to the rollers engaging the other side of the wire structure so that each portion of the wire 1 passing through the rollers 6 is in contact with at least one of the rollers. The rollers 6 act to apply pressure to the wire structure in generally opposing directions transverse to its path of travel toward the core element. The wire structure 1 is therefore subjected to increased tension in that portion of its length passing between the rollers, with compressive forces being exerted on the wire structure at the pressure points between opposing pairs of rollers.

Due to the undulating action imparted to the wire structure 1 by its undulated path and due to the pressure exerted on the wire structure between opposing pairs of rollers, induced torsion is effectively contained in the zone A extending between the pressure rollers 6 and the point of convergence of the wire structure 1 with the core element 2. Feedback of resultant torsion into the region upstream of the pressure rollers 6 is thereby effectively inhibited in a controlled manner. As a result, the wire structure 1 is forced to absorb torsional stress existing in zone A as it is wrapped about the core element 2. Accordingly, any torsion existing in zone A does not become additive and it is, therefore, possible to continuously wrap the wire about the core element without danger of breakage of the wire structure in torsion or other malfunction of the wire structure in other areas of the apparatus.

With the apparatus of the present invention the supply spool 4 is able to be mounted with its axis coinciding with the center axis of the core element. This relieves the support member 7 of weight which it would otherwise carry were the supply spool to be cradled on the support member as is generally the case with conventional planetary winding equipment. Furthermore, because of the separate operating positions of the supply spool and support member, the rotating support member 7 is of considerably less size and complexity thereby permitting it to be rotated at higher and more economical speeds than existing planetary winding equipment. Moreover, the use of costly spool cradles and other planetary devices required with conventional planetary winding equipment is advantageously eliminated.

I CLAIM:

1. Apparatus for wrapping at least one wire structure about a longitudinal axis to produce a composite multiwire structure having an absorbed torsional stress comprising:
   a. means for directing each wire structure from a supply along a path converging at a predetermined point along said axis;
   b. means for rotating each wire structure about said axis as it is being advanced toward the point of convergence to helically wind the wire structure at said point with an induced torsion; and
   c. torsion isolation means disposed along the converging path of travel of said wire structure for isolating torsion in said wire structure to the portion disposed downstream thereof.
2. Apparatus according to claim 1 wherein:
   a. said torsion isolation means is located in closely spaced relationship to said point of convergence.
3. Apparatus according to claim 2 wherein said torsion isolation means includes:
   a. means for applying pressure to each wire structure in generally opposing directions transverse to its direction of travel to thereby impart undulating movement to each wire structure as it is advanced toward said point of convergence, said means compressively engaging each wire structure during said undulating movement.
4. Apparatus according to claim 3 wherein said means for applying pressure to each wire structure comprises:
   a. a plurality of spaced rollers engaging one side of each wire structure; and
   b. a plurality of spaced rollers engaging the other side of each wire structure, the rollers engaging the one side of each wire structure being aligned between the rollers engaging the other side of each wire structure.
5. Apparatus according to claim 4 wherein:
   a. the rollers of said torsion isolation means are in compressive engagement with each wire structure.
6. Apparatus according to claim 5 wherein:
   a. each roller of the torsion isolation means compressively engages the wire structure against the next downstream roller.
7. Apparatus according to clai m 6 further including:
   a. spool means for said supply having an axis of rotation which is coincident with the axis of the composite multiwire structure.
8. Apparatus according to claim 7 further comprising:
   a. means for feeding a core wire structure along said longitudinal axis.
9. A method for wrapping at least one wire structure about a longitudinal axis to produce a composite multiwire structure having an absorbed torsional stress comprising the steps of:
   a. directing each wire structure from a supply along a path converging at a predetermined point along said axis;

b. rotating each wire structure about said axis as it is being advanced toward the point of convergence to helically wind the wire structure at said point with an induced torsion;

c. isolating torsion in said wire structure to the portion disposed downstream of and spaced from said supply by subjecting each wire structure to pressure in generally opposing directions transverse to its direction of travel along said converging path to provide undulating movement thereto and subjecting said wire structure to opposed compressive forces during said undulating movement.

10. The method according to claim **9** wherein:

a. each wire structure is fed from a supply coil mounted for rotation about an axis coincident with said longitudinal axis.

11. The method according to claim **10** further including the step of:

a. feeding a core element along said axis as each wire structure is rotated thereabout.

* * * * *