# United States Patent [19]

**Scott et al.**

[11] **3,791,131**

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[54] **METHOD OF MAKING A CONCENTRIC WIRE ROPE ON A DOUBLE TWIST STRANDER**


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[52] **U.S. Cl.** ..... **57/161,** 57/58.52, 57/166

[51] **Int. Cl.** ..... **D07b 3/00**

[58] **Field of Search** .... 57/3, 6, 58.49, 58.52, 58.54, 57/58.55, 58.57, 156, 160, 161, 166



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*Primary Examiner*—John Petrakes

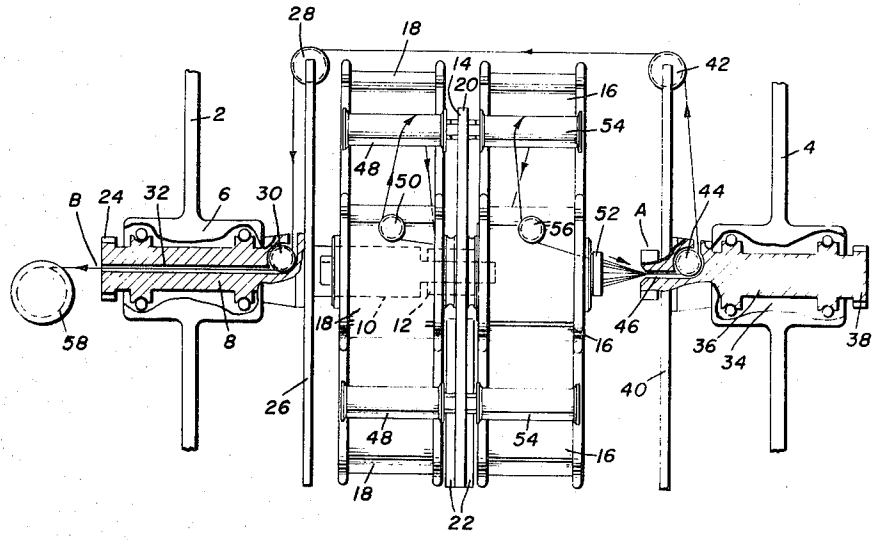
*Attorney, Agent, or Firm*—Chittick, Thompson & Pfund



[57] **ABSTRACT**

The method of making a concentric wire rope on a double twist strander in which the rope is comprised of outer strands and a core strand and in which the lay of the wires of the outer strands is opposite the lay of the wires of the core strand and in the finished rope the length of the lay of the wires of the core strand has been shortened and the length of the lay of the wires of the outer strands has been increased.


**5 Claims, 6 Drawing Figures**



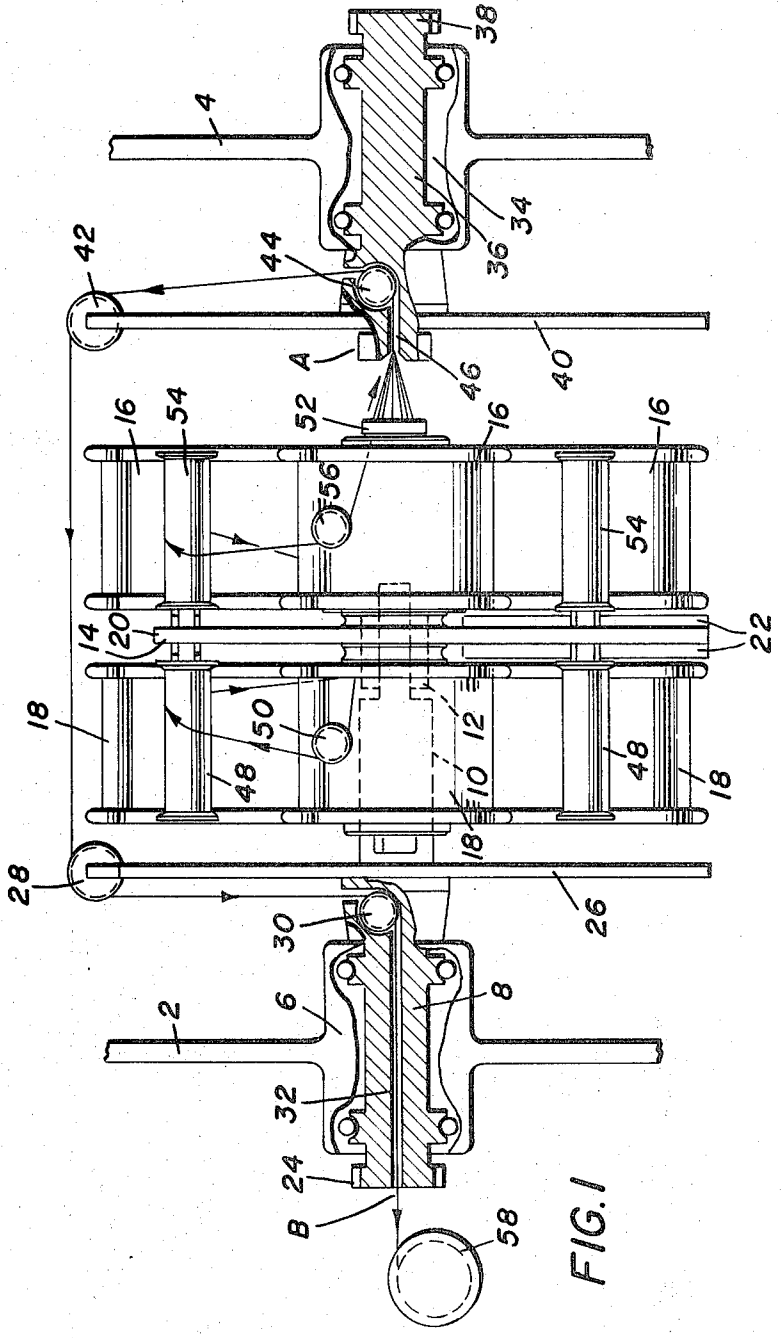

38
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A
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14
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28
26
30
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8
2
32
24
B
58

FIG. 1

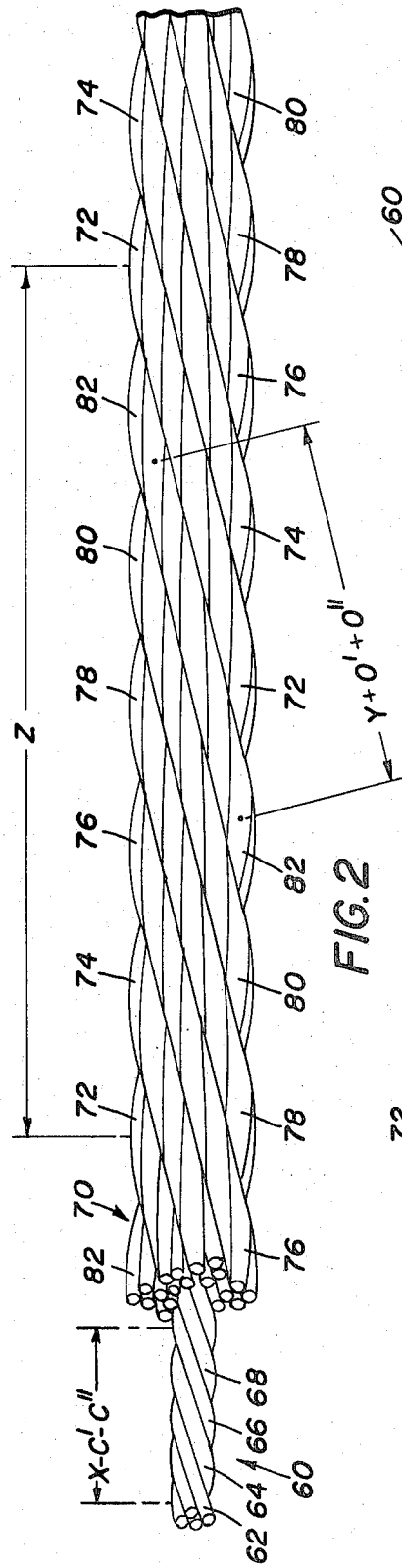



FIG. 2

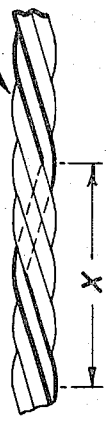



FIG. 5 ORIGINAL CORE STRAND




FIG. 6 SHORTENED LAY OF CORE STRAND

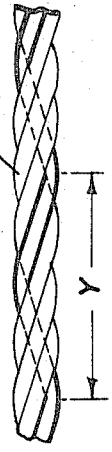



FIG. 3 ORIGINAL OUTER STRAND

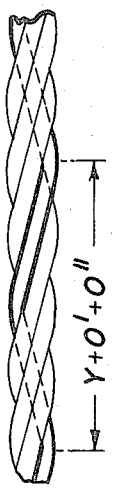



FIG. 4 LENGTHENED LAY OF OUTER STRAND

# METHOD OF MAKING A CONCENTRIC WIRE ROPE ON A DOUBLE TWIST STRANDER

## BACKGROUND OF THE INVENTION

The manufacture of wire ropes is a well understood art. The type of known wire rope with which this invention is concerned would be described as a concentric rope or cord and more specifically in the form disclosed, a 7 × 7 rope or a 6 × 7 wire strand core rope. Wire rope of this construction is customarily made on a machine known as a tubular strander or a planetary strander. Production on these machines, however, is slow and expensive for small size ropes.

Double twist stranding machines can produce rope at a greater rate than tubular or planetary stranders. However, where a rope made by a double twist strander includes a wire strand core of the same lay as the individual wires of the outer strands, it will often be defective because the core strand lengthens in relation to the outer strands causing a periodic popping out of the core strand between the outer strands in the finished rope. Such defect cannot occur if all of the twisting is done at a single position as in the tubular or planetary strander. For this reason, the double twist strander has not heretofore been used in the making of ropes although its economy in manufacture is well understood.

## SUMMARY OF THE INVENTION

The rope or wire cord in a preferred form comprises identical outer strands each comprised of two or more wires and a core strand also comprised of two or more wires. The numbers and sizes of the wires in the core strand may or may not be the same as the number and sizes of the wires in the outer stands. Similarly, the length of the lay of the wires of the core strand may or may not be the same as the length of the lay of the wires of the outer strands. In all cases, however, the lay of the core strand is opposite the lay of the wires of the individual outer strands.

Spools of wire strands are mounted on the pay-off of a double twist strander in conventional arrangement. In the specific form of rope described hereinafter, the wires of the outer strands have a right hand lay while the wires of the core strand have a left hand lay. At the first twisting position of the double twist strander, the outer strands are twisted to the right to produce a left hand lay of the strands thereby to untwist somewhat the individual wires of the outer strands. At the same time, the wires forming the core strand which have left hand lay are twisted more tightly to the right along with the outer strands thereby to shorten the lay of the wires of the core strand.

At the initial twisting position, the strands are under only the relatively small braking tension of the spools. The strands being properly aligned by the circularly arranged guides and the center guide group themselves together to form an initial partly twisted wire rope with, preferably, six outer strands and a core strand. This partially completed rope then travels to the second twisting position of the double twist strander where the final twisting occurs. This final twisting shortens the lay of the outer strands, lengthens the lay of the individual wires of the outer strands and shortens the lay of the wires of the core strand. The net effect of the additional twisting at the second position is to shorten the core strand at least as much as the net shortening (if any) of the outer strands. This produces the desirable result of creating a finished wire rope in which there is no tendency for the core strand to buckle and force itself outwardly between any two of the outer strands.



While a double twist strander is an old and well known machine, it has not, as far as we are aware, ever been used to perform the series of steps which constitute the present invention, namely, the process of manufacturing concentric cords or ropes as hereinafter claimed.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation partly in section of a double twist strander showing the essential elements of the machine.

FIG. 2 is an enlarged detail showing one form of wire rope produced by the process performed by the double twist strander.

FIG. 3 is a detail showing the right lay of the wires of the original outer strands prior to formation of the rope.

FIG. 4 is a detail showing the final lengthened right lay of the wires of the outer strands.

FIG. 5 is a detail showing the left lay of the original core strand.

FIG. 6 is a detail showing the final shortened left lay of the wires of the core strand.

It should be noted that the double twist strander shown in FIG. 1 is a preferred construction. In another form of double twist strander, the payoff spools and the take-up mechanism are placed in positions reversed from those shown in FIG. 1. However, the steps of the claimed method will be performed by either machine.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1 there are shown the end walls 2 and 4 of a supporting housing. Extending through end wall 2 is a bearing 6 which carries a rotatable hollow shaft 8. Shaft 8 has an extension 10 on the end of which is a bearing 12 which carries a platelike circular frame 14 but shown herein in side elevation. Frame 14 is arranged to support a plurality of spools 16 on one side thereof and 18 on the other. The frame 14 is cut away at its upper portion as at 20 and has counter weights 22 at its bottom so that it will hang stationary even though its supporting shaft 10 is rotating.

Shaft 8 has on its left end a sprocket 24 driven by a power source. To the right of bearing 6 shaft 8 carries a dynamically balanced arm 26 including on one end a small sheave 28. Another sheave 30 is mounted within a suitable cavity in shaft 8 so that a rope or cord feeding from sheave 28 to sheave 30 will be led into the axial passage 32 of shaft 8.

On the other side 4 of the housing is another bearing 34 carrying a rotatable shaft 36. On the right hand end of shaft 36 is a sprocket 38 driven by the power source and on the left end of shaft 36 is another dynamically balanced arm 40 including on one end a sheave 42. Another sheave 44 is mounted within shaft 36 in a position to receive a rope coming from the axially aligned twisting sleeve 46 at the first twisting position A.

The driving mechanism for the aforementioned parts is such that shafts 8 and 36 revolve at the same speed as do the the associated arms 26 and 40 which are radially aligned as shown in FIG. 1. Thus, upon operation

of the power source, shafts 8 and 36 and their associated arms 26 and 40 will be rotated at equal speeds while the spool carrying frame 14 supported by the shaft extension 10 remains stationary.

FIG. 1 shows a plurality of spools 16 and 18 that are carried by and on opposite sides of the frame 14. In the present disclosure, seven spools will be in use. Each of these spools carries the supply for one of the strands from which the wire rope will be formed. Each strand leads from each spool 18 over its respective guide roll 48 to a centrally related sheave 50 whence it passes through an aperture in frame 14 to its respective guide 52 and thence to twisting sleeve 46. Similarly, the strands on spools 16 on the opposite side of frame 14 pass therefrom over guide rolls 54 to sheaves 56, thence through their respective guides 52 and on with the other strands from spools 18 to the twisting sleeve 46.

The supporting frame 14 and the spools 16 and 18 mounted thereon along with their respective guide rolls 48 and 54 and sheaves 50 and 56 all represent conventional construction found in a double twist strander and it is believed further detailed description is unnecessary as the construction is well known to those skilled in the art.

From the description thus far, it will be recognized that a plurality of strands may be delivered from the spools on frame 14 through the eyes 52 to the twisting sleeve 46, at which point initial twisting will occur due to the continuous rotation of shaft 36. The partially twisted strands, now forming a loosely twisted rope, move on over sheave 44, thence to sheave 42, across to sheave 28, radially inward to sheave 30 and axially through the core 32 of shaft 8 to a holding point pulley 58 which instantaneously holds the remote end of the moving rope as the final twist is applied by rotation of arm 26 at the second twisting position B.

The take-up mechanism which continuously draws the strands from the spools 16 and 18 through the machines to the holding point pulley 58 and finally to the rope collecting drum is conventional and hence is not shown.

From the foregoing, it will be understood that the first stage of twisting occurs at the twisting sleeve 46 at position A between the guides 52 and sheave 44. The second stage of twisting occurs at position B between the sheave 30 and the holding point pulley 58. The number of turns of twist applied at position A per unit of length is the same as the number of turns of twist added at position B per unit of length.

## DESCRIPTION OF THE STRANDS COMPRISING THE ROPE

In a preferred form of rope, there will ordinarily be six outer strands, each strand being formed from two or more wires. The core strand is also formed of two or more wires. In the embodiment shown in FIG. 2 and the detail in FIG. 3, the lay of the individual wires of the outer strands is right. The lay of the individual wires of the core strand, as shown in FIGS. 2 and 5, is left and the opposite of the wires of the outer strands. The lay of the six outer strands as shown in FIG. 2 comprising the rope is left. In the original strands on the spools 16 and 18, the length of the lay of the individual wires of the core strand would preferably (but not necessarily) be longer than the length of the lay of the individual wires of the outer strands but in the opposite direction. As the initial twisting together of the outer and core strands occurs at position A, the lay of the individual wires of the core strand is shortened somewhat because of the increased twist, whereas the lay of the individual wires in the outer strands is lengthened somewhat because the direction of the collective twisting of the outer strands to produce a left lay rope untwists somewhat the individual wires of the right lay outer strands.

The foregoing is illustrated by reference to FIG. 2 which shows a section of the finished rope made by the claimed process, and FIGS. 3, 4, 5 and 6 which show details of the change occurring in the strands as the twisting proceeds. The length of the lay of the individual wires in the left lay core strand initially supplied to the first twisting position A will be referred to as the length X and the length of the lay of the individual wires in the right lay outer strands initially supplied to the twisting position will be referred to as the length Y. The core strand generally referred to at 60 is comprised of four wires, 62, 64, 66 and 68. The lay is left and in a typical rope produced by the process, the length of the lay of the wires of the core strand is shortened at the first twisting position A an amount C', and at position B an additional amount C''. The exact amount of shortening of the lay of the wires of the core strand is a function of the number of turns of twist introduced during the formation of the rope at the two twisting positions.

The outer strands that surround the core strands are generally indicated at 70. The outer strands as shown are six in number and comprise those indicated at 72, 74, 76, 78, 80 and 82. Each of the outer strands is shown as comprised of four wires preferably (but not necessarily) the same size as the wires in core strand 60. Thus, initially, before any twisting of the wires has occurred and as shown in FIGS. 3 and 5, the core strand 60 and the outer strands 72, 74, 76, 78, 80 and 82 were,preferably, all of the same size and the length of the lay of the individual wires in all strands, both core and outer, is shown for convenience in illustration as being the same, that is, the lay X of the core strand wires is shown as equal to the lay Y of the outer strand wires. In actual practice, however, the lay X is preferably greater than lay Y. In the finished rope, as shown in FIG. 2, the length of the lay of the six outer strands is shown as Z. The length of the lay of the four individual wires of each outer strand in the finished rope is as shown in FIGS. 2 and 4, $Y + 0' + 0''$, in which 0' is the extent of increase in the lay of the wires due to the untwisting of the individual outer strands that occurs at position A, and 0'' is the additional increase that occurs at position B.

From the foregoing discussion, it can be seen that by providing the double twist strander with six spools of identical strands of right lay and one spool preferably (but not necessarily) of the same size strand of left lay, the rope may be initially twisted at position A to produce an initial lay of the outer strands determined by the number of turns of twist and to shorten the lay of the core strand slightly to X - C'. At position A, all strands are, as noted above, under only slight tension as may be applied by the conventional brakes (not shown) used on spools 16 and 18. In the initial assembly at position A, the outer strands surround and engage the core strand holding the latter centrally in position as the preliminary rope formation passes from sheave 44 to sheave 42 to sheave 28 to sheave 30 and

thence to the second twisting position B and on to holding point pulley **58.**

When the second twisting position B is reached, the core strand **60** over the moving length that is being twisted is held by the surrounding outer strands **72, 74, 76, 78, 80** and **82.** Thus, when further twisting occurs at position B, the additional shortening C'' of core strand **60** is at least as great as the net shortening of the outer strands **72, 74, 76, 78, 80** and **82** over a unit length. Hence, there is no possibility of the core strand **60** subsequently working its way outwardly between any of the outer strands in the damaging way that so often happens in the ropes of the prior art in which the lay of the wires of the core strand is the same as the lay of the wires of the outer strands to cause the core strand to lengthen during twisting and to be in buckling compression with respect to the outer strands.

It will be understood that the net shortening of the outer strands is caused by the added twist applied to the outer strands less the untwisting of the individual wires of each outer strand that occurs at positions A and B to produce a lengthened lay of $Y + 0' + 0''$ as shown in FIGS. **2** and **4.**

By way of illustration only and in no way limiting the construction of a rope made by the claimed process, the shortening of the lay of the wires of the core strand might be one-sixth at twisting position A and the further shortening of the lay at position B might result in the final lay of the core strand wires being two-thirds of the original lay. At the same time, while the outer strands are collectively being twisted about the core strand to shorten the lay of the outer strands to a final length Z shown in FIG. **2,** the lay of the individual wires of the outer strands may increase a distance more or less equal to the distance the lay of the core wires had been shortened. The net effect is that during the twisting at position B, the core strand has been shortened at least as much as the outer strands. This double twisting procedure prevents the core strand from being longer than the surrounding outer strands and insures against any popping out of the core strand between the outer strands in the finished rope.

Accordingly, from the foregoing description, it is apparent that a conventional double twist strander may be utilized to practice the method of assembly of a plurality of preferably identical sized outer strands into a regular lay wire rope in which the wires of the core strands are of opposite lay to the wires of the outer strands. However, it is to be understood that the sizes of the strands and the wire sizes therein may be varied at will. The double twist strander produces wire rope of the same final degree of twist at twice the rate of the tubular of planetary stranders operating at the same rotating speed.

Modifications and further applications of the invention will now be apparent to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

**1.** The method of making a concentric regular lay wire rope comprised of a plurality of outer strands and a core strand in which the lay of the core strand is the same as the lay of the rope and is opposite that of the outer strands, said method comprising the steps of continuously supplying a plurality of outer strands of the same lay and a core strand of the opposite lay to the initial twisting position of a double twist stranding machine, twisting together said continuously advancing outer and core strands at said initial twisting position to start a concentric regular lay wire rope in which the wires of said core strand are twisted more tightly to shorten their lay and the wires of said outer strands are untwisted somewhat to lengthen their lay, passing the partially twisted rope under tension to the second twisting position of said double twist stranding machine to complete the twisting of all said strands in the same direction thereby to further shorten the lay of the wires of said core strand and to further lengthen the lay of the wires of said outer strands and to shorten the lay of the outer strands, the additional shortening in length of the core strand at the second twisting position being at least as great as the additional shortening in length, if any, of the outer strands at the second twisting position.

**2.** The method set forth in claim **1,** all said strands being under substantially equal tension on leaving said first twisting position, the additional twisting at said second twisting position causing said outer strands to grip said core strand and to cause said core strand to be under tension with respect to said outer strands.

**3.** The method set forth in claim **1,** the twisting of said strands at said first and second twisting positions resulting in a finished rope in which the length of the lay of the wires of said outer strands is increased to about the same extent as the length of the lay of said wires of the core strand is decreased.

**4.** The method set forth in claim **1,** said method utilizing outer strands and a core strand the wires of which prior to the initial twisting were of the same length of lay.

**5.** The method set forth in claim **1,** said method utilizing outer strands and a core strand the wires of which prior to the initial twisting were of unequal lengths of lay.

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